



(51) International Patent Classification:
A61L 2/10 (2006.01)

(21) International Application Number:
PCT/KR2014/006702

(22) International Filing Date:
23 July 2014 (23.07.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10-2013-0089163 26 July 2013 (26.07.2013) KR
10-2013-0106338
4 September 2013 (04.09.2013) KR

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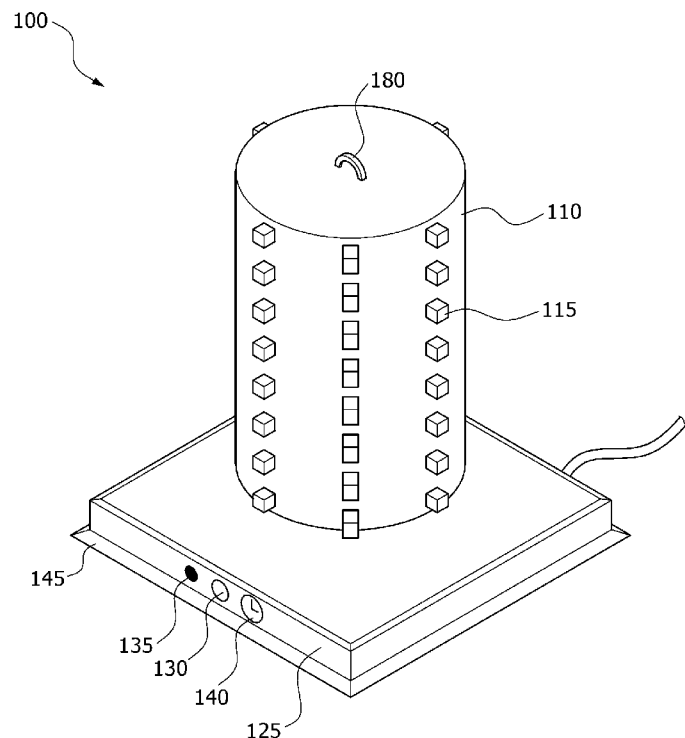
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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD,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

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM,

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(54) Title: STERILIZATION APPARATUSES USING ULTRAVIOLET LIGHT EMITTING DIODES



(57) Abstract: Sterilization apparatuses are provided. The sterilization apparatus includes a case having a sidewall surface and a top surface, a plurality of ultraviolet light emitting diodes (UV LEDs) disposed on an outer surface of the case to generate UV rays, and a prop on which the case is mounted.



TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, —
KM, ML, MR, NE, SN, TD, TG).

*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))*

Published:

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

Description

Title of Invention: STERILIZATION APPARATUSES USING ULTRAVIOLET LIGHT EMITTING DIODES

Technical Field

- [1] The present disclosure herein relates to sterilization apparatuses and, more particularly, to sterilization apparatuses using ultraviolet light emitting diodes (UV LEDs).

Background Art

- [2] Ultraviolet (UV) rays have different properties according to wavelengths thereof. Accordingly, the UV rays have been used in sterilization apparatuses utilizing their own properties which are different according to the wavelengths thereof. The sterilization apparatuses using the UV rays may include mercury lamps. Lights emitted from the mercury lamps may generate an ozone (O₃) gas, and the ozone gas may act as a sterilizer.
- [3] In general, the sterilization apparatuses using UV LEDs may correspond to stationary sterilization apparatuses in which the mercury lamps are fixed. For example, the mercury lamps may be fixed in refrigerators to sterilize food and water. In such a case, since the mercury lamps are fixed to specific positions, there may be limitations in sterilizing all spaces in the refrigerators. Moreover, the mercury lamps contain a mercury material to cause environmental contamination as the time elapses.

Disclosure of Invention

Technical Problem

- [4] Embodiments of the present disclosure provide sterilization apparatuses that are movable to freely sterilize using UV LEDs without any spatial limitations.

Solution to Problem

- [5] In one embodiment, a sterilization apparatus includes a case configured to have a sidewall surface and a top surface, a plurality of ultraviolet light emitting diodes (UV LEDs) disposed on an outer surface of the case to generate UV rays, and a prop on which the case is mounted.
- [6] In some embodiments, the case may have a cylindrical shape with a horizontal sectional view of a circular shape or a pillar shape with a horizontal sectional view of a rectangular shape.
- [7] In some embodiments, the plurality of UV LEDs may be disposed on at least one surface of the case and may emit UV rays having a wave length of about 250 nanometers to about 280 nanometers.
- [8] In some embodiments, the sterilization apparatus may further include an adsorption plate or a magnetic plate attached to a bottom surface of the prop. The adsorption plate

may include a rubber material.

- [9] In some embodiments, the prop may include a power button for turning on or off the sterilization apparatus, an illumination sensor disposed at one side of the power button to sense brightness of light, and a timer for controlling a time that the UV rays are emitted from the UV LEDs.
- [10] In some embodiments, the sterilization apparatus may further include a supporter attached to a bottom surface of the case to connect the case to the prop. The supporter may support the case and may be rotatable together with the case. The supporter may be rotatable within a range of 10 degrees to 360 degrees.
- [11] In some embodiments, the sterilization apparatus may further include a plurality of reflection hats surrounding respective ones of the UV LEDs.
- [12] In some embodiments, a diameter of each of the reflection hats may increase toward a direction that the UV rays emitted from each of the UV LEDs travel.
- [13] In some embodiments, the case may have a plurality of sidewalls and the case may further include reflection plates outwardly extending from edges of the plurality of sidewalls.
- [14] In some embodiments, the reflection plates may extend from edges that the plurality of sidewalls of the case contact each other or from all edges of the plurality of sidewalls of the case.
- [15] In some embodiments, each of the reflection plates may further include an uneven surface causing an irregular reflection of the UV rays.
- [16] According to further embodiments, a sterilization apparatus includes a case having a bellows-type structure including first reflection plates and second reflection plates which are alternately stacked. The first reflection plates have a negative sloped profile and the second reflection plates have a positive sloped profile. A plurality of first ultraviolet light emitting diodes (UV LEDs) are disposed on the first reflection plates and a plurality of second UV LEDs are disposed on the second reflection plates. The plurality of first UV LEDs and the plurality of second UV LEDs emit UV rays. The case is mounted on a prop.
- [17] In some embodiments, the plurality of first and second UV LEDs on the first and second reflection plates adjacent to each other may be disposed to face each other.
- [18] In some embodiments, each of the first and second reflection plates may have an uneven surface causing an irregular reflection of the UV rays.
- [19] According to further embodiments, a sterilization apparatus includes a lamp body including a screw-shaped plug having a connection terminal. An ultraviolet light emitting diode (UV LED) illumination portion is combined with the lamp body. The UV LED illumination portion includes a case and a plurality of UV LEDs disposed on a surface of the case. An optical lens portion is combined with the lamp body to cover

the UV LED illumination portion.

[20] In some embodiments, the lamp body may have a reflection hat shape, and the case may include a cylinder-shaped sidewall and a lower end portion attached to a lower end of the cylinder-shaped sidewall.

[21] According to further embodiments, a sterilization apparatus includes a case and a plurality of ultraviolet light emitting diodes (UV LEDs). The case has a front surface, sidewall surfaces and a top surface. The case includes a plurality of openings disposed at the front surface, the sidewall surfaces and the top surface. The plurality of UV LEDs are disposed in the case and are exposed by the plurality of openings of the case.

[22] According to further embodiments, a sterilization apparatus includes a case, a plurality of openings, and a plurality of ultraviolet light emitting diodes (UV LEDs). The case has a top surface and a bottom surface. The top surface includes a flat top surface and a pair of top mesa sidewall surfaces extending from both edges of the flat top surface to have downwardly inclined profiles, and the bottom surface includes a flat bottom surface and a pair of bottom mesa sidewall surfaces extending from both edges of the flat bottom surface to have upwardly inclined profiles. The plurality of openings are disposed at a front surface and sidewall surfaces of the case. The plurality of UV LEDs are disposed in the case and are exposed by the plurality of openings of the case.

Advantageous Effects of Invention

[23] According to the present disclosure, sterilization apparatuses using UV LEDs are not fixed to specific places but movable to freely sterilize without any spatial limitations.

[24] For example, the sterilization apparatuses according to the embodiments may be rotatable to perform sterilization processes even in blind spots or dead zones.

Brief Description of Drawings

[25] The accompanying drawings, together with the specification, illustrate some exemplary embodiments of the present invention, and, together with the description, serve to explain principles and aspects of the present invention.

[26] FIGS. 1 and 2 illustrate a perspective view and a front view of a sterilization apparatus according to some embodiments of the present disclosure, respectively.

[27] FIG. 3 illustrates a front view of a sterilization apparatus according to some embodiments of the present disclosure.

[28] FIGS. 4 and 5 illustrate perspective views of sterilization apparatuses according to some embodiments of the present disclosure.

[29] FIGS. 6A and 6B illustrate a reflection plate portion of the sterilization apparatuses shown in FIGS. 4 and 5.

[30] FIG. 7 illustrates a front view of a sterilization apparatus according to some em-

bodiments of the present disclosure.

- [31] FIG. 8 illustrates an example of a reflection plate of the sterilization apparatus shown in FIG. 7.
- [32] FIG. 9 illustrates a sterilization apparatus according to some embodiments of the present disclosure.
- [33] FIGS. 10A and 10B illustrate a sterilization apparatus according to some embodiments of the present disclosure.
- [34] FIGS. 11 and 12 illustrate a sterilization apparatus according to some embodiments of the present disclosure.
- [35] FIGS. 13 and 14 illustrate sterilization apparatuses according to some embodiments of the present disclosure.
- [36] FIGS. 15A and 15B illustrate sterilization apparatuses according to some embodiments of the present disclosure.
- [37] FIG. 16 illustrates a sterilization apparatus according to some embodiments of the present disclosure.
- [38] FIG. 17 illustrates a plurality of sterilization apparatuses combined with each other according to some embodiments of the present disclosure.
- [39] FIG. 18A illustrates a plurality of sterilization apparatuses combined with each other according to a modified embodiment of the present disclosure.
- [40] FIG. 18B illustrates a plurality of sterilization apparatuses combined with each other according to another modified embodiment of the present disclosure.

Mode for the Invention

- [41] Korean Patent Application Nos. 10-2013-0089163 and 10-2013-0106338, filed on July 26, 2013 and September 4, 2013, respectively, are incorporated herein by reference in their entirety.
- [42] Exemplary embodiments of the present disclosure will be described more fully hereinafter with reference to the accompanying drawings. In the drawings, the sizes and the shapes of elements (e.g., layers and regions) are exaggerated for clarity. It will be understood that when an element is referred to as being on, above, below, or under another element, it can be directly on, above, below, or under the other element, respectively, or intervening elements may also be present.
- [43] Like reference numerals refer to like elements throughout the specification and the drawings. As used herein, the singular terms "a," "an" and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms "comprise," "comprising," "includes," "including," "have," "having" and variants thereof specify the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence and/

or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof.

[44] FIG. 1 is a perspective view illustrating a sterilization apparatus 100 according to some embodiments of the present disclosure, and FIG. 2 is a front view of the sterilization apparatus 100 shown in FIG. 1.

[45] Referring to FIGS. 1 and 2, the sterilization apparatus 100 may include a case 110 defining an external appearance of the sterilization apparatus 100, a plurality of ultraviolet light emitting diodes (UV LEDs) 115 attached to and arrayed on an outside surface of the case 110, a prop 125 on which the case 110 is mounted, and a supporter 120 for connecting the case 110 to the prop 125 and for supporting the case 110.

