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CERAMIC ELECTRON TUBE

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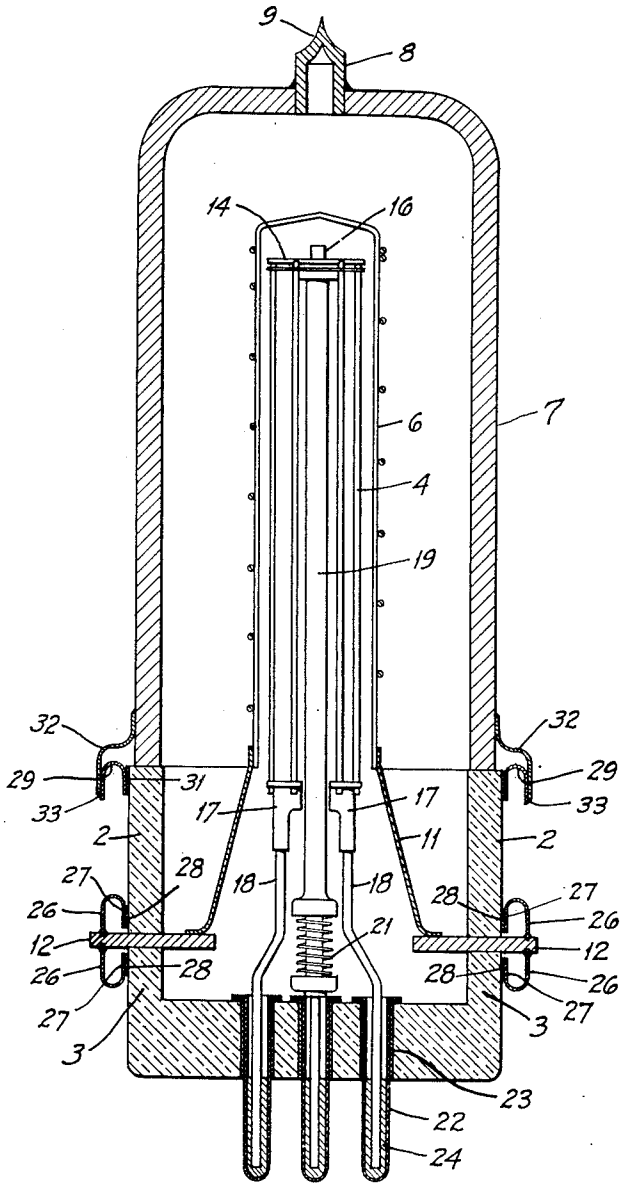

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CERAMIC ELECTRON TUBE

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My invention relates to electron tubes and more particularly to tubes having ceramic envelopes.

The principal object of my invention is to provide an improved joint structure connecting a ceramic envelope section to a metal part of the envelope.

Another object is to provide a structure of the character described, wherein a considerable difference in thermal expansions between the ceramic and metal parts may be tolerated without danger of destroying the vacuum-tight properties of the joint.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention, as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawing, the single figure is a vertical sectional view of a tube embodying the improvements of my invention.

My improved electron tube, illustrated as a triode, comprises a generally cylindrical evacuated envelope having ceramic wall sections 2 and 3, the lower section 3 being preferably cup-shaped and the upper section 2 being a simple cylinder. The ceramic used in making up the envelope sections may be any suitable ceramic-like material, preferably the more refractory compositions such as the alumina or zircon type ceramic bodies which have good mechanical strength, thermal resistance and electrical insulating properties.

The electrodes of the triode are coaxially arranged and comprise a cathode 4, grid 6 and anode 7. The latter is an external type of anode comprising a tubular cup-shaped metal piece, such as copper, forming part of the envelope. This anode is fastened to the upper ceramic section 2 and carries an exhaust tubulation 8 which is pinched off at 9 after evacuation of the envelope.

