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(72) Inventors:

- **Ishida, Shizuka**
Kanagawa, 237-8510 (JP)
- **Suzuki, Norimasa**
Kanagawa, 237-8510 (JP)

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(71) Applicant: **Toshiba Lighting & Technology
Corporation**
Yokosuka-shi
Kanagawa 237-8510 (JP)

(74) Representative: **Bokinge, Ole**

Awapatent AB
Junkersgatan 1
582 35 Linköping (SE)

(54) **Luminaire**

(57) According to one embodiment, a luminaire includes a light source, a prism sheet and a reflector. The prism sheet includes an incident surface on which light from the light source is incident, and a light emission surface from which light having a refraction angle corresponding to an incident angle of the light incident from

the incident surface is emitted. The reflector is arranged between the light source and the prism sheet, and includes a mirror surface which reflects the light from the light source to the prism sheet and controls the incident angle of the light to the prism sheet.

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Description

FIELD

[0001] Embodiments described herein relate generally to a luminaire using a prism sheet.

BACKGROUND

[0002] Hitherto, there is a luminaire in which a light source is arranged in an equipment body having an opening and a prism sheet is arranged at the opening of the equipment body. The prism sheet is constructed such that light is formed to have a refraction angle corresponding to an incident angle of light incident from the light source, and luminous intensity distribution of the luminaire is controlled.

[0003] However, in the luminaire using the prism sheet, if the incident angle of the light incident on the prism sheet is not limited, there is a problem that the light is totally reflected in the prism sheet according to the incident angle of the light and is not emitted from a light emission surface, and the equipment efficiency is reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004]

FIG. 1 is a sectional view of a luminaire of an embodiment.

FIG. 2 is a perspective view of a decomposed state of the luminaire.

FIG. 3 is a perspective view of the luminaire.

FIG. 4 is a sectional view of a prism sheet of the luminaire.

FIG. 5 is a table showing a relation among a prism angle of the prism sheet, an incident angle and a refraction angle.

FIG. 6 is a table showing results of measurement of equipment light flux with respect to the embodiment, comparative example 1 and comparative example 2.

FIG. 7 is a luminous intensity distribution view of a case of the prism sheet and mirror surface reflection.

FIG. 8 is a luminous intensity distribution view of a case of the prism sheet and white reflection.

FIG. 9 is a luminous intensity distribution view of a case of only the prism sheet.

DETAILED DESCRIPTION

[0005] In general, according to one embodiment, a luminaire includes a light source, a prism sheet and a reflector. The prism sheet includes an incident surface on which light from the light source is incident, and a light emission surface from which light having a refraction angle corresponding to an incident angle of the light incident from the incident surface is emitted. The reflector is arranged between the light source and the prism sheet,

and includes a mirror surface which reflects the light from the light source to the prism sheet and controls the incident angle of the light to the prism sheet.

[0006] According to this structure, the light from the light source is reflected to the prism sheet by the mirror surface of the reflector, and the incident angle of the light incident on the prism sheet is controlled. Accordingly, the light emitted from the prism sheet increases, and the improvement of equipment efficiency can be expected.

[0007] Hereinafter, an embodiment will be described with reference to FIG. 1 to FIG. 9.

[0008] FIG. 1 to FIG. 3 show a luminaire. The luminaire 10 is, for example, a hanging type equipment hung by a wire or the like from the ceiling. Incidentally, the luminaire may be a direct mounting type equipment directly mounted on the ceiling or the like.

[0009] The luminaire 10 includes an equipment body 11, a light source unit 12, a power supply unit 13, a prism sheet 14 and a reflection unit 15. The luminaire 10 is formed to be thin and long. A direction extending between both ends of the luminaire 10 is defined as a longitudinal direction, and a direction extending between both sides perpendicular to the longitudinal direction is defined as a width direction.

[0010] The equipment body 11 is formed into a thin and long box shape, and an opening 18 is formed at the lower surface. The equipment body 11 includes a thin and long body part 19 opened at the lower side and at both ends in the longitudinal direction, and end plates 20 attached to both ends of the body part 19.

[0011] The body part 19 and the end plates 20 are made of a metal material such as aluminum or a resin material. The body part 19 is formed by, for example, extrusion molding.

