July 16, 1963 R. H. GORDON ET AL 3,098,207

OUTPUT WINDOW FOR ELECTRON TUBE APPARATUS

Original Filed Nov. 14, 1955

FIG. 1

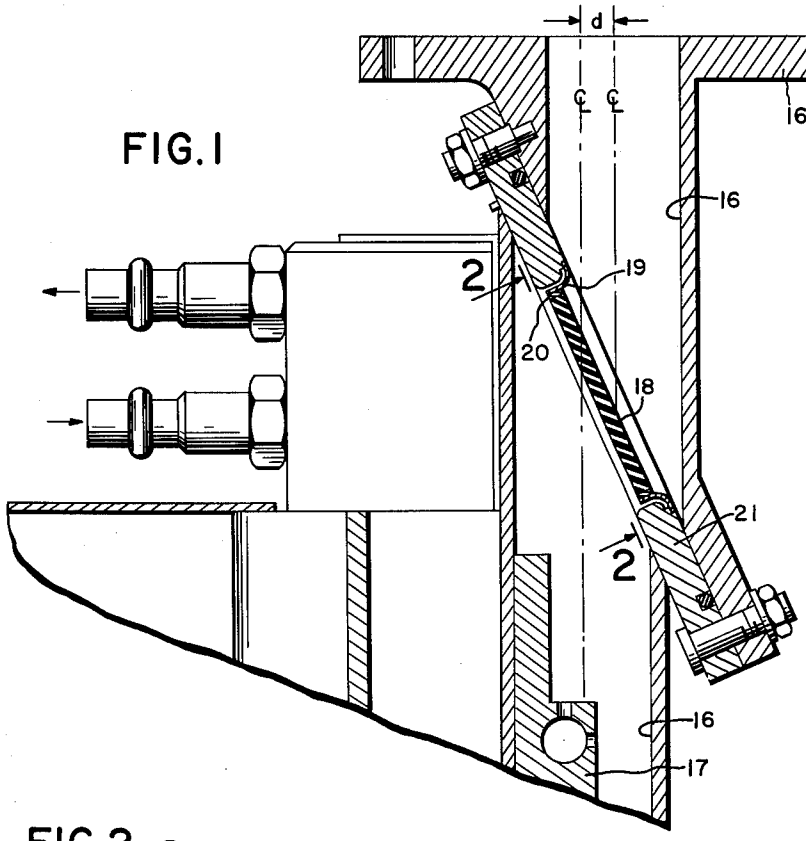


FIG. 2

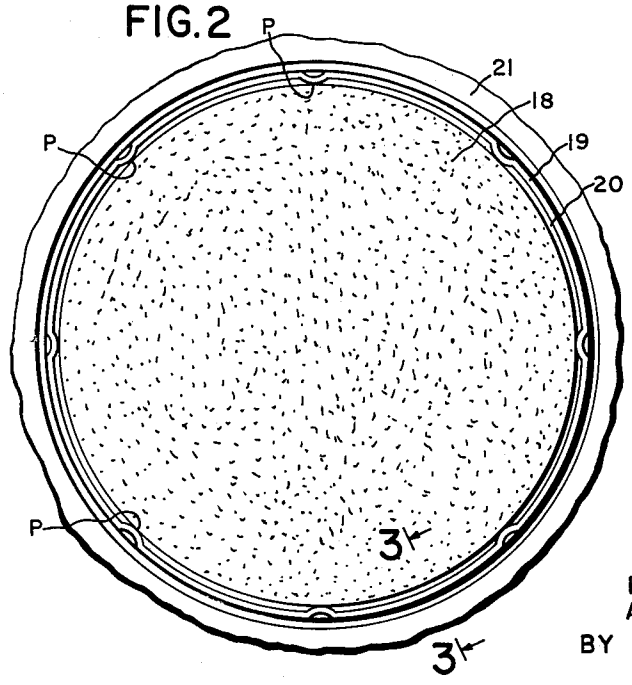
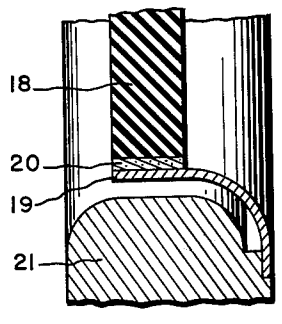


FIG. 3



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United States Patent Office 3,098,207 Patented July 16, 1963

3,098,207

OUTPUT WINDOW FOR ELECTRON TUBE APPARATUS

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Original application Nov. 14, 1955, Ser. No. 546,624. Divided and this application Apr. 4, 1960, Ser. No. 19,709

8 Claims. (Cl. 333—98)

This invention, a division of co-pending application, Serial No. 546,624, filed November 14, 1955, now Patent No. 2,939,036, relates to improvements in vacuum sealed radio frequency window structure useful, for example, in high power electron tube apparatus such as high power klystron tubes utilized in systems employed in radar, linear accelerators, navigation beacons, microwave transmission, etc.

The life of a high power tube, heretofore, has been seriously limited by the unreliability of output windows. Failure of the output window normally causes a leak allowing the vacuum within the tube to go up to atmospheric pressure thereby rendering the tube inoperative and permanently damaging the cathode necessitating its replacement.

It is, therefore, the principal object of the present invention to provide a novel output window cup which provides a precisely controlled metal-to-ceramic seal thereby substantially increasing the reliability and life of the output window.

