INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPES CO AND COH OVERCURRENT RELAYS

CAUTION Before putting protective 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 can close properly. Operate the relay to check the settings and electrical connections.

APPLICATION

These induction-overcurrent relays are used to disconnect circuits or apparatus when the current in them exceeds a given value. Where a station battery (48 volts or over) is available, the circuit closing type relays are normally used to trip the circuit breaker. Where low voltage or no station battery exists, the circuit opening type relay in conjunction with a-c series trip coils can be used to open the breaker.

The inverse time (low-energy) type relay is used in preference to the definite minimum time (standard energy) relay where the requirements necessitate (1) a lower burden on the current transformer, or (2) a more inverse curve for selectivity, or (3) a very low current range as for example, ground protection of transmission systems.

The very-inverse time (low-energy) relay is similar to the inverse relay and is used where a still more inverse curve is desired. The term "low energy" refers to the burden at tap value that is placed on the current transformers and does not refer to the current rating.

The long time (40 second) relay is designed to protect motors against overloads. This can be equipped with an instantaneous attachment that will operate, if a short-circuit occurs in the motor.

The type COH relay finds application for phase and ground protection where a high speed induction type relay is desired. It is sometimes used in differential protective schemes.

The above relays can be supplied with the secondary electromagnet circuit brought out to separate terminals. This variety is known as the type CO or COH Torque Control Relay. Thus the contacts of a separate relay can be used to control the operation of the torque control relay. For example, a three phase directional relay plus suitable auxiliary relays can be used to directionally control three torque control relays.

CONSTRUCTION AND OPERATION

Circuit-Closing Relay

The circuit-closing types CO and COH relays consist of an overcurrent element, an operation indicator, a contactor switch, and an instantaneous trip attachment where required.

Overcurrent Element

This element is an induction-disc type element 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

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*Denotes change from superseded issue

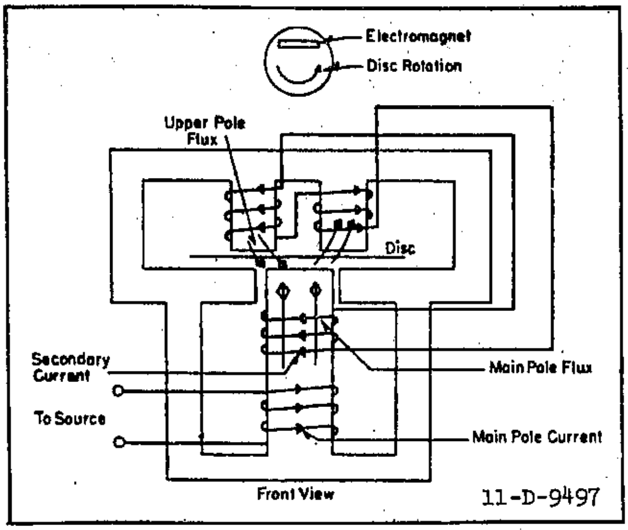

Fig. 1—Flux And Current Relations In The Type COH, Type CO Inverse and Very Inverse Time Relays Without The Torque Compensator.

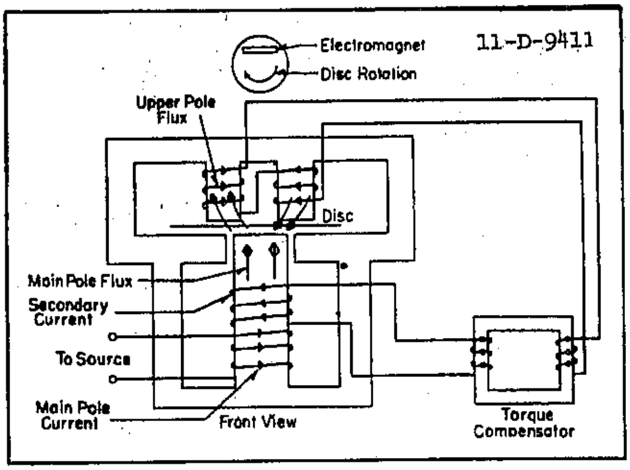

Fig. 2—Flux And Current Relations In The Long Time and Definite Minimum Time Relays With The Torque Compensator.

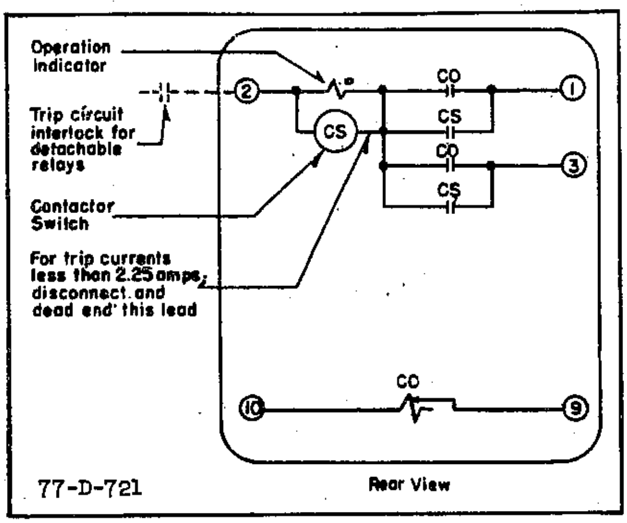

Fig. 3—Internal Schematic Of The Double Trip Circuit Closing Types CO And COH Relays In The Standard Case. The Single Trip Relays Have Terminal 3 And Associated Circuits Omitted.

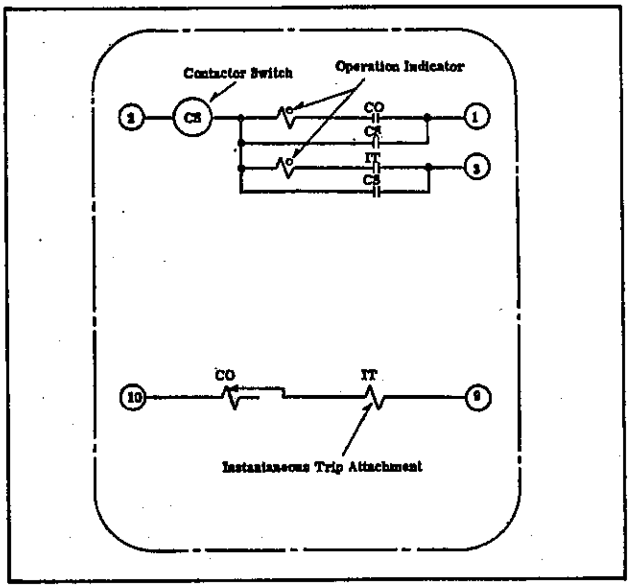

Fig. 4—Internal Schematic Of The Single Trip Circuit Closing Types CO And COH Relays With Instantaneous Trip Attachment In The Standard Case.

geared to the disc shaft in the geared type relays. The electrical connection is made from the moving contact through 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 simultaneously.

The moving disc is rotated by an electromagnet in the rear and damped by a permanent magnet in the front. The operating torque of the inverse or very inverse relays is obtained

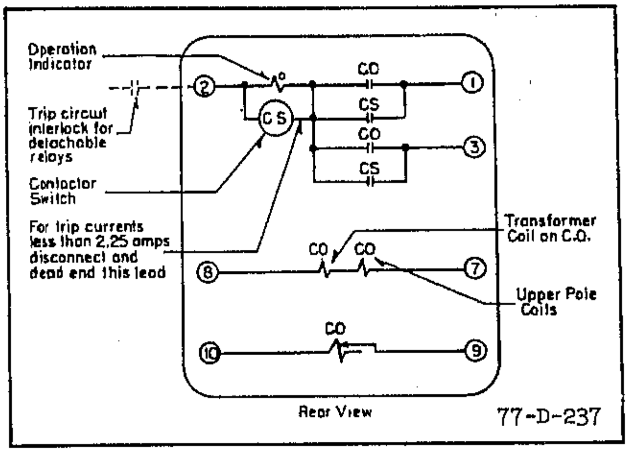

Fig. 5—Internal Schematic Of The Double Trip Circuit Closing Inverse And Very Inverse Types CO And COH Relays With Torque Control Terminals In The Standard Case. The Single Trip Relays Have Terminal 3 And Associated Circuits Omitted.

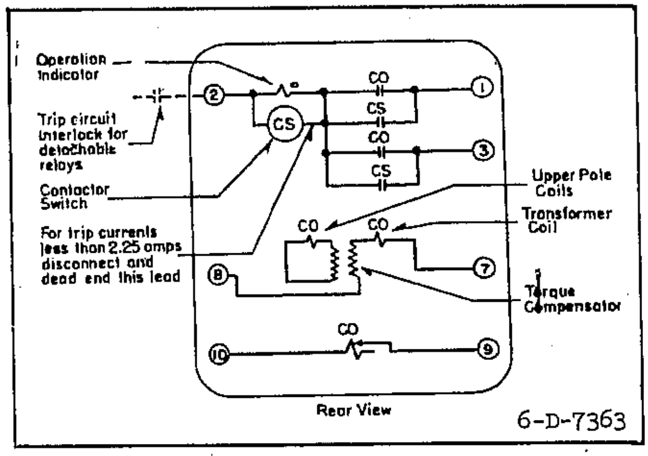

Fig. 6—Internal Schematic Of The Double Trip Circuit Closing Definite Minimum Time Type CO Relay With Torque Control Terminals In The Standard Case. The Single Trip Relays Have Terminal 3 And Associated Circuits Omitted.

