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(74) Representative: **Mallens, Erik Petrus Johannes Philips**
Intellectual Property & Standards
P.O. Box 220
5600 AE Eindhoven (NL)

(71) Applicant: **Koninklijke Philips Electronics N.V.**
5621 BA Eindhoven (NL)

Remarks:
Claims 11-14 are deemed to be abandoned due to non-payment of the claims fees (Rule 45(3) EPC).

(72) Inventor: **The designation of the inventor has not yet been filed**

(54) **Low-pressure mercury vapour discharge lamp for disinfecting a medium**

(57) The use of certain wavelengths of ultraviolet radiation in particular UV-C light for its purification, germicidal and bactericidal effect is well known. The invention relates to an improved discharge lamp for disinfecting a medium, comprising means (4) for covering a cold sport

region of the discharge vessel (2) of the lamp. Thus the temperature of the cold spot can be held sufficiently high to secure an improved light output, substantially independent from the temperature of a surrounding medium to be disinfected.

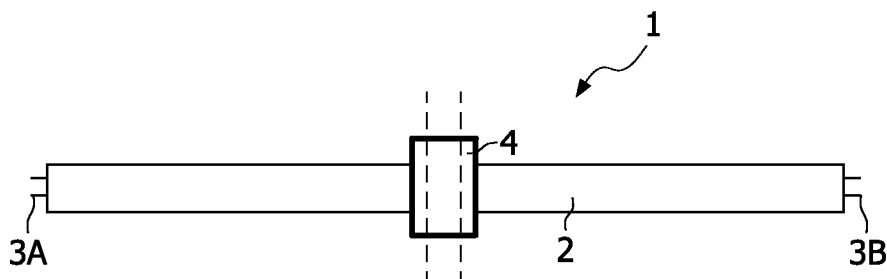


FIG. 1a

Description

FIELD OF THE INVENTION

[0001] The invention relates to a low-pressure mercury vapour discharge lamp for disinfecting a medium.

BACKGROUND OF THE INVENTION

[0002] The use of certain wavelengths of ultraviolet ("UV") light or radiation for its purification, germicidal and bactericidal effect is well known. UV light, in particular UV-C light, is commonly used to reduce or stop the growth of impurities in septic, water and air systems. For example, UV light or UV lamps are commonly used in heating, ventilation, and air conditioning systems for purification or air cleaning purposes. UV lamps are typically installed or mounted in the air ducts of air conditioning systems in such a manner that the UV light emitted by the lamp floods the interior of the air duct. Air flowing through that duct will be irradiated with UV radiation which will have a germicidal or bactericidal effect on the moving air thereby reducing the impurities in the air flow. Low-pressure mercury vapour discharge lamps, such as Compact Fluorescent Lamps ("CFLs"), e.g. bitubular fluorescent lamps, are commonly very suitable to generate light with appropriate wavelengths for disinfection purposes. The light output of low-pressure mercury vapour discharge lamps is critically dependent upon mercury vapour pressure (vapour density) within a discharge vessel of the lamp. The luminous efficacy of a mercury vapour discharge lamp changes according to the mercury-vapour pressure in the lamp. The mercury vapour atoms efficiently convert electrical energy to ultraviolet radiation with a typical wavelength of 253.7 nm when the mercury vapour pressure is in the proper range. The mercury-vapour pressure is controlled by the temperature of a cold spot, which is the coldest region of the discharge lamp during lamp operation. In air condition applications, used for disinfection of the air, the ambient temperature can be relatively low (commonly between 5° and 15° Celsius), but also the air velocity is such that the cold spot temperature decreases to values far below an optimum of approximately 42° Celsius for most typical low-pressure mercury vapour discharge lamps. Hence, for these applications, the output is much lower than the maximum achievable output of the lamp, which leads to a considerable inefficiency of the known low-pressure discharge lamps.

[0003] It is an object of the invention to provide a relatively efficient low-pressure mercury vapour discharge lamp.

