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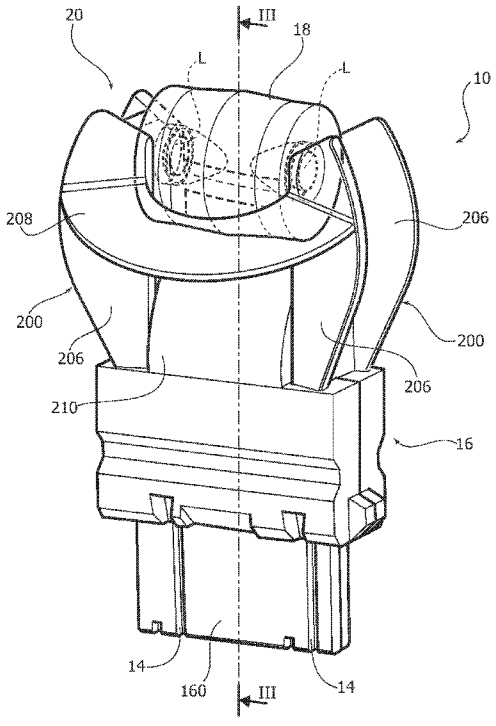
(54) Title: A LIGHTING DEVICE AND CORRESPONDING METHODS

FIG. 1



(57) Abstract: A lighting device (10) includes a support member (16) with a fork-like shape with a body portion (160) and two prongs (162) carrying mutually facing electrically powered light radiation sources (L), e.g. LED sources, having a space therebetween, and a housing member (20), e.g. a heatsink (20), fitted onto said prongs with one or more reflective members (208) extending bridge-like between the prongs to reflect light radiation, e.g. towards body portion (160) of support member (16).

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"A lighting device and corresponding methods"

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Technical Field

The present description relates to lighting devices.

One or more embodiments may refer to lighting devices employing solid state light radiation sources, such as LED sources.

Technological Background

The introduction and the increasingly widespread use of solid state light radiation sources, such as LED sources, has opened new possibilities of implementation of lighting devices.

This is true e.g. for the retrofitting replacement of existing traditional light radiation sources, such as filament lamps, thereby offering improved mechanical, electrical, thermal and optical performances while preserving, as regards appearance and use, features which are substantially similar to traditional electrically powered light radiation sources.

While pursuing these goals, solutions have been developed envisaging e.g. mounting several LEDs onto support members such as one or more printed circuit boards (PCBs). This board or these boards may be fixed on an extruded/moulded/cast heatsink for managing the heat produced during operation of the sources, the light radiation produced thereby being driven towards the outside e.g. via lenses.

While pursuing these goals, it is desirable to integrate thermal and optical functions, so as to manage thermal dissipation without interfering with optical functions and possibly while improving the latter.

Object and Summary

One or more embodiments aim at providing further improvements in this respect.

According to one or more embodiments, said object is achieved thanks to a device having the features specifically set forth in the claims that follow.

One or more embodiments may also concern a corresponding manufacturing method, as well as a corresponding designing method.

The claims are an integral part of the technical teaching provided herein with reference to the embodiments.

One or more embodiments may offer the advantage of providing a heatsink adapted to cooperate in determining the angles at which the light radiation heads towards the body (e.g. towards the socket) of the lighting device.

In one or more embodiments, e.g. those which envisage the use of a reflector illuminated by the "bulb" of the lighting device, it is possible to increase the portion of radiation which is sent towards the reflector with respect to the portion emitted directly, without being subjected to a reflection.

Brief Description of the Figures

One or more embodiments will now be described, by way of non-limiting example only, with reference to the annexed Figures, wherein:

- Figure 1 is a perspective view of a lighting device which may be implemented according to one or more embodiments,

- Figure 2 is a view of various components adapted to be included into the device shown in Figure 1,

- Figures 3 and 4, substantially corresponding to sectional views along line III-III of Figure 1, show further possible features of one or more embodiments, as well as possible designing criteria according to one

or more embodiments.

It will be appreciated that, for ease of understanding, the views in the various Figures may not be drawn to the same scale.

Detailed Description

In the following description, numerous specific details are given to provide a thorough understanding of exemplary embodiments. One or more embodiments may be practiced without one or several specific details, or with other methods, components, materials, etc. In other instances, well-known structures, materials, or operations are not shown or described in detail to avoid obscuring various aspects of the embodiments.

Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the possible appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, particular features, structures, or characteristics may be combined in any suitable manner in one or more embodiments.

The headings provided herein are for convenience only, and therefore do not interpret the extent of protection or the scope of the embodiments.

In one or more embodiments, a lighting device 10 as shown in Figure 1 (as well as in Figure 2, which shows various parts adapted to be included into such a device, shown with covering parts removed and in a partially exploded view) may comprise:

- a support member 16 with a fork-like shape, having a body portion 160 and a pair of prongs 162 carrying mutually facing electrically powered light

radiation sources L, and optionally

- a spacer member such as an optical member, e.g. a lens 18, arranged in the space between prongs 162 carrying the mutually facing electrically powered light radiation sources L.

In one or more embodiments, sources L may be solid state light radiation sources, e.g. LED sources.

According to criteria known in themselves, sources L of this kind may be driven by drive circuits 12 connected to electrically conductive lines 14, adapted to supply power to light radiation sources L. In one or more embodiments, such power supply function may be integrated with functions for a "smart" driving of sources L (e.g. dimming, thermal control, etc.).

Although the presently exemplified embodiments refer to the presence of two light radiation sources L, which are arranged at the distal ends of prongs 162, one or more embodiments may envisage, on each prong 162, a higher number of light radiation sources L, and/or the arrangement of light radiation sources L in a position other than distal.

In one or more embodiments, the space between both prongs 162 carrying the light radiation sources L may be left empty, so that the light radiation emitted by sources L propagates towards the surrounding environment.

In one or more embodiments, in the space between both prongs 162 carrying light radiation sources L there may be inserted a spacer member, e.g. in order to keep prongs 162 ad a predetermined distance.

In one or more embodiments, in the space between both prongs 162 carrying light radiation sources L there may be inserted an optical member (such as e.g. one or more reflectors or a lens 18) acting on at least part of the light radiation emitted by sources L.

In one or more embodiments, the functions of a spacer member and of an optical member may be performed by a single component, such as e.g. lens 18 exemplified herein.

In one or more embodiments, the supporting or holding action of component 18 between prongs 162 may be simply due to the fact that prongs 162 clamp, or so to say "pinch", member 18 therebetween. In one or more embodiments, the holding action by prongs 162 on member 18 may be strengthened by applying adhesive material between prongs 162 and optical member 18.

The Figures exemplify moreover the possibility of providing lighting device 10 with a heatsink 20, adapted to be fitted onto prongs 162, with member 18 - if present - being sandwiched therebetween. In one or more embodiments, heatsink 20 may have an annular shape, wherein device 10 is adapted to be inserted (i.e. fitted) thereinto. Heatsink 20 may therefore form a sort of collar fitted onto prongs 162, so as to perform, in addition to the function of a heatsink, also the possible function of keeping prongs 162 clamped against the ends of member 18, if the latter is present; in this way, member 18 may be held in the desired position, sandwiched between light radiation sources L, without requiring further fixation means such as the provision of adhesive layers (which however is not excluded in one or more embodiments).

In one or more embodiments, heatsink 20 may be fitted onto prongs 162 through an interference fit. In this way, in one or more embodiments heatsink 20 may be mounted and held on device 10 without the provision of specific fixation or holding means.

In one or more embodiments, as exemplified in the Figures, heatsink 20 may comprise two mutually opposed bodies 200, located at the mutually opposed outer sides

of prongs 162, so as to achieve a heat transfer action from light radiation sources L. In one or more embodiments, as exemplified in the Figures, heat dissipating bodies 200 of heatsink 20 may have the shape of finned bodies, e.g. generally channel-shaped bodies having side walls 206. In one or more embodiments, side walls 206 may be mutually diverging.

Further details about the implementation of a lighting device such as device 10 of the Figures may be found in two Italian Patent Applications filed on the same date by the same Applicants.

In one or more embodiments, the general annular shape of heatsink 20 may include in addition bridge-like members 208, extending between heat dissipating bodies 200. Advantages may thus be drawn from the presence of such structures, which are adapted to contribute to the "mechanical" stability of heatsink 20, while participating, as a part thereof, in the dissipating action of the heat produced by sources L in operation.

