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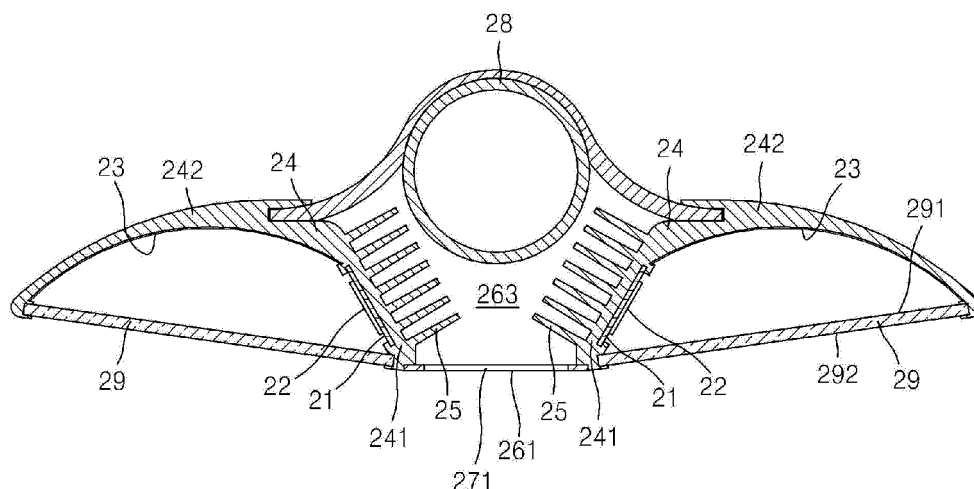
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(54) **LED LIGHTING APPARATUS**

(57) The present invention relates to an LED lighting apparatus which has uniform illumination and increases heat-dissipation effects to improve stability. The LED lighting apparatus includes: a panel having a plate shape, wherein the panel has a first plane and a second plane disposed on the side opposite to that of the first plane; a light-emitting part disposed on the first plane of the panel and including a plurality of LED devices, wherein the light-emitting part has a light-emitting surface parallel to the

first plane and inclined at a first angle such that the light-emitting surface forms an acute angle with the ground; and a reflective plate extending from the panel. The reflective plate includes a first portion extending at an incline so as to form a second angle with the ground that is smaller than the first angle, a second portion extending from the panel at an incline in a direction away from the ground, and a third portion connecting the first portion to the second portion.

Fig.2



Description

[0001] The present invention relates to an LED lighting apparatus.

[0002] Light emitting diodes (LEDs) are used in various light apparatuses as a next-generation light source that substitutes for a fluorescent light.

[0003] It should be contemplated that such LEDs may be used in an external environment and should emit light with certain illumination onto the ground.

[0004] In a streetlight using LED devices, when high-watt LEDs are used for improving the illumination with the respect to the ground, the LED devices may be deteriorated by heat emitted from the LED devices, leading to reduction in the service life of the LED devices. In a case where the heat of the LED device is not emitted efficiently to the outside, the overall temperature of lighting apparatuses are increased, thereby having adverse effects on electrical components such as a ballast stabilizer installed the inside the lighting apparatuses. Also, a protective member of the tempered glass which is disposed on a front surface of the LED devices may be easily damaged due to an external shock.

[0005] The present invention provides an LED lighting apparatus which can provide a uniform illumination with respect to the ground.

[0006] The present invention also provides an LED lighting apparatus which enhance stability by improving heat-dissipation effects.

[0007] According to an aspect of the present invention, there is provided an LED lighting apparatus including: a panel including a plate shape, the panel having a first plane and a second plane disposed on an opposite side of the first plane; a light-emitting part disposed on the first plane of the panel and including a plurality of LED devices, wherein the light-emitting part has a light-emitting surface parallel to the first plane, and is slantly disposed at a first angle which is an acute angle at which the light-emitting surface is inclined with respect to the ground; and a reflective plate extending from the panel, wherein the reflective plate includes a first portion slantly extended at a second angle which is smaller than the first angle; a second portion extending from the panel and extended in a direction away from the ground to be inclined with respect to the ground; and a third portion connecting the first portion and the second portion.

[0008] According to another aspect of the present invention, there is provided a shortest distance between the light-emitting surface and the ground may be less than a shortest distance between the first portion and the ground.

[0009] According to another aspect of the present invention, there is provided the first angle is less than a half of a viewing angle of the LED device.

[0010] According to another aspect of the present invention, there is provided the third portion may include a portion which is parallel to the ground.

[0011] According to another aspect of the present in-

vention, including: a chassis plate coupled to the second plane of the panel and made of a material allowing heat generated from the panel to be transferred; and a plurality of heat dissipation fins disposed at a side opposite to the panel of the chassis plate.

[0012] According to another aspect of the present invention, including a case coupled to the chassis plate and having a space accommodating the heat dissipation fins, wherein the case has a plurality of air holes communicated with the space.

[0013] According to another aspect of the present invention, there is provided the air holes may include a plurality of first air holes which are penetrated toward the ground and a plurality of second air holes which are disposed higher than the first air holes from the ground.

[0014] According to another aspect of the present invention, there is provided a sum of areas of the first air holes may be greater than a sum of areas of the second air holes.

[0015] According to another aspect of the present invention, further including a spread plate disposed to face the light-emitting part and the reflective plate.

[0016] According to another aspect of the present invention, there is provided the spread plate may include a third plane facing the light-emitting part and the reflective plate, a fourth plane which is opposed to the third plane, and a plurality of first grooves provided in the third or fourth plane such that the first grooves are spaced from each other, and a plurality of second holes disposed in the third or fourth plane such that the second holes are spaced from each other and cross the first holes, wherein the first holes and the second holes are spaced from each other.

[0017] According to the present invention, the LED lighting apparatus can have the uniform illumination with respect to the ground.

[0018] Since the light efficiency can be maximized to emit light with uniform illumination onto the ground, low-output LEDs can be used, thereby reducing costs and power consumption.

