INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPES RS AND RSN CARRIER AUXILIARY RELAYS FOR PLATE KEYED CARRIER SETS

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 RS relay is an auxiliary relay used in the carrier relaying scheme to block or prevent instantaneous tripping for faults external to the line section to which it is applied and to permit instantaneous simultaneous tripping for internal faults. The relay is arranged to respond to indications of fault power and direction provided by the phase and ground relays, thereby controlling the transmission of the carrier signals. The response to ground faults may be given preference over the response to phase faults.

The type RSN relay is identical to the type RS except that it includes additional blocking elements to prevent tripping due to out-of-step system conditions. These elements do not prevent or delay instantaneous fault tripping during out-of-step conditions except for three phase faults. Three phase faults occurring during out-of-step conditions can be cleared by tripping after a short time delay.

For type HZ carrier relaying either the RS or RSN relay may be used depending on application requirements. With type HZM distance relays, however, the RS relay, which has no out-of-step blocking facilities, is always used. The HZM relay is set so that it does not trip for power swings from which the system can recover without going out-of-step. If the system does go out-of-step, tripping may be desired. To meet this requirement, a separate impedance-type out-of-step tripping relay is used. The out-of-step elements of the RSN cannot be used since the Z3 element of the HZM relay is set with its maximum reach opposite to that of the Z2 element.

CONSTRUCTION AND OPERATION

The type RS or RSN relay consists of directional auxiliary, receiver and alarm elements, contactor switches and operation indicators. In addition, the type RSN relay contains three voltage elements, a combination pendulum and time-delay drop-out relays which are the out-of-step elements. The construction and operation of the relay elements are described below. Complete details of the operation of this relay in the carrier relaying scheme is described in I.L. 41-600.6.

Directional Auxiliary Elements

These are two solenoid type contactor switches designated as CSP and CSG. The plunger of the contactor switch operates a spring leaf arm with a silver contact surface on one end and rigidly fixed to the frame on the other end. The stationary contact is also fastened to the frame and in the deenergized position the contacts are held closed by the leaf spring. When the coil is energized, the plunger travels upward breaking the contacts. The CSP switch is energized by the operation of the directional and second impedance element of the phase relays; and the CSG switch, by the operation of the directional and overcurrent elements of the ground relay. The back contacts of the two switches are connected in series in the oscillator and amplifier cathode circuits. The operation of either of these switches opens up the cathode

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circuit to stop carrier and to open the short around the RRT Operating coil. Ground preference is obtained by connecting the auxiliary (CSO) contacts of the ground relay in parallel with CSP contacts. In this case if the ground relay starts carrier, the phase relays cannot stop carrier and thus the ground relay completely supersedes the phase relays, as far as carrier control is concerned.

Receiver Element

The polarized relay consists of an armature and contacts mounted on a leaf spring supported symmetrically within a magnet frame. The armature rides in the front air gap of the frame with the contacts projecting outside. The poles of a permanent magnet clamp directly to each side of the frame. Two adjustable shunts are located across the rear air gaps. These change the reluctance of the magnetic path so as to force some of the flux thru the moving armature which is fastened to the frame midway between the two rear air gaps. Flux in the armature polarizes it and creates a magnetic bias, causing it to move towards either the left or the right, depending upon the adjustment.

Two stationary contact screws are mounted to the left (front view) of the moving contact assembly and adjusted for normally open contacts. These contacts are designated, RRP and RRG, and are connected in the phase and ground trip circuits respectively. One stationary contact screw is mounted to the right of the assembly and adjusted for normally closed contact. This contact is designated RRB and used in connection with the out-of-step protection features. These contacts are operated by two concentric coils, RRT and RRH, which are placed around the armature and within the magnetic frame. RRT is the operating coil and receives its energy from the local battery when either CSP or CSG is opened. RRH is the holding coil and receives its energy from the carrier transmitted either from the local transmitter or the one at the other end of the

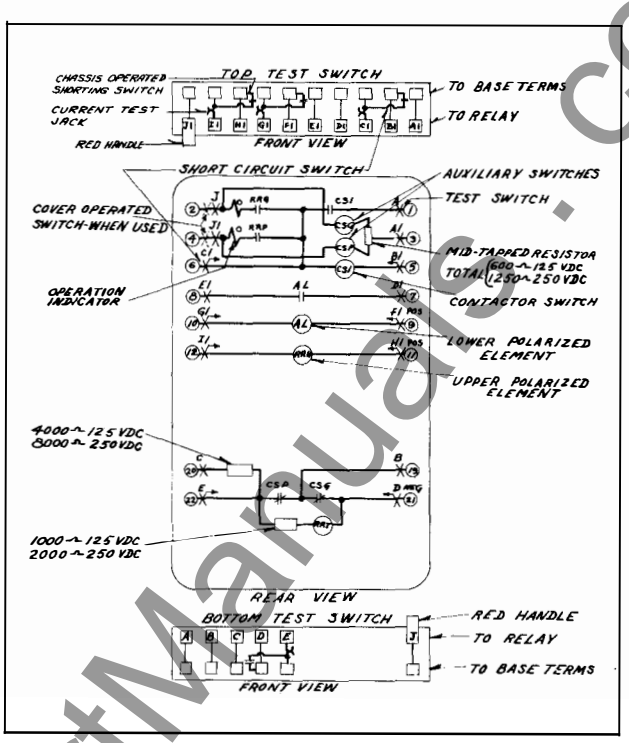

Fig. 1—Internal Schematic of the Type RS Relay in the Type FT Case for use in the Type HZ Carrier Scheme. Omit Test Switches for the Relay in the Standard Case.

section. These two coils are connected to oppose each other with the operating coil RRT, operating to close the RRP and RRG contacts and trip; and the holding coil, RRH, to hold the RRP and RRG contacts open and block tripping. The restraining torque of the RRH coil is sufficient to overcome the operating torque of the RRT coil. Consequently, RRP and RRG contacts cannot close as long as RRH is energized.

Alarm Element

The alarm element is similar in construction to the receiver element except that it is energized by a single coil and operates a single set of contacts. The coil is energized by the received carrier to close the contacts and give an alarm. This element has a higher pick-up than that of the receiver element in order to obtain a direct check on the sensitivity of the tubes in the carrier transmitter-receiver. The failure of the alarm relay to pick-up when carrier is started indicates insufficient output from the transmitter-receivers.

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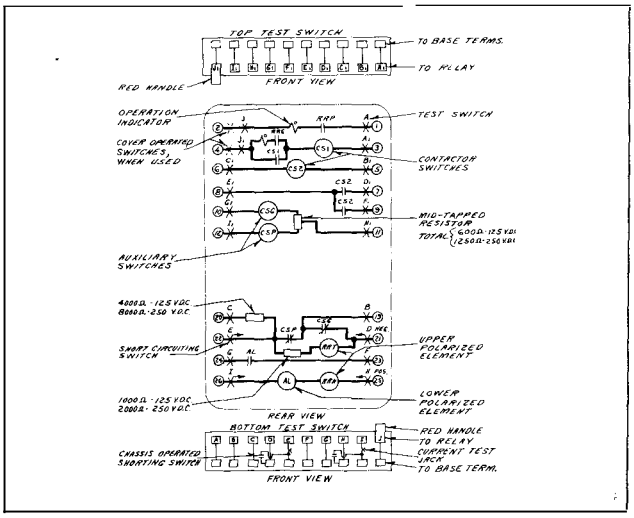

Fig. 2—Internal Schematic of the Type RS Relay in the Type FT Case for Use in the Type HZM Carrier Scheme.

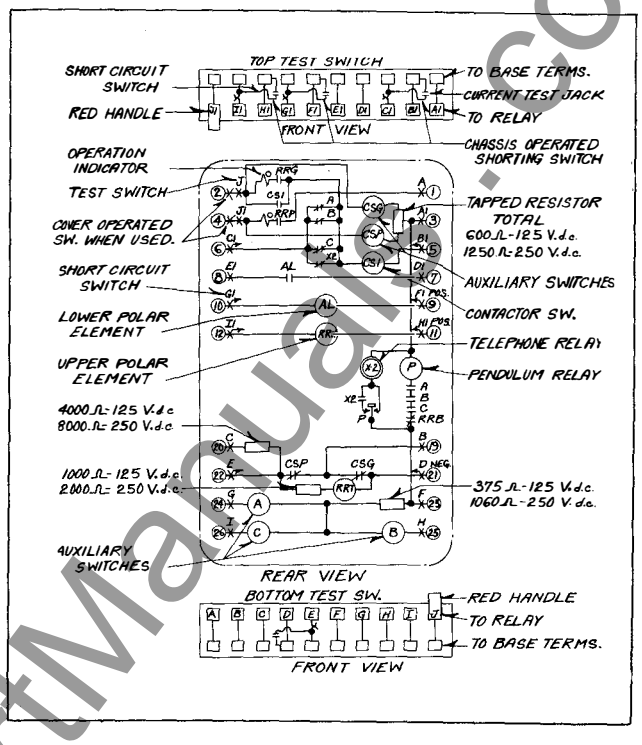

Fig. 3—Internal Schematic of the Type RS Relay in the Type FT Case for use in the Type HZ Carrier Scheme.

Contactor Switch

The contactor switch, CSI, is a small solenoid auxiliary switch connected in series in the trip circuit. The plunger of the switch has a circular conducting disc mounted on its lower end, and as the plunger travels upward, the disc bridges three silver stationary contacts. The contacts of CSI seal in the trip circuit until the auxiliary switch on the breaker opens the trip circuit.

Operation Indicators

Two operation indicators show whether the fault was a phase fault or a ground fault by indicating which relays did the actual tripping, the phase relays thru RRP, or the ground relay thru RRG.

Out-Of-Step Elements

The three voltage elements designated as A, B, and C are contactor switches similar to those described above except that each is provided with a set of back or normally closed contacts as well as the normal make contacts. Their coils are energized by the third impedance element of the corresponding phase relay thru the contacts of an auxiliary switch CSA from the trip voltage source. The back contacts of the voltage elements are connected in parallel and permit tripping as long as any one of the back contacts is closed. The front contacts of the voltage elements are in series with the back contact on the receiver element, RRB, and the coil of the pendulum relay.

The pendulum relay is a telephone type relay with a horizontal spring arm extending between two contact points. A counterweight is fastened to the free end of the arm. The X2 relay is a telephone type relay with slow drop-out characteristics. A solenoid attracts an iron right-angle bracket which in turn operates a set of break and make contacts. Drop-out delay is obtained by the air gap and adjustment between the solenoid core and the armature, and the copper slug on the core. X2 is energized by the pendulum relay contacts with its back contact in parallel with the back contacts of the voltage switches and connected in the phase trip circuit. When the pendulum relay is energized, its arm is pulled downward, to close the lower contact. This energized the X2 relay. After the pendulum relay is deenergized, the pendulum will oscillate for a short time alternately breaking and making both of its contacts. Consequently,

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the X2 relay will not drop-out until after the pendulum oscillations have deenergized its coil. The complete operation of these elements during out-of-step are explained in connection with the operation of the carrier scheme. See I.L. 41-600.6.

CHARACTERISTICS

The characteristics of the various elements of the relays are as follows:

	125 Volts Avg. Ohms	250 Volts Avg. Ohms
CSP or CSG Coil	70	70
CSP & CSG Tapped Resistor	600	1250
Carrier Resistor	4000	8000
RRT Operating Coil	1100	1100
RRT Coil Resistor	1000	2000
RRH Holding Coil	1700	1700
AL Alarm Coil	500	500
P Pendulum Relay	2000	2000
A, B, C, Contactor Switches	1170	1170
X2 Telephone Relay	2000	2000
CS1 Contactor Switch (2 amps.)	0.23	0.13
Operation Indicator (1 amp.)	0.16	1.16

The pick-up and operating values of these elements are given under "Adjustments and Maintenance".

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 assemble 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 from 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 short circuiting test switch prevents open circuiting that circuit when the short circuiting type test switches are closed.

When the chassis is to be put back in the case, the above procedure is to be followed in 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

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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 short circuiting test switch short-circuits that circuit and disconnects one side of the relay element but leaves the other side of the element 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 short circuiting test switch pair must be open when using the current test plug or insulating material in this manner to short-circuit the external circuit.

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

Testing

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

Testing in Service

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

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

Testing in Case

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

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the short circuiting 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 of the 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 con-

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nections 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-asbestoes 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.

The carrier relaying d-c schematic (supplied with the carrier order) should be consulted for details of the external connections of these relays.

ADJUSTMENTS AND MAINTENANCE

The operating time of this relay may be affected by disturbing the flexible leads to the moving contacts. Care should be taken that they are not disturbed during 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.

Directional Auxiliary Elements

The two contactor switches, CSP and CSG, have adjustable plunger travel. Adjust the two nuts on the bottom of the fixed shaft so that the plunger has 1/8" travel after the lower contacts make. The plunger should have 1/64" travel in the opposite direction after the upper contacts make. This is accomplished by screwing down the set screw on top of the switch until the upper contacts are just able to make as the plunger hits the upper stop. Then back off this screw 1/2 turn and lock in place.

Each contactor switch has a section of a tapped resistor in series with it, and will pick up positively when rated trip circuit voltage is applied across the coil and its section of the resistor.

The minimum pick-up of the coil and its resistor is 40 volts for the 125 volt relays and 100 volts for the 250 volt relay.

Receiver Element

Back off contact screws so that they do not make contact. Screw magnetic shunts into the all-out position. The armature should remain against whichever side it is pushed with this adjustment.

