E. L. MUELLER.

ELECTRON TUBE.

APPLICATION FILED NOV. 18, 1920.

1,437,607.

Patented Dec. 5, 1922.

2 SHEETS—SHEET 1.

Fig. 1.

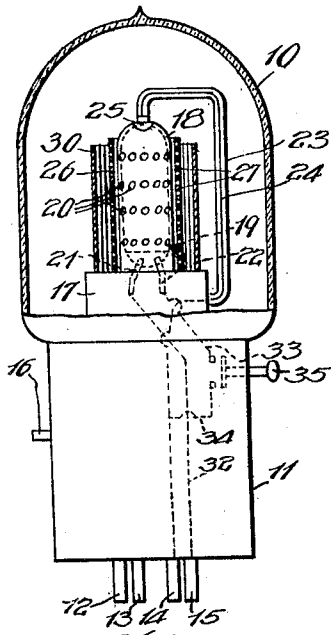


Fig. 2.

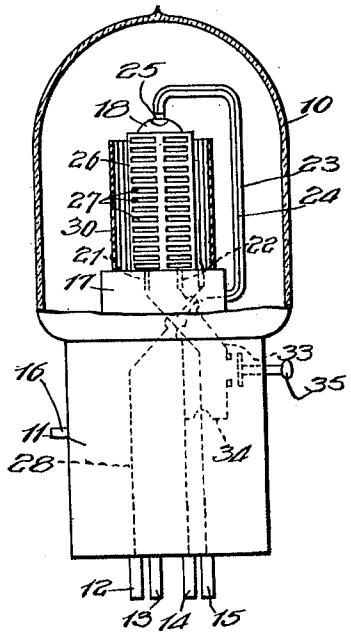


Fig. 3.

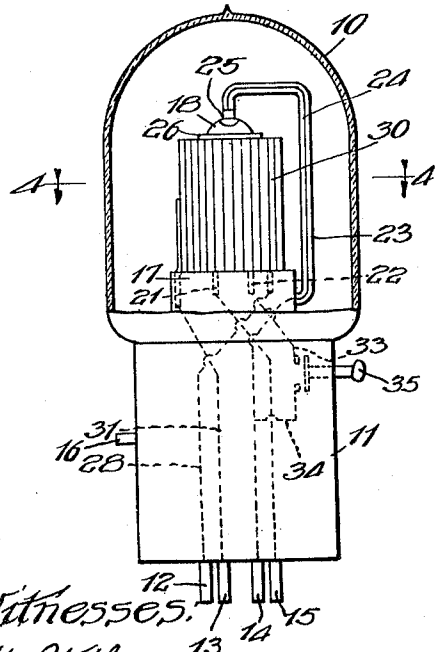
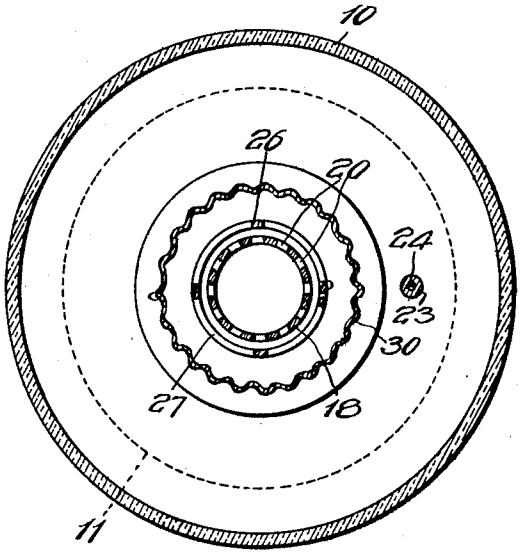


Fig. 4.



Witnesses.

W. F. Kilroy

Stacy R. Lockett

Inventor.

Eugene L. Mueller

By Hill & Hill Attys

E. L. MUELLER.

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2 SHEETS—SHEET 2.

Fig. 5.

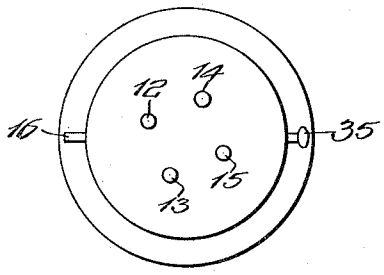


Fig. 6.

