CONTACT CLOSURE TEST SET

J94724A

1. GENERAL

1.01 This section describes the J94724A contact closure test set SD-95365-01, and its use in testing and adjusting 206-, 227-, 231-, 239-, and 280- type relays in conjunction with the 35 type or equivalent test set.

1.02 The section is being reissued to revise information on the power cord, to revise the list of tools, and to revise the information for the application of the contact closure test set.

1.03 The contact closure test set makes use of lamp signals as a positive means of indicating contact closures. Two lamps mounted in the No. 587A contact closure indicator are used to indicate when the left or right contacts are closed. The use of lamp indications of contact closure in place of visual inspection of the armature position facilitates the testing and adjusting of polarized relays.

1.04 Within the limitations covered by this section the J94724A test set may be used to check relays to either the A and B adjustments or to the numerical adjustments 1-13 inclusive specified on the circuit requirement table or in Sections A460.023 and A460.059.

1.05 Contacts: For the purpose of this section the term "contact" is used to designate the left (L) and right (R) contacts and the armature (A) on the relay. While these letters appear on the figures in this section as a means of identifying the points to which the contact closure indicator should be connected, the letters do not appear on the relay or on any circuit requirement table.

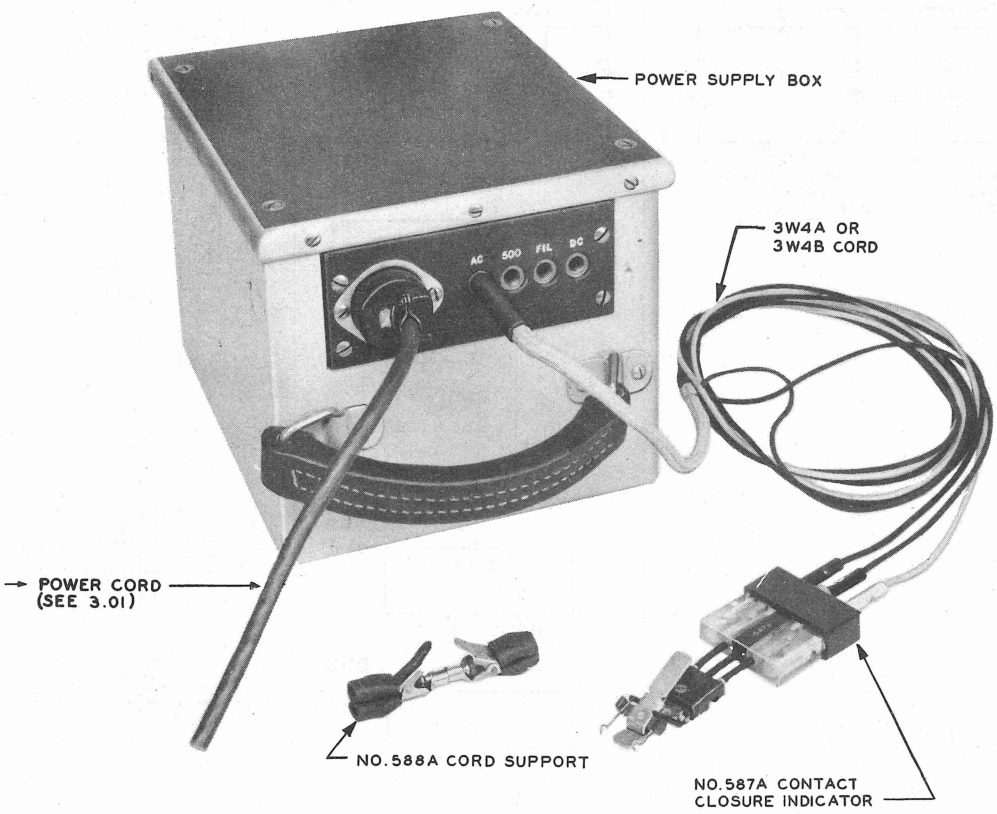


Fig. 1 - J94724A Contact Closure Test Set

1.06 Loop Resistance: For the purpose of this section the term "loop resistance" is the resistance of the circuit path connecting two contacts either directly, as indicated in Fig. 5 of Table B or indirectly through battery or ground as shown in Fig. 6 or 7 of Table B.

