

March 9, 1965

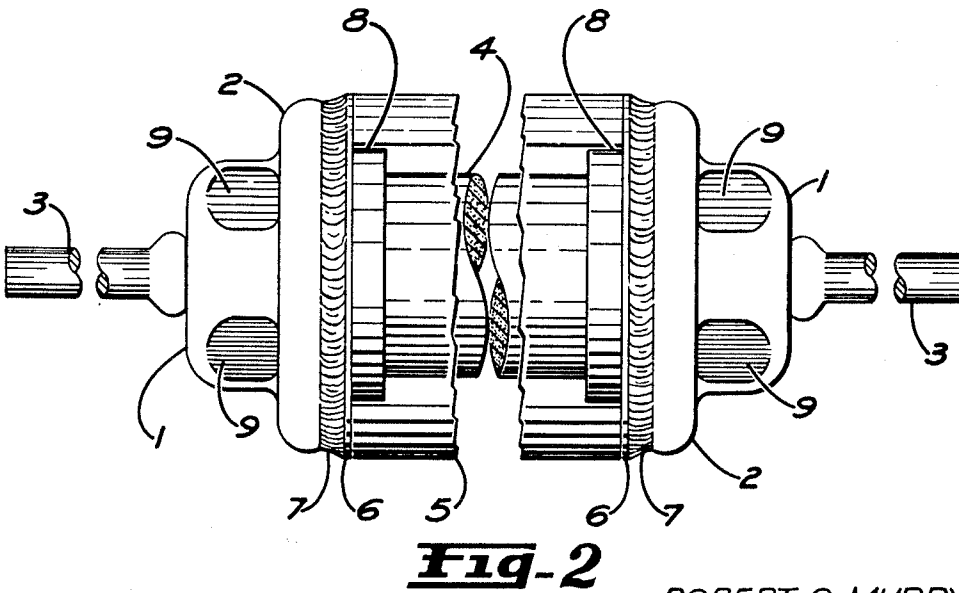
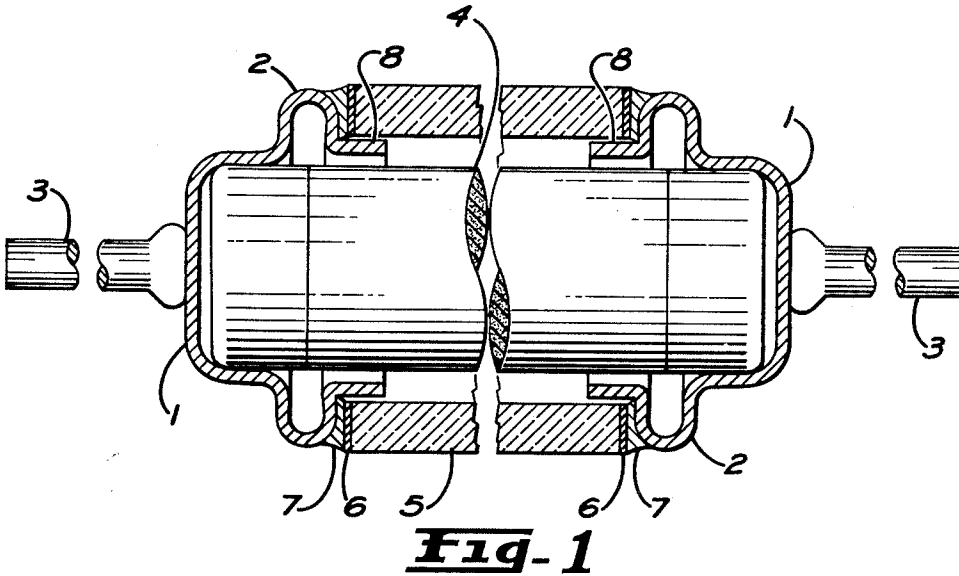
R. O. MURRY

3,173,121

HERMETICALLY SEALED RESISTOR

Filed June 18, 1962

2 Sheets-Sheet 1



ROBERT O. MURRY
INVENTOR

W. T. H. S.
ATTORNEY

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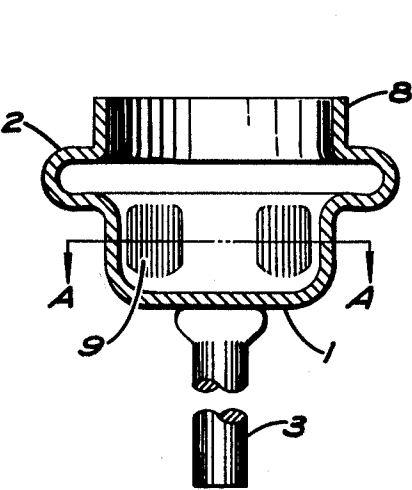


