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(54) Metal vapour discharge lamp.

(57) Disclosed is a metal vapor discharge lamp having mercury and iron filled therein, in which the iron is prevented from depositing on the internal surface of the bulb of said lamp and forming a thin iron film. Namely, in the metal vapor discharge lamp according to this invention, the amount of thallium to be incorporated relative to iron is 1/200 to 1/2 in terms of gram atom number ratio, whereby formation of thin iron film can be prevented without affecting the spectrum outputs of mercury and iron.

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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.

High-pressure mercury vapor discharge lamps have conventionally been used as sources of such ultraviolet rays. However, the light emitted from a high-pressure mercury vapor discharge lamp consists of a multiplicity of luminescent line spectra, and each spectrum distributes over a considerably broad range of wavelength. Accordingly, it is not efficient to use the high-pressure mercury vapor discharge lamp to achieve photochemical reactions or curing of paints, in which the effective wavelength range is about 280 to 400 nm as described above. In other words, while the ultraviolet rays must penetrate through the layer of the material to be cured such as a paint or an ink so that it can completely be cured, it requires a considerable time to achieve the complete curing only with the aid of the luminescent line spectrum of mercury. In order to cope with such problem, a metal vapor discharge lamp is frequently used, which has an increased quantity of light emission in the effective wavelength range by using a metal halide-filled bulb. Further, an iron-filled metal vapor discharge lamp is particularly convenient to achieve curing of paints and inks since it continuously emits ultraviolet rays in the wavelength range of 350 to 400 nm.

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 thin iron film formed inhibits transmission of the ultraviolet rays therethrough to reduce output of the ultraviolet rays.

In order to solve the above problem, it was disclosed to additionally incorporate lead to an iron-filled metal vapor discharge lamp (Japanese Patent Publication No. 15503/1979). This type of metal vapor discharge lamp additionally containing lead can attain the intended object of preventing formation of thin iron film and maintaining output of the ultraviolet rays, but the output of the luminescent line spectra of mercury in the wavelengths of 302, 313 and 365 nm in the above range are extremely reduced by the presence of the lead. Accordingly, the metal vapor discharge lamp additionally containing lead is rarely used for the purpose of inducing photochemical reactions or curing paints. On other hand, it is also disclosed to additionally incorporate tin to an iron-filled metal vapor discharge lamp (Japanese Patent Publication No. 18743/1983). In this type of metal vapor discharge lamp either, the tin notably reduces the output of the luminescent line spectra of mercury as in the case of lead.

SUMMARY OF THE INVENTION

It is a first object of this invention to provide a metal vapor discharge lamp having mercury and iron filled therein, in which the iron is prevented from depositing on the internal surface of the bulb so that emission of ultraviolet rays may not be hindered.

It is a second object of this invention to provide a metal vapor discharge lamp having mercury and iron filled therein, in which the luminescent spectra of mercury and iron are designed not to be affected.

The present inventors found that halide of thallium (Tℓ) is effective for achieving the above objects, and they made various experiments to accomplish this invention. To describe in detail, by additionally incorporating a metal thallium or a thallium halide into the metal vapor discharge lamp having mercury and iron filled therein in such a way that the gram atom number ratio of Tℓ/Fe may be 1/200 to 1/2, deposition of iron on the internal wall surface of the bulb to form a thin film can be prevented, and thus output of the ultraviolet rays can be maintained for a long time. It should be noted, however, if the amount of thallium incorporated relative to iron is less than 1/200 in terms of the gram atom number ratio, the effect of inhibiting deposition of iron on the internal surface of the bulb will be low, whereby the output of ultraviolet rays may not sufficiently be maintained; whereas if the amount of thallium relative to iron is more than 1/2 in terms of gram atom number ratio, the luminescent spectra of iron will slightly be weakened.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a cross section of a metal vapor discharge lamp; and Fig. 2 shows characteristic curves demonstrating high % output retention achieved according to this invention.

DETAILED DESCRIPTION OF THE INVENTION AND PREFERRED EMBODIMENT

Fig. 1 shows a metal vapor discharge lamp

with a rated power of 4 KW to be used as a light source for curing paints or inks. This metal vapor discharge lamp has a tubular quartz bulb 1 with an internal diameter of 22 mm, and a pair of electrodes 2,2 disposed therein to oppose each other with a distance of 250 mm therebetween. The bulb 1 has a sealed portion 11 at each end, and a molybdenum foil 3 is sealed therein, which connects the corresponding electrode 2 with an outer lead 4. In the bulb 1 are filled 120 mg of a metal mercury (Hg), 13 mg of mercury iodide (Hg_2I_2), 3.5 mg of iron (Fe), 1.1 mg of thallium iodide (TlI) and 30 mmHg of xenon gas. The amount of thallium to be incorporated relative to iron is 1/19 in terms of gram atom number ratio.

