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(71) Applicant: **Lledo Iluminación, SA**
28935 Móstoles (ES)

(72) Inventor: **García Rodríguez, Lucas**
28049 Madrid (ES)

(74) Representative: **Naranjo Marcos, Maria Antonia**
Paseo de la Habana 200
28036 Madrid (ES)

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(54) **Lighting system based on light-emitting diodes with mobile optics for control of the exit light beam**

(57) The LED lighting system (1), with mobile optics for control of the exit light beam, is made up of a an LED panel (2) and a mobile optical device (4) with individual optics forming groups with different patterns for different light distributions which are repeated sequentially in each group. The individual LEDs (3) occupy circumferences which are concentric to the centre of the LED panel (2), and the individual optical structures (5) of each group

occupy circumferences which are concentric to the centre of the optical device (4); these positions match the positions occupied by the individual LEDs (3). The optical device (4) is designed as a disc which rotates around axis E and may include the help of driving means (9) in order to turn between a plurality of operating positions, so that at least one of the optical structures (5) of a group is completely or partially situated over one of the individual LEDs (3) when the optical device (4) turns.

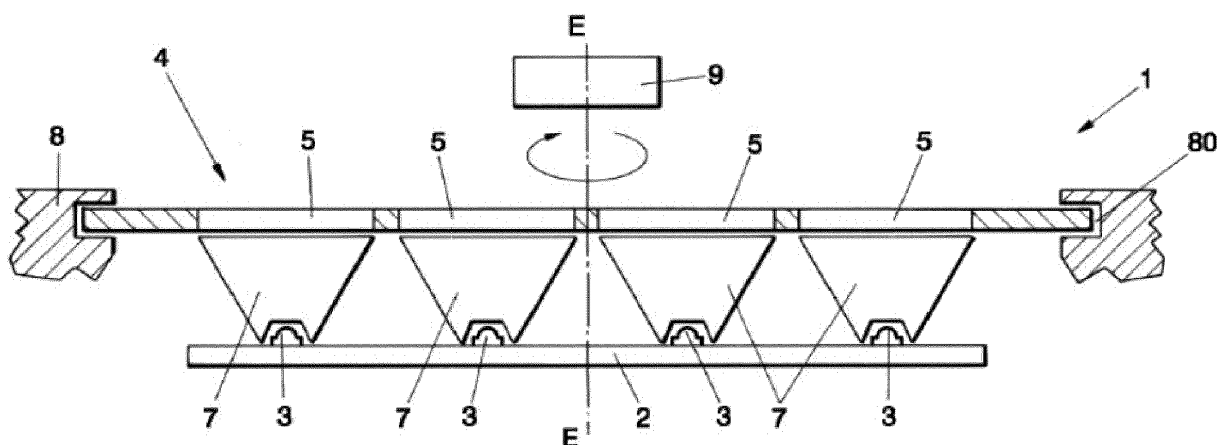


FIG. 1

Description

[0001] This invention relates to the field of lighting elements.

Field and previous technique

[0002] The invention refers in general to a lighting system with light-emitting diodes which enables the distribution of the light emitted by the diodes to be controlled. It has uses in all kinds of lighting facilities for both domestic and industrial or public use.

[0003] US patent application US 2008/0231162 A1 relates to a lighting device which includes a light source designed as a strip of light-emitting diodes and at least two panels on which, alternately, the respective transparent areas and areas made up of the respective different-coloured phosphors are defined, with the panels being designed to move relative to each other and also relative to the light source, either in a linear direction or rotating direction, in order to gradually overlap the transparent areas and areas with different phosphors of the respective panels. This enables the radiation spectrum, that is to say the colour, to be varied and more specifically the colorimetric properties of the light source, taking advantage, so to speak, of the principle of additive synthesis for the generation of colours. Starting off with a blue emitted light and using red and green phosphors, an RGB model is created which is similar to that used in colour television and enables a wide range of colours to be synthesised; but all this without mentioning the possibility of modifying the light distribution pattern of the beams generated by the LEDs.

[0004] Patent application WO 2005/093319 A1 relates to a lighting system comprising a means for generating a convergent light beam with a central axis and a lens situated substantially around the central axis, as well as a means to move the lens in relation to the light generation means. When a lens, for example, a plano-concave lens moves along the aforementioned central axis, the width of the light beam can be changed and when a lens, for example, a bi-concave lens moves perpendicular to the central axis, the exit angle of the light beam is varied. The possibility of grouping together several lenses with different light distribution patterns in order to change alternately between various types of light beam distribution patterns is not considered here. Furthermore, in order to vary the beam distribution, consideration is only given to a movement of the lens longitudinal to the central axis of the system and mention is only made of a movement of the lens perpendicular to the central axis in order to change the direction of the beam, but not to produce a change in the distribution of the beam.

[0005] In addition, patent application ES 2339209 A1, in the name of the applicant, relates to an optical system made up of a panel of electro-luminous diodes (LEDs) arranged longitudinally and equidistant from each other and a single mobile optical part made up of a periodic

strip, with a period equal to the distance between the LEDs, formed by sequences of lenses with different light distribution patterns. In this system, by means of a longitudinal movement of the mobile optical part in relation to the LEDs, the type of lens that collects the light from the LED is selected and, consequently, it is possible to vary the width and distribution of the resulting light beam with the appropriate choice of lens. This system is adapted to linear lighting and is designed as a single optical stage implemented by a single lens, but does not enable its use in floodlight-type circular optics systems.

