(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 904 757 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.11.2021 Bulletin 2021/44

(21) Application number: **20172517.3**

(22) Date of filing: **30.04.2020**

(51) Int Cl.:
F21V 5/04 *(2006.01)* ***F21V 17/02*** *(2006.01)*
F21V 14/06 *(2006.01)* ***F21V 17/00*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Neonlite Distribution Limited**
Kowloon (HK)

(72) Inventor: **LEE, Wing Tak**
Kwun Tong
Kowloon (HK)

(74) Representative: **Potter Clarkson**
The Belgrave Centre
Talbot Street
Nottingham NG1 5GG (GB)

(54) LIGHT MODULE WITH SLIDING LENS MECHANISM FOR ADJUSTING ILLUMINATION PATTERN, LIGHT ARRAY AND LIGHTING SYSTEM FORMED BY THE LIGHT MODULES

(57) The invention provides a light module having adjustable illumination pattern, comprising a light unit for generating a light beam, a light unit holder for securing the light unit, two or more lens units each being adapted for the light unit to generate different illumination patterns, and a lens mount for mounting the two or more lens units. The lens mount is slidably coupled to the light unit holder so that the slidable movement of the lens mount enables said two or more lens units to slide relative to the light unit on the holder until a desirable one of said two or more lens units is in alignment with the light unit, thereby to provide the light module with a selectable illumination pattern. The invention also relates to a linear light array and a lighting system formed by two or more light modules.

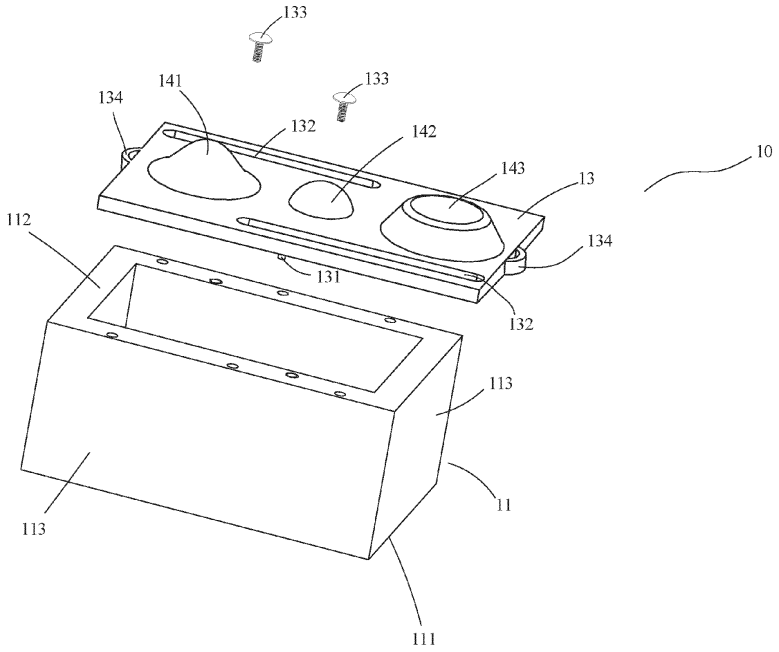


Fig. 1

EP 3 904 757 A1

Description

FIELD OF THE INVENTION

[0001] The present invention is generally in the field of lighting fixtures. More specifically, the present invention concerns a light module which comprises a sliding lens mechanism useful for adjusting light illumination pattern thereof, providing an ease of selecting different illumination beam angles and illumination patterns to adapt for various illumination purposes and illumination occasions.

BACKGROUND OF THE INVENTION

[0002] LED light modules become more popular in a wide range of lighting applications. Typically a LED lighting fixture is an arrangement of a LED light source, heat sink, driver electronics, and most importantly a lens or reflector is being used to collect lights from the light source and direct them to form an illumination pattern defined mainly by the illumination beam angle it was designed for.

[0003] Application of LED directional Lighting fixtures generally includes down lights, spot lights, wall washers and linear fixtures for general and ambient illuminations. Nowadays some specialized lighting applications in retailing utilize split beam technologies for a single lighting fixture to illuminate both the supermarket walkways and product display shelves on the side. Always there is a need for change of the illumination patterns and the beam angles of lighting fixtures in many occasions, such as updating a new season's merchandise in retail stores, or highlighting promotional products on display. It would be more convenient and value added if the illumination pattern of a lighting fixture can be changed on the fly, saving a lot of money for inventory, installation time and labor.

[0004] US patent no.6632004 issued to Sugawara et al. discloses a lighting device with two sliding lens on the light exit axis direction of a reflector lamp, by sliding to open and close the two lens on its horizontal axis at the light exit, the beam angle characteristics of the lighting device are changed between wide and narrow illumination patterns.

[0005] Spanish patent no. ES2278955 discloses a module in which each optical element consists of a plurality types of LEDs (four types of LEDs in one embodiment) installed on a substrate that couples to the corresponding lens of such optical element, by rotating the lens or the substrate, the optical element can provide multiple (up to four in this embodiment) illumination characteristics provided by the different type LEDs.

[0006] All these prior arts have limited applications due to bulkiness, complexity of control and high costs. There is a need for a more simple way to conveniently adjust the illumination characteristics of a lighting fixture.

SUMMARY OF THE INVENTION

[0007] An object of the invention is to provide a novel way to adjust the illumination patterns of a lighting fixture with a simple adjustment mechanism for varying the beam angles and/or the illumination patterns at ease. The adjustment mechanism is arranged such that the user simply pushes a tab at an end face of the lighting fixture to select a plurality of desirable preset beam angles or illumination patterns.

[0008] The above object can be attained by providing a light module having adjustable illumination pattern, comprising:

a light unit comprising one or more light sources for generating a light beam,
a light unit holder on which the light unit is secured,
two or more lens units having same or different illumination patterns, each of the lens units being adapted for the light unit to generate an illumination pattern, and
a lens mount comprising a base member on which the two or more lens units are mounted,
wherein the lens mount is slidably coupled to the light unit holder so that the slidable movement of the lens mount enables said two or more lens units to slide relative to the light unit on the holder until a desirable one of said two or more lens units is in alignment with the light unit, thereby to provide the light module with a selectable illumination pattern.

[0009] In certain cases, the two or more lens units may be provided as a one-piece lens constructed to have two or more lens parts having same or different illumination patterns, and the two or more lens parts are slidable along with the slidable movement of the lens mount in a manner that a desirable one of said two or more lens parts aligns with the light unit, thereby to provide the light module with a selectable illumination pattern. The two or more lens parts may be fabricated integrally or connected in a substantially flat configuration.

[0010] "Connection" (connect, connected and connecting) herein refers to two or more lens parts are put together or combined or linked or fastened or coupled.

[0011] In certain cases, the light unit holder may be provided as a frame box comprising a closed end, an open end and two pairs of opposite sides to define a cavity, and the light unit is secured on the closed end within the cavity.

[0012] In one preferred embodiment of the invention, the lens mount may be configured as a plate slidably resting on the open end of the frame box in a manner that the plate slides to two or more resting positions on the frame box, and the light unit substantially aligns with one of the lens unit in a respective one of the two or more resting positions. The plate may include at least one stopper stud protruding from at least one of two opposite edges of an underside of the plate in a sliding direction of

the plate, and the open end of the frame box may be formed with two or more dimples positioned to correspond to the stopper stud and alternately engageable with the stopper stud in the two or more resting positions. It would be possible to have the dimples formed on the plate while the stopper studs arranged on the frame box for engagement. Advantageously, the plate may include on the two opposite edges thereof at least one sliding slot extending in the sliding direction of the plate, and the plate may be slidably fastened by bolts constrained in the sliding slot to the open end of the frame box at the two or more resting positions. In this instance, the sliding slots are configured to allow the lens mount to slide slightly at an angle from the sliding direction to achieve a slight change in a beam angle.

[0013] In certain cases, the frame box may be configured to comprise a pair of inwardly facing grooves opposite to and facing each other on the two opposite sides of the frame box, and the pair of grooves extend entirely in the sliding direction of the plate, and wherein the plate is dimensioned to be slidably received and constrained in the pair of grooves.

[0014] In certain cases, the frame box may be configured to comprise a pair of outwardly facing grooves facing away from each other on the two opposite sides of the frame box, and the pair of grooves extend entirely in the sliding direction of the plate, and the plate has two or more clips protruding downwardly from the two opposite edges thereof, and the clips are dimensioned to be slidably received in the respective grooves.

[0015] In another preferred embodiment of the invention, the light unit holder is provided as a substantially flat plate member on which the light unit is secured, and the lens mount is configured as a U-shaped structure comprising a base member having a first surface facing the light unit on one side and a second surface on the other side, and two side panels extending from the first surface, and wherein the two side panels are slidably coupled to the flat plate member to define a cavity in which the light unit is placed, and wherein the U-shaped structure slides to two or more resting positions on the plate member, and the light unit substantially aligns with one of the lens unit mounted on the base member in a respective one of the two or more resting positions.

[0016] Preferably, the plate member may include at least one stopper stud protruding from two opposite edges of a top side of the plate member in a sliding direction of the U-shaped structure, and the two side panels each may be configured to have an end face formed with two or more dimples positioned to correspond to the stopper stud and alternately engageable with the stopper stud in the two or more resting positions. In certain cases, the plate member may include on the two opposite edges thereof at least one sliding slot extending in the sliding direction, and the plate member is slidably fastened by bolts constrained in the sliding slot to the U-shaped structure at the two or more resting positions. In certain cases, each of the side panels may be configured to comprise one or more inwardly facing clip extending in the sliding direction of the U-shaped structure, and the plate member may be dimensioned to be slidably engageable with the clips opposite to and facing each other. As an example of the plate member, a lamp substrate or a printed circuit board may be selected.

[0017] In a particular embodiment of the invention, the light module comprises three lens units of different illumination patterns arranged in the sliding direction of the lens mount, each of the lens units is caused by the slidable movement of the lens mount to alternately align with the light unit thereby to generate up to three different illumination patterns, preferably selected from wide beam down light illumination pattern, asymmetric illumination pattern with high and/or low beam angles. In the case of the one-piece lens comprising three lens parts of different illumination patterns, said three lens parts may be similarly arranged in the sliding direction of the lens mount, each of the lens parts is caused by the slidable movement of the lens mount to alternately align with the light unit thereby to generate up to three different illumination patterns, preferably selected from wide beam down light illumination pattern, asymmetric illumination pattern with high and/or low beam angles.

[0018] One or more color filtering sheets may be placed between the light unit and the lens units to emit color lights to increase the capability of creating different color scenes, for example, during special events and holiday seasons. Alternatively, one or more light engines may be mounted on the lens mount such that the light engines are caused by the slidable movement of the lens mount to slide relative to the light unit on the holder till a selected one of the light engines is in alignment with the light unit, and the selected light engine emits light patterns with desired colors or color temperatures.

[0019] At least one tab may be provided at an end face of the lens mount for a user to grasp and slide the lens mount.

[0020] A second aspect of the invention provides a linear light array comprising a plurality of the light modules of the invention arranged end-to-end in sequence. The light modules may preferably be of same construction and same sets of lens units having same illumination patterns for selection. Advantageously, all the light units in the array are arranged in a single linear light unit holder, and/or all sets of the lens mounts are constructed as a single linear lens mount.

[0021] A third aspect of the invention provides a lighting system comprising two or more linear light arrays according to the second aspect of the invention. The two or more linear light arrays may be of same or different illumination pattern sets, and connected with one another in side to side relation. One or more of the light arrays are slidable so as to provide the lighting system with selectable illumination patterns.

[0022] In a preferred embodiment, the lighting system comprises three linear light arrays with a middle array sandwiched between two outer-side arrays. The two out-

er-side arrays may be configured to be aligned in opposite head-to-tail configuration and slidable along sliding directions thereof such that their asymmetrical beams are pointing away from each other. Each of the two outer-side arrays is configured to have wide beam lens unit, asymmetrical high beam lens unit and asymmetrical low beam lens units for selection, and the middle array is fixed in position and configured to have wide beam lens units only.

[0023] By utilizing different lens mounts with different lens units in the light module of the invention, many different illumination patterns can be formed and selected at ease in a single lighting fixture platform. As the size of LED light sources is so small, smaller LED lens units can be used to make the sliding adjustment LED lighting fixture thin and light weight, opening up new applications in the lighting industry.

[0024] The objects, characteristics, advantages and technical effects of the invention will be further elaborated in the following description of the concepts and structures of the invention with reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig.1 illustrates an exploded perspective view of a light module constructed consistent with a first embodiment of the invention.

Figs. 2A and 2B illustrates perspective bottom and top views of the frame box shown in Fig. 1.

Fig. 3 illustrates a top view of the light module shown in Fig. 1 with the sliding plate removed.

Fig. 4 illustrates a top view of the sliding plate of the light module shown in Fig. 1.

Figs. 5A to 5C are schematic diagrams of respective positions of the sliding plate relative to the frame box.

Fig. 6A is a top view of a one-piece lens configured to have three different lens parts mounted on the sliding plate.

Figs. 6B to 6D are schematic diagrams of respective positions of the sliding plate with the one-piece lens shown in Fig. 6A relative to the frame box.

Figs. 7A to 7E are schematic diagrams of a first example of fastening method using screws and sliding slots to fasten the sliding plate and the frame box, wherein Fig. 7A is a top view of the sliding plate; Fig. 7B is a top view of the frame box with the light source inside; Fig. 7C is a bottom view of the sliding plate; Fig. 7D is a side view of the light module; and Fig. 7E is a cross section of the light module taken along line A-A of Fig. 7A.

Figs. 8A to 8D are schematic diagrams of a second example of fastening method using side tabs and slots to fasten the sliding plate and the frame box, wherein Fig. 8A is atop view of the sliding plate; Fig. 8B is a top view of the frame box with the light source inside; Fig. 8C is a bottom view of the sliding plate; Fig. 8D is a side view of the light module; and Fig. 8E is a cross section of the light module taken along line B-B of Fig. 8A.

