INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE D-3 DIRECT CURRENT AND TYPE DT-3 TEMPERATURE RELAYS

CAUTION Before putting 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

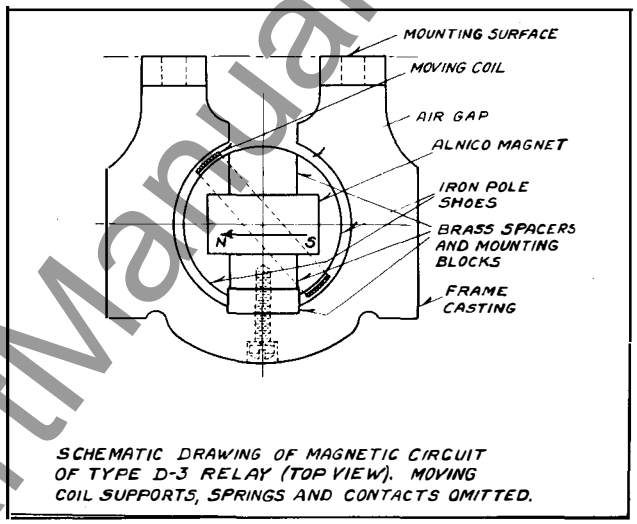
The type D-3 relay is suitable for applications where overload, underload, or reverse-current protection is required on direct current circuits. One particular application is in the protection of rotary converters which require sensitive reverse-current relays to prevent running inverted.

The type DT-3 relay is a temperature relay operating from exploring coils installed in the apparatus to be protected. The relay is used for protecting transformers and either a-c or d-c generators and motors from damage resulting from abnormally high temperatures. The operation of the relay contacts may be used to open the circuit breaker, sound an alarm, start blowers, or take care of the high temperature in any desired manner.

Both the type D-3 and the type DT-3 relay have a permanent magnet field. Consequently their operation does not require a d-c potential source and they are free from variations in the operating point which would result from voltage fluctuations of the potential source.

CONSTRUCTION AND OPERATION

The types D-3 and DT-3 relays are d'Arsonval type d-c contact making milliammeters. The



SCHEMATIC DRAWING OF MAGNETIC CIRCUIT OF TYPE D-3 RELAY (TOP VIEW). MOVING COIL SUPPORTS, SPRINGS AND CONTACTS OMITTED.

Fig. 1—Schematic Drawing of Magnetic Circuit of Type D-3 Relay (Top View). Moving Coil Bearing Supports, Springs and Contacts Omitted.

magnetic circuit is shown schematically in Fig. 1. A cylindrical core, consisting of an Alnico permanent magnet, two iron pole pieces and two brass spacer blocks, is mounted concentrically in the bore of a malleable iron frame casting. The moving coil rotates in the air gap between the core and the frame casting. A Moldarta bracket mounted on the rear of the core carries bearings for the frame on which the moving coil is wound, and also provides connection points for the spiral springs through which electrical connection is made to the moving contact and the moving coil. The two springs which are connected to the moving coil are located at the top of the element. The outer ends of these springs are fastened to posts mounted in a circular insulating plate. This plate is mounted on the Moldarta bracket by means of the upper bearing screw and a spring washer, so that it is held in position securely, but yet can be rotated to permit adjustment of the zero position of the moving element.

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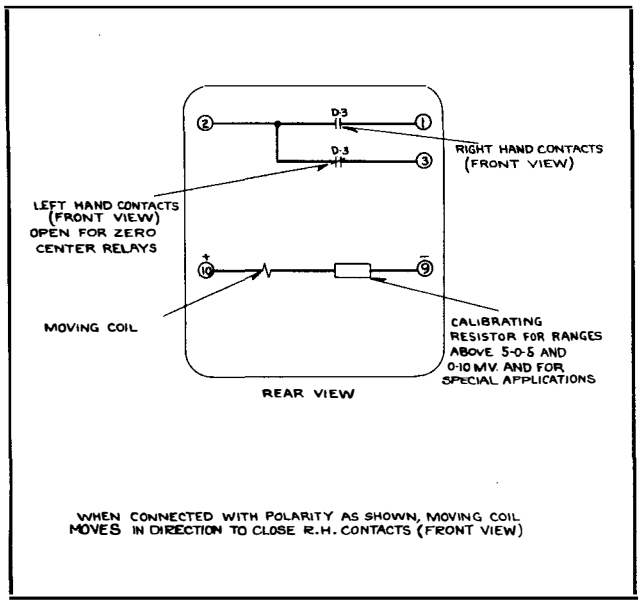

Fig. 2—Internal Connections of the Type D-3 Relay in the Standard Case.

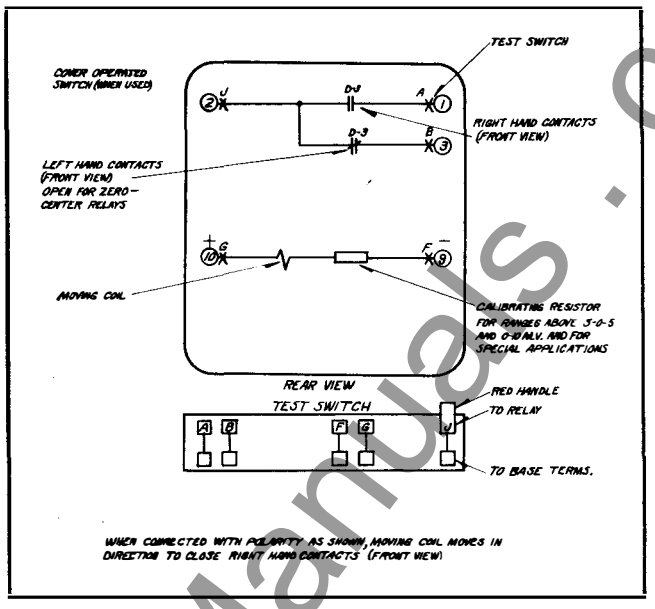

Fig. 3—Internal Connections of the Type DT-3 Relay in the Type FT Case.

The moving contact is mounted on the outer end of a counterbalanced arm fastened to the bottom of the moving coil shaft. Current is introduced into this contact by the third spiral spring. On either side, a stationary contact arm is fastened to the frame. Each of these stationary contacts is adjustable in a small arc and an upright guide arm indicates its position relative to a calibrated scale on the lower part of the nameplate. Relays for certain special applications are provided with a pointer, which is fastened to the contact arm and moves in front of the calibrated scale.

A screw containing a sapphire thrust bearing and a ring guide bearing is mounted in the lower bearing support of the moving element. The inverted position of this bearing screw prevents dirt particles from falling into it. A guide bearing only is provided at the top of the moving element, but the bearing pin is the lower of the two bearing members here also.

Type D-3 Relay

In the usual application of the D-3 relay the moving coil is connected to a shunt in the circuit being protected. Thus, by suitable selection of relay calibration and of shunt rating, the relay can be made to respond to particular magnitudes or directions of current flow through the shunt as required.

When the relay is calibrated to have a zero center the stationary adjustable contacts may be set to permit the moving contacts to move either right or left depending on the polarity. In all other standard relays the moving contact and one stationary contact are normally making at zero current. With proper polarity the contacts close to the opposite side.

The relay contacts will close a circuit carrying one ampere, but they should not be used to open an appreciable current. Figures 4 and 5 show typical external connections for overload or reverse current protection using the type D-3 relay on the standard and the type FT cases. These diagrams are for applications in which the trip coil current is within the capacity of the relay contacts. For larger tripping currents an auxiliary relay should be interposed, as shown in Fig. 6. In all cases an auxiliary contact on the circuit breaker must be provided to open the tripping circuit when the breaker opens.

In applications where the D-3 relay is used for the purpose of regulating a load rather than for circuit interruption upon the occur-

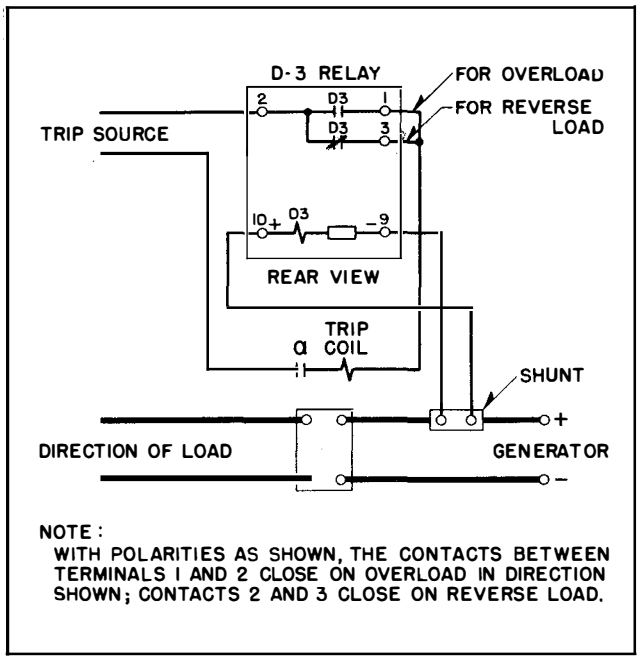

Fig. 4—External Connections for Overload or Reverse Current Protection, Using the Type D-3 Relay in the Standard Case.

