INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CF-1 FREQUENCY RELAY

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 CF-1 relay is an induction disc type frequency relay. It is used for the protection or control of equipment on systems where the frequency of the system changes. A typical application is in the protection of local generators in industrial plants from severe overload when the power company tie is lost.

CONSTRUCTION AND OPERATION

The type CF-1 relay contains an electromagnet, contactor switch, and operation indicator. A condenser and resistor associated with the relay circuits are mounted in an external box.

Frequency Element

The operating element consists of an electromagnet operating on a conducting disc. The electromagnet has potential windings on both the upper and lower poles. The lower pole circuit has capacitance in series, the upper pole has not. The underfrequency relay is so designed that at normal frequency (60) cycles the upper pole current leads the lower pole current and the two out of phase fluxes thus produced act to give contact opening torque on the disc. When the frequency drops, the phase angle of the lower pole circuit becomes more leading, until at the frequency setting of the relay the lower pole current begins to lead the upper pole current, and the relay torque is reversed to the tripping direction. The lower the frequency the greater the phase angle displacement and hence the faster the relay trips. An adjustable resistor in the upper pole circuit is provided to set the frequency at which the relay trips.

Contactor Switch

The d-c contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch contacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. These contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker. The contactor switch is equipped with a third point which may be connected to a terminal on the relay to operate a bell alarm.

Operation Indicator

The operation indicator is a small solenoid coil connected in the trip circuit. When the coil is energized, a spring-restrained armature releases the white target which falls by gravity to indicate completion of the trip circuit. The indicator is reset from outside of the case by a push rod in the cover or cover stud.

CHARACTERISTICS

The type CF-1 relay is available in two

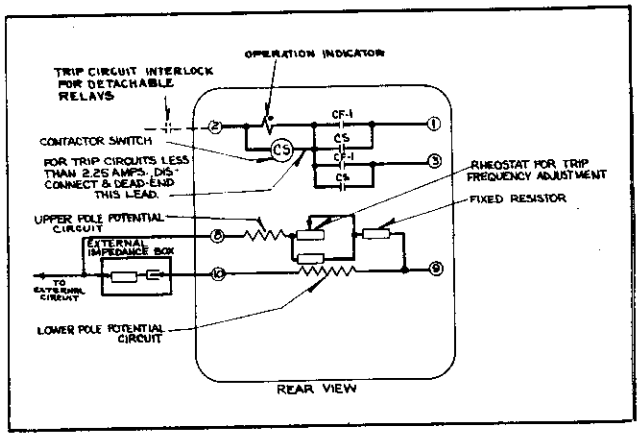

Fig. 1—Internal Schematic of the Double Pole, Single Throw Type CF-1 Relay in the Standard Case. The Relay With Single Pole, Single Throw Contacts Has Terminal 3 and Associated Circuits Omitted.

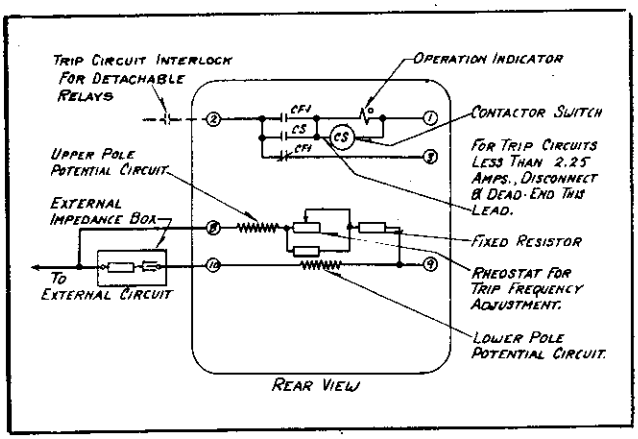

Fig. 2—Internal Schematic of the Single Pole, Double Throw Type CF-1 Relay in the Standard Case.

