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ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

— as to the applicant's entitlement to claim the priority of the
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[Continued on next page]

(54) Title: ILLUMINATING DEVICE, OMNIDIRECTIONAL LUMINAIRE AND RETROFIT LAMP WITH THE ILLUMINATING DEVICE

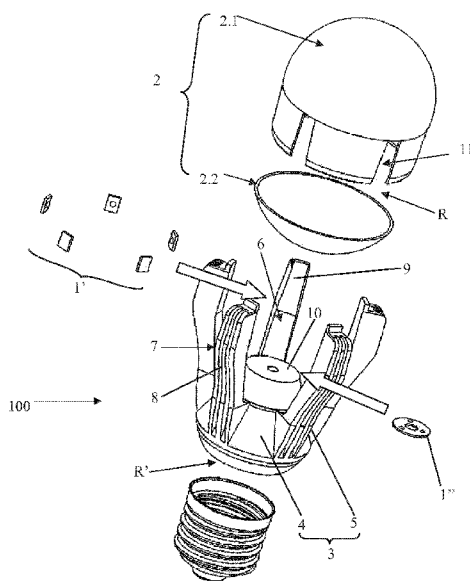


Figure 1

(57) Abstract: The present invention relates to an illuminating device (100), comprising a plurality of light sources (1), a bulb (2) and a heat sink (3), characterized by that the heat sink (3) comprises a base (4) and a plurality of support arms (5) extending from a circumferential edge of the base (4), an inner surface of respective support arm (5) is mounted with a part of the light source (1), and the heat sink (3) is partially inserted into the bulb (2) with the plurality of support arms (5) and define an enclosed space (R) with the bulb (2) for accommodating the light sources (1). In addition, the present invention further relates to an omnidirectional luminaire and a retrofit lamp comprising such heat sink.

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Description

Illuminating Device, Omnidirectional Luminaire and Retrofit Lamp with the Illuminating Device

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Technical Field

The present invention relates to an illuminating device, an omnidirectional luminaire and a retrofit lamp with the illuminating device.

10 Background Art

With the development of illumination technology, the omnidirectional illuminating devices have gradually become a new research field. The omnidirectional illuminating devices generally refer to illuminating devices having a uniform light distribution over a large area. The light diffusion angle (light distribution angle) of an omnidirectional illuminating device in the prior art has reached 320°. Especially in the US market, many illuminating devices must be designed as energy-saving illuminating devices in order to meet the "Energy Star" criteria. The research and development goal at the current stage is to enable the omnidirectional illuminating device to completely meet the "Energy Star" criteria, while having a low BOM and low manufacturing cost.

The currently known omnidirectional illuminating devices are, for example: with a complicated heat dissipation structure, and with many LEDs placed all around the surface of the illuminating device; with LED arrays arranged in a form of fly-eye; with remote phosphor light bulbs; with light guide structures; or with reflecting structures inside the bulb. Although the omnidirectional illuminating devices of the

above types substantially can achieve the expected illumination effects, they have either a very high manufacturing cost or material cost. For the omnidirectional illuminating devices, another problem to be solved is how to enhance the
5 brightness of the omnidirectional illuminating devices, and to reasonably use a heat sink to release the heat in the illumination device generated by, for example, the light source.

Summary of the Invention

10 Therefore, one object of the present invention lies in providing an illuminating device that is featured by a low cost, a simple structure and easy installation, and can realize good heat dissipating and illuminating effects.

15 The illuminating device in accordance with the present invention comprises a plurality of light sources, a bulb and a heat sink, characterized by that the heat sink comprises a base and a plurality of support arms extending from a circumferential edge of the base, an inner surface of respective
20 support arm is mounted with a part of the light source, and the heat sink is partially inserted into the bulb with the plurality of support arms and define an enclosed space with the bulb for accommodating the light sources. Assembling the bulb and the heat sink together can define the enclosed space
25 for mixing light so that light can directly emerge outwardly from inside of the bulb and the luminous efficiency is improved. Illumination to different directions is provided and the illuminating range of emergent light is increased by using a plurality of support arms; moreover, compared with the
30 prior "basin-shaped" heat sink, the heat sink in accordance with the present invention has a reduced mass, a low cost and advantageously supports the bulb. Besides, as the light

sources that generate heat in operation are mounted on the support arms, the heat can be transferred directly in a thermal contact manner to the whole heat sink, and thus heat dissipation is realized. The heat sink in accordance with the present invention has dual functions of providing support and dissipating heat. The "inner surface" in the present text refers to one side surface of respective support arm at least partially located in the enclosed space.

In one preferred embodiment, only a region of respective inner surface carrying the light source is located inside the enclosed space, and other portions of the heat sink, e.g. outer surface of respective support arm, are still located outside the enclosed space, so as to improve the heat dissipating effect.

