INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE HCRD DUAL POLARIZED DIRECTIONAL OVERCURRENT 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 settings and electrical connections.

APPLICATION

The type HCRD relay is a dual polarized overcurrent relay directionally controlled by a high speed directional unit. It is used to disconnect transmission and feeder circuits when the current through them exceeds a pre-determined value in the tripping direction.

The type HCRD relay can be polarized from a potential source, from a local ground current source, or from both simultaneously.

CONSTRUCTION AND OPERATION

The relay consists of a type CO overcurrent unit, a type H directional unit, a contactor switch, auxiliary switches, operation indicators, and an instantaneous trip unit.

Overcurrent Unit

This unit is an induction-disc type unit operating on overcurrent. The induction disc is a thin four-inch diameter aluminum disc mounted on a vertical shaft. The shaft is supported on the lower end by a steel ball bearing riding between concave sapphire jewel surfaces, and on the upper end by a stainless steel pin.

The moving contact is a small silver hemisphere fastened on the end of an arm. The other end of this arm is clamped to an insulated section of the disc shaft in the non-geared type relays, or to an auxiliary shaft geared to the disc shaft in the geared type relays. The electrical connection is made from the moving contact thru the arm and spiral spring. One end of the spring is fastened to the arm, and the other to a slotted spring adjuster disc which in turn fastens to the element frame.

The stationary contact assembly consists of a silver contact attached to the free end of a leaf spring. This spring is fastened to a Micarta block and mounted on the element frame. A small set screw permits the adjustment of contact follow. When double trip is required, another leaf spring is mounted on the Micarta block and a double contact is mounted on the rigid moving arm. Then the stationary contact set screws permit adjustment so that both circuits will be made simulatneously.

The moving disc is rotated by an electro-magnet in the rear and damped by a permanent magnet in the front. The main pole coil of the relay acts as a transformer and induces a voltage in a secondary coil. Current from this secondary coil flows through the upper pole coils and thus produces torque on the disc by the reaction between the fluxes of the upper and lower poles.

Directional Unit

A small transformer causes a large current to flow in a single-turn movable aluminum secondary. The operating current coils are mounted on a magnetic frame and the operating and polarizing current elements are assembled at right angles to each other with the one-turn loop in the air gaps of the operating current flux path. The interaction of the operating and polarizing current fluxes produces a torque which rotates the loop in one of two directions depending on the direction of current flow.

A ceramic arm extends from the moving loop and supports a rectangular silver contact which bridges the stationary contacts located on either side of the loop. The stationary contacts are silver hemispheres mounted on the lower end of vertically-hanging spring leaves. The contact separation is adjustable by a small screw near the upper end of the rigid stationary contact supporting arm. One of these supporting arms hangs parallel to each of the four stationary contacts. The set screw on the lower end of this arm provides the contact follow adjustment. Two additional screws on the movement

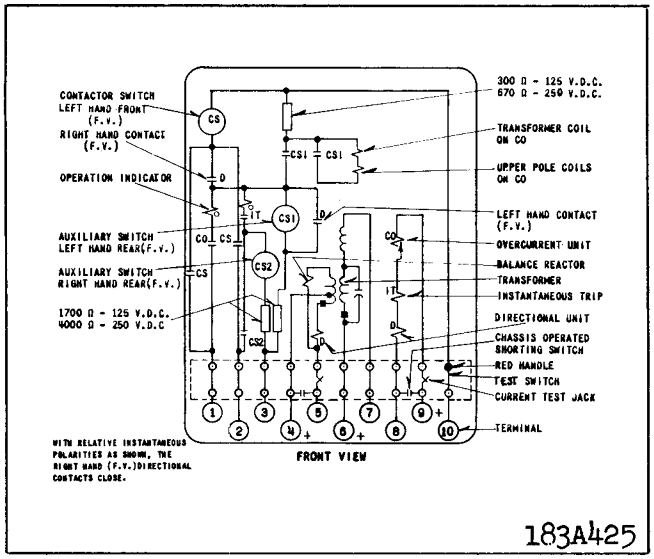

Fig. 1. Internal Schematic of the Single Trip Type HCRD Relay in the FT31 Case.

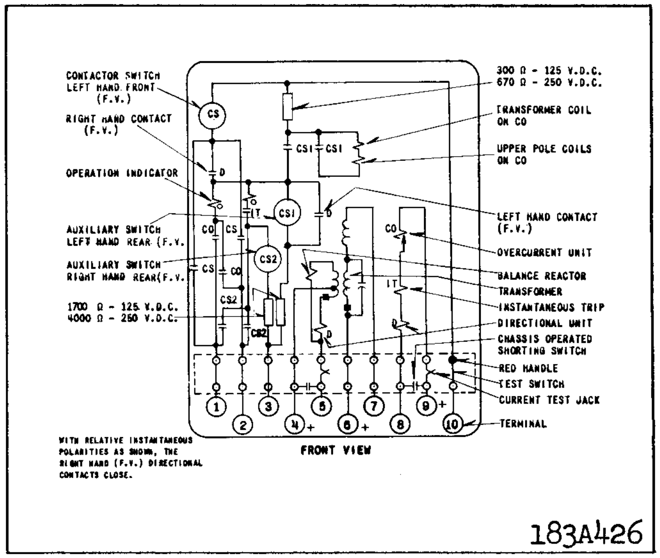

Fig. 2. Internal Schematic of the Double Trip Type HCRD Relay in the FT31 Case.

frame beneath the current coil iron limit the movement of the one-turn loop.

