INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPES HRD CARRIER DUAL POLARIZED DIRECTIONAL OVERCURRENT GROUND RELAYS (WITH TYPE HL-2 DIRECTIONAL 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

This relay is used to provide directional ground fault protection in the carrier relaying scheme using plate keyed carrier sets. The HRD relay has provision for dual polarization of the directional element. With this feature, the relay can be polarized by residual current from a power transformer bank or by residual voltage. In addition, both polarizing quantities can be used simultaneously.

CONSTRUCTION AND OPERATION

This relay consists of two beam-type overcurrent elements, a directional element, seal-in contactor switch, and operation indicator. The trip circuit of the relay includes the directional contacts in series with the contacts of one overcurrent element, the operation indicator, and the contactor switch. The other overcurrent element is used to start carrier signal transmission. Operation of this relay in connection with the carrier scheme is fully described in I. L. 41-904.

Overcurrent Element

The construction details of the two overcurrent elements are shown in Figure 1. The element consists of a pivoted beam with contact arm on one end and a restraining spring acting on the other. The beam is pulled down to make contact by a current coil, and resets through the action of the restraining spring.

The moving contact is a thin-walled silver shell practically filled with tungsten powder. When this contact strikes the rigid stationary contact, the movement of the tungsten powder creates sufficient friction to absorb practically all of the energy of impact and thus the tendency of the contact to bounce is reduced to a minimum. The moving contact is loosely mounted on the beam and held in place by a leaf spring. The construction is such that the beam continues to move slightly after the contacts close deflecting the spring. This provides the required contact follow. Current is conducted into the moving contact by means of a flexible metal ribbon.

Directional Element

The directional element is made up of five basic parts: the die-cast aluminum frame, the electromagnet, the molded cover assembly, the moving element assembly, and the bridge and upper bearing pin assembly. The lower bearing pin and the magnetic core with its adjustment lever are mounted on the frame. The electromagnet has two series-connected polarizing coils mounted diametrically opposite one another, two series-connected current coils mounted diametrically opposite one another and two magnetic plugs accessible through the cover. The moving element consists of a spring and contact arm assembly and a double aluminum loop mounted on a shaft which has end jewels for the top and bottom bearings. This shaft rides between the bottom steel bearing pin mounted in the frame and a similar pin in the bridge that mounts on the two longer studs of the electromagnet. The stops for the moving element are mounted on the cover and are easily accessible for the adjustment of the contact travel. The spring adjuster seats on the molded cover and is attached to the contact through a spiral spring. The moving contact is made of two thin-walled silver shells practically filled with tungsten powder

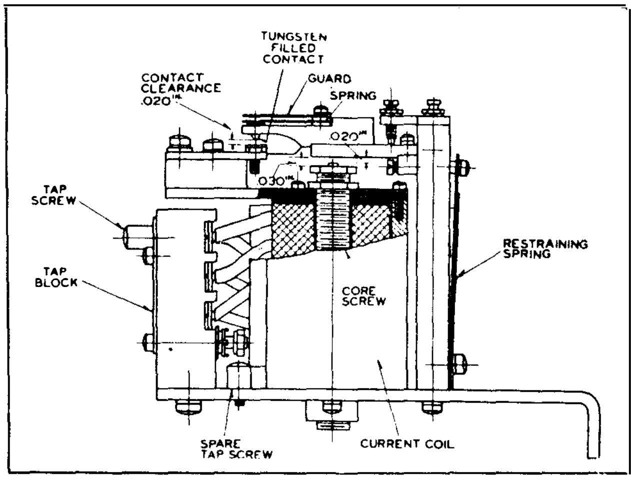

Fig. 1. Sectional View of the Overcurrent Elements.

and mounted back to back on a thin leaf spring. The stationary silver contacts are mounted on the molded cover. The electrical connection is made from the stationary contact to the moving contact, through the spiral and spring adjuster to the spring adjuster clamp. The flux in each pole face is lagged on the outside edges by copper loops. This produces a torque that counter-balances the centering torque, caused by the small power factor angle of the moving element.

The torque of the element is produced by the interaction of the current and flux which develops forces on the two aluminum loops. The resulting torque is substantially free of vibrations, because the double-frequency torques that are produced on the two loops are equal and opposite in sign. The flux in each pole face is lagged on the outside edges. This produces a torque that counter-balances the centering torque, caused by the small power factor angle of the moving element.

