INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE TSP MAGNETIZING INRUSH TRIPPING SUPPRESSOR FOR USE WITH TYPE HCB PILOT WIRE 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 TSP suppressor provides a time delay to prevent unnecessary tripping of transformer bank breakers upon the occurrence of a magnetizing inrush or recovery surge, but does not interfere with the prompt operation of the differential relay when a fault exists in the transformer bank or on the transmission line either during normal operation or when it is initially energized.

The suppressor described in this leaflet is intended for use with type HCB Relays and not with the types CA, CA4 and CA6 relays. The type TSI tripping suppressor is for use with the induction type relays mentioned above and is covered in I.L. 41-346.

CONSTRUCTION

The type TSP relay consists of three type SV voltage elements, synchronous timer, and three auxiliary contactor switches. The construction of the elements is described below.

Type SV Voltage Elements

These elements, designated S1, S2, S3 are solenoid types with a U-shaped iron frame that supports the coil and serves as the external magnetic path for the coil. The coil surrounds a core and an adjustable flux shunt by which calibration is obtained. The plunger moves in the core and is guided by two bearings, one at the top of the assembly, and one at the bottom of a bronze guide tube for the flux shunt.

Make and break contacts are required. The moving contacts are assembled on Micarta insulation plate attached to the upper end of the moving plunger. The electrical connections are made by means of coiled flexible wire. The stationary contacts are attached to the end of a slotted bracket. The bracket is held in place by screws to which the electrical connections are made.

Synchronous Timer

The timer designated T2 is a small synchronous motor operating on voltage and driving a moving contact arm thru a gear train. The contact arm terminates in a short flat spring with contacts on the opposite outer ends. When the arm travel time elapses, the moving contacts strike two rigid stationary contacts to stall the motor. Contact follow is obtained by the deflection of the moving contact spring.

The synchronous motor has a floating rotor which is in mesh with the gear train only when energized. The rotor falls out instantly when the motor is de-energized and permits a spiral spring to reset the moving arm quickly.

Auxiliary Contactor Switches

These switches designated as CS1, CS2, CS3 are small solenoid type switches. A cylindrical plunger with a silver disc mounted on its

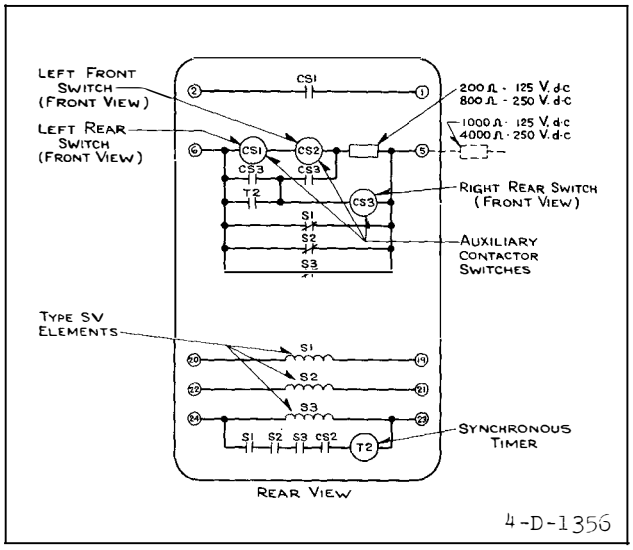

Fig. 1—Internal Schematic of the Type TSP Tripping Suppressor in the Standard Case.

lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts, only two of which are used in this relay. A small threaded stud projects below the plunger which supports the silver disc and carries the adjusting nuts. A weight is used on the plunger assembly to improve the drop-out characteristics of the switch.

OPERATION

The operation of the tripping supressor in conjunction with the type HCB relay is as follows with reference to the schematic diagram of Figs. 1, 2 or 4, 5.

The voltage switches S1, S2, and S3 are energized by potential transformers. These transformers should be energized at the same time the power transformer is energized. (An alternate method, using bus potential transformers, is described under "Installation").

Assume that a circuit breaker is closed to energize the transformer bank and line included in the type HCB differential zone, and that the circuit is not faulted. The voltage elements operate, so that the break contacts, S1, S2, S3, open to remove a short circuit around CS1, CS2 and the internal resistor. This causes CS1 and CS2 to operate. The CS1 switch short circuits the output terminals of the type HCB relay on the relay side of the insulating transformer, as shown in Figure 3. If the type HCB relay contacts have already closed due to the inrush, they will immediately reset when this short circuit is established before tripping can be accomplished. It is the purpose of the type SG relay inserted in the trip circuit to provide a slight time delay in tripping to guarantee that CS1 will be able to operate in time to block tripping. The CS2 switch closes the circuit to the synchronous timer T2, the front contacts of the voltage switches S1, S2, and S3 having closed when the voltage switches picked up. At the expiration of the time interval corresponding to the setting of the timer, the timer contacts, T2, will close and energize auxiliary switch coil, CS3. Contacts CS3 short circuit the coils of CS1 and CS2, which open their contacts and remove the short circuit from the type HCB relay output terminals. When the CS2 contacts open, the timer will be de-energized and will reset. However, CS3 contacts provide a seal in circuit, and CS3 remains in the operated position. If a short circuit now occurs in the transformer bank, or on the line, operation of the type HCB relays will trip the breakers. If a short circuit occurs during the inrush period, the voltage will be reduced causing one or more break contacts S1, S2 or S3 to close, which will cause CS1 and CS2 to drop out, thus removing the short circuit from the type HCB relay output terminals, and permitting a tripping operation. If a fault already exists when the breaker is closed, the low voltage encountered will fail to open one or more break contacts, S1, S2 or S3 and operation of the type HCB relay will not be blocked.

In the event of a severe external fault, which reduces the system voltage to such an extent that the power bank will suffer another magnetizing inrush, or recovery surge, when the fault is cleared, then the suppressor will act in the same way as for an initial inrush. This is because the low voltage during the short-circuit will cause one or more of

the SV relays to drop out, thus opening the circuits to the synchronous timer coil so that it will have to time out again when the external short-circuit is cleared and the voltage goes back to normal.

