July 11, 1933. K. W. DAUMANN 1,917,703

THERMIONIC TUBE

Filed Feb. 27, 1930

Fig. 1.

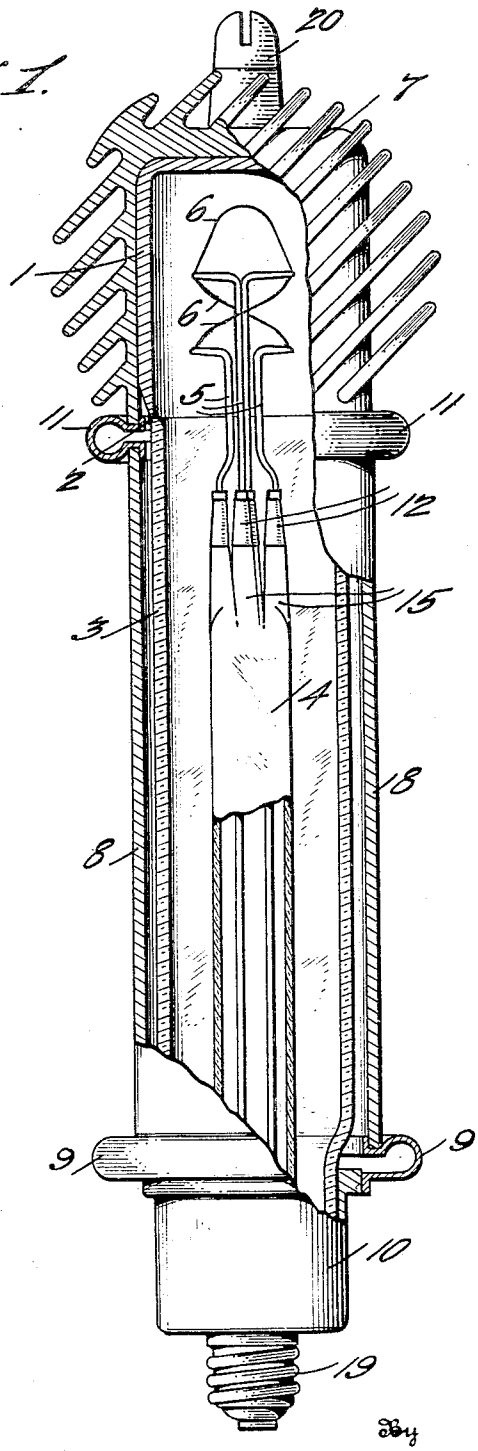
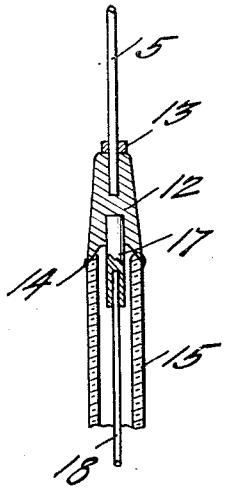


Fig. 2.



Inventor
Karl Wilhelm Daumann
By Lee B. Kennon
his Attorney

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UNITED STATES PATENT OFFICE

KARL WILHELM DAUMANN, OF HAMBURG, GERMANY, ASSIGNOR TO THE FIRM C. H. F. MÜLLER AKTIENGESELLSCHAFT, OF HAMBURG, GERMANY

THERMIONIC TUBE

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My invention relates to an improved thermionic tube.

In thermionic tubes such as are used in the Roentgen ray and high voltage arts for the purpose of obtaining a uni-directional voltage and for other purposes, the voltage drop which is required for driving the electrons through the thermionic tubes must not assume high values. The voltage drop of a properly operating thermionic tube is not greater than 2 to 3 kilovolts. However, under certain conditions, it may assume substantially higher values. The reason therefor may be that there are too few free electrons at the incandescent cathode to convey the electricity. This may occur, for instance, when the cathode is not sufficiently heated. Moreover an increase in the voltage drop may result from the fact that a negative charge on the glass wall of such a thermionic tube produces an effect similar to the effect produced by a negatively charged grid in a three electrode thermionic tube.

Of course, such a voltage drop is undesirable, since the anode of the tube is strongly heated and when the potential difference reaches 15 kilovolts and more, the high-speed electrons produce on the anode of the tube Roentgen rays which pass through the glass wall and may be injurious to persons who may be present in the neighborhood of the tube. In order to prevent the passage of the said Roentgen rays outside the tube, it has been proposed to make the glass bulb of the tube of lead glass. However, glass containing a sufficiently large amount of lead cannot be blown, and a lead glass which is lighter does not give sufficient protection with respect to the said rays.

The drawbacks above referred to are avoided by the thermionic tubes constructed according to the present invention. According to the invention, the anode consists of a pot-like cylindrical metal part which constitutes a portion of the outer wall of the thermionic tube and which is connected to the coaxial vacuum vessel consisting of glass. The latter vessel has preferably the same diameter as the pot-like anode and at the end opposite to that of the anode it is fused to the arm-like support of the incandescent cathode. The latter projects axially into the pot-like anode and its arc-shaped incandescible wires of tungsten have their apices directed towards the inner wall of the anode. As the heat produced by the incandescent wire is absorbed by the anode and as in addition thereto the anode is heated by the loss of energy in the thermionic tube, the anode is provided with a cap-like covering which has cooling ribs. These ribs have preferably an inclination of about 45° with respect to the axis of the tube, in order to obtain the same cooling effect in a vertical as in a horizontal position. The arrangement of the anode in the form of a pot and its thick walls prevent the passage at that point of any Roentgen rays which may be produced. The Roentgen rays which pass through the glass wall of the evacuated vessel in the direction of the cathode end of the tube are absorbed preferably by an insulating cylinder which is pushed over the glass portion of the evacuated vessel and which is opaque with respect to light and Roentgen rays, and which may consist of a sleeve of sufficiently thick lead glass.

