DRY-REED-TYPE RELAYS
EDUCATIONAL INFORMATION

1. GENERAL

1.01 This section describes dry-reed-type relays.

1.02 This section is reissued to change the title and amplify the information covering dry-reed relays. Detailed reasons for reissue will be found at the end of the section. Since the reissue covers a general revision, the arrows ordinarily used to indicate changes have been omitted.

1.03 Dry-reed-type relays are so called because their sealed contacts operate dry while the sealed contacts of certain other relays are mercury wetted. Dry-reed relays are intended for use instead of armature-operated relays in new circuits where applicable, and also where the redesign of existing circuits will justify their use.

1.04 For certain applications the dry-reed relays offer a number of advantages over other types of relays including:

(a) Equipment and wiring savings.

(b) Power savings.

(c) Space savings.

(d) High speed of operation.

(e) Improved contact reliability.

(f) Reduced field maintenance.

1.05 Dry-reed relays are not interchangeable with other types; therefore, equipment and circuit engineering is required in applying them in existing systems.

1.06 The following Bell System Practices contain information concerning dry-reed relays.

SECTION

A304.454 — Dry-Reed-Type Relays Precautions to be Observed When Testing

SECTION

A502.029 — Methods of Removing and Mounting 289-, 290-, and 293-Type Relays

A502.036 — Method of Making Test Connections to Apparatus

A507.075 — Dry-Reed-Type Relay — 302-Type — Piece-Part Data and Replacement Procedures

A804.007 — Winding and Spring Designations — Apparatus Connecting Points Referred to in Circuit Requirement Tables

2. DESCRIPTION

General

2.01 The characteristic element common to all dry-reed relays is the sealed contact shown in Fig. 1. This contact consists of a gas-filled glass tube into each end of which is sealed a magnetic reed whose terminal extends through the end of the tube. The inner ends of the reeds overlap by 0.050 inch and normally are separated by a gap of about 0.010 inch. The gas in the tube is under low pressure which eliminates hazards present where high-pressure gas is used.

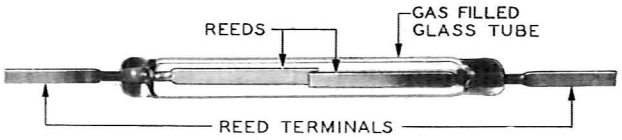


Fig. 1 – Sealed Contacts

2.02 When the sealed contact is placed in a magnetic field having a direction lengthwise with respect to the reeds, the overlapping ends of the reeds attract each other. If the field is sufficiently strong, the ends of the reeds will come together closing an electrical path through the reeds. A dry-reed relay in its simplest form consists of a sealed contact placed in the core

space of a coil. When current is passed through the coil, the magnetic field created causes the ends of the contact reeds to come together.

2.03 A magnetic latching feature is provided on certain dry-reed relays. This feature provides a relay which, once operated, will remain in the operated condition without a holding current.

2.04 The magnetic latching feature is based on the characteristic that the strength of the magnetic field required to cause the ends of the reeds of a sealed contact to come together is considerably greater than that required to hold them together. In its simplest form, a magnetically latching relay has a small permanent magnet associated with the sealed contact. The permanent magnet creates a field which, although insufficient to cause the ends of the reeds to come together, is strong enough to hold them once they have been brought together.

2.05 When the coil of a latching relay is momentarily energized in the direction which creates a field aiding that of the permanent magnet, the ends of the contact reeds come together. Then, with no current through the coil, the circuit through the contact reeds remains closed. To open the circuit, a current of opposite polarity is momentarily applied to the coil creating a magnetic field which overcomes that of the permanent magnet, thus allowing the ends of the reeds to separate and the circuit to open.

2.06 A single unit of a dry-reed relay consists of one or more sealed contacts placed in the core space of a coil. However, a dry reed relay may have more than one unit. For example, the 293-type relay is made up of five units, each of which consists of a coil and one or two sealed contacts. Thus, a 293-type relay is the equivalent of five individual armature operated relays each having a spring combination consisting of one or two makes. A 290-type relay has a single unit consisting of a coil and 12 sealed contacts and is the equivalent of a single relay having a spring combination consisting of 12 makes.

289-Type Relays

2.07 The 289-type relay which was primarily intended for use in the AMA assembler computer consists of five coils each containing one sealed contact. Each coil has a resistor connected in series with it to limit the current through the coil. Internal interconnections between the five units are provided in the 289-type relay. An external view of the 289-type relay is shown in Fig. 2.