2. EQUIPMENT AND CIRCUIT FEATURES

2.01 General: The contact closure test set shown in Fig. 1 and 2 consists of a power supply box, a No. 587A contact closure indicator, a set of interconnecting cords, and a No. 588A cord support.

Power Supply Box

2.02 The power supply box shown in Fig. 1 is approximately 9-1/4 inches long, 7-3/4 inches wide and 6-3/4 inches high. The top of the box is secured to it by means of four screws. When in use the power supply box is intended to be placed on the floor.

2.03 A jack panel mounted on the side of the box contains the following receptacle and jacks.

(a) One Hubbell plug base for connection to the ac central office power outlet by means of the power cord described in 3.01.

(b) AC Jack: A 9.5 volt nongrounded alternating current supply is provided at the tip and sleeve and ring and sleeve of this jack for lighting the indicating lamps of the contact closure indicator. The ac central office supply is connected to the primary winding of a transformer by means of a power cord. One terminal of the secondary winding of this transformer connects to the sleeve of the AC jack. The other terminal of the transformer connects to the tip and ring of the AC jack through two separate 50mf nonpolarized capacitors. This nongrounded supply is used to isolate the indicating lamps from any ground circuits which may exist on the contacts of the

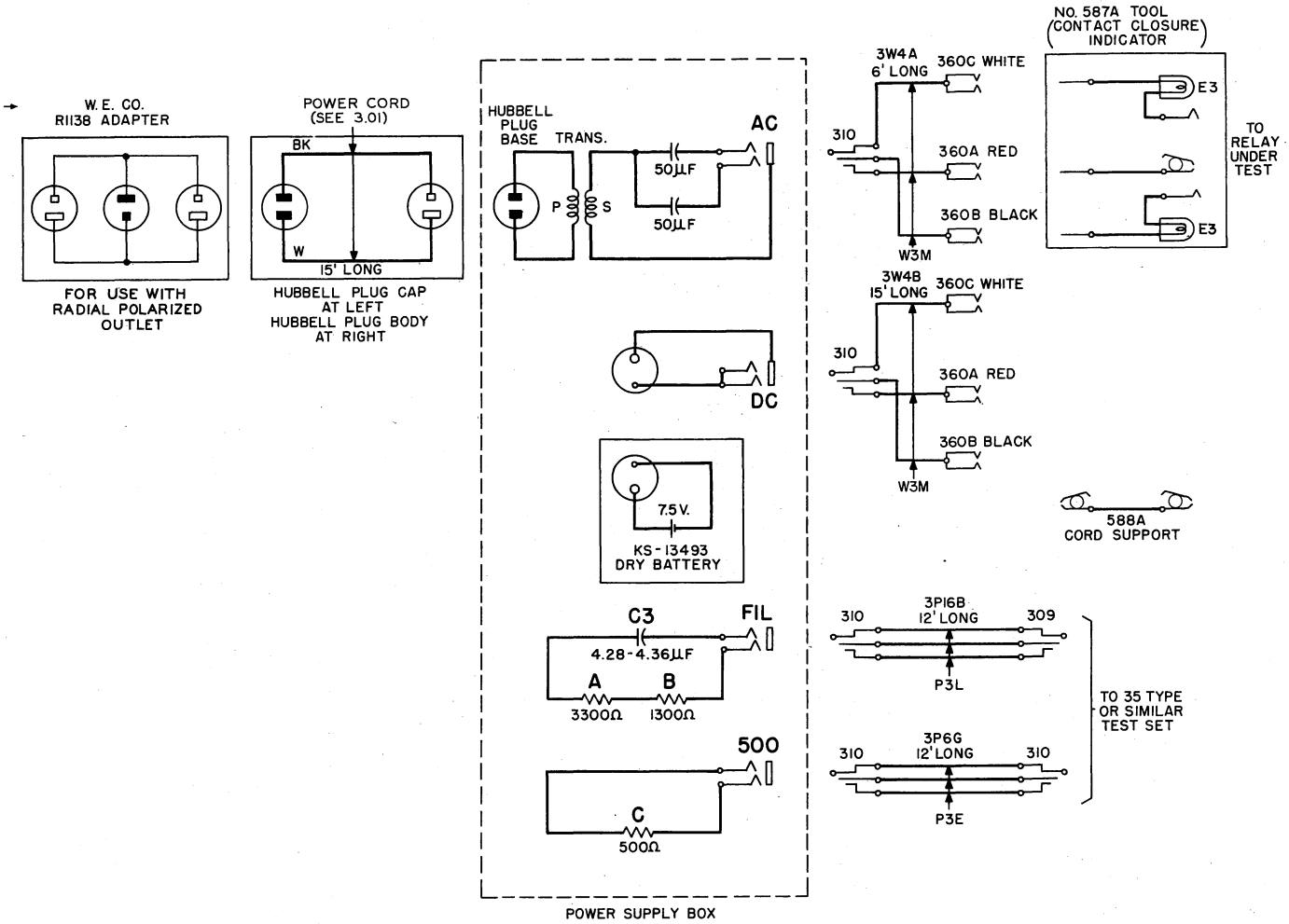


Fig. 2 - Schematic of J94724A Contact Closure Test Set

relay being tested so as to prevent false lamp indications.

(c) DC Jack: A 7.5 volt nongrounded dry cell battery is connected across the DC jack, the positive terminal being connected to the sleeve and the negative terminal being connected to the tip and ring. This provides a direct current supply for the indicating lamps of the contact closure indicator for use where an AC central office supply is not available or where the use of the AC lamp supply connection would introduce false currents in the winding of the relay under test which would interfere with its adjustment.

(d) FIL Jack: A filter consisting of a 4.28 to 4.36 mf capacitor in series with a 4600-ohm resistor is bridged across the tip and ring of the FIL jack. This filter is provided for use where the circuit requirement table specifies that this capacitor or resistor (which may be specified as the network part of the R-2717 filter) is to be connected across the winding of the relay under