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J. L. H. JONKER ET AL
ELECTRON DISCHARGE DEVICE

2,203,221

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Fig. 1

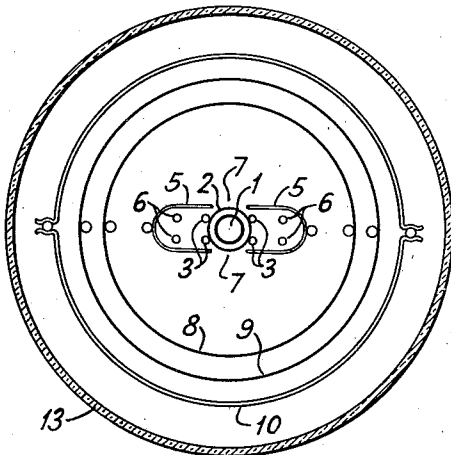


Fig. 2

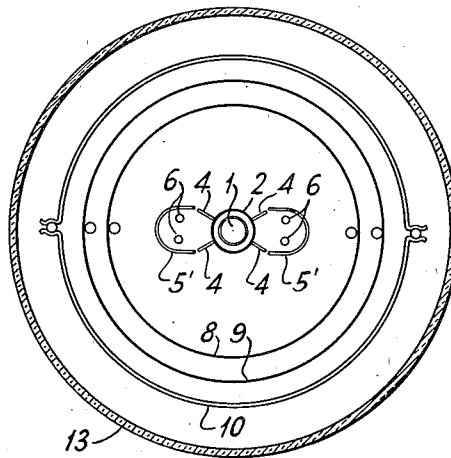


Fig. 3

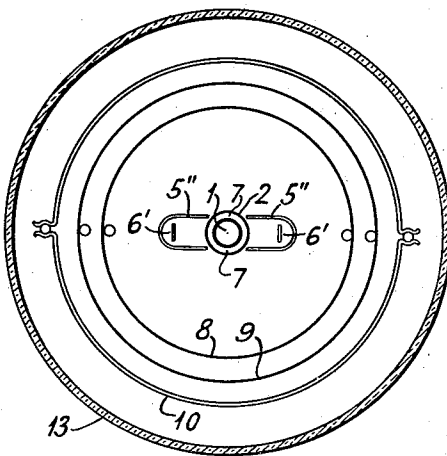
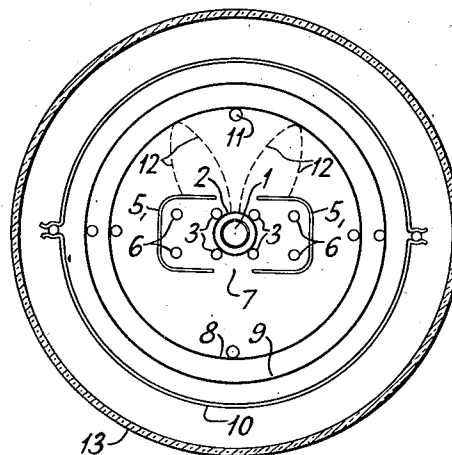


Fig. 4



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ELECTRON DISCHARGE DEVICE

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11 Claims. (Cl. 250—27.5)

This invention relates to electron discharge tubes particularly suited to perform simultaneously various functions, such, for example, as a so-called mixing tube or a converter tube in the form of a hexode, a pentagrid or an octode, and which comprises four or more electrodes located between the cathode and the anode.

With the use of such tubes it has been recognized to be necessary to screen, as much as possible from one another, the electrodes which perform different functions. Thus, it has been proposed to provide in hexodes and similar tubes a screen grid between the oscillator electrodes and the input control grid, while, in addition, it has been proposed to arrange the oscillator anode in a mixing tube, which anode may be, for example, a few plates or rods, inside of the control grid of the oscillator and to constitute parts of this control grid of solid sheet material, particularly for the purpose of improving the screening. Now the applicants have found that these solutions are not sufficiently satisfactory. The principal object of our invention is to provide an improved electron discharge device particularly suitable for use as a mixer or converter tube which may be used in superheterodyne circuits.

After extensive investigation on this subject, the applicants have succeeded in providing a useful and advantageous solution of the problem presented above. According to the invention, in an electron discharge tube comprising a cathode, an anode and four or more intermediate electrodes, the electrons proceeding from the cathode are formed into at least four beams by means of the electrode closest to the cathode, which electrode has parts parallel to the cathode, or by members located in the immediate vicinity of this electrode and parallel to the cathode. Screens are arranged, in direct connection with the beam-forming elements or as parts thereof, in such a manner that the electron streams in the various beams cannot influence one another. It thus becomes possible to utilize a plurality of these beams for one of the functions performed by the tube and other beams for another function, the different beams being well separated.