[0019] In addition, the heat dissipation efficiency can be maximized using convention, thereby preventing the temperature of the light-emitting part from increasing and the life cycle of the LED device from being reduced.

FIG. 1 is a schematic view of a streetlight adopting an LED lighting apparatus according to a preferred embodiment of the present invention.

FIG. 2 is a cross-sectional view of the LED lighting apparatus according to a preferred embodiment of the present invention.

FIG. 3 is a cross-sectional view of a panel, a reflective plate, and a structure of a light-emitting part of an LED lighting apparatus according to a preferred embodiment of the present invention.

FIG. 4 is a schematic view of a divergence condition of light when the LED lighting apparatus is applied to the streetlight according to FIG. 3.

FIG. 5 is a schematic view of a divergence condition of light when the LED lighting apparatus is applied to the streetlight according to FIG. 3.

FIG. 6 is a cross-sectional view of a panel, a reflective plate, and a structure of a light-emitting part of an LED lighting apparatus according to another preferred embodiment of the present invention.

FIG. 7 is a bottom perspective view of an LED lighting apparatus according to another preferred embodiment of the present invention.

FIG. 8 is a partial perspective view of a spread plate of an LED lighting apparatus according to another preferred embodiment of the present invention.

FIG. 9 is a partial perspective view of a spread plate of an LED lighting apparatus according to another preferred embodiment of the present invention.

FIG. 10 is a plan view of patterns of first grooves and second grooves of a spread plate according to an embodiment.

FIG. 11 is a plan view of patterns of first grooves and second grooves of a spread plate according to another embodiment.

FIG. 12 is a plan view of patterns of first grooves and second grooves of a spread plate according to still another embodiment.

FIG. 13 is a cross-sectional view of an LED lighting apparatus according to another embodiment of the present invention.

[0020] Hereinafter, preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0021] FIG. 1 shows a streetlight adopting a LED lighting apparatus according to an embodiment of the present invention.

[0022] As shown in FIG. 1, the streetlight disposed along a driveway and/or a sidewalk has a structure in which LED lighting apparatuses 2 are installed on pillars 1 that are arranged at regular intervals along the ground.

[0023] Here, since the LED lighting apparatus 2 installed on each of the pillars 1 may have a uniform illumination with respect to the ground onto which light is emitted in a state of being partially overlapped, the light emitted from the LED lighting apparatus 2 may be spread in a gull wing-shaped form.

[0024] FIG. 2 shows an LED lighting apparatus 2 according to a preferred embodiment of the present invention. FIG. 3 is a schematic view illustrating the relationship between a light-emitting part 22 and a reflective plate 23 of the LED lighting apparatus 2 in FIG. 2.

[0025] Referring to FIGS. 2 and 3, the LED lighting apparatus 2 may include a panel 21, the light-emitting part 22, and the reflective plate 23.

[0026] The panel 21 has a flat plate shape and includes a first plane 211 and a second plane 212 disposed on an opposite side of the first plane 211.

[0027] The panel 21 may be a printed circuit board (PCB). Preferably the panel 21 may use a metal PCB.

The panel 21 may have a surface of a rectangular plate-like object.

[0028] The light-emitting part 22 is disposed on the first plane 211 of the panel 21.

[0029] The light-emitting part 22 may be installed on a pad on which a plurality of LED devices are disposed on the first plane 211 of the panel 21. Also, the LED devices may be covered with a sealant having a phosphor.

[0030] The light-emitting part 22 has a light-emitting surface 221 on a surface thereof. The light-emitting surface 221 is substantially parallel to the first plane 211.

[0031] Light is emitted toward a space facing the first plane 211 of the panel 21 from the light-emitting surface 221 of the light-emitting part 22.

[0032] The light-emitting part 22 is inclined in an upward direction so as to have a first angle α_1 which is an acute angle at which the light-emitting surface 221 is inclined with respect to the ground 3. Accordingly, if the light-emitting surface 221 is perfectly parallel to the first plane 211 of the panel 21, the first plane 211 of the panel 21 may have the first angle α_1 with respect to the ground 3.

[0033] The reflective plate 23 extends from the panel 21. As shown in FIG. 3, the reflective plate 23 includes a first portion 231 to a third portion 233.

[0034] The first portion 231 corresponds to a portion disposed farthest away from the light-emitting part 22 among parts of the reflective plate 23. A second portion 232 corresponds to a portion extending from the panel 21. The third portion 233 corresponds to a middle portion connecting the first portion 231 and the second portion 232.

[0035] The first portion 231 slantly extends in an upward direction so as to have a second angle α_2 with respect to the ground 3. Here, the second angle α_2 is less than the first angle α_1 .

[0036] When the first angle α_1 of the light-emitting surface 221 with respect to the ground 3 is larger than the second angle α_2 of the first portion 231 with respect to the ground 3, the amount of light directly emitted onto the ground 3 among lights emitted from the light-emitting surface 221 is increased. Also, a portion of the lights emitted from the light-emitting surface 221 is reflected by the reflective plate 23 and is overlapped with the light directly emitted from light-emitting surface 221 toward the ground 3, thereby further increasing the intensity of illumination on the ground 3.

[0037] The second angle α_2 may be set to a range of about 10 degree to about 60 degree. When the second angle α_2 is over about 60 degree, the illumination of a region which is closer to the light-emitting surface 221 may be increased in comparison with the illumination of light that is farther from the light-emitting surface 221. Thus, it is difficult to obtain a uniform illumination on the whole. When the second angle α_2 is less than about 10 degree, an amount of the light reflected by the reflective plate 23 is decreased to decrease the overall illumination.

[0038] The shortest distance t_1 between the light-emit-

ting surface 221 and the ground 3 may be less than the shortest distance t_2 between the first portion 231 and the ground 3. In this case, the amount of light directly emitted toward the ground 3 among lights emitted from the light-emitting surface 221 is larger than the amount of light reflected by the reflective plate 23 thus to emit light in a wider range.

