May 27, 1958 H. J. WIRTH, JR 2,836,676

SEALED MAGNETIC RELAY

Filed Feb. 17, 1955

FIG. 1

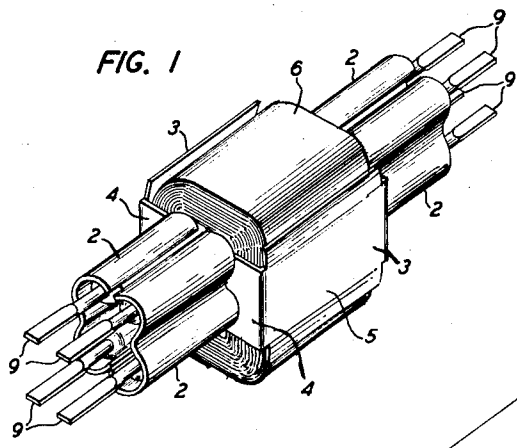
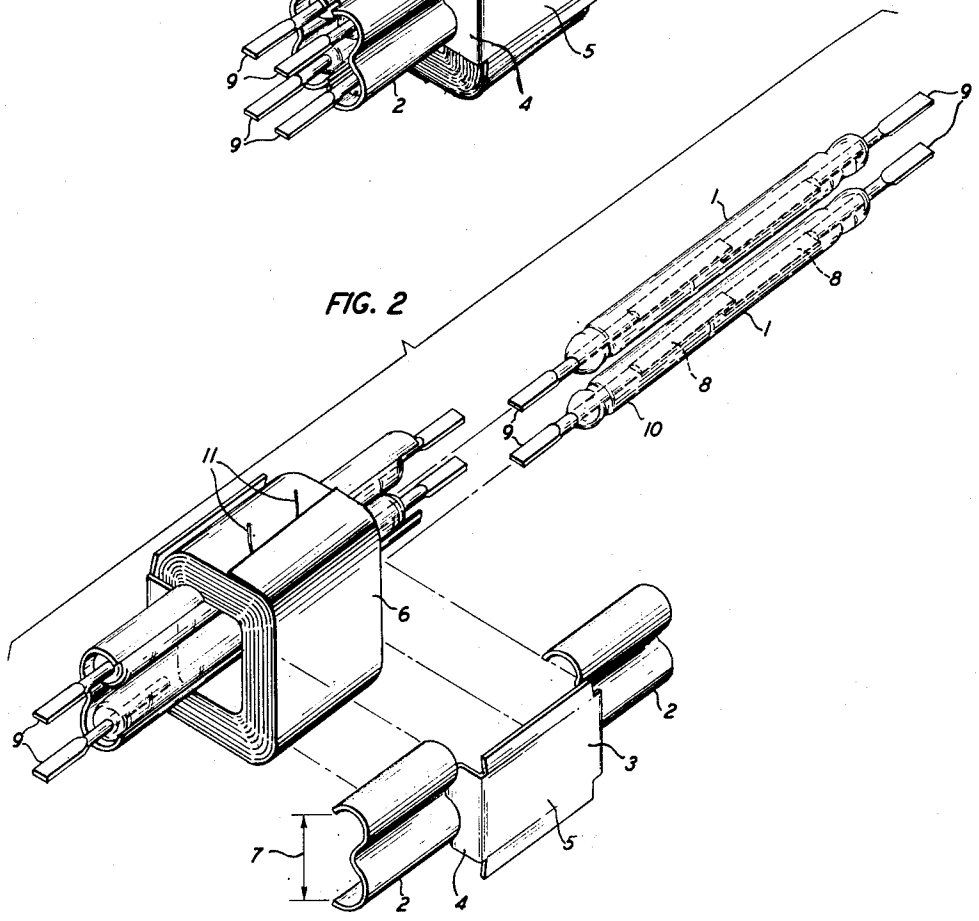


FIG. 2



INVENTOR
H. J. WIRTH, JR.

BY

ATTORNEY

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SEALED MAGNETIC RELAY

Henry J. Wirth, Jr., Millington, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application February 17, 1955, Serial No. 488,773

9 Claims. (Cl. 200—104)

This invention relates to electromagnetic circuit controlling devices and, more particularly, to such devices of the general type disclosed in the application Serial No. 488,778, filed February 17, 1955, of R. L. Peek, Jr., including a plurality of sealed reed switching units or relays such as those disclosed in Patent 2,289,830, granted July 14, 1942, to W. B. Ellwood.

