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TECHNIQUES FOR THE CONSTRUCTION OF REED RELAYS

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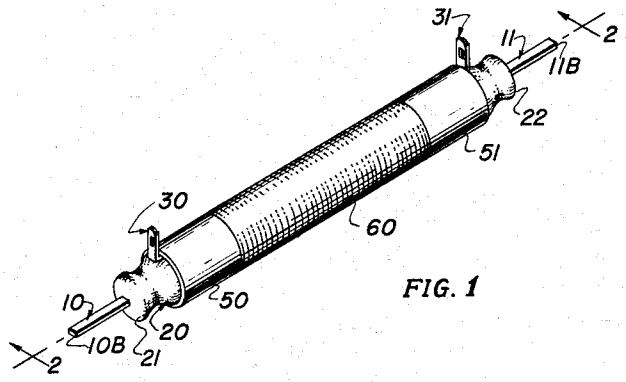


FIG. 1

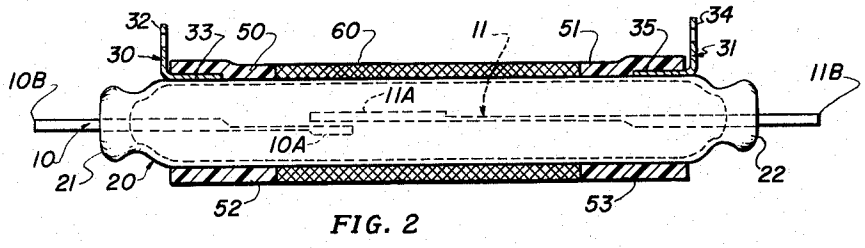


FIG. 2

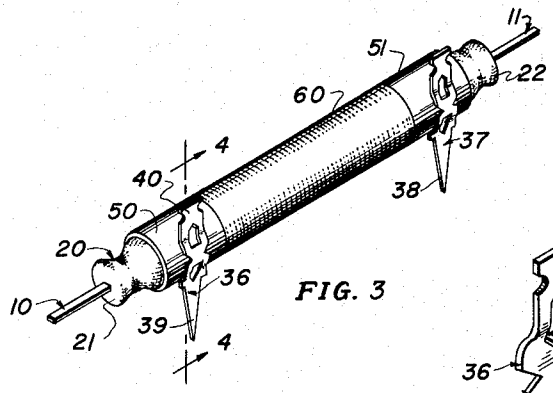


FIG. 3

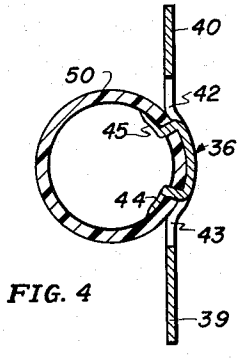


FIG. 4

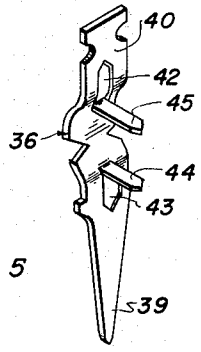


FIG. 5

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TECHNIQUES FOR THE CONSTRUCTION OF REED RELAYS

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This invention relates to electromagnetic devices such as for example relays having encapsulated reed switches for the switching element. More particularly, however, it relates to an improved relay structure and to the technique of making it.

While it has been an object of relay manufacturers to simplify the construction of relays and to reduce their cost and size, thereby making them more suitable where economy is essential and space is a premium, efforts toward this end have been frustrated because prior to the invention the only satisfactory approach for securing a coil and corresponding coil terminals to a reed switch capsule was through the use of a molded bobbin or frame structure. The typical relay bobbin includes a spool portion with a flange at each end for supporting a coil and slots in which terminals are inserted. Although bobbins are commonly used and have found wide acceptance in the industry, they add to the size of the relay and increase the magnetic reluctance by increasing the distance that the coil is from the reeds. Consequently, some manufacturers have placed the coil directly on the capsule to avoid the wall thickness of the bobbin and thereby reduce the reluctance in the relay structure, and have placed a casing around the coil to prevent it from slipping on the capsule. An example of such a relay device is disclosed in U.S. Patent 2,903,536, filed November 8, 1957, and issued September 8, 1959, to J. E. McBrian. According to this structure the coil is retained in one place by an outside casing and the coil terminals are wrapped around the capsule.

