(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 0 900 514 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
29.10.2003 Bulletin 2003/44

(21) Application number: **98900333.0**

(22) Date of filing: **27.01.1998**

(51) Int Cl.[7]: **H05B 41/00**, H01J 61/067

(86) International application number:
PCT/IB98/00100

(87) International publication number:
WO 98/036621 (20.08.1998 Gazette 1998/33)

(54) **LIGHTING UNIT, LOW-PRESSURE MERCURY DISCHARGE LAMP, SUPPLY UNIT, AND COMBINED PACKAGING**

LEUCHTEINHEIT, NIEDERDRUCKQUECKSILBERENTLADUNGSLAMPE, STROMVERSORGUNGSEINHEIT UND KOMBINATIONSPAKET

UNITE D'ECLAIRAGE, LAMPE A DECHARGE AVEC VAPEUR DE MERCURE BASSE PRESSION, UNITE D'ALIMENTATION ET ENSEMBLE COMBINE

(84) Designated Contracting States:
DE FR GB

(30) Priority: **14.02.1997 EP 97200420**

(43) Date of publication of application:
10.03.1999 Bulletin 1999/10

(73) Proprietor: **Koninklijke Philips Electronics N.V.**
5621 BA Eindhoven (NL)

(72) Inventors:
- **HEUVELMANS, Jean, Johan**
  NL-5656 AA Eindhoven (NL)
- **DE SMIT, Abraham, Leedert**
  NL-5656 AA Eindhoven (NL)

(74) Representative:
van Wermeskerken, Stephanie Christine et al
Philips
Intellectual Property & Standards
P.O. Box 220
5600 AE Eindhoven (NL)

(56) References cited:
US-A- 5 233 268
US-A- 5 406 174
US-A- 5 498 930

EP 0 900 514 B1

Description

[0001] The invention relates to a lighting unit comprising a supply unit and a low-pressure mercury discharge lamp, which low-pressure mercury discharge lamp has a light-transmitting discharge vessel which is provided with a luminescent layer on an inner surface and which encloses a discharge space in a gastight manner, said discharge space being provided with a filling comprising one or several rare gases in addition to mercury, while in this discharge space a first and a second electrode are positioned, which electrodes each comprise a coiling of a metal wire coated with one or several metal oxides which emit electrons, and which electrodes are each electrically connected to a respective current supply conductor which extends to outside the discharge vessel and is electrically connected there to the supply unit, which unit ignites the low-pressure mercury discharge lamp in the cold state upon switching-on.

[0002] Lighting units with a low-pressure mercury discharge lamp, also referred to as "lamp" hereinafter, are widely used for general lighting purposes. They render possible a considerable energy saving owing to the high luminous efficacy in comparison with that of incandescent lamps.

[0003] A discharge is maintained with a discharge current between the electrodes during nominal operation of the lighting unit. The manner in which the lamp is ignited depends on the type of lighting unit.

[0004] In a lighting unit of the "hot start" type, the electrodes each have a further current supply conductor. Before an ignition voltage is applied between the electrodes, the latter are brought to a temperature required for nominal operation by means of an auxiliary current from the current supply conductor to the further current supply conductor. This method of igniting, however, leads to a comparatively long delay, called ignition delay hereinafter, between the moment of switching-on of the lighting unit and actual lamp ignition. This is a disadvantage. Moreover, the provisions required for this render such a lighting unit comparatively expensive.

[0005] In a lighting unit of the "rapid start" type, the electrodes also each have a further current supply conductor, and the electrodes are given a raised temperature by means of an auxiliary current. It is true that an ignition voltage is applied immediately after switching on in this type of lighting unit. An ignition delay is realized here, however, in that the ignition voltage is insufficiently high for igniting the lamp with its still cold electrodes. The lamp does not ignite until after the electrodes have assumed a sufficiently high temperature.

[0006] A lighting unit of the kind described in the opening paragraph, in which the lamp ignites in the cold state, is described in US 5,341,067. In such a lighting unit, also referred to as "cold start" or "instant start", an ignition voltage is applied between the electrodes of a sufficient level for igniting the lamp practically immediately after switching-on, i.e. with an ignition delay of less than 100 ms. The electrodes only assume their nominal operational temperature after ignition. A further current supply conductor to the electrodes is not necessary in lighting units of this type. The electrodes are exclusively heated by the discharge arc applied thereto and by the discharge current during nominal operation in this case. If the electrodes have a further current supply conductor, an auxiliary current may contribute to maintaining the nominal operational temperature of the electrodes.

[0007] The lamps of the lighting units mentioned above in general have a long life in continuous operation. The life of lighting units in which the lamps are ignited in the cold state is limited in practice by the switching life of the lamp, i. e. the number of times the lamp can be switched on. It was in fact found that the ignition of the lamp whose electrodes are still cold causes comparatively much damage to the electrodes, so that the electrode becomes defective after a comparatively small number of switching operations. To reduce the switching frequency, the lamps are often operated continuously also in cases where the need for lighting is of short duration only. This strongly detracts from the energy saving which could be achieved in comparison with incandescent lamps.

