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GETTER FOR ELECTRON TUBE

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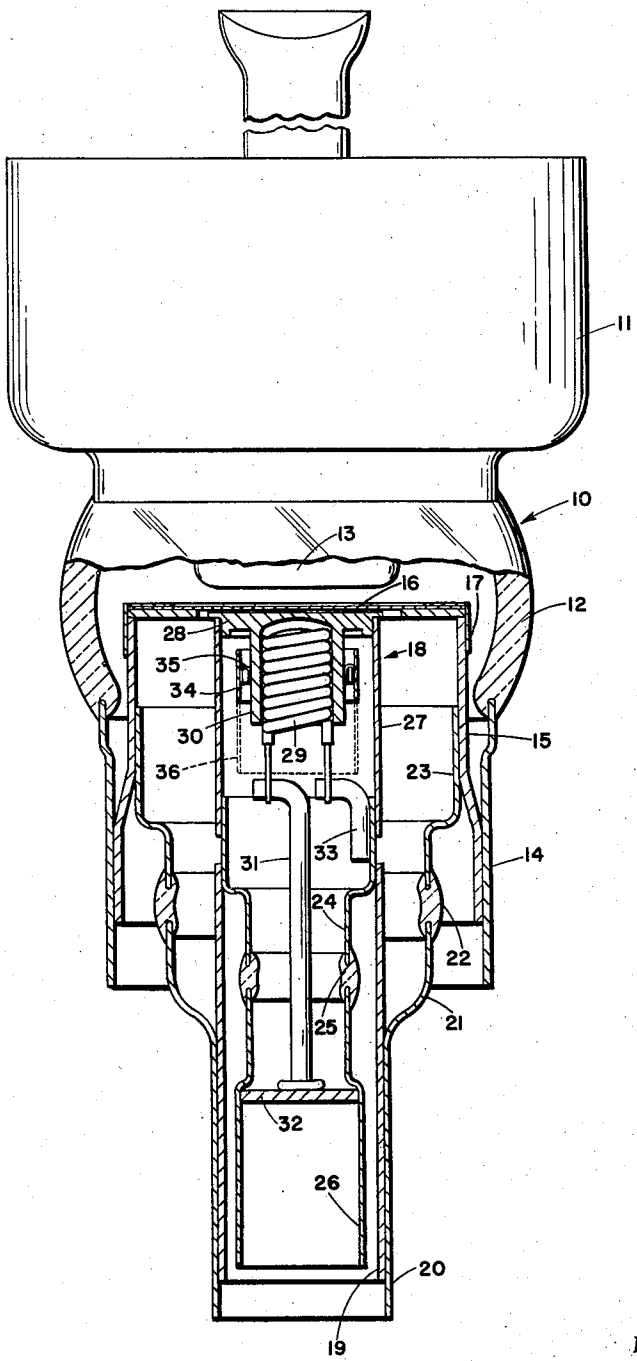

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GETTER FOR ELECTRON TUBE

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3 Claims. (Cl. 313—178)

This invention relates to improvements in electron discharge devices and has particular reference to novel gettering means for electron tubes.

In my copending application Serial Number 548,172, filed jointly with E. J. Naill and B. H. Wadia on November 21, 1955, there is described a novel cathode structure, for coaxial high frequency type electron tubes, which embodies a disclike cathode emitter supported by a tubular metal foil on the inner end of an annular terminal member. In that type of tube, the gettering function is performed by a foil of gettering material disposed upon either the inner or the outer surface of the supporting foil.

The present invention is a further improvement upon such an electron tube and is primarily concerned with the provision of a strip or hollow cylinder of gettering material in a location within the tube where it is most advantageously heated so that it may readily perform its function.

More particularly, I have found that a strip of gettering material may be secured directly upon a portion of the emitter by means of an intermediate joint or connector formed of a material which will not readily alloy with either the material of the emitter or of the getter at tube operating temperatures.

As pointed out in the aforementioned copending application, the use of zirconium, tantalum, hafnium, titanium or the like in an electron tube as a gettering material is highly desirable, but has not been entirely successful because of the difficulties encountered in positioning the material in close proximity to the parts of the tube which operate at the elevated temperatures necessary for the material to function properly as a getter. Such parts are normally made of a material, such as nickel, which alloys readily with the getter material.

