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DISCHARGE LAMP HAVING HEAT REFLECTING SHIELDS
SURROUNDING ITS ELECTRODES
Filed May 19, 1964

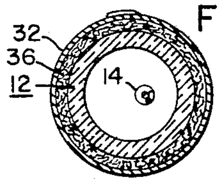

Fig.2.

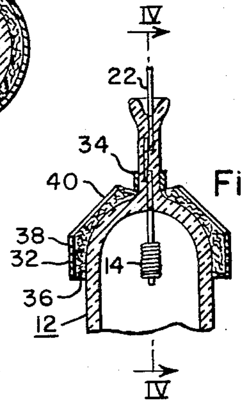

Fig.3.

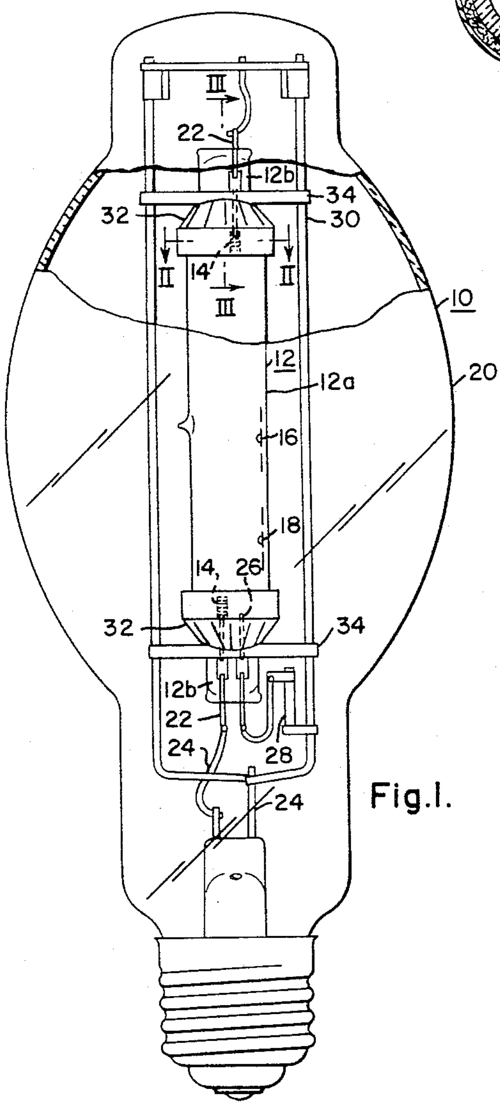

Fig.1.

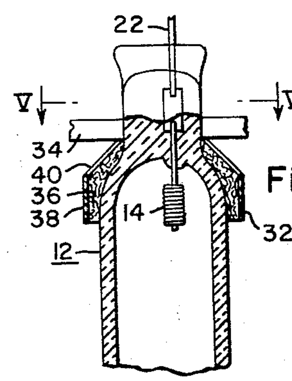

Fig.4.

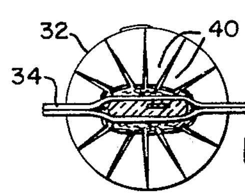

Fig.5.

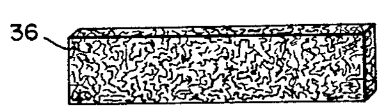

Fig.6.

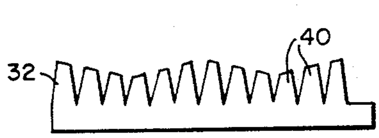

Fig.7.

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DISCHARGE LAMP HAVING HEAT REFLECTING SHIELDS SURROUNDING ITS ELECTRODES

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ABSTRACT OF THE DISCLOSURE

An arc tube for a discharge lamp of the mercury-metallic iodide additive type has special metal caps carried over the arc tube end portions to act as heat traps. Each end cap has a portion bent into a ring-like form which fits about an end portion of the arc tube. Another portion of each end cap is formed as a series of adjacent, generally trapezoidal-shaped members connecting at their bases to the ring-like end cap portion, and the trapezoidal-shaped members are bent proximate their bases to conform to and cover over an end of the arc tube. A mat of refractory material is packed between each end cap and the portion of the arc tube which is covered by each end cap.

This invention relates to discharge devices and, more particularly, to high-pressure, vapor-discharge lamps of the so-called additive type.

It is known to modify high-pressure, mercury-vapor discharge lamps by including additive materials, and particularly selected metallic iodides, in the arc tubes. In the operation of such devices, the mercury, which is fully vaporized, usually establishes the proper loading or voltage drop across the lamp and the additive iodides improve the color and luminous output of the discharge. Such so-called additive lamps are generally disclosed in Illuminating Engineering Society, Paper 29, entitled "Higher Efficiency Light Source Through the Use of Additives to Mercury Discharge," September 1962.

