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(71) Applicant (for all designated States except US):
KONINKLIJKE PHILIPS ELECTRONICS N.V.
[NL/NL]; Groenewoudseweg 1, NL-5621 BA Eindhoven
(NL).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **KESER, Merijn**
[NL/NL]; c/o High Tech Campus, Building 44, NL-5656
AE Eindhoven (NL). **VAN AS, Marco** [NL/NL]; c/o High

Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).
VAN KEMPEN, Frank Walterus Franciscus Marie
[NL/NL]; c/o High Tech Campus, Building 44, NL-5656
AE Eindhoven (NL).

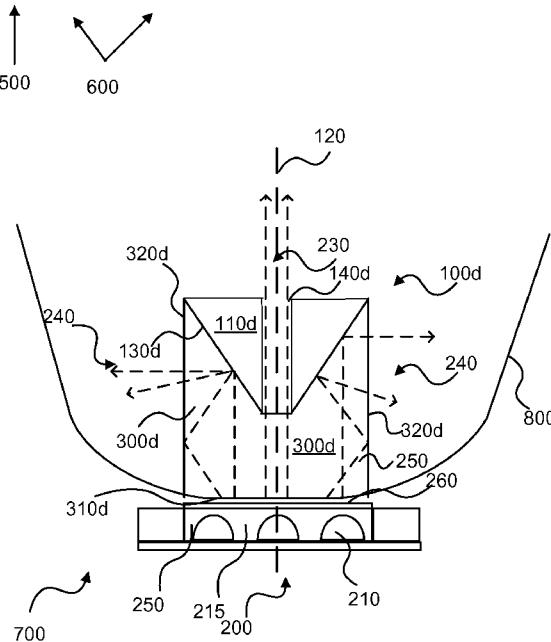
(74) Agents: **VAN EEUWIJK, Alexander** et al.; c/o High
Tech Campus, Building 44, NL-5656 AE Eindhoven (NL).

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(54) Title: LIGHT GUIDE



(57) Abstract: The disclosed embodiments relate to a light guide (100a) and a luminaire (700) including such a light guide (100a). The light guide (100a) guides light emitted in a first direction (500) from a light source (200) comprising at least one light emitting diode (210). The light guide (100) directs a major part of the light in a second direction (600), wherein the first direction (500) is not equal to the second direction (600). The light guide (100a) comprises a cone part (110a) having a shape of a cone, and a center axis (120) of the cone part (110a) is in the first direction (500). The light guide (100a) can be used with reflectors (800) that have originally been manufactured for use with high intensity discharge lamps or halogen lamps but because of the light guide (100a), the reflectors (800) can be used together with light sources (200) in the form of at least one light emitting diode (210).

Fig. 4

Declarations under Rule 4.17:

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— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

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LIGHT GUIDE

FIELD OF THE INVENTION

The present invention relates to the field of light sources, and more specifically to a light guide.

5 BACKGROUND OF THE INVENTION

LEDs (Light Emitting Diodes) or modules comprising LEDs, generate light in the form of a half sphere instead of the omnidirectional light pattern emitted by other present art light sources like HID (High Intensity Discharge) lamps and halogen lamps. A LED light source is also often located at the bottom of a reflector. This makes it necessary to develop 10 reflectors designed specifically for such LED light sources which can be cost and capacity demanding. Furthermore, standard LED light source applications often suffer from glare.

SUMMARY OF THE INVENTION

It is an object of the present invention to overcome or alleviate problems of the 15 prior art.

According to a first aspect of the invention, this and other objects are achieved by a light guide for guiding light emitted in a first direction from a light source comprising at least one light emitting diode, wherein the light guide is arranged to direct a major part of the light in a second direction, wherein the first direction is not equal to the second direction, 20 wherein the light guide comprises a cone part having a shape of a cone, wherein a center axis of the cone part is in the first direction, and wherein the cone part has a circumferential surface. This is advantageous in that glare is limited since a major part of the light leaves the cone part in the second direction and thus less light comes directly from the light source. Furthermore, because the light travels through the light guide, the light will be mixed to some 25 extent, enabling a more homogeneous beam pattern.

The light emitted from the light source may be arranged to be reflected on the circumferential surface of the cone part such that after the reflection, the light is directed in the second direction.

The circumferential surface may comprise a reflective coating. This is 30 advantageous in that light incident on the circumferential surface that is not reflected by total internal reflection (because the angle of incidence is to small) is reflected.

The reflective coating may be at least one from the group of a specularly reflective, and diffusively reflective. This is advantageous in that the distribution of the light can be made more uniform in terms of brightness.

