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THERMIONIC CATHODE ASSEMBLY

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Fig. 1

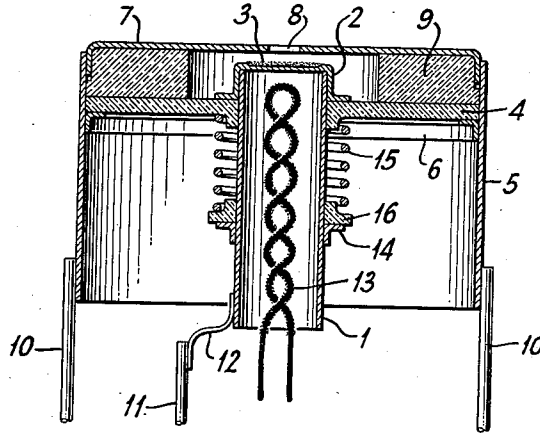
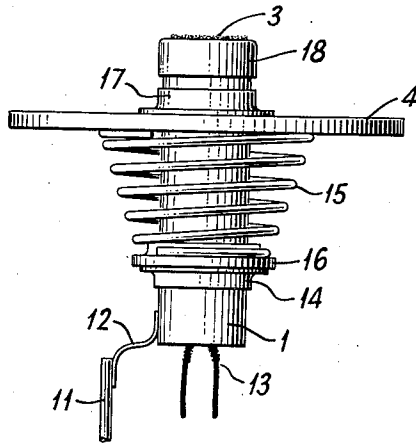


Fig. 2



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THERMIONIC CATHODE ASSEMBLY

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7 Claims. (Cl. 250-141)

My invention relates to electron emitting cathodes and more particularly to electron emitting cathodes for use in cathode ray tubes and similar electron discharge devices.

It is an object of my invention to provide a thermionic cathode so disposed and mounted in conjunction with a control grid or electrode that the cathode is maintained in a definite fixed relationship with respect to the control grid without introducing nonsymmetrical forces which tend to distort the cathode. Another object of my invention is to provide such an electron emitting cathode so mounted with respect to the grid that the cathode is resiliently positioned and wholly supported by the control grid structure. It is a still further object to provide a cathode which retains its accurate positioning irrespective of temperature variations during tube manufacture and life.

These and other objects, features and advantages of my invention will become apparent when considered in connection with the accompanying drawing in which:

Figure 1 is a cross-sectional view of one modification of my invention and

Figure 2 is a plan view showing a preferred form or modification of my invention.

Referring to Figure 1, I provide a cathode assembly comprising a sleeve 1 to serve as the body of the cathode assembly, the sleeve 1 being surmounted by a flat cathode 2 closing one end of the sleeve and provided with electron emitting material 3 such as oxides of barium and strontium. The cathode 2 is preferably provided with a flange which abuts an insulating spacer 4 which fits snugly within a cylindrical sleeve member 5. The sleeve member 5 forms a support for a retaining ring 6 and for the control grid such as a disc 7 having an aperture 8. The aperture 8 of the disc 7 is axially and symmetrically positioned with respect to the cathode 2 and the spacing between the disc 7 and the electron emitting material 3 is determined by the thickness of a second insulating spacer 9 which extends to and is a snug fit within the cylindrical sleeve member 5. The member 5 and the apertured disc 7 are preferably of metal and form the control grid electrode such as is used in conventional cathode ray tubes. The cathode and grid assemblies may be supported in a manner well known in the art by rigid conductors 10 which extend to and are sealed within the conventional press or stem, while the cathode sleeve 1 is connected to a lead 11 through the flexible connection 12 so that the cathode sleeve may be maintained at operating potential. The flexible connection 12 is preferably of very fine wire to minimize heat loss from the cathode through heat conduction. To complete the cathode assembly I provide a conventional type heater 13

within the cathode sleeve 1 and I prefer to use a heater of the double-helical type to prevent the generation of undesired magnetic fields surrounding the sleeve 1 which might affect electron emission from the material 3.

In accordance with my invention I resiliently support the cathode assembly between the flanged cathode 2 which abuts the insulating spacer 4 and a second flange 14 located adjacent the open end of the sleeve 1 and on the opposite side of the insulating spacer 4 from the cathode 2 by means of a resilient member or spring 15. The spring 15, which is preferably of tungsten or other material which retains its resiliency under operating temperature, is maintained in compression so that the cathode 2 is forced into contact with and abuts the insulating spacer 4. The spring 15 in the modification shown in Figure 1 is of cylindrical form of somewhat larger diameter than and surrounds a portion of the cathode sleeve between the two flanges. Since the spring 15 is maintained in compression, this portion of the sleeve 1 is maintained in tension.

During assembly the cathode 2 is first welded or otherwise rigidly affixed to the cathode sleeve 1, the spacer 4 and spring slipped over the sleeve 1 and the flange 14 moved into a position so that the spring is compressed slightly but not enough to cause bowing and contacting of the spring 15 with the sleeve 1. Spacing between the spring 15 and the cathode sleeve may be assured by providing a shoulder on the spacer 4 as shown in Figure 1. Heating of the spring 15 by the sleeve is therefore reduced and may be further reduced by interposing an insulating spacer such as an annular ceramic disc 16 between the flange 14 and the spring 15. With this new and improved construction the cathode is operated very efficiently and expansion effects which change the spacing between the emitting material 3 and the apertured disc 7 are practically eliminated without resorting to a nonsymmetrical construction which tends to bow the cathode.

