INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE COV VOLTAGE CONTROLLED OVERCURRENT RELAY WITH ADJUSTABLE INVERSE OVERCURRENT ELEMENT

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 close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type COV relay is applicable where it is desired that an overcurrent element be set to operate on less than full load current when the voltage falls below a predetermined value, and it is desired not to operate for any magnitude of current when the voltage is above the predetermined value. A typical application is overcurrent back-up protection for generators.

CONSTRUCTION

The relay consists of an overcurrent element, a voltage element, an operation indicator, and a contactor switch.

Overcurrent Element

This is an induction-disc type element operating on overcurrent. The induction disc is a spiral shaped aluminum type mounted on a vertical shaft. The shaft is 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 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 and mounted on the element frame. A small set screw permits the adjustment of contact follow.

Voltage Element

The type SV element operates on the solenoid principle. A U-shaped iron frame, mounted on the moulded base, supports the coil and serves as the external magnetic path for the coil. The coil surrounds a core and flux shunt. The upper end of the core is threaded and projects through the upper side of the frame, to which it is fastened by a nut. A tube threaded on the outside at its lower end is assembled in the core, and the threaded end extends below the core. The lower bearing for the plunger shaft is inserted in the lower end of this threaded tube, and is held in place by a set screw. This bearing consists of a graphite bushing in a brass holder. The bearing for the upper end of the plunger shaft is a graphite bushing which is pressed in the upper end of the core. This bearing is visible when the plunger is in the energized position. The plunger itself does not touch the walls of the tube in which it moves.

A flux shunt which surrounds the core is screwed on the tube, and its lower end projects below the relay frame. The position of this shunt determines the drop-out setting of the relay. The lower end of the shunt is beveled and knurled, so that it can be grasped by

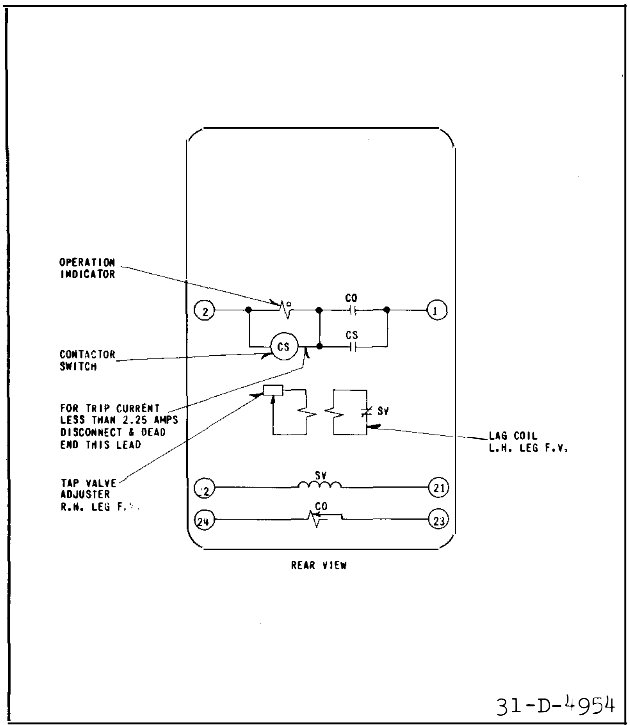

Fig. 1 — Internal Schematic of the Type COV Relay in the Standard Case.

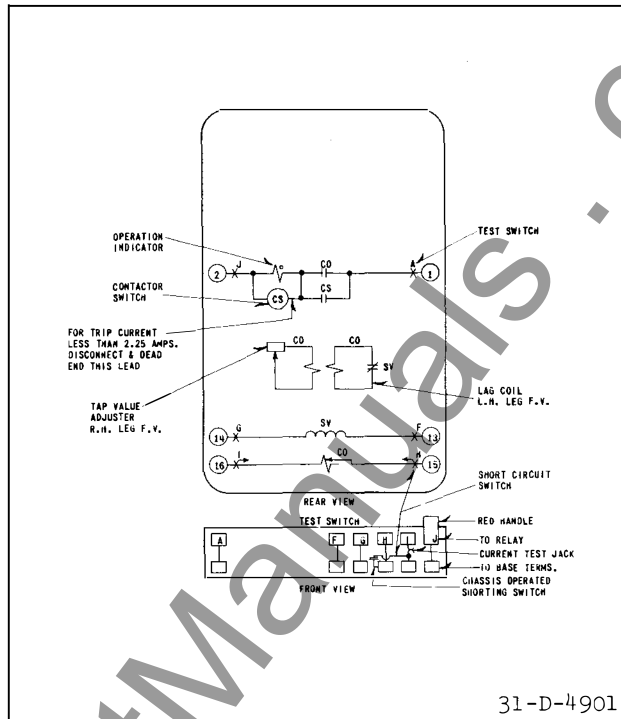

Fig. 2 — Internal Schematic of the Type COV Relay in the Type FT Case.

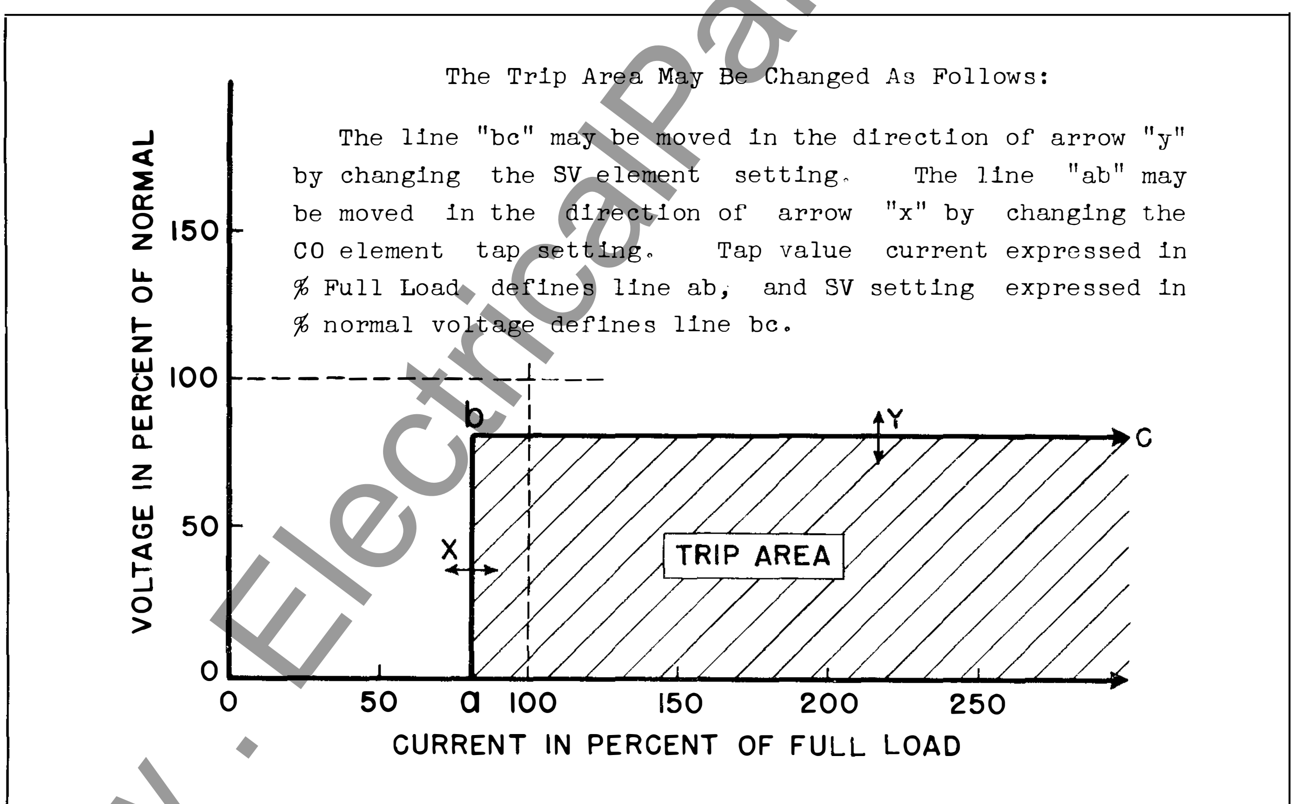

Fig. 3 — Typical Tripping Characteristics of Type COV Relay.

the fingers and turned to change the setting. A calibrated scale plate is mounted adjacent to the shunt. A groove just above the knurl in the lower end of the shunt serves as an index mark, and the relay drop-out setting is indicated by the calibration scale marking which is adjacent to the groove.

