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D. ALPERT
WINDOW CONSTRUCTION
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Fig. 1.

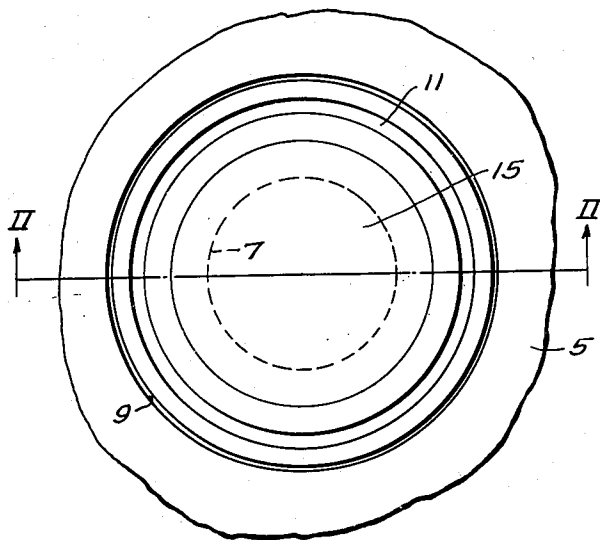


Fig. 2.

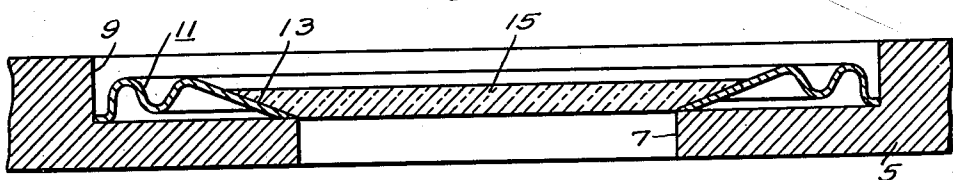
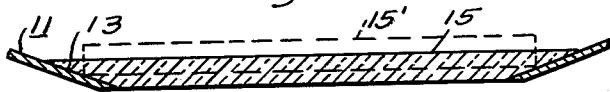


Fig. 3.



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WINDOW CONSTRUCTION

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2 Claims. (Cl. 189-77)

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This invention relates to a metal-supported glass window and to the method of making such a window.

In manufacturing various products, it is often necessary to provide a vacuum-tight glass window across an opening in a metal body having a coefficient of expansion considerably higher than that of the glass. In the field of ultra-high frequency electromagnetic energy, for example, it is desirable to have such a window across an opening in the body of a cavity resonator, as shown in my copending application, Serial No. 480,991, filed March 29, 1943 now Patent Number 2,525,486. The body of the cavity resonator, being formed necessarily of a highly conductive material such as copper or brass, has a high coefficient of expansion. As illustrated in my copending application, the window for such a body is formed of a flat metallic plate having an opening therein filled with glass of substantially the same thickness as the plate with a glass-to-metal seal at the edges of the opening. The metallic plate is formed of an alloy having substantially the same coefficient of expansion as the glass and is rigidly secured with a vacuum-tight joint to the body.

The prior arrangement just described is quite satisfactory under many conditions. However, even greater efficiency is desired in the large scale manufacture of windows than is provided by known methods of producing windows of this type. When high-frequency heating is employed in making the glass-to-metal seal in such a window, the glass of the window is invariably asymmetrical and the sides thereof are not substantially flat. Such a glass window causes a difference in the amount of electromagnetic energy passing through different parts of the window, increases the mechanical difficulties in mounting the window, and renders the window more susceptible to failure under stress. Moreover, when this prior arrangement is subjected to a considerable temperature change, the difference in the expansion of the body and the glass causes an appreciable stress to be placed through the metallic plate on the glass and the glass-to-metal seal, tending to cause a breakage thereof.

It is accordingly an object of my invention to provide a new and improved metal-supported glass window.

Another object of my invention is to provide

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a new and improved metal-supported glass window which may be readily and efficiently manufactured in large quantities.

A further object of my invention is to provide a novel metal-supported glass window adapted to be rigidly mounted on a body having a coefficient of expansion substantially higher than that of the glass.

Still another object of my invention is to provide a novel method of forming a metal-supported glass window.

The features of my invention which I consider novel are set forth with particularity in the accompanying claims. The invention itself, however, together with additional objects and advantages thereof, may be better understood from the following description of a specific embodiment when read in connection with the accompanying drawing, in which:

Figure 1 is a plan view of a metal-supported glass window embodying my invention, as mounted on a body having a high coefficient of expansion;

Fig. 2 is an enlarged cross-sectional view taken along line II—II of Fig. 1; and

Fig. 3 is a partial view in section of the window of my invention illustrating the position of the glass before and after sealing to the metal support.

As shown in the drawings, a window is provided for use with a metal body 5 having a high coefficient of expansion. By a high coefficient of expansion I mean one greater than that of a suitable glass so as to preclude a satisfactory glass-to-metal seal between the glass and body for the purposes desired. The body 5 has an opening 7 therein and may also have an annular recess 9 provided about the opening 7 on the outer side of the body in which recess the window is mounted across the opening.

The window comprises a relatively thin metallic frame 11 having a central opening therein. The plate is formed to have the opening bounded by a surface 13 which inclines away from the center line of the opening by an angle of the order of 70 degrees. A flat plate-like glass member 15 is mounted across the opening in the frame 11 and has its edges conforming with, and sealed to, the inclined surface 13. The frame 11 is provided with deep annular corrugations be-

tween its outer periphery and the glass-to-metal seal, the corrugations having a depth up to ten times the thickness of the metal of the frame which is relatively thin so that the frame is flexible between the seal and its outer periphery. The frame 11 is rigidly secured to the body 5 by soldering thereto all around the outer periphery of the frame. With a vacuum-tight glass-to-metal seal and with a vacuum-tight joint between the frame 11 and the body 5, a vacuum may be established on the lower side of the body as in Fig. 2 which would tend to draw the window down against the bottom of the recess 9.