CHARACTERISTICS

The type TSP tripping suppressor is rated 115 volts, 60 cycles and separate models are available for 125 or 250 volt d-c trip circuits. The type SV voltage elements pick-up at approximately 100 volts and drop out at approximately 90 volts or more. The pick-up setting is adjustable, however, and the drop out is from 90-98 per cent of the pick-up. The synchronous timer scale is marked in 30 cycle divisions and is adjustable up to 5 seconds.

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 the two nuts on the studs and then turning the proper nut with a wrench.

The potential transformers used to energize the type TSP tripping suppressor should be located within the differential zone so that they are energized at the same time that the power transformer is energized. An alternate method is to use bus potential transformers, in which case auxiliary switches on the breakers must be used so that the voltage elements of the tripping suppressor are de-energized when the power transformer is de-energized. In this case, it is preferable

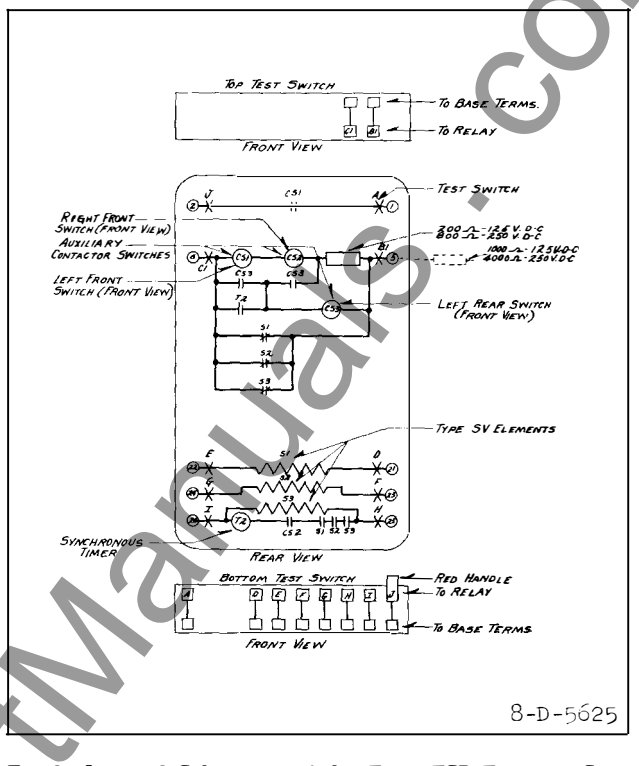

Fig. 2—Internal Schematic of the Type TSP Tripping Suppressor in the Type FT Case.

that the breaker auxiliary switch contacts close before the main contacts close. This alternate scheme will not be effective, however, if the bank is energized by closing the breaker at the far end of the line.

The multi-contact auxiliary tripping relays should have suitable contacts to open the trip circuit after the breaker trip circuits are energized and sealed in.

SETTINGS

The settings to be made are the pickup values on the voltage elements, and the time setting on the synchronous timer. The drop-out voltage of the SV voltage elements should always be higher than the drop out of the synchronous timer.

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 ad-

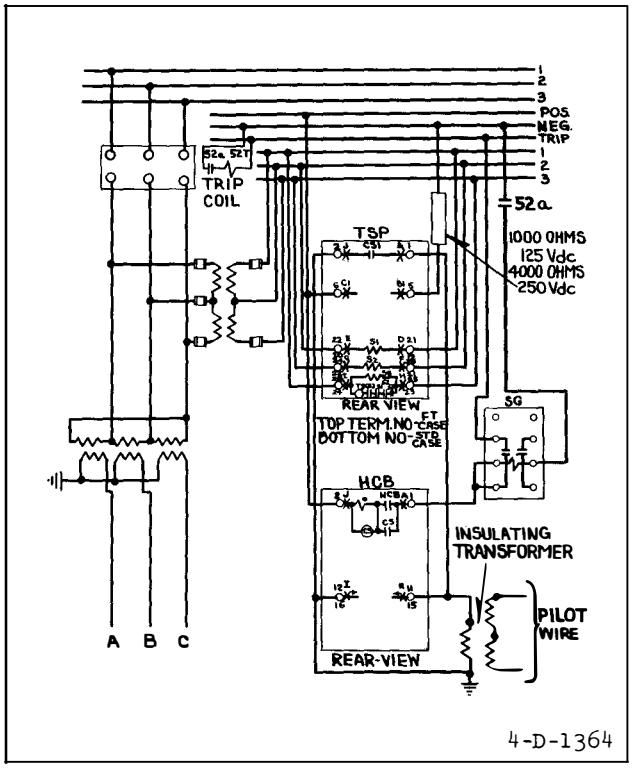

Fig. 3—External Connections of the Type TSP Tripping Suppressor Used With the Type HCB Relay.

justments at regular maintenance periods, the instruction 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.

Type SV Voltage Elements

Adjust the make contact for 9/64 inch contact separation with the break contact out of the way. In other words, when the plunger rises from the de-energized position it should travel 9/64 inch before the make contacts touch.

The clearance between the bob on the back-up-spring and the silver stationary contact should be .008 to .015 inch.

Adjust the magnetic shunt on each element so that the elements pick-up at 100 volts, 60 cycles. When moving the shunt be sure that the locking lever is pushed out to free the shunt. Energize all three elements at once, and make sure that all three make contacts maintain a steady circuit to the motor with 100 to 130 volts on the type SV elements. This is indicated by uniform operation of the motor without flutter.

The drop out of the elements should be 90 volts or more when the pick-up setting is 100 volts, 60 cycles.

Synchronous Timer

The moving contacts should have approximately 1/16 inch follow after the motor stalls. Make sure that the spiral spring returns the contact arm to the full open position quickly when the motor is de-energized. The motor should pick-up and run in synchronism at 100 volts, 60 cycles, and drop out at below 90 volts.