The construction of the plunger, core and flux shunt causes the plunger to float in its energized position, without being held against a stop, even when energized much above the pick-up value. Consequently, there is negligible noise and the contacts are free from chatter.

The core, shunt and plunger construction also provides a high ratio of drop-out to pick up. This ratio is above 90% for any drop-out setting.

The shunt is held in any desired position by means of a locking mechanism in which a spring, through the medium of a lever, presses a pin against the shunt. The pressure is removed by pushing the free end of the lever to the left. Only a small amount of movement is necessary to remove the pressure on the locking pin entirely. The limit of the lever movement is readily apparent on inspection of the assembly, and this should not be exceeded since the lever may be bent. The shunt is made a fairly snug fit in the frame and on the coil core tube, but when the pressure on the locking pin is released, it can be readily turned by the fingers alone. By applying greater force, it will be possible to turn the shunt without moving the lever fully to the left, but the pressure of the locking pin will prevent any creeping of the shunt or undesired change of setting.

The stationary contacts are assembled on slotted brackets. These are held in position on the base by filister-head screws which are threaded into the terminal inserts. The moving contacts are mounted on a Micarta insulation plate which is secured to the threaded end of the plunger shaft by a nut. The rear portion of the plate is slotted and a post which is screwed to the frame passes through this slot to prevent the plate from rotating. The moving contacts are connected to the base terminals by flexible leads. All contacts are pure silver.

Contactor Switch and Operation Indicator

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.

The operation indicator coil is connected in the trip circuit to show a white target when the trip circuit is completed.

CHARACTERISTICS

To prevent the relay from operating for currents above the overcurrent element setting when the voltage is above the setting of the voltage element, the normally closed SV contacts are connected in the lag coil circuit of the overcurrent element. This means that the overcurrent element cannot operate unless the voltage drops to such a value as to close the SV contacts. This construction results in a tripping characteristic as shown in Fig. 3.

The time vs current curves for the overcurrent element with the SV contacts closed are shown in Figs. 6 and 7.

CO Overcurrent Element

The type CO adjustable inverse time circuit closing element 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

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

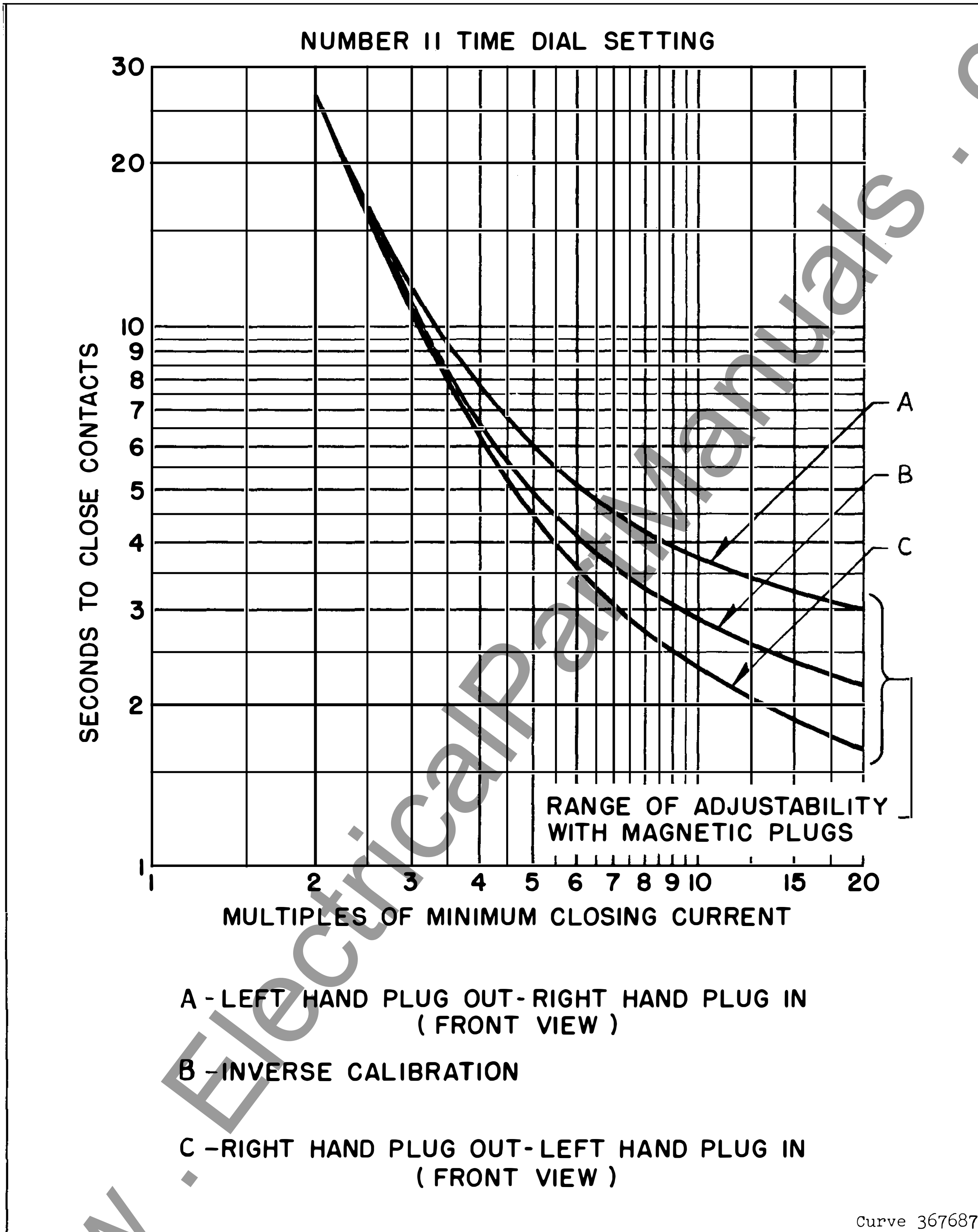

Fig. 4—Example of the Range of Adjustability of the Time Curves by Means of the Adjustable Magnetic Plugs.