5 The circumferential surface may be at least one from the group of segmented and faceted. This is advantageous in that the distribution of the light can be made more uniform in terms of brightness.

The light guide may be arranged to direct a minor part of the light in the first direction. This is advantageous in that there is less loss due to reflection.

10 A center of the cone part may comprise a through opening such that light emitted from the light source directed to the center of the cone part continues through the cone part in the first direction. This is advantageous in that there is less loss due to reflection.

The cone part may be arranged in a cylinder part in the shape of a cylinder.

The cylinder part may be arranged to provide total internal reflection. This is advantageous in that there is less loss due to reflection.

15 According to a second aspect of the invention, this and other objects are achieved by a luminaire. The luminaire comprises: a light guide according to anyone of the embodiments under the first aspect.

The luminaire may further comprise a light source comprising at least one light emitting diode (LED). This is advantageous in that it is capacity and cost efficient.

20 Alternatively, the luminaire may comprise a LED lighting module comprising at least one light emitting diode or an array of light emitting diodes. An example of such a LED lighting module are the LED lighting modules being standardized within the standardizing consortium Zhaga.

25 The light source may further comprise at least one of a mix box and a diffusive exit window. This is advantageous in that properties of the light emitted from the light source can be adjusted.

30 The luminaire may further comprise a reflector wherein the reflector is adapted for a light source selected from the group of high intensity discharge lamps and halogen lamps. This is advantageous in that the light guide may be used with reflectors that are adapted for light sources selected from the group of high intensity discharge lamps and halogen lamps which is both capacity and cost efficient.

The advantages of the first aspect are equally applicable to the second aspect. Furthermore, the second aspect can be embodied in accordance with the first aspect.

It is noted that the invention relates to all possible combinations of features recited in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

5 This and other aspects of the present invention will now be described in more detail, with reference to the appended drawings showing embodiments of the invention in which,

Fig. 1 is a schematic illustration of a cross-section of an embodiment of the inventive light guide arranged in an embodiment of the inventive luminaire.

10 Fig. 2 is a schematic illustration of a cross-section of an embodiment of the inventive light guide arranged in an embodiment of the inventive luminaire.

Fig. 3 is a schematic illustration of a cross-section of an embodiment of the inventive light guide arranged in an embodiment of the inventive luminaire.

15 Fig. 4 is a schematic illustration of a cross-section of an embodiment of the inventive light guide arranged in an embodiment of the inventive luminaire.

Fig. 5 is a schematic illustration of a perspective view of an embodiment of the inventive light guide.

DETAILED DESCRIPTION

20 Figs. 1-4 are schematic illustrations of cross-sections of embodiments of the inventive light guide arranged in an embodiment of the inventive luminaire. Firstly, the features in common will be described jointly with reference to Figs. 1-4. Secondly, the differences will be described. When referring to, e.g., all embodiments of the light guide, a generic reference, such as 100 will be used. When referring to specific embodiments, specific references, such as, e.g., 100bd will be used.

25 A luminaire 700 is disclosed comprising a light guide 100, a light source 200 and a reflector 800. The reflector 800 may be adapted for a light source selected from the group of high intensity discharge lamps and halogen lamps. Thus, the reflector 800 may originally be manufactured for use with high intensity discharge lamps or halogen lamps but due to the light guide 100, the reflector 800 can be used together with a light source 200 in the form of at least one light emitting diode 210.

30 The light source 200 may comprise a light emitting diode module 215 comprising the at least one light emitting diode 210. A diffusive window 260 may be arranged in the light source 200 such that light emitted from the at least one light emitting

diode 210 travels through the diffusive window 260. The diffusive window 260 is arranged to spread the light that travels through it which results in more uniform brightness of the light emitted from the light source 200. The light source 200 may also comprise a mix box 250 arranged to mix the light emitted from the light source 200. A mix box is a space surrounded by reflective walls, in which light is reflected multiple times. Due to the multiple reflections, the light can be seen as to originate from any point within this space, thus creating the effect of a single (larger) light source, instead of multiple (small) light sources. The diffusive window 260 may be arranged in front of the mix box 250 and be covered by a diffusive cover.

10 The light guide 100 has a cone part 110 having a shape of a cone. A center axis 120 of the cone part 110 is in a first direction 500.

Light from the light source 200 is emitted in a semispherical distribution, which is oriented in the first direction 500. The light guide 100 is arranged to direct a major part of the light 240 in a second direction 600, wherein the first direction 500 is not equal to the second direction 600. It is to be noted that the second direction 600 is herein to be interpreted broadly. The second direction 600 can be any direction that is not parallel to the first direction 500.

