

diffusion sheet 12, the first prism sheet 14, the second prism sheet 16 and the second diffusion sheet 18 in a thickness of 0.03 to 0.2 g/m².

The method of forming a coating film of an aqueous solution of a water-soluble antistatic agent and a fluorine surfactant on the light diffusion sheets 12, 18 and the prism sheets 14, 16 is not particularly limited. Various methods such as an application method using a brush, a dipping method, a spraying method and an aerosol spraying method may be used. Of these, an aerosol spraying method, in particular, an aerosol spraying method in which mist is generated using an ultrasonic oscillator is most preferred because optical properties and appearance can be maintained. The aerosol spraying method provides excellent wetting properties on the surface of light diffusion sheets 12, 18 and the prism sheets 14, 16. Since particles spread into a thin film without agglomeration, an extremely thin and uniform coating film can be easily formed on both sides of the sheet substantially simultaneously even in the case of light diffusion sheets 12, 18 and prism sheets 14, 16 of various surface shapes only by subjecting them to aerosol spraying. A known aerosol spraying method is used as the aerosol spraying method.

The water-soluble antistatic agent to be used is a water-soluble antistatic agent generally used for preventing electrostatic charge of synthetic resin. Examples thereof include cationic antistatic agents such as lauryltrimethylammonium chloride, stearyltrimethylammonium chloride, lauryldiethanolamine and stearylamine hydrochloride, anionic antistatic agents such as diethanolamine alkylphosphate, potassium alkylphosphate and alkylbenzenesulfonate and nonionic antistatic agents such as polyoxyethylene glycol monooleate and polyethylene sorbitan monooleate. Of these, cationic antistatic agents are particularly preferably used. For preventing static charge in optical sheets such as light diffusion sheets and prism sheets, sufficient anti-static effects can be produced when the water-soluble antistatic agent is a cationic antistatic agent even if the coating film has a thin film thickness.

Examples of fluorine surfactants include fluoroalkyl carboxylates (alkali metal salts, alkaline earth metal salts, amine salts), perfluoroalkyl carboxylates, fluoroalkyl phosphate ester salts, perfluoroalkyl phosphate ester salts, polyoxyethylene perfluoroalkyl phosphate ester salts, perfluoroalkyl sulfate ester salts, polyoxyethylene perfluoroalkyl sulfate ester salts, perfluoroalkylsulfonamide derivatives,

perfluoroalkylamine salts, perfluoroalkyl quaternary ammonium salts, perfluoroalkylimidazolidine derivatives, perfluoroalkylbetaine, polyoxyethylene perfluoroalkylphenol, polyoxyethylene perfluoroalkylamine and perfluoroalkylcarboxylic acid sorbitan ester.

5 Specific examples of such surfactants include sodium 16-fluorohexadecyl carboxylate, perfluorooctylcarboxylic acid N,N-diethanolamine, sodium perfluorodecyl phosphate ester, sodium perfluorooctyl phosphate ester, polyoxyethylene sodium perfluorooctyl phosphate ester, N-polyoxyethylene-N-ethyl perfluorooctylsulfonamide, N,N-di(polyoxyethylene) perfluorooctylsulfonamide, N-polyoxyethylene-N-butyl
10 perfluorodecylsulfonamide, N-polyoxyethylene-N-ethyl perfluorooctadecylsulfonamide, perfluorooctadecyl-N-ethyldimethylammonium salt, perfluorododecyltrimethylammonium salt, perfluorooctadecylbetaine, polyoxyethylene perfluorooctyl ether, polyoxyethylene perfluorooctadecenyl ether, polyoxyethylene perfluorohexylamine and perfluorododecyl carboxylic acid sorbitan ester. These may
15 be used alone or in combination of two or more.

 The film thickness of the coating film containing a water-soluble antistatic agent and a fluorine surfactant may be adjusted according to the concentration of the water-soluble antistatic agent and the fluorine surfactant in the aqueous solution or coating conditions such as treating time. By adjusting the thickness to 0.03 to 0.2 g/m²
20 after drying, anti-static effects can be given to optical sheets such as diffusion sheets and prism sheets. Further, in the secondary processing in which optical sheets are combined by bonding described later, the bonded surface is not separated in usual handling. In other words, a coating film containing not only a water-soluble antistatic agent but also a fluorine surfactant produces anti-static effects, and also prevents decrease in the adhesion
25 strength caused by the antistatic agent and improves adhesiveness. In short, the fluorine surfactant produces wettability and thus prevents decrease in adherability of films due to the antistatic agent without damaging anti-static effects. Herein, the thickness of the coating film is set at 0.03 to 0.2 g/m², because not only anti-static effects but also wettability cannot be obtained when the coating film is thinner than 0.03 g/m², and also
30 because optical properties and appearance are affected by visible light when the coating film is thicker than 0.2 g/m².

Such a coating film is formed by forming a coating film of an aqueous solution containing a water-soluble antistatic agent and a fluorine surfactant using device for forming a coating film P, P ... and then drying. Drying may be performed by a known method such as air drying at room temperature, allowing to stand under a predetermined temperature condition or spraying of warm air.

YAG laser irradiation apparatuses and semiconductor laser irradiation apparatuses with a wavelength of 355 to 1064 nm and carbon dioxide gas laser irradiation apparatuses with a wavelength of 9 to 11 μm can be used as a laser irradiation apparatus including the laser head 24. The mode of oscillation may be continuous oscillation or pulse oscillation, but when welding is almost simultaneously performed with cutting, spotting by pulse oscillation is preferred because appearance upon finish is good.

The output and the frequency required for performing cutting (cutting step) and welding (joining step) almost simultaneously vary depending on the feed rate of materials, the scanning rate of laser beams and the thickness of materials. Good welding results are obtained under conditions of an output of about 2 to 50 W and a frequency of about 100 kHz or lower.

The laser head 24 is attached to an X drive robot axis or an XY drive robot axis movable to the X direction (in the direction of the width of sheet) or the XY direction, and this makes it possible to determine positions or change tracks optionally. The entire laser head 24 may be moved depending on the irradiation pattern of laser beams, but the laser head 24 may be separately arranged (fixed) and only laser beams are guided by optical fiber to simplify the XY direction moving mechanism.

A known mechanism (aspirator, etc) which sucks in smoke generated upon cutting and welding by the laser head 24 may also be provided.

Periphery portions of a laminate which are to be cut and joined are irradiated with laser beams from the laser head 24 and with moving the irradiation spot at a constant rate, the periphery of the laminate is cut into a product size, melted and joined.

On the other hand, the sheet-shaped laminate 34 from which the optical sheet for a display 10 is punched out by the laser head 24 is taken up on a take-up roll 36 in a take-up device (details not shown).

The above first method for producing an optical sheet for a display provides the following advantages.

1) Advantage of reducing scratch defect

When there are scratches on the upper surface and the lower surface of a lens sheet (a first prism sheet 14, a second prism sheet 16), they are noticeable due to lens effect. On the other hand, when scratches are present on the lower surface of a diffusion sheet (a first diffusion sheet 12, a second diffusion sheet 18), they are not noticeable because light is diffused. From these facts, prevention of scratches on the lens sheet leads to reduction of scratch defects. Scratches are often generated upon handling after processing into sheet. By combining a lens sheet and a diffusion sheet, the diffusion sheet serves as a protective sheet and therefore defects due to scratches can be reduced. This effect is particularly large in the optical sheet for a display 10 in the first embodiment (see Figure 1) and the optical sheet for a display 30 in the second embodiment (see Figure 3) in which the lens sheet is not exposed on the surface.

Further, by applying an aqueous solution containing a water-soluble antistatic agent and a fluorine surfactant, the coating film protects the surface of sheets, and the sheets have improved scratch resistance compared to those without such a coating film. As a result, defects due to scratches can be reduced.

2) Advantage of reducing the number of assembling steps

When, for example, an optical sheet for a display 10 (see Figure 1) of the first embodiment is used in assembling a liquid crystal display device, the number of assembling steps is only one, which is to incorporate the optical sheet for a display 10; but when a conventional sheet is used, assembling involves 8 steps of incorporating a first diffusion sheet ⇒ removing the protective sheet on the back side of a first lens sheet ⇒ removing the protective sheet on the surface of the first lens sheet ⇒ incorporating the first lens sheet ⇒ removing the protective sheet on the back side of a second lens sheet ⇒ removing the protective sheet on the surface of the second lens sheet ⇒ incorporating the second lens sheet ⇒ incorporating a second diffusion sheet. As described above, according to the first production method, assembling steps can be significantly reduced and thus the product cost can be reduced.

3) Advantage of saving on protective sheet

A protective sheet is often put on both sides of a lens sheet for prevention of scratches. The protective sheet is discarded after the lens sheet is assembled and so is very wasteful. In the present embodiment, the diffusion sheet serves as a protective sheet and thus helps to save on the protective sheets.

5 Specifically, one protective sheet can be reduced in the optical sheet for a display 40 of the fourth embodiment (see Figure 4) and the optical sheet for a display 60 of the sixth embodiment (see Figure 6); two protective sheets can be reduced in the optical sheet for a display 30 of the third embodiment (see Figure 3); three protective sheets can be reduced in the optical sheet for a display 20 of the second embodiment (see
10 Figure 2) and the optical sheet for a display 50 of the fifth embodiment (see Figure 5); and four protective sheets can be reduced in the optical sheet for a display 10 of the first embodiment (see Figure 1).

4) Advantage of preventing attachment of dust

Surfaces of optical films such as lens sheets and diffusion sheets are easily
15 electrostatically charged in processing steps, and so dust is easily attached thereto. Since such attachment of dust can be prevented, a high quality optical sheet for a display in which no dust is included can be obtained.

5) Advantage of improving adhesiveness

A coating layer containing a fluorine surfactant prevents separation of bonded
20 surfaces in usual handling during the secondary processing of combining optical sheets such as diffusion sheets and prism sheets by bonding. This leads to cut down of time spent for dealing with separation of optical sheets for a display upon handling after processing.

A second method for producing an optical sheet for a display is now described.
25 Figure 8 is a schematic view of production line for an optical sheet for a display 21 applied to the second method. The same reference numerals are used for members which are the same as or similar to those in the production line for an optical sheet for a display 11 of the first method (see Figure 7), and detailed description thereof is omitted.

In the production line for an optical sheet for a display 21, dispensers 42, 44, 46
30 and a punching press device 48 are employed instead of the laser head 24 in the production line for an optical sheet for a display 11.

The dispensers 42, 44, 46 each are a feeder which discharges adhesive from the tip. The dispenser 42 supplies adhesive to the first diffusion sheet 12 to bond the first diffusion sheet 12 and the first prism sheet 14. The dispenser 44 supplies adhesive to the first prism sheet 14 to bond the first prism sheet 14 and the second prism sheet 16.

- 5 The dispenser 46 supplies adhesive to the second prism sheet 16 to bond the second prism sheet 16 and the second diffusion sheet 18.

Preferably, the adhesive supplied from the dispensers 42, 44, 46 bonds sheets with the aid of heat or a catalyst. Specifically, general adhesives such as silicon adhesives, polyurethane adhesives, polyester adhesives, epoxy adhesives, cyanoacrylate
10 adhesives and acrylic adhesives can be used.

Since optical sheets for a display 10 to 60 may be used at high temperatures, adhesives stable at room temperature to 120°C are preferred. Of the above adhesives, epoxy adhesives have excellent strength and heat resistance, and therefore are preferably used. Cyanoacrylate adhesives have excellent immediate effects and strength, and
15 therefore are applicable to efficient preparation of optical sheets for a display. Polyester adhesives are particularly preferred because they have excellent strength and processability.

These adhesives are roughly classified into thermosetting adhesives, hot melt adhesives and two-component adhesives according to bonding methods. Preferably,
20 thermosetting adhesives or hot melt adhesives which enable continuous production are used. Preferably, the adhesive is applied in a coating thickness of 0.5 µm to 50 µm regardless of which adhesive is used.

A drying device for drying adhesive is preferably provided before press rollers G (guide rollers G) at the downstream. The drying device is not particularly limited,
25 and examples thereof include known drying methods such as drying with warm air or hot air and drying with dehumidified air.

The dispensers 42, 44, 46 are attached to an X drive robot axis or an XY drive robot axis movable to the X direction (in the direction of the width of sheet) or the XY direction, and this makes it possible to determine positions or change tracks optionally.

- 30 The dispensers 42, 44, 46 supply adhesive to the periphery portions of a laminate which are to be joined, and with transferring the laminate, the periphery of the laminate is joined by press rollers (guide rollers G) at the downstream.

A punching press device 48 at the downstream of the dispensers 42, 44, 46 cuts the periphery of the laminate into product size. In the punching press device 48, the blade pierces through the center of the bonded portion, and thus composite sheets, which are punched sheets (optical sheets for a display 10 to 60) all or some of which are bonded only at the edges, can be obtained.

A third method for producing an optical sheet for a display is now described. Figure 9 is a schematic view of production line for an optical sheet for a display 31 applied to the third method. The same reference numerals are used for members which are the same as or similar to those in the production line for an optical sheet for a display 11 of the first method and the production line for an optical sheet for a display 21 of the second method (see Figures 7 and 8), and detailed description thereof is omitted.

In the production line for an optical sheet for a display 31, tape feeders 52, 54, 56 are used instead of the dispensers 42, 44, 46 in the production line for an optical sheet for a display 21. The tape feeders 52, 54, 56 are each a feeder which supplies double-sided adhesive tape from the tip.

The tape feeder 52 supplies double-sided adhesive tape to the surface of the first diffusion sheet 12 to adhere the first diffusion sheet 12 and the first prism sheet 14. The tape feeder 54 supplies double-sided adhesive tape to the surface of the first prism sheet 14 to adhere the first prism sheet 14 and the second prism sheet 16. The tape feeder 56 supplies double-sided adhesive tape to the second prism sheet 16 to adhere the second prism sheet 16 and the second diffusion sheet 18.

The double-sided adhesive tape supplied from the tape feeders 52, 54, 56 have adhesive applied to both faces. Highly adhesive acrylic copolymer resin can be used as the adhesive for the double-sided adhesive tape. In addition to this, for example, silicon, natural rubber or synthetic rubber adhesive may be used. In consideration of all of heat resistance, physical strength such as creep resistance and costs, acrylic adhesives are preferably used.

For the tape feeders 52, 54, 56 which supply double-sided adhesive tape, commercially available general tape dispensers may be used. The tape feeders 52, 54, 56 are attached to a uniaxial moving mechanism which is movable to any position in the X direction (direction of the width of the sheet), and the position where double-sided adhesive tape is applied can be changed according to punching patterns.

A pivot mechanism is disposed at the part where the tape feeders 52, 54, 56 are fixed. The mechanism is capable of dealing with taping patterns in diagonal directions as well by changing the position of the tape feeders 52, 54, 56 corresponding to the feeding rate of the sheet.

5 A fourth method for producing an optical sheet for a display is now described. Figure 10 is a schematic view of production line for an optical sheet for a display 41 applied to the fourth method. The same reference numerals are used for members which are the same as or similar to those in the production lines for an optical sheet for a display of the first to third methods (see Figure 7 to 9) and detailed description thereof is
10 omitted.

In the production line for an optical sheet for a display 41, ultrasonic horns 62, 64, 66 are used instead of the dispensers 42, 44, 46 in the production line for an optical sheet for a display 21. The ultrasonic horns 62, 64, 66 are each provided at the downstream of press rollers (guide rollers G).

15 The ultrasonic horns 62, 64, 66 are a device which fuses two or more stacked sheets. Specifically, ultrasonic horn 62 fuses the first diffusion sheet 12 and the first prism sheet 14. The ultrasonic horn 64 fuses the first prism sheet 14 and the second prism sheet 16. The ultrasonic horn 66 fuses the second prism sheet 16 and the second diffusion sheet 18.

20 Ultrasonic horns which are moved up and down with an air cylinder or ultrasonic horns which are moved up and down by a servomotor are conventionally known as ultrasonic horns 62, 64, 66 (ultrasonic fusion device). However, any type of ultrasonic fusion device may be employed as long as sheets can be fused by applying ultrasonic vibration with applying load to the sheets.

25 For controlling the position of ultrasonic horns 62, 64, 66, positions are changed only in the width direction of the sheet when the punching pattern is parallel to the feed direction of the sheet. However, to respond to punching patterns in diagonal directions, an oscillating mechanism which can change the moving direction of the ultrasonic horns 62, 64, 66 to any direction is provided, and the ultrasonic horns 62, 64, 66 are moved in
30 the width direction corresponding to the moving distance of the sheet.

Setting conditions of the ultrasonic horns 62, 64, 66 are determined so that the portion to be fused is not melted down by heat. The portion to be bonded may be

cooled after bonding (fusing) using an air cooling mechanism such as air blowing according to need.

A fifth method for producing an optical sheet for a display is now described. Figure 11 is a schematic view of production line for an optical sheet for a display 51

5 applied to the fifth method. The same reference numerals are used for members which are the same as or similar to those in the production lines for an optical sheet for a display of the first to fourth methods and detailed description thereof is omitted.

10 In the production line for an optical sheet for a display 51, laser heads 72, 74, 76 are used instead of the ultrasonic horns 62, 64, 66 in the production line for an optical sheet for a display 41. The laser heads 72, 74, 76 are each disposed at the downstream of press rollers (guide rollers G) as are the ultrasonic horns 62, 64, 66.

15 The laser heads 72, 74, 76 are a device which fuses two or more stacked sheets as does the ultrasonic horns 62, 64, 66. Specifically, the laser head 72 fuses the first diffusion sheet 12 and the first prism sheet 14. The laser head 74 fuses the first prism sheet 14 and the second prism sheet 16. The laser head 76 fuses the second prism sheet 16 and the second diffusion sheet 18.

20 The laser heads 72, 74, 76 are different from the laser head 24 in the production line for an optical sheet for a display 11 of Figure 7 (the first method), and are used only for the joining step. The cutting step is performed in the punching press device 48. The basic specification and surrounding configurations of the laser heads 72, 74, 76 are substantially the same as those in the first method.

25 Setting conditions of the laser heads 72, 74, 76 are determined so that the portion to be fused is not melted down by heat. The portion to be bonded may be cooled after bonding (fusing) using an air cooling mechanism such as air blowing according to need.

A sixth method for producing an optical sheet for a display is now described. Figure 12 is a schematic view of production line for an optical sheet for a display 61 applied to the sixth method. The same reference numerals are used for members which are the same as or similar to those in the production lines for an optical sheet for a display of the first to fifth methods (see Figures 7 to 11), and detailed description thereof is omitted.

In the production line for an optical sheet for a display 61, a laser head 78 is used instead of the three laser heads 72, 74, 76 in the production line for an optical sheet for a display 51. The laser head 78 is disposed at the downstream of press rollers (guide rollers G).

5 The laser head 78 is a device which fuses two or more stacked sheets. Specifically, the laser head 78 fuses a laminate of the first diffusion sheet 12, the first prism sheet 14, the second prism sheet 16 and the second diffusion sheet 18.

10 The laser head 78 is different from the laser head 24 in the production line for an optical sheet for a display 11 of Figure 7 (the first method), and is used only for the joining step. The cutting step is performed in the punching press device 48. The basic specification and surrounding configurations of the laser head 78 are substantially the same as those in the first method.

15 Setting conditions of the laser head 78 are determined so that the portion to be fused is not melted down by heat. The portion to be bonded may be cooled after bonding (fusing) using an air cooling mechanism such as air blowing according to need.

 Figures 13A and 13B illustrate arrangement of sheets (optical sheets for a display 10 to 60) on a plane, which are punched out from a laminate in the first method. Figures 14A and B illustrate arrangement of sheets (optical sheets for a display 10 to 60) on a plane, which are punched out from a laminate in the second to sixth methods.

20 Referring to Figure 13A illustrates performing fusing (joining step) and punching (cutting step) parallel to the transferring direction of a laminate. Figure 13B illustrates performing fusing (joining step) and punching (cutting step) diagonal to the transferring direction of a laminate. In the figures, points on the periphery of sheets that are punched out from the laminate indicate fused portions.

25 Referring to Figure 14A illustrates performing fusing or bonding (joining step) in directions parallel to and perpendicular to the transferring direction of a laminate. Figure 14B illustrates performing fusing or bonding (joining step) in the direction diagonal to the transferring direction of a laminate. In the figures, points on the periphery of sheets that are punched out from the laminate indicate fused portions or
30 bonded portions.

As described above, the present invention can produce a high quality optical sheet in a simple method without decrease in the adhesion strength upon bonding optical sheets when producing an optical sheet for a display.

The present invention also provides the following advantages.

5 1) Improvement in product value by cost reduction and thinning

Since rigidity is required for optical sheets used in large liquid crystal TVs, supports whose thickness is about twice the thickness of conventional supports are used. In contrast, since the optical sheet according to the present invention is a composite of sheets, the composite sheet has sufficient rigidity without increasing the thickness of
10 each layer and the thickness of such layers can be reduced.

2) Improvement in performance by preventing reduction of converging effect

To prevent scratches on the lens sheet (make scratches less noticeable), matte treatment is performed on the backside of some products. However, the optical sheet according to the present invention does not require such treatment, and thus not only
15 production cost can be reduced but also reduction of converging effect due to such matte treatment can be prevented, and therefore performance is improved.

3) Improvement in anti-fogging properties

Since a coating film containing a water-soluble antistatic agent and a fluorine surfactant is formed on at least the surface of an optical sheet in a thickness of 0.03 to 0.2
20 g/m², fogging due to temperature change is significantly improved when the optical sheet for a display of the present invention is used in a backlight unit of a liquid crystal display device.

Embodiments of the method for producing an optical sheet for a display of the present invention have been described above, but the present invention is not limited to
25 the above embodiments and various other aspects are also possible.

For example, although the prism of the first prism sheet 14 and the second prism sheet 16 is always upward in the present embodiments, the sheets can be stacked with the prism downward.

The layer structure of the optical sheet for a display is not limited to those in the
30 embodiments either, and for example, protective sheets can be stacked on the top and the bottom surfaces.

Further, although an aqueous solution containing a water-soluble antistatic agent and a fluorine surfactant is applied using coating device P, P ... in the line for producing an optical sheet for a display in these embodiments, embodiments in which the solution is applied in the production of a prism sheet or a diffusion sheet can also be applied.

5 Such configurations function in the same way as in the present embodiments and produce similar effects.

[Method for packaging optical sheet for display]

10 The method for packaging an optical sheet for a display described above is now described with reference to Figures 17A to 17D. Figures 17A to 17D show a procedure of deaeration packaging in which optical sheets for a display which are bundled in a predetermined number to be packaged (hereinafter a "bundle") are packaged with deaerating (pressure reduction).

15 The optical sheet for a display to be packaged through the method is not limited to the optical sheets for a display produced by the above-described methods. The bundles as used herein include not only optical sheets for a display joined at one or more parts shown in Figure 1 to Figure 6, but also combination of a light diffusion sheet and a prism sheet which are not bonded and are bundled in an order to be installed in a backlight unit.

20 Configurations of light diffusion sheets and prism sheets to which the packaging method shown in this embodiment can be suitably applied include (1) combination of a second light diffusion sheet 18 and a first prism sheet 14 (the optical sheet for a display 60 in Figure 6), (2) combination of a second light diffusion sheet 18, a second prism sheet 16 and a first prism sheet 14 (the optical sheet for a display 50 in Figure 5), (3) combination of a second diffusion sheet 18, a first prism sheet 14 and a first diffusion sheet 12 (the optical sheet for a display 30 of Figure 3); (4) combination of a second diffusion sheet 18, a second prism sheet 16, a first prism sheet 14 and a first diffusion sheet 12 (the optical sheet for a display 10 in Figure 1), (5) combination of a first prism sheet 14 and a first diffusion sheet 12 (the optical sheet for a display 40 in Figure 4), and (6) combination of a second prism sheet 16, a first prism sheet 14 and a first diffusion sheet 12 (the optical sheet for a display 20 in Figure 2).

30 In the combinations of a light diffusion sheet and a prism sheet (1) to (6), the first diffusion sheet 14 and the second diffusion sheet 18 may be accordingly exchanged,

or the first prism sheet 14 and the second prism sheet 16 may be accordingly exchanged. For example, in the combination of the light diffusion sheet and the prism sheet shown in (1), a second prism sheet may be combined with the second diffusion sheet 18 instead of the first prism sheet 14.

5 In aspects using the first prism sheet 14 and the second prism sheet 16, the respective prism sheets are disposed so that the axes of the convex lenses of the prism sheets are substantially at right angles (ridgeline directions of the convex lenses of the prism sheets are substantially at right angles).

10 In the temporary packaging step shown in Figure 17A, a bundle 100 (laminate) is inserted into a packaging bag 104 (packaging material) whose one end (first end 102) is previously sealed and an air suction nozzle 108 (deaeration device) for removing air in the packaging bag 104 is put into an opening (second end 106) on the other end. A heat seal mechanism (not shown in Figure 17A, shown by reference numeral 110 in Figure 17D) longer than the width of the packaging bag 104 is disposed above and below the air suction nozzle 108. The bundle 100 and the packaging bag 104 shown in Figure 17A are held at the bottom in the Figure 17A.

 Upon temporary packaging of the non-bonded combination of a light diffusion sheet and a prism sheet bundled in an order to be installed in a backlight unit, the sheets are handled with one end being clipped (the left end in Figure 17A in this embodiment).

20 In the deaeration step shown in Figure 17B, the air in the packaging bag 104 is removed by operating a vacuum pump connected to the air suction nozzle 108, which is not shown, by a deaeration control circuit (not shown)(pressure reduction), thereby allowing the packaging bag 104 to shrink. Figure 17C shows an advanced state of shrinkage of the packaging bag 104. When the pressure in the packaging bag 104 is reduced, air and contaminants (dust) in the packaging bag 104 are discharged to the outside. Further, since the bundle 100 is appropriately fixed to the packaging bag 104, generation of dust, formation of scratches and generation of electrostatic charge due to friction between sheets constituting the bundle or between the bundle and the packaging bag 104 can be prevented.

30 In the deaeration step, the inside of the packaging bag 104 in which the bundle 100 is temporarily packaged may be brought into a vacuum condition at a predetermined degree of vacuum.

In the sealing step shown in Figure 17D, the air suction nozzle 108 is retreated in the retreating direction (shown by an arrow in the figure) when the packaging bag 104 is completely shrunk (namely, the bundle 100 and the packaging bag 104 are appropriately brought into close contact and the bundle 100 is fixed to the packaging bag 104). Simultaneously, the second end 106 shown in Figures 17A to 17C is heat-sealed by the heat seal mechanism 110 to form a sealed part 116.

To ensure close contact with the bundle 100, preferably the packaging bag 104 has a predetermined elasticity at least at a portion where the bag comes into contact with the bundle 100. Examples of materials having a predetermined elasticity include PVC (polyvinyl chloride), PP (polypropylene), PE (polyethylene), PS (polystyrene), PO (polyolefin) and PET (polyethylene terephthalate). The above materials are heat-shrinkable and when heat is applied upon sealing (employing shrink packaging together), the contact between the packaging bag 104 and the bundle 100 (air tightness of the packaging bag 104) is increased.

The packaging method described above reduces defects in bundles due to scratches or attachment of contaminants and eliminates assembling steps and inspection steps. The method also contributes to cost reduction because the number of protective sheets can be reduced.

Examples

Examples of optical sheets for a display produced by the method of the present invention are now described.

[Preparation of prism sheet]

A prism sheet used for the first prism sheet 14 and the second prism sheet 16 was prepared. The prism sheet is commonly used for the first prism sheet 14 and the second prism sheet 16.

Preparation of resin solution

Compounds listed in the table of Figure 15 were mixed at weight ratios shown in the table. The mixture was heated to 50°C and the compounds were dissolved with stirring to give a resin solution. The name and the type of the compounds are as follows.

EB3700: Ebecryl 3700 available from Daicel UCB Corporation, bisphenol A epoxyacrylate, (viscosity: 2200 mPa·s/65°C)

BPE200: NK Ester BPE-200 available from SHIN-NAKAMURA CHEMICAL CORPORATION, dimethacrylate of ethylene oxide adduct bisphenol A (viscosity: 590 mPa.s/25°C)

BR-31: New Frontier BR-31 available from DAI-ICHI KOGYO SEIYAKU CO., LTD., tribromophenoxyethyl acrylate (solid at room temperature, melting point 50°C or higher)

LR8893X: Lucirin LR8893X, radical generator available from BASF, ethyl-2,4,6-trimethylbenzoyl ethoxyphenylphosphine oxide

MEK: methyl ethyl ketone

10 A prism sheet was produced using an apparatus for producing a prism sheet having a configuration shown in Figure 16.

A transparent PET (polyethylene terephthalate) film having a width of 500 mm and a thickness of 100 µm was used as sheet W.

15 A roller having a length (in the direction of the width of the sheet W) of 700 mm and a diameter of 300 mm made of S45C whose surface is made of nickel was used as an emboss roller 83. Grooves with a pitch of 50 µm in the roller axis direction were formed on the surface of the roller in a width of about 500 mm across the entire circumference by cutting using a diamond tool (single point). The cross-section of the groove is a triangle having an apex angle of 90 degrees, and the bottom of the groove is
20 also a triangle of 90 degrees without flat part. In other words, the groove has a width of 50 µm and a depth of about 25 µm. The groove is endless without joints in the circumferential direction of the roller. Thus, a lenticular lens (prism sheet) having a triangle cross section can be formed on the sheet W by the emboss roller 83. The surface of the roller is plated with nickel after making the groove.

25 A die coater with an extrusion type application head 82C was used as an application device 82.

A solution having a composition described in the table of Figure 15 was used as a coating solution F (resin solution). The amount of the coating solution F fed to the coating head 82C was controlled by a feeder 82B so that the coating solution F (resin)
30 has a film thickness of 20 µm in a wet state after removing an organic solvent by drying.

A hot air circulating drier was used as a drying device 89. The temperature of the hot air was 100°C. A roller having a diameter of 200 mm and on which a layer of

silicon rubber having a rubber hardness of 90 is formed was used as a nip roller 84. The nip pressure (effective nip pressure) for pressing the sheet W with the emboss roller 83 and the nip roller 84 was 0.5 Pa.

5 A metal halide lamp was used as a device for curing resin 85 and irradiation was performed at a dose of 1000 mJ/cm².

A prism sheet having an irregularity pattern was prepared by the above method.
[Preparation of first diffusion sheet 12]

10 A first diffusion sheet 12 (lower diffusion sheet) was prepared by forming an undercoat layer, a backcoat layer and a light diffusion layer in that order by the following method.

undercoat layer

A solution A having the following composition which is a coating solution for an undercoat layer was applied to one surface of a polyethylene terephthalate film (support) having a thickness of 100 μm with a wire bar (wire bar size: #10). The solution was dried at 120°C for 2 minutes to give an undercoat layer having a film thickness of 1.5 μm.

(Coating solution for undercoat layer)

	methanol	4165 g
	JURYMER SP-50T (available from NIHON JUNYAKU Co., Ltd.)	1495 g
20	cyclohexanone	339 g
	JURYMER MB-1X (available from NIHON JUNYAKU Co., Ltd.)	1.85g
	(organic particles: cross linked polymethyl methacrylate, ultrafine spherical particles having a weight average particle size of 6.2 μm)	

backcoat layer

25 A solution B having the following composition which is a coating solution for a backcoat layer was applied to a surface of the support opposite from where the undercoat layer was applied with a wire bar (wire size: #10). The solution was dried at 120°C for 2 minutes to give a backcoat layer having a film thickness of 2.0 μm.

(Coating solution for backcoat layer)

30	methanol	4171 g
	JURYMER SP-65T (available from NIHON JUNYAKU Co., Ltd.)	1487 g
	cyclohexanone	340 g

JURYMER MB-1X (available from NIHON JUNYAKU Co., Ltd.) 2.68 g
 (organic particles: crosslinked polymethyl methacrylate, ultrafine spherical
 particles having a weight average particle size of 6.2 μm)
 light diffusion layer

- 5 A solution C having the following composition which is a coating solution for a
 light diffusion layer was applied to the undercoat layer side of the support prepared
 above with a wire bar (wire size: #22). The solution was dried at 120°C for 2 minutes
 to give a light diffusion layer. As described later, a light diffusion layer was prepared
 by applying the solution C immediately after preparation of the solution or applying the
 10 solution C after allowing the solution to stand for two hours after preparation.

(Coating solution for light diffusion layer)

- cyclohexanone 20.84g
 DISPARLON PFA-230, solid concentration 20% by mass 0.74g
 (particle anti-settling agent: fatty acid amide available from Kusumoto
 15 Chemicals, Ltd.)

- 20% by mass acrylic resin (DIANAL BR-117 available from Mitsubishi Rayon
 Co., Ltd.) solution in methyl ethyl ketone 17.85 g
 JURYMER MB-20X (available from NIHON JUNYAKU Co., Ltd.) 11.29 g
 (organic particles: crosslinked polymethyl methacrylate, ultrafine spherical
 20 particles having a weight average particle size of 18 μm)
 F780F (available from Dainippon Ink & Chemicals Incorporated) 0.03 g
 (30% by mass methyl ethyl ketone solution)

[Preparation of second diffusion sheet 18]

- 25 A second diffusion sheet 18 (upper diffusion sheet) was prepared under the same
 condition and the same flow as in the above-described first diffusion sheet 12 except that
 the amount added of JURYMER MB-20X in the light diffusion layer of the first
 diffusion sheet 12 is changed to 1.13 g from 11.29 g.

[Preparation of optical sheet for display 10]

- Each sheet (a first diffusion sheet 12, a first prism sheet 14, a second prism sheet
 30 16 and a second diffusion sheet 18) is exposed to fine mist of an aqueous solution
 containing 2% by weight of stearyltrimethylammonium chloride and 0.2% by weight of a
 fluorine nonionic surfactant using a commercially available ultrasonic oscillating aerosol

spraying apparatus for 5 seconds. The sheets were air dried and sheets having a coating film with a film thickness of 0.04 g/m^2 were obtained. The surface resistivity of the samples was measured. In addition, the light diffusion sheets and the prism sheets were stacked and the four sides of the sheets were bonded by a commercially available

5 ultrasonic welding sealing apparatus to give a composite sheet.

[Preparation of optical sheet for display: Comparative Example]

A composite sheet was prepared by a method in which the sheets (the first diffusion sheet 12, the first prism sheet 14, the second prism sheet 16 and the second diffusion sheet 18) were stacked and the four sides of the sheets were bonded by a
10 commercially available ultrasonic welding sealing apparatus.

[Evaluation of optical sheet for display]

The optical sheets for a display in Examples have a surface specific resistivity of $2.5 \times 10^{10} \Omega$, which is sufficiently small for preventing attachment of dust. The sheets also have sufficient adhesion strength so that the sheets are not separated in usual
15 handling, and have no problem of optical properties and appearance.

For comparing adhesion strength, 100 sets each of the optical sheets of Example and Comparative Example were usually handled and those with separation were marked NG. Of the 100 sets of the Example, only 1 set was marked NG. In contrast, of the 100 sets of the Comparative Example, 24 sets were marked NG. The result of the
20 comparison shows that the optical sheet of Example of the present invention has anti-static effects and improved adhesiveness between sheets.

Claims

1. An optical sheet for a display comprising, two or more optical sheets which are stacked and bonded at one or more parts, wherein
a coating film containing a water-soluble antistatic agent and a fluorine
5 surfactant is formed on at least one side of each bonding surface of the two or more optical sheets in a thickness of 0.03 to 0.2 g/m².
2. An optical sheet for a display, comprising:
a lens sheet in which convex lenses are formed adjacent to each other in an axial
direction almost on the whole area; and
10 a light diffusion sheet stacked on a surface and/or a backside of at least one lens sheet, wherein
the lens sheet and the light diffusion sheet are bonded at one or more parts, and
a coating film containing a water-soluble antistatic agent and a fluorine
surfactant is formed on at least one side of each bonding surface of the lens sheet and the
15 light diffusion sheet in a thickness of 0.03 to 0.2 g/m².
3. An optical sheet for a display comprising, two lens sheets which are stacked and in which convex lenses are formed adjacent to each other in an axial direction almost on the whole area and a light diffusion sheet stacked on a surface and/or a backside of a
lamine of the lens sheets, wherein
20 the lens sheets themselves and the lens sheets and the light diffusion sheet are bonded at one or more parts, and
a coating film containing a water-soluble antistatic agent and a fluorine
surfactant is formed on at least one side of each bonding surface of the lens sheets
themselves and the lens sheets and the light diffusion sheet in a thickness of 0.03 to 0.2
25 g/m².
4. The optical sheet for a display according to any one of claims 1 to 3, wherein the water-soluble antistatic agent is a cationic antistatic agent.

5. A method for producing an optical sheet for a display, comprising the steps of:
forming a coating film of an aqueous solution containing a water-soluble
antistatic agent and a fluorine surfactant on at least one side of each bonding surface of
two or more optical sheets whose plane size is equal to or larger than a product size in a
5 thickness after drying of 0.03 to 0.2 g/m²;
stacking the two or more optical sheets whose plane size is equal to or larger
than a product size;
joining the two or more optical sheets at one or more parts; and
cutting a laminate of the two or more optical sheets into the product size.
- 10 6. A method for producing an optical sheet for a display, comprising the steps of:
forming a coating film of an aqueous solution containing a water-soluble
antistatic agent and a fluorine surfactant on at least one side of each bonding surface of a
lens sheet in which convex lenses are formed adjacent to each other in an axial direction
almost on the whole area and whose plane size is equal to or larger than a product size
15 and a light diffusion sheet whose plane size is equal to or larger than a product size in a
thickness after drying of 0.03 to 0.2 g/m²;
stacking the light diffusion sheet on a surface and/or a backside of at least one
lens sheet;
joining the lens sheet and the light diffusion sheet at one or more parts; and
20 cutting a laminate of the light diffusion sheet and the lens sheet into the product
size.
7. A method for producing an optical sheet for a display, comprising the steps of:
forming a coating film of an aqueous solution containing a water-soluble
antistatic agent and a fluorine surfactant on at least one side of each bonding surface of a
25 lens sheet in which convex lenses are formed adjacent to each other in an axial direction
almost on the whole area and whose plane size is equal to or larger than a product size
and a light diffusion sheet whose plane size is equal to or larger than the product size in a
thickness after drying of 0.03 to 0.2 g/m²;
stacking two of the lens sheet and stacking the light diffusion sheet on a surface
30 and/or a backside of a laminate of the lens sheets;

joining the lens sheets themselves and the lens sheets and the light diffusion sheet at one or more parts; and

cutting periphery of a laminate of the light diffusion sheet and the lens sheets into the product size.

5 8. The method for producing an optical sheet for a display according to any one of claims 5 to 7, wherein
coating in the step of coating film forming is performed by an aerosol spraying method.

9. A package of an optical sheet for a display, comprising a laminate of a product
10 size in which two or more kinds of optical sheets are stacked in a predetermined order and which is packaged in a packaging material, wherein
the packaging material is sealed by reducing pressure with the packaging material being brought into close contact with the laminate.

10. A package of an optical sheet for a display, comprising a laminate of a product
15 size in which two or more kinds of optical sheets are stacked in a predetermined order and periphery of the optical sheets is joined at one or more parts and which is packaged in a packaging material, wherein
the packaging material is sealed by reducing pressure with the packaging material being brought into close contact with the laminate.

20 11. The package of an optical sheet for a display according to claim 9 or 10, wherein the optical sheets include a lens sheet and a diffusion sheet.

12. The package of an optical sheet for a display according to claim 9, 10 or 11, wherein the optical sheets include a stacked lens sheet in which a plurality of lens sheets are stacked and a diffusion sheet.

25 13. The package of an optical sheet for a display according to any one of claims 9 to 12, wherein

the optical sheets in the laminate are stacked in an order to be installed in a backlight unit.

14. The package of an optical sheet for a display according to any one of claims 9 to 13, wherein

5 the packaging material has a predetermined elasticity at least at a portion where the member comes into contact with the laminate.

15. A method for packaging an optical sheet for a display, comprising the steps of:
temporarily packaging a laminate of a product size in which two or more kinds of optical sheets are stacked in a predetermined order in a packaging material;

10 reducing the pressure in the packaging material so that the packaging material is brought into close contact with the laminate; and

sealing the packaging material with the packaging material being brought into close contact with the laminate.

16. A method for packaging an optical sheet for a display, comprising the steps of:

15 joining a laminate of a product size in which two or more kinds of optical sheets are stacked in a predetermined order at one or more parts of the periphery of the optical sheets;

temporarily packaging the laminate whose periphery is joined at one or more parts in the joining step in a packaging material;

20 reducing the pressure in the packaging material so that the packaging material is brought into close contact with the laminate; and

sealing the packaging material with the packaging material being brought into close contact with the laminate.

FIG.1

10

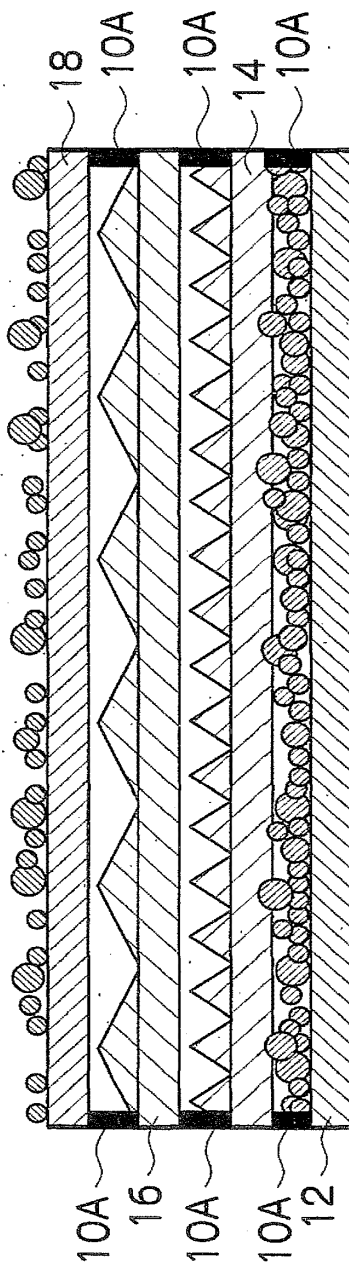


FIG.2

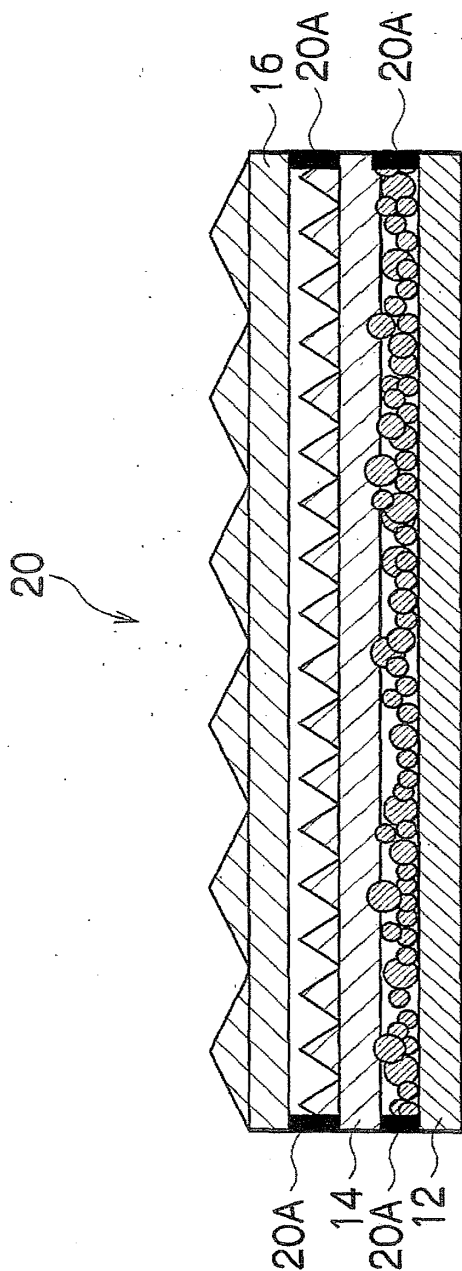


FIG.3

30

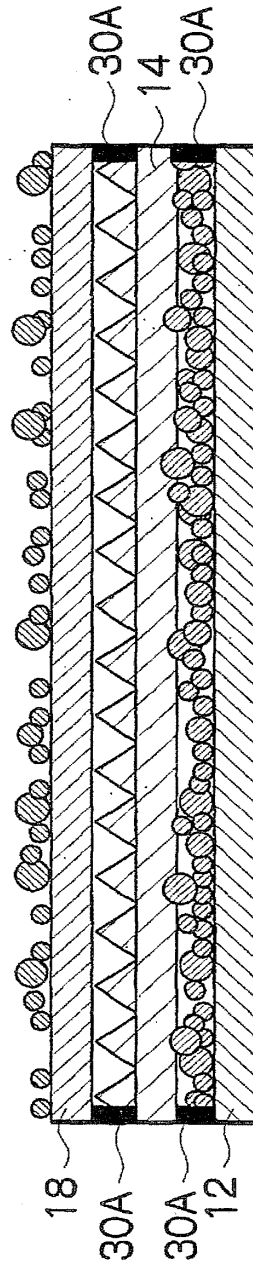


FIG. 4

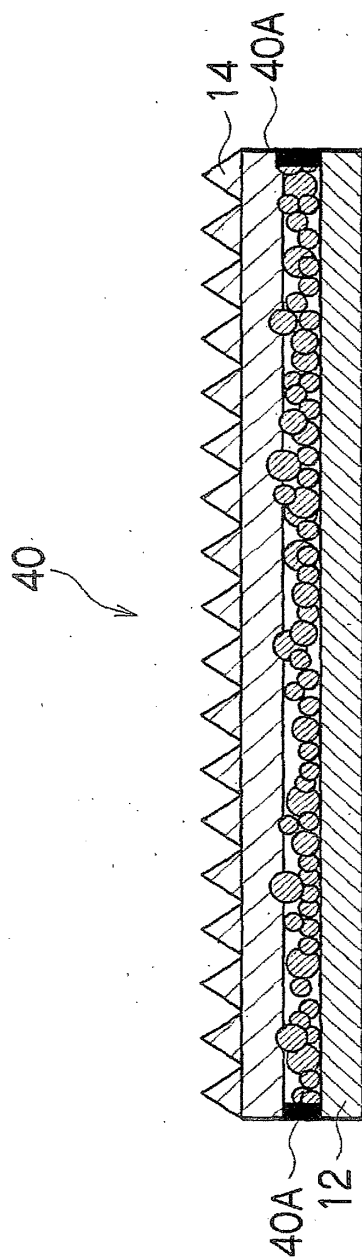


FIG.5

50

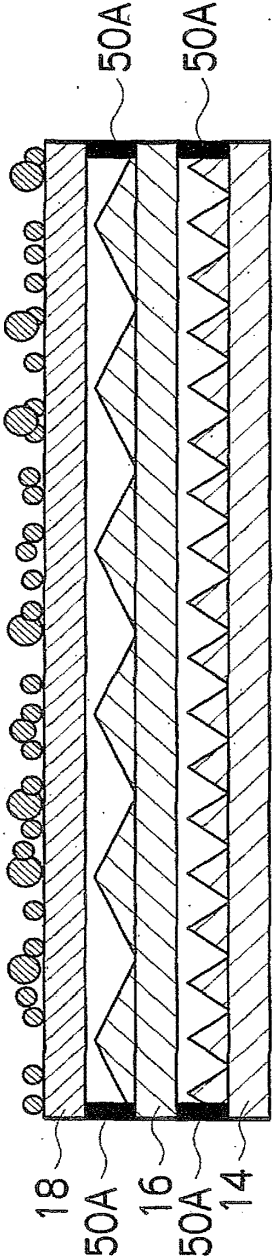


FIG.6

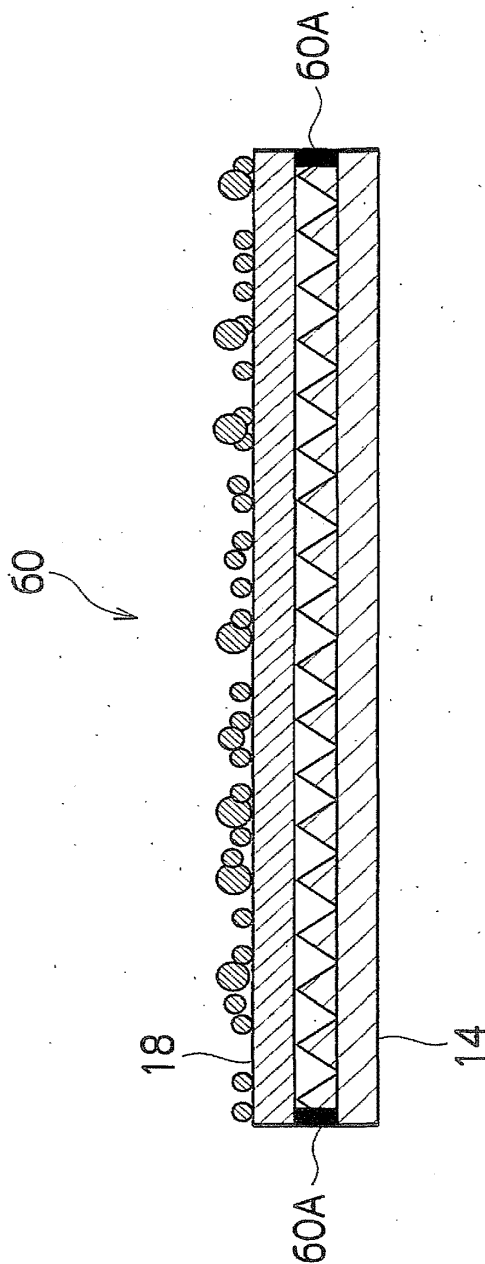


FIG.7

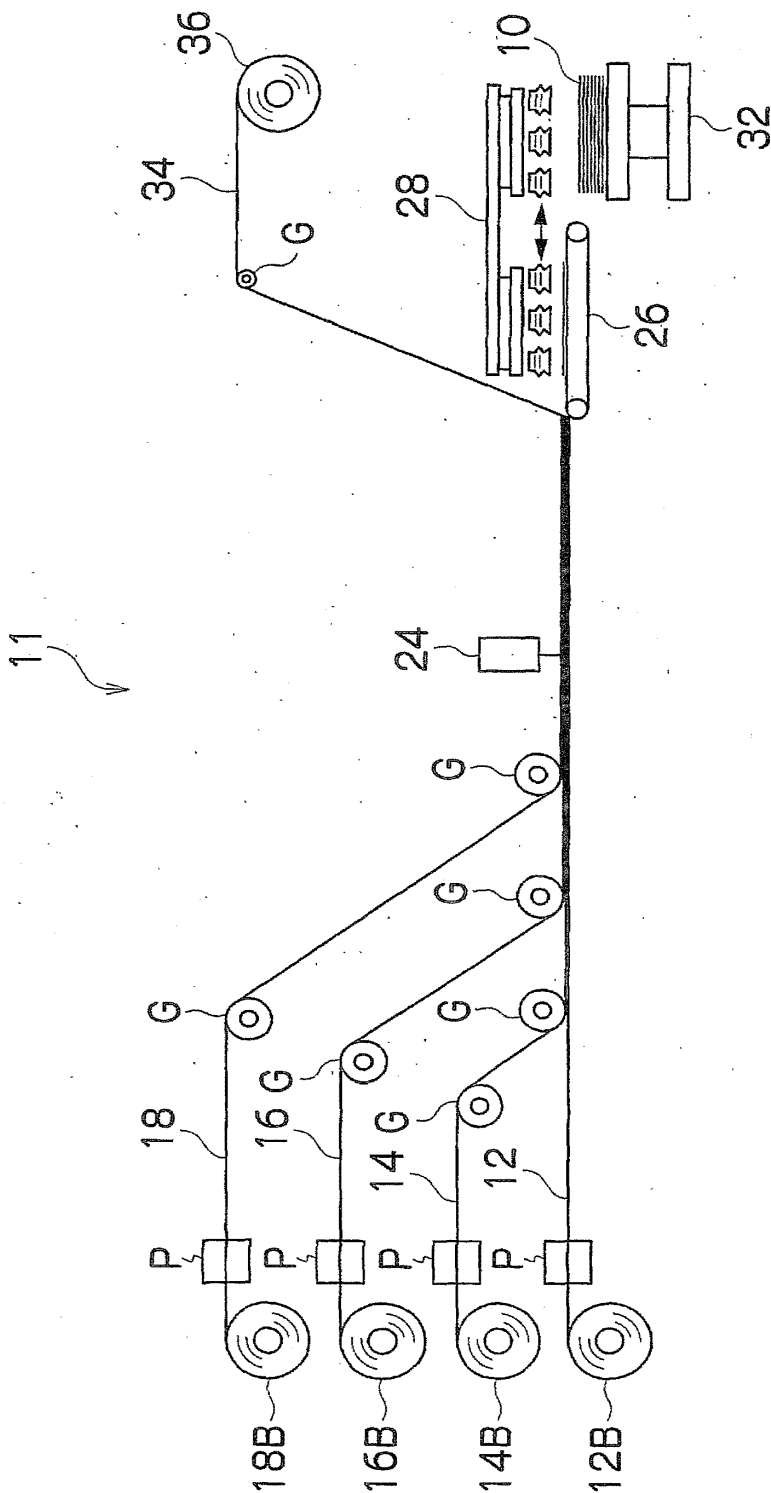
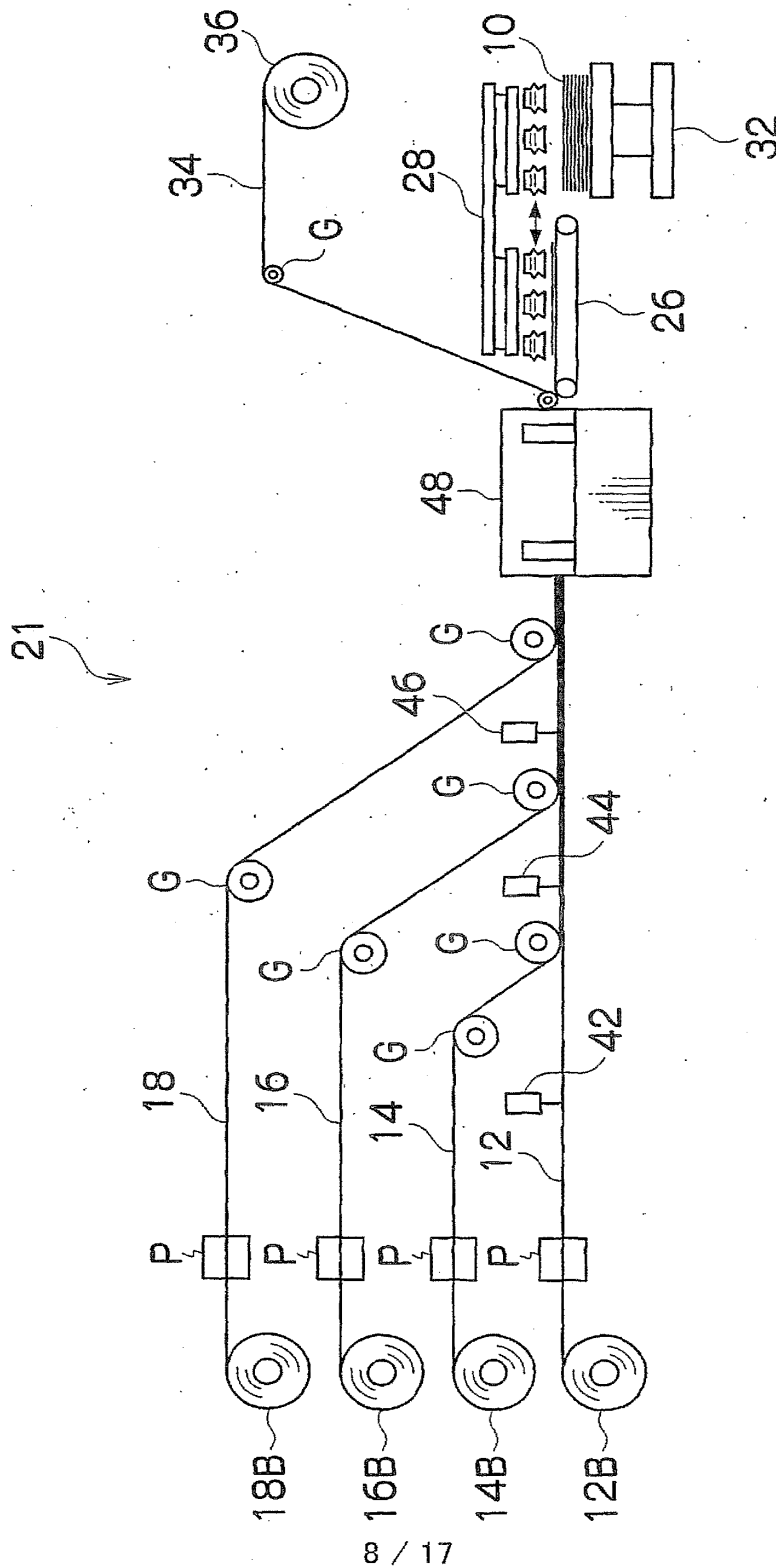
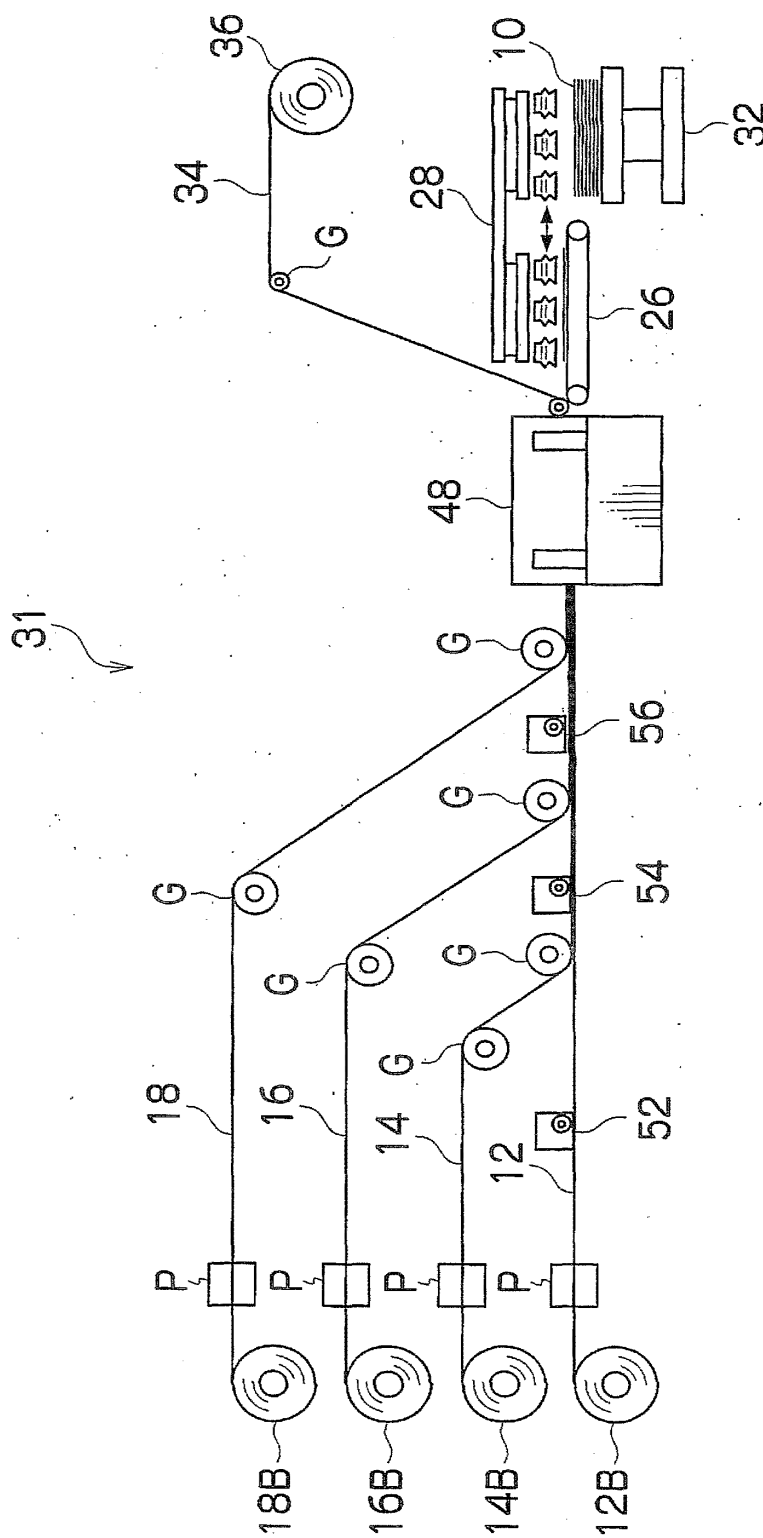


FIG.8



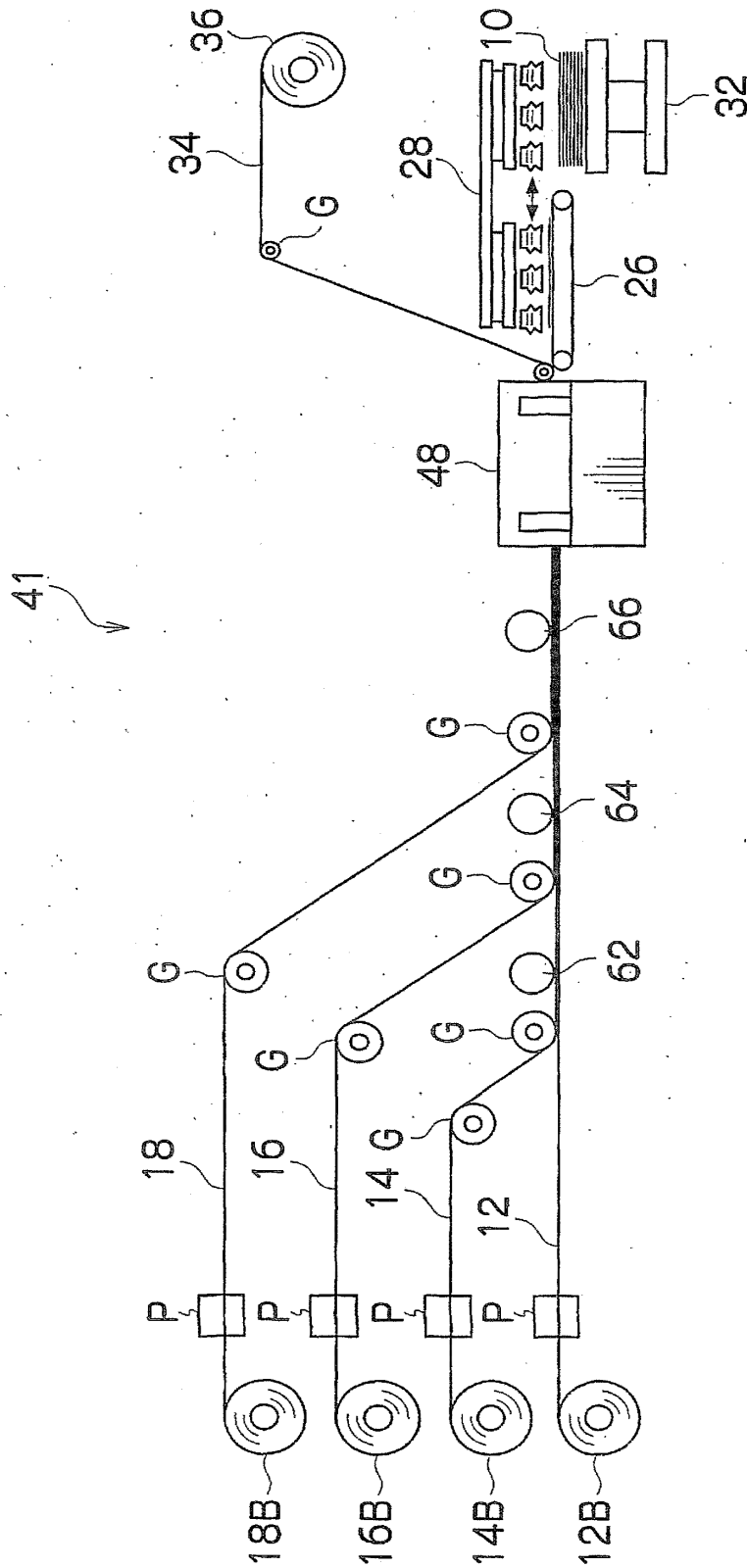
8 / 17

Fig. 9.



9 / 17

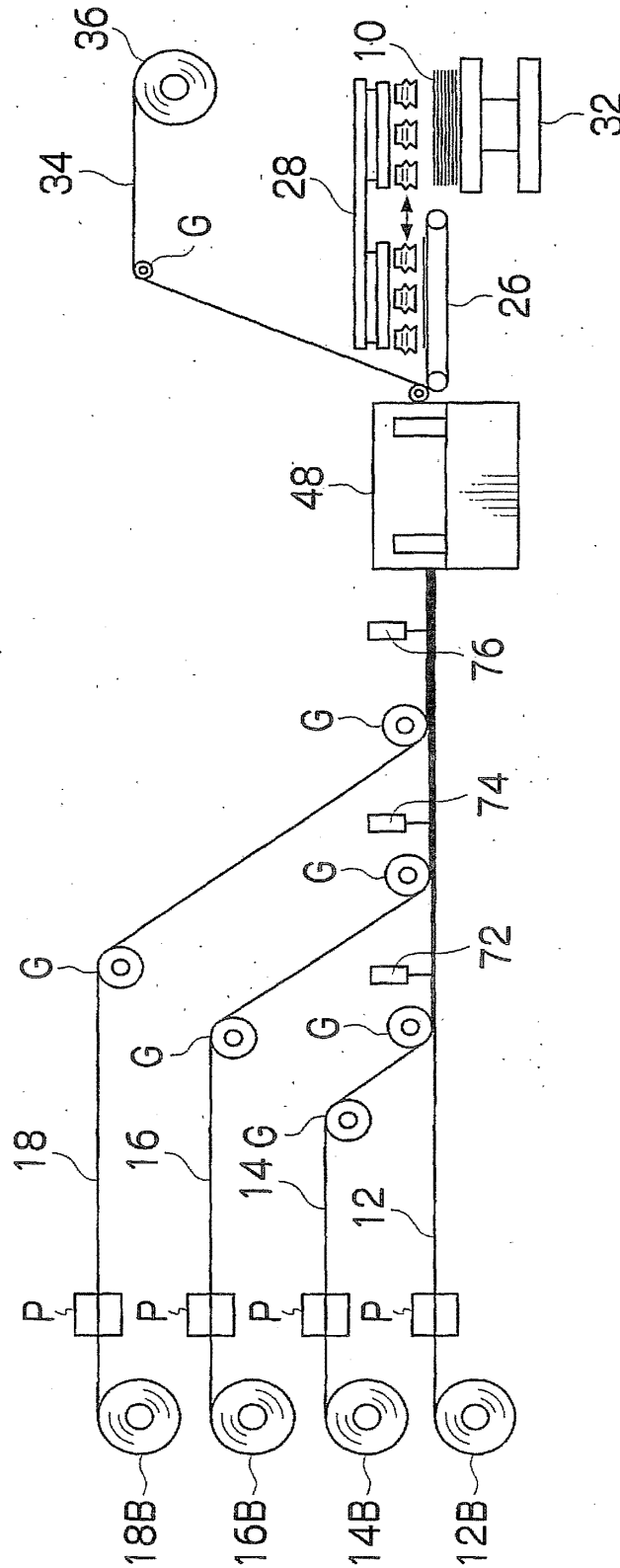
FIG.10



10 / 17

FIG.11

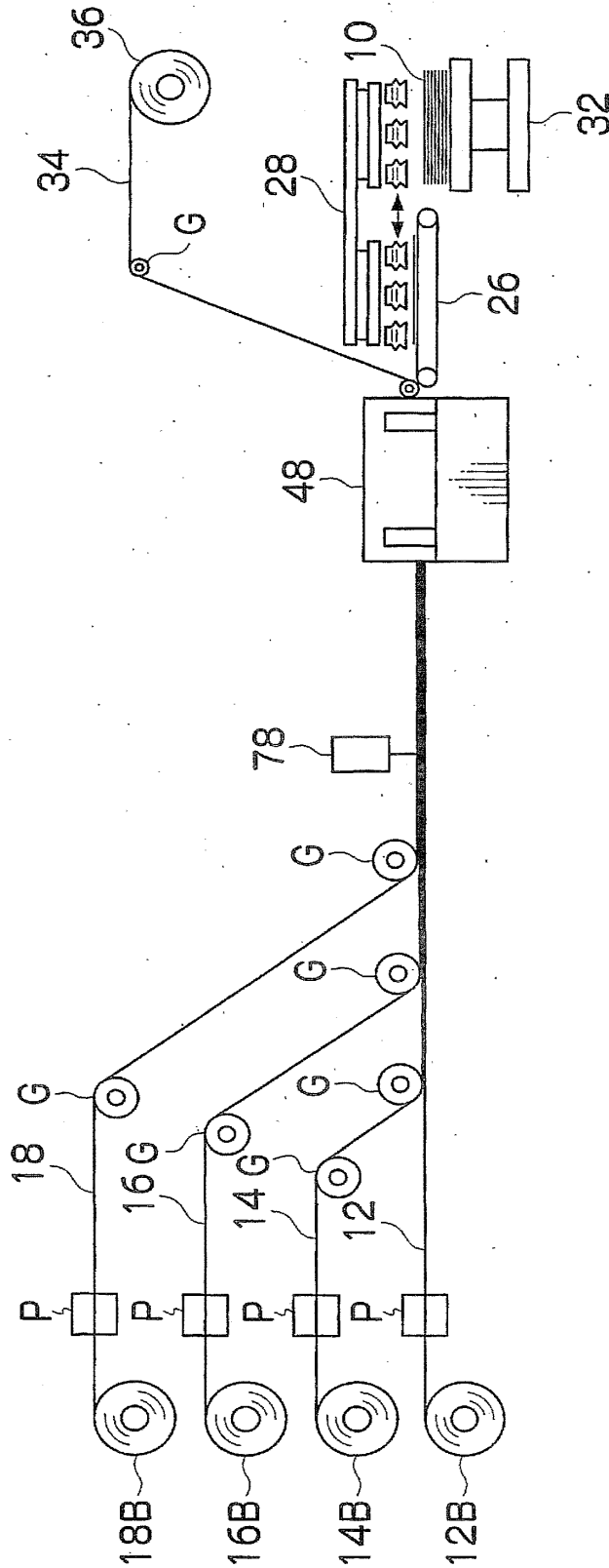
51



11 / 17

FIG.12

61



12 / 17

FIG.13B

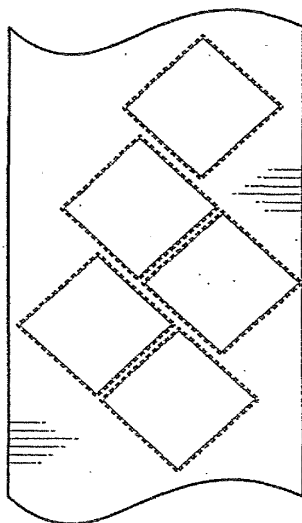


FIG.13A

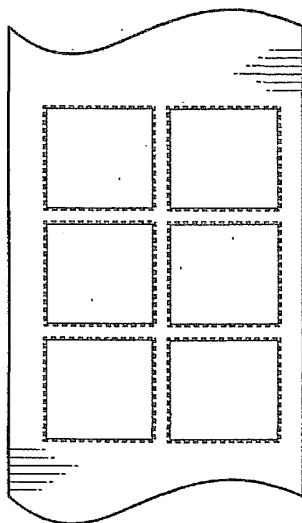


FIG.14B

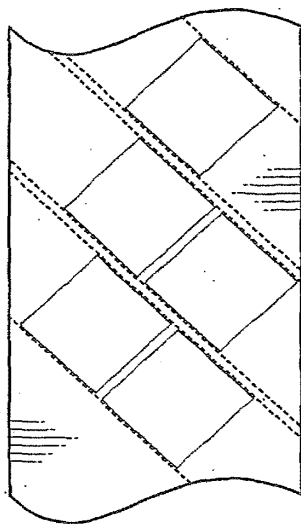


FIG.14A

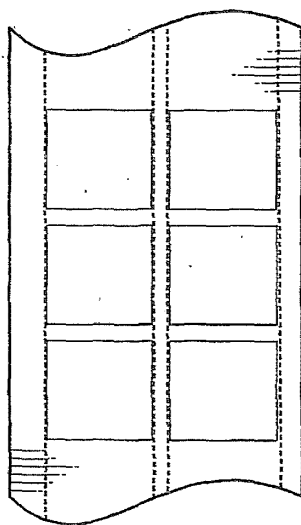


FIG.15

	RESIN SOLUTION
EB3700	35.0
BPE200	35.0
BR31	30.0
LR8893X	2.0
MEK	20.5
MEK CONTENT (%)	16.7
SOLUTION VISCOSITY (mPa·s)	90

FIG.16

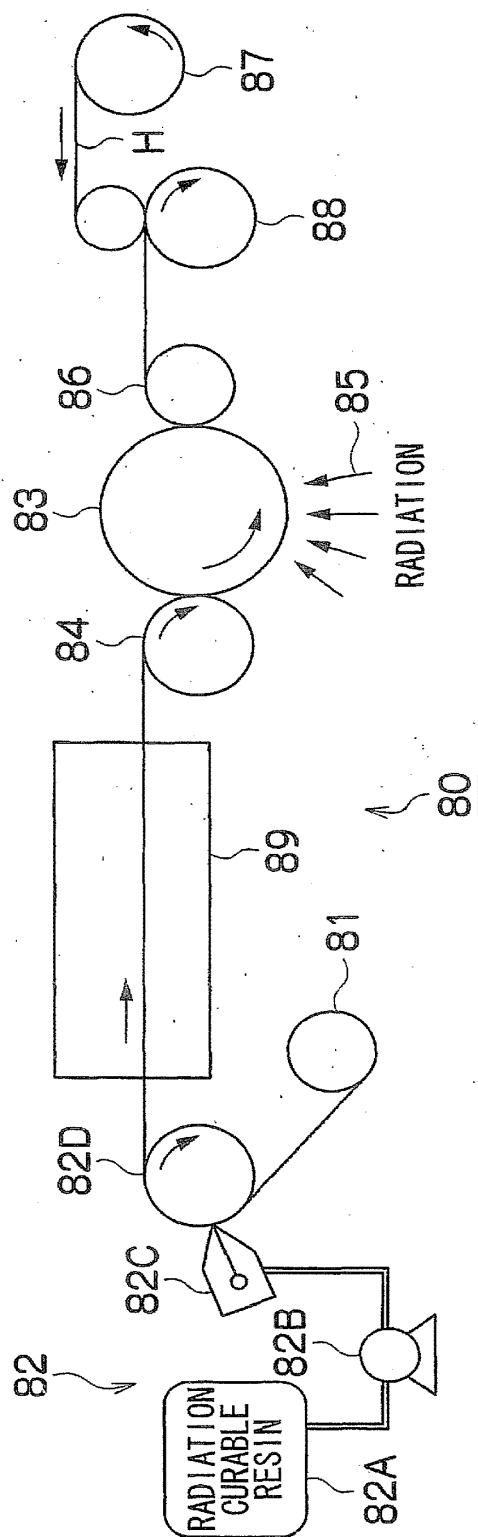


FIG.17A

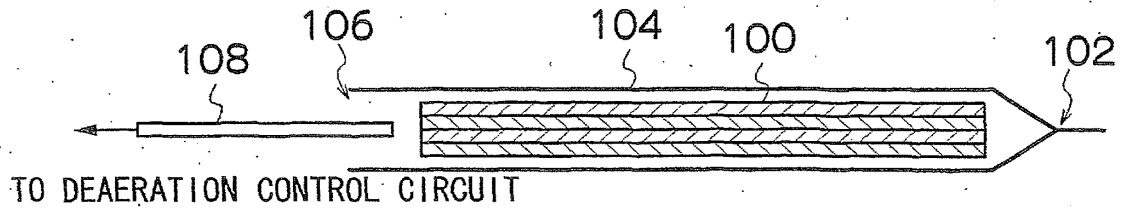


FIG.17B

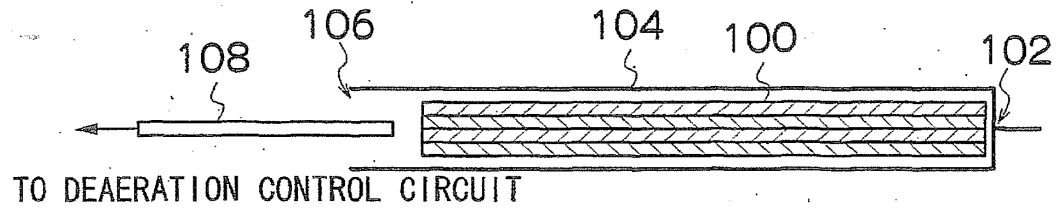


FIG.17C

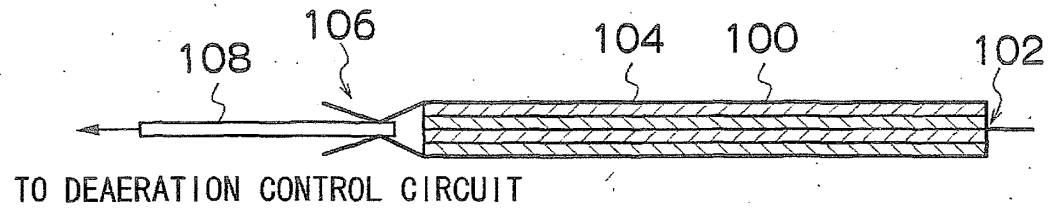
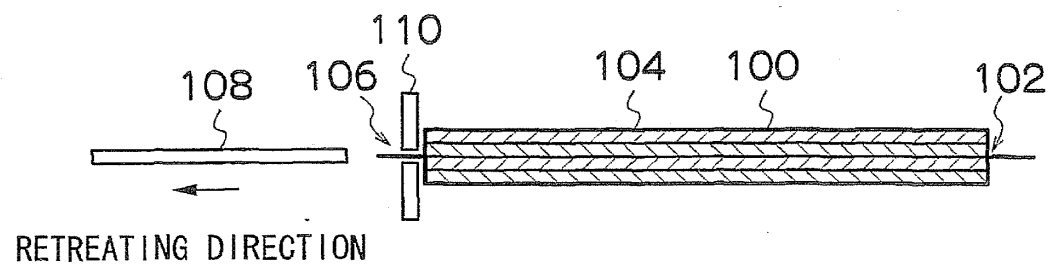


FIG.17D



INTERNATIONALSEARCHREPORT

International application No.
PCT/JP2006/318315

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. G09F9/00 (2006.01) i, B65B25/00 (2006.01) i, B65B31/06 (2006.01) i,
B65D81/20 (2006.01) i, G02F1/13357 (2006.01) i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Int.Cl. G09F9/00, B65B25/00, B65B31/06, B65D81/20, G02F1/13357

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2006
Registered utility model specifications of Japan 1996-2006
Published registered utility model applications of Japan 1994-2006

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 8-211205 A (Goyo Paper Working Co., Ltd.) 1996.08.20, Paragraph [0002], [0022], [0023] & US 5885490 A & KR 167860 B	1-8
Y	JP 7-261277 A (Tokyo Kōparu Kagaku Kabushiki Kaisha) 1995.10.13, Whole document (Family none)	1-8
Y	JP 2005-212900 A (Optimax technology corporation) 2005.08.11, Whole document & US 2005/145524 A1 & TW 231376 B	9-16
Y	JP 2001-278214 A (Fuji Photo Film Co., Ltd.) 2001.10.10 Paragraph [0044] (Family none)	9-16

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not
considered to be of particular relevance"E" earlier application or patent but published on or after the inter-
national filing date"L" document which may throw doubts on priority claim(s) or which
is cited to establish the publication date of another citation or other
special reason (as specified)"O" document referring to an oral disclosure, use, exhibition or other
means"P" document published prior to the international filing date but later
than the priority date claimed"T" later document published after the international filing date or
priority date and not in conflict with the application but cited to
understand the principle or theory underlying the invention"X" document of particular relevance; the claimed invention cannot
be considered novel or cannot be considered to involve an
inventive step when the document is taken alone"Y" document of particular relevance; the claimed invention cannot
be considered to involve an inventive step when the document is
combined with one or more other such documents, such
combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

30.11.2006

Date of mailing of the international search report

12.12.2006

Name and mailing address of the ISA/JP

Japan Patent Office

3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan

Authorized officer

Hajime Kitagawa

Telephone No. +81-3-3581-1101 Ext. 3273

21 9804

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/318315

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

The "special technical features" of claims 1-8 relate to an optical sheet for a display or a method of producing an optical sheet for a display, wherein a coating film containing a water-soluble antistatic agent and fluorine surfactant is formed on at least one side of each bonding surface of the two or more optical sheets in a thickness of 0.03 to 0.2 g/cm², while the "special technical features" of claims 9-16 relate to a package of an optical sheet for display or a method for packaging an optical sheet for display, wherein the packaging material is sealed by reducing pressure with the packaging material being brought into close contact with the laminate.