Figs. 9A to 9D are schematic diagrams of a third example of fastening method using clips and slots to fasten the sliding plate and the frame box, wherein Fig. 9A is a top view of the sliding plate; Fig. 9B is a top view of the frame box with the light source inside; Fig. 9C is a bottom view of the sliding plate; Fig. 9D is a side view of the light module; and Fig. 9E is a cross section of the light module taken along line C-C of Fig. 9A.

Figs. 10A to 10C are schematic diagrams of cross section of the light module comprising a flat plate member in place of the frame box for mounting the light sources, wherein Fig. 10A shows the fastening method using screws and sliding slots; and Figs. 10B and 10C show the fastening method using clips and slots, with an additional color filter sheet insert is placed between the lens units and the light source in Fig. 10C.

Fig. 11A illustrates a variant of the sliding plate having elongated M-shaped sliding slots, which allows for adjustment of a beam angle through latitudinal movement of the sliding plate.

Figs. 11B to 11D illustrate how the sliding plate is moved to achieve the minor adjustment of beam angles.

Figs. 12A and 12B illustrate an example of the change in the beam angle through latitudinal movement of the sliding plate.

Figs. 13A and 13B illustrate a wide beam down light illumination pattern output of the light module shown in Fig. 1 when the middle lens unit on the sliding plate aligns with the light source.

Figs. 14A and 14B illustrate an asymmetric high beam illumination pattern output of the light module shown in Fig. 1 when the left lens unit on the sliding plate aligns with the light source.

Figs. 15A and 15B illustrate an asymmetric low beam illumination pattern output of the light module shown

in Fig. 1 when the right lens unit on the sliding plate aligns with the light source.

Figs. 16A to 16F are schematic views of an exemplary linear light array formed by connecting a plurality of the light modules shown in Fig. 1 having the sliding plate sets in different resting positions and corresponding illumination pattern outputs.

Fig. 17A is a schematic view of a variation of the linear light array comprising a common sliding plate for mounting the lens unit and a common frame box for mounting the light sources; and Fig. 17B is the top view of the common sliding plate.

Figs. 18A to 18E are schematic views of an exemplary lighting system formed by connecting three linear light arrays in three different positions and corresponding combined illumination pattern outputs.

Figs. 19A and 19B are cross section views of the linear light arrays comprising a cover case.

Figs. 20A and 20B are cross section views of the linear light arrays comprising a common substrate.

DETAILED DESCRIPTION OF THE INVENTION

[0026] While this invention is illustrated and described in preferred embodiments, light modules with the sliding lens mechanism for adjusting illumination pattern may be produced in many different configurations, sizes, forms and materials.

[0027] Referring now to the drawings, Figs. 1 to 5C provide a light module 10 constructed consistent with a first preferred embodiment of the present invention. In this embodiment, the light module 10 includes a frame box 11, a LED light source 12 which is secured inside the frame box 11, a sliding plate 13 arranged to have a centerline coaxially with and being spaced apart from the light source 12, and three lens units which are mounted on the sliding plate 13.

[0028] The frame box 11 is constructed to have a generally cubed-shape, and comprises a closed end 111, an open end 112 and two pairs of opposite side walls 113 to define a cavity. The inner surfaces of the closed end 111 and the side walls 113 are preferably coated with a reflective material to enhance illumination efficiency of the light module 10. The frame box 11 has a screw hole 114, and three dimples 115 which are equidistantly positioned at the open end 112 on each of two side walls 113 in parallel with the sliding direction of the sliding plate 13. The positions of the three dimples 115 represent three resting positions at which the sliding plate 13 slides to rest on the frame box 11. It is also possible to configure a screw hole at each of four corners for fastening the frame box 11 to the sliding plate 13.

[0029] The LED light source 12 can consist of one or more LED chips with light beams directed upwards towards the open end 112 of the frame box 11. In this embodiment, the LED light source 12 consists of multiple LED chips which are secured at the center of the closed end 111 inside the cavity of the frame box 11 (see Fig. 3). The LED light source 12 can be secured at the center of the closed end 111 by glue dispensing or mechanically or any means known in the art.

[0030] The sliding plate 13 is rectangular in this embodiment and is generally made of clear plastic or glass materials. One feature of the invention is that the sliding plate 13 is slidably resting on the open end 112 of the frame box 11 in a manner that the sliding plate 13 slides to the three resting positions on the frame box 11. For this purpose, the sliding plate 13 includes two stopper studs 131 protruding from an underside of the sliding plate 13 adjacent to two opposite edges and in the sliding direction thereof. The stopper studs 131 are positioned to correspond to the dimples 115 formed on the open end 112 of the frame box 11, and alternately engageable with the corresponding dimples in the three resting positions. The stopper studs 131 and the dimples 115 cooperate to provide the positioning effect for the sliding plate 13. The sliding plate 13 further includes on each of the two opposite edge portions thereof a sliding slot 132 extending in the sliding direction of the sliding plate 13, allowing the sliding plate 13 to be slidably fastened by bolts 133 constrained in the sliding slot 132 to the open end 112 of the frame box 11. Two tabs 134 are provided at respective end faces of the sliding plate 13 for the ease of the user to hold on for sliding adjustment.

[0031] The three lens units including a first lens unit 141, a second lens unit 142 and a third lens unit 143 mounted on the sliding plate 13, all of which are in the form selected from the group consisting of Fresnel lens, TIR lens, other types of lens with special illumination pattern design, and any combination thereof. The special illumination pattern design includes but not limited to asymmetric illumination patterns. The first lens unit 141, the second lens unit 142 and the third lens unit 143 have different illumination patterns from one another, and are selected to produce asymmetric illumination pattern with high beam angle, wide beam down light illumination pattern, and asymmetric illumination pattern with low beam angle, respectively, in this embodiment. These three lens units may be mechanically mounted or molded longitudinally along the centerline of the sliding plate 13 and positioned to correspond the first, second and third resting positions of the sliding plate 13 on the frame box 11. In the illustrated embodiment, the three lens units 141, 142, 143 are spaced apart in such a manner that any one of the three lens units 141, 142, 143 is in alignment with the LED light source 12 by sliding the sliding plate 13 in the longitudinal direction to rest at one of the above-discussed resting positions. The light beams generated by the LED light source 12 is therefore changed into the desired illumination pattern by the lens unit being selected and exit from the top end of the light module 11, as

shown in Figs. 5A to 5C.

[0032] As a variation, the three lens units may be fabricated as a one-piece lens constructed to have three lens parts that correspond to the different illumination patterns of the lens units 141, 142, 143, respectively. The three lens parts may be fabricated integrally or connected in a substantially flat configuration. Figs. 6A to 6D illustrates an exemplary one-piece lens comprising three lens parts 141', 142', 143' which are fabricated integrally, wherein the lens parts 141', 142', 143' are constructed to generate down light pattern, first side beam and second side beam, respectively. Similarly, this one-piece lens is slidably mounted on the sliding plate 13 in the same manner of the lens units discussed above, such that the three lens parts 141', 142', 143' are slidable relative to and alternatively align with the appropriately sized small LED light source 12, with the same effect achieved that the light beams generated by the LED light source 12 can be changed into the desired illumination pattern by the lens part being selected and exit from the top end of the light module 11.

[0033] Now turning to Figs. 7A to 7E and also Fig. 1, the two bolts 133 are engaged respectively with the two sliding slots 132 formed through the sliding plate 13, which allows the sliding plate 13 to slide and select the desired one of the lens units 141, 142, 143 through sliding action of the sliding plate 13 along the two longitudinal directions, namely in the left and the right directions viewed in Figs. 7A to 7C. After the desired lens unit is caused to move to be in alignment with the LED light source 12, the two stopper studs 131 protruding downwardly from the sliding plate are snugly received in the respective dimples 115 of the open end 112 of the frame box, which also helps to position the sliding plate 13 during its slidable movement. Then the two bolts 133 are screwed into the screw holes 114 to secure the frame box 11 and the sliding plate 13 in place.

[0034] In addition to the method of using the screw fasteners and sliding slot in Figs. 7A to 7E, other methods capable of fastening the frame box 11 and the sliding plate 13 in a manner to allow for slidable movement of the sliding plate 13 relative to the frame box 11 are possible. For example, Figs. 8A to 8E illustrate the frame box 11 comprises a pair of inwardly facing grooves 16 opposite to and facing each other on the two opposite sides of the frame box 11, and the pair of grooves 16 extend entirely in the sliding direction of the sliding plate 13. The pair of grooves 16 are dimensioned such that two edge portions of the sliding plate 13 are slidably received and constrained in the pair of grooves 16. In Figs. 9A to 9E, there is illustrated another fastening method used in the invention. As illustrated, the frame box 11 comprises a pair of outwardly facing grooves 17 facing away from each other on the two opposite sides of the frame box 11, and the pair of grooves 17 extend entirely in the sliding direction of the sliding plate 13. Correspondingly, the sliding plate 13 has two clips 135 protruding downwardly from the two opposite edges thereof, and the clips 135 are dimensioned to be slidably received and constrained in the respective grooves 17.

[0035] If the user wishes to vary the illumination pattern of the light module 10, he just needs to slide the sliding plate 13 by pushing and/or pulling the tab 134 at the end face of the sliding plate 13, until the selected one of the first, second and third lens units 141, 142, 143 (or the three lens parts 141', 142', 143' in case of one-piece lens) aligns with the LED light source. When the sliding plate 13 is resting in the second middle resting position where the second lens unit 142 mounted thereon is precisely in alignment with the LED light source 12 at the center of the closed end 111 of the frame box 11, the light emitted from the LED light source 12 towards the second lens unit 142 generates wide beam down light illumination pattern (see Figs. 13A and 13B). If it is necessary for the asymmetric illumination pattern with high beam angle, the user simply slides the sliding plate 13 in the direction as indicated by an arrow until the sliding plate 13 reaches the first resting position where the first lens unit 141 mounted thereon is precisely in alignment with the LED light source 12, the light emitted from the LED light source 12 towards the first lens unit 141 generates asymmetric illumination pattern with high beam angle (see Figs. 14A and 14B). If it is necessary for the asymmetric illumination pattern with low beam angle, the user simply slides the sliding plate 13 in the direction as indicated by an arrow until the sliding plate 13 reaches the third resting position where the third lens unit 143 mounted thereon is precisely in alignment with the LED light source 12, the light emitted from the LED light source 12 towards the third lens unit 143 generates asymmetric illumination pattern with low beam angle (see Figs. 15A and 15B).

[0036] Figs. 10A and 10B shows a light module 20 constructed consistent with a second embodiment of the invention, which has the same sliding lens mechanism discussed in the above first embodiment. The light module 20 of this embodiment is similar as the one shown in the first embodiment above, except the sliding plate for mounting the lens units and the holder for securing the LED light source. Specifically, the light module 20 comprises a substantially flat plate member 21 on which the LED light source 22 is secured, and a U-shaped structure 23. The substantially flat plate member 21 may be selected from a lamp substrate or a printed circuit board. The U-shaped structure 23 comprises a base member 231 having a first surface facing the LED light source 22 on one side and a second surface on the other side, and two side panels 232 extending from the first surface. The two side panels 232 are slidably coupled to the flat plate member 21 to define a cavity inside which the LED light source 22 is placed. Like the sliding plate 13 of the above first embodiment, the U-shaped structure 23 can slide to two or more resting positions on the flat plate member 21 to enable the LED light source 22 substantially aligns with the selected one of the lens units mounted or molded on the base member 231.

[0037] Similarly, the flat plate member 21 includes two

stopper studs (not shown) protruding from two opposite edges of a top side of the plate member in a sliding direction of the U-shaped structure 23, and the two side panels 232 each has an end face formed with two or more dimples (not shown) positioned to correspond to the stopper studs and alternately engageable with the stopper studs when the U-shaped structure 23 rests in the resting positions. It would also be possible to have the dimples formed on the plate member 21 while the stopper studs are arranged on the side panels 232 for engagement.

[0038] Fig. 10A shows the flat plate member 21 includes on the two opposite edge portions thereof sliding slots extending in the sliding direction to allow for sliding action, and the plate member 21 is slidably fastened by bolts 234 constrained in the sliding slots and screwed into screw holes formed on two side panels 232 to the U-shaped structure. Fig. 10B shows each of the side panels 232 comprises two inwardly facing clips 235 extending in the sliding direction of the U-shaped structure 23 and opposite to and facing each other, and the flat plate member 21 is dimensioned to be slidably engageable with the two opposite clips 235.

[0039] Different color filtering sheets can be placed between the LED light source and the lens units, increasing the capability of creating different color scenes, for example, during special events and holiday seasons. Fig. 10C shows the similar light module of Fig. 10B, but this light module additionally includes a color filter sheet 24 between the LED light source 22 and the lens units within the cavity defined by the U-shaped structure 23 and the flat plate member 21 to provide colored illumination patterns for special applications. Although the color filtering sheet 24 is provided in this illustrated embodiment, it would be within the ability of a person skilled in the art for provision of the color filtering sheets in the light module 10 discussed hereinabove, which comprises the frame box 11 and the sliding plate 13.

[0040] Instead of using color filtering sheets, it is possible to install one or more light engines (not shown) on the sliding plate in the same manner of the lens units for the purpose of creating different color scenes. Specifically, one or more light engines may be installed on the sliding plate in a spaced-apart fashion at the installing positions in correspondence to the resting positions of the sliding plate, such that the light engines on the sliding plate are caused by the slidable movement of the sliding plate to slide relative to the LED light source till a selected one of the light engines is in alignment with and also covers up the LED light source. The selected light engine is then activated to emit light patterns with desired colors or color temperatures. Therefore, a plurality of optical elements including the lens units and the light engines may be mounted on the same sliding plate in a manner that any one of the lens units and the light engines is slidable along with the sliding plate to align with the LED light source, providing the effect of generation of selected illumination patterns, desired light colors, color temperatures, or colored illumination patterns to cater for various occasions.

[0041] LED light engines (LLEs) are a combination of one or more LED modules, together with an LED driver, which are well known in the art, and therefore are not elaborated herein.

