INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CO MULTI-RANGE CONTACT MAKING AMMETER

Superseded by 41-279.1A see relay Book

CAUTION Before putting relays into service, remove all blocking 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

These relays are used to initiate switching or control operations when the line current rises above a preset value, or falls below a preset value. Thus the relay is a contact making ammeter with high and low current settings.

CONSTRUCTION AND OPERATION

The relay consists of a current operated induction disc element, a tap adjuster to change the relay operating range, and adjustable front and back contacts to set the upper and lower tripping limits. There is no torque compensator, operation indicator, or contactor switch.

The operating element is an induction-disc type element operating on overcurrent. The induction disc is a thin four-inch diameter conducting 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 rod hemispherically shaped at either end to form a double throw arrangement. It is fastened on the end of a conducting arm. The other end of this arm is clamped to an insulating tube on

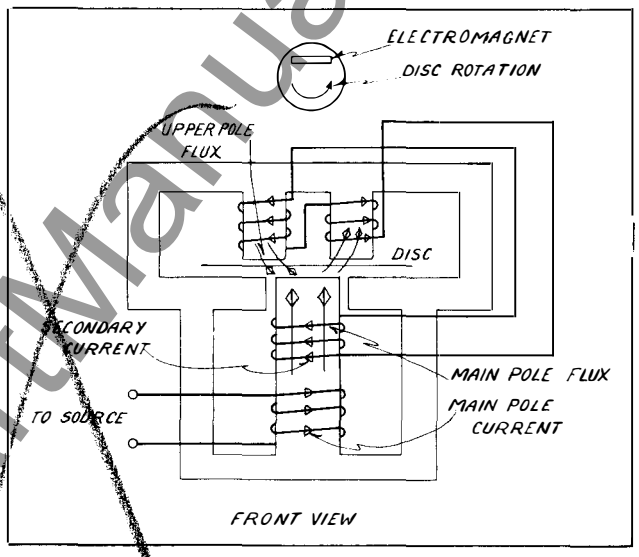

Fig. 1—Flux and Current Relations In The Induction Type Element

the disc shaft. The electrical connection is made from the moving contact thru the arm and a 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 moulded insulation block mounted on the element.

The front and back stationary contact assemblies are both adjustable. Each mounts on a lever which can be set anywhere about the periphery of a calibrated scale. The moulded brackets, upon which the stationary contact leaf springs are mounted, are each secured to their respective lever arms by two screws. These screws may be loosened and the moulded contact supports pivoted to the positions required for correct tracking of both contact assemblies on the calibrated scale.

The moving disc is rotated by an electromagnet in the rear and damped by a permanent

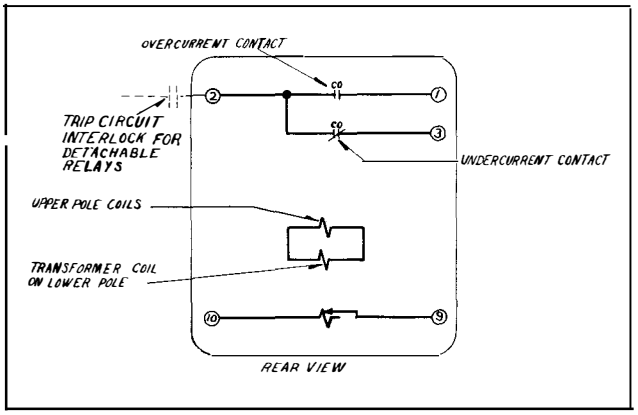

Fig. 2—Internal Schematic of the Type CO Multi-range Contact Making Ammeter in the Standard Case.

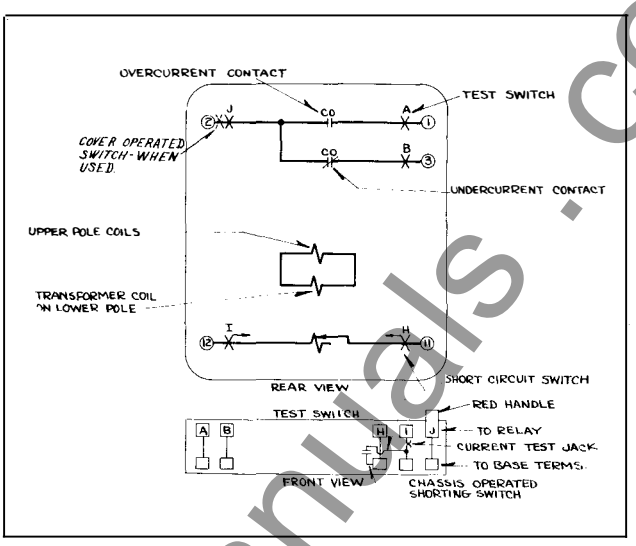

Fig. 3—Internal Schematic of the Type CO Multi-range Contact Making Ammeter in the Type FT Case.

