March 20, 1962 A. J. KODA 3,026,390

RELAY CONSTRUCTION

Filed Jan. 19, 1959

Fig. 1

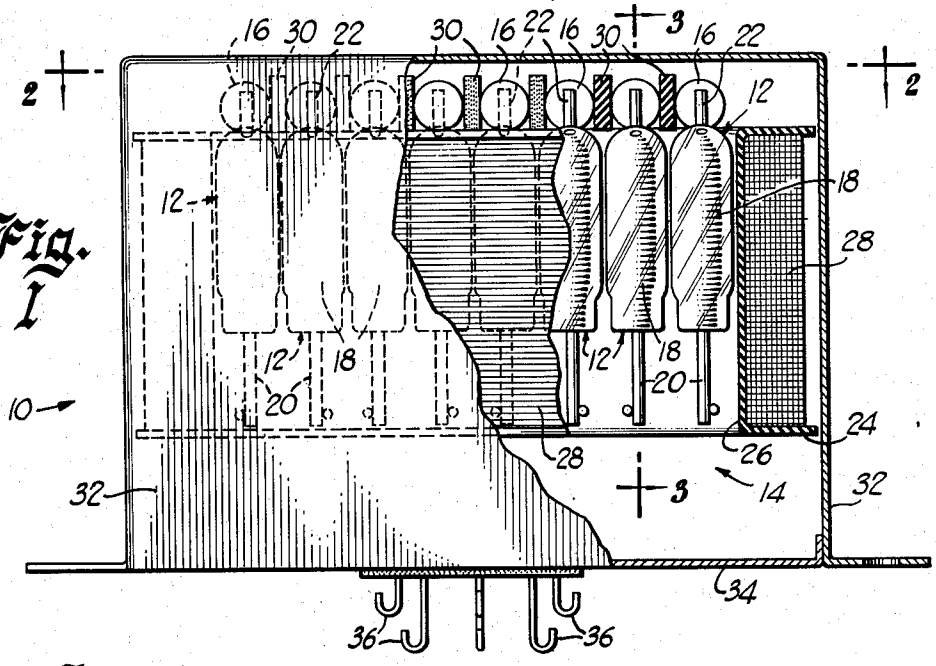
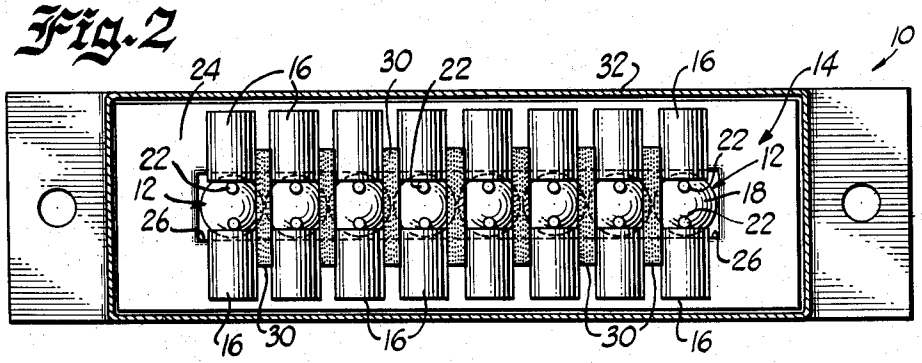


Fig. 2



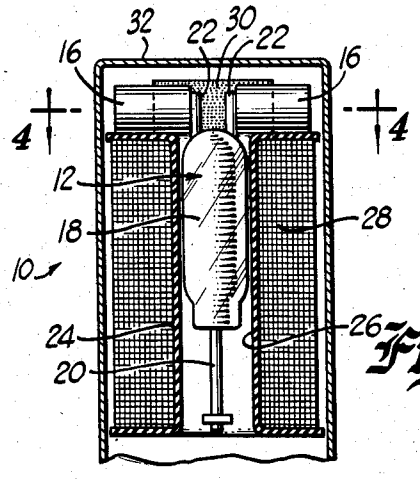


Fig. 3

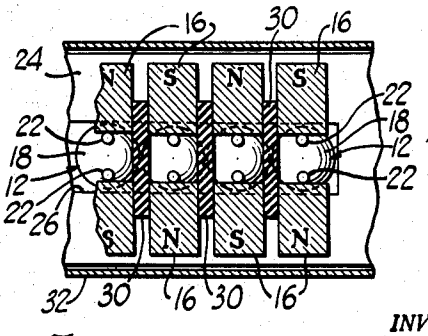


Fig. 4

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3,026,390

RELAY CONSTRUCTION

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11 Claims. (Cl. 200—104)

This invention relates to a relay construction and, more particularly, to a plural pole switching means including a plurality of sealed switch units with separate magnetic biasing means.

