

Dec. 16, 1969

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3,484,645

NON-INTERCEPTING GRID STRUCTURE FOR AN ELECTRON TUBE

Filed March 6, 1967

FIG. 1

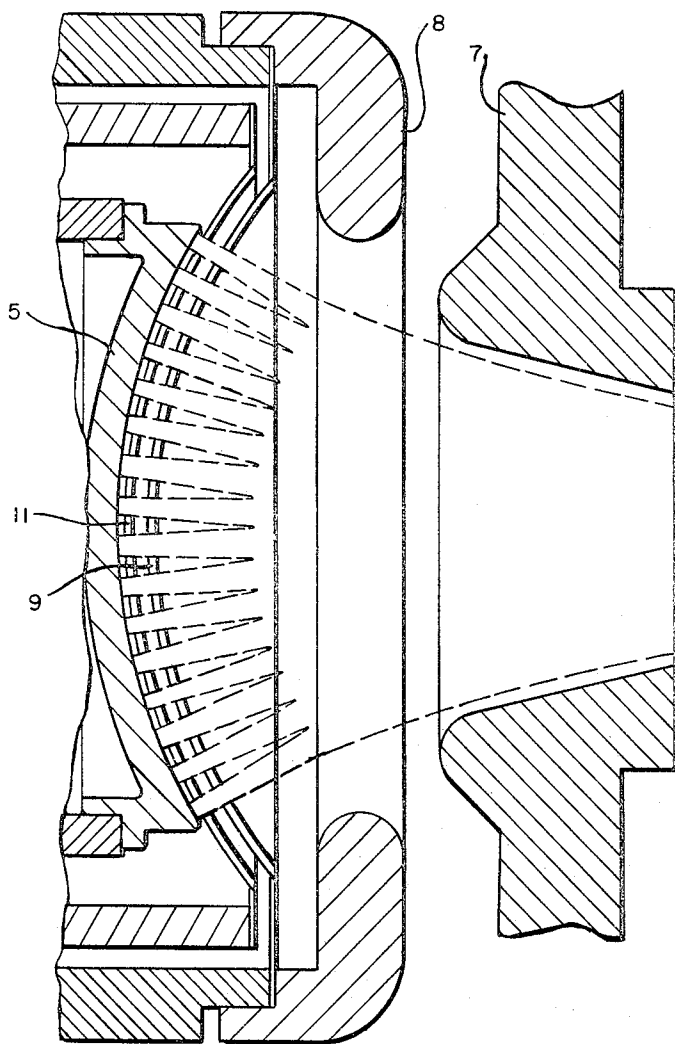
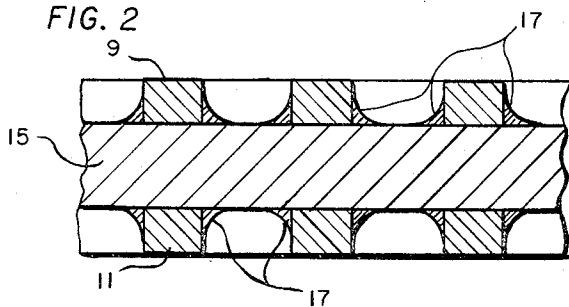


FIG. 2



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Filed Mar. 6, 1967, Ser. No. 621,405

Int. Cl. H01j 1/46, 1/52, 17/04

U.S. Cl. 313—348

4 Claims

ABSTRACT OF THE DISCLOSURE

A non-intercepting grid arrangement for electron tubes using a pair of aligned grids, wherein one grid is placed on or near the cathode and operates at cathode potential, thereby shielding the other control grid from interception.

The present invention relates to electron tubes and more particularly to a special grid structure therefor.

The performance of electron tubes is dependent upon the flow of electrons between the cathode and anode. In many tubes, this electron flow is hindered in that the electrons leaving the cathode surface strike the mesh of the control grid. An example of one such tube in which the number of electrons striking the mesh of the control grid presents a great problem is a convergent flow electron gun wherein the cathode and grid surfaces are spherical. In such an arrangement, the electrons leave the cathode in a direction which is essentially normal to the point of departure from such surface and thus strike the mesh of the control grid in substantial quantities rather than passing unhindered through the grid. This striking of the control grid thereby tends to reduce the performance of such tubes.

It is therefore an object of the present invention to provide an electron tube having improved performance characteristics.

It is another object of the present invention to provide an electron tube in which the flow of electrons between the cathode and anode is improved.

It is a further object of the present invention to provide a novel grid construction for electron tubes.

In accordance with the present invention, the novel grid construction comprises a first control grid and a second grid spaced from and aligned with the first grid. The second grid is disposed between the control grid and the cathode. In this arrangement, with the second grid preferably being held at cathode potential, the second grid acts as a "shadow" grid in that it shadows the electrons from the control grid so that they are not intercepted by the control grid.

According to another feature of the present invention, during the fabricating operation both the control grid and the shadow grid are brazed to a common spacer by means of gold-copper fillets. Such fillets provide the necessary strength for the shear stresses which are created when the grid structure is drawn into a spherical configuration.

Other objects and features of the invention will become apparent from the following description when considered in connection with the accompanying drawings in which:

FIG. 1 is a partial cross sectional view of an embodiment of the present invention incorporated into a convergent flow electron gun with spherical cathode and grid surfaces; and

FIG. 2 is a partial cross sectional view of the grid construction of the present invention.