[0008] It is an object of the invention to provide a lighting unit of the kind described in the opening paragraph in which the lamp is ignited substantially immediately after switching-on and which nevertheless has a long switching life.

[0009] According to the invention, the lighting unit of the kind described in the opening paragraph is for this purpose characterized in that during nominal operation at least a portion of each of the electrodes passes an electrode current Iel with an effective value $\bar{I}$el of at least 1.8 times the minimum electrode current Ip4 required for thermal emission. The effective value $\bar{I}$ of a current I is defined as:

$$\bar{I} = 1/T \surd \int_0^T I^2 \, dt, \quad ,$$

in which T is the duration of one cycle of the current I. The temperature of the electrode is exactly high enough for thermal emission to occur in the case of an electrode current having an effective value equal to Ip4. This temperature is approximately 950 K. Tungsten electrodes have a resistance at this temperature which is four times that at room temperature. The electrodes assume a comparatively high hot spot temperature in the location where the arc applies

itself in the case of an electrode current having an effective value $\bar{I}el$ of at least 1.8 times Ip4. Surprisingly, the lamp of the lighting unit according to the invention has a considerably longer switching life in spite of the heavier thermal load on its electrodes. A possible explanation for this is that the metals whose oxides are used as electron emitters play an important part during lamp ignition. It is assumed that the higher hot spot temperature reduces the electron-emitting metal oxides, for example barium oxide, to the respective metals, for example barium, at a faster rate, so that this metal is accordingly available in a sufficient quantity also during short operating times of the lamp. Preferably, the effective value $\bar{I}el$ of the electrode current is at most 3.0 times Ip4. Higher values will lead to an excessive shortening of lamp life in the case of continuous operation owing to attacks on the metal wires of the electrodes.

[0010] In an embodiment of the lighting unit according to the invention, the electrode current Iel is the discharge current Id. In a favourable embodiment, the electrodes each have a respective further current supply conductor, a discharge current Id flowing from the first to the second electrode during nominal operation, while an auxiliary current Ih flows from the current supply conductor to the further current supply conductor. The electrode current Iel in that case is the sum of the discharge current Id and the auxiliary current Ih.

[0011] Preferably, the ratio $\bar{I}h/\bar{I}d$ is at most 1.0. A comparatively strong loss of emitter material occurs in the electrodes with a ratio above 1.0.

[0012] A favourable embodiment of the lighting unit according to the invention is one which is characterized in that the supply unit is provided with a high-frequency circuit arrangement with a first and a second output terminal and is provided with inductive and capacitive means, said first output terminal being connected to the current supply conductor of the first electrode via the inductive means, and said second output terminal being connected to the current supply conductor of the second electrode, while the further current supply conductors of the electrodes are interconnected via the capacitive means. The capacitive means together with the inductive means form a resonant circuit which causes an ignition voltage to arise after the lighting unit has been switched on. If one of the electrodes has become defective, the circuit with the capacitive means is broken, so that no ignition voltage can be generated anymore. Unsafe situations at the end of lamp life are avoided thereby. The values of the auxiliary current and the discharge current can be adjusted in a simple manner through the choice of said capacitive and inductive means.

[0013] In an attractive embodiment, the electron-emitting metal oxide of the electrodes comprises barium oxide, calcium oxide, and strontium oxide.

[0014] The lamp and the supply unit may be integrated into one unit. Alternatively, the lamp may be detachably coupled to the supply unit. The invention accordingly also relates to a low-pressure mercury discharge lamp provided with a first coupling member specially adapted for cooperation with a second coupling member of a supply unit for the electrical and mechanical coupling of the low-pressure mercury discharge lamp to the supply unit, such that the low-pressure mercury discharge lamp and the supply unit in the coupled state constitute a lighting unit according to the invention.

[0015] The invention also relates to a supply unit provided with a second coupling member which is specially adapted for cooperation with a first coupling member of a low-pressure mercury discharge lamp for the electrical and mechanical coupling of the low-pressure mercury discharge lamp to the supply unit, such that the low-pressure mercury discharge lamp and the supply unit in the coupled state constitute a lighting unit according to the invention.

[0016] Since the first and the second coupling member are specially adapted to cooperate with one another, it will be clear which combination of supply unit and low-pressure mercury discharge lamp should be chosen for achieving the object of the invention.

[0017] Alternatively, a supply unit and a low-pressure mercury discharge lamp forming a combination suitable for achieving said object may be packed together.

[0018] The invention accordingly also relates to a combined packaging containing a low-pressure mercury discharge lamp provided with a first coupling member and a supply unit provided with a second coupling member, which first and second coupling member have a mutually cooperating state in which they couple the low-pressure mercury discharge lamp electrically and mechanically to the supply unit such that the low-pressure mercury discharge lamp and the supply unit constitute a lighting unit according to the invention. The very fact that the two are packed together in itself indicates that this combination of lamp and supply unit forms a lighting unit according to the invention. It is not necessary then for the coupling members to be capable of cooperation exclusively with one another.

