

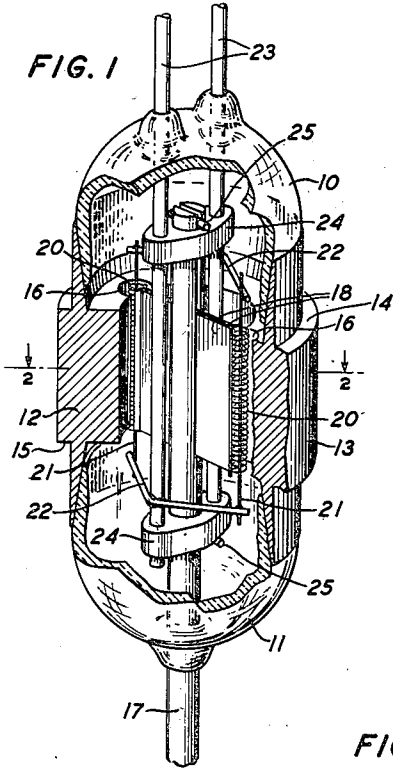
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**A. L. SAMUEL**

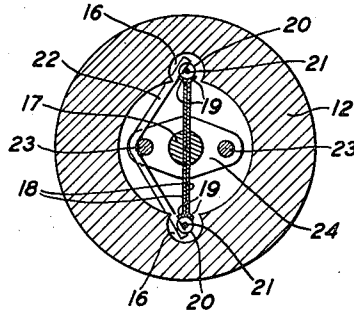
**2,044,369**

## ELECTRON DISCHARGE DEVICE

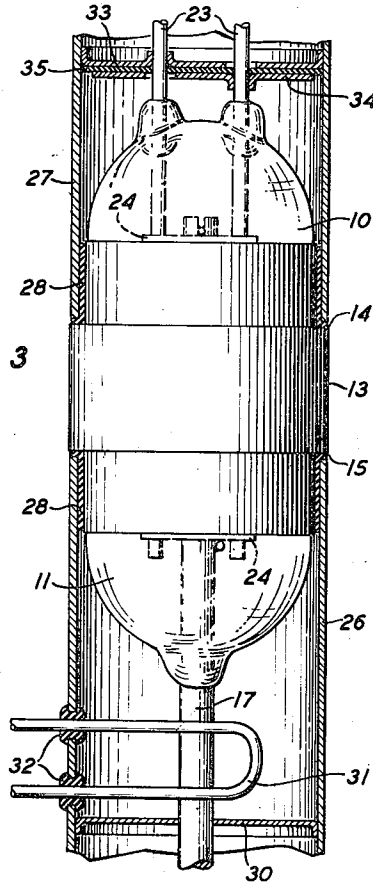
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**FIG. 2**



**FIG. 3**



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## ELECTRON DISCHARGE DEVICE

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9 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices capable of generating and amplifying ultra-high frequency impulses.

One object of this invention is to increase the power capacity and the efficiency of high frequency electron discharge devices.

Another object of this invention is to expedite the control of circuits including high frequency electron discharge devices.

In one embodiment of this invention, an electron discharge device comprises an enclosing vessel having vitreous end portions and an intermediate metallic cylindrical portion which serves as the anode of the device. The metallic portion is provided on its inner surface with a plurality of substantially cylindrical grooves or recesses in each of which a control electrode and a cathode are disposed.

The control electrodes may comprise wire helices carried by a metallic member or fins which are supported by a single metallic rod sealed in one of the vitreous end portions.

The cathodes may be linear filaments supported by and electrically connected to two metallic rods sealed in the other vitreous end portion.

The enclosing vessel may be encompassed by two coaxial conductors disposed one about the control electrode supporting rod and the other about the cathode supporting rods. These conductors and rods form external circuits between the cathode and anode, and control electrode and anode, and the effective impedance between the several electrodes may be controlled by varying the length of these conductor systems.

The conductor encompassing the grid supporting rod may be connected directly to the rod by a movable short circuiting wire or disc whereby the operating frequency of the device may be adjusted. This conductor need not be so connected, but may also be coupled to the grid rod solely through the distributed capacitances and inductances between the conductor and the rod.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawing in which:

Fig. 1 is a perspective view of an electron discharge device constructed in accordance with this invention, portions of the enclosing vessel being broken away to show the internal structures more clearly;

Fig. 2 is a cross-sectional view along line 2—2 of Fig. 1 showing the configuration and relative positions of the electrodes, and

Fig. 3 is a view partly in cross-section showing the combination of the electron discharge device illustrated in Fig. 1 and cylindrical conductors associating the anode with the cathode and control electrode, in accordance with this invention.