Contactor Switches (CS1, CS2, CS)

The contactor switch is a small solenoid type d-c switch, the coil of which is connected in the trip circuit. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts. In the single-trip relay, two of these contacts seal around the main relay contact. In the double-trip relays, all three contacts are used to seal in both trip circuits.

The operation of the d-c auxiliary switch is controlled by the directional unit which in turn directionally controls the overcurrent unit. When sufficient power flows in the tripping direction, the auxiliary contactor switch operates to close and seal in the upper pole circuit of the overcurrent unit, permitting the disc to rotate. If the direction of power flow reverses, a contact on the directional unit shorts the auxiliary contactor switch coil, causing it to drop out. This opens the directional control circuit and allows the overcurrent unit to reset.

Operation Indicator

The operation indicator is a small solenoid coil connected in the trip circuit. When the coil is energized, a spring-restrained armature releases the white target which falls by gravity to indicate completion of the trip circuit. The indicator is reset from outside of the case by a push rod.

Instantaneous Trip

The instantaneous trip is a small solenoid type unit. A cylindrical plunger rides up and down on a vertical guide rod in the center of the solenoid coil. The guide rod is fastened to the stationary core, which in turn screws into the element frame. A silver disc is fastened to the moving plunger through a helical spring. When the coil is energized, the plunger moves upward carrying the silver disc which bridges three conical-shaped stationary contacts. In this position, the helical spring is compressed and the plunger is free to move while the contact remains stationary. Thus, a-c vibrations of the plunger are prevented from causing contact bouncing. A Micarta disc screws on the bottom of the guide rod and is locked in position by a small nut. Its position determines the pick-up current of the unit.

CHARACTERISTICS

The type HCRD inverse, very inverse (low energy) or short time (using type COH over-current unit) relays are available in the following current ranges.

0.5	0.6	0.8	1.0	1.5	2.0	2.5
2	2.5	3	3.5	4	5	6
4	5	6	8	10	12	15

The tap value is the minimum current required to just close the relay contacts. In addition to the taps, the initial position of the moving contact is adjustable around a semi-circular lever scale calibrated in 11 divisions.

These relays may have either single or double circuit closing contacts for tripping either one or two breakers.

The instantaneous trip unit has a 4 to 1 range. Typical ranges are 10-40 or 20-80 but other ranges may be supplied as ordered.

When potential polarized, the type HCRD relay directional unit minimum pickup is 2 volts 10 amperes in phase for relays with 2 to 6 ampere and 4 to 15 ampere current ranges and 2 volts 2 amperes in phase for the 0.5 to 2.5 ampere current range relay.

When the relay is current polarized, the directional unit minimum pickup is 3 amperes in each winding in phase for the 2 to 6 ampere and 4 to 15 ampere current range relays and 0.5 amperes in each winding in phase for the 0.5 to 2.5 ampere current range relay.

Maximum torque for potential polarization occurs when the current lags the voltage by approximately 50 degrees. For current polarization maximum torque occurs when the operating and polarizing currents are in phase.

Relay With Quick Opening Contacts

When the relays are used with circuit breakers that are instantaneously reclosed, it is necessary to arrange the relay contacts to be quick opening. This is done by screwing in the small set screw on the stationary contact assembly until the contact rivet rests solidly on the Micarta support. When this is done, the position of the contact stop on the time lever should be shifted so that the moving and stationary contacts barely touch when the time lever is set on zero.

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 four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the stud and then turning the proper nut with a wrench.

For detailed FT case information refer to I.L. 41-076.

SETTINGS

There are two settings: namely the current value at which the relay closes its contacts, and the time required to close them. When the relay is to be used to protect equipment against overload, the setting must be determined by the nature of the load, the magnitude of the peaks and the frequency of their occurrence.

For sectionalizing transmission systems the current and time setting must be determined by calculation, due consideration being given to the time required for circuit breakers to open so that proper selective action can be obtained throughout the system.

Current Setting

The connector screw on the terminal plate above the time scale makes connections to various turns on the operating coil. By placing this screw in the the various holes, the relay will just close contacts at the corresponding current, 4-5-6-8-10-12 or 15 amperes, or as marked on the terminal plate.

The tripping value of the relay on any tap may be altered by changing the initial tension of the spiral spring. This can be accomplished by turning the spring adjuster by means of a screw driver inserted in one of the notches of the plate to which the outside convolution of the spring is fastened. An adjustment of tripping current approximately 15 per cent above or below any tap value, can be secured. For example, on the 4 to 15 amp. relay, by choosing the proper tap, a continuous adjustment of tripping current from 3.4 amperes to 17.5 amperes may be secured. The characteristic time curve will be affected less for any large adjustment if the next higher tap is selected and the initial tension of the spiral spring is decreased to secure the desired tripping value. For example, the relay should be set on the 8 ampere tap with less initial tension in order to secure a 7 ampere tripping value.

