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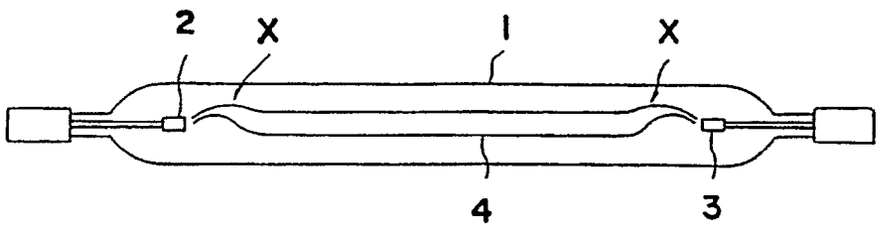
(54) Metal vapor discharge lamp.

(57) Disclosure is given for a technique of preventing arc displacement from occurring in an iron-filled metal vapor discharge lamp which additionally contains magnesium so as to prevent the iron from depositing on the internal wall surface of the bulb (1) of said lamp and forming a thin iron film. Namely, in the disclosed metal vapor discharge lamp arc displacement can securely be prevented by incorporating thallium in an amount of 3.2 x 10^{-9} to 2.0 x 10^{-7} mol per cc of content volume of the bulb.

FIG. 1



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BACKGROUND OF THE INVENTION

(1) Field of the Invention

This invention relates to a metal vapor discharge lamp to be employed for photochemical reactions or curing of paints and inks.

(2) Description of the Prior Art

Ultraviolet rays are often used for inducing photochemical reactions or curing paints and inks, and those having a wavelength in the range of about 280 to 400 nm are useful for such purposes.

Metal vapor discharge lamps are often used as sources of such ultraviolet rays. Such metal vapor discharge lamp has a pair of electrodes disposed at each end of a tubular bulb to oppose each other, and the tubular bulb contains a metal halide together with sufficient amounts of mercury and a rare gas so as to maintain arc discharge to occur, whereby to increase the quantity of light emission in the effective wavelength range. Particularly those metal vapor discharge lamps having incorporated therein iron in the form of metal halide is conveniently used for the purpose of curing paints and inks, since they can continuously emit ultraviolet rays in the wavelength range of 350 to 400 nm. In other words, since the iron-filled metal vapor discharge lamp can emit a large quantity of ultraviolet rays, ultraviolet rays can penetrate the internal portion of the paint or ink layer quickly, to allow curing of the material to be cured in a short time.

However, if such iron-filled metal vapor discharge lamp is lit for a long time, the iron deposits on the internal wall surface of the bulb to form a thin film, so that the amount of the iron which can contribute to light emission will be reduced, and the thus-formed thin iron film prevents transmission of ultraviolet rays therethrough to reduce output of ultraviolet rays. In order to solve the above problem, the present inventors have previously developed a metal vapor discharge lamp in which magnesium is additionally incorporated so as to maintain output of ultraviolet rays for a long time (Japanese Patent Application No. 220325/1985; USP 4,769,576).

By the way, such metal vapor discharge lamp is occasionally used at a power demand which is lower than the rated power depending on the application. Once the metal vapor discharge lamp is turned off, it requires several minutes until it can be lit again. Accordingly, when ultraviolet rays are irradiated onto materials to be irradiated flowing intermittently, on/off operation of the metal vapor discharge lamp cannot be repeated in short cycles, so that a contrivance is used to shield the lamp with a shutter when irradiation should be screened. Thus, while the shutter is closed, the metal vapor discharge lamp is lit on with the power demand of the metal vapor discharge lamp being dropped to about, for example, 1/2 the rated power. Therefore, in the case of a magnesium-filled metal vapor discharge lamp and when it is lit at a power demand which is lower than the rated power, the following problems arise. As shown in Fig. 1, the arc 4 to be generated between the electrodes 2,3 disposed to oppose each other at both internal ends of the tubular bulb 1 displaces in the vicinity of the electrodes 2,3 as indicated with X. Such arc displacement phenomenon occur either or both of the electrodes 2,3, and the degree and state thereof vary widely. When such arc displacement occurs, the portion of the bulb immediately above the displaced portion X is overheated by the arc approaching thereto. Accordingly, the quartz glass is opacified to have reduced life. In the case where the metal vapor discharge lamp is used in combination with a long converging reflector having an ellipsoidal cross section and the like, the position of the arc in the metal vapor discharge lamp is allowed to coincide with the focal point of the reflector. However, the light at the displaced portion X deviates from the focal point and cannot be utilized, to afford low light utilization efficiency.