In accordance with one preferred solution of the present invention, respective support arm has the outer surface outside the enclosed space, and cooling ribs are arranged on the outer surface. The cooling ribs can be made in one piece with the support arm or additionally mounted on the support arm, thus, the heat dissipating area of the heat sink is increased, so that heat can be dissipated, for instance, in a manner of radiation. In another preferred solution, the cooling ribs further can be replaced by other cooling structures such as cooling holes. The "outer surface" in the present text refers to one side surface formed opposite to the "inner surface" and located outside the enclosed space.

In accordance with one preferred solution of the present invention, respective support arm has a hollow structure, with an accommodating cavity opened in the arm, for accommodating an electronic device for controlling the light source. Preferably, respective electronic device can be, for instance, a

flexible circuit board. The flexible circuit boards can be independent from each other and accommodated in the accommodating cavities, respectively, so as to control the light sources. Wires further can be preferably used to electrically connect the light sources respectively mounted on the support arms with, e.g. a circuit board mounted on the base. Via the configuration of the hollow structure, spaces for accommodating the electronic devices are skillfully provided, reducing circuit complexity when the electronic devices are placed on the inner surfaces of the support arms.

In accordance with one preferred solution of the present invention, the support arms in an odd number are provided. There may be preferably three, five or more support arms. Upon experiments, the best heat dissipating and illuminating effects can be obtained when there are five support arms. In another preferred solution, the support arms further can be provided in pairs, for instance, there are two pairs, three pairs or more pairs of support arms.

In accordance with one preferred solution of the present invention, light source comprised a plurality of first light sources, and respective first light source is mounted in a first region of the inner surface facing away from the base, and the first region is a flat surface. At a free end of respective support arm facing away from the base, the first region located on an inner side of respective support arm, i.e. in the inner surface, is configured to mount the light source. In order to obtain good illuminating effect, respective first region is advantageously configured as flat surface so that an optical path of the light source mounted thereon is directed to a central axis of the illuminating device. Since the illuminating device has a plurality of support arms, the first regions can be simply configured as flat

surfaces, which not only can assure good omnidirectional illuminating effect, but also simplifies the manufacturing process of the heat sink at the same time.

In accordance with one preferred solution of the present invention, respective first region is perpendicular to the base, in which situation the optical path of the light source located in respective first region is parallel to the base and extends in the enclosed space. Preferably, respective first region is inclined with respect to the base, in which situation the first region can be, for instance, slightly inclined to the base until it forms an angle of 5° with the base, thus an illuminating effect close to omnidirectional illumination can be obtained. The light distribution effect of the illuminating device can be adjusted by adjusting the positional relation between the first regions and the base.

In one preferred embodiment, the first light sources mounted in the first regions are arranged in a form of point light sources. One or more first light sources can be mounted in respective first region according to demand to luminance. The "point light source" herein is a term in relation to the "linear light source", specifically referring to that when an arrangement of a plurality of first light sources is designed, they can be arranged, for instance, concentratedly or compactly into a ring shape or rectangular shape but not linear shape.

Preferably, a single first light source is mounted in respective first region, thus the energy can be saved and the illumination precision can be improved.

In accordance with one preferred solution of the present invention, the plurality of support arms are configured to have

an identical arc-shaped profile, and the arc-shaped profile matched with a profile of the bulb. The support arm configured in such a manner has a high universality, and is particularly adapted to support a bulb usually configured to be pear-shaped or spherical. As a result, the illuminating device is pleasing, and the assembling process can be simplified.

In accordance with one preferred solution of the present invention, the light source comprised at least one second light source, and a surface of the base facing the bulb comprises a second region for mounting the second light source. An optical path of the second light source mounted in the second region advantageously can extend upwardly in a direction perpendicular to the base, and thus, when it is used simultaneously with the first light sources in the first regions, a light angle of emergent light can be bigger than 180° in vertical direction.

In accordance with one preferred solution of the present invention, surfaces of the heat sink located inside the enclosed space are at least partially configured as reflective surfaces. By configuring a plurality of surfaces of the heat sink that can receive light in the enclosed space as reflective surfaces, the light efficiency of an illuminating device with such heat sink and the omnidirectional illuminating effect can be improved.

In accordance with one preferred solution of the present invention, the bulb is opened with a plurality of first openings for at least partially accommodating the support arms, respectively, and a second opening corresponding to the second region, and the second opening and the first openings are in communication with each other. By opening the first open-

ings and the second opening that are in communication with each other on the spherical bulb, the bulb can be mounted on the heat sink and forms with the heat sink a complete and enclosed illuminating device.

5 In accordance with another preferred solution of the present invention, the bulb comprises an upper shell and a lower shell capable of being assembled together, wherein a circumferential wall of the upper shell is opened with a plurality of first openings for at least partially accommodating the
10 support arms, respectively, and a second opening is opened in a center of the lower shell. As a result, the upper shell and the lower shell, when assembled into a complete bulb, further can be installed together with the heat sink so as to form the complete and enclosed illuminating device.

