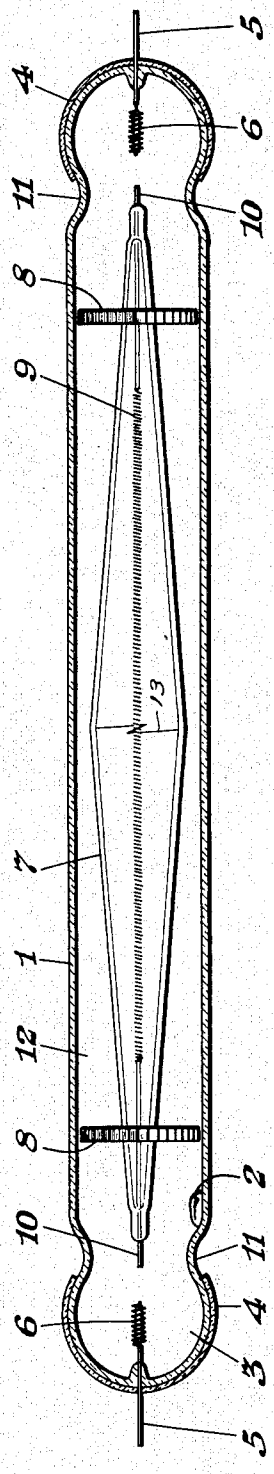
Feb. 11, 1936. K. WIEGAND 2,030,806

GASEOUS ELECTRIC DISCHARGE DEVICE

Filed March 25, 1935



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Patented Feb. 11, 1936 2,030,806

UNITED STATES PATENT OFFICE

2,030,806

GASEOUS ELECTRIC DISCHARGE DEVICE

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Application March 25, 1935, Serial No. 12,927
In Germany March 29, 1934

4 Claims. (Cl. 176—122)

The present invention relates to gaseous electric discharge devices generally and more particularly the invention relates to such devices useful as light sources.

The efficiency of gaseous electric discharge lamps having a tubular container filled with rare gas and operating on high voltage and low current, that is, a glow discharge lamp, is increased by mounting another tube closed at both ends axially in the container and between the electrodes. The inner tube reduces the discharge space in the container and increases the luminous surface of the discharge with relation to the volume thereof which increases the efficiency of the lamp. Discharge lamps of the high voltage, low current type while useful in signs or the like due to the high surface brilliancy thereof are not useful as illuminants because such lamps do not emit sufficient light to be practical for this purpose. Lamps operating on low voltage and high current, that is, arc lamps, are very useful as light sources. Mounting a tube in the container of the lamp, as above, to increase the efficiency thereof is not practical in this type of lamp since the discharge does not distribute itself uniformly in the annular discharge space in such lamps and the lamp emits an irregular, flickering light useless for illuminating purposes.

The object of the present invention is to provide an efficient gaseous electric discharge lamp of the low voltage, high current type. 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.

I have discovered that the light emitted by tubular, gaseous electric discharge lamps of the low voltage, high current type, that is, an arc lamp, having a closed tube axially mounted in the container and between the electrodes thereof is a steady, non-flickering light when the gaseous atmosphere therein consists of or comprises the vapor of a vaporizable metal, for example, mercury, or a difficultly vaporizable metal, by which I mean a metal the vapor pressure of which at a temperature of 200° C. is less than 1 mm., such as sodium, cadmium, zinc, or magnesium. My explanation of this phenomenon is that low pressure of the metal vapor in the lamp during the operation thereof causes a uniform distribution of the arc discharge in the annular discharge space between the electrodes and the light emitted by said discharge is a steady, non-flickering light useful for illumination.

In the drawing accompanying and forming part of this specification an embodiment of the invention is shown in a front elevational, partly sectional view.

Referring to the drawing the new and novel gaseous electric discharge device comprises an elongated, tubular, glass container 1 having a thermionic electrode 6 mounted on a current lead 5 sealed therein at each end thereof and a gaseous atmosphere therein comprising a starting, rare gas, such as neon, argon, or krypton, and a quantity of vaporizable material 2, such as sodium. Said electrode 6 consists of a pulverized mixture of barium oxide, strontium oxide and tungsten, pressed and sintered in a rod or bar and having the current lead 5 wrapped therearound and making electrical contact therewith. Said electrodes 6 are heated to an electron emitting, discharge supporting temperature by the discharge incident thereat. Said container 1 has electrode chambers 3 at each end thereof covered with heat insulating material 4, such as asbestos, which reduces the heat losses from each of said electrode chambers 3 to a minimum. A constricted part 11 is provided in the walls of said container 1 contiguous to said electrode chambers 3. A sealed glass tube 7 closed at both ends and having the longitudinal axis thereof coincident with the longitudinal axis of said container 1 is mounted in said container 1 with the ends thereof terminating adjacent said electrode chambers. Said tube 7 tapers down evenly from the middle thereof toward both ends. Said tube 7 is supported in the longitudinal axis of said container 1 by resilient spring members 8 attached thereto and pressing against the inner wall of said container 1. A coiled high resistance wire 9 extends along the longitudinal axis of said tube 7 and the ends 10 of said wire 9 protrude from the ends of said tube 7 toward the adjacent electrode 6. The center of said wire 9 is supported by the wire 13 looped therearound and pressing against the tube 7. Said wire 9 facilitates the starting of the main discharge between said electrodes 6. When desired, the tube 7 is evacuated or filled with an indifferent gas, such as argon.

