Aug. 31, 1937. R. M. HEINTZ 2,091,443

SHIELDED ELECTRODE TUBE

Original Filed Sept. 6, 1933

Fig. 1.

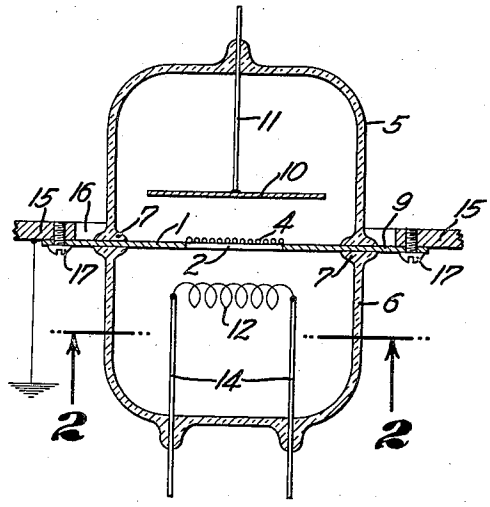


Fig. 2.

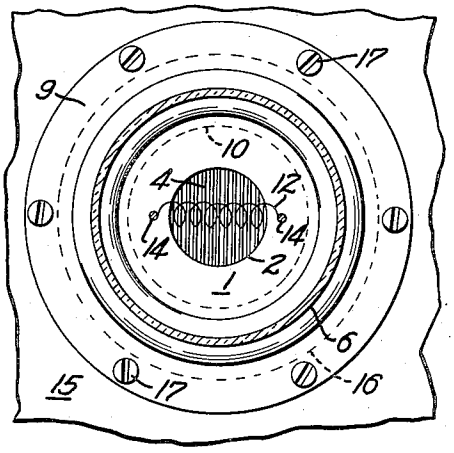


Fig. 3.

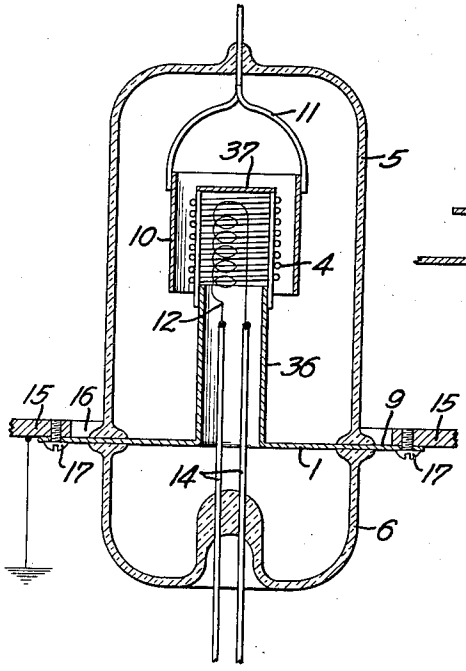
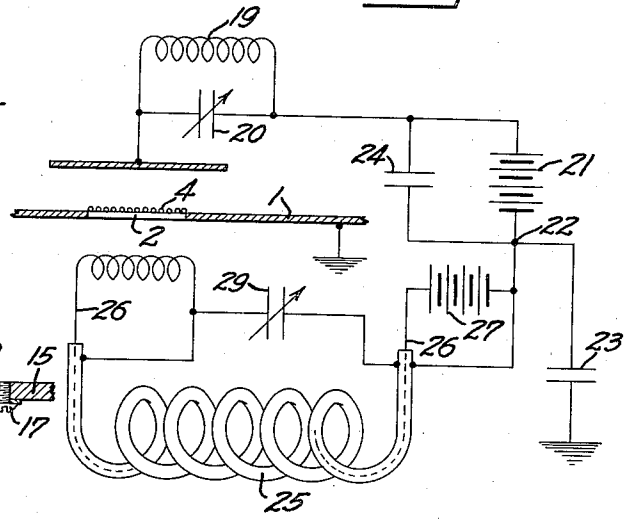


Fig. 4.



INVENTOR,
RALPH M. HEINTZ.
BY
Lippincott & Metcalf
ATTORNEYS.