Contact Adjustment

Apply 125 volts d-c to the 125 volt relay or 250 volts d-c to the 250 volt relay across RRT Coil, the operating coil resistor and the carrier resistor in series (RRT coil in series with 5000 or 10,000 ohms) with polarity as shown in the schematic diagram. The CSP and CSG switch back contacts should be blocked open. The armature should move to the left (front view). Adjust both left-hand contacts until they barely make a light circuit. A flickering light is permissible. Give both of the left-hand contact screws an additional 1/3 turn to secure the required 8 mil follow. Similarly, apply 125 or 250 volts d-c to the operating coil as before and 10 to 20 milliamperes d-c to the holding coil (RRH) with the correct polarity. The armature should move to the right. Adjust the right-hand stationary contact until it barely makes a light circuit, then give the right-hand contact screw an additional 1/3 turn to secure the proper contact follow. Deenergize both coils and see that the back contact stays closed.

Calibration

Screw in the left-hand shunt so that the top air gap alone is shunted. This should increase the armature bias towards the right-hand back contact. Energize the operating coil with 125 or 250 volts d-c and the holding

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coil with 4 milliamperes d-c. The right hand contact should remain closed. Screw in the right-hand shunt until the armature moves to the left. Tighten up both lock screws on both shunts and recheck the above adjustments. Increase the holding coil current to 6 ± .25 milliamperes d-c and see that the armature closes the back contact with a snappy action.

Alarm Element (Normal Adjustment)

Contact Adjustment

Adjust the right-hand contact in the same manner as described above under the Receiver Element.

Calibration

Screw in the right-hand shunt until the top air gap alone is shunted. Apply 8 milliamperes d-c to the coil with correct polarity and then screw in the left-hand shunt until the armature closes the right-hand contact. With this adjustment, the armature should move to the left with 4 to 6 milliamperes in the holding coil. Lock the shunts in position and recheck the calibration several times.

Alarm Element (Telemetering Adjustment)

Telemetering impulses over the carrier channel would normally impulse the alarm element and the alarm bell unless they are disconnected. To retain the alarm feature for communication signalling, a time delay circuit is used which requires reconnection and readjustment of the alarm element to have the opposite polarity and normally closed contacts. Where specified, this adjustment is made before shipment. This adjustment gives approximately 1 second delay.

Contact Adjustment

With the element de-energized, screw the left-hand shunt all the way in, and back the right-hand shunt all the way out. This will increase the armature bias towards the right and move the armature in that direction. Back off the stationary contact screw and then screw it up until it barely makes a light circuit. Give the screw an additional one-third of a turn to secure the required 8 mil follow.

Calibration

Reverse the polarity of the coil. This means that the contacts will be held open when the coil is energized. Back off the left-hand shunt slightly and screw in the right-hand shunt until the contact closes at 1 milliampere. The contacts should open at 6 milliamperes or less. This differential between pick-up and drop-out is decreased by closing more of the rear air gaps. This can be done by further screwing in both the right and left-hand shunts and rechecking the pick-up and drop-out values. This recheck is important, since any change of the shunts affects both calibration points. Lock the shunts in position and recheck the calibration several times.

CS-1 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 and screwing up the core screw of the switch until the contacts just separate. Then 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 is passed thru the coil.

Operation Indicator

Adjust the indicators to operate at one ampere d-c gradually increased. Test for sticking after 30 amperes d-c has been applied. Check the indicator and the contactor switches at 5 and 30 amperes d-c to make sure that the indicator operates before its coil is shorted by the contactor switch.

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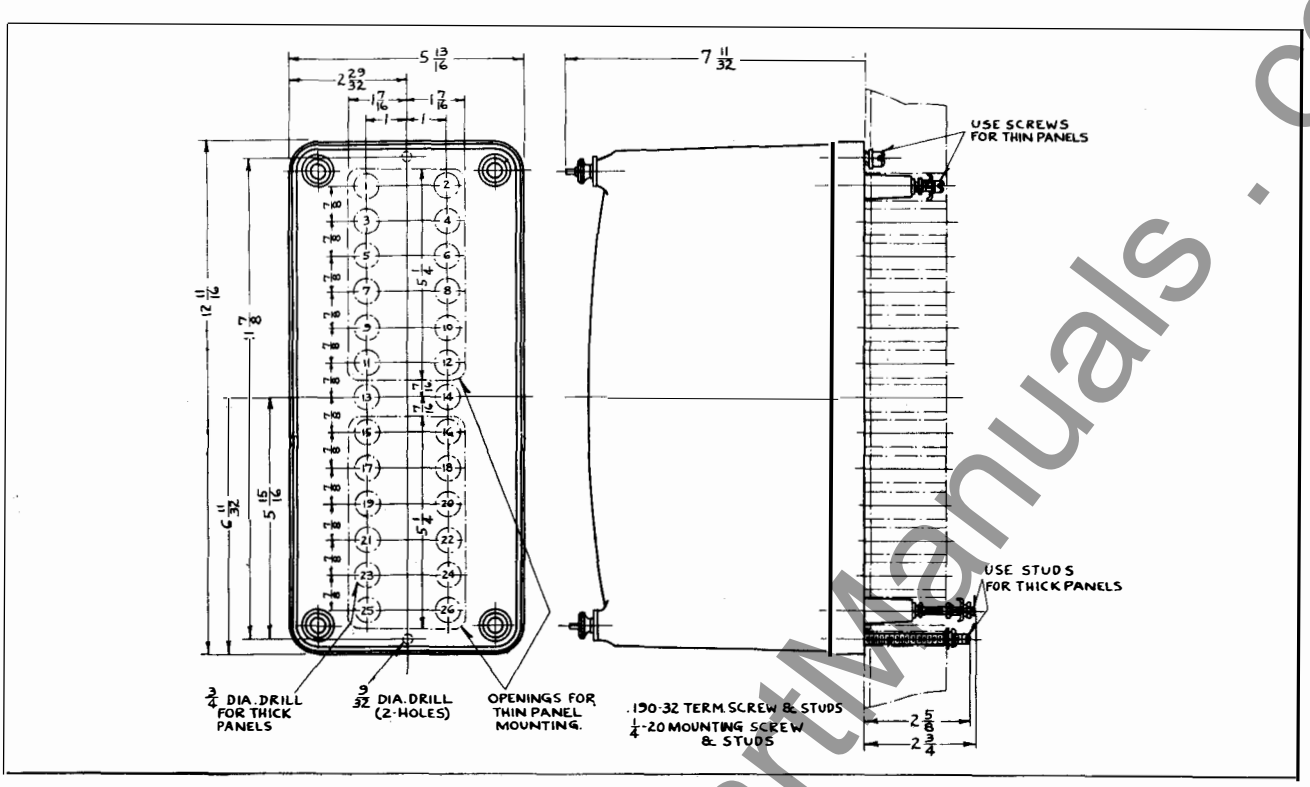

Fig. 4– Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

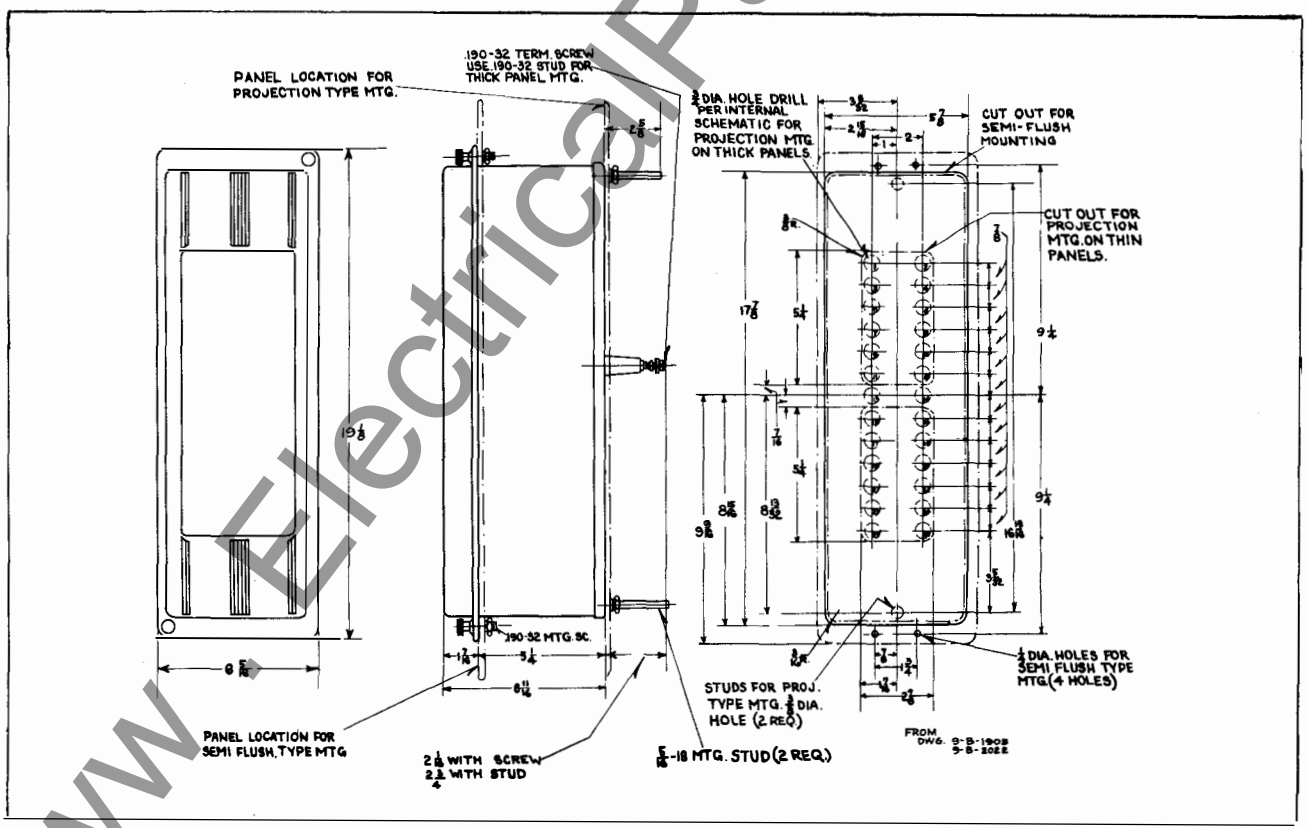

Fig. 5—Outline and Drilling Plan for the M20 Semi-Flush or Projection Type FT Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

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Out of Step Blocking Elements for Type RSN Relay Only

Telephone Relay

Energize the telephone relay, X2, by applying 80 volts d-c with the pendulum relay armature held in the operated position. The telephone relay should operate positively, when the pendulum relay armature is held down to make the lower contact and should not operate when the armature is held up to make the top contact.

Pendulum Relay

To check the operation of the pendulum relay, connect jumpers across the make contact on the voltage elements, A, B, and C, and apply 125 volts or 250 volts d-c across the pendulum relay. (The voltage will depend upon the relay range.) The pendulum relay armature should be pulled against the core screw and the X2 telephone relay should pick-up. Remove the jumpers from the voltage switch contacts. The pendulum relay armature should oscillate and hold the X2 relay closed for approximately 3 seconds. This is the standard factory adjustment. The drop-out of the pendulum and X2 relay combination can be adjusted from approximately 20 cycles to 10 seconds. The drop out time of X2 is adjusted by means of the armature set screw. The time that P will keep X2 picked up is adjusted by changing the spacing of the two outer contacts of the P relay.

Voltage Switches

Voltage Switches, A, B, and C, should be adjusted so that there is a clearance of 1/64" between the plunger and the core with the plunger picked up.

Energize each switch separately thru the common resistor. The switches should pick-up at 35 volts for the 125-volt relay and 50 volts for the 250-volt relay. Check to make sure the switches do not stick closed after rated voltage (125 to 250 volts) is applied.

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.

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APPLICATION

The type RS relay is an auxiliary relay used in the carrier relaying scheme to block or prevent instantaneous tripping for faults external to the line section to which it is applied and to permit instantaneous simultaneous tripping for internal faults. The relay is arranged to respond to indications of fault power and direction provided by the phase and ground relays, thereby controlling the transmission of the carrier signals. The response to ground faults may be given preference over the response to phase faults.

The type RSN relay is identical to the type RS except that it includes additional blocking elements to prevent tripping due to out-of-step system conditions. These elements do not prevent or delay instantaneous fault tripping during out-of-step conditions except for three phase faults. Three phase faults occurring during out-of-step conditions can be cleared by tripping after a short time delay.

For type HZ carrier relaying either the RS or RSN relay may be used depending on application requirements. With type HZM distance relays, however, the RS relay, which has no out-of-step blocking facilities, is always used. The HZM relay is set so that it does not trip for power swings from which the system can recover without going out-of-step. If the system does go out-of-step, tripping may be desired. To meet this requirement, a separate impedance-type out-of-step tripping relay is used. The out-of-step elements of the RSN cannot be used since the Z3 element of the HZM relay is set with its maximum reach opposite to that of the Z2 element.

CONSTRUCTION AND OPERATION

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Directional Auxiliary Elements

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circuit to stop carrier and to open the short around the RRT Operating coil. Ground preference is obtained by connecting the auxiliary (CSO) contacts of the ground relay in parallel with CSP contacts. In this case if the ground relay starts carrier, the phase relays cannot stop carrier and thus the ground relay completely supersedes the phase relays, as far as carrier control is concerned.

