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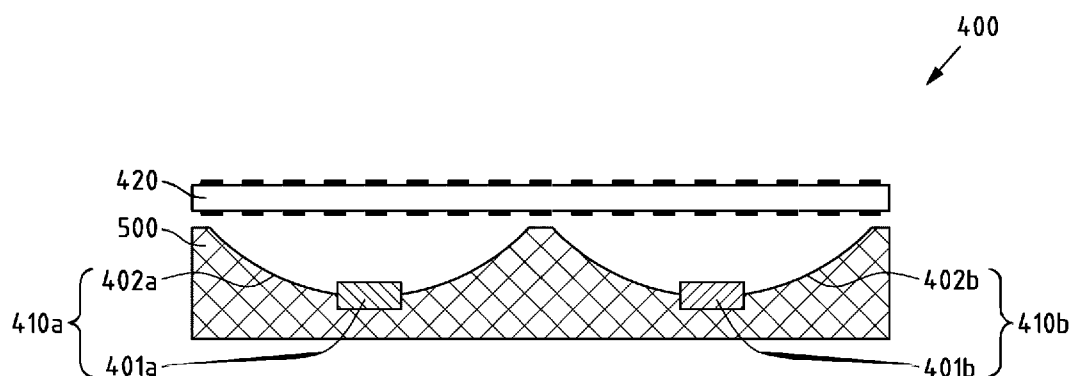


Fig.4

(57) Abstract: The invention relates to a lighting system, in particular for 3D imaging. The object to provide a lighting system (100, 400) that is capable of providing illumination for 3D imaging for a large range of distances and wider view angles, while the heat generation may be limited, is solved in that the lighting system (100, 400) comprises: a first lighting device (110a, 410a) configured to generate a first beam profile (200a, 300a), wherein the first lighting device (110a, 410a) comprises at least one individual light-emitting element (101a, 401a); a second lighting device (110b, 410b) configured to generate a second beam profile (200b, 300b), wherein the second lighting device (110b, 410b) comprises at least one individual light-emitting element (101b, 401b); wherein the lighting system (100, 400) is configured to combine the first beam profile (200a, 300a) and the second beam profile (200b, 300b) into a total beam profile (200c, 300c); and a pattern element (420) configured to generate a pattern on the first beam profile ((200a, 300a)) and/or the second beam profile (200b, 300b). The invention further relates to a method for producing a lighting system (100, 400) and the use of a lighting system (100, 400)

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LIGHTING SYSTEM WITH PATTERN ELEMENT

FIELD OF THE INVENTION

5 The present disclosure relates to lighting systems comprising lighting devices configured to generate patterned beam profiles, in particular in the area of pattern illuminators for 3D imaging purposes.

BACKGROUND OF THE INVENTION

10 In recent years, 3D imaging has become increasingly important in industrial and consumer applications. 3D imaging can be used for a wide range of applications, such as identification, authentication and/or machine vision. Means to perform 3D imaging have already been incorporated in mobile devices.

 For illumination in 3D imaging, various types of light patterns are used, for
15 example dot patterns, crosses, grids and lines. Such light patterns are typically generated by laser devices such as VCSEL arrays. The distortion of the light pattern on an object under investigation may be analysed to obtain depth information, from which a 3D representation of the object may be derived.

 In principle, as an alternative for laser light sources, light emitting diodes
20 (LEDs) could provide suitable light sources for 3D imaging. While LEDs may emit sufficient intensities for 3D imaging, LED devices are typically subject to high heat loads. In case a large range of distances of the object under investigation and the light source is needed, a lighting device with a wider angle emission angle and high flux is required, significantly increasing the drive current and heat generation when LEDs are
25 used. Further, the precision in depth sensing based on optical methods may still be further improved.

 US 2014/197314 A1 discloses a method for generating an infrared (IR) beam for illuminating a scene to be imaged, the method comprising providing at least two IR emitters, including a first IR emitter operable to emit a wide beam component of
30 the IR beam, and a second IR emitter operable to emit a narrow beam component of the IR beam, wherein the wide beam component has a linear profile that has a lower

standard deviation than a linear profile of the narrow beam component. The method also comprises selecting a desired linear profile for the IR beam, and selecting a power ratio of power directed to the first IR emitter and power directed to the second IR emitter that produces the IR beam with the desired linear profile when the narrow beam component and wide beam component are combined; and directing power to the first and second IR emitters at the selected power ratio to generate the wide and narrow beam components, and combining the generated wide and narrow beam components to produce the IR beam.

10 SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a lighting system that is capable of illuminating objects for 3D imaging for a large range of distances and wider view angles, while in particular the heat generation in the lighting system may be limited. The invention further relates to a method for producing such a lighting system and a use of such a lighting system based on the aforementioned object.

According to a first aspect of the present invention, a lighting system is provided comprising: a first lighting device configured to generate a first beam profile, wherein the first lighting device comprises at least one individual light-emitting element; a second lighting device configured to generate a second beam profile, wherein the second lighting device comprises at least one individual light-emitting element; wherein the lighting system is configured to combine the first beam profile and the second beam profiles into a total beam profile; and a pattern element configured to generate a pattern on the first beam profile and/or the second beam profile, wherein the lighting system is configured to provide a third beam profile, different from the first and the second beam profile such that at least three different beam profiles are obtained, wherein the lighting system is configured to combine the first beam profile and the second beam profile into the third beam profile; and the pattern element is configured as a pattern element arranged in the lighting system, generating a pattern on both the first beam profile, the second beam profile and the third beam profile.

