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(54) LUMINAIRE WITH MOTION DETECTION MEANS

(57) A luminaire (1, 11) including at least one LED module (5), a reflector (2, 9) for influencing the light emitted by the LED module (5) and motion detection means comprising at least one sensor (4) having a detection surface, wherein the luminaire (i) further comprises guiding means (3, 8) for guiding infrared radiation arriving at

or in the reflector (2, 9) to the detection surface of the sensor (4), wherein the guiding means (3) are at least partly integrated in the reflector (2) or wherein the guiding means (8) are at least partly arranged on the LED module (5) or on/in a light emitting surface (6).

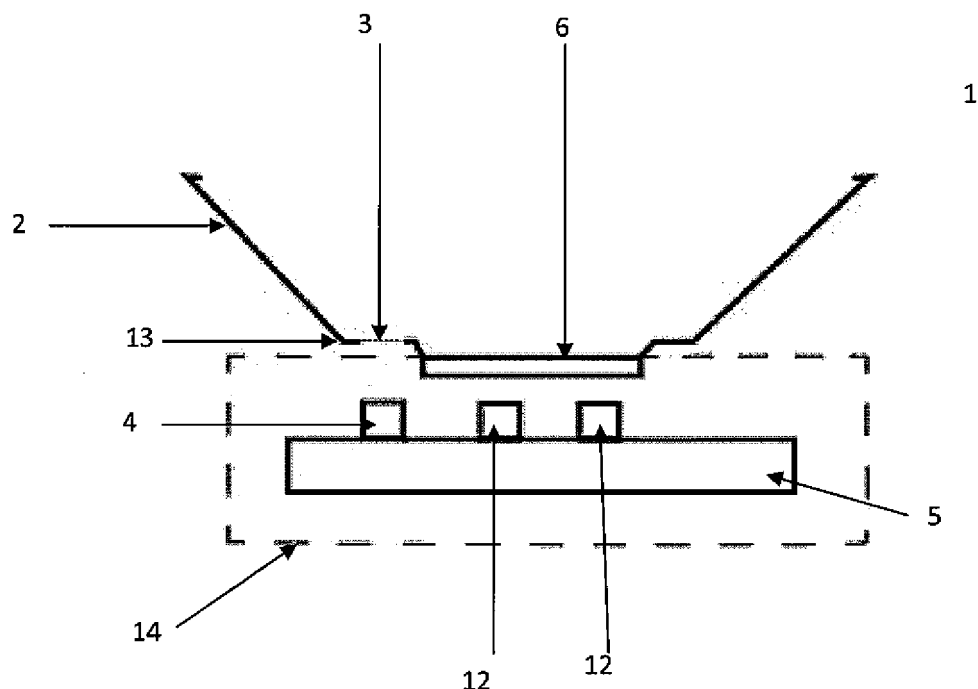


Fig. 3

Description

[0001] The present invention relates to a luminaire including at least one LED module, a reflector for influencing the light emitted by the LED module and motion detection means comprising at least one sensor having a detection surface. Further, the present invention relates to a system having at least two of the luminaires.

[0002] Motion detection means or motion detection sensors are widely used in combination with any kind of light sources or luminaires. For example, such a motion detection sensor is used to detect the motion of a person or object in the detection area of the motion detection sensor and then controls the luminaire to be switched on. Accordingly, it is possible with such a motion detection sensor to only switch on a luminaire in case a person or object is close or near the luminaire (in the lighting area of the luminaire). Otherwise, the luminaire is not switched on and energy and costs can be reduced.

[0003] For motion detection commonly a passive infrared sensor (PIR sensor) is used as a motion detection sensor, wherein a PIR sensor is an electronic sensor that measures infrared light radiating from persons or objects in its field of view.

[0004] Such PIR sensors or motion detection sensors are then often placed close to the luminaire which should be switched on. Further, it is already known to include a motion detection sensor in the housing of the luminaire. However, in case the luminaire is a downlight luminaire it is not as easy to match the downlight luminaire with the motion detection sensor respectively arrange the downlight luminaire together with the motion detection sensor in one housing, since either the light emitting surface and reflector combination of the luminaire is disrupted or an external housing for the motion detection sensor is needed.

[0005] It is therefore an object of the present invention to propose a luminaire that offers the possibility, in particular in case of a downlight luminaire, that the motion detection sensor respectively the motion detection means are included together with the luminaire in for example a housing.

[0006] This object is achieved by means of the features of the independent claims. The dependent claims further develop the central idea of the present invention.

[0007] The present invention relates to a luminaire including at least one LED module, a reflector for influencing the light emitted by the LED module and motion detection means comprising at least one sensor having a detection surface, wherein the luminaire further comprises guiding means for guiding infrared radiation arriving at or in the reflector to the detection surface of the sensor, wherein the guiding means are at least partly integrated in the reflector.

[0008] The guiding means can then comprise a surface integrated in the reflector through which the infrared radiation is guided to the detection surface of the sensor, wherein the surface can be reflective for the light emitted

by the LED module and translucent for infrared radiation. This surface could comprise a window integrated in the reflector. This surface could be for example then flush with a surface of the reflector.