[0012] The body part 19 includes an upper surface part 21 and side surface parts 22 at both sides in the width direction. An attachment part 23 for attachment of the power supply unit 13 is protrudingly provided at the lower surface of the upper surface part 21. Attachment parts 24, 25 and 26 for attachment of the light source unit 12, the reflection unit 15 and the prism sheet 14 are protrudingly provided at the inner surfaces of the side surface parts 22 at both sides.

[0013] The light source unit 12 includes a light-emitting module 29 as a light source, a light diffusion cover 30 to cover the light-emitting module 29, and a support plate 31 to support the light-emitting module 29 and the light diffusion cover 30.

[0014] The light-emitting module 29 includes a thin and long board 32, and plural light-emitting elements 33 mounted on a mount surface of the board 32 along the longitudinal direction. The light-emitting elements 33 are, for example, LED elements. Incidentally, a light-emitting element such as an organic EL may be used.

[0015] The light diffusion cover 30 has light transparency and light diffusibility. The light diffusion cover 30 covers the whole of the light-emitting module 29 and is attached to the support plate 31. The light diffusion cover

30 protrudes into an inner space 50a of a reflector 50. The light diffusion cover 30 is provided with a light diffusion part 34 which faces the light-emitting elements 33 and has an arc-shaped section in the width direction.

[0016] The support plate 31 is integrally formed by bending, for example, a metal plate. The support plate 31 is provided with a flat support part 35 to which the light-emitting module 29 and the light diffusion cover 30 are attached, and edge parts 36 are provided protrudingly from both sides of the support part 35 in the width direction. Contact parts 37 in contact with the attachment parts 24 of the equipment body 11 are formed at tips of the edge parts 36 at both the sides. Attachment members 38 for attachment to the attachment parts 24 of the equipment body 11 are fixed to plural places of the edge parts 36 at both the sides in the longitudinal direction. The attachment member 38 is constructed of, for example, a plate spring, and one end is attached to the edge part 36 by a screw 39. The other end side of the attachment member 38 is a free end, and a hook part 40 hooked to the attachment part 24 protruding from the equipment body 11 is formed. In this embodiment, the hook part 40 is bent into an L shape so as to protrude to the inside, and elastically contacts the tip of the attachment part 24 and urges the contact part 37 of the support plate 31 toward the direction of contacting the lower surface of the attachment part 24.

[0017] The power supply unit 13 is attached to the attachment part 23 of the equipment body 11, and is housed on an upper side in the equipment body 11. A power supply line inserted inside from the outside of the equipment body 11 is electrically connected to an input side of the power supply unit 13, and an output line electrically connected to the board 32 is connected to an output side of the power supply unit 13. The power supply unit 13 converts, for example, commercial AC power into specified DC power and supplies the power to the plural light-emitting elements 33 of the board 32, and lights the plural light-emitting elements 33.

[0018] The prism sheet 14 is made of a material having light transparency. Resin or glass is used as the material. In this embodiment, polycarbonate with a refractive index of 1.585 is used.

[0019] The prism sheet 14 is arranged so as to close the opening 18 of the equipment body 11. The prism sheet 14 includes a flat sheet part 42 and attachment edges 43 rising from both sides of the sheet part 42 in the width direction. Projections 44 hooked on the attachment parts 24 are protrudingly provided on the outer surfaces of the attachment edges 43 at both the sides. The projection 44 is formed in the whole area of the attachment edge 43 in the longitudinal direction.

[0020] An upper surface of the sheet part 42 is an incident surface 45 which faces the light-emitting module 29 and on which light from the light-emitting module 29 is incident. A lower surface of the sheet part 42 opposite to the incident surface 45 is a light emission surface 46 from which the incident light is emitted. Plural prisms 47

are formed on the light emission surface 46. As shown in FIG. 4, the prism 47 is formed into a conical shape or a pyramid shape having a triangular section and an apex. A prism surface 47a inclined to the apex is formed on the prism 47. The prisms 47 are formed in the whole area of the light emission surface 46.

