INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CWK POWER FACTOR 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 CWK power factor relay is an A-C relay suitable for applications which require a circuit to be opened or to be closed when the power factor of a circuit drops below a predetermined amount. One such application is in connection with synchronous motors where the power factor decreases considerably when the machine falls out of step.

CONSTRUCTION AND OPERATION

The type CWK relay consists of a power factor element and may have a contactor switch and an operation indicator.

Power Factor Element

This element is a non-geared induction disc type element. The induction disc is mounted on a vertical shaft supported on the lower end by a steel ball bearing riding between concave sapphire jewel surfaces, and at the upper end by a stainless steel pin. The rotation of the disc is limited in the opening direction by a projecting stop on the disc which strikes the element frame, and in the closing direction by the rigid moving arm striking the stationary contact arm.

The moving contact assembly consists of a rigid counterweighted arm fastened to an insulated section of the disc shaft. A leaf spring fastens to the shaft end of the arm with a silver contact attached to the free end of the leaf spring. When the moving contact strikes the left hand, front view, stationary contact, the spring deflects to provide the required contact follow. The electrical connection is made from the moving contact thru the arm and spiral spring. One end of the spring is fastened to the arm, and the other to a slotted spring adjuster disc which in turn fastens to the element frame. The relay back contact (right hand, front view) is of special "shock proof" design and is shown in Figure 2. This construction insures that the back contacts will remain definitely closed until the relay operates positively in the tripping direction.

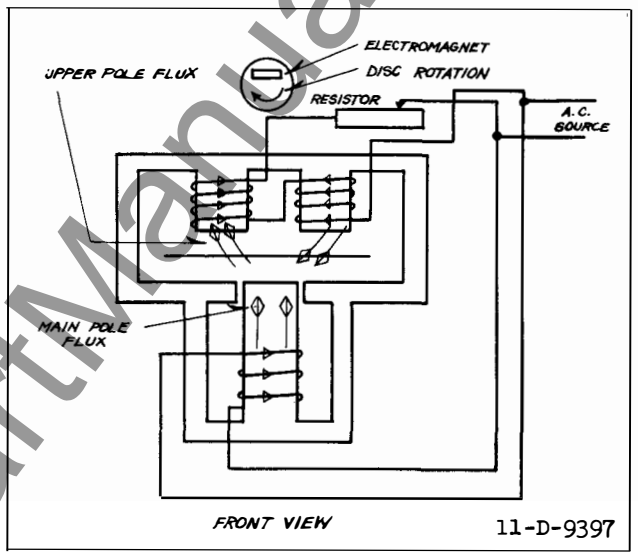

Fig. 1—Flux and Current Relations in Type CWK Relay Operating Element.

The moving contacts can be biased by means of a spiral control spring, so that when the relay is de-energized they stand against the front or the back contacts. Usually the