[0009] It would be also possible that the guiding means comprise a surface integrated in the reflector for guiding the infrared radiation to the detection surface, wherein the surface can be reflective or refractive. This surface could be for example then flush with a surface of the reflector

[0010] The area of reflector where at least part of the guiding means can be integrated in the reflector could be for example an area, which is not of highest importance for the reflector of the luminaire (the reflecting characteristics of the reflector regarding the influencing of the light emitted by the LEDs). For example the guiding means can be at least partly integrated in the rim area of the reflector, wherein the rim area of the reflector is used to mount the reflector on a support mount of the luminaire.

[0011] By using guiding means for guiding infrared radiation to the detection surface of the sensor, wherein the guiding means are at least partly integrated in the reflector, it is then possible that the sensor of the motion detection means are build together with the downlight luminaire, in, for example, one housing and therefore the luminaire together with the motion detection sensor does need less space. Further, by integrating the guiding means at least partly in the reflector, it is possible to reduce the impact on the aesthetic of the luminaire to a minimum.

[0012] The present invention further relates to a luminaire including at least one LED module, a reflector for influencing the light emitted by the LED module and motion detection means comprising at least one sensor having a detection surface, wherein the luminaire further comprises guiding means for guiding infrared radiation arriving at or in the reflector to the detection surface of the sensor, wherein the guiding means are at least partly arranged on the LED module or on/in a light emitting surface.

[0013] The guiding means can comprise a surface through which the infrared radiation is guided by the guiding means to the detection surface, wherein the surface can be reflective for light emitted by the LED module and translucent for infrared radiation.

[0014] It would be also possible that the guiding means comprise a surface for guiding the infrared radiation to the detection surface, wherein the surface can be reflective or refractive.

[0015] By using guiding means for guiding infrared radiation to the detection surface of the sensor, wherein the guiding means are at least partly arranged on the LED module, it is then possible that the sensor of the motion detection means are build together with the downlight luminaire, in, for example, one housing and therefore the luminaire together with the motion detection sensor does need less space. Further, by integrating the guiding

means at least partly in the reflector, it is possible to reduce the impact on the aesthetic of the luminaire to a minimum.

[0016] In both cases, in case the guiding means are at least partly integrated in the reflector and in case the guiding means are at least partly arranged on the LED module, the LED module comprises at least one LED.

[0017] Further, the motion detection means can be arranged on the LED module.

[0018] It would be also possible that the luminaire further comprises a circuit board with electronic elements for controlling and powering the LED module, wherein the motion detection means are arranged on the circuit board.

[0019] In addition, the reflector can have reflective elements and/or a reflective surface for reflecting the infrared radiation to the guiding means.

[0020] In case the guiding means are at least partly integrated in the reflector and the guiding means comprise a surface integrated in the reflector through which the infrared radiation is guided to the detection surface, the reflector can have at least one reflective element for reflecting the infrared radiation to the guiding means, wherein the at least one reflective element is positioned close to the surface of the guiding means through which the infrared radiation is guided to the detection surface. The sensor of the motion detection means can be a passive infrared, PIR, sensor.

[0021] Further, the motion detection means can comprise more than one sensor, wherein each sensor has a detection surface. With a plurality of sensors, for example three sensors as motion detection means, it is possible for example that the direction of a movement of a person or object can be detected.

[0022] Preferably the luminaire is a downlight luminaire.

[0023] The present invention further relates to a lighting system having at least two of the luminaires, wherein the system is configured to control the luminaires according to a movement and a movement direction of a person or object detected by at least one of the luminaires.

[0024] Such fully integrated motion detection sensors have the advantage that no external housing is needed for the motion detection sensor and further the impact on the aesthetic of the luminaire is minimized.

[0025] These and other aspects and advantages of the present invention will become more apparent when studying the following detailed description, in connection with the figures, in which:

Fig. 1 shows a top view of a luminaire according to the present invention;

Fig. 2 shows a top view of a further luminaire according to the present invention;

Fig. 3 shows a side view of the luminaires in the fig. 1 and 2;

Fig. 4 shows a top view of a further luminaire according to the present invention;

Fig. 5 shows a top view of a further luminaire according to the present invention;

Fig. 6 shows a side view of the luminaires in the fig. 4 and 5;

Fig. 7 shows a side view of a luminaire according to a further embodiment of the invention

Fig. 8 shows a lighting system according to the present invention.

[0026] Fig. 1 shows schematically a top view of a luminaire 1 according to the present invention. The luminaire 1 shown in fig. 1 is a downlight luminaire with a circularly formed light emitting surface 6 with a cup-shaped reflector 2. The side view of the luminaire 1 is illustrated by Fig3..

[0027] According to Figs 1-3 luminaire 1 comprises a reflector 2, a LED module 5 with motion detection means including a motion detection sensor 4, and a housing 14 providing the light emitting surface 6. The light emitting surface 6 is realized by a cover/diffuser element applied on the housing 14 of the downlight luminaire 1. The motion detection sensor 4 and the LEDs 12 are part of the LED module 5 and they can be placed or arranged on a circuit board of the LED module 5. Further, the motion detection sensor 4 comprises a detection surface for detecting infrared radiation and can further comprise an optical element for collecting/enhancing the infrared signal, The optical element can be a lens or a reflector known from the state of art (illustrated e.g. on Fig 6 as optical element 8). Preferably the sensor 4 is a PIR sensor.