Auxiliary Contactor Switches

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 moving core just separates from the stationary core screw. Back off the stationary core screw 1/2 turn beyond this point and lock in place with the locknut provided. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 1/16 inch by means of the two small nuts on either side of the Micarta Disc. The switch in the 125 volt relays should pick up on not less than 75 volts d-c. Test for sticking when 125 volts d-c is removed. For the 250 volt relays, double the voltage values above.

Overall Test

Connect the relay per Fig. 4 or 5 with all

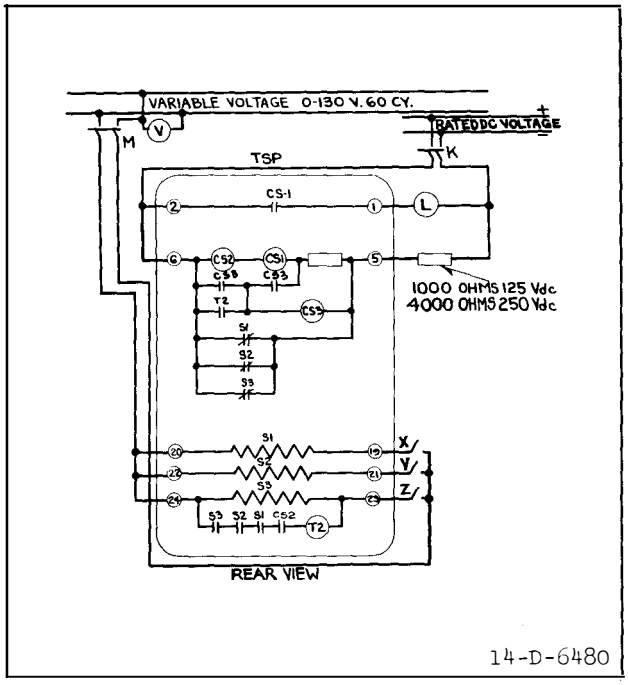

Fig. 4—Diagram of Test Connections For the Type TSP Tripping Suppressor in the Standard Case.

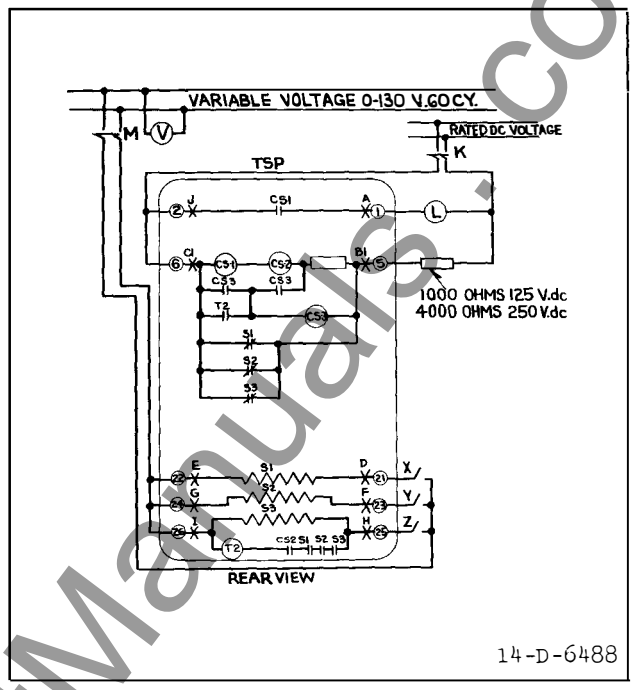

Fig. 5—Diagram of Test Connections For the Type TSP Tripping Suppressor in the Type FT Case.

switches closed. All three SV elements should pick up and the timer motor should run at all voltages from 100 to 130 volts. With the SV elements set for 100 volts pick-up.

Close switches X, Y, Z and K. Now close switch M, with the voltage adjusted for 115 volts. The lamp should light until the timer times out, at which time the lamps should go out and the timer should reset.

ENERGY REQUIREMENTS

The burdens of the type TSP Tripping Suppressor are as follows:

Element	Watts at 125 V. or 250V d-c.	Voltamperes at 115 volts, 60 cycles	P.F. Angle Degrees Lag
Auxiliary Switches	8.8	-----	-----
Synchronous Timer T2	-----	2.50	56.6
Type SV Relay, S1, S2, S3 (each)	-----	7.30	62.2

