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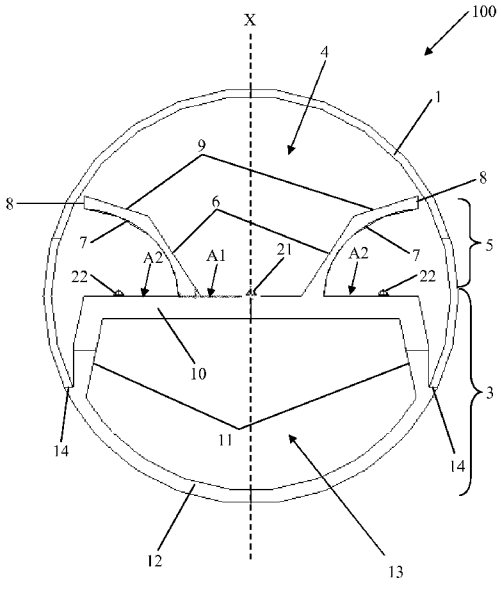

Figure 1

(57) Abstract: The present invention relates to an illuminating device (100), having a housing (1), a plurality of groups of light sources (21, 22) and a base (3), wherein the base (3) and the housing (1) define a first accommodating cavity (4) for accommodating the plurality of groups of light sources (21, 22), characterized by further comprising at least one pair of reflectors (5) arranged at one side of the base (3), the at least one pair of reflectors (5) separate the base (3) into a first region (A1) located between the at least one pair of reflectors (5) for carrying a first group of light sources (21) and second regions (A2) located at both sides of the first region for carrying a second group of light sources (22), a surface of respective reflector (5) facing to the first group of light sources (21) comprises a first reflection surface (6), and a surface of respective reflector (5) facing to the second group of light sources (22) comprises a second reflection surface (7). In addition, the present invention further relates to a retrofit lamp comprising such illuminating device.

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Description

Illuminating Device and Retrofit Lamp Comprising the Illuminating Device

Technical Field

The present invention relates to an illuminating device and a retrofit lamp comprising the illuminating device.

Background Art

Currently, cove light has gradually become a mainstream product in the market of illuminating device due to merits such as simple structure and capability of realizing linear illumination. Classical T5 or T8 batten light is widely used as it can accomplish omnidirectional illumination. Compared with directional illuminating devices, the light distribution area of an omnidirectional illuminating device is quite diffusive with soft luminance and is more easily accepted by users, and is particularly adapted to meet requirements of large-area illumination.

With the development of LED technology, more and more T8 retrofit lamps appear in the market in recent years. Such retrofit lamps are used as cove lights mounted near to the ceiling and they can provide directional light to a direction towards the ceiling, but the light is restricted by emergent angle and cannot completely fill the cove space. In this situation, the reflector opposite to the cove light must be used for reflection to increase the illumination area. If a light-absorbing material or pollutant covers a region of the ceiling used as reflector, the reflection and illumination effects will be notably affected.

Summary of the Invention

An object of the present invention lies in providing an illuminating device that can realize omnidirectional illumination and thus has a strong universality and uniform illumination effect, saves energy and is highly effectively.

The illuminating device in accordance with the present invention has a housing, a plurality of groups of light sources and a base, wherein the base and the housing define a first accommodating cavity for accommodating the plurality of groups of light sources, characterized by further comprising at least one pair of reflectors arranged at one side of the base, the at least one pair of reflectors separate the base into a first region located between the at least one pair of reflectors for carrying a first group of light sources and second regions located at both sides of the first region for carrying a second group of light sources, a surface of respective reflector facing to the first group of light sources comprises a first reflection surface, and a surface of respective reflector facing to the second group of light sources comprises a second reflection surface.

The concept of the present invention lies in arranging a plurality of groups of light sources of the illuminating device in different regions and separating the light sources from each other by using reflectors located in various regions. In order to realize the omnidirectional illumination, the reflectors are particularly used to reflect light emitted from these light sources towards the first and second regions carrying the first and second groups of light sources, respectively. Light from the first group of light sources emerges from the middle through the housing of the illuminating device and light from the second group of light sources located

at both sides of the first group of light sources emerges from both sides of the housing, and thus omnidirectional illumination can be realized.

