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[33] **France**

[31] **159,213**

[54] **DISCHARGE LAMP HAVING VAPOR PRESSURE**
CONTROL MEANS
9 Claims, 8 Drawing Figs.

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313/109

[51] Int. Cl. **H01j 17/26,**
H01j 61/24

[50] Field of Search. **313/109,**
174, 151; 206/0.4; 315/108

[56]

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ABSTRACT: A device for use with fluorescent lamps, including a mercury and metal amalgam disposed on a bimetallic element, said element being attached to a supporting member which is resiliently mounted against the lamp wall. The device is so placed inside the tube that the amalgam is moved towards a colder area of the tube as the tube heats, thereby providing substantially constant pressure and luminous flux output over a wide temperature range.

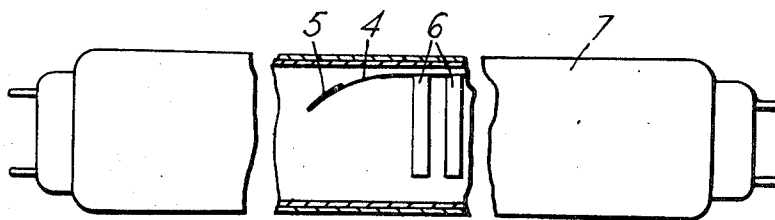
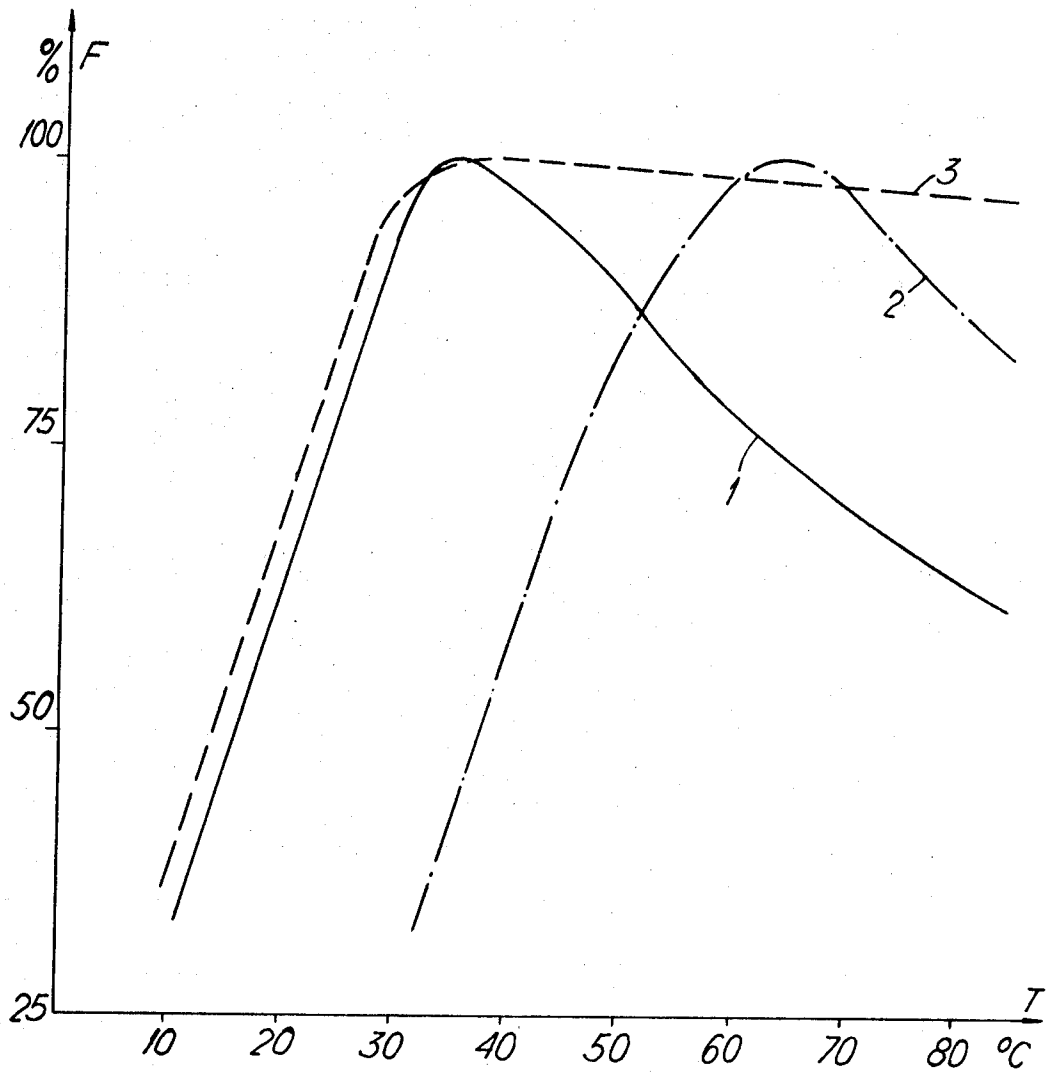