Receiver Element

The polarized relay consists of an armature and contacts mounted on a leaf spring supported symmetrically within a magnet frame. The armature rides in the front air gap of the frame with the contacts projecting outside. The poles of a permanent magnet clamp directly to each side of the frame. Two adjustable shunts are located across the rear air gaps. These change the reluctance of the magnetic path so as to force some of the flux thru the moving armature which is fastened to the frame midway between the two rear air gaps. Flux in the armature polarizes it and creates a magnetic bias, causing it to move towards either the left or the right, depending upon the adjustment.

Two stationary contact screws are mounted to the left (front view) of the moving contact assembly and adjusted for normally open contacts. These contacts are designated, RRP and RRG, and are connected in the phase and ground trip circuits respectively. One stationary contact screw is mounted to the right of the assembly and adjusted for normally closed contact. This contact is designated RRB and used in connection with the out-of-step protection features. These contacts are operated by two concentric coils, RRT and RRH, which are placed around the armature and within the magnetic frame. RRT is the operating coil and receives its energy from the local battery when either CSP or CSG is opened. RRH is the holding coil and receives its energy from the carrier transmitted either from the local transmitter or the one at the other end of the

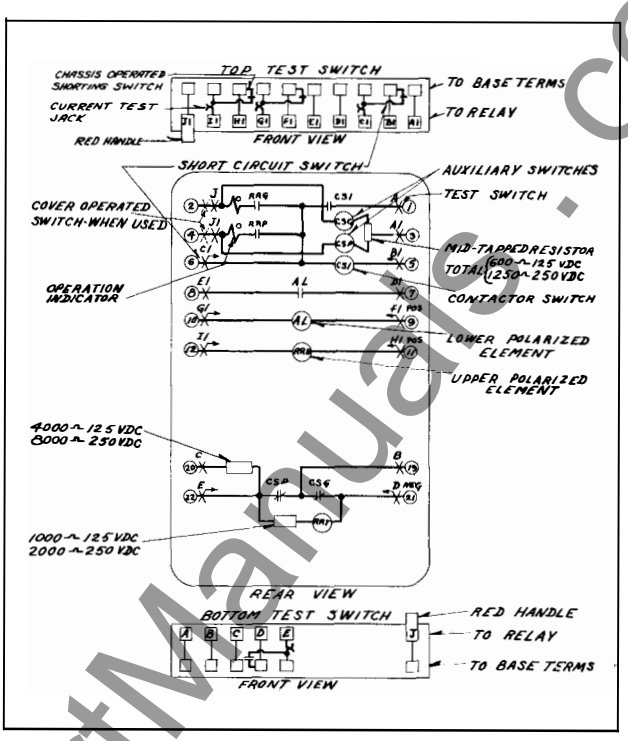

Fig. 1—Internal Schematic of the Type RS Relay in the Type FT Case for use in the Type HZ Carrier Scheme. Omit Test Switches for the Relay in the Standard Case.

section. These two coils are connected to oppose each other with the operating coil RRT, operating to close the RRP and RRG contacts and trip; and the holding coil, RRH, to hold the RRP and RRG contacts open and block tripping. The restraining torque of the RRH coil is sufficient to overcome the operating torque of the RRT coil. Consequently, RRP and RRG contacts cannot close as long as RRH is energized.

Alarm Element

The alarm element is similar in construction to the receiver element except that it is energized by a single coil and operates a single set of contacts. The coil is energized by the received carrier to close the contacts and give an alarm. This element has a higher pick-up than that of the receiver element in order to obtain a direct check on the sensitivity of the tubes in the carrier transmitter-receiver. The failure of the alarm relay to pick-up when carrier is started indicates insufficient output from the transmitter-receivers.

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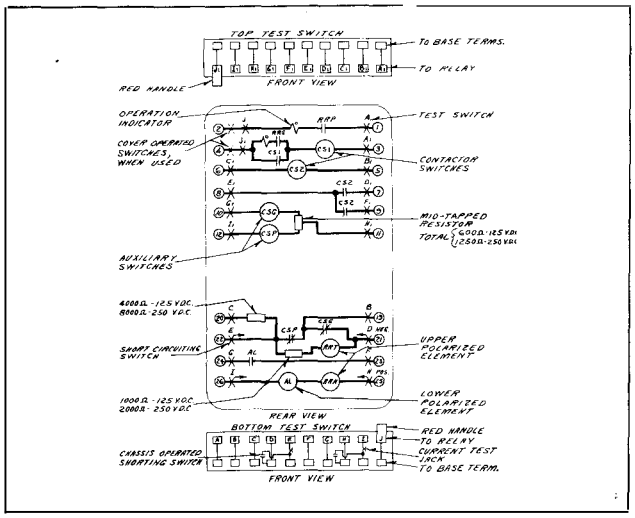

Fig. 2—Internal Schematic of the Type RS Relay in the Type FT Case for Use in the Type HZM Carrier Scheme.

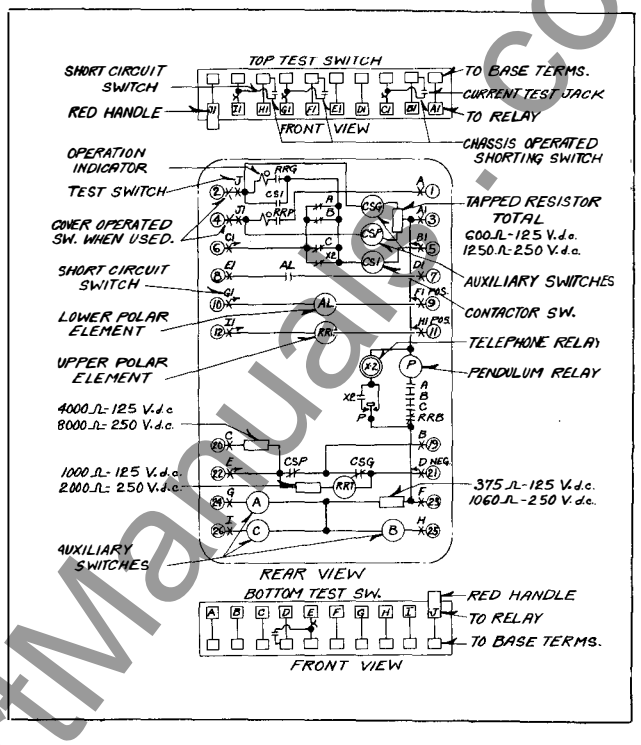

Fig. 3—Internal Schematic of the Type RS Relay in the Type FT Case for use in the Type HZ Carrier Scheme.

Contactor Switch

The contactor switch, CSI, is a small solenoid auxiliary switch connected in series in the trip circuit. The plunger of the switch has a circular conducting disc mounted on its lower end, and as the plunger travels upward, the disc bridges three silver stationary contacts. The contacts of CSI seal in the trip circuit until the auxiliary switch on the breaker opens the trip circuit.

Operation Indicators

Two operation indicators show whether the fault was a phase fault or a ground fault by indicating which relays did the actual tripping, the phase relays thru RRP, or the ground relay thru RRG.

Out-Of-Step Elements

The three voltage elements designated as A, B, and C are contactor switches similar to those described above except that each is provided with a set of back or normally closed contacts as well as the normal make contacts. Their coils are energized by the third impedance element of the corresponding phase relay thru the contacts of an auxiliary switch CSA from the trip voltage source. The back contacts of the voltage elements are connected in parallel and permit tripping as long as any one of the back contacts is closed. The front contacts of the voltage elements are in series with the back contact on the receiver element, RRB, and the coil of the pendulum relay.

The pendulum relay is a telephone type relay with a horizontal spring arm extending between two contact points. A counterweight is fastened to the free end of the arm. The X2 relay is a telephone type relay with slow drop-out characteristics. A solenoid attracts an iron right-angle bracket which in turn operates a set of break and make contacts. Drop-out delay is obtained by the air gap and adjustment between the solenoid core and the armature, and the copper slug on the core. X2 is energized by the pendulum relay contacts with its back contact in parallel with the back contacts of the voltage switches and connected in the phase trip circuit. When the pendulum relay is energized, its arm is pulled downward, to close the lower contact. This energized the X2 relay. After the pendulum relay is deenergized, the pendulum will oscillate for a short time alternately breaking and making both of its contacts. Consequently,

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the X2 relay will not drop-out until after the pendulum oscillations have deenergized its coil. The complete operation of these elements during out-of-step are explained in connection with the operation of the carrier scheme. See I.L. 41-600.6.

CHARACTERISTICS

The characteristics of the various elements of the relays are as follows:

	125 Volts Avg. Ohms	250 Volts Avg. Ohms
CSP or CSG Coil	70	70
CSP & CSG Tapped Resistor	600	1250
Carrier Resistor	4000	8000
RRT Operating Coil	1100	1100
RRT Coil Resistor	1000	2000
RRH Holding Coil	1700	1700
AL Alarm Coil	500	500
P Pendulum Relay	2000	2000
A, B, C, Contactor Switches	1170	1170
X2 Telephone Relay	2000	2000
CS1 Contactor Switch (2 amps.)	0.23	0.13
Operation Indicator (1 amp.)	0.16	1.16

The pick-up and operating values of these elements are given under "Adjustments and Maintenance".

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 assemble 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 from 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 short circuiting test switch prevents open circuiting that circuit when the short circuiting type test switches are closed.

When the chassis is to be put back in the case, the above procedure is to be followed in 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

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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 short circuiting test switch short-circuits that circuit and disconnects one side of the relay element but leaves the other side of the element 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 short circuiting test switch pair must be open when using the current test plug or insulating material in this manner to short-circuit the external circuit.

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

Testing

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

Testing in Service

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

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

Testing in Case

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

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the short circuiting 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 of the 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 con-

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nections 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-asbestoes 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.

The carrier relaying d-c schematic (supplied with the carrier order) should be consulted for details of the external connections of these relays.

ADJUSTMENTS AND MAINTENANCE

The operating time of this relay may be affected by disturbing the flexible leads to the moving contacts. Care should be taken that they are not disturbed during 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.

Directional Auxiliary Elements

The two contactor switches, CSP and CSG, have adjustable plunger travel. Adjust the two nuts on the bottom of the fixed shaft so that the plunger has 1/8" travel after the lower contacts make. The plunger should have 1/64" travel in the opposite direction after the upper contacts make. This is accomplished by screwing down the set screw on top of the switch until the upper contacts are just able to make as the plunger hits the upper stop. Then back off this screw 1/2 turn and lock in place.

Each contactor switch has a section of a tapped resistor in series with it, and will pick up positively when rated trip circuit voltage is applied across the coil and its section of the resistor.

The minimum pick-up of the coil and its resistor is 40 volts for the 125 volt relays and 100 volts for the 250 volt relay.

Receiver Element

Back off contact screws so that they do not make contact. Screw magnetic shunts into the all-out position. The armature should remain against whichever side it is pushed with this adjustment.

Contact Adjustment

Apply 125 volts d-c to the 125 volt relay or 250 volts d-c to the 250 volt relay across RRT Coil, the operating coil resistor and the carrier resistor in series (RRT coil in series with 5000 or 10,000 ohms) with polarity as shown in the schematic diagram. The CSP and CSG switch back contacts should be blocked open. The armature should move to the left (front view). Adjust both left-hand contacts until they barely make a light circuit. A flickering light is permissible. Give both of the left-hand contact screws an additional 1/3 turn to secure the required 8 mil follow. Similarly, apply 125 or 250 volts d-c to the operating coil as before and 10 to 20 milliamperes d-c to the holding coil (RRH) with the correct polarity. The armature should move to the right. Adjust the right-hand stationary contact until it barely makes a light circuit, then give the right-hand contact screw an additional 1/3 turn to secure the proper contact follow. Deenergize both coils and see that the back contact stays closed.

Calibration

Screw in the left-hand shunt so that the top air gap alone is shunted. This should increase the armature bias towards the right-hand back contact. Energize the operating coil with 125 or 250 volts d-c and the holding

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coil with 4 milliamperes d-c. The right hand contact should remain closed. Screw in the right-hand shunt until the armature moves to the left. Tighten up both lock screws on both shunts and recheck the above adjustments. Increase the holding coil current to 6 ± .25 milliamperes d-c and see that the armature closes the back contact with a snappy action.

Alarm Element (Normal Adjustment)

Contact Adjustment

Adjust the right-hand contact in the same manner as described above under the Receiver Element.

Calibration

Screw in the right-hand shunt until the top air gap alone is shunted. Apply 8 milliamperes d-c to the coil with correct polarity and then screw in the left-hand shunt until the armature closes the right-hand contact. With this adjustment, the armature should move to the left with 4 to 6 milliamperes in the holding coil. Lock the shunts in position and recheck the calibration several times.

Alarm Element (Telemetering Adjustment)

Telemetering impulses over the carrier channel would normally impulse the alarm element and the alarm bell unless they are disconnected. To retain the alarm feature for communication signalling, a time delay circuit is used which requires reconnection and readjustment of the alarm element to have the opposite polarity and normally closed contacts. Where specified, this adjustment is made before shipment. This adjustment gives approximately 1 second delay.

Contact Adjustment

With the element de-energized, screw the left-hand shunt all the way in, and back the right-hand shunt all the way out. This will increase the armature bias towards the right and move the armature in that direction. Back off the stationary contact screw and then screw it up until it barely makes a light circuit. Give the screw an additional one-third of a turn to secure the required 8 mil follow.

