Jan. 24, 1950 G. S. JACKSON 2,495,259

TAUT GRID ELECTRODE FOR ELECTRON TUBES

Filed Nov. 14, 1945 2 Sheets-Sheet 1

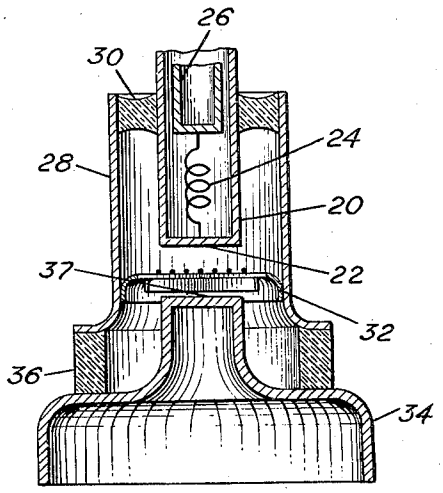


FIG. 1

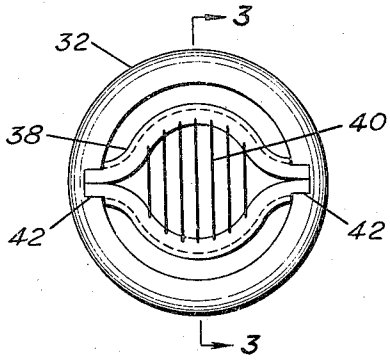


FIG. 2

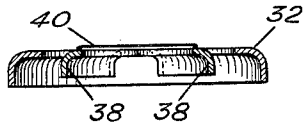


FIG. 3

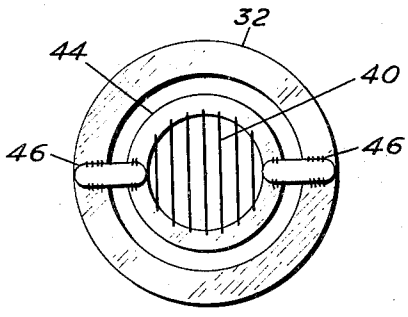


FIG. 4

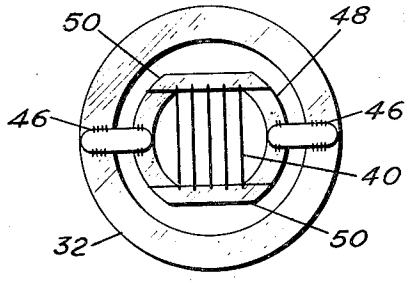


FIG. 5

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TAUT GRID ELECTRODE FOR ELECTRON TUBES

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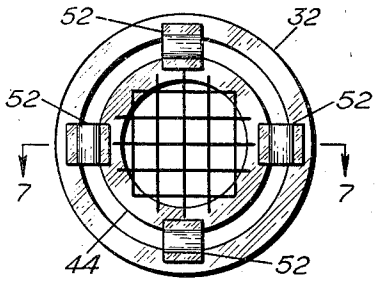


FIG. 6

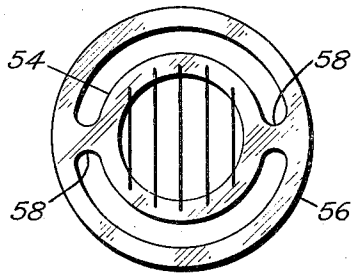


FIG. 8

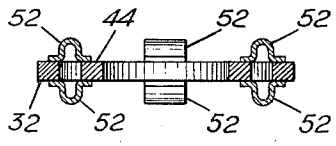


FIG. 7

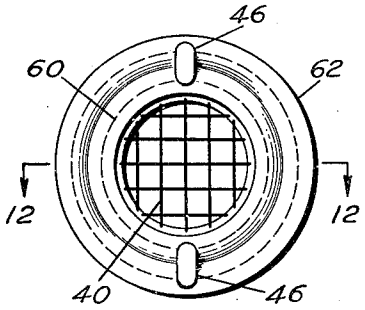


FIG. 11

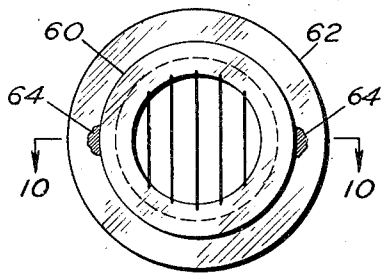


FIG. 9

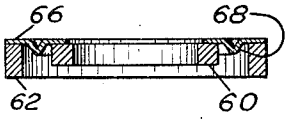


FIG. 12

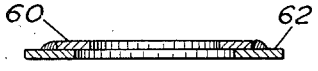


FIG. 10

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TAUT GRID ELECTRODE FOR ELECTRON TUBES

