Jan. 18, 1955 E. H. NELSON ET AL 2,699,847

QUARTZ-TO-METAL SEAL

Filed Sept. 1, 1949

Fig. 3.

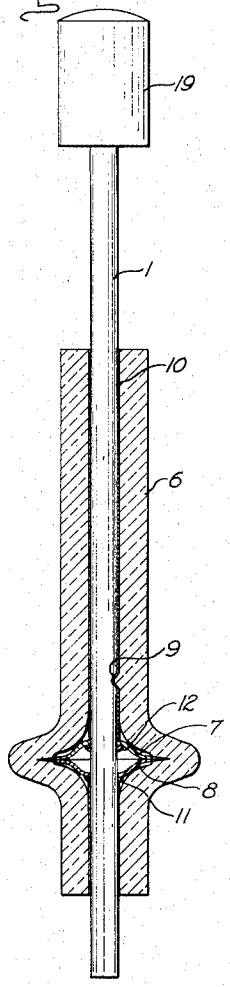


Fig. 1.

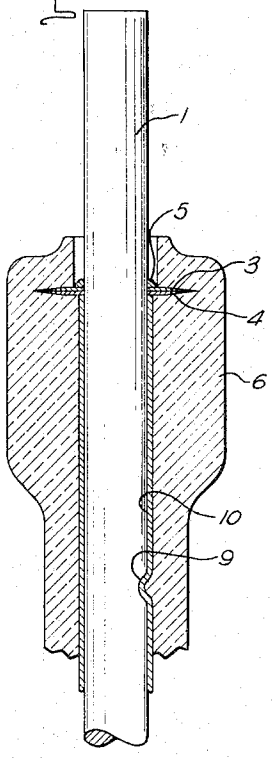


Fig. 2.

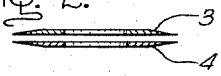


Fig. 4.

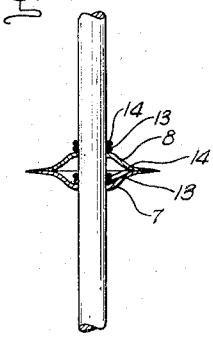


Fig. 5.

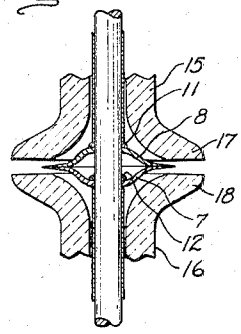
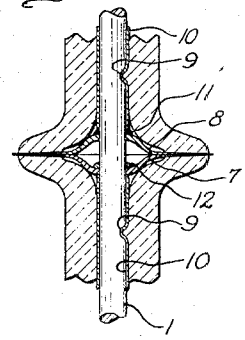


Fig. 6.



Inventors:
Ernest Benjamin Power,
Evan Herbert Nelson,
by Vernet C. Kauffman
Their Attorney.

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QUARTZ-TO-METAL SEAL

Evan Herbert Nelson, Harrow Weald, and Ernest Benjamin Power, Kenton, England, assignors to General Electric Company, a corporation of New York

Application September 1, 1949, Serial No. 113,644

Claims priority, application Great Britain September 1, 1947

7 Claims. (Cl. 189—36.5)

This invention relates to seal-bodies of the type comprising at least one conductor hermetically sealed through a quartz body and adapted for sealing into apertures in quartz envelopes, for example the envelopes of electric discharge devices such as high pressure metal vapor electric discharge lamps, to provide an hermetically sealed conductive connection between the interior and exterior of the envelope, and is an improvement in or modification of the invention described in our copending application Serial No. 46,916, filed August 30, 1948, now Patent No. 2,659,964, dated November 24, 1953, assigned to the assignee of this application and of which this application isa continuation-in-part. The copending application is hereinafter referred to as the parent application. Here and hereinafter it will be understood that the term "quartz" includes any other vitreous material whose thermal expansion coefficient is as low as that of quartz.