Devices of the type comprehended by this invention find application in a variety of fields, notably in telephone switching systems. They comprise basically a plurality of sealed switch units associated with an electromagnet structure. This structure includes an energizing coil and a magnetic core and is effective in accordance with the energization or deenergization of the coil to control the contacts of circuit-closing elements of the units.

In the fields of application of such devices, a number of factors are of major moment in determining the practical utility and economic suitability of the device. For example, among the desiderata are small size, simplicity of structure, low manufacturing cost and facility of assembly and disassembly as for repair, replacement and maintenance. Prior art structures are not entirely satisfactory from the standpoints indicated.

One general object of this invention is to improve circuit controlling devices of the type above noted.

More specifically, objects of this invention are to reduce the size of such devices, simplify the structure thereof, reduce the manufacturing cost and enable ready assembly and disassembly.

An electromagnetic circuit controlling device constructed in accordance with the invention disclosed in the above-mentioned application of R. L. Peek, Jr. is especially advantageous where a large number of contacts are to be controlled by one coil. The design of that device contemplates the mounting of switch units external to the coil, thus substantially minimizing the size of the coil required, and further permitting the use of high permeability core material whereby a high degree of sensitivity is obtained.

On the other hand, an electromagnetic circuit controlling device constructed in accordance with the present invention is especially advantageous where a relatively small number of contacts are to be controlled by one coil. The invention contemplates inclusion of the contact-making devices within an opening through the central part of the coil, i. e., the core. This construction results in passage of substantially all of the induced flux through the switch units and thereby allows the maximum sensitivity of the switch units to be realized. However, this design cannot be efficiently extended to include large numbers of switch units because the coil would thereby be rendered unduly large and as the size of the coil opening increased, the mean length of turn would be correspondingly increased, thereby reducing efficiency and sensitivity. Where a relatively small number of contact-making devices are to be controlled by one coil, they may be included within the core without unduly enlarging the same and without increasing the magnetic reluctance above the minimum presented by the switches themselves. This design is particularly advantageous in subject invention in that it permits the use of unique magnetic structures, which in cooperative association with the coil and switch units, form an assembled relay which is locked together by the insertion of the sealed switch units through the coil and specially formed magnetic structure extremities, the sealed switch units acting as keystones to hold the relay parts in assembly. This unique design is particularly adaptable to automation in production and assembly, thereby resulting in substantial savings in cost over sealed reed relays heretofore proposed.

In accordance with one feature of this invention, the electromagnet structure is constructed and arranged for cooperative association with a plurality of switch units in such manner as to provide a magnetically efficient and physically simple structure.

In accordance with another feature of this invention, the magnetic structure is fabricated in sections which are readily associable with the energizing coil and the sealed reed units and maintained in cooperative relation therewith by frictional forces, the sealed reed switch units acting as keys whereby both assembly and disassembly are facilitated.

In one specific and illustrative embodiment of this invention, the magnetic structure comprises two similar sections each having an intermediate U-shaped portion and having also end portions of channel or trough configuration, the intermediate portions being constructed to fit upon the coil and frictionally adhere thereto, the end portions being formed to frictionally engage the switch units. The two sections are adapted to be mounted upon the coil in juxtaposed relation thereby to form cylindrical elements each encompassing a respective one of the units and extending from the central portions which constitute a yoke closely coupled magnetically to the coil. The sealed reed switch units act as keys and are inserted through the cylindrical elements and the core of the coil to lock them in cooperative association each with the others.

The invention and the above-noted and other features thereof will be more fully understood from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a perspective view of an electromagnetic circuit controlling device illustrative of one embodiment of this invention; and

Fig. 2 is a partially exploded perspective view of the device depicted in Fig. 1 showing the relation of the coil, magnetic members, and switch units.

Referring now to the drawing, four sealed reed switch units **1** are mounted within a conventional energizing coil **6** in such manner that their extremities project without the coil. These sealed reed switches, which may be of the type disclosed in the hereinbefore-mentioned patent issued to W. B. Ellwood, may each take the form of a cylindrical enclosure **10** of electrically insulating nonmagnetic material such as glass, surrounding a pair of reeds **8** extending into the enclosure **10** from opposite ends. These reeds **8**, which are of magnetic material such as soft iron and which may be coated with other material or have precious metal contact surfaces, are positioned to overlap at their inner extremities, the inner extremities, however, being normally separated by a small distance. In response to induction by the coil **6** of magnetic flux within the reeds, the extremities are attracted one to the other, and as the reeds are quite flexible, their inner extremities move toward each other until they meet, thus completing an electrical path through the switch unit from one electrode **9** to the opposite electrode **9**.

