

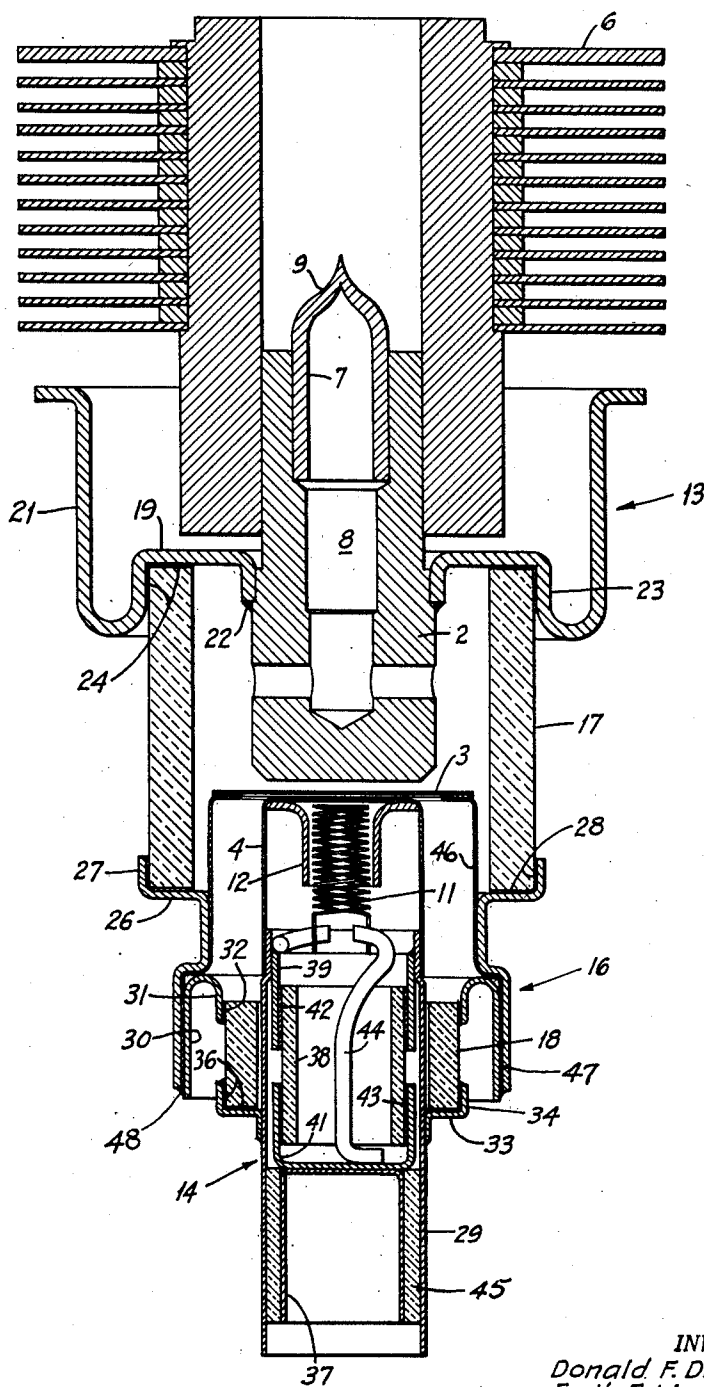
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ELECTRON TUBE

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ELECTRON TUBE

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Our invention relates to an electron tube of the type having coaxial terminals, and more particularly to improvements in the envelope structure of such tube.

The principal object of our invention is to provide a tube wherein the metal terminal parts of the envelope are separated by ceramic pieces.

Another object is to provide an envelope and electrode mounting construction specially adapted for ceramic-to-metal sealing techniques.

A further object is to provide an envelope of the character described for a tube having planar type electrodes.

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

Referring to the drawing, the single figure is an axial sectional view of a tube embodying the improvements of our invention.

In terms of broad inclusion, our improved tube comprises an envelope of generally cylindrical shape enclosing electrodes such as a cathode, grid and anode, these electrodes preferably having active surfaces disposed in parallel planes. Terminals for the electrodes comprise cylindrical metal members forming part of the envelope, which terminals are arranged in coaxial alignment. The terminals are separated and electrically insulated by cylindrical ceramic sections also forming part of the envelope and connected to the terminal members by ceramic-to-metal brazes.

In our preferred construction, the grid mount and cathode stem are designed for insertion in the grid terminal member and the final seal is made by a metallic bond.

In greater detail and referring to the drawing, our improvements are illustrated by a triode structure comprising an anode 2, grid 3 and cathode 4 having active surfaces disposed in parallel planes. Metal anode 2 at the upper end of the tube envelope has an inwardly projecting portion having a flat end face presented interiorly of the envelope and an outwardly projecting portion carrying a suitable cooler 6. The anode also carries the metal exhaust tubulation 7 which communicates with the envelope through passage 8, the tubulation being pinched off at tip 9 after evacuation of the envelope.

