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(54) Title: HEAT DISSIPATING STRUCTURE AND LIGHTING DEVICE

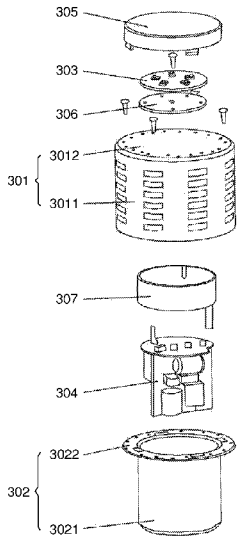

FIG. 5

(57) Abstract: The invention relates to a lighting device (300) including a light emitting unit (303), a driving unit (304) for driving the light emitting unit and a heat dissipating structure. The heat dissipating structure includes an inner housing (302) for accommodating the driving unit therein; and an outer housing (301) configured to encircle the inner housing, thereby forming a space (309) between the inner housing and the outer housing. A plurality of openings (30111) are arranged in the side wall (3011) of the outer housing so as to allow air to flow into the space and moves over the surfaces of the inner housing and the outer housing. One of the main advantages of this invention is that the heat dissipating structure is concise in structure and can be manufactured at low cost while the thermal performance can remain almost the same or is even better.

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HEAT DISSIPATING STRUCTURE AND LIGHTING DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a heat dissipating structure and a lighting device using such a heat dissipating structure.

2. Description of the Prior Art

LED lamp products are widely used in retail, hospital and home lighting applications. By virtue of its high lighting efficiency and long lifetime, LED lighting may replace traditional lamps in the future. However, heat dissipation may become the bottleneck of LED lamp products. Normally, a LED lamp product may be connected with a heat sink to dissipate heat, or a modular housing may be designed with an integrated heat sink.

Referring to Figs. 1 and 2, a traditional LED lamp product 100 including a heat sink 101, a light emitting unit 102 and a driving unit 103 for driving the light emitting unit 102 is shown. The metal housing of the heat sink 101 of the LED lamp product 100 is generally made by means of a die-casting or extrusion process, and the metal housing is designed with fins to dissipate heat. In view of die-casting process limitations, both the fin base and the fin thickness should meet certain process requirements, which may lead to the die-cast housing becoming very heavy. Consequently, the cost of the metal-fin housing is high because of its complex structure and high manufacturing cost.

Accordingly, there is a need to improve such an LED lamp product in terms of conciseness in structure and manufacturing cost.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a heat dissipating structure for cooling a lighting device, which is concise in structure and which can be manufactured at low cost while the thermal performance can remain almost the same or is even better.

To this end, there is provided a heat dissipating structure for cooling a

lighting device comprising a light emitting unit and a driving unit for driving the light emitting unit. The heat dissipating structure comprises an inner housing for accommodating the driving unit therein; and an outer housing configured to encircle the inner housing, thereby forming a space between the inner housing and the outer housing; a plurality of openings are arranged in the side wall of the outer housing so as to allow air to flow into the space and move over the surfaces of the inner housing and the outer housing.

According to an example of the invention, the outer housing further comprises a top wall at the top portion with a plurality of openings therein, which top wall is configured to mount the light emitting unit thereon, and air flows into the space between the inner housing and the outer housing through the plurality of openings in the top wall.

According to an example of the invention, at a bottom portion of the heat dissipating structure, an aperture is created between the outer housing and the inner housing, allowing the air to flow out of the space.

According to an example of the invention, the top wall of the outer housing comprises a plurality of openings at the circumference.

According to an example of the invention, the inner housing comprises a side wall and a ring portion, the ring portion being arranged at the top portion of the inner housing and being assembled to the top wall of the outer housing.

According to an example of the invention, the inner housing further comprises a bottom wall at the bottom portion of the inner housing, opposing the top wall of the outer housing, and the inner housing is assembled to the top wall of the outer housing, thereby defining a space for accommodating the driving unit.