When the above metal vapor discharge lamp was lit, it showed an initial lamp current of 12.5 A at the lamp output of 4 KW, and no iron deposited on the internal surface of the bulb 1, when the above metal vapor discharge lamp was lit for 1,000 hours, to form no thin iron film. The variation in the output of ultraviolet rays in the wavelength range of 280 to 400 nm was measured as shown by the characteristic curve A in Fig. 2, indicating an output retention of 90 % after 1,000 hours of lighting test.

Incidentally, when the above lighting test was repeated using the same metal vapor discharge lamp except that it does not contain thallium as a control, iron started to deposit on the internal surface of the bulb 1 after about several tens of hours to form a thin iron film, and as shown by the characteristic curve B in Fig. 2, % output retention dropped to 50 % after 1,000 hours.

Next, the effect of the thallium incorporated to the metal vapor discharge lamp in which no thin iron film had yet been formed on the output of the luminescent line spectra of mercury and that of iron was investigated. It was found that the decrease in the spectrum output of mercury was 3 % and that of iron was 5 % which are insignificant values compared with those in the metal vapor discharge lamp containing no thallium. On the other hand, in those metal vapor discharge lamps which contain lead or tin instead of thallium, the decrease in the spectrum output of mercury was 35 % in the case of lead and 28 % in the case of tin. The above results prove that thallium substantially does not affect the spectrum output of mercury. Further, the addition of thallium gives no substantial affect on the electrical characteristics such as starting current and reignition voltage.

While a metal iron and thallium halide were additionally incorporated in this embodiment, they may be replaced by an iron halide and a metal thallium. The same effect can be obtained by using a mixture of such metals and metal halides.

Claims

1. A metal vapor discharge lamp comprising a bulb with electrodes containing suitable amounts of iron and a halogen together with sufficient amounts of mercury and a rare gas for maintaining arc discharge to occur, characterized in that a metal thallium or a thallium halide is additionally incorporated so that the amount of thallium relative to the iron may be 1/200 to 1/2 in terms of gram atom number ratio, whereby to prevent deposition of the iron to form a thin iron film.

FIG. 1

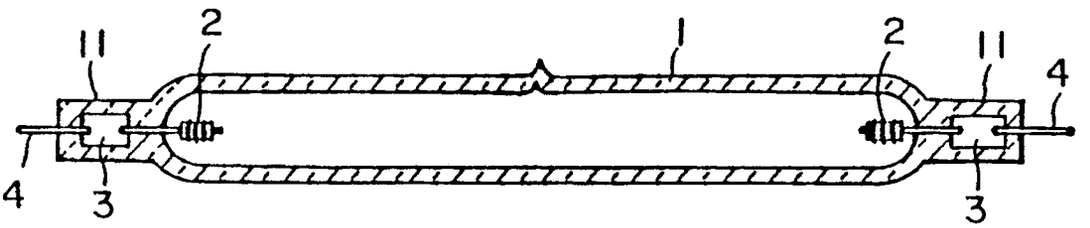
11
2
1
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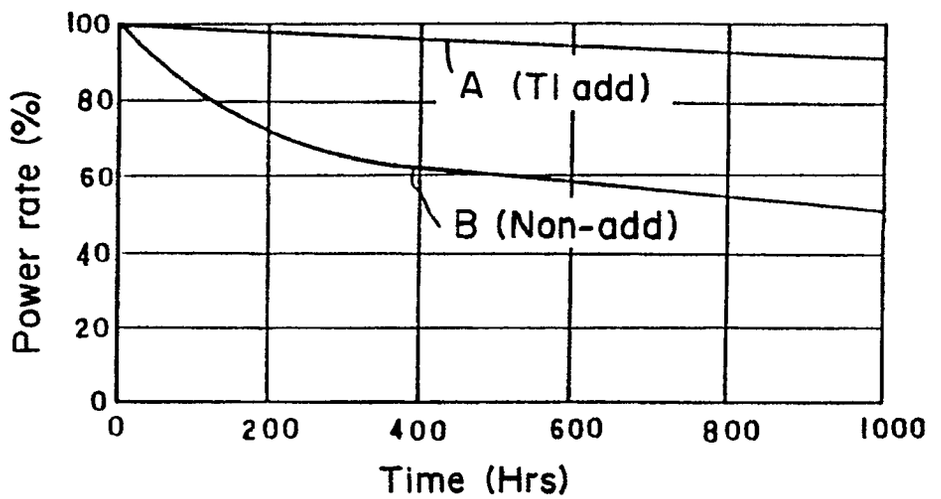
FIG. 2


100
80
60
40
20
0
Power rate (%)
A (Tl add)
B (Non-add)
0
200
400
600
800
1000
Time (Hrs)