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ELECTRON DISCHARGE DEVICE

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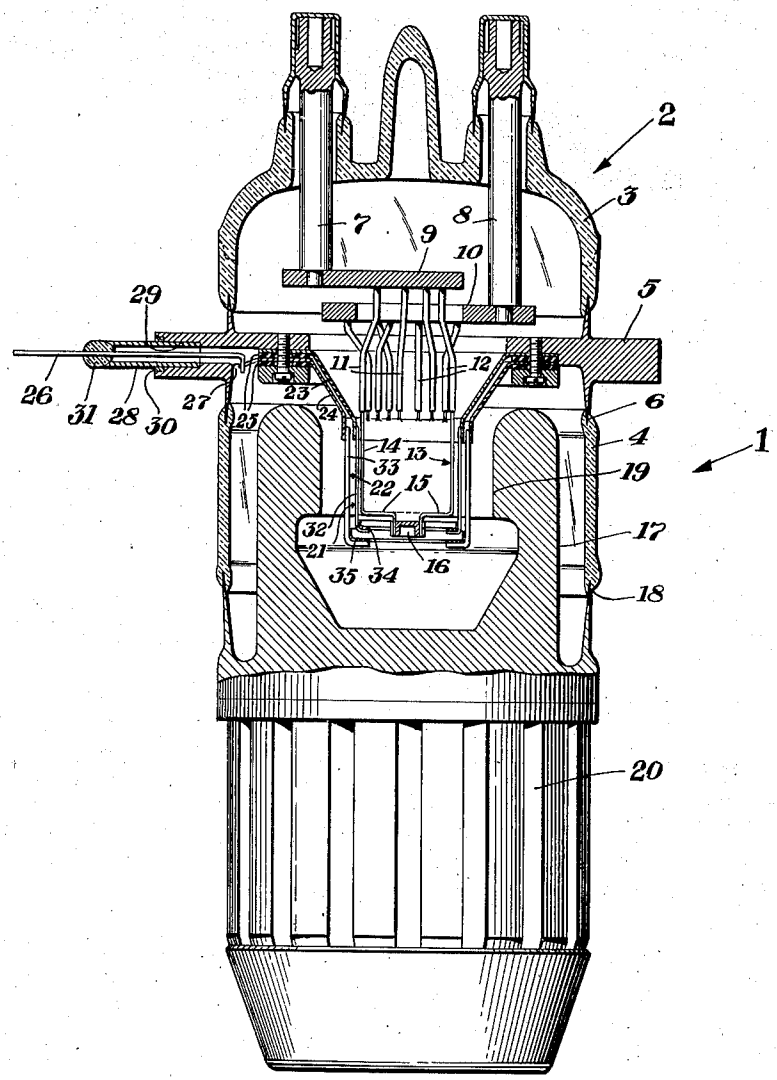

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ELECTRON DISCHARGE DEVICE

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1

This invention relates generally to electron discharge devices and particularly to those designed for operation at ultra-high frequencies.

In electron discharge devices for ultra-high frequency applications, it is essential that the inductance and capacitance of the leads carrying the high frequency currents be kept to a minimum. As the number of elements, usually grids, is increased, the problem becomes more difficult, for the leads of each added element must be disposed so as to avoid coupling between said lead and the other leads of the device, such as for example the cathode lead.

An object of the present invention is the provision in an electron discharge device for ultra-high frequency applications of an improved lead arrangement, and in particular that of the grid leads.

In certain applications of electron discharge devices two or more elements of said devices may be operated at substantially the same high frequency potentials though at different direct current potential levels. For example, in certain modes of operation, of beam type tetrodes, as ultra-high frequency generators the two grids are maintained at the same high frequency potential but at different direct current levels.

Another object of the present invention is the provision of an electron discharge device for use in applications of the afore-described type in which only one low impedance lead is used for two elements, for example, two grids. The term "low impedance lead" is used in the specification and claims to denote a lead which has low impedance at the operating frequencies of said device. The term "high impedance leads" is likewise used to denote leads whose impedance is too high for use at the aforesaid high frequency at which said device is operated.