[0021] The reflection unit 15 is arranged between the light-emitting module 29 and the prism sheet 14. The reflection unit 15 includes a reflection mirror 50 as a reflector. The reflection mirror 50 includes reflection plates 51 at both sides in the width direction, and reflection plates 52 at both ends in the longitudinal direction, and is formed into a rectangular frame shape opened up down. Inner surfaces of the respective reflection plates 51 and 52 are formed into mirror surfaces 51a and 52a. The reflection plates 51 at both the sides expand from the light-emitting module 29 side to the prism sheet 14 side, and the mirror surfaces 51a are formed into recessed curved surfaces. The reflection plates reflect the light from the light-emitting module 29 to the prism sheet 14, and control the incident angle of the light to the prism sheet 14. Contact parts 53 in contact with the support plate 31 of the light source unit 12 are formed at upper ends of the reflection plates 51 at both the sides.

[0022] Attachment members 54 for attaching the reflection mirror 50 to the equipment body 11 are attached to plural places of the reflection mirror 50 in the longitudinal direction. The attachment member 54 is constructed of, for example, a plate spring, and an upper end is fixed to the contact part 53 by a screw 55. A lower end of the attachment member 54 is a free end, and is provided with a hook part 56 hooked to the attachment part 25 protruding from the equipment body 11. In this embodiment, the hook part 56 is bent into an L shape protruding to the outside, elastically contacts the attachment part 25, and urges the contact part 53 of the reflection plate 51 in a direction of contacting the lower surface of the support plate 31. Incidentally, cut parts 57 for avoiding interference with the screws 55 are formed in the support plate 31.

[0023] Incidentally, if an opening width of an opening 58 at the light emission side (prism sheet 14 side) of the reflection mirror 50 is excessively smaller than the width of the prism sheet 14, light is not incident on an edge of the prism sheet 14 and it becomes dark. Thus, the opening width of the reflection mirror 50 at the light emission side (prism sheet 14 side) is preferably formed to have a size close to the width of the prism sheet 14.

[0024] Next, in order to assemble the luminaire 10, the power supply unit 13 is inserted in the equipment body 11, and the power supply unit 13 is screwed to the attachment part 23.

[0025] Subsequently, the light source unit 12 is inserted in the equipment body 11, and is inserted between the attachment parts 24 at both the sides while the attachment members 38 at both the sides are elastically deformed to the inside. By this, the hook parts 40 of the attachment members 38 elastically contact the tips of the

attachment parts 24, and urge the contact parts 37 of the support plates 31 in the direction of contacting the lower surfaces of the attachment parts 24, and the light source unit 12 is attached to the equipment body 11.

[0026] Subsequently, the reflection unit 15 is inserted in the equipment body 11, and is inserted between the attachment parts 25 at both the sides while the attachment parts 54 at both the sides are elastically deformed to the inside. By this, the hook parts 56 of the attachment members 54 elastically contact the attachment parts 25, and urge the contact parts 53 of the reflection plates 51 in the direction of contacting the lower surface of the support plate 31, and the reflection unit 15 is attached to the equipment body 11.

[0027] Subsequently, the prism sheet 14 is inserted in the opening 18 of the equipment body 11, and is inserted between the attachment parts 26 at both the sides while the attachment edges 43 at both the sides are elastically deformed to the inside. By this, the projections 44 of the attachment edges 43 contact the attachment parts 26, and the prism sheet 14 is attached to the equipment body 11.

[0028] In the assembled luminaire 10, the power supply unit 13 supplies DC power to the plural light-emitting elements 33, so that the plural light-emitting elements 33 are lit. The light emitted from the plural light-emitting elements 33 passes through the light diffusion cover 30, is diffused and is emitted to the inner space 50a of the reflection mirror 50. Part of the light passing through the light diffusion cover 30 is directly incident on the prism sheet 14, and part of the other light is reflected by the mirror surfaces 51a and 52a of the reflection mirror 50, and is incident on the prism sheet 14. The light incident on the prism sheet 14 becomes light having a refraction angle corresponding to an incident angle, and is emitted to the lighting space from the light emission surface 46 of the prism sheet 14, that is, the prism surface 47a of each of the prisms 47.

[0029] Here, a relation between the incident angle and the refraction angle (light emission angle) at the prism sheet 14 will be described with reference to FIG. 4. Incidentally, the incident angle and the refraction angle are angles with respect to a direction perpendicular to the surface (incident surface 45) of the prism sheet 14, and the angle in the vertical direction is 0° , and the angle in the direction perpendicular to the vertical direction is 90° .

