

Dec. 24, 1935.

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2,025,075

ELECTRON DISCHARGE DEVICE

Filed April 27, 1934

FIG. 1

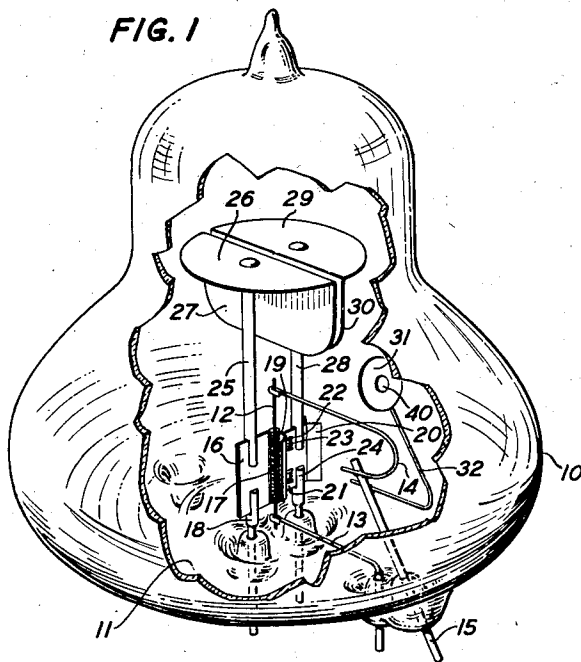


FIG. 3

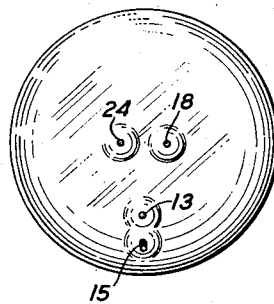


FIG. 2

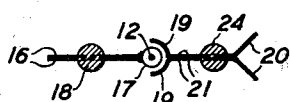
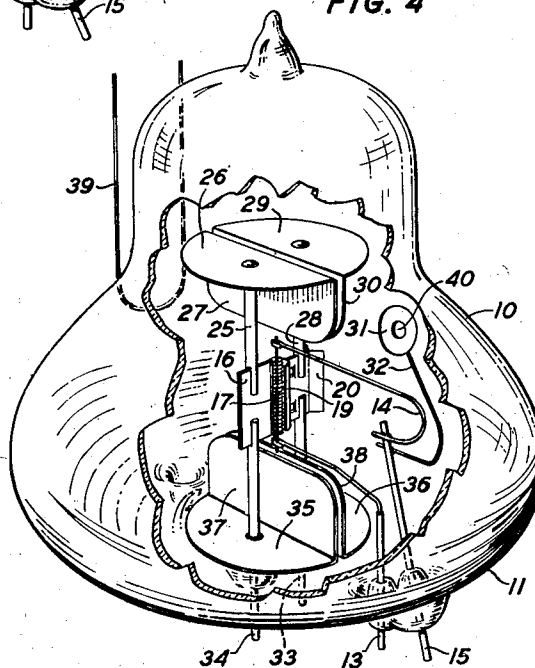


FIG. 4



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2,025,075

ELECTRON DISCHARGE DEVICE

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Application April 27, 1934, Serial No. 722,706

7 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices capable of generating oscillations of extremely low wave lengths, for example of the order of 30 centimeters or less.

In ultra-short wave oscillators of the negative grid type, the upper limit of the frequency of oscillations generated is dependent in a large measure upon circuit resonance determined by the interelectrode capacities and the impedance of the leading-in conductors for the electrodes. The impedance of the leading-in conductors is dependent primarily upon the dimensions of the conductors and their spacing relative to each other. The spacing of the conductors in turn is dependent upon the temperature to which the vessel in which the conductors are sealed may be heated safely.

One object of this invention is to decrease the impedance of the leading-in conductors for the electrodes in electron discharge devices in relation to the impedance of the electrodes.

Another object of this invention is to dissipate efficiently the heat from the electrode assemblies in electron discharge devices.

In one embodiment of this invention an electron discharge device comprises an enclosing vessel having a cathode, grid electrode, and anode supported therein by rods sealed directly in a wall of the enclosing vessel. The grid electrode and anode are provided with large surface heat radiating fins to which the grid and anode leading-in conductors are secured and which extend to immediately adjacent the wall of the enclosing vessel in which these conductors are sealed.