The frame 11 is preferably formed of an alloy comprised essentially of nickel, cobalt and iron, a preferred composition having approximately 23% to 34% nickel, 5% to 25% cobalt with substantially all of the remainder being iron. With this alloy, a borosilicate glass which is suitable for sealing with the alloy and having substantially the same coefficient of expansion as the alloy is employed. Seals between an alloy comprised essentially of nickel, cobalt and iron and a borosilicate glass as may be here employed are described in detail in the Scott Patent No. 2,217,421 of October 8, 1940.

In manufacturing the window, a sheet of alloy is first stamped and punched to form the frame 11 having the opening bounded by the inclined surface with the corrugations between the inclined surface and the outer periphery of the frame. Then the frame is supported with the center line of the opening therein substantially vertical and the inclined surface facing upward. A substantially flat plate-like glass member is placed on top of the frame across the opening therein as illustrated by the dotted line member 15' of Fig. 3. The glass member 15' is substantially uniform in thickness with its edges at right angles to the sides thereof, the glass having the same general configuration but being larger than the opening in the frame whereby the corners formed by the edges and lower side of the glass member 15' rest on the inclined surface 13 with the lower side above the lower extremity of the inclined surface 13 by a vertical distance substantially no less than one-half the thickness of the glass member. Thereafter the frame may be heated by any suitable method, such as by high-frequency heating. As the frame is heated, the portion of the glass engaging and adjacent to the frame begins to melt and the glass member slides downward. By the time the glass member reaches the horizontal position shown by the solid line member 15 in Fig. 3, the edges of the glass member conform with and engages the inclined surface of the frame as shown. At this time, heating of the metallic plate is stopped and the glass-to-metal seal at the inclined surface is completed.

It is to be noted that the angle of the inclined surface 13 of the frame is of importance in determining the cross-sectional configuration of the glass member 15 after the seal is made. I have discovered that using the alloy and the glass mentioned with the inclined surface 13 at an angle of the order of 70 degrees to the vertical, the force of gravity, the surface tension between the metal and the glass, and such other factors as may affect the action of the glass, combine to enable production of the glass-to-metal seal as described with each side of the glass member substantially flat over its entire surface at the completion of the seal. This permits uniform passage of electromagnetic energy through the glass

and makes it possible to fit the window accurately with other machined metal parts. In addition, the area of the glass-to-metal seal is very large with respect to the thickness of the glass member which adds considerably to the strength of the seal and window.

Along with the added strength of the window, the provision of a frame which is flexible between the glass and the points at which the frame is secured to the body results in greatly increased protection against failure of the window under temperature change. By this arrangement, relative movement of the body 5 and the glass member 15 caused by temperature changes is absorbed in the flexible frame 11.

It is to be noted particularly that the frame is flexible radially from the center of the opening therein. Consequently, the window may be placed within a recess, as shown in Fig. 2, to permit fitting of the body to other rigid parts of a system, and expansion and contraction of the body radially with respect to the window is taken up in the flexible frame. I have found that in such window of the approximate proportions shown in Fig. 2, in which the frame has an outer diameter of the order of $\frac{5}{8}$ inch and the opening therein has a diameter of the order of $\frac{3}{8}$ inch, the outer diameter of the frame may be changed by as much as ± 0.01 inch without damaging the seal or glass. While I have illustrated the frame as having a circular outline and with a circular opening, other shapes may, of course, be used.

It is also to be noted that the frame for the window may be easily formed in a punching operation and the use of the inclined surface eliminates the need for any rounding or polishing of the frame in preparation for the sealing operation. Moreover, high-frequency heating may be efficiently used in making the seal so that the entire window may be readily and inexpensively manufactured.

While I have shown and described a preferred embodiment of my invention, I am aware that many modifications thereof may be made without departing from the spirit of the invention. It is not my intention, therefore, to limit the invention to the specific arrangement disclosed.

I claim as my invention:

1. A metal supported glass window for use with a body of a material having a high coefficient of expansion, comprising a frame of an alloy comprised essentially of nickel, cobalt and iron, said frame having an opening therethrough bounded on one side of the frame by a boundary surface inclined away from the center line of said opening at an angle of the order of 70 degrees, and a glass plate member extending across said opening substantially perpendicular to said center line with the peripheral edges thereof conforming with and sealed to said boundary surface, said glass member being of a borosilicate glass having substantially the same coefficient of expansion as said alloy which is lower than that of said body, said frame being adapted to be rigidly secured to said body at a plurality of points about but spaced from said boundary surface and being flexible between said points and boundary surface to permit relative movement between said glass member and body with temperature changes.

2. A metal supported glass window comprising a frame of a sheet of an alloy comprised essentially of nickel, cobalt and iron and having an opening therethrough, said frame having a shape

providing a boundary surface about said opening on one side of the frame which is inclined away from the center line of said opening at an angle of the order of 70 degrees and also providing corrugations surrounding said boundary surface whereby said frame is flexible in the region of said corrugations, and a borosilicate glass plate extending across said opening perpendicular to said center line with the peripheral edges thereof conforming with and sealed to said boundary surface, said glass having substantially the same coefficient of expansion as said alloy.

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