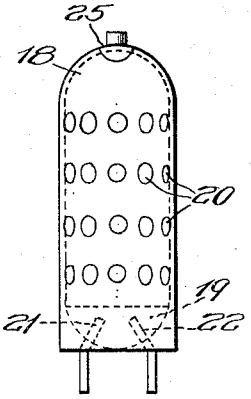


Fig. 7.

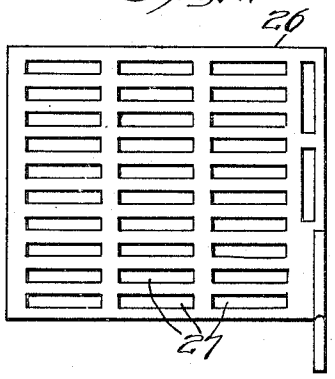


Fig. 8.

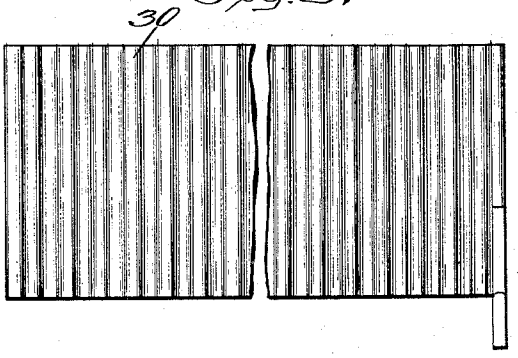
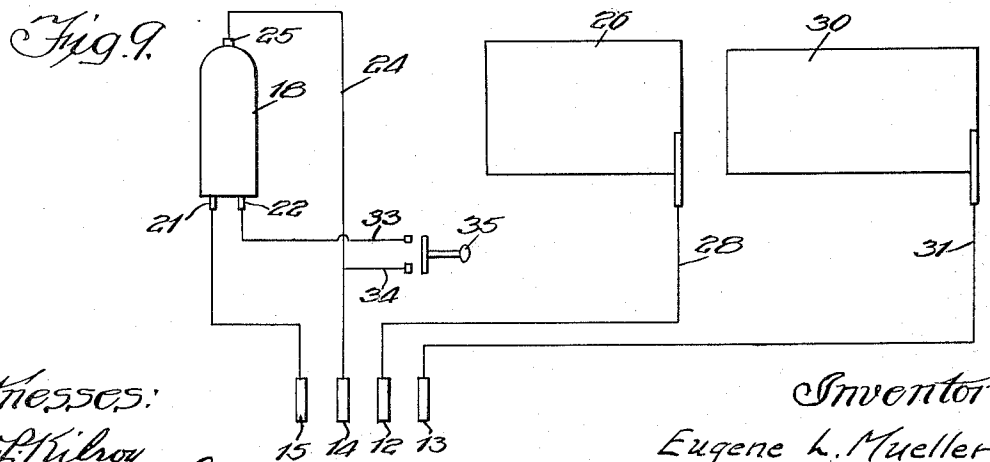


Fig. 9.



Witnesses:
W. L. Kilroy
Harry R. White

Inventor:
Eugene L. Mueller
By Hice & Hice
Attys.

Patented Dec. 5, 1922. 1,437,607

UNITED STATES PATENT OFFICE.

EUGENE L. MUELLER, OF CHICAGO, ILLINOIS.

ELECTRON TUBE.

Application filed November 18, 1920. Serial No. 424,949.

To all whom it may concern:

Be it known that I, EUGENE L. MUELLER, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Electron Tubes, of which the following is a description.

This invention relates to electron tubes, and more especially to electron tubes wherein the source of electrons comprises an arc.

Electron tubes are of general use as sources of high-frequency current, detectors of radio-frequent oscillations, and also as amplifiers of feeble currents.

These electron tubes comprise an evacuated bulb containing a source of electrons, a metal "plate" member and a "grid" member consisting of fine wire or a perforated metal sheet interposed between the source of electrons and the "plate" member.

In the arts of space telegraphy, telephony and the like, the electron tube finds great application, but the particular method employed to enable the tube to function properly on one of its several uses is not a part of this invention. The specific requirements of the use to which the tube is put will necessitate adaption of the tube to meet these requirements. However, such adaption is only for the purpose of obtaining a certain capacity or obtaining some result which does not alter the fundamental characteristics of the tube. To cause the tube to function in any of its capacities as a detector, high-frequency current generator or as an amplifier, it is only necessary to properly place it in the circuit of which it is to be a part. The tube must have suitable coacting elements in the circuit. This fact is well known to those skilled in the art and no attempt will be made to describe the specific application of the tube to its several uses.

