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(54) Lighting fixtures with LED lights for illumination of outside public areas

(57) A first aspect concerns to a lighting fixture which comprises:
- a cover and a bottom plate mutually coupled to form an enclosure, said bottom plate having one or more through openings;
- a carrier or circuit board placed inside said enclosure;
- one or more LEDs, mechanically fixed to said circuit board and electrically connected to the circuit there defined, to emit light though said openings; and
- one or more refractive optical elements fixed to the internal face of the bottom plate through the periphery of one of said through openings, intended to guide the light emitted by the LEDs to an illumination area on an illumination surface out of said enclosure.

A second aspect of the invention relates to a street lamp which comprises the lighting fixture of the first aspect.

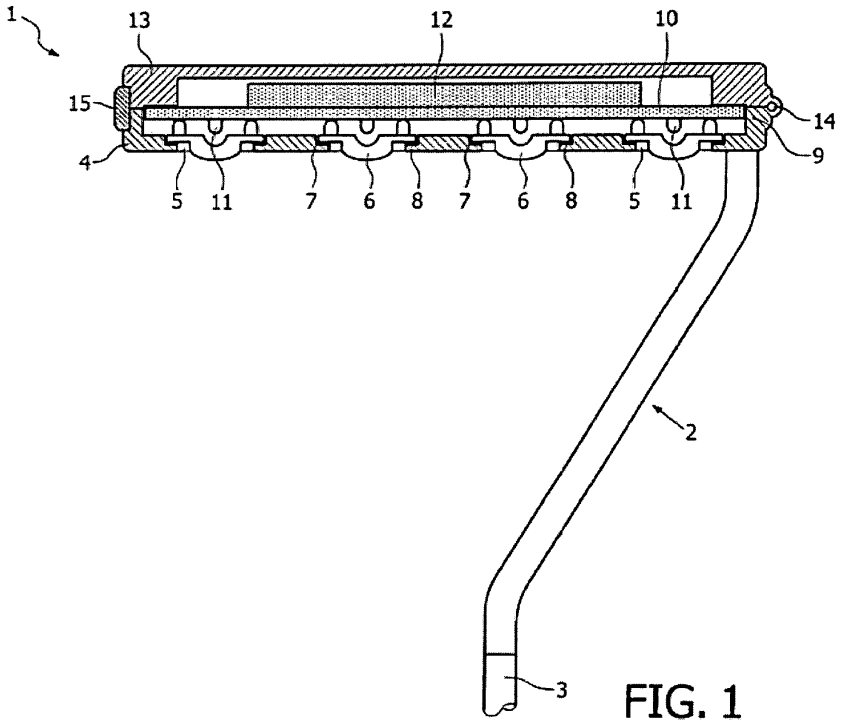

FIG. 1

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Description

[0001] The present invention is related, in a first aspect, to a lighting fixture for illumination of outside public areas, comprising one or more light emitting diode and corresponding refractive optical elements to guide the emitted light to one or more illumination areas.

[0002] A second aspect of the invention relates to a street lamp comprising the lighting fixture of the first aspect attached to a post.

Background art

[0003] It is of common knowledge that similar lighting fixtures are known as street lamps or streetlights. These street lamps are often fitted with light sources such as vapour lamps, due to their low energy consumption and long service life.

[0004] Given the increasing specific light output per watt of light emitting diodes (LEDs) it is becoming attractive to apply LEDs in such lighting fixtures. Although the effective light output of LEDs is still lower than that of vapour lamps at present, it is still attractive to apply LEDs here because a larger proportion of the generated light would be used than in the case of vapour lamps. Refractive optical elements are then implemented with LEDs, just as lenses, whose losses are smaller than in the case of the unavoidable reflectors used in vapour lamps.

[0005] There are already known lighting fixtures for illumination of outside public areas, such as streets, which comprise at least one fixed light emitting diode (LED) in a carrier and one refractive optical element per LED, such as a lens, to guide the emitted light to an illumination area on an illumination surface.

