INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CO ADJUSTABLE INVERSE TIME OVERCURRENT RELAY

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 no suitable station battery is available, the circuit opening type relay in conjunction with a-c series trip coils can be used to trip the breaker.

CONSTRUCTION AND OPERATION

Circuit-Closing Relay

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

Circuit-Opening Relay

The circuit-opening type CO Relay consists of an overcurrent element, a de-ion contactor switch, a small transformer to energize the de-ion contactor switch, an operation indicator and an instantaneous trip attachment when required.

OVERCURRENT ELEMENT

Electromagnet

The electromagnet is shown in the schematic diagram of Fig. 1. The main tapped coil produces a flux which splits and returns through the outer legs. A shading coil causes the flux through the left hand leg to lag the main pole flux. The out of phase fluxes thus produced cause a contact closing torque. The tap value adjuster is a single turn shading coil mounted on the right hand leg. It is short circuited through an adjustable length of wire and tends to partially neutralize the effect of the shading coil. The function of the tap value adjuster is fully described under Adjustments. Adjustable magnetic plugs in the magnetic circuit are held in position by means of elastic clinch nuts located on the rear of the electromagnet.

Disc, Shaft and Bearings

The spiral shaped disc is fastened to a vertical shaft supported on the lower end by a pin and end stone type bearing and on the upper end by a pin and olive bearing. The upper and lower disc shaft bearings are removable, and the corresponding upper and lower bearing pins are removable and adjustable. The bottom bearing pin is securely locked in position by means of a set screw and nylon plug, and the top bearing pin by a shoulder nut that holds the time dial in position.

Damping Magnet

The damping magnet is an Alnico 5 permanent magnet with an adjustable keeper. The keeper is locked in position by means of a set screw and nylon plug in the casting that secures the damping magnet to the movement frame.

SUPERSEDES I. L. 41-280.7A
*Denotes change from superseded issue.

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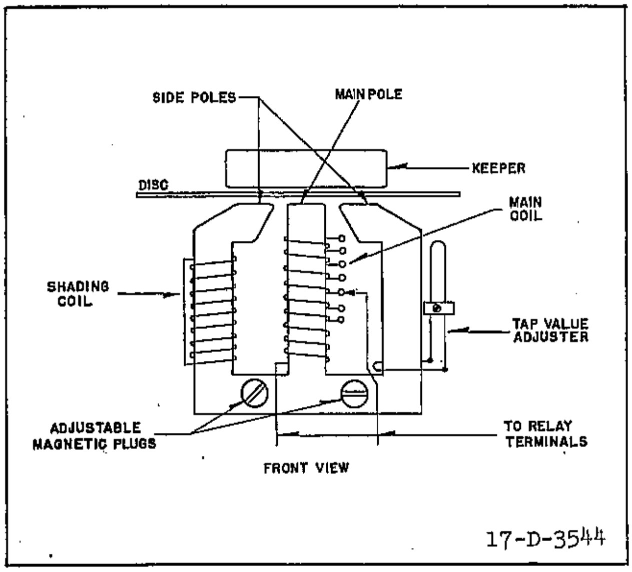


Fig. 1—Schematic Diagram of the Overcurrent Element Electromagnet.

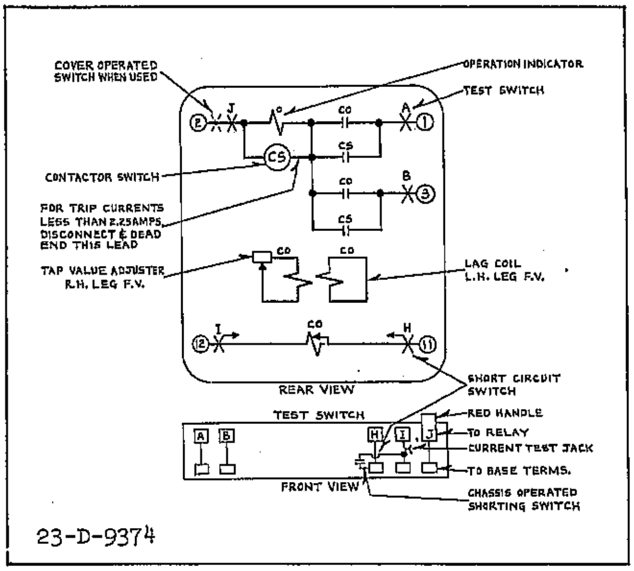


Fig. 2—Internal Schematic of the Double Trip Circuit Closing Relay in the Type FT Case. The Single Trip Relay has Terminal 3 and Associated Circuits Omitted.

Tap Block Assembly

The tap block assembly consists of eight spring loaded tap terminals housed in a moulded tap block, a tap plate secured to the front of the moulded block, and a tap screw. The tap screw engages the tap terminal and pulls the terminal forward to cause a direct metal to metal contact with the tap plate. When the tap screw is removed, the terminal is pushed back by a spring so that it will no longer be in contact with the tap plate. The tap screw is equipped with an insulating nylon sleeve.

Contacts

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. 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 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. Then the stationary contact set screws permit adjustment so that both circuits will be made simultaneously.

Time Dial

The time dial is a moulded adjustable contact stop with 11 equal scale divisions marked through a 270 degree arc. The time dial is held in position at the top of the disc shaft by means of a star cupped spring washer and a shoulder nut.

An adjustable index pointer is located on the movement frame top bearing mount.

Contactor Switch (Circuit Closing)

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.

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

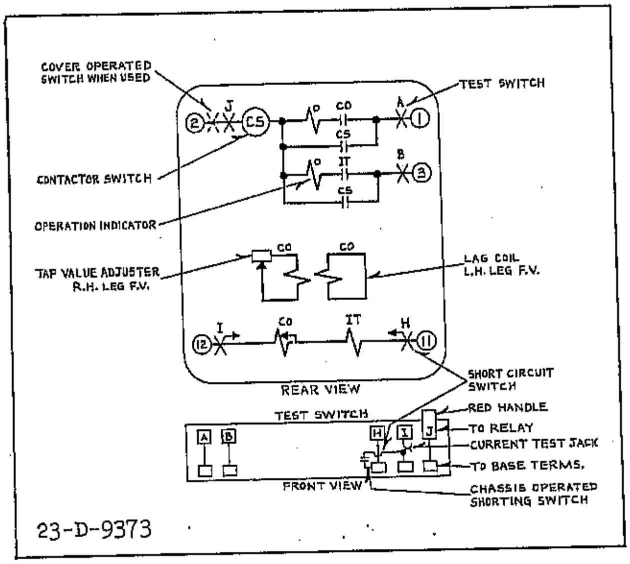


Fig. 3—Internal Schematic of the Single Trip Circuit Closing Relay with Instantaneous Trip Attachment in the Type FT Case.

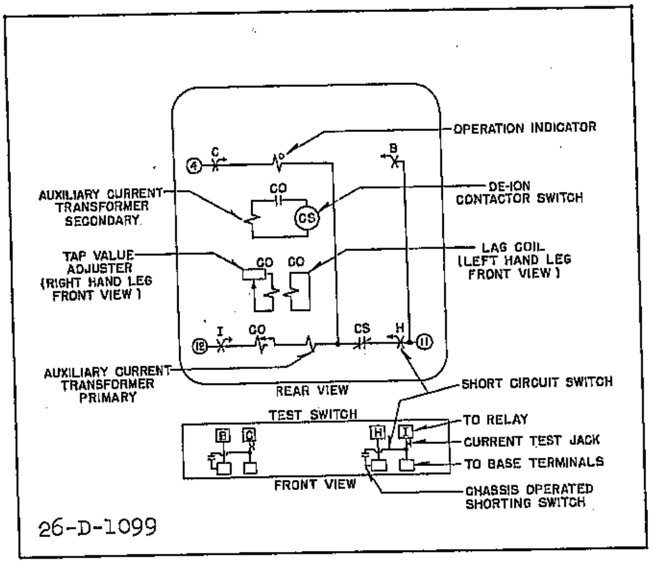


Fig. 4—Internal Schematic of the Circuit Opening Relay in the Type FT Case.

closed until the trip circuit is opened by the auxiliary switch on the breaker.

