(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
23 January 2014 (23.01.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/013398 A1

(51) International Patent Classification:
F21V 29/00 (2006.01) *F21K 99/00* (2010.01)

(21) International Application Number:
PCT/IB2013/055732

(22) International Filing Date:
12 July 2013 (12.07.2013)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/673,296 19 July 2012 (19.07.2012) US

(71) Applicant: **KONINKLIJKE PHILIPS N.V.** [NL/NL]; High Tech Campus 5, NL-5656 AE Eindhoven (NL).

(72) Inventor: **DE BOER, Reinier Imre Anton**; c/o High Tech Campus 5, NL-5656 AE Eindhoven (NL).

(74) Agents: **VAN EEUWIJK, Alexander Henricus Walterus** et al.; High Tech Campus Building 5, NL-5656 AE Eindhoven (NL).

(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, 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, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

WO 2014/013398 A1

(54) Title: HEAT SINK ARRANGEMENT

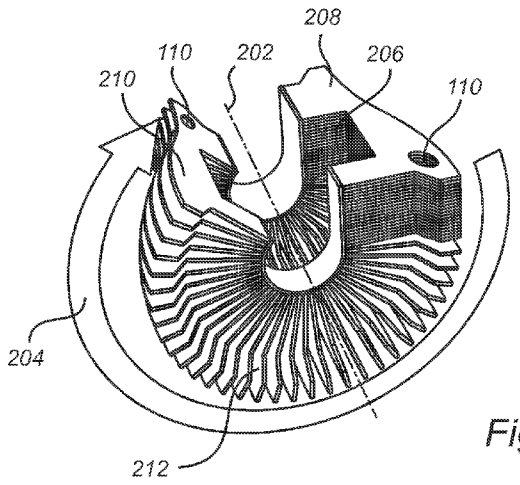


Fig. 2

(57) Abstract: The present invention relates to a method for providing a heat sink arrangement, comprising the steps of providing (S1) a plurality of heat transferring sheets(102) stacked in a pile, each heat transferring sheet (102) comprises an inner edge surface (104) and an outer edge surface (114), wherein the inner edge surfaces (104) of the heat transferring sheets (102) are provided substantially parallel to each other in the pile; fixating (S2) a first distance between the inner edge surfaces (104) of the heat transferring sheets (102) by means of a connecting element; revolving (S4) the pile of heat transferring sheets (102) around a geometric axis (202) located parallel to and in proximity of an inner edge surface extension, such that the outer edge surfaces (114) of the heat transferring sheets(102) are spaced apart from each other by a second distance in the revolving direction(204) in relation to the stacked pile of sheets, the second distance being larger than the first distance, thereby forming an at least partial enclosure (206) by the inner edge surfaces (104) of the heat transferring sheets (102); and fixating (S4) a first (208) and a last(210) heat transferring sheet in relation to each other

Heat sink arrangement

TECHNICAL FIELD

The present invention relates to the field of heat management of light emitting diodes, and more specifically to a method for providing a heat sink arrangement. The present invention also relates to a revolvable heat sink configuration and a lighting assembly comprising the heat sink arrangement.

BACKGROUND OF THE INVENTION

Light emitting diodes, LEDs, are employed in a wide range of lighting applications. As LEDs have the advantage of providing a bright light, being reasonably inexpensive and has low power consumption, it is becoming increasingly attractive to use LEDs as an alternative to traditional lighting. Furthermore, LEDs have a long operational lifetime. As an example, LED lamps may last 50 000 hours which is up to 50 times the operational life of an incandescent lamp.

To achieve such a long operational lifetime, one important aspect to consider is the heat management of the LEDs in order to avoid overheating of the LEDs or the LED module. This is not an uncomplicated task since LEDs release heat backwards, i.e. in the opposite direction compared to the direction of the light, in comparison to traditional lighting which mainly transfer the generated heat by the radiation of the light. Accordingly, the heat generated by the LEDs during operation needs to be handled efficiently. This is often taken care of by a heat sink arrangement which is configured to dissipate heat to the ambient air of the environment. It is hence important to provide a heat sink which is able to dissipate as much heat as possible.

US 2010/0 212 859 presents an approach to improve heat dissipation from the LEDs. Specifically, in US 2010/0 212 859, a plurality of fins are mutually spaced and one after the other is connected to the lighting assembly and to the neighboring fin. Hereby, the fins are mutually spaced from each other such that the surface of each fin is able to dissipate heat to the ambient air. However, although the heat sink arrangement in US 2010/0 212 859 provides advantages in terms of efficient cooling of the LEDs, the assembling of the heat sink

arrangement disclosed is relatively time consuming. Accordingly, there is a need for further improvement in terms of e.g. simplified heat sink assembling and cost efficiency.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide an improved method for providing a heat sink arrangement in order to at least partially overcome the above mentioned drawbacks of the prior art.