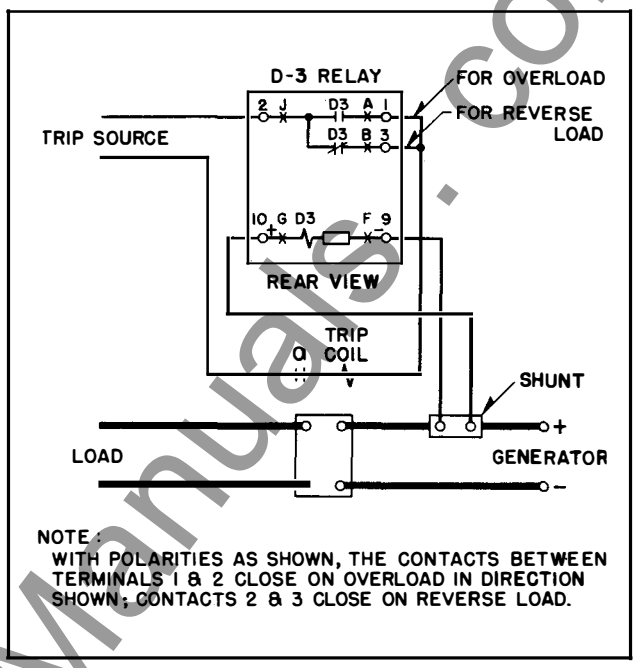

Fig. 5—External Connections for Overload or Reverse Current Protection, Using the Type D-3 Relay in the Type FT Case.

rence of predetermined overload, closing of the overload contacts will initiate action to reduce the amount of the load. Since a very slight reduction in the load will cause the overload contacts to open, if this interrupted the reduction of load the relay would close contacts again on a small load increase. Thus small load fluctuations might cause excessively frequent operation of the relay and the device controlled by it. The connections of Fig. 8 show the use of an external auxiliary relay (type SG) to keep the controlled device energized until the load had dropped by an amount determined by the setting of the left-hand contact of the D-3 relay.

An auxiliary relay, consisting of a standard d.c. contactor switch except with voltage coil, can be mounted inside the D-3 relay case for such an application if the smaller contact capacity is suitable. Figures 9 and 10 show the internal connections of type D-3 relays so equipped.

In applications where it is desired to handle currents above the capacity of the D-3 contacts but within the capacity of the contactor switch, two of these switches can be mounted inside the relay case, as indicated by Figures 11 and 12. Internal resistors are required in series with the contactor switch coils for most control voltages, since the winding space is not sufficient for the winding of a self-contained coil for voltages higher than about 40 volts.

A modification of the D-3 relay, in which a small Rectox rectifier is mounted internally, makes it suitable for certain A-C applications. Full scale deflection can be obtained at a relay current of 5 milliamperes or less. By using a suitable external series resistor, the relay scale can be calibrated in volts. The internal connections of this relay are shown in Fig. 13.

Type DT-3 Relay

The construction of the type DT-3 relay is identical with that of the type D-3 relay except for the moving coil winding and the scale marking. In addition to the relay itself, two external resistor boxes are furnished. The larger of these is the bridge box and the smaller is a series resistor. The moving coil is connected to the external bridge box, of which the search of exploring coil forms

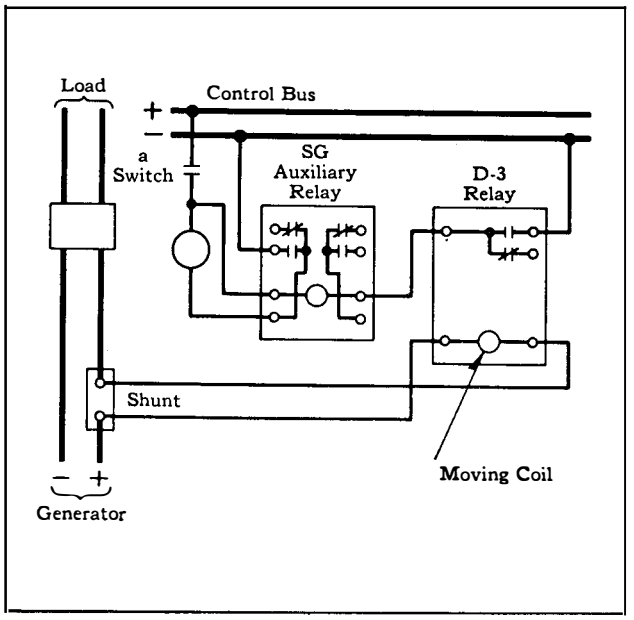

Fig. 6—External Connections for Overload Protection Using the Type D-3 Relay Where Trip Currents in Excess of One Ampere Require Use of an Auxiliary Relay.

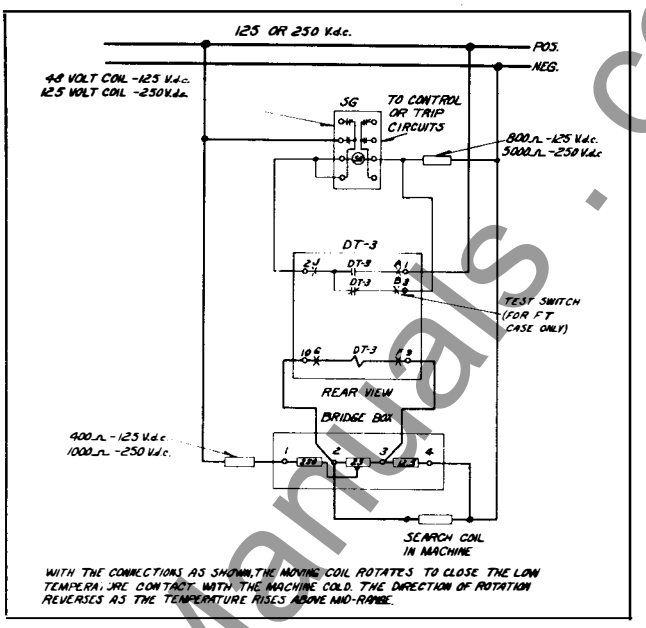

Fig. 7—External Connections for Thermal Protection of Electrical Equipment, Using the Type DT-3 Relay in Either the Standard Case or the Type FT Case.

one arm. In other words, the relay is connected across the center of a Wheatstone bridge composed of three resistors mounted in the external bridge box of Figure 7 and the exploring coil located in the equipment being protected.

CHARACTERISTICS AND SETTINGS

Type D-3 Relay

The type D-3 relay is supplied in the standard ranges listed in the table below. The numbers on the scale indicate in millivolts the potential required at the relay base terminals to operate the moving element to the indicated scale position.

MOVING COIL CIRCUIT

Ranges in Millivolts, d-c	Average Resistance in Ohms at 25°C
0-10	0.3
5-0-5	0.3
40-80	1.2
100-0-100	6.0
0-200	6.0

Relays calibrated for other millivolt ranges may be supplied on special order, and for a particular rating of shunt it is possible to calibrate the scale in amperes. It is possible also to connect the moving coil across a potential source in series with a suitable external resistor, and the scale may be calibrated in volts for such an application.

For reverse-current protection a sensitivity of 2 per cent is obtained when using a standard 50 millivolt shunt and setting the relay at 1 millivolt. A 10 per cent sensitivity is obtained by setting the relay at 5 millivolts. These values of sensitivity can be doubled by using a 100 millivolt shunt.

For overload protection the relay is set at the index setting which, with respect to the millivolt drop of the shunt, will operate at desired per cent of overload.

* The relay has a slight time-delay, with inverse characteristics. In the usual application the moving coil terminals are connected across a shunt, and this results in longer delay for both operating and reset times. When a shunt is used the operating time for full scale travel at 125% of the minimum operating current is about 4 seconds, while at 1000% it is about .25 second. In applications where no shunt is used, the operating times for the same conditions are about 1.25 and .15 second respectively. When the relay is de-energized,

the time required for it to reset from the full scale position to the 10% position is approximately 5 seconds when a shunt is used, and 2 seconds when there is no shunt.

Type DT-3 Relay

The standard type DT-3 relay has a scale calibrated from 60 to 120 degrees centigrade. It has a moving coil resistance of approximately 15 ohms at 25° C. Included with the relay is an external series resistor S#98663 (400 Ohms) and a bridge box S#507200.

The right-hand (front-view) stationary contact can be set so that a circuit is closed at and above any search coil temperature within the calibrated range of the relay. Similarly, the left-hand stationary contact can be set so that a second circuit is closed at and below any temperature less than the setting of the right-hand contact.

The standard relay is designed for operation with a 10 ohm copper exploring coil, and is calibrated for a range of settings from 60°C. to 120°C. The moving element is arranged so that the contacts stand at the 90°C. position when where is no current in the moving coil. The resistors forming the three fixed legs of the bridge are adjusted to a value of 12.50 ohms, which is the resistance at 90°C. of a copper search coil which measures 10 ohms at 25°C. When the bridge and field circuits are energized, the current in the moving coil, and the resulting torque, will be in one direction or the other, depending upon whether the search coil temperature is above or below 90°C., and the contacts will move to the position where the electrical torque is balanced by the restraining torque of the control springs.

EXTERNAL RESISTORS

Style No.	Resistance in Ohms	Outline Figure	Number of Terminals
507200		14	4
98663	400	15	2
1333490A	1,000	16	2

Type DT-3 Relay with Micron Scale

A special type of the Type DT-3 relay used as part of a vacuum-measuring device is calibrated in microns. It has a moving coil with a resistance of approximately 90 ohms, and sufficient resistance is connected in series with the moving coil internally to increase the resistance measured across the relay terminals to 100 ohms. This relay has a pointer which indicates the moving contact position on the calibrated scale.