20 The cone part 110 has a circumferential surface 130. The light emitted from the light source 200 is arranged to be reflected on the circumferential surface 130 of the cone part 110 such that after the reflection, the light is directed in the second direction 600.

The circumferential surface 130 may comprise a reflective coating. The reflective coating may be at least one from the group of a specularly reflective, and diffusively reflective. The reflective coating can be any type known to the skilled person, e.g., a metallic coating.

25 The circumferential surface 130 may be at least one from the group of segmented and faceted. This is to be interpreted as that the circumferential surface may be embodied having all sorts of embodiments comprising amounts of facets and/or segments ranging from 0 to infinity. Facets may be distributed along segments. Alternatively, facets may be distributed randomly. The facets and/or segments may be flat. Alternatively, the facets and/or segments may have a corrugated surface.

Fig. 5 discloses an embodiment of a light guide. It is to be understood that the features of the light guide 100e are applicable also to the light guides 100abcd. The circumferential surface of the light guide 100e comprises facets and segments. The facets 140

form a segment. The facet 160 has a corrugated surface. It is to be noted that the light guides may be embodied having facets but no segments.

The light guides 100ac in Figs. 1 and 3 have, as previously discussed, cone parts 110ac. These cone parts 110ac can, e.g., be attached to the reflector 800 or to a housing 5 (not shown) of the luminaire 700. Methods can be used that are known to those skilled in the art of fitting optical elements in front of a light source. For instance, a steel bracket can be used.

The light guides 100cd of Figs. 3-4 comprise, in the center part of the cone part 110cd, a through opening 140cd such that light emitted from the light source 200 10 directed to the center of the cone part 110cd continues through the cone part 110cd in the first direction 500. Thus, the light guides 100cd are arranged to direct a minor part of the light 230 in the first direction 500.

In Figs. 2 and 4, the light guides 100bd comprise cylinder parts 300bd in the shape of a cylinder. Preferably, the cylinder parts 300bd provide total internal reflection. 15 Total internal reflection is to be interpreted as that light reflected internally in the cylinder parts 300bd is reflected solely due to difference in refractive index between the light guide and the surrounding air, resulting in reflection without loss. Light emitted from the light source 200 enters the light guide 100bd through a base 310bd of the cylinder part 300bd. Light that is incident on the side walls 320bd in a direction close to the surface normal 20 continues through the side walls 320bd towards the reflector 800. Light that is incident on the side walls 320bd at a large angle in relation to the surface normal is reflected (see, e.g., light ray 250. The larger the angle of incidence in relation to the surface normal, the more light is reflected.

The height at which the light from the light guide 100 reaches the reflector 800 25 is determined by the height of the cone part 110. This can be varied by either varying the height at which the cylinder part 110ac is attached, or by varying the height of the cylinder part 300bd.

The angle at which the light is emitted from the light guide 100ac is determined by the top angle 135 of the cone part 110ac.

30 In summary, the disclosed embodiments relate to a light guide 100a and a luminaire 700 including such a light guide 100a. The light guide 100a guides light emitted in a first direction 500 from a light source 200 comprising at least one light emitting diode 210. The light guide 100 directs a major part of the light in a second direction 600, wherein the first direction 500 is not equal to the second direction 600. The light guide 100a comprises a

cone part 110a having a shape of a cone, and a center axis 120 of the cone part 110a is in the first direction 500. The light guide 100a can be used with reflectors 800 that have originally been manufactured for use with high intensity discharge lamps or halogen lamps but because of the light guide 100a, the reflectors 800 can be used together with light sources 200 in the 5 form of at least one light emitting diode 210.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments.

Other variations to the disclosed embodiments can be understood and effected 10 by those skilled in the art in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single processor or other unit may fulfill the functions of several items recited in the claims. The mere fact that certain measures are recited in mutually different dependent 15 claims does not indicate that a combination of these measures cannot be used to advantage. Any reference signs in the claims should not be construed as limiting the scope.

CLAIMS:

1. Light guide (100) for guiding light emitted in a first direction (500) from a light source (200) comprising at least one light emitting diode (210),

wherein the light guide (100) is arranged to direct a major part of the light in a second direction (600), wherein the first direction (500) is not equal to the second direction (600),
5 (600),

wherein the light guide (100) comprises a cone part (110) having a shape of a cone, wherein a center axis (120) of the cone part (110) is in the first direction (500), and wherein the cone part (110) has a circumferential surface (130).