According to an aspect of the present invention there is provided a method for providing a heat sink arrangement, comprising the steps of providing a plurality of heat transferring sheets stacked in a pile, each heat transferring sheet comprises an inner edge surface and an outer edge surface, wherein the inner edge surfaces of the heat transferring sheets are provided substantially parallel to each other in the pile; fixating a first distance between the inner edge surfaces of the heat transferring sheets by means of a connecting element; revolving the pile of heat transferring sheets around a geometric axis located parallel to and in proximity of an inner edge surface extension, such that the outer edge surfaces of the heat transferring sheets are spaced apart from each other by a second distance in the revolving direction in relation to the stacked pile of sheets, the second distance being larger than the first distance, thereby forming an at least partial enclosure by the inner edge surfaces of the heat transferring sheets; and fixating a first and a last heat transferring sheet in relation to each other.

The present invention is based on the insight that by arranging the heat transferring sheets in a stacked pile and thereafter fixating a first distance between the inner edge surfaces to each other, it is possible to revolve the pile in a controlled and relatively simple way to form an assembled heat sink arrangement. An advantage is, at least, that the method provides for an easier and less time consuming assembling of the heat sink arrangement in comparison to prior art solution, since the stacked pile of heat transferring sheets can be revolved and assembled in more or less one single motion, whereas in prior art solutions, each heat transferring sheet is individually positioned and adjusted on a surface of the heat generated lighting assembly. Furthermore, the heat transferring sheets may also be shaped in any desired pattern before being stacked in the pile. Hereby, the method provides for an improvement in flexibility when producing heat sink arrangements having various shape and design. Also, the plurality of heat transferring sheets arranged in the stacked pile may be provided with different shapes and configurations in relation to each other, thereby enabling for the provision of providing assembled heat sink arrangements which may not be

entirely symmetrical. Moreover, another advantage of the present invention is that heat generating structures of a lighting assembly may be more or less embedded within the revolved and assembled heat sink arrangement, allowing these parts to be "covered" by a relatively large amount of the heat transferring sheets which may further improve the dissipation of heat from the heat generating structures to e.g. the ambient air.

The above described inner edge surface extension of the heat transferring sheet should in the following and throughout the entire description be interpreted as an extension which is substantially perpendicular to a radial extension of the assembled heat sink arrangement, i.e. perpendicular to an extension of the heat transferring sheets from the inner edge surface towards the outer edge surface, and also perpendicular to a height of the pile of heat transferring sheets. Hereby, when fixating the first distance between the inner edge surfaces of the heat transferring sheets, the sheets may only be allowed to be spaced apart from each other in the revolving direction and hence not in the axial- and tangential direction in relation to the extension of the inner edge surface. Furthermore, it should be noted that the enclosure may not necessarily be entirely enclosed by the inner edge surfaces. For example, the step of revolving the pile of heat transferring sheets may be executed by revolution of, for example, 270°, i.e. not necessarily revolved by 360°.

According to an example embodiment of the present invention, the method may be preceded by the step of providing a through-hole in each of the heat transferring sheets. Hereby, the through-holes, together and in conjunction with each other, may form a channel in the assembled heat sink arrangement. An advantage is, at least, that the channel may provide for improved cooling of the assembled heat sink arrangement. The through-hole in the heat transferring sheets may be arranged at a substantially equal position for each of the heat transferring sheets, thus forming a substantially circular channel in the assembled heat sink arrangement, or they may be positioned differently for all heat transferring sheets in order to form an irregular channel such as e.g. a channel extending circularly and in the above described extension of the inner edge surface of the heat transferring sheets forming a spiral-like channel. Furthermore, each heat transferring sheet may be provided with more than one through hole, such that two or more channels are formed in the assembled heat sink arrangement.