[0030] At a point on the prism surface 47a inclined to the apex of the prism 47 from the right to the left, incident light from the left side (0 to 90°) of the point is made B, and incident light from the right side (0 to -90°) of the point is made A. In this case, the incident angle of the light B is $\theta B1$, and the refraction angle is $\theta B2$. The incident angle of the light A is $\theta A1$, and the refraction angle is $\theta A2$. With respect to the light B, even if the incident angle $\theta B1$ becomes large, the light is emitted from the prism surface 47a. However, with respect to the light A, if the incident angle $\theta A1$ becomes large (see light An), the light is totally reflected by the prism surface 47a and is not

emitted.

[0031] The table of FIG. 5 shows results of measurement of a relation among the prism angle θp of the prism 47, the incident angle $\theta A1$, and the refraction angles $\theta B2$ and $\theta A2$. The prism angle θp is an angle of the prism surface 47a with respect to a virtual line connecting the apexes of the prisms 47. The incident angle $\theta A1$, and the refraction angles $\theta B2$ and $\theta A2$ are respectively maximum values. The refraction angle $\theta B2$ is a value when the incident angle $\theta B1$ is fixed to 89° .

[0032] As is apparent from the table of FIG. 5, the maximum refraction angles $\theta B2$ and $\theta A2$ are determined by the prism angle θp . Since light is not emitted in the directions of the maximum refraction angles $\theta B2$ and $\theta A2$ or larger, when the prism angle θp becomes large, a light shielding range by the prism 47 becomes large, and a glare suppression effect becomes high. For example, when the prism angle is 20° , the light emitted at the maximum diffraction angle of 65° or larger is suppressed. When the prism angle is 35° , the light emitted at the maximum refraction angle of 48° or larger is suppressed.

[0033] For example, in the case of the prism angle of 25° , if light is incident at the incident angle $\theta A1$ of 0° to 23° , the light is emitted in the range in which the refraction angle $\theta A2$ is 57° or less. However, if light is incident at the incident angle $\theta A1$ of 23° to 90° , the light is totally reflected by the prism surface 47a and is not emitted.

[0034] As described above, since the prism sheet 14 has the refraction angle range in which light can be emitted (the range in which the refraction angle $\theta A2$ is 57° or less), the incident angle of the light to the prism sheet 14 is controlled by the reflection mirror 50, so that the refraction angle of the light incident on the prism sheet 14 falls within the refraction angle range in which the light can be emitted from the prism sheet 14. For example, if the prism angle is 25° , since the range of the refraction angle $\theta A2$ in which the light can be emitted is 57° or less, the reflection mirror 50 controls so that the incident angle $\theta A1$ falls within the range of 0° to 23° .

[0035] FIG. 6 shows results of measurement of equipment light flux with respect to the embodiment in which the prism sheet 14 and the reflection mirror 50 having the mirror surface 51a are combined, comparative example 1 in which the prism sheet 14 and a white reflection surface are combined, and comparative example 2 in which only the prism sheet 14 is used and the reflection mirror 50 is not used. Incidentally, conditions such as power consumption are common.

[0036] As a result of the measurement of the equipment light flux, the light flux was 1570.2 lm in the embodiment, 1442.2 lm in the comparative example 1 and 1256.6 lm in the comparative example 2. Accordingly, when the equipment efficiency of the embodiment was assumed to be 100%, the equipment efficiency was 92% in the comparative example 1, and 80% in the comparative example 2.

[0037] As in the comparative example 2, when only the prism sheet 14 was used, since incident angle of the light

incident on the prism sheet 14 was not limited, the light was totally reflected by the prism sheet 14 according to the incident angle of the light and was not emitted, and the equipment efficiency was low.

[0038] As in the comparative example, 1, when the prism sheet 14 and the white reflection surface were combined, the equipment efficient was improved as compared with the comparative example 2. However, since the directionality of the reflected light from the white reflection surface is low, the reflected light is apt to be dif-

[0039] As in this embodiment, when the prism sheet 14 and the reflection mirror 50 having the mirror surface 51a were combined, the directionality of the light reflected by the mirror surface 51a was high, the incident angle of the light incident on the prism sheet 14 was sufficiently controlled, and the equipment efficiency was improved as compared with the comparative examples 1 and 2.

[0040] FIG. 7 to FIG. 9 are luminous intensity distribution views in which the luminous intensity distribution is measured with respect to the embodiment, the comparative example 1, and the comparative example 2.