The fins also have secured thereto conductors each of which carries a metallic plate, the plates being disposed adjacent each other to form a condenser. These conductors and plates together with the electrodes define a tuned circuit. If desired, another condenser may be connected between the leading-in conductors for the grid and anode adjacent the points where these conductors are sealed in the enclosing vessel, the condensers, conductors and electrodes forming another tuned circuit within the enclosing vessel. This construction enables the close positioning of the elements forming the tuned circuits, and hence provides a low conductor impedance so that the device may be utilized to generate oscillations of extremely low wave lengths.

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 illustrative of one embodiment of the invention, portions of the enclosing vessel being broken away to show the electrode assembly more clearly;

Fig. 2 is an end view of the electrodes of the device shown in Fig. 1 showing the configuration and arrangement thereof;

Fig. 3 is a bottom view of the base of the enclosing vessel of the device illustrated in Fig. 1 showing the arrangement of the electrode leading-in conductors; and

Fig. 4 is a perspective view of another embodiment of this invention.

Referring now to the drawing, the electron discharge device shown in Fig. 1 comprises an enclosing vessel 10 having a base wall 11 from which a cathode, an anode, and a control electrode or grid are supported. The electrodes preferably are positioned as closely together as is mechanically and electrically feasible so that the electron transit times are small and the device may be operated at extremely high frequencies.

The cathode comprises a linear filament 12, which may be of thoriated tungsten, secured at one end to a rigid bent wire or rod 13 sealed in the base wall 11 of the enclosing vessel. The filament is secured at its other end to a J-shaped flexible member or spring 14 carried by a rigid support or rod 15 sealed in the base wall 11 adjacent the periphery thereof.

The control electrode or grid comprises a pair of fins 16 to one edge of which a helical grid 17 is secured, as by welding, the grid 17 being coaxially disposed about the filamentary cathode 12. The fins 16, which preferably are of large area and hence radiate heat efficiently to maintain the grid at a safe operating temperature, are secured in a slot in a rigid metallic support or rod 18, sealed in the base wall 11 of the enclosing vessel. Preferably, the fins extend to immediately adjacent the base wall as shown.

The anode comprises two metallic plates each including an arcuate portion 19 coaxial with the filamentary cathode 12, a flange 20, and an intermediate portion or fin 21. The intermediate portions 21 are secured together in face to face relation by bent integral tabs 22 on one portion extending through apertures 23 in the other portion, and are fitted in a slot in a rigid metallic support or rod 24 sealed in the base wall 11 of the enclosing vessel. The intermediate and flanged portions 21 and 20 respectively are of sufficient area to effectively cool the anode by radiation, and preferably extend to immediately

adjacent the base wall 11, the intermediate portion being coplanar with the fins 16.

Inasmuch as the intermediate portions 21 of the anode and the fins 16 extend to immediately adjacent the base wall 11 of the enclosing vessel, heat is radiated from the point of the base wall 11 at which the rods 18 and 24 are sealed in the base wall. Hence the rods 18 and 24, which serve as leading-in conductors for the control electrode and anode, may be made very short and spaced close together so that the inductance thereof is small. Although positioning the rods 18 and 24 closely together increases the capacity therebetween, this is not detrimental for at very high frequencies, for example frequencies corresponding to wave lengths of the order of 30 centimeters or less, the inductance of the leading-in conductors constitutes the dominating factor in the impedance of the conductors. The rods 18 and 24 are made of relatively large diameter with respect to the distance between their axes so that the inductance of the rods per unit of length is small. At very high frequencies, the inductance of the rods is still of considerable magnitude and together with the capacity between the control electrode and anode assemblies provides a material portion of the tuned circuit in which the device is included.

By virtue of this construction, the surge impedance of the leading-in conductors may be made of the order of but two or three times the impedance of the electrodes whereby a relatively high operating efficiency for the device may be attained, and the device may be operated at extremely high frequencies.

A metallic disc 31, having a getter material 40, such as magnesium, thereon, is supported from the rod or support 15 by a wire 32. During the fabrication of the device the magnesium may be vaporized to fix residual gases in the enclosing vessel 10.