A further object of the present invention is the provision in an electron discharge device having two elements operating at the same high frequency but different direct current levels, of means providing reactive coupling between said elements, and a single low impedance lead connected to one of said elements and supplying high frequency potentials for both elements.

Still another object of the present invention is the provision of an improved electron-discharged device for use at ultra-high frequencies.

Other and further objects of the present invention will become apparent and the foregoing will be best understood from the following description of an embodiment thereof, reference being had to the drawing, in which the single figure is a view partly in elevation, partly in section of an electron discharge device embodying our invention.

2

Referring now to the figure, numeral 1 generally designates a beam type power tetrode which may be used for the generation of ultra-high frequency oscillations. The tube envelope 2 includes an upper insulating portion 3 and a lower cylindrical insulating portion 4 joined together by a generally annular metallic member 5. The member 5 serves as a means for mounting the grid structure and also as a low impedance lead as will be apparent from the subsequent description. The member 5 may be of copper and is sealed to the upper and lower portions 3 and 4 of the envelope by any suitable means such as knife edge seals 6. Cathode support members or leads 7 and 8 pass through and are sealed in the upper portion 3 of the envelope 2. Metallic rings 9 and 10 are respectively attached to the inner ends of leads 7 and 8, said rings 9 and 10 in turn having attached thereto a plurality of conducting rods 11 and 12 respectively. A cylindrical cathode 13 comprised of a plurality of parallel filament elements 14, arranged in a circle concentric with the central longitudinal axis of the tube depends from the rods 11 and 12. The lower ends 15 of filament elements 14 are bent inwardly and gathered together and attached to a castellated nut 16 which holds these elements in place and electrically connects them together at their lower ends 15. Alternate ones of the elements 14 are connected to rods 11, the rest of said elements 14 being connected to rods 12. It will thus be seen that filament current flows through lead 7, ring 9, rods 12 and through alternating ones of filament elements 14 to the castellated nut 16 and then out through the other of said elements 14 which are connected to rods 12 through ring 10 and lead 8.

The anode electrode 17 may be formed from a solid block of metal, preferably copper. A knife edge 18 is formed on the outside of the anode structure in order to seal the anode to the lower cylindrical portion 4 of the envelope and thus complete the tube envelope. The active portion of the anode or that portion thereof which receives the electron current from the cathode is a cylindrical surface 19 which may be formed by boring a hole in the end of the copper block. The length of this active surface 19 is preferably substantially equal to the length of the cathode facing it. The active surface 19 is concentric with the cylindrical cathode 13. The lower portion of the copper block may be provided with

any suitable cooling means such as vanes 20 adapted to be cooled by either blasts of air or by a circulating liquid medium, and external electrical connection may be made to said lower end of the anode.

Tube 1 also includes two grid electrodes 21 and 22. Tube 1 is intended to be used in an application in which grids 21 and 22 are operated at the same high frequency potentials but are at different direct current levels. In accordance with our invention, grids 21 and 22 are reactively coupled together to be maintained at the same high frequency potentials while maintaining said grids at different direct current voltage levels. For this purpose a pair of generally conical conducting members 23 and 24 are secured at their lower ends to grids 21 and 22 respectively. The conical members 23 and 24 are of relatively large area and are relatively close together to thereby provide a substantial capacity therebetween and thus couple the grids 21 and 22. The conical members 23 and 24 also serve to support said grids, said members being in turn supported from annular member 5.

