(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 2 085 681 A2**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.08.2009 Bulletin 2009/32

(21) Application number: **09151178.2**

(22) Date of filing: **23.01.2009**

(51) Int Cl.:
F21K 7/00 *(2006.01)* ***F21V 29/00*** *(2006.01)*
F21Y 101/02 *(2006.01)*

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR
Designated Extension States:
AL BA RS

(30) Priority: **31.01.2008 CN 200810033327**

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(54) **LED illuminating device, LED light source module, and LED support member**

(57) A light emitting diode (LED) illuminating device is disclosed and includes a housing (7) and a LED light source module (8) which has a plurality of LEDs and a LED support member (2). The LEDs are installed on the LED support member which is provided with a foam metal layer (21) and a metal support layer (20) having at least one portion for supporting the LEDs. The foam metal layer (21) is made of foam metal having porous structures, and the metal support layer (20) is formed on a portion of a surface of the foam metal layer (21), so that the metal support layer (20) and the foam metal layer (21) are connected to each other. Furthermore, a LED light source module and a LED support member are also disclosed and applied to the LED illuminating device.

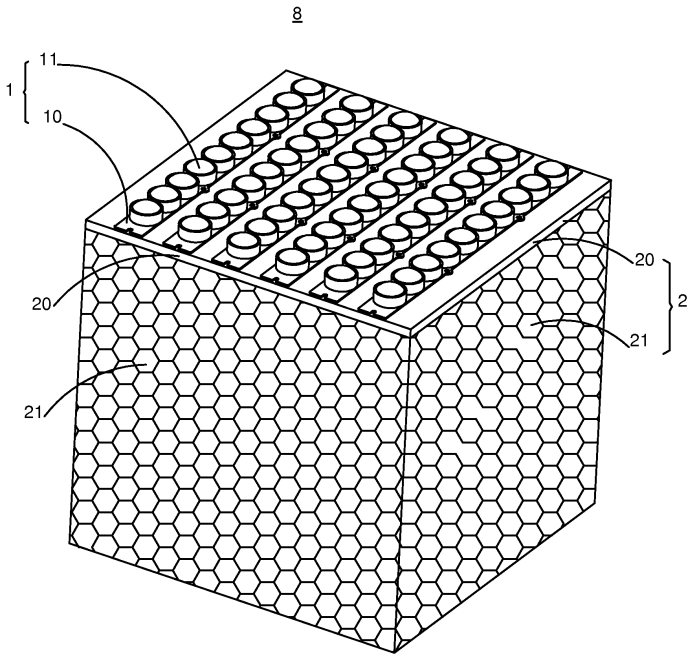

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a light emitting diode (LED) illuminating structure, and more particularly to a LED illuminating device, a LED light source module, and a LED support member.

BACKGROUND OF THE INVENTION

[0002] Recently, with the development and improvement of light emitting diode (LED) technologies, performance indexes of LEDs are continuously increased day by day. Currently, the light extraction efficiency of white light LEDs is almost close to or greater than that of traditional incandescent lamps, while the luminous flux of white light LEDs is substantially increased. Thus, the LEDs are generally applied to the illuminating field. In comparison with traditional energy-saving illuminators provided with photovoltaic power sources, the LEDs has advantages of longer life span, lower waste heat, and higher damage-resistance, lower driving power, and higher energy-saving performance. Thus, the LEDs are also called "21th-century fluorescent light substitutes" and "4th-generation illuminating light sources".

[0003] Generally, traditional LED illuminating devices is a LED light source module having a plurality of LEDs installed on an aluminum (Al) substrate and arranged according to a predetermined manner, wherein the Al substrate is used to dissipate heat generated by the LEDs. For improving the heat-dissipation efficiency, the thickness of the Al substrate must be increased. However, the weight of the entire LED illuminating device may be inevitably increased, the operational convenience thereof may be lowered, and the manufacture cost thereof may be increased. Especially, the foregoing shortcomings of high-power LED illuminating devices are apparent. For example, a high-power LED street lamp of 120 watts, which is provided with a Al substrate for dissipating heat, has a weight about 9kg, wherein most of the weight is due to the thickness and height of the Al substrate increased for heat-dissipating purpose. As a result, the weight of the entire street lamp is substantially increased, so that the installation and disassembly thereof is inconvenient and the material cost thereof is increased. Moreover, because the Al substrate has too large integrated heat sinks, the demand of cast molds for the Al substrate may be increased. Meanwhile, the product yield thereof may be lowered, and the manufacture cost thereof may be substantially increased. However, the heat-dissipation efficiency of the entire street lamp can not be enhanced to an ideal value.

SUMMARY OF THE INVENTION

[0004] It is therefore tried by the inventor to develop a LED illuminating device, a LED light source module, and a LED support member to solve the problems existing in the traditional LED illuminating device, as described above, so as to lower the weight and the manufacture cost thereof, and enhance the heat-dissipation efficiency thereof.

[0005] To achieve the above object, a primary object of the present invention is to provide a LED illuminating device, which includes a housing and a LED light source module which has a plurality of LEDs and a LED support member. The LEDs are installed on the LED support member which is provided with a foam metal layer and a metal support layer having at least one portion for supporting the LEDs. The foam metal layer is made of foam metal having porous structures, the metal support layer is formed on a portion of a surface of the foam metal layer, and the metal support layer and the foam metal layer are connected to each other.

