Oct. 13, 1942. J. B. J. M. ABADIE 2,298,581

LUMINESCENT LAMP BULB

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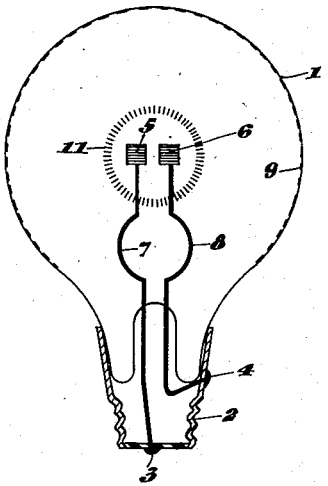

Fig. 1

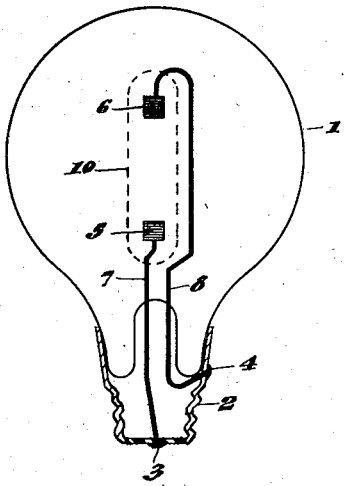

Fig. 2

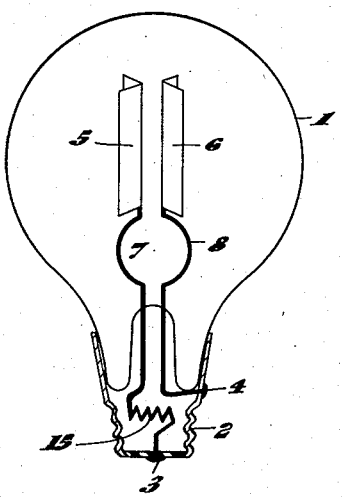

Fig. 4

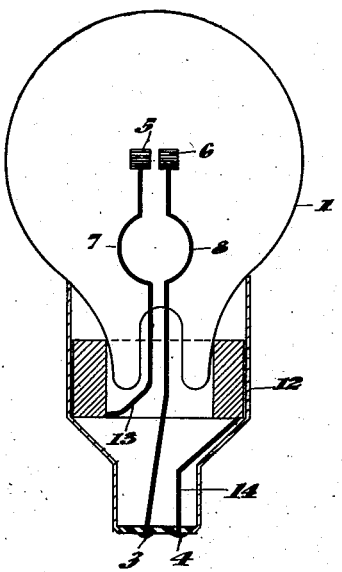

Fig. 3

INVENTOR.

Jean Baptiste Joseph Marcel Abadie

BY

Wood & Wood ATTORNEYS

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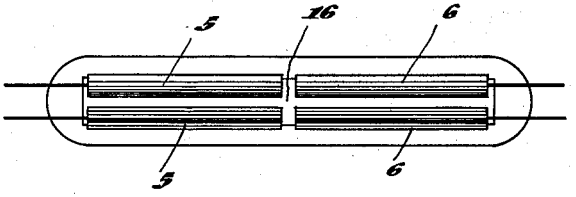

Fig. 5

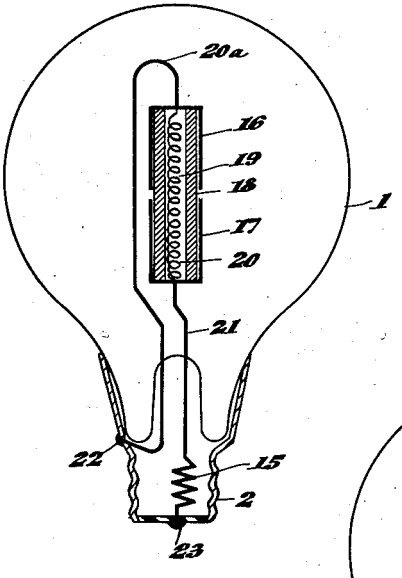

Fig. 6

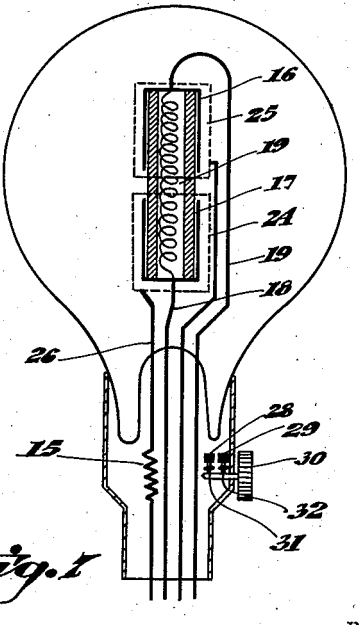

Fig. 7

INVENTOR.

