

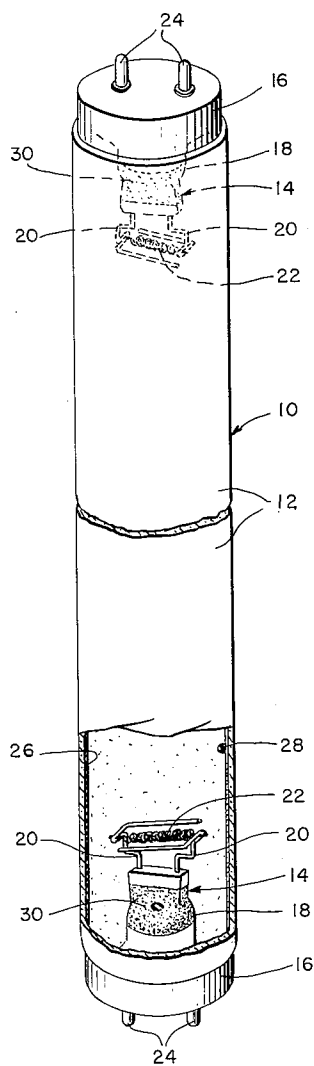
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GASEOUS DISCHARGE DEVICE AND METHOD

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GASEOUS DISCHARGE DEVICE AND METHOD
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This invention relates to discharge devices and, more particularly, to a fluorescent lamp having improved light output as well as improved maintenance of light output and a method for improving the output and maintenance of output of such devices.

The maintenance of output of low-pressure discharge devices such as fluorescent lamps (called lumen maintenance) is an important factor in measuring their performance. In actual practice, the light output of a fluorescent lamp is measured at 100-hours operation since the performance during the first 100 hours is apt to vary somewhat from lamp to lamp. In the usual fluorescent lamp, the light output decreases something in the order of 4% to 5% during the first 100 hours of operation and after 500 hours of operation, the light output of an average lamp will have dropped approximately 7% to 8% from the zero-hour output. Thereafter the light output drops off or decreases at a slower rate.

It is the general object of this invention to avoid and overcome the foregoing and other difficulties of and objections to prior-art practices by the provision of a low-pressure discharge device having improved output and maintenance.

It is another object to provide a fluorescent lamp having improved light output and lumen maintenance.

It is a further object to provide a method for increasing the output and maintenance of low-pressure discharge devices such as fluorescent lamps.

The aforesaid objects of the invention, and other objects which will become apparent as the description proceeds, are achieved by providing a low-pressure discharge device such as a fluorescent lamp which includes a predetermined surface area of selected material having an affinity for mercury. This material is preferably spaced from the envelope of the device and is also spaced from the device electrodes. There is also provided a method for increasing output and maintenance, wherein a predetermined surface area of such material is included within the discharge device.

For a better understanding of the invention, reference should be had to the accompanying drawing wherein the sole FIGURE shows a fluorescent lamp, partly in section, incorporating selected material having an affinity for mercury.

Although the principles of the invention are broadly applicable to any low-pressure discharge device, the invention has particular utility with respect to fluorescent lamps such as a 40W T12 type and hence it has been so illustrated and will be so described.

With specific reference to the form of the invention illustrated in the drawing, the numeral 10 indicates generally a 40W T12-type fluorescent lamp comprising a sealed, light-transmitting tubular envelope 12 having mounts 14 sealed into either end thereof. The envelope terminates in base caps 16 to facilitate lamp support and electrical connection, as is customary. Each mount 14 comprises a stem portion 18 supporting lead-in conductors 20 sealed therethrough and extending into the envelope 12. Coiled tungsten or other suitable refractory metal coils 22 carrying electron-emission material such as alkaline-earth oxides are supported proximate the ends of the envelope 12 and are carried between the inwardly-extending extremities of the lead-in conductors 20. As a

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specific example, the electron-emission material comprises 60% BaO, 36% CaO and 10% SrO by weight. Base pins 24 are affixed to the base caps 16 and electrically connect to the lead-in conductors 20 in order to facilitate energization of the lamp 10. The envelope 12 carries on its interior surface a coating 26 comprising phosphor material, which as an example is manganese-activated zinc silicate. Also contained within the envelope 12 is a filling of inert ionizable starting gas such as argon at a pressure of 4 mm. and a small charge of mercury 28.