Because of the reactive coupling between the grids, which acts as a substantial short circuit for the high frequency currents, only one low impedance lead is employed for both grids. The annular member 5 serves as this relatively low impedance lead. For this purpose conical member 23 is electrically connected to annular member 5 while conical member 24 is electrically insulated from said member 5 by suitable insulating washers 25. While no separate low impedance lead is provided for grid 22, a relatively high impedance lead is used to maintain said grid 22 at its proper D. C. level. For this purpose conical member 24 is connected to a lead-in wire 26 which passes through an opening 27 formed in the annular member 5 and through a conducting pipe 28 which is secured in an enlargement 29 of said opening by any hermetically sealing means such as a suitable metallic joint 30. The lead-in wire 26 is supported in the center of pipe 28 by means of a glass bead 31 through which said wire 26 passes and which bead hermetically seals the end of the pipe. The external high frequency connection for the grids may be made to the pipe 28 or to annular member 5. This connection also will apply a direct current potential to grid 21, while the direct current potential for grid 22 is applied by a connection to wire 26.

From the foregoing it will be seen that only one low impedance lead is employed for both grids, this lead being directly connected to one grid and coupled to the other grid through the capacity effect between the grid supporting members. It will furthermore be seen that the high impedance lead for said other grid is led out as the inner member of a concentric line of which the outer member is the lower impedance lead. Furthermore it is to be noted that all the grid leads are taken out of the side of the envelope while the anode leads and the cathode leads are taken out at opposite ends. Thus undesired coupling is reduced to a minimum.

Grids 21 and 22 may each consist of a plurality of parallel bars 32 and 33 arranged in circles concentric with the cylindrical cathode 13 and the active anode surface 19. These bars 32 and 33 are secured at their upper ends to conical members 23 and 24 respectively and are held in place at their lower ends by suitable spacing members 34 and 35 respectively. Each of the

bars 32 of grid 21 is radially aligned with its corresponding one of bars 33 of grid 22 to provide beam paths leading from the filament elements 14 to the active surface 19 of the anode. This structure is more fully described in the copending application of P. G. Chevigny, entitled "Electron discharge devices," Serial Number 544,053, filed July 8, 1944.

The above described structure is that of a beam type tetrode which may be employed for the generation of ultra-high frequency oscillations and which may be operated with its two grids at the same high frequency potential.

It will be clear to those skilled in this art that the principles of this invention are applicable to electron discharge devices having other forms of cathodes, grids and anodes, and while we have described above the principles of our invention in connection with specific apparatus, it is therefore to be clearly understood that this description is made only by way of example and not as a limitation on the scope of our invention as set forth in the objects of our invention and the accompanying claims.

We claim:

1. An electron discharge device comprising an envelope, a plurality of electrodes mounted therein, means within said envelope reactively coupling two of said electrodes with one another, a relatively low impedance lead at high frequencies at which the electron device is adapted to operate, extending through said envelope and connected to one of said two electrodes, and a relatively high impedance lead at said high frequencies extending through said envelope and connected to the other of said two electrodes, the reactive coupling between said two electrodes being low at said high frequencies whereby through said coupling said low impedance lead may supply high frequency potential to both of said two electrodes to maintain them at substantially the same high frequency potential.

2. An electron discharge device according to claim 1, wherein said two electrodes are grids and said reactively coupling means includes a pair of conductive supporting members each connected to one of said grids said supporting members having surfaces of substantial area mounted close together providing substantial capacity therebetween.

3. An electron discharge device according to claim 1, wherein said envelope includes two insulating portions joined together by a metallic member which provides the low impedance lead, said metallic member having an opening therein through which said high impedance lead extends, and means sealing said high impedance lead in said opening.

4. An electron discharge device in accordance with claim 1, wherein said envelope includes two insulating portions, a metallic member joining said two portons and providing the low impedance lead, said metallic member having an opening therein through which said high impedance lead extends, and means sealing said high impedance lead in said opening, and wherein said two electrodes are grids, and said reactively coupling means includes a pair of conductive supporting members each connected to and supporting one of said grids, said supporting members having surfaces of substantial area mounted close together to provide a substantial capacity therebetween, said supporting members being mounted on said metallic member.