Jean Baptiste Joseph Marcel Abadie

BY

Wood, Wood

ATTORNEYS

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LUMINESCENT LAMP BULB

Jean Baptiste Joseph Marcel Abadie,
Puteaux, France

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4 Claims. (Cl. 176—122)

This invention relates to luminous electric discharge lamps. It is directed particularly to the production of lamps or bulbs which provide illumination through electrical excitation of gases, vapors, or so-called photo luminescent bodies such as sulfides, silicates or tungstenates, as distinguished from the heating of filaments to incandescence.

Prior to the present invention, various luminescent lamps and tubes providing illumination from a positive column have been proposed. However, these devices all have been of elongated or tubular form, with the electrodes spaced substantially apart from one another to permit them to operate. Such tubes produce an elongated luminous positive column when they are energized. Due to the shape of the tubes they are cumbersome and difficult to install in conventional equipment.

The present invention contemplates the production of lamps which are of the typical bulbous spherical or ovoidal form employed in incandescent lamps and bulbs. One of the primary objectives of the inventor has been to provide such lamps, capable of being operated when the electrodes are spaced relatively closely together as in a lamp of bulbous form. The objective, in other words, has been to provide luminous discharge lamps which are of the same general spherical shape as the present day incandescent lamp, and suitable for use in place of them, with greater efficiency of operation. These bulbs are filled with gas or gases, or admixtures of gas and metallic vapors. They contain electrodes capable of emitting ionic discharges for ionizing the gases.

The interest of this invention is that it presents all of the characteristics of new products, for its essential characteristics result, in its production in the form and in the appearance of lamps to which the user is thoroughly accustomed, in its operation by the application of the phenomena of luminescence, while at the same time the essential difficulty from the point of view of application, of the negative characteristic of a luminescent tube, is obviated.

The present invention, briefly, is predicated upon the concept of spacing the electrodes relatively closely adjacent one another, that is, sufficiently close so that they may be arranged within a bulb of the type used for conventional incandescent lamps. However, the pressure of the filling gas is controlled so that the tubes display a positive resistance characteristic instead of a negative resistance characteristic when energy is applied to the electrodes. Otherwise expressed, the position of the electrodes relative to one another and the pressure of the filling gas within the tube are so corelated that the positive resistance characteristic is displayed by the tube. When the electrodes are energized a spherical or bulbous luminous field is established. The radiations of this field may be exerted upon photo luminescent bodies incorporated in the lamp for increasing the intensity of illumination.

Various typical embodiments of the lamps of the present invention are shown in the accompanying drawings in which:

Figure 1 illustrates a typical bulb of spherical shape containing a pair of electrodes spaced side by side.

Figure 2 illustrates a lamp similar to Figure 1 but containing a pair of electrodes spaced relatively opposite one another in the lamp.

Figures 3 and 4 illustrate further modifications of the lamp of Figure 1.

Figure 5 illustrates a still further modification of the particular form of the electrodes.

Figure 6 shows a lamp similar to Figure 1 but adapted for use with thermo emissive electrodes.

Figure 7 shows a further modification of a lamp similar to Figure 6.

The lamp of Figure 1 is comprised of a transparent bulb 1 containing a receptacle plug 2. The bulb and the plug are of the type conventionally used in incandescent lamps, the plug containing appropriately insulated electrical contacts 3 and 4 through which energy is supplied to the lamp.

Within the bulb a pair of electrodes 5 and 6 are provided. These electrodes are spaced adjacent one another and are connected, through the leads 7 and 8 respectively, to the terminals 3 and 4 of the cap 2. A lining 9 of suitable photo luminescent material may be installed upon the interior of the bulb as shown by the dotted line. Alternatively, a fabric or mantle of gauze material containing photo sensitive bodies may be installed within the bulb.

The electrodes 2 are of the emissive type, and the filling gas for the bulb may be comprised of rare gases and metallic vapors as, for instance, mercury vapor. For example, the bulb may be filled with argon at a pressure of approximately 7 millimeters of mercury, or may be filled with neon at a pressure of approximately 2 millimeters of mercury. Under such conditions the lamp may be illuminated spontaneously upon the application of approximately 115 volts to the electrodes.