There is no technical relationship among those inventions involving one or more of the same or corresponding technical features. Therefore, these groups of inventions are not so linked as to form a single general inventive concept.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2005)

Electronic Acknowledgement Receipt	
EFS ID:	5463027
Application Number:	12045729
International Application Number:	
Confirmation Number:	9825
Title of Invention:	Apparatus and Methods for Multiplanar Optical Diffusers and Display Panels for Using the Same
First Named Inventor/Applicant Name:	John Roberts
Customer Number:	65106
Filer:	Timothy Jennings Wall/Paula Fisher
Filer Authorized By:	Timothy Jennings Wall
Attorney Docket Number:	5308-824
Receipt Date:	05-JUN-2009
Filing Date:	11-MAR-2008
Time Stamp:	14:36:57
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no
------------------------	----

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		5308-824_IDS_Transmittal_B.pdf	292505 41d6bd2d5a930a43f6b4dfd6dc58c54b944e708f	yes	3

	Multipart Description/PDF files in .zip description				
	Document Description		Start	End	
	Transmittal Letter		1	2	
	Information Disclosure Statement (IDS) Filed (SB/08)		3	3	
Warnings:					
Information:					
2	Foreign Reference	5308-824_For_Ref_JP_2008_034342A.pdf	2272593	no	20
			97cb506a780d43d0ca9a13c0777035e115a73148		
Warnings:					
Information:					
3	Foreign Reference	5308-824_For_Ref_WO_2007_088655A1.pdf	4266406	no	44
			79bb9caea2f2111e444eb5b93d81560f502300b2		
Warnings:					
Information:					
4	Foreign Reference	5308-824_For_Ref_WO_2007_032454A1.pdf	5170830	no	60
			2e055aa905e3fed1190f911836e3200da94b8b3f		
Warnings:					
Information:					
5	NPL Documents	5308-824_NPL_Ext_EP_Srch_Rpt_EP_091549196.pdf	939436	no	10
			22aae192041ce24794df3528a07df3b39e92d1f8		
Warnings:					
Information:					
Total Files Size (in bytes):			12941770		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

Attorney Docket No. 5308-824

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re: John Roberts et al.
Application No.: 12/045,729
Filing Date: March 11, 2008

Confirmation No. 9825
Examiner: David C. Nelms
Group Art Unit: 2871

For: Apparatus and Methods for Multiplanar Optical Diffusers and Display Panels for Using the Same

Date: June 5, 2009

Mail Stop: Amendment
Commissioner for Patents
Box 1450
Alexandria, VA 22313-1450

SUPPLEMENTAL INFORMATION DISCLOSURE STATEMENT TRANSMITTAL

Sir:

Attached is an Information Disclosure Statement listing of documents, together with a copy of any listed foreign patent document and/or non-patent literature. A copy of any listed U.S. patent and/or U.S. patent application publication is not provided herewith in accordance with 37 C.F.R. § 1.98(a)(2)(ii).

☒ In accordance with **37 CFR 1.97(b)**, the information disclosure statement is being filed:

- ☐ (1) within three months of the filing date of a national application other than a continued prosecution application under §1.53(d);
- ☐ (2) within three months of the date of entry of the national stage as set forth in §1.491 in an international application;
- ☒ (3) before the mailing of a first Office Action on the merits; or
- ☐ (4) before the mailing of a first Office Action after the filing of a request for continued examination under §1.114.

☐ In accordance with **37 CFR 1.97(c)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(b) above, but before the mailing date of any of a final action under §1.113, a notice of allowance under §1.311, or an action that otherwise closes prosecution in the application, and is accompanied by **one** of the following:

☐ (1) The statement specified under **37 CFR 1.97(e)**, as follows:

☐ Each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ No item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **or**

☐ (2) The fee set forth in §1.17(p);

☐ In accordance with **37 CFR 1.97(d)**, the information disclosure statement is being filed after the period specified in 37 CFR 1.97(c) above, but on or before payment of the issue fee, and is accompanied by **both** of the following:

☐ (1) The statement specified under **37 CFR 1.97(e)**, as follows:

☐ That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement; **or**

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in §1.56(c) more than three months prior to the filing of the information disclosure statement; **and**

☐ (2) The fee set forth in §1.17(p);

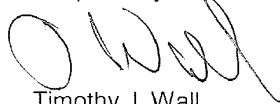
In accordance with **37 CFR 1.97(g)**, the information disclosure statement shall not be construed as a representation that a search has been made.

In accordance with **37 CFR 1.97(h)**, the information disclosure statement shall not be construed to be an admission that the information cited in the statement is, or is considered to be, material to patentability as defined in §1.56(b).

☐ The Director is hereby authorized to charge the fee specified in 37 C.F.R. § 1.17(p), and any fee deficiency or credit any overpayment, to Deposit Account No. 50-0220; **or**

☒ No fee is believed due. However, the Director is hereby authorized to charge any deficiency or credit any overpayment to Deposit Account No. 50-0220.

Respectfully submitted,



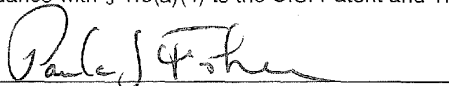
Timothy J. Wall
Registration No. 50,743
Attorney for Applicant(s)

Customer Number 65106

Myers Bigel Sibley & Sajovec, P.A.
P.O. Box 37428, Raleigh, NC 27627
919-854-1400
919-854-1401 (Fax)

CERTIFICATION OF TRANSMISSION

I hereby certify that this correspondence is being transmitted via the Office electronic filing system in accordance with § 1.6(a)(4) to the U.S. Patent and Trademark Office on June 5, 2009.



Name: Paula J. Fisher

INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(use as many sheets as necessary)</i>				Complete if Known	
				Application Number	12/045,729
				Filing Date	March 11, 2008
				First Named Inventor	John Roberts et al.
				Art Unit	2871
				Examiner Name	David C. Nelms
Sheet	A1	of	A2	Attorney Docket Number	5308-824

U.S. PATENT DOCUMENTS AND APPLICATIONS					
Examiner Initials*	Cite No.	Document Number	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear
		Number-Kind Code (if known)			
	1.	US- 7,355,284	04-08-2008	Negley	
	2.	US- 6,932,497	08-23-2005	Huang	
	3.	US- 6,657,393	12-02-2003	Natsume	
	4.	US- 6,331,915	12-18-2001	Myers	
	5.	US- 6,330,111	12-11-2001	Myers	
	6.	US- 5,477,436	12-19-1995	Bertling et al.	
	7.	US- 4,675,575	06-23-1987	Smith et al.	
	8.	US- 2007/0127129 A1	06-07-2007	Wood et al.	
	9.	US- 2007/0127098 A1	06-07-2007	Wood	
	10.	US- 2007/0047204 A1	03-01-2007	Parker et al.	
	11.	US- 2007/0014004 A1	01-18-2007	Wood	
	12.	US- 2007/0008738 A1	01-11-2007	Han et al.	
	13.	US- 2007/0003868 A1	01-04-2007	Wood et al.	
	14.	US- 2006/0285332 A1	12/21/2006	Goon et al.	
	15.	US- 2006/0275714 A1	12-07-2006	Rinehart et al.	
	16.	US- 2006/0164729 A1	07-27-2006	Wood	
	17.	US- 2006/0158899 A1	07-20-2006	Ayabe et al.	
	18.	US- 2006/0114569 A1	06-01-2006	Capaldo et al.	
	19.	US- 2006/0061869 A1	03-23-2006	Fadel et al.	
	20.	US- 2005/0168689 A1	08-04-2005	Knox	
	21.	US- 2005/0058949 A1	03-17-2005	Wood et al.	
	22.	US- 2005/0058948 A1	03-17-2005	Freese et al.	
	23.	US- 2005/0058947 A1	03-17-2005	Rinehart et al.	
	24.	US- 2004/0096666 A1	05-20-2004	Knox et al.	
	25.	US- 2002/0054495 A1	05-09-2002	Natsume	
	26.	US- 12/174,053	07-16-2008	Negley	
	27.	US- 11/949,222	12-03-2007	Negley	
	28.	US- 11/949,182	12-03-2007	Negley	

FOREIGN PATENT DOCUMENTS						
Examiner Initials*	Cite No.	Foreign Patent Document	Publication Date MM-DD-YYYY	Name of Patentee or Applicant of Cited Document	Pages, Columns, Lines, Where Relevant Passages or Relevant Figures Appear	T
		Country Code, Number, Kind Code (if known)				
	29.	EP 1 681 509	07-19-2006	Omron Corporation (JP)		Yes

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT <i>(use as many sheets as necessary)</i>			Complete if Known		
			Application Number	12/045,729	
			Filing Date	March 11, 2008	
			First Named Inventor	John Roberts et al.	
			Art Unit	2871	
Sheet	A2	of	A2	Examiner Name	David C. Nelms
				Attorney Docket Number	5308-824

	30.	EP 1 653 255	05-03-2006	Pentair Water Pool and Spa, Inc. (US)		Yes
	31.	FR 2 814 220	03-22-2002	Koito Manufacturing Co., Ltd. (JP)		Abstract
	32.	FR 2 759 188	08-07-1998	Thery Hindrick (FR)		Yes
	33.	FR 2 586 844	03-06-1987	Sofrela SA (FR)		Abstract
	34.	JP 05-100106	04-23-1993	Dainippon Printing Co., Ltd.		Yes
	35.	WO 2007/026776	03-08-2007	Mitsubishi Rayon Co., Ltd. (JP)		Abstract
	36.	WO 03/044870	05-30-2003	Georges, Mireille (FR)		Abstract

NON PATENT LITERATURE DOCUMENTS			
Examiner Initials*	Cite No.	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc.), date, page(s), volume-issue number(s), publisher, city and/or country where published	T
	37.	International Search Report and Written Opinion (14 pages) corresponding to International Application No. PCT/US2008/070132; Mailing Date: October 14, 2008.	Yes
	38.	International Search Report and Written Opinion (14 pages) corresponding to International Application No. PCT/US2007/086237; Mailing Date: May 8, 2008.	Yes
	39.	International Search Report and Written Opinion (14 pages) corresponding to International Application No. PCT/US2007/086242; Mailing Date: March 4, 2008.	Yes

iDoc# 772540

Examiner Signature		Date Considered	
--------------------	--	-----------------	--

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through citation if not in conformance and not considered. Include copy of this form with next communication to applicant.



(11) EP 1 681 509 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
19.07.2006 Bulletin 2006/29

(51) Int Cl.:
F21V 8/00 (2006.01)

(21) Application number: 06100391.9

(22) Date of filing: 16.01.2006

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR
Designated Extension States:
AL BA HR MK YU

(72) Inventors:
• AYABE, Takahiro
600-8530, KYOTO (JP)
• MATSUI, Akira
600-8530, KYOTO (JP)
• KIYOMOTO, Hironobu
600-8530, KYOTO (JP)

(30) Priority: 17.01.2005 JP 2005008760
05.12.2005 JP 2005351315

(74) Representative: Weihs, Bruno Konrad et al
Osha Liang
121, Avenue des Champs Elysées
75008 Paris (FR)

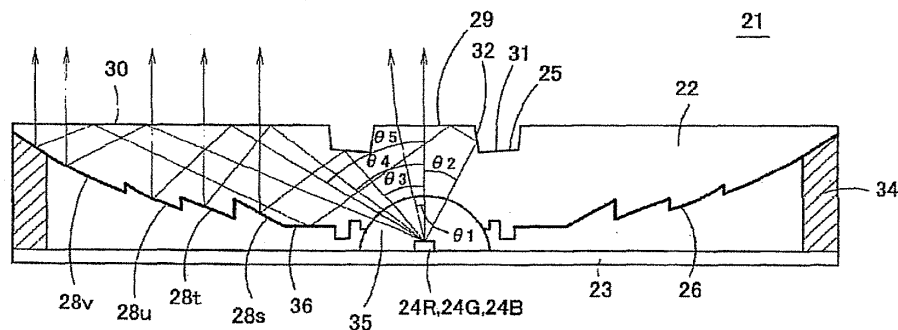
(71) Applicant: OMRON CORPORATION
Kyoto-shi, Kyoto 600-8530 (JP)

(54) Luminescent light source and luminescent source array

(57) To provide a luminescent light source that can increase the number of divisions of a reflecting mirror without reducing pitch interval of (28i, 28j, 28k, ..., 28p, 28q, 28r, ..., 28s, 28t, 28u, ..., 28R, 28G, 28G). A luminescent light source 1 comprises a reflecting mirror (26) for reflecting light, a mold unit (22) arranged on a light re-

flection surface of the reflecting mirror 26, and light emitting devices (24R, 24G, 24B) of three luminescent devices of red, blue and green that are placed in the central part and output light to the mold unit (22). In the reflecting mirror (26), rectangular reflection areas (28i), (28j), (28k), ... are arranged vertically and horizontally in a grid.

Fig. 12



Printed by Jouve, 75001 PARIS (FR)

EP 1 681 509 A1

Description

BACKGROUND OF THE INVENTION

Technical Field

[0001] This invention relates to a luminescent light source and a luminescent light source array, and, more specifically, to a luminescent light source or a luminescent light source array using an LED (light emitting diode) chip. In addition, the invention relates to a lighting system or a liquid crystal display device, etc.

Background Art

[0002] A luminescent light source that has a large area and high light use efficiency is disclosed in Patent Document 1. Fig. 1 shows a cross sectional view of a part of such a luminescent light source. In the luminescent light source 11, a white-color or monochromatic light emitting device 13 is arranged in the central part of the back side of a mold unit 14 made of transparent resin, and a reflecting mirror 12 is formed by depositing a metal thin film such as Al or Au, Ag, etc. in a concentric pattern formed on the back side of the mold unit 14. FIG. 2 shows a front elevation in which the light emitting device 13 and the reflecting mirror 12 are represented with the mold unit 14 excluded from the luminescent light source 11. The reflecting mirror is concentric and consists of a plurality of concentrically arranged ring zone shaped reflecting areas 12a, 12b,

[0003] Thus, at the luminescent light source 11, as shown in Fig. 1, among light exiting from the light emitting device 13, light L1 incident to a central part 15a of the front side of the mold unit 14 (hereinafter referred to as a direct output area) transmits through the direct output area 15a and is outputted to the front side. In addition, light L2 incident to an area other than the direct output area 15a on the front face of the mold unit 14 (hereinafter referred to as total reflection area) 15b is reflected by the reflecting mirror 12 after being totally reflected in the total reflection area 15b, then transmits through the total reflection area 15b, and is outputted to the front face. Thus, in such the luminescent light source 11, expansion A of the light L2 reflected by one reflection area (e.g., 12c) almost equals to size of the reflection area (e.g., 12c).

[0004] In a backlight for color liquid crystal display, use of a multi-color light source such as red LED, green LED, blue LED, etc. allows three primary colors of the color liquid crystal display to exhibit bright color and to offer excellent color reproducibility, than using a white light source such as white LED. However, in the luminescent light source 11 configured as described above, when three light emitting devices of red, green and blue, for instance, are arranged in the central area of the reflecting mirror 12 to configure a white light source, each color will be separated, leading to the problem of irregular color in the luminescent light source 11. In the following we explain the reasons. Fig. 3 represents light behavior of respective colors when the light emitting devices of three luminescent colors 13R, 13G, 13B of three colors, i.e., red, green and blue are arranged in the central area of the luminescent light source 11. For instance, in Fig. 3, red light is represented as LR, green light is represented as LG, and blue light is represented as LB, wherein an irradiated area of red light LR at a certain distance from the luminescent light source 11 is represented as AR, that of green light LG is represented as AG, and that of blue light LB is represented as AB.

[0005] In the case of the luminescent light source 11, since positions of the respective light emitting devices 13R, 13G, 13B are slightly offset, output directions of light reflected by the reflection area 12c after being reflected by the total reflection area 15b differ, depending on a color of light, and thus the irradiated areas AR, AG, AB of the respective colors are mutually offset. Accordingly, a region where light of the respective colors overlap to be a white color is a shaded region in Fig. 3. Also as can be seen from Fig. 3, the shaded white light region is narrower than the reflection area 12c, in the outer region of which output light is colored, resulting in irregular light.

[0006] To solve such the problem, it is only necessary to subdivide the respective reflection areas 12a, 12b, ... to design a cross sectional shape of the reflection area according to light of the respective colors. For instance, in a luminescent light source 16 shown in Fig. 4, the reflection area 12c is subdivided into three reflection areas 19a, 19b, 19c, wherein the reflection area 19a is designed so that blue light LB is outputted to the front face direction in the reflection area 19, the reflection area 19b is designed so that green light LG is outputted to the front face direction in the reflection area 19b, and the reflection area 19c is designed so that red light LR is outputted to the front face direction in the reflection area 19c.

[0007] In the luminescent light source 16 thus designed, a region where light of the respective colors overlap to be white light is almost the same size as the whole reflection areas 19a, 19b, 19c (i.e., the reflection area 12c), as shown in Fig. 4.

[0008] As can be seen from the example of Fig. 4, also when the light emitting devices of multiple colors are used, it is learned that if a greater number of divisions of a reflecting mirror of a light source is set, it becomes possible to set in details a traveling direction of light, which thus improves degree of freedom in designing of a light path, enables finer adjustment of the light output direction, and also improves uniformity in optical intensity.

[0009] Now, as shown in Fig. 5, on the basis of the reflecting mirror 12 wherein the number of divisions of the reflecting mirror 12 (the number of the reflection areas) is 3, and pitch interval P (width in a radial direction of the reflection area) of the reflection areas 12a, 12b, 12c is 6 mm, consider respective reflection areas that are further divided into three reflection areas. Fig. 6 shows such the reflecting mirror 12. In the reflecting mirror 12 as shown in Fig. 6, the number of divisions of the reflecting mirror 12 is 9, and the pitch interval of the reflection areas 17a, 17b, 17c, 18a, 18b, 18c, 19a, 19b, and 19c is 2 cm. Thus, although use of the reflecting mirror 12 as shown in Fig. 6 could improve color uniformity of a luminescent light source, increased number of divisions will narrow the pitch interval of a reflection area, thus making it difficult to manufacture a reflecting mirror, and increasing cost. In other words, there is the problem that as the number of the divisions of the reflecting mirror 12 increases, a balance between performance improvement and the cost will be lost.

[0010] In addition, as the light emitting devices 13R, 13G, 13B are arranged in two dimensions, a distance between the light emitting devices of the respective colors 13R, 13G, 13B and the reflection areas 12a, 12b, ... differs depending on a direction of viewing. Therefore, in the concentric reflecting mirror 12 in which the respective reflecting areas 12a, 12b, ... are arranged circumferentially and equidistant around one point, comparable overlap (mixed colors) in the whole circumferential direction cannot be achieved. To describe this concretely with reference to Fig. 4, when the red light emitting device 13R, the green light emitting device 13G, and the blue light emitting device 13B are arranged in this order from the left as one faces, to the left thereof are arranged the reflection area 19a from which red light is vertically outputted, the reflection area 19b from which green light is vertically outputted, and the reflection area 19c from which blue light is vertically outputted in this order from the inner circumference. On the contrary, to the right of the light emitting devices 13R, 13G, 13B, the reflection area 19c from which blue light is vertically outputted, the reflection area 19b from which green light is vertically outputted, and the reflection area 19a from which red light is vertically outputted must be arranged in this order from the inner circumference side. Such the arrangement cannot be implemented with the ring zone shaped reflection areas.

DISCLOSURE OF THE INVENTION

[0011] The primary object of the present invention is to provide a luminescent light source that can increase the number of divisions of a reflecting mirror without narrowing pitch intervals of reflection areas. Another object of the invention is to enable light traveling direction to be set in details in a luminescent light source, thus improving degree of freedom in optical designing and enabling finer adjustment of light output direction.

[0012] In a luminescent light source comprising a reflecting mirror for reflecting light, a light guide unit arranged on the side of a light reflection surface of the reflecting mirror, and a light emitting device for outputting light to the light guide unit, a first luminescent light source according to the present invention is characterized in that the light emitting device is arranged in the central area of the reflecting mirror, the light guide unit has a light output surface that outputs to the external light outputted from the light emitting device and light of the emitting device reflected by the reflecting mirror, the reflecting mirror has a light reflection surface that reflects the light outputted from the light emitting device and reflected by the light output surface of the light guide plate, and the light reflection surface comprises a plurality of reflection areas arranged along at least two directions.

[0013] As the first luminescent light source of the present invention consists of a plurality of reflection areas in which light reflection surfaces of the reflecting mirror are arranged along at least two directions, the number of divisions (number of reflection areas) of the reflecting mirror can be increased without narrowing the pitch interval of the reflection areas. Thus, as the light traveling direction in the luminescent light source can be set in details, the degree of freedom in designing of a light path, thus enabling finer adjustment of the light output direction. Hence, distribution of optical intensity of light outputted from a luminescent light source can be equalized. In addition, if light emitting devices of more than one luminescent color are used, color uniformity can be improved and color irregularity can be reduced, thereby enabling quality of the luminescent light source to be improved. Yet, since there is no need to reduce pitch intervals of the reflection areas, neither manufacturing of a reflecting mirror will be difficult nor cost will increase, even though the degree of freedom in designing of a light path is increased, more detailed adjustment of the light output direction is enabled, or optical intensity or color uniformity is improved.

[0014] In addition, arrangement of a plurality of reflection regions along at least two directions is not necessarily limited to a case in which they are arranged along two orthogonal directions. For instance, reflection areas may be arranged along two directions defined in polar coordinates (i.e., radial direction and circumferential direction). Furthermore, they may even be arranged along at least two arbitrary curved lines.

[0015] In a luminescent light source comprising a reflecting mirror for reflecting light, a light guide unit arranged on the side of a light reflection surface of the reflecting mirror, and a light emitting device for outputting light to the light guide unit, a second luminescent light source according to the present invention, wherein the light emitting device is arranged in the central area of the reflecting mirror, the light guide unit has a light output surface that outputs to the external light outputted from the light emitting device and light of the emitting device reflected by the reflecting mirror, the reflecting mirror has a light reflection surface that reflects the light outputted from the light emitting device and reflected

by the light output surface of the light guide plate, and the light reflection surface is a mosaic arrangement of a plurality of reflection areas.

[0016] The reflection areas arranged in mosaic herein refers to reflection areas having comparable horizontal and vertical size (those having about several hold horizontal to vertical ratio may also be acceptable) and being arranged without a space. In addition, respective reflection areas may have an identical shape, reflection areas of different shapes may be combined, or irregular shaped reflection areas may be arranged. Also, respective reflection areas may be arranged regularly or irregularly.

[0017] In the second luminescent light source of the present invention, as a plurality of reflection areas are arranged in mosaic to configure reflection areas, the number of divisions of reflection surfaces of a reflecting mirror (the number of the reflection areas) can be increased without narrowing pitch interval of the reflection areas. Thus, as light traveling direction within the luminescent light source can be set in details, degree of freedom in designing of a light path increases, and more detailed adjustment of light output direction becomes possible. Thus, optical intensity distribution of light to be outputted from the luminescent light source can be equalized. In addition, if light emitting devices of a plurality of luminescent colors are used, color uniformity can be improved, color irregularity can be reduced, and quality of the luminescent light source can be improved. Yet, since there is no need to reduce pitch intervals of the reflection areas, neither manufacturing of a reflecting mirror will be difficult nor cost will increase, even though the degree of freedom in designing of a light path is increased, more detailed adjustment of the light output direction is enabled, or optical intensity or color uniformity is improved.

[0018] In one embodiment of the first or the second luminescent light source of the present invention, reflection areas are square, rectangular, hexagonal, triangular, or fan-shaped. Thus, a light reflection surface can be formed by arranging reflection areas without a space therebetween, thereby increasing light use efficiency. In particular, if reflection areas are arranged by dividing a light reflection surface of a reflecting mirror into concentric ring zone shaped regions centering on the optical axis thereof, and by dividing the regions into a plurality of regions along circumferential direction, it becomes possible to arrange a plurality of fan-shaped reflection areas without a space therebetween.

[0019] In another embodiment of the first or the second luminescent light source of the present invention, reflection areas that are adjacent in respective directions in which the reflection areas are arranged are characterized in that they have mutually different amount of characteristic that characterizes respective reflection areas.

[0020] In further different embodiment of the first or the second luminescent light source of the present invention, reflection areas that are adjacent in intermediate direction between respective directions in which the reflection areas are arranged are characterized that they have mutually different amount of characteristic that characterizes respective reflection areas. Now, the intermediate direction refers to a diagonal direction if the directions in which the reflection areas are arranged are directions in opposite sides.

[0021] In the above two embodiments, if each reflection area is expressed by a curves surface expression including the amount of characteristic (parameter) of 1 or more than 1, reflection direction or degree of expansion of light, etc., to be reflected by each reflection area can be adjusted by determining, as appropriate, a value of amount of characteristic that characterizes each curved surface, thereby facilitating designing of a reflecting mirror.

[0022] For instance, amount of displacement of the each reflection area in the optical axis direction of the reflecting mirror can be selected as the amount of characteristic. Thus, designing as appropriate the amount of displacement of each reflection area in the optical axis direction enables adjustment of the reflection direction or degree of expansion, etc., thereby facilitating designing of a reflecting mirror.

[0023] In addition, if the each reflection area is represented as a conic surface and radius of curvature is used as amount of characteristic of the conic surface, the reflection direction of light reflected by each reflection area can be adjusted by the radius of curvature, and uniformity of optical intensity can be improved in a narrow area. In addition, if more than one light emitting device is used, color uniformity can be enhanced by improving color mixing performance in a narrow area.

[0024] In addition, if the each reflection area is represented as a conic surface and a conic efficient is used as amount of characteristic of the conic surface, spread of light reflected by each reflection area depending on a distance from the light emitting device, etc. can be adjusted by the conic efficient, and uniformity of optical intensity in a wide area can be improved. In addition, if more than one light emitting device is used, color uniformity can be enhanced by improving color mixing performance in a wide area.

[0025] Another embodiment of the first or the second luminescent light source of the present invention comprises a plurality of the light emitting devices of different luminescent colors. In the luminescent light source of the invention, even when light is emitted in a color different from that of the original light emitting device, by mixing light of a plurality of light emitting devices having different luminescent colors, light can be uniformly mixed, thereby reducing color irregularity.

[0026] In particular, if light of respective light emitting devices is reflected in reflection areas so that light outputted from light emitting devices that are mutually different in adjacent reflection areas are outputted almost vertically to the front face direction, an overlap area of light from the respective light emitting devices expands, thereby reducing color irregularity.

[0027] Still different embodiment of the first or the second luminescent light source of the present invention is characterized in that a surface of the light guide unit is divided into a plurality of areas and an angle of inclination or direction of inclination of the surface is varied in every divided area. According to the embodiment, output direction or reflection direction of light distributed from the light emitting devices to each divided area of the surface of the light guide unit can be adjusted with a high degree of freedom by an angle of inclination or direction of inclination of each area of the light guide plate. Thus, uniformity of optical intensity of the luminescent light source can be improved. In addition, if more than one light emitting device is used, color mixing performance of light to be outputted from each light emitting device can be improved, thereby reducing color irregularity. If a plurality of a light emitting device is used, light of the respective light emitting colors can be mixed uniformly.

[0028] A luminescent light source array of the present invention is characterized in that a plurality of the first or the second luminescent light source of the invention are arranged.

According to the luminescent light source array, a degree of freedom in designing a light path can increase, more detailed adjustment of light output direction is enabled, and a surface light source having uniform optical intensity distribution of output light, having a large area, and being thinned can be implemented.

[0029] In a luminescent light source comprising a reflecting mirror for reflecting light, a light guide unit arranged on the side of a light reflection surface of the reflecting mirror, and a light emitting device for outputting light to the light guide unit, a method of setting a light path in the inventive luminescent light source is characterized in that the light emitting device is arranged in the central area of the reflecting mirror, the light guide unit has a light output surface that outputs to the external light outputted from the light emitting device and light of the emitting device reflected by the reflecting mirror, the reflecting mirror has a light reflection surface that reflects the light outputted from the light emitting device and reflected by the light output surface of the light guide plate, and the light reflection surface comprises a plurality of reflection areas arranged along at least two directions, and reflection direction of reflected light by each reflection area can be individually set.

[0030] In the method of setting a light path in the luminescent light source of the present invention, since the reflection direction of the reflected light can be individually set by reflecting light by a plurality of reflection areas arranged along at least two directions, light traveling direction within the luminescent light source can be elaborately set, and the degree of freedom in designing a light path increases, thereby enabling more detailed adjustment of light output direction. Thus, optical intensity distribution of light to be outputted from the luminescent light source can be equalized. In addition, if more than one light emitting device is used, color uniformity can be improved, color irregularity can be reduced, and quality of the luminescent light source can be enhanced. Yet, as there is no need to reduce pitch intervals of reflection areas, neither manufacturing of a reflecting mirror will be difficult nor cost will increase, even when the degree of freedom in designing of a light path or color uniformity is improved.

[0031] In a luminescent light source comprising a reflecting mirror for reflecting light, a light guide unit arranged on the side of a light reflection surface of the reflecting mirror, and a light emitting device for outputting light to the light guide unit, a method of outputting light in the inventive luminescent light source is characterized in that the light emitting device is arranged in the central area of the reflecting mirror, the light guide unit has a light output surface that outputs to the external light outputted from the light emitting device and light of the emitting device reflected by the reflecting mirror, the reflecting mirror has a light reflection surface that reflects the light outputted from the light emitting device and reflected by the light output surface of the light guide plate, and the light reflection surface comprises a plurality of reflection areas arranged along at least two directions, and light output direction and optical intensity distribution of light to be outputted from the light output surface of the light guide unit can be adjusted by individually setting a reflection direction of reflected light by each reflection area.

[0032] In the method of outputting light in the inventive luminescent light source, since the light output direction and optical intensity distribution of light to be outputted from the light output surface of the light guide unit can be adjusted by reflecting light by the plurality of reflection areas arranged along at least two directions and thus individually setting the reflection direction of the reflected light, the light traveling direction within the luminescent light source can be set elaborately, the degree of freedom in designing a light path increases, and more detailed adjustment of the light output direction is enabled. Thus, the optical intensity distribution of light to be outputted from the luminescent light source can be equalized. In addition, if more than one light emitting device of more than one luminescent color is used, color uniformity can be improved, color irregularity can be reduced, and quality of the luminescent light source can be improved. Yet, as there is no need to reduce pitch intervals of reflection areas, neither manufacturing of a reflecting mirror will be difficult nor cost will increase, even when the degree of freedom in designing of a light path or color uniformity is improved.

[0033] A lighting system according to the present invention comprises a luminescent light source array in which a plurality of the first or the second luminescent light source of the invention are arranged and a power supply unit that supplies electricity to the luminescent light source array. According to the lighting system, a light system having a large area and uniform optical intensity can be provided.

[0034] A backlight according to the present invention is characterized in that a plurality of the first or the second luminescent light sources are arranged in the same plane.

According to the backlight, a backlight having a large area and uniform optical intensity can be provided. In addition, in the case of color display, color uniformity can be improved by reducing color irregularity.

[0035] A liquid crystal display according to the present invention comprises a luminescent light source array in which a plurality of the first or the second luminescent light source of the invention are arranged, and a liquid crystal display panel arranged opposed to the luminescent light source array. According to the liquid crystal display panel, brightness of the screen can be improved. In addition, in a liquid crystal display of color display, color uniformity can be improved.

[0036] An illustrative embodiment of a liquid crystal display device according to the present invention is characterized in that between the luminescent light source array and the liquid crystal display panel, it does not have an optical element for directing to the front face direction of the liquid crystal display panel traveling direction of light outputted from the luminescent light source array. Now, the optical element for directing to the front face direction of the liquid crystal display panel the traveling direction of the light outputted from the luminescent light source array refers to, for instance, a prism sheet in line with the embodiment. As use of the luminescent light source array comprising the luminescent light source of the invention enables adjustment with high precision of the direction or spread of light to be outputted from the luminescent light source, the optical element such as a prism sheet, etc. that was used in a conventional liquid crystal display device or backlight can be rendered unnecessary. As a result, thinning of the liquid crystal display device and reduction of assembly cost can be tried. Furthermore, as there will be no loss of light due to the light emitting device, the light use efficiency can be improved.

[0037] Another illustrative embodiment of the liquid crystal display device according to the present invention is characterized in that between the luminescent light source and the liquid crystal panel, it does not have the optical element for improving intensity of light illuminating the liquid crystal display panel. Now, the optical element for improving intensity of light illuminating the liquid crystal display panel refers to, for instance, a luminance improvement film in line with the embodiment. As use of the luminescent light source array comprising the luminescent light source of the invention enables adjustment of the direction or spread of light to be outputted from the luminescent light source, thereby improving the optical intensity, the optical element such as a luminance improvement film, etc. that was used in a conventional liquid crystal display device can be rendered unnecessary. As a result, thinning of the liquid crystal display device and reduction of assembly cost can be tried. Furthermore, as there will be no loss of light due to the light emitting device, the light use efficiency can be improved.

[0038] In addition, components of the present invention as described above can be combined as arbitrarily as possible.

BRIEF DESCRIPTION OF THE DRAWINGS

[0039]

Fig. 1 shows a cross section showing a part of a conventional luminescent light source.

Fig. 2 shows a front elevation illustrating a light emitting device and a reflecting mirror, except for a mold unit, of the conventional luminescent light source.

Fig. 3 shows a partial cross sectional view illustrating optical behavior of respective light in the conventional luminescent light source, with light emitting devices of three luminescent colors of red, green and blue arranged in the central area.

Fig. 4 shows a partial cross sectional view illustrating optical behavior of each light in the luminescent light source same as above, when reflection areas are divided smaller.

Fig. 5 shows a front elevation of the reflecting mirror of the conventional example in which the number of divisions is 3.

Fig. 6 shows a front elevation of the reflecting mirror of the conventional example in which the number of divisions is 9.

Fig. 7 shows a partially broken-away perspective view of the luminescent light source according to Embodiment 1 of the present invention.

Fig. 8 shows a perspective view from the rear, illustrating the condition in which a wiring board is removed from the luminescent light source according to Embodiment 1.

Fig. 9A and Fig. 9B show a perspective view when viewed from the front side and a perspective view when viewed from the rear side, illustrating the mold unit on the rear of which the reflecting mirror is formed.

Fig. 10A shows a front elevation of the mold unit on the rear of which the reflecting mirror is formed, Fig. 10B shows a backside view thereof, and Fig. 10C shows a bottom view thereof.

Fig. 11A shows a front elevation of the luminescent light source of Embodiment 1, Fig. 11B shows a cross sectional view in X-X direction (diagonal direction) of Fig. 11A, and Fig. 11C shows a cross sectional view in Y-Y direction (opposite side direction) of Fig. 11A.

Fig. 12 shows a cross sectional view illustrating optical behavior of light in the luminescent light source according to Embodiment 1.

Fig. 13 shows a schematic front elevation of the reflecting mirror used in the luminescent light source of Embodiment 1.

Fig. 14 shows a front elevation of the reflecting mirror of Embodiment 1 the number of divisions of which is made

greater than that of the reflecting mirror same as above.

Fig. 15 shows distribution of optical distribution in the diagonal direction of the luminescent light source of the conventional example.

Fig. 16 shows distribution of optical intensity in the diagonal direction of the luminescent light source of Embodiment 1 of the present invention.

Fig. 17 shows a schematic front elevation of the reflecting mirror according to variant (variant 1) of Embodiment 1 of the present invention, illustrating one way of allocating curved shape of divided reflection areas.

Fig. 18 shows a schematic front elevation of the reflecting mirror according to variant 2 of the present invention, illustrating another way of allocating curved shape of divided reflection areas.

Fig. 19 shows a schematic view for illustrating how a curvature in a reflecting mirror in which each reflection area is a conic surface is determined.

Fig. 20 shows a view illustrating how layout or pitch interval of virtual light emitting devices in each direction are determined.

Fig. 21 shows a view illustrating how layout or pitch interval of virtual light emitting devices in each direction are determined when the number of the light emitting devices is 5.

Fig. 22 shows a view for illustrating how a conic efficient is determined in a reflecting mirror in which each reflection area is a conic surface.

Fig. 23 shows a view illustrating how size of the conic efficient is determined when each reflection area is a conic surface.

Fig. 24A shows a front elevation of a luminescent light source for illustrating a design case, and Fig. 24B shows a front elevation of the luminescent light source with a mold unit thereof removed.

Fig. 25 shows a cross sectional view of the luminescent light source of Fig. 24.

Fig. 26 shows a view illustrating how control colors of reflection areas are determined.

Fig. 27 shows a view illustrating how control colors of reflection areas are determined, following steps of Fig. 26.

Fig. 28 shows a view illustrating how control colors of reflection areas are determined, following steps of Fig. 27.

Fig. 29 shows a view illustrating how control colors of reflection areas are determined, following steps of Fig. 28.

Fig. 30 shows a view illustrating how control colors of reflection areas are determined, following steps of Fig. 29.

Fig. 31 shows distribution of irradiation light amounts in an irradiated surface of light outputted from the direct output area.

Fig. 32 shows distribution of irradiation light amounts in an irradiated surface of light outputted from the direct output area, distribution of irradiation light amounts in the irradiate surface of light reflected by each reflection area, and distribution of whole light amounts.

Fig. 33 shows a view illustrating another example of how control colors of reflection areas are determined.

Fig. 34 shows a view illustrating how control colors of reflection areas are determined, following steps in Fig. 33.

Fig. 35 shows a view illustrating how control colors of reflection areas are determined, following steps in Fig. 34.

Fig. 36 shows a view illustrating how control colors of reflection areas are determined, following steps in Fig. 35.

Fig. 37 shows a view illustrating problems resulting from arrangement of the control colors of Fig. 33.

Fig. 38 shows a view illustrating a method of solving the problems as shown in Fig. 37.

Fig. 39A shows a front elevation of the luminescent light source according to variant 3 of the present invention, B shows a cross sectional view of the luminescent light source in the diagonal direction, and C shows a cross sectional view of the luminescent light source in the opposite side direction.

Fig. 40A shows a perspective view from the front face of the mold unit and the reflecting right used in the variant 3.

Fig. 41A shows a front elevation of the mold unit and the reflecting mirror used in the variant 3, B shows a back side view thereof, C shows a right side view thereof, and D shows a bottom view thereof.

Fig. 42 shows a schematic front elevation of the structure of the reflecting mirror in the variant 3.

Fig. 43 shows a front elevation of the structure of the reflecting mirror in the variant 4 of the present invention.

Fig. 44 shows a front elevation of the structure of the reflecting mirror in the variant 5 of the present invention.

Fig. 45 shows a front elevation of the structure of the reflecting mirror in the variant 6 of the present invention.

Fig. 46 shows a front elevation of the structure of the reflecting mirror in the variant 7 of the present invention.

Fig. 47 shows a front elevation of the structure of the reflecting mirror in the variant 8 of the present invention.

Fig. 48 shows a front elevation of the structure of the reflecting mirror in the variant 9 of the present invention.

Fig. 49 shows a front elevation of the structure of the reflecting mirror in the variant 10 of the present invention.

Fig. 50 shows a front elevation of the structure of the reflecting mirror in the variant 11 of the present invention.

Fig. 51 shows a front elevation of the structure of the reflecting mirror in the variant 12 of the present invention.

Fig. 52 shows a front elevation of the structure of the reflecting mirror in the variant 13 of the present invention.

Fig. 53 shows a front elevation of the structure of the reflecting mirror in the variant 14 of the present invention.

Fig. 54 shows a front elevation of the structure of the reflecting mirror in the variant 15 of the present invention.

Fig. 55 shows a front elevation of the structure of the reflecting mirror in the variant 16 of the present invention.

Fig. 56 shows a partial cross sectional view of a shape of the cross section of the direct output area in the variant 17 of the present invention.

Fig. 57 shows a cross sectional view of optical behavior of light in the luminescent light source in the variant 17 of the present invention.

Fig. 58 shows a front elevation of the luminescent light source of the variant 18 of the present invention.

Fig. 59 shows a front elevation of the luminescent light source of the variant 19 of the present invention.

Fig. 60 shows a front elevation of the luminescent light source of the variant 20 of the present invention.

Fig. 61 shows a front elevation of the luminescent light source of the variant 21 of the present invention.

Fig. 62 shows a front elevation of the luminescent light source of the variant 22 of the present invention.

Fig. 63 shows a front elevation of the luminescent light source of the variant 23 of the present invention.

Fig. 64 shows a front elevation of the luminescent light source of the variant 24 of the present invention.

Fig. 65A shows a view of optical behavior of light in the cross section in the diagonal direction of the luminescent light source in the variant 18 as shown in Fig. 58, and B shows a view of optical behavior in the cross section in the opposite side direction.

Fig. 66A shows a view of optical behavior of light in the cross section in the diagonal direction of the luminescent light source in the variant 19 as shown in Fig. 59, and B shows a view of optical behavior in the cross section in the opposite side direction.

Fig. 67 shows a front elevation of the luminescent light source of the variant 25 of the present invention.

Fig. 68A shows a perspective view of the structure of the direct output area and the total reflection area in the luminescent light source in the variant 25, B shows a cross sectional view in the opposite side direction of the luminescent light source, and C shows a schematic view of how light is distributed to each reflection area of the luminescent light source.

Fig. 69A shows a perspective view showing the structure of the direct output area and the total reflection area in the luminescent light source in the comparable example, B shows a cross sectional view in the opposite side direction of the luminescent light source, and C shows a schematic view of how light is distributed to each reflection area of the luminescent light source.

Fig. 70A shows a perspective view of the structure of the direct output area and the total reflection area in the luminescent light source in the variant 26 of the present invention, B shows a cross sectional view in the opposite side direction of the luminescent light source, and C shows a schematic view of how light is distributed to each reflection area of the luminescent light source.

Fig. 71 shows a front elevation of the luminescent light source of the variant 27 of the present invention.

Fig. 72 shows a front elevation of the luminescent light source of the variant 28 of the present invention.

Fig. 73 shows a front elevation of the luminescent light source of the variant 29 of the present invention.

Fig. 74A shows a cross sectional view in the opposite side direction, illustrating optical behavior in the luminescent light source according to the variant 29, and B shows a front elevation thereof.

Fig. 75A shows a cross sectional view in the opposite side direction, illustrating optical behavior in the luminescent light source of the comparable example, and B shows a front elevation thereof.

Fig. 76 shows a cross sectional view illustrating optical behavior in the luminescent light source of the variant 29.

Fig. 77 shows a cross sectional view illustrating optical behavior in the luminescent light source of the comparable example.

Fig. 78 shows a front elevation of a luminescent light source array according to Embodiment 2 of the present invention.

Fig. 79 shows a schematic cross sectional view of the structure of a liquid crystal display according to Embodiment 3 of the present invention.

Fig. 80 shows a schematic cross sectional view of the structure of the liquid crystal display according to the variant of Embodiment 3 of the present invention.

Fig. 81 shows a perspective view of a lighting system for indoor lighting using the luminescent light source array according to Embodiment 4 of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0040] In the following, we describe the embodiments of the present invention with reference to the drawings. However, the invention is not limited to the following embodiments but can undergo design changes, as appropriate, depending on an application, etc.

[Embodiment 1]

[0041] Fig. 7 shows a partly broken perspective view of a luminescent light source 21 according to Embodiment 1 of the present invention. Fig. 8 shows a perspective view of the luminescent light source that is viewed from the rear side

and from which a wiring board has been removed. Fig. 9A and B show perspective views, viewed from the front side and from the rear side, respectively, of a mold unit 22 (light guide unit) on the rear side of which a reflecting mirror 26 is formed. In addition, Fig. 10A, B and C show a front elevation, a back side view, and a bottom plan view of the mold unit 22. Fig. 11A shows a front elevation of the luminescent light source 21, Fig. 11 (b) shows a cross sectional view in X-X direction (diagonal direction) of Fig. 11A, and Fig. 11 (c) shows a cross sectional view in Y-Y direction (opposite side direction) of Fig. 11A.

[0042] In the luminescent light source 21, an almost dish-shaped mold unit (light guide unit) 22 is formed of optically-transparent material of high refractive index, for instance, transparent resin. As the optically-transparent material comprising the mold unit 22, the optically-transparent materials such as epoxy resin or acrylic resin or glass materials may also be used.

[0043] As shown in Fig. 7, Fig. 10 or Fig. 11, when viewed from the front face, the mold unit 22 is rectangular. In the central front area of the mold unit 22 is provided a circular direct output area 29, outside of which a total reflection area 30 is provided. The direct output area 29 is a smooth, circular region formed by a plane perpendicular to a central axis of the mold unit 22, and the total reflection area 30 is also a smooth region formed by the plane perpendicular to the central axis of the mold unit 22. In addition, in the illustrated examples, although the direct output area 29 and the total reflection area 30 are formed in the same plane and the direct output area 29 is located level with the total reflection area 30, it would be reasonable to protrude the direct output area 29 in a channel 25, making the direct output area higher than the total reflection area 30. On the contrary, it would also be reasonable to retract the direct reflection area 29 into the channel 25 so as to make the direct output area 29 lower than the total reflection area 30. Although primarily the direct output area 29 serves to directly outputting light output from the light emitting devices 24R, 24G, 24B to the external, as described later, it also serves to totally reflect incident light. Similarly, although the total reflection area 30 primarily serves to totally reflect incident light toward a reflecting mirror 26, it also serves to transmit and output the incident light to the external.

[0044] The toric channel 25 is provided between the direct output area 29 and the total reflection area 30, and on the base of the channel 25 a total reflection area 31 is formed by an annular plane. In addition, an obliquely tilted inclined total reflection area 32 is formed on the inner circumferential flank of the channel 25, and the inclined total reflection area 32 is formed like a tapered truncated cone so that the diameter decreases as it moves to the front face of the mold unit 22. Although the total reflection area 31 and the inclined total reflection area 32 primarily serve to totally reflect incident light, it is also possible that some of the incident light may transmit the inclined total reflection area 32 and be outputted to the external.

[0045] As shown in Fig. 9, the back side of the mold unit 22 is curved, and on the back side is provided a concave mirror shaped reflecting mirror 26 for reflecting the light totally reflected by the front face of the mold unit 22. The reflecting mirror 26 may be a metal coating such as Au, Ag, Al, etc. deposited on the back side (pattern surface) of the mold unit 22, white paint painted on the back side of the mold unit 22, a metal plate such as aluminum, etc. having surface reflectance improved by specular working the surface, a metal or resin curved plate a surface of which is plated by Au, Ag, Al, etc., or a curved plate a surface of which is painted with white paint.

[0046] As shown in Fig. 10, a light reflection surface of the reflecting mirror 26 is formed in mosaic by a plurality of reflection areas arranged along at least two directions when viewed from the light output direction. A ring zone shaped reflection area 36 is provided in the periphery of an opening located in the central part of the reflecting mirror 26, and in the peripheral area of the reflection area 36, the reflecting mirror 26 is divided into a plurality of columns and a plurality of rows, thus being divided into the grid reflection areas 28i, 28j, 28k The reflection areas 28i, 28j, 28k... comprise the reflection surface shaped like a concentric circle. In addition, although the light reflection surface such as the reflection areas 28i, 28j, 28k... is a mirror plane, a light reflection surface of the reflection area 36 may be made to be slightly rough so as to diffuse light.

[0047] Also, as shown in Fig. 9, the reflecting mirror 26 is open in the central area of the back side of the mold unit 22. In the opening of the reflecting mirror 26, a semispherical concave portion 27a is formed in the central part of the back side of the mold unit 22, and a convex portion 27b is protruded in the periphery of the concave portion 27a.

[0048] To assemble the luminescent light source 21, as shown in Fig. 11, the light emitting devices 24R, 24G, 24B, such as three LED chips having luminescent colors of red, green, and blue are installed on the surface of the wiring board 23, and then a holder 34 is secured to the surface of the wiring board 23. Next, the concave portion 27a on the back side of the mold unit 22 is filled with transparent resin 35 such as thermosetting resin or ultraviolet-curing resin, etc., and the holder 34 secured to the wiring board 23 is made to support the mold unit 22 (Fig. 8 shows how the holder 34 supports the mold unit 22). Then, the transparent resin 35 being hardened, the mold unit 22 and the wiring board 23 are integrally bonded by the transparent resin 35. In addition, the light emitting devices 24R, 24G, 24B are sealed in the transparent resin 35 at positions biased more to the front of the optical axis than to the center of the semispherical surface forming the concave portion 27a.

[0049] In addition, the transparent resin 35 may be same as or different from the material of the mold unit 22. Also, an electronic circuit for adjusting amount of light of the light emitting devices 24R, 24G, 24B may be installed in a space

(space outside of the transparent resin 35) between the wiring board 23 and the mold unit 22.

[0050] When viewed from the front face, the outline size of the above luminescent light source 21 is, for instance, 30 mm by 30 mm, and is 5mm thick when viewed from lateral direction, thus being thinner than the outline. In addition, the concave portion 27a on the back side of the mold unit 22 is formed like a hemisphere having a radius of 3.90 mm. However, the concave portion 27a is slightly smaller than 1/2 of a sphere, the radius of the opening of the concave portion being 3.25 mm. In addition, values mentioned herein are simply an example, the size may be designed as appropriate so that it may be optimal values depending on the efficiency of light emitting devices or desired amount of light, etc.

[0051] Fig. 12 shows a cross sectional view of the structure of the luminescent light source 21 of the invention and behavior of light outputted from the light emitting devices 24R, 24G, 24B which represent a cross section in the diagonal direction. In the drawings, a thin line arrow designates a light. The reflection areas shall be the reflection area 28s, the reflection area 28t, the reflection area 28u, and the reflection area 28v in this order from the side closer to the reflection area 36. When the light emitting devices 24R, 24G, 24B of three colors, i.e., red, green, and blue, arranged in the central area of the luminescent light source 21 are emitted, among light outputted from this light emitting devices 24R, 24G, 24B, light outputted at an output angle θ_1 ($<\theta_c$) smaller than a critical angle θ_c of total reflection on a boundary face of the mold unit 22 enters the direct output area 29, and this light transmits through the direct output area 29 and is directly outputted to the front from the luminescent light source 21. In addition, light outputted at the output angle θ_3 ($>\theta_c$) greater than the critical angle θ_c of total reflection enters the total reflection area 31, and this light, by being totally reflected by the total reflection area 31, enters the reflection area 28s, and transmits through the total reflection area 30 and is outputted to the front after being reflected by the reflection area 28c. In addition, when the total reflection area 31 is slightly inclined as shown in Fig. 12, the output angle θ_3 may be slightly smaller than the critical angle θ_c of the total reflection. Also, the light outputted at the output angle θ_4 ($>\theta_3$) greater than the critical angle θ_c of the total reflection enters the total reflection area 30, and this light, by being totally reflected by the total reflection area 30, enters the reflection area 28t, and transmits through the total reflection area 30 and is outputted to the front after being reflected by the reflection area 28t. Furthermore, light outputted at the output angle θ_5 ($>\theta_4$) greater than the output angle θ_4 or at the output angle greater than that, by being totally reflected by the total reflection area 30, enters the reflection area 28u or the reflection area 28v, and transmits through the total reflection area 30 and is outputted to the front after being reflected by the reflection areas 28u, 28v. In addition, light outputted from the light emitting devices 24R, 24G, 24B at the output angle θ_2 ($\theta_1 < \theta_2 < \theta_3$) intermediate the output angle θ_1 to the direct output area 29 and the output angle θ_3 to the total reflection area 31 enters the inclined total reflection area 32, and then the reflection area 36 after being totally reflected twice by the inclined total reflection area 32 and the direct reflection area 29. The light reflected by the reflection area 36 is reflected toward the corner area of the luminescent light source 21, and outputted to front from the corner area by further being reflected by the total reflection area 30 and the reflection area 28v.

[0052] In addition, in the Embodiment 1, as the reflecting mirror 26 consists of mosaic arrangement of either square or rectangular reflection areas 28i, 28j, 28k,..., color uniformity at the luminescent light source 21 can be improved. In particular, when the luminescent light source is used as white light source, color irregularity or a partial coloring can be reduced. In the following, we describe this in details.

[0053] Fig. 13 shows a schematic front elevation of the reflecting mirror 26. The opening is provided in the central area of the reflecting mirror 26, and the light emitting devices 24R, 24G, 24B are positioned in the opening. The light reflection surface of the reflecting mirror 26 are divided into a plurality of columns and a plurality of rows, and the reflection areas 28i, 28j, 28k... are arranged like a grid. In Fig. 13, to make the description simple, the number of divisions of the reflecting mirror is small, and the reflecting mirror 26 is divided into 5 columns and 5 rows. Thus, except for the opening, the reflecting mirror 26 has the reflection areas 28i, 28j, 28k.... The reflection area 28i, 28j, 28k... comprise a concentric reflection surface. With the reflection mirror 28 formed concentrically as shown, the luminescent light source 21 can be further thinned. In addition, designing the plurality of the respective reflection areas 28i, 28j, 28k... with parameters that are independent of each other allows the respective areas to be designed optimally and to emit light more uniformly.

[0054] It would be desirable to design a curved surface of the respective reflection areas 28i, 28j, 28k... to a shape that allows light to be outputted from the front face of the luminescent light source 21 as uniformly as possible. For instance, the respective reflection areas 28i, 28j, 28k... maybe a conic surface, respectively, as shown in the following expression (1):

$$Z = \frac{CV\rho^2}{1 + \sqrt{1 - CV^2(CC + 1)}\rho^2} + A + a\rho^4 + b\rho^6 + c\rho^8 + d\rho^{10} + \dots \quad \dots (1)$$

However,

$$\rho = \sqrt{X^2 + Y^2}$$

wherein X, Y, Z are orthogonal coordinates with their origin at the center of the reflecting mirror 26, and the axis Z coincides with the optical axis of the reflecting mirror 26 and the central axis of the mold unit 22. ρ is a distance (radius) from the origin when viewed from the front face (namely, projection to the XY plane). Also, CV is a curvature ($=1/\text{radius of curvature}$) of the reflecting mirror 26 or the reflection areas 28i, 28j, 28k..., CC is a conic coefficient, A is an amount of displacement of the center of the reflecting mirror 26 to the axis Z, a, b, c, and d are quartic, sextic, octal, and decadal non-sphere coefficients, respectively. However, values of these coefficients are defined for every reflection area 28i, 28j, 28k....

[0055] In the drawings attached to the specification of the present invention, reflection areas having same amount of characteristic that characterizes a shape of a curved surface of a reflecting surface (hereinafter referred to as a curve constant), for instance, reflection areas having an equal curvature CV or conic coefficient CC, non-sphere constant a, b, ..., as described above, are expressed as an area having a same hatching pattern. In the reflecting mirror 26 as shown in Fig. 13, the reflection areas having an equal distance from the center thereof are designed to have a same curve constant. In addition, it is assumed in the reflecting mirror 26 of Fig. 13 that pitch interval P of the reflection areas 28i, 28j, 28k... is 6 mm.

[0056] When the reflecting mirror 26 of Fig. 13 is compared with the reflecting mirror 12 of a conventional example as shown in Fig. 5, both of them have pitch interval of 6 mm, and the front size of the luminescent light sources is equal to each other. However, in the latter, the number of divisions of the reflection areas is 3, whereas in the former, the number of the divisions is 24. Then, when reflection areas having a same curve constant (reflection areas being equidistant from the center) are grouped, the reflecting mirror of the conventional example of Fig. 5 has 3 types of reflection areas, whereas the reflecting mirror 26 of Fig. 13 has 5 types. Thus, according to the luminescent light source 21 of the Embodiment 1, compared with the conventional example, the light traveling direction can be set more elaborately, the degree of freedom in designing a light path is greater, more detailed adjustment of the light output direction is enabled, and coloring of the luminescent light source 21 can be prevented by uniformly mixing respective colors. Yet, as the number of divisions can be increased without changing pitch interval P, neither manufacturing will be difficult nor cost will increase, even when the number of divisions is increased.

[0057] In addition, if the respective reflection areas 28i, 28j, 28k... are further trisected, the respective reflection areas will be smaller, as shown in Fig. 14. The pitch interval of the reflection areas 28i, 28j, 28k... will be 2 mm, and the number of divisions of the reflecting mirror 26 will be 216. For the reflection areas 17a, 17b, 17c, 18a, 18b, ... of the reflecting mirror 12 of Fig. 6 that were obtained by trisecting the respective reflection areas 12a, 12b, 12c based on the reflecting mirror 12 of Fig. 5, the number of divisions of the reflecting mirror 12 is only 9, although the pitch interval P is 2mm. Thus, the smaller the pitch interval P of the reflection areas is or the greater size of the luminescent light source is, superiority of the reflecting mirror 26 of the Embodiment 1 to the conventional reflecting mirrors divided into ring zones becomes remarkable, and the degree of freedom in light path designing or color uniformity further improves.

[0058] According to the luminescent light source 21 of the Embodiment 1, as light outputted from the light emitting devices 24R, 24G, 24B is outputted to the front after repeating reflections between the total reflection areas 30, etc. of the mold unit and the reflecting mirror 26, light path length can be obtained within the luminescent light source 21, thus consequently enabling equalization of optical strength of the light radiated from the light emitting devices 24R, 24G, 24B and outputted to the front from the luminescent light source 21. In addition, if the light emitting devices 24R, 24G, 24B of more than one color are used, degree of color mixture of the light to be outputted from the luminescent light source

21 can be enhanced.

[0059] In the luminescent light source 21 of the Embodiment 1, as the respective reflection areas 28i, 28j, 28k... of the reflecting mirror 26 can be divided smaller than the conventional case, the degree of freedom in light path design when designing the luminescent light source 21 increases, thereby enabling more detailed adjustment of the light output direction. In particular, in the luminescent light source 1 of the Embodiment 1, (1) the inside light path length can be obtained as described above. In addition, (2) the respective reflection areas 28i, 28j, 28k... that are divided smaller than the conventional case allows the direction of light reflection or output to be designed elaborately. In addition, (3) the respective reflection areas 28i, 28j, 28k... that are divided smaller than the conventional case allows spread of light to be designed more elaborately. As a result of (1) to (3) above, uniformity of optical strength at the luminescent light source 21 can be improved, or degree color mixing can be enhanced when the light emitting device of more than one color is used.

[0060] Fig. 15 shows optical intensity distribution in diagonal direction in the case of the concentric luminescent light source in which the reflecting mirror 12 is divided into the ring zones as shown in Fig. 5 or Fig. 6, and Fig. 16 shows optical intensity distribution in the case in which the reflecting mirror 26 is divided like a grid as shown in Fig. 13 or Fig. 14. The horizontal axis in Fig. 15 and Fig. 16 is a distance in diagonal direction, measured from the center of the reflecting mirror 26, and the vertical axis is optical intensity at each position. As can be seen when Fig. 15 and Fig. 16 are compared, while the optical intensity fluctuates $\pm 15\%$ with the convention method, fluctuation in the optical intensity in the embodiment is about $\pm 8\%$ and uniformity of the optical intensity has improved.

[0061] Although in the embodiment, the curve constant was determined depending on the distance from the center of the reflecting mirror 26, the way of distribution of reflection areas having a same curve constant is arbitrary. For instance, in the variant 1 as shown in Fig. 17, distribution in the triangular area surrounded by the dashed line in the reflecting mirror 26 (1/8 area of the reflecting mirror 26) is determined, and then, by making this axisymmetric with respect to the two diagonal directions and two opposite side direction, distribution in other areas is determined.

[0062] In addition, if the reflecting mirror is designed so that the optical intensity distribution of the luminescent light source 21 is uniform and color uniformity can be improved, as in the reflecting mirror 26 of the variant 2 shown in Fig. 18, the divided respective reflection areas 28i, 28j, 28k, ... may be arranged in random manner, having curve constants that are different to each other. However, although the degree of freedom in designing increases if the respective reflection areas are randomly arranged, color irregularity at the luminescent light source 21 will be greater. In fact, as described in Fig. 4, in order to keep color irregularity at a luminescent light source small, it is necessary to dispose reflection areas that have light of respective colors to be vertically outputted in a predetermined sequence, considering the order in which light emitting devices are arranged. On the one hand, since the light emitting devices or the reflection areas are arranged in two dimensions, there will be an area among adjacent reflection areas that has light of a same color to be outputted vertically to the front face direction, even if the reflection areas are determined regularly in respective diagonal directions or opposite side directions. Hence, it is necessary to adjust the reflection areas so that such an area will not be generated.

[0063] In the following, we describe a method of designing each reflection area. First, with reference to Fig. 19, we describe a method of designing in the case in which, as a curve constant, a curvature CV of the expression (1) is changed for every reflection area. Now, as adjacent three areas in the diagonal direction or a direction parallel to the side are treated as one pair, Fig. 19 only shows the adjacent three reflection areas. The three reflection areas shall be 28R, 28G, 28B, and the curvature thereof shall be CVr, CVg, CVb, respectively. Now, the reflection area 28R is the reflection area designed to have red light outputted from the light emitting device 24R to exit vertically to the front face direction, the reflection area 28G is the reflection area designed to have green light outputted from the light emitting device 24G to exit vertically to the front face direction, and the reflection area 28B is the reflection area designed to have blue light exit vertically to the front face direction. As shown in Fig. 19, if the red light emitting device 24R, the green light emitting device 24G, and the blue light emitting device 24B are arranged in this order from the left on the figure, in order to reduce color irregularity of the luminescent light source 21, the reflection areas have to be arranged from the left as one faces, in the order of the reflection area 28B that has blue light to exit to the front face direction, the reflection area 28G that has green light to exit to the front face direction, and the reflection area 28R that has red light to exit to the front face direction (see Fig. 4). In addition, if color of the light to be reflected by the reflection area and to be outputted vertically to the front face direction is considered a control color of that reflection area, the reflection area 28R is the reflection area whose control color is red, the reflection area 28G is the reflection area whose control color is green, and the reflection area 28B is the reflection area whose control color is blue.

[0064] The curvature CV of the conic surface can change the traveling direction of light reflected by each reflection area, and decreasing the curvature CV tilts the light reflected by that reflection area outward, while increasing the curvature CV tilts the light reflected by that reflection area inward. Thus, the light output direction in the respective reflection areas 28R, 28G, 28B could be adjusted if the curvature CVr, CVg, CVb, etc., of the adjacent reflection areas 28R, 28G, 28B was designed, considering pitch interval Q among the respective light emitting devices 24R, 24G, 24B, a distance H between the light output surface of the light emitting devices 24R, 24G, 24B and the surface of the mold unit 22, positions of the respective reflection areas 28R, 28G, 28B, etc. Therefore, when priority of the control color of the adjacent reflection areas, etc. is determined depending on arrangement of the light emitting devices 24R, 24G, 24B,

and the curvature CVr, CVg, CVb, etc. is designed in consideration of the priority, a white overlapped area (shaded portion in Fig. 19) of the area AR of red light LR, the area AG of green light LG and the area AB of blue light LB can be widened, thus obtaining uniform white light. For instance, in the configuration such as Fig. 19, red light LR is outputted vertically to the front side in the reflection area 28R, green light LG is outputted vertically to the front side in the reflection area 28G, and blue light LB is outputted vertically to the front side in the reflection area 28B. Based on the curvature CVg of the central reflection area 28G, the curvature CVr of the reflection area 28R closer to the center is greater than CVg, and the curvature CVb of the reflection area 28b farther from the center is smaller than CVg.

[0065] In the mean time, when the curvature of the reflection area is determined as described above, the curvature varies depending on a position of the light emitting devices 24R, 24G, 24B. In practice, as the respective light emitting devices 24R, 24G, 24B are not arranged in a line, the position or pitch interval Q changes depending on a viewing direction. For instance, as shown in Fig. 20A, the arrangement of the light emitting devices 24R, 24G, 24B of when the curve constant of the reflection areas 28R, 28G, 28B in the opposite side direction K1 is defined needs to be handled as being different from that of the light emitting devices 24R, 24G, 24B of when the curve constant of the reflection areas 28R, 28G, 28B in the diagonal direction is defined.

[0066] For instance, when the reflection areas 28R, 28G, 28B on the opposite side direction K1 are considered, K1, as shown in Fig. 20B, the curve constants of the reflection area 28R, 28G, 28B are defined by using virtual light emitting devices 32R, 32G, 32B that project respective light emitting devices 24R, 24G, 24B onto the straight line of the opposite side direction K1. In other words, for the reflection area 28R on the opposite side direction K1, the curve constant is defined so that red light outputted from the virtual light emitting device 32R is vertically outputted to the front face, for the reflection area 28G on the opposite side direction K1, the curve constant is defined so that green light outputted from the virtual light emitting device 32G is vertically outputted to the front face, and for the reflection area 28B on the opposite side direction K1, the curve constant is defined so that blue light outputted from the virtual light emitting device 32B is vertically outputted to the front face. In addition, when the reflection areas 28R, 28G, 28B on the opposite side direction K2 of Fig. 20A are considered, as shown in Fig. 20B, as shown in Fig. 20B, the curve constants of the reflection area 28R, 28G, 28B are defined by using virtual light emitting devices 33R, 33G, 33B that project respective light emitting devices 24R, 24G, 24B onto the straight line of the diagonal direction K2. In other words, for the reflection area 28R on the diagonal direction K2, the curve constant is defined so that red light outputted from the virtual light emitting device 33R is vertically outputted to the front face, for the reflection area 28G on the diagonal direction K2, the curve constant is defined so that green light outputted from the virtual light emitting device 33G is vertically outputted to the front face, and for the reflection area 28B on the diagonal direction K2, the curve constant is defined so that blue light outputted from the virtual light emitting device 33B is vertically outputted to the front face.

[0067] In the example shown in Fig. 20, the virtual light emitting devices 32R, 32G, 32B projected onto the straight line of the opposite side direction K1 are equally spaced, thus facilitating designing of the respective reflection areas.

[0068] In addition, Fig. 21A, B show the case in which 5 light emitting devices are used. For instance, when the light emitting devices of red, green, and blue are used, the respective emitting devices may be combined at a certain proportion to uniformly balance luminance of respective colors because these light emitting devices have different luminance. For instance, in Fig. 21A, as luminance of the red light emitting device 24R is high, one red light emitting device 24R, and two each of green and blue light emitting devices 24G, 24B are used.

[0069] In this case, in the opposite side direction K1, as shown in Fig. 21B, as it can be considered that the green and blue light virtual light emitting devices 32G, 32B are arranged in same positions that mutually overlap on the both sides of the red light emitting device 32R, the control color and curvature CV of the respective reflection areas may be defined corresponding to the layout of such the virtual light emitting devices. In the opposite side direction K1, the reflection area 28R is designed to correspond to the red virtual light emitting device 32R, and the reflection area 28GB being adjacent to the reflection area 28R on the inner circumference side is designed to correspond to the green and blue virtual light emitting devices 33G, 33B located to the left as one faces in the opposite side direction K1, and the reflection area 28GB being adjacent to the reflection area 28R on the outer circumference side is designed to correspond to the green and blue virtual light emitting devices 33G, 33B located to the right as one faces in the opposite side direction K1.

[0070] In addition, in the diagonal direction K2, as shown in Fig. 21B, as it can be considered that intermediate the blue virtual light emitting devices 33B, one red virtual light emitting device 33R and two green virtual light emitting device 33G are arranged, overlapping in the same position, the control color and curvature CV are defined corresponding to the layout of such the virtual light emitting devices. For instance, the reflection area 28RG in the diagonal direction K2 is designed to correspond to the red and green virtual light emitting devices 33R, 33G, the reflection area 28B being adjacent to the reflection area 28RG on the inner circumference side is designed to correspond to the virtual light emitting device 24B located in the left top in the diagonal direction K2, and the reflection area 28B being adjacent to the reflection area 28RG on the outer circumference side is designed to correspond to the light emitting device 24B located in the right bottom in the diagonal direction K2.

[0071] Similarly, in the diagonal direction K3, as shown in Fig. 21B, as it can be considered that intermediate the green virtual light emitting devices 33G, one red virtual light emitting device 33R and two blue virtual light emitting device 33B

are arranged, overlapping in the same position, the control color and curvature CV are defined corresponding to the layout of such the virtual light emitting devices. For instance, the reflection area 28RB in the diagonal direction K3 is designed to correspond to the red and blue virtual light emitting devices 33R, 33B, the reflection area 28G being adjacent to the reflection area 28RB on the inner circumference side is designed to correspond to the virtual light emitting device 33G located in the left bottom in the diagonal direction K3, and the reflection area 28G being adjacent to the reflection area 28RB on the outer circumference side is designed to correspond to the light emitting device 33G located in the right top in the diagonal direction K3.

[0072] In the following, we describe a method of designing in the case in which as a curve constant, the conic coefficient CC of the expression (1) is changed for every reflection area. The conic coefficient CC can change a degree of spread of the light reflected by that reflection area, and decreasing the conic coefficient CC expands the spread of the light reflected by the reflection area and increasing the conic coefficient CC shrinks the spread of the light reflected by the reflection area. Thus, when designing the conic coefficient CC, the conic coefficient CC may be determined based on a distance between the light output surface of the light emitting devices 24R, 24G, 24B and the surface of the mold unit 22, distance D1, D2 between the reflection area and the light emitting devices 24R, 24G, 24B, etc.

[0073] Specifically, as shown in Fig. 22, in the reflection areas 28R, 28G, 28B having a short distance D1 to the light emitting devices 24R, 24G, 24B, the conic coefficient CC may be reduced, and in the reflection areas 128R, 128G, 128B having a long distance D2 to the light emitting devices 24R, 24G, 24B, the conic coefficient CC may be increased. Consequently, in the reflection areas 28R, 28G, 28B close to the light emitting devices 24R, 24G, 24B, the spread of the output light is great and directivity is wide. In the reflection areas 28R, 28G, 28B near the light emitting devices 24R, 24G, 24B, light of respective colors does not mix easily as the light path length is short although much light arrives. However, by reducing the conic constant to widen directivity of the reflected light, not only the optical intensity is suppressed by diffusing light, but also the degree of color mixture can be enhanced. In contrast to this, in the reflection areas 128R, 128G, 128B remote from the light emitting devices 24R, 24G, 24B, the spread of the output light is small and directivity is narrow. In the reflection areas 128R, 128G, 128B remote from the light emitting devices 24R, 24G, 24B, the amount of arriving light is small, while the light path length is long and color mixing progresses well. However, by increasing the conic constant CC and narrowing directivity of the reflected light, light diffusion is reduced and the optical intensity is improved even at the expense of the color mixing degree to some extent. Thus, according to the method of designing, optical intensity can be equalized in the whole luminescent light source 21, and furthermore color uniformity can be achieved by balancing the color mixing degree across the luminescent light source 21. However, this does not mean that such the designing policy is given the highest priority, and as the object is to design so that the optical intensity and color mixing degree in the irradiated surface (target surface) defined to be ahead of the luminescent light source in the design will be optimal, there might be the case in which the reflection area near the light emitting device has narrower spread of light as a result of optimal designing of the optical intensity and color mixing degree on the target surface.

[0074] On the one hand, tracking or fine tuning of light would be easier if respective reflection areas 28i, 28j, 28k, ... on the reflecting surface 26 were designed on a continuous axis (on the line). Thus, when the reflection areas 28i, 28j, 28k, ... are designed, first, reflection areas positioned in the diagonal or opposite side direction are designed. After the conic coefficient CC of the reflection areas positioned in the diagonal direction K2 or the opposite side direction K1 is thus determined, as shown by the solid line arrow in Fig. 23, the conic coefficient CC in each reflection area is defined so that the farther from the center of the light emitting devices 24R, 24G, 24B the reflection area is, the greater the conic coefficient is. Then a constant of a curved surface of the reflection area adjacent to the reflection area is designed. In this case, as shown by the dashed line arrow in Fig. 23, the conic coefficient CC may be set so that it increases from the opposite side direction to the diagonal direction.

[0075] In the following, we describe the method of specifically designing the reflecting mirror 26 according to the principle as discussed above. Fig. 24A and B show a front elevation of the luminescent light source 21 with one each of red light emitting device 24R, green light emitting device 24G, and blue light emitting device 24B arranged in the central area, and a front elevation with the mold unit 22 removed. Fig. 25 shows a cross sectional view in the diagonal direction thereof. The outside dimension of the luminescent light source 21 when viewed from the front face is 30 mm x 30 mm, respectively. The reflecting mirror 26 is vertically and horizontally divided into 15 areas, respectively, forming a mesh-like reflection areas 28a, 28b, ... and each reflection area is 2 mm x 2mm, respectively. The respective light emitting devices 24R, 24G, 24B are triangularly arranged, wherein the red light emitting device 24R and the blue light emitting device 24B are arranged side by side in a direction parallel to the upper and lower sides of the reflecting mirror 26, and the green light emitting device 24G is located above them. In addition, the diameter of the direct output area 29 is 5mm, the bore (diameter) of the bottom face of the channel 25 is 5.5 mm, outside diameter (diameter) of the top surface of the channel 25 is 10mm, and depth of the channel 25 is 1.8 mm.

[0076] First of all, we describe the procedure of determining control color of every reflection area 28a, 28b, First, array of control colors in the four diagonal directions K2, K3, K5, K6 and the four opposite side directions K1, K4, K7, K8 is determined. As the arrangement of the light emitting devices 24R, 24G, 24B is same as that as shown in Fig. 20,

as seen from the description on Fig. 20, the virtual light emitting devices 33G, 33R, 33B are arranged from the left top to the right bottom in the diagonal directions K2, K6. Thus, in the diagonal direction K2 in the left top as one faces, the control colors are arranged in the order of green (G), red (R), blue (B), while those are arranged in the order of blue (B), red (R), blue (B) in the diagonal direction K6 in the right bottom.

[0077] In the diagonal directions K3, K5, as the virtual light emitting devices 33R, 33B, 33G are arranged from the left bottom to right top. Thus, in the diagonal direction K3 in the left bottom as one faces, the control colors are arranged in the order of red (R), blue (B), green (G), while in the right horizontal opposite side direction K4, in the diagonal direction K5 in the right top as one faces, the control colors are arranged in the order of green (G), blue (B), red (R).

[0078] In addition, as the virtual light emitting devices 32R, 32G, 32B are arranged from left to right in the horizontal direction, the control colors in the left horizontal opposite side direction K1 as one faces arranged in the order of red (R), green (G), blue (B) from the inner side to the outer side, while the control colors are arranged in the order of blue (B), green (G), red (R), from the inner side to the outer side.

[0079] In addition, as it can be considered that in the vertical direction, one red virtual light emitting device 32R and one blue virtual light emitting device 32B overlap and are arranged in the same position, and one green virtual light emitting device 32G is arranged adjacent to them, in the upper vertical opposite side direction K7, the control colors are arranged in the order of green (G), red and blue (RB) from the inner side to the outer side, while in the lower vertical opposite side direction K8, the control colors are arranged in the order of red and blue (RB), green (G) from the inner side to the outer side. Fig. 26 shows the state in which the order of control colors in the respective directions K1 to K8 has been thus determined.

[0080] When the order of the control colors in the respective directions K1 to K8 is determined as described above, as shown in Fig. 27, the control color of each reflection area, for instance, one in the left top diagonal direction K2 is first determined. For instance, if the control color of the reflection area at the upper left corner is arbitrarily determined, the control color in the diagonal direction K2 is arbitrarily determined.

[0081] Then, with the order of the control colors in the diagonal direction K2 as a starting point, the control colors of the reflection areas located in the outer circumferential area of the reflecting mirror 26 are determined so that the control colors in the reflection areas that are adjacent on the left, right, top and bottom are not in a same color. Then, in the respective directions K1, K3 to K8 except for K2, the order of control colors thus determined remains unchanged, and the position is just shifted in the respective directions of K1, K3 to K8. Fig. 27 shows the control colors thus determined in the outer circumferential area.

[0082] Furthermore, as shown in Fig. 28, based on the control colors of the respective reflection areas in the directions K1, K2, K4, K5, K7 and those of the respective reflection areas in the outer circumferential area, in the upper half area of the reflecting mirror 26, the control colors of empty reflection areas are determined so that the control colors in the reflection areas that are adjacent on the left, right, top and bottom are not in a same color.

