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[54] **MEANS FOR PROVIDING HERMETIC SEALS**

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Related U.S. Application Data

[62] Division of Ser. No. 691,421, Dec. 18, 1967, abandoned.

[52] **U.S. Cl.** ..... **220/2.3 R**, 29/472.9, 29/473.1, 215/37 R, 215/88, 220/46 MS, 220/55 D, 220/55 F

[51] **Int. Cl.** **H01k 1/42**

[58] **Field of Search** ..... 220/2.3, 2.3 A, 2.1, 220/2.1 A, 55 D, 55 F, 67, 46 MS; 29/472.9, 473.1; 215/37, 88

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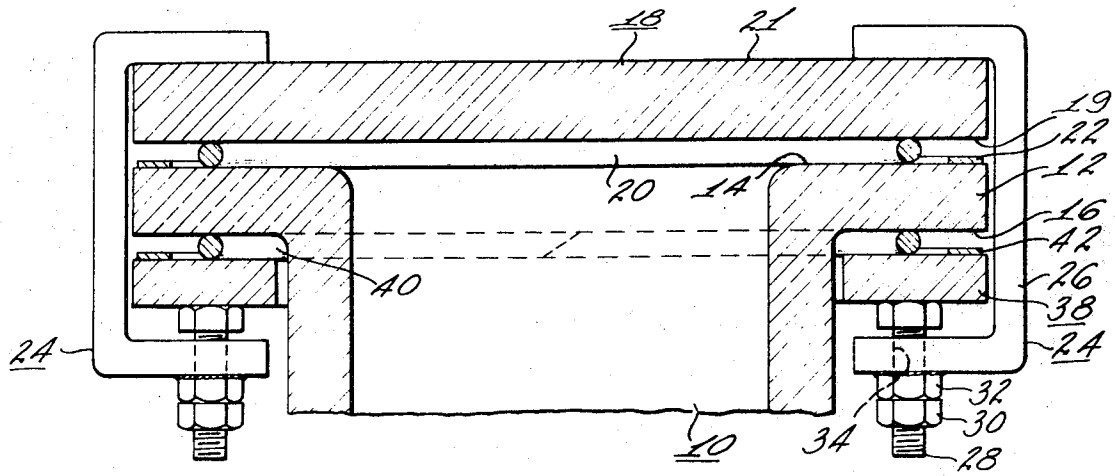
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[57] **ABSTRACT**

The outwardly flanged end of a glass tube is hermetically sealed by means of a pure or indium coated aluminum wire gasket which is squeezed at a pressure of about 5,000 pounds per linear inch of wire between the glass flange and a metal closure plate and heated to about 482°F or above. The pressure is applied by C-clamps which grip the closure plate and a split ring collar surrounding the tube. An aluminum cushioning gasket is disposed between the collar and the glass flange to prevent glass fracture. Steel spacer shims surround both gaskets to prevent extrusion of the gaskets under pressure.