Once the electrodes reach emissive condition the lamp operates upon a voltage of approxi-

mately 10 to 25 volts. The original voltage of 115 volts may be termed, for convenience, the "starting" or "striking" voltage, and the latter may be termed the "cruising" voltage. The magnitude of the cruising voltage will vary with the nature of the metallic vapor and the nature of the filling gas, as well as the pressure.

The lamp illustrated in Figure 2 is similar to the lamp in Figure 1, with the exception that the electrodes 5 and 6 are spaced opposite one another and are housed within a mantle 10. This mantle may be of the type of a typical Welsbach or Auer mantle, with the exception that the mantle contains photo luminescent bodies, such as complex silicates, zinc, cadmium, beryllium, and calcium tungstenates, sulfides, or the like, in the manner understood by those skilled in the art.

When the electrodes are brought to emissive state an arc intermediate the electrodes 5 and 6 is established. In Figure 1 this arc is illustrated at 11 as a luminous spherical field surrounding the electrodes. This field is imposed upon the photo luminescent bodies in the layer 9. The photo sensitive bodies are excited and their luminosity is superimposed upon the luminosity of the field itself.

The photo luminescent bodies contained in the mantle 10 of Figure 2 reside in the trajectory of the ions travelling from one electrode to the other; increase in the intensity of the light radiations is accomplished in this manner.

In the production of the lamps of the type shown in Figure 2 it is preferred to employ helium as the filling gas, since helium provides a high potential gradient which will accommodate an increase in the voltage drop between the two electrodes. The increased voltage drop effects an increase in the luminous energy given from the lamp.

For the purpose of controlling the relatively low cruising voltage of the lamps shown in Figures 1 and 2 either a choke or capacity may be used. The use of a choke is illustrated in Figure 3, the choke being of annular form and being housed within cap 12. One terminal of the choke is connected through lead 13 to one of the electrodes 5; the remaining terminal of the choke is connected through lead 14 to a connector 4 carried on the cap. Electrode 6 is connected to the other cap terminal 3. The choke preferably surrounds the base of the bulb.

The use of surface type electrodes in the tubes of the present invention is shown in Figure 4. These electrodes may be of plate-like or angle shape in cross section and are oppositely disposed adjacent one another.

A higher cathodic drop of potential is encountered when surface electrodes are utilized. For controlling this drop a resistance 15 may be housed and concealed within the base of the lamp. This resistance is adjusted so that the magnitude of it is sufficient to assure the stability of the operation of the lamp with cold cathode electrodes. Electrodes other than the forms shown also may be used.

The photo luminescent bodies employed in tubes of the type shown in Figure 4 may be comprised of complex silicates of zinc, cadmium, beryllium, calcium and tungstenates, and the like. When argon is used as a filling gas with traces of mercury, the pressure may be as high as 1 c/m. Under such instances, a white light is produced, having a spectrum very similar to that of sunlight. It is preferred that the filling gas be such that its maximum emission of ultra-violet light will correspond and complement the ultra-violet radiations of the photo luminescent bodies which the lamp may contain, in order that these materials will be excited to the best advantage.

According to the modification shown in Figure 5, the electrodes 5—5 and 6—6 are supported upon an insulating or refractory tube 16. This tube contains a metallic coating applied either in the form of thin metallic leaf, or by electrolysis, or by metallization. The electrodes 5—6 are cupped to fit the insulating tube and are preferably treated with a barium salt and are cleared in the tube by heating them by a high frequency inductance or by high voltage over the period of time during which the tube is being pumped out.

The foregoing parts of the present description illustrate the employment of cold cathodes. When the electrodes are cold, there is loss of energy in the electrodes themselves. This loss of energy may be avoided by heating the electrodes. Figures 6 and 7 show structures employing this general principle.

The tube of Figure 6 is comprised of a bulb having a cap and containing a filling gas, constructed in accordance with the description concerning Figure 1. However, the tube of Figure 6 comprises a pair of electrodes 16 and 17. These are in the form of metallic caps. The electrodes are coated with alkaline salts or alkaline earth salts, or combinations of them. For instance, the electrodes 16 and 17 may be comprised of nickel cup-shaped elements coated with barium salts.

The cup electrodes 16 and 17 are disposed opposite to one another, and refractory tube 18 is inserted in between them. This tube contains a bore 19, within which a resistance heating element 20 is buried. The resistance is connected to the two cap electrodes 16 and 17, so that when the electrodes are energized the resistance becomes heated, and the elevation of the temperature provokes emission of electrons from the electrodes.

The electrodes 16 and 17 are connected through leads 20*a* and 21 respectively, to terminals 22 and 23 of a cap 2, with which the bulb is provided. Within the cap a resistance 15 is installed in series with one of the leads 20 or 21. This resistance may be comprised of a tungsten wire buried in a vitrified mass of material, so that it is capable of limiting the formation of an arc within the tube by virtue of the increases in the resistivity of it as its temperature is increased.