[0028] It should be noted that the reflector 2 influences/reflects the light emitted by the light emitting surface 6. Reflectors are widely applied at downlight luminaires. The cup-shaped reflector 2 has at one end a smaller opening compared to the opening at the other end. The light emitting surface 6 is then arranged in the middle of the circular opening at the smaller end of the cup-shaped reflector 2, as it can be seen on the fig. 1 and 3. This is a well-known application of a reflector at a downlight luminaire, and it is not explained in more details.

[0029] As it can be further seen on the fig. 1 and 3 luminaire 1 comprises the guiding means, which are at least partly integrated in the reflector 2, wherein the guiding means on fig. 1 and 3 in particular include a window 3 that is integrated into/onto the reflector 2. Preferably the window 3 is then flush with the surface of the reflector. The window 3 forms a surface of the guiding means through which the infrared radiation is guided to the detection surface of the motion detection sensor 4. The window 3 can be realized as a hole or as a cover element (e.g. optical element). In a further embodiment of the invention the guiding means can comprise the optical ele-

ment 8. Said optical element 8 can be mounted close to window 3 or directly onto it (not shown on Figs 1 and 3).

[0030] The window 3 is placed in the cup-shaped reflector 2 in particular in an area, which does not affect (or its effect is negligible) the original function of the reflector 2 concerning its reflective, diffusive and/or light guiding properties influencing the light emitted by the light emitting surface 6. For example, the window 3 can be integrated in the rim area 13 of the reflector 2, wherein the rim area 13 of the reflector 2 is used to mount the reflector 2 on a top surface of the luminaire housing 14.

[0031] It should be noted that on fig.1 the window 3 is shown having a square shape. However, it is also possible that the window 3 has any other shape.

[0032] The detection surface of the motion detection sensor 4 is not positioned on the reflector 2, but close or near to the window 3 in such a way that infrared radiation originated from the inner surface of the reflector 2 and passing through the window 3 is guided to the detection surface of the sensor 4. Thus, as it is illustrated by the example on fig. 3, the motion detection sensor 4 is positioned on the LED module 5 in such a way that it is also close to the window 3.

[0033] The guiding means represented by the window 3 guide the infrared radiation appearing at or in the reflector 2 to the detection surface of the sensor 4. The sensor 4 can detect the infrared radiation that reaches the luminaire 1, particularly the reflector 2, and the sensor can measure the infrared radiation from objects or persons in its field of view. Therefore, the luminaire 1 detects e.g. a person who is in the viewing area of the luminaire 1 (or of the detector 4) and switches the LEDs 12 on.

[0034] Further, it is possible that the window 3 is configured in such a way that it is reflective for the light emitted by the LEDs 12 and translucent for infrared radiation. Thus, only the infrared radiation is guided from the inside of the reflector 2 to the detector 4 through the window 3. On the other side, window 3 is reflective for the light emitted by the LEDs 12/light emitting surface 6 and the ambient light reaching the surface of the reflector 2. So, the reflective characteristics of the reflector surfaces 2 are not modified and its original function remains concerning the light emitted by the LEDs 12 after the application of the window 3.

[0035] In a further embodiment of the invention the reflective surface of the reflector 2 is configured to reflect at least a part of or all infrared radiation reaching the surface of the reflector 2 and said radiation is reflected/guided to the window 3. The light distribution of the luminaire 1 won't be modified by the application of said reflector 2 comprising said surfaces reflective (window 3) for the infrared radiation. Both functions could be incorporated into reflector 2 at the same time.

[0036] As it is shown in Fig. 2 the reflector 2 additionally can comprise at least one reflective element 7, which is positioned in the reflector 2 in such a way that infrared radiation arriving in or at the reflector 2 is focused to the window 3 by the at least one reflective element 7. The

reflective element(s) 7 can be positioned on the rim 13 of the reflector 2.

[0037] It is possible that the reflective element(s) 7 could be positioned into the vicinity of (close to) the window 3 (or they could be integrally formed/integrated). In a particular embodiment the reflective element 7 could be a reflector (a horseshoe-shaped one) and window 3 could be realized as a hole.

[0038] In a further embodiment of the invention the reflective element 7 can represent the optical element 8 of the motion detector 4.

[0039] In a further embodiment of the invention there can be more than one e.g. 3 windows applied onto the reflector 2, which are in connection with 3 corresponding motion detection sensors 4. On this way basically the viewing/detection angle of the luminaire is close to or reaches 360°. Optionally, the window(s) 3 could be applied for mounting the reflector 2 to the housing 14 at the same time (e.g. a bayonet connector).

[0040] The detection surface of the sensor 4 and therefore also the sensor 4 could be according to Fig. 3 placed directly or close to the window 3, so that there is no further element needed for guiding the infrared radiation that passes through the window 3 to the detection surface of the sensor 4. However, it could be also possible that the detection surface of the sensor is not directly positioned to the window. In such a case, the guiding means can comprise further elements, which should guide the infrared radiation that passes through the window to the detection surface of the sensor.

[0041] It should be further noted that not only the sensor 4 itself can be placed on the LED module 5, but also other parts of the motion detection means needed for the motion detection and switching on and off the LEDs 12.