magnet in the front. The operating torque is obtained by the circuit arrangement shown in Fig. 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 in the disc by the reaction between the fluxes of the upper and lower poles. When the current rises above the preset value the moving contact closes to the right (front view). When the current falls below a preset value the moving contact closes to the left (front view).

CHARACTERISTICS

The type CO multi-range contact making ammeter has adjustable high and low current contacts that can be set around an 180° arc which is calibrated from 80% to 105% in 5% steps. It is possible to move the adjustable contacts to their extreme positions corresponding to approximately 75% and 110%. These values represent the tripping position of the moving contacts when that percent of tap current is applied to the relay. The tap plate is marked in amperes as follows: 2.0, 2.5, 3.0, 3.5, 4.0, 5.0 and 6.0.

The moving contacts will assume a position corresponding to the current thru the relay and the relay setting and will stay in that position until the current changes. If the current changes either gradually or suddenly, the contact will assume a new position corresponding to that change unless the travel is limited by the setting of the adjustable contacts. If the contacts are set to close for a particular percentage of tap current, and if a current of that exact amount flows, then the relay is operating at its minumum trip point and the times on repeated operations are not repetitive within close tolerances. However, currents appreciably greater than the overcurrent setting, or appreciably less than the undercurrent setting, result in relay timing operations which are consistent for repeated trials.

The relay has inverse timing; that is, the greater the increase in current the faster the relay contact will travel. From the mid scale position (92.5%) the moving contact will travel to the 105% and 80% points respectively in approximately 30 seconds when the current is suddenly increased to slightly greater than 105% of tap value or suddenly decreased to slightly less than 80% of tap value.

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. There are two cover nuts on the S size case and four on the L and M size cases. This exposes the relay elements 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 any of the black handle switches 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 as well as on its top, back or sides for easy inspection, maintenance and test.

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 circuit 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 insulation 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 post 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 calibration.

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 two 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 adjustments for making a relay setting. First, the tap screw position, and second, the stationary contact setting. The tap screw position fixes the relay range, the stationary contacts fix the upper and lower contact making limits. The latter are calibrated in percent of the former. For example, suppose it is desired to set the relay with upper limit 3.60 amps and lower limit 3.30 amps. This may be done with the tap screw in either the 3.5 amp or the 4.0 amp position. With the tap screw in the 3.5 amp position, the left hand (lower limit) stationary contact is set at $\frac{3.3}{3.5} \times 100 = 94\%$ and the right hand (upper limit) stationary contact is set at $\frac{3.6}{3.5} \times 100 = 103\%$. With the tap screw in the 4.0 amp position, the left hand (lower limit) stationary contact is set at $\frac{3.3}{4.0} \times 100 = 82\%$, and the right hand (upper limit) stationary contact is set at $\frac{3.6}{4.0} \times 100 = 90\%$. In general, it is preferable to use the lowest tap possible since this gives the greatest moving contact travel. Therefore, in this case the tap screw should be set in the 3.5 ampere hole.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct

operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be 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.

The relay has front and back adjustable stationary contacts; to adjust these properly set the two levers so that both point to the 90% scale division. Then adjust the position of the front and back contacts so they both just touch on either side of the moving contact. This is done by loosening the two screws at the top of each lever and rotating the adjustable contact assembly slightly until the desired contact positions are obtained. The screws should be tightened securely.

To calibrate the relay, it should be connected in series with a resistance load and an ammeter, and energized from a 60 cycle source of at least 115 volts. The trip circuit should be connected to suitable indicating lamps. Current corresponding to the various percentages of tap value marked on the semi-circular scale plate should be passed through the relay and the position of the adjustable contacts checked for the various values. Readjustments can be made by rotating the notched spring adjuster with a screw driver blade inserted in one of the notches. The left hand adjustable contact should be used in calibrating the 80% - 85% - 90% points, and the right hand adjustable contact should be used for the 95% - 100% - 105% points.

