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(54) **A LED lighting unit and a method**

(57) The invention relates to a LED lighting unit, comprising an armature (2) and a lighting module (3) carried by the armature (2). The lighting module (3) includes at least one regular LED light source (6) and an optic element (4) forming a radiation pattern from an optic beam generated by the regular LED light source (6). The lighting module (3) further includes an emergency unit (7) having a printed circuit substrate (8) and at least one emergency LED light source (9) placed adjacent the regular LED light source (6) such that the optic element (4) also forms a radiation pattern from an optic beam generated by the emergency LED light source (9).

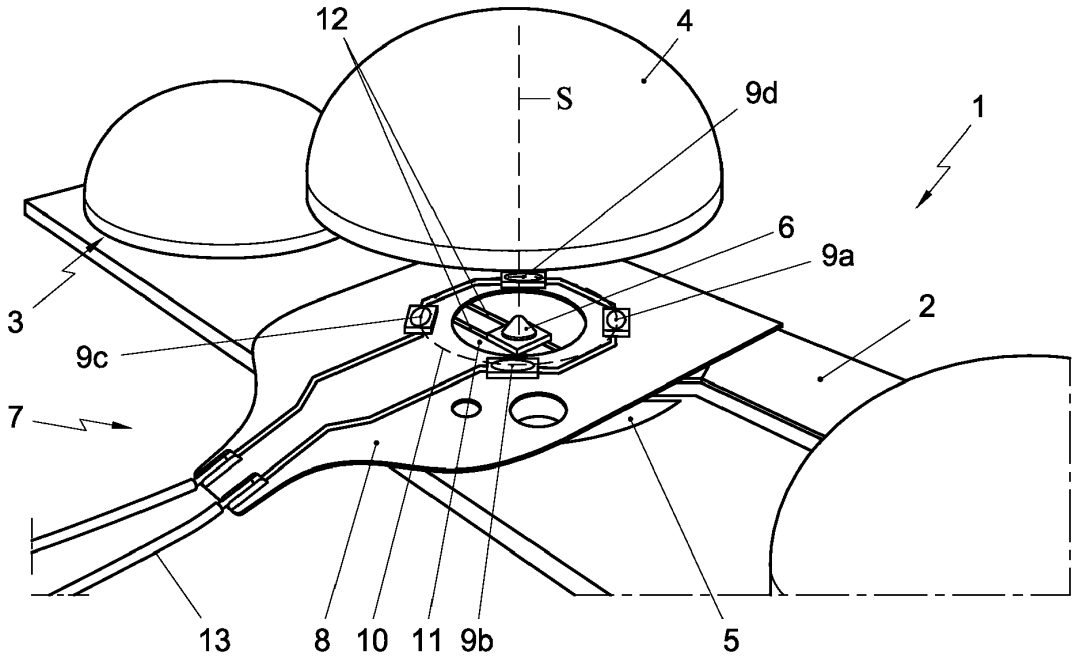

Fig. 2

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Description

[0001] The invention relates to LED lighting unit, comprising an armature and a lighting module carried by the armature, the lighting module including at least one regular LED light source and an optic element forming a radiation pattern from an optic beam generated by the regular LED light source.

[0002] Such a LED lighting unit is generally known for lighting rooms in buildings, such as offices etc. The driver is arranged for generating power signals to the individual LED's so that an optimal light beam is generated and focused to an area to be lighted, usually the floor. For energy consumption purposes, the optical element is typically designed such that a so-called depth radiation pattern is provided.

[0003] Also emergency lighting units are known for providing light in emergency situations, especially when the mains power voltage drops. Such emergency lighting units are powered by an emergency power source and have a specific optic element for providing a so-called wide radiation pattern, thereby minimizing the number of emergency lighting units that are required in an area to be lighted.

[0004] It is an object of the present invention to provide a LED lighting unit that is suitable for generating an emergency light and that is also attractive from an economical point of view. Thereto, according to the invention, a LED lighting unit according to the preamble is provided, wherein the lighting module further includes an emergency unit having a printed circuit substrate and at least one emergency LED light source mounted on said printed circuit substrate and placed adjacent the regular LED light source such that the optic element also forms a radiation pattern from an optic beam generated by the emergency LED light source.

[0005] By integration the function of regular lighting with the function of emergency lighting, a single lighting unit can advantageously be used for both purposes.

[0006] The invention is at least partially based on the insight that for the purpose of the emergency function, only a reduced light intensity is required that can be generated by a reduced number of LED's, or even a single LED in the lighting unit. Here, the property can advantageously be exploited that the light intensity generated by a LED is easily controlled by the electrical power that is offered to the LED, thereby enabling a very efficient emergency function. Also, the generation of the so-called depth radiation pattern enables efficient use of energy, also in the emergency state of the lighting unit.

