Dec. 1, 1931. D. McF. MOORE 1,834,251

ELECTRICAL DISCHARGE DEVICE

Filed Sept. 2, 1930

Fig. 1.

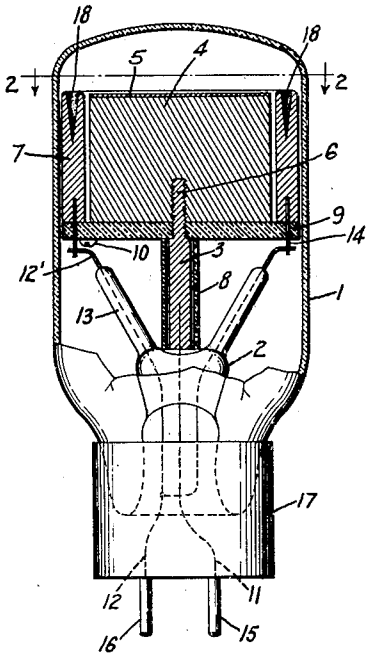


Fig. 2.

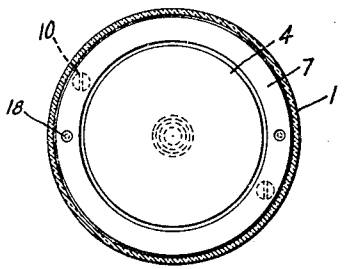
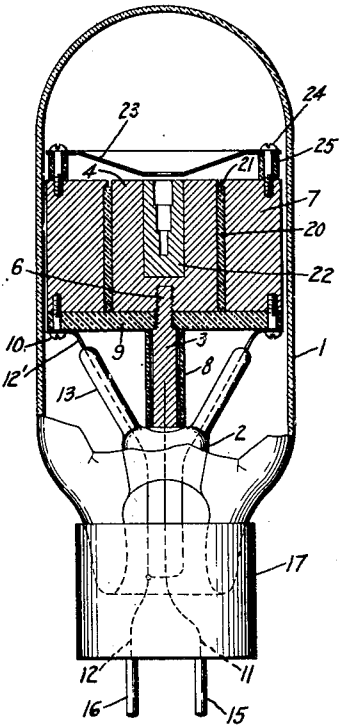


Fig. 3.



Inventor:
Daniel McFarlan Moore,
by Charles V. Mullen
His Attorney.

Patented Dec. 1, 1931 1,834,251

UNITED STATES PATENT OFFICE

DANIEL McFARLAN MOORE, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

ELECTRICAL DISCHARGE DEVICE

Application filed September 2, 1930. Serial No. 479,171.

The present invention relates to gaseous conduction devices and constitutes an improvement in the negative glow type of electric discharge device, an example of which is described and claimed in my United States Patent 1,316,967 patented September 23, 1919, and in my co-pending application Serial No. 292,223, filed July 12, 1928. Such a device comprises non-thermionic electrodes (sometimes called "cold" electrodes) spaced relatively close to one another and operating in a gas which produces a luminous sheath on the surface of the cathode known as the negative glow. In one form the negative glow device has been provided with a depression, or crater, in the cathode in which a highly concentrated negative glow is formed at suitable operating potentials. A crater-type lamp is described and claimed in my prior Patent 1,816,690, patented July 28, 1931. The negative glow lamp, in both the plane cathode and the crater cathode types, is particularly suitable as the light source for electrical devices in which luminous image is formed, such as facsimile apparatus, television, signaling apparatus, stroboscopic devices or for any other purposes requiring accurate and instantaneous response in light emission to rapid variations in voltage of an electric current.

In accordance with my present invention, I have provided improved insulating and supporting structures and a new arrangement of electrodes in negative glow devices.

In accordance with one feature of my invention, the electrodes are fixedly supported by an insulating plate which functions also as a shield to prevent the formation of negative glow on parts of the cathode where it is not desired.

In accordance with another feature of my invention, I have provided a construction which dispenses with an insulating member between the cooperating electrodes of a negative glow device when spaced in close proximity.

The novel features of my invention will be set forth in greater particularity by the appended claims.

Specific embodiments of my invention are shown on the accompanying drawings, Fig. 1 being a vertical section and Fig. 2 a horizontal section of one form of glow device and Fig. 3 being a vertical section of a different form of glow device, both embodying my invention.