[0019] The first and the second coupling member may have, for example, separate means for electrically and for mechanically coupling the low-pressure mercury discharge lamp to the supply unit.

[0020] The mechanical coupling means may be, for example, a snap connection, a clamp connection, or a screw connection. In an embodiment, the electrical coupling means are realized in that the first and the second coupling member each comprise a coil, said coils forming a transformer together with the supply unit in the coupled state of the low-pressure mercury discharge lamp.

[0021] In an alternative embodiment, the electrical coupling means are realized, for example, in the form of contact pins which can be held with clamping fit in contact sockets of the supply unit. These means may at the same time be the means for mechanical coupling.

[0022] These and other aspects of the lighting unit according to the invention are explained in more detail with reference to the drawing, in which:

Fig. 1 shows a first embodiment of the lighting unit according to the invention,
Fig. 2 shows a detail II from Fig. 1, and
Fig. 3 shows a second embodiment of the lighting unit according to the invention.

[0023] The lighting unit according to the invention shown in Fig. 1 comprises a supply unit 1 and a low-pressure mercury discharge lamp 2. The lighting unit can serve as a replacement for an incandescent lamp. The low-pressure mercury discharge lamp 2 has a light-transmitting discharge vessel 3 which is provided with a luminescent layer 3' on an inner surface. The discharge vessel 3 encloses a discharge space 4, which is provided with a filling of mercury and argon, in a gastight manner. A first and a second electrode 5a, 5b are arranged in the discharge space 4. Fig. 2 shows the electrode 5a in more detail. The electrode 5b is of a similar construction. The electrodes 5a, 5b each comprise a metal coil coated with one or several electron-emitting metal oxides. The electrodes are formed from a triple coiling of tungsten wire with a diameter d_{el} of 24 μm in this case, coated with a mixture of barium oxide, calcium oxide, and strontium oxide. The minimum electrode temperature required for thermal emission is 950 K. The current Ip4 required for achieving this temperature is 60 mA for these electrodes. The electrodes 5a, 5b are each electrically connected to a respective current supply conductor 6a, 6b which extends to outside the discharge vessel 3 and is connected to the supply unit 1 there. The electrodes 5a, 5b are also each connected to a respective further current supply conductor 6a', 6b' which extends to outside the discharge vessel 3.

[0024] The supply unit 1 is accommodated in a housing 7 which supports the lamp 2 and a lamp cap 8. The supply unit 1 is provided with a high-frequency circuit arrangement S having a first and a second output terminal K1, K2 and having inductive means L and capacitive means C. The high-frequency circuit arrangement S supplies an AC voltage with a frequency of 50 kHz. The first output terminal K1 of the circuit arrangement S is connected to the current supply conductor 6a of the first electrode 5a via inductive means L. The second output terminal K2 is connected to the current supply conductor 6b of the second electrode 5b. The further current supply conductors 6a', 6b' of the electrodes are interconnected via the capacitive means C. The inductive means L are formed by a coil having a self-inductance of 3.1 mH. A capacitor having a capacitance value of 4.7 nF forms the capacitive means C. The supply unit 1 is connected to contacts 8a, 8b of the lamp cap 8.

[0025] Contributions to the electrode current Iel are formed by a discharge current Id with an effective value $\bar{I}d$ of 135 mA which maintains the discharge and an auxiliary current Ih with an effective value $\bar{I}h$ of 100 mA flowing through each electrode 5a, 5b from its current supply conductor 6a, 6b to its further current supply conductor 6a', 6b' and providing additional heating for the electrode. The discharge current Id flows through an end portion 5a* of the electrode 5a, 5b which extends between its current supply conductor 6a, 6b and the location where the discharge arc applies itself to the electrode. The currents Id and Ih in this example show a phase difference ϕ of approximately 90°. The ratio $\bar{I}h/\bar{I}d$ is smaller than 1.0, i.e. 0.74 in the present case.

[0026] During nominal operation, an electrode current Iel with an effective value $\bar{I}el$ of 165 mA flows through said end portion 5a* of the electrodes 5a, 5b. This value is more than 1.8 times the minimum current Ip4 required for thermal emission. The value of $\bar{I}el$ is 2.8 times Ip4 in this case. The lamp in this lighting unit consumes a power of 10 W.

[0027] The lighting unit according to the invention described above is referred to below as "inv1". A lighting unit not according to the invention (ref1) differs from this in that the effective value $\bar{I}el$ of the electrode current is no more than 1.5 times Ip4. The lamp consumes a power of 7 W.

[0028] In a further lighting unit according to the invention (inv2), the electrode is a triple coiled tungsten wire with a diameter d_{el} of 38 μm, again coated with a mixture of barium oxide, calcium oxide, and strontium oxide. The discharge vessel contains a filling of mercury and a mixture of neon and argon. The effective value $\bar{I}el$ of the electrode current is 2.0 times Ip4 during nominal operation. The ratio $\bar{I}h/\bar{I}d$ is smaller than 1.0, i.e. 0.74 in the present case. A further lighting unit not according to the invention (ref2) differs from the lighting unit inv2 in that the effective value $\bar{I}el$ of the electrode current is no more than 1.6 times Ip4. The lamps of the lighting units inv2 and ref2 consume a power of approximately 16 W during nominal operation.