In accordance with one preferred solution of the present invention, the at least one pair of reflectors are arranged symmetrically with respect to a vertical axis of the housing. In this situation, the first group of light sources located between the one pair of reflectors are arranged in a central region of the illuminating device, and an optical axis thereof overlaps the vertical axis, and the second group of light sources are arranged at both sides of the first group of light sources symmetrically and separated from the first group of light sources by the reflectors, as a result, a part of emergent light can emerge through the central region of the housing with the aid of the first reflection surfaces of the reflectors facing to the first group of light sources, and the other part of emergent light can emerge from both sides of the housing by means of the second reflection surfaces of the reflectors facing to the second group of light sources. In addition, such symmetrical configuration also simplifies the manufacturing process of the illuminating device.

In accordance with one preferred solution of the present invention, the one pair of reflectors form a wing structure. The wing structure extends from the base towards side regions of the housing engaged with the base. One pair of symmetrically configured reflectors are in connection with the base using two fixed ends of the wing structure. The first group of light sources are located between the two fixed ends, and free ends of the wing structure are oriented to the housing, respectively, so as to cover, in a form of curved surface in a direction of the vertical axis, the second group of light

sources arranged at both sides of the wing structure. Thus, the reflectors can reflect the first and second groups of light sources with various surfaces of the wing structure.

In accordance with one preferred solution of the present invention, the free ends of the one pair of reflectors and the housing are separated with a predetermined distance. Undesirable block spot will be formed in an illumination area of the illuminating device when the free ends of the reflectors are in contact with the housing. Therefore, the free ends of the reflectors and the housing should keep a predetermined interval therebetween.

In accordance with one preferred solution of the present invention, a surface of respective reflector facing to the first group of light sources comprises a first reflection surface extending from the base and an joining surface adjacent to the first reflection surface. A first surface of respective reflector facing to the first group of light sources thus is formed by two curved surfaces, wherein the joining surface is not configured as a reflection surface. A second surface facing to the second group of light sources can be only a curved surface having reflection function.

In accordance with one preferred solution of the present invention, the reflectors are arranged in such a manner that light emitted from the first group of light sources and light emitted from the second group of light sources jointly form omnidirectional illumination. Since respective reflector can reflect, by its own first and second reflection surfaces, the first and second groups of light sources arranged in different regions , reflected and refracted light and light from various groups of light sources directly refracted by the housing can cover, in the direction of the vertical axis, the

central region and side regions at both sides of the central region of the illuminating device so as to realize omnidirectional illumination.

In accordance with one preferred solution of the present invention, respective first reflection surface in cross section is a straight line extending outwardly from the base, and an angle between the straight line and the vertical axis is 50°-75°. Respective first reflection surface extending obliquely from the base towards both sides in the vertical axis direction can effectively reflect received light towards the vertical axis in a convergence manner. The first region, the first reflection surfaces and the joining surfaces located at both sides and a central section of the housing define a first space inside the illuminating device. Emergent light reflected and/or refracted in this space is central emergent light of the illuminating device.

In accordance with one preferred solution of the present invention, respective second reflection surface in cross section is a curved line extending outwardly from the base, and the curved line has a profile defined by the expression

$$\mathbf{p}(t)=\frac{(1-t)^2w_0\mathbf{v}_0+2t(1-t)w_1\mathbf{v}_1+t^2w_2\mathbf{v}_2}{(1-t)^2w_0+2t(1-t)w_1+t^2w_2},\quad 0\leqslant t\leqslant 1,$$

where control vertexes v_0, v_1 and v_2 and weight factors ω_0, ω_1 and ω_2 are preset values. The second regions, the second reflection surfaces covering these regions and side sections of the housing define second spaces located at both sides of the first space. Emergent light reflected and/or refracted in these spaces is lateral emergent light of the illuminating device.

In accordance with one preferred solution of the present in-

vention, the base comprises a carrying portion for carrying the light sources, a bottom wall formed opposite to the carrying portion and side walls joining the carrying portion and the bottom wall at both sides, wherein the carrying portion, the bottom wall and the side walls define a second accommodating cavity. The base herein not only can carry the light sources and the reflectors, but also provide, using the second accommodating cavity defined by itself, a space for placing other components of the illuminating device. With the aid of the dual-functional base, the structure space of the illuminating device can be reduced, and the number of fixing elements or carrying elements for the illuminating device is advantageously reduced.

