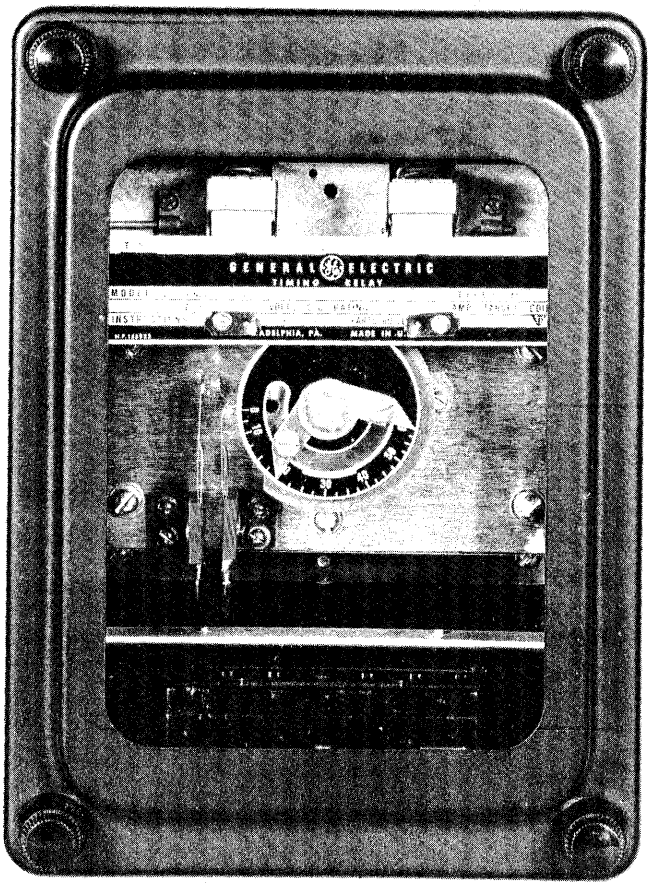
INSTRUCTIONS

GEH-2031C

SUPERSEDES GEH-2031B

TIMING RELAYS



Types
RPM 13A, 13B, 13D
RPM15A, 15B, 15C and 15D

GENERAL ELECTRIC

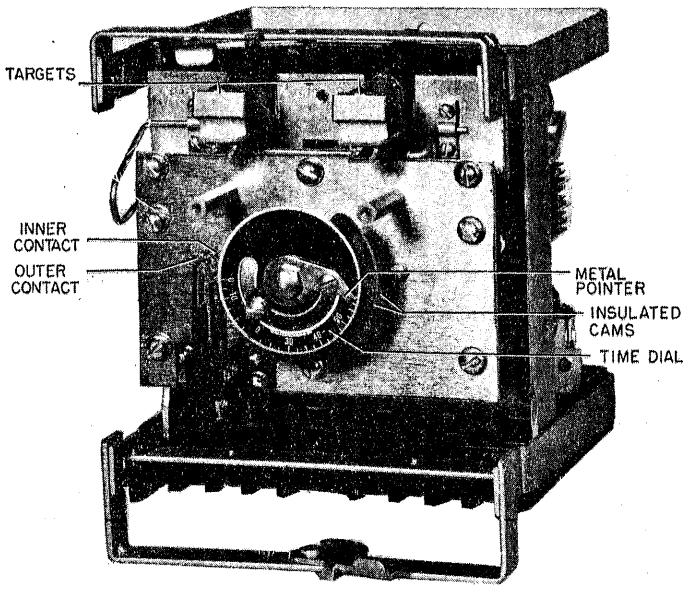


Fig. 1 (8030298) RPM Relay, Unit Withdrawn From Case (Front View)

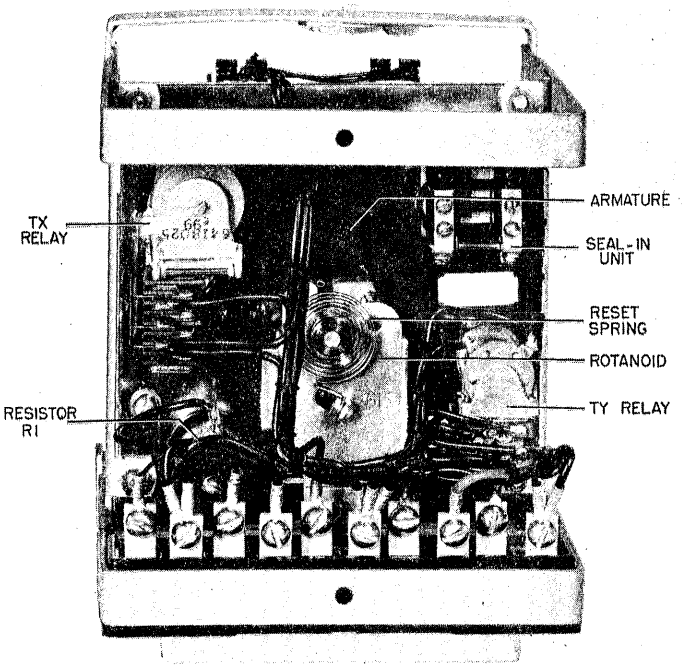
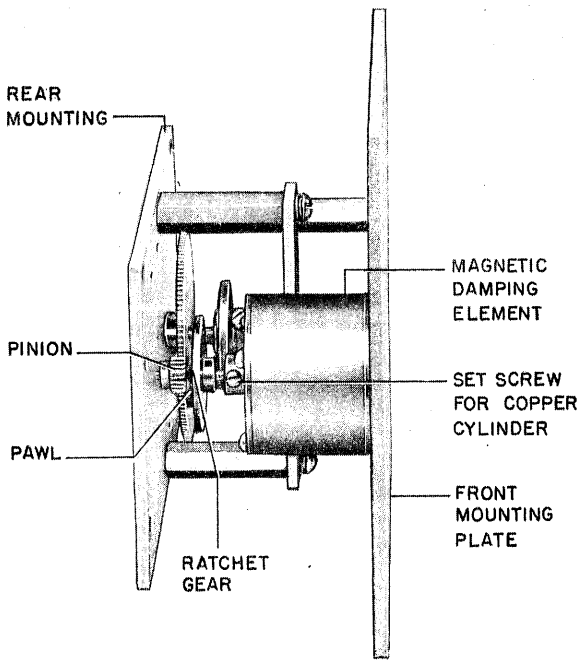
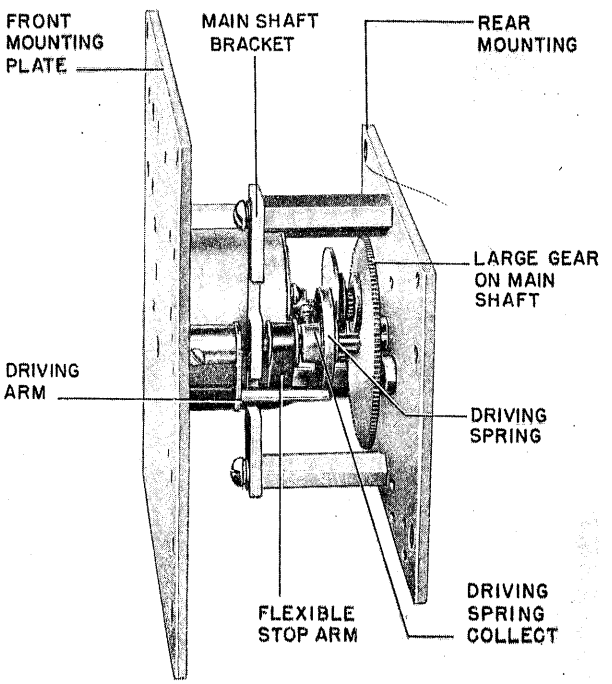