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 cycles burden of the type CO multi-range contact making ammeter at tap value current is 2 VA. at a power factor angle of 66.4° lag. The continuous current rating is 8 amperes. The one second current rating is 250 amperes.

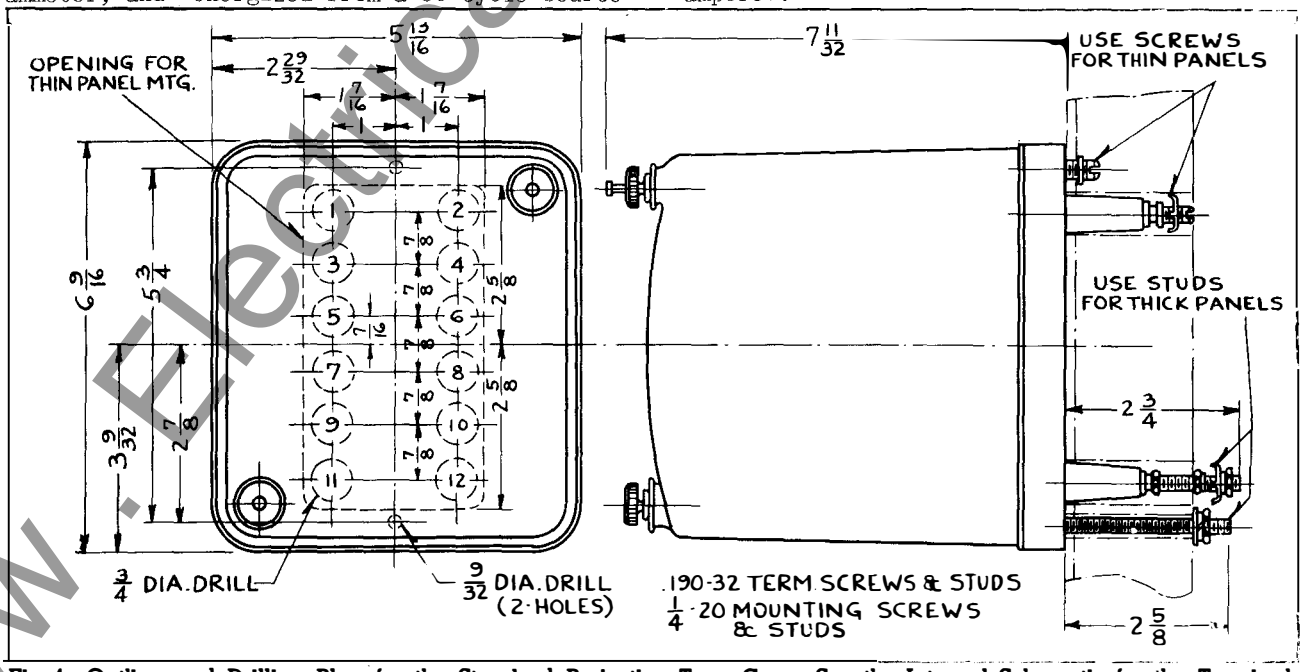

Fig. 4—Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

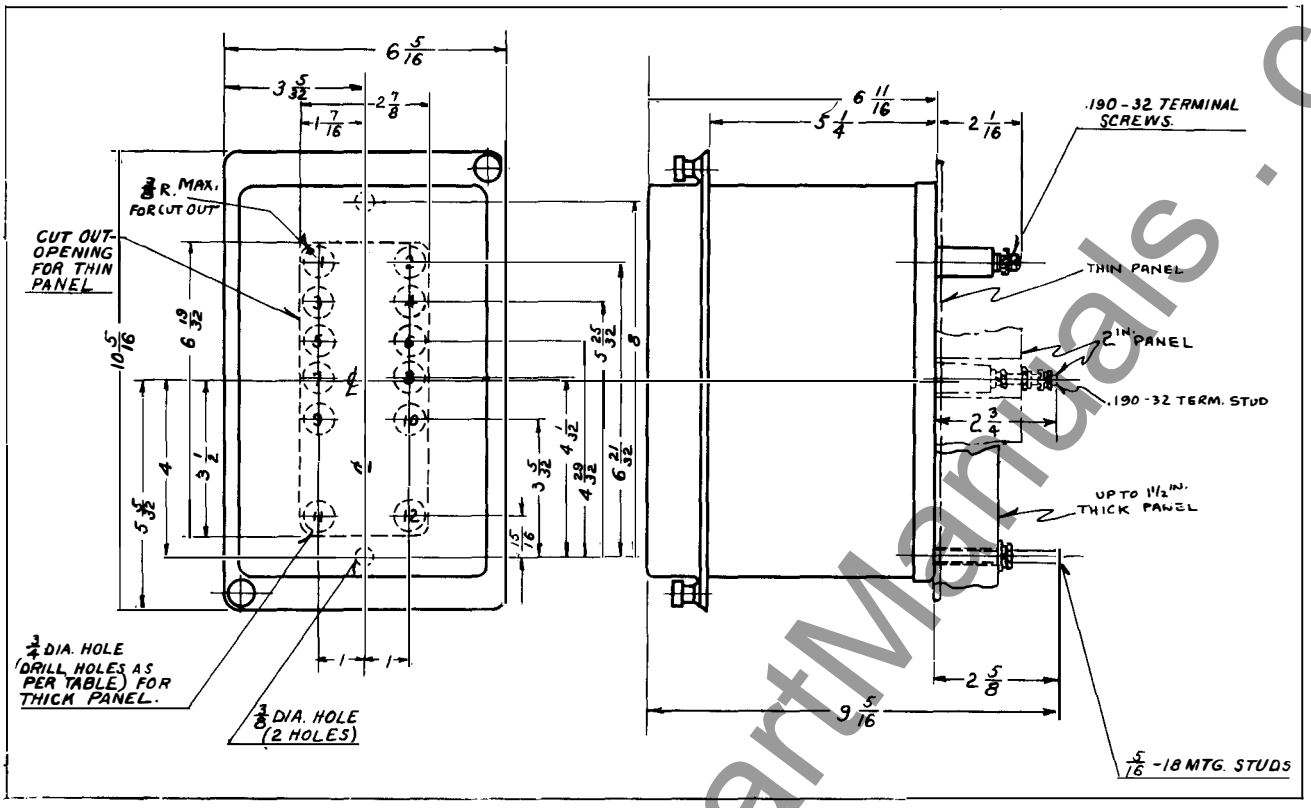

Fig. 5—Outline and Drilling Plan for the S10 Projection Type FT Case. See the Internal Schematic for the Terminals Supplied For Reference Only.