[0029] Six lighting units of the embodiment inv1 and six of the embodiment inv2 according to the invention and five lighting units of the embodiment ref1 and five of the embodiment ref2 not according to the invention were switched on and off periodically for one minute and three minutes, respectively, so as to determine their switching lives. The lamps were ignited cold with an ignition voltage of 750 Vrms, with the result that they ignited within 100 ms after switching-on of the lighting unit. The results are given in the Table below. Ths therein is the hot spot temperature of the electrode, and Ns is the switching life.

	d_{el} (µm)	Ip4 (mA)	$\bar{I}d$ (mA)	$\bar{I}h$ (mA)	$\bar{I}el$ (mA)	$\bar{I}el/Ip4$	Ths (K)	Ns
inv1	24	60	135	100	165	2.8	1750 ±50	12000 ±3500
ref1	24	60	90	30	95	1.5	1400 ±50	3000 ±1500
inv2	38	125	195	145	250	2.0	1600 ±50	13000 ±4000
ref2	38	125	180	60	195	1.6	1450 ±50	4500 ±2000

It is apparent from the Table that the lighting units inv1 and inv2 according to the invention, in which the effective value $\bar{I}el$ of the electrode current is at least 1.8 times Ip4, have a considerably longer switching life than the lighting units ref1 and ref2 not according to the invention.

[0030] A second embodiment of the lighting unit according to the invention is shown in Fig. 3. Components therein which correspond to those in Fig. 1 have reference numerals which are 10 higher. In the embodiment shown, the low-pressure mercury discharge lamp 12 is provided with a first coupling member 19. The supply unit is provided with a second coupling member 20. The supply unit is accommodated in a housing 17 which supports a lamp cap 18 with contacts 18a and 18b. The first coupling member 19 and the second coupling member 20 are mutually specially adapted so as to cooperate in realizing an electrical and a mechanical coupling of the low-pressure mercury discharge lamp 12 to the supply unit 11. The combination of the low-pressure mercury discharge lamp 12 and the supply unit 11 is accommodated in a packaging 21. The low-pressure mercury discharge lamp 12 and the supply unit 11 together form a lighting unit according to the invention in the coupled state.

[0031] In Fig. 3, contact pins 19a, 19b which can be held with clamping fit in contact sockets 20a, 20b of the supply unit 11 form means for the electrical as well as the mechanical coupling between the low-pressure mercury discharge lamp 12 and the supply unit 11. The further current supply conductors of the electrodes are not connected in Fig. 3. In a modification of this embodiment, the further current supply conductors are interconnected inside the first coupling member via an impedance, for example a capacitive impedance, so that not only a discharge current flows between the electrodes during operation, but an auxiliary current also flows through the electrodes. In another embodiment, the further current supply conductors are also connected to contact pins which cooperate with contact bushes.

Claims

1. A lighting unit comprising a supply unit (1; 11) and a low-pressure mercury discharge lamp (2; 12), which low-pressure mercury discharge lamp has a light-transmitting discharge vessel (3; 13) which is provided with a luminescent layer (3'; 13') on an inner surface and which encloses a discharge space (4; 14) in a gastight manner, said discharge space being provided with a filling comprising one or several rare gases in addition to mercury, while in this discharge space a first (5a; 15a) and a second electrode (5b; 15b) are positioned, which electrodes (5a, 5b; 15a, 15b) each comprise a coiling of a metal wire coated with one or several metal oxides which emit electrons, and which electrodes are each electrically connected to a respective current supply conductor (6a, 6b; 16a, 16b) which extends to outside the discharge vessel (3; 13) and is electrically connected there to the supply unit, which unit ignites the low-pressure mercury discharge lamp in the cold state upon switching-on, **characterized in that** the electrodes (5a, 5b) are each connected to a respective further current supply conductor (6a', 6b') which extends to outside the discharge vessel (3), a discharge current Id flowing from the first to the second electrode during nominal operation, while an auxiliary current Ih flows from the current supply conductor (6a, 6b) to the further current supply conductor (6a', 6b') of each electrode, such that during nominal operation at least a portion (5a*) of each of the electrodes (5a, 5b) passes an electrode current Iel with Iel or Id + Ih, with an effective value $\bar{I}el$ of at least 1.8 times the minimum electrode current Ip4 required for thermal emission.

2. A lighting unit as claimed in Claim 1, **characterized in that** the ratio $\bar{I}h/\bar{I}d$ is at most 1.0, $\bar{I}d$ and $\bar{I}n$ being the effective values of Id and Ih, respectively.