In accordance with one preferred solution of the present invention, the second accommodating cavity accommodates electronic components for the light sources. The electronic components are, for instance, driver or power line for the light sources or other components of the illuminating device.

In accordance with one preferred solution of the present invention, adjoining edges of the side walls and the bottom wall form stop structures for engagement with the housing. In order to meet requirements of "non-bolt assembling" of modern illuminating devices, the stop structures for mechanical connection with the housing can be formed with the aid of the special profile of the base for avoiding use of additional fixing elements.

In accordance with one preferred solution of the present invention, respective stop structure is a protrusion extending radially outwardly. Preferably, end sections of the housing hold the side walls in a radial direction and press against the protrusions in an axial direction. In this situation, the

housing that is often made from an elastic transparent material can be in connection with the base in a holding manner using two free ends thereof to form a complete illuminating device.

In accordance with one preferred solution of the present invention, the base is a heat sink. In order to assure the heat dissipation performance of the illuminating device, the base with preferably, a part of regions, e.g. the bottom wall that can conduct heat exchange with external environment, is configured as a heat sink, and then heat generated by the light sources can be transferred to the bottom wall for effective heat exchange.

In accordance with one preferred solution of the present invention, the at least one pair of reflectors and the base are made in one piece. As a result, the reflectors and the light sources arranged on the base can be assured to be fixed in place with respect to each other to realize precise reflection. In addition, such integratedly manufactured reflectors and base are favorable for simplifying the manufacturing process of the illuminating device and facilitates installation and removal.

In accordance with one preferred solution of the present invention, the base is made from a metal. Since metal such as aluminum or other high-conductivity metal has good heat conducting performance, it is particularly suitable for manufacturing the heat sink.

Preferably, the first and second reflection surfaces are formed through a polishing process. When the reflectors and the base are made in one piece from a metal, processing can

be carried out directly on a metal structure that is configured as reflectors through a polishing or similar process to form the first and second reflection surfaces.

In accordance with one preferred solution of the present invention, the illuminating device has a tubular profile and the first and second group of light sources are light sources in a linear arrangement, respectively. In such illuminating device having a tubular profile, the housing, the base and the reflectors arranged on the base correspondingly are configured to be strip-shaped, and then T5/T8 illuminating device, for instance, can be assembled.

In addition, the present invention further relates to a retrofit lamp comprising the above illuminating device, wherein the first and second group of light sources are LED light sources. Such retrofit lamp has a strong universality and can realize omnidirectional illumination effect.

Brief Description of the Drawings

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

Fig. 1 is a cross-sectional view of a first embodiment of an illuminating device in accordance with the present invention;

Fig. 2 is a first local 3D view of the illuminating device as

shown in Fig. 1;

Fig. 3 is a second local 3D view of the illuminating device as shown in Fig. 1; and

Fig. 4 is an optical pathway diagram of the illuminating device according to the present invention.

Detailed Description of the Embodiments

In the following detailed description, reference is made to the accompanying drawings, which form a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced. In this regard, directional terminology, such as "top", "bottom", "inner", "outer", is used in reference to the orientation of the figures being described. Because components of embodiments of the present invention can be positioned in a number of different orientations, the directional terminology is used for purposes of illustration and is in no way limiting. It is to be understood that other embodiments may be utilized and structural or logical changes may made without departing from the scope of the present invention. The following detailed description, therefore, is not to be taken in a limiting sense, and the scope of the present invention is defined by the appended claims.

It is to be understood that the features of the various exemplary embodiments described herein may be combined with each other, unless specifically noted otherwise.

Fig. 1 is a cross-sectional view of a first embodiment of an illuminating device in accordance with the present invention. An illuminating device 100 that is preferably configured to

be symmetrical with respect to a vertical axis X comprises a housing 1 on top and a base 3 at bottom as shown in Fig. 1, and the housing 1 and the base 3 define a first accommodating cavity 4 for accommodating, e.g. two groups of light sources 21, 22. In order to enable the illuminating device 100 to realize omnidirectional illumination, one pair of reflectors 5 symmetrical with respect to the vertical axis X are particularly provided on the base 3, separate the two groups of light sources 21, 22 mounted on a carrying portion 10 of the base 3, and reflect light emitted from the first and second groups of light sources 21, 22 mounted in the center and at two sides.

