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E. BRUCE

2,201,880

ELECTRON DISCHARGE DEVICE

Filed July 27, 1937

FIG. 1

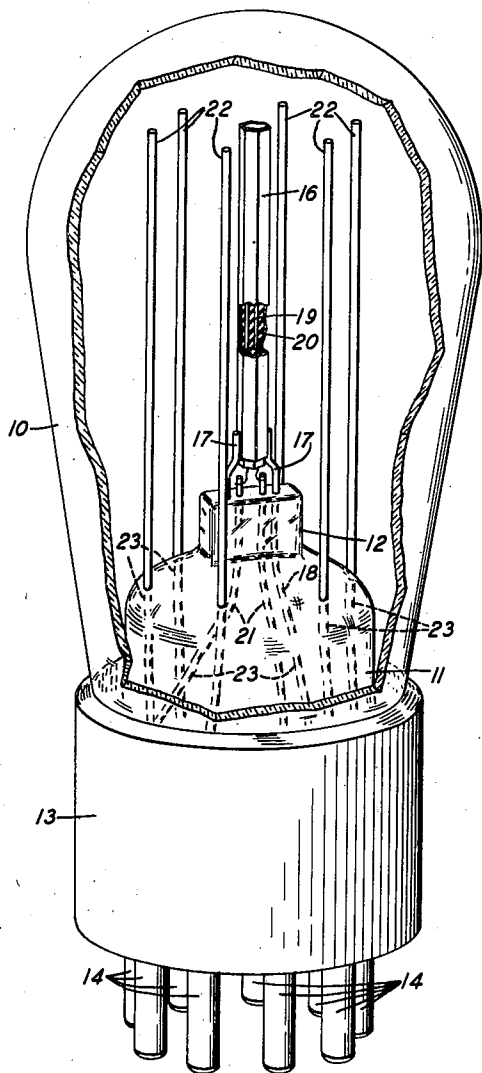


FIG. 2

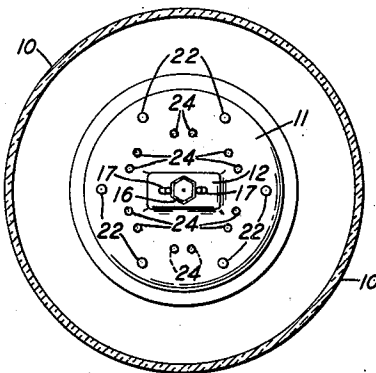


FIG. 3

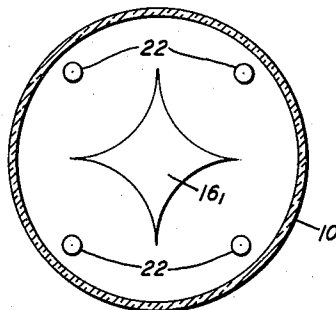


FIG. 4

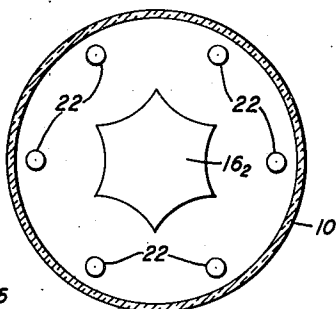


FIG. 5

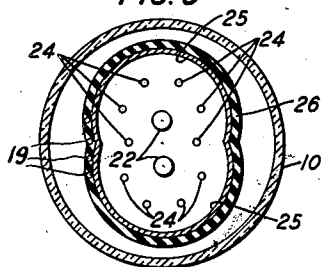
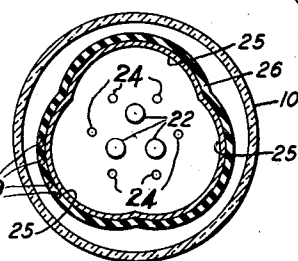


FIG. 6



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ELECTRON DISCHARGE DEVICE

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4 Claims. (Cl. 250—27.5)

This invention relates to electron discharge devices and more particularly to such devices especially suitable for use in broad-band and ultra-high frequency transmission systems.