Fig. 1

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Fig. 2

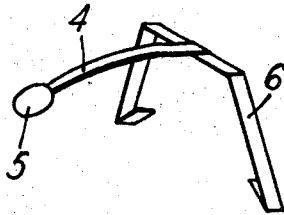


Fig. 3

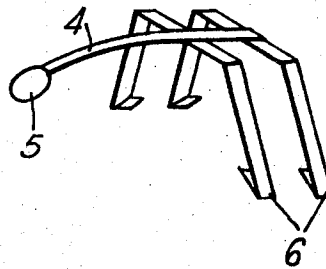


Fig. 4

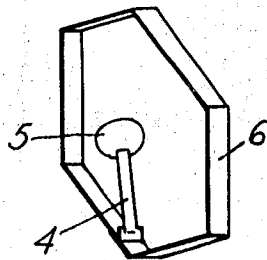
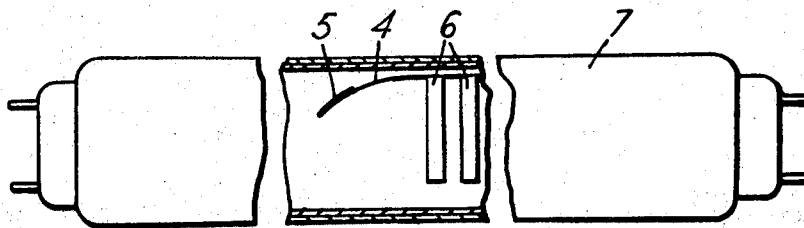


Fig. 5



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Fig. 6.

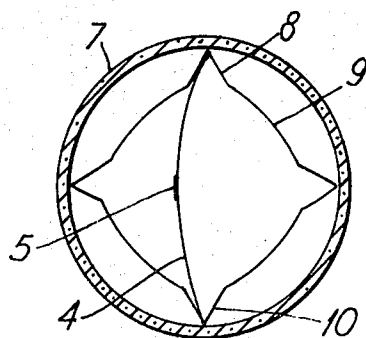


Fig. 7.

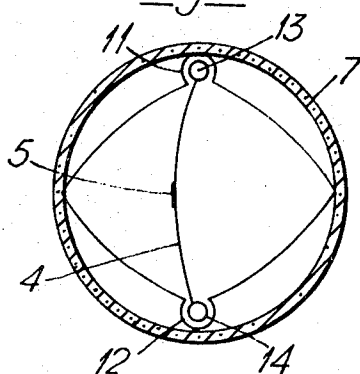
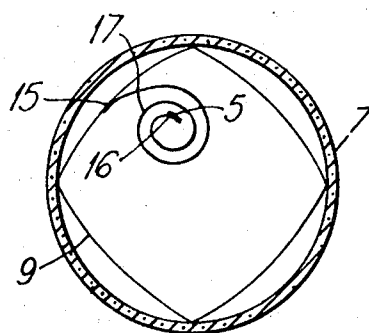


Fig. 8.



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DISCHARGE LAMP HAVING VAPOR PRESSURE CONTROL MEANS

BACKGROUND OF THE INVENTION

The present invention relates to improvements in low-pressure mercury vapor discharge lamps, and more particularly to means for maintaining constant the mercury vapor pressure within a wide range of temperatures.

It is known in the art that in a low-pressure mercury vapor discharge tube the luminescent product deposited on the internal surface of the tube is excited by the resonant radiation of mercury to provide the luminous emission. This resonant radiation has its maximum value for a mercury vapor pressure ranging between 5×10^{-3} - 2 Torr. The pressure varies with the temperature and the aforementioned values are obtained in a classical fluorescent tube for a tube wall temperature of approximately 40° C.

When, due to the variation of the ambient temperature and/or to a change in the output power of the tube, the temperature of the wall varies on either side of the optimum temperature, the mercury vapor pressure also varies, and therefore the efficiency of the resonant radiation decreases. The same is true of the luminous efficiency of the tube and thus also for the luminous flux supplied by the tube.