One end of each of the two reflectors 5 is fixed on the carrying portion 10, and the other end extends towards two sides of the housing 1 to form a wing structure. The carrying portion 10 is separated by fixed ends of the wing structure into a first region A1 in the center and second regions A2 at both sides. Two side surfaces of the reflector 5 are a first surface that comprises at least one plane and a second surface formed oppositely , respectively. The first surface facing to the vertical axis X comprises a first reflection surface 6 with one end in connection with the carrying potion 10 and an joining surface 9 extending from the first reflection surface 6 to the housing 1, wherein the first reflection surface 6 is configured as a plane. The second surface is a second reflection surface 7 of the reflector 5 facing away from the vertical axis X. Respective second reflection surface 7 is configured as a curved surface.

The two first reflection surfaces 6 formed opposite to each other define the first region A1 on the carrying portion 10 for mounting the first group of light sources 21. The first

region A1, the oppositely formed first reflection surfaces 6 and the joining surfaces 9, and a central section of the housing 1 define a first space inside the illuminating device 100. An optical axis of the first group of light sources 21 provided in the center of the first region A1 overlaps the vertical axis X. Among light from the first group of light sources 21, part of light that has a small angle with the vertical axis X is directly refracted by a central section of the housing 1 and emerges, and remaining light is reflected by the planar first reflection surfaces 6 towards the vertical axis X and then is refracted by the housing 1 and emerges. For the sake of good reflection effect, an angle between respective first reflection surface 6 and the vertical axis X is 50°-75°.

Respective second reflection surface 7 and an edge region of the carrying portion 10 define the second region A2 for arranging the second group of light sources 22. The second regions A2, the second reflection surfaces 7 and side sections of the housing 1 define second spaces located at both sides of the first space. Among light from the second group of light sources 22, part of light having a small angle with the carrying portion 10 is directly refracted by the side sections of the housing 1 and emerges, and remaining light is reflected outwardly and downwardly by the first reflection surfaces 6 extending along a curved line towards and then is refracted by the housing 1 and emerges. In order to realize good reflection effect, respective second reflection surface 7 in cross section is defined by the expression:

$$\mathbf{p}(t) = \frac{(1-t)^2 w_0 \mathbf{v}_0 + 2t(1-t) w_1 \mathbf{v}_1 + t^2 w_2 \mathbf{v}_2}{(1-t)^2 w_0 + 2t(1-t) w_1 + t^2 w_2}, \quad 0 \leqslant t \leqslant 1$$

where control vertexes v_0, v_1 and v_2 and weight factors ω_0, ω_1 and ω_2 are preset values.

In order to realize good heat-dissipating effect, a metal material is chosen to manufacture the base 3, and the base 3 is used as a heat sink. The base 3 comprises the carrying portion 10 for carrying the first and second light sources 21, 22, a bottom wall 12 formed opposite to the carrying portion 10 and side walls 11 joining the carrying portion 10 and the bottom wall 12 respectively from both sides, wherein the carrying portion 10, the bottom wall 12 and the side walls 11 define a second accommodating cavity 13 for accommodating, e.g. driver, power line and similar electronic components. For the sake of formation of form-fitted connection with the housing 1, adjoining edges of the side walls 11 and the bottom wall 12 are configured as stop structures for the housing 1, for instance, protrusions 14 as shown in the figures. End sections of the housing 1 can hold the side walls 11 in a radial direction and press against the protrusions 14 extending outwardly in an axial direction.

Besides, it should be noted that a free end 8 of respective reflector 5 needs to keep a predetermined gap from the housing 1 to prevent occurrence of black spot in an illumination area.

In the present embodiment, the illuminating device 100 has a tubular profile, and multiple groups of light sources 21, 22 are arranged on the carrying portion 10 in a linear arrangement. Such illuminating device 100 can be used as T5/T8 illuminating device.