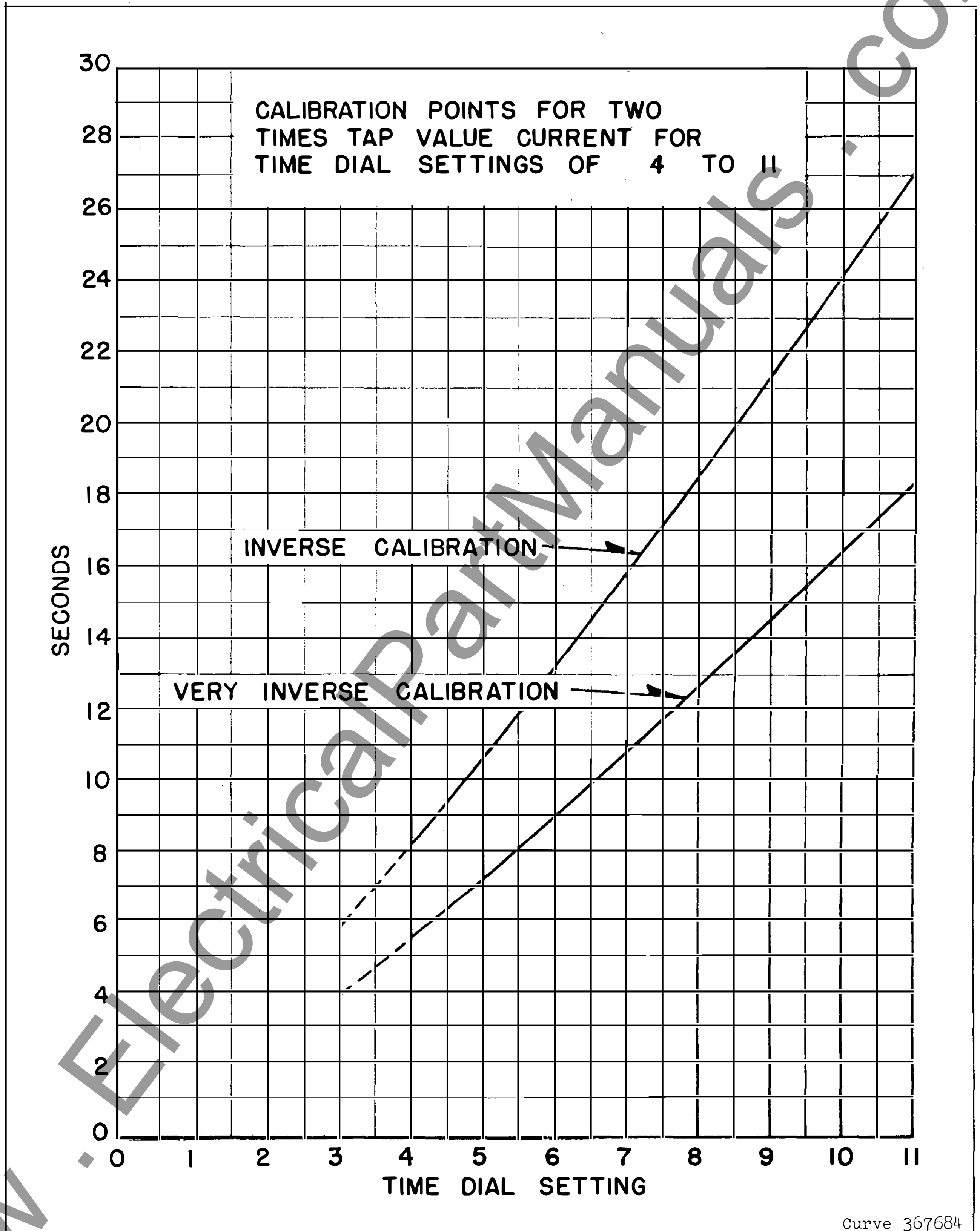

Fig. 5 — Time vs Time Dial Setting for Inverse and Very Inverse Calibration at 2 Times Minimum Trip.

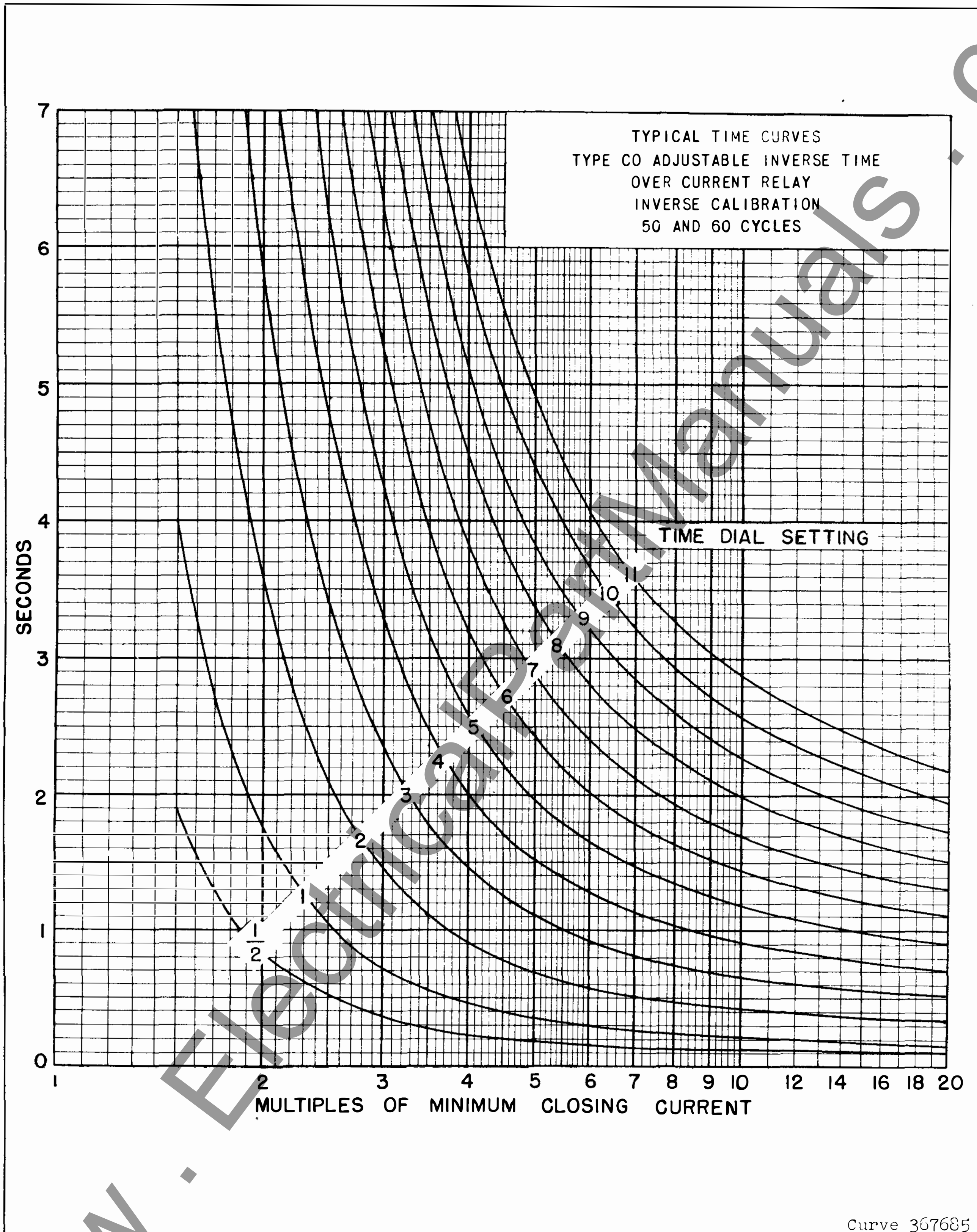

Fig. 6—Typical 50 and 60 Cycle Time Curves for the Inverse Calibration.