Further, it could be possible that the LED module 5 already comprises further electronic elements for controlling and powering the LEDs 12 of the LED module. It would be, however, also possible that the luminaire 1 comprises an additional circuit board with electronic elements for controlling and powering the LED module 5 respectively the LEDs 12, wherein further elements of the motion detection means could be then also placed on this additional circuit board. In such a case, it would be additionally also be possible that also the motion detection sensor with the detection surface is placed on this additional circuit board and the guiding means then comprises further elements that could guide the infrared radiation, which passes through the corresponding window in the reflector, to the detection surface of the sensor.

[0042] In the Figs. 1, 2 and 3 a window 3 is shown as the guiding means through which the infrared radiation can pass through. However, it would be also possible that the guiding means comprise a surface integrated in the reflector for guiding the infrared radiation to the detection surface of the sensor, wherein the surface is reflective or refractive. In such a case it could be possible that the guiding means comprises further elements, which can guide the infrared radiation by their reflective

or refractive surface to the detection surface of the sensor 4. This surface could then be flush with surface of the reflector.

[0043] A downlight luminaire 11 similar to the one illustrated by Figs. 1-3 according to a further embodiment of this invention is shown on Figs. 4-7. However in this embodiment the guiding means is not integrated onto/in to the reflector 9, but it is arranged on the LED module 5 or on/in the light emitting surface 6. As it is illustrated on figures 4 to 7, the guiding means comprise an optical element 8, for example a lens, which is positioned directly in front of the detection surface of the motion detection sensor 4.

[0044] The light emitting surface 6 is similar to the light emitting surface 6 shown in the Figs. 1-3, wherein the light emitting surface 6 can comprise a window, as part of the guiding means, that could be flush with the light emitting surface 6. Through this window the infrared radiation is then guided to the detection surface of the motion detection sensor 4 respectively to the optical element 8. The window could be also formed as a hole in the light emitting surface 6.

[0045] In a further embodiment of the invention the optical element 8 (or the guiding means) is mounted onto or incorporated into the light emitting surface 6, which could be realized like in case of luminaire 11 by an optical element such as a diffusor plate, cover or a remote phosphor element. This embodiment is illustrated by Fig. 7. It should be further noted that in the luminaire 11 in Fig. 7 the optical element 8 (or the guiding means) itself can be a window or a hole incorporated into the light emitting surface 6.

[0046] The reflector 9 is similar to the reflector 2 shown in the Fig. 1 to 3 with the difference that the reflector 9 does not comprise a window.

[0047] In difference to the luminaire 1 shown in the figures 1 to 3, in the luminaire 11 shown in the figures 4 to 7, the sensor 4 is then arranged close to the LEDs 12 in such a way that the reflector 9 does not cover the sensor 4. Thus, it is not necessary that a window is placed in the reflector 9. The infrared radiation, reaching the reflector 9, approaches the element 8 of the guiding means, wherein this element 8 guides the infrared radiation to the detection surface of the sensor 4. However, as an alternative not shown, it would still be possible that reflector respectively the rim area of the reflector comprises a window or hole.

[0048] The LEDs 12 can be switched on and off (or eventually dimmed) according to this embodiment of the invention like in case of the luminaire 1 shown on Figs 1-3 corresponding to the motion detected according the sensed IR signal.

The reflector 9 of the luminaire 11 of the figures 4 to 7 can then also comprises a reflective surface for reflecting the infrared radiation to the guiding means, in particular to the element 8, similarly as already described in details in case of the luminaire 1 of the figures 1 to 3. The same also applies to reflective elements 7 shown in figure 5,

which have the same function as the reflective elements 7 shown in figure 2.

[0049] The surface and therefore the element 8 of the guiding means by which the infrared radiation is guided to the detection surface can be reflective for light emitted by the LED module 5 and translucent for infrared radiation, similar to the function of the window 3 in the figures to 3. Alternatively, it could be possible that the guiding means comprise a surface for guiding infrared radiation to the detection surface, wherein the surface is reflective or refractive. In such a case, the guiding means then preferably comprise further elements which can guide the infrared radiation from the reflective or refractive surface to the detection surface of the sensor (in difference to the one shown in figure 6).

[0050] Regarding further elements of the motion detection means and the arranging/placing of the sensor on the LED module, it is again referred to the detailed explanations in view of the figures to 3, which also apply for the luminaire 11 shown in the figures 4 to 7. The same is valid for the electronic elements for controlling and powering the LEDs 12 and for an additional circuit board which could comprise these electronic elements. It is here again referred to the detailed description to the figures 1 to 3, which also applies here.

[0051] It should be further noted that the motion detection means can comprise more than one sensor (e.g. 3 pieces), wherein each sensor has a detection surface. The sensors could then be evenly distributed in the luminaire and on this way it is possible to detect for example movement of a person or an object and possibly also the direction of the movement by applying a viewing/detection angle of nearly 360°.

[0052] Figure 8 shows a lighting system that comprises four luminaires 1, which are shown in the figures 1 to 3. Further, a person is shown in the area of one of the luminaires 1 and moves in the direction 10. By using many pieces of the luminaires 1, it is then possible not only detect a person, but also in case the person is moving, detect its movement and its movement direction 10. With help of this information it is possible to control the luminaires 1 accordingly. For example, the luminaires 1 are switched on and off according to the anticipated further movement detected by a the next or a further luminaire in the system of the person monitored.