The polarizing windings of the directional element, a phase shifting circuit, a center tapped reactor and an equivalent impedance are connected so as to form the four legs of a bridge circuit. The equivalent impedance consists of a reactor and an adjustable resistor with a total impedance equal to the impedance of the polarizing windings of the directional element.

Energy from the current polarizing source is introduced into two opposite corners of the bridge circuit by means of an air gap transformer while energy from the voltage polarizing source is impressed directly upon the other two corners. The balanced bridge design is necessary so that the voltage and current transforming devices deliver secondary quantities which do not affect each other and depend only on system conditions.

Seal-In Contactor Switch

The seal-in d-c contactor switch (CS) in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves 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 closed until the trip circuit is opened by the auxiliary switch on the breaker. The contactor switch is equipped with a third point which is connected to a terminal on the relay to operate a bell alarm.

The seal-in contactor switch operates on a minimum of 1.0 amperes, but the trip circuit should draw at least 4 or 5 amperes in order to keep the time of operation of the switch to a minimum and provide positive operation.

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 show the completion of the trip circuit. The high-speed action of the indicator is obtained by fastening a weight through a leaf spring to the armature. The added inertia causes the armature to continue its motion after the coil has been short-circuited.

CHARACTERISTICS AND SETTINGS

The overcurrent element of the relays operates in one cycle or less on values of ground fault current above 200% of the tap setting. The taps available are:

0.5, 0.75, 1.0, 2.0, 4.0, 6.0.

The settings should be made by inserting the tap screw in the tap to give the required pick-up.

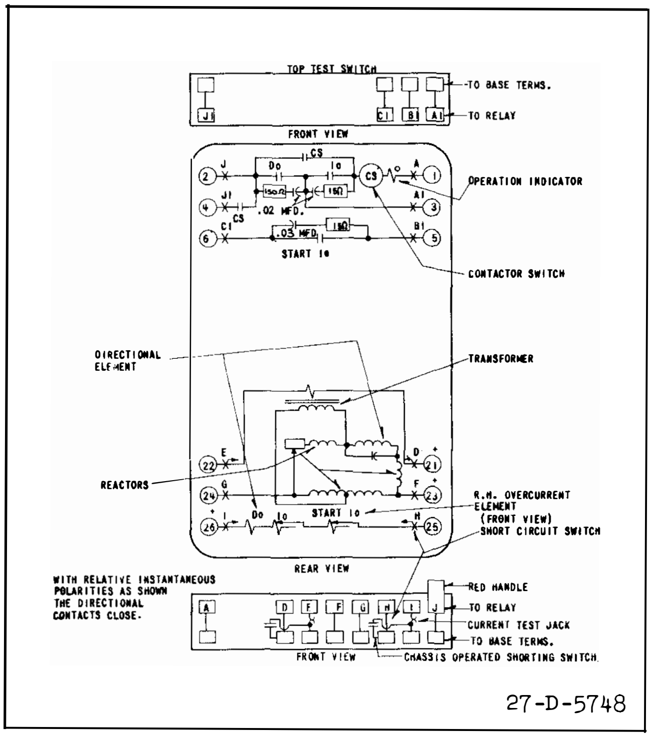

Fig. 2. Internal Schematic of the Type HRD Relay in the Type FT Case. The Relays in the Standard Case Have the Same Terminals But With the Test Switches Omitted.

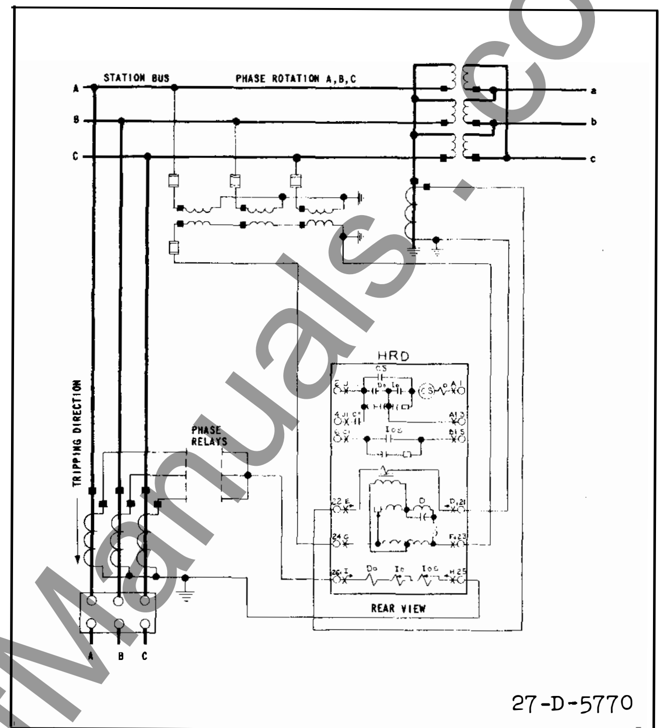

Fig. 3. External A-C Connections of the Type HRD Relay.