Description of the invention

[0006] Based on the state of the technique described above, the objective set is to develop a system of the type indicated which initially enables the problems of the above technique to be solved.

[0007] This objective is achieved through the characteristics indicated in claim 1. The other objectives and advantages of the invention are achieved by means of the characteristics indicated in the dependent claims.

[0008] The system is made up of a panel of LEDs with a plurality of individual light-emitting diodes and an optical device with a plurality of individual optical structures forming groups with different patterns for different light distributions which are repeated sequentially in each group. The optical device is arranged so as to move in relation to the LED panel in such a way that its respective light beams fall on the optical structures of each group with a particular common light distribution pattern. According to the invention the system is characterised as follows:

- The LED panel is designed as a panel with a plurality of individual light-emitting diodes, which are distributed so as to occupy their respective circumferences concentric to the centre of the panel in positions defined by the radius of a respective circumference in the panel and the angular coordinate of a polar system which originates in the aforementioned centre of the panel.
- The optical device is essentially designed as a disc that rotates around an axis which contains the geometric centre of the LED panel and the geometric centre of the rotating disc, so that it can move and turn between a plurality of operating positions.
- In the optical device, the individual optical structures of each group are distributed so as to occupy the respective circumferences concentric to the centre of the disc in positions defined by the radius of a respective circumference in the disc and the angular coordinate of a polar system which originates in the aforementioned centre of the disc; these positions match the positions occupied by the associated individual LEDs of the LED panel, so that at least one of the optical structures of a group is completely or

partially situated over one of the individual LEDs of the LED panel when the optical device moves in order to control the distribution of the light beam emitted by the LED.

Advantages

[0009] The main advantages of this device include, but are not limited to, the following:

- According to an additional characteristic of the invention, it is an advantage when each of the individual LEDs is equipped with the respective reflector/lens in order to control and direct its light beam in a normal direction to the LED panel.
- According to an additional characteristic of the invention, an advantageous layout of the system is achieved when the individual LEDs are angularly distributed in an equidistant manner in the LED panel, and in the optical device the first individual optical structures of each group are also angularly distributed in an equidistant manner and with the same angular separation (B_h) in each group.
- According to an additional characteristic of the invention, it is an advantage for the optical device in the shape of a disc to be mounted on a guide support with an annular guide groove.
- According to an additional characteristic of the invention, it is especially advantageous to have driving means adapted to move the optical device between the operating positions in which the light beam of at least one individual LED of the LED panel falls completely or partially on at least one of the individual optical structures of the groups of optical structures in order to control the distribution of the light beam according to the distribution pattern of the optical structure or structures on which it falls.
- According to an additional characteristic of the invention, it is an advantage for the driving means to be adapted to move the optical device progressively or continuously in relation to the LED panel.
- According to an additional characteristic of the invention, an advantageous layout of the system is also achieved when the driving means are adapted to move the optical device discontinuously or step by step in relation to the LED panel.
- Also according to an additional characteristic of the invention, an advantageous layout of the system is achieved when the optical structures are chosen from a group including concave lenses, convex lenses which provide intensive or extensive distributions, cylindrical or prismatic surfaces which can offer dis-

tributions without rotational symmetry such as elliptical light patterns, conical lenses which have annular patterns, or Fresnel lenses which produce a specific pattern.

- Finally, according to an additional characteristic of the invention, an advantageous layout of the system is achieved when the optical structures are designed as matrix groupings of concave, convex, cylindrical, prismatic, conical or pyramidal micro-lenses.

Brief description of the drawings

[0010] The other characteristics and advantages of the invention can be seen more clearly through the description below, as well as the attached diagrams referring to an exemplary embodiment in which:

Figure 1 shows a sketch of a partial sectional view of a lighting system according to the invention.

Figure 2 shows the system from figure 1 partially divided into an operating position which produces an intensive distribution of the light beam.

Figure 3 shows the system from figure 1 partially divided into another operating position which produces an extensive distribution of the light beam.

Figure 4 shows a sketch of the distribution of the individual LEDs in an electronic panel for the system in figure 1.

Figure 5 also shows a sketch of the distribution of the individual optical structures over a mobile optical device in the system from figure 1.

Figures 6 and 7 show respective views of the LED panel and the optical device for a variant of the number of LEDs and optical structures.

Figures 8A and 8E show optical structures with various layouts for using the system according to the invention.

Figure 9 shows a simplified view of a lighting system according to the invention implemented as a flood-light.

Detailed description of the preferred embodiments

[0011] As is shown in figure 1, the lighting system according to the invention, in general referred to under reference number (1), is essentially made up of an LED panel (2) and an optical device (4) which is arranged so as to rotate in relation to the LED panel.

[0012] The LED panel (2) consists of a plurality of individual light-emitting diodes (3), whilst the optical device (4) is equipped with a plurality of individual optical structures (5) which form groups (6) of different optical structures for different light distribution patterns which are repeated sequentially, as will be explained in further detail below.