Other features and advantages of the present invention will become evident upon a perusal of the following specification taken in connection with the accompanying drawings wherein:

FIG. 1 is a longitudinal cross sectional view of a vacuum sealed output window of the present invention shown mounted in the output waveguide of a high power electron tube,

FIG. 2 is a plan view of the window of FIG. 1 taken along line 2—2 looking in the direction of the arrows, and

FIG. 3 is an enlarged fragmentary cross sectional view of a portion of the window structure of FIG. 2 taken along the line 3—3 in the direction of the arrows.

The novel output window assembly shown in FIGS. 1, 2 and 3 comprises the disk-shaped output window **18**, as of aluminia ceramic, sealed to an annular flanged window cup **19**. The flanged portion of the window cup **19** is fixedly held by an apertured window frame member **21**. The window frame member **21** is secured transversely in the output waveguide **16** between the waveguide impedance transformer **17** and the output flange **16'**. The flanged window cup **19** has a plurality of indentations or dimples P equally spaced around its perimeter. The indentations extend inwardly a distance of approximately 0.003" and make physical contact with the metallized edge of the ceramic window **18** thus providing a 0.003" gap between the metallized ceramic and the window cup **19**. A solder alloy **20** such as, for example, copper-gold is disposed between the ceramic window and the window cup and alloys with the metallized ceramic and the window cup **19** thereby forming a vacuum-tight ductile seal. The window cup member **19** is made relatively thin, for example, approximately 0.020". The cup is made thin to prevent undue stress on the ceramic-to-solder-to-cup seal caused by differential coefficients of thermal expansion of the ceramic, solder and cup members.

The window cup **19** may be made of a ductile material as of, for example, copper or it may be made of a copper coated less ductile but stronger material as of, for example, iron or nickel. The copper coating is provided to assure high electrical and thermal conductivity of the

seal and cup member **19** whereby R.F. heating in the joint is minimized and in addition heat generated in the ceramic may be conducted away.

The thickness of the solder **20** must be accurately controlled because the forces exerted on the adjacent bonds between the jointed elements vary as the mass of the joined materials. For example, in the ceramic-to-cup joint as shown in FIG. 3, if the thickness of the solder **20** is allowed to become too thick, for example, in excess of 0.005", the force exerted as the temperature rises, in use, may cause a failure of the ceramic or a failure in the solder-to-ceramic or solder-to-cup bond. The indentations P have been provided to assure proper centering of the ceramic window **18** within the window cup **19** thereby controlling the solder thickness and preventing uneven solder thicknesses about the periphery of the ceramic window **18**.

The output waveguide **16** (FIG. 1) has been offset outwardly of the output window **18**. It has been found that power reflections from the window assembly are substantially eliminated over a broad band of frequencies by providing a certain amount of offset between the axial center lines of the segments of waveguide abutting the window assembly and the center of the circular window. In the present tube apparatus it has been found that an offset of approximately 0.325" substantially eliminates power reflections over the frequency range of the tube. However, the amount of offset required for different tubes will vary. The dimensions given here are to be considered only exemplary and not in a limiting sense.

In addition it has been found that power reflections from the window assembly may be further reduced by adjusting the geometric center of the dielectric window such that it is slightly radially displaced from the axial center line of the adjoining segment of waveguide **16** on the tube side of the window **18**.

The aforementioned offset waveguides and the radially displaced window member for obtaining a reflectionless R.F. match of the window assembly form the subject matter of and are claimed in a copending divisional application, U.S. Serial No. 277,332 titled "Electron Tube Apparatus" filed May 1, 1963, Richard B. Nelson, inventor. Such divisional application is a continuation application of divisional application, U.S. Serial No. 19,710, filed April 4, 1960, said latter divisional application being a divisional of a copending parent application U.S. Serial No. 546,624, filed November 14, 1955, now U.S. Patent 2,939,036. All of said aforementioned applications have been assigned to the same assignee as the present invention.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departure from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a high frequency apparatus, an apertured member through which electromagnetic energy is to pass, a wave-energy permeable member mounted on said member substantially closing the aperture, protuberances extending from the surface of said apertured member adjacent the wave permeable member whereby the spacing between said wave-energy permeable member and said apertured member may be accurately controlled, and a sealing material disposed between said wave permeable material and said apertured member whereby a vacuum-tight seal is provided between said members.

2. An apparatus as claimed in claim 1 wherein said wave permeable member and said apertured member are figures of revolution.

3. An apparatus as claimed in claim 1 wherein said protuberances are radially directed and circumferentially spaced indentations in said apertured member.

4. An apparatus as claimed in claim 3 wherein said apertured member is an annular window cup.

5. An apparatus as claimed in claim 4 wherein said wave-energy permeable member is made of an alumina ceramic having a metallized layer around its edge surface adjacent said apertured member, and said sealing material is a copper-gold solder.

6. An apparatus according to claim 4 further including an apertured support frame member for supporting said window cup within its apertured portion.

7. An apparatus according to claim 6 wherein said window cup includes an outwardly directed flanged portion for securing said window cup to said frame member in a vacuum tight manner.

8. An apparatus according to claim 7 wherein said window cup member is secured to said frame member

only at the outer end of said flanged portion whereby the remaining portion of the window cup member is spaced from said frame member.

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