



(51) International Patent Classification:

F21V 23/00 (2006.01) F21Y 105/00 (2006.01)
F21Y 101/02 (2006.01)

(21) International Application Number:

PCT/EP2013/067997

(22) International Filing Date:

30 August 2013 (30.08.2013)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

201210416909.6 17 October 2012 (17.10.2012) CN

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV,

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(54) Title: LED LIGHTING DEVICE AND LUMINAIRE WITH SUCH AN LED LIGHTING DEVICE

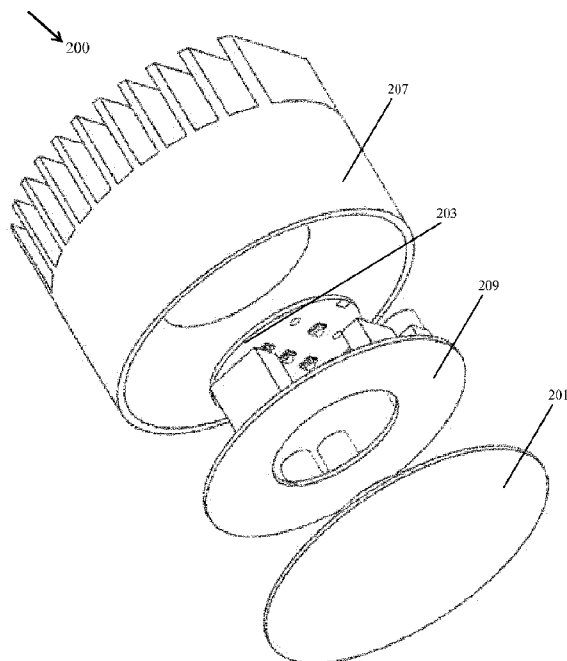


Figure 4

(57) Abstract: The present invention discloses an LED lighting device and a luminaire with such an LED lighting device. The LED lighting device comprises a first circuit board (203) supporting LEDs on a first surface; a lens (201) one side of which is mounted on the first surface of the first circuit board; a heatsink (207) at least comprising a first part (2074) that supports the first circuit board (203) on a second surface of the first circuit board opposite to the first surface; and a second circuit board for a power supply (209), characterized in that the second circuit board (209) thermally contacts with the first circuit board (203) so that heat could be transferred to a heatsink (207) via the first circuit board (203). Good heat dissipation effect could be achieved according to the LED lighting device of the present application, and the number of components could be decreased, so as to simplify the structure and assembly.



MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, **Published:**
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, — *with international search report (Art. 21(3))*
GW, KM, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

Description

LED Lighting device and Luminaire with Such an LED Lighting device

5

Technical Field

The present invention relates to an LED lighting device and a luminaire with such an LED lighting device.

Background Art

10 As a new light source, the LED luminaire has such advantages as high efficiency, pure light color, low energy consumption, long lifespan, reliability, durability, zero pollution, flexible controlling, etc., and therefore gains wide application.

15 For LED luminaires, LED emits light by virtue of the electric energy received, and thereby generates heats. In addition, the PCB used for driving LED also generates heats in operation. Therefore, the LED lighting device needs to dissipate heats to maintain its performance.

20 It's well known that heat dissipation in the LED lighting device is an important issue, and the design of heat dissipation channels is very important to heat dissipation. However, for the LED lighting device with a built-in drive in the solution, to obtain a good heat dissipation effect, the design
25 of heat dissipation channels is a difficult issue.

Reference can be made to FIG. 1 and 2, which schematically illustrates the exploded perspective view and the cross section view of the LED lighting device 100. The LED lighting

device 100 comprises the lens 101, the first circuit board (printed circuit board assembly) 103 that supports LED, the second circuit board 109 directly over the first circuit board 103 that supports the power supply, the lead 105 connecting the first circuit board 103 and the second circuit board 109, the heatsink 107, and the PS (polystyrene) cover 111. Under normal conditions, the second circuit board 109 hangs over the first circuit board 103 in the manner of being kept some distance away from the first circuit board 103. In addition, as there exist the lens 101 under the first circuit board 103 and the second circuit board 109 directly over the first circuit board 103, the heatsink 107 is provided as having the central platform part between the first circuit board 103 and the second circuit board 109, as well as a plurality of radially extending surrounding vertical fins that compass the lens 101, the first circuit board 103, the second circuit board 109 and the lead 105.

Reference can be made to FIG. 3, which shows the heat flow in the structure of FIG. 1. The first circuit board 103 is the heat source of the structure, wherein the heat flows toward the surrounding vertical fins of the structure along the central platform part of the heatsink 107, and then the surrounding vertical fins dissipate the heats to the environment around.

Based on FIGS. 1-3, it can be seen that the existing LED Lighting device at least has the following defects:

1. The second circuit board 109 hangs over the first circuit board 103 in the manner of being kept some distance away from the first circuit board 103, therefore not a good heat conduction channel could be formed between the

second circuit board and the heatsink, so that the heat dissipation of the second circuit board is poor.