George Samuel Jackson, United States Navy

Application November 14, 1945, Serial No. 628,630

12 Claims. (Cl. 250—27.5)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

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This invention relates to a mount for an electrode of an electron tube to prevent deformation on heating. More particularly, this invention relates to a mount for a planar grid constructed to keep the grid wires taut at high operating temperatures.

The use of higher frequencies in radio transmission has brought about radical changes in design of the electron tubes used in radio frequency circuits. One outgrowth of the use of higher frequencies is the so-called planar type tube in which the electrodes are arranged in a series of parallel planes. Concurrently with the use of higher frequencies, steps have been taken to decrease the size of the tube. This has resulted in operating temperatures higher than those previously encountered.

Because of the higher frequencies and the higher operating temperatures, frequency drift caused by the deformation of tube electrodes, particularly the grids, has become more pronounced. The deformation of the grid caused by the heat generated in the tube elongates the grid wires thus permitting them to sag. This disturbs the spacing relationship between the grid and the other electrodes, and causes undesired changes in the operation characteristics of the electron tube. Not only is such deformation disadvantageous in the operation of the electron tube when it is used in a static mount, but the altered characteristics become still more objectionable when the tube is subject to shock and vibration. The increasing use of electron tubes on moving vehicles especially for military purposes, makes it necessary that the grid structure be kept taut, and therefore less subject to deformation upon shock and vibration. It is an object of my invention to provide supporting structure for a grid or other electrode which keeps such electrode taut at elevated temperatures.

It is a further object of my invention to provide a mount for an electrode which permits the electrode to expand to equal or greater extent than the mount when subject to an increased temperature.

It is another object of my invention to provide an electrode-supporting structure which enables expansion to take place upon an increase in temperature without affecting the ability of the support to conduct high-frequency currents and/or the heat generated in the tube when in operation.

It is still another object of my invention to provide an electrode mount which is resistant to deformation caused by shock and vibration particularly under high temperature conditions,

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In the drawing:

Figure 1 is a sectional view of an electron tube to which my structure is particularly applicable.

Figure 2 shows a grid structure consisting of oppositely disposed bowed members.

Figure 3 is a sectional view taken on section 3—3 of Figure 2.

Figure 4 shows a ring support for a grid maintained in place by diametrically-placed supporting tabs.

Figure 5 shows a modification of the structure shown in Figure 4.

Figure 6 shows the use of an expansive ring resiliently supported.

Figure 7 is a sectional view taken on section 7—7 of Figure 6.

Figure 8 shows an expansive ring-type grid support with an integrally formed base.

Figure 9 illustrates a construction for a grid support in which the supporting ring overlaps the base member.

Figure 10 is a sectional view taken on section 10—10 of Figure 9.

Figure 11 sets forth an expansible electrode support with the addition of an annular conducting member between the supporting ring and the base.

Figure 12 is a sectional view taken on section 12—12 of Figure 11.

In Figure 1 a sectional view of a modern type of so-called "oilcan" tube construction is shown in simplified form. The tube consists of a cathode 20 which produces radiation from the circular end portion 22. The cathode is heated by means of a heater 24 supplied through terminal 26. A cylindrical conductor 28 is hermetically sealed to the cathode by means of the annular glass seal 30. The cylindrical conductor as in the usual tube of this type is rigidly connected to the grid-supporting metal ring 32 and to the anode 34 by means of an annular glass seal 36. It will be noted that the cathode, anode and grid are planar surfaces in vertically spaced relation. Additional grids may be interposed between the cathode and the anode in accordance with the tube characteristics desired. It will be seen that the grid wires are in close thermal relation with respect to the heated cathode 20 and the heat generating anode surface 37. The heating produced thereby causes the grid wires to expand and to sag, especially with the aid of gravity unless provision is made for keeping the wires taut. As above stated, the change in position of the grid wires undesirably varies the electrical operating characteristics of the tube.

