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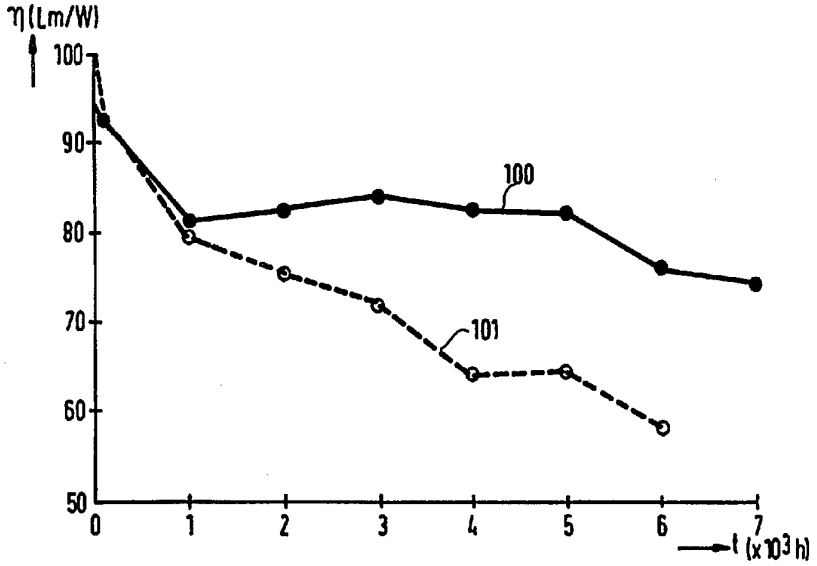
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(54) Title: METAL HALIDE LAMP



(57) Abstract

The invention relates to a metal halide lamp provided with a discharge vessel (3) with a ceramic wall (31) and a filling which comprises besides mercury and a halogen also Na, Tl and one or several of the elements from the group formed by Sc, Y and lanthanides. According to the invention, the filling also contains Mg. It is achieved thereby that the luminous efficacy of the lamp remains substantially constant over a long period.

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Metal halide lamp.

The invention relates to a metal halide lamp provided with a discharge vessel having a ceramic wall and a filling which comprises besides mercury and a halogen also Na, Tl and at least one of the elements from the group formed by Sc, Y and lanthanides.

A lamp of the kind mentioned in the opening paragraph is known from EP-A-0 215 524 (PHN 11.485). The term ceramic material is understood to mean herein a refractory material such as monocrystalline metal oxide (for example sapphire), polycrystalline densely sintered metal oxide (for example polycrystalline densely sintered aluminium oxide, yttrium-aluminium garnet, or yttrium oxide) and polycrystalline non-oxidic material such as, for example, aluminium nitride. Such a material allows a high wall temperature up to 1500-1600 K and is well capable of resisting chemical attacks by Na and halides. The addition of metal halides of Na, Tl and at least one of the elements from the group formed by Sc, Y and the lanthanides (Ln), more in particular in the form of metal iodides, to the ionizable filling of the lamp is an effective means of obtaining a lamp with a comparatively low colour temperature of the emitted light (approximately 2600-4000 K), a comparatively high luminous efficacy, and a comparatively high colour rendering index Ra. The term lanthanides (Ln) is understood to mean herein a compound with at least one of the chemical elements 57 to 71. The lamp, which radiates light mainly in the visible region, is thus suitable in many circumstances, both for general lighting and for interior lighting. It is a disadvantage of the known lamp that the luminous efficacy shows a strong, continuous decrease during lamp life owing to discharge vessel wall blackening.

The invention has for its object to provide a measure whereby an improvement in the luminous efficacy is achieved over lamp life. According to the invention, a lamp of the kind mentioned in the opening paragraph is for this purpose characterized in that the filling also comprises Mg.

It was surprisingly found that the lamp according to the invention has a strongly improved behaviour as to the luminous efficacy during lamp life, this luminous efficacy remaining substantially constant over a few thousands of hours of operation. The Mg, which is present in the discharge vessel in the form of magnesium halide (MgJ_2), does contribute to the spectrum of the lamp, but since this refers mainly to the wavelength region corresponding to green light, it is not found to be disadvantageous for the value of the luminous efficacy. Any undesirable influence of the added Mg on the colour temperature and the colour point of the light emitted by the lamp may be readily compensated for by an adaptation in the proportions of the other filling ingredients.

A possible explanation of the detrimental decrease in the luminous efficacy as found in practice is the occurrence of chemical reactions between the filling ingredients from the group formed by Sc, Y and Ln with spinel ($MgAl_2O_4$) which is present in the discharge vessel wall, so that the ingredients Sc, Y and Ln are withdrawn from the portion of the filling contributing to light generation and are deposited on the discharge vessel wall. It is found to be possible through the addition of Mg to influence the balance of one or several of the chemical reactions to such an extent that this balance is already achieved shortly after the beginning of lamp life, after which a further removal of the ingredients Sc, Y and Ln does not take place.