[0042] A modification of the sliding slot formed on the sliding plate can be used to adjust the beam angle of the resultant light beams through the lens units. Figs. 11A to 11D show an exemplary implementation of minor adjustment of beam angle by modification of sliding slots which are configured to allow for minor latitudinal movement of the sliding plate 33. As shown, the sliding plate 33 in this embodiment has two sliding slots 332 on the opposite side edges thereof. The sliding slots 332 are configured to have an elongated longitudinal section 3321 and three latitudinal sections 3322 extending from the longitudinal section 3321 at two ends and the middle point thereof. In other words, the sliding slots 332 takes a shape similar to an elongated "M" (see Fig. 11A). The bolts can either slide in the longitudinal directions to select the three different lens units, or nudge in the latitudinal directions after the lens unit is selected in order to perform minor adjustment of the beam angle of the selected lens unit. As clearly shown in the figures, the latitudinal sections 3322 are perpendicular to the longitudinal section 3321. However, it would be appreciated that the latitudinal sections 3322 may be configured to extend from the longitudinal section 3321 at any desirable angle.

[0043] Figs. 11B to 11D show how the beam angle is changed with the latitudinal movement of the sliding plate 33. The sliding plate 33 is caused to slide longitudinally to a predetermined resting position, for example a right end of the sliding slot 332 in Fig. 11B, and then to slide latitudinally such that the right latitudinal section 3322 is in alignment with the screw hole (not shown) formed on the open end of the frame box to enable engagement of the bolts 333 with both the right latitudinal section 3322 and the screw hole. Because of positional change in the latitudinal direction, the illumination angle of the light module is changed and adjustable to provide the increased capability of the light module.

[0044] Figs. 12A and 12B demonstrate the minor adjustment of illumination angle from the light module using the so-called "M" shaped sliding slots 332 discussed above. The light beams from the light source normally in alignment with the convex lens selected for in this light module becomes biased to one side, resulting in bending of light beam off the normal target towards an angle to the latitudinal direction that the sliding plate 33 has moved.

[0045] Referring now to Figs. 16A to 16F, an exemplary linear LED light array 1 constructed in one preferred embodiment of the present invention is illustrated. The linear LED light array 1 comprises a plurality of the light modules of the invention, for example the light modules 10 discussed above, to form a larger lighting fixture with higher illumination output. The light modules 10 in this embod-

iment are of same construction and have the same first, second and third lens units 141, 142, 143. It can be seen that the plurality of light modules 10 are arranged end-to-end in sequence in the sliding direction of the sliding plates 13. Sliding the tab 134 on the outmost sliding plate can align all the light modules 10 with all the same type of lens units having same illumination pattern in the array with the respective LED light sources 12, thereby to select the desired illumination patterns in unison throughout the array 1.

[0046] Figs. 16A and 16B show that a set of the light sources 12 are being aligned with a set of the second lens units 142 (i.e. the middle lens units), and the light array 1 provides a wide beam down light pattern (see Fig. 16B) according to the optical characteristics of the second lens units 142. Figs. 16C and 16D show that the sliding plate 13 slides towards the right direction till the set of light sources 12 are being aligned with a set of the first lens units 141 (i.e. the left lens units), and the light array 1 provides an asymmetric high illumination pattern (see Fig. 16D) according to the optical characteristics of the first lens unit 141. Figs. 16E and 16F show that the sliding plate 13 slides towards the left direction till the set of light sources 12 are being aligned with a set of the third lens units 143 (i.e. the right lens units), and the light array 1 provides an asymmetric low illumination pattern (see Fig. 16F) according to the optical characteristics of the third lens unit 143.

[0047] The plurality of the light modules 10 forming the linear light array 1 shown in Figs. 16A to 16F have their respective frame boxes and respective sliding plates which are connected together end-to-end in sequence. As a variant, a set of the LED light sources 12 may be arranged in a single elongated frame box 10', and/or a set of the sliding plates are constructed as a single one-piece. All sets of the lens units are mounted on the common one-piece sliding plate 13', as shown in Figs. 17A and 17B. Different illumination patterns of all sets of the first, second and third lens units from left to right on the common sliding plate 13' can be selected by sliding the common sliding plate 13', as clearly shown in Fig. 17B.

[0048] In order to provide a much higher power LED lighting fixture with a greater selection of illumination patterns, it is possible to form a lighting system comprising a plurality of linear light arrays of same or different illumination patterns to provide various combinations of illumination patterns. Figs. 18A to 18F illustrate a lighting system 1000 that is suitable for retail application, for example, for illuminating the walkway as well as the merchandise on the shelves in a supermarket.

[0049] As illustrated, the lighting system 1000 comprises first linear light array 1001, second linear light array 1002, and third linear light array 1003, which are connected in side to side relation with the second linear light array 1002 arranged between the first and third linear light array 1001, 1003. In this lighting system 1000, the first and third linear light arrays 1001, 1003 are mounted in a slidable manner on the frame box, whereas the second linear light array 1002 is fixed on the frame box and remains immobile. On the two outer sides of the lighting system 1000, the first and third linear light arrays 1001, 1003 each has a plurality of sets of lens units, consisting three different types of wide beam lens unit, asymmetrical high beam lens unit and asymmetrical low beam lens unit. The lens units on the two light arrays 1001, 1003 are aligned in opposite head-to-tail configuration along the sliding directions, such that their asymmetrical beams are pointing to the opposite directions and away from each other. The middle second linear light array 1002 in the lighting system 1000 has only one type of wide beam lens unit. This arrangement and configuration of the lighting system 1000 allows for the first and third linear light arrays 1001, 1003 each being slidably selectable among the wide beam lens unit, the asymmetrical high beam lens unit and the asymmetrical low beam lens unit, so as to provide a number of illumination patterns more than those in any one of the single linear light arrays, including but not limited to:

- combined illumination patterns of all wide beam lens in the arrays for center line illumination,
- wide beam lens in the middle plus asymmetrical low beams on the two sides for combined wider beam illumination pattern, and
- wide beam lens in the middle plus asymmetrical high beams on the two sides for combined super wide beam illumination.

[0050] Fig. 18B illustrates the illumination pattern corresponding to the selection of lens units shown in Fig. 18A where the first, second and third linear light arrays 1001, 1002, 1003 all are aligned in the middle position, such that the LED light sources are in alignment with all the wide beam lens units of the three light arrays. The resultant illumination pattern of the lighting system 1000 is of wide beam with highest intensity because all three arrays are illuminating the same area. This lighting pattern is suitable for general lighting of public places.

[0051] Fig. 18D illustrates the illumination pattern corresponding to the selection of lens units shown in Fig. 18C where the first and third linear light arrays 1001, 1003 on the outer sides slide together in the same direction, for example, towards the direction of selecting the asymmetrical high beam lens units for alignment with the LED light sources. The resultant illumination pattern of the lighting system 1000 is of wide beam in the center illuminating the walkway, and two high beams illuminating and highlighting the higher location of the merchandise shelves on the two sides.

[0052] Fig. 18F illustrates the illumination pattern corresponding to the selection of lens units shown in Fig. 18E where the first and third linear light arrays 1001, 1003 on the outer sides slide in opposite directions, for example, the first linear light array 1001 slides towards the direction of selecting the asymmetrical low beam lens units for alignment with the LED light sources, whereas

the third linear light array 1003 slides towards the direction of selecting the asymmetrical high beam lens units for alignment with the LED light sources. The resultant illumination pattern of the lighting system 1000 is of wide beam in the center and one low beam at the side. This is particularly suitable for locations with merchandise shelves on one side and open areas on the other side.

[0053] Now Turning to Figs.19A and 19B, there are illustrated in cross section the side views of the lighting system 1000 in which the respective common sliding plates and the respective common frame boxes are used for the first, second and third linear light arrays 1001, 1002, 1003. The common sliding plate and the common frame box are fastened together by bolts and screws type (Fig. 19A) or clips and grooves type (Fig. 19B) for each of the first, second and third linear light arrays 1001, 1002, 1003. The lighting system further comprises a common U-shaped cover case 1004 for accommodating the lighting system 1000 with the lens units emerged from the cover case for emitting light.

[0054] Figs. 20A and 20B illustrate in cross section the side views of the lighting system 1000 in which the respective common sliding plates and the respective common flat plate members are used for the first, second and third linear light arrays 1001, 1002, 1003. The common sliding plate and the common flat plate members are fastened together by bolts and screws type (Fig. 20A) or clips and grooves type (Fig. 20B) for each of the first, second and third linear light arrays 1001, 1002, 1003. The lighting system further comprises a common substrate 1005, which is substantially flat, arranged to support the flat plate members the lighting system 1000 with the lens units exposed for emitting light.

[0055] The other structures of the lighting systems including LED drivers, other electronics and electrical connections are not the essence of the invention and therefore not described in detail herein.

[0056] Thus, the present invention provides a light module which effectively solves the problem of adjusting the illumination pattern with ease, which is accomplished by simply pushing a tab, for example, on the end face of the sliding plate to select the different lens unit to realize a plurality of illumination patterns. The light module of the invention also allows for formation of a light array and a lighting system having a higher power and/or a wider selection of illumination patterns

[0057] Having sufficiently described the nature of the present invention according to some preferred embodiments, the invention, however, should not be limited to the structures and functions of the embodiments and drawings. It is stated that insofar as its basic principle is not altered, changed or modified it may be subjected to variations of detail. Numerous variations and modifications that are easily obtainable by means of the skilled person's common knowledge without departing from the scope of the invention should fall into the scope of this invention.

Claims

1. A light module having adjustable illumination pattern, comprising:

   a light unit comprising one or more light sources for generating a light beam,
   a light unit holder on which the light unit is secured,
   two or more lens units having same or different illumination patterns, each of the lens units being adapted for the light unit to generate an illumination pattern, and
   a lens mount comprising a base member on which the two or more lens units are mounted,
   characterized in that the lens mount is slidably coupled to the light unit holder so that the slidable movement of the lens mount enables said two or more lens units to slide relative to the light unit on the holder until a desirable one of said two or more lens units is in alignment with the light unit, thereby to provide the light module with a selectable illumination pattern.

2. A light module according to claim 1, wherein the two or more lens units are provided as a one-piece lens constructed to have two or more lens parts having same or different illumination patterns, and the two or more lens parts are slidable along with the slidable movement of the lens mount in a manner that a desirable one of said two or more lens parts aligns with the light unit, thereby to provide the light module with a selectable illumination pattern.

3. A light module according to claim 1 or 2, wherein the light unit holder is provided as a frame box comprising a closed end, an open end and two pairs of opposite sides to define a cavity, and the light unit is secured on the closed end within the cavity.

4. A light module according to claim 3, wherein the lens mount is configured as a plate slidably resting on the open end of the frame box in a manner that the plate slides to two or more resting positions on the frame box, and the light unit substantially aligns with one of the lens unit in a respective one of the two or more resting positions.

5. A light module according to claim 4, wherein the plate includes at least one stopper stud protruding from at least one of two opposite edges of an underside of the plate in a sliding direction of the plate, and the open end of the frame box is formed with two or more dimples positioned to correspond to the stopper stud and alternately engageable with the stopper stud in the two or more resting positions.

6. A light module according to claim 5, wherein the plate

includes on the two opposite edges thereof at least one sliding slot extending in the sliding direction of the plate, and the plate is slidably fastened by bolts constrained in the sliding slot to the open end of the frame box at the two or more resting positions.

7. A light module according to claim 5, wherein the frame box comprises a pair of inwardly facing grooves opposite to and facing each other on the two opposite sides of the frame box, and the pair of grooves extend entirely in the sliding direction of the plate, and wherein the plate is dimensioned to be slidably received and constrained in the pair of grooves.

8. A light module according to claim 5, wherein the frame box comprises a pair of outwardly facing grooves facing away from each other on the two opposite sides of the frame box, and the pair of grooves extend entirely in the sliding direction of the plate, and wherein the plate has two or more clips protruding downwardly from the two opposite edges thereof, and the clips are dimensioned to be slidably received in the respective grooves.

9. A light module according to claim 1 or 2, wherein the light unit holder is provided as a substantially flat plate member, preferably selected from a lamp substrate or a printed circuit board, on which the light unit is secured, and the lens mount is configured as a U-shaped structure comprising a base member having a first surface facing the light unit on one side and a second surface on the other side, and two side panels extending from the first surface, and wherein the two side panels are slidably coupled to the flat plate member to define a cavity in which the light unit is placed, and wherein the U-shaped structure slides to two or more resting positions on the plate member, and the light unit substantially aligns with one of the lens unit mounted on the base member in a respective one of the two or more resting positions.

10. A light module according to claim 9, wherein the plate member includes at least one stopper stud protruding from two opposite edges of a top side of the plate member in a sliding direction of the U-shaped structure, and the two side panels each has an end face formed with two or more dimples positioned to correspond to the stopper stud and alternately engageable with the stopper stud in the two or more resting positions.

11. A light module according to claim 10, wherein the plate member includes on the two opposite edges thereof at least one sliding slot extending in the sliding direction, and the plate member is slidably fastened by bolts constrained in the sliding slot to the U-shaped structure at the two or more resting positions.

12. A light module according to claim 10, wherein each of the side panels comprises one or more inwardly facing clip extending in the sliding direction of the U-shaped structure, and the plate member is dimensioned to be slidably engageable with the clips opposite to and facing each other.

13. A light module according to any of claims 1 to 12, which comprises three lens units of different illumination patterns arranged in the sliding direction of the lens mount, each of the lens units is caused by the slidable movement of the lens mount to alternately align with the light unit thereby to generate up to three different illumination patterns, preferably selected from wide beam down light illumination pattern, asymmetric illumination pattern with high and/or low beam angles.

14. A light module according to any of claims 1 to 6, 9 and 10, wherein the sliding slots are configured to allow the lens mount to slide slightly at an angle from the sliding direction to achieve a slight change in a beam angle.

15. A light module according to any of claims 1 to 14, wherein one or more color filtering sheets are placed between the light unit and the lens units to emit color lights.