[0083] Then, in the distribution state of the control colors shown in Fig. 28, the green control color are adjacent side by side in α portion. If a same control color is contiguous on the left, right, top and bottom like this, the control colors will be adjusted by shifting them in trial and error manner so that control colors in adjacent reflection areas will not be same. In Fig. 29, the control colors of red, green, and blue are shifted one by one in the α portion of Fig. 28 and in the vicinity thereto.

[0084] Then, as shown in Fig. 30, the control colors in the lower half of the reflection areas are determined so that they can be symmetrical about a line with the control colors of the upper half of the reflection areas, with respect to the horizontal direction K1 to K4. The control colors of the lower half of the reflection areas thus determined by axisymmetric manipulation correspond to the order of the originally determined control colors. Then, if the number of the longitudinally arranged reflection areas is odd, there will be no problem. However, if the number of the longitudinally arranged reflection areas is even, the control colors of vertically adjacent reflection areas will be same along the horizontal direction in the upper and lower central areas. Thus, in such a case, it is necessary to shift the control colors therein in the trial and error manner so that the control colors in adjacent reflection areas will not be same. Thus, it would be desirable if an odd number of the reflection areas is arranged.

[0085] Alternatively, if the symmetric manipulation as described above is not desirable, similar to determination of the control colors of the upper half of the reflection areas, the control colors of the lower half of the reflection areas are independently determined. If a same control color is contiguous on the left, right, top and bottom of the upper and lower half of the reflection areas, they may be adjusted. When the control colors in the whole reflecting mirror 26 have been thus determined, assignment of the control colors completes.

[0086] In addition, depending on the number of divisions or a shape of reflection areas, there are some cases in which a control color of reflection areas being adjacent on the left, right, top, and right will be same even after the assignment of the control colors is adjusted. In such a case, it shall be ensured that reflection areas remote from light emitting devices are preferentially adjusted so that same control colors will not overlap, and they will be contiguous in reflection areas closer to the light emitting devices. As described above, as reflection areas close to light emitting devices are controlled so that reflected light can be spread, thus being hard to affect color mixing performance of the luminescent light source

21, it is only necessary to shift them onto the vicinity of the light emitting devices.

[0087] When the control colors of the respective reflection areas have been thus determined, a constant of each reflection area, in particular, curvature CV, may be designed so that light of that color is outputted vertically to the front face direction. However, a reflection area whose control colors are red and blue (RB) is the reflection area such designed that red light and blue light outputted from the red and blue virtual light emitting devices 32R, 32B located in a same position in a certain direction will be outputted vertically to the front face direction.

[0088] When the control colors of each reflection area have been thus determined, a curvature or shape of each reflection area is determined so that the light is outputted to the front face direction, depending on the control color. Specifically, if a conic surface comprises a reflection area, a conic efficient CC or curvature CV being parameters thereof may be determined.

[0089] First, we should consider determining the conic coefficient CC of each reflection area so that light exits uniformly from the whole luminescent light source 21. The light to be outputted from the luminescent light source 21 can be divided into light to be outputted directly from the light emitting devices 24R, 24G, 24B and the light to be outputted after being reflected by the reflecting mirror 26. Thus, it is necessary to know distribution of amount of light to be outputted directly from the light emitting devices 24R, 24G, 24B. As shown in Fig. 12, this is the light to be outputted from the direct output area 29.

[0090] Fig. 31 shows distribution of irradiation light amounts of light to be outputted from the direct output area 29 of the luminescent light source 21. The irradiation light amounts are those on the irradiated surface (target surface) 20mm distant from the front face of the luminescent light source 21. The horizontal axis of Fig. 31 designates a distance in the diagonal direction from the center of the luminescent light source 21, and the vertical axis designates relative values of the irradiation light amounts that are normalized so that the maximum value of the light amounts will be 1. In addition, the curved line C29 in Fig. 32 represents a partly expanded distribution of light amounts of Fig. 31. Thus, given the diagonal directions of the luminescent light source 21 as shown in Fig. 24 or Fig. 25, as on the cross section, the five reflection areas 28a, 28b, 28c, 28d, 28e are arranged in this order from the inner side, it would be good if the irradiation light amounts to be outputted from the front face direction from the reflection regions 28a, 28b, 28c, 28d, 28e made up for distribution of the irradiation light amounts on the target surface of the light to be outputted from the direct output area 29, and almost uniform amount of light as a whole could be obtained.

[0091] For instance, to distribution of irradiation light amounts of light to be outputted from the direct output area 29 as shown in Fig. 31, if distribution of irradiation light amounts to be outputted after being reflected by the respective reflection areas 28a, 28b, 28c, 28d, 28e is the distribution as shown by C28a, C28b, C28c, C28d, C28e in Fig. 32, the total irradiation light amount distribution C total will be almost uniform light amount distribution. However, at the end of the luminescent light source 21, if a plurality of luminescent light sources 21 are arranged, light from adjacent four luminescent light sources 21 overlap, and thus light amounts at the end may be small in a single luminescent light source 21.

[0092] Thus, if the distribution of light amounts of light to be outputted from the direct output area 29 is as shown in Fig. 31, peak values of the irradiation light amounts of light to be reflected by the respective reflection areas 28a, 28b, 28c, 28d, 28e may be 1.0 time, 1.8 times, 2 times, 2 times, 1 time higher than the peak values of the light to be outputted from the direct output area 29, as shown in Fig. 32. The amount of light to be incident on the reflection areas 28a, 28b, 28c, 28d, 28e rapidly decreases as it moves farther from the center. Thus, if given this, the conic coefficient CC of the reflection areas 28a, 28b, 28c, 28d, 28e is determined, the respective conic efficient CC shall be -5, -2, -1.5, -1, -1 in this order.

[0093] Then, after the conic efficient CC of the respective reflection areas 28a, 28b, 28c, 28d, 28e is determined, the curvature CV of the respective reflection areas 28a, 28b, 28c, 28d, 28e is determined depending on the control colors as determined above, adjustment should be made so that light of each control color is outputted to the front face direction from the respective reflection areas, 28a, 28b, 28c, 28d, 28e, and color uniformity is ensured by improving color mixing performance on the target surface of the luminescent light source 21. Specifically, the curvature of the respective reflection areas 28a, 28b, 28c, 28d, 28e shall be 1/5, 1/29, 1/28, 1/31, 1/31 in this order. Thus, if the conic efficient CC or the curvature CV of the respective reflection areas 28a, 28b, 28c, 28d, 28e in the diagonal direction is determined, the conic efficient CC or the curvature CV is determined for other remaining reflection areas, and a shape of each reflection area is determined. Distribution of optical intensity shown in Fig. 16 represents the distribution of irradiated light amounts on the target surface of the luminescent light source 21 for which the curve constant is thus determined.

[0094] Alternatively, as another example, the luminescent light source such as Fig. 33 in which the red light emitting device 24R is placed in the center, the green light emitting devices 24G are arranged on both sides in one diagonal direction K2 or K6, and the blue light emitting devices 24B are arranged on both sides in other diagonal direction K3 and K5 is considered. This arrangement of the light emitting devices is basically same as that as shown in Fig. 21, and the number of vertical and horizontal arrays in the reflection areas 28R, 28G, 28B is also same, being 15. In this case, also as can be seen from the description on Fig. 21, the control colors in the upper left diagonal direction K2 and in the lower right diagonal directions K6 shall be green (G) and a mixed color of red/blue (RB), the control colors in the lower left diagonal direction K3 and in the upper right diagonal direction K5 shall be blue (B) and a mixed color of red/green

(RG), the control colors in the horizontal directions K1, K4 shall be red (R) and a mixed color of green/blue (GB), and the control colors in the vertical directions K7, K8 shall also be red (R) and a mixed color of green/blue (GB).

[0095] Thus, in this case, as shown in Fig. 33, in the upper left diagonal direction K2 and the lower right diagonal direction K6, with green (G) and the mixed color of red/blue (RB) are mutually assigned as control colors. In the lower left diagonal direction K3 and the upper right diagonal direction K5, blue (B) and the mixed color of red/green (RG) are mutually assigned as control colors. In the horizontal directions K1, K4, red (R) and the mixed color of green/blue (GB) are mutually assigned as control colors. In addition even in the vertical directions K7, K8, red(R) and the mixed color of green/blue (GB) are mutually assigned as control colors.

[0096] However, also in any of diagonal directions, horizontal directions, or vertical directions, the control colors at both ends of a set of three control colors are same. If this is repeatedly arranged, a same control color will be contiguous in the diagonal direction, horizontal direction and the vertical direction, thus leading to color irregularity. For instance, when the diagonal direction K2 is considered, the two green light emitting devices 33G are discriminated to be the virtual light emitting device 33G (1) and the virtual light emitting device 33G (2). In addition, if control colors by the virtual light emitting devices 33G (1) is made to be G (1) and control colors by the virtual light emitting device 33G (2) is made up to be G (2), the arrangement of the control colors in the diagonal direction K2 will be as shown in Fig. 37. In this case, as seen from the outputted light from the virtual light emitting devices 33G (1), 33R, 33B, and 33G (2) as shown in Fig. 37, the green light partly converges to be dense, while they partly become scarce, thus leading to color irregularity.

[0097] Thus, in such a case, as shown in Fig. 38, it would be desirable to have only the light from the virtual light emitting devices (virtual light emitting devices close to the reflection areas) on one side to be outputted to the front face. For instance, in the diagonal direction K2, the control colors by the green virtual light emitting device 33G (1) close to the reflection areas in the diagonal direction K2 and those by the red/blue virtual light emitting devices 33R, 33B are alternately arranged, and the control colors by the virtual light emitting device 33G (2) are not used. With this, as can be seen from the light diagram of Fig. 38, uniform light distribution free from color irregularity can be obtained.

[0098] Thus, after the control colors are determined in respective directions, only overlapping control colors by the virtual light emitting devices close to the reflection areas are considered so that a same control color will not be contiguous. Thus, as shown in Fig. 34, in the upper left and lower right diagonal directions K2, K6, green control color (G) and red/blue control color (RB) are alternately arranged, and in the lower left and upper right diagonal directions K3, K5, green control color (B) and red/green control color (RG) are alternately arranged. In addition, in the horizontal directions K1, K4 and the vertical directions K7, K8, red control color (R) and green/blue control color (GB) are alternately arranged. However, the control color G in the diagonal direction K2 is by the virtual light emitting device 33G (24G) located in the left top, and the control color G in the diagonal direction K6 is by the virtual light emitting device 33G (24G) located in the right bottom. This applies to the other direction as well.

[0099] If the respective control colors in the diagonal direction, horizontal direction and vertical direction are thus determined, as shown in Fig. 34, control colors along at least one side located in the periphery of the reflecting mirror 26 are determined. When the control colors are determined, a control color of each reflection area is determined in trial and error manner by assigning six types of the control colors, so that a same control color will not be contiguous on left, right, top and bottom.

[0100] Furthermore, control colors are assigned to blank reflection areas in the area (e.g., the area between the diagonal directions K2 and K3) for which peripheral control colors are determined, so that a same control color will not be contiguous on left, right, top and bottom, and as shown in Fig. 35, control colors in about 1/4 area, for instance, are determined. Then, the control colors that have been already determined are transferred to the remaining areas so that they will be symmetric about a line, and as shown in Fig. 36, the control colors are assigned to the whole.

[0101] When the control colors of the respective reflection areas are thus determined, as with the case of the three light emitting devices, the conic efficient CC or curvature CV, etc. may be determined so that uniform light will be outputted to the front face direction.

[0102] In the above embodiment, although the square reflecting mirror 26 has been divided into a plurality of square reflection areas 28i, 28j, 28k, ..., various forms other than this are also possible. Those as shown in Fig. 39 to Fig. 42 are variant 3 of the luminescent light source 21, wherein the reflecting mirror 26 being hexagonal when viewed from the front is divided into the reflection areas 28i, 28j, 28k, ... also having a same hexagonal shape as the contour thereof. Fig. 39A is a front elevation of the luminescent light source in the variant 3, and Fig. 39B, C are a cross sectional view of the luminescent light source in the diagonal direction and a cross sectional view in the opposite side direction, respectively. Fig. 40A, B are a perspective view viewed from the front of the mold unit 22 having the reflecting mirror 26 on the back side and a perspective view viewed from the rear, respectively. In addition, Fig. 41A is a front elevation of the mold unit, Fig. 41B is a back side view thereof, Fig. 41C is a right side view thereof, and Fig. 41D is a bottom view thereof. In addition, Fig. 42 is a schematic front elevation of the reflecting mirror 26 used in the luminescent light source. The luminescent light source 21 is formed like a hexagon when viewed from the front, and its reflecting mirror 26 is also formed like a hexagon. Then, the hexagonal reflecting mirror 26 is divided into a plurality of hexagonal reflection areas 28i, 28j, 28k, ... without a space therebetween.

[0103] In the case of the reflection areas 28i, 28j, 28k, ... shaped like the variant 3, while the reflection areas are contiguous in the opposite side direction K9-K9 as shown in Fig. 42, the reflection areas in the opposite side direction K10-K10 as shown in Fig. 42 are discrete (partly, passing through the boundary between the reflection areas). In such a case, first, respective curve constants such as the curvature CV or the conic coefficient CC, are first designed for the reflection areas arranged along the opposite side direction, and then, the curve constants may be sequentially determined for adjacent reflection areas being adjacent to the reflection areas. In addition, reflection areas located at the edge of the reflecting mirror 26 are partly notched trapezoids, the effective area thereof is reduced. In the reflection areas of such void-edged trapezoids, first designing takes place on the assumption that reflection shape of the edge is hexagonal, and then a value greater than the conic efficient determined as a hexagon may be assigned to the reflection area of void hexagons. If the contour of the reflecting mirror 26 is same as the shape of each reflection area 28i, 28j, 28k, ... designing can take place as described above, thus facilitating adjustment of the curve constants such as the curvature CV or conic efficient CC.

[0104] Fig. 43 is a front elevation showing the structure of the reflecting mirror 26 in the variant 4. In the reflecting mirror 26, the triangle-shaped reflecting mirror 26 is divided into a plurality of triangular reflection areas 28i, 28j, 28k, In this case, when the reflection area on the line segment K11-K11 connecting the vertex with the center of the side as shown in Fig. 43 is considered, the outermost reflection areas (the reflection area positioned at the vertex and that position at the center of the side) have a different distance from the center. Thus, in the variant, rather than designing the reflection areas on the line segment K11-K11 sequentially, designing may start with the reflection area 28h located on the vertex. In other words, first, the conic coefficient, etc. is designed for the reflection areas 28h positioned at the three vertices, then, if with the reflection areas 28h positioned at the vertices a starting point, adjacent reflection areas are sequentially designed inward, and the curve constants such as the curvature CV or conic efficient CC can be easily adjusted.

[0105] In addition, Fig. 44, Fig. 45, and Fig. 46 shows variants in which the reflecting mirror 26 is divided into the reflection areas 28i, 28j, 28k, ... whose shape is different from the contour of the reflecting mirror. In the variant 5 as shown in Fig. 44 and the variant 6 as shown in Fig. 45, the rectangular shaped reflecting mirror 26 is divided into a plurality of triangular reflecting areas 28i, 28j, 28k, ..., and in the variant 7 as shown in Fig. 46, the hexagonal reflecting mirror 26 is divided into a plurality of triangular reflecting areas 28i, 28j, 28k, According to these variants 5 to 7, the reflection areas 28i, 28j, 28k, ... can be subdivided. At the same time, since directions of the reflection areas are disparate to light to be radially outputted from the reflection areas 28i, 28j, 28k, ..., it becomes difficult to design each reflection area. Thus, in these variants, it would be desirable if designing could take place as described below.

[0106] In the variants 5 and 6 as shown in Fig. 45 and Fig. 46 in which the square reflecting mirror 26 is divided into triangular reflection areas, the opposite side direction K12-K12 is a boundary among the reflection areas, however, the reflection areas are arranged continuously in the diagonal direction K13-K13. Thus, in this case, for the reflection areas arranged in the diagonal direction K12-K12, the curve constants such as the conic coefficient, etc. are first designed, and then the reflection areas adjacent to the reflection area may be sequentially designed.

[0107] Also, in the variant 7 in which the hexagonal reflecting mirror 26 is divided into triangular reflection areas 28i, 28j, 28k, ..., the diagonal direction K14-K14 is a boundary among the reflection areas, however, the reflection areas are arranged continuously in the opposite side direction K15-K15. Thus, in this case, for the reflection areas arranged in the opposite side direction K15-K15, the curve constants such as the conic coefficient, etc. are first designed, and then the reflection areas adjacent to the reflection area may be sequentially designed.

[0108] In addition, in Fig. 47 to Fig. 49 are variants, wherein with the light emitting devices 24R, 24G, 24B as a center, the reflecting mirror 26 is divided into concentric ring zones, and the ring zone shaped areas are further divided circumferentially. In fact, in the reflecting mirror 26 of the variant 8 as shown in Fig. 47, the square reflecting mirror 26 is divided into ring zones and radially, comprising the plurality of reflection areas 28i, 28j, 28k, In the reflecting mirror 26 of the variant 9 in Fig. 48, the hexagonal reflecting mirror 26 is concentrically and radially divided, comprising the plurality of reflection areas 28i, 28j, 28k, In the reflecting mirror 26 of the variant 10 as shown in Fig. 49, the triangular reflecting mirror 26 is divided concentrically and radially, comprising the plurality of the reflecting areas 28i, 28j, 28k, In addition, like the variant 11 as shown in Fig. 50, the reflection areas of each bearing may be offset radially.

[0109] In these variants 8 to 11, as size of the reflection areas closer to the central area is smaller, manufacturing of the reflection areas near the central area is difficult. Thus, in the outer ring zone shaped area, the number of divisions may be increased, and that in the reflection areas near the central area may be reduced. In these variants, it is possible to assume same radial arrangement at each bearing to light to be radially outputted from the light emitting devices 24R, 24G, 24B, thus facilitating designing of the reflecting mirror 26 or adjustment of the curve constants.

[0110] In addition, Fig. 52 is the variant in which the reflection areas 28i, 28j, 28k, ..., having the same shape as the contour of the reflecting mirror 26 are rotated, and the reflecting mirror 26 is divided by the reflection areas 28i, 28j, 28k, In the variant 12 as shown in Fig. 51, the square reflecting mirror 26 is divided by the square reflection areas 28i, 28j, 28k, ..., that are rotated by 45° (i.e., rhombus). In the variant 13 as shown in Fig. 52, the hexagonal reflecting mirror 26 is divided by hexagonal reflection areas 28i, 28j, 28k, ..., that are rotated by 30° or 90°. In these variants 12, 13, the

reflection areas are continuous in the diagonal direction in which light amounts tend to be short, thus facilitating designing of the reflection areas. However, since many partially void shaped reflection areas tend to take place in the periphery, light loss is easy to occur. In these variants, as the reflection areas are continuous in the diagonal direction, the reflection areas arranged along the diagonal direction can be easily designed. Then, by sequentially designing the reflection areas from those adjacent to the reflection areas in the diagonal direction, designing of the reflecting mirror 26 or adjustment of the curve constants can be easily done.

[0111] Fig. 53 to Fig. 55 are variants in which the reflection areas 28i, 28j, 28k, ... 28x, 28y, 28z, ... having a different shape or size depending on a distance from the light emitting devices 24R, 24G, 24B are arranged. In fact, in the variant 14 as shown in Fig. 53, the square reflection areas 28i, 28j, 28k, ... 28x, 28y, 28z, ... are formed in the square reflecting mirror 26, and the greater the size of the reflection area is, the farther it is from the center. When an attempt to design such the reflecting mirror is made, the whole reflecting mirror 26 is divided in the largest reflection area, then, the reflection areas are sequentially divided vertically and horizontally by 1 division (i.e., no division), 2 divisions, 3 divisions, ... starting with the outermost reflection area.

[0112] In addition, in the variant 15 as shown in Fig. 54, the hexagonal reflection areas 28i, 28j, 28k, ... 28x, 28y, 28z, ... are formed in the hexagonal reflecting mirror 26, and the farther it is from the center, the greater the size of the reflection area 28i, 28j, 28k, ... 28x, 28y, 28z, ... is. Also in this case, first, the whole hexagonal reflecting mirror 26 is equally divided in the hexagonal reflection area having the largest size, and then, the reflection area having the largest size may be subdivided.

[0113] In the variant 16 as shown in Fig. 55, the triangular reflection areas 28i, 28j, 28k, ... 28x, 28y, 28z, ... are formed in the triangular reflecting mirror 26, and the farther it is from the center, the greater the size of the reflection area 28i, 28j, 28k, ... 28x, 28y, 28z, ... is. According to the variant, the degree of freedom in designing increases and optical intensity or color uniformity improves. Also in this case, first, the whole triangular reflecting mirror 26 is equally divided in the triangular reflection area having the largest size, then the reflection area having the large size may be subdivided.

[0114] In the variants 14 to 16 as shown in Fig. 53 to Fig. 55, the reflecting mirror 26 can be first divided into the reflection areas having same size, each curve constant can be designed, then each reflection area can be further divided, and the curved shape of the divided reflection areas can be fine adjusted, thus facilitating designing of the reflecting mirror 26. In addition, in such the variants, as amount of light to be outputted from the light emitting devices 24R, 24G, 24B is great, the degree of freedom in designing increases, and uniformity of optical intensity improves. However, on the one hand, luminescent area near the central area is small, manufacturing of the luminescent area near the central area is difficult.

[0115] In addition, various design changes may be added to a shape of the mold unit 22. For instance, in the variant 17 as shown in Fig. 56, the direct output area 29 is formed as a conical curve, a truncated cone shaped curve, spherical curve, etc. With the direct output area 29 formed as such the curved surface, the reflection direction of light being totally reflected by the inclined total reflection area 32 and entering the direct output area 29 can be adjusted by the tilt angle or curvature, etc., thus improving the degree of freedom in designing the reflecting mirror 26.

[0116] Fig. 57 shows a cross sectional view in the diagonal direction for describing behavior of light in the variant 17 in which the direct output area 29 is formed conically. If the direct output area 29 is thus formed conically and the direct output area 29 is caused to have an appropriate tilt angle, as shown in Fig. 57, light to be outputted from the direct output area 29 can be oriented almost parallel to each other.

[0117] Various design changes may also be added to the front shape of the mold unit 22 or the channel 25. For instance, in the variant 18 as shown in Fig. 58, the toric channel 25 and the circular direct output area 29 are formed in the luminescent light source 21 the contour of which is square. In addition, in the variant 19 as shown in Fig. 59, the square annular channel 25 and the square direct output area 29 are formed in the luminescent light source the contour of which is square. In the variant 20 as shown in Fig. 60, the hexagonal channel and the hexagonal direct output area 29 are formed in the luminescent light source the contour of which is hexagonal. In the variant 21 as shown in Fig. 61, the triangular channel 25 and the triangular direct output area 29 are formed in the triangular light source.

[0118] In the variant 18 as shown in Fig. 58, as the direct output area 29 can be designed in accordance with beam to be radially outputted from the luminescent light source 21 positioned in the central area, the direct output area 29 can be designed easily. In addition, in the variants 19 to 21 as shown in Fig. 59 to Fig. 61, the degree of freedom in designing increases and optical intensity or color uniformity improves.

[0119] In addition, in the variant 22 as shown in Fig. 62, in the luminescent light source 21 the contour of which is square, the channel 25 the contour of which is square is formed and the circular direct output area 29 is provided at the center thereof. In addition, in the variant 23 of Fig. 63, in the luminescent light source the contour of which is hexagonal, the hexagonal channel 25 is provided and the circular direct output area 29 is provided at the center thereof. In the variant 24 of Fig. 64, in the luminescent light source 21 the contour of which is triangular, the triangular channel 25 is provided and the circular direct output area 29 is provided at the center thereof.

[0120] Now we describe advantages of the variants 22 to 24 in which the outer circumferential shape of the channel 25 corresponds with the contour of the luminescent light source, as shown in Fig. 62 to Fig. 64, by comparing them with

the variants 18, 19 of Fig. 58 and Fig. 59. Fig. 65A, B represent the variant 18 of Fig. 58 in which the toric channel 25 having constant width is provided. Fig. 65A shows a cross sectional view thereof in the diagonal direction, and Fig. 65B shows a cross sectional view thereof in the opposite side direction. As shown in Fig. 65A, B, length of the respective reflection areas 28p, 28q, 28r, ... is shorter than length of the respective reflection areas 28s, 28t, 28u, ... in the cross section in the diagonal direction, and in the opposite side direction, the respective reflection areas 28p, 28q, 28r, ... are more offset to the center than in the diagonal direction. Thus, as shown in Fig. 65A, for instance, in the cross section in the diagonal direction, even if it is such designed that light is outputted from the light emitting devices 24R, 24G, 24B and the light reflected by the total reflection area 31 at the bottom of the channel 25 enters the whole second innermost reflection area 28s, in the cross section in the opposite side direction as shown in Fig. 65B, the light reflected by the total reflection area 31 enters not only the second innermost reflection area 28p, but also the third innermost reflection area 28q. Thus, even the reflection area 28q receives the light reflected by the total reflection area 31, thus complicating designing of the reflection area 28q.

[0121] On the one hand, Fig. 66A, B shows the variant 19 of Fig. 59 in which the channel 25 being square annular corresponding with the contour of the luminescent light source 22 and having constant width is provided. Fig. 66A shows a cross sectional view thereof in the diagonal direction, and Fig. 66B shows a cross sectional view thereof in the opposite side direction. Also in this case, length of each reflection area 28p, 28q, 28r, ... in the cross section in the opposite side direction is shorter than length of each reflection area 28s, 28t, 28u, ... in the diagonal direction, and in the opposite side direction, the respective reflection areas 28p, 28q, 28r, ... are more offset to the center than in the diagonal direction. However, in the case of variant 18 of Fig. 58 and Fig. 65A, B, the position of the channel 25 is constant independent of the cross sectional direction, whereas in the case of variant 19 of Fig. 59 and Fig. 66A, B, in the cross section in the opposite side direction, the position of the channel 25 is more offset to the center than in the cross section in the diagonal direction. Thus, it can be such designed that in the cross section in the diagonal direction as shown in Fig. 66A, light outputted from the light emitting devices 24R, 24G, 24B, and reflected by the total reflection area 31 at the bottom of the channel 25 enters the whole second innermost reflection area 28s, and it can be further designed that even in the cross section in the opposite side direction as shown in Fig. 66B, the light reflected by the total reflection area 31 can enter the whole second innermost reflection area 28p. Thus, according to such the variant 19, the reflection areas can be easily designed. However, such the variant 19 has the disadvantage that stray light increases, as the direct output area 29 is square shaped, the light radially outputted from the light emitting devices 24R, 24G, 24B is reflected by the square direct output area 29 or transmits the square direct output area 29. Such the disadvantage can also be seen in the variants 20, 21 of Fig. 60 and Fig. 61.

[0122] At the same time, according to the variant 22 of Fig. 62 in which the contour of the channel 25 is formed to be square corresponding with the contour of the luminescent light source 21, and the circular direct output area 29 is provided in the center thereof, the light reflected by the total reflection area 31 in both the diagonal and the opposite side directions, similar to Fig. 66A, B, can enter the specific reflection areas 28s, 28p. In addition, according to the variant 22, as the direct output area 29 is circular, light radially outputted from the light emitting devices 24R, 24G, 24B can be reflected or transmit in each direction, which can thus restrain occurrence of stray light. The effect can also be seen in the variants 23, 24 of Fig. 63 and Fig. 64.

[0123] The variant 25 as shown in Fig. 67 is the luminescent light source 21 having the total reflection area 31 at the bottom of the channel 25 divided into a plurality of segment areas 31a, 31b, In addition, Fig. 68A shows a perspective view illustrating the structure of the direct output area 29 and the total reflection area 31 of the luminescent light source 21. Fig. 68B, C shows the optical behavior in the luminescent light source 21. Fig. 68B shows a schematic cross sectional view of the luminescent light source 21 in the opposite side direction and Fig. 68C is a front elevation thereof. In addition, the total reflection area 31 shown by the chain line in Fig. 68B represents a part of the total reflection area 31 located before the cross section of the same figure. According to the variant 25, the degree of freedom in designing increases and the optical intensity or color uniformity can be improved. In the variant 25, the total reflection area 31 is divided into eight equal parts, and the segment area 31a and the segment area 31b are alternately arranged along the circumferential direction. The segment area 31a and the segment area 31b are reversely inclined along the circumferential direction, and are arranged so that light outputted in the opposite side direction can be spread in both sides, and light outputted in the diagonal direction can converge in the diagonal direction.

[0124] Fig. 69A shows a perspective view of the total reflection area 31 having uniform tilt angle around the center of the axis of the direct output area 29. Fig. 69B, C shows optical behavior in the luminescent light source. Fig. 69B shows a schematic sectional view of the luminescent light source 21 in the opposite side direction, and Fig. 69C shows a front elevation thereof. In the comparative example having such the total reflection area 31, as shown in Fig. 69B, C, light outputted from the light emitting devices 24R, 24G, 24B is spread radially after being reflected by the total reflection area 31, and thus as the result of the light being equally distributed in each direction, the amount of light in the diagonal direction is short. At the same time, in the variant 25 as shown in Fig. 67, since, as shown in Fig. 68B, C, the segment area 31a and the segment area 31b are arranged to spread the light outputted in the opposite side direction in both sides, and converge the light outputted in the diagonal direction to the diagonal direction, more light can be collected in

the diagonal direction than in the opposite side direction, and great amount of light can be distributed in the diagonal direction, which can thus improve optical intensity or color uniformity in the front face of the luminescent light source 21.

[0125] Fig. 70A shows a perspective view of the structure of the direct output area 29 and the total reflection area 31 of the luminescent light source 21 according to the variant 26. Fig. 70B, C shows the optical behavior in the luminescent light source 21. Fig. 70B shows a schematic cross sectional view of the luminescent light source 21 in the opposite side direction, and Fig. 70C is a front elevation thereof. In addition, the total reflection area 31 shown by the chain line in Fig. 68B represents a part of the total reflection area 31 located before the cross section of the same figure. In the variant 26, in the luminescent light source 21 of Fig. 67, a chamfer shaped segment area 31c is further formed between the segment area 31a and the segment area 31b of the total reflection area 31. According to the variant 26, since light outputted from the light emitting devices 24R, 24G, 24B can be further diffused in the chamfer shaped segment area 31c, optical strength or color uniformity in the front side of the luminescent light source 21 can be improved.

[0126] In addition, in the variant 27 of Fig. 71, the surface of the direct output area 29 is divided into a plurality of segment areas 29a, 29b, ..., and each segment area 29a, 29b, ... has a different inclination direction or tilt angle. Since amount of light to be distributed to each reflection area 28i, 28j, 28k can be adjusted by dividing the direct output area 29 and adjusting the inclination direction or tilt angle of each segment area 29a, 29b, ..., optical intensity or color uniformity in the front face of the luminescent light source 21 can be improved. In addition, as with the variant 28 of Fig. 72, the total reflection area 31 at the bottom of the channel 25 is divided, and the surface of the direct output area 29 may be further divided into the plurality of segment areas 29a, 29b,

[0127] Fig. 73 shows a front elevation of the luminescent light source 21 according to the variant 29. In the variant 29, the total reflection area 30 is divided into the plurality of grid-like segment areas 30a, 30b, ..., thereby forming a convex-concavo pattern on the surface of the total reflection area 30. In the luminescent light source 21 having the flat total reflection area 30, as with the comparative example as shown in Fig. 75A, B, leakage of light from the outer circumferential surface of the mold unit 22 may lead to loss of light amounts, or a corner area tends to be dark because the amount of light at the corner area in the diagonal direction that is located farthest from the light emitting device is short. At the same time, as with the variant 29 of Fig. 73, if the total reflection area is divided into more than one segment area 30a, 30b, ..., as shown in Fig. 74A, B, light can be guided to any of the reflection areas 28i, 28j, 28k, ..., by adjusting inclination or tilt angle of each segment area 30a, 30b, ... of the total reflection area 30. Thus, as the degree of freedom in designing increases, a difference in light amounts of light arriving at each reflection area of the reflecting mirror 26 can be alleviated, thus improving optical intensity or color uniformity on the front face of the luminescent light source.

[0128] In the variant 29, in the opposite side direction, for instance, light can be diffused by bending an area of the total reflection area 30 like a concave lens, or light amounts to be distributed to the diagonal direction can be increased by inclining an area of the total reflection area 30 to the diagonal direction and having the light reflected to the diagonal direction, which can thus prevent the corner area in the diagonal direction from being dark. In addition, the area of the total reflection area 30 at the end of the diagonal direction reduces lost light that leaks from the outer circumferential surface of the luminescent light source 21 and effectively utilizes light, it would be desirable to incline it to the center or to the opposite side direction.

[0129] In addition, in the luminescent light source in which the total reflection area 30 is flat, as with the comparative example as shown in Fig. 77, although light is equally outputted from the total reflection area 30, optical intensity is weak because light to be outputted from the end of the total reflection area 30 has long light path length from the light emitting device, and thus, it tends to be dark at the edge of the luminescent light source. In addition, light leaks from the outer circumferential surface of the luminescent light source, becoming lost light, which may reduce utilization efficiency of light. In the variant 29, in such a case, as shown in Fig. 76, among the total reflection areas 30, the segment areas 30a, 30b, ... other than those in the periphery, are inclined to the outer circumferential side, and light reflected by the segment areas 30a, 30b, ... other than those in the periphery can be transmitted to the periphery, which can thus prevent the periphery of the luminescent light source 21 from being dark. In addition, by inclining the segment areas 30a, 30b, ... in the periphery among the total reflection areas 30, lost light that leaks from the outer circumferential surface of the luminescent light source 21 can be reduced. Thus, according to the variant 29, the degree of freedom in designing increases, and optical intensity or color uniformity can improve.

[Embodiment 2]

[0130] Fig. 78 shows a front elevation of the luminescent light source array 50 according to Embodiment 2 of the present invention. The luminescent light source array 50 is an array of the luminescent light sources 21 according to the invention either without a gap or with some gap in the same plane. The luminescent light source array 50 is used as a liquid crystal display or a backlight for liquid crystal display television, or a lighting system, and is advantageous in that it is thin, has excellent color reproducibility, is less susceptible to color irregularity, and has high color uniformity.

[0131] In addition, if the luminescent light source array 50 using the luminescent light source 21 of the present invention is used as a backlight, the front space (space to the target surface) needed for equalization of optical intensity and color

mixing degree can be short, information display equipment (e.g., a liquid crystal display to be discussed later) in which the luminescent light source array 50 is incorporated as a backlight can be thin, thereby enabling an attempt to thin the information display equipment.

[0132] In addition, in the luminescent light source array 50 using the luminescent light source 21, the light emitting devices does not become crowded even though the array of the luminescent light sources 21 is made, thus improving radiation performance, and enabling simplification of a radiation mechanism. Then, simplification of the radiation mechanism contributes to thinning of the information display equipment such as the liquid crystal display, etc.

[Embodiment 3]

[0133] Fig. 79 shows a schematic cross section of the structure of a liquid crystal display (liquid crystal display device) 51 according to Embodiment 3 of the present invention. The liquid crystal display 51 is comprised by arranging a backlight 53 on the rear of a liquid crystal panel 52. The liquid crystal panel is a general one, and comprised by sequentially laminating a polarization plate 54, a liquid crystal cell 55, a phase difference plate 56, a polarization plate 57 and antireflection film 58 from the rear.

[0134] The backlight 53 is comprised by placing a light diffusion film 61, a prism sheet 62 and a luminance improvement film 63 on the front face on the luminescent light source array 50 on which a plurality of luminescent light sources 21 are arranged. As described later, the luminescent light source 21 is formed like a square when viewed from the front, and the luminescent light source array 50 is comprised by arrangement of about one hundred or several hundreds of the luminescent light sources 21 in a grid. By diffusing light outputted from the luminescent light source array 50, the light diffusion film 61 not only attempts to equalize luminance, but also serves to uniformly mix light of respective colors outputted from the luminescent light source array 50. By having obliquely incident light to refract or internally reflected, the prism sheet 62 bends the prism sheet in vertical direction and has the light transmit, thereby improving luminance on the front face the backlight 53.

[0135] The luminance improvement film 53 is a film that has straight polarized light within a plane of polarization to transmit and reflects the straight polarized light being orthogonal thereto, and serves to improve utilization efficiency of light to be outputted from the luminescent light source array 50. In fact, the luminance improvement film 63 is arranged to coincide with the plane of polarization of the polarizing plate 54. Thus, among light to be outputted from the luminescent light source 50, although light for which the polarizing plate 54 and the plane of polarization coincide transmits through the luminance improvement film 63 and enters the liquid crystal panel 52, light for which the polarizing plate 54 is orthogonal to the plane of polarization is reflected back by the luminance improvement film 63 and enters the luminance improvement film 63 again. The light reflected back by the luminance improvement film 63 is reflected by the luminescent light source array 50, and a part of it transmits the luminance improvement film 63 because the plane of polarization is rotating till it re-enters the luminance improvement film 63. Repetition of such actions enables most of light outputted from the light source array 50 to be utilized by the liquid crystal panel 52, thus improving luminance of the liquid crystal panel.

[0136] Fig. 80 shows a schematic sectional view of a variant of Embodiment 3. In the liquid crystal display 64 according to the variant, the prism sheet 62 and the luminance improvement film 63 that were placed between the luminescent light source array 50 and the liquid crystal panel 52 in the liquid crystal display 51 of Fig. 79 can be omitted. Of course, either one of the prism sheet 62 and the luminance improvement film 63 can be omitted. Use of the luminescent light source array 50 of the present invention could enable adjustment with high precision of the direction or spread of light to be outputted from the luminescent light source 21, thus eliminating the need for the prism sheet used in the conventional liquid crystal display device or backlight. In addition, use of the luminescent light source array 50 of the present invention could improve optical intensity by adjusting the direction or spread of the light to be outputted from the luminescent light source 21, thus eliminating the need for the luminance improvement film used in the conventional liquid crystal display device.

[0137] Thus, according to the variant, since the prism sheet or the luminance improvement film can be omitted, the liquid crystal display 64 can be thinned and assembly cost can also be reduced. In addition, since loss of light in the prism sheet or the luminance improvement film is eliminated, the light use efficiency can be improved.

[Embodiment 4]

[0138] Fig. 81 shows a perspective view of a lighting system 72 for indoor lighting that uses the luminescent light source array of the present invention. The lighting system 72 houses the luminescent light source array 73 of the invention in a housing 74, and a power supply unit 75 is attached to the housing 74. A plug from the power supply unit 75 is inserted into the outlet of a commercial power supply and the switch is turned on, alternating power supply to be supplied from the outlet of the commercial power supply is converted into direct current power, by which the luminescent light supply array 73 emits light. Thus, the lighting system 72 can be used in, for instance, a wall-mounted indoor lighting system.

Claims

1. A luminescent light source (21), comprising:

5 a reflecting mirror (26) for reflecting light,
a light guide unit arranged on a light reflection surface of the reflecting mirror (26), and
a light emitting device arranged in the central area of the reflecting mirror (26) and outputting light to the light
guide unit,

10 wherein the light guide unit has a light output surface for outputting to the external light outputted from the light
emitting device and light of the light emitting device reflected by the reflecting mirror (26), the reflecting mirror (26)
has a light reflection surface for reflecting light outputted from the light emitting device and reflected by the light
output surface of the light guide plate, the light reflection surface comprises a plurality of reflection areas (28i, 28j,
28k, ...) arranged along at least two directions.

- 15 2. A luminescent light source (21), comprising:

a reflecting mirror (26) for reflecting light,
a light guide unit arranged on a light reflection surface of the reflecting mirror (26), and
20 a light emitting device arranged in the central area of the reflecting mirror (26) and outputting light to the light
guide unit,

wherein the light guide unit has a light output surface for outputting to the external light outputted from the light
emitting device and light of the light emitting device reflected by the reflecting mirror (26), the reflecting mirror (26)
25 has a light reflection surface for reflecting light outputted from the light emitting device and reflected by the light
output surface of the light guide plate, the light reflection surface is a mosaic arrangement of a plurality of reflection
areas (28i, 28j, 28k, ...).

- 30 3. The luminescent light source (21) according to Claim 1 wherein the reflection areas (28i, 28j, 28k, ...) are square,
rectangular, hexagonal, triangular, or fan-shaped.

4. The luminescent light source (21) according to Claim 1, wherein a part of the reflection areas (28i, 28j, 28k, ...)
being adjacent in each direction in which the reflection areas (28i, 28j, 28k, ...) are arranged have mutually different
amount of characteristic that characterizes each reflection area.

- 35 5. The luminescent light source (21) according to Claim 1, wherein the reflection areas (28i, 28j, 28k, ...) being adjacent
in an intermediate direction of respective directions in which the reflection areas (28i, 28j, 28k, ...) are arranged have
mutually different amount of characteristic that characterizes each reflection area.

- 40 6. The luminescent light source (21) according to Claim 4, wherein the amount of characteristic is amount of displace-
ment of the each reflection area in the optical axis direction of the reflecting mirror (26).

7. The luminescent light source (21) according to Claim 4 wherein the each reflection area is a conic surface, and the
amount of characteristic is a curvature radius that characterizes the conic surface.

- 45 8. The luminescent light source (21) according to Claim 4, wherein the each reflection area is a conic surface, and the
amount of characteristic is conic efficient that characterizes the conic surface.

9. The luminescent light source (21) according to Claim 1, **characterized by** comprising a plurality of the light emitting
50 devices (24R, 24G, 24B) having different luminescent colors.

10. The luminescent light source (21) according to Claim 9, wherein adjacent reflection areas (28i, 28j, 28k, ...) reflect
light of each light emitting device so that light outputted from mutually different light emitting devices (24R, 24G,
24B) are outputted to the front face direction almost vertically.

- 55 11. The luminescent light source (21) according to Claim 1, wherein the surface of the light guide unit is divided into a
plurality of areas, and for every divided area, a tilt angle or inclination direction of the surface thereof is changed.

12. A luminescent light source array, comprising:

a plurality of arranged light luminescent sources;
the luminescent light sources, comprising:

a reflecting mirror (26) for reflecting light,
a light guide unit arranged on a light reflection surface of the reflecting mirror (26), and
a light emitting device arranged in the central area of the reflecting mirror (26) and outputting light to the
light guide unit,

wherein the light guide unit has a light output surface for outputting to the external light outputted from the light
emitting device and light of the light emitting device reflected by the reflecting mirror (26), the reflecting mirror (26)
has a light reflection surface for reflecting light outputted from the light emitting device and reflected by the light
output surface of the light guide plate, the light reflection surface is comprised of a plurality of reflection areas (28i,
28j, 28k, ...) arranged along at least two directions.

13. A method of setting a light path of a luminescent light source, comprising the steps of:

preparing the luminescent light source comprising a reflecting mirror (26) for reflecting light, a light guide unit
arranged on a light reflection area of the reflecting mirror (26), and a light emitting device for outputting light to
the light guide unit;
arranging the light emitting device in the central area of the reflecting mirror (26);
configuring a light output surface for outputting to the light guide unit light outputted from the light emitting device,
and to the external light of the light emitting device reflected by the reflecting mirror (26);
configuring a light reflection surface for reflecting to the reflecting mirror (26) light outputted from the light emitting
device and reflected by the light output surface of the light guide plate, and
forming on the light reflection surface a plurality of reflection areas (28i, 28j, 28k, ...) arranged along at least
two directions, and individually setting a reflection direction of reflected light for every reflection area.

14. A method of outputting light of a luminescent light source, comprising the steps of:

preparing the luminescent light source comprising a reflecting mirror (26) for reflecting light, a light guide unit
arranged on a light reflection surface of the reflecting mirror (26), and a light emitting device for outputting light
to the light guide unit,
arranging the light emitting device in the central area of the reflecting mirror (26);
configuring a light output surface for outputting to the light guide unit light outputted from the light emitting device,
and to the external light of the light emitting device reflected by the reflecting mirror (26);
configuring a light reflection surface for reflecting to the reflecting mirror (26) light outputted from the light emitting
device and reflected by the light output surface of the light guide plate,
forming on the light reflection surface a plurality of reflection areas (28i, 28j, 28k, ...) arranged along at least
two directions, and individually setting a reflection direction of reflected light for every reflection area, and
outputting light by adjusting an outputting direction and a optical intensity distribution of light outputted from the
light output surface of the light guide plate.

15. A lighting system, comprising:

a luminescent light source array in which a plurality of luminescent light sources are arranged, and
a power supply unit for supplying power to the luminescent light source array, wherein
the luminescent light source, comprising:

a reflecting mirror (26) for reflecting light,
a light guide unit arranged on a light reflection surface of the reflecting mirror (26), and
a light emitting device arranged in the central area of the reflecting mirror (26) and outputting light to the
light guide unit,

wherein the light guide unit has a light output surface for outputting to the external light outputted from the light
emitting device and light of the light emitting device reflected by the reflecting mirror, the reflecting mirror has a light
reflection surface for reflecting light outputted from the light emitting device and reflected by the light output surface

EP 1 681 509 A1

of the light guide plate, the light reflection surface is comprised of a plurality of reflection areas (28i, 28j, 28k, ...) arranged along at least two directions.

16. A backlight, comprising:

a plurality of luminescent light sources arranged in a same plane;
the luminescent light sources, comprising:

a reflecting mirror for reflecting light,
a light guide unit arranged on a light reflection surface of the reflecting mirror, and
a light emitting device arranged in the central area of the reflecting mirror and outputting light to the light guide unit,

wherein the light guide unit has a light output surface for outputting to the external light outputted from the light emitting device and light of the light emitting device reflected by the reflecting mirror, the reflecting mirror has a light reflection surface for reflecting light outputted from the light emitting device and reflected by the light output surface of the light guide plate, the light reflection surface is comprised of a plurality of reflection areas (28i, 28j, 28k, ...) arranged along at least two directions.

17. A liquid crystal display device, comprising:

a luminescent light source array in which a plurality of luminescent light sources are arranged, and
a liquid crystal display panel arranged opposed to the luminescent light source array;
the luminescent light source, comprising:

a reflecting mirror for reflecting light,
a light guide unit arranged on a light reflection surface of the reflecting mirror, and
a light emitting device arranged in the central area of the reflecting mirror and outputting light to the light guide unit,

wherein the light guide unit has a light output surface for outputting to the external light outputted from the light emitting device and light of the light emitting device reflected by the reflecting mirror, the reflecting mirror has a light reflection surface for reflecting light outputted from the light emitting device and reflected by the light output surface of the light guide plate, the light reflection surface is comprised of a plurality of reflection areas (28i, 28j, 28k, ...) arranged along at least two directions.

18. The liquid crystal display device according to Claim 17, wherein there is no optical element for directing a traveling direction of light outputted from the luminescent light source array to the front face direction of the liquid crystal display panel, between the luminescent light source array and the liquid crystal display panel.

19. The liquid crystal display device, according to Claim 17, wherein there is no optical element for improving luminance of light for illuminating the liquid crystal display pane, between the luminescent light source array and the liquid crystal display panel.

Petitioner Hisense USA Corporation
Exhibit 1002 - Page 423 of 836

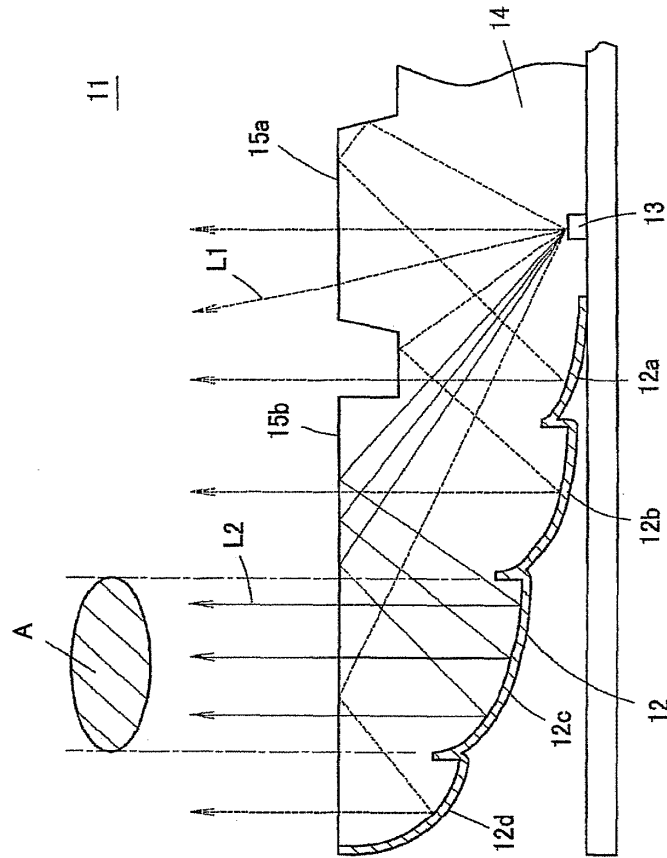
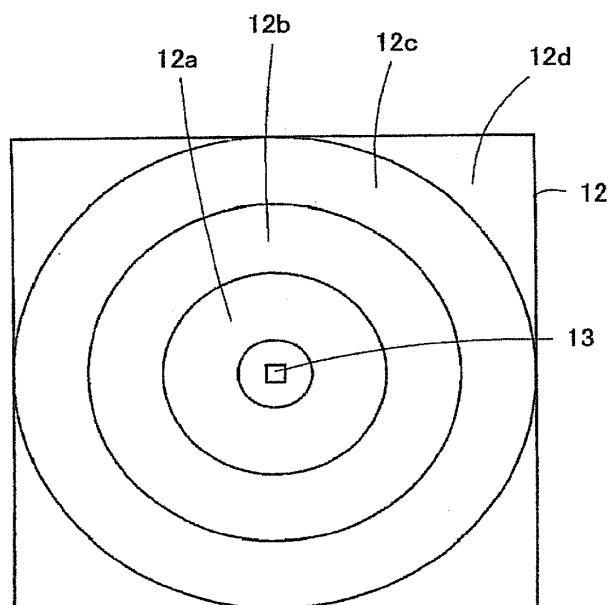


Fig. 2



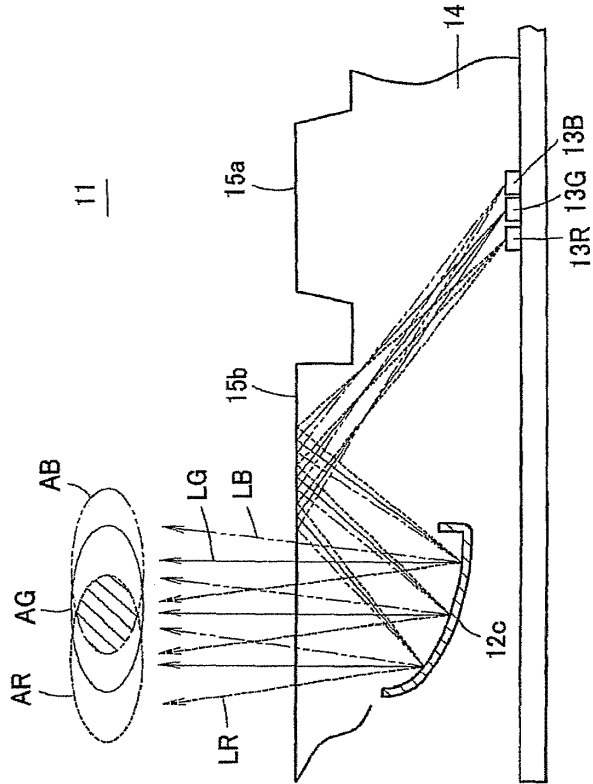


Fig. 3

Fig. 4

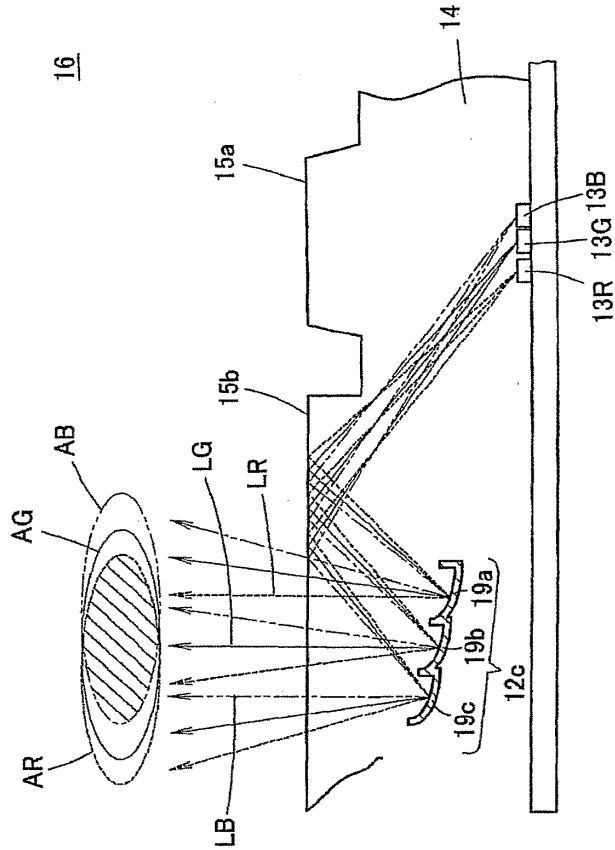


Fig. 5

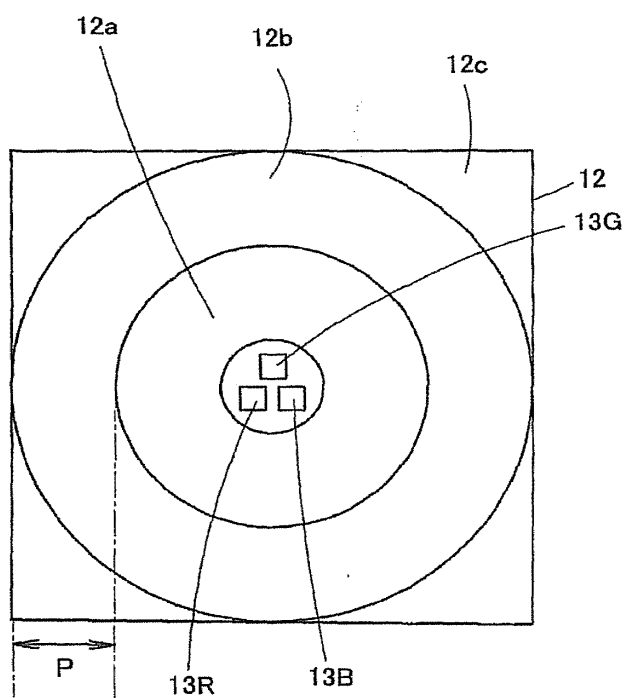


Fig. 6

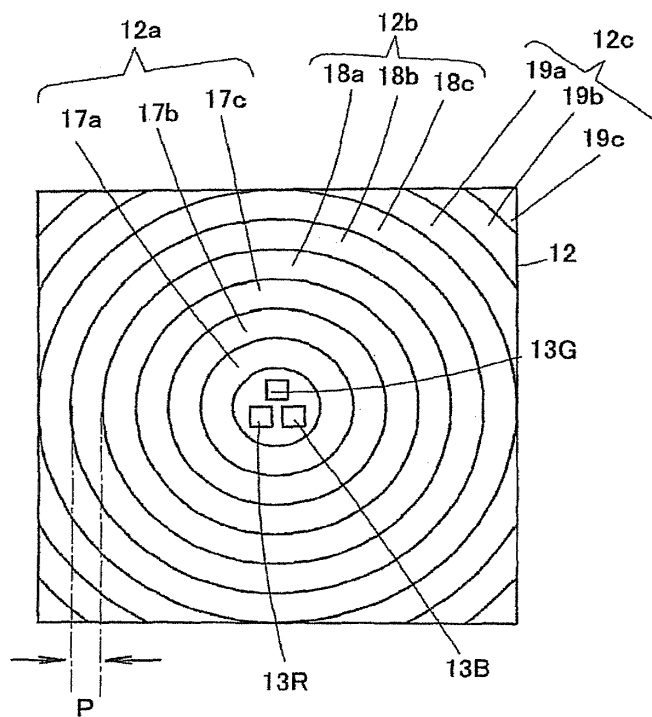


Fig. 7

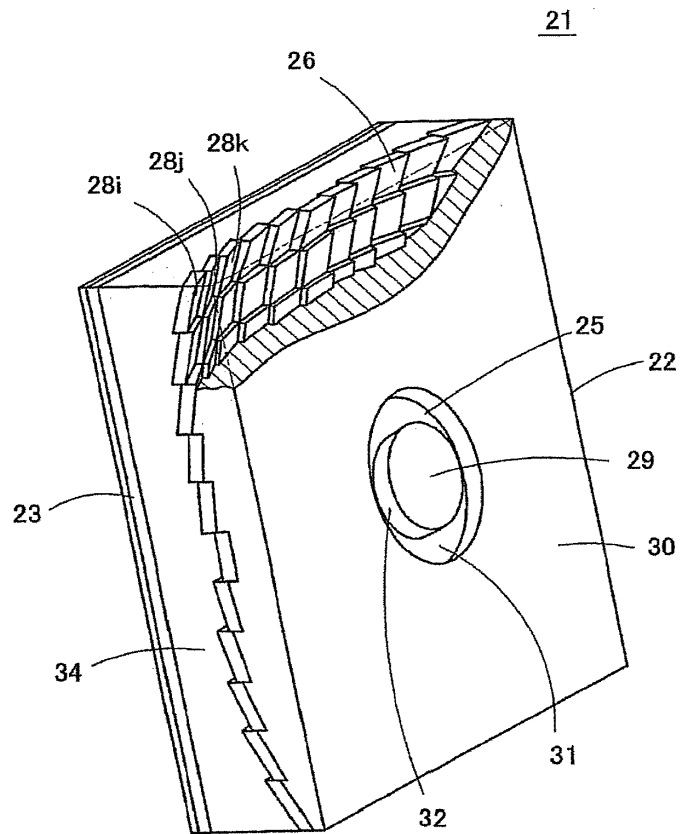


Fig. 8

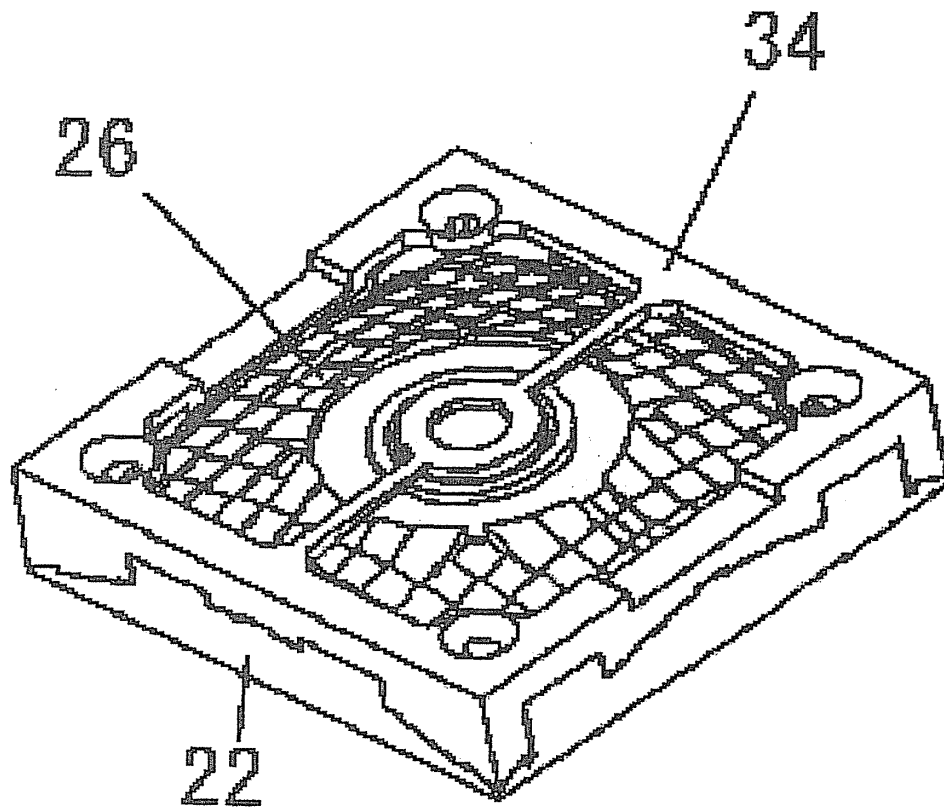


Fig. 9

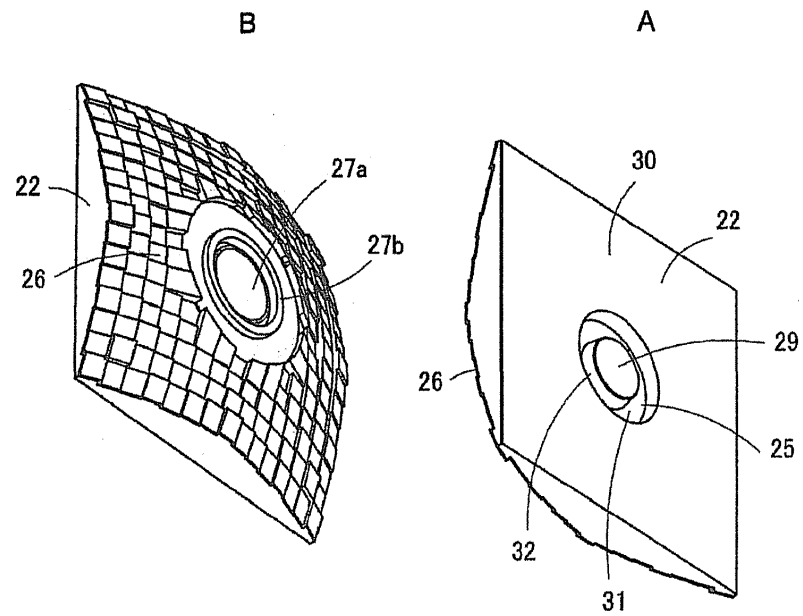
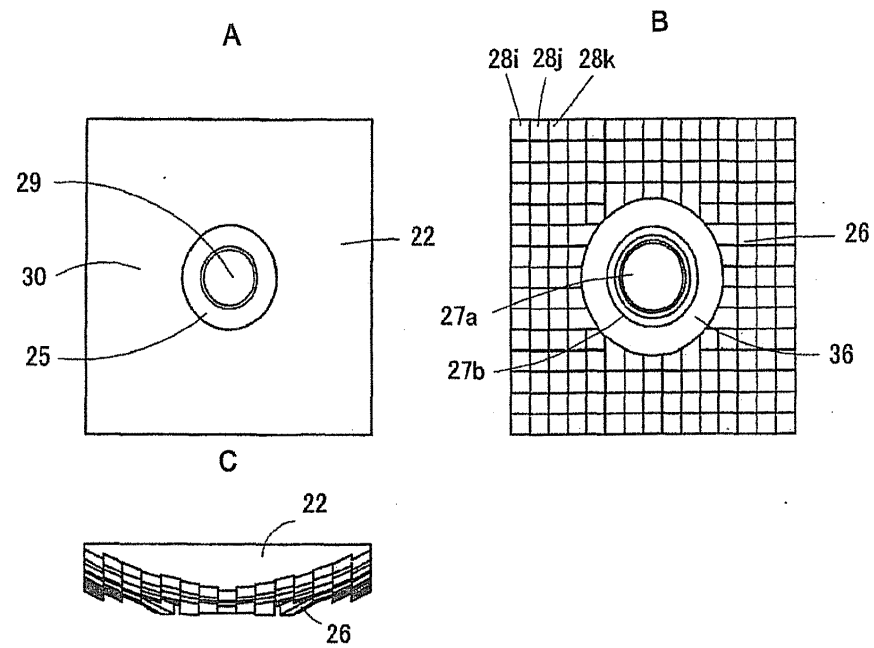


Fig. 10



EP 1 681 509 A1

Fig. 11

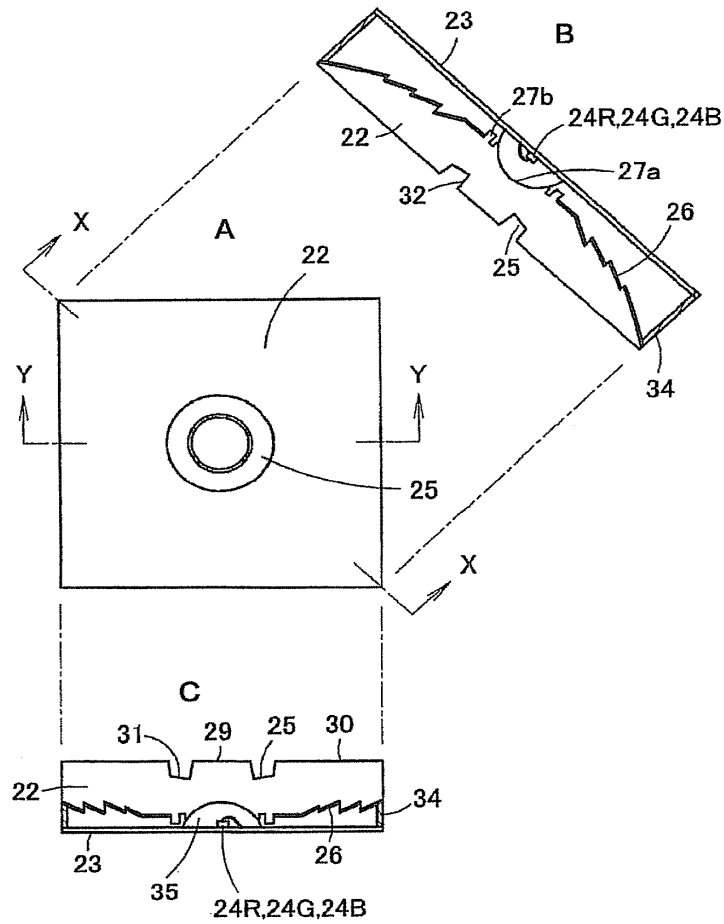
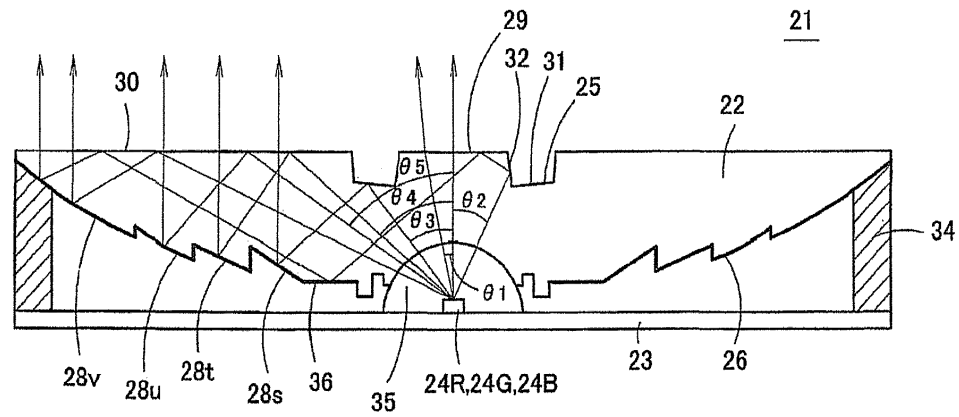


Fig. 12



EP 1 681 509 A1

Fig. 13

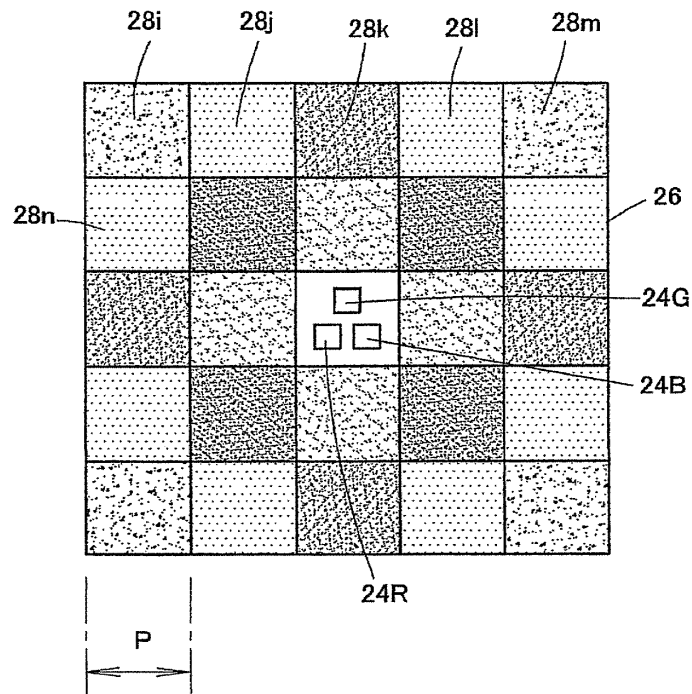
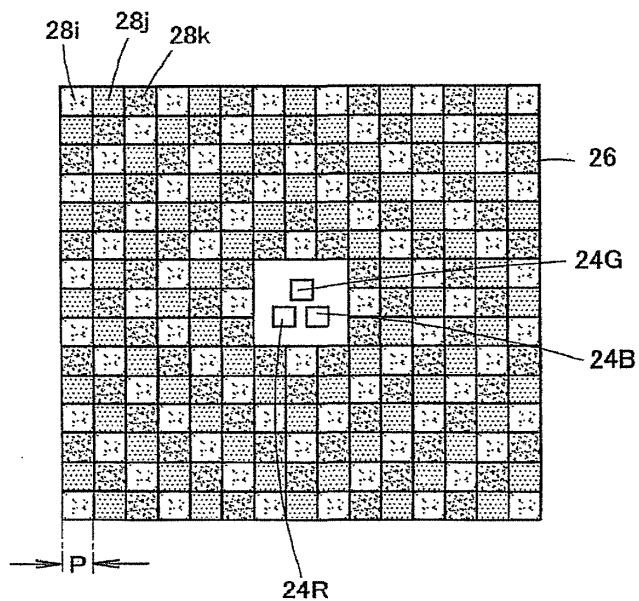


Fig. 14



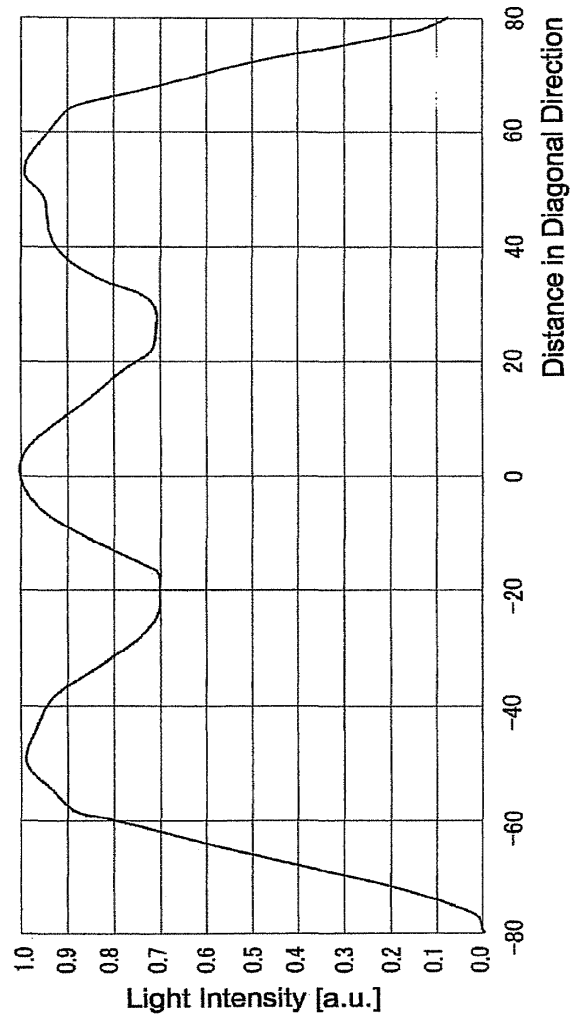


Fig. 15

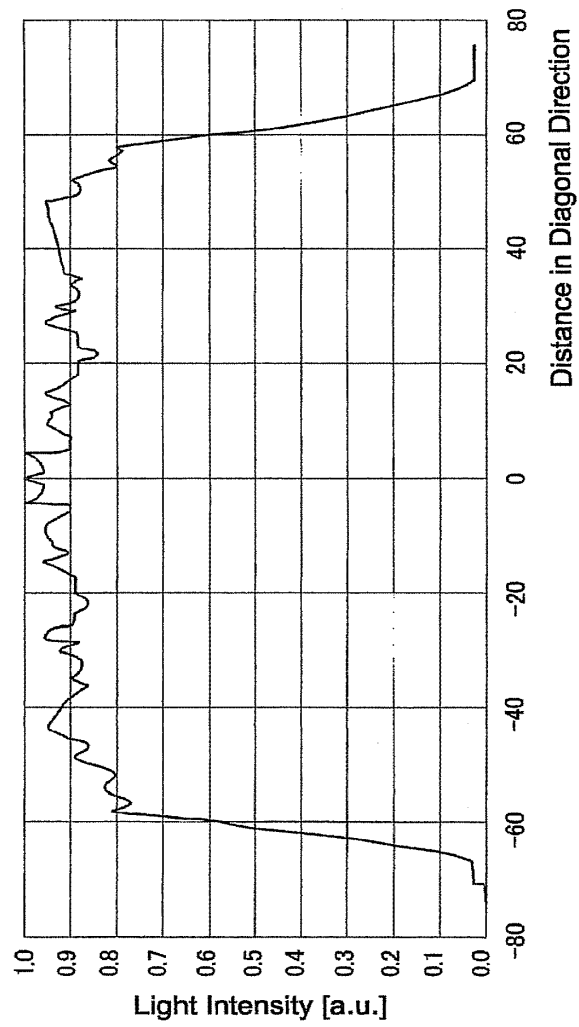


Fig. 16

Fig. 17

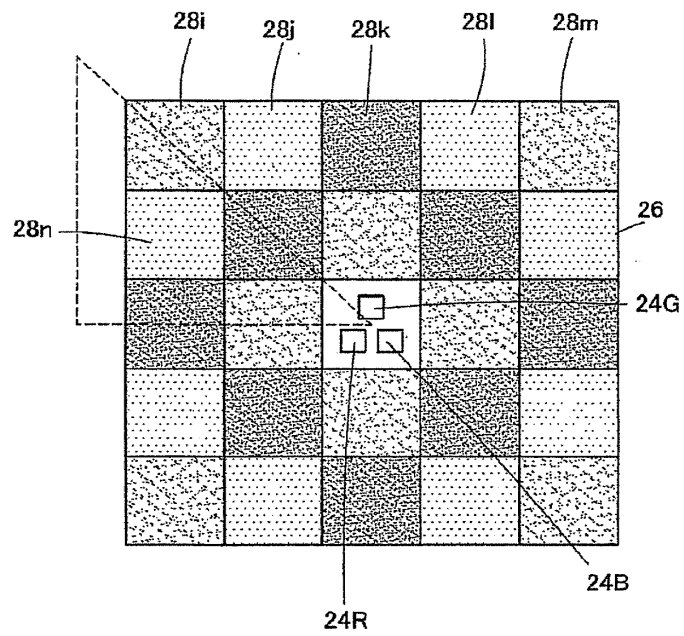


Fig. 18

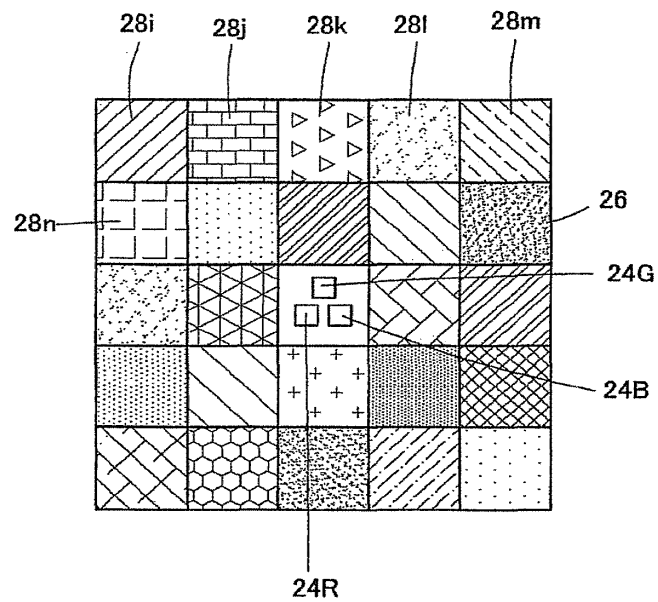
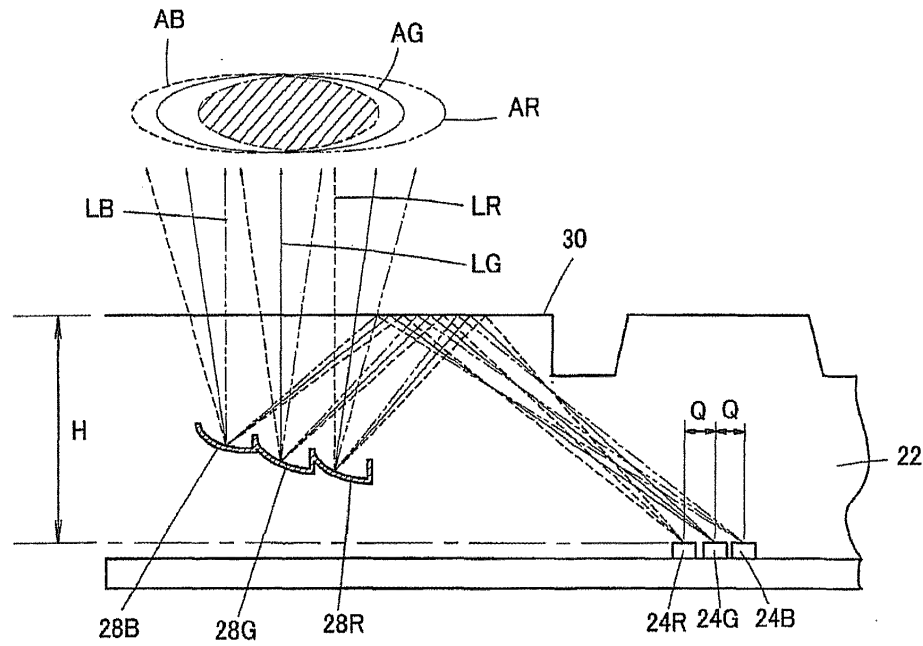
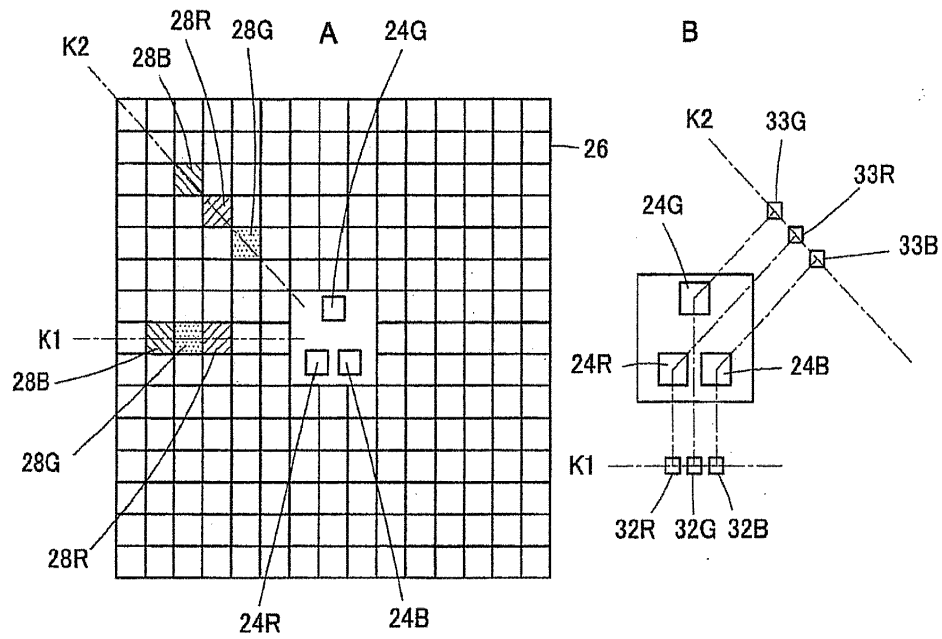