[0053] The present invention provides a luminaire comprising a motion detection sensor without its external housing. Said solution is resulted in an easily assembling of the luminaire, offers a price reduction and opens the aesthetical design options, because the housing of the sensor can be eliminated.

Claims

1. A luminaire (1) comprising

- at least one LED module (5),

- a reflector (2) for influencing the light emitted by the LED module (5) and
- motion detection means comprising at least one sensor (4) having a detection surface,

characterized in that

the luminaire (1) further comprises guiding means (3) for guiding infrared radiation arriving at or in the reflector (2) to the detection surface of the sensor (4), wherein the guiding means (3) are at least partly integrated in the reflector (2).

2. The luminaire according to claim 1,
characterized in that
the guiding means comprise a surface (3) integrated in the reflector (2) through which the infrared radiation is guided to the detection surface of the sensor (4).

3. The luminaire according to claim 2,
characterized in that
the surface (3) of the guiding means through which the infrared radiation is guided to the detection surface is reflective for the light emitted by the LED module (5) and translucent for infrared radiation.

4. The luminaire according to any one of the claim 2-3,
characterized in that
the surface of the guiding means through which the infrared radiation is guided to the detection surface comprises a window (3) integrated in the reflector (2).

5. The luminaire according to claim 1,
characterized in that
the guiding means comprise a surface integrated in the reflector for guiding the infrared radiation to the detection surface.

6. The luminaire according to claim 5,
characterized in that
the surface of the guiding means for guiding the infrared radiation to the detection surface is reflective or refractive.

7. A luminaire (11) comprising
- at least one LED module (5),
 - a reflector (9) for influencing the light emitted by the LED module (5) and
 - motion detection means comprising at least one sensor (4) having a detection surface,

characterized in that

the luminaire (11) further comprises guiding means (8) for guiding infrared radiation arriving at or in the reflector (9) to the detection surface of the sensor (4), wherein the guiding means (8) are at least partly arranged on the LED module (5) or on/in a light emitting surface (6).

8. The luminaire according to claim 7,
characterized in that
the guiding means comprise a surface (8) through which the infrared radiation is guided by the guiding means to the detection surface.

9. The luminaire according to claim 8,
characterized in that
the surface (8) of the guiding means through which the infrared radiation is guided to the detection surface is reflective for light emitted by the LED module (5) and translucent for infrared radiation.

10. The luminaire according to claim 7,
characterized in that
the guiding means comprise a surface for guiding the infrared radiation to the detection surface.

11. The luminaire according to claim 10,
characterized in that
the surface of the guiding means for guiding the infrared radiation to the detection surface is reflective or refractive.

12. The luminaire according to any one of the claims 1-11,
characterized in that
the LED module (5) comprises at least one LED (12).

13. The luminaire according to any one of the claims 1-12,
characterized in that
the motion detection means are arranged on the LED module (5).

14. The luminaire according to any one of the claims 1-12,
characterized in that
the luminaire further comprises a circuit board with electronic elements for controlling and powering the LED module, wherein the motion detection means are arranged on the circuit board.

15. The luminaire according to any one of the claims 1-14,
characterized in that
the reflector (2, 9) has at least one reflective element (7) and/or a reflective surface for reflecting the infrared radiation to the guiding means (3, 8).

16. The luminaire according to any one of the claims 2-4,
characterized in that
the reflector (2) has at least one reflective element (7) for reflecting the infrared radiation to the guiding means (3, 8), wherein the at least one reflective element (7) is positioned close to the surface (3) of the guiding means through which the infrared radiation is guided to the detection surface.

17. The luminaire according to any one of the claims 1-16,
characterized in that
the sensor is a passive infrared, PIR, sensor (4). 5
18. The luminaire according to any one of the claims 1-17,
characterized in that
the motion detection means comprise more than one sensor, wherein each sensor has a detection surface. 10
19. The luminaire according to any one of the claims 1-18,
characterized in that 15
the luminaire (1, 11) is a downlight luminaire.
20. A lighting system having at least two of the luminaires (1, 11) according to one of the claims 1-19,
characterized in that 20
the system is configured to control the luminaires (1, 11) according to a movement and a movement direction (10) of a person or object detected by at least one of the luminaires (1, 11). 25
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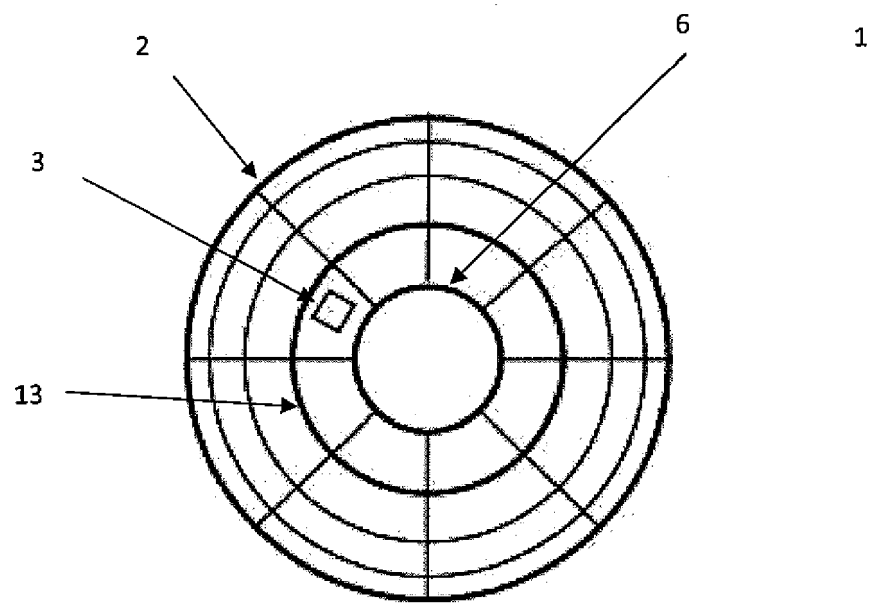