Patented Aug. 31, 1937 2,091,443

UNITED STATES PATENT OFFICE

2,091,443

SHIELDED ELECTRODE TUBE

Ralph M. Heintz, Palo Alto, Calif., assignor to Heintz & Kaufman, Ltd., San Francisco, Calif., a corporation of Nevada

Original application September 6, 1933, Serial No. 688,328. Divided and this application December 17, 1934, Serial No. 757,751

3 Claims. (Cl. 250—27.5)

My invention relates to a thermionic tube, and more particularly to a tube in which the anode and cathode are separated by an electrostatic shield which also acts as a control electrode.

This application is a division of my Patent No. 2,034,433, issued March 17, 1936.

Among the objects of my invention are: to provide a thermionic tube capable of oscillation at ultra high frequencies; to provide a thermionic tube in which a control electrode acts as an electrostatic shield between anode and cathode; to provide a control electrode sealed through the side walls of an envelope adapted to cooperate with an external shield to regulate the effective capacity between anode and cathode; to provide a thermionic tube having a control electrode adapted to operate at ground potential; and to provide a thermionic tube wherein the capacity between anode and cathode is controlled substantially entirely by the extent and dimension of the reticulated portion of the grid.

Other objects of my invention will be apparent or will be specifically pointed out in the description forming a part of this specification, but I do not limit myself to the embodiment of the invention herein described, as various forms may be adopted within the scope of the claims.

Referring to the drawing which illustrates several embodiments of my invention, all somewhat diagrammatically represented for the sake of clearness:

Figure 1 is a longitudinal sectional view of a thermionic tube embodying my invention.

Figure 2 is a cross sectional view taken as indicated by the line 2—2 in Figure 1.

Figure 3 is a longitudinal sectional view of an embodiment having concentric electrodes.

Figure 4 is a circuit diagram, reduced to lowest terms, of the tube of my invention connected as an oscillation generator.

In the generation and amplification of ultra high frequency radio waves, interelectrode capacities, especially those capacities which occur between electrodes of fluctuating potentials, become so important as to require, in many cases, special neutralizing expedients. Such expedients are invariably loss producing and reduce efficiency of conversion. In addition, at wavelengths around three meters and below, the usual type of three-electrode tube is practically useless for the generation of any appreciable amount of oscillating current.

Attempts have heretofore been made to separate the fluctuating potentials by using opposed grid and anode, and inserting the filament between them. The filamentary cathode being grounded, acts as a partial shield between the other electrodes. Such a construction, while an improvement over ordinary types of tubes, is subject to the disadvantage of having a low amplification factor, and as the control is electrostatic the shielding effect of the cathode can only be increased at the expense of loss of control. I have, however, been able to completely shield the fluctuating electrodes in a thermionic tube.

In broad terms, my invention comprises shaping the grid into an electrostatic shield between anode and cathode. I prefer to have the grid material pass through the envelope along all radii to a point where it will cooperate with an external shield. I then position the anode on one side of the grid and the cathode on the other, the two electrodes last referred to being positioned to cause a stream of electrons to pass through a control portion of the grid when energized.

The broad aspects of my invention may be further understood by reference to the drawing.

Referring directly to the embodiment of my invention shown in Figures 1 and 2, a grid electrode 1 is preferably formed out of chrome iron of a composition to which glass may be sealed. The grid is preferably of circular shape and is provided with a central aperture 2 crossed by grid wires 4.

Sealed to the grid electrode on one side is an anode envelope portion 5 and on the other side a cathode envelope portion 6, the seals 7 preferably registering on opposite sides of the grid electrode, to leave an exterior grid flange 9 projecting outside of the combined envelopes.

As the envelope portions are connected by the central aperture 2, the combined envelopes may be considered as a single tube envelope, the grid electrode passing through its walls.

An anode 10 is mounted in the anode envelope portion on an anode lead 11 sealed through the envelope wall, and in the cathode envelope portion, on the other side of the grid electrode, is positioned a cathode 12 supported by cathode leads 14. The anode and cathode are thus completely separated within the tube by the grid electrode.

