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ELECTRON DISCHARGE DEVICE

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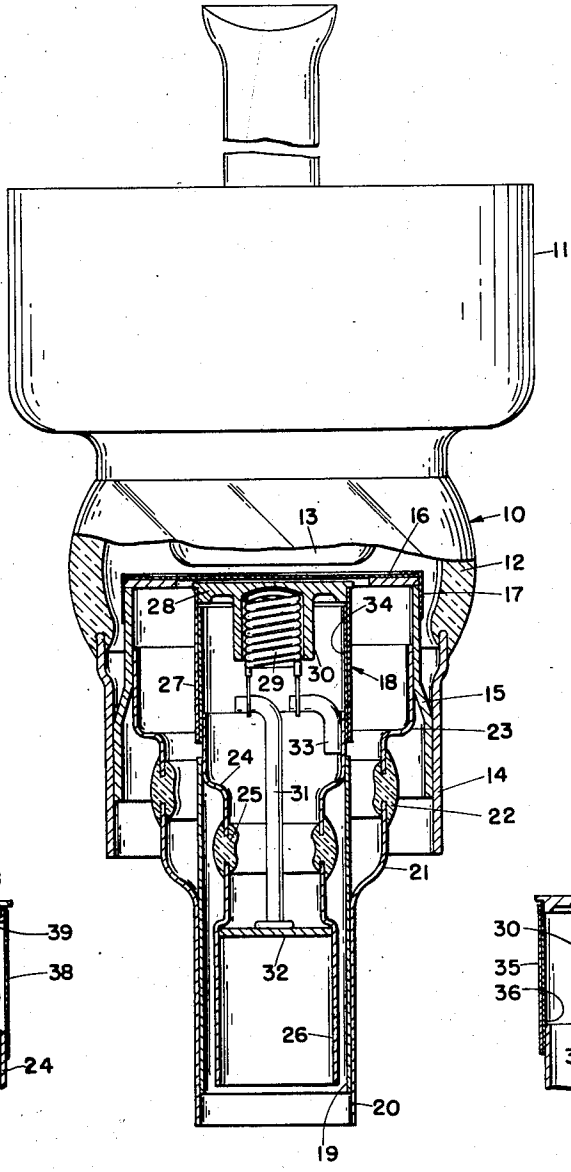


FIG. 1

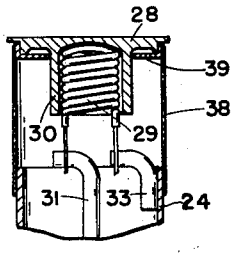


FIG. 3

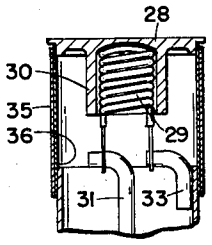


FIG. 2

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ELECTRON DISCHARGE DEVICE

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2 Claims. (Cl. 313—178)

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

In the development and manufacture of electron tubes, particularly of the so-called "coaxial" high frequency type, it has become a common practice to provide cathodes which embody a disclike emitter supported on one end of a tubular foil member carried by the cathode terminal structure. The present invention is directed to the provision of such a cathode structure wherein the tubular foil member is formed at least in part of a gettering material such as titanium, zirconium, columbium or tantalum which is arranged to operate at normal electron tube operating temperatures.

In known prior art types of structures it has become conventional to provide a gettering device in the form of a source of gettering material secured to one of the inner or outer surfaces of the supporting foil. One of the most common types of getters has been a semi-circular shaped metal device which was mounted usually on the inner wall of the foil. Barium was selected for such getters and was provided as a compound within a thin-walled sheath of a suitable soft metal such as iron or nickel-iron alloy. In operation of the tube, the temperature in the area of the getter rose to a point where the barium would vaporize and rupture the sheath and deposit on adjacent parts of the tube to perform its gettering function.

