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2,889,423

HERMETICALLY SEALED UNIT SUCH AS AN ELECTRICAL
RELAY AND THE LIKE, AND METHOD

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2 Sheets-Sheet 1

FIG. 1.

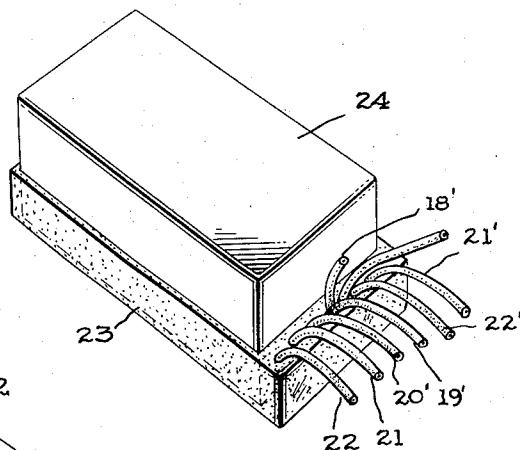


FIG. 4.

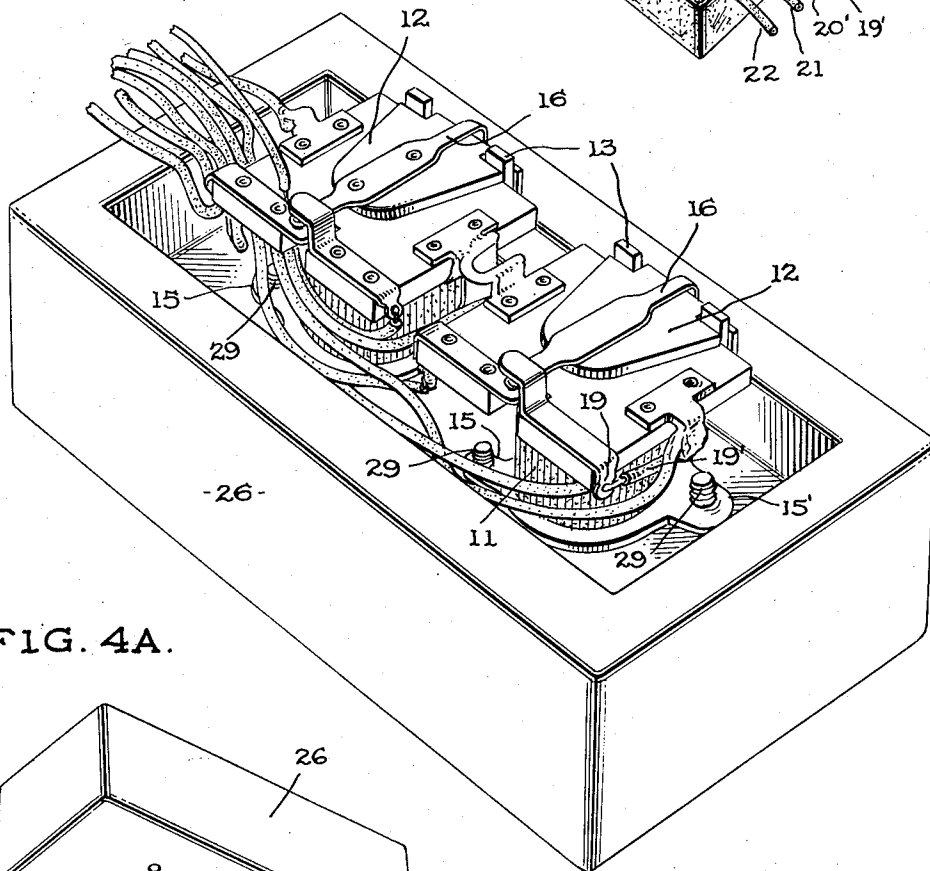
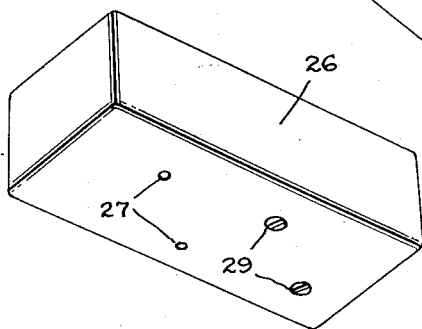


FIG. 4A.