CAUTION Be sure that the connector screw is turned up tight so as to make a good contact, for the

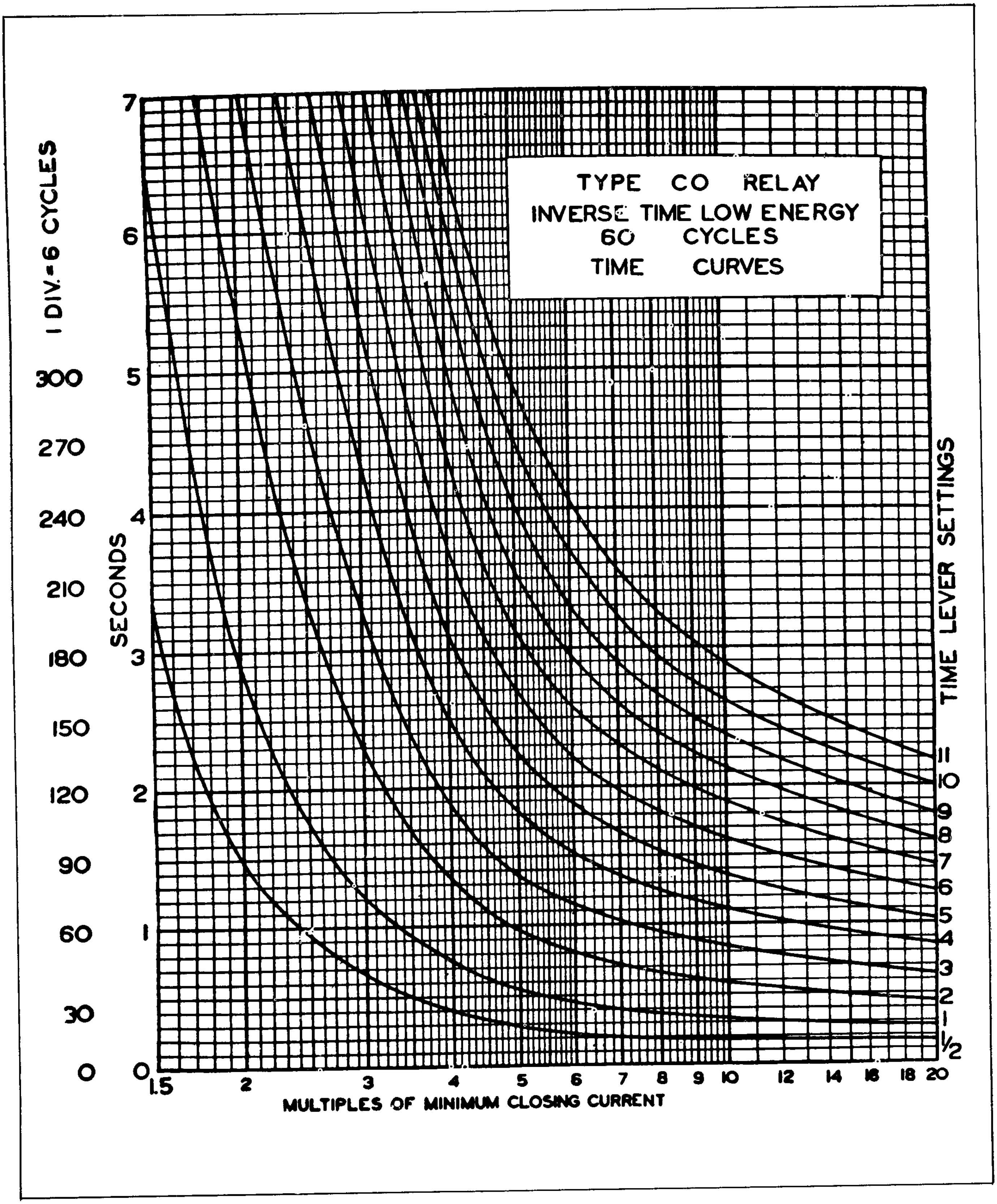

Fig. 3. Typical 60 Cycle Time Curves of the Time-Overcurrent Unit – Inverse Time (Low Energy).