According to a second aspect of the present invention, a method for producing a lighting system is provided, the method comprising: providing a first

lighting device comprising at least one individual light-emitting element configured to generate a first beam profile; providing a second lighting device comprising at least one individual light-emitting element configured to generate a second beam profile, wherein the first lighting device and second lighting device are arranged such that the first beam profile and the second beam profile are combined into a total beam profile; and
5 providing a pattern element configured to generate a pattern on the first beam profile and/or the second beam profile, wherein the lighting system is configured to provide a third beam profile, different from the first and the second beam profile such that at least three different beam profiles are obtained, wherein the lighting system is configured to
10 combine the first beam profile and the second beam profile into the third beam profile; and the pattern element is configured as a pattern element arranged in the lighting system, generating a pattern on both the first beam profile, the second beam profile and the third beam profile.

According to a third aspect of the present invention, a use of a lighting
15 system according to the first aspect is provided to determine depth information of an object illuminated by the lighting system.

Exemplary embodiments of the first, second and third aspect of the invention may have one or more of the properties described below.

The at least one individual light-emitting element of the first and/or second
20 lighting device may comprise an LED. The at least one individual light-emitting element of the first lighting device may be different from the at least one individual light-emitting element of the second lighting device. For example, the types, size and/or provided intensity of the at least one individual light-emitting element of the first lighting device may differ from the at least one individual light-emitting element of the
25 second lighting device.

A first/second beam profile may be generated when an object is illuminated by the first/second lighting device. For instance, the generated beam profiles may have different shapes and/or intensities. A first/second beam profile may be understood as the illumination pattern that is generated by the first/second lighting device when an
30 object like a screen is brought at a given distance before the lighting system. That is, the beam profile may be described by the illuminance depending on the distance and the

angular orientation, e.g. the angles relative to an optical axis of the lighting device and the distance of the object relative to the lighting device.

The lighting system is configured to combine the first beam profile and the second beam profiles into a total beam profile. Hence, the lighting system is configured
5 such that an object under investigation may be illuminated together by the first and second lighting device when first and second lighting devices are activated at the same time. For instance, the first lighting device and the second lighting device may be orientated such that the first and second lighting devices emit light substantially towards the same direction, e.g. optical axes of the lighting devices are orientated
10 substantially along the same direction. The first beam profile and the second beam profile may have intensities adjacent to each other or overlapping intensities in at least at some distances to the lighting system.

Further, only the first lighting device or only the second lighting device may be activated, such that only the first or second beam profile is generated. Hence, with
15 the lighting system according to the invention, at least three different beam profiles may be obtained.

A pattern element of the lighting system may be any optical element configured to generate a pattern on the generated beam profile. In particular, the pattern element is configured to absorb and/or reflect light emitted by the first and/or second
20 lighting device such that regions of the first and/or second beam profile are reduced in intensity and/or increased in intensity compared to the first and/or second beam profile that occurs without the pattern element. The pattern element may be configured as a single pattern element arranged in the lighting system, generating a pattern on both the first and second beam profiles. The pattern element may also comprise separated sub-
25 pattern elements. For example, the pattern element may generate a first pattern on the first beam profile and a second pattern on the second beam profile. The pattern is in particular a regular pattern that is suitable for analysis in 3D imaging. For instance, the pattern may be a (regular) line pattern, dot pattern, rectangular or square pattern.

In an exemplary embodiment of the invention, the lighting system is
30 configured to combine a first pattern generated by the pattern element on the first beam profile and a second pattern generated by the pattern element on the second beam

profile into a total pattern on the total beam profile. For example, a first pattern can be generated on a first beam profile when only the first lighting device is in operation. A second pattern can be generated on a second beam profile when only the second lighting device is in operation. When both the first and second lighting devices are
5 activated, a total pattern on the total beam profile may be different or similar to the first and second pattern.

The first pattern and second pattern may be configured as matching patterns. For instance, the first pattern and the second pattern may be formed of a similar or identical line patterns with the same period. The first pattern and second
10 pattern may be matched in that the first and second pattern combine in a constructive manner into the total (line) pattern, e.g. maxima and minima of the first pattern and the second pattern are situated at similar/identical positions in the total pattern. In other embodiments, the first and second pattern may be complementary and may in particular have different contributions to the total (line) pattern.

15 Alternatively, the generated first pattern is different from the generated second pattern. The first pattern and the second pattern may be complementary patterns. For example, the first pattern may form horizontal lines in the first beam profile and the second pattern may form vertical lines in the second beam profile, with the total pattern comprising a rectangular pattern as a result of the combination of the first and second
20 beam profiles.

In an exemplary embodiment of the invention, the first beam profile is different from the second beam profile. For example, the shapes and/or the intensity of the first beam profile and the second beam profile may be different. Therefore, the first and second beam profiles may be used to illuminate objects under different conditions.
25 For instance, the angular dependence of the illuminance of the first and second beam profile may be different. Hence, the shape of a “spot” provided by each of the lighting devices may be different, with the combination of the lighting devices yielding another beam profile. The illumination of an object can therefore be adapted by activating only the first lighting device, only the second lighting device, or by activating both lighting
30 devices to obtain the total beam profile.