test. The circuit specifies this filter where a relay under test is shunted by a capacitor, and the filter will eliminate the oscillatory surge generated when soak currents are applied to the relay. The 206L (CS) relay in the panel district circuit SD-21627-01 is a typical illustration of a relay requiring such a filter. The connection to the relay under test is made by patching the FIL jack to the proper jack of the 35 type or similar test set by means of the 3P16B or 3P6G cords.

(e) 500 Jack: A 500-ohm resistor is bridged across the tip and ring of the 500 jack. This resistor is provided for use where the circuit requirement table specifies that a 500-ohm resistor (which may be specified as the 500-ohm resistor part of the R-2717 filter) is to be connected across the winding of the relay under test. This resistor is used to eliminate the oscillatory surges generated when soak currents are applied to the relay. The connection to the relay under test is made by patching the 500 jack to the proper jack of the 35 type or similar test set by means of 3P16B or 3P6G cords.

No. 587A Contact Closure Indicator

2.04 The No. 587A contact closure indicator shown on Fig. 3 consists of a plastic frame 2 inches by 2-1/4 inches by 1/2 inch, a connecting block, a heavy suspender type clamp, two wire-spring connectors and a guard block. The contact closure indicator is attached to the relay under test using the suspender clamp thus providing a connection between the contacts and armature of the relay under test and the indicating lamps and their supply in the power supply box.

2.05 The plastic frame houses two E3 switchboard type lamps, one on the left and the other on the right side of the indicator frame. These lamps indicate the closure of the left and right contacts of the relay respectively. The one end of the frame has three pin terminals for connecting the No. 360 tools of the 3W4A or 3W4B cords. One terminal of the left and right lamps is connected respectively to the left and right pin terminal.

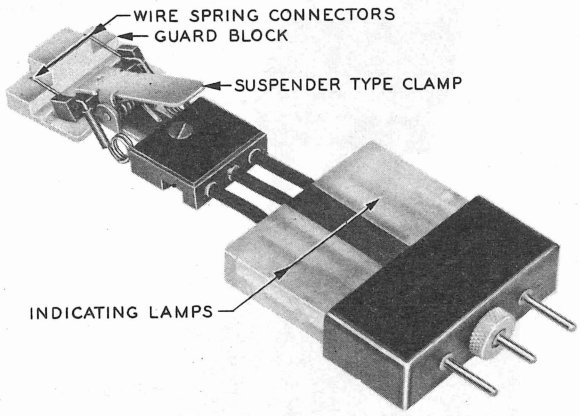


Fig. 3 - No. 587A Contact Closure Indicator

2.06 Three flexible leads connect the plastic frame and the connecting block. Two of these leads connect the lamps in the left and right of the plastic frame to the wire spring connectors to the left and right respectively of the suspender clip. The third lead connects the center pin terminal in the plastic frame to the suspender type clamp.