Mercury relays generally include a movable armature enclosed within a sealed dielectric envelope that is partially filled with mercury so that, when the armature is deflected into engagement with one of a pair of spaced magnetic terminals also carried on the envelope, the contact between the free end of the armature and the engaged portion of the terminal is wetted by mercury. Thus, the mercury switch unit or capsule can be considered to provide a center-stable switching device. In order to render the switch unit bistable or single-side-stable, permanent magnets are secured to or positioned adjacent one or more of the magnetic terminals. The switch capsule and associated biasing magnet or magnets are then placed within the winding of a test fixture, and the magnetic characteristics of the unit including the effective field of the biasing magnet are then adjusted so that the switch unit provides certain "operate" and "release" sensitivities. Because of the varying physical and magnetic parameters of even like manufactured switch units, the biasing magnets in different switch units possess different magnetic fields following the adjusting operation.

The adjusted mercury switch capsule or unit can then be placed in an individual operating winding and housed within the container. In addition, because of the many desirable characteristics of mercury switch units, such as uniform contact characteristics over a virtually unlimited life span and good operating sensitivity, it is often desirable to place a number of these adjusted and magnetically biased switch units within a common operating winding to provide a plural pole relay. However, if several magnetically biased switch capsules are placed in proximity, magnetic interaction occurs between the fields of the different permanent magnets and the sensitivity adjustments of the various switch units are adversely affected. This deficiency cannot be overcome by attempting to individually adjust the operating characteristics of the switch capsules after these units are assembled in a common operating winding because of the magnetic interaction between the single switch unit under adjustment and those in the adjacent positions.

Accordingly, one object is to provide a new and improved relay construction.

Another object is to provide a new and improved relay construction including a plurality of individual sealed switch units.

A further object is to provide a relay including means for preventing adverse magnetic interaction between adjacent mercury switch capsules including permanent magnet biasing means.

Another object is to provide a switch assembly including a plurality of individual sealed switch units and new and improved means for magnetically biasing these units.

Another object is to provide a relay construction in which the biasing magnets for a plurality of adjacent sealed switch units are alternated in polarization.

A further object is to provide a relay construction including a plurality of sealed switch units having individual permanent biasing magnets, which units are placed within

a common operating winding with biasing magnets of opposite polarities disposed adjacent each other.

Another object is to provide a novel method of assembling relays using a plurality of sealed switch units each having an individual magnetic biasing means.

In accordance with these and many other objects, a relay embodying the invention includes a common operating winding defining a somewhat elongated, axially extending opening in which are disposed, in side-by-side relationship, a plurality of sealed switch capsules or units. Each of these units contains a mass of mercury and a movable armature, the upper or free end of which is adapted to be moved into engagement with one of a pair of magnetic terminal elements or pins carried on the upper end of the dielectric envelope. In order to render each of the individual switch capsules or units bistable or single-side-stable, a permanent biasing magnet is secured to or positioned adjacent one or more of the magnetic terminals. The biasing magnets secured to or positioned adjacent the switch capsules within the winding are so located that the magnets for any given switch unit are oppositely polarized with respect to the biasing magnets for the adjacent switch units. This effectively prevents magnetic interaction between adjacent switch units within the common winding so that the adjusted "operate" and "release" sensitivities thereof are not adversely affected. If desired, a dielectric barrier is interposed between the magnets on adjacent capsules to electrically isolate the magnetic terminals of the different switch units. By this alternate arrangement of the polarities of the biasing magnets for the switch units, these units can be individually adjusted to provide proper "operate" and "release" characteristics, and a plurality of the magnetically biased switch capsules can then be inserted into a common winding in proximity to each other without the varying magnetic fields of the biasing magnets adversely affecting the previously adjusted operating characteristics of the individual switches.

Many other objects and advantages of the present invention will be apparent from considering the following detailed description in conjunction with the drawings wherein;

FIG. 1 is a front elevational view in partial section illustrating a relay construction embodying the present invention;

FIG. 2 is a sectional view taken along line 2—2 in FIG. 1 assuming that the entire relay construction is illustrated therein;

FIG. 3 is a sectional view taken along line 3—3 in FIG. 1 again assuming that the entire relay constrution is illustrated therein; and

FIG. 4 is a fragmentary sectional view taken along line 4—4 in FIG. 3.