The grid electrode may then be continued away from the tube by the use of an exterior shield 15 which is provided with an envelope aperture 16. The tube is inserted in this aperture, which is preferably larger than the envelope but smaller than the grid flange 9, the tube being supported by fastening the grid flange to the

shield by screws 17, the positioning being preferably concentric so that no openings are present in the combined shield.

The combined shield, formed by contact of the grid with the exterior shield, is preferably used to separate a pair of tuned circuits, as shown in Figure 4. Here the grid electrode 1 is shown grounded and may be extended to completely surround one or both of the tuned circuits. An anode tuned circuit comprising the anode inductance 19 and anode variable capacity 20 is connected in series with an anode source 21 to the anode, the other end of the anode source going to a common anode-cathode point 22, grounded for radio frequency through condenser 23. The anode source is also preferably shunted by a by-pass capacity 24.

As the cathode 12 requires two leads for conducting current thereto, it is desirable to include both leads in a cathode-tuned circuit. This may be done in several ways, all well known in the art, but I prefer to make one lead a hollow conductor 25 wound into an inductance, the other lead 26 being run through the tube. The hollow conductor 25 and inner lead 26 are then connected to a cathode source 27, the ends of the hollow conductor being shunted by a cathode variable capacity 29 to complete the cathode-tuned circuit. The hollow conductor side of the cathode source is then connected to the common anode-cathode point 22.

The circuit thus formed will cause the tube to oscillate, having parallel tuned-anode tuned-cathode circuits, behaving in much the same manner as the well known tuned-grid tuned-plate circuit, in which the coupling between the two circuits is the anode-grid capacity. In this case the coupling is the anode-cathode capacity.

The tube and circuit described, however, differ from the ordinary tuned-grid tuned-plate combination in that in this example the two fluctuating electrodes are separated by the grounded grid. The electron stream, however, is under complete control as the grid is in its usual position for proper control. Furthermore, as control is increased, as by making the grid wires finer and closer together, the shielding becomes better and reaches the point where it is virtually complete.

The tube as above described, in combination with the related circuits, will oscillate freely and supply substantial amounts of power of high frequencies at which the usual tube and associated circuits fail.

The embodiment shown in Figure 3 is practically identical with that shown in Figure 1, except that in this example the grid control portion and the anode are concentric cylinders, the grid control wires 4 being supported by a tube 36 extending from the body of the grid electrode which is sealed through the envelope walls as shown in Figure 1. The cathode leads pass along this tube, and the grid wires are provided with a top cap 37 to complete the shielding.

It should also be noted that when the grid electrode is sealed through the walls, the tube may be mounted on the panel or shield by the direct fastening of the exterior portion to the panel, thus obviating a base of any kind, as connections from the associated circuits can be made to the leads of the remaining electrodes on the proper side of the shield.

I claim:

1. A thermionic tube comprising an envelope having a stem, cathode leads sealed through said stem and supporting a thermionic cathode, a cylindrical grid having a closed end and an open end surrounding said cathode and coaxial with said stem and envelope, an anode surrounding said grid, a planar sheet of conducting material extending through the walls of said envelope along all radii, and perforated to admit said cathode leads, and conducting support means joining said grid and said sheet.

2. A thermionic tube comprising an envelope having a stem, cathode leads sealed through said stem and supporting a thermionic cathode, a cylindrical grid having a closed end and an open end surrounding said cathode and coaxial with said stem and envelope, an anode surrounding said grid, a planar sheet of conducting material extending through the walls of said envelope along all radii, and perforated to admit said cathode leads, and a cylinder coextensive with said grid joining said sheet and said grid.

3. A thermionic tube comprising an envelope having a stem, cathode leads sealed through said stem and supporting a thermionic cathode, a cylindrical grid having a closed end and an open end surrounding said cathode and coaxial with said stem and envelope, an anode surrounding said grid, a planar sheet of conducting material extending through the walls of said envelope along all radii, and perforated to admit said cathode leads, and an imperforate cylinder coextensive with said grid joining said sheet and said grid.

RALPH M. HEINTZ.