Oct. 10, 1944. C. V. LITTON 2,359,769

ELECTRON DISCHARGE DEVICE

Filed Dec. 22, 1943

Fig. 1

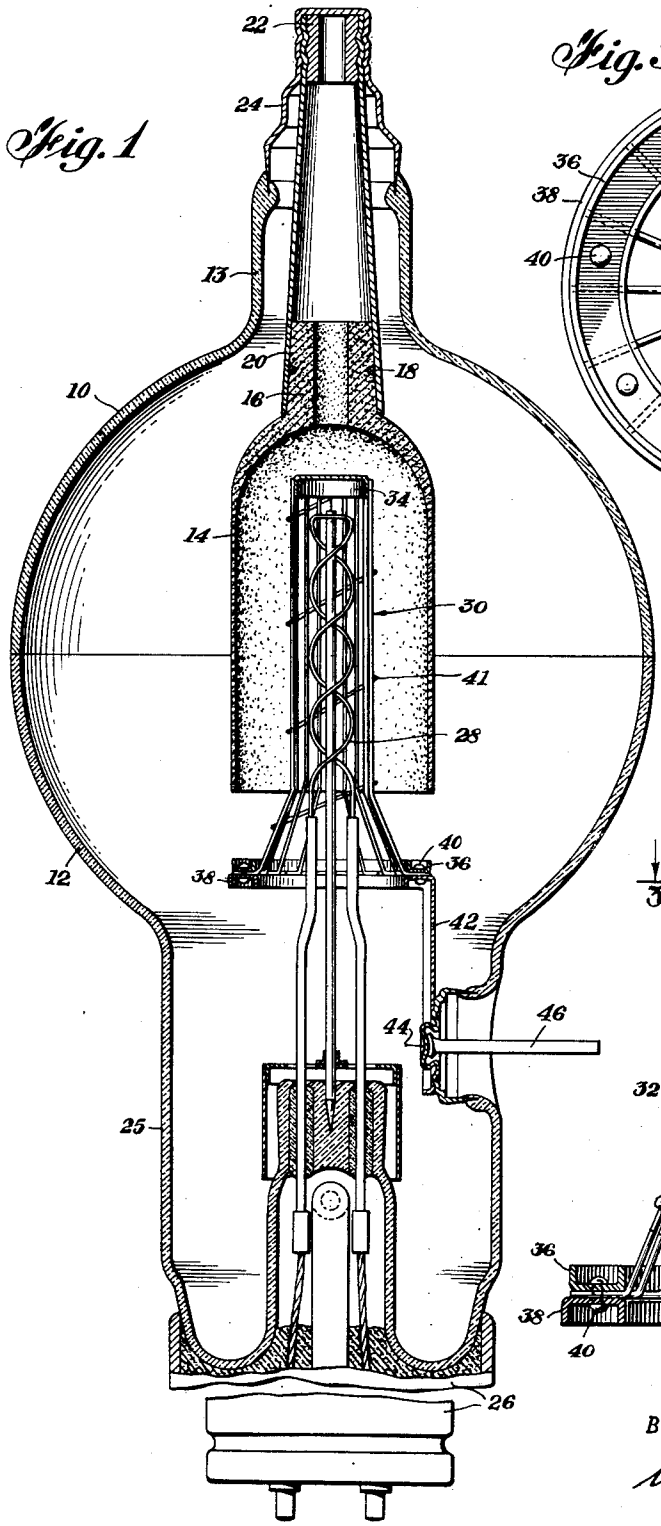


Fig. 3.

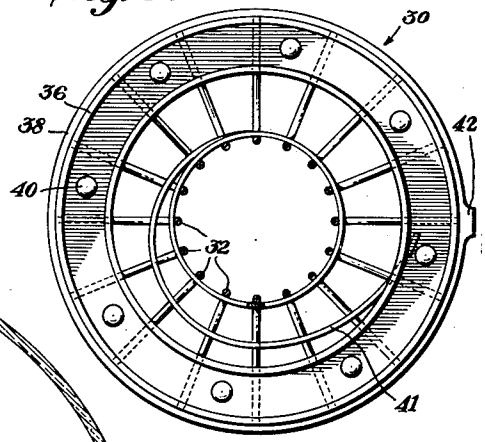
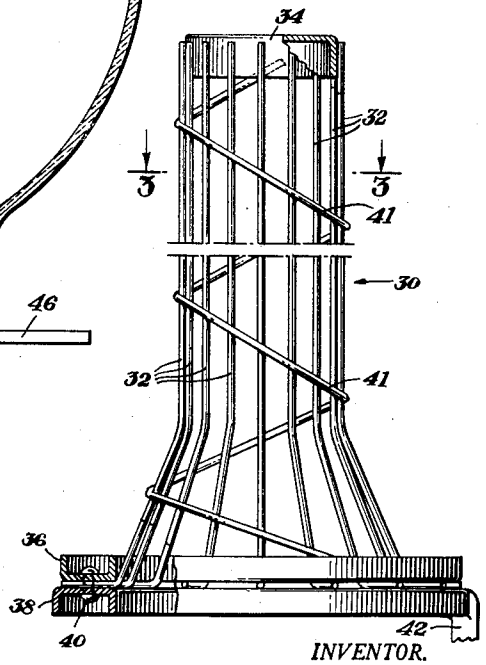


Fig. 2.