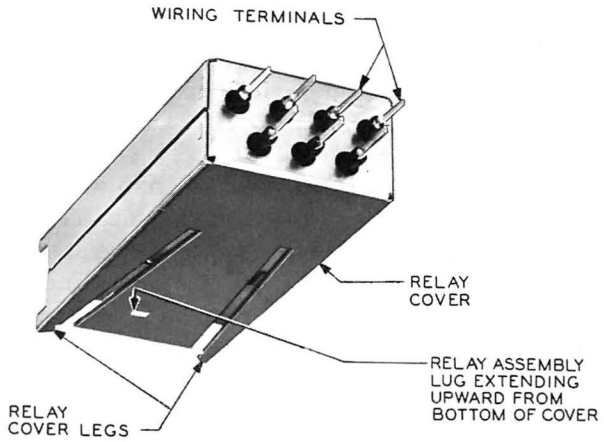


Fig. 2 – 289-Type Relay

2.08 Fig. 3 shows the bottom view of the 289-type relay with the cover and cover shield removed. As shown in the figure, the five units of the relay are held in the base shield by a spring clip formed from each side of the shield. A sheet of insulating material is wrapped around the five units before they are mounted in the base shield to provide protection for the coils and to aid in holding them in position. A terminal block, to which are secured the seven wiring terminals, is supported between slots in the sides of one end of the base shield. The terminals are arranged for wrapped connections and are insulated by tubing where they pass through the holes in the relay cover. These terminals extend from the end of the relay opposite to that at which the relay is mounted.

2.09 Fig. 4 shows the top view of a 289-type relay with the cover and cover shield removed. Referring to the figure, the center portion of the base shield is channel shaped. Small terminal blocks are secured between slots at each end of the channel portion to support five resistors each of which is connected in series with one of the coils.

2.10 The cover shield is positioned over the relay units and held in place by locking tabs which engage holes in the sides of the base

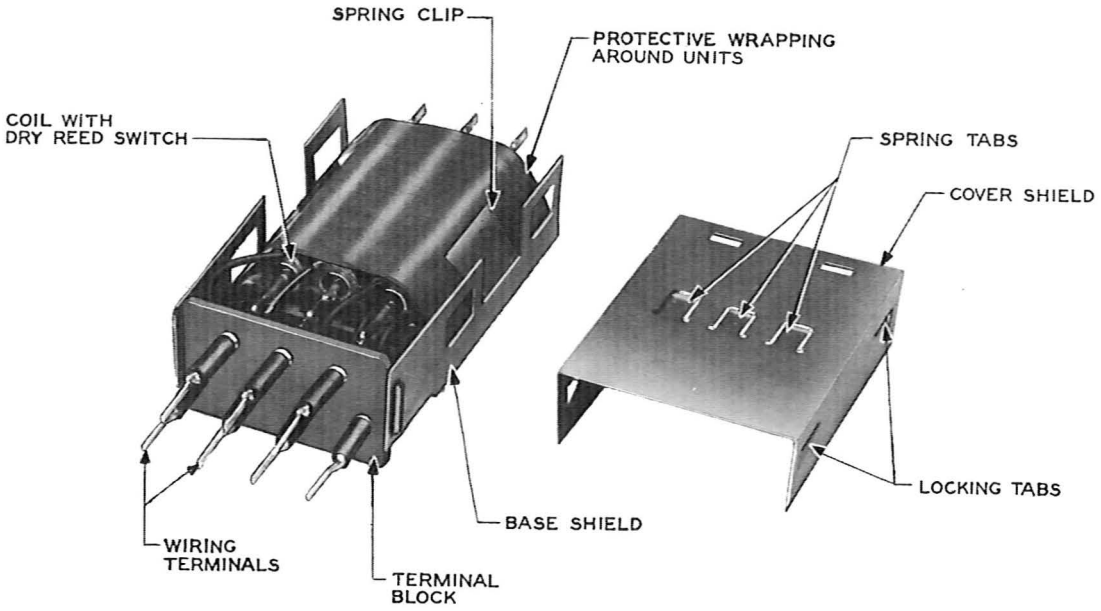


Fig. 3 – 289-Type Relay With Cover and Cover Shield Removed (Bottom View)

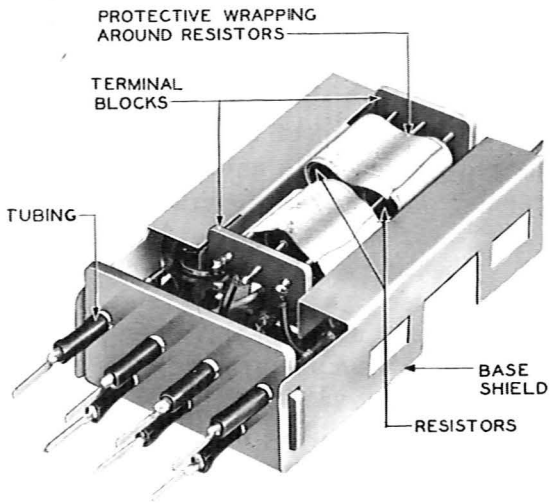


Fig. 4 – 289-Type Relay With Cover and Cover Shield Removed (Top View)

shield. Three spring tabs in the top of the cover shield shown in Fig. 3 exert downward pressure on the three units directly below the shield to further hold them securely in place.