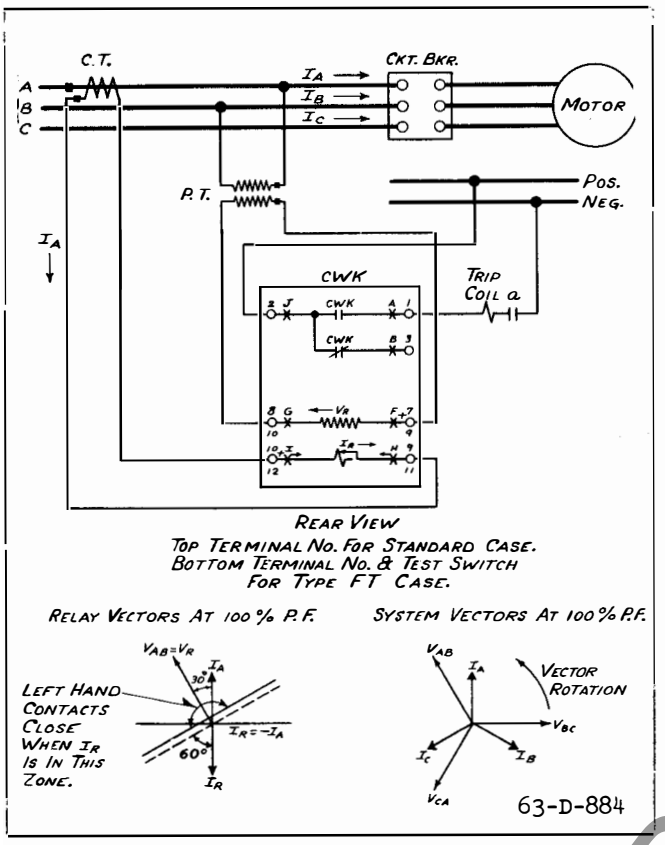

Fig. 12—External Connections of the Type CWK Relay in the Standard or Type FT Case for a Three Phase System.

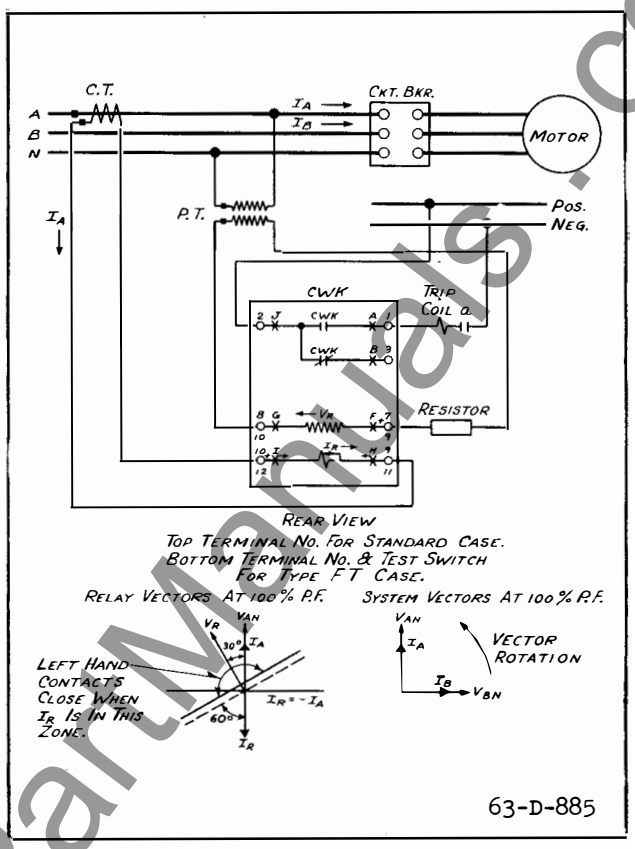

Fig. 13—External Connections of the Type CWK Relay in the Standard or Type FT Case for a Two Phase Three Wire System.

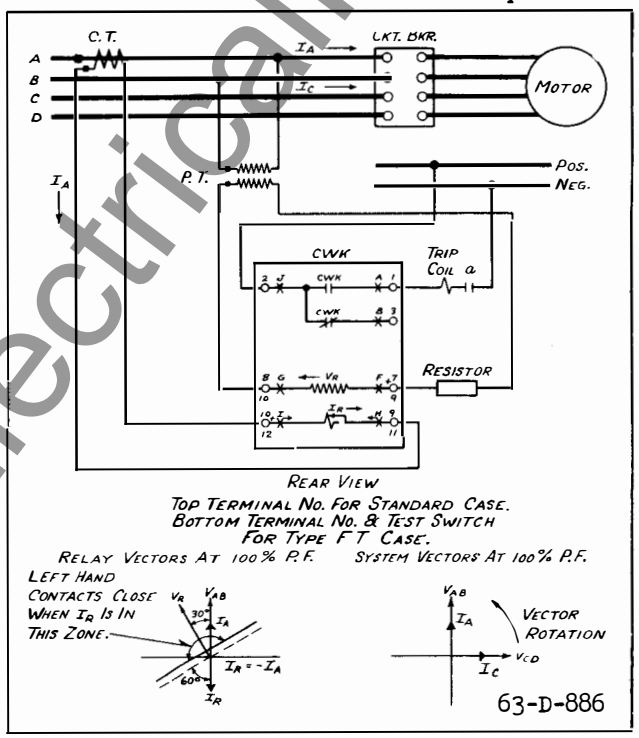

Fig. 14—External Connections of the Type CWK Relay in the Standard or Type FT Case for a Two Phase Four Wire System.

switches of the current test switch pair must be open when using the current test plug or insulating material in this manner to short-circuit the current transformer secondary.