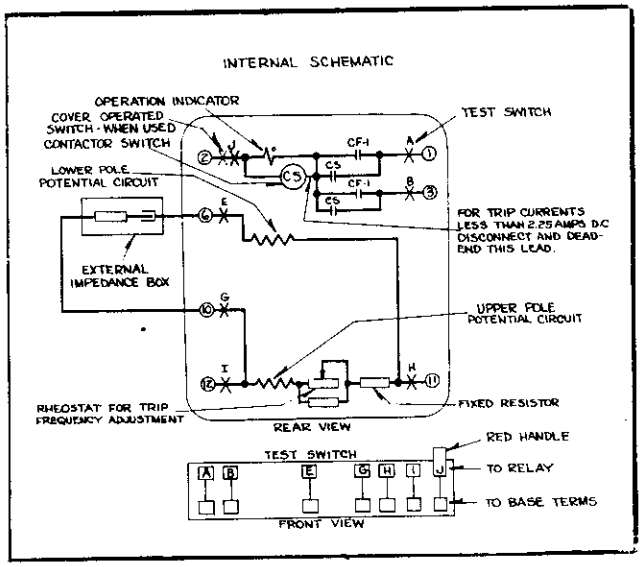

Fig. 3—Internal Schematic of the Double Pole, Single Throw Type CF-1 Relay in the Type FT Case. The Relay With Single Pole, Single Throw Contacts Has Terminal 3 and Associated Circuits Omitted.

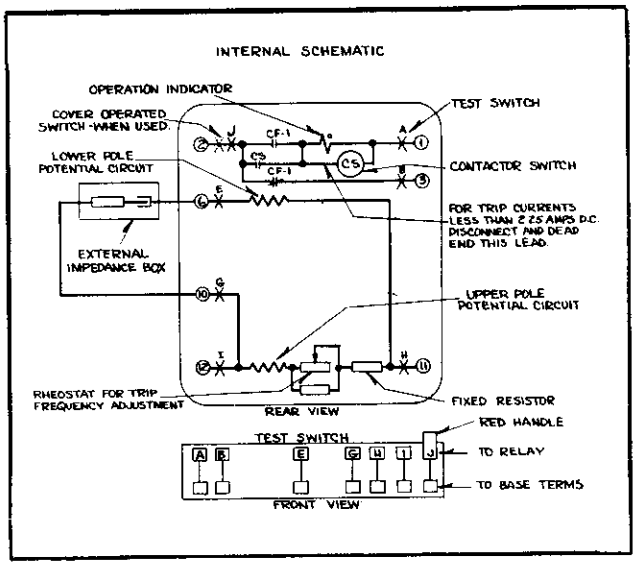

Fig. 4—Internal Schematic of the Single Pole, Double Throw Type CF-1 Relay in the Type FT Case.

forms--either as an underfrequency relay or an overfrequency relay. Where operation on both underfrequency and overfrequency is desired, two relays are required, one of each form. Major changes are required to convert from one form to the other. The relay contacts are single or double pole single throw, or single pole double throw.

The underfrequency relay can be set to close contacts for any desired frequency between 50 and 60 cycles by setting the knob of the frequency adjusting rheostat to the desired frequency marked on the calibrated dial. Since the relay at minimum trip operates like a directional element near zero torque, the relay is very sensitive to phase angle change resulting from a frequency change. Thus minimum trip is little affected by voltage variation. Typical voltage vs. minimum trip frequency curves are shown in Fig. 5. The circuits are also designed to minimize temperature error. Typical minimum trip frequency vs. temperature curves are shown in Fig. 6.

The relay has adjustable inverse time characteristics. Desired time settings may be made by means of the time lever which is continuously adjustable from the #1/2 to #10 lever positions. Typical time curves for the

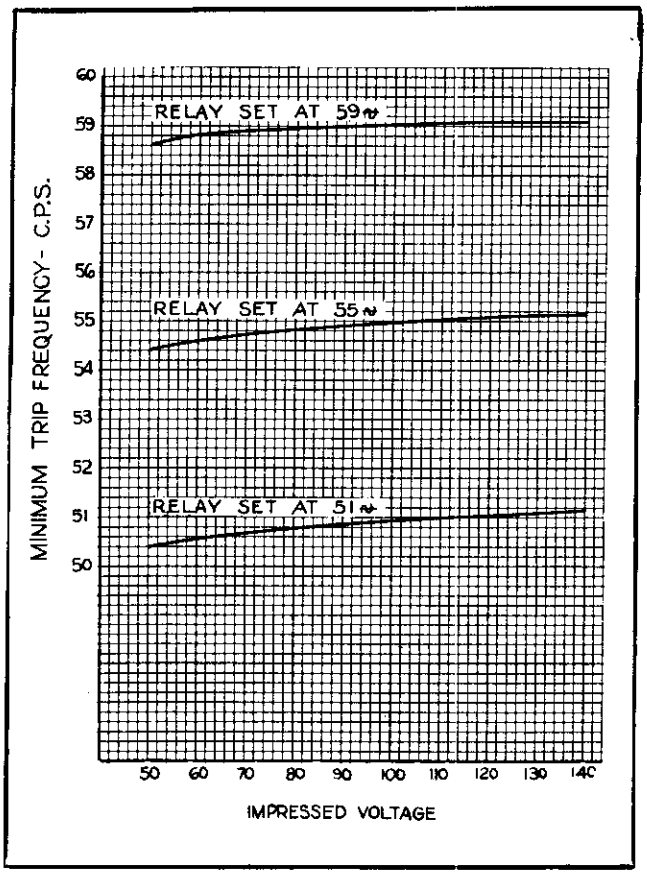

Fig. 5—Typical Voltage-Minimum Trip Frequency Curves of the Type CF-1 Underfrequency Relay.