2.11 The assembly of relay units in the cover and base shields slides into the relay cover. The lug in the bottom of the cover engages the edge of the cover shield to hold the relay securely in the cover. The position of this lug in the bottom of the the cover is shown in Fig. 2. The base and cover shields and the relay cover are made of magnetic material and serve both as magnetic return paths for the coil flux and as shields to minimize magnetic interference from adjacent apparatus.

2.12 The 289-type relay was primarily intended for use as a 2-out-of-5-digit register in the AMA assembler computer. The assembler computer employs a number of identical circuits each of which requires five relays. Since the 289-type relay is the equivalent of five individual relays with suitable interconnections, its use in this case results in appreciable space, wiring, and equipment savings.

2.13 The 289-type relay is mounted on the rear of the frame with its wiring terminals extending from the free end of the relay. The relay mounts on a channel-shaped mounting plate by means of notches in the relay cover legs which latch into holes in the mounting plate. The latching of the relay cover leg notches in the mounting plate is similar to that shown in Fig. 10 for the 293-type relay. Although the relay may be latched in place without the use of tools, the No. 654A tool is provided for removing it. The use of this tool in unlatching the relay cover legs from the relay mounting plate is described in Section A502.029.

290-Type Relays

2.14 The 290-type relay which, like the 289-type, was primarily intended for use in the AMA assembler computer has a single coil containing 12 sealed contacts. An external view of this relay is shown in Fig. 5. The wiring terminals of the relay are arranged for wrapped connections, and, in addition, the terminals associated with the sealed contacts provide for vertical strapping.

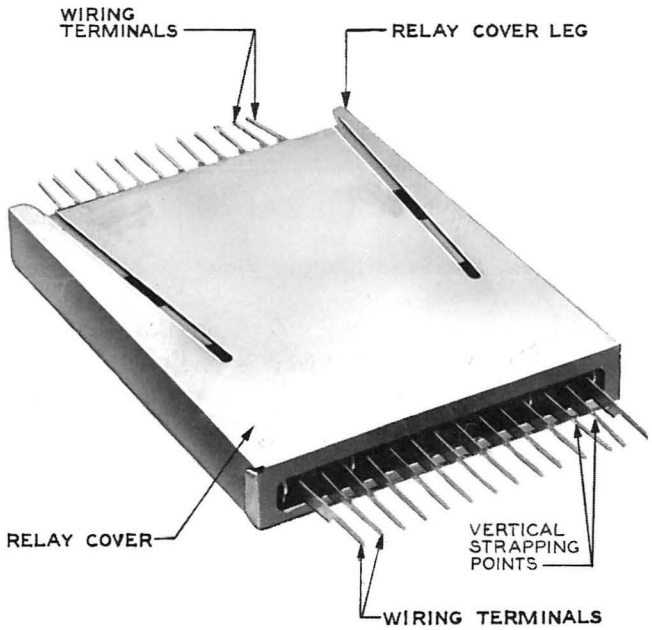


Fig. 5 – 290-Type Relay

2.15 Fig. 6 shows the 290-type relay with the cover and cover shield removed. The single unit of this relay is assembled in a base shield. The coil is positioned in the base shield by means of a projection on one spoolhead which fits into a slot in the bottom of the shield. A group of 14 wiring terminals (including the two terminals for the coil leads) at one end of the relay and a group of 12 terminals at the other end are secured in terminal blocks. Each of these terminal blocks is mounted between slots in the sides of the base shield, and projections on the terminal blocks engage slots in the bottom of the shield.

2.16 The coil leads and the terminals of the individual sealed contacts are connected directly to the wiring terminals. The inner ends of the wiring terminals associated with the sealed contacts are formed to provide some flexibility in order to prevent strains on the contact reeds due to slight misalignment of the sealed contacts in the assembly. Since there is a wiring terminal at both ends of each sealed contact, these terminals also serve to position the sealed contacts in the coil.

2.17 The cover shield fits over the base shield and is held in place by locking tabs which engage holes in the sides of the base shield. A sheet of insulating material is placed between the cover shield and the coil to provide additional mechanical protection for the coil. Slots in the top of the cover shield engage projections on one of the spoolheads of the coil and on both of the terminal blocks. Four spring tabs in the top of the shield exert downward pressure on the coil to aid in holding it securely in place.

2.18 The assembly of the relay unit in the cover and base shields slides into the relay cover. Two lugs at the bottom of the cover engage slots in the base shield and hold the relay in the cover. The base and cover shields and the relay cover are made of magnetic material and serve both as magnetic return paths for the coil flux and as shields to minimize magnetic interference from adjacent apparatus.

2.19 The 290-type relay was primarily intended for use as a connector relay in the AMA assembler computer. In this application the relay provides a simple strapping and wiring layout in combination with the 289-type relay.