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 electric connections between the base and chassis are completed through the closed knife-blades.

Removing Chassis

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

for easy inspection, maintenance and test.

After removing the chassis a duplicate chassis may be inserted in the case or the blade portion of the switches can be closed and the cover put in place without the chassis.

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

Electrical Circuits

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

The potential and control circuits thru the relay are disconnected from the external circuit by opening the associated test switches.

A cover-operated switch can be supplied with its contacts wired in series with the trip circuit. This switch opens the trip circuit when the cover is removed. This switch can be added to the existing 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:

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

Testing In Case

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

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug.

Testing Out of Case

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

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the standard cases and the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or 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.

Standard D-3 relays are calibrated in millivolts measured at the relay terminals. For relays with low millivolt scales, such as 0.10 or 5-0-5- millivolts, the resistance of the leads between the relay and the ammeter shunt must be sufficiently low to avoid introducing an excessive error in the relay indication. With the 0-10 or 5-0-5 millivolt relays, leads 8 feet long of #10 B&S gauge copper wire will reduce the relay indication by approximately 5%. If the lead length is less or the conductor size is larger, the error will be correspondingly reduced. However, relays with higher millivolt ranges have proportionally

greater internal resistances, and consequently error due to lead resistance is reduced. For example, a 0-100 millivolt relay with leads as described above would have an error of only 0.5% due to lead resistance.

The D-3 relay may be used as a sensitive reverse-current relay, and in such an application it may be subjected to considerable continuous overload with current in the normal direction. The 0-10 and 5-0-5-millivolt relays may be connected to a shunt which will produce a drop as high as 150 millivolts at full load. In the higher millivolt ranges, the capacity of the internal resistor will limit the percent overload capacity to a lower value.

The use of standard ammeter shunts may be avoided by connecting the moving element leads over an equivalent length of bus-bar or cable. On a basis of 1000 amp. per square inch, at 20°C., 6 feet of copper bus-bar will give 50 millivolts drop.

The ambient temperature at the Type DT-3 relay has no appreciable effect on its operation. The ambient temperature will affect the resistance of the leads to the search coil, of course, but by connecting these as shown in Figure 7, one lead is included as a part of leg 3-4 of the bridge and the variation of lead resistance is thus substantially balanced out. It might be more convenient in some cases to connect the bridge box and series resistor directly to the source, instead of having to run one supply lead to a search coil terminal at the machine. This can be done if the search coil leads are short or have a total resistance less than about 0.25 ohms. Such a lead resistance would cause the relay contacts to close when the search coil was 6.5C. below the relay temperature setting, but this error can be compensated largely by adjusting the relay setting accordingly.

ADJUSTMENTS AND MAINTENANCE

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

All contacts should be periodically cleaned with a fine file. S#1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

If the moving element should be removed, the bearing end-play should be checked when replacing it This should be from .020 inch to .025 inch, and can be measured by inserting a feeler gauge between the upper bearing screw and the shoulder on the moving element shaft.

In case it should be desirable to check the calibration of the Type DT-3 relay, this can be conveniently done by substituting a variable resistor for the search coil. Any scale point can be checked by setting the resistor for the corresponding resistance, as indicated in the table below, and seeing that the moving contacts travel to the indicated scale position. The relay should be energized at normal voltage for the test, and all other connections should be made as shown in Fig. 7.

Temperature Degrees Centrigrade	Resistance Ohms
60°	11.35
70°	11.73
80°	12.12
90°	12.50
100°	12.89
110°	13.28
120°	13.66

The core and moving coil assembly should not be removed from the frame casting of the D-3 or DT-3 relays unless a keeper having the same radius on the core is placed on the core in such manner as to bridge the iron pole pieces as the core is withdrawn from the bore of the casting. It is necessary also to insert spacers in the air gap so that the core will remain approximately centered when the mounting screws are removed, to prevent damaging the coil winding when sliding the assembly out of the casting. The factory assembly is made

before the magnet has been magnetized, and the complete assembly is placed between the poles of a magnetizer which produces a field sufficiently strong to saturate both the magnet and the frame casting. This avoids the necessity of using magnet keepers and simplifies the assembly.

REPAIRS AND RENEWAL PARTS

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

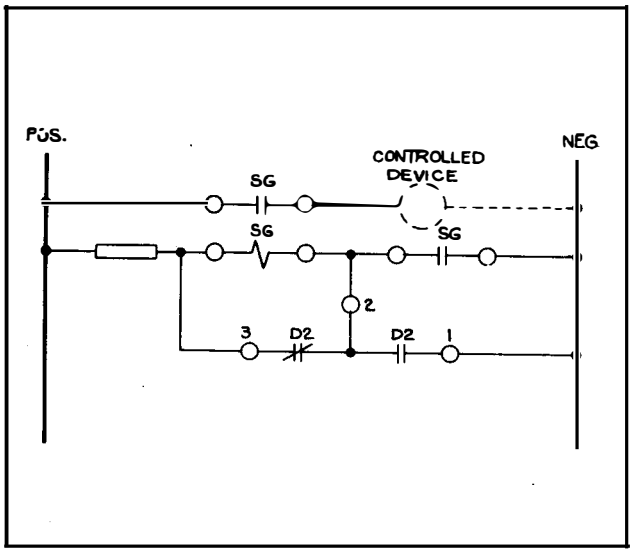

Fig. 8—Schematic Connections for Use of External Auxiliary Relay to Prevent Pumping of the Type D-3 Relay When Used for Overload Protection. The Numbers Indicate the Contact Circuit Terminal Numbers for Either the Standard or the Type FT Case.

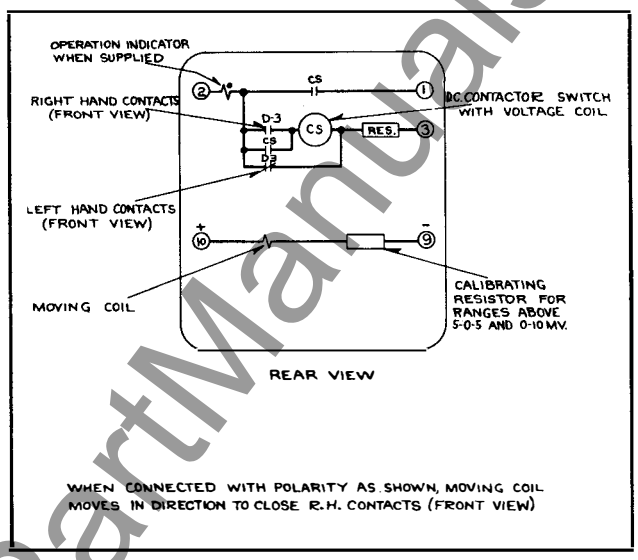

Fig. 9—Internal Connections of Type D-3 Relay in Standard Case with Self-Contained D.C. Auxiliary Relay Used to Prevent Pumping on Overload Protection.

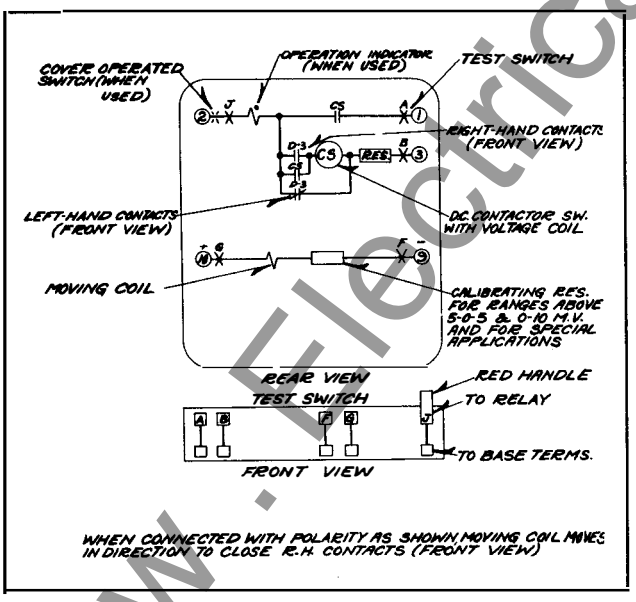

Fig. 10—Internal Connections of Type D-3 Relay in Type FT Case with Self-Contained D.C. Auxiliary Relay Used to Prevent Pumping on Overload Protection.

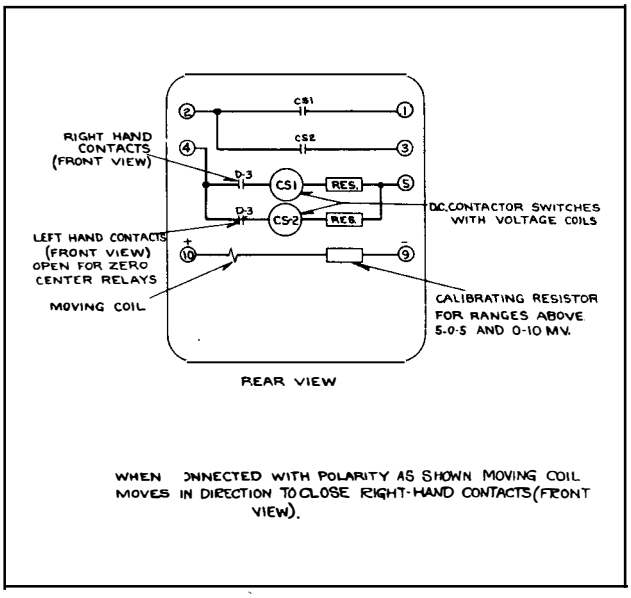

Fig. 11—Internal Connections of Type D-3 Relay in Standard Case with Two Self-Contained D.C. Auxiliary Relays Used to Increase Contact Capacity.