Referring now more specifically to the drawings, therein is shown a relay or switching construction **10** which embodies the present invention and which includes a plurality of mercury switch units or capsules, indicated generally as **12**, that are disposed within the axial opening of a common operating winding **14**. In order to condition the individual switch capsules **12** for either bistable or single-side-stable operation, one or more permanent magnets **16** are disposed adjacent each switch unit **12** to magnetically bias these units for a desired type of operation. In order to prevent magnetic interaction between the fields of the various magnets **16** from affecting the operating characteristics of the different units **12** when a group of these units is disposed within the common winding **14**, the magnets **16** are arranged so that the polarity of the field due to any given one of the magnets **16** is opposite to the polarities of the fields of all adjacent permanent magnets **16** (FIG. 4). By this means, a plurality of magnetically biased mercury switch capsules **12** can be dis-

posed in proximity to each other without adversely affecting the adjusted operating characteristics or sensitivities thereof.

Referring now more specifically to the mercury switch capsules **12**, these units can be of the type used in mercury relays manufactured by C. P. Clare & Company, of Chicago, Illinois, and identified as type "HGS" or of the constructions shown in Brown et al. Patents Nos. 2,609,464 and 2,769,875. These mercury switch capsules generally comprise an elongated and somewhat rounded glass or dielectric envelope **18** containing a movable magnetic armature (not shown) carried on a header or terminal element **20**. The outer surface of the armature is wetted by capillary action with mercury derived from a mass thereof contained in the envelope **18**, and the upper free end of the armature is adapted to be selectively moved into engagement with the lower ends of a pair of spaced magnetic terminal pins or elements **22** which are sealed in the upper end of the dielectric envelope **18**. Thus, the contact of the armature with the terminal pins **22** is wetted by mercury to provide uniform contact resistance.

To render the switch capsules or units **12** bistable or single-side-stable, a permanent magnet **16** is supported adjacent one or more of the magnetic terminals **22**. In the illustrated embodiment, the permanent magnets **16** are secured, as by soldering, directly to the terminal pins **22** with the magnetic polarization of the magnets such that one of the pins **22** is biased to assume a one polarity and the other of the pair of pins **22** is biased to assume an opposite polarity. Thus, in the switch capsule **12** shown to the right in FIG. 4 of the drawings, the uppermost pin **22** is biased to assume a north polarity by the permanent magnet **16** secured thereto and the lower terminal **22** is biased to assume a south polarity by the permanent magnet **16** secured thereto.

After the permanent magnets **16** have been secured to the terminal pins **22**, the switch capsule **12** and the magnets carried thereon are inserted into a coil forming a part of an adjusting fixture. The effective field of the coil is varied to adjust the switch unit **12** so that certain specified "operate" and "release" sensitivities are obtained. Because of the different physical and magnetic characteristics of each switch unit **12**, the magnetic adjustment of the unit to uniform "operate" and "release" sensitivities results in the biasing magnets **16** being stabilized with unequal magnetic fields.

To provide means for concurrently operating a plurality of the adjusted and magnetically biased mercury switch units **12**, the operating winding **14** is provided. This winding includes a coil bobbin **24** defining a somewhat elongated axially extending opening **26** and a coil **28** which is carried on the bobbin **24**. The adjusted switch units **12** are disposed within the opening **26** in side-by-side relationship and supported therein by suitable means. If desired, the switch capsules **12** can be physically and electrically secured to an apertured printed circuit board which is then mounted in the opening **26** as shown and described in detail in the copending application of Arthur J. Koda, Serial No. 731,390, filed April 28, 1958.

In order to prevent magnetic interaction between the permanent magnets **16** on adjacent switch capsules **12** which would adversely affect the previously adjusted operating characteristics of the switches, the switch units **12** are placed within the opening **26** so that the magnetic fields due to the magnets **16** secured to any given one of the capsules **12** are oriented in opposition to the magnetic fields produced by the permanent magnets **16** secured to the adjacent ones of the capsules **12** (see FIG. 4). Thus, each switch unit **12** and the permanent magnets **16** secured thereto can be adjusted to have specified "operate" and "release" sensitivities, and a group of the adjusted capsules can then be suitably supported within the opening **26** in the operating winding **14** with the fields of the magnets **16** arranged in an alternate order to prevent adverse magnetic interaction between adjacent units **12**. This insures that the individual switches **12** retain the operating characteristics previously established in the adjusting or test fixture.