3. A lighting unit as claimed in Claim 1 or 2, **characterized in that** the supply unit (1) is provided with a high-frequency circuit arrangement (S) with a first (K1) and a second output terminal (K2) and provided with inductive (L) and

capacitive means (C), said first output terminal (K1) being connected to the current supply conductor (6a) of the first electrode (5a) via the inductive means (L), and said second output terminal (K2) being connected to the current supply conductor (6b) of the second electrode (5b), while the further current supply conductors (6a', 6b') of the electrodes are interconnected via the capacitive means (c).

4. A lighting unit as claimed in any one of the preceding Claims, **characterized in that** the one or several electron-emitting metal oxides of the electrodes are barium oxide, calcium oxide and strontium oxide.

5. A low-pressure mercury discharge lamp (12) provided with a first coupling member (19, 19a, 19b) which is specially adapted to cooperate with a second coupling member (20, 20a, 20b) of a supply unit (11) for electrically and mechanically coupling the low-pressure mercury discharge lamp to the supply unit such that the low-pressure mercury discharge lamp and the supply unit in the coupled state constitute a lighting unit as claimed in any one of the Claims 1 to 4.

6. A supply unit (11) provided with a second coupling member (20, 20a, 20b) which is specially adapted to cooperate with a first coupling member (19, 19a, 19b) of a low-pressure mercury discharge lamp (12) for electrically and mechanically coupling the low-pressure mercury discharge lamp to the supply such that the low-pressure mercury discharge lamp and the supply in the coupled state constitute a lighting unit as claimed in any one of the Claims 1 to 4.

7. A combined packaging comprising a packaging (21) in which a low-pressure mercury discharge lamp (12) provided with a first coupling member (19, 19a, 19b) and a supply unit (11) provided with a second coupling member (20, 20a, 20b) are accommodated, which first and second coupling member have a mutually cooperating state in which they couple the low-pressure mercury discharge lamp electrically and mechanically to the supply unit such that the low-pressure mercury discharge lamp and the supply unit constitute a lighting unit as claimed in any one of the Claims 1 to 4.

Patentansprüche

1. Beleuchtungseinheit mit einer Speiseeinheit (1; 11) und einer Niederdruck-Quecksilberentladungslampe (2; 12), welche Niederdruck-Quecksilberentladungslampe ein lichtdurchlässiges Entladungsgefäß (3; 13) aufweist, das auf einer Innenfläche mit einer Leuchtschicht (3'; 13') versehen ist und das einen Entladungsraum (4; 14) gasdicht einschließt, der mit einer zusätzlich zum Quecksilber ein oder mehrere Edelgase umfassenden Füllung versehen ist, wobei in diesem Entladungsraum eine erste (5a; 15a) und eine zweite Elektrode (5b; 15b) platziert sind, welche Elektroden (5a, 5b; 15a, 15b) je eine Wicklung aus einem Metalldraht umfassen, der mit einem Elektronen emittierenden Metalloxid oder mehreren Elektronen emittierenden Metalloxiden beschichtet ist, und welche Elektroden je elektrisch mit einem jeweiligen Stromzuführleiter (6a, 6b; 16a, 16b) verbunden sind, der sich nach außerhalb des Entladungsgefäßes (3; 13) erstreckt und dort elektrisch mit der Speiseeinheit verbunden ist, die die Niederdruck-Quecksilberentladungslampe beim Einschalten im kalten Zustand zündet, **dadurch gekennzeichnet, dass** die Elektroden (5a, 5b) je mit einem jeweiligen weiteren Stromzuführleiter (6a', 6b') verbunden sind, der sich nach außerhalb des Entladungsgefäßes (3) erstreckt, wobei im Nennbetrieb ein Entladungsstrom Id von der ersten zur zweiten Elektrode fließt, während vom Stromzuführleiter (6a, 6b) zu dem weiteren Stromzuführleiter (6a', 6b') jeder Elektrode ein Hilfsstrom Ih fließt, sodass im Nennbetrieb zumindest ein Abschnitt (5a*) jeder der Elektroden (5a, 5b) einen Elektrodenstrom Iel mit Iel = Id + Ih führt, mit einem Effektivwert $\bar{I}$el von zumindest 1,8 mal dem minimalen für die thermische Emission erforderlichen Elektrodenstrom Ip4.

2. Beleuchtungseinheit nach Anspruch 1, **dadurch gekennzeichnet, dass** das Verhältnis $\bar{I}$h/$\bar{I}$d höchstens 1,0 ist, wobei $\bar{I}$d und $\bar{I}$h die Effektivwerte von Id bzw. Ih sind.

3. Beleuchtungseinheit nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die Speiseeinheit (1) mit einer hochfrequenten Schaltungsanordnung (S) mit einer ersten (K1) und einer zweiten Ausgangsklemme (K2) sowie mit induktiven (L) und kapazitiven Mitteln (C) versehen ist, wobei die genannte erste Ausgangsklemme (K1) mit dem Stromzuführleiter (6a) der ersten Elektrode (5a) über die induktiven Mittel (L) verbunden ist und die genannte zweite Ausgangsklemme (K2) mit dem Stromzuführleiter (6b) der zweiten Elektrode (5b) verbunden ist, während die weiteren Stromzuführleiter (6a', 6b') der Elektroden über die kapazitiven Mittel (C) miteinander verbunden sind.