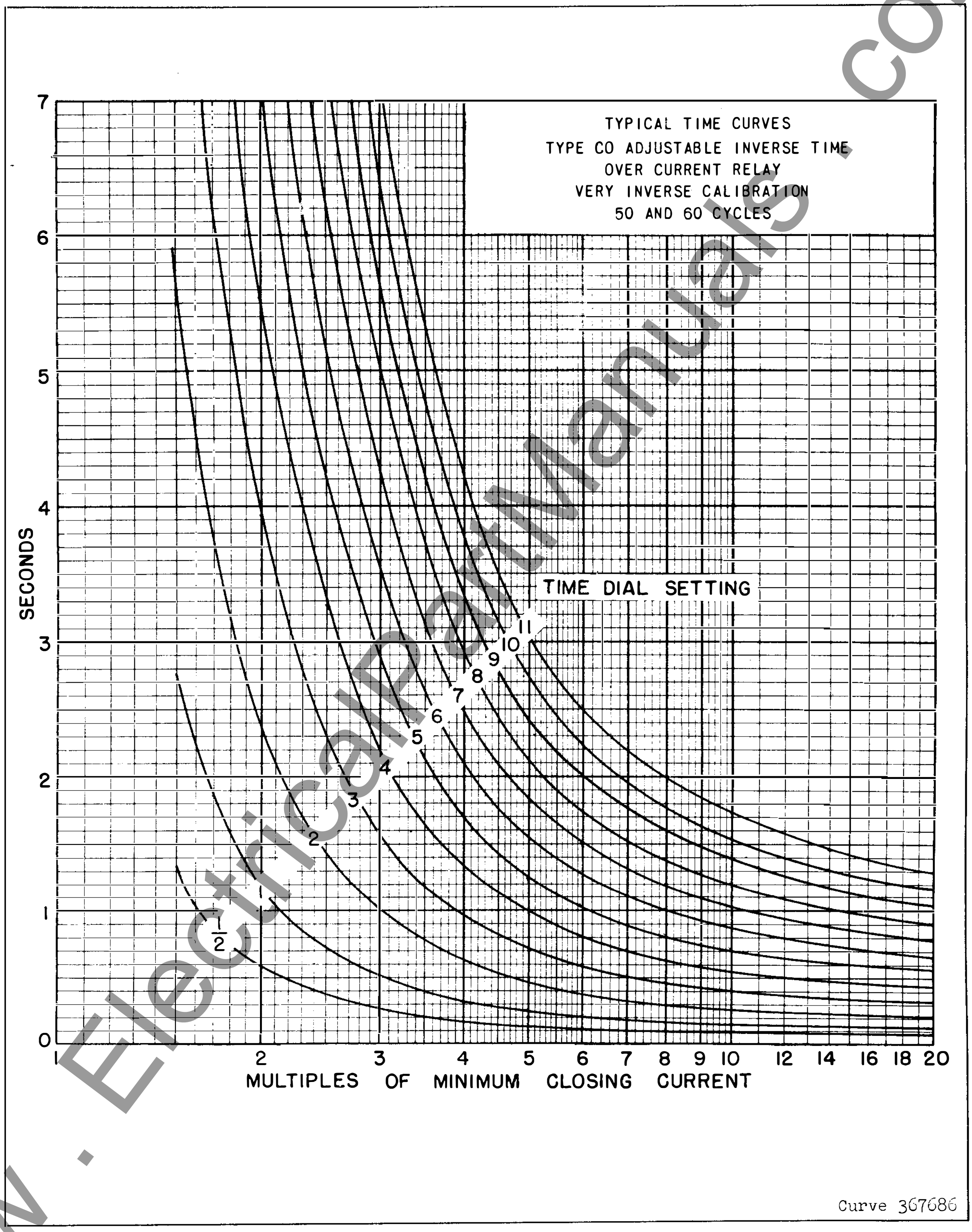

Fig. 7—Typical 50 and 60 Cycle Time Curves for the Very Inverse Calibration.

to touch the stationary contacts at tap value current.

The time vs current characteristics for the style calibration of inverse or very inverse are shown in Fig. 6 and Fig. 7 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. 4, 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.

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

Settings for the CO Element

There are two settings, namely the current value at which the relay closes its contacts and the time required to close them.

For sectionalizing transmission systems the current and time setting must be determined by calculation, with due consideration being given to the time required for circuit breakers to open so that the 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.

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.

CAUTION Be sure that the connector screws are turned up tight so as to make a good contact, for the operating current passes through it.

Since the overload current coil 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, in the new tap and removing the old screw from its original setting.

Voltage Setting

The position of the magnetic shunt of the SV element determines the voltage value at which the SV contacts will close. The lower end of the shunt is beveled and knurled, so that it can be grasped by the fingers and turned to change the setting. A calibrated scale plate is mounted adjacent to the shunt. A groove is above the knurl in the lower end of the shunt serves as an index mark, and the relay dropout setting is indicated by the calibration scale marking which is adjacent to the groove.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not require readjustment 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.

All contacts should be periodically cleaned with a fine file. S #1002110 file 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.

CO Element

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 that 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 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 electro-magnet. 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. 5 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 than 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 Fig. 6 or Fig. 7 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.

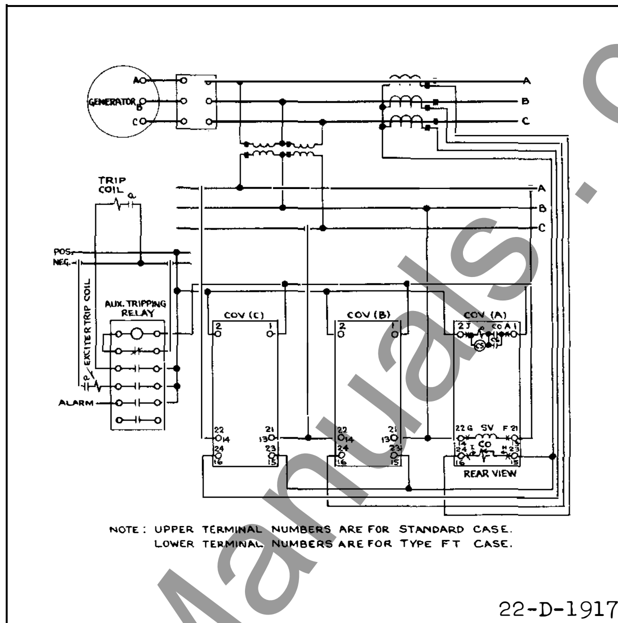

Fig. 8—External Connections of the Type COV Relay.

Curve shapes that are different from the inverse or very inverse may be obtained by the adjustable magnetic plugs. An example of this adjustment has been referred to under "Characteristics", and wherein one range of possibilities is shown by Fig. 4.

Voltage Element

In order to remove the plunger and shaft assembly, it is necessary to loosen the set screw in the lower guide bearing and slip the bearing out of the tube. The spool-shaped bushing assembled on the upper end of the plunger shaft has a portion of its center section machined off so that the shaft is exposed at this point and can be prevented from turning by gripping shaft and bushing with a pair of long-nose pliers. The set screw and nut at the upper end of the shaft can then be removed, after which the shaft and plunger will drop out of the core assembly. The shaft and plunger assembly should be handled carefully to avoid bending the shaft or damaging the bearing surfaces. The shaft should never be gripped on its upper bearing surface, below the spool shaped bushing, when loosening the nut and set screw, as this would almost certainly damage the bearing surface. The shaft bearing surfaces should not be cleaned or polished with any abrasive material, as the abrasive particles might become imbedded in the shaft and cause difficulty later. The plunger shaft and bearings may be cleaned by wiping them carefully with a clean, lintless cloth. This may be moistened with benzene or some other cleaning solvent if necessary. Use no lubricant on the plunger shaft or bearings when reassembling the relay, since this will eventually become gummy and prevent proper operation.

The stationary contacts should be located so that they just touch the moving contacts when the latter are 1/32" above the de-energized position.

The lever of the shunt-locking device should be approximately parallel with the mounting block. A variable number of thin spacer washers are assembled on the left hand end of the locking pin in order to obtain this adjustment when the relay is assembled at the factory. If the locking device is dismantled later, these washers should be preserved and replaced.

Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core of 1/64" 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.

Operation Indicator

Adjust the indicator to operate at 0.2 ampere d.c. gradually applied. Test for sticking after 5 amperes d.c. is passed.

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.

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

ENERGY REQUIREMENTS

The burdens of the various circuits of the 60 cycle relay are as follows:

Ampere Range	Tap	Continuous Rating (Amperes)	One Second Rating (Amperes)	Power Factor Angle∅	Volt Amperes △ At Tap Value Current	At 3 Times Tap Value Current	At 10 Times Tap Value Current	At 20 Times Tap Value Current
	(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
0.5/2.5-	(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	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
2/6-	(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	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.

∅ Degrees current lags voltage at tap value current.

△ Voltages taken with Rectox Type Voltmeter.

CHARACTERISTICS OF SV ELEMENT

Frequency Cycles	Range of Adjustment Volts	Max. Volts Continuous	Watts at 115 V. AC 125 V. for DC	V.A. at 115 V.	Drop-out Ratio
60	70-160	160	3.4	7.3	90-98%

Values of watts and volt-amperes in the table are average for various plunger and shunt positions.

Drop-out ratio varies somewhat with drop-out adjustment but will be approximately constant for any given drop-out setting. Limits in tables include variables such as friction and other individual relay variations.

Maximum continuous volts given for the SV drop-out element is for the relay set for minimum drop-out. With the relay set for maximum drop-out the continuous voltage can be increased 10 to 20%.