[46] Although FIG. 1 illustrates an example in which the case 110 of the sterilization apparatus 100 has a cylindrical shape with a horizontal sectional view of a circular shape, the inventive concept is not limited thereto. For example, in some embodiments, the case 110 may have a horizontal sectional view of a rectangular shape. As described above, the UV LEDs 115 may be disposed on the outside surface of the case 110. The UV LEDs 115 may be arrayed in at least one column on the outside surface of the case 110. In some embodiments, the UV LEDs 115 may be arrayed in two or more vertical column lines on the outside surface of the case 110. The UV LEDs 115 may emit UV rays having a wavelength of about 200 nanometers to about 400 nanometers. For example, the UV LEDs 115 may emit UV rays having a wavelength of about 250 nanometers to about 280 nanometers.

[47] The case 110 may be mounted on and fixed to the prop 125. The sterilization apparatus 100 may further include an adsorption plate 145 which is attached to a bottom surface of the prop 125 opposite to the case 110 to fix the sterilization apparatus 100 to a certain place. The adsorption plate 145 may include a rubber material. Although not shown in the drawings, the sterilization apparatus 100 may be fixed to a certain place using a magnetic force.

[48] The prop 125 may include a power button 130. The power button 130 is a button for electrically turning on or off the sterilization apparatus 100. The prop 125 may further include an illumination sensor 135 which is disposed at one side of the power button 130. The illumination sensor 135 may sense brightness of light to control an on-off operation of the UV LEDs 115. For example, the illumination sensor 135 may sense brightness of light in shoes, sinks such as kitchen furniture, or clothes closets to prevent users from being exposed to UV rays.

[49] In addition, the prop 125 may further include a timer 140 which is disposed at the other side of the power button 130. The timer 140 may control an on-off operation of the UV LEDs 115 to adjust time that UV rays generated from the UV LEDs 115 are irradiated. The sterilization apparatus 100 may be configured to receive electric power

through a plug 150 for home appliances, a universal serial bus (USB) cable 160, or a cigar jack 170 used in automobiles. Moreover, the sterilization apparatus 100 may be configured to receive the electric power from a rechargeable battery (not shown). Accordingly, the sterilization apparatus 100 may be used in houses as well as automobiles. In addition, if the sterilization apparatus 100 is configured to receive the electric power from a rechargeable battery, the sterilization apparatus 100 may be used as a portable sterilization apparatus to perform a sterilizing action without limitation of places.

[50] The case 110 may be connected to the prop 125 through the supporter 120 attached and fixed to a bottom surface of the case 110. The supporter 120 may have a pillar shape to support the case 110. The supporter 120 may be configured to rotate. For example, the supporter 120 may rotate together with the case 110 within a range of 10 degrees to 360 degrees. If the supporter 120 rotates 360 degrees, the case 110 may also rotate 360 degrees. In such a case, the UV rays generated from the UV LEDs 115 may be irradiated in all directions. If the supporter 120 does not rotate, the UV rays generated from the UV LEDs 115 may be irradiated only in specific directions to create dead zones in which a sterilization action is insufficiently occurred. However, the supporter 120 fixed to the case 110 may be configured to rotate, as described above. Thus, the sterilization apparatus 100 according to the embodiment may sufficiently perform a sterilization action without any dead zones in a limited space. The sterilization apparatus 100 may further include a link 180 disposed on a top portion thereof. Accordingly, the sterilization apparatus 100 may be suspended in a space defined by clothes closets or shoe racks using the link 180, thereby sterilizing an inside space of the clothes closets or the shoe racks. UV LEDs of the present disclosure are not fixed to specific places such as an inside wall of a refrigerator or an inside wall of a closet but movable to freely sterilize without any spatial limitations.

[51] FIG. 3 illustrates a front view of a sterilization apparatus 200 according to some embodiments of the present disclosure.

[52] Referring to FIG. 3, the sterilization apparatus 200 may include a case 210 defining an external appearance of the sterilization apparatus 200, a plurality of UV LEDs 215 arrayed on an outside surface of the case 210, a prop 225 on which the case 210 is mounted, and a supporter 220 for connecting the case 210 to the prop 225 and for supporting the case 210.

[53] The case 210 of the sterilization apparatus 200 may have a cylindrical shape with a horizontal sectional view of a circular shape, but not limited thereto. For example, in some embodiments, the case 210 may have a horizontal sectional view of a rectangular shape. The UV LEDs 215 may be arrayed in at least one column on the outside surface of the case 210. In some embodiments, the UV LEDs 215 may be arrayed in two or

more vertical column lines on the outside surface of the case 210. The UV LEDs 215 may emit UV rays having a wavelength of about 200 nanometers to about 400 nanometers. For example, the UV LEDs 215 may emit UV rays having a wavelength of about 250 nanometers to about 280 nanometers.

[54] The sterilization apparatus 200 may further include a plurality of reflection hats 240. The reflection hats 240 may be disposed to surround respective ones of the UV LEDs 215, and each of the UV LEDs 215 may have a funnel shape. That is, a diameter of each of the reflection hats 240 may increase toward a direction that UV rays generated from each UV LED 215 travel. The reflection hats 240 may be formed of a material which is capable of reflecting the UV rays. For example, the reflection hats 240 may be formed to include an aluminum material. Because each the reflection hats 240 having funnel shapes is disposed to surround each UV LED 215, the UV rays emitted from each UV LED 215 may travel in a specific direction. Thus, each of the reflection hats 240 may concentrate the UV rays emitted from each UV LED 215 on a specific area to increase the intensity of the UV rays. As a result, the reflection hats 240 may improve a sterilization effect of the sterilization apparatus 200. Each of the reflection hats 240 may be fabricated to have an opening angle 1 of about 30 degrees to about 45 degrees. Accordingly, even though the number of the UV LEDs 215 is less than the number of the UV LEDs 115 of the sterilization apparatus 100, a sterilization efficiency of the sterilization apparatus 200 including the reflection hats 240 may be equal to or greater than that of the sterilization apparatus 100 without the reflection hats 240.

[55] The case 210 may be mounted on and fixed to the prop 225. The sterilization apparatus 200 may further include an adsorption plate 245 which is attached to a bottom surface of the prop 225 opposite to the case 210 to fix the sterilization apparatus 200 to a certain place. The adsorption plate 245 may include a rubber material. Although not shown in the drawings, the sterilization apparatus 200 may be fixed to a certain place using a magnetic force.

[56] The prop 225 may include a power button 230. The power button 230 is a button for electrically turning on or off the sterilization apparatus 200. The prop 225 may further include an illumination sensor 235 which is disposed at one side of the power button 230. The illumination sensor 235 may sense brightness of light to control an on-off operation of the UV LEDs 215. In addition, the prop 225 may further include a timer 240 which is disposed at the other side of the power button 230. The timer 240 may control an on-off operation of the UV LEDs 215 to adjust time that UV rays generated from the UV LEDs 215 are irradiated. Although not shown in FIG. 3, the sterilization apparatus 200 may also be configured to receive electric power through a plug for home appliances, a USB cable, a cigar jack, or a rechargeable battery, as described

with reference to FIG. 2.

- [57] The case 210 may be connected to the prop 225 through the supporter 220 attached and fixed to a bottom surface of the case 210. The supporter 220 may have a pillar shape to support the case 210. The supporter 220 may be configured to rotate. For example, the supporter 220 may rotate together with the case 210 within a range of 10 degrees to 360 degrees.
- [58] FIGS. 4 and 5 illustrate perspective views of sterilization apparatuses 300 and 400 according to some embodiments of the present disclosure, respectively.
- [59] Referring to FIGS. 4 and 5, the sterilization apparatus 300 (or 400) may include a case 310 (or 410) defining an external appearance of the sterilization apparatus 300 (or 400), a plurality of UV LEDs 315 (or 415) arrayed on outer sidewall surfaces of the case 310 (or 410), a prop 325 (or 425) on which the case 310 (or 410) is mounted, and a supporter 320 (or 420) for connecting the case 310 (or 410) to the prop 325 (or 425) and for supporting the case 310 (or 410).
- [60] Although FIGS. 4 and 5 illustrate examples in which each of the cases 310 and 410 is a square pillar having four sidewalls, the inventive concept is not limited thereto. For example, in some embodiments, the case 310 (or 410) may be a cylindrical pillar having a horizontal sectional view of a circular shape. Two or more UV LEDs 315 (or 415) may be arrayed in at least one vertical column on each of four outer sidewall surfaces of the case 310 (or 410). At one of the UV LEDs 315 (or 415) may also be disposed on a top surface of the case 310 (or 410). In some embodiments, the UV LEDs 315 (or 415) may be disposed on one outer sidewall surface of the case 310 (or 410), two opposing outer sidewall surfaces of the case 310 (or 410), or all of the four outer sidewall surfaces of the case 310 (or 410). The UV LEDs 315 (or 415) may emit UV rays having a wavelength of about 200 nanometers to about 400 nanometers. For example, the UV LEDs 315 (or 415) may emit UV rays having a wavelength of about 250 nanometers to about 280 nanometers.
- [61] The case 310 (or 410) may include reflection plates 340 (or 440) outwardly extending from four edges that the four sidewalls thereof contact each other. The reflection plates 340 (or 440) may extend from the edges of the sidewalls at a predetermined angle θ , for example, at an angle of 135 degrees to the sidewalls of the case 310 (or 410). The reflection plates 340 may be disposed to extend from only the four edges between the four sidewalls of the case 310, as illustrated in FIG. 4. Alternatively, the reflection plates 440 may be disposed to extend from all of eight edges that the four sidewalls and the top surface of the case 410 contact each other, as illustrated in FIG. 5. If an intensity or a density of the UV rays irradiated on a unit area increases, a sterilization time may be reduced even without degradation of the sterilization effect. According to the sterilization apparatus 300 (or 400) having the aforementioned con-

figuration, the reflection plates 340 (or 440) may reflect the UV rays emitted from the UV LEDs 315 (or 415) to concentrate the UV rays on specific areas. As a result, the reflection plates 440 may increase the intensity of the UV rays to improve the sterilization effect of the sterilization apparatus 300 (or 400) even though an operation time of the sterilization apparatus 300 (or 400) is reduced. The reflection plates 340 (or 440) may be formed of a material which is capable of reflecting the UV rays. For example, the reflection plates 340 (or 440) may be formed to include an aluminum material.

- [62] In some embodiments, each of the reflection plates 340 (or 440) may be configured to include an uneven surface 345 causing an irregular reflection of the UV rays, as shown in a perspective view of FIG. 6A and a horizontal cross-sectional view of FIG. 6B. The uneven surface 345 of each of the reflection plates 340 (or 440) may irregularly reflect the UV rays emitted from the UV LED 315 (or 415) to spread the UV rays. That is, the reflection plates 340 (or 440) including the uneven surfaces 345 may increase an area of a region on which the reflected UV rays are irradiated. As a result, the reflection plates 340 (or 440) including the uneven surfaces 345 may increase a sterilization area of the sterilization apparatus 300 (or 400).
- [63] The case 310 (or 410) may be mounted on and fixed to the prop 325 (or 425). The sterilization apparatus 300 (or 400) may further include an adsorption plate 345 (or 445) which is attached to a bottom surface of the prop 325 (or 425) opposite to the case 310 (or 410) to fix the sterilization apparatus 300 (or 400) to a certain place. The adsorption plate 345 (or 445) may include a rubber material. Although not shown in the drawings, the sterilization apparatus 300 (or 400) may be fixed to a certain place using a magnetic force. The prop 325 (or 425) may include a power button 330 (or 430). The power button 330 (or 430) is a button for electrically turning on or off the sterilization apparatus 300 (or 400). The prop 325 (or 425) may further include an illumination sensor 335 (or 435) which is disposed at one side of the power button 330 (or 430). The illumination sensor 335 (or 435) may sense brightness of light to control an on-off operation of the UV LEDs 315 (or 415). In addition, the prop 325 (or 425) may further include a timer 337 (or 437) which is disposed at the other side of the power button 330 (or 430). The timer 337 (or 437) may control an on-off operation of the UV LEDs 315 (or 415) to adjust time that UV rays generated from the UV LEDs 315 (or 415) are irradiated. Although not shown in FIGS. 4 and 5, the sterilization apparatus 300 (or 400) may also be configured to receive electric power through a plug for home appliances, a USB cable, a cigar jack, or a rechargeable battery, as described with reference to FIG. 2.
- [64] The case 310 (or 410) may be connected to the prop 325 (or 425) through the supporter 320 (or 420) attached and fixed to a bottom surface of the case 310 (or 410).