In order to enable operation of the tube at temperatures and/or other output powers than those of maximum efficiency for a classical fluorescent tube, it is known in the prior art to introduce into the tube an amalgam, based for example on indium or cadmium combined with mercury. Depending on the composition of this amalgam, and depending on the temperature of which it is brought due to its position in the tube, the optimum operating temperature of the tube is shifted.

SUMMARY OF THE INVENTION

An object of the present invention is therefore to provide a device for use with a low-pressure mercury vapor discharge tube so that the luminous flux of the tube remains substantially constant over a wide temperature range.

It is a further object of the present invention to provide a device for use with a low-pressure mercury vapor discharge tube so that the optimum operational pressure is reached rapidly after the ignition of the tube.

According to the present invention there is provided, inside a low-pressure mercury vapor discharge tube, an amalgam disposed on an element, the shape of the element varying with temperature, so that the amalgam moves towards the colder regions of the lamp when the temperature increases.

It is a feature of this invention to connect said element to a support member which is in contact with the tube wall so as to maintain the position of the amalgam and element within the tube.

Further objects and features of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 represents curves indicating the variation of the luminous flux output of a fluorescent tube with temperature;

FIGS. 2, 3 and 4 represent preferred embodiments of the device according to the present invention;

FIG. 5 is a view of the position of the device of FIG. 3 inside a discharge tube; and

FIGS. 6, 7 and 8 represent additional preferred embodiments of the inventive device located inside discharge tubes.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The curve of FIG. 1 represents the relative variation of the luminous flux F of a low-pressure mercury vapor discharge tube with the temperature T of the tube, that is, with the temperature of the wall of the tube. This curve shows that the tube provides 90 percent of the maximum flux for wall temperatures ranging between 29° and 48° C.

As has been previously mentioned, when it is required to operate the tube at higher temperatures, an amalgam which can be based on indium or cadmium is introduced into the tube. In the usual method of manufacture of a fluorescent tube, the mercury and the metal which constitutes the base of the amalgam are generally introduced separately, the amalgam being formed afterwards. By using amalgams of differing compositions and/or by varying the temperatures of the amalgam by changing the position of the amalgam in the tube, luminous flux curves which are similar to curve 1 of FIG. 1 are obtained, but the curves are shifted along the temperature axis as shown by the dashed line curve 2 and FIG. 1. In this manner tubes having different optimum temperatures are obtained.

It will be observed that in a tube with amalgam, the pressure is imposed by the temperature of the amalgam, whereas in a tube with only mercury, the pressure is imposed by the temperature of the coldest point of the tube, that is, the temperature of the tube wall. Therefore, the amalgam must be at a temperature such that the pressure it imposes due to its temperature should be lower than the pressure provided by mercury alone. If this were not the case, the mercury would distill toward the wall and the tube would behave in the same way as a tube using mercury alone.

As previously stated, this invention proposes the changing of the position of the amalgam inside the tube, the relation to the temperature of said tube, the change of position being such that the amalgam moves towards colder regions, that is, toward the walls of the tube while the tube is being heated.

FIG. 2 shows one preferred embodiment of a device which fulfills the object of the present invention. The device is composed of a bimetallic strip 4 one end of which is fixed to a support or clip 6, while an amalgam 5 is fixed to the other end of the strip 4. The clip 6 may comprise a metallic strip bent in several places, the elasticity of which enables both the folding over of itself so as to facilitate the introduction of the clip into the tube and also allows the clip to rest against the walls of the tube so as to maintain the clip and bimetallic strip 4 in place within the tube regardless of the tube position. Further, the clip 6 assures a thermal contact with the wall. If the rigidity of the device obtained by means of the single clip 6 is not sufficient, provision can be made for the use of a second clip as shown in FIG. 3.

FIG. 4 represents another embodiment of the clip 6 which is in the shape of a closed polygon.

FIG. 5 represents the position in the tube 7 of the subject invention, in particular, the embodiment shown in FIG. 3. Although the device, in particular the amalgam, is shown located at the midpoint of the longitudinal axis of the tube, that is, between the discharge electrodes at the ends of the tube, it is to be understood it may be located anywhere within the tube where the results are optimum.

It is possible to use the same amalgam in either a classical tube or in a tube known as a "high-output power" tube of the same length, by varying the length of the bimetallic strip. The bimetallic strip will be longer in the case of a "high-output power" tube than in a classical tube, since the difference in temperatures between the discharge axis and the wall is more important in a "high-output power" tube than in a classical tube.

FIG. 6 represents a cross section of a discharge tube 7 in which is located a device embodying the features of the present invention. This device consists of a bimetallic element 4, or any dilatable element, on which is disposed the amalgam 5. The ends of the element 4 are arranged in two notches 8 and 10 of a support member 9, the support resting against the wall of the tube 7. The support 11 may comprise an elastic metallic strip bent in the shape of a square, the apexes of which constitute notches such as those referenced 8 and 10.