16. A light module according to any of claims 1 to 14, further comprising one or more light engines mounted on the lens mount such that the light engines are caused by the slidable movement of the lens mount to slide relative to the light unit on the holder till a selected one of the light engines is in alignment with the light unit, and the selected light engine emits light patterns with desired colors or color temperatures.

17. A light module according to any of claims 1 to 16, wherein at least one tab is provided at an end face of the lens mount for a user to grasp and slide the lens mount.

18. A linear light array comprising a plurality of the light modules, preferably of same construction and same sets of lens units having same illumination patterns, according to any of claims 1 to 17 arranged end-to-end, preferably all the light units are arranged in a single light unit holder, and/or all sets of the lens mounts are constructed as a single lens mount.

19. A lighting system comprising two or more linear light arrays of same or different illumination patterns according to claim 18, wherein the two or more linear light arrays are connected with one another in side to side relation, and one or more of the light arrays

are slidable to provide the lighting system with selectable illumination patterns.

20. A lighting system according to claim 19, comprising three linear light arrays with a middle array sandwiched between two outer-side arrays, wherein the two outer-side arrays are slidable and aligned in opposite head-to-tail configuration and slidable along sliding directions thereof such that their asymmetrical beams are pointing away from each other; each of the two outer-side arrays is configured to have wide beam lens unit, asymmetrical high beam lens unit and asymmetrical low beam lens units, and the middle array is fixed in position and configured to have wide beam lens units only.