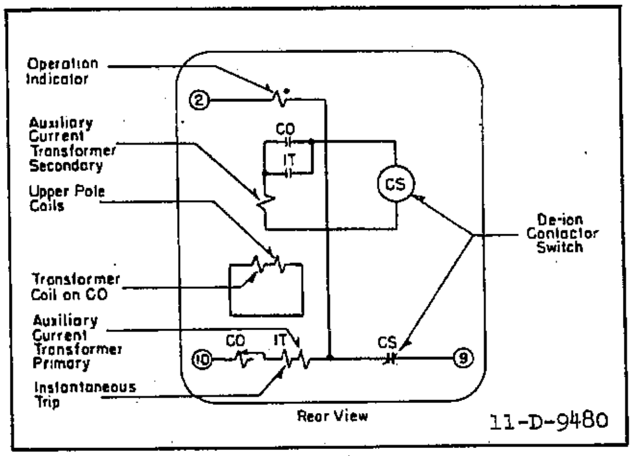

Fig. 7—Internal Schematic Of The Circuit Opening Inverse And Very Inverse Time Type CO Relays With Instantaneous Trip Attachment In The Standard Case.

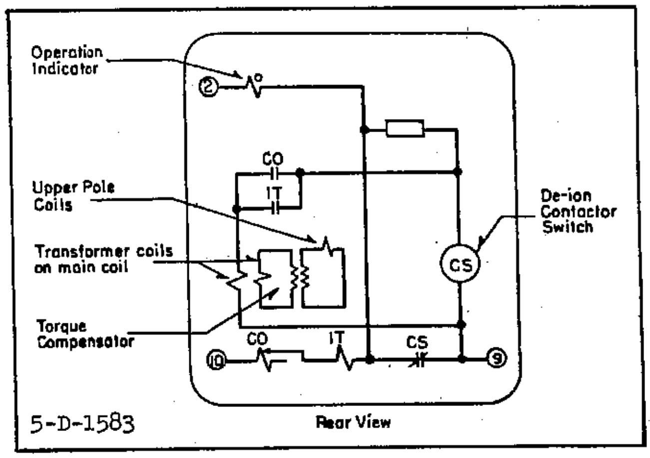

Fig. 8—Internal Schematic Of The Circuit Opening Definite Minimum Time Type CO Relays With Instantaneous Trip Attachment In The Standard Case.

by the circuit arrangement shown in Figure 1. 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.

The definite-time relay obtains its flat characteristic curve because of a small saturating transformer that is interposed between the secondary coil and the upper pole coils. This is called the torque conpensator and it slows down the disc movement to such an extent that no gearing is required. (See Figure 2).

The long time relay is a geared relay with a torque compensator.

The type COH relay is a non-geared relay without a torque compensator.

Contactor Switch

The d-c. contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid.

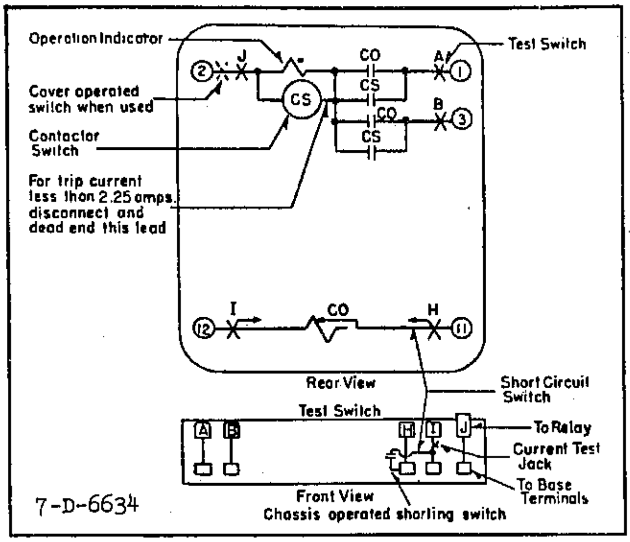

Fig. 9—Internal Schematic Of The Double Trip Circuit Closing Types CO And COH Relays In The Type FT Case. The Single Trip Relays Have Terminal 3 And Associated Circuits Omitted.

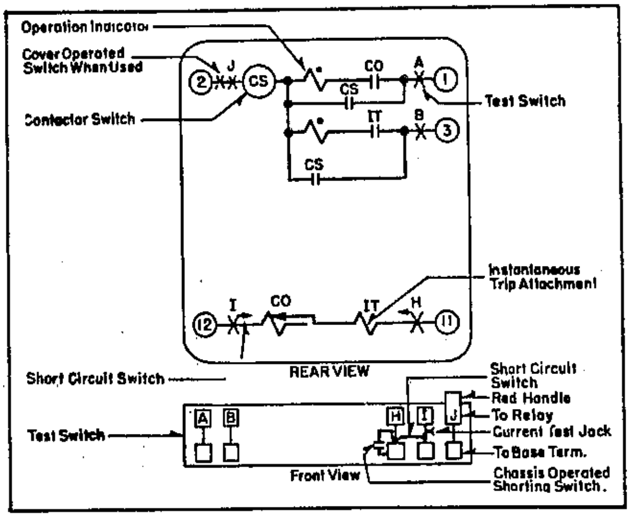

Fig. 10—Internal Schematic Of The Single Trip Circuit Closing Types CO And COH Relays With Instantaneous Trip Attachment In The Type FT Case.

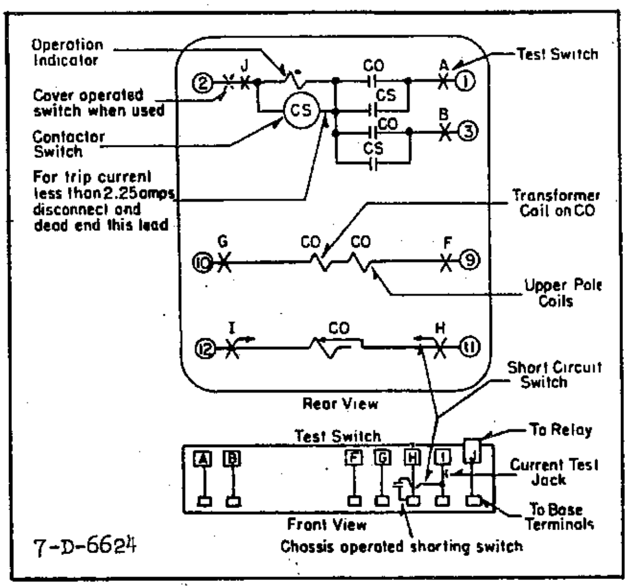

Fig. 11—Internal Schematic Of The Double Trip Circuit Closing Inverse And Very Inverse Types CO And COH Relays With Torque Control Terminals In The Type FT Case. The Single Trip Relays Have Terminal 3 And Associated Circuits Omitted.

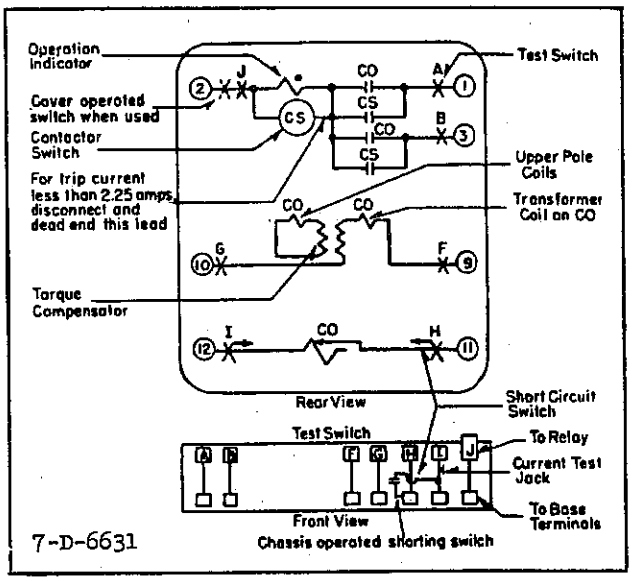

Fig. 12—Internal Schematic Of The Double Trip Circuit Closing Definite Minimum Time Type CO Relay With Torque Control Terminals In The Type FT Case. The Single Trip Relays Have Terminal 3 And Associated Circuits Omitted.

As the plunger travels upward, the disc bridges three silver stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch contacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. These contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker.

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 in the cover or cover stud.

Instantaneous Trip (When Supplied)

The instantaneous trip attachment is a small solenoid type element. 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 element.