Moreover, the step of revolving the pile of heat transferring sheets may be preceded by the step of providing a driver of a lighting assembly in close vicinity of the inner edge surfaces of the pile of heat transferring sheets such that the driver is at least partially enclosed by the heat sink arrangement after revolving the pile. Hereby, when revolving the

pile as described above, the driver may be enclosed within the revolved heat sink arrangement and be in thermal connection with, for example, the inner edge surfaces of the sheets so that the heat generated by the driver during operation of the lighting assembly may be dissipated to the ambient air via the heat transferring sheets. The driver may also be provided with a slightly larger dimension than the enclosed area formed by the inner edge surfaces of the heat transferring sheets such that a pressure between the driver and the assembled heat sink arrangement is provided, which may allow for a more controlled and increased thermal interface between the driver and the assembled heat sink arrangement. Furthermore, the inner edge surface may also be arranged such that it is more or less press-fitted to a connecting element, such as e.g. a lamp foot. Hereby, a thermal interface between the inner edge surfaces and e.g. the lamp foot may be improved for allowing heat from e.g. the lamp foot to be transported through the heat transferring sheets. The press-fitting may be accomplished by, in the described example, connecting the assembled heat sink arrangement to the lamp foot by mounting it under tension. Mounting the heat sink arrangement under tension may also be beneficial if, for example, the heat sink arrangement is configured to be provided to a non-circular arrangement, such as a screw-like component or an elliptic component. Hereby, the thermal connection between the inner edge surfaces of the heat sink arrangement and the non-circular component may be achieved in a more reliable manner.

Furthermore, a substantially plane upper surface may be formed on each of the heat transferring sheets, the upper surface being substantially perpendicular to the extension of the inner edge surface of the heat transferring sheets and configured to connect to a circuit board of the lighting assembly. When revolving the pile of heat transferring sheets as described above, a generally plane surface will be formed by the cross sections of the upper surfaces of the plurality of heat transferring sheets. The density of cross-sectional surfaces will, due to their extension from the centre towards a periphery thereof in the assembled heat sink arrangement, be higher at a centre portion of the assembled heat sink arrangement in relation to the periphery. Accordingly, a heat generating area of the circuit board may to a relatively large extent be in abutment with the cross-sectional surfaces forming the upper surface. Hereby, the assembled heat sink arrangement may be able to sufficiently dissipate heat, generated by the circuit board during operation of the lighting assembly, to e.g. ambient air. Moreover, at least some of the heat transferring sheets may also comprise a folded geometry arranged on the upper plane surface, which in addition to the cross sectional surface formed by the heat transferring sheets may provide for a further improved heat dissipation surface for e.g. the heat generating circuit board.

According to an embodiment, at least one of the inner edge surfaces and the upper surfaces may comprise a thermal interface material. Hereby, the dissipation of heat from the heat generating structures to the heat sink arrangement may be further improved. The thermal interface material may, for example, be a thermal interface glue or pad, or an aluminum heat spreader part with e.g. a self positioning geometry which may be pressed onto the sheets.

Moreover, the above described method may also be followed by the step of fixating a metal base on at least a portion of the outer edge surfaces of the heat transferring sheets. Hereby, the assembled heat sink arrangement may be provided with increased thermal capabilities towards e.g. a housing or the like in which the heat sink arrangement may be positioned. Also, an increased stiffness of the assembled heat sink arrangement may be provided. The fixation of the metal base may, for example, be provided by soldering, pressing, laser welding, gluing, etc.

According to another aspect of the present invention there is provided a heat sink configuration, comprising a plurality of heat transferring sheets stacked in a pile, each of the heat transferring sheet comprises an inner edge surface and an outer edge surface, wherein the inner edge surfaces of the heat transferring sheets are arranged substantially parallel to each other in the pile; and a connecting element for flexibly arranging the inner edge surfaces of the heat transferring sheets at a first distance from each other, wherein the heat transferring sheets are configured to revolve around a geometric axis located parallel to and in proximity of an inner edge surface extension, such that the outer edge surfaces of the heat transferring sheets are spaced apart from each other by a second distance in the revolving direction, the second distance being larger than the first distance, thereby forming an at least partial enclosure provided by the inner edge surfaces of the heat transferring sheets.

According to an embodiment, the connecting element may comprise flexible properties.

Furthermore, at least one of the heat transferring sheets may be provided with a through hole.

Still further, each heat transferring sheet may comprise an upper edge surface substantially perpendicular to the inner edge surface extension of the heat transferring sheets.

According to an embodiment, at least one of the inner edge surfaces and the upper edge surface of the heat transferring sheets may be provided with a thermal interface material.

Moreover, each heat transferring sheet may comprise a recess in the inner edge surface configured to receive a driver of a lighting assembly. Hereby, heat transferring sheets may be pre-shaped such that the driver of the lighting assembly is sufficiently fitted in the recess. More specifically, the driver may have a circular shape such that the radius of the circularly shaped driver is fitted in the recess and when revolving the heat sink configuration, the driver sufficiently enclosed in the assembled heat sink arrangement.

Other effects and features of this aspect of the invention provide similar advantages as discussed above in relation to the previous aspect of the invention.