[0006] Some proposals apply lenses in front of the LEDs, but then comprise a separate translucent bottom plate or cover, to protect the LEDs against environmental influences such as dirt and moisture, nut which must be also be passed by the light emitted by LEDs, being the consequence of using said separate elements (bottom plate and lenses) that the cost increases, while double losses occur as the LEDs' emitted light also pass through both elements.

[0007] JP2005116182 concerns to an illumination lighting fixture forming an enclosure, or insulating case, housing a circuit board with a plurality of LEDs, and also a bottom plate with through openings, through which LEDs emit light. On the external face of said bottom plate, denominated "lens fixing means", there is fixed a plurality of bulk lenses, each covering one of the through openings. Sad bulk lenses have an inner well-shaped recessed part into which a part of one respective LED enters. The LEDS described in JP2005116182 have flat faces which, when introduced into said bulk lenses, stay perpendicular to the optical axis direction of the lenses, and act as light outgoing faces.

Description of the invention

[0008] The purpose of the present invention is to provide an alternative to the conventional lighting fixtures, which provides a better performance relating to, mainly, their optical arrangements, easier assembly, immunity against environmental influences, and heat sinking.

[0009] For that purpose the present invention concerns, in a first aspect, to a lighting fixture for illumination of outside public areas, of the type which comprises:

- a cover and a bottom plate mutually coupled to form an enclosure, said bottom plate having one or more through openings;
- a carrier or circuit board placed inside said enclosure;
- one or more LEDs, mechanically fixed to said circuit board and electrically connected to the circuit there defined, to emit light though said openings; and
- one or more refractive optical elements fixed to said bottom plate covering said openings, intended to guide the light emitted by the LEDs to an illumination area on an illumination surface out of said enclosure;

[0010] Differently from the background art, particularly from JP2005116182 which is here considered to be the closest prior art, in the lighting fixture proposed by the first aspect of the present invention each of the refractive optical elements is fixed to the internal face of the bottom plate through the periphery of one of said through openings.

[0011] For an embodiment, each of said openings has a stepped edge through its periphery, embracing the internal face of the bottom plate, and at least one refractive optical element is fitted and retained sideways in said stepped edge.

[0012] In order to guarantee said immunity to environment influences, the proposed lighting fixture comprises at least one sea (for instance made of synthetic material or glass), per opening, fitted between each refractive optical element and each stepped edge, around its whole periphery, for sealing the interior of said enclosure from said environmental influences.

[0013] For a preferred embodiment the bottom plate of the lighting fixture proposed has a plurality of through openings distributed there along, such as according to a regular pattern, with their corresponding stepped edges and seals, and said lighting fixture comprises a plurality of LEDs, at least one per opening.

[0014] The fact that refractive optical elements, such as lenses, are fixed to the inner face of bottom plate, provides a pleasing appearance on one hand, while assembly is made easier on the other hand.

[0015] The lighting fixture proposed by the first aspect of the invention has, for a preferred embodiment a flattened shape, where said refractive optical elements are flattened lenses, and said bottom plate is arranged substantially parallel to the circuit board.

[0016] To enable the fixture to generate adequate light, for an embodiment the lighting fixture comprise a group of at least two LEDs with respective refractive optical elements, whereby each combination of LED and reflective optical element that belongs to the group are arranged to illuminate mainly the same illumination area on an illumination surface. As a consequence of this measure, the light output of each LED in the group contributes to the light intensity of the illuminated area. In this way the generated illumination areas of each of these combinations only coincides for the most part because they are being generated by combinations situated in close proximity to each other.

[0017] In the interest of simpler manufacturing, and to simplify the technical light calculations, it is preferred that LEDs belonging to a group, be fixed on the same surface. The refractive optical elements belonging to the group are joined with the referred inner face of the bottom plate, extending out parallel to the surface of the carrier. In fact this facilitates the LEDs and the optical elements to be as parallel to each other as reasonably possible, so that their combined generated beams are also parallel.