2. The second circuit board 109 hangs over the first circuit board 103 in the manner of being kept some distance away from the first circuit board 103. Therefore, separate fasteners are required to fix the second circuit board 109.
3. As there exists a lens 101 under the first circuit board 103 and the second circuit board 109 directly over the first circuit board 103, the heatsink 107 could only be provided as having the central platform part and radially extending surrounding fins. As a result, the heats could only flow along the directions as shown in FIG. 3, and could not form heat conduction paths directly passing heats upward, viz. heat conduction routes of this LED lighting device are very tortuous, with a low heat dissipation efficiency.
4. The second circuit board 109 is located at the top of the first circuit board 103 as the heat source, the central platform part of the heatsink 107 is between the second circuit board 109 and the first circuit board 103, and all these components are encircled by the radially extending surrounding fins of the heatsink 107. Therefore, the lead 105 must be used to connect the second circuit board 109 and the first circuit board 103. However, this connection is hard to carry out in such a compact structure, which further adds to the complexity of the structure and difficulty of the assembly.
5. The second circuit board 109 is located at the top of

the first circuit board 103 as the heat source, and therefore is roasted by the heat source, which would affect the operation and lifespan of the second circuit board 109.

6. The second circuit board 109 and the first circuit board
5 103 shall serve as separators at the central platform part of the heatsink 107 for isolation and heat conduction, and such an arrangement makes the heatsink 107 complex in structure and hard to produce.

Summary of the Invention

- 10 The object of the present invention lies in overcoming defects of the prior art and providing an LED lighting device and a luminaire with such an LED lighting device, so that the LED lighting device with built-in drive could obtain a good heat dissipation effect.
- 15 Provide an LED lighting device according to an aspect of the present invention, characterized in that the LED lighting device comprises a first circuit board supporting a LED chip on the first surface; a lens one side of which is mounted on the first surface of the first circuit board; a heatsink at least
20 comprising a first part that supports the first circuit board on a second surface of the first circuit board opposite to the first surface; a second circuit board for a power supply, characterized in that the second circuit board thermally contacts with and the first circuit board so that heat could be
25 transferred to the heatsink via the first circuit board.

Preferably, the second circuit board thermally contacts with the first circuit board at the first side of the first circuit board.

Preferably, the second circuit board is provided around the first circuit board, and the second circuit board thermally contact with the first circuit board at the edge of the first circuit board.

- 5 Preferably, the second circuit board comprises a connection part connecting with the edge, and corresponding bonding pads are provided respectively on the connection part and on the edge, so that the second circuit board and the first circuit board are connected electrically.
- 10 Preferably, a hole is provided on a center of the second circuit board, and the lens is mounted on the first circuit board through the hole.

Preferably, the first circuit board is provided as a circle, and the second circuit board is provided as a ring.

- 15 Preferably, the heatsink also comprises a second part which starts from the first part, and extends from the second side of the first circuit board to the first side of the first circuit board where the LED chip is provided, so as to define a cavity open at one side for receiving the first and second
- 20 circuit boards.

Preferably, the heatsink and lens co-define a closed space enclosing the first and second circuit boards.

- Preferably, the second part comprises a first section defining a top wall of the cavity together with the first part and
- 25 a second section defining a side wall of the cavity.

Preferably, the second part has a main body which comprises a first vertical wall far away from the first circuit board, a

horizontal part extending horizontally outward from the first vertical wall, and a second vertical wall extending outward from the perimeter of the horizontal part.

Preferably, the first part has a main body, the first part
5 and the second part have fins extending vertically from the surface of the horizontal part of the main body of the second body and from the surface of the main body of the first part, respectively.

Preferably, the main body of the first part is a circle, the
10 first vertical wall is a cylinder, the horizontal part is a ring, and the second vertical wall is a cylinder.

Preferably, the fins are higher than the horizontal part in height.

Preferably, the fins are flat and straight fins arranged in
15 parallel with equal distance.

Preferably, the fins, the main body of the first part and the main body of the second part have uniform thickness.

Preferably, the LED lighting device, as a whole, is in a centrosymmetrical shape.

20 Provide a luminaire according to another aspect of the present invention, comprising any of the above-mentioned LED lighting device.

Through the various Examples of the present invention, at least one or a plurality of the following effects could be
25 achieved:

1. Heat conduction routes that make heats radiate upward are formed in the heatsink, so that all areas of the heatsink are used for heat dissipation, leading to a high heat dissipation efficiency.
- 5 2. The heatsink 207 embraces the first circuit board 103 and the second circuit board 209 inward, so that the heatsink 207 could function as a shell to protect the first circuit board 203 and the second circuit board 209.
3. As the heatsink functions as a shell and forms an closed
10 space with the lens, the PS cover in the technology indicated in FIGS 1 and 2 could be saved, so that the number of components required by the structure could be decreased, and the structure and assembly procedure could be simplified.
- 15 4. As the first circuit board 203 and the second circuit board 209 are connected via bonding pads, there is no need to set separate fasteners for the second circuit board 209.
5. As the first circuit board 203 and the second circuit
20 board 209 are directly connected using corresponding bonding pads, the lead in the technology indicated in FIGS 1 and 2 could be saved, so that the number of components of the LED lighting device could be decreased, and the assembly could be simplified.

