Feb. 1, 1949. O. H. FULTON, JR 2,460,382

MOUNT FOR ELECTRON DISCHARGE DEVICES

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Fig. 1.

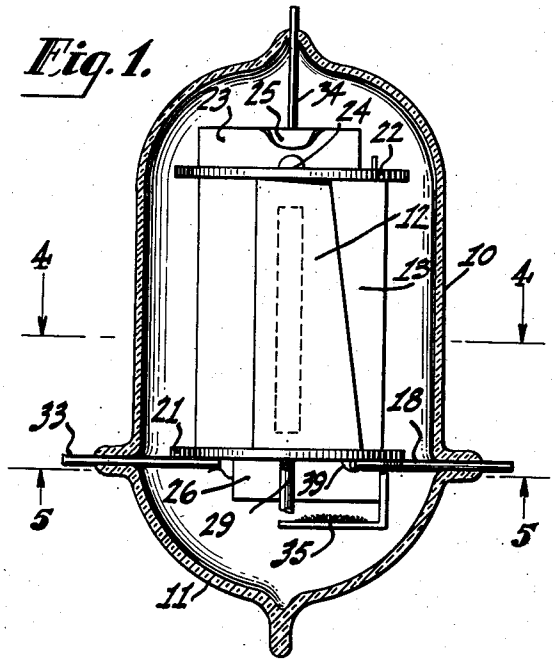


Fig. 2.

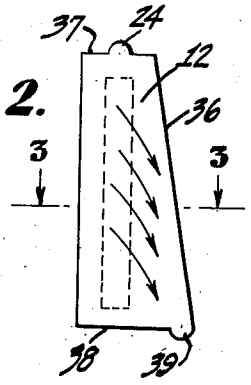


Fig. 3.

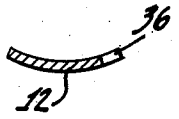


Fig. 4.

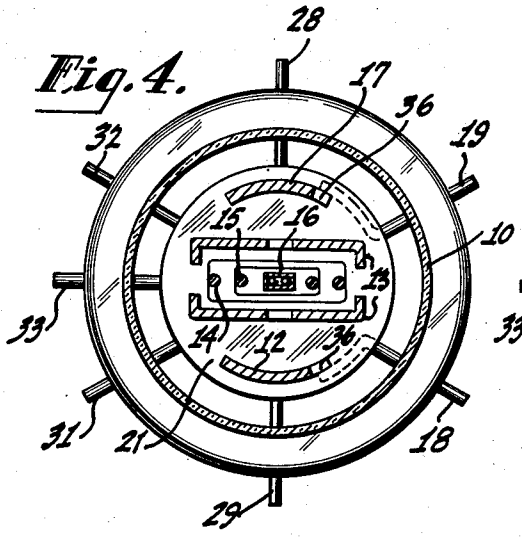
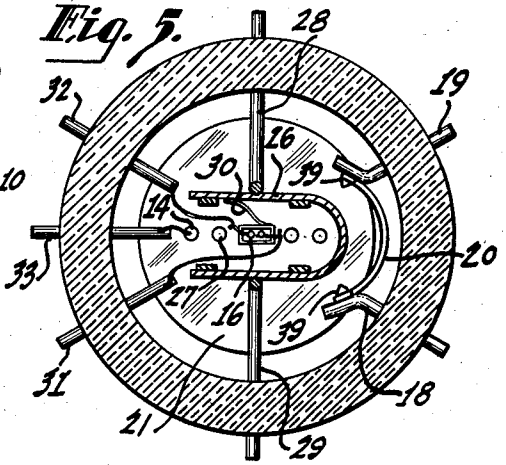


Fig. 5.



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MOUNT FOR ELECTRON DISCHARGE DEVICES

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7 Claims. (Cl. 250—27.5)

1

The present invention relates to electron discharge devices and more particularly to improved mounts therefor.

