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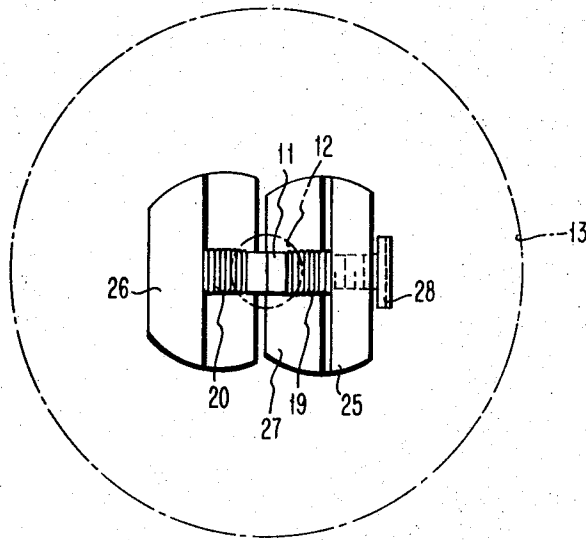


FIG. 2

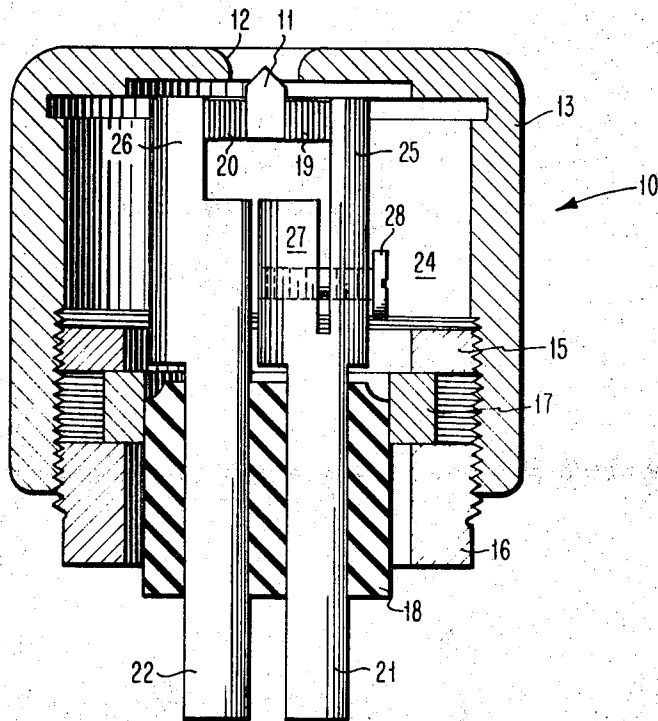


FIG. 1

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PYROLYTIC GRAPHITE SUPPORT FOR LANTHANUM HEXABORIDE CATHODE EMITTER

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7 Claims

ABSTRACT OF THE DISCLOSURE

A thermionic cathode such as a lanthanum hexaboride emitter supported on a pyrolytic graphite member for improved emission and support.

BACKGROUND OF THE INVENTION

As disclosed in the prior art and specifically in the U.S. Pat. 2,639,399 to J. M. Lafferty, lanthanum hexaboride is particularly desirable as a material for electron emitters. However, as also disclosed in U.S. Pat. 3,312,856, Lafferty et al., the manufacture of the support for emitters made of this material is difficult. It is the primary object of this invention to disclose an improved support for a thermionic cathode structure such as one utilizing a lanthanum hexaboride emitter.

SUMMARY OF THE INVENTION

A thermionic cathode such as one using a lanthanum hexaboride emitter and a support therefor made of pyrolytic graphite material abutting and holding said emitter and through which heating current is passed for raising the temperature of the cathode to cause emission.

DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cathode structure utilizing a first embodiment of the subject invention.

FIG. 2 is a top view of the emission tip and supporting structure.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The invention is to be used in a thermionic emitter such as the cathode structure 10 having a lanthanum hexaboride emitter tip 11 for use in electron beam devices. Emission, occurring when the tip is heated, passes through an opening 12 in a Wehnelt cylinder 13 mounted on the cathode structure. The cylinder is held in position by a pair of locking rings 15 and 16 threaded to the inside of the cylinder and clamping therebetween a ring 17 fixed to a ceramic insulator 18. By the application of a controlled voltage to the Wehnelt cylinder of a much lower potential than that of the emitting tip, the flow of electrons from the emitting tip is regulated.