According to a still further aspect of the present invention there is provided a lighting assembly comprising at least one light emitting diode, a driver for electrically connecting the at least one light emitting diode to a power source; and a heat sink arrangement formed by the above mentioned heat sink configuration. The lighting assembly may also comprise a shaping element configured to receive light emitted by the light emitting diode and to provide a light beam according to a predetermined form. According to an embodiment, the shaping element may be at least one of a reflector, a collimator, or a lens. Effects and features of this aspect are largely analogous to those described above in relation to the other aspects of the present invention.

Further features of, and advantages with, the present invention will become apparent when studying the appended claims and the following description. The skilled addressee realize that different features of the present invention may be combined to create embodiments other than those described in the following, without departing from the scope of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects of the present invention will now be described in more detail, with reference to the appended drawings showing example embodiments of the invention, wherein:

Fig. 1 is a perspective view illustrating a stacked pile of heat transferring sheets according to an embodiment of the present invention;

Fig. 2 is a perspective view of the stacked pile of heat transferring sheets in Fig. 1 when being revolved;

Fig. 3 is a perspective view of an assembled heat sink arrangement according to an embodiment of the present invention; and

Fig. 4 is a flow chart of a method for providing a heat sink arrangement according to an example embodiment of the present invention.

DETAILED DESCRIPTION

The present invention will now be described more fully hereinafter with reference to the accompanying drawings, in which currently preferred embodiments of the invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided for thoroughness and completeness, and fully convey the scope of the invention to the skilled addressee. Like reference characters refer to like elements throughout.

Referring now to the drawings and to Fig. 1 in particular, there is depicted a perspective view of a heat sink configuration 100 comprising a plurality of heat transferring sheets 102. The heat transferring sheets 102 are arranged in a pile, where the inner edge surfaces 104 for each of the heat transferring sheets 102 are arranged substantially parallel to each other in the pile, thereby forming a substantially plane vertical surface. Furthermore, each of the heat transferring sheets 102 are connected to each other by means of a connecting element 106 arranged on the inner edge surfaces 104 of heat transferring sheets 102. The connecting element is in the illustrated embodiment depicted as a connecting element having flexible properties which is fixated to the inner edge surfaces 104 by means of e.g. gluing, welding, soldering, or some other type of suitable adhesive composition. Although the connecting element 106 in Fig. 1 is depicted as being connected to the entire inner edge surfaces 104 of the heat transferring sheets 102, it should be readily understood that the use of, for example, a wire extending through each of the heat transferring sheets 102 at a position adjacent the inner edge surfaces 104 may be equally applicable for connecting the heat transferring sheets 102 to each other. Still further, the connecting element 106 may also comprise a thermal interface material to improve heat dissipation from e.g. a circuit board configured to be arranged within an assembled heat sink arrangement and through the heat transferring sheets 102. Such thermal interface material may, for example, be a thermal interface glue or pad, etc.

Moreover, the depicted heat sink configuration 100 is arranged such that an upper surface 108 is formed substantially perpendicular to the inner edge surfaces 104 of the heat transferring sheets 102. The functionality of the upper surface 108 will be described further below in relation to Fig. 2. Furthermore, each of the heat transferring sheets 102 in the

pile may be provided with through holes arranged on the surface of each of the heat transferring sheets 102. In the illustrated embodiments described herein, one through hole 110 is arranged in each of the heat transferring sheets and positioned at different locations on the sheets in comparison to each other. The heat transferring sheets 102 may however also be provided with more than one through hole and the relative position between each through hole 110 may also vary depending on e.g. desired cooling effect, etc.

As is also depicted in Fig. 1, a recess 112 is arranged in each of the heat transferring sheets 102. The recess 112 may be configured to receive a driver (not shown) or other component of a lighting assembly for enclosing such component within the assembled heat sink arrangement, described below in relation to Fig. 2.