In one or more embodiments, members 208 may perform a shaping function on the distribution of the light radiation emitted by sources L in a lighting device which comprises in general:

- a support member 16 with a fork-like shape, comprising body portion 160 and both prongs 162 carrying the mutually facing light radiation sources L with a space therebetween (wherein member 18 may optionally be inserted), and
- a housing member, e.g. heatsink 20, arranged on prongs 162 with one or more reflective members 208, extending bridge-like between prongs 162 to reflect the light radiation towards the body portion of support member 16, i.e. in the direction of said body portion, therefore downwards according to the viewpoint of the

annexed Figures.

One or more embodiments may envisage a pair of reflective members 208 which extend, optionally symmetrically, on both sides of the space between light radiation sources L.

Specifically, in one or more embodiments, members 208 may be located at a position which leads to a maximum direct reflection angle towards the body (so-called socket) 16 of support member, i.e. the portion wherefrom prongs 162 mounting light radiation sources L extend, with the possible sandwiching of member 18 (e.g. a lens).

In one or more embodiments, bridge-like members may be implemented as crescent-shaped members, having a corresponding, e.g. equally crescent-shaped (i.e. C-shaped) reflective surface, adapted to face sources L.

In one or more embodiments, reflective surfaces 208a of bridge-like members 208 may lie on a plane which is at least approximately radial with respect to the alignment axis of light radiation sources L.

In one or more embodiments, upper surface 210 of the body of support member 16 may equally be made reflective (as well as surfaces 208a and optionally every surface of heatsink 20), e.g. through an aluminisation treatment.

A mechanism as exemplified in Figures 3 and 4 may thus be obtained whereby, of the light radiation emitted by sources L:

- a portion is emitted from device 10 (e.g. through lens 18, if present) without being reflected,
- another portion is reflected by the upper reflective surface 210 of body 16 towards the outside of device 10,
- a further portion is reflected by reflective surfaces 208a towards the outside of device 10 and/or

towards reflective surface 210 of body 16 (where it can undergo a further reflection before exiting device 10).

In any case, in one or more embodiments, it is possible to achieve a mechanism for propagating the light radiation emitted by sources L with the presence of a housing member (e.g. heatsink 20) arranged on prongs 162, and with at least one reflective member extending bridge-like (such as bridges 208) between prongs 162, to reflect light radiation towards body portion 160 (e.g. towards surface 210 enclosing body portion 160) of support member 16.

In one or more embodiments, e.g. comprising a reflector illuminated by lighting device 10, it is therefore possible to increase the portion of radiation heading towards the reflector with respect to the portion which is emitted directly, without being subjected to reflection.

Figure 4 exemplifies that, at least in principle, by making members 208 movable with respect to device 10 and, in any case, at the designing stage of device 10, the position and/or the orientation of members 208 may be adjusted (see e.g. the distance denoted as d and angles α and α' in Figure 3) so as to modify the previously described mechanism, through which the light radiation emitted by sources L exits device 10, by varying the radiation distribution among the various previously listed portions thereof.

Of course, without prejudice to the basic principles, the implementation details and the embodiments may vary, even appreciably, with respect to what has been described herein by way of non-limiting example only, without departing from the extent of protection.

The extent of protection is defined by the annexed claims.

CLAIMS

1. A lighting device (10), including:

- a support member (16) with a fork-like shape with a body portion (160) and two prongs (162) carrying mutually facing electrically powered light radiation sources (L) having a space therebetween, and

- a housing member (20) fitted onto said prongs (162) with at least one reflective member (208) extending bridge-like between said prongs (162) to reflect light radiation towards said body portion (160) of said support member (16).

2. The lighting device of claim 1, wherein said at least one reflective member (208) includes a crescent-shaped reflective surface (208a).

3. The lighting device of claim 1 or claim 2, including a pair of reflective members (208) extending on respective sides of said space between said mutually facing light radiation sources (L).

4. The lighting device of any of the previous claims, including a spacer member (18) in said space between said light radiation sources (L).

5. The lighting device of any of the previous claims, including an optical member (18) in said space between said light radiation sources (L).

6. The lighting device of any of the previous claims, wherein said body portion (160) of the support member (16) includes a reflective surface (210).

7. The lighting device of any of the previous claims, including a heat sink member (20) fitted onto said prongs (162) and wherein said at least one reflective member (208) is coupled with said heat sink member (20).