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

Testing

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

Testing In Service

The ammeter test plug can be inserted in the current test jaws to check the current thru the relay after opening the knife-blade switch. 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 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 the top test switch jaws with the binding posts down.

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the current elements using clip leads, care should be taken to see that the current test jack jaws 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 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 type CWK power factor relay is often used to remove a synchronous motor from the line upon the loss of field or after it has pulled out of step. For either case, the power factor of the load drawn by the motor falls below 50%. That is, the line current lags the line-to-neutral voltage by more than 60°. However, by selecting the proper delta voltage, an extra 30° shift is secured so that the line current will lag this delta voltage by more than 90° when the motor pulls out of step. If the type CWK relay is properly connected to receive this voltage and current, the moving contact will leave the right-hand stationary contact and move to the left-hand contact when the motor pulls out of step. External connection diagrams are shown in Figures 9 to 14. Arrow with V_R shows direction of voltage drop across relay coil.

SETTINGS

In a typical installation the operation of the relay contacts during the starting time of the motor will be as follows: The relay contacts are closed to the right (front view) with no current flowing in the motor circuit. During the starting period a heavy lagging current flows and the moving contact swings over to the left. When the motor is synchronized, the back contacts again close.

In general the relay cannot be set to prevent tripping during starting, without excessively reducing the sensitivity to abnormal conditions for which the relay should trip. Therefore, the type CWK relay trip circuit is generally locked out by auxiliary circuits during startings.

The relay operation is determined by the position of the zero torque line. This may be located by the tap screw setting of the relay. For setting between taps the tripping value of the relay may be altered by changing the initial tension of the spiral spring. This can be accomplished by turning the spring adjuster by means of a screw driver inserted in one of the notches of the plate to which the outside convolution of the spring is fastened. **CAUTION**--Be sure that the connector screw is turned up tight so as to make a good contact, for the operating current passes through it. Since the current winding is connected directly ir the current transformer circuit, the latter should be short-circuited before changing the connector screw. This can be done conveniently by inserting the extra connector screw in the new tap and removing the old screw from its original setting.

The relay setting will be determined by the operating characteristics of the motor. For example, in certain cases the sudden removal of maximum load may cause an extra-heavy reverse power flow due to the motor feeding back into the line. This may cause the relay to operate unnecessarily and remove the excitation. For this condition a relatively high tap setting would be required.

In any case, required tripping and non-tripping currents should be plotted on a polar diagram. The zero torque line may then be properly located and the relay set 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.

Power Factor Element

Turn the adjusting screw of the shock-proof contact assembly, so that the flat stationary contact is deflected 1/32" by the spherical contact. This will require approximately 1/4 turn of the adjusting screw beyond the point where the spherical and flat contacts just make.

Adjust the left-hand (front view) stationary contact adjusting screw so that the moving contact travel is 1/16" from the point at which the back contact just opens to where the front contact just makes.

Adjust the spiral spring tension so that with rated voltage and tap value of current in phase, the back contacts are just opened by the moving arm. The front contacts should then close at 150% or less of tap value current.

Contactor Switch (When Supplied)

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 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 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 (When Supplied)

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. 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 name-plate data.

ENERGY REQUIREMENTS

The 60 cycle burdens of the type CWK relay are as follows:

I a) Potential coil burdens at rated voltage

Rated Volts	VA	PF Angle (Current Lagging)
115	19.4	77.2°
230	22.3	76.2°
550	17.7	77.1°

b) Maximum continuous voltage is 110% of rated value.