The carrier - start overcurrent element at each line terminal is set on a lower tap than the tripping element at either end of the line. This arrangement insures proper blocking for remote external faults which may not pick up both overcurrent elements at each line terminal.

Select a tap for the tripping overcurrent element (left-hand, front view) which will allow tripping the minimum internal ground fault. Set the carrier-start element (right-hand, front view) on the next lower tap.

The HRD relay is designed so that for current polarization only, maximum torque occurs when the operating current leads the polarizing current by approximately 10°. The minimum pickup has been set by the spring tension to be approximately 1.3 amperes when the current circuits are connected in series. Greater sensitivity may be obtained by decreasing the spring tension; however, this will also decrease the restoring force when the element is de-energized.

For potential polarization of the HRD relay, the maximum torque occurs when the operating current lags the polarizing voltage by approximately 60 degrees. With the spring tension at the factory setting, minimum pickup is approximately 2.5 volts and 4 amperes with the current lagging the voltage by 60°.

INSTALLATION

The relay 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.

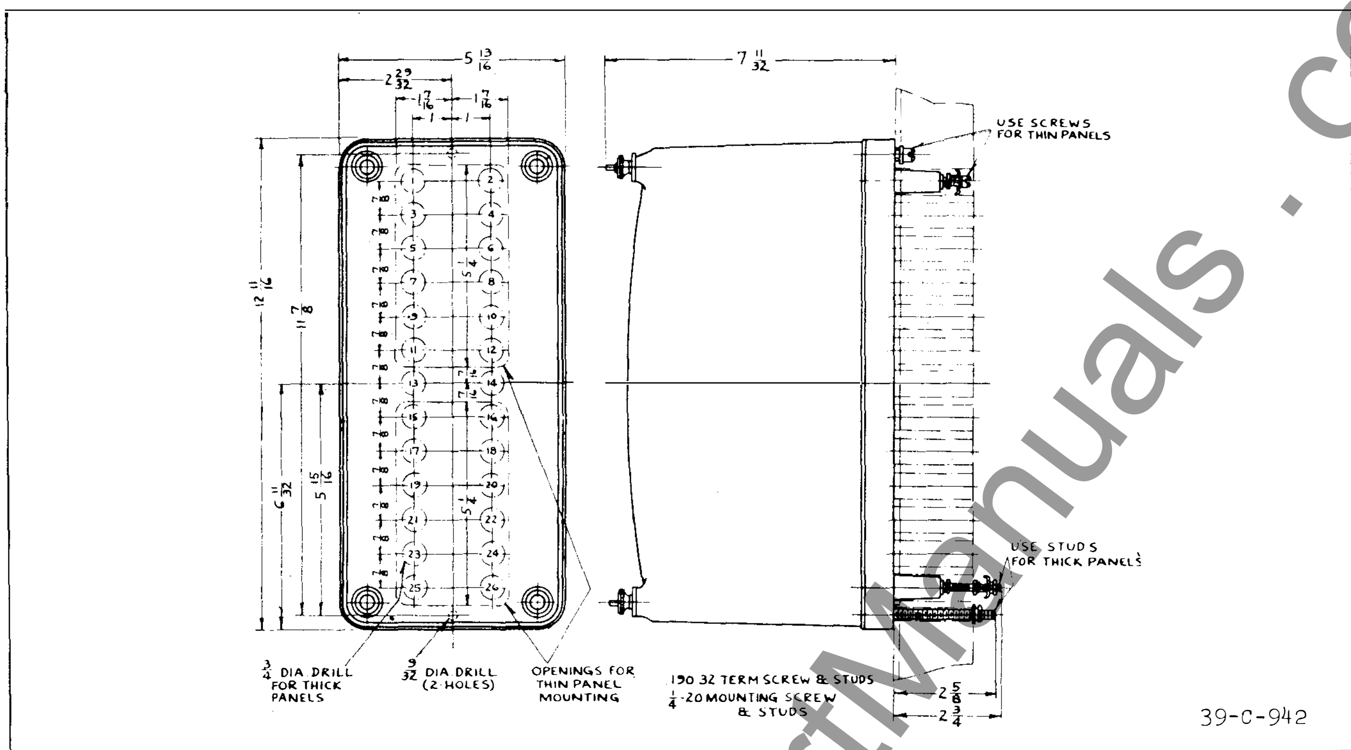

Fig. 4. Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

The external a-c connections of the type HRD relay are shown in Figure 3. The carrier relaying d-c schematic (supplied with all carrier orders) should be consulted for the details of the external d-c connections of these relays.