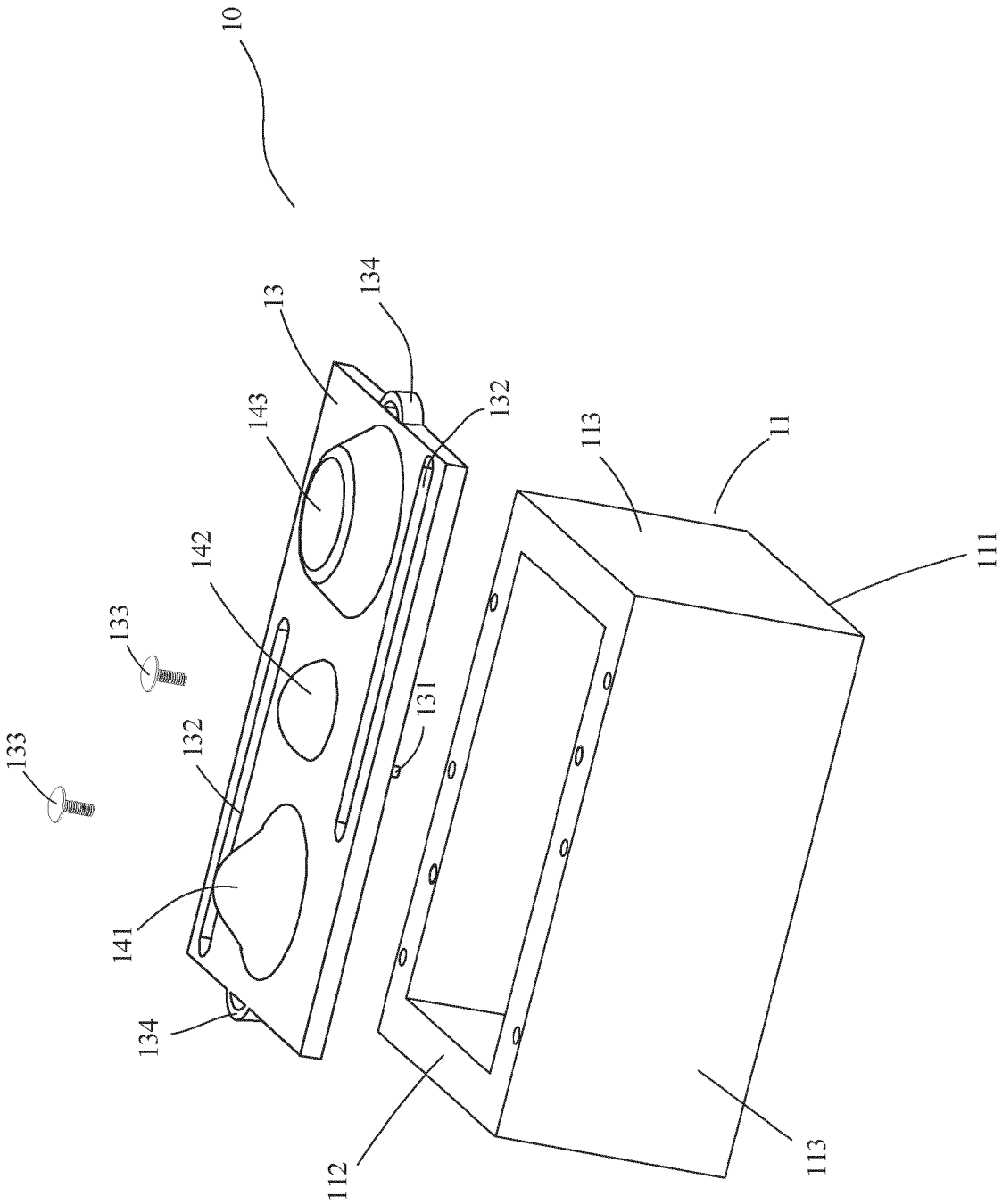


Fig. 1

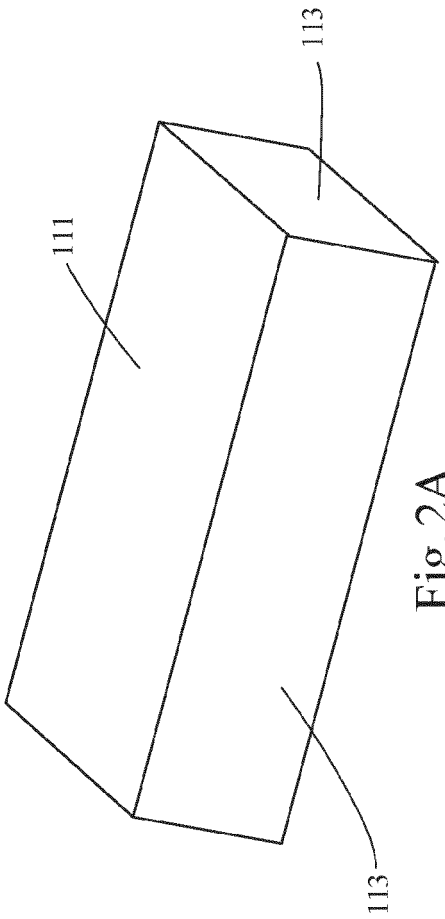


Fig. 2A

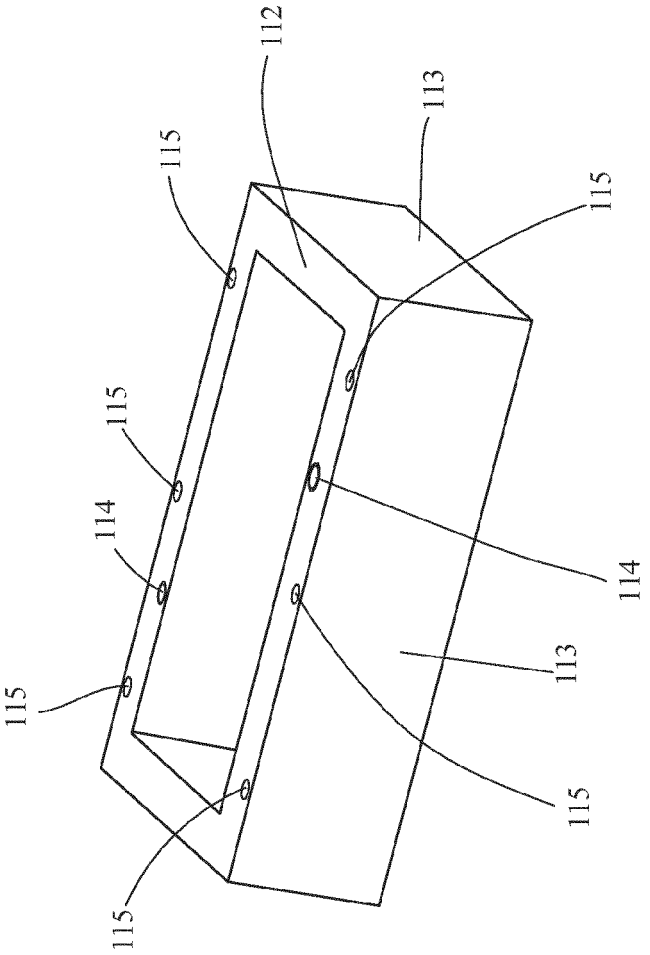


Fig. 2B

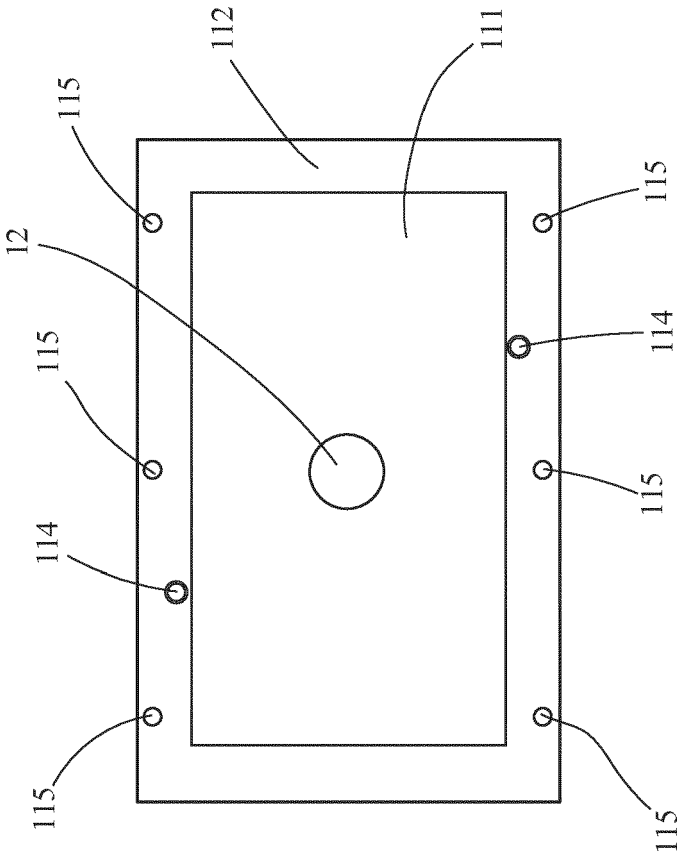


Fig. 3

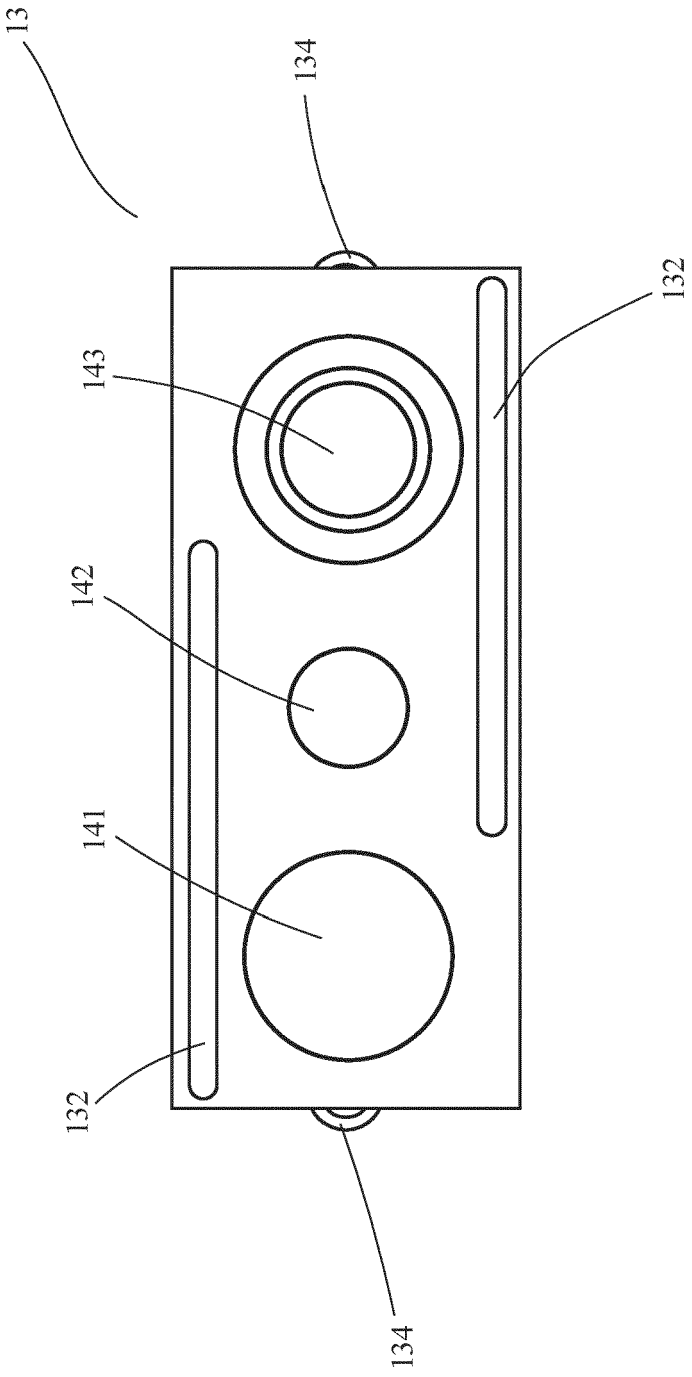


Fig. 4

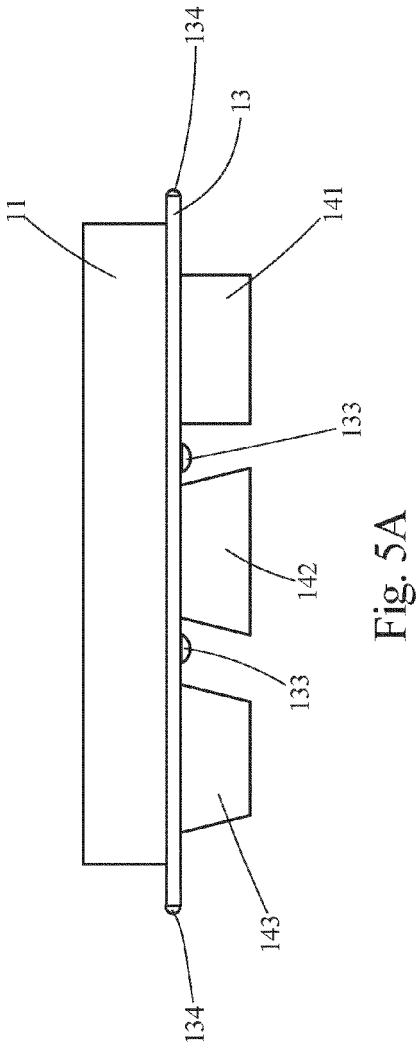


Fig. 5A

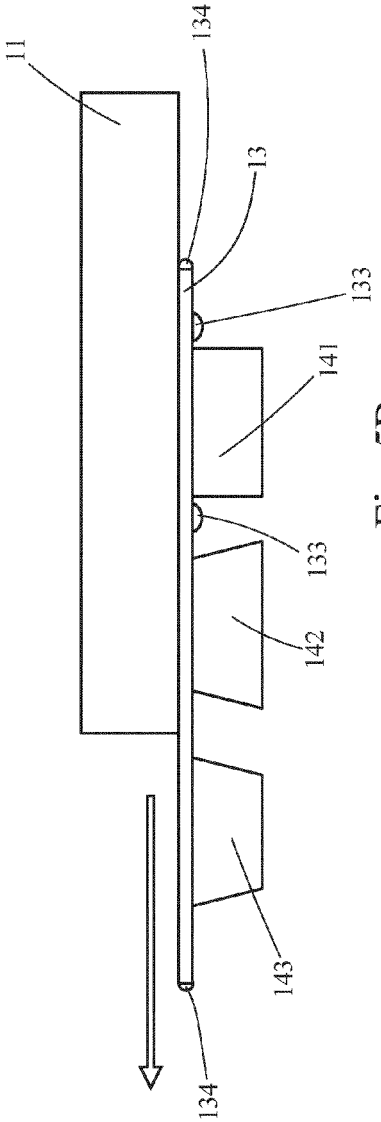


Fig. 5B

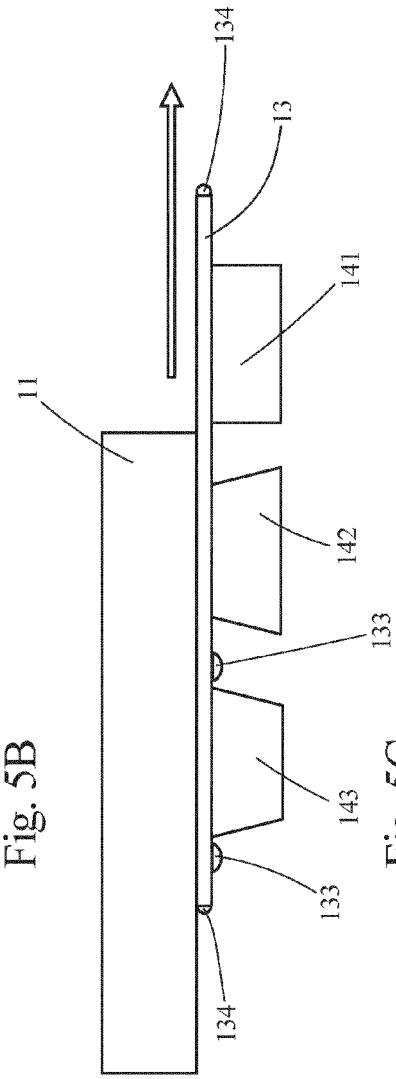


Fig. 5C

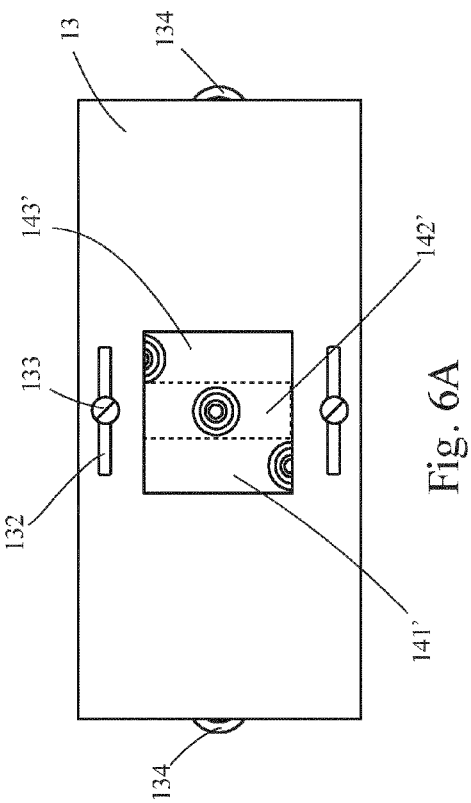


Fig. 6A

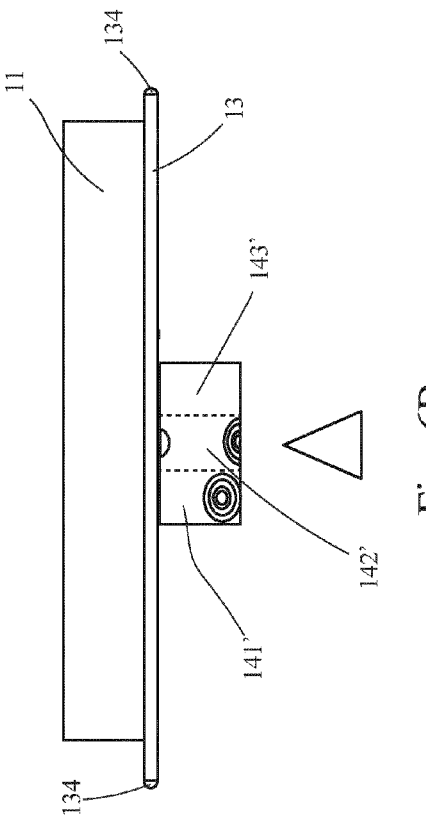


Fig. 6B

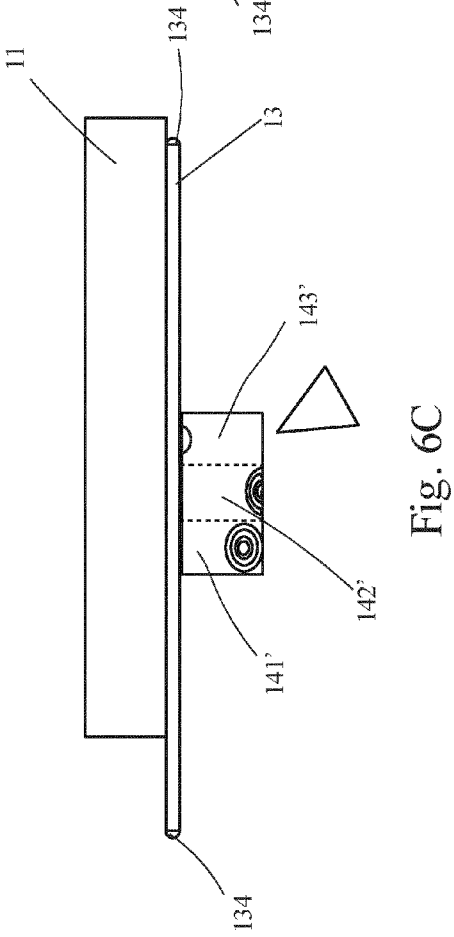


Fig. 6C

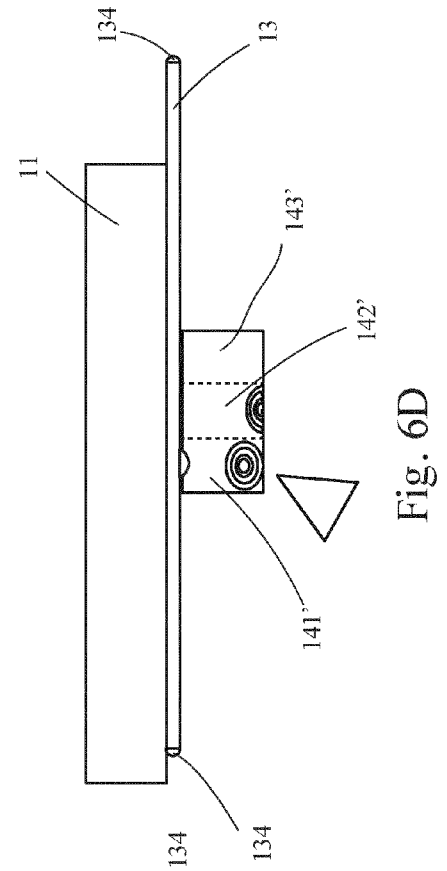


Fig. 6D

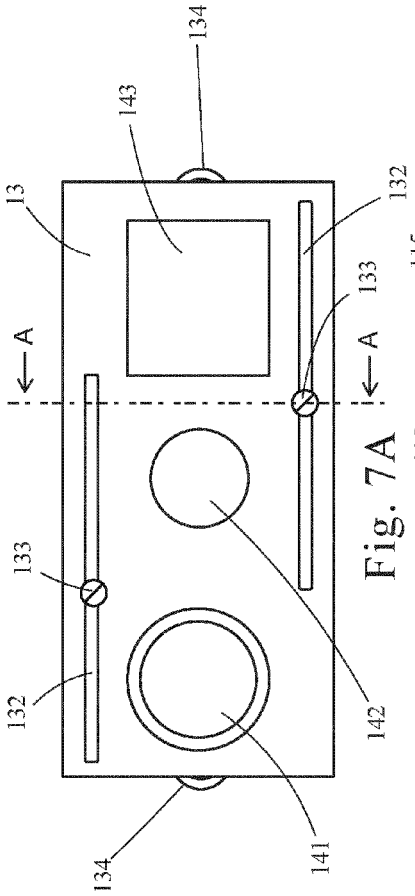


Fig. 7A

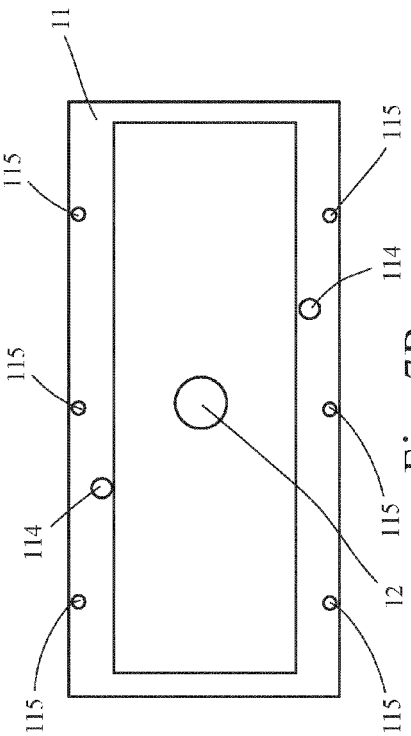


Fig. 7B

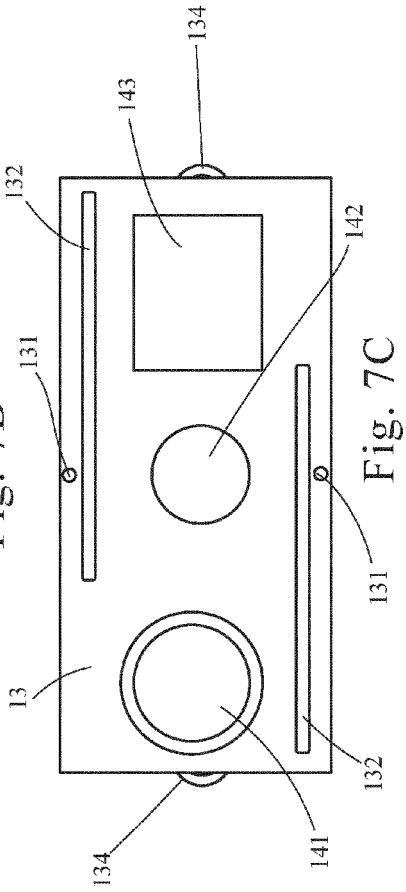


Fig. 7C

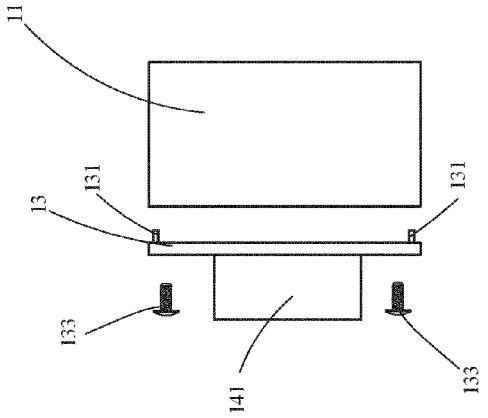
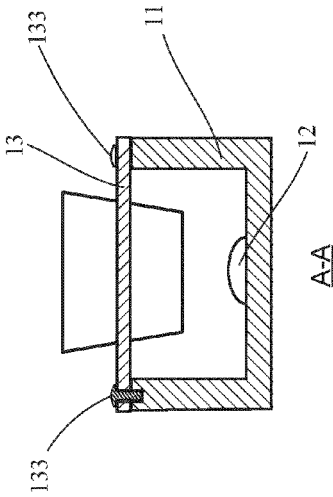