As previously stated, the pressure of the filling gas is corelated to the spacing of the electrodes, so that the voltage drop between the electrodes 1 and 2 is increased—that is, pressure of the filling gas is much below that which would correspond to a minimum voltage drop between the two electrodes.

By virtue of the low pressure, the trajectories followed by the ions and the electrons do not follow straight lines between the two electrodes, but deviate therefrom. The arrangement permits the whole volume of the bulb to become filled with luminous emission. If the inside of a tube such as that shown in Figure 6 contains photo luminescent bodies, these bodies will then be subjected to the direct action of electronic and ionic friction. Therefore, an effect is obtained of superimposing upon the photo luminescence the cathode luminescence estab-

lished by the electrodes. Such tubes may be constructed so that the voltage drop across the electrodes is approximately equivalent to the distribution system voltage, and the loss through the resistance 15 carried in the cap of the tube becomes negligible.

When the pressure of the filling gas is very low, the intensity of the emission of short-wave length radiations is increased at the expense of the emission of long-wave length radiations. If traces of mercury vapor are to be added to the rare gas filling of the tube without increasing the pressure of the mercury vapor to such an extent that a lowering of the voltage drop between the electrodes is encountered, the mercury may be introduced in the form of an alloy with cadmium or similar metal which will exert a retention effect upon the absolute value of the tension of the mercury vapor.

The lamp of Figure 6 may contain mantles of the type shown in Figure 2, if desired. In general, it is recommended that the irradiated photo luminescent surface, based upon the power of the lamp, should average approximately 5 to 20 centimeters per watt.

The electrodes shown in Figure 6 may be spaced side by side, if desired, as shown in Figure 1, or positioned in the similar manner shown in Figure 2.

Grids of the type commonly employed in Thyratron valves also may be employed in the bulbs, as shown in Figure 7. The grids are indicated at 24 and 25. One of the grids is connected in series with a resistance 15, as shown in Figure 6, through a lead 26. The other grid 23 is energized through a lead 27. The leads to the electrodes 16 and 17 are shown at 18 and 19 respectively. The grids may be controlled by small resistance connected in series with two small capacities 28 and 29, set in the cap of the lamp. A ridge screw 30, controlling two small condensers 31 and 32, connected in series with the capacities 28 and 29, is employed for modification of the luminous energy discharged from the lamp. In other words, the intensity of lumination from a lamp constructed according to the invention may be varied at will without modification of the nature of the light obtained. When the grids are employed, it will suffice that the average path of the electrons (which depends upon the gas or metallic vapor pressure) be greater than the diameter of the meshes or the holes in the command grids.

Having described my invention, I claim:

1. A luminescent gaseous discharge lamp comprised of a bulb, a pair of cup shaped electrodes within the bulb disposed relatively opposite to one another, an insulator disposed intermediate the electrodes and extending within the said electrode cups, a heating element disposed within the insulator for heating the electrodes, said heating element being connected to the bottoms of said electrode cups respectively, and connector means for supplying energy to said electrodes, one of said connectors containing a resistance member.

2. A luminescent gaseous discharge lamp comprised of a bulb, a pair of electrodes within the bulb and comprised of cup shaped elements, a tubular insulator disposed intermediate the cup shaped electrode elements and having endwise portions residing in said electrode cups, and a heating resistance disposed within the tubular insulator and having its ends respectively connected to the bottoms of the said electrode cups.

3. A luminescent gaseous discharge lamp comprised of a bulb, a pair of cup shaped electrodes facing one another disposed within said bulb, an electrical heating resistance interconnecting the bottoms of said cup shaped electrodes, and disposed therebetween to heat the electrodes when they are energized, a cap adapted to be inserted in an electrified receptacle and having terminal connectors for supplying energy from the receptacle to the electrodes, and a controlling device selected from the group consisting of an impedance connected in series with the electrodes and installed within said cap.

4. A luminescent gaseous discharge device comprised of a bulb, a hollow cup-shaped electrode, a second hollow cup-shaped electrode oppositely arranged with respect to the first with the hollow portions of the cups in aligned relationship, a tubular element of refractory material having its respective end portions seated within the cups, connection wires extending through the bulb into respective electrical connection, with said electrodes and a resistance heater located within said tubular element and having its ends respectively connected with said electrodes at the bottoms of the cup portions thereof.

JEAN BAPTISTE JOSEPH MARCEL ABADIE.