In order for such additive-type discharge devices to operate properly, it is necessary that the additive material be heated during operation to a high temperature so that it will have a relatively high vapor pressure. The vapor pressure of such additive material is normally controlled by the coolest portion of the arc tube, and this coolest portion will frequently occur at an end of the lamp, particularly when the arc tube is operated in a vertical position. It is also desirable to be able to efficiently operate such additive lamps in any position.

It is the general object of this invention to provide a high-pressure, vapor-discharge lamp of the so-called additive type which operates with improved efficiency.

It is another object to provide a vapor-discharge lamp of the additive type wherein the cooler portions of the arc tube are heated in order to increase the vapor pressure of the additive material.

It is a further object to provide an additive-type discharge device which can be operated in any position without sacrificing efficiency.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by positioning a refractory metallic retaining cap over each end of the arc tube, with each metallic retaining cap extending from each arc tube end and along the arc tube body a distance sufficient to overlap substantially all portions of the electrode which is positioned proximate that respective end of the arc tube. Between each metallic retaining cap and the arc tube is packed a refractory fibrous material mat, with the material of which the mat is formed being non-gas-emitting, inert and non-reactive with respect to the arc tube and the metallic end caps at the operating temperatures of the arc tube. As a result, the heat which is generated proximate each electrode during operation of the device is entrapped at the ends of the arc tube, in order to inhibit condensation of the additive material filling at the end portions of the arc tube. As a result, the operation of the device is improved.

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For a better understanding of the invention, reference should be had to the accompanying drawing wherein:

FIGURE 1 is an elevational view, partly in section, of a completed additive-type, high-pressure discharge lamp, with portions of the outer envelope broken away to show an end cap in detail;

FIG. 2 is an enlarged cross sectional view taken on the line II—II in FIG. 1;

FIG. 3 is a fragmentary, enlarged sectional view taken on the line III—III in FIG. 1 showing construction details of an end cap;

FIG. 4 is an enlarged sectional view taken on the line IV—IV in FIG. 3, showing details for the mounting of an end cap;

FIG. 5 is a sectional view taken on the line V—V in FIG. 4 illustrating a top plan view of an end cap;

FIG. 6 illustrates a refractory fiberous mat as is used for insulation between the end cap and the arc tube; and

FIG. 7 is a stamping showing one embodiment of an end cap before it is formed around an end portion of the arc tube.

With specific reference to the form of the invention illustrated in the drawing, the lamp **10** in FIG. 1 is generally similar in construction to the usual high-pressure, mercury-vapor (HPMV) lamp, such as described in U.S. Patent No. 2,748,303, dated May 29, 1956 to Thorington, with the arc tube modified somewhat as described in detail hereinafter. The lamp **10** generally comprises a radiation-transmitting, sealed inner envelope or arc tube **12** of quartz, polycrystalline alumina, or other suitable material, having operating electrodes **14** disposed proximate either end thereof and operable to sustain a vapor discharge therebetween. A charge of mercury **16** and a small amount of inert, ionizable starting gas, such as argon, are contained within the arc tube **12**. The charge of mercury is present in predetermined amounts so that when the mercury is fully vaporized during operation of the lamp, the proper voltage drop across the lamp and the power input to the lamp will be realized.

As a specific example 117 mg. of mercury are included in the arc tube **12** which has a volume of 23.5 cc., a spacing between electrodes of 62 mm., and an argon filling at a pressure of 20–25 mm. Hg. Additive materials **18** which can be included in the arc tube include thallium iodide, sodium iodide and indium iodide, and other metallic iodides, chlorides or bromides can be used to supplement or replace these indicated additive materials, in order to obtain different discharge characteristics. As a specific example, thallium iodide can be included within the arc tube **12** in amount of 0.3 milligram per cc. of total volume enclosed by the arc tube and sodium iodide can be included in amount of one milligram per cc. of volume enclosed by the arc tube. A small amount of additional thallium metal can also be included in the arc tube, if desired. The arc tube has a main body portion **12*a*** of generally uniform diameter and is closed at each end by a flattened seal **12*b***. The arc tube is designed to operate with a power input of 400 watts.

A radiation-transmitting, sealed outer envelope **20** is spaced from and surrounds the arc tube **12**, and the arc tube electrodes **14** connect to lead-in conductors **22** which are sealed through the ends of the arc tube. Additional lead-in connections **24** sealed through the outer envelope **20** are electrically connected to the arc tube lead-in conductors **22** and serve to connect the operating electrodes **14** to a conventional power source (not shown).

A conventional starting electrode **26** is also included within the arc tube **12** and connects through a conventional starting resistor **28** to one of the lead-in connectors **24**. The arc tube **12** is supported within the outer envelope **20** by a conventional supporting frame **30**.

