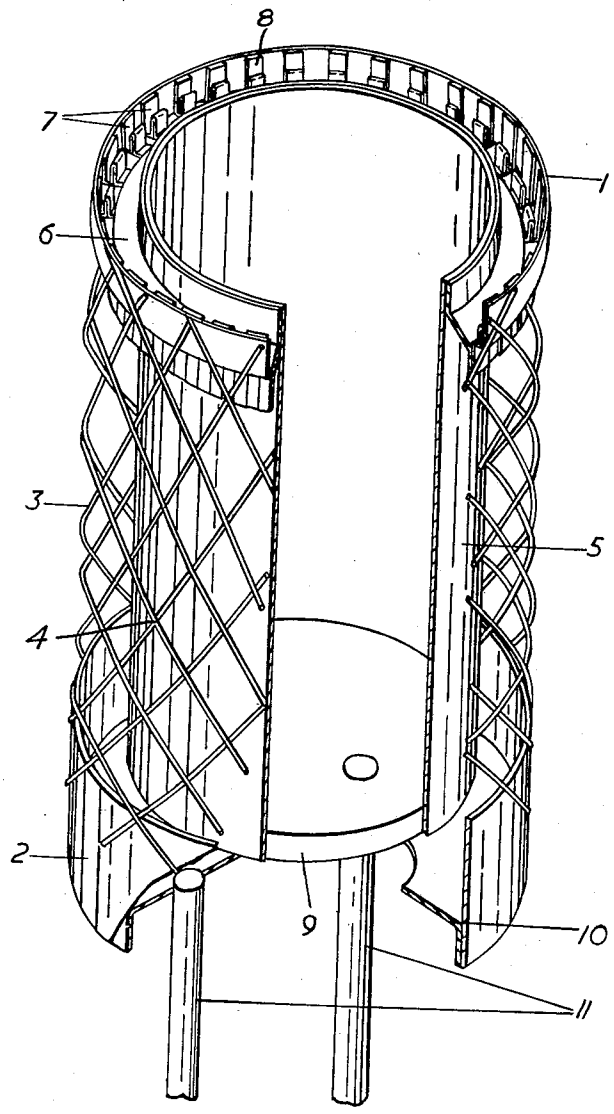
March 15, 1960 G. A. MORTON 2,928,978

MOUNTING OF THERMIONIC CATHODES

Filed July 29, 1957

2 Sheets-Sheet 1

FIG. 1.



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2 Sheets-Sheet 2

FIG. 2.

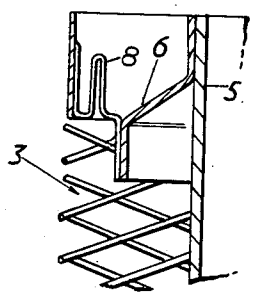
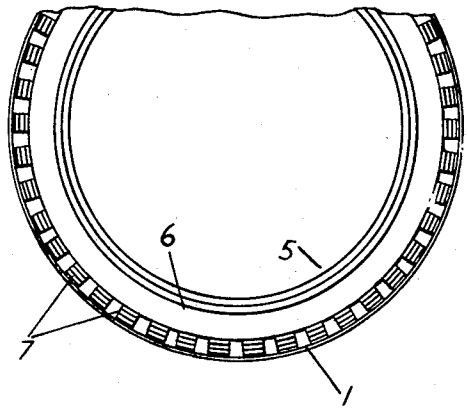


FIG. 3.



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MOUNTING OF THERMIONIC CATHODES

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Application July 29, 1957, Serial No. 674,780

Claims priority, application Great Britain August 3, 1956

4 Claims. (Cl. 313—343)

The present invention relates to filamentary thermionic cathodes such as used in radio transmitting valves.

In high power valves using tungsten or thoriated tungsten filaments it is the aim of the designer to achieve, so far as possible, a unipotential cathode and to reduce cathode lead inductance. For certain applications where the filaments are heated by alternating current it is necessary to neutralise the magnetic field of the heating current by arranging go and return current paths closely adjacent to one another. A common form of construction is to space the cathode filaments about a central lead rod, the upper end of the rod being connected to the filaments. At the same time it is necessary, in the case of a squirrel cage arrangement of filaments, to maintain the filament wires in tension. An alternative to the squirrel cage arrangement is that in which the wires are inclined, as parts of helices, at opposite angles to the cathode axis, the wires being joined together where they cross one another so as to form a substantially rigid and self-supporting reticulated grid structure.

With either of the two arrangements described above it is highly desirable to allow for some relative axial movement between the heated filaments and the central support due to differential thermal expansion. In the case of individually sprung squirrel cage filaments this is automatically taken care of. With the reticulated grid structure other provision has to be made.

It is an object of the present invention to provide a mounting arrangement for a filamentary thermionic cathode where a degree of axial movement between a set of filament wires and the coaxial heating current lead is permitted by means which provide support and connection means between wires and current lead.