Fig. 2 (8030297) RPM Relay, Unit Withdrawn From Case (Rear View)



Left Side View



Right Side View

Fig. 3 (8004823 & 8004824) RPM Relay Unit Subassembly Between Front and Rear Mounting Plates

TIMING RELAYS
TYPE RPM

INTRODUCTION

The RPM 13 and 15 relays mounted in an S1 drawout case are general purpose direct current operated auxiliary timing relays having two cam operated closing contacts. Each contact has an independent adjustable time setting with the exception that the contacts must always close in the same sequence with a minimum time of several cycles between the closings of the two contacts. See the section on CHARACTERISTICS for further discussion of the minimum time between contact closings. Each contact has its own target and the relay has one electrically separate seal-in unit generally used with the TU-1 contact. In addition the RPM15 relay employes a telephone type relay, TY, to provide a continuous coil rating. See Table No. A for different models.

TABLE A

MODEL	TIMING RANGE	COIL CIRCUIT TIME RATING	CONTACT DWELL TIME	
			TU-1	TU-2
	Seconds	Seconds	Cycles (60 Cycle Base)	
12RPM13A11 & Up	0.15 - 3.0	60	9-15	9-15
12RPM13B11 & Up	0.10 - 1.0	60	Maintained	3-5
12RPM13D11 & Up	0.15 - 3.0	60	Maintained	9-15
12RPM15A1 & Up	0.15 - 3.0	Continuous	9-15	Maintained
12RPM15B11 & Up	0.10 - 1.0	Continuous	Maintained	Maintained
12RPM15C1 & Up	0.15 - 3.0	Continuous	Maintained	Maintained
12RPM15D1 & Up	0.15 - 3.0	Continuous	Maintained	Maintained

APPLICATION

These RPM relays can be applied wherever an accurate, direct current operated, timing device with adjustable timing ranges 0.1 to 1 second or 0.15 to 3 seconds is required. A typical application is illustrated in Fig. 4 where the RPM13 relay is used to provide a time delay before the back-up fault relays become effective. The fault relays together with the RPM relays are used here to provide back-up protection for a unit type generator installation against prolonged multiphase faults on the adjacent system. When the fault relays operate, they start the RPM relay which trips the main breaker after a predetermined time thru its own TU-1 contact and the fault relay contacts. If for some reason the generator is still connected to the fault, the fault relays will remain picked up and when the second RPM contact (TU-2) closes after an additional predetermined time it will operate a lockout relay, Type HEA, which shuts down the unit generator.

Fig. 5 shows the RPM15 relay substituted for the RPM13 relay in a similar application.

The RPM relay tripping contacts should always be used in series with the initiating relay contacts in a trip circuit. In this way any overtravel which may exist in the RPM relay is negated by the opening of the initiating relay contacts.

The TX coil of the RPM relay has a very low drop-out voltage. This low drop-out makes it possible for an indicating lamp in series with the TX coil to keep that element picked up after it has operated. For this reason it is important that caution be exercised in the application of the relays to insure that there are no sneak circuits which can permit the TX coil to be sealed in through a lamp or some other device.

RATINGS

These RPM relays are available with operating coils for 24 to 250 volts D.C. As indicated in Table A the RPM13 relays have coils rated for one minute and the RPM15 relays have continuously rated coils.

The target and seal-in units are current operated devices with ratings of either 0.2 or 1.0 amperes.

The timing contacts TU-1 and TU-2 are for circuit closing only. They will carry a maximum of 30 amperes for the time it takes to trip a breaker and have no interrupting rating. Since these contacts have no interrupting rating, any control circuit involving these contacts must be cleared by a circuit breaker auxiliary switch or other suitable means.

The contact interrupting rating of the telephone type relays are shown in Table B.

The rating of the seal-in unit is shown in Table C.

CONTACT INTERRUPTING ABILITY

TABLE B

Volts	Interruption Current (Amps)	
	Inductive*	Non-Inductive
48-DC	1.0	3.0
125-DC	0.5	1.5
250-DC	0.25	0.75
115-60 cy.	0.75	2.0
230-60 cy.	0.5	1.0

* Inductance of Average Trip Coil

* SEAL-IN UNIT

TABLE C

	1.0 Amp	0.2 Amp
D.C. Resistance (ohms)	0.31	8.1
Minimum Operating (amps)	1.0	0.2
Carry Continuously (secs.)	1.9	0.37
Carry 30 amps for (secs.)	2.2	0.08
Carry 10 amps for (secs.)	20	0.75
60 Hertz Impedance (ohms)	2.6	50

CHARACTERISTICS

OPERATING PRINCIPLE

The RPM relay operates on the principle of using the energy from a charged spring.