[0039] As shown in FIG. 2, an embodiment of the LED lighting apparatus 2 of the present invention may be used such that it includes the same panel 21 and has a dual structure having the light-emitting part 22 and the reflective plate 23 at both sides thereof. This structure may be more favorable when the light should be emitted toward both sides with respect to center of the pillar 1, for example, in the streetlight of FIG. 1.

[0040] In this case, the first angle a_1 may be about a half or less of a viewing angle b of the LED device mounted on the light-emitting part 22. Thus, in a case where an LED device having a viewing angle of about 120 degree is used, the first angle a_1 may be set to be less than 60 degree. As shown in FIG. 4, in the panel 21 and the dual structure having the light-emitting part 22 and the reflective plate 23 at both sides thereof, it is possible to secure a sufficient illumination on the ground 3 in an area directly under the light-emitting parts 22 at both sides of the dual structure. When the first angle a_1 is equal to a half of a viewing angle of the LED device, the light of the light-emitting part 22 is emitted directly below. Since a distance between the light-emitting parts 22 at both sides is small, a sufficient brightness may be maintained in an area of the ground 3 directly under the light-emitting parts 22 at both sides. When the first angle a_1 is less than a half of the viewing angle b of the LED device, the lights of the light-emitting parts 22 are partially overlapped each other, and thus a sufficient brightness state may be maintained in an area of the ground 3 directly under the light-emitting parts 22.

[0041] In a case where the LED lighting apparatus 2 according to the present invention is installed in a place having a wall 31 as shown in FIG. 5, the first angle a_1 may be slightly greater than a half of the viewing angle b of the LED device installed on the light-emitting part 22. That is, this is a case in which light needs not to be emitted onto a region of the ground 3 adjacent to the wall 31. The first angle a_1 may be slightly greater than a half of the viewing angle b of the LED device installed on the light-emitting part 22 for allowing the light to be emitted from a region spaced a predetermined distance from the wall 31. When the first angle a_1 is significantly greater than a half the viewing angle b of the LED device, a region disposed directly under the light-emitting part 22 is too darkened. In this case, therefore, the first angle a_1 may be equal to or greater than a half of the viewing angle b of the LED device.

[0042] The second portion 232 may slantly extend upward at a third angle a_3 with respect to the ground 3. The third angle a_3 may be set to be about 10 degree to about 60 degree. When the third angle a_3 is over about 60

degree, a shape of the reflective plate 23 has an extremely convex shape. Accordingly, the illumination of the light at a position which is closer to the light-emitting surface 221 may be increased in comparison with the illumination of light at a position which is far away from the light-emitting surface 221, and thus it is difficult to obtain uniform illumination on the whole. When the third angle a_3 is less than about 10 degree, the shape of the reflective plate 23 is significantly flattened, and thus an amount of light reflected by the reflective plate 23 may be decreased to reduce the overall illumination.

[0043] The third portion 233 connects the first portion 231 to the second portion 232 and may have a curved shape so that the light is reflected at various angles to provide uniform illumination toward the ground 3.

[0044] As shown FIG. 3, the reflective plate 23 according to embodiment of the present invention may have a curved shape on the whole. The first portion 231 and the third portion 233 may have a radius of curvature of 40 mm to 80 mm, and preferably, a radius of curvature of 50 mm to 70 mm. The first portion 231 and the third portion 233 according to an embodiment of the present invention may have a radius of curvature of about 60 mm.

[0045] The second portion 232 may have a radius of curvature of 70 mm to 110 mm and, preferably, a radius of curvature of about 80 mm to about 100 mm. The second portion 232 according to an embodiment of the present invention may have a radius of curvature of about 90 mm.

[0046] The radius of curvature of the second portion 232 may be greater than the radius of curvature of the first portion 231 and/or the third portion 233. Accordingly, a distal portion of the reflective plate 23 from the light-emitting part 22 may be more rounded, whereas a proximal portion of the reflective plate 23 from the light-emitting part 22 may be less rounded. In such a structure, the light emitted from the light-emitting part 22 may be further uniformly emitted in a region below the lighting according to the present invention.

[0047] The third portion 233 may be disposed closer to the first portion 231 rather than disposed in a central portion between the first portion 231 and the second portion 232.

[0048] Also, only the third portion 233 has a curved surface while the first portion 231 and/or the second portion 232 may have the straight line shape.

[0049] As shown in FIG. 6, all of the first to third portions 231 to 233 may have a straight line shape. Here, the third portion 233 may be parallel to the ground 3.

[0050] Referring to FIGS. 2 and 3, in the LED lighting apparatus 2 according to a preferred embodiment of the present invention, a chassis plate 24 may be further coupled to the second plane 212 of the panel 21. Preferably, the chassis plate 24 is formed of a metal material to transfer heat generated from the panel 21. For example, the chassis plate 24 may be formed of Al or Al alloy.

[0051] The chassis plate 24 may have a first support 241 supporting the panel 21 and a second support 242

supporting the reflective plate 23. The first support 241 and the second support 242 may be integrally formed.

[0052] Although not illustrated in the drawings, a heat transfer sheet may be further disposed between the first support 241 and the panel 21. The heat transfer sheet allows heat emitted from the light-emitting part 22 to be further efficiently transferred to the first support 241 via the panel 21. Thus, heat-dissipation effects of the light-emitting part 22 may be further improved.

[0053] A plurality of heat dissipation fins 25 may be installed at a side opposite to the panel 21 of the chassis plate 24. Particularly, the heat dissipation fins 25 are installed on the first support 241 to assist in heat dissipation of the first support 241. Thus, the heat-dissipation effects of the light-emitting part 22 may be further maximized. The heat dissipation fin 25 is disposed at the shortest distance from the light-emitting part 22 so that the heat-dissipation effects may further be improved.

[0054] A case may be further coupled to the chassis plate 24. As shown FIGS. 2 and 7, according to the embodiment of the present invention, the case may include a first case 261 connected to the first support 241 and a second case 262 connected to the second support 242.