The supporter 320 (or 420) may have a pillar shape to support the case 310 (or 410). The supporter 320 (or 420) may be configured to rotate. For example, the supporter 320 (or 420) may rotate together with the case 310 (or 410) within a range of 10 degrees to 360 degrees.

[65] FIG. 7 illustrates a front view of a sterilization apparatus 500 according to some embodiments of the present disclosure, and FIG. 8 illustrates an example of a reflection plate of the sterilization apparatus 500 shown in FIG. 7.

[66] Referring to FIG. 7, the sterilization apparatus 500 may include a case 510 defining an external appearance of the sterilization apparatus 500, a plurality of UV LEDs 515 arrayed on outside surfaces of the case 510, a prop 525 on which the case 510 is mounted, and a supporter 520 for connecting the case 510 to the prop 525 and for supporting the case 510.

[67] The case 510 may have a bellows-type structure including a first reflection plate 511 and a second reflection plate 512 which are alternately stacked. The first reflection plate 511 may correspond to a first partition 513 and the second reflection plate 512 may correspond to a second partition 514. That is, the first partition 513 may have a negative sloped profile and the second partition 514 may have a positive sloped profile. At least one among the UV LEDs 515 may be disposed on each first partition 513 and at least one among the UV LEDs 515 may be disposed on each second partition 513. The UV LEDs 515 may emit UV rays having a wave length of about 200 nanometer to about 400 nanometers. In some embodiments, the UV LEDs 515 may emit UV rays having a wavelength corresponding to a UV-C range, for example, a wave length of about 250 nanometer to about 280 nanometers. The first reflection plate 511 and the second reflection plate 512 may be combined with each other at a predetermined angle 3. The first and second reflection plates 511 and 512 may be formed of a material which is capable of reflecting the UV rays. For example, the first and second reflection plates 511 and 512 may be formed to include an aluminum material.

[68] The UV LEDs 515 may include first UV LEDs 515a disposed on the first partitions 513 having a negative sloped profile and second UV LEDs 515b disposed on the second partitions 514 having a positive sloped profile. Thus, the first UV LEDs 515a disposed on the first partitions 513 may face the second UV LEDs 515b disposed on the second partitions 514. The UV rays reflected from surfaces of the first and second partitions 513 and 514 may travel along arrows illustrated in FIG. 7.

[69] A portion of the UV rays emitted from the first UV LEDs 515a may be directly irradiated onto objects (not shown) to be sterilized and the remaining portion of the UV rays emitted from the first UV LEDs 515a may be reflected from the surfaces of the second partitions 514 to travel toward the objects to be sterilized. Similarly, a portion of the UV rays emitted from the second UV LEDs 515b may be directly irradiated onto

the objects to be sterilized and the remaining portion of the UV rays emitted from the second UV LEDs 515b may be reflected from the surfaces of the first partitions 513 to travel toward the objects to be sterilized. In FIG. 7, light paths L2 and L4 may denote paths of the UV rays reflected from the surfaces of the second and first partitions 514 and 513, respectively. Thus, the light paths L2 and L4 may occur constructive interference with light paths L1 and L2 corresponding to paths of the UV rays that are directly irradiated from the first and second UV LEDs 515a and 515b onto the objects to be sterilized. In such a case, a total intensity of the UV rays irradiated onto the object to be sterilized may increase to improve the sterilization effect even though an operation time of the sterilization apparatus 500 is reduced.

[70] In some embodiments, each of the first and second reflection plates 511 and 512 may be configured to include an uneven surface 545 causing an irregular reflection of the UV rays, as illustrated in FIG. 8. The uneven surface 545 may irregularly reflect the UV rays emitted from the UV LEDs 515 to spread the UV rays. That is, the first and second reflection plates 511 and 512 including the uneven surfaces 545 may increase an area of a region on which the reflected UV rays are irradiated. As a result, the first and second reflection plates 511 and 512 including the uneven surfaces 545 may increase a sterilization area of the sterilization apparatus 500.

[71] The case 510 may be mounted on and fixed to the prop 525. The sterilization apparatus 500 may further include an adsorption plate (not shown) which is attached to a bottom surface of the prop 525 opposite to the case 510 to fix the sterilization apparatus 500 to a certain place. The adsorption plate may include a rubber material. Although not shown in the drawings, the sterilization apparatus 500 may be fixed to a certain place using a magnetic force instead of the adsorption plate.

[72] The prop 525 may include a power button 530. The power button 530 is a button for electrically turning on or off the sterilization apparatus 500. The prop 525 may further include an illumination sensor 535 which is disposed at one side of the power button 530. The illumination sensor 535 may sense brightness of light to control an on-off operation of the UV LEDs 515. In addition, the prop 525 may further include a timer 540 which is disposed at the other side of the power button 530. The timer 540 may control an on-off operation of the UV LEDs 515 to adjust time that UV rays generated from the UV LEDs 515 are irradiated. Although not shown in FIGS. 7 and 8, the sterilization apparatus 500 may also be configured to receive electric power through a plug for home appliances, a USB cable, a cigar jack, or a rechargeable battery, as described with reference to FIG. 2.

[73] The case 510 may be connected to the prop 525 through the supporter 520 attached and fixed to a bottom surface of the case 510. The supporter 520 may have a pillar shape to support the case 510. The supporter 520 may also be configured to rotate. For

example, the supporter 520 may rotate together with the case 510 within a range of 10 degrees to 360 degrees.

[74] FIG. 9 illustrates a sterilization apparatus 600 according to some embodiments of the present disclosure.

[75] Referring to FIG. 9, the sterilization apparatus 600 may include a lamp body 620, UV LED illumination portion 617, and an optical lens portion 630. The lamp body 620 may include a screw-shaped plug 625 having a connection terminal 627 disposed on a top surface thereof. The lamp body 620 may be configured to have a reflection hat shape for diffusion of UV rays emitted from the UV LED illumination portion 617. The UV LED illumination portion 617 may be combined with the lamp body 620. The UV LED illumination portion 617 may include a case 613 and a plurality of UV LEDs 615 arrayed on outside surfaces of the case 613.

[76] The case 613 may be configured to include a cylinder-shaped sidewall 611 and a lower end portion 612 attached to a lower end of the cylinder-shaped sidewall 611. At least one among the UV LEDs 615 may be disposed on each of the cylinder-shaped sidewall 611 and the lower end portion 612. Although the present embodiment illustrates an example in which the case 613 includes the cylinder-shaped sidewall 611, the inventive concept is not limited thereto. For example, the case 613 may be configured to have any one of various shapes described with reference to FIGS. 1 to 8. The UV LEDs 615 may emit UV rays having a wave length of about 200 nanometer to about 400 nanometers. In some embodiments, the UV LEDs 615 may emit UV rays having a wavelength corresponding to a UV-C range, for example, a wave length of about 250 nanometer to about 280 nanometers.

[77] The optical lens portion 630 may be combined with the lamp body 620 to physically protect the UV LED illumination portion 617. The optical lens portion 630 may be detachable from the lamp body 620 and may be composed of a transparent material to diffuse the UV rays emitted from the UV LED illumination portion 617. As described above, the lamp body 620 is configured to include the screw-shaped plug 625 having the connection terminal 627 disposed on a top surface thereof. Thus, the sterilization apparatus 600 may be inserted into a general socket for electric bulbs. Accordingly, the sterilization apparatus 600 may be used as a sterilizer in houses or office buildings even without installation of any special sockets. As a result, the sterilization apparatus 600 may be realized to include the optical lens portion 630 for diffusing the UV rays and the screw-shaped plug 625 for combining with general sockets to serve as a sterilization lamp.

[78] FIG. 10A and FIG. 10B illustrates a front side of a sterilization apparatus 650 according to some embodiments of the present disclosure, and FIG. 11 illustrates a rear side of the sterilization apparatus 650 shown in FIG. 10A and 10B. FIG. 12 illustrates a

UV irradiation region of the sterilization apparatus 650 shown in FIGS. 10 and 11.

- [79] Referring to FIGS. 10A, 10B and 11, the sterilization apparatus 650 may include a case 660 defining an external appearance of the sterilization apparatus 650 and having a plurality of openings 665, a plurality of UV LEDs 670 exposed by the openings 665, and a pair of props 690 on which the case 660 is mounted.
- [80] The case 660 may be a polyhedron, for example, a hexahedron. If the case 660 is a hexahedron, the openings 665 may be disposed at a front surface A, two opposing sidewall surfaces C, and a top surface B of the case 660. Each of the openings 665 may have a rectangular shape or a circular shape. Although FIG. 10A and FIG. 10B illustrate an example in which three openings of the openings 665 are disposed at three points of the front surface A to correspond to three vertices of a triangle, the inventive concept is not limited thereto. For example, four or more openings of the openings 665 may be disposed at the front surface A. The openings 665 disposed at the sidewall surfaces C and the top surface B may be arrayed in a single line.
- [81] A storage portion 680 for accommodating batteries may be disposed at a rear surface D of the case 660, as illustrated in FIG. 11. The storage portion 680 may provide a space in which batteries 685 such as primary batteries or secondary batteries are loaded. The storage portion 680 may be sealed with a cover 683.
- [82] The UV LEDs 670 disposed in the case 660 may be exposed by the openings 665. The UV LEDs 670 may emit UV rays having a wave length of about 200 nanometer to about 400 nanometers. In some embodiments, the UV LEDs 670 may emit UV rays having a wavelength corresponding to a UV-C range, for example, a wave length of about 250 nanometer to about 280 nanometers.
- [83] The pair of props 690 may be provided to stand and fix the case 660. Each of the pair of props 690 may have a groove 695 in which a portion of the case 660 is inserted. Accordingly, the case 660 may be combined with the pair of props 690 to stably install on a certain place if the case 660 is inserted into the grooves 695 of the props 690, as illustrated in FIG 10B.
- [84] Referring to FIG. 12, each of the UV LEDs 670 may emit UV rays at a spread angle which is equal to or greater than 90 degrees, for example, a spread angle of about 100 degrees to about 135 degrees. Thus, two or more UV LEDs 670 may be disposed at each of the front surface A, the top surface B and the two sidewall surfaces C of the case 660 to minimize an area of dead zones between irradiation regions of the UV rays which are emitted from the UV LEDs 670 through the openings 665 of the front surface A of the case 660. In such a case, the irradiation regions U1, U2 and U3 of the UV rays emitted from the UV LEDs 670 through the openings 665 of the front surface A of the case 660 may partially overlap with each other to provide an overlapping irradiation region U4. Accordingly, the intensity of the UV rays irradiated on the

overlapping irradiation region U4 may increase. The distribution of the irradiation regions of the UV rays may vary according to the number of the openings 665 and the locations of the openings 665.

[85] Meanwhile, if two or more sterilization apparatuses may be combined with each other, an area or a volume of the sterilization region may increase.

[86] FIGS. 13 illustrates a sterilization apparatus 700 according to some embodiments of the present disclosure. FIG. 14 illustrates two sterilization apparatuses to be combined with each other, and FIG. 15 illustrates four sterilization apparatuses combined with each other.

[87] Referring to FIG. 13, the sterilization apparatus 700 may include a case 710 defining an external appearance of the sterilization apparatus 700 and having a plurality of openings 705 and a plurality of UV LEDs 720 exposed by the openings 705.