Instantaneous Lock-Out Attachment (When Supplied)

The lock-out attachment is used to prevent the relay from tripping a circuit breaker when current is too high-above its interrupting capacity.

Circuit-Opening Relay

The circuit-opening type CO Relay consists of an overcurrent element, a de-ion contactor switch, an operation indicator and an instantaneous trip attachment where required.

Overcurrent Element

The overcurrent construction and operation is similar to that described for the circuit closing relays.

De-ion Contactor Switch

This switch is a small a-c. solenoid switch whose coil is energized from a few turns on the lower pole of the overcurrent element in the standard-energy type relays, and from a small transformer connected in the main current circuit in the low-energy type relays. Its construction is similar to the d-c. type switch except that the plunger operates a spring leaf arm with a silver contact surface on one end and rigidly fixed to the frame at the other end.

The overcurrent element contacts are in the contactor switch coil circuit and when they close, the solenoid plunger moves upward to open the de-ion contacts which normally short circuit the trip coil. These contacts are able to transfer the heavy current due to a short circuit and permit this current to energize the breaker trip coil.

The transformer coil on the lower pole of the overcurrent element and the contactor switch circuits in the standard energy type relays are connected to the main circuits as shown in Figures 8 and 14. When the overcurrent contact closes, the contactor switch operates, and the voltage across the trip coil is impressed on the transformer and contactor switch coils. This voltage acts to seal-in the contactor switch, and to feed energy through the transformer coil to the main overcurrent winding which produces contact closing torque. This arrangement provides a definite minimum pick-up value largely independent of the value of trip coil impedance.

Operation Indicator

The operation indicator is in series with the breaker trip coil. Its construction is as described above.

CHARACTERISTICS

The type CO definite minimum time (standard energy) or long time (40 second) circuit closing relay is available in either of the following current ranges.

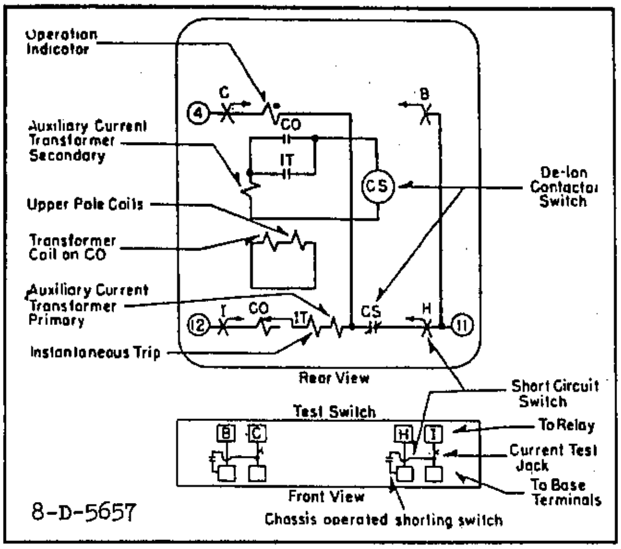

Fig. 13—Internal Schematic Of The Circuit Opening Inverse And Very Inverse Time Type CO Relays With Instantaneous Trip Attachment In The Type FT Case.

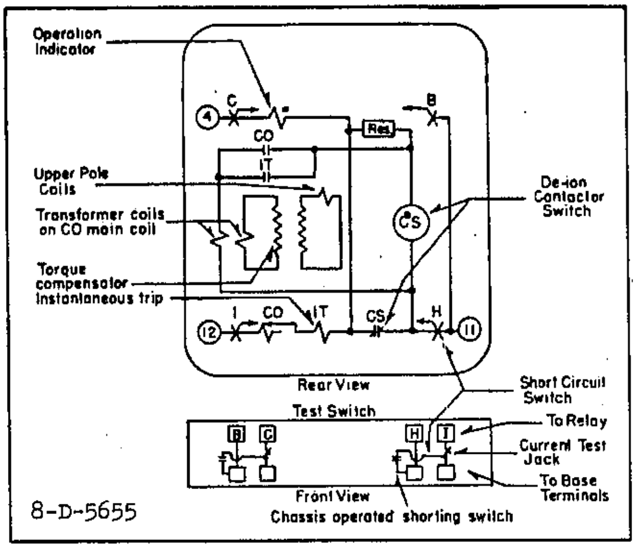

Fig. 14—Internal Schematic Of The Circuit Opening Definite Minimum Time Type CO Relays With Instantaneous Trip Attachment In The Type FT Case.

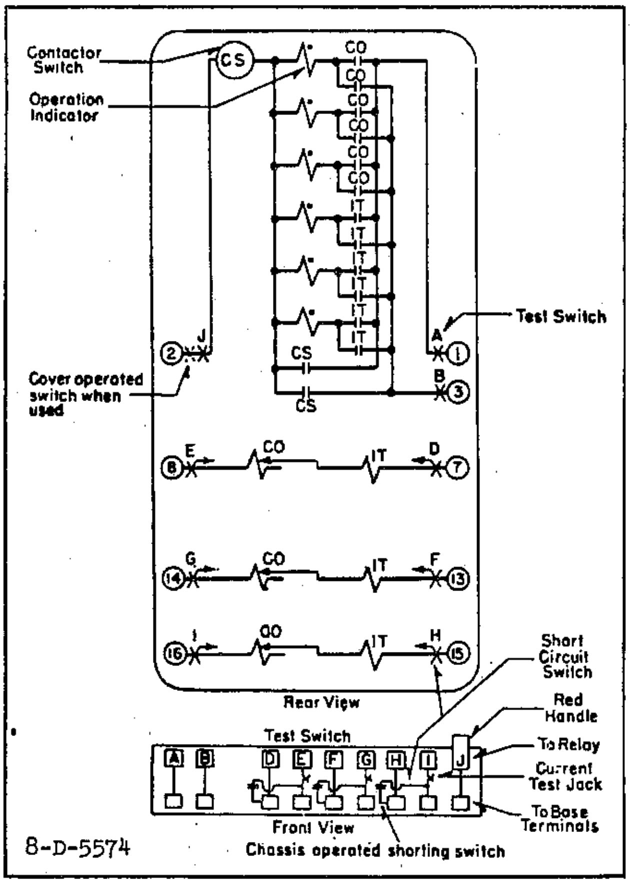

Fig. 15—Internal Schematic Of The Three Element Double Trip Circuit Closing Types CO And COH Relays With Instantaneous Trip Attachment In The Type FT Case. The Single Trip Relays Have Terminal 3 And Associated Circuits Omitted.

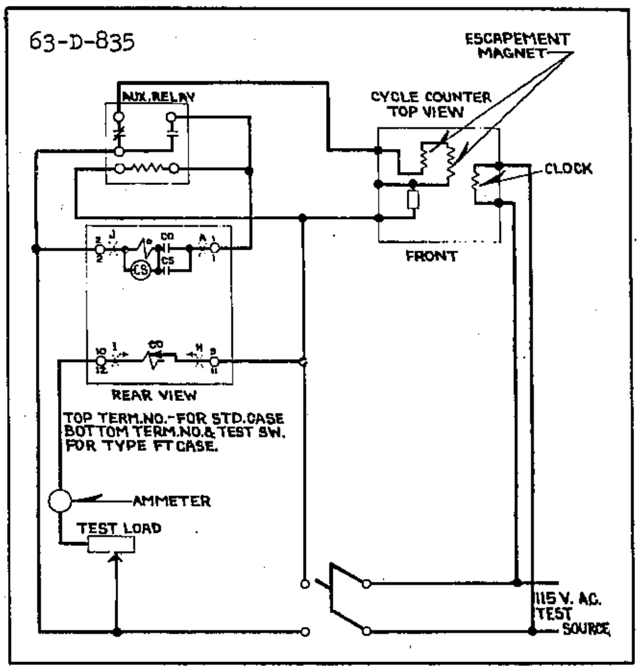

Fig. 16—Diagram Of Test Connections For Circuit Closing Types CO And COH.

2	2.5	3	3.5	4	5	6
4	5	6	8	10	12	15

The type CO inverse, very inverse (low energy) or the type COH circuit closing relay is 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 type CO circuit-opening relay is made only in the 4 to 15 ampere range. A lower range is not desirable because the burden of a low-range trip coil is too heavy on the current transformer. One trip coil is required for each relay.

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 semicircular lever scale calibrated in 11 divisions.

These relays may have either single or double circuit closing contacts for tripping either one or two breakers, or may have circuit-opening contacts for tripping the breakers by current from the current transformers.

The characteristics of the various varieties of type CO and COH relays usually supplied are as shown on page 13.

The burdens and thermal ratings are listed under Energy Requirements.

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

The De-ion contactor switch on the circuit opening relays has a minimum pick-up of 4 amperes a-c.

The instantaneous lock-out attachment has a 3 to 1 range with typical ranges similar to the instantaneous trip attachment.

Trip Circuit

The main contacts will safely close 30 amperes at 250v. d-c, and the switch contacts will safely carry this current long enough to trip a breaker.