2.07 The suspender type clamp connects the indicator to the base of the relay frame as shown in Fig. 4, the two wire spring connectors being so placed as to make contact with the left and right contact brackets; providing a connection between the left and right contacts and the left and right lamps respectively. The suspender clamp also completes the electrical connection between the center terminal of the plastic frame and the armature of the relay, which is connected to the frame.

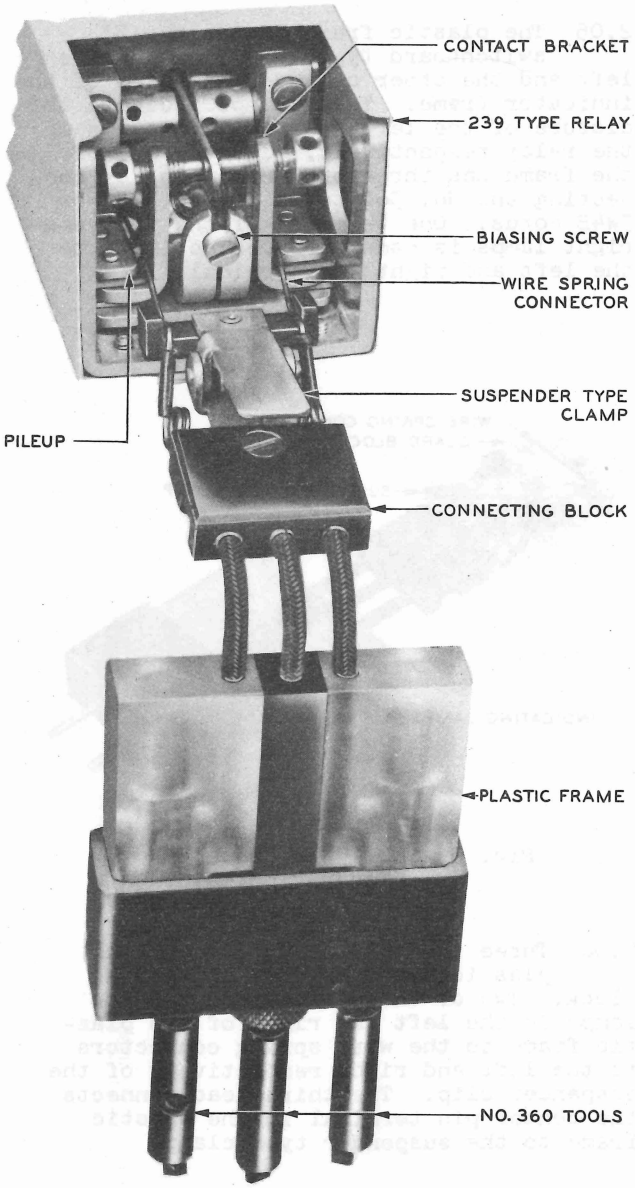


Fig. 4 - No. 587A Contact Closure Indicator Attached to 239-Type Relay

Miscellaneous

2.08 No. 588A Cord Support: This cord support is provided to support the weight of the 3W4A or 3W4B cord to the frame so that the No. 360 tools will not pull loose from the terminals of the plastic frame.

2.09 Guard Block: The guard block is provided to protect the wire-spring connectors from damage when the contact closure indicator is not in use as shown in Fig. 3.

2.10 Cords: Miscellaneous cords are provided for use as power cords and for interconnection between the power supply box and the 35 type test set or contact closure indicator as shown in Fig. 2.

2.11 R-1138 Adapter: This adapter is supplied for use with radial polarized central office outlets.

2.12 Lamp Supply Connection: The test set provides means for testing polarized relays using either the AC or DC lamp supply connections. 2.03(b) and (c) describe the AC and DC jacks of the power supply box and their general purposes. Parts 5 and 6 of this section describe in detail the method of determining whether the AC or DC lamp supply connection shall be used.