Fig. 1

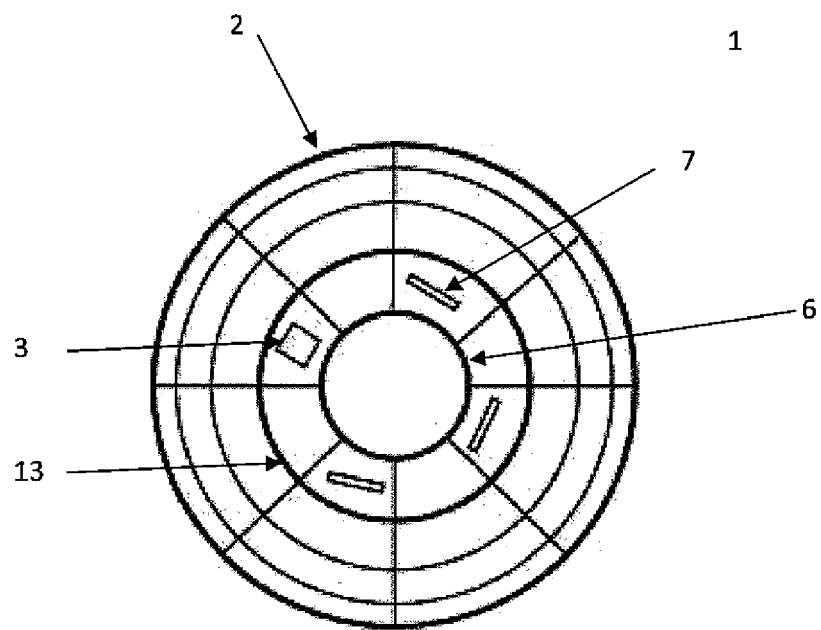


Fig. 2

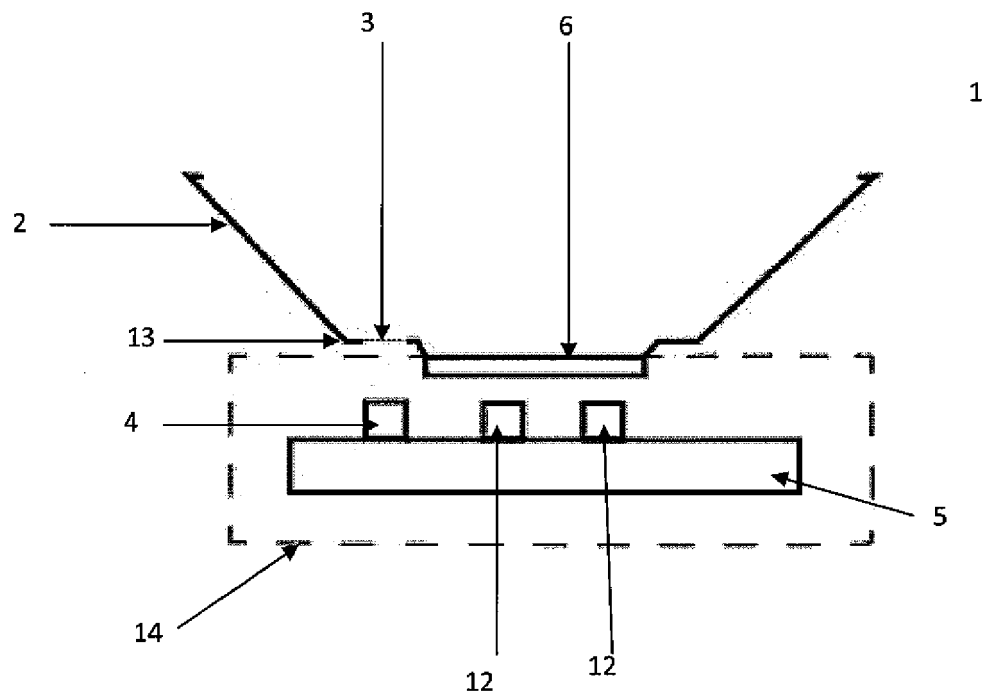


Fig. 3

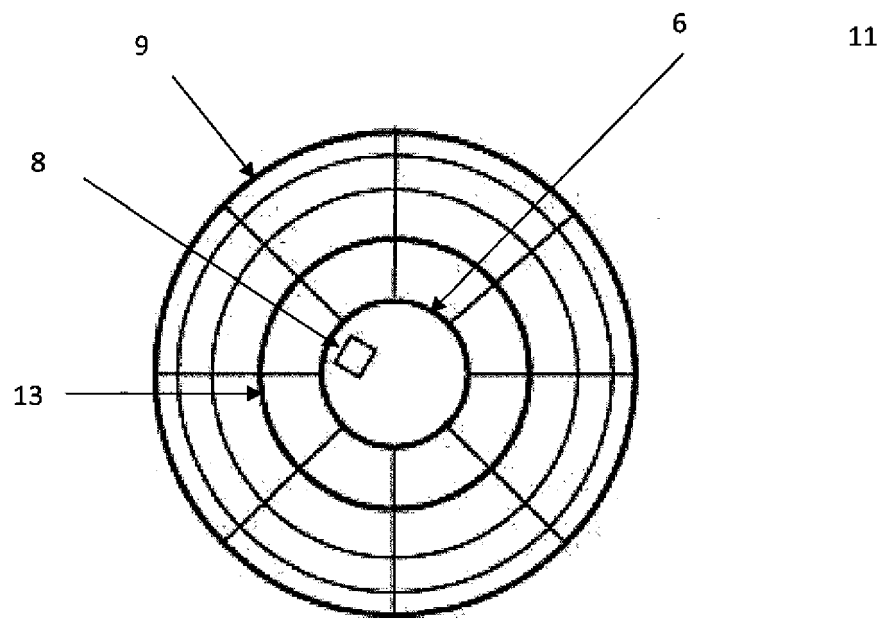


Fig. 4