[88] The case 710 may be a polyhedron, for example, a hexahedron. The case 710 may be designed to have a width and a height which are less than 100 millimeters and a thickness which is less than 32 millimeters. This is for improving a portability of the sterilization apparatus 700. The openings 705 may be disposed at a front surface A, two opposing sidewall surfaces B, a top surface C and a rear surface D of the case 710. Each of the openings 705 may have a rectangular shape or a circular shape. Although FIG. 13 illustrates an example in which three openings of the openings 705 are disposed at three points of the front surface A to correspond to three vertices of a triangle, the inventive concept is not limited thereto. The openings 705 disposed at the sidewall surfaces B and the top surface C may be arrayed in a single line. A clamping protrusion 730 may be disposed at each of edges that the top surface C, the front surface A and the rear surface D of the case 710 contact each other. In addition, a clamping groove 740 may be disposed at each of edges that a bottom surface, the front surface A and the rear surface D of the case 710 contact each other.

[89] Referring to FIG. 14, a clamping protrusion 730a of a first case 710a of a first sterilization apparatus having substantially the same configuration as the sterilization apparatus 700 may be slid into a clamping groove 740b of a second case 710b of a second sterilization apparatus having substantially the same configuration as the sterilization apparatus 700 in order to combine the first sterilization apparatus with the second sterilization apparatus. A unified sterilization apparatus including the first and second sterilization apparatuses combined with each other by sliding the clamping protrusion 730a into the clamping groove 740b may sterilize without any limitations of a volume or an area of a place which is sterilized. For example, in some embodiments, a plurality of sterilization apparatuses 750a, 750b, 750c and 750d may be vertically combined with each other by sliding the clamping protrusions thereof into the clamping grooves thereof (see FIG. 15A). Alternatively, two sterilization apparatuses

760a and 760b may be vertically disposed and one sterilization apparatus 760c may be horizontally disposed and combined with the sterilization apparatuses 760a and 760b by sliding the clamping protrusions of the sterilization apparatuses 760a and 760b into the clamping grooves of the sterilization apparatus 760c (see FIG. 15B). Therefore, a plurality of sterilization apparatuses including the clamping protrusions 730a and the clamping grooves 740b may be combined with each other to constitute a high performance sterilization apparatus which is appropriate to sterilize a large place.

[90] FIG. 16 illustrates a sterilization apparatus 800 according to some embodiments of the present disclosure. FIG. 17 illustrates two sterilization apparatuses to be combined with each other, and FIGS. 18A and 18B illustrate modified embodiments of the present disclosure.

[91] Referring to FIG. 16, the sterilization apparatus 800 may include a case 810 defining an external appearance of the sterilization apparatus 800 and having a plurality of openings 805 and a plurality of UV LEDs 820 exposed by the openings 805.

[92] The case 810 may be a polyhedron, for example, a hexahedron or an octahedron. The openings 805 may be disposed at a front surface 25 and two opposing sidewall surfaces 30 of the case 810. A top surface 20a of the case 810 may have a mesa-shaped cross-section. That is, the top surface 20a may include a first top surface 10a having a flat profile and a pair of first mesa sidewall surfaces 15a extending from both edges of the first top surface 10a to have downwardly inclined profiles. Similarly, a bottom surface 20b of the case 810 may also have a mesa-shaped cross-section. That is, the bottom surface 20b may include a second top surface 10b having a flat profile and a pair of second mesa sidewall surfaces 15b extending from both edges of the second top surface 10b to have upwardly inclined profiles.

[93] Each of the openings 805 may have a rectangular shape or a circular shape. Although FIG. 16 illustrates an example in which three openings of the openings 805 are disposed at three points of the front surface 25 to correspond to three vertices of a triangle, the inventive concept is not limited thereto. For example, four or more openings of the openings 805 may be disposed at the front surface 25. The openings 805 disposed at the sidewall surfaces 30 may be arrayed in a single line.

[94] The UV LEDs 820 disposed in the case 810 may be exposed by the openings 805. The UV LEDs 820 may emit UV rays having a wave length of about 200 nanometer to about 400 nanometers. In some embodiments, the UV LEDs 820 may emit UV rays having a wavelength corresponding to a UV-C range, for example, a wave length of about 250 nanometer to about 280 nanometers.

[95] A second clamping protrusion 830 may be disposed on each of the first top surface 10a and the pair of first mesa sidewall surfaces 15a in a length direction of the case 810. The second clamping protrusion 830 may include a vertical plate 831 and a

horizontal plate 832 disposed on the vertical plate 831 to have a T-shaped cross-section. A second clamping groove 840 may be disposed on each of the second top surface 10b and the pair of second mesa sidewall surfaces 15b in a length direction of the case 810. The second clamping groove 840 may be designed such that the second clamping protrusion 830 is inserted into the second clamping groove 840.

[96] A plurality of sterilization apparatuses including the second clamping protrusions 830 and the second clamping grooves 840 may be combined with each other to minimize an area of dead zones between irradiation regions of the UV rays which are emitted from the UV LEDs 820 and to improve a sterilization effect. Specifically, referring to FIG. 17, a second clamping protrusion 830a of a first case 810a of a first sterilization apparatus having substantially the same configuration as the sterilization apparatus 800 may be slid into a second clamping groove 840b of a second case 810b of a second sterilization apparatus having substantially the same configuration as the sterilization apparatus 800 in order to combine the first sterilization apparatus with the second sterilization apparatus. In such a case, a distribution of the irradiation regions of the UV rays emitted from the UV LEDs of the combined sterilization apparatus may be different according to locations of the second clamping protrusion 830a and the second clamping groove 840b which are combined with each other. Thus, if the locations of the second clamping protrusion 830a and the second clamping groove 840b combined with each other are appropriately selected, an area of dead zones between irradiation regions of the UV rays emitted from the UV LEDs in the first and second cases 810a and 810b can be minimized to improve a sterilization effect.

[97] In some embodiments, as illustrated in 18B, if a first clamping groove 940a on a first top surface 10a of a first sterilization apparatus 900a is combined with a second clamping protrusion 930b on a second top surface 10b of a second sterilization apparatus 900b, the first and second sterilization apparatuses 900a and 900b may be arrayed in a single line. Thus, main UV rays V1 and V2 emitted from UV LEDs in the first and second sterilization apparatuses 900a and 900b may travel in a first direction perpendicular to a front surface 25a and a second direction perpendicular to a rear surface 25b.

[98] In some embodiments, as illustrated in 18A, a clamping groove 940c on a third mesa sidewall surface 15c of a third sterilization apparatus 900c is combined with a clamping protrusion 930d on a fourth top surface 10d of a fourth sterilization apparatus 900d. In such a case, third UV rays V3 emitted from a front surface 25a of the third sterilization apparatus 900c may travel in a first direction perpendicular to the front surface 25a of the third sterilization apparatus 900c and fifth UV rays V5 emitted from a front surface 25a of the fourth sterilization apparatus 900d may travel in a second direction crossing the third UV rays V3. Accordingly, the third UV rays V3 and the

fifth UV rays V5 may overlap with each other to increase a density of total UV rays. As a result, a sterilization efficiency on the front surfaces 25a of the third and fourth sterilization apparatuses 900c and 900d may be improved. Meanwhile, fourth UV rays V4 emitted from a rear surface 25b of the third sterilization apparatus 900c may travel in a third direction perpendicular to the rear surface 25b of the third sterilization apparatus 900c and sixth UV rays V6 emitted from a rear surface 25b of the fourth sterilization apparatus 900d may travel in a fourth direction perpendicular to the rear surface 25b of the fourth sterilization apparatus 900d. Accordingly, the fourth UV rays V4 and the sixth UV rays V6 may be scattered to increase a total area of irradiation regions of the fourth and sixth UV rays V4 and V6. As a result, an area of the sterilization region on the rear surfaces 25b of the third and fourth sterilization apparatuses 900c and 900d may be increased.

- [99] Although the embodiments of FIGS. 18A and 18B illustrate examples in which a plurality of sterilization apparatuses are combined with each other to be arrayed in a straight line or in a bent line when viewed from a plan view, it will be apparent to those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the inventive concept.

Claims

- [Claim 1] A sterilization apparatus comprising:
a case configured to have a sidewall surface and a top surface;
a plurality of ultraviolet light emitting diodes (UV LEDs) disposed on an outer surface of the case to generate UV rays; and
a prop on which the case is mounted.
- [Claim 2] The sterilization apparatus of claim 1, wherein the case has a cylindrical shape with a horizontal sectional view of a circular shape or a pillar shape with a horizontal sectional view of a rectangular shape.
- [Claim 3] The sterilization apparatus of claim 1, wherein the plurality of UV LEDs are disposed on at least one surface of the case.
- [Claim 4] The sterilization apparatus of claim 1, wherein the plurality of UV LEDs emit UV rays having a wave length of about 250 nanometers to about 280 nanometers.
- [Claim 5] The sterilization apparatus of claim 1, further comprising an adsorption plate or a magnetic plate attached to a bottom surface of the prop, wherein the adsorption plate includes a rubber material.
- [Claim 6] The sterilization apparatus of claim 1, wherein the prop includes:
a power button for turning on or off the sterilization apparatus;
an illumination sensor disposed at one side of the power button to sense brightness of light; and
a timer for controlling a time that the UV rays are emitted from the UV LEDs.
- [Claim 7] The sterilization apparatus of claim 1, further comprising a supporter attached to a bottom surface of the case to connect the case to the prop, wherein the supporter supports the case and is rotatable together with the case.
- [Claim 8] The sterilization apparatus of claim 7, wherein the supporter is rotatable within a range of 10 degrees to 360 degrees.
- [Claim 9] The sterilization apparatus of claim 1, further comprising a plurality of reflection hats surrounding respective ones of the UV LEDs.
- [Claim 10] The sterilization apparatus of claim 9, wherein a diameter of each of the reflection hats increases toward a direction that the UV rays emitted from each of the UV LEDs travel.
- [Claim 11] The sterilization apparatus of claim 1,
wherein the case has a plurality of sidewalls; and
wherein the case further includes reflection plates outwardly extending

- from edges of the plurality of sidewalls.
- [Claim 12] The sterilization apparatus of claim 11, wherein the reflection plates extend from edges that the plurality of sidewalls of the case contact each other or from all edges of the plurality of sidewalls of the case.
- [Claim 13] The sterilization apparatus of claim 11, wherein each of the reflection plates further includes an uneven surface causing an irregular reflection of the UV rays.
- [Claim 14] A sterilization apparatus comprising:
a case having a bellows-type structure including first reflection plates and second reflection plates which are alternately stacked, the first reflection plates having a negative sloped profile and the second reflection plates having a positive sloped profile;
a plurality of ultraviolet light emitting diodes (UV LEDs) including a plurality of first UV LEDs disposed on the first reflection plates and a plurality of second UV LEDs disposed on the second reflection plates, the plurality of UV LEDs emitting UV rays; and
a prop on which the case is mounted.
- [Claim 15] The sterilization apparatus of claim 14, wherein the plurality of first and second UV LEDs on the first and second reflection plates adjacent to each other are disposed to face each other.
- [Claim 16] The sterilization apparatus of claim 14, wherein each of the first and second reflection plates has an uneven surface causing an irregular reflection of the UV rays.
- [Claim 17] The sterilization apparatus of claim 14, wherein the prop includes:
a power button for turning on or off the sterilization apparatus;
an illumination sensor disposed at one side of the power button to sense brightness of light; and
a timer for controlling a time that the UV rays are emitted from the UV LEDs.
- [Claim 18] The sterilization apparatus of claim 14, further comprising a supporter attached to a bottom surface of the case to connect the case to the prop, wherein the supporter supports the case and is rotatable together with the case.
- [Claim 19] The sterilization apparatus of claim 18, wherein the supporter is rotatable within a range of 10 degrees to 360 degrees.
- [Claim 20] A sterilization apparatus comprising:
a lamp body including a screw-shaped plug having a connection terminal;

an ultraviolet light emitting diode (UV LED) illumination portion combined with the lamp body, the UV LED illumination portion including a case and a plurality of UV LEDs disposed on a surface of the case; and

an optical lens portion combined with the lamp body to cover the UV LED illumination portion.

