

Nov. 25, 1947.

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2,431,337

ELECTRON DISCHARGE DEVICE FOR HIGH FREQUENCY

Filed May 7, 1943

2 Sheets-Sheet 1

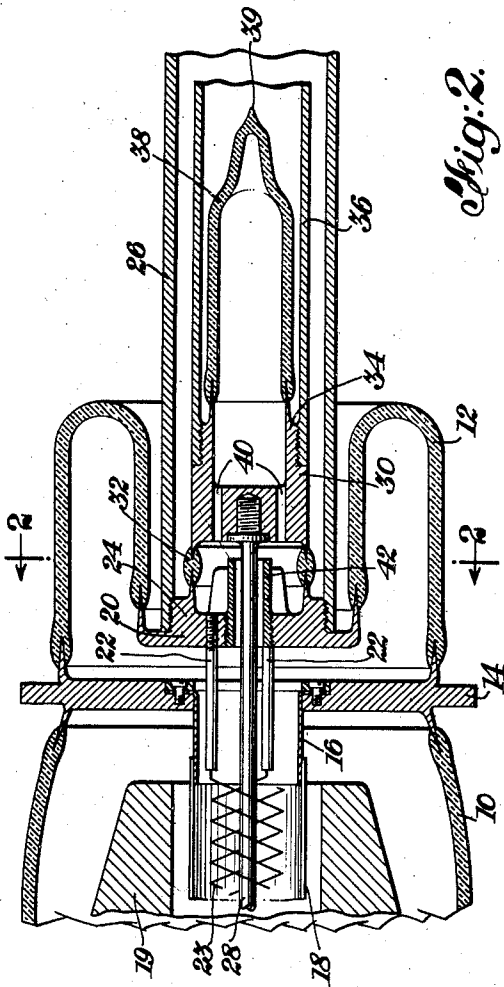


Fig. 1.

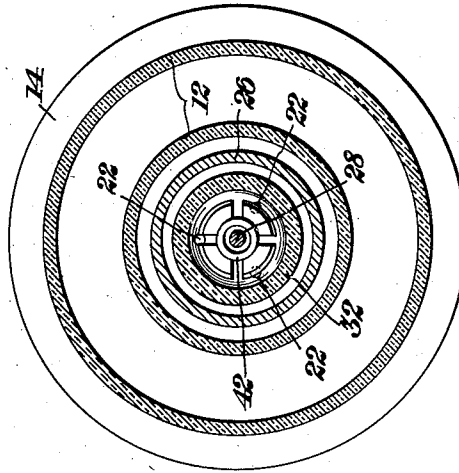


Fig. 2.

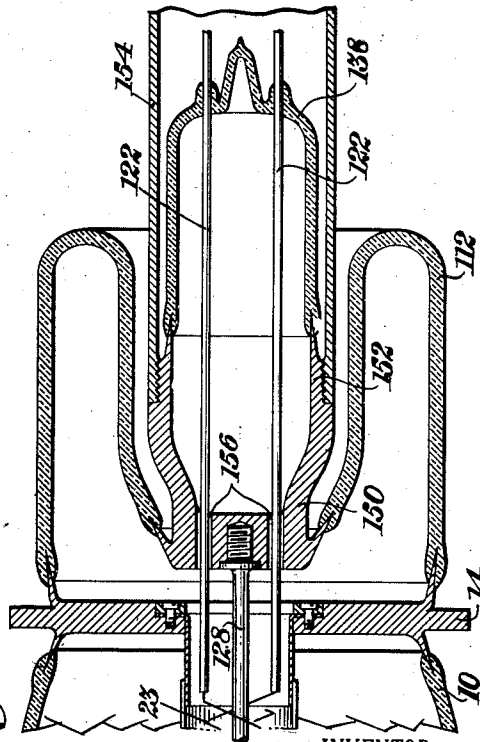


Fig. 3.