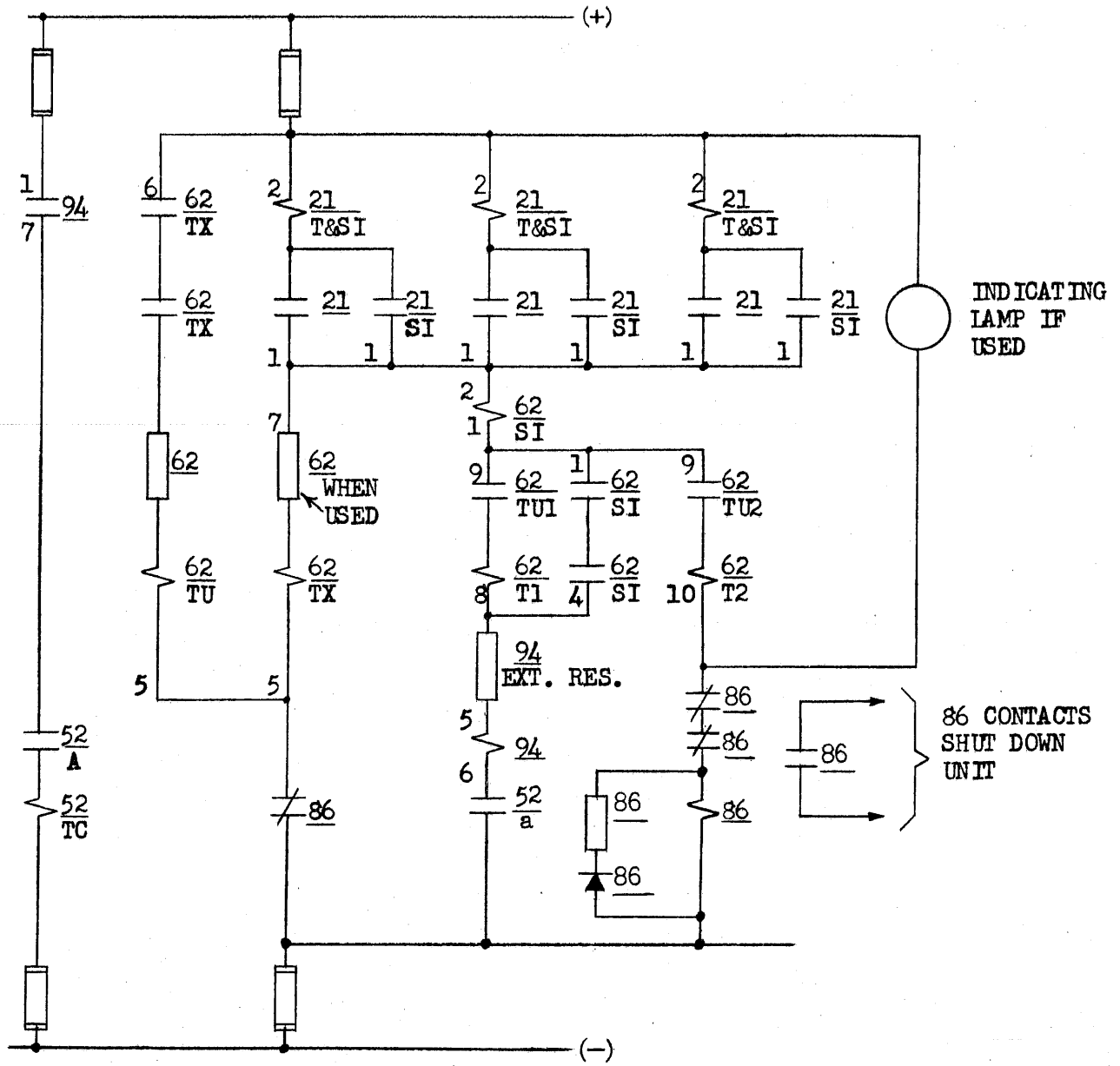
The spring is charged by a solenoid called a rotonoid because of its circular shaped plunger. The energy of the spring is dissipated through a gear train at a rate controlled by a damping magnet. The timing contacts are operated by cams attached to this gear train.

MINIMUM OPERATING VOLTAGE

The operation of the rotonoid designated as "TU" is controlled by the contacts of the telephone type relay designated as "TX".

Both this telephone type relay "TX", and the telephone type relay "TY" which is used in the RPM15 relays will operate at 80% of rated voltage or above.

*Indicates Revision



LEGEND		
DEVICE NO.	DEVICE TYPE	FUNCTION
21	CEB12C	BACK UP DISTANCE RELAY
94	HGA14AM or AL	AUXILIARY TRIPPING RELAY
86	HEA	LOCKOUT RELAY
62	RPM13A,13B or 13D	TIMING RELAY

Fig. 4 (104A8985-1) Typical Application of the RPM13 Relay As A Timer In A Unit Generator Back Up Scheme

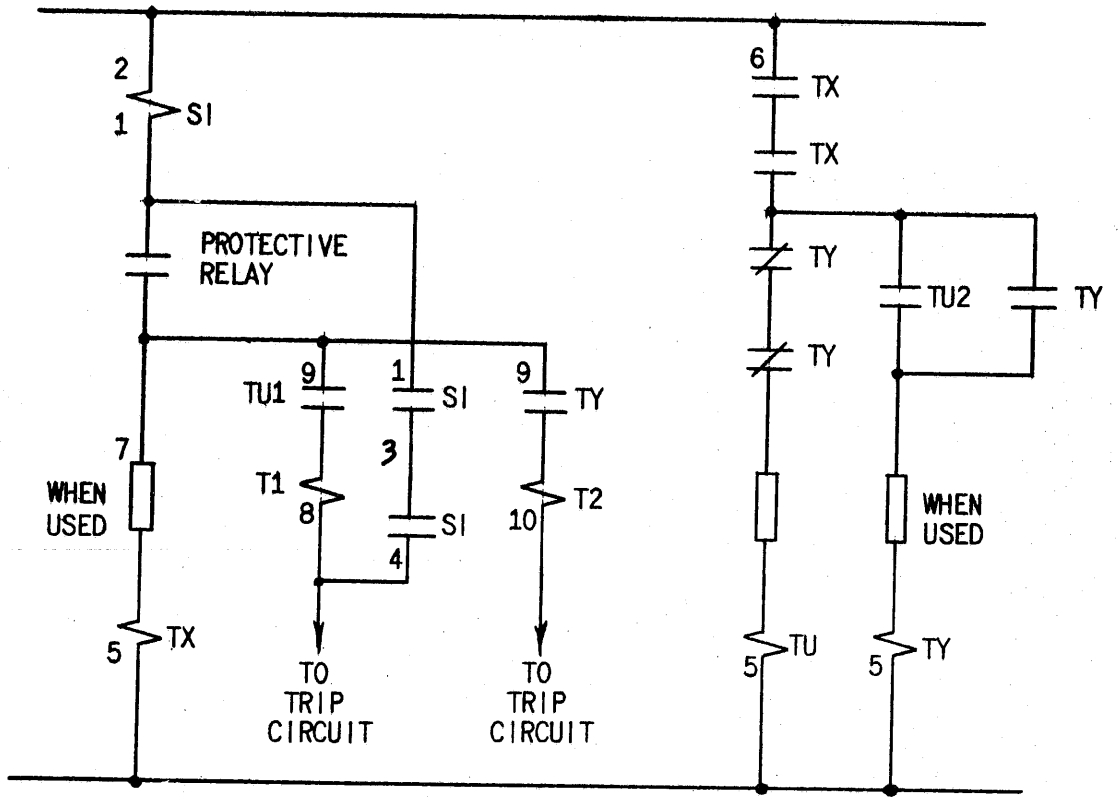
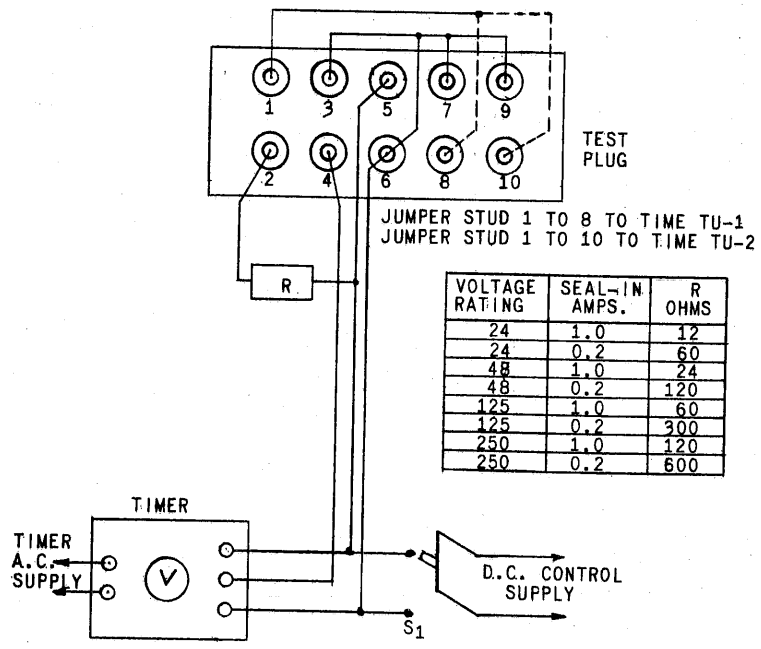