10 2. Light guide (100) according to claim 1, wherein the light emitted from the light source (200) is arranged to be reflected on the circumferential surface (130) of the cone part (110) such that after the reflection, the light is directed in the second direction (600).

15 3. Light guide (100) according to anyone of claims 1-2, wherein the circumferential surface (130) comprises a reflective coating.

4. Light guide (100) according to claim 3, wherein the reflective coating is at least one from the group of a specularly reflective, and diffusively reflective.

20 5. Light guide (100e) according to anyone of claims 1-4, wherein the circumferential surface (130) is at least one from the group of segmented and faceted.

6. Light guide (100) according to anyone of claims 1-5, wherein the light guide (100cd) is arranged to direct a minor part of the light (230) in the first direction (500).

25

7. Light guide (100) according to anyone of claims 1-6, wherein a center of the cone part (110cd) comprises a through opening (140cd) such that light emitted from the light source (200) directed to the center of the cone part (110cd) continues through the cone part (110cd) in the first direction (500).

8. Light guide (100) according to anyone of claims 1-7, wherein the cone part (110bd) is arranged in a cylinder part (300bd) in the shape of a cylinder.

5 9. Light guide (100) according to claim 8, wherein the cylinder part (30bd) is arranged to provide total internal reflection.

10. Luminaire (700) comprising a light guide (100) according to anyone of claims 1-9.

10 11. Luminaire (700) according to claim 10, further comprising the light source (200) comprising at least one light emitting diode (200).

12. Luminaire (700) according to claim 11, wherein the light source further 15 comprises at least one of a mix box (250) and a diffusive exit window (260).

13. Luminaire (700) according to anyone of claims 10-12, further comprising a reflector (800) wherein the reflector (800) is adapted for a light source selected from the group of high intensity discharge lamps and halogen lamps.

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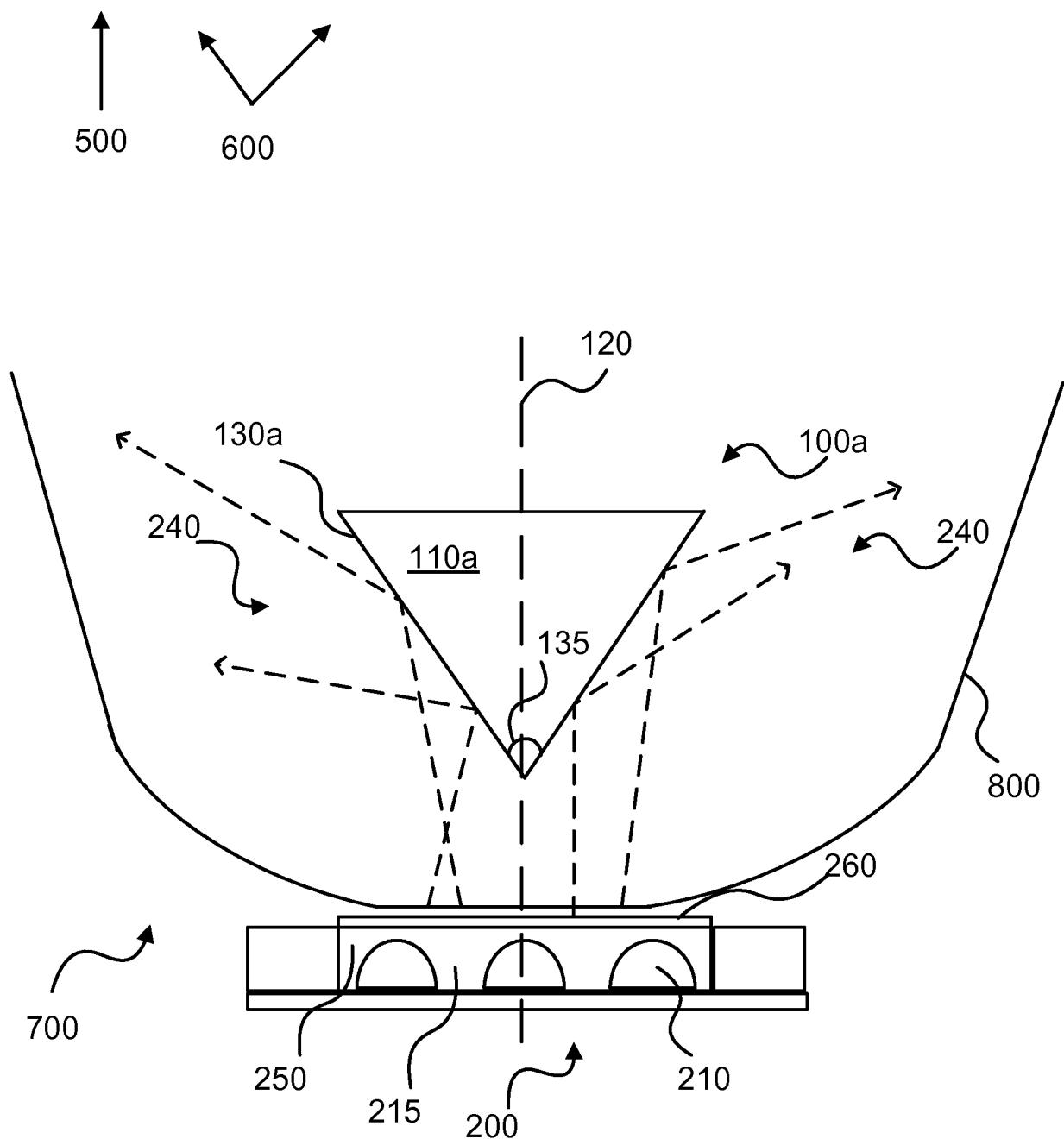