ADJUSTMENTS

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

All contacts should be cleaned periodically. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

Overcurrent Elements

Refer to Figure 1. Adjust the stop screw until the beam is in a horizontal position when resting against it. Adjust the magnetic gap to .020 inch. This is the gap between the beam and the stop pin. Adjust the stationary contact for an .020 inch gap when the beam is in the reset position. When the beam is in the operated position, there should be an .015 inch deflection of the moving contact. See that the spring which carries the moving element lies flat on the Micarta arm with no initial tension in either direction. Also, make sure that the flexible pigtail is at least 3/32 inch away from the end of the stationary contact.

Pass 0.5 ampere thru the element with the tap screw in the 0.5 tap and adjust the beam spring tension until the beam just trips. This spring tension should hold the beam in the reset position, and when the beam is tripped on 0.5 ampere, the beam should deflect the moving contact spring and rest on the front stop pin. The tripping point of the other taps should be within ± 5% of the tap values.

Directional Element

The upper bearing screw should be screwed down until there is only three to four thousandths of an inch clearance between it and the shaft, and then securely locked in position with the lock nut. This adjustment can be made best by carefully screwing down the top bearing screw until the double loop fails to turn freely and then backing up 1/8 of a turn. Great care must be taken in making this adjustment to prevent damage to the bearings.

The travel of the moving contact is limited by the stationary contacts mounted on the molded cover. The contact gap should be adjusted as follows: With the moving contact centered between the studs, close the contact gaps by advancing the two front stationary contacts. Then back off the right-hand stationary contact .035 inch and lock both contacts in place. The front contact spring should be positioned in the center of the .020 inch slot of the aluminum guard by means of the small adjusting screw located on the nut plate that holds the spring on the moving element. The complete moving element is limited in travel by two stop screws located on the molded cover assembly.

The moving element stops should be adjusted so that the moving contacts barely touch the right front stationary contacts and just miss the others when energized in the opening and closing direction with 5.0 amperes in phase in the current circuits. The right-hand stationary contact should be turned 1/6 of a turn to obtain .005 inch contact follow. Energize the element in the opening direction by passing 60 amperes through the current circuits in series. The contact should not bounce closed when the element is suddenly deenergized. Slight readjustment of the left-hand stop may be necessary to insure that this does not happen.

There are two separate magnetic adjustments. A small lever arm extending to the front on the bottom of the element controls a magnetic bias in the center of the electromagnet. This should be adjusted so that the element will operate with .1 to .6 volts applied to the voltage polarizing circuit with 25 amperes at 60° lagging in the operating coils and the current polarizing circuit open. This adjustment can be made approximately merely by shorting the voltage circuit and with the 25 amperes, adjust the lever so that the contacts just remain open. The second magnetic adjustment is made by magnetic plugs accessible from the top. With the voltage between .1 and .6 volt and the current polarizing circuit opened, the plugs should be adjusted so that with approximately 60 amperes at 60° lag, applied momentarily in the operating coil, the contacts should just close. Raising the right hand plug will produce torque to the right when considering the front moving contact. This adjustment also can be made approximately merely by shorting the voltage circuit and with 60 amperes applied momentarily in the operating coil, adjust the plugs so that the contacts just remain open. Excess heating, the overcurrent tap settings, and the particular setting of the lever and plugs have a slight influence on the final setting of these magnetic adjustments.

Seal-In Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core of .025 inch 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 point 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 inch by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 1 ampere d-c. Test for sticking after 30 amperes d-c have been passed through the coil. The coil resistance is approximately 0.84 ohm.

Operation Indicator

Adjust the indicator to operate at 1.0 ampere d-c gradually applied. Test for sticking after 30 amperes d-c is passed thru the coil. The coil resistance is approximately 0.16 ohm. Adjustments may be made by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. Also, the amount of overhang of the armature on the latch may be adjusted by means of the small screw bearing on the flat spring carrying the inertia weight. The best adjustment will usually be

WESTINGHOUSE ELECTRIC CORPORATION

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

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPES HRD CARRIER DUAL POLARIZED DIRECTIONAL OVERCURRENT GROUND RELAYS (WITH TYPE HL-2 DIRECTIONAL 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

This relay is used to provide directional ground fault protection in the carrier relaying scheme using plate keyed carrier sets. The HRD relay has provision for dual polarization of the directional element. With this feature, the relay can be polarized by residual current from a power transformer bank or by residual voltage. In addition, both polarizing quantities can be used simultaneously.

