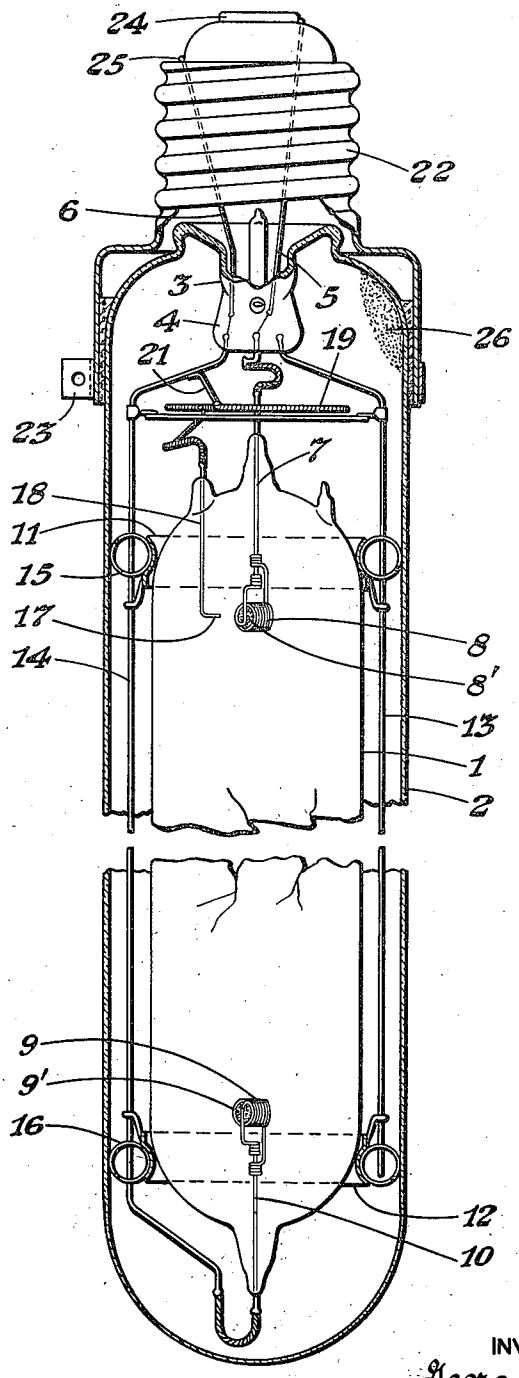
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GASEOUS ELECTRIC DISCHARGE LAMP

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GASEOUS ELECTRIC DISCHARGE LAMP

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The present invention relates to gaseous electric discharge lamps generally and more particularly the invention relates to such lamps having a vaporizable material therein the vapor of which is light emitting during the operation of the lamp.

It is frequently desirable to operate such lamps with elevated container temperatures and means to thermally insulate the container from the ambient, such as an evacuated envelope or jacket enclosing the lamp container, is useful for this purpose. In many cases the efficiency of this type of lamp decreases rapidly during the operation thereof.

The object of the present invention is to provide a gaseous electric discharge lamp comprising a sealed container having a quantity of vaporizable material therein and an evacuated envelope enclosing said container which retains its efficiency for a long operating life. Still further objects and advantages attaching to the device and to its use and operation will be apparent to those skilled in the art from the following particular description.

Heretofore the loss in efficiency of lamps of the above type has been thought to be due to various phenomena occurring in the lamp container itself, such as sputtering of the electrode material, the clean up of the metal vapor filling, or changes in the glass of the container. We have discovered that the cause of the loss of efficiency of lamps of this type is due to a loss of vacuum in the enclosing envelope which reduces the effectiveness of the envelope as a heat insulator for the lamp container since the increased quantity of gas in the envelope transfers more heat from the container to the envelope where it is dissipated. The lamp container is then at a lower temperature and the vapor therein at a correspondingly lower pressure after the lamp has been operating a few hundred hours than is the case when the lamp is new. The lower vapor pressure has a detrimental effect on the efficiency of the lamp.

Take, for example, a gaseous electric discharge lamp comprising a sealed container having a quantity of sodium therein and enclosed by an evacuated envelope. Let us assume that the container must be at a temperature of about 230° C. to have a sodium vapor pressure of about 0.001 mm. in said container during the operation of the lamp. Careful evacuation of the envelope can reduce the pressure therein to about 0.00001 mm. We have observed that after the lamp has been operating approximately 500 hours the pressure in the envelope has increased substantially due to the escape of gases from the walls of the lamp container and the envelope and in many cases the pressure in the envelope is approximately 0.2 mm. As pointed out above the increased quantity of gas in the envelope transfers more heat from the lamp container to the envelope where it is dissipated. The lamp container is thus at a lower temperature during the operation of the lamp, such as a temperature of about 200° C., and the sodium vapor pressure is reduced to about a pressure of 0.0001 mm. while the wattage consumption of the lamp remains about the same. The lamp under these pressure conditions emits much less light, approximately half as much, than when the sodium vapor pressure is about 0.001 mm.

Having discovered the cause of the difficulty the solution of the problem is comparatively simple and we have solved the problem by introducing a quantity of gas absorbing material in the evacuated envelope. Finely divided metals of the alkaline or alkaline earth groups are useful for this purpose as these metals have a large absorption capacity for the gases issuing from the walls of the lamp bounding the evacuated space about the container.

