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DIELECTRIC WINDOW STRUCTURE

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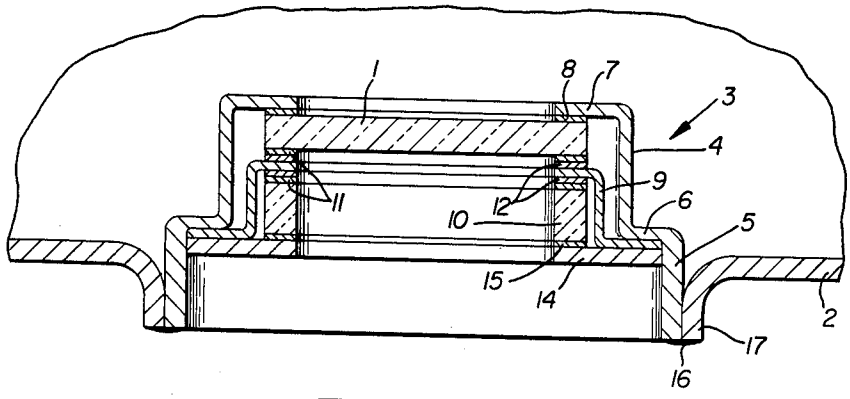


Fig. 1

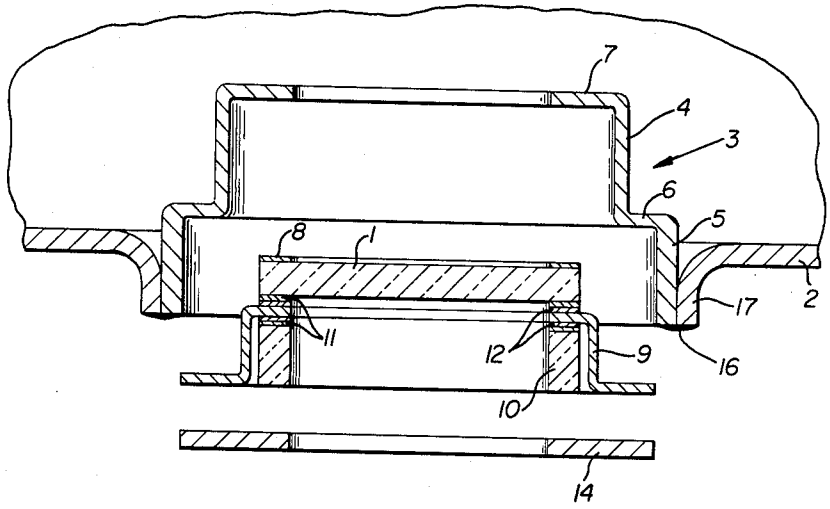


Fig. 2

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DIELECTRIC WINDOW STRUCTURE

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This invention relates to dielectric windows; and more particularly to dielectric windows hermetically sealed to metal members.

In many devices employed in modern technology, it is necessary to provide electrical or optical windows of dielectric material in metal walls, such as the electrical windows in resonant cavities or waveguides, and the optical windows in vacuum furnaces. In many cases, such as the mentioned examples, it is not only necessary that the seal between the dielectric and metal members be hermetic, but it is also necessary that the members have a strong mechanical connection.

Accordingly, an object of the present invention is to provide a hermetically sealed window structure having improved mechanical strength.

Another object of the invention is to provide a hermetically sealed window structure wherein either side of the window can be the low pressure or vacuum side of the window.

A further object of the invention is to provide a hermetically sealed window structure in which quartz can be employed as the window material.

An additional object of the invention is to provide a tubular hermetically sealed window assembly which can be easily connected to a main metal member which requires a window.

By way of brief description a preferred embodiment of the improved window structure comprises a metal shell and a disk-shaped quartz window. The shell has an inturned flange against which said window rests in sliding abutment. A deformable sealing ring has one edge bonded to the window and the other edge bonded to the metal shell. A quartz backing ring is preferably employed to reinforce the connection between the sealing ring and the window. Where particular rigidity is required or where the inside of said shell is exposed to low pressure, said shell is provided with another inwardly projecting flange against which said backing ring rests.

Other and further objects and features of advantage will be apparent from the following detailed description wherein reference is made to the accompanying drawings in which:

FIGURE 1 is a vertical cross-sectional view illustrating a window structure according to the invention; and

FIGURE 2 is a cross-sectional view similar to FIGURE 1 but showing a partially exploded arrangement of the parts.

Referring in more detail to the drawings, FIGURE 1 shows a completed window structure according to the invention. In this specific embodiment, a dielectric window 1 is shown in an envelope 2 of a conventional piece of equipment. The envelope 2 is normally of metal and the window normally has a circular disk shape. If the window is for optical purposes, it must, of course, be transparent. Quartz is transparent with excellent optical properties, as well as excellent electrical properties, and is, therefore, a preferred material for window 1. The window is supported in a metal shell 3 having a small diameter end 4 and a large diameter end 5 interconnected by an annular shoulder 6. The small diameter end of shell 3 has an inturned flange 7 against which an annular portion of one face of window 1 is in sliding abutment. The slidability is preferably enhanced by a coating 8 of "Aquadag," a colloidal dispersion of graphite in water.