[0018] For an embodiment the lighting fixture proposed by the invention comprises two or more refractive elements integrated into a multistage optical element covering one of said openings, in front of at least two LEDs.

[0019] The assembly of the fixture is further simplified when the group of refractive elements belonging together between the bottom plate and the carrier includes the group of LEDs that also belong together.

[0020] While not ruling out that the illuminated area being illuminated by the fixture is mainly round or square, for an embodiment each of the combinations of LEDs and refractive elements in the group are arranged to illuminate an oblong illuminated area, for instance when illuminating streets. Hereby the illuminated area itself will mainly stretch out along the longitudinal direction of the street.

[0021] For another embodiment they are arranged to illuminate an asymmetrical illuminated area.

[0022] Lighting fixtures for illuminating streets, like lampposts, are often placed on the edge of a sidewalk or its fixtures are fastened to a building. In such applications it would be desirable if the fixture could be placed off-centre while still providing excellent illumination on the road and sidewalk.

[0023] Optical losses in the optical refractive element occur, partly as result of reflection. To prevent this phenomenon as much as possible, it is preferred that at least one of the active optical surfaces of a refractive element be covered with an anti-reflective coating. It is therefore feasible that this coating be applied to the inner side, the external side, or on both sides. The advantage of coating the inner side is that it would be better protected.

[0024] To alter the light emitted from the LEDs before leaving the refractive element, the preference would be that at least one of the optical active surfaces of the refractive elements be coated with a phosphorus layer. It is understood that the word 'phosphorus' means in this case a material, which under the influence of light, emits light at a different wave length to that of its incoming light.

[0025] Although in principle, high light output can be achieved by applying the LEDs without using reflectors, the light output is improved when a reflector, preferably a small one, is applied by being moulded around the conical collar of the LED.

[0026] The assembly of the fixture is simplified when more than one optical refractive element belonging to a group are joined to form a single component.

[0027] Although the largest portion of the combinations of LEDs and optical refractive elements are arranged to generate coincidental illuminated areas, for an embodiment, in order to provide for larger illumination intensity around the edges of an illuminated area, the lighting fixture of the invention provides some combinations of LEDs and optical refractive elements arranged solely to illuminate these edge areas. Regarding this matter, a embodiment is provided where the fixture includes an amount of secondary combinations of LEDs and optical refractive elements which do not belong to the main group, arranged for the illumination of a divergent illuminated area.

[0028] For an embodiment, at least some of the combinations of LEDs and optical elements not belonging to the secondary group to be arranged for illuminating the secondary illuminated area, forming part of the illuminated area. In this way, the areas around the edge of the illuminated area can be illuminated better. This does not rule out the secondary illuminated area itself from extending outside the illuminated area.

[0029] To lower the operating temperature of the LEDs and therefore extend their service life, for an embodiment of the invention the LEDs' carrier is manufactured from suitable thermal conducting material and then contacts (preferably by means of a large contact surface), at its edges, the fixture's enclosure in order to transfer the heat from the LEDs, and other possible components, to at least said cover, which is also made of a good thermal conducting material, for acting as a heat sink.

[0030] Nor is it ruled out that the carrier be moulded to form part of the enclosure. It is worth mentioning that these carriers are produced as printed circuit boards in many cases. The surface on which the components are being placed needs to be manufactured from an electrical insulator type of material so that functional conductive tracks can be laid down thereon. This essential measure is combined with that of the present embodiment by a so-called 'metal core' printed circuit board. It will soon be clear that other printed circuit boards, completely manufactured from electrically isolated material, could be applied as well.

[0031] In the interest of effective cooling, a clean cooling surface is important. To keep the cooling surface of the fixture as clean as possible without effort, it is preferred that the enclosure be designed with at smooth or

partially smooth surface. It will soon be clear that the design of a smooth cooling surface ought to be applied to the fixtures that are equipped with LEDs as light sources; this measure also needs to apply to fixtures for different light sources such as vapour lamps.