Partly surrounding the extremities of the sealed reed

switch units 1 are form-fitting cylindrically shaped members 2 which are a part of each of the two identical magnetic structures 3 which may preferably be stamped from any suitable resilient sheet magnetic material. This method of fabrication is particularly advantageous economically in that it readily lends itself to low-cost mass production techniques. The shape of magnetic structures 3 is especially important because it is this shape together with the shape of the sealed reed switch units 1 that provides the key-locking action of the reeds as will now be explained in detail.

Referring to Fig. 2, it will be noted that one of the magnetic structures 3 and its two associated switch units 1 have been removed from the coil 6, whereas the remaining magnetic member and its two associated switch units remain locked to the coil. In order to remove either of the magnetic structures it is necessary that the switch units be removed from the ends, not only because the coil would prevent their being withdrawn in any other direction, but in addition because the dimension 7 (Fig. 2) is less than twice the diameter of the switch units, and further because the members 2 are shaped to partially surround the switch units. It can be seen from the drawing that if the coil were not included in an assembly of one magnetic structure and its associated switch units, there would nevertheless be a locking action to lock the switch units within the magnetic structure because, although the first switch unit could be installed in the magnetic structure from either the side or the end of the structure, the second switch unit could only be inserted from the end; and once it was so inserted it would lock itself and the first unit within the cylindrically shaped members 2 because the edges between which the dimension 7 is taken are bent around the units sufficiently to provide a tight fit when both are installed. It will also be readily observed that if the switch units are locked to the structure, the structure will be similarly locked to the units, that is, the structure may be removed from the units (when both units are in place) only by sliding it endwise along the axis of the switch units. Another advantage that accrues through a snug fit of the cylindrically shaped members 2 about the sealed switch units 1 is that a frictional force is thereby created between the magnetic members and the switch units which tends to oppose any force conducive to withdrawal of the units; and although this force is not of sufficient magnitude to entirely prevent removal, it is sufficient to prevent disassociation in the absence of determined effort.

Now reintroducing the coil, it can be seen that it must be placed within the form-fitting recess of the magnetic structure before the sealed switch units are installed, the structure base section 5 lying immediately adjacent to a side of the coil, and structure offset sections 4 lying adjacent to and snugly fitting against the ends of the coil. The magnitude of the offset provided by structure sections 4 between the base section 5 and the cylindrically shaped sections 2 is determined by and is substantially equal to the thickness of the coil winding in order that proper alignment of the cylindrically shaped members 2 and the coil opening may be made. If the offset provided by structure sections 4 is substantially greater than the thickness of the adjacent coil winding, the base section 5 will not be held firmly against the side of the coil when assembled; whereas if the offset is substantially less than the thickness of the adjacent coil winding there will be an interference between the switch unit and the inner portion of the coil as the switch unit is attempted to be inserted, thereby preventing assembly.

Similarly, the width of the structure base section 5 is dependent upon the width of the side of the coil and should be just sufficiently wide to provide a snug fit of the offset sections 4 against the coil ends.

The coil itself may preferably be wound with silver, copper, aluminum or other highly conductive wire, the layers being separated with any suitable substance such as impregnated paper, cellulose acetate, or polyethylene terephthalate, use of the latter being especially advantageous. The particular shape of the coil is not critical except insofar as it correspondingly determines the dimensions of the fitting magnetic structure as previously described. Any suitable terminals or leads 11 may be provided for making connections to the coil from a source of operating potential (not shown). The number of turns of wire required will vary depending upon the magnitude of the operating voltage and current; however, one representative coil wound for a source of 20 volts, D. C. comprises 191 turns in each of 67 layers, making a total of 12,797 turns.

Assembly of the relay may be made by first bringing the two magnetic structures 3 and the coil 6 in cooperative association in the manner shown in the drawing and then inserting the four sealed reed switch units 1 through the cylindrically shaped members 2 at one extremity of the magnetic structures, through the coil, and then into the cylindrically shaped members 2 at the opposite end of the magnetic structures.

Disassembly of the relay may similarly be accomplished in the reverse order. The sealed switch units must first be removed to unlock the remaining members. Once the switch units are removed, the magnetic structures may be removed from the coil and disassembly is completed.

As previously explained, assembly and disassembly is performed in an exceedingly simple manner and does not require the tightening, fastening or loosening of any bolts, screws, nuts, etc. Because of this feature the subject-matter of this invention is especially adaptable to mass production techniques and may be readily assembled at low cost. Similarily, ease of disassembly is highly advantageous in that it permits replacement of any inoperable component by test or maintenance personnel with ease and rapidity.