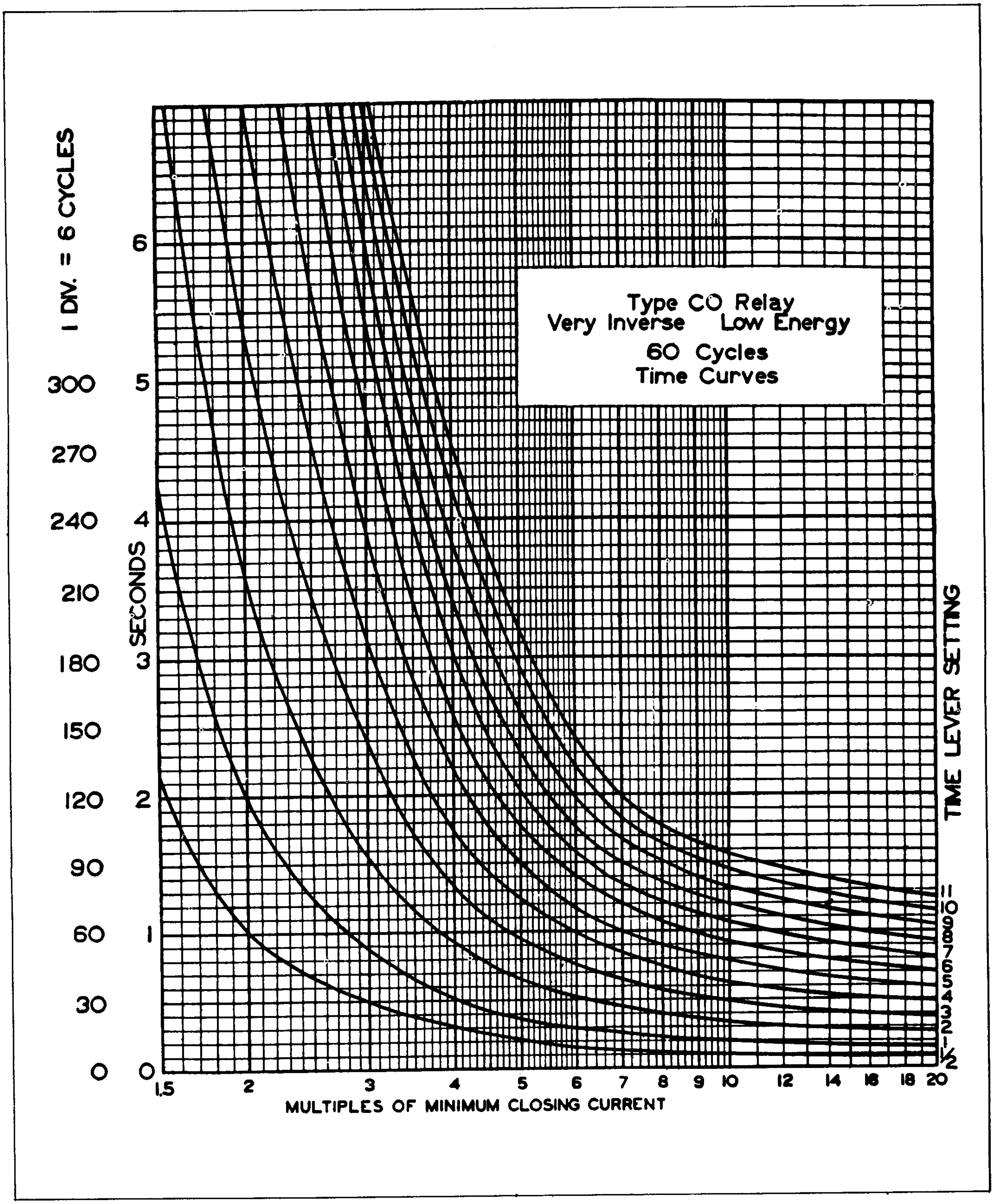

Fig. 4. Typical 60 Cycle Time Curves of the Time-Overcurrent Unit – Very Inverse Time (Low Energy).