According to an example of the invention, thermal grease is applied between the top wall of the outer housing and the ring portion of the inner housing for decreasing contact thermal resistance.

According to an example of the invention, the thickness of the outer housing is greater than that of the inner housing.

According to an example of the invention, the inner and/or outer housing are manufactured by means of sheet metal technology.

According to another example of the invention, the light emitting unit comprises at least one light emitting diode.

According to still another example of the invention, the openings in the side

wall of the outer housing are oriented horizontally or vertically.

The present invention also provides a lighting device comprising a light emitting unit, a driving unit for driving the light emitting unit, and a heat dissipating structure, wherein the heat dissipating structure comprises:

- an inner housing for accommodating the driving unit therein; and

- an outer housing configured to encircle the inner housing, thereby forming a space between the inner housing and the outer housing;

wherein a plurality of openings are arranged in the side wall of the outer housing so as to allow air to flow into the space and move over the surfaces of the inner housing and the outer housing.

Other objects, advantages, and novel features of the present invention will be apparent from the following detailed description of a preferred embodiment thereof with reference to the attached drawings, in which:

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1	is a schematic perspective view of an LED lamp product of the prior art;
Fig. 2	is a sectional side view of Fig. 1;
Fig. 3	is a schematic perspective view of a lighting device in an assembled state according to the present invention;
Fig. 4	is a sectional side view of Fig. 3 with an optical element covering an LED unit of the lighting device;
Fig. 5	is an exploded view of Fig. 3 with an optical element covering an LED unit of the lighting device;
Fig. 6	shows the bottom structure of Fig.3; and
Fig. 7	is a reversed view of Fig. 4 showing the air flowing state.

DETAILED DESCRIPTION OF THE PRESENT INVENTION

With reference to Figs. 3-7, a lighting device 300 according to one aspect of the present invention comprises a light emitting unit 303, a driving unit 304 for driving the light emitting unit 303 and a heat dissipating structure.

The light emitting unit 303 comprises a PCB (not labeled) and at least one

light emitting diode supported on the PCB.

The driving unit 304 for driving the light emitting unit 303 is accommodated within the heat dissipating structure.

The heat dissipating structure comprises an inner housing 302 for accommodating the driving unit 304 therein and an outer housing 301 configured to encircle the inner housing 302, thereby forming a space 309 between the inner housing 302 and the outer housing 301. The inner and/or outer housing 302, 301 are manufactured by means of sheet metal technology (such as a stamping process, spinning process, bending process, stretch forming process and punching process), with the thickness of the outer housing 301 (e.g., 1.5mm or thicker) being greater than that of the inner housing 302 for further facilitating the heat conduction efficiency.

The outer housing 301 includes a side wall 3011 at the side portion thereof and a top wall 3012 at the top portion thereof. A plurality of openings （oriented horizontally or vertically） 30111 are arranged in the side wall 3011 of the outer housing 301 so as to allow air to flow into the space 309 and move over the surfaces of the inner housing 302 and the outer housing 301. The top wall 3012 is configured so as to enable the light emitting unit 303 to be mounted thereon via a thermal interface material (TIM) 306. Air flows into the space 309 through the plurality of openings 30111. The top wall 3012 of the outer housing 301 preferably comprises a plurality of openings 30121 in the top portion thereof and preferably at the circumference thereof for facilitating the air flow into and/or out of the space 309.

The inner housing 302 includes a side wall 3021 and a ring portion 3022 (shaped as a flange), wherein the ring portion 3022 is arranged at the top portion of the inner housing 302 and is assembled to the top wall 3012 of the outer housing 301 for instance by one or more screws (not labeled). The inner housing 302 further comprises a bottom wall (not labeled) at the bottom portion thereof, opposing the top wall 3012 of the outer housing 301, the inner housing 302 being assembled to the top wall 3012 of the outer housing 302, thereby defining a cavity 3023 for accommodating the driving unit 304 therein. Moreover, at the bottom portion, an aperture 308 is created between the outer housing 301 and the inner housing 302, allowing the air to flow out of the space 309. Preferably, the side wall 3021 of the inner housing 302 can also comprise a plurality of openings (oriented horizontally or vertically, not shown) so as to allow air to flow into/out of the cavity 3023, thus

facilitating the dissipation of the heat generated by the driving unit 304.

