March 29, 1949. J. J. GLAUBER 2,465,370

ULTRA HIGH FREQUENCY ELECTRON DISCHARGE DEVICE

Filed June 26, 1944 2 Sheets-Sheet 1

Fig. 1.

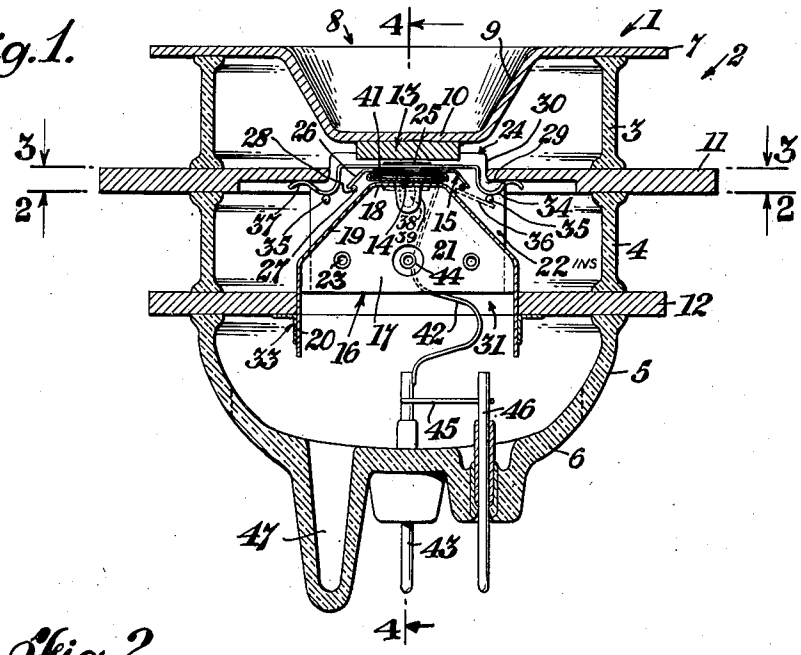
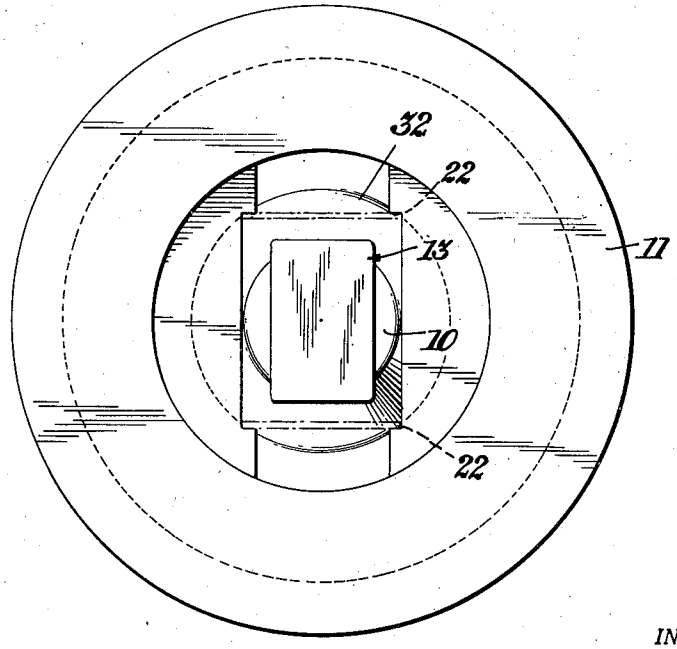


Fig. 2.



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Fig. 3.