De-ion Contactor Switch (Circuit Opening)

This switch is a small a-c solenoid switch whose coil is energized from a small transformer connected in the main current circuit. 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.

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 may be reset from outside of the case.

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 mains 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.

CHARACTERISTICS

The type CO adjustable inverse time 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	7	8	10	12

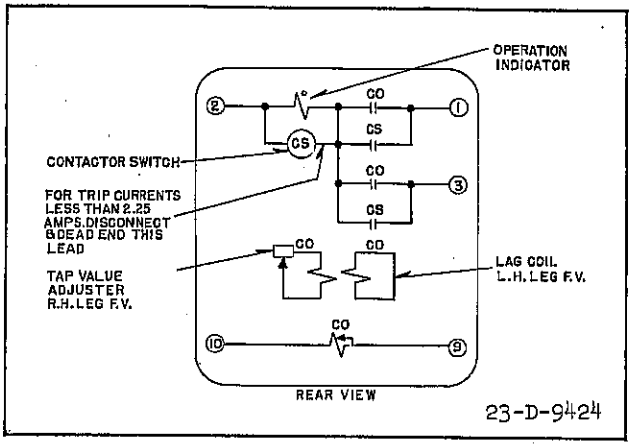


Fig. 5—Internal Schematic of the Double Trip Circuit Closing Relay in the Standard Case. The Single Trip Relay has Terminal 3 and Associated Circuits Omitted.

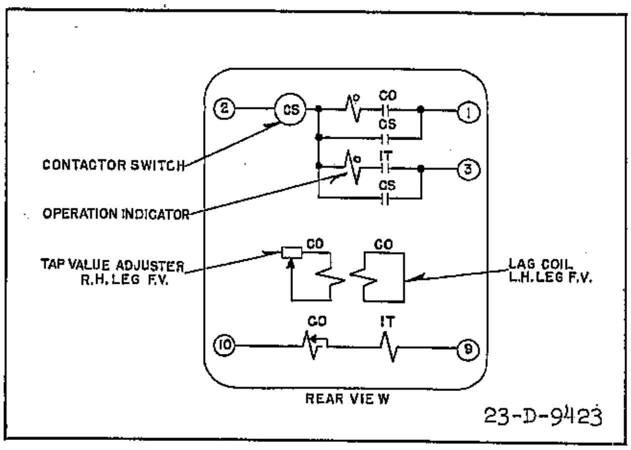


Fig. 6—Internal Schematic of the Single Trip Circuit Closing Relay with Instantaneous Trip Attachment in the Standard Case.

The type CO adjustable inverse time circuit-opening relay is recommended only in the 4 to 12 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. The moving contacts will leave the time dial stop, regardless of the time dial setting, and move to touch the stationary contacts at tap value current.

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 time vs current characteristics for the style calibration of inverse or very inverse are shown in Fig. 10 and Fig. 11 respectively. The term "style calibration" is used as there is no difference between the inverse and very inverse relays except in their calibration. Relays carrying a style number which indicates the inverse calibration may be changed to the very inverse calibration or vice versa through two simple adjustments. This is outlined in detail under Adjustments.

In addition to the one relay covering the inverse or the very inverse curves, the relay may be re-calibrated for a characteristic other than either of these. An example of the spread of adjustments to provide different curve shapes is shown by Fig. 8 wherein all curves are passed through 27 seconds at 2 times minimum trip current. The curves may be passed through a common point other than 27 seconds by adjustment of the damping magnet keeper screw. The range of adjustability indicated at 20 times minimum trip current is obtained by means of the magnetic plugs. The upper limit curve is obtained with the right hand plug "all in" and the left hand plug "all out" (approximately 20 turns of the screw). The lower limit is obtained with the left hand plug "all in" and the right hand plug "all-out". Various adjustments of the plugs partially withdrawn from the magnetic circuit may be used as desired to obtain a curve within the band shown, including the standard or "pattern" curve to which the relay is calibrated at the factory. Thus, one or the other of the plugs will be partially withdrawn in the factory calibration to one or the other of the inverse or very inverse standard curves. Similarly, the factory set position of the damping magnet keeper screw will depend upon the "style calibration".

The burdens and thermal ratings are listed under Energy Requirements. The instantaneous trip attachment has a 1 to 4 ratio. Typical ranges are 10-40 or 20-80, but other ranges are also available.

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

Trip Circuit

The main contacts will safely close 30 amperes at 250 V. 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 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 filister head screw located in the Micarta base of the contactor switch.

The relay with the instantaneous trip attachment has a two ampere contactor switch in series with a one or 0.2 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 contact back stop. When this is done, the position of the index pointer should be shifted so that the moving and stationary contacts barely touch when the time dial is set on zero.

CONTACT CIRCUIT CONSTANTS

Universal Trip Circuit

Resistance of 0.2 ampere Target.......2.8 ohms
Resistance of 2.0 ampere Contactor Switch 0.25ohms
Resistance of Target and Switch in Parallel 0.23ohms

Trip Circuit with Instantaneous Trip

Resistance of 1.0 ampere Target...... 0.16ohms
Resistance of 0.2 ampere Target...... 2.8 ohms
Resistance of 2.0 ampere Contactor Switch 0.25ohms

RELAYS IN TYPE FT CASE

The type FT cases are dust-proof enclosures combining relay elements and knife-blade test switches in the same case. This combination provides a compact flexible assembly easy to maintain, inspect, test and adjust. There are three main units of the type FT case: the case, cover, and chassis. The case is an all welded steel housing containing the hinge half of the knife-blade test switches and the terminals for external connections. The cover is a drawn steel frame with a clear window which fits over the front of the case with the switches closed. The chassis is a frame that supports the relay elements and the contact jaw half of the test switches. This slides in and out of the case. The electrical connections between the base and chassis are completed through the closed-knife blades.

Removing Chassis

To remove the chassis, first remove the cover by unscrewing the captive nuts at the corners. This exposes the relay element and all the test switches for inspection and testing. The next step is to open the test switches. Always open the elongated red handle switches first before opening any of the black handle or the cam action latches. This opens the trip circuit to prevent accidental trip out. Then open all the remaining switches. The order of opening the remaining switches is not important. In opening the test switches they should be moved all the way back against the stops. With all the switches fully opened, grasp the two cam action latch arms and pull outward. This releases the chassis from the case. Using the latch arms as handles, pull the chassis out of the case. The chassis can be set on a test bench in a normal upright position for test as well as on its back or sides for easy inspection and maintenance.

After removing the chassis a duplicate chassis may be inserted in the case or the blade portion of the switches can be closed and the cover put in place without the chassis. The chassis operated shorting switch located behind the current test switch prevents open circuiting the current transformers when the current type test switches are closed.

When the chassis is to be put back in the case, the above procedure is to be followed in the reversed order. The elongated red handle switch should not be closed until after the chassis has been latched in place and all of the black handle switches closed.

Electrical Circuits

Each terminal in the base connects thru a test switch to the relay elements in the chassis as shown on the internal schematic diagrams. The relay terminal is identified by numbers marked on both the inside and outside of the base. The test switch positions are identified by letters marked on the top and bottom surface of the moulded blocks. These letters can be seen when the chassis is removed from the case.