[0041] In the embodiment of FIG. 7, bat-wing luminous intensity distribution is possible in which light intensity in the direction of a refraction angle of 30° is intensified. While glare is prevented, the wide luminous intensity distribution is obtained, and the illuminance of the irradiation surface can be uniformed.

[0042] When the prism sheet 14 is combined with the white reflection surface as in the comparative example 1, and when only the prism sheet 14 is used as in the comparative example 2, bat-wing luminous intensity distribution is difficult, downlight illuminance is high, and wide luminous intensity distribution can not be obtained.

[0043] As described above, in the luminaire 10 of the embodiment, the light from the light-emitting module 29 is reflected to the prism sheet 14 by the mirror surface 51a of the reflection mirror 50, and the incident angle of the light incident on the prism sheet 14 is controlled. Accordingly, the light emitted from the prism sheet 14 increases, and the equipment efficiency can be improved.

[0044] Besides, the incident angle of the light to the prism sheet 14 is controlled by the reflection mirror 50 so that the refraction angle of the light incident on the prism sheet 14 falls within the refraction angle range of the prism sheet 14 in which the light can be emitted. Accordingly, the light emitted from the prism sheet 14 increases, and the equipment efficiency can be improved.

[0045] Besides, since the reflection mirror 50, together with the light-emitting module 29, is attached to the equipment body 11, the light-emitting module 29 and the reflection mirror 50 are positioned through the equipment body 11, and the control of the incident angle of the light to the prism sheet 14 by the reflection mirror 50 can be certainly performed.

[0046] Besides, when the light-emitting elements 33 to emit light having high directivity are used, by using the

light diffusion cover 30, it is possible to prevent that images of the plural light-emitting elements 33 are projected on the prism sheet 14 and uneven brightness occurs.

[0047] Incidentally, as the light source, no limitation is made to the light-emitting module 29 using the light-emitting elements 33, and a lamp such as a straight tube type fluorescent lamp may be used.

[0048] While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

Claims

1. A luminaire (10) comprising:

a light source (29);
a prism sheet (14) including an incident surface (45) on which light from the light source (29) is incident, and a light emission surface (46) from which light having a refraction angle corresponding to an incident angle of the light incident from the incident surface (45) is emitted; and
a reflector (50) arranged between the light source (29) and the prism sheet (14) and including a mirror surface (51a) which reflects the light from the light source (29) to the prism sheet (14) and controls the incident angle of the light to the prism sheet (14).

2. The luminaire (10) according to claim 1, wherein the prism sheet (14) has a refraction angle range in which the light can be emitted according to the incident angle of the light, and the reflector (50) controls the incident angle of the light to the prism sheet (14) so that the refraction angle of the light incident on the prism sheet (14) falls within the refraction angle range of the prism sheet (14) in which the light can be emitted.

3. The luminaire (10) according to claim 1 or 2, further comprising an equipment body (11) to which the light source (29), the prism sheet (14) and the reflector (50) are attached.

4. The luminaire (10) according to any one of claims 1 to 3, wherein the light source (29) include a light-emitting element (33), and a light diffusion cover (30) covers the light source

(29).

5. The luminaire (10) according to claim 4, wherein the light diffusion cover (30) protrudes into an inner space (50a) of the reflector (50). 5
6. The luminaire (10) according to claim 4 or 5, wherein the light emitted by the light-emitting element (33) passes through and is diffused by the light diffusion cover (30) and is emitted to the inner space (50a) of the reflector (50), 10
part of the light passing through the light diffusion cover (30) is directly incident on the prism sheet (14), and part of the other light is reflected by the mirror surface (51a) and is incident on the prism sheet (14). 15
7. The luminaire (10) according to any one of claims 1 to 6, wherein the mirror surface (51a) of the reflector (50) is a recessed curved surface. 20
8. The luminaire (10) according to any one of claims 1 to 7, further comprising a support plate (31) to support the light source (29), wherein the reflector (50) includes a reflection plate (51) forming the mirror surface (51a), and a contact part (53) 25
which is provided on an upper end of the reflection plate (51) and contacts the support plate (31).
9. The luminaire (10) according to any one of claims 1 to 8, wherein the reflector (50) includes an opening (58) opened to the prism sheet (14), and an opening width of the opening (58) is close to a width of the prism sheet (14). 30