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2 Sheets-Sheet 2

FIG. 3.

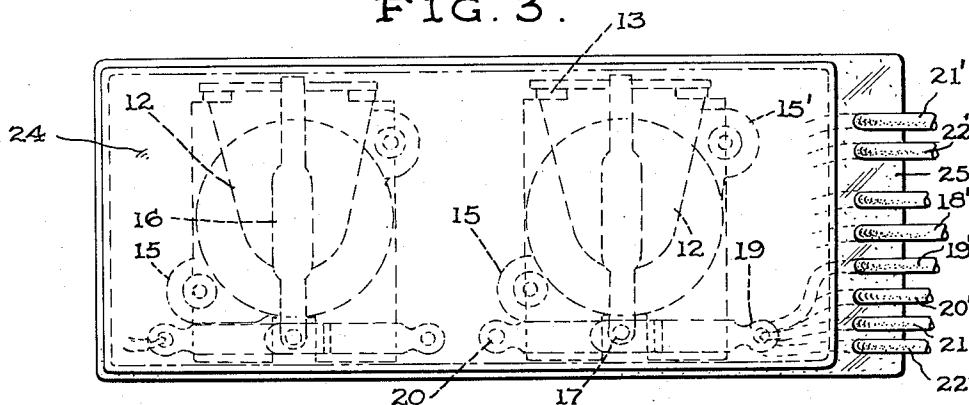


FIG. 2.

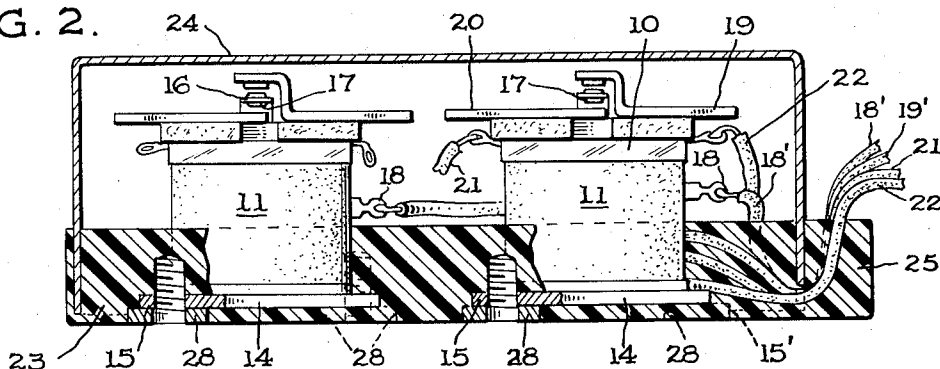
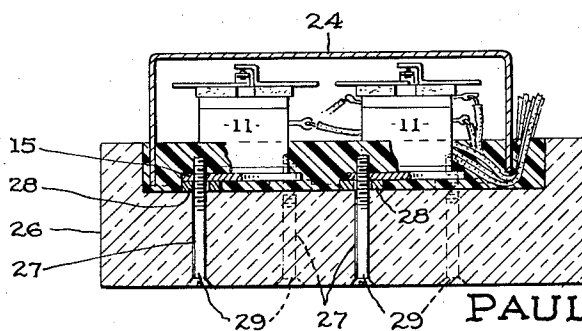


FIG. 5.



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1

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HERMETICALLY SEALED UNIT SUCH AS AN ELECTRICAL RELAY AND THE LIKE, AND METHOD

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3 Claims. (Cl. 200—87)

This invention relates to hermetically sealed electrical relays and analogous components incorporating movable parts required to be enclosed or housed in a manner such as to be sealed against the entrance into, or escape from the enclosure of fluid or gaseous mediums, and which at the same time are free to operate with complete safety in the region of combustible gases and under varying pressures and conditions which might otherwise cause damage to, or hinder the operation of the relay.