25 **Brief Description of the Drawings**

The Drawings constitute a part of the Description, used to help further understand the present invention. The drawings

illustrate the Examples of the present invention, used to explain the principles of the present invention along with the Description. In the Drawings, the same components are labeled using the same reference sign. In the Drawings:

5 FIG. 1 shows the exploded perspective view of the LED lighting device according to the prior art;

FIG. 2 shows the cross section view of the LED lighting device according to the prior art;

FIG. 3 is a schematic view of the heat flow routes of the LED
10 lighting device according to the prior art;

FIG. 4 shows the exploded perspective view of the LED lighting device according to the Examples of the present invention;

FIG. 5 shows the cross section view of the LED lighting device
15 according to the Examples of the present invention;

FIG. 6 is a schematic view of the heat flow routes of the LED lighting device according to the Examples of the present invention;

FIG. 7 is a heat simulation diagram of the LED lighting device
20 according to the prior art; and

FIG. 8 is a heat simulation diagram of the LED lighting device according to the Examples of the present invention.

Detailed Description of the Embodiments

The present invention would be described more comprehensively
25 in reference to the Drawings that schematically illustrate

the exemplary embodiments of the present invention. However, the present invention could be carried out in various forms, and should not be constructed merely with the exemplary embodiments stated herein. Of course, the object of providing these exemplary embodiments is to make this publication more comprehensive and complete, and fully convey the scope of the present invention to the person skilled in the art.

Next, the present invention would be explained in detail in reference to the Drawings.

Reference can be made to FIGS. 4-6, which schematically illustrate an LED lighting device according to the Examples of the present invention, characterized in that an LED lighting device comprises a lens 201, a first circuit board 203, a heatsink 207, and a second circuit board 209. The first circuit board 203 supports the LED chip on the first surface. One side of the lens 201 is mounted on the first surface of the first circuit board.

The second circuit board 209 thermally contact with the first circuit board 203 so that heat could be transferred to the heatsink 207 via the first circuit board 203. Specifically, as indicated in FIGS. 5 and 6, the second circuit board 209 could be provided on the first side of the first circuit board (that is, the lower side of the first circuit shown in FIGS. 5 and 6), so that it thermally contact with the first circuit board. Furthermore, the second circuit board 209 is provided around the first circuit board 203, and the second circuit board thermally contact with the first circuit board at the edge 2031 of the first circuit board 203. Accordingly, the second circuit board comprises the connection part 2092 connecting with the edge 2031, and corresponding bonding pads are provided respectively on the connection part 2092 and the

edge 2031 (not indicated), so that the second circuit board 209 and the first circuit board 203 could be connected electrically by aligning and welding together the bonding pads of the connection part 2092 and the edge 2031. In addition, thermal contact could be formed through the bonding pads, so that heats on the second circuit board 209 could also be passed to the heatsink 207 via the first circuit board 203. As the first circuit board 203 and the second circuit board 209 are directly connected using corresponding bonding pads, the lead 205 in the technology indicated in FIGS 1-3 could be saved. As a result, the number of components of the LED lighting device could be decreased, and the assembly could be simplified.

By providing the second circuit board 209 as encircling the first circuit board 203, the heatsink 207 could be provided on the first circuit board 203, so as to form the vertical and upward heat conduction routes as indicated in FIG. 6, leading to high heat dissipation efficiency. In addition, it would exempt the second circuit board 209 from being roasted by the heats generated by the first circuit board 203 if the second circuit board 209 is provided as encircling the first circuit board 203.

Specially, as indicated in FIGS 5 and 6, a hole 2091 may be provided on the center of the second circuit board 209, and the lens 201 could be mounted on the first circuit board 203 through the hole 2091. The providing of the hole 2091 enables that the lens could pass through the second circuit board 209, and further enables that, even if the second circuit board 209 is provided under the first circuit board 203, the installation of the lens 201 may not be affected.

Preferably, as shown in FIG. 4, the first circuit board 203

may be provided as a circle, and the second circuit board 209 may be provided as a ring accordingly so as to touch the edge 2031 of the first circuit board 203. Circles and rings are easy to manufacture, and easy to generate good and even heat
5 dissipation when matched with the circular heatsink 207 (will be described in the following sections).

More preferably, at the connection part 2092 that connects the edge 2031 of the first circuit board 203 and the second circuit board 209, there is a plurality of corresponding cen-
10 trosymmetrical weld joints. For example, along the diameter direction of the ring-like connection part 2092 on the second circuit board 209, there are two solder joints, which correspond with and electrically connect the two solder joints along the diameter direction of the edge 2031 of the first
15 circuit board 203. At the same time, a thermal contact is formed.

The heatsink 207 may at least comprise the first part 2074 that supports the first circuit board 203 on the second surface of the first circuit board 203 (that is, the upper sur-
20 face of the first circuit board 203) opposite to the first surface. As shown in FIG. 5, the first part 2074 may be provided so as to directly contact with the second surface of the first circuit board 203, so that the thermal conduct effect is improved.

25 In addition, the heatsink 207 may also comprise the second part (the second part is shown with the reference numbers 2073, 2075 and 2076), which starts from the first part, and extends from the second side (i.e upper side) of the first circuit board to the first side (i.e lower side) of the first
30 circuit board where the LED chip is provided, so as to define

the cavity open on one side for receiving the first and second circuit boards. More specially, the heatsink 207 and the lens may co-define the closed space (that is, cavity 210) encompassing the first circuit board 203 and the second circuit board 209. The heatsink 207 embraces the first circuit board 203 and the second circuit board 209 inward, so that the heatsink 207 could function as a shell to protect the first circuit board 203 and the second circuit board 209. In addition, as the heatsink 207 functions as a shell and forms an closed space with the lens 201, the PS cover in the technology indicated in FIGS 1-3 could be saved. As a result, the number of components required by the structure could be decreased, and the structure and assembly procedure could be simplified. In addition, the first circuit board 203 and the second circuit board 209 are wholly encircled by the heatsink 207. Therefore, the heat dissipation efficiency could be further improved.