Fig. 7D



A-A

Fig. 7E

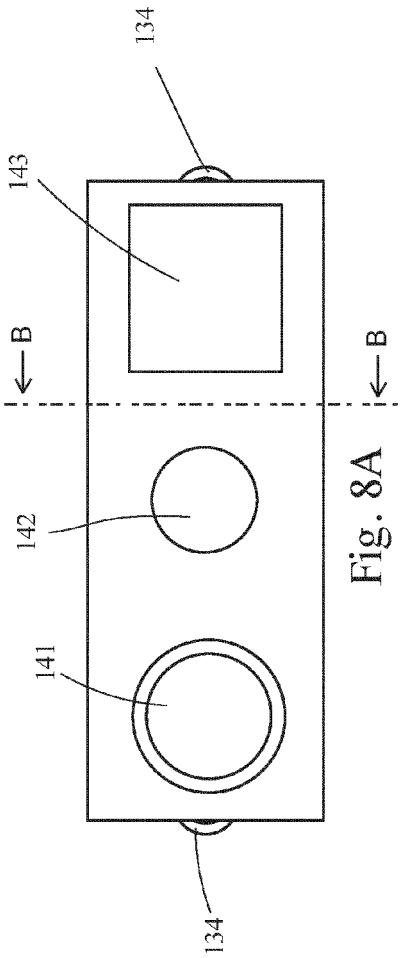


Fig. 8A

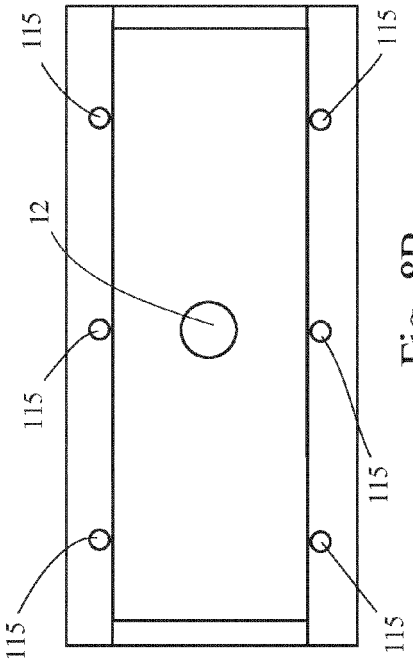


Fig. 8B

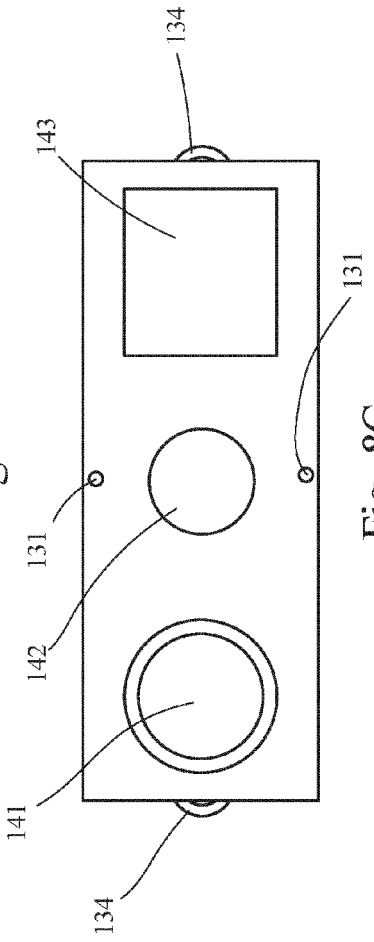


Fig. 8C

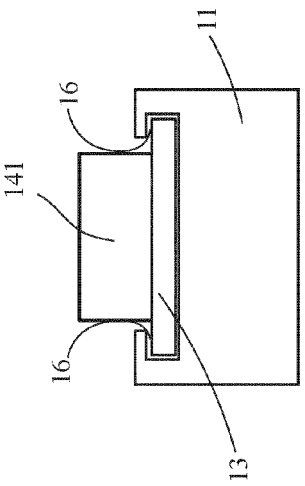


Fig. 8D

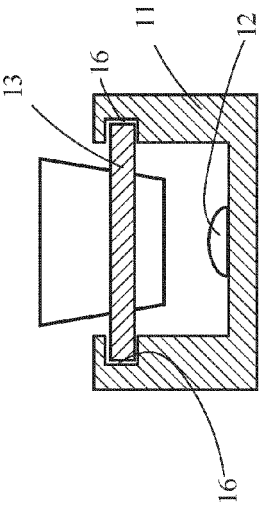


Fig. 8E

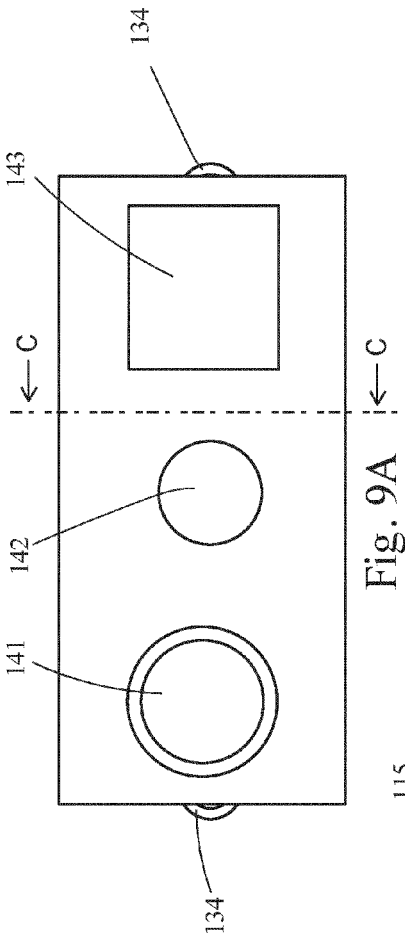


Fig. 9A

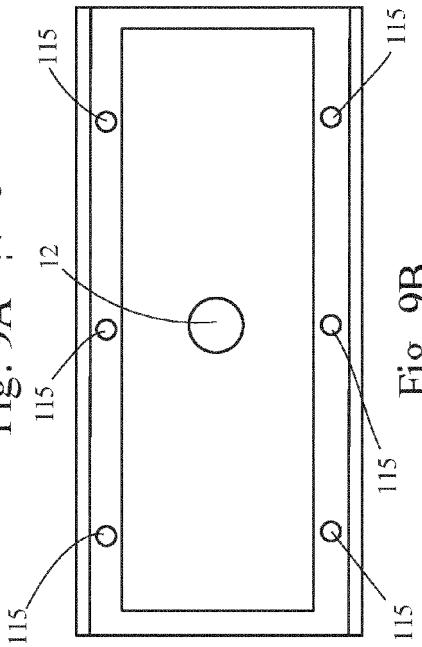


Fig. 9B

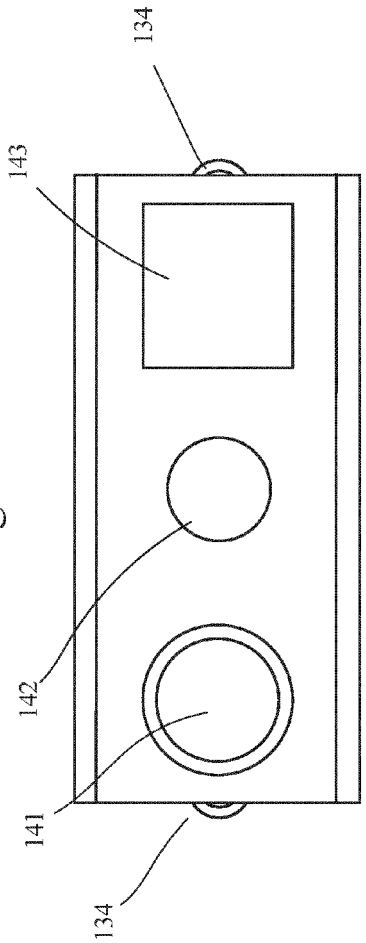


Fig. 9C

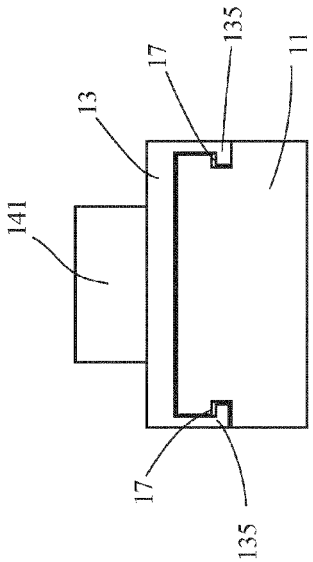
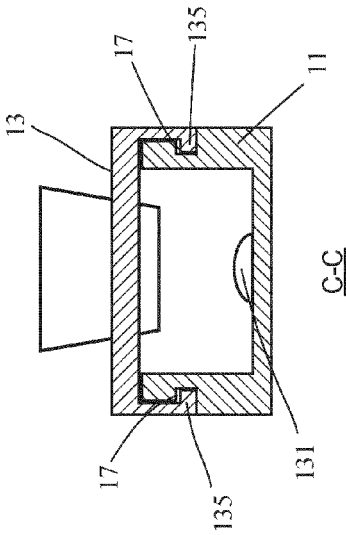