II Current coil burdens and ratings at 5 amperes.

Tap	VA	PF Angle (Current Lagging)	Continuous Current Rating	1 Second Current Rating
2	.675	39.3°	5.0	140
2-1/2	.503	35.1°	5.0	140
3	.351	31.9°	5.0	140
3-1/2	.264	27.4°	5.0	140
4	.179	25.5°	6.4	185
5	.135	20.1°	6.4	185
6	.100	16.7°	6.4	185

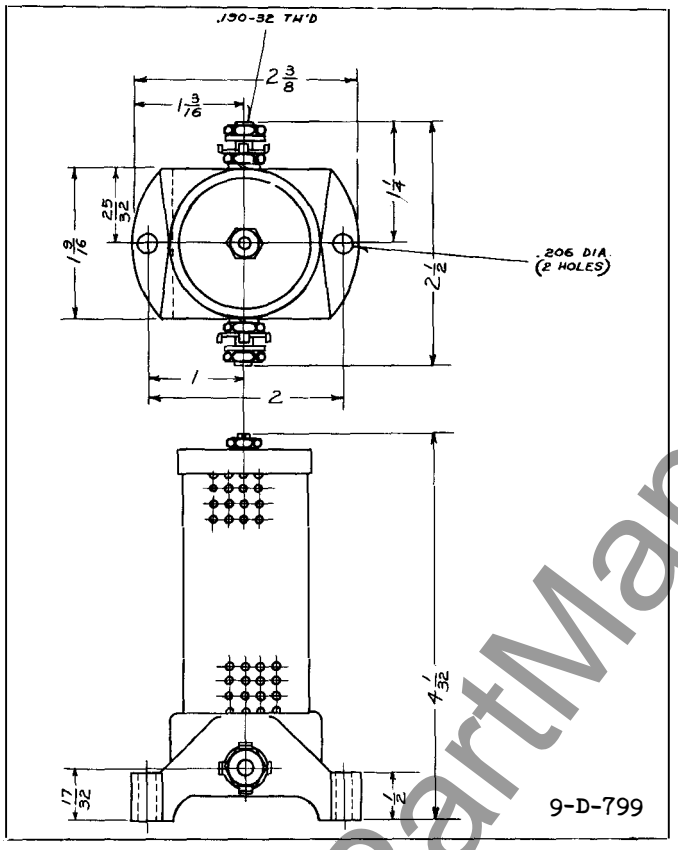

Fig. 15—Outline and Drilling Plan of the External Potential Coil Resistor for the Type CWK Relay Applied to Two Phase Systems.