The structure of the second part of the heatsink 207 will be described with reference to FIGS. 5 and 6. The second part may comprise the first section (shown with the reference numbers 2075 and 2076) defining the top wall of the cavity 210 together with the first part 2072, as well as the second section (shown with the reference numbers 2073) defining the side wall of the cavity. The main body of the second part comprises the first vertical wall 2075 far away from the first circuit board, the horizontal part 2076 extending horizontally outward from the first vertical wall 2075, and the second vertical wall 2073 extending outward from the perimeter of the horizontal part 2076.

The first part 2074 and the second part each has its main body and fins 2072 extending vertically from the surface of the main body. As indicated in FIG. 6, such a structure could

form vertical and upward heat conduction paths, so as to greatly improve the heat dissipation efficiency.

Preferably, with reference to both FIGs. 5 and 6, the main body 2074 of the first part is a circle, the first vertical wall 2075 is a cylinder, the horizontal part 2076 is a ring, and the second vertical wall 2073 is a cylinder. Such a centrosymmetrical shape makes the heatsink 207 easy to manufacture, and helps improve the evenness of the heat dissipation.

In addition, for the benefit of better heat dissipation, the fins, as a whole, extend out of the main body. Preferably, the fins 2072 are higher than the horizontal part 2076 in height. More preferably, the fins 2072 are flat and straight fins arranged in parallel with equal distance. The fins 2072 and the main body of the first part and the main body of the second part may have uniform thickness, so that the fins 2072 and the main bodies 2071 may take shape easily by means of casting, etc.

Preferably, the LED lighting device, as a whole, shall take a centrosymmetrical shape, so that it would be easy to produce and the heats could be dissipated evenly.

From FIGS 7 and 8, it can be seen that the heat dissipation effect of the LED lighting device according to the present invention is obviously better than that in the prior art.

Good heat dissipation effect could be achieved according to the LED lighting device of the present application, and the number of components could be decreased, so as to simplify the structure and assembly.

The above is merely the preferred embodiments of the present invention, and is not used to define the present invention. For the person skilled in the art, the present invention may have various changes and variations. Any modification, equivalent substitution, amendment, etc. made in the spirit and principle of the present invention shall be included in the scope of protection of the present invention.

Claims

1. An LED lighting device comprising: a first circuit board (203) supporting a LED chip on a first surface; a lens (201),
5 one side of which is mounted on the first surface of the first circuit board; a heatsink (207) at least comprising a first part (2074) that supports the first circuit board (203) on a second surface of the first circuit board opposite to the first surface; and a second circuit board (209) for a
10 power supply, characterized in that the second circuit board (209) thermally contacts with the first circuit board (203) so that heat could be transferred to the heatsink (207) via the first circuit board (203).
2. An LED lighting device according to Claim 1, characterized in that the second circuit board (209) thermally con-
15 tacts with the first circuit board (203) at the first side of the first circuit board (203).
3. An LED lighting device according to Claim 2, characterized in that the second circuit board (209) is provided
20 around the first circuit board (203), and the second circuit board (209) thermally contact with the first circuit board (203) at the edge (2031) of the first circuit board.
4. An LED lighting device according to Claim 3, characterized in that the second circuit board comprises a connection
25 part (2092) connecting with the edge (2031), and corresponding bonding pads are provided respectively on the connection part and the edge (2031), so that the second circuit board (209) and the first circuit board (203) are connected electrically.
- 30 5. An LED lighting device according to Claim 1, 2 or 3,

characterized in that a hole (2091) is provided on a center of the second circuit board (209), and the lens is mounted on the first circuit board (203) through the hole.

6. An LED lighting device according to Claim 1, 2 or 3,
5 characterized in that the first circuit board (203) is provided as a circle, and the second circuit board (209) is provided as a ring.

7. An LED lighting device according to Claim 1, 2 or 3,
characterized in that the heatsink also comprises a second
10 part (2073, 2075, and 2076) which starts from the first part (2074), and extends from the second side of the first circuit board to the first side of the first circuit board where the LED chip is provided, so as to define a cavity open at one side for receiving the first and second circuit boards.

15 8. An LED lighting device according to Claim 7, characterized in that the heatsink (207) and the lens co-define a closed space (210) enclosing the first circuit board (203) and the second circuit board (209).

9. An LED lighting device according to Claim 7, characterized in that the second part (2073, 2075, and 2076) comprises
20 a first section (2075, 2076) defining a top wall of the cavity together with the first part (2074) and a second section (2073) defining a side wall of the cavity.

10. An LED lighting device according to Claim 10, characterized
25 in that the second part (2073, 2075, and 2076) has a main body which comprises a first vertical wall (2075) far away from the first circuit board, a horizontal part (2076) extending horizontally outward from the first vertical wall (2075), and a second vertical wall (2073) extending outward

from the perimeter of the horizontal part (2076).