Taking small relays such as those used to illustrate the instant invention as an example, a common commercial practice in sealing the same is to utilize a two-part metal container or can, one part of the can having a glass header or insulator provided with conductors which are molded in the glass for connection to the various electrical leads. This part of the can, with the glass header soldered in place, may be considered as the cover. The other part of the can simply serves to complete the container. The relay per se is installed on a frame-work or shelf attached to the inside of the cover, and the terminals of the relay are connected to the conductors of the header. The two parts of the can are then joined and soldered at the line of jointure. This type of sealed relay is not only relatively expensive due to the amount of costly labor and materials involved, but it is also bulky and hence adds to installation-space problems, oftentimes present in high altitude flight components, such as telemetering devices, aircraft and missile controls and the like. Furthermore, this can-type of enclosure or envelope oftentimes involves considerably more space within the envelope than is actually necessary for the size of the relay, thereby not only adding to the size of the unit but rendering it more difficult to evacuate and maintain evacuation over long periods of time as well as requiring an unnecessary quantity of gas in the event the envelope is to be charged following evacuation.

An object of the present invention, therefore, is to provide a hermetically sealed relay or analogous electrical component incorporating movable parts which are firmly held against displacement due to vibration or shock, the entire unit being rugged, compact and relatively low in cost of construction with respect to known relays of this general type.

Another object is to provide a sealed relay having an effective barrier against infiltration of moisture and consequent breakdown of electrical resistance along the insulated lead wires or conductors which serve to electrically connect the relay with external circuitry.

Another object is to provide a sealed relay assembly wherein the lead wires can readily be made the correct length to attach directly to the desired external circuits, eliminating terminals and consequent solder joints usually found in conventional sealed relays at the point where the electrical leads are brought out through the relay envelope or housing.

Another object is to provide a method of housing a relay or like electrical component which permits ready control of the space for accommodating movable parts

2

of the component while at the same time the method insures effective sealing at the points where the supply and take-off leads are brought out without requiring the use of glass headers or the like, and it also enables the use of a housing or envelope made of material capable of withstanding rough handling during storage and installation and high pressures while in use.

The foregoing and other objects and advantages will become apparent in view of the following description taken in conjunction with the drawings, wherein:

Figure 1 is a perspective view of a sealed relay in accordance with the invention;

Figure 2 is a longitudinal cross-section through the unit of Figure 1;

Figure 3 is a top plan view thereof;

Figure 4 is a perspective view of the mold for fabricating the sealed relay unit, showing a pair of relays located in the mold cavity ready for pouring of the potting compound and subsequent placement of the metallic envelope or cover before the compound solidifies;

Figure 4A is a reduced-sized view in bottom perspective of the mold of Figure 4; and

Figure 5 is a longitudinal cross-section through the mold of Figure 4, showing the two relays along with the metallic envelope or cover in place, the potting material having been poured in the mold cavity and being in the process of solidification.

Referring to the drawings and particularly to Figures 2 and 4, the relay per se, which is typical of the type which the present invention is concerned, may be briefly described as containing a hollow solenoid spool 10, having a winding 11 thereon. A magnetic core element, not visible, projects axially through the spool and at its upper end is adapted to alternately attract and repel or release an armature 12, which is in the form of a flat, thin metallic member, hingedly or flexibly anchored at its rear broadened edge to the bifurcated upper end of a supporting member 13, the bifurcations of said member engaging in notches formed in the side edge portions of said armature. The supporting member 13 lies in back of the spool 10 as viewed in Figure 2; at the bottom of the spool it is bent at right angles to provide an anchoring or mounting base, which is formed with internally bored and threaded ears or lugs 15 and 15', adapted to receive anchor screws, not shown, by means of which the relay together with its housing may be fixed to a suitable support at the point of installation. Connected to the top of the relay is a thin ribbon-like conductor strip 16, having a contact 17 at its free end and at its opposite end it is connected to a terminal 18, which projects laterally from the rear upright portion of the member 13. In the example illustrated, the terminal 18 is provided with an insulated conductor wire 18', which leads to ground. Above and below the vibrating contact 17 are a pair of fixed contacts which are connected to the adjacent inner ends of terminal strips 19 and 20, the terminal strip 19 having an insulated wire conductor 19' connected thereto and leading to a humidity or other sensing circuit or resistor, not shown, and the terminal strip 20 having a wire 20' connected thereto and leading to another circuit, for instance a temperature-sensing circuit, also not shown. When the armature vibrates, it alternately connects the humidity and temperature elements into a telemetering circuit such as that illustrated in the U.S. patent to Cosby No. 2,558,343. In addition there are other wires, 21, 21' and 22, 22', by means of which the solenoid windings are connected to a source of supply.