SUMMARY OF THE INVENTION

[0004] This object can be achieved by providing a low-pressure mercury vapour discharge lamp according to the preamble, comprising: a discharge vessel filled with

a mercury comprising substance, multiple electrodes connected to said vessel, between which electrodes a discharge extends during lamp operation, and covering means for a position selective covering of a cold spot region of the discharge vessel. By position selective covering of the cold spot, and preferably the cold spot region, the temperature of the cold spot can be held sufficiently high to secure an improved and preferably optimum light output, substantially independent of the temperature of a surrounding medium to be disinfected. Since merely the cold spot region is covered by the covering means, and other parts of the discharge vessel are thus left uncovered, the effective light output can be optimised. Hence, a relatively cool medium (compared to the temperature of the cold spot of the discharge vessel) can be disinfected in a relatively efficient and effective manner. The covering means being position selectively applied to the discharge vessel act in a passive manner, meaning that the covering means are not employed to be powered by an external power source (other than eventually the discharge lamp itself), which makes the application of the covering means relatively simple and cheap. The discharge lamp according to the invention is suitable for disinfecting both gas, in particular air, and liquids, in particular water, or mixtures of a gas and a liquid.

[0005] To maintain the temperature of the cold spot of the discharge vessel sufficiently high during lamp operation, the covering means may employ various characteristics. In a preferred embodiment the covering means are at least partially made of a thermally insulating material to preclude, or at least to counteract, heat transfer by the cold spot of the discharge vessel to a surrounding medium to be disinfected as much as possible. Possible thermally insulating materials to be applied are cork and polymers, such as polyurethane, polystyrene, wherein the polymer used may be foamed. In an alternative preferred embodiment the covering means is adapted for absorbing heat generated within the vessel. In this way, the cold spot of the discharge vessel can be kept at a sufficiently high temperature by heat generated within the discharge vessel. For a person skilled in the art, it is also conceivable that the covering means is adapted to convert electromagnetic radiation generated within the vessel into heat. By means of this conversion the temperature of the cold spot (region) can also be held at a sufficiently high temperature to secure an optimum light output.

[0006] In an alternative embodiment the covering means comprises a photocatalytic oxidation material, as a result of which the covering means are not merely adapted to maintain the cold spot region of the discharge vessel at a sufficiently high temperature, but also to remove particular species, such as unwanted organic substances. Hence, in this way the covering means is provided an additional functionality.

[0007] The covering means is preferably at least partially made of a reflective material. More preferably a surface of the covering means facing the discharge vessel

is made reflective at least partially. In this manner, electromagnetic radiation generated within the discharge vessel can be reflected within the cold spot region. The reflective character of the coating may be dependent on the wavelength of the electromagnetic radiation generated within the vessel. Reflection of electromagnetic radiation may be beneficial either for heating the cold spot region due to reflection (and subsequent absorption) of IR radiation and/or for improving the light output of the discharge lamp. The shape and dimensioning of the covering means may be of various nature. In a preferred embodiment the covering means comprises a coating applied to the cold spot region of the discharge vessel. The coating is preferably thermally conductive to achieve sufficient heating of the cold spot region of the discharge vessel. To this end, a graphite coating and/or other suitable coatings, such as e.g. a stamp pad ink based coating or a glass ink based coating, may be used. Preferably, the thermal conductivity of the coating will be larger than the thermal conductivity of glass (approx. $0.8\text{--}0.9\text{ Wm}^{-1}\text{ K}^{-1}$). Preferably, the thermal conductivity of the coating is larger than 1 W/m/K , and more preferably over $10\text{ Wm}^{-1}\text{ K}^{-1}$. A graphite coating will commonly have a thermal conductivity of approximately $150\text{ Wm}^{-1}\text{ K}^{-1}$. In case a Compact Fluorescent Lamp ("CFL") is used, which commonly comprises two discharge vessel parts mutually connected by means of a bridge, wherein the geometry of the bridge may be of various nature. The cold spot (region) of the discharge vessel is commonly located near the bridge, dependent on the geometry of the bridge. Hence, in this case preferably discharge vessel near (and/or at) the bridge is provided with a coating. Instead of applying a coating, it is also imaginable that the covering means comprises at least one shielding element, commonly being relatively thick compared to a coating. In case of the application of a CFL the shielding element is preferably adapted to enclose the extreme portion of the CFL (near the bridge), to commonly shield the cold spot region. Possibly, the shielding element is adapted to enclose the bridge at least partially, as a consequence of which the shielding element is preferably given more or less a cap shape. The extreme portion of the discharge vessel is preferably shielded to since the cold spot region is commonly located at this extreme portion. In a preferred embodiment the shielding element is attached to the vessel. In this manner, an adequate shielding of the cold spot region can be secured. In a more preferred embodiment the shielding element is sealed to the vessel. Separate sealing means may be applied. Shielding of the cold spot region can be further optimized in this manner. In a particular preferred embodiment the shielding element and the discharge vessel mutually enclose an air gap. Since an air gap exhibits relatively good thermally insulating characteristics, applying an air gap could be applied very well to counteract cooling down of the cold spot region of the discharge vessel. It will be clear that the coating and/or the shielding element could also be applied to (conventional) TL lamps, wherein the cold