Fig. 9D



C-C

Fig. 9E

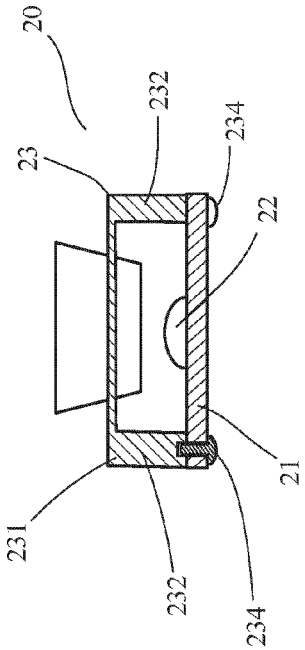


Fig. 10A

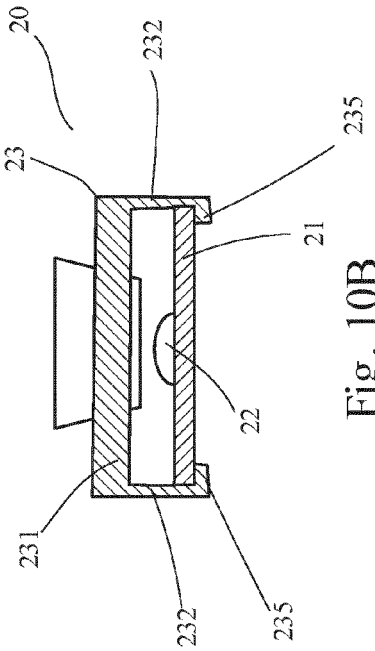


Fig. 10B

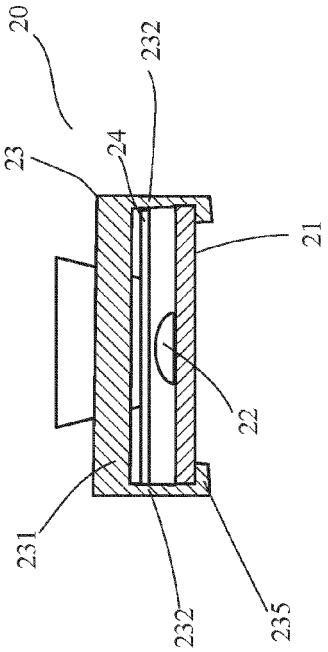


Fig. 10C

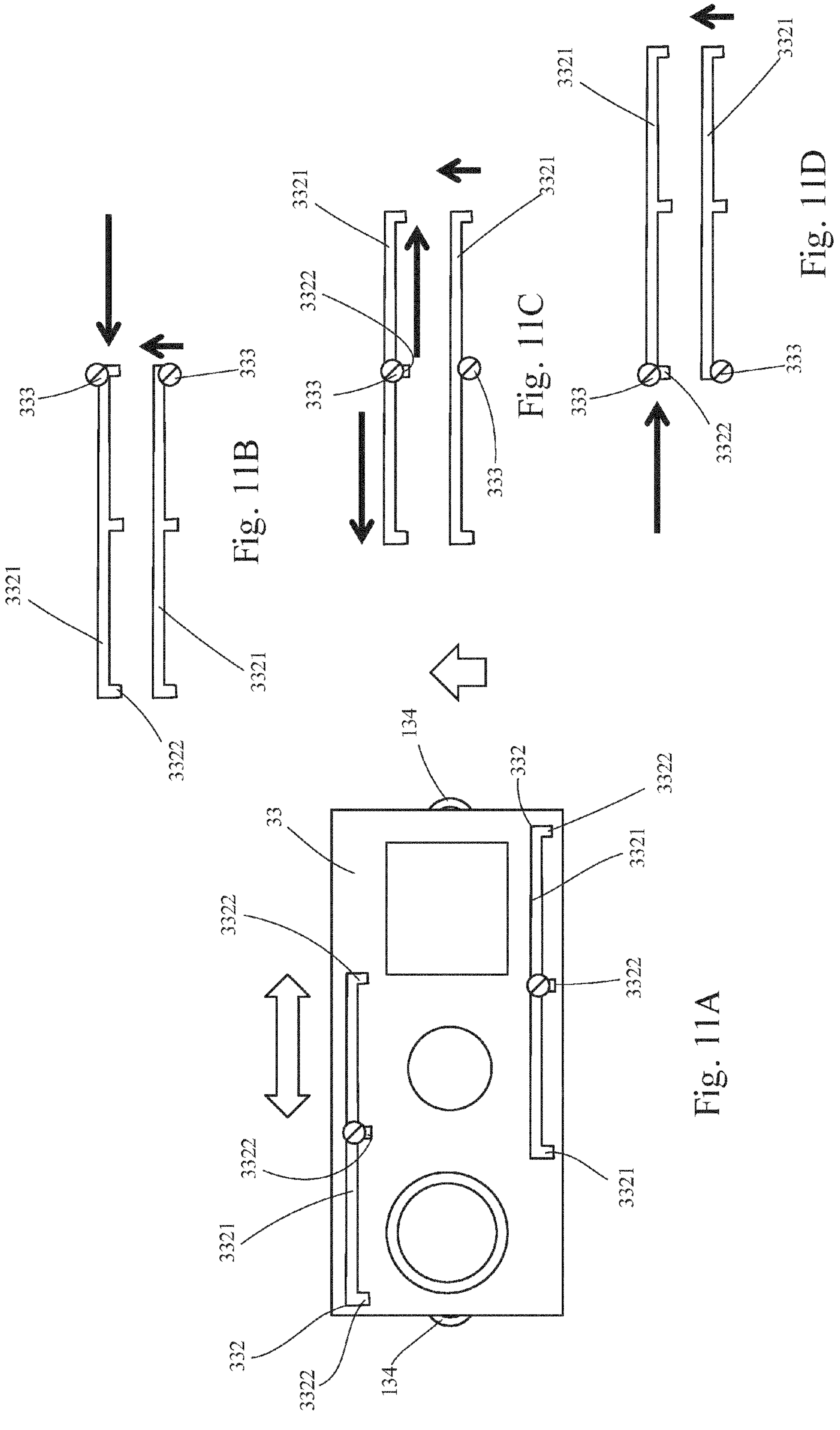


Fig. 11A

Fig. 11B

Fig. 11C

Fig. 11D

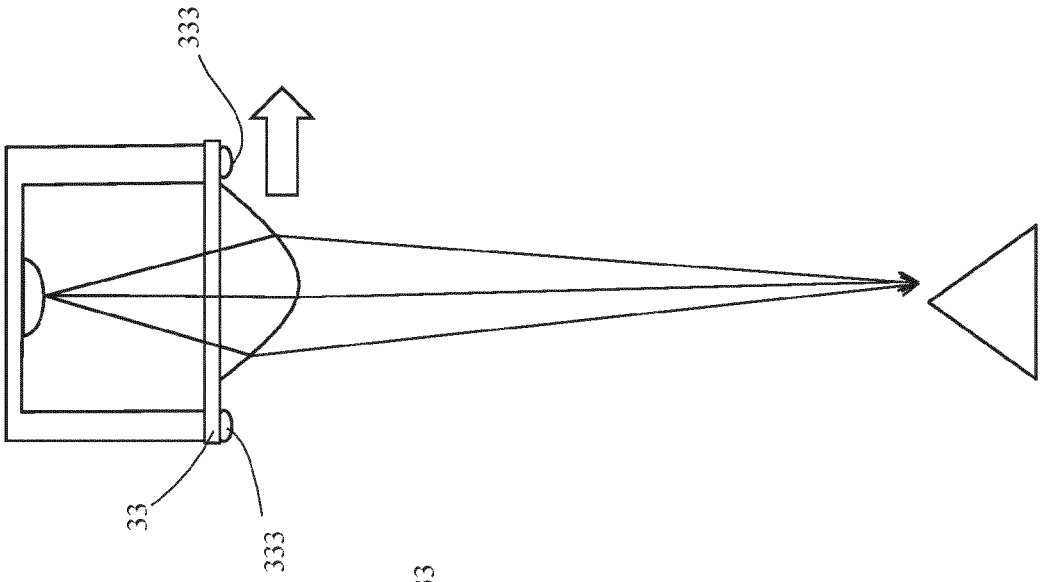


Fig. 12B

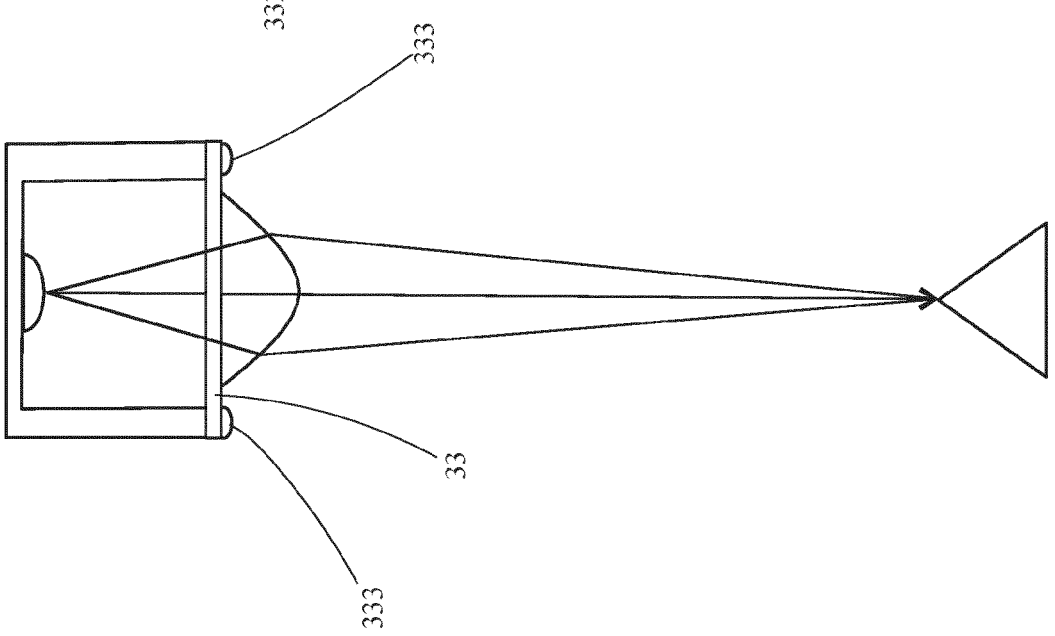


Fig. 12A

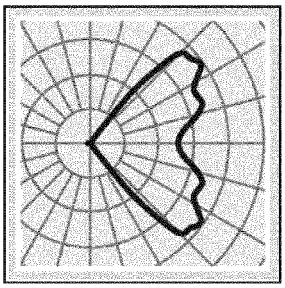


Fig. 13B

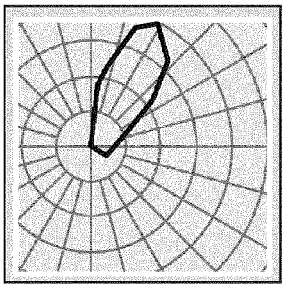


Fig. 14B

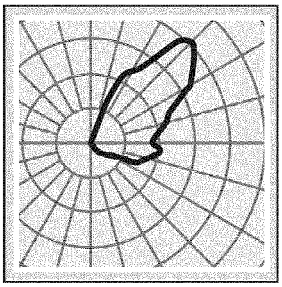


Fig. 15B

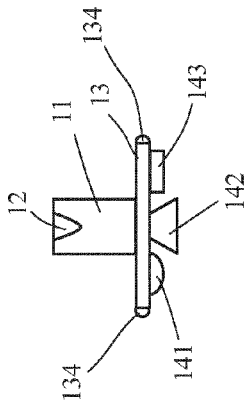


Fig. 13A

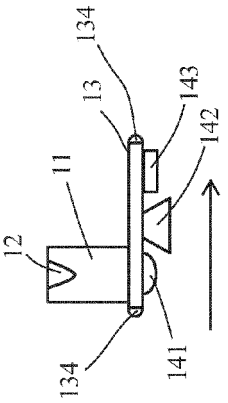


Fig. 14A

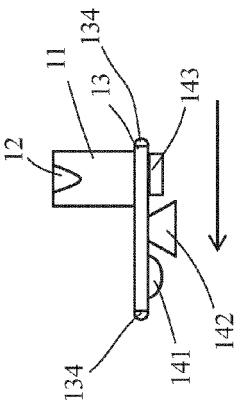


Fig. 15A

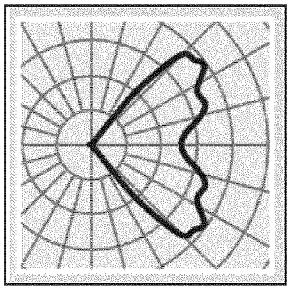


Fig. 16B

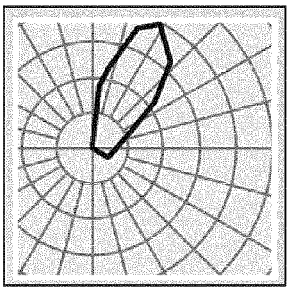


Fig. 16D

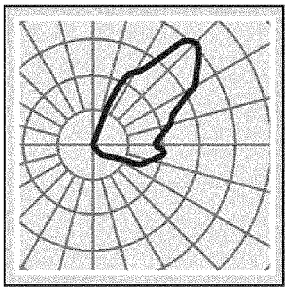


Fig. 16F

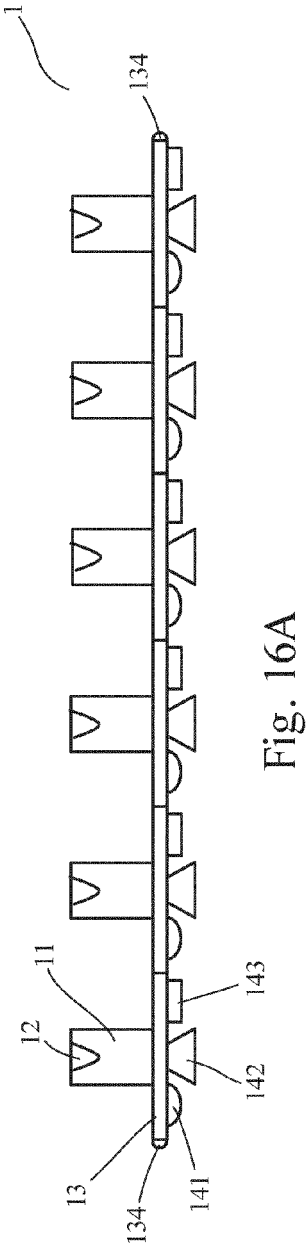


Fig. 16A

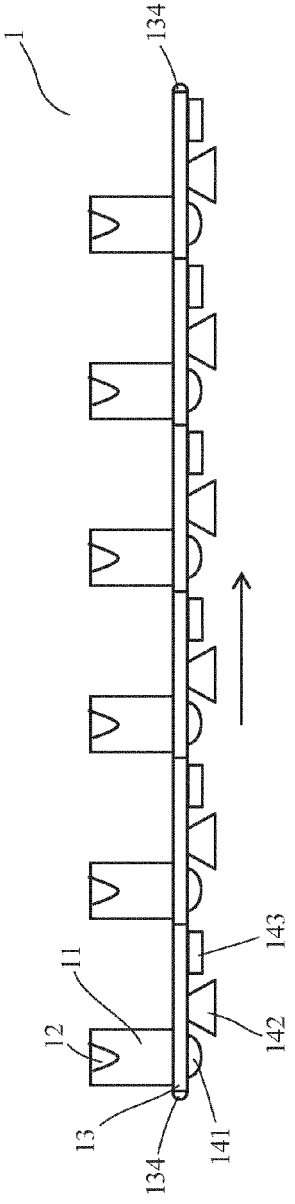


Fig. 16C

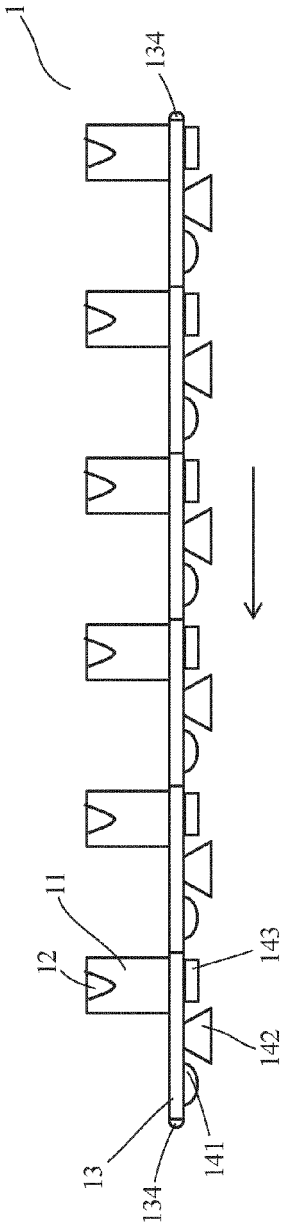


Fig. 16E

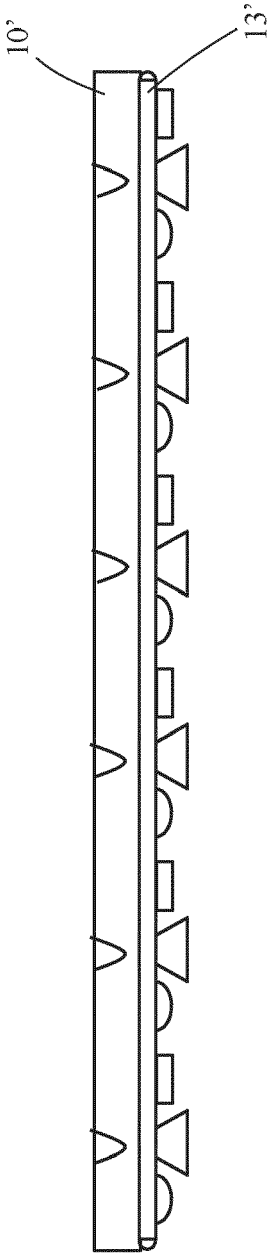


Fig. 17A

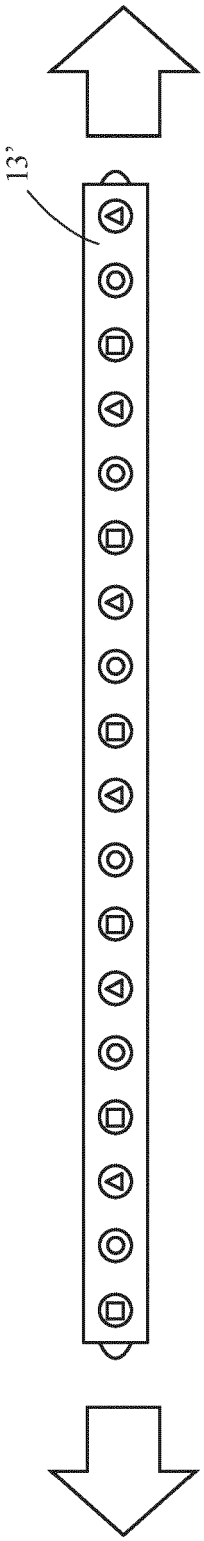


Fig. 17B

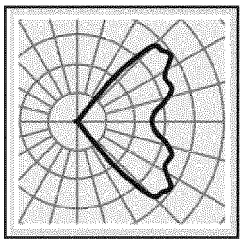


Fig. 18B

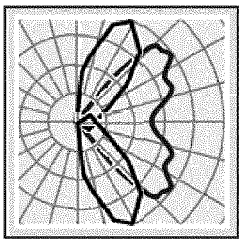


Fig. 18D

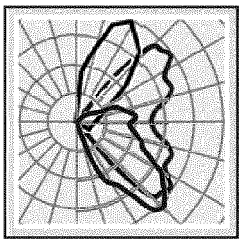


Fig. 18F

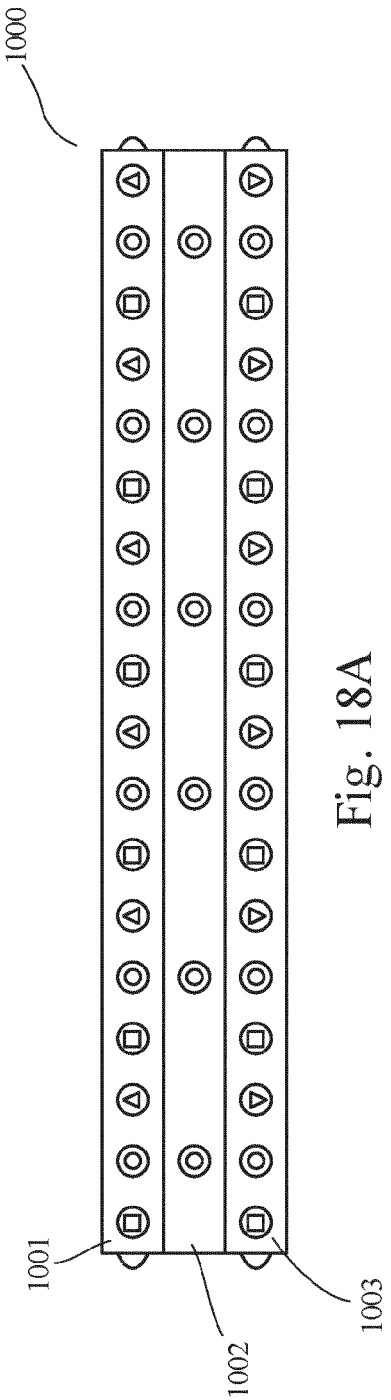


Fig. 18A

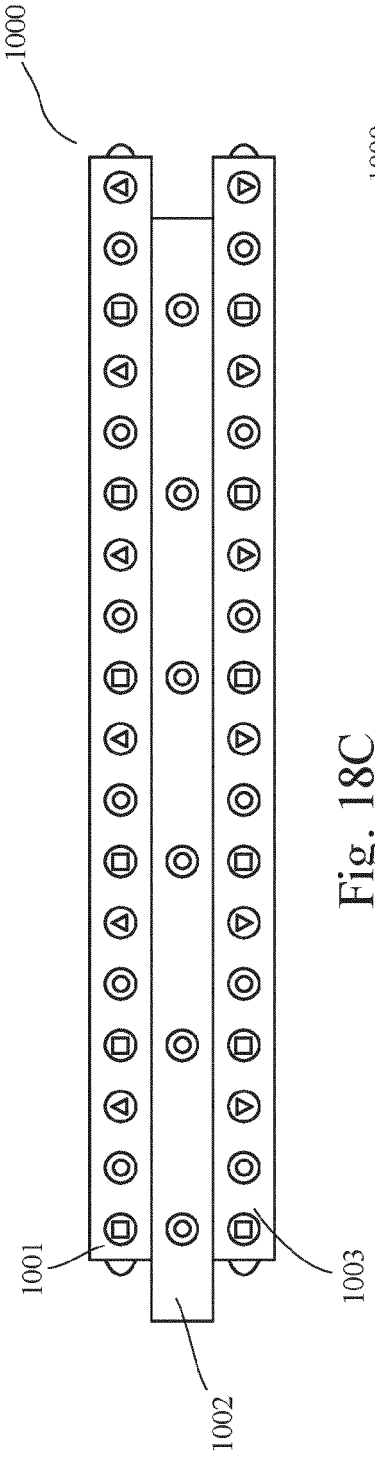


Fig. 18C

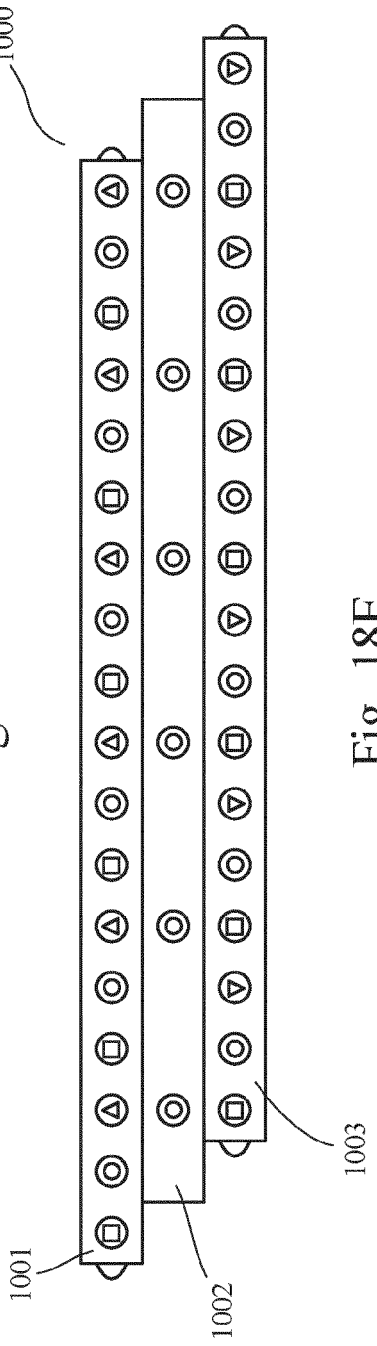


Fig. 18E

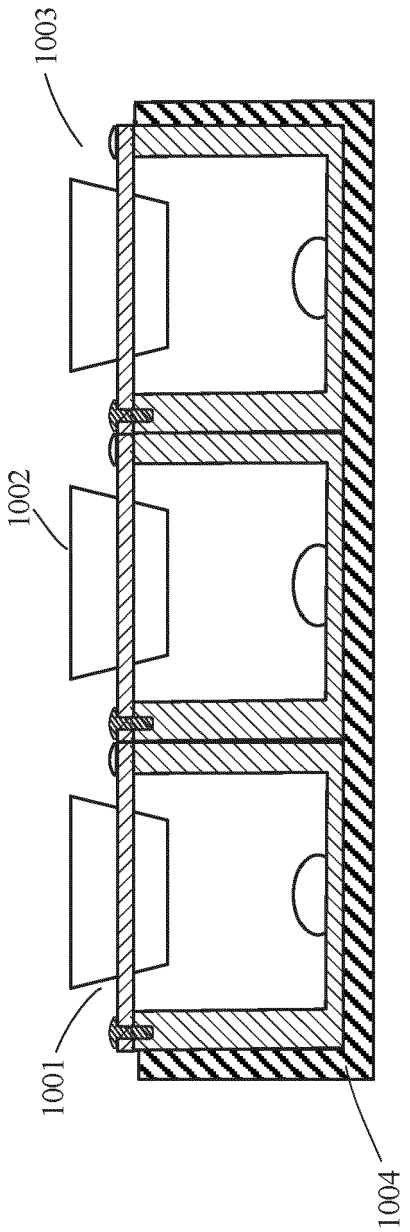


Fig. 19A

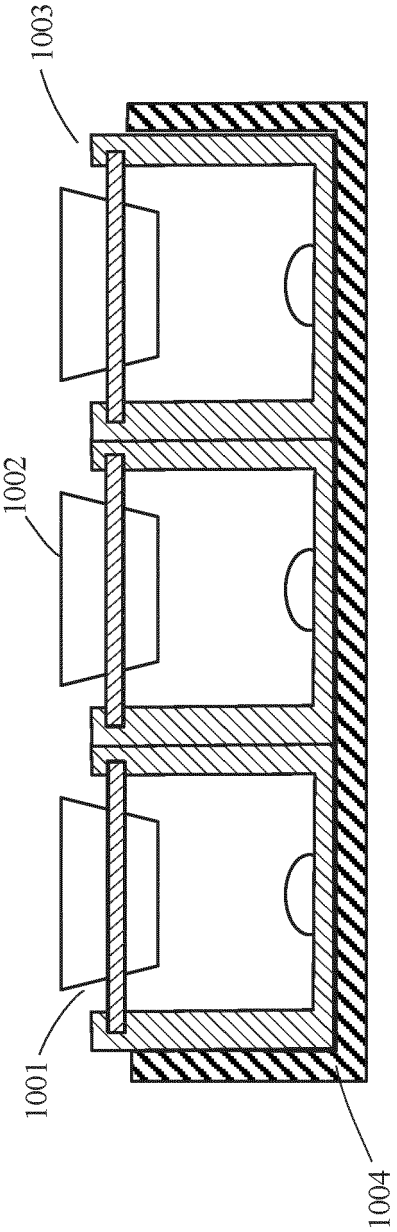


Fig. 19B

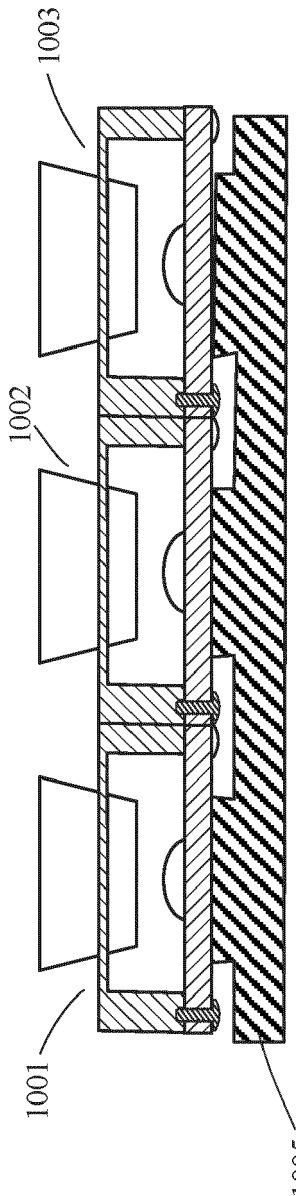


Fig. 20A

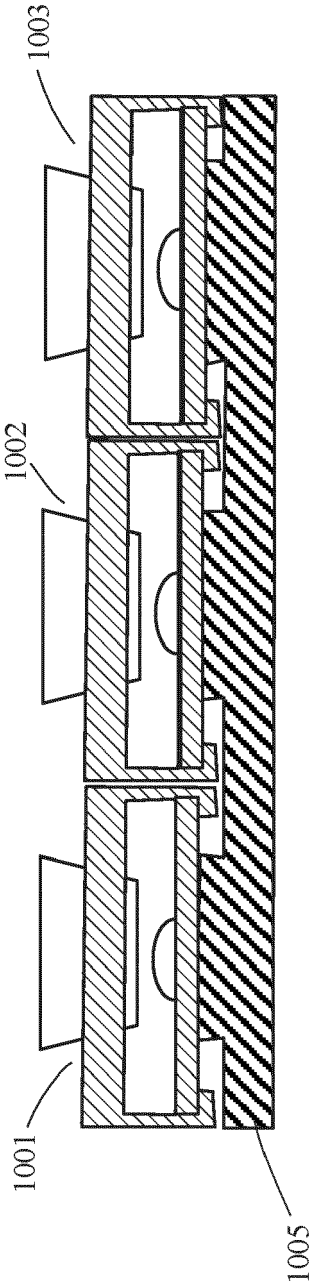


Fig. 20B

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 17 2517