2.20 The 290-type relay, like the 289-type, is mounted on the rear of the frame. A group of 14 terminals projects from the free end of the relay and a group of 12 terminals projects through the relay mounting plate to the front of the frame. The relay mounts on a channel-shaped mounting plate by means of notches in the relay cover legs which latch into holes in the mounting plate. The latching of the relay cover leg notches in the mounting plate is similar to that shown in Fig. 10 for the 293-type relay. Although the relay may be latched in place without the use of tools, the No. 654B tool is provided for removing it. The use of this tool in unlatching the relay cover legs from the relay mounting plate is described in Section A502.029.

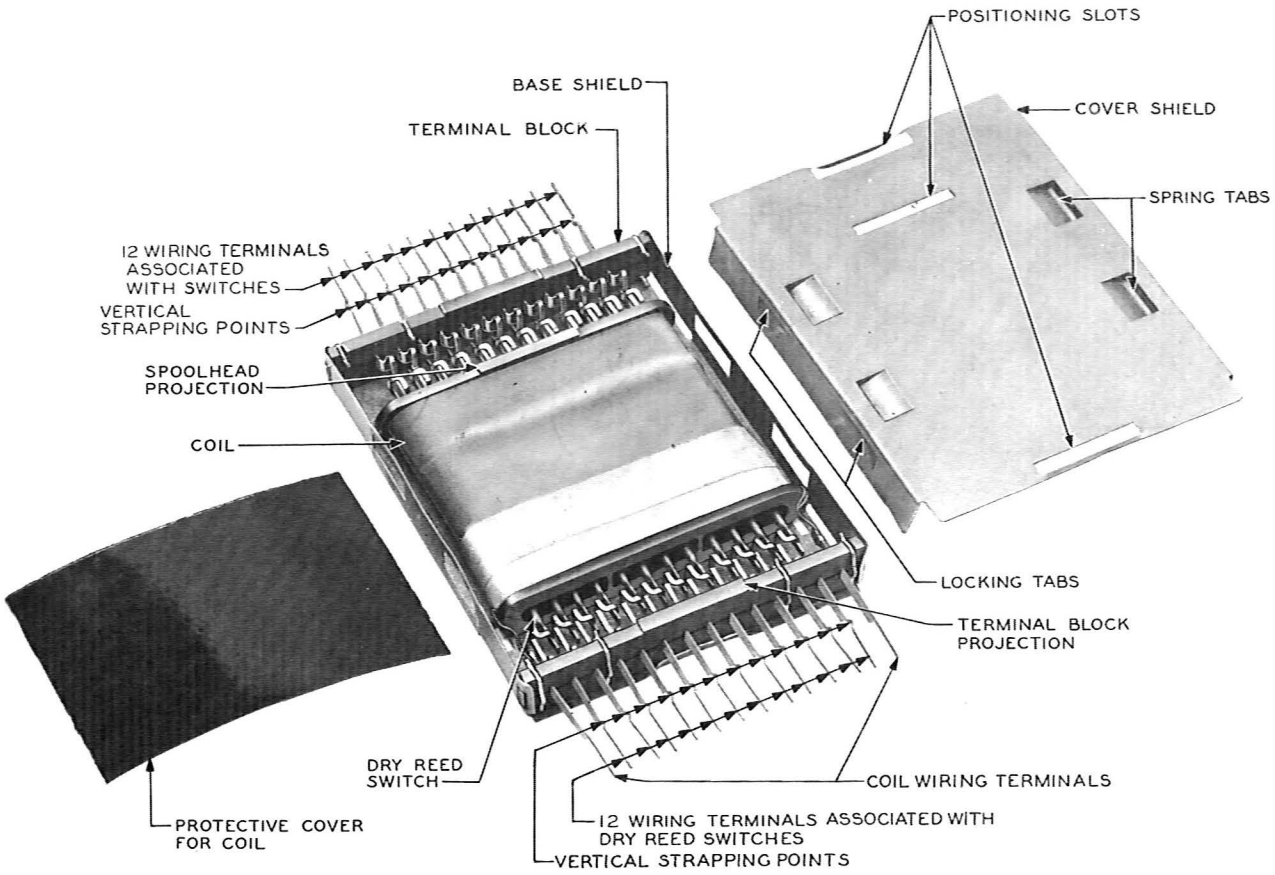


Fig. 6 – 290-Type Relay With Cover and Cover Shield Removed

293-Type Relays

2.21 The 293-type relay is made up of five basic units having either one or two sealed contacts per unit. An external view of this relay is shown in Fig. 7. Fig. 8 shows a 293-type relay having two sealed contacts per unit with the cover and shield removed. The terminals connected to the sealed contact terminals as well as those connected to the coil extend the entire length of the unit and are held in place by the spoolheads of the coil and by an insulator wrapped around the coil and terminals. At one end of the unit the terminals are arranged for wrapped connections and at the other end for making test connections.

2.22 The five units of the 293-type relay are assembled between two terminal blocks which fit over the terminals at each end of the units and through which the terminals project. A magnetic shield encloses the units between the terminal blocks. The assembly of units in the shield slides into the relay cover. Four lugs on the cover hook over the edges of the rear terminal block and hold the assembly securely in the cover. Fig. 7 shows the position of the assembly lugs on the top of the cover.