Such devices have not been entirely satisfactory, however, because the temperatures of the cathode structure become greater than optimum temperatures at which barium getters operate efficiently. Another undesirable feature is that after prolonged periods of normal operation or short periods of operation at elevated temperatures deposits of the barium getter material appear on the surfaces of the parts interiorly of the tube. Such deposits sometimes form loose particles and also sometimes accumulate sufficiently to provide undesired conductive paths and discolor the inside of the tube structure.

The use of titanium as the getter material has been attempted but was not entirely successful because titanium requires a relatively high temperature, at least 500° C. for operation as a getter. This meant placing the titanium close to the cathode parts which normally operate at elevated temperatures. Since titanium alloys rather easily with nickel it was very difficult to position the titanium in any form in contact with the parts of the cathode which are formed of nickel and which operate at high temperatures.

In electron tubes of prior art constructions, the cathode emitter is generally supported by a tube or cylinder of kovar having the getter secured to one wall thereof. In order to reduce loss of heat from the cathode, the kovar cylinder is preferably made relatively thin. In such electron tubes failure sometimes has been caused by the effect of vibration on the tube due to the relatively low mechanical strength of the kovar cylinder.

It is, accordingly, an object of this invention to provide an electron tube with a cathode structure which embodies a getter operable efficiently at normal electron tube operating temperatures.

Another object is to provide a getter in an electron tube in close proximity to the parts of the cathode structure which operate at relatively high temperatures.

A further object is to provide a cathode structure which embodies a tubular foil support for the emitter, which support is relatively rugged and which may itself perform the gettering function.

A still further object is to provide a cathode structure wherein the kovar cathode supporting foil is reinforced by the getter material.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawing, wherein

Fig. 1 is a front elevational view partly in axial section of an electron tube embodying a preferred form of the invention; and

Figs. 2 and 3 are fragmentary vertical sectional views of the cathode structure of the tube of Fig. 1 showing modifications thereof.

In accordance with the present invention the cathode of the tube embodies an emitter formed of nickel which is supported upon the cathode terminal structure by a tubular support formed of kovar foil. Superimposed upon either the inner or outer wall of the kovar tube is a layer of titanium foil, or other selected foil material which is operable as a getter material at relatively high temperatures. In such structures the getter foil is slightly shorter than the kovar foil so that it will not contact the nickel emitter and alloy therewith when the parts become heated. The getter foil in the presently described construction extends not only into the area of the cathode where the temperature is highest but also into cooler cathode areas. Thus a portion of the getter will always be functioning during normal operation of the tube.

The kovar foil may be eliminated and replaced by the getter foil, in which case a platinum cap is placed at the emitter end of the foil between the foil and the emitter. In this way the emitter and foil are not directly in contact with each other and consequently the cap will tend to prevent alloying of the getter material with the nickel of the emitter.

Referring more particularly to the drawing, wherein like characters of reference designate like parts throughout the several views, the tube embodying the invention as shown in Fig. 1 comprises a gas tight envelope generally designated 10 having a metal portion 11 at one end connected by a suitable metal-to-glass seal to a glass or similar dielectric bulb portion 12. Within the envelope and supported by portion 11, which functions as a terminal therefor, is an axially disposed anode 13. Concentric with the anode 13 is a tubular grid terminal 14 which is sealed throughout one end to the end of the glass portion 12 of the envelope. A tubular grid support 15 is sealed at one end to the inner wall of the grid terminal 14 and carries at its other end a grid 16. The grid 16 is maintained in position on the flanged end of the support by a flanged annular retainer 17 and is positioned in predetermined spaced relation from the anode 13 and from a cathode structure 18 located coaxially therewith within the grid support 15.

The cathode structure 18 comprises a first terminal formed by a pair of coaxial tubular members, an inner member 19 and an outer member 20, which are joined and form a portion of the envelope 10. Outer member 20 is flared outwardly at 21 and is sealed to one end of an annular ceramic or glass insulating ring 22. The other end of the ring 22 is sealed to one end of an annular metal ring 23 which is in turn sealed through-

out its opposite peripheral end to the inner surface of the grid support 15.