The relay without the instantaneous trip attachment is shipped with the operation indicator and the contactor switch connected in parallel. This circuit is suitable for all trip currents above 2.25 amperes d-c. If the trip current is less than 2.25 amperes, there is no need for the contactor switch and it should be disconnected. To disconnect the coil in the standard case relays, remove the short lead to the coil on the front stationary contact of the contactor switch. This lead should be fastened (dead ended) under the small filisterhead screw located in the Micarta base of the contactor switch. For the Flexitest relays, the coil is disconnected by removing the coil lead at the spring adjuster and dead-ending it under a screw at the top of the Micarta support.

The relay with the instantaneous trip attachment has a two ampere contactor switch in series with a one ampere operation indicator in each trip path.

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.

CONTACT CIRCUIT CONSTANTS

Universal Trip Circuit

Resistance of 0.2 ampere Target......2.8 ohms

Resistance of 2.0 ampere Contact Switch.............................0.25 ohms

Resistance of Target and Switch in Parallel.........................0.23 ohms

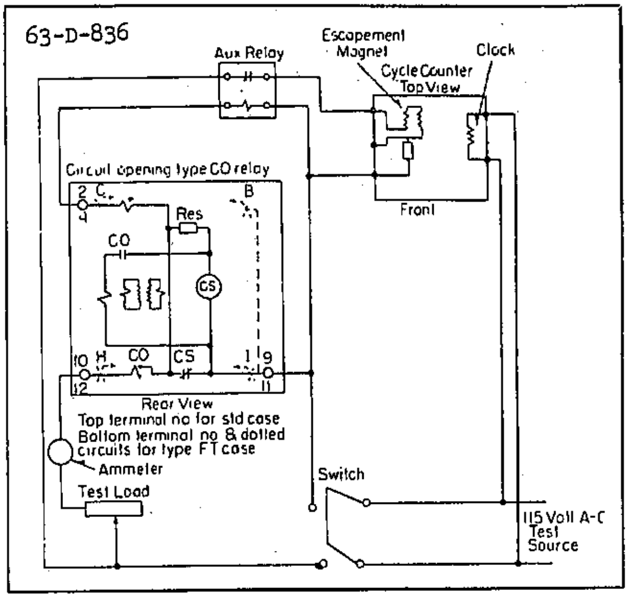

Fig. 17—Diagram Of Test Connection For Circuit Opening Type CO Relay.

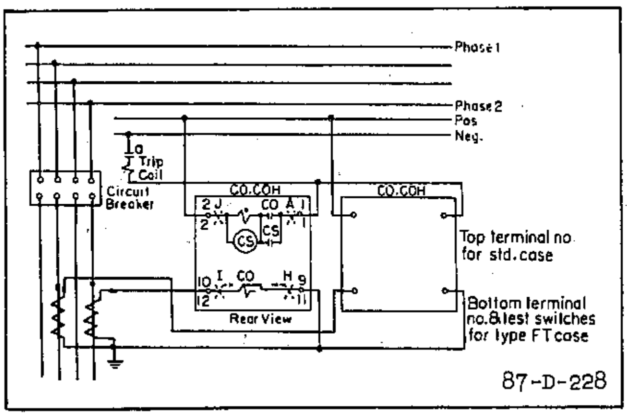

Fig. 19—External Connections Of The Circuit Closing Types CO And COH Relays For Overcurrent Protection On A Two-Phase System.

Trip Circuit with Instantaneous Trip

Resistance of 1.0 ampere Target......0.16 ohms
Resistance of 2.0 ampere Contactor Switch..............................0.25 ohms
Resistance of Target and Switch in Series..............................0.41 ohms

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

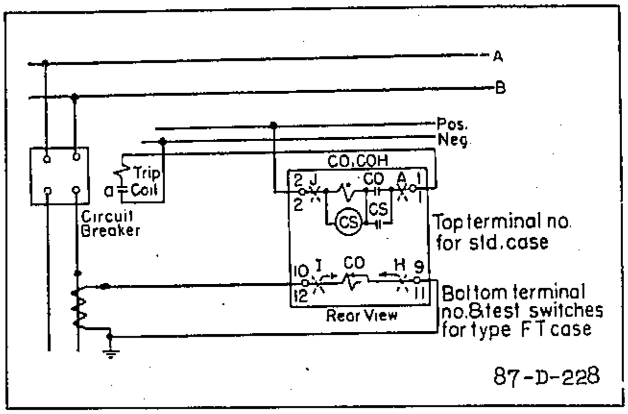

Fig. 18—External Connections Of The Circuit Closing Types CO And COH Relays For Overcurrent Protection On A Single Phase System.

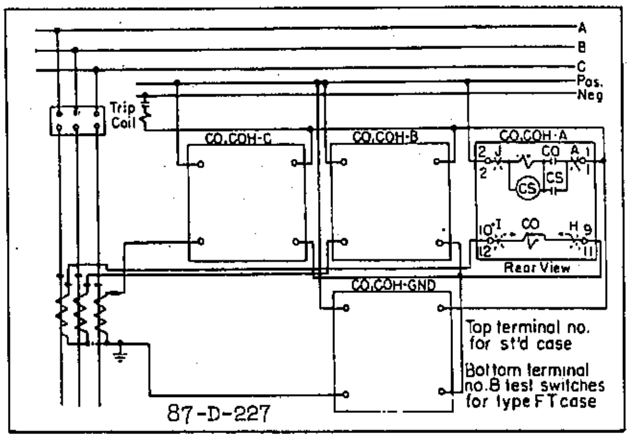

Fig. 20—External Connections Of The Circuit Closing Types CO And COH Relays For Phase And Ground Overcurrent Protection On A Three-Phase System.

the two mounting studs for the standard cases and the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

Because the circuit-opening relay contacts short circuit the trip coil, it is important that the relay be mounted where it will not be subject to shocks which may jar the contacts

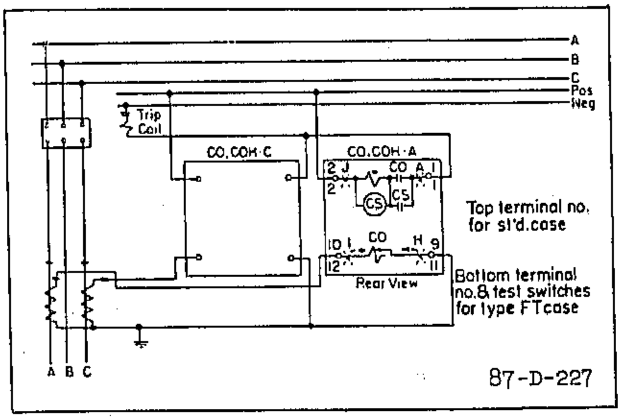

Fig. 21—External Connections Of The Circuit Closing Types CO And COH Relays For Phase Overcurrent Protection On An Ungrounded Three-Phase System.

open and thereby allow current to flow through the trip coil. Trouble of this kind can be avoided by preventing jars to the switchboard and also by setting the trip coil high enough so that it will not operate on normal load current. This is an extra safeguard so that there is no danger from even an excessive shock unless the current is also heavy.

Typical external connections are shown in Figures 18 to 22. When using the circuit-opening relays for phase protection, ground protection may be secured by using a low-energy circuit-closing relay operating on a-c. voltage trip coil, as shown in Figure 22.

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.

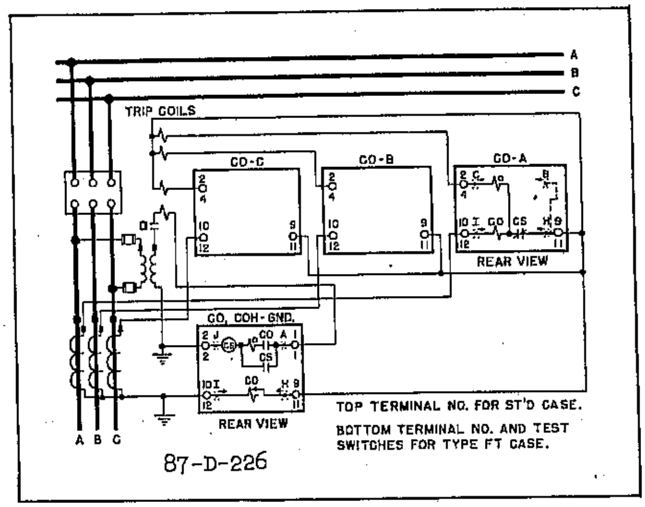

Fig. 22—External Connections Of The Circuit Opening Type CO Relay For Phase Overcurrent Protection And Of The Circuit Closing Types CO And COH Relays For Ground Protection On A Three-Phase System.

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 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 screwdriver 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 percent above or below any tap value, can be secured.

CAUTION Be sure that the connector screw is turned up tight so as to make a good contact, for the operating current passes through it. Since the overload element is connected directly in the current transformer circuits the latter should be short-circuited before changing the connector screw. This can be done conveniently by inserting the extra connector screw, in the new tap and removing the old screw from its original setting.

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 as shown in the typical time curves of Figures 23 to 27.