Mounts for electron discharge devices, suitable for use at high frequencies, are called upon to observe certain structural and positional requirements of their parts in order to assure good operation. The anode and its lead-in represent parts of the mount that are particularly sensitive to these requirements.

A significant consideration in the design of anodes for use at high frequencies, is the necessity to provide for adequate heat dissipation therefrom. To facilitate such heat dissipation by radiation the anode is sometimes provided with a large surface, and in some instances provided with heat radiating fins. Heat dissipation by conduction is usually relied on to a minor extent and may be effected through the anode lead-in.

Some uses to which electron discharge devices are put, for example in small-sized devices, do not permit the employment of anodes having large surfaces or heat radiating fins. In these applications heat dissipation from the anode is to a great extent limited to conduction through the anode lead-in.

Several difficulties are encountered in attempting to effect an efficient heat conduction from the anode through its lead-in. As will be appreciated, it is desirable that the heat conduction be uniform on all portions of the anode. The desired uniformity of heat conduction is not secured in some conventional structures in which the anode lead-in is connected to the anode at a portion thereof substantially centrally located transversely of the anode. Such structures result in comparatively good heat conduction from areas adjacent the lead-in connection, but leaves other areas of the anode exposed to the danger of overheating. Furthermore, in small size devices, a relatively large portion of the anode surface is exposed to impinging electrons which impart their kinetic energy to this surface to generate heat therein. To require that this portion of the anode surface also conduct the heat away that is thus generated therein, results in inefficient heat dissipation.

Another important consideration affecting the design of anodes for electron discharge devices useful at high frequencies is the space requirement between the anode lead-in and projecting parts of the input electrode to avoid undesired capacity effects therebetween. Not only should these elements be spaced from each other as far as possible consistent with desired operating

2

characteristics but in addition the arrangement of the lead-ins to the anode and to other electrodes should be such as to render further electrostatic shielding between them, as by a metallic shield, easy to accomplish. In addition the lead-ins should be as short as possible to further reduce capacity effects therebetween.

A further consideration that is presented in the design of anodes for use at high frequencies, particularly in small sized devices, is associated with the requirement that the anode possess sufficient mechanical strength, not only to give it a support function in the mount but also to enable it to withstand the tendency to buckle under the relatively high temperatures incidental to operation.

While these considerations and the difficulties associated therewith appear to be unrelated and thus suggest distinct treatment, it is obvious that a common expedient fulfilling all of the requirements of an anode and its lead-in for good operation at high frequencies would be desirable.

It is accordingly an object of the present invention to provide an electron discharge device having an improved mount structure, and more particularly an anode structure having characteristics making it suitable for use at high frequencies.

It is another object of my invention to provide an anode for an electron discharge device having a structure which permits substantially uniform heat conduction therefrom and provides for desired spacing of its lead-in from the input electrode.

A further object is to provide an anode for an electron discharge device useful at high frequencies which possesses desirable heat dissipating properties, and mechanical strength, and permits desired spacing between its lead-in connection and the input electrode to minimize capacity effects therebetween and to contribute convenience in the employment of an elctrostatic shielding means.

A still further object of my invention is to provide an anode for a small sized electron discharge device useful at high frequencies wherein the surface portion thereof wherein heat is generated during operation of the device, is distinct from the surface portion thereof through which heat is conducted away from the anode.

An additional object is to provide an anode for an electron discharge device having a structure which permits the use of a relatively short lead-in conductor.

The invention will be understood best from a

detailed description of an embodiment thereof taken in connection with the attached drawing and the scope thereof will be pointed out in the appended claims. In the drawing:

Figure 1 shows an elevation partly in section of an electron discharge device in which the novel anode of my invention is used;

Figure 2 is an elevation of one part of a two-part anode employing my invention, the heat generating and heat conducting surface portions being clearly indicated;

Figure 3 is a cross sectional view along the line 3—3 of Figure 2 and shows the curvature which may characterize my anode;

Figure 4 is a section taken through the line 4—4 of Figure 1 looking towards the base of the device and shows the electrode arrangement thereof and particularly the mounted relationship of my novel anode parts; and

Figure 5 is a section taken through the line 5—5 of Figure 1 looking towards the upper part of the device from a plane below that of the lead-in conductors and shows the convenient connections of my anode to its lead-in conductors.