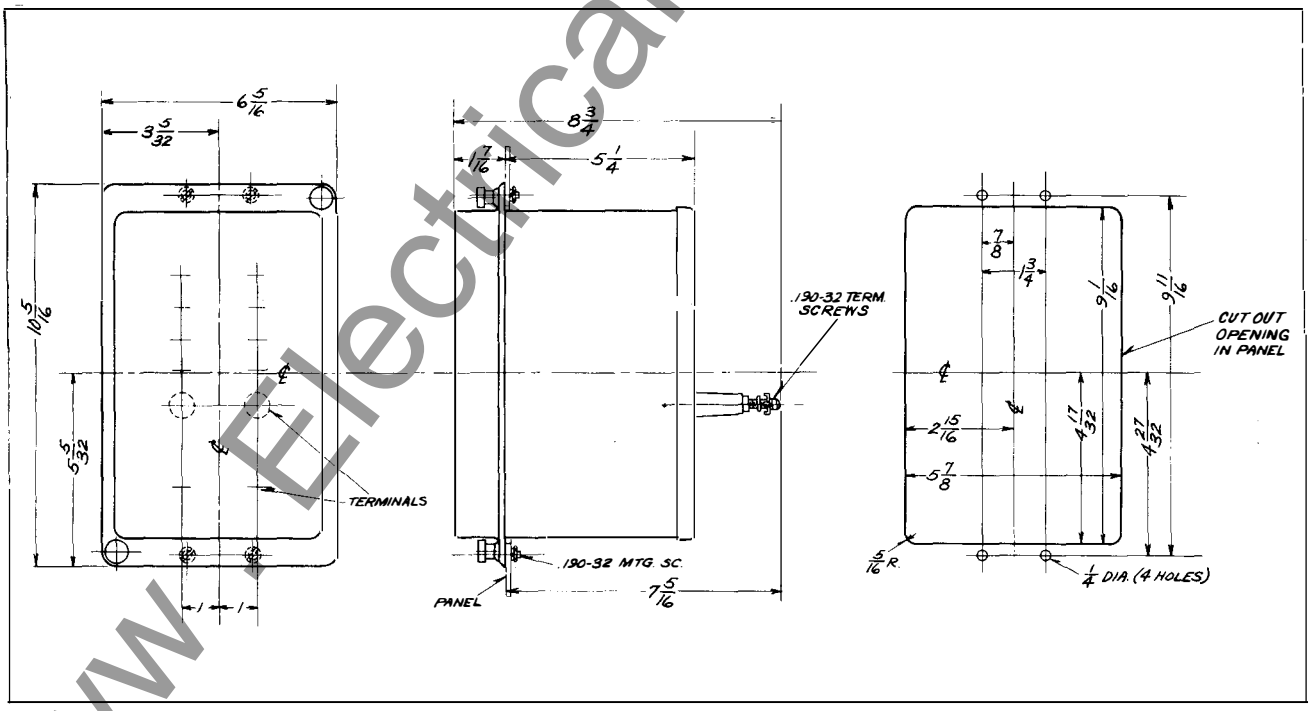

Fig. 6—Outline and Drilling Plan for the S10 Semi-flush type FT Case. For Reference Only.

WESTINGHOUSE ELECTRIC CORPORATION

METER DIVISION **NEWARK, N.J.**

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CO CONTACT MAKING AMMETER

Superseded by 41-279 A See relay Book

CAUTION Before putting relays into service, remove all blocking 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

These relays are used to initiate switching or control operations when the line current rises above a preset value, or falls below a preset value. Thus the relay is a contact making ammeter with high and low current settings.

CONSTRUCTION AND OPERATION

The relay consists of a current operated induction disc element, with adjustable front and back contacts to set the upper and lower tripping limits. There is no operation indicator, or contactor switch.

The operating element is an induction disc type element operating on current. The induction disc is a thin four-inch diameter conducting 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 rod hemispherically shaped at either end to form a double throw arrangement. It is fastened on the end of a conducting arm. The other end of this arm is clamped to an insulating tube on the disc shaft. The electrical connection is made from the moving contact thru the arm and a 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 moulded insulation block mounted on the element.

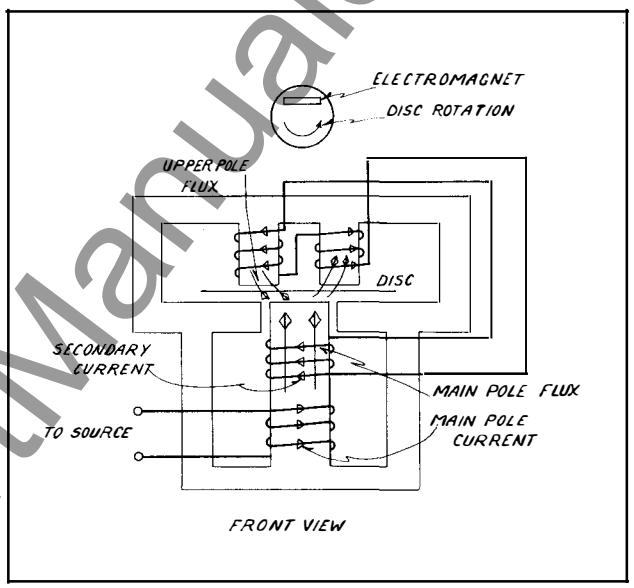

Fig. 1—Flux and Current Relations in the Induction Type Element.

The front and back stationary contact assemblies are both adjustable. Each mounts on a lever which can be set anywhere about the periphery of a calibrated scale. The moulded brackets, upon which the stationary contact leaf springs are mounted, are each secured to their respective lever arms by two screws. These screws may be loosened and the moulded contact supports pivoted to the positions required for correct tracking of both contact assemblies on the calibrated scale.