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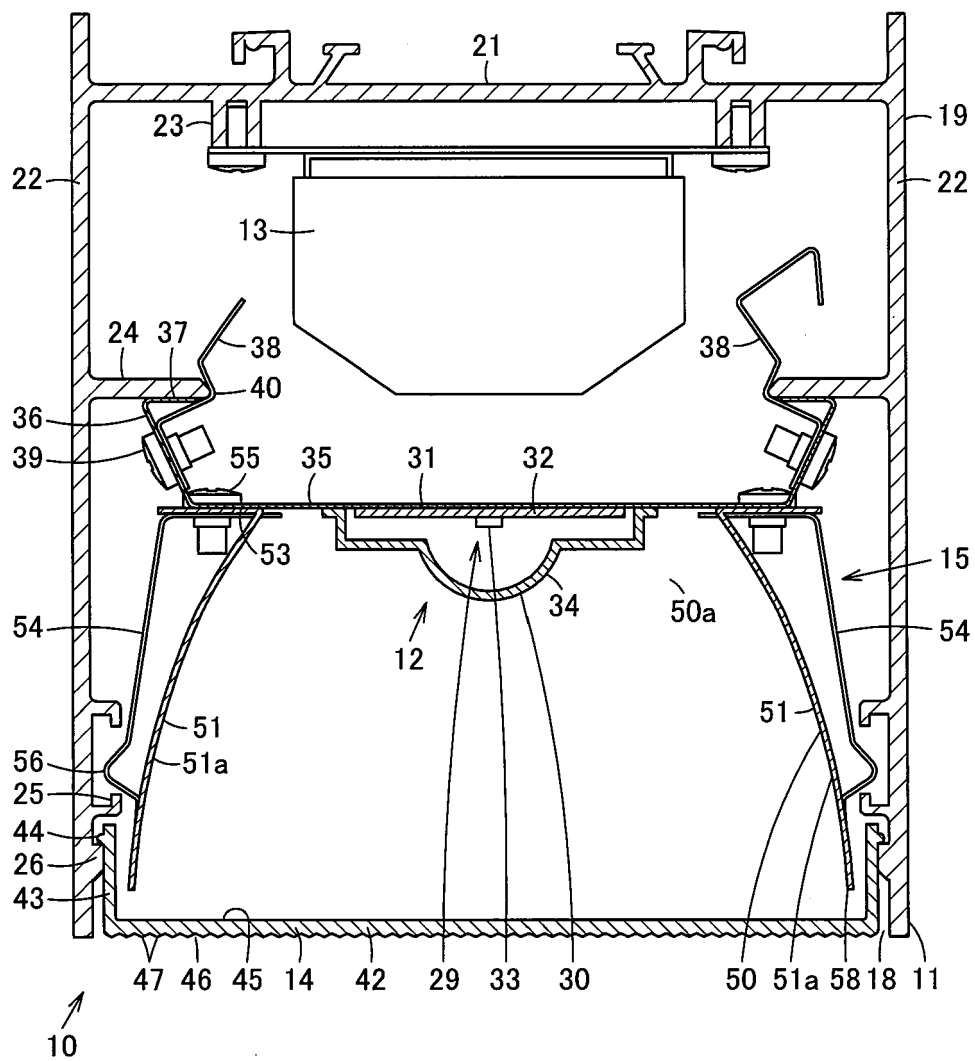