11. An LED lighting device according to Claim 10, characterized in that the first part (2074) has a main body, the first part and the second part have fins (2072) extending vertically from the surface of the horizontal part (2076) of the main body of the second body and from the surface of the main body of the first part, respectively.

12. An LED lighting device according to Claim 11, characterized in that the main body of the first part (2074) is a circle, the first vertical wall (2075) is a cylinder, the horizontal part (2076) is a ring, and the second vertical wall (2073) is cylinder.

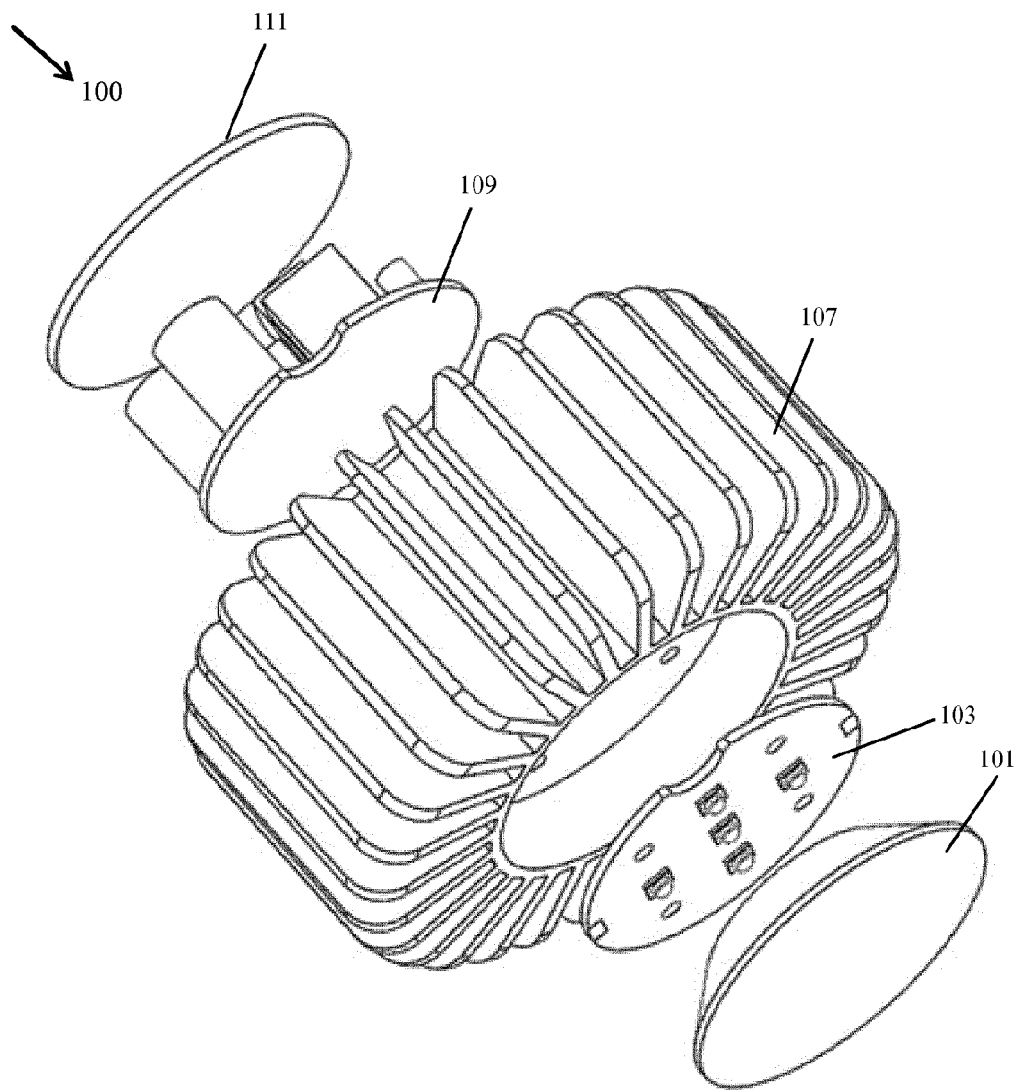
13. An LED lighting device according to Claim 11, characterized in that the fins (2072) are higher than the horizontal part (2076) in height.

14. An LED lighting device according to Claim 11, characterized in that the fins (2072) are flat and straight fins arranged in parallel with equal distance.

15. An LED lighting device according to Claim 11, characterized in that the fins (2072), the main body (2071) of the first part and the main body of the second part have uniform thickness.

16. An LED lighting device according to Claim 1, 2 or 3, characterized in that the LED lighting device, as a whole, is in a centrosymmetrical shape.