[0032] According to an embodiment of the invention, the proposed lighting fixture comprises coupling means (such as a hinge and a fitting) for removably coupling its cover and bottom plate in a sealed manner.

[0033] A second aspect of the invention relates to a streetlight comprising the lighting provided by the first aspect, attached to a lamppost, with said cover and said bottom plate staying parallel or inclined with respect to the area to be illuminated.

[0034] Throughout the description and claims the word "comprise" and variations of the word, such as "comprising", is not intended to exclude other technical features, additives, components, or steps.

[0035] Additional objects, advantages and features of the invention will become apparent to those skilled in the art upon examination of the description or may be learned by practice of the invention. The following examples and drawings are provided by way of illustration, and is not intended to be limiting of the present invention. Furthermore, the present invention covers all possible combinations of particular and preferred embodiments described herein.

Brief description of the drawings

[0036] Next the present invention will be explained on the basis of the accompanying drawings, wherein the following is represented:

Figure 1: A schematic cross-section view of a fixture in accordance with the invention;
Figure 2: A schematic cross-section view showing more detail of the fixture featured in Figure 1;
Figure 3: A cross-section view of a second embodiment, corresponding to Figure 2;
Figure 4: A cross-section view of a third embodiment, corresponding to Figure 2;
Figure 5: A cross-section view of a fourth embodiment, corresponding to Figure 2; and
Figure 6: A cross-section view of a fifth embodiment, corresponding to Figure 2;

Detailed description of specific embodiments

[0037] The fixture shown in Figure 1 is attached to a lamppost 3 by means of a bar 2. The fixture 1 comprises a bottom plate 4, which is furnished with a regular pattern of openings. In each of the openings 5 an optical refraction element 6 is fitted. These openings 5 each have a stepped edge 7 in which the optical elements 6 are retained sideways. In-between each of the optical elements 6 and the stepped edge 7 a seal 8 is fitted. The embodiment shown here comprises a flat fixture that extends horizontally. However, it is also possible that a similar fixture could extend at a slight angle.

[0038] The bottom plate 4 of the fixture has a raised edge, inside which a printed circuit board 10 is placed, with the LEDs 11 situated on the underside thereof. On the upper side of the printed circuit board 10 components 12 such as driver circuitry are mounted to ensure the LEDs 11 are being supplied with the correct current and voltage. The components 12 could also be mounted onto the underside of the printed circuit board 10. It is also possible to utilize circuitry that is not mounted onto a printed circuit board 10 for the purpose of driving the LEDs 11. Hereby the printed circuit board 10 is retained between the raised edges 9. The placement of the LEDs 11 on the printed circuit board 10 are such that the LEDs 11 are mounted precisely above the void created by the optical elements 6. The fixture 1 comprises a cover 13 which is connected to the edge 9 by means of a hinge 14, opposite which a fitting 15 is situated for the purpose of sealing of the inside of the fixture. Naturally, packing can be used.

[0039] Notice that the upper side of cover 13 is smooth. This result in possible contamination such as bird excrement being washed away more easily when it rains, so that the cooling surface is better maintained than would have been the case with the usual cooling fins. Such cooling fins would build up grime quickly, while rain scarcely has the potential to clean it off.

[0040] The printed circuit board 10 is fitted with a metal core, preferably made from aluminium, for efficient conducting of heat produced by the LEDs 11 and the components 12 towards the edge of the printed circuit board 10, where the heat can be transferred to the cover 13, is similar to the rest of the fixture and is preferably also made of a metal such as aluminium. The bottom plate 4 also serves as a heat sink; given its large surface area, which is likewise smoothly finished and also exposed to the ambient conditions. It stands to reason that a fixture which is mounted at a slant still benefits from this cooling feature where the slanted surfaces lead to even better cleaning by the rain. This measure can also be realized in other configurations, such as with other shapes of the carrier 10 or when the carrier 10 extends at various angles.