8. The lighting device of any of the previous claims, wherein said light radiation sources include solid state radiation sources, preferably LED sources

(L).

9. A method of designing a lighting device according to any of claims 1 to 8, the method including selecting at least one of:

- a location (d) of said at least one reflective member (208) with respect to said body portion (106) of said support member (16), and
- an angle (α, α') formed by a reflective surface (208a) of said at least one reflective member (208) with respect to said body portion (106) of said support member (16).

10. A method of producing a lighting device (10), including:

- providing a support member (16) with a fork-like shape with a body portion (160) and two prongs (162) carrying mutually facing electrically powered light radiation sources (L) having a space therebetween, and
- fitting onto said prongs (162) a housing member (20) fitted with at least one reflective member (208) extending bridge-like between said prongs (162) to reflect light radiation towards said body portion (160) of said support member (16).

FIG. 1

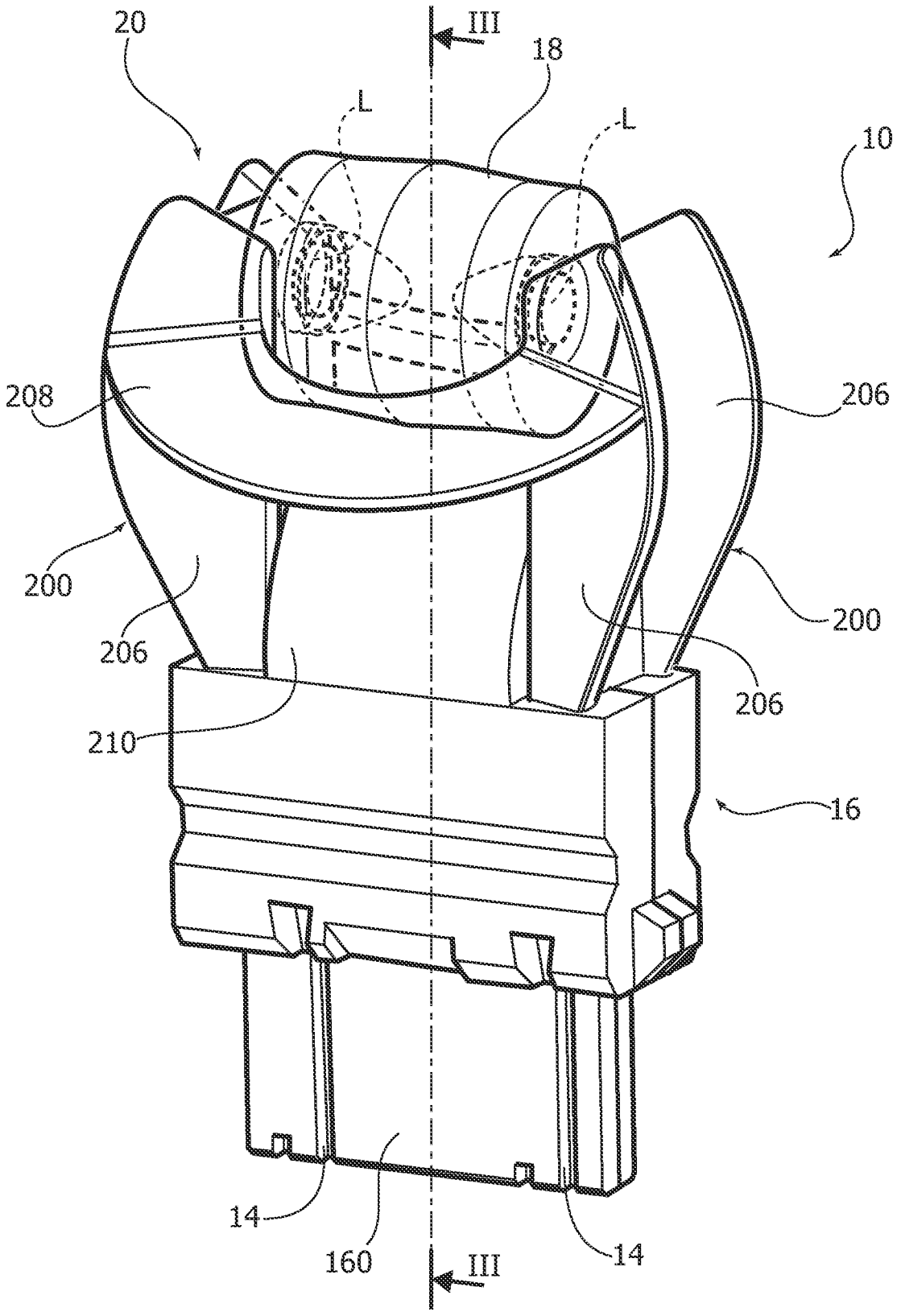


FIG. 2

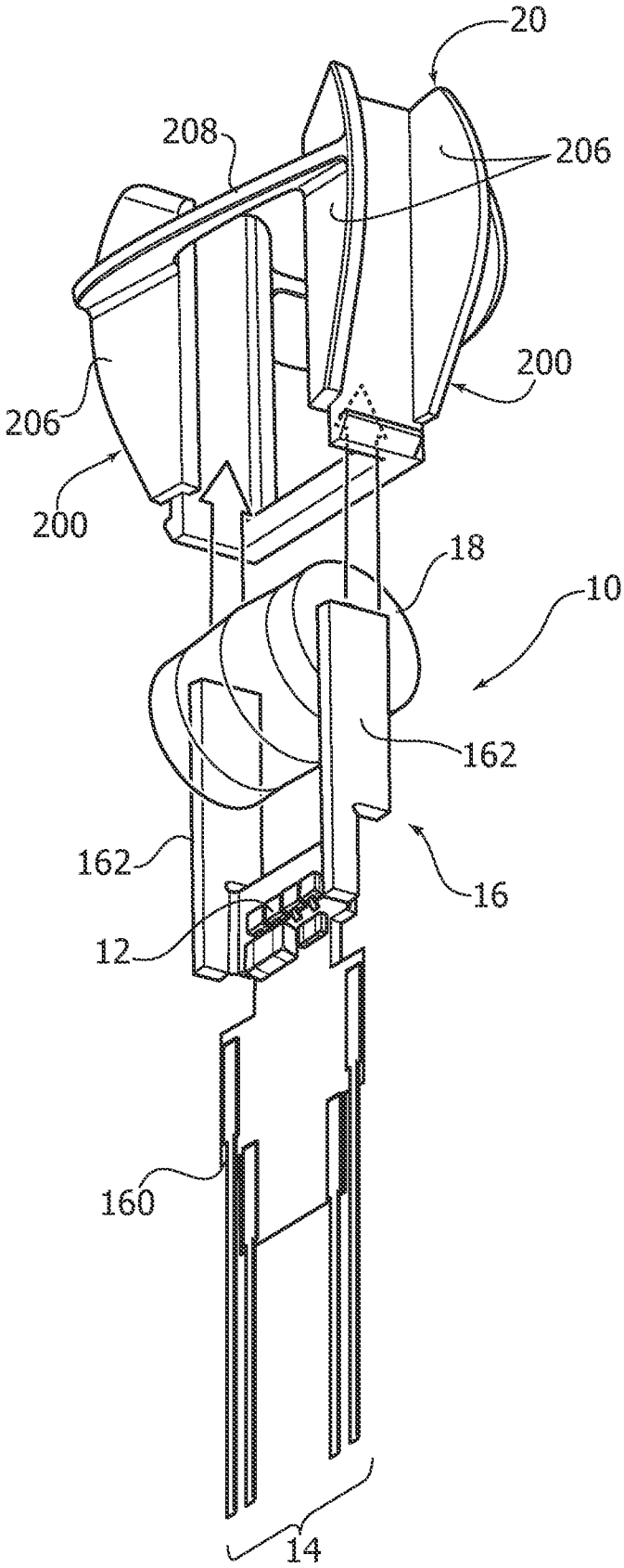


FIG. 3

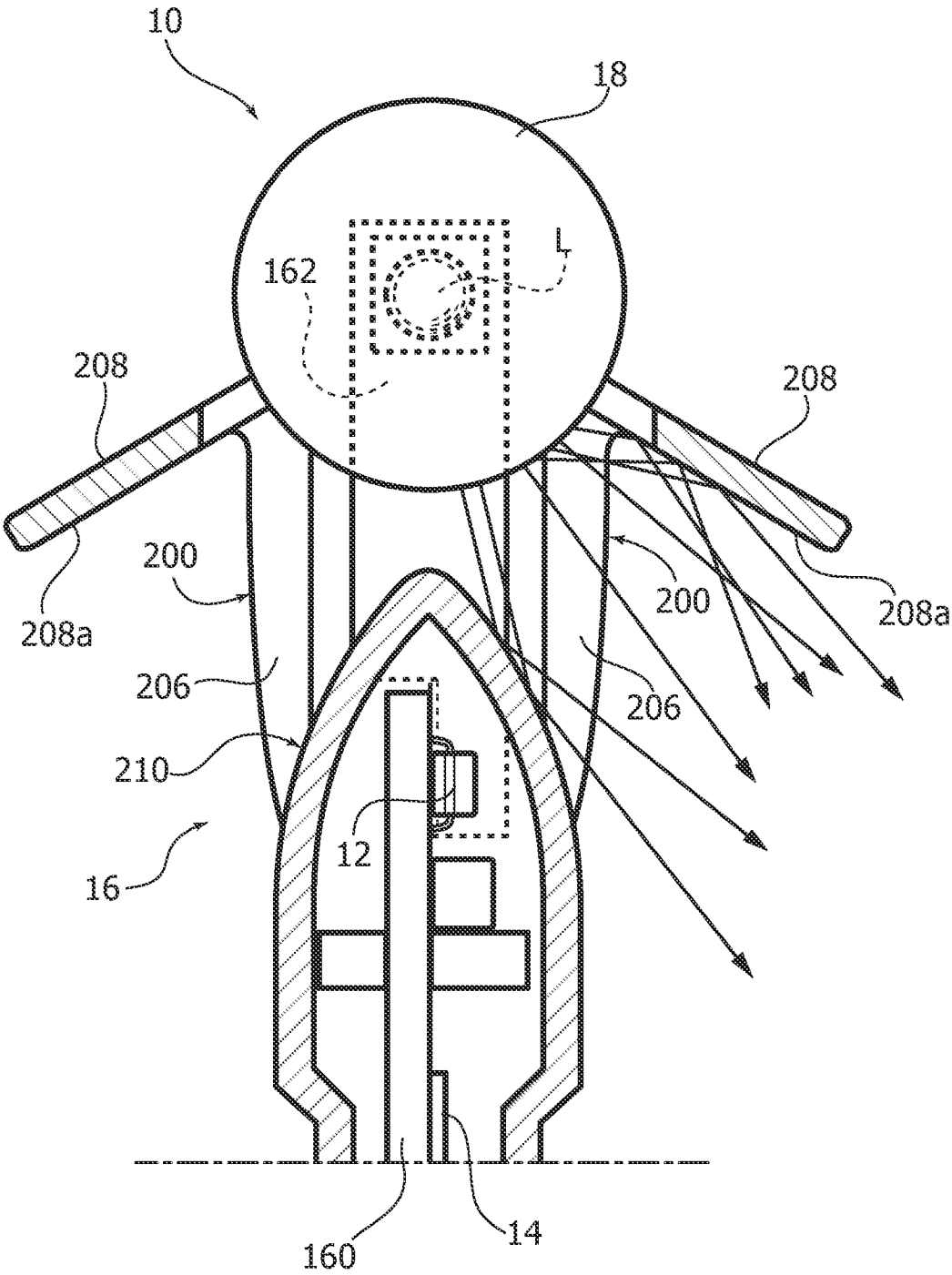
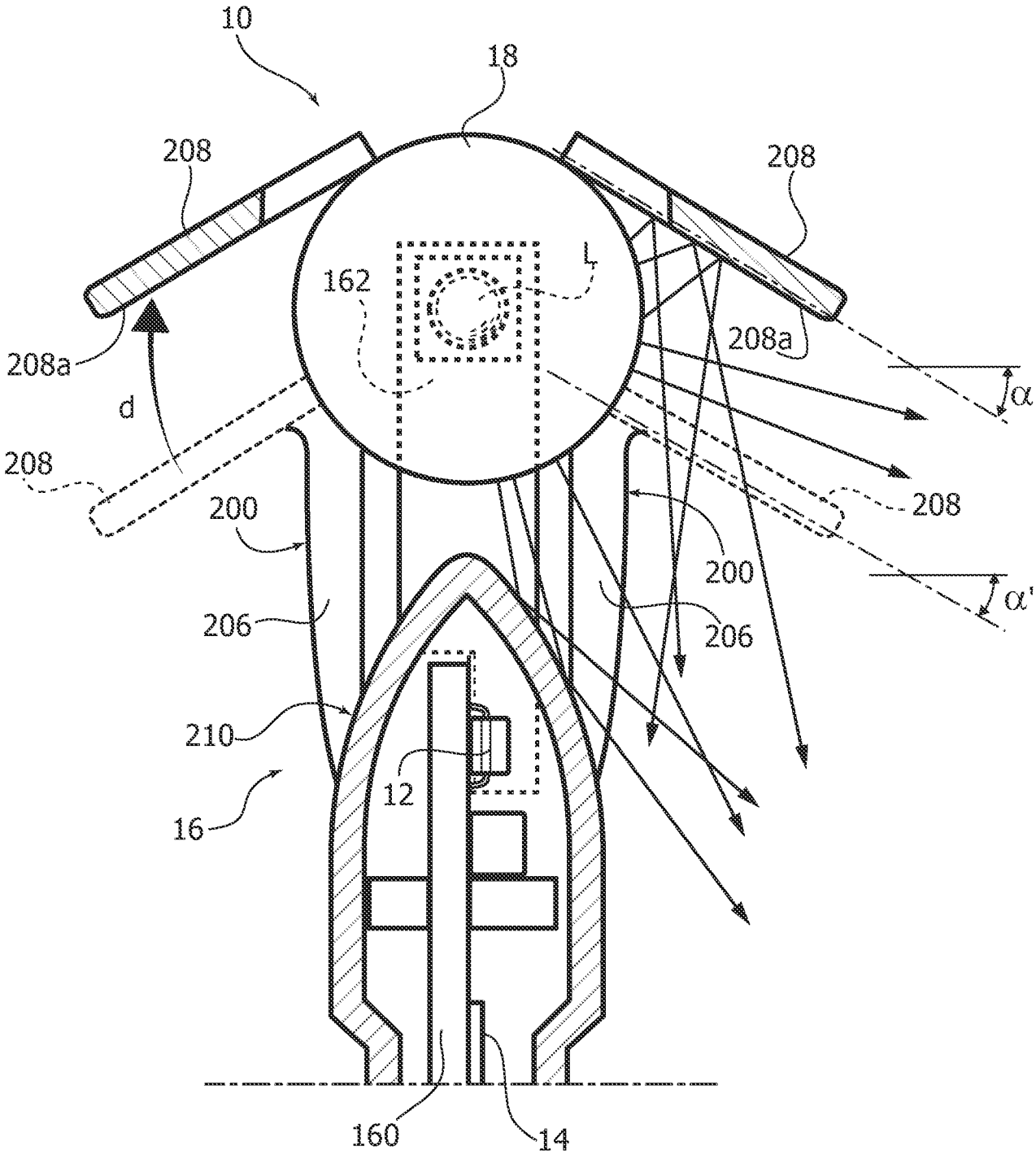


FIG. 4


10
18
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208
162
208a
208a
d
208
208
200
200
206
206
210
12
16
160
14
α
α'

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/052889

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21V7/00 F21V29/70 F21K9/00
ADD. F21Y115/10

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	US 2014/119007 A1 (EDMOND JOHN ADAM [US] ET AL) 1 May 2014 (2014-05-01) paragraph [0039] - paragraph [0068]; figures 1-16	1-3,5,6, 8-10
X	US 2012/126260 A1 (HUSSELL CHRISTOPHER P [US] ET AL) 24 May 2012 (2012-05-24) paragraph [0056]; figure 17 paragraph [0050]; figure 8	1,4-6, 8-10
X	US 2013/286664 A1 (WANG TIEN YANG [TW]) 31 October 2013 (2013-10-31) figures 1-5, 14A-14C the whole document	1,5-10

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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2016/052889

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2012/147024 A1 (KONINKL PHILIPS ELECTRONICS NV [NL]; HAENEN LUDOVICUS JOHANNES LAMBERT) 1 November 2012 (2012-11-01) the whole document -----	1-10
A	WO 2015/040240 A1 (OSRAM GMBH [DE]) 26 March 2015 (2015-03-26) the whole document -----	1-10

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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