Fig-3

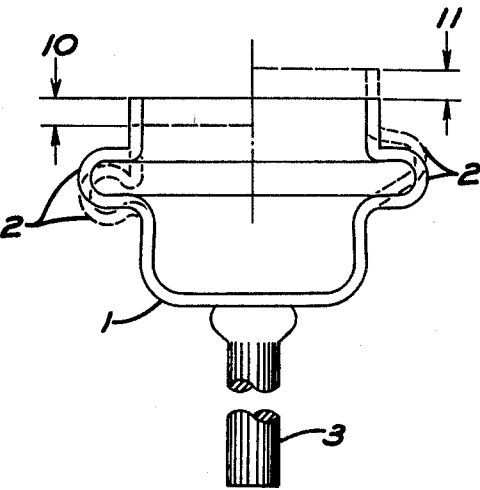


Fig-5

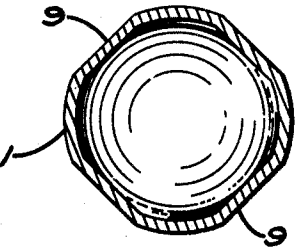


Fig-4

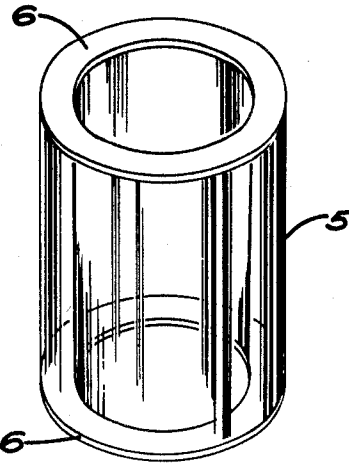


Fig-6

ROBERT O. MURRY
INVENTOR

Wm. T. M...
ATTORNEY

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3,173,121

HERMETICALLY SEALED RESISTOR

Robert O. Murry, 1388 Summer St., Burlington, Iowa

Filed June 18, 1962, Ser. No. 203,104

5 Claims. (Cl. 338—237)

This invention pertains to resistors and more particularly to hermetically sealed resistors.

Heretofore hermetic enclosures which have been used for hermetically sealed resistors have had disadvantages in that, in the case of solder-sealed units, if the solder which sealed the cap of the resistor to the hermetic jacket would become softened or molten after the seals were completed the jacket was liable to become separated from the cap. A further disadvantage of this type of resistor has been a lack of longitudinal flexibility in the hermetic jacket, so that differences in expansion between the jacket and the resistor element have caused damage to the resistors. Another problem which has been incurred in the manufacture of hermetically sealed resistors of the glass-to-metal fusion sealed type has been that the temperatures necessary to produce the fusion glass to metal seal will destroy or radically alter the resistance value of many kinds of resistance elements. Further, hermetically sealed resistors have been used wherein the glass to metal seal has been prepared in advance before insertion of the resistive element. This, however, requires a number of seals, usually four, which increases the chance for leakage. It also requires several component parts with the attendant additional cost of these parts and the cost of making the additional seals.

It is therefore an object of this invention to provide a hermetically sealed resistor which has only two seals.

It is a further object of this invention to provide a hermetically sealed resistor which has flexibility between the hermetic jacket and the resistive element, thus avoiding damaging stresses.

It is a further object of this invention to provide a means of avoiding the high and damaging temperatures necessary for glass-to-metal fusion seals by utilizing solder seals.

It is a further object of this invention to provide a hermetically sealed resistor which uses a solder seal thus making the seal capable of yielding sufficiently to accommodate differences of thermal expansion between the metal and non-metal parts of the hermetic jacket, thus avoiding the necessity for these parts to be of materials with matched coefficients of expansion.

It is a further object of this invention to provide a hermetically sealed resistor which will stay assembled, being held together by mechanical means both before and after sealing even if the solder used should become molten.