Referring now to the drawings, there is shown in FIG. 1 a convergent flow electron gun provided with a cathode 5 and having a spherical surface. It should be noted, however, that although the present invention will be described

in terms of convergent flow electron guns, it is not limited thereto and may be used in planar form in other tubes. As shown, there is also provided an anode 7, a focus electrode 8 and a control grid 9. In accordance with the present invention an additional grid 11 hereinafter referred to as the shadow grid is arranged between the control grid and the cathode. As shown both the control grid 9 and shadow grid 11 are curved to conform with the spherical configuration of the cathode and are spaced apart and secured within the tube.

The operation of the grid arrangement is such that the shadow grid 11 is placed on or near the cathode and is preferably maintained at cathode potential. The control grid 9, however, is maintained at a few hundred volts below cathode potential for beam cutoff and for beam operation; the control grid is maintained at 200 to 500 volts positive with respect to the cathode; the particular voltage, of course, being dependent upon the beam voltage. The use of the shadow grid substantially reduces electron interception by the control grid. This reduction occurs because of the alignment of the mesh of the shadow grid and control grid, the spacing of the grids, and that the shadow grid is held at cathode potential. Thus, the shadow grid does not cause deflection of the electrons and the electrons which pass through the shadow grid are so close to the control grid that the control grid cannot cause their deflection and interception. Therefore, since the electrons have not been intercepted by the shadow grid, the electrons will also pass through the control grid as shown in dashed line.

FIG. 2 shows the grid structure during a part of the fabricative process. As shown, the structure includes the control grid 9 and the shadow grid 11 mounted on a common spacer member 15 which may be made of any suitable material such as stainless steel. The structure is formed by aligning two identical flat photo etched grids of, for example, molybdenum, on opposite sides of the common spacer and then brazing the grids to the spacer. If the spacer thickness is uniform, the spacer thickness will then be equal to the radial grid to grid spacing when the grids and spacer are drawn, i.e., bent into a spherical shape to conform to the configuration of the cathode 5. As shown in FIG. 1, the shadow grid being adjacent to the cathode, the shadow grid is proportionately larger than the control grid 9 by the thickness of the spacer member.

Due to the grids being rigidly secured to the spacer and in alignment in planar form, when the spacer is deformed, the grid portions on opposite sides thereof are similarly deformed with the grids remaining in alignment relative to the common center of curvature. This structure thus reduces deflection and interception of the electrons by the control grid to an extent which has not heretofore been possible. In fact, in accordance with the present invention, the alignment of the mesh of the grids relative to their common center of curvature is such that electron interception by the control grid is reduced approximately 95% of that achieved by prior art arrangements.

It should be noted, however, that in order to obtain and maintain the required radial mesh alignment when the grids are being deformed to the desired configuration, a high strength grid to spacer braze is required. Also, it has been found that grids having a hexagonal mesh are better able to withstand the stress occurring in the bending or drawing operation than those grids having a rectangular mesh. Accordingly, grids having a hexagonal mesh are preferred. It has also been found that the shear stress produced at the grid-spacer interface during the drawing operation necessitates the presence of braze fillets 17 as shown in FIG. 2. However, the fillet cannot be obtained by a pure metal or a eutectic braze alloy since the liquid state flow of such materials is not controllable. Thus, in accordance with the method of forming the grid struc-

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ture of the present invention, a gold-copper fillet is used for brazing the grids to the spacer.

The brazing of the grids to the spacer is carried out by first gold plating the grid and copper plating the spacer to equal thicknesses, e.g., approximately .0003 inch per surface, and firing at 980° C. This temperature is approximately mid-way between the temperature at which eutectic percentages melt (880° C.) and the melting temperature of copper and gold (1100° C.). The result of this firing is that the copper-gold liquid flows in the direction of the copper until the percent of copper in solution corresponds to the 980° C. temperature. The copper-gold liquid also flows in the direction of the gold plate until the solution is gold saturated for the 980° C. temperature, as a consequence of which, the required fillet having the desired shear stress characteristic is formed.

The thus formed structure may then be drawn or bent to conform to the configuration of the cathode with the fillets maintaining the original grid mesh alignment. When the desired deformation is obtained, alignment holes may be provided about the flange of the formed structure. The metallic spacer is then dissolved so that the shadow grid and the control grid may be mounted within the tube. The mounting is such that the grids are spaced apart by the same distance as the spacer with the alignment holes serving to maintain the alignment in the tube. The grids may thus be maintained at different potentials for beam operation whereby electron interception by the control grid is substantially reduced and improved electron tube operation results.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. An electron tube having reduced electron interception at the control grid comprising: a cathode for emitting electrons; an anode; a control grid disposed between said

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anode and said cathode and maintained at a potential positive with respect to the cathode for beam operation; and a shadow grid spaced from said control grid and arranged between said cathode and said control grid, said shadow grid being maintained at cathode potential, the mesh of said shadow grid being in alignment with the mesh of said control grid for shadowing the electrons emitted by said cathode from said control grid such that the electrons pass substantially unhindered through said control grid.

2. An electron tube as defined in claim 1 wherein said shadow grid and said control grid are provided with a surface configuration which conforms to the surface configuration of the cathode.

3. An electron tube as defined in claim 2 wherein the configuration of said cathode, said shadow grid and said control grid is spherical.

4. An electron tube as defined in claim 1 wherein each of said grids is formed from molybdenum.

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U.S. Cl. X.R.

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