ADJUSTMENTS AND MAINTENANCE

All relays should be inspected periodically and the time of operation should be checked at least once every six months. For this purpose, a cycle counter should be employed, because of its convenience and accuracy. Phantom loads shoudl 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 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.

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 or the relay taken apart for repairs, the following instructions should be followed in reassembling and setting it.

(Overcurrent Element Circuit-Closing Relays)

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 tap block. Check the time curve as shown by test with a cycle counter, to be as shown on the typical time curves. 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 operation 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.

The position of the torque compensator on the overload element is adjustable. influencing the shape of the curve. This is a factory adjustment and the location of the torque compensator should not be changed in the field. If the relay has a metal cover, this cover must be in place when making tests.

The relays with torque control terminals will not operate until these terminals are short-circuited either by a jumper or by the external control contacts.

Contactor Switch (Circuit-Closing Relays)

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 most conveniently done by disconnecting the switch and turning it or the relay upside-down. 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 moving contact assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the stationary core screw one turn beyond this point 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 inch 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.

Operation Indicator (Circuit-Closing Relays)

Adjust the indicator to operate at 0.2 or 1.0 ampere d-c. as supplied gradually applied by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. Test for sticking after 10 times rated pick-up current has been applied.

Overcurrent Element (Circuit Opening Relays)

Adjust the relay with the instructions given under "Overcurrent Element (Circuit Closing Relays)" using the test connection of Figure 17 except that for the definite minimum time circuit opening relay the following caution should be observed:

CAUTION When a signal lamp or other voltage operated device is to be connected in series with the relay contacts, disconnect the internal leads of the element from the stationary and moving contacts respectfully and dead end them. Then the lamp or other device can be connected to the stationary and moving contacts.

De-ion Contactor Switch (Circuit Opening Relays)

Adjust the core stop on the top as high as possible without allowing the insulating bushing at the bottom of the plunger to touch the Micarta angle. The contact will be separated from the Micarta angle by 1/32" to 1/16". Adjust the contact gap spacing to slightly less than 1/16 of an inch. Bend down the contact springs so that a firm contact is made but not so strong that the minimum pick-up value cannot be obtained. The spring tension should be about 15 grams.

Hold the relay contacts closed and with an auxiliary relay coil connected across terminals to simulate the circuit breaker trip coil, note that the contactor switch picks up on less than 4 amperes on the 4 ampere overcurrent tap setting.

In the case of the standard energy circuit opening relay the contactor switch should pick-up and seal itself open at 75% of minimum trip current.

Operation Indicator (Circuit Opening Relays)

Adjust the indicator similar to that described for the circuit closing relay except to operate at 4 amperes a-c.

Instantaneous Trip Attachment

The position of the Micarta disc at the bottom of the element with reference to the calibrated guide indicates the minimum overcurrent required to operate the element. This disc should be lowered or raised to the proper position by loosening the locknut which locks the Micarta disc and rotating the Micarta disc. The nominal range of adjustments is 1 to 4, for example 10 to 40 amperes, and it has an accuracy within the limits 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. It should be adjusted for about 2/3 of the minimum pick-up.

This element will not fit in the round-type case.

Instantaneous Lock-Out Attachment

The position of the bottom of the plunger with reference to the calibrated guide indicates the minimum current required to open the contacts. To change the setting hold the top slotted head of the plunger rod fixed with a screwdriver. Then with a second screwdriver adjust the lower end of the plunger for the current pick-up desired.

These contacts must be given special care because they are in series with the main tripping circuit and may prevent proper relay operation if they become dirty. The nominal range of adjustment is 3 to 1.

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.

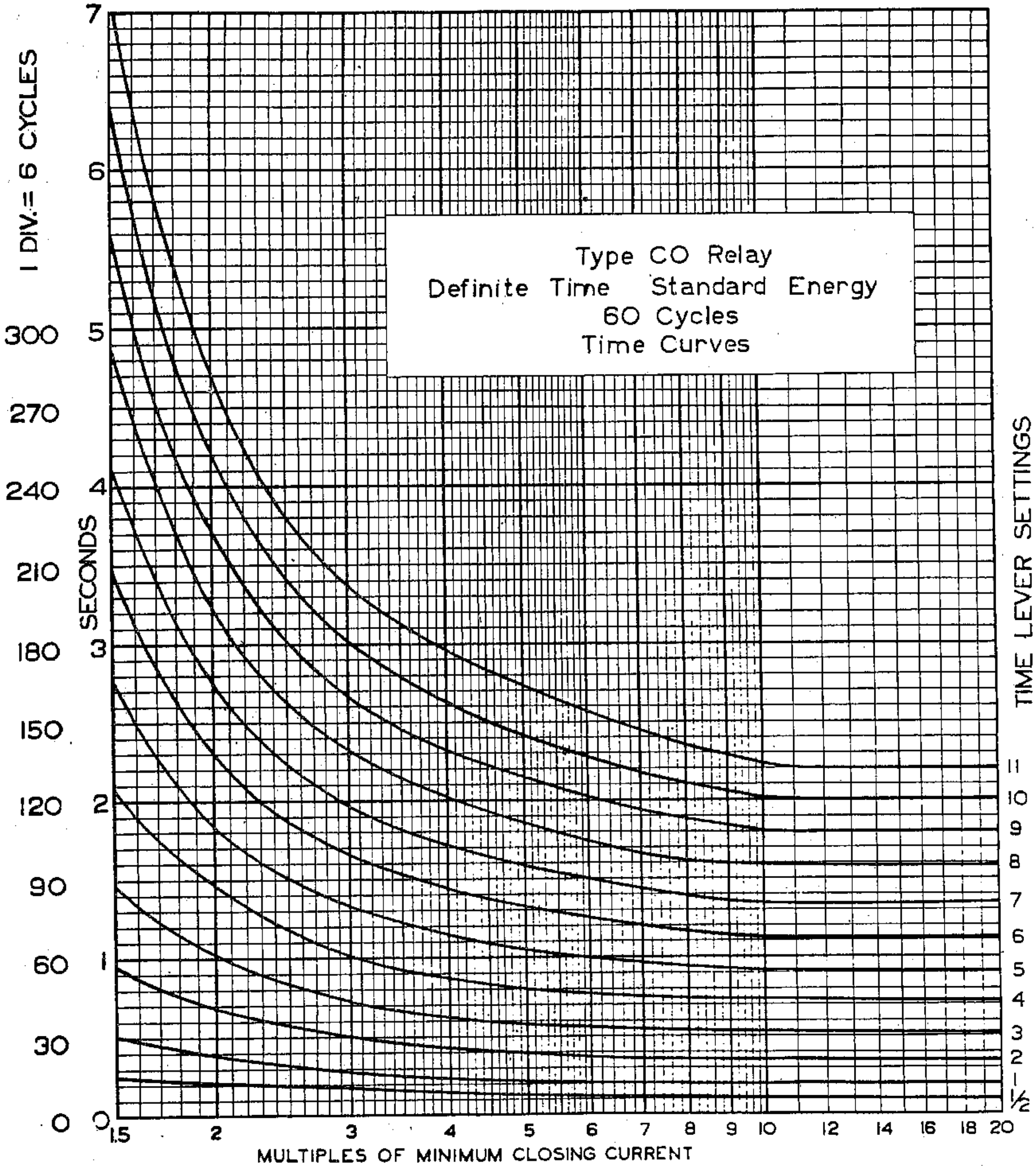

Fig. 23—Typical 60 Cycle Time Curves Of The Definite Minimum Time (Standard Energy) Type CO Relay.

