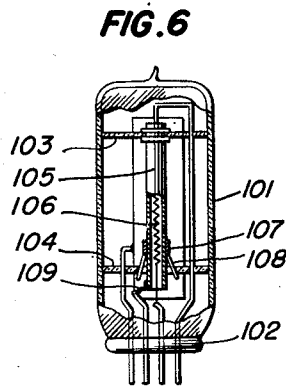
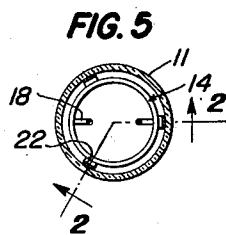
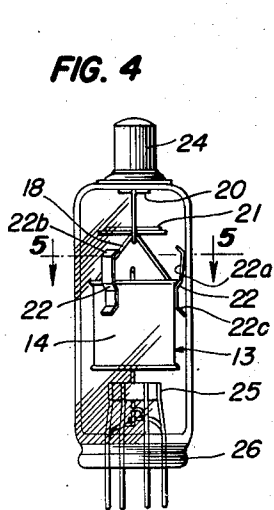
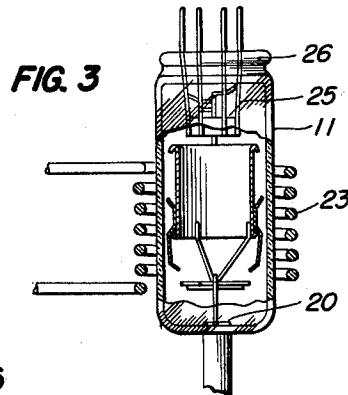
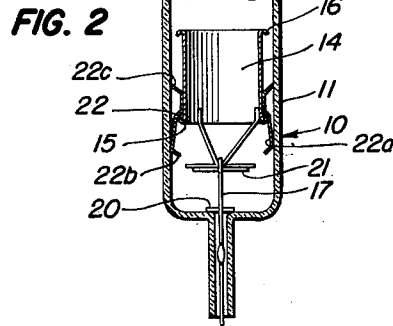
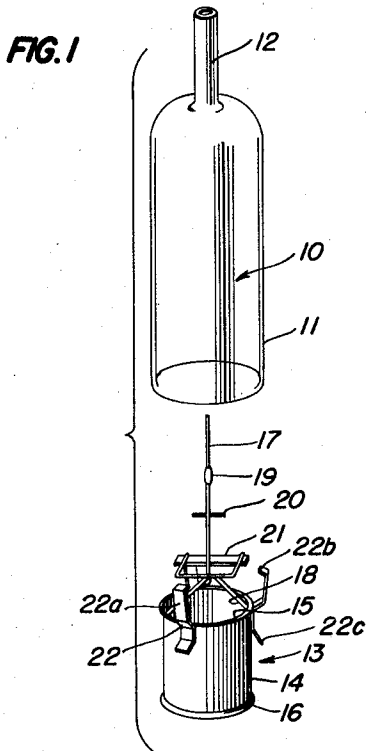


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SUPPORT FOR THE ELECTRODES OF
ELECTRON DISCHARGE DEVICES
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SUPPORT FOR THE ELECTRODES OF
ELECTRON DISCHARGE DEVICES

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6 Claims. (Cl. 250-27.5)

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The present invention relates generally to supports for the electrodes of electron discharge devices and more particularly to an improved support for the anode of a high voltage rectifier tube. The invention further relates to improved means for reducing microphonism in electron discharge tubes.

In high voltage rectifier tubes it is necessary that the anode be well isolated from the cathode structure and, to accomplish this end, the anode is usually supported by the glass envelope employed, from one end thereof, and the cathode is mounted by a stem or header carried at the opposite end of the tube. The cycle of operation of a rectifier tube includes a conducting period, during which electrons flow from the cathode to the anode and current is delivered to the load with minimum voltage drop, and a blocking period when the voltage across the tube electrodes is high and reversed, and little or no current flows in the reverse direction. The peak value of this reverse voltage applied to the tube is, of course, known as the inverse peak voltage.

When the inverse peak voltage is extremely high, for example of the order of from 10 to 50 kilovolts, special precautions must be taken to prevent the reverse flow of current by cold field emission of electrons from the anode which, as stated, is negatively charged at this part of the cycle of operation. Cold field emission depends upon the gradient of the electric field at the surface of the metal, the nature of the surface, and the gas contained in the metal and on the surface.

Thorough degassing of the anode greatly reduces cold field emission, with the result that the tube may be designed with higher gradient at the surface of said anode, so that the dimensions of the tube may be much smaller for the same high inverse peak voltage rating. Proper degassing of the tube anode, moreover, insures longer tube life and increased current rating because the electron emitting cathode will not be deactivated by liberated gas and can therefore be operated at a value near its initial maximum value.