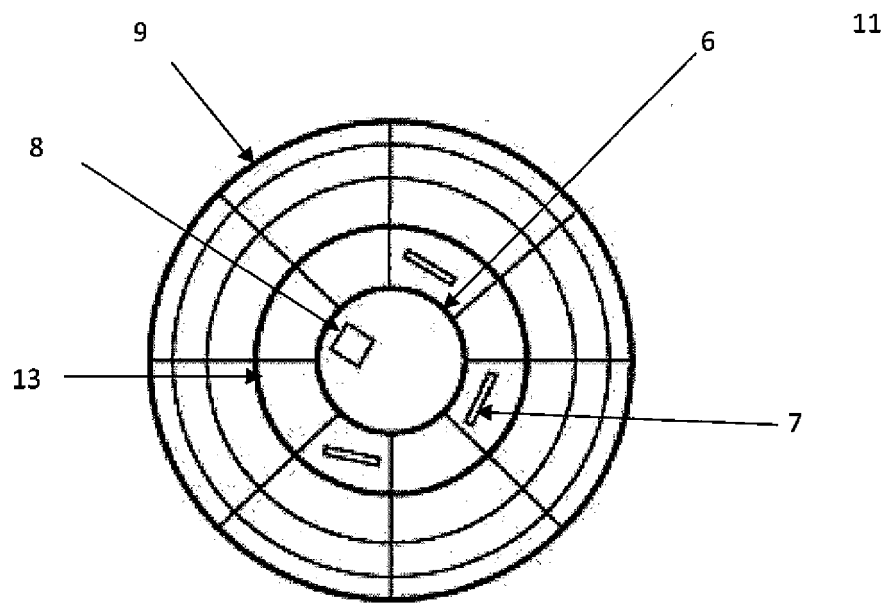


Fig. 5

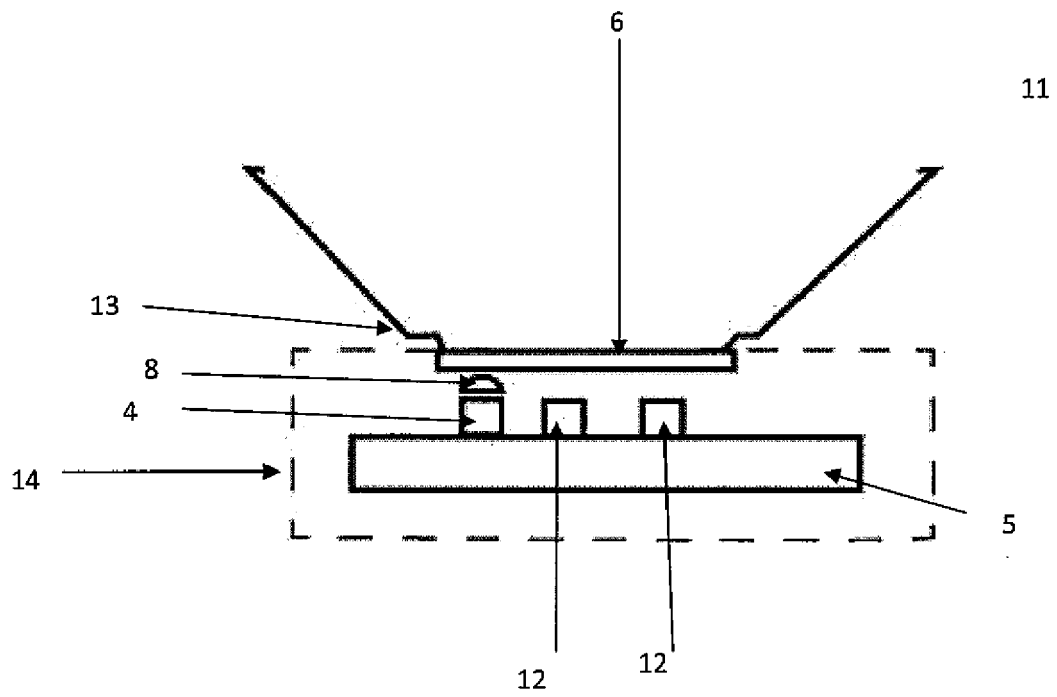


Fig. 6

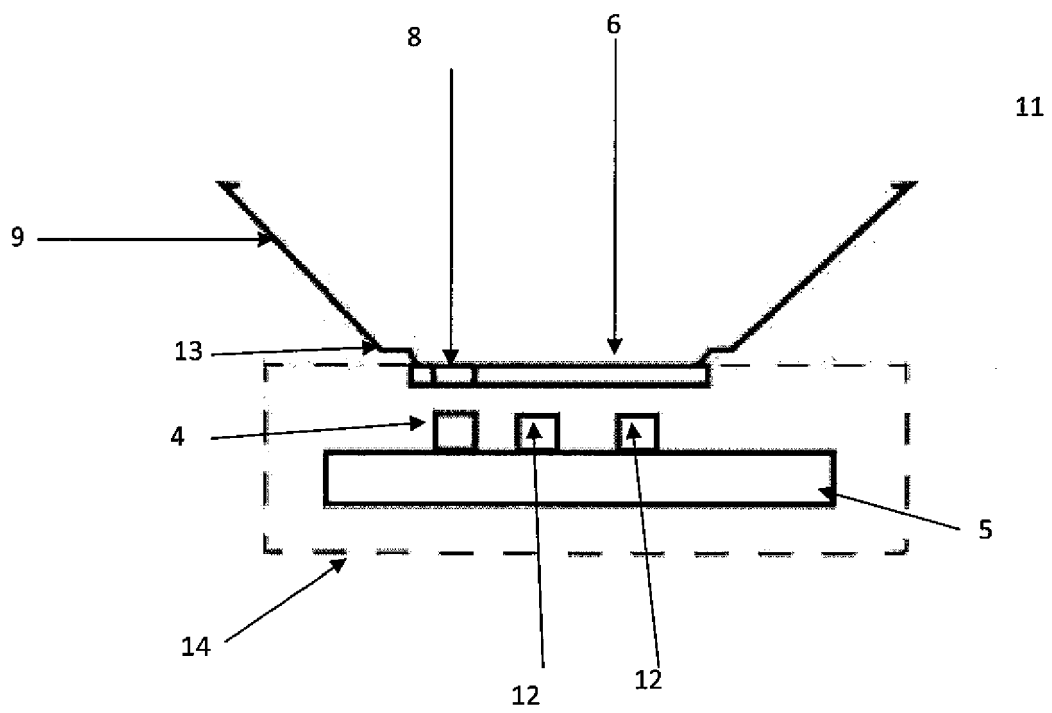


Fig. 7