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ELECTRON DISCHARGE DEVICE

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17 Claims. (Cl. 250—27.5)

This invention relates to improvements in electron discharge devices, and more particularly to a vacuum tube having improved anode and grid structures.

An object of this invention is to provide a novel vacuum tube of a type embodying a carbon anode.

Another object of this invention is to provide a vacuum tube embodying a novel grid structure.

A further object of this invention is directed to improved means for supporting a carbon anode within and from the envelope of a vacuum tube.

Still another object of this invention is the provision of a novel, cylindrical, self-supporting grid structure for vacuum tubes and the like.

With these and incidental objects in view, the invention consists in certain novel features of construction and combination of parts which are set forth in the appended claims and a preferred embodiment thereof is hereinafter described with reference to the drawing which accompany and form part of the specification, wherein:

Fig. 1 is a vertical cross-sectional view of a vacuum tube formed in accordance with the present invention;

Fig. 2 is a front elevation, shown partially in section, of the grid structure illustrated in Fig. 1, but drawn to a larger scale;

Fig. 3 is a horizontal cross-sectional view taken along the line 3—3 of Fig. 2.

In the preferred embodiment of the instant invention, illustrated in Fig. 1, the vacuum tube in the form of a triode is formed with a suitable envelope, such as glass, and preferably initially in two generally hemispherical parts 10 and 12, sealed together before evacuation. The part 10 may be provided with a generally cylindrical extension 13 from which is supported a hollow, generally cylindrical carbon anode 14 formed with an integral tapered extension 16. The extension 16 is provided with an annular groove into which fits a ring 18, made for example, of molybdenum. A hollow tapered molybdenum sleeve 20 fits over the tapered extension 16 and is attached as by welding to the enclosed ring 18. The upper end of the sleeve 20 is adapted to receive a copper plug 22 and a copper end cap 24 may have its end walls crimped against the plug 22 with the sleeve 20 in between. The plug 22 may be formed with suitable indentations to assist in this crimping operation. The sleeve 20 with the attached carbon anode 14 is thus integrally joined to the end cap 24 which, in turn, will have its lip sealed to the cylindrical extension 13 of the envelope 10.

The lower envelope section 12 will be provided with an opposite, generally cylindrical re-entrant section 25, to the end of which may be attached a base 26, in the usual manner, containing leads for a suitable cathode structure 28, supported in any desired manner, as from the re-entrant portion of the envelope section 25. About the cathode 28 and intermediate the latter and the anode 14, is positioned a grid structure generally indicated at 30, and more clearly shown in Figs. 2 and 3. This grid structure may consist of a plurality of circumferentially spaced wires, one end of each of which is welded or otherwise attached about an annular cap 34, and whose other ends are outwardly flared. These outwardly flared ends are adapted to be clamped between two metal rings 36 and 38, the two rings holding the ends between them and being held together by suitable means such as rivets 40. A tie wire 41 may be wound about the grid wires 32, one end of this tie wire welded or otherwise attached to the annular cap 34, and the other end also being clamped between the two rings 36 and 38.

The lower ring 38 is preferably provided with an integral extension 42 which may extend at right angles to the plates of this ring and be attached to the side wall of the cylindrical envelope extension 25. This attaching means 44 may also embody an external lead 46, the particular manner of forming this vacuum-tight grid-support and external lead connection being described in more detail in my copending application, S. N. 515,268, filed of even date herewith. In order to provide extra rigidity to the grid support, the rings 36 and 38 as well as the extension 42 may be formed with a U channel, as illustrated, the rivets 40, in this case, being positioned between the sides of the channel of each ring.

It will be noted that the aforedescribed construction fulfills the objects and advantages primarily stated. The tube is easily fabricated and assembled since the anode section may be formed with the upper envelope section 10 and the grid and cathode may be formed within the lower envelope section 12, these two sections being then joined together and the tube evacuated. The use of the molybdenum ring together with the tapered sleeve crimped to the end cap of the tube, provides a simple manner for supporting the carbon anode and at the same time forms a relatively sturdy anode lead. The grid structure is self-supporting and at the same time relatively rigid as compared with other grid structures heretofore proposed. It will be clear, of course, that the particular method of supporting the carbon anode as well as the details of the grid structure per se are usable in connection with vacuum tubes other than the type shown illustrated and while I have described above the principles of my invention in connection with a specific tube, 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. Electron discharge device, including, in combination, an envelope having a generally cylin-