[0006] A secondary object of the present invention is to provide a LED light source module, which includes a plurality of LEDs and a LED support member. The LEDs are installed on the LED support member which is provided with a foam metal layer and a metal support layer having at least one portion for supporting the LEDs. The foam metal layer is made of foam metal having porous structures, the metal support layer is formed on a portion of a surface of the foam metal layer, and the metal support layer and the foam metal layer are connected to each other.

[0007] A third object of the present invention is to provide a LED support member, which is used to support a plurality of LEDs. The LED support member includes a foam metal layer and a metal support layer having at least one portion for supporting the LEDs. The foam metal layer is made of foam metal having porous structures, the metal support layer is formed on a portion of a surface of the foam metal layer, and the metal support layer and the foam metal layer are connected to each other.

[0008] In one embodiment of the present invention, the foam metal is foam iron, foam copper, foam aluminum, foam iron alloy, foam copper alloy, or foam aluminum alloy. The foam metal has 10-50 micro-pores per inch. The metal support layer is a solid metal layer made of the same metal material as the foam metal.

[0009] In one embodiment of the present invention, a cooling fan is mounted on a surface of the foam metal layer different from the surface thereof formed with the metal support layer or received in a receiving space defined by the foam metal layer.

[0010] In one embodiment of the present invention, remaining surfaces of the foam metal layer different from the surface thereof formed with the metal support layer has at least one covered portion.

[0011] In one embodiment of the present invention, the metal support layer is connected to the foam metal layer by electro-plating.

[0012] In comparison with the traditional LED illuminating device, the LED support member of the LED illuminating device according to the present invention is im-

proved, wherein the surface of the foam metal layer is formed with the metal support layer, and the LEDs are installed on the metal support layer through a printed circuit board. Thus, the heat generated by the LEDs is speedily transmitted to the foam metal layer through the metal support layer. The foam metal layer provides 3-dimensional webbed structures therein, so as to substantially increase surface area of the foam metal layer for being in contact with external air. Thus, the heat-dissipation efficiency can be improved. Furthermore, the foam metal layer made of foam metal is advantageous to save considerable metal material, so as to substantially lower the weight of the entire LED illuminating device and the manufacture cost thereof, and enhance the convenience thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The structure and the technical means adopted by the present invention to achieve the above and other objects can be best understood by referring to the following detailed description of the preferred embodiments and the accompanying drawings, wherein

[0014] Fig. 1 is an assembled perspective view of a LED light source module in a LED illuminating device according to a first embodiment of the present invention;

[0015] Fig. 2 is an assembled perspective view of a LED light source module in a LED illuminating device according to a second embodiment of the present invention;

[0016] Fig. 3 is another perspective view of the LED light source module in the LED illuminating device, as shown in Fig. 2;

[0017] Fig. 4 is an assembled perspective view of a LED light source module in a LED illuminating device according to a third embodiment of the present invention;

[0018] Fig. 5 is an assembled perspective view of a LED light source module in a LED illuminating device according to a fourth embodiment of the present invention;

[0019] Fig. 6 is an assembled perspective view of a LED light source module in a LED illuminating device according to a fifth embodiment of the present invention; and

[0020] Fig. 7 is a schematic view of the LED illuminating device according to the first embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Referring now to Figs. 1 and 7, a LED illuminating device 9 according to a first embodiment of the present invention is illustrated. As shown, the LED illuminating device 9 comprises a housing 7 and a LED light source module 8 which has a LED light source 1 and a LED support member 2. The LED light source 1 comprises a plurality of LEDs (not-shown) and a plurality of printed circuit boards 10 made of high thermal conductive material (such as aluminum) for supporting the LEDs. The LEDs are arranged on each of the printed circuit boards 10 to define a plurality of LED illuminating strips (unlabeled). Furthermore, in order to increase the light extraction efficiency, each of the LEDs can be provided with a lens means 11 according to an actual desire. The LED support member 2 comprises a foam metal layer 21 and a metal support layer 20 having at least one portion for supporting the LEDs. The foam metal layer 21 is made of foam metal having porous structures, such as foam iron, foam copper, foam aluminum, foam iron alloy, foam copper alloy, foam aluminum alloy, and etc, wherein the foam metal has about 10-50 micro-pores per inch. In the embodiment, the foam metal layer 21 is made of foam copper, and the metal support layer 20 is formed on a portion of a surface of the foam metal layer 21. The metal support layer 20 is a solid metal layer made of the same metal material as the foam metal. For example, in the embodiment, the foam metal layer 21 is made of foam copper, and the metal support layer 20 is a solid metal layer made of copper. The metal support layer 20 and the foam metal layer 21 are connected to each other. Preferably, the metal support layer 20 is connected to the foam metal layer 21 by electro-plating. Furthermore, the LEDs are mounted on the LED support member 2 through the printed circuit board 10. In the embodiment, the LEDs are mounted on the metal support layer 20 through the printed circuit board 10 which is tightly in contact with the metal support layer 20 to increase the surface area therebetween. Moreover, a thermal conductive material (such as a thermal conductive adhesive) can be optionally disposed between the printed circuit board 10 and the metal support layer 20. When the LED light source module 8 operates, heat generated by the LEDs is transmitted to the metal support layer 20 through the thermal conductive printed circuit board 10, and then speedily transmitted to the foam metal layer 21 through the metal support layer 20. At this time, the foam metal layer 21 provides 3-dimensional webbed structures therein, so as to substantially increase surface area of the foam metal layer 21 for being in contact with external air. Thus, the heat-dissipation efficiency can be improved. Furthermore, the foam metal layer 21 made of foam metal is advantageous to save considerable metal material, so as to substantially lower the weight of the entire LED illuminating device 9 and the manufacture cost thereof, and enhance the convenience thereof.