In electron discharge devices utilized in broad-band and ultra-high frequency transmission systems, it is desirable that the capacitances between the electrodes themselves and between the electrodes and ground be very small. In order to obtain such small capacitances it has been proposed to make the electrodes, particularly the control electrode and anode, of small area, for example of linear rods or wires parallel to one another and to the cathode. Because of the small area of the anodes thus provided, however, but a relatively small number of the electrons emanating from the cathode may flow directly to the anode without the use of electron focussing means so that the efficiency of the device may be relatively low and the power capacity of the device may be limited.

One object of this invention, therefore, is to improve the efficiency and to increase the power capacity of electron discharge devices having anodes of relatively small area.

In accordance with one feature of this invention, the electron emitting surfaces of the cathode are so designed that the electron streams emanating therefrom are concentrated in streams focussed upon the anodes.

In one illustrative embodiment of this invention, an electron discharge device comprises an indirectly heated cathode including a metallic sleeve coated with thermionic material, the sleeve being generally polygonal in cross-section so that, in effect, the electron emitting surface of the cathode is composed of a plurality of distinct sections or surfaces. The anode of the device may comprise a plurality of rod members each parallel to and in alignment with a corresponding one of the electron emitting sections or surfaces.

The faces of the cathode may be plane or they may be arcuate. In the latter case, the rod members constituting the anode preferably are mounted coaxial with the cathode section or surface corresponding thereto.

It has been found that electrons emitted from the cathode sections or surfaces emanate substantially normal thereto. Consequently the electrons emitted from each of the sections or surfaces are substantially focussed upon the anode member in alignment therewith.

The invention and the various 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 an elevational view of an electron discharge device constructed in accordance with this invention, portions of the enclosing vessel and of the cathode being broken away to show elements of the device more clearly;

Fig. 2 is a top view of the electron discharge device shown in Fig. 1 with the enclosing vessel broken away, illustrating the relative positions of the cathode and anode and indicating the association of a control electrode therewith;

Fig. 3 is a top view of an electron discharge device including a cathode constructed in accordance with this invention and having arcuate electron emitting sections or surfaces;

Fig. 4 is a top view of a modification of the embodiments of this invention shown in Figs. 1 to 3;

Fig. 5 illustrates another embodiment of this invention wherein the anode members are mounted within the cathode; and

Fig. 6 illustrates a modification of the embodiment of this invention shown in Fig. 5.

Referring now to the drawing, the electron discharge device shown in Figs. 1 and 2 comprises an evacuated enclosing vessel 10 having an inwardly extending stem 11 at one end, terminating in a press 12. Secured to one end of the enclosing vessel is a cup-shaped base 13, which may be of insulating material, carrying a plurality of terminal prongs 14 through which the electrodes of the device may be associated with external circuits.

Mounted upon the press 12 is a heater type thermionic cathode comprising a metallic sleeve 16, the outer surfaces of which are coated with an electron emitting material, such as barium and strontium oxides, the sleeve being supported from the stem 11 by a pair of rigid wires 17 embedded in the press 12. One of the wires 17 may be connected electrically to one of the terminal prongs 14 by a conductor 18. As shown clearly in Fig. 2, the sleeve 16 is hexagonal in lateral section so that the faces or sides thereof define distinct electron emitting sections or surfaces. Disposed within the sleeve 16 is a heater element, which may be, for example, a hairpin-shaped filament 19, spaced from the sleeve 16 by an insulating or ceramic body 20. The heater filament 19 may be supplied with the necessary current to heat the electron emitting coating upon the sleeve 16, through leading-in conductors 21 connected to the ends of the filament and to two of the terminal prongs 14.

Arranged about the cathode sleeve 16 and preferably equally spaced therefrom are a plurality of anode members 22, which may be linear wires or rods embedded in the stem 11 and connected to corresponding ones of the terminal prongs 14 by a leading-in conductor 23. Each of the anode members 22 as shown in Fig. 2, is directly opposite and in radial alignment with a corresponding one of the electron emitting sections or surfaces of the cathode, and preferably is parallel thereto.

It has been found that the electrons emanating from the sections or surfaces of the cathode traverse paths substantially normal to these surfaces. Consequently, and because of the alignment of the several sections and the anode members, the electrons emanating from the various sections or surfaces of the cathode sleeve define concentrated streams substantially focussed upon the anode members 22 so that a high operating efficiency and relatively large anode current are obtained.