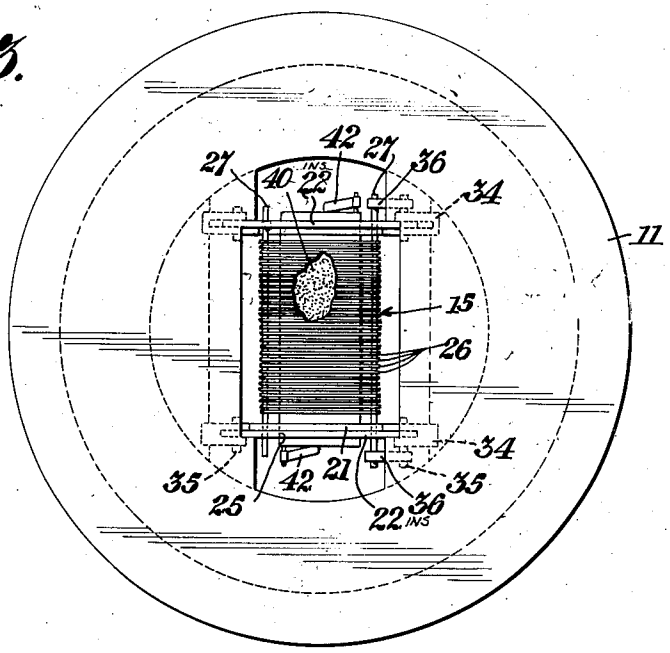
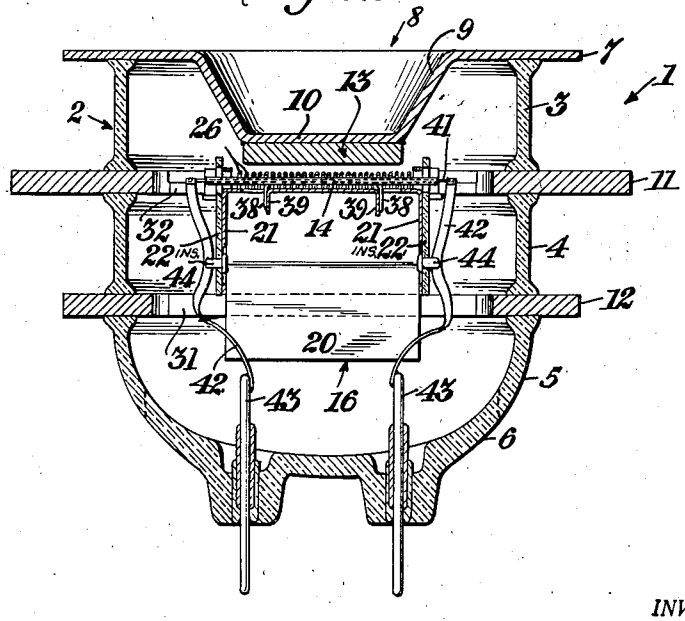


Fig. 4.



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ULTRA HIGH FREQUENCY ELECTRON DISCHARGE DEVICE

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19 Claims. (Cl. 315—5)

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This invention relates to an assembly for an electron discharge device and has particular applicability to ultra-high frequency devices.

An object of the present invention is the provision of an improved assembly for an electron discharge device particularly an assembly for use in ultra-high frequency applications.

Another object of the present invention is the provision of such an assembly in which the electrodes are accurately spaced and in which such accurate spacing is readily accomplished during assembly.

Another object of the present invention is the provision of a novel cathode connection. One feature of this connection is the fact that not only is it of relatively low impedance, but it is also of relatively low thermal conductivity, thus preventing dissipation of the energy supplied to the cathode. Another feature of this connection is the use of the cathode and grid mount to provide such connection.

Some of the other features of this invention include an assembly characterized by simplicity, ease of assembly, sturdiness, and tolerance for heat expansion and contraction.

Other and further objects, features, and advantages 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 drawings, in which:

Fig. 1 is a sectional view of an assembly for an electron discharge device embodying my invention; and

Figs. 2, 3 and 4 are sections taken substantially along the lines 2—2, 3—3, and 4—4, respectively, of Fig. 1, but in case of Figs. 2 and 3 certain central elements which would appear in section have been omitted or shown in plan for clarity. See elements 22.

Referring now to the drawings and particularly Fig. 1, the numeral 1 generally designates the assembly which includes an envelope generally indicated at 2, said envelope 2 including insulating portions 3, 4 and 5. Envelope 2 is closed at its lower end by a preformed header 6 of insulating material, and closed at its upper end by a conductive disc 7 which includes a depressed or dished-in portion 8 at the center thereof comprising a substantially conical wall 9 and a flat circular bottom portion 10. Conductive discs 11 and 12 extend through the envelope between insulating portions 3 and 4, and 4 and 5, respectively, and are hermetically

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sealed to said portions to thereby complete the envelope.