17. A luminaire, characterized in that it comprises the LED lighting device according to any of the Claims 1-16.

**Figure 1**

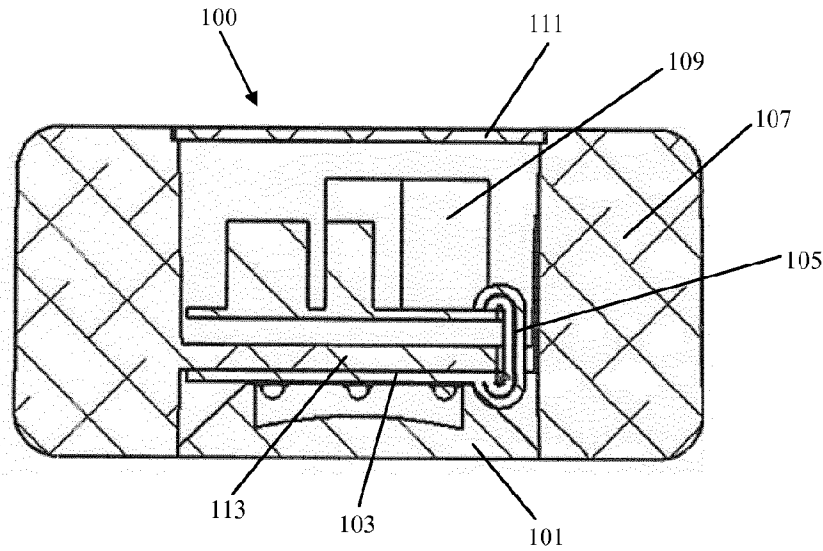


Figure 2