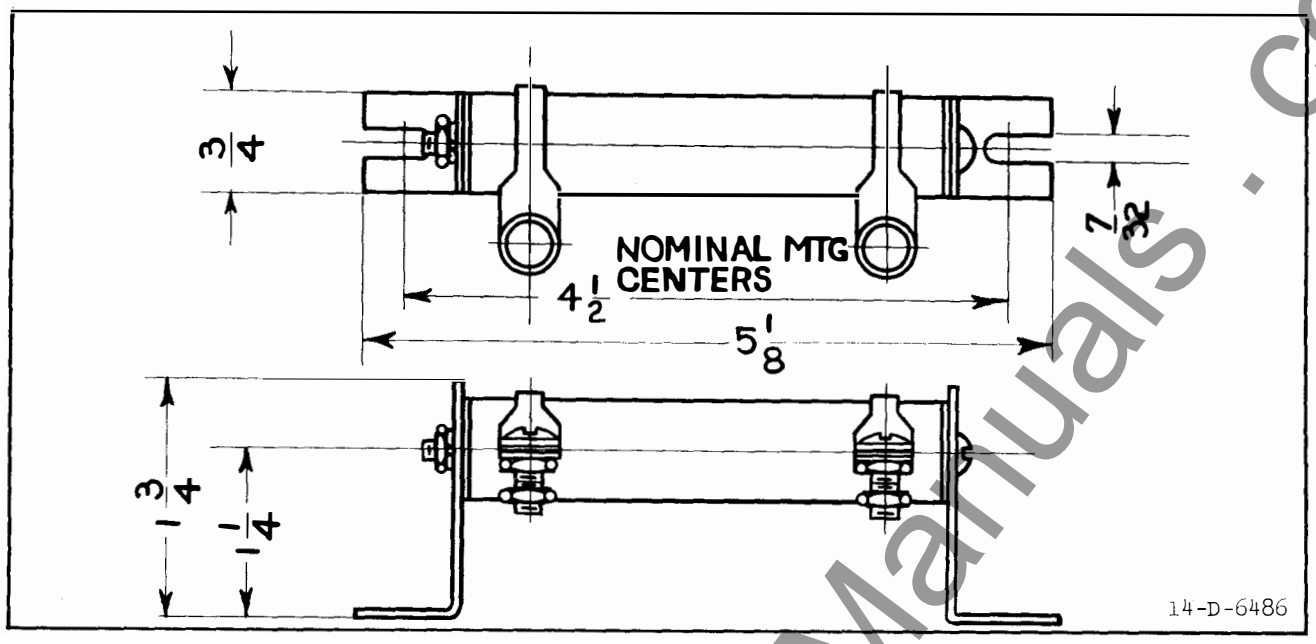

Fig. 6—Outline of the External Resistor. For Reference Only.

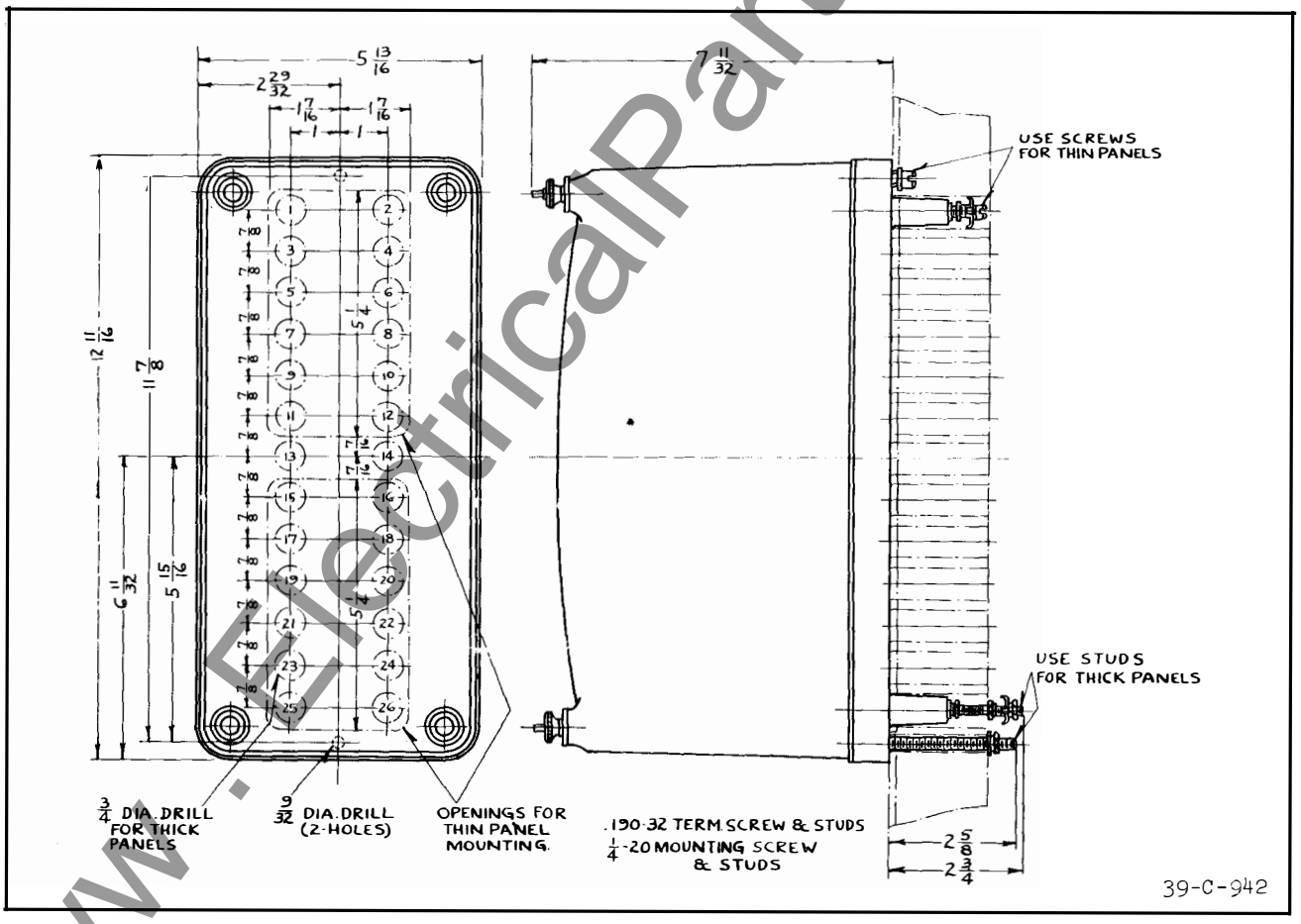

Fig. 7—Outline and Drilling Plan For the Projection Type Standard Case. See the Internal Schematic For Terminals Supplied. For Reference Only.