The parent application describes and claims a seal-body of the type specified wherein at least part of the said conductor comprises a body of metal passing through an aperture in a thin sheet of metal, which sheet is hermetically joined to the body of metal by brazing or soldering, and part of the said thin sheet is embedded in the quartz body to complete the hermetic sealing of the conductor through the quartz body.

According to the present invention, a seal-body of this kind is modified by the use of two thin sheets of metal in place of a single thin sheet, the two sheets contacting, or lying very close to each other without any quartz between them so as to be in simple abutting contact at least over the region where they are embedded in the quartz.

With this arrangement the opposing inner surfaces of the two sheets are free to move relative to each other and in this way stresses set up on cooling of the heated quartz in manufacture, or during use of the seal-body, which might lead to rupture of a single thin sheet, can be relieved by such relative movement without damage.

In the drawing accompanying and forming part of this specification species of the invention are shown in which Fig. 1 is an elevational, partly sectional view of one end of a completed seal-body embodying the invention and made by the method disclosed and claimed in our copending application referred to above; Fig. 2 is a side sectional view of the two thin sheets of metal, which are in the form of discs having a central aperture and a tapered feathered sealing edge, spaced apart to clearly show their shape; Fig. 3 is an elevational, partly sectional view of a completed seal-body also embodying the invention and made by the method disclosed and claimed in copending application Serial No. 42,823, filed August 6, 1948, now Patent No. 2,607,981, dated August 26, 1952, and assigned to the assignee of this application. Fig. 4 is a fragmentary, partly sectional view of the metal parts of the seal-body of Fig. 3 assembled for being joined together; Fig. 5 is a similar view of the metal and vitreous parts of the seal-body of Fig. 3 assembled for being joined together and Fig. 6 is a fragmentary, elevational partly sectional view of another seal-body of our invention.

Referring to Figs. 1 and 2 of the drawing, the seal-body comprises a metal rod 1, preferably tungsten, passing through apertures in two thin metal sheets in the form of annular discs 3 and 4, prefereably of molybdenum. The discs 3 and 4 are hermetically united around the rod 1 by brazing or soldering as indicated at 5 in Fig. 1. The surface of each disc 3 or 4 in contact with the other disc is plane and the said plane surfaces are in

simple abutting contact with each other. The composite disc made up of the two discs 3 and 4 has a feathered seal edge which is embedded in the quartz body 6 to complete the hermetic sealing of the conductor rod 1 through the quartz body 6. The latter is preferably in the form of a tube having the end opposite that shown adapted to be hermetically joined to the quartz envelope of an electric discharge device, such as a high pressure mercury vapor discharge lamp, with the corresponding end of the rod 1 extending into the envelope. A discharge supporting electrode, such as that shown in Fig. 3, may be mounted on the inner end of the rod 1.

Preferably both of the thin sheets or discs 3 and 4 are hermetically brazed or soldered to the body or rod 1 of metal, but if the peripheries of the discs are completely embedded in the quartz, as is preferred and shown in Fig. 1, obviously it will suffice for only one disc 3 to be hermetically brazed or soldered to the metal body to secure the required hermetic sealing of the metal body through the quartz.

Preferably both of the contacting surfaces of the thin discs 3 and 4 are plane, so that they are everywhere substantially in simple abutting contact, but this need not necessarily be the case; thus the sheets may have the form of cups 7 and 8 with opposed flanged rims in simple abutting contact and embedded in the quartz, the hollows of the cups 7 and 8 being opposed to each other with the rod 1 passing through apertures in their bases, as shown in Figs. 3 to 5 of the drawing.

As in the parent application, the metals of the thin sheets in the form of discs 3 and 4 or cups 7 and 8, which is preferably the same in each case, must be capable of withstanding the temperatures involved in the embedding thereof in quartz, for which purpose the quartz 6 must in general be rendered molten, and tungsten and molybdenum are the metals best suited for this use.