Fig. 2 is a first local 3D view of the illuminating device as shown in Fig. 1. The base 3 and one pair of reflectors 5 as shown in Fig. 2 are made in one piece from a metal such as aluminum. Accordingly, the wing structure formed on the carrying potion 10 can be processed through a polishing or mill-

ing process to manufacture the reflectors 5 having the first and second reflection surfaces 6, 7. Respective base 3 and respective reflector 5 as shown in Fig. 2 each have a strip profile and can form, together with the semitubular housing 1 as shown in Fig. 3, into a tubular illuminating device 100. The housing 1 as shown in Fig. 3 is made from a non-rigid light-transmission material such as PMMA.

In one embodiment not shown, the base 3 and the reflectors 5 also can be manufactured individually, and the reflectors 5 are fixed on the carrying portion 10 of the base 3 in an appropriate manner.

In another embodiment not shown, the first and second reflection surfaces 6, 7 also can be formed by coating a reflective material on two side surfaces of the wing structure.

The light sources in the above embodiments can be classical light sources and preferably also can be LED light sources. The illuminating device 100 having the LED light sources can be retrofit lamp that replaces common tube.

Fig. 4 is an optical pathway diagram of the illuminating device is the present invention. It can be seen from Fig. 4 that as the light sources of the illuminating device 100 are arranged axially symmetrically in the central region and at two sides, it can emit emergent light with the aid of the reflectors to an upper direction and two sides as shown in the figure. The illuminating device 100 in accordance with the present invention can realize effect of omnidirectional illumination.

In addition, while a particular feature or aspect of an embodiment of the invention may have been disclosed with re-

spect to only one of several implementations, such feature or aspect may be combined with one or more other features or aspects of the other implementations as may be desired and advantageous for any given or particular application. Furthermore, to the extent that the terms “include”, “have”, “with”, or other variants thereof are used in either the detailed description or the claims, such terms are intended to be inclusive in a manner similar to the term “comprise”.

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	housing
21	first group of light sources
22	second group of light sources
3	base
4	first accommodating cavity
5	reflector
6	first reflection surface
7	second reflection surface
8	free end
9	joining surface
10	carrying portion
11	bottom wall
12	side wall
13	second accommodating cavity
14	protrusion
100	illuminating device
A1	first region
A2	second region

Claims

1. An illuminating device (100), having a housing (1), a plurality of groups of light sources (21, 22) and a base (3), wherein the base (3) and the housing (1) define a first accommodating cavity (4) for accommodating the plurality of groups of light sources (21, 22), characterized by further comprising at least one pair of reflectors (5) arranged at one side of the base (3), the at least one pair of reflectors (5) separate the base (3) into a first region (A1) located between the at least one pair of reflectors (5) for carrying a first group of light sources (21) and second regions (A2) located at both sides of the first region for carrying a second group of light sources (22), a surface of respective reflector (5) facing to the first group of light sources (21) comprises a first reflection surface (6), and a surface of respective reflector (5) facing to the second group of light sources (22) comprises a second reflection surface (7).

2. The illuminating device (100) according to Claim 1, characterized in that the at least one pair of reflectors (5) are arranged symmetrically with respect to a vertical axis (X) of the housing (1).

3. The illuminating device (100) according to Claim 1 or 2, characterized in that the one pair of reflectors (5) form a wing structure.

4. The illuminating device (100) according to Claim 3, characterized in that the free ends (8) of the one pair of reflectors (5) and the housing (1) are separated with a predetermined distance.

5. The illuminating device (100) according to Claim 1 or 2,

characterized in that a surface of respective reflector (5) facing to the first group of light sources (21) comprises a first reflection surface (6) extending from the base (3) and an joining surface (9) adjacent to the first reflection surface (6).

6. The illuminating device (100) according to Claim 1 or 2, characterized in that the reflectors (5) are arranged in such a manner that light emitted from the first group of light sources (21) and light emitted from the second group of light sources (22) jointly form omnidirectional illumination.

7. The illuminating device (100) according to Claim 6, characterized in that respective first reflection surface (6) in cross section is a straight line extending outwardly from the base (3), and an angle between the straight line and the vertical axis (X) is 50°-75°.