In one of the supporting arrangements now in use, a comparatively large diameter, rigid metallic member is fastened to the anode and sealed through the glass envelope. The disadvantages for this method include relatively great expense, the objection that more space than can be spared in a small glass envelope is required, and lack of uniformity in heating the anode. Sheet mica disks and metal springs have also been used as supports for the anodes of high voltage rectifier

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tubes, but both have been found unsatisfactory. The mica disks under high temperature continuously produce a gas while the metal springs, under high temperature, take a permanent set and subsequently exert no pressure against the inner surface of the envelope to hold the anode in place.

One of the principal objects of the present invention, therefore, is to provide a simple and efficient anode support which will neither produce gas nor permanently lose its resiliency as a result of exposure to high temperatures, with the result that thorough degassing of the anode during manufacture of the tube may be effected.

Another object of the invention is to provide an electrode support which will be small in size and economical to manufacture.

A further object of the invention is to provide an electrode support which satisfies the requirements of an entirely reliable, low cost, small size high voltage rectifier tube.

And another object of the invention is to provide temperature change responsive means for reducing microphonism in an electron discharge tube.

In the drawings forming a part of this patent application:

Fig. 1 is an exploded perspective view showing the anode assembly ready for insertion into a partially formed envelope.

Fig. 2 is a vertical sectional view on the line 2-2 of Fig. 5.

Fig. 3 is a vertical sectional view, partly in elevation, showing the anode supporting spring fingers with their end portions displaced from the wall of the envelope during a degassing operation.

Fig. 4 is a side elevation of a completed high voltage rectifier tube according to my invention, and showing the anode supporting spring fingers in their normal operative positions.

Fig. 5 is a transverse sectional view on the line 5-5 of Fig. 4.

Fig. 6 is a vertical section, partly in elevation, illustrating an electron discharge tube having an improved cathode support for reducing microphonism.

My invention contemplates overcoming the objections inherent in present electron tube construction methods by fastening the anode of the tube to a comparatively small diameter wire which serves as an electrical connection to said anode and at the same time prevents it from moving axially along the envelope. The anode is normally held in its proper operative position

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in the envelope by bimetallic spring fingers fastened to said anode and having end portions which, at normal temperatures, bear against the envelope wall. As the temperature increases, during the anode degassing operation, the behavior of the bimetallic spring fingers changes; first, without changing their shape, they relax their pressure on the wall of the envelope. Subsequently, and as the temperature is further increased, the spring fingers again change their shape to the extent that their end portions move out of engagement with the envelope wall. Thus, although the fingers are heated to a high temperature during the anode degassing operation, they are in inoperative positions and will not assume a permanent set. After the anode degassing operation is completed, and the temperature of the anode and the spring fingers is returned to normal, the said fingers will again assume their original shapes, when their end portions will bear against the envelope wall for retaining the anode in place.

In Fig. 1 of the drawings a partially completed vacuum tube is shown at 10. The tube 10 is preferably of glass and includes a cylindrical envelope 11, open at its lower end, and a sealing off stem 12. The anode assembly is indicated generally at 13 and includes a cylindrical anode 14 having rolled upper and lower rims 15 and 16. The anode is supported from the top of the envelope 11 by a conductor 17 formed of the well known "Dumet" wire, said conductor engaging, at its lower end, the mid-portion of a bail 18 which extends transversely of and is secured to the upper end of said anode. A bead of glass 19, to combine with the glass of the envelope during the sealing operation, is carried on the conductor 17, and a transversely disposed wire stop 20 is welded to said conductor beneath the bead to limit downward movement of the assembly. A getter 21 of conventional arrangement is secured to the conductor 17 above the bail 18.

The spring fingers normally operative for mounting the anode in the envelope 11 are shown at 22. Inasmuch as said fingers are of identical formation and composition, a description of one will suffice for all. Three fingers 22 are shown but it should be understood that a greater or less number can be used, if desired. Typically, one of the fingers 22 is of substantially elongated S shape and is formed of iron and nickel laminations so that, under conditions of high temperature, it will change its shape, only to return to its original shape when the temperature has returned to normal. It has been found in practice that deformation of the finger takes place at substantially 300° centigrade.

The bimetallic spring fingers 22 are secured to the anode by welding their lower mid-portions to the outer wall of said anode directly beneath the upper rim 15 thereof, the upper mid-portions of said fingers being of substantially greater length than said lower mid-portions and constituting resilient envelope engaging portions 22a. The upper end portions of the fingers 22 are directed inwardly, as at 22b, to permit easy insertion of the anode assembly into the envelope. The lower ends of the fingers are bent outwardly to define lower envelope engaging portions 22c. The portions 22a and 22c will cooperate to prevent longitudinal wobbling of the anode in the envelope.

