

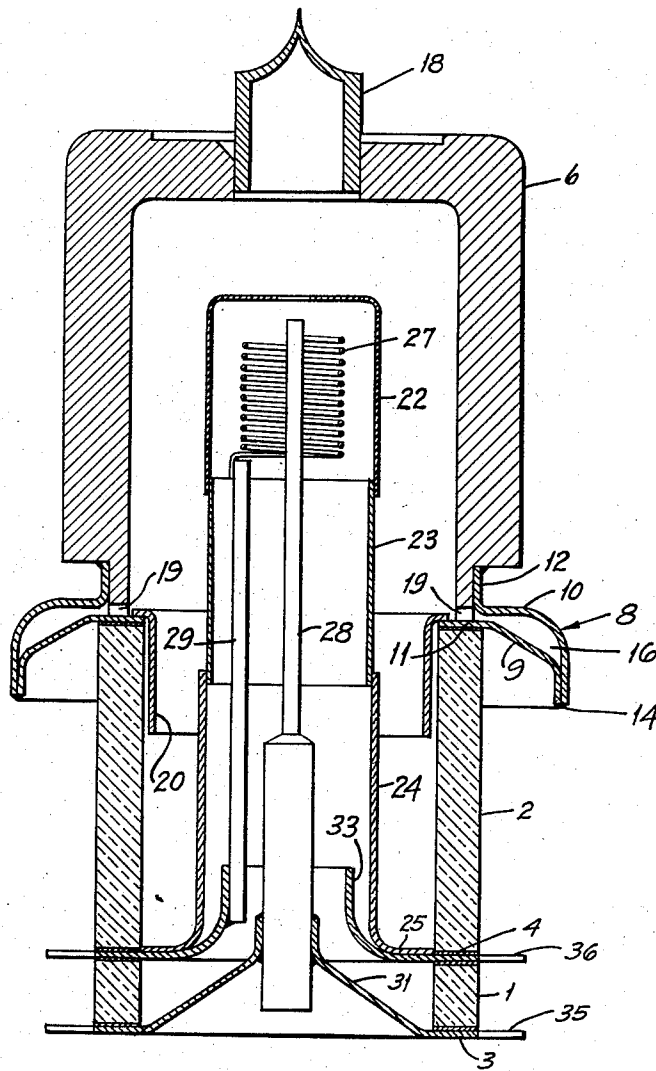
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ELECTRON TUBE

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ELECTRON TUBE

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This invention relates to electron tubes, and more particularly to such tubes having an improved ceramic envelope construction.

It is among the objects of this invention to provide a particularly simple and rugged tube having an envelope structure comprising ceramic and metal rings arranged alternately in a stack.

In the particular tube construction of this invention, an external copper anode forms a section of the tube envelope adjacent one of the ceramic sections of the envelope, and a further object of the invention is to provide an improved arrangement for connecting the anode to the adjacent ceramic section in a manner which will accommodate the distortion caused by the unequal coefficients of expansion of the anode and the adjacent ceramic section.

Another object of the invention is to provide in conjunction with the improved connecting arrangement a simplified arrangement for shielding the ceramic section adjacent the anode from electron bombardment.

A further object of the invention is to provide a simplified arrangement for supporting both the cathode and its heater on one of the metal rings which make up the tube envelope.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of the invention. It is to be understood that the invention is not limited to the disclosed species, as variant embodiments thereof are contemplated and may be adopted within the scope of the claims.

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

In terms of broad inclusion, the improved electron tube structure comprises a plurality of ceramic rings and flat metal rings arranged alternately in a stack with the ends of the ceramic rings being metalized and metal-bonded to the adjacent metal rings. An external anode forms a section of the tube envelope adjacent one of the ceramic rings and is joined to the adjacent ceramic ring by a deformable air-tight connection, with a shielding ring extending from the connection partway along the inside of the ceramic ring. A cathode and heater therefor are positioned in the tube envelope and are supported by the flat metal rings, the cathode and one of the heater supports being joined to a single one of the flat rings.

In greater detail and referring to the drawing, the evacuated tube envelope is of generally cylindrical shape, having a side wall structure comprising two ceramic rings 1 and 2 and two flat metal rings 3 and 4 arranged alternately in a stack. The ceramic is preferably a high refractory body such as alumina, and the ends of the ceramic rings are metalized by a suitable metalizing procedure such as the molybdenum-manganese powder sintering process. The flat metal rings 3 and 4 are relatively thin, having a thickness of about .010", and are of a material having good electrical conductivity such as copper. The ceramic rings and the metal rings are brazed together, using high temperature brazing alloys such as copper-silver or the like.