15 Respective support arm is clamped in respective first opening clamps corresponding. Since part of respective support arm, especially the first region of respective support arm, can be inserted into inside of the bulb through the first opening, the bulb clamps the support arms with the first openings in a
20 horizontal direction, and meanwhile, the support arms, especially horizontal end surfaces thereof located between the inner surfaces and the outer surfaces, further support the bulb in a vertical direction with the first openings.

In accordance with one preferred solution of the present invention,
25 the illuminating device further comprises a driver located in a cavity of the heat sink facing away from the bulb. Accordingly, the driver can be mounted in the heat sink in a compact manner, thus reducing the volume of the illuminating device.

Besides, the present invention further relates to an omnidirectional luminaire, characterized by comprising the illuminating device above. The omnidirectional illumination effect can be obtained by adjusting the number of light sources

5 mounted in various regions of the illuminating device.

Further, the present invention further relates to a retrofit lamp which is an illuminating device according to the present invention taking LED chips as the light sources. The retrofit

10 lamp in accordance with the present invention has the advantages of energy saving and high efficiency.

Brief Description of the Drawings

The accompanying drawings constitute a part of the present Description and are used to provide further understanding of

15 the present invention. Such accompanying drawings illustrate the embodiments of the present invention and are used to describe the principles of the present invention together with the Description. In the accompanying drawings the same components are represented by the same reference numbers. As shown

20 in the drawings:

Fig. 1 is a 3D exploded view of a first embodiment of an illuminating device in accordance with the present invention;

Fig. 2 is a sectional view of the first embodiment shown in Fig. 1;

25 Fig. 3 is a 3D view of the first embodiment shown in Fig. 1; and

Fig. 4 is a 3D exploded view of a second embodiment of an illuminating device in accordance with the present invention.

Detailed Description of the Embodiments

Fig. 1 is a 3D exploded view of a first embodiment of an illuminating device 100 in accordance with the present invention. The illuminating device 100 comprises a plurality of light sources 1, a bulb 2 and a heat sink 3. The heat sink 3 preferably serves dual functions of dissipating heat and providing support so as to support the bulb 2 and improve the heat dissipating effect of the illuminating device 100. The heat sink 3 comprises a base 4 and five support arms 5 extending from a circumferential edge of the base 4. When the heat sink 3 and the bulb 2 are assembled into the complete illuminating device 100, the five support arms 5 of the heat sink 3 are partially inserted into the bulb 2, respectively, and define an enclosed space R for accommodating the light sources 1. The bulb 2 in the present embodiment consists of an upper shell 2.1 and a lower shell 2.2, wherein five first openings 11 are opened on a circumferential sidewall of the upper shell 2.1 for supporting on the heat sink 3 and accommodating the support arms 5, respectively, and a second opening 12 (see Fig. 2) that is not shown in Fig. 1 is opened in a center of the lower shell 2.2.

In the present embodiment, the five support arms 5 are uniformly distributed on the circumferential edge of the base 4, and one end of respective support arm 5 is connected with the circumferential edge, and the other end extends in a direction facing away from the base 4 and particularly extends following a profile curve of the bulb 2, so as to form a structure that can support the bulb 2. The light sources 1 comprise a plurality of first and second sources 1', 1''. The plurality of first sources 1' are mounted on inner surfaces 6 of the support arms 5. Heat generated in operation of the first light sources 1' can pass through the support arms 5

and be transferred directly in a thermal contact manner to various locations of the heat sink 3. There are, for instance, two, three or four, preferably five or six or more support arms 5. On one hand, these support arms 5 provided in pairs or not in pairs can assure the illuminating device 100 to realize homogeneous and good illuminating effect, and on the other hand, they can meet desired heat dissipating requirements based on a sufficiently big heat dissipating area. In addition, in order to further improve the heat dissipating effect, cooling ribs 8 are preferably arranged on surfaces of the support arms 5 exposed outside the enclosed space R, particularly on an outer surface 7 of respective support arm 5 formed opposite to the inner surface 6. The cooling ribs 8 can be made in one piece with the support arms 5, or additionally arranged on the support arms 5.

In accordance with one embodiment of the present invention not shown, the cooling ribs further can be replaced by other cooling structures such as cooling holes so as to realize convective heat dissipation.

The inner surface 6 of respective support arm 5 comprises an end region facing away from the base 4. This region is advantageously configured as a first region 9 for mounting the first light sources 1'. As shown in Fig. 2, a single first light sources 1' is mounted in respective first region 9, as a result, omnidirectional illumination can be realized with the five light sources mounted in the circumferential direction.