In Fig. 2 of the drawings the anode assembly 13 is shown in the inverted, partially completed envelope 11, with the portions 22a and 22c of the fingers 22 in engagement with the inner surface

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of the envelope wall. In Fig. 3 a completed tube is shown as it would appear during the anode degassing operation, the anode heating coil being shown schematically at 23. As will be seen, the envelope engaging portions 22a and 22c of the fingers 22 have been displaced inwardly and away from the envelope wall by the effect of the high temperatures imposed on the anode. Displacement of the anode toward the stem will be prevented by the stop 20. In Fig. 4 there is shown the completed tube, base down, with the portions 22a and 22c of the fingers 22 again in engagement with the envelope wall in anode centering and supporting positions. The completed tube includes, of course, the anode terminal cap 24, the cathode assembly 25 and the button, or base, 26.

It is desired to call attention to the fact that the spring fingers 22 are mounted on the anode at the end thereof most remote from the cathode so as to be out of the electric field during the blocking period (period of high inverse peak voltage) of the cycle of operation of the tube.

To illustrate another use to which bimetallic springs may be used in the manufacture of electron discharge tubes, the structure of Fig. 6 has been included. In this view an envelope somewhat similar to the envelope 11 is shown at 101. The envelope 101 is closed at its lower end by a base 102. Mica electrode supporting disks are shown at 103 and 104. A cathode 105, comprising the usual nickel or nickel alloy tube, appropriately coated to provide electron emission when heated, is supported at its upper end by the mica 103. A heater 106, energizable to bring the cathode to the operating temperature of approximately 1000° K., is conventionally contained in said cathode. As will be understood, the length of the cathode will increase appreciably as it is brought up to operating temperature. For this reason it can be rigidly secured only at one end, as by the mica 103. The other end must be received freely through the mica 104 if buckling is to be prevented. This free mounting of one end of the cathode causes electro-mechanical noise commonly known as microphonism.

To overcome microphonism caused by inadequate cathode support, I provide a collar 107 which surrounds the cathode near its lower end. The collar 107 is, like the fingers 22, of bimetallic material (nickel and iron) and has integrally formed spring fingers 108 which project through the central opening in the mica. Electrical connection from the cathode prong of the tube to the lower end of the cathode is made by a flexible metal member 109. It will be understood that the temperature of the collar 107 and fingers 108 will be raised as the cathode reaches operating temperature, with the result that the springs will expand for rigidly mounting the lower end of said cathode in the mica 104, whereby microphonism caused by improper cathode support will be eliminated.

It should be understood that, while I have described my invention as applied to anode and cathode supports for electrode discharge devices, it has other applications too numerous to mention.

I claim:

1. An electron discharge device having an envelope, and an anode in the envelope, means supporting the anode in the envelope and including a conductor, a stop on the conductor for preventing displacement of the anode in the

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envelope during the degassing of said anode, and normally resilient means supporting the anode in the envelope, said last mentioned means being deformable from supporting position by the effect of raising the anode to high temperature and being restorable to supporting position by lowering the anode temperature.

2. An electron discharge device as recited in claim 1, wherein said last mentioned means consists of a bimetallic spring finger.

3. An electron discharge device as recited in claim 1, wherein said last mentioned means consists of a plurality of bimetallic spring fingers secured to the anode and having portions normally bearing against the wall of the envelope.

4. An electron discharge device having an envelope, a cathode in the envelope, a heater for the cathode, and means rigidly mounting one end of the cathode, means freely receiving the opposite end of the cathode, and a bimetallic spring finger extending between the cathode and said last mentioned means and responsive to temperature changes on said cathode for restraining the lower end of said cathode against lateral movement.

5. An electron discharge device having an envelope, a cathode in the envelope, a heater for raising the cathode to operating temperature, and a support rigidly mounting one end of the cathode, a disk having an opening freely receiving the opposite end of the cathode, and a collar surrounding the cathode and having fingers engaging said disk, said collar and fingers being of bimetallic material responsive to temperature changes on the cathode and restraining the low-

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er end of said cathode against lateral movement, whereby microphonism will be reduced.

6. An electron discharge device, an envelope, an electrode structure in the envelope and having a plurality of electrode elements, and means for permitting limited movement of one of said electrode elements during heating of the device, said means including a temperature responsive bimetallic resilient finger having a free end deformable by heat for permitting limited movement of the electrode element and restorable upon cooling for rigidly mounting said element.

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