In accordance with the present invention, and as clearly shown in FIGS. 1 through 5, a refractory metallic retaining cap **32** is supported by a transverse supporting strap **34** over each closed end of the arc tube **12**. Each metallic retaining cap **32**, which is formed of nickel plated steel for example, extends from an arc tube sealed end **12*b*** and along the arc tube body **12*a*** a distance sufficient to overlap substantially all portions of the respective electrode **14** which is positioned proximate the same end of the arc tube **12**. The overlapping positioning of the end cap **32** is shown more clearly in FIGS. 3 and 4.

Between each end cap **32** and those portions of the arc tube **12** which are covered by the end caps **32** is a tightly packed, refractory, fibrous material mat **36**, shown in unwrapped form in FIG. 6. The mat **36** is formed of material which is non-gas-emitting, inert and non-reactive with respect to the arc tube **12** and the metallic end caps **32** at the operating temperatures of the arc tube. As a specific example, the mats **36** are formed of aluminum silicate fiber or quartz wool, and other suitable material can be substituted therefor. In operation of the device, the end caps **32** and tightly packed mat **36** entrap heat generated proximate each of the electrodes **14** during operation of the device **10**, in order to inhibit condensation of the additive discharge-sustaining filling at the arc tube ends.

In one form of the invention, and as shown more clearly in FIGS. 3, 4, 5 and 7, the end caps **32** are supported in position by the transverse arc tube retaining straps **34**. Each metallic end cap **32** comprises a first end cap portion **38** having a generally ring-like configuration and encircling a portion of the body of the arc tube. A second end cap portion generally conforms to an end of the arc tube and is formed as a series of adjacent, generally trapezoidal-shaped members **40**. The members **40** are connected at their respective bases to the ring-like end cap portion **38** and each of the trapezoidal-shaped members **40** are bent proximate their base to generally conform to and cover over an end of the arc tube. While the end caps **32** could be formed as a continuous member, it is preferable to form them as a strip of metal, such as is shown in FIG. 7, which strip of metal is bent to conform to the arc tube **12** and overlap itself.

In the operation of the additive-type discharge devices which incorporate the foregoing end caps **32** and mat **36** of refractory insulation, there is substantially no tendency for any condensation of additive discharge-sustaining material at the ends of the arc tube, irrespective of the operating position of the arc tube. This accordingly increases the vapor pressure of the additive discharge-sustaining material so that the lamps operate with improved efficiency.

It will be recognized that the objects of the invention have been achieved by providing an additive-type discharge lamp which operates with improved efficiency wherein the coolest portions of the arc tube are heated. In addition, the discharge device can be operated in any position without sacrificing efficiency.

While a best embodiment of the invention has been

illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

We claim:

1. In combination with a high-pressure arc-discharge device comprising, an elongated light-transmitting refractory arc tube having a main body of generally uniform diameter and closed at each end by a seal, said arc tube enclosing a predetermined charge of selected discharge-sustaining substance which is required to be maintained at a high tmperature for proper operation of said device, electrodes operatively disposed within said arc tube proximate each end thereof and electrically connecting to lead-in conductors sealed through said arc tube seals, a light-transmitting outer envelope enclosing said arc tube, arc tube support means within said outer envelope for engaging and supporting said arc tube proximate the end seals thereof, and additional lead-in connections electrically connected to said arc tube lead-in conductors and sealed through said outer envelope for electrically energizing said arc tube, the improvement which comprises:
   (a) a refractory metallic retaining end cap over each closed end of said arc tube, each said metallic end cap extending from an arc tube end and along the arc tube body a distance sufficient to overlap substantially all portions of the said electrode which is positioned proximate the same end of said arc tube to entrap heat generated proximate each said electrode during operation of said device, each said metallic end cap comprising a first portion having a generally ring-like configuration and encircling a portion of the body of said arc tube and a second portion formed as a series of adjacent generally trapezoidal-shaped members connected at their bases to said ring-like first portion and bent proximate their bases to generally conform to and cover over an end of said arc tube; and
   (b) a refractory fibrous material mat tightly packed between each said end cap and those portions of said arc tube which are covered by said end caps, and each said refractory mat being non-gas-emitting, inert and non-reactive with respect to said arc tube and said metallic end caps at the operating temperatures of said arc tube; whereby during operation of said device each end portion of said arc tube comprises an effective heat trap to inhibit condensation of discharge-sustaining filling at the end portions of said arc tube.

2. The discharge device as specified in claim 1, wherein each said metallic end cap comprises a strip of metal bent to conform to said tube and overlapping itself at its ends.

3. The discharge device as specified in claim 1, wherein each said refractory mat is formed of aluminum silicate fiber or quartz wool.

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