In Figure 2 is shown one construction which insures that the grid wires shall remain taut even under conditions of elevated temperature. The mount, referring to the assembly, comprises a metal grid frame which consists of two oppositely-disposed bowed members 38. These members are mounted in an aperture provided in the base or supporting member 32. The grid wires 40 are fastened to the frame members 38 and are arranged in a direction perpendicular to the extension 42 at which the frame member is supported on the base member. Members 38 serve not only as mechanical supports and electrical connections to the grid wire but also provide through extension 42 a good path for conduction of heat from them to external metal shell 28.

It will be seen that the frame members 38 form a roughly circular grid space. The frame members 38 are formed of a metal having a coefficient of expansion equal to or greater than the grid wire 40 attached thereto. However, the base member 32 is constructed of a metal having a low temperature coefficient of expansion. Thus, as the temperature of the assembly is increased and the length of the grid wires becomes greater, expansion taking place in the frame members 38 increases the amount of "bow" thus keeping the grid wires taut. Preferably the frame members 38 should have a temperature coefficient of expansion which produces elongation of the grid wires slightly greater than that due alone to their elevated temperature. The differential expansion should preferably not be sufficiently great to impart to the grid wires a permanent elongation or "set" under the temperatures encountered in service although this condition may be obtained if desired.

Figure 4 shows the use of a grid supporting ring 44 constructed of material having suitably high temperature coefficient of expansion. The ring frame 44 is in turn supported by diametrically placed metal bridging tabs 46 which are rigidly attached, for example by welding, to the base 32 and to the ring. The expansion characteristics of the tabs is not critical although it is preferable to use material which has a low temperature coefficient of expansion. In operation an increase of temperature causes the ring 44 to expand in the direction of lateral freedom thereby compensating for the linear expansion taking place in the grid wires and otherwise causing them to sag. The grid wires may be attached to the supporting ring 44 by any desired means, for example by welding. Tabs 46 also provide paths for conduction of heat from the grid structure to the exterior of the tube.

Figure 5 shows another embodiment of my invention in which the rings are replaced by expansion members 48 joined by end pieces 50 of low-expansion coefficient material to which the grid wires 40 are attached.

Figures 6 and 7 show a resilient form of metallic connectors 52 joining the grid ring 44 with the supporting base 32. This construction permits the grid ring to expand freely in all directions and yet maintains the desired fixed planar relationship between the grid ring and the supporting base. Connectors 52 also serve to conduct heat from the grid structure to the exterior of the tube.

In Figure 8 I have shown a structure in which the grid-supporting ring 54 and a supporting base 56 are formed integrally from the same piece of metal. Integral tabs 58 serve the purposes of extension 42, Fig. 1, tabs 46, Figs. 4 and 5 and connectors 52, Figs. 6 and 7.

In Figure 9 the supporting ring 60 overlaps the base 62. The ring and the base are fastened together for example, by means of a tack weld at points 64. This structure has the advantage that the thermal path is shortened by reason of the close proximity of the supporting base and the grid ring. It has the further advantage of providing a means for minimizing the capacitance and inductance effect of the separate grid ring and supporting base structure of Figures 2, 4, 5, 6 and 8.

In Figures 11 and 12 improved thermal contact between the base member 62 and the grid ring 60 is provided by joining the base and grid ring by an annular conductor 66. This conductor is made of thin flexible material of suitable thermal and electrical characteristics. If desired, a rib or convolution may be formed in this conductor as shown at 68 in order to take up the differential expansion occurring between the ring 60 and the base 62. The diametrically placed tabs 46 are joined to the grid ring 60 and the base 62, for example, by means of tack welds. These tabs maintain the grid ring 60 and the base 62 in fixed planar relationship.

It will be seen in Figures 6 and 11 that the grid-supporting structure which I propose is equally suitable for a grid composed of mutually perpendicular wires in the form of a network or screen. The screen type of grid is also applicable in the structures of a network or screen. The screen type of grid is also applicable in the structures shown in Figures 2, 4, 5, 8 and 9 since the tautness of the wires running in one direction will result in the maintaining in place of the mutually perpendicular wires.

While I have, for the sake of ready understanding, described my electrode supporting structures with particular reference to a grid, it will be obvious to one skilled in the art that this structure is applicable to any electrode or multiple electrodes within an electron tube in which it is necessary to maintain a planar surface in spite of use over a wide temperature range.

It will be obvious to one skilled in the art that a number of grids in accordance with my construction may be placed in superposed relation to maintain constant overall tube characteristics even at elevated temperatures.