Cathode 4 at the lower portion of the envelope

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is of the indirectly heated type and comprises a cup-shaped metal sleeve having a flat upper surface coated with a suitable electron emissive material. The heater 11 for the cathode comprises a coil disposed within the cathode sleeve and is preferably surrounded by a suitable heat shield 12. Grid 3 is of the disk type having parallel wire bars lying in a plane parallel with the opposing ends of the anode and cathode.

Coaxial metal terminals are provided on the envelope for the electrodes, including an upper anode terminal 13, a cathode terminal on the stem structure 14 and an intermediate grid terminal 16. These terminals are arranged coaxially of the envelope and present external contact surfaces having different diameters of which the anode contact surface is the largest, the grid surface the next largest and the cathode surface the smallest. This terminal arrangement permits plugging the tube into a socket.

In our improved tube, the electrode terminals are separated and electrically insulated by coaxial cylindrical ceramic sections including a section 17 interposed between the grid and anode terminals and a section 18 interposed between the grid and cathode terminals. The ceramic sections thus forming portions of the envelope are united to the adjacent metal parts by metallic bonds, such as ceramic-to-metal brazes, to establish vacuum-tight joints.

The ceramic used in making up the envelope sections may be of any suitable ceramic-like material such as the alumina or zircon type ceramic bodies commercially available. We prefer the alumina or zircon type bodies because of their good mechanical strength, thermal resistance and electrical insulating properties.

The ceramic-to-metal bonds forming the vacuum-tight seals may be made in several ways utilizing known metalizing and brazing techniques. For example, the surfaces of the ceramic pieces may be coated with finely divided molybdenum powder, or a mixture of molybdenum and iron powders or the like, and fired in hydrogen to a temperature of about 1500° C. to sinter the metal powder to the ceramic surface. This produces a thin metallic layer firmly bonded to the ceramic. Such metalized surfaces may then be brazed or soldered to adjacent metal parts with silver solder or brazing alloys such as silver-copper, gold-copper or the like. The brazes are readily made by fitting the metalized ceramic surfaces against the metal parts with rings of wire solder adjacent the joints, and then elevating the temperature of the whole up

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to the melting point of the solder in a suitable furnace. Another metalizing technique is to paint titanium or zirconium hydride powders on the surfaces of the ceramic parts and fire in vacuum to about 1200° C., after which the metalized surfaces may be brazed with silver solder of the like.

The metal terminal construction in our tube is specially designed for the ceramic sections employed in the envelope structure. As shown, the anode terminal member 13 comprises a cup-shaped member having a bottom wall 19 surrounding anode 2 and a cylindrical flange 21 forming the contact surface of the terminal. This terminal member is united to the anode at braze 22. The bottom wall 19 is formed with a re-entrant portion for receiving the ceramic section and to provide a downturned lip 23 engaging the outer peripheral edge of ceramic cylinder 17. In this case, the ceramic is metalized along both the upper and outer peripheral surfaces and the brazing material 24 extends over both of these areas so that the ceramic is brazed to the flat bottom wall 19, as well as to the downturned lip 23. This provides an extremely strong joint construction which is especially important at this end of the tube carrying the relatively heavy anode and cooler structure.

The grid terminal member 16 is tubular in shape and has an outturned flange 26 with an upturned lip 27 for engaging the outer peripheral edge of ceramic cylinder 17. Here again the ceramic section is metalized along both the lower and outer peripheral surfaces and the brazing material 28 extends over both of these areas, namely, at the flange 26, as well as along the lip 27.

Cathode stem 14 includes a tubular metal stem member 29 which comprises the cathode terminal. This stem structure is so designed that the cathode may be completely mounted on the stem and the entire unit inserted into the tube through the tubular grid terminal 16. For this purpose the cathode stem includes a supporting sleeve 30 which slidably fits into the lower end of the grid terminal member. Sleeve 30 is preferably of U-shape to provide a downturned lip 31 engaging the upper peripheral surface of ceramic section 18. This peripheral surface is metalized and brazed at 32 to lip 31. An outwardly extending flange 33 brazed on stem member 29 has an upturned lip 34 engaging the lower peripheral surface of the ceramic section, the lower edge and peripheral surface of the ceramic being metalized and brazed as indicated at 36.

Cathode sleeve 4 is connected to and supported directly by the upper end of stem member 29. One end of the heater coil 11 is also connected to the tubular member 29, which stem member thus functions as a cathode terminal as well as one of the connections for the heater. In order to provide the other heater connection, an inner stem member 37 is provided coaxial with the outer member 29, the inner member 37 being preferably an inverted cup-shaped metal piece located at the lower portion of the stem structure. A cylindrical ceramic section 38 is interposed between the inner and outer stem members. Brazing flanges for the ceramic are provided by a downwardly extending sleeve 39 on the outer stem member and an upwardly extending sleeve 41 on the inner stem member. Sleeve 39 is brazed to the upper end of tubular member 29 and sleeve 41 is preferably a cup-shaped piece secured to the top of the inner mem-

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ber 37. These sleeves engage the outer peripheral surfaces of the ceramic section, the latter being metalized and brazed at 42 and 43. A rod 44 connects the end of heater coil 11 to the inner terminal member 37.