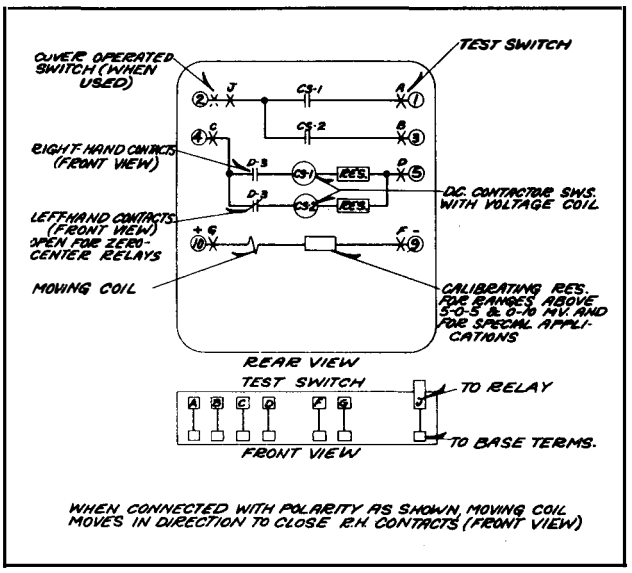

Fig. 12—Internal Connections of Type D-3 Relay in Type FT Case with Two Self-Contained D.C. Auxiliary Relays Used to Increase Contact Capacity.

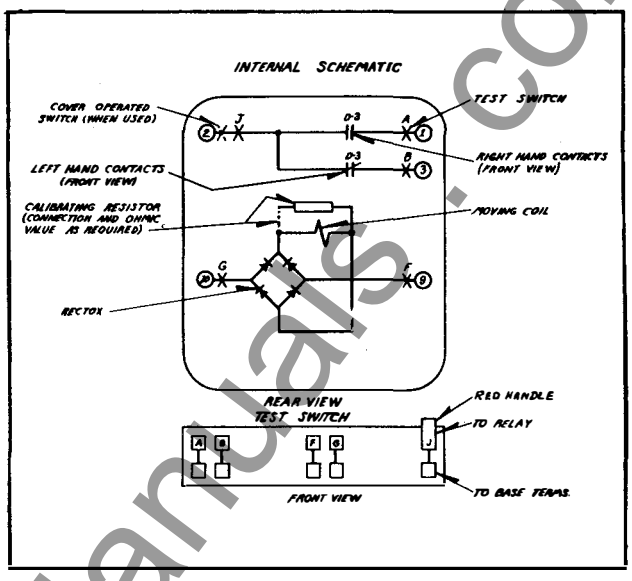

Fig. 13—Internal Connections of the Type D3 Relay in the Type FT Case with Internal Rectifier for a-c operation.

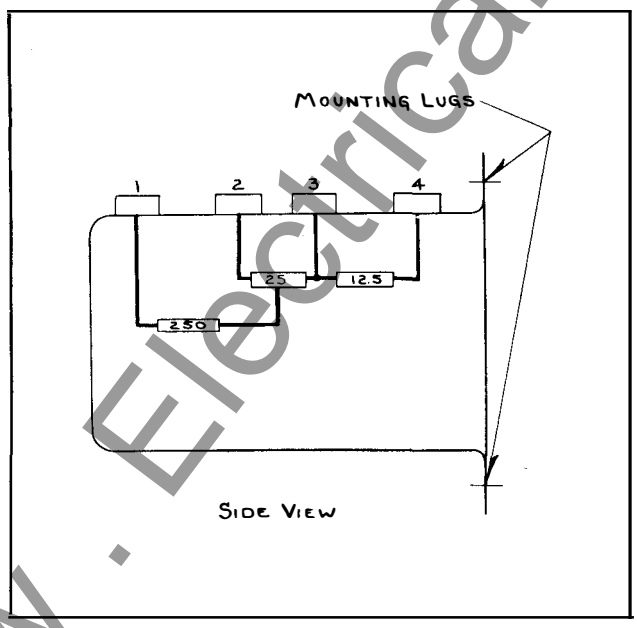

Fig. 14—Internal Connections of the Bridge Box Supplied with the Type DT-3 Relays.

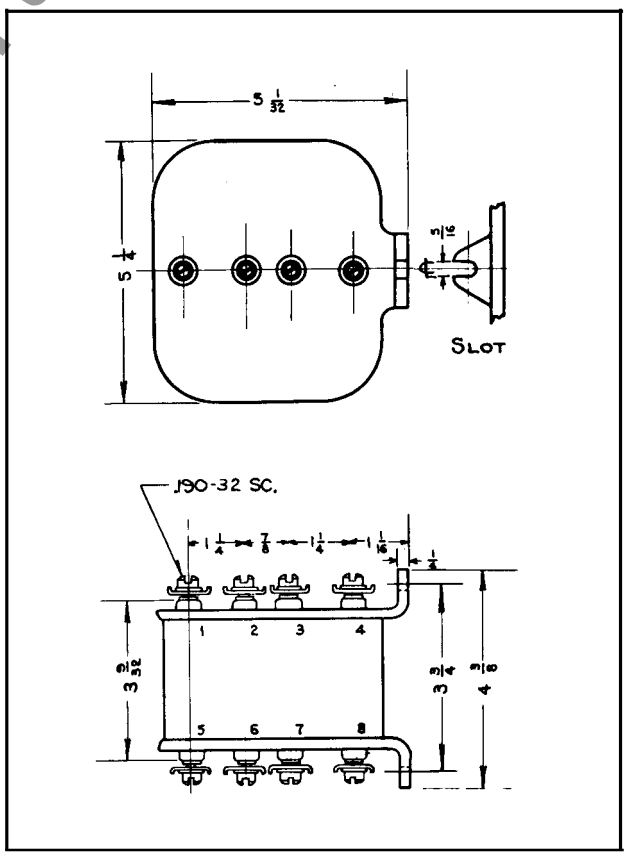

Fig. 15—Outline and Drilling Plan for the Four-Spool Resistor Cage Used for the Type DT-3 Relay Bridge Box. See Internal Connections for Terminals Used. For Reference Only.

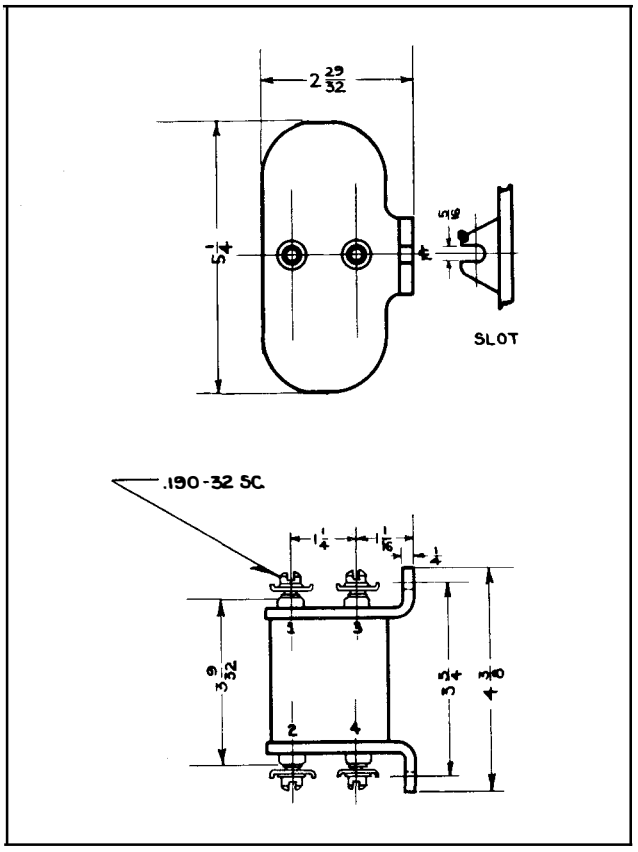

Fig. 16—Outline and Drilling Plan for the Two-Spool Resistor Cage Used With the Type DT-3 Relay. For Reference Only.

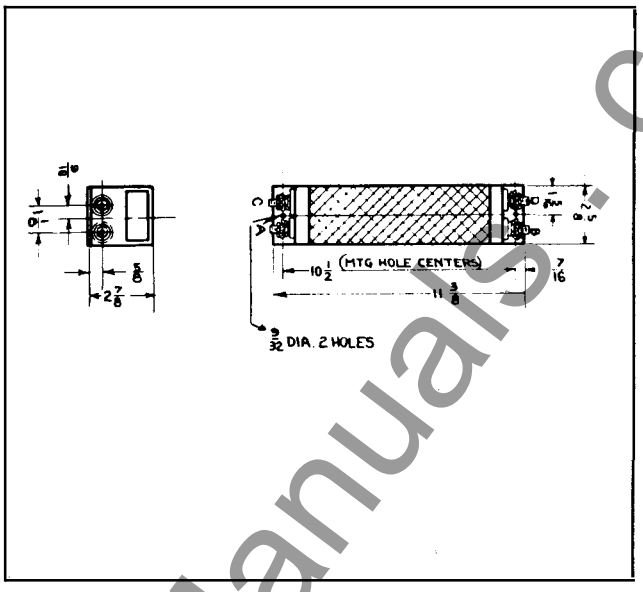

Fig. 17—Outline and Drilling Plan for the 8½" Resistor Enclosure Used With the Type DT-3 Relay. For Reference Only.