Fig. 1

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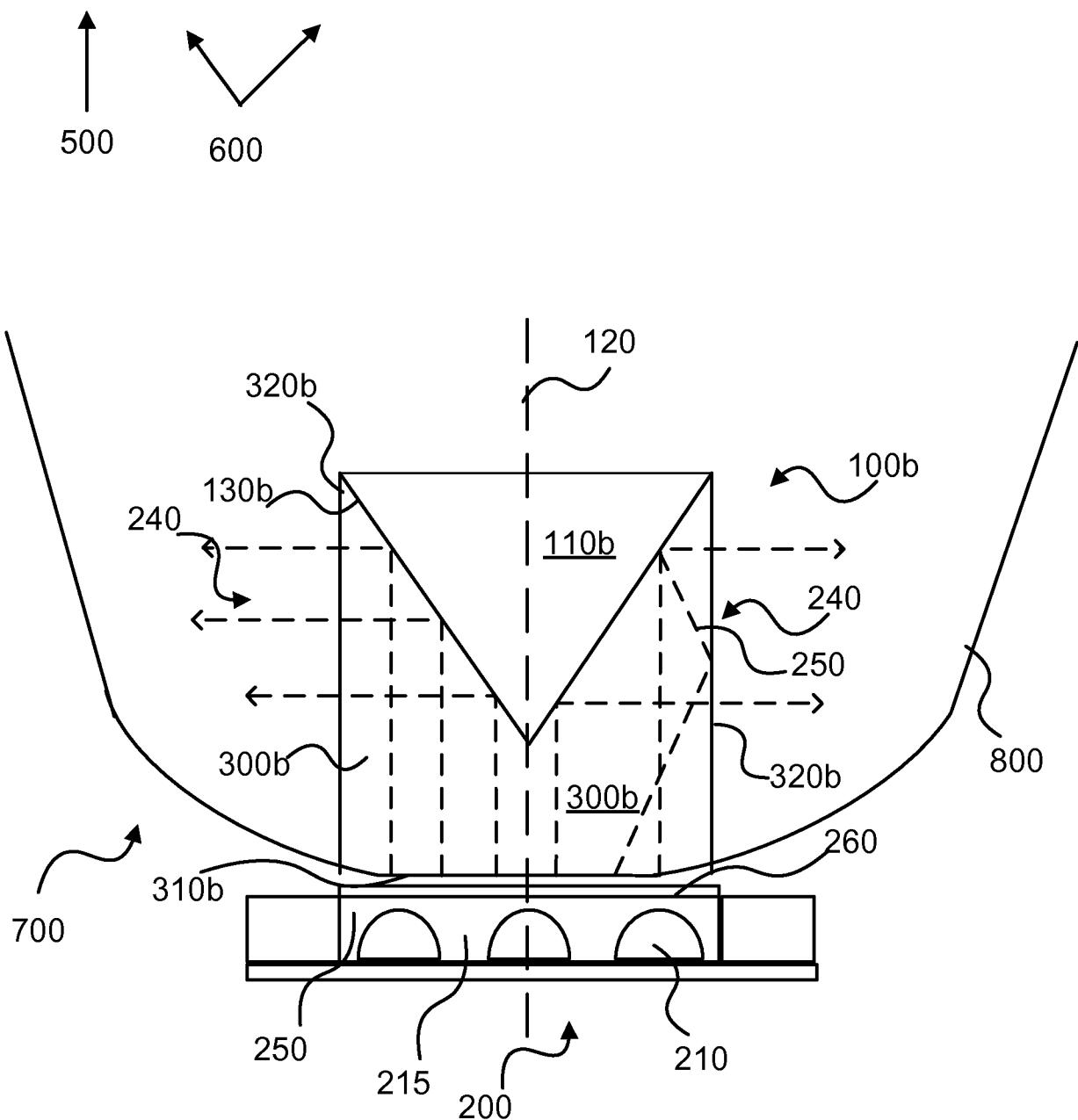