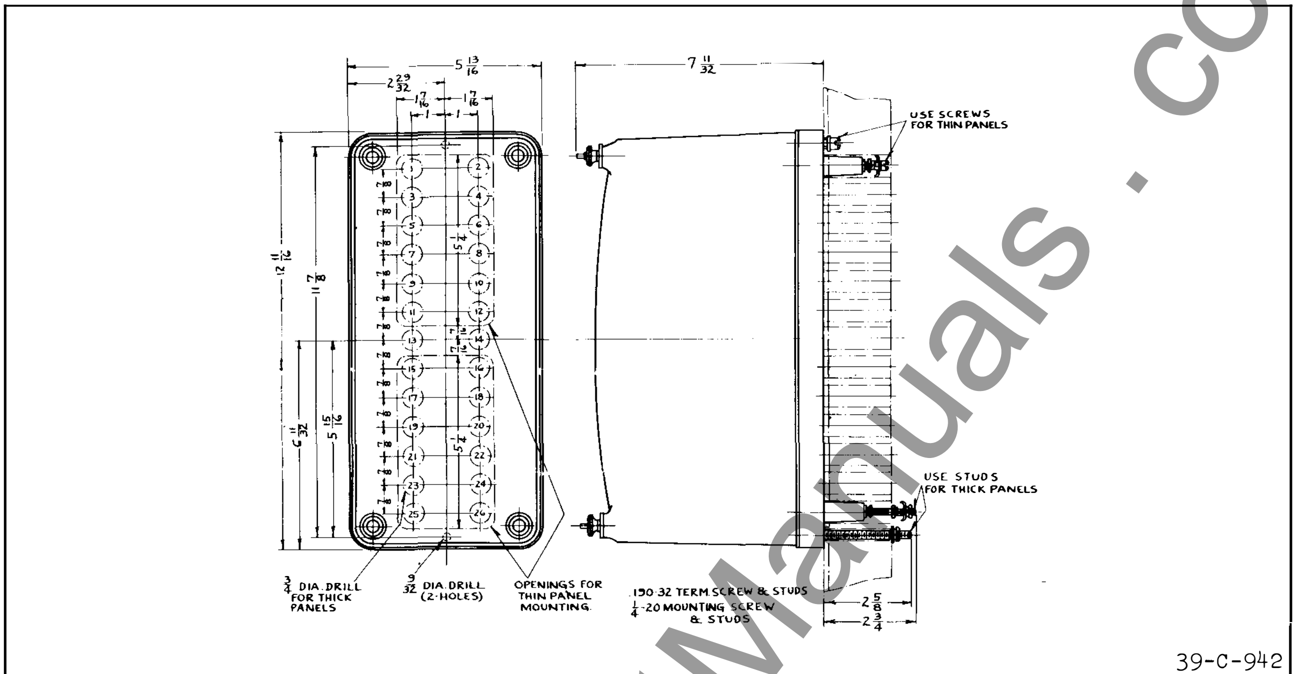

Fig. 9—Outline and Drilling Plan for the Standard Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

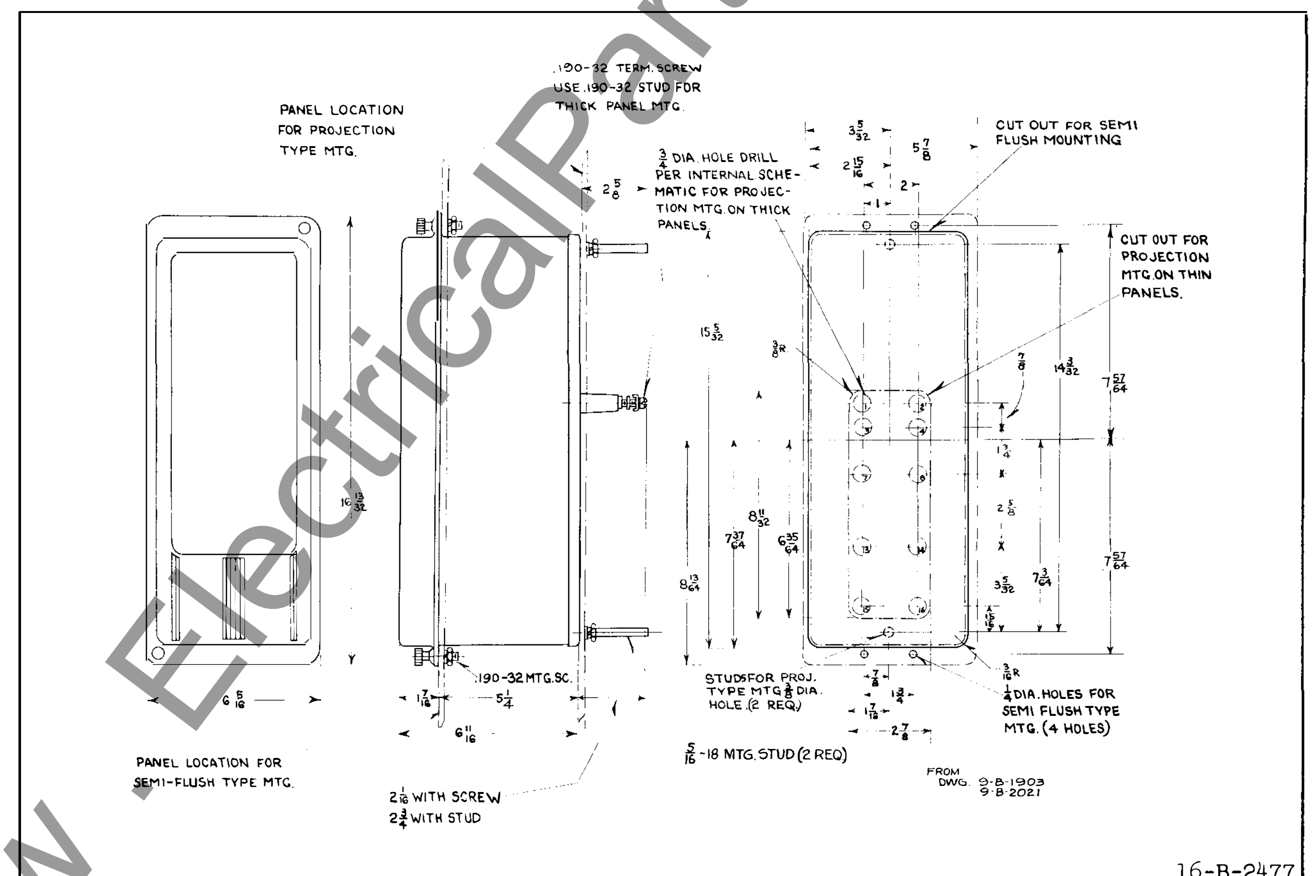

Fig. 10—Outline and Drilling Plan for the M-10 Semi-flush or Projection Type FT Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

WESTINGHOUSE ELECTRIC CORPORATION

METER DIVISION • NEWARK, N.J.

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TYPE COV VOLTAGE CONTROLLED 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 close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type COV relay is applicable where it is desired that an overcurrent element be set to operate on less than full load current when the voltage falls below a predetermined value. Furthermore, not to operate for any magnitude of current when the voltage is above the predetermined value. A typical application is overcurrent back-up protection for generators.

CONSTRUCTION

The relay consists of an overcurrent element, a voltage element, an operation indicator, and a contactor switch.

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 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 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.

Voltage Element

The type SV element operates on the solenoid principle. A U-shaped iron frame, mounted on the moulded base, supports the coil and serves as the external magnetic path for the coil. The coil surrounds a core and flux shunt. The upper end of the core is threaded and projects through the upper side of the frame, to which it is fastened by a nut. A tube threaded on the outside at its lower end is assembled in the core, and the threaded end extends below the core. The lower bearing for the plunger shaft is inserted in the lower end of this threaded tube, and is held in place by a set screw. This bearing consists of a graphite bushing in a brass holder. The bearing for the upper end of the plunger shaft is a graphite bushing which is pressed in the upper

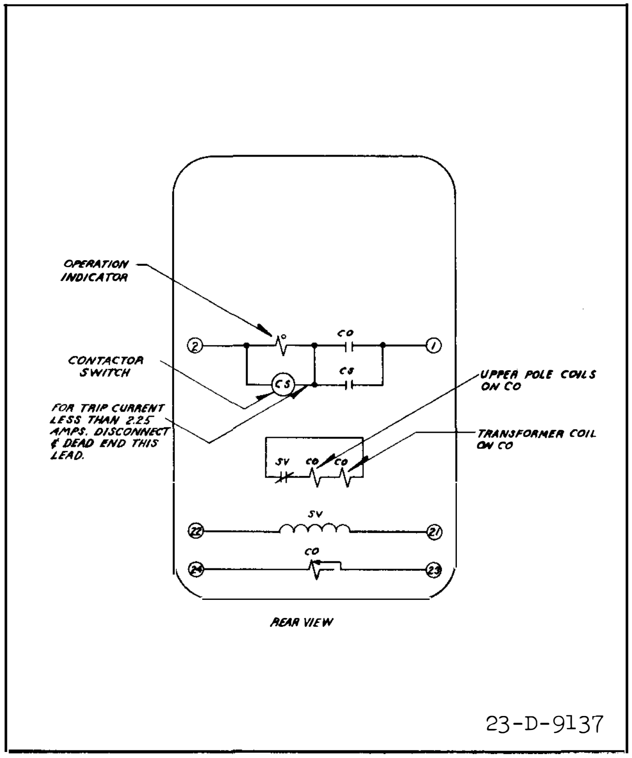

Fig. 1—Internal Schematic of the Type COV Relay in the Standard Case.