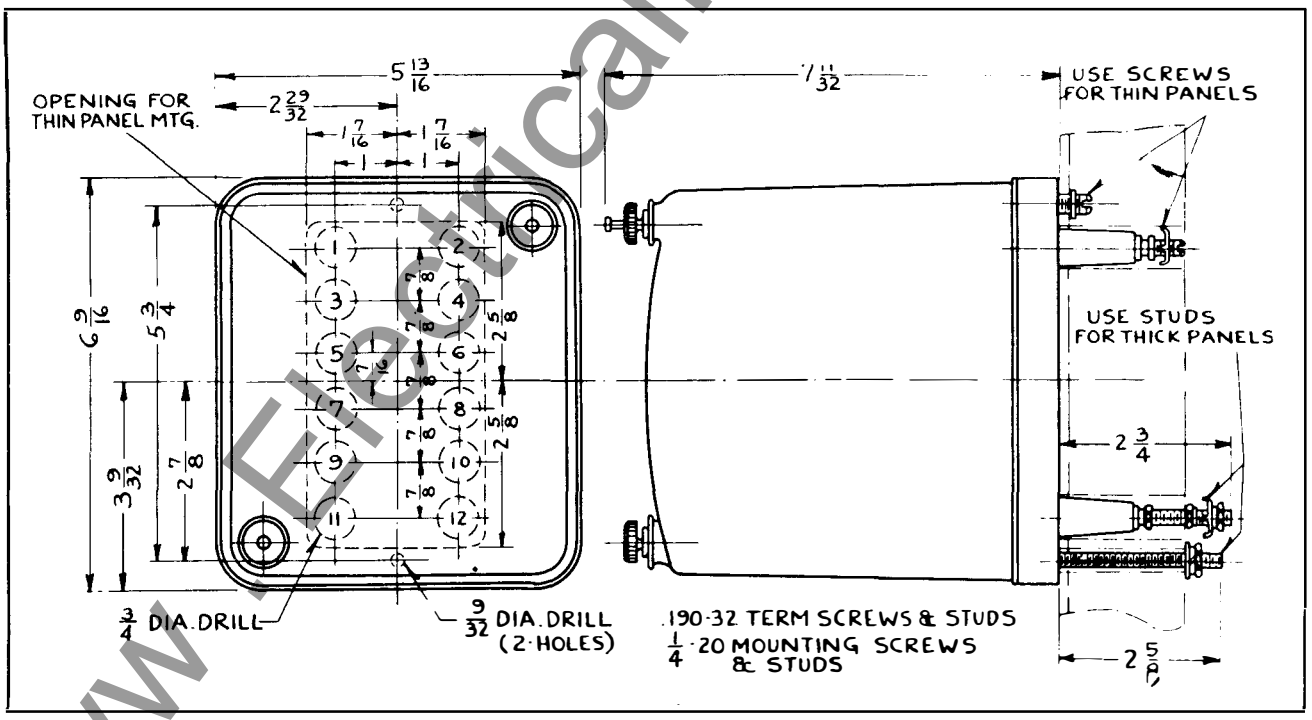

Fig. 18—Outline and Drilling Plan for the Types D-3 and DT-3 Relays in the Standard Projection Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

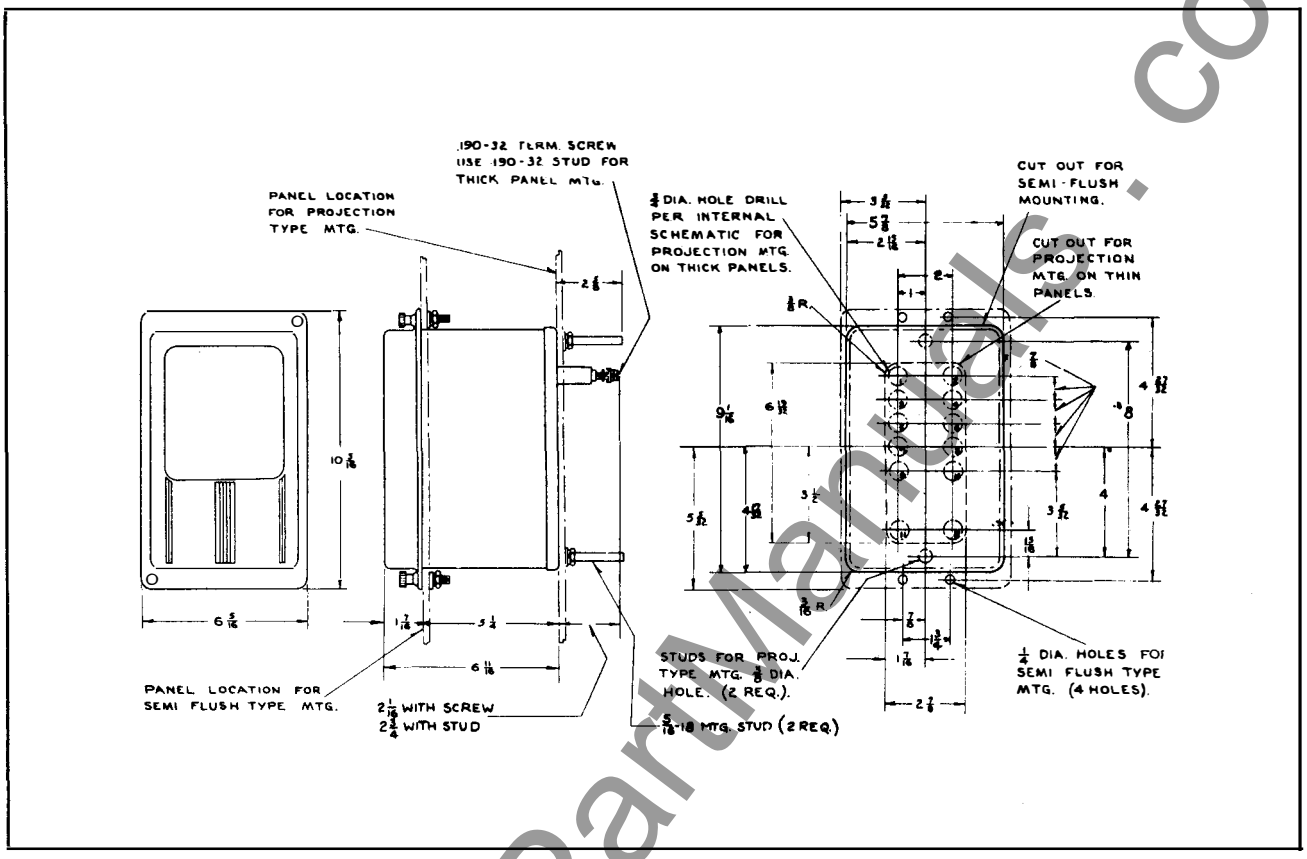

Fig. 19—Outline and Drilling Plan for the Types D-3 and DT-3 Relays in the S-10 Projection or Flush Type FT Case. See the Internal Schematics for the Terminals Supplied.

WESTINGHOUSE ELECTRIC CORPORATION

METER DIVISION • **NEWARK, N.J.**

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Westinghouse

TYPE D-2 DIRECT CURRENT AND TYPE DT-2 TEMPERATURE RELAYS

INSTRUCTIONS

CAUTION

Before putting 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 D-2 relay is for applications where overload, underload, or reverse-current protection is required on direct current circuits. One particular application is in the protection of rotary converters which require sensitive reverse-current relays to prevent running inverted.

The type DT-2 relay is a temperature relay operating from exploring coils installed in the apparatus to be protected. The relay is used for protecting transformers, either a-c or d-c generators and motors from damage resulting from abnormally high temperatures. The operation of the relay contacts may be used to open the circuit breaker, sound an alarm, start blowers, or take care of the high temperature in any desired manner.

Both the type D-2 and DT-2 relays require a constant d-c potential source for their operation.

CONSTRUCTION AND OPERATION

The types D-2 and DT-2 relays are d'Arsonval type d-c contact making milliammeters. They consist of a large magnetic u-shaped core, and a moving coil. The poles of the magnetic core are magnetized by two solenoid field coils at the bottom as shown in figures 1 and 4. The moving coil is wound on a supporting frame vertically pivoted between the pole faces of the magnet. Current is introduced to the moving coil by means of two spiral springs located above the element.

The moving contact is mounted on the outer end of a counterbalanced arm fastened to the bottom of the moving coil shaft. Current is introduced into this contact by another spiral spring. On either side, a stationary contact arm is fastened to the frame. Either of these stationary contacts are adjustable in a small arc and an upright guide arm indicates their position relative to a calibrated scale on the lower part of the nameplate.

Type D-2 Relay

The field coils of this relay are connected across the main bus or control circuit, and the moving coil to a shunt in the circuit being protected. Thus by suitable calibration, the relay responds to changes in the protected circuit by the change in voltage across the shunt.

When the relay is calibrated to have a zero center the stationary adjustable contacts may be set to permit the moving contacts to move either right or left depending on the polarity. In all other standard relays the moving contact and one stationary contact are normally making at zero current. With proper polarity the contacts close to the opposite side.

Type DT-2 Relay

The construction of the type DT-2 relay is identical with that of the type D-2 relay except for the moving coil winding and the scale marking. In addition to the relay itself, two external resistor boxes are furnished. The larger of these is the bridge box and the smaller is a series resistor.