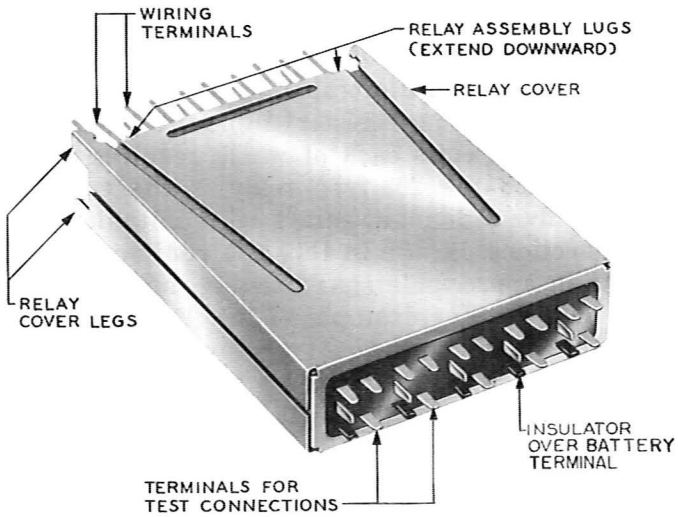


Fig. 7 – 293-Type Relay

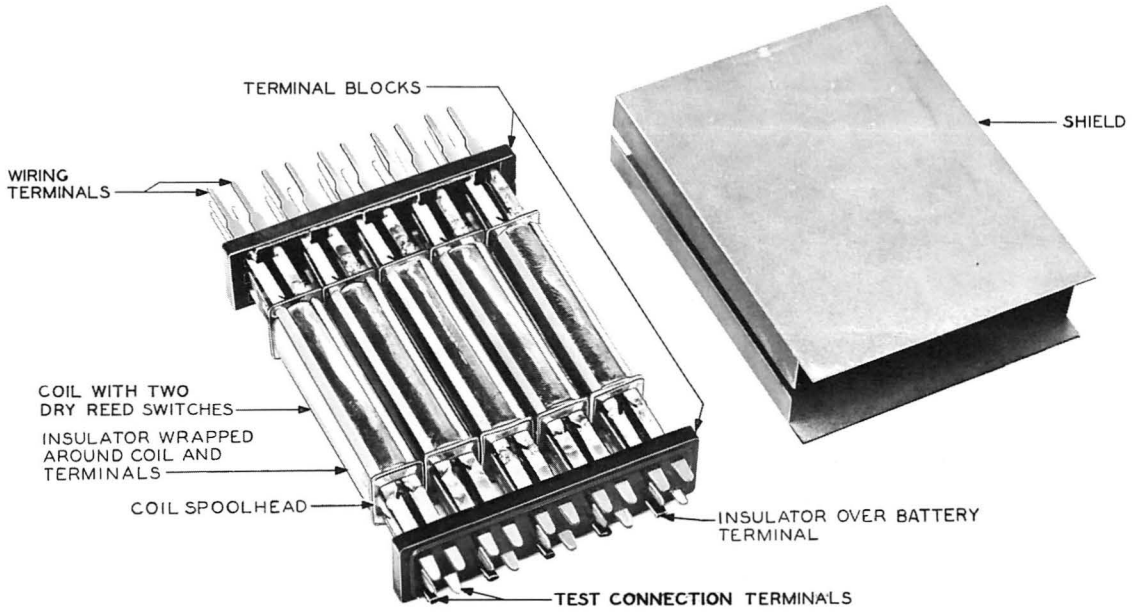


Fig. 8 – 293-Type Relay With Cover and Shield Removed

2.23 All terminals of 293-type relays are designated by 2-digit numbers, the terminals of each unit having the same initial digit. The designation of each terminal is shown on both terminal blocks. The terminals for test connections on which battery appears when the relay is in a circuit are insulated with short lengths of tubing. While all 293-type relays consist of five units each having four or five terminals, individual codes of this relay differ in internal electrical connections. The internal connections of the No. 293A relay are shown in Fig. 9.

2.24 One of the applications of the 293-type relay is a 2-out-of-5-digit register in such circuits as the No. 5 crossbar originating register. The originating register employs a number of identical circuits each of which requires five relays. Since the 293-type relay is the equivalent of five individual relays with suitable interconnections, its use in this and similar cases results in appreciable space, wiring, and equipment savings. For example, if five EA-type relays were used, they would occupy about three times as much mounting space as the one 293-type relay which may be used to perform the same function.

2.25 The 293-type relay mounts on the front of the frame and its wiring terminals project through the relay mounting plate to the rear of the frame. The relay mounts on a channel-shaped mounting plate by means of notches in the relay cover legs which latch into holes in the mounting plate as shown in Fig. 10. Although the relay may be latched in place without the use of tools, the No. 654C tool is provided for removing it. The use of this tool in unlatching the relay cover legs from the mounting plate is described in Section A502.029.

