March 29, 1932. A. W. HULL 1,851,706

ELECTRON DISCHARGE DEVICE

Filed Aug. 19, 1927

Fig. 1.

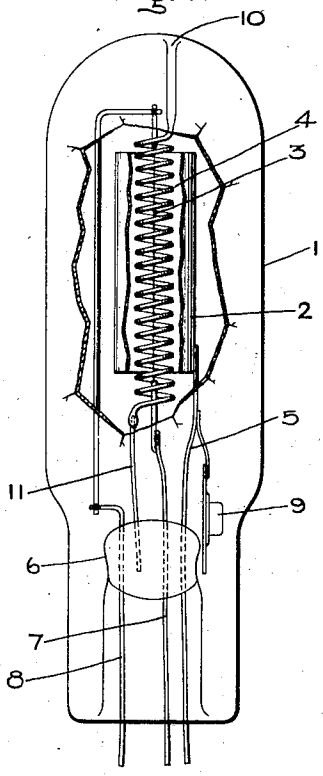
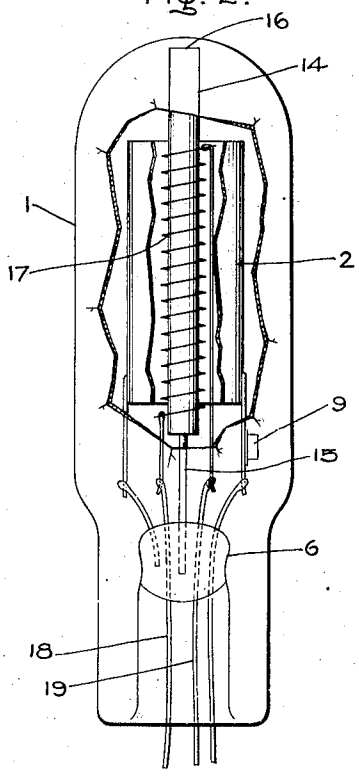


Fig. 2.



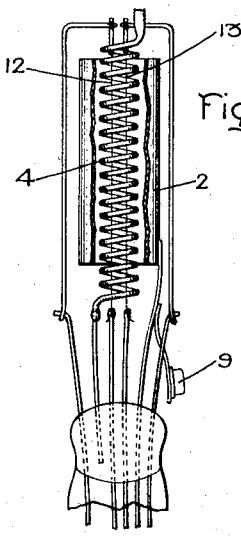


Fig. 3.

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Patented Mar. 29, 1932 1,851,706

UNITED STATES PATENT OFFICE

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ELECTRON DISCHARGE DEVICE

Application filed August 19, 1927. Serial No. 214,199.

The present invention relates to electron discharge devices and more particularly to an electron discharge device employing a light sensitive control electrode for governing the output of such a device.

It is one of the objects of the present invention to provide, in an electron discharge device, an improved form of control electrode electrically insulated from the exterior of the discharge device.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, will best be understood from reference to the following specification when considered in connection with the accompanying drawings in which Fig. 1 shows an elevation, partly broken away, of an electron discharge device embodying the features of the present invention; Fig. 2 is an elevation partly broken away of a modified form of the invention; while Fig. 3 is an elevation partly broken away of a modified form of cathode adapted to be employed with the grid and anode disclosed in Fig. 1.

Referring to the drawings, I have indicated at 1 an evacuated receptacle provided with a substantially cylindrical anode 2, a filamentary cathode 3 and a control electrode or grid 4. The anode is supported upon a leading-in wire 5 extending through stem 6. The filamentary cathode 3 is concentrically disposed within the anode and connected to leading-in wires 7 and 8 which extend through the stem portion of the device. The grid or control electrode 4 as disclosed in Figs. 1 and 3 comprises a solid, helical, insulating member or rod made of quartz or optical glass and having on its surface a monatomic coating or layer of cæsium or other alkali metal which may be introduced into the tube from a metallic capsule 9 attached to the leading-in wire 5. The upper end of the quartz or glass rod 4 is fused to the container 1, as indicated at 10 in Fig. 1, and the lower end of the rod is fused to a metal supporting rod 11 embedded in stem 6. The filament is preferably a tungsten wire coated with a monatomic film of cæsium, though other forms of filaments may be employed. If desired, the entire inner surface of the container may be provided with a coating of alkali metal. It is sufficient, however, for the operation of the device, that a minute quantity of alkali metal be present, for example, a thin coating of cæsium on a small portion of the bulb. In some forms of the device all free alkali may be driven out of the tube, leaving only the monatomic film on the glass.

Light directed on to the end of the spiral grid rod 4 traverses the rod from end to end. The light impinges internally on the quartz surface and is reflected therefrom, losing, however, but little of its energy at each reflection, so that many reflections take place permitting thereby a large photoelectron emission from the surface of the grid 4 with a very weak beam of light.

The quartz rod or grid, when light is directed onto its end portion 10 gives up photoelectrons to the plate or anode member 2 thereby becoming more positive. This action permits more current to flow from the filament to the plate. The loss of electrons by the grid is balanced by electrons received from the filament, so that for each value of light intensity the grid assumes a definite potential at which the number of electrons lost, due to the light, is just equal to the number received from the filament.

If desired, a pair of filamentary electrodes 12 and 13 may be employed, as indicated in Fig. 3, the filament 13 being negative by a few volts with respect to filament 12 and operating at a much lower temperature. The purpose of filament 13 is to supply a small, temperature limited, balancing current of any desired magnitude, to the quartz grid. In this way the sensitiveness of the device may be varied over a wide range.

Instead of the helical form of grid, a straight piece of quartz or optical glass rod 14 may be mounted concentrically within the anode 2, as shown in Fig 2. The quartz rod is in this case supported on a stem 6 by means of a metal rod 15 embedded in the stem. The upper end 16 of the grid rod extends close to the inner surface of the container 1 and may, if desired, be fused thereto as in

Fig. 1. The surface of the quartz rod is coated with a monatomic layer of cæsium or other alkali metal. A filament 17 surrounds the quartz grid and is supplied with current through the leading-in wires 18 and 19. This filament may be of the thorium-coated or of the Wehnelt type, but is preferably a cæsium-coated tungsten wire, operating at a temperature between 800° K. and 1000° K.

Instead of the alkali metal coating on the grid other substances may be used, such as magnesium or calcium, which are sensitive only to ultraviolet light, or substances such as barium oxide or compounds of sulphur which are sensitive to infra red light.

The amount of light directed onto the end of the quartz or glass grids will in each case determine or control the flow of current between the cathode and anode electrodes.

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

1. An electron discharge device comprising a container, an anode, cathode and control electrode mounted in said container, said control electrode comprising a coiled vitreous member coated with alkali metal, one end of the coiled member being designed to receive light thereon to thereby control the current flow between the cathode and anode.

2. An electron discharge device comprising an anode, cathode and control electrode, said control electrode being interposed between the anode and cathode members and comprising a vitreous member, elongate in dimension, and having a monatomic layer of alkali metal thereon, and means whereby light rays may be directed longitudinally through said member and may be caused to impinge on the alkali metal a plurality of times to thereby control the electron current flowing between the cathode and anode.

3. An electron discharge device comprising an envelope containing an anode, a cathode and control electrode, said control electrode comprising a quartz rod through which light may be transmitted longitudinally, said rod having thereon a coating of light-sensitive material which is activated by the transmitted light for controlling the electron current flowing between the anode and cathode members.

In witness whereof I have hereunto set my hand this 17th day of August, 1927.

ALBERT W. HULL.