SUMMARY OF THE INVENTION

It is a first object of this invention to provide a metal vapor discharge lamp having mercury, iron and magnesium filled therein, in which no arc displacement occurs when it is lit at a power demand which is lower than the rated power, and the bulb is prevented from opacifying.

It is a second object of this invention to provide a metal vapor discharge lamp having mercury, iron and magnesium filled therein, in which the light utilization efficiency does not drop when it is used in combination with a converging reflector.

The present inventors found that thallium (Tℓ) is effective for achieving the above objects, and after they made various experiments they accomplished this invention. To describe in detail, displacement in the arc can be prevented by incorporating thallium in an amount of 3.2×10^{-9} to 2.0×10^{-7} mol per cc of the

content volume of the bulb even when the metal vapor discharge lamp is lit at a power demand which is considerably lower than the rated power. Therefore, the bulb is prevented from being opacified by overheating and can enjoy long life. When the metal vapor discharge lamp is used in combination with a converging reflector, the arc can entirely be allowed to coincide with the focal point of the reflector, so that no reduction in the light utilization efficiency will occur.

Incidentally, if the amount of thallium is less than 3.2×10^{-9} mol per cc of the content volume of the bulb, the effect of preventing displacement in the arc may not sufficiently be exhibited; whereas if it is more than 2.0×10^{-7} mol per cc, outputs of the luminescence spectrum of mercury, iron and magnesium will be lowered, whereby intensity of the ultraviolet rays in the effective wavelength range of 280 to 400 nm will consequently be lowered, disadvantageously.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an illustration of a metal vapor discharge lamp.

DETAILED DESCRIPTION OF THE INVENTION AND PREFERRED EMBODIMENT

The metal vapor discharge lamp according to this invention has a basic structure as shown in Fig. 1; wherein a pair of electrodes 2,3 are disposed in a tubular bulb 1 made of a quartz tube having an inner diameter of 22 mm at each end to oppose each other with a distance of 750 mm therebetween. This metal vapor discharge lamp is operated at a rated power demand of 9 KW and has a content volume of 285 cc. The bulb 1 contains 285 mg of a metal mercury (Hg), 30 mg of mercury iodide (Hg_2I_2), 5.0 mg of iron (Fe), 0.7 mg of magnesium, 1.9 mg of thallium iodide and 30 mmHg of xenon gas. The amount of thallium to be incorporated is 2.0×10^{-8} mol per cc of the content volume of the bulb 1. When such metal vapor discharge lamp was lit at a rated power demand of 9 KW, the lamp current showed 10.3 A with no displacement in the arc 4.

When the above metal vapor discharge lamp was used in combination with a converging reflector, the arc can entirely be allowed to coincide with the focal point of the reflector, so that no reduction in the light utilization efficiency occurred.

Next, such lamps containing thallium in various amounts were prepared (20 pieces per one amount) to investigate arc displacement and variation in the ultraviolet output by operating them at a power demand of 4.5 KW which is 1/2 the rated power, and the test results are as shown in Table 1.

Table 1

Amount of Tℓ (mol/cc)	Arc displacement	Ultraviolet output
2.5×10^{-9}	X	100
3.0×10^{-9}	○	100
3.2×10^{-9}	○	100
3.5×10^{-9}	○	100
8.0×10^{-9}	○	100
2.0×10^{-8}	○	100
4.0×10^{-8}	○	100
6.0×10^{-8}	○	100
8.0×10^{-8}	○	100
1.0×10^{-7}	○	97
1.8×10^{-7}	○	92
2.0×10^{-7}	○	90
2.2×10^{-7}	○	83

Incidentally, in Table 1, the mark X in the column of Arc displacement means that arc displacement occurred at both end portions of the lamp in 18 lamps out of 20, and at either end portion of the lamp in the remaining 2 lamps; and the mark ○ means that no arc displacement occurred in any of 20 lamps. The numerical values in the column of the Ultraviolet output are relative values in the wavelength range of 280 to 400 nm.