3 Claims, 4 Drawing Figures



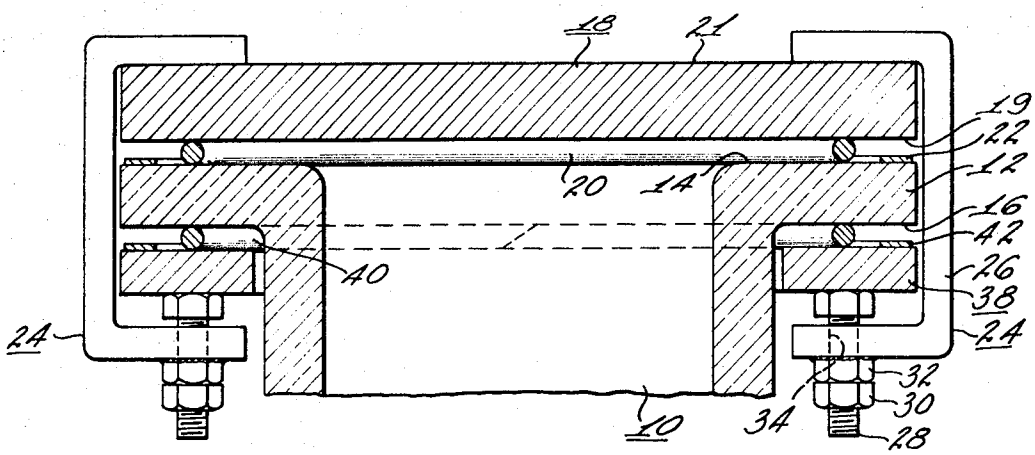


Fig. 1

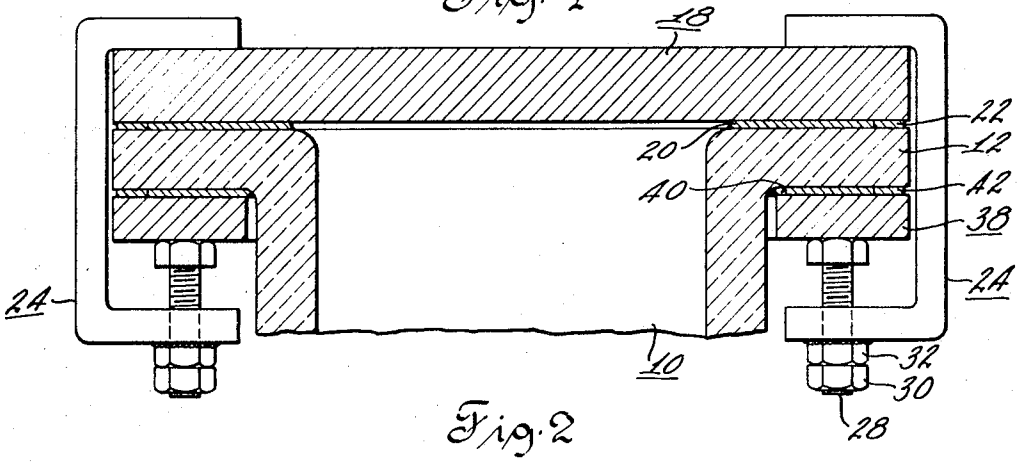


Fig. 2

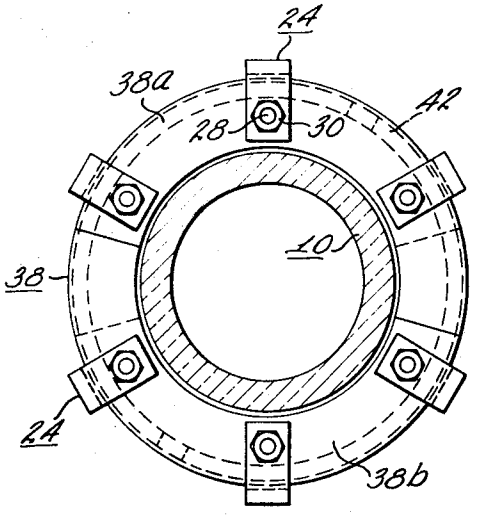


Fig. 3

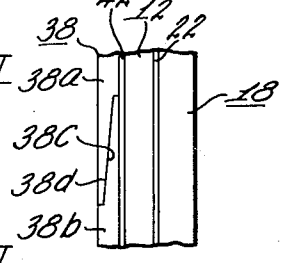


Fig. 4

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MEANS FOR PROVIDING HERMETIC SEALS

This is a division of application Ser. No. 691, 421, filed Dec. 18, 1967, now abandoned.

SUMMARY OF THE INVENTION

This invention relates generally to improved means for providing hermetic seals. More particularly, it relates to metal-to-glass seals for evacuated containers.

Some high voltage vacuum switches employ a hollow cylindrical container of ceramic or glass in which electrical contacts are housed and the container ends are closed by disk like metal end plates which are hermetically sealed to the container. Formerly, for example, if the seal was permanently made, subsequent separation for inspection and repair was impossible. On the other hand, if releasable seals such as O-ring gaskets were used, they deteriorated and introduced contaminants into the vacuumized container. Further, the use of finely ground mating surfaces required extensive, accurate and costly machining processes. Finally, various types of cements and solder have not always proven satisfactory.