[0007] The invention is also at least partially based on the insight that due to the size of LED light sources, the emergency LED light source can be placed close to the regular LED light source such that a single optic element is required for providing a desired radiation pattern both from light generated by the regular LED light source and form light generated by the emergency LED light source.

[0008] Further, the emergency function of the lighting unit is invisibly integrated in the regular LED lighting unit, and no separate emergency lighting units have to be installed, implying that a costly and relatively complicated study and design of the number and location of emergency lighting units having specific optical modules is now superfluous. Also, a cost reduction can be obtained in terms of installation effort. As in principle each LED lighting unit in an area in the building can be used in an emergency state, the emergency lighting approach is inherently more safe compared to the traditional design of dedicated emergency lighting units. This is due to the fact that traditional emergency lighting units are minimized in number, causing a relatively dark spot when an emergency lighting unit does not provide light, while in the new approach a relatively large number of lighting units can be used, so that a single defect lighting unit generates only a minor dark spot. In addition, the depth radiation pattern of the LED light unit reduces the chance of dazzling persons, in contrast to the traditional emergency lighting units that usually have a wide radiation pattern.

[0009] Advantageously, by providing the emergency unit with a printed circuit substrate that is separate from the structure on which the regular LED light sources are mounted, a conventional LED lighting unit that has been installed can easily be upgraded to a LED lighting unit according to the invention. Further, the emergency unit can thus be repaired or exchanged easily without interfering with the regular functionality of the LED lighting unit.

[0010] Additional advantageous embodiments according to the invention are described in the following claims.

[0011] By way of example only, embodiments of the present invention will now be described with reference to the accompanying figures in which

Fig. 1 shows a schematic perspective view of a LED lighting unit according to a first embodiment of the invention, and

Fig. 2 shows a schematic perspective partial exploded view of a LED lighting unit according to a second embodiment of the invention.

[0012] It is noted that Fig. 1 and Fig. 2 show merely preferred embodiments according to the invention. In the figures, the same reference numbers refer to equal or corresponding parts.

[0013] Figure 1 shows a schematic perspective view of a LED lighting unit 1 according to a first embodiment of the invention. The unit 1 comprises an armature 2 and a multiple number of lighting modules 3 carried by the armature 2. Each of the lighting modules 3 includes a single or a multiple number of regular LED light sources. Further, each of the lighting modules 3 includes an optic element 4 for forming a radiation pattern B from an optic beam generated by the regular LED light sources. The optic element 4 may include a single or a multiple number of optical parts, such as reflecting and/or diffusing parts,

for providing a so-called depth radiation pattern wherein the light is mainly focused downwardly towards the floor of the space wherein the unit 1 has to be mounted. The intensity of light propagating in a sideward direction is relatively small. However, the optic element 4 may also be designed to form another radiation pattern from the light that is generated by the regular LED light sources, e.g. a relatively wide beam. In the shown embodiment, the lighting modules 3 are arranged in a matrix having rows and columns. However, the lighting modules can also be arranged in another pattern, e.g. in a one-dimensional row or in another mainly uniform or non-uniform distributed manner.

[0014] According to an aspect of the invention, the lighting module further includes an emergency unit having a printed circuit substrate and at least one emergency LED light source placed adjacent the regular LED light source such that the optic element also forms a radiation pattern from an optic beam generated by the emergency LED light source.

[0015] Figure 2 shows a schematic perspective partial exploded view of a LED lighting unit 1 according to a second embodiment of the invention. Here, the lighting modules 3 are arranged in a one-dimensional row. In Fig. 2, three lighting modules 3 are visible. The optic element 4 of the lighting module 3 in the middle has been lifted making the structure behind the optic element 4 visible.

[0016] The lighting module 3 includes a mounting unit 5, attached to the armature 2 on which mounting unit 5 the regular LED light source 6 is mounted. The emergency unit 7 includes a printed circuit substrate 8 and four emergency LED light sources 9a-d placed adjacent the regular LED light source 6. The emergency LED light sources 9 are located on a circle 10, preferably evenly distributed in the circumferential direction, surrounding a line of symmetry S of the optic element 4 such that the optic element 4 also forms a radiation pattern from the optic beams generated by the emergency LED light sources 9. By locating the emergency LED light sources close to the regular LED light source, the optic element 4 provides a desired light pattern, both from the regular and the emergency LED light sources 6, 9. Thus, the use of additional optic elements is superfluous, thereby reducing costs and maintaining an esthetical design of the LED lighting unit 1.