Now, reference is made to Fig. 2 in conjunction with Figs. 1 and 4 in order to describe the method for providing the heat sink arrangement. As illustrated in Fig. 1 and described above, the heat transferring sheets 102 are provided S1 in a pile. Thereafter, the heat transferring sheets 102 are connected to each other by fixating S2 the inner edge surfaces 104 of the heat transferring sheets 102 to each other. The pile of heat transferring sheets is thereafter revolved S3 around a geometric axis 202 which is located parallel to and in proximity of the inner edge surface extension of the heat transferring sheets 102. Accordingly, the heat sink configuration 100 is revolved in a revolving direction 204 around the geometric axis 202. When the pile of heat transferring sheets 102 is revolved as depicted in Fig. 2, the outer edge surfaces 114 of the heat transferring sheets 102 are spaced apart from each other in the revolving direction 204 such that an at least partial enclosure 206 is formed by the inner edge surfaces 104. Hereby, the driver arranged within the recess 112 of the heat transferring sheets 102, as described above, is at least partially enclosed by the enclosure formed when revolving the pile of heat transferring sheets 102. Finally, a first 208 and a last 210 heat transferring sheet in the pile is fixated S4 in relation to each other in order to form the assembled heat sink arrangement. The fixation of the first 208 and the last 210 heat transferring sheets may be conducted in a plurality of ways. For example, if the pile of heat transferring sheets 102 is revolved a full 360°, the first 208 and the last 210 heat transferring sheet may be fixated in relation to each other by means of interconnecting them with each other. However, the pile of heat transferring sheets 102 may not necessarily be revolved 360°, the pile may, if desired, for example be revolved 270°. In such a case, the first 208 and the last 210 heat transferring sheets in the pile may be fixated in relation to each other by means of individually connecting them to, for example, the lamp foot of the lighting arrangement, or the like.

Furthermore, when revolving the pile of heat transferring sheets 102, the above described upper surfaces 108 of the heat transferring sheets 102 forms a substantially plane surface 212 of the plurality of heat transferring sheets 102. The substantially plane surface 212 is configured to receive e.g. a printed circuit board and/or an LED module in the assembled configuration. As the plurality of heat transferring sheets 102 are extending radially at substantially mutually relative distance from each other after being revolved, there is a higher density of material towards the centre in relation to the periphery of the assembled heat sink arrangement. Hereby, a larger surface being able to dissipate heat is provided towards the centre where it may be beneficial to position the circuit board or the LED module. However, the entire substantially plane surface 212 may also, after revolving the pile of heat transferring sheets 102, be arranged with some kind of thermal interface material in order to even further dissipate heat from e.g. the circuit board or the LED module through the plurality of heat transferring sheets 102.

Turning to Fig. 3 illustrating the assembled heat sink arrangement 302 connected to a lighting arrangement 300 according to an embodiment of the present invention. The heat sink arrangement 302 is assembled in accordance with the above description in relation to Figs. 1, 2 and 4. In the illustrated embodiment depicted in Fig. 3, the heat sink arrangement 302 is connected to a lamp foot 304 of the lighting arrangement 300 and a lens 306 or the like is positioned on top of the heat sink arrangement 302. As described above, but not visibly illustrated in Fig. 3, the lighting arrangement 300 may also comprises a driver enclosed by the inner edge surfaces 102, or more specifically, enclosed by the recesses 112 of the heat transferring sheets 102. Furthermore, the circuit board and/or LED module may also be positioned on the substantially plane surface 108 formed by the upper surfaces 108 as also described above.

Moreover, the above described through holes 110 is in the illustrated embodiment depicted in Fig. 4 located on different positions for each of the heat transferring sheets 102. Hereby, a spiral-like channel is formed which may enable the heat transferring sheets 102 to be cooled to a larger degree compared to if no through-holes are provided.

The lighting arrangement 300 in Fig. 3 is hence arranged with the above described heat sink arrangement, where each of the plurality of heat transferring sheets are arranged at a substantially mutual distance from each other in order to be cooled to a sufficient amount by, for example, ambient air. Although the heat sink arrangement 302 in Fig. 3 is illustrated as being cooled by ambient air, the heat sink arrangement may also be configured to be positioned in a housing or the like. In such a case, at least a portion of the

outer edge surfaces 114 is in abutment with such a housing or the like in order to dissipate heat generated by, for example, the LED module towards the housing, which in turn may dissipate the heat to the ambient air.

Even though the invention has been described with reference to specific exemplifying embodiments thereof, many different alterations, modifications and the like will become apparent for those skilled in the art. Variations to the disclosed embodiments can be understood and effected by the skilled addressee in practicing the claimed invention, from a study of the drawings, the disclosure, and the appended claims. For example, a centre portion of the heat transferring arrangement, for insertion in a generally rectangular shaped housing, may be circularly shaped having its elongated heat transferring elements in a generally rectangular shape instead of the circular shape described above. Furthermore, 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.

CLAIMS:

1. A heat sink configuration (100), comprising:

- a plurality of heat transferring sheets (102) stacked in a pile, each of the heat transferring sheet (102) comprises an inner edge surface (104) and an outer edge surface (114), wherein the inner edge surfaces (104) of the heat transferring sheets (102) are arranged substantially parallel to each other in the pile; and

- a connecting element (106) for flexibly arranging the inner edge surfaces (104) of the heat transferring sheets (102) at a first distance from each other, wherein the heat transferring sheets (102) are configured to revolve around a geometric axis (202) located parallel to and in proximity of an inner edge surface extension, such that the outer edge surfaces (114) of the heat transferring sheets (102) are spaced apart from each other by a second distance in the revolving direction (204), the second distance being larger than the first distance, thereby forming an at least partial enclosure (206) provided by the inner edge surfaces (104) of the heat transferring sheets (102).