[0055] When the LED lighting apparatus 2 is installed at the outside, the LED lighting apparatus 2 may be easily damaged by weather conditions such as rain and wind, animals such as birds or squirrels, leaves or the like. However, the case covers the light-emitting part 22 from exterior environments and may thus protect the panel 21 and the heat dissipation fins 25. Also, the case may protect a number of electrical devices not illustrated in the drawings.

[0056] An inner space 263 may be defined by the first case 261 and the second case 262. A pipe 28 may be installed inside the space 263, and various wirings connected to the panel 21 may pass through the pipe 28.

[0057] The first case 261 and/or the second case 262 may further have a plurality of air holes that are communicated with the space 263. The heat dissipation fins 25 may extend toward the space 263. Thus, the heat emitted through the heat dissipation fins 25 may be discharged to the outside through the air holes via the space 263.

[0058] The present inventors use air convection to efficiently discharge the heat of the space 263. As shown in FIGS. 2 and 7, a plurality of first air holes 271 passing toward the ground are provided in the first case 261 and a plurality of second air holes 272 are provided in the second case 262. Here, the second air holes 272 may be formed higher than the first air hole 271 from the ground. Thus, cold air introduced into the space 263 from the first air hole 271 is heated by heat-exchanging with the heat dissipation fins 25 and the first support 241, and then discharged through the second air holes 272. The convection effect results in further maximization of the heat-dissipation effects in the heat dissipation fins 25 and the first support 241.

[0059] According to another embodiment of the present invention, a sum of areas of the first air holes

271 may be greater than a sum of areas of the second air holes 272. In this case, an amount of the cold air introduced from the first air hole 271 may be increased to maximize the convective effect.

[0060] As shown in FIG. 7, the second air hole 272 may be provided in a side surface 262a of the second case 262. As shown in FIG. 2, when the second air hole 272 is provided in a top surface of the second case 262, a foreign substance is easily introduced from the outside so that the second air hole 272 may clogged and the space 263 may be easily contaminated. However, the present invention is not necessarily limited to the second air hole 272 being provided in the side surface 262a, and, although not shown, the second air hole 272 may also be provided in the top surface of the second case 262.

[0061] The LED lighting apparatus 2 may further include a spread plate 29 that is opposite to the light-emitting part 22 and the reflective plate 23. As shown in FIG. 2, the spread plate 29 may be installed on the chassis plate 24. The spread plate 29 may be coupled to an edge of the first support 241 and an edge of the second support 242.

[0062] The spread plate 29 may directly protect the light-emitting part 22, the reflective plate 23, and the panel 21 from external environments. Also, the spread plate 29 diffuses the light emitted from the light-emitting part 22 to provide light with high and uniform illumination onto the ground 3.

[0063] The spread plate 29 may be formed of a self-luminous material and may diffuse the light using a transparent panel in which scattering particles are distributed.

[0064] The spread plate 29 includes a third plane 291 facing the light-emitting part 22 and the reflective plate 23, and a fourth plane 292 that is opposite to the third plane 291. The spread plate 29 also includes a plurality of first grooves provided in the third plane 291 or the fourth plane 292 such that the first grooves are spaced from each other, and a plurality of second grooves provided in the third plane 291 or the fourth plane 292 such that the second grooves are spaced from each other and cross the first grooves. The first grooves and the second grooves may be spaced from each other.

[0065] FIG. 8 illustrates the spread plate 29 according to an embodiment of the present invention.

[0066] In the embodiment according to FIG. 8, a plurality of first grooves 293 and a plurality of second grooves 294 are provided in the fourth plane 292 and spaced from each other. The second grooves 294 are arranged spaced from the first grooves 293 to cross the first grooves 293. The first grooves 293 and the second grooves 294 are respectively recessed inwardly from the fourth plane 292. When the spread plate 29 is formed of a plastic, the spread plate 29 may be formed by pressing with a heated mold or by injecting with a mold. When the spread plate 29 is formed using the heated mold, the spread plate 29 may be simultaneously formed using the mold having patterns of the first grooves 23 and the second grooves 24.

[0067] The fourth plane 292 between the first grooves 293 and the fourth plane 292 between the second grooves 294 may have a curved shape. Lenticular patterns may respectively be defined by the first grooves 293 and a portion of the fourth plane 292 between the first grooves 293 and the second grooves 294 and a portion of the fourth plane 292 between the second grooves 294.

[0068] The first grooves 293 and the second grooves 294 may also be defined in the third plane 291. Although not shown in the drawings, the first grooves 293 and the second grooves 294 may be defined in both the third plane 291 and the fourth plane 292.

[0069] In addition, as shown in FIG. 9, the first grooves 293 and the second grooves 294 may also be defined in the third plane 291 and the fourth plane 292, respectively. In this case, the lenticular patterns may respectively be defined by the first grooves 293 and a portion of the third plane 291 between the first grooves 293 and the second grooves 294 and a portion of the fourth plane 292 between the second grooves 294.

[0070] FIG. 10 is a schematic view of patterns defined by the first grooves 293 and the second grooves 294. In an embodiment according to FIG. 10, all of the first grooves 293 and the second grooves 294 are formed in the shape of regular patterns. Thus, the surface of the first plane 21 has a three-dimensional structure having a tetragonal shape at a bottom surface thereof and having a curved shape at a central portion thereof

[0071] Under this structure, the light emitted from the light-emitting part 22 does not diffuse in a specific direction but uniformly diffuses in a plane direction. Here, if a distance d1 between the first grooves 293 is equal to a distance d2 between the second grooves 294, it is possible to improve a uniform diffusion effect on the whole.

[0072] Although not shown in the drawings, the diffusion effect may be locally different by allowing the distance d1 between the first grooves 293 to differ from the distance d2 between the second grooves 294. Accordingly, the brightness of the light in a distal direction from the light-emitting part 22 may also be increased.

