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GASEOUS ELECTRIC DISCHARGE DEVICE

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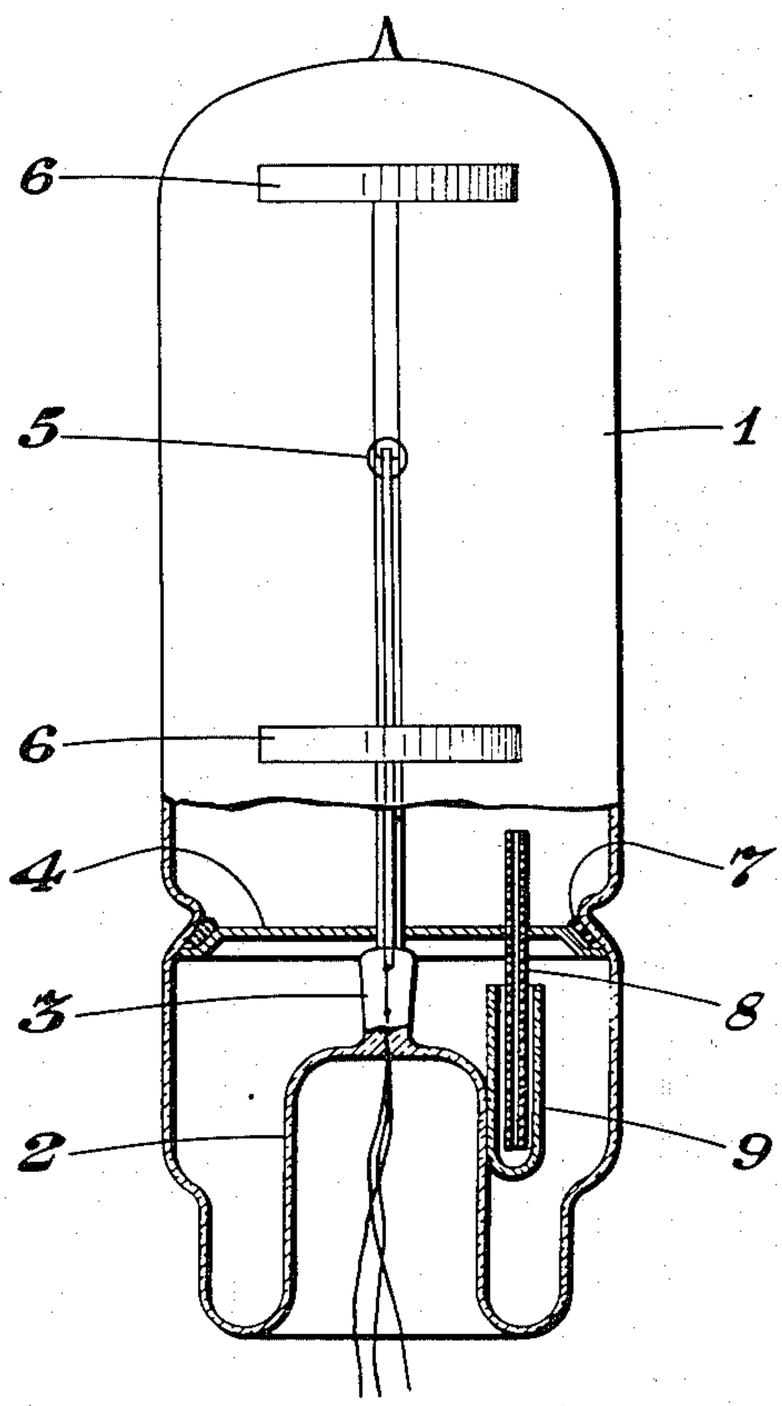

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GASEOUS ELECTRIC DISCHARGE DEVICE

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2 Claims. (Cl. 176—122)

The present invention relates to gaseous electric discharge devices generally and more particularly the invention relates to such devices the gaseous atmosphere of which consists wholly or in part of a vaporizable material.

A general problem in such devices is to maintain the vaporizable material in vaporous condition in the discharge path in the device. Another problem in connection with devices of the type having containers the stem parts of which are subject to attack by the gaseous filling, such as lead glass stems in a container having sodium therein, is to protect the stems from the gaseous filling. In my co-pending application, Serial No. 671,318 filed May 16, 1933, a septum is interposed between the electrodes and the stem parts of the container which septum closes off said stem parts from the other parts of the container during the operation of the device to avoid condensation of the vapor at said stem parts which are the coolest parts during the operation of the device and to protect said stem parts from chemical attack by the metal vapor. The septum is pierced by a tube of small internal diameter and of comparatively long length connecting the spaces on either side of the baffle to facilitate the exhausting process during the manufacture of the device. The greater part of said tube is located in the cooler stem part of the container so that the metal vapor condenses therein to form deposits in the small opening in the tube during the first few hours of operation of the device to close said opening and the spaces on either side of the septum are thus divided during the operation of the device with the results mentioned above. The separation of these two spaces in the container likewise prevents conducting deposits of the condensed vaporous material from forming between the electrode leads at the stem parts of the container and thus avoids leakage currents between these leads which currents are harmful to the successful operation of the device.