2. The heat sink configuration (100) according to claim 1, wherein the connecting element (106) comprises flexible properties.

3. The heat sink configuration (100) according to claim 1 or 2, wherein at least one of the heat transferring sheets (102) comprises a through-hole (110).

4. The heat sink configuration (100) according to any one of claims 1 to 3, wherein each heat transferring sheet (102) comprises an upper edge surface (108) substantially perpendicular to the inner edge surface extension of the heat transferring sheets (102).

5. The heat sink configuration (100) according to any one of claims 1 to 4, wherein at least one of the inner edge surfaces (104) and the upper edge surface (108) of the heat transferring sheets (102) is provided with a thermal interface material.

6. The heat sink configuration (100) according to any one of claims 1 to 5, wherein each heat transferring sheet (102) comprises a recess (112) in the inner edge surface (104) configured to receive a driver of a lighting assembly.

7. A lighting assembly (300), comprising:

- at least one light emitting diode,
- a driver for electrically connecting the at least one light emitting diode to a power source; and
- a heat sink arrangement formed by a heat sink configuration (100) according to any one of claims 1 – 6.

8. The lighting assembly according to claim 7, further comprising a shaping element configured to receive light emitted by the light emitting diode and to provide a light beam according to a predetermined form.

9. The lighting assembly according to claim 8, wherein the shaping element is at least one of a reflector, a collimator, or a lens.

10. A method for providing a heat sink arrangement, comprising the steps of:

- providing (S1) a plurality of heat transferring sheets (102) stacked in a pile, each heat transferring sheet (102) comprises an inner edge surface (104) and an outer edge surface (114), wherein the inner edge surfaces (104) of the heat transferring sheets (102) are provided substantially parallel to each other in the pile;
- fixating (S2) a first distance between the inner edge surfaces (104) of the heat transferring sheets (102) by means of a connecting element;
- revolving (S3) the pile of heat transferring sheets (102) around a geometric axis (202) located parallel to and in proximity of an inner edge surface extension, such that the outer edge surfaces (114) of the heat transferring sheets (102) are spaced apart from each other by a second distance in the revolving direction (204) in relation to the stacked pile of sheets, the second distance being larger than the first distance, thereby forming an at least partial enclosure (206) by the inner edge surfaces (104) of the heat transferring sheets (102); and

- fixating (S4) a first (208) and a last (210) heat transferring sheet in relation to each other.

11. The method according to claim 10, preceded by the step of:
- providing a through-hole (110) in each of the heat transferring sheets (102).

12. The method according to claim 10 or 11, wherein the step of revolving the pile of heat transferring sheets (102) is preceded by the step of:
- providing a driver of a lighting assembly (300) in close vicinity of the inner edge surfaces (104) of the pile of heat transferring sheets (102) such that the driver is at least partially enclosed by the heat sink arrangement after revolving the pile.

13. The method according to any one of the preceding claims, wherein a substantially plane upper surface (108) is formed on each of the heat transferring sheets, the upper surface (108) being substantially perpendicular to the extension of the inner edge surface (104) of the heat transferring sheets (102) and configured to connect to a circuit board of the lighting assembly (300).

14. The method according to any one of the preceding claims, wherein at least one of the inner edge surfaces (104) and the upper surfaces (108) comprises a thermal interface material.

15. The method according to any one of the preceding claims, followed by the step of:
- fixating a metal base on at least a portion of the outer edge surfaces of the heat transferring sheets.

