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REED RELAY FOR SMALL VOLTAGES

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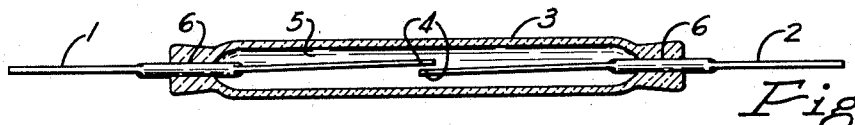


Fig. 1a

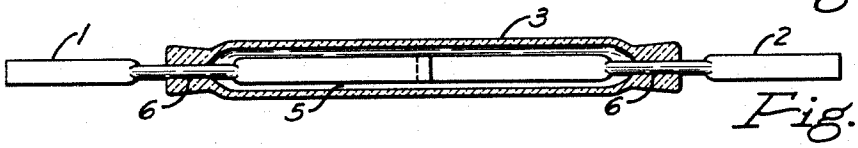


Fig. 1b

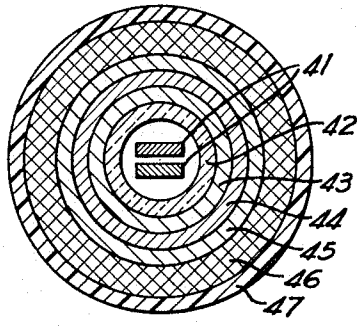


Fig. 2

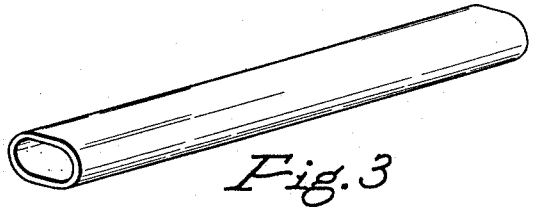


Fig. 3

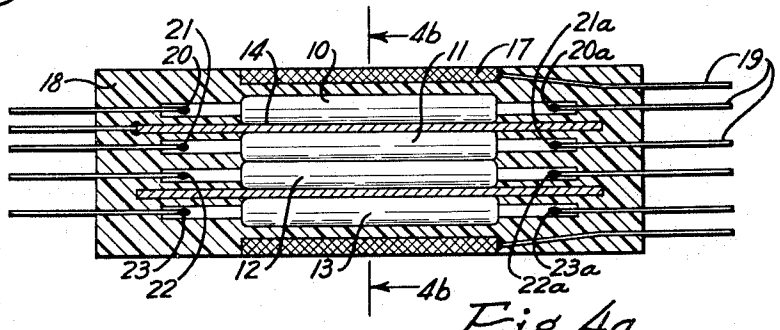


Fig. 4a

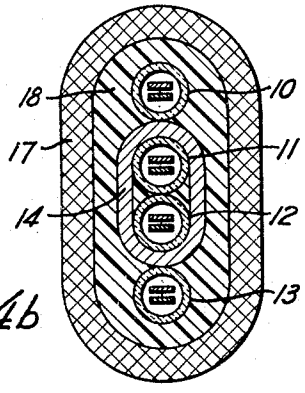


Fig. 4b

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REED RELAY FOR SMALL VOLTAGES

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5 Claims. (Cl. 200—87)

This invention relates to electrical relays. In particular, it relates to means for maintaining equal temperatures at the terminals of magnetically activated reed relays.

The so-called reed relay has recently become extensively used in electrical devices requiring many switching operations because of its low cost, long life, and minimum contact contamination. The life expectancy of a reed relay is in the many millions of operations. The cost, on the other hand, is small compared to standard mercury or other types of relays. There is, however, a difficulty with reed relays which is especially troublesome when the relay is handling voltages in the microvolt ranges. This difficulty is that the junctions of the leads and the terminals of the reeds are ordinarily unavoidably subject to small differences in temperature. The reed contact strips, which are generally made of a ferrous alloy having a high nickel content, are joined to the leads, which are generally of copper, at points several inches apart on the same relay. The junctions form thermocouples which produce an E.M.F. in the neighborhood of 30 microvolts per degree centigrade of temperature difference. The E.M.F. generated by the thermocouple junctions at each end of the relay is canceled out to the extent that there is no difference in the two temperatures. However, where there is a difference in temperature between the two lead-reed junctions of a single relay, the E.M.F. is quite significant. Where the relay is to be used to close a circuit from a transducer having an output measured in microvolts, such as a thermocouple, for example, the error is likely to be as large as the analog signal. It is therefore imperative, if the reed relay is to be used for handling small voltages, that a means for compensating or correcting this error be provided.

We have invented a device for virtually equalizing the temperatures at the terminals of one or more reed relays. Our device also has the advantage of minimizing the error caused by thermocouple effects at the contact point where slight variations in alloy composition may be present in the reeds. An additional function of our device is that it provides an electrostatic shield between the coil and the capsule containing the reeds. Other advantages of the invention will be mentioned in the description and will in part be apparent to those skilled in the art to which the invention pertains.

Our invention is illustrated in its presently preferred forms in the accompanying drawings.

FIGURES 1*a* and 1*b* are two views of a single presently commercially available reed relay capsule.

FIG. 2 is a cross section of a single complete reed relay equipped with our invention.

FIG. 3 is a perspective view of a presently preferred form of our thermal shunt capable of accommodating two reed relays.

FIGS. 4*a* and 4*b* are an overhead sectional view and a cross section of a package of four relays, two of which are enclosed in the thermal shunt of our invention and two of which are outside the thermal shunt but within the insulated package.