Fig. 19



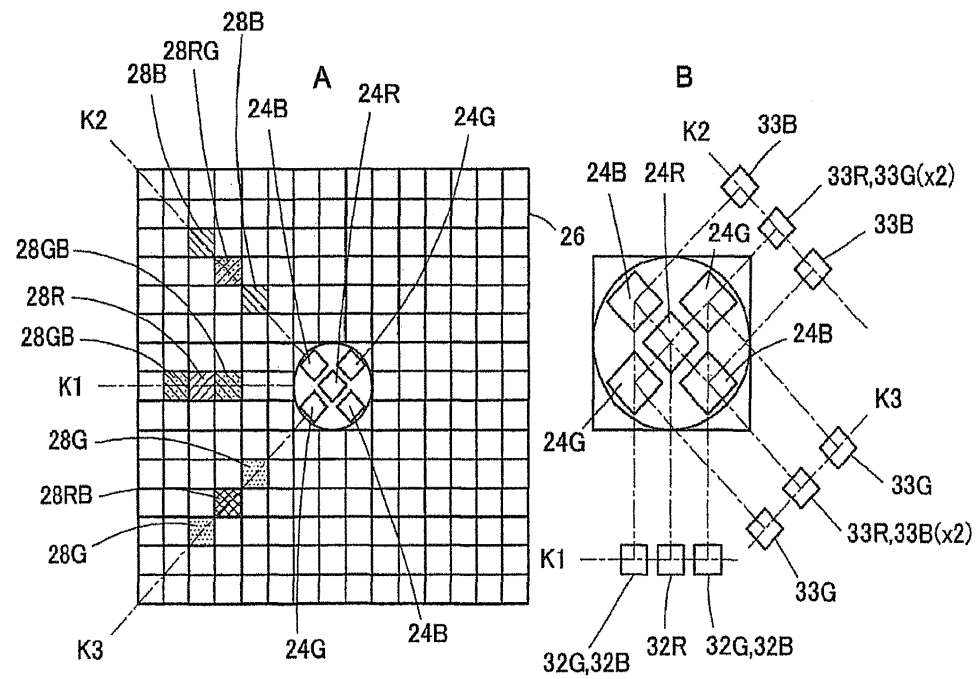
EP 1 681 509 A1

Fig. 20



EP 1 681 509 A1

Fig. 21



EP 1 681 509 A1

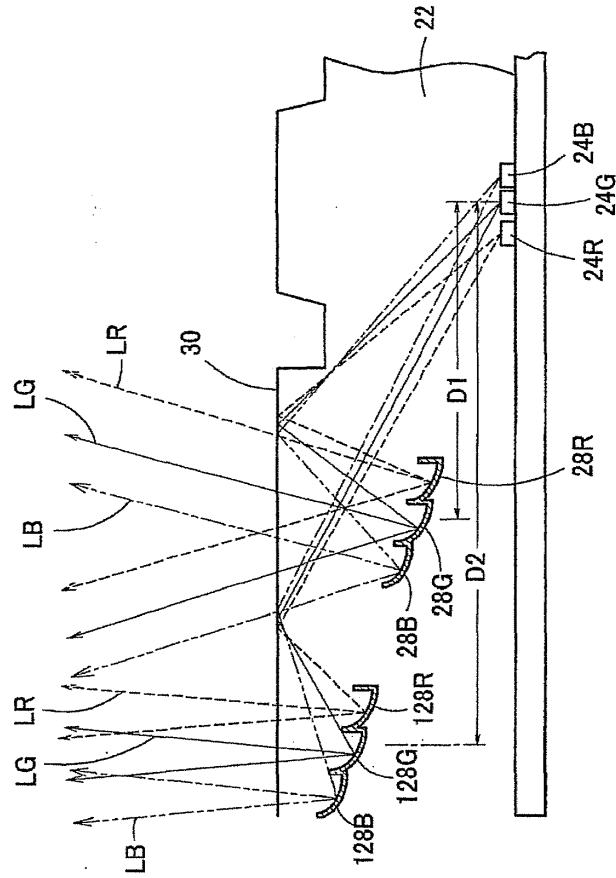


Fig. 22

Fig. 23

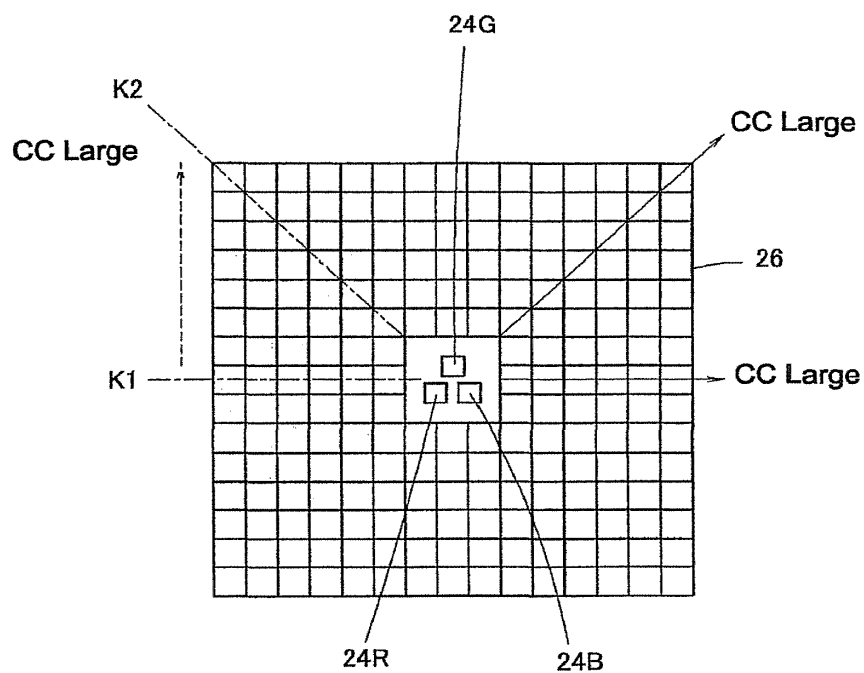
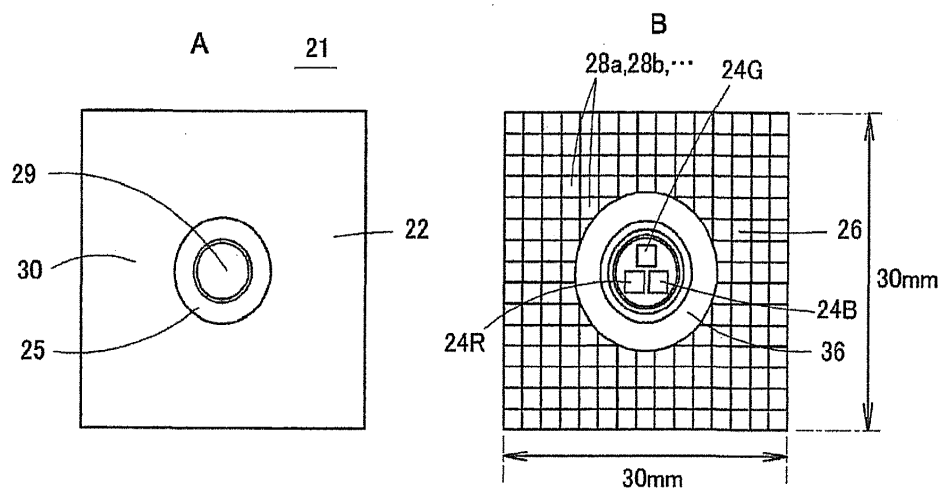


Fig. 24



EP 1 681 509 A1

Fig. 25

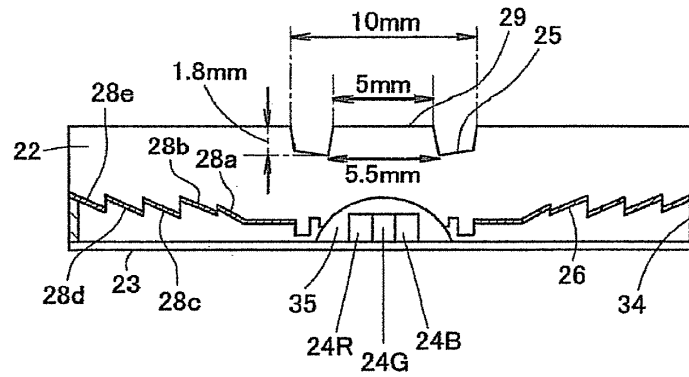
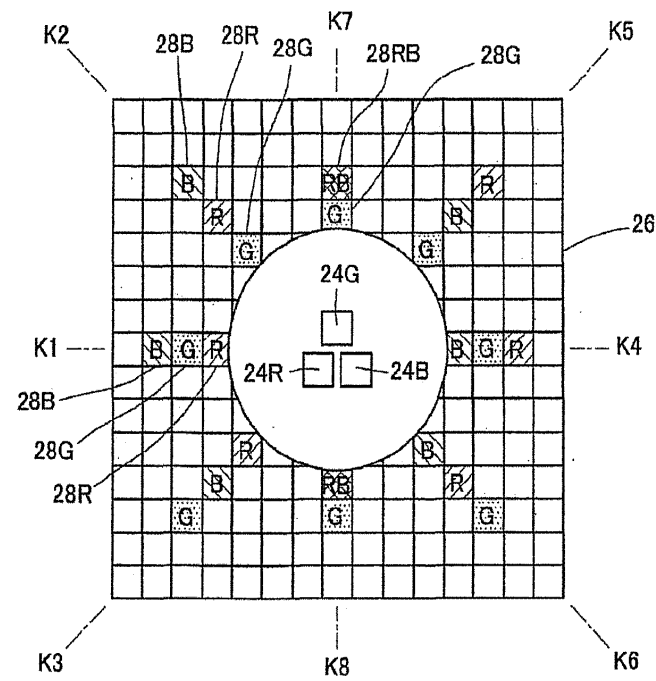


Fig. 26



EP 1 681 509 A1

Fig. 27

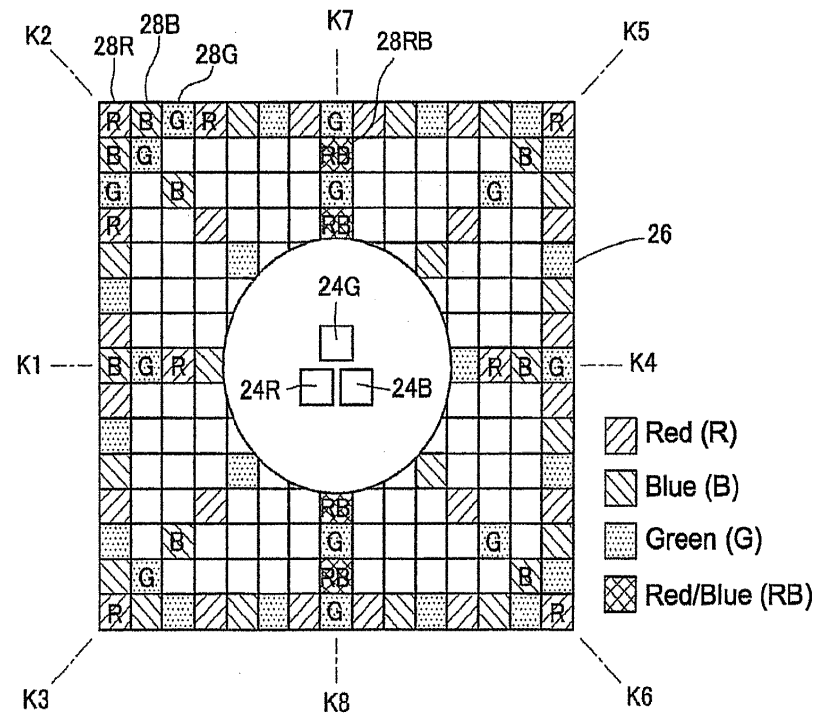


Fig. 28

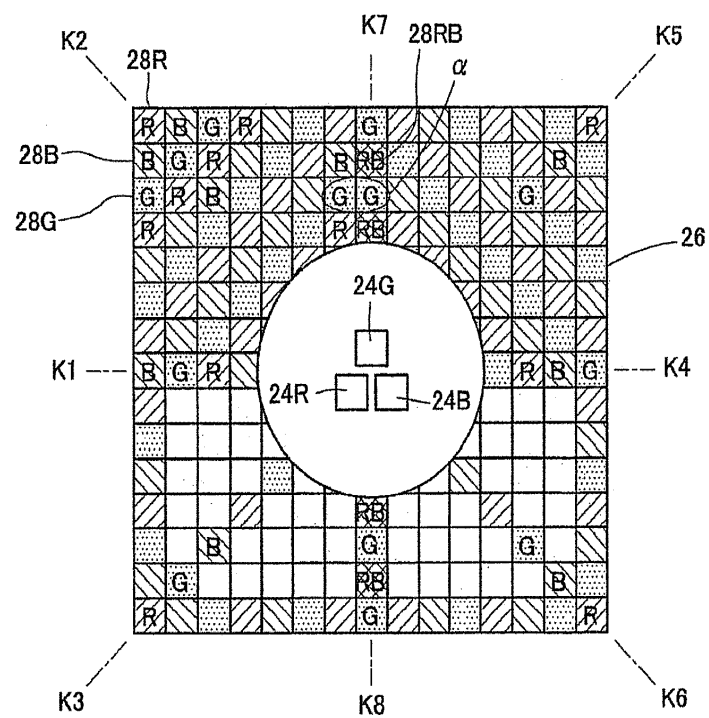
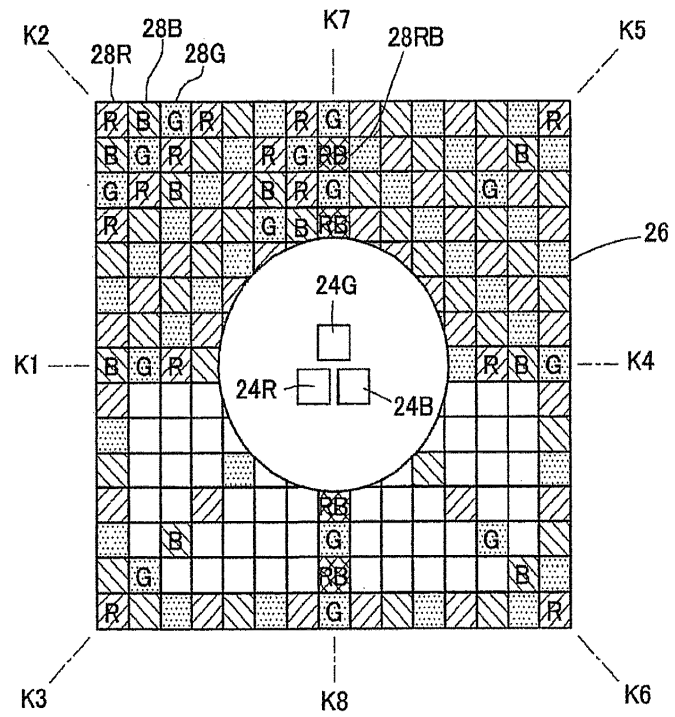
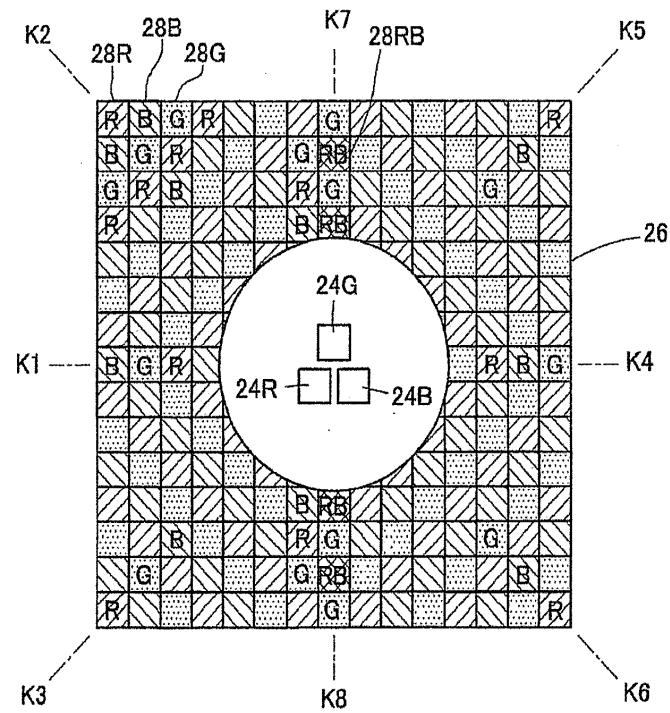


Fig. 29



EP 1 681 509 A1

Fig. 30



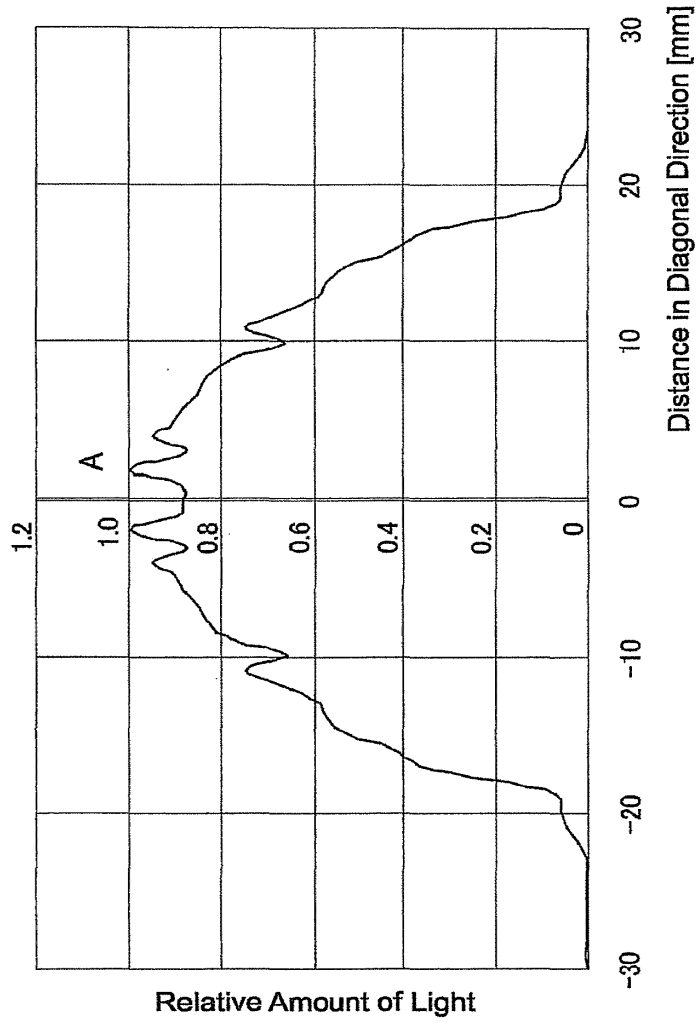
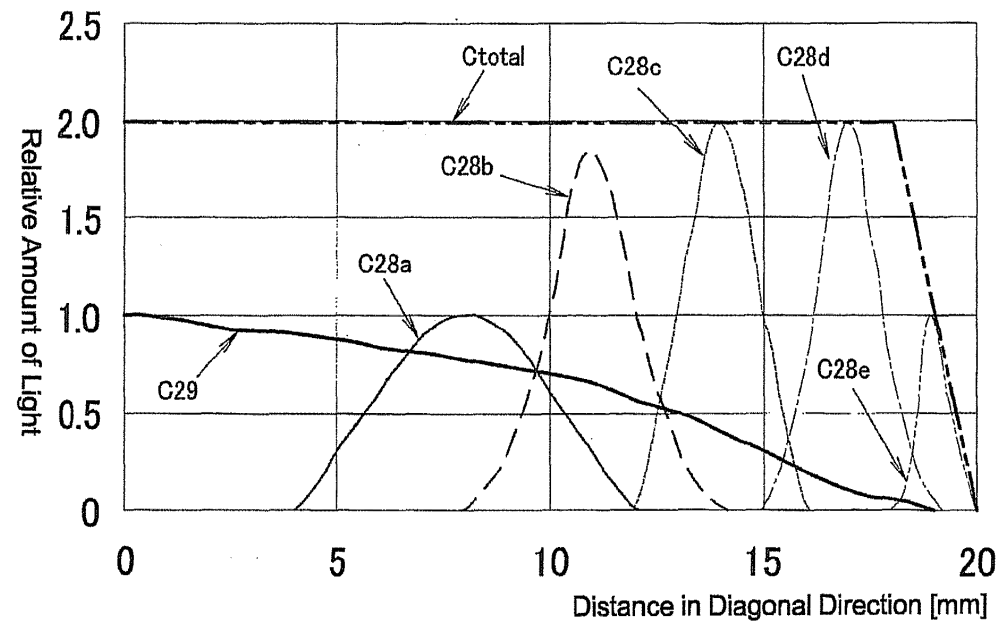


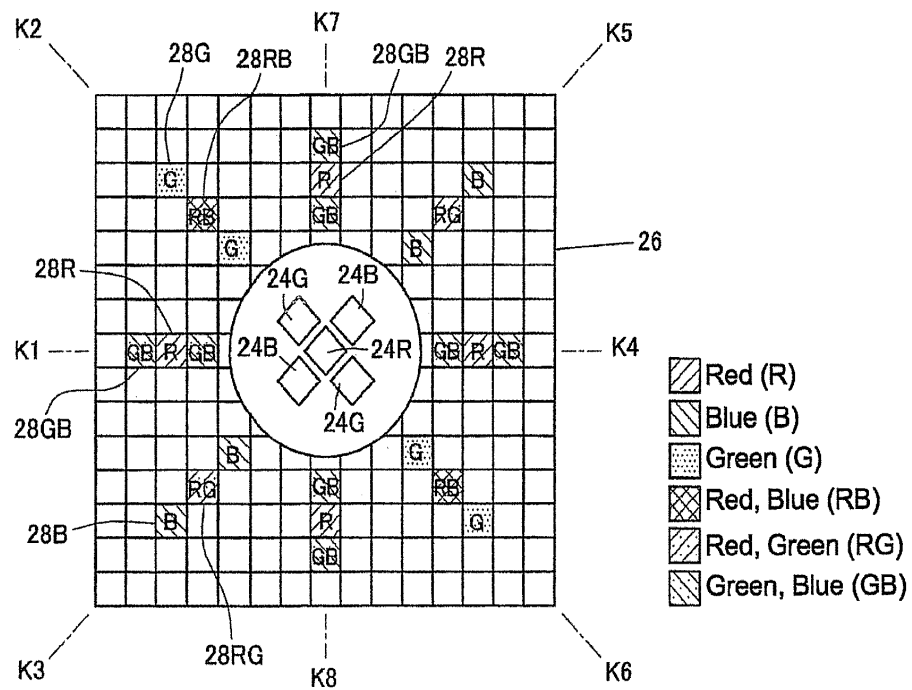
Fig. 31

Fig. 32



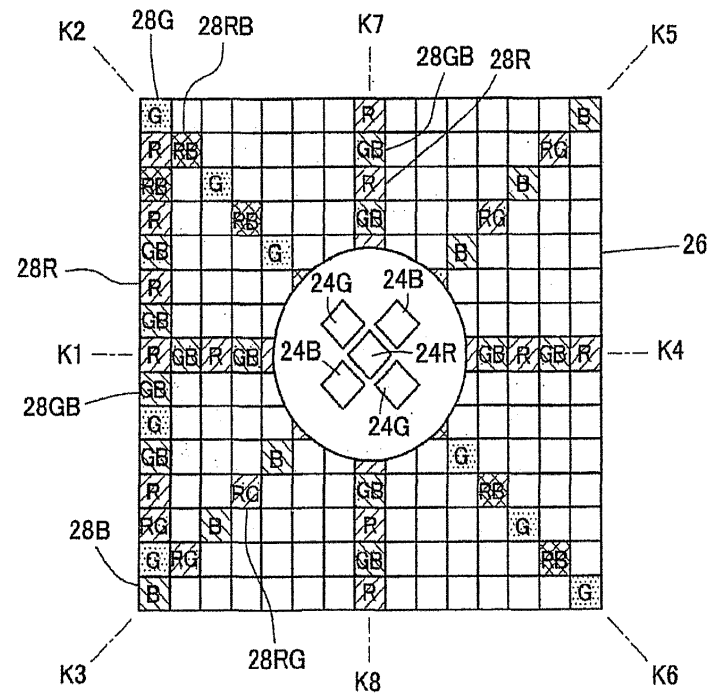
EP 1 681 509 A1

Fig. 33



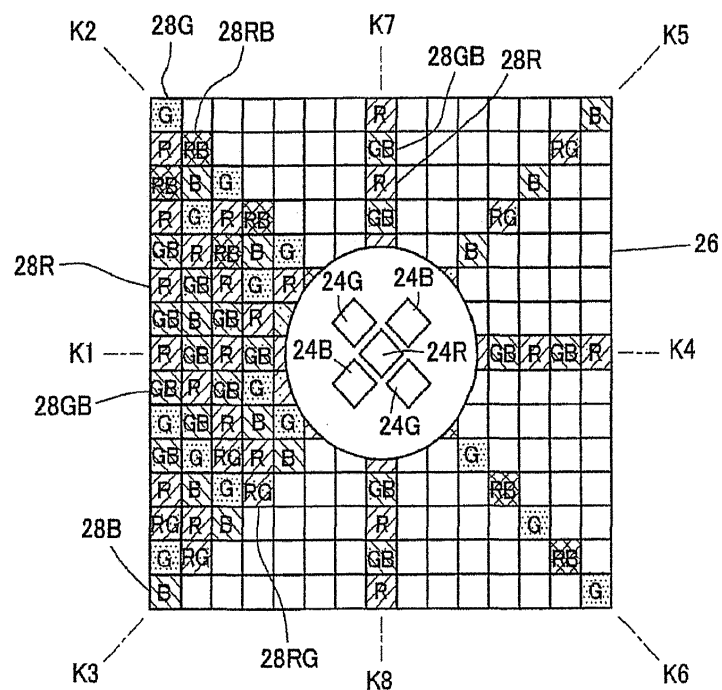
EP 1 681 509 A1

Fig. 34



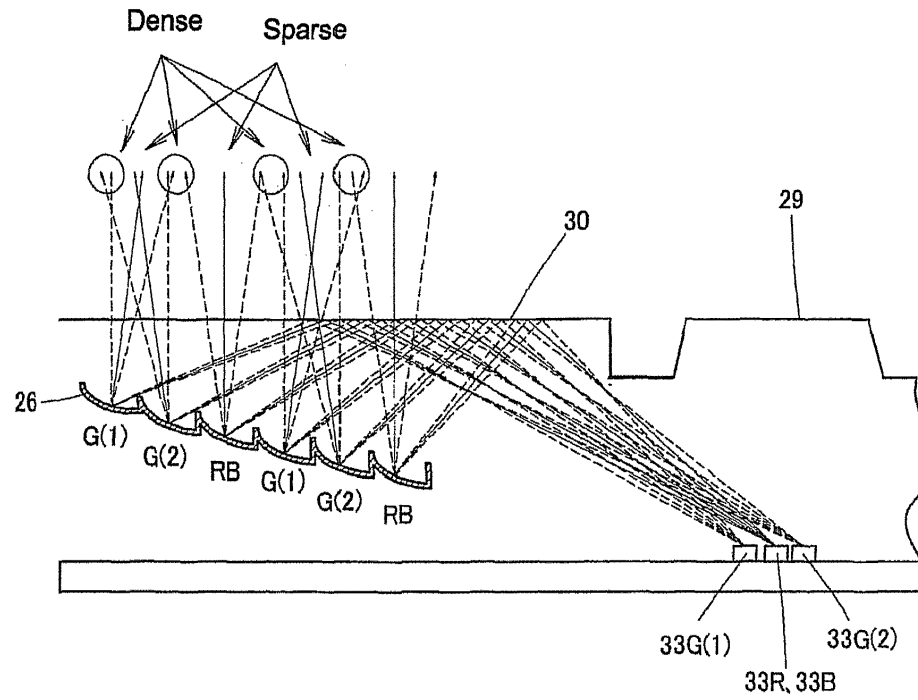
EP 1 681 509 A1

Fig. 35



EP 1 681 509 A1

Fig. 37



EP 1 681 509 A1

Fig. 38

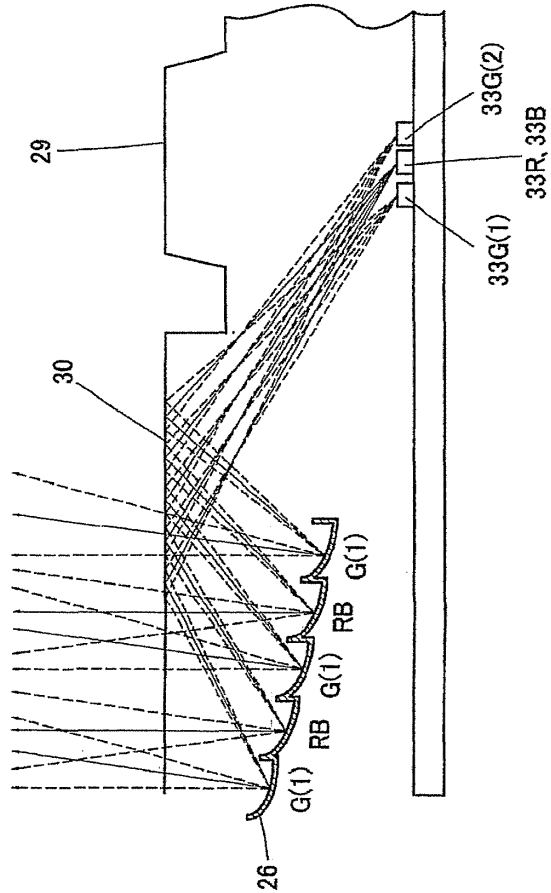


Fig. 39

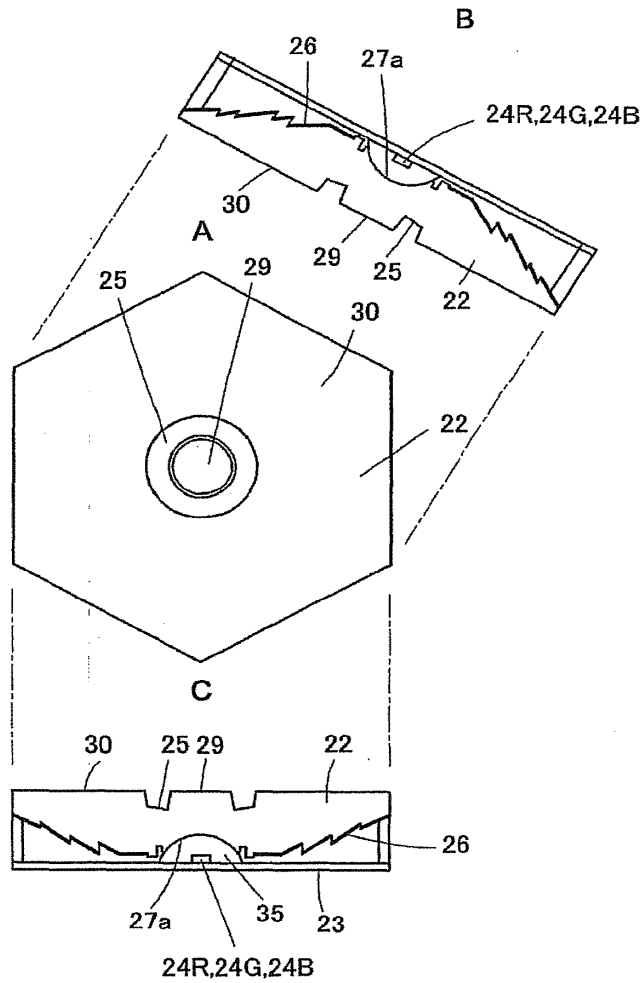
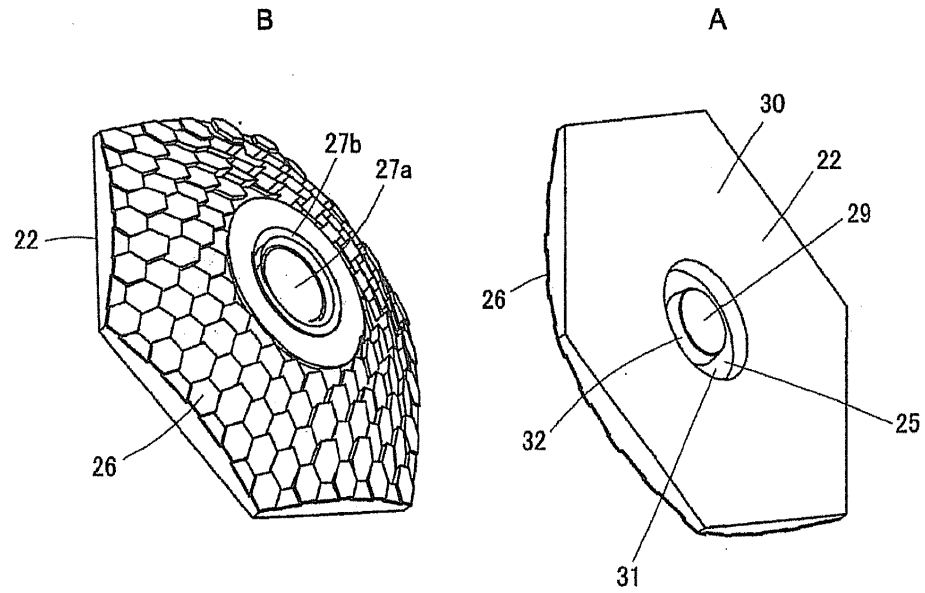
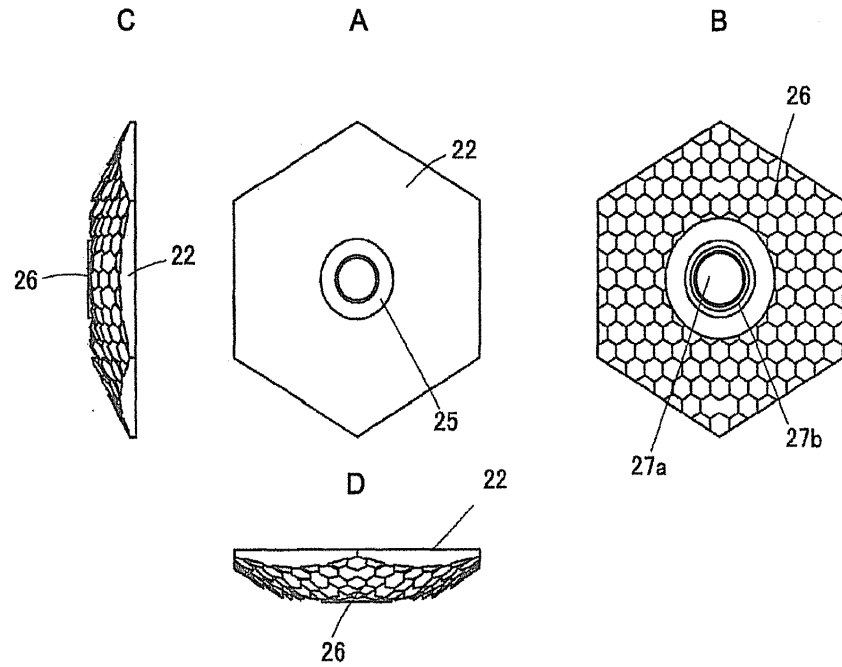


Fig. 40



EP 1 681 509 A1

Fig. 41



EP 1 681 509 A1

Fig. 43

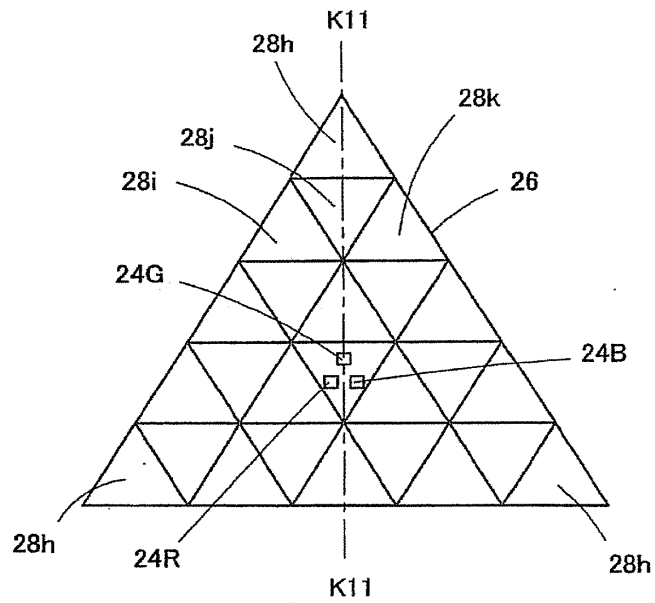


Fig. 44

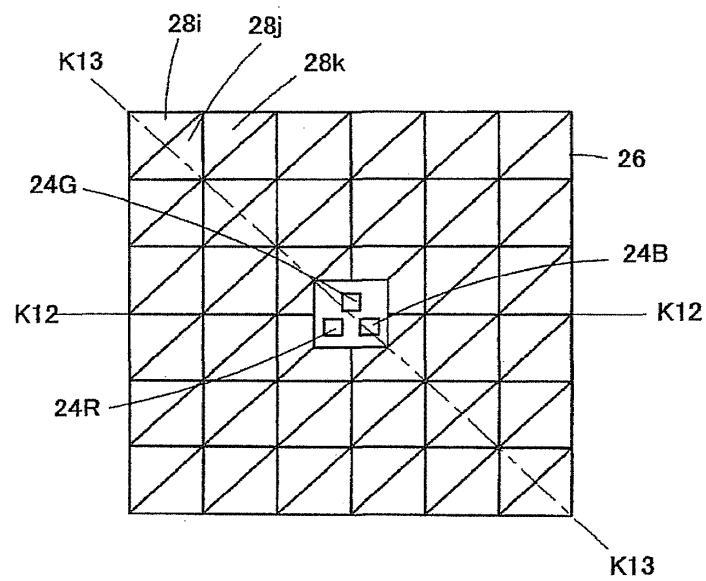


Fig. 45

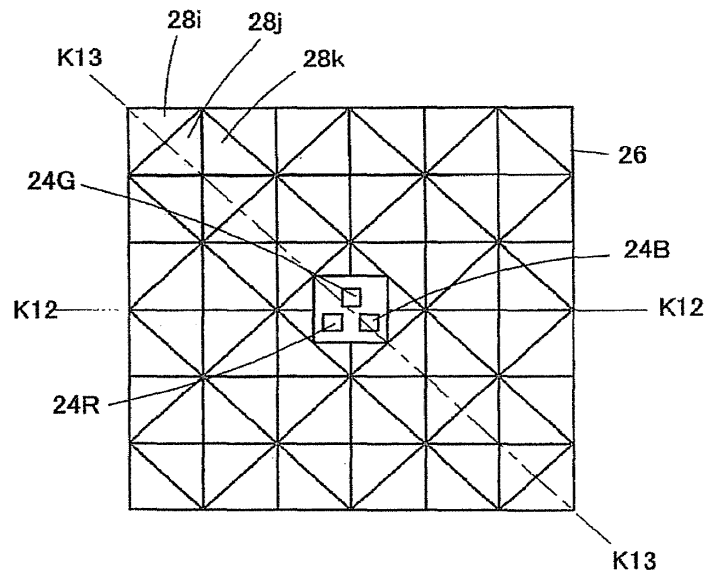


Fig. 46

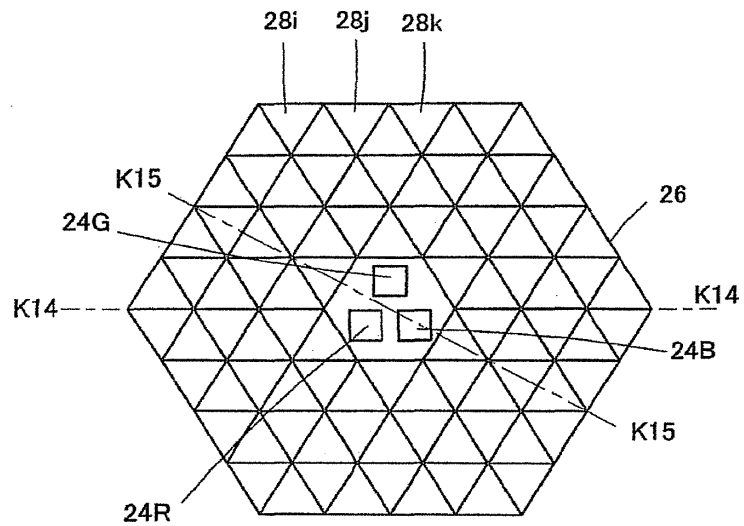


Fig. 47

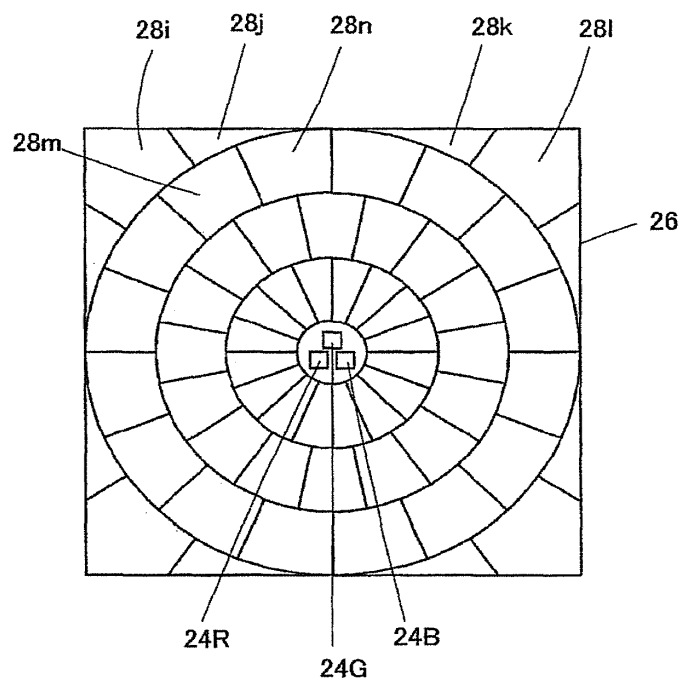


Fig. 48

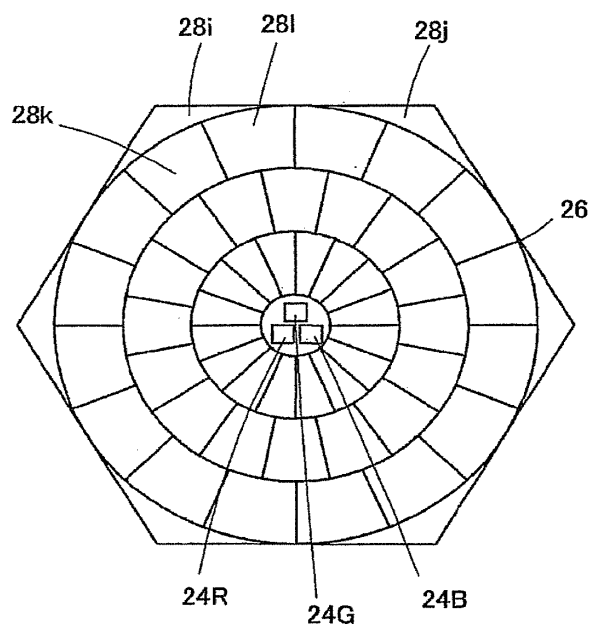


Fig. 49

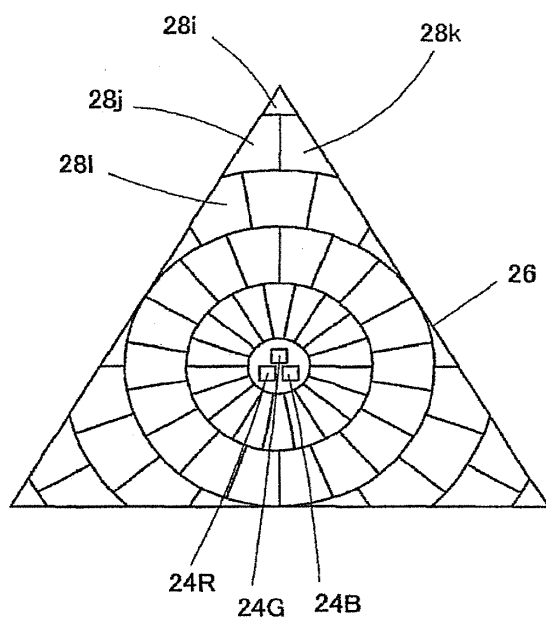


Fig. 50

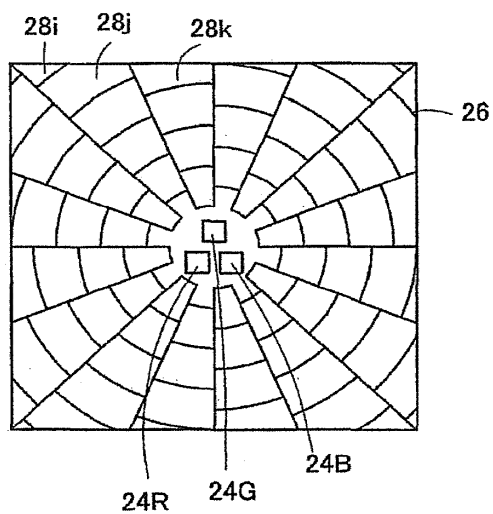


Fig. 51

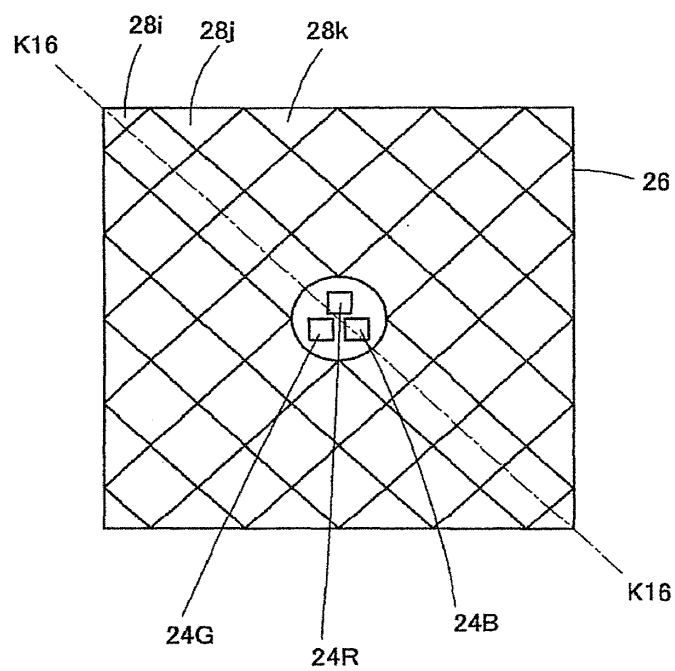


Fig. 52

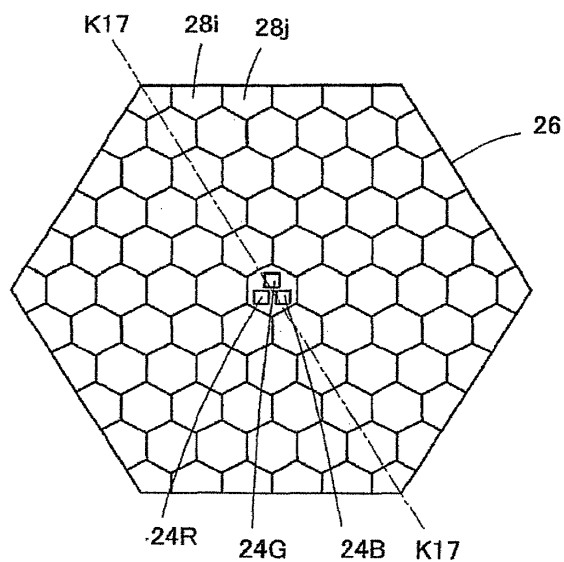


Fig. 53

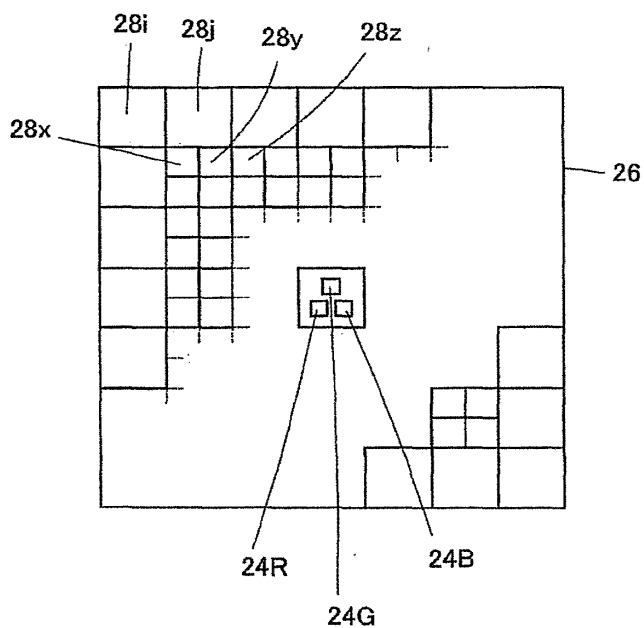


Fig. 54

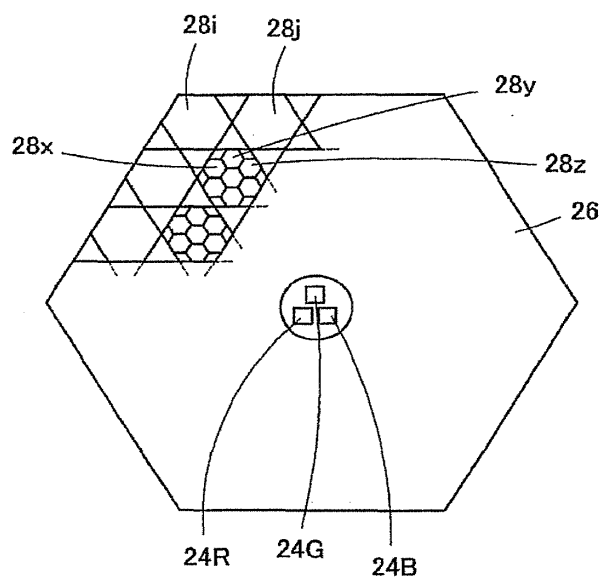


Fig. 55

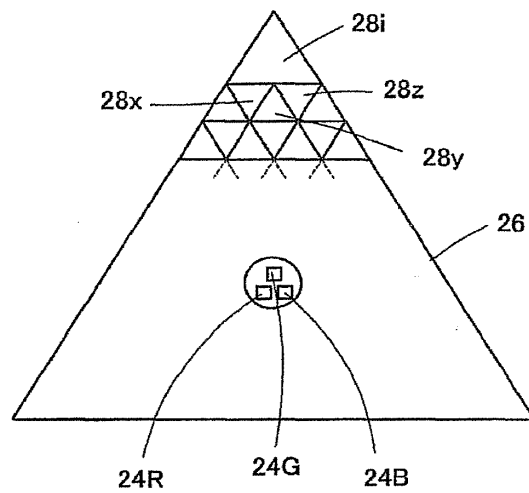


Fig. 56

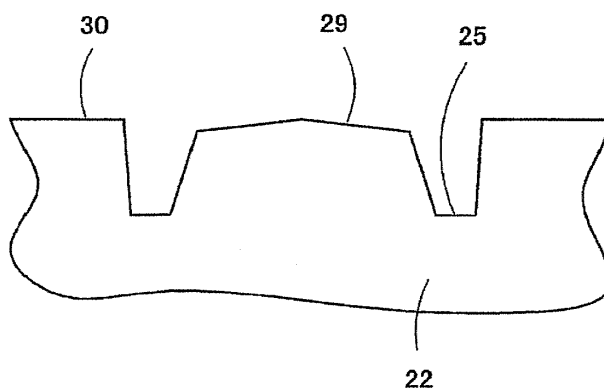


Fig. 57

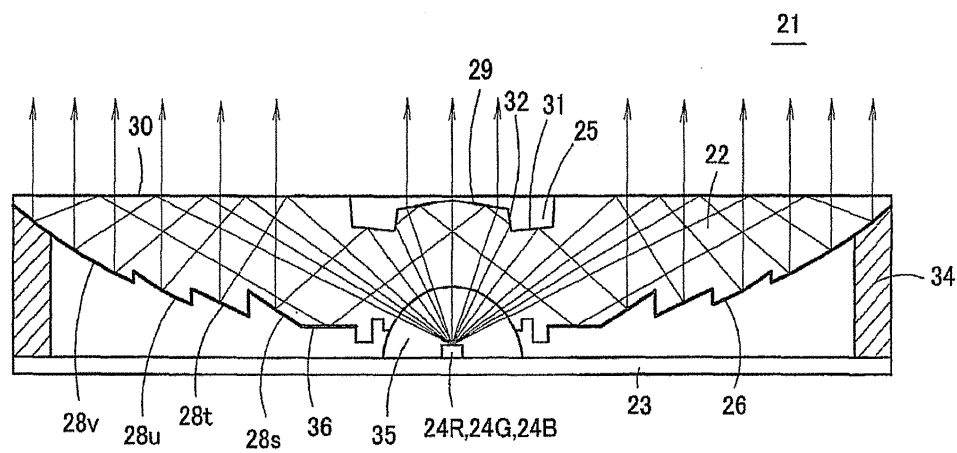


Fig. 58

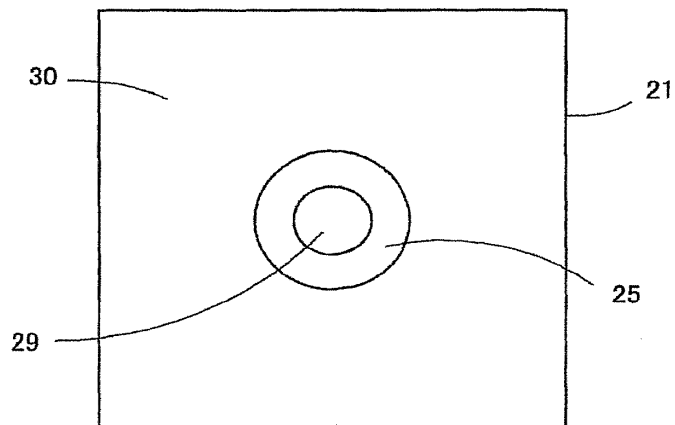


Fig. 59

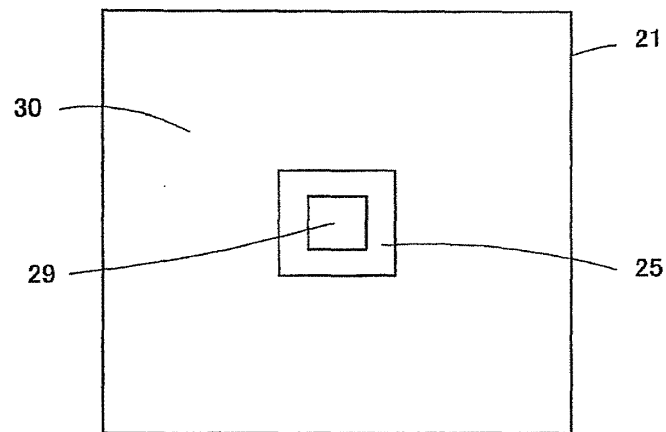


Fig. 60

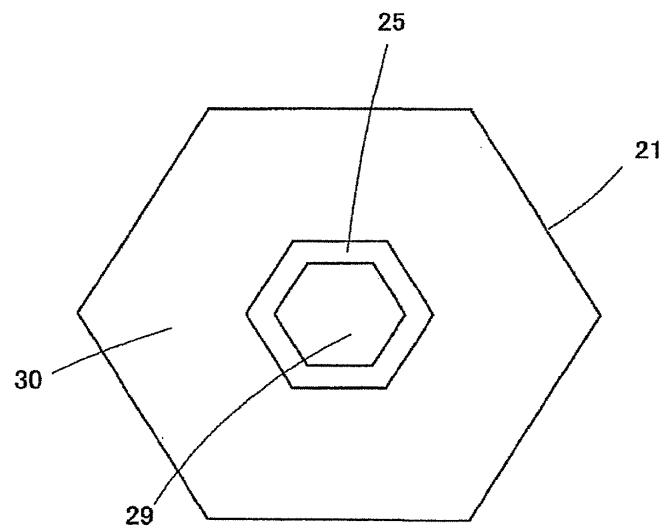


Fig. 61

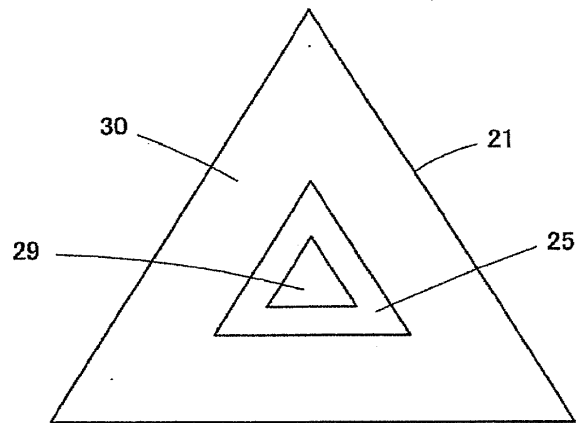


Fig. 62

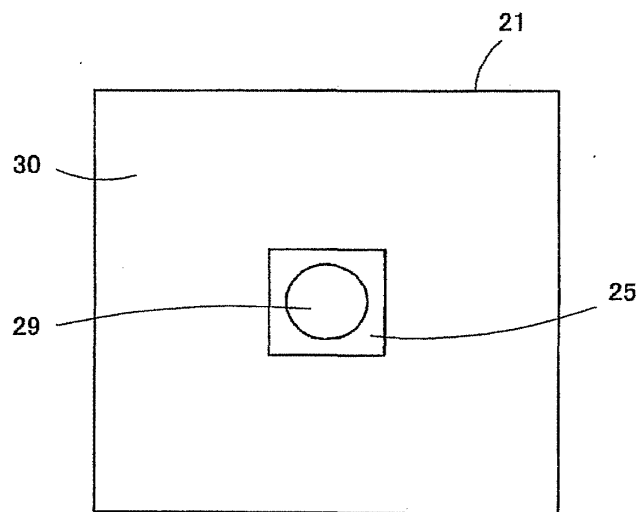


Fig. 63

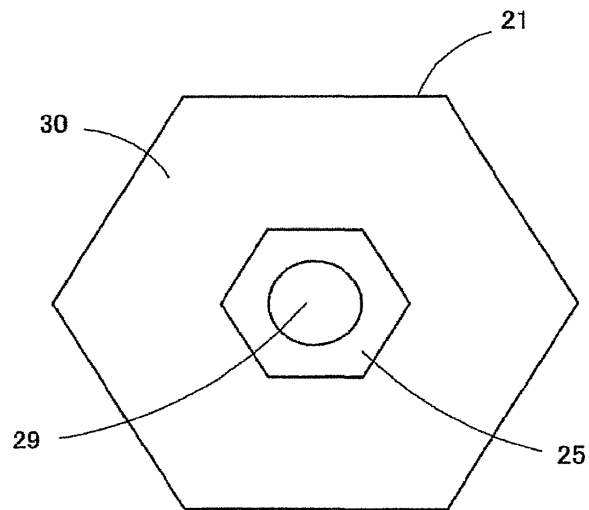


Fig. 64

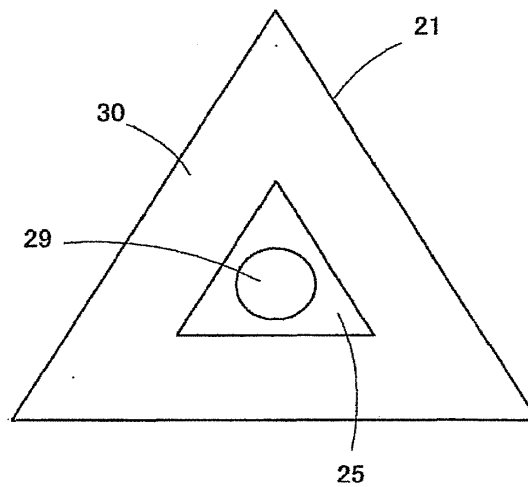
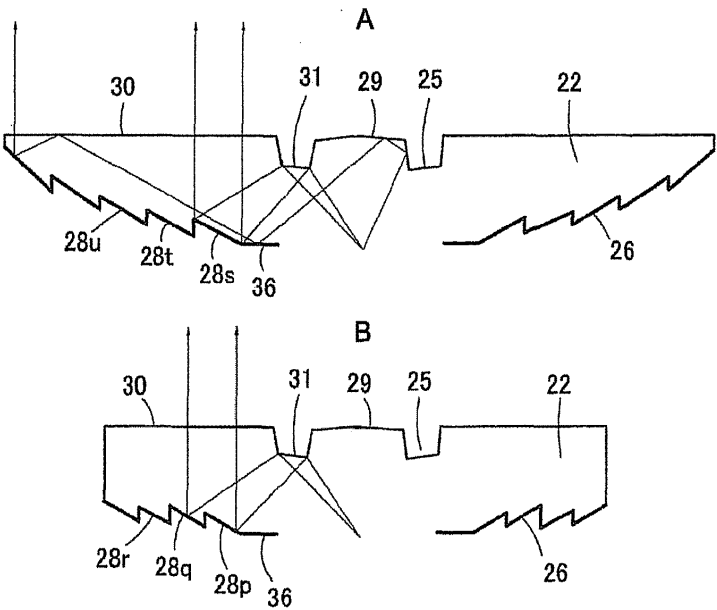
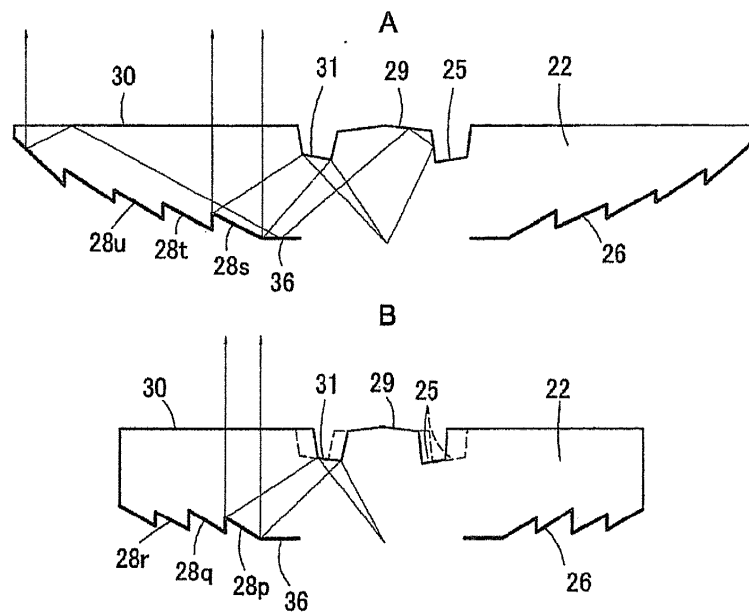


Fig. 65



EP 1 681 509 A1

Fig. 66



EP 1 681 509 A1

Fig. 67

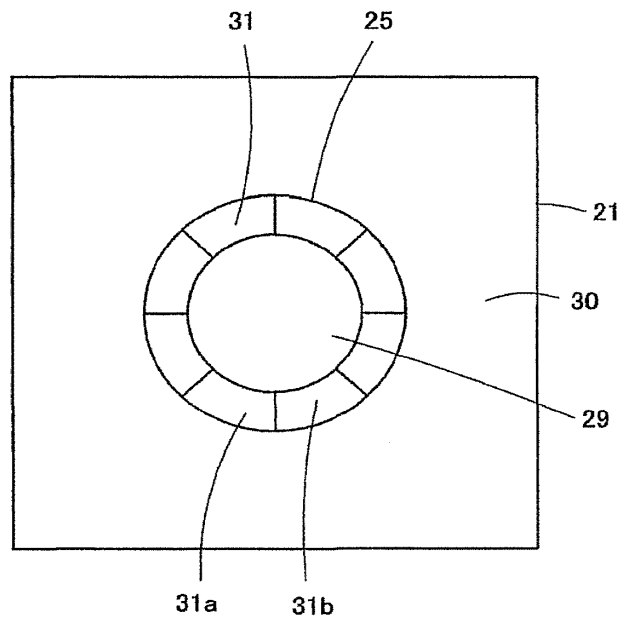


Fig. 68

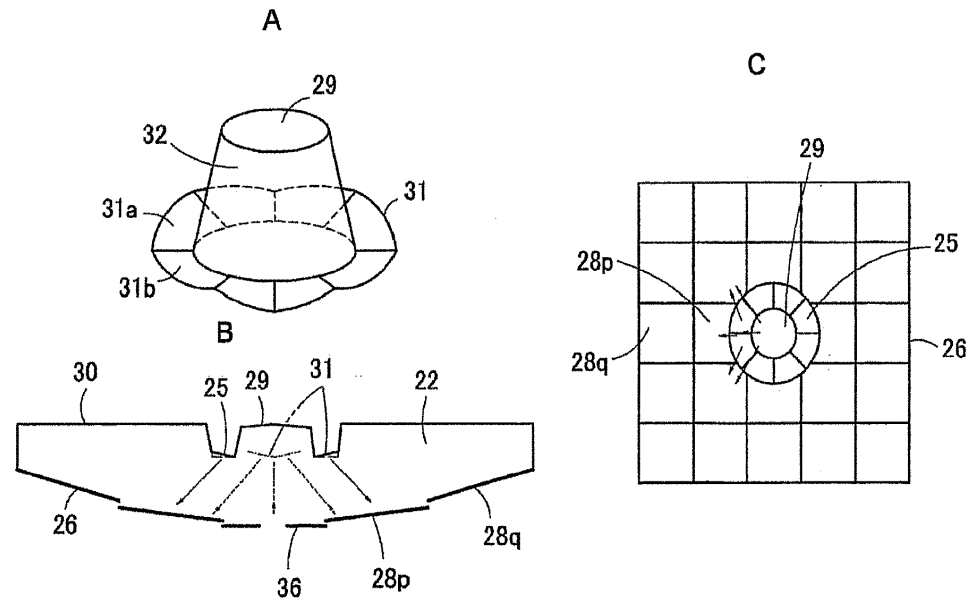
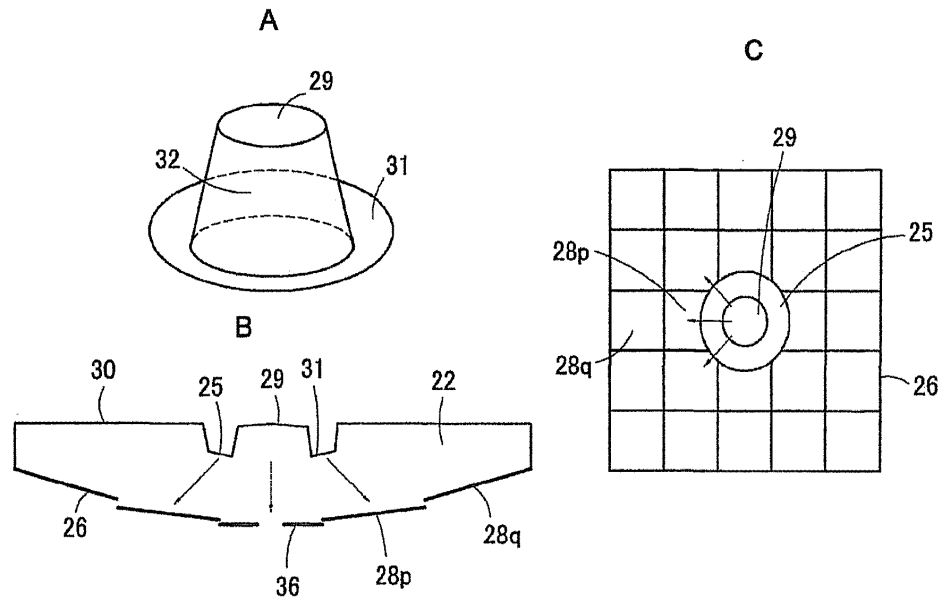
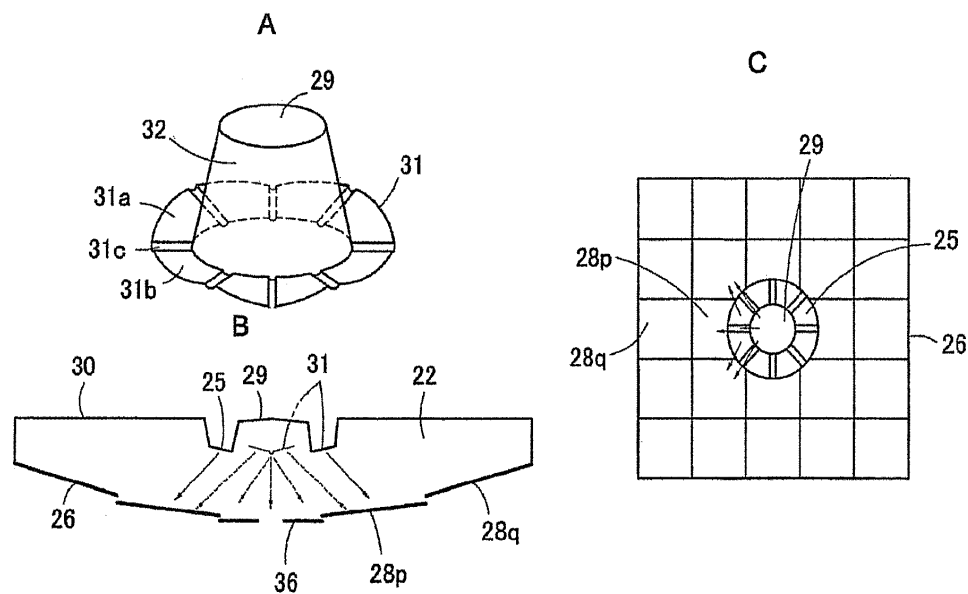


Fig. 69



EP 1 681 509 A1

Fig. 70



EP 1 681 509 A1

Fig. 71

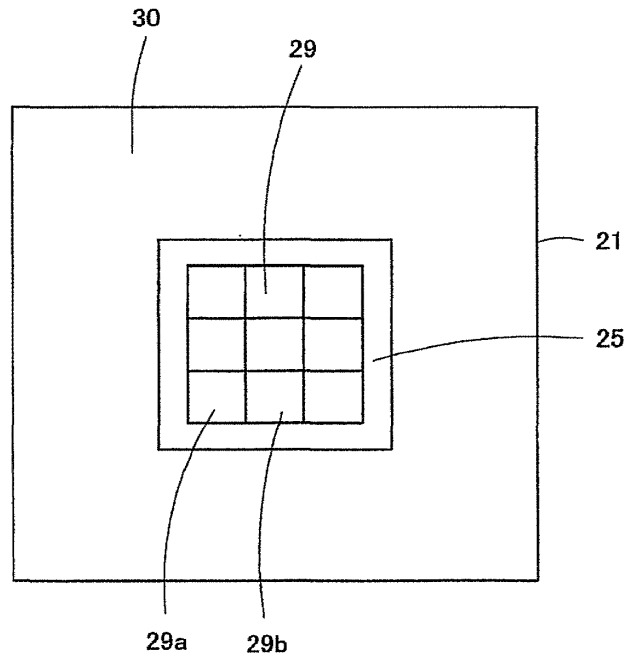


Fig. 72

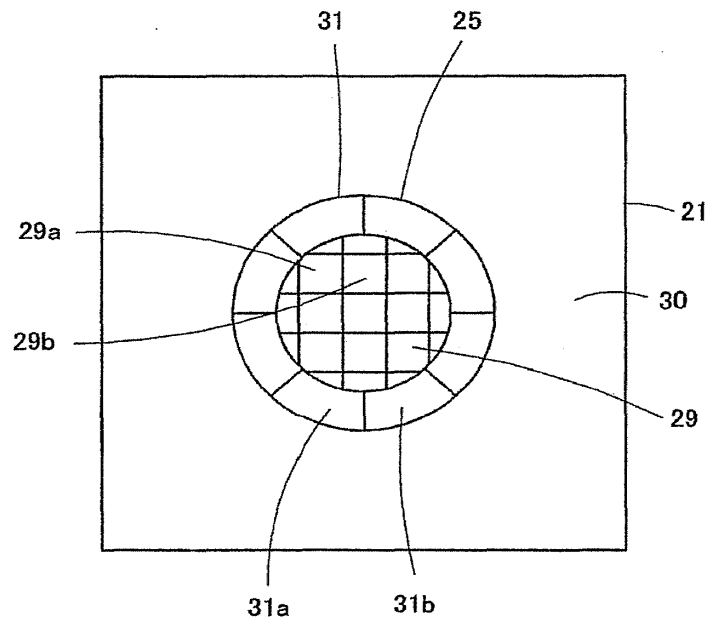
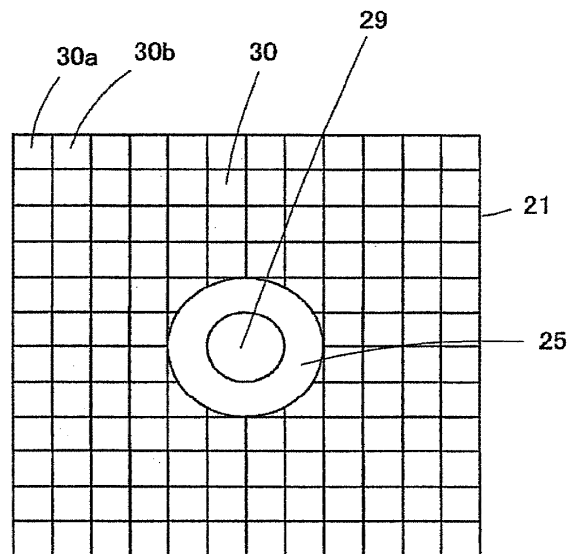


Fig. 73



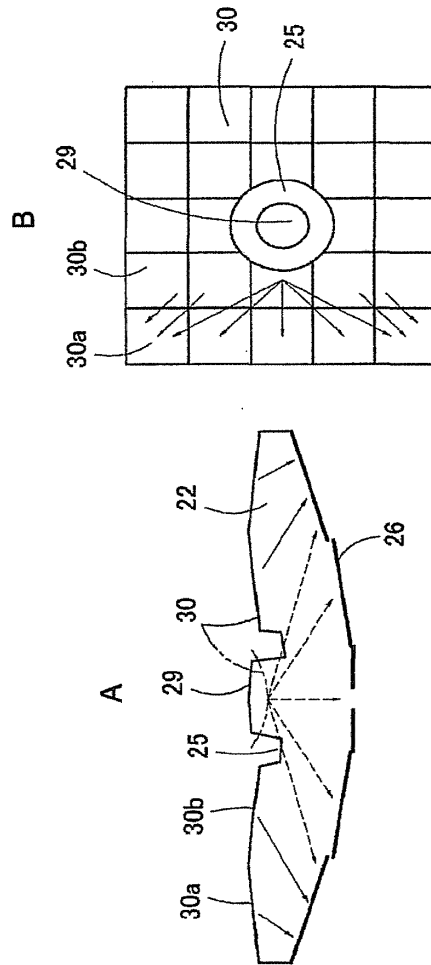
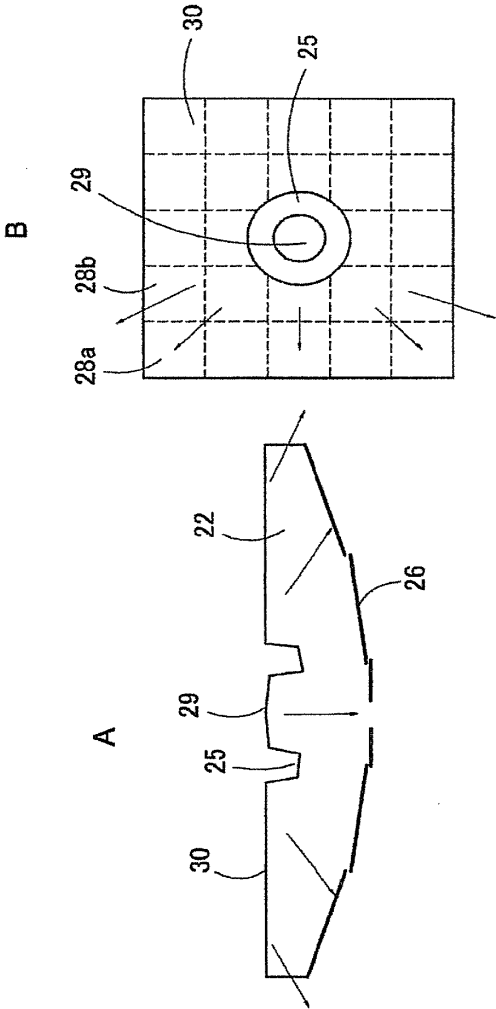


Fig. 74

Fig. 75



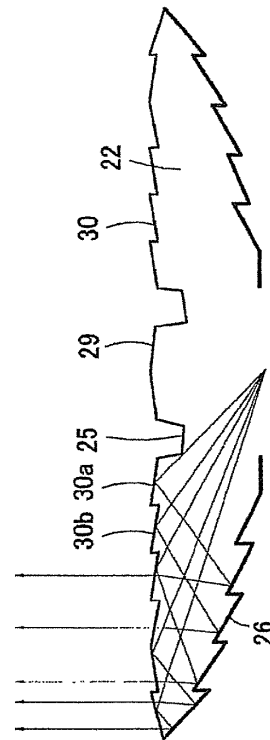


Fig. 76

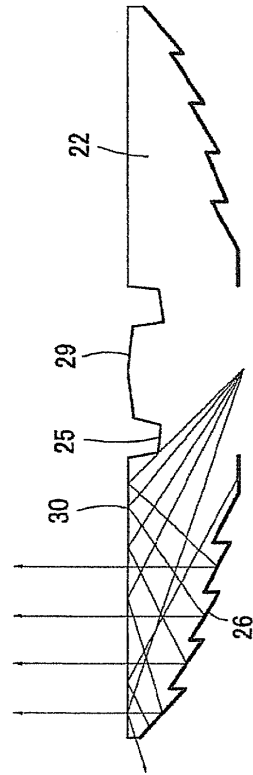


Fig. 77

Fig. 78

50

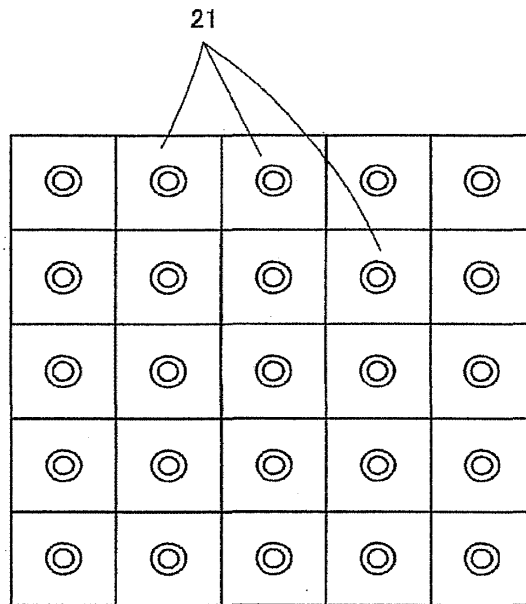
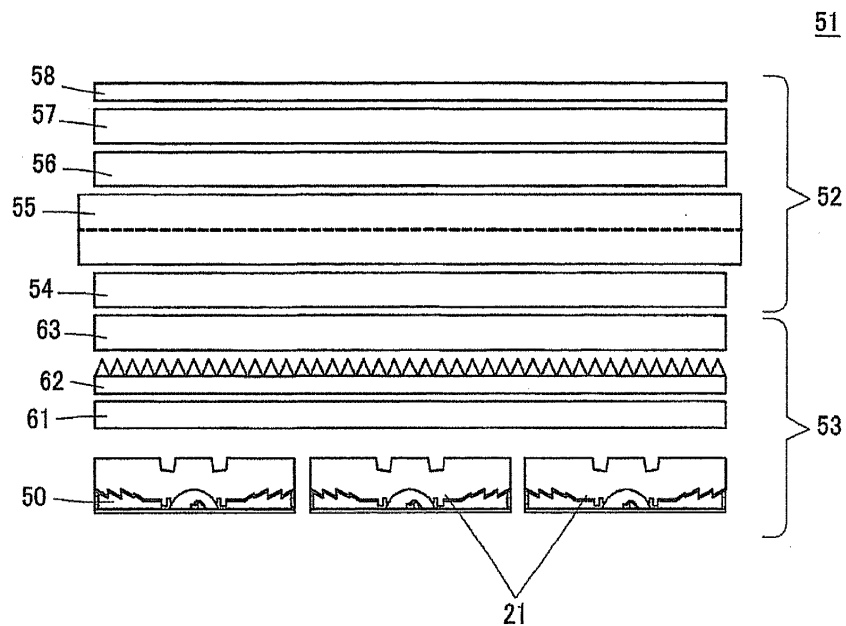


Fig. 79



EP 1 681 509 A1

Fig. 80

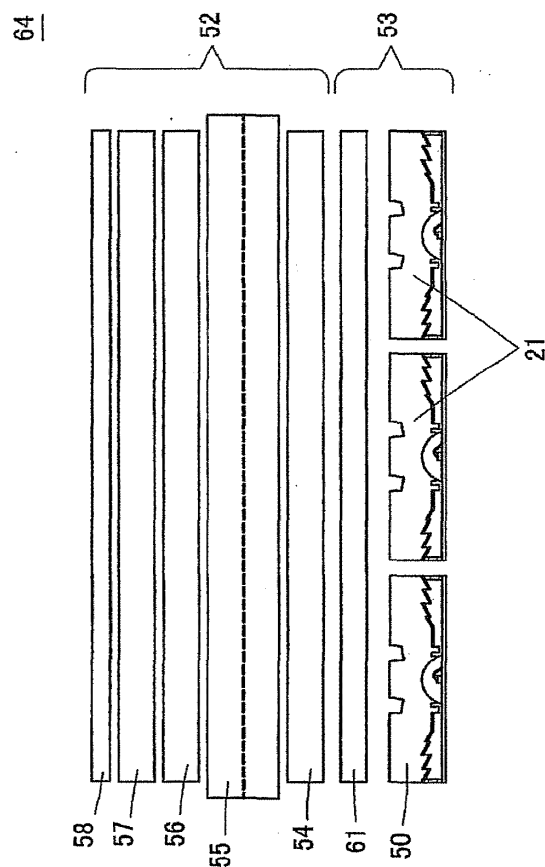
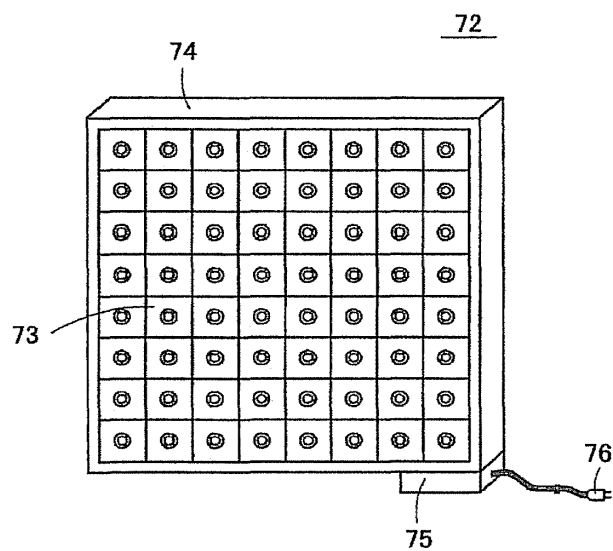


Fig. 81





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 06 10 0391

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	US 2004/027833 A1 (AMANO YASUYUKI ET AL) 12 February 2004 (2004-02-12)	1-8, 12-19	INV. F21V8/00
Y	* figure 2 * * figure 16 * * paragraph [0049] * * paragraph [0048] *	9-11	
Y	----- US 2002/080622 A1 (PASHLEY MICHAEL ET AL) 27 June 2002 (2002-06-27) * abstract *	9-11	
Y	----- US 4 021 659 A (WILEY ET AL) 3 May 1977 (1977-05-03) * column 3, line 27 - line 31 *	9-11	
			TECHNICAL FIELDS SEARCHED (IPC)
			G02B F21V
2 The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 21 April 2006	Examiner Orignac, X
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p>			

EPO FORM 1503 03.02 (P/UCI)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 06 10 0391

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.