As the applicant has found, it is necessary, in order to ensure a completely undisturbed use for the various functions for which the tube is intended, that the electrons formed into four or more beams do not influence one another in passing through the tube.

The novel features which we believe to be characteristic of our invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which Figure 1 is a top end view of the mount of an electron discharge tube according to the invention, while Figures 2, 3 and 4 show top end views of mounts of modifications of the tube shown in Figure 1.

In the drawing the cathode 1 is formed as an indirectly heated cathode and consists of a cylindrical cathode body inside of which a heater (not shown) is arranged, for example, with the interposition of insulating material. This cathode is surrounded by a grid shaped electrode 2 which is secured, in the forms of construction of Figures 1 and 4, to so-called grid bars or side rods 3 and which is connected, in the form of construction according to Figure 2, to a plurality of plates 4. In a tube according to Figure 3 the grid-like electrode is formed as a self-supporting grid. These electrodes are surrounded by a screening electrode which may have different shapes shown in Figures 2, 3 and 4 as elements 5', 5'' and 5i. Inside this screening electrode is arranged an oscillator anode which may consist of only a few rods 6, as shown in Figures 1, 2 and 4, or which may be composed of two thin plates 6' as is shown in Figure 3. The electrodes 2 and 6 may be advantageously utilized as oscillator electrodes in a mixing tube in which event the slope of the oscillator may be increased by coating the inside of the screen 5 with a material that readily emits secondary electrons. As may be seen from the drawing, the electrons proceeding from the cathode are formed into four well defined beams. Two of these beams, that is to say the beams located in the practical example shown on the left-hand and on the right-hand side of the cathode are utilized, for example, for the supply of current to the oscillator anode rods. The beams on the upper and the lower sides of the cathode pass through apertures 7 of the screening electrode and they successively pass through electrodes 8, 9 to 10 which may constitute, for example, the second control or signal grid, the screen grid and the anode of an amplifier system. Between the electrodes 9 and 10 may be arranged, in addition, a pentode suppressor grid, the tube being suitable for use in this case as an octode. The elements are enclosed by an envelope 13.

As is shown in Figure 4, a rod-shaped member

11 which may form, for example, part of the second control grid 8 may be arranged in the space between the grid and the screening electrode 5, said member 11 having such an influence on the electron paths that the electrons passing through the aperture 7 do not reach the grid 8 at right angles and therefore, when returning from this grid, will reach the screening electrode 5 over the paths indicated by dotted lines 12 to the solid sheet metal portion and cannot reach the electrodes located inside this screen.

While we have indicated the preferred embodiments of our invention of which we are now aware and have also indicated only one specific application for which our invention may be employed, it will be apparent that our invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of our invention as set forth in the appended claims.

What we claim as new is:

1. An electron discharge device having a cathode for emitting electrons and an output anode for receiving electrons, a control grid surrounding said cathode, means adjacent the cathode for forming electrons from said cathode into a plurality of pairs of oppositely disposed beams, an auxiliary anode in the path of one of said beams, and means adjacent said auxiliary anode for shielding said auxiliary anode and its associated beam from the other beams and said output anode.
2. An electron discharge device comprising a cathode for emitting electrons, and an anode for receiving electrons, a grid surrounding said cathode and means for forming the electrons from said cathode into a plurality of pairs of oppositely disposed beams, an auxiliary anode positioned between said grid and said output anode and in the path of one of said beams, and a shielding member partially surrounding said auxiliary anode and extending toward said grid for shielding said auxiliary anode and its associated beam from the other beams emanating from said cathode.
3. An electron discharge device comprising a cathode for emitting electrons, and an anode for receiving electrons, a grid surrounding said cathode and means for forming the electrons from said cathode into a plurality of oppositely disposed beams, an auxiliary anode positioned between said grid and said output anode and in the path of one of said beams, and a shielding member partially surrounding said auxiliary anode and extending toward said grid for shielding said auxiliary anode and its associated beam from the other beams emanating from said cathode, and a grid positioned between the output anode and said shielding member.
4. An electron discharge device comprising a cathode for emitting electrons, and an anode for receiving electrons, a first control grid surrounding said cathode and means for forming the electrons from said cathode into a plurality of oppositely disposed beams, an auxiliary anode positioned between said grid and said output anode and in the path of one of said beams, and a shielding member partially surrounding said auxiliary anode and extending toward said grid for shielding said auxiliary anode and its associated beam from the other beams emanating from said cathode, and a second control grid surrounding said cathode, first control grid and

shielding members and positioned between the cathode and said output anode.