CONSTRUCTION AND OPERATION

This relay consists of two beam-type overcurrent elements, a directional element, seal-in contactor switch, and operation indicator. The trip circuit of the relay includes the directional contacts in series with the contacts of one overcurrent element, the operation indicator, and the contactor switch. The other overcurrent element is used to start carrier signal transmission. Operation of this relay in connection with the carrier scheme is fully described in I. L. 41-904.

Overcurrent Element

The construction details of the two overcurrent elements are shown in Figure 1. The element consists of a pivoted beam with contact arm on one end and a restraining spring acting on the other. The beam is pulled down to make contact by a current coil, and resets through the action of the restraining spring.

The moving contact is a thin-walled silver shell practically filled with tungsten powder. When this contact strikes the rigid stationary contact, the movement of the tungsten powder creates sufficient friction to absorb practically all of the energy of impact and thus the tendency of the contact to bounce is reduced to a minimum. The moving contact is loosely mounted on the beam and held in place by a leaf spring. The construction is such that the beam continues to move slightly after the contacts close deflecting the spring. This provides the required contact follow. Current is conducted into the moving contact by means of a flexible metal ribbon.

Directional Element

The directional element is made up of five basic parts: the die-cast aluminum frame, the electromagnet, the molded cover assembly, the moving element assembly, and the bridge and upper bearing pin assembly. The lower bearing pin and the magnetic core with its adjustment lever are mounted on the frame. The electromagnet has two series-connected polarizing coils mounted diametrically opposite one another, two series-connected current coils mounted diametrically opposite one another and two magnetic plugs accessible through the cover. The moving element consists of a spring and contact arm assembly and a double aluminum loop mounted on a shaft which has end jewels for the top and bottom bearings. This shaft rides between the bottom steel bearing pin mounted in the frame and a similar pin in the bridge that mounts on the two longer studs of the electromagnet. The stops for the moving element are mounted on the cover and are easily accessible for the adjustment of the contact travel. The spring adjuster seats on the molded cover and is attached to the contact through a spiral spring. The moving contact is made of two thin-walled silver shells practically filled with tungsten powder

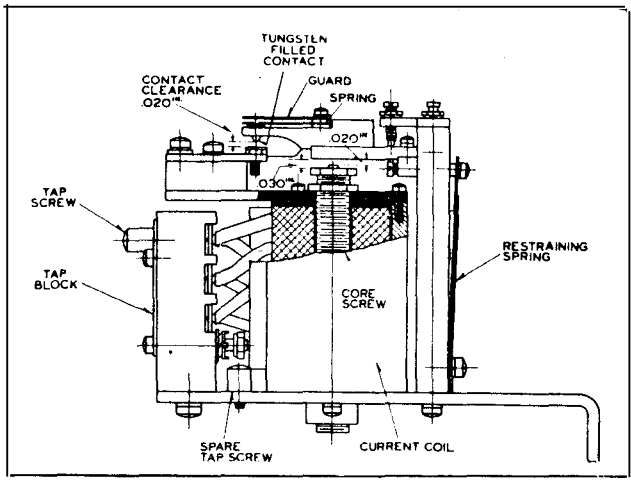

Fig. 1. Sectional View of the Overcurrent Elements.

and mounted back to back on a thin leaf spring. The stationary silver contacts are mounted on the molded cover. The electrical connection is made from the stationary contact to the moving contact, through the spiral and spring adjuster to the spring adjuster clamp. The flux in each pole face is lagged on the outside edges by copper loops. This produces a torque that counter-balances the centering torque, caused by the small power factor angle of the moving element.

The torque of the element is produced by the interaction of the current and flux which develops forces on the two aluminum loops. The resulting torque is substantially free of vibrations, because the double-frequency torques that are produced on the two loops are equal and opposite in sign. The flux in each pole face is lagged on the outside edges. This produces a torque that counter-balances the centering torque, caused by the small power factor angle of the moving element.

The polarizing windings of the directional element, a phase shifting circuit, a center tapped reactor and an equivalent impedance are connected so as to form the four legs of a bridge circuit. The equivalent impedance consists of a reactor and an adjustable resistor with a total impedance equal to the impedance of the polarizing windings of the directional element.