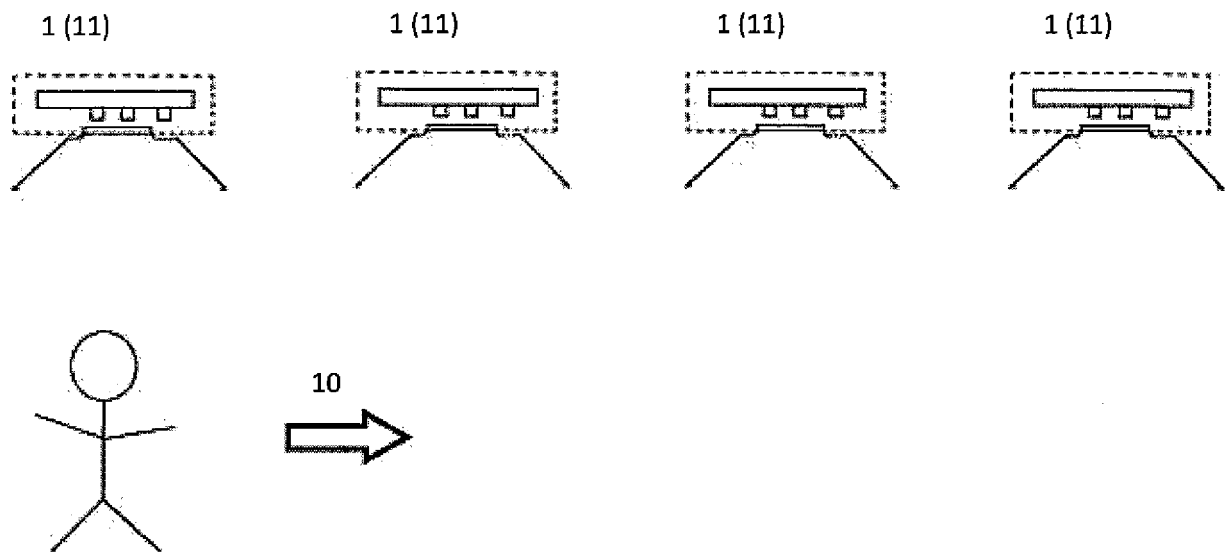


Fig. 8



EUROPEAN SEARCH REPORT

 Application Number
 EP 16 16 0139

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