Based on the cause suggested above, it is advisable that the quantity of Mg of the MgJ_2 present per unit surface area of the inner wall of the discharge vessel is at least 3 $\mu g/cm^2$.

Since the ingredients Sc, Y and Ln will usually be present in the form of halogen salts in excess quantities during lamp operation, the Mg will partly be dissolved as a halogen salt in the salt reservoir thus formed. Therefore, the quantity of Mg preferably is above 8 $\mu g/cm^2$.

These and other aspects of the invention will be explained in more detail with reference to a drawing of an embodiment in which

Fig. 1 shows a lamp according to the invention,

Fig. 2 is a cross-section of a discharge vessel of the lamp of Fig. 1, and

Fig. 3 gives life test results of the lamp according to Fig. 1 and of a prior-art lamp.

Fig. 1 shows a metal halide lamp provided with a discharge vessel 3 having a ceramic wall and a filling which comprises besides mercury and a halogen also Na, Tl and one or more of the elements from the group formed by Sc, Y and lanthanides. The filling also comprises Mg. The discharge vessel is enclosed by an outer bulb 1 which is provided with electrical connection contacts 2a, 2b at its two ends. The discharge vessel is provided with internal electrodes 4, 5 between which a discharge extends in the operational state of the lamp. Electrode 4 is connected to a first electrical connection contact 2a *via* a current conductor 8. Electrode 5 is connected to a second electrical connection contact 2b *via* a current conductor 9.

The discharge vessel 3 is shown in detail in Fig. 2. The discharge vessel has a ceramic wall 31 which is provided at either end with a projecting ceramic plug 34, 35 for accommodating electric lead-throughs to the electrodes 4 and 5, respectively. The lead-throughs each comprise a halide-resistant portion 41, 51 made of, for example, Mo and a portion 40, 50, which is connected to a respective plug 34, 35 in a gastight manner by means of a ceramic glaze connection 10. The portions 40, 50 are made of a metal which corresponds very well to the projecting plugs as to its coefficient of expansion. For example, Nb is a highly suitable material. The portions 40, 50 are connected to the current conductors 8, 9, respectively, in a manner not shown.

Each electrode 4, 5 comprises an electrode rod 4a, 5a which is provided with a winding 4b, 5b at an end.

The discharge vessel 3 encloses a discharge space 11 in which the filling ingredients are present.

In a practical realisation of a lamp according to the invention, the discharge vessel is made from polycrystalline densely sintered aluminium oxide, as are the projecting plugs. The electrodes are made of tungsten and free from emitter. The rated power of the lamp is 70 W. The filling of the discharge vessel was 12 mg Hg and 5 mg of the metal halides NaJ, TlJ and DyJ_3 in a weight ratio 52:23:25. In addition, the lamp comprised 0.5 mg MgJ_2, and Ar as a starter gas.

The discharge vessel has an internal diameter of 9 mm and an internal length of 14 mm, resulting in a discharge vessel inner surface area of 5.4 cm^2. The quantity of Mg per unit surface area was thus 8.2 $\mu g/cm^2$.

The luminous efficacy of the lamp was measured in an endurance test.

For comparison purposes, the luminous efficacy during lamp life was also measured for a lamp according to the present art, identical to the lamp according to the

invention, but without Mg in the filling.

The results of the photometric measurements are given in Fig. 3. The operational time of the lamps is plotted on a horizontal axis in 10^3 hours. The luminous efficacy in lm/W is plotted on a vertical axis. Curve 100 gives the result for the lamp according to the invention, curve 101 the result for the prior-art lamp.

It is evident that the luminous efficacy of the lamp according to the invention remains constant over several thousands of hours of operation, *i.e.* from 1000 h up to 5000 h. The luminous efficacy of the prior-art lamp shows a strong, continuous decrease throughout its life.

Claims:

1. A metal halide lamp provided with a discharge vessel having a ceramic wall and a filling which comprises besides mercury and a halogen also Na, Tl and one or several of the elements from the group formed by Sc, Y and lanthanides, characterized in that the filling also comprises Mg.

2. A lamp as claimed in Claim 1, characterized in that the quantity of Mg per unit surface area of the inner wall of the discharge vessel is at least 3 $\mu g/cm^2$.