8. The illuminating device (100) according to Claim 6, characterized in that respective second reflection surface (7) in cross section is a curved line extending outwardly from the base (3), and the curved line has a profile defined by expression

$$\mathbf{p}(t) = \frac{(1-t)^2 w_0 \mathbf{v}_0 + 2t(1-t) w_1 \mathbf{v}_1 + t^2 w_2 \mathbf{v}_2}{(1-t)^2 w_0 + 2t(1-t) w_1 + t^2 w_2}, \quad 0 \leqslant t \leqslant 1,$$

where control vertexes v_0, v_1 and v_2 and weight factors ω_0, ω_1 and ω_2 are preset values.

9. The illuminating device (100) according to Claim 2 or 3, characterized in that the base (3) comprises a carrying portion (10) for carrying the light sources (21, 22), a bottom wall (12) formed opposite to the carrying portion (10) and side walls (11) joining the carrying portion (10) and the

bottom wall (12) at both sides, wherein the carrying portion (10), the bottom wall (12) and the side walls (11) define a second accommodating cavity (13).

10. The illuminating device (100) according to Claim 9, characterized in that the second accommodating cavity (13) accommodates electronic components for the light sources (21, 22).

11. The illuminating device (100) according to Claim 9, characterized in that adjoining edges of the side walls (11) and the bottom wall (12) form stop structures for engagement with the housing (1).

12. The illuminating device (100) according to Claim 11, characterized in that respective stop structure is a protrusion extending radially outwardly.

13. The illuminating device (100) according to Claim 12, characterized in that end sections of the housing (1) hold the side walls (11) in a radial direction and press against the protrusions (14) in an axial direction.

14. The illuminating device (100) according to Claim 2 or 3, characterized in that the base (3) is a heat sink.

15. The illuminating device (100) according to Claim 14, characterized in that the at least one pair of reflectors (5) and the base (3) are made in one piece.

16. The illuminating device (100) according to Claim 15, characterized in that the base (3) is made from metal.

17. The illuminating device (100) according to Claim 16,

characterized in that the first and second reflection surfaces (6, 7) are formed through a polishing process.

18. The illuminating device (100) according to Claim 2 or 3, characterized in that the illuminating device (100) has a tubular profile and the first and second group of light sources (21, 22) are light sources in a linear arrangement, respectively.

19. A retrofit lamp, characterized by comprising the illuminating device (100) according to any one of Claims 1-18, wherein the first and second group of light sources (21, 22) are LED light sources.