3. APPARATUS

3.01 Contact closure test set J94724A (SD-95365-01) is furnished with the following equipment.

Code or Spec No.	Description
Cords	
3P6G	P3E cord, 12 ft. long, equipped with two No. 310 plugs
3P16B	P3L cord, 12 ft. long, equipped with one No. 309 plug and one No. 310 plug
3W4A	W3M cord, 6 ft long, equipped with one No. 310 plug and No. 360A, 360B and 360C tools
3W4B	W3M cord, 15 ft. long, equipped with one No. 310 plug and No. 360A, 360B and 360C tools
-	Power cord prepared locally as follows, KS-15143 Rubber Cordage 15 ft. long, 18AWG, Flexible 2 Conductor, with a No. 9754 Plug Cap (Armored parallel nonpolarized), H. Hubbell Inc. (or equivalent) at one end, and a No. 7259 Plug Body (armored, Parallel, Polarized) H. Hubbell Inc. (or equivalent) at the other end.
Tools	
587A	Contact Closure Indicator
588A	Cord Support
R-1138	Adapter

Code or Spec No.	Description
Gauges	
70D	50-0-50 Gram Gauge (Not Furnished With J94724A Test Set)

4. PREPARATION

AC Lamp Supply Connection Used

4.01 When tests are made which require the use of the AC lamp supply connection, connect the Hubbell plug base in the test set to a 110-120V, 50 or 60 cycle outlet by means of the power cord. When radial receptacles are provided, use the R-1138 adapter.

4.02 Insert the No. 310 plug of the 3W4A cord into the AC jack of the power supply box.

DC Lamp Supply Connection Used

4.03 When tests are made which require the use of the DC lamp supply connection insert the No. 310 plug of the 3W4B cord into the DC lamp supply jack of the power supply box.

Connection to Relay Under Test

4.04 Connect the No. 360 tools of the W3M cord to the plug type terminals of the No. 587A contact closure indicator, connecting the No. 360A (red) tool to the center terminal and the No. 360B (black) and No. 360C (white) tools to the other two terminals irrespectively.

4.05 Make all circuit preparation, as specified for the relay on the circuit requirement table. If the circuit requirement table does not provide circuit preparation to be used in conjunction with the contact closure test set, apply the required circuit preparation as determined from the information given in Part 6.

4.06 Clamp the No. 587A contact closure indicator to the front end of the relay frame, Fig. 4, making sure that each of the wire spring connectors bears down and makes contact with the base of the associated contact bracket at a point on the base of the bracket between the pile-up and the upright part of the bracket. Exercise care when applying the indicator to relays equipped with biasing springs to see that it is not pushed in to such an extent that it makes contact with or interferes with the adjustment of the biasing screw. Check the tension of the wire-spring connectors periodically as outlined in Part 7 to see that they are within their allowable limits, as too high a tension may affect the adjustment of the relay.

4.07 Use the No. 588A cord support to support the weight of the 3W4A or 3W4B cord by connecting one clip to the cord and the other clip to the apparatus frame or to a suitable point of support.

5. APPLICATION OF CONTACT CLOSURE TEST SET TO CIRCUITS ANALYZED FOR ITS USE

5.01 Circuits which have been analyzed for use of the contact closure test set can be identified by the fact that an A or B adjustment appears in the "BSP Fig." column of the circuit requirement table for polarized relays in the circuit. Where necessary in a few cases test notes on the circuit requirement table or information in the "Remarks" column specify any special circuit preparation required for use of the contact closure test set and indicate that a DC lamp supply connection must be used if such is the case.

5.02 If an A or B adjustment does not appear in the "BSP Fig." column of the circuit requirement table this is an indication that the circuit has not been analyzed for use of the contact closure test set. Application of the test set in such cases is covered in Part 6.

5.03 The information on the circuit requirement table should be interpreted as follows if the circuit has been analyzed for use of the contact closure test set.

Table A - Circuit Requirement Table Analyzed For Use Of Contact Closure Test Set

Use Lamp Supply Connection Indicated	Circuit Requirement Table Information
AC	If there is no note on the circuit requirement table and an AC outlet is available
DC	If there is no note on the circuit requirement table and an AC outlet is not available use DC lamp supply connection within the limitations of 6.04 and 6.05 If test note on circuit requirement table specifies that a DC lamp supply connection must be used
Do not use contact closure test set	If test note on circuit requirement table specifies that contact closure test set should not be used

6. APPLICATION OF CONTACT CLOSURE TEST SET TO CIRCUITS NOT ANALYZED FOR ITS USE

6.01 Circuits which have not been analyzed for the use of the contact closure

test set can be identified by the fact that the "BSP Fig." column of the circuit requirement table does not show an A or B adjustment for the polarized relay in the circuit.