Fig. 5 (418A836-1) Typical Application of the RPM15 Relay



VOLTAGE RATING	SEAL-IN AMPS.	R OHMS
24	1.0	12
24	0.2	60
48	1.0	24
48	0.2	120
125	1.0	60
125	0.2	300
250	1.0	120
250	0.2	600

CAUTION:- DO NOT KEEP S_1 CLOSED LONGER THAN NECESSARY TO OBTAIN TIME TEST, BECAUSE OF THE SHORT TIME RATING OF THE ROTONOID.

Fig. 6 (377A129-1) Test Circuit For Checking Time Calibration of the RPM Relays Covered By This Book. Test Plug Terminal Numbers Correspond to the Relay Stud Numbers

The minimum pickup of the rotonoid is well below the pickup level of the "TX" relay or about 50% of rated voltage.

THE TIMING OPERATION

The maximum operating times of these RPM relays are either "one" or "three" seconds depending upon the model. The minimum operating time is in the order of 0.1 seconds.

The desired operating time is controlled by cams which can be set at any position on the time dial. These cams as they rotate will close the front and back contacts called TU-1 and TU-2 respectively. The cams in passing will hold the contacts closed for a specific time called "DWELL TIME". Some of the models have the front contact maintaining, cam shaped to hold the contact closed through the balance of the time range. The back contact on the continuously rated relay is in effect maintained by a contact of the "TY" relay which seals around TU-2.

NOTE: The "dwell" time will vary depending upon the time range and position of the cam. See Table No. A for details.

The cams cannot be set together to operate their contacts at the same time. The time difference between the closing of the front contact and the back contact with the cams set as close together as the mechanism will permit will vary depending on the time range and the position of the cams on the dial. For the one second relay this time difference range will be between 0.030 and 0.06 seconds. The range for the three second relay is .08 to 0.12 seconds.

Under normal operating voltage, the operating time at the maximum dial setting will be accurate within ± 5%. As the dial scale settings are decreased, the variation will approach a maximum of ± 10% of the scale reading. The consistency of the operating time on any specific setting will be within ± 2%.

The resistance of the various relay components is shown in Table D.

CONSTRUCTION

The general construction of these relays is shown in Figs. 1 and 2.

The basic elements are the driving magnet, the gear train, the damping magnet and the time dial assembly. The auxiliary elements such as the telephone type relay, targets and seal-in unit round out the construction.

The driving magnet, or rotonoid charges two spiral springs as it rotates approximately 180 degrees. One of the springs located on the rotonoid serves to reset the assembly. The other in the gear train drives the gearing and the associated damping system.

The gear train is an accurately assembled clock type mechanism mounted between two parallel plates in such a manner as to provide proper shaft end play and gear mesh (see Fig. 3). The charged spring drives this mechanism at a speed which is controlled by the damping system. A ratchet-pawl assembly permits quick reset. The damping system consists of a copper cup mounted on a shaft rotating in an annular gap across which exists a permanent magnet field. While the position of the cup in the magnetic field will provide some control of the time, the main control varies with the degree to which the spring is charged. On the one second relays the length of the copper cup has been reduced to provide less drag which helps to obtain the faster operating time.

The time dial assembly is mounted on the out-put shaft of the gear train. The unit consists of adjustable insulated cams which operate the TU-1 and TU-2 contacts. There are pointers on the cams which can be lined-up on the time dial scale. The time dial scale on the three second relays is calibrated in tenths of a second. The one second relay is calibrated in cycles (60 cycle bases) with graduations of 2.5 cycles.

TABLE D

VOLTAGE RATING	RESISTANCE IN OHMS					
	TU	R1	TX	R3	TY	R4
250	100	300	5000	5000	7500	7500
220	100	250	5000	5000	7500	7500
125	100	100	5000		7500	
110	100	75	5000	7500	7500	
48	7	13.5	200	200	425	425
32	7	6	200	70		
24	7	3	200		425	

CURRENT RATING	RESISTANCE IN OHMS	
	TARGET	SEAL-IN UNIT
0.2A	7.5	*8.1
1.0A	0.35	0.31

*Indicates Revision

The relays may have either a pointed shaped cam in the front position which in passing closes the TU-1 contact momentarily or a contact maintaining cam which when engaging the TU-1 contact holds it closed throughout the timing range.

The "TX" and "TY" components are telephone type relays.

The seal-in unit is a small hinged armature type relay consisting of a "U" shaped magnet frame, fixed pole piece, armature, and a tapped coil. The armature carries a "T" shaped moving contact which bridges the two stationary contacts.

The targets are hinged armature assemblies with armatures painted orange. When operated they release a shield which drops and exposes the orange colored surface of the armature.

RELAY CASE

Components of each relay are mounted on a cradle assembly which can be easily removed from the relay case. The cradle is locked in the case by means of latches at the top and bottom. The electrical connections between the case-block and cradle block are completed through a removable connection plug. A separate testing plug can be inserted in place of the connection plug to permit testing the relay in its case. The cover is attached to the front of the case and includes the target reset mechanism and an interlock arm to prevent the cover from being replaced until the connection plug has been inserted.

The case is suitable for either semi-flush or surface mounting on panels up to two inches thick. Hardware is available for all panel thickness up to two inches, but panel thickness must be specified on the order to insure that the proper hardware will be provided. Outline and panel drilling dimensions are shown in Fig. 14.