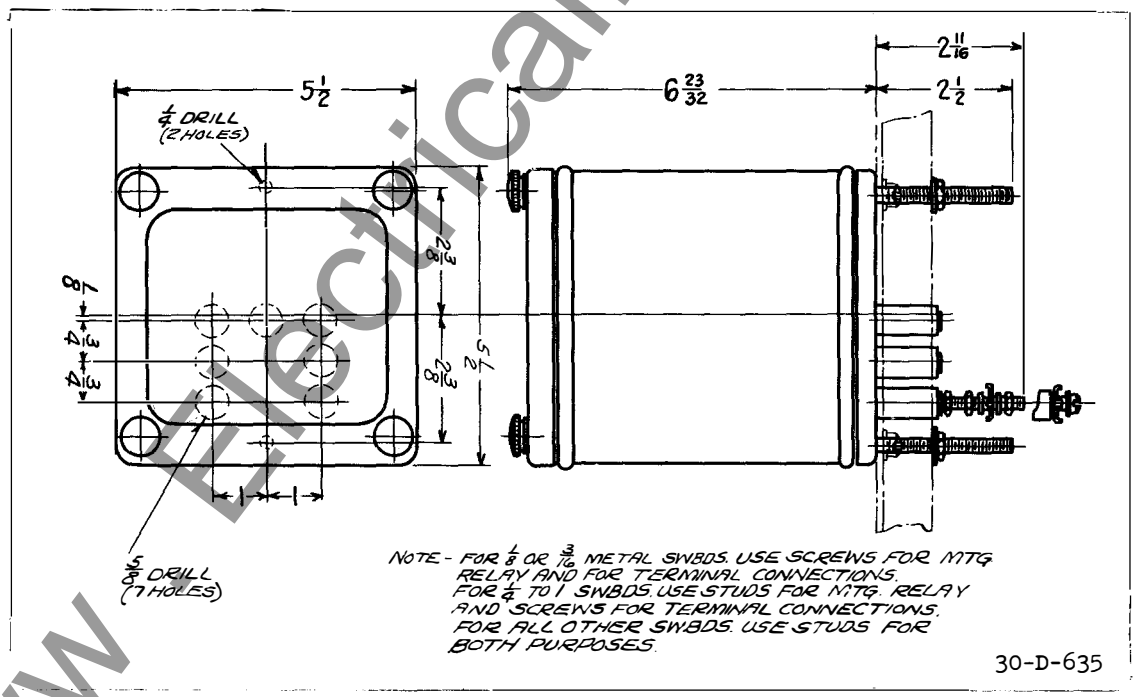

Fig. 16—Outline and Drilling Plan for the Metal Case. See the Schematics for the Terminals Supplied. For Reference Only.

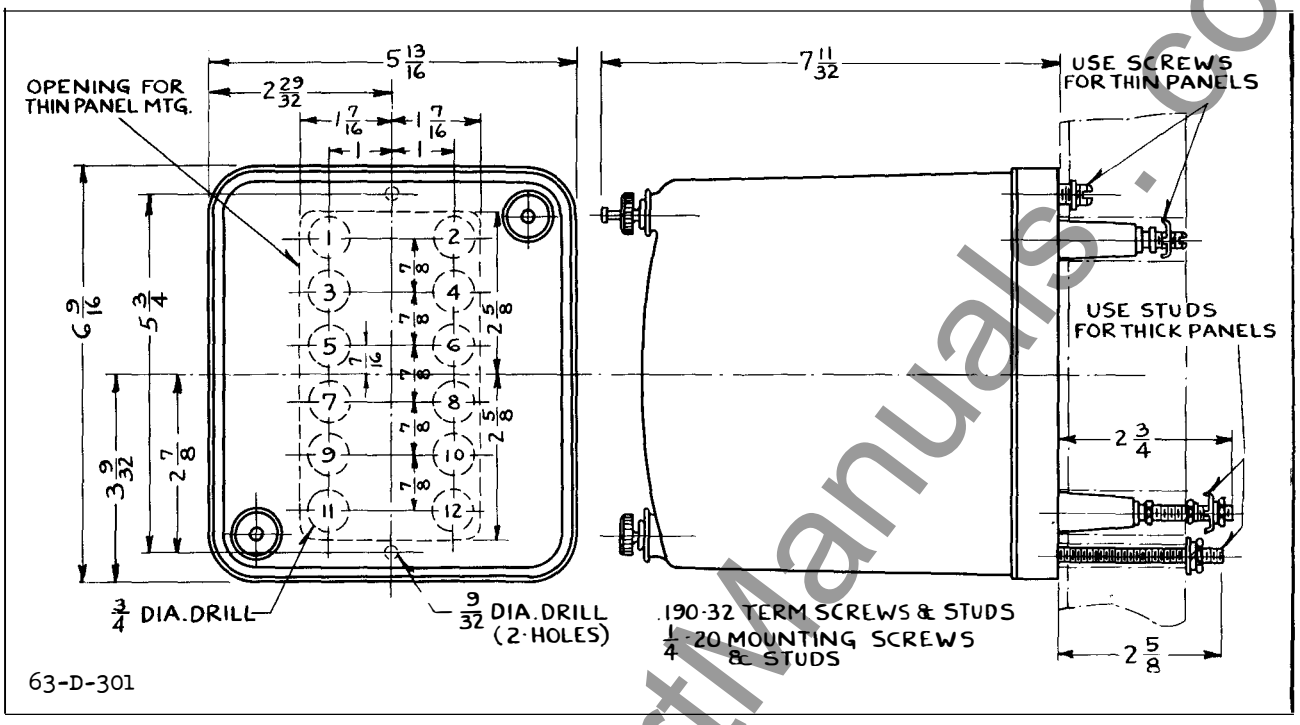

Fig. 17—Outline and Drilling Plan for the Standard Projection Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