4. Beleuchtungseinheit nach einem der vorhergehenden Ansprüche, **dadurch gekennzeichnet, dass** das eine Elek-

tronen emittierende Metalloxid oder die mehreren Elektronen emittierenden Metalloxide der Elektroden Bariumoxid, Calciumoxid und Strontiumoxid sind.

5. Niederdruck-Quecksilberentladungslampe (12) mit einem ersten Kopplungsglied (19, 19a, 19b), das speziell zum Zusammenarbeiten mit einem zweiten Kopplungsglied (20, 20a, 20b) einer Speiseeinheit (11) ausgebildet ist, um die Niederdruck-Quecksilberentladungslampe elektrisch und mechanisch mit der Speiseeinheit zu koppeln, sodass die Niederdruck-Quecksilberentladungslampe und die Speiseeinheit im gekoppelten Zustand eine Beleuchtungseinheit nach einem der Ansprüche 1 bis 4 bilden.

6. Speiseeinheit (11), versehen mit einem zweiten Kopplungsglied (20, 20a, 20b), das speziell zum Zusammenarbeiten mit einem ersten Kopplungsglied (19, 19a, 19b) einer Niederdruck-Quecksilberentladungslampe (12) ausgebildet ist, um die Niederdruck-Quecksilberentladungslampe elektrisch und mechanisch mit der Speiseeinheit zu koppeln, sodass die Niederdruck-Quecksilberentladungslampe und die Speiseeinheit im gekoppelten Zustand eine Beleuchtungseinheit nach einem der Ansprüche 1 bis 4 bilden.

7. Kombinierte Verpackung mit einer Verpackung (21), in der eine mit einem ersten Kopplungsglied (19, 19a, 19b) versehene Niederdruck-Quecksilberentladungslampe (12) und eine mit einem zweiten Kopplungsglied (20, 20a, 20b) versehene Speiseeinheit (11) untergebracht sind, wobei das erste und zweite Kopplungsglied einen miteinander zusammenwirkenden Zustand haben, in dem sie die Niederdruck-Quecksilberentladungslampe elektrisch und mechanisch mit der Speiseeinheit koppeln, sodass die Niederdruck-Quecksilberentladungslampe und die Speiseeinheit eine Beleuchtungseinheit nach einem der Ansprüche 1 bis 4 bilden.

Revendications

1. Unité d'éclairage comprenant une unité d'alimentation (1; 11) et une lampe à décharge dans la vapeur de mercure à basse pression à basse pression (2; 12), laquelle lampe à décharge dans la vapeur de mercure à basse pression à basse pression est munie d'une enceinte à décharge transmettant la lumière (3; 13), qui est munie d'une couche luminescente (3'; 13') appliquée sur la surface intérieure et qui enferme un espace à décharge (4; 14) d'une façon étanche au gaz, ledit espace à décharge étant muni d'un remplissage contenant, outre le mercure, également un ou plusieurs gaz rares, alors que dans cet espace à décharge sont positionnées une première électrode (Sa; 15a) et une deuxième électrode (5b; 15b), lesquelles électrodes (5a, 5b; 15a, 15b) comprennent chacune un enroulement en fil métallique recouvert d'un ou de plusieurs oxydes métalliques qui émettent des électrons, et lesquelles électrodes sont connectées chacune électriquement à un conducteur d'alimentation de courant respectif (6a, 6b; 16a, 16b) qui s'étend vers l'extérieur de l'enceinte à décharge (3; 13) et qui y est connecté à l'unité d'alimentation, laquelle unité assure l'amorçage de la lampe à décharge dans la vapeur de mercure à basse pression à basse pression à l'état froid pendant la mise en service, **caractérisée en ce que** les électrodes (5a, 5b) sont connectées chacune à un autre conducteur d'alimentation de courant respectif (6a', 6b'), qui s'étend vers l'extérieur de l'enceinte à décharge (3), un courant à décharge Id circulant à partir de la première électrode vers la deuxième électrode pendant le fonctionnement nominal, alors qu'un courant auxiliaire Ih circule à partir du conducteur d'alimentation de courant (6a, 6b) à l'autre conducteur d'alimentation de courant (6a', 6b') de chaque électrode, de façon que, lors du fonctionnement nominale, au moins une partie (5a '') de chacune des électrodes (Sa, 5b) présente un courant d'électrode Iel avec Iel = Id + Ih, présentant une valeur effective $\bar{I}$el égale à au moins 1, 8 fois le courant d'électrode minimal Ip4 requis pour l'émission thermique.

2. Unité d'éclairage selon la revendication 1, **caractérisée en ce que** le rapport $\bar{I}$h/ $\bar{I}$d est d'au moins 1.0, $\bar{I}$d et $\bar{I}$h étant les valeurs effectives de, respectivement, Id et Ih.