Fig. 2

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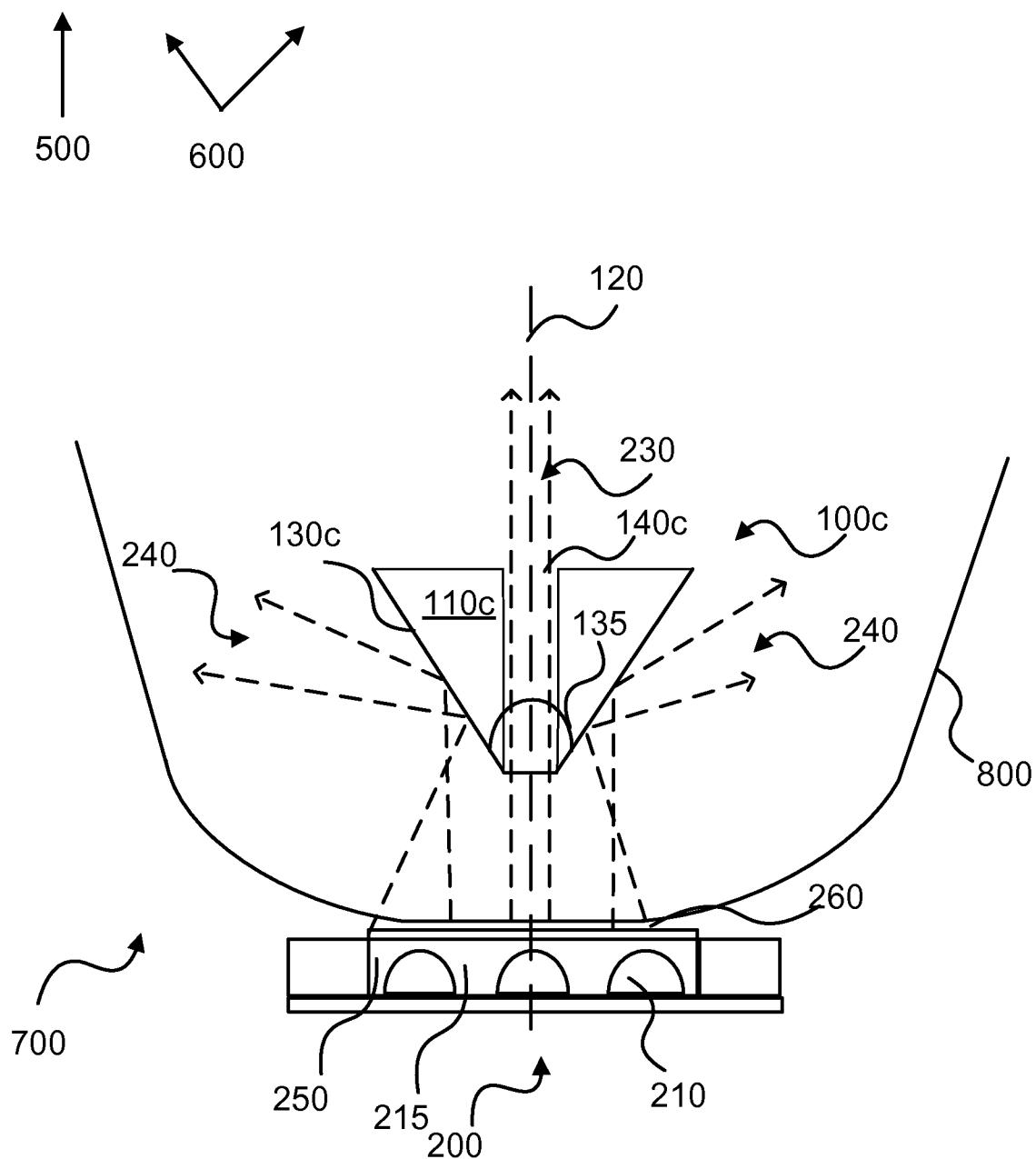