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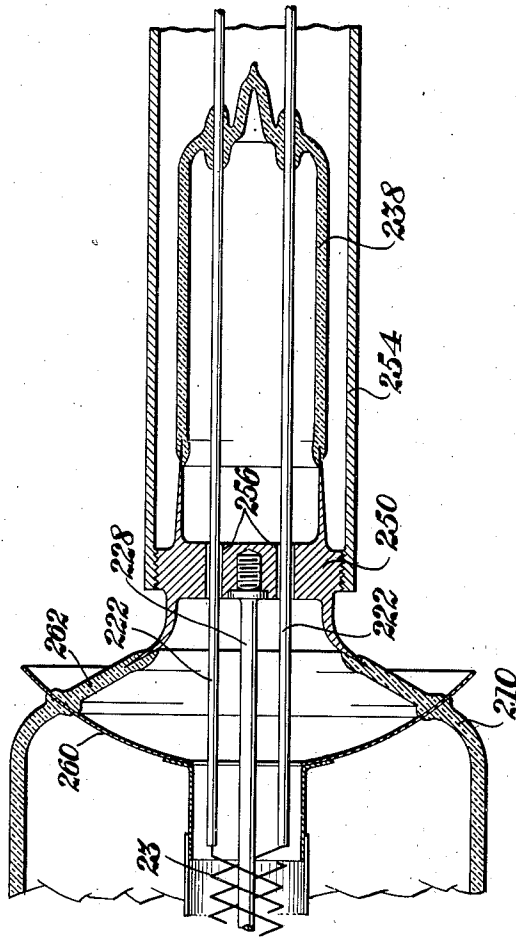
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Fig. 4.



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ELECTRON DISCHARGE DEVICE FOR HIGH FREQUENCY

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18 Claims. (Cl. 315—39)

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This invention relates to improvements in electron discharge devices, and more particularly to improved arrangements for the cathode lead-in terminals for such devices.

An object of the present invention is to provide an electron discharge device in which the cathode leads are structurally arranged to form part of a high frequency transmission line.

Another object of the present invention is to provide an electron discharge device in which the glass evacuating seal is protected by being surrounded by attached cylindrical and/or coaxial cathode leads.

A general object of the present invention is to provide an electron discharge device having a novel arrangement for supporting the cathode lead rods.

An additional object of this invention is the provision of a novel electron discharge device into which a condenser is built between the central lead rod of a spiral filament and the lead rods connected to the ends of the filament wires.

Still another object of this invention is to provide an electron discharge device in which a portion of the tube envelope is formed by cathode lead rod supports which, at the same time, serve as connectors for cylindrical and/or coaxial cathode leads.

Generally speaking, my invention may be defined as comprising the constructions and combinations recited in the annexed claims and illustrated in certain embodiments in the drawings accompanying and forming a part of this application, wherein:

Fig. 1 is a longitudinal cross-sectional view of a portion of an electron discharge device illustrating one embodiment of my novel cathode lead-in arrangement;

Fig. 2 is a transverse cross sectional view taken along the line 2—2 of Fig. 1;

Fig. 3 is a partial longitudinal cross-sectional view of an electron discharge device illustrating a modified cathode lead-in arrangement;

Fig. 4 is a partial longitudinal cross-sectional view of still another modified cathode lead-in and connector arrangement.

In the form of invention illustrated in Figs. 1 and 2, I have indicated part of the glass tube 10 which forms the major part of the envelope for the electron discharge device, and is positioned

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immediately about the tube electrodes. One end of the tube is formed with a second, re-entrant glass envelope 12 connected to the glass tube 10 through a split metal disk 14 which may be provided with a central opening surrounding a hollow sleeve 16 supporting a grid electrode 18. The latter may be surrounded by an anode 19, a portion of which is illustrated in Fig. 1. The use of a metal disk 14 serving as a grid support in conjunction with the type of anode 19 partially illustrated in Fig. 1, forms no specific part of the invention of the present case and is similar, for example, to grid-anode arrangements such as are illustrated, for example, in my copending application, S. N. 474,092, filed January 30, 1943, and the copending application of Paul G. Chevigny, S. N. 474,085, filed January 30, 1943.