According to another exemplary embodiment of the invention, the first

beam profile has a first distance dependence and the second beam profile has a second distance dependence, the first distance dependence and the second distance dependence being different from each other. For instance, the first beam profile may be suitable for far distances and/or a narrow field of view, while the second beam profile may be suitable for shorter distances and/or a wider field of view. Hence, the lighting system is capable to provide illumination of objects with a pattern in a wider range of distances and/or a wider field of view. Further, by analysing the contribution of each lighting device to the illumination on an object under investigation, information on the distance of the object to the lighting system may be derived.

For instance, if an object is close to the lighting system, a first beam profile suitable for far distances may provide lower illumination and a second beam profile suitable for shorter distances may provide higher illumination. Vice versa, when the object is far from the lighting system, the first beam profile suitable for far distances may provide higher illumination and a second beam profile suitable for shorter distances may provide lower illumination. Hence, in addition or as alternative to the depth information that may be derived from an analysis of the pattern, the relative illumination generated by the lighting devices with different distance dependences provides distance information.

According to an exemplary embodiment of the invention, a shape of the first beam profile surrounds a shape of the second beam profile; or a shape of the second beam profile surrounds a shape of the first beam profile. That is, at least in some distances of the object or screen to the lighting system, the first beam profile may at least partially surround or enclose the second beam profile or vice versa. For example, the first beam profile may have a circular shape, where the area within the circle is illuminated. The second beam profile may have a ring shape, with area of the ring being illuminated and a centre area of the ring being not illuminated. The first beam profile and the second beam profile may be combined such that the ring encloses the circle.

According to another exemplary embodiment of the invention, the first lighting device and/or the second lighting device is configured to generate a first beam profile and/or a second beam profile having a decreasing intensity from a profile centre to a profile edge. For example, a beam profile has a circular shape, where the area

within the circle is illuminated. The illuminated intensity have a maximum intensity at the centre of the circle and with angles leading away from the circle center, the intensity of the beam profile is reduced.

According to another exemplary embodiment of the invention, the first
5 lighting device and/or the second lighting device is configured to generate a first beam profile and/or a second beam profile having an increasing intensity from a profile center to a profile edge. For example, a beam profile has a ring shape, where the intensity has a minimum at the centre of the ring. The intensity may increase to a maximum at the radius of the ring. At higher angles from the centre, the intensity may again be
10 decreased.

According to another exemplary embodiment of the invention, the total beam profile, without the pattern generated by the pattern element, has at least one local minimum in intensity, wherein the at least one local minimum in intensity of the total beam profile is located between two local maxima in intensity. Here, the local
15 minimum and the local maxima in intensity are referring to local minima and maxima of the total beam profile without the influence of the pattern element, i.e. the total beam profile that is obtained when the pattern element is omitted. In this sense, the local minimum and the local maxima in intensity of the total beam profile are to be distinguished from the minima and maxima generated by the pattern element, e.g. the
20 maxima and minima of a line pattern generated by the pattern element.

For instance, the total beam profile has one local minimum in intensity and two local maxima in intensity (e.g. in dependence of an angle relative to an optical axis of the lighting system), wherein the local minimum is located between these two local maxima of the beam profile. In the aforementioned combination of a circular shape and
25 a ring shape of the beam profiles, the local minimum in intensity may form a “dark” or “darker” ring between the circular shape and the ring shape. That is, a (local) maximum may be in the centre of the total beam profile caused by the circular beam profile. When the angle from the centre is increased, a local minimum may be reached between the circular beam profile and the ring shaped beam profile, which is visible in the total
30 beam profile as “dark” ring. When the angle is further increased, a second (local) maximum in intensity may be reached that is caused by the “bright” ring shaped beam

profile. The position of the local minimum may give a calibration reference for an object illuminated by the lighting system, e.g. in applications like depth mapping. The width of the local minimum can be optimized for different sizes and/or distances of objects under investigation.

5 According to an alternative exemplary embodiment of the invention, the lighting system is configured to illuminate an object with a total beam profile having a substantially uniform intensity distribution in a region. In the aforementioned combination of a circular shape and a ring shape of the beam profiles, the circle and ring may be combined into a (larger) circular shaped total beam profile that has a
10 substantially uniform intensity distribution in a region, e.g. up to at least a certain angle. Hence, the lighting system may provide for a wider field of view than a single lighting device, wherein in addition the field of view may for example be varied by only activating the lighting device with a circular beam profile or by activating both lighting devices.

15 According to another exemplary embodiment of the invention, the pattern element is configured as a line pattern projector element comprising one or more gratings having light-blocking sections and light-permeable sections. With at least one grating, a line pattern may be obtained by absorption and/or reflection of light at the light-blocking sections. In particular, a combination of at least two gratings is used, the
20 gratings having the same pitch and being arranged parallel to each other.

 According to another exemplary embodiment of the invention, the first lighting device and second lighting device are arranged in a common package, in particular together with the pattern element. The first lighting device and the second lighting devices may be arranged in a lead frame package. Alternatively, the pattern
25 element may be arranged outside of the lead frame package.