[0041] Figure 2 shows an optical refraction element 6, i.e. a lens, in more detail. From this drawing it is apparent that there is a void 20 in optical element 6 in which the corresponding LED 11 extends at least partially. On the one hand this void forms a surface with a refractive function, and on the other hand it encloses part of the LED 11, whereby a large part of the light emitted by the LED 11 is collected by the optical element 6 and being utilized effectively.

[0042] The same parts are shown in Figure 3, but in addition the outside of the optical element 6 is covered with an anti-reflective coating, whereby borderline reflection losses are greatly reduced. It is likewise possible that the anti-reflective coating could be applied to the inside

only, or on both sides.

[0043] The same parts are shown in Figure 4, but here, the inner surface of the optical element 6 is covered with a phosphorus layer to alter the colour of the light in the same way as in the case of a discharge lamp, and in particular as used in a fluorescent lamp.

[0044] Figure 5 also shows the same parts, but here a collar-shaped reflector 23 is fitted around LED 11. Because of this the light output of LED 11 is utilized even more effectively.

[0045] Figure 6 shows a multistage optical element 24 which performs the function of three integrated independent optical elements, simplifying assembly and reducing the number of parts.

[0046] It should be clear that a large number of alterations can be made to these embodiments without deviating from the scope of the invention as defined in the appended claims

Claims

1. A lighting fixture for illumination of outside public areas, of the type which comprises:

   - a cover (13) and a bottom plate (4) mutually coupled to form an enclosure, said bottom plate (4) having at least one through opening (5);
   - a carrier or circuit board (10) placed inside said enclosure;
   - at least one light emitting diode, or LED (11), mechanically fixed to said circuit board (10) and electrically connected to the circuit there defined, to emit light though said at least one opening (5);
   - at least one refractive optical element (6) fixed to said bottom plate (4) covering said at least one opening (5), intended to guide the light emitted by the at least one LED (11) to an illumination area on an illumination surface out of said enclosure;

   said lighting fixture being **characterised in that** said at least one refractive optical element (6) is fixed to the internal face of the bottom plate (4) through the periphery of said at least one opening (5).

2. The lighting fixture of claim 1, **characterised in that** said at least one opening (5) has a stepped edge (7) through its periphery, embracing the internal face of the bottom plate (4), and **in that** said at least one refractive optical element (6) is fitted and retained sideways in said stepped edge (7).

3. The lighting fixture of claim 2, **characterized in that** it comprises at least one seal (8) fitted between said at least one refractive optical element (6) and said stepped edge (7), around its whole periphery, for sealing the interior of said enclosure from environmental influences.

4. The lighting fixture of claim 3, **characterized in that** said bottom plate (4) has a plurality of said through openings (5) distributed there along, with their corresponding stepped edges (7) and seals (8), and **in that** said lighting fixture comprises a plurality of said LEDs (11), at least one per opening (5).

5. The lighting fixture of claim 4, **characterised in that** said through openings (5) are distributed along said bottom plate (4) according to a regular pattern.

6. The lighting fixture of any of previous claims, **characterised in that** said circuit board (10) is of a thermal conducting material, and **in that** it contacts, at its edges, the fixture's enclosure in order to transfer the heat from the LED or LEDs (11), and other possible components (12), to at least said cover (13), which is also made of a good thermal conducting material, for acting as a heat sink.

7. The lighting fixture of any of previous claims, **characterized in that** it comprises coupling means (14, 15) for removably coupling said cover (13) and said bottom plate (4) in a sealed manner.

8. The lighting fixture of any of previous claims, **characterised in that** it comprises a group of at least two LEDs (11) with respective refractive optical elements (6), whereby each combination of LED (11) and refractive optical element (6) that belongs to the group are arranged to illuminate mainly the same illumination area on an illumination surface.