6.02 If it is desired to use the contact closure test set for a relay in a circuit which has not been analyzed for its use, connect the test set to the relay using an AC lamp connection as covered in 4.01, 4.02 and 4.04 to 4.07 if an AC supply is available (See 6.09). If an AC supply is not available, connect the test set to the relay using a DC lamp connection as covered in 4.03 to 4.07.

6.03 After applying the AC or DC lamp connection to the circuit two factors must be considered.

(1) Effect of Circuit on Functioning of Lamps: This involves determining whether the lamps function properly, and if they do not, the procedures to follow which will insure proper lamp functioning, if this is practicable.

(2) Effect of Test Set on Relay Adjustment: This involves determining whether the test set interferes with the adjustment of the relay under test, and, if it does, the procedures to follow to avoid this interference, if this is practicable.

Effect of Circuit on Functioning of Lamps

6.04 Check for Proper Lamp Functioning: To determine whether the lamps of the contact closure indicator function properly, check that the lamp on the right lights when the A and R contacts (See Fig. Table B) on the relay close, and that the lamp on the left lights when the A and L contacts on the relay close. Check that only one lamp lights at a time or that there is sufficient dimming of each lamp to indicate opening of the associated relay contact. Fig. 5 to 7 Table B show the limitations of resistance and battery voltage which are necessary for extinguishing (or sufficient dimming) of the lamps when the associated contacts open.

6.05 Procedures to Obtain Proper Lamp Functioning: If the dimming of the lamps is insufficient to indicate opening of the contacts of the relay under test, this is probably due to the circuit conditions. The following procedures may provide proper lamp functioning.

(a) Isolate the Contact of Relay Under Test: This may be done, for example, by blocking an associated relay, by insulating the contact of an associated relay, or by removing a lamp from its socket to open the circuit. (See Table C, Fig. 8 and 9.)

(b) Try the Other Lamp Connection: If an AC lamp connection cannot be made to function properly without removing wires, try a DC lamp connection. Similarly, if a DC lamp connection cannot be made to function properly without removing wires try an AC lamp connection (if AC supply is available).

(c) Do Not Use Test Set: If neither an AC or DC lamp connection can be made to function properly without removing wires the contact closure test set cannot be used. In this case check the contact closure by observing the contacts.

Effect of Test Set on Relay Adjustment

6.06 If one of the contacts of the relay under test is connected to one of the windings of the relay, either directly or through a capacitor network, either an AC or DC lamp connection may cause interference with the adjustment of the relay under test. In the case of an AC lamp connection the alternating current may cause this interference. In the case of a DC lamp connection, a capacitor in the circuit may cause a surge to occur in one of the relay windings as the capacitor charges or discharges when the relay contacts make or break. This may interfere with the adjustment of the relay. To check whether either of these conditions exist, proceed as follows.

6.07 Check for Interference: Check the adjustment of the relay with and without the contact closure test set. This check need be made only once for a particular relay in a particular type of circuit to determine whether with this circuit arrangement the test set interferes with the relay adjustment.

6.08 Procedures to Eliminate Interference With Adjustment of Relay Under Test: If a check of the relay adjustment with and without the test set indicates interference, the test set indicates interference, the following procedures may eliminate the interference.

(a) Isolate the Windings of the Relay Under Test: This may be done, for example, by insulating the contact of an associated relay. (See Fig. 10, Table C or Fig. 11, Table D)

(b) Try the Other Lamp Connection: If an AC lamp connection affects the adjustment of the relay under test, and the interference cannot be eliminated by insulating contacts, try the DC lamp connection. If the DC lamp affects the adjustment of the relay under test and the interference cannot be eliminated by insulating contacts try an AC lamp connection (If an AC supply is available).

(c) Do Not Use Test Set: If both the AC and DC lamp connections affect the adjustment of the relay, and the interference cannot be eliminated by insulating contacts, the test set should not be used. In this case check the contact closure of the relay by observing the relay contacts.

