

W. W. EITEL

ELECTRON TUBE GRID STRUCTURE

Fig. 3

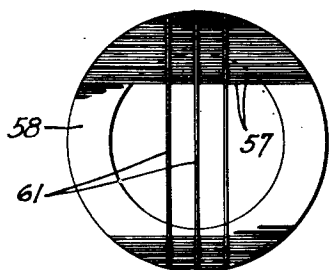


Fig.2

INVENTOR
WILLIAM W. EITEL
BY *Harold E. Day*
ATTORNEY

UNITED STATES PATENT OFFICE

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ELECTRON TUBE GRID STRUCTURE

William W. Eitel, Woodside, Calif., assignor to
Eitel-McCullough, Inc., San Bruno, Calif., a
corporation of California

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My invention relates to an electron tube having parallel plane electrodes.

One of the principal problems in tubes having planar electrodes with close spacings is to maintain the grid wires in a common plane and prevent grid distortion due to warping and sagging of the wires under heat during operation of the tube, which deformation alters the electrode spacings and thereby changes the operating characteristics of the tube, causing frequency drift and other undesirable effects.

The broad object of my invention is to provide an improved grid structure in a tube of the character described, so that initial spacings between electrodes are accurately maintained during operation of the tube.

A more specific object includes the provision, in a grid having a multiplicity of parallel grid wires, of means for retaining the wires in a common plane.

Another object is to provide a grid of the character described embodying improvements whereby problems of grid warpage, spot heating and grid emission are alleviated.

A further object is to provide an improved method of fabricating a grid structure.

The invention possesses other objects and features of advantage, some of which, with the foregoing, will be set forth in the following description of my invention. It is to be understood that I do not limit myself to this disclosure of species of my invention as I may adopt variant embodiments thereof within the scope of the claims.

Referring to the drawing:

Figure 1 is an axial sectional view of a tube embodying my invention; and

Figure 2 is a plan view looking down at the grid, portions of the structure being omitted for simplicity.

Figure 3 is an enlarged detail view showing an intersection of the grid wires.

In terms of broad inclusion, my electron tube embodies a grid having a multiplicity of closely spaced main grid wires lying in a common plane presenting a flat grid surface, and a wire disposed transversely of the first mentioned wires and lying flat against the grid surface. In my preferred structure, several transverse wires are provided, spaced more widely apart than the main grid wires. The transverse wires are preferably bonded to the main wires at the intersections thereof. In a triode having my improved grid interposed between an anode and cathode, the grid is preferably positioned with the transverse wires on the surface facing the anode.

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In greater detail, and referring to the drawing, my improvements are illustrated by a triode structure comprising an anode 2, grid 3 and cathode 4 arranged with active surfaces disposed in parallel planes. These electrodes are mounted in a suitable envelope structure, that chosen for illustration comprising a body section 6 of vitreous material, such as glass, sealed at one end to an anode supporting member 7 and at the other end to a tubular envelope section 8. Anode support 7 also functions as the anode terminal and comprises a metal cup having a cylindrical wall 9 extending from a flange 11 to which the glass is sealed. Anode 2 is secured to neck 12 of the support by braze 13.

The anode is preferably of metal having good heat conductivity, such as copper, with a flat anode surface presented interiorly of the envelope and having a stem portion 14 extending outwardly of the envelope. A suitable cooler is provided on the anode, preferably comprising a metal core 16 fitted on stem 14 and carrying a series of transverse disk-like heat radiating fins 17 separated by spacing rings 18, the fins and spacers being clamped together by a crimped lip 19 on core 16.

The tube is exhausted through a metal tubulation 21 secured to anode stem 14 by braze 15 and communicating with a passage 22 ported into the envelope through opening 23. After exhaust, the tube is sealed by pinching off the tubulation at tip 24.

Envelope section 8 at the opposite end of the envelope is a cylindrically shaped metallic member having an outturned flange 26 to which glass body section 6 is sealed. Section 8 is arranged coaxially with the anode and also functions as the terminal for grid 3. During assembly, the outer end of tubular section 8 is open, whereby the grid and cathode structures may be inserted through this end of the envelope.

Grid 3 is supported on a sleeve 27 of metal having good heat conductivity, such as copper, insertable in envelope section 8. The section 8 and sleeve 27 are shaped and proportioned to provide limit stops to establish a predetermined spacing between the grid and anode. This is preferably accomplished by an offset portion 29 on section 8 providing an annular seat engageable by a lip formed by an offset portion 31 on sleeve 27.