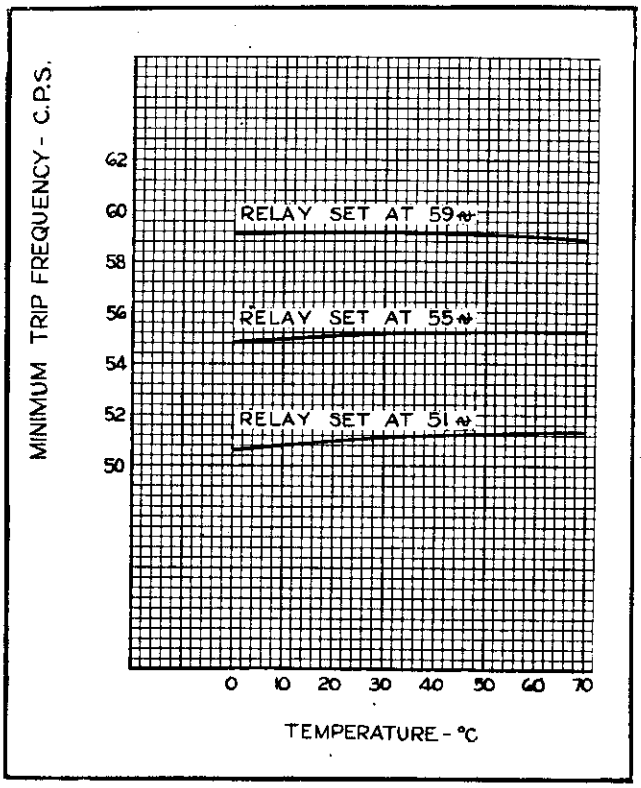

Fig. 6—Typical Temperature-Minimum Trip Frequency Curves of the Type CF-1 Underfrequency Relay.

different lever settings are shown in Figs. 7, 8 and 9. Individual relays may vary ±10% from these curves.

The frequency relay contact closing and opening points are essentially the same. The relay will reset to the maximum time lever setting when the frequency changes .1 to .2 cycles from the setting. For example, suppose the 60 cycle under-frequency relay is set to close its contacts at 59 cycles from the #10 lever setting. The contact will start to move at 59.1 to 59.2 cycles but will not close until the frequency drops to 59 cycles or below. As the frequency rises just above 59 cycles, the contacts open, but will not completely reset to the #10 lever setting until the frequency rises to 59.1 or 59.2 cycles. With the time lever set at less than its maximum position, the .1 to .2 cycle differential is correspondingly less.

The continuous rating of the relay is 127 volts, 50 to 60 cycles.

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

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

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

Electrical Circuits

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

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

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

Testing

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

Testing In Service

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

Testing In Case

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

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

Testing Out of Case

With the chassis removed from the base, relay elements may be tested by using the ten circuit test plug or by #2 test clip leads as described above. The factory calibration is made with the chassis in the case and removing the chassis from the case will change the calibration values by less than 1 or 2%. It is recommended that the relay be checked in position as a final check on the calibration.