The inner tubular member 19 is sealed at its inner end to a substantially tubular cathode supporting ring 24. The supporting ring 24 is in turn sealed to an annular insulating member 25 to which is sealed 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 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 of copiously emitting electrons when heated. The emitter is connected to the support foil 27 adjacent its periphery and is disposed with its effective electron emitting surface adjacent and parallel with the grid 16 and in coaxial predetermined spaced relation therewith.

It is apparent that the terminal 19—20 and 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. The other end of the heater coil 29 is connected by 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 heater coil 29. Heating of the emitter 28 will cause copious production of electrons which will flow to the anode 13 under control of the grid 16 in the normal function of a tube of this type.

In the conventional manufacture of electron tubes it has been found to be practically impossible to completely "outgas" a tube, that is, remove all the gas from all the elements within the envelope. Therefore, gettering means is provided for removing gasses that may appear during operation of the tube.

It is known that the cathode areas of tubes of the presently described type became hot during operation, usually reaching to the vicinity of 800° C. The temperatures of the parts of the cathode structure outwardly from the emitter toward the terminals are substantially progressively lower. Therefore, it is desirable to provide a getter which will operate satisfactorily at the relatively high temperatures reached by parts of the tube structure as well as throughout the range of operating temperatures, for example, approximately between 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 to some extent into the area of the cathode operating at the highest temperatures and also into the cooler areas of the cathode.

Therefore, the present invention relates to the use of a foil 34 of such gettering material which is applied over one of the surfaces of the cathode support foil 27. Fig. 1 shows such a getter foil 34 superimposed over the inner surface of the support foil 27. It is important to note that while the getter foil 34 covers most of the surface of the support foil 27, it terminates slightly

short of the emitter 28 and thus the possibility of the material of the getter foil alloying with the material of the emitter is avoided. Conduction through the getter foil is provided, however, by its close superimposition upon support foil 27.

It is also contemplated that, as shown in Fig. 2, a getter foil 35 may be placed on the outer surface of a support foil 36 where it will function satisfactorily.

A modified structure is shown in Fig. 3 wherein the emitter 28 is supported by a single foil 38 of getter material of the desired type which is secured at one end directly to the cathode supporting ring 24. However, to prevent alloying of the foil 38 with the emitter 28, an annular spacer 39 is provided between these members to separate them physically. The spacer may be formed of kovar or like conductive material whereby a circuit is completed through the emitter and foil.

It has been found that gettering materials of the type described possess greater mechanical strength than kovar and, therefore, the structures embodying the present invention, whether of the types shown in Figs. 1 and 2 or the modification of Fig. 3, are of increased rigidity sufficient to withstand amounts of vibration which sometimes caused failure of prior art types of devices.

It is apparent from the foregoing description that an improved cathode structure for electron tubes has been provided embodying novel gettering means in accordance with the objects of this invention.

While the novel features of the invention have been shown and described and are pointed out in the annexed claims, it is to be understood that various omissions, substitutions and changes in the construction and arrangement of parts shown and described may be made by those skilled in the art without departing from the spirit of the invention. Therefore it is to be understood that all matter shown or described is to be interpreted as illustrative and not in a limiting sense.

We claim:

1. A cathode structure for electron tubes, said structure comprising a disclike emitter formed entirely of a selected electron emissive material, supporting means for the emitter comprising a tubular conductive member having one end connected directly to the peripheral portion of the emitter, the conductive member being in part a getter material which is characterized by its tendency to alloy with material of the type selected for the emitter at tube operating temperatures and which is itself operable to getter gases at relatively high temperatures, said getter material being located out of bodily engagement with the emitter to prevent alloying therewith.

2. A cathode structure for electron tubes, said structure comprising a disclike emitter formed entirely of a selected electron emissive material, supporting means for the emitter comprising a tubular conductive member having one end connected directly to the peripheral portion of the emitter, and getter means comprising a tubular foil of a getter material selected from the group consisting of titanium, zirconium and tantalum, said getter material being characterized by its tendency at tube operating temperatures to alloy with the material of the emitter, said tubular foil being mounted upon a surface of the tubular conductive member and having one end adjacent and out of bodily engagement with the emitter to prevent alloying therewith.

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