[0022] Referring to Figs. 2 and 3, a LED illuminating device according to a second embodiment of the present invention is illustrated and similar to the first embodiment. As shown, the LED illuminating device of the second embodiment comprises a LED light source module 8' different from that of the first embodiment. In the second embodiment, the LED light source module 8' has a LED support member 2 which is further provided with a cooling fan 23. The cooling fan 23 is mounted on a surface of the foam metal layer 21 different from the surface thereof

formed with the metal support layer 20. As shown in Figs. 2 and 3, the cooling fan 23 is mounted on a surface of the foam metal layer 21 opposite to the surface formed with the metal support layer 20.

[0023] In the second embodiment of the present invention, when the LED illuminating device operates, the cooling fan 23 rotates, and the foam metal layer 21 made of foam metal having porous structures can provide 3-dimensional webbed structures and micro-pores therein. Thus, it is advantageous to increase the flowing rate of internal air in the foam metal layer 21, so that heat generated by the LEDs (not-shown) can be speedily dissipated, for the purpose of providing a better heat dissipation efficiency.

[0024] Referring to Fig. 4, a LED illuminating device according to a third embodiment of the present invention is illustrated and similar to the second embodiment. As shown, the LED illuminating device of the third embodiment comprises a LED light source module 8'' different from that of the second embodiment. In the third embodiment, the LED light source module 8'' is provided with a cooling fan 23. The cooling fan 23 is mounted on a side surface of the foam metal layer 21 adjacent to the surface thereof formed with the metal support layer 20. The operational principle of the LED illuminating device of the third embodiment is similar to that of the second embodiment, so that the description thereof will be omitted hereinafter.

[0025] Referring to Fig. 5, a LED illuminating device according to a fourth embodiment of the present invention is illustrated and similar to the first embodiment. As shown, the LED illuminating device of the fourth embodiment comprises a LED light source module 8''' different from that of the first embodiment. In the fourth embodiment, the LED light source module 8''' has a foam metal layer 21 which has a side surface covered by a thermal insulation plate 25. In the fourth embodiment, the thermal insulation plate 25 covers a desired side surface of the foam metal layer 21 according to an actual position of a heat source and a possible position of a cooling fan 23, so as to provide a better heat-dissipation efficiency and efficiently solve the problem of partial concentration of the heat source. The covered side surface of the foam metal layer 21 is determined according to the actual position of the heat source. For example, a side surface of the foam metal layer 21 which the heat source is close to may keep open, while the remaining side surfaces thereof are covered by the thermal insulation plate 25. When the cooling fan 23 operates, air mainly flows through the side surface of the foam metal layer 21 where the heat source is close to, so as to efficiently solve the problem of partial concentration of the heat source.

[0026] Referring to Fig. 6, a LED illuminating device according to a fifth embodiment of the present invention is illustrated and similar to the first embodiment. As shown, the LED illuminating device of the fifth embodiment comprises a LED light source module 8'''' different from that of the first embodiment. In the fifth embodiment, the LED light source module 8'''' has a cooling fan 23 received in a receiving space (unlabeled) defined by a foam metal layer 21. The operational principle of the LED illuminating device of the fifth embodiment is similar to that of the second embodiment, so that the description thereof will be omitted hereinafter.

[0027] The present invention has been described with a preferred embodiment thereof and it is understood that many changes and modifications to the described embodiment can be carried out without departing from the scope and the spirit of the invention that is intended to be limited only by the appended claims.

Claims

1. A light emitting diode (LED) illuminating device, comprising a housing and a LED light source module which has a LED support member and a plurality of LEDs installed on the LED support member, the LED illuminating device **characterized in that:**

   the LED support member is provided with a foam metal layer and a metal support layer having at least one portion for supporting the LEDs; wherein the foam metal layer is made of foam metal having porous structures, the metal support layer is formed on a portion of a surface of the foam metal layer, and the metal support layer and the foam metal layer are connected to each other.

2. The LED illuminating device of claim 1, wherein the foam metal is foam iron, foam copper, foam aluminum, foam iron alloy, foam copper alloy, or foam aluminum alloy, and the foam metal has 10-50 micropores per inch.

3. The LED illuminating device of claim 1, wherein the metal support layer is a solid metal layer made of the same metal material as the foam metal.

4. The LED illuminating device of claim 1, further comprising a cooling fan which is mounted on a surface of the foam metal layer different from the surface thereof formed with the metal support layer or received in a receiving space defined by the foam metal layer.

5. The LED illuminating device of claim 4, wherein remaining surfaces of the foam metal layer different from the surface thereof formed with the metal support layer has at least one covered portion.

6. A light emitting diode (LED) light source module, comprising a LED support member and a plurality of LEDs installed on the LED support member, the LED light source module **characterized in that**:

the LED support member is provided with a foam metal layer and a metal support layer having at least one portion for supporting the LEDs; wherein the foam metal layer is made of foam metal having porous structures, the metal support layer is formed on a portion of a surface of the foam metal layer, and the metal support layer and the foam metal layer are connected to each other.

7. The LED light source module of claim 6, wherein the foam metal is foam iron, foam copper, foam aluminum, foam iron alloy, foam copper alloy, or foam aluminum alloy, and the foam metal has 10-50 micro-pores per inch.