INSTALLATION

The relays should be mounted on switchboard

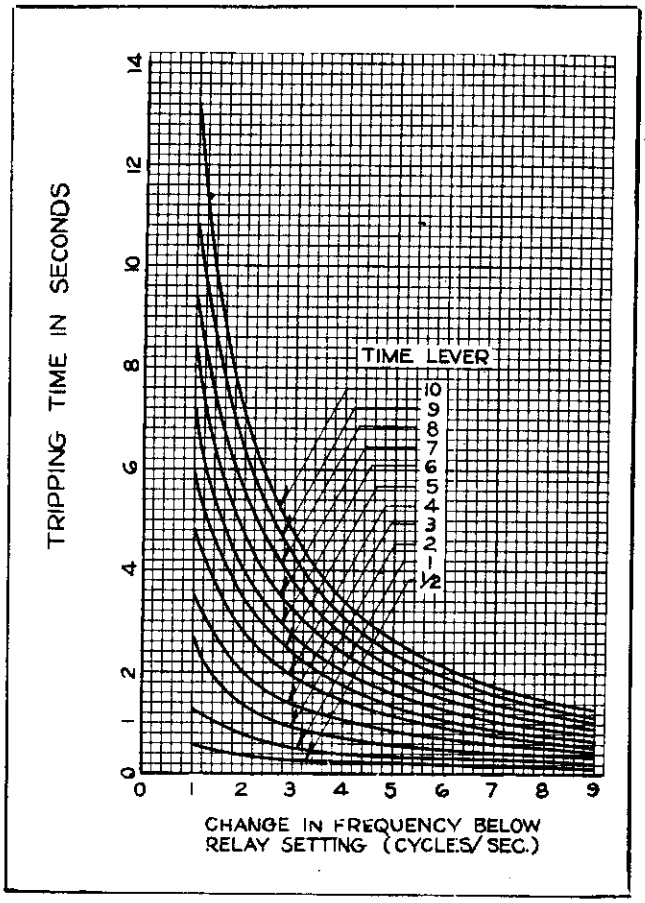

Fig. 7—Typical 57-60 Cycle Time Curves of the Type CF-1 Underfrequency Relay.

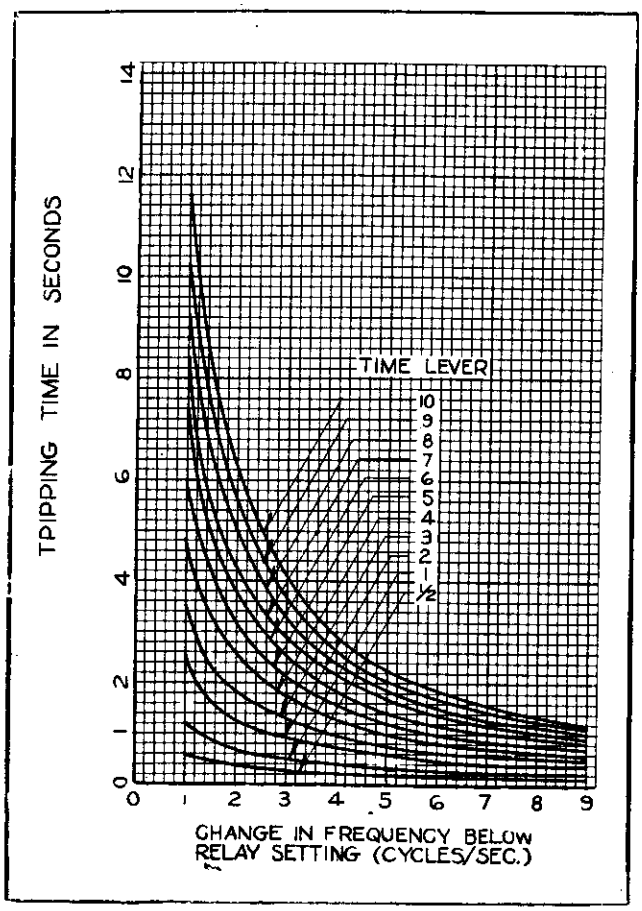

Fig. 8—Typical 53-57 Cycle Time Curves of the Type CF-1 Underfrequency Relay.

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 operating windings of the relay should be connected across a suitable potential transformer with the external impedance box connected as shown in Figs. 1 to 4. Each relay must be used with its designated auxiliary unit. Relays and auxiliary units may not be interchanged.

The relay is shipped with the operation indicator and contactor switch coils in parallel. This circuit has a resistance of approximately 0.25 ohm and is suitable for all trip currents above 2.25 amperes d-c. If the trip circuit is less than 2.25 amperes, there is no need for the contactor switch and it should be disconnected. This can be conveniently done by removing the lower lead on the front stationary contact of the contactor switch and dead-ending it under the small filister head screw located in the Micarta base of the switch. The operation indicator will operate for trip currents above 0.2 ampere d-c. The resistance of this coil is approximately 2.8 ohms.