It will be at once apparent that a relay of the type shown herein requires a plurality of circuit wires, and it is also apparent that it incorporates a movable armature which must be free to operate within the sealed housing or envelope provided therefor. These relays are oftentimes

placed in storage for indefinite periods and must be effectively sealed against the entrance of moisture or other deteriorating fluids or gases both while in storage and in use; and the enclosure which performs this desired function will now be described.

Referring to Figures 1 and 2, which show a pair of relays in a sealing enclosure, it will be noted that the latter essentially comprises a molded composition or plastic base 23 and an envelope or cover 24, the latter in the present instance being made of sheet metal or like material having its lower edge portions embedded in the plastic base. At one end of the housing, the right-hand end as viewed in Figures 1, 2, 3 and 5, the wall of the cover or envelope stops short of the base, or in other words, the base projects outwardly beyond the cover as indicated at 25; and it is at this point that the various insulated lead wires are brought out through a relieved or cut-away area in the bottom edge of the cover and upwardly and out through the material of the base, as best shown in Fig. 2. Thus the insulated conducting wires are embedded in the plastic material along a substantial length thereof to insure effective sealing against the escape or entrance of fluid around the said conductors. It will be noted that the upper ends of the relays lie well above the plastic base, so that all working parts are free to operate without hindrance.

The preferred method of fabricating the hermetically sealed relay is as follows:

A mold 26, see Figures 4, 4A and 5, is initially provided; it may be made of suitable molding material such as that sold under the trade name of Teflon. The mold is formed with a number of vertically-extending holes 27, one for each of the internally-threaded mounting ears or lugs 15, 15' which extend outwardly from the base member 14, there being in the present instance four of these lugs, two for each relay. Spacing washers 28 are located in the base of the mold cavity in registration with the ears or lugs 15, 15', and screws 29 are projected upwardly through the holes 27 and the spacing washers 28 and are threaded through the lugs 15, 15'. The spacers 28 insure a flow of the potting material beneath the lower end of each spool as well as beneath the anchoring members 14; they determine the thickness of the base 23 at these areas. The various leads should be attached before the potting compound is poured.

The assembled parts are now ready for pouring of the potting material and placement of the envelope or cover 24 in the mold cavity. This may be done in any order desired, i.e. the cover or envelope may be located in the mold cavity and the potting material then poured around and beneath the cover, or the potting material may be poured in the mold cavity and the cover then so positioned that its lower edge portions are immersed in the potting material, it only being necessary that the cover or envelope be located in the potting material while the latter is in a soft or pliable state.

The type of potting material used should be of a nature such that it will effect a bond between the material of the cover or envelope and the base. When the envelope or cover is made of metal, as in the present instance, a flexible epoxy resin has been used with marked success. By using potting material of a flexible or semi-flexible nature, the bond between the cover and base will remain intact should there be a differential in the ratio of expansion and contraction between the parts when the unit is subjected to rapidly changing temperatures. Another method which has been used successfully to ensure against breaking of the bond between the cover and the base where metal is used, is to first coat the edges of the cover with a flexible bonding material, such as a flexible epoxy resin, which is allowed to set or partly solidify before the cover and base are molded to one another.

The cover or envelope is placed in the mold cavity over the relays in a position such that at one end and on two sides the free edges of the envelope abut, or sub-

stantially abut, the adjacent walls of the mold cavity. All of the terminal wires are then brought out at one end of the mold before the cover is definitely located as shown in Figures 2 and 5.