It is a further object of this invention to provide a hermetically sealed resistor which is economical to produce and reliable after assembled.

Further objects and advantages of this invention will become more readily apparent from the following drawings, descriptions and claims:

In the drawings FIG. 1 is a lengthwise section view of the assembled resistor. FIG. 2 shows the exterior view of the assembled resistor. FIG. 3 is a sectional view of the cap of the resistor. FIG. 4 is a sectional view of the cap taken on line A—A of FIG. 3. FIG. 5 shows the manner in which the cap flexes. FIG. 6 is an oblique view of the hermetic jacket.

The hermetically sealed resistor is composed of two metal caps 1 which have bellows beads 2. Lead wires 3 are attached to the caps 1. Resistive element 4 is shortened for purposes of illustration. The hermetic jacket 5 which is also shortened for purposes of illus-

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tration receives the resistive element 4. Assembly is accomplished by pressing a cap 1 on one end of the resistive element 4 sliding this combination into the hermetic jacket 5 and then pressing the other cap 1 onto the other end of the resistive element 4. The hermetic jacket 5 is made of a suitable insulating material such as glass or ceramic and capable of being metalized on its ends 6. A layer of solder or other fusible alloy 7 seals the hermetic jacket 5 to the bellows beads 2 of the caps 1.

The resistive element 4 may be provided with a surrounding protective atmosphere in several ways, such as for instance by performing the capping and sealing operation in such protective atmosphere.

Lead wires 3 may be attached to the caps 1 by any suitable means or if electrical contact means are provided separately the lead wires 3 may be eliminated.

The hermetic jacket 5 is held in place between the caps 1 prior to sealing by the clearance fit between the annular skirts 8 of the caps 1. After sealing is accomplished by means of the solder or other fusible alloy 7 the assembly will not come apart if the solder or other fusible alloy 7 melts because of the friction fit between the gripping areas 9 of the caps 1 and the ends of the resistive element 4. Once in place, the solder remains in the joint between the caps 1 and the hermetic jacket 5 due to capillary action, even if remelted. If the joint becomes heated beyond the melting point of the solder the resistor will not come apart due to the friction fit and upon cooling the solder will again make the seal.

In FIG. 2 an exterior view of the hermetically sealed resistor is shown with a transparent glass hermetic jacket 5 for illustrative purposes. However, suitable opaque materials may be used for the hermetic jacket 5.

Gripping areas 9 in the caps 1 are for the purpose of providing yielding interference with the resistive element 4 when the caps 1 are pressed onto the resistive element 4. The gripping areas 9 allow the caps 1 to yield by bending outwards rather than by stretching as would be the case if the caps 1 were round in the area which comes into contact with the resistive element 4. The corners between the gripping areas 9 and the resistive element 4 also allow the atmosphere between the end of the resistive element 4 and the closed ends of the caps 1 to escape during capping. The bellows beads 2 serve two purposes. They serve to locate the jacket 5 lengthwise, and they provide a flexible configuration on the caps 1 so that relative movement can take place between the portion of the caps 1 having the gripping areas 9 and the portion of the caps 1 sealed to the hermetic jacket 5. This thus allows relative movement between the resistive element 4 and the hermetic jacket 5 relieving stresses which may be caused by temperature differences or differences in thermal expansion without damage to the hermetic jacket 5, the seal 7, or the resistive element 4.

FIG. 5 shows the manner in which the bellows beads 2 on the caps 1 move to relieve stresses and accommodate movement of the portion of the caps 1 sealed to the hermetic jacket 5 and the portions of the caps 1 which grip the resistive element 4. The left hand side of FIG. 5 shows in exaggeration the approximate shape of the caps 1 when they are shortened a distance 10 and the right side of the FIG. 5 similarly shows the approximate shape of the caps 1 when they are lengthened a distance 11.

The metallized coatings 6 on the surface of the ends of the hermetic jacket 5 are shown in more detail in FIG. 6. These coatings may be obtained by any of the means well known to the art, such as flame spraying,

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reducing metal oxides, firing on of the various proprietary mixtures for gold, silver, platinum and other films of metals onto the surfaces of glass, ceramics and other materials.

Although this hermetically sealed resistor is shown to enclose a resistive element 4 the invention may be used to hermetically seal any type component requiring a hermetic jacket.