Also the rod 1 must again be of a similar refractory nature if it is also heated to the temperature of molten quartz in manufacture, for example if, as will in general be desirable for supporting purposes, molten quartz is collapsed on to it in making the seal-body, and here also tungsten and molybdenum are the metals best suited for such use. However, in some cases the rod 1 may not be heated in manufacture, for example it may be brazed or soldered to the thin sheets after the latter have been embedded in the quartz body, and then a wider choice of metal is possible, consistent with the requirement that it must be capable of being brazed or soldered to at least one, sometimes both, of the thin metal sheets and must also be suitable for the use for which the seal-body is intended, for example a copper rod would not in general be suitable for use in a device containing a mercury vapor filling.

As in the seal-body described and claimed in the parent application, preferably the whole of the conductor rod 1 passing through the seal-body consists of a single metal body, for example a single solid rod 1, and the quartz body 6 consists of a tube at least an appreciable length of which is collapsed onto the rod 1 to support it; preferably the rod 1 is keyed into position by means of an indentation 9 formed in it into which quartz enters during the collapsing. The rod 1 may have to be wrapped with metal foil 10 where the quartz tube 6 is collapsed onto it to prevent the quartz cracking on cooling of the seal-body after the collapsing.

As shown in the drawing, the edges of the thin sheets of metal, that is the edges of discs 3 and 4 and cups 7 and 8, are preferably embedded in the quartz body 6, but this need not necessarily be the case since the edges may in some cases project through the quartz body as shown in Fig. 6 of the drawing. In this case at least the cup 7 lying on the side for which hermetic sealing is required, i. e. the side adapted to be presented to the interior of an envelope when the seal-body is sealed into the envelope, must be brazed or soldered to the metal rod 1 and preferably both cups 7 and 8 are brazed or soldered to the rod 1, as shown at 11 and 12 of the drawing. If cup 8 were not so fixed to the rod 1, the quartz attached to this cup might be removable, with the cup, from the seal-body; this may be avoided by keying the quartz to the rod 1, as shown at 9, and in any case with a

seal-body in which the edges of the cup project through the quartz body, both of the parts of the quartz body into which it is divided by the cups are preferably keyed to the rod 1 as shown in Fig. 6. It will be understood that discs 3 and 4 may be used in place of cups 7 and 8 in the seal-body of Fig. 6.

The brazing or soldering medium used will depend on the nature of the metals to be joined. For joining a molybdenum sheet to a tungsten rod, nickel which unites both with molybdenum and tungsten, may be used, but whilst nickel may in some cases be used satisfactorily we have found that it often attacks the thin molybdenum sheet so as to leave gaps between the sheet and the tungsten conductor, accordingly it is better to use instead of metal a molybdenum-rich alloy of nickel and molybdenum. Such an alloy may readily be produced in situ in performing the soldering or brazing operation. However it will be understood that other soldering or brazing media may be used and may be preferable.

In one method of forming the seal-body in accordance with the present invention in which the places where the two thin sheets are brazed or soldered to the body of metal are spaced apart, which method is described by way of example and shown in Figs. 3 to 5 of the drawing, a tungsten rod 1 is passed through a central aperture in each of two thin molybdenum cup-shaped discs 7 and 8 (Fig. 4), the rod 1 fitting each aperture closely. For each cup a ring 13 of thin molybdenum wire fitting closely round the rod 1 is then placed round the rod 1 in the corner between the rod and a surface of the molybdenum cup and a similar ring 14 of nickel wire is placed next to the ring 13 of molybdenum wire.

The rod 1 is held vertically with each of the pairs of wire rings 13 and 14 above the corresponding molybdenum cups 7 and 8 and the rings 13 and 14 are heated until each nickel ring 14 melts and flows down over the associated molybdenum ring 13 to form a molybdenum-rich alloy which solders or brazes the corresponding molybdenum disc 7 or 8 to the tungsten rod 1 on cooling, the joint being shown at 11 and 12 in Figs. 3, 5, and 6. To avoid oxidation the heating is carired out in an electric oven in a reducing atmosphere such as forming gas.

