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(71) Applicant: **Regent Beleuchtungskörper AG**
4053 Basel (CH)

(72) Inventors:
- **Fernández, Oscar**
  4133 Pratteln (CH)
- **Müller, Bernd**
  79650 Schopfheim (DE)

(74) Representative: **Latscha Schöllhorn Partner AG**
Grellingerstrasse 60
4052 Basel (CH)

(54) **LIGHTING DEVICE**

(57) A lighting device (1) comprises a plurality of LED light sources (2) each provided with a collimating member (3) having a main direction of light propagation (33), and an at least partially transparent optical arrangement (4, 6) positioned adjacent to the collimating members (3) such that light generated by the LED light sources (2) and propagated by the collimating members (3) into the main direction of light propagation (33) passes through the optical arrangement (4, 6). The optical arrangement (4, 6) has a microstructure (41) with a plurality of refractive cells (43) configured to shape the light passing through the optical arrangement (4, 6). Each of the plurality of refractive cells has a shoulder angle relative to the main direction of light propagation and the plurality of refractive cells (43) has refractive cells (43) with differing shoulder angles.

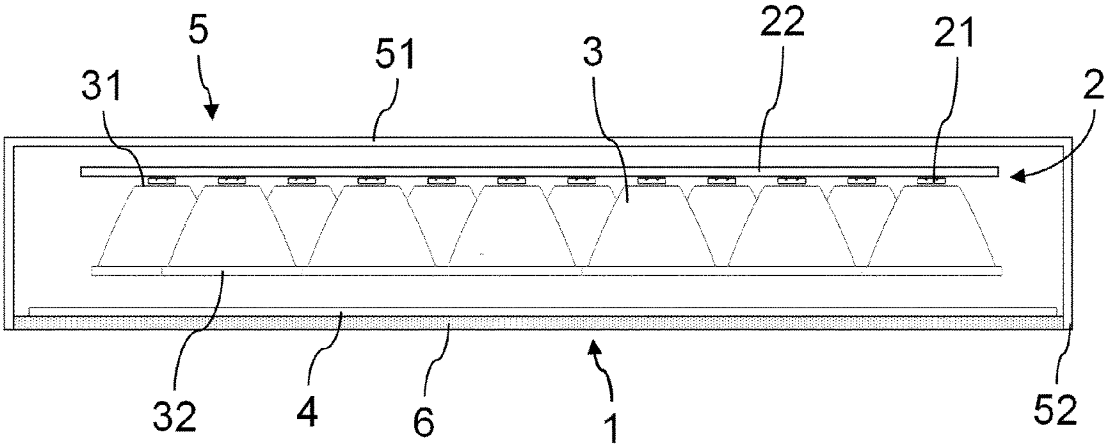

Fig. 1

EP 3 770 491 A1

Description

Technical Field

[0001] The present invention relates to a lighting device. Such lighting devices can be used as downlights for illuminating rooms from the ceiling of the room.

Background Art

[0002] For illuminating rooms often so-called downlights are used as lighting devices or luminaires. Such downlights typically are mounted onto or into ceilings and provide light essentially top down into the room. Downlights are known in a variety of shapes. Often downlights are round luminaires built in a ceiling of a room.

[0003] Typically, downlights comprise a plurality of light sources, wherein the use of light emitting diodes (LED) is getting increasingly popular. The light sources are mounted in a housing which often is closed by an optical plate or a similar element. The optical plates can be fully or partially transparent in order to allow the light generated by the light sources to pass and to exit the luminaire.

[0004] For shaping the light in downlights, it is known to use reflectors or similar optical components. The reflectors are positioned and configured to redirect the light emitted from the light source such that a desired light distribution is achieved. For allowing the light redirected by the reflector and directly emitted from the light sources towards the optical plate to be mixed, a light mixing chamber is provided in known luminaires.

[0005] However, even though known downlights allow to provide a broad variety of light distributions such that they may suit for many given situations, they typically require comparably lot of space due to the rather bulky reflectors and the need of a mixing chamber. Particularly when it is intended to mount the downlight into a ceiling the size of the downlight can be crucial. Furthermore, the use of reflectors or similar optical components in downlights makes it difficult to provide irregular or customized shapes since the shape of the reflector is important for the light distribution of the luminaire.

[0006] Therefore, there is a need for a lighting device suitable as downlight which requires comparably little space and which allows to be provided in a flexible or customized shape.

Disclosure of the Invention

[0007] According to the invention this need is settled by a lighting device as it is defined by the features of independent claim 1. Preferred embodiments are subject of the dependent claims.