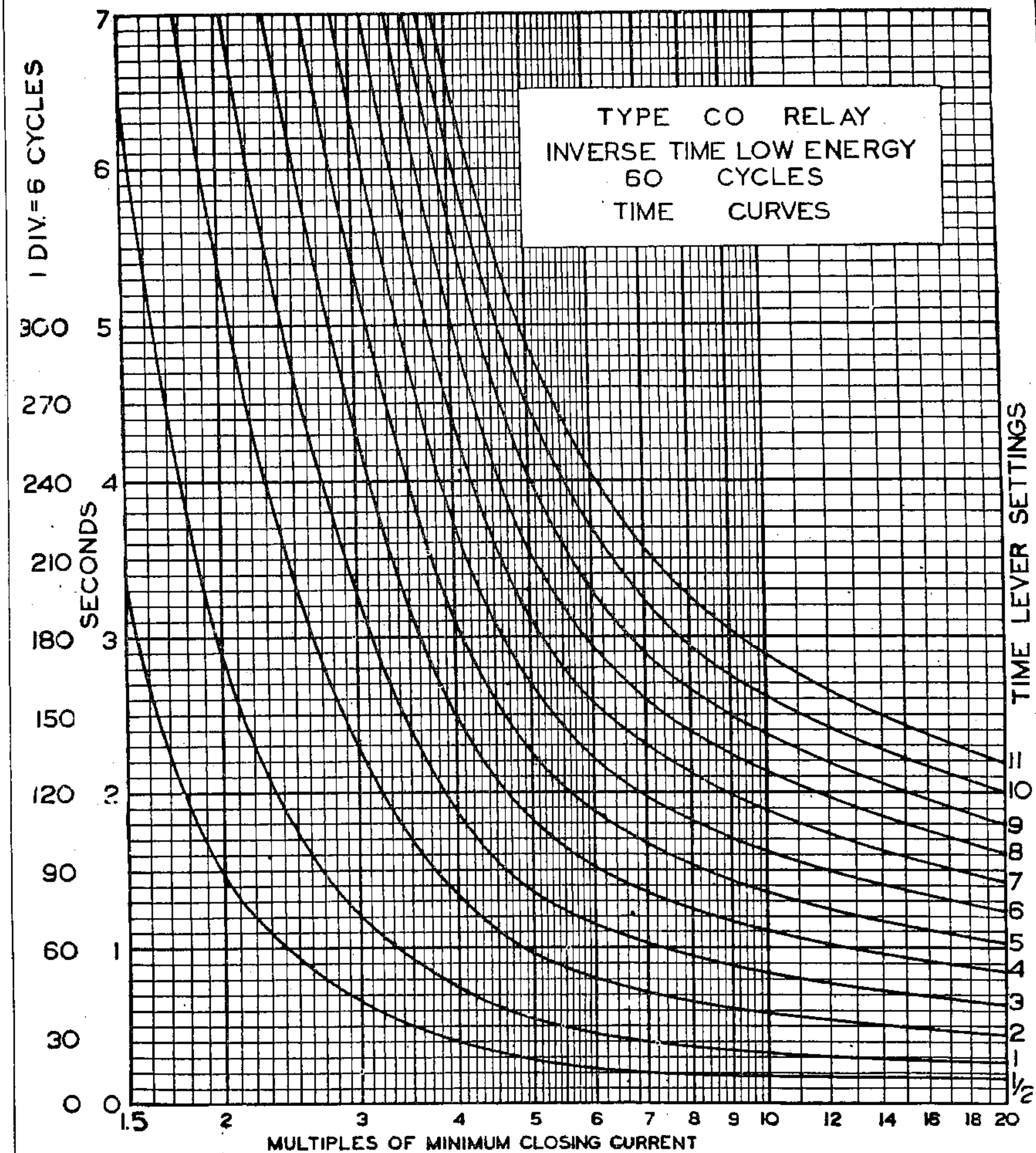

Fig. 24—Typical 60 Cycle Time Curves Of The Inverse Time (Low Energy) Type CO Relay.

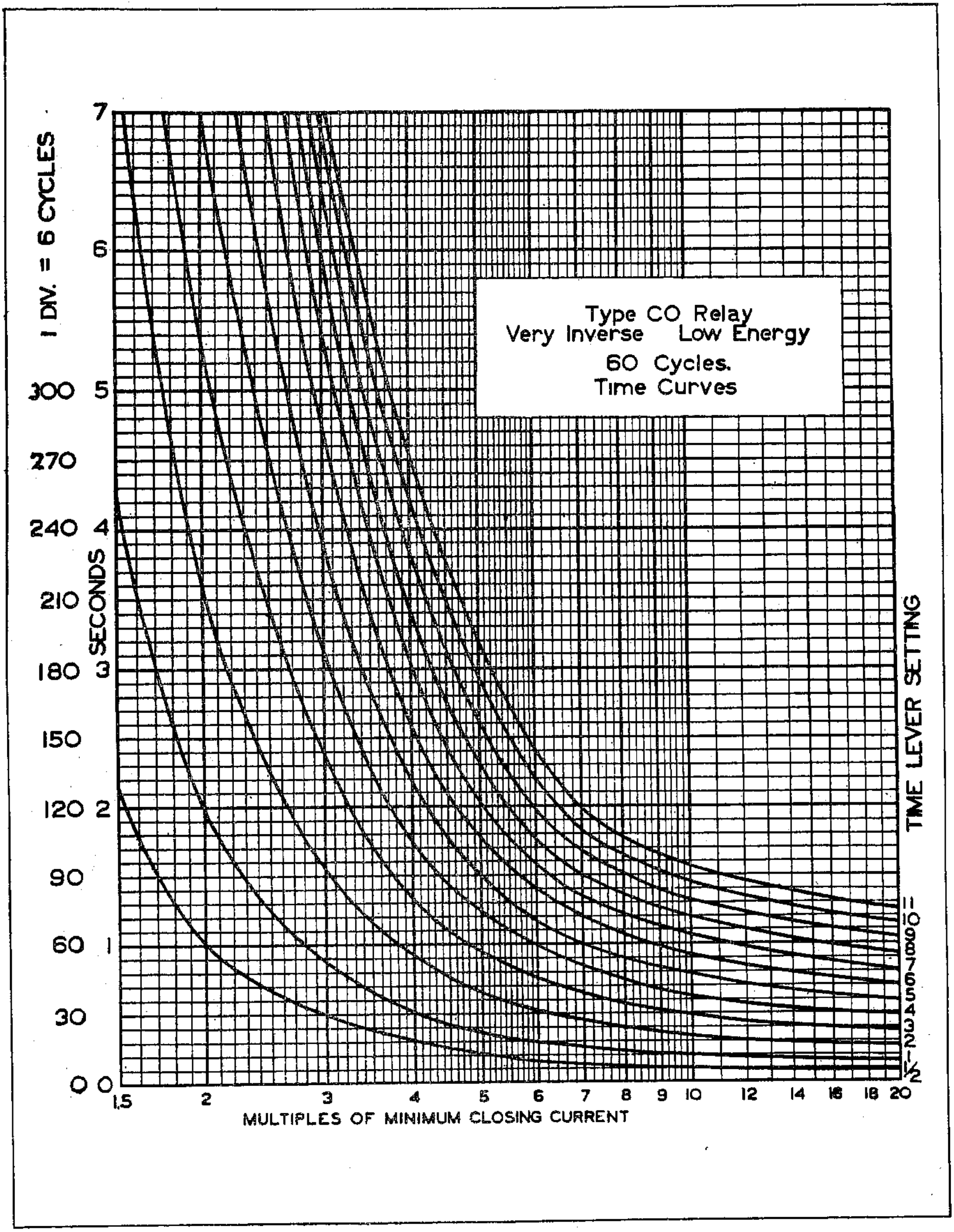

Fig. 25—Typical 60 Cycle Time Curves Of The Very Inverse Time (Low Energy) Type CO Relay.