21-04-2006

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004027833 A1	12-02-2004	CN 1470799 A	28-01-2004
		DE 10330261 A1	29-01-2004
		FR 2841966 A1	09-01-2004
		GB 2391930 A	18-02-2004
		JP 2004087461 A	18-03-2004
US 2002080622 A1	27-06-2002	CN 1404564 A	19-03-2003
		EP 1259754 A1	27-11-2002
		WO 0250472 A1	27-06-2002
		JP 2004516666 T	03-06-2004
US 4021659 A	03-05-1977	CA 1072930 A1	04-03-1980

EPO FORM P0459

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

(19)



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 653 255 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
03.05.2006 Bulletin 2006/18

(51) Int Cl.:
G02B 3/02 (2006.01) *F21S 8/00* (2006.01)
F21V 5/04 (2006.01)

(21) Application number: 05110078.2

(22) Date of filing: 27.10.2005

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR**
Designated Extension States:
AL BA HR MK YU

(72) Inventors:
• Potucek, Kevin
Far Hills, NJ 07931 (US)
• Dunn, Dennis
Thousand Oaks, CA 91360 (US)

(30) Priority: 29.10.2004 US 623607 P

(74) Representative: P&TS
Patents & Technology Surveys SA
Rue des Terreaux 7,
Postfach 2848
2001 Neuchâtel (CH)

(71) Applicant: Pentair Water Pool and Spa, Inc.
Moorpark, CA 93021 (US)

(54) **Selectable beam lens for underwater light**

(57) A lens for a wet environment lighting device that has a fixture with an interior that has an opening, and at least one light source located within the fixture interior. Light from the light source proceeds out through the opening. The lens is for location in front of the fixture and the light source located therein and the lens encloses the opening from the wet environment. The lens has a first light-directing area for directing light in a first beam pattern. The lens also has a second light-directing area, distinct from the first light-directing area, for directing light in a second beam pattern, distinct from the first beam pattern. The lens is positioned relative to fixture and light source therein to select from the distinct beam patterns based on the alignment of the light-directing areas relative to the light source resulting from a positioning of the lens.

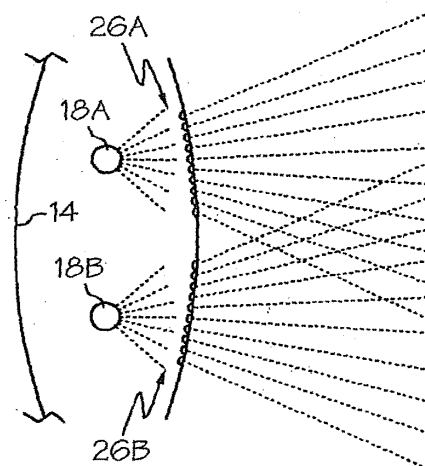


FIG. 4A

EP 1 653 255 A2

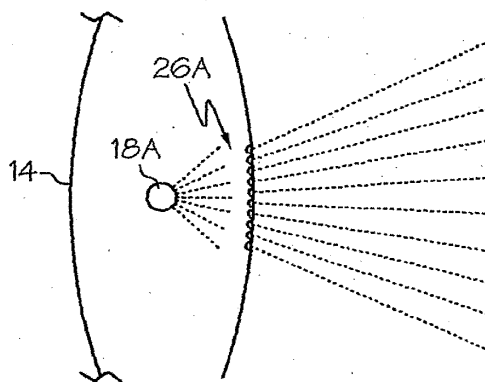


FIG. 4B

Description

[0001] This application claims the benefit of U.S. Provisional Application No. 60/623,607 filed on October 29, 2004, which is entirely incorporated herein by reference.

BACKGROUND OF THE INVENTION

[0002] Lights that operate in a wet environment are known. One example of such a wet environment light is an underwater light that is within an aquatic environment. One example of an aquatic environment is a swimming pool.

[0003] Underwater lights have different objectives depending on the shape and dimension of the aquatic environment that has to be illuminated and the relative locations of the lights therein. In one case, the objective could be to deliver light longitudinally (horizontally), while in another, the object could be to deliver a homogeneous illumination in all directions (horizontally and vertically). Presently, such different objectives are accomplished by manufacturing lenses designed specifically to achieve the desired beam patterns. Such an approach requires the lens to be removed and replaced to obtain a different beam pattern. Also, such an approach requires separate manufacture, supply, etc. of the different lenses. As one example of such separate aspects, inventories of different lens models need to be maintained.

[0004] As can be appreciated, such manufacture, supply, etc., is costly and time consuming. Moreover, there may also be the added expense, etc. created by a wrong type of lens being delivered or even installed at a use site.

SUMMARY OF THE INVENTION

[0005] In accordance with one aspect, the present invention provides a lens for a wet environment lighting device that has a fixture with an interior that has an opening, and at least one light source located within the fixture interior. Light from the light source proceeds out through the opening. The lens is for location in front of the fixture and the light source located therein and the lens encloses the opening from the wet environment. The lens has a first light-directing area for directing light in a first beam pattern. The lens also has a second light-directing area, distinct from the first light-directing area, for directing light in a second beam pattern, distinct from the first beam pattern. The lens is positioned relative to fixture and light source therein to select from the distinct beam patterns based on the alignment of the light-directing areas relative to the light source resulting from a positioning of the lens.

[0006] In accordance with another aspect, the present invention provides a lighting device for a wet environment. The lighting device has a fixture for location within the wet environment and that has an interior with an opening. The lighting device has at least one light source located within the fixture interior. Light from the light source

can proceed from the interior through the opening. The lighting device has a lens located in front of the fixture and the light source located therein. The lens encloses the opening from the wet environment and has a plurality of light-directing areas. Each light-directing area has a different light-directing feature. The relative position between the lens and the light source is variable to associate different light-directing areas with the light source and provide different light beam patterns for light proceeding from the light source through the lens and into the wet environment dependent upon the different light-directing areas and light source associations resulting from the position variation.

[0007] In accordance with yet another aspect, the present invention provides a lighting device for a wet environment. The lighting device has a fixture for location within the wet environment and that has an interior with an opening. The lighting device has multiple light sources located within the fixture interior. The lighting device has a lens located in front of the fixture and the light sources located therein. The lens encloses the opening from the wet environment. The relative position between the lens and the light sources is variable to align different light-directing areas with the light sources and provide different light beam patterns for light proceeding from the light source through the lens and into the wet environment dependent upon the different light-directing areas and light source alignments resulting from the position variation.

[0008] In accordance with still another aspect, the present invention provides a lighting device for a wet environment. The lighting device has a fixture for location within the environment and that has an interior with an opening. The lighting device has at least one light source located within the fixture interior. The lighting device has a lens located in front of the fixture and the light source located therein. The lens closes the opening from the wet environment. The lens is repositioned to select from multiple, distinct beam patterns based on the alignment of the light-directing areas relative to the light source resulting from a repositioning of the lens.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a perspective view of an example wet environment in which an example lighting device in accordance with the present invention can be used; Fig. 2 is a front view of an example embodiment of a selectable beam lens that can be used in the lighting device shown in Fig. 1; Fig. 3A is a schematic, top view illustration of an example light-directing effect from a first primary light-directing area of the selectable beam lens of Fig. 2; Fig. 3B is a schematic, side view illustration of the light-directing effect of Fig. 3A; Fig. 4A is a schematic, top view illustration of an ex-

ample light-directing effect from a second primary light-directing area of the selectable beam lens of Fig. 2;

Fig. 4B is a schematic, side view illustration of the light-directing effect of Fig. 4A;

Fig. 5 is a cross-sectional view taken along line 5-5 through the selectable beam lens of Fig. 2;

Fig. 6 is a cross-sectional view taken along line 6-6 through the selectable beam lens of Fig. 2;

Fig. 7 is a perspective, torn-away view of the first primary light-directing area of the selectable beam lens of Fig. 2; and

Fig. 8 is a perspective, torn-away view of the second primary light-directing area of the selectable beam lens of Fig. 2.

DETAILED DESCRIPTION OF AN EXAMPLE EMBODIMENT

[0010] Certain terminology is used herein for convenience only and is not to be taken as a limitation on the present invention. Further, in the drawings, the same reference numerals are employed for designating the same elements throughout the figures, and in order to clearly and concisely illustrate the present invention, certain features may be shown in schematic form.

[0011] Fig. 1 shows an example wet environment 10, which happens to be an aquatic environment, in which a lighting device 12 in accordance with one aspect of the present invention can be used to provide illumination. It should be appreciated that the present invention can be used in various other wet environments. Some examples of such other wet environments include spas, baths, ponds, fountains, water spraying devices, and the like. Herein, the wet environment 10 is presented as a swimming pool 10. However, the swimming pool 10 is not a limitation on the present invention.

[0012] In the shown example, the lighting device 12 is installed at the periphery of the swimming pool 10. More specifically, the lighting device 12 is located on one of the walls of the swimming pool 10. Also, the lighting device 12 is located below the waterline of the water located within the swimming pool 10. As such, light proceeding from the lighting device 12 directly illuminates the water. It is to be appreciated that the lighting device 12 may be otherwise located within the swimming pool 10, such as at or near a waterline (e.g., only partially submerged within water). In general, it is to be appreciated that the lighting device 12 may be at any desired location within a wet environment.

[0013] The lighting device 12 includes a fixture 14 that has an interior 16. It is to be appreciated that the fixture 14 is only schematically shown in the figures. This schematic showing indicates that the specific construction and configuration of the fixture 14 are not a limitation on the present invention. Moreover, the construction and configuration of the fixture 14 may be varied. For example, the fixture 14 may even be provided by the wall structure

of the swimming pool 10 itself.

[0014] At least one light source 18A is located within the interior 16 of the fixture 14. An opening into the interior 16 permits light from the light source 18A to proceed out of the interior. Similar to the aspect that the fixture 14 is not a limitation on the present invention, the interior 16 is not a limitation on the present invention. As such, the interior 16 of the fixture 14 may be varied. As one example, the interior is configured such that the fixture 14 provides for light reflection out of the fixture.

[0015] Although the lighting device 12 in accordance with one aspect of the present invention includes at least one light source 18A, another aspect of the present invention provides for the lighting device having multiple light sources. For one particular example, which is described herein, the lighting device 12 includes two light sources 18A and 18B. Each light source (e.g., 18A) may have any construction and configuration. In general, each light source is electrically energized to emit light. Some example types of light sources include incandescent, fluorescent, halogen, and light-emitting diode. Also, each light source may have one or more specialized properties or characteristics, such as being a color changing light source.

[0016] A lens 20 of the lighting device 12 is in accordance with one aspect of the present invention. The lens 20 is located in front of the fixture 14 and the light sources 18A, 18B located therein. The lens 20 is transparent, or at least translucent, to the light proceeding from the light sources.

[0017] The lens 20 may be made of glass, plastic, acrylic, or other substance that is transparent or translucent to the light. As such, the light proceeds through the lens 20. In the shown example, the lens 20 encloses the opening of the fixture 14 and is in direct contact with the water within the swimming pool 10. As such, the lens 20 acts as a barrier between the water and the interior 16 of the fixture 14. In the shown example, the lens 20 is a unitary member. However, it is to be appreciated that the lens 20 may be multi-component. Within such a multi-component lens, the lenses may be in a stacked arrangement along a major axis or the lenses may be located adjacent to each other in an array. Also, within such a multi-component lens, each lens component may have light-directing properties (e.g., refraction) or some of the lenses may have light-directing properties. In one particular embodiment, the lens is a multi-component lens that includes a cover lens that is in contact with the wet environment. The cover lens may not have light-directing properties (e.g., the cover lens is optically inert). For example, the cover lens may just have smooth planar faces. Within a multi-component lens, the lenses may be spaced apart or in contact with each other.

[0018] A seal (not shown) may be located between the fixture 14 and the lens 20 to prevent water entry into the fixture 14 at an edge of the lens 20. It is to be appreciated that the seal may take any form, may be of any material, etc. to accomplish a sealing function. In one example,

the seal is a separate ring that is sandwiched between the fixture 14 and the lens 20. However, it is to be appreciated that the seal may be attached to or part the fixture 14 or the lens 20. Also, it is to be appreciated that the lens 20 can be secured to the fixture 14. The methodology and structure for sealing and securing the lens 20 to the fixture 14 may be varied and are not limitations on the present invention.

[0019] One example of the lens 20 is shown in Fig. 2. The example lens 20 shows light-directing areas in accordance with one aspect of the present invention. However, it must be understood that the example need not be a limitation on the present invention.

[0020] In this example, two pairs of primary light-directing areas 24A, 24B and 26A, 26B are provided. Within each of the two pairs of light-directing areas, at least one area can be associated with one of the light sources. Within the shown example, the association of a light-directing area with a light source is accomplished via positioning of the lens such that the light-directing area is in front of one of the light sources. In other words, the light-directing area is aligned with the light source.

[0021] Of course, it is to be appreciated that the light-directing areas need not be provided in pairs. Such an embodiment would be suitable for a lighting device that has only one light source. Also, it is to be appreciated that the number of light-directing areas, or pairs of areas, need not correspond to the number of light-directing areas. As one example, the embodiment that has only one light source would have a lens that has at least two light-directing areas that can be associated or aligned with the lighting device. For such aspects, the light sources and/or the light-directing areas would have locations (e.g., off-axis locations) that would permit different association/alignment combinations.

[0022] In the shown example, the lens 20 is circular with a central axis 22, and each pair of light-directing areas (e.g., 24A, 24B) is symmetrically disposed about the central axis of the lens. Specifically, for each pair (e.g., 24A, 24B), the light-directing areas are located on opposed sides of the central axis 22. Also, the light-directing areas are located (e.g., center-located) away from the axis 22. Still further, the two pairs of light-directing areas 24A, 24B and 26A, 26B are interspersed or alternated with each other about the axis 22. In the shown example, the pairs of light-directing areas 24A, 24B and 26A, 26B can be considered to be oriented 90° relative to each other.

[0023] In view of the circular shape of the lens 20, association or alignment of one of the light-directing areas (e.g., 24A) relative to a light source (e.g., 18A) is accomplished via rotation of the lens. In the shown example, the lens is rotated 90° to go from one association or alignment position to another association or alignment position. The rotation can be accomplished while the lens 20 is loosely attached to the fixture 14. In other words, the lens 20 need not be completely removed from the fixture 14 to change the light beam that is provided by

the lighting device 12. During rotation, the lens position is variable without change of distance between the lens 20 and the light sources 18A, 18B. However, it is to be appreciated that the selection of association or alignment of one of the light-directing areas (e.g., 24A) relative to a light source (e.g., 18A) may be a one-time determination. For example, the selection may be done when the lens 20 is initially installed. In summary, one aspect of the present invention provides for the ability to select a beam pattern from a single lens.

[0024] Focusing again upon the example that has two pairs of primary light-directing areas 24A, 24B and 26A, 26B, the light-directing areas are arranged so that two distinct beam patterns can be achieved depending on the location of the light-directing areas relative to the light sources 18A and 18B. In the shown example embodiment, the two light sources 18A and 18B are located side by side horizontally (Fig. 3A) and the light-directing areas that are immediately in front of the light sources 18A and 18B (i.e., associated or aligned) will primarily be responsible for the resulting beam patterns. Light emitted from the light sources 18A and 18B will be directed by the associated/aligned light-directing areas dependent upon the particular light-directing properties.

[0025] Within the shown example, the light-directing properties of the light-directing areas 24A, 24B and 26A, 26B include refraction characteristics provided by curvatures on the surface of the lens 20. Thus, each light-directing area (e.g., 24A) creates a distinct beam pattern, as compared to the other light-directing area choice (e.g., 26A). In the shown example, the beam pattern is dependent upon the geometry of the light-directing area (e.g., 24A) that is directly in front of the light sources 18A and 18B. Briefly, the two light-directing areas have different geometries. However, it is to be appreciated that other light-directing properties could be utilized. Examples of such other properties may include diffraction gratings, holographic aspects, selective transmission, and the like.

[0026] Figs. 3A and 3B are schematic illustrations to show sample beam patterns that may be created by an embodiment of the lens 20. It should be appreciated that the sample beam patterns are provided only to illustrate the concept of different beam patterns and are not intended to provide an exact indication of actual beam patterns.

[0027] Fig. 3A is a top view of the lens 20 which shows the light sources 18A and 18B located side by side on a horizontal plane while Fig. 3B is a side view of the lens 20 in which one of the light sources is hidden behind the other. In Figs. 3A and 3B, the first primary light-directing areas 24A, 24B are associated (e.g., aligned) with the light sources 18A, 18B. Light emitted from the light sources 18A, 18B is dispersed significantly horizontally, as shown in Fig. 3A (see dotted lines), but the light is not significantly dispersed vertically, as shown in Fig. 3B (see dotted lines). As such, the first primary light-directing areas 24A, 24B include structure for directing light such that the first beam pattern is laterally oriented.

[0028] Figs. 4A and 4B are similar to Figs. 3A and 4B,

but the second primary light-directing areas 26A, 26B are associated (e.g., aligned) with the light sources 18A, 18B. After being refracted by the second primary light-directing areas 26A, 26B the light is significantly dispersed horizontally, as shown in Fig. 4A (see dotted lines), and significantly dispersed vertically, as shown in Fig. 4B (see dotted lines). As such, the second primary light-directing areas 26A, 26B includes structure for directing light such that the first beam pattern is both laterally and vertically oriented. The dispersion is thus omni-directional within a hemisphere in front of the lens 20. In contrast with the first primary light-directing areas 24A, 24B, the second primary light-directing areas 26A, 26B cause light to have dispersion both horizontally and vertically, offering a more homogeneous illumination in all directions. It is to be appreciated that the beam patterns shown herein are only a set of examples and that other beam patterns can be accomplished with light-directing areas made up of protrusions of different geometry.

[0029] The versatility of the present invention derives from the fact that a number of distinct beam patterns can be obtained as or after the lens 20 is installed for end use. In the preferred embodiment, such versatility is obtained by rotating the lens 20 about its central axis 22 without removing any parts. With two primary light-directing areas, rotating the lens 20 90° about its central axis 22 results in two distinct beam patterns.

[0030] It is to be appreciated that different arrangements of light-directing areas might make it possible to generate more than two beam patterns from the rotation of the lens 20. Therefore, the angle of rotation needed to change beam patterns will depend on the number of possible beam patterns and is not necessarily limited to 90°.

[0031] Turning again to the specific example shown in Fig. 2, the outer periphery of the lens 20 is circular. One specific example of the lens 20 has a diameter that is approximately 8.25 inches. Each of the light-directing areas 24A, 24B and 26A, 26B has a generally hexagonal shape, and the light-directing areas abut each other. The shown example also has first ancillary light-directing areas 30A-30D extending over an outer portion of the lens 20 and a second ancillary light-directing area 32 covering an area at the center of the lens. The first ancillary light-directing areas 30A-30D may be contiguous or separated. The shown example includes both contiguous and separated areas. It is to be appreciated that some or all of the ancillary areas may be omitted or replaced with a different ancillary light-directing area.

[0032] As is shown in Figs. 5 and 6, the lens 20 has a convex outer surface and a concave inner surface. Moreover, Figs. 5 and 6 are cross-section views of the lens that show the first and second, respectively, light-directing areas 24A, 24B and 26A, 26B. Figs. 7 and 8 are, respectively, perspective views of a first light-directing areas and a second light-directing areas (e.g., 24A and 26A). It is to be appreciated that shapes, dimensions, etc. of the shown example, are merely examples and are

not required limitations on the present invention.

[0033] Turning to the specifics of the example light-directing areas, the two areas (e.g., 24A and 26A) have different types of protrusions 38 and 40 to refract light differently. The first primary light-directing area (e.g., 24A) is made up of elongate prism-like protrusions 38, which are arranged such that the elongation directions of all of the protrusions are generally parallel. In one example, the elongate protrusions 38 have a height that is approximately 1/8 of an inch high. It should be further noted that in one specific example, the elongated protrusions 38 are asymmetrical when viewed from their ends. Specifically, the elongate protrusions 38 are somewhat inclined away from the central axis 22 of the lens 20. However, it is to be appreciated that such dimensions and configurations are not required limitations of the present invention. Also, such configuration may be associated with overall curvature of the concavity/convexity of the lens, the manufacture process, etc. The first light-directing area (e.g., 24A) has a propensity to direct light transverse to the elongation of the protrusions 38.

[0034] The second primary light-directing area (e.g., 26A) is made up of matrices of hemi-spheroid (e.g., bead-like) protrusions 40. Each beadlike protrusion 40 has a generally circular cross-section taken along the protrusion extent (e.g., along an individual protrusion axis). Each beadlike protrusion 40 also has a slight conical configuration as the protrusion extends upwardly from the point of contact with the overall lens structure. In one example, each beadlike protrusion 40 has a diameter of approximately 3/16 of an inch across the base and a height that is approximately 1/16 of an inch high. However, it is to be appreciated that such dimensions and configurations are not required limitations on the present invention. The second light-directing area (e.g., 26A) has a propensity to direct light omni-directionally within the hemisphere in front of the lens.

[0035] Turning to the specifics of the example, as shown in the Fig. 2, for the ancillary light-directing areas 30A-30D and 32, these areas cover portions of the surface of the lens 20 different than portions covered by the primary light-directing areas 24A, 24B and 26A, 26B. The first and second ancillary light-directing areas 30A-30D and 32 have protrusions 44 and 46, respectively. The protrusions 44 and 46 are less pronounced (e.g., lower height) than the protrusions 38 and 40 of the primary light-directing areas 24A, 24B and 26A, 26B. In the shown example, the protrusions 44 and 46 of the first and second ancillary light-directing areas 30A-30D and 32 are, respectively, parallels of semi cylinder-like protrusions and matrices of hemi-spheroid (beadlike) protrusions.

[0036] The elongate protrusions 44 of the first ancillary light-directing areas 30A-30D have a height that is less than the height of the protrusions 38 within the first primary light-directing areas 24A, 24B. In one example, the height of the elongate protrusions 38 is approximately 1/16 of an inch. It is to be appreciated that the protrusions 40 of the second primary light-directing areas 26A, 26B

have a height that is approximately the same as the height of the elongate protrusions 44 of the first ancillary light-directing areas 30A-30D. However, such dimensioning is not a required limitation of the present invention.

[0037] In the shown example, the second ancillary light-directing area 32 does not have a definite border from second primary light-directing areas 26A, 26B because of the use of beadlike protrusions for all of these areas. The second ancillary light-directing area 32 merely comprises beadlike protrusions 46 that diminish in size as protrusion to axis distance diminishes. The beadlike protrusions 46 within the center of the second ancillary light-directing area 32 diminish to approximately 1/4 of the height of the beadlike protrusions of the second primary light-directing areas 26A, 26B.

[0038] The invention has been described herein above using specific examples; however, it will be understood by those skilled in the art that various alternatives may be used and equivalents may be substituted for elements or steps described herein, without deviating from the scope of the invention. Modifications may be necessary to adapt the invention to a particular situation or to particular needs without departing from the scope of the invention. It is intended that the invention not be limited to the particular implementation described herein, but that the claims be given their broadest interpretation to cover all embodiments, literal or equivalent, covered thereby.

Claims

1. A lens for a wet environment lighting device that has a fixture with an interior that has an opening, and at least one light source located within the fixture interior, light from the light source proceeding out through the opening, the lens being for location in front of the fixture and the light source located therein, the lens enclosing the opening from the wet environment, the lens comprising:

a first light-directing area for directing light in a first beam pattern; and

a second light-directing area, distinct from the first light-directing area, for directing light in a second beam pattern, distinct from the first beam pattern;

wherein the lens is positioned relative to fixture and light source therein to select from the distinct beam patterns based on the alignment of the light-directing areas relative to the light source resulting from a positioning of the lens.

2. A lens as set forth in claim 1, wherein the lens has a central axis, and the first and second light-directing area are located away from the axis.

3. A lens as set forth in claim 1, wherein the first light-

directing area includes structure for directing light such that the first beam pattern is laterally oriented, and the second light-directing area includes structure for directing light such that the second beam pattern is laterally and vertically disperse.

4. A lens as set forth in claim 3, wherein the first light-directing area includes elongate protrusions that are parallel to each other, and the second light-directing area includes hemi-spheroid protrusions.

5. A lens as set forth in claim 1, wherein the lighting device has two light sources, and the lens has a pair of first light-directing areas and a pair of second light-directing areas.

6. A lens as set forth in claim 1, wherein the lens is a unitary member.

7. A lighting device for a wet environment, the lighting device comprising:

a fixture for location within the wet environment and having an interior with an opening;

at least one light source located within the fixture interior, light from the light source being able to proceed from the interior through the opening; and

a lens located in front of the fixture and the light source located therein, the lens enclosing the opening from the wet environment and having a plurality of light-directing areas, and each light-directing area having a different light-directing feature;

wherein the relative position between the lens and the light source is variable to associate different light-directing areas with the light source and provide different light beam patterns for light proceeding from the light source through the lens and into the wet environment dependent upon the different light-directing areas and light source associations resulting from the position variation.

8. A lighting device according to claim 7, wherein each light-directing area includes a surface geometry on the lens.

9. A lighting device according to claim 8, wherein one of the light-directing areas includes elongate, protrusions that are parallel to each other, and another of the light-directing areas includes hemi-spheroid protrusions.

10. A lighting device according to claim 7, wherein the lens has a circular periphery and variation of positioning of the lens includes rotation of the lens about a central axis of the lens.

11. A lighting device according to claim 7, wherein the lens position is variable without change of distance between the lens and the light source.

12. A lighting device according to claim 7, wherein the light source is a color-changing light source.

13. A lighting device for a wet environment, the lighting device comprising:

a fixture for location within the wet environment and having an interior with an opening; multiple light sources located within the fixture interior; and a lens located in front of the fixture and the light sources located therein, the lens enclosing the opening from the wet environment; wherein the relative position between the lens and the light sources is variable to align different light-directing areas with the light sources and provide different light beam patterns for light proceeding from the light source through the lens and into the wet environment dependent upon the different light-directing areas and light source alignments resulting from the position variation.

14. A lighting device according to claim 13, wherein the relative position between the lens and the light source is varied by a 90° relative reposition of the lens and the fixture.

15. A lighting device according to claim 13, wherein the light-directing areas of the lens each include a surface geometry on the lens.

16. A lighting device according to claim 15, wherein one of the light-directing areas includes elongate protrusions that are parallel to each other, and another of the light-directing areas includes hemi-spheroid protrusions.

17. A lighting device according to claim 13, wherein the lens has a circular periphery and variation of positioning of the lens includes rotation of the lens on a central axis of the lens.

18. A lighting device according to claim 13, wherein the lens position is variable without change of distance between the lens and the light sources.

19. A lighting device according to claim 13, wherein the lighting device is an underwater lighting device, and the beam patterns proceed through water.

20. A lighting device for a wet environment, the lighting device comprising:

a fixture for location within the environment and having an interior with an opening; at least one light source located within the fixture interior; and

a lens located in front of the fixture and the light source located therein, the lens closing the opening from the wet environment; wherein the lens is repositioned to select from multiple, distinct beam patterns based on alignment relative to the light source resulting from a repositioning of the lens.

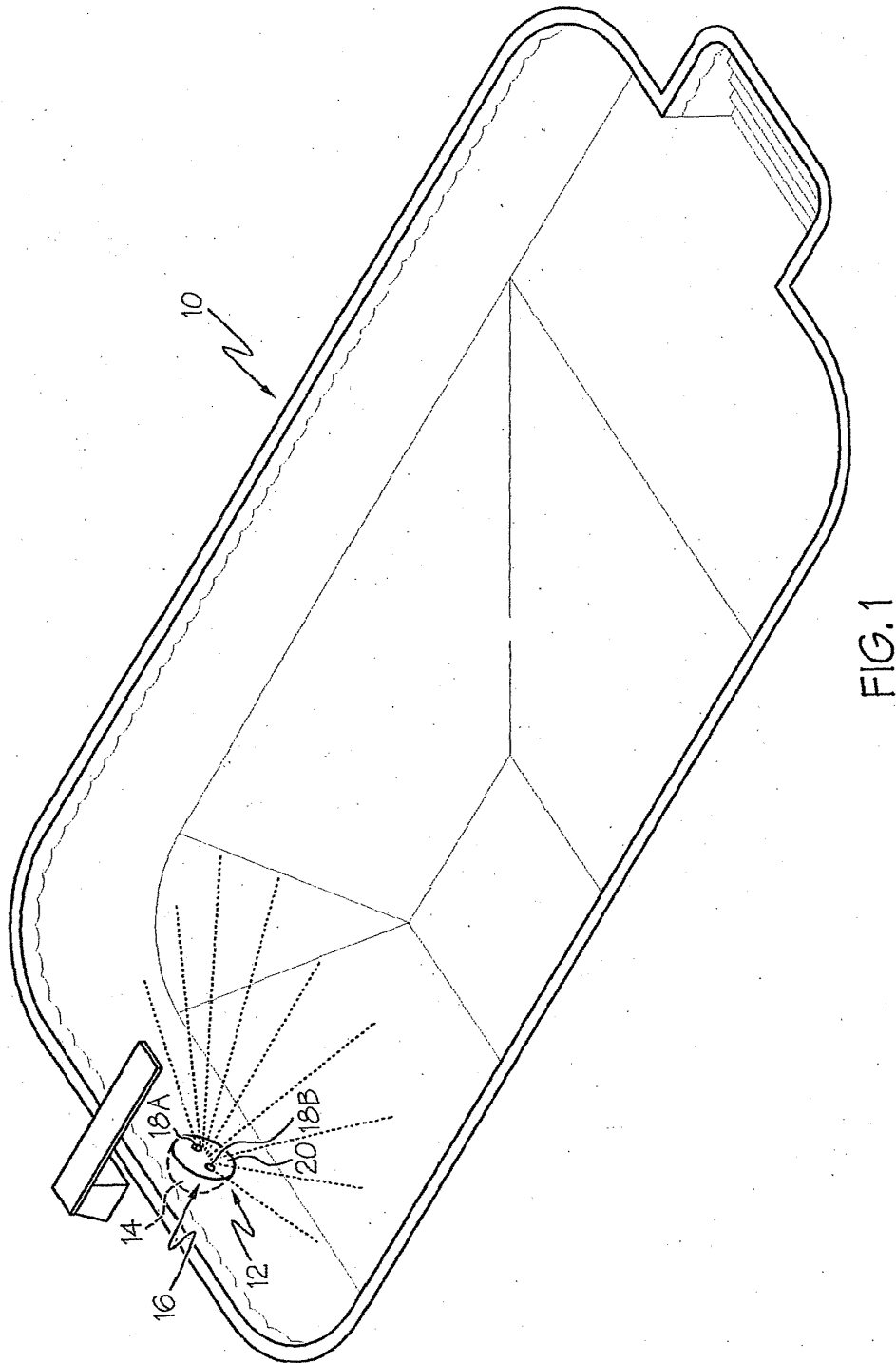
21. A lighting device according to claim 20, wherein repositioning the lens includes rotating the lens, the light source is located within the fixture interior such that the rotation of the lens provides for the repositioning.

22. A lighting device according to claim 20, wherein the lens is positionable at first and second locations relative to the fixture and the light source therein, the lens has a first light-directing portion for directing light proceeding from the light source in a first manner when the lens is at the first location, and the lens has a second light-directing portion for directing light proceeding from the light source in a second manner, different from the first manner, when the lens is at the second location.

23. A lighting device according to claim 22, wherein the first light-directing area includes elongate protrusions that are parallel to each other, and the second light-directing area includes hemi-spheroid protrusions.

24. A lighting device according to claim 23, wherein the first light-directing area has a propensity to direct light transverse to the elongation of the protrusions, and the second light-directing area has a propensity to direct light omni-directionally within a hemisphere.

25. A lighting device according to claim 20, wherein the lighting device is an underwater lighting device, and the multiple, distinct beam patterns proceed through water.



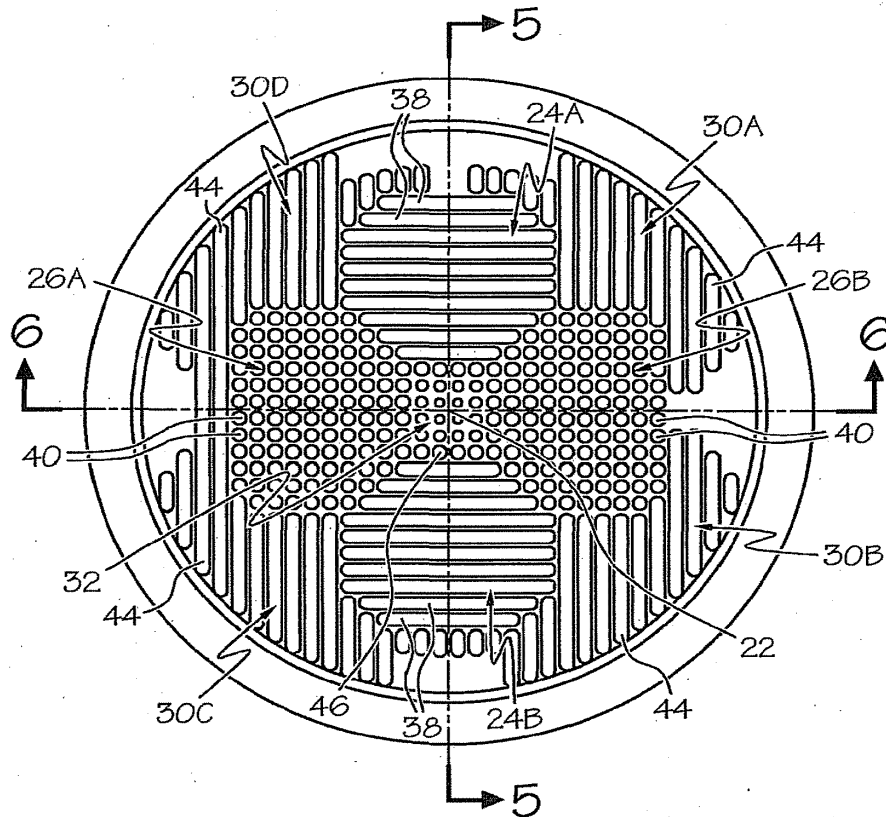


FIG. 2

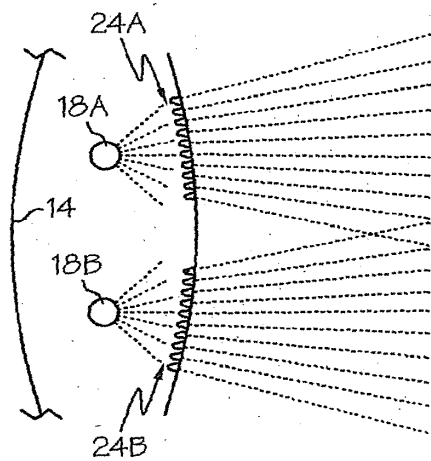


FIG. 3A

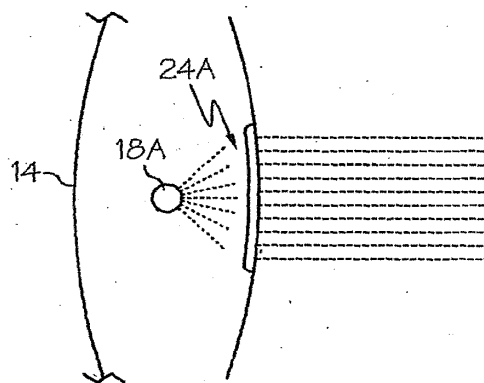


FIG. 3B

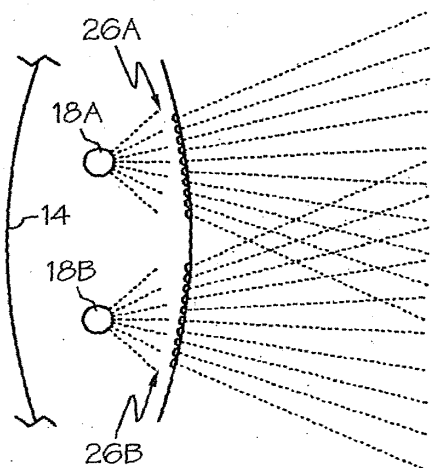


FIG. 4A

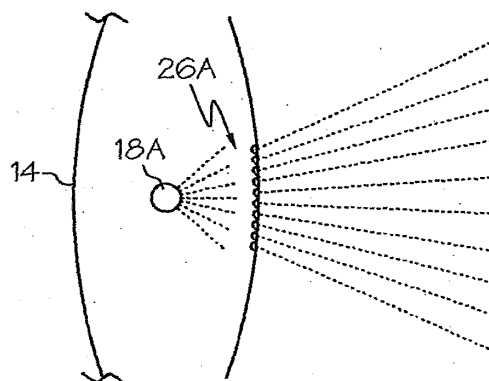


FIG. 4B

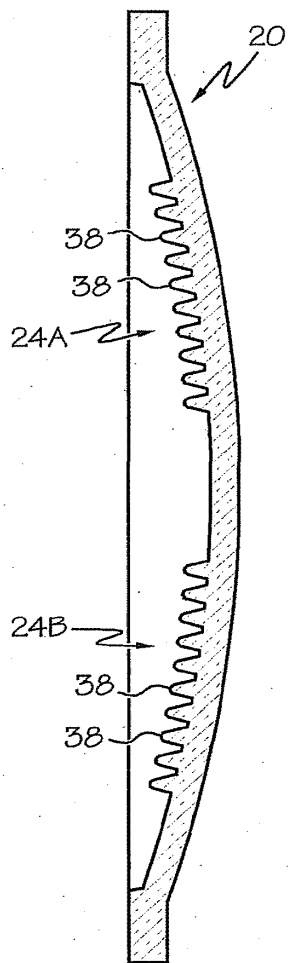


FIG. 5

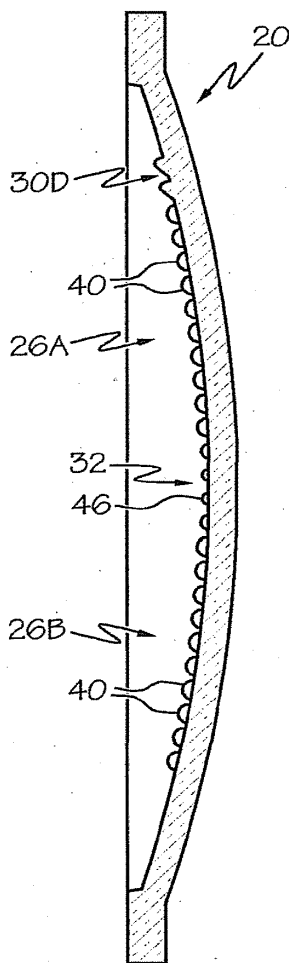


FIG. 6

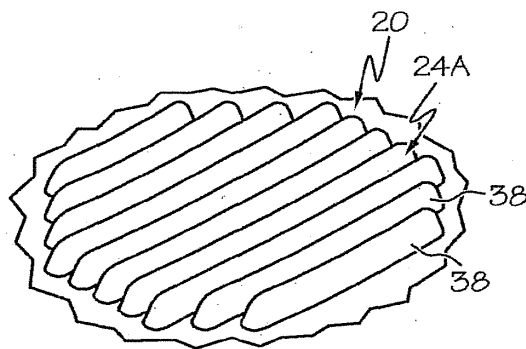


FIG. 7

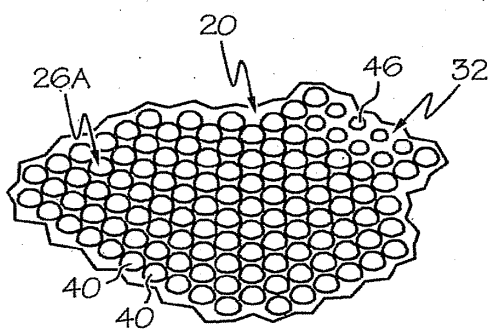


FIG. 8



(11) **EP 1 653 255 A3**

(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
21.06.2006 Bulletin 2006/25

(51) Int Cl.:
G02B 3/02 (2006.01) F21S 8/00 (2006.01)
F21V 5/04 (2006.01)

(43) Date of publication A2:
03.05.2006 Bulletin 2006/18

(21) Application number: **05110078.2**

(22) Date of filing: **27.10.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI
SK TR
 Designated Extension States:
AL BA HR MK YU

(72) Inventors:
 • **Potucek, Kevin**
 Far Hills, NJ 07931 (US)
 • **Dunn, Dennis**
 Thousand Oaks, CA 91360 (US)

(30) Priority: **29.10.2004 US 623607 P**

(74) Representative: **P&TS**
Patents & Technology Surveys SA
 Rue des Terreaux 7,
 Postfach 2848
 2001 Neuchâtel (CH)

(71) Applicant: **Pentair Water Pool and Spa, Inc.**
Moorpark, CA 93021 (US)

(54) **Selectable beam lens for underwater light**

(57) A lens for a wet environment lighting device that has a fixture with an interior that has an opening, and at least one light source located within the fixture interior. Light from the light source proceeds out through the opening. The lens is for location in front of the fixture and the light source located therein and the lens encloses the opening from the wet environment. The lens has a first light-directing area for directing light in a first beam pattern. The lens also has a second light-directing area, distinct from the first light-directing area, for directing light in a second beam pattern, distinct from the first beam pattern. The lens is positioned relative to fixture and light source therein to select from the distinct beam patterns based on the alignment of the light-directing areas relative to the light source resulting from a positioning of the lens.

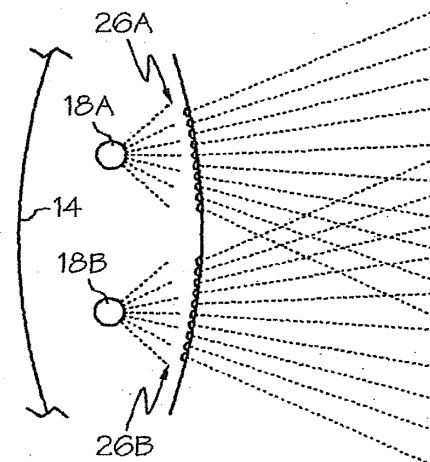


FIG. 4A

EP 1 653 255 A3

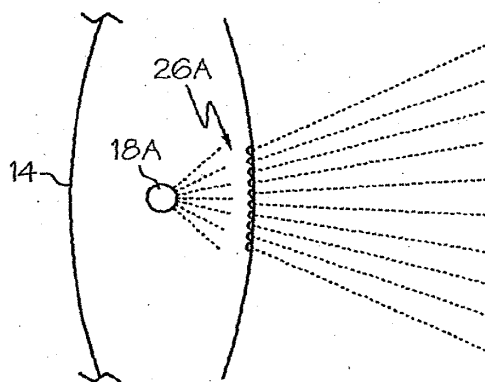


FIG. 4B



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 05 11 0078

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	WO 2004/053387 A (AQUA PHAROS INTERNATIONAL LIMITED; POGGI, BRIAN) 24 June 2004 (2004-06-24) * page 9, line 15 - page 10, line 32 * * page 13, lines 17-22 * * page 14, lines 11-30 *	1,3,6	INV. G02B3/02 F21S8/00 F21V5/04
X	US 2 481 054 A (WENDEL RUDOLF) 6 September 1949 (1949-09-06) * the whole document *	1,3,5	
P,X	DE 103 21 992 A1 (WTS KERESKEDELMI ES SZOLGALTATO KFT., SZENTENDRE) 10 March 2005 (2005-03-10) * paragraphs [0008] - [0010] * * paragraphs [0024] - [0027] *	1	
A	US 5 349 505 A (POPPENHEIMER ET AL) 20 September 1994 (1994-09-20) * figures 1,2,11 *	1	
A	PATENT ABSTRACTS OF JAPAN vol. 2002, no. 04, 4 August 2002 (2002-08-04) & JP 2001 357703 A (INAX CORP), 26 December 2001 (2001-12-26) * abstract *	1	TECHNICAL FIELDS SEARCHED (IPC) G02B F21S F21V
1 The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 25 January 2006	Examiner Mollenhauer, R
<p>CATEGORY OF CITED DOCUMENTS</p> <p>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</p> <p>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</p> <p>& : member of the same patent family, corresponding document</p>			



European Patent
Office

Application Number
EP 05 11 0078

CLAIMS INCURRING FEES

The present European patent application comprised at the time of filing more than ten claims.

- ☐ Only part of the claims have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims and for those claims for which claims fees have been paid, namely claim(s):
- ☐ No claims fees have been paid within the prescribed time limit. The present European search report has been drawn up for the first ten claims.

LACK OF UNITY OF INVENTION

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

see sheet B

- ☐ All further search fees have been paid within the fixed time limit. The present European search report has been drawn up for all claims.
- ☐ As all searchable claims could be searched without effort justifying an additional fee, the Search Division did not invite payment of any additional fee.
- ☐ Only part of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the inventions in respect of which search fees have been paid, namely claims:
- ☒ None of the further search fees have been paid within the fixed time limit. The present European search report has been drawn up for those parts of the European patent application which relate to the invention first mentioned in the claims, namely claims:
- see annex



European Patent
Office

**LACK OF UNITY OF INVENTION
SHEET B**

Application Number
EP 05 11 0078

The Search Division considers that the present European patent application does not comply with the requirements of unity of invention and relates to several inventions or groups of inventions, namely:

1. claims: 1-6

lens with a central axis and first and second
light-directing areas located away from the axis

2. claims: 7-12,20-25

lighting device with variable position between the lens and
the light source

3. claims: 13-19

lighting device with multiple light sources

EP 1 653 255 A3

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 05 11 0078

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.

25-01-2006

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
WO 2004053387	A	24-06-2004	AU 2003288430 A1	30-06-2004
			EP 1570206 A1	07-09-2005
			GB 2398374 A	18-08-2004
			US 2006072323 A1	06-04-2006
US 2481054	A	06-09-1949	NONE	
DE 10321992	A1	10-03-2005	NONE	
US 5349505	A	20-09-1994	US 5483428 A	09-01-1996
JP 2001357703	A	26-12-2001	NONE	

EPO FORM P0459

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

LAMPE DE VEHICULE COMPRENANT PLUSIEURS DIODES PHOTOEMISSIVES

AT

Publication number: FR2814220

Publication date: 2002-03-22

Inventor: NATSUME KAZUNORI

Applicant: KOITO MFG CO LTD (JP)

Classification:

- international: **B60Q1/26; F21S8/10; F21V5/00; F21V13/04; F21W101/14; F21Y101/02; B60Q1/26; F21S8/10; F21V5/00; F21V13/00; (IPC1-7): F21S8/10; F21S10/02; F21S10/06; F21V5/04; F21V7/00; F21W101/02; F21W101/12; F21W101/14; F21Y101/02**

- European: B60Q1/26B; B60Q1/26L; F21S8/10Q2; F21V5/00Q

Application number: FR20010012037 20010918

Priority number(s): JP20000281899 20000918

Also published as:

 US 6657393 (B2)
 US 2002054495 (A1)
 J P2002093212 (A)
 DE 10145962 (A1)

Report a data error here

Abstract not available for FR2814220

Data supplied from the **esp@cenet** database - Worldwide

LAMPE DE VEHICULE COMPRENANT PLUSIEURS DIODES PHOTOEMISSIVES**Publication number:** FR2814220 (A1)**Publication date:** 2002-03-22**Inventor(s):** NATSUME KAZUNORI**Applicant(s):** KOITO MFG CO LTD [JP]**Classification:**

- international: **B60Q1/26; F21S8/10; F21V5/00; F21V13/04; F21W101/14; F21Y101/02; B60Q1/26; F21S8/10; F21V5/00; F21V13/00; (IPC1-7): F21S8/10; F21S10/02; F21S10/06; F21V5/04; F21V7/00; F21W101/02; F21W101/12; F21W101/14; F21Y101/02**

- European: B60Q1/26B; B60Q1/26L; F21S8/10Q2; F21V5/00Q

Application number: FR20010012037 20010918**Priority number(s):** JP20000281899 20000918**Also published as:**

 FR2814220 (B1)
 US2002054495 (A1)
 US6657393 (B2)
 JP2002093212 (A)
 DE10145962 (A1)

Cited documents:

 EP0984220 (A1)
 DE3916875 (A1)
 GB2139340 (A)
 DE19853742 (A1)
 EP0326668 (A2)

Abstract of FR 2814220 (A1)

L'invention concerne une lampe de véhicule. Elle se rapporte à une lampe de véhicule comprenant une source lumineuse ayant plusieurs diodes photoémissives qui peuvent être allumées dans au moins deux types de modes d'éclairage de lampe. La source lumineuse a un premier groupe de diodes photoémissives comprenant au moins une diode (24R1, 32R) placée en position pratiquement centrale de la source lumineuse et un second groupe de diodes photoémissives comprenant plusieurs diodes (24R2, 32U) qui entourent le premier groupe de diodes. Les modes d'éclairage de la lampe comprennent un premier mode dans lequel seul le premier groupe de diodes photoémissives (24R1, 32R) est allumé et un second mode dans lequel le second groupe de diodes photoémissives (24R2, 32U) est allumé. Application aux lampes des véhicules automobiles. <P>

Data supplied from the esp@cenet database — Worldwide

AI

①⑨ RÉPUBLIQUE FRANÇAISE
INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE
PARIS

①⑪ N° de publication : 2 814 220

(à n'utiliser que pour les
commandes de reproduction)

②① N° d'enregistrement national : 01 12037

⑤① Int Cl⁷ : F 21 S 8/10, F 21 S 10/02, 10/06, F 21 V 5/04, 7/00 //
F 21 W 101:02, 101:12, 101:14, F 21 Y, 101:02

⑫ DEMANDE DE BREVET D'INVENTION

A1

②② Date de dépôt : 18.09.01.

③⑦ Priorité : 18.09.00 JP 00281899.

④③ Date de mise à la disposition du public de la
demande : 22.03.02 Bulletin 02/12.

⑤⑥ Liste des documents cités dans le rapport de
recherche préliminaire : *Ce dernier n'a pas été
établi à la date de publication de la demande.*

⑥⑦ Références à d'autres documents nationaux
apparentés :

⑦① Demandeur(s) : KOITO MANUFACTURING CO LTD—
JP.

⑦② Inventeur(s) : NATSUME KAZUNORI.

⑦③ Titulaire(s) :

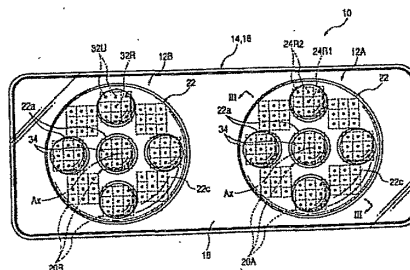
⑦④ Mandataire(s) : CABINET BEAU DE LOMENIE.

⑤④ LAMPE DE VEHICULE COMPRENANT PLUSIEURS DIODES PHOTOEMISSIVES.

⑤⑦ L'invention concerne une lampe de véhicule.

Elle se rapporte à une lampe de véhicule comprenant
une source lumineuse ayant plusieurs diodes photoémissi-
ves qui peuvent être allumées dans au moins deux types de
modes d'éclairage de lampe. La source lumineuse a un pre-
mier groupe de diodes photoémissives comprenant au
moins une diode (24R1, 32R) placée en position pratique-
ment centrale de la source lumineuse et un second groupe
de diodes photoémissives comprenant plusieurs diodes
(24R2, 32U) qui entourent le premier groupe de diodes. Les
modes d'éclairage de la lampe comprennent un premier
mode dans lequel seul le premier groupe de diodes photoé-
missives (24R1, 32R) est allumé et un second mode dans
lequel le second groupe de diodes photoémissives (24R2,
32U) est allumé.

Application aux lampes des véhicules automobiles.



FR 2 814 220 - A1



La présente invention concerne une lampe de véhicule qui possède une source lumineuse comprenant plusieurs diodes photoémissives qui peuvent être mises en fonctionnement dans des modes d'éclairage qui peuvent être commutés.

5 Les lampes classiques de véhicule, telles que les lanternes et feux de stop, ont été réalisées afin qu'elles puissent être mises en fonctionnement avec deux types de modes d'éclairage de lampe. Une disposition particulière à cet effet comprend l'utilisation de sources lumineuses à
10 deux filaments, si bien que les modes d'éclairage de lanterne et de feu de stop peuvent être commutés par changement du nombre de filaments chauffés.

On connaît aussi des lampes de véhicules qui utilisent plusieurs diodes photoémissives comme source lumineuse, si
15 bien que les modes d'éclairage de lanterne et de feu de stop sont commutés par changement convenable du nombre de diodes en fonctionnement.

Dans le cas où le nombre de diodes photoémissives en fonctionnement dans une telle lampe de véhicule est changé
20 sans précautions, le nombre de sources lumineuses est tel qu'il donne une impression d'augmentation ou de réduction de nombre et de variation de position de chaque source lumineuse lors de la commutation des modes d'éclairage. En conséquence, on peut craindre que les conducteurs des autres
25 véhicules ne reçoivent une indication erronée.

L'invention a donc pour objet la réalisation d'une lampe de véhicule qui permet la commutation de modes d'éclairage de la lampe sans donner aux conducteurs d'autres
30 véhicules une indication erronée, même lorsque chaque source lumineuse est formée de plusieurs diodes photoémissives.

L'invention atteint l'objet précité par mise en oeuvre de groupes prédéterminés de lentilles placés devant les diodes photoémissives.

Une lampe de véhicule selon l'invention comprend une
35 source lumineuse possédant plusieurs diodes photoémissives qui peuvent être mises en fonctionnement avec au moins deux sortes de modes d'éclairage. La source lumineuse a un premier groupe de diodes photoémissives comprenant au moins

une diode photoémissive placée en position pratiquement centrale par rapport à la source lumineuse, et un second groupe de diodes photoémissives comprenant plusieurs diodes disposées afin qu'elles entourent le premier groupe de diodes. Les modes d'éclairage comprennent un premier mode
5 dans lequel seules les diodes du premier groupe sont en fonctionnement, et un second mode dans lequel les diodes du second groupe sont mises en fonctionnement.

Tant que la lampe a une source lumineuse possédant
10 plusieurs diodes photoémissives, la disposition des autres éléments qui forment le dispositif d'éclairage n'est pas limitée à une disposition particulière.

Dans la mesure où le premier groupe de diodes photoémissives est en position pratiquement centrale par rapport à la source lumineuse, la disposition des diodes formant le premier groupe n'est pas limitée à une disposition particulière quelconque. Dans la mesure où le second
15 groupe de diodes est disposé afin qu'il entoure le premier groupe, la disposition des diodes photoémissives formant le second groupe n'est pas limitée à une disposition spécifique quelconque. Par exemple, des dispositions de diodes photoémissives formant le premier groupe ou le second groupe peuvent comprendre une disposition symétrique par rapport à un point qui occupe la position centrale de la source
20 lumineuse ou une disposition à symétrie axiale par rapport à une droite passant par la position centrale de la source.

En outre, les diodes photoémissives formant le premier groupe et celles qui forment le second groupe peuvent avoir la même couleur ou des couleurs différentes.

Bien que le second groupe de diodes photoémissives soit destiné à être mis en fonctionnement dans le second mode d'éclairage, la mise en fonctionnement des diodes du second
30 groupe peut comporter un mode dans lequel seules les diodes du second groupe sont en fonctionnement, et un mode dans lequel les diodes du premier groupe et celles du second groupe sont ensemble en fonctionnement.

Grâce à la disposition indiquée, la lampe de véhicule a une source lumineuse possédant plusieurs diodes

photoémissives qui peuvent être mises en fonctionnement dans au moins deux types de modes d'éclairage. La source lumineuse possède le premier groupe, qui comprend au moins une diode photoémissive, en position pratiquement centrale de la source, et le second groupe qui comprend plusieurs diodes photoémissives disposées afin qu'elles entourent le premier groupe. En outre, les modes d'éclairage de la lampe comprennent le premier mode d'éclairage dans lequel seules les diodes du premier groupe sont en fonctionnement et le second mode dans lequel les diodes du second groupe sont en fonctionnement, si bien qu'on peut obtenir le fonctionnement suivant.

Plus précisément, comme les diodes photoémissives du premier groupe comprennent au moins une diodes photoémissive en position pratiquement centrale par rapport à la source lumineuse et le second groupe comprend plusieurs diodes photoémissives disposées afin qu'elles entourent les diodes du premier groupe, il est possible de donner à la source lumineuse un aspect analogue à celui qui est obtenu lorsque la source est mise en fonctionnement autour de sa position pratiquement centrale dans l'un des cas suivants : (1) seules les diodes du premier groupe sont en fonctionnement, (2) seules les diodes du second groupe sont en fonctionnement, et (3) les diodes du premier groupe et du second groupe sont simultanément en fonctionnement.

En conséquence, le nombre de sources lumineuses est tel que l'aspect obtenu donne un effet d'augmentation ou de réduction du nombre de diodes, et la position de la source ne peut pas donner un effet de variation au moment de la commutation des modes d'éclairage, si bien que les conducteurs des autres véhicules ne risquent pas de recevoir une indication erronée.

Dans la lampe de véhicule ayant la source qui comprend plusieurs diodes photoémissives qui sont mises en fonctionnement dans des modes commutables, il est possible de commuter les modes d'éclairage sans donner aux conducteurs des autres véhicules une indication erronée.

Bien que la source lumineuse puisse ne comporter que le premier groupe et le second groupe de diodes photo-émissoires, elle peut aussi comporter un troisième groupe comprenant plusieurs diodes photoémissoires disposées afin qu'elles entourent le second groupe de diodes. Dans ce cas, un plus grand nombre de modes d'éclairage peut être établi.

Dans la disposition précitée, dans le cas où les diodes du premier groupe et celles du second groupe ont la même couleur, la luminosité peut beaucoup varier lors de la commutation des modes d'éclairage grâce à l'éclairage simultané du premier et du second groupe. Lorsqu'un feu de stop est mis en fonctionnement alors que la lanterne reste allumée, les conducteurs des autres véhicules et d'autres personnes peuvent reconnaître nettement l'éclairage du feu de stop, par exemple par réalisation des diodes photo-émissoires du premier et du second groupe par des diodes de couleur rouge, le premier mode d'éclairage étant le mode de lanterne et le second étant le mode de feu de stop.

Dans la disposition précitée d'autre part, dans le cas où les diodes photoémissoires du premier groupe et du second groupe ont des couleurs différentes, seules les diodes du second groupe sont allumées dans le second mode d'éclairage. En conséquence, la source lumineuse ne fonctionne pas avec les deux couleurs simultanément, et il est possible de commuter les modes sans donner une indication erronée aux conducteurs des autres véhicules.

Lorsqu'un indicateur de changement de direction est manoeuvré, un clignotant jaune peut être mis en fonctionnement, par exemple parce que les diodes du premier groupe sont rouges et celles du second groupe jaunes, et le premier mode d'éclairage est le mode de lanterne et le second mode d'éclairage est le mode de clignotant.

Avec la disposition précitée, l'incorporation d'une lentille de diffusion comprenant plusieurs éléments de lentille de diffusion en avant de la source lumineuse permet de rendre pratiquement uniforme la luminosité donnée par l'ensemble de la source. La source lumineuse ressemble alors plus à une source lumineuse unique.

Dans ce cas, la disposition d'une lentille formant condenseur devant la lentille de diffusion permet l'obtention des performances nécessaires de distribution de l'intensité lumineuse du dispositif d'éclairage, grâce à la
5 combinaison de la lentille formant condenseur et de la lentille de diffusion.

La source lumineuse peut être une source unique. Cependant, une quantité suffisante de lumière peut être obtenue par disposition de plusieurs sources lumineuses. Selon
10 l'invention, la disposition prédéterminée des sources lumineuses n'est pas limitée à une disposition particulière et cette disposition peut comprendre une disposition en série, une disposition annulaire ou tout autre type de disposition convenable.

15 Il est en outre possible d'adopter une lampe de véhicule ayant plusieurs unités à lampe, la lampe précitée constituant une unité. Dans ce cas, les deux types au moins de modes d'éclairage de chaque unité sont combinés afin qu'ils donnent différentes combinaisons entre les unités et
20 qu'un nombre de modes d'éclairage encore plus grand puisse être utilisé.

D'autres caractéristiques et avantages de l'invention seront mieux compris à la lecture de la description qui va suivre d'exemples de réalisation, faite en référence aux
25 dessins annexés sur lesquels :

la figure 1 est une vue en élévation d'une lampe de véhicule dans un mode de réalisation de l'invention ;

la figure 2 est une coupe horizontale d'une lampe de véhicule dans un mode de réalisation de l'invention ;

30 la figure 3 est une coupe détaillée suivant la ligne III-III de la figure 1 ;

la figure 4 est une vue en élévation représentant un état dans lequel la lampe de véhicule est en fonctionnement comme en mode d'éclairage de lanterne ;

35 la figure 5 est une vue en élévation représentant un état dans lequel la lampe du véhicule est en mode d'éclairage de lanterne-feu de stop ;

la figure 6 est une vue en élévation représentant l'état dans lequel la lampe de véhicule est en mode d'éclairage de lanterne et de clignotant ;

la figure 7 est une vue en élévation représentant un état dans lequel la lampe de véhicule est en mode d'éclairage de feu de stop et de clignotant ;

les figures 8(a) à 8(f) sont des schémas représentant des exemples de disposition de diodes photoémissives constituant chaque source lumineuse de la lampe de véhicule ; et

les figures 9(a) à 9(e) sont des schémas représentant des exemples de disposition de diodes photoémissives constituant chaque source lumineuse de la lampe de véhicule.

La figure 1 est une vue en élévation d'une lampe 10 de véhicule selon l'invention, la figure 2 une coupe horizontale de cette lampe, et la figure 3 une coupe détaillée suivant la ligne III-III de la figure 1.

Comme l'indiquent les figures 1 à 3, la lampe 10 de véhicule selon l'invention est une lampe arrière combinée placée à la partie d'extrémité arrière gauche d'un véhicule. Cette lampe 10 comporte deux unités 12A et 12B à lampe logées dans une chambre de lampe. Cette chambre comporte un corps 14 de lampe ayant un contour allongé latéralement, une glace translucide continue 16, et un panneau 18 de protection qui entoure ces unités 12A et 12B à lampe.

La lampe 10 de véhicule est utilisée fonctionnellement comme lanterne, comme feu de stop et comme clignotant. Plus précisément, l'unité 12A placée du côté interne du véhicule dans la direction de la largeur peut fonctionner en mode d'éclairage de lanterne et en mode d'éclairage de feu de stop. L'unité à lampe 12B placée du côté extérieur du véhicule dans la direction de la largeur peut être mise en fonctionnement en mode d'éclairage de lanterne et en mode d'éclairage de clignotant.

On décrit d'abord la construction de l'unité à lampe 12A.

L'unité à lampe 12A comporte neuf sources lumineuses 20A et un panneau translucide 22 placé devant ces sources 20A (c'est-à-dire en avant du dispositif d'éclairage mais en

pratique à l'arrière du véhicule, la même remarque s'appliquant dans la suite).

Chacune des sources lumineuses 20A comprend neuf diodes photoémissives rouges 24R1 et 24R2, telles que les diodes photoémissives sont placées verticalement et horizontalement sous forme d'un carré, c'est-à-dire d'un carré de 3 x 3 diodes. Sur les neuf diodes rouges 24R1 et 24R2, une diode 24R1 (premier groupe) placée en position centrale dans la source 20A est mise en fonctionnement en mode d'éclairage de lanterne. Les huit diodes rouges 24R2 (second groupe) qui entourent la diode rouge 24R1 sont mises en fonctionnement avec la diode 24R1 en mode d'éclairage de feu de stop.

L'une des neuf sources lumineuses 20A est placée sur un axe optique Ax disposé dans la direction longitudinale et passant par la position centrale de l'unité à lampe 12A. Les huit sources lumineuses restantes sont disposées afin qu'elles entourent l'axe optique Ax à des intervalles de 45° autour de celui-ci.

Sur la figure 2, les neuf diodes photoémissives rouges 24R1 et 24R2 formant chacune des neuf sources lumineuses 20A sont montées sur une seule carte de circuit imprimé 26. Une lentille de diffusion 28 ayant plusieurs éléments de lentille de diffusion (lentille en oeil de poisson) est placée devant chaque source lumineuse 20A. Ces lentilles 28 de diffusion sont formées sur une même carte 30 de lentilles de diffusion.

On se réfère à la figure 3 ; pour la source lumineuse 20A placée sur l'axe optique Ax et les quatre sources lumineuses 20A placées verticalement et horizontalement à côté de la source lumineuse 20A placée sur l'axe optique Ax (cinq sources lumineuses 20A disposées en croix), des lentilles 34 formant condenseur sont en outre placées devant les lentilles de diffusion 28. Comme décrit précédemment, les lentilles de diffusion 28 sont placées devant les sources lumineuses respectives 20A. Chacune de ces lentilles 34 formant condenseur est une lentille plan-convexe ayant une surface convexe à la face avant et elles sont formées sur une seule carte 36 de lentilles formant condenseur.

Le panneau translucide 22 a une forme de dôme et il dépasse vers l'avant. A la partie avant de chacune des cinq sources lumineuses en croix 20A placées dans le panneau translucide 22, est formée une partie circulaire d'ouverture 5 22a de diamètre légèrement supérieur à celui de la lentille 34 formant condenseur vue sur une élévation du dispositif d'éclairage. Une partie cylindrique 22b tournée vers la carte 36 de lentilles formant condenseur qui conserve la configuration périphérique externe pratiquement de la partie 10 d'ouverture 22a est formée dans cette partie d'ouverture 22a. De plus, un traitement semi-réfléchissant est appliqué à la surface en forme de dôme du panneau translucide 22 pour la constitution d'une partie semi-réfléchissante 22c. Ce traitement semi-réfléchissant est aussi appliqué à la 15 surface de la partie cylindrique 22b dans le panneau translucide 22.

Le panneau translucide 22 a une partie périphérique externe sous forme d'une partie annulaire plate 22d. Cette partie plate 22d, la carte de circuit imprimé 26, la carte 20 30 de lentilles de diffusion et la carte 36 de lentilles formant condenseur sont fixées, par l'intermédiaire d'entre-toises 38 et 40, au corps 14 de lampe par des boulons 42 et des écrous 44 à plusieurs emplacements périphériques de la partie annulaire plate 22d.

25 L'émission lumineuse est réalisée de la manière suivante dans cette unité à lampe 12A.

Dans le cas des cinq sources lumineuses placées en croix 20A, la lumière des diodes photoémissives rouges 24R1 et 24R2 formant la source 20A diffuse dans la lentille de 30 diffusion 28. La lentille 34 formant condenseur concentre la lumière diffusée puis l'émet vers l'avant. D'autre part, pour les quatre autres sources lumineuses restantes 20A, la lumière des diodes photoémissives rouges 24R1 et 24R2 qui forment chacune des quatre sources lumineuses est diffusée 35 par la lentille 28 de diffusion. La lumière émise par cette lentille 28 traverse le panneau translucide 22 pour être émise en avant. Ainsi, la distribution nécessaire d'intensité lumineuse peut être donnée au dispositif d'éclairage.

On décrit maintenant la construction de l'unité à lampe 12B.

Comme l'indique la figure 1, la construction de l'unité à lampe 12B est fondamentalement analogue à celle de l'unité à lampe 12A, mais les diodes photoémissives formant les sources 20B sont différentes de celles de l'unité à lampe 12A.

Plus précisément, l'unité à lampe 12B a aussi neuf sources lumineuses 20B comprenant chacune neuf diodes photoémissives disposées verticalement et horizontalement, c'est-à-dire sous forme d'un carré de 3 x 3 diodes. Une diode placée en position centrale dans la source 20B est une diode rouge 32R et huit diodes photoémissives entourant la diode rouge 32R sont des diodes jaunes 32U. De plus, dans chaque source lumineuse 20B, la diode rouge 32R (premier groupe) est mise en fonctionnement en mode d'éclairage de lanterne. Les huit diodes jaunes 32U (second groupe) sont mises en fonctionnement en mode de clignotant.

Les figures 4 à 7 sont des vues en élévation d'un état dans lequel la lampe 10 de véhicule de ce mode de réalisation est mise en fonctionnement dans divers modes d'éclairage.

Comme l'indique la figure 4, seules les diodes photoémissives rouges 24R1 et 32R placées au centre des sources lumineuses respectives 20A et 20B des deux unités à lampe 12A et 12B sont mises en fonctionnement dans le mode d'éclairage de lanterne. Ainsi, les deux unités à lampe 12A et 12B de la lampe 10 sont mises en fonctionnement sous forme rouge et jouent le rôle des lanternes.

Comme l'indique la figure 5, en mode d'éclairage de lanterne-feu de stop, le feu de stop est mis en fonctionnement lorsque la lanterne reste allumée. Dans le cas de l'unité à lampe 12B, chacune des sources lumineuses 20B reste au repos en mode d'éclairage de lanterne-feu de stop alors que la lanterne reste allumée. Dans le cas de l'unité à lampe 12A, les huit diodes rouges 24R2 placées autour de la diode rouge 24R1 de chacune des sources lumineuses 20A sont mises en fonctionnement avec la diode 24R1. Lorsque les

huit diodes rouges 24R2 sont mises en fonctionnement en mode d'éclairage de lanterne-feu de stop, l'unité à lampe 12A est bien plus brillante qu'en mode d'éclairage de lanterne. La lampe 10 du véhicule joue donc le rôle de la lanterne et du feu de stop, lorsque l'unité à lampe 12A est mise en fonctionnement en mode d'éclairage de feu de stop alors que l'unité à lampe 12B reste en mode d'éclairage de lanterne.

Par ailleurs, lorsque les huit diodes photoémissives rouges 24R2 de chacune des sources lumineuses 20A de l'unité à lampe 12A sont mises en fonctionnement, la surface d'éclairage et la luminosité centrée sur la position centrale de la source lumineuse 20A donnent l'impression d'une surface d'éclairage et d'une luminosité accrues. Ceci est dû au fait que les diodes photoémissives rouges 24R2 sont disposées afin qu'elles entourent la diode rouge 24R1. En conséquence, le nombre de sources lumineuses ne paraît pas augmenter ou diminuer et la position des sources lumineuses ne paraît pas varier.

Comme l'indique la figure 6, chacune des sources lumineuses 20A de l'unité 12A reste au repos en mode d'éclairage de lanterne et en mode d'éclairage de lanterne et de clignotant. Le clignotant est mis en fonctionnement lorsque la lanterne reste allumée en mode d'éclairage de lanterne et de clignotant. Dans l'unité à lampe 12B, la diode photoémissive rouge 32R occupant la position centrale dans chaque source lumineuse 20B ne fonctionne pas et les huit diodes jaunes 32U placées autour de la diode rouge 32R fonctionnent par intermittence. Ainsi, la lampe 10 de véhicule a les fonctions de lanterne et clignotant lorsque l'unité à lampe 12B fonctionne en mode de clignotant alors que l'unité à lampe 12A garde le mode de lanterne.

