Oct. 28, 1958 W. GILLIES ET AL 2,858,471

ANODE FOR ELECTRON DISCHARGE DEVICE

Filed April 1, 1955

Fig.1.

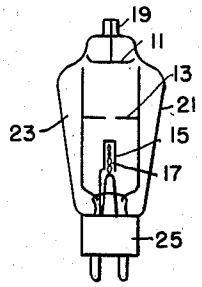


Fig.2.

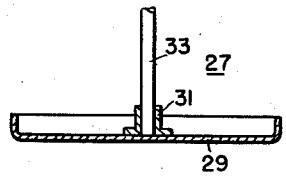


Fig.3.

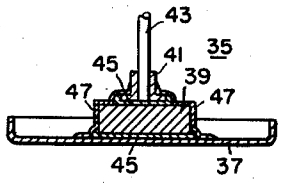
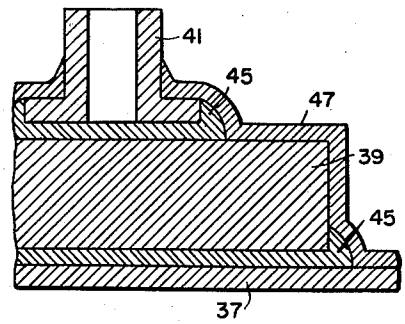


Fig.4.



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ANODE FOR ELECTRON DISCHARGE DEVICE

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6 Claims. (Cl. 313—352)

This invention relates to electron discharge devices and, more particularly, to the construction of anode electrodes for electron discharge devices.

In prior art electron discharge devices, particularly thyratrons operating with appreciable average anode currents, anodes were subject to overheating due to short duration overload currents which caused rapid excessive increases in temperature. This overheating caused (1) distortion of the anode which frequently led to tube failure because of a short between the anode and an adjacent electrode; (2) mechanical failure of the spot welds used to attach the anode to the cathode support member; and (3) undesirable vaporization of the anode material. Anodes were made of relatively thin (.020 inch) material because of the ease of fabrication and the lightness of weight.

It is an object of this invention to provide an improved anode in an electron discharge device with improved heat conduction.

It is another object of this invention to provide an improved anode in an electron discharge device with reduced structural distortion.

It is a further object to provide an improved method of using copper brazes in electron discharge devices.

It is a different object to provide an improved method of using silver brazes in electron discharge devices.

It is an additional object to provide an improved method of joining a first member to a second member in an electron discharge device.

These and other objects of the invention will be apparent from the following description, taken in accordance with the accompanying drawings which form a part of this application, and in which:

Figure 1 is a schematic view of a typical prior art electron discharge device, namely a thyratron gas triode;

Fig. 2 is a cross-sectional view of a typical prior art anode assembly for such an electron discharge device as shown in Fig. 1;

Fig. 3 is a cross-sectional view of an anode assembly showing an embodiment of my invention; and

Fig. 4 is a portion of Fig. 3 showing a metallic coating over the brazed material.

In Fig. 1 there is shown an electron discharge device including an anode **11**, a cathode **15**, and a grid electrode **13** between the anode **11** and the cathode **15**. The cathode is heated by a heater member **17**. An anode cap member **19** provides a terminal for the anode **11**. A suitable glass or metal envelope **21** encloses the electrode structure of the electron discharge device. In this case, the envelope **21** is filled with a suitable gas **23**. The electron discharge device is supported by a base member **25**.

In Fig. 2, there is shown an anode assembly **27** including a cup-shaped member **29** to which is attached an anode support member **31** and a lead member **33**.

In Fig. 3, there is shown an anode assembly **35** embodying my invention and including a cup-shaped member **37** to which has been attached a disk member **39**. Attached to the disk member **39** are an anode support member **41** and a lead member **43**. Copper brazing material **45** is used to attach the members to each other.

In Fig. 4 there is shown an enlargement of a portion of Fig. 3 showing the cup-shaped member **37**, the disk member **39**, the copper brazing material **45** and a metal coating **47** which is positioned over at least the copper brazing material **45**.

