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(71) Applicant: **Koito Manufacturing Co., Ltd.**
Tokyo 108-8711 (JP)

(72) Inventor: **TANAKA, Hidetada**
SHIZUOKA-SHI, SHIZUOKA (JP)

(74) Representative: **Intès, Didier Gérard André et al**
Cabinet Beau de Loménie
158, rue de l'Université
75340 Paris Cedex 07 (FR)

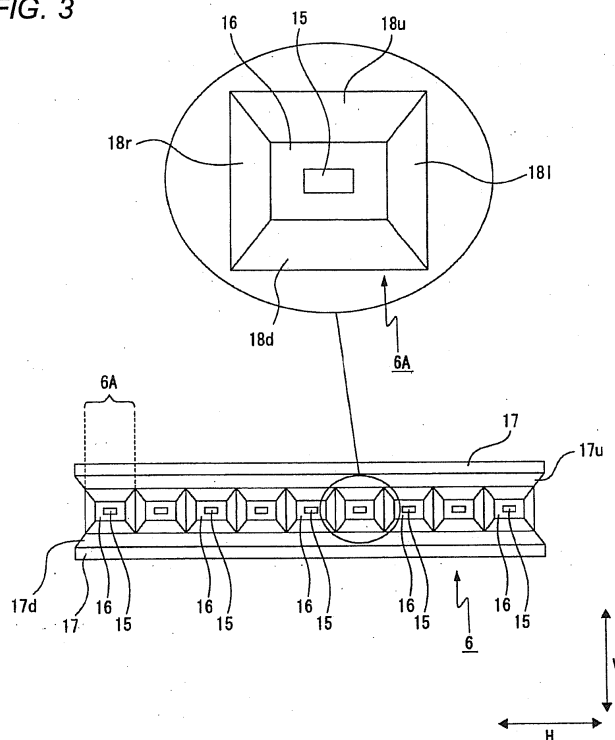
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(54) **Vehicle headlamp**

(57) There is provided a vehicle headlamp including: plural semiconductor light emitting elements (15) which are arranged in a left and right direction and each has a light emitting surface; plural first reflectors each provided for corresponding one of the semiconductor light emitting elements (15), each including: a first upper reflector (18u) on an upper side of the light emitting surface; a first lower reflector (18d) on a lower side of the light emitting surface;

a first right reflector (18r) on a right side of the light emitting surface; and a first left reflector (18l) on a left side of the light emitting surface, a projection lens which projects light emitted from the semiconductor light emitting elements (15) toward a outside region. A reflection surface of the first right reflector (18r) and a reflection surface of the first left reflector (18l) are formed as a flat surface.

FIG. 3



Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] The present invention relates to a vehicle headlamp. Particularly, the present invention relates to a vehicle headlamp which includes a light source in which a plurality of semiconductor light emitting elements are arranged.

2. Background Art

[0002] In a vehicle headlamp, for example, as a light source, a semiconductor light emitting element such as a Light Emitting Diode (LED) is disposed in an inner portion of a lamp outer case which is formed of a cover and a lamp body (for example, see JP-A-2007-213877).

[0003] Moreover, as the vehicle lamp, an array structure in which a plurality of the semiconductor light emitting elements are disposed in a horizontal direction (left and right direction) is adopted.

[0004] However, by only arranging the plurality of semiconductor light emitting elements in the left and right direction and projecting the outgoing light via a projection lens, a region (boundary) between respective semiconductor light emitting elements may be a region (a non-light region) in which the light is not emitted, and in this case, there is a concern that vertical dark stripes may occur in a plurality of locations in a light distribution pattern of projection light distributed by the projection lens.

[0005] As a method for preventing the above-described vertical dark stripes, a method, which provides a minute reflection surface (reflector) for each semiconductor light emitting element, can be considered. Specifically, reflectors are provided in at least left and right positions of the front side of the semiconductor light emitting element, respectively, reflected light of the left and right reflectors is distributed to the boundary of the light distribution region of direct light which is not reflected by the reflectors, and thus the dark stripes can be prevented.

[0006] However, even in the case where the reflectors are provided in the left and right sides, the light distributed in the boundary of the light distribution region of the direct light is insufficient according to the shapes of reflection surfaces of the left and right reflectors, and there is a concern that the vertical dark stripes may not be sufficiently prevented.

SUMMARY OF THE INVENTION

[0007] The present invention is made in consideration of the above-described circumstances, and an object thereof is to prevent a vertical dark stripes and form an improved light distribution pattern in a vehicle headlamp having a light source in which a plurality of semiconductor light emitting elements are arranged.