Fig. 3

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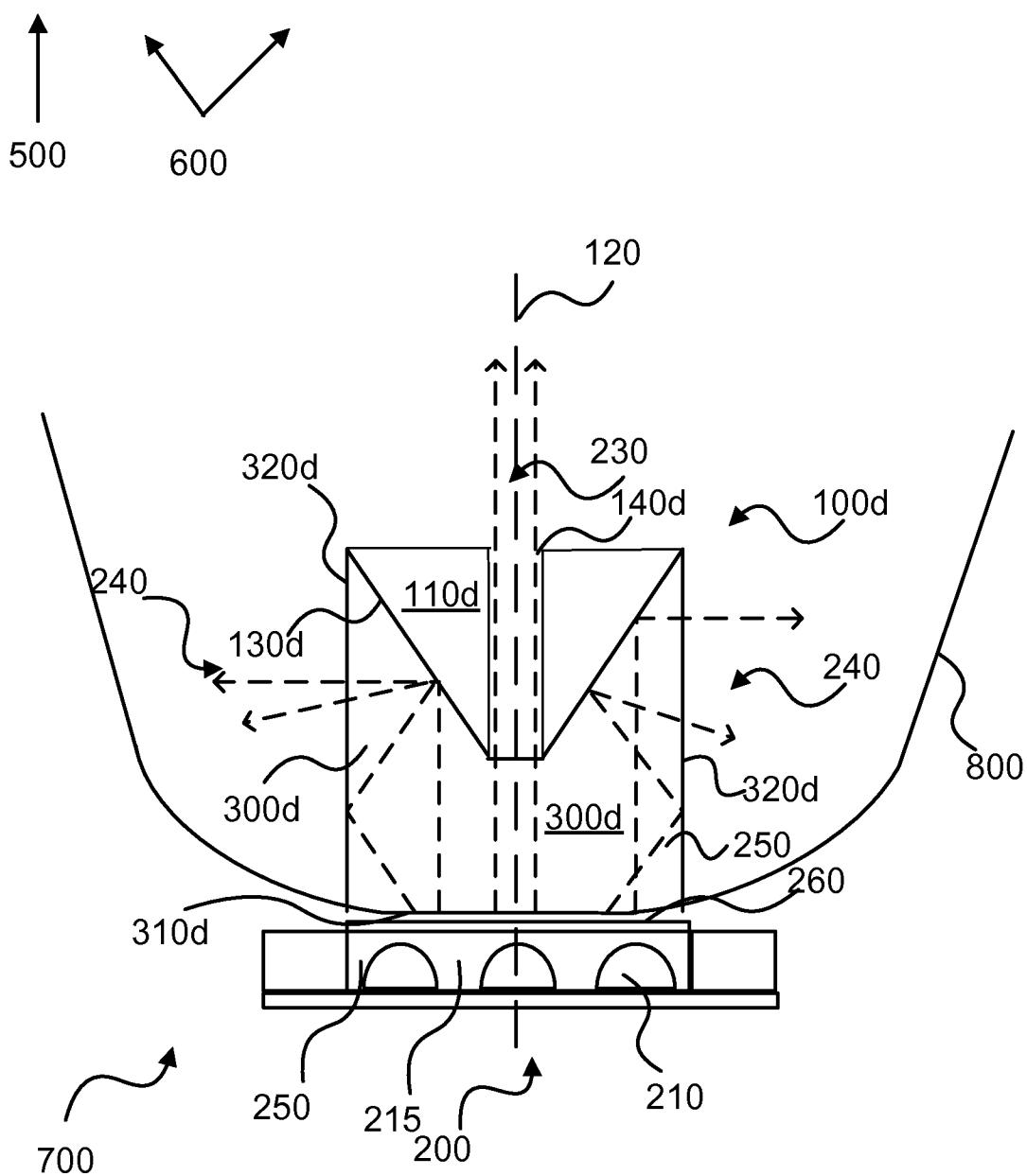