Since the assembly comprising the sleeve 1, cathode 2, spacer 4, flange 14, and spring member 15 forms a single self-contained unit assembly, this entire assembly may be termed a unitary assembly requiring no outside support such as from the stem or stem leads of the tube in which it is used.

Referring to Figure 2 which shows a preferred modification of my invention and wherein the parts shown in Figure 1 are similarly referenced, the cathode assembly is maintained against the spacer 4 by a separate flange 17 instead of the flange combined with the cathode 2 as shown in Figure 1. This construction is preferable where it is desired to manufacture tubes having various characteristics wherein the spacing between the

apertured disc 7 and the electron emitting material 3 may vary for different tubes. For this type of manufacture I prefer to use an unflanged cathode 18 carrying the electron emitting material 3 because the axial length of this cathode does not determine the spacing between the electron emitting material and apertured disc as shown in Figure 1. In accordance with my invention as disclosed with reference to Figure 2, I provide the spring 15 of conical shape having a considerably larger diameter at the end contacting the spacer 4 than at the opposite end in contact with the annular ceramic disc 16. The second flange member 14 maintains the spring 15 in slight compression, and due to the wide spacing between the spring 15 and the sleeve 1, the heating of the spring is reduced to a minimum.

Prior to my invention it was proposed to mount the cathode, such as upon the spacer 4, depending upon two flange members, one abutting each side thereof to maintain the cathode permanently aligned with the aperture 7. During manufacture and use, however, it was found that, due to continued expansion and contraction of the cathode sleeve, the two flanges became separated by a greater amount than the mere thickness of the spacer 4 so that the cathode was free to move with respect to the spacer 4 and the apertured disc 7, resulting in microphonics and a variation of the tube characteristics. With my new and improved construction, however, the cathode is very effectively insulated against heat conduction and is permanently aligned with the apertured disc 7 and aperture 8. And since the unsupported length between the insulating spacer 4 and the emitting material 3 is very small, the change of length by expansion when hot is so small as to be negligible.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

I claim:

1. A self-contained unitary electrode assembly comprising a tubular thermionic cathode, including a heater associated with said tubular cathode, a pair of axially separated flanges rigidly fixed to said tubular cathode, a single supporting means between said flanges abutting one of said flanges, said means being the sole support for said tubular cathode, and a coiled resilient member between said supporting means and the other of said flanges surrounding a portion of said tubular cathode between said flanges.

2. A self-contained unitary electrode assembly for cathode ray tubes including a cathode sleeve closed at one end with an electron emitting portion and enclosing a heating element, a pair of radially extending members rigidly secured to said sleeve, an insulating spacer between said members abutting one of said members, a single resilient means between the other of said mem-

bers and said spacer to maintain the said spacer in compression against the abutting member, and insulating means between said resilient means and the nonabutting member to reduce heat transfer between said last-mentioned member and said resilient means.

3. A unitary cathode assembly for cathode ray tubes comprising a tubular metallic member closed at one end, a coating of electron emitting material on the closed end of said member, an annular flange adjacent the closed end rigidly secured to said tubular member, an annular flange adjacent the open end of said member and rigidly secured thereto, an insulating supporting spacer surrounding said tubular member restrained from axial movement in one direction by said first-mentioned flange, a coiled resilient metallic member between said spacer and the flange adjacent the open end of said tubular member and means to insulatingly support said coiled resilient metallic member from said tubular member in spaced relationship therewith.

4. A self-contained unitary electrode assembly for a cathode ray tube including a tubular member closed at one end, electron emitting material on the closed end of said tubular member, means to heat said material to liberate electrons therefrom, an electron control element partially surrounding said tubular member, means including an apertured insulator surrounding said tubular member to support said member radially with respect to said electron control element, a flanged ring rigidly secured to said tubular member on one side of said apertured insulator, a second flanged ring rigidly secured to the tubular member and spaced longitudinally thereof from the other side of said apertured insulator, and a single resilient means positioned between said apertured insulator and one of said flanges to maintain the other of said flanges in compression against said apertured insulator.

5. A self-contained unitary electrode assembly including a tubular metallic sleeve closed at one end with an electron emitting portion, an annular flange rigidly secured to said sleeve close to the closed end thereof, an apertured insulating disc surrounding said sleeve and supported against axial displacement in the direction of said closed end by said flange, a second flange adjacent the opposite end of said sleeve and a coiled conical spring between said disc and said last-mentioned flange to maintain said insulating disc in compression against said first-mentioned flange.

6. A unitary cathode assembly as claimed in claim 5 wherein the larger diameter of the conical spring is adjacent the insulating disc.

7. A self-contained unitary electrode assembly comprising an elongated cathode sleeve closed at one end with an electron emitting portion and enclosing a heating element, a pair of radially extending axially separated members rigidly secured to said sleeve, an insulating spacer between said members restrained from axial movement by one of said members, and a resilient member between said spacer and the other of said members to maintain the portion of said sleeve between said flanges in tension and said closed end of said cathode sleeve in substantially fixed position with respect to said spacer.

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