Energy from the current polarizing source is introduced into two opposite corners of the bridge circuit by means of an air gap transformer while energy from the voltage polarizing source is impressed directly upon the other two corners. The balanced bridge design is necessary so that the voltage and current transforming devices deliver secondary quantities which do not affect each other and depend only on system conditions.

Seal-In Contactor Switch

The seal-in d-c contactor switch (CS) in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves 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 closed until the trip circuit is opened by the auxiliary switch on the breaker. The contactor switch is equipped with a third point which is connected to a terminal on the relay to operate a bell alarm.

The seal-in contactor switch operates on a minimum of 1.0 amperes, but the trip circuit should draw at least 4 or 5 amperes in order to keep the time of operation of the switch to a minimum and provide positive operation.

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 show the completion of the trip circuit. The high-speed action of the indicator is obtained by fastening a weight through a leaf spring to the armature. The added inertia causes the armature to continue its motion after the coil has been short-circuited.

CHARACTERISTICS AND SETTINGS

The overcurrent element of the relays operates in one cycle or less on values of ground fault current above 200% of the tap setting. The taps available are:

0.5, 0.75, 1.0, 2.0, 4.0, 6.0.

The settings should be made by inserting the tap screw in the tap to give the required pickup.

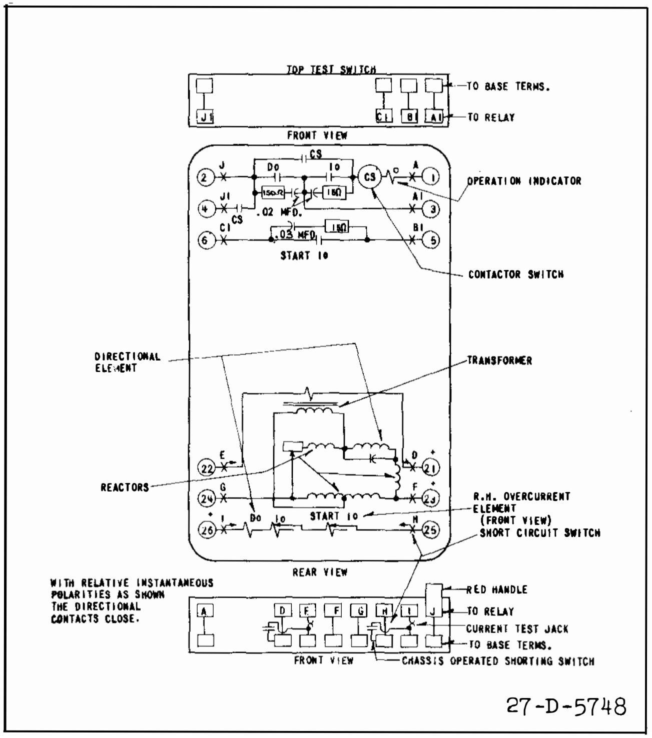

Fig. 2. Internal Schematic of the Type HRD Relay in the Type FT Case. The Relays in the Standard Case Have the Same Terminals But With the Test Switches Omitted.

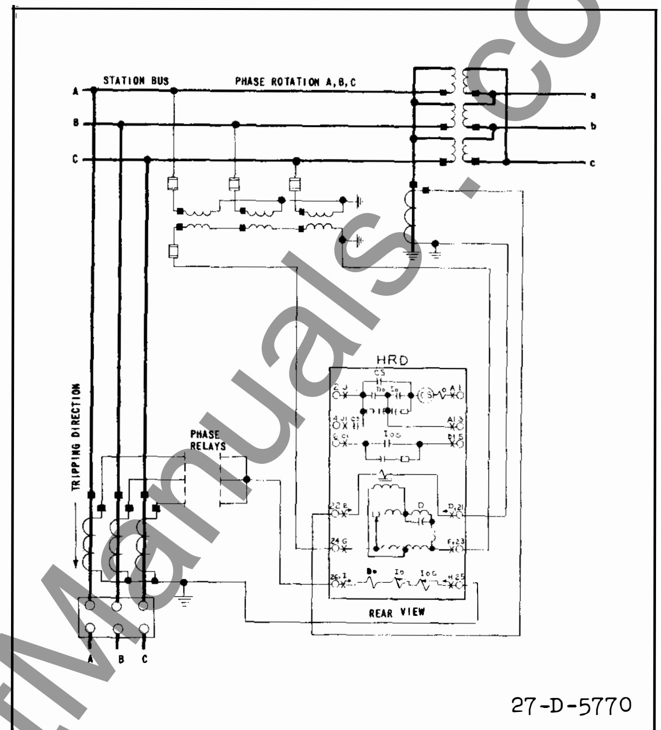

Fig. 3. External A-C Connections of the Type HRD Relay.