SETTINGS

The relay is set for minimum trip by means

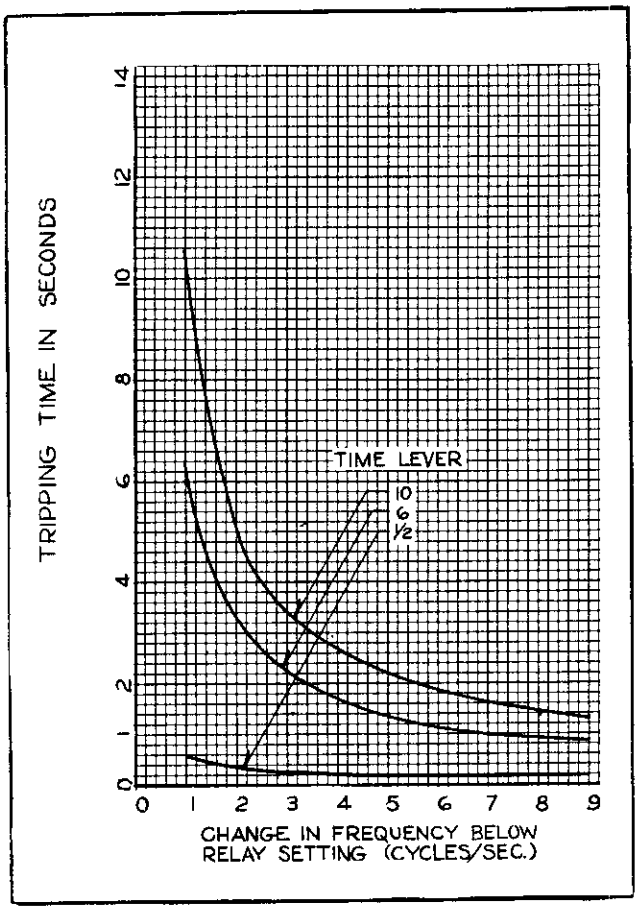

Fig. 9—Typical 50-53 Cycle Time Curves of the Type CF-1 Underfrequency Relay.

of the frequency adjusting rheostat. The time lever position determines relay timing. The curves are drawn for variation of frequency in cycles below the frequency adjusting rheostat setting.

To adjust the CF-1 relay contacts to be quick opening, screw in the small set screw on the stationary contact assembly until the contact rivet rests solidly on the Micarta support. When this is done, the position of the contact stop on the time lever should be shifted so that the moving and stationary contacts barely touch when the time lever is set on zero. The contact opening time with no follow will be 3 to 6 cycles.

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.

Frequency Element

Shift the position of the contact stop on the time lever, and adjust the contacts so that they barely touch when the time lever is set on zero.

The relay spring tension is adjusted to just reset the moving contact to the #10 lever position when the operating windings are de-energized, and the adjuster is then wound up an additional 1/4 to 1/2 turn.

To check the minimum trip calibration of any point on the frequency scale, the relay should be energized at 115 volts and 60 cycles for at least 1/2 hour. The frequency may then be changed to the desired value, and the relay checked for minimum trip.

To check the time curves, the relay, after being energized at 60 cycles and 115 volts for at least 1/2 hour to reach equilibrium coil temperature, should be de-energized and then the desired frequency applied at 115 volts. Timing may be determined by means of a cycle counter, and the damping magnet shifted to make the relay timing agree with the curves.

Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and the moving core when the switch is picked up. This can be most conveniently done by turning the relay up-side-down. Screw up the core screw until the moving core starts rotating. Now, back off the core screw until the moving