spot region is covered by the coating and/or the shield element. The cold spot region of conventional TL lamps is located either in the centre of the lamp (between the electrodes) or behind the electrodes at an extreme section of the lamp.

[0008] The discharge vessel is commonly made of glass, in particular quartz glass. Glass is a thermally stable and transparent material. The glass discharge vessel is substantially left uncovered to achieve a maximum light output. Since the discharge lamp is adapted to disinfect a surrounding medium, a conventional phosphorous coating is omitted. In this manner, UV(-C) radiation will be emitted by the discharge vessel in order to inactivate micro-organisms and other impurities contained by the medium.

[0009] As mentioned above the discharge lamp according to the invention is suitable for disinfecting both air and water (or a mixture thereof). In case a liquid, such as water, has to be disinfected by means of the discharge lamp according to the invention, the discharge lamp preferably comprises a sleeve surrounding the discharge vessel at least substantially. In this manner physical contact between the liquid to be disinfected and the lamp can be prevented, as a result of which the discharge lamp can be held relatively easily at an optimum operating temperature.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The invention is illustrated by way of the following non-limitative examples, wherein:

Figure 1a shows a side view of a first embodiment of a discharge lamp according to the invention, Figure 1b shows a detailed cross-section of a critical part the discharge lamp as shown in figure 1a, Figure 2 shows a side view of a second embodiment of a discharge lamp according to the invention, and Figure 3 shows a side view of a third embodiment of a discharge lamp according to the invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0011] Figure 1a shows a side view of a first embodiment of a low-pressure mercury vapour discharge lamp 1 according to the invention. The discharge lamp 1 comprises an elongated light-transmissive discharge vessel 2 made of glass. The discharge vessel 2 is provided with electrical contacts 3a, 3b at the extreme ends of the discharge vessel 2. The discharge vessel 2 is filled with a mercury comprising substance, which will be ionised and discharged during lamp operation, as a result of which electromagnetic radiation, in particular UV radiation, will be emitted by the discharge vessel 2 for disinfection purposes. The location of the cold spot (region) is well known, wherein the cold spot (region) is located in a centre part of the discharge vessel 2 between the electrical contacts 3a, 3b. In this figure, the cold spot region is

located between the dashed lines. As mentioned afore the cold spot forms a critical part of the discharge lamp 1, whereas the temperature of the cold spot determines the light output of the discharge lamp 1. A temperature decrease of the cold spot will lead to a diminished light output, which will easily occur during disinfection of a relatively cold medium, such as water or air. To prevent this adverse effect the discharge lamp 1 according to the invention has been improved covering the cold spot region of the discharge vessel 2 by a shielding element 4, while remaining parts of the discharge vessel 2 have been left uncovered. In this manner the cold spot region is thermally insulated, as a result of which cooling down of the cold spot can be counteracted leading to an optimization of the light output of the discharge lamp 1. Figure 1b shows a detailed cross-section of a critical part the discharge lamp 1 as shown in figure 1a. In this figure it is shown that the shielding element 4 at attached to the discharge vessel 2 by means of a seal 5. The shielding element 4 and the discharge vessel 2 mutually enclose an air gap 6 to thermally insulate the cold spot region. The shielding element 4 as such is preferably also made of a thermally insulating material such as plastic to further counteract cooling down of the cold spot region of the discharge vessel 2.