Referring now to the drawing, the electron discharge device shown in Fig. 1 comprises an enclosing vessel having vitreous end portions 10 and 11 and an intermediate metallic portion 12, which may be of copper, hermetically sealed at its ends to the vitreous portions 10 and 11. The metallic portion 12 serves as the anode of the device and is provided on its outer surface with a cylindrical raised portion 13 forming spaced shoulders 14 and 15. The inner surface of the metallic portion 12 is provided with two parallel diametrically opposite grooves or recesses 16 which may be substantially cylindrical as shown clearly in Fig. 2.

A control electrode assembly comprises a single metallic support or rod 17 sealed in the vitreous end portion 11 of the enclosing vessel and serving as a leading-in conductor. The inner end portion of the support or rod 17 is provided with a slot or groove for receiving a relatively large area plate member or fin which may comprise two plates 18 suitably secured together and to the rod 17, as by welding. The opposite lateral edges of the plates 18 are provided with outwardly bent lips 19 to which each turn or a suitable number of turns of wire helices or grids 20 are secured, as by welding. The helices 20, which constitute control electrode elements, are disposed one within each of the grooves or recesses 16 and coaxial therewith. Inasmuch as the plate members 18 are of relatively large area, they will radiate heat rapidly so that the grids 20 will be maintained at a relatively low temperature during operation of the device.

Disposed within each of the helices 20 and coaxial therewith is a linear filamentary cathode 21, which may be of thoriated tungsten or other material having good thermionic emission characteristics. The filamentary cathodes 21 are secured at their ends to flexible metallic members or springs 22 which are individually supported by supports or rods 23 sealed in the vitreous end portion 10 of the enclosing vessel and preferably disposed parallel to the support or rod 17.

The supports or rods 17 and 23 are maintained in the proper relation by insulating members 24 which are frictionally fitted on the support or rod 17 and held in position by wire stubs 25 secured to the rod. The insulating members 24 are provided with apertures for receiving the

supports or rods 23. The latter may fit loosely in the apertures in the insulating members 24 to allow free expansion and contraction of the supports or rods 17 and 23.

5 As clearly shown in Fig. 3, the enclosing vessel may be encompassed by two metallic conductors in the form of cylinders 26 and 27 which may fit loosely about cylindrical insulating members 28, for example, mica sheets, suitably secured about the anode 12 and abutting against the shoulders 14 and 15. The conductor 26 preferably is coaxial with the control electrode leading-in conductor 17 and provides a portion of the external circuit between the control electrode and the anode. The conductor 27 preferably is disposed coaxially with the cylinder 26 and provides a portion of the external circuit between the cathode and the anode.

10 It will be apparent that the electrode structures, the cylindrical conductors 26 and 27, and the leading-in conductors 17 and 23 form distributed constant circuits, the tuning of which is controllable by the length thereof. As shown in Fig. 3, the length of the control electrode-anode system may be adjusted by a tie wire or short-circuiting disc 30 contacting with the rod 17 and the cylindrical conductor 26 and slidable along the rod and conductor. If there is no impedance discontinuity between the coaxial conductor system comprising the cylinder 26 and rod 17 and the distributed constant system comprising the anode and the control electrode or grid structure, the tie wire or disc 30 will be positioned substantially one-quarter of the wave length of the operating frequency from the remote end of the control electrode or grid structure. If an impedance discontinuity does exist between the coaxial conductor system and the distributed constant system noted, the requisite position of the tie wire or short-circuiting disc to tune the anode-control electrode system to a desired frequency may be calculated readily in ways known to those skilled in the art.

15 An output or utilization circuit may be coupled to the control electrode circuit by a looped or U-shaped conductor 31 extending through insulating bushings 32 fitted in the metallic cylinder 26, the conductor 31 extending adjacent, but not contacting with the support or rod 17.