9. The lighting fixture of claim 8, **characterised in that** it comprises at least two refractive elements integrated into a multistage optical element (24) covering one of said openings (5), in front of at least two LEDs (11).

10. The lighting fixture of any of claims 8 or 9, **characterised in that** each of the combinations of LEDs (11) and refractive optical elements (6, 24) in said group is arranged to illuminate an oblong illuminated area or to illuminate an asymmetrical illuminated area.

11. The lighting fixture of any of claims 8 to 10, **characterised in that** it comprises a secondary group or combinations of LEDs (11) and refractive optical elements (6) which do not belong to said group, arranged for the illumination of a divergent illuminated area.

12. The lighting fixture of any of previous claims, **characterised in that** said bottom plate (4) is arranged

substantially parallel to said circuit board (10), and **in that** said refractive optical elements (6) are flattened lenses (6).

13. The lighting fixture of any of previous claims, **characterised in that** at least one inner surface of said refractive optical elements (6) is covered with an anti-reflective coating and/or coated with a phosphorus layer.

14. The lighting fixture of any of previous claims, **characterised in that** it comprises a conical collar reflector (23) surrounding each LED (11).

15. Street lamp comprising the lighting fixture of any of previous claims attached to a lamppost (3), with said cover (13) and said bottom plate (4) staying parallel or inclined with respect to the area to be illuminated.