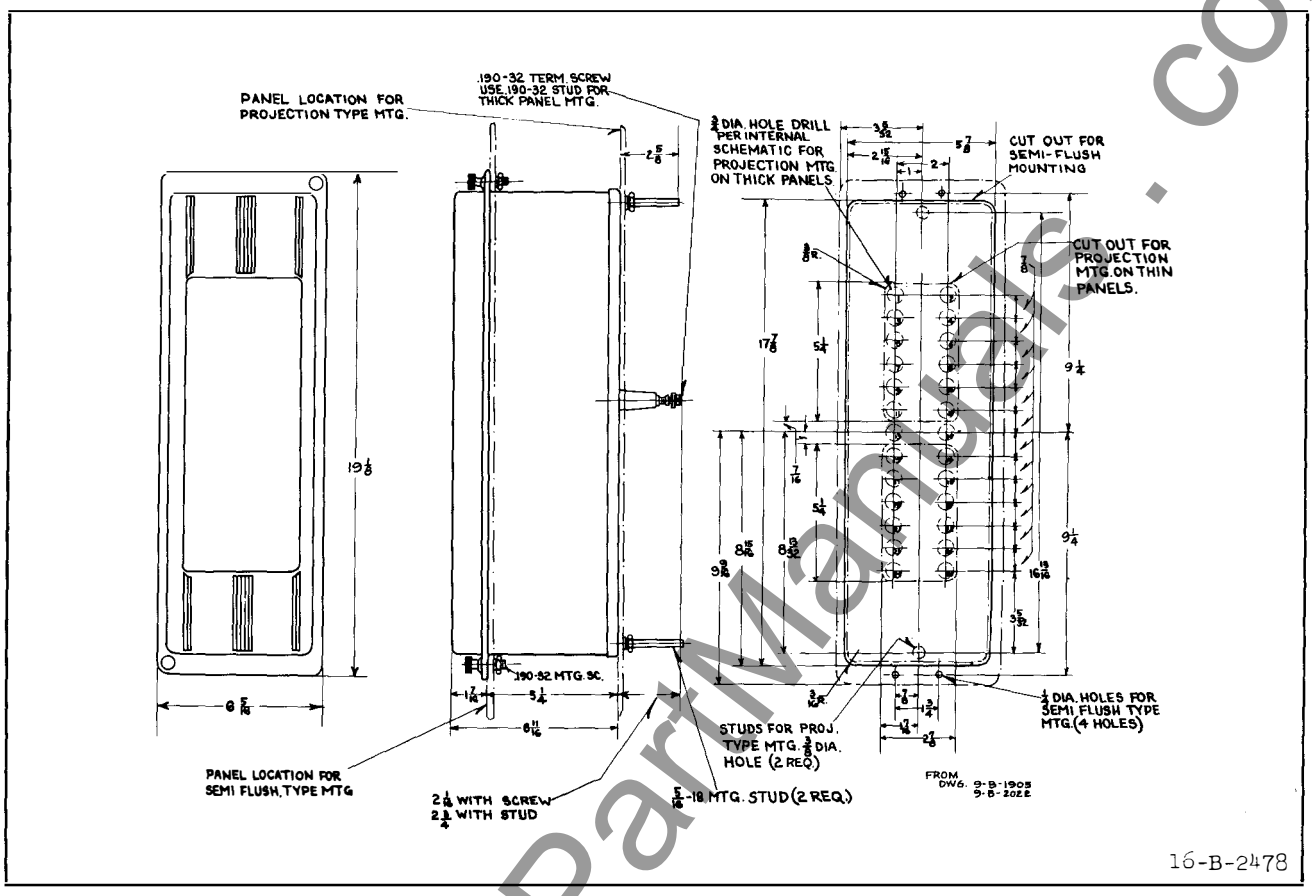

Fig. 8—Outline and Drilling Plan For the M20 Projection or Semi-Flush Type FT Flexitest Case. See the Internal Schematic For Terminals Supplied. For Reference Only.

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INSTRUCTIONS

TYPE TSP MAGNETIZING INRUSH TRIPPING SUPPRESSOR

FOR USE WITH TYPE HCB PILOT WIRE 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 TSP suppressor provides a time delay to prevent unnecessary tripping of transformer bank breakers upon the occurrence of a magnetizing inrush or recovery surge, but does not interfere with the prompt operation of the differential relay when a fault exists in the transformer bank or on the transmission line either during normal operation or when it is initially energized.

The suppressor described in this leaflet is intended for use with type HCB Relays and not with the types CA, CA4 and CA6 relays. The type TSI tripping suppressor is for use with the induction type relays mentioned above and is covered in I.L. 41-346.1.

CONSTRUCTION

The type TSP relay consists of three type SV voltage units, synchronous timer, and three auxiliary contactor switches. The construction of the units is described below.

Type SV Voltage Units

These units, designated S1, S2, S3 are solenoid types with a U-shaped iron frame that supports the coil and serves as the external magnetic path for the coil. The coil surrounds a core and an adjustable flux shunt by which calibration is obtained. The plunger moves in the core and is guided by two bearings, one at the top of the assembly, and one at the bottom of a bronze guide tube for the flux shunt.

Make and break contacts are required. The moving contacts are assembled on Micarta insulation plate attached to the upper end of the moving plunger. The electrical connections are made by means of coiled flexible wire. The stationary contacts are attached to the end of a slotted bracket. The bracket is held in place by screws to which the electrical connections are made.

Synchronous Timer

The timer designated T2 is a small synchronous motor operating on voltage and driving a moving contact arm thru a gear train. The contact arm terminates in a short flat spring with contacts on the opposite outer ends. When the arm travel time elapses, the moving contacts strike two rigid stationary contacts to stall the motor. Contact follow is obtained by the deflection of the moving contact spring.

The synchronous motor has a floating rotor which is in mesh with the gear train only when energized. The rotor falls out instantly when the motor is de-energized and permits a spiral spring to reset the moving arm quickly.

Auxiliary Contactor Switches

These switches designated as CS1, CS2, CS3 are small solenoid type switches. 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, only two of which are used in this relay. A small threaded stud projects below the plunger which supports the silver disc and carries the adjusting nuts. A weight is used on the plunger assembly to improve the drop-out characteristics of the switch.

OPERATION

The operation of the tripping suppressor in conjunction with the type HCB relay is as follows with reference to the schematic diagram Fig. 2.

The voltage units S1, S2, and S3 are energized by potential transformers. These transformers should be energized at the same time the power transformer is energized. (An alternate method, using bus potential transformers, is described under "Installation").