The potential and control circuits thru the relay are disconnected from the external circuit by opening the associated test switches. Opening the current test switch short-circuits the current transformer secondary and disconnects one side of the relay coil but leaves the other side of the coil connected to the external circuits thru the current test jack-jaws. This circuit can be isolated by inserting the current test plug (without external connections), by inserting the ten circuit test plug, or by inserting a piece of insulating material approximately 1/32" thick into the current test jack jaws. Both switches of the current test switch pair must be open when using the current test plug or insulating material in this manner to short-circuit the current transformer secondary.

A cover operated switch can be supplied with its contacts wired in series with the trip circuit. This switch opens the trip circuit when the cover is removed. This switch can be added to the existing type FT cases at any time.

TESTING

The relays can be tested in service, in the case but with the external circuits isolated, or out of the case as follows:

Testing In Service

The ammeter test plug can be inserted in the current test jaws after opening the knife-blade switch to check the current thru the relay. This plug consists of two conducting strips separated by an insulating strip. The ammeter is connected to these strips by terminal screws and the leads are carried out thru holes in the back of the insulated handle.

Voltages between the potential circuits can be measured conveniently by clamping #2 clip leads on the projecting clip lead lug on the contact jaw.

Testing In Case

With all blades in the full open position, the ten circuit test plug can be inserted in the contact jaws. This connects the relay elements to a set of binding posts and completely isolates the relay circuits from the external connections by means of an insulating barrier on the plug. The external test circuits are connected to these binding posts. The plug is inserted in the bottom test jaws with the binding posts up and in the top test switch jaws with the binding posts down.

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the current elements using clip leads, care should be taken to see that the current test jack jaws are open so that the relay is completely isolated from the external circuits. Suggested means for isolating this circuit are outlined above under "Electrical Circuits".

Testing Out of Case

With the chassis removed from the base, relay elements may be tested by using the ten circuit test plug or by #2 test clip leads as described above. The factory calibration is made with the chassis in the case and removing the chassis from the case will change the calibration values by a small percentage. It is recommended that the relay be checked in position as a final check on the calibration.

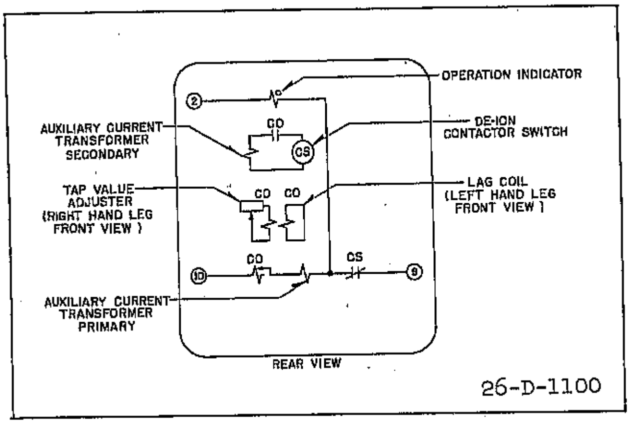


Fig. 7—Internal Schematic of the Circuit Opening Relay in the Standard Case.

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 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.

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 settings must be determined by the nature of the load, the magnitude of the peaks and the frequency of their occurence.

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 dial 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 4.0 - 5.0 - 6.0 - 7.0 - 8 - 10 - 12 amperes, or as marked on the terminal plate.

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 Dial Setting

The time dial limits the motion of the disc and thus varies the time of operation. The latter decreases with lower time dial settings as shown in the typical time curves.

ADJUSTMENTS AND MAINTENANCE

All relays should be inspected periodically and the time of operation should be checked at least once every six months 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 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 require readjustment

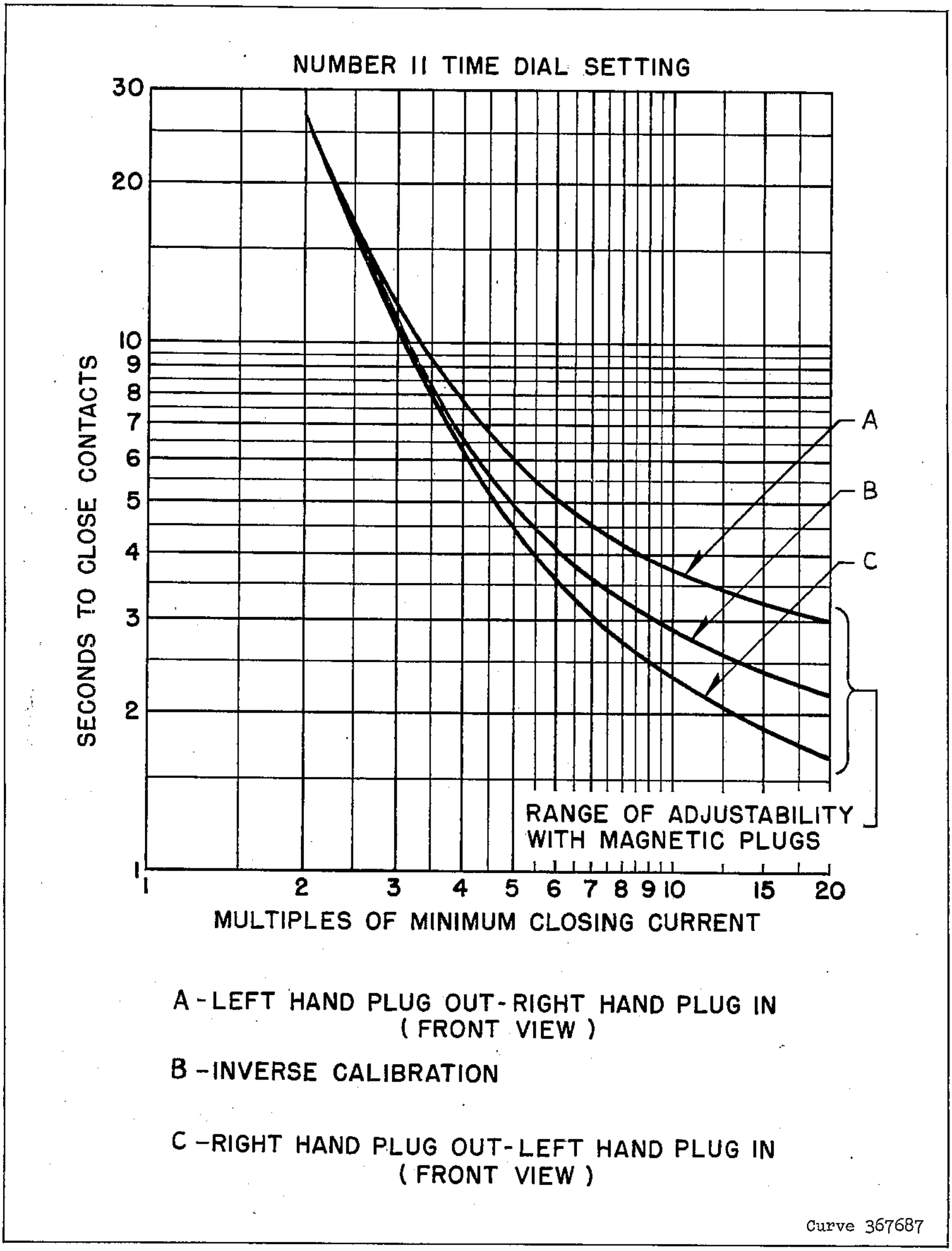


Fig. 8—Example of the Range of Adjustability of the Time Curves by Means of the Adjustable Magnetic Plugs.