The outer housing 301 and the inner housing 302 are preferably made of an Al material, such as Al1070 and Al6063, to maintain a high thermal conductivity.

In the assembly process, first, the driving unit 304 is mounted in the inner housing 302 with an insulation element 307 arranged therebetween. Next, the inner housing 302 together with the driving unit 304 is assembled to the outer housing 301 for instance by means of one or more screws. Thermal grease and/or a low surface roughness are applied between the top wall 3012 of the outer housing 301 and the ring portion 3022 of the inner housing 302 for decreasing the contact resistance between them. Then, the light emitting unit 303 together with the thermal interface material 306 is assembled onto the top wall 3012 of the outer housing 301. Finally, an optical element 305, such as a collimator, a reflector or a condenser, is disposed over the light emitting unit 303 for adjusting the light emitted from the light emitting unit 303.

Simulation results show that: for sheet-metal housing 301, 302, the temperature of the LED is a little lower than that of the die-cast metal fin housing and the temperature of the outside of the housing is much lower than that of the die-cast metal fin structure. In view of the heat transfer coefficient (HTC), it has also been found that the sheet-metal housing structure is better than the die-cast housing structure. Concretely, the average HTC is $6.08W/m^2.K$ for the sheet-metal housing structure and $4.53W/m^2.K$ for the traditional die-cast metal fin housing structure.

Besides, according to the cost information from the manufacturer, the sheet-metal housing manufactured using a stamping process should be about 40% lower in cost than the die-cast housing with fin structure. Low cost improvement will be greatly beneficial to spreading LED lighting technology more widely.

Moreover, a sheet-metal housing in general will be about 41% lighter than a die-cast housing; thus, this innovative heat dissipation structure is especially desirable where weight is a sensitive issue when driver components are encapsulated in a potting material.

From the above, it can be concluded that a sheet-metal housing can provide a better thermal performance at lower cost and a lower weight. This can be attributed to the fact that the new structure allows the airflow to be improved such that a higher heat transfer coefficient is generated, and hence the heat-dissipation efficiency for the sheet-metal surface is better than that of a fin surface.

Thus, the main advantage of this invention is that: compared with the traditional LED lamp product 100 including a metal housing made by means of a die-casting or extrusion process, the lighting device 300 according to the present invention is provided with the innovative heat-dissipation structure comprising two parts made by means of the sheet-metal technology and having openings 30111 in the outer housing 301, allowing air to flow into the space 309 between the inner housing 302 and the outer housing 302, as a result of which, the cost and weight of the housing are greatly improved, while thermal performance can remain almost the same or is even better.

It is to be understood, however, that even though numerous characteristics and advantages of the present invention have been set forth in the foregoing description, together with details of the structure and function of the invention, the disclosure is illustrative only, and changes may be made in detail, especially in matters of shape, size, number, and arrangement of parts within the principles of the invention to the full extent indicated by the broad general meaning of the terms in which the appended claims are expressed.

It should be noted that the abovementioned embodiments illustrate rather than limit the invention and that those skilled in the art will be able to design alternative embodiments without departing from the scope of the appended claims. For instance, the housings 301, 302 are not limited to two parts, since three or more parts can also be adopted; the manner in which the inner housing 302 is assembled to the outer housing 301 is not limited to screwing, since bonding, clipping, snapping or clicking can also be adopted. Moreover, the heat-dissipation structure cannot only be applied in an LED lamp, but also in other lighting products.

