H. P. DONLE.

ELECTRON VALVE.

APPLICATION FILED AUG. 8, 1918.

1,291,441. Patented Jan. 14, 1919.

Fig. 1.

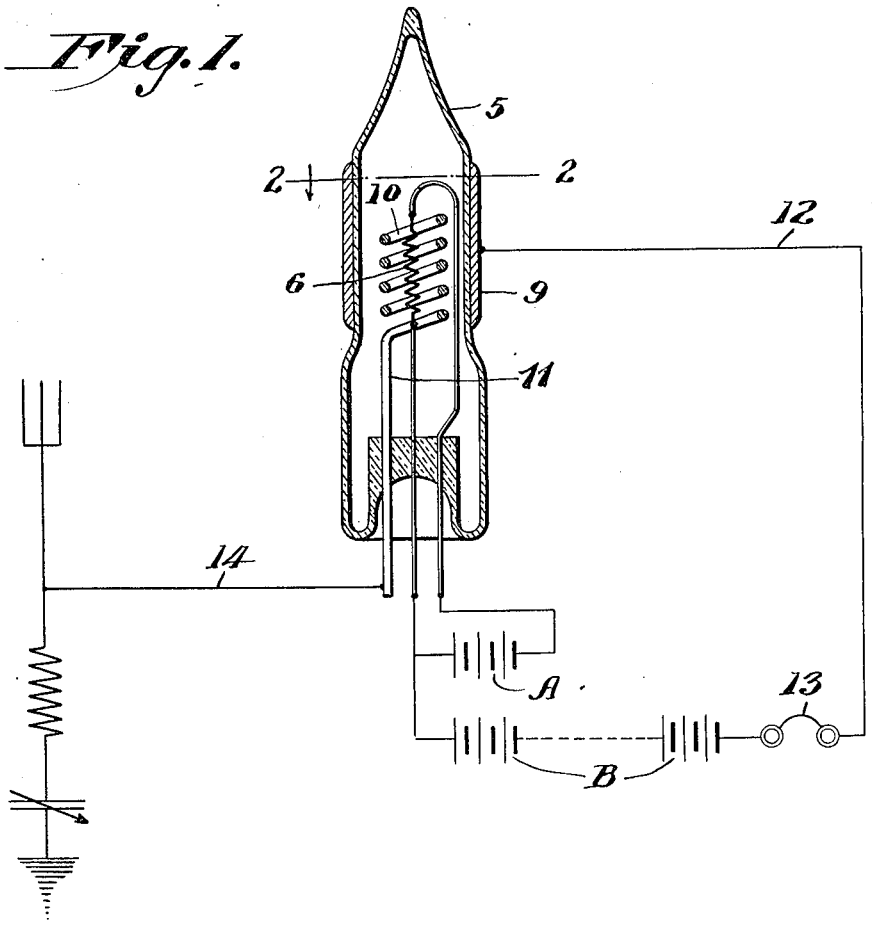


Fig. 3.

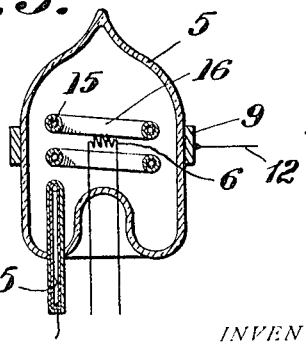
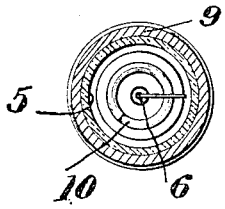


Fig. 2.



INVENTOR.

Harold P. Donle,

BY

Whitelaw & Holt

ATTORNEYS

UNITED STATES PATENT OFFICE.

HAROLD P. DONLE, OF MERIDEN, CONNECTICUT, ASSIGNOR TO CONNECTICUT TELEPHONE & ELECTRIC CO., INC., OF MERIDEN, CONNECTICUT, A CORPORATION OF CONNECTICUT.