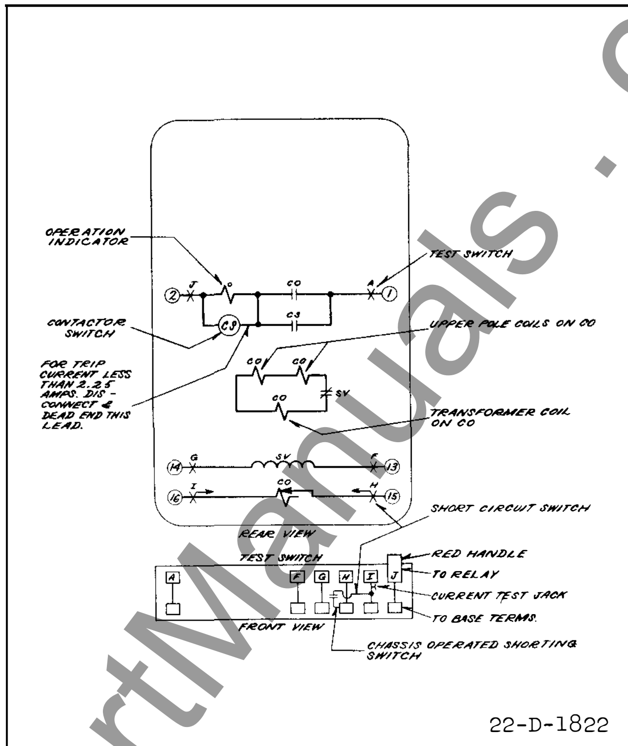

Fig. 2—Internal Schematic of the Type COV Relay in the Type FT Case.

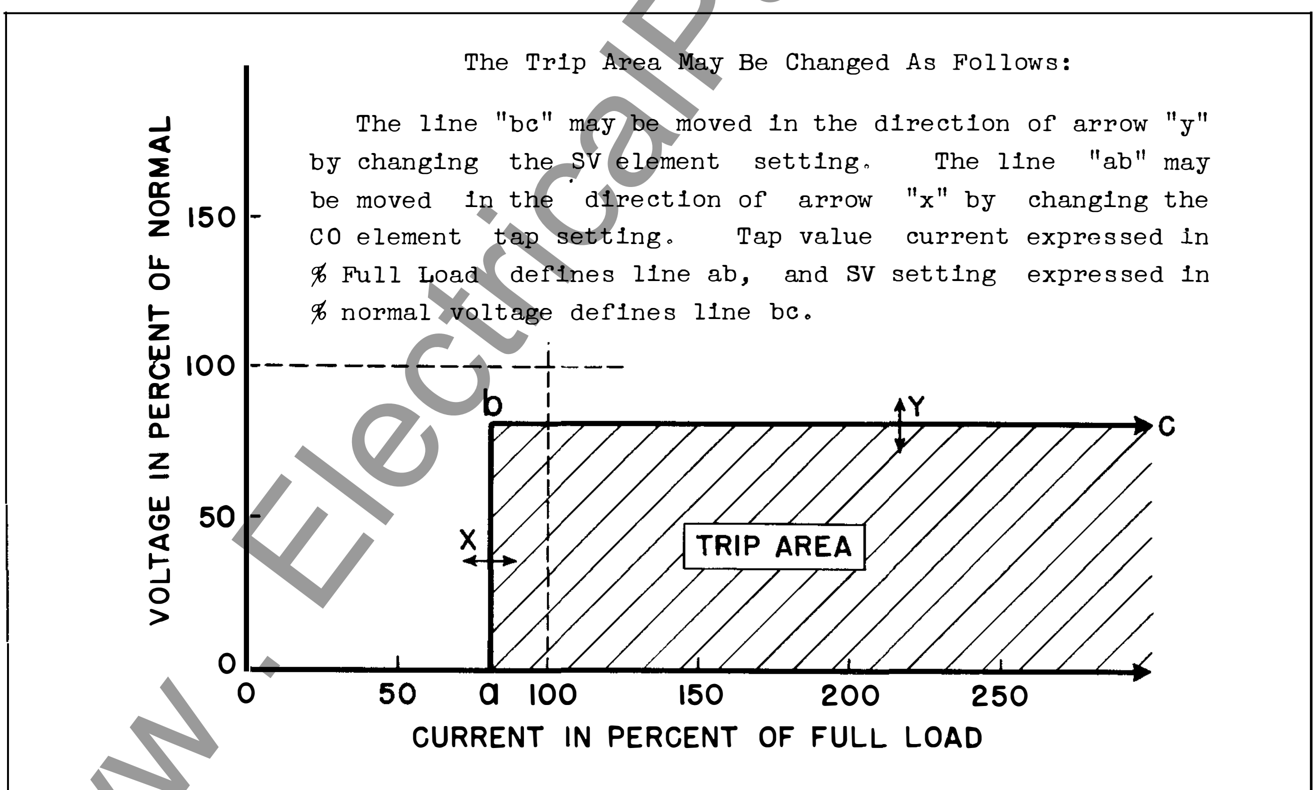

Fig. 3—Typical Tripping Characteristics of Type COV Relay.

end of the core. This bearing is visible when the plunger is in the energized position. The plunger itself does not touch the walls of the tube in which it moves.

A flux shunt which surrounds the core is screwed on the tube, and its lower end projects below the relay frame. The position of this shunt determines the drop-out setting of the relay. The lower end of the shunt is beveled and knurled, so that it can be grasped by the fingers and turned to change the setting. A calibrated scale plate is mounted adjacent to the shunt. A groove just above the knurl in the lower end of the shunt serves as an index mark, and the relay drop-out setting is indicated by the calibration scale marking which is adjacent to the groove.

The construction of the plunger, core and flux shunt causes the plunger to float in its energized position, without being held against a stop, even when energized much above the pick-up value. Consequently, there is negligible noise and the contacts are free from chatter.

The core, shunt and plunger construction also provides the high ratio of drop-out to pick-up. This ratio is above 90% for any drop-out setting.

The shunt is held in any desired position by means of a locking mechanism in which a spring, through the medium of a lever, presses a pin against the shunt. The pressure is removed by pushing the free end of the lever to the left. Only a small amount of movement is necessary to remove the pressure on the locking pin entirely. The limit of the lever movement is readily apparent on inspection of the assembly, and this should not be exceeded since the lever may be bent. The shunt is made a fairly snug fit in the frame and on the coil core tube, but when the pressure on the locking pin is released, it can be readily turned by the fingers alone. By applying greater force, it will be possible to turn the shunt without moving the lever fully to the left, but the pressure of the locking pin will prevent any creeping of the shunt or undesired change of setting.

The stationary contacts are assembled on slotted brackets. These are held in position on the base by filister-head screws which are threaded into the terminal inserts. The moving contacts are mounted on a Micarta insulation plate which is secured to the threaded end of the plunger shaft by a nut. The rear portion of the plate is slotted and a post screwed to the frame passes through this slot to prevent the plate from rotating. The moving contacts are connected to the base terminals by flexible leads. All contacts are pure silver.

Contactor Switch and Operation Indicator

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.

The operation indicator coil is connected in the trip circuit to show a white target when the trip circuit is completed.

CHARACTERISTICS

To prevent the relay from operating for currents above the overcurrent element setting when the voltage is above the setting of the voltage element, the normally closed SV contacts are connected in the upper pole circuit of the overcurrent element. This means that the overcurrent element cannot operate unless the voltage drops to such a value as to close the SV contacts. This construction results in a tripping characteristic as shown in Fig. 3.