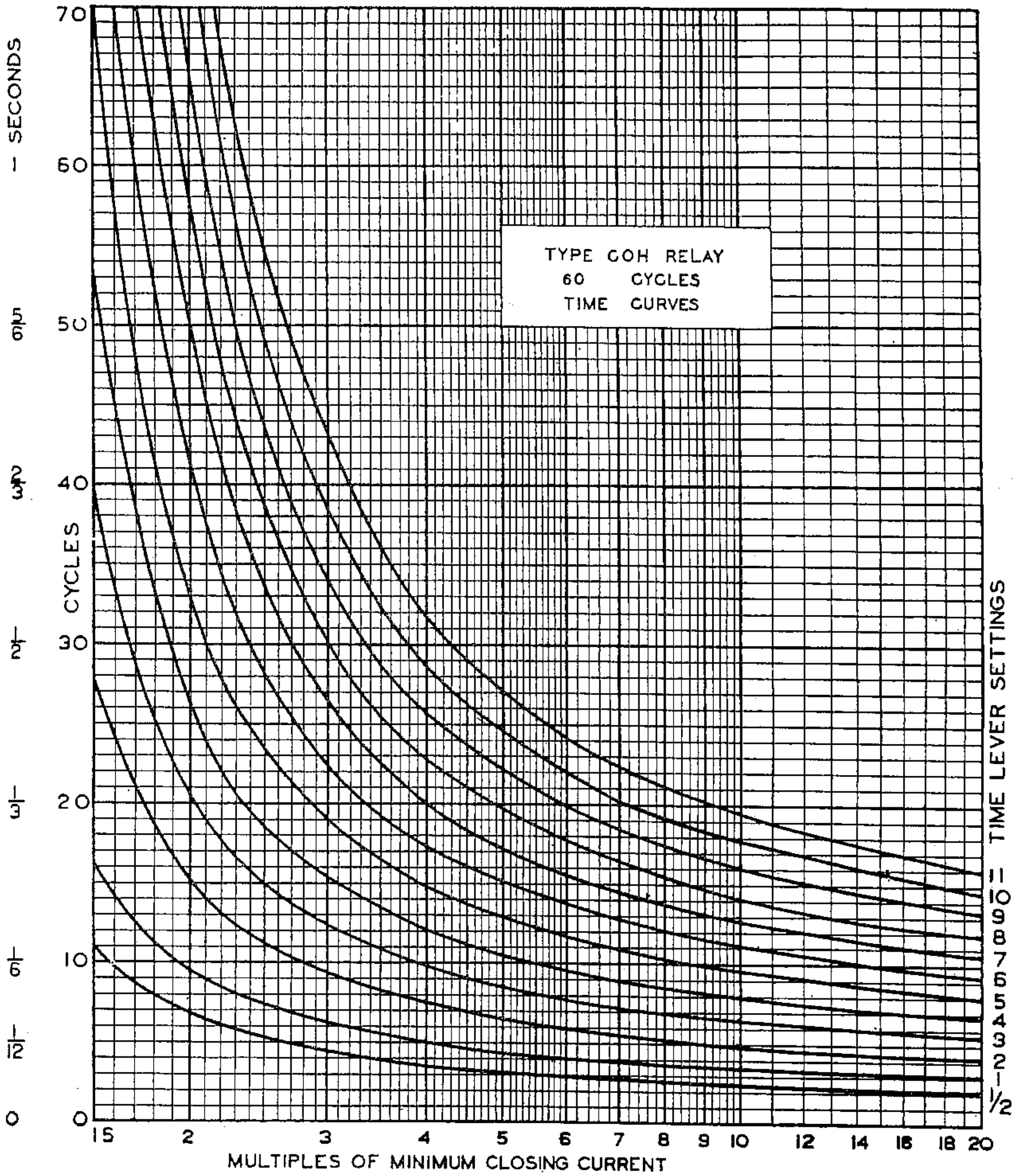

Fig. 26—Typical 60 Cycle Time Curves Of The Type COH Relay.

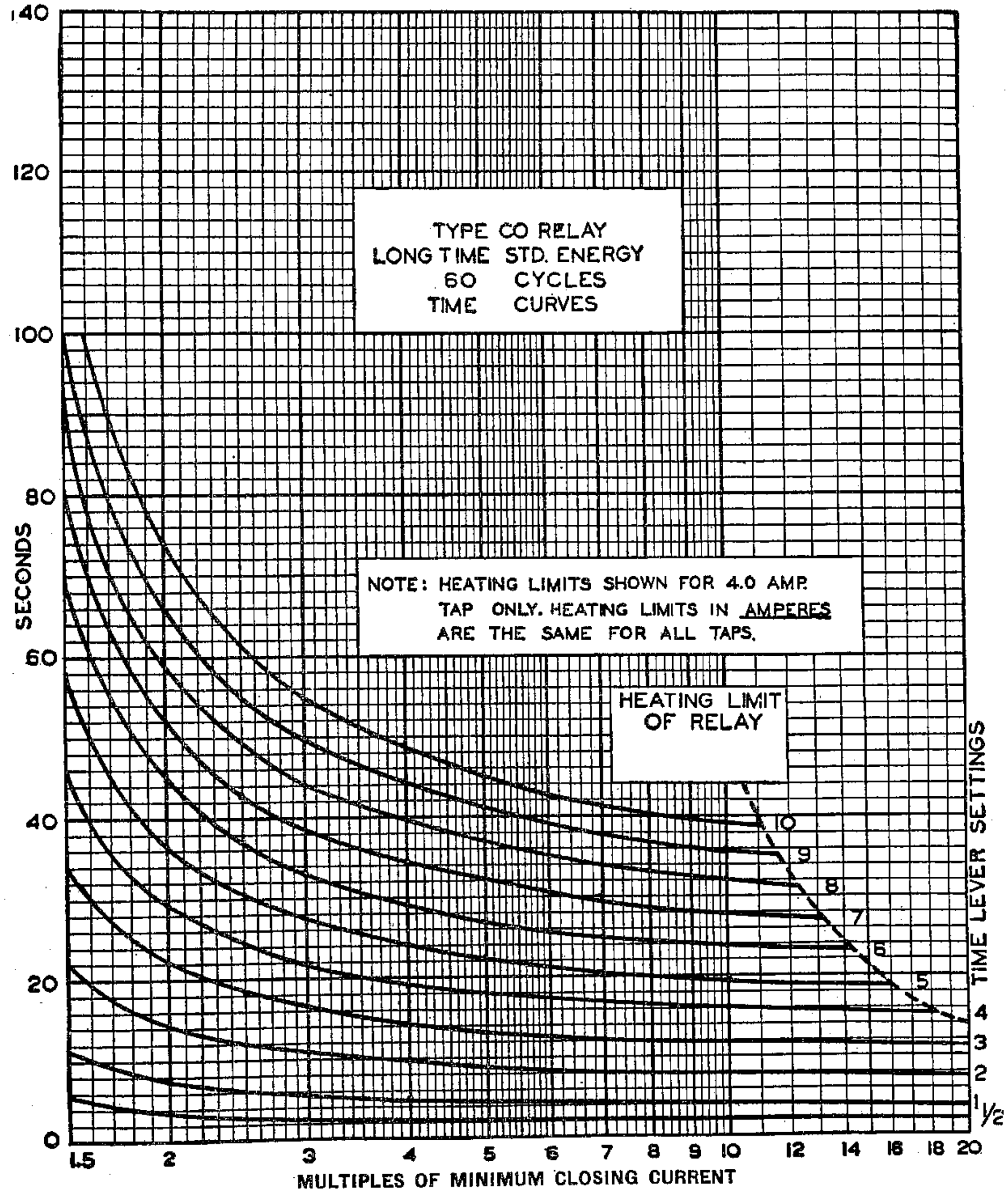

Fig. 27—Typical 60 Cycle Time Curves Of The Long Time (40 Second) Type CO Relay.

ENERGY REQUIREMENTS

The burdens and thermal capacities of the various circuits of the relay are as follows:

DEFINITE MINIMUM 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)
2/6	2	108	17	60° lag	4	140
	2.5	68	17	60° lag	5	140
	3	47	17	60° lag	5	140
	3.5	35	17	60° lag	6	140
	4	26	17	60° lag	7	140
	5	17	17	60° lag	8	140
	6	12	17	60° lag	10	140
4/15	4	26	17	60° lag	8	250
	5	17	17	60° lag	8	250
	6	12	17	60° lag	9	250
	8	6.5	17	60° lag	10	250
	10	4.5	17	60° lag	12	250
	12	3	17	60° lag	13	250
	15	2	17	60° lag	15	250

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)
0.5/2.5	0.5	200	2	66° lag	2	70
	0.6	140	2	66° lag	2	70
	0.8	78	2	66° lag	2	70
	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
2/6	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
	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
4/15	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
	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)
0.5/2.5	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
	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
2/6	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
	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
4/15	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
	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

*Thermal capacities for other than one second may be calculated on the basis of time being inversely proportional to the square of the current.

LONG 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)
4/15	4	26	17	60° lag	8	250
	5	17	17	60° lag	8	250
	6	12	17	60° lag	9	250
	8	6.5	17	60° lag	10	250
	10	4.5	17	60° lag	12	250
	12	3	17	60° lag	13	250
	15	2	17	60° lag	15	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)
0.5/2.5	0.5	400	4	60° lag	2	56
	0.6	280	4	60° lag	2	56
	0.8	156	4	60° lag	2	56
	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
2/6	2	25	4	60° lag	8	250
	2.5	16	4	60° lag	8	250
	3	11	4	60° lag	8	250
	3.5	8	4	60° lag	8	250
	4	6.3	4	60° lag	9	250
	5	4	4	60° lag	9	250
	6	2.8	4	60° lag	10	250
4/15	4	6.3	4	60° lag	16	250
	5	4.0	4	60° lag	16	250
	6	3.0	4	60° lag	16	250
	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

BURDENS AT TAP CURRENT ON 25 AND 50 CYCLES

	25 Cycles V.A.	25 Cycles Power Factor	50 Cycles V.A.	50 Cycles Power Factor
Definite Minimum Time CO...	16	53° lag	17	60° lag
Inverse Time CO............	2	60° lag	2	60° lag
Very Inverse Time CO........	1.25	60° lag	1.25	66.4° lag
Long Time CO...............	16	53° lag	17	60° lag
Short Time COH.............	4	53° lag	4	60° lag

BURDENS FOR SATURATION DATA

Voltage taken with Rectox type voltmeter.

Multiples of Tap Values of Current		1	3	10	20
Definite Time	V.A. Burden	17	100	490	1300
Inverse Time	V.A. Burden	2.0	18.3	136	351
Very Inverse Time	V.A. Burden	1.25	10.75	97	254
COH Time	V.A. Burden	4	37.4	198	506

Characteristics of Types CO and COH Relays

Type	Energy	Time	Approx. #10 Lever Time at 20 x Tap Value	Gearing	Torque Compen-sator	Schematic per Figure No.	Typical 60 Cycle Time Curve per Fig. No.
CO	Std.	Definite Time	2 Sec.	Non-geared	Yes	3,4,6,8,9,10,12,14&15	23
CO	Std.	Definite Time	4 Sec.	Non-geared	Yes	3,4,6,8,9,10,12,14&15	..
CO	Low	Inverse	2 Sec.	Geared	No	3,4,5,7,9,10,11,13&15	24
CO	Low	Inverse	4 Sec.	Geared	Yes	3,4,6,8,9,10,12,14&15	..
CO	Low	Very Inverse	1 + Sec.	Geared	No	3,4,5,7,9,10,11,13&15	25
CO	Std.	Definite Time	40 Sec.	Geared	Yes	3,4,6,8,9,10,12,14&15	27
COH	....	Inverse	18 Cyc.	Non-Geared	No	3,4,5,9,10,11&15	26

Three element relay characteristics are the same as in single element forms.