Referring now to the drawing in more detail, there is shown in Figure 1 a relatively small sized electron discharge device of the acorn type employing my invention. Envelope 10 having base 11 encloses an electrode mount including anode part 12 of a two-part anode and suppressor grid 13. As more clearly shown in Figure 4, the envelope also encloses a screen grid 14, signal grid 15, cathode 16 and second anode part 17. Anode parts 12, 17 are connected to lead-ins 18, 19 shown in Figure 5, and electrical connection between the parts is accomplished by connector 20.

Insulating spacer plates 21, 22 are provided at the ends of the electrode assembly. Suppressor grid 13 has a portion 23 thereof extending from the surface of spacer 22 remote from the electrode assembly to shield projecting ear 24 of anode part 12 from a projecting portion not shown of the signal grid 15 and signal grid lead-in 34. Portion 23 of the suppressor grid has an ear 25 to further contribute to its shielding action. Suppressor grid 13 is also provided with a lower portion 26 extending from the surface of spacer 21 remote from the electrode assembly, to provide an electrostatic shield between anode lead-ins 18, 19 and projecting portions 27 of the signal grid 15 shown in Figure 5.

The lower portion 26 of suppressor grid 13 is connected to lead-ins 28, 29 and to cathode 16 by wire 30. Heater connections for the cathode are provided by lead-ins 31, 32. Screen grid 14 is connected to lead-in 33. Signal grid 15 is connected to lead-in 34 which enters the envelope 10 at the end thereof remote from base 11. A getter 35 suitably supported completes the device.

In accordance with my invention anode part 12 is of novel construction to give it desired heat conducting properties and to permit it to be mounted in such relation to the other electrodes as to reduce undesired capacity effects between its lead-ins and projecting portions and lead-ins of other electrodes of the mount. This novel structure of my anode is shown in the drawing as applied to a two-part anode for illustrative purposes only. Figure 2 shows one of the parts of a two-part anode which includes my invention. This anode part is provided with a tapered edge 36 resulting in end portions 37, 38 of unequal lengths. End portion 37 is provided with an ear 24 which may be positioned centrally of said end portion. End portion 38 is provided with ear 39 adjacent the tapered edge 36. Anode part 12 may be curved as shown in Figure 3 to contribute added mechanical strength thereto.

Figure 4 shows the relationship of anode part 12 to anode part 17. The concave surface of the anode parts and their tapered edges 36 are in oppositely disposed relation. Part 17 is also provided with ears similar to ears 24, 39 of anode part 12 and corresponding ears on the anode parts are also oppositely disposed. Ears 24 of the anode parts 12, 17 are received in suitable apertures in top spacer 22, and the ears 39 adjacent the tapered edge of the anode parts are received in apertures in bottom spacer 21. As shown best in Figure 5, ears 39 are connected to anode lead-ins 18, 19.

The provision of tapered edge 36 on my anode parts and the positioning of ears 39 adjacent these tapered edges contributes to good heat conduction from the anode and reduction in undesired capacity effects between input and output elements of the device. In the particular use illustrated of my invention in a relatively small sized device, the surface area of the anode is necessarily limited. Therefore, it is not feasible to rely entirely on radiation for heat dissipation therefrom. The structure of my novel anode therefore is designed to effect heat dissipation from the anode by conduction to a greater extent than heretofore possible.