The time VS current curves for the overcurrent element with the SV contacts closed are shown in Fig. 4, 5 and 6.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free

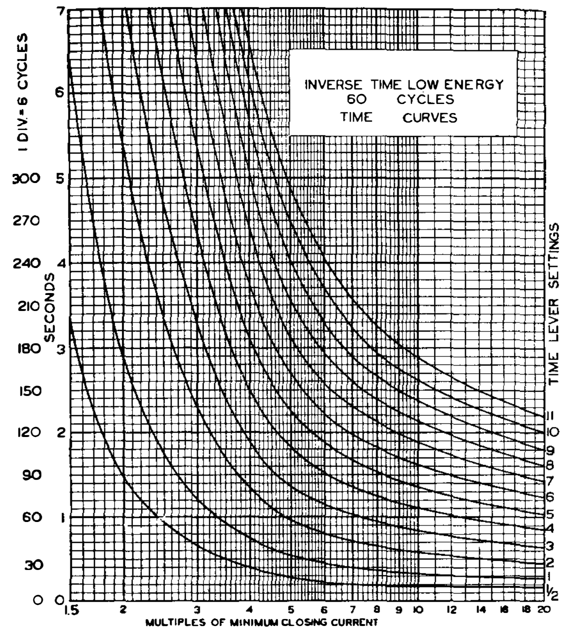

Fig. 4—Typical Inverse Time Curves of the Overcurrent Element of the Low Energy 60 Cycle Relays.

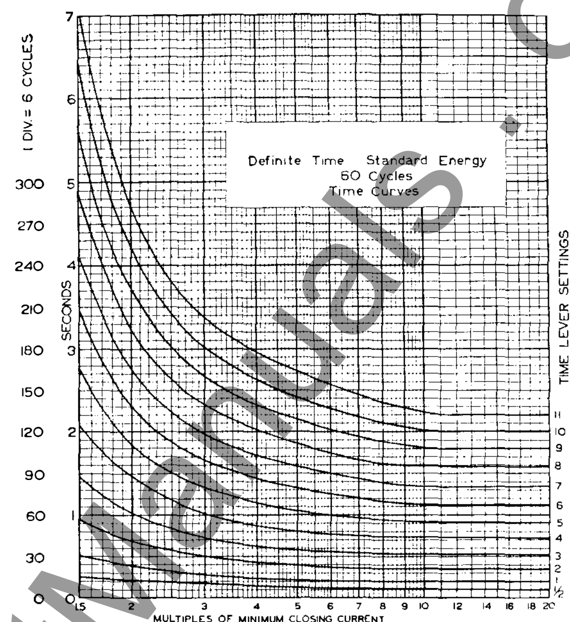

Fig. 5—Typical Inverse Definite Minimum Time Curves of the Overcurrent Element of the Standard Energy 60 Cycle Relays.

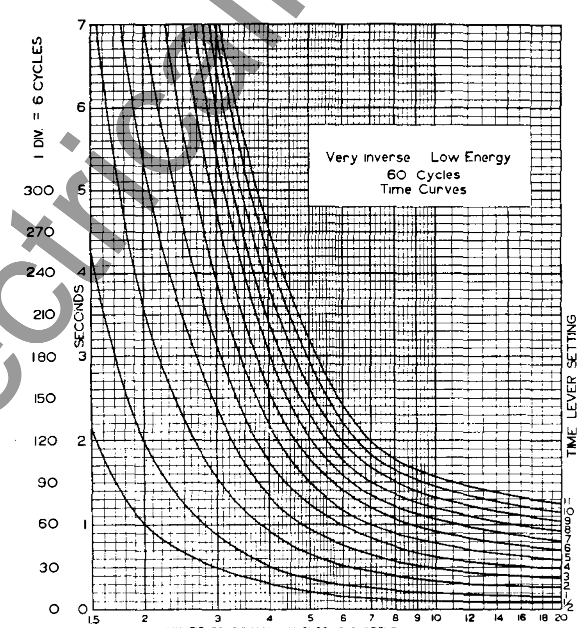

Fig. 6—Typical Very Inverse Time Curves of the Overcurrent Element of the Low Energy 60 Cycle Relays.

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

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 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. By choosing the proper tap, a continous adjustment of tripping current from 3.4 amperes to 17.5 amperes may 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 circuit, 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.

Voltage Setting

The position of the magnetic shunt of the SV element determines the voltage value at which the SV contacts will close. The lower end of the shunt is beveled and knurled, so that it can be grasped by the fingers and turned to change the setting. A calibrated scale plate is mounted adjacent to the shunt. A groove is above the knurl in the lower end of the shunt serves as an index mark, and the relay drop-out setting is indicated by the calibration scale marking which is adjacent to the groove.

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 should not be used in testing induction-type relays because of the resulting distorted current wave from which produces an error in timing.

All contacts should be periodically cleaned with a fine file. S#1022110 file 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

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, are as shown on the typical time curve.

Voltage Element

In order to remove the plunger and shaft assembly, it is necessary to loosen the set screw in the lower guide bearing and slip the bearing out of the tube. The spool-shaped bushing assembled on the upper end of the plunger shaft has a portion of its center section machined off so that the shaft is exposed at this point and can be prevented from turning by gripping shaft and bushing with a pair of long-nose pliers. The set screw and nut at the upper end of the shaft can then be removed, after which the shaft and plunger will drop out of the core assembly. The shaft and plunger assembly should be handled carefully to avoid bending the shaft or damaging the bearing surfaces. The shaft should never be gripped on its upper bearing surface, below the spool shaped bushing, when loosening the nut and set screw, as this would almost certainly damage the bearing surface. The shaft bearing surfaces should not be cleaned or polished with any abrasive material, as the abrasive particles might become imbedded in the shaft and cause difficulty later. The plunger shaft and bearings may be cleaned by wiping them carefully with a clean, lintless cloth. This may be moistened with benzene or some other cleaning solvent if necessary. Use no lubricant on the plunger shaft or bearings when reassembling the relay, since this will eventually become gummy and prevent proper operation.

The stationary contacts should be located so that they just touch the moving contacts when the latter are 1/32" above the de-energized position.

The lever of the shunt-locking device should be approximately parallel with the mounting block. A variable number of thin spacer washers are assembled on the left hand end of the locking pin in order to obtain this adjustment when the relay is assembled at the factory. If the locking device is dismantled later, these washers should be preserved and replaced.

Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core of 1/64" 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

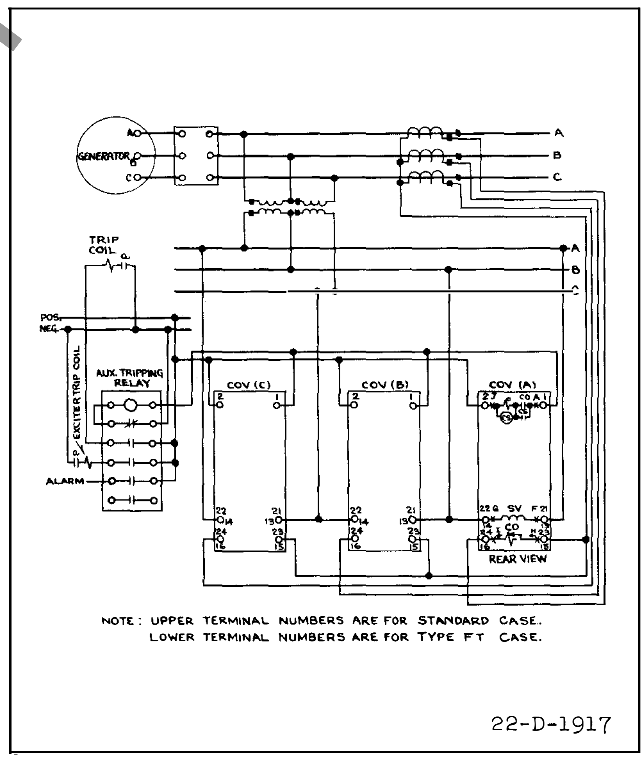

Fig. 7—External Connections of the type COV Relay.

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.

Operation Indicator

Adjust the indicator to operate at 0.2 ampere d.c. gradually applied. Test for sticking after 5 amperes d.c. is passed.