Fig. 4

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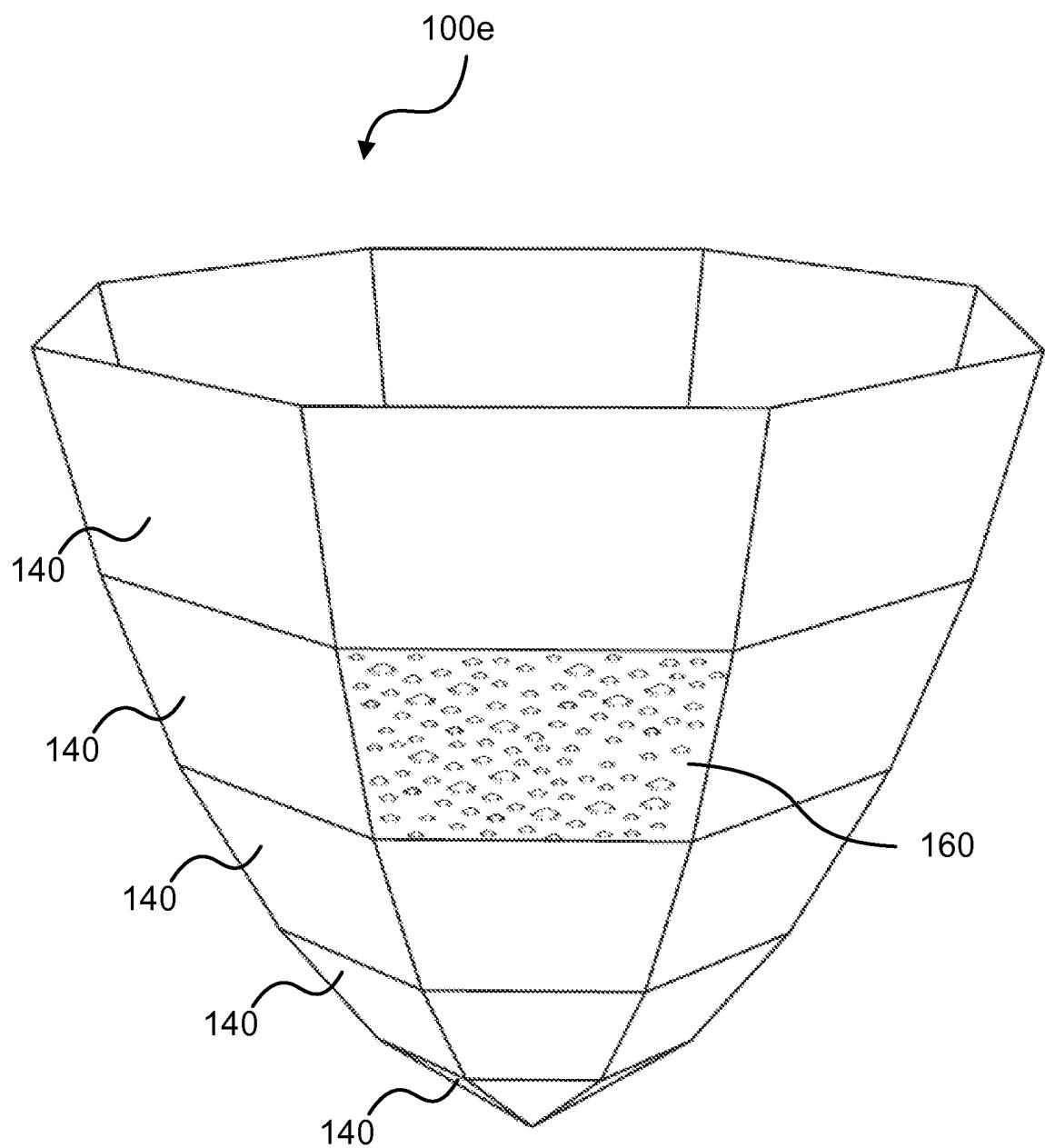


Fig. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2012/053273

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21V7/00
ADD.

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	FR 2 639 683 A1 (AUTORUPTEUR CIE NLE [FR]) 1 June 1990 (1990-06-01)	1,2,6, 10,11,13
Y	page 6, line 5 - page 11, line 30; figures 1-3	3-5,8,9, 12
Y	----- US 2010/254128 A1 (PICKARD PAUL KENNETH [US] ET AL) 7 October 2010 (2010-10-07) paragraph [0027] - paragraph [0065]; figures 1-12	3-5,8,9, 12
X	----- US 6 758 582 B1 (HSIAO YA-KUANG [TW] ET AL) 6 July 2004 (2004-07-06) column 2, line 56 - column 4, line 30; figures 5,6	1,2,6,7



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Arboreanu, Antoniu

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2012/053273

Patent document cited in search report	Publication date	Patent family member(s)		Publication date
FR 2639683	A1	01-06-1990	NONE	
US 2010254128	A1	07-10-2010	CN 102449386 A EP 2417386 A1 KR 20120027222 A TW 201043864 A US 2010254128 A1 WO 2010117409 A1	09-05-2012 15-02-2012 21-03-2012 16-12-2010 07-10-2010 14-10-2010
US 6758582	B1	06-07-2004	NONE	