I claim:

1. A hermetically sealed resistor comprised of a hermetic jacket in the shape of a hollow cylinder having two flat ends each of which are metalized, a resistive element in the shape of a cylinder having two ends, two caps each having surfaces therein disposed so as to grip the resistive element, one cap being pressed onto one end of the resistive element until its surfaces are in yielding interference with the resistive element, the other cap being pressed onto the other end of the resistive element until its surfaces are in yielding interference with the resistive element, each of the caps having a bellows bead disposed so as to compensate for relative movement between the resistive element and the hermetic jacket due to differences in thermal expansion between the resistive element and the hermetic jacket, each of the caps having an annular skirt, the annular skirt of one cap having a clearance fit into one end of the hermetic jacket, the annular skirt of the other cap having a clearance fit into the other end of the hermetic jacket, a fusible alloy seal between one flat end of the hermetic jacket and the bellows bead of one cap, a fusible alloy seal between the other flat end of the hermetic jacket and the bellows bead of the other cap.

2. A hermetically sealed resistor comprised of a hermetic jacket in the shape of a hollow cylinder having two ends each of which are metalized, a resistive element having two ends, two caps each having surfaces therein disposed so as to grip the resistive element, one cap being pressed onto one end of the resistive element, the other cap being pressed onto the other end of the resistive element, each of the caps having bellows beads disposed so as to compensate for relative movement between the resistive element and the hermetic jacket, each of the caps having an annular skirt, the annular skirt of one cap having a clearance fit into one end of the hermetic jacket, the annular skirt of the other cap having a clearance fit into the other end of the hermetic jacket, a solder seal between one end of the hermetic jacket and the bellows bead of one cap, a solder seal between the other end of the hermetic jacket and the bellows bead of the other cap.

3. A hermetically sealed resistor comprised of a resistive element having two ends, a hermetic jacket having two ends each of which are metalized, the hermetic jacket disposed so as to receive the resistive element, two caps each disposed so as to have a friction fit on one end of the resistive element, each of the two caps having a bellows bead and an annular skirt, the annular skirt of one cap having a clearance fit into one end of the hermetic jacket, the annular skirt of the other cap having a clearance fit into the other end of the hermetic jacket, a fusible alloy seal between one end of the hermetic jacket and the bellows bead of one cap, a fusible alloy seal between the other end of the hermetic jacket and the bellows bead of the other cap.

4. A hermetically sealed resistor comprised of a hermetic jacket in the shape of a hollow cylinder having

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two flat ends each of which are metalized, a resistive element in the shape of a cylinder having two ends, two caps each having surfaces therein disposed so as to grip the resistive element, one cap being pressed onto one end of the resistive element until its surfaces are in yielding interference with the resistive element, the other cap being pressed onto the other end of the resistive element until its surfaces are in yielding interference with the resistive element, each of the caps having a bellows bead disposed so as to compensate for relative movement between the resistive element and the hermetic jacket due to differences in thermal expansion between the resistive element and the hermetic jacket, each of the caps having an annular skirt, the annular skirt of one cap having a clearance fit into one end of the hermetic jacket, the annular skirt of the other cap having a clearance fit into the other end of the hermetic jacket, a solder seal between one flat end of the hermetic jacket and the bellows bead of one cap, a solder seal between the other flat end of the hermetic jacket and the bellows bead of the other cap, the solder seals being capable of yielding sufficiently to accommodate differences of thermal expansion between the hermetic jacket and the caps.

5. A hermetically sealed resistor comprised of a hermetic jacket in the shape of a hollow cylinder having two flat ends, each of which are metalized, a resistive element in the shape of a cylinder having two ends, two caps each having surfaces therein disposed so as to grip the resistive element, one cap being pressed onto one end of the resistive element until its surfaces are in yielding interference with the resistive element, the other cap being pressed onto the other end of the resistive element until its surfaces are in yielding interference with the resistive element, each of the caps having a bellows bead and an annular skirt, the annular skirt of one cap having a clearance fit into one end of the hermetic jacket, the annular skirt of the other cap having a clearance fit into the other end of the hermetic jacket, a fusible alloy seal between one flat end of the hermetic jacket and the bellows bead of one cap and a fusible alloy seal between the other flat end of the hermetic jacket and the bellows bead of the other cap.

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RICHARD M. WOOD, *Primary Examiner*.