In accordance with the present invention, a resealable hermetic seal between similar and dissimilar materials, such as glass-glass or glass-metal, is provided by means of a pure or indium coated aluminum gasket which is disposed between the two materials and subjected to pressure of about 5,000 pounds per inch length of gasket and heated to about 482°F or above. Pressure is applied and maintained by suitable clamping means which can be removed when the seal is to be broken.

In accordance with a preferred embodiment of the invention, there is provided a tube made of frangible material such as glass having an opening and at least one outwardly flanged end which is hermetically sealed by means of a pure or indium coated aluminum gasket which is squeezed at about 5,000 pounds per linear inch between the glass flange and a metal closure plate and heated to about 482°F or above. Pressure is applied and maintained by C-clamps which grip the closure plate and a split ring collar surrounding the glass tube. An aluminum cushioning gasket is disposed between the collar and the glass flange to prevent glass fracture. Steel spacer shims surround both gaskets to prevent extrusion of the gaskets under pressure.

OBJECTS

It is an object of the present invention to provide improved means for providing hermetic seals which can be subsequently unsealed and resealed.

Another object is to provide hermetic seals of the aforesaid character which are useful to join similar materials, such as glass-glass or metal-metal, or to join dissimilar materials such as glass-metal.

Another object is to provide hermetic seals of the aforesaid character which are especially well adapted to seal off cavities in which an uncontaminated high vacuum is to be maintained.

Another object is to provide hermetic seals of the aforesaid character which are applicable to make a seal between the end of a hollow glass tube and a disk type metallic end plate.

Another object is to provide an improved resealable hermetic seal for use on vacuum type electric circuit interrupters.

Other objects and advantages of the invention will hereinafter appear.

DRAWINGS

The accompanying drawing illustrates a preferred embodiment of the invention, but it is to be understood that the embodiment illustrated susceptible of modifications with respect to details thereof without departing from the cope of the appended claims.

In the drawing:

FIG. 1 is a cross sectional view showing one end of a hollow cylindrical glass container with an end plate and sealing means associated therewith prior to formation of a hermetic seal;

FIG. 2 is a view similar to FIG. 1 but showing the components after formation of the hermetic seal;

FIG. 3 is an end elevational view, reduced in scale, of the structure shown in FIGS. 1 and 2; and

FIG. 4 is a detailed view taken along line IV—IV of FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1 of the drawing, the numeral **10** designates a portion of a hollow cylindrical glass container or body which, for example, could be part of the housing of a vacuum type electric circuit interrupter. Container **10** has an opening at least at one end and is provided at that one end with an outwardly extending annular flange **12** which is provided with an upper surface **14** and a lower surface **16.** Flange **12** is shown as continuous but it is to be understood that it could take the form of separate projections.

A closure member or end plate **18** having surfaces **19** and **21** is disposed adjacent the end of container **10** and is of sufficient size so as to overlie a substantial portion of surface **14** of flange **12.** In a practical embodiment of a vacuum circuit interrupter, end plate **18** is preferably metallic for electrical and mechanical reasons but it could be made of other material such as glass. Preferably, end plate **18** is made of stainless steel and its surface **19,** at least near the periphery, is machined to a 10 micro-inch surface finish.

A gasket **20** formed into a ring by fusing together the ends of a length of wire is disposed between end plate **18** and surface **14** of flange **12** of container **10.** In accordance with one aspect of the invention, gasket **20** is pure aluminum which has been chemically cleaned to remove insofar as possible any oxide coating which may have formed thereon. In accordance with another aspect of the invention, gasket **20** may be pure aluminum which is provided with a coating of indium which flows under pressure to help fill any imperfections or voids which may exist on the aluminum or on the surfaces **19** or **14.**

A first spacer shim **22** is also disposed between the surface **19** and **14** around the outer periphery of gasket **20** to prevent inadvertent extrusion of gasket **20** under pressure. In practice, shim **22** is preferably formed by punching from steel shim stock which is on the order of 0.01 inch to 0.004 inch thick, if gasket **20** is on the order of the diameter of No. 20 size wire.