The inventors have found that a relay structure having an encapsulated reed switch can be substantially simplified by using spool heads made of heat shrinkable material. While it is appreciated that heat shrinkable material and tubing has been used in a number of applications it has heretofore not been used in connection with relay structures. By using spool heads of this material both the coil and coil terminals are secured rigidly to the capsule upon heating them to their shrinkable temperature. Moreover, the coil terminals can be conveniently placed with respect to the ends of the winding thus facilitating the terminating operation.

Therefore, the principal object of the present invention is to provide a technique of constructing a relay whereby the size of the relay can be reduced.

Another object of the invention is to provide a convenient and simplified means for supporting a coil directly on a reed switch capsule and to secure coil terminals thereto.

Still another object of the invention is to reduce the reluctace of a relay structure without decreasing its overall ruggedness.

One embodiment of the invention features a relay with a reed capsule that is parallel to its support board and which includes the aforementioned spool heads. These are placed toward the ends of the reed capsule with one leg of the L-shaped coil terminals extending between the inside surface of the spool head and the exterior surface of the capsule. The terminals become automatically secured and erect upon heating the spool heads to their shrinkable temperature.

According to a second embodiment instead of L-shaped, the terminals are straight and tapered to a point so as to

be mountable on a printed circuit card for example. The opposite end serves as the actual terminal portion. Furthermore, these terminals include tabs or prongs which extend outwardly from the terminal and pierce through the wall of the corresponding spool head. The tabs therefore are the portion of the terminals that are made integral with the spool heads.

The heat shrinkable material envisioned by the invention is commercially available in a variety of sizes and shapes. It is sold under many tradenames as for example "Thermofit" sold by Rayclad Tubes Incorporated and is a semi-rigid, tough, strong, modified polyvinylchloride whose molecules have been cross-linked by high-energy electron beam radiation, producing a compound which will not melt or flow at any temperature, can be cold crimped in either expanded or recovered form and which possesses a unique elastic memory .

As used in the invention the material can be extruded in the form of tubing, then irradiated and finally expanded by a special process to twice its original diameter by the supplier. Then upon exposing the material to a temperature in excess of 350° F., the radiation induced elastic memory causes instantaneous shrinkage of approximately 50 percent in diameter while less than 10 percent in length.

It should now be appreciated that a pair of spool heads made of the above material and positioned on a capsule will secure any portion of a terminal placed underneath it when shrunk and will render side support to a coil. The entire relay unit is actually encapsulated and made into a strong and rugged unit capable of holding up under severe shock and vibration conditions.

These and other objects and features will become apparent after making a perusal of the following detailed description which makes reference to the accompanying drawings of which:

FIG. 1 shows a perspective view of a relay according to one embodiment of the invention.

FIG. 2 shows a plan view of a cross-section taken along lines **2—2** of the embodiment shown in FIG. 1.

FIG. 3 shows a perspective view of a relay structure according to the second embodiment of the invention.

FIG. 4 shows a view taken of a cross-section along a line **4—4** of the spool head with the coil terminal attached thereto; and

FIG. 5 shows a view in perspective of a terminal used in the embodiment shown in FIG. 3.

Referring now to the drawings, FIGS. 1 and 2 show an electromagnetic device consisting of the components: reeds **10** and **11**, capsule **20**, terminals **30** and **31**, spool heads **50** and **51** and coil **60**. According to the invention the capsule **20** serves as the frame or support structure and therefore it is preferably made of rigid material such as glass and in the form of an elongated tube or encapsulation closed at both ends. To improve the environment for electrical contact the capsule can be filled with an inert gas.

Reeds **10** and **11** are preferably flat and made of magnetic material so as to be responsive to the aforementioned electromagnetic field. They include a terminal portion **10B** and **11B**, in addition to the aforementioned contact portions **10A** and **11A**. Intermediate these two portions is where the reeds are supported and cantilevered by the ends **21** and **22** of the capsule. The reeds include an offset to enable the contact portions to be substantially parallel to each other thereby providing maximum contact area. It should be appreciated that the combination of the reeds and capsule as shown are considered as a standard reed switch in the industry. The invention, however, embraces variations of this, in that non-standard size and shaped switches can also be used.

Spool heads **50** and **51** are slipped over the terminal portions of the reeds and the ends of capsule **20**. The inside diameter of the spool heads are slightly larger than the outside diameter of the capsule to provide room for insertion of portions **33** and **35** of the L-shaped coil terminals **30** and **31**.

Coil **60** is either wound directly on capsule **20** or placed thereon after being formed into an air core self supporting type coil. Use of either of these types avoids any reluctance that is incurred with the use of a bobbin for supporting the coil. In either instance the coil is secured on the capsule by virtue of the support from the end surfaces **52** and **53** of the spool heads and will not slide. It should be appreciated that where a coil is used consisting of electrical winding that will not withstand the shrinkable temperature of the spool heads then it would be preferred to wind the coil directly on the capsule after the spool heads are formed on it.