Calibration

Reverse the polarity of the coil. This means that the contacts will be held open when the coil is energized. Back off the left-hand shunt slightly and screw in the right-hand shunt until the contact closes at 1 milliampere. The contacts should open at 6 milliamperes or less. This differential between pick-up and drop-out is decreased by closing more of the rear air gaps. This can be done by further screwing in both the right and left-hand shunts and rechecking the pick-up and drop-out values. This recheck is important, since any change of the shunts affects both calibration points. Lock the shunts in position and recheck the calibration several times.

CS-1 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 and screwing up the core screw of the switch until the contacts just separate. Then 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 is passed thru the coil.

Operation Indicator

Adjust the indicators to operate at one ampere d-c gradually increased. Test for sticking after 30 amperes d-c has been applied. Check the indicator and the contactor switches at 5 and 30 amperes d-c to make sure that the indicator operates before its coil is shorted by the contactor switch.

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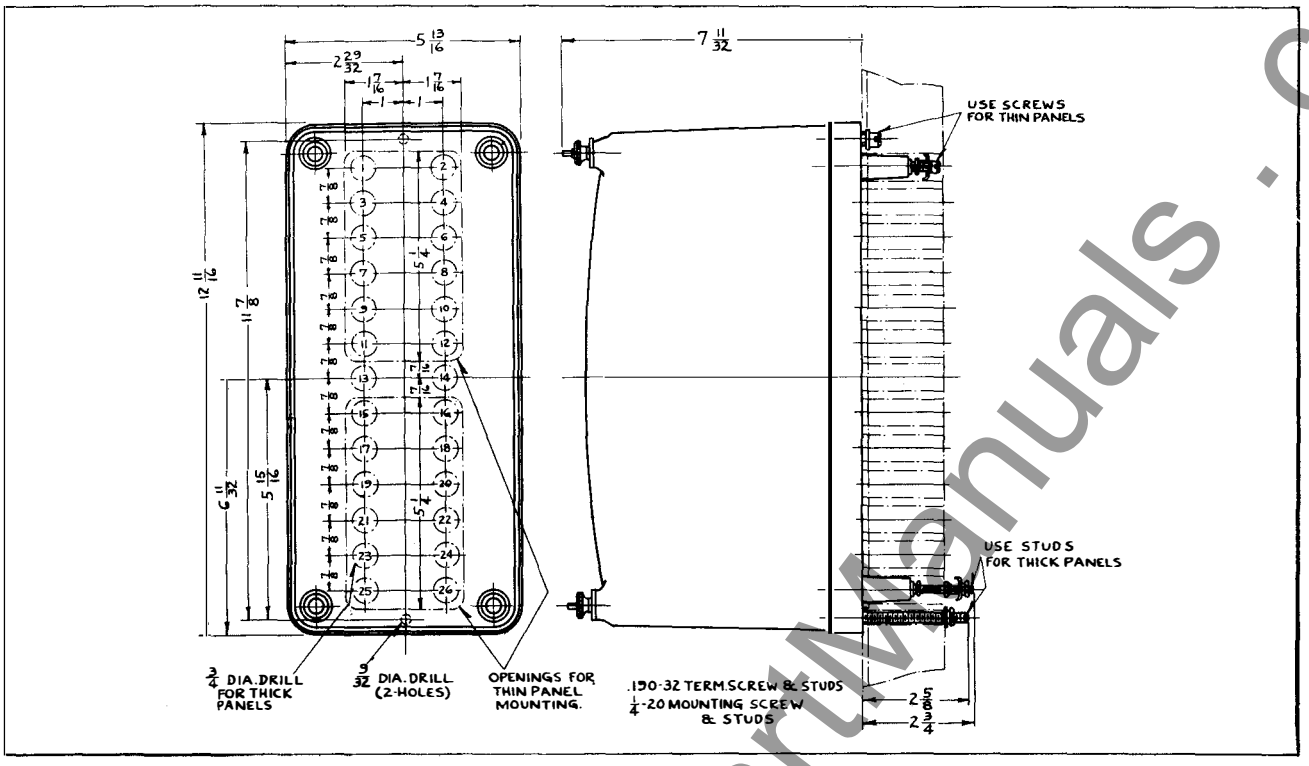

Fig. 4– Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

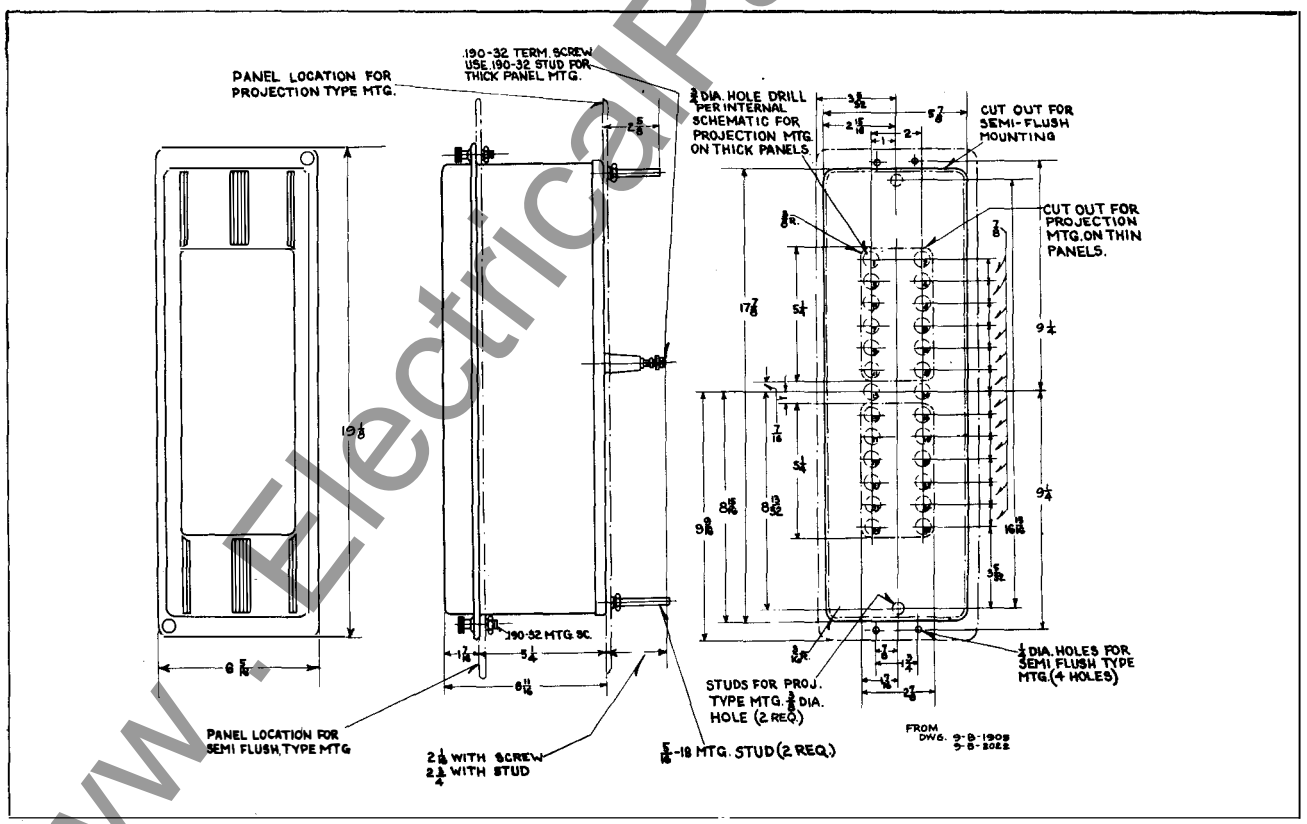

Fig. 5—Outline and Drilling Plan for the M20 Semi-Flush or Projection Type FT Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

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Out of Step Blocking Elements for Type RSN Relay Only

Telephone Relay

Energize the telephone relay, X2, by applying 80 volts d-c with the pendulum relay armature held in the operated position. The telephone relay should operate positively, when the pendulum relay armature is held down to make the lower contact and should not operate when the armature is held up to make the top contact.

Pendulum Relay

To check the operation of the pendulum relay, connect jumpers across the make contact on the voltage elements, A, B, and C, and apply 125 volts or 250 volts d-c across the pendulum relay. (The voltage will depend upon the relay range.) The pendulum relay armature should be pulled against the core screw and the X2 telephone relay should pick-up. Remove the jumpers from the voltage switch contacts. The pendulum relay armature should oscillate and hold the X2 relay closed for approximately 3 seconds. This is the standard factory adjustment. The drop-out of the pendulum and X2 relay combination can be adjusted from approximately 20 cycles to 10 seconds. The drop out time of X2 is adjusted by means of the armature set screw. The time that P will keep X2 picked up is adjusted by changing the spacing of the two outer contacts of the P relay.

Voltage Switches

Voltage Switches, A, B, and C, should be adjusted so that there is a clearance of 1/64" between the plunger and the core with the plunger picked up.

Energize each switch separately thru the common resistor. The switches should pick-up at 35 volts for the 125-volt relay and 50 volts for the 250-volt relay. Check to make sure the switches do not stick closed after rated voltage (125 to 250 volts) is applied.

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.

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WESTINGHOUSE ELECTRIC CORPORATION

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

Printed in U.S.A.

INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPES RS AND RSN CARRIER AUXILIARY RELAYS FOR PLATE KEYED CARRIER SETS

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 RS relay is an auxiliary relay used in the carrier relaying scheme to block or prevent instantaneous tripping for faults external to the line section to which it is applied and to permit instantaneous simultaneous tripping for internal faults. The relay is arranged to respond to indications of fault power and direction provided by the phase and ground relays, thereby controlling the transmission of the carrier signals. The response to ground faults may be given preference over the response to phase faults.

The type RSN relay is identical to the type RS except that it includes additional blocking elements to prevent tripping due to out-of-step system conditions. These elements do not prevent or delay instantaneous fault tripping during out-of-step conditions except for three phase faults. Three phase faults occurring during out-of-step conditions can be cleared by tripping after a short time delay.

CONSTRUCTION AND OPERATION

The type RS or RSN relay consists of directional auxiliary, receiver and alarm elements, contactor switches and operation indicators. In addition, the type RSN relay contains three voltage elements, a combination pendulum and time-delay drop-out relays which are the out-of-step elements. The construction and operation of the relay elements are described below. Complete details of the operation of this relay in the carrier relaying scheme is described in I.L. 41-600.6.

Directional Auxiliary Element

These are two solenoid type contactor switches designated as CSP and CSG. The plunger of the contactor switch operates a spring leaf arm with a silver contact surface on one end and rigidly fixed to the frame on the other end. The stationary contact is also fastened to the frame and in the deenergized position the contacts are held closed by the leaf spring. When the coil is energized, the plunger travels upward breaking the contacts. The CSP switch is energized by the operation of the directional and second impedance element of the phase relays; and the CSG switch, by the operation of the directional and overcurrent elements of the ground relay. The back contacts of the two switches are connected in series in the oscillator and amplifier cathode circuits. The operation of either of these switches opens up the cathode circuit to stop carrier and to open the short around the RRT Operating coil. Ground preference is obtained by connecting the auxiliary (CSO) contacts of the ground relay in parallel with CSP contacts. In this case if the ground relay starts carrier, the phase relays cannot stop carrier and thus the ground relay completely supersedes the phase relays, as far as carrier control is concerned.

Receiver Element

The polarized relay consists of an armature and contacts mounted on a leaf spring supported symmetrically within a magnet frame. The armature rides in the front air gap of the

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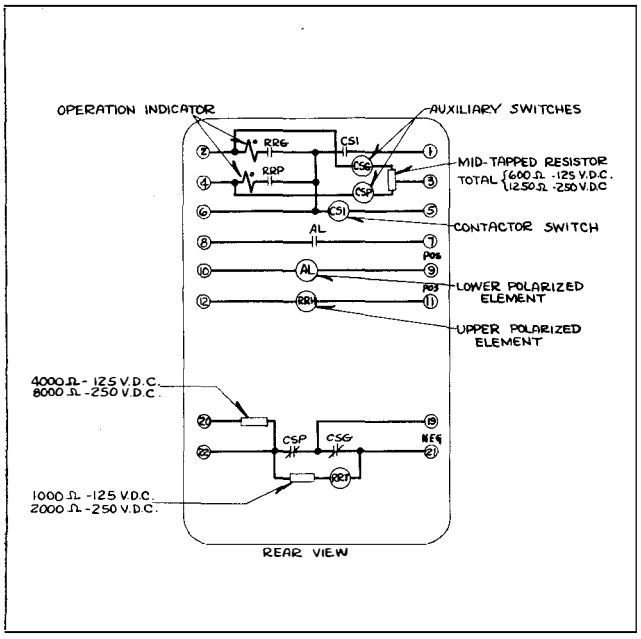

Fig. 1—Internal Schematic of the Type RS Relay in the Standard Case.