FIG. 1

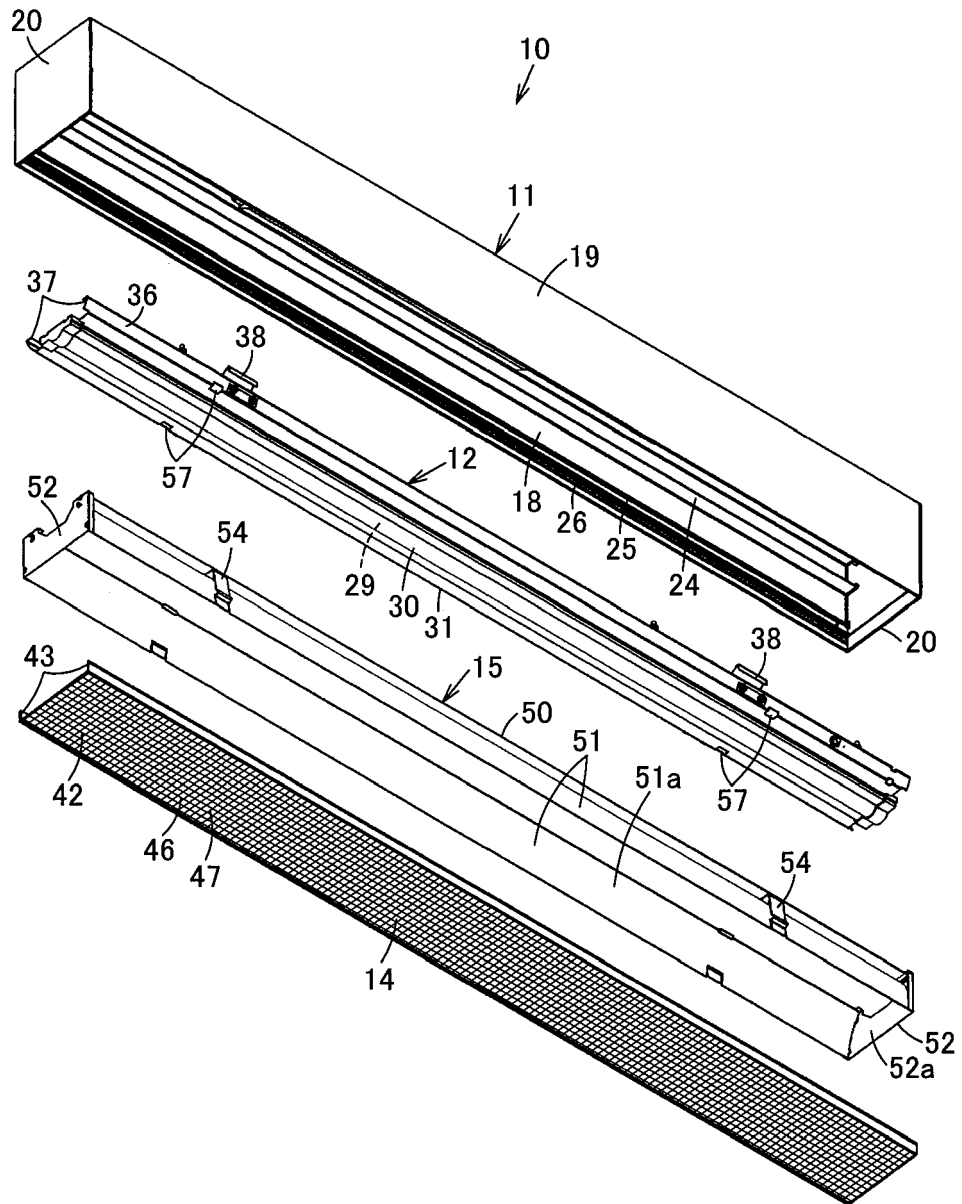


FIG. 2

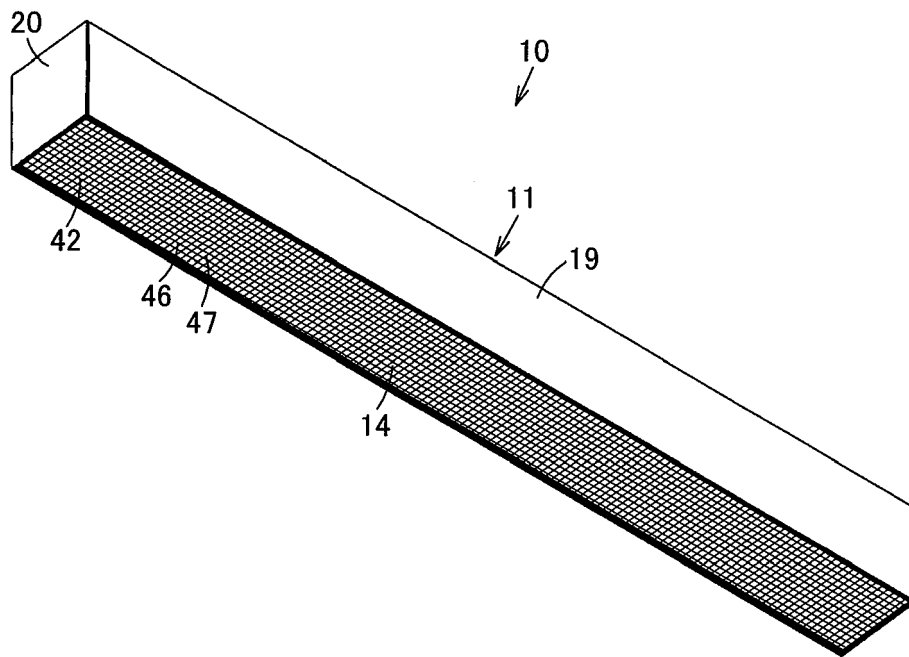


FIG. 3

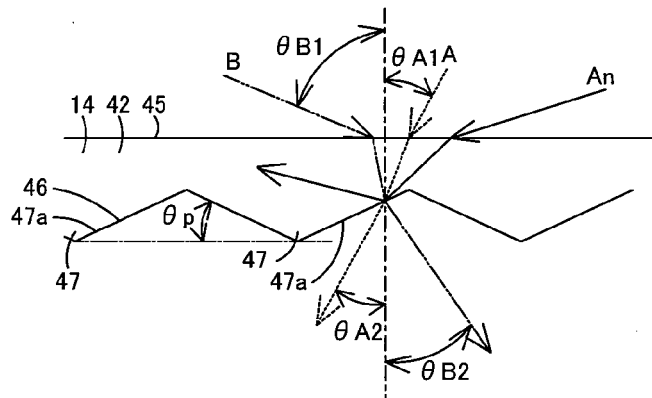


FIG. 4

PRISM ANGLE $\theta_{pmax} (^{\circ})$	5	10	15	20	25	30	35	40
REFRACTION ANGLE $\theta_{B2max} (^{\circ})$	67	65	55	51	47	44	41	38
REFRACTION ANGLE $\theta_{A2max} (^{\circ})$	79	75	70	65	57	53	48	43
INCIDENT ANGLE $\theta_{A1max} (^{\circ})$	62	50	40	31	23	14	6	-2

FIG. 5

TEST SAMPLE	EMBODIMENT PRISM SHEET + MIRROR SURFACE REFLECTION	COMPARATIVE EXAMPLE 1 PRISM SHEET + WHITE REFLECTION	COMPARATIVE EXAMPLE 2 ONLY PRISM SHEET
EQUIPMENT LIGHT FLUX	1570.2 lm	1442.2 lm	1256.6 lm