[Claim 21] The sterilization apparatus of claim 20, wherein the lamp body has a reflection hat shape.

[Claim 22] The sterilization apparatus of claim 20, wherein the case includes a cylinder-shaped sidewall and a lower end portion attached to a lower end of the cylinder-shaped sidewall.

[Claim 23] A sterilization apparatus comprising:
a case having a front surface, sidewall surfaces and a top surface, the case including a plurality of openings disposed at the front surface, the sidewall surfaces and the top surface; and
a plurality of ultraviolet light emitting diodes (UV LEDs) disposed in the case and exposed by the plurality of openings of the case.

[Claim 24] The sterilization apparatus of claim 23,
wherein the openings disposed at the front surface are located adjacent to edges of the front surface; and
wherein the openings disposed at the sidewall surfaces and the top surface are arrayed in a single line.

[Claim 25] The sterilization apparatus of claim 23, wherein the case further includes a pair of clamping protrusions disposed on both edges of the top surface of the case and a pair of clamping grooves disposed on both edges of a bottom surface of the case.

[Claim 26] A sterilization apparatus comprising:
a case having a top surface and a bottom surface, the top surface including a flat top surface and a pair of top mesa sidewall surfaces extending from both edges of the flat top surface to have downwardly inclined profiles and the bottom surface including a flat bottom surface and a pair of bottom mesa sidewall surfaces extending from both edges of the flat bottom surface to have upwardly inclined profiles;
a plurality of openings disposed at a front surface and sidewall surfaces of the case; and
a plurality of ultraviolet light emitting diodes (UV LEDs) disposed in the case and exposed by the plurality of openings of the case.

[Claim 27] The sterilization apparatus of claim 26, wherein the case further

includes

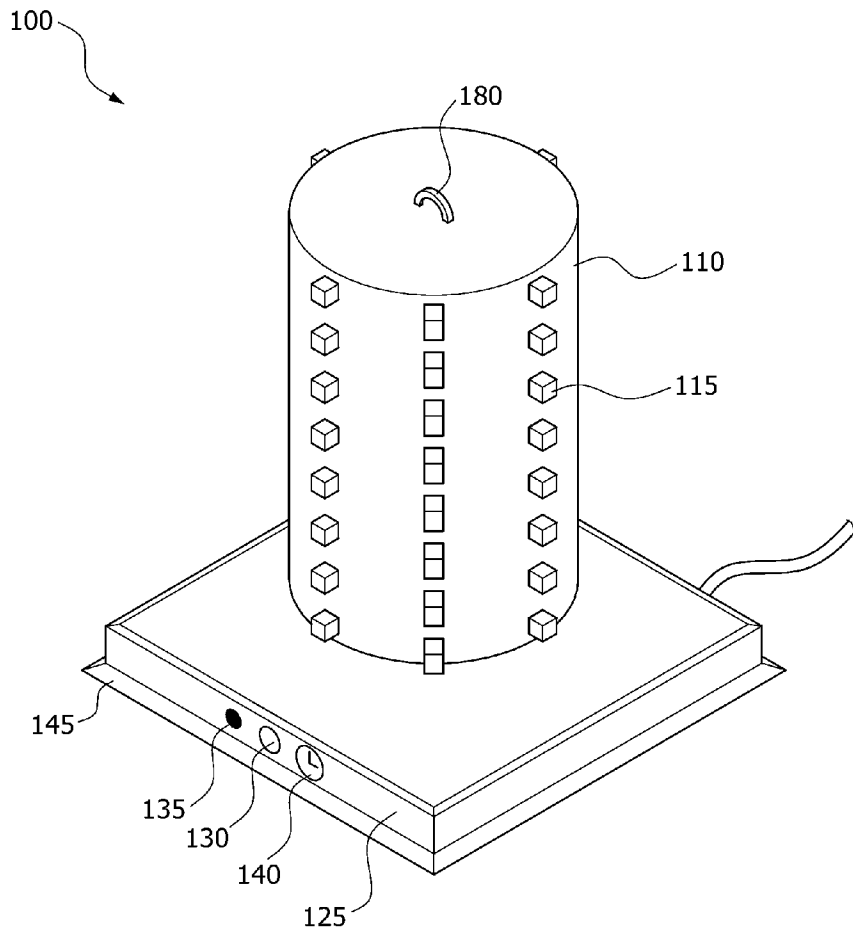
a plurality of clamping protrusions disposed on respective ones of the flat top surface and the pair of top mesa sidewall surfaces in a length direction of the case; and

a plurality of clamping grooves disposed on respective ones of the flat bottom surface and the pair of bottom mesa sidewall surfaces in a length direction of the case.

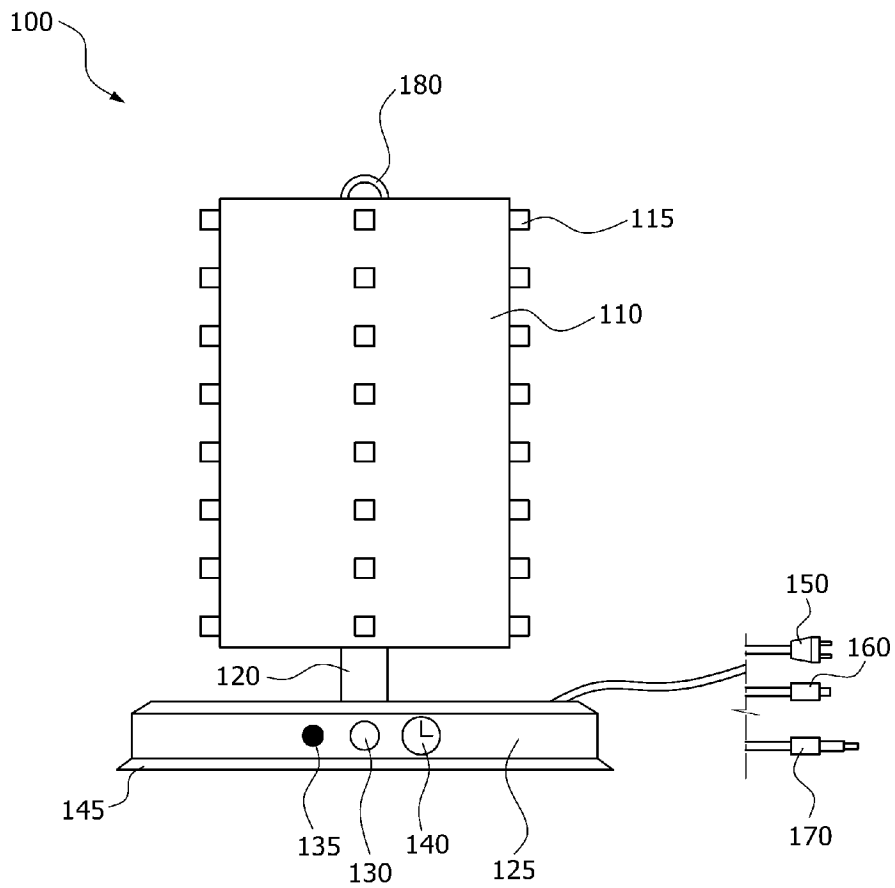
[Claim 28] The sterilization apparatus of claim 27, wherein each of the plurality of clamping protrusions includes a vertical plate and a horizontal plate disposed on the vertical plate to have a T-shaped cross-section.

[Claim 29] The sterilization apparatus of claim 27, wherein the UV LEDs emits UV rays having a wavelength of about 250 nanometers to about 280 nanometers.

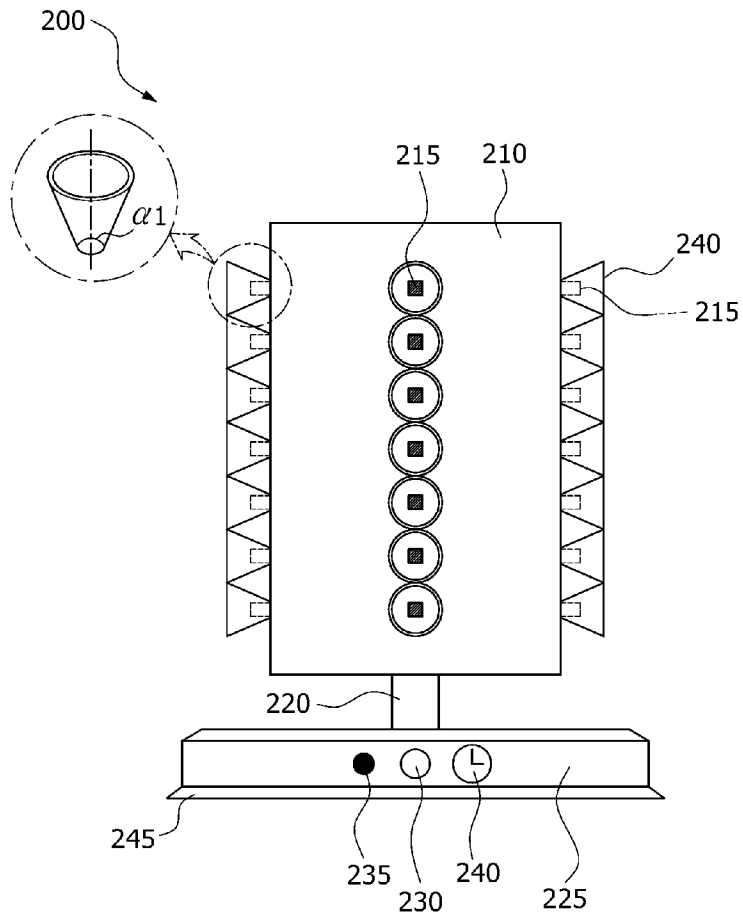
[Fig. 1]



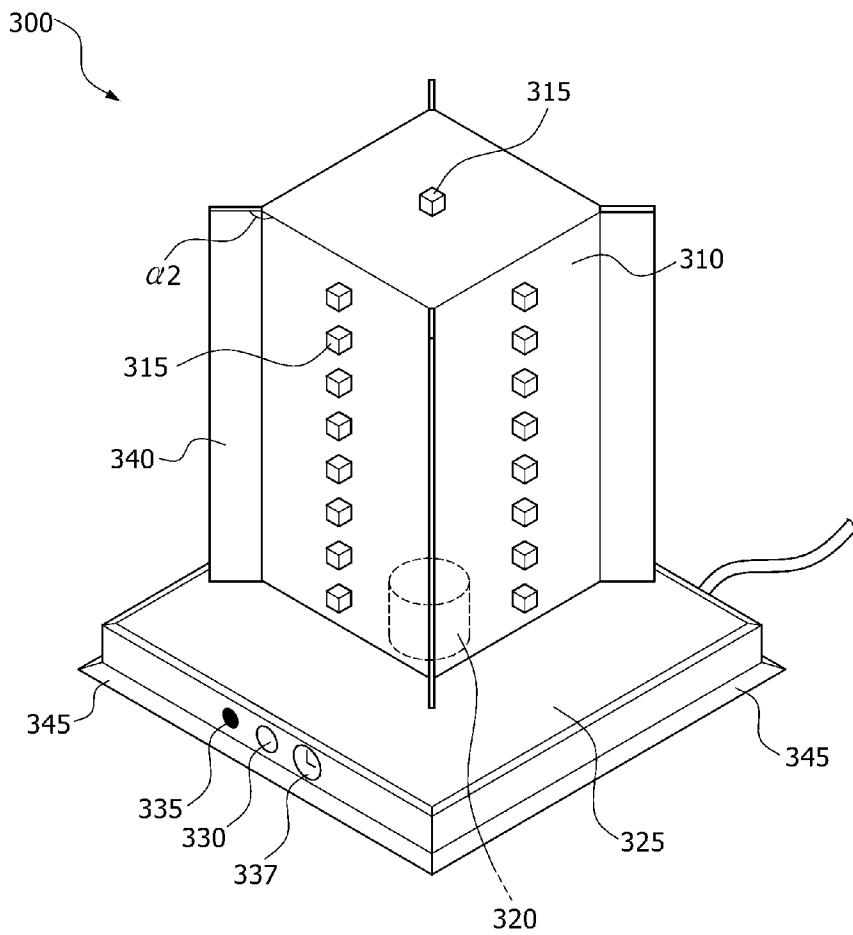
[Fig. 2]