In a substitutable embodiment not shown, a plurality of first light sources 1' further can be mounted in respective first region 9. These first light sources 1' are arranged concentratedly or compactly into a ring shape or rectangular shape

but not linear shape, so as to create an effect similar to that of "point light sources", and thus the light efficiency of the illuminating device 100 can be improved.

In order to power and control an operation state of the first
5 light sources 1', electronic devices for controlling the first light sources 1' are placed in the accommodating cavities of the support arms 5 in the present embodiment. The electronic devices in the present embodiment are, for instance, flexible circuit boards directly mounted into the ac-
10 commodating cavities, respectively.

In other substitutable embodiments not shown, a circuit board is mounted on the base 4, and electronic devices are wires adapted to electrically connect first light sources 1' with the circuit board mounted on the base 4.

15 In the first embodiment of the present invention, the support arms 5 are identically configured and each has an arc-shaped profile corresponding to an outer profile of the bulb 2. In the present embodiment, the base 4 is configured to have a truncated cone shape which can provide a curved surface with
20 an area as big as is possible to be used as a functional surface of the heat sink 3. A second region 10 for mounting the second sources 1'' is formed in a center of a top surface of the base 4 so as to realize illumination in a vertical direction.

25 For the sake of omnidirectional illuminating effect and cooperation with the circumferential profile of the bulb 2, the first region 9 is advantageously configured as a flat surface such that first light sources 1' mounted in various first regions 9 illuminate in a radial direction towards a central
30 axis of the illuminating device 100. The first regions 9 can

be configured to be perpendicular to the second region 10, and further can be slightly inclined towards the second region 10 so as to realize illumination in horizontal and circumferential directions.

- 5 The illuminating device 100 further comprises a driver located in a cavity R' of the heat sink 3 facing away from the bulb. As a result, the driver can be mounted in the heat sink 3 in a compact manner, thus reducing the volume of the illuminating device 100.
- 10 Fig. 2 is a sectional view of the first embodiment shown in Fig. 1. It can be seen from Fig. 2 that the first openings 11 opened in the circumferential wall of the upper shell 2.1 hold corresponding support arms 5, respectively, and the upper shell 2.1 is assembled together with the lower shell 2.2
- 15 pressed against the base 4. Herein, only the first regions 9 are preferably located inside the enclosed space R , i.e. the first regions 9 and inner walls of the upper shell 2.1 and of the lower shell 2.2 define the enclosed space R , while other portions of the heat sink 3, such as outer surface 7 and side
- 20 surfaces between the inner surface 6 and the outer surface 7 of respective support arm 5, are still located outside the enclosed space R , as a result, the heat dissipating effect can be improved. Besides, regions of the heat sink 3 located inside the enclosed space R , e.g. the first and second re-
- 25 gions 9, 10, can be at least partially configured as reflective surfaces.

Fig. 3 is a 3D view of the first embodiment shown in Fig. 1. When the light sources 1 are LED chips, the illuminating device 100 can be useful as retrofit lamp. In addition, since the

30 illuminating device 100 can create omnidirectional illuminating effect, it further can be used as omnidirectional lumi-

naire.

Fig. 4 is a 3D exploded view of a second embodiment of an illuminating device in accordance with the present invention. Different from the first embodiment, the bulb of the illuminating device 100 herein is configured as an independent part, e.g. pear-shaped bulb, and a plurality of first openings 11 and one second opening 12 opened in the bulb 2 are in perpendicular communication. As the support arms 5 have a profile corresponding to that of the bulb 2, the inner surfaces 6 can be completely located in the enclosed space R. All the inner surfaces 6 and the top surface of the base 4 herein can be preferably configured as reflective surfaces to improve the light efficiency.

The above is merely preferred embodiments of the present invention but not to limit the present invention. For the person skilled in the art, the present invention may have various alterations and changes. Any alterations, equivalent substitutions, improvements, within the spirit and principle of the present invention, should be covered in the protection scope of the present invention.

List of reference signs

	1	light source
	1'	first light source
	1''	second light source
5	2	bulb
	2.1	upper shell
	2.2	lower shell
	3	heat sink
	4	base
10	5	support art
	6	inner surface
	7	outer surface
	8	cooling rib
	9	first region
15	10	second region
	11	first opening
	12	second opening
	100	illuminating device
	R	enclosed space
20	R'	cavity

Patent claims

1. An illuminating device (100), comprising a plurality of light sources (1), a bulb (2) and a heat sink (3), characterized by that the heat sink (3) comprises a base (4) and a plurality of support arms (5) extending from a circumferential edge of the base (4), an inner surface of respective support arm (5) is mounted with a part of the light source (1), and the heat sink (3) is partially inserted into the bulb (2) with the plurality of support arms (5) and define an enclosed space (R) with the bulb (2) for accommodating the light sources (1).
2. The illuminating device (100) according to Claim 1, characterized in that respective support arm (5) has an outer surface (7) outside the enclosed space (R), and cooling ribs (8) are arranged on the outer surface (7).
3. The illuminating device (100) according to Claim 1, characterized in that respective support arm (5) has a hollow structure, with an accommodating cavity opened in the arm, for accommodating an electronic device for controlling the light source (1).
4. The illuminating device (100) according to Claim 3, characterized in that respective electronic device is a flexible circuit board.
5. The illuminating device (100) according to Claim 1, characterized in that the support arms (5) in an odd number are provided.
6. The illuminating device (100) according to Claim 4, characterized in that five support arms (5) are provided.