8. The LED light source module of claim 6, wherein the metal support layer is a solid metal layer made of the same metal material as the foam metal.

9. The LED light source module of claim 6, further comprising a cooling fan which is mounted on a surface of the foam metal layer different from the surface thereof formed with the metal support layer or received in a receiving space defined by the foam metal layer.

10. The LED light source module of claim 9, wherein remaining surfaces of the foam metal layer different from the surface thereof formed with the metal support layer has at least one covered portion.

11. A light emitting diode (LED) support member for supporting a plurality of LEDs, **characterized in that:**

the LED support member is provided with a foam metal layer and a metal support layer having at least one portion for supporting the LEDs; wherein the foam metal layer is made of foam metal having porous structures, the metal support layer is formed on a portion of a surface of the foam metal layer, and the metal support layer and the foam metal layer are connected to each other.

12. The LED support member of claim 11, wherein the metal support layer is connected to the foam metal layer by electro-plating, and the foam metal has 10-50 micro-pores per inch.

13. The LED support member of claim 11, wherein the metal support layer is a solid metal layer made of the same metal material as the foam metal.

14. The LED support member of claim 11, further comprising a cooling fan which is mounted on a surface of the foam metal layer different from the surface thereof formed with the metal support layer or received in a receiving space defined by the foam metal layer.

15. The LED support member of claim 14, wherein remaining surfaces of the foam metal layer different from the surface thereof formed with the metal support layer has at least one covered portion.