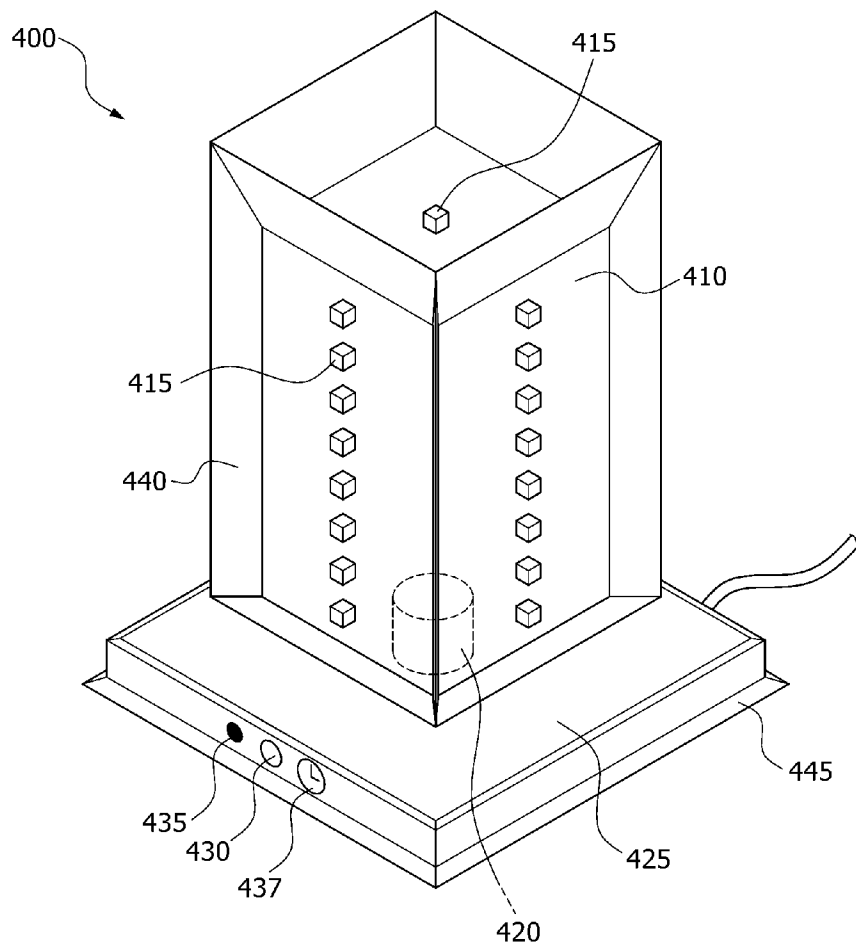
[Fig. 3]



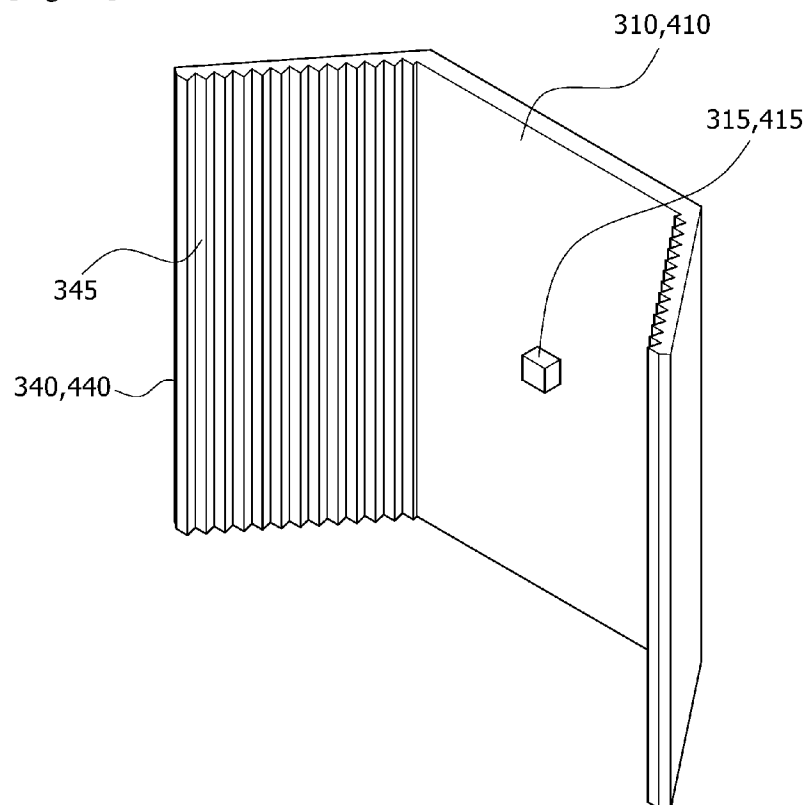
[Fig. 4]



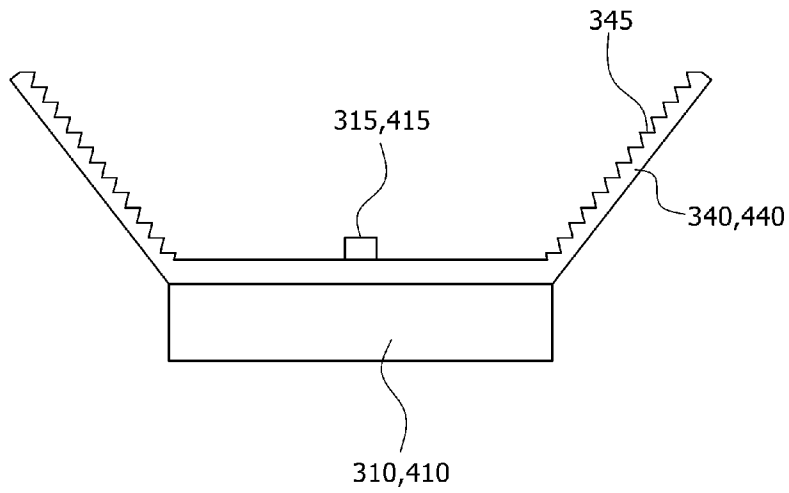
[Fig. 5]



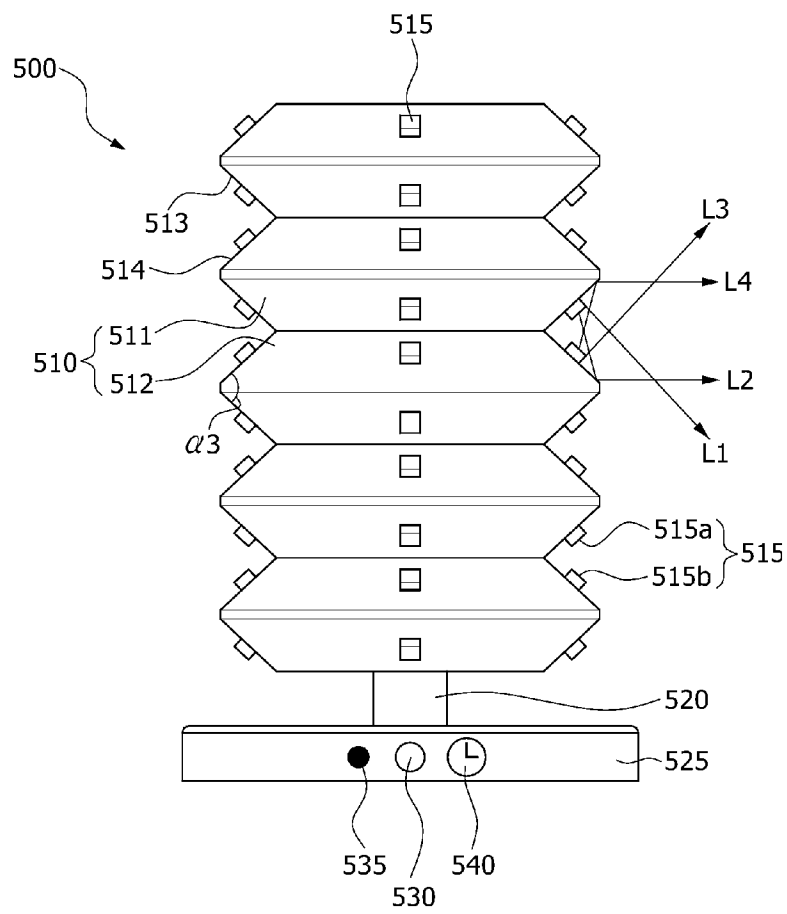
[Fig. 6a]



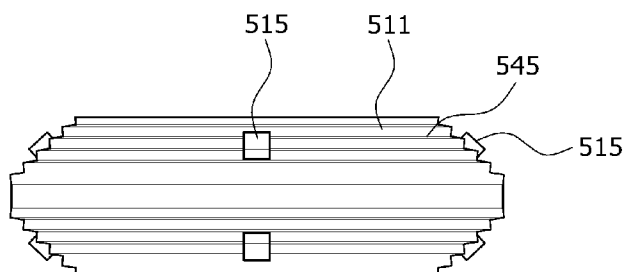
[Fig. 6b]



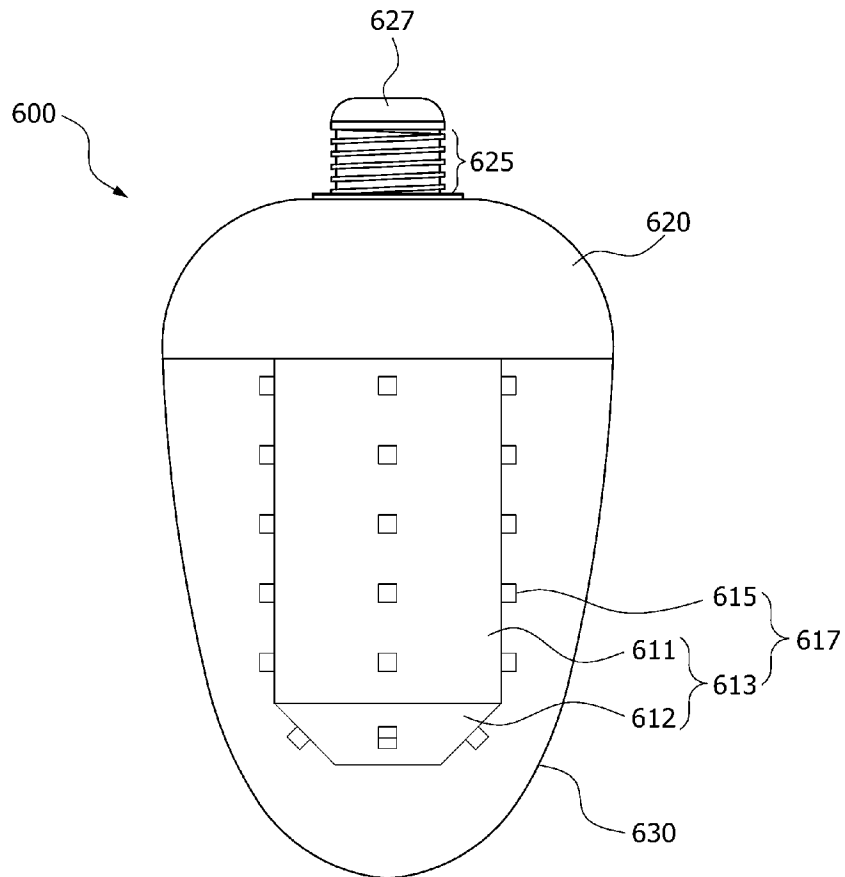
[Fig. 7]