The insulating portions of the envelope are preferably made of a heat resistant material, and the conductive discs 7, 11 and 12 are preferably made of some known conductive material having the same coefficient of expansion as the insulating portions.

In the assembly illustrated in the drawings, three electrodes are employed, comprising an anode 13, a cathode 14, and a grid 15 interposed between the anode and cathode. The anode is supported and electrically connected to the inner side of the bottom portion 10 of disc 7 by any suitable method such as, for example, by welding. The cathode 14 and the grid 15 are supported on a mount 16 at an accurate distance from said anode, said mount being inserted into the assembly before the header 6 is secured to the insulating portion 5.

The mount 16 includes a conductive portion 17. As viewed in cross-section (see Fig. 1) this conductive portion 17 is comprised of a flat top 18, diverging walls 19 and vertical walls 20 depending from the lower ends of the diverging walls 19. A pair of aprons 21, (see Fig. 4), are formed at opposite ends of said conductive portion 17. Said portion 17 may be drawn from a single piece of metal by the use of a suitable die, or may be formed of separate sheets of metal welded together or by any other suitable method.

The mount also includes two insulating members 22 which may be made of mica and consist of thin, substantially rectangular plates, vertically arranged on opposite ends of the conductive portion 17, each abutting one of the aprons 21 and secured to said apron by any suitable means such as, for example, eyelets 23. The tops 24 of said insulating members 22 extend a substantial distance above the top 18 of the conductive portion 17. A horizontal opening 25 is provided in each of said insulating members 22 a short distance above the top 18 of the conductive portion 17. The cathode 14 which is of the indirectly heated type is hollow and of substantially flat cross-section. The cathode 14 is inserted into the horizontal openings 25 and is supported therein. The grid 15, which is comprised of a plurality of transverse wires 26 secured at their ends to longitudinal supports 27, is supported in said insulating members 22 by providing a pair of holes 28 in each of said members in which the ends of said supports 27 are arranged and supported. The holes 28 are positioned so that the grid wires 26 are disposed at

a predetermined accurate distance above the cathode 14.

To assure accurate spacing between the grid, cathode and the anode, a predetermined exact rectangular portion of the top corners of the insulating members 22 are cut away to thereby form positioning shoulders 29 adjacent positioning ends 30 on top of each of said insulating members 22. In arranging the mount 16 in the assembly, the mount is inserted through a relatively large opening 31 in disc 12. The disc 11 is provided with a rectangular but smaller opening 32 through which the top 24 of the insulating members 22 projects. The opening 32 is too small, however, to permit shoulders 29 to pass through said opening, and said shoulders engage the bottom portions of said disc 11 adjacent said opening, thereby determining how far the mount can be inserted upward into the assembly. In forming the envelope 2, disc 11 is spaced from disc 7 by a predetermined accurate distance. This may be accomplished by using a suitable fixture or jig. Therefore since disc 11 is accurately spaced from disc 7 and since mount 16 is accurately spaced in relation to disc 11, the anode 13 on disc 7 will consequently be accurately spaced from the cathode and grid which are in turn accurately arranged on mount 16. To insure further that the grid and cathode will be aligned directly underneath the anode, and to prevent horizontal displacement from this position, the upper portion of the insulating members, that is, the portion within the opening 32, registers with portions of disc 11 defining said opening, and the mount is thereby positioned horizontally.

To secure the mount in the aforedescribed accurately determined position, L-shaped flanges 33 are provided at the bottom of disc 12 immediately adjacent opening 31 and the vertical walls 20 are welded to the depending portion of said flanges 33 after the mount is in said position.