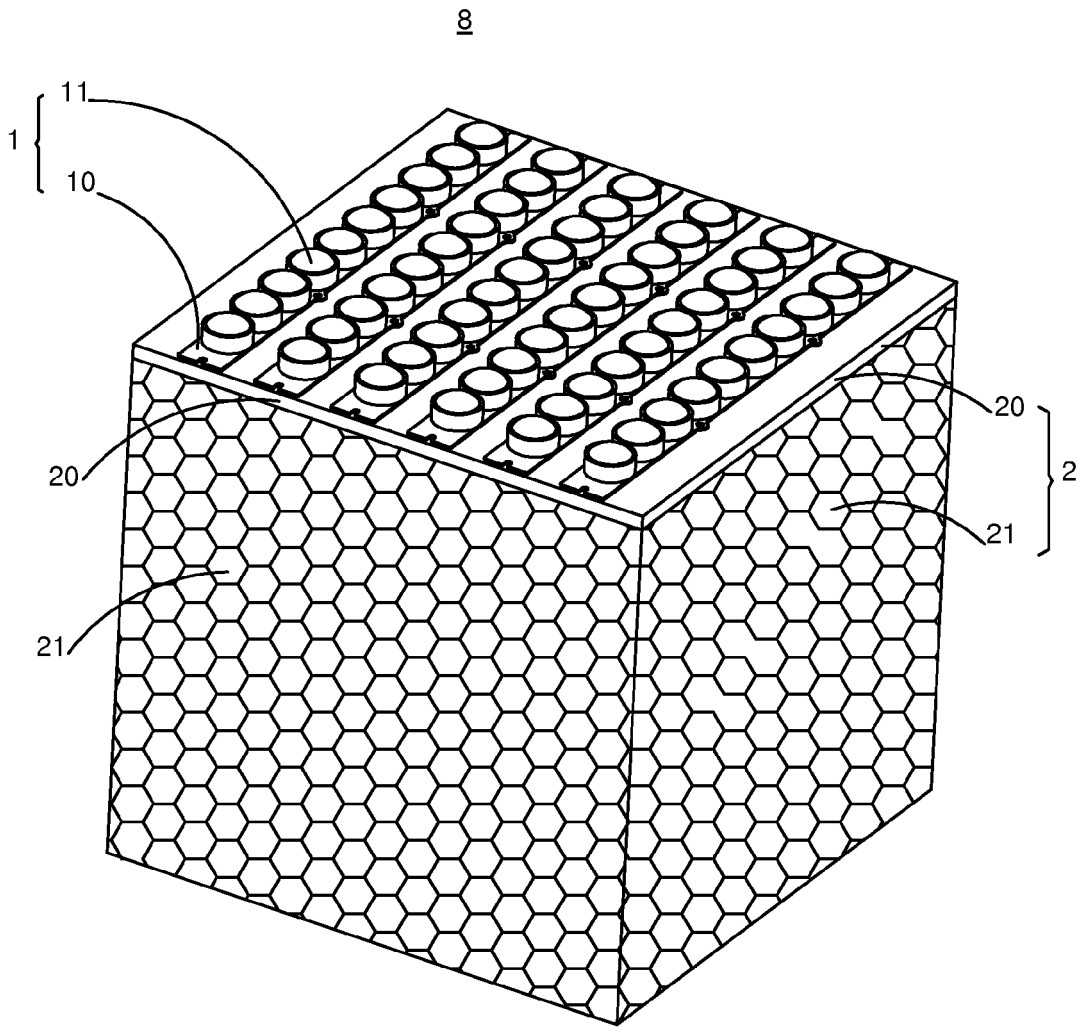

FIG. 1

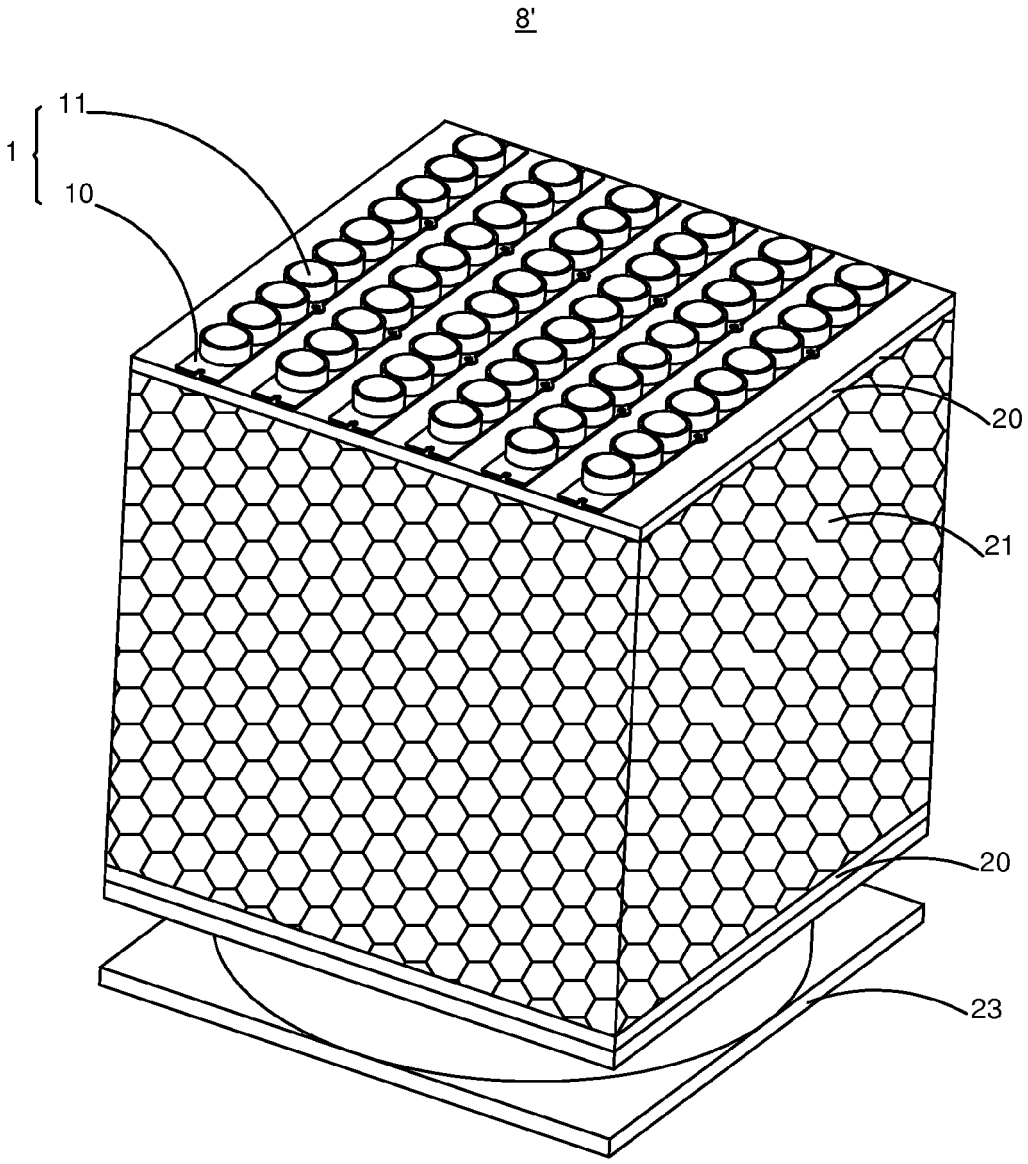