3. Unité d'éclairage selon la revendication 1 ou 2, **caractérisée en ce que** l'unité d'alimentation (1) est munie d'un dispositif de circuit à haute fréquence (S) présentant une première borne de sortie (K1) et une deuxième borne de sortie (K2) et muni de moyens inductifs (L) et de moyens capacitifs (C), ladite première borne de sortie (K1) étant connectée au conducteur d'alimentation de courant (6a) de la première électrode (5a) par l'intermédiaire des moyens inductifs (L), et ladite deuxième borne de sortie (K2) étant connectée au conducteur d'alimentation de courant (6b) de la deuxième électrode (5b), alors que les autres conducteurs d'alimentation de courant (6a', 6b') des électrodes sont interconnectés par l'intermédiaire des moyens capacitifs (C).

4. Unité d'éclairage selon l'une des revendications précédentes, **caractérisée en ce que** l'un ou plusieurs oxydes métalliques émettant des électrons des électrodes sont constitués par de l'oxyde de baryum, de l'oxyde de calcium

et de l'oxyde de strontium.

5. Lampe à décharge dans la vapeur de mercure à basse pression (12) munie d'un premier élément d'accouplement (19, 19a, 19b) qui est en particulier conçu pour coopérer avec un deuxième élément d'accouplement (20, 20a, 20b) d'une unité d'alimentation (11) pour assurer l'accouplement mécanique et électrique de la lampe à décharge dans la vapeur de mercure à basse pression à l'unité d'alimentation de façon que la lampe à décharge dans la vapeur de mercure à basse pression et l'unité d'alimentation constituent, à l'état accouplé, une unité d'éclairage comme revendiquée dans l'une des revendications 1 à 4.

6. Unité d'alimentation (11) munie d'un deuxième élément d'accouplement (20, 20a, 20b) qui est en particulier conçu pour coopérer avec un premier élément d'accouplement (19, 19a, 19b) d'une lampe à décharge dans la vapeur de mercure à basse pression (12) pour l'accouplement mécanique et électrique de la lampe à décharge dans la vapeur de mercure à basse pression à l'unité d'alimentation de façon que la lampe à décharge dans la vapeur de mercure à basse pression et l'unité d'alimentation constituent, à l'état accouplé, une unité d'éclairage comme revendiquée dans l'une des revendications 1 à 4.

7. Ensemble combiné comprenant un emballage (21) dans lequel sont logées une lampe à décharge dans la vapeur de mercure à basse pression (12) munie d'un premier élément d'accouplement (19, 19a, 19b) et une unité d'alimentation (11) munie d'un deuxième élément d'accouplement (20, 20a, 20b), lesquels premier et deuxième éléments d'accouplement présentant un état de coopération mutuelle dans lequel ils assurent l'accouplement mécanique et électrique de la lampe à décharge dans la vapeur de mercure à basse pression à l'unité d'alimentation de façon que la lampe à décharge dans la vapeur de mercure à basse pression et l'unité d'alimentation constituent une unité d'éclairage comme revendiquée dans l'une des revendications 1 à 4.