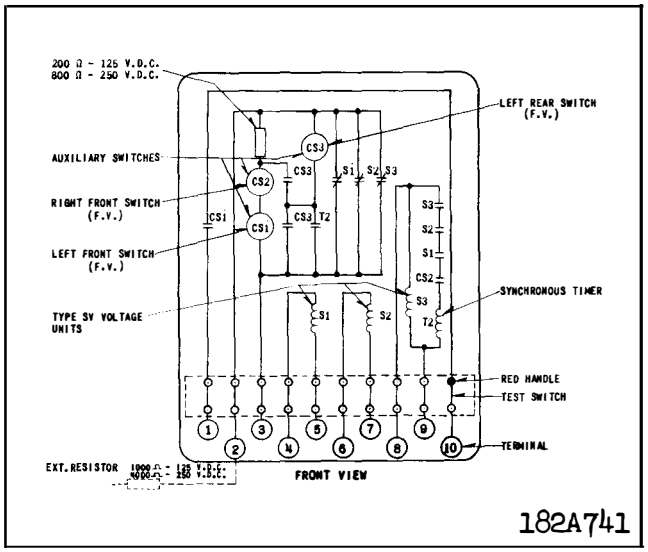

Fig. 1. Internal Schematic of the Type TSP Tripping Suppressor in the Type FT31 Case.

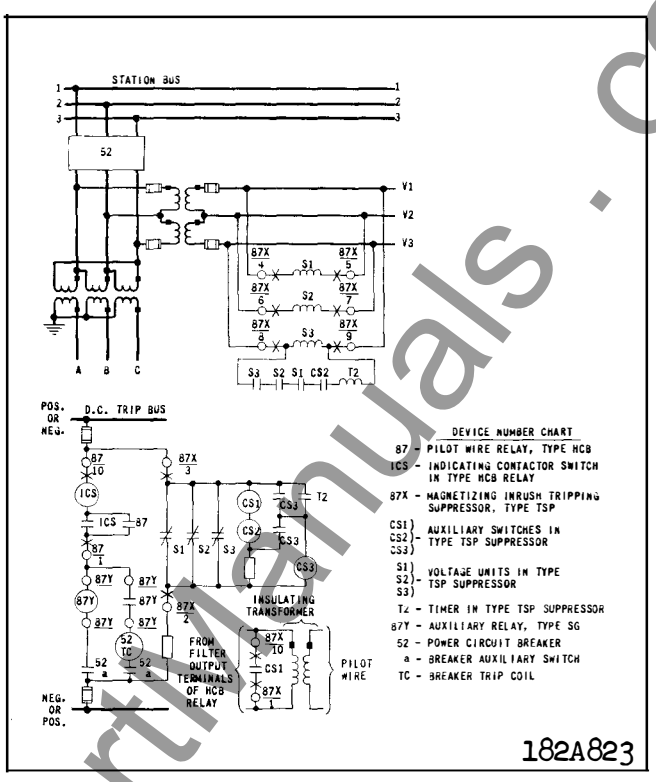

Fig. 2. External Schematic for the Type TSP Tripping Suppressor used with the Type HCB Relay.

Assume that a circuit breaker is closed to energize the transformer bank and line included in the type HCB differential zone, and that the circuit is not faulted. The voltage units operate, so that the break contacts, S1, S2, S3, open to remove a short circuit around CS1, CS2 and the internal resistor. This causes CS1 and CS2 to operate. The CS1 switch short circuits the output terminals of the type HCB relay on the relay side of the insulating transformer. If the type HCB relay contacts have already closed due to the inrush, they will immediately reset when this short circuit is established before tripping can be accomplished. It is the purpose of the type SG relay inserted in the trip circuit to provide a slight time delay in tripping to guarantee that CS1 will be able to operate in time to block tripping. The CS2 switch closes the circuit to the synchronous timer T2, the front contacts of the voltage units S1, S2, and S3 having closed when the voltage units picked up. At the expiration of the time interval corresponding to the setting of the timer, the timer contacts, T2, will close and energize auxiliary switch coil, CS3. Contacts CS3 short circuit the coils of CS1 and CS2, which open their contacts and remove the short circuit from the type HCB relay output terminals. When the CS2 contacts open, the timer will be de-energized and will reset. However, CS3 contacts provide a seal in circuit, and CS3 remains in the operated position. If a short circuit now occurs in the transformer bank, or on the line, operation of the type HCB relays will trip the breakers. If a short circuit occurs during the inrush period, the voltage will be reduced causing one or more break contacts S1, S2 or S3 to close, which will cause CS1 and CS2 to drop out, thus removing the short circuit from the type HCB relay output terminals, and permitting a tripping operation. If a fault already exists when the breaker is closed, the low voltage encountered will fail to open one or more break contacts, S1, S2 or S3 and operation of the type HCB relay will not be blocked.

In the event of a severe external fault, which reduces the system voltage to such an extent that the power bank will suffer another magnetizing inrush, or recovery surge, when the fault is cleared, then the suppressor will act in the same way as for an initial inrush. This is because the low voltage during the short-circuit will cause one or more of the SV units to drop out, thus short circuiting the CS3 and thereby opening the seal in circuit so that the synchronous timer will have to time out again when the external short-circuit is cleared and the voltage goes back to normal.