6.09 Protection of Contact Closure Indicating Lamp Against Burning Out: The following voltage limitations are necessary to avoid burning out the lamps of the contact closure indicator. The AC connection is limited to applications where the DC voltage on the contacts of the relay under test does not exceed 60 volts, or 130 volts if the circuit to the mating contact is open.

7. CHECKING TENSION OF WIRE SPRING CONNECTORS OF NO. 587A CONTACT CLOSURE INDICATOR

7.01 Fasten the No. 587A contact closure indicator to its guard as shown in Fig. 3.

7.02 By means of a No. 70D gauge measure the force required to lift each leg of the wire-spring connector in turn. The tension of the wire-spring connectors against the guard block, measured as near as possible to the point of contact, shall be min 30, max 40 grams for each spring.

7.03 If the tension is outside the above limits adjust the spring tension by manually weakening or stiffening the spring tension as required.

Table B - Effect of Circuit On Lamps In Contact Closure Test Set

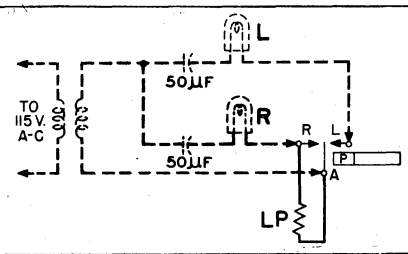
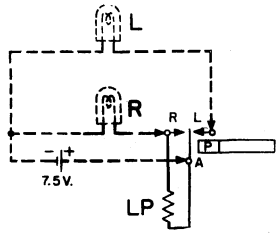
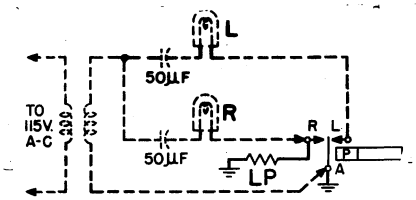
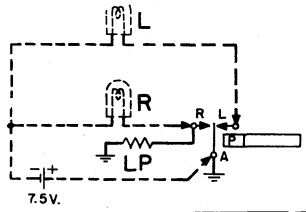
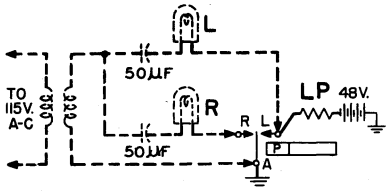
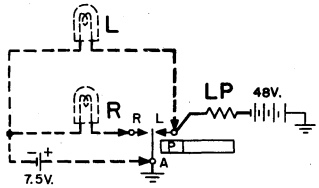
Fig. No.	Title	AC Lamp Supply Connection	Notes	DC Lamp Supply Connection
5	Direct Loop Between A and R Contacts		LP Register must be greater than 160 ohms (AC lamp supply connection) or 130 ohms (DC lamp supply connection) so as to extinguish the R lamp when the armature is not on the R contact.	
6	Loop through Ground Between A and R Contacts		LP resistor must be greater than 160 ohms (AC lamp supply connection) or 130 ohms (DC lamp supply connection) so as to extinguish the R lamp when the armature is not on the R contact. The same limitations exist if the circuit is through battery instead of ground	
7	Loop through Battery and Ground Between A and L Contacts		1. LP resistor must be greater than 160 ohms (AC lamp supply connection), so as to extinguish the L lamp when the armature is not on the L contact. 2. The same limitations in the LP resistor apply when the battery and ground through the LP resistor are interchanged. 3. If the potential difference between contacts on the DC lamp supply connection is greater than 48 volts the minimum resistance of the path between contacts must be proportionately higher. If the total loop voltage is less than 48 volts the resistance may be proportionately lower.	