The object of the present invention is to improve the structure of the above described lamp device and to increase the useful life of such devices. Other 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.

In accordance with this object the invention comprises a material which combines with and changes to a non-vaporous state the metal vapor which might flow through the tube piercing the septum at any time during the operation of the device. This combining material is located adjacent the stem end of the tube piercing the septum and the vapor is changed to a non-vaporous state by the combining material at that part. The stem parts of the container are thus protected from said metal vapor and the formation of conducting deposits of condensed metal vapor between the electrode leads is avoided at all times and particularly during the first few hours of operation of the lamp device.

I have found by actual use that when an alkali metal, such as sodium, is used as the vapor component of the gaseous filling in the lamp the following materials combine with and change the metal vapor to a non-vaporous state:—lead oxide, tin dioxide and tungsten oxide. A glass which is chemically attacked by the alkali metal vapor, such as lead glass, is also useful for this purpose. Substances which react chemically with the metal vapor to form solid substances are likewise useful. Tellurium is an example of such substances. This material forms sodium telluride when in contact with sodium. A material which forms an alloy with the metal is also useful and such materials are tin, lead, or zinc. An absorbing material, such as calcium fluoride which absorbs sodium vapor, particularly when produced as an active layer by means of vacuum sublimation, likewise has utility in this connection.

The vapors of metals other than sodium are used in such lamp devices and materials which combine with and change to a non-vaporous state the vapor of the particular metal used are easily found. When the vapor of caesium, for example, is used in the lamp lead glass or tungsten oxide which react chemically with caesium vapor, or tin or lead which form alloys with caesium vapor, or graphite which absorbs caesium vapor are suitable materials for the purpose indicated above. Lead glass and tin are useful for this purpose when the vapor of magnesium or lithium is used in the lamp. Thallium vapor is combined with tin or lead to form an alloy.

In selecting the materials to combine with the metal vapor care must be exercised, of course, that the vapor pressure of such materials and the vapor pressure of the product resulting from the combination at the temperature of that part of the container where such materials are located is not sufficient to deleteriously affect the operation of the lamp device. It will be understood, of course, that a plurality of such binding materials, or mixtures or combinations thereof can be used when desired.

While the binding material can be mounted in many different ways I prefer to surround the end

of the tube opening into the stem part of the container by a sleeve closed at the end opposite the opening of the tube. This sleeve, or at least the surface thereof facing the tube, is made of a material which combines with the metal vapor, such as the material indicated above. The metal vapor emerging from the tube then strikes the surface of the sleeve where it is changed to a non-vaporous state, that is, a solid or a liquid state. Another way in which the binding material can be mounted is by making the connecting tube in part of the combining material. For example, when the tube is made of magnesium oxide another tube made of the combining material, such as a lead glass tube, is appended at the stem end of the magnesium oxide tube. The interior wall of the magnesium oxide tube is coated or impregnated wholly or in part with the combining material, when desired.

Another way of employing the combining material is to place a material which expands in contact with the metal vapor in the passage through the tube. The expansion of the material thus decreases the size of the passage and in some cases actually closes the tube completely. The material is placed loosely in the tube so as not to interfere with the exhaustion of the device during the manufacture thereof. Good results are attained along this line in a caesium vapor lamp by placing a compacted cylinder of graphite having a smaller diameter than the inside diameter of the tube in the stem end of the tube. When the graphite cylinder absorbs the caesium vapor the volume thereof increases with the results indicated above.

In the drawing accompanying and forming part of this specification an embodiment of the invention is shown in a side elevational, partly sectional view but as such illustration is primarily for purposes of disclosure it will be understood of course that numerous changes in the form and details of the device and in its use and operation may be made by those skilled in the art from the following particular description and from the appended claims.