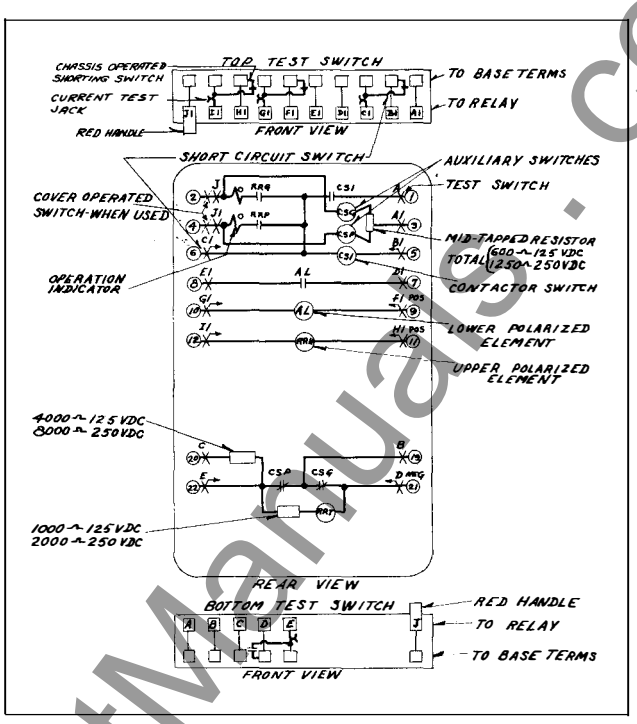

Fig. 2—Internal Schematic of the Type RS Relay in the Type FT Case.

frame with the contacts projecting outside. The poles of a permanent magnet clamp directly to each side of the frame. Two adjustable shunts are located across the rear air gaps. These change the reluctance of the magnetic path so as to force some of the flux thru the moving armature which is fastened to the frame midway between the two rear air gaps. Flux in the armature polarizes it and creates a magnetic bias, causing it to move towards either the left or the right, depending upon the adjustment.

Two stationary contact screws are mounted to the left (front view) of the moving contact assembly and adjusted for normally open contacts. These contacts are designated, RRP and RRG, and are connected in the phase and ground trip circuits respectively. One stationary contact screw is mounted to the right of the assembly and adjusted for normally closed contact. This contact is designated RRB and used in connection with the out-of-step protection features. These contacts are operated by two concentric coils, RRT and RRH, which are placed around the armature and within the magnetic frame. RRT is the operating coil and receives its energy from the local battery when either CSP or CSG is opened. RRH is the holding coil and receives its energy from the carrier transmitted either from the local transmitter or the one at the other end of the section. These two coils are connected to oppose each other with the operating coil RRT, operating to close the RRP and RRG contacts and trip; and the holding coil, RRH, to hold the RRP and RRG contacts open and block tripping. The restraining torque of the RRH coil is sufficient to overcome the operating torque of the RRT coil. Consequently, RRP and RRG contacts cannot close as long as RRH is energized.

Alarm Element

The alarm element is similar in construction to the receiver element except that it is energized by a single coil and operates a single set of contacts. The coil is energized by the received carrier to close the contacts and give an alarm. This element has a higher pick-up than that of the receiver element in order to obtain a direct check on the sensitivity of the tubes in the carrier transmitter-receiver. The failure of the alarm relay to pick-up when carrier is started indicates insufficient output from the transmitter-receivers.

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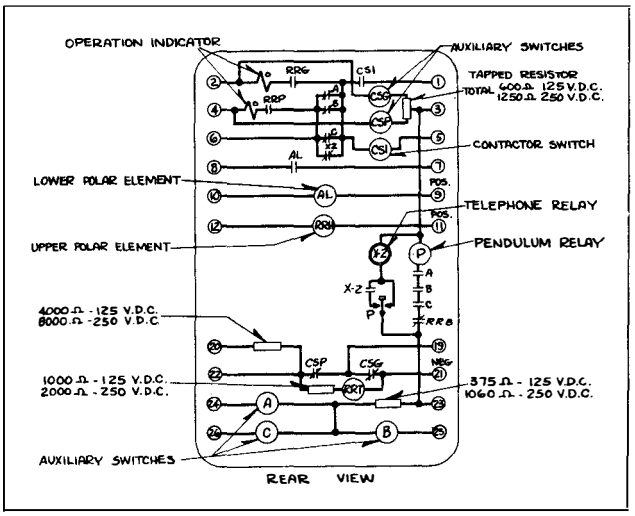

Fig. 3—Internal Schematic of the Type RSN Relay in the Standard Case.

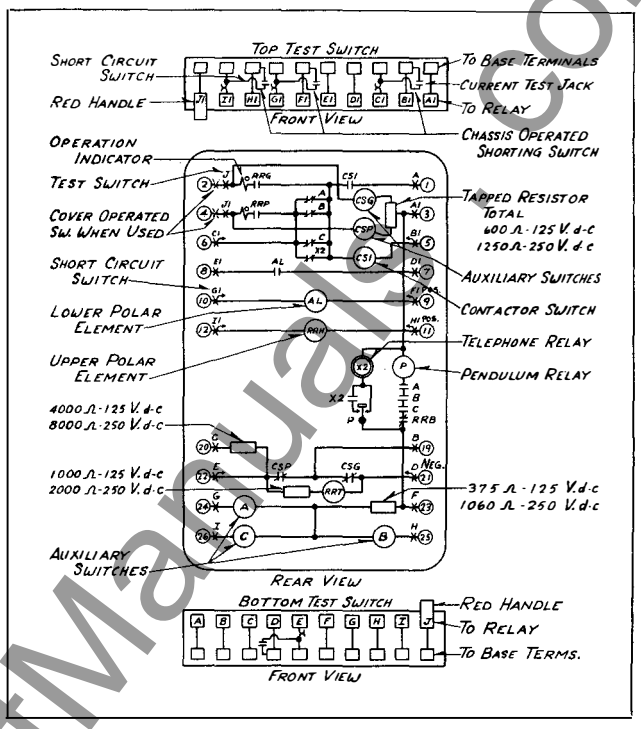

Fig. 4—Internal Schematic of the Type RSN Relay in the Type FT Case.

Contactor Switch

The contactor switch, CSI, is a small solenoid auxiliary switch connected in series in the trip circuit. The plunger of the switch has a circular conducting disc mounted on its lower end, and as the plunger travels upward, the disc bridges three silver stationary contacts. The contacts of CSl seal in the trip circuit until the auxiliary switch on the breaker opens the trip circuit.

Operation Indicators

Two operation indicators show whether the fault was a phase fault or a ground fault by indicating which relays did the actual tripping, the phase relays thru RRP, or the ground relay thru RRG.

Out-Of-Step Elements

The three voltage elements designated as A, B, and C are contactor switches similar to those described above except that each is provided with a set of back or normally closed contacts as well as the normal make contacts. Their coils are energized by the third impedance element of the corresponding phase relay thru the contacts of an auxiliary switch CSA from the trip voltage source. The back contacts of the voltage elements are connected in parallel and permit tripping as long as any one of the back contacts is closed. The front contacts of the voltage elements are in series with the back contact on the receiver element, RRB, and the coil of the pendulum relay.

The pendulum relay is a telephone type relay with a horizontal spring arm extending between two contact points. A counterweight is fastened to the free end of the arm. The X2 relay is a telephone type relay with slow drop-out characteristics. A solenoid attracts an iron right-angle bracket which in turn operates a set of break and make contacts. Drop-out delay is obtained by the air gap and adjustment between the solenoid core and the armature, and the copper slug on the core. X2 is energized by the pendulum relay contacts with its back contact in parallel with the back contacts of the voltage switches and connected in the phase trip circuit. When the pendulum relay is energized, its arm is pulled downward, to close the lower contact. This energized the X2 relay. After the pendulum relay is deenergized, the pendulum will oscillate for a short time alternately breaking and making both of its contacts. Consequently,

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the X2 relay will not drop-out until after the pendulum oscillations have deenergized its coil. The complete operation of these elements during out-of-step are explained in connection with the operation of the carrier scheme. See I.L. 41-600.6.

CHARACTERISTICS

The characteristics of the various elements of the relays are as follows:

	125 Volts Avg. Ohms	250 Volts Avg. Ohms
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AL Alarm Coil	500	500
P Pendulum Relay	2000	2000
A, B, C, Contactor Switches	1170	1170
X2 Telephone Relay	2000	2000
CS1 Contactor Switch (2 amps.)	0.23	0.13
Operation Indicator (1 amp.)	0.16	1.16

The pick-up and operating values of these elements are given under "Adjustments and Maintenance".

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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 assemble 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 from 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 short circuiting test switch prevents open circuiting that circuit when the short circuiting type test switches are closed.

When the chassis is to be put back in the case, the above procedure is to be followed in 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

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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 short circuiting test switch short-circuits that circuit and disconnects one side of the relay element but leaves the other side of the element 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 short circuiting test switch pair must be open when using the current test plug or insulating material in this manner to short-circuit the external circuit.

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

Testing

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

Testing in Service

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

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

Testing in Case

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

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the short circuiting 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 of the 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 con-

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nections 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-asbestoes 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.

The carrier relaying d-c schematic (supplied with the carrier order) should be consulted for details of the external connections of these relays.

ADJUSTMENTS AND MAINTENANCE

The operating time of this relay may be affected by disturbing the flexible leads to the moving contacts. Care should be taken that they are not disturbed during 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.

Directional Auxiliary Elements

The two contactor switches, CSP and CSG, have adjustable plunger travel. Adjust the two nuts on the bottom of the fixed shaft so that the plunger has 1/8" travel after the lower contacts make. The plunger should have 1/64" travel in the opposite direction after the upper contacts make. This is adjustable by screwing down the set screw on top of the switch until the upper contacts are just able to make as the plunger hits the upper stop. Then back off this screw 1/2 turn and lock in place.

Each contactor switch has a section of a tapped resistor in series with it, and will pick up positively when rated trip circuit voltage is applied across the coil and its section of the resistor.

The minimum pick-up of the coil and its resistor is 40 volts for the 125 volt relays and 100 volts for the 250 volt relay.

Receiver Element

Back off contact screws so that they do not make contact. Screw magnetic shunts into the all-out position. The armature should remain against whichever side it is pushed with this adjustment.

Contact Adjustment

Apply 125 volts d-c to the 125 volt relay or 250 volts d-c to the 250 volt relay across RRT Coil, the operating coil resistor and the carrier resistor in series (RRT coil in series with 5000 or 10,000 ohms) with polarity as shown in the schematic diagram. The CSP and CSG switch back contacts should be blocked open. The armature should move to the left (front view). Adjust both left-hand contacts until they barely make a light circuit. A flickering light is permissible. Give both of the left-hand contact screws an additional 1/3 turn to secure the required 8 mil follow. Similarly, apply 125 or 250 volts d-c to the operating coil as before and 10 to 20 milliamperes d-c to the holding coil (RRH) with the correct polarity. The armature should move to the right. Adjust the right-hand stationary contact until it barely makes a light circuit, then give the right-hand contact screw an additional 1/3 turn to secure the proper contact follow. Deenergize both coils and see that the back contact stays closed.

Calibration

Screw in the left-hand shunt so that the top air gap alone is shunted. This should increase the armature bias towards the right-hand back contact. Energize the operating coil with 125 or 250 volts d-c and the holding

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coil with 4 milliamperes d-c. The right hand contact should remain closed. Screw in the right-hand shunt until the armature moves to the left. Tighten up both lock screws on both shunts and recheck the above adjustments. Increase the holding coil current to 6 ± .25 milliamperes d-c and see that the armature closes the back contact with a snappy action.

Alarm Element (Normal Adjustment)

Contact Adjustment

Adjust the right-hand contact in the same manner as described above under the Receiver Element.

Calibration

Screw in the right-hand shunt until the top air gap alone is shunted. Apply 8 milliamperes d-c to the coil with correct polarity and then screw in the left-hand shunt until the armature closes the right-hand contact. With this adjustment, the armature should move to the left with 4 to 6 milliamperes in the holding coil. Lock the shunts in position and recheck the calibration several times.

Alarm Element (Telemetering Adjustment)

Telemetering impulses over the carrier channel would normally impulse the alarm element and the alarm bell unless they are disconnected. To retain the alarm feature for communication signalling, a time delay circuit is used which requires reconnection and readjustment of the alarm element to have the opposite polarity and normally closed contacts. Where specified, this adjustment is made before shipment. This adjustment gives approximately 1 second delay.

Contact Adjustment

With the element de-energized, screw the left-hand shunt all the way in, and back the right-hand shunt all the way out. This will increase the armature bias towards the right and move the armature in that direction. Back off the stationary contact screw and then screw it up until it barely makes a light circuit. Give the screw an additional one-third of a turn to secure the required 8 mil follow.

Calibration

Reverse the polarity of the coil. This means that the contacts will be held open when the coil is energized. Back off the left-hand shunt slightly and screw in the right-hand shunt until the contact closes at 1 milliampere. The contacts should open at 6 milliamperes or less. This differential between pick-up and drop-out is decreased by closing more of the rear air gaps. This can be done by further screwing in both the right and left-hand shunts and rechecking the pick-up and drop-out values. This recheck is important, since any change of the shunts affects both calibration points. Lock the shunts in position and recheck the calibration several times.

CS-1 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 and screwing up the core screw of the switch until the contacts just separate. Then 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 is passed thru the coil.

Operation Indicator

Adjust the indicators to operate at one ampere d-c gradually increased. Test for sticking after 30 amperes d-c has been applied. Check the indicator and the contactor switches at 5 and 30 amperes d-c to make sure that the indicator operates before its coil is shorted by the contactor switch.