FIG. 2

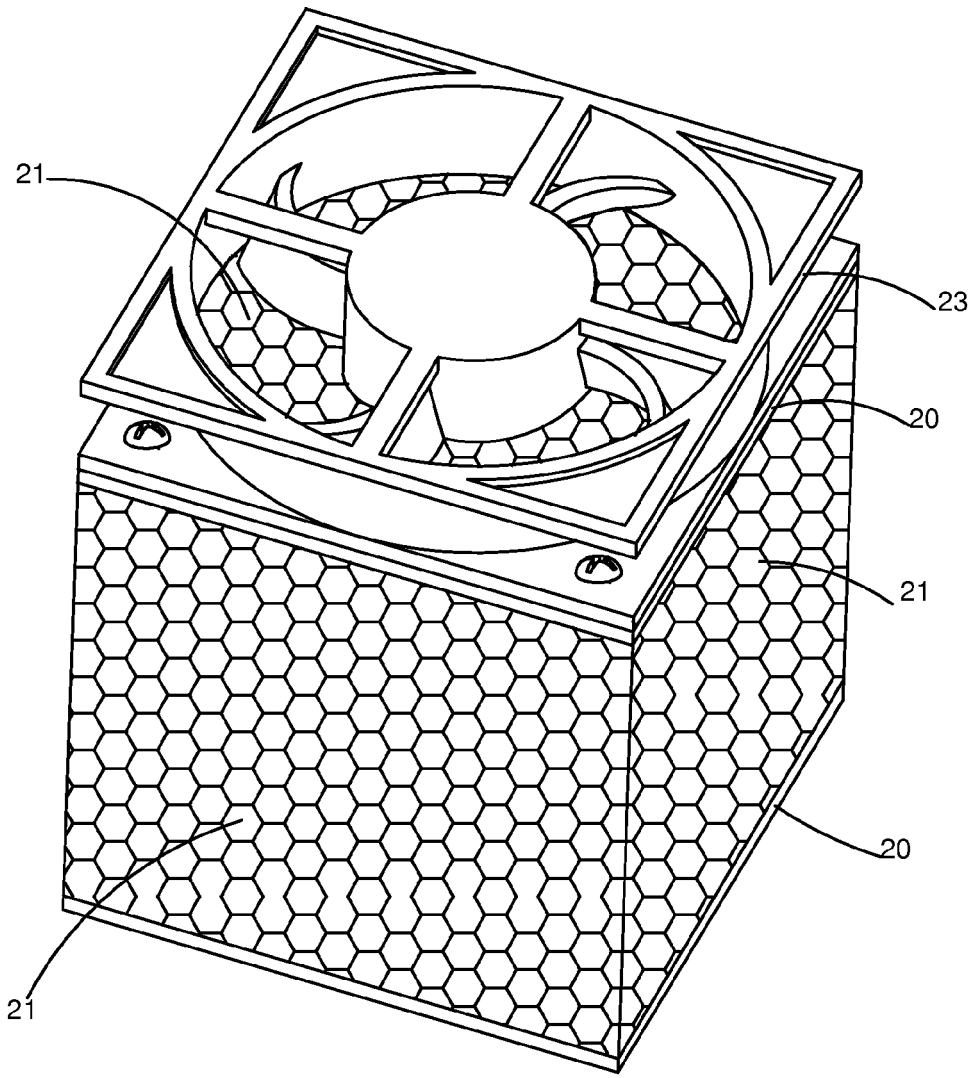

FIG. 3

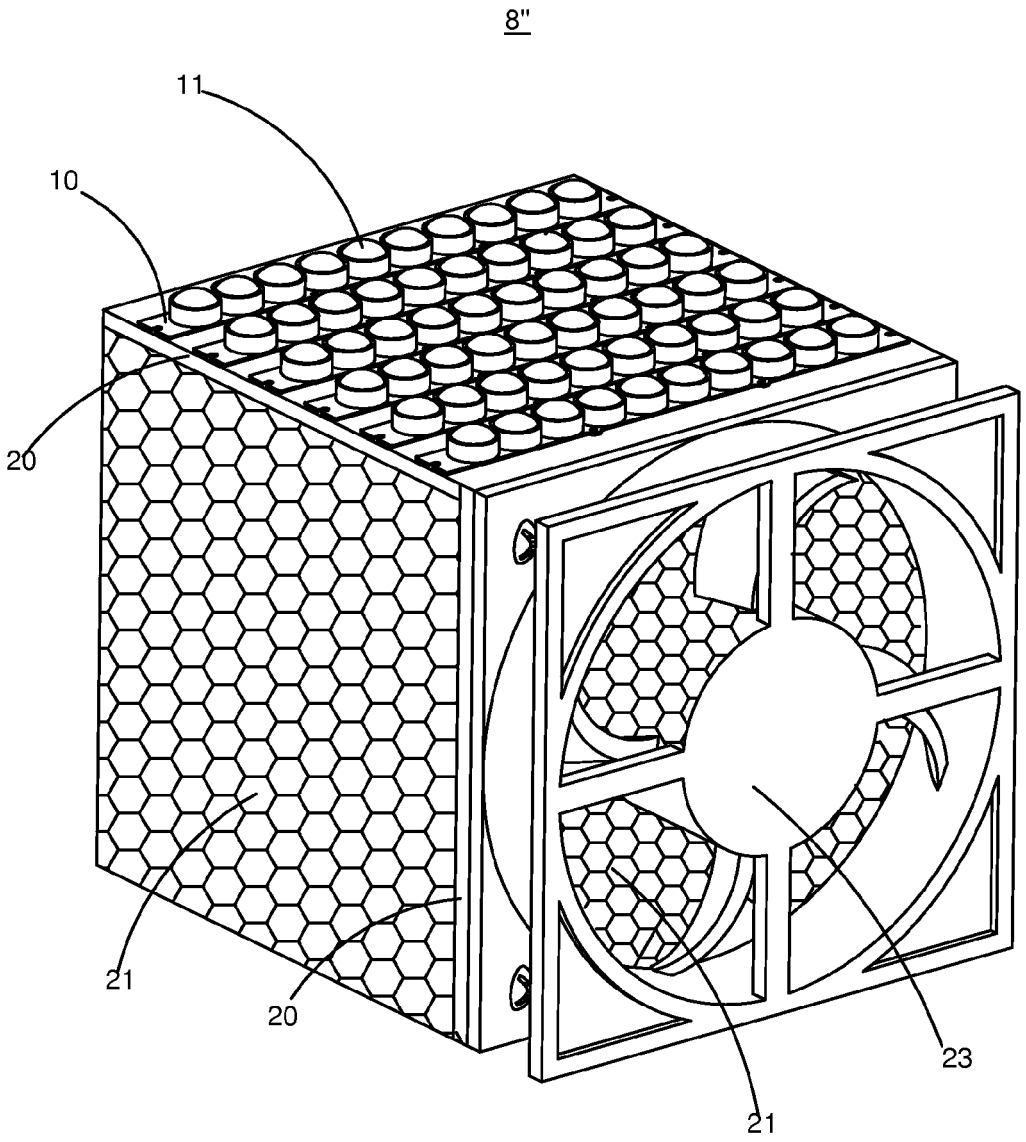