After the brazing operation has been completed the edges of the molybdenum cups 7 and 8 may be embedded in quartz in any suitable manner, for example, by inserting flanged quartz tubes 15 and 16, one of which 15 is closed at the non-flanged end (not shown), over the ends of the rod 1 so that the molybdenum cups 7 and 8 are sandwiched between and overlapped by the opposed quartz flanges 17 and 18. The edges of the quartz flanges 17 and 18 are then fused together whilst nitrogen is passed through the tubes to avoid oxidation of the metal parts during the heating and thereafter the flanges 17 and 18 and tubes 15 and 16 are collapsed, by heating, onto the edges of the molybdenum cups 7 and 8 and onto rod 1 whilst a reduced pressure is maintained within the tubes.

The closed end of tube 15 is then cut away to expose the end of tungsten rod 1 and the other tube 16 may also be cut to a suitable length as required. The electrode 19 may then be secured, as by welding, to the end of rod 1.

It is, however, preferable if possible to reverse the order of soldering or brazing and sealing to reduce the possibility of the soldered or brazed joints being damaged by heat in the embedding of the thin metal sheets. Thus in the preferred method of making a seal-body in accordance with the invention in which two plane contacting thin sheets are used as in the embodiment of Figs. 1 and 2, parts of the thin sheets in the form of annular discs 3 and 4 with the rod 1 passing through them are first embedded in the quartz and the rod 1 thereafter soldered or brazed to the sheets to complete the hermetic sealing. A seal-body of this kind may be manufactured exactly as described in the parent copending application Serial No. 46,916 with reference to Figs. 1 to 4 of the drawing accompanying the copending application, the single thin molybdenum disc of that seal-body being merely replaced by two thin molybdenum discs, which

may conveniently each be of approximately half the thickness of the single disc of that seal-body.

In our copending application Serial No. 113,645 of even date herewith, and assigned to the assignee of the present application, we have described and claimed a seal-body in which one side only of a single thin metal sheet is sealed to a quartz body to reduce the possibility of the thin sheet of metal being ruptured by stresses set up by contraction of the quartz and the metal sheet while cooling after heating in the manufacture or use of the seal-body or of the device of which the seal-body may form part. The seal bodes of the present application are similar in that one side only of each of the two metal sheets is sealed to the quartz.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A seal-body comprising a quartz tube, a metal conductor rod extending along the interior of said tube and a pair of thin juxtaposed metal sheets around said rod and hermetically united therewith, the outer edges of said sheets being in simple abutting contact with each other and hermetically united directly wtih said quartz tube.

2. A seal-body comprising a quartz tube, a metal rod extending along the interior of said tube and a pair of thin juxtaposed metal discs around said rod and hermetically united therewith, the peripheries of said discs being in simple abutting contact with each other and hermetically united directly with said quartz tube.

3. A seal-body comprising a quartz tube, a metal rod extending along the interior of said tube and a pair of thin juxtaposed metal cup-shaped discs disposed around said rod and hermetically united therewith, said discs opening toward each other with their rims in simple abutting contact and hermetically united directly with said quartz tube.

4. A seal-body comprising a quartz tube, a metal rod extending along the interior of said tube and a pair of thin juxtaposed metal flat discs around said rod and hermetically united therewith, each of said discs having a plane surface in simple abutting contact with the corresponding surface of the other disc, the edges of said discs being embedded in said quartz tube with one side only of the edge of each disc hermetically united directly with the quartz.

5. A seal-body comprising a quartz tube, a metal rod extending along the interior of said tube and a pair of thin juxtaposed metal cup-shaped discs around said rod and hermetically united therewith, said discs opening toward each other with their rims in simple abutting contact and completely embedded in said quartz tube with one side only of the rim of each cup hermetically united directly with the quartz.

6. A seal-body comprising a quartz tube, a metal rod extending along the interior of said tube and a pair of thin juxtaposed metal sheets around said rod one of which is hermetically united with said rod, the outer edges of said sheets being in simple abutting contact with each other and hermetically united directly with said quartz.

7. A seal-body comprising a quartz tube, a tungsten rod extending through said tube, a pair of thin juxtaposed molybdenum sheets around said rod and hermetically united therewith, the outer edges of said sheets being in simple abutting contact with each other and hermetically united directly on one side only with said quartz.

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