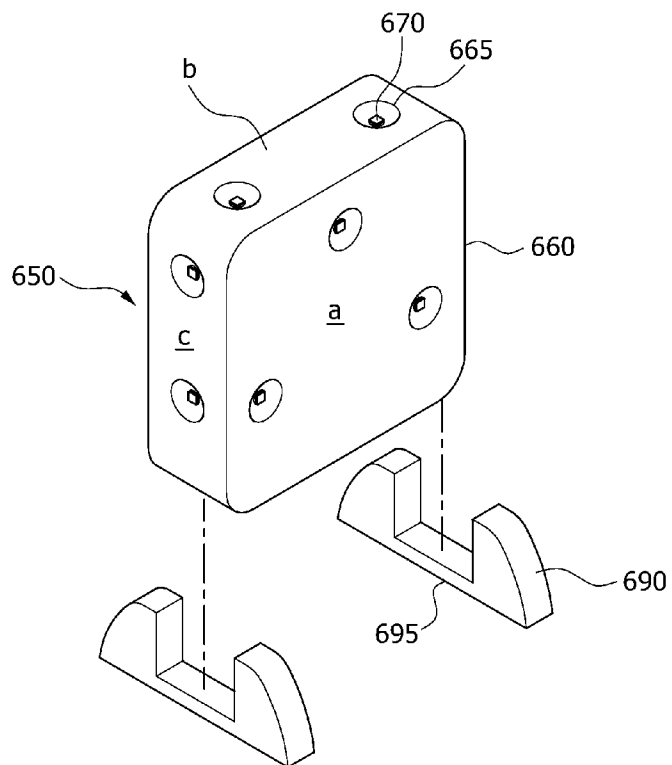
[Fig. 8]



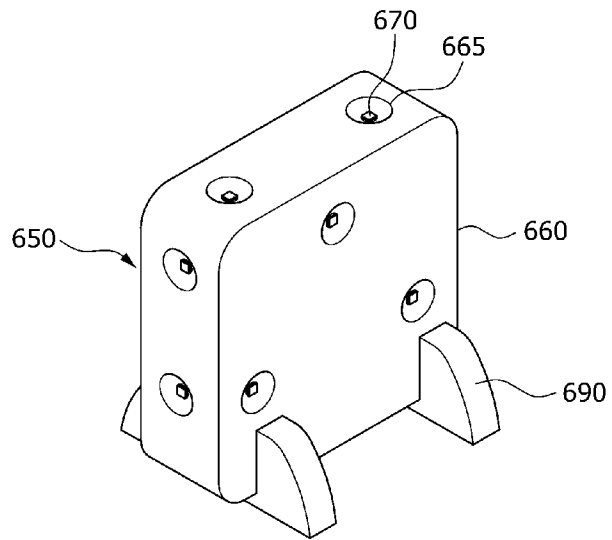
[Fig. 9]



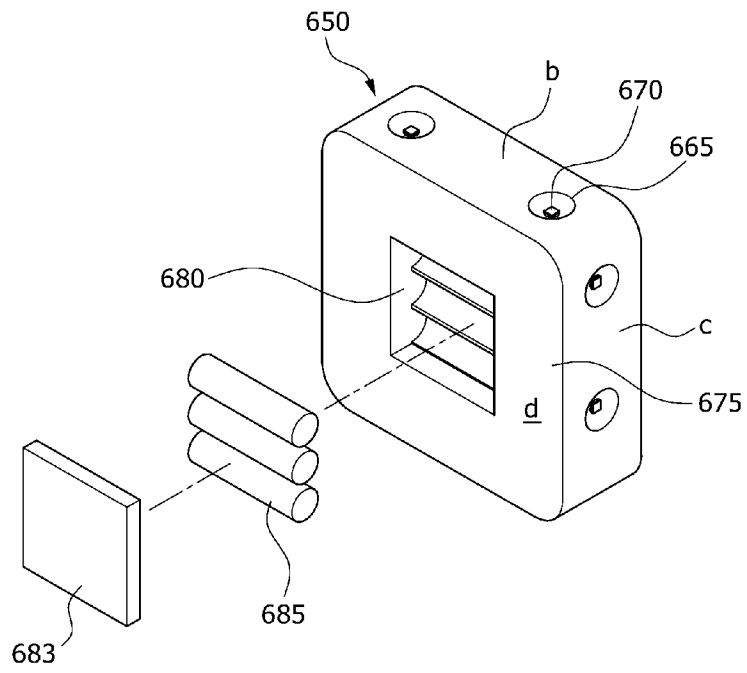
[Fig. 10a]



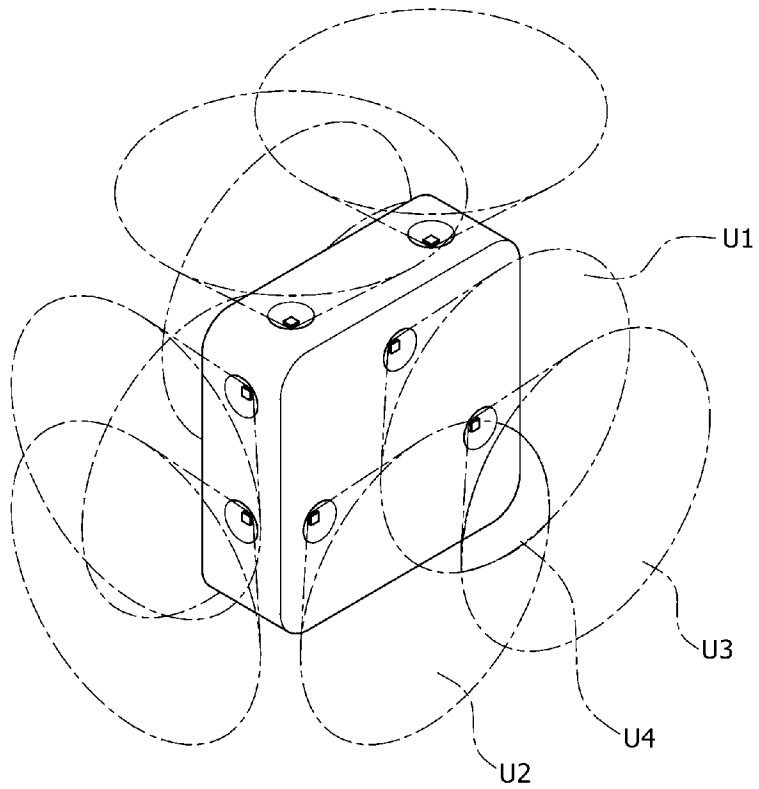
[Fig. 10b]



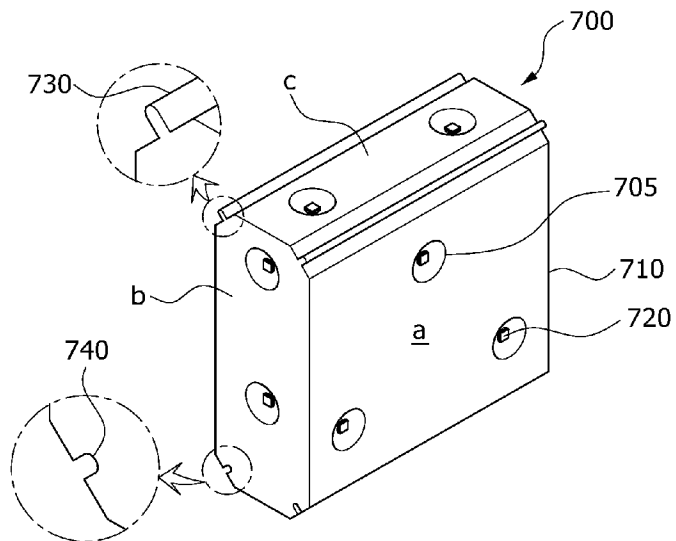
[Fig. 11]



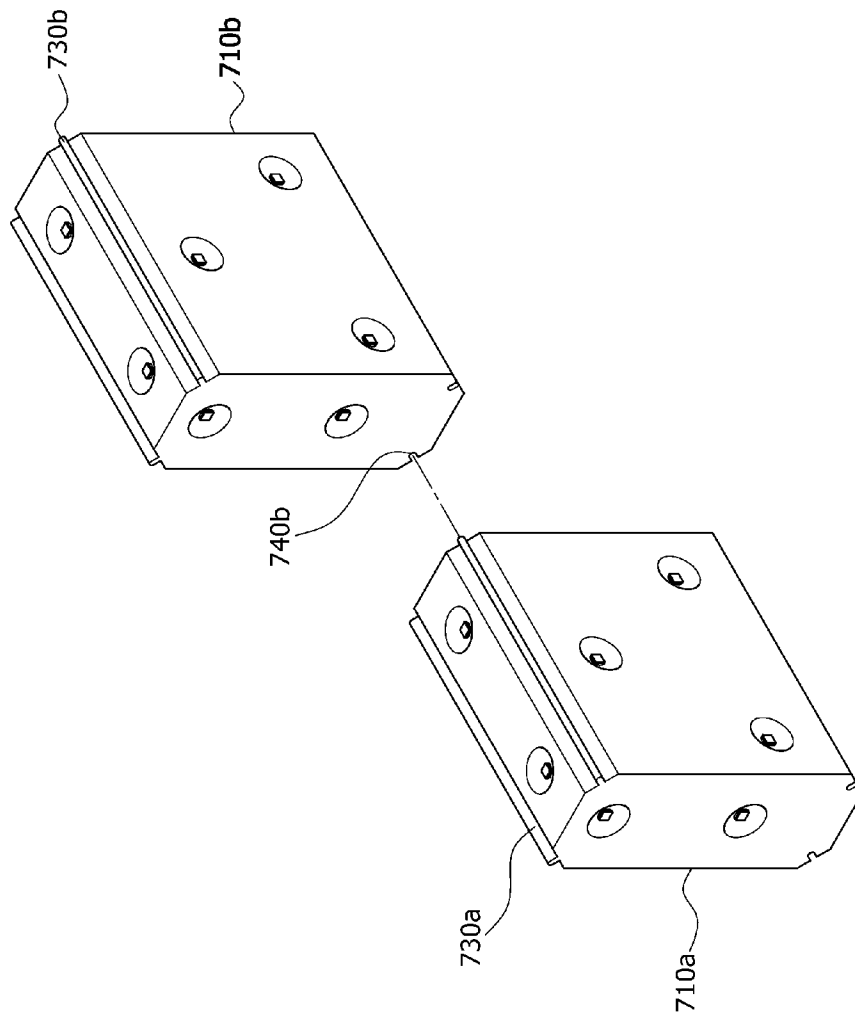
[Fig. 12]