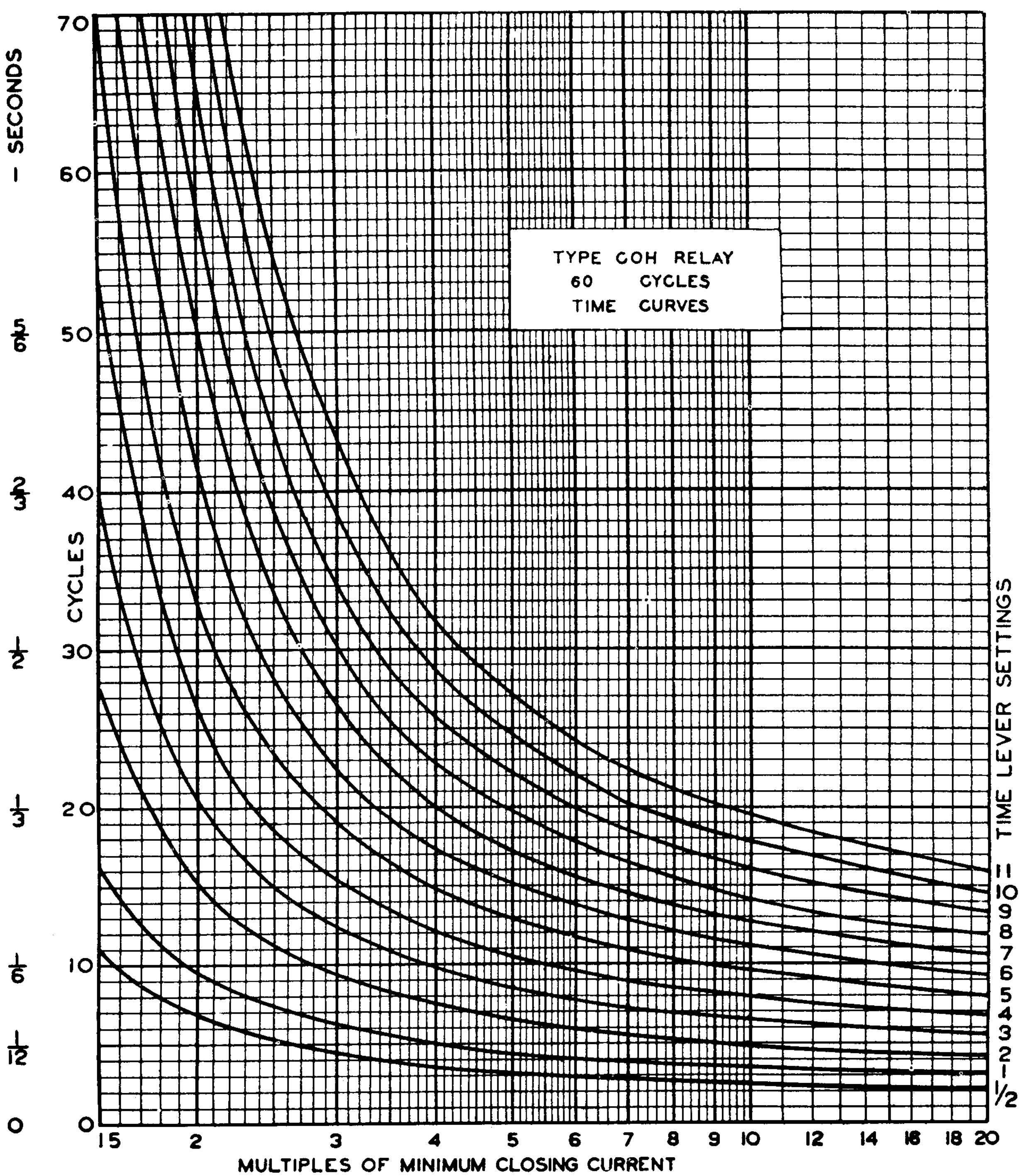

Fig. 5. Typical 60 Cycle Time Curves of the Time-Overcurrent Unit – Short Time (COH).

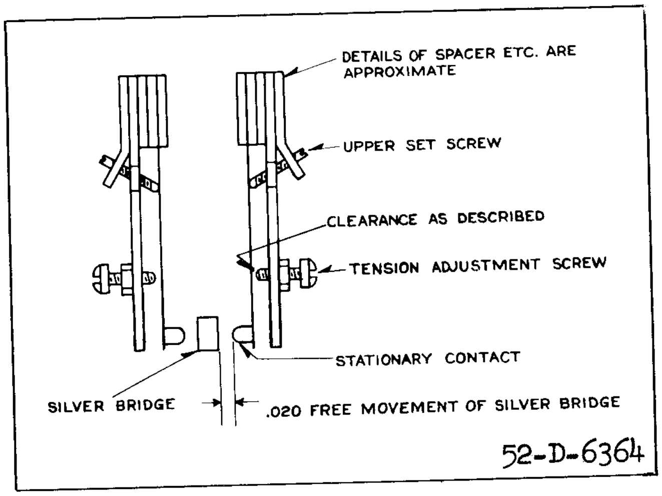

Fig. 6. Front View of the Directional Unit Showing Contact Adjustment Details.

operating current passes through it. Since the overload unit is connected directly in the current transformer circuit, the latter should be short-circuited before changing the connector screw. This can be done conveniently by inserting the extra connector screw, located on the right-hand mounting boss, in the new tap and removing the old screw from its original settings.

Time Lever Setting

The index or time lever limits the motion of the disc and thus varies the time of operation. The latter decreases with lower lever settings. Typical relay time curves are shown in Fig. 3 to 5.

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 below should be followed.

All contacts should be cleaned periodically. A contact burnisher S#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.

Overcurrent Unit

Shift the position of the contact stop on the time lever and adjust the contacts so that they barely touch when the time lever is set on zero.

Adjust the tension of the spiral spring so that the relay will close its contacts at its rated current, as shown by the position of the screw on the terminal block. Shift the position of the damping magnets so that the time characteristics of the relay, as shown by test with a timer, are as shown on the typical time curves. Note that in the factory the relay is tested from the No. 10 lever position. The calibration is intended to be on the basis of the cool or normal operating condition inasmuch as overloads are of short duration. When checking a number of points on the time curves, it will be necessary to cool the relay coils between points particularly after operating at high currents. An air hose may be used for this purpose.

Directional Unit

Check the free movement of the directional unit loop with the relay in a vertical position to see that it is free from friction and properly centered. The loop should assume a vertical position with the contacts open when the unit is completely de-energized.

The essential details of the stationary contact assembly are shown in Fig. 6. The backstop screws located in the rear of the current coil and iron assembly which limit the travel of the loop should be backed out of the way to the point where they give maximum loop movement without allowing the loop to strike on the movement frame, which must be avoided. Adjust the left hand stationary contacts, front view, with the upper set screws to .005" to .010" clearance between the moving silver contact bridge and the stationary contacts. Adjust the right hand stationary contacts to give approximately .020" clearance between the stationary contacts and the moving contact bridge. The moving contact bridge should make with both bridge contacts at the same instant. The tension adjustment screws are then set to clear the stationary contact leaf spring by approximately 0" to .005". This gives contact wipe, and frictional damping which enable the directional unit contacts to operate the CS-1 auxiliary switch satisfactorily at very high torques, which are pulsating. The operation of the contacts should be checked at high, low, and intermediate currents over the expected range of operation to see that a satisfactory adjustment has been made. The unit for the 2-6 ampere and 4-15 ampere relay current ranges will operate satisfactorily with 3 amperes, 60 cycles in each winding up to 80 amperes in each winding and the unit for the 0.5 to 2.5 ampere relay current range will operate satisfactorily with 0.5 amperes, 60 cycles, in each

