June 8, 1965 R. K. ELSE ETAL 3,188,424

RELAY CONSTRUCTION

Filed April 30, 1962

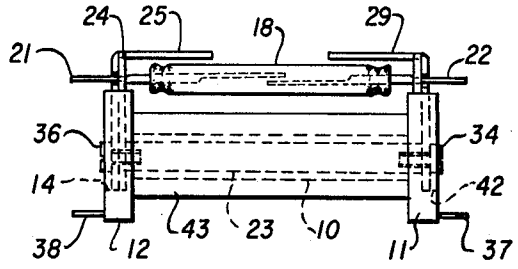

FIG. 1

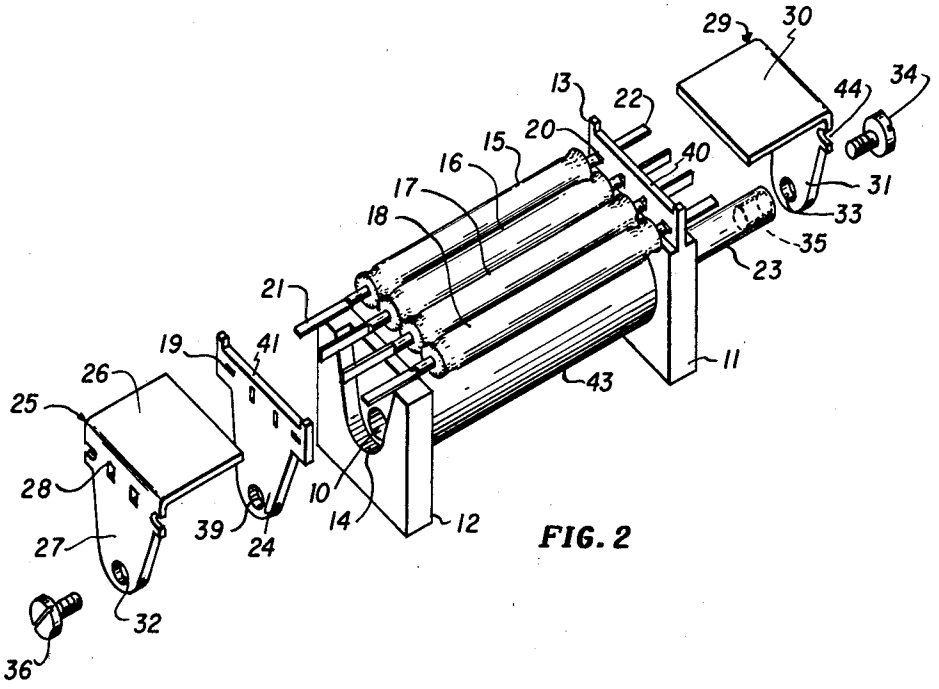

FIG. 2

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United States Patent Office 3,188,424 Patented June 8, 1965

3,188,424

RELAY CONSTRUCTION

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Filed Apr. 30, 1962, Ser. No. 191,238
1 Claim. (Cl. 200—87)

This invention relates to reed-type relays and more specifically to a reed relay construction which renders the relay, for example, particularly suitable as a pulsing battery feed relay used in a telephone line.

In the above application, for instance, it is necessary for the contact switches of the relay to operate with a certain percent "make" in order to operate the associated equipment. That is, in order for a telephone system to respond to the dial pulses reproduced by the battery feed relay the complete time interval for the contacts of the relay to close and open must be separated into a specific percent "make" interval and a specific percent "break" interval. Consequently, reed relays were heretofore not used as battery feed relays for the reason that the particular forms of pulses required could not be reproduced by them. Although the reed relays are fast operating they cannot be adjusted to achieve a particular percent "make" and "break" condition like a conventional telephone relay having adjustable contact springs. Furthermore, reed relays ordinarily are characterized by their relatively low inductance. Accordingly, if a high inductance condition is required such as in the case of a battery feed relay the coil becomes relatively large and the overall relay structure bulky. This is because in the ordinary reed relays the encapsulated reed switches are placed in the center of the core and therefore the diameter of the spool portion on which the coil is wound is correspondingly larger. The result of this large coil is that the resistance per turn is increased and the relay operating efficiency decreased.

The present relay construction solves the problems confronted heretofore in connection with many reed relay applications. The instant invention enables the reed relay to be used as a battery feed relay, a slow-to-release or a magnetic-latching relay for example by virtue of its unique construction. Thus, the state of the art is advanced by being able to use the more reliable reed type relays in applications heretofore not used. Furthermore, with this innovation it is possible to have a matched telephone system, for example, which utilizes reed-type relays exclusively as its switching element.