The stem structure is completed by an insulating sleeve 45 inserted between terminal members 29 and 37, this being merely a spacer sleeve and not relied upon as part of the evacuated envelope since the vacuum-tight wall is formed by the ceramic section 38.

Grid 3 is supported by a cylindrical mount 46 having a depending flange 47 adapted for insertion into the tubular grid terminal 16. In the fabrication and assembly of our tube the upper anode portion of the envelope is completed, including the brazing of ceramic section 17 in place between the anode and grid terminal pieces 13 and 16. At this stage of assembly the envelope is open at the lower end of grid terminal 16. The cathode stem portion of the tube is completed apart from the rest of the tube, the ceramic sections 18 and 38 being brazed in position during stem fabrication. After the heater and cathode have been mounted on the stem, the stem structure is ready for the final tube assembly.

The grid 3 on its mount 46 is then inserted into the grid terminal 16, the lower edge of mount 46 being brought into registration with the lower edge of the grid terminal. Cathode stem 14 is then inserted into the grid terminal, within the cylindrical grid mount, until the lower edge of support 30 registers with the lower edges of the grid mount and grid terminal. The three registering edges are then simultaneously bonded together at braze 48.

We claim:

1. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, coaxial metal terminals on the envelope for the electrodes, a ceramic section interposed between the grid and anode terminals, and metallic bonds uniting the ceramic section to said terminals, the anode terminal having a re-entrant portion for receiving the ceramic section.

2. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, coaxial metal terminals on the envelope for the electrodes, a ceramic section interposed between the grid and anode terminals, and metallic bonds uniting the ceramic section to said terminals, the anode terminal being cup-shaped and having a re-entrant bottom portion for receiving the ceramic section.

3. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, coaxial metal terminals on the envelope for the electrodes, a ceramic section interposed between the grid and anode terminals and metallic bonds uniting the ceramic section to said terminals, the anode terminal having a re-entrant portion providing a downturned lip engaging the upper end of the ceramic section and the grid terminal having a flange with an upturned lip engaging the lower end of said ceramic section.

4. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, a tubular metal grid terminal on the envelope, a cathode stem comprising a metal stem member coaxial with the grid terminal, a metal supporting sleeve having an edge registering with the lower edge of the grid terminal, a ceramic section interposed between the

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stem member and said supporting sleeve, said ceramic section having an inner diameter larger than the outer diameter of the stem member, metallic bonds uniting the ceramic section to said stem member and sleeve, and a metallic bond uniting the registering edges of said sleeve and grid terminal.

5. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, a tubular metal grid terminal on the envelope, a cathode stem comprising a metal stem member coaxial with the grid terminal, a metal supporting sleeve having an edge registering with the lower edge of the grid terminal, a ceramic section interposed between the stem member and said supporting sleeve, said ceramic section having an inner diameter larger than the outer diameter of the stem member, metallic bonds uniting the ceramic section to said stem member and sleeve, and a metallic bond uniting the registering edges of said sleeve and grid terminal, said supporting sleeve being U-shaped to provide a downturned lip engaging the upper end of the ceramic section.

6. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, a tubular metal grid terminal on the envelope, a cathode stem comprising a metal stem member coaxial with the grid terminal, a metal supporting sleeve having an edge registering with the lower edge of the grid terminal, a ceramic section interposed between the stem member and said supporting sleeve, said ceramic section having an inner diameter larger than the outer diameter of the stem member, metallic bonds uniting the ceramic section to said stem member and sleeve, and a metallic bond uniting the registering edges of said sleeve and grid terminal, said supporting sleeve being U-shaped to provide a downturned lip engaging the outer peripheral surface at the upper end of the ceramic section and said stem member having a flange with an upturned lip engaging the outer

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peripheral surface at the lower end of the ceramic section.

7. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, a tubular metal grid terminal on the envelope, a cathode stem comprising a metal stem member coaxial with the grid terminal, a metal supporting sleeve having an edge in substantial registry with the lower edge of the grid terminal, a ceramic section interposed between the stem member and said supporting sleeve, metallic bonds uniting the ceramic section to said stem member and sleeve, a grid mount having a depending flange lying between said sleeve and grid terminal and having an edge registering with the lower edges thereof, and a metallic bond uniting the registering edges of said sleeve and flange and grid terminal.

8. An electron tube comprising an envelope, electrodes in the envelope including an anode and grid and cathode, a tubular metal grid terminal on the envelope, a cathode stem comprising inner and outer stem members coaxial with the grid terminal, a ceramic section interposed between the stem members, and metallic bonds uniting the ceramic section to said stem members, the outer stem member having a downwardly extending flange providing a lip engaging the upper end of the ceramic section and the inner stem member having an upwardly extending flange providing a lip engaging the lower end of said ceramic section.

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