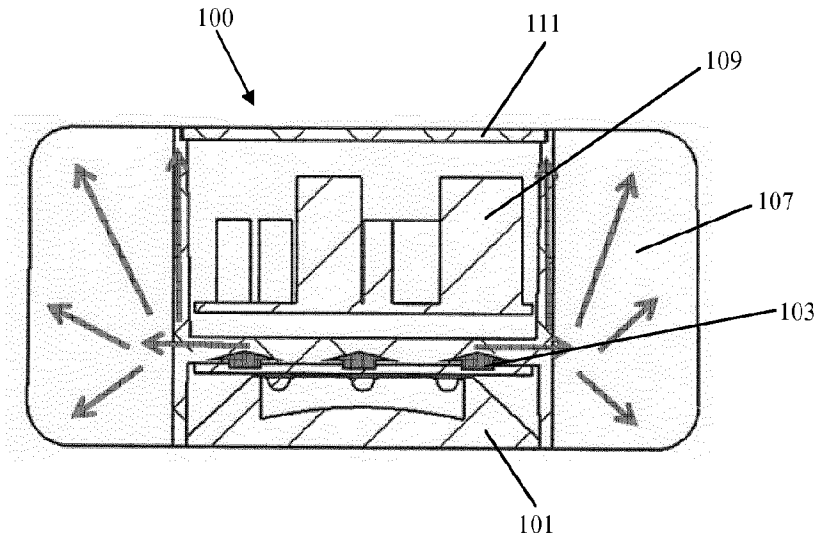


Figure 3

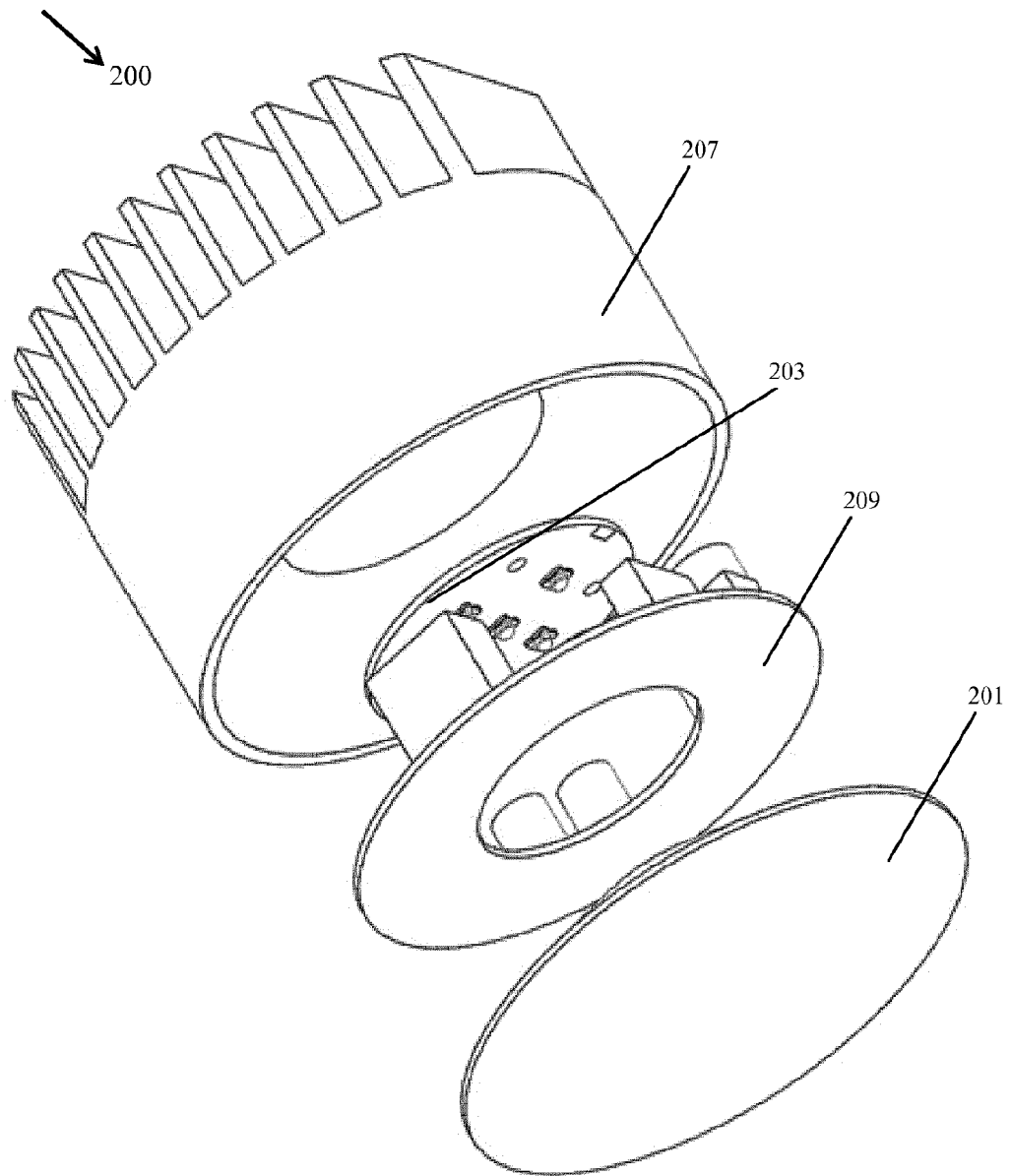
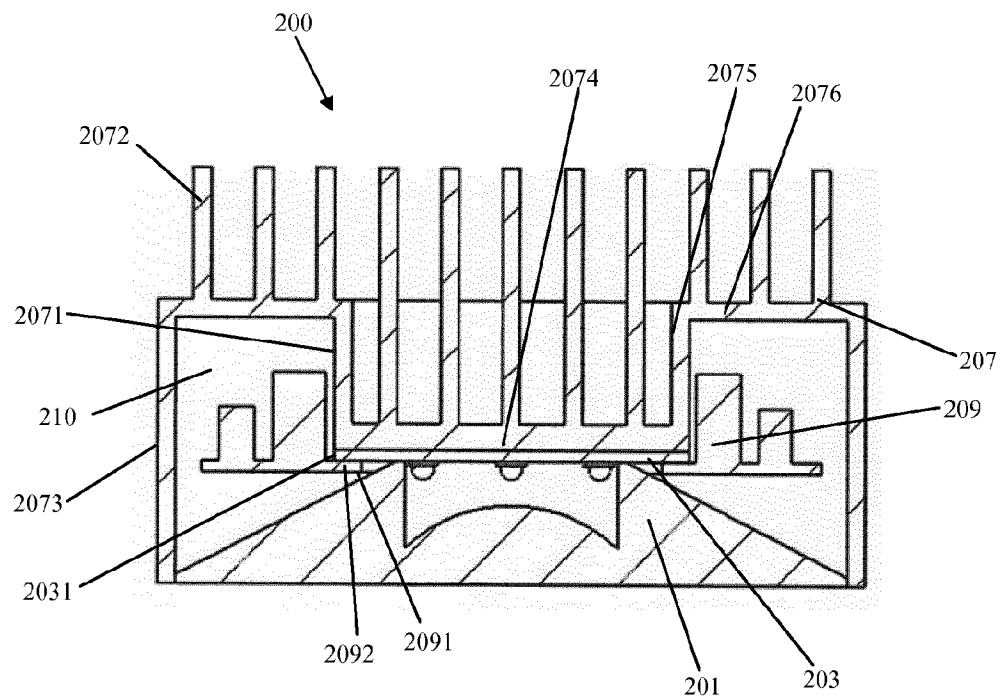
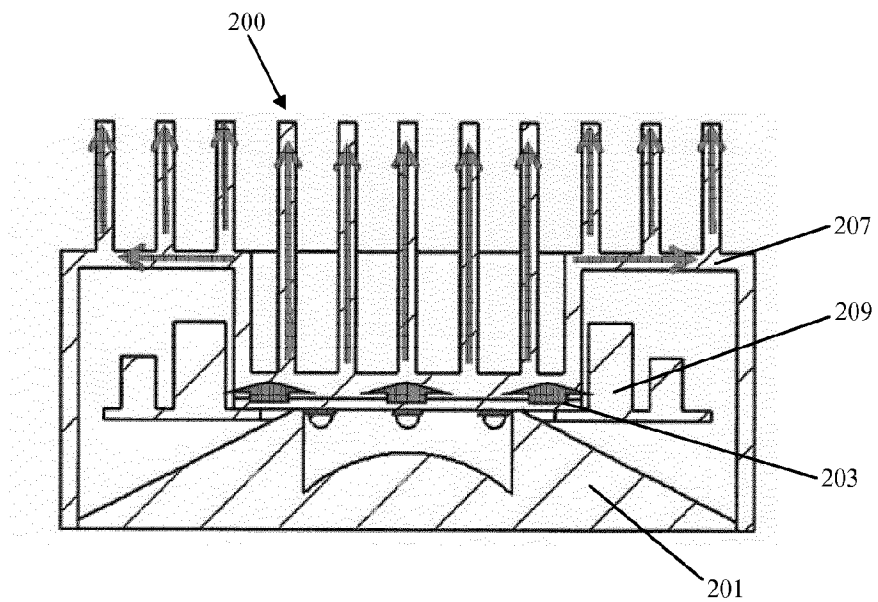
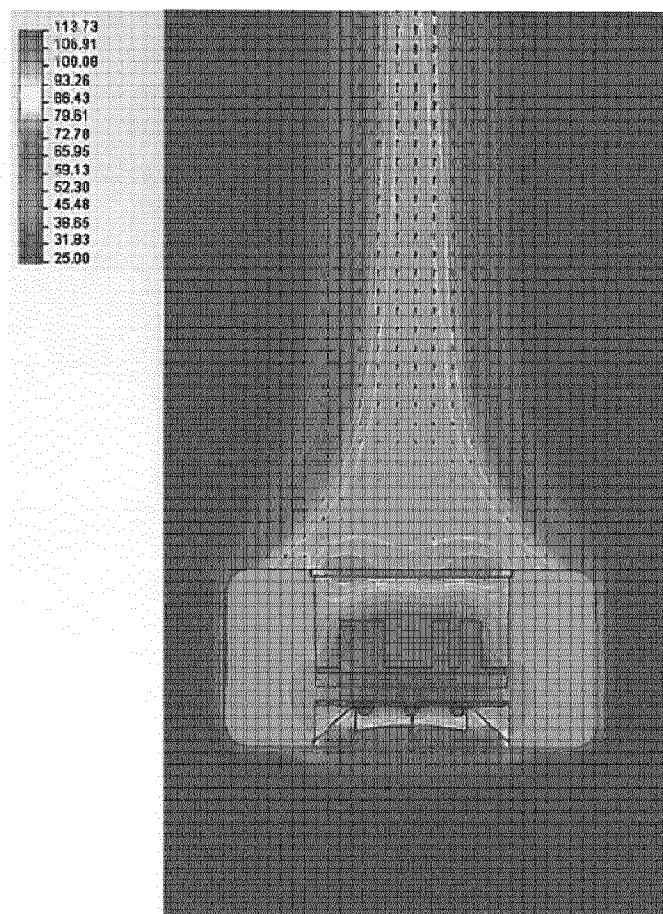