The electric discharge between said electrodes 6 starts in the gas and the heat of the gas discharge raises the temperature of the sodium 2 to the vaporization temperature thereof. During the operation of the lamp the light emitted thereby is rich in rays characteristic of the sodium vapor and the lamp is a highly efficient source of light useful for purposes of illumination. The lamp is a low voltage, high current arc lamp. The electron emitting electrodes 6 make possible

the use of high current densities in the lamp and the arc discharge therein heats the walls of container 1 to a temperature above the condensation temperature of the metal vapor therein. When desired, the lamp is mounted in a heat conservator, such as a single wall, or double wall evacuated jacket, to reduce the heat losses therefrom to a minimum.

During the operation of the above described lamp the mid-portion of the container 1 is at as high, if not a higher, temperature as the other parts thereof due to the fact that the discharge between said electrodes 6 is constricted at this part and condensation of the metal vapor cannot take place at said mid-portion. This avoids light obstructing deposits of condensed vapor on said mid-portion. The electrode chambers are at a temperature above the condensation temperature of the metal during the operation of the device due to the heating thereof by the electrodes 6, and to the reduction of heat losses therefrom by the insulating material 4. The constriction 11 likewise prevents deposits of condensed vapor in said chambers 3. The coolest part of said container 1 is the region thereof contiguous to the constriction 11 and between said constriction 11 and the center of container 1, but during the operation of the device even this region is above the condensation temperature of the metal vapor.

While I 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 spirit and scope of the invention, for example, indirectly heated thermionic electrodes, such as the Hull electrode, are used in place of the directly heated electrodes 6, when desired, or, when desired, cold, solid electrodes are used, the tapered tube 7 is not hermetically sealed in the case of a low vapor pressure in the tube, when desired, since the vapor particles do not penetrate into small openings at low pressures; a high resistance heater wire connected across the electrodes 6 is mounted in said tube 7 to heat the vapor in the discharge path, and increase the efficiency of the device, when desired.

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

1. A gaseous arc discharge lamp comprising a tubular container, electrodes sealed therein, a gaseous atmosphere therein comprising a metal vapor and a closed tube in said container, a high electrical resistance conductor in said tube the ends of said conductor protruding from said tube and being adjacent said electrodes to facilitate the starting of the discharge therebetween, the longitudinal axis of said tube being in the longitudinal axis of said container and the outside diameter of said tube being less than the inside diameter of said container to permit the passage of the arc discharge between said electrodes.

2. A gaseous arc discharge lamp comprising a tubular container, electrodes sealed therein, a gaseous atmosphere therein comprising a metal vapor and a closed tube in said container, the longitudinal axis of said tube being in the longitudinal axis of said container and the largest outside diameter of said tube being less than the inside diameter of said container to permit the passage of the arc discharge between said electrodes, the mid-portion of said tube being the part of largest outside diameter thereof, the outside diameter of said tube decreasing as the distance from the center thereof increases, the ends of said tube being adjacent said electrodes.

3. A gaseous arc discharge lamp comprising a tubular container, electrodes sealed therein, a gaseous atmosphere therein comprising a difficulty vaporizable metal vapor and a closed tube in said container, the longitudinal axis of said tube being in the longitudinal axis of said container and the largest outside diameter of said tube being less than the inside diameter of said container to permit the passage of the arc discharge between said electrodes, the mid-portion of said tube being the part of largest outside diameter thereof, the outside diameter of said tube decreasing as the distance from the center thereof increases, the ends of said tube being adjacent said electrodes.

4. A gaseous arc discharge lamp comprising a tubular container, electrodes sealed therein, a gaseous atmosphere therein comprising a sodium metal vapor and a closed tube in said container, the longitudinal axis of said tube being in the longitudinal axis of said container and the largest outside diameter of said tube being less than the inside diameter of said container to permit the passage of the arc discharge between said electrodes, the mid-portion of said tube being the part of largest outside diameter thereof, the outside diameter of said tube decreasing as the distance from the center thereof increases, the ends of said tube being adjacent said electrodes.

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