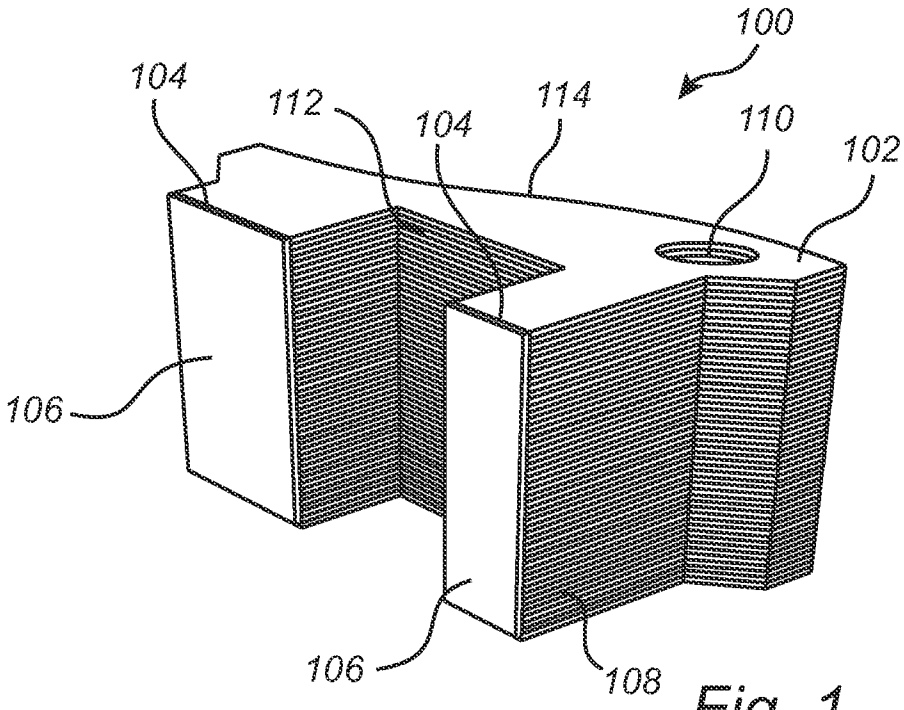

100
104
112
104
114
110
102
106
106
108

Fig. 1

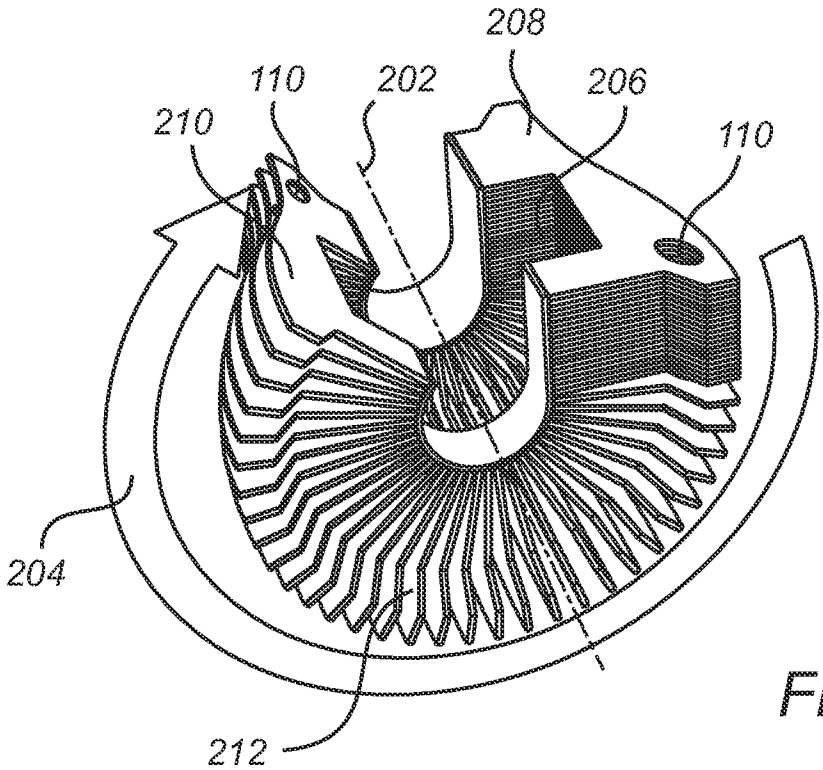

208
110
202
206
210
110
204
212

Fig. 2

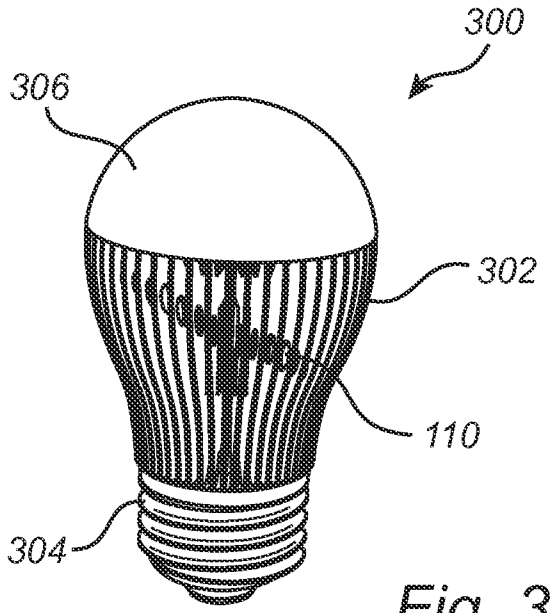

300
306
302
110
304

Fig. 3

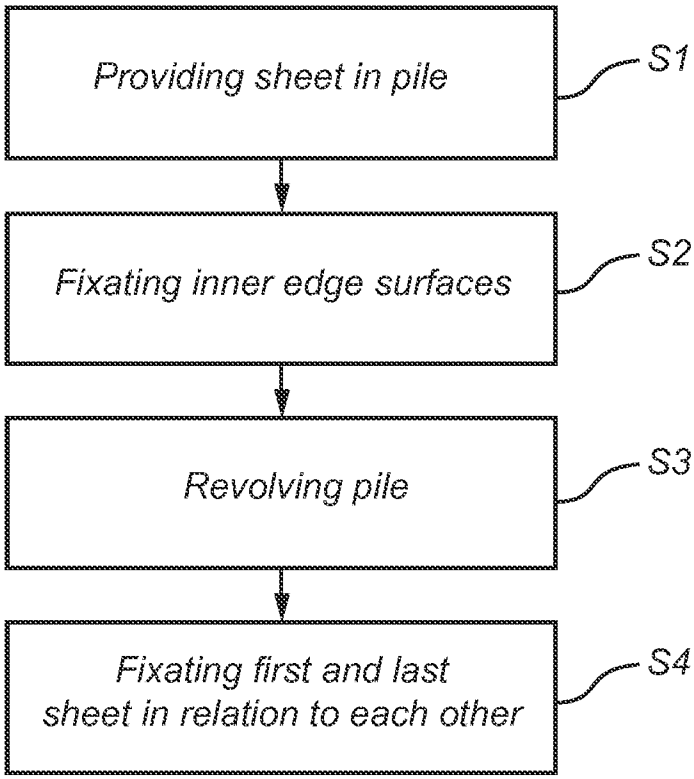

Providing sheet in pile
S1
Fixating inner edge surfaces
S2
Revolving pile
S3
Fixating first and last sheet in relation to each other
S4

Fig. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/055732

A. CLASSIFICATION OF SUBJECT MATTER
INV. F21V29/00
ADD. F21K99/00

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 F21K F21Y F28C F28D F28F A47C F16J

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	DE 20 2011 104159 U1 (CHENG CHEN YI [TW]; CHENG YU CHEN [TW]; CHIEN YU YO [TW]) 9 November 2011 (2011-11-09) figures 5, 7, 8	1-15
A	US 2010/212859 A1 (LIANG CHIEN-KUO [TW]) 26 August 2010 (2010-08-26) cited in the application figures 1, 5-7 paragraphs [0008] - [0010]	1-15
A	US 2007/096609 A1 (CHIU CHI-SHEN [TW]) 3 May 2007 (2007-05-03) figures 4E, 4F paragraphs [0037] - [0043]	1-15

-/--

[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

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 December 2013	18/12/2013

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	Vida, Gyorgy