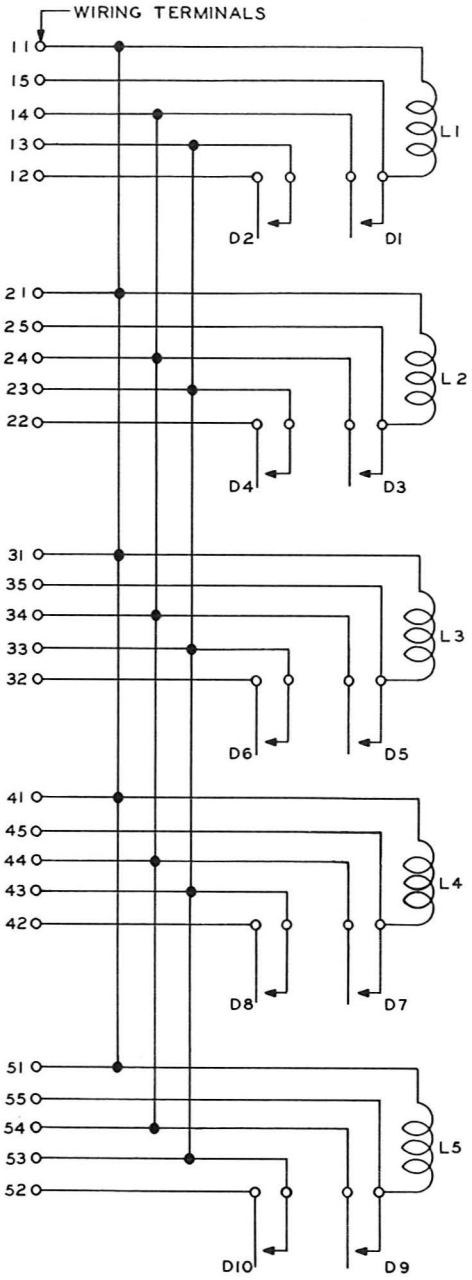
295-Type Relays

2.26 The 295-type relay is similar in construction to the 293-type except that the 295-type employs a single basic unit instead of five and the basic unit in this case contains six sealed contacts. One of the applications of the 295-type relay, which is shown in Fig. 11, is in telegraph systems. Although the relay may be latched in place without the use of tools, the No. 654C tool is provided for removing it.

302-Type Relays

2.27 Fig. 12 shows an external view of the 302-type relay. This relay is made up of 50 basic units some of which may be magnetic latching units. The magnetic latching feature is described in 2.03 through 2.05. For example, the No. 302A relay has 25 latching units and 25 nonlatching units. On the other hand, all 50 units of the No. 302B relay are latching.

2.28 Individual units of a 302-type relay are shown in Fig. 13. Each unit of a 302-type relay has a coil containing two sealed contacts. The terminals connected to the sealed contact terminals, as well as those connected to the coil, extend the entire length of the unit and are held in place by the spoolheads of the coil and by an insulator wrapped around the coil and terminals. At one end of the unit the terminals are arranged for wrapped connections and at the other end for making test connections. The terminals project through terminal blocks which fit over the terminals at each end of the unit.



L1 TO L5 REPRESENT COILS OF INDIVIDUAL UNITS (5) IN RELAY. D1—D2; D3—D4; D5—D6; D7—D8; D9—D10 REPRESENT THE CONTACTS OF THE PAIR OF DRY REED SWITCHES IN THE INDIVIDUAL UNITS OF THE RELAY.