RECEIVING, HANDLING AND STORAGE

These relays, when not included as a part of a control panel, will be shipped in cartons designed to protect them against damage. Immediately upon receipt of a relay, examine it for any damage sustained in transit. If injury or damage resulting from rough handling is evident, file a damage claim at once with the transportation company and promptly notify the nearest General Electric Apparatus Sales Office.

Reasonable care should be exercised in unpacking the relay. If the relays are not to be installed immediately, they should be stored in their original cartons in a place that is free from moisture, dust, and metallic chips. Foreign matter collected on the outside of the case may find its way inside when the cover is removed and cause trouble in the operation of the relay.

ACCEPTANCE TESTS

Immediately upon receipt of the relay an inspection and acceptance test should be made to insure that no damage has been sustained in shipment and that the relay calibration has not been disturbed.

VISUAL INSPECTION

Check the nameplate stamping to insure that the model number, rating and calibration range of the relay received agree with the requisition.

Remove the relay from its case and check by visual inspection that there are no broken or cracked molded parts or other signs of physical damage that may have occurred in transit and that all screws are tight.

MECHANICAL INSPECTION

The essentials of a mechanical inspection are to determine that all of the operating elements are free from any tendency to bind and are in correct adjustment as specified below:

1. The rotonoid - The shaft end play in this assembly is limited to insure proper clearances between the armature and the spool body. The armature should rotate without any tendency to bind.

2. The gear train - Check for end play in all the shafts. Rotate the assembly by the rotonoid and note that it moves with a steady motion to the limit of its travel. Permit the assembly to reset reasonably fast to check the action of the ratchet. See that the pawl engages the gear teeth with positive action. Check all the set screws to see that they are tight.

3. The time dial - Check the action of the cams as they engage the timing contacts. They should engage at the "V" section only, causing the contact to deflect and close with about 1/64" wipe. The contact gap at the TU-1 and TU-2 contact should be about 1/16".

4. Telephone Type relays - With telephone relays in the de-energized position all circuit closing contacts should have a gap of 0.015" and all circuit opening contacts have a wipe of 0.005". Gap may be checked by inserting a feeler gage and wipe can be checked by observing the amount of deflection on the stationary contact before parting the contacts. The armature should then be operated by hand and the gap and wipe again checked as described above.

5. Seal-In unit - The seal-in unit should be checked as follows: The armature and seal-in contacts should move freely when operated by hand. There should be a screw in only one of the tap positions on the right stationary contact strip. Operate the armature by hand and check that there is at least 1/32" wipe on the seal-in contacts.

6. The targets - Operate the armature and note that when the shield drops the armature will continue to travel. This indicates that the shield will have adequate clearance when it falls.

ELECTRICAL TESTS

The following electrical tests are recommended upon receipt of the relay.

1. Make time tests.
2. Check minimum operating value of telephone relay.
3. Check target and seal-in unit pickup values.

Check the time calibration using the connections shown in Fig. 6. Check the operating time at the maximum time range setting and again at some point about 1/2 of the time range. The relay timing accuracy should be within the test limits indicated in the section under CHARACTERISTICS. The test circuit is arranged to include the seal-in unit time which was not included in the factory time setting. However, since this seal-in unit time is about 0.01 seconds, it will have little effect on the final results.

Using connections shown in Fig. 7 the telephone type relays should pick up at 80% or less of rated voltage. When testing the RPM15 relays the normally closed contacts of the TY relay should blocked open and the TU-2 (rear) contact should be closed manually. This is to prevent the operation of solenoid TU so that the regulation of the test circuit will be adequate to permit reliable test results.

Using connections shown in Fig. 7 check the targets and the seal-in unit pickup to confirm that they will operate on rated current or less. While making these tests the operating cams can be manually held in the proper position to keep the desired contact closed. When seal-in unit (SI) is picked up the opening of switch "S" should not de-energize this unit.

Connections can be made to the relay studs but for panel-mounted relays a test plug can be used to facilitate the operation. Since the rotonoid has only a one minute rating, the operator must be sure that this solenoid is not damaged by overheating. If as a result of these tests any adjustments are necessary, refer to the section on SERVICING for information.

INSTALLATION PROCEDURE

If after the ACCEPTANCE TESTS the relay is held in storage before shipment to the job site, it is recommended that the visual and mechanical inspection described under the section on ACCEPTANCE TESTS be repeated before installation. It is also advisable to check the specific time settings that are to be used.

PERIODIC CHECKS AND ROUTINE MAINTENANCE

In view of the vital roll of protective relays in the operation of a power system it is important that a periodic test program be followed. It is recognized that the interval between periodic checks will vary depending upon environment, type of relay and the user's experience with periodic testing. Until the user has accumulated enough experience to select the test interval best suited to his individual requirements, it is suggested that the following points be checked at an interval of from one to two years.

ELECTRICAL TEST

Using connections shown in Fig. 6 check the operating time of the TU-1 and TU-2 contacts at rated voltage and present time setting to be sure they are within the limits specified under ACCEPTANCE TEST and that the targets operate properly.

If for any reason the operating times are outside these limits, refer to the SERVICING section.

SERVICING

CONTACT CLEANING

For cleaning fine silver contacts, a flexible burnishing tool should be used. This consists of a flexible strip of metal with an etched roughened surface, resembling in effect a superfine file. The polishing action is so delicate that no scratches are left, yet corroded material will be removed rapidly and thoroughly. The flexibility of the tool insures the cleaning of the actual points of contact.

Fine silver contacts should not be cleaned with knives, files or abrasive paper or cloth. Knives or files may leave scratches which increase arcing and deterioration of the contacts. Abrasive paper or cloth may leave minute particles of insulating abrasive material in the contacts, thus prevent closing.

A burnishing tool as described above can be obtained from the factory.

MECHANICAL ADJUSTMENTS

The specific adjustments and setting on this relay should rarely require attention. If for one reason or another they have been disturbed the following points should be observed in restoring them:

1. The gap between the contact tips on each set of the timing unit contacts should be approximately 1/16 inch. Each contact brush should bear against its respective scraper brush.

2. When rotated, the insulated cams should touch the inner contact brush at the "V" only, but high enough on the "V" to insure 1/64 inch wipe on the outer contact brush. These cams should not extend beyond the edge of their respective contact brush.

3. With the pointer of the rear insulated cam set at the maximum time setting on the scale, this cam should rotate far enough beyond the apex of the "V" in the contact brush to allow the contacts to reopen when the timing unit is fully operated.

4. There should be at least 1/32 inch clearance between the time scale assembly and the front mounting plate.

5. There should be no binding between the gear on the main shaft and the pinion on the magnetic damping element shaft.

6. The pawl of the ratchet assembly on the magnetic damping element shaft should remain engaged to the same tooth when the time scale is rotated from zero to the maximum time setting mark and should allow the gear to slip when the scale is released.