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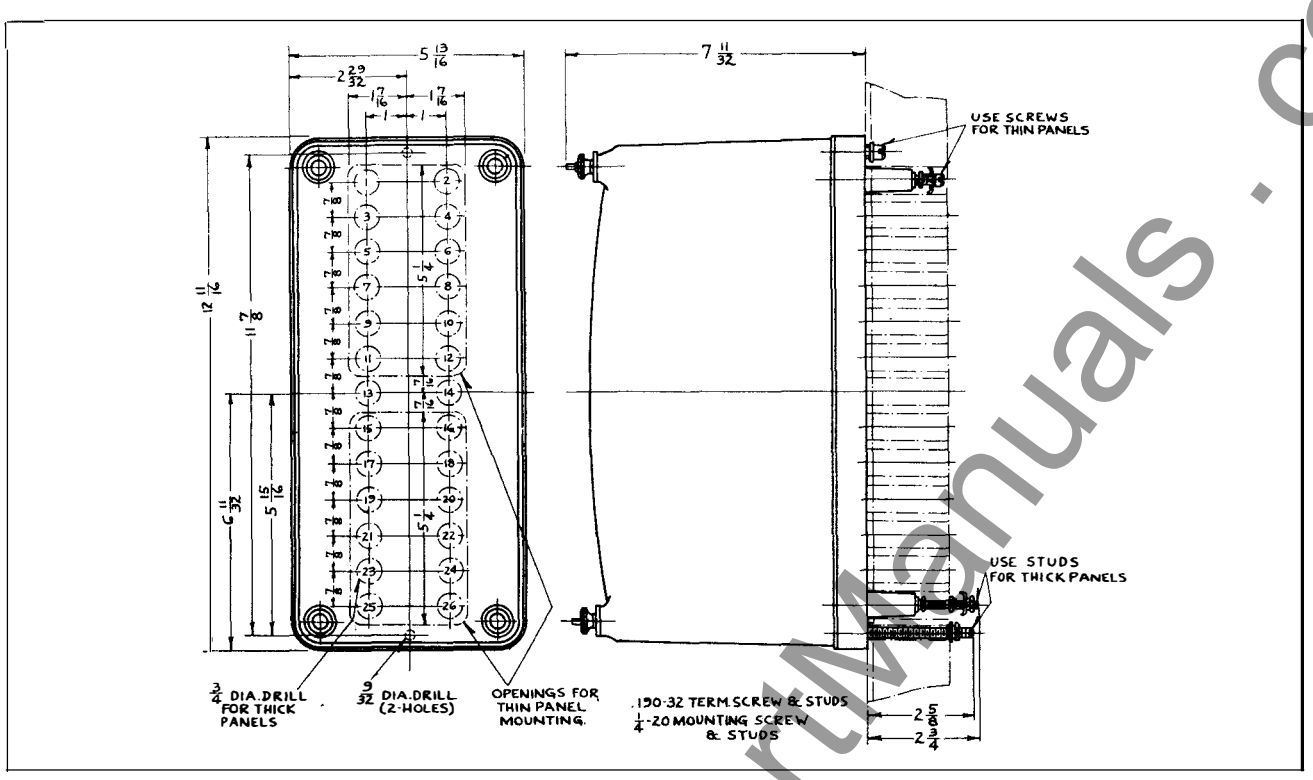

Fig. 5—Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.

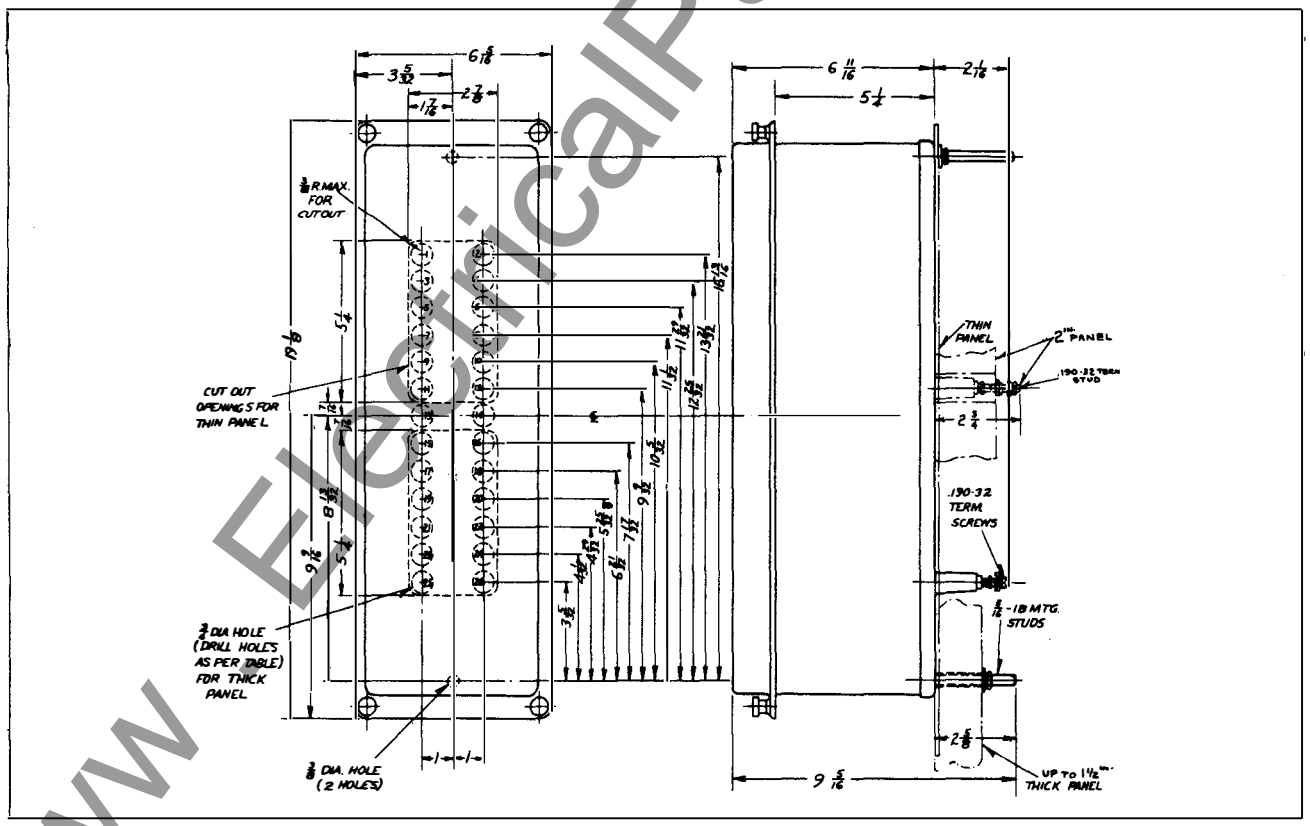

Fig. 6—Outline and Drilling Plan for the M20 Projection Type FT Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

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Out of Step Blocking Elements for Type RSN Relay Only

Telephone Relay

Energize the telephone relay, X2, by applying 80 volts d-c with the pendulum relay armature held in the operated position. The telephone relay should operate positively, when the pendulum relay armature is held down to make the lower contact and should not operate when the armature is held up to make the top contact.

Pendulum Relay

To check the operation of the pendulum relay, connect jumpers across the make contact on the voltage elements, A, B, and C, and apply 125 volts or 250 volts d-c across the pendulum relay. (The voltage will depend upon the relay range.) The pendulum relay armature should be pulled against the core screw and the X2 telephone relay should pick-up. Remove the jumpers from the voltage switch contacts. The pendulum relay armature should oscillate and hold the X2 relay closed for approximately 3 seconds. This is the standard factory adjustment. The pick-up of the pendulum and X2 relay combination can be adjusted from approximately 20 cycles to 10 seconds. The drop out time of X2 is adjusted by means of the armature set screw. The time that P will keep X2 picked up is adjusted by changing the spacing of the two outer contacts of the P relay.

Voltage Switches

Voltage Switches, A, B, and C, should be adjusted so that there is a clearance of 1/64" between the plunger and the core with the plunger picked up.

Energize each switch separately thru the common resistor. The switches should pick-up at 35 volts for the 125-volt relay and 50 volts for the 250-volt relay. Check to make sure the switches do not stick closed after rated voltage (125 to 250 volts) is applied.

RENEWAL PARTS

Repair work can be done most satisfactorily at the factory. However, interchangeable parts can be furnished to the customers who are equipped for doing repair work. When ordering parts, always give the complete nameplate data.

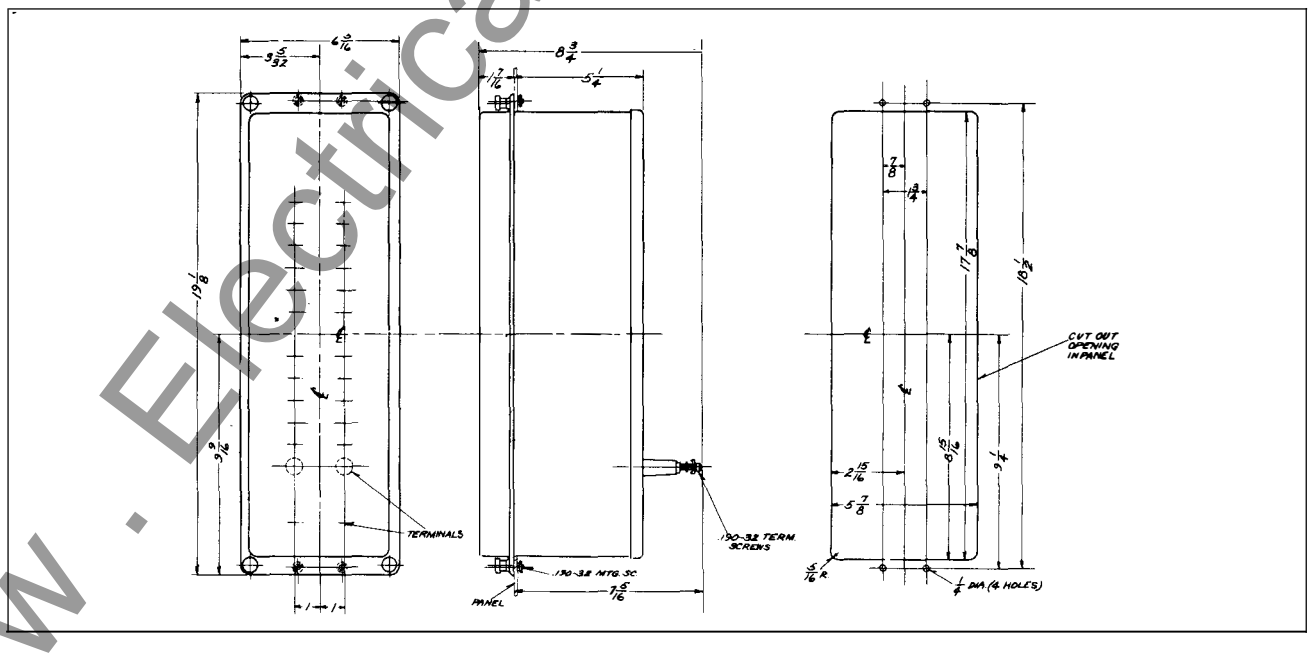

Fig. 7—Outline and Drilling Plan for the M20 Semi-flush Type FT Case. For Reference Only.

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TYPES RS AND RSN CARRIER AUXILIARY RELAYS FOR PLATE KEYED CARRIER SETS

INSTRUCTIONS

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 RS relay is an auxiliary relay used in the carrier relaying scheme to block or prevent instantaneous tripping for faults external to the line section to which it is applied and to permit instantaneous simultaneous tripping for internal faults. The relay is arranged to respond to indications of fault power and direction provided by the phase and ground relays, thereby controlling the transmission of the carrier signals. The response to ground faults may be given preference over the response to phase faults.

The type RSN relay is identical to the type RS except that it includes additional blocking elements to prevent tripping due to out-of-step system conditions. These elements do not prevent or delay instantaneous fault tripping during out-of-step conditions except for three phase faults. Three phase faults occurring during out-of-step conditions can be cleared by tripping after a short time delay.

CONSTRUCTION AND OPERATION

The type RS or RSN relay consists of directional auxiliary, receiver and alarm elements, contactor switches and operation indicators. In addition, the type RSN relay contains three voltage elements, a combination pendulum and time-delay drop-out relays which are the out-of-step elements. The construction and operation of the relay elements are described below. Complete details of the operation of this relay in the carrier relaying scheme is described in I.L. 41-600.6.

Directional Auxiliary Elements

These are two solenoid type contactor switches designated as CSP and CSG. The plunger of the contactor switch operates a spring leaf arm with a silver contact surface on one end and rigidly fixed to the frame on the other end. The stationary contact is also fastened to the frame and in the deenergized position the contacts are held closed by the leaf spring. When the coil is energized, the plunger travels upward breaking the contacts. The CSP switch is energized by the operation of the directional and second impedance element of the phase relays; and the CSG switch, by the operation of the directional and over-current elements of the ground relay. The back contacts of the two switches are connected in series in the oscillator and amplifier cathode circuits. The operation of either of these switches opens up the cathode circuit to stop carrier and to open the short around the RRT Operating coil. Ground preference is obtained by connecting the auxiliary (CSO) contacts of the ground relay in parallel with CSP contacts. In this case if the ground relay starts carrier, the phase relays cannot stop carrier and thus the ground relay completely supersedes the phase relays, as far as carrier control is concerned.

Receiver Element

The polarized relay consists of an armature and contacts mounted on a leaf spring supported symmetrically within a magnet frame. The armature rides in the front air gap of the frame with the contacts projecting outside. The poles of a permanent magnet clamp directly to each side of the frame. Two adjustable shunts are located across the rear air gaps. These change the reluctance of the magnetic path so as to force some of the flux thru the moving armature which is fastened to the frame midway between the two rear air gaps. Flux in the armature polarizes it and creates a magnetic bias, causing it to move towards either the left or the right, depending upon the adjustment.