FIG. 4

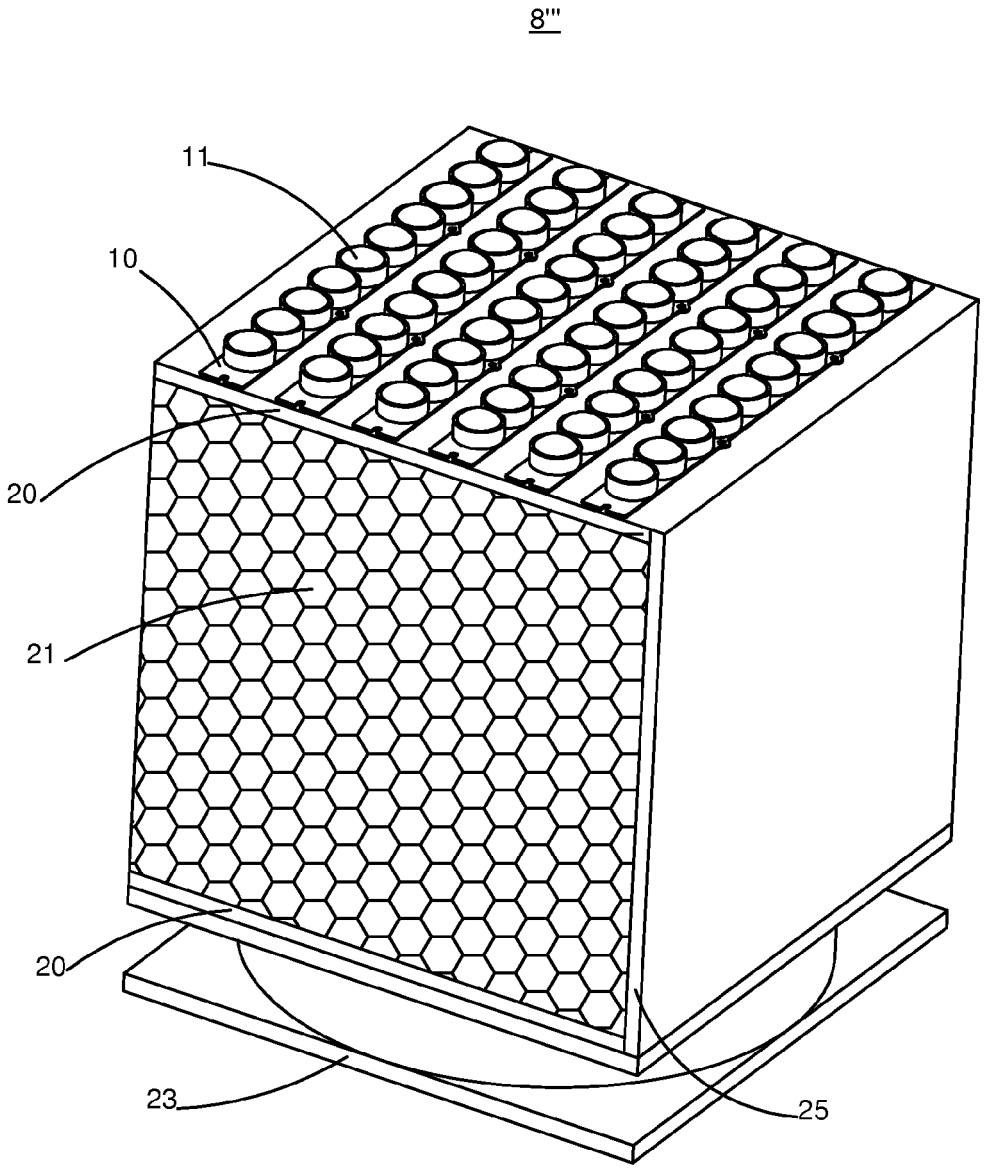

FIG. 5

8''''