Dans l'unité à lampe 12B, bien que la diode photoémissive rouge 32R ne fonctionne pas et les huit diodes jaunes 32U fonctionnent dans chaque source lumineuse 20B, le centrage de la couleur en position centrale de la source 20B ne varie pas. La zone éclairée et la luminosité sont dues au fait que les diodes jaunes 32U sont placées autour de la diode rouge 32R. En conséquence, le nombre de sources

lumineuses ne paraît pas augmenter ou diminuer, et la position de l'une quelconque des sources lumineuses ne paraît pas varier.

Comme l'indique la figure 7, en mode d'éclairage de feu de stop et de clignotant, le clignotant et un feu de stop sont simultanément en fonctionnement. Dans l'unité à lampe 12B, les huit diodes jaunes 32U placées autour de la diode rouge 32R dans chacune des sources lumineuses 20B fonctionnent alors que la diode rouge 32R ne fonctionne pas. Dans l'unité à lampe 12A, les huit diodes rouges 24R2 placées autour de la diode rouge 24R1 dans chaque source lumineuse 20A, ainsi que la diode rouge 24R1, fonctionnent. De cette manière, la lampe 10 de véhicule a les fonctions d'une lanterne et d'un clignotant, lorsque l'unité à lampe 12A est mise en fonctionnement en mode d'éclairage de feu de stop alors que l'unité à lampe 12B conserve le mode d'éclairage de clignotant.

Comme décrit précédemment en détail, la lampe 10 de véhicule selon l'invention a deux unités à lampe 12A et 12B qui sont mises en fonctionnement dans deux modes d'éclairage qui diffèrent. Ainsi, un nombre de modes d'éclairage de lampe peut être réglé par une de leurs combinaisons.

De plus, comme chacune des unités à lampe 12A et 12B a neuf sources lumineuses 20A et 20B, une quantité suffisante de lumière peut être obtenue pour chacune des unités à lampe 12A et 12B.

A cause de la disposition des sources lumineuses 20A et 20B des unités à lampe 12A et 12B, la diode photoémissive occupant la position centrale de chacune des sources lumineuses 20A et 20B paraît devenir lumineuse dans tous les modes d'éclairage, et il n'apparaît pas un effet d'augmentation ou de réduction du nombre de sources lumineuses. En outre, la position de chaque source lumineuse ne paraît pas non plus varier lors de la commutation des modes d'éclairage. En conséquence, les conducteurs des autres véhicules ne risquent pas d'avoir une indication erronée.

Dans ce mode de réalisation de l'invention, la diode photoémissive rouge 24R1 occupant la position centrale de

chaque source lumineuse 20A de l'unité à lampe 12A est mise en fonctionnement en mode d'éclairage de lanterne. En outre, la diode rouge 24R1 et les diodes rouges 24R2 placées autour de la diode rouge 24R1 sont simultanément mises en
5 fonctionnement en mode d'éclairage de feu de stop. En conséquence, la luminosité globale peut varier beaucoup lors de la commutation des modes d'éclairage. Ainsi, lorsque le feu de stop est mis en fonctionnement alors que la lanterne reste allumée, les conducteurs des autres véhicules peuvent
10 reconnaître l'éclairage du feu de stop.

De plus, dans ce mode de réalisation de l'invention, la diode rouge 32R occupant la position centrale de chaque source lumineuse 20B de l'unité à lampe 12B est mise en fonctionnement en mode d'éclairage de lanterne. En outre,
15 les diodes jaunes 32U placées autour de la diode rouge 32R sont mises en fonctionnement et la diode rouge 32R est éteinte en mode d'éclairage de clignotant. Ainsi, chaque source lumineuse 20B ne peut pas être allumée avec deux types de couleurs simultanément, et il est donc possible de
20 commuter les modes d'éclairage sans donner d'indication erronée aux conducteurs des autres véhicules.

Dans ce mode de réalisation de l'invention, dans chaque unité à lampe 12A et 12B, une lentille 28 de diffusion ayant plusieurs éléments de lentille de diffusion est placée
25 devant chacune des neuf sources lumineuses 20A et 20B. En conséquence, la luminosité de chacune des sources lumineuses 20A et 20B paraît pratiquement uniforme lorsqu'elles sont toutes activées. Les sources lumineuses 20A et 20B donnent donc l'impression d'une seule source lumineuse.

En outre, dans ce mode de réalisation de l'invention, une lentille 34 formant condenseur est placée devant chacune des cinq sources lumineuses parmi les neuf sources lumineuses 20A (les lentilles formant condenseur sont associées
aux sources lumineuses 20B). La combinaison des lentilles 34
35 formant condenseur et des lentilles de diffusion 28 permet l'obtention des performances nécessaires de distribution d'intensité lumineuse de l'appareil d'éclairage.

Dans le mode de réalisation précité de l'invention, les diodes photoémissives sont disposées verticalement et horizontalement dans chacune des sources lumineuses 20A et 20B, c'est-à-dire suivant un carré de 3 x 3 diodes.

5 Cependant, des dispositions autres que celles qu'on a décrites peuvent être adoptées, comme indiqué dans les exemples des figures 8(a) à 8(f) et 9(a) à 9(e). Les exemples de disposition des diodes photoémissives des sources lumineuses 20A des figures 8(a) à 8(f) et 9(a) à

10 9(e) s'appliquent également aux sources lumineuses 20B.

Les exemples de disposition de diodes photoémissives représentés sur les figures 8(a) à 8(f) sont tels que, lorsqu'une diode photoémissive rouge 24R1 parmi les diodes 24R1 et 24R2 constituant la source lumineuse 20A est placée

15 au centre comme indiqué précédemment, la disposition des diodes photoémissives rouges 24R2 placées autour de la diode photoémissive rouge 24R1 peut varier.

La figure 8(a) représente un mode de réalisation de l'invention dans lequel huit diodes photoémissives rouges 24R2 sont placées autour de la diode photoémissive rouge 24R1 sous forme d'un carré. La figure 8(b) représente un mode de réalisation de l'invention dans lequel quatre diodes photoémissives rouges 24R2 placées aux coins respectifs sont omises. La figure 8(c) représente un mode de réalisation de

20 l'invention dans lequel quatre diodes photoémissives rouges 24R2 (deux verticales et deux horizontales) sont omises. La figure 8(d) représente un mode de réalisation de l'invention dans lequel huit diodes photoémissives rouges 24R2 sont placées en losange sous forme décalée. La figure 8(e)

25 représente un mode de réalisation de l'invention dans lequel trois diodes photoémissives rouges 24R2 sont placées à des intervalles de 120° sur une même circonférence. La figure 8(f) représente un mode de réalisation dans lequel six diodes photoémissives rouges 24R2 sont placées à des

30 intervalles de 60° sur une même circonférence.

35

Dans tous les exemples de disposition précités, plusieurs diodes photoémissives rouges 24R2 sont disposées afin qu'elles entourent la diode photoémissive rouge 24R1 placée

au centre de la source lumineuse 20A. En conséquence, la source lumineuse 20A donne l'impression d'une source lumineuse unique qui devient lumineuse dans l'un quelconque des modes d'éclairage de lampe comprenant le mode où seule la diode rouge 24R1 est en fonctionnement, le mode dans lequel les diodes rouges 24R1 et 24R2 sont en fonctionnement et, en outre, le mode dans lequel seules les diodes 24R2 (seules les diodes jaunes 32U de la source lumineuse 20B) sont en fonctionnement.

Comme les diodes rouges 24R2 ont une régularité géométrique dans tous les exemples de disposition, la source lumineuse 20A peut être mise en fonctionnement en donnant l'impression d'une source lumineuse unique sans indication erronée. Même si la disposition des exemples précédents présente une certaine irrégularité de disposition géométrique, la source lumineuse 20A peut apparaître comme une seule source lumineuse en fonctionnement.

Les exemples de disposition de diodes photoémissives des figures 9(a) à 9(e) sont tels que la disposition des diodes photoémissives rouges 24R1 et 24R2 formant la source lumineuse 20A varie.

Plus précisément, la figure 9(a) représente un mode de réalisation de l'invention dans lequel quatre diodes rouges 24R1 sont sous forme d'un carré et douze diodes rouges 24R2 sont sous forme d'un carré autour des quatre diodes rouges 24R1. La figure 9(b) représente un mode de réalisation dans lequel cinq diodes rouges 24R1 sont disposées en croix et huit diodes rouges 24R2 sont disposées en losange sous forme décalée. La figure 9(c) représente un mode de réalisation de l'invention dans lequel quatre diodes rouges 24R1 sont disposées verticalement sous forme allongée et en losange, et dix diodes rouges 24R2 sont disposées verticalement sous forme allongée, pratiquement en losange et sous forme décalée. La figure 9(d) représente un mode de réalisation de l'invention dans lequel quatre diodes rouges 24R1 sont alignées horizontalement et dix diodes rouges 24R2 sont placées autour des quatre diodes 24R1. La figure 9(e) représente un mode de réalisation de l'invention dans lequel

huit diodes rouges 24R1 sont placées à intervalles de 45° sur une même circonférence, et douze diodes rouges 24R2 sont placées à des intervalles de 30° autour des huit diodes rouges 24R2.

5 Dans tous les exemples de disposition décrits précédemment, les diodes rouges 24R1 occupent la position centrale de la source lumineuse 20A. Les diodes rouges 24R2 sont disposées afin qu'elles entourent les diodes rouges 24R1. Ainsi, la source lumineuse 20A apparaît comme une
10 seule source lumineuse dans l'un quelconque des modes d'éclairage selon que seule la diode rouge 24R1 est en fonctionnement ou que les diodes 24R1 et 24R2 sont en fonctionnement, ou même dans le mode dans lequel seules les diodes 24R2 sont en fonctionnement (uniquement les diodes
15 jaunes 32U dans la source lumineuse 20B). En outre, comme plusieurs diodes rouges 24R1 sont utilisées dans chacun des exemples précédents, une quantité suffisante de lumière peut être obtenue dans le mode d'éclairage dans lequel seules les diodes rouges 24R1 sont en fonctionnement.

20 Dans tous les exemples de disposition décrits précédemment, les diodes rouges 24R1 et 24R2 présentent une régularité géométrique, et la source lumineuse 20A peut être mise en fonctionnement comme une source lumineuse sans donner d'indication erronée. Même lorsque l'un quelconque
25 des exemples de disposition précédents présente une certaine irrégularité géométrique, la source lumineuse 20A peut apparaître comme une seule source lumineuse mise en fonctionnement.

30 La description qui précède concerne une lampe de véhicule 10 qui est une lampe arrière combinée. La lampe arrière combinée comprend l'unité à lampe 12A qui est mise en fonctionnement en mode d'éclairage de lanterne et en mode d'éclairage de feu de stop. La lampe combinée arrière a aussi une unité à lampe 12B qui est mise en fonctionnement
35 en mode d'éclairage de lanterne et en mode d'éclairage de clignotant. Dans le mode de réalisation précité de l'invention cependant, on peut obtenir le même effet avec des

dispositions analogues à celles qui sont utilisées dans d'autres types de lampe de véhicule.

Bien entendu, diverses modifications peuvent être apportées par l'homme de l'art aux lampes qui viennent
5 d'être décrites uniquement à titre d'exemple non limitatif sans sortir du cadre de l'invention.

REVENDICATIONS

1. Lampe de véhicule comprenant une source lumineuse ayant plusieurs diodes photoémissives qui peuvent être mises en fonctionnement dans au moins deux types de modes d'éclairage de lampe, caractérisée en ce que

la source lumineuse a un premier groupe de diodes photoémissives comprenant au moins une diode photoémissive (24R1, 32R) placée en position pratiquement centrale de la source lumineuse et un second groupe de diodes photoémissives comprenant plusieurs diodes photoémissives (24R2, 32U) qui entourent le premier groupe de diodes photoémissives, et

les modes d'éclairage de la lampe comprennent un premier mode d'éclairage dans lequel seul le premier groupe de diodes photoémissives (24R1, 32R) est allumé et un second mode d'éclairage dans lequel le second groupe de diodes photoémissives (24R2, 32U) est allumé.

2. Lampe selon la revendication 1, caractérisée en ce que le premier groupe et le second groupe de diodes photoémissives (24R1, 24R2) comprennent des diodes photoémissives ayant pratiquement la même couleur, et le premier et le second groupe de diodes photoémissives (24R1, 24R2) sont allumés simultanément dans le second mode d'éclairage de lampe.

3. Lampe selon la revendication 1, caractérisée en ce que le premier groupe de diodes photoémissives (32R) comprend des diodes photoémissives ayant une première couleur et le second groupe de diodes photoémissives (32U) comprend des diodes photoémissives ayant une seconde couleur différente de la première couleur, et seules les diodes photoémissives du second groupe sont allumées dans le second mode d'éclairage de la lampe.

4. Lampe selon la revendication 1, caractérisée en ce qu'une lentille de diffusion comprenant plusieurs éléments de lentille de diffusion est placée devant la source lumineuse.

5. Lampe selon la revendication 4, caractérisée en ce qu'une lentille formant condenseur est placée devant la lentille de diffusion.

5 6. Lampe selon la revendication 5, caractérisée en ce qu'un panneau en forme de dôme ayant une partie d'ouverture est placé devant la lentille formant condenseur.

7. Lampe selon la revendication 6, caractérisée en ce que la partie d'ouverture du panneau en forme de dôme comporte une partie cylindrique qui s'étend vers la lentille
10 formant condenseur.

8. Lampe selon la revendication 7, caractérisé en ce que la surface périphérique interne de chacune des parties cylindriques du panneau en forme de dôme a reçu un traitement réfléchissant.

15 9. Lampe selon la revendication 5, caractérisée en ce que la lentille formant condenseur est une lentille plan-convexe qui a une surface convexe du côté opposé à celui de la lentille de diffusion.

20 10. Lampe selon la revendication 1, caractérisée en ce qu'elle comporte plusieurs unités à lampe disposées afin qu'elles donnent deux types différents de modes d'éclairage de lampe en combinaison entre les unités à lampe.

11. Lampe selon la revendication 5, caractérisée en ce que la lentille de diffusion et la lentille formant
25 condenseur sont placées le long d'un axe optique de la source lumineuse.

12. Lampe de véhicule comprenant un dispositif à source lumineuse possédant plusieurs diodes photoémissives qui peuvent être allumées dans au moins deux types de modes
30 d'éclairage de lampe, caractérisée en ce que

le dispositif à source lumineuse comprend un premier groupe de diodes photoémissives comprenant au moins une diode photoémissive (24R1, 32R) placée en position pratiquement centrale du dispositif à source lumineuse, et un second
35 groupe de diodes photoémissives comprenant plusieurs diodes photoémissives (24R2, 32U) et entourant le premier groupe de diodes photoémissives, et

les modes d'éclairage de lampe comprennent un premier mode d'éclairage dans lequel seules les diodes photoémis-
sives (24R1, 32R) du premier groupe sont allumées et un
second mode d'éclairage de lampe dans lequel les diodes
5 photoémisives (24R2, 32U) du second groupe sont allumées.

13. Lampe selon la revendication 12, caractérisée en
ce que les diodes photoémisives (24R1, 24R2) du premier
groupe et du second groupe sont des diodes photoémisives
ayant pratiquement la même couleur, et les diodes photo-
émisives (24R1, 24R2) du premier et du second groupe sont
10 allumées simultanément dans le second mode d'éclairage de la
lampe.

14. Lampe selon la revendication 12, caractérisée en
ce que les diodes photoémisives (32R) du premier groupe
15 sont des diodes photoémisives ayant une première couleur,
et les diodes photoémisives (32U) du second groupe sont des
diodes photoémisives ayant une seconde couleur différente
de la première couleur, et seules les diodes photoémisives
du second groupe (32U) sont allumées dans le second mode
20 d'éclairage de la lampe.

15. Lampe selon la revendication 12, caractérisée en
ce qu'elle comporte plusieurs unités à source qui sont
disposées afin qu'elles possèdent deux types de modes
d'éclairage différents en combinaison entre les unités à
25 source.

16. Lampe selon la revendication 12, caractérisée en
ce que le dispositif de diffusion et le dispositif formant
condenseur sont placés le long d'un axe optique du dispo-
sitif à source lumineuse.

30 17. Lampe de véhicule possédant plusieurs modes
d'éclairage de lampe, la lampe de véhicule étant carac-
térisée en ce qu'elle comprend :

une première source lumineuse ayant un premier groupe
de diodes photoémisives comprenant au moins une diode
35 photoémisive (24R1, 32R) placée en position pratiquement
centrale de la première source lumineuse, et un second
groupe de diodes photoémisives comprenant plusieurs diodes

photoémissives entourant le premier groupe de diodes photoémissives (24R1, 32R),

une seconde source lumineuse ayant un troisième groupe de diodes photoémissives comprenant au moins une diode photoémissive (24R1, 32R) placée en position pratiquement centrale de la seconde source lumineuse et un quatrième groupe de diodes photoémissives comprenant plusieurs diodes photoémissives (24R2, 32U) entourant le troisième groupe de diodes photoémissives, et

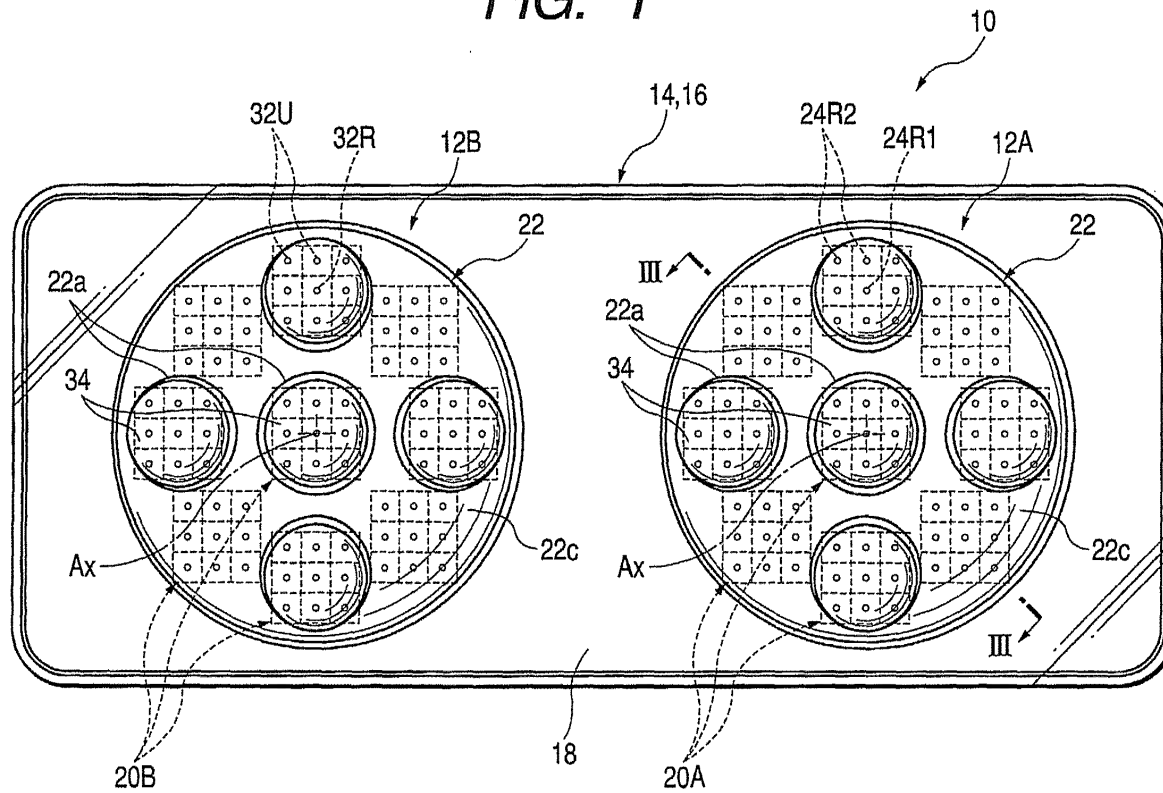
les modes d'éclairage de lampe comprennent un premier mode d'éclairage de lampe dans lequel seuls les premier et troisième groupes de diodes photoémissives sont allumés, un second mode d'éclairage de lampe dans lequel le premier et le second groupe de diodes photoémissives (24R2, 32U) sont allumés, et un troisième mode d'éclairage de lampe dans lequel le troisième groupe de diodes photoémissives est éteint et le quatrième groupe de diodes photoémissives est allumé par intermittence.

18. Lampe selon la revendication 17, caractérisée en ce que le premier groupe et le second groupe de diodes photoémissives (24R1, 24R2) comprennent des diodes photoémissives ayant pratiquement la même couleur.

19. Lampe selon la revendication 17, caractérisée en ce que les premier, second et troisième groupes de diodes photoémissives comprennent des diodes photoémissives ayant pratiquement la même couleur.

20. Lampe selon la revendication 17, caractérisée en ce que le premier groupe de diodes photoémissives (32R) comprend des diodes photoémissives ayant une première couleur et le quatrième groupe de diodes photoémissives comprend des diodes photoémissives ayant une seconde couleur différente de la première couleur.

FIG. 1



1 / 9

2814220

FIG. 2

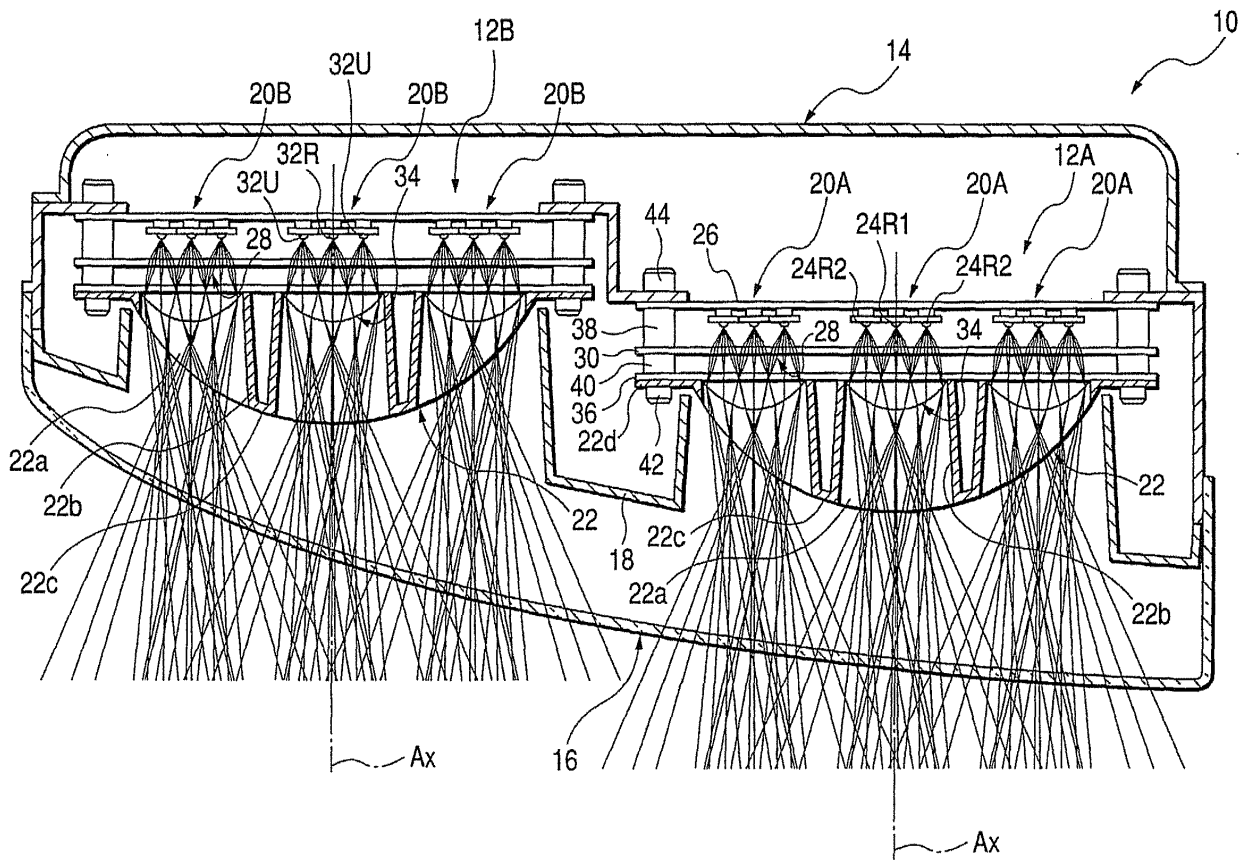
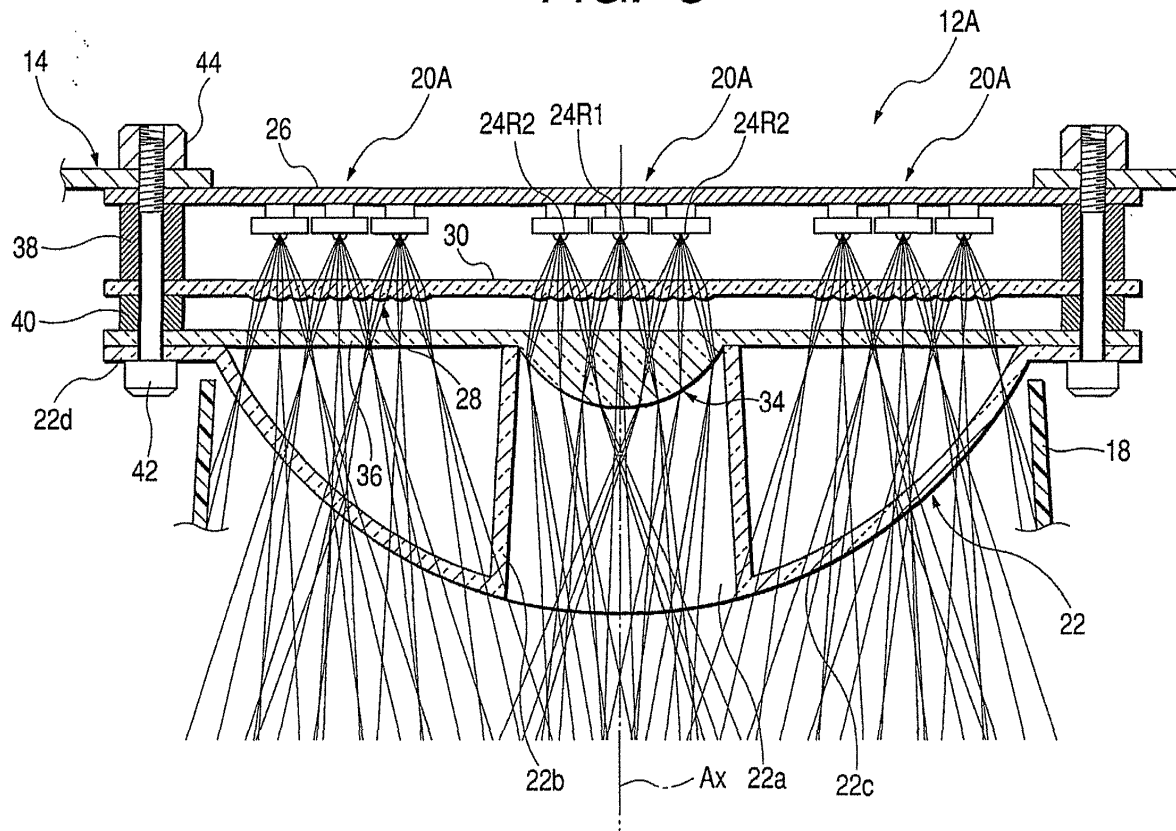


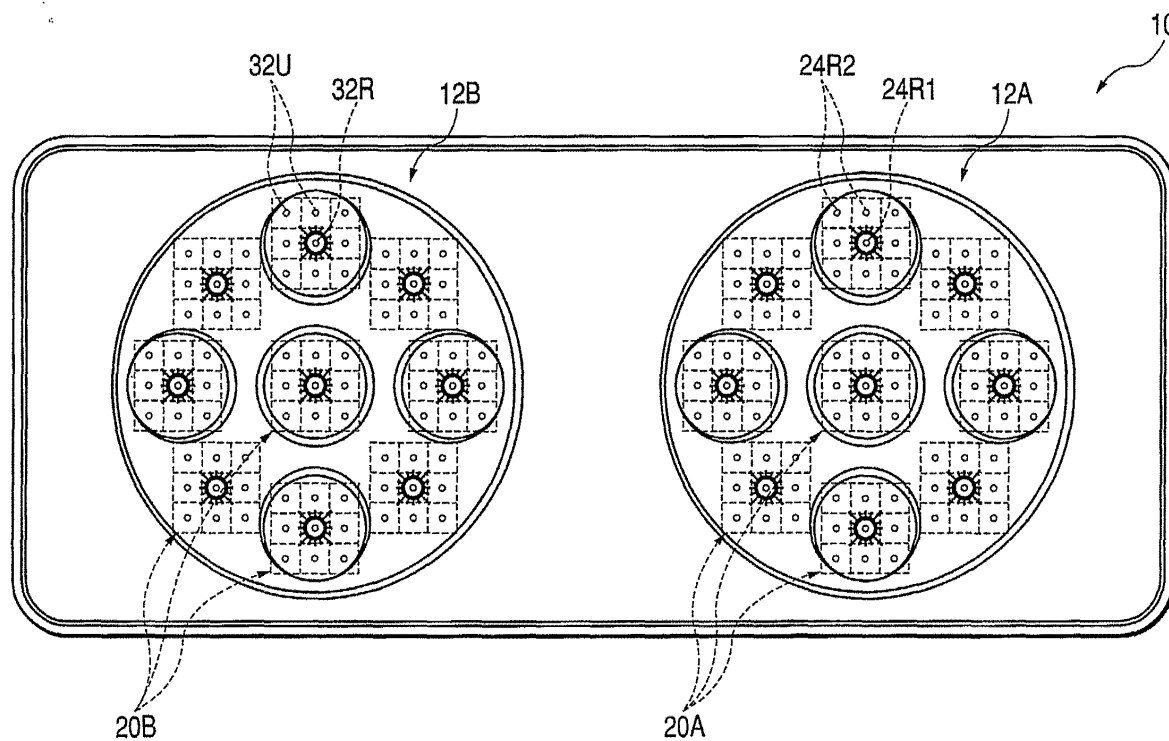
FIG. 3



3 / 9

2814220

FIG. 4



4 / 9

2814220

FIG. 5

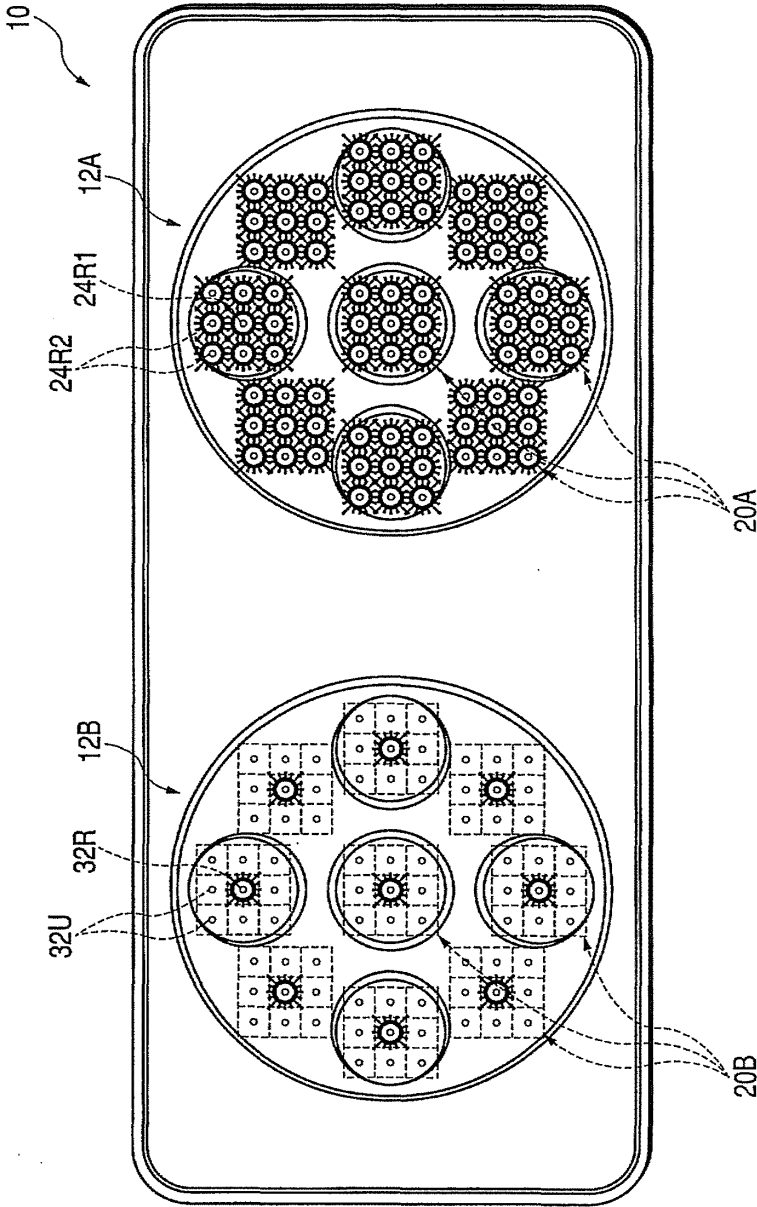


FIG. 6

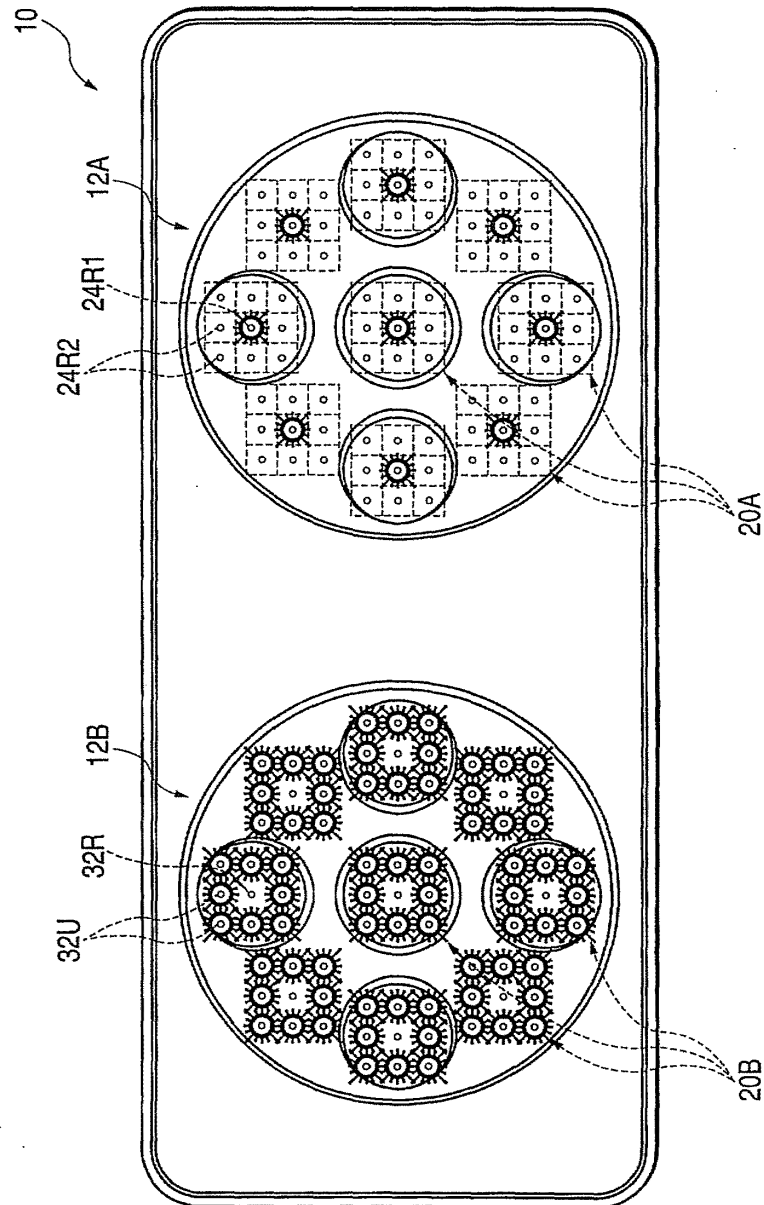


FIG. 7

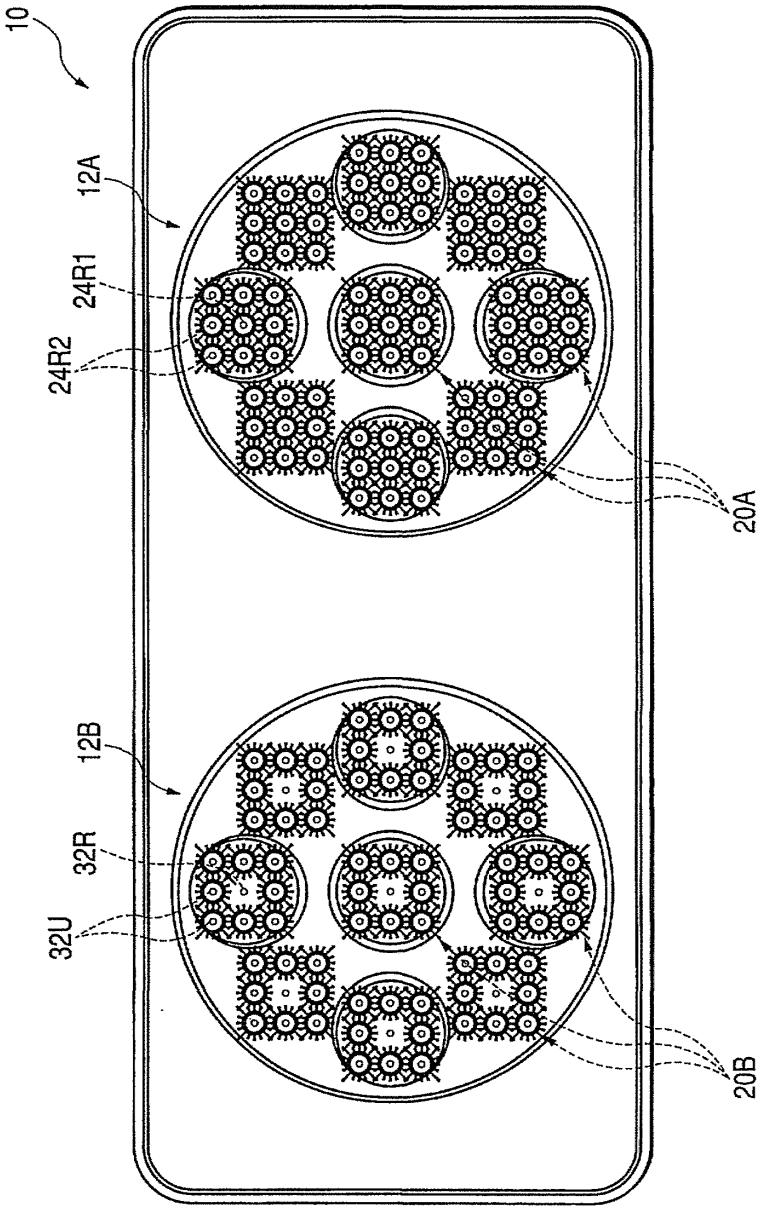


FIG. 8(a)

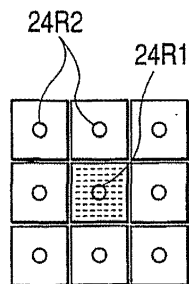


FIG. 8(b)

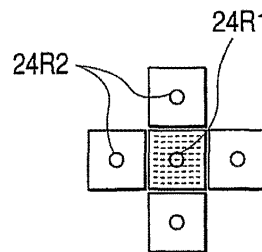


FIG. 8(c)

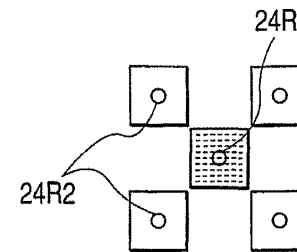


FIG. 8(d)

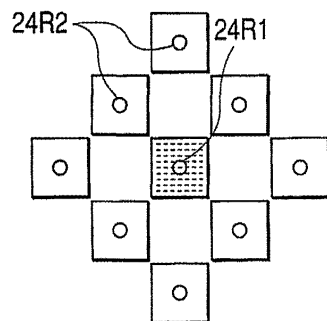


FIG. 8(e)

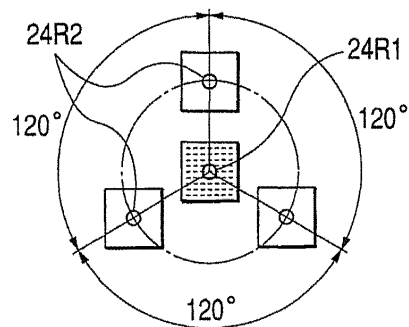
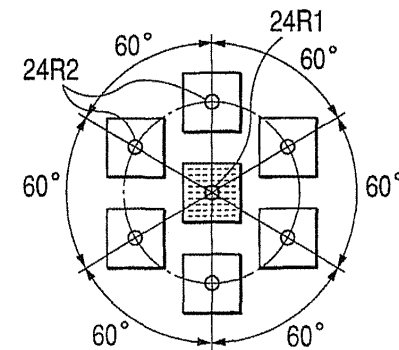


FIG. 8(f)



8 / 9

2814220

FIG. 9(a)

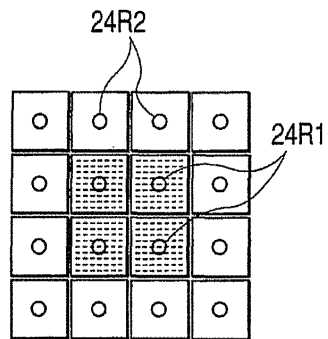


FIG. 9(b)

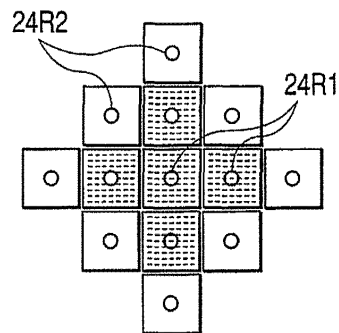


FIG. 9(c)

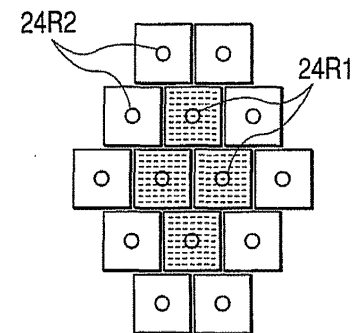


FIG. 9(d)

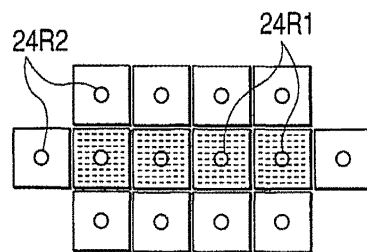
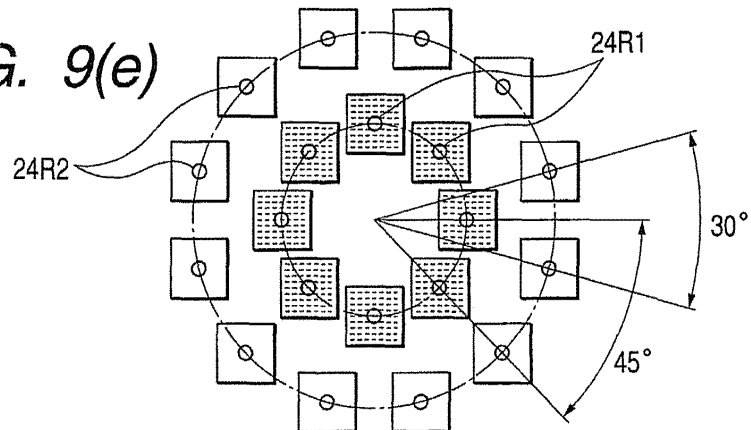


FIG. 9(e)



9 / 9

2814220

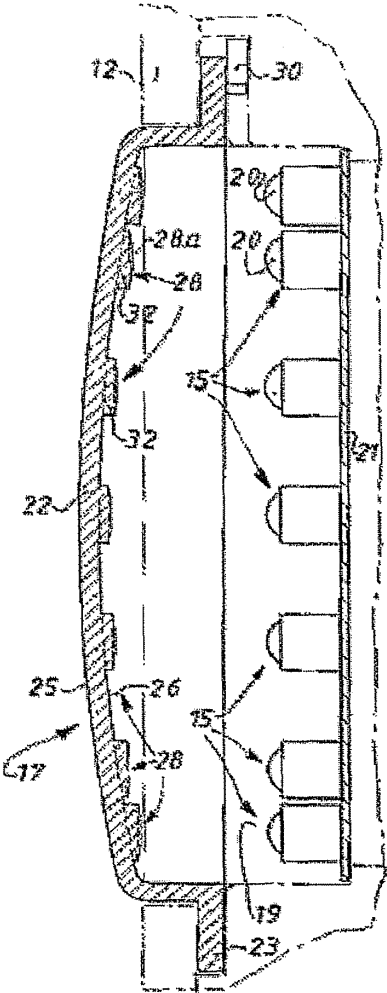
Signal light used for controlling road traffic

AH

Publication number: FR2759188
Publication date: 1998-08-07
Inventor: LEEMANS JEAN; GENISSON
Applicant: THERY HINDRICK (FR)
Classification:
- **international:** *F21K7/00; F21S8/00; F21S8/10; F21V5/00; G08G1/095; F21K7/00; F21S8/00; F21S8/10; F21V5/00; G08G1/095; (IPC1-7): G08B5/36; G08G1/095*
- **European:** *F21K7/00; F21S8/00Q4; F21S8/10Q2; F21V5/00; G08G1/095*
Application number: FR19970001065 19970131
Priority number(s): FR19970001065 19970131

[Report a data error here](#)**Abstract of FR2759188**

The signal light consists of a housing containing at least one light source (15) and an optical refractor(17) situated opposite it and having one of its faces equipped with a series of light transmission elements (28) designed to concentrate the light vertically and diverge it horizontally. Each light transmission element is in the shape of a lens (28a) with a toroid relief surface on the inside of the refractor, with the lenses located on the ends of parallel cylinders set on a base (22) of a transparent or translucent material which is the same as that of the transmission elements. The material has a refraction index above 1.45, preferably close to 1.58, e.g. polycarbonate. The light sources are in the form of electro luminescent diodes equal in number to the lenses.



Data supplied from the **esp@cenet** database - Worldwide

①⑨ RÉPUBLIQUE FRANÇAISE
INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE
PARIS

①⑪ N° de publication : **2 759 188**
(à n'utiliser que pour les
commandes de reproduction)

②① N° d'enregistrement national : **97 01065**

⑤① Int Cl⁶ : G 08 B 5/36, G 08 G 1/095

⑫

DEMANDE DE BREVET D'INVENTION

A1

②② Date de dépôt : 31.01.97.

③⑦ Priorité :

④③ Date de mise à la disposition du public de la
demande : 07.08.98 Bulletin 98/32.

⑤⑥ Liste des documents cités dans le rapport de
recherche préliminaire : *Se reporter à la fin du
présent fascicule*

⑥⑦ Références à d'autres documents nationaux
apparentés :

⑦① Demandeur(s) : THERY HINDRICK SOCIETE ANO-
NYME — FR.

⑦② Inventeur(s) : LEEMANS JEAN et GENISSON.

⑦③ Titulaire(s) :

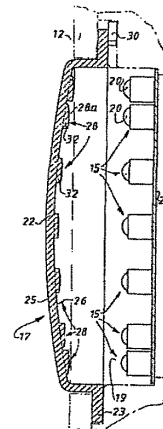
⑦④ Mandataire(s) : CABINET BONNET THIRION.

⑤④ DISPOSITIF DE SIGNALISATION LUMINEUSE, NOTAMMENT POUR REGULATION DU TRAFIC ROUTIER.

⑤⑦ Dispositif de signalisation lumineuse à réflecteur opti-
que perfectionné.

Selon l'invention, le réflecteur (17) comporte des élé-
ments de transmission de lumière (28), typiquement des
lentilles à surface torique, en regard de la source lumineuse
(15), pour faire subir au flux lumineux deux anamorphoses,
respectivement de concentration, verticalement, et de diver-
gence, horizontalement.

La source lumineuse est de préférence constituée de
diodes électroluminescentes.



FR 2 759 188 - A1



"Dispositif de signalisation lumineuse, notamment pour
régulation du trafic routier"

L'invention se rapporte à un dispositif de
signalisation lumineuse pouvant par exemple former un feu
tricolore destiné à réguler le trafic routier à un
carrefour; elle concerne plus particulièrement la
5 conception d'un réfracteur optique de lumière placé en
regard de la source lumineuse.

L'invention trouve son domaine d'application optimum
dans le cas où ladite source lumineuse est constituée par
un ensemble de diodes électroluminescentes.

10 Classiquement, un dispositif de signalisation
lumineuse tel qu'un feu tricolore comprend un boîtier
renfermant trois sources lumineuses placées dans des
compartiments indépendants dudit boîtier et chaque
compartiment est coiffé frontalement d'un réfracteur en
15 matériau transparent ou translucide comme par exemple du
verre minéral ou organique. La source lumineuse peut être
une lampe classique à filament, éventuellement du type
allogène basse tension ou encore un tube fluorescent.

Plus récemment, on a tenté d'utiliser des diodes
20 électroluminescentes. Ces essais se sont révélés décevants
principalement en raison de la faible luminosité des diodes
électroluminescentes proposées sur le marché. Des
tentatives ont été faites pour mieux canaliser le flux
lumineux émis par l'ensemble des diodes. On a ainsi, par
25 exemple, proposé d'optimiser le réfracteur. Par exemple, on
connaît un tel dispositif de signalisation dans lequel le
réfracteur comporte sur sa face interne des stries à
section triangulaire s'étendant horizontalement ou
verticalement et de préférence dans les deux directions.
30 Cette configuration striée fait donc face à la source
lumineuse constituée par les diodes électroluminescentes
agencées côte-à-côte. Cependant, le résultat est
insuffisant et les dispositifs à diodes
électroluminescentes équipés de tels réfracteurs permettent
35 très difficilement de satisfaire les normes.

L'invention concerne un nouveau concept de réfracteur placé en regard de la source lumineuse et plus particulièrement efficace lorsque cette source lumineuse est constituée par un ensemble de diodes électroluminescentes.

Plus précisément, l'invention concerne un dispositif de signalisation lumineuse comprenant un boîtier renfermant au moins une source lumineuse et un réfracteur optique correspondant placé en regard de cette source lumineuse, caractérisé en ce que ledit réfracteur comporte, répartis sur l'une de ses faces, une pluralité d'éléments de transmission de lumière, chacun conformé pour faire subir au flux lumineux qui le traverse deux anamorphoses, respectivement de concentration selon une direction verticale et de divergence selon une direction horizontale.

Selon un exemple actuellement préféré, chaque élément de transmission a la forme d'une lentille à surface torique définie en relief sur la face interne dudit réfracteur, en regard de la source lumineuse.

En outre, chaque lentille est avantageusement définie à l'extrémité d'un cylindre; les cylindres étant par exemple parallèles entre eux et parallèles à un axe principal de symétrie du réfracteur. Cet agencement s'est révélé particulièrement efficace pour rendre le réfracteur sélectif à la lumière émise par la source lumineuse interne. En effet, pour les rayons lumineux provenant de l'extérieur, ledit réfracteur se comporte alors comme un piège à lumière empêchant leur rétrodiffusion par les lentilles. La signalisation demeure donc bien perceptible même lorsque le dispositif de signalisation est exposé à un rayonnement solaire direct. Dans ce cas, les rayons lumineux qui pénètrent à l'intérieur du boîtier sont très fortement atténués et ne peuvent être rediffusés par les lentilles si leurs directions sont différentes des axes optiques parallèles desdites lentilles. Ce filtrage des rayons lumineux parasites est effectif quelle que soit la nature de la source lumineuse interne.

Dans le cas où cette dernière est constituée par une pluralité de diodes électroluminescentes, le meilleur résultat est obtenu en faisant en sorte que le nombre de diodes soit égal au nombre de lentilles et que chaque diode soit placée en regard d'une lentille spécifique.

Dans la pratique, le réfracteur se compose d'une dalle en matériau transparent ou au moins translucide, et les éléments de transmission précités, c'est-à-dire par exemple les lentilles définies aux extrémités de cylindres respectifs, sont venus de matière sur la face interne de ladite dalle, par moulage. L'ensemble est réalisé en un matériau présentant un indice de réfraction supérieur à 1,45 et de préférence voisin de 1,58.

Pour un feu de signalisation de petite dimension, par exemple un feu répétiteur, toutes les lentilles sont de mêmes dimensions. Dans une version actuellement préférée, le réfracteur comporte 91 lentilles de 6 mm de diamètre et la source lumineuse est constituée de 91 diodes électroluminescentes. Les lentilles peuvent être agencées sur une surface concave et les diodes électroluminescentes sur un plan. Dans ce cas, la distance moyenne entre une diode et la lentille qui lui correspond est de l'ordre de 12 à 14 mm.

Conformément à la définition qui précède, chaque lentille présente un rayon de courbure suivant la direction verticale plus grand que le rayon de courbure suivant la direction horizontale, de préférence deux fois plus grand. Ainsi, dans la pratique, on a expérimenté avec succès un réfracteur équipé de lentilles présentant chacune deux rayons de courbure différents, de 20 et 10 mm, respectivement.

Pour un feu de signalisation plus grand, on augmente le nombre de lentilles et le nombre de diodes électroluminescentes, les dimensions de celles-ci ne variant pas. Cependant, il n'est pas nécessaire d'augmenter le nombre de diodes électroluminescentes dans de grandes proportions si on augmente le diamètre des lentilles, dans les régions périphériques du réfracteur. Le meilleur

résultat reste acquis en faisant correspondre une diode électroluminescente à une lentille correspondante.

En outre, il sera avantageux d'agencer les diodes sur des surfaces annulaires décalées axialement de façon que
5 les diodes soient toutes approximativement à la même distance des lentilles correspondantes.

Dans le cas où le nombre de diodes électroluminescentes est différent du nombre de lentilles, la diffusion de la lumière se fait néanmoins de façon
10 satisfaisante et permet de répondre aux normes. Le réfracteur est également compatible avec d'autres sources lumineuses plus classiques, telles que des lampes à incandescence ou des tubes fluorescents ou encore des lampes à allogène, basse tension.

15 L'invention sera mieux comprise et d'autres avantages de celle-ci apparaîtront plus clairement à la lumière de la description qui va suivre d'un mode de réalisation d'un dispositif de signalisation lumineuse conforme à son principe, donnée uniquement à titre d'exemple et faite en
20 référence aux dessins annexés dans lesquels:

- la figure 1 est une vue partielle d'un dispositif de signalisation lumineuse conforme à l'invention et montrant plus particulièrement un réfracteur vu de l'intérieur selon la flèche I de la figure 2;

25 - la figure 2 est une vue de côté du réfracteur de la figure 1;

- la figure 3 est une section III-III du réfracteur de la figure 1; et

30 - la figure 4 est une section IV-IV de la figure 1, les diodes électroluminescentes étant représentées non coupées.

Sur les dessins, on a représenté une partie d'un dispositif de signalisation lumineuse 11, en l'occurrence ici un feu de signalisation comprenant un boîtier 12
35 renfermant trois sources lumineuses de couleurs différentes, classiquement rouge, orange et vert. Il s'agit ici d'un feu de signalisation de petite dimension dit "feu répétiteur" placé à hauteur de véhicule. Sur les dessins,

le boîtier 12 apparaît en trait fantôme et n'est pas entièrement représenté; on voit seulement la partie qui renferme une source lumineuse 15 et un réfracteur optique 17 placé en regard de cette source lumineuse. La source lumineuse, entièrement contenue dans un compartiment 19 du boîtier, indépendant, est ici constituée d'une pluralité de diodes électroluminescentes 20. Ces diodes sont montées sur un support plan 21, côte-à-côte sur sensiblement toute la surface disponible. Les axes d'émission des diodes sont tous parallèles. Le compartiment 19 est fermé frontalement, par le réfracteur optique 17.

Comme le montrent les figures 2 à 4, le réfracteur optique 17 comporte une dalle bombée 22 translucide ou transparente, à contour circulaire et une collerette périphérique de montage 23, annulaire et plate. La dalle 22 présente une face extérieure 25 globalement convexe et une face interne 26 globalement concave.

Selon une caractéristique remarquable de l'invention, ce réfracteur comporte, répartis sur l'une de ses faces, et en l'occurrence ici la face interne 26, une pluralité d'éléments de transmission de lumière 28 et chacun de ces éléments est conformé pour faire subir au flux lumineux qui le traverse deux anamorphoses, respectivement une anamorphose de concentration selon la direction verticale et une anamorphose de divergence selon la direction horizontale. Sur les dessins, la direction verticale du réfracteur est indiquée par l'axe y-y. La collerette 23 comporte deux éléments de détrompage 30 à sa périphérie, venant se loger dans des cavités correspondantes du boîtier 12 pour que le réfracteur soit toujours monté dans une position correcte, à savoir avec l'axe y-y orienté verticalement.

Les éléments de transmission 28 précités sont venus de matière avec la dalle. L'ensemble est réalisé par moulage à partir d'un matériau présentant un indice de réfraction supérieur à 1,45 et de préférence voisin de 1,58. Un matériau synthétique tel qu'un polycarbonate donne des résultats particulièrement satisfaisants.

Selon l'exemple, chaque élément de transmission 28 a la forme d'une lentille 28a à surface torique définie en relief sur la face interne 26 dudit réfracteur, en regard de la source lumineuse. En outre, chaque lentille 28a est
5 définie à l'extrémité d'un petit cylindre 32 se rattachant à la face interne de la dalle. Tous ces cylindres sont parallèles. Par conséquent, les axes optiques de toutes les lentilles sont également parallèles entre eux et parallèles à l'axe principal de symétrie de la dalle du réfracteur.
10 Dans l'exemple, on a prévu 91 lentilles de ce genre, installées côte-à-côte (voir figure 1). Sur la paroi de fond du compartiment 19 correspondant, la source lumineuse 15 précitée est elle-même constituée de 91 diodes électroluminescentes 20 et, par conséquent, chaque diode
15 électroluminescente est placée en regard d'une lentille spécifique. Pour un résultat optimum, l'axe optique de la diode est sensiblement confondu avec l'axe optique de la lentille qui lui correspond.

Pour obtenir la double anamorphose mentionnée ci-dessus, la surface frontale convexe de chaque lentille 28a
20 s'inscrit sur une surface torique orientée suivant les directions horizontale et verticale du réfracteur. Plus précisément, elle présente un rayon de courbure suivant ladite direction verticale (figure 4) qui est plus grand
25 que le rayon de courbure suivant la direction horizontale (figure 3). De préférence, le rayon de courbure suivant la direction verticale est deux fois plus grand, environ, que le rayon de courbure suivant la direction horizontale. Dans l'exemple, ces deux rayons de courbure sont respectivement
30 de 20 et 10 mm pour un diamètre de lentille de 6 mm. La focale moyenne de chaque lentille est de l'ordre de 14 mm. Par conséquent, la distance séparant une diode électroluminescente de sa lentille est voisine de cette valeur.

REVENDICATIONS

1- Dispositif de signalisation lumineuse comprenant un boîtier renfermant au moins une source lumineuse (15) et un réfracteur optique correspondant placé en regard de cette source lumineuse, caractérisé en ce que ledit réfracteur
5 (17) comporte, répartis sur l'une de ses faces, une pluralité d'éléments de transmission de lumière (28), chacun conformé pour faire subir au flux lumineux qui le traverse deux anamorphoses, respectivement de concentration selon une direction verticale et de divergence selon une
10 direction horizontale.

2- Dispositif selon la revendication 1, caractérisé en ce que chaque élément de transmission (28) a la forme d'une lentille (28a) à surface torique définie en relief sur la face interne (26) dudit réfracteur, en regard de ladite
15 source lumineuse (15).

3- Dispositif selon la revendication 2, caractérisé en ce que chaque lentille (28a) est définie à l'extrémité d'un cylindre (32).

4- Dispositif selon la revendication 3, caractérisé en
20 ce que ces cylindres sont parallèles.

5- Dispositif selon l'une des revendications précédentes, caractérisé en ce que ledit réfracteur comporte une dalle (22) de matériau transparent ou au moins translucide avec laquelle lesdits éléments de transmission
25 (28) sont venus de matière.

6- Dispositif selon la revendication 5, caractérisé en ce que ladite dalle est réalisée en un matériau présentant un indice de réfraction supérieur à 1,45 et de préférence voisin de 1,58.

7- Dispositif selon la revendication 6, caractérisé en
30 ce que ce matériau est un polycarbonate.

8- Dispositif selon l'une des revendications précédentes, caractérisé en ce que la source lumineuse (15) précitée est constituée d'une pluralité de diodes
35 électroluminescentes (20).

5 9- Dispositif selon l'une des revendications 2 à 7 et la revendication 8, caractérisé en ce que le nombre de diodes (20) est égal au nombre de lentilles (28a) et en ce que chaque diode électroluminescente est placée en regard d'une lentille spécifique.

10 10- Dispositif selon l'une des revendications 2 à 9, caractérisé en ce que chaque lentille (28a) présente un rayon de courbure suivant ladite direction verticale plus grand que le rayon de courbure suivant ladite direction horizontale, de préférence deux fois plus grand.

11- Dispositif selon la revendication 10, caractérisé en ce que les deux rayons de courbure précités sont respectivement de 20 et 10 mm pour un diamètre de lentille de 6 mm.

1/2

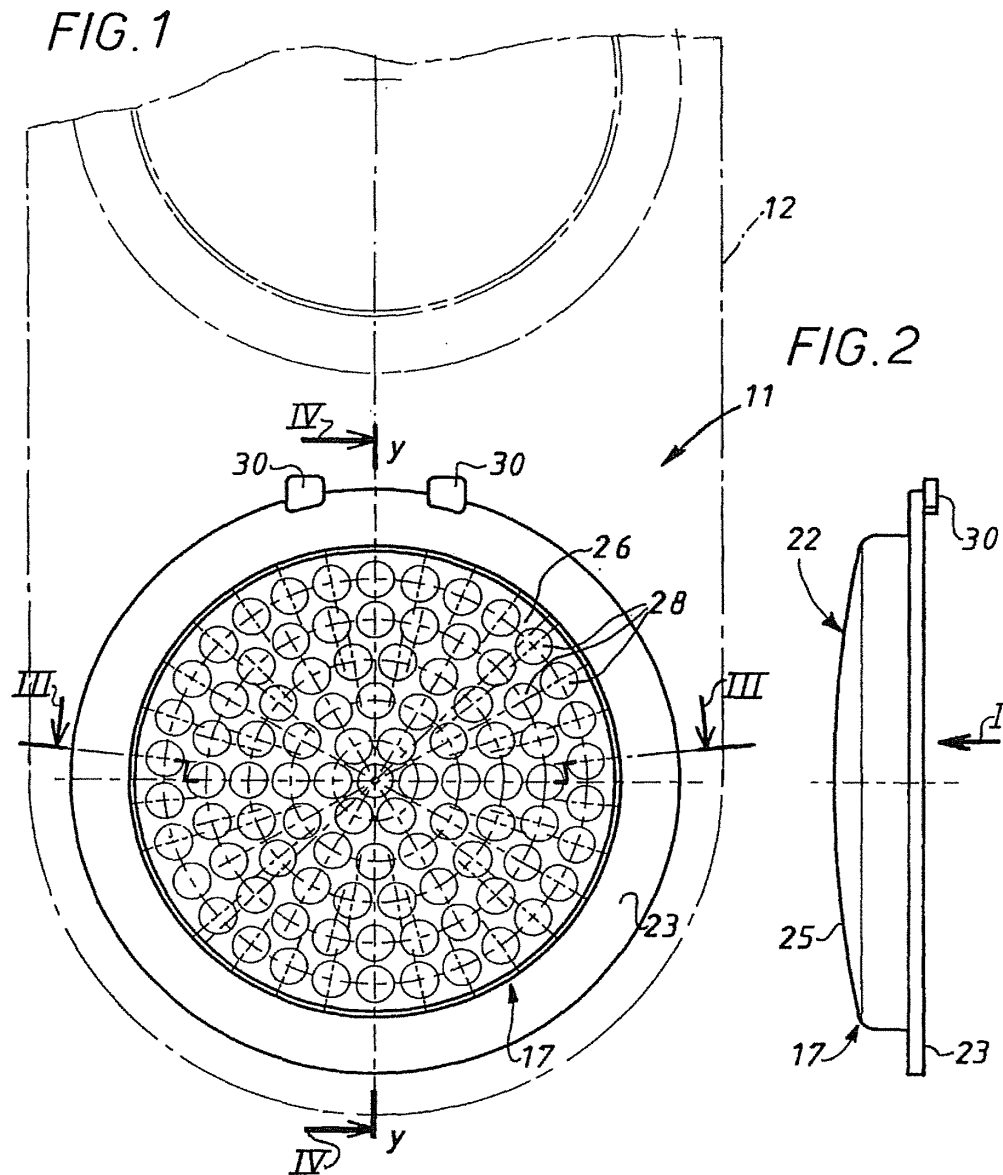


FIG. 3

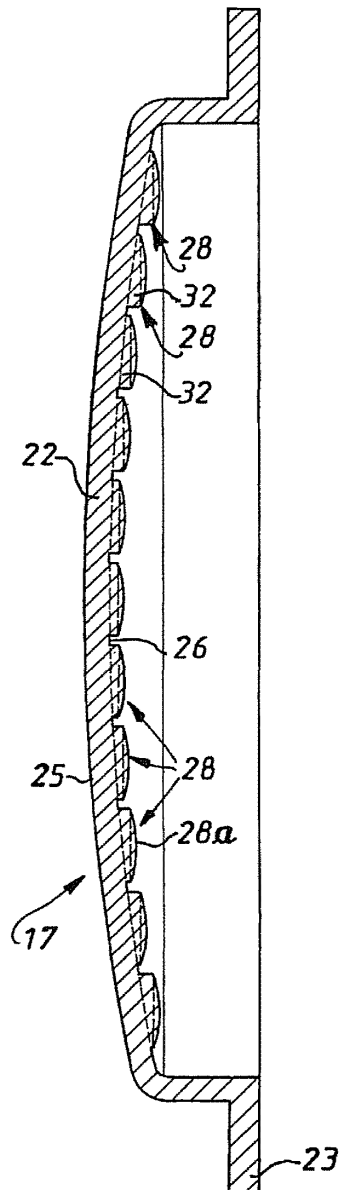
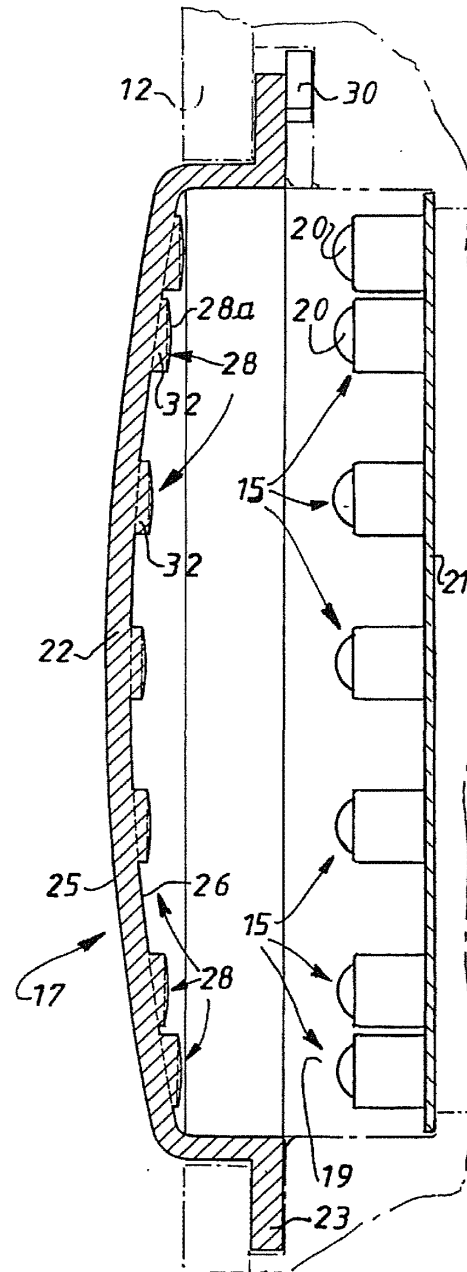


FIG. 4



2759188

REPUBLIQUE FRANÇAISE

INSTITUT NATIONAL
de la
PROPRIETE INDUSTRIELLE

**RAPPORT DE RECHERCHE
PRELIMINAIRE**

établi sur la base des dernières revendications
déposées avant le commencement de la recherche

N° d'enregistrement
national

FA 538767
FR 9701065

DOCUMENTS CONSIDERES COMME PERTINENTS		Revendications concernées de la demande examinée
Catégorie	Citation du document avec indication, en cas de besoin, des parties pertinentes	
A	WO 95 25244 A (ITAB IND AB ; ROSENGREN LARS (SE)) 21 Septembre 1995 * le document en entier *	1-11
A	WO 86 00146 A (GRANSTROEM ERNST AB) 3 Janvier 1986 * le document en entier *	1-11
A	FR 2 563 929 A (THERY HINDRICK SA) 8 Novembre 1985 * figures 1-3 *	1-11
A	FR 2 586 844 A (SOFRELA SA) 6 Mars 1987 * figures 1-6 *	1-11
A	US 4 630 180 A (MURAKI KATSUO ET AL) 16 Décembre 1986	
		DOMAINES TECHNIQUES RECHERCHES (Int.CL.6)
		G08G F21Q
Date d'achèvement de la recherche		Examineur
10 Septembre 1997		Crechet, P
<p>CATEGORIE DES DOCUMENTS CITES</p> <p>X : particulièrement pertinent à lui seul Y : particulièrement pertinent en combinaison avec un autre document de la même catégorie A : pertinent à l'encontre d'au moins une revendication ou arrière-plan technologique général O : divulgation non-écrite P : document intercalaire</p> <p>T : théorie ou principe à la base de l'invention E : document de brevet bénéficiant d'une date antérieure à la date de dépôt et qui n'a été publié qu'à cette date de dépôt ou qu'à une date postérieure. D : cité dans la demande L : cité pour d'autres raisons & : membre de la même famille, document correspondant</p>		

1

EPO FORM 150 (01.92) (P/C/L)

Translate Text

Original text:

Description of FR2759188

"Dispositif de signalisation lumineuse, notamment pour régulation du trafic routier"

L'invention se rapporte à un dispositif de signalisation lumineuse pouvant par exemple former un feu tricolore destiné à réguler le trafic routier à un carrefour; elle concerne plus particulièrement la conception d'un réfracteur optique de lumière placé en regard de la source lumineuse.

L'invention trouve son domaine d'application optimum dans le cas où ladite source lumineuse est constituée par un ensemble de diodes électroluminescentes.

Classiquement, un dispositif de signalisation lumineuse tel qu'un feu tricolore comprend un boîtier renfermant trois sources lumineuses placées dans des compartiments indépendants dudit boîtier et chaque compartiment est coiffé frontalement d'un réfracteur en matériau transparent ou translucide comme par exemple du verre minéral ou organique. La source lumineuse peut être une lampe classique à filament, éventuellement du type allogène basse tension ou encore un tube fluorescent.

Plus récemment, on a tenté d'utiliser des diodes électroluminescentes. Ces essais se sont révélés décevants principalement en raison de la faible luminosité des diodes électroluminescentes proposées sur le marché. Des tentatives ont été faites pour mieux canaliser le flux lumineux émis par l'ensemble des diodes. On a ainsi, par exemple, proposé d'optimiser le réfracteur. Par exemple, on connaît un tel dispositif de signalisation dans lequel le réfracteur comporte sur sa face interne des stries à section triangulaire s'étendant horizontalement ou verticalement et de préférence dans les deux directions.

Cette configuration striée fait donc face à la source lumineuse constituée par les diodes électroluminescentes agencées côte-à-côte. Cependant, le résultat est

Translation: French » English

Description of FR2759188

"A light-especially for regulation of road traffic "

The invention relates to a light-signalling device for example can form a traffic lights to regulate traffic at a crossroads, and more specifically the design of a refractor optical light placed next to the light source.

The invention finds its scope optimum where the light source is constituted by a number of light-emitting diodes.

Usually, a light-signalling device such as a traffic light includes a box containing three light sources placed in compartments that independent housing and each compartment is headed head of a refractor transparent or translucent material such as glass of mineral or organic . The light source may be a conventional filament lamp, possibly type allogeneic low voltage or a fluorescent tube.

More recently, it has attempted to use light-emitting diodes. These tests have proved disappointing, mainly because of the low-light-emitting diodes on the market. Attempts were made to better channel the flow of light emitted by all the diodes. It was, for example, proposed to optimize the refractor. For example, we know such a signalling device in which the refractor has on its inner surface streaks of triangular section stretching horizontally or vertically and preferably in both directions.

This configuration striped therefore face the light source constituted by the light-emitting diodes arranged side by side. However, the result is insufficient and dispositifsa light-emitting diodes equipped with such refractors can hardly meet the standards.

The invention relates to a new concept of refractor placed next to the light source and more particularly effective when the light source is constituted by a number of light-emitting diodes.

More specifically, the invention relates to a signalling device comprising a box containing at least one light source and an optical refractor corresponding placed next to the light source, wherein said refractor includes

over one of its sides , A plurality of transmission elements of light, each pursuant to undergo the flow of light that passes through two anamorphoses, respectively concentration according to a vertical direction and divergence according to a horizontal direction.

According to one currently preferred example, each element of transmission is shaped like a lens surface torique defined embossed on the inner side of the refractor, against the light source.

In addition, each lens is advantageously defined at the end of a cylinder; cylinders for example, parallels between them and parallel to a main axis of symmetry of the refractor. This arrangement has proved particularly effective in making the refractor selective in the light emitted by the light source. Indeed, for light rays coming from outside, said refractor behaves like a light trap backscatter by preventing their lenses. Signage is therefore evident even when the signalling device is exposed to direct sunlight. In this case, light rays that penetrate inside the box are highly attenuated and can not be redistributed by the lenses if their directions are different from those axes parallel optical lenses. This filtering light parasites is effective regardless of the nature of the light source.

In cases where the latter is constituted by a plurality of light-emitting diodes, the best result is achieved by ensuring that the number of diodes is equal to the number of lenses and each diode is placed next to a specific lens.

In practice, the refractor consists of a slab transparent material or at least translucent, and transmission components above, ie for example lenses defined the respective ends of the cylinders, came to terms on the inner side of the slab, by moulding. The ensemble is made of a material with a refractive index greater than 1.45 and preferably adjacent to 1.58.

For a traffic light small, such as a fire repeater, all lenses are of equal size. In a version currently preferred, refractor comprises 91 lenses 6 mm in diameter and the light source is made up of 91 light-emitting diodes. The lenses may be arranged on a concave surface and light-emitting diodes on a plan. In this case, the average distance between a diode and the lens that goes with it is about 12 to 14 mm.

Pursuant to the above definition, each lens has a radius of curvature following the vertical direction larger than the radius of curvature after the horizontal direction, preferably twice as large.

Thus, in practice, it has successfully tested

a refractor equipped with lenses each with two radii of curvature different, 20 and 10 mm respectively.

For a set of traffic lights bigger, you increase the number of lenses and the number of light-emitting diodes, dimensions that they do not vary. However, it is not necessary to increase the number of LEDs in large proportions if you increase the diameter of lenses, in the peripheral regions of the refractor. The best result is achieved by matching a light-emitting diode corresponding to a lens.

In addition, it will be advantageous to organize diodes on surfaces annular axially shifted so that the diodes are all approximately the same distance corresponding lenses.

In case the number of light-emitting diodes is different from the number of lenses, light scattering is nevertheless satisfactorily and can meet the standards. The refractor is also compatible with other more conventional light sources such as light bulbs and fluorescent tubes or lamps allogeneic, low voltage.

The invention will be better understood and other benefits thereof will appear more clearly in light of the description which will follow a way of achieving a light-signalling device conforms to its principle, given solely as a d 'example and made reference to the drawings in which:

- Figure 1 is a partial view of a light-signalling device conforms to the invention and showing more particularly a refractor seen inside as I arrow in Figure 2;
- Figure 2 is a side view of the refractor Figure 1;
- Figure 3 is a section III-III refractor Figure 1;
- Figure 4 is a section IV-IV in Figure 1, light emitting diodes are represented uncut.

Of the drawings, it represented a part of a light-signalling device 11, in this case by a signal light including a box containing 12 three light sources of different colors, usually red, orange and is vert.11 here a set of traffic lights said small-scale "fire repeater" placed at the height of the vehicle. Of the drawings, the housing 12 appears to relate ghost and is not fully represented, we see only the part that contains a light source 15 and a 17 refractor optical placed next to the light source. The light source, fully contained in a compartment 19 of housing, independent, is constituted by a plurality of light-emitting diodes 20. These diodes are mounted on a support plan 21, side-by-side on substantially the entire surface available. The axes emission diodes are all parallel. The compartment 19 is closed head by the optical refractor 17.

As shown in figures 2 to 4, the optical refractor 17 includes a slab 22 domed translucent or transparent, contour and a circular collar device mounting 23, and annular plate. The slab 22 presents a whole outer face 25 and a convex side 26 generally concave.

According to a remarkable characteristic of the invention, this refractor includes over one of its sides, and in this case by the inner side 26, a plurality of transmission components of light 28 and each of these elements is in accord to undergo the flow of light that passes through two anamorphoses, respectively anamorphosis concentration according to the vertical direction and an anamorphic divergence according to the horizontal direction. Of the drawings, the vertical direction of the refractor is indicated by the axis yy. The collar 23 has two elements keyed 30 at its periphery, from shelter in cavities corresponding box 12 for the refractor is still mounted in a correct position, namely with the axis yy oriented vertically.

The transmission components are above 28 from the field with slab. The ensemble is directed by casting from a material with a refractive index greater than 1.45 and preferably adjacent to 1.58. A synthetic material such as polycarbonate gives particularly satisfactory results.

As an example, each element of transmission 28 is shaped like a lens surface 28a torique defined embossed on the inner side of the refractor 26, against the light source. In addition, each lens 28a is defined at the end of a small cylinder 32 connected to the inner side of the slab. All these cylinders are parallel. Hence, the optical axes of all lenses are also parallels between them and parallel to the main axis of symmetry of the slab of refractor.

