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ELECTROMAGNETIC WAVE PERMEABLE WINDOW INCLUDING CENTER CONDUCTOR THEREFOR

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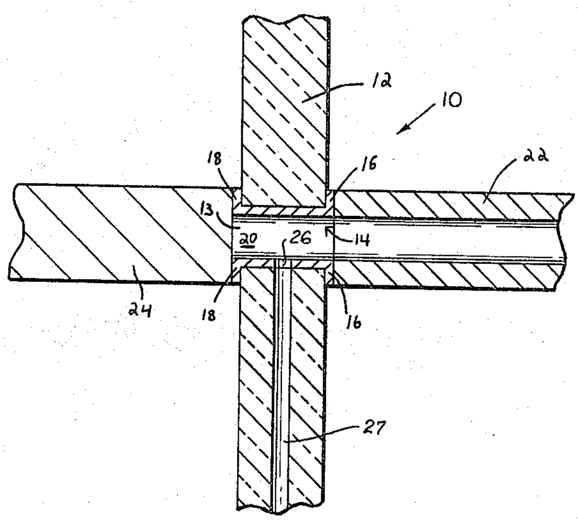

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ELECTROMAGNETIC WAVE PERMEABLE WINDOW INCLUDING CENTER CONDUCTOR THEREFOR

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This invention relates generally to electromagnetic wave permeable windows and, more particularly, relates to electromagnetic wave permeable windows having improved center conductors especially useful in coaxial waveguide assemblies.

It is well known to use dielectric windows made of materials such as alumina, beryllia, silica, etc. to permit electromagnetic wave energy to pass therethrough and, in addition, to maintain vacuum conditions such as exist within various electron tubes including klystrons and traveling wave tubes. Dielectric windows used in both input and output waveguide assemblies for such electron tubes permit input electrical energy to be supplied thereto and output electrical energy to be extracted therefrom.

Some input or output waveguide assemblies utilize a coaxial waveguide arrangement which includes a dielectric window containing a center aperture for the insertion therethrough of the center conductor for the coaxial waveguide arrangement. The center conductor of the coaxial waveguide arrangement has generally been a cylinder of high electrically conductive material such as copper which had to be bonded to the dielectric window in a vacuum tight manner so as to prevent loss of the existing vacuum within the electron tube.

Ceramic or glass-to-metal seals, depending upon whether ceramic or quartz windows were used, were required to create a vacuum tight connection between the outer surface of the center, cylindrical, metal conductor and the circular portion of the dielectric window defining the center aperture.

The use of such peripheral seals had two major disadvantages. One disadvantage was the requirement that a metallized coating had to be deposited on the circular portion of the dielectric window defining the center aperture in order to secure a good bond between the center conductor and the window. This intermediate metallized layer was necessary, as a copper center conductor would not adhere well to an unmetallized dielectric window and thus not provide an adequate vacuum tight bond. Therefore, a great deal of care was required to insure that the entire center aperture of the dielectric window had enough metallization thereon to insure a good vacuum tight bond along and about the specific length of the center conductor that had to be sealed. The coefficients of expansion between the copper center conductor and the dielectric window are substantially different thereby making peripheral seals for a cylindrical center conductor more difficult to make especially in situations where the center copper conductor became excessively hot during use in supplying energy to or in extracting energy from an electron tube. The longitudinal and cylindrical expansions and contractions of the copper center conductor caused rupture of the dielectric-to-metal seals and hence, resulted in the loss of vacuum and consequential nonoperability of very expensive electron tubes.

The second major disadvantage that existed previously with the prior art technique of sealing a cylindrical copper center conductor to a dielectric window was the high R.F. loss caused by the lossy metallized layer that was located intermediate the copper center conductor and the dielectric window. Since the electromagnetic wave energy in a coaxial waveguide assembly travels between the center and outer conductors, the metallized layer located about the center conductor created a substantial R.F. loss problem. In addition, the metallized layer can also serve to provide an undesirable source of electrons that could create arcing problems which may result in the puncture of the dielectric window and thereby destroy its utility.