Grid 6 is of the wire cage type having a conical mount 11 and supported by a flat ring-shaped metal part 12 extending through the side wall of the envelope between ceramic sections 2 and 3. This metal part is preferably of copper and also functions as a terminal for the grid. Such a mounting arrangement on terminal ring 12 of adequate thickness provides a rigid support for the grid electrode.

Cathode 4 is preferably of the filamentary type, say of thoriated tungsten, with vertical wires connected at the top by a disk 14 slidable on a center rod 16, half of the wires being connected at the lower ends to a bracket 17 and the other half to a similar bracket at the opposite side. These brackets are mounted on downwardly extending rods 18. Tensioning means for the filament wires comprises a sleeve 19 on the center rod pressed upwardly against disk 14 by a spring 21.

Center rod 16 and side rods 18 project into metal sleeves 22 which extend through holes in the bottom wall of ceramic section 3. Such holes in the ceramic are metalized and sleeves 22 are secured in place by brazing

at 23. The pins in turn are likewise brazed in the sleeves at 24. Such arrangement provides adequate support for the pins, yet there is sufficient yield in the thin-wall mounting sleeves 22 so as to compensate for differences in thermal expansions between the metal and ceramic parts.

Important features of my invention have to do with the joint structures at the grid terminal and anode portions of the envelope, which improved joint structures also allow for differences in thermal expansions between the ceramic and metal parts without danger of destroying the vacuum-tight properties of the joints. This overcomes a real problem because metals of good electrical conductivity such as copper have relatively high coefficients of thermal expansion compared to ceramics. At the grid terminal I provide ring-shaped metal sealing flanges 26 extending in opposite directions from the terminal part 12, these flanges being brazed to the peripheral portions of the terminal and projecting in spaced overlapping relationship with the ceramic bodies. Such flanges are formed from relatively thin sheet metal such as copper, say about 20 mils thick, and are of U-shaped cross section having inturned portions providing lips 27 lying against the ceramic. The underlying surfaces of the ceramic are metalized, to which lips 27 are brazed at 28. It is to be noted that ceramic walls 2 and 3 are abutted against the ring-shaped terminal part 12, thus providing a firm seat for the ceramic walls to take the thrust imposed by atmospheric pressure when the envelope is evacuated.

The joint at the anode also incorporates a copper U-shaped sealing ring 29, the inner lip of which is brazed at 31 to the metalized periphery of ceramic section 2. A complementary flange 32 brazed to the anode fits over the outside of flange 29. This enables the lower portion of the tube, including the cathode and grid structures, to be completely assembled prior to putting on the anode. As a final step the anode is mounted in position with flange 32 engaged over flange 29, the lower registering edges being then brazed together at 33. At this joint it is also to be noted that ceramic section 2 abuts the metal anode part 7.

Thus at both the anode and grid terminal joints the thrust imposed by atmospheric pressure is adequately supported by a direct abutting relationship between the ceramic sections and the associated metal parts of the envelope. With the axial thrust thus taken care of, the vacuum sealing flanges 26 and 29—32 may be made of sufficiently thin metal and shaped as illustrated to provide enough flexibility to allow for differential expansions between the ceramic and metal parts.

The ceramic-to-metal bonds at 28 and 31 may be accomplished in several ways, using known metalizing and brazing techniques. For example, the surface of the ceramic may be coated with finely divided molybdenum powder, or a mixture of molybdenum and iron powders or the like, and then fired to a temperature sufficient to sinter the metal powder to the ceramic. Such metalized surface may then be brazed to a metal member with silver solder or a brazing alloy such as copper-gold or the like. Another metallizing technique is to paint titanium or zerconium hydride powders on the ceramic and fire in hydrogen or vacuum.

I claim:

1. An electron device having an evacuated envelope comprising a ceramic wall section, a metal envelope part directly abutting the ceramic section, and a flexible metal sealing flange extending from said metal part and being spaced from and overlapping the ceramic section, the flange having an inturned portion providing a lip, said lip being metallically bonded to the ceramic section.