In the example, it was anticipated 91 lenses of this type, installed side by side (see Figure 1). On the back wall of the corresponding compartment 19, the light source is above 15 itself consists of 91 light-emitting diodes 20 and, therefore, each light-emitting diode is placed next to a specific lens. For an optimum result, the optical axis of the diode is significantly confused with the optical axis of the lens that goes with it.

For a double anamorphosis mentioned above, the front surface of each convex lens 28a falls on a surface-oriented O-ring following directions horizontal and vertical refractor. More precisely, it has a radius of curvature of such vertical direction (Figure 4), which is larger than the radius of curvature after the

horizontal direction (Figure 3). Preferably, the radius of curvature following the vertical direction is twice as large, about the radius of curvature after the horizontal direction. In the example, these two radii of curvature are respectively 20 and 10 mm for a lens diameter of 6 mm. The focal average each lens is about 14 mm.

Hence, the distance separating a light-emitting diode its lens is close to that value.

French » English Translate

[+ Suggest a better translation](#)

Translate a Web Page

http://

French » English Translate

[Google Home](#) - [About Google Translate](#)

©2008 Google

[Text and Web](#)[Translated Search](#)[Dictionary](#)[Tools](#)

Translate Text

Original text:

Translate this text Claims of FR
2759188 (A1)

REVENDECATIONS

1- Dispositif de signalisation lumineuse comprenant un boîtier renfermant au moins une source lumineuse (15) et un réfracteur optique correspondant placé en regard de cette source lumineuse, caractérisé en ce que ledit réfracteur (17) comporte, répartis sur l'une de ses faces, une pluralité d'éléments de transmission de lumière (28), chacun conformé pour faire subir au flux lumineux qui le traverse deux anamorphoses, respectivement de concentration selon une direction verticale et de divergence selon une direction horizontale.

2- Dispositif selon la revendication 1, caractérisé en ce que chaque élément de transmission (28) a la forme d'une lentille (28a) à surface torique définie en relief sur la face interne (26) dudit réfracteur, en regard de ladite source lumineuse (15).

3- Dispositif selon la revendication 2, caractérisé en ce que chaque lentille (28a) est définie à l'extrémité d'un cylindre (32).

4- Dispositif selon la revendication 3, caractérisé en ce que ces cylindres sont parallèles.

5- Dispositif selon l'une des revendications précédentes, caractérisé en ce que ledit réfracteur comporte une dalle (22)

Translation: French » English

Translate this text Claims of FR
2759188 (A1)

CLAIMS

1 - signaling device comprising a housing containing at least one light source (15) and a corresponding optical refractor attached to the light source, wherein the refractor (17) has spread over one of its sides, A plurality of power transmission light (28), each pursuant to undergo the luminous flux that crosses between two anamorphoses respectively concentration according to a vertical direction and divergence according to a horizontal direction.

2 - The method of claim 1, wherein each element of transmission (28) is shaped like a lens (28a) ring surface defined in relief on the inside (26) said refractor, next to the source Light (15).

3 - The method of claim 2, wherein each lens (28a) is defined at the end of a cylinder (32).

4 - The method of claim 3, wherein these cylinders are parallel.

5 - The method of claim wherein the refractor includes a slab (22) of transparent material or at least translucent with which such transmission components (28) came matter.

6 - The method of claim 5, wherein the slab is made of a material with a refractive index higher than 1.45 and preferably close to 1.58.

7 - The method of claim 6, wherein the

material is a polycarbonate.

8 - The method of claim that the light source (15) above consists of a plurality of light emitting diodes (20).

9 - The method of claims 2 to 7 and claim 8, wherein the number of diodes (20) equals the number of lenses (28a) and that each LED is placed in relation to ' a lens specific.

10 - The method of claims 2 to 9, wherein each lens (28a) presents a radius of curvature following the vertical direction greater than the radius of curvature of such horizontal direction, preferably twice as large.

11 - The method of claim 10, wherein the two radii of curvature above are respectively 20 and 10 mm lens diameter of 6 mm.

French » English Translate

[+ Suggest a better translation](#)

Translate a Web Page

http://

French » English Translate

[Google Home](#) - [About Google Translate](#)

©2008 Google

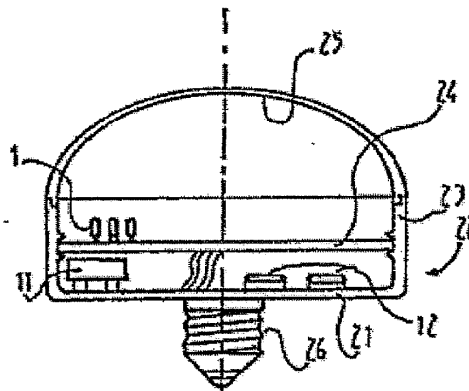
Signalling device using light-emitting diodes

Publication number: FR2586844
Publication date: 1987-03-06
Inventor: CHERVALIER MICHEL; GONVIN DIDIER; MOYSON BERNARD; ROMATET A
Applicant: SOFRELA SA (FR)
Classification:
- international: **F21K7/00; G08G1/095; H05B33/08; F21K7/00; G08G1/095; H05B33/02; (IPC1-7): G08G1/095**
- European: **F21K7/00S; G08G1/095; H05B33/08D**
Application number: FR19850013029 19850827
Priority number(s): FR19850013029 19850827

Report a data error here

Abstract of **FR2586844**

The present invention is in the field of signalling and its subject, more precisely, is an illumination device especially intended for light signalling for traffic, of the type employing light-emitting light generators such as light-emitting diodes LED characterised mainly in that it consists of: at least a first plurality of LED's 1 arranged on at least one so-called first plate 24, forming a printing circuit chassis, rectifier means 11, 12 for the alternating current intended to supply the said LED with rectified current, and a diffuser 25 made of a substantially transparent material, possibly an ordinary lamp cap, of the screw or bayonet type directly or indirectly integral with the LED plate. Applications especially to warning lights at cross roads but also to signalling by letters, numbers, symbols, etc.



Data supplied from the **esp@cenet** database - Worldwide

(19) RÉPUBLIQUE FRANÇAISE
INSTITUT NATIONAL
DE LA PROPRIÉTÉ INDUSTRIELLE
PARIS

(11) N° de publication : **2 586 844**
(à n'utiliser que pour les
commandes de reproduction)

(21) N° d'enregistrement national : **85 13029**

(51) Int Cl⁴ : G 08 G 1/095.

(12) **DEMANDE DE BREVET D'INVENTION**

A1

(22) Date de dépôt : 27 août 1985.

(30) Priorité :

(71) Demandeur(s) : *SOFRELA S.A.* — FR.

(72) Inventeur(s) : Michel Chervelier, Didier Gonvin, Bernard Moyson et A. Romatet.

(43) Date de la mise à disposition du public de la demande : BOPI « Brevets » n° 10 du 6 mars 1987.

(60) Références à d'autres documents nationaux apparentés :

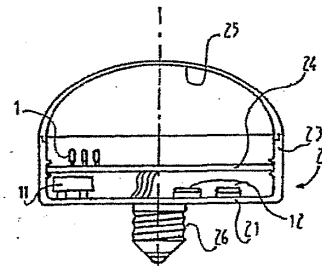
(73) Titulaire(s) :

(74) Mandataire(s) : Jacques Chanet.

(54) Dispositif de signalisation utilisant des diodes électroluminescentes.

(57) La présente invention est du domaine de la signalisation et elle a plus précisément pour objet un dispositif d'éclairage notamment destiné à la signalisation lumineuse pour le trafic, du type mettant en œuvre des générateurs de lumière électroluminescents tels que diodes électroluminescentes LED principalement caractérisé en ce qu'il est constitué par : au moins une première pluralité de LED 1 disposé sur au moins une plaque 24 dite première, formant châssis à circuit imprimé, des moyens de redressement 11, 12 du courant alternatif destinés à alimenter en courant redressé lesdites LED et un diffuseur 25 d'une matière substantiellement transparente, éventuellement une culotte de lampe ordinaire, à vis ou à baïonnette, solidaire directement ou indirectement de la plaque des LED.

Applications notamment aux feux de rappel des carrefours mais aussi aux signalisations par lettres, chiffres, symboles, etc.



FR 2 586 844 - A1

Vente des fascicules à l'IMPRIMERIE NATIONALE, 27, rue de la Convention — 75732 PARIS CEDEX 15

La présente invention est du domaine de la signalisation et elle a plus précisément pour objet un dispositif de signalisation lumineuse notamment applicable aux feux de carrefour ou analogues.

5 On connaît, en matière de signalisation routière, l'utilisation de diodes électroluminescentes (LED) comme sources lumineuses ; on connaît par exemple un dispositif lumineux dans lequel des LED
10 verts et des LED rouges dessinent côte à côte un piéton à l'arrêt (LED rouge) et un piéton en marche (LED vert), dispositif disposé à l'entrée du passage pour piéton à travers la rue. On connaît aussi d'autres formes de tels panneaux lumineux clignotant ou non indiquant des limitations de vitesse, présence de travaux, etc... Dans tous
15 ces cas d'application, les LED sont utilisés sans surface diffusante intermédiaire et cela en raison de leur relativement faible luminosité.

La présente invention s'est donnée deux buts essentiels : proposer un dispositif d'éclairage d'une très grande fiabilité destiné à être
20 substitué de façon immédiate, aux ampoules électriques à incandescence équipant notamment les feux de rappel c'est-à-dire ceux des feux de carrefour qui sont à la hauteur de l'automobiliste ; par façon immédiate, on
25 entend le fait qu'ayant retiré une ampoule détériorée, on puisse simplement mettre à sa place le dispositif objet de l'invention. Proposer un feu de rappel d'une très haute fiabilité et une faible épaisseur destinée à remplacer les actuels feux de rappel fonctionnant au
30 moyen de lampes à incandescence.

Selon l'invention, dans sa généralité, un dispositif d'éclairage notamment destiné à la signalisation lumineuse pour le trafic, du type
35 mettant en oeuvre des générateurs de lumière électroluminescents tels que diodes électroluminescentes (LED), est caractérisé principalement en ce qu'il est constitué par au moins une première pluralité de LED disposés sur une

première plaque formant châssis à circuit imprimé, des moyens de redressement du courant alternatif destinés à alimenter en courant redressé lesdites LED et un diffuseur d'une matière substantiellement transparente, incolore ou très faiblement colorée, ledit diffuseur comportant au moins une face pourvue de reliefs réguliers serrés les uns contre les autres et ayant des dimensions sensiblement du même ordre de grandeur que la face de sortie des LED.

Le premier but fixé à la présente invention est réalisé par un dispositif d'éclairage comportant la caractéristique générale sus-énoncée et caractérisé en outre en ce que ladite première plaque est circulaire et d'un encombrement approximativement comparable à celui d'une lampe à incandescence, en ce que la première plaque est solidaire et maintenue espacée à une certaine distance d'une deuxième plaque de mêmes dimensions, l'espace compris entre les deux plaques servant à loger lesdits moyens de redressement et autres organes d'alimentation, et en ce que ladite deuxième plaque comporte sur sa face opposée à la première plaque un culot de lampe à incandescence.

De préférence, chacune desdites plaques est utilisée comme support de circuit imprimé, le circuit imprimé de la première plaque distribuant la tension redressée aux dites LED et étant imprimé sur la face de la première plaque en regard de la seconde plaque, le circuit de la deuxième plaque reliant en pont des diodes d'alimentation ledit pont recevant directement la tension du réseau par l'intermédiaire du culot ; il résulte de cette disposition particulière que les plaques peuvent servir en même temps de bâti, boîtier et autres éléments de structure et d'élément de circuit.

Avantageusement la pluralité des LED est elle-même divisée en deux groupes équinumériques de LED, ce qui rend le système bitension (110 ou 220 V) les LED de chaque groupe étant montés en série et

suivant une forme préférée de réalisation, les LED sont du type à haute luminosité et le nombre de LED de chaque groupe est compris entre 40 et 50.

Avantageusement enfin la
5 deuxième plaque peut être en même temps la paroi de fond d'un boîtier cylindrique dont le fond supporte sur sa face extérieure le culot, et dont la paroi latérale supporte, sur son pourtour, le diffuseur et sur sa face interne, ladite première plaque. On notera aussi que les
10 LED peuvent être disposés suivant une nappe curviligne. On notera encore que tous les éléments constitutifs (LED, redresseur, résistance, culot) peuvent être montés sur une seule plaque.

On a ainsi réalisé dans les
15 deux cas avantageux précédents, une source lumineuse d'une structure physique et mécanique tout à fait comparable à celle d'une ampoule à incandescence mais qui présente l'avantage d'avoir la fiabilité réputée des LED, soit une durée de vie considérablement supérieure à celle
20 d'une ampoule à incandescence. On sait que la lumière émise par les LED est colorée ; chaque ampoule à LED conforme à l'invention aura donc la couleur correspondante, rouge, vert ou orangé à l'élément de signalisation auquel elle est associée.

Le second but fixé à la présente invention est réalisé par un dispositif de signalisation comportant la caractéristique générale énoncée plus haut et caractérisé en outre en ce que la première plaque
25 comporte une triple pluralité de LED, chaque pluralité ayant l'une des couleurs rouge, vert et orangé, en ce que les LED de chaque pluralité sont disposés suivant une surface circulaire, en ce que le diffuseur est formé par une pièce unique de ladite matière, ladite pièce unique
30 ayant sensiblement les mêmes dimensions que ladite première plaque, et en ce qu'une deuxième plaque est constitué par le fond d'un boîtier de forme allongée, de
35 mêmes dimensions que la première plaque, ledit boîtier

supportant, intérieurement ladite première plaque, et supportant, sur son pourtour, le diffuseur et, sur la face externe de son fond, des moyens de fixation et de relation électrique. De préférence, le diffuseur formant
5 couvercle du boîtier est conformé en trois dômes alignés en regard des surfaces circulaires des LED. On dispose ainsi d'un dispositif de signalisation, pour feux de rappel notamment, très plat, très simple de fabrication et d'une grande fiabilité quant à la durée de vie des
10 sources de lumière que constituent les pluralités de LED.

D'une manière générale, et lorsque les dispositifs de l'invention seront utilisés sans faire appel aux diffuseurs colorés traditionnels, le diffuseur, qu'il soit intégré ou séparé, qu'il soit celui
15 du dispositif remplaçant une ampoule ou qu'il soit celui du dispositif de signalisation à trois feux, sera de préférence légèrement bombé de façon à pallier facilement la directionnalité de la lumière émise par les LED et en même temps à avoir une plus grande résistance mécanique,
20 et la matière qui le constitue sera incolore ou très faiblement teintée ; cette dernière caractéristique a pour avantage d'éviter l'effet de signal fantôme dû à une source extérieure de lumière, soleil par exemple ; la présence de la lumière réémise par ce phénomène sera de
25 la lumière blanche qui ne pourra être confondue avec l'une des lumières colorées.

La présente invention sera mieux comprise et des détail en relevant apparaîtront à la description qui va être faite de formes particulières de réalisation en relation avec les figures des planches
30 annexées, dans lesquelles :

- la fig.1 est une vue schématique et de face d'un dispositif à LED formant une source lumineuse conforme à l'invention,
35

- la fig.2 est une illustration analogue du même vue de côté, avec deux versions du culot,

- la fig.3 est un schéma électronique de câblage des LED du dispositif des figures précédentes, et de leur alimentation,

5 - la fig.4 est une coupe schématique d'une seconde version d'un dispositif analogue à celui des fig.1 et 2,

- la fig.5 est une coupe partielle et à échelle grossie d'une paroi de réflecteur,

10 - les fig.6, 7 et 8 illustrent différents types de reliefs de la face interne des réflecteurs,

- la fig.9 est une coupe schématique d'un dispositif à trois feux conforme à l'invention, et

15 - la fig.10 est une vue de face du même.

Sur les fig.1 et 2, une source lumineuse pouvant être substituée à une lampe incandescente est constituée conformément à l'invention d'une pluralité de LED 1 disposés sur une première plaque 2 dont la face interne 3 comporte un circuit imprimé ; cette première plaque de forme circulaire est solidaire au moyen d'entretoises telles que 4 d'une seconde plaque 5 dont la face interne 6 comporte elle aussi un circuit imprimé ; un culot soit à vis tel que 7, soit à baïonnette tel que 8, de dimensions standardisées, est fixé sur la face externe 9 de la deuxième plaque ; l'espace compris entre la première et la deuxième plaque est occupé par des composants électroniques tels que pont redresseur 11 et résistance d'adaptation 12.

30 Sur la fig.3, on a représenté symboliquement un pont redresseur à diode 11 pouvant être alimenté en tension alternative 110 ou 220 V, deux possibilités de câblage 14 et 15 suivant que la tension primaire est 110 ou 220 V respectivement, des résistances d'adaptation d'intensité 16 et 17 montées chacune en série avec des LED 1 dans deux circuits, respectivement

18 et 19 ; pour fixer les idées, les caractéristiques des composants sont les suivantes : le pont redresseur est un pont à 400 V/1 A, les résistances 16 et 17 sont des résistances de $1.200 \Omega / 3 \text{ W}$ et les LED sont du type à haute luminosité et sont au nombre de 44 pour chaque circuit 18 et 19.

Le trait mixte 20 sépare les éléments qui sont au-dessus (LED) de la première plaque 2 de la figure précédente, des éléments (résistance, pont redresseur, et câblage) qui sont au-dessous.

Sur la fig.4, un dispositif analogue à celui des figures précédentes en diffère cependant en ce que ladite deuxième plaque est constituée par le fond 21 d'un boîtier cylindrique 22 dont la paroi latérale 23 supporte sur sa face interne une plaque 24 et sur son pourtour un diffuseur 25 pourvu d'un relief interne ; la plaque 24 supporte elle-même les LED 1 d'un côté et leur circuit d'alimentation de l'autre, tandis que le fond 21 comporte d'un côté un circuit imprimé pour les organes d'alimentation et de l'autre un culot 26 à vis par exemple. Le dispositif, ou ampoule à LED, de la fig.4 remplace à la fois l'ampoule à incandescence et le diffuseur traditionnels utilisés par exemple dans les feux de rappel.

Sur les fig.5 à 8, on a illustré en coupe (fig.5) ou en plan (fig.6 à 8) différents reliefs de la face interne et concave des diffuseurs : ainsi la coupe de la fig.5 illustre des reliefs en creux 27 en forme de demi-sphère ; sur les autres figures les reliefs sont des pointes creuses, ou polyèdres, de forme hexaédrique (fig.6), tétraédrique (fig.7), triédrique (fig.8). On notera que la surface interne concave du diffuseur correspond à une conformation en dôme de celui-ci.

Puisque les LED émettent une lumière monochromatique d'une couleur approchant l'une des couleurs requises pour la signalisation des car-

fours, il est inutile que le diffuseur soit lui-même coloré. Il est cependant apparu à la Demanderesse qu'il était avantageux d'incorporer, soit superficiellement, soit dans la masse du diffuseur, un colorant du genre fluorescéine ou éosine pour modifier la couleur de la lumière émise par le dispositif et la rapprocher de la couleur plus conventionnelle des feux de carrefours.

Sur les fig.9 et 10, un dispositif de signalisation, notamment de rappel des feux de carrefour, comprend trois groupes de LED 1 analogues chacun au groupe de LED des ampoules à LED des fig.1 et 4, et montés sur une plaque unique 28 à circuit imprimé, elle-même montée à l'intérieur d'un boîtier 29 dont le fond 30 supporte les organes d'alimentation ; le boîtier est refermé par un couvercle 31 à trois dômes formant diffuseur incolore ; la plaque de fond du boîtier supporte des moyens de fixation 32 et de relation électrique 33 ; chacun des groupes de LED émet une lumière de couleur correspondante à sa position dans le dispositif, à savoir rouge (R) pour le groupe supérieur de LED, jaune-orangé (O) pour le groupe intermédiaire et jaune-vert (V) pour le groupe inférieur.

Suivant l'exemple ci-dessus, on a associé au moins un groupe de LED à un organe diffuseur, l'un et l'autre ayant une certaine configuration, à savoir celle d'un feu de rappel ; il est évident que, sans sortir du cadre de l'invention on pourra donner à cette association d'autres configurations : par exemple, celles de lettres, de chiffres, de symboles, habituels en matière de signalisation tels que triangles, cercles, silhouettes, etc...

Bien que l'on ait décrit et/ou représenté des formes particulières de réalisation de dispositifs de signalisation conformes à l'invention, il doit être compris que la portée de cette dernière n'est pas limitée à ces formes mais qu'elle s'étend à tout dispositif comportant les caractéristiques générales énoncées plus haut.

R E V E N D I C A T I O N S

1.- Dispositif d'éclairage notamment destiné à la signalisation lumineuse pour le trafic, du type mettant en oeuvre des générateurs de lumière électroluminescents tels que diodes électroluminescente (LED), caractérisé :

5

en ce qu'il est constitué par :

- au moins une première pluralité de LED disposé sur au moins une plaque, dite première, formant châssis à circuit imprimé,
- 10 - des moyens de redressement du courant alternatif destinés à alimenter en courant redressé lesdites LED et,
- un diffuseur d'une matière substantiellement transparente, incolore ou très faiblement colorée, ledit diffuseur comportant au moins une face pourvue de reliefs réguliers serrés les uns contre les autres et ayant des dimensions sensiblement du même ordre de grandeur que la face de sortie des LED ;

10

15

2.- Dispositif selon la revendication 1, caractérisé :

20

en ce que lesdits reliefs sont des reliefs en creux relevant de l'une des formes géométriques comprenant la demie sphère et les polyèdres ;

3.- Dispositif selon la revendication 1, plus spécialement destiné à être substitué dans la tête de signalisation d'un feu de carrefour ou analogue, à la source lumineuse, utilisée habituellement dans de tels feux, caractérisé :

25

en ce que ladite première plaque

30

est circulaire et d'un encombrement approximativement égal à celui d'une lampe à incandescence,

en ce que la première plaque est solidaire et maintenue espacée à une certaine

distance d'une deuxième plaque de mêmes dimensions, l'espace compris entre les deux plaques servant à loger lesdits moyens de redressement et autres organes d'alimentation, et

5 en ce que ladite deuxième plaque comporte sur sa face opposée à la première plaque un culot de lampe à incandescence ;

4.- Dispositif selon la revendication 3, caractérisé :

10 en ce que chacune desdites plaque est utilisée comme support de circuit imprimé, le circuit imprimé de la première plaque distribuant la tension redressée aux dits LED et étant imprimé sur la face de la première plaque en regard de la seconde plaque, le circuit de la deuxième plaque reliant en
15 pont des diodes d'alimentation ledit pont recevant directement la tension du réseau par l'intermédiaire du culot ;

5.- Dispositif selon la revendication 4, caractérisé :

20 en ce que ladite pluralité des LED est elle-même divisée en deux groupes équinumériques de LED, les LED de chaque groupe étant montés en série ;

6.- Dispositif selon la revendication 5, caractérisé :

25 en ce que le nombre de LED de chaque groupe est compris entre 40 et 50 ;

7.- Dispositif selon la revendication 4, caractérisé :

30 en ce que ladite deuxième plaque est la paroi de fond d'un boîtier cylindrique dont le fond supporte sur sa face extérieure le culot, et dont la paroi latérale supporte, sur son pourtour, le diffuseur et sur sa face interne, ladite première plaque ;

8.- Dispositif selon la revendication 1, caractérisé :

en ce que ladite première plaque comporte trois pluralités de LED, chaque pluralité ayant l'une des couleurs rouge, vert et orangé,

5 en ce que les LED de chaque pluralité sont disposés suivant une surface circulaire,

10 en ce que le diffuseur est formé par une pièce unique de ladite matière, ladite pièce unique ayant sensiblement les mêmes dimensions que ladite première plaque, et

15 en ce qu'une deuxième plaque est constitué par le fond d'un boîtier de forme allongée, de mêmes dimensions que la première plaque, ledit boîtier supportant, intérieurement ladite première plaque, et supportant, sur son pourtour, le diffuseur et, sur la face externe de son fond, des moyens de fixation et de relation électrique ;

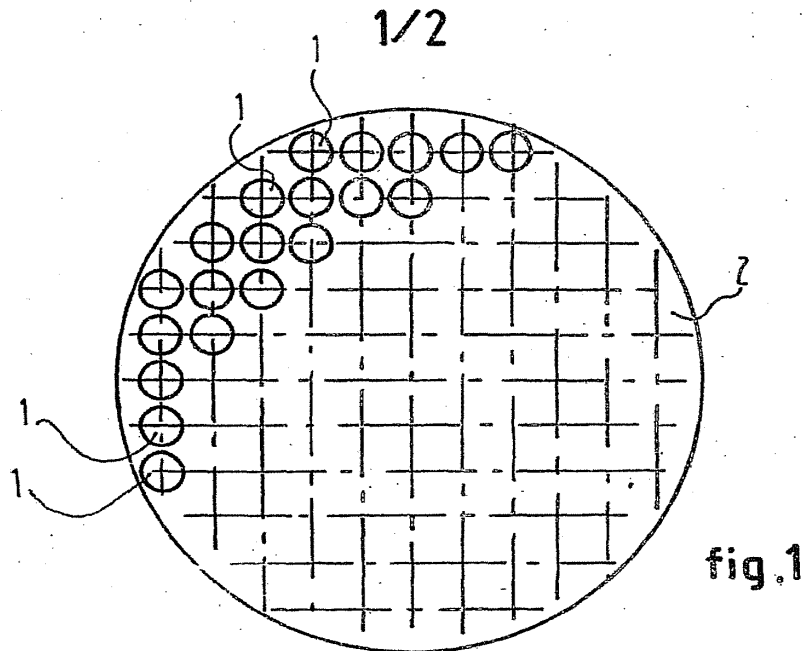
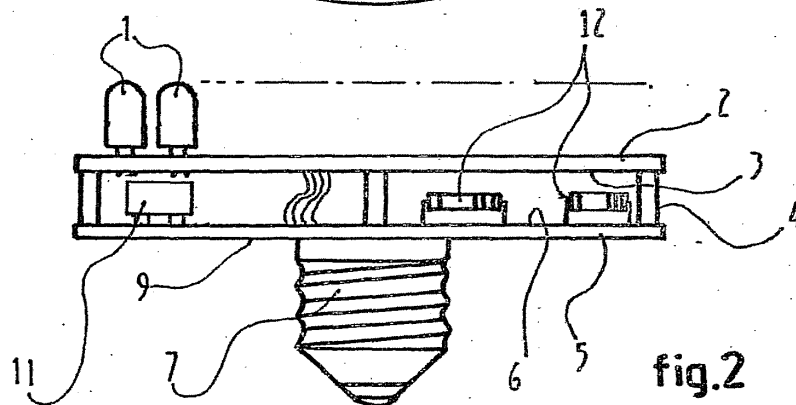
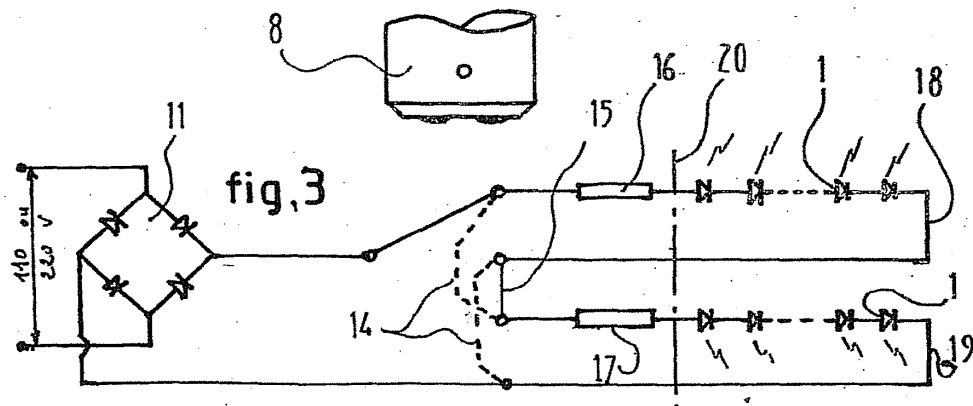
9.- Dispositif selon la revendication 8, caractérisé :

20 en ce que le diffuseur est conformé suivant trois dômes alignés en regard desdites surfaces circulaires des LED ;

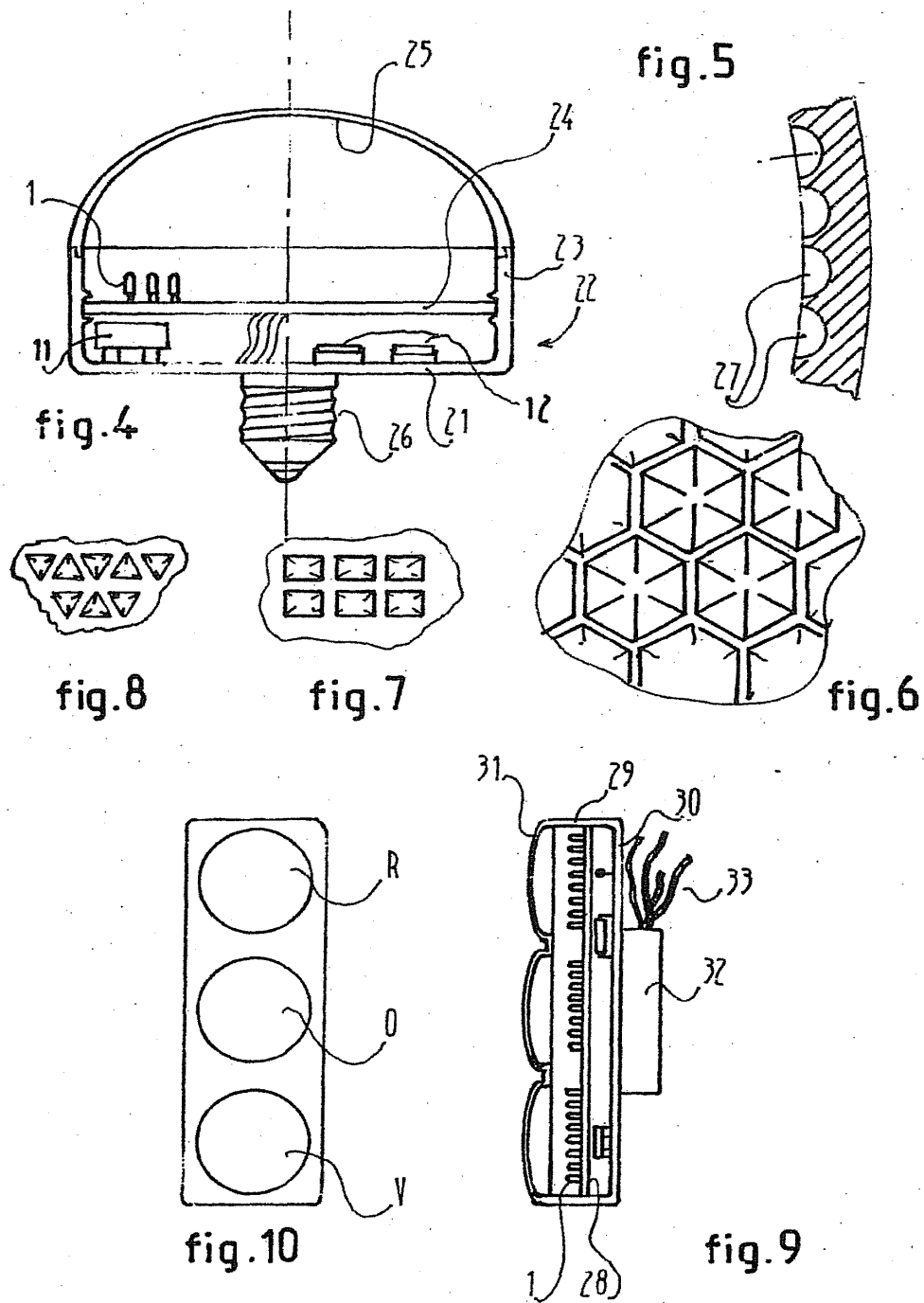
10.-Dispositif selon la revendication 1, caractérisé :

25 en ce que ledit diffuseur incorpore au moins superficiellement une substance fluorescente.

2586844



2/2



This invention is the field of signalling and more precisely to a light-signalling device particularly applicable to fires or similar crossroads.

One knows, on road signs, the use of light emitting diodes (LED) as light sources, we know for example a device in which light LED green and red LEDs draw alongside a pedestrian at a standstill (LED red) and a pedestrian running (Green LED), a device fitted at the entrance to the pedestrian passage across the street. It also knows other forms of such panels flashing light or not indicating speed limit, presence of work, etc. ... In all these applications, LEDs are used without diffuse surface intermediate-and that because of their relatively low light.

This invention has provided two essential goals: to propose a lighting device of a very high reliability to be substituted immediately, the incandescent light bulbs fitted including fires reminder ie those Fire crossroads which are at the height of the motorist, for the immediate, means that it has withdrawn a bulb deteriorated, we can simply put in its place the device object of the invention. Submit a fire reminder of a very high reliability and low thickness intended to replace the current lights recall running through incandescent lamps.

According to the invention, in its generality, a lighting device intended to signal light for traffic, type implementing generators such as light électroluminescents electroluminescent diodes (LED), is characterized mainly in that it is formed by at least one first plurality deLED D arranged on a plate forming the first chassis printed circuit board, means of recovery alternating current to direct current power righted said LED and a broadcaster with a substance substantially transparent, colorless or very low-colored, with broadcaster said at least one side filled with reliefs regular tight against each other and having dimensions substantially the same order of magnitude as the face of output LEDs.

The first goal in] this invention is made by a lighting device with the general feature above-stated and further characterized in that the first plate is circular and a footprint roughly comparable to that of a lamp incandescence, as the first plate is united and maintained spaced at a distance of a second plate of the same size, the space between the two plates used to house those means of recovery and other organs of power, and that said second-plate has on its side the first plate a cap of incandescent lamp.

Preferably, each of these plates is used as a printed circuit, the circuit board of the first plate distributing tension recovered the so-called LED and being printed on the face of the first plate against the second plate, the circuit of the second plate connecting bridge diodes feeding the bridge directly receiving the voltage through the cap, it is clear from this provision that the plates can be used at the same time frame, chassis and other structural elements and " circuit element.

Preferably the plurality of LED itself is divided into two groups équinumérique LED, which makes the system bitension (110 or 220 V) LED of each group being mounted in series and following a formepréférée realizable, LEDs are the type high brightness and the number of LED each group is between 40 and 50.

Preferably ladeuxième plate may finally be time enmêse the back wall of a box cylindrical whose substantive support on its outer face the cap, and whose side supports on its periphery, the broadcaster and its inner surface, said first plate . It is also worth noting that LEDs can be arranged along a curved water.

It should be noted that all the constituent elements (LED, rectifier, resistance, cap) can be fitted on a single plate.

It has been made in the two previous cases advantageous, a light source of a

physical structure and mechanical quite comparable to that of an incandescent ampoule but has the advantage of having known the reliability of LED, is a term life considerably greater than that of an incandescent bulb. It is known that the light emitted by the LED is colored, each bulb LED accordance with the invention will have the corresponding color, red, green or orange to] 'élément signalling which it is associated.

The second goal in this invention is made by a signalling device with the general feature set forth above and characterized further in that the first plate includes a triple multiple LED, each with a plurality of colors red, green and orange, that the plurality of each LED is arranged according to a circular area in what the broadcaster is formed by a single piece of that substance, that single piece with substantially the same size as the first plate, and that a second plate is the bottom of a box elongated, same dimensions as the first plate, said supporting box, inside the first plate, and bearing on its periphery, the broadcaster and on the outer side of basically, means of securing and relationship électrique. De preference, the broadcaster forming cover case has complied with three domes aligned against the circular LED surfaces. This provides a device deignalisation for fires reminder particular, very flat, very simple manufacturing and high reliability as the lifetime of light sources that are pluralities LED.

Broadly speaking, and when the devices of the invention will be used without calling on the colourful traditional broadcasters, the broadcaster, whether incorporated or separated, whether the device replacing a light bulb or whether the signalling device to three fires, should preferably be slightly curved so as to overcome easily ladirectionnalité of light emitted by the LED and at the same time to have a greater solidity and matter who is to be colourless or very low Dye, the latter characteristic has the advantage of éviter l'effet signal ghost due to an external source delumière, sun for example, the presence of lumière émise by this phenomenon will be white light which could not be confused with one of colored lights .

This invention will be better understood and retail relevant apparaitront the description that will be of particular forms of achievement in relation to the figures planks attached, in which

- Fig.1 is a schematic view and deal with a device LED forming a source lumineuse accordance with the invention,
- Fig.2 is a similar illustration of the same side view asec two versions of cul ot,
- Fig.3 is a blueprint electronic wiring LED device of the previous figures, and their food,
- Lafg.4 is a schematic cut a second version of a device similar to that desfig.1 and 2,
- Fig.5 is partial harvest and magnified scale a wall reflector,
- Fig.6, 7 and 8 illustrate different types of reliefs on the inner side reflectors,
- Lafig.9 a cut-east schematic of a device to three fires according to the invention, and
- Fig.10 is a front view dumême.

On lesfig.1 and 2, a light source that can be substituted inferior "incandescent lamp is made in accordance with a 3. 'Invention of a plurality of LED 1 arranged on a plate the first 2 whose inner 3 includes a printed circuit this first plate circular shape is solidarity through spacers such as 4 of a second plate 5 whose inner 6 also includes a printed circuit board, a screw cap is as 7 or 8 as balonnette, dimensions standardized , Is mounted on the outer surface 9 of the second plate the space between the first and second plate is occupied by electronic components such as bridge rectifier 11 and resistance adaptation 12.

On the fig.3 were symbolically represented a bridge rectifier diode 11 can be powered by AC voltage 110 or 220 V, two possibilities cabling 14 and 15 depending on whether the primary voltage is 110 or 220 V, respectively, resistors d'adaptation of intensity 16 and 17 each mounted in series with LED 1 in two circuits, respectively 18 and 19; to fix the ideas, features components are: the rectifier bridge is a bridge to 400 V / 1 A, resistances 16 and 17 are resistance del.200 SI / 3 W and are LED-type à haute brightness and they number 44 for each circuit 18 and 19.

Dashed 20 Joint separates the elements that are above (LED) of the first plate 2 of the above figure, elements (resistance, bridge rectifier, and wiring) are below.

On the fig.4, a device similar to that of previous figures, however, differs in that the second plate is formed by the bottom 21 of a box 22 whose cylindrical sidewall 23 bears on its inner side a plate and 24 its perimeter a broadcaster 25 with an internal relief; plate 24 supports itself LED 1 on one side and their fuel system on the other, while the bottom 21 on one side has a printed circuit bodies for food and the other a screw cap 26 for example. The device, or LED bulb, the fig.4 replaces both the bulb à incandescence and the traditional broadcaster used for example in fires reminder.

On fig.5 to 8, were shown to cut (fig.5) or plan (fig. 6 to 8) different reliefs of the inner side and concave broadcasters and cutting the fig.5 shows the reliefs 27 hollow-shaped half sphere, on the other figures reliefs are hollow points, or polyhedrons, forme hexaédrique (fig.6), tétraédrique (fig.7), triédrique (fig.8). It should be noted that the inner surface of the concave broadcaster is a conformation dome of it.

Since the LEDs emit light of a monochromatic color approaching one of colors required for signing of square ovens, it is unnecessary for the same broadcaster soit lui-colored. It appeared, however, the Applicant. it was advantageous to incorporate, or superficially, either in the mass of broadcaster, a kind of fluorescein dye or eosin to change the color of light emitted by the device and bring lacouleur more conventional lights decarrefours, On fig.9 e 10, a signalling device, including reminder fire crossroads, comprises three groups of LED 1 similar to each group of LED bulbs LED of fig.1 and 4. And mounted on a single plate 28 printed circuit itself dtun camera mounted inside the bottom 29 of which supports 30 agencies feeding the case is closed by a lid 31 to trois dômes forming broadcaster colourless; a bottom plate of boitiersupporte means Fasteners 32 and électrique 33 relationship, each individual des groupes LED emits unelumière color corresponding to its position in the device, namely red (P) for the top group of LED, yellow-orange (o) in the intermediate group and Yellow-green (Vj) for the lower group.

Following the exempleci above, it has involved at least one group of LED a organedi 2fu-ness, either with a certaine configuration, namely that of a fire reminder, it is obvious that without leave del'invention frame can be given to the association other configurations: for example, those letters, deciffres, symbols, normal on signs such as triangles, circles, silhouettes, etc. ...

Although que.l 'has been described and / or represented des firmes special achievement of warning devices conformgs to the invention, it must be understood that the scope of the latter is pas limitée these forms but it extends to any device with the general characteristics set forth above.

CLAIMS

1.- lighting device intended to signalisation light for traffic, type setting work generators light electroluminescent such as electroluminescent diodes (LED), characterized in that it consists of
 -- At least one first multiple LED willing to.

at least a plaque, known as the first, forming a chassis printed circuit,
 -- Means of recovery ac intended to supply current righted said LED and,
 -- Undiffuseur of a substance-substantiellement transparent, colorless or very low colourful said broadcaster with at least one side fitted with reliefs regular tight against each other and with dimensions substantially similar magnitude as the face of exit LED 2.- The method of claim 1 in that those reliefs are intaglio relief under one form l'adoption including geometric spheres and polyèdres

-- The method of claim 1, plus specialment to be substituted in the head signs of a fire or similar crossroads, the light source, usually used in telsux characterised CEQ said in the first Pla that estcirt-xlaire etd'un approximately congestion vement equal to that of an incandescent lamp, ceque in the première plaque is united and maintained spaced a certain distance of a second plate of the same size, the space between the two plates used to accommodate such means of recovery and other organizations NES food, and in that the second pla that includes on its face against the first plate a cap of the filament lamp; 4.- The method of claim 3, wherein: in that each of those pla that is used as a printed circuit, printed circuit of the first plate distributing the tension recovered the so-called LED and is printed on the face of the first plate against the second plate, the plate ladesième circuit linking bridge diodes power that receives Deck directly voltage through cap 5.- The method of claim 4, wherein in that the plurality of LED is itself divided into two-groupes equinumeri de LED question, LED of each group being mounted Series 6.- The method of claim 5, characterized in that the number of LED each group is understood entre 40 and 50, 7.- The method of claim 4, wherein in that the second pla that the east wall of a box cylindrical

whose substantive support on its outer face the cap, and whose side supports on its periphery, the broadcaster and its inner surface, said the first plate 8 .- The method of claim 1: in that the first plate includes three pluralities of LEDs each plurality with a red, green and orange, in that each LED plurality is arranged according to a surface circularly, in that the broadcaster is formed by a single piece of that substance, said single piece with substantially the same dimensions that the first plate, and in a second plate is the bottom of a box-shaped elongated, same dimensions as the first plate, said box supports, said plate internally, bearing on its periphery, the broadcaster and on the outer side of its background, fastenings and electrical relationship. The method of claim 8, characterized in that the broadcaster is in accordance next three domes aligned against desd your surfaces circularly desLED 10.-Operative by revendication1 characterised ceque said a broadcaster in corpore at least superficially a substance fluorescent.

PATENT ABSTRACTS OF JAPAN

(11)Publication number : 05-100106
(43)Date of publication of application : 23.04.1993

(51)Int.Cl.

G02B 3/08
B29C 39/10
G02B 1/04
G02B 3/06
G03B 21/62
// B29L 11:00

(21)Application number : 03-289341

(71)Applicant : DAINIPPON PRINTING CO LTD

(22)Date of filing : 08.10.1991

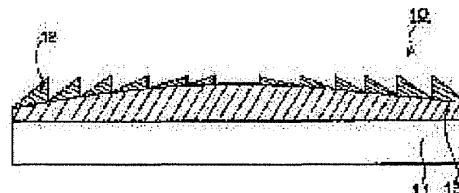
(72)Inventor : HONDA MAKOTO

(54) FRESNEL LENS SHEET AND PRODUCTION THEREOF

(57)Abstract:

PURPOSE: To improve a yield by reducing the consumption of costly UV resins, etc., enhancing productivity and ameliorating the adhesion defect to a transparent substrate by the deformation or strains of a lens by volumetric shrinkage on curing of the UV resin, etc.

CONSTITUTION: This Fresnel lens consists of the substantially transparent substrate 11, a Fresnel lens part 12 which is formed to a Fresnel lens shape by a UV and/or radiation curing type resin on the substrate and an intermediate resin layer 13 which is formed of the UV and/or radiation curing type resin between the substrate and the bottom of the Fresnel lens part to the thickness gradually decreasing from the central part toward the peripheral part.



(19) 日本国特許庁 (J P)

(12) 公開特許公報 (A)

(11) 特許出願公開番号

特開平5-100106

(43) 公開日 平成5年(1993)4月23日

(51) Int.Cl. ⁵	識別記号	序内整理番号	F I	技術表示箇所
G 0 2 B 3/08		8106-2K		
B 2 9 C 39/10		2126-4F		
G 0 2 B 1/04		7132-2K		
3/06		8106-2K		
G 0 3 B 21/62		7316-2K		

審査請求 未請求 請求項の数 6 (全 10 頁) 最終頁に続く

(21) 出願番号 特願平3-289341

(22) 出願日 平成3年(1991)10月8日

(71) 出願人 000002897

大日本印刷株式会社

東京都新宿区市谷加賀町一丁目1番1号

(72) 発明者 本田 誠

東京都新宿区市谷加賀町一丁目1番1号

大日本印刷株式会社内

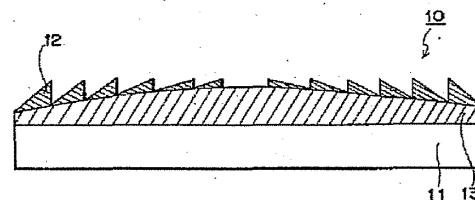
(74) 代理人 弁理士 鎌田 久男

(54) 【発明の名称】 フレネルレンズシートとその製造方法

(57) 【要約】

【目的】 高価なUV樹脂等の使用量を減らし、かつ、生産性を上げるとともに、そのUV樹脂等の硬化に伴う体積収縮によるレンズの変形又は歪による透明基板との密着性不良を改善し、歩留まりの向上を図る。

【構成】 実質的に透明な基板11と、基板の上に紫外線及び/又は放射線硬化型樹脂によりフレネルレンズ形状に形成したフレネルレンズ部12と、基板とフレネルレンズ部の底部の間に、前記紫外線及び/又は放射線硬化型樹脂により、その厚みが中央部から周辺部に行くに従って徐々に薄くなる中間樹脂層13とからなる。



【特許請求の範囲】

【請求項1】 実質的に透明な基板と、

前記基板の上に紫外線及び／又は放射線硬化型樹脂によりフレネルレンズ形状に形成したフレネルレンズ部とからなるフレネルレンズシートにおいて、

前記基板と前記フレネルレンズ部の底部の間に、前記紫外線及び／又は放射線硬化型樹脂により、その厚みが中央部から周辺部に行くに従って徐々に薄くなる中間樹脂層を設けたことを特徴とするフレネルレンズシート。

【請求項2】 前記基板のフレネルレンズ部と反対側の面に、レンチキュラーレンズ又はプリズムが形成されていることを特徴とする請求項1に記載のフレネルレンズシート。

【請求項3】 前記基板は、屈折率が前記フレネルレンズ部の樹脂の屈折率と異なり、かつ、フレネルレンズ部側の面にレンチキュラーレンズ又はプリズムが形成されていることを特徴とする請求項1に記載のフレネルレンズシート。

【請求項4】 前記基板は、湾曲していることを特徴とする請求項1～請求項3に記載のフレネルレンズシート。

【請求項5】 フレネルレンズ形状の型が設けられた成形型の略全面に、紫外線及び／又は放射線硬化性の第1の樹脂を塗布する第1の樹脂塗布工程と、

前記成形型の側端部又は側端部及び両端部に、前記第1の樹脂と略屈折率の等しい第2の樹脂の樹脂溜まりを形成する第2の樹脂塗布工程と、

前記第2の樹脂を均しながら加圧ロールによって実質的に透明な基板を前記第1の樹脂に積層する均し積層工程と、

紫外線及び／又は放射線を照射して前記樹脂を硬化させる樹脂硬化工程と、

前記樹脂を離型する離型工程とを順に行ってなり、前記加圧ロールは、中央部が凹状となった状態で加圧することを特徴とするフレネルレンズシートの製造方法。

【請求項6】 前記第1の樹脂は、前記第2の樹脂よりも粘度が低い状態で塗布することを特徴とする請求項5に記載のフレネルレンズシートの製造方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は、紫外線及び／又は放射線硬化樹脂を用いて成形したプロジェクションスクリーン用のフレネルレンズシートに関するものである。

【0002】

【従来の技術】従来、この種の紫外線（UV）及び／又は放射線硬化樹脂を用いたフレネルレンズシートについては、さきに本件発明者等は、透明基板にフレネル以外の他の要素を付加した特開昭63-82401号、63-132227号、63-163329号、63-186224号、63-191140号、連続生産による生

産性向上をめざした特開昭63-134227号、光学要素の付加された連続生産をめざした特開昭63-162224号、UV樹脂の生産性の良い脱泡に関する特開昭64-7001号、64-86102号、接着性及び取り扱い性の良い透明基板に関する特開平2-63035号の提案を行ってきた。

【0003】また、特開昭58-33429号、61-114232号、61-114233号、61-116338号、61-164807号、61-167506号、61-177215号、61-182908号、61-219610号、61-219611号、61-248707号、61-248708号、62-33613号、62-62716号、62-90634号、62-161532号、62-161533号、63-16330号、特開平1-192529号、1-192530号、1-192531号、1-142901号、1-285332号、1-298302号、2-119201号、2-2406022号、2-22901号、2-193102号、2-80432号、2-157801号、2-157801号、2-157702号、2-132402号、2-240601号、2-102031号、2-32301号、3-9301号、3-122601号、3-101907号、3-98040号、3-81753号、3-81702号、3-35535号、3-80202号、3-80201号、3-75703号、3-75702号、3-75701号、3-73319号、3-54502号、3-54501号、3-46601号、3-45902号、3-45901号等にもUV樹脂を用いたフレネルレンズの記載がなされている。

【0004】従来のフレネルレンズシートは、①透明基板81の表面に金型を突き当てるようにしてフレネルレンズ部82を形成したもの（図8参照）、②透明基板91の表面と金型の凸部（すなわちフレネルレンズ部82の谷部）に、UV樹脂層83による均一なギャップを形成したもの（図9参照）に大別される。

【0005】

【発明が解決しようとする課題】しかし、前記①の場合には、実質的にフレネルレンズ部82の鋸歯状の部分が各溝部で分割されていることになり、UV硬化樹脂が硬化するときに、体積収縮が起こるので、鋸歯状の部分の成形が完全に行われず、成形不良を生じるうえ、鋸歯状部分の樹脂が分離して、透明基板81から剥離しやすいという問題があった。

【0006】また、前記②の場合には、UV樹脂層83を設けるので、透明基板81とフレネルレンズ部82との接着性は改善されるが、UV硬化樹脂の使用量の増加によるコストアップと、反応熱の増加に起因した樹脂粘度の低下によって、加圧条件の制御が困難になり、成形不良が発生するという問題があった。

3

【0007】さらに、UVランプの強度分布が中央部で強く、周辺部で弱いものに対して、従来の鋸歯状の部分は、中央部より周辺部で厚く（図8、図9参照）、これを十分に硬化させるためには、UVランプ自体のパワーをアップする必要がある、また、UVランプの発熱量は端部で大きく、中央部で小さいので、パワーアップをすることはレンズ周辺部での硬化時の温度を非常に高くすることになる。このように、硬化温度が部分的に不均一になることは、UV樹脂粘度が部分的に不均一になることを意味し、一定のニップ圧で加圧した場合でも、粘度の低下部分では圧力が十分にかからないことになり成形不良が生じる可能性がある。

【0008】また、図10に示すように、従来のフレネルレンズシート80をレンチキュラーレンズシートなどの他のレンズシート90と密着させて使用する場合に、レンズ中央部が凹状になってしまうので、密着性が悪いという問題があった。

【0009】本発明の目的は、前述の課題を解決して、高価なUV樹脂等の使用量を減らし、かつ、生産性を上げるとともに、そのUV樹脂等の硬化に伴う体積収縮によるレンズの変形または歪みによる透明基板との密着性不良を改善し、歩留まりの向上を図ることができるフレネルレンズシートとその製造方法を提供することである。

【0010】

【課題を解決するための手段】本発明によるフレネルレンズシートは、実質的に透明な基板と、前記基板の上に紫外線及び／又は放射線硬化型樹脂によりフレネルレンズ形状に形成したフレネルレンズ部とからなるフレネルレンズシートにおいて、前記基板と前記フレネルレンズ部の底部の間に、前記紫外線及び／又は放射線硬化型樹脂により、その厚みが中央部から周辺部に行くに従って徐々に薄くなる中間樹脂層を設けた構成としてある。

【0011】この場合に、前記基板のフレネルレンズ部と反対側の面に、レンチキュラーレンズ又はプリズムが形成されていることを特徴とすることができる。また、前記基板は、屈折率が前記フレネルレンズ部の樹脂の屈折率と異なり、かつ、フレネルレンズ部側の面にレンチキュラーレンズ又はプリズムが形成されていることを特徴とすることができる。さらに、前記基板は、湾曲していることを特徴とすることができる。

【0012】一方、本発明によるフレネルレンズシートの製造方法は、フレネルレンズ形状の型が設けられた成形型の略全面に、紫外線及び／又は放射線硬化性の第1の樹脂を塗布する第1の樹脂塗布工程と、前記成形型の側端部又は側端部及び両端部に、前記第1の樹脂と略屈折率の等しい第2の樹脂の樹脂溜まりを形成する第2の樹脂塗布工程と、前記第2の樹脂を均しながら加圧ロールによって実質的に透明な基板を前記第1の樹脂に積層する均し積層工程と、紫外線及び／又は放射線を照射し

4

て前記樹脂を硬化させる樹脂硬化工程と、前記樹脂を離型する離型工程とを順に行ってなり、前記加圧ロールは、中央部が凹状となった状態で加圧する構成としてある。

【0013】この場合に、前記第1の樹脂は、前記第2の樹脂よりも粘度が低い状態で塗布することを特徴とすることができる。

【0014】

【作用】本発明によれば、透明基板上に紫外線及び／又は放射線硬化樹脂によりフレネルレンズ部を形成するときに、フレネルレンズ部の中央からレンズ周辺部に向かって紫外線及び／又は放射線硬化樹脂の中間樹脂層の膜厚（フレネルレンズ部の谷部から透明基板までの厚さ）が徐々に小さくなる。

【0015】この中間樹脂層は、加圧ロールを、中央部が凹状となるようにクラウニングするか、又は、加圧ロールとして、表面硬度が低く、加圧によりベンディングが生じてロール中央部が凹状に変形するものを用いることにより、製造することができる。

【0016】

【実施例】以下、図面等を参照して、実施例につき、本発明を詳細に説明する。図1は、本発明によるフレネルレンズシートの実施例を示した模式図、図2は実施例に係るフレネルレンズシートを他のレンズシートと組み合わせた例を示した模式図である。この実施例のフレネルレンズシート10は、基板11と、フレネルレンズ部12と、中間樹脂層13とから構成されている。

【0017】基板11は、フレネルレンズ部12の支持体としてレンズシート10の一部を構成するとともに、紫外線及び／又は放射線を透過する実質的に透明な板であればよく、アクリル、ポリカーボネイト等のシート又はフィルムを使用することができる。なお、この基板11には、塩化ビニル／酢酸ビニル共重合体系、ウレタン系、ブチラール系、アクリル系等の接着性向上のためのプライマ層を設けることができる。また、基板11は、湾曲していてもよい。基板11を湾曲させると、図11に示すように、フレネルレンズシート41をレンチキュラーレンズシート42等の他のシートと組み合わせるプロジェクションスクリーンを構成する場合に、他のシートと湾曲させる曲率を変えておいて、これを重ね合わせ両者を周辺部において粘着テープ43等により固定することにより、環境の変化で各シートに伸縮が生じてもシート間に隙間が発生するのを防止することができる。この基板11は、予め基板の樹脂の熱変性温度以上の加工条件で湾曲させておくと、従来行われていたようなレンズの形成後に熱変性温度以下で湾曲した形状に加工する場合に比べて長期的に安定な形状が維持できる。

【0018】フレネルレンズ部12は、紫外線及び／又は放射線硬化型樹脂によりフレネルレンズ形状が形成されている部分である。この紫外線及び／又は放射線硬化

5

型樹脂としては、例えば、ウレタンアクリレート、エポキシアクリレート、ポリエステルアクリレート、ポリエーテルアクリレート、メラミンアクリレート等のアクリロイル基をもつ重合性オリゴマー、モノマーと、アクリル酸、アクリルアミド、アクリロニトリル、スチレン等重合性ビニル基をもつ重合性オリゴマー、モノマー等の単体あるいは配合したものや、これらに増感剤等を加えたもの、さらに消泡剤、レベリング剤、安定剤、難燃剤、離型剤等を加えたものを用いることができる。

【0019】この紫外線及び／又は放射線硬化型樹脂は、表面強度や硬度等の一般機械物性を高くするために、多官能基をもつモノマーまたはプレポリマーを使用するほうがよく、実際にも2官能基以上のものが好ましく使用される。また、紫外線及び／又は放射線硬化型樹脂には、拡散剤を含ませることができる。拡散剤は、コーティング適性を向上させるとともに、重合収縮を防止することができ、さらに、拡散性を付与することができる。拡散剤としては、ガラス、シリカ、アルミナ、不溶性プラスチック、タルク等を用いることができる。

【0020】中間樹脂層13は、基板11とフレネルレンズ部12の底部の間に、前述した紫外線及び／又は放射線硬化型樹脂により、その厚みが中央部から周辺部に行くに従って徐々に薄くなる層である。この中間樹脂層13を設けることにより、ひけ状の欠陥が防止できる。この中間樹脂層13の厚みは、10 μ m以上であることが好ましい。この理由は、実験結果等から考察すると、10 μ m未満の樹脂層の場合には、ひけ状の不良があるが、10 μ m以上の場合には発生しないからである。ただし、この値はUV樹脂の種類（硬化収縮率、粘度等）により多少異なる。厚みの変化に付いては、UV樹脂の硬化に伴う発熱量と、UVランプの発熱量分布により変える必要がある。一例としては、アクリルウレタン系UV樹脂（粘度2000cP、重合収縮率8%）、50インチサイズの場合には、UV樹脂の厚みは端部が10 μ m、中央部が30 μ m程度が良好であった。

【0021】このフレネルレンズシート10は、基板11のフレネルレンズ部12と反対側の面10aに、レンチキュラーレンズ又は光軸屈折用プリズムレンズを形成することができる。例えば、レンズのピッチが0.1mmの垂直方向拡散レンチキュラーレンズ（拡散角5°）を形成した場合では、垂直方向の拡散を大きくできるとともに、フレネルレンズシート内の内部反射光による迷光が、垂直方向拡散レンチキュラーレンズ面で拡散されるので、いわゆるレインボーが防止できる。また、例えばレンズピッチが0.1mmの水平方向プリズムを形成すると、光軸の補正ができるとともにフレネルレンズのセンターシフトをする必要がなくなるので、高価なフレネルレンズ成型型を大きくしないで済む。また、ロールニップの場合には、成型型を、縦にしても横にしても、フレネルレンズの中心は常にロールの中心と一致するの

6

で、成型型の縦及び横置きを混用してもよいので、サイズの異なる成型型をいくつか連続して流すようなラインの場合によい。なお、フレネルレンズの中心とロールの中心とが一致しない場合には、成型型の位置を、フレネルレンズの中心とロールの中心と一致するようにコントロールする必要がある。さらに、基板11の屈折率をフレネルレンズ部12の樹脂の屈折率を変えておき、かつ、基板のフレネルレンズ部を形成する面にレンチキュラーレンズ又はプリズムを形成しておくことでレンチキュラーレンズ、プリズムレンズのどちらにしても、拡散面がフレネルレンズ部12の面に近いので、基板11の裏面に設けるよりも解像度が上がる。

【0022】また、図2に示すように、他のレンズシート20と組み合わせて使用することができる。この場合には、他のレンズシート20としては、レンチキュラーレンズシート又は光軸屈折用プリズムレンズシートなどがあげられるが、通常のプロジェクションスクリーンにおいては、水平拡散用レンチキュラーレンズシートが最も良く用いられる。このフレネルレンズシート10は、フレネルレンズ部12の山部が同一平面になるので、他のレンズシート20との密着性が向上する。また、基板11の屈折率は、フレネルレンズ部12の樹脂の屈折率とは同一にしないとも良い。基板11は紫外線又は放射線の透過性が良ければよく、例えば、基板11はTVセット組立て時に必要な機械的強度（腰の強さ）や難燃性、耐衝撃性を主に考慮して選定すれば良く、紫外線及び放射線硬化型樹脂は、屈折率、耐摩擦性、成型性を主として選定すれば良い。

【0023】図3～図5は、本発明によるフレネルレンズシートの製造方法の実施例を示した図であって、図3は工程図、図4は各工程を示した模式図、図5は均し積層工程を示した模式図である。次に、このレンズシートの製造方法は、図3に示すように、第1の樹脂塗布工程101と、第2の樹脂塗布工程102と、均し積層工程103と、樹脂硬化工程104と、離型工程105とから構成されている。

【0024】第1の樹脂塗布工程101は、フレネルレンズ形状の型が設けられた成型型31の略全面に、紫外線及び／又は放射線硬化性の第1の樹脂12Aを塗布する工程である。この工程は、成型型31の濡れ性を均一化するとともに、塗布量の安定化を図り、さらに、次工程102での脱泡を促進するための工程である。具体的には、ロールコート法、シルクスクリーン法、カーテン法、グラビア法、スクイーピング法等により実施することができる。

【0025】第2の樹脂塗布工程102は、成型型31の側端部又は側端部及び両端部に、第1の樹脂12Aと略屈折率の等しい第2の樹脂13Aの樹脂溜まりを形成する工程である。この工程における紫外線及び／又は放射線硬化性樹脂は、ラミネートする基板11と成型型間

に入り込む気泡を押し出すとともに、基板12との接着性を持たせる働きをする。この第2の樹脂13Aの樹脂溜まりを形成する方法としては、ロールコート法、カーテンコート法、ノイズコート法等の方法をとることができる。

【0026】均し積層工程102は、第2の樹脂13Aを均しながら加圧ロール32によって実質的に透明な基板11を第1の樹脂12Aに積層する工程である。この工程は、透明な基板11を加圧ロール32側端部のほうだけ成形型31に接するように積層して、基板11の上と成形型31の下から加圧ロール32、33で加圧してラミネートしていくことにより、樹脂12A、13A内および成形型31のレンズパターン型の谷の間に入り込む気泡を押し出すとともに、成形物の厚みを均一にする働きをする。なお、基板11は、湾曲しているものを使用することができる。

【0027】樹脂硬化工程103は、紫外線及び／又は放射線を照射して前記樹脂を硬化させる工程である。この工程では、紫外線及び／又は放射線を照射することにより、前記樹脂12A、13Aを硬化させるが、この際、加圧ロール32、33の加圧部にできるだけ光源34を近づけることが好ましい。これは、成形型31と基板11間の浮き上がりや、それらの間に気泡が再混入するのを防止するためである。離型工程104は、成形型31から前記樹脂12A、13Aを離型する工程である。

【0028】この実施例では、図4の(c)に示した加圧ロール32は、表面硬度が低く、図5に示すように、加圧によりベンディングが生じ、ロール中央部が凹状に変形するものが使用されている。このようにして塗布すると、第1の樹脂12A、第2の樹脂13Aの量が図6(A)に示すように、中央部から周辺部に行くに従って徐々に少なくなる。図6(B)、(C)には、図8、図9に示した従来のフレネルレンズシートのUV樹脂の塗布量を示してある。なお、加圧ロール32は、あらかじめ中央部が凹状となるようにクラウニングされているものを使用してもよい。

【0029】均し積層工程103では、図12に示すように、加圧ロール32と基板11との間に、カバーフィルム35を挟みながら、均し積層することができる。こうすることにより、成形型31と基板11の間から溢れた樹脂等による汚れが加圧ロール32に付着して、後から成形される製品に汚れが転写されるのを防止することができる。特に、加圧ロール32としてスポンジロールを用いた場合には有効である。

【0030】図7は、UVランプ強度及びUVランプの発熱量の分布を示した概念図である。図7に示すように、UVランプの発熱量（破線で示してある）は、ランプの端部が大きく、中央部が小さい。図6(B)、(C)に示した従来のフレネルレンズシート80B、8

0Aは、UV樹脂量82A+83A、82Aが端部ほど多くなっていたので、硬化に伴う反応熱も端部ほど大きくなり、UVランプの発熱との相乗効果で成形型の温度の不均一性が増すことになっていた。本願においては、図6(A)に示すように、UV樹脂量12A+13Aは、中央部から周辺部に行くに従って徐々に小さくなり、これにより端部ほど硬化に伴う反応熱が小さくなり、UVランプの発熱強度分布と逆の分布を示すので、成形型の温度の不均一性をより小さくすることができる。

【0031】樹脂硬化工程104では、加圧ロール32と平行となるように紫外線及び／又は放射線の光源34を配置してある。基板1に樹脂12A、13Aを接合するときに、温度分布にムラがあると、樹脂13Aの粘度もそれに応じて部分的に異なるので、得られるフレネルレンズシート10の板厚にもムラがでると共に、UV樹脂12A、13Aの厚みの薄い部分に、ひけた状態の成形不良が発生する。特に、加圧ロール32、33を用いたニッピングにより積層した場合や基板11が薄い場合には顕著である。

【0032】また、樹脂硬化工程104では、基板11のフレネルレンズ部12と反対側の面に、オゾン非透過性の被覆フィルムをマスキングすることが好ましい。こうすることにより、紫外線により発生するオゾンが、基板を劣化させ基板の表面強度を低下させることを防止できる。

【0033】第1の樹脂12Aの物性としては、成形型31への転写性、脱泡性、成形型31に対する濡れ性、表面硬化性が重視され、第2の樹脂13Aとしては、基板11との接着性、流動性が重視される。

【0034】また、第1の樹脂12Aは、第2の樹脂13Aよりも粘度が低い状態で塗布することが好ましい。つまり、第1の樹脂12Aは、200センチポイズ以下に調整された低粘度のものが好ましく、第2の樹脂13Aは、500～5000センチポイズに調整された比較的高い粘度のものが使用される。この理由は、第1の樹脂12Aは、成形型31の微細なレンズパターンとの間に気泡を含まないように全面に塗布するので粘度は低くなければならない、第2の樹脂13Aは、均しながら塗布して樹脂内の気泡を追い出すのである程度粘度が高くななければならないからである。このように、第1の樹脂12Aの層を形成することにより、成形型31の界面での脱泡性がより向上する。

【0035】また、樹脂12A、13Aを2層にすることにより、成形型31、基板11あるいは成形されたフレネルレンズシート10自体の各部に対応するそれぞれの機能をより有効に果たすことができるとともに、それらの機能を2層に分けることで樹脂選択の幅を広げることができる。

【0036】次に、各樹脂12A、13Aの選択条件を

さらに説明する。フレネルレンズシート10の場合には、少なくとも両者の屈折率は略等しいことが要求される。これは、第1の樹脂12Aと第2の樹脂13Aとが積層された界面は、必ずしもフラットになるとは限らないので、2つの樹脂の屈折率が大きく異なると、均一な光が得られなくなるためである。

【0037】この関係を満たせば、第1の樹脂12Aと第2の樹脂13Aとは、同一の材質であってもよいし、異なる材質のものであってもよい。異なる樹脂の場合には、略屈折率の等しい組み合わせのものを、物性を考慮して用いればよく、例えば、第1の樹脂12Aとして成形型再現性のよいウレタンアクリレート樹脂を用い、第2の樹脂13Aとして基板11との密着性のよいエポキシアクリレート樹脂を用いることができる。また、第1の樹脂12Aと第2の樹脂13Aの加工工程における樹脂温度を変化させるとか、添加剤（消泡剤、レベリング剤等）、溶剤等を添加するとか、あるいは、第1の樹脂12Aと第2の樹脂13Aのモノマー、オリゴマー等の配合比を変化させるとかして成形型に対する濡れ性、流動性、粘性等を適性に調整すればよい。

【0038】さらに、第1の樹脂12Aと第2の樹脂13Aの双方または一方に、前述のような拡散剤を含ませることができる。

【0039】（製造例）最後に、図4を参照しながら、具体的な製造例を挙げて説明する。まず、図4（a）に示すように、縦横1mで、ピッチ0.1mmのフレネルレンズ形状の成形型31に、屈折率1.49、粘度を、3000センチポイズのウレタンアクリレートを酢酸エチルで希釈することにより20センチポイズに調整したUV硬化樹脂をスクイーピング法により厚さ100μmに塗布した後、80℃のオーブンにて90秒間乾燥して希釈溶剤を除去して第1の樹脂12Aの層を形成した。ついで、図4（b）に示すように、第2の樹脂13Aを成形型31の左端（ロール32側）にノズルコート法により滴下し、1.0g/cm²の樹脂溜まりを形成した。第2の樹脂13Aとしては、屈折率1.49、粘度3000センチポイズの希釈溶剤を含まないウレタンアクリレート系のUV硬化樹脂を用いた。さらに、図4（c）に示すように、透明基板11として、アクリル樹脂を押し出してシート状にロール成形すると同時に、ナイロンフィルムに塩化ビニル/酢酸ビニル共重合体系プライマーを塗布した転写フィルムを貼り合わせしてプライマーをアクリルシートに転写するとともに、成形時のロール温度を制御することにより曲率半径が6000mmになるように曲げ加工した、紫外線透過性のある厚さ3.0mmのアクリル板を積載し、厚さ15mmにスポンジを巻いた加圧ロール32、33を速度50cm/minで転動して加圧した。このとき、図中Aで示す部分で、成形型31と基板11の間に入る気泡を押し出し

【0040】この際、基板11側からUV光源34を用いて、160W/cmで紫外線（UV）を照射し、第1の樹脂12Aと第2の樹脂13Aを硬化した。最後に、図4（d）に示すように、成形型31を解離型して、弓形に湾曲したフレネルレンズシート10を得た。

【0041】このフレネルレンズシート10は、基板11とフレネルレンズ部12の底部の間に、UV樹脂により、その厚みが中央部から周辺部に行くに従って徐々に薄くなる中間樹脂層13が形成されていた。フレネルレンズ部12、特に表面には、気泡を混入しておらず、同サイズのレンチキュラーレンズシート（板厚1.25mm）と組み合わせて使用した結果、密着性のよいものであった。

【0042】

【発明の効果】本発明によれば、以下のような種々の効果がある。第1に、中間樹脂層の厚みは、フレネルレンズ部の鋸歯状部の体積の小さい中央部では厚く、体積の大きい端部では薄いため、体積収縮によるレンズ欠陥、接着力の低下がなく、しかもUV硬化樹脂等の使用量が少なくて済む。

【0043】第2に、UVランプのUV強度分布は、中央部が強く、端部が弱いので、従来はUV樹脂量がフレネル端部ほど多くなると、フレネル端部の反応に必要なUV強度を得ようとする、ランプ容量を大きくする必要があったが、本発明によれば、UV樹脂は、フレネルレンズ部の中央部で多く、端部で少なくなるので、反応に必要なUV強度分布が一致するので、UVランプの容量が小さくて済み、成形型温度の上昇も小さくて済む。

【0044】第3に、UVランプによる発熱は、ランプの端部が大きく、中央部が小さいので、従来はUV樹脂量がフレネルレンズ部の端部ほど多くなると、硬化に伴う反応熱も端部ほど大きくなり、成形型の温度の不均一性が増すことになっていたが、本発明によれば、端部ほど硬化に伴う反応熱が小さいので、成形型の温度の不均一性が向上する。

【0045】第4に、本発明によれば、UV樹脂量の厚み分布のコントロールは、クラウニング又はベンディングを生じやすい加圧ロールを使用して、均し積層工程を行うので、厚み分布を得るための成形型のベンディング加工や、塗布量の微妙なコントロールの必要がなく、生産性、作業性に優れている。

【0046】第5に、レンチキュラーレンズシート等の他のレンズシートとセットしたときに、フレネルレンズシートはシャープな形状を持っているので、レンチキュラーレンズシート等との摩擦によって、フレネルレンズ部の端部が欠けやすいが、従来は中央部に比較して端部の突出する量が大きかったため、傷つきやすかったが、本発明では端部の突出量が減り、傷つきにくくなった。

【図面の簡単な説明】

11

【図1】本発明によるフレネルレンズシートの実施例を示した模式図である。

【図2】実施例に係るフレネルレンズシートを他のレンズシートを組み合わせた例を示した模式図である。

【図3】本発明によるフレネルレンズシートの製造方法の実施例を示した工程図である。

【図4】図3の各工程を示した模式図である。

【図5】図4の均し積層工程を示した模式図である。

【図6】実施例に係るフレネルレンズシートの製造方法のUV硬化樹脂の塗布量を示した概念図である。

【図7】実施例に係るフレネルレンズシートの製造方法のUVランプの発熱及びUV強度分布を示した線図である。

【図8】フレネルレンズシートの従来例を示した模式図である。

【図9】フレネルレンズシートの従来例を示した模式図である。

12

【図10】従来のフレネルレンズシートを他のレンズシートを組み合わせた例を示した模式図である。

【図11】実施例に係るフレネルレンズシートを他のシートと組み合わせてプロジェクションスクリーンを構成する場合を示した模式図である。

【図12】図4の均し積層工程の他の実施例を示した模式図である。

【符号の説明】

10 フレネルレンズシート

11 基板

12 フレネルレンズ部

13 中間樹脂層

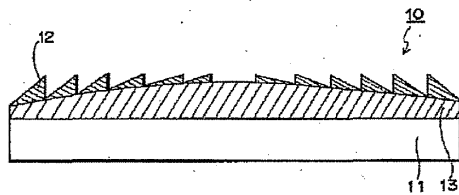
20 他のレンズシート

31 成形型

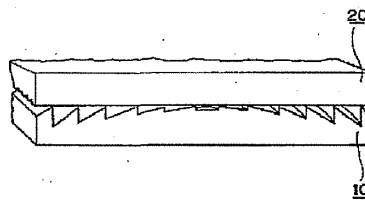
32, 33 加圧ロール

34 光源

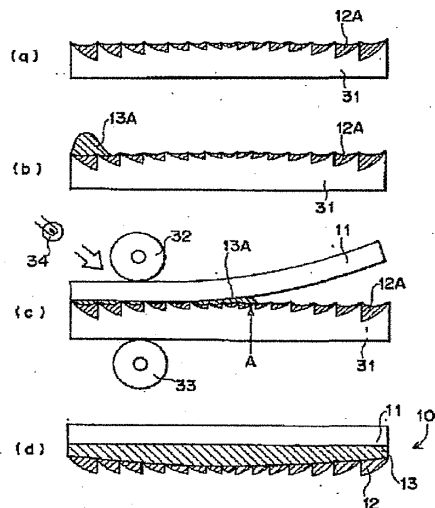
【図1】



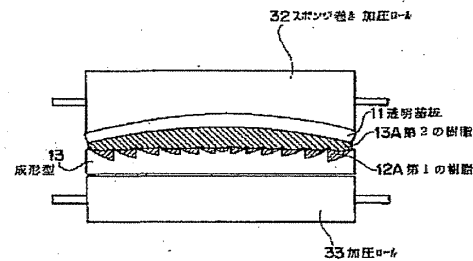
【図2】



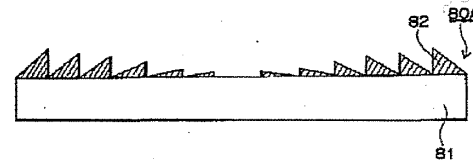
【図4】



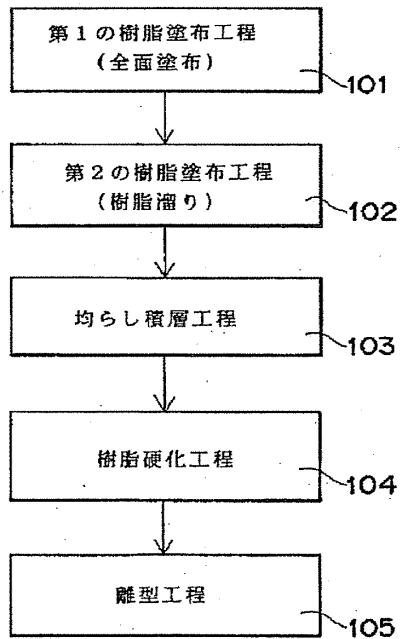
【図5】



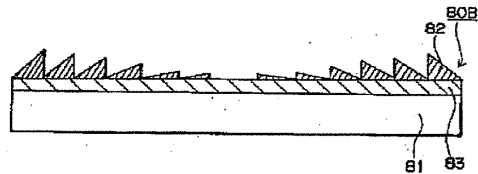
【図8】



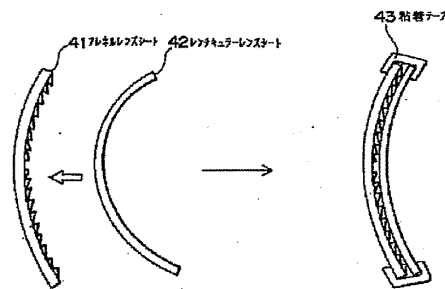
【図3】



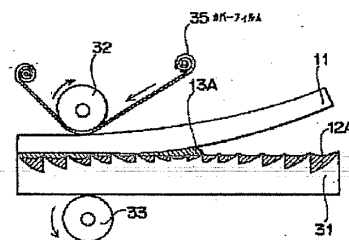
【図9】



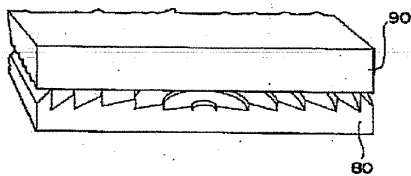
【図11】



【図12】



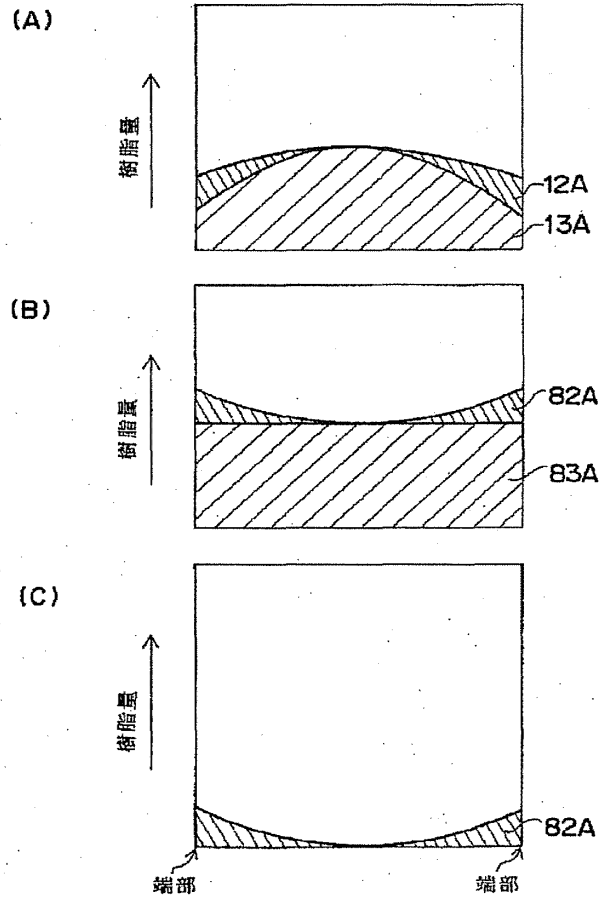
【図10】



(9)

特開平5-100106

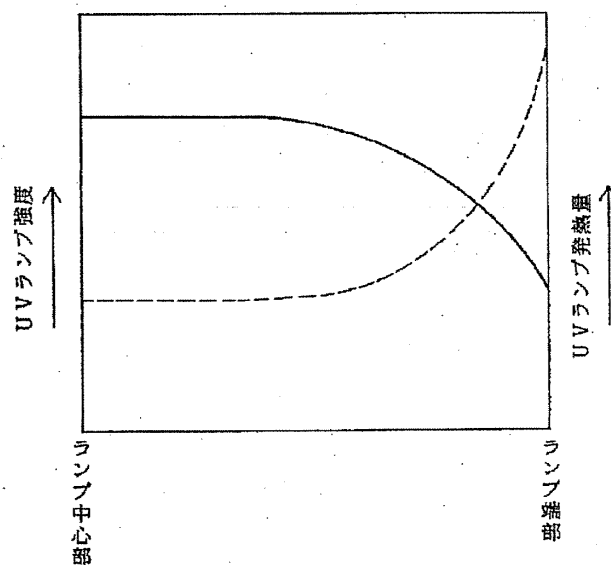
【図6】



(10)

特開平5-100106

【図7】



フロントページの続き

(51) Int. Cl.⁵

// B 2 9 L 11:00

識別記号

庁内整理番号

4F

F I

技術表示箇所

* NOTICES *

JP0 and INPIT are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

CLAIMS

[Claim(s)]

[Claim 1]In an Fresnel lens sheet characterized by comprising the following, An Fresnel lens sheet providing an intermediate resin layer which becomes thin gradually with said ultraviolet rays and/or radiation-curing type resin as the thickness goes to a periphery from a center section between said substrate and a pars basilaris ossis occipitalis of said Fresnel lens section.