[0073] FIG. 11 a plan view of patterns of first grooves 293' and second grooves 294' according to another preferred embodiment of the present invention.

[0074] As shown in FIG. 11, the first grooves 293' and the second grooves 294' may have a curved line. Due to the curved pattern shape, the light emitted from the light-emitting part 22 has various forms to further improve an illumination effect.

[0075] FIG. 11 shows both the first grooves 293' and the second grooves 294' have curved patterns. However, the present invention is not limited thereto, and thus, only at least one of first grooves 293' and second grooves 294' may have the curved pattern, wherein the curved pattern may be defined only locally.

[0076] In the embodiments of FIG. 10, the first grooves and the second grooves have crossing patterns such that the first grooves are perpendicular to the second

grooves.

[0077] However, the present invention is not limited to the patterns above, and thus, as shown in FIG. 12, first grooves 293' and second grooves 294' cross each other at an inclined angle θ .

[0078] The inclined angle θ may be an acute angle.

[0079] The light emitted from the light-emitting part 22 according to this pattern configuration shows diffusivity and brightness distribution which are different from those of the embodiment according to FIG. 10.

[0080] The above-described LED lighting apparatus includes two light-emitting parts 22, however, the present invention is not limited thereto. The light-emitting part 22 may be used alone as shown in FIG. 13 when only one side is illuminated with the light. The embodiment as shown in FIG. 13 corresponds to a half structure of the embodiment as shown in FIG. 2, the first case 261 and the second case 262 are coupled to a fixation piece 264. The fixation piece 264 enables the lighting apparatus of the present invention to be installed on a pole or wall. Other functions are the same as described above.

[0081] Although the exemplary embodiments have been described with reference to the specific embodiments, they are not limited thereto. Therefore, it will be readily understood by those skilled in the art that various modifications and changes can be made thereto without departing from the spirit and scope of the present disclosure defined by the appended claims.

Claims

1. An LED lighting apparatus comprising:

a panel having a plate shape, the panel comprising a first plane and a second plane disposed on an opposite side of the first plane;
a light-emitting part disposed on the first plane of the panel and comprising a plurality of LED devices, wherein the light-emitting part has a light-emitting surface parallel to the first plane, and is slantly disposed at a first angle which is an acute angle at which the light-emitting surface is inclined with respect to the ground; and
a reflective plate extending from the panel, wherein the reflective plate comprises:

a first portion slantly extended at a second angle which is smaller than the first angle;
a second portion extending from the panel and extended in a direction away from the ground to be inclined with respect to the ground; and
a third portion connecting the first portion and the second portion.

2. The LED lighting apparatus of claim 1, wherein a shortest distance between the light-emitting surface

and the ground is less than a shortest distance between the first portion and the ground.

3. The LED lighting apparatus of claim 1, wherein the first angle is less than a half of a viewing angle of the LED device. 5
4. The LED lighting apparatus of claim 1, wherein the third portion comprises a portion which is parallel to the ground. 10
5. The LED lighting apparatus of claim 1, comprising: a chassis plate coupled to the second plane of the panel and made of a material allowing heat generated from the panel to be transferred; and a plurality of heat dissipation fins disposed at a side opposite to the panel of the chassis plate. 15
6. The LED lighting apparatus of claim 5, comprising a case coupled to the chassis plate and having a space accommodating the heat dissipation fins, wherein the case has a plurality of air holes communicated with the space. 20
7. The LED lighting apparatus of claim 6, wherein the air holes comprise a plurality of first air holes which are penetrated toward the ground and a plurality of second air holes which are disposed higher than the first air holes from the ground. 25
30
8. The LED lighting apparatus of claim 7, wherein a sum of areas of the first air holes are greater than a sum of areas of the second air holes.
9. The LED lighting apparatus of any one of claims 1 to 8, further comprising a spread plate disposed to face the light-emitting part and the reflective plate. 35
10. The LED lighting apparatus of claim 9, wherein the spread plate includes a third plane facing the light-emitting part and the reflective plate, a fourth plane which is opposed to the third plane, a plurality of first grooves provided in the third or fourth plane such that the first grooves are spaced from each other, and a plurality of second holes disposed in the third or fourth plane such that the second holes are spaced from each other and cross the first holes, wherein the first holes and the second holes are spaced from each other. 40
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50