2. An electron device having an evacuated envelope

comprising ceramic wall sections, a metal envelope part interposed between the ceramic sections, and flexible metal sealing flanges extending in opposite directions from said metal part and being spaced from and overlapping the ceramic sections, the flanges having inturned portions providing lips, said lips being metallically bonded to the ceramic sections, the latter sections being positioned to abut directly said metal part.

3. An electron device having an evacuated envelope comprising a cylindrical ceramic wall section, a ring-shaped metal envelope part directly abutting the ceramic section, an electrode in the envelope supported by said metal part, and a flexible metal sealing flange extending from said metal part and being spaced from and overlapping the ceramic section, the flange having an inturned portion providing a lip, said lip being metallically bonded to the ceramic section.

4. An electron device having an evacuated envelope comprising cylindrical ceramic wall sections, a ring-shaped metal envelope part interposed between and directly abutting the ceramic sections, an electrode in the envelope supported by said metal part, and flexible metal sealing flanges extending in opposite directions from said metal part and being spaced from and overlapping the ceramic sections, the flanges having inturned portions providing lips, said lips being metallically bonded to the ceramic sections.

5. An electron device having an evacuated envelope comprising cylindrical ceramic wall sections, a ring-shaped metal envelope part interposed between the ceramic sections and having portions projecting inwardly and outwardly of the envelope, the ceramic sections directly abutting opposite sides of said metal part, a grid electrode in the envelope supported by the inwardly projecting portion of said flexible metal part, and metal sealing flanges extending in opposite directions from the outwardly projecting portion of said metal part and being spaced from and overlapping the ceramic sections, the flanges having inturned portions providing lips, said lips being metallically bonded to the ceramic sections.

6. An electron device having an evacuated envelope comprising cylindrical ceramic wall sections, a ring-shaped metal envelope part interposed between the ceramic sections and having portions projecting inwardly and outwardly of the envelope, the ceramic sections directly abutting opposite sides of said metal part, a grid electrode in the envelope supported by the inwardly projecting portion of said metal part, and flexible metal sealing flanges extending in opposite directions from the outwardly projecting portion of said metal part and being spaced from and overlapping the ceramic sections, the flanges having inturned portions providing lips, said lips being metallically bonded to the ceramic sections, the flanges being relatively thin compared to the thickness of said metal part.

7. An electron device having an evacuated envelope comprising a cylindrical ceramic wall section, a cup-shaped metal anode forming the upper portion of the envelope and having an edge directly abutting the ceramic section, an inverted U-shaped metal sealing ring embracing the ceramic section and having an inner lip metallically bonded to the ceramic, a complementary metal sealing ring on the anode engaging the first mentioned sealing ring and having an edge registering with an edge of the latter, one of said sealing rings being flexible, and a metallic bond uniting the registering edges of the sealing rings.

8. An electron device having an evacuated envelope comprising a cylindrical ceramic wall section, a cup-shaped metal anode forming the upper portion of the envelope and having an edge directly abutting the ceramic section, an inverted U-shaped flexible metal sealing ring embracing the ceramic section and having an inner lip metallically bonded to the ceramic, a complementary metal sealing ring on the anode engaging the first mentioned sealing ring and having an edge registering with an edge of the latter, and a metallic bond uniting the registering edges of the sealing rings, said sealing rings being relatively thin compared to the thickness of said metal anode.

References Cited in the file of this patent

UNITED STATES PATENTS

2,164,910	Gaebel et al.	July 4, 1939
2,173,906	Katsch	Sept. 26, 1939
2,178,826	Bowie	Nov. 7, 1939
2,212,556	Baier	Aug. 27, 1940
2,412,836	Rose	Dec. 17, 1946
2,423,066	Gibson	June 24, 1947
2,431,226	Berkey	Nov. 18, 1947
2,644,907	Drieschman et al.	July 7, 1953
2,650,683	McPhee	Sept. 1, 1953
2,723,044	Barasch	Nov. 8, 1955

OTHER REFERENCES

Kohl: "Materials Technology for Electron Tubes," Reinhold Pub. Corp., New York, 1951, pages 417–420.