In the claims, the word “comprising” does not exclude the presence of elements or steps not listed in a claim or in the description. The word “a” or “an” preceding an element does not exclude the presence of a plurality of such elements. In the apparatus claims enumerating several units, several of these units can be embodied by one and the same item of hardware or software. The usage of the words first, second and third, et cetera, does not indicate any ordering. These words are to be interpreted as names.

CLAIMS:

1. A heat dissipating structure for cooling a lighting device (300) comprising a light emitting unit (303) and a driving unit (304) for driving the light emitting unit, the heat dissipating structure comprising:

an inner housing (302) for accommodating the driving unit therein;

an outer housing (301) configured to encircle the inner housing, thereby forming a space (309) between the inner housing and the outer housing;

wherein a plurality of openings (30111) are arranged in a side wall (3011) of the outer housing so as to allow air to flow into the space and move over surfaces of the inner housing and the outer housing.

2. The heat dissipating structure according to claim 1, wherein the outer housing further comprises a top wall (3012) at the top portion with a plurality of openings (30121) therein, which top wall is configured to mount the light emitting unit thereon, and air flows into the space through the plurality of openings in the top wall.

3. The heat dissipating structure according to claim 2, wherein, at a bottom portion of the heat dissipating structure, an aperture (308) is created between the outer housing and the inner housing, allowing the air to flow out of the space.

4. The heat dissipating structure according to claim 2, wherein the top wall of the outer housing comprises a plurality of openings at the circumference.

5. The heat dissipating structure according to claim 2, wherein the inner housing (302) comprises a side wall (3021) and a ring portion (3022), the ring portion being arranged at a top portion of the inner housing and being assembled to the top wall (3012) of the outer housing.

6. The heat dissipating structure according to claim 5, wherein the inner housing further comprises a bottom wall at a bottom portion of the inner housing, opposing the top wall of the outer housing, and the inner housing is assembled to the top wall (3012) of the outer housing, thereby defining a cavity (3023) for accommodating the driving unit.

7. The heat dissipating structure as claimed in claim 5, wherein thermal grease is applied between the top wall (3012) of the outer housing and the ring portion (3022) of the inner housing for decreasing contact thermal resistance.

8. The heat dissipating structure according to any one of the claims 1 to 7, wherein the thickness of the outer housing is greater than that of the inner housing.

9. The heat dissipating structure according to any one of the claims 1 to 7, wherein the inner and/or outer housing are manufactured by means of sheet metal technology.

10. The heat dissipating structure according to any one of the claims 1 to 7, wherein the light emitting unit comprises at least one light emitting diode.

11. The heat dissipating structure according to any one of claims 1 to 7, wherein the openings (30111) in the side wall of the outer housing are oriented horizontally or vertically.

12. A lighting device (300) comprising a light emitting unit (303), a driving unit (304) for driving the light emitting unit, and a heat dissipating structure, wherein the heat dissipating structure comprises:

an inner housing (302) for accommodating the driving unit therein;

an outer housing (301) configured to encircle the inner housing, thereby forming a space (309) between the inner housing and the outer housing;

wherein a plurality of openings (30111) are arranged in a side wall (3011) of the outer housing so as to allow air to flow into the space and move over surfaces of the inner housing and the outer housing.

13. The lighting device (300) according to claim 12, wherein the outer housing further comprises a top wall (3012) at the top portion, configured to mount the light emitting unit thereon, and air flows through the plurality of openings into the space and moves over the top wall.

14. The lighting device (300) according to claim 13, wherein, at a bottom portion of the heat dissipating structure, an aperture (308) is created between the outer housing (301) and the inner housing (302), allowing the air to flow out of the space.

15. The lighting device (300) according to claim 13, wherein the inner housing (302) comprises a side wall (3021) and a ring portion (3022), the ring portion being arranged at a top portion of the inner housing and being assembled to the top wall (3012) of the outer housing.