The intensity of the electron streams may be controlled or varied in accordance with a signal to be translated, by a suitable grid disposed between the cathode 16 and the anode members 22. As illustrated in Fig. 2, the control electrode or grid may comprise a plurality of pairs of linear rods or wires 24, which may be embedded in the stem 11, preferably mounted in a cylindrical boundary and parallel to the cathode 16 and anodes 22. The rods or wires 24 are disposed on opposite sides of and equally spaced from radii extending from the anode members 22 to the cathode 16 and may be electrically connected together and to a leading-in conductor, not shown, extending from the enclosing vessel 10. Alternatively each of the rods or wires 24 or each pair thereof may be provided with leading-in conductors extending from the vessel 10.

During operation of the device, the several anode members 22 may be connected together and maintained at the same potential or the anode members may be electrically separate and associated with the cathode through individual external circuits.

In the embodiments of the invention illustrated in Figs. 3 and 4, the electron emitting sections or surfaces of the cathode sleeves 16₁ and 16₂ are arcuate and similar in form and the various anode members 22 preferably are concentric with the corresponding cathode section or surface. In these devices, a control electrode or grid similar to that illustrated in Fig. 2 may be provided between the cathode and the anode members for controlling the electron streams emanating from the cathode.

In the embodiment of the invention illustrated in Fig. 5, the cathode comprises a metallic shell having two distinct arcuate sections 25, the inner surface of which is coated with a thermionic material, such as barium and strontium oxides. These emitting surfaces may be heated to the requisite temperature during operation of the device, by a filament 19, a portion only of which is shown, embedded in or carried by an insulating or ceramic body 26 encompassing the cathode sections 25. Mounted within the cathode 25 are a pair of linear rod anodes 22, which may be electrically separate or connected together, each of the anodes 22 being concentric with a corresponding one of the sections 25 so that the electrons emanating from each section are focussed upon the anode corresponding thereto.

The intensity of the electron streams may be controlled or varied by a control electrode or grid comprising a plurality of wires or rods 24 mounted parallel to one another and to the anodes 22 and equally spaced from the inner surfaces of the cathode.

In a modification of the structure shown in Fig. 5, the cathode comprises three distinct sections 25, as illustrated in Fig. 6, and each of the three anode members 22 is concentric with a corresponding one of the cathode sections. A suitable control electrode or grid, similar to that shown in Fig. 5, may be provided also in the device illustrated in Fig. 6.

Although specific embodiments of the invention have been shown and described, it will be understood, of course, that these embodiments are but illustrative and that various modifications may be made therein without departing from the scope and spirit of this invention as defined in the appended claims. For example, although the cathode has been shown as having four distinct sections or surfaces in Fig. 3 and six sections or surfaces in Figs. 1 and 4, it may have a greater or lesser number of surfaces or sections, each having an anode member in alignment therewith. Similarly, cathodes such as shown in Figs. 5 and 6, having internal emitting surfaces, may include more than three distinct sections, each having an anode member in alignment and concentric therewith.

What is claimed is:

1. An electron discharge device comprising a thermionic cathode having a plurality of distinct electron emitting sections disposed side by side and defining a closed multisided surface, an anode in alignment with and parallel to each of said sections, each anode being of less width than the section with which it is in alignment, and control electrode means including a plurality of pairs of linear members, one pair for each anode, the members of each pair being mounted parallel to the corresponding anode and on opposite sides of a line extending from the corresponding anode to the section in alignment therewith.

2. An electron discharge device comprising a cathode having a plurality of plane electron emitting sections disposed side by side and in polygonal formation, means for heating said sections to emitting temperatures, a plurality of rod anodes each in alignment with and parallel to a corresponding one of said sections, and a control electrode comprising a plurality of pairs of linear rods encompassing and parallel to said cathode, the opening between the members of each pair being in alignment with an anode and its corresponding section.

3. An electron discharge device comprising a hollow cathode having a plurality of distinct arcuate sections disposed side by side, the inner surface of said sections being coated with electron emissive material, means for heating said cathode, and a plurality of anodes within said cathode, each of said anodes being in alignment with a corresponding one of said sections.

4. An electron discharge device in accordance with claim 3 wherein said anodes are linear rod members, each parallel to and concentric with the section corresponding thereto.

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