The carrier - start overcurrent element at each line terminal is set on a lower tap than the tripping element at either end of the line. This arrangement insures proper blocking for remote external faults which may not pick up both overcurrent elements at each line terminal.

Select a tap for the tripping overcurrent element (left-hand, front view) which will allow tripping the minimum internal ground fault. Set the carrier-start element (right-hand, front view) on the next lower tap.

The HRD relay is designed so that for current polarization only, maximum torque occurs when the operating current leads the polarizing current by approximately 10°. The minimum pickup has been set by the spring tension to be approximately 1.3 amperes when the current circuits are connected in series. Greater sensitivity may be obtained by decreasing the spring tension; however, this will also decrease the restoring force when the element is de-energized.

For potential polarization of the HRD relay, the maximum torque occurs when the operating current lags the polarizing voltage by approximately 60 degrees. With the spring tension at the factory setting, minimum pickup is approximately 2.5 volts and 4 amperes with the current lagging the voltage by 60°.

INSTALLATION

The relay 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.

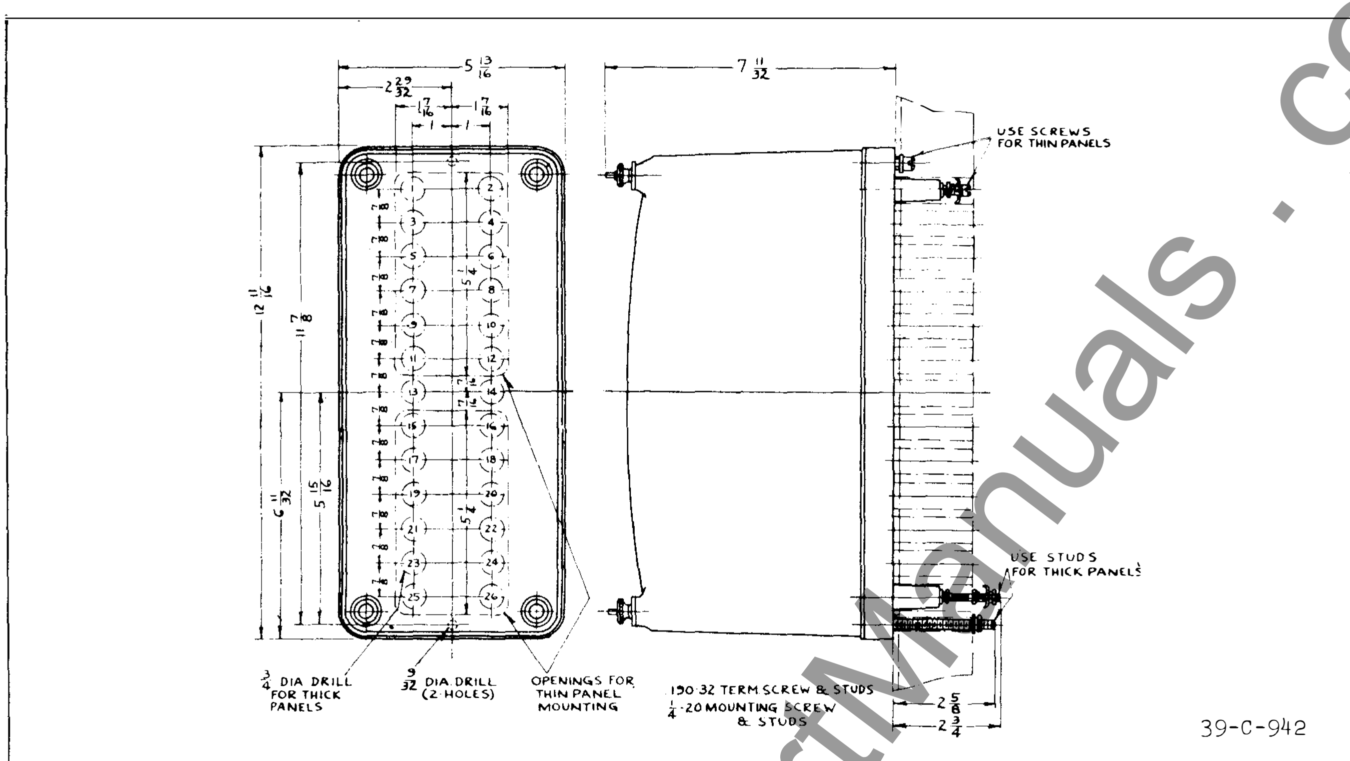

Fig. 4. Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

The external a-c connections of the type HRD relay are shown in Figure 3. The carrier relaying d-c schematic (supplied with all carrier orders) should be consulted for the details of the external d-c connections of these relays.