[0013] When the optical device (4) occupies an operating position such as that shown in figure 2, the light

beams of each individual LED (3) fall on optical structures (5) of the groups (6) which have a common first light distribution pattern, in this case an intensive light pattern which is shown in the figure with barely diverging arrows; however, when the optical device (4) turns and moves to occupy another operating position as is shown in figure 3, the light beams of each LED fall on other optical structures (5) of the groups (6) with a different second common light distribution pattern, in this case an extensive light pattern which is shown in the figure with arrows which noticeably diverge. It should be explained here that for simplicity of representation in figures 2 and 3, the device from figure 1 is fragmented in the centre, showing only the individual LEDs (3) and the individual optical structures (5) in their respective proximities from the edge of the LED panel (2) and the edge of the disc (4).

[0014] As is shown, for example, in figure 1, each of the individual LEDs (3) is equipped with its respective reflector/lens (7) in order to control and direct its light beam in a normal direction to the LED panel (2).

[0015] Referring again to figure 4, it can be seen that the LED panel (2) is designed as a circular panel with a plurality of individual light-emitting diodes (3) which are distributed so as to occupy their respective circumferences concentric to the centre Op of each panel in positions Rpi-Apj, which are angularly equidistant, where Rpi is the radius of a respective circumference in the panel and Apj is the angular coordinate of a polar system which originates in the aforementioned centre of the panel.

[0016] With additional reference to figure 5, it can be seen that in the rotating optical device (4), the individual optical structures (5) of each group (6) are distributed so as to occupy their respective circumferences concentric to the centre Od of the disc in positions Rdl-Adm, which are angularly equidistant, where Rdl is the radius of a respective circumference in the disc and Adm is the angular coordinate of a polar system which originates in the aforementioned centre of the disc, these positions matching the positions occupied by the associated individual LEDs (3) of the LED panel (2). Furthermore, it can be seen that the individual optical structures (5) of each group (6) are arranged with the same angular separation Bh, and that this separation is angular, sufficient for only one of the optical structures (5) of each group (6) to collect the light beam of the associated individual LED (3) when the optical device is turned to an operating position; nevertheless, even though the separation between optical structures (5) of each group is not shown, it may be adapted so that adjacent optical structures may partially collect the light beam coming from a single individual LED (3).

[0017] It should be pointed out here that for clarity of representation in figure 5, only some of the groups of optical structures included in the device (4) are shown; for the same reason only some of the individual LEDs (2) of the LED panel (2) are shown in figure 4.

[0018] As has already been mentioned and is shown in figure 1, the optical device (4) essentially has the shape of a disc and is designed to turn around an axis E which

extends between the geometric centre OP of the LED panel (2) and the geometric centre OD of the rotating disc (4). It can therefore move between a plurality of discrete operating positions separated angularly such as those shown in figures 2 and 3.

[0019] As is shown in figures 6 and 7, in a particular embodiment, the LED panel (2) can be designed with three circumferences of individual LEDs (3), the optical device being arranged with three circumferences of individual optical structures (5) and each respective group (6) consisting of only two individual optical structures for two different light distribution patterns, for example an intensive distribution pattern and an extensive distribution pattern.

[0020] However, it should be mentioned that the number of circumferences occupied by the LEDs and the individual optical structures, as well as the number of one or the other, may be chosen on a discretionary basis according to the chosen lighting application. In addition, the number of optical structures of each group (6) may be two or more, with the light distribution patterns consisting of one intensive pattern and another extensive pattern, and some even having other light distribution patterns; the only important thing according to the invention is that the sequence of light distribution patterns must be repeated in the same order for each group (6).

[0021] Although it is not shown, mention should still be made of the fact that according to the invention the groups (6) of optical structures (5) do not necessarily have to be arranged in an angularly equidistant manner, nor do the optical structures (5) of each group have to be distributed with the same angular separation.

[0022] Making reference once again to figure 1, it can be seen that the optical device (4) in the shape of a disc is mounted on a guide support (8) with an annular guide groove (80). In addition, driving means (9) can be designed which are adapted to move the optical device (4) either progressively/continuously or discontinuously/step by step between the operating positions in which the light beam of each individual LED (3) of the LED panel (2) either falls only on the individual optical structures (5) of the groups (6) which have a certain common light distribution pattern or the light beam of the associated individual LED (3) falls on two or more adjacent optical structures (5) of each group (6).

[0023] It should be pointed out here that the driving means (9) are symbolically shown as being associated with axis of rotation E of the optical support in order to show that their function is to rotate the optical device (4), however, they may be arranged in the system (1) in any other technically appropriate manner.

[0024] In addition, it should also be mentioned that the individual optical structures (5) can be designed as lenses to shape the light beams, for example with intensive or extensive patterns. In particular, concave lenses of the type shown in figure 8A could be used; however, it would also be possible to use convex lenses which provide intensive or extensive distributions, cylindrical or

prismatic surfaces, not shown, which can offer distributions without rotational symmetry such as elliptical light patterns, conical lenses which have annular patterns, or Fresnel lenses which produce a specific pattern, which are not shown.

[0025] However, as can be seen through figures 8B to 8E, the optical structures (5) can be respectively designed as matrix groupings of concave, convex, cylindrical, prismatic, conical or pyramidal micro-lenses (50), which provide similar optical characteristics in a limited space.

[0026] As will be easily understood by people well versed in the art, the above description of preferred exemplary embodiments of the invention is for illustrative purposes only. Technical modifications of any kind are therefore possible and the invention will only be limited by the scope of the claims below.