To this end the filament wires—which are preferably arranged as a reticulated grid, as discussed above, but which may also be arranged squirrel cage fashion—are each secured at one end to the same ring and a set of flexible metal members, preferably tapes, forms a radiating suspension and connection means between the ring and the coaxial current lead.

Differential radial thermal expansion may readily be allowed for with tapes by turning back upon itself a portion of each tape and forming the turned-back portion to project axially from the radial portion.

An embodiment of the invention will be described with reference to the accompanying drawings in which:

Fig. 1 shows a diagrammatic perspective view of a cathode according to the invention partly cut away;

Fig. 2 shows an enlarged sectional view of the suspension/connection tape end of the cathode; and

Fig. 3 shows part of a top plan view of the cathode of Fig. 1.

In the cathode of Fig. 1 the filament wires are of tungsten or thoriated tungsten welded at one end to top filament ring 1, which is the metal ring previously referred to, and at the other end, to a bottom filament ring 2, the set of wires 3 being arranged to form a reticulated grid or mesh construction. The top and bottom rings

are preferably made of tantalum, but molybdenum may be substituted. At each cross-over, such as 4, the filament wires are welded together so that the set of wires 3, together with the rings 1 and 2, forms a substantially rigid and self supporting sub-unit.

The coaxial current lead, referred to previously, takes the form of a thin tube 5 of molybdenum sheet and provides a support for the filament sub-unit just described. To provide rigidity and to ensure circularity of the top end of the tube 5, a skirted support flange 6 is secured around the tube.

The tubular construction of the current lead has been found to provide a more robust construction than a simple rod and to reduce heat losses. In the embodiment shown on the drawings the tube 5 is cylindrical, but if desired it may be made to form a hollow frustum of a cone.

The filament sub-unit is connected to the tube 5 by means of a number of formed tapes 7 of molybdenum which are secured at one end to the top filament ring and at the other to the skirt of the flange 6 with a radial portion in between. The flexibility of the tapes allows for relative axial movement between the tube 5 and the filament sub-unit.

To allow for radial differential thermal expansion a portion of each tape is bent back upon itself and formed to project axially from the radial portion as shown at 8.

It will be evident that it is not essential that the radial portions of the tapes be precisely at right angles to the cathode axis. If they were initially at right angles to the axis when the cathode is cold, they will be inclined to the transverse plane when differential axial expansion occurs. In this connection the double back loop 8 ensures that the tapes are not unduly strained by this movement.

With the reticulated grid construction shown, it is required that the tapes be flexible, of soft rather than resilient material, for the filament mesh is self supporting and does not require axial tension. Where axial tension is required, as in the case of a squirrel cage filament arrangement, the tapes should be of harder material. With any desired relative diameters of filament surface and support tube 5, freedom of choice of the length of the tapes 7 may be provided by suitable choice of the dimensions of the flange 6.

The base connections and support means for the cathode may take various forms. If a coaxial stem construction for the discharge device is required, coaxial tubes may be secured to the tube 5 and to the bottom filament ring 2. In the case where minimum capacitance between cathode and grid leads of the discharge tube is desired, base pin connections and supporting means may be preferred. In Fig. 1 the lower end of the cathode is arranged for base pin connection and support. A disc 9 is secured in the lower end of the tube 5 and an annular dish 10 is secured inside the end of the bottom filament ring 2. The cathode structure is then mounted on a pair of rods 11, secured respectively to the disc 9 and dish 10, which rods, by conventional arrangements with which we are not here concerned, provide the necessary alignment of the lower end of the cathode structure.

In a practical embodiment of the invention the filament mesh 3, of thoriated tungsten wires, was 2½ inches long, and 2 inches in diameter. The central current lead tube 5 was 1.6 inches in diameter and the tapes 7 were 0.004 inch thick and 0.040 inch wide.

While the principles of the invention have been described above in connection with specific embodiments, and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What I claim is:

1. A filamentary thermionic cathode comprising a set

of filament wires lying on the surface of an imaginary cylinder and secured at one end to a metal ring, a current lead coaxial with the said set of wires extending substantially to the ends of said set, and a plurality of flexible metal members radiating between the said metal ring and the said lead to provide electrical connection therebetween while permitting their relative axial movement due to thermal expansion.

2. A cathode according to claim 1 in which the said filament wires are inclined to the axis of the said imaginary cylinder to form a substantially rigid reticulated grid structure with wires welded together where they cross one another.

3. A cathode according to claim 1 in which the said flexible metal members are metal tapes having ends bent

to conform to the surfaces of the said ring and said lead respectively, and each member between the said metal ring and the said lead being provided with a section formed back along itself and projecting from the radial portion of the tape to permit differential radial expansion between said ring and said lead.

4. The cathode according to claim 1 in which the said lead is a hollow cylinder joined to the said flexible metal members through an intervening projecting flange.

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