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Accordingly, it is an object of this invention to provide an improved electromagnetic wave permeable window including center conductor therefor.

It is another object of this invention to provide an improved electromagnetic wave permeable window.

It is a still further object of this invention to provide an improved center conductor and dielectric window combination especially useful in a coaxial waveguide assembly.

Briefly described, this invention relates to an electromagnetic wave permeable window having an aperture located substantially in the center thereof. A reel shaped electrically conductive coating is provided in the center portion of the window. One electrically conductive flange portion located on one side of the dielectric window and disposed about the center aperture, another electrically conductive flange portion located on the other side of the dielectric window and disposed about the center aperture, and a cylindrical, electrically conductive portion disposed on the portion of the dielectric window defining the center aperture and connected to each of the flange portions make up the reel shaped electrically conductive coating.

If desired, a first conductor can be connected to one of the electrically conductive flange portions and a second conductor can be connected to the other of the flange portions thereby extending the center conductor as long as necessary. Either one or both of the conductors can be hollow and at least one aperture can be provided in the cylindrical, electrically conductive portion of the reel shaped coating which should be in line with or communicate with an aperture in the dielectric window extending radially from the cylindrical, electrically conductive portion of the reel shaped coating thereby providing an arrangement for facilitating fluid cooling of both the window and the center conductor.

These and other objects of this invention will be readily ascertained after consideration of the following description read in conjunction with the attached drawing in which:

The sole figure is an elevational cross-sectional view of the improved dielectric window and center conductor combination of this invention.

Referring to the sole figure, numeral **10** generally designates the improved dielectric window and center conductor combination of this invention which is particularly useful in a coaxial waveguide assembly the outer conductor of which is not shown. Dielectric window **12** is shown preferably having a disc or cylindrical configuration and made of any suitable dielectric material useful in permitting electromagnetic wave energy to permeate therethrough. The dielectric window **12** is provided with a center aperture **13** which extends completely through the width of the window **12**.

A reel shaped, electrically conductive coating generally designated by numeral **14** is associated with the center aperture **13** of the window **12**. The reel shaped, electrically conductive coating **14** consists of one electrically conductive flange portion **16** located on one side of the dielectric window **12** and disposed about the center aperture **13**. Another electrically conductive flange portion **18** is located on the other side of the dielectric window **12** and is also disposed about the center aperture **13**. A cylindrical, electrically conductive portion **20** disposed on the portion of the dielectric window 12 defining the center aperture 13 and connected to both flange portions 16 and 18 forms therewith the reel shaped, electrically conductive portion 14.

The reel shaped, electrically conductive portion 14 consists preferably of a single layer of a high electrically conductive metal. For example, the desired reel shaped coating configuration can be of molybdenum which can be evaporated onto a ceramic window heated in the temperature region of 500° C. to 1,000° C. employing filamentary evaporation sources and a resistance furnace. A vacuum of better than 5×10^{-6} torr is maintained during the evaporation process. The ceramic surface that is to be metalized can be ground or prepared by standard diamond grinding techniques. In addition, the ceramic surface is cleaned using normal water detergent solution followed by firing in air at 1000° C. Before the evaporation step, the surface is preferably further cleaned with a plasma arc when the vacuum is of the order of 100 microns in the evaporator. Vacuum tight coatings of molybdenum up to 10 microns thick may be deposited.

The resultant high, electrically conductive, metalized, reel shaped coating 14 can be vacuum tight brazed at flange portions 16 and 18 to a first 22 and a second 24 conductor, respectively. The first conductor 22 is shown preferably hollow whereas the second conductor 24 is shown to be solid. The first and second conductors can both be hollow or solid or the second conductor 24 can be hollow and the first conductor 22 can be solid, if desired.

In some situations, it may be desirable to fluid cool the dielectric window 12 for extracting excess heat therefrom. In addition, passing a cooling fluid such as glycol within a dielectric window is also known to remove unwanted ghost modes. Accordingly, at least one aperture 26 is provided in the hollow, cylindrical, electrically conductive portion 20 which is lined up with or in communication with an aperture 27 in the dielectric window 12 that extends radially from the aperture 26, preferably, to the outer conductor of the coaxial waveguide assembly so that the cooling fluid can be supplied to the radial aperture in the dielectric window 12 through a suitable opening in the outer conductor.