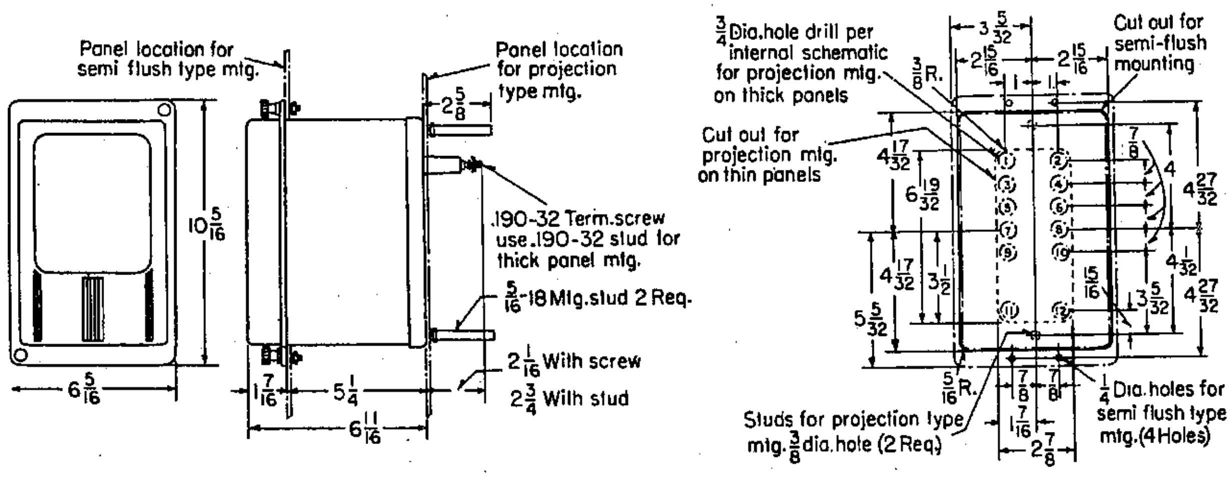

Fig. 28—Outline And Drilling Plan For The Single Element Types CO And COH Relays In The S10 Projection Or Semi-Flush Type FT Flexitest Case. See The Internal Schematics For The Terminals Supplied. For Reference Only.

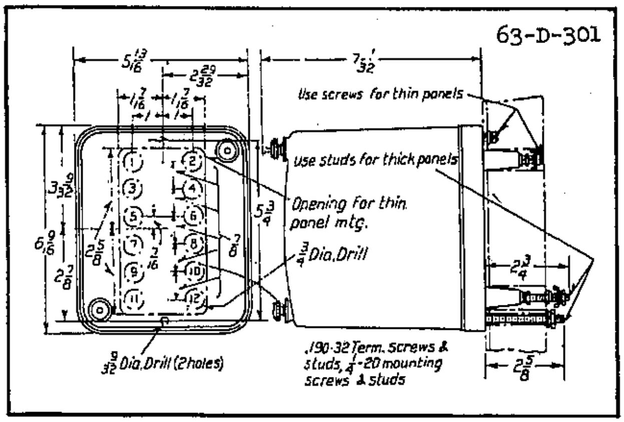

Fig. 29—Outline And Drilling Plan For The Single Element Types CO And COH Relays In The Projection Type Standard Case. See The Internal Schematics For The Terminals Supplied. For Reference Only.

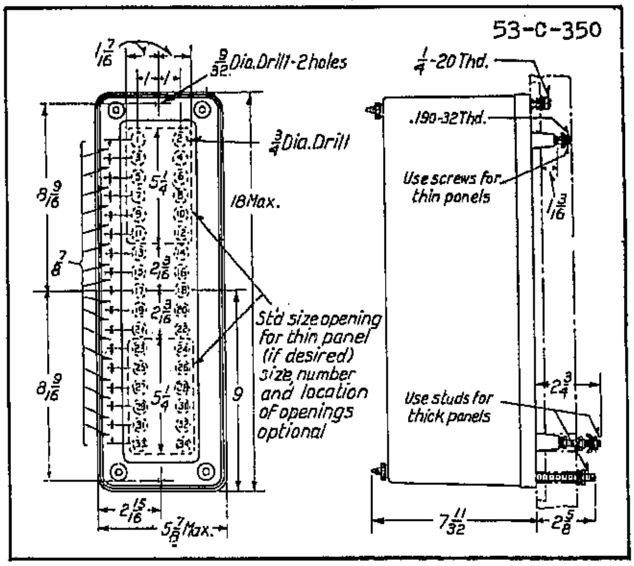

Fig. 30—Outline And Drilling Plan For The Three Element Types CO And COH Relays In The Projection Type Standard Case. See The Internal Schematics For The Terminals Supplied. For Reference Only.

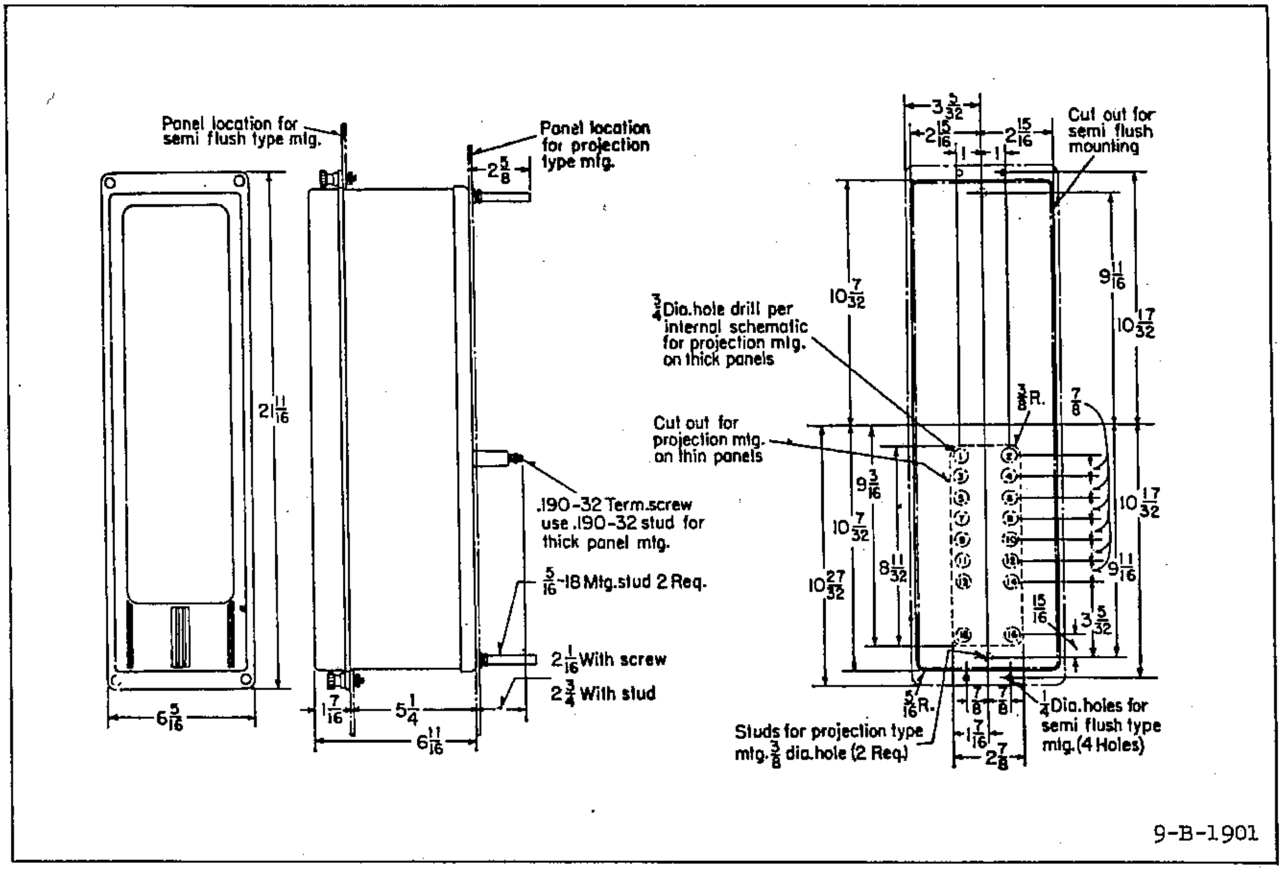

Fig. 31— Outline And Drilling Plan For The Three Element Types CO And COH Relays In The L10 Projection Or Semi-Flush Type FT Flexitest Case. See The Internal Schematics For The Terminals Supplied. For Reference Only.

WESTINGHOUSE ELECTRIC CORPORATION

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