There are two major circuits for the magnetic flux induced by the operating coil 6, each of which circuits comprises a magnetic structure 3, its two associated sealed reed switch units 1 and the source of magnetic flux, i. e., the coil 6. Electrical connections are made to each switch unit by attaching conductors to the electrodes 9 at the switch extremities, and the contacts operate in response to energization of the operating coil 6 in the manner previously disclosed.

While I have illustrated my invention by a particular embodiment thereof, said invention is not limited in its application to the specific apparatus and particular arrangement therein disclosed. Various applications, modifications and arrangements of the invention will readily occur to those skilled in the art. For example, unsealed reed switch units with insulators near their extremities could be employed in place of the sealed reed switch units herein disclosed.

The terms and expressions which I have employed in reference to the invention are used as terms of description and not of limitation, and I have no intention in the use of such terms and expressions of excluding equivalents of the features shown and described or parts thereof, but on the contrary, intend to include therein any and all equivalents, modifications and adaptations which may be employed without departing from the spirit of the invention.

What is claimed is:

1. In a relay having an energizing coil with an opening therein, a magnetic circuit for said coil including magnetic structure and a switch unit arranged serially in said circuit and projecting through said coil opening, said magnetic structure comprising a metallic member having at two extremities cylindrically shaped members surrounding and engaging both ends of said switch unit.

2. In a relay having an energizing coil with an opening therein, a magnetic circuit for said coil including magnetic structure and a sealed switch unit arranged

serially in said circuit and projecting through said coil opening, said magnetic structure comprising a U-shaped metallic member having extending cylindrically shaped members at its extremities surrounding and frictionally fitting upon both ends of said switch unit.

3. In a relay having an energizing coil with an opening therein, a magnetic circuit for said coil including magnetic structure and a plurality of sealed switch units arranged in parallel magnetically and axially, said group of switches being connected serially in said magnetic circuit, said magnetic structure comprising a pair of U-shaped metallic members arranged external to said coil and immediately adjacent thereto, said members having semicylindrically shaped members at their extremities to partly surround and hold said switch units within said semicylindrically shaped members and within said coil.

4. In a relay having an energizing coil with an opening therein, a magnetic circuit for said coil including magnetic structure and a plurality of sealed switch units arranged in parallel magnetically and axially, said group of switches being connected serially in said magnetic circuit, said magnetic structure comprising a pair of U-shaped metallic members external to and partly surrounding said coil and having semicylindrically shaped members at their extremities to engage and partially surround said switch units to hold said switch units in position through the opening in said coil, whereby said coil, switch units and magnetic structure are cooperatively held in physical association.

5. In a relay having an energizing coil with an opening through the center thereof, a magnetic circuit for said coil including magnetic structure and a plurality of sealed switch units arranged in parallel magnetically and axially and projecting through the opening in said coil, said group of switches being connected serially in said magnetic circuit, said magnetic structure comprising a pair of U-shaped metallic members each having a flat base portion, two right angle extensions pointing in the same direction and an extremity section at right angles to each extension, said extremity sections lying substantially in the same plane but extending in opposite directions, said extremity sections forming semicylindrically shaped members, said magnetic structure partly surrounding said coil, the base portion lying adjacent to a side of said coil and parallel to the magnetic axis thereof, the extensions lying adjacent to the ends of said coil and projecting toward the center thereof and the extremity sections projecting away from the ends of said coil and parallel to the axis thereof, the center portions of said sealed switch units being contained within the opening in said coil, and the outer portions being gripped by the semicylindrically shaped members comprising said extremity sections.

6. A relay comprising a coil, engageable contact members within said coil, and two complementary members of magnetic material for exteriorly supporting and interlocking said coil with said complementary members and said contact members.

7. A relay comprising a coil, engageable contact members within said coil and extending without said coil, and two complementary members of magnetic material for exteriorly supporting and interlocking said coil with said complementary members and said contact members.

8. A relay according to claim 7 in which said engageable contact members comprise sealed switch units.

9. A relay comprising an energizing coil with an opening therein, a pair of complementary magnetic members mounted in juxtaposition on said coil, and a plurality of keying members projecting through said opening and cooperatively constructed and associated with said coil and said magnetic members to interlock said coil, said magnetic members and said keying members in assembly, said keying members comprising a plurality of engageable contact members operable in response to the energization of said coil.

References Cited in the file of this patent

UNITED STATES PATENTS

2,187,115	Ellwood et al.	Jan. 16, 1940
2,289,830	Ellwood	July 14, 1942
2,318,405	Leveridge	May. 4, 1943
2,397,123	Brown	Mar. 26, 1946