The moving disc is rotated by an electromagnet in the rear and damped by a permanent magnet in the front. The operating torque is

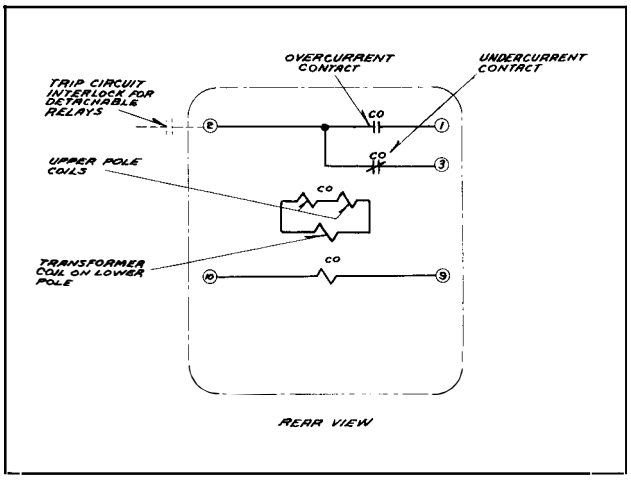

Fig. 2—Internal Schematic of the Type CV Contact Making Ammeter in the Standard Case.

obtained 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 in the disc by the reaction between the fluxes of the upper and lower poles. When the current rises above the preset value the moving contact closes to the right (front view). When the current falls below a preset value the moving contact closes to the left (front view).

CHARACTERISTICS

The type CO contact making ammeter has adjustable high and low current contacts that can be set around an 180° arc which is calibrated in amperes. These values represent the tripping position of the moving contacts when that value of current is applied to the relay.

CO CONTACT MAKING RANGES

Continuous Amps	Range
10	0.5 to 2
16	1.5 to 6

The moving contacts will assume a position corresponding to the current applied to the relay and will stay in that position until the current changes. If the current changes either gradually or suddenly, the contact will assume a new position corresponding to the change unless the travel is limited by the setting of the adjustable contacts. If the contacts are set to close for a particular valve of current, and if a current of that exact amount is applied, then the relay is operating at its minimum trip point and the times on repeated operations are not repetitive within close tolerances. However, currents appreciably greater than the overcurrent setting, or appreciably less than the undercurrent setting, result in relay timing operations which are consistent for repeated trials.

The relay has inverse timing; that is, the greater the increase in current the faster the relay contact will travel.

The contacts will close 30 amperes at 250 volts d-c. It is recommended that auxiliary relays be used to seal in the control circuit to reduce the contact duty.

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. There are two cover nuts on the S size case and four on the L and M size cases. This exposes the relay elements 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 any of the black handle switches 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 as well as on its top, back or sides for easy inspection, maintenance and test.

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.

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.

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

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.

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 less than 1 or 2%. It is recommended that the relay be checked in position as a final check on the calibration.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and

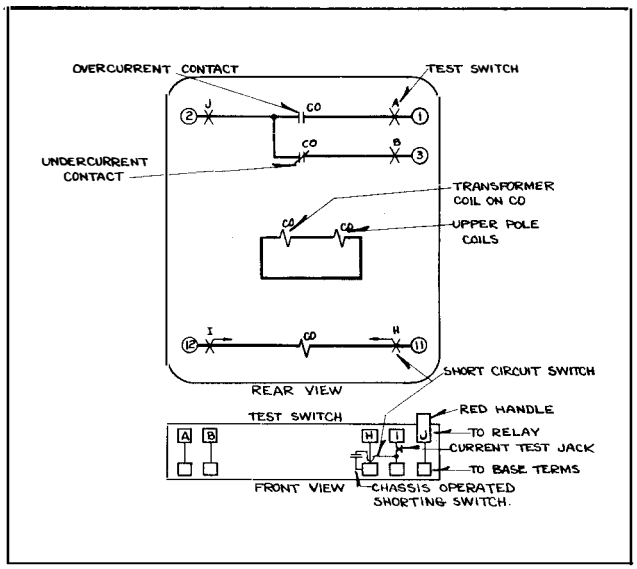

Fig. 3—Internal Schematic of the Type CV Contact Making Ammeter in the Type FT Flexitest Case.

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.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be 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.