Mounted on the fins 16 is a metallic rod 25 having a slot for receiving the fins and disposed in alignment with the support or rod 18. The rod 25 has secured to its free end a metallic plate having a semicircular portion 26 at right angles to the rod 25 and a substantially rectangular plate portion 27 parallel to the rod. Similarly, a metallic rod 28 is mounted on the intermediate portions 21 of the anode and carries a metallic plate having a semicircular portion 29 coplanar with the portion 26 and a substantially rectangular portion 30 parallel to the portion 27. The portions 27 and 30 form a condenser in series with the rods 25 and 28, which serve as inductances, and together with the rods 25 and 28 and the control electrode or grid and anode provide a tuned circuit within the enclosing vessel.

The resonant frequency of this circuit will, of course, be determined by the capacity of the condenser formed by the plate portions 27 and 30, the inductance of the rods 25 and 28 and the capacity therebetween, and the capacity and inductance between the anode and control electrode or grid.

In another embodiment of this invention, two tuned circuits may be provided within the enclosing vessel 10. As shown in Fig. 4, illustrating this embodiment, the anode and control electrode supporting members 33 and 34 respectively are substantially of the same length as the supports or rods 28 and 25 and carry plate members 35 and 36 respectively having parallel spaced portions 37 and 38 forming a condenser. The

supporting members 33 and 34 and spaced portions 37 and 38 are designed so as to form a circuit tuned to substantially the same frequency as the circuit including the supports or rods 25 and 28. Preferably, these circuits are tuned to substantially the frequency at which the device is intended to be operated. The output circuit for the device may be a Lecher circuit including a looped member 39 adjacent the enclosing vessel and inductively coupled to one of the circuits within the enclosing vessel. For example, the looped member may be parallel to the rods 25 and 28.

In this embodiment, the portions of the electrode supports extending through the wall of the enclosing vessel do not form a part of the oscillating circuits of the device. Hence, the conductors comprising the circuit may be made very short so that the device may be operated at extremely high frequencies, for example at frequencies corresponding to wave lengths of the order of 12 centimeters.

Although two specific embodiments of the invention have been shown and described, it will be understood of course that modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims.

What is claimed is:

1. An electron discharge device comprising an enclosing vessel, a pair of parallel conductors sealed in one wall of said vessel closely adjacent each other, a control electrode having a fin secured to one of said conductors and extending to immediately adjacent said wall, an anode having a fin disposed coplanar with said first fin, secured to the other of said conductors and extending to immediately adjacent said wall, a cathode, and leading-in conductors for said cathode sealed in said vessel at points remote from said parallel conductors.

2. An electron discharge device for the generation of ultra-high frequency oscillations, comprising an enclosing vessel housing a cathode, a control electrode, an anode, supporting members connected to said anode and control electrode at one end, inductive members individually secured to said control electrode and anode at the other end thereof, and plate members carried by said inductive members and spaced to form a condenser, said inductive members and condenser forming a tuned circuit with said anode and control electrode tuned to the frequency at which the device is intended to oscillate.

3. An electron discharge device comprising an enclosing vessel housing a cathode, an anode and a control electrode, and means within said vessel connecting said control electrode and anode and forming a plurality of tuned circuits therewith.

4. An electron discharge device comprising an enclosing vessel housing a cathode, an anode, and a control electrode, means within said vessel including a condenser electrically connecting said anode and control electrode at one end and forming a tuned circuit therewith, and means within said vessel including a condenser electrically connecting said anode and control electrode at the other end and forming another tuned circuit therewith.

5. An electron discharge device comprising a cathode, an anode, a control electrode, a pair of parallel conductive members individually connected to one end of said control electrode and anode, a condenser bridging said members, another pair of parallel conductive members disposed one in

alignment with each of said first conductive members and individually connected to the other end of said control electrode and anode, said second members being of substantially the same length
5 as said first members, and a condenser bridging said second members, said condensers having substantially the same capacity.

6. An electron discharge device comprising a cathode, a pair of parallel metallic supports, a control electrode and an anode individually mounted
10 on said supports, plate members carried by said supports and spaced to form a condenser, a pair of metallic members extending from said control electrode and anode remote from said supports, each of said metallic members being longitudi-

nally aligned with a corresponding one of said support members, and plates carried by said metallic members and spaced to form a condenser.

7. In combination, an electron discharge device for generating ultra-high frequency oscillations
5 comprising an enclosing vessel housing a cathode, an anode and a control electrode, means within said vessel including a plurality of inductive members connecting said control electrode and anode
10 and forming a plurality of tuned circuits therein, and a conductor in juxtaposition to said enclosing vessel and inductively coupled to one of said inductive members.

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