Discs 7, 11 and 12 provide external terminals which are connected inside the tube to anode 13, grid 15 and cathode 14 respectively. These discs are of relatively low impedance. Anode 13 is directly mounted on the reentrant bottom portion 10 of disc 7 and electrically connected thereto. Grid 15 is electrically connected to disc 11 by means such as a pair of preformed springs 34, each of which is mounted on one of the insulating members 22 by any suitable means such as, for example, pins 35. One of the pins 35 on each of the insulating members 22 is connected by means of a metallic strap 36 to one of the longitudinal supports supporting the transverse grid wires. When the mount 16 is inserted into the assembly, the ends 37 of springs 34 contact the bottom of disc 11. If desired, the ends 37 may be thereafter welded to the disc 11. This is accomplished before the header 6 is sealed to insulating portion 5 and for this purpose the large opening 31 in disc 12 is preferably substantially wider than the distance between the insulating members 22 arranged on opposite ends of the mount 16. A small welding tool may thereby be inserted through disc 12 to weld the ends 37 of spring 34 to the bottom of the disc 11.

Disc 12 provides the external connection for cathode 14. In a device of the type described herein, various potentials must be applied to and various types of current must flow to said cathode. For example, D. C. potentials are usually applied between the anode and cathode, and grid and cathode; alternating current of intermediate frequencies, usually the modulation frequencies, and higher frequency currents flow to the cathode. Therefore the connection to the cathode must carry direct current, intermediate frequencies and higher frequencies. The connection should offer low resistance to the D. C. currents and also have low impedance for the intermediate and higher frequencies. At the same time, in order to prevent dissipation of the heat of the cathode, this connection should have relatively low thermal conductivity. The foregoing is accomplished in the following manner in accordance with my invention.

The disc 12 is electrically connected with the conductive portion 17 of the mount 16. The conductive portion 17 is of low inductance, low impedance to both the intermediate and higher frequencies, and low resistance to direct current. The flat top 18 of the conductive portion 17 is arranged close to and parallel with the undersurface of the cathode 14, thereby providing a substantial capacity therebetween forming a low impedance connection for the higher frequency currents. This connection is obviously of low thermal conductivity since the cathode and said flat top 18 are spaced apart. In addition to this low impedance connection, a galvanic connection is provided between the conductive portion 17 of the mount and the cathode 14. This galvanic connection may be made by providing a pair of downwardly-projecting ears 38 on the cathode towards opposite ends thereof, which ears 38 lie adjacent similar ears 39 struck out of the flat top 18 of the conductive portion 17 of the mount. Ears 38 and 39 are connected together to thereby provide the galvanic connection. It is important that the cross-sectional area of the ears be small so that the connection will be of relatively low thermal conductivity and relatively little heat will be transferred thereby from the cathode to the mount. The intermediate frequencies will tend to divide themselves between the aforementioned galvanic connection and the low impedance connection, and the dimensions of said connections should be proportioned so that low impedance is offered to the intermediate currents flowing to the cathode.

In regard to the cathode 14, only the upper surface thereof facing the anode 13 through grid wires 26 is coated with an emissive coating as indicated by numeral 40, Fig. 3. A heater element 41 is inserted within the cathode after it has been arranged on the mount, and lead wires 42 are connected to opposite ends of said heater element. The lead wires 42 are connected, for example, by welding, to the inner ends of contact pins 43 which are sealed through the header 6. This welding is accomplished before the header 6 is sealed to the insulating portion 5. The header 6 is held a sufficient distance away from the insulating portion 5 to allow a welding tool to be inserted therebetween and the lead wires 42 are made long enough to reach the inner ends of pins 43 while the header is maintained at this distance from said insulating portion 5. After the welds have been made, the welding tool is removed and the header is then moved up to and sealed to the insulating portion 5. The lead wires 42 bend and take the shape indicated in Fig. 1. To control the bending of the lead wires 42, each of said wires is welded to a central eyelet 44 fastened to one of the insulating members 22. A portion of each of the aprons 21 is cut away

around the eyelet so that the eyelets 44 and the lead wires 42 which are attached to said eyelets are electrically insulated from the conductive portion of the mount.

A gettering element 45 may be connected between one of the contact pins 43 and a similar contact pin 46 sealed through the header. The assembly may be provided with the usual exhaust tip 47 through which it is evacuated. Other details of the assembly will be apparent from the foregoing description to those versed in the art.