That increased heat conduction away from the anode is accomplished by the novel structure of my anode will become evident from the following explanation. As shown in Figures 1 and 2, the dotted lines on anode part 12 indicate the portion of its surface which is exposed to electrons from the cathode. Such electrons strike the surface within the dotted lines and release their kinetic energy thereto, thus generating heat in this surface. A relatively small portion of this heat is radiated from the anode and the greater portion must be dissipated by conduction. As is well known, the conduction of heat proceeds from high temperature regions of a body to low temperature regions thereof and tends to equalize the temperature of all regions of the body. The general tendency, therefore, is transfer of heat from the portion of the anode within the dotted lines to other cooler portions of the anode. There is a relatively small amount of heat that will be conducted to the end portion of the anode due to the smaller areas at these portions that are outside of the dotted line portion. Therefore, if the ear 39 were placed adjacent the dotted line portion of the anode surface, such as centrally of end portion 38, conduction of heat through the lead-in to which such ear would be connected would be inefficient. Such inefficiency would result from the fact that very little heat would be directly conducted from the dotted portion of the anode surface to such lead-in due to the high temperature of such portion which would oppose heat transfer therethrough. Heat transfer from the edge portions outside of the dotted portion to the lead-in would also be inefficient since the heated portion remote from the lead-in would have to traverse intermediate portions of high temperature.

As shown in Figure 2, the novel structure of my anode provides for the efficient conduction of heat from the dotted line portion of the anode to the ear 39 connected to a lead-in. As the arrows indicate, heat is conducted from all longitudinal portions of the dotted line enclosed surface portion of the anode to the ear 39 and con-

sequently to the lead-in to which it is connected. The tapered form of the anode provides a gradually increased area from end 37 to end 38 for heat conduction. Therefore, the heat conducted from different portions of the heated area within the dotted lines follows distinct paths through the tapered side portion of the anode to the ear 39 and the lead-in to which this ear is connected. There is, therefore, a temperature gradient from each transverse portion of the area within the dotted lines and the heat dissipating ear 39 of the anode. This results in a uniform conduction of heat from all portions of the heated area and contributes to good operation of the device in which my novel anode is used.

In the embodiment illustrated the mount is supported on the lead-ins which extend radially through the envelope wall. The lead-ins therefore have a substantial cross sectional area to enable them to perform their supporting function. It will be noted from Figure 5, that my novel anode structure permits direct connections between ear 39 thereon and the large cross sectioned lead-ins 18, 19. Heat from the anode is, therefore, transferred directly to these lead-ins through which it is conducted to external heat dissipation means, not shown.

From the foregoing it will be appreciated that the combination of the tapered edge 36 and the protruding ear on the wider end 38 adjacent the tapered edge for connection to a lead-in results in efficient heat conduction from the anode. In addition, the disposition of ear 39 adjacent the tapered edge 36 also contributes to a desired arrangement of the lead-ins to the anode and to other electrodes of the device. Thus, as will appear from Figure 5, anode leads 18, 19 may be of reduced length since the wider end 38 of the anode and the ear 39 thereon extend toward the envelope wall and the lead-ins. This reduced length of the lead-ins 18, 19 contributes to a reduction of undesired capacity effects between these lead-ins and lead-ins serving other electrodes or projecting portions of other electrodes extending below bottom spacer 18.

Not only does the structure of my anode permit the use of shorter lead-ins, but the portion represented by ear 39 to which the lead-ins are connected is displaced a desired distance from other elements of the device. This further aids in reducing undesired capacity effects in the device.

Furthermore, the spacing between the anode-lead-in connections and other elements of the device provides a convenient space within which to mount a metallic electrostatic shield, to further reduce capacity effects between input and output elements of the device. Thus a U-shaped metallic shield 26 may be interposed between anode lead-ins 18, 19 on the one hand and the cathode heater and screen grid lead-ins 31, 32, 33 and projecting portions 27 of the signal grid on the other hand. The end of the shield 26 adjacent the anode lead-ins 18, 19 is closed, since these lead-ins are not required to enter the enclosure of the shield. However, the end of the shield remote from the anode lead-ins 18, 19 is open to permit entering of leads to the screen grid and cathode heater, the projecting ends of which are enclosed by the shield.

The structure of my novel anode also contributes to its mechanical strength. Thus the additional metal body provided at one end adds rigidity to the anode. If desired, the anode may be curved as shown in Figure 3 to add to its mechanical strength, although my invention does not require it.