55

Fig.1

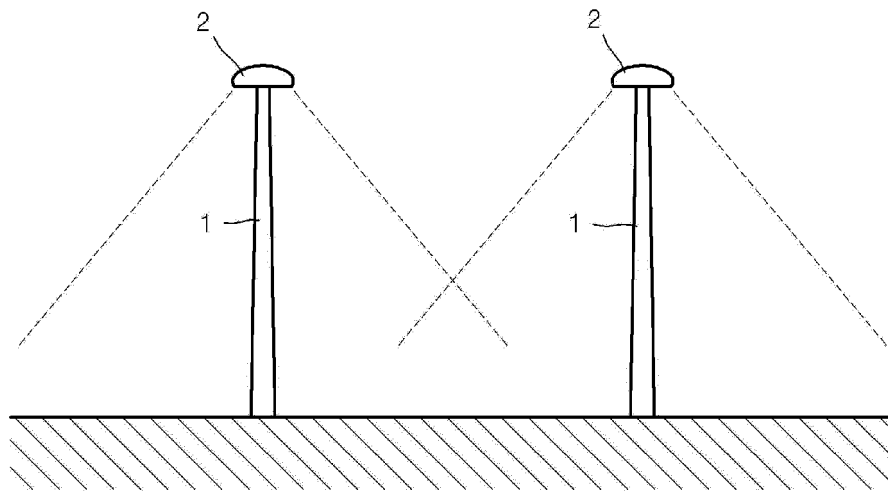


Fig.2

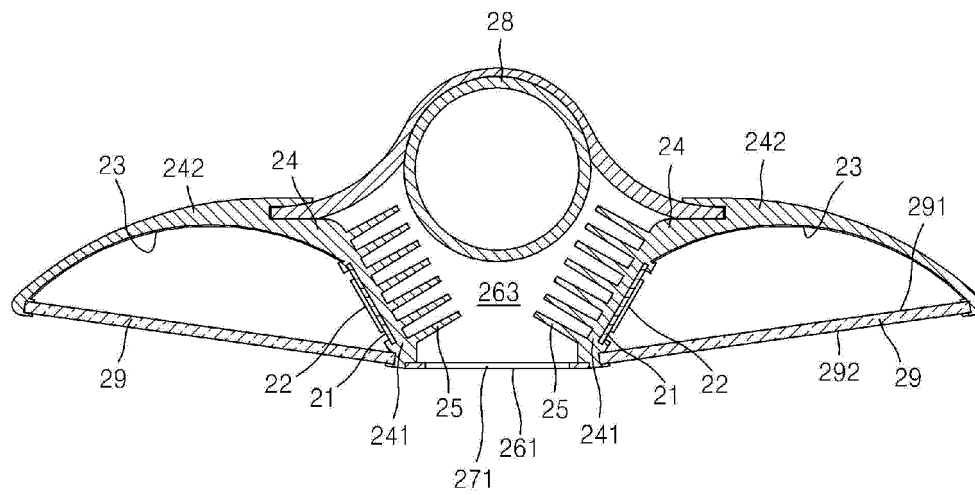


Fig. 3

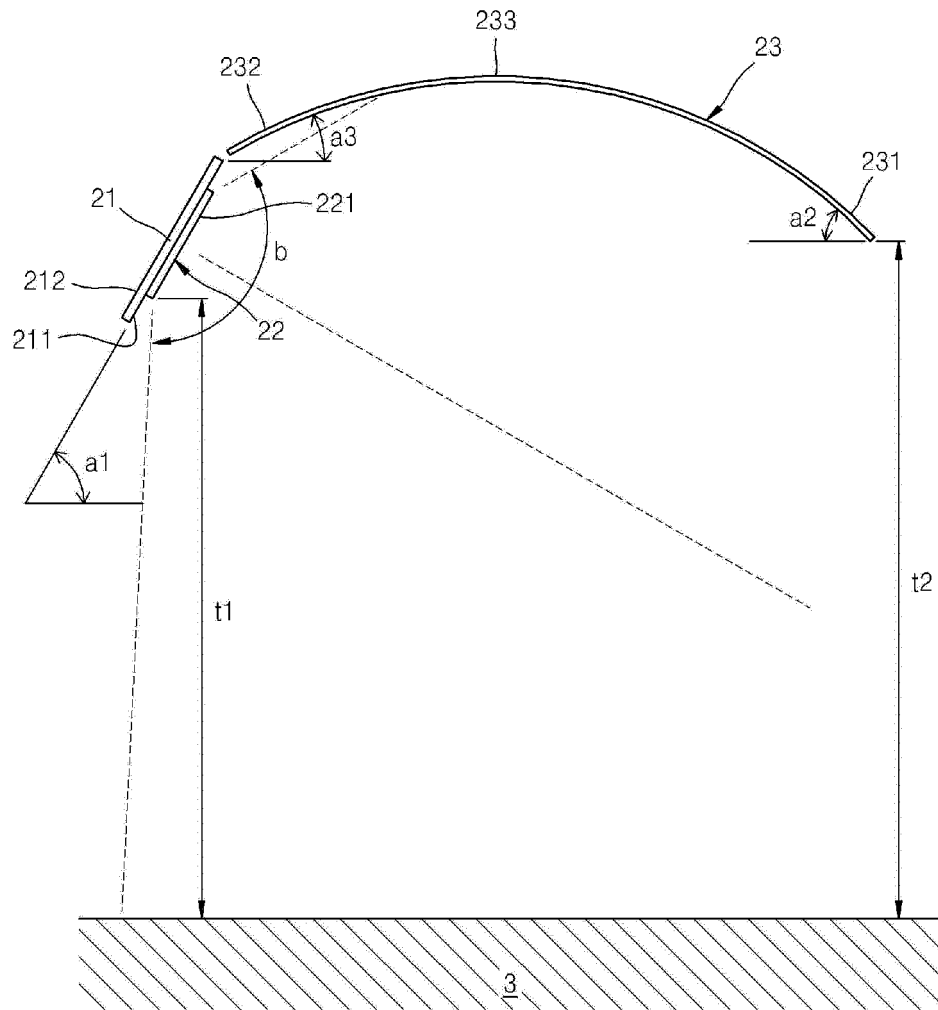


Fig. 4

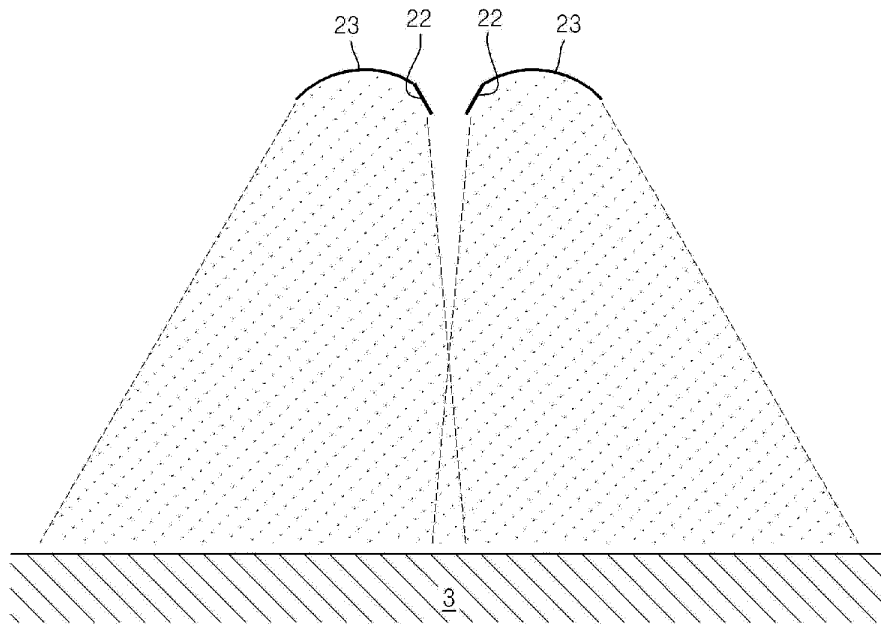