The field coils of this relay are connected across the main bus or control circuit. The moving coil is connected to an external bridge box, of which the search or exploring coil forms one arm. In other words, the relay is connected across the center of a Wheatstone bridge composed of three resistors mounted in the external bridge box of figure 10 & the exploring coil located in the equipment being protected.

CHARACTERISTICS & SETTINGS

Type D-2 Relay

The type D-2 relay is available in any combinations of stationary and moving coil circuits listed below. The contacts are single trip.

Moving Coil Circuit

Range in Millivolts, d-c.	Average Resistance in Ohms at 25°C
0-10	.35
5-0-5	.35
40-80	1.4
100-0-100	6.5
0-200	6.5

Stationary Field Coil Circuit

Control Voltage	Connection Of Coils	Average Total Coil Resistance In Ohms at 25°C.
100-125	Parallel	700
200-250	Series	2,800
500-625	Series	2,800*
1200-1500	Series	2,800▭

* S#819967 4800 Ohm External Resistor Supplied.
▭ S#819968 16000 Ohm External Resistor Supplied.

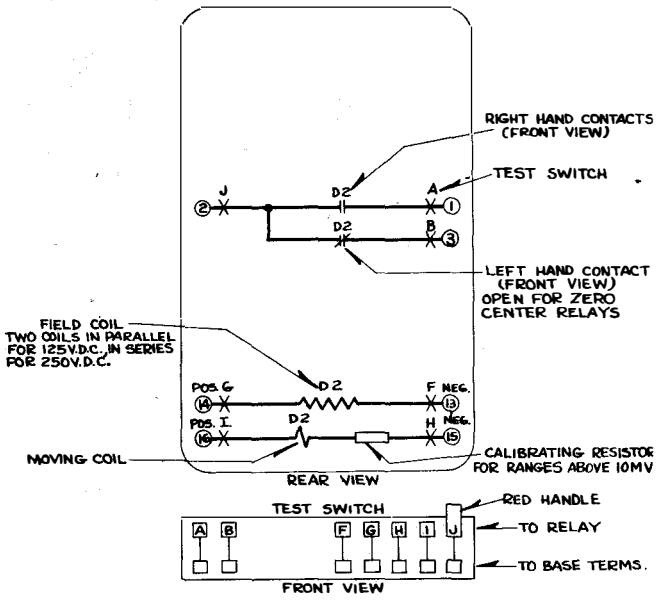


Figure 5
Internal Schematic of the Type D-2 Relay in the Type FT Cases.

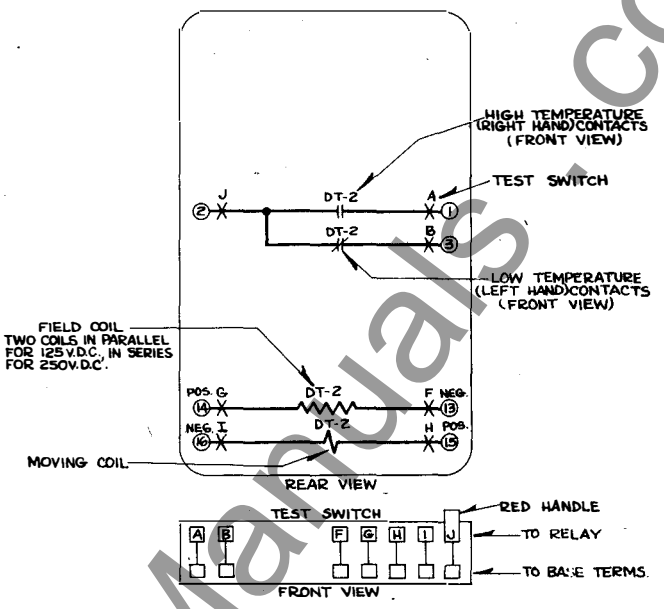


Figure 6
Internal Schematic of the Type DT-2 Relay in the Type FT Case.

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

The potential and control circuits thru the relay are disconnected from the external circuit by opening the associated test switches.

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

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

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

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

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug.

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

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the standard cases and the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or 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 external connections are shown in figures 3, 4, 7,8,9,11 & 12. The potential field coils should be energized from the generator side of the circuit-breaker.

The tripping circuit will close one ampere, but should not be used to open the circuit. For larger tripping circuits a control relay should be interposed. An auxiliary contact on the circuit-breaker must be provided to open the tripping circuit when the breaker opens.

The connections between the moving element of the type D-2 relay and the ammeter shunt should use leads of copper conductor No. 10 B and S gauge, or larger, where the distance

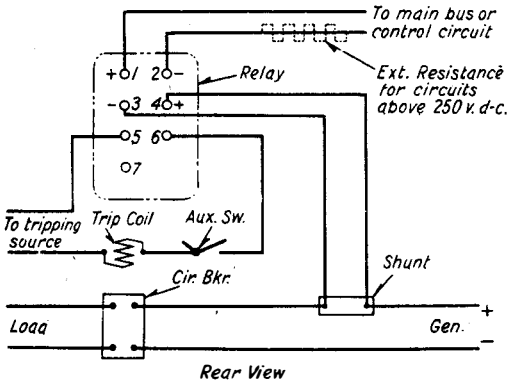


Figure 7
External Connections of the Type D-2 Relay in the Case of Fig. 14 for Overload Protection.

between relay and shunt does not exceed 12 feet. For greater distances, the leads should be proportionally larger. The 0-10 and 5-0-5 millivolt relays should not be connected across a shunt which will produce a drop greater than 200 millivolts at full load, as this would endanger the coil.

The use of standard ammeter shunts may be avoided by connecting the moving element leads over an equivalent length of bus-bar or cable. On a basis of 1000 amp. per square inch, at 20° C., 6 feet of copper bus-bar will give 50 millivolts drop.

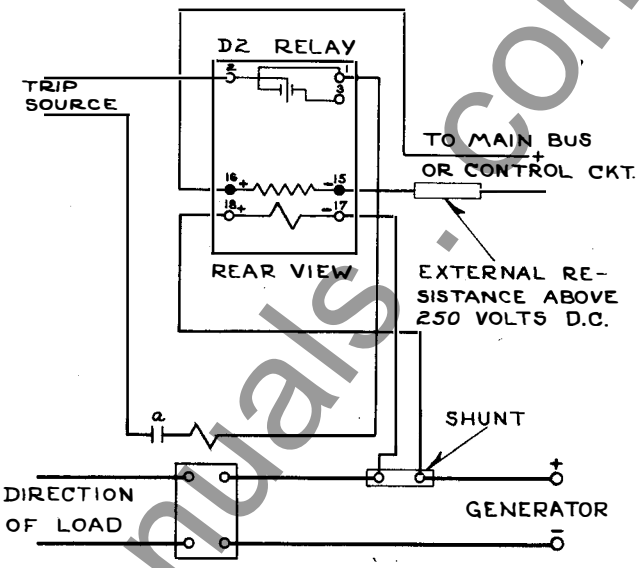
The ambient temperature at the Type DT-2 relay has no appreciable effect on its operation. The ambient temperature will affect the resistance of the leads to the search coil, of course, but by connecting these as shown in figures 3 or 4, one lead is included as a part of leg BC of the bridge and the variation of lead resistance is thus substantially balanced out. It might be more convenient in some cases to connect the bridge box and series resistor directly to the source, instead of having to run one supply lead to a search coil terminal at the machine. This can be done if the search coil leads are short or have a total resistance less than about 0.25 ohm. Such a lead resistance would cause the relay contacts to close when the search coil was 6.5° C. below the relay temperature setting, but this error can be compensated largely by adjusting the relay setting accordingly.

ADJUSTMENTS AND MAINTENANCE

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

All contacts should be periodically cleaned with a fine file. S#1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

If the moving element should be removed, the bearing end-play should be checked when replacing it. This should be from .020



NOTE: WITH POLARITIES AS SHOWN, THE CONTACTS BETWEEN TERMINALS 1 AND 2 CLOSE ON OVERLOAD IN DIRECTION SHOWN; CONTACTS 1 AND 3 CLOSE ON REVERSE LOAD.

Figure 8
External Connections of the Type D-2 Relay in Standard Cases of Fig. 15.

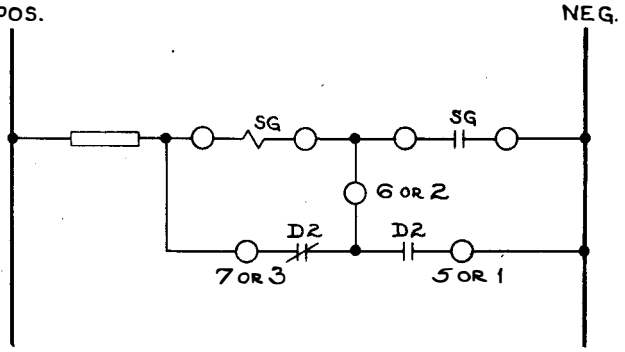


Figure 9
Schematic Connections for Anti-pumping of the Type D-2 Relay When Used For Overload Protection. First Number Indicates Terminal Number in Figures 1 and 3; Second, in Figures 2 and 4.