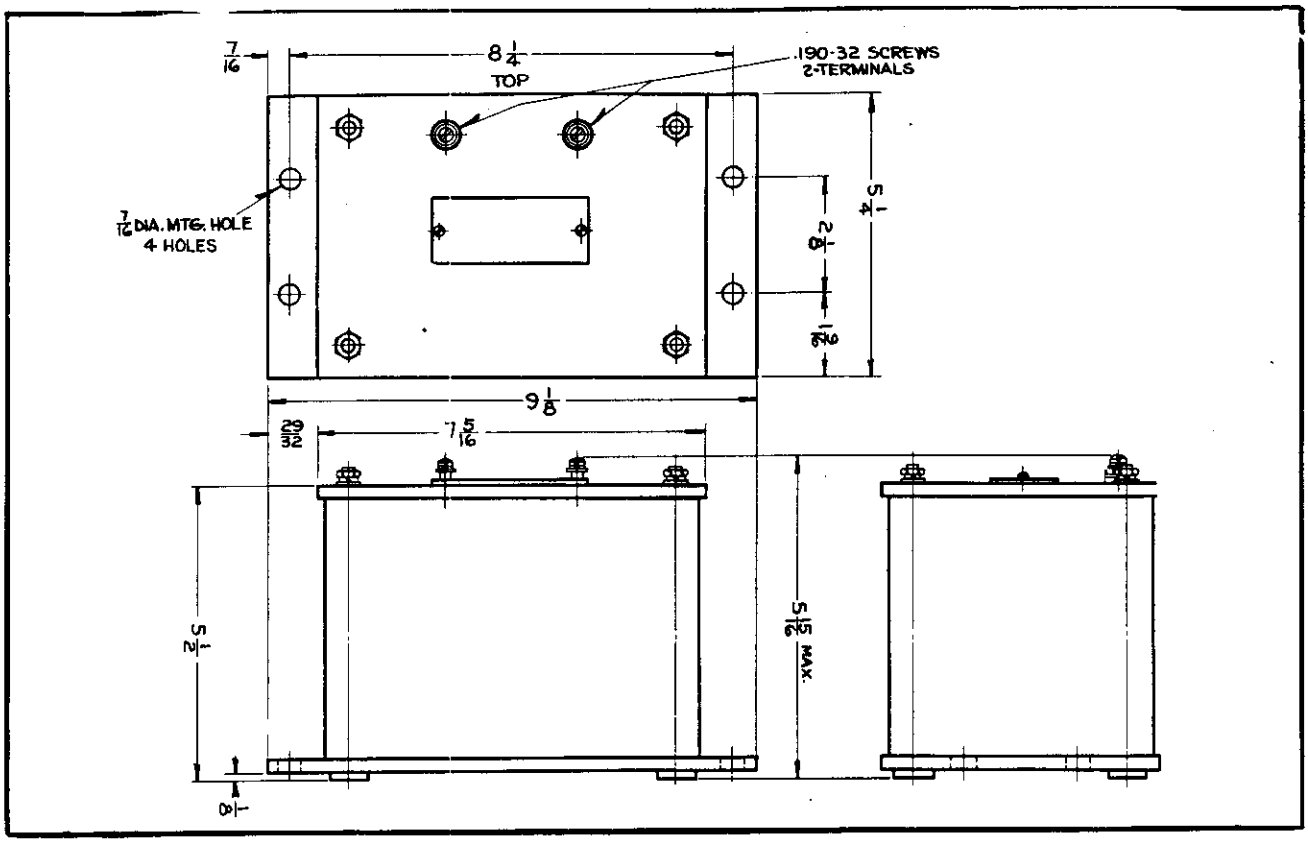

Fig. 10—Outline and Drilling Plan for the External Impedance Box. For Reference Only.