It will be seen that this assembly allows for expansion and contraction of the various portions such as, for example, the discs, without injury to the assembly. For example, if disc 12 expands the vertical walls 20 of the mount 16 are sufficiently flexible to give, without causing distortion of the mount. Likewise if disc 11 expands, there is sufficient flexibility in the insulating members 22, particularly if they are made of mica, to allow for this expansion.

While the above description has been that of a triode, it will be obvious that my invention is also applicable to electrode discharge devices having a different number of electrodes. Other variations in the above-described structure may be made without departing from the teachings of my invention. Accordingly, while I have described above the principles of my invention in connection with a specific device, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of my invention as set forth in the objects and the claims.

I claim:

1. An electron discharge device comprising an envelope, an electrode mounted on a portion of and located within the envelope, a member mounted through the envelope and at a distance from said electrode fixed by the dimension of the envelope portion extending between said electrode and said member, a mount arranged adjacent said member, a second electrode supported on said mount, means on said mount providing with said member accurate spacing of said electrodes from each other, and means fixing said mount in position within the envelope to maintain said accurate spacing.

2. An electron discharge device comprising an electrode in said device, a member having an opening therein and mounted at a fixed distance from said electrode, a mount arranged adjacent said member inside said envelope, a second electrode supported on said mount including a portion projecting into and registering with portions of said member and having means engaging said member and thus accurately spacing said electrodes from each other, and means fixing said mount in a given position to maintain said accurate spacing.

3. An electron discharge device according to claim 2, wherein the portions of the walls are those defining said opening, and the means of the mount engaging said member comprises shoulders engaging portions of said member adjacent said opening.

4. An electron discharge device comprising an envelope, a pair of members defining portions of said envelope, one member extending through said envelope with an envelope portion between said members, said members being spaced apart a distance fixed by the dimensions of said envelope portion, an electrode mounted on one of said members, a mount, a second electrode supported on said mount, means on said mount providing

with the other of said members accurate spacing of the electrodes in relation to each other, and means fixing said mount in position within said envelope to maintain said accurate spacing.

5. An electron discharge device comprising an envelope, a pair of members extending through said envelope and separated a fixed distance by a portion of said envelope, an electrode mounted on one of said members, a mount, a second electrode supported on said mount, means on said mount providing with the other of said members accurate spacing for said electrodes in relation to each other, and means fixing said mount in position within said envelope to maintain said accurate spacing.

6. An electron discharge device comprising an envelope having an insulating portion, a pair of conductive members located on either side of said insulating portion and each having a portion thereof extending inside and outside of the envelope, said insulating portion separating said conductive members by a predetermined distance, an electrode mounted on and electrically connected to one of said members, a mount, a second electrode supported on said mount and electrically connected to the other of said members, means on said mount providing with said other of said members accurate spacing of said electrodes in relation to each other, and means fixing the said mount within said envelope to maintain said spacing.

7. An electron discharge device in accordance with claim 5, wherein said envelope has an insulating portion, said other member is a metallic disc supported in said insulating portion and connected inside the envelope to said second electrode.

8. An electron discharge device comprising an envelope having insulating portions, a plurality of conductive members mounted on said envelope and separated a fixed distance by said insulating portions, a plurality of electrodes, one of said electrodes supported by and electrically connected with one of said members, a conductive mount supported by and electrically connected to a second of said members, a second electrode supported on said mount and electrically connected thereto, a third electrode, insulating means supporting said third electrode on said mount at a fixed distance from said second electrode, means on said mount providing with a third of said members accurate spacing of said mount in regard to said third member, and means electrically connecting said third electrode with said third member, said members extending outside said envelope providing external terminals connecting with said electrodes.

9. An electron discharge device in accordance with claim 8, wherein said first electrode is an anode, said second electrode a cathode, and said third electrode a grid.

10. An electron discharge device comprising an envelope, a conductive mount supported within said envelope, an electrode supported on said mount, means providing a relatively high impedance connection between said electrode and said mount, means coupling said electrode and said mount to provide a relatively low impedance connection therebetween, and a relatively low impedance lead extending outside of said envelope and connected inside of said envelope to said mount, the value of the aforesaid impedances being relatively high and low respectively at the highest frequencies at which said device is to be operated.

