Feb. 18, 1930. L. E. MITCHELL 1,748,026

ELECTRON DISCHARGE DEVICE

Original Filed June 22, 1927

Fig. 1

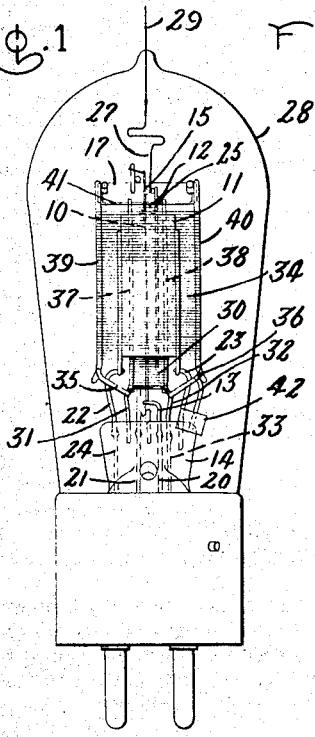



Fig. 2

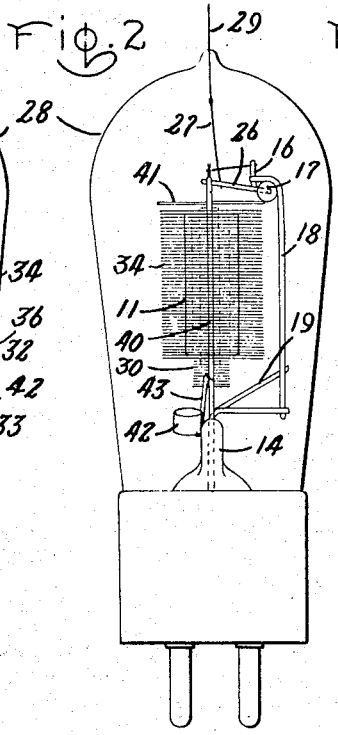



Fig. 4

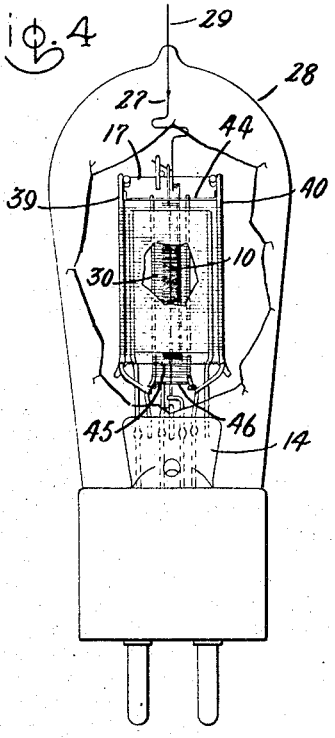



Fig. 3

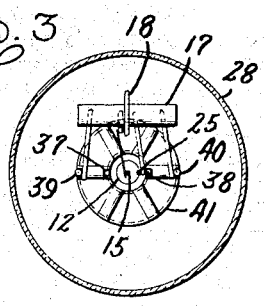



Fig. 6

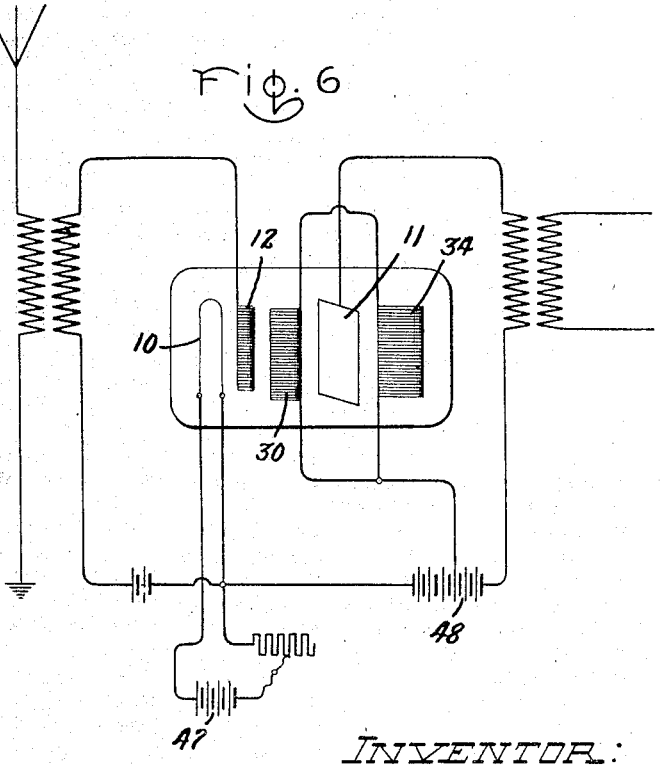
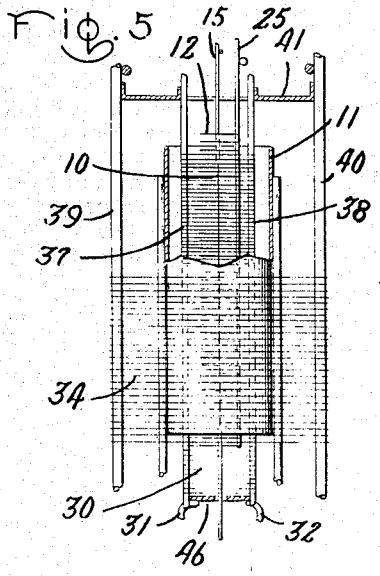



Fig. 5

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Patented Feb. 18, 1930 1,748,026

# UNITED STATES PATENT OFFICE

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## ELECTRON-DISCHARGE DEVICE

Application filed June 22, 1927, Serial No. 200,705. Renewed February 14, 1929.

My invention relates to electron discharge devices, and more particularly to devices of the four-electrode type such as disclosed in the United States patent application, Serial No. 696,665, filed by Albert W. Hull, March 3, 1924 in which certain features disclosed in this application are claimed. The object of such devices is to reduce the undesired effects of capacity between the control grid and the anode.

According to my invention, a screen is provided outside the anode in addition to the screen interposed between the control grid and the anode, as disclosed in the aforesaid Hull application. The purpose of this is to more effectively cut off or intercept the lines of force extending between the anode and control grid, and to lower the capacity between the control grid and anode, thereby making possible much greater radio frequency amplification per stage without neutralizing. Preferably I employ as a screen a grid made up of turns of fine wire such as molybdenum. This has the advantages over a plate that it is easier to mount, introduce less metal into the tube which renders exhausting less difficult, and facilitates heating of the anode by the high frequency furnace coil during the exhaust process. In addition to the inner and outer screens, top and bottom screens may also be used and these may be plates or grids.