Accordingly, a primary object of the present invention is to provide an electron tube with an efficiently functioning getter of zirconium, titanium, tantalum or the like.

Another object is to provide a getter actually supported by and in close proximity to a heated part of the structure which is formed of a material known to readily alloy with the material of the getter.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing, wherein the figure is a front elevational view partly in axial section of an electron tube embodying a preferred form of the invention.

Referring more particularly to the drawing, the tube embodying the invention comprises a gas-tight envelope generally designated by numeral **10** and having a cylindrical metal terminal portion **11** at one end connected by a vacuum seal to one end of a glass or similar dielectric bulb portion **12**. Within the envelope and supported by portion **11** is an axially disposed anode **13**, portion **11** being the external terminal thereof. Concentric with anode **13** is a tubular grid terminal **14** which is sealed throughout one end to the other end of the dielectric bulb

portion **12** of the envelope. A tubular grid support **15** is sealed at one end to the inner wall of grid terminal **14** and carries on its other end a grid **16**. The grid **16** is maintained in position on a flange formed on the inner end of the support **15** by a retainer **17**, and is disposed in predetermined spaced relation to the anode **13** and to a cathode structure **18** located coaxially therewith within the grid support **15**.

The cathode structure **18** includes a first terminal formed by a pair of coaxial tubular members, an inner member **19** and an outer member **20**, which are joined together adjacent the end of the tube and form a portion of the envelope **10**. Outer member **20** is flared outwardly at **21** and is sealed by an annular dielectric insulating ring **22** to one end of an annular metal ring **23** which is in turn sealed throughout its opposite end to the inner surface of the grid support **15**.

The inner tubular member **19** encircles and is sealed to the outer surface of a substantially tubular cathode supporting ring **24**. The supporting ring **24** is in turn sealed by an annular insulating member **25** to the inner end of a second tubular terminal **26** which extends coaxially within and in spaced relation to the first cathode terminal **19—20**.

The inner end of the cathode supporting ring **24** has secured to it one end of a cathode support member **27** which consists of a tubular foil formed of Kovar or other selected material having relatively low thermal conductivity. The opposite end of the support member **27** is secured throughout its periphery to and supports a disc-like cathode emitter **28** formed of nickel or like material which carries either thereon or therein a material which is capable, when heated, of emitting copious supplies of electrons. The emitter is connected adjacent its periphery to the support foil **27** and is disposed with its effective electron emitting surface adjacent and parallel to the grid **16** and in coaxial predetermined spaced relation thereto.

It is apparent that the terminal **19—20** and support foil **27** form one side of a circuit to the emitter **28**. The circuit is completed to the second terminal **26** through a filament or heater coil **29** which is positioned in close proximity to the emitter **28**, preferably within a cup-shaped portion **30** thereof. The heater coil has one end connected by a metal supporting conductor **31** to a metal disc **32** which is sealed throughout its periphery to the inner wall of the second terminal **26** and thus also forms a portion of the envelope **10**. The other end of the heater coil **29** is connected by a supporting conductor **33** to the cathode supporting ring **24** and thereby to the first cathode terminal **19—20**. Thus, a circuit is completed through both the emitter **28** and the heater coil **29**. Upon application of suitable electrical energy to the cathode terminal, the heater **29** will raise the temperature of the emitter **28** whereupon a copious supply of electrons will be produced, the electrons flowing to the anode **13** under control of the grid **16** in the normal operation of a tube of this type.

The cup-shaped portion **30** of the emitter structure is preferably an integral tubular member depending from the under side of the main disc-shaped portion **28** and closely encircling the heater coil **29** so as to confine as much heat as possible to the central portions of the emitter. In such an arrangement the tubular member **30** will acquire a considerable amount of heat which will be transferred to the electron emitting surface of the emitter.

It has been found to be practically impossible to completely outgas an electron tube, during manufacture thereof, by conventional methods. Therefore, continuous gettering means is required for removing from all the elements within the envelope such gases as may appear during operation of the tube.