A substantially transparent substrate.

An Fresnel lens section formed with ultraviolet rays and/or radiation-curing type resin on said substrate at Fresnel lens shape.

[Claim 2]The Fresnel lens sheet according to claim 1, wherein a lenticular lens or prism is formed in an Fresnel lens section of said substrate, and a field of an opposite hand.

[Claim 3]The Fresnel lens sheet according to claim 1, wherein a lenticular lens or prism is formed [as for said substrate] in a field by the side of an Fresnel lens section for a refractive index unlike a refractive index of resin of said Fresnel lens section.

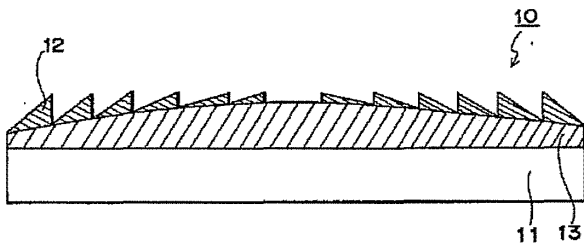
[Claim 4]The Fresnel lens sheet according to claim 1 to 3, wherein said substrate is curving.

[Claim 5]The 1st resin application process that applies the 1st resin of ultraviolet rays and/or radiation-curing nature to an approximately whole area of a die with which a mold of Fresnel lens shape was formed, The 2nd resin application process that forms a resin rich area ball of said 1st resin and the 2nd resin with an equal abbreviated refractive index in a side edge part or a side edge part, and both ends of said die, a transparent substrate is substantially laminated to said 1st resin with a pressure roll, leveling said 2nd resin - it leveling and with a laminating process. A manufacturing method of an Fresnel lens sheet performing in order a resin curing process which irradiates with ultraviolet rays and/or radiation and stiffens said resin, and a release process which releases said resin from mold, and pressurizing said pressure roll after a center section has become a concave.

[Claim 6]A manufacturing method of the Fresnel lens sheet according to claim 5 applying said 1st resin in the state where viscosity is lower than said 2nd resin.

[Translation done.]

Drawing selection Representative drawing 



[Translation done.]

*** NOTICES ***

JP0 and INPIT are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application]This invention relates to the Fresnel lens sheet for projection screens fabricated using ultraviolet rays and/or radiation-curing resin.

[0002]

[Description of the Prior Art]About the Fresnel lens sheet using this kind of ultraviolet rays (UV) and/or radiation-curing resin, conventionally. JP,63-82401,A by which this artificer added other elements other than Fresnel to the transparent substrate previously, No. 132227 [63 to], No. 163329 [63 to], No. 186224 [63 to], No. 191140 [63 to], JP,63-134227,A which aimed at the productivity drive by mass production, JP,2-63035,A about the good transparent substrate of JP,63-162224,A which aimed at the mass production to which the optical element was added, JP,64-7001,A about good defoaming of the productivity of UV resin, No. 86102 [64 to], an adhesive property, and handling nature has been proposed.

[0003]JP,58-33429,A, No. 114232 [61 to], No. 114233 [61 to], No. 116338 [61 to], No. 164807 [61 to], No. 167506 [61 to], No. 177215 [61 to], No. 182908 [61 to], No. 219610 [61 to], No. 219611 [61 to], No. 248707 [61 to], No. 248708 [61 to], No. 33613 [62 to], No. 62716 [62 to], No. 90634 [62 to], No. 161532 [62 to], No. 161533 [62 to], No. 163330 [63 to], JP,1-192529,A, No. 192530 [one to], No. 192531 [one to], No. 142901 [one to], No. 285332 [one to], No. -2406022 of -119201 No. two of one to 298302 No. two, No. -157801 of -80432 No. two of -193102 No. two of two to 22901 No. two, No. -240601 of -132402 No. two of -157702 No. two of two to 157801 No. two, No. -122601 of -9301 No. three of -32301 No. three of two to 102031 No. two, No. -73319 of -75701 No. three of -75702 No. three of -75703 No. three of -80201 No. three of -80202 No. three of -35535 No. three of -81702 No. three of -81753 No. three of -98040 No. three of three to 101907 No. three, The statement of the Fresnel lens which used UV resin for No. -45901 of -45902 No. three of -46601 No. three of -54501 No. three of three to 54502 No. three, etc. is made.

[0004]What formed Fresnel lens section 82 as the conventional Fresnel lens sheet dashed the metallic mold against the surface of the ** transparent substrate 81 (refer to drawing 8), ** It is divided roughly into what (refer to drawing 9) formed the uniform gap by UV resin layer 83 in the surface of the transparent substrate 91, and the heights (namely, trough of Fresnel lens section 82) of a metallic mold.

[0005]

[Problem(s) to be Solved by the Invention]However, since a volumetric shrinkage happens when the serrate

portion of Fresnel lens section 82 will be substantially divided to the case of the aforementioned ** in each slot and UV curing resin hardens to it, Shaping of a serrate portion is not performed thoroughly but produces poor molding, and also resin of the serrate portion dissociated and there was a problem of being easy to exfoliate from the transparent substrate 81.

[0006]Since UV resin layer 83 is formed in the aforementioned **, the adhesive property of the transparent substrate 81 and Fresnel lens section 82 improves, but. Control of the pressurizing condition became difficult due to the fall of the resin viscosity resulting from the cost hike by the increase in the amount of the UV curing resin used, and the increase in reaction fever, and there was a problem that poor molding occurred.

[0007]The intensity distribution of a UV lamp is strong in the center section, and to weak one by a periphery the conventional serrate portion, More thickly [in a periphery] (refer to drawing 8 and drawing 9) than a center section, in order to fully stiffen this, Since it is necessary to raise the power of the UV lamp itself and, the calorific value of a UV lamp is large at the end and it is small in the center section, upgrading will make very high temperature at the time of hardening by a lens periphery. Thus, even when UV resin viscosity means becoming uneven selectively and pressurizes with fixed nip pressure, as for a pressure, that curing temperature becomes uneven selectively will not fully start in the fall portion of viscosity, and poor molding may produce it.

[0008]Since the lens center section became a concave when it was used having stuck conventional Fresnel lens sheet 80 with other lens sheets 90, such as a lenticular lens sheet, as shown in drawing 10, there was a problem that adhesion was bad.

[0009]While the purpose of this invention solves the above-mentioned technical problem, and reducing the amount of the expensive UV resin used etc. and raising productivity, It is providing the Fresnel lens sheet which can improve the modification of a lens by the volumetric shrinkage accompanying hardening of the UV resin, or an adhesion defect with the transparent substrate by distortion, and can aim at improvement in the yield, and its manufacturing method.

[0010]

[Means for Solving the Problem]In an Fresnel lens sheet which consists of an Fresnel lens section which formed an Fresnel lens sheet by this invention with ultraviolet rays and/or radiation-curing type resin on a transparent substrate and said substrate substantially at Fresnel lens shape, It has composition which provided an intermediate resin layer which becomes thin gradually with said ultraviolet rays and/or radiation-curing type resin as the thickness goes to a periphery from a center section between said substrate and a pars basilaris ossis occipitalis of said Fresnel lens section.

[0011]In this case, it can be characterized by forming a lenticular lens or prism in an Fresnel lens section of said substrate, and a field of an opposite hand. As for said substrate, unlike a refractive index of resin of said Fresnel lens section, a refractive index can be characterized by forming a lenticular lens or prism in a field by the side of an Fresnel lens section. Said substrate can be characterized by curving.

[0012]On the other hand, a manufacturing method of an Fresnel lens sheet by this invention, The 1st resin application process that applies the 1st resin of ultraviolet rays and/or radiation-curing nature to an approximately whole area of a die with which a mold of Fresnel lens shape was formed, The 2nd resin application process that forms a resin rich area ball of said 1st resin and the 2nd resin with an equal abbreviated refractive index in a side edge part or a side edge part, and both ends of said die, a transparent

substrate is substantially laminated to said 1st resin with a pressure roll, leveling said 2nd resin -- it leveling and with a laminating process. A resin curing process which irradiates with ultraviolet rays and/or radiation and stiffens said resin, and a release process which releases said resin from mold are performed in order, and said pressure roll is considered as composition pressurized after a center section has become a concave.

[0013]In this case, said 1st resin can be characterized by applying in the state where viscosity is lower than said 2nd resin.

[0014]

[Function]When forming an Fresnel lens section with ultraviolet rays and/or radiation-curing resin on a transparent substrate according to this invention, The thickness (thickness from the trough of an Fresnel lens section to a transparent substrate) of the intermediate resin layer of ultraviolet rays and/or radiation-curing resin becomes small gradually toward the center of an Fresnel lens section to a lens periphery.

[0015]This intermediate resin layer can be manufactured by using what crowns so that a center section may serve as a concave, or whose surface hardness is low, and bending arises by application of pressure as a pressure roll, and changes a roll center section into a concave for a pressure roll.

[0016]

[Example]Hereafter, with reference to drawings etc., this invention is explained in detail about an example. The mimetic diagram showing the example of the Fresnel lens sheet according [drawing 1] to this invention and drawing 2 are the mimetic diagrams showing the example which combined the Fresnel lens sheet concerning an example with other lens sheets. Fresnel lens sheet 10 of this example comprises the substrate 11, Fresnel lens section 12, and the intermediate resin layer 13.

[0017]The substrate 11 should just be a substantially transparent board which penetrates ultraviolet rays and/or radiation, and a sheet or films, such as an acrylic and polycarbonate, can be used for it while it constitutes some lens sheets 10 as a base material of Fresnel lens section 12. The primer layer for the adhesive improvement in VCM/PVC / vinyl acetate copolymer system, a urethane system, a butyral system, acrylic, etc. can be provided in this substrate 11. The substrate 11 may be curving. If the substrate 11 is incurvated, as shown in drawing 11, when it constitutes a projection screen combining other sheets of lenticular lens sheet 42 grade, Fresnel lens sheet 41, Other sheets and the curvature to incurvate are changed and a crevice can be prevented from generating this between sheets, even if elasticity arises on each sheet in an environmental change by fixing heavy doubling both by adhesive tape 43 grade in a periphery. If this substrate 11 is beforehand incurvated by the processing conditions beyond the thermal change temperature of resin of a substrate, it can maintain shape stable in the long run compared with the case where the shape which curved below with heat deflection temperature after formation of a lens which was performed conventionally is processed.

[0018]Fresnel lens section 12 is a portion in which Fresnel lens shape is formed with ultraviolet rays and/or radiation-curing type resin. As these ultraviolet rays and/or radiation-curing type resin, For example, polymerization nature oligomer with acrylyl groups, such as urethane acrylate, epoxy acrylate, polyester acrylates, polyether acrylate, and melamine acrylate, and a monomer, A simple substance or the things which were blended, such as polymerization nature oligomer with polymerization nature vinyl groups, such as acrylic acid, acrylamide, acrylonitrile, and styrene, and a monomer, What added the sensitizer etc. to these, and the thing which added a defoaming agent, a leveling agent, stabilizer, fire retardant, a release

agent, etc. further can be used.

[0019]In order that these ultraviolet rays and/or radiation-curing type resin may make high general instrument physical properties, such as surface intensity and hardness, a monomer or a prepolymer with a polyfunctional basis is used, it is [way] good and, also actually, the thing of two or more functional groups is used preferably. A dispersing agent can be included in ultraviolet rays and/or radiation-curing type resin. A dispersing agent can prevent curing shrinkage and can give diffusibility further while it raises coating fitness. As a dispersing agent, glass, silica, alumina, an insoluble plastic, talc, etc. can be used.

[0020]The intermediate resin layer 13 is a layer which becomes thin gradually with the ultraviolet rays and/or radiation-curing type resin which were mentioned above between the substrate 11 and the pars basilaris ossis occipitalis of Fresnel lens section 12 as the thickness goes for a periphery from a center section. A surface sink-like defect can be prevented by forming this intermediate resin layer 13. As for the thickness of this intermediate resin layer 13, it is preferred that it is not less than 10 micrometers. If it considers from an experimental result etc., in the case of resin thickness below 10 micrometers, -like [surface sink / poor] will come out, but this is because it does not generate in the case of not less than 10 micrometers. However, this value changes somewhat with kinds (the rate of cure shrinkage, viscosity, etc.) of UV resin. If attached to change of thickness, it is necessary to change according to the calorific value accompanying hardening of UV resin, and calorific value distribution of a UV lamp. As an example, about 30 micrometers of the end were [the thickness of UV resin / 10 micrometers and a center section] good in the case of acrylic urethane system UV resin (viscosity 2000cp, 8% of rate of curing shrinkage), and 50 inch size.

[0021]This Fresnel lens sheet 10 can form a lenticular lens or the prism lenses for optic-axis refraction in Fresnel lens section 12 of the substrate 11, and the field 10a of an opposite hand. For example, in the case where the perpendicular direction diffusion lenticular lens (5 degrees of diffusion angles) whose pitch of a lens is 0.1 mm is formed. Since the stray light by the internal reflection in an Fresnel lens sheet diffuses in a perpendicular direction diffusion lenticular lens surface while being able to enlarge vertical diffusion, what is called a rainbow can be prevented. Since it becomes unnecessary to carry out the center shift of a Fresnel lens if a lens pitch forms the horizontal prism which is 0.1 mm, for example while being able to perform amendment of an optic axis, it is not necessary to enlarge an expensive Fresnel lens die. Since in the case of roll nip the center of a Fresnel lens is always in agreement with the center of a roll and the length of a die and every width may be mixed even if it makes a die into length and turns it sideways, in the case of a line which pours partly the die with which sizes differ in succession, it is good. When the center of a Fresnel lens and the center of a roll are not in agreement, it is necessary to control the position of a die in agreement with the center of a Fresnel lens, and the center of a roll. The refractive index of resin of Fresnel lens section 12 is changed for the refractive index of the substrate 11, And since a diffusing surface is close to the field of Fresnel lens section 12 whichever it uses [of a lenticular lens and prism lenses] when a lenticular lens or prism is formed in the field which forms the Fresnel lens section of a substrate, resolution goes up rather than providing in the rear face of the substrate 11.

[0022]As shown in drawing 2, it can be used combining other lens sheets 20. In this case, although a lenticular lens sheet or the prism lens sheet for optic-axis refraction is raised as other lens sheets 20, in the usual projection screen, the lenticular lens sheet for horizontal proliferations is used best. Since the peak parts of Fresnel lens section 12 become the same flat surface, adhesion of this Fresnel lens sheet 10 with other lens sheets 20 improves. It is not necessary to make the refractive index of the substrate 11 the same

as that of the refractive index of resin of Fresnel lens section 12. The substrate 11 should have the just good permeability of ultraviolet rays or radiation, for example, what is necessary is just to select mainly in consideration of a mechanical strength (nerve) required at the time of a TV set assembly, or fire retardancy and shock resistance, and, as for the substrate 11, ultraviolet rays and radiation-curing type resin should just mainly select a refractive index, abrasion resistance, and a moldability.

[0023]Drawing 3 - drawing 5 are the figures showing the example of the manufacturing method of the Fresnel lens sheet by this invention, and they are the mimetic diagram in which drawing 3 showed process drawing and drawing 4 showed each process, and a mimetic diagram in which drawing 5's having leveled and showing a laminating process. Next, as shown in drawing 3, the manufacturing method of this lens sheet is leveled with the 1st resin application process 101 and the 2nd resin application process 102, and comprises the laminating process 103, the resin curing process 104, and the release process 105.

[0024]The 1st resin application process 101 is a process of applying the 1st resin 12A of ultraviolet rays and/or radiation-curing nature to the approximately whole area of the die 31 with which the mold of Fresnel lens shape was formed. This process attains stabilization of coverage and is a process for promoting defoaming by the next process 102 further while it equalizes the wettability of the die 31. Specifically, it can carry out by the roll coat method, the silk screen method, the curtain method, the photogravure method, the squeezing method, etc.

[0025]The 2nd resin application process 102 is a process of forming the resin rich area ball of the 1st resin 12A and the 2nd resin 13A with an equal abbreviated refractive index in the side edge part or side edge part, and both ends of the die 31. The ultraviolet rays and/or radiation-curing nature resin in this process serve to give an adhesive property with the substrate 12 while extruding the substrate 11 to laminate and the air bubbles which enter between dice. As a method of forming the resin rich area ball of this 2nd resin 13A, methods, such as the roll coat method, the curtain coat method, and the noise coat method, can be taken.

[0026]It levels and the laminating process 102 is a process of laminating the transparent substrate 11 to the 1st resin 12A substantially with the pressure roll 32, leveling the 2nd resin 13A. By this process's laminating the transparent substrate 11 so that only the way of pressure roll 32 side edge part may touch the die 31, and pressurizing and laminating with the pressure rolls 32 and 33 from under the substrate 11 top and the die 31, While extruding the air bubbles which enter between the lens pattern type valleys of the die 31 in the resin 12A and 13A, it serves to make thickness of a molded product uniform. A straight thing can be used for the substrate 11.

[0027]The resin curing process 103 is a process which irradiates with ultraviolet rays and/or radiation and stiffens said resin. Although said resin 12A and 13A is stiffened by irradiating with ultraviolet rays and/or radiation in this process, it is preferred in this case to bring the light source 34 close to the pressurization part of the pressure rolls 32 and 33 as much as possible. This is to prevent air bubbles from re-mixing between the relief between the die 31 and the substrate 11, and them. The release process 104 is a process of releasing said resin 12A and 13A from mold from the die 31.

[0028]In this example, the pressure roll 32 shown in (c) of drawing 4 has low surface hardness, as shown in drawing 5, bending arises by application of pressure and what a roll center section transforms into a concave is used. Thus, if it applies, it will decrease gradually as the quantity of the 1st resin 12A and the 2nd resin 13A shows drawing 6 (A) and it goes to a periphery from a center section. The coverage of UV resin of the conventional Fresnel lens sheet shown in drawing 8 and drawing 9 is shown in drawing 6 (B) and (C).

That by which clowning is carried out so that a center section may serve as a concave beforehand may be used for the pressure roll 32.

[0029]It can level and laminate, inserting the cover film 35 between the pressure roll 32 and the substrate 11, as it levels and the laminating process 103 shows to drawing 12. Dirt can be prevented from the dirt by resin overflowing from between the die 31 and the substrates 11 etc. adhering to the pressure roll 32, and being transferred by the product fabricated later by carrying out like this. It is effective when a sponge roll is especially used as the pressure roll 32.

[0030]Drawing 7 is a key map showing distribution of UV lamp intensity and the calorific value of a UV lamp. As shown in drawing 7, the calorific value (the dashed line has shown) of a UV lamp has a large end of a lamp, and its center section is small. Since amount of UV resin 82A+83A and 82A had increased as the end, the end became large and the heterogeneity of conventional Fresnel lens sheets 80B and 80A shown in drawing 6 (B) and (C) of the temperature of a die was to also increase the reaction fever accompanying hardening by a synergistic effect with generation of heat of a UV lamp. As shown in drawing 6 (A), in this application amount of UV resin 12A+13A, It becomes small gradually as it goes to a periphery from a center section, and thereby, since the reaction fever accompanying hardening becomes small and shows distribution contrary to the exothermic intensity distribution of a UV lamp, heterogeneity of the temperature of a die can be made smaller as an end.

[0031]In the resin curing process 104, the light source 34 of ultraviolet rays and/or radiation is arranged so that it may become parallel to the pressure roll 32. Since the viscosity of the resin 13A also differs selectively according to it when temperature distribution has nonuniformity when joining the resin 12A and 13A to the substrate 1, Nonuniformity appears also in the board thickness of Fresnel lens sheet 10 obtained, and the poor molding of surface sink ***** occurs into a portion with thin thickness of UV resin 12A and 13A. It is remarkable, when especially laminated by nipping using the pressure rolls 32 and 33, or when the substrate 11 is thin.

[0032]It is preferred to mask the covering film of ozone impermeability in the resin curing process 104 in Fresnel lens section 12 of the substrate 11 and the field of an opposite hand. It can be prevented from the ozone generated by ultraviolet rays degrading a substrate, and reducing the surface intensity of a substrate by carrying out like this.

[0033]As physical properties of the 1st resin 12A, the transfer nature to the die 31, defoaming nature, the wettability to the die 31, and case hardening nature are thought as important, and an adhesive property with the substrate 11 and mobility are thought as important as the 2nd resin 13A.

[0034]As for the 1st resin 12A, applying in the state where viscosity is low is more preferred than the 2nd resin 13A. That is, the 1st resin 12A has a preferred thing of the hypoviscosity adjusted to 200 or less centipoises, and the thing which has comparatively high viscosity and by which the 2nd resin 13A was adjusted to 500 to 5000 centipoise is used. It is because this reason applies the 1st resin 12A to the whole surface so that air bubbles may not be included between the detailed lens patterns of the die 31, so viscosity must be low and the grade viscosity which applies leveling the 2nd resin 13A and drives out the air bubbles in resin must be high. Thus, the defoaming nature in the interface of the die 31 improves more by forming the layer of the 1st resin 12A.

[0035]While being able to achieve more effectively each function corresponding to the die 31, the substrate 11, or fabricated each part of Fresnel lens sheet 10 the very thing by making the resin 12A and 13A two-

layer, Width of resin selection can be made large by dividing those functions into two-layer.

[0036]Next, the selection condition of each resin 12A and 13A is explained further. At least, in the case of Fresnel lens sheet 10, both refractive index is omitted, and is, and things are required of it. Since the interface by which the 1st resin 12A and 2nd resin 13A were laminated as for this does not necessarily become a flat, when the refractive indices of two resin differ greatly, it is because a uniform light is no longer obtained.

[0037]As long as it fills this relation, the 1st resin 12A and 2nd resin 13A may be the same construction material, and may be a thing of different construction material. What is necessary is just to use the thing of combination with an equal abbreviated refractive index in consideration of physical properties in the case of different resin, For example, good epoxyacrylate resin of adhesion with the substrate 11 can be used as the 2nd resin 13A using good urethane acrylate resin of die reproducibility as the 1st resin 12A. Change the resin temperature in the work process of the 1st resin 12A and the 2nd resin 13A, add additive agents (a defoaming agent, a leveling agent, etc.), a solvent, etc., or. Or what is necessary is just to adjust the wettability [as opposed to / melt and / a die] to which compounding ratios, such as a monomer of the 1st resin 12A and the 2nd resin 13A and oligomer, are changed, mobility, viscosity, etc. to fitness.

[0038]The above dispersing agents can be included in the both sides or one side of the 1st resin 12A and the 2nd resin 13A.

[0039](Example of manufacture) Finally the concrete example of manufacture is given and explained, referring to drawing 4. First, as shown in drawing 4 (a), by 1 m of every direction to the die 31 of pitch 0.1mm Fresnel lens shape. After applying to 100 micrometers in thickness the UV curing resin which adjusted the refractive index 1.49 and viscosity to 20 centipoises by diluting urethane acrylate of 3000 centipoises with ethyl acetate by the squeezing method, It dried for 90 seconds in 80 °C oven, the diluting solvent was removed, and the layer of the 1st resin 12A was formed. Subsequently, as shown in drawing 4 (b), the 2nd resin 13A was dropped at the left end (roll 32 side) of the die 31 with the nozzle coating method, and the resin rich area ball of 1.0 g/cm^2 was formed. As the 2nd resin 13A, UV curing resin of a urethane acrylate system which does not contain the diluting solvent of the refractive index 1.49 and 3000 centipoise viscosity was used. As shown in drawing 4 (c), at the same time as it extrudes an acrylic resin and carries out roll forming to a sheet shaped as the transparent substrate 11, While pasting together and making a nylon film the transfer film which applied VCM/PVC / vinyl acetate copolymer system primer and transferring a primer to an acrylic sheet, By controlling the roll temperature at the time of shaping, the acrylic board with a thickness [with diactinism] of 3.0 mm which carried out bending was loaded so that a curvature radius might be set to 6000 mm, and the pressure rolls 32 and 33 which wound sponge around 15 mm in thickness were rolled and pressurized by speed 50 cm/min. At this time, the air bubbles which enter between the die 31 and the substrate 11 are extruded in the portion shown in [A] a figure.

[0040]Under the present circumstances, it irradiated with ultraviolet rays (UV) by 160 W/cm using the source 34 of UV light from the substrate 11 side, and the 1st resin 12A and 2nd resin 13A were hardened. At the last, as shown in drawing 4 (d), decompression mold release of the die 31 was carried out, and Fresnel lens sheet 10 which curved to the arch was obtained.

[0041]As for this Fresnel lens sheet 10, the intermediate resin layer 13 which becomes thin gradually with UV resin as that thickness goes to a periphery from a center section was formed between the substrate 11

and the pars basilaris ossis occipitalis of Fresnel lens section 12. Adhesion was good, as a result of especially not mixing air bubbles in the surface but using it combining the lenticular lens sheet (1.25 mm of board thickness) of the same size, Fresnel lens section 12 and.

[0042]

[Effect of the Invention]According to this invention, there are following various effects. Since it is thin, there is no fall of the lens defect by a volumetric shrinkage and adhesive strength, and moreover, there is little amount of the UV curing resin used etc., and it can be managed [1st] with an end with thickness of an intermediate resin layer thick in the center section where the volume of the serrate part of an Fresnel lens section is small, and large volume.

[0043]Since UV intensity distribution of a UV lamp had the strong center section and the end was [2nd] weak, when the amount of UV resin increased conventionally as the Fresnel end, and it was going to obtain UV intensity required for the reaction of the Fresnel end, needed to enlarge lamp capacity, but. In this invention, there is much UV resin in the center section of the Fresnel lens section, and it decreases at the end.

Therefore, since UV intensity distribution required for a reaction is in agreement, the capacity of a UV lamp is small and ends, and the rise of die temperature is also small and ends.

[0044]When the amount of UV resin increased as the end of an Fresnel lens section, the end became large and the heterogeneity of reaction fever accompanying hardening of the temperature of a die was 3rd to increase conventionally, since generation of heat by a UV lamp has a large end of a lamp and the center section is small, but. In this invention, the reaction fever accompanying hardening is as small as an end. Therefore, the homogeneity of the temperature of a die improves.

[0045]By this invention, in the flesh, clowning or bending is in control of the thickness distribution of the amount of UV resin, it uses and levels a pressure roll, and performs [4th] a laminating process.

Therefore, there is no necessity for bending processing of the die for acquiring thickness distribution and delicate control of coverage, and it excels in productivity and workability.

[0046]Since the Fresnel lens sheet has sharp shape when it sets [5th] with other lens sheets, such as a lenticular lens sheet, although the end of the Fresnel lens section was easily missing by friction with a lenticular lens sheet etc., since the quantity in which an end projects conventionally as compared with a center section was large -- with a crack -- although cut, in this invention, the projection amount of an end becomes less and it becomes difficult to get damaged.

[Translation done.]

*** NOTICES ***

JP0 and INPIT are not responsible for any damages caused by the use of this translation.

- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1]It is a mimetic diagram showing the example of the Fresnel lens sheet by this invention.

[Drawing 2]It is a mimetic diagram showing the example which combined other lens sheets for the Fresnel lens sheet concerning an example.

[Drawing 3]It is process drawing showing the example of the manufacturing method of the Fresnel lens sheet by this invention.

[Drawing 4]It is a mimetic diagram showing each process of drawing 3.

[Drawing 5]It is a mimetic diagram in which drawing 4's having leveled and showing a laminating process.

[Drawing 6]It is a key map showing the coverage of UV curing resin of the manufacturing method of the Fresnel lens sheet concerning an example.

[Drawing 7]It is a diagram showing generation of heat and UV intensity distribution of the UV lamp of the manufacturing method of an Fresnel lens sheet concerning an example.

[Drawing 8]It is a mimetic diagram showing the conventional example of an Fresnel lens sheet.

[Drawing 9]It is a mimetic diagram showing the conventional example of an Fresnel lens sheet.

[Drawing 10]It is a mimetic diagram showing the example which combined other lens sheets for the conventional Fresnel lens sheet.

[Drawing 11]It is a mimetic diagram showing the case where a projection screen is constituted for the Fresnel lens sheet concerning an example combining other sheets.

[Drawing 12]It is a mimetic diagram in which drawing 4's having leveled and showing other examples of a laminating process.

[Description of Notations]

10 Fresnel lens sheet

11 Substrate

12 Fresnel lens section

13 Intermediate resin layer

20 Other lens sheets

31 Die

32, 33 pressure rolls

34 Light source

[Translation done.]

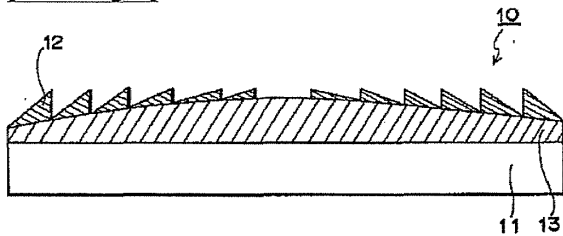
* NOTICES *

JP0 and INPIT are not responsible for any damages caused by the use of this translation.

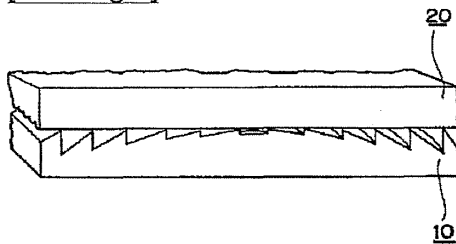
- 1.This document has been translated by computer. So the translation may not reflect the original precisely.
- 2.**** shows the word which can not be translated.
- 3.In the drawings, any words are not translated.

DRAWINGS

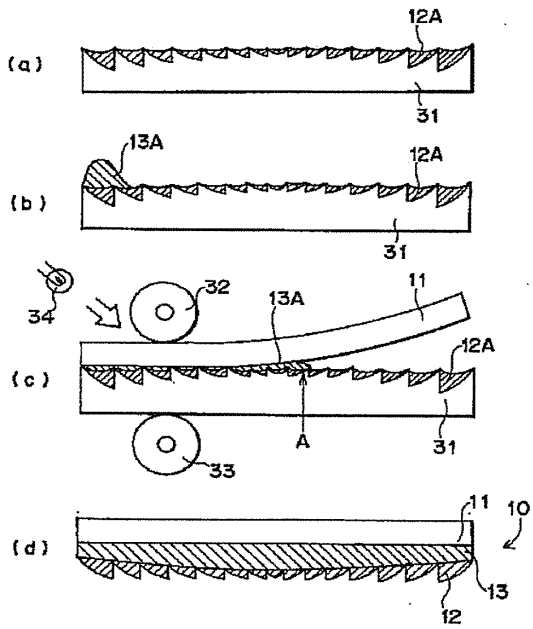
[Drawing 1]



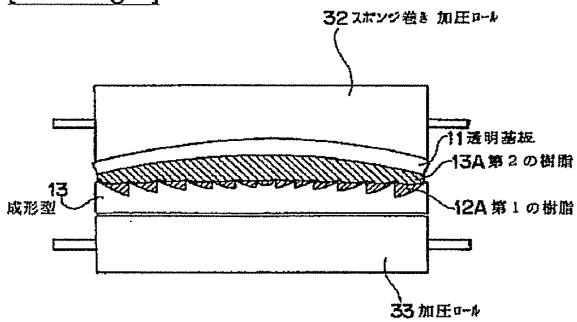
[Drawing 2]



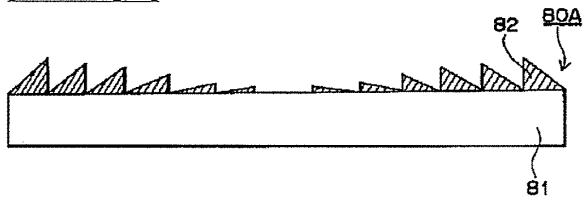
[Drawing 4]



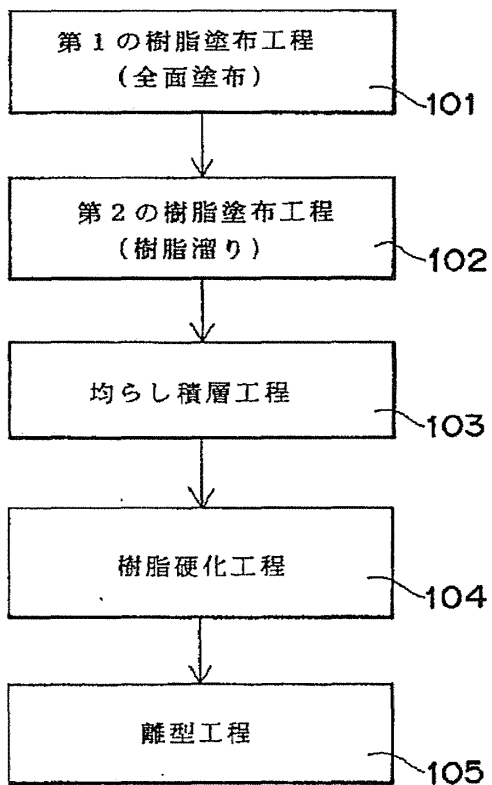
[Drawing 5]



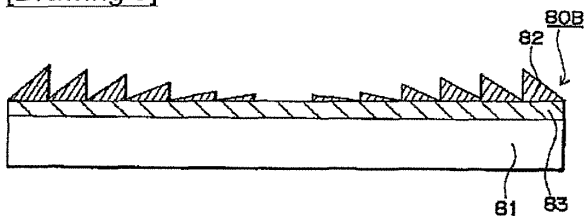
[Drawing 8]



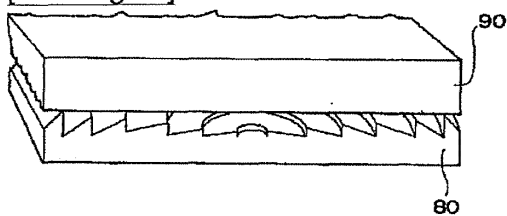
[Drawing 3]



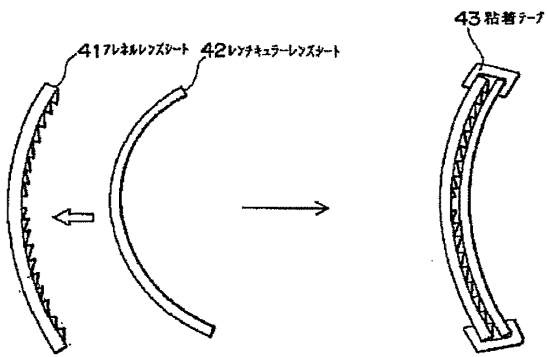
[Drawing 9]



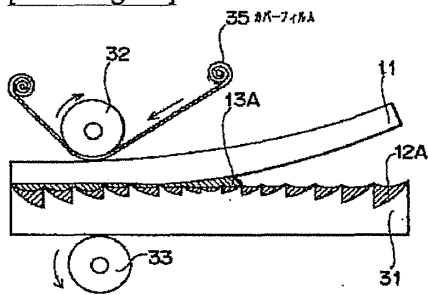
[Drawing 10]



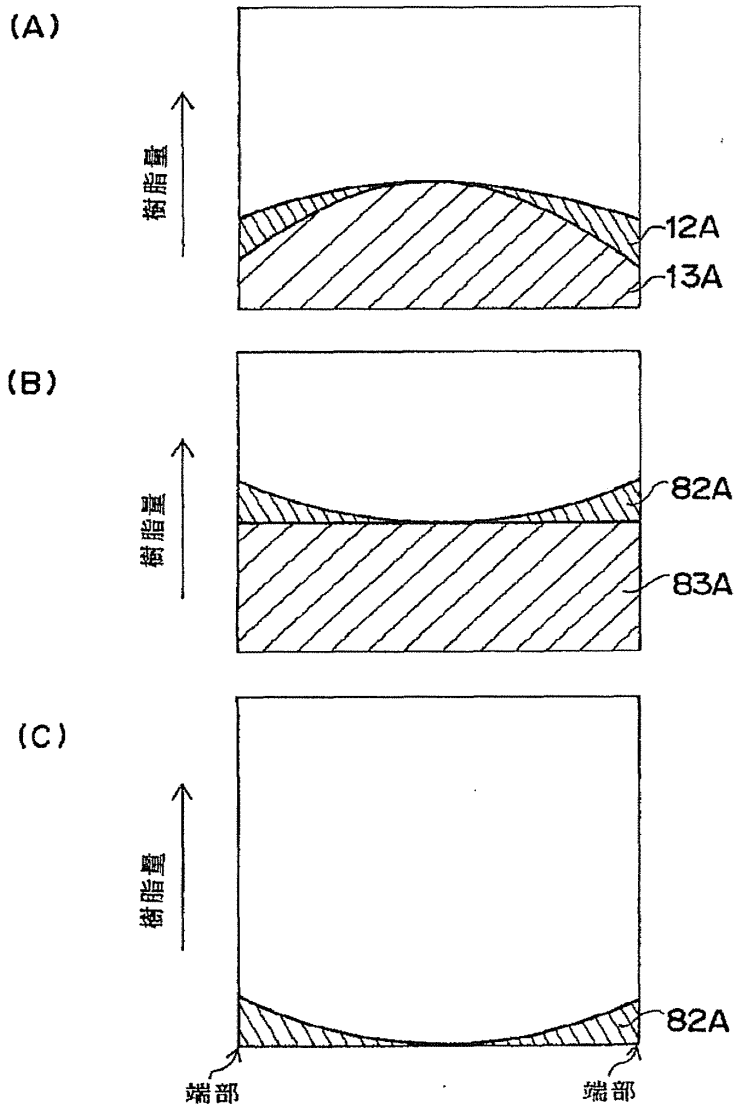
[Drawing 11]



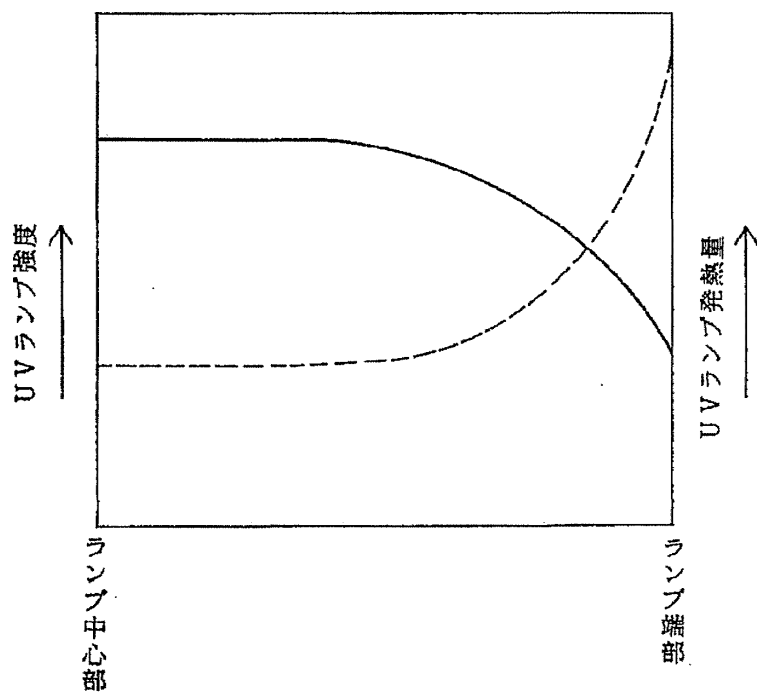
[Drawing 12]



[Drawing 6]



[Drawing 7]



[Translation done.]

LIGHT DEFLECTION SHEET AND ITS MANUFACTURING METHOD**Publication number:** WO2007026776 (A1)**Publication date:** 2007-03-08**Inventor(s):** KURACHI YOSHIYA [JP]; SUDA TETSUYA [JP]; ONO MASAE [JP]; TODA MASATOSHI [JP]; OOTSUKI HARUKO [JP]; MIZUHARA KAZUMI [JP]; YOSHIMURA TOMONARI [JP]**Applicant(s):** MITSUBISHI RAYON CO [JP]; KURACHI YOSHIYA [JP]; SUDA TETSUYA [JP]; ONO MASAE [JP]; TODA MASATOSHI [JP]; OOTSUKI HARUKO [JP]; MIZUHARA KAZUMI [JP]; YOSHIMURA TOMONARI [JP]**Classification:****- International:** G02B5/02; G02F1/1335; G02F1/13357; G02B5/02; G02F1/13**- European:** G02B5/02**Application number:** WO2006JP317128 20060830**Priority number(s):** JP20050249521 20050830; JP20060212172 20060803**Also published as:**

KR20080042908 (A)

Cited documents:

WO03102642 (A2)

JP2001091709 (A)

JP2004054035 (A)

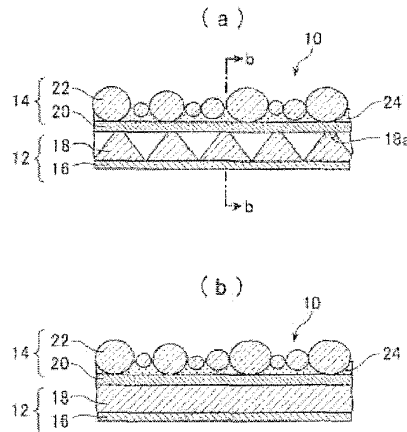
JP8184704 (A)

JP2002096395 (A)

more >>

Abstract of WO 2007026776 (A1)

It is possible to provide a light deflection sheet which can easily be manufactured and has functions of a plurality of conventional sheets satisfying both the luminance and view angle characteristic required for the liquid crystal television. The light deflection sheet includes a sheet-shaped substrate, a first deflection lens sheet having a first lens portion formed on one side of the substrate, a sheet-shaped substrate, and a second deflection lens sheet having a second lens portion formed on one side of the substrate with a flat portion at the tip end. The flat portion of the first deflection lens sheet is bonded to the other side of the substrate of the second deflection lens sheet by a transparent material.



Data supplied from the esp@cenet database — Worldwide

(12) 特許協力条約に基づいて公開された国際出願

(19) 世界知的所有権機関
国際事務局



(43) 国際公開日
2007年3月8日 (08.03.2007)

PCT

(10) 国際公開番号
WO 2007/026776 A1

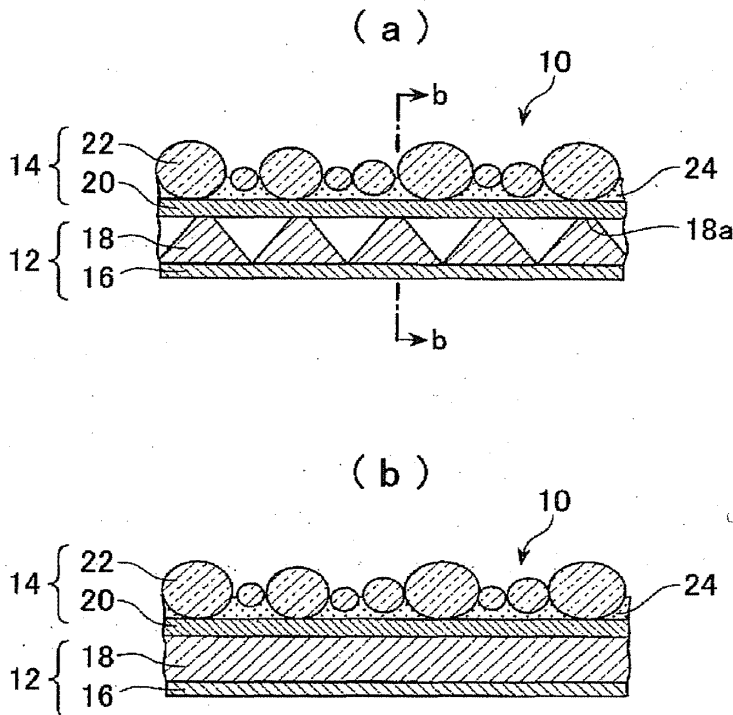
- (51) 国際特許分類:
G02B 5/02 (2006.01) G02F 1/13357 (2006.01)
G02F 1/1335 (2006.01)
- (21) 国際出願番号: PCT/JP2006/317128
- (22) 国際出願日: 2006年8月30日 (30.08.2006)
- (25) 国際出願の言語: 日本語
- (26) 国際公開の言語: 日本語
- (30) 優先権データ:
特願2005-249521 2005年8月30日 (30.08.2005) JP
特願2006-212172 2006年8月3日 (03.08.2006) JP
- (71) 出願人 (米国を除く全ての指定国について): 三菱レイヨン株式会社 (Mitsubishi Rayon Co., Ltd.) [JP/JP];
〒1088506 東京都港区港南一丁目6番41号 Tokyo (JP).

- (72) 発明者; および
(75) 発明者/出願人 (米国についてのみ): 倉地 与志也 (KURACHI, Yoshiya) [JP/JP]; 〒2140014 神奈川県川崎市多摩区登戸3816番地 三菱レイヨン株式会社 東京技術・情報センター内 Kanagawa (JP). 須田 哲也 (SUDA, Tetsuya) [JP/JP]; 〒2140014 神奈川県川崎市多摩区登戸3816番地 三菱レイヨン株式会社 東京技術・情報センター内 Kanagawa (JP). 小野 雅江 (ONO, Masae) [JP/JP]; 〒2140014 神奈川県川崎市多摩区登戸3816番地 三菱レイヨン株式会社 東京技術・情報センター内 Kanagawa (JP). 戸田 正利 (TODA, Masatoshi) [JP/JP]; 〒2140014 神奈川県川崎市多摩区登戸3816番地 三菱レイヨン株式会社 東京技術・情報センター内 Kanagawa (JP). 大槻 陽子 (OOTSUKI, Haruko) [JP/JP]; 〒2140014 神奈川県川崎市

[続葉有]

(54) Title: LIGHT DEFLECTION SHEET AND ITS MANUFACTURING METHOD

(54) 発明の名称: 光偏向シートとその製造方法



(57) Abstract: It is possible to provide a light deflection sheet which can easily be manufactured and has functions of a plurality of conventional sheets satisfying both the luminance and view angle characteristic required for the liquid crystal television. The light deflection sheet includes a sheet-shaped substrate, a first deflection lens sheet having a first lens portion formed on one side of the substrate, a sheet-shaped substrate, and a second deflection lens sheet having a second lens portion formed on one side of the substrate with a flat portion at the tip end. The flat portion of the first deflection lens sheet is bonded to the other side of the substrate of the second deflection lens sheet by a transparent material.

(57) 要約: 製造が容易であり、従来の複数のシートの機能を兼ね備えた、液晶TVなどに要求される輝度と視野角特性の両方を満足する光偏向シートを提供すること。本発明の光偏向シートは、シート状の基材と、該基材の一方の面に形成された第1レンズ部とを備えた第1偏向レンズシートとを備えた第2偏向

と、シート状の基材と、該基材の一方の面に形成され先端に平坦部を有する第2レンズ部とを備えた第2偏向

[続葉有]

LIGHT DEFLECTION SHEET AND ITS MANUFACTURING METHOD**Publication number:** WO2007026776 (A1)**Publication date:** 2007-03-08**Inventor(s):** KURACHI YOSHIYA [JP]; SUDA TETSUYA [JP]; ONO MASAE [JP]; TODA MASATOSHI [JP]; OOTSUKI HARUKO [JP]; MIZUHARA KAZUMI [JP]; YOSHIMURA TOMONARI [JP]**Applicant(s):** MITSUBISHI RAYON CO [JP]; KURACHI YOSHIYA [JP]; SUDA TETSUYA [JP]; ONO MASAE [JP]; TODA MASATOSHI [JP]; OOTSUKI HARUKO [JP]; MIZUHARA KAZUMI [JP]; YOSHIMURA TOMONARI [JP]**Classification:****- International:** G02B5/02; G02F1/1335; G02F1/13357; G02B5/02; G02F1/13**- European:** G02B5/02**Application number:** WO2006JP317128 20060830**Priority number(s):** JP20050249521 20050830; JP20060212172 20060803**Also published as:**

KR20080042908 (A)

Cited documents:

WO03102642 (A2)

JP2001091709 (A)

JP2004054035 (A)

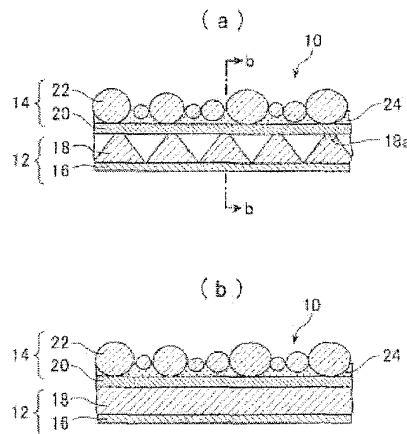
JP8184704 (A)

JP2002096395 (A)

more >>

Abstract of WO 2007026776 (A1)

It is possible to provide a light deflection sheet which can easily be manufactured and has functions of a plurality of conventional sheets satisfying both the luminance and view angle characteristic required for the liquid crystal television. The light deflection sheet includes a sheet-shaped substrate, a first deflection lens sheet having a first lens portion formed on one side of the substrate, a sheet-shaped substrate, and a second deflection lens sheet having a second lens portion formed on one side of the substrate with a flat portion at the tip end. The flat portion of the first deflection lens sheet is bonded to the other side of the substrate of the second deflection lens sheet by a transparent material.



Data supplied from the esp@cenet database — Worldwide



市多摩区登戸 3 8 1 6 番地 三菱レイヨン株式会社
東京技術・情報センター内 Kanagawa (JP). 水原 和美
(MIZUHARA, Kazumi) [JP/JP]; 〒2140014 神奈川県川
崎市多摩区登戸 3 8 1 6 番地 三菱レイヨン株式会社
東京技術・情報センター内 Kanagawa (JP). 吉村 朋也
(YOSHIMURA, Tomonari) [JP/JP]; 〒2140014 神奈川県川
崎市多摩区登戸 3 8 1 6 番地 三菱レイヨン株式
会社 東京技術・情報センター内 Kanagawa (JP).

(74) 代理人: 熊倉 禎男, 外(KUMAKURA, Yoshio et al.);
〒1008355 東京都千代田区丸の内 3 丁目 3 番 1 号 新
東京ビル 中村合同特許法律事務所 Tokyo (JP).

(81) 指定国 (表示のない限り、全ての種類の国内保護
が可能): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG,
BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK,
DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HN,
HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ,
LA, LC, LK, LR, LS, LT, LU, LV, LY, MA, MD, MG, MK,
MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG,

PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM,
SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC,
VN, ZA, ZM, ZW.

(84) 指定国 (表示のない限り、全ての種類の広域保護が可
能): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD,
SL, SZ, TZ, UG, ZM, ZW), ユーラシア (AM, AZ, BY,
KG, KZ, MD, RU, TJ, TM), ヨーロッパ (AT, BE, BG,
CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE,
IS, IT, LT, LU, LV, MC, NL, PL, PT, RO, SE, SI, SK, TR),
OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML,
MR, NE, SN, TD, TG).

添付公開書類:

- 国際調査報告書
- 補正書

2 文字コード及び他の略語については、定期発行される
各 PCT ガゼットの巻頭に掲載されている「コードと略語
のガイダンスノート」を参照。

レンズシートとを備え、前記第 1 偏向レンズシートのレンズ部の平坦部と、前記第 2 偏向レンズシートの基材の他
方の面とが、透明材料で貼り付けられている。

明 細 書

光偏向シートとその製造方法

技術分野

- [0001] 本発明は、面光源装置用の光偏向シートに関し、詳細には、直下方式の面光源装置で用いられる光偏向シートに関する。

背景技術

- [0002] 液晶パネル等のディスプレイパネルを照明するバックライトとして、複数の冷陰極管 (CCFL) や発光ダイオード (LED) アレイからなる光源を液晶表示板の直下に配置するいわゆる直下方式のバックライトが知られている。このような直下方式のバックライトでは、光源からの光を拡散・偏向させて、液晶表示板を均一に照射することが必要である。
- [0003] このため従来のバックライトでは、例えば、光源側から順に拡散シート、拡散フィルム、プリズムシートを配置することによって、光源からの光を拡散・偏向させ、液晶表示板を均一に照射している。
- 拡散シートは、光源の像ぼかし、輝度均一化を行う機能を有する。拡散フィルムは、輝度を均一化させる機能を有する。プリズムシートは、光源方向に向かう光を上方向 (出射方向) に向けるとともに、拡散フィルムから出射した光を偏向して視野角を制御する機能を有する。
- [0004] これらの拡散シート、拡散フィルム、プリズムシートは別々のシートとして供給されて積層されるので、個々に打ち抜き・加工が必要となる。この結果、バックライトのコストが高くなる、組み立て時に混入する塵埃のためにバックライトの歩留まりが低下する、熱によるたわみ防止のためそれぞれを厚くする必要がありバックライトの重量ならびに厚さが増加する等の問題があった。
- [0005] このため、1枚で光源からの光の拡散・偏向を行うことができる、光偏向シートおよび集光性光拡散板が提案されている (特許文献1、特許文献2、特許文献3、および特許文献4参照)。
- [0006] 特許文献1: 特開平8-184704号公報

特許文献2:特開平10-48430号公報

特許文献3:米国特許第6846089号明細書

特許文献4:特開2005-99803号公報

発明の開示

発明が解決しようとする課題

[0007] しかしながら、特許文献1の光偏向シートには、微粒子を分散させて散布、乾燥させる工程が複雑であるという問題がある。又、特許文献2の集光性光拡散板には、構成部品となる各シート材料の一体化が難しいという問題がある。

[0008] また、特許文献3の頂角90°のプリズムシートを貼り合せた光学シートには、広視野角を得ることが難しいという問題がある。

特許文献4の光学シートには、一体化したときの密着性に問題があり、さらに、温度変化による膨張または伸縮により、隆起スペーシング構造間の接合されていないギャップ間隔にムラが生じ、均一な光学特性を得るのが難しくなるという問題もある。

[0009] 本発明は、このような問題を解決するためになされたもので、製造が容易であり、従来の複数のシートの機能を兼ね備えた、液晶TVなどに要求される輝度と視野角特性の両方を満足する光偏向シートを提供することを目的とする。

課題を解決するための手段

[0010] 本発明によれば、

シート状の基材と、該基材の一方の面に形成された第1レンズ部とを備えた第1偏向レンズシートと、

シート状の基材と、該基材の一方の面に形成され先端に平坦部を有する第2レンズ部とを備えた第2偏向レンズシートとを備え、

前記第2偏向レンズシートの第2レンズ部の平坦部と、前記第1偏向レンズシートの基材の他方の面とが、透明材料で貼り付けられている、

ことを特徴とする光偏向シートが提供される。

[0011] 本発明の他の好ましい態様によれば、前記透明材料が、硬化後粘着性を有する電離放射線硬化樹脂からなる。

本発明の他の好ましい態様によれば、前記透明材料が、前記平坦部の一部分に

配置されている。

[0012] 本発明の他の態様によれば、

シート状の基材と、該基材の一方の面に形成されたレンズ部とを備えた第1偏向レンズシートと、

シート状の基材と、該基材の一方の面に形成されたレンズ部とを備えた第2偏向レンズシートとを備え、

前記第1偏向レンズシートが、該第1偏向レンズシートのレンズ部が前記第2偏向レンズシートの基材の他方の面に対向するように配置され、前記第1および第2偏向レンズシートの間に電離放射線硬化性樹脂あるいは粘着性粒子が充填されている、ことを特徴とする光偏向シートが提供される。

[0013] 本発明の他の好ましい態様によれば、前記電離放射線硬化性樹脂の屈折率が、第2偏向レンズシートのレンズ部の屈折率より0.05以上低く設定されている。

[0014] 本発明の他の態様によれば、

シート状の基材と、該基材の一方の面に形成された第1レンズ部とを備えた偏向レンズシートと、

該光偏向シートの他方の面に対向して配置された拡散シートと、

前記光偏向シートに対向する前記拡散シートの面に設けられた樹脂製の第2レンズ部と、を備え、

前記基材の他方の面と第2レンズ部との間に、該第2レンズ部を形成している樹脂より屈折率が0.05以上高い樹脂が充填されている、

ことを特徴とする光偏向シートが提供される。

[0015] 本発明の他の好ましい態様によれば、前記第1レンズ部が、並列配置された断面三角形の複数の柱状プリズムからなり、前記第2レンズ部が、並列配置された断面半円状の複数の柱状レンズからなり、前記柱状レンズは、前記柱状プリズムと直交して延びるように配置されている。

[0016] 本発明の他の態様によれば、

シート状の基材と、該基材の一方の面に形成されたレンズ部とを備えた偏向レンズシートと、

一端が前記基材の他方の面に接触するように配置された突起構造物と、
前記突起構造物の他端に支持され、前記基材の他方の面に対向するように配置された拡散シートと、備えている、
ことを特徴とする光偏向シートが提供される。

[0017] 本発明の他の好ましい態様によれば、前記突起構造物の他端が、前記拡散シートに透明材料で貼り付けられている。

本発明の他の好ましい態様によれば、前記第1レンズ部が断面三角形の柱状プリズム部であり、該柱状プリズム部の頂角が 60° 以上 150° 以下である。

[0018] 本発明の他の好ましい態様によれば、前記第2レンズ部が、断面形状が、三角形の頂部を切取った形状である柱状プリズム部であり、前記三角形の頂角が 60° 以上 150° 以下である。

[0019] 本発明の他の態様によれば、
シート状の基材と、該基材の一方の面に形成されたレンズ部とを備えた偏向レンズシートと、
前記偏向レンズシートの基材の他方の面に対向するように配置された拡散シートと、
備え、
該拡散シートが、前記偏向レンズシートの基材の他方の面と前記拡散シートとの間に離散的に配置された硬化後粘着性を有する透明性電離放射線硬化樹脂部によって、前記偏向連シートの他方の面から離間して配置されている、
ことを特徴とする光偏向シートが提供される。

[0020] 本発明の他の態様によれば、
シート状の基材と、該基材の一方の面に並列配置された三角柱状プリズムからなる第1レンズ部とを備えた第1偏向レンズシートと、
シート状の基材と、該基材の一方の面に並列配置された三角柱状プリズムからなる第2レンズ部とを備えた第2偏向レンズシートと、を備え、
前記第1偏向レンズシートと第2偏向レンズシートとが、前記第1レンズ部が、前記第2レンズ部と直交して延びるように配置され、さらに、前記第2偏向レンズシートの基材の前記第2レンズ部とは反対側の面に設けられた透明材料による粘着層に、前記第

1偏向レンズシートの第1レンズ部の先端が埋設されることによって前記第1偏向レンズシートと第2偏向レンズシートとが一体化されている光偏向シートであって、

前記第1レンズ部および第2レンズ部の内の水平視野方向を制御するレンズ部の頂角をX、前記第1レンズ部および第2レンズ部の内の垂直視野方向を制御するレンズ部の頂角をYとしたとき、下記(1)式から(3)式が満たされる、

$$70^{\circ} \leq X \leq 150^{\circ} \quad \dots (1)$$

$$70^{\circ} \leq Y \leq 130^{\circ} \quad \dots (2)$$

$$195^{\circ} \leq X + Y \leq 255^{\circ} \quad \dots (3)$$

ことを特徴とする光偏向シートが提供される。

[0021] 本発明の他の態様によれば、

シート状の基材と、該基材の一方の面に形成された第1レンズ部とを備えた第1偏向レンズシートと、シート状の基材と、該基材の一方の面に形成され先端に平坦部を有する第2レンズ部とを備えた第2偏向レンズシートとを備え、前記第1偏向レンズシートのレンズ部の平坦部と、前記第2偏向レンズシートの基材の他方の面とが、透明材料で貼り付けられていることを特徴とする光偏向シートの製造方法であって、

前記第1偏向レンズシートの基材の他方の面、前記第2偏向レンズシートの第2レンズ部の平坦部、または、前記第1偏向レンズシートの基材の他方の面および前記第2偏向レンズシートの第2レンズ部の平坦部に透明材料による粘着層を形成するステップと、

前記第1偏向レンズシートの基材の他方の面に前記第2偏向レンズシートの第2レンズ部の平坦部を貼りつけるステップと、備えている、

ことを特徴とする光偏向シートの製造方法が提供される。

[0022] 本発明の他の態様によれば、

シート状の基材と、該基材の一方の面に形成された第1レンズ部とを備えた偏向レンズシートと、一端が前記基材の他方の面に連結された突起構造物と、前記突起構造物の他端に支持され、前記基材の他方の面に対向するように配置された拡散シートと、備えている光偏向シートの製造方法であって、

前記突起構造物の他端に、硬化後粘着性のある透明材料による粘着層を形成す

るステップと、

前記拡散シートを前記突起構造物の他端に押圧し、前記偏向レンズシートと拡散シートを貼り合わせるステップと、備えている、

ことを特徴とする光偏向シートの製造方法が提供される。

[0023] 本発明の他の態様によれば、

拡散シートと、シート状の基材と該基材の一方の面に形成されたレンズ部とを有する偏向レンズシートとを備えた光偏向シートの製造方法であって、

前記偏向レンズシートの基材の他方の面に、硬化後粘着性のある透明材料をドット状またはストライプ状のパターンで塗布するステップと、

前記偏向レンズシートの基材の他方の面と前記拡散シートの方の面とを重ね、前記偏向レンズシートと拡散シートとを貼り合わせるステップと、備えている、

ことを特徴とする光偏向シートの製造方法が提供される。

発明の効果

[0024] 本発明によれば、製造が容易であり、従来の複数のシートの機能を兼ね備えた、液晶TVなどに要求される輝度と視野角特性の両方を満足する光偏向シートが提供される。

発明を実施するための最良の形態

[0025] 以下、添付図面を参照して本発明の実施形態について詳細に説明する。

まず、本発明の第1の実施形態の光偏向シート10について説明する。図1(a)は、本実施態様の光偏向シート10の模式的な模式的な断面図であり、図1(b)は、図1(a)のb-b線に沿った模式的な断面図である。図2は、光偏向シート10を液晶表示装置のバックライトに組み込んだ状態を示す模式的な断面図である。

[0026] 光偏向シート10は、従来の直下方式バックライトに使用されている拡散フィルムおよびプリズムシートを一体化した光偏向シートである。この光偏向シート10は、図2に示されているように、バックライト2内で、並列配置された複数の冷陰極管等の線状光源4と、液晶表示板6との間に配置され、線状光源2から出射する光を拡散シート8と共に拡散・偏向させ、液晶表示板6に均一に照射させる機能を有する。

[0027] 光偏向シート10は、図1に示されているように、第1のシートである等方性レンズシ

ート14と、第2のシートであるプリズムシート12と、を備えている。

プリズムシート12は、平坦なシート状の基材部16と、基材部16の一方の面(表面)に並列配置された複数の柱状プリズム部18とを備えている。柱状プリズム部18は、頂部に底面と平行な平坦部18aを有する台形の断面形状を有している。また、台形は、頂角が 60° 以上 150° 以下の三角形の頂部を切り取った形状を有するのが好ましい。基材部16と柱状プリズム部18は透明材料で形成されている。

[0028] 基材部16は、(メタ)アクリル樹脂、ポリカーボネート樹脂、PET樹脂、ポリスチレン樹脂、AS樹脂(アクリロニトリルスチレン共重合樹脂)、ポリオレフィン樹脂などの透明樹脂のフィルムで形成されているのが好ましい。また、透明樹脂中に無機系あるいは有機系(ポリマービーズ)の拡散剤を含有させた光拡散性のあるフィルムを用いても良い。

[0029] また、柱状プリズム部18は、屈折率が1.50~1.54程度の、(メタ)アクリレート系活性エネルギー線硬化性組成物等の活性エネルギー線硬化物で形成されているのが好ましい。(メタ)アクリレート系活性エネルギー線硬化性組成物としては、例えば、ポリエステル(メタ)アクリレート、エポキシ(メタ)アクリレート、ウレタン(メタ)アクリレート等の(メタ)アクリレート系樹脂等が挙げられる。

[0030] 柱状プリズム部18の厚さは $5\sim 500\mu\text{m}$ 程度、ピッチは $5\sim 500\mu\text{m}$ 程度とすることが好ましい。ピッチは、 $10\sim 100\mu\text{m}$ がより好ましく、 $10\sim 50\mu\text{m}$ がさらに好ましい。

[0031] 柱状プリズム部18に代えて、全体でフレネルレンズを構成するような凹凸形状、断面略半円形あるいは断面略半楕円形などのレンチキュラーレンズ形状、波形レンズ面を構成するような形状などを用いてもよい。同一の種類または寸法の形状を配置しても、異なる種類または寸法の形状を配置してもよい。

[0032] 本実施形態では、光偏向シート10が拡散・偏向させる光の輝度の低下を抑制するため、平坦部18aの幅が、柱状プリズム部18の配列ピッチの10%以下に設定されている。例えば、頂角 90° の柱状プリズム18をピッチ 50μ で配列する構成では、平坦部18aの幅を約 5μ に設定すると、法線方向の輝度低下は約5%となる。

[0033] 等方性レンズシート14は、透明材料で構成された平坦なシート状の基材部20と、透明材料で形成された直径約 $1\sim 20\mu\text{m}$ の多数の粒子22とを備えている。粒子22

は、基材部20の一方の面(表面)全体に略隙間無く配列され、透明なバインダ24で基材部20の一方の面(表面)に接着されている。

[0034] 基材部20は、(メタ)アクリル樹脂、ポリカーボネート樹脂、PET樹脂、ポリスチレン樹脂、AS樹脂(アクリロニトリルスチレン共重合樹脂)、ポリオレフィン樹脂などの透明樹脂のフィルムで形成されているのがよい。また、透明樹脂中に無機系あるいは有機系(ポリマービーズ)の拡散剤を含有させた光拡散性のあるフィルムを用いても良い。

[0035] 粒子22は、(メタ)アクリル樹脂、MS樹脂(メタクリルスチレン共重合樹脂)、ポリスチレン樹脂、シリコン樹脂、ウレタン樹脂、エポキシ樹脂、ポリオレフィン樹脂、ベンゾグアナミン-メラミン-ホルムアルデヒド樹脂などで形成されているのが好ましい。本実施形態では、粒子22は真球状であるが、その他の形状、例えば楕円形状(ラグビーボール形状)でもよい。

[0036] 本実施形態では、粒子22の径は、ピーク粒子径に対して多分散(ブロードな)粒子径分布とされている。しかしながら、粒子22は、径がランダムな複数の径の粒子から構成されていても、径が単一あるいは複数の単分散粒子径(シャープな粒子径分布)を採る粒子から構成されているものであってもよい。

[0037] 特定波長の散乱・反射による着色、モアレ縞、粒子同士のスティッキング(貼りつき)等の問題を回避するため、粒子22の径は、広く分布またはランダムであるのが好ましい。

[0038] この等方性レンズシート14は、視野角を調整する機能を有する。等方性レンズシート14には、拡散機能が必要ではないため、粒子22およびバインダ24の屈折率 n は略等しく、例えば、約1.5に設定されている。

[0039] 本実施形態の光偏向シート10では、プリズムシート12の柱状プリズム部18の平坦部18aが、等方性レンズシート14の基材部20の他方の面(裏面)に、粘着剤(図示せず)によって接着され、プリズムシート12が等方性レンズシート14と一体化されている。なお、粘着剤は、柱状プリズム部18を構成する樹脂と略等しい屈折率を有する透明な粘着剤である。

[0040] 粘着剤としては、アクリル系、ウレタン系、ポリエステル系、エポキシ系、シリコン系な

どの粘着剤あるいは接着剤が使用される。粘着剤あるいは接着剤の種類としては、ホットメルト系、溶剤系、反応型(熱硬化、紫外線や電子線などによる電離放射線硬化系)などが挙げられる。

[0041] 硬化後、粘着性を有する粘着剤が、より好ましい。硬化後、貼り合わせ時の圧力により粘着剤が変形することを防止でき、さらに貼り合わせ時に粘着剤がプリズムの先端部の傾斜面に溢れでて先端部を粘着剤中に埋没させてしまうことがなく、光学的特性が安定するためである。

[0042] さらに、硬化後粘着性を有する電離放射線硬化樹脂からなる透明樹脂が好ましい。紫外線及び電子線などの電離放射線により硬化する粘着剤は、揮発性物質の拡散を抑制することができ、さらに紫外線あるいは電子線を照射する装置がコンパクトであることから製造ラインの簡略化が可能であるからである。

[0043] 次に、本発明の第2実施形態の光偏向シート25について説明する。図3(a)は、本実施態様の光偏向シート25の模式的な断面図であり、図3(b)は、図3(a)のb-b線に沿った模式的な断面図である。

光偏向シート25は、第1実施形態の光偏向シート10と同様に、拡散フィルムおよびプリズムシートを一体化した光偏向シートである。

[0044] 図3に示されているように、本実施形態の光偏向シート25は、第1のシートであるプリズムシート26と、第2のシートであるクロスプリズムシート28とが貼り合わされた構造を有している。

[0045] プリズムシート26は、平坦なシート状の基材部30と、基材部30の一方の面(表面)に並列配置された複数の柱状プリズム部32とを備えている。基材部30と柱状プリズム部32は透明材料で構成されている。柱状プリズム部32は、並列配置された断面三角形の複数の柱状プリズムからなり、主に垂直方向の視野角を調整する。柱状プリズム部32の頂角は、60°～150°の範囲内が好ましく、本実施形態では90°に設定されている。

基材部30および柱状プリズム部32は、それぞれ、上記第1実施態様の光偏向シートの基材部と柱状プリズム部と同様の材料で形成されている。

[0046] 次に、クロスプリズムシート28の構成を説明する。図4(a)は、クロスプリズムシート2

8の一部分の平面図であり、図4(b)は図4(a)のb-b線に沿った模式的な断面図、図4(c)は図4(a)のc-c線に沿った模式的な断面図であり、図4(d)は図4(a)のd-d線に沿った模式的な断面図であり、図4(e)は図4(a)のe-e線に沿った模式的な断面図である。

[0047] 図3に示されているように、クロスプリズムシート28は、平坦なシート状の基材部33と、基材部33の一方の面に配置されたプリズム部34とを備えている。図3及び図4に示されているように、プリズム部34は、横方向(画面水平方向)プリズムの頂角が120度、上下方向(画面垂直方向)のプリズム頂角が110度のプリズム部である。

本実施形態のクロスプリズムシート28では、上下方向(画面垂直方向)に延びる軸の先端に平坦部34aが形成されている。

基材部33およびプリズム部34も、それぞれ、上記第1実施態様の光偏向シートの基材部および柱状プリズムと同様の材料で形成されている。

[0048] 本実施形態のクロスプリズムシート28では、プリズム部の水平方向と垂直方向のプリズムピッチ比は1:3である。すなわち、プリズムシート26の柱状プリズム部32が延びる方向と同一方向Xのプリズムピッチを1とすると、プリズムシート26の柱状プリズム部32が延びる方向と直交する方向Yのプリズムピッチが3となるように設定されている。本実施形態では、水平方向のピッチを 35μ 、垂直方向のピッチを 105μ に設定している。

[0049] クロスプリズムシート26は、プリズム部34の平坦部34aがプリズムシート26の基材部30の他方の面(裏面)に粘着剤(図示せず)によって接着され、プリズムシート26と一体化されている。なお、粘着剤は、プリズム部34を構成する樹脂と略等しい屈折率を有する透明な粘着剤である。

[0050] クロスプリズムシート28に代えて、図5、図6に示されているようなクロスプリズムシートを用いてもよい。

[0051] 図5(a)は、代替例のクロスプリズムシート36の一部分を示す模式的な平面図であり、図5(b)はb-b線に沿った模式的な断面図であり、図5(c)はc-c線に沿った模式的な断面図である。

図5に示されているように、クロスプリズムシート36は、平坦なシート状の基材部38と

、基材部38の一方の面(表面)に配置されたプリズム部40とを備えている。プリズム部40は、基材部38の表面に、底面が長方形の略四角錐状の微小プリズム42が隙間無く配置されることによって形成されている。各微小プリズム42の先端には、底面と平行な平坦部42aが形成されている。このクロスプリズムシート36は、例えば、電鍍処理によって逆型を製作し、この逆型を金型として使用することによって製造されるい

。

[0052] 本実施形態では、平坦部42aが、プリズムシート26の基材部30の他方の面(裏面)に粘着剤(図示せず)で接着され、クロスプリズムシート36がプリズムシート26と一体化されている。

[0053] 図6(a)は、もう一つの代替例のクロスプリズムシート44の一部分を示す模式的な平面図であり、図6(b)は図6(a)のb-b線に沿った模式的な断面図であり、図6(c)は図6(a)のc-c線に沿った模式的な断面図であり、図6(d)は図6(a)のd-d線に沿った模式的な断面図であり、図6(e)は図6(a)のe-e線に沿った模式的な断面図である。

[0054] 図6に示されているように、クロスプリズムシート44は、平坦なシート状の基材部46と、基材部46の一方の面に配置されたプリズム部48とを備えている。クロスプリズムシート44は、左右方向(画面水平方向)に延びる軸の先端に、平坦部48aを備えている

。

この平坦部48aが、プリズムシートの基材部の他方の面(裏面)に粘着剤(図示せず)によって接着され、クロスプリズムシート44がプリズムシートと一体化される。

[0055] 本実施形態の光偏向シートでは、貼り合わされたシート間で、各シートのプリズム部が平行に配置されると、モアレ縞が発生することがある。このようなモアレ縞の発生を防止するため、一方のシートのプリズム配列ピッチをランダムにするか、あるいは一方のシートにプリズム配列ピッチを、他方のシートのプリズム配列ピッチの $(N+0.4)$ 倍ないし $(N+0.6)$ 倍(N は整数)に設定するのが好ましい。

[0056] さらに、クロスプリズムシート28に代えて、図7、図8に示されているようなクロスレンチ形状のクロスプリズムシートを用いてもよい。

[0057] 図7(a)は、代替例のクロスプリズムシート50の一部分を示す平面図であり、図7(b)

は図7(a)のb-b線に沿った模式的な断面図であり、図7(c)は図7(a)のc-c線に沿った模式的な断面図であり、図7(d)は図7(a)のd-d線に沿った模式的な断面図であり、図7(e)は図7(a)のe-e線に沿った模式的な断面図である。

- [0058] 図7に示されているように、クロスプリズムシート50は、平坦なシート状の基材部52と、基材部52の一方の面に配置されたプリズム部54とを備えている。また、クロスプリズムシート50のプリズム部54の先端には、左右方向(画面水平方向)に延びる平坦部54aが形成されている。

この平坦部54aが、プリズムシートの基材部の他方の面(裏面)に粘着剤(図示せず)によって接着され、クロスプリズムシート50がプリズムシートと一体化される。

- [0059] 図8(a)は、代替例のクロスプリズムシート56の一部分を示す平面図であり、図8(b)は図8(a)のb-b線に沿った模式的な断面図であり、図8(c)は図8(a)のc-c線に沿った模式的な断面図であり、図8(d)は図8(a)のd-d線に沿った模式的な断面図であり、図8(e)は図8(a)のe-e線に沿った模式的な断面図である。

- [0060] 図8に示されているように、クロスプリズムシート56は、平坦なシート状の基材部58と、基材部58の一方の面に配置されたプリズム部60とを備えている。また、クロスプリズムシート56では、プリズム部60の先端に、上下方向(画面上下方向)に延びる平坦部60aが形成されている。

この平坦部60aが、プリズムシートの基材部の他方の面(裏面)に粘着剤(図示せず)によって接着され、クロスプリズムシート56がプリズムシートと一体化される。

- [0061] 次に、本発明の第3実施形態の光偏向シート62について説明する。図9(a)は、本実施態様の光偏向シート62の模式的な断面図であり、図9(b)は、図9(a)のb-b線に沿った模式的な断面図である。

- [0062] 図9に示されているように、本実施形態の光偏向シート62は、重ね合わされた第1および第2のプリズムシート64、66を備えている。

第1のプリズムシート64は、平坦なシート状の基材部68と、基材部68の一方の面(表面)に並列配置された断面三角形の複数の柱状プリズム部70とを備えている。

柱状プリズム部70の頂角は、60°～150°の範囲内が好ましい。基材部68と柱状プリズム部70は、上記第1実施形態と同様の透明材料で構成されている。