[0008] In particular, the invention is a lighting device comprising a plurality of LED light sources and an at least partially transparent optical arrangement. Each of the LED light sources is provided with a collimating member having a main direction of light propagation. The at least partially transparent optical arrangement is positioned adjacent to the collimating members such that light generated by the LED light sources and propagated by the collimating members into the main direction of light propagation passes through the optical arrangement. The optical arrangement has a microstructure with a plurality of refractive cells configured to shape the light passing through the optical arrangement. Each of the plurality of refractive cells has a shoulder angle relative to the main direction of light propagation. The plurality of refractive cells has refractive cells with differing shoulder angles.

[0009] The lighting device can also be referred to as lighting fixture or luminaire. It can particularly be a downlight.

[0010] Each LED light source can comprise one or more printed circuit boards (PCB) equipped with one or more light emitting diodes (LED) and associated electronic components for running the LED. The LED can have a rectangular or any other suitable form.

[0011] The microstructure can be provided at one face or side of the optical arrangement whereas the other or opposite face or side can have essentially no roughness such as being polished. Such microstructure allows to flexibly and efficiently define a light distribution of the lighting device. It can also be economically and accurately manufactured at almost any desired shape.

[0012] Furthermore, the provision of a microstructure can be beneficial from an aesthetic point of view as it is discernible only very limitedly or even not at all with the naked eye. An inconspicuous clean appearance can thereby be achieved. Also, a "tilting effect" that may occur with macrostructures can be prevented with the microstructure. In this connection, the term "tilting effect" means a visual perception of structures or geometries. In particular, this term can refer to the fact that the illumination surface image produced changes suddenly, i.e. abruptly and not smoothly, at a certain visual angles.

[0013] In connection with the optical arrangement, the term "transparent" can relate in particular to an attenuated or non-attenuated permeability of the light generated by the LED light sources.

[0014] The term "refractive" in connection with the refractive cells of the microstructure relates to the change in direction of a light wave passing the optical arrangement. Thereby, the light wave can be redirected when entering the optical arrangement and/or when leaving it. This is, by changing from one medium, e.g. air, to another medium, e.g. the substrate of the optical arrangement, and by non-orthogonally hitting the border face between the two media the light wave changes its direction.

[0015] The refractive cells allow for precisely shaping the light emitted by the lighting device in a broad variety of ways. Therefore, a desired light distributing curve (LDC) can be generated.

[0016] The optical arrangement can be positioned comparably close to a light emitting side or face of the collimator members. For example, the distance between the light emitting face and the optical arrangement can be in a range of about 2 mm to about 6 mm, of about 3 mm to about 5 mm, or it can be about 4 mm. Due to the use of the optical arrangement having the microstructure for shaping the light no light mixing chamber is required such that no space has to be provided for such chamber. Additionally, compared to a reflector or a similar element, the optical arrangement itself can be comparably or very thin. In sum, the provision of the collimator members and the optical arrangement allows to provide a thin arrangement compared to known downlights. Thus, the lighting device according to the invention can be mounted to or into a ceiling requiring comparably few space. Like this, the lighting device can also be mounted into comparably thin ceilings and/or be esthetically reserved.

[0017] In addition to a compact design, the lighting device can efficiently be shaped as desired. In particular, when the optical arrangement comprises a light shaping foil as described below, shaping of the lighting device can be comparably easy and efficient. Like this, a broad variety of forms of lighting devices can efficiently be provided. Also, customization of the lighting device to the given situation of its application can efficiently be implemented.

[0018] Further, by the light shaping via the microstructure having the refractive cells with differing shoulder angles, de-glaring or glare suppression can efficiently be implemented. According to known standards such as DIN EN 12464-1 of the German Institute for Standardization, the term "glare suppression" can refer to the fact that, for certain applications of light fixtures or lighting devices, the light radiated in all lighting angles greater than 65°, when measured in relation to the vertical line directed downwards, must not exceed a light density of 3000 Candela per square meter (cd/m^2).

[0019] The relatively strong glare suppression and light guiding or light shaping made possible by the microstructure may also be non-visible by the eye. Rather, the optical arrangement can simply visually appear as diffused. This offers many possible applications in design, for example in architecturally integrated lighting. Various LDC can be realized with the same aesthetics.

[0020] The microstructure can be provided to the optical arrangement by various techniques. For example, engraving by means of a laser can be efficient particularly when a light shaping foil is involved as explained below. Or, in some embodiments, (injection) molding or UV replicating the microstructure into the optical arrangement can be efficient.