[0012] Figure 2 shows a side view of a second embodiment of a discharge lamp 7 according to the invention. The type of discharge lamp 7 shown in this figure is a CFL. The discharge lamp 7 comprises two discharge vessel parts 8a, 8b which are mutually connected by means of a bridge 9 which in fact also makes part of the discharge vessel 8 as a whole. The vessel parts 8a, 8b are connected to electrodes (not shown). The discharge vessel 8 is filled with a mercury-rare gas atmosphere. The cold spot region of the discharge vessel 8 is located at an extreme end of the discharge vessel 8 near the bridge 9. An estimated end of the cold spot region is indicated by the dashed line. The cold spot region is shielded by applying a shielding cap 10 around the cold spot region to prevent, or at least to counteract, cooling down of the cold spot region. The shielding cap 10 is at least partially made of a heat absorbing material. After heat absorption by the shielding cap 10, the shielding cap 10 will be able to actively heat the cold spot region which is in favour of the light output of the discharge lamp 10. In an alternative embodiment the shielding cap 10 could at least partially be made of material which is adapted to convert UV radiation into heat to achieve the same latter effect. Since the discharge lamp 7 will be used for disinfection purposes, it could be beneficial in case the shielding cap 10 is at least partially made of a photocatalytic oxidation material to inactivate micro-organisms surrounding the discharge lamp 7.

[0013] Figure 3 shows a side view of a third embodiment of a discharge lamp 11 according to the invention. The discharge lamp 11 comprises a discharge vessel 12. The discharge vessel comprises two vessel parts 12a, 12b being mutually coupled by means of a bridge 13.

The discharge vessel 12 is coupled to electrodes (not shown). The cold spot region of the discharge vessel 12, being defined as the region below the dashed horizontal line in this figure, has been coated by a thermally conductive coating 14, such as a graphite coating, by means of which coating 14 the cold spot region can be kept at a sufficiently high temperature to secure an optimum light output of the discharge lamp 11. The discharge lamp 11 is adapted for disinfecting a medium, which may be air. However, it is also conceivable that the discharge lamp 11 is adapted to disinfect a liquid medium, such as water. In this latter case, preferably a sleeve 15 is positioned around the discharge vessel 12 to avoid physical contact between water and the discharge vessel 12, as a result of which an optimum discharge lamp operation temperature can be achieved relatively easily. In case water has to be disinfected, it would also be conceivable to position the lamps at a short distance, like above, the water to be disinfected.

[0014] It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting the claim. Use of the verb "comprise" and its conjugations does not exclude the presence of elements or steps other than those stated in a claim. The article "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage.

Claims

1. Low-pressure mercury vapour discharge lamp for disinfecting a medium, comprising:
 - discharge vessel filled with a mercury comprising substance,
 - multiple electrodes connected to said vessel, between which electrodes a discharge extends during lamp operation, and
 - covering means for a position selective covering of a cold spot region of the discharge vessel.
2. Discharge lamp according to claim 1, **characterised in that** the covering means is adapted for thermally insulating the cold spot region.
3. Discharge lamp according to claim 1 or 2, **characterized in that** the covering means is adapted for absorbing heat generated within the vessel.
4. Discharge lamp according to one to of the foregoing claims, **characterized in that** the covering means

is adapted to convert electromagnetic radiation generated within the vessel into heat.

5. Discharge lamp according to one of the foregoing claims, **characterized in that** the covering means is at least partially made of a photocatalytic oxidation material. 5
6. Discharge lamp according to one of the foregoing claims, **characterized in that** the covering means is at least partially made of a reflective material. 10
7. Discharge lamp according to one of the foregoing claims, **characterized in that** the covering means comprises a coating. 15
8. Discharge lamp according to one of the foregoing claims, **characterized in that** the covering means comprises at least one shielding element. 20
9. Discharge lamp according to one of the foregoing claims, **characterized in that** the shielding element is attached to the vessel.
10. Discharge lamp according to claim 8 or 9, **characterized in that** the shielding element is sealed to the vessel. 25
11. Discharge lamp according to one of claims 8-10, **characterized in that** the shielding element and the discharge vessel mutually enclose an air gap. 30
12. Discharge lamp according to one of the foregoing claims, **characterized in that** the discharge vessel is made of glass. 35
13. Discharge lamp according to one of the foregoing claims, **characterized in that** the discharge lamp comprises a sleeve surrounding the discharge vessel at least substantially. 40
14. Discharge lamp according to one of the foregoing claims, **characterized in that** the discharge lamp is a Compact Fluorescent Lamp (CFL). 45