In accordance with the present invention, there is provided within the envelope 12 and preferably proximate each end thereof a predetermined quantity of selected material having an affinity for mercury. This material 30 is preferably supported by the stems 18 so that it is spaced from the phosphor coating 26 to prevent appearance defects and is also spaced from the electrodes 22. As a specific example, the selected material 30 which has an affinity for mercury comprises sodium sulphate or silver flake. Sodium sulphate is preferred because of cost and will be considered in detail. A sodium sulphate-silica slurry is first formed by dissolving thirteen grams of sodium sulphate in fifty cubic centimeters of water and adding thereto 4.7 grams of silica binder. This slurry is painted on each stem 18 as an annular band 30 in such amount as to leave a residual deposit of five milligrams sodium sulphate and two milligrams silica binder. The surface area of each band 30 is approximately 3.5 sq. cm. A sufficient surface area of sodium sulphate is required in order to enable this material to serve as a collector for at least a substantial portion of the dark mercury oxide generated during lamp operation, as will be elaborated on hereinafter. While the foregoing indicated surface area of sodium sulphate is preferred from the standpoint of lamp performance and convenience of manufacture, it should be understood that this surface area can be varied considerably and good results will still be obtained. In addition, each annular band 30 comprising sodium sulphate is separated at its closest point from the nearest electrode 22 by a distance of 16 mm. for example. This spacing can be increased or decreased considerably, but the foregoing example has been found to provide very satisfactory results. The purpose of maintaining a spacing between the sodium sulphate as coated and the closest electrode 22 is to prevent any appreciable volatilization of the dark mercury oxide which is collected on the material 30 during lamp operation. Since the dark mercury oxide appears relatively difficult to volatilize once it is collected, the annular bands 30 comprising sodium sulphate can be positioned quite close to the nearest electrode 22. Alternatively, similar annular bands of silver flake bonded to the stems 18 by sodium silicate can be used to replace the sodium sulphate. Both of these indicated materials are desirably placed on the stems 18 of the lamp 10 before the mounts 14 are sealed into the ends of the envelope 12.

When the lamps incorporating the specified material 30 were operated, a dark deposit comprising mercury oxide gradually accumulated on the material 30. The longer the operation, the greater the deposit of dark material. Between periods of operation, additional mercury collected as small droplets on the material 30. When operation of the lamps was resumed, however, the deposited mercury droplets evaporated leaving only the accumulated dark deposit. From this it is surmised that the dark deposit comprising mercury oxide which was collected by the material 30 would normally deposit on the envelope or phosphor, thereby cutting down on emitted light. In control tests, lamps constructed in accordance with the present invention displayed an average output after 100-hours operation which was approximately 1.3% greater than otherwise similar control lamps. After 600-hours

operation, lamps constructed in accordance with the present invention displayed an output averaging approximately 2% higher than the otherwise similar control lamps.

The actual initial or zero-hour readings for the foregoing control lamps and lamps constructed in accordance with the present invention were approximately the same. In this regard, the actual initial light output of the lamps of the present invention does not appear to be improved over the actual initial light output of the lamps of the prior art. Inasmuch as the reported or rated initial light output is normally taken after 100-hours operation and the maintenance of light output from zero to 100 hours is improved for lamps of the present invention, it is proper to state that not only is the maintenance of light output improved, but the rated initial light output is also improved over the lamps of the prior art.