Claims

1. A lighting system based on light-emitting diodes with mobile optics for control of the exit light beam. The system is made up of (1) an LED panel (2) with a plurality of individual light-emitting diodes (3) and an optical device (4) with a plurality of individual optical structures (5) forming groups (6) with different patterns for different light distributions which are repeated sequentially in each group. The optical device (4) is arranged so as to move in relation to the LED panel (2) in such a way that its respective light beams fall on the optical structures of each group with a particular common light distribution pattern. The system is characterised as follows:

- The LED panel is designed as a panel with a plurality of individual light-emitting diodes (3) which are distributed so as to occupy their respective circumferences concentric to the centre (Op) of the panel in positions (Rpi and Apj), where Rpi is the radius of a respective circumference in the panel and Apj is the angular coordinate of a polar system which originates in the aforementioned centre of the panel.

- The optical device (4) is essentially designed as a disc that rotates around an axis (Eg) which contains the geometric centre (Op) of the LED panel (2) and the geometric centre (Od) of the rotating disc, so that it can move and turn between a plurality of operating positions.

- In the optical device (4), the individual optical structures (5) of each group (6) are distributed so as to occupy the respective circumferences concentric to the centre (Od) of the disc in positions (Rdl and Adm), where Rdl is the radius of a respective circumference in the disk and Adm is the angular coordinate of a polar system which originates in the aforementioned centre of the

disc; these positions match the positions occupied by the associated individual LEDs (3) of the LED panel (2), so that at least one of the optical structures of a group is completely or partially situated over one of the individual LEDs (3) of the LED panel (2) when the optical device moves in order to control the distribution of the light beam emitted by the LED.

2. A system according to claim 1 which is **characterised by** the fact that each of the individual LEDs (3) is equipped with the respective reflector/lens (7) in order to control and direct its light beam in a normal direction to the LED panel (2).
3. A system according to claim 1 which is **characterised by** the fact that individual LED diodes (3) are angularly distributed in an equidistant manner in the LED panel (2), and in the optical device (4) the first individual optical structures (5) of each group (6) are also angularly distributed in an equidistant manner and with the same angular separation (Bh) in each group.
4. A system according to claim 1 which is **characterised by** the fact that the optical device (4) in the shape of a disc is mounted on a guide support (8) with an annular guide groove (80).
5. A system according to at least one of the above claims which is **characterised by** the fact that it is equipped with driving means (9) adapted to move the optical device (4) between the operating positions in which the light beam of at least one individual LED (3) of the LED panel (2) falls completely or partially on at least one of the individual optical structures (5) of the groups of optical structures (6) in order to control the distribution of the light beam according to the distribution pattern of the optical structure or structures (5) on which it falls.
6. A system according to claim 5 which is **characterised by** the fact that the driving means (9) are adapted to move the optical device (4) progressively or continuously in relation to the LED panel.
7. A system according to claim 5 which is **characterised by** the fact that the driving means (9) are adapted to move the optical device (4) discontinuously or step by step in relation to the LED panel.
8. A system according to the above claims which is **characterised by** the fact that the optical structures (5) are designed as concave lenses, convex lenses which provide intensive or extensive distributions, cylindrical or prismatic surfaces which can offer distributions without rotational symmetry such as elliptical light patterns, conical lenses which have annular

patterns, or Fresnel lenses which produce a specific pattern.

9. A system according to claim 8 above which is **characterised by** the fact that the optical structures (5) are designed as matrix groupings of concave, convex, cylindrical, prismatic, conical or pyramidal micro-lenses (50).

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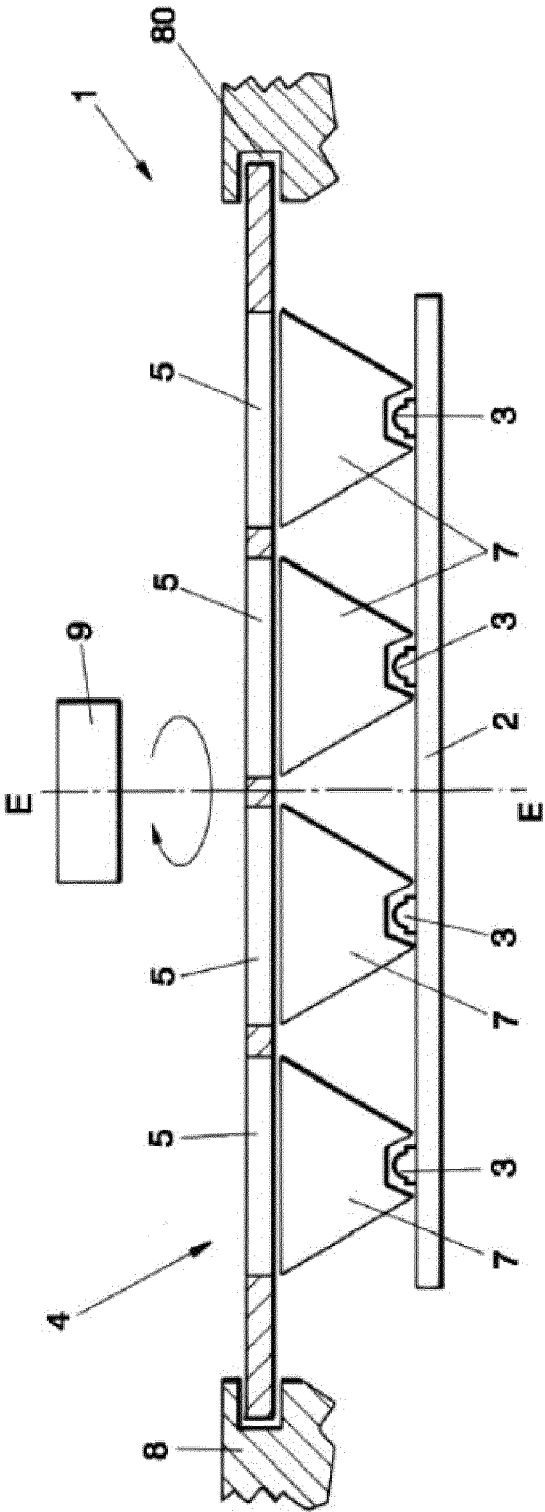