As compared with the thermionic tubes for high voltages as hitherto known, the construction according to the present invention has a further advantage that the space charge is very small and that consequently the voltage drop is also small, being in the case of a maximum current only about 800 volts as compared with 2,000 volts in other thermionic tubes. As the incandescent cathode is arranged within the anode, charges on the glass which may increase the internal resistance of the tube can hardly occur, and, should they occur, they cannot have an appreciable effect on the discharges.

The accompanying drawing illustrates, by way of example, one mode of carrying the invention into effect:—

Fig. 1 being a part sectional elevation of the improved thermionic tube and

Fig. 2 being a detail showing the method of securing the support of the cathode.

1 is a pot-like anode, which preferably consists of an alloy of chromium and iron and is fused to the evacuated glass vessel 3 at

the point 2. 4 is a glass support arranged coaxially with the anode but spaced therefrom and carrying at its upper end supporting wires 5 to which the arc-like tungsten wires of the incandescent cathode 6 are secured. The cathode 6 shown on the drawing comprises two arcs running at an angle of 45° to the axis of the tube, joined by a third arc at the top, said arcs being symmetrically arranged with respect to the anode so that the ends of the cathode cross each other in spaced relation. 7 is a cooling body which is secured on the anode 1, for instance by being threaded thereon and which serves for radiating the heat imparted to the anode. The evacuated glass vessel 3 is surrounded by an insulating cylinder 8 which is opaque and does not allow the Roentgen rays to pass through; the same may consist, for instance, of lead glass or of an artificial resin with additions which would absorb the said rays. The insulating cylinder 8 is secured in position by means of a screw-nut 9, which is screwed on to the cathode cap 10. The upper end of the insulating cylinder 8 is held in position by means of an annular member 11 of sheet metal of the same type as the member 9 which, owing to its small cross-section and its large surface, prevents the transmission of the heat from the cooling body 7 to the insulating cylinder 8. The supporting wires of the incandescent cathode 6 partly serve at the same time as leads for the current and their construction is shown in detail in Fig. 2. The supporting wires 5 are welded on to the conical members 12 made of an alloy of chromium and iron at the point 13. At the opposite end the member 12 of chromium and iron is tapered all around and at the point 14 it is fused on to the glass tube 15 which belongs to the glass support 4. If the support 5 of the incandescent wire serves at the same time to lead the current, a pin 17 is screwed into the screw-thread which is formed in the member 12 and the lead 18 is soldered thereon. The leads 18 are connected to the Edison screw-cap 19, which is secured to the cathode cap 10 and to which the heating transformer is intended to be connected. A terminal 20 is provided on the cooling member 7 for effecting a connection with the source of high voltage.

I claim:—

1. A thermionic tube consisting of an evacuated, insulating vessel which is closed at one end by a pot-like cylindrical anode and in which a support for the incandescible cathode is mounted axially at the end opposite to that where the anode is mounted, the cathode consisting of arc-like wires, the apices of which are directed towards the end wall of the anode, and an insulating cylinder of a material which is impervious to X-rays mounted concentrically over the evacuated vessel and coaxial therewith, said cylinder being resiliently held in position by an annular sheet metal member having a small cross-section and large surface in order to minimize the transmission of heat.

2. A high-potential thermionic tube comprising a cylindrical envelope closed at one end by a cup-shaped anode of substantially the same cross section as said envelope, an incandescible cathode consisting of a plurality of arc-like filamentary portions supported in said envelope from the side opposite said anode, the apices of said arc-like portions of the cathode being directed toward the inner wall of said anode, and supports for said cathode engaging the same at points intermediate its ends and spaced from the crest portion thereof.

3. A high-potential thermionic tube comprising a substantially cylindrical envelope closed at one end by a cup-shaped anode and an incandescible cathode consisting of two arc-like filamentary end portions connected by an arc-like crest portion, the bases of said two end portions of the cathode being disposed at an angle of approximately 45° to the axis of the tube and the apex of each of said arc-like portions being directed towards an inner wall of said anode to secure substantially uniform spacing between the anode and the major portion of the cathode, the arc-like crest portion of the cathode extending substantially perpendicular to the axis of the tube and being directed toward the transverse or end portion of said cup-shaped anode.

4. A high-potential thermionic tube comprising a substantially cylindrical envelope closed at one end by a cup-shaped anode, an incandescible cathode supported from the opposite end of said envelope and disposed entirely within said anode and an insulating cylinder surrounding said envelope and extending substantially to said anode, said cylinder being of such material as to absorb X-rays produced in the tube.

In testimony whereof I have signed my name to this specification.

KARL WILHELM DAUMANN.