In accordance with the present invention the re-entrant end of the glass tube 12 has sealed thereto a metal plate 20 into which are inserted as by threading therein, lead rods 22 connected to the ends of the filament wire 23. The number of lead rods 22 will vary, depending upon the type of the filament structure. For purposes of illustration I have illustrated three rods 22, in which case there will be three filament windings. The metal plate 20 is formed with an externally threaded shoulder 24 upon which is threaded a hollow cylindrical conductor 26 which may form part of a transmission line and which will then be directly electrically connected to the ends of the filament wires. The central filament support rod 28 is threaded into the base of a metal cylinder 30 sealed to the metal plate 20 as by the annular bead 32. The open end of the metal cylinder 30 is formed with an externally threaded shoulder 34 upon which is screwed a second hollow cylindrical conductor 36, the conductors 26 and 36 in this case forming a coaxial cathode line. The end of the tube is closed by the glass bulb 38 sealed about the open end of the sleeve 30, and this glass bulb may be used as the evacuating seal for the entire tube members, as indicated by the evacuating nipple 39. It will be noted that the glass bulb 38 is in communication with the glass bulb 10 through openings 40 formed for this purpose through the base of the metal cylinder 30 and through the central lead rod opening in the metal plate 20.

If desired, the central opening in the metal

plate 20 may have threaded therein a metal sleeve 42 which extends so as to surround a portion of the central lead rod 28 to form a condenser therewith.

In Fig. 3 I have illustrated a modified, alternative construction; in this case the glass bulb 10 and the intermediate grid support 14 are the same as illustrated in Fig. 1 and described above. The re-entrant glass bulb 112 is similar to the re-entrant glass bulb 12 and in this case has connected about its re-entrant edge a metal cylinder 150 into whose base the central lead rod 128 is directly connected. The open end of the metal cylinder 150 is provided with an externally threaded cylinder 152 on which is screwed the hollow cylindrical cathode conductor 154. The glass bulb 138 seals the open end of the metal cylinder 150, serves as the evacuating seal for the entire envelope, and at the same time supports the lead rods 122 connected to the ends of the wires of the filament structure 23. These wires, in this case, pass through the openings 156 in the base of the metal cylinder 150. The openings 156 permit communication between the glass bulb 138 and the glass bulb 10 for purposes of the evacuation and at the same time the relationship between the lead rods 122 surrounded by a portion of the base 150 to which the lead rod 128 is connected, inherently forms a condenser between the two sets of lead rods.

In the form of invention illustrated in Fig. 4, the main glass bulb 210 is joined to a secondary bulb section 262 through a generally conical grid-supporting disk 260. The bulb section 262 is sealed to suitable extensions on a metal supporting plate 250 into which the central lead rod 228 is threadably secured. The other side of the metal support 250 has sealed thereto a third glass bulb 238 which may serve as the evacuating bulb for the entire vacuum tube envelope, being in communication with the main glass bulb through openings 256 extending through the metal support 250. Through the openings 256 also extend lead rods 222 connected to the filament wires 23 and extending outwardly of the tube through the glass bulb 238 which also serves to support them. The outer periphery of the member 250 may be threaded and have screwed therein the hollow metal conductor 254 serving as a cathode line. The capacity between the metal support 250 and the leads 222 extending therethrough also serves as an effective condenser connected across the cathode leads. It will be noted that all forms of invention described and illustrated admirably fulfill the objects primarily stated. In all cases part of the tube envelope is formed by a metal cathode rod support and at the same time hollow cylindrical cathode leads may be readily and easily attached to the metal members. The evacuating seal for the entire vacuum tube envelope is relatively small and is protected by the hollow cylindrical cathode lines. The cathode leads are easily and properly positioned by means of the described construction and the various parts are simple to make and assemble.

While I have described above the invention in connection with certain specific examples thereof, 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 accompanying claims.