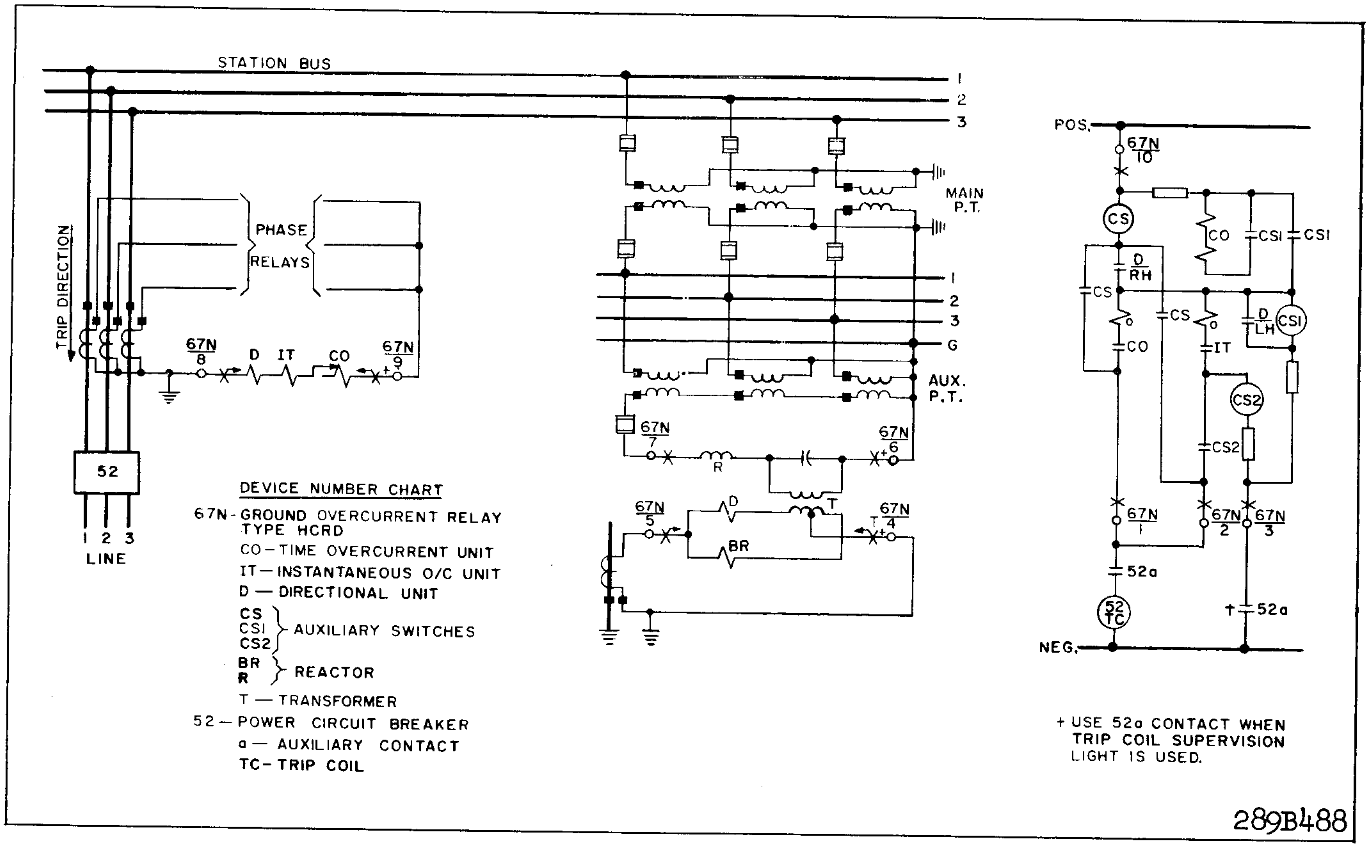

Fig. 7. Typical External Schematic of the HCRD Relay.

winding up to 14 amperes in each winding.

When the directional unit is energized on voltage alone, there may be a small torque which may hold contacts either open or closed. This torque is small and shows up only at high voltages with the entire absence of current. At voltages high enough to make this torque discernible, it will be found that only a fraction of an ampere in the current coils will produce torque to insure positive action. This is mentioned because the slight torque shown on voltage alone has no practical effect on the directional unit operation.

Contactor Switch (CS)

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core when the switch is picked up. This can be done by turning the relay up-side-down or by disconnecting the switch and turning it up-side-down. Then screw up the core screw until the moving core starts rotating. Now, back off the core screw until the moving core stops rotating. This indicates the points where the play in the assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the core screw approximately one turn and lock in place. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 3/32" by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 2 amperes d-c. Test for sticking after 30 amperes d-c have been passed through the coil.