According to FIGS. 1 and 2, the terminals used are L-shaped with legs **33** and **35** extending between the exterior surface of the capsule and the interior surface of the spool head. Terminal portions **32** and **34** stand erect and fixedly so as to be conveniently accessible to the ends of the winding which are terminated thereat. It should be emphasized that through the use of the particular spool heads the terminals are made secure and capable of withstanding shock and rough treatment, thereby imparting ruggedness to the relay structure.

FIGS. 3–5 show a second embodiment of the invention. According to this one the relay employes the same basic components namely: capsule **20**, reeds **10** and **11**, coil **60**, spool heads **52** and **53**, and terminals **36** and **37**. The distinction between the embodiments is in the terminal design and in the manner the spool heads support them.

Terminals **36** and **37** are tapered with portion **39** being the mountable end and portion **40** being the terminal end. Tabs or prongs **44** and **45** are located between these portions and are the means for securing the terminal to the capsule. They extend through the walls of the spool head with the end turned back or crimped as shown in FIG. 4 to follow the surface of the capsule thereby keeping the size of the assembly at a minimum. Upon shrinking the spool heads, the terminal becomes fixed leaving the terminal portion very accessible and providing a means whereby the relay can be mounted to its support (not shown).

It should now be appreciated that the use of the particular spool heads provide the technique whereby the relay structure is simplified and the size thereof reduced.

The invention has been described in connection with certain embodiments, however, it should be understood that this was done by way of example only and not as a limitation, to the spirit and scope of the invention as hereafter defined by the appended claims.

What is claimed is:

1. An electromagnetic device comprising: an elongated capsule; reeds supported by said capsule and including overlapping contact portions; a coil for producing an electromagnetic field to thereby actuate said contact portions, said coil having at least two ends and being wound on said capsule; terminals connected to said coil ends; and a pair of sleeves of heat-shrinkable insulating material secured to said capsule so as to axially contain said coil on, and secure said terminals to, said capsule.

2. An electromagnetic device comprising: an elongated capsule; reeds supported by said capsule and including overlapping contact portions; a coil being wound directly on said capsule for producing an electromagnetic field to thereby actuate said contact portions, said coil having a pair of end faces; a pair of terminals for said coil; two spaced sleeves of insulating material mounted in tightly fitting relation on the outer peripheral surface of said capsule so as to contain end faces of said coil; said coil terminals being secured to said capsule, and located with respect to said end faces by means of said sleeves.

3. An electromagnetic device comprising: an elongated vitreous capsule; reeds supported by said capsule and including overlapping contact portions, two spaced tubular shaped spool heads positioned over said capsule toward the ends thereof, said spool heads being made of heat shrinkable material; a coil for producing an electromagnetic field to thereby actuate said contact portions, said coil having at least two ends and being supported by said capsule between said spool heads; and terminals in spaced relation with, but electrically connected to said coil ends and having a portion extending between said spool heads and said capsule wherethrough both said spool heads and said terminals are secured to said capsule as said spool heads are heated to their heat shrinkable temperature.

4. An electromagnetic device as claimed in claim **3** wherein said terminals are L-shaped with one leg thereof extending between said spool heads and said capsule and the other being connected to said coil ends and extending substantially perpendicular to said reeds.

5. An electromagnetic device as claimed in claim **3** wherein said terminals extend substantially perpendicular to said reeds and include a pair of projecting tabs which pierce through the wall of corresponding spool heads with the end of the tabs flared outward between the inside surface of the capsule.

6. An electromagnetic device comprising: an elongated vitreous capsule; reeds supported by said capsule and including overlapping contact portions; two spaced tubular shaped spool heads positioned over said capsule and each having an end surface substantially perpendicular to the exterior surface of said capsule, said spool heads being made of heat shrinkable material so they can be secured to said capsule by heating them to their shrinkable temperature; a coil for producing an electromagnetic field to thereby actuate said contact portions, said coil having at least two ends and being wound on said capsule between said spool heads and supported by said end surfaces; and thin terminals having a terminal portion and a mountable portion; said terminal portion connected to corresponding terminal ends, said terminals also extending substantially perpendicular to said reeds and including a pair of projecting tabs which pierce through the wall of corresponding spool heads with the end of the tabs flared outward between the inside surface of the spool head and the exterior surface of the capsule.

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