While my invention has been described in connection with a two part anode employed in a small sized acorn type tube, it is not intended that it be limited thereto. For example, a single part anode may include my invention. Neither do I wish to be limited to a straight tapered edge as shown in the drawing. Edge 26 may be curved or stepped to provide the desired gradient of heat conduction without departing from the invention. Although the invention finds particular usefulness in small sized devices, it can also be employed in larger devices to advantage. Therefore I desire to include the foregoing and other modifications which may suggest themselves to persons skilled in the art within the scope of the invention as pointed out in the appended claims.

I claim:

1. An electron discharge device having an anode and a cathode, said anode having a surface for receiving impinging electrons from said cathode whereby heat is generated in said anode, and means for efficiently conducting said heat from said anode, said means comprising a progressively increased lateral extension of said anode from one end thereof to the other whereby one end of said anode is wider than the other end thereof, and a lead-in connected to said anode at said wider end thereof.

2. An electron discharge device having an anode and a cathode, said anode having a surface for receiving impinging electrons from said cathode, whereby heat is generated in said anode, and means for efficiently conducting said heat from said anode, said means comprising a progressively increased lateral extension of said anode from one end thereof to the other, whereby one end of said anode is wider than the other end thereof, and a lead-in connected to said anode at said wider end thereof eccentrically with respect to the longitudinal axes of said anode.

3. An electrode for a high frequency electron discharge device for intercepting electrons, said electrode having a different cross sectional area at axially displaced locations thereon, said cross sectional area being greatest at one end of one dimension of said electrode, one edge of said electrode extending in said one dimension parallel to the longitudinal axis thereof, the opposite edge of said electrode extending angularly with respect to said one edge, and a lead for said electrode connected to said one end thereof adjacent said opposite edge, whereby heat from said electrode is efficiently conducted therefrom through said lead.

4. A high frequency electron discharge device including input and output electrodes, an insulating spacer plate engaging one end of each of said electrodes for supporting the same in axially parallel relation, said input electrode extending through said plate to a normally inoperative region of said device, said output electrode having opposite longitudinal edges spaced differently from the axis thereof, and a lead-in to said output electrode at said one end thereof adjacent the one of said edges spaced farthest from the opposite edge thereof.

5. A high frequency electron discharge device including cathode grid and anode electrodes in axially parallel relation, an insulating spacer having apertures therein for supporting said electrodes on one face thereof, said cathode and grid extending coextensively through said apertures for connection to lead-ins, an ear on said

anode adjacent a longitudinal edge thereof and extending through one of said apertures for connection to a lead-in, said edge being farther displaced from the lead-in to said grid than other edges of said anode for maximum separation of the respective lead-ins serving said anode and grid.

6. A high frequency electron discharge device including anode, cathode and grid electrodes, an insulating plate for supporting said electrodes on one face thereof, said cathode and grid electrodes extending through said plate to project beyond the opposite face thereof and having parallel sides, the extending end portions of said cathode and grid being laterally spaced from each other to the same extent as the cathode and grid proper, said anode having diverging sides to provide a larger cross section at one end thereof than the other, one of said sides being parallel to said cathode and grid, said end having the larger cross section being adjacent said one face of said plate, an ear on said anode at said one end thereof adjacent an edge thereof, said ear extending through said plate, and lead-ins for said electrodes connected thereto beyond the other face of said plate.

7. An anode for an electron discharge device having a predetermined surface shape for receiving impinging electrons and for uniformly conducting heat therefrom, said shape being defined by two parallel ends and two angular sides, one of the said angular sides being normal to said two parallel ends, one of said parallel ends extending laterally farther from said one of said angular sides than the opposite end, an ear on said one of said parallel ends adjacent the other of said angular sides, and a lead-in of relatively large cross section connected to said ear.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,125,317	Ronci	Aug. 2, 1938
2,167,885	Glans	Aug. 1, 1939
2,227,025	Schlesinger	Dec. 31, 1940