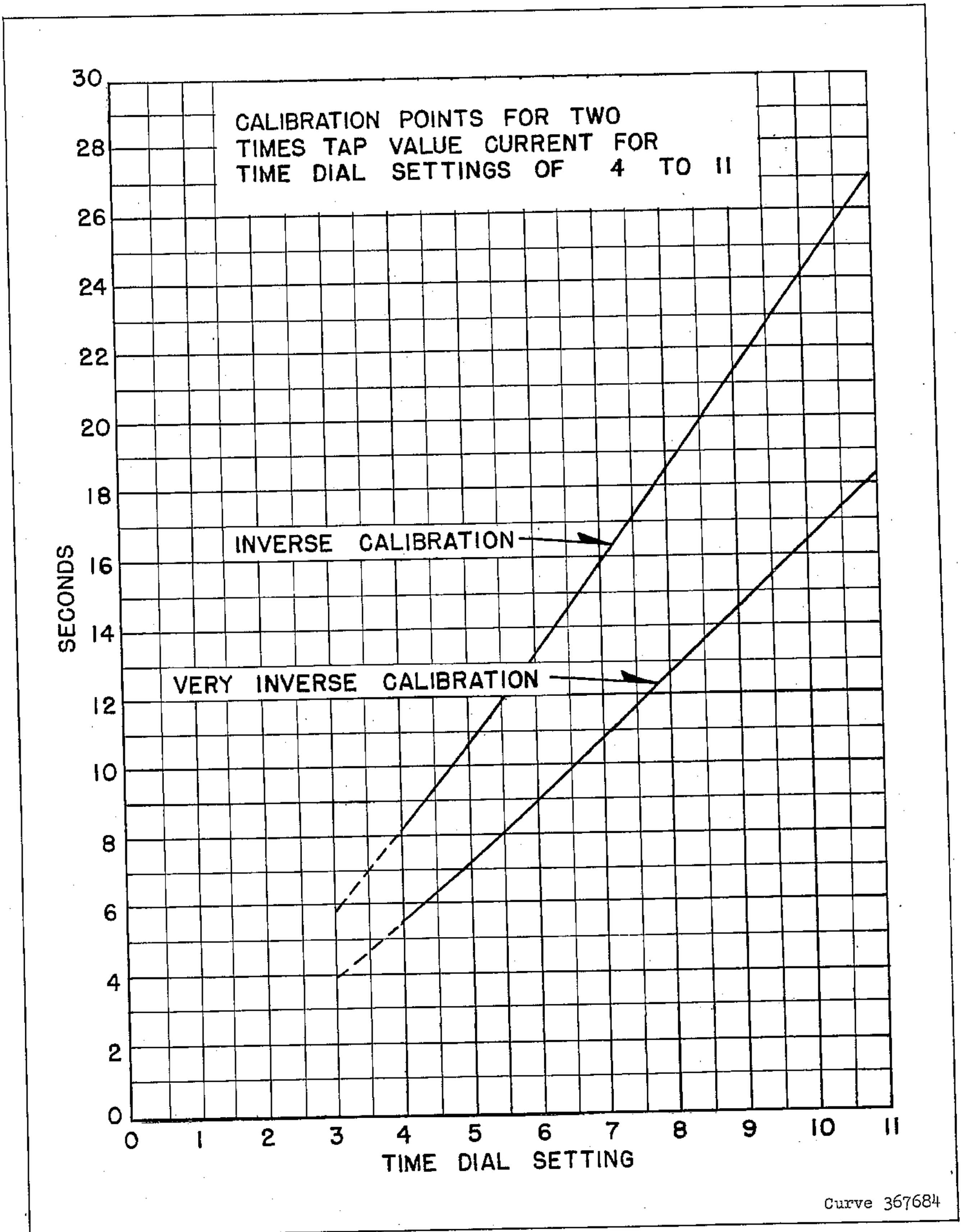


Fig. 9—Time VS Time Dial Setting for Inverse and Very Inverse Calibration at 2 Times Minimum Trip.

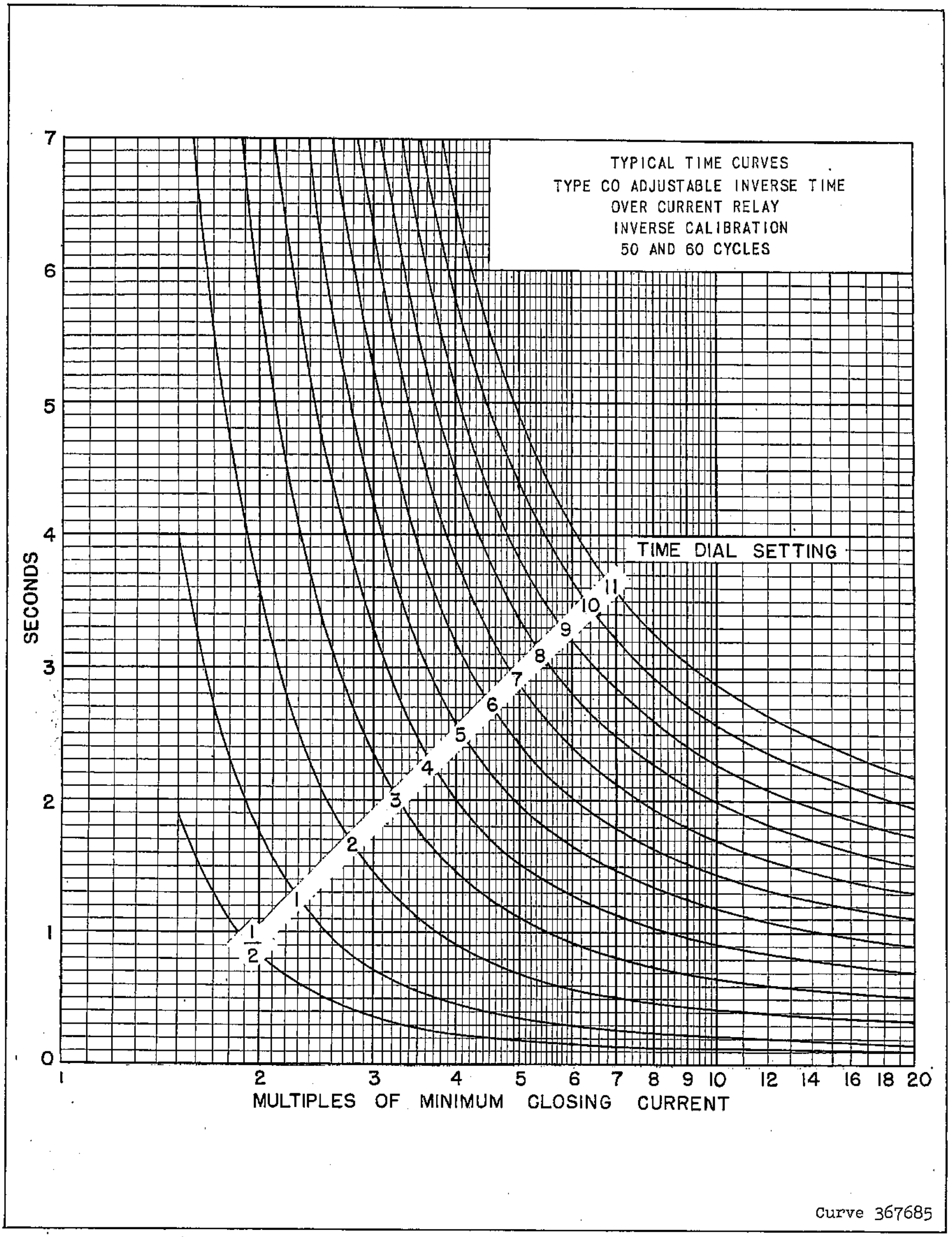


Fig. 10—Typical 50 & 60 Cycle Time Curves for the Inverse Calibration.