FIG. 1

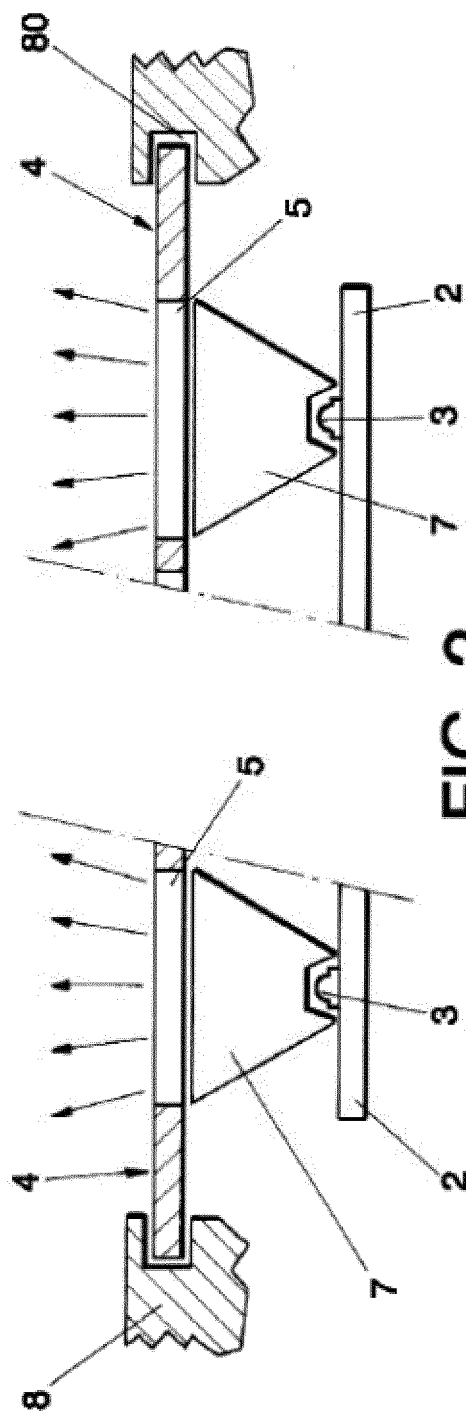


FIG. 2

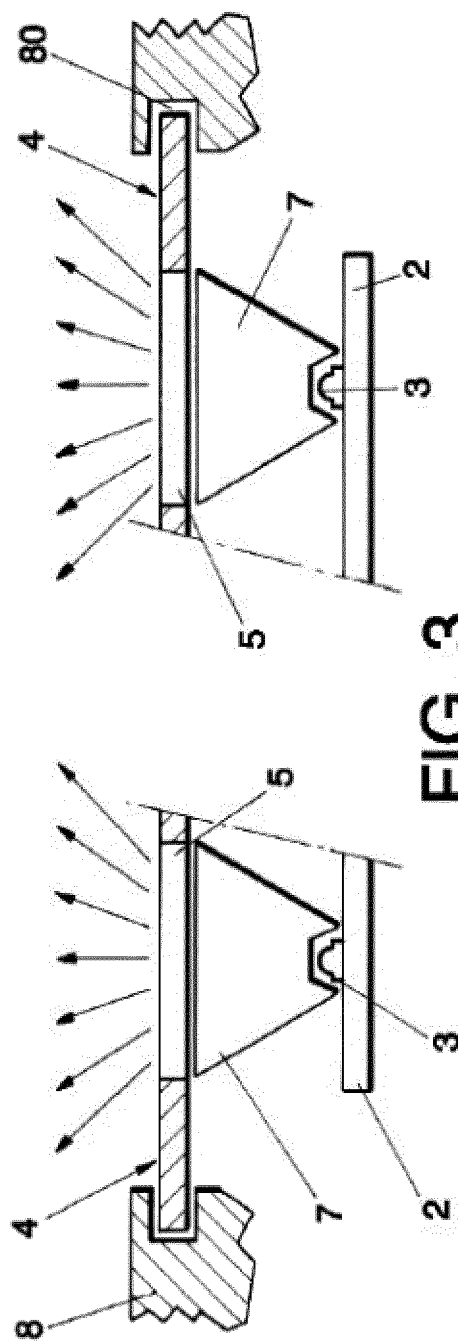


FIG. 3

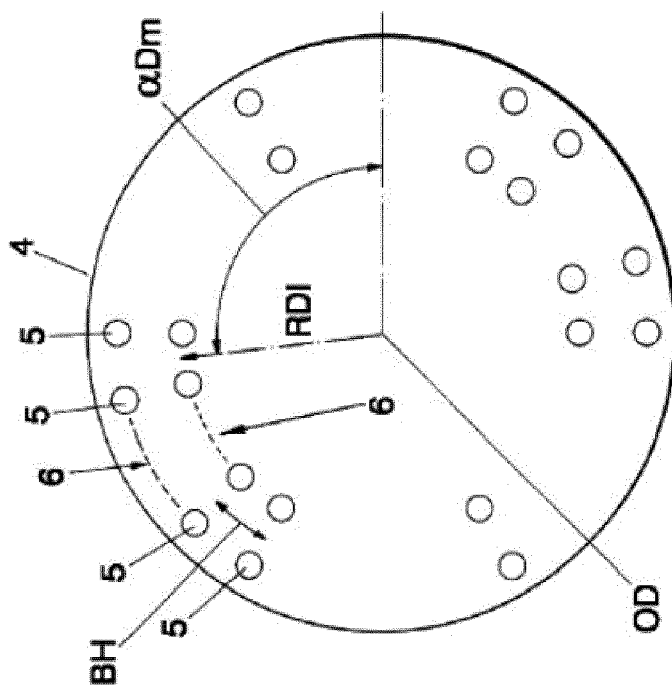


FIG. 5

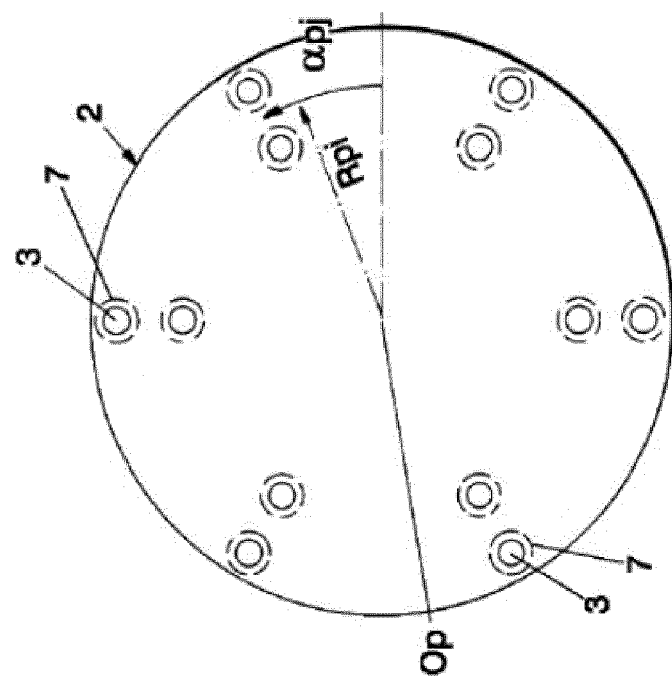