Referring to the drawing the new and novel gaseous electric discharge device comprises a container 1 of the usual container glass, such as lime glass or pyrex glass, having an interior coating thereon of boro-cilicate glass having a low content of silicic acid, which coating is chemically resistant to alkali metal vapors, particularly sodium vapor. It will be understood, of course, that said container 1 consists wholly of such resistant glass when desired. Said container 1 has a stem 2 therein made of the usual sealing glass, such as lead glass, which is not resistant to alkali metal vapor. The interior of said container 1 is divided by a septum 4 of heat resistant material chemically stable in the presence of the metal vapor and said septum 4 is interposed between the electrodes 5 and 6 and the stem 2. The septum 4 is of chromium steel and has a flanged rim to give said septum 4 flexibility. Said septum 4 is held in position in said container 1 by a circular recess in the wall of said container 1 and by a suitable adhesive material 7, such as a solution of talcum in water glass, between the flange of said septum 4 and the inner wall of said container 1. The material 7 likewise aids in sealing and making gas tight the joint between said septum 4 and said container 1. When desired discs of other material having suitable properties, such as a mica disc, is used as the septum 4.

The electrode 5 is the cathode and comprises a helically wound filament, such as a tungsten filament, coated or impregnated with an electron emitting material, such as barium oxide, and is electron emitting when heated. Said electrodes 6 are anodes and are mounted on either side of said cathode 5 and at equal distances therefrom. The current supply leads for said electrodes 5 and 6 are sealed into the pinch-part 3 of the stem 2 and are led through the septum 4. Said current leads are insulated from the septume 4 and from each other by a covering of insulation material; close-fitting magnesium oxide tubes about the leads are useful for this purpose. The insulation material fits tightly into the openings in said septum 4 through which the current leads pass to close said openings.

A tube 8 pierces the septum 4 and forms a communicating passage between the spaces on either side of said septum 4 to permit the exhausting of all parts of said container 1 through a single exhaust tube. While I have shown the exhaust tip as being at the part of the container 1 enclosing the electrodes 5 and 6 it will be understood, of course, that the exhaust tube can communicate with the stem part of said container 1. Said tube 8 has a small internal diameter and is of comparatively long length in order to reduce to a minimum the flow of metal vapor therethrough. The greater part of the length of said tube 8 is located in the cooler stem parts of said container 1 in order to condense the metal vapor in that part of the tube 8 located in the stem part of said container 1. The portion of said tube 8 in the stem part of said container 1 is surrounded by a sleeve 9 the internal diameter of which is greater than the outside diameter of said tube 8. Said sleeve 9 is closed at the end thereof opposite the end of said tube 8. Said tube 9 is attached to the stem 2 by fusing these parts together or by using an adhesive material to bind said parts 9 and 2 together.

The gaseous atmosphere in the lamp device comprises a starting gas, such as argon or neon, or mixtures of these gases, at approximately 2 mm. pressure and a metal vapor, such as sodium vapor. A quantity of metal is introduced into that part of the container 1 enclosing the electrodes 5 and 6 to supply the metal vapor component of the gaseous filling during the operation of the device. The lamp starts as a gas lamp and operates as a vapor lamp after a sufficient quantity of metal has been vaporized by the heat of the discharge in the gas.

During the operation of the lamp device the flow of vapor through the tube 8 is very slow and the vapor that does not condense in said tube 8 strikes the inner wall of said sleeve 9. The inner wall of said sleeve 9 consists of a material which combines with the vapor, such as lead glass in the case of sodium vapor, and the vapor is thus changed to a non-vaporous state and prevented at all times during the operation of the device from attacking or depositing upon the non-chemically resistant glass of said stem 2.

The structure of the lamp device can be changed in many respects and the combining material can be of different kinds depending upon the metal vapor used in the lamp and said binding material can be located in many different ways in or adjacent the tube 8, all as indicated above. When desired the sleeve 9 is surrounded by a second sleeve opening in the opposite direction from the opening in said sleeve 9. The lamp device is surrounded by a heat

conservator, when desired, to maintain the container 1 at an elevated temperature and the vaporizable material at an effective pressure during the operation of the device This is particularly valuable when a difficulty vaporizable material, such as an alkali metal vapor, is present in the container of the lamp device. A double walled jacket having the space between the walls thereof evacuated is valuable for this purpose. Other structural details and operating characteristics of the new and novel lamp device are disclosed in my copending applications referred to hereinbefore.

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

1. An electric discharge device comprising a container, electrodes sealed therein, a vaporizable material therein, a stem fused to said container, a septum interposed between said electrodes and said stem and dividing the interior of said container, a tube of small internal diameter extending through said septum and a binding material for said metal vapor adjacent the end of said tube.

2. An electric discharge device comprising a container, electrodes sealed therein, a vaporizable material therein, a stem fused to said container, a septum interposed between said electrodes and said stem and dividing the interior of said container, said container and said septum being of a material resistant to the chemical effects of the gaseous filling, said stem being of a different material, a tube of small internal diameter extending through said septum and a binding material for said metal vapor adjacent the end of said tube.

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