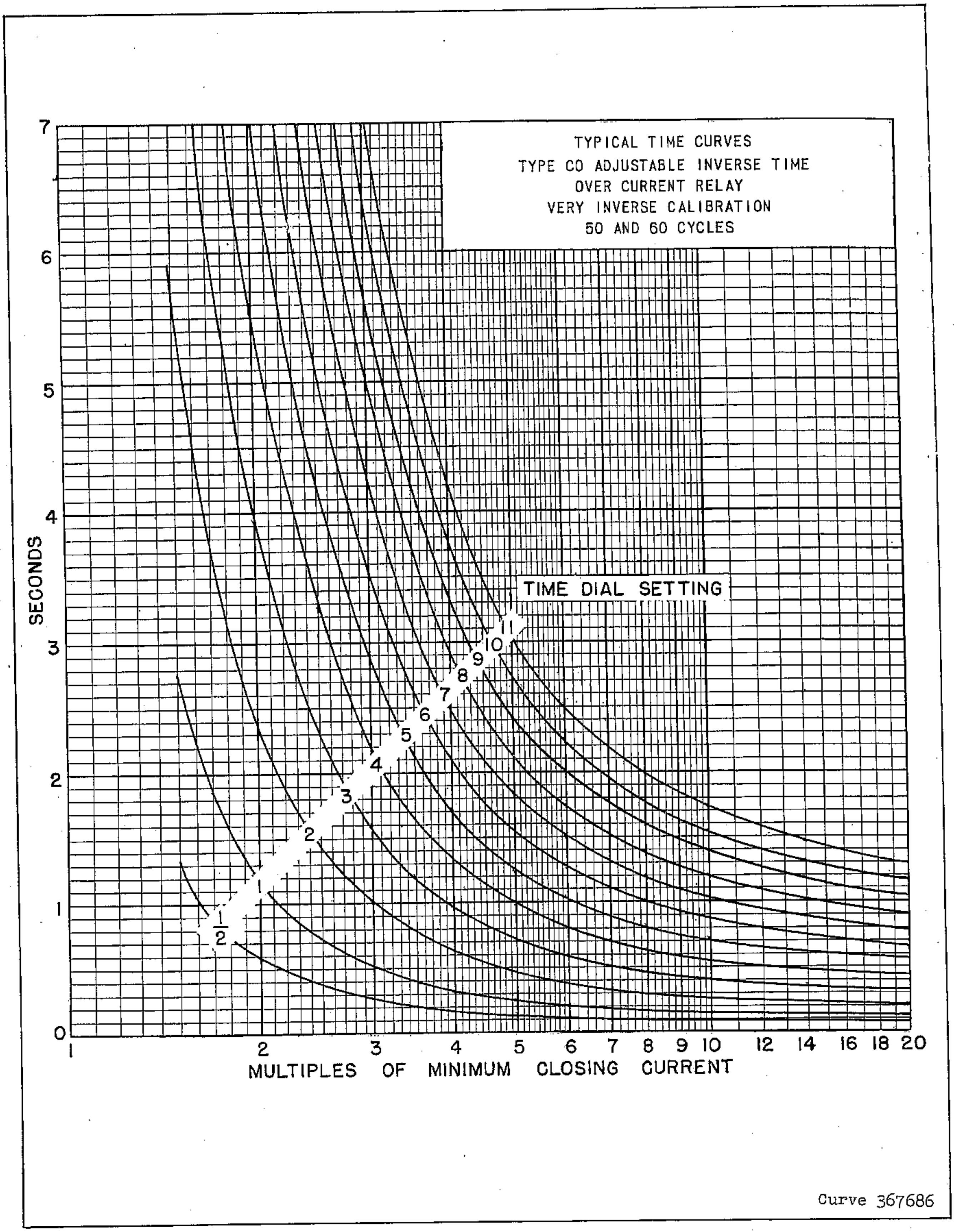
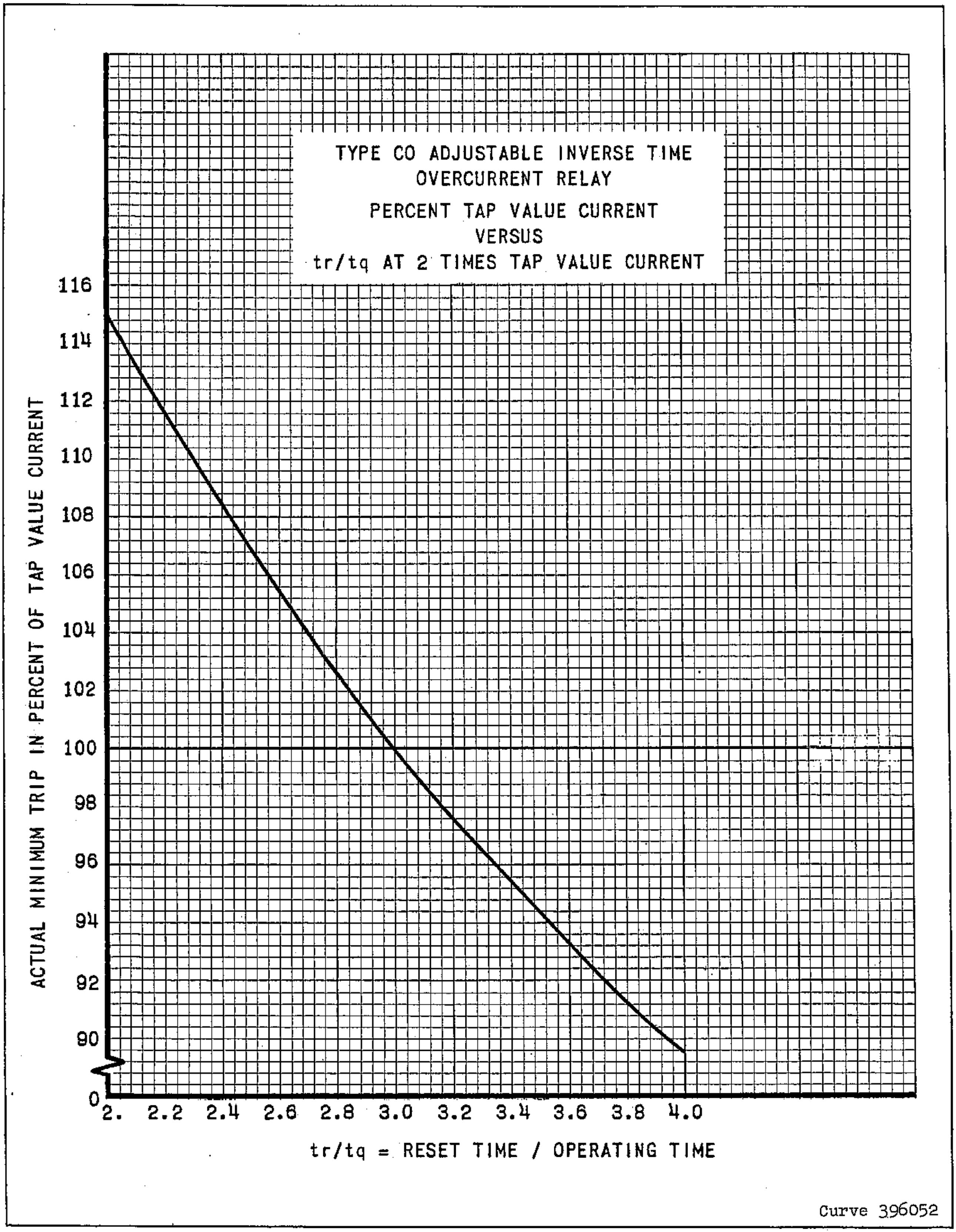


Fig. 11—Typical 50 & 60 Cycle Time Curves for the Very Inverse Calibration.