The principal object of the invention is to provide a reed relay which is particularly suitable as a pulsing battery feed relay in a telephone system.

Another object of the invention is to provide a reed relay which will operate as a slow-to-release relay or as a magnetic latching relay.

Still another object of the invention is to provide a reed relay which has a wide range of operating parameters and whose cost of manufacture is minimized.

The particular relay construction features a neat, compact, and easily assembled relay which includes the components: a frame structure or bobbin made of insulating material and having a tubular section with a rectangular shaped flange, for instance, at each end; a core having a low resistance per turn ratio consisting of two or three windings; four, for instance, encapsulated gas filled reed switch capsules placed outside of the coil in a horizontal plane; and a corresponding relatively high inductance magnetic circuit. Furthermore, embedded in at least one flange of the frame structure are terminals to which the ends of the coil windings are secured.

The unique pulsing characteristics of this reed relay is attributed primarily to its low reluctant magnetic circuit which includes the components: a solid core made of a

selective material positioned within the tubular section of the frame structure; two L-shaped flux concentrators which are connected to the ends of the core and extend over the four switch capsules; and the reed members of the switch capsules. The flux concentrators materially reduce the reluctance in the magnetic circuit. Furthermore, they serve as a magnetic shield against adjacent stray fluxes. This characteristic results from extending them outside and over the reed switch capsules and the coil. Additional shielding if desired can be achieved by employing a cover can and placing it over the relay. In addition to the arrangement of these components the material from which they are made is also a contributed factor to the claimed pulsing possibilities. For instance, the preferred material of the core and flux concentrators in the battery feed relay is a nickel-iron composition. The preferred material for these parts in the slow-to-release relay is a magnetic-iron composition. The material of the core in the magnetic-latching relay is a high carbon steel composition and the corresponding flux concentrators thereof are preferably made of magnetic iron.

The relay according to the invention operates in the normal manner, that is, the reed switch capsules are actuated by the energization of the coil. In the case of the battery feed relay the coil includes three windings in order to provide balance between the resistance in the relay with that of the telephone line. In the case of the slow-to-relese relay there are two windings in the coil. The one winding is short circuited when intermediate time delays are desired, for example, or in cases where relatively long time delays are desired one winding is short circuited and the other includes a diode. With this arrangement delay times of 7.7 milliseconds to 180 milliseconds can be obtained. In the case of the magnetic latching relay a control pulse will render the switch capsules in their operate condition and hold them by the remanent state of the core. The switch capsule can be restored to their inoperative state by means of a subsequent control pulse, applied to a second windings, which demagnetizes the core and releases the switch capsules. The magnitude of the demagnetizing pulse must be limited to present reoperating and latching the reed switch capsules by the second stable limit state of the core.

These and other objects and features of the invention will become more apparent from a perusal of the following detailed description taken with the accompanying drawings of which:

FIG. 1 shows a side view of the relay according to the invention.

FIG. 2 shows an exploded perspective view of the relay according to the invention.

Referring now to the drawings, the preferred embodiment of the relay construction according to the invention includes a frame structure made of an insulating material, for instance a plastic, and formed as an integral part. It comprises a tubular section **10** and two end flanges **11** and **12**. These flanges in the preferred embodiment are substantially rectangular shaped. Integrally formed with flange **11** is an extension **13** which includes, for instance, four apertures **24** and a slot **40**. The apertures **24** receive terminal ends **22** of switch capsules **15–18**. Furthermore, flange **11** has a recessed portion **42** (see FIG. 1) which receive flux concentrator **29**, particularly leg **31** thereof. This particular recess corresponds to a similar shaped recess **14** formed in flange **12**. The difference between recesses **41** and **14** is that the latter is deeper than the former. This is because recess **14** in addition to receiving flux concentrator **25**, receives key member **24**. Key member **24** is also made of an insulating material and is the means whereby symmetry is acquired between flanges **11** and **12**. Accordingly, after the key member is inserted in the recess **14** of flange **12** it serves as an

extension to flange 12 which corresponds in shape and position to extension 13. It includes four apertures 19 and a slot 41. Apertures 19 receive the terminal ends 21 of the reed switch capsules 15–18. The use of the key member facilitates assembly of the relay, that is, the assembly of the switch capsules 15–18 to the frame structure. Moreover, the key member enables the frame structure, comprising the tubular section 10 and the end flanges 11 and 12, to remain an integral part. This feature then renders a compact and strong relay unit.