 According to another exemplary embodiment of the invention, the lighting system further comprises at least one optical element. For instance, an optical element may comprise a lens, e.g. a Fresnel lens, and/or may comprise at least one reflector cup, in particular a reflector cup for the first lighting device and/or a reflector cup for the
30 second lighting device. A reflector cup may effectively reflect light emitted from the light-emitting element. The reflector cup may be configured as element with high

(specular and/or diffuse) reflectance that surrounds the light-emitting element. The reflector cup may have a shape that is adapted to the geometry of the spatial distribution of light emission of the light-emitting element and to produce a specific first and/or second beam profile. The amount of light provided by the light-emitting element for illumination may also be further optimized. In an embodiment, the reflector cup may also serve as support for the pattern element, such that the lighting device can be arranged in a very compact manner.

It is to be understood that the presentation of embodiments of the invention in this section is merely exemplary and non-limiting.

Other features of the present invention will become apparent from the following detailed description considered in conjunction with the accompanying drawings. It is to be understood, however, that the drawings are designed solely for purposes of illustration and not as a definition of the limits of the invention, for which reference should be made to the appended claims. It should be further understood that the drawings are not drawn to scale and that they are merely intended to conceptually illustrate the structures and procedures described herein.

BRIEF DESCRIPTION OF THE DRAWINGS

Examples of the invention will now be described in detail with reference to the accompanying drawing, in which:

- Fig. 1 schematically shows a lighting system comprising two lighting devices according to the invention;
- Fig. 2 schematically shows two examples for first and second beam profiles generated by the first and second lighting devices and one example of a total beam profile of a lighting system according to an embodiment of the invention;
- Fig. 3 schematically shows two examples for first and second beam profiles generated by the first and second lighting devices and one example of a total beam profile of a lighting system according to another embodiment of the invention; and

Fig. 4 schematically shows a sectional view of a lighting system according to the invention.

DETAILED DESCRIPTION OF THE EMBODIMENTS

5 A lighting system 100 comprising two lighting devices 110a, 110b is illustrated in Fig. 1. The first lighting device 110a comprises one individual LED 101a as light-emitting element and a reflector cup 102a having a reflective surface. The second lighting device 110b comprises one individual LED 101b as light-emitting element and a reflector cup 102b having a reflective surface. The first lighting device 10 110a is configured to generate a first beam profile. The second lighting device 110b is configured to generate a second beam profile. The beam profiles are different from each other due to different configurations of the reflector cups 102a, 102b. Further, the lighting system 100 comprises a pattern element (not depicted in Fig. 1).

Fig.2 schematically shows two examples for beam profiles 200a, 200b 15 generated by the lighting devices and one example total beam profile 200c combined by the lighting system according to a second embodiment of the invention.

A first beam profile 200a is generated by a first lighting device (e.g. by the first lighting device 110a in Fig.1) of a lighting system (e.g. the lighting system 100 in Fig.1). A pattern with lines is generated on the first beam profile 200a by the pattern 20 element of the lighting system, wherein the pattern element is configured as a line pattern projector element comprising one or more gratings having light-blocking sections and light-permeable sections. The first beam profile 200a has an increasing intensity from the profile centre to the profile edge in that the first beam profile 200a comprises a ring shape. The centre of the first beam profile 200a has a minimum in 25 illuminance, resulting in a dark centre region.

A second beam profile 200b is generated by a second lighting device (e.g. by the second lighting device 110b in Fig.1) of the lighting system. A pattern with lines is generated on the beam profile 200b by the line pattern projector element. The second beam profile 200b has a decreasing intensity from the profile centre to the profile edge. 30 As can be seen in Fig. 2, the second beam profile 200b has a circular shape. Hence, the first beam profile 200a generated by the first lighting device is different from the

second beam profile 200b generated by the second lighting device.

The first beam profile 200a has a first distance dependence and the second beam profile 200b has a second distance dependence. Furthermore, the first distance dependence and the second distance dependence are different from each other. By selective activation of the first lighting device 110a and the second lighting device 110b, illumination may be provided for a larger range of distances. Further, by comparing the (relative) illumination by the first lighting device 110a and the second lighting device 110b, information on the distance of the object to the lighting system 100 may be obtained.

The lighting system 100 is configured to combine the first beam profile 200a and the second beam profiles 200b into a total beam profile 200c with the line pattern generated by the line pattern projector element. As can be seen in Fig. 2, the total beam profile 200c (also without the pattern generated by the line pattern projector element) has one local minimum 200c_1 in intensity, which is located between the two local maxima in intensity, the two local maxima being formed at the centre from the second beam profile 200b and at the ring from the first beam profile 200a. The first local maximum in intensity is illustrated in the middle area as a bright dot and the second local maximum in intensity is illustrated at the edge of the total beam profile 200c as a bright ring. The dark ring illustrated between the first local maximum in intensity (the bright dot in the middle) and the second local maximum in intensity (the bright ring at the edge) represents the local minimum 200c_1 in intensity of the total beam profile 200c. Depth information of an object illuminated by the lighting system can be determined based on the beam profiles 200a, 200b and 200c. Further, the local minimum 200c_1 may provide a calibration reference for an object illuminated by the lighting system.