* Fig. 12—Curve For Determining Actual Minimum Trip Current In Percent Of Tap Value Current.

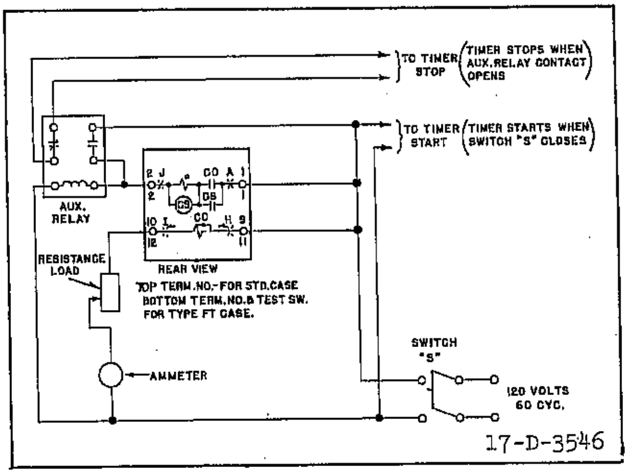


Fig. 13—Diagram Of Test Connections For The Circuit Closing Type CO Relay

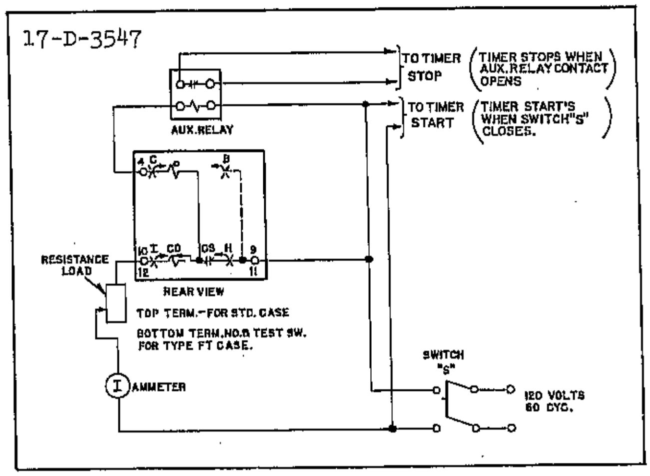


Fig. 14—Diagram Of Test Connections For The Circuit Opening Type CO Relay

after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to change the operating characteristic, such as from inverse to very inverse, the instructions below should be followed.

For relays that are used with circuit breakers that are not instantaneously reclosed, adjust the stationary contact by means of its adjusting screw such that the contact spring is just free of the front spring stop. By means of the time dial, move the moving contacts until they deflect the stationary contacts approximately 1/64 inch. Set the index pointer such that it points to the "0" mark on the time dial. Adjust the stationary contact by means of its adjusting screw until the moving and stationary contacts just touch. This adjustment is to set "0" on the time dial and provide follow for the contacts.

For relays that are used with circuit breakers that are instantaneously reclosed, adjust the stationary contact for quick opening. This is done by screwing in the contact adjusting screw until the stationary contact rests solidly against the contact back stop. By means of the time dial, move the moving contacts until they just touch the stationary contact. Set the index pointer such that it points to the "0" mark on the time dial.

The adjustment of the spring tension and the tap value adjuster are most conveniently made with the damping magnet removed. The reason for this is both adjustments require the balance of two torques which can best be recognized with no damping magnet to retard the motion of the disc.

With the time dial still set on "0", wind up the spiral spring by means of the spring adjuster until approximately 6-3/4 convolutions show. This is an initial rough adjustment. From this preliminary setting, and using minimum tap setting, adjust the spring tension so that the electrical torque balances the spring torque at a fixed value of current at #10-1/2 and #1/2 time dial settings. The best way to do this is to first measure the actual current required to balance the spring torque at the #1/2 and #10-1/2 time dial settings. If less current is required to balance the spring torque at the #10-1/2 position than at the #1/2 position, it is an indication that the spring needs to be wound up more, and vice-versa. All spring convolutions must be free. This setting of the spring will not necessarily be at tap value of current. By winding up or unwinding the spring as required, the current required to move the disc at the extreme limits of its travel (and consequently through the entire range of travel) may be made constant within very close tolerances.

After having balanced the spring torque and the electrical torque as above to match at a

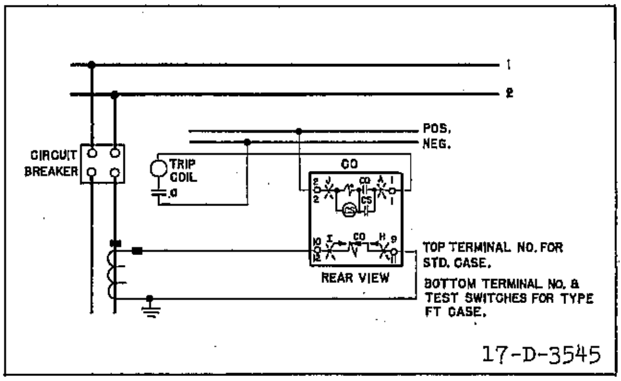


Fig. 15—External Connections of the Circuit Closing Type CO Relay for Overcurrent Protection on a Single Phase System.

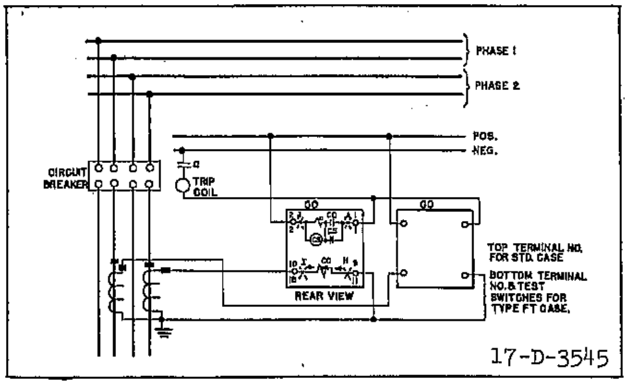


Fig. 16—External Connections of the Circuit Closing Type CO Relay for Overcurrent Protection on a Two-Phase System.

substantially constant value of current, then adjust this constant current value up or down as required to match the tap value current by means of the tap value adjuster located on the right hand leg, front view, of the electromagnet. Moving the slider toward the top decreases minimum trip current and moving the slider toward the bottom increases minimum trip current. The slider must be clamped tight when checking this adjustment.

Time Curve Calibration

After checking the adjustments as outlined above replace the permanent magnet and adjust it to calibrate the relay at 2 times tap value current. This adjustment is made by means of the damping magnet keeper screw. Adjust the keeper screw position such that the relay will operate in the time as defined by the curve of Fig. 9 for inverse or very inverse depending upon the calibration desired. For example, if the inverse calibration is desired, the damping magnet may be adjusted for 27 seconds from the #11 time dial setting. If the very inverse calibration is desired,the adjustment may be made for 18.3 seconds from the #11 time dial setting. Time values somewhat greater than those shown for the inverse calibration and somewhat less that those shown for the very inverse calibration may be obtained if particular problems require them.