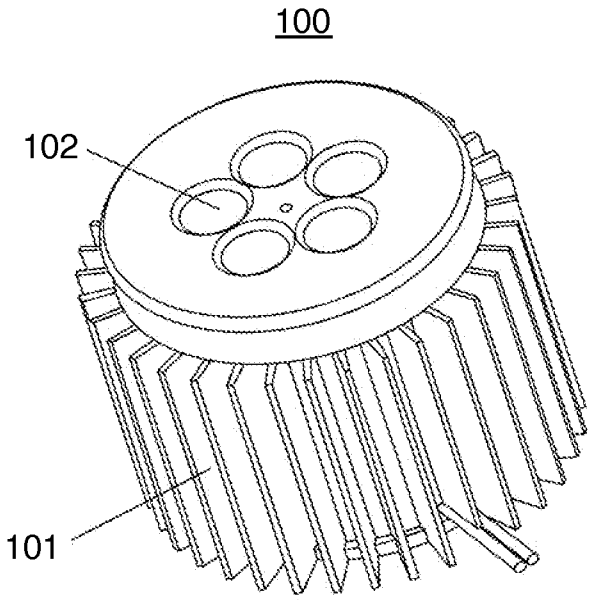

FIG. 1

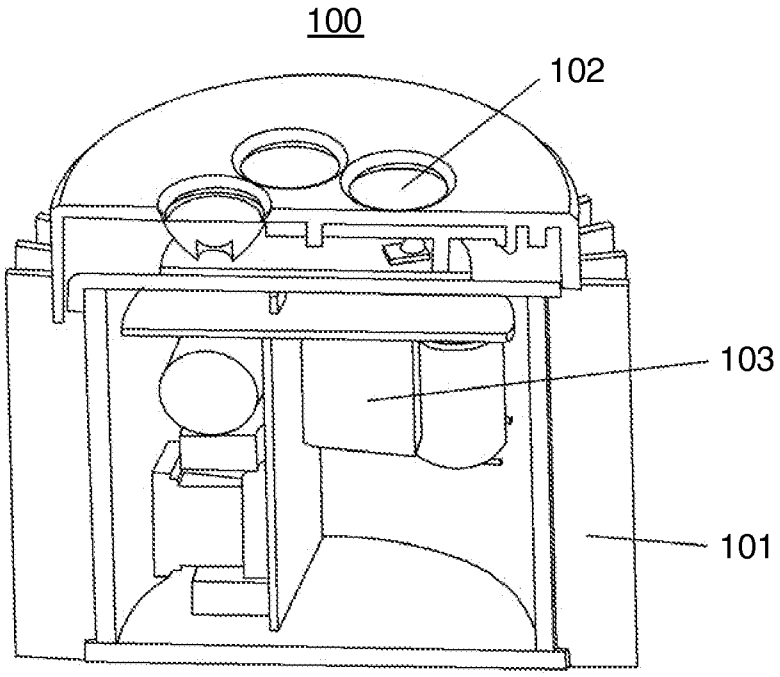

FIG. 2

300

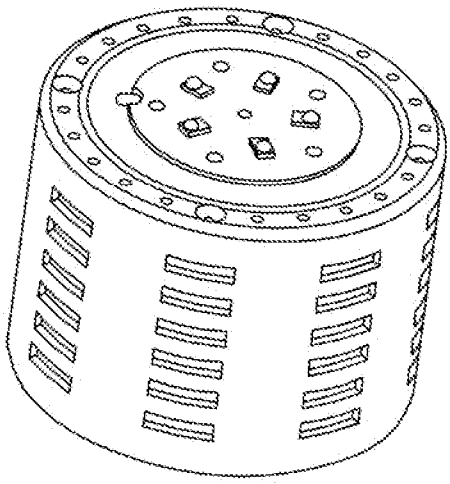

FIG. 3

300

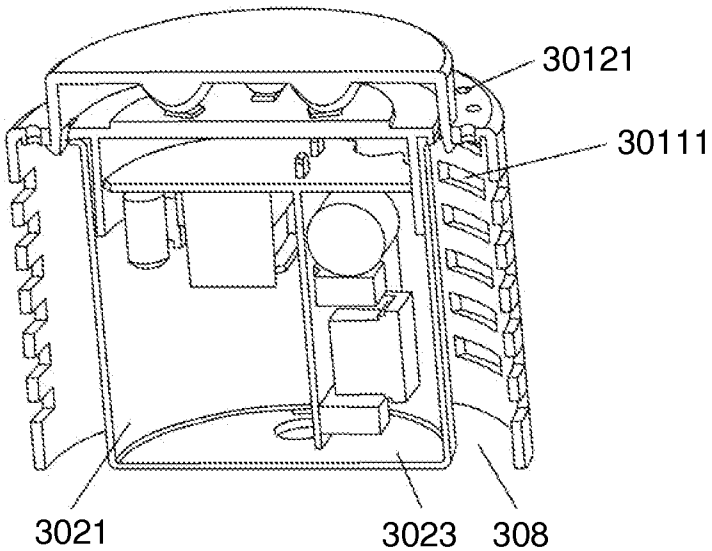

FIG. 4

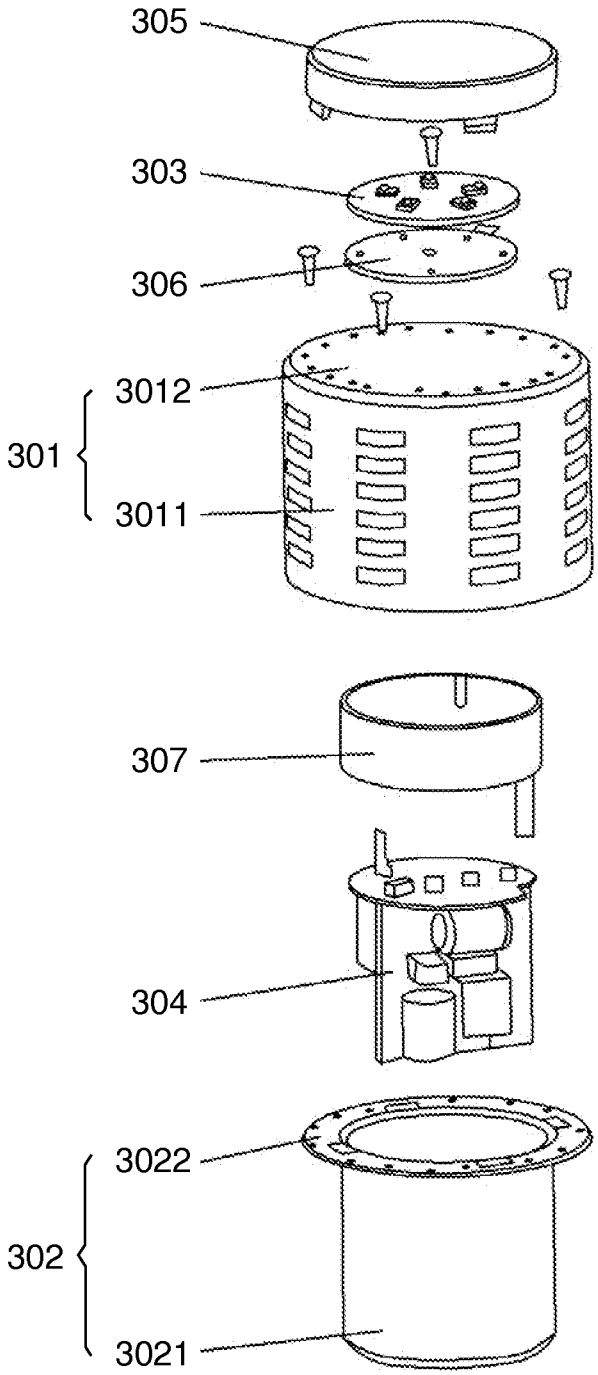

FIG. 5

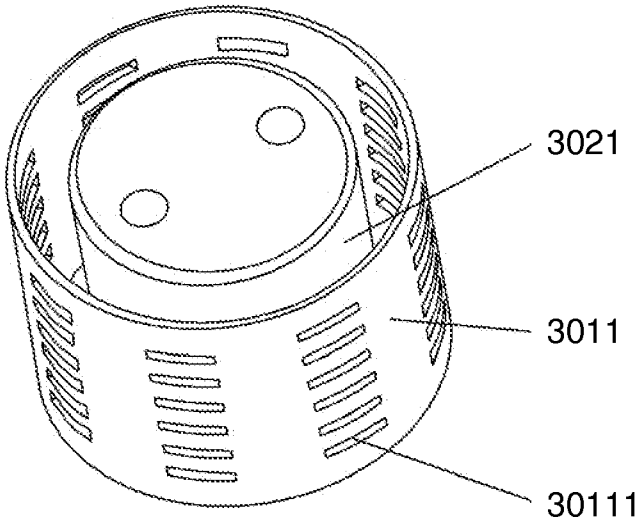

FIG. 6

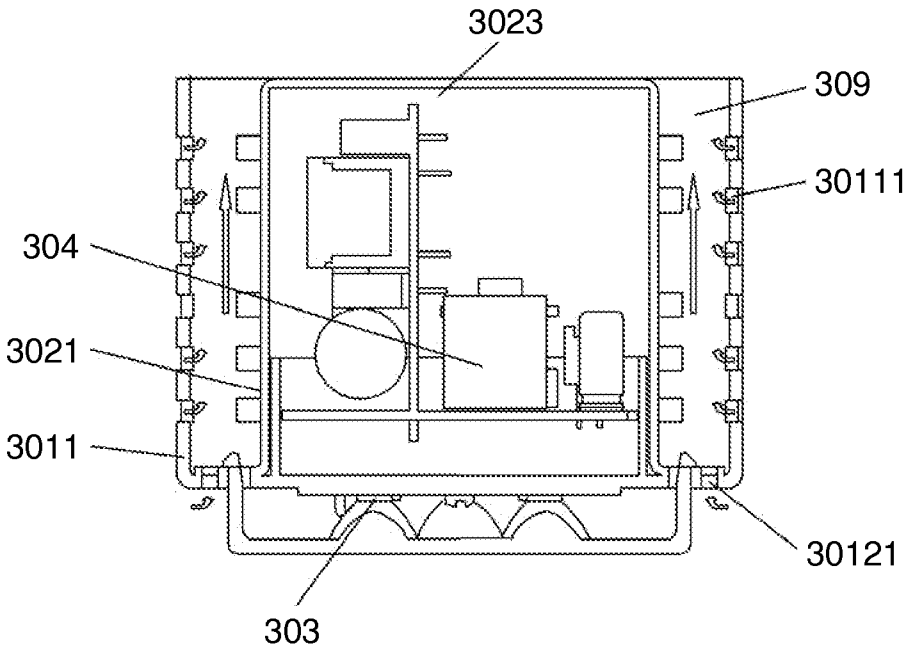

FIG. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/050540

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21V15/01 F21V23/00 F21V29/00
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 F21K

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

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X	CN 102 022 657 A (HON HAI PRECISION IND CO LTD) 20 April 2011 (2011-04-20) figures 1-5 -& US 2012/161628 A1 (CHANG SHAO-HAN [TW] ET AL) 28 June 2012 (2012-06-28) paragraph [0014] - paragraph [0020]; figures 1-5	1-8, 10-15

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

[X] 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
11 April 2013	24/04/2013

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Thibaut, Arthur

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/050540

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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