7. The illuminating device (100) according to Claim 1, characterized in that light source (1) comprised a plurality of first light sources (1'), and respective first light source (1') is mounted in a first region (9) of the inner surface (6) facing away from the base (4), and the first region (9) is a flat surface.

8. The illuminating device (100) according to Claim 7, characterized in that respective first region (9) is perpendicular to the base (4).

9. The illuminating device (100) according to Claim 7, characterized in that respective first region (9) is inclined with respect to the base (4).

10. The illuminating device (100) according to Claim 7, characterized in that the first light sources (1') mounted in the first regions (9) are arranged in a form of point light sources.

11. The illuminating device (100) according to Claim 10, characterized in that a single first light source (1') is mounted in respective first region (9).

12. The illuminating device (100) according to any one of Claims 1-7, characterized in that the plurality of support arms (5) are configured to have an identical arc-shaped profile, and the arc-shaped profile matched with a profile of the bulb (2).

13. The illuminating device (100) according to any one of Claims 1-7, characterized in that the light source (1) comprised at least one second light source (1''), and a surface of the base (4) facing the bulb (2) comprises a second region

(10) for mounting the second light sources (1'').

14. The illuminating device (100) according to Claim 13, characterized in that the bulb (2) is opened with a plurality of first openings (11) for at least partially accommodating
5 the support arms (5), respectively, and a second opening (12) corresponding to the second region (12), and the second opening (12) and the plurality of first openings (11) are in communication with each other.

15. The illuminating device (100) according to Claim 13,
10 characterized in that the bulb (2) comprises an upper shell (2.1) and a lower shell (2.2) capable of being assembled together, wherein a circumferential wall of the upper shell (2.1) is opened with a plurality of first openings (11) for at least partially accommodating the support arms (5), and a
15 second opening (12) is opened in a center of the lower shell (2.2).

16. The illuminating device (100) according to Claim 14 or 15, characterized in that respective support arm (5) is clamped in respective first opening (11).

20 17. The illuminating device (100) according to any one of Claims 1-7, characterized in that surfaces of the heat sink (3) located inside the enclosed space (R) are at least partially configured as reflective surfaces.

18. The illuminating device (100) according to any one of
25 Claims 1-7, characterized by further comprising a driver located in a cavity (R') of the heat sink (3) facing away from the bulb (2).

19. An omnidirectional luminaire, characterized by compris-

ing the illuminating device (100) according to any one of Claims 1-18.

20. A retrofit lamp, characterized by comprising the illuminating device (100) according to any one of Claims 1-18, wherein the light sources (1) are LED chips.