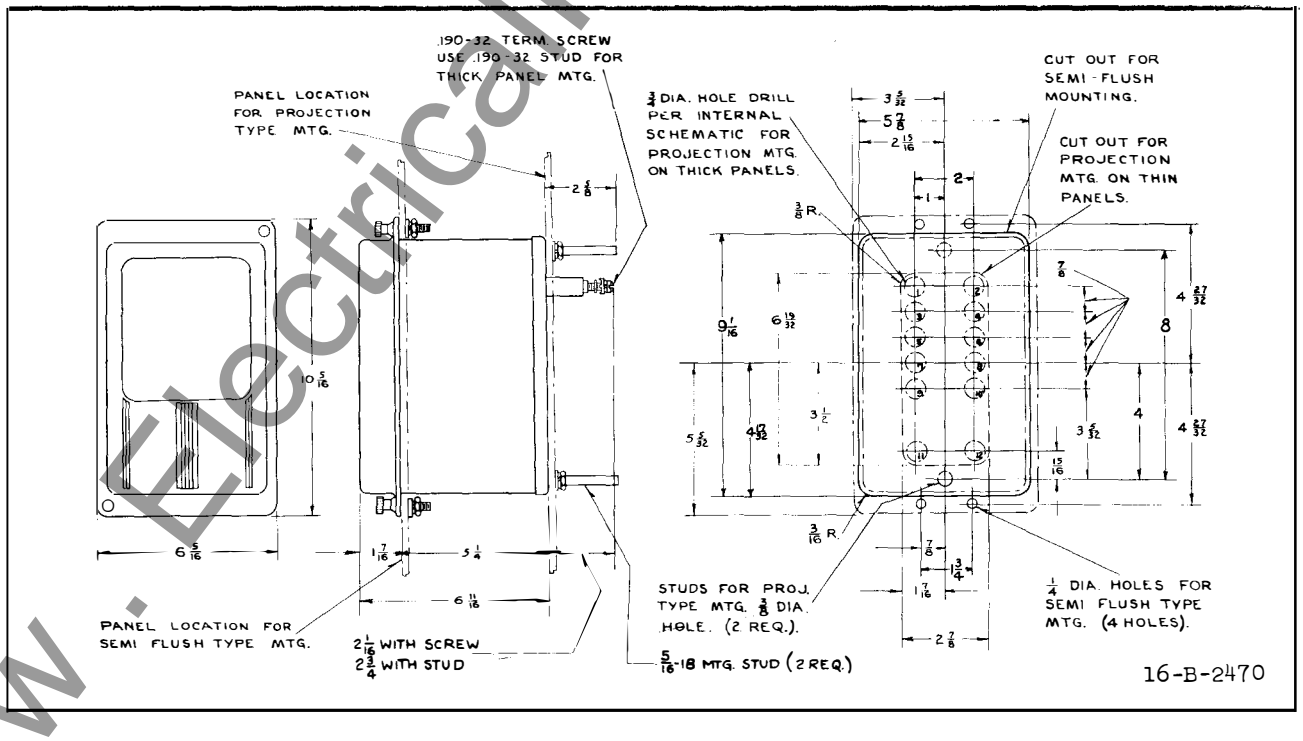

Fig. 18—Outline and Drilling Plan for the S10 Projection or Semi-Flush Type FT Flexitest Case. See the Internal Schematics for the Terminals Supplied. For Reference Only.

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