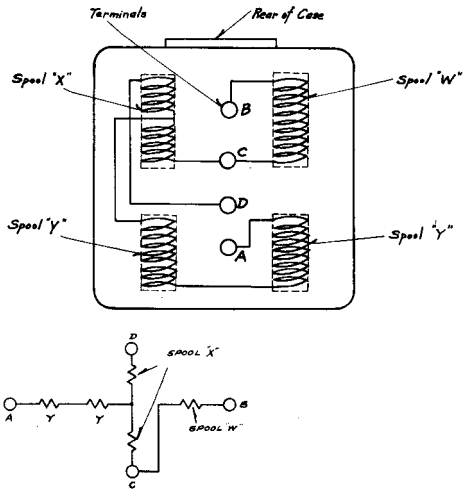
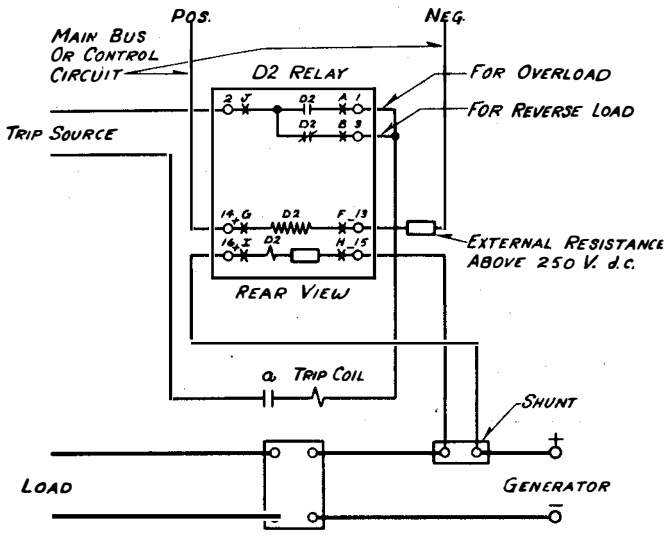
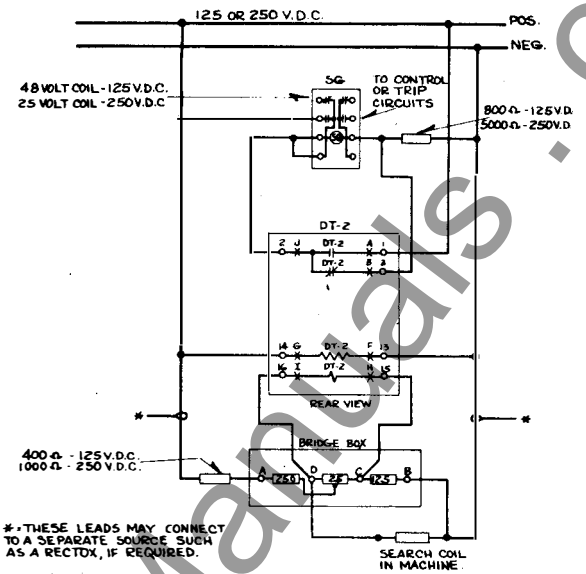


Figure 10
Internal Connections of the Bridge Box Supplied with the Type DT-2 Relays.



NOTE: WITH POLARITIES AS SHOWN, THE CONTACTS BETWEEN TERMINALS 1 & 2 CLOSE ON OVERLOAD IN DIRECTION SHOWN; CONTACTS 1 & 3 CLOSE ON REVERSE LOAD.

Figure 11
External Connections of the Type D-2 Relay in the Type FT Case for Overload or Reverse Load Protection.



WITH THE CONNECTIONS AS SHOWN THE MOVING COIL ROTATES CLOCKWISE AND THE LOW TEMPERATURE CONTACT CLOSES WITH THE MACHINE COLD. THE DIRECTION OF ROTATION REVERSES AS THE TEMPERATURE RISES ABOVE MID-RANGE.

Figure 12
External Connections of the Type DT-2 Relay in the Type FT Case for the Thermal Protection of Electrical Equipment.

inch to .025 inch, and can be measured by inserting a feeler gauge between the upper bearing screw and the shoulder on the moving element shaft.

In case it should be desirable to check the calibration of the Type DT-2 relay, this can be conveniently done by substituting a variable resistor for the search coil. Any scale point can be checked by setting the resistor for the corresponding resistance, as indicated in the table below, and seeing that the moving contacts travel to the indicated scale position. The relay should be energized at normal voltage for the test, and all other connections should be made as shown in Figs. 3, 4 & 12.

Temperature Degrees Centigrade	Resistance Ohms
60°	11.35
70°	11.73
80°	12.12
90°	12.50
100°	12.89
110°	13.28
120°	13.66

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.

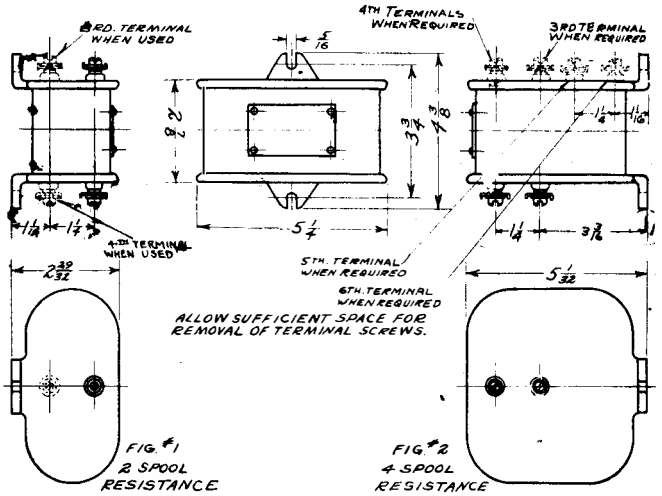


Figure 13
Outline & Drilling Plan for the External Resistor Units. (See Table for Size & Number of Terminals.) (For Reference Only.)

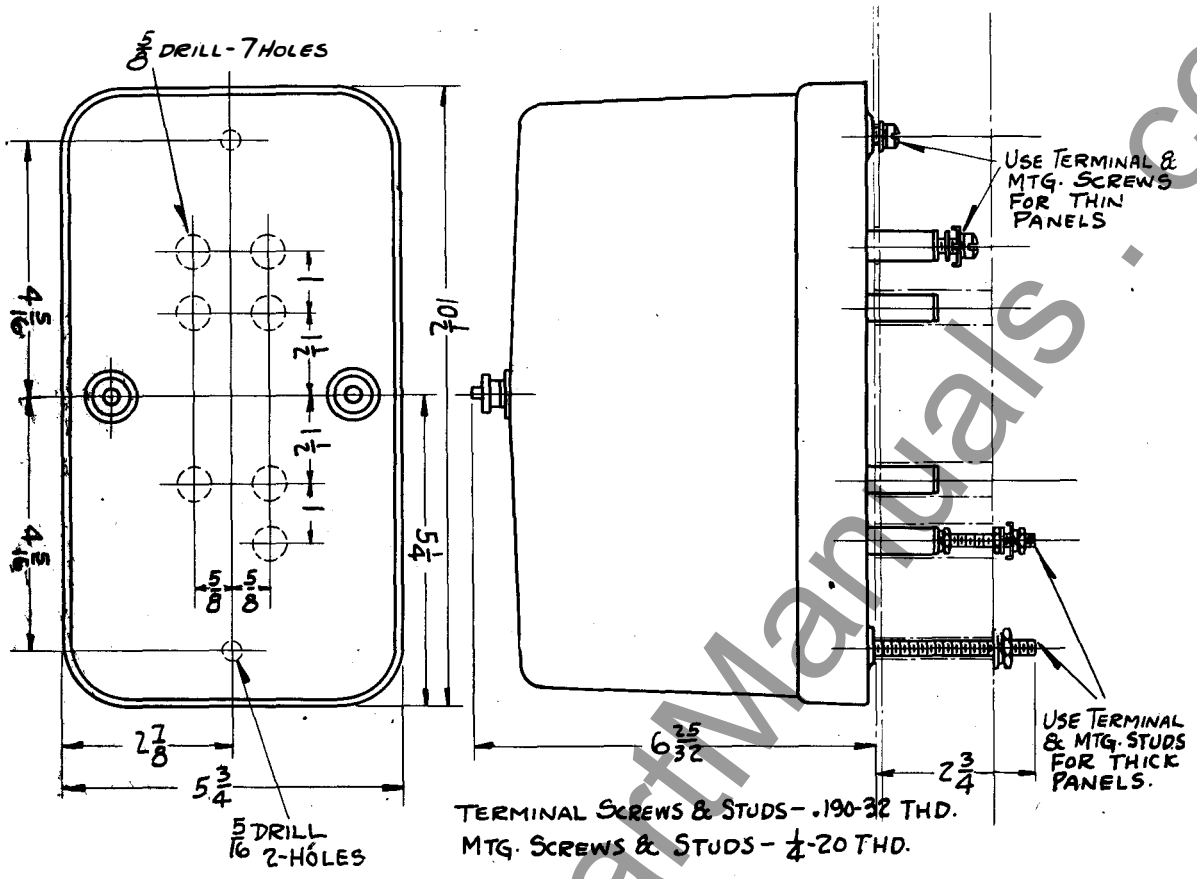


Figure 14
Outline & Drilling Plan for the Older Type Glass Cases. For Reference Only.

