BEAM-TYPE ELECTRON DISCHARGE DEVICE

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Fig. 1.

Fig. 2.

Fig. 3.

INVENTORS
William A. Gerard
Carl H. Scullin

WITNESSES
Edwin E. Baseler

BY
F. C. Bronner
ATTORNEY
BEAM-TYPE ELECTRON DISCHARGE DEVICE

William A. Gerard, Horseheads, and Carl H. Scullin, Brecoport, N. Y., assignors to Westinghouse Electric Corporation, East Pittsburgh, Pa., a corporation of Pennsylvania

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This invention relates to electron discharge devices and, more particularly, to an improved structure for beam-type electron discharge devices. It is an object of this invention to provide an electron discharge device with an improved electrode structure. It is a further object to provide an electron discharge device with an improved screen grid structure.

It is an additional object of this invention to provide an improved electron discharge device with reduced interelectrode capacitance characteristics. It is a further object to provide an improved electron discharge device with reduced feed-back coupling characteristics between the input circuit and the output circuit.

It is still another object to provide an improved electron discharge device which may be operated at higher frequencies than comparable prior art electron discharge devices.

These and other objects of the invention will be apparent from the following description taken in accordance with the accompanying drawings, which form a part of the application and in which:

Figure 1 is a top cross-sectional view of the prior art beam-type electron discharge device;

Figure 2 is a top cross-sectional view, taken along line II—II of Fig. 3, of a beam-type electron discharge device embodying the present invention; and

Figure 3 is a partial side sectional view, taken along line III—III of Fig. 2, of an electron discharge device embodying the present invention.

In Fig. 1 there is shown a top sectional view of a conventional prior art beam-type electron discharge device including a cathode 11 comprising a number of filament members 13, a cylindrical anode 23 surrounding the cathode 11, and between said cathode 11 and said anode 23 there is positioned a control grid 15. The latter control grid 15 comprises a number of filament members 17. A screen grid 19, comprising a number of filament members 21, is positioned between the control grid 15 and the anode 23. The filament members 17 and 21 of said grids 15 and 19 are radially aligned in such a manner as to provide or establish an unobstructed path for the electrons which move from the cathode 11 to the anode 23 in the form of beams 25.

In Fig. 2 of the drawing there is shown a top sectional view of an embodiment of the present invention including a cylindrical anode 43 and a cathode 29 comprising a plurality of filament members 31 positioned symmetrically in a cylindrical manner about the central longitudinal axis of the device. A control grid 33 comprising a plurality of filament members 35 twice in number relative to the filament members 31 of the cathode 29 is located between the latter cathode 29 and the anode 43 and is positioned coaxially with respect to said cathode 29. A screen grid 37 comprising a plurality of filament members 39 and 41, three times in number relative to the filament members of said cathode 29, is located between the control grid 33 and the anode 43 and is positioned coaxially with respect to said cathode 29 and said control grid 33.

In Fig. 3 of the drawing there is shown a partial side sectional view of an illustrative form of an electron discharge device similar to that pictured in Fig. 2 and embodying the teachings of the present invention. This device may include the cathode 29, the control grid 33, the screen grid 37 and the anode 43, as shown in Fig. 2. The anode 43 is composed of suitable material in the form of a tubular member closed at one end. The anode 43 is supported by an insulating member 49 which is joined to the screen grid support terminal member 51. The screen grid support terminal member 51 is insulated from and supported by the control grid support terminal member 53 by a preformed glass seal 55. The control grid support terminal member is insulated from and supported by the upper cathode terminal member 57 by a preformed glass seal 59. The upper cathode terminal member 57 is, in turn, insulated from and supported by the lower cathode terminal member 61 by a preformed glass seal 63.

A more detailed description of the latter electron discharge device structure may be found in a copending application assigned to the same assignee, entitled "Coaxial Filament Connector," filed June 26, 1953, Serial No. 364,354.

As can be seen from Fig. 2, the control grid 33 is comprised of substantially twice the number of filament members 35 as the control grid 15 of the conventional prior art electron discharge device, as shown in Fig. 1. Also, the screen grid 37 is comprised of substantially three times the number of the filament members 39 and 41 as the screen grid 19 of the conventional prior art electron discharge device, as shown in Fig. 1. Two of the screen grid filament members 39 are radially aligned with the control grid filament members 35 in such a manner as to provide or establish an unobstructed electron path for the electrons moving from the cathode 29 to the anode 43 in the form of beams 45.

In accordance with the present invention, between the two aligned screen grid filament members 39 and in the region of relatively negligible electrons between the beam paths 45 there is placed a third screen grid filament member 41.

The addition of the third filament member 41 to the screen grid 37 will not appreciably affect the tube beam ing characteristics, since said filament members 41 are not located in the path of the main electron beams 45.

In a conventional prior art electron discharge device, such as shown in Fig. 1, undesirable coupling between the input circuit and the output circuit can be reduced considerably by proper design, such as shielding. However, even after the input circuit and the output circuit are shielded as much as practicable from each other, a source of input-output coupling still remains, which operates through the active electronic portion of the device. The latter coupling limits the high frequency operation of the device and requires neutralization at lower frequencies than would otherwise be necessary. Neutralization, consisting of feeding a voltage to the grid equal and opposite to the internal feedback voltage in order to cancel the latter voltage, involves relatively unstable circuitry and requires much care and delicate adjustment. The parameter which measures the degree of feedback coupling is the interelectrode capacity; for example, the capacity between the anode 23 and the control grid 17 in a grid drive circuit. Also, it can be shown that the interelectrode capacity is determined by the size and number of both the control grid and the screen grid filament members, and, further, by the distance or spacing of the elements of the electron discharge device.

In a conventional prior art electron discharge device, the addition of extra filaments to the screen grid would
result in an approximately proportional increase in the electron current intercepted by the screen grid. In the present invention, the extra filament member 41 of the screen grid 37 is located between the filament members 39 and, therefore, in a region where very few electrons are present. Thus, it can be seen that the teachings of the present invention result in a reduction of the interelectrode capacitance without appreciably increasing the screen grid current. This reduces the amount of feedback coupling and thereby permits the operation of the device at higher frequencies without neutralization.

While the present invention has been shown in one form only, it will be obvious to those skilled in the art that it is not so limited but is susceptible of various changes and modifications without departing from the spirit thereof.

For example, while we have illustrated our invention in connection with a tetrode discharge device, it is obvious that it is equally applicable to a pentode or to other multi-element tubes. Furthermore, while we have shown a bird-cage type of electrode assembly, it will be apparent that other forms of assembly may be used embodying our invention. Also, the screen grid 37 may include more than three times the number of filament members as the cathode 29 by providing for more than one additional filament member 41 in the space between the filament members 39.

We claim as our invention:

1. In a beam type electron discharge device including an anode and a cathode, at least one filamentary control electrode, said control electrode being positioned in such a manner so as to provide a substantially unobstructed path for the electrons to move from said cathode to said anode in the form of beams, said control electrode including a plurality of pairs of filament members, each pair of filament members being operative to establish a beam path, and at least one additional filament member positioned between said pairs of filament members, each of said additional filament members lying approximately in the same plane as the two adjacent filament members.

2. In an electron discharge device in which the electrons move from the cathode to the anode in an electron beam path, the combination of an anode, a cathode and a grid for controlling said electrons, said grid including pairs of filament members, each of said pairs including a first and a second filament member, each of said pairs of filament members being operative to establish an electron beam, said grid further including third filament members, at least one of said third filament members being positioned between said pairs of first and second filament members, each of said third filament members lying approximately in the same plane as the adjacent first and second filament members.

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