drical open integral extension, a cathode mounted substantially centrally within said envelope, means supporting said cathode within said envelope, a generally cylindrical grid spaced from and surrounding said cathode, said grid comprising an annular cap positioned above said cathode, a plurality of circumferentially spaced self-supporting wires connected at one end to and depending from said cap and surrounding said cathode, and having their other ends outwardly directed, a pair of rings coaxial with said cathode, and means clamping the outwardly directed ends of said wires between said rings, means supporting said rings inside of said envelope, a hollow, cylindrical carbonaceous anode spaced from and surrounding said grid, said anode being open at its lower end and having an integral upwardly directed tapered projection at its upper end above said cap, said projection having a groove, a metal member in said groove, a hollow metal internally tapered sleeve extending at one end over said tapered projection and attached to said metal member and means supporting the other end of said hollow sleeve and closing the open cylindrical extension of said envelope.

2. The combination according to claim 1, in which said last means includes a metal plug in the other end of said hollow sleeve, and a generally cup-shaped metal member whose sides are crimped about the other end of the hollow sleeve and against said plug, and whose lip is sealed to the open cylindrical extension of said envelope.

3. The combination according to claim 1, in which the means for supporting said rings inside of said envelope includes an integral extension of one of said rings.

4. The combination according to claim 1, in combination with a tie wire wound helically about said grid wires, one end between said rings and attached at its other end to said cap.

5. The combination according to claim 1, in which said envelope is in the form of two hollow hemispherical parts sealed together, and one part of which has said cylindrical extension, and in which the grid and cathode-supporting means are attached to the other part.

6. The combination according to claim 1, in which said envelope has a second, generally cylindrical integral extension projecting opposite to the first-named extension, and in which the cathode is supported from the end of the second extension, and the grid from a side wall of said extension.

7. Electron discharge device including, in combination, an envelope having a generally cylindrical extension open at its outer end, a cathode mounted substantially centrally within said envelope, means supporting said cathode within said envelope, a hollow cylindrical carbonaceous anode spaced from and surrounding said cathode, said anode being open at one end and at its other end having an integral tapered projection provided with a groove, a metal member in said groove, a hollow metal internally tapered sleeve extending at one end over said tapered projection and attached to said metal member, and means supporting the other end of said hollow sleeve and closing the open cylindrical extension of said envelope.

8. The combination according to claim 7, in which said last means includes a metal plug in the other end of said hollow sleeve, and a generally cup-shaped metal member whose sides are crimped about the other end of the hollow sleeve and against said plug, and whose lip is sealed to the open cylindrical extension of said envelope.

9. In an electron discharge device of the type in which an evacuated envelope encloses the tube electrodes, the combination of a hollow carbonaceous anode open at one end and having an integral tapered projection on its other end, said projection having an annular groove, a metal ring in said groove, a hollow internally tapered metal sleeve extending over said tapered projection and fastened to said metal ring, and means forming part of said evacuated envelope and supporting said metal sleeve.

10. The combination according to claim 9, in which said last means includes a metal plug in said sleeve, and a generally cup-shaped end member whose sides are crimped about said plug with the sleeves between them, and whose lip is sealed to the rest of the envelope.

11. Electron discharge device including, in combination, an envelope, cathode, grid and anode electrodes, means mounting said electrodes within said envelope, said grid comprising an annular cap, a plurality of circumferentially spaced, self-supporting wires connected at one end to and depending from said cap, and having their other ends outwardly directed, a pair of rings, means clamping the outwardly directed ends of said wires between said rings and means supporting one of said rings inside of said envelope.

12. The combination according to claim 11, in which said last means includes an integral extension of one of said rings.

13. The combination according to claim 11, in combination with a tie wire wound helically about said grid wires, one end of said wire being clamped between said rings, and attached at its other end to said cap.

14. Grid structure for electron discharge devices, comprising an annular member, a plurality of circumferentially spaced, self-supporting wires connected at one end to and depending from said member, and having their other ends outwardly directed, a pair of rings and means clamping the outwardly directed ends of said wires between said rings.

15. The combination according to claim 14, in combination with a tie wire wound helically about said grid wires, one end being clamped between said rings, and attached at its other end to said cap.

16. The combination according to claim 14, in which each of said rings are formed with a circular lateral channel, the rings being mounted relatively to one another with the channels extending outwardly in opposite directions, and means in said channels holding the rings together with the wire ends between them.

17. In an electron discharge device of the type in which an evacuated envelope encloses the tube electrodes, the combination of a carbonaceous anode having an integral tapered projection on one end, said projection having an annular groove, a metal ring in said groove, a hollow, internally tapered metal sleeve extending over said tapered projection and fastened to said metal ring, and means supporting said metal sleeve in said evacuated envelope.

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