Auxiliary Contactor Switch (CS1 & CS2)

The adjustments for the auxiliary switch CS-1 are the same as for the seal-in contactor switch except that the contact separation should be 3/64". The switch should pick up at or below 80 volts applied to the relay d-c terminals. Apply 140 volts d-c to the circuit and see that the contactor drops out when shorted by the left hand directional contacts. For 250 volt d-c relays, the pick-up should be 165 volts or less. With 280 volts applied to the circuit the contactor must drop out when shorted by the left hand directional contacts.

The adjustments for the auxiliary switch CS-2 are the same as for the seal-in contactor switch except that the contact separation should be 3/64". The switch should pickup at or below 80 volts applied to the relay d-c terminals. For 250 volt d-c relays, the pick-up should be 165 volts or less.

When the CS-2 auxiliary switch is used with a trip coil supervising indicator lamp, a breaker "a" switch must be connected between terminal 4 of the relay and the negative bus of the trip circuit.

Operation Indicator

Adjust the indicator to operate at 1.0 ampere d-c, gradually applied, by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. If the two helical springs which reset the armature are replaced by new springs, they should be weakened slightly by stretching to obtain the 1 ampere calibration. The coil resistance is approximately 0.16 ohms.

Instantaneous Trip Unit

The position of the Micarta disc at the bottom of the unit with reference to the calibrated guide indicates the minimum over-current required to operate the unit. The disc should be lowered or raised to the proper position by loosening the lock nut which locks the Micarta disc, and rotating the Micarta disc. The nominal range of adjustment is 1 to 4; for example, 10 to 40 amperes, and it has an accuracy within the range of approximately ±10%.

The drop out value is varied by raising or lowering the core screw at the top of the switch, and after the final adjustment is made, the core screw should be securely locked in place with the lock nut. The drop out should be adjusted for about 2/3 of the minimum pick-up. Adjusting the drop out will slightly effect the value of pick-up.

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.

ENERGY REQUIREMENTS

The burden and thermal capacities of the over-current units are as shown on the following pages:

INVERSE TIME CO RELAYS AT 60 CYCLES

Ampere Range	Tap	V.A. at 5 Amperes	V.A. at Tap Current	Power Factor	Continuous Rating (Amperes)	One Second Rating (Amperes)
	0.5	200	2	66° lag	2	70
	0.6	140	2	66° lag	2	70
	0.8	78	2	66° lag	2	70
0.5/2.5	1.0	50	2	66° lag	3	70
	1.5	22	2	66° lag	3	70
	2.0	12.5	2	66° lag	4	70
	2.5	8	2	66° lag	5	70
	2	12.4	2	66.4° lag	8	250
	2.5	8	2	66.4° lag	8	250
	3	5.6	2	66.4° lag	8	250
2/6	3.5	4.1	2	66.4° lag	8	250
	4	3.1	2	66.4° lag	9	250
	5	2	2	66.4° lag	9	250
	6	1.3	2	66.4° lag	10	250
	4	3.1	2	66.4° lag	16	250
	5	2	2	66.4° lag	16	250
	6	1.4	2	66.4° lag	16	250
4/15	8	0.8	2	66.4° lag	17	250
	10	0.5	2	66.4° lag	18	250
	12	0.3	2	66.4° lag	19	250
	15	0.2	2	66.4° lag	20	250

VERY INVERSE TIME CO RELAYS AT 60 CYCLES

Ampere Range	Tap	V.A. at 5 Amperes	V.A. at Tap Current	Power Factor	Continuous Rating (Amperes)	One Second Rating (Amperes)
	0.5	125	1.25	66.4° lag	2	100
	0.6	87	1.25	66.4° lag	2	100
	0.8	49	1.25	66.4° lag	2	100
0.5/2.5	1.0	31	1.25	66.4° lag	3	100
	1.5	14	1.25	66.4° lag	3	100
	2.0	8	1.25	66.4° lag	4	100
	2.5	5	1.25	66.4° lag	5	100
	2	8	1.25	66.4° lag	8	250
	2.5	5	1.25	66.4° lag	8	250
	3	3.5	1.25	66.4° lag	8	250
2/6	3.5	2.5	1.25	66.4° lag	8	250
	4	1.9	1.25	66.4° lag	9	250
	5	1.25	1.25	66.4° lag	9	250
	6	0.9	1.25	66.4° lag	10	250
	4	1.9	1.25	66.4° lag	16	250
	5	1.25	1.25	66.4° lag	16	250
	6	0.9	1.25	66.4° lag	16	250
4/15	8	0.5	1.25	66.4° lag	17	250
	10	0.3	1.25	66.4° lag	18	250
	12	0.2	1.25	66.4° lag	19	250
	15	0.15	1.25	66.4° lag	20	250

SHORT TIME COH RELAYS AT 60 CYCLES

Ampere Range	Tap	V.A. at 5 Amperes	V.A. at Tap Current	Power Factor	Continuous Rating (Amperes)	One Second Rating (Amperes)
	0.5	400	4	60° lag	2	56
	0.6	280	4	60° lag	2	56
	0.8	156	4	60° lag	2	56
0.5/2.5	1.0	100	4	60° lag	3	56
	1.5	44	4	60° lag	3	56
	2.0	25	4	60° lag	4	56
	2.5	16	4	60° lag	5	56
	2	25.0	4	60° lag	8	250
	2.5	16	4	60° lag	8	250
	3	11	4	60° lag	8	250
2/6	3.5	8.2	4	60° lag	8	250
	4	6.3	4	60° lag	9	250
	5	4.0	4	60° lag	9	250
	6	3.0	4	60° lag	10	250
	4	6.3	4	60° lag	16	250
	5	4.0	4	60° lag	16	250
	6	3.0	4	60° lag	16	250
4/15	8	1.6	4	60° lag	17	250
	10	1.0	4	60° lag	18	250
	12	0.7	4	60° lag	19	250
	15	0.4	4	60° lag	20	250