ELECTRON-VALVE.

1,291,441. Specification of Letters Patent. Patented Jan. 14, 1919.

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To all whom it may concern:

Be it known that I, HAROLD P. DONLE, a citizen of the United States of America, residing at Meriden, Connecticut, have invented a new and useful Electron-Valve, of which the following is a specification.

My present invention relates to what are known as electron valves.

The objects of this invention are to increase the efficiency and sensitiveness of said valves and to render them more durable and less complicated in structure than such valves have been heretofore.

Prior to my invention valves of this character have been constructed with plate and grid elements mounted within an evacuated bulb containing a filament and have been largely dependent for their operation upon the maintenance of a proper vacuum within the bulb.

A variation of this type has been proposed with the plate and filament mounted within opposite end portions of an evacuated bulb and the grid element surrounding the bulb in such a manner that its electrostatic field cuts across the electron stream.

The terms "plate" and "grid," as used in this art have been commonly applied to two conductors within the bulb, generally surrounding the filament, the grid of mesh-like construction immediately surrounding the filament, and the plate a solid conductor disposed outside the grid.

In the operation of such valves the filament is rendered incandescent by the passage through it of electrical energy and upon being made the cathode terminal of a battery, the electrons, or ions, emitted from the filament pass across the intervening space through the mesh of the grid to the plate and act as carriers for the energy of the battery. Between the filament and plate the grid acts simply as a controlling member to the passage of this electron flow, the electrostatic field created by a slight charge impressed upon the grid either increasing or diminishing the number of electrons reaching the plate, depending upon the polarity of such charge.

In my invention the valve operates upon a quite different principle. I employ an incandescent filament mounted within a bulb with a spiral conductor surrounding the filament. On the external surface of this bulb, which is of glass or like material, I mount a conductor of a material that does not polarize when in contact with the warm glass. When the filament is rendered incandescent by electrical energy the stream of electrons flowing from it apparently forms a layer upon the inner surface of the globe, which layer seemingly has the property of polarizing when in contact with the warm glass. With the cathode terminal of the battery connected to the filament and the anode terminal connected with the external conductor on the outer wall of the globe, some current will flow from the external conductor through the glass to the layer of electrons on the inner wall of the globe and by means of the stream of electrons to the filament.

It will be seen that the extent of this conduction will depend upon the area of the polarizing layer of electrons on the inner wall of the globe. The magnitude of this area is altered by the action of the spiral conductor surrounding the filament, a slight negative charge placed upon this conductor serving to diminish the number of electrons reaching the wall of the globe and hence decreasing the supply and the area of the polarizing surface.

By the development of this new method of operation I have overcome to a large degree many objections found in the present types of valves where all the elements are placed in the electron stream. My valve generally speaking, is independent of the vacuum about the filament. In fact, for many purposes an inert gas may be used in which case of course the conduction would be by means of ions instead of electrons.

Further features of the invention and details of construction, etc., will appear as the specification proceeds.

In the accompanying drawing I have illustrated my invention embodied in several practical forms, this with the understanding however, that changes and modifications may be made without departure from the true spirit and scope of the invention.

In said drawing:

Figure 1, is a vertical sectional view of one form of my valve in use as a detector for a radio receiving set.

Fig. 2, is a cross sectional view of the same substantially on the plane of the line 2—2 of Fig. 1.

Fig. 3, is a vertical sectional view of a modified form of the invention.

Referring to said drawing now in detail, 5 designates the body portion of the valve, here shown in the form of a hollow globe of glass or like material. 6, designates the electrons emitting filament which here acts in the capacity of a cathode and is shown as a heating filament supported by relatively rigid lead wires.

9 designates the external plate or anode which is shown as a metalic ring or band mounted directly on the outer wall of the globe and surrounding the filament.