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X A	WO 2019/134875 A1 (SCHREDER SA [BE]) 11 July 2019 (2019-07-11) * claims 1,16; figures 2,3C *	1-4,15, 16,18,19 5-14,17, 20	INV. F21V5/04 F21V17/02 F21V14/06 F21V17/00
X	JP 2012 113924 A (PANASONIC CORP) 14 June 2012 (2012-06-14) * paragraphs [0010] - [0014]; figures 1-5, 10 *	1,2,14, 18,19	
X	JP 2004 199891 A (MATSUSHITA ELECTRIC WORKS LTD) 15 July 2004 (2004-07-15) * paragraphs [0017], [0020]; figures 1,2,3 *	1,2,13, 14	
E	WO 2020/136202 A1 (SCHREDER SA [BE]) 2 July 2020 (2020-07-02) * claims 1, 15-17; figures 1, 5B *	1,2,17	
A	US 2009/207614 A1 (CHENG YI-KAI [TW] ET AL) 20 August 2009 (2009-08-20) * paragraphs [0025], [0026]; figure 1 *	1,15	TECHNICAL FIELDS SEARCHED (IPC) F21V F21Y
A	US 2014/313744 A1 (COLLIAS JAMES H [US]) 23 October 2014 (2014-10-23) * paragraph [0053] *	1,16	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	23 September 2020	Krikorian, Olivier

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 20 17 2517

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

23-09-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2019134875 A1	11-07-2019	AU 2018400376 A1	23-07-2020
		BE 1025877 A1	30-07-2019
		WO 2019134875 A1	11-07-2019
JP 2012113924 A	14-06-2012	JP 5820967 B2	24-11-2015
		JP 2012113924 A	14-06-2012
JP 2004199891 A	15-07-2004	NONE	
WO 2020136202 A1	02-07-2020	NONE	
US 2009207614 A1	20-08-2009	CN 101514803 A	26-08-2009
		US 2009207614 A1	20-08-2009
US 2014313744 A1	23-10-2014	US 2014313744 A1	23-10-2014
		WO 2014172684 A1	23-10-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 6632004 B, Sugawara **[0004]**
- ES 2278955 **[0005]**