FIG. 4

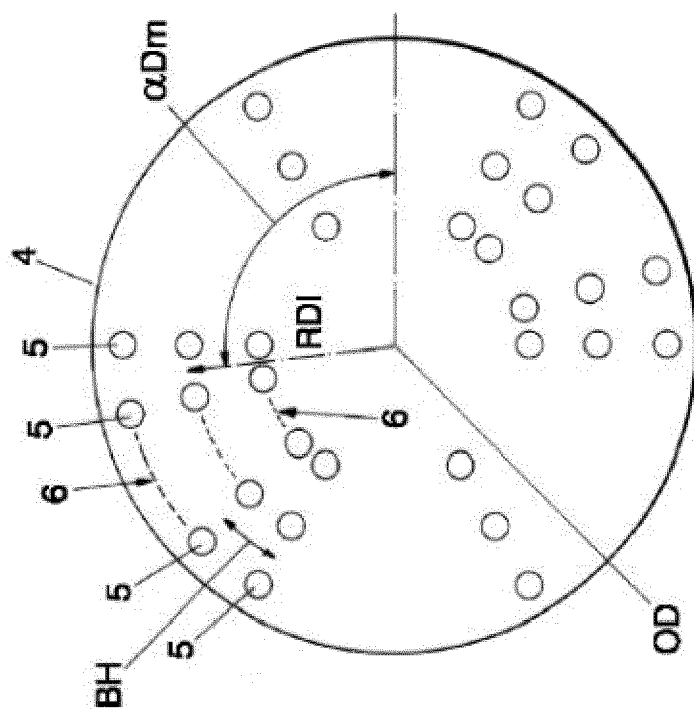


FIG. 6

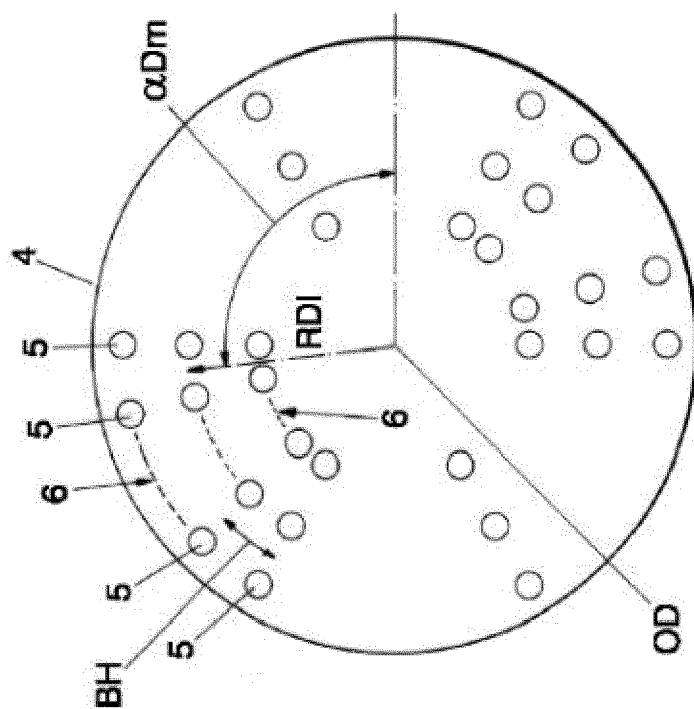


FIG. 7

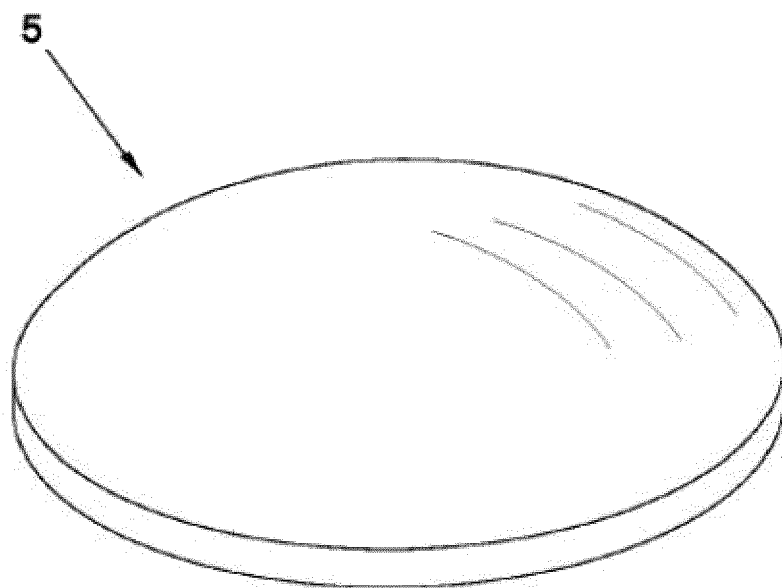


FIG. 8A