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2013/055732

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 135 589 A (HAMMERTON RODERIC H) 23 January 1979 (1979-01-23) figures 1, 2	1-15
A	US 2007/230186 A1 (CHIEN CHEN-CHUN [TW]) 4 October 2007 (2007-10-04) figures 3, 5, 6 paragraphs [0020] - [0022]	1-15
A	DE 20 2011 005015 U1 (FIN CORE CORP [TW]; WU WEI CHUNG [TW]) 26 July 2011 (2011-07-26) figure 7 paragraphs [0032], [0033]	1-15

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2013/055732

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 202011104159 U1	09-11-2011	NONE	
US 2010212859 A1	26-08-2010	NONE	
US 2007096609 A1	03-05-2007	EP 1844678 A2	17-10-2007
		TW I292742 B	21-01-2008
		US 2007096609 A1	03-05-2007
US 4135589 A	23-01-1979	BE 864094 A1	16-06-1978
		CA 1107314 A1	18-08-1981
		DE 2806684 A1	24-08-1978
		FR 2380832 A1	15-09-1978
		GB 1582581 A	14-01-1981
		IT 1107288 B	25-11-1985
		JP S53122618 A	26-10-1978
		SE 7801763 A	18-08-1978
		US 4135589 A	23-01-1979
US 2007230186 A1	04-10-2007	JP 3129417 U	22-02-2007
		TW M297441 U	11-09-2006
		US 2007230186 A1	04-10-2007
DE 202011005015 U1	26-07-2011	CN 202024257 U	02-11-2011
		DE 202011005015 U1	26-07-2011
		TW M409368 U	11-08-2011
		US 2012195053 A1	02-08-2012