Referring to FIG. 1, it will be seen that the illustrated relay capsule comprises two metal strips **1** and **2** sealed in glass enclosure **3**. The strips are of ferromagnetic,

electrically conductive metal, preferably a nickel-iron alloy having a coefficient of expansion approximately equal to that of the glass enclosure. Contact surfaces **4** are gold-coated for improved conductance at the contact point. The interior **5** of the glass enclosure **3** is preferably filled with an inert gas to minimize contact contamination and deterioration through corrosion, etc. The space between contacts **4** is preferably about 2 or 3 millimeters. Each reed is securely anchored in the glass enclosure at **6**. Application of a magnetic field from the coil causes the reeds to assume a position parallel with the magnetic lines of force, thereby contacting each other.

The commercially available relay is not complete, of course, without the energizing coil surrounding it. The coil provided for the unit described should have at least about 110 ampere turns per capsule to operate dependably.

FIG. 2 is a cross section of a complete relay including our invention. Reeds **41** are enclosed in glass capsule **42**, which is surrounded by insulating material **43**. Thermal shunt **44** next surrounds the relay. On this is placed another layer of insulating material **45**. The energizing coil **46** is positioned concentrically on the insulating layer. The coil may, of course, be covered by a plastic insulating or protective layer **47**.

FIG. 3 is a presently preferred form of our thermal shunt. This shunt is capable of accommodating two reed relays side by side. The material is one of high thermal conductivity but preferably also of relatively high specific heat; that is, it should be a good conductor of heat and at the same time a given mass of material should absorb a relatively large number of calories for each degree of temperature change. A relatively large mass of such material in the form of our thermal shunt will result in a correspondingly high thermal inertia. However, the relay will not operate if the thermal shunt has ferromagnetic properties. We have found that an excellent material with respect to thermal conductivity, specific heat, and cost, is copper. Copper is our presently preferred composition for the thermal shunt. Among other suitable materials may be mentioned silver and copper alloys having the above described characteristics.

FIG. 4*a* shows the use of our invention in a package of four relays. This is an overhead view illustrating relays **10**, **11**, **12**, and **13** of the type illustrated in FIG. 1. Surrounding relays **11** and **12** is the thermal shunt **14** of FIG. 3. The other relays **10** and **13** are preferably positioned as shown, adjacent to the thermal shunt. Coil **17** surrounds the several relays such that energizing the coil **17** actuates all four relays at once. The entire package as shown is surrounded by a plastic protector. Insulating material **18** performs the important function of insulating the thermal shunt and the relay capsule within it from the relatively large temperature changes which occur in the coil. The insulating material should extend beyond the ends of the reeds and seal off the ends of the package, as shown. By retarding the conduction of heat from the coil to the thermal shunt, the insulating material minimizes the effect of temperature change, resulting in minimal thermal gradients in the contact strips. The coil is preferably of the same shape as the shunt and equidistant from it on opposite sides.

The copper leads **19** are preferably as thin as possible in order to minimize the conductance of heat through them to the thermocouple-like junctions **20**, **21**, **22**, and **23**. It is these junctions, of course, which should be equalized so far as is possible in temperature. Our invention provides a remarkably effective means for accomplishing this object.

The shunt should overhang the lead junctions to equalize the temperature so far as possible on all sides. In-

sulating material 18 should fill the space of the overhang to protect the junction from temperature influences of the outside world.

The thermal shunt is placed concentrically between the coil and the relay or relays to be protected. Most of the heat changes which cause the thermal gradients at the ends of an ordinary relay originate with the energizing of the coil. The balance of the trouble comes from the influence of air currents and the like originating outside the relay. The heat changes caused by the coil and conducted to the ends of the relay are thus virtually equal. Indeed, the temperature changes throughout the length of the relay at the same rate. Compensation is therefore also made for any differences in alloy composition of the reeds resulting in a thermocouple effect at the contact surface.

It is to be distinctly understood that the embodiments of our invention illustrated and described herein are the presently preferred embodiments. Our invention may be otherwise variously practiced within the scope of the following claims.

We claim:

1. A reed relay unit comprising an elongated energizing coil, a layer of insulating material concentrically within said coil, a copper enclosure within said insulating layer, and two elongated gas filled reed relay capsules substantially enclosed by said copper enclosure.

2. A reed relay capable of handling very small voltages without errors caused by temperature gradients comprising an elongated gas filled glass capsule having two ferromagnetic contact strips passing through it, a copper tube enclosing said capsule, an insulating layer surrounding said copper tube, and an energizing coil around said insulating layer.

3. The relay unit of claim 1 including at least one additional elongated reed relay capsule within said insulating layer but outside said copper enclosure.

4. An electrical reed relay unit capable of simultaneously achieving a plurality of electrical contacts without significant temperature gradients within said unit comprising:

(*a*) an energizing coil;

(*b*) an insulating layer within said energizing coil;

(*c*) a plurality of reed relay capsules; and

(*d*) a thermal shunt of a material selected from the group consisting of copper, copper alloys, and silver in the form of an elongated open-end enclosure within said insulating layer, said thermal shunt enclosing said reed relay capsules.

5. A reed relay free of temperature gradients comprising:

(*a*) a reed capsule comprising an elongated glass enclosure and two ferromagnetic contact reeds passing through said glass enclosure;

(*b*) a thermal shunt comprising an open-ended elongated enclosure made of a nonferromagnetic material having a high thermal conductivity and high specific heat, said shunt enclosing and extending at least to the extremities of said reeds;

(*c*) a layer of insulating material surrounding said thermal shunt; and

(*d*) an energizing coil over said insulating material approximately concentric with said thermal shunt.

No references cited.