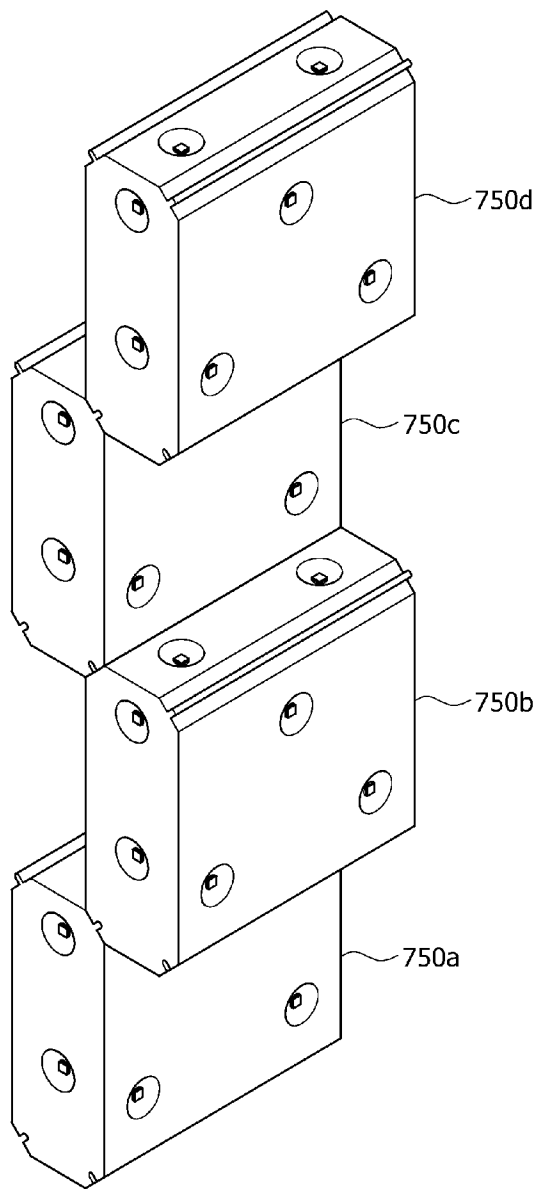
[Fig. 13]



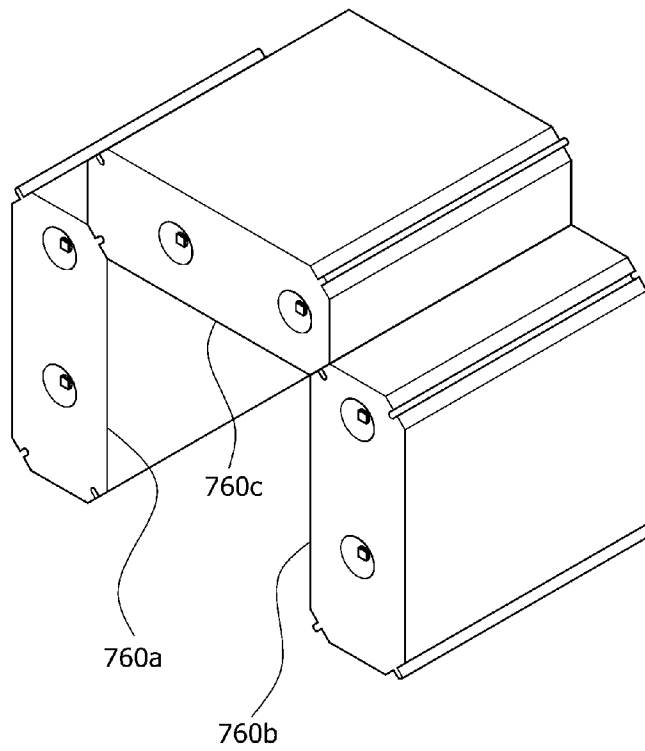
[Fig. 14]



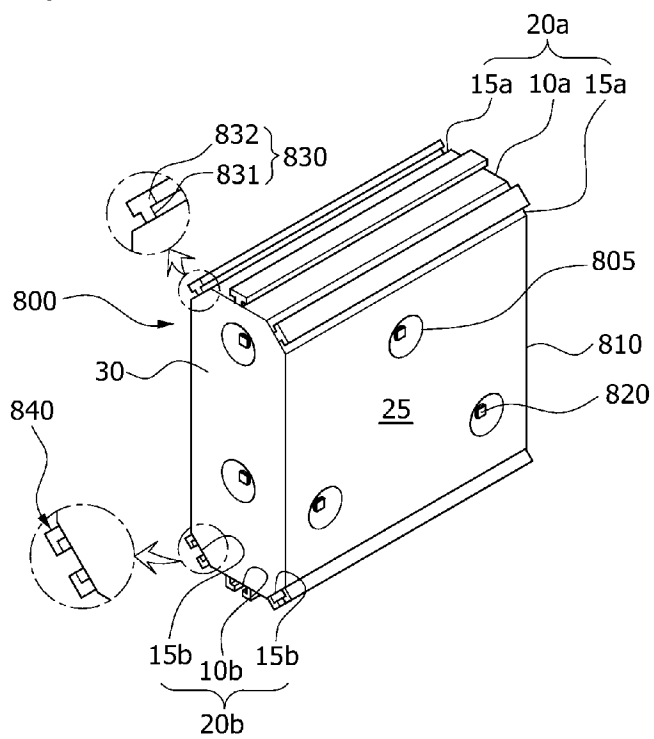
[Fig. 15a]



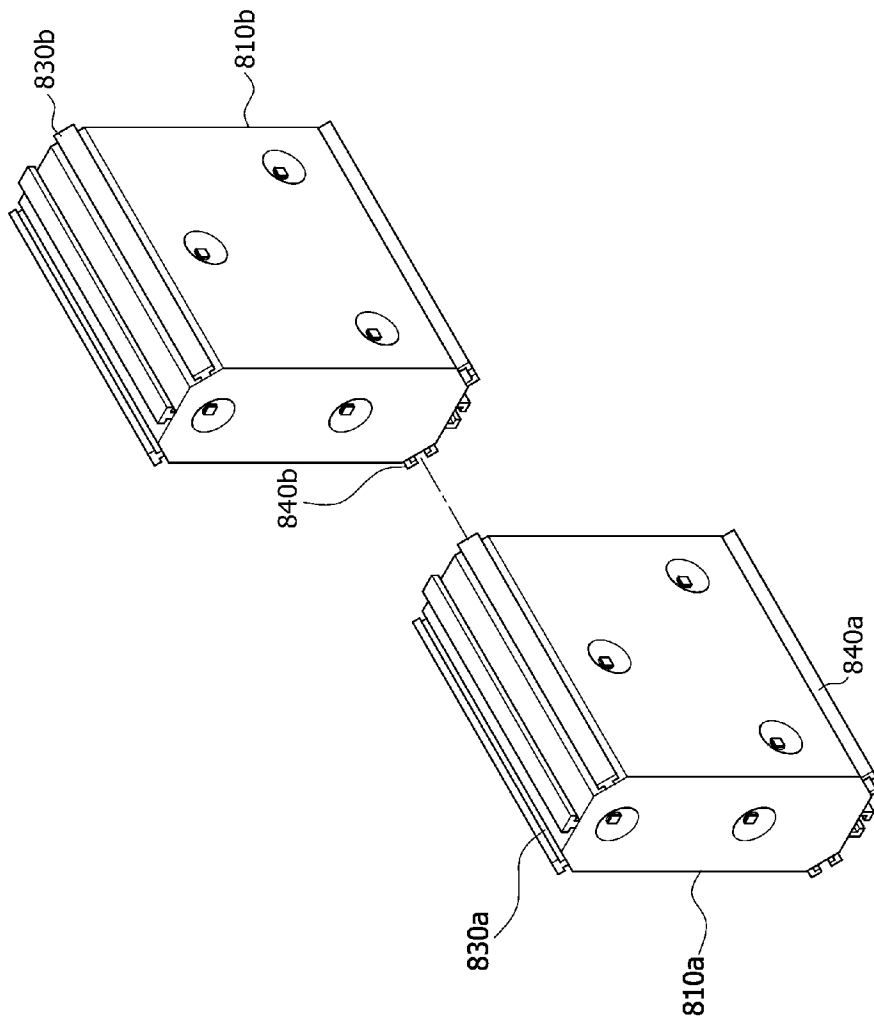
[Fig. 15b]



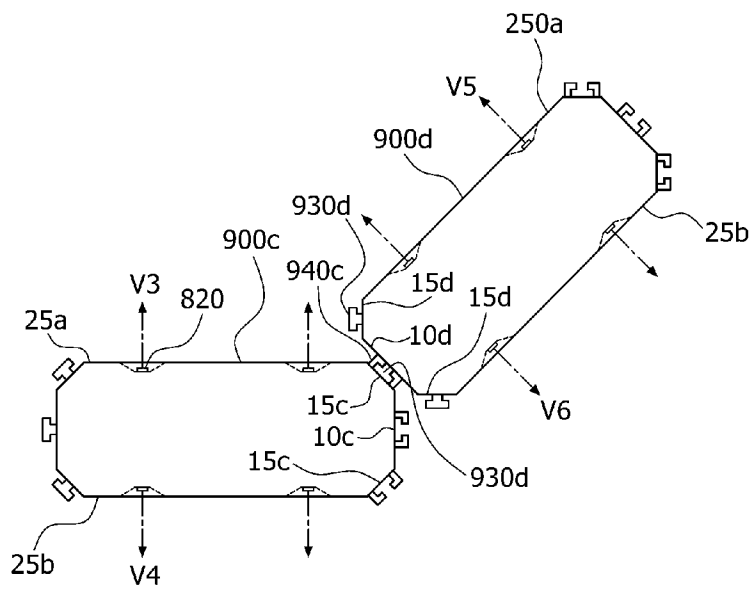
[Fig. 16]



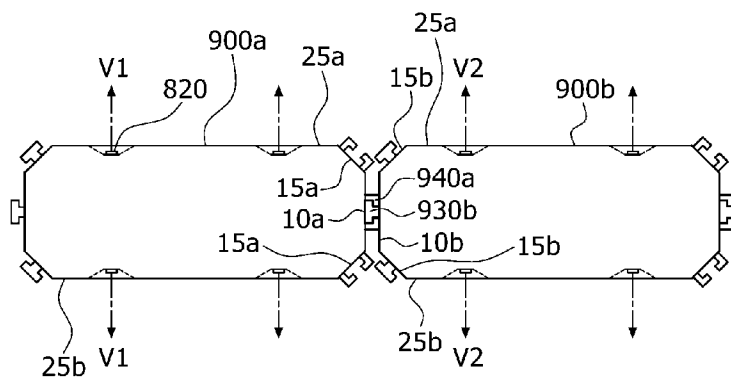
[Fig. 17]



[Fig. 18a]



[Fig. 18b]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2014/006702**A. CLASSIFICATION OF SUBJECT MATTER****A61L 2/10(2006.01)i**

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)

A61L 2/10; H05B 37/02; A61L 9/20; A61L 9/18; B01J 19/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKOMPASS(KIPO internal) & Keywords:sterilization, disinfection, ultraviolet light, reflector, bulb

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013-0126760 A1 (KLEIN, E. S. et al.) 23 May 2013	1-13, 23-29
Y	See abstract; figures 1-5; paragraphs [0020]-[0028]; claims 1-12.	14-22
Y	US 2011-0163683 A1 (STEELE, R. et al.) 7 July 2011	14-22
A	See abstract; figures 17-20 and 25; paragraphs [0112], [0128] and [0143]; claims 1-18.	1-13, 23-29
A	US 2012-0282135 A1 (TRAPANI, S. R.) 8 November 2012	1-29
A	See abstract; figure 1; claims 1-16.	
A	US 2011-0215261 A1 (LYSLO, W. J. et al.) 8 September 2011	1-29
A	See abstract; figures 1-4; claims 1-12.	
A	US 2005-0167611 A1 (ELSEGOOD, C. J. et al.) 4 August 2005	1-29
A	See abstract; figure 3; claims 1-19.	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

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"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

28 November 2014 (28.11.2014)

Date of mailing of the international search report

01 December 2014 (01.12.2014)

Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2014/006702

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013-0126760 A1	23/05/2013	CA 2796577 A1	23/05/2013
US 2011-0163683 A1	07/07/2011	US 8314566 B2	20/11/2012
		US 8791640 B2	29/07/2014
		WO 2012-115884 A1	30/08/2012
US 2012-0282135 A1	08/11/2012	EP 2696902 A1	19/02/2014
		JP 2014-523257 A	11/09/2014
		WO 2012-142427 A1	18/10/2012
US 2011-0215261 A1	08/09/2011	EP 2509639 A1	17/10/2012
		US 8575567 B2	05/11/2013
		WO 2011-072087 A1	16/06/2011
US 2005-0167611 A1	04/08/2005	US 7002140 B2	21/02/2006