An object of my invention is to provide an electron tube having an arc for a source of electrons. Another object of my invention is to provide an electron tube having an arc for a source of electrons, said arc being confined in a tube containing a vaporizable material.

A further object of my invention is to provide an electron tube capable of sustained and prolonged usage. In continuous wave telephone work, the filament of the oscillator and modulator is subject to a great strain from the high voltage and amperage of the grid and plate circuits so that the life of the tube is very short. In my improved device the filament is done away with, thus increasing the life of the tube.

These and other objects of my invention will be more clearly pointed out as the following description progresses, reference being had to the accompanying drawings, wherein:

Figure 1 is an elevation, partially in section, of an electron tube embodying the novel features of my invention;

Fig. 2 is an elevation of the electron tube, partially in section, to illustrate the construction of the "grid" member;

Fig. 3 is an elevation of the electron tube, partially in section, to illustrate the construction of the "plate" member;

Fig. 4 is a section taken on line 4—4 of Fig. 3;

Fig. 5 is a bottom plan view of the electron tube;

Fig. 6 is a detail view of the vapor tube wherein the arc is confined;

Fig. 7 is a development of the "grid" member;

Fig. 8 is a development of the "plate" member; and

Fig. 9 is a diagram of the local current of the electron tube.

Similar characters of reference indicate similar parts throughout the several views.

Referring to the drawings, 10 indicates an evacuated bulb, said bulb being made of glass in my preferred construction. The bulb 10 is provided with a plug portion 11 whereby it may be inserted into a suitable socket (not shown) having terminals adapted to engage the terminals 12, 13, 14 and 15 projecting from the lower end of the plug 11. A pin 16 projects from the plug 11 to insure proper positioning of the plug 11 in said socket. The plug 11 is preferably made of insulating material encased in a metal cylinder.

As shown in Fig. 1, the upper end of the plug 11 is provided with a boss 17 extending into the chamber of the bulb 10. Rest-

ing upon the boss 17 is a sealed glass tube 18, containing a comparatively small quantity of vaporizable material, such as mercury, as indicated at 19. The tube 18 has a high vacuum when cold. A plurality of metallic discs 20—20 are sealed into the wall of the tube 18 and provide a path for electrons flowing from the tube 18 into the evacuated chamber of the bulb 10. A pair of electrodes 21 and 22 are sealed into the lower end of the tube 18 and project into the vaporizable material 19. A glass arbor 23 is mounted upon the boss 17, said arbor 23 having sealed therein a conductor 24. The conductor 24 connects the terminal 14 with an electrode 25 sealed in the upper end of the tube 18.

Disposed about the tube 18 is a cylindrical sheet metal grid member 26, said grid member 26 being provided with a plurality of perforations 27—27. A conductor 28 connects the terminal 12 with the grid member 26 (Fig. 2).

A cylindrical corrugated plate member 30 is disposed around the grid member 26, said plate member 30 being connected with the terminal 13 by a conductor 31.

The electrode 21 is connected with the terminal 15 by a conductor 32. The electrode 22 may be connected with the terminal 14 by means of conductors 33 and 34 and a push button switch 35, the purpose of which will presently appear.

In the operation of the device, the terminals 14 and 15 are associated with the high and low potential sides respectively of a suitable source of electrical energy. The said source is generally termed the "A" battery. A momentary closure of the switch 35 permits a current to flow between the electrodes 21 and 22, whereby a sufficient quantity of the vaporizable material 19 is vaporized. This vapor will permit a current to flow from the negative electrode 21 to the positive electrode 25, creating an arc between said electrodes. It is well known to those skilled in the art that the arc thus formed is a source of gaseous ions.

The plate 30 is associated with the circuit of which the electron tube is a part in such a manner as to cause it to become a constantly or intermittently positively charged body. The gaseous ions flowing from the arc carry negative charges of electricity to the metallic discs 20—20, imparting a negative charge to the discs which are heated to a comparatively high temperature by the arc. Electrons are generated from the metallic discs 20—20 by reason of the negative charge imparted to them and by reason of their temperatures. The electrons impinge upon the plate 30, the grid 26 neutralizing the space charge to increase the flow of electrons to the plate.