The relay has front and back adjustable stationary contacts; to adjust these properly set the two levers so they both point to the same calibration point at approximately mid-scale. Then adjust the position of the front and back contacts so they both just touch on either side of the moving contact. This is done by loosening the two screws at the top of each lever and rotating the adjustable contact assembly slightly until the desired contact positions are obtained. The screws should be tightened securely.

To calibrate the relay, it should be connected to a suitable 60 cycle current source. The trip circuit should be connected to suitable indicating lamps. Current corresponding to the various values marked on the semi-circular scale plate should be applied to the relay and the position of the adjustable contacts checked for the various values. Readjustments can be made by rotating the notched spring adjuster with a screw driver blade inserted in one of the notches.

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 name-plate data.

ENERGY REQUIREMENTS

The 60 cycle burdens of the Type CO Contact Making Ammeter are as follows:

0.5 to 2 Amp Range

Amps.	Volt-Amps.	Power Factor Angle
0.5	0.22	65° Current Lagging Voltage
2	3.5	65° " " "
5	22	65° " " "

1.5 to 6 Amp Range

1.5	0.22	65° Current Lagging Voltage
6	3.5	65° " " "
5	2.45	65° " " "

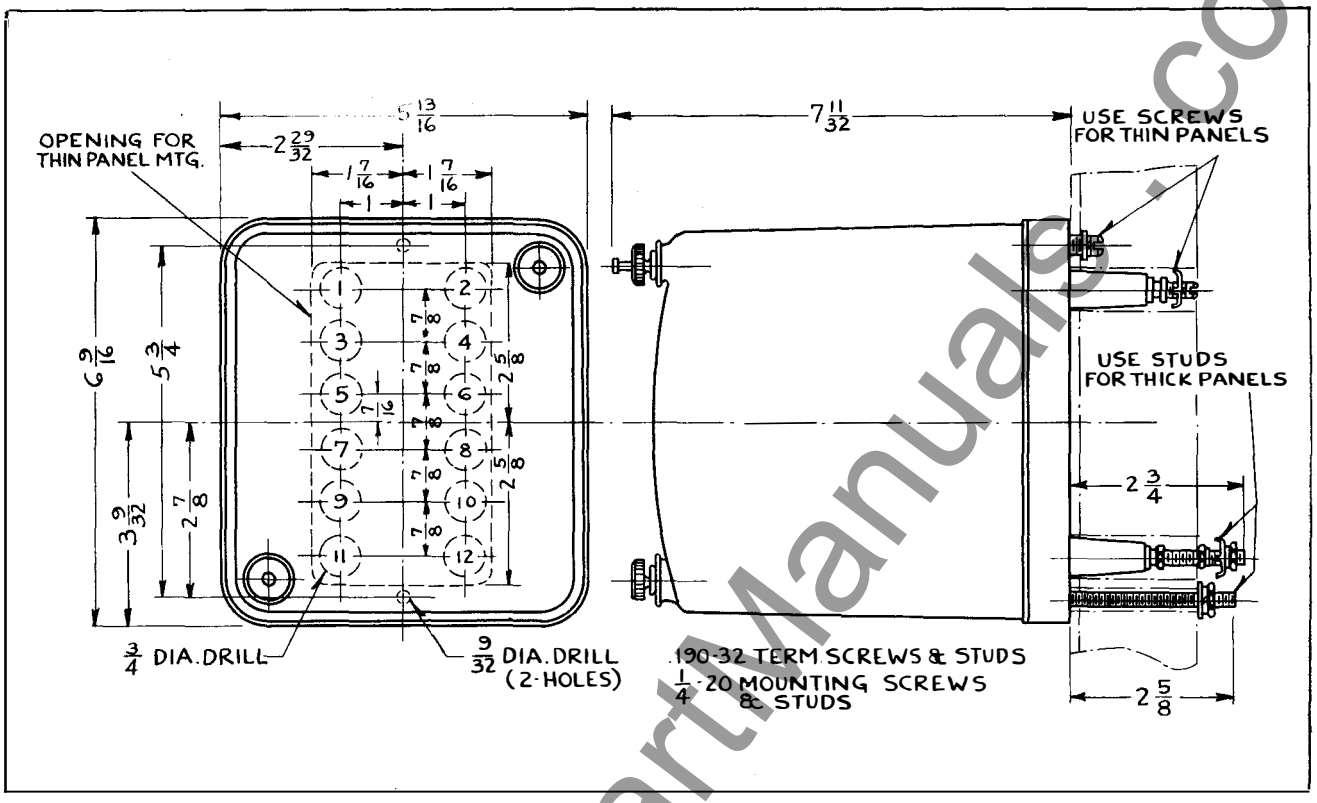

Fig. 4—Outline and Drilling Plan of the Standard Projection Type Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