Fig. 3 schematically shows two examples for beam profiles generated by the lighting devices and one example total beam profile combined by the lighting system according to another embodiment of the invention.

In Fig. 3, a first beam profile 300a is generated by a first lighting device (e.g. by the first lighting device 110a in Fig. 1) of a lighting system (e.g. the lighting system 100 in Fig. 1). A second beam profile 300b is generated by a second lighting

device (e.g. by the second lighting device 110b in Fig.1) of the lighting system. As can be seen in Fig. 3, the first beam profile 300a has an increasing intensity from the profile centre to the profile edge similar to the first beam profile 200a in Fig. 2. The second beam profile has a decreasing intensity from the profile centre to the profile edge is similar to the beam profile 200b in Fig. 2. However, in this embodiment, the first and second lighting devices are configured such that the first beam profile 300a and the second beam profile 300b may be combined to a total beam profile 300c having a substantially uniform intensity distribution in a region. The first beam profile 300a has a wider view and is suitable for objects at short distances to the lighting system 100. The second beam profile 300b has a narrow view and is suitable for objects in far distance. Therefore, objects with significantly different widths may be illuminated by the lighting system by means of selectively activating the first and/or second lighting device.

Fig. 4 schematically shows a sectional view of a lighting system 400 within a lead frame package according to the invention. The lighting system 400 comprises a first lighting device 410a and a second lighting device 410b and a line pattern projector element 420. Each lighting device 410a or 410b comprises one LED chip (reference numerals 401a for 410a and 401b for 410b) and one reflector cup (reference numerals 402a for 410a and 402b for 410b), respectively.

The lighting devices 410a, 410b with the LED chips 401a, 401b and the reflector cups 402a, 402b are formed and packaged within a lead frame package 500. The line pattern projector 420 is arranged outside of the lead frame package 500. Optionally, the line pattern projector 420 can also be formed with the lighting devices and reflectors within a common lead frame package.

CLAIMS:

1. A lighting system (100, 400), comprising:
 - a first lighting device (110a, 410a) configured to generate a first beam profile (200a, 300a), wherein the first lighting device (110a, 410a) comprises at least one individual light-emitting element (101a, 401a);
 - a second lighting device (110b, 410b) configured to generate a second beam profile (200b, 300b), wherein the second lighting device (110b, 410b) comprises at least one individual light-emitting element (101b, 401b); and
 - a pattern element (420) configured to generate a pattern on the first beam profile (200a, 300a) and/or the second beam profile (200b, 300b), characterized in that
 - the lighting system (100, 400) is configured to provide a third beam profile (200c, 300c), different from the first (200a, 300a) and the second beam profile (200b, 300b) such that at least three different beam profiles are obtained,
 - wherein the lighting system (100, 400) is configured to combine the first beam profile (200a, 300a) and the second beam profile (200b, 300b) into the third beam profile (200c, 300c); and
 - the pattern element (420) is configured as a pattern element arranged in the lighting system (100, 400), generating a pattern on both the first beam profile (200a, 300a), the second beam profile (200b, 300b) and the third beam profile (200c, 300c).
2. The lighting system (100, 400) according to claim 1,
 - wherein the first beam profile (200a, 300a) is different from the second beam profile (200b, 300b).
3. The lighting system (100, 400) according to claim 2,
 - wherein the first beam profile (200a, 300a) has a first distance dependence and the second beam profile (200b, 300b) has a second distance dependence, the first distance dependence and the second distance dependence being different from each other.

4. The lighting system (100, 400) according to claim 2 or 3,
wherein a shape of the first beam profile (200a, 300a) surrounds a shape of the second beam profile (200b, 300b); or
wherein a shape of the second beam profile (200b, 300b) surrounds a shape of the first beam profile (200a, 300a).
5. The lighting system (100, 400) according to any one of the preceding claims,
wherein the first lighting device (110a, 410a) and/or the second lighting device (110b, 410b) is configured to generate a first beam profile (200b, 300b) and/or a second beam profile (200b, 300b) having a decreasing intensity from a profile center to a profile edge.
6. The lighting system (100, 400) according to any one of the preceding claims,
wherein the first lighting device (110a, 410a) and/or the second lighting device (110b, 410b) is configured to generate a first beam profile (200a, 300a) and/or a second beam profile (200a, 300a) having an increasing intensity from a profile center to a profile edge.
7. The lighting system (100, 400) according to any one of the preceding claims,
wherein the third beam profile (200c), without the pattern generated by the pattern element (420), has at least one local minimum (200c_1) in intensity,
wherein the at least one local minimum in intensity of the third beam profile (200c) is located between two local maxima in intensity.
8. The lighting system (100, 400) according to any one of claims 1 to 6,
wherein the lighting system (100, 400) is configured to illuminate an object with a third beam profile (300c) having a substantially uniform intensity distribution in a region.
9. The lighting system (100, 400) according to any one of the preceding claims,
wherein the pattern element (420) is an optical element.