In addition, hollow conductor 22 can also be fluid cooled since the hollow portion of the conductor 22 communicates with the center aperture 13 of the dielectric window 12. Therefore, in situations where it is desirable to fluid cool a center conductor that extends into either an input or output cavity of a klystron to prevent excess heating and possible melting or distortion of the center conductor due to electron bombardment thereof the dielectric window 12 and center conductor fluid coupling arrangement shown in the sole figure is especially useful.

Many variations and embodiments can be made of the arrangement shown in the sole figure. Two or more radially extending apertures can be used in the dielectric window 12 each of which can communicate with individual apertures in the cylindrical, electrically conductive portion 20. Furthermore, inlet and outlet fluid passages can be incorporated in the conductor 22 by means of baffles located therein and communicating with inlet and outlet apertures in the dielectric window. Therefore, the specific embodiment shown and described herein should not be construed in a limiting sense, but the following claims are intended to encompass this invention.

I claim:

1. In a coaxial wave guide assembly the combination comprising an electromagnetic wave permeable dielectric window having an aperture located substantially in the center thereof; a reel shaped, electrically conductive coating comprising one electrically conductive flange portion located on a portion of one side of and in contact with said dielectric window and disposed about said center aperture, the other electrically conductive flange portion of said reel shaped, electrically conductive coating located

on a portion of and in contact with the other side of said dielectric window and disposed about said center aperture, and a cylindrical, electrically conductive portion disposed on the portion of said dielectric window defining said center aperture and connected to each of said electrically conductive flange portions; a first conductor connected to said one electrically conductive flange portion of said reel shaped, electrically conductive coating; and a second conductor connected to said other electrically conductive flange portion of said reel shaped, electrically conductive coating.

2. The combination according to claim 1, in which said cylindrical electrically conductive portion of said reel shaped electrically conductive coating being hollow and provided with at least one aperture located between said flange portions of said reel shaped electrically conductive coating, said dielectric window having an aperture communicating with said aperture in said hollow cylindrical electrically conductive coating portion of said reel shaped electrically conductive coating, said first conductor being hollow and communicating with said hollow cylindrical electrically conductive portion of said reel shaped electrically conductive coating.

3. An electromagnetic wave permeable window comprising, in combination, a dielectric window having an aperture located substantially in the center thereof; and a reel shaped, electrically conductive coating comprising one electrically conductive flange portion located on a portion of one side of and in contact with said dielectrc window and disposed about said center aperture, the other electrically conductive flange portion of said reel shaped, electrically conductive coating located on a portion of the other side of and in contact with said dielectric window and disposed about said center aperture, and a cylindrical, electrically conductive portion disposed on and in contact with the portion of said dielectric window defining said center aperture and connected to each of said electrically conductive flange portions.

4. An electromagnetic wave permeable window comprising, in combination, a dielectric window adapted to transmit electromagnetic wave energy therethrough, and a high electrically conductive, electromagnetic wave guiding coating located on and penetrating through said window, said coating being deposted on said window and having a cylindrically conductive portion and two outwardly directed conductive flange portions integral with and closely surrounding said cylindrically conductive portion at opposite ends thereof, said two outwardly directed flange portions being directed away from the center axis of said dielectric window.

5. An electromagnetic wave permeable window comprising, in combination, a dielectric window adapted to transmit electromagnetic wave energy therethrough, a high electrically conductive, electromagnetic wave guiding coating located on and penetrating through said window, said coating having a cylindrically conductive portion and at least one conductive flange portion connected to said cylindrically conductive portion, an aperture loated in said cylindrically conductive porton, and an aperture in said dielectric window communicating with the aperture in said cylindrically conductive portion whereby fluid cooling of the dielectric window and cylindically conductive portion is permitted.

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