There are many well known methods of introducing finely divided metals into glass envelopes, such as by vaporizing the metal from a hot wire and condensing the metal vapor on the wall of the envelope. We prefer to introduce the finely divided metal in the form of a solution comprising alkali-azide or an earth alkali azide, such as barium azide. Several drops of the solution are placed on the inner wall of the envelope before the envelope is exhausted. During the exhausting process of the envelope the glass walls are heated to drive out the gases therefrom and the gases are pumped out of the envelope. The solvent is vaporized by the heat and the vapor thereof is removed from the envelope during the usual exhausting process of the envelope. The azide disintegrates during the heating period leaving a residue of finely divided metal which does not interfere to any appreciable extent with the transmission of light by the envelope.

In the drawing accompanying and forming part of this specification a metal vapor discharge lamp embodying the invention is shown in a front elevational partly sectional view.

Referring to the drawing the new and novel lamp comprises a tubular inner container or envelope 1 of glass or the like which is filled with a starting gas, such as neon, or a mixture of starting gases, such as a mixture of argon and

neon, at a pressure of about 1 to 10 mm. and which has a difficultly vaporizable material therein, such as sodium, the vapor of which is light emitting during the operation of the lamp. A sealed, evacuated envelope or jacket 2 encloses said envelope 1 to reduce the heat losses from said envelope 1 to a minimum. At one end of the jacket 2 there is a reentrant stem 3 through the pinch 4 of which are sealed a pair of inleads 5 and 6. Said inlead 5 is flexibly connected to the inlead 7 which is sealed into the adjacent end of the envelope 1. A thermionic electrode 8 is carried by the inner end of said inlead 7, while a similar thermionic electrode 9 at the other end of the envelope 1 is carried by a similar inlead 10. These thermionic electrodes can be of any desired type or composition, but as here shown consist of a wound tungsten helix within which are retained the rods 8' and 9' of electron emitting oxides, such as a sintered mixture of 90 parts of barium oxide and calcium oxide with 10 parts of tungsten. A pair of metal rings 11 and 12 whose smallest diameter is slightly less than that of the envelope 1 are placed snugly against the ends of said envelope and are held in this position by the rigid longitudinal wires 13 and 14, to which they are affixed in any suitable manner. These rings 11 and 12 are formed with a groove therein, as shown. The wires 13 and 14, which together with the metal rings 11 and 12 form a stiff frame or cradle surrounding the envelope 1, are anchored in the pinch 4. As shown the wire 14 is preferably connected to both the inlead 6 and the inlead 10, so that it also serves as the current conductor for the thermionic electrode 9. The rings 15 and 16, which are formed of any suitable resilient wire wound into a loose helix, are tightly inserted between the rings 11 and 12, respectively, and the jacket 2, the grooves in said rings 11 and 12 firmly holding said rings 15 and 16 in the desired position. Since these wire rings 15 and 16 are inherently very flexible and likewise touch the jacket 2 at many points the envelope 1 is firmly but resiliently held in its axial position.

An auxiliary electrode 17 is arranged near the thermionic electrode 8. This may consist of a short piece of tungsten or a small helix thereof, but in any case is preferably activated with an active thermionic substance, such as barium oxide, in any usual manner. This auxiliary electrode is carried by the inlead 18 which is sealed through the adjacent end of the envelope 1, said inlead in turn being flexibly connected to one end of a high resistance 19 which is arranged on a mica disc 20 carried by the wires 13 and 14. The other end of said resistance is connected by the wire 21 to the wire 14, and thus to the other thermionic electrode 9. A screw base 22 is placed over the stem end of the jacket 2, and tightly clamped thereon by means of the band 23. The inlead 5 is connected with the tip 24 of said base while the inlead 6 is connected to the screw shell or sleeve 25 thereof.

Said jacket 2 has a thin coating 26 of finely divided alkaline earth metal, such as barium, on the inner surface thereof near the stem 2. Said coating 26 is deposited on the inner surface of said jacket 2 during the usual exhaust procedure of the jacket 2 in the manufacture of the lamp by the method of first vaporizing the solvent of a solution comprising barium azide and then breaking up the azide leaving a residual coating of finely divided barium. The barium absorbs any gas given off from the lamp parts enclosed by the jacket 2 and a high vacuum is maintained in said jacket 2 during the operating life of the lamp.

It will be understood, of course, that while we have described our invention in connection with electric discharge vapor lamps having a low vapor pressure therein during the operation of the lamp, such as a sodium vapor discharge lamp, the invention is likewise useful in connection with such lamps having a higher vapor pressure therein during the operation thereof, such as mercury vapor discharge lamps which operate at a pressure of approximately 1 atmosphere. This type of mercury vapor lamp requires an appreciable time after starting for the mercury vapor pressure to build up to the operating pressure and the use of the gas absorbing material in the enclosing envelope or jacket of the lamp is advantageous since the high vacuum in the jacket, by reducing the heat losses from the inner envelope, shortens the time interval between the starting of the discharge and the attaining of the operating vapor pressure in the lamp.

While we have shown and described and have pointed out in the annexed claims certain novel features of the invention, it will be understood that various omissions, substitutions and changes in the forms and details of the device illustrated and in its use and operation may be made by those skilled in the art without departing from the broad spiirt and scope of the invention.

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

1. A gaseous electric discharge lamp comprising a container, electrodes sealed therein, a vaporizable material therein, an evacuated jacket enclosing said container and a gas absorbing material in said jacket whereby the high efficiency of said lamp is maintained for a long operating life.

2. A gaseous electric discharge lamp comprising a container, electrodes sealed therein, a vaporizable material therein, an evacuated jacket enclosing said container and a finely divided alkaline earth metal in said jacket whereby the high efficiency of said lamp is maintained for a long operating life.

3. A gaseous electric discharge lamp comprising a ocntainer, electrodes sealed therein, a vaporizable material therein, an evacuated jacket enclosing said container and a thin coating of finely divided barium on the inner surface of said jacket whereby the high efficiency of said lamp is maintained for a long operating life.

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