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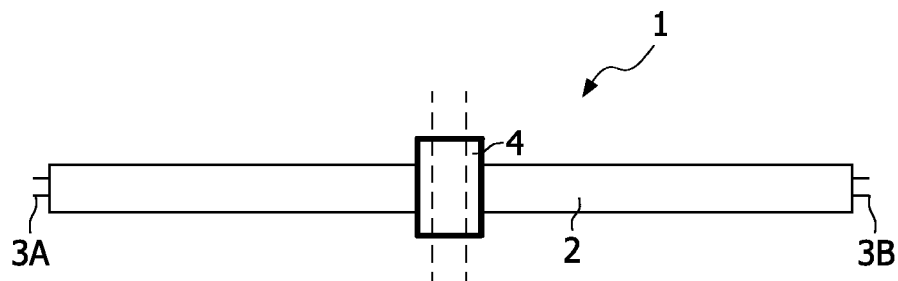


FIG. 1a

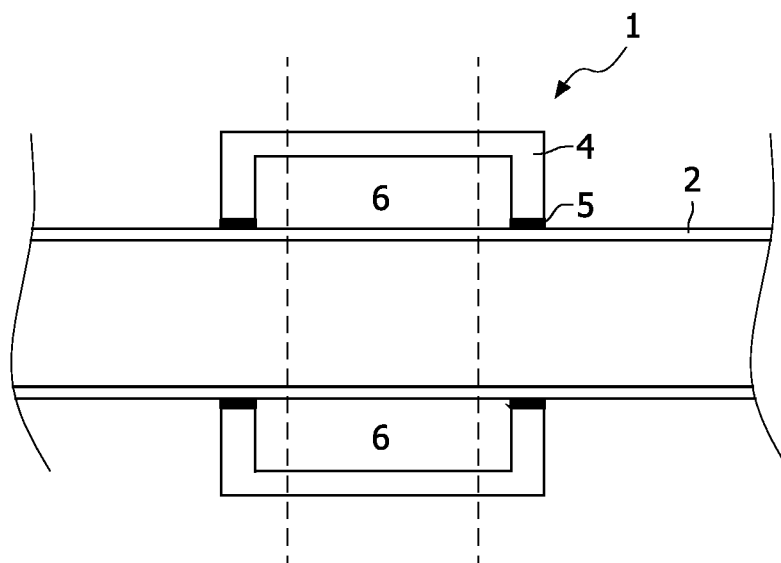


FIG. 1b

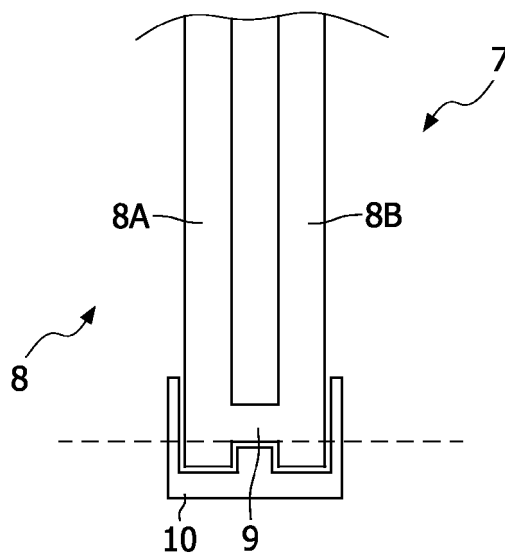


FIG. 2

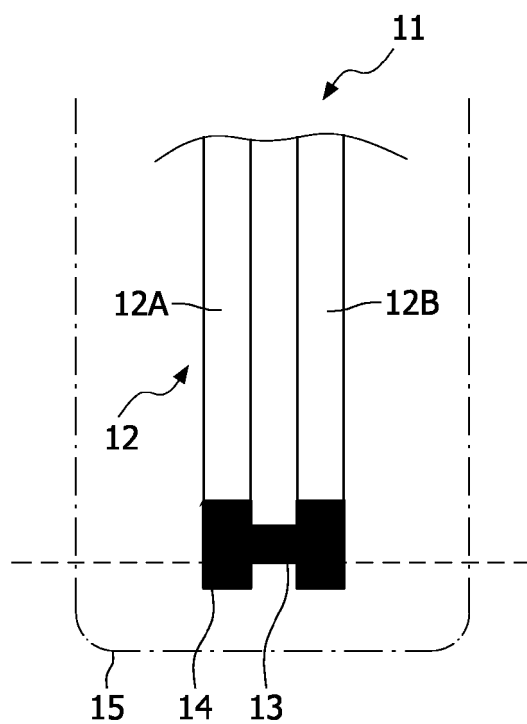


FIG. 3



European Patent
Office

PARTIAL EUROPEAN SEARCH REPORT

Application Number

which under Rule 63 of the European Patent Convention EP 07 10 4972 shall be considered, for the purposes of subsequent proceedings, as the European search report

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 96/31902 A (WEDECO UMWELTECHNOLOGIE WASSER-BODEN-LUFT GMBH; WEDEKAMP, HORST) 10 October 1996 (1996-10-10) * abstract; figure 1 *	1,3,8,9	INV. H01J61/52 H01J61/72 H01J61/34
X	DE 43 02 852 A1 (BRUECK GERNOT K [DE]) 4 August 1994 (1994-08-04) * column 1, line 42 - column 2, line 51; figures 3-6 *	1,3,8,9	
X	US 2004/232846 A1 (FISCHER JOACHIM [DE] ET AL) 25 November 2004 (2004-11-25) * paragraph [017-]; figures 1,2a,2b *	1-4,6,8,9	
X	US 4 751 392 A (WIESMANN RUDOLF [CH]) 14 June 1988 (1988-06-14) * abstract * * column 2, line 66 - column 5, line 12; figure 1 *	1-3,6,8,9	
			TECHNICAL FIELDS SEARCHED (IPC)
			H01J A61L C02F
INCOMPLETE SEARCH			
The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC to such an extent that a meaningful search into the state of the art cannot be carried out, or can only be carried out partially, for these claims. Claims searched completely : Claims searched incompletely : Claims not searched : Reason for the limitation of the search: see sheet C			
Place of search		Date of completion of the search	Examiner
Munich		23 August 2007	Lang, Thomas
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.82 (P04E07)



European Patent
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PARTIAL EUROPEAN SEARCH REPORT

Application Number
EP 07 10 4972

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