Fig. 5

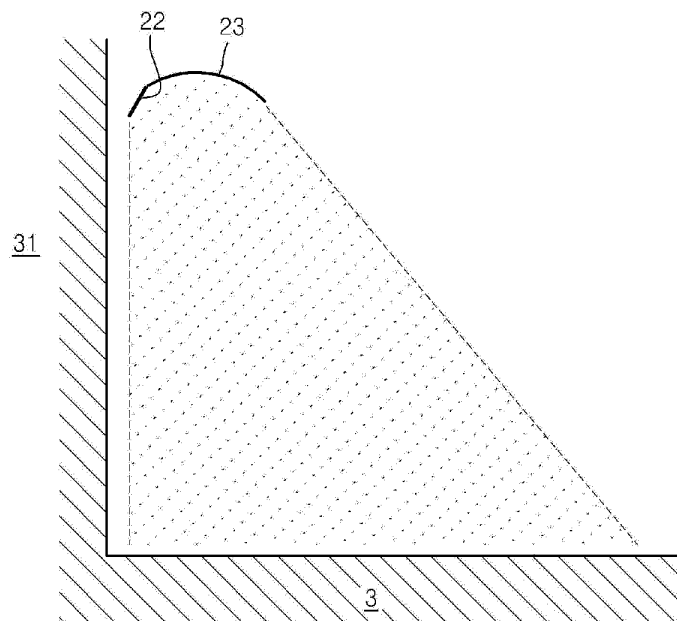


Fig. 6

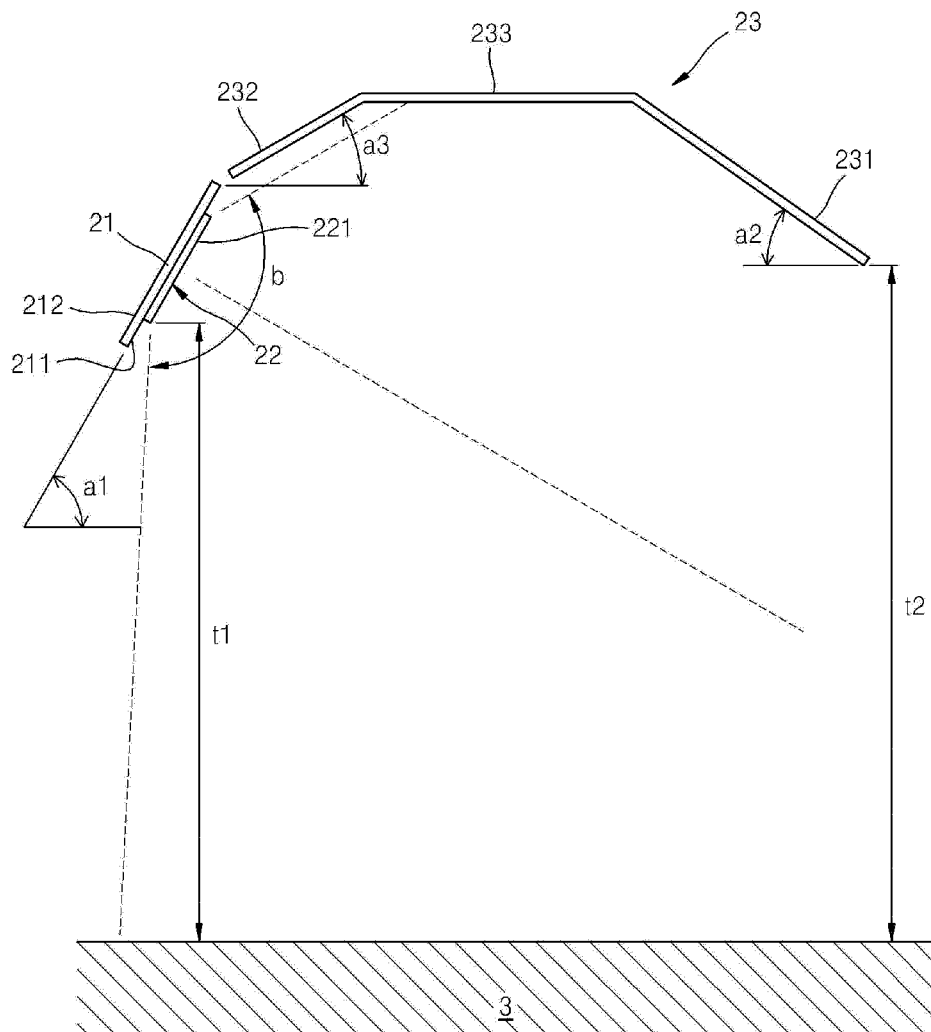


Fig. 7

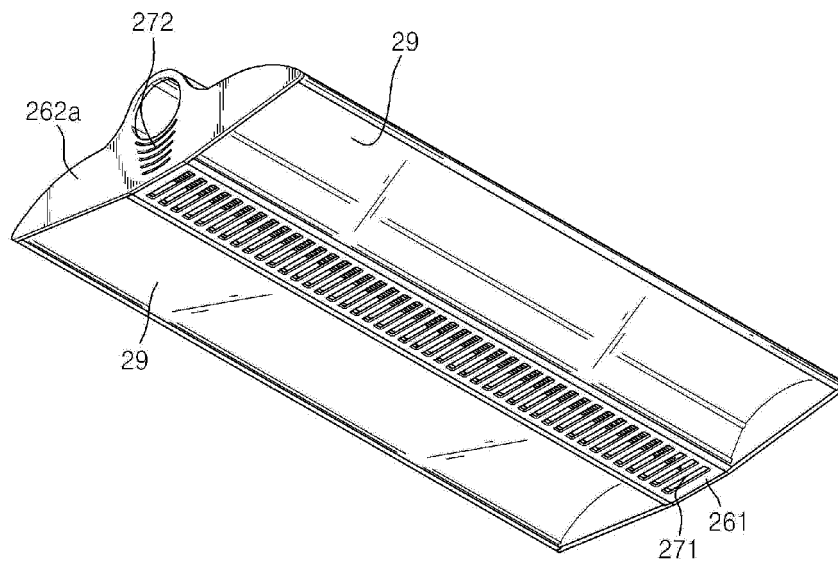


Fig. 8

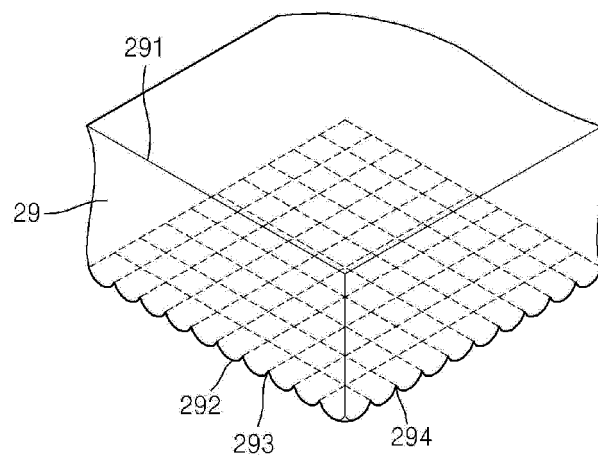


Fig. 9