Two stationary contact screws are mounted to the left (front view) of the moving contact assembly and adjusted for normally open contacts. These contacts are designated, RRP and RRG, and are connected in the phase and ground trip circuits respectively. One stationary contact screw is mounted to the right of the assembly and adjusted for normally closed contact. This contact is designated RRB and used in connection with the out-of-step protection features. These contacts are operated by two concentric coils, RRT and RRH, which are placed around the armature and within the magnetic frame. RRT is the operating coil and receives its energy from the local battery when either CSP or CSG is opened. RRH is the holding coil and receives its energy from the carrier transmitted either from the local transmitter or the one at the other end of the section. These two coils are connected to oppose each other with the operating coil, RRT, operating to close the RRP and RRG contacts and trip; and the holding coil, RRH, to hold the RRP and RRG contacts open and block tripping. The restraining torque of the RRH coil is sufficient to overcome the operating torque of the RRT coil. Consequently, RRP and RRG contacts cannot close as long as RRH is energized.

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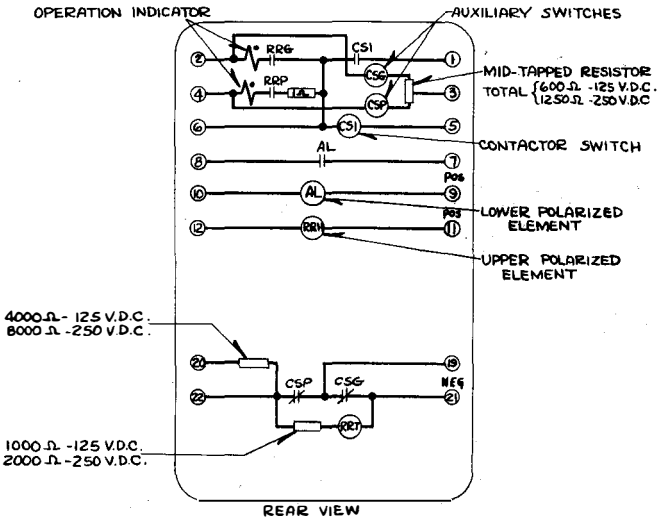

Figure 1
Internal Schematic of the Type RS Relay in the Standard Case.

Alarm Element

The alarm element is similar in construction to the receiver element except that it is energized by a single coil and operates a single set of contacts, The coil is energized by the received carrier to close the contacts and give an alarm. This element has a higher pick-up than that of the receiver element in order to obtain a direct check on the sensitivity of the tubes in the carrier transmitter-receiver. The failure of the alarm relay to pick-up when carrier is started indicates insufficient output from the transmitter-receivers.

Contactor Switch

The contactor switch, CS1, is a small solenoid auxiliary switch connected in series in the trip circuit. The plunger of the switch has a circular conducting disc mounted on its lower end, and as the plunger travels upward, the disc bridges three silver stationary contacts. The contacts of CS1 seal in the trip circuit until the auxiliary switch on the breaker opens the trip circuit.

Operation Indicators

Two operation indicators show whether the fault was a phase fault or a ground fault by indicating which relays did the actual tripping, the phase relays thru RRP, or the ground relay thru RRG.

Out-of-Step Elements

The three voltage elements designated as A, B, and C are contactor switches similar to those described above except that each is provided with a set of back or normally closed contacts as well as the normal make contacts. Their coils are energized by the third impedance element of the corresponding phase relay thru the contacts of an auxiliary switch CSA from the trip voltage source. The back contacts of the voltage elements are connected in parallel and permit tripping as long as any one of the back contacts is closed. The front contacts of the voltage elements are in series with the back contact on the receiver element, RRB, and the coil of the pendulum relay.

The pendulum relay is a telephone type relay with a horizontal spring arm extending between two contact points. A counterweight is fastened to the free end of the arm. The X2 relay is a telephone type relay with slow drop-out characteristics. A solenoid attracts an iron right-angle bracket which in turn operates a set of break and make contacts. Drop-out delay is obtained by the air gap adjustment between the solenoid core and the armature, and the copper slug on the core. X2 is energized by the pendulum relay contacts with its back contact in parallel with the back contacts of the voltage switches and connected in the phase trip circuit. When the pendulum relay is energized, its arm is pulled downward to close the lower contact. This energizes the X2 relay. After the pendulum relay is deenergized, the pendulum will oscillate for a short time alternately breaking and making both of its contacts. Consequently, the X2 relay will not drop-out until after the pendulum oscillations have deenergized its coil. The complete operation of these elements during out-of-step are explained in connection with the operation of the carrier scheme. See I.L. 41-600.6.

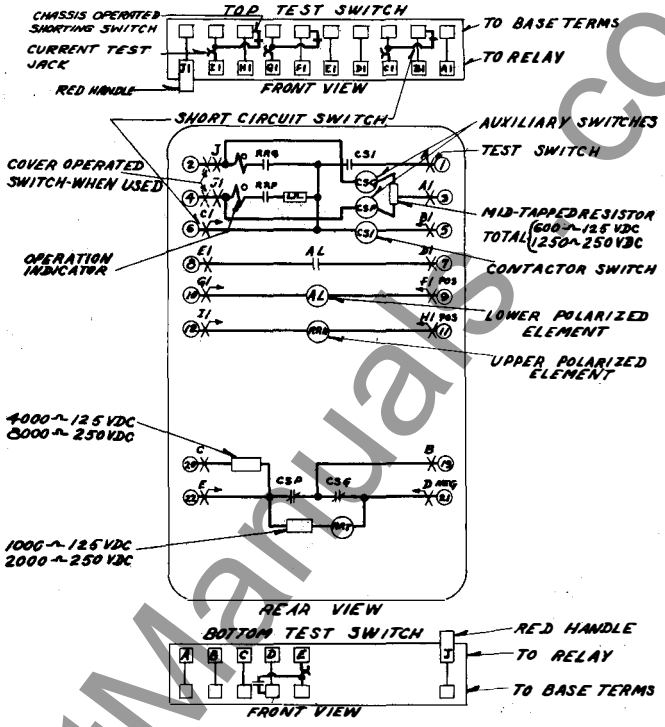

Figure 2
Internal Schematic of the Type RS Relay in the Type FT Case.

CHARACTERISTICS

The characteristics of the various elements of the relays are as follows:

	125 Volts Avg. Ohms	250 Volts Avg. Ohms
CSP or CSG Coil	70	70
CSP & CSG Tapped Resistor	600	1250
Carrier Resistor	4000	8000
RRT Operating Coil	1100	1100
RRT Coil Resistor	1000	2000
RRH Holding Coil	1700	1700
AL Alarm Coil	500	500
P Pendulum Relay	2000	2000
A,B,C, Contactor Switches	1170	1170
X2 Telephone Relay	2000	2000
CS1 Contactor Switch (2 amps.)	0.23	0.13
Operation Indicator (1 Amp.)	0.16	0.16

The pick-up and operating values of

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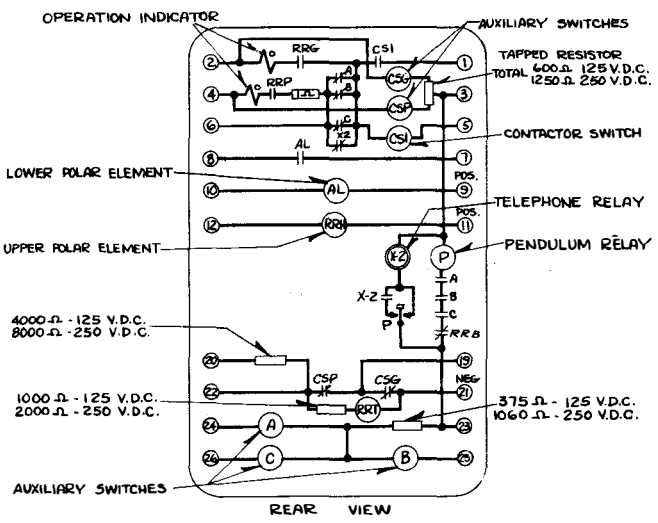

Figure 3
Internal Schematic of the Type RSN Relay in the Standard Case.

these elements are given under "Adjustments and Maintenance".

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 arm 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

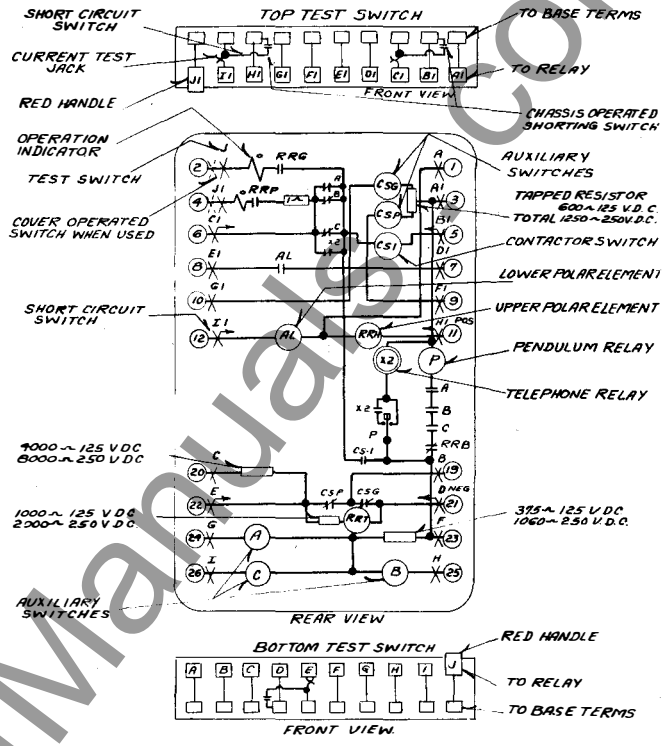

Figure 4
Internal Schematic of the Type RSN Relay in the Type FT Case.

cover put in place without the chassis. The chassis operated shorting switch located behind the short circuiting test switch prevents open circuiting that circuit when the short circuiting 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 short circuiting test switch short-circuits that circuit and disconnects one side of the relay element but leaves the other side of the element 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 short circuiting test switch pair must be open when using the current test plug or insulating material in this manner to short-circuit the external circuit.

A cover operated switch can be supplied with its contacts wired in series with the

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trip circuit. This switch opens the trip circuit when the cover is removed. This switch can be added to the existing type FT cases at any time.

Testing

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

Testing in Service

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

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

Testing in Case

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

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the short circuiting 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 of the 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 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.

The carrier relaying d-c schematic (supplied with the carrier order) should be consulted for details of the external connections of these relays.

ADJUSTMENTS AND MAINTENANCE

The operating time of this relay may be affected by disturbing the flexible leads to the moving contacts. Care should be taken that they are not disturbed during 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.

Directional Auxiliary Elements

The two contactor switches, CSP and CSG, have adjustable plunger travel. Adjust the two nuts on the bottom of the fixed shaft so that the plunger has 1/8" travel after the lower contacts make. The plunger should have 1/64" travel in the opposite direction after the upper contacts make. This is adjustable by screwing down the set screw on top of the switch until the upper contacts are just able to make as the plunger hits the upper stop. Then back off this screw 1/2 turn and lock in place.

Each contactor switch has a section of a tapped resistor in series with it, and will pick up positively when rated trip circuit voltage is applied across the coil and its section of the resistor.

The minimum pick-up of the coil and its resistor is 40 volts for the 125 volt relays and 100 volts for the 250 volt relays.

Receiver Element

Back off contact screws so that they do not make contact. Screw magnetic shunts into the all-out position. The armature should remain against whichever side it is pushed with this adjustment.

Contact Adjustment: Apply 125 volts d-c to the 125 volt relay or 250 volts d-c to the 250 volt relay across RRT Coil, the operating coil resistor and the carrier resistor in series (RRT coil in series with 5000 or 10,000 ohms) with polarity as shown in the schematic diagram. The CSP and CSG switch back contacts should be blocked open. The armature should move to the left (front veiw). Adjust both left-hand contacts until they barely make a light circuit. A flickering light is permissible. Give both of the left-hand contact screws an additional 1/3 turn to secure the required 8 mil follow. Similarly, apply 125 or 250 volts d-c to the operating coil as before and 10 to 20 milliamperes d-c to the holding coil (RRH) with the correct polarity. The armature should move to the right. Adjust the right-hand stationary contact until it barely makes a light circuit, then give the right-hand contact screw an additional 1/3 turn to secure the proper contact follow. Deenergize both coils and see that the back contact stays closed.

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Calibration: Screw in the left-hand shunt so that the top air gap alone is shunted. This should increase the armature bias towards the right-hand back contact. Energize the operating coil with 125 or 250 volts d-c and the holding coil with 4 milliamperes d-c. The right hand contact should remain closed. Screw in the right-hand shunt until the armature moves to the left. Tighten up both lock screws on both shunts and recheck the above adjustments. Increase the holding coil current to 6 ± .25 milliamperes d-c and see that the armature closes the back contact with a snappy action.

Alarm Element (Normal Adjustment)

Contact Adjustment: Adjust the right-hand contact in the same manner as described above under the Receiver Element.

Calibration: Screw in the right-hand shunt until the top air gap alone is shunted. Apply 8 milliamperes d-c to the coil with correct polarity and then screw in the left-hand shunt until the armature closes the right-hand contact. With this adjustment, the armature should move to the left with 4 to 6 milliamperes in the holding coil. Lock the shunts in position and recheck the calibration several times.

