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ELECTRON DISCHARGE TUBE STRUCTURE

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FIG.1.

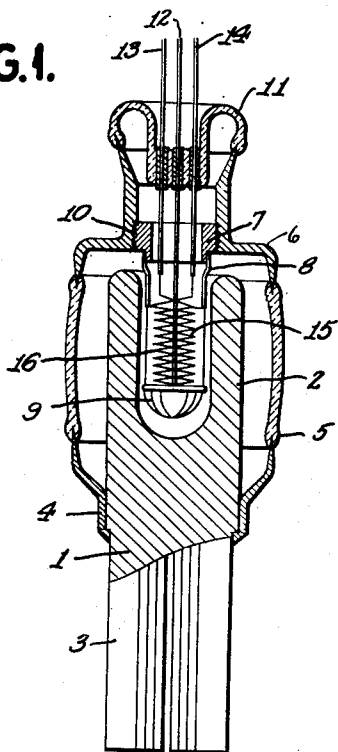


FIG.3.

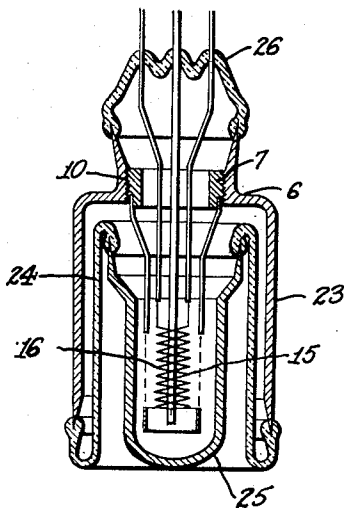


FIG.4.

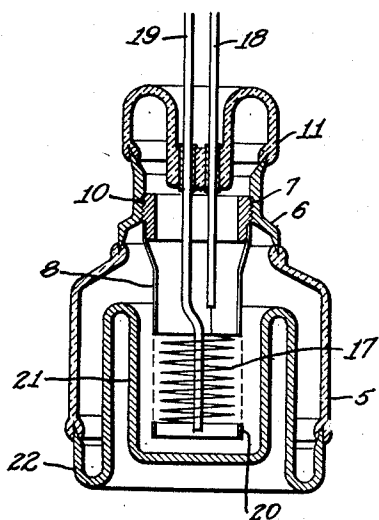
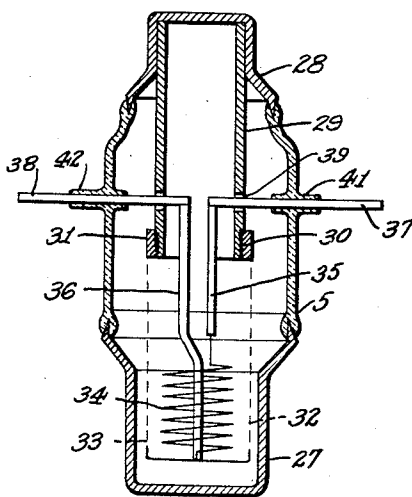


FIG.2.



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ELECTRON DISCHARGE TUBE STRUCTURE

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The present invention relates to types of electron discharge tubes and its main object is to provide structures that are specially adapted to operate at very high frequencies, for example, at those corresponding to decimeter wavelengths.

Another object of the invention is to provide ultra-high frequency tube structures that permit use of coaxial transmission lines as electric current and potential feed connections.

In an electric discharge tube that incorporates characteristic features of the invention, the control electrode is supported and fed by an annular member that forms part of the outer bulb and surrounds the output structure of the cathode; the structure of the control electrode properly so-called ends in an annular member that screws into the annular member that forms part of the bulb, and this permits an adjustment of the position of this electrode during the fitting of the tube. Furthermore, the anode structure also forms part of the outer bulb and preferably comprises a portion reentrant within this bulb, the anode conductive portion and the grid connection annular member being mechanically connected by an insulating portion that completes the bulb with an insulating base through which the cathode connections pass coaxially to the grid connection member.

The invention is explained in detail in the following description covering various examples of embodiments shown in the appended drawing, in which Figs. 1 to 4 show in sectional elevation types of discharge tubes that incorporate features of the invention.