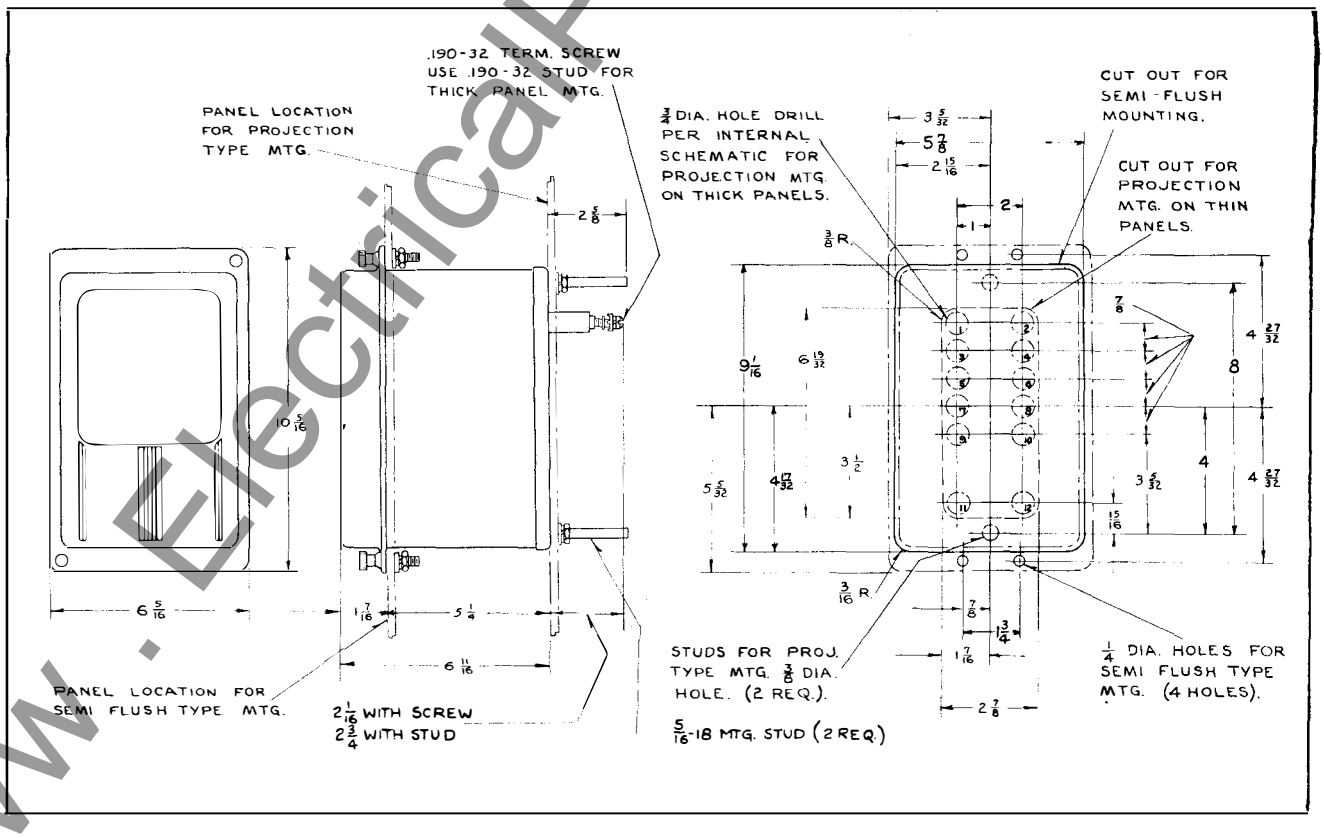

Fig. 5—Outline and Drilling Plan of the S10 Semi-Flush or Projection Type FT Flexitest Case. For Reference Only.

WESTINGHOUSE ELECTRIC CORPORATION

METER DIVISION • **NEWARK, N.J.**

Printed in U. S. A.