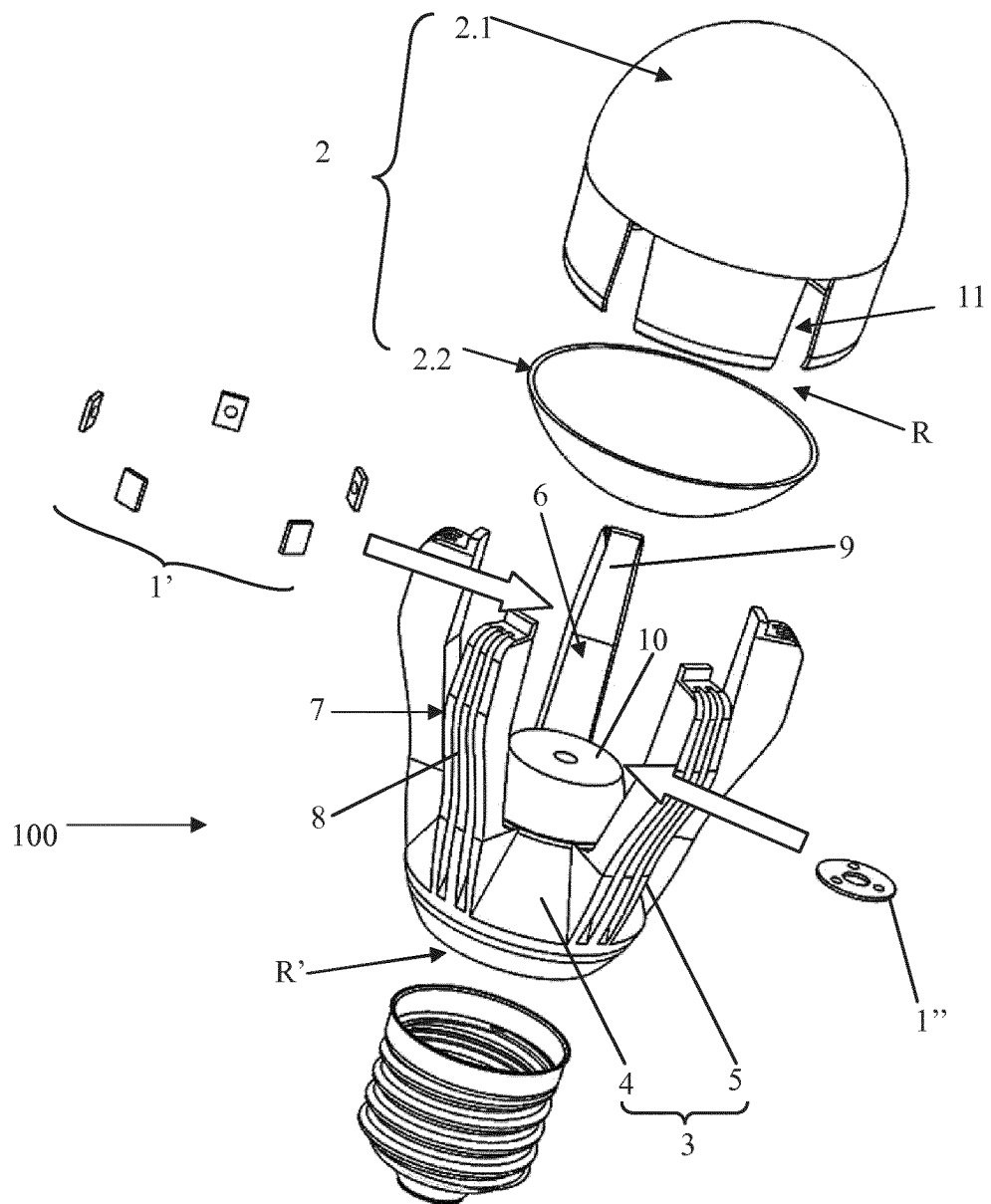


Figure 1

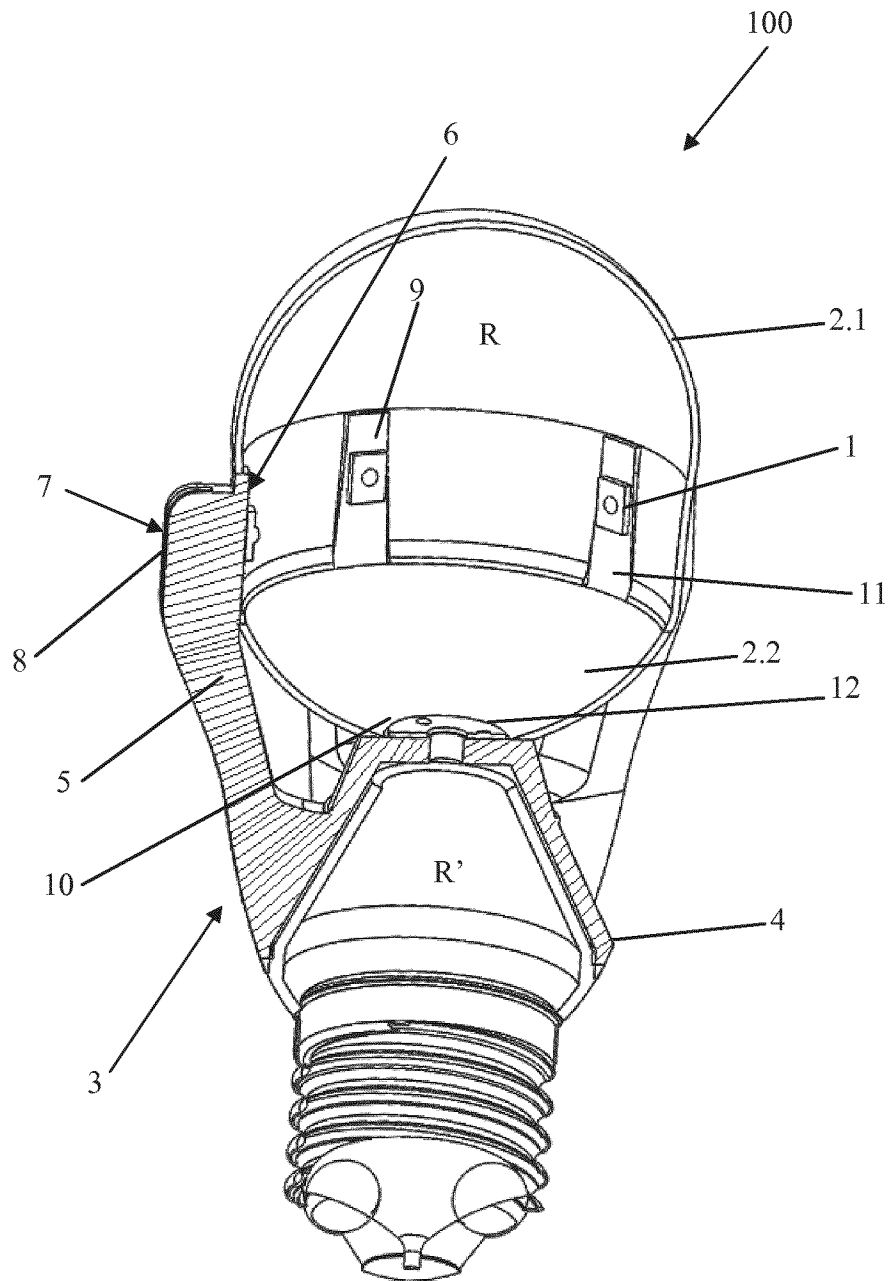


Figure 2

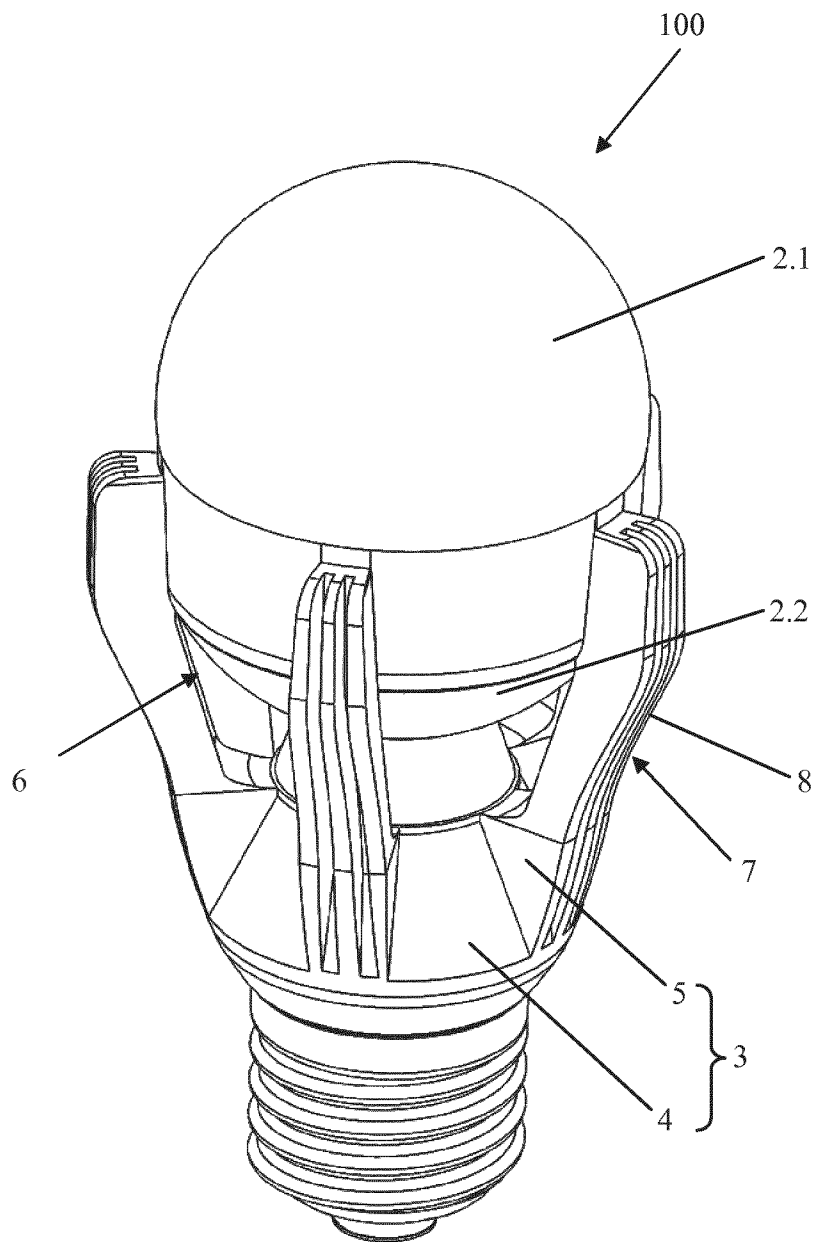


Figure 3

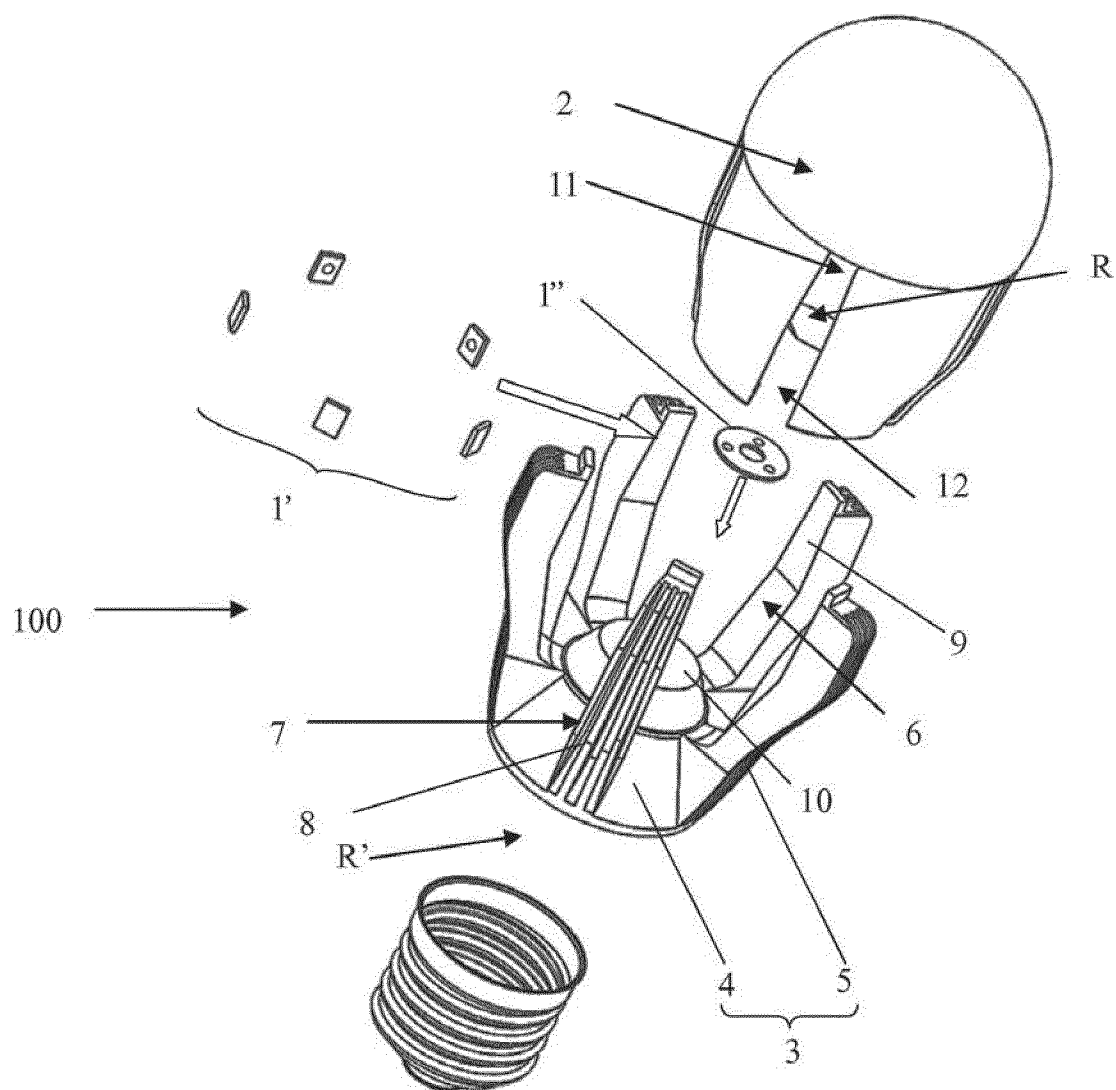


Figure 4

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. F21V29/00 F21V3/02 F21K99/00
ADD. F21Y101/02

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)
F21V

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2012/043878 A1 (LIANG CHIH-LUNG [TW] ET AL) 23 February 2012 (2012-02-23) figures 1-4 paragraph [0017] - paragraph [0026] paragraph [0035]	1-14, 16-20
A	----- WO 2009/149263 A1 (FOREVER BULB LLC [US]; CARROLL DAVID W [US]; CARROLL WENDELL L [US]) 10 December 2009 (2009-12-10) abstract; figures 1,2,4 paragraph [0033] paragraph [0040]	1-4,7,8
A	----- WO 2010/058325 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; GIELEN VINCENT S D [NL]; ANSEMS J) 27 May 2010 (2010-05-27) page 6, line 1 - page 9, line 22; figures 2A, 2D, 5 ----- -/-	1,7,8, 16,17



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

27 May 2013

Date of mailing of the international search report

06/06/2013

Name and mailing address of the ISA/

European Patent Office, P.B. 5818 Patentlaan 2
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Thibaut, Arthur

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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