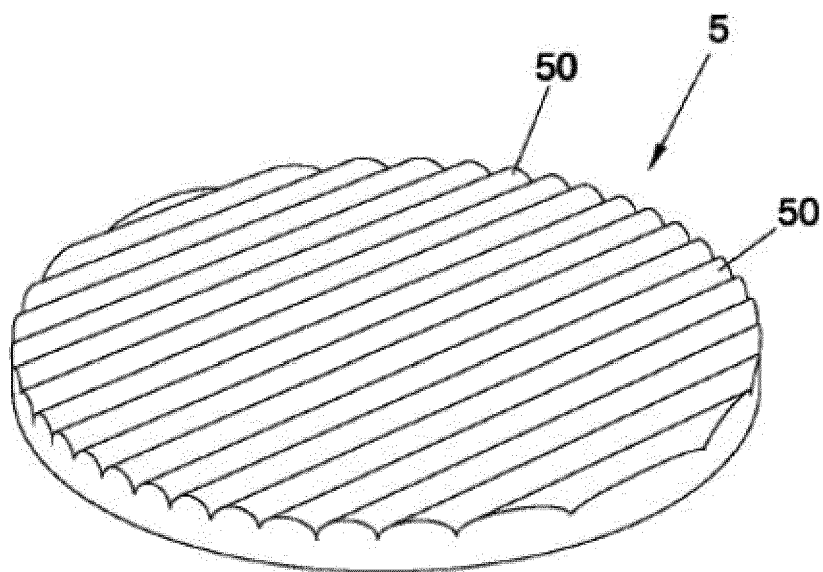


FIG. 8B

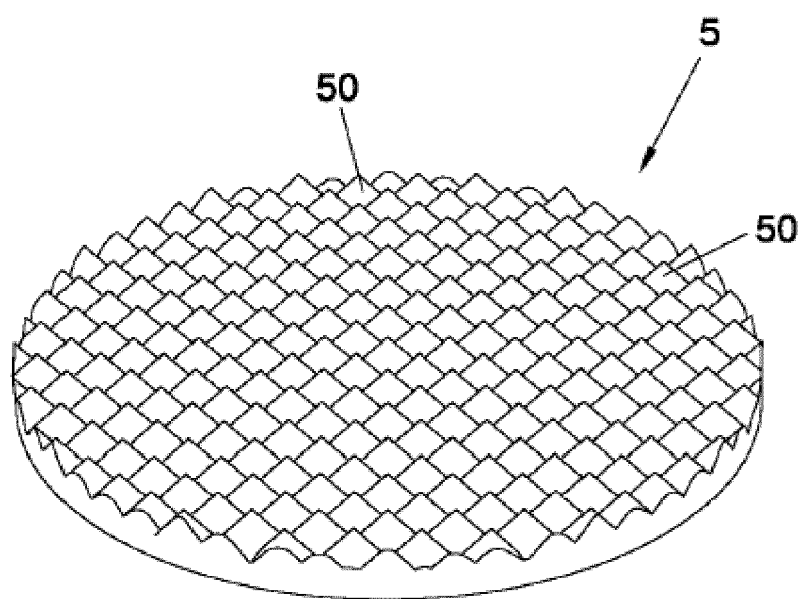


FIG. 8C

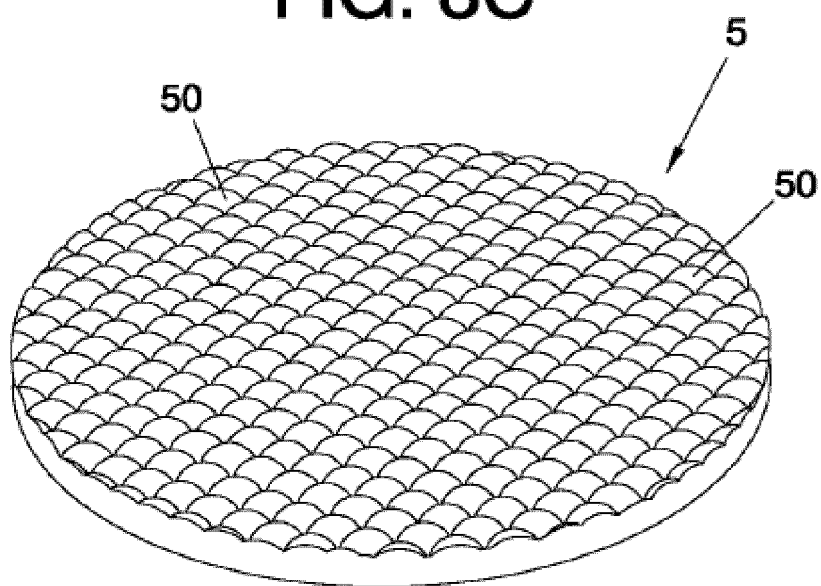


FIG. 8D

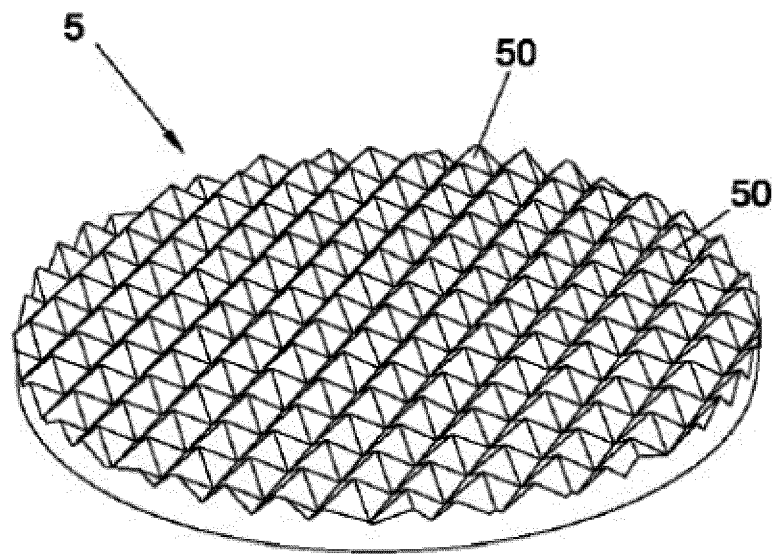