The time of operation at 20 times tap value current is adjusted by means of the two adjustable magnetic plugs. Adjust the plug position such that the relay will operate in the time as defined by the current vs time curves of figure 10 or 11 for inverse or very inverse calibration depending upon the characteristic desired for which the 2 times tap value adjustment of time was made. For example, if the inverse calibration is desired, the relay may be calibrated for 2.18 seconds from the #11 time dial position at 20 times minimum trip current by screwing the right hand plug all the way in and adjusting the left hand plug for 2.18 seconds. If the very inverse calibration is desired, screw the left hand plug all the way in and adjust the right hand plug for 1.28 seconds from the #11 time dial position at 20 times minimum trip current.

Curve shapes that are different from the inverse or very inverse may be obtained by adjustable magnetic plugs. An example of this adjustment has been referred to under "Characteristics", and wherein one range of possibilities is shown by Fig. 8.

* Minimum Trip Current

The minimum trip current for a calibrated relay may be checked to an accuracy of ±5% by the use of the following formula:

$$I = \frac{I_2}{\sqrt{1 + t_r/t_2}}$$

where:

I = Actual minimum trip current.

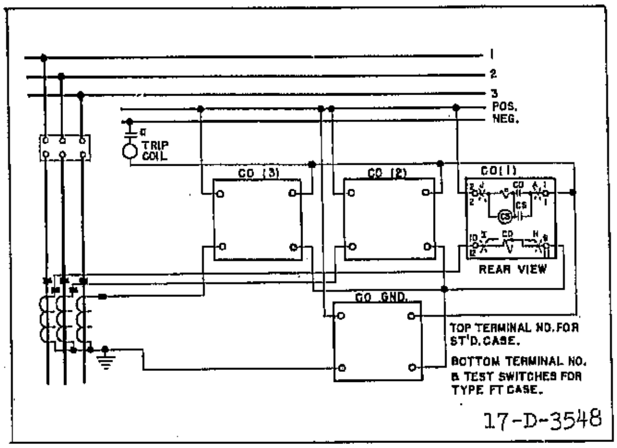


Fig. 17—External Connections of the Circuit Closing Type CO Relay for Phase and Ground Overcurrent Protection on a Three-Phase System.

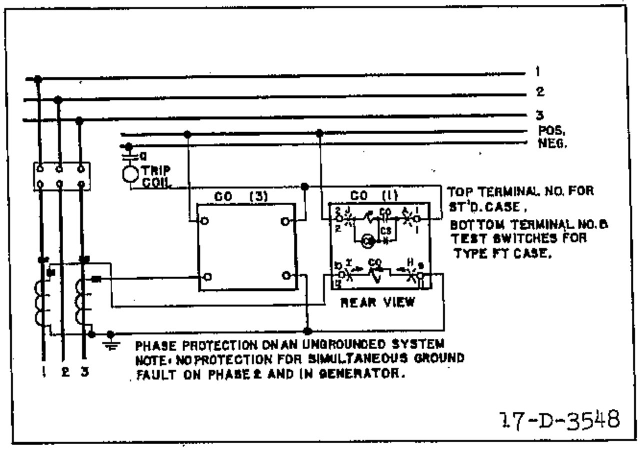


Fig. 18—External Connections of the Circuit Closing Type CO Relay for Phase Overcurrent Protection on an Ungrounded Three-Phase System.

I_2 = Current at a multiple of 2 times the minimum tap setting.

t_2 = Operating time at the #11 time dial setting with I_2 applied.

t_r = Reset time of the relay to the #11 time dial position.

To aid in determining the minimum trip current Fig. 12 has been provided in which a plot has been made of the minimum trip current for the minimum tap setting in percent of tap value current versus values of tr/tq.

Example: $I_2 = 8$ amperes

$t_2 = 27$ seconds

$t_r = 81$ seconds

$t_r/t_q = 3$

I = 100% TAP VALUE CURRENT, Fig. 12.

TRIP CIRCUIT

For Relays with Universal Trip

This combination uses a 2.0 amp. contactor switch and a 0.2 amp. operation indicator connected in parallel. Adjust the contactor switch and indicator as outlined below:

Contactor Switch - Turn the relay up side down. Screw up the core screw until the contact ring starts rotating. Now back off the core until the contact ring stops rotating. Back off the core screw one more turn and lock in place. Adjust the two nuts at the bottom of the switch so that there is 3/32 inch clearance between the moving contact ring and the stationary contacts in the open position. The guide rod may be used as a scale as it has 52 threads per inch, therefore, 5 turns of the nuts will equal approximately 3/32 inch.

Combination Test - Close the main relay contacts and pass 2.25 amps d.c. through the trip circuit. The contactor switch must pick-up. Adjust the operation indicator by moving the flag holder such that the indicator operates

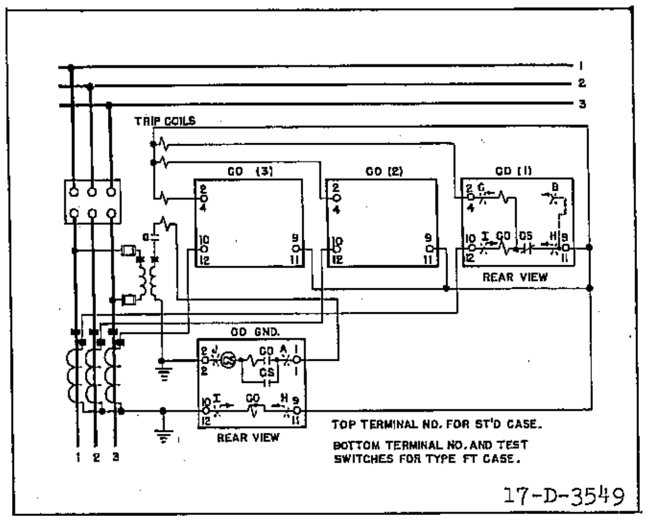


Fig. 19—External Connections of the Circuit Opening Type CO Relay for Phase Overcurrent Protection and of the Circuit Closing Type CO Relay for Ground Protection on a Three-Phase System.

with the application of the 2.25 amps. Pass 30 amps d.c. through the trip circuit. The indicator and contactor switch must not stick in the operated position when the current is interrupted.

For Relays with Series Trip

This combination uses a 2.0 amp. contactor switch and either a 1.0 amp or a 0.2 amp operation indicator connected in series. Adjust the contactor switch and operation indicator as outlined below:

Contactor Switch Adjust the same as above for Contactor Switch.

Operation Indicator Close the main relay contacts and pass 95% of rated indicator current d.c. through the trip circuit. Adjust the operation indicator by moving the flag holder such that the indicator operates with the application of the 95% current.

Combination Test Pass 30 times indicator rating through the trip circuit. The contactor switch and indicator must operate with the application of the current and the contactor switch and indicator must not stick in the operated position when the current is interrupted.

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.

Operation Indicator (Circuit Opening Relays)

Adjust the indicator similar to that described for the circuit closing relay except to operate at 2 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 ratio 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 pickup.

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

Ampere Range	Tap	Continuous Rating (Amperes)	One Second Rating* (Amperes)	Power Factor Angle Ø	At Tap Value Current	At 3 Times Tap Value Current	Volt Amperes△ At 10 Times Tap Value Current	At 20 Times Tap Value Current
0.5/2.5	0.5	2	56	72	2.38	21	132	350
	0.6	2.2	56	71	2.38	21	134	365
	0.8	2.5	56	69	2.40	21.1	142	400
	1.0	2.8	56	67	2.42	21.2	150	440
	1.5	3.4	56	62	2.51	22	170	530
	2.0	4.0	56	57	2.65	23.5	200	675
	2.5	4.4	56	53	2.74	24.8	228	800
2/6	2	8	230	70	2.38	21	136	360
	2.5	8.8	230	66	2.40	21.1	142	395
	3	9.7	230	64	2.42	21.5	149	430
	3.5	10.4	230	62	2.48	22	157	470
	4	11.2	230	60	2.53	22.7	164	500
	5	12.5	230	58	2.64	24	180	580
	6	13.7	230	56	2.75	25.2	198	660
4/12	4	16	460	68	2.38	21.3	146	420
	5	18.8	460	63	2.46	21.8	158	480
	6	19.3	460	60	2.54	22.6	172	550
	7	20.8	460	57	2.62	23.6	190	620
	8	22.5	460	54	2.73	24.8	207	700
	10	25	460	48	3.00	27.8	248	850
	12	28	460	45	3.46	31.4	292	1020

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

Ø Degrees current lags voltage at tap value current.