POWER CONSUMPTION	18.0 W	18.0 W	18.0 W
EFFICIENCY	87.2 lm/W	80.1 lm/W	69.8 lm/W
EFFICIENCY RATIO	100%	92%	80%

FIG. 6

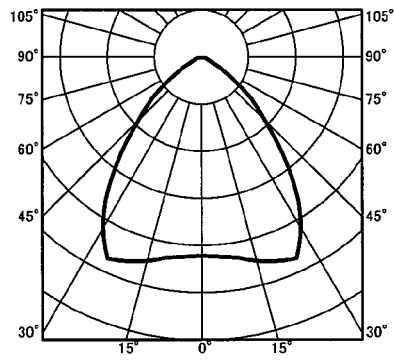


FIG. 7

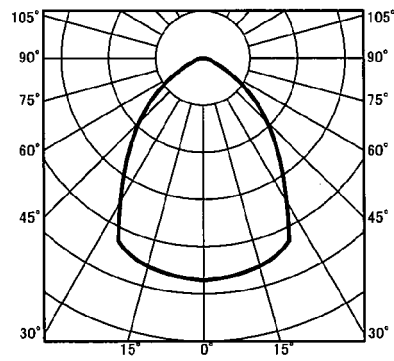


FIG. 8

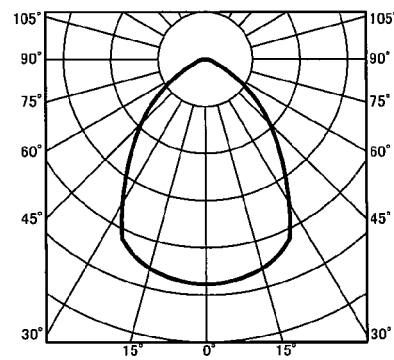


FIG. 9



EUROPEAN SEARCH REPORT

Application Number
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 January 2015	Examiner Demirel, Mehmet
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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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
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