[0021] Preferably, the main directions of light propagation of the collimating members of the plurality of LED light sources are essentially or mostly parallel to each other. In such embodiment the complete lighting device can have one main direction of light propagation. Such orientation of the collimator members allow for efficiently forming the generated light by means of the light shaping foil.

[0022] Preferably, the lighting device comprises a housing, wherein the plurality of LED light sources and the optical arrangement are mounted in the housing such that they are in fixed position and orientation relative to each other. The optical arrangement can be mounted to the housing by being fixed to it, connected to it, or by being part of the housing, i.e. integral with it. Such a housing allows for providing support for the components of the lighting device in order that they are correctly positioned and oriented relative to each other. Also, such housing may protect the components of the device and easy handling of the complete lighting device.

[0023] The refractive cells of the optical arrangement comprise bases having the same size. Thereby, each base of the plurality of refractive cells is hexagonal. By having bases of the same size particularly when being hexagonal, it can be achieved that essentially the complete optical arrangement or a face thereof is covered by the refracting cells. Like this, all light passing the foil can be shaped and distorting effects can be minimized.

[0024] The refractive cells preferably comprise lenses. The shape of the lenses may define the varying shoulder angles. Such lenses allow for providing a well predefined refraction of the light passing the foil. However, more preferably, each of the refractive cells comprises a dome extending from a ground plane. The ground plane can be connecting the lower ends of the domes. The domes can be cone-like bulges, coni, pyramids, tetrahedrons, prismatic structures, or frustums thereof. The domes allow to provide the optical arrangement with a continuous curvature which can provide for an efficient manufacture and shaping of the light. Thereby, the domes may be configured such that the foil does not have any sharp edges or the like which may disturb proper light distribution.

[0025] Preferably, the hexagonal bases of the plurality of refractive cells are contacting each other such that the ground plane of the light shaping foil consists of the hexagonal bases of the plurality of refractive cells. In particular, the bases can be arranged such that each side of a hexagon of one cell is one of the sides of a hexagon of the base of a neighboring cell. Like this, the complete optical arrangement or a face thereof can efficiently be covered with domes.

[0026] Preferably, different domes have different heights. By having domes of differing heights on the same optical arrangement, the light distribution can appropriately be defined and varied. In particular, such different heights allow for efficiently providing different shoulder angles.

[0027] Preferably, the domes extend from the ground plane towards the LED light sources. Like this, the domes are directed towards the LED light sources, which allows for efficiently and accurately refracting the light and, thus, shaping the light passing the foil.

[0028] The optical arrangement can be a single piece construction such as a plate or plate-like component. Such single piece can be directly provided with the microstructure for appropriately shaping the light. However, preferably the optical arrangement comprises a carrier structure and a light shaping foil attached to the carrier structure, wherein, advantageously, the light shaping foil has the microstructure configured to shape light passing through the light shaping foil.

[0029] The term "foil" as used herein can refer to a relatively large-area thin structure which typically has a much larger surface in relation to its thickness. For example, such structures can have a thickness of 1 millimeter (mm) or less and typically less than 0.1 mm. The associated surface can be virtually any size. For example, it can be at least 5 centimeters (cm) by 5 cm. This gives a ratio of surface to thickness of at least about 25,000 or typically at least about 250,000. The foil can be made of various different materials. However, foils made of plastics such as, for example, polycarbonate, polyethylene or polymethyl methacrylate (PMMA) have proved to be beneficial in many given situations.

[0030] The carrier structure can be any element or composition suitable for holding or supporting the light shaping foil. It can comprise any clamping means for grabbing the foil and/or mounting means for being connected to other parts of the lighting device. In particular, it can be important that the foil lies in a predefined flat or stretched arrangement in order to ensure proper light shaping. For this purpose, the carrier structure can have strain means configured to strain the foil such that it is stretched. Preferably, the carrier structure comprises an at least partially transparent optical element. In such embodiments the light shaping foil can be arranged at the optical element. For example, the foil can be adhered to a flat surface of the optical element. Like this, it can efficiently be achieved that the foil is stretched and correctly oriented. The light propagated by the collimating members is then passing the foil as well as the optical element. The optical element can be a plate or plate-like component. It can be a clear plate, for example, or a similar element. with the microstructure. Like this, many desired shapes of optical arrangements can efficiently be implemented.