7. The flexible stop arm at the rear of the main shaft should clear the supporting bracket by at least 1/32 inch.

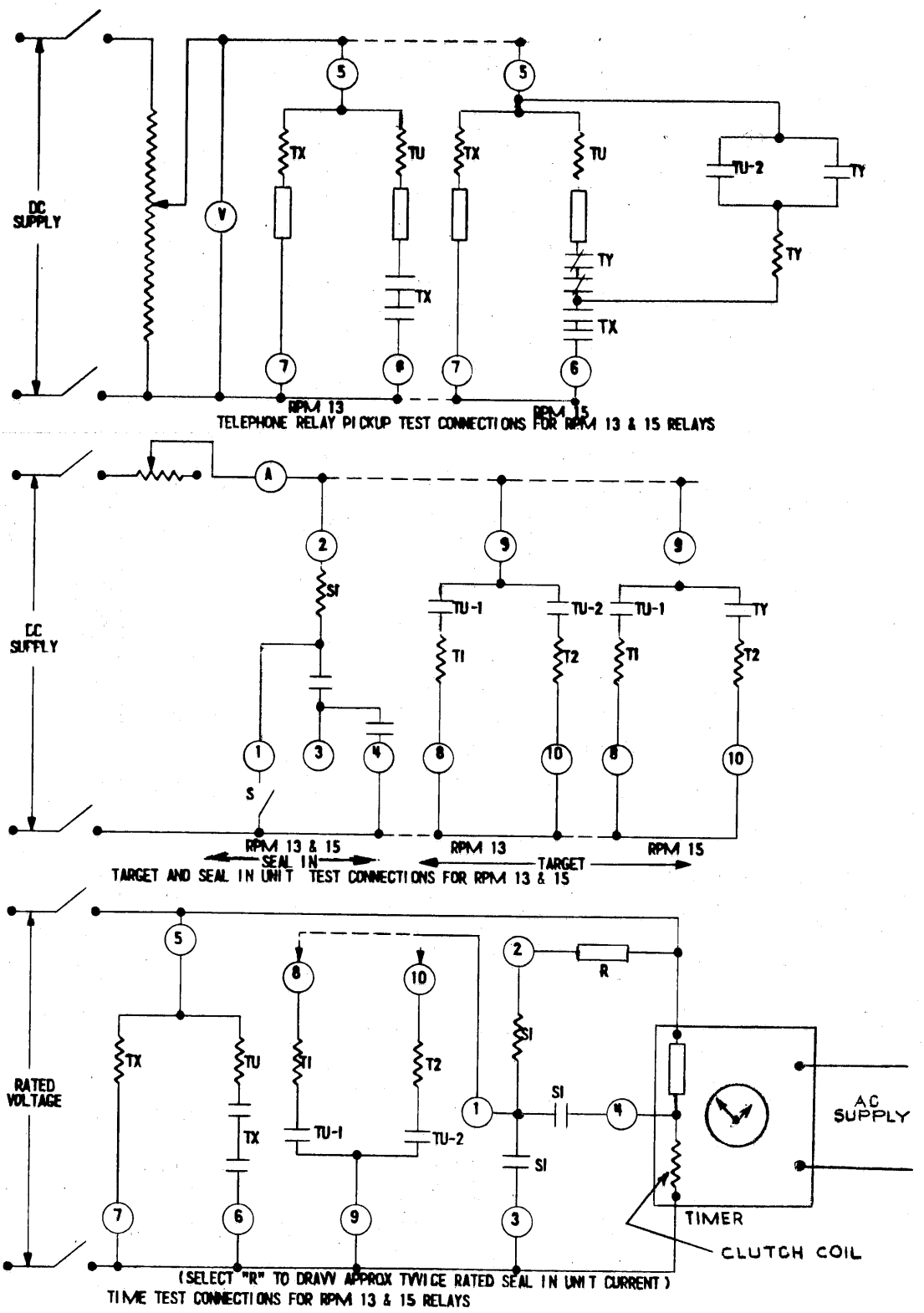


Fig. 7 (0148A3989-3) Laboratory Test Connection Diagrams For The RPM Relays Covered By This Book

8. With the operating magnet in either the de-energized or the fully operated position, the driving arm should clear the cutout section of the main shaft supporting bracket by at least 1/32 inch.

9. The driving arm assembly should clear the rear mounting plate by at least 1/32 inch.

10. There should be at least 1/64 inch clearance between the reset spring collet and the rear bearing of the rotonoid.

11. The time of operation for any scale setting may be varied by sliding the copper cup forward or backward on its shaft or turning the driving spring collet on its shaft. Be sure to tighten the set screw after adjustments have been made.

12. With the rotonoid de-energized, the reset spring is prewound approximately one-half revolution and the driving spring is prewound approximately three-fourths of a turn.

13. The gap of all TX and TY unit contacts should be 0.015".

14. The wipe of all TX and TY unit contacts should be approximately 0.005 inch.

15. The end of the residual screw of the TX unit should project at least 0.002" beyond the inside surface of the armature.

16. The seal-in unit should have at least 1/32" wipe on its contacts, measured at the end of the armature adjacent to the contacts. If wipe is too small, it can be increased by lowering the position of the stationary contact members. In the final adjustment the contacts should make approximately at the same instant whe the armature is operated by hand.

TIME CALIBRATION

Adjust the front cam so that it approaches the zero mark on the time dial scale. The TU-1 contact should just make when the pointer reaches zero.

Set the time dial at its maximum setting and with the test circuit shown in Fig. 6 check the time at rated voltage. The limits should be within ± 5% of the dial reading. If the time is outside these limits it can be corrected by sliding the copper cup forward or backward on the magnetic damping element shaft or by turning the driving spring collet on its shaft.

Moving the copper cup forward decreases the time delay and moving it backward increases the time delay. Never move the copper cup backward enough to strike the rear plate of damping magnet element.

Turning the driving spring collet in a counter clockwise direction (front view) decrease the time delay and in a clockwise direction increase the time delay.

RENEWAL PARTS

It is recommended that sufficient quantities of renewal parts be carried in stock to enable the prompt replacement of any that are worn, broken or damaged.