In accordance with my invention, a disk member **39** is brazed to an anode in an electron discharge device to provide improved heat conduction and to improve structural distortion in the anode without the addition of excessive additional weight. The brazing material **45** should exhibit a high heat conductivity. Materials such as copper or silver possess the necessary high heat conductivity but have had limited previous use in electron discharge devices because of their high vapor pressure at high temperatures. My invention allows the use of copper or silver brazing materials because the brazing material **45** is coated with a protective material **47** which has a lower vapor pressure than the brazing material **45** throughout the range of temperatures encountered during the manufacture and operation of the electron discharge device. In this way, the vaporization of the brazing material is reduced or eliminated.

Brazing is preferred to spot welding as a method of joining the disk member **39** to the cup member **37** because brazing provides a better flow of heat from the cup member **37** to the disk member **39** due to the better contact provided by the brazing.

In a suitable brazing operation, the members may be spot welded together or placed in positioning fixtures before being brazed. A ring of .050 inch copper wire is placed around the joint between the cup member **37** and disk member **39** and a ring of .025 inch copper wire is placed around the joint between the disk member **39** and the anode support member **41**. The anode assembly **35** is heated in a reducing atmosphere to a temperature of 1140° C., thus brazing the members together.

After the brazing operation the braze **45** itself and usually the entire anode assembly **35** is coated with a metal which has a comparatively low vapor pressure at high temperatures. Such metals include nickel, chromium and rhodium. Electroplating is a suitable method of coating the anode assembly with metal.

If the copper or silver braze is not coated with another metal, the copper or silver and their surface compounds tend to vaporize during heat treatment and operation. This vaporized copper or silver would be deposited on the envelope and the other electrodes of the electron discharge device causing contamination of the cathode which results in undesirably low cathode emission. Other undesirable defects of the copper or silver deposits are a lowering of the work function of the grid surfaces which results in undesirable high grid emission and coating of insulating materials in the electron discharge devices which results in undesirably high leakage currents. This vaporization and deposition of copper, silver and their compounds has previously restricted the use of copper, silver, copper alloys and silver alloys in electron discharge devices to applications where the temperature does not exceed approximately 600° C. during the manufacture and operation of the tube.

While the present invention has been shown in one form only, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit thereof. For example, brazing materials other than copper, silver and copper or silver alloys may be used if they exhibit the necessary high heat conductivity.

Also members other than those specified in the disclosed embodiment in electron discharge devices may be joined by the brazing method described above.

We claim as our invention:

1. In an electron discharge device within an at least partially evacuated envelope, the combination of a cathode, at least one control grid and an anode, said anode including a cup member and a disk member, a braze between said cup member and said disk member, a layer of protective material coating said braze, said protective material being operable to reduce the vaporization of the surface layer of said braze during the manufacture and operation of the device.

2. In an electron discharge device within an at least partially evacuated envelope, the combination of a cathode, at least one control grid and an anode, said anode including a cup member and a disk member, a braze between said cup member and said disk member, a layer of protective material coating said braze, said protective material being operable to reduce the vaporization of the surface layer of said braze during manufacture and operation of the device, said protective material having a vapor pressure lower than the vapor pressure of the material of said braze throughout the range of temperatures encountered during the manufacture and operation of the electron discharge device.

3. In an electron discharge device within an at least partially evacuated envelope, the combination of a cathode, at least one control grid and an anode, said anode including a cup member, a disk member, and a support member, a first braze between said cup member and said disk member, a second braze between said disk member and said support member, and a layer of protective material coating said first braze and said second braze.

4. In an electron discharge device within an at least partially evacuated envelope, a combination of a cathode, at least one control grid and an anode, said anode including a cup member and a disk member, a braze between said cup member and said disk member, a layer of protective material coating said braze, said protective material having a lower work function than the material of said braze.

5. In an electron discharge device within an at least partially evacuated envelope, the combination of a cathode and an anode, said anode including a cup member and a disk member, a braze between said cup member and said disk member, a layer of protective material coating said braze, said protective material being operable to reduce the vaporization of the surface layer of said braze during manufacture and operation of the device, the material of said braze being selected from the group consisting of copper, silver, copper alloys and silver alloys.

6. In an electron discharge device within an at least partially evacuated envelope, the combination of a cathode and an anode, said anode including a cup member and a disk member, a braze between said cup member and said disk member, a layer of protective material coating said braze, said protective material being operable to reduce the vaporization of the surface layer of said braze during manufacture and operation of the device, the material of said braze being selected from the group consisting of copper, silver, copper alloys and silver alloys, said protective material being selected from the group consisting of nickel, chromium and rhodium.

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