[0031] Thereby, the light shaping foil preferably is attached to a surface of the optical element oriented towards the plurality of LED light sources. A surface of the optical element opposite to the surface with the foil can form an outer surface of the lighting device. Like this, the light shaping foil can be inside the lighting device, the foil can be protected and the outer surface can easily be cleaned or the like.

[0032] More generally, the microstructure preferably is oriented towards the plurality of LED light sources. Such arrangement of the microstructure allows for providing an efficient light shaping, for providing a desired aesthetics since the outer surface of the optical arrangement can be flat, and for protecting the microstructure.

[0033] Thereby, preferably a gaseous medium is arranged between the collimating members of the LED light sources and the optical arrangement, wherein the optical arrangement has a higher refracting index than the gaseous medium. The gaseous medium can particularly be air.

[0034] Air has a refractive index of about 1. The portion of the optical arrangement having the microstructure such as the foil can be produced from a material having a refractive index in a range of about 1.3 to about 1.7, such as from a plastic like a polycarbonate. Alternative plastics can be, for example, polyethylene or polymethyl methacrylate (PMMA) having a refractive index in the same range. In this context, the term "refractive index" is understood to be an optical material property which indicates the factor by which the wavelength and the phase speed of light in a material are less than in a vacuum. By having such refractive indexes, the foil allows a specifically efficient light shaping, particularly when having a microstructure as mentioned above.

[0035] Preferably, the plurality of LED light sources with the collimating members are configured to propagate light in various directions being different from the main direction of light propagation by a maximum of 30°. Thereby, each of the plurality of LED light sources and its associated collimator member preferably is configured to propagate light in directions distributed such that a luminous flux in a range of 0° to 15° is bigger than a luminous flux in a range of 15° to 30°. In course of developing variants of the lighting device it has turned out that for any application and, more specifically, for generating many advantageous LDC, it is beneficial when the collimator members do allow a certain deviation from the provision of perfectly parallel unidirectional light propagation. Thereby, whereas a certain collimation is desired for achieving an accurate and efficient shaping by the foil, light direction distribution as mentioned above has proved to be beneficial in many applications.

[0036] Preferably, the plurality of LED light sources are rotated towards each other. Thereby, the plurality of LED light sources preferably is mounted in one plane, which can be formed by a printed circuit board (PCB) to which the LED are mounted. Like this, a homogeneous overall light distribution and LDC generation can be achieved.

Brief Description of the Drawings

[0037] The lighting device according to the invention are described in more detail below by way of an exemplary embodiment and with reference to the attached drawings, in which:

Fig. 1 shows schematic view of an embodiment of a lighting device according to the invention;
Fig. 2 shows a detail view of the emission of the lighting device of Fig. 1;
Fig. 3 shows a perspective view of a light shaping foil of an optical arrangement of the lighting device of Fig. 1;
Fig. 4 shows a top view of the light shaping foil of Fig. 3;
Fig. 5 shows a side view of the light shaping foil of

Fig. 3; and

Fig. 6 shows detail A of Fig. 5.

Description of Embodiments

[0038] In the following description certain terms are used for reasons of convenience and are not intended to limit the invention. The terms "right", "left", "up", "down", "under" and "above" refer to directions in the figures. The terminology comprises the explicitly mentioned terms as well as their derivations and terms with a similar meaning. Also, spatially relative terms, such as "beneath", "below", "lower", "above", "upper", "proximal", "distal", and the like, may be used to describe one element's or feature's relationship to another element or feature as illustrated in the figures. These spatially relative terms are intended to encompass different positions and orientations of the devices in use or operation in addition to the position and orientation shown in the figures. For example, if a device in the figures is turned over, elements described as "below" or "beneath" other elements or features would then be "above" or "over" the other elements or features. Thus, the exemplary term "below" can encompass both positions and orientations of above and below. The devices may be otherwise oriented (rotated 90 degrees or at other orientations), and the spatially relative descriptors used herein interpreted accordingly. Likewise, descriptions of movement along and around various axes include various special device positions and orientations.

[0039] To avoid repetition in the figures and the descriptions of the various aspects and illustrative embodiments, it should be understood that many features are common to many aspects and embodiments. Omission of an aspect from a description or figure does not imply that the aspect is missing from embodiments that incorporate that aspect. Instead, the aspect may have been omitted for clarity and to avoid prolix description. In this context, the following applies to the rest of this description: If, in order to clarify the drawings, a figure contains reference signs which are not explained in the directly associated part of the description, then it is referred to previous or following description sections. Further, for reason of lucidity, if in a drawing not all features of a part are provided with reference signs it is referred to other drawings showing the same part. Like numbers in two or more figures represent the same or similar elements.