Various other features and advantages of my device will appear from the description which follows.

Fig. 1 is an elevation of a vacuum tube comprising my invention; Fig. 2 is another elevation at right angles to that of Fig. 1; Fig. 3 is a top plan view partially in section of the said vacuum tube; Fig. 4 is an elevation of a modification; Fig. 5 is an elevation on an enlarged scale of the elements of the tube shown in Fig. 1; and Fig. 6 is a diagrammatic view of the parts and fundamental electrical circuits.

Referring to the drawing, and particularly to Figs. 1, 2, 3 and 5, the vacuum tube shown is provided with the usual cathode 10, plate or anode 11, and control grid 12. As shown, the cathode extends between the conducting support 13 sealed in the stem 14 and the support 15, which connects with the conductor 16 embedded in an insulating support 17. Electrically connected to the conductor 16 is the conductor 18, which in turn is electrically connected to the conductor 19, the other end of which is embedded in the stem 14 The electrical connections to the cathode are through conductors 20 and 21 sealed in the stem 14. The plate 11 is supported by wires 22 and 23, and the electrical connection is through conductor 24 sealed in the stem. The control grid 12 is supported by the conductor 25 which is supported by the wire 26, having its end sealed in the insulating support 17. The electrical connection is through the conductor 27, the other end of which passes through and has a portion thereof sealed in the top of the glass bulb 28. A projecting end 29 of the conductor 27 affords means for making the electrical connections to the control grid.