Alarm Element (Telemetering Adjustment)

Telemetering impulses over the carrier channel would normally impulse the alarm element and the alarm bell unless they are disconnected. To retain the alarm feature for communication signalling, a time delay circuit is used which requires reconnection and re-adjustment of the alarm element to have the opposite polarity and normally closed contacts. Where specified, this adjustment is made before shipment. This adjustment gives approximately 1 second delay.

Contact Adjustment: With the element de-energized, screw the left-hand shunt all the way in, and back the right-hand shunt all the way out. This will increase the armature bias towards the right and move the armature in that direction. Back off the stationary contact screw and then screw it up until it barely makes a light circuit. Give the screw an additional one-third of a turn to secure the required 8 mil follow.

Calibration: Reverse the polarity of the coil. This means that the contacts will be held open when the coil is energized. Back off the left-hand shunt slightly and screw in the right-hand shunt until the contact closes at 1 milliampere. The contacts should open at 6 milliamperes or less. This differential between pick-up and drop-out is decreased by closing more of the rear air gaps. This can be done by further screwing in both the right and left-hand shunts and rechecking the pick-up and drop-out values. This recheck is important, since any change of the shunts affects both calibration points. Lock the shunts in position and recheck the calibration several times.

CS-1 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 and screwing up the core screw of the switch until the contacts just separate. Then 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 is passed thru the coil.

Operation Indicators

Adjust the indicators to operate at one ampere d-c gradually increased. Test for sticking after 30 amperes d-c has been applied. Check the indicator and the contactor switches at 5 and 30 amperes d-c to make sure that the indicator operates before its coil is shorted by the contactor switch.

Out of Step Blocking Elements for Type RSN Relay Only

Telephone Relay: Energize the telephone relay, X2, by applying 80 volts d-c with the pendulum relay armature held in the operated position. The telephone relay should operate positively, when the pendulum relay armature is held down to make the lower contact and should not operate when the armature is held up to make the top contact.

Pendulum Relay: To check the operation of the pendulum relay, connect jumpers across the make contact on the voltage elements, A, B, and C, and apply 125 volts or 250 volts d-c across the pendulum relay. (The voltage will depend upon the relay range.) The pendulum relay armature should be pulled against the core screw and the X2 telephone relay should pick up. Remove the jumpers from the voltage switch contacts. The pendulum relay armature should oscillate and hold the X2 relay closed for approximately 3 seconds. This is the standard factory adjustment. The pick-up of the pendulum and X2 relay combination can be adjusted from approximately 20 cycles to 10 seconds. The drop out time of X2 is adjusted by means of the armature set screw. The time that P will keep X2 picked up is adjusted by changing the spacing of the two outer contacts of the P relay.

Voltage Switches

Voltage switches, A, B, and C, should be adjusted so that there is a clearance of 1/64" between the plunger and the core with the plunger picked up.

Energize each switch separately thru the common resistor. The switches should pick-up at 35 volts for the 125-volt relay and 50 volts for the 250-volt relay. Check to make sure the switches do not stick closed after rated voltage (125 or 250 volts) is applied.

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.

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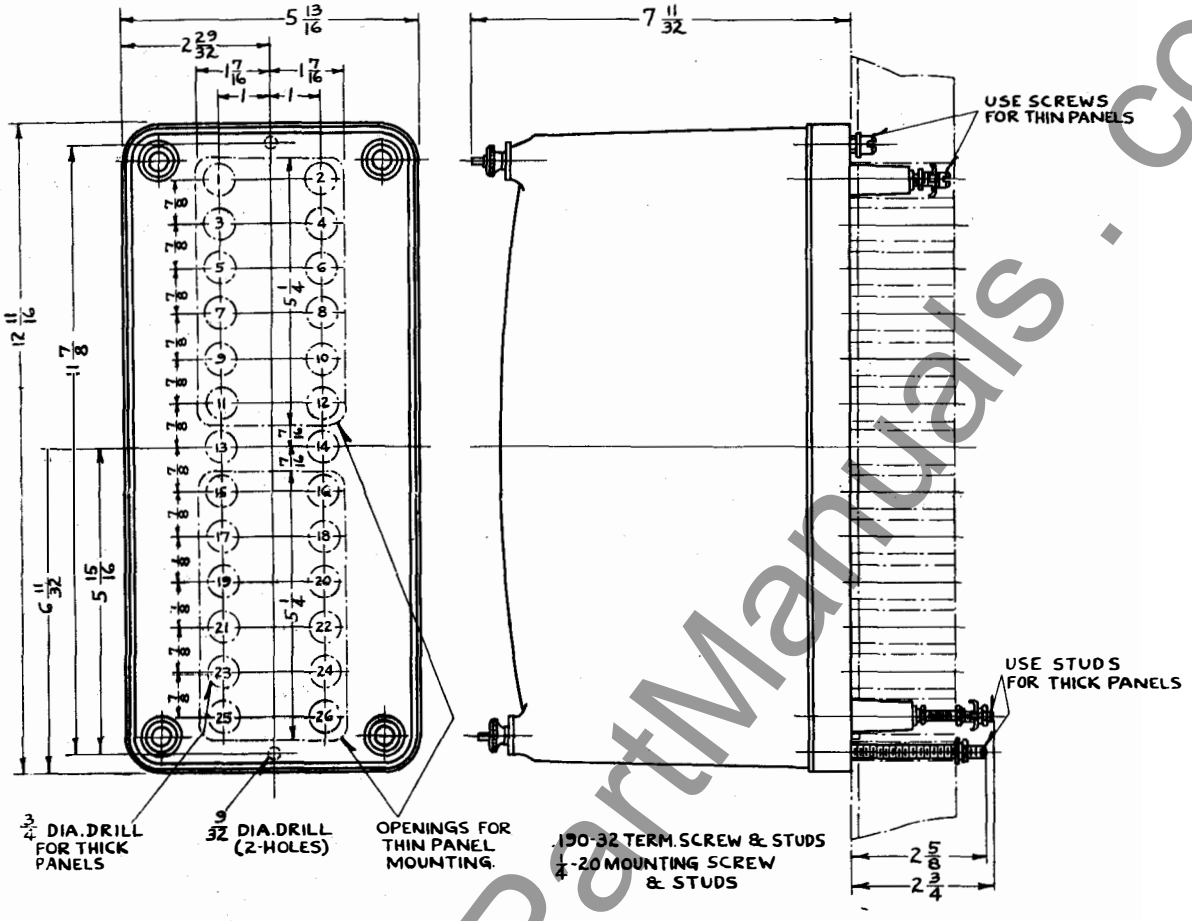

Figure 5.
Outline and Drilling Plan for the Standard Projection Type Case.
See the Internal Schematic for the Terminals Supplied.
For Reference Only.

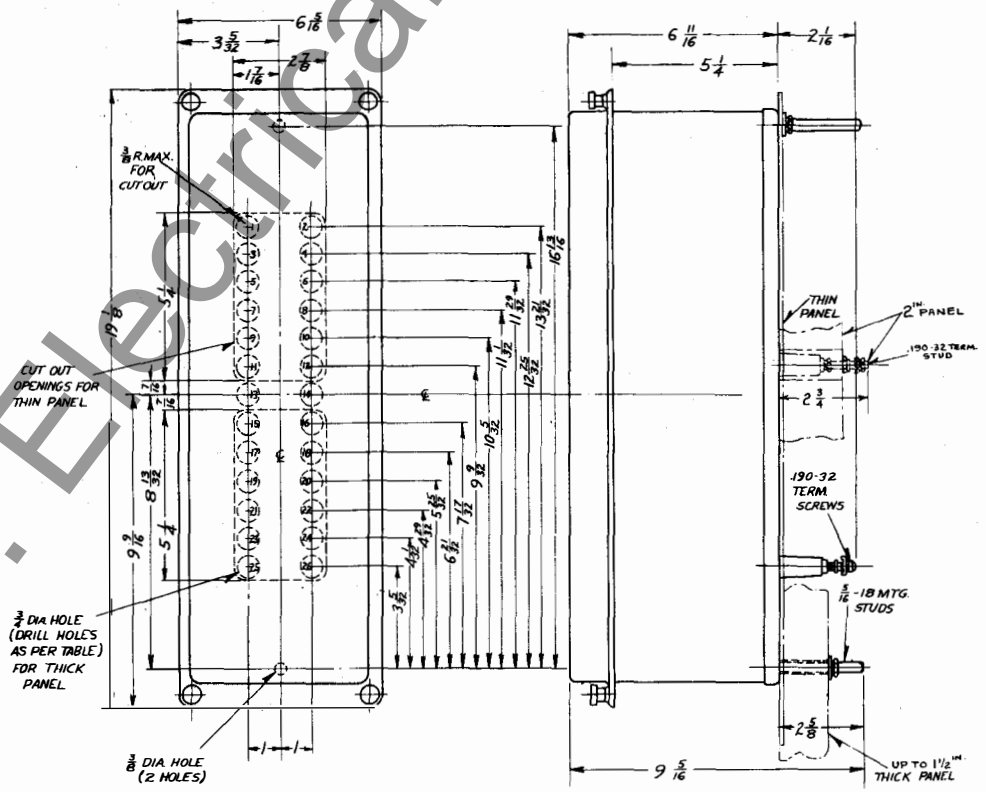

Figure 6.
Outline and Drilling Plan for the M20 Projection Type FT Case.
See the Internal Schematics for the Terminals Supplied.
For Reference Only.

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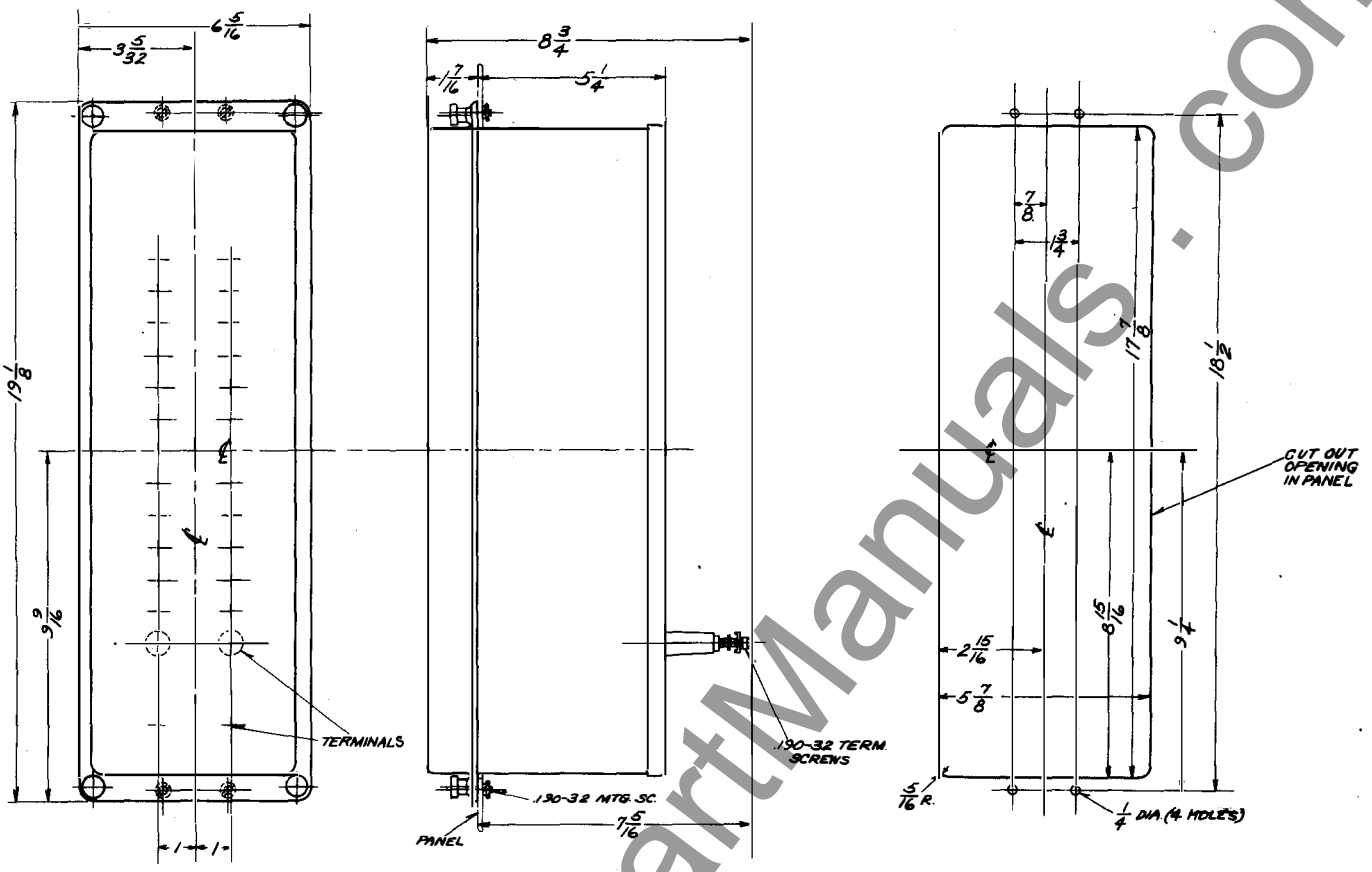

Figure 7.
Outline and Drilling Plan for the M20 Semi-flush Type FT Case.
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