In the type of construction shown in Fig. 1, a metallic block 1 serves as one-piece structure for the anode which consists of a hollowed portion 2 of this block and the anode cooling device, which consists of the other end 3 of block 1 and is divided into ribs for forced ventilation but which may likewise be provided with grooves forming suitable channels for cooling by circulation of a refrigerant fluid. A tapered sleeve 4 is screwed and soldered on an intermediate portion of this anode. On the end of this tapered sleeve 4 there is sealed a cylinder or revolving wall of insulating material 5 which turns around portion 2 of the anode.

To the other end of this insulating portion 5 of the bulb there is sealed a tapered metallic sleeve 6 within which there is screwed an annular metallic collar that serves as support for rods like 8 which form a control grid for the tube or on which there is wound a grid wire according to a well known arrangement. The rods 8 are at one end brazed on the inner periphery of the annular member 7 and extend along sides of one cylinder to within the cavity provided within the hollowed portion 2 of the anode. At this end they terminate in a grid structure 9 of cup shape in such a way as to determine the grid anode

capacity by its construction. This capacity may furthermore be adjusted during the fitting by means of the threading 10 between the members 6 and 7 which form the grid support.

On the other end of the annular metallic member 6 there is sealed an insulating reentrant end plate 11 through the seals of which cathode connections pass, three in the example shown in the drawing, with the mid point of the filament projecting. The lead-in 12 from the mid-point of the filament extends directly coaxially to the grid and anode structures as far as a point near the cup 9 at the bottom of the grid. The two other leads-ins 13 and 14 stop at the top level of the grid properly so-called and are prolonged by two reversed spiral filaments 15 and 16 connected to the end of rod 12.

The type of construction shown in Fig. 2 uses a similar arrangement for the grid supporting elements 6—7, the outer annular member that forms part of the bulb being sealed to two insulating members respectively, one of cylindrical or revolving surface shape 5 and the other of pressed-on endplate shape 11, for the connecting and supporting leads of the filament to pass through. This is shown in Fig. 2 as a simple filament in series, that is, as one that only comprises a simple spiral 17 supported and fed by two rods 18 and 19, rod 19 extending axially to the bottom of the grid. This grid bottom, which is insulated from rod 19, consists in the arrangement shown in Fig. 2 of a simple end ring 20 on the periphery of which the grid supporting and feed rods 8 are secured.

The general dimensions of the tube of Fig. 2 are made even smaller than those of Fig. 1 by using as anode a reentrant member 21 having its rim bent, as shown at 22, for sealing it to the insulating portion 5. Any suitable refrigerant fluid circulation cooling system may be used in the annular cavity formed in this way between the reentrant anode 21 and the rim 22, which may or may not be integral with the same.

In the type of construction shown in Fig. 3, the filament structure is similar to that of Fig. 1 and the grid structure is similar to that of Fig. 2. However, the outer grid connection portion 6 which forms part of the bulb is prolonged cylindrically as shown at 23 in such a way that it can be sealed to a reentrant insulating portion 24 of the bulb in which there is sealed coaxially a tubular anode 25 closed at one end.

Furthermore, the output connections of the filament structure that pass through a reversed pressed-on endplate 26 are disposed so as to keep the outlet seals of connections 12, 13 and 14 apart from the active portion of the structure.

In the type of construction shown in Fig. 4, the bulb of the tube consists of a sleeve-shaped insulating portion 5 which is sealed at both ends to two closed metallic cylinders 27 and 28. Cyl-

inder 27 is made of suitable shape and dimensions to act as the anode of the tube, and it is evident that a cooling device of any desired type can easily be provided around this anode. Cylinder 28 is disposed so as to serve as electrical connection and mechanical support for the grid structure of the tube and it may also be cooled if desired.

The grid structure comprises a conducting sleeve 29 shrunk on and brazed, for example, within cylinder 28. This conducting sleeve 29 extends within the tube and its end is provided with a thread 30 on which there is screwed a threaded metal ring 31 which supports the active structure 32 of the grid and which may consist, for example, of rigid rods disposed on the periphery of an upright cylinder surrounded by a helical grid wire (not shown). An end cap or screen of any suitable shape is shown at 33 at the end of the grid near anode 27. In this way the thread 30 permits the grid-anode capacity to be easily adjusted during fitting to the desired value or at least to a definite value. Besides, the alignment of the electrodes of the structure is made easier.