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The electron tube includes an external copper anode 6 positioned in end-to-end relationship with the longer ceramic ring 2, so that the walls of the anode complete the envelope structure. If desired, the anode may be surrounded by a conventional cooler of the type having fins radiating outwardly from the anode. The lower rim of the anode is supported on the upper rim of the ceramic ring 2 and is secured in place by the connecting ring unit 8. Ring unit 8 consists of a lower ring 9 and an upper ring 10, the lower ring having a flat portion 11 which is brazed to the upper metalized end of the ceramic ring 2. The upper connecting ring 10 has a flat portion 12 which is brazed to the side of anode 6. The outer ends of rings 9 and 10 are arc welded to form the metallic bond 14 and thus form an air-tight connection between the anode and ceramic ring 2. It will be noted that rings 9 and 10 are separated intermediate their inner and outer ends to form an annular space 16. The rings 9 and 10 are preferably made from thin deformable material such as copper having a thickness of .010", and the upper ring 10 is curved intermediate its ends in order to accommodate distortion of the connecting unit 8 caused by radial movement of the side wall of the anode relative to the ceramic ring 2 due to the unequal coefficients of expansion of the anode and ceramic ring.

The preferred method of assembling the improved electron tube is first to assemble all of the parts with the exception of anode 6. At this stage, the lower connecting ring 9 has been bonded to the ceramic ring 2, and the upper connecting ring 10 has been bonded to the anode 6. Next the anode is placed in position on the ring 2 and the outer ends of connecting rings 9 and 10 are then bonded at 14 to complete the tube envelope. The final step is to evacuate the tube and pinch off the exhaust tubulation 18 in the usual manner. If desired, a cup-shaped cap may be inverted over the outer end of tubulation 18 and brazed to the upper end of anode 6 in order to protect the tubulation from damage. It will be understood that when the anode 6 is secured in position prior to the exhaust step, the annular space 16 in the connecting unit 8 is filled with air. If this condition were allowed to exist, the trapped air could slowly leak between the lower rim of anode 6 and the flat portion 11 of connecting ring 9 to destroy the tube vacuum. In order to prevent this condition, the annular space 16 is vented to the interior of the tube by means of one or more notches 19 in the rim of anode 6 so that the annular space 16 will be exhausted during evacuation of the tube.

In order to protect the ceramic ring 2 from electron bombardment adjacent its upper end, a shielding ring 20 is provided, the upper end of ring 20 being flanged outwardly to rest on the flat portion 11 of connecting ring 9 and to space the ring 20 inwardly from the ceramic ring 2. It will be noted that the internal diameter of anode 6 is greater than the internal diameter of connecting ring 9 in order to provide ample seating for the upper flanged end of shielding ring 20, which is held in place by brazing to the flat portion 11 of ring 9.

The tube includes a cathode 22, preferably of the oxide coated type and having the appearance of an inverted cup. A cathode skirt 23 is attached to the bottom of cathode 22 and in turn is mounted on a cylindrical cathode support 24. Cathode support 24 has an out-turned flanged portion 25 on its lower end which is seated on an inward extension of the metal ring 4 and brazed thereto. Internally of cathode 22 a coil heater filament 27 is positioned for the purpose of heating the cathode. The heater filament 27 is mounted on two supports, namely, the coaxial center support 28 and the outside support 29. The center support 28 is connected to

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the lowermost metal ring 3 by means of the upwardly directed funnel portion 31 or ring 3, the center support 28 being brazed to the neck of funnel portion 31. The outside heater support 29 is conveniently mounted on metal ring 4 which supports the cathode, and for this purpose ring 4 is provided with an upwardly extending tubular boss 33, to which the support 29 is firmly spot welded.

The metal rings 3 and 4 are designed to serve not only as supports for cathode 22 and heater 27 but also as terminals for these members, and for this latter purpose each of the rings 3 and 4 is provided with a plurality of tabs 35 and 36, respectively, extending outwardly from the tube envelope and spaced equally around the circumference of the envelope. In the preferred embodiment of the disclosed tube, six tabs are provided on each of the rings 3 and 4, but any other suitable number of tabs may be employed. It will be understood that the single drawing figure is a vertical section of the tube taken on a plane passing between adjacent tabs so that the tabs appear solid rather than in section. The tabs 35 and 36 are aligned with each other longitudinally of the tube so that the tube may be inserted axially into a socket having two rings of inwardly directed tabs corresponding to the outwardly directed tabs 35 and 36. After the tube has been inserted axially into such a socket, it may be rotated until tabs 35 and 36 overlap the socket tabs. It is customary in the described type of socketting to provide the tube socket with a spring which acts to resist insertion of the tube into the socket and thus holds the tube tabs 35 and 36 in firm engagement with the corresponding socket tabs. Although the described socketting arrangement is preferred, it will be understood that other types of socket fittings could be connected to rings 3 and 4 in place of tabs 35 and 36.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. An electron tube comprising a generally cylindrical envelope having a plurality of ceramic rings and flat metal rings mounted alternately in a stack in axially abutting relation, said ceramic rings having metalized ends and metallic bonds uniting said ceramic and metal rings together, a cathode mounted concentrically within said tube envelope, a generally cylindrical support for said cathode extending upwardly from one of said metal rings internally of said envelope, the lower end of said cathode support having an outwardly extending flange to provide a substantial base in contact with said one metal ring, a heater inside said cathode, and a support for said heater connected to said one metal ring internally of said cathode support, said one metal ring having a tubular central boss to provide substantial contact area with the lower end of said heater support.