As aforementioned the relay has high inductance characteristics. This is a result of its magnetic circuit which includes: a solid core 23 extending within tubular section 10 of the frame structure; the aforementioned flux concentrators 25 and 29, and the reed members 21 and 20 of switch capsules 15–18. The core is a solid piece and is made of a magnetic material. The composition of this material depends primarily on the use to which the relay will ultimately be put, that is, as a battery feed relay, a magnetic-latching relay or a slow to release relay.

Positioned at the ends of the core 23 are flux concentrators 25 and 29. Flux concentrator 29 is connected to the core by inserting screw 34 through aperture 33 of leg 31 and into tap hole 35. Similarly, flux concentrator 25 is connected to core 23 by inserting screw 36 through apertures 32 and 39 of leg 37 and key member 24 respectively, and into a second tap hole of the core (not shown). Flux concentrators 25 and 29 includes each four apertures 28 and 44 corresponding in position to apertures 19 and 20 of the key member and flange 11. Thus, the terminal ends 21 and 22 of the switch capsules extend through these apertures. After assembly the legs 27 and 31 of the flux concentrators lie within the confines of the depressions in flanges 12 and 11 respectively. At most they lie flush with the external surface of these flanges. Extending from one side of these flanges are the corresponding legs 26 and 30. These legs are at a 90° angle with respect to their adjacent legs. Consequently legs 26 and 30 lie parallel to the switch capsules and externally thereto. Thus, the switch capsules lie intermediate the legs 26 and 30 and the coil 43. The legs 26 and 30 extend toward each other and toward the center of the relay. In this connection it is to be noted that the flux concentrators by being placed on the outside of the switch capsules provide in effect a magnetic shield for the relay and a substantial increase in inductance to the reed members of the switch capsules.

The coil used comprises one or more windings depending upon the use to which the relay is to be put. In each case, however, it is to be noted that by virtue of the fact that the reed switch capsules are located outside rather than within the coil the resistance per turn of the winding is kept at a minimum. This then renders a more responsive and efficient relay. The end of the windings are connectable to terminals 37 or 38 which are embedded in flanges 11 and 12 respectively for instance.

The particular construction renders an easily assembled relay. This becomes apparent by noting that the frame structure is an integral part including an extension 13 which supports and locates the switch capsules 15 through 18. Moreover, these apertures 20 insulate the terminal ends 22 of the switch capsules. Likewise the apertures 19 in key member 24 support and locate the other ends of the switch capsules. Assembly then takes place by: first, winding the coil on the bobbin through manual or preferably automatic means such as a coil winding machine; secondly, placing the switch capsules within their respective apertures in flange 11; thirdly, assembling or inserting the key member in its respective depression 14 and over the terminal ends 21 of the switch capsules; fourthly, inserting the magnetic core 23 within the tubular section 10; and finally, placing the two flux concentrators in their respective depressions and securing them to the core. To prevent the flux concentrators from relative movement with respect to the other components of the relay it is to be noted that they are located within slots 40 and 41.

One embodiment of the invention has been disclosed and described in detail, however, it is to be understood that this was merely by way of example and not done as a limitation or restriction to the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

A switching device comprising: a frame structure made of insulating material and having a tubular section with a flange at each end thereof, at least one of said flanges having a depression and the other including at least two apertures located substantially along one section of the periphery thereof; a key member made of insulating material and being insertable within said depression, said key member having also apertures corresponding to said apertures in said flange; a core made of magnetic material and positioned within said tubular section; terminal means embedded in at least one of said flanges; a coil wound on said tubular section and comprising at least one winding, the ends of said coil being connected to said terminals; a pair of flux concentrators being made of magnetic material and substantially L-shaped and being positioned adjacent the external surfaces of said flanges so as to be insulated from said coil, one leg of each flux concentrator being connected to an end of said core and the other leg thereof extending inwardly over said coil toward each other; said flux concentrators including apertures corresponding in location to said apertures in said key member and said flange; and at least two glass encapsulated reed switches having cooperating contact ends and terminal ends, said contact ends being normally opened and responsive upon energization of said coil, said terminal ends extending through said apertures in said key member, said flange and said flux concentrators so as to be in a plane intermediate said coil and said other end of said flux concentrators and to be secured from any material relative motion with said device.

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