[0017] Preferably, the printed circuit substrate 8 of the emergency unit 7 includes a flexible circuit foil, e.g. made from a flexible PCB or a plastic such as a polyimide, PEEK or a transparent conductive polyester film. By applying a flexible circuit foil, the process of assembling the lighting module is rendered simple and a chance of damage during handling the armature is low. Alternatively, another printed circuit substrate can be applied, such as a rigid printed circuit board, e.g. FR4, can be applied.

[0018] It is noted that, generally, the emergency LED light sources 9 are located close to the line of symmetry S of the optic element 4, thereby improving the optical performance of the optic element 4 relative to the emergency LED light sources 9. Generally, the emergency LED light sources have an offset relative to said line of symmetry S. However, an emergency LED light source can also be located at said line of symmetry S, or at a distance more remote from said line of symmetry S.

[0019] As shown in Fig. 2, the printed circuit substrate 8 of the emergency unit 7 is located between the mounting unit 5 and the optic element 4 of the lighting module 3. By interposing the printed circuit substrate 8 between the optic element 4 and the structure on which the regular LED light source is mounted, the regular LED light source and the emergency LED light sources can be located close to each other, thereby providing a module 3 with a single optic element 4 generating a desired radiation pattern for both the regular and the emergency LED light sources. In this respect it is noted that the mounting unit 5 can be replaced by another structure on which the regular LED light source 6 is mounted. Further, the regular LED light source 6 can be mounted directly on the armature 2 of the lighting unit 1.

[0020] According to an aspect of the invention, the structure on which the regular LED light source is mounted and the printed circuit substrate of the emergency unit are different.

[0021] The printed circuit substrate 8 is provided with an opening 11 allowing light generated by the regular LED light source 6 of the lighting module 3 to propagate towards the optic element 4. By providing the opening 11, the regular LED light source 6 and the emergency LED light sources 9 can be located close to each other in a compact design while maintaining a reliable, stable assembling process. In particular embodiments, the lighting module 3 includes a multiple number of regular LED light sources. Then, the printed circuit substrate of the emergency unit 7 can be provided with a multiple number of openings, each of them allowing light generated by a single or a multiple number of regular LED light sources 6 to propagate towards the optic element 4. In the shown embodiment, the number of emergency LED light sources 9 is four. However, also another number of emergency LED light sources 9 can be applied, e.g. three, two or one emergency LED light source, or more than four light sources, e.g. five or ten emergency LED light sources.

[0022] In an alternative embodiment, the mounting unit 5 with the at least one regular LED light source is interposed between the optic element 4 and the printed circuit substrate 8. Then, openings can be provided in the mounting unit 5 allowing light generated by the at least one emergency LED light source to propagate towards the optic element 4.

[0023] In the shown embodiment, the optic element 4 is dome-shaped, and the emergency LED light sources are located within the dome of the optic element. Apparently, the optic element 4 may have another geometry, e.g. being plate-shaped. Generally, the light generated by the LED light sources propagates through and/or along the optic element 4 for obtaining a desired radiation

pattern.

[0024] Preferably, the emergency LED's generate an emitted flux that is less than 10% of the flux emitted by the regular LED's, thereby saving power during an emergency situation.

[0025] The LED lighting unit 1 may includes a multiple number of lighting modules 3 as described above, i.e. including an emergency unit 7. However, the LED lighting unit 1 may also include only one lighting module 3 with an emergency unit 7. Further, the LED lighting unit 1 may include lighting modules 3 without an emergency unit, i. e. including only one or more regular LED light sources, not including an emergency LED light source.

[0026] The LED lighting unit 1 further includes regular input terminals 12 for being connected to a regular driver driving the regular LED's when the LED lighting unit 1 is switched on. The printed circuit substrate 8 of the emergency unit 7 includes also emergency input terminals 13 for being connected to an emergency driver for driving the emergency LED's in case of emergency. Preferably, all emergency LED light sources of the LED lighting unit, optionally from a multiple number of emergency units, are driven via a single set of emergency input terminals 13.

[0027] According to an aspect of the invention, a lighting system is provided including a regular driver, an emergency driver and a LED lighting unit as described above, wherein the regular driver is connected to the regular input terminals for driving the at least one regular LED light source of the lighting module, and wherein the emergency driver is connected to the emergency input terminals for driving the at least one emergency LED light source.