5. An electron discharge device comprising an

envelope, a plurality of electrodes mounted therein, said envelope including upper and lower insulating portions, a metallic member joining said upper and lower portions and electrically connected to one of said electrodes, said metallic member having an opening therein, a metallic pipe mounted on and having one end thereof hermetically sealed to said metallic member, said pipe having an opening aligned with the opening in said metallic member, a conductor connected to another of said electrodes and extending through said openings, and a glass bead in said pipe hermetically sealing said pipe and supporting said conductor therein.

6. An electron discharge device comprising an envelope, a plurality of electrodes mounted therein, said envelope including substantially cylindrical upper and lower insulating portions, a first external lead in the form of an annular metallic member joining said upper and lower portions and electrically connected to one of said electrodes, said metallic member having an opening therethrough, a second external lead in the form of a conductor connected to another of said electrodes and extending through said opening, means hermetically sealing said opening, and means reactively coupling the electrode connected to the metallic member and the electrode connected to said conductor, the reactive coupling being of low impedance at the high frequencies at which the device is designed to operate whereby through said coupling one of said leads can supply high frequency potential to said coupled electrodes to maintain them at substantially the same high frequency potential.

7. An electron discharge device comprising an envelope, a plurality of electrodes mounted therein, said envelope including upper and lower insulating portions, a metallic member joining said upper and lower portions, said metallic member having an opening therein, a conductor extending through said opening, means hermetically sealing said opening, and a pair of conductive supporting members on each of which one of said electrodes is mounted, said supporting members having surfaces of substantial area, said surface of one of said supporting members being disposed close to said surface of the other of said supporting members to provide substantial capacity therebetween, said conductive supporting members being mounted on said metallic member, one of said supporting members being electrically connected to said metallic member, the other of said supporting members being electrically connected with said conductor.

8. An electron discharge device comprising an envelope, a cylindrical cathode, a cylindrical anode, a plurality of cylindrical grids interposed therebetween, said cathode, anode and grids being substantially concentrically mounted within said envelope, said envelope including substantially cylindrical upper and lower insulating portions, an annular metallic member joining said upper and lower portions, a plurality of conical

conducting supporting members mounted on said annular metallic member, one of said conical supporting members being galvanically connected to said annular metallic member, each of said grids being electrically connected to and mounted on one of said conical members, said conical members being disposed close to each other to provide a substantial capacity therebetween, said annular metallic member having an opening therethrough, a conductor connected to that conical supporting member not connected to the annular metallic member, and passing through the opening in said annular metallic member, and means hermeticaly sealing said opening.

9. An electron discharge device comprising an envelope, a plurality of electrodes mounted therein, said envelope including upper and lower insulating portions, an annularly shaped metallic member joining said upper and lower portions and electrically connected to one of said electrodes, said metallic member having an opening through a wall portion thereof, a conductor connected to another of said electrodes and extending through said opening, and means hermetically sealing said opening.

10. An electron discharge device comprising an envelope, a plurality of electrodes mounted therein, said envelope including upper and lower insulating portions, a metallic member joining said upper and lower portions, said electrodes including a cathode, an anode and a plurality of grid electrodes, a lead for said cathode extending through the upper portion of said envelope and connected to said cathode, said anode having a portion thereof extending through the lower portion of said envelope adapted to be electrically connected at said lower portion of said anode, said metallic member having an opening therein, a pipe having one end thereof mounted on and sealed to said metallic member, the opening in said pipe aligned with the opening in said metallic member, a conductor extending through said openings, said conductor being connected to one of said grids, the other of said grids being connected to the metallic member.

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REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,282,392	Bieling	May 12, 1942
2,309,966	Litton	Feb. 2, 1943
2,190,511	Cage	Feb. 13, 1940
2,320,941	Litton	June 1, 1943
2,345,794	Chevigny	Apr. 4, 1944
1,850,104	Hansell	Mar. 22, 1932
2,107,945	Hull	Feb. 8, 1938
2,272,374	Kallmann et al.	Feb. 10, 1942
2,303,166	Laico	Nov. 24, 1942