10. The lighting system (100, 400) according to any one of the preceding claims,
wherein the pattern element (420) is configured as a line pattern projector element comprising one or more gratings having light-blocking sections and light-permeable sections.
11. The lighting system (100, 400) according to claim 1 or claim 2,
wherein the pattern element (420) is a single pattern element generating a pattern on both the first (200a, 300a) and the second beam profile (200b, 300b).
12. The lighting system (100, 400) according to any of the preceding claims,
wherein the pattern element (420) comprises separate sub-pattern elements generating a first pattern on the first beam profile (200a, 300a) and a second pattern on the second beam profile (200b, 300b).
13. The lighting system (100, 400) according to claim 12,
wherein the first and the second pattern are matching patterns.
14. The lighting system (100, 400) according to claim 12,
wherein the first and the second pattern are complementary patterns.
15. The lighting system (100, 400) according to any of the preceding claims,
wherein the pattern element (420) is a regular pattern suitable for 3D imaging.
16. The lighting system (100, 400) according to claim 15,
wherein the regular pattern is one of a line pattern, a dot pattern, a rectangular pattern or a square pattern.
17. The lighting system (100, 400) according to any one of the preceding claims,
wherein the first lighting device (110a, 410a) and second lighting device (110b, 410b) are arranged in a common package (500), in particular together with the pattern element (420).

18. The lighting system (100, 400) according to any one of the preceding claims, further comprising at least one optical element, in particular having a reflector cup (102a, 402a) for the first lighting device (110a, 410a) and/or a reflector cup (102b, 402b) for the second lighting device (110b, 410b).
19. A pattern element (420) of a lighting system (100, 400) according to one of the previous claims.
20. A method for producing a lighting system (100, 400), the method comprising:
 - providing a first lighting device (110a, 410a) comprising at least one individual light-emitting element (101a, 401a) configured to generate a first beam profile (200a, 300a);
 - providing a second lighting device (110b, 410b) comprising at least one individual light-emitting element (101b, 401b) configured to generate a second beam profile (200b, 300b); and
 - providing a pattern element (420) configured to generate a pattern on the first beam profile (200a, 300a) and/or the second beam profile (200b, 300b), characterized in that
 - the lighting system (100, 400) is configured to provide a third beam profile (200c, 300c), different from the first (200a, 300a) and the second beam profile (200b, 300b) such that at least three different beam profiles are obtained,
 - wherein the lighting system (100, 400) is configured to combine the first beam profile (200a, 300a) and the second beam profile (200b, 300b) into the third beam profile (200c, 300c); and
 - the pattern element (420) is configured as a pattern element arranged in the lighting system (100, 400), generating a pattern on both the first beam profile (200a, 300a), the second beam profile (200b, 300b) and the third beam profile (200c, 300c).
21. A use of a lighting system (100, 400) according to any of claims 1 to 18 to determine depth information of an object illuminated by the lighting system (100, 400).
22. The use according to claim 21, wherein the third beam profile (200c) provides a calibration reference for an object illuminated by the lighting system (100, 400).