Interposed between the control grid and the plate is the inner screening grid 30. This is supported by the wires 31 and 32, having their ends sealed in the glass stem 14, the latter of which is connected to the conductor 33. The lower end of an outer screening grid 34 is supported through the wires 35 and 36 by the wires 31 and 32, which support the inner screening grid and thereby is electrically connected to the inner screening grid. Both the inner and outer screening grids are preferably composed of spirals of fine molybdenum wire wound with very close turns on the conducting supports 37—38 and 39—40 respectively. The outer screening grid is preferably at least as long as the anode while the inner screening grid is somewhat longer in the form shown in Fig. 1 in order to provide effective screening between the lower ends of the control grid and anode. Another screen or shield may be provided, preferably consisting of a washer 41, which is carried by the supports 39—40, and covers the opening of the plate, the outer diameter of this washer being at least as great as that of the outer screening grid and the inner diameter being no greater than that of the inner screening grid. The supports 37—38 of the inner

screening grid are also secured to the washer 41. The supports and conductors to the cathode and control grid pass through the opening in this washer. In the manufacture of these tubes it is customary to volatilize magnesium or other getter material, and a suitable support for such material is the inverted cup 42, which is preferably supported by a wire 43 welded or otherwise attached to the support 40.

In the modification shown in Fig. 4, two shields 44 and 45 are provided to ensure more effective screening. In this modification is also shown a lower shield 46 which substantially closes the lower end of the inner screening grid. These lower shields have openings through which the supports for the cathode and anode extend.

The electrical connections are shown in diagrammatic view in Fig. 6. The cathode 10 is connected to the A battery 47. The plate 11 is connected to the B battery 48. The control grid 12 is connected to the secondary of a transformer in the receiving circuit. The screen 30 and the outer screen 34 are in parallel and are connected to a source of potential such as an intermediate point on the B battery 48.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. The combination in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid.

2. The combinaton in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid at both ends.

3. The combination in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid at both ends, the connection at one end comprising a metal washer having an outer diameter at least as great as that of the outer receiving grid and an inner diameter no greater than that of the inner screening grid.

4. The combination in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid, both of said screening grids being at least as long as the anode.

5. The combination in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid at both ends, the connection at one end comprising a metal washer having an outer diameter at least as great as that of the outer screening grid and an inner diameter no greater than that of the inner screening grid, said inner and outer screening grids being wound over supports which are secured at one end to said washer.

6. The combination in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid at both ends, the connection at one end comprising a metal washer having an outer diameter at least as great as that of the outer screening grid and an inner diameter no greater than that of the inner screening grid, said inner and outer screening grids being wound over supports which are secured at one end to said washer, said supports having their opposite ends supported from a stem through which leading-in conductors for the screening grids, cathode and anode are sealed.

7. The combination in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid at both ends, the connection at one end comprising a metal washer having an outer diameter at least as great as that of the outer screening grid and an inner diameter no greater than that of the inner screening grid, the connection at the other end comprising a metal washer having an outer diameter at least as great as that of the inner screening grid, said inner and outer screening grids being wound over supports which are secured at one end to said first-mentioned washer.

8. The combination in an electron discharge device of an electron emitting cathode, an anode, a control grid, an inner screening grid interposed between the anode and control grid, and an outer screening element in the form of a grid surrounding the anode and electrically connected to the inner screening grid, said screening grids being provided with metallic shields adjacent to each end thereof.

9. The combination in an electron discharge device of an electron-emitting cathode, an

anode, a control grid, an inner screening grid interposed between the anode and control grid and an outer screening element in the form of a grid surrounding the anode, said screening grids being adapted to be charged to a potential such that the electrostatic lines of force extending between the anode and control grid are substantially intercepted.

In witness whereof, I have hereunto set my hand this 20th day of June, 1927.

LORIS E. MITCHELL.