I claim:

1. An electron discharge device adapted to be directly connected to a coaxial line, having an

anode, a cathode, a grid, said cathode comprising a filament consisting of a wire coil supported at one end by one end of an internal central lead rod, and means constituting a sealed envelope for said electron discharge device, said envelope means including a glass bulb immediately about the electrodes, a cylindrical metal support provided with an opening therethrough, means sealing one side of said support to one end of said glass bulb, and a second glass bulb closed at one end and sealed at its other end to the other side of said metal support, whereby the interior of said second glass bulb is open to the interior of said first glass bulb through said opening, and means securing the other end of said rod to said metal support, said metal support being provided with an externally threaded portion adapted to receive a cylindrical conductor of the coaxial line.

2. An electron discharge device having an anode, a cathode, a grid, said cathode comprising a wire coil supported at one end by one end of an internal central lead rod, and means constituting a sealed envelope for said electron discharge device, said envelope means including a glass bulb immediately about the electrodes, a metal disk provided with a central opening therethrough surrounding a portion of said central lead rod and sealed on one side to one end of said glass bulb, a second glass bulb sealed at one end to the other side of said metal disk, a metal support having openings therethrough and sealed on one side to the other end of said second glass bulb, and a third glass bulb closed at one end and sealed at its other end to the other side of said metal support, whereby said bulbs are all open to one another through the openings in said support, means securing the other end of said rod to said metal support, means supporting the grid from said metal disk, and a cylindrical lead-in conductor threadably connected to said metal support and surrounding said third glass bulb.

3. An electron discharge device having an anode, a cathode, a grid, said cathode comprising a filament consisting of a wire coil supported at one end by one end of an internal central lead rod, and means constituting a sealed envelope for said electron discharge device, said envelope means including a glass bulb immediately about the electrodes, a metal disk provided with a central opening therethrough, surrounding a portion of said central lead rod and sealed on one side to one end of said glass bulb, a second glass bulb sealed at one end to the other side of said metal disk, and formed at its other end with an internal re-entrant portion, a metal plate having openings therethrough sealed on one side to the other, re-entrant end of said second glass bulb, and a third glass bulb closed at one end and having a sealed connection at its other end to the other side of said metal plate, whereby said bulbs are all open to one another through the opening in said disk and the openings in said plate, means for securing the other end of said rod to said metal plate, means for supporting the grid from said metal disk, and a cylindrical lead-in conductor threadably connected to said metal plate and surrounding said third glass bulb.

4. An electron discharge device having an anode, a cathode, a grid, said cathode comprising a filament consisting of a wire coil supported at one end by one end of an internal central lead rod, and means constituting a sealed envelope for said electron discharge device, said envelope

means including a glass bulb immediately about the electrodes, a metal cylinder open at one end and provided with a base at its other end having openings therethrough, means sealing the closed end of said cylinder to one end of said glass bulb, and a second glass bulb closed at one end and sealed at its other end about the open end of said cylinder, whereby the interior of said second glass bulb is open to the interior of said first glass bulb through said openings in said base, means securing the other end of said lead rod to the base of said cylinder, and a hollow cylindrical lead-in conductor threadably connected to the open end of said cylinder and surrounding said second glass bulb.

5. An electron discharge device of the type having an anode, a cathode and a grid, the combination of means for constituting a sealed envelope for said electron discharge device, said envelope means including a glass bulb immediately surrounding said electrodes, a metal disk having a central opening sealed on one side to one end of said first glass bulb, a second glass bulb sealed at one end to the other side of said metal disk and formed at its other end with an internal re-entrant portion, a metal plate having a central opening sealed on one side to the internal re-entrant end of said second glass bulb, a metal cylinder open at one end and having a base provided with a plurality of openings in its other end, means sealing the base of said second metal cylinder to the other side of said metal plate, and a third glass bulb closed at one end and sealed at its other end to the open end of said metal cylinder, whereby all of said glass bulbs are open to one another through the openings in said metal disk, metal plate, and the base of said metal cylinder, and a central cathode lead extending through said openings in said metal disk and said metal plate and secured to the base of said metal cylinder.

6. The combination according to claim 5, in combination with at least one additional lead connected at one end to said cathode and secured at the other end to said metal plate.