△ Voltages taken with Rectox Type Voltmeter.

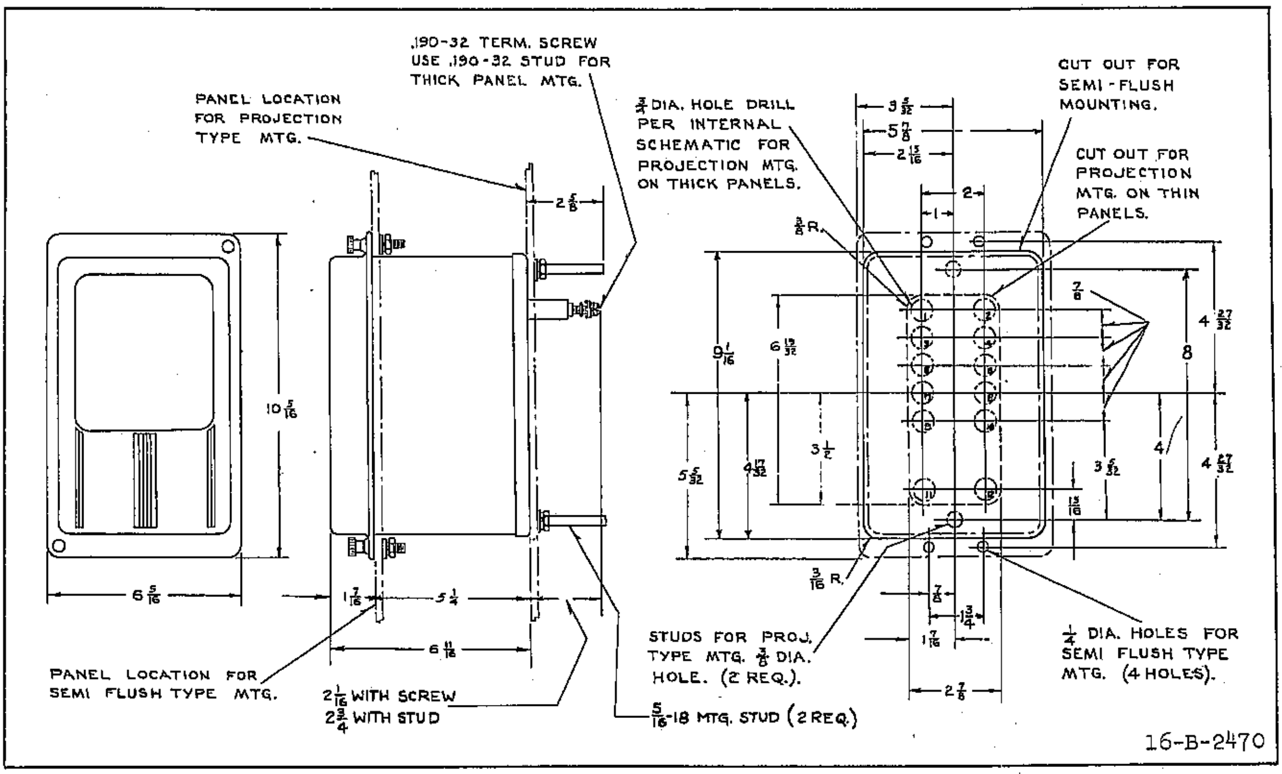


Fig. 20—Outline And Drilling Plan For The Type CO Relay In The S10 Projection Or Semi-Flush Type FT Flexitest Case. See The Internal Schematics For The Terminals Supplied. For Reference Only.

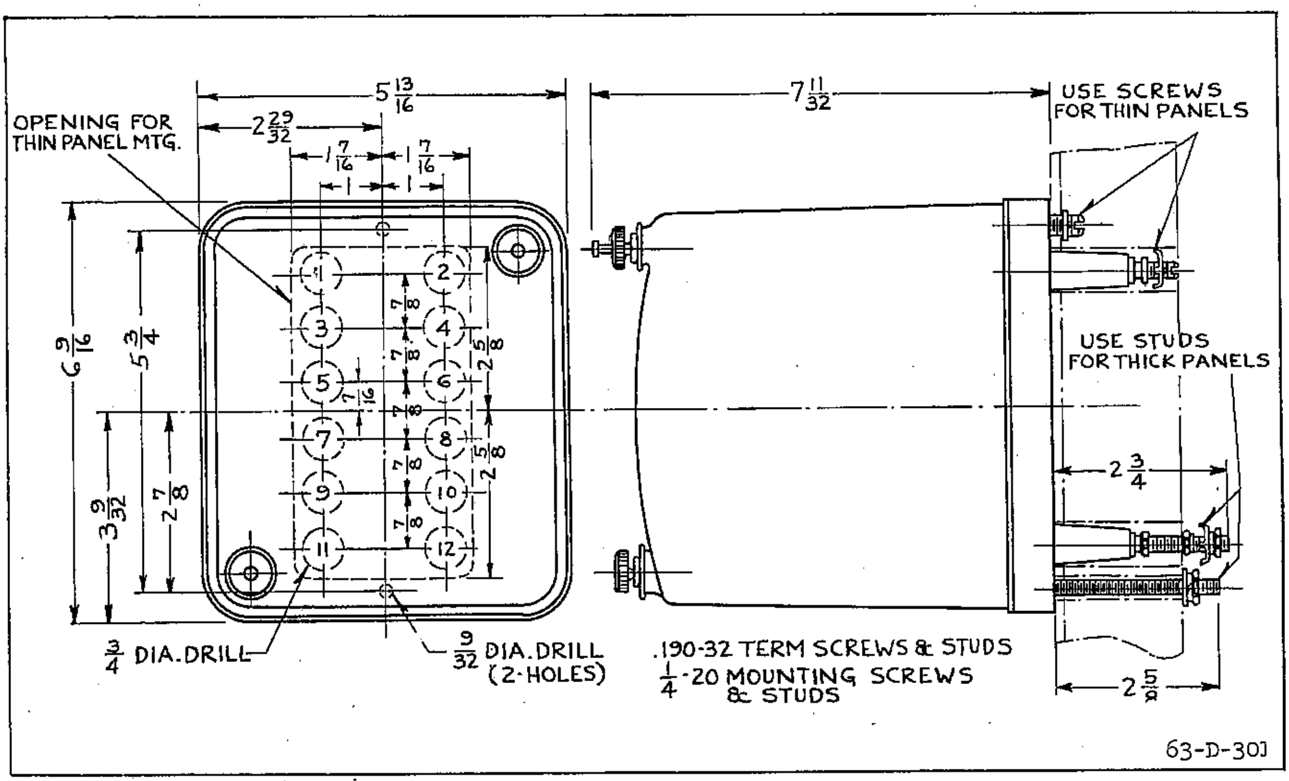


Fig. 21—Outline And Drilling Plan For The Type CO Relay In The Projection Type Standard Case. See The Internal Schematics For The Terminals Supplied. For Reference Only.