The discs are made of metal having a coefficient of expansion similar to the coefficient of expansion of the glass, thus insuring against fracture of the glass.

The flow of electrons to the plate permits the "plate" current to flow, as is well known to those skilled in the art. The manner in which the electron tube is connected into a circuit depends upon the use to which it is to be put.

With a filament type of tube, when the filament is overheated it becomes fused, thus breaking the circuit. With my improved tube the filament is done away with by using the vapor arc, thus the life of the tube is prolonged indefinitely.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence I do not wish to be understood as limiting myself to the exact form, construction, arrangement and combination of parts herein shown and described or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

1. In a device of the class described, a chamber having a high vacuum, a cylindrical corrugated plate member therein, a cylindrical grid member disposed within said plate member, a second chamber having a high vacuum when cold disposed within said grid member, said second chamber comprising an enveloping wall of refractory material, a mercury cathode in said second chamber, a main and an auxiliary anode in said second chamber, conductors hermetically sealed in the wall of said second chamber whereby electrical energy may flow from one of said chambers into the other, and means for short-circuiting said mercury cathode and said auxiliary anode.

2. In a device of the class described, a chamber having a high vacuum, a plate member therein, a second chamber within said first mentioned chamber having a high vacuum when cold, the second chamber comprising an enveloping wall of dielectric material, a grid member disposed between said plate member and said second chamber, a mercury cathode in said second chamber, a main and an auxiliary anode in said second chamber, and conductors hermetically sealed in the wall of said second chamber whereby electrical energy may flow from one of said chambers into the other.

3. In a device of the class described, a chamber having a high vacuum, a plate member therein, a second chamber disposed within said first mentioned chamber having a high vacuum when cold, the second chamber comprising an enveloping wall of dielectric material, a grid member disposed between said plate member and said second chamber, a mercury cathode in said second

chamber, an anode in said second chamber, and conductors hermetically sealed in the wall of said second chamber whereby electrical energy may flow from one of said chambers into the other.

4. In a device of the class described, a chamber having a high vacuum, a plate member therein, a second chamber having a high vacuum when cold disposed within said first mentioned chamber, the second chamber comprising a wall of dielectric material, a grid member disposed between said plate member and said second chamber, a mercury cathode in said chamber, an anode in said chamber, and a conductor in the wall of said second chamber for connecting said chambers.

5. In a device of the class described, a chamber having a high vacuum, a plate member therein, a second chamber having a high vacuum when cold disposed within said first mentioned chamber, the second chamber comprising a wall of dielectric material, a grid member disposed between said plate member and said second chamber, a plurality of electrodes in said second chamber, one of said electrodes being a mercury electrode, and an electrical conductor secured in the wall of dielectric material, the conductor electrically connecting the chambers.

6. In a device of the class described, a chamber having a vacuum, a plate member therein, a second chamber within said first mentioned chamber having a high vacuum when cold, said second chamber comprising a wall of dielectric material, a grid member disposed between said plate member and said second chamber, a plurality of electrodes in said second chamber, one of said electrodes being a mercury electrode, and a conductor connecting said chambers, the conductor being disposed in the wall of dielectric material.

7. An electron tube comprising a sealed envelope, a plate member, a grid member, a vapor tube hermetically sealed within said envelope, the tube comprising a wall of dielectric material, an anode, a cathode, the anode and cathode being disposed within the vapor tube, and a metallic conductor disposed in the dielectric wall for electrically connecting the chamber of the tube with the chamber formed by the sealed envelope.

8. An electron tube comprising a chamber, a plate member, a grid member, a second chamber disposed within the first mentioned chamber, the second chamber comprising a wall of dielectric material, a source of electrons disposed within the second chamber, and a metallic insert secured in the dielectric material for electrically connecting the chambers.

9. The combination in a thermionic device of a chamber having a high vacuum, a plate member, a grid member, a second chamber disposed within the first mentioned chamber, the second chamber having a wall of dielectric material, means for producing an arc within said second chamber, and a conductor secured in the dielectric material directly connecting the chambers.

In testimony whereof, I have hereunto signed my name in the presence of two subscribing witnesses:

EUGENE L. MUELLER.

Witnesses:
ROY W. HILL,
BERTHA HARTMANN.