10 designates the electron controlling member, this element being shown mounted within the globe and in the form of a spiral or helix surrounding the filament and interposed between the filament and the wall of the globe. The controlling member is supported in position, in the illustration, on a suitable supporting lead wire 11.

In Fig. 1 the valve is shown in use as a detector for a receiving set, a typical circuit arrangement for this purpose being illustrated embodying an energizing circuit for the filament, including battery A, having its anode terminal connected by a conductor 12 with the external conductor or anode 9, this circuit including the telephone receivers 13 and battery B. The controlling member is shown connected with the antenna by a conductor 14.

From the tests which I have conducted I understand the operation of this device to be as follows:—

The filament when energized by the battery A heats up the globe which, as before stated, is usually made of glass or other material normally non-conductive at room temperature but which when heated to a higher temperature of say—100° C. or over, becomes conductive to a certain degree, whereupon current from battery B passes from the anode through the heated glass to the layer of electrons on the inner wall of the globe, said current being conducted between this wall and the filament by the electron stream. If a charge is now placed upon the controlling member, as by means of radio oscillations, for instance, the flow of current through the glass is decreased by the decreasing in area of the electrons laying upon the inner wall of the globe, the controlling member apparently acting in this case to absorb unto itself a certain number of these electrons.

I have found this new type of valve, having the anode located outside the bulb and the controlling member inside the bulb, more efficient than the valves now on the market in many ways, being more sensitive and much more readily adjusted to meet varying conditions. From a practical standpoint also this new valve is possessed of many advantages in the way of greater simplicity of manufacture and greater durability and reduced cost.

The construction illustrated in Fig. 3 differs from the first form described, particularly in that both the anode and the controlling member are separated from the filament or electron source by a wall of glass. In this case the anode is located on the outside of the globe 5, as in the first instance but the controlling member is in the form of a metallic coating 15 of silver, or the like, lining the inner wall of a sealed glass tube 16 located within the globe and surrounding the filament.

The operation of this device is in general similar to that of the first form, the controlling member being connected to the oscillation circuit, and controlling the electron flow reaching the inner wall of the globe in the manner before described.

The polarizing layer of electrons or ions in contact with the inner wall of the globe, it will be seen forms in effect a polarizing conductor which in combination with the non-polarizing conductor in contact with the outer wall of the globe makes of the device a rectifier which may be used as such. The device may also be used as an amplifier in which event the connections will be such that the area of the polarizing conductor will be varied in accordance with the energy to be amplified.

I claim:—

1. An electron valve comprising a globe, a filament within the globe, an anode outside the globe in contact with the outer surface of the globe and separated from the filament by the wall of the globe, and an electron control within the globe.

2. An electron valve comprising a globe, a heating element within the globe, an electron control within the globe and surrounding the heating element, and an anode on the outside surface of the globe and in contact therewith.

3. An electron valve comprising a globe, a filament therein, an anode outside the globe, and an electron control within the globe and between the filament and anode.

4. In an electron valve, a filament, an electron control about said filament, a glass-like wall surrounding said control, and an anode conductor outside said glass-like wall.

5. An electron valve comprising, a globe of glass-like material, a heating element within the globe, a controlling member within the globe, and a non-polarizing anode conductor outside the globe and in contact with the outer surface of the same.

6. In a radio receiving system, a globe, a

filament in said globe, an energizing circuit for said filament, an anode conductor outside and in contact with the outer surface of the globe, an anode circuit connected with said anode, an electron control within the globe, and a charging circuit connected with said electron control.

7. An electron valve comprising a globe, a filament within said globe, an anode in contact with the outer surface of the globe, and an electron control in the form of a spiral within the globe and encircling the filament.

8. An electron valve comprising a globe, a filament within said globe, an anode outside and in contact with the outer surface of the globe, and an electron control within the globe comprising a tube in the form of a helix encircling the filament and provided with a conductive lining.

HAROLD P. DONLE.