As a possible alternative embodiment, other materials which have an affinity for mercury can be used to replace the preferred sodium sulphate or silver flake, examples being silver foil or gold or copper flake or foil, used in a manner similar to the silver flake. In addition, the specified material such as silver flake need not be supported by the stems in the manner as indicated, although the stem-supporting construction is preferred because of manufacturing cost and convenience. If the appearance defect of a dark deposit can be tolerated, the selected material can be placed directly on the ends of the envelope rather than spaced therefrom. As still another alternative construction, the indicated selected material 30 can be included at only one end of the lamp 10.

As noted hereinbefore, the present invention is also applicable to low-pressure discharge devices other than the usual fluorescent lamps. This includes the so-called high-loaded fluorescent lamps as well as "bactericidal" ultraviolet-generating devices which use no phosphor coating on the envelope and which normally use cold cathode electrodes. High-loaded fluorescent lamps are well known and are generally similar to the usual fluorescent lamp except that some provision is made to limit the mercury-vapor pressure to enable the power input to the lamp to be increased without an appreciable sacrifice in efficiency.

It will be recognized that the objects of the invention have been achieved by providing a low-pressure discharge device such as a fluorescent lamp having improved output and maintenance. There has also been provided a method for increasing the output and maintenance of such devices.

While best embodiments of the invention have been illustrated and described in detail, it is to be particularly understood that the invention is not limited thereto or thereby.

I claim:

1. A low-pressure discharge device comprising, a sealed elongated and radiation-transmitting envelope enclosing electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and an affinity for mercury positioned within said envelope and proximate at least one end thereof, and said selected material spaced from the electrodes of said device.

2. A fluorescent lamp comprising, a sealed phosphor-coated elongated and light-transmitting envelope enclosing electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and an affinity for mercury positioned within said envelope and proximate at least one end thereof, and said selected material spaced from the electrodes of said lamp.

3. A fluorescent lamp comprising, a sealed phosphor-coated elongated and light-transmitting envelope enclosing electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and

an affinity for mercury positioned within said envelope and proximate at least one end thereof, and said selected material spaced from said phosphor-coated envelope and also spaced from the electrodes of said lamp.

4. A fluorescent lamp comprising, a sealed phosphor-coated elongated and light-transmitting envelope enclosing electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and an affinity for mercury positioned within said envelope and proximate both ends thereof, and said selected material spaced from said phosphor-coated envelope and also spaced from the electrodes of said lamp.

5. A fluorescent lamp comprising, a sealed phosphor-coated elongated and light-transmitting envelope enclosing electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and comprising one of the group consisting of sodium sulphate and silver positioned within said envelope and proximate at least one end thereof, and said selected material spaced from said phosphor-coated envelope and also spaced from the electrodes of said lamp.

6. A fluorescent lamp comprising, a selected phosphor-coated elongated and light-transmitting envelope enclosing stem-supported electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and an affinity for mercury carried on a stem of said lamp and within said envelope proximate at least one end thereof, and said selected material spaced from said phosphor-coated envelope and also spaced from the electrodes of said lamp.

7. A fluorescent lamp comprising, a sealed phosphor-coated elongated and light-transmitting envelope enclosing stem-supported electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and comprising sodium sulphate supported on the stems of said lamp, and said selected material spaced from said phosphor-coated envelope and also spaced from the electrodes of said lamp.

8. A fluorescent lamp comprising, a sealed phosphor-coated elongated and light-transmitting envelope enclosing stem-supported electrodes operatively disposed proximate the ends thereof and containing a predetermined pressure of inert ionizable starting gas and a small charge of mercury, selected material having a predetermined surface area and comprising silver flake supported on the stems of said lamp, and said selected material spaced from said phosphor-coated envelope and also spaced from the electrodes of said lamp.

9. The method of improving the output and maintenance of a low-pressure discharge device having a sealed light-transmitting and elongated envelope, electrodes operatively positioned within said envelope and proximate the ends thereof, and a predetermined pressure of inert ionizable gas and a small charge of mercury also contained within said envelope, which method comprises: including within said device in spaced relationship from said envelope and said electrodes and proximate at least one end of said envelope, a selected material having a predetermined surface area and an affinity for mercury.

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