Fig. 9 – Schematic Diagram of the No. 293A Relay

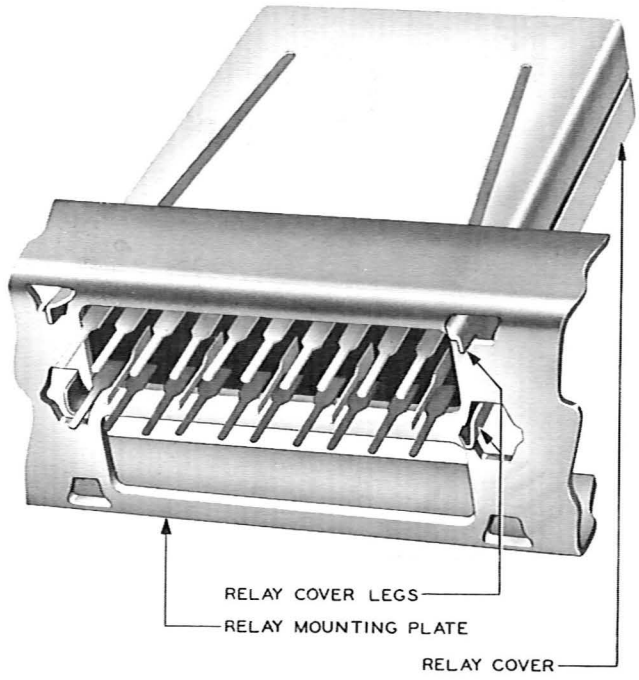


Fig. 10 – Mounting of 293-Type Relay

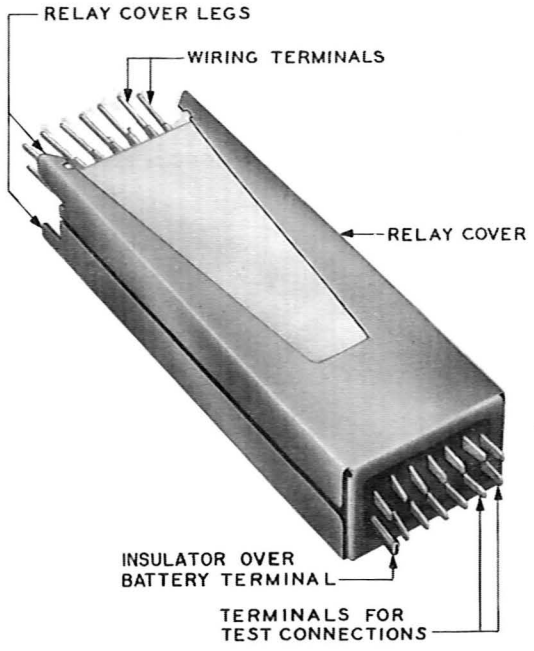


Fig. 11 – 295-Type Relay

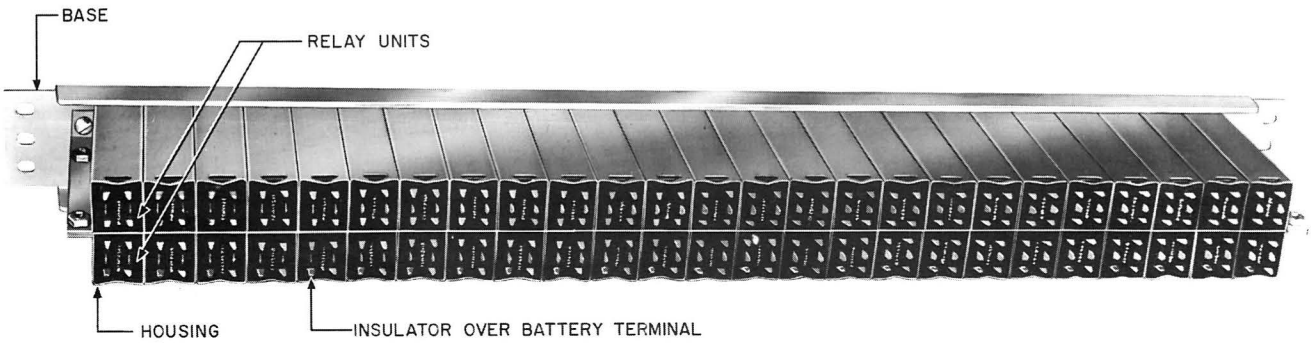


Fig. 12 – 302-Type Relay

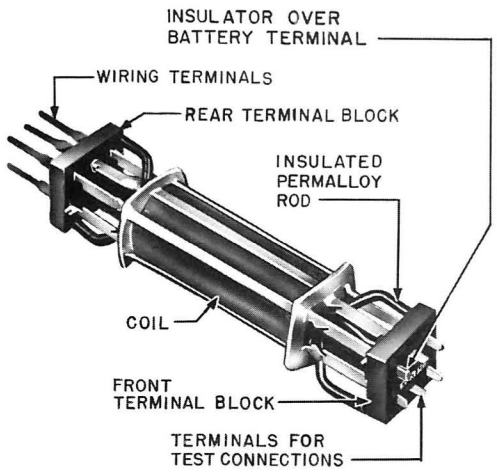


FIG. 13A-NON LATCHING UNIT

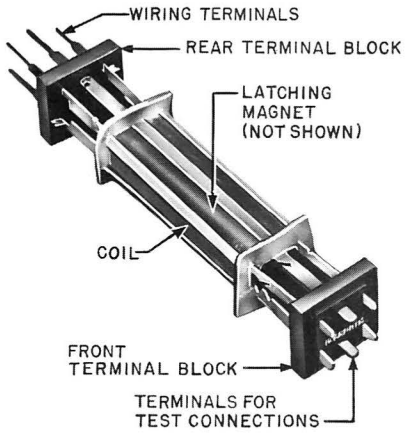


FIG. 13B-LATCHING UNIT

Fig. 13 – Relay Units of 302-Type Relay

2.29 A latching unit has a small permanent magnet in the core space of the coil between the two sealed contacts and adjacent to the ends of the contact reeds. A nonlatching unit has insulated permalloy rods extending into the core space of the coil. These rods form part of the magnetic circuit and increase the efficiency of the unit. On a nonlatching unit, the terminal for test connections on which battery appears when the relay is in a circuit is insulated with a short length of tubing.