The mold and relay assembly are then placed in an oven and baked, if baking is required to effect solidification of the potting material. After the potting material has solidified, the screws 29 are backed off, releasing the unit so that it can be freely removed from the mold cavity. Usually a venting hole is provided in the cover or envelope to permit gases to escape during the molding operation; and this vent may also be used to evacuate the interior of the envelope or to charge the latter with an inert gas, as required. It will be noted that the upper ends of the screws 29 terminate short of the upper level of the potting material, so that the internally-threaded lugs 15, 15' are effectively sealed while at the same time they are accessible for fastening the sealed relay to mounting studs or the like.

Actual practice has demonstrated that one or more relays may be hermetically sealed within a single housing in the foregoing manner at a cost which is only a fraction of that required for fabricating a sealed unit in accordance with conventional known practices. It will be noted that a substantial portion of the relay is embedded in the material of the base, thus reducing the space required to accommodate the moving parts of the relay while at the same time the relay is held firmly against displacement and all parts are capable of withstanding extreme vibration and shock. This combined with the facility with which the size of the cover may be varied to meet requirements facilitates control of the space to be evacuated or charged with an inert gas following evacuation. Since the electrical leads are tightly encased in the potting material throughout a substantial portion of their length, there is no chance of infiltration of moisture around the leads and consequent electrical leakage, which is often a source of trouble in other known types of sealed relays. Furthermore, since no terminals or solder joints are necessary where the leads come through the base, the cost of the method is reduced and there is less chance of electrical deterioration at these points. In cases where terminals are desired where the leads are brought out, they may be first wired and then molded in the material of the base. In this manner, leakage around the terminals will be prevented. The envelope or cover may be made of suitable gauge sheet metal or like material sufficiently rugged and strong to withstand rough handling and extreme pressures, both while in storage and in use. Also, the unit may be made exceedingly compact so that it will occupy a minimum of installation space.

Obviously, limited changes in construction and design of the relay and also in the steps of the method will become apparent to those skilled in the art once the concept of the invention has been made known.

What is claimed is:

1. A hermetically sealed electrical device wherein the device per se has a movable operating part and a relatively fixed part carrying a mounting member formed with one or more internally-threaded holes or bores to receive mounting screws, comprising a base of molded composition material, the relatively fixed part of the electrical device per se having a substantial portion thereof together with said mounting member embedded in said base, a deeply-dished cover of thin-section metallic material enclosing the exposed part of the electrical device per se and having its free edge portions telescoped over and bonded to the material of said base at the marginal edge portions of the latter, said electrical device per se having one or more electrical leads which are brought out through the material of said base to the exterior of the enclosure defined by the cover and base, said internally-threaded screw holes being exposed through the exterior surface of said base but terminating short of the interior surface thereof.

5

2. A hermetically sealed electrical relay wherein the relay per se includes a spool having a winding thereon, an armature at one end of the spool and an anchor member at its opposite end provided with one or more internally-threaded mounting holes, comprising a base of molded composition material, a portion of the spool together with said anchoring member being embedded in said material with said mounting holes exposed through the exterior surface of the base but terminating short of the interior surface thereof, a deeply-dished cover of thin-section metallic material enclosing the exposed part of said relay and having its free edge portions telescoped over and bonded to the material of said base at the marginal edge portion of the latter, said cover terminating a substantial distance short of the base at one edge section of the base and said relay having one or more electrical leads which are brought out through the material of said base at said edge section to the exterior of the enclosure defined by said cover and base, a substantial portion of said leads being embedded in the material of said base at said edge section.

3. The method of sealing an electrical unit having one or more movable parts and a relatively fixed part provided with a mounting member having one or more internally-threaded holes or bores, which comprises providing a mold having a cavity contoured to define the base of a sealed housing for the unit and performing the

6

following steps: filling said cavity with molding material to a depth corresponding to the desired thickness of the base of the housing, imbedding the relatively fixed part of said electrical unit per se along with said mounting member in the material of the base while such material is in a soft or pliable state, inserting screws through the mold into said internally threaded holes or bores to a depth short of the thickness of said base, positioning a deeply-dished cover over the exposed portion of said unit with the edge portions of the cover telescoped into the mold cavity, coating the said edge portions with a flexible epoxy resin prior to the molding operation to ensure adherence of the material of the base to said edge portions, bringing out any electrical leads for said unit through the material of the base, and permitting the material to solidify and effect a bond between said cover and base.

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