It is known that the cathode areas of tubes of the presently described type become relatively hot during operation, usually reaching temperatures in the vicinity of 800° C. The temperatures of the parts of the cathode structure which are nearest the heater coil of course attain the highest levels. Therefore, it is desirable to provide a getter which will operate satisfactorily at or near the relatively high temperatures reached by parts of the cathode structure as well as throughout the range of operating temperatures of the parts, for example, between approximately 300–700° C. Materials such as titanium, zirconium and tantalum are known to function satisfactorily as gettering materials at such relatively high temperatures and can be readily manufactured in the form of thin foils which, when used in the manner taught herein, extend into the areas of the cathode structure which operate at the highest temperatures, and can be made also to extend into the cooler areas of the structure as well.

Therefore, the present invention relates to the use of a foil **34** of gettering material which is mounted on the tubular member **30** which encircles the heater coil **29**. Since the getter foil **34** may alloy with the material of the member **30** and emitter **28**, particularly in the case of zirconium, titanium or tantalum, the getter foil is spaced slightly from the member **30** but is connected thereto by suitable means such as an annular ring **35**. The connector **35** must be formed of a material which will not alloy with the foil, such as platinum or other selected material. The getter foil **34** is preferably formed to a tubular shape with one end terminating adjacent, but slightly spaced from, the disclike portion of the emitter **28**. The foil may be as long as desired so as to extend to the desired extent into cooler areas of the structure, as shown by dotted lines **36**. Thus, such a getter is able to perform its gettering function throughout a wide range of temperatures, such as approximately from 300° C. to 800° C., since some portion of the foil will always be positioned in an area having a temperature at which the gettering occurs most efficiently.

An additional advantage of a structure of this type is that the getter foil **34** also provides a heat shield for the inner surface of the cathode-supporting foil **27**, which further improves the overall cathode operation.

It will be apparent from the foregoing description that all of the objects and advantages of this invention have been accomplished by the provision of the novel gettering device described hereinbefore. It is also apparent, however, that certain changes may be made without departing from the spirit of the invention.

I claim:

1. A cathode structure for electron tubes, said structure comprising a metal emitter having an integral substantially tubular extension on one side thereof, a heater relatively closely confined within the extension for heating the emitter and extension, a tubular support having one end secured to the periphery of the emitter and extending in encircling relation parallel to and spaced from the extension, a getter encircling the extension and located between it and the support, the getter being a material which readily alloys with the material of the extension, and means mounting the getter on the outer surface of the extension in closely spaced relation thereto comprising a strip of material which is non-alloying with the getter and extension at tube operating temperatures.

2. A cathode structure for electron tubes, said structure comprising an emitter having an integral substantially tubular extension on one side thereof, the emitter and extension being basically nickel, a heater relatively closely confined within the extension for heating the emitter and extension, a tubular support having one end secured to the periphery of the emitter and extending in encircling relation parallel to and spaced from the extension, a getter encircling the extension and located between it and the support, the getter being basically of a metal selected from the group consisting of zirconium, titanium and tantalum, and a strip of platinum between the extension and getter and securing the getter in closely spaced relation with the outer surface of the extension.

3. A cathode structure for electron tubes, said structure comprising an emitter having a substantially tubular extension on one side thereof formed of a selected material, a heater within the extension, a support for the emitter comprising a tubular member encircling the extension in spaced relation therewith and having one end fixed to the emitter, a tubular foil of getter material characterized by its tendency to alloy with the material of the extension, said foil being located substantially coaxially with and between the extension and the support and extending at one end adjacent the emitter and at its other end into a relatively cool area of the cathode structure, and means for supporting the getter foil comprising a strip of material which is nonalloying with the material of the extension at tube operating temperatures, said strip being mounted on the outer surface of the extension and secured to the foil and maintaining the foil spaced from the extension.

References Cited in the file of this patent

UNITED STATES PATENTS

2,445,993 Beggs ..... July 27, 1948

FOREIGN PATENTS

875,551 Germany ..... May 4, 1953