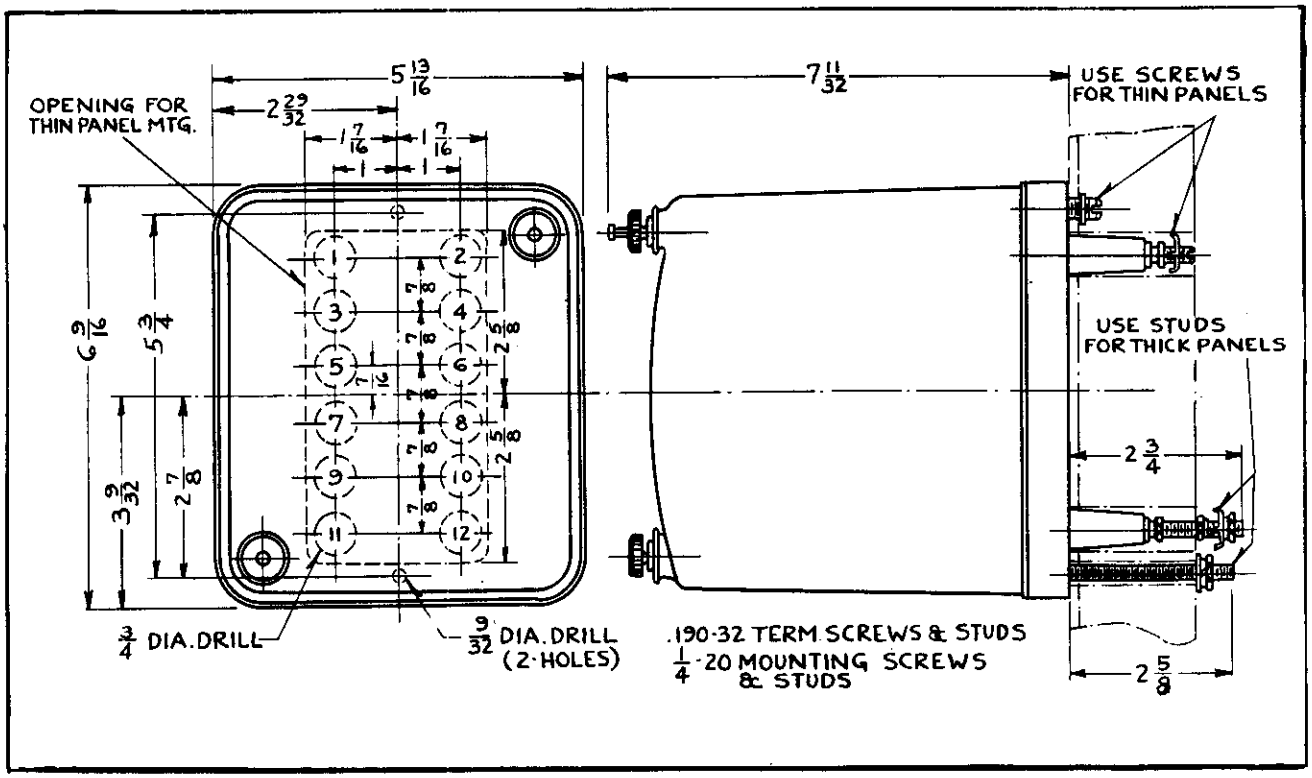

Fig. 11—Outline and Drilling Plan for the Standard Projection Type Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

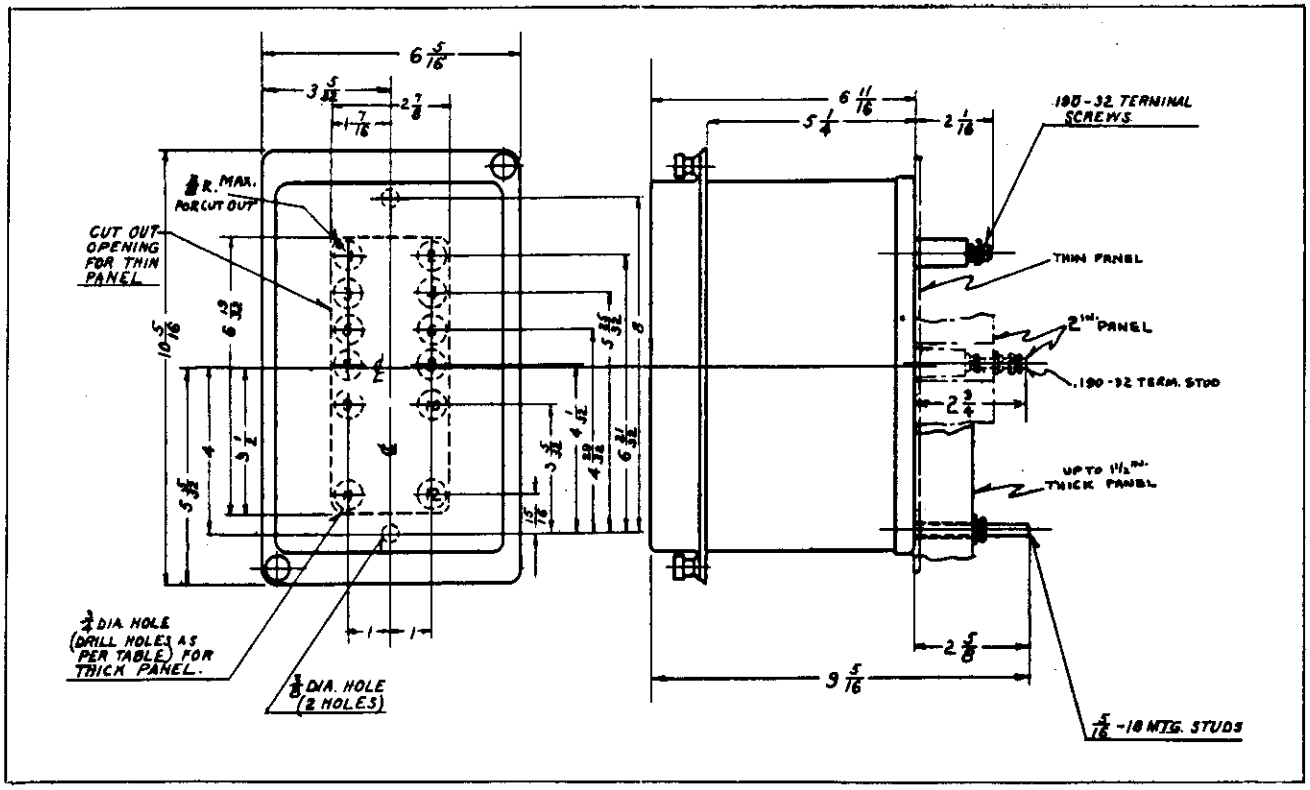

Fig. 12—Outline and Drilling Plan for the S10 Projection Type FT Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