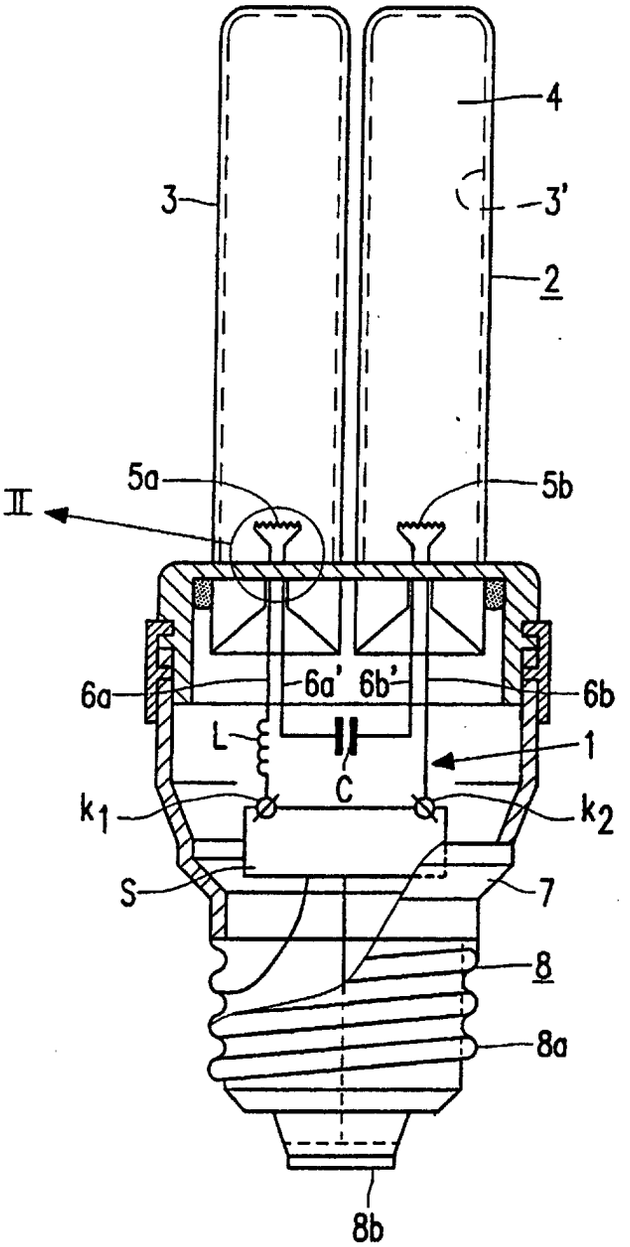

FIG. 1

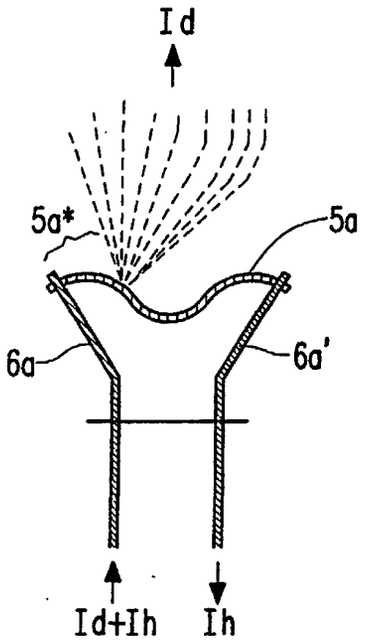
Id
5a*
5a
6a
6a'
Id+Ih
Ih

FIG. 2

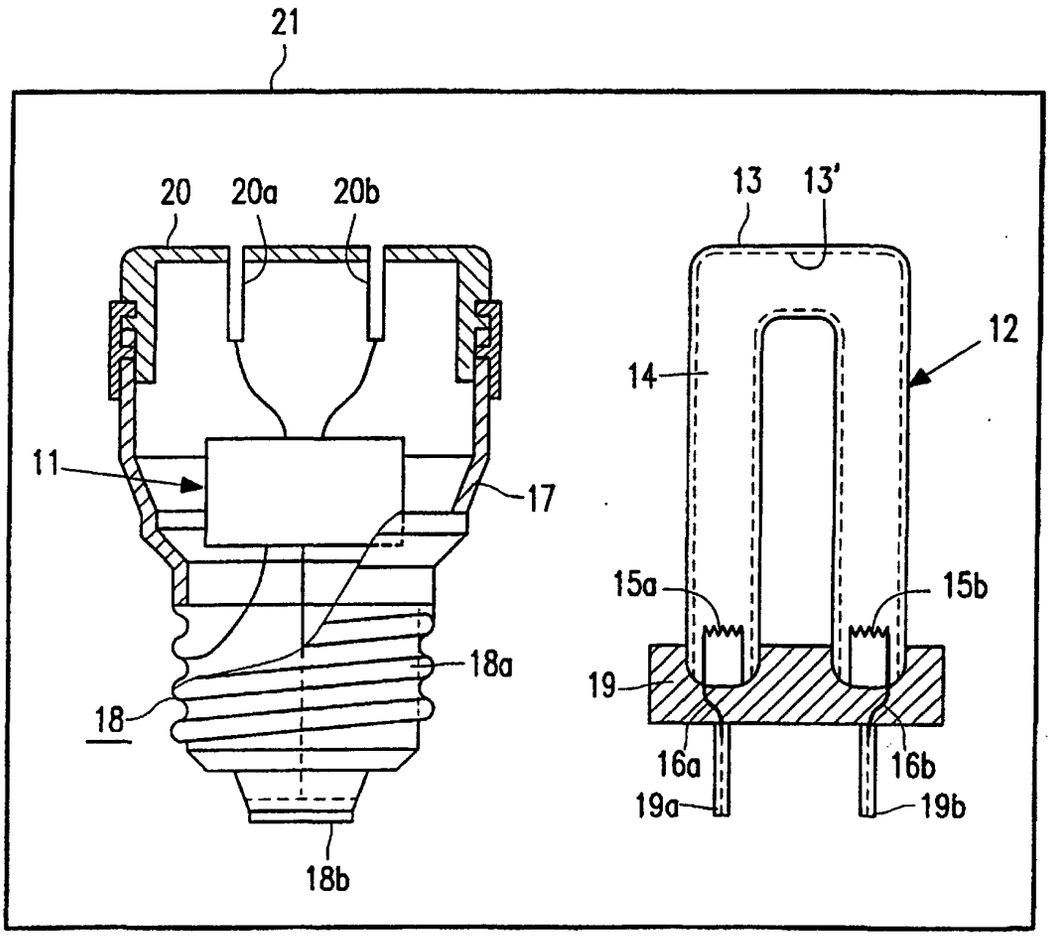
21
20
20a
20b
11
17
18a
18
18b
13
13'
12
14
15a
15b
19
16a
16b
19a
19b

FIG. 3