[0040] Fig. 1 shows a downlight 1 as an embodiment of a lighting device according to the invention. The downlight 1 comprises a housing 5, a plurality of LED light sources 2 and a transparent clear plate 6 as optical element of a carrier structure of an optical arrangement. The housing 5 has a horizontal top wall 51 and side walls 52 perpendicularly extending from the top wall 51. The housing 5 is configured to be embedded into a ceiling or into a panel construction mounted to the ceiling. At the bottom the housing 5 is open.

[0041] The plurality of LED light sources 2 is positioned inside und fixed to the housing 5. It comprises a printed circuit board (PCB) 22 to which plural LED 21 are mounted in one single plane. The LED 21 are rotated towards each other in order to generate an inhomogeneous light generation. Each LED 21 is provided with a collimator 3 as collimating member. In particular, each collimator 3 is positioned at one of the LED 21 such that essentially all light generated by the LED 21 passes the associated collimator 3. Each collimator 3 has an upper light collecting side 31 and a lower light emitting side 32.

[0042] The clear plate 6 is mounted to the side walls 52 of the housing 5 such that it forms a flat bottom boundary of the lighting device 1. The optical arrangement comprises a light shaping foil 4, which is attached to the top surface of the clear plate 6. More specifically, the foil 4 is adhered to the diffusor plate 6 such that extends along the essentially complete top surface.

[0043] As can be best seen in Fig. 2, each collimator 3 collects the light generated by its associated LED 21, collimates the light and downwardly emits it. Thereby, it generates a main direction of light propagation 33 which extends vertically down. More specifically, the light is propagated by the collimators 3 in various directions being different from the main direction of light propagation by a maximum of 30° such that a luminous flux in a range of 0° to 15° is bigger than a luminous flux in a range of 15° to 30°.

[0044] The clear plate 6 is positioned adjacent to the collimators such that the light generated by the LED 31 and propagated by the collimators 3 passes through the light shaping foil 4 and the clear plate 6. In between the collimators 3 and the light shaping foil 4 a slim gap of air is arranged. As depicted in Fig. 3, the foil 4 has a microstructure 41 configured to shape light passing through the optical arrangement. In particular, the microstructure 41 of the foil 4 has a plurality of domes 43 as refractive cells 42 of the microstructure 41.

[0045] As can be best seen in Fig. 4, the domes 43 of the microstructure 41 have identical hexagonal bases 42. The hexagonal shape of the bases 42 allow for continuously providing the refractive cells 42 all over the complete foil 4. As best visible in Fig. 5 the domes 43 extend from a ground plane 44 vertically upwards towards the LED light source 2.

[0046] Turning to Fig. 6, it can be seen that the domes 43 have differing heights 431. In particular, the microstructure 41 comprises three types of domes 43 having a first height 431_i, a second height 431_{ii} and a third height 431_{iii}, respectively. More specifically, the first height 431_i is larger than the second height 431_{ii} which is larger than the third height 431_{iii}.

[0047] Shoulders of the domes 43 and the main direction of light propagation 33 define a shoulder angle α of the respective dome 43. More specifically, relative to the main direction of light propagation 33 the domes 43 of the first height 431_i define a first shoulder angle α_i, the domes of the second height 431_{ii} define a second shoulder angle and the domes 43 of the third height 431_{iii} define a third shoulder angle α_{iii}. Thus, by providing the microstructure 41 with domes 43 with identical bases 42 but differing heights 431, different shoulder angles α can efficiently be formed.

[0048] This description and the accompanying drawings that illustrate aspects and embodiments of the present invention should not be taken as limiting-the claims defining the protected invention. In other words, while the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive. Various mechanical, compositional, structural, electrical, and operational changes may be made without departing from the spirit and scope of this description and the claims. In some instances, well-known circuits, structures and techniques have not been shown in detail in order not to obscure the invention. Thus, it will be understood that changes and modifications may be made by those of ordinary skill within the scope and spirit of the following claims. In particular, the present invention covers further embodiments with any combination of features from different embodiments described above and below.

[0049] The disclosure also covers all further features shown in the Figs. individually although they may not have been described in the afore or following description. Also, single alternatives of the embodiments described in the figures and the description and single alternatives of features thereof can be disclaimed from the subject matter of the invention or from disclosed subject matter. The disclosure comprises subject matter consisting of the features defined in the claims or the exemplary embodiments as well as subject matter comprising said features.