Lamps in which the negative glow emanates from comparatively large areas or from plate or plane surfaces have heretofore generally been constructed so that the plane of luminous surface is parallel to the axis of the lamp. Figs. 1 and 2 illustrate a lamp having nested electrodes so arranged that the exposed surface from which a luminous discharge emanates is vertical to said axis and can, therefore, be called an "end-on" lamp which has definite advantages for many purposes.

The device shown in Figs. 1 and 2 comprises an elongated, generally cylindrical envelope 1 consisting of glass, or other suitable transparent material and being provided with a reentrant stem 2. Supported on this stem by a pedestal 3 is a cylindrical cathode 4 consisting of copper, aluminum, or other suitable metal. Preferably the cathode 4 is provided by electroplating, or otherwise, with a surface layer 5 of nickel, chromium, or other metal which is capable of being highly polished, and which preferably is relatively non-volatile. The pedestal 3 may be affixed to the main body of the cathode by a screw threaded tip 6 of reduced section. Surrounding the cathode and substantially filling the space between the cathode and the envelope 1 is an anode 7 also consisting of copper, aluminum, or other suitable metal, the two electrodes 4 and 7 being separated by a space of about .01 mil. The cathode pedestal 3 is surrounded by a sleeve 8 of suitable insulating material, as for example, lava.

The anode 7 is supported from an insulating plate 9 consisting of lava, isolantite, alumina, magnesia or the like which is firmly held between a shoulder on the pedestal 3 and the cathode 4. The screws 10 (best shown in Fig. 2) unite the anode 7 with the plate 9. The plate 9 which extends over the lower surfaces of the electrodes 4, 7 shields

these surfaces and prevents undesired formation of a glow discharge thereon.

Electrical connection to the cathode 4 is made by a conductor 11 which is joined to the pedestal 3 and electrical connection to the anode 7 is made by a conductor 12, the branches 12′, which are in part surrounded by extensions 13 of the stem being joined by welding to short conductors 14 extending into the anode 7. The conductors 11 and 12 are connected respectively to external contact posts of a base 17.

The sealed envelope 1 is evacuated by approved methods including heating of metal parts by high frequency during exhaust and treatment of the electrodes by discharges produced with applied potentials higher than normal operating potential. The envelope is charged with a suitable gas, such as neon, argon, helium or a suitable gaseous mixture at a pressure of about 30 mm. of mercury. A suitable getter may be employed, such as calcium, magnesium, sodium, potassium, caesium or the like which may be volatilized by approved methods to chemically remove undesired chemically active gases. The getter may be introduced into depressions 18 in the anode and volatilized by heating the anode by high frequency induction in a known manner, or in other suitable manner.

For example, after the lamp has been charged with gas and sealed, it is operated with direct current making the outer electrode the cathode, (normally it is anode). Under these conditions the cone-shaped depressions 18 (lined with magnesium or the like) become craters temporarily filled with intense light. The accompanying heat vaporizes some of the getter metal and its vapor chemically unites with deleterious gases and water vapor which may be present.

When a lamp, such as described in Fig. 1, is operated by applying a direct current potential of about 425 volts to the terminals 15 and 16, the terminal 15 being connected to the negative pole and the terminal 16 to the positive pole of the source, a suitable series resistance or impedance (not shown) being employed, a bright glow appears upon the exposed top surface of the cathode which, as will be observed, is closed to the end wall of the envelope. When the lamp is used as a television receiver this is an important advantage over the parallel plate type of lamp. No glow appears in the narrow space between the electrodes 4 and 7 as the distance between the electrodes in this space is less than the mean free path between gas molecules of the ionizable gas and therefore no appreciable ionization by collision can occur. The lower surface of the main body of the cathode is shielded by the plate 9 and the external surface of the pedestal 3 shielded by the insulating sleeve 8. Therefore, no undesired negative glow can form on the lower side of the cathode. In other words, the glow is entirely confined to the part of the cathode from which light radiation is desired and therefore most efficient operation is obtained. It is desirable to obtain as high a light intensity per unit of area as possible and this is accomplished by increasing the amperage through the lamp with consequent increased heating. These electrodes of considerable mass make it possible to obtain a much higher intrinsic brilliancy.