2. An electron tube comprising a generally cylindrical envelope having a plurality of ceramic rings and flat metal rings mounted alternately in a stack, the ends of said ceramic rings having metal coatings thereon and metallic bonds uniting said ceramic and metal rings together, an electrode and a heater for the electrode in said envelope, supports to said electrode and heater extending from said metal rings, an anode having a generally cylindrical wall portion forming a section of the envelope, said anode wall positioned adjacent one of said ceramic rings in end-to-end relationship therewith, a metal ring unit joining said anode wall and the adjacent ceramic ring, said metal ring unit comprising two metal connecting rings, a first one of said connecting rings having a flat portion seated on the end of said one ceramic ring adjacent said anode, a metallic bond between said flat portion of the first connecting ring and the end of said one ceramic ring, the end of said anode wall seated on said flat portion of the first connecting ring, a second one of said connecting rings having its inner end portion joined to said anode, said first and second connecting rings extending outwardly of said

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envelope and a metallic bond joining the outer ends of said connecting rings together, said connecting rings being spaced from each other between their outer joined ends and their inner flat portions forming an annular space, and said anode wall having a passageway there-through connecting said annular space with the interior of the envelope.

3. An electron tube comprising a generally cylindrical envelope having a plurality of ceramic rings and flat metal rings mounted alternately in a stack, the ends of said ceramic rings having metal coatings thereon and metallic bonds uniting said ceramic and metal rings together, an electrode and a heater for the electrode in said envelope, supports to said electrode and heater extending from said metal rings, an anode having a generally cylindrical wall portion forming a section of said envelope, said anode wall positioned adjacent one of said ceramic rings in end-to-end relationship therewith, a connecting ring unit extending coaxially around the tube envelope and joining said anode and the adjacent ceramic ring together, said connecting ring comprising a flat portion seated on the end of the ceramic ring adjacent the anode, said flat portion of the connecting ring extending inwardly of said anode wall, and a shielding ring secured to said inwardly extending portion of the connecting ring, said shielding ring extending coaxially along the inner wall of said one ceramic ring and spaced inwardly therefrom.

4. An electron tube comprising a generally cylindrical envelope having a plurality of ceramic rings and flat metal rings mounted alternately in a stack, the ends of said ceramic rings having metal coatings thereon and metallic bonds uniting said ceramic and metal rings together, an electrode and a heater for the electrode in said envelope, supports to said electrode and heater extending from said metal rings, an anode having a generally cylindrical wall portion forming a section of said envelope, said anode wall positioned adjacent one of said ceramic rings in end-to-end relationship therewith, a connecting ring unit joining said anode and the adjacent ceramic ring together and forming an annular space around the outside of said anode wall, said anode wall having a passageway therethrough connecting said annular space with the inside of the tube envelope, said connecting ring comprising a flat portion positioned between the end of the anode wall and the end of the adjacent ceramic ring, said flat portion of the connecting ring extending inwardly of the anode wall, and a shielding ring connected to said inwardly extending portion of the connecting ring, said shielding ring extending coaxially along the inner wall of the adjacent ceramic ring and spaced inwardly therefrom.

5. An electron tube having an envelope comprising a ceramic ring, an anode in the form of a metal ring coaxial with said ceramic ring adjacent one end of said ceramic ring, and a flexible metal connecting ring unit joining said end of said ceramic ring to the adjacent end of said metal ring, one end of said connecting ring unit being sealed to said ceramic ring, the other end of said connecting ring unit being sealed to said metal ring, the intermediate portion of said connecting ring unit extending outwardly of said envelope to provide an annular space, said metal ring and said ceramic ring being supported on each other against axial movement toward each other, one of said rings having a passageway through the wall thereof connecting said annular space formed by said connecting ring unit with the interior of said envelope.

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