[0050] Furthermore, in the claims the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. A single unit or step may fulfil the functions of several features recited in the claims. The mere fact that certain measures are recited in mutually different dependent claims does not indicate that a combination of these measures cannot be used to advantage. The terms "essentially", "about", "approximately" and the like in connection with an attribute or a value particularly also define exactly the attribute or exactly the value, respectively. The term "about" in the context of a given numerate value or range refers to a value or range that is, e.g., within 20%, within 10%, within 5%, or within 2% of the given value or range. Components described as coupled or connected may be electrically or mechanically directly coupled, or they may be indirectly coupled via one or more intermediate components. Any reference signs in the claims should not be construed as limiting the scope.

Claims

1. A lighting device (1) comprising

a plurality of LED light sources (2) each provided with a collimating member (3) having a main direction of light propagation (33), and

an at least partially transparent optical arrangement (4, 6) positioned adjacent to the collimating members (3) such that light generated by the LED light sources (2) and propagated by the collimating members (3) into the main direction of light propagation (33) passes through the optical arrangement (4, 6),

characterized in that

the optical arrangement (4, 6) has a microstructure (41) with a plurality of refractive cells (43) configured to shape the light passing through the optical arrangement (4, 6), wherein

each of the plurality of refractive cells (43) has a shoulder angle (α) relative to the main direction of light propagation (33)

the plurality of refractive cells (43) has refractive cells (43) with differing shoulder angles (α), and

the plurality of refractive cells (43) comprise bases (42) having the same size being hexagonal.

2. The lighting device (1) of claim 1, wherein the main directions of light propagation of the collimating members (3) of the plurality of LED light sources (2) are essentially parallel to each other.

3. The lighting device (1) of claim 1 or 2, wherein each of the refractive cells (43) comprises a dome (43) extending from a ground plane (44).

4. The lighting device (1) of claim 3, wherein the hexagonal bases (42) of the plurality of refractive cells (43) are contacting each other such that the ground plane (44) of the light shaping foil (4) consists of the hexagonal bases (42) of the plurality of refractive cells (43).

5. The lighting device (1) of claim 3 or 4, wherein different domes (43) of the domes (43) have different heights (431).

6. The lighting device (1) of any one of claims 3 to 6, wherein the domes (43) extend from the ground plane (44) towards the LED light sources (2).

7. The lighting device (1) of any one of the preceding claims, wherein the refractive cells (43) comprise lenses.

8. The lighting device (1) of any one of the preceding claims, comprising a housing (5) wherein the plurality of LED light sources (2) and the optical arrangement (4, 6) are mounted in the housing (5) such that they are in fixed position and orientation relative to each other.

9. The lighting device (1) of any one of the preceding claims, wherein the optical arrangement (4, 6) comprises a carrier structure (6) and a light shaping foil (4) attached to the carrier structure (6).

10. The lighting device (1) of any one of the preceding claims, wherein the light shaping foil (4) has the microstructure (41) configured to shape light passing through the light shaping foil (4).

11. The lighting device (1) of claim 9 or 10, wherein the carrier structure (6) comprises an at least partially transparent optical element.

12. The lighting device (1) of any one of the preceding claims, wherein the microstructure (41) is oriented towards the plurality of LED light sources (2), wherein, preferably, a gaseous medium is arranged between the collimating members (3) of the LED light sources (2) and the light shaping foil (4), and the light shaping foil (4) has a higher refracting index than the gaseous medium.

13. The lighting device (1) of any one of the preceding claims, wherein the plurality of LED light sources (2) with the collimating members (3) are configured to propagate light in various directions being different from the main direction of light propagation (33) by a maximum of 30°, wherein each of the plurality of LED light sources (2) and its associated collimator member preferably is configured to propagate light in directions distributed such that a luminous flux in a range of 0° to 15° is bigger than a luminous flux in a range of 15° to 30°.

14. The lighting device (1) of any one of the preceding claims, wherein the plurality of LED light sources (2) are rotated towards each other.