Following the assembly of the operating winding **14** and the plurality of switch capsules **12**, a dielectric barrier element **30** can be inserted between the various biasing magnets **16** to insure the electrical isolation thereof. This is desirable because the output leads are connected to the magnetic terminals **22** as well as to the headers **20**. The winding **14** and the switch capsules **12** mounted thereon can then be inserted into a suitable housing or cover **32**, the lower open end of which is closed by a base plate **34**. A plurality of connecting pins **36** carried on the plate **34** and electrically insulated therefrom are connected to the coil **28**, the headers **20**, and the magnetic terminals **22** to provide means for operating the relay **10** and for deriving an output therefrom.

Although the present invention has been described with regard to a single embodiment thereof using a particular type of switch unit, it should be understood that many other embodiments may be devised by those skilled in the art which will fall within the spirit and scope of the principles of this invention.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. A relay construction comprising a plurality of sealed switch units disposed in proximity to each other, a plurality of biasing means each adapted to magnetically bias one of said sealed switch units, means for positioning said plurality of biasing means adjacent said plurality of switch units so that the magnetic polarizations of the biasing means associated with adjacent ones of the switch units are oppositely directed, and winding means for operating said sealed switch units.

2. A relay construction comprising an operating winding defining an opening, a plurality of sealed switch units disposed in said opening, each of said switch units including at least one terminal element, and a plurality of permanent magnets for applying magnetic biasing forces to said sealed switch units, each of said permanent magnets being disposed adjacent one of said terminal elements and having a magnetic field alignment that is opposite to that of the permanent magnet for the adjacent switch unit.

3. A relay construction comprising a plurality of sealed switch units each including at least one terminal element, a permanent magnet secured to each of the terminal elements, and an operating winding defining an opening for receiving said plurality of sealed switch units, said sealed switch units being disposed in said opening so that the permanent magnet secured to any given one of said switch units has a magnetic field alignment that is opposite to that of the magnets secured to the adjacent switch units.

4. A relay construction comprising a winding defining an elongated opening, a plurality of sealed switch units disposed in side-by-side relation within said opening to form a row of generally aligned switch units, each of said units including a magnetic terminal element, a plurality of permanent magnets, and means supporting each of said permanent magnets adjacent one of said magnetic terminal elements with its magnetic field oriented oppositely with respect to the permanent magnets for the adjacent switch units in the row thereof.

5. A relay construction comprising a winding defining an axially extending opening, a plurality of sealed switch units disposed in said opening adjacent each other, each of said switch units including a pair of magnetic terminals, a plurality of permanent magnets, and means for supporting one of said magnets adjacent each of said terminals, the two magnets adjacent the two terminals on each switch unit having their magnetic fields oppositely oriented and the two magnets adjacent each switch unit having their magnetic fields oppositely oriented relative to the pairs of magnets associated with the adjacent switch units.

6. A relay construction comprising a winding defining an elongated opening, a plurality of sealed switch units disposed in said elongated opening to form a row, each of said switch units including a pair of magnetic terminals, and a plurality of permanent magnets each secured to one of said terminals, the two magnets secured to the pair of terminals on each switch unit being oppositely polarized and the pairs of magnets secured to each of the switch units being oppositely polarized relative to the pairs of magnets secured to the adjacent switch units in the row thereof.

7. The relay construction set forth in claim 6 in which the two magnets secured to each switch unit are substantially aligned with each other in a direction transverse to the elongated opening in the winding.

8. The relay construction set forth in claim 6 including dielectric means interposed between the magnets secured to adjacent ones of the switch units.

9. A relay construction comprising a plurality of sealed switch units each including an elongated dielectric envelope from which two spaced magnetic terminals extend, a permanent magnet secured to each of said magnetic terminals, the two magnets secured to the terminals of each switch unit being oppositely polarized and extending generally transverse to the longitudinal axis of the dielectric envelope, and an operating winding defining an elongated opening, said switch units being disposed in said opening with the magnets secured thereto extending generally transverse to the axis of the opening.

10. A relay construction comprising a common operating winding defining an opening, a plurality of sealed switch units each including at least one magnetic terminal, said plurality of sealed switch units being disposed within said opening in proximity to each other, and a plurality of permanent magnets each positioned adjacent one of said magnetic terminals, said magnets being arranged so that the magnets for adjacent ones of said switch units are disposed on opposite sides of said magnetic terminals.

11. A relay construction comprising a common operating winding defining an elongated axial opening, a plurality of sealed switch units each including at least one magnetic terminal, said plurality of sealed switch units being mounted in said elongated opening in side-by-side relation to form a row, and a plurality of permanent magnets each positioned adjacent one of said magnetic terminals to magnetically bias the associated switch, the magnets positioned adjacent successive ones of the switch units in said row extending outwardly from opposite sides of said row and being oriented to bias the magnetic terminals to assume identical polarities.

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