3. A lamp as claimed in Claim 2, characterized in that the quantity of Mg is at least 8 $\mu g/cm^2$.

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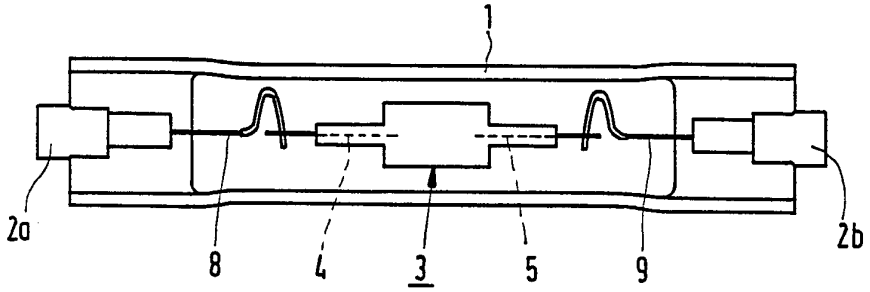


FIG.1

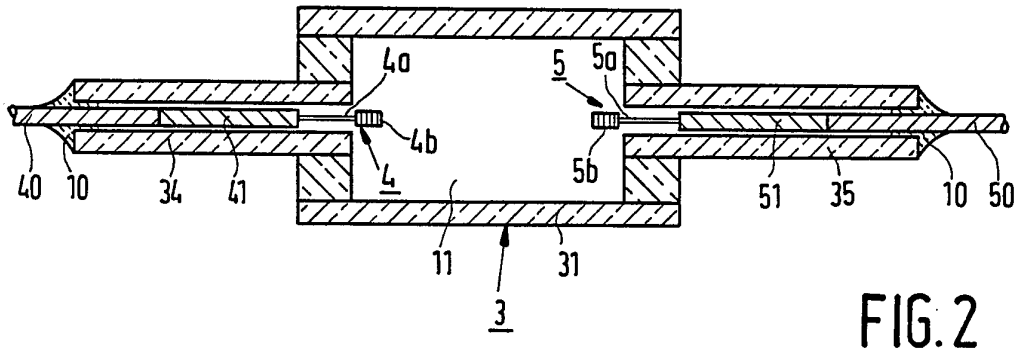


FIG.2

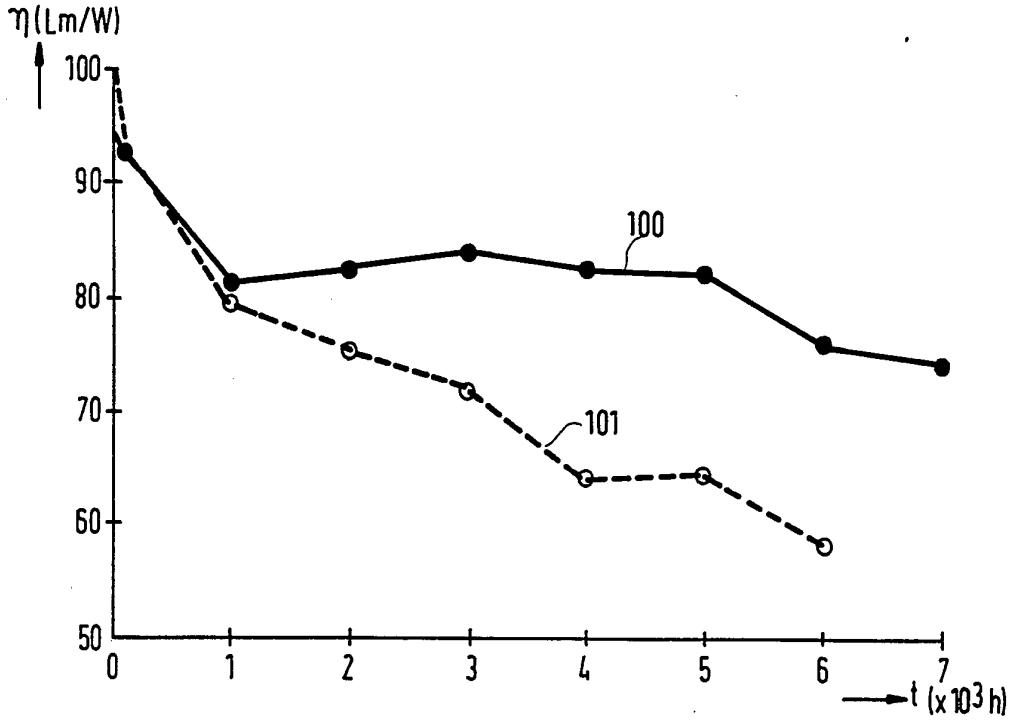


FIG.3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB 95/00235

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01J 61/12
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01J

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3867665 A (KENNETH FREDERICK FURMIDGE ET AL), 18 February 1975 (18.02.75), column 5, line 11 - line 21, abstract	1-3
X	US 4769576 A (MASACHIKA OHYAMA ET AL), 6 Sept 1988 (06.09.88), figure 2, abstract	1-3
A	US 4745335 A (MASACHIKA OHYAMA ET AL), 17 May 1988 (17.05.88), abstract	1-3

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 July 1995	21 -07- 1995
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Anders Axberger Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

29/05/95

International application No.
PCT/IB 95/00235

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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