FIG. 8E

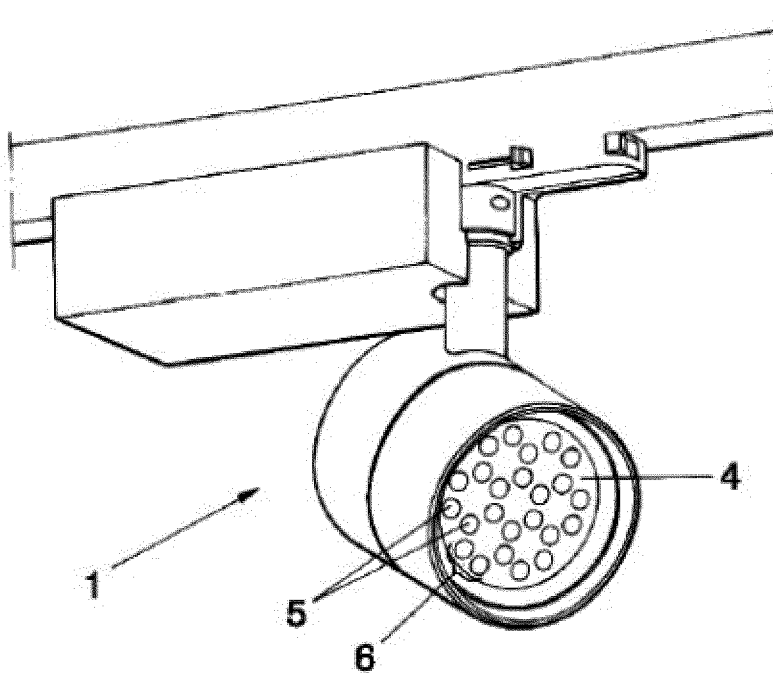


FIG. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20080231162 A1 [0003]
- WO 2005093319 A1 [0004]
- ES 2339209 A1 [0005]