Cathode 4 is mounted on a stem 32 also coaxial with the anode and arranged to project into the envelope through tubular section 8. The cathode stem comprises a pair of concentric stem members including an outer tubular part 33 and an inner rod-like part 34. These stem members

are joined together by a glass bead 36 sealed between rod 34 and the lower end of a sleeve 37, which sleeve is fitted into stem member 33 and secured thereto by braze 38. For convenience in making connection with the inner stem member, a cup-shaped terminal 39 is preferably fixed to the outer end of rod 34 and spaced from the outer stem member by insulator 41.

The cathode comprises a cylindrical can 42 having a flat top carrying the active coating which may be of the usual oxide type commonly used for indirectly heated cathodes. Can 42 is coaxial with and secured to the inner end of stem member 33. The cathode heater comprises a spiral 43 having one end connected to stem member 34 by bracket 44 and the other end connected to stem member 33 by bracket 46. Suitable baffles 47 and 48 arranged in can 42 serve to confine the heat and direct it toward the active surface of the cathode.

The cathode structure is supported from envelope section 8 by a U-shaped metallic sleeve having an outer flange 49 and an inner flange 51, this cathode supporting sleeve being fitted into section 8 in nested relation to grid supporting sleeve 27. A vitreous ring 52 is sealed between stem member 33 and inturned lip 53 on sleeve flange 51. A shield 54 on the stem above glass ring 52 serves to direct the latter against heat and material sputtered from the cathode.

Cathode supporting sleeve 49-51 is also shaped and proportioned to provide a limit stop to establish a predetermined spacing between the cathode and grid, this being accomplished by utilizing the folded inner end of the sleeve as a lip for engaging the seat provided by offset portion 31 of the grid supporting sleeve. The various parts are so proportioned that the distance between the upper grid surface and the lip at offset 31 is less than that between the anode surface and the seat at offset 29 by the anode-grid spacing. Likewise, the distance between the cathode surface and the lip at the end of the cathode sleeve is less than that between the lower grid surface and the seat at offset 31 by the grid-cathode spacing. By this arrangement the electrodes are accurately and positively positioned with the desired electrode spacings. Tubes with an anode-grid spacing of .025 inch and a grid-cathode spacing of .0045 inch have been satisfactorily made and used.

The final closure is made by a fused metallic bond 56 joining the outer adjacent edges of section 8, sleeve 27 and sleeve flange 49. This bond may be formed by welding or grazing to simultaneously join the three edges together.

While the tube structure above described is preferred, it is understood that my improved grid structure, hereinafter described, may be incorporated in any tube having planar type electrodes, including tubes having more than one grid, the triode illustrated being chosen for purposes of simplicity.

As stated earlier herein, one of the principal problems in tubes having planar electrodes with close spacings is to maintain the grid wires in a common plane and prevent misalignment due to warping and sagging of the wires under heat during operation of the tube, which deformation alters the operating characteristics of the tube. In the past, grids of this type have been made with straight parallel wires supported at the ends, these grids being particularly bad because of relative warping between the wires. Grids of mesh construction have also been used, embodying woven wires, but prefabricated meshes are diffi-

cult if not impossible to mount on a support and insure uniform tautness of the individual wires in the mesh. A woven structure is also bad because the bends formed in the individual wires of the mesh complicate the warping problem when the structure is subsequently heated.

My improved grid shown in Figures 1, 2 and 3 comprises a multiplicity of straight wires 57 lying parallel in a common plane to present a flat grid surface. These main grid bars are of small diameter and are closely spaced, being preferably of a refractory metal wire such as molybdenum or tungsten, the latter being preferred. Main grid wires of .0018 inch diameter spaced .006 inch apart have been satisfactorily used in a tube having electrode spacings of the character described. Grid wires 57 are stretched across and secured to a flat mounting ring 58, preferably of tungsten, adapted for fastening to a flange 59 on supporting sleeve 27.

A plurality of say three straight tungsten wires 61 are disposed transversely of wires 57 to lie flat against the surface formed by the main grid wires. These secondary grid wires are preferably of the same material and diameter as the main grid bars and are stretched across and secured to mounting ring 58. Since the main and transverse grid bars are all straight wires they may be positioned across the mounting ring with uniformly applied tension. The transverse wires 61 are bonded to each of the main wires 57 at each intersection thereof. This bonding is accomplished by a metallic coating 62 over all of the wires, which coating preferably extends over ring 58 to simultaneously braze the wires to the mounting ring. Coating 62 is of a metal having a lower melting point than that of the grid wires and is preferably of a material, such as gold, acting as a suppresser of electron emission as well as a bonding agent.