[0028] Advantageously, the lighting system includes a multiple number of LED lighting units as described above, wherein the emergency driver is connected to the emergency input terminals of the multiple number of LED lighting units, for driving the at least one emergency LED light source of the multiple number of LED lighting units. Alternatively, the emergency input terminals of each LED lighting unit are connected to a corresponding emergency driver so that each emergency driver drives the at least one emergency LED light source of a corresponding LED lighting unit.

[0029] Preferably, each LED lighting unit in a room and/or each LED lighting unit of a lighting system is provided with an emergency unit as described above.

[0030] The emergency driver drives the emergency LED light sources when the mains voltage drops and the regular driver stops operating.

[0031] A mains power keeping the regular driver in operation can be implemented as 230 V or other typical voltage values offered by regular electrical power connections. The emergency power can be formed by a separate mains voltage and/or a local power supply, such as a battery 7. Further, control lines can be connected to manual or automatic switches.

[0032] During regular use of the LED lighting unit 1, when the mains voltage is active, the multiple number of regular LED's 3 are driven by providing a mains voltage, via the regular driver, to the individual LED's 3.

[0033] However, during a mains voltage drop, the emergency driver starts operating supplying power to the emergency LED's, via the emergency input terminals 13.

[0034] The invention is not restricted to the embodiments described herein. It will be understood that many variants are possible.

[0035] A regular or emergency LED light source can be implemented as an OLED or a chip on board (COB) module, and/or may include a remote phosphor module.

[0036] These and other embodiments will be apparent for the person skilled in the art and are considered to fall within the scope of the invention as defined in the following claims.

Claims

1. A LED lighting unit, comprising an armature and a lighting module carried by the armature, the lighting module including at least one regular LED light source and an optic element forming a radiation pattern from an optic beam generated by the regular LED light source, wherein the lighting module further includes an emergency unit having a printed circuit substrate and at least one emergency LED light source mounted on said printed circuit substrate and placed adjacent the regular LED light source such that the optic element also forms a radiation pattern from an optic beam generated by the emergency LED light source,
   wherein the printed circuit substrate of the emergency unit is located between a structure on which the regular LED light source is mounted and the optic element of the lighting module,
   and wherein the printed circuit substrate of the emergency unit and the mounting unit of the lighting module are separate.

2. A LED lighting unit according to claim 1, wherein the lighting module includes a multiple number of regular LED light sources.

3. A LED lighting unit according to claim 1 or 2, wherein the emergency unit includes a multiple number of emergency LED light sources.

4. A LED lighting unit according to any of the preceding claims, wherein the printed circuit substrate of the emergency unit includes a flexible circuit foil.

5. A LED lighting unit according to any of the preceding claims, wherein a geometric centre of the at least one emergency LED light source is close to a line of symmetry of the optic element.

6. A LED lighting unit according to any of the preceding claims, wherein the at least one emergency LED light sources are located on a circle surrounding a line of symmetry of the optic element.

7. A LED lighting unit according to any of the preceding claims, wherein the lighting module further includes a mounting unit or another structure on which the regular LED light source is mounted.

8. A LED lighting unit according to any of the preceding claims, wherein the printed circuit substrate of the emergency unit includes at least one opening allowing light generated by the regular LED light source of the lighting module to propagate towards the optic element.

9. A LED lighting unit according to any of the preceding claims, wherein the optic element has dome-shaped.

10. A LED lighting unit according to claim 8, wherein the at least one emergency LED light source is located within the dome of the optic element.

11. A LED lighting unit according to any of the preceding claims, comprising a multiple number of lighting modules exclusively including at least one regular LED light source.

12. A LED lighting unit according to any of the preceding claims, comprising a multiple number of lighting modules, including lighting modules without an emergency unit.

13. A LED lighting unit according to any of the preceding claims, including regular input terminals for driving the at least one regular LED light source of the lighting module, wherein the printed circuit substrate of the emergency unit includes emergency input terminals for driving the at least one emergency LED light source.

14. A lighting system, comprising a regular driver, an emergency driver and a LED lighting unit according to claim 13, wherein the regular driver is connected to the regular input terminals for driving the at least one regular LED light source of the lighting module, and wherein the emergency driver is connected to the emergency input terminals for driving the at least one emergency LED light source.

15. A lighting system according to claim 14, comprising a multiple number of LED lighting units according to claim 13, wherein the emergency driver is connected to the emergency input terminals of the multiple number of LED lighting units, for driving the at least one emergency LED light source of the multiple number of LED lighting units.