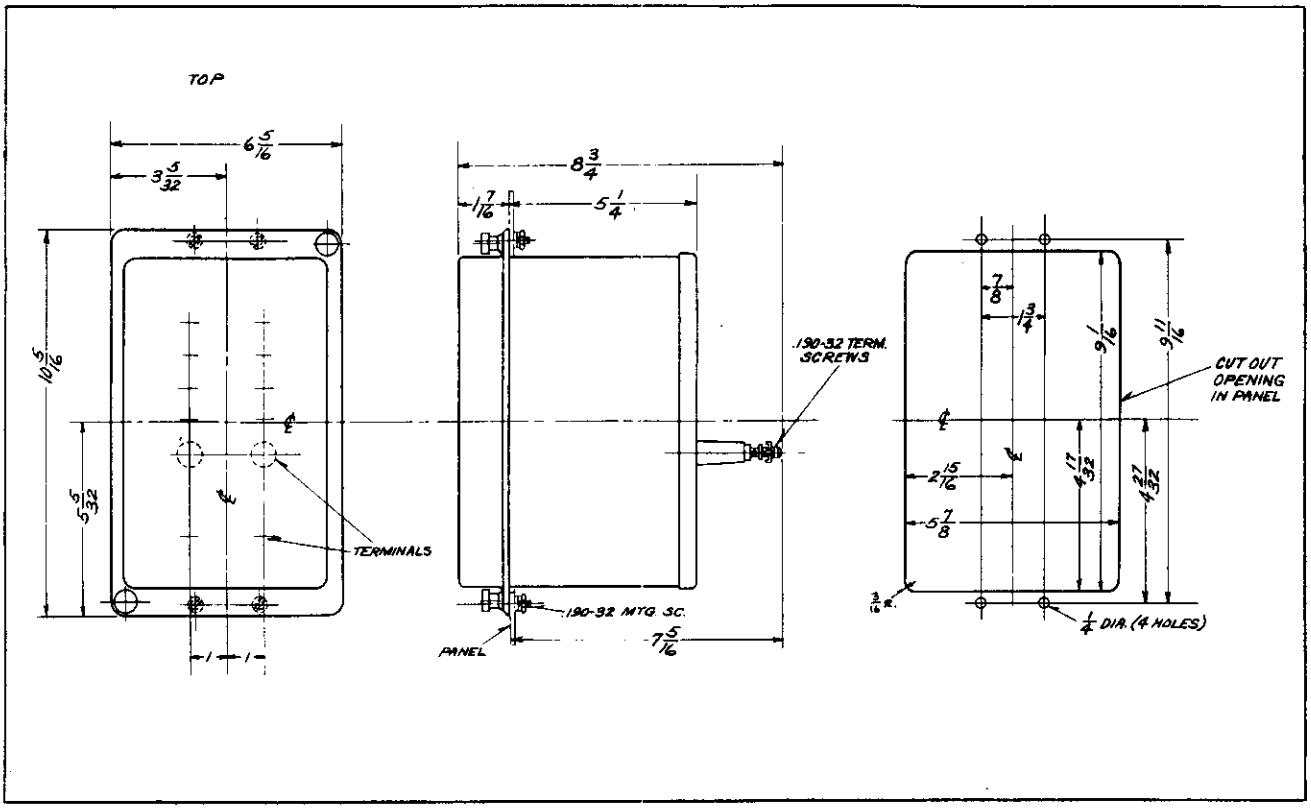

Fig. 13—Outline and Drilling Plan for the S10 Semi-Flush Type FT Case. For Reference Only.

core stops rotating. This indicates the point where the play in the moving contact assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the stationary core screw one-half turn beyond this point and lock in place. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 3/32 inch by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 2 amperes d-c. Test for sticking after 30 amperes d-c have been passed thru the coil. The coil resistance is approximately 0.25 ohm.

Operation Indicator

Adjust the indicator to operate at 0.2 ampere d-c gradually applied by loosening the two screws on the under side of the assembly, and moving the bracket forward or backward. If the two helical springs which reset the armature are replaced by new springs, they should be weakened slightly by stretching to obtain the .2 ampere calibration. The coil resistance is approximately 2.8 ohms.

RENEWAL PARTS

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

ENERGY REQUIREMENTS

Typical burden characteristics of the relay coils at 115 volts, 60 cycles are as follows:

Frequency Adjusting Rheostat set for	VA	Watts	Lagging Vars
59 Cycles	16.5	12.3	11
55 Cycles	15.1	12	9.3
51 Cycles	12.9	10.8	7.1