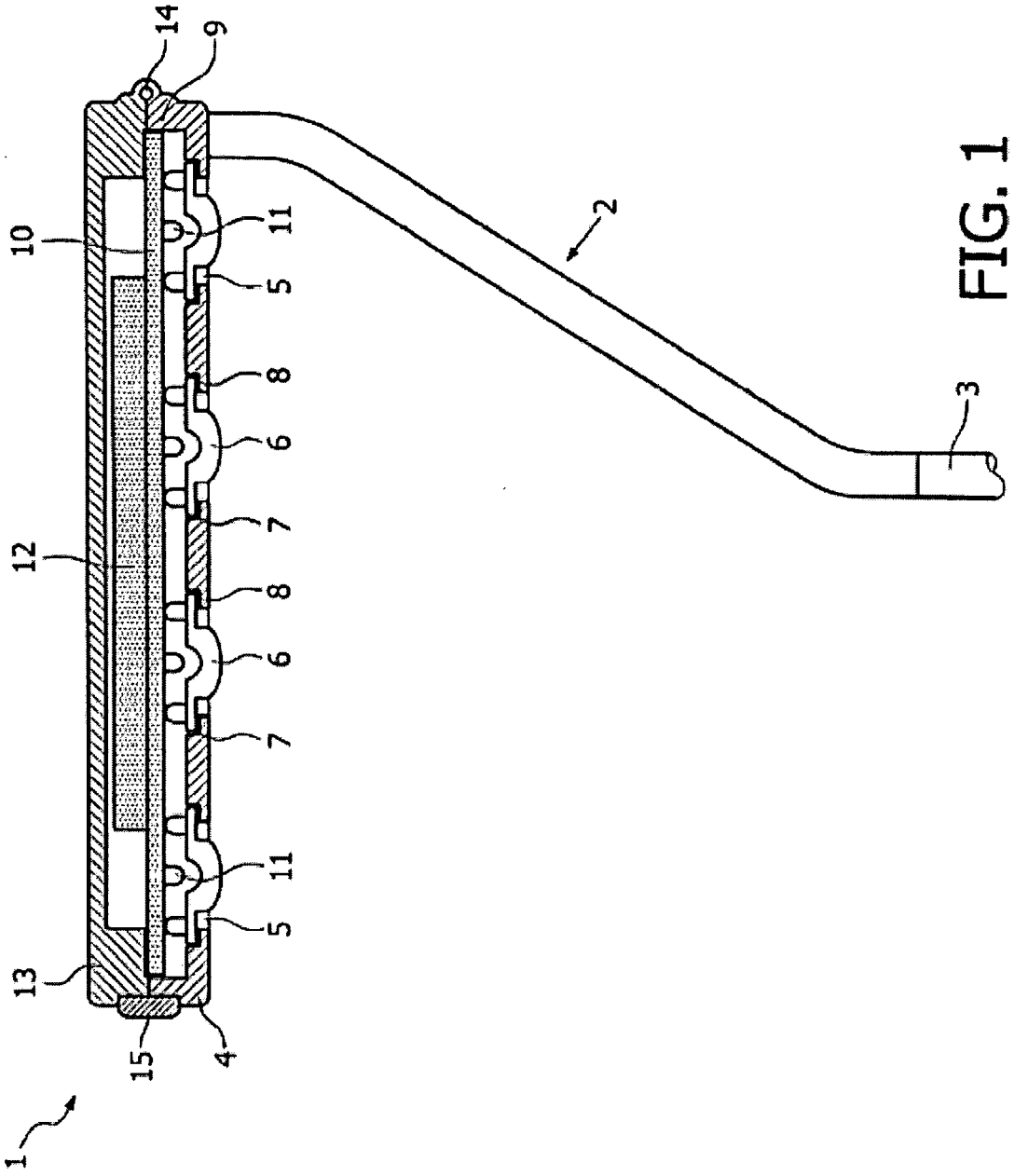

FIG. 1

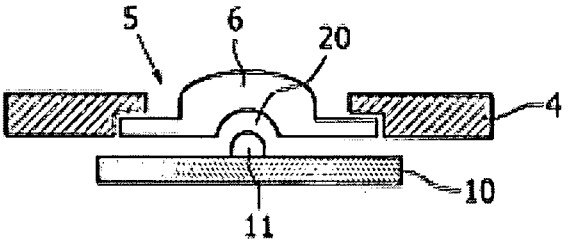

FIG. 2

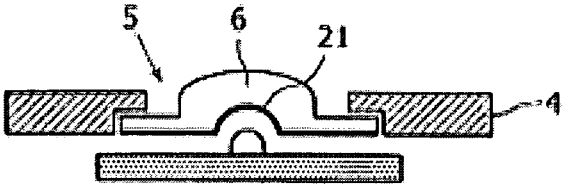

FIG. 3

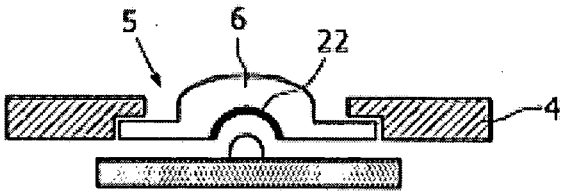

FIG. 4

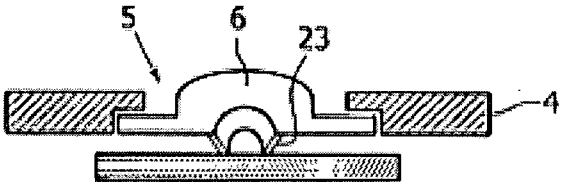

FIG. 5

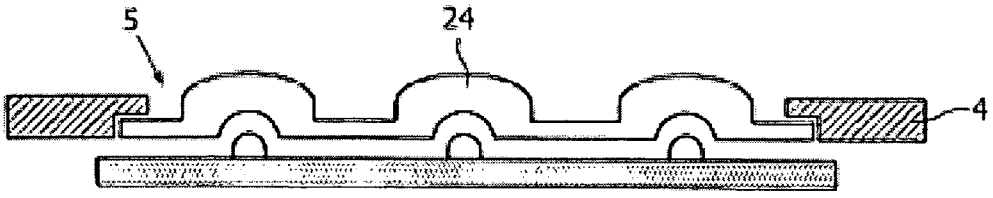

FIG. 6

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EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 February 2009	Prévot, Eric

CATEGORY OF CITED DOCUMENTS

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A : technological background
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EUROPEAN SEARCH REPORT

Application Number
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