When ordering renewal parts, address the nearest Sales Office of the General Electric Company, specifying the quantity required and describing the parts by catalogue numbers as shown in Renewal Parts Bulletin No. GEF-3538.*

VOLTS	RESISTANCE		
	TX	TU	RI
125	5000	100	100
110	5000	100	75
24	200	7	3

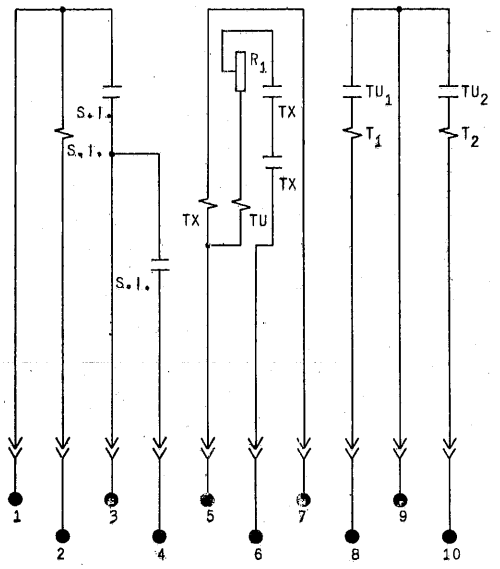


Fig. 8 (6375892-2) Internal Connections (Front View) For The RPMI3A, B and D Relays Rated 24, 110 or 125 VDC

VOLTS	RESISTANCE				
	TX	R3	TU	RI	
250	5000	5000	100	300	
48	200	200	7	13.5	
220	5000	5000	100	250	
32	200	70	7	6	

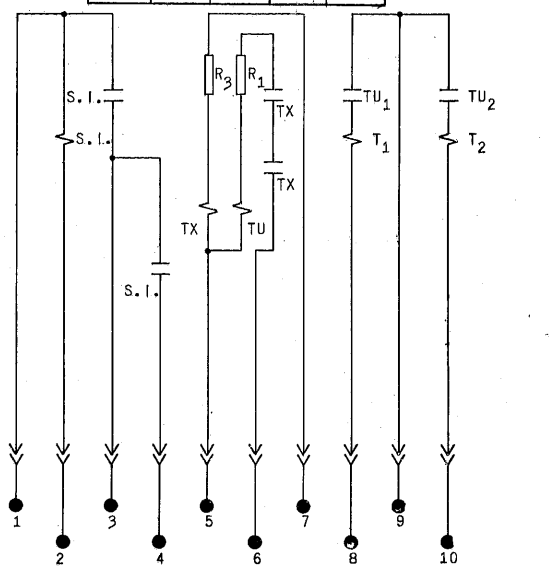


Fig. 9 (6375893-5) Internal Connections (Front View) For The RPMI3A, B and D Relays Rated 32, 48, 220 or 250 VDC

VOLTS	RESISTANCE					
	TX	R3	TU	R1	TY	R4
48	200	200	7	13.5	425	425
250	5000	5000	100	300	7500	7500
220	5000	5000	100	250	7500	7500

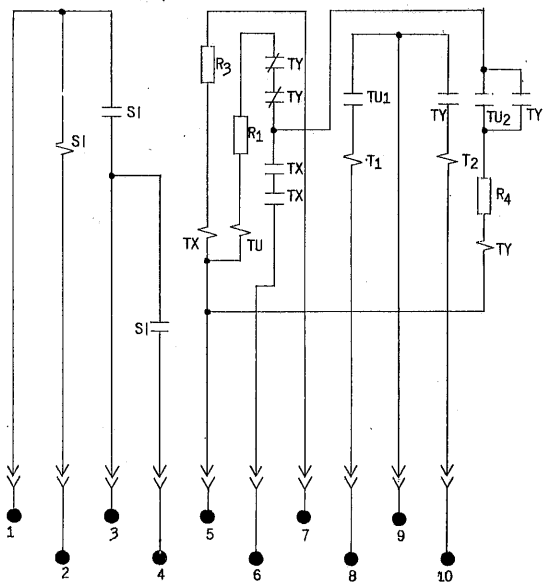


Fig. 10 (403A184-2) Internal Connections (Front View) For The RPMI5A Relays Rated 48, 220 or 250 VDC

VOLTS	RESISTANCE			
	TX	TU	R1	TY
24	200	7	3	425
125	5000	100	100	7500
110	5000	100	75	7500

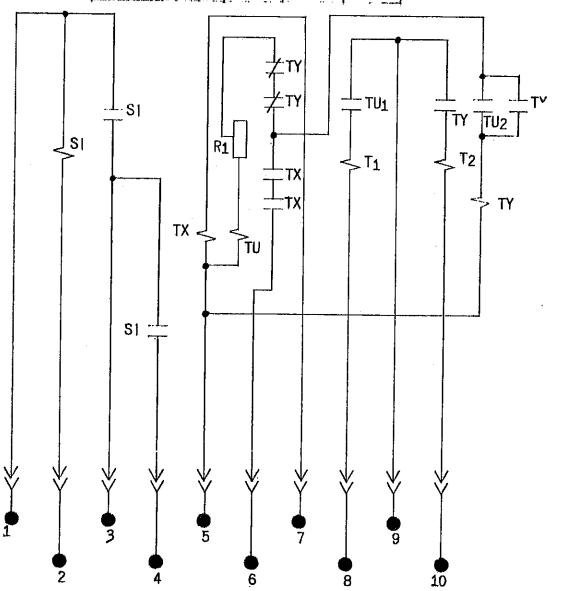


Fig. 11 (403A183-3) Internal Connections (Front View) For The RPMI5A and C Relays Rated 24, 110 or 125 VDC

VOLTS	RESISTANCE			
	TX	TU	R1	TY
24	200	7	3	425
125	5000	100	100	7500
110	5000	100	75	7500

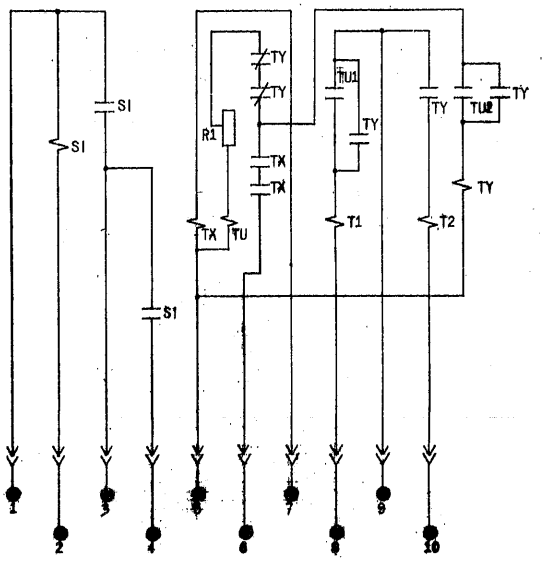


Fig. 12 (127A9402-1) Internal Connections (Front View) For The RPM15B Relays Rated 24, 110 or 125 VDC

VOLTS	RESISTANCE					
	TX	R3	TU	R1	TY	R4
48	200	200	7	13.5	425	425
250	5000	5000	100	300	7500	7500
220	5000	5000	100	250	7500	7500