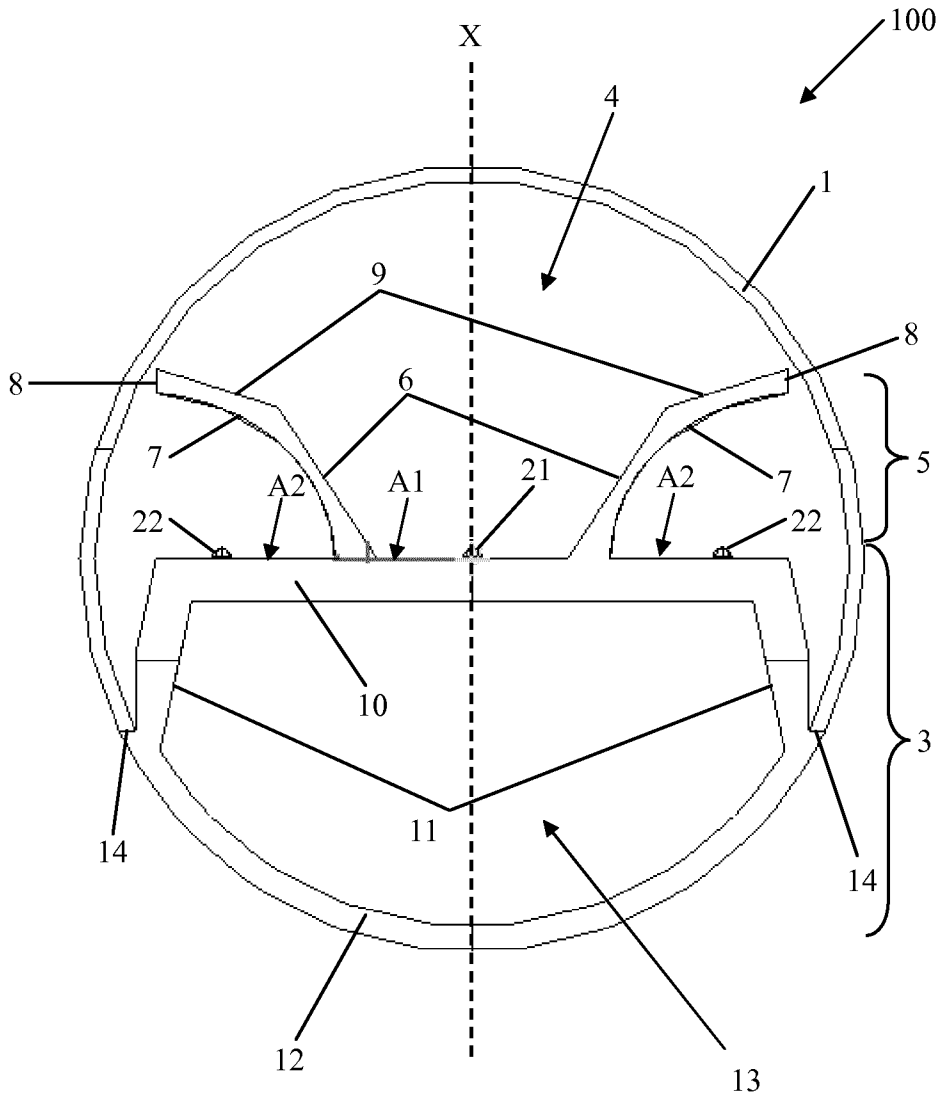

Figure 1

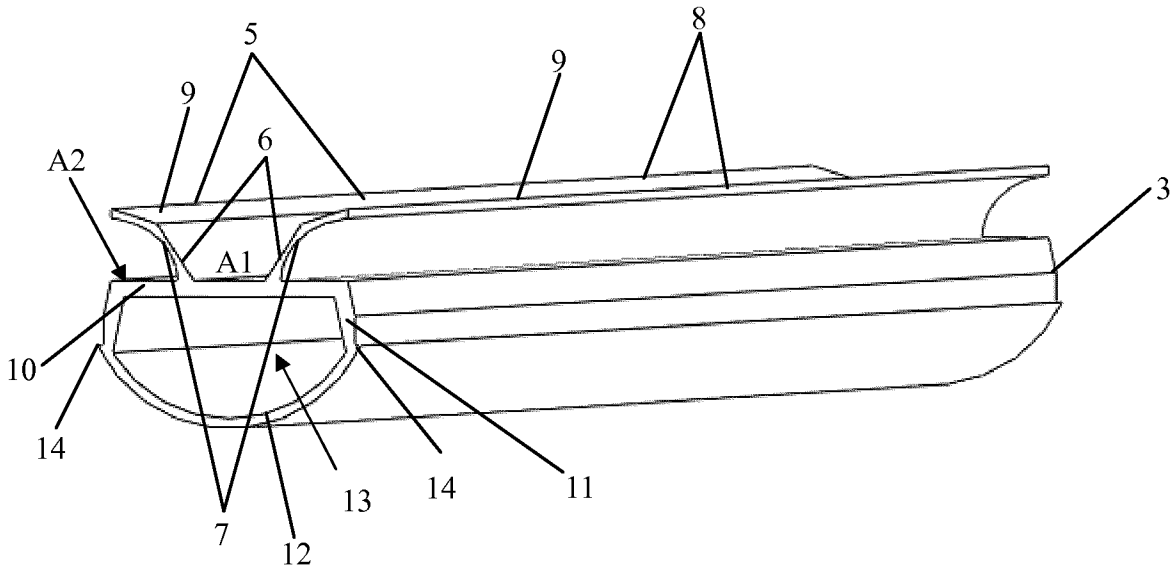

Figure 2

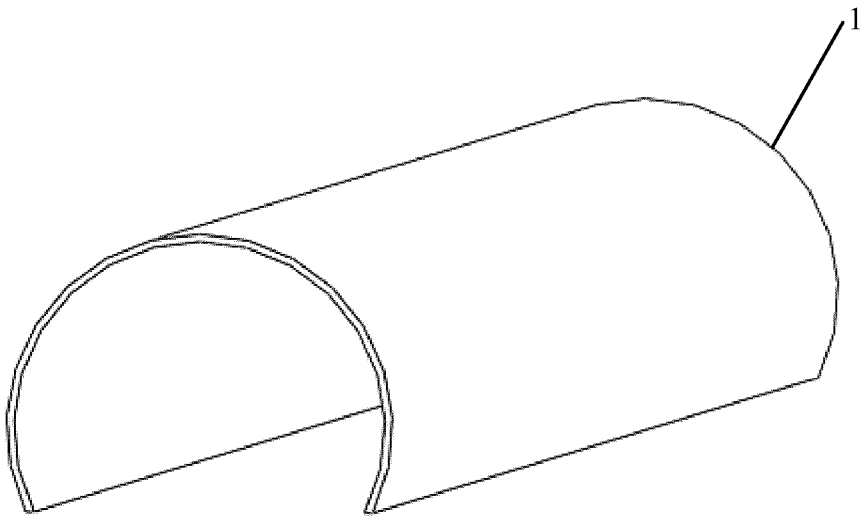

Figure 3

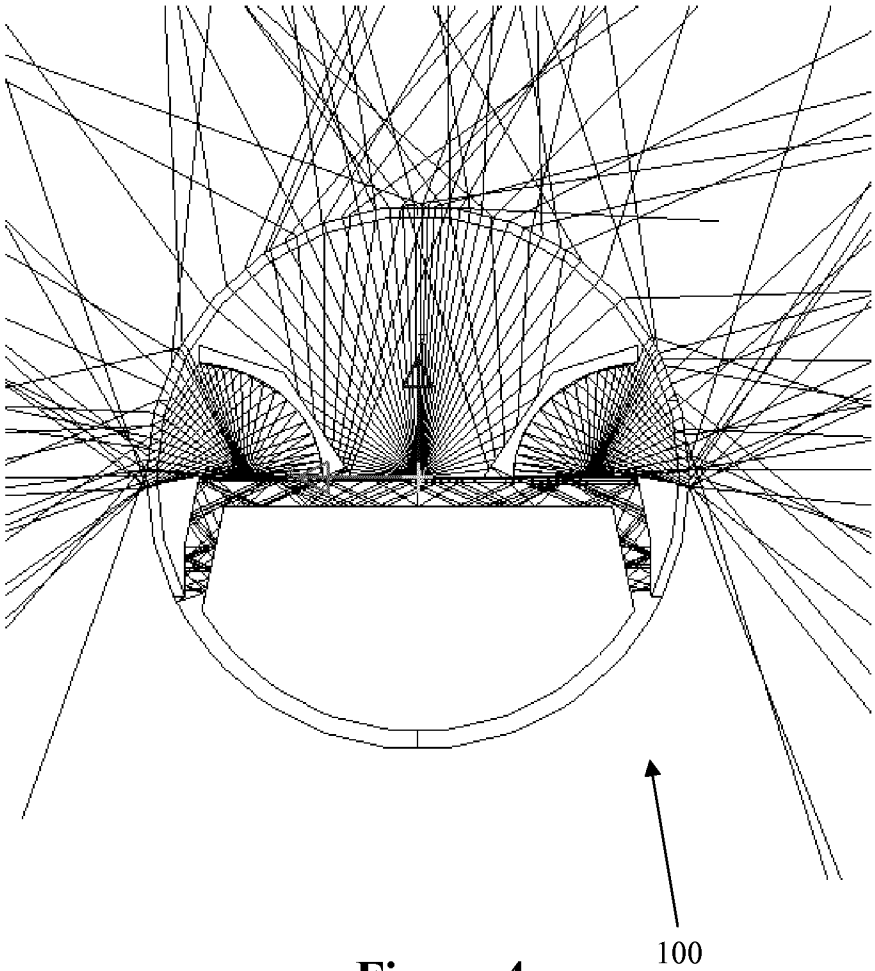

Figure 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/062445

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21K99/00 F21V7/00
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)
F21K F21V F21Y

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	WO 2011/005046 A2 (KIM JONGSUNG [KR]; KWON MOOSUNG [KR]) 13 January 2011 (2011-01-13) paragraph [0001] - paragraph [0100] figures 4-6	1-19
X	US 2012/134133 A1 (KANG KI TAE [KR]) 31 May 2012 (2012-05-31) paragraph [0087] - paragraph [0315] figures 1-50	1-14,16, 17,19

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2013/062445

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