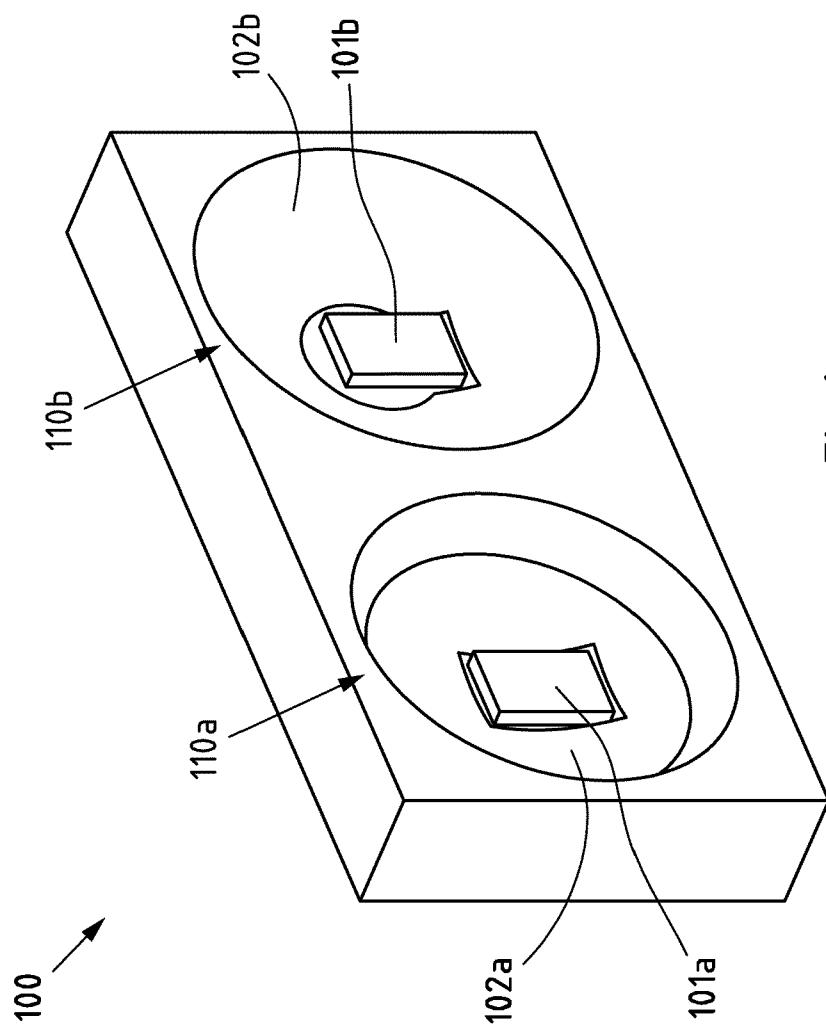


Fig.1

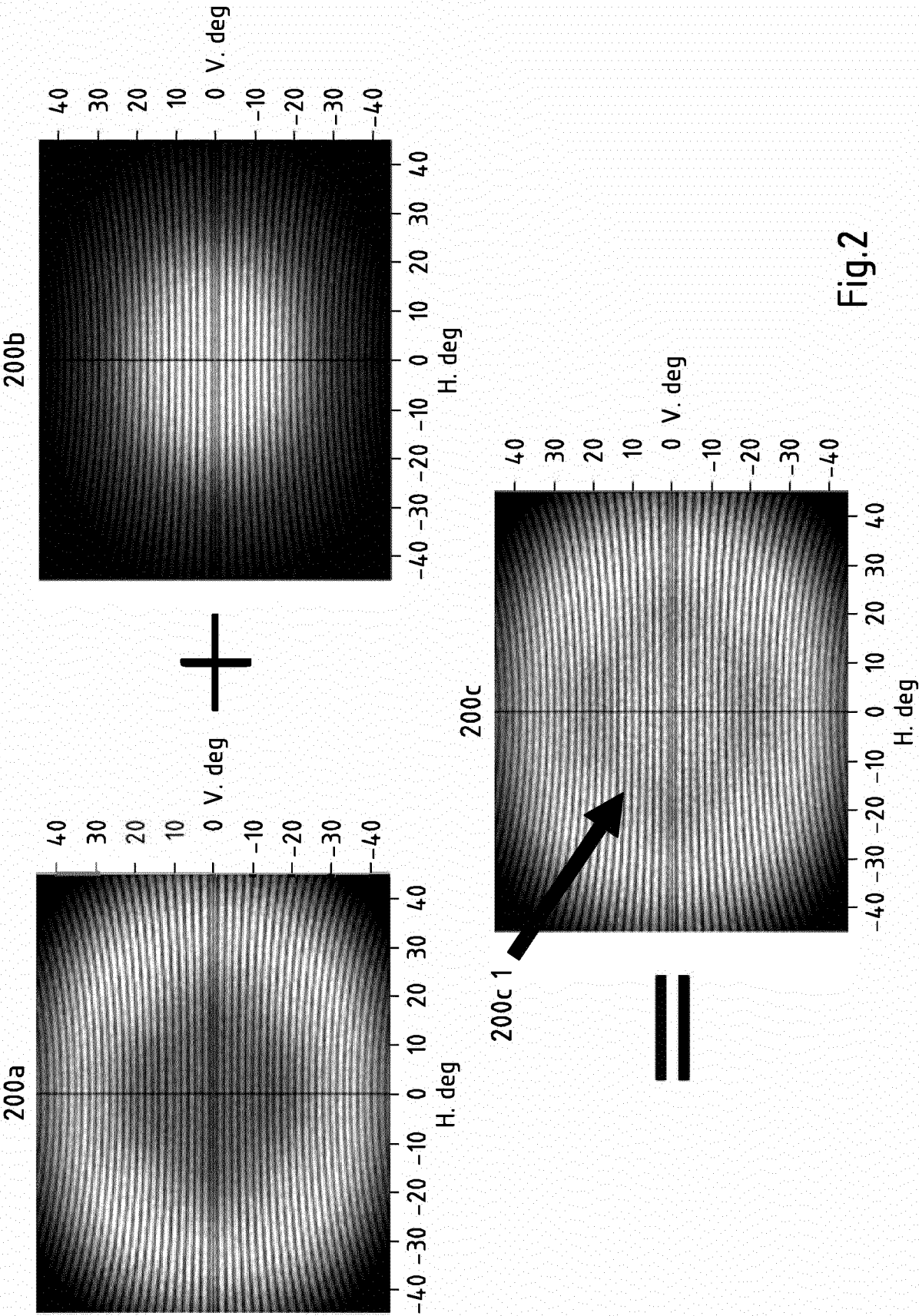


Fig.2

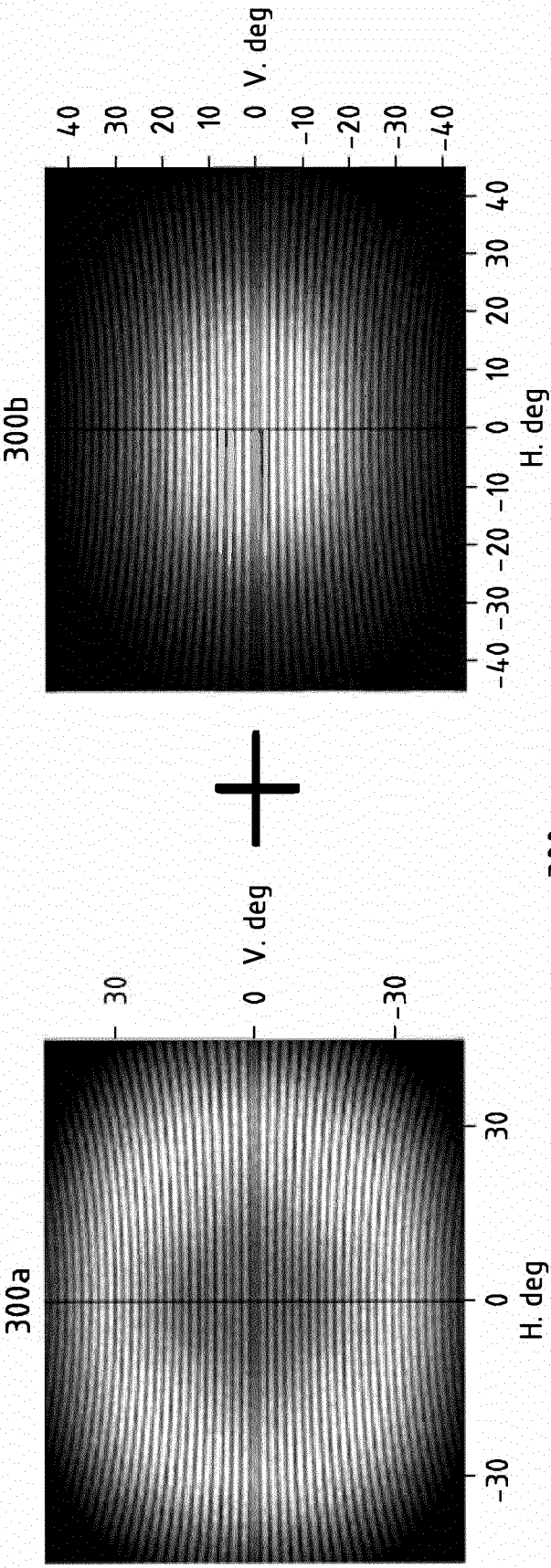


Fig.3

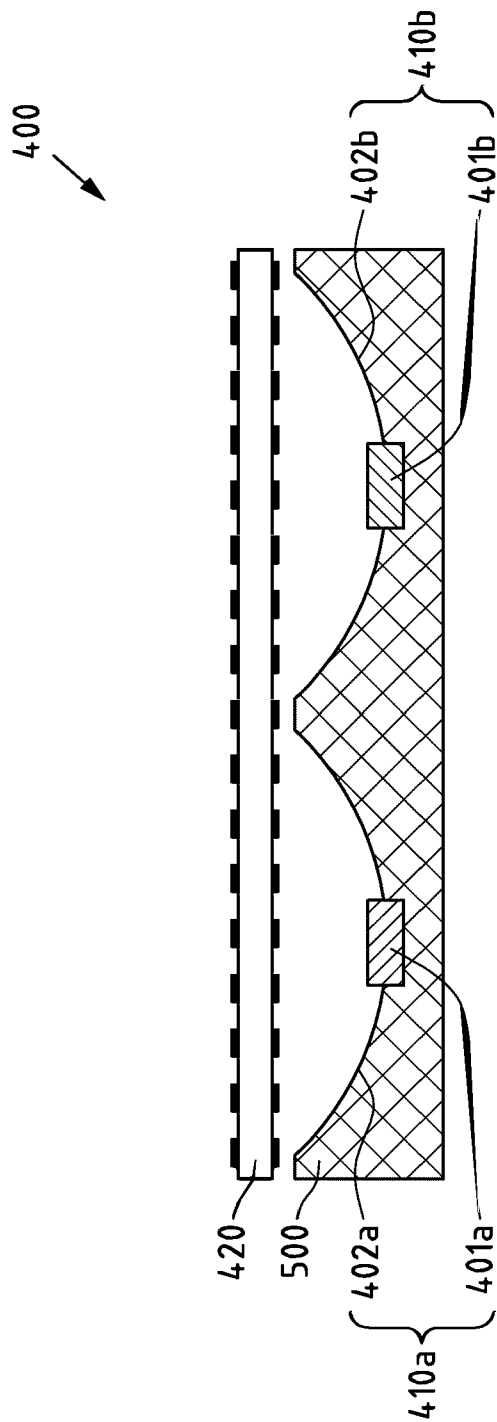


Fig.4

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2020/050710

A. CLASSIFICATION OF SUBJECT MATTER
INV. H05B45/00
ADD.

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)
H05B

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

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

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	paragraphs [0002], [0004], [0016] - [0020], [0029]; claims 1,2; figure 1	18,21,22
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Y	paragraphs [0025] - [0047]; figures 1,2,4,8 paragraphs [0061] - [0075]	4,7,8,21,22
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Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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

5 February 2020

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2020/050710

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	page 8, line 13 - page 9, line 22; figure 7a -----	1,19,20
Y	US 2017/359883 A1 (ANSARI SAMEER [US] ET AL) 14 December 2017 (2017-12-14) paragraph [0048]; figure 2 -----	21,22
Y	US 6 527 419 B1 (GALLI ROBERT D [US]) 4 March 2003 (2003-03-04)	18
A	column 1, line 30 - line 47 column 5, line 37 - column 7, line 9 -----	1,19,20

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International application No

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