11. An electron discharge device comprising an envelope, a conductive mount supported within said envelope, an electrode supported on said mount, means providing a relatively high impedance connection between said electrode and said mount, cooperative means on said electrode and said mount capacitatively coupling said electrode and mount to provide a relatively low impedance connection therebetween, and a relatively low impedance lead extending outside of said envelope and connected inside of said envelope to said mount, the value of the aforesaid impedances being relatively high and low respectively at the higher frequencies at which said device is to be operated.

12. An electron discharge device comprising an envelope, a conductive member mounted in said envelope, an electrode, insulating means mounted on said conductive member and supporting said electrode, said electrode being disposed adjacent said conductive member forming a substantial capacity therebetween to provide a low impedance connection between said electrode and said conductive member, and a lead extending through said envelope and connected within said envelope to said conductive member, the value of said impedance being relatively high and low respectively at the higher frequencies at which said device is to be operated.

13. An electron discharge device in accordance with claim 12 and including in addition a high impedance lead interconnecting said conductive member and said electrode, said lead having low heat conductivity.

14. A structural assembly in accordance with claim 1, wherein said mount is conductive, and including means forming a relatively high impedance connection between said mount and said second electrode, means capacitatively coupling said mount and second electrode to provide a relatively low impedance connection therebetween, a relatively low impedance lead extending outside of said envelope and connected within said envelope to said mount, said impedances being relatively high and low respectively at the higher frequencies at which said device is to be operated.

15. In an electron discharge device, an electrode and mount assembly comprising, an electrode, a conductive member, insulating means supported on said conductive member for supporting said electrode adjacent to said conductive member, said electrode and conductive member being disposed adjacent each other to form a substantial capacity therebetween providing a low impedance interconnection, and a lead of relatively high impedance and low thermal conductivity connecting said electrode and said conductive member, the value of said impedances being relatively high and low respectively at the higher frequencies at which said device is to be operated.

16. In an electron discharge device, an electrode and mount assembly comprising, an electrode, a conductive member, a pair of insulating members supported on opposite sides of said conductive member, said insulating members having openings therein within which said electrode is supported adjacent said conductive member to form a substantial capacity therebetween to provide a low impedance interconnection, and a lead of relatively high impedance and low thermal conductivity connecting said electrode and said conductive member, the value of said impedances being relatively high and low respectively at the higher frequencies at which said device is to be operated.

17. In an electron discharge device, an electrode and mount assembly comprising, a mount including a conductive member and a pair of insulating members supported on opposite sides of said conductive member, said insulating members having openings therein; a cathode supported within said openings adjacent said conductive member to provide a substantial capacity therebetween forming a low impedance interconnection; a lead of relatively high impedance and low thermal conductivity connecting said cathode and said conductive member, the value of said impedances being relatively high and low respectively at the higher frequencies at which said device is to be operated; and a grid supported on said mount by said insulating members at a fixed distance from said cathode.

18. In an electron discharge device, an electrode and mount assembly comprising, a mount including a conductive member and a pair of insulating members supported on opposite sides of said conductive member, said insulating members having openings therein; an indirectly heated cathode supported within said openings adjacent said conductive member to provide a substantial capacity therebetween forming a low impedance interconnection; a lead of relatively high impedance and low thermal conductivity connecting said cathode and said conductive member, the value of said impedances being relatively high and low respectively at the higher frequencies at which said device is to be operated; and a grid supported by said insulating members at a fixed distance from said cathode, said cathode having an electron emissive coating on the face thereof towards said grid.

19. In the method of assembling an electron discharge device, the steps comprising fixedly spacing an electrode and a member within the envelope at an accurate distance from each other, attaching a second electrode to a support, forming an abutment on said support having an accurate position in regard to said second electrode, inserting said electrode-carrying support in said envelope until said abutment abuts said member to thereby accurately space said electrodes from each other, and fixing said support in said position.

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