In accordance with the present invention, the thermionic emitting tip is held by a pyrolytic graphite member which serves both as the mechanical support and the heater for the emitting tip. By using the pyrolytic graphite material for the emitter support, the life of the cathode tip made of such materials as lanthanum hexaboride, LaB₆, is extended because of the low interaction between the materials. In the past, reactions occurred which generally involved a migration of tip material, i.e. the lanthanum hexaboride, into the support material thereby causing a reduction in the efficiency of the emitter tip.

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To hold the combined pyrolytic graphite support and the emitter tip, a pair of conductor posts 21 and 22 are extended through the insulator 18 and into the cavity 24 of the Wehnelt electrode such that the extending tips 25 and 26 clamp a pair of pyrolytic graphite members 19 and 20 against the emitter tip. The tip is held at a position in alignment with the opening 12. To provide the clamping pressure, the post 21 is formed with a body member 27 extending parallel to the tip 25 such that a screw 28 threaded therein will exert lateral pressure on the tip in a direction towards the other tip 26 as shown in FIG. 2 thereby serving as a clamping means for said cathode. Thus, by tightening and loosening the screw, the pressure on the electrode tip is lessened to permit its removal and replacement in the cathode structure. Spring members, not shown, can be substituted for supplying the clamping pressure in the manner similar to the screw 28. Also, the lanthanum hexaboride and emitter tip can be brazed together before assembly into the cathode assembly if desired.

In operation an electric current is passed into one of the posts 21 or 22 for conduction through the series circuit comprising the pyrolytic graphite members 19 and 20 and the emitter tip 11, and thereafter out the other post. The emitter tip is heated by the resistivity of the pyrolytic graphite members to raise the temperature of the emitter tip above that necessary for the desired electron emission.

The pyrolytic graphite is well-adapted as a heater since in one direction of material alignment it has a high electrical resistance with a high ratio of electrical resistivity to heat conductivity thereby serving not only to supply the heat to the emitter tip but also to isolate the high temperature area from that of the supporting posts 21 and 22. The pyrolytic graphite is formed in a layered structure with the preferable cathode assembly of the subject invention having these layers extending perpendicular to the direction of current flow between the supporting posts 21 and 22. The layered structure tends to oppose the conduction of heat from the emitter tip while serving to raise the electrical resistivity of the members 19 and 20. Thus, by making the support such that the direction of high electrical resistivity and low heat conductivity extends between the emission tip and the support tips, a higher heating effect is obtained for a given current flow with a lower heat conduction away from the emitting tip. Thus, the pyrolytic graphite material is uniquely suited for use as a support member for thermionic emitters, and in particular those utilizing lanthanum hexaboride as the emitter material.

While the invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in the form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A thermionic cathode comprising:

an emitter tip made of a material capable of electron emission when heated, and

a support for said emitter made of a pyrolytic graphite material in heat transfer relationship with said emitter tip such that with the passage of electric current therethrough, said support will become heated and transmit heat to said tip to cause emission therefrom.

2. A thermionic cathode as defined in claim 1 wherein said support is made of a layered structure with the indi-

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vidual layers extending perpendicular to the electric current flow to increase the electrical resistance thereof and decrease the heat conduction away from said tip.

3. A thermionic cathode as defined in claim 1 wherein said support is formed of two pyrolytic graphite members positioned to clamp said emitter tip therebetween.

4. A thermionic cathode as defined in claim 3 wherein said emitter tip is made of lanthanum hexaboride material.

5. A thermionic cathode as defined in claim 4 including means to exert a clamping pressure on said pyrolytic graphite members thereby holding said cathode structure together.

6. A thermionic cathode as defined in claim 5 wherein said clamping means also serves to conduct electric heating current to said cathode.

7. A thermionic cathode as defined in claim 6 includ-

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ing a Wehnelt cylinder fixed to said clamping means and extending around said cathode.

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