CHARACTERISTICS

The type TSP tripping suppressor is rated 120 volts, 60 cycles and separate models are available for 125 or 250 volt d-c trip circuits. The type SV voltage units pick-up at approximately 100 volts and drop out at approximately 90 volts or more. The

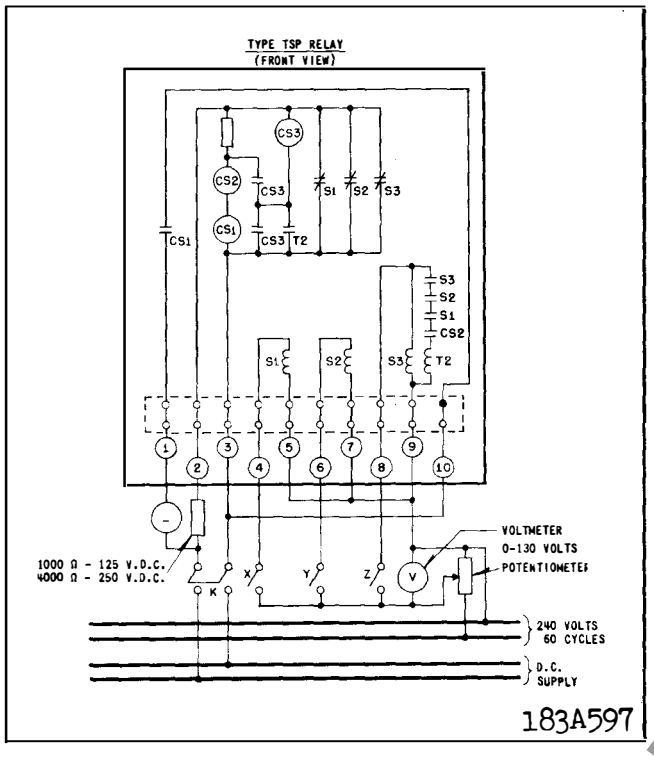

Fig. 3. Diagram of Test Connections for the Type TSP Tripping Suppressor in the Type FT31 Case.

pick-up setting is adjustable, however, and the drop out is from 90-98 per cent of the pick-up. The synchronous timer scale is marked in 30 cycle divisions and is adjustable up to 5 seconds.

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 four mounting holes on the flange for semi-flush mounting or by means of the rear mounting stud or studs for projection mounting. Either a mounting stud or the mounting screws may be utilized for grounding the relay. The electrical connections may be made directly to the terminals by means of screws for steel panel mounting or to the terminal studs furnished with the relay for thick panel mounting. The terminal studs may be easily removed or inserted by locking two-nuts on the stud and then turning the proper nut with a wrench.

For detailed FT case information refer to I.L. 41-076.

The potential transformers used to energize the type TSP tripping suppressor should be located within the differential zone so that they are energized at the same time that the power transformer is energized. An alternate method is to use bus potential transformers, in which case auxiliary switches on the breakers must be used so that the voltage units of the tripping suppressor are de-energized when the power transformer is de-energized. In this case, it is preferable that the breaker auxiliary switch contacts close before the main contacts close. This alternate scheme will not be effective, however, if the bank is energized by closing the breaker at the far end of the line.

The multi-contact auxiliary tripping relays should have suitable contacts to open the trip circuit after the breaker trip circuits are energized and sealed in.

SETTINGS

The settings to be made are the pickup values on the voltage units, and the time setting on the synchronous timer. The drop-out voltage of the SV voltage units should always be higher than the drop out of the synchronous timer.

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 instruction below should be followed.

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

Type SV Voltage Units

Adjust the make contact for 9/64 inch contact separation with the break contact out of the way. In other words, when the plunger rises from the de-energized position it should travel 9/64 inch before the make contacts touch.

The clearance between the bob on the back-up-spring and the silver stationary contact should be .008 to .015 inch.

Adjust the magnetic shunt on each unit so that the elements pick-up at 100 volts, 60 cycles. When

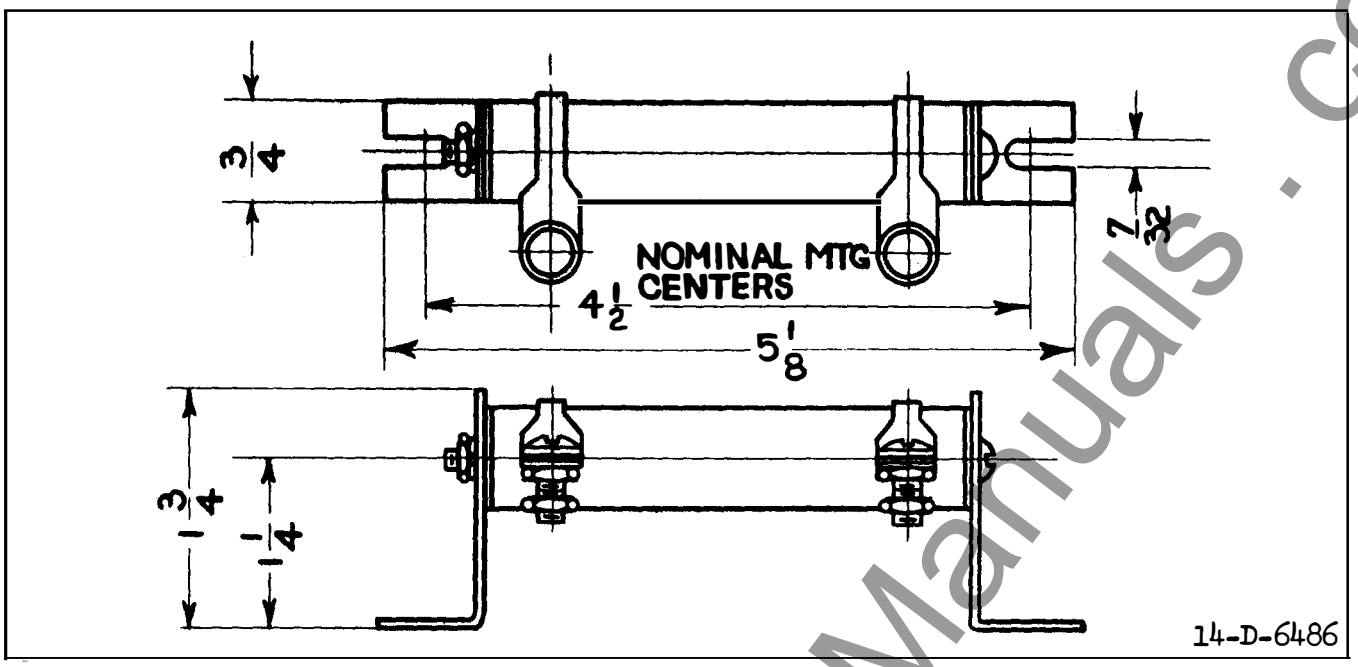

Fig. 4. Outline of the External Resistor.

moving the shunt be sure that the locking lever is pushed out to free the shunt. Energize all three units at once, and make sure that all three contacts maintain a steady circuit to the motor with 100 to 130 volts on the type SV units. This is indicated by uniform operation of the motor without flutter.