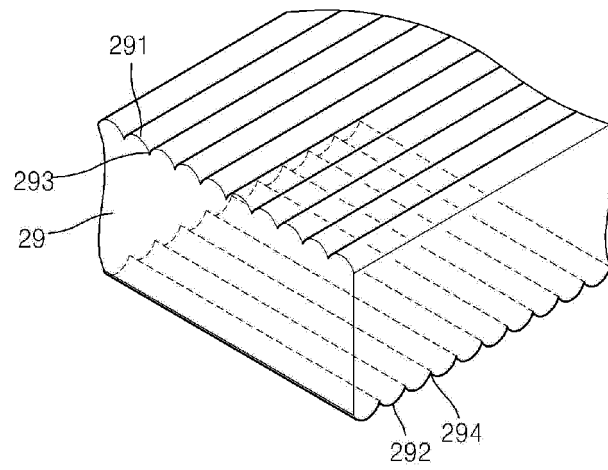


Fig. 10

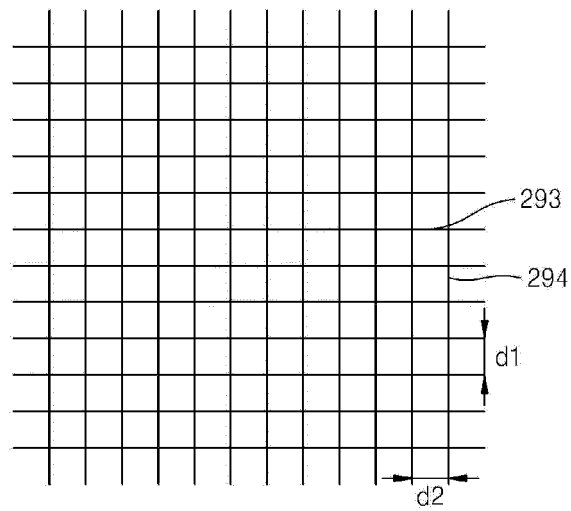


Fig. 11

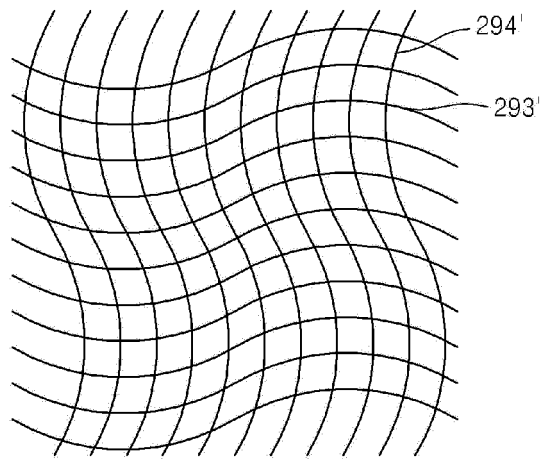


Fig. 12

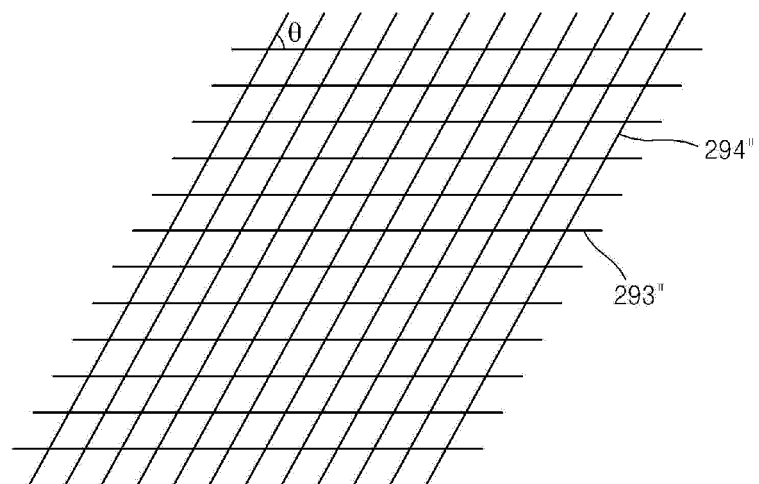


Fig. 13