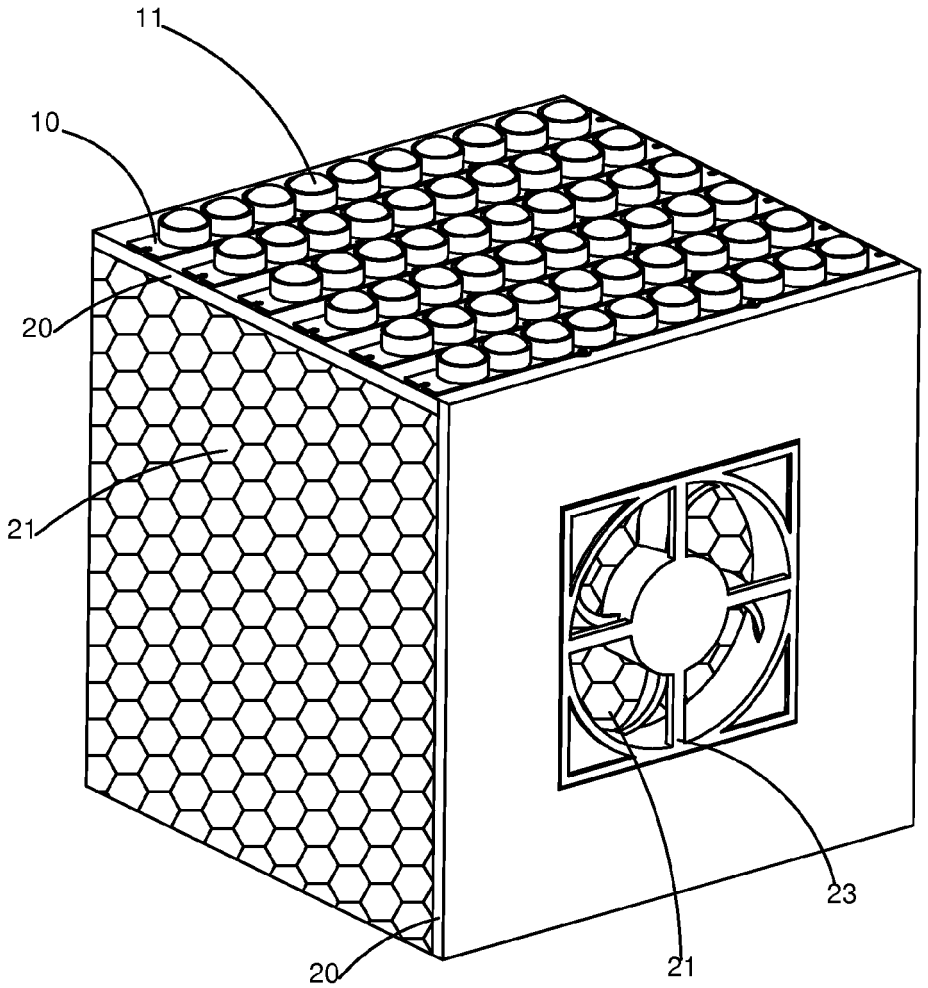

FIG. 6

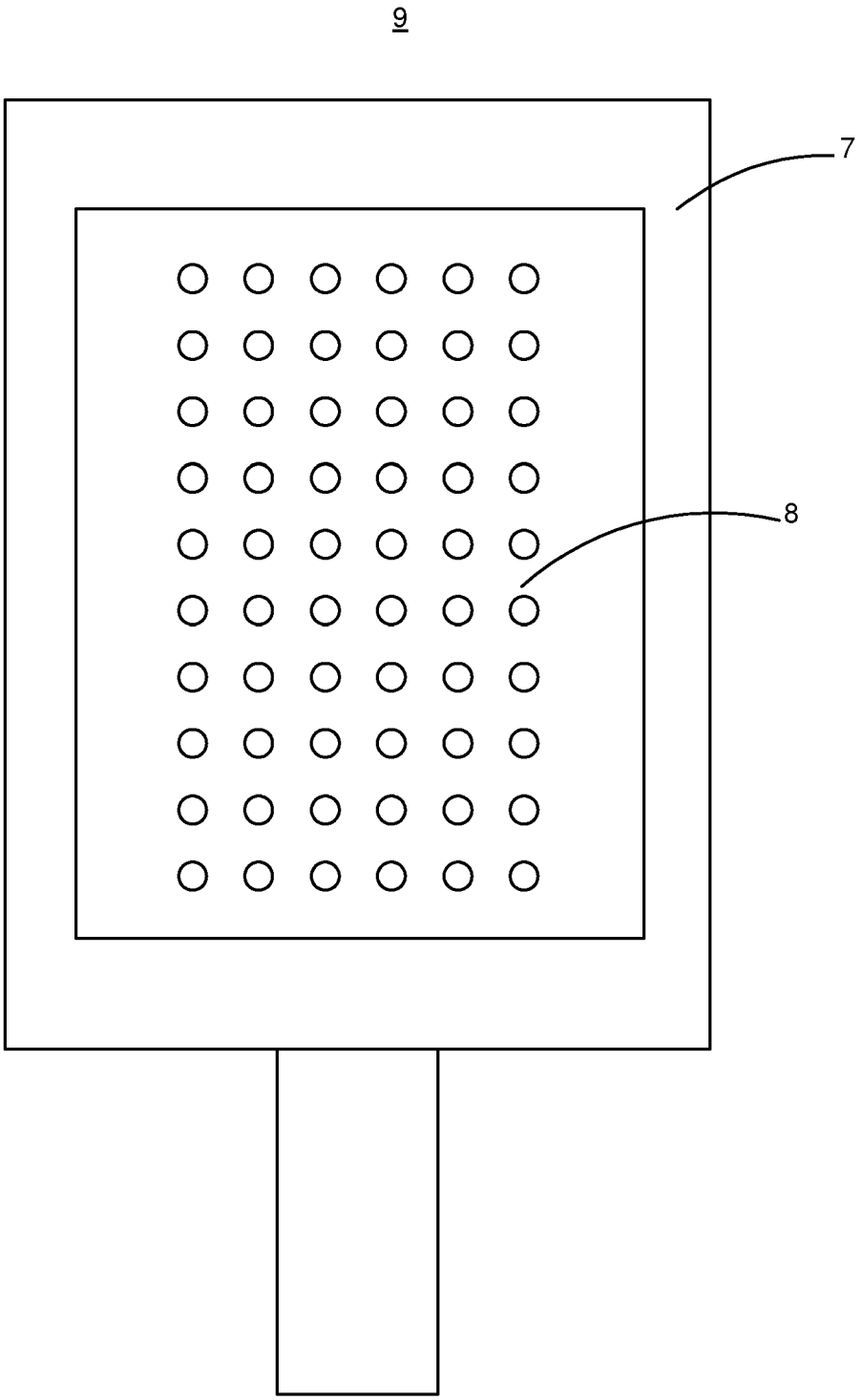

FIG. 7