The window 1 is sealed to the metal shell 3 by a thin, deformable sealing ring 9 preferably of gold. Ring 9 is bonded to window 1 and to the upper end of a backing ring 10 which is preferably of the same material as the window, again preferably quartz. When the backing ring is made of the same material as the window, the backing ring and window will of course both have the same thermal coefficient of expansion. The purpose of the backring 10 is to help overcome or restrain the sealing ring 9 so that the sealing ring will not break its bond with the window upon heat cycling. The bonds between the sealing ring 9 and the adjacent quartz members are preferably conventional pressure seals. In order to facilitate the bonds between the quartz members 1 and 10 and the gold ring 9, the quartz members are each metalized, for example, with a primary molybdenum layer 11 followed by a gold coating 12. The molybdenum and gold layers are deposited in conventional manner as by vapor deposition. The main function of the gold layer, as is well known in the art, is to prevent oxidation of the molybdenum. The lower end of the sealing ring 9 is bonded to shell 3, preferably on shoulder 6 and preferably by a pressure seal. In one example, shell 3 is "Kovar" copper plated on the shoulder.

In order to relieve the thin flexible ring 9 of all need to resist axial or tilting motion of window 1 relative to shell 3, an abutment ring 14 is secured to shell 3 in abutment with the lower end of the backing ring 10. The contact between the backing ring and the abutment ring is preferably a sliding contact. Accordingly, the backing ring 10 is preferably given an "Aquadag" coating 15 to facilitate the slidability. It should be understood that the thickness of the coatings 8, 11, 12 and 15 is greatly exaggerated in order to be visible in the scale of the drawings. Ring 14 is preferably copper plated "Kovar" and can be brazed to the inner wall of the large diameter end 5 of the shell 3.

In order to fabricate the structure of FIGURE 1, the elements 1, 9 and 10 are preferably first bonded together under heat and pressure to form a subassembly or unit which is shown separately in FIGURE 2. This unit is then inserted into the shell 3, and the lower flange of ring 9 is pressure sealed to shoulder 6. Next, the abutment ring 14 is brazed in place, and finally the sleeve 3 is welded or brazed at 16 to the rim 17 of an opening in the envelope 2. In most installations the inside of the envelope 2 is evacuated so that the lower side of the window is the high pressure side. However, in view of the presence of the abutment ring 14, the upper side of the window can be exposed to high pressure. Thus, instead of the high pressure force being resisted by the weak, deformable gold sealing ring 9, it is transmitted through the backing ring and is resisted by the relatively strong abutment ring 14.

Although specific details of the present invention are shown and described herein, it is to be understood that modifications may be made therein without departing from the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. A window structure comprising a tubular metal shell having a large diameter end and a small diameter end interconnected by an annular shoulder, an inturned rim adjacent the end of said small diameter end, a dielectric window in said small diameter end and having one face in slidable contact with said rim, a backing ring having one end adjacent the other face of said window, a deformable sealing ring sandwiched between and bonded to said window and backing ring, said sealing ring having an outturned rim bonded to said shoulder, and an abutment ring secured to said shell and slidably contacting the other end of said backing ring.

2. A window structure as claimed in claim 1 in which said large diameter end is bonded to the wall of an aperture in a larger metal member.

3. A hermetic seal structure comprising a metal unit having two axially spaced flat annular surfaces, a dielectric unit having an annular portion fitting between said flat surfaces and having one face slidably abutting one of said flat surfaces, a flexible metal sealing ring bonded to said metal and dielectric units, and a backing ring between the other face of said annular portion and the other of said flat surfaces, said backing ring having a coefficient of expansion substantially equal to that of said window.

4. A hermetic seal structure comprising a metal unit and a dielectric unit, said metal unit having two axially spaced flat annular surfaces, said dielectric unit having an annular portion having opposite faces thereof slidably confined between said flat surfaces, and a flexible metal ring bonded to said metal and dielectric units.

5. A window structure comprising a tubular metal shell having an inwardly projecting flange thereon, a dielectric window in said shell and having one face in slidable contact with said flange, and a deformable sealing ring having one portion bonded to said window and a spaced portion bonded to said shell.

6. A window structure as claimed in claim 5 further comprising a backing ring, said one portion of the sealing ring being sandwiched between said window and said backing ring and bonded to said backing ring, and said backing ring having substantially the same coefficient of expansion as said window.

7. A window structure as claimed in claim 6 further comprising an abutment ring connected to said shell and abutting the end of said backing ring remote from said window.

8. A window structure comprising a metal member having a flat annular surface around an aperture, a disk-shaped dielectric window in slidable contact with said surface and covering said aperture, a backing ring on the side of said window opposite said surface, a deformable sealing ring having one portion sandwiched between and bonded to said window and said backing ring, said sealing ring having another portion spaced from said one portion and bonded to said metal member, said backing ring having a coefficient of expansion substantially equal to that of said window, and said metal member having a second flat annular surface abutting the end of said backing ring opposite said window.

9. A window structure comprising a tubular metal unit and a disk-shaped dielectric window unit, a deformable metal sealing ring having one portion bonded to said metal unit and a spaced portion bonded to said dielectric window unit, the periphery of said disk-shaped window being radially spaced from the inside of said tubular metal unit, said metal unit having two axially spaced support portions overlapping said disk-shaped dielectric unit on opposite sides of the dielectric unit, and each of said support portions being in non-bonded supporting engagement with its respective side of said dielectric unit, whereby said dielectric unit is substantially free to expand and contract radially with respect to said tubular metal unit but is substantially restrained axially by said supporting engagement.

10. A window structure comprising an apertured metal member, a disk-shaped dielectric window across said aperture, a deformable metal sealing ring having one portion bonded to said window and a spaced portion bonded to said metal member, the diameter of said window being larger than the diameter of said aperture whereby said window overlaps said metal member, said overlapping portion of said window being in non-bonded slidable association with said metal member, and said portion of the sealing ring which is bonded to said window being spaced from said metal member.

11. A window structure as claimed in claim 10 in which means are positioned between said overlapping portion of the window and said metal member to reduce the friction therebetween.

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