2.30 The 50 units of a 302-type relay mount in a housing assembled on a channel-shaped base. The housing provides an individual cell for each unit and furnishes a magnetic return path for the coil flux as well as magnetic shielding between units. Each unit is locked in its cell by bending a narrow section at the front of the housing to engage the front terminal block of the unit.

2.31 The base of the 302-type relay mounts directly on the frame with the wiring terminals projecting to the rear of the frame.

2.32 The initial use of the 302-type relay was in the No. 1A line concentrator.

3. OPERATING CHARACTERISTICS

Speed and Power Consumption

3.01 Since the only moving parts of a dry-reed relay are the contact reeds which have very little mass and are spaced close together, it is possible to obtain very fast operate and re-

lease times with little power. For example, in the No. 5 crossbar originating register circuit, a 293-type relay will operate about five times as fast at about one-fourth the power in comparison with the five EA-type relays which might be used to perform the same function.

Contact Performance

3.02 Dry-reed relays provide a high degree of contact reliability since the reeds which serve as contacts are enclosed in a glass tube and are thus permanently protected from dirt or other contamination in the atmosphere. In general, these relays are particularly suitable for use in circuits where they are not required to make or break current. Where they are required to make or break current adequate contact protection is essential.

Magnetic Interference

3.03 Magnetic interference from adjacent apparatus on dry-reed relays is negligible due to the efficient shielding provided by the construction of the relays. Therefore, they can be mounted without taking special precautions to prevent magnetic interference.

Current-Carrying Capacity

3.04 The contacts of dry-reed relays have limited current-carrying capacity and are not suitable for making and breaking unprotected loads. As a consequence, certain precautions must be observed in circuit testing which are covered in Part 5.

4. MAINTENANCE

4.01 Dry-reed relays have no adjustable parts. Therefore, a dry-reed relay or, in the case of the 302-type relay, a unit of the relay not meeting the electrical requirements on the circuit requirement table must be replaced.

5. PRECAUTIONS NECESSARY TO AVOID DAMAGING DRY-REED RELAYS DURING CIRCUIT TESTING

5.01 *General:* The characteristics of the reeds of all dry-reed relays limit to rather low values the current which they can safely carry. If no current is made or broken the reeds can carry up to 2 amperes. If the reeds are required to make or break current it is essential that suitable contact protection be provided and that the current be limited to maximum 0.5 amperes. It is possible that with the circuit closed through the reeds, transient currents which may cause fuses of 1-1/3 ampere capacity or greater to blow may also damage the reeds. Therefore, in testing circuits containing these relays or in testing the relays as apparatus units, precautions must be taken to avoid subjecting the reeds to currents over the values noted above. Also, in the case of magnetically latching relay units it is essential that precautions be taken to avoid damaging the permanent magnets in these units during testing, and to return the contacts to a normal condition after testing. Specific precautions are described in 5.02 through 5.04.

5.02 *Making Test Connections:* In making test connections, special care must be taken to avoid shorting terminals on these relays which might result in applying excessive current to the reeds.

5.03 *Testing With Headsets or Test Equipment:* It is necessary that care be taken to avoid the use of any testing equipment which might result in applying excessive currents to the reeds of dry-reed relays. Provided that the relay is not operated or released with the receiver in series with the reeds, a headset having a high-resistance receiver may safely be used in testing circuits containing these relays. Suitable high-resistance receivers for this purpose are the 280-ohm No. 716C receiver and the 1100-ohm No. 509 receiver. Making or breaking the contacts with the receiver in series may result in damage to the reeds due to the high transient currents caused by the inductance of the receiver. Headsets with low-resistance receivers, such as the 56-ohm No. 528 receiver or the 1011-type handset, should not be used unless a suitable resistance is put in series with the receiver. Particular care should be taken in the use of testing equipment employing such elements as tungsten filament lamps which limit the current to low values when hot, but permit the passage of considerably higher currents when cold.

5.04 *Testing Magnetically Latching Relays:* Excessive current through the coil of these relays may change the magnetization of the permanent magnets, thus altering the

operating characteristics of the relay. Therefore, magnetically latching relays should be tested only with testing equipment approved for use with these relays.

KS-16751 Indicator

5.05 The KS-16751 indicator provides visual means of determining closure of sealed contacts in 293-type relays when these relays are used in circuits in which ground is connected to terminals 12, 22, 32, 42, and 52 of the relays by closure of the sealed contacts associated with these terminals. Lamps in the indicator light when these contacts are closed.

REASONS FOR REISSUE

1. To amplify the general description of dry-reed relays (2.01 through 2.06).
2. To add the description of the 302-type relay (2.27 through 2.32).
3. To add figures illustrating the 302-type relay (Fig. 12 and 13).
4. To add precautions for testing magnetically latching relays (5.04).
5. To add information covering the KS-16751 indicator (5.05).