While the electrode supporting structure is particularly applicable to use in the tube having vertically stacked electrodes such as the "lighthouse" or "oil can" type, my invention is applicable in other types of tubes where it may be desired to maintain the shape of the electrode or to compensate for expansion under conditions of elevated temperatures.

While the invention admits various additional modifications and alternative constructions, I have shown in the drawings and have described only the preferred embodiments. It is to be understood, however, my invention is of scope defined by the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What I claim is:

1. A mount for a planar electrode comprising a base having an aperture, a pair of oppositely-disposed bowed thermally expansive members secured in said aperture, the ends of said bowed

members engaging said base, and a metallic electrode consisting of a plurality of conductors in a plane, the ends of said electrode conductors engaging said bowed members.

2. The subject matter as claimed in claim 1, said base member being provided with diametrically-opposed notches receiving the ends of said bowed members.

3. An electron tube including a mount for a planar electrode comprising a ring member designed normally to expand upon being subject to increased temperature, a planar electrode fastened at displaced points thereof to said ring, said electrode consisting of material having a thermal coefficient of expansion not greater than that of said ring, a base member, and supporting tabs engaging said ring and said base member at least at two diametrical points of said ring to allow expansion of said ring.

4. An electronic device comprising, a base ring, a frame composed of bowed members in confronting relationship defining an opening, the ends of the bowed members attached to the base ring and defining bridging means between the frame and base ring, and a filamentary grid connected to the bowed members and spanning the opening perpendicularly of the direction of the extensions.

5. In an electron tube, a base ring, a frame member centered in respect to the base ring and consisting of end pieces and oppositely bowed confronting expansion members connected by the end pieces to define an opening, extension tabs attaching the expansion members to the base ring and forming bridging means between the frame and base ring, and a filamentary grid attached to said frame member and spanning the frame opening perpendicularly to the direction of the extension tabs.

6. An electronic device of the class described, comprising a metal ring and a rigid mounting therefor, a thermo-expansive apertured frame disposed parallel to said ring with its aperture substantially aligned with the hole of the ring, a plurality of parallel grid wires secured at their ends to opposite sides of the frame, and means rigidly securing said frame to said ring in two diametrically opposite zones that are aligned in a direction perpendicular to the grid wires.

7. An electrode comprising, a first annular metallic member, a grid consisting of a plurality of substantially parallel wires the opposite ends of which are attached to opposite sides of said annular member, and a pair of sole supporting members for said annular member, said supporting members being attached to opposite sides of said annular member at points which form a line substantially perpendicular to said parallel wires, and a second annular metallic member which is relatively fixed surrounding said first annular member, said second annular member being attached to said supporting members to restrain expansion of said first annular member in a direction substantially perpendicular to said parallel wires.

8. In an electronic device having a mount for a planar electrode comprising a ring of conducting material, a plurality of wires fastened at their ends to said ring, forming a grid, said wires being constructed preferably of material having a thermal co-efficient of expansion not greater than that of said ring, a rigid base member, and ring supporting elements attached to said base member and engaging said ring at diametrically located points whereby expansion of the ring relative to the base is facilitated.

9. In an electronic device, a base ring, a ring-like frame centered within and in respect to said base ring and consisting of diametrically located heat expansible members and diametrically located end pieces joining the ends of the expansible members, supporting tabs attaching the expansion members to said base ring at the approximate central points of the respective expansion members, and a filamentary grid connected at its ends to said end pieces, said end pieces having a heat expansibility less than that of said expansion members.

10. An electronic device comprising a rigid support element, a heat-expansible, curvilinear, elongated frame secured fixedly at displaced points to said support element, and a grid wire attached to said frame and extending perpendicularly to a line joining said displaced frame points, said grid having a co-efficient of thermal expansion not greater than that of said frame whereby the grid is held taut irrespective of variation in operating temperatures of the device.

11. In an electronic device having a mount for a planar electrode comprising a ring of conducting material, a plurality of wires fastened at their ends to said ring, forming a grid, said wires being constructed preferably of material having a thermal co-efficient of expansion not greater than that of said ring, a rigid base member, and ring supporting elements attached to said base member and engaging said ring at diametrically located points whereby expansion of the ring relative to the base is facilitated, said base member and ring being coplanar and integral.

12. An electronic device as described in claim 6 modified in that the frame surrounding the frame aperture overlies the inner edge of the base ring.

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