As apparent from Table 1, when the amount of thallium incorporated is 2.5×10^{-9} mol/cc, arc displacement was observed. However, in those cases where said amount is 3.0×10^{-9} mol/cc or more, no arc displacement was observed. On the other hand, it can be seen that the ultraviolet output tends to be lowered as the amount of thallium is increased. In other words, when the amount of thallium added is 2.0×10^{-7} mol/cc, loss in the ultraviolet output is only 10 %, such a loss is not at all significant and allows practical application of these metal vapor discharge lamps. However, when the amount of thallium incorporated is 2.2×10^{-7} mol/cc, loss in the ultraviolet output will greatly be increased to 17 %. Consequently, 3.2×10^{-9} to 2.0×10^{-7} mol/cc of thallium to be added is practical since ultraviolet loss in the effective wavelength range of 280 to 400 nm is small and practical with substantially no arc displacement.

It should be noted, however, in the metal vapor discharge lamp according to this invention, the iron will not be deposited on the internal surface of the bulb 1 even after extended lighting to form no thin iron film, so that output of the ultraviolet rays can be maintained. On the other hand, the effect of the thallium additionally incorporated to the metal vapor discharge lamp in which no thin iron film had yet been formed on the spectrum output of mercury and those of iron and magnesium was investigated. It was found that in the metal vapor discharge lamp of this embodiment, the loss in the spectrum output of mercury was 4 %, that of iron was 4 %, and that of magnesium was 1 %, which are insignificant values compared with the metal vapor discharge lamp containing no thallium.

Accordingly, the above data proves that if thallium is added in an amount of 2.0×10^{-8} mol/cc content volume of of the bulb 1, spectrum outputs of mercury, iron and magnesium will not be affected by the

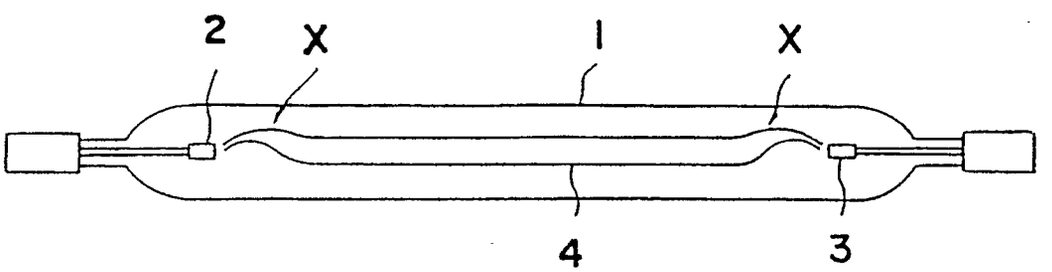
thallium. Further, addition of thallium gives no substantial affect on the electrical characteristics such as starting current and reignition voltage.

While a thallium halide was used in this embodiment, it may be replaced by a metal thallium. The same effect can be obtained by using a mixture of such materials.

Claims

1. A metal vapor discharge lamp comprising a bulb and a pair of electrodes disposed therein, containing suitable amounts of iron, halogen and magnesium together with sufficient amounts of mercury and a rare gas so as to maintain arc discharge to occur, characterized in that thallium is additionally incorporated in an amount of 3.2×10^{-9} to 2.0×10^{-7} mol per cc of content volume of the bulb.

FIG. 1



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EUROPEAN SEARCH REPORT

Application Number EP 91102794.4

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US - A - 4 745 335 (OHYAMA) * Claims * --	1	H 01 J 61/18
A	US - A - 4 074 164 (LEYENDECKER) * Column 2, lines 27-32; claims 1-4,8-10 * ----	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

H 01 J 61/00
H 01 J 17/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	03-05-1991	BRUNNER

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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