20 The distributed constant system including the conductors 23 and 27 may be terminated by a movable assembly including metallic discs 33 and 34 insulated from each other as by a disc of mica 35. Each of the discs 33 and 34 engages a corresponding one of the rods 23 and is provided with an oversized aperture, as shown in Fig. 3, through which the other rod extends. One of the discs, for example the disc 33, engages the cylindrical conductor 27. The length of the system affects the tuning of the device only indirectly and the position of the discs 33 and 34 may be varied to obtain the optimum operating condition.

25 The heating current for the cathode may be supplied from a suitable source, such as a battery, connected between the leading-in conductors 23, one terminal of the source being grounded. Suitable potentials may be applied to the anode and control electrode by suitable sources, such as batteries, connected to the raised portion 13 of the anode and to the rod 17 respectively, one terminal of each of these sources also being grounded.

30 Although in the specific embodiment of the invention shown and described, the anode is provided with two grooves or recesses in which cath-

ode and control electrode elements are disposed, it will be understood, of course, that it may be provided with a different number of grooves or recesses, each having therein a cathode and a control electrode element. It will be understood also that various modifications may be made in the specific structure shown and described without departing from the scope and spirit of the invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel including vitreous end portions and an intermediate cylindrical metallic portion, said metallic portion having a plurality of recesses in its inner wall and serving as the anode of the device, a support extending from one of said end portions, a plate member carried by said support and having edges adjacent said recesses, helical grids secured to said edges and disposed in said recesses, a plurality of supports extending from the other of said end portions, and filaments carried by said second supports and disposed within said grids.

2. An electron discharge device comprising an enclosing vessel including a vitreous portion and a metallic portion, said metallic portion serving as an electrode of the device, an electrode within said envelope and cooperatively disposed with respect to said metallic portion, a leading-in conductor for said second electrode extending from said vitreous portion, and a hollow conductor encircling said first conductor and said vitreous portion and portions of said metallic portion.

3. An electron discharge device comprising an enclosing vessel having vitreous end portions and an intermediate metallic portion constituting the anode of the device, a control electrode and a cathode within said vessel, a leading-in conductor for said cathode extending from one of said end portions, and a leading-in conductor for said control electrode extending from the other of said end portions, and tubular conductors encompassing said end portions and coupling said anode with said leading-in conductors.

4. An electron discharge device comprising an enclosing vessel including a vitreous portion and a metallic portion forming an electrode of the device, another electrode within said enclosing vessel, a leading-in conductor for said second electrode extending from said vitreous portion, a tubular conductor encompassing said first conductor and a part of said metallic portion, and a conductor insulated from and extending through said tubular conductor and having a portion in proximity to said leading-in conductor.

5. An electron discharge device comprising an enclosing vessel having vitreous end portions and a metallic portion serving as the anode of the device, a cathode and a control electrode within said anode, leading-in conductors for said cathode extending through one of said end portions, a leading-in conductor for said control electrode extending through the other of said end portions, a tubular conductor encompassing said first conductors and a portion of said anode, a metallic member slidably contacting with said tubular conductor and one of said first conductors, another tubular conductor encompassing a portion of said anode and the leading-in conductor for said control electrode, and a metallic conductor slidably contacting with said second tubular conductor and said control electrode leading-in conductor.

6. An electron discharge device comprising an enclosing vessel having a portion serving as an anode, a cathode, a control electrode, means carried by said vessel and disposed adjacent one end thereof for varying the capacitance and inductance between said anode and said control electrode, and means carried by said vessel and disposed adjacent the opposite end thereof for varying the capacitance and inductance between said cathode and said anode.

7. An electron discharge device comprising a pair of electrodes, a leading-in conductor extending from one of said electrodes, a metallic member in juxtaposition to said conductor and the other of said electrodes, and means electrically connecting said conductor and said member, said means being movable along said conductor and said member whereby the inductance

and capacitance between said electrodes may be varied.

8. An electron discharge device comprising an anode, a cathode, and a control electrode, a leading-in conductor extending from said cathode, a leading-in conductor extending from said control electrode, means including a tubular metallic member encompassing said first conductor and a portion of said anode and forming a distributed constant system therewith, and means including another tubular metallic member encompassing said second conductor and another portion of said anode and forming a distributed constant system therewith.

9. An electron discharge device in accordance with claim 8 including means for varying the length of said second distributed constant system.

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