It will be understood by those skilled in the art that the length of the dilatation element 4 must be such that it remains in the notches at the lowest temperature that the tube experiences during the time that the tube is off. It will also be understood that the notches 8 and 10 and the ends of the dilata-

ble element must be joined in such a way that neither end can escape from its notch when the temperature of the tube increases, thereby increasing the camber of the dilatable element 4, especially when the camber becomes equal to the radius of the tube. For this purpose the notches and dilatable element may be arranged as shown in FIG. 7, where discs or cylinders 13 and 14 are connected to the ends of the dilatable element 4. The discs or cylinders are fitted into notches 11 and 12 which have a circular cross section in such a way as to prevent the escape of either end of the dilatable element 4 when the camber of said element increases. The notches 8 and 10 of FIG. 6 and 11 and 12 of FIG. 7 are also shaped, obviously, to prevent the escape of the dilatable element when the tube is in a vertical position. Although the notches shown in FIGS. 6 and 7 are diametrically opposed, the relative positions of the two notches may be in any relation desired. Further, although the amalgam is preferably disposed in the middle of the dilatable elements so that it may have maximum displacement, it may also be disposed at any other point on the dilatable element if a particular adjustment is desired.

Although FIGS. 2, 3, 4, 6 and 7 have shown an element, the shape of which varies with temperature, configured as a bimetallic strip, elements in other configurations which are distorted by temperature variations may be used. Thus, FIG. 8 illustrates a tube 7 in which a spiral 17 comprising a bimetallic strip is utilized, the spiral 17 being connected to a support 9 which rests against the wall of the tube. End 16 of the spiral 17 is free and has disposed thereon the amalgam 5. The other end of the spiral 17, end 15, is fixed to said support 9. As in the previously discussed embodiments, the displacement of the end 16 must be such that the amalgam approaches the wall of the tube as the temperature increases.

Utilization of the inventive device in conjunction with a fluorescent tube will result in a temperature versus luminous flux curve such as that shown by the dashed line curve 3 of FIG. 1. From this curve it is seen that at least 90 percent of the maximum flux output is provided over a much greater temperature range than heretofore realizable. The devices embodying the subject invention which are illustrated in FIGS. 2, 3, 4, 5, 6, 7 and 8, further improve the performance of a fluorescent tube in that they provide quick mercurization during the ignition of the tube. This is due to the fact that when the tube is ignited the amalgam is close to the discharge axis and therefore heats more quickly than it would in a tube comprising an amalgam fixed to the tube. This causes the mercury to vaporize more quickly than it would if the amalgam were fixed to the tube and therefore the optimum mercury vapor pres-

sure is reached more quickly.

To instruct those who wish to use the device embodying the subject invention with classical fluorescent tubes it is noted that the device is usually introduced into the tube after the powdering and reburning process, well known in the fluorescent tube art, is completed. The mercury is introduced in the conventional way in the form of a liquid drop, the weight of which depends on the length of the tube and the range of temperatures under which it is desired that the tube operate.

We claim:

1. In a low-pressure mercury vapor discharge lamp including an elongated envelope having a longitudinal axis, a pair of electrodes sealed at opposite ends of said envelope, and a mercury and metal amalgam within said envelope, the improvement comprising control means, located within said envelope and intermediate said electrodes, for moving said amalgam away from said longitudinal axis when said lamp is ignited and toward a colder area of said envelope in response to temperature variations as said lamp is heated, said means including a bimetallic element, said amalgam being disposed on and directly fixed to said element.

2. In a discharge lamp according to claim 1, further comprising a supporting member, at least one end of said bimetallic element being connected to said member, and said member being resiliently mounted against and in contact with the envelope of said lamp.

3. In a discharge lamp according to claim 3, wherein said element is in the shape of a strip.

4. In a discharge lamp according to claim 3, wherein said element is in the shape of a spiral.

5. In a discharge lamp according to claim 4, wherein said member is formed with notches therein and the ends of said strip are disposed within said notches.

6. In a discharge lamp according to claim 3, wherein said supporting member comprises a metallic strip bent in several places.

7. In a discharge lamp according to claim 3, wherein said supporting member comprises a metallic strip in the shape of a closed polygon.

8. In a discharge lamp according to claim 6, wherein said supporting member is in the shape of a square, said notches being formed at at least two of the corners of said square.

9. In a discharge lamp according to claim 5, wherein said supporting member is in the shape of a square and wherein one end of said spiral element is connected to one side of said square.

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