My preferred method of making the grid is to place ring 58 on a flat mandrel and wrap a tungsten wire about the mandrel to lay the multiplicity of grid bars 57 over the ring. Secondary wires 61 are then laid across the mandrel in a transverse direction. A ring-shaped piece of gold wire is then placed over the wires on ring 58 and the entire assembly is heated in hydrogen to flow the gold over the wires and mounting ring. The wires are then clipped about the periphery of ring to free the completed grid from the mandrel. A series of grids may be made on a single mandrel in this way. If desired, the transverse wires 61 may be laid on first to underlie main wires 57.

While three transverse wires 61 are shown, it is understood that more or less may be used, the spacing between the transverse wires being optional and, of course, much wider than that between the main wires. In any event, but few of these secondary wires are required to perform their function of reinforcing and cooling the main grid wires. The transverse wires serve as supporting straps to hold the main wires in a common plane, and also serve as heat conductors to aid in carrying heat away from the central portions of the grid. Both of these functions operate to prevent grid warpage. Bonding of the wires at the intersections helps from the standpoint of heat conduction as well as mechanical support.

Since few of the transverse wires are used they have no perceptible influence on the electrical characteristics of the grid. Also, since the transverse wires lie flat against the main grid bars the latter are not disturbed from their flat-lying

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planar relationship. As a result, the main grid bars present truly flat grid surfaces to the other electrodes.

I claim:

1. In an electron tube having parallel plane electrodes, a grid comprising a multiplicity of closely spaced parallel wires lying in a common plane presenting a flat grid surface spaced from an adjacent electrode, and a wire disposed transversely across the mid-portions of the first mentioned wires and lying flat against said surface, said transverse wire having a diameter less than the spacing between the grid and adjacent electrode.

2. A grid electrode for an electron tube comprising a mounting ring, a multiplicity of closely spaced parallel wires extending across the ring and lying in a common plane presenting a flat grid surface, and a plurality of more widely spaced wires extending across said ring in transverse relation to the first mentioned wires and lying flat against said surface, said wires being bonded to the mounting ring and to each other at the intersections thereof.

3. A grid electrode for an electron tube comprising a mounting ring, a multiplicity of closely spaced parallel wires extending across the ring and lying in a common plane presenting a flat grid surface, a plurality of more widely spaced wires extending across said ring in transverse relation to the first mentioned wires and lying flat against said surface, and a metallic coating on the electrode bonding said wires to the mounting ring and to each other at the intersections thereof.

4. A grid electrode for an electron tube comprising a mounting ring, a multiplicity of closely spaced parallel wires of refractory metal extending across the ring and lying in a common plane presenting a flat grid surface, a plurality of more widely spaced wires of refractory metal extending across said ring in transverse relation to the first mentioned wires and lying flat against said surface, and a coating on the electrode of metal having a lower melting point than

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that of the wires bonding said wires to the mounting ring and to each other at the intersections thereof.

5. A grid electrode for an electron tube comprising a mounting ring, a multiplicity of closely spaced parallel wires of tungsten extending across the ring and lying in a common plane presenting a flat grid surface, a plurality of more widely spaced wires of tungsten extending across said ring in transverse relation to the first mentioned wires and lying flat against said surface, and a coating of gold on the electrode bonding said wires to the mounting ring and to each other at the intersections thereof.

6. In an electron tube having parallel plane electrodes, a grid comprising a multiplicity of closely spaced parallel wires lying in a common plane presenting a flat grid surface spaced from an adjacent electrode, and a plurality of more widely spaced wires disposed transversely across the mid-portions of the first mentioned wires and lying flat against said surface, said transverse wires having a diameter less than the spacing between the grid and adjacent electrode.

WILLIAM W. ETTTEL.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
1,472,505	Trimble	Oct. 30, 1923
1,892,819	Van Gessel	Jan. 3, 1933
2,045,526	Harries	June 23, 1936
2,047,369	Hickok	July 14, 1936
2,338,036	Gorton	Dec. 28, 1943
2,402,119	Beggs	June 18, 1946
2,413,689	Clark et al.	Jan. 7, 1947
2,415,360	McIntosh	Feb. 4, 1947

FOREIGN PATENTS

Number	Country	Date
365,303	Great Britain	Jan. 21, 1932