X	EP 0 066 860 A (GEN ELECTRIC [US]) 15 December 1982 (1982-12-15) * abstract * * page 3, line 14 - page 8, line 14; figure 1 *	1-4,8,9	
X	JP 63 116353 A (HITACHI LTD) 20 May 1988 (1988-05-20) * abstract *	1-4,6,8,9	
			TECHNICAL FIELDS SEARCHED (IPC)



European Patent
Office

**INCOMPLETE SEARCH
SHEET C**

Application Number
EP 07 10 4972

Claim(s) searched completely:
1-10

Claim(s) not searched:
11-14

Reason for the limitation of the search (non-patentable invention(s)):
claims fees for claims 11-14 not paid

**CLAIMS INCURRING FEES**

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☒ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:
- 1-4, 6, 8, 9
- ☐ The present supplementary European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims (Rule 164 (1) EPC).



The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-4,6,8,9

A low-pressure mercury vapour discharge lamp for disinfecting a medium, comprising discharge vessel filled with a mercury comprising substance, multiple electrodes connected to said vessel, between which electrodes a discharge extends during lamp operation, and covering means for a position selective covering of a cold spot region of the discharge vessel (claims 1); wherein the covering means is adapted for thermally insulating the cold spot region (claim 2)

2. claim: 5

The discharge lamp according to claim 1, wherein the covering means is at least partially made of a photocatalytic oxidation material

3. claim: 7

The discharge lamp according to claim 1, wherein the covering means comprises a coating

4. claim: 10

The discharge lamp according to claim 8, wherein the shielding element is sealed to the vessel

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 07 10 4972

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-08-2007

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