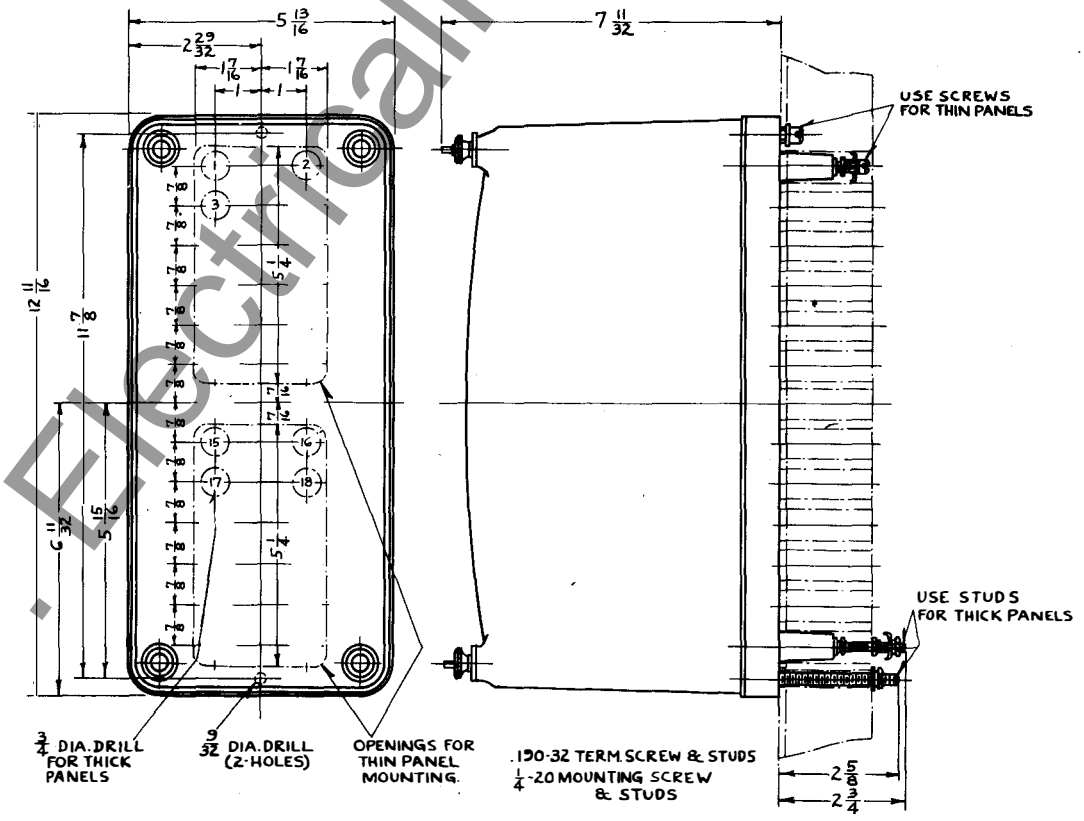


Figure 15
Outline & Drilling Plan for the Standard Projection Case. See Internal Connection Figures for Terminals Supplied. For Reference Only.

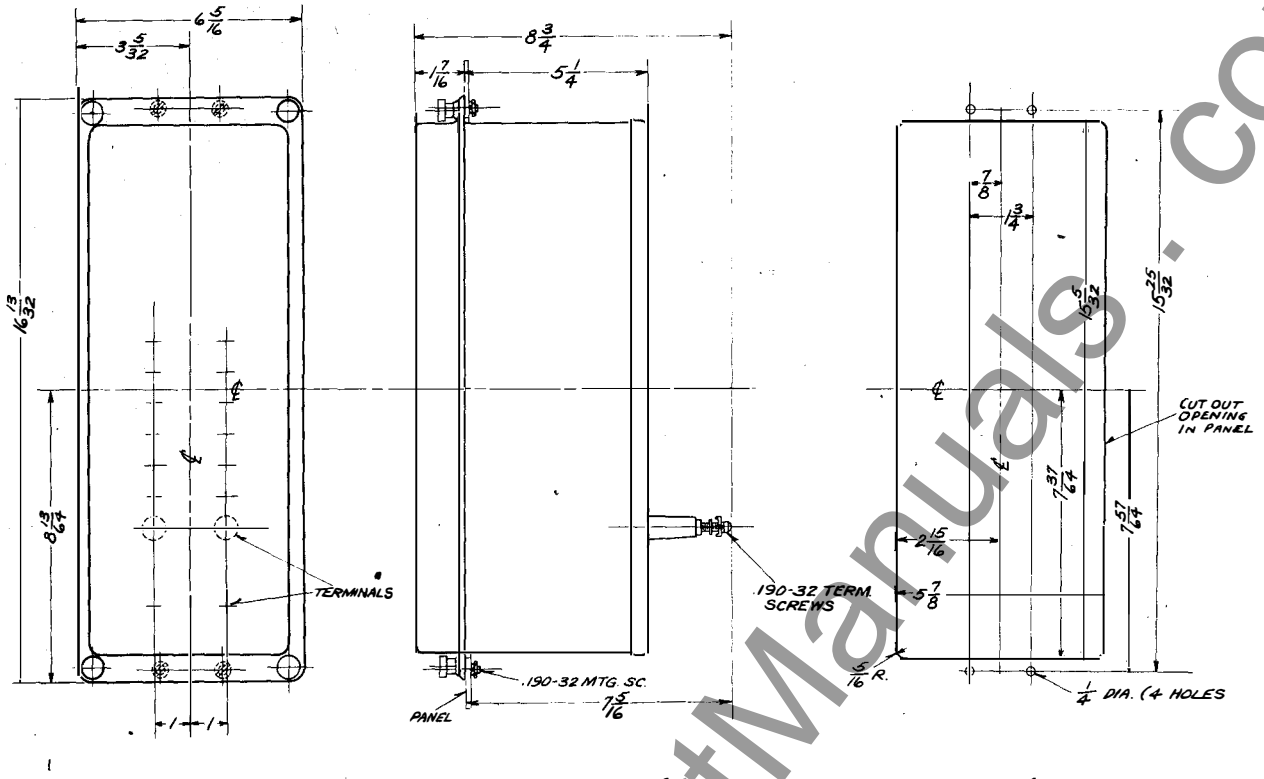


Figure 16
Outline & Drilling Plan for the M10 Semi-flush Type FT Case. For Reference Only.

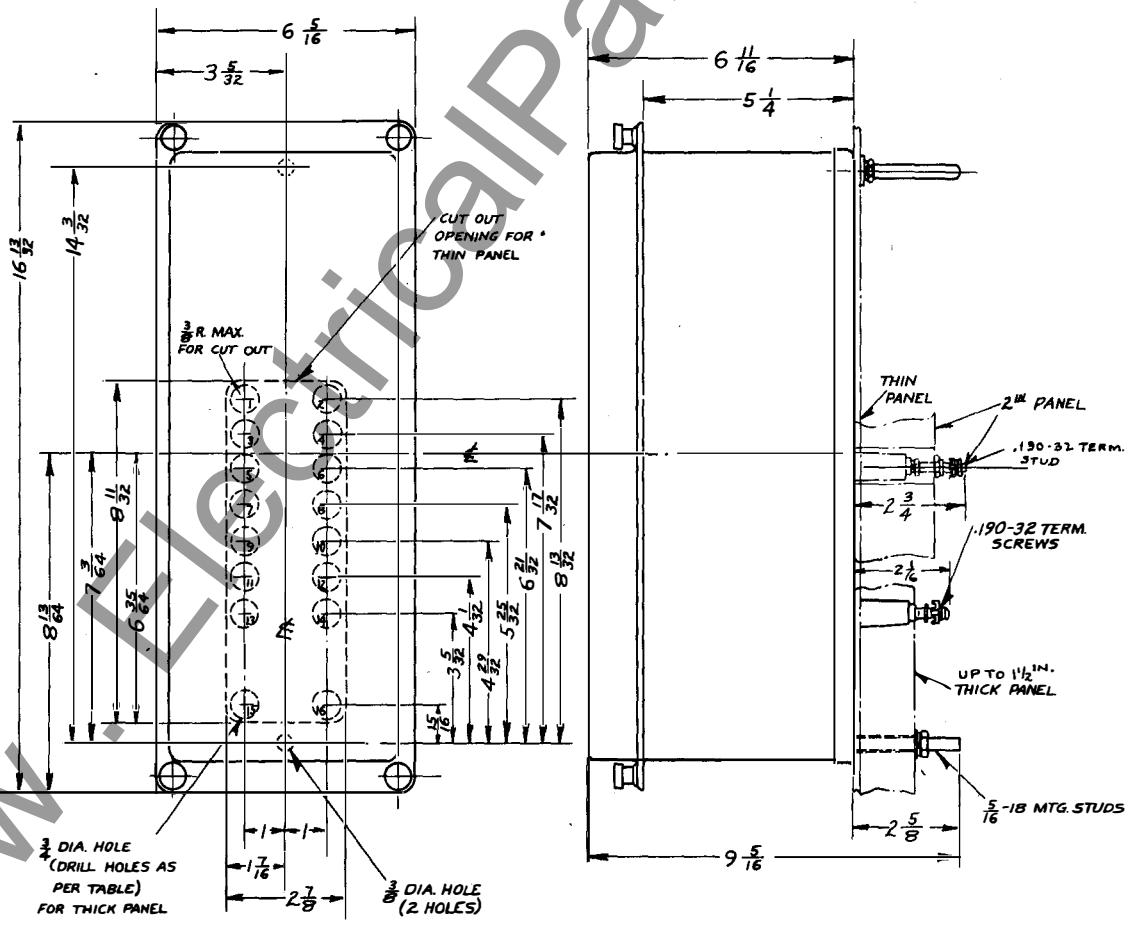


Figure 17
Outline & Drilling Plan for the M10 Projection Type FT Case. See the Internal Schematic for the Terminals Supplied. For Reference Only.