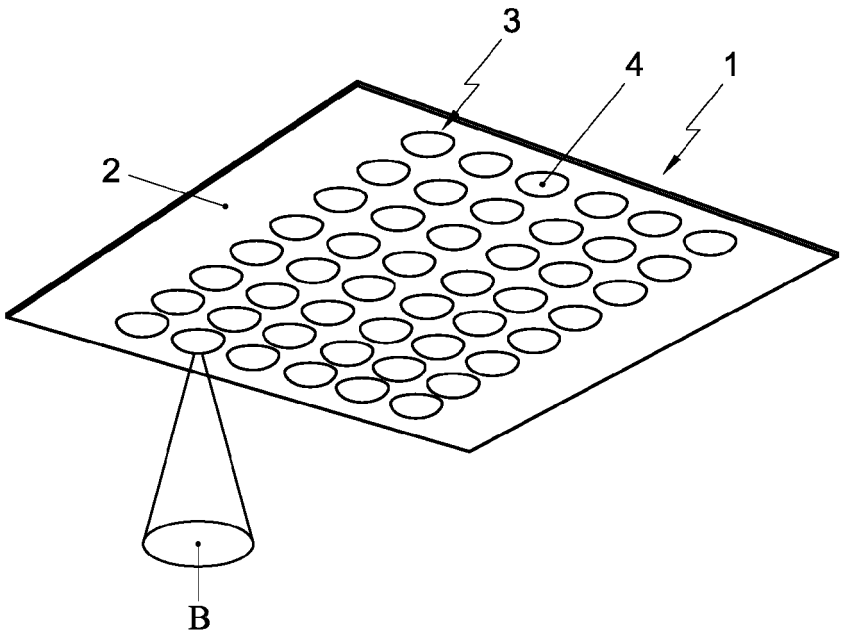

Fig. 1

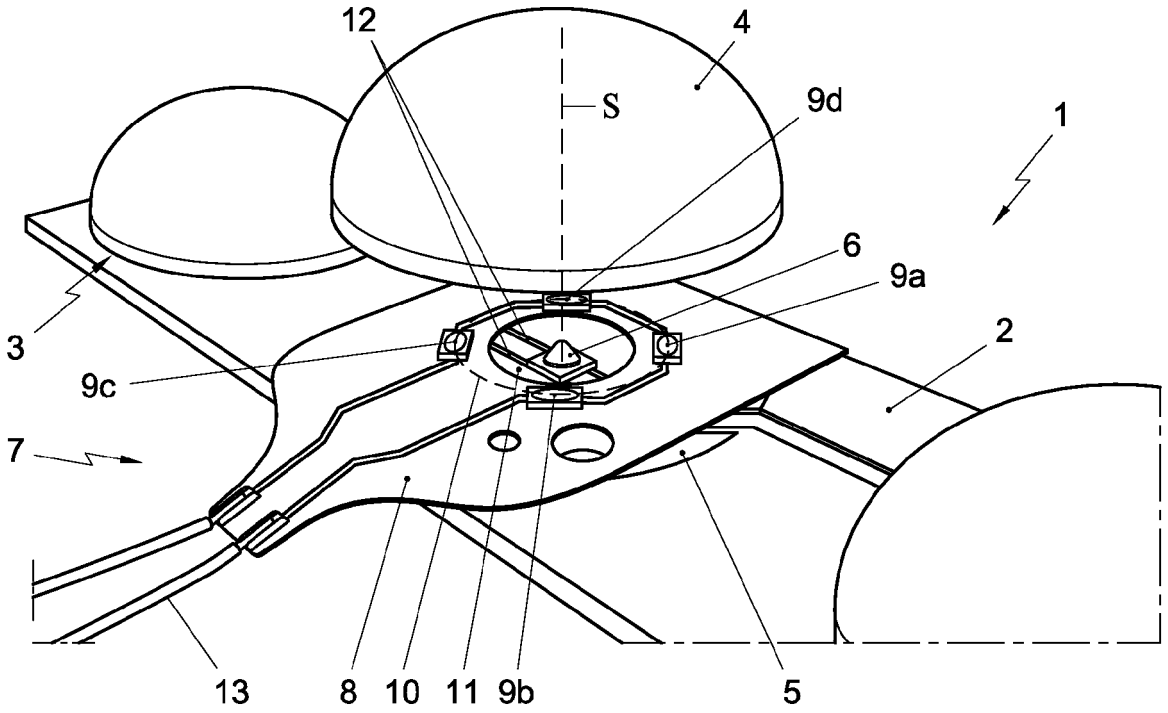

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 2498

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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	20 January 2015	Dinkla, Remko

CATEGORY OF CITED DOCUMENTS

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