Referring to FIGS. **1, 2** and **3,** means are provided to exert evenly distributed clamping pressure on flange **12** of container **10** and end plate **18** so that gasket **20** is subjected to a pressure of about 5,000 pounds per inch of gasket length. Such means take the form of a plurality of clamps **24,** each of which comprise a C-shaped

body 26 and an adjustable threaded bolt 28 having a pair of nuts 30 and 32 associated therewith. As will be understood, bolt 28 extends through an unthreaded hole 34 in clamp body 26 and takes up into nut 32 which is understood to be rigidly secured as by welding to body 26. In practice, lock nut 30 is loosened and bolt 28 is turned to move it the desired distance and to exert the required pressure. Then, lock nut 30 is moved up tight against nut 32 to prevent inadvertent movement of bolt 28.

In practice, it is undesirable that the heads of the bolts 28 bear directly against glass flange 12 of container 10, as this would damage the glass. Accordingly, means are provided for cushioning and take the form of a collar 38 which fits around container 10 adjacent surface 16 of flange 12 thereof. For convenience, collar 38 is made in two sections 38*a* and 38*b*, as FIGS. 3 and 4 show, so that it need not be slipped onto container 10 axially. Preferably, collar 38 is metallic and its sections 38*a* and 38*b* have overslipping and interlocking surfaces 38*c* and 38*d*, respectively, which prevent the ends from riding up on one another under compression.

A gasket 40, similar to gasket 20, is disposed between collar 38 and surface 16 of flange 12 of container 10 to effect even distribution of pressure on glass surface 16. A shim 42, similar to shim 22 is provided around gasket 40 to prevent extrusion of gasket 40 under pressure. The clamping arrangement should be flexible enough to allow for internally caused expansion and contraction of dissimilar materials.

During fabrication, the aforedescribed assembly shown in FIG. 1 is subjected to pressure caused by tightening the clamps 24 until the requisite amount of force (about 5,000 pounds per linear inch of gasket 20) is applied and the components assume the configuration and positions shown in FIG. 2. At this point, however, no "cold-welding" or true bonded state exists between gasket 20 and metal surface 19 of plate 18 and gasket 20 and glass surface 14 of flange 12 of container 10. However, when the assembly is baked at a emperature of about 482°F (250°C) or above, the aluminum of gasket 20 adheres to the mating surfaces. The strength of the joint rises with temperature, and when the temperature exceeds 842°F (450°C), there is an intermetallic alloy formed.

Heat is applied for a length of time sufficient to raise the interior of the aluminum gasket to the specified temperature, i.e., for about 10 minutes for gaskets of the size hereinbefore specified.

A joint in accordance with the present invention can withstand a squarely applied separating force of about two tons without separating or breaking.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. In combination;
a tubular frangible body having an opening at one end;
radial outwardly extending flange means on the exterior of said body adjacent the opening at the one end;
a closure member overlying the opening of said body in registering engagement with said flange means;
a first aluminum gasket disposed on said flange means and surrounding the opening in said body, said gasket being constructed and arranged to abut the surface of said closure member adjacent to said flange means;
a cushioning collar surrounding said body and disposed adjacent to the undersurface of said flange means;
a second aluminum gasket disposed between said cushioning collar and said flange means; and,
removable pressure exerting means operably connected to apply oppositely acting forces to said closure member and to said cushioning collar;
whereby both of said aluminum gaskets are compressed into vacuum tight sealing engagement with the surfaces they engage.

2. The combination according to claim 1 wherein there is also provideda first circular shim disposed between said flange means and said closure member and surrounding said first aluminum gasket; and,
a second circular shim disposed between said cushioning collar and said flange means and surrounding said second aluminum gasket;
whereby said shims operate to limit the extrusion of said gaskets to a predetermined amount.

3. The combination according to claim 1 wherein said cushioning collar is constructed in two sections wih the ends of the sections being formed with mating overslipping and interlocking surfaces.

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