Figure 4

**Figure 5****Figure 6**

**Figure 7**

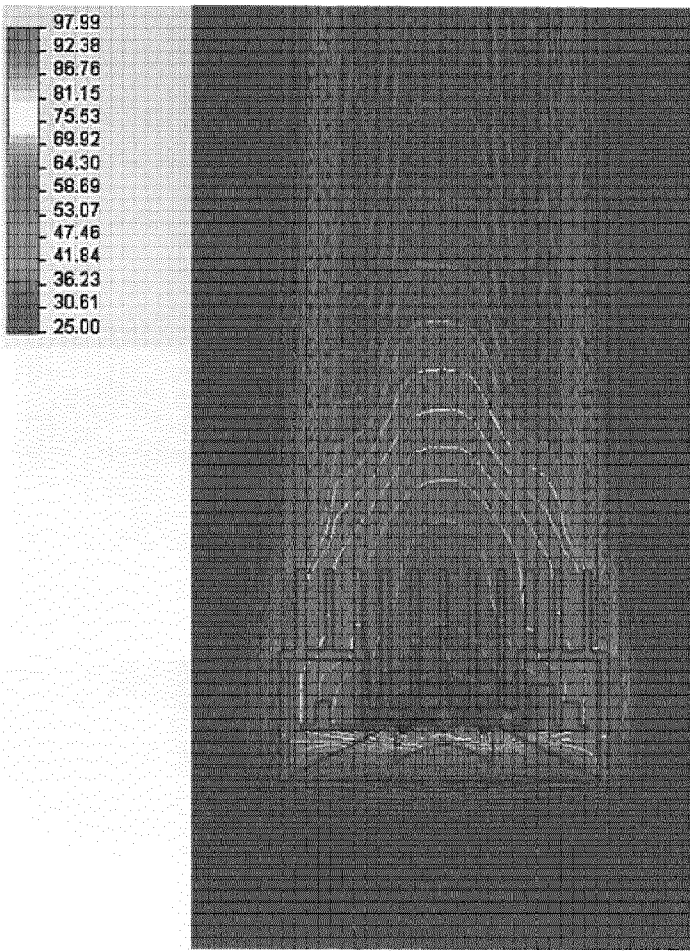


Figure 8

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/067997

A. CLASSIFICATION OF SUBJECT MATTER

INV. F21V23/00
ADD. F21Y101/02 F21Y105/00

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 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 2010/164348 A1 (HUANG TSUNG-CHIN [TW] ET AL) 1 July 2010 (2010-07-01)	1,16,17
Y	figures 1, 2, 5 paragraphs [0014], [0015], [0016], [0018], [0021]	2-4,6-10
X	----- EP 2 339 230 A2 (TYCO ELECTRONICS CORP [US]) 29 June 2011 (2011-06-29) figures 1, 2 paragraphs [0017], [0018], [0019], [0021]	1,16,17
X	----- EP 2 083 214 A1 (NENG TYI PREC IND CO LTD [TW]) 29 July 2009 (2009-07-29) figures 1, 2, 5 paragraphs [0013], [0023] ----- -/-	1,16,17



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

24 September 2013

Date of mailing of the international search report

04/10/2013

Name and mailing address of the ISA/

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NL - 2280 HV Rijswijk
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Fax: (+31-70) 340-3016

Authorized officer

Sacepe, Nicolas

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/067997

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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