A filament structure is disposed coaxially to anode 27 and the active portion 32 of the grid, in the illustrated example this filament structure consists of a single helical winding 34 supported and fed by two conductive leads 35 and 36, rod 36 extending axially into the entire tube structure for part of its length. These two rods 35 and 36 are themselves connected electrically and mechanically to two rods 37 and 38 which pass through oversize openings 39 and 40 of the grid sleeve 29 and through tight seals 41 and 42 in the insulating portion 5 of the bulb.

It can be seen that these various types of construction, which are only shown as examples, are particularly adapted for operating on short wavelengths with adequate cooling. Indeed, the anode structures permit cooling to any desired degree in a simple manner. The adjustment of the distance between the bottom of the grid and the bottom of the anode makes it possible to determine the capacity between these electrodes with precision. The annular outlet of the tube likewise permits exact centering during fitting of the grid and filament structures with respect to the anode. Besides, the outlet structures are arranged to cooperate with shapes of electrodes, particularly anodes, so as to furnish tubes having electrode dimensions and connections that are small in comparison with the wavelengths used.

Such types of tubes are also readily adaptable for use with 2-wire and even 3-wire coaxial lines for feeding the tube. The filament's output connections can be screened and a cylindrical sleeve coaxial to this screen may be fitted on the annular outlet of the grid for the feeding of the grid, and this constitutes a coaxial grid-filament transmission line. Furthermore, coaxial transmission lines of this kind may likewise be readily disposed between the grid electrode and the anode, and the cylindrical sleeve fitted on the latter may also surround the cylindrical grid sleeve that encloses the sleeve of the cathode filaments. The connections of such tubes may consequently be disposed in such a way that these tubes are specially suitable for insertion in coaxial or dielectric transmission lines.

It is evident that numerous modifications, chiefly relating to the electrode structures properly so-called, may be made in the tubes de-

scribed and illustrated as examples without departing from the scope of the invention.

The claim is:

1. A symmetrical electron discharge device adapted for ultra high frequency operation comprising an evacuated vessel having a generally cylindrical side wall including a vitreous section, and a pair of end walls, a cathode located coaxially within the side wall, a control grid concentrically surrounding the cathode within the vessel, a conducting sleeve forming part of the side wall, the grid being supported by and electrically connected to the sleeve, one of the end walls being of vitreous substance through which the electrical connection to the cathode passes, the other end wall being formed by a metallic anode sealed to the vitreous side wall section and having a cylindrical portion extending into the vessel and concentrically surrounding the grid within the vessel.

2. An electron discharge device comprising an evacuated, generally cylindrical envelope consisting of a vitreous end piece, a metallic sleeve sealed to said end piece, a vitreous sleeve sealed to said metallic sleeve, and a hollow metallic anode element sealed to said vitreous sleeve and forming the opposite end of the envelope, a cathode positioned coaxially within said anode and supported from said vitreous end piece, a grid surrounding said cathode inside of said anode, and means adjustably supporting said grid including a collar threadably secured to the inside of said metallic sleeve for adjusting the grid-anode capacity during assembly.

3. The combination according to claim 1 and a collar threadably secured to the inside of said metallic sleeve and supporting said grid.

4. An electron discharge device comprising an evacuated, generally cylindrical envelope consisting of a vitreous end piece, a metallic sleeve sealed to said end piece, a vitreous sleeve sealed to said metallic sleeve, and a metallic end member sealed to said vitreous sleeve, said metallic end member having a re-entrant double-wall section concentric with said vitreous sleeve, the inner wall of said end member forming the anode for said electron discharge device, a cathode supported from said vitreous end piece, positioned within said anode, and a grid electrode supported from said metallic sleeve and positioned intermediate said cathode and anode.

5. The combination according to claim 4 and an adjustable grid supporting collar threadably secured to the inside of said metallic sleeve for adjusting the grid-anode capacity during assembly.

6. An electron discharge device comprising an evacuated, generally cylindrical envelope consisting of a vitreous end piece, a metallic sleeve sealed to said end piece, a vitreous re-entrant sleeve sealed to and lying partially within said metallic sleeve, and a hollow metallic anode element sealed to said vitreous sleeve and forming the opposite end of the envelope, a cathode positioned coaxially within said anode and supported from said vitreous end piece, and a grid electrode supported from said metallic sleeve and positioned intermediate said cathode and anode.

7. The combination according to claim 6, and an adjustable grid-supporting collar threadably secured to the inside of said metallic sleeve for adjusting the grid-anode capacity during assembly.

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