Table C - Examples of Circuits Where Either AC or DC Lamp Connections May be Used Only With Special Circuit Preparation

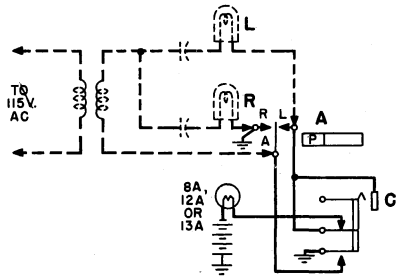
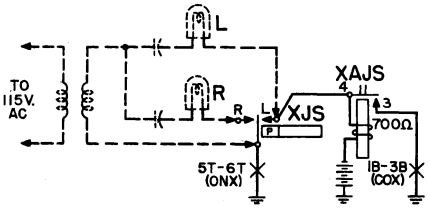
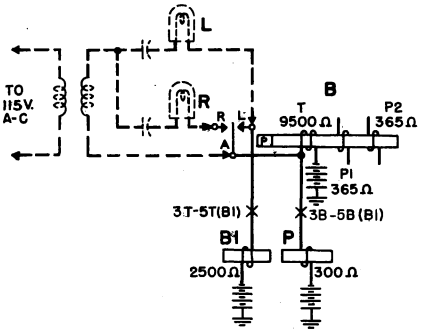
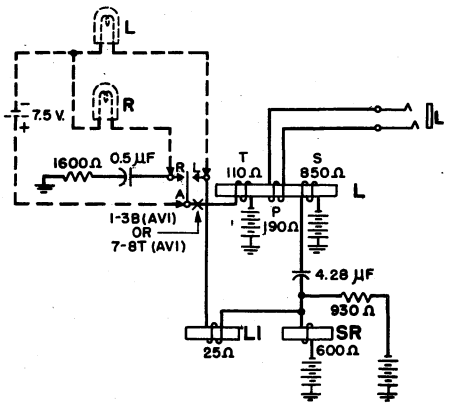
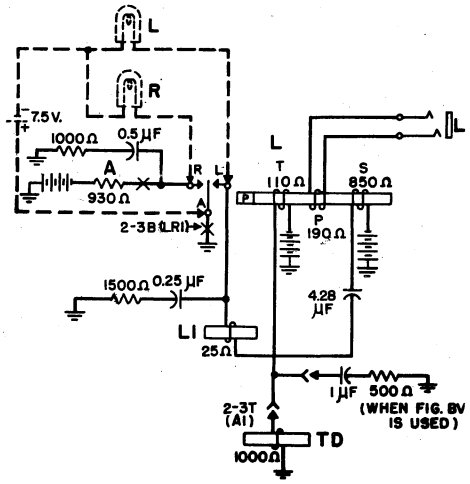
Fig. No.	Typical Circuit	Cause of Interference With Lamp Circuit	Circuit Preparation Required To Permit Use of Contact Closure Test Set
8	Test on (A) Relay 	Resistance of lamp B is less than 160 ohms. L lamp is not extinguished when A relay is not on L contact. (See Fig. 5, Table B)	Remove No. 8A or No. 12A Lamp from lamp socket. Since No. 13A lamp cannot be removed, the contact closure indicator cannot be used when this lamp is provided
9	Test on (XJS) Relay 	When XAJS relay operates, connecting ground to the L contact of the XJS relay, the R lamp is not extinguished even though the (XJS) R contact is open.	Block XAJS relay non-operated.
10	Test on any winding of (B) relay 	The alternating current in the case of the AC connection or the direct current in the case of the DC connection, flows through the tertiary winding of the B relay and will affect the adjustment. The circuit is complete from battery on the winding of the B1 relay through the contact closure test set and through the P and B relay windings in parallel to battery.	Insulate 3T-5T and 3B-5B of (B1) relay.

Table D - Examples of Circuits Where DC Lamp Connection Can Be Used Only With Special Circuit Preparation

Fig. No.	Typical Circuit	Cause of Interference with Adjustment of Relay under Test	Circuit Preparation Required to Permit Use of Contact Closure Test Set
11	Test on Pri. wdg of L relay 	1. When the A and L contacts of L relay close, a surge through the 4.28 MF capacitor may affect the adjustment of the L relay. 2. A surge through the tertiary winding from the 0.5 MF capacitor as the L relay makes or breaks the R contact may affect the relay adjustment.	
12	Test on Pri. wdg of L relay 	1. When the A and L contacts of L relay close, a surge through the 4.28 MF capacitor may affect the adjustment of the L relay. 2. The R lamp will remain lighted on a circuit from ground on the armature, thru the 7.5V battery, the R lamp and the A resistor even though the A and R contacts of the L relay are open. (See Fig. 6 Table B)	