7. The combination according to claim 5, in which said metal plate comprises an outer threaded peripheral shoulder inside of the re-entrant portion of said second glass bulb but of greater diameter than said metal cylinder, in combination with at least one lead connected at one end to said cathode and at the other end to said metal plate, and a hollow cylindrical conductor surrounding the third glass bulb, the metal cylinder and threaded on the shoulder of the metal plate.

8. The combination according to claim 5, in combination with at least one additional lead connected at one end to said cathode and secured at the other end to said metal plate, and a metal sleeve in the central opening of said metal plate surrounding a substantial portion of the central cathode lead constituting with the latter an internal condenser between the additional leads and the central cathode leads.

9. The combination according to claim 5, in which the open end of said cylinder is provided with an external threaded shoulder in combination with a cylindrical lead-in conductor surrounding the third glass bulb and threaded on said shoulder.

10. The combination according to claim 5, in which the open end of said cylinder is provided with an external threaded shoulder and said metal plate is provided with an outer threaded

peripheral shoulder inside of the re-entrant portion of said second glass bulb but of greater diameter than said metal cylinder, in combination with a cylindrical lead-in conductor surrounding the third glass bulb and threaded on the shoulder on said cylinder, at least one lead connected at one end to said cathode and at the other end to said metal plate, and a second hollow cylindrical conductor surrounding the first cylindrical lead-in conductor and threaded on the shoulder of the metal plate.

11. An electron discharge device having an anode, a cathode, a grid, and means constituting a sealed envelope for said electron discharge device, said envelope means including a first glass bulb immediately surrounding said electrodes, a metal disk having a central opening sealed on one side to one end of said first glass bulb, a second glass bulb sealed at one end of the other side of said metal disk and having an internal re-entrant portion at its other end, a metal cylinder open at one end and having a base connected at its other end and provided with a plurality of openings, means sealing said base to the other internal, re-entrant end of said second glass bulb, and a third glass bulb closed at one end and sealed at its other end to the open end of said metal cylinder.

12. The combination according to claim 11, including at least one additional cathode lead connected at one end to said cathode, passing through the opening in said metal disk and the openings in said cylindrical base, and outwardly of the envelope through the closed end of said third glass bulb.

13. The combination according to claim 11, in which the open end of said cylinder is provided with an external threaded shoulder in combination with a cylindrical lead-in conductor surrounding the glass bulb and threaded on said shoulder.

14. The combination according to claim 11, in which the open end of said cylinder is provided with an external threaded shoulder, in combination with a cylindrical lead-in structure surrounding the third glass bulb and threaded on said shoulder, and at least one additional cathode lead connected at one end to said cathode, passing through an opening in said metal disk and an opening in said cylindrical disk and outwardly of the envelope through said closed end of said third glass bulb.

15. The combination according to claim 11, including a grid-supporting sleeve in the opening in said metal disk.

16. The combination according to claim 1, including lead rods attached to the other ends of the filament wires, extending through the openings in said metal support and outwardly through said second glass bulb.

17. An electron discharge device having an anode, a cathode, a grid, and means constituting a sealed envelope for said electron discharge device, said envelope means including a first glass bulb immediately surrounding said electrodes, a metal disk having a central opening sealed on one side to one end of said first glass bulb, a second glass bulb sealed at one end to the other side of said metal disk, a metal plate having openings thereto sealed on one side to the other end of said glass bulb, and a third glass bulb closed at one end and sealed at its other end to the other side of said metal plate, whereby said bulbs are all open to one another through the openings in said disk and the openings in said plate, a central

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cathode lead extending through the openings in said metal disk and secured to said metal plate, at least one additional cathode lead extending through an opening in said metal disk and said metal plate and outwardly through the closed end of said third glass bulb, threaded on the periphery of said metal plate, and a hollow cylindrical lead-in conductor surrounding said other lead and said third glass bulb and threaded on said metal plate.

18. The combination according to claim 17, in which said metal disk is in the form of a section of a cone, and which further includes a grid-supporting sleeve mounted at the central opening in said disk.

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