ADJUSTMENTS

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

All contacts should be cleaned periodically. A contact burnisher S#182A836H01 is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

Overcurrent Elements

Refer to Figure 1. Adjust the stop screw until the beam is in a horizontal position when resting against it. Adjust the magnetic gap to .020 inch. This is the gap between the beam and the stop pin. Adjust the stationary contact for an .020 inch gap when the beam is in the reset position. When the beam is in the operated position, there should be an .015 inch deflection of the moving contact. See that the spring which carries the moving element lies flat on the Micarta arm with no initial tension in either direction. Also, make sure that the flexible pigtail is at least 3/32 inch away from the end of the stationary contact.

Pass 0.5 ampere thru the element with the tap screw in the 0.5 tap and adjust the beam spring tension until the beam just trips. This spring tension should hold the beam in the reset position, and when the beam is tripped on 0.5 ampere, the beam should deflect the moving contact spring and rest on the front stop pin. The tripping point of the other taps should be within ± 5% of the tap values.

Directional Element

The upper bearing screw should be screwed down until there is only three to four thousandths of an inch clearance between it and the shaft, and then securely locked in position with the lock nut. This adjustment can be made best by carefully screwing down the top bearing screw until the double loop fails to turn freely and then backing up 1/8 of a turn. Great care must be taken in making this adjustment to prevent damage to the bearings.

The travel of the moving contact is limited by the stationary contacts mounted on the molded cover. The contact gap should be adjusted as follows: With the moving contact centered between the studs, close the contact gaps by advancing the two front stationary contacts. Then back off the right-hand stationary contact .035 inch and lock both contacts in place. The front contact spring should be positioned in the center of the .020 inch slot of the aluminum guard by means of the small adjusting screw located on the nut plate that holds the spring on the moving element. The complete moving element is limited in travel by two stop screws located on the molded cover assembly.

The moving element stops should be adjusted so that the moving contacts barely touch the right front stationary contacts and just miss the others when energized in the opening and closing direction with 5.0 amperes in phase in the current circuits. The right-hand stationary contact should be turned 1/6 of a turn to obtain .005 inch contact follow. Energize the element in the opening direction by passing 60 amperes through the current circuits in series. The contact should not bounce closed when the element is suddenly deenergized. Slight readjustment of the left-hand stop may be necessary to insure that this does not happen.

There are two separate magnetic adjustments. A small lever arm extending to the front on the bottom of the element controls a magnetic bias in the center of the electromagnet. This should be adjusted so that the element will operate with .1 to .6 volts applied to the voltage polarizing circuit with 25 amperes at 60° lagging in the operating coils and the current polarizing circuit open. This adjustment can be made approximately merely by shorting the voltage circuit and with the 25 amperes, adjust the lever so that the contacts just remain open. The second magnetic adjustment is made by magnetic plugs accessible from the top. With the voltage between .1 and .6 volt and the current polarizing circuit opened, the plugs should be adjusted so that with approximately 60 amperes at 60° lag, applied momentarily in the operating coil, the contacts should just close. Raising the right hand plug will produce torque to the right when considering the front moving contact. This adjustment also can be made approximately merely by shorting the voltage circuit and with 60 amperes applied momentarily in the operating coil, adjust the plugs so that the contacts just remain open. Excess heating, the overcurrent tap settings, and the particular setting of the lever and plugs have a slight influence on the final setting of these magnetic adjustments.

Seal-In Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core of .025 inch 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 point 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 inch by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 1 ampere d-c. Test for sticking after 30 amperes d-c have been passed through the coil. The coil resistance is approximately 0.84 ohm.

Operation Indicator

Adjust the indicator to operate at 1.0 ampere d-c gradually applied. Test for sticking after 30 amperes d-c is passed thru the coil. The coil resistance is approximately 0.16 ohm. Adjustments may be made by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. Also, the amount of overhang of the armature on the latch may be adjusted by means of the small screw bearing on the flat spring carrying the inertia weight. The best adjustment will usually be

WESTINGHOUSE ELECTRIC CORPORATION

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

Printed in U.S.A.