5. An electron discharge device having a cathode for emitting electrons, and an output anode for receiving electrons, and a control grid surrounding said cathode and a plurality of longitudinally extending members parallel to said cathode and adjacent said grid for forming the electrons from said cathode into a plurality of oppositely disposed beams, anode rods positioned between the grid and output anode and in the path of two of the oppositely disposed beams of electrons, a control electrode surrounding said cathode and anode rods and between said cathode and output anode, and shielding members partially surrounding said anode rods and extending toward said longitudinally extending members parallel to the cathode for shielding the anode rods and their associated beams from the other beams emanating from said cathode.

6. An electron discharge device having a cathode for emitting electrons, and an output anode for receiving electrons, and a control grid surrounding said cathode and having a plurality of longitudinally extending side rods parallel to said cathode for forming the electrons from said cathode into a plurality of oppositely disposed beams, anode rods positioned between the control grid and anode and in the path of two of the oppositely disposed beams of electrons, a control electrode surrounding said cathode and anode rods and between said cathode and output anode, and shielding members partially surrounding said anode rods and extending toward said longitudinally extending side rods for shielding the anode rods and their associated beams from the other beams emanating from said cathode.

7. An electron discharge device having a cathode for emitting electrons, and an output anode for receiving electrons, and a control grid surrounding said cathode having a plurality of longitudinally extending fins parallel to said cathode for forming the electrons from said cathode into a plurality of oppositely disposed beams, anode rods positioned between the grid and output anode and in the path of two of the oppositely disposed beams of electrons, a control electrode surrounding said cathode and anode rods and between said cathode and output anode, and shielding members partially surrounding said anode rods and extending toward said longitudinally extending fins for shielding the anode rods and their associated beams from the other beams emanating from said cathode.

8. An electron discharge device having a cathode for emitting electrons, and an output anode for receiving electrons, and a first control grid surrounding said cathode, and a plurality of longitudinally extending members parallel to said cathode for forming the electrons from said cathode into a plurality of oppositely disposed beams, anode rods positioned between the grid and output anode and in the path of two of the oppositely disposed beams of electrons, a second control grid surrounding said cathode and anode rods and between said cathode and output anode, and shielding members partially surrounding said anode rods and extending toward said longitudinally extending members for shielding the anode rods and their associated beams from the other beams emanating from said cathode and a screen grid between said control grid and said output anode.

9. An electron discharge device having a cath-

ode for emitting electrons, and an output anode for receiving electrons, and a control grid surrounding said cathode and a plurality of longitudinally extending members parallel to said cathode for forming the electrons from said cathode into a plurality of oppositely disposed beams, anode rods positioned between the grid and anode and in the path of two of the oppositely disposed beams of electrons, and shielding members partially surrounding said anode rods and extending toward said longitudinally extending members for shielding the anode rods and their associated beams from the other beams emanating from said cathode, a second control grid surrounding said cathode, first control grid and anode rods and a screen grid coaxial therewith, said second control grid and said screen grid being positioned between the first control grid and said output anode, and a longitudinally extending member positioned between the first and second control grids and in the path of two of the oppositely extending electron beams directed from the cathode to the output anode.

10. An electron discharge device having a cathode for emitting electrons, and an output anode for receiving electrons, and a first control grid surrounding said cathode and means for forming the electrons from said cathode into a plurality of oppositely disposed beams, anode rods positioned between the grid and anode and in the path of two of the oppositely disposed beams of electrons, shielding members partially surrounding said anode rods for shielding the anode rods and their associated beams from the other beams emanating from said cathode, a

second control grid surrounding said cathode, first control grid and anode rods, and a screen grid coaxial therewith, said second control grid and said screen grid being positioned between the first control grid and said anode, longitudinally extending side rods connected to said second control grid and in the path of oppositely extending beams directed from the cathode to the output anode.

11. An electron discharge device having a cathode for emitting electrons, and an output anode for receiving electrons, and a first control grid surrounding said cathode and means for forming the electrons from said cathode into a plurality of oppositely disposed beams, anode rods positioned between the grid and output anode and in the path of two of the oppositely disposed beams of electrons, shielding members partially surrounding said anode rods and extending toward said first control grid for shielding the anode rods and their associated beams from the other beams emanating from said cathode, a second control grid surrounding said cathode, first control grid and anode rods, and a screen grid coaxial therewith, said second control grid and said screen grid being positioned between the first control grid and said anode, the second control grid being provided with a portion in the path of the oppositely extending beams directed from said cathode to the output anode to cause electrons from said cathode to said output anode to have a curved path.

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