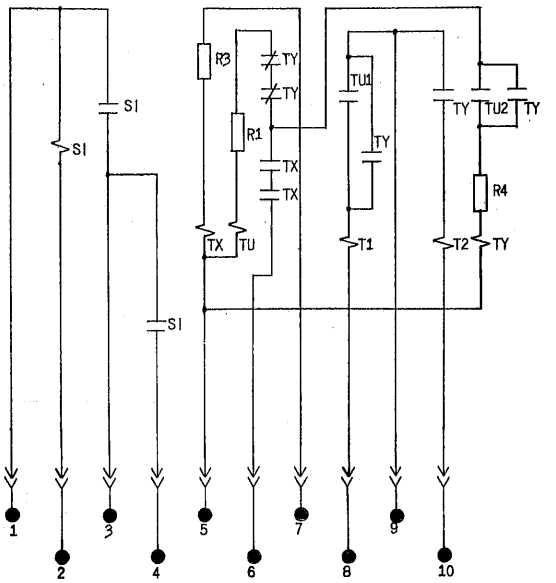
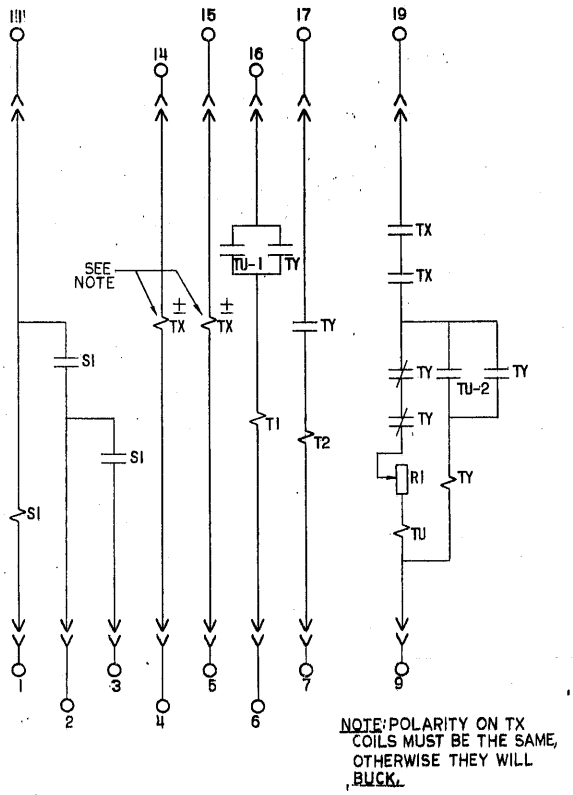


Fig. 13 (127A9401-0) Internal Connections (Front View) For The RPM15B Relays Rated 48, 220 or 250 VDC



* Fig. 14A (0208A5573-0) Sh.1 Internal Connections (Front View) For The RPM 15D Relay

VOLTS	RESISTANCE			
	TX	TU	R1	TY
48				
125	5K 5K	100	100	7.5K
250				

*Fig. 14B (0208A5573-0) Sh.2) Internal Connections (Front View) For The RPM 15D Relay

* Denotes change since superseded issue.

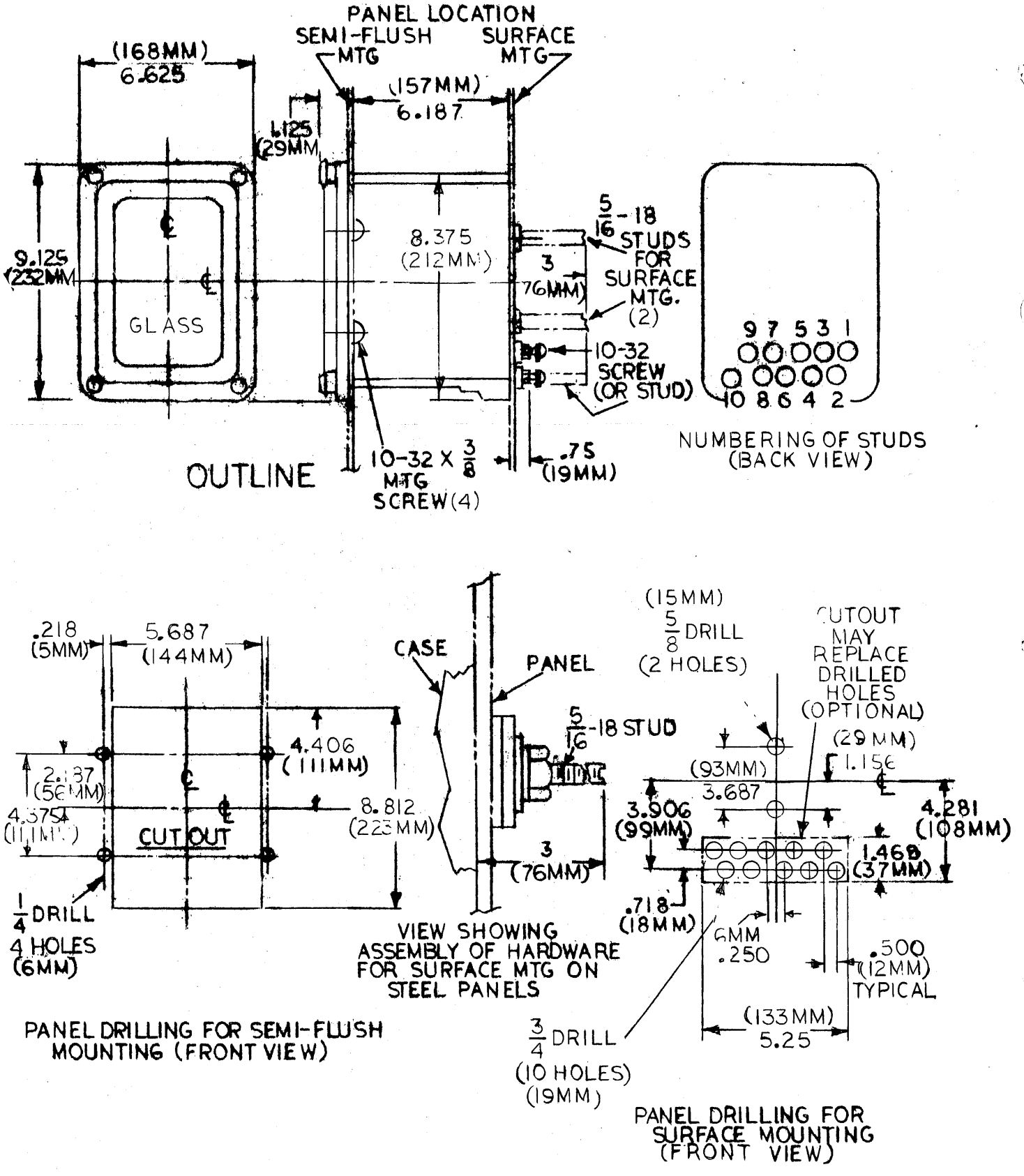


Fig. 14 (6209271-5) Outline and Panel Drilling Dimensions for the RPM Relays Covered by this Book