The drop out of the units should be 90 volts or more when the pick-up setting is 100 volts, 60 cycles.

Synchronous Timer

The moving contacts should have approximately 1/16 inch follow after the motor stalls. Make sure that the spiral spring returns the contact arm to the full open position quickly when the motor is de-energized. The motor should pick-up and run in synchronism at 100 volts, 60 cycles, and drop out at below 90 volts.

Auxiliary Contactor Switches

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 moving core just separates from the stationary core screw. Back off the stationary core screw 1/2 turn beyond this point and lock in place with the locknut provided. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 1/16 inch by means of the two small nuts on either side of the Micarta Disc. The switch in the 125 volt relays should pick up on not less than 75 volts d-c. Test for sticking when 125 volts d-c is removed. For the 250 volt relays, double the voltage values above.

Overall Test

Connect the relay per Fig. 3 with all switches closed. All three SV units should pick up and the timer motor should run at all voltages from 100 to 130 volts. With the SV units set for 100 volts pick-up.

Close switches X, Y, Z and K, with the voltage adjusted for 115 volts. The lamp should light until the timer times out, at which time the lamps should go out and the timer should reset.

ENERGY REQUIREMENTS

The burdens of the type TSP Tripping Suppressor are as follows:

Element	Watts at 125V or 250V d-c.	Voltamperes at 120 volts, 60 cycles	P.F. Angle Degrees Lag
Auxiliary Switches	8.8	-----	-----
Synchronous Timer T2	-----	2.72	56.6
Type SV Unit, S1, S2, S3 (each)	-----	7.95	62.2

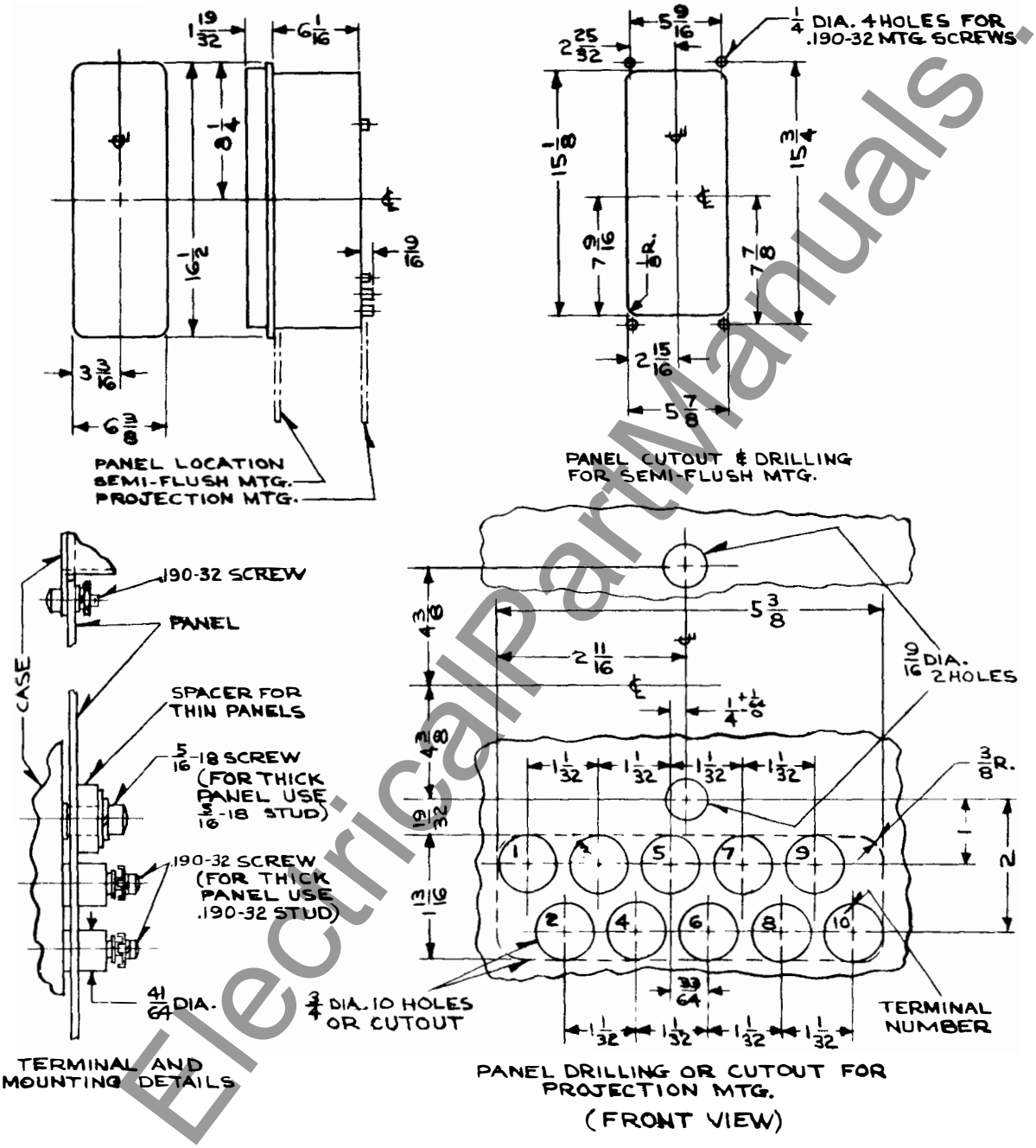

Fig. 5. Outline and Drilling Plan for the Type TSP Tripping Suppressor in the Type FT31 Case.

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