15. The lighting device (1) of claim 14, wherein the plurality of LED light sources (2) is mounted in one plane.

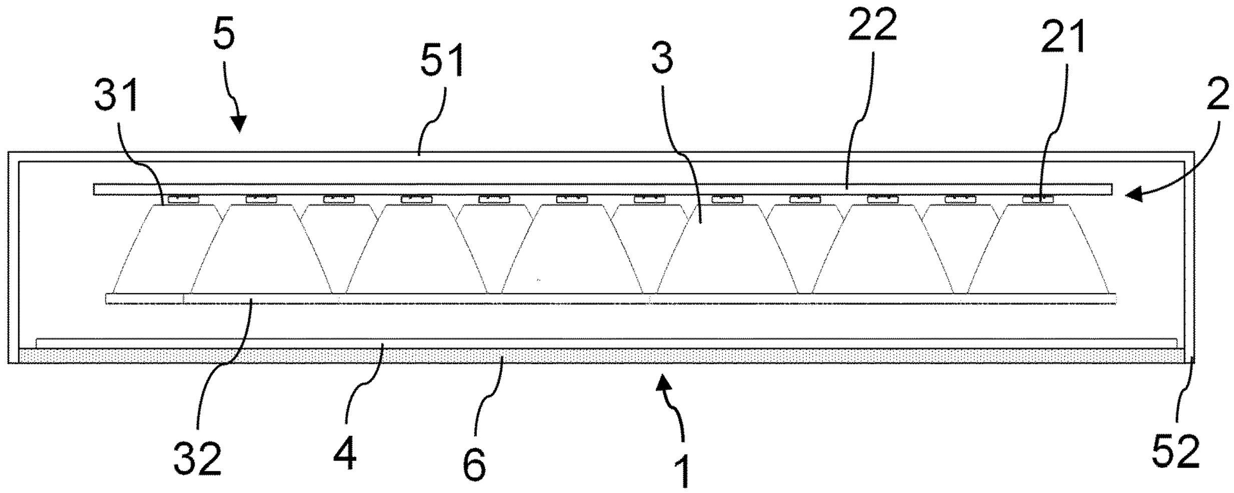

Fig. 1

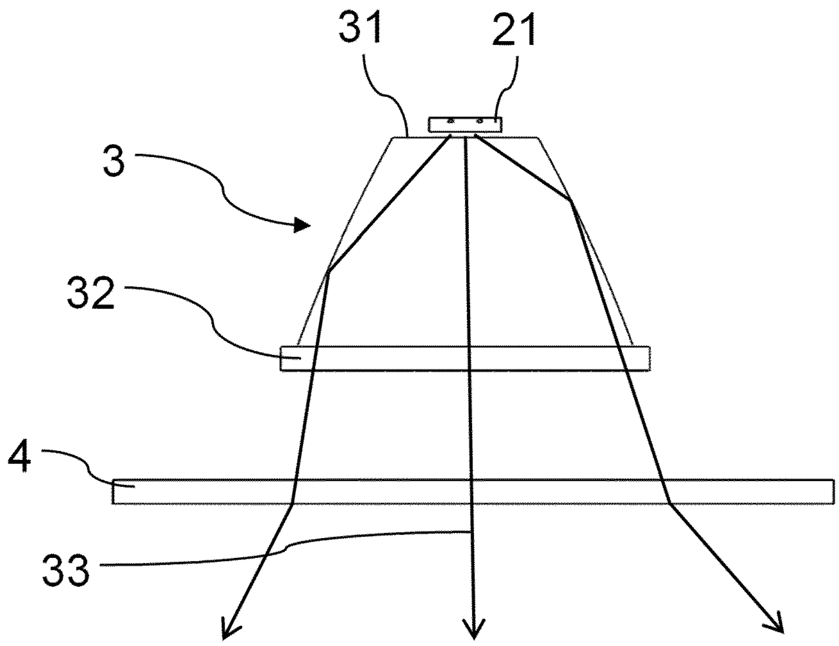

Fig. 2

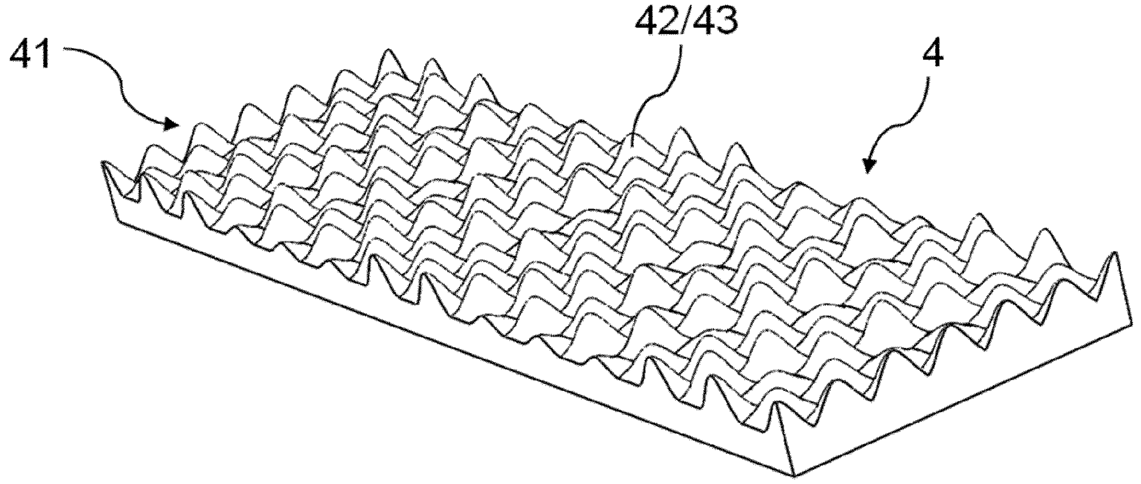

Fig. 3

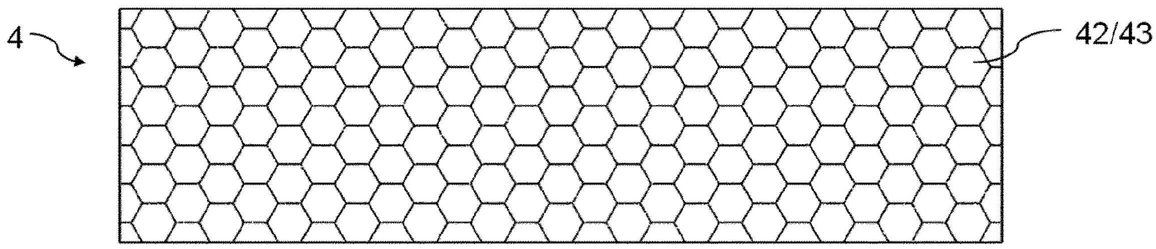

Fig. 4

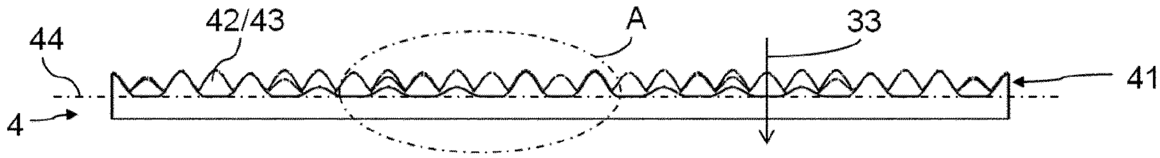

Fig. 5

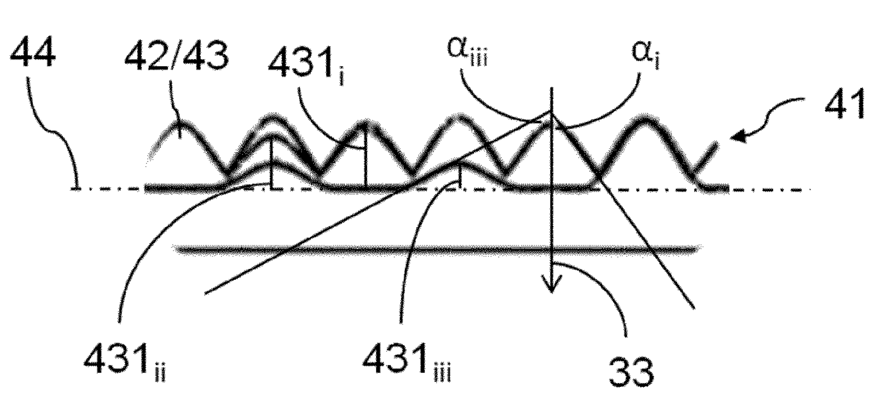

Fig. 6

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 20 18 7725

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	WO 2011/010247 A2 (KONINKL PHILIPS ELECTRONICS NV [NL]; SNIJDER PIETER JACOB [NL] ET AL.) 27 January 2011 (2011-01-27) * claims 1,17; figures 1,3 *	1-5, 7-11,13, 15	INV. F21V5/00 F21V7/00
Y	WO 2017/050929 A1 (REGENT BELEUCHTUNGSKÖRPER AG [CH]) 30 March 2017 (2017-03-30) * paragraphs [0007], [0008]; figures 2,4 *	1-5, 7-11,13, 15	
A	US 2018/335191 A1 (STEFANOV EMIL P [DE] ET AL) 22 November 2018 (2018-11-22) * paragraphs [0062], [0081], [0082]; figures 14a,14d, 15a *	1-15	
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Place of search	Date of completion of the search	Examiner
The Hague	2 November 2020	Krikorian, Olivier

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