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.

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

ENERGY REQUIREMENTS

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

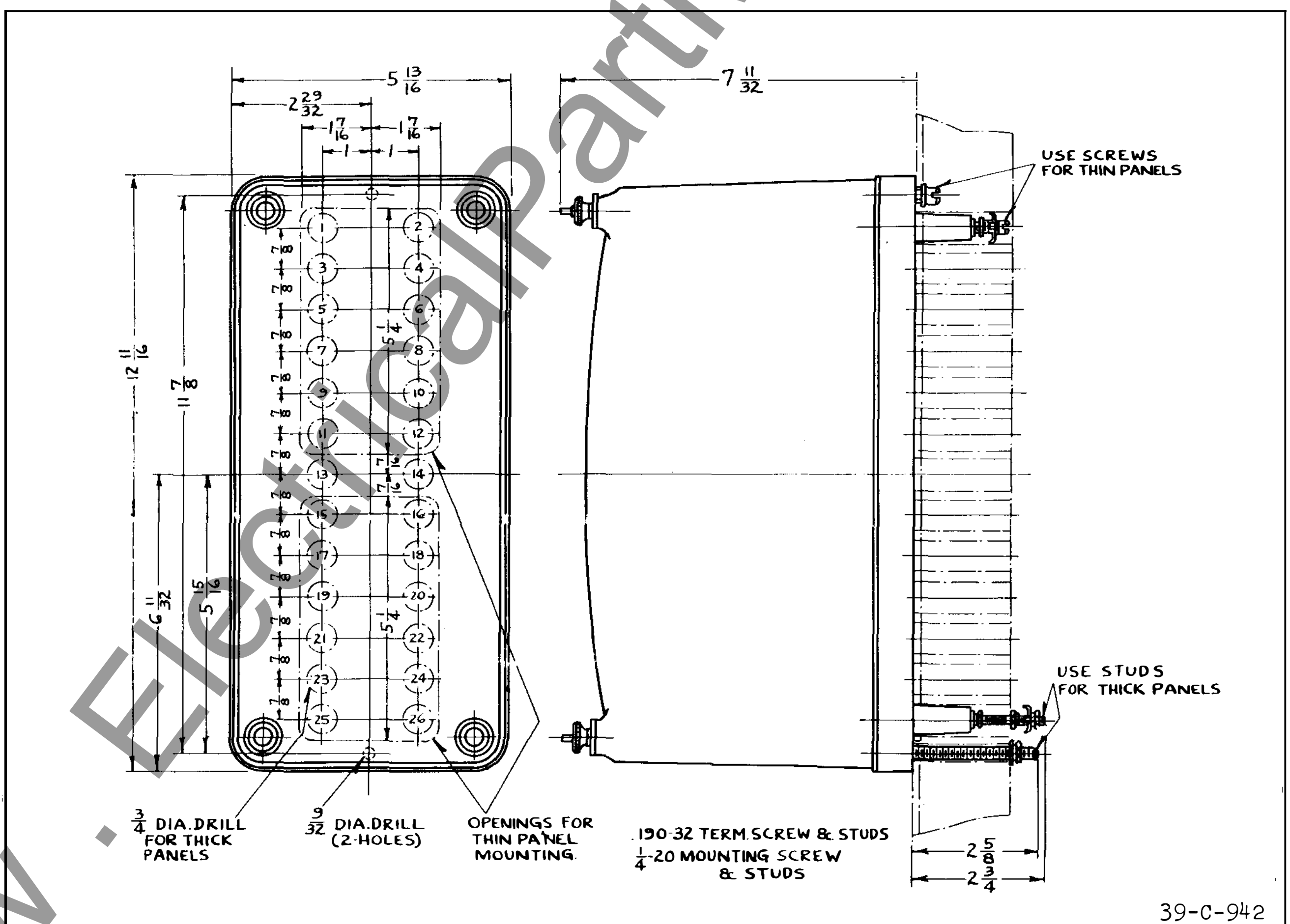

Fig. 8—Outline and Drilling Plan for the Standard Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

DEFINITE MINIMUM TIME OVERCURRENT ELEMENT 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 OVERCURRENT ELEMENT 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 OVERCURRENT ELEMENT 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.

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	20	136	351
Very Inverse Time	V.A. Burden	1.25	10.75	97	254

CHARACTERISTICS OF SV ELEMENT

Frequency Cycles	Range of Adjustment Volts	Max. Volts Continuous	Watts at 115 V. AC 125 V. for DC	V.A. at 115 V.	Drop-out Ratio
60	70-160	160	3.4	7.3	90-98%

Values of watts and volt-amperes in the table are average for various plunger and shunt positions.

Drop-out ratio varies somewhat with drop-out adjustment but will be approximately constant for any given drop-out setting. Limits in tables include variables such as friction and other individual relay variations.

Maximum continuous volts given for the SV drop-out element is for the relay set for minimum drop-out. With the relay set for maximum drop-out the continuous voltage can be increased 10 to 20%.

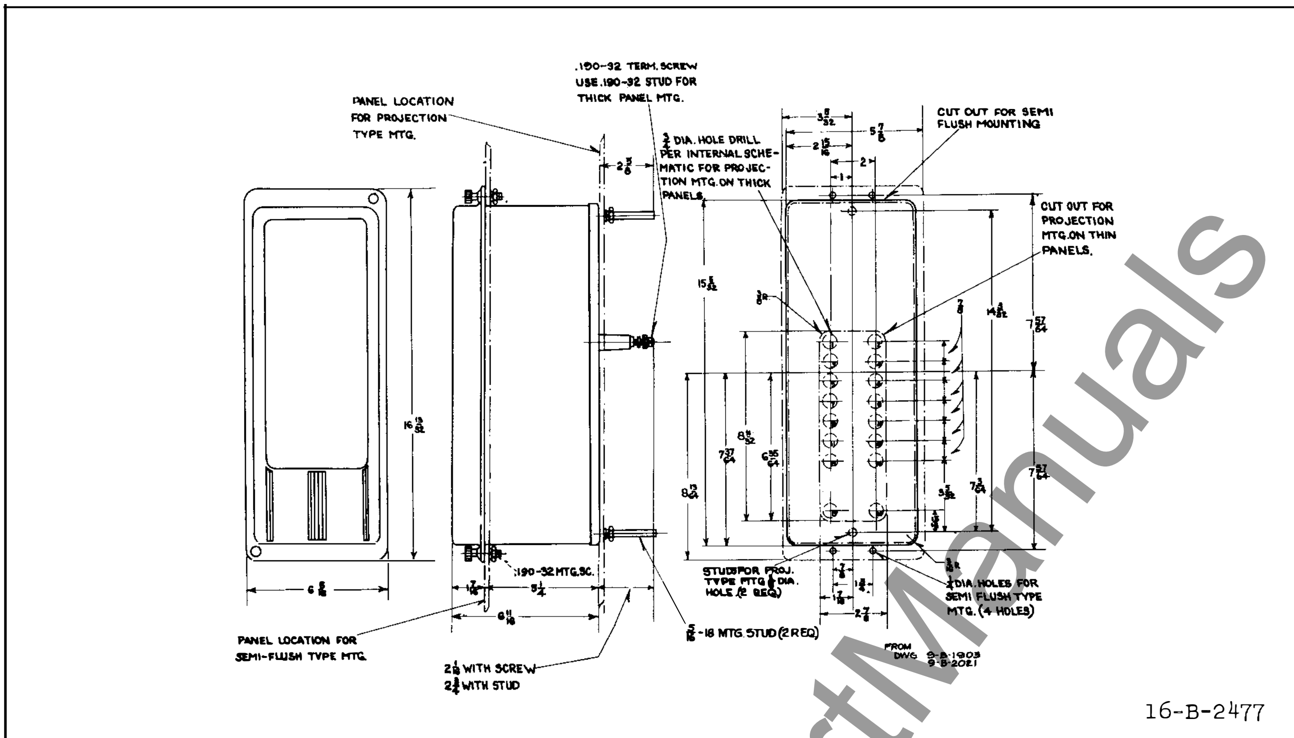

Fig. 9—Outline and Drilling Plan for the Semi-flush or Projection Type FT Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

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