The lamp shown in Fig. 3 differs in several respects from the lamp shown in Fig. 1. The space between the cathode 4 and the anode 7 is almost completely filled by a layer of electrical insulation 20 which may consist of mica, isolantite, or other suitable material. The electrical insulation 20 is held in position by a shoulder 21 near the upper part of the anode. This shoulder also provides means to make the width of the annular space a gap between the anode and cathode as desired, for example, .010 mil. The cathode is provided with a central insert 22 of iron, tungsten, thorium, an alloy of ferro-cerium, or other metal of good electron emissivity. In this insert is provided a crater. It may be produced for example by using progressively larger drills to make the cathode walls outwardly divergent, as shown. This construction providing a cone-shaped cavity permits small currents to produce a light of high intrinsic brilliancy in the small bore. A negative glow lamp providing a cone-shaped cavity is claimed in my application Serial No. 292,223, filed July 12, 1928, improvements therein being claimed in my application Serial No. 440,178, filed March 31, 1930. A perforated disk or plate 23 is affixed to the anode by screws 24 and spacing sleeves 25. This plate 23 confines the radiation of light entirely to the crater. This latter construction is claimed in my application Serial No. 440,178. The fabrication of this form of cathode is similar to the fabrication of the form shown in Fig. 1. During operation the crater in the cathode is filled with an intensely luminous glow, the brilliancy of which varies with the voltages within the working range of the device which are impressed upon the electrodes.

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

1. A gaseous conduction device comprising a sealed elongated envelope having a stem at one end thereof, an attentuated gas content for said envelope, juxtaposed electrodes extending from wall to wall in said envelope transverse to its major axis, and having exposed end surfaces remote from said stem, a plate of insulation extending over end surfaces of said electrodes adjacent said stem and electrical conducting and

mechanical supporting means for said electrodes extending from said stem through said plate.

2. A gaseous conduction device comprising a sealed envelope, an attenuated gas therein, a tubular electrode, a cooperating electrode fitting into the bore of said tubular electrode, a stem projecting into said envelope, conductors for said electrodes sealed into said stem, means for supporting one of said electrodes from said stem, a plate of insulation extending from said support over one of the end surfaces of said electrodes, and means for securing said electrodes and plate into fixed relation.

3. A negative glow device comprising a sealed envelope, a content of attenuated gas therein, cooperating electrodes constructed and arranged in close juxtaposition to constitute a transverse partition in said envelope, electrical conductors for said electrodes sealed into said envelope, and a plate of insulating material covering end surfaces of said electrodes on one side, the opposite ends of said electrodes having exposed portions where a negative glow discharge may be formed.

4. A negative glow lamp comprising an elongated cylindrical envelope, a gaseous filling, nested cooperating electrodes extending transversely from wall to wall in said envelope, said electrodes having exposed end surfaces substantially vertical to the longitudinal axis of said lamp and located close to one end of said envelope, electrical conductors united with said electrodes and sealed into the opposite end of said envelope and insulating structure so united with said electrodes and said conductors that a luminous discharge between said electrodes is confined to the exposed portion of said electrodes remote from said conductors.

5. A gaseous conduction lamp comprising a sealed envelope containing a gas at a pressure at which at normal operating potentials of the lamp consists solely of a negative glow, a tubular anode, a cathode fitted within said anode and spaced away therefrom such distance that no glow will be formed in the space between said electrodes, an electrically insulating plate affixed to the base of said electrode whereby said electrodes are held in spaced relation with respect to one another and conductors for said electrodes sealed into said envelope.

6. A gaseous conduction lamp comprising a sealed envelope containing a gas at a pressure at which at normal operating potentials of the lamp consists solely of a negative glow, a tubular anode, a cathode consisting of a metal of good heat conductivity fitted with said anode and having a coating of a metal capable of taking a high polish, an electrically insulating plate affixed to the base of said electrode, and arranged to hold said electrodes in spaced relation with respect to one another, conductors for said electrodes sealed into said envelope, and sleeves of electrical insulating material surrounding said conductors.

7. A gaseous conduction lamp comprising a sealed bulb, an attenuated gas therein, electrodes therein one of which surrounds the other, said electrodes being spaced apart a short distance, a plate of non-conducting material affixed to the base of said electrodes and extending transversely in said bulb, conductors extending from said electrodes through said plate to the exterior, being sealed into the wall of said bulb and non-conducting sleeves surrounding said conductors between said plate and the wall of said bulb.

In witness whereof I have set my hand this 20th day of August, 1930.

DANIEL McFARLAN MOORE.