DIRECTIONAL UNIT SERIES COIL

Relay Range	Coil Rating	V.A. at Rated Amperes	Power Factor	One Second Rating (Amperes)
2-6	5	3.5	45° lag	140
4-15	5	3.5	45° lag	140
0.5-2.5	0.8	2.8	45° lag	23

DIRECTIONAL UNIT CURRENT POLARIZING CIRCUIT

2-6	5	2.2	28° lag	140
4-15	5	2.2	28° lag	140
0.5-2.5	0.8	2.1	28° lag	23

DIRECTIONAL UNIT POTENTIAL POLARIZING CIRCUIT

Rating	V.A. at 115 Volts	Power Factor
115 V	30	0°

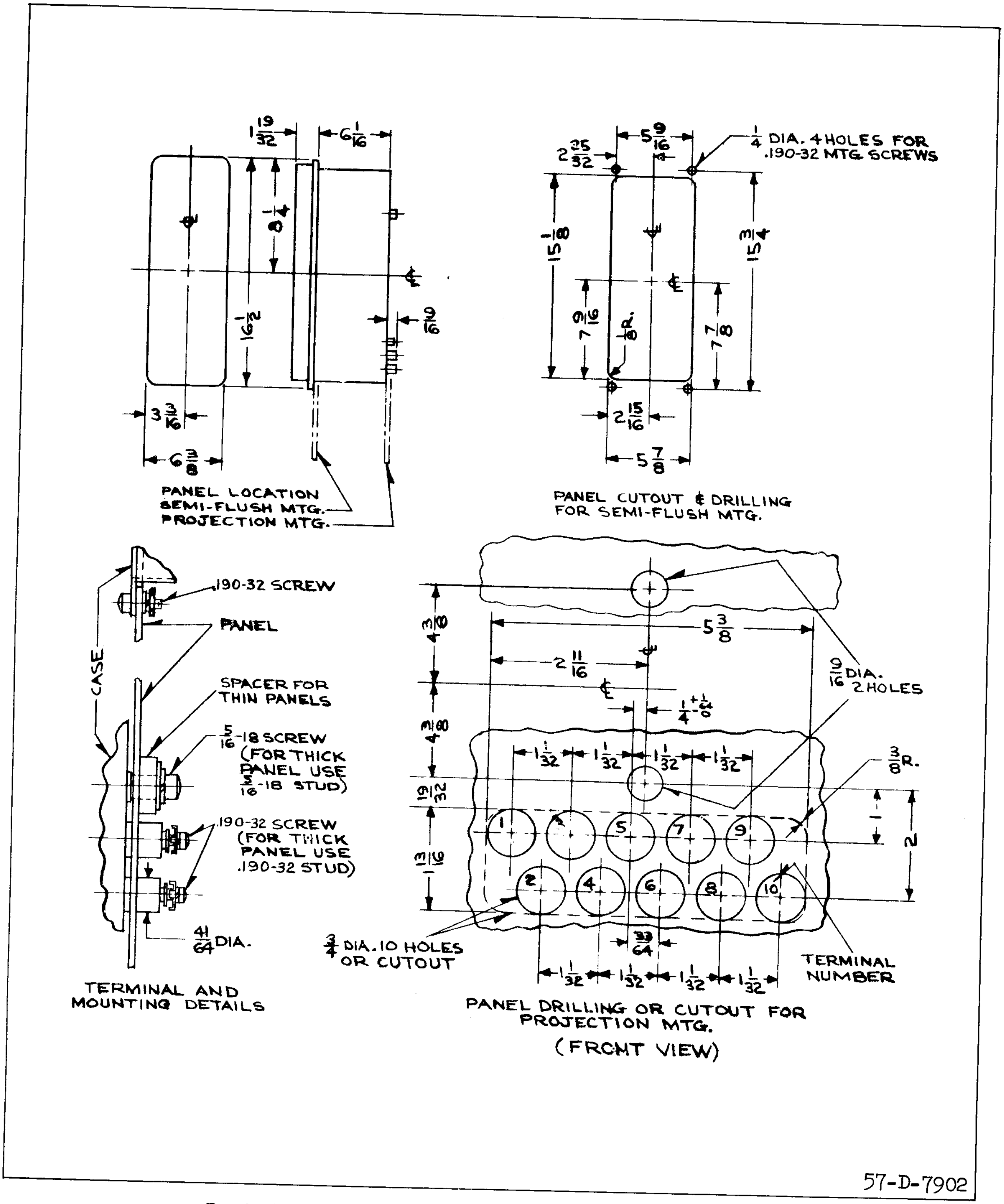

Fig. 8. Outline and Drilling Plan for the HCRD Relay in the FT31 Case.