[0008] According to one or more aspects of the present invention, there is provided a vehicle headlamp. The vehicle headlamp comprises: a plurality of semiconductor light emitting elements which are arranged in a left and right direction and each has a light emitting surface; a plurality of first reflectors each provided for corresponding one of the semiconductor light emitting elements, each of the first reflectors comprising: a first upper reflector on an upper side of the light emitting surface; a first lower reflector on a lower side of the light emitting surface; a first right reflector on a right side of the light emitting surface; and a first left reflector on a left side of the light emitting surface, a projection lens which projects light emitted from the semiconductor light emitting elements toward a outside region. A reflection surface of the first right reflector and a reflection surface of the first left reflector are formed as a flat surface.

[0009] According to one or more aspects of the present invention, an interval between adjacent semiconductor light emitting elements and an angle between the reflection surface of the first right reflector and the reflection surface of the first left reflector near an edge position of the array length of the plurality of semiconductor light emitting elements is larger than those at a center position of the array length of the plurality of semiconductor light emitting elements.

[0010] According to one or more aspects of the present invention, the vehicle headlamp further comprises: a second upper reflector on an upper side of the first upper reflector; and a second lower reflector on a lower side of the first lower reflector. The length of a reflection surface of the second upper reflector is longer than the length of a reflection surface of the second lower reflector.

[0011] According to one or more aspects of the present invention, the vehicle headlamp further comprises: a second upper reflector on an upper side of the first upper reflector; and a second lower reflector on a lower side of the first lower reflector. The length of a reflection surface of the second upper reflector is longer than the length of a reflection surface of the second lower reflector. The projection lens has a radiation surface, wherein the curvature of an upper portion of the radiation surface is gradually decreased toward an outer circumferential portion thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a schematically vertical cross-sectional view of a vehicle headlamp;
Fig. 2 is a schematic front view of the vehicle headlamp;
Fig. 3 is a schematic front view of light emitting portions;
Fig. 4 is a view schematically showing a light distribution pattern formed by the vehicle headlamp;
Fig. 5 is an explanatory view for explaining an interval

of semiconductor light emitting elements and angles of first left and right reflectors;

Fig. 6 is an explanatory view when reflection surfaces of the first left and right reflectors are set to a radiation surface shape;

Fig. 7 is an explanatory view when reflection surfaces of the first left and right reflectors are set to a flat surface shape;

Fig. 8 is an explanatory view of a first setting example with respect to angles and lengths of the first left and right reflectors;

Fig. 9 is an explanatory view of a second setting example with respect to angles and lengths of the first left and right reflectors;

Fig. 10 is an explanatory view of horizontal dark stripes;

Fig. 11 is an explanatory view of setting of angles and lengths of first upper and lower reflectors to prevent the horizontal dark stripes;

Fig. 12 is an image view showing a state that a portion of light is projected in a light shielding area;

Fig. 13 is an explanatory view of a second reflector of a second embodiment;

and

Fig. 14 is an explanatory view of an operation of a projection lens used in the second embodiment.

DETAILED DESCRIPTION

[0013] Hereinafter, exemplary embodiments of a vehicle headlamp of the present invention will be now described with reference to the accompanying drawings.

<First Embodiment>

[1-1. Overall Configuration of Vehicle Lamp]

[0014] Figs. 1 and 2 are explanatory views of a configuration of a vehicle headlamp 1 which is an embodiment, Fig. 1 is a schematically vertical cross-sectional view of the vehicle headlamp 1, and Fig. 2 is a schematic front view of the vehicle headlamp 1.

[0015] In the vehicle headlamp 1, an inner portion of a lamp outer case 4, which comprises a lamp body 2 and a cover 3 attached to the front end of the lamp body 2, is formed as a lamp chamber 5, and a lamp unit 20 which includes a light emitting portion 6 or a projection lens 12 is disposed in the lamp chamber 5 (see Figs. 1 and 2).

[0016] The vehicle headlamp 1 of the present embodiment is a high-beam (upward and farsighted) headlamp which irradiates a long distance region.

[0017] The lamp unit 20 is configured so that respective necessary portions are mounted on a bracket 7 disposed in the lamp chamber 5.

[0018] The bracket 7 is formed of a metal material having high thermal conductivity, and supported portions 7a are provided in both upper and lower ends. A heat radiation member (heat radiation pin) 8 is mounted on the

rear surface of the bracket 7. A heat radiation fin 9 is mounted on the rear surface of the heat radiation member 8.

[0019] A light emitting portion 6 is mounted in a center portion of the front surface of the bracket 7. Although details are described below, the light emitting portion 6 has a plurality of semiconductor light emitting elements as a light source.

[0020] A lens holder 11 is mounted on the front surface of the bracket 7 (see Fig. 1). The lens holder 11 is formed in an approximately cylindrical shape which penetrates in the front and rear direction and is mounted on the bracket 7 so as to cover the light emitting portion 6.

[0021] A projection lens 12 is mounted on the front end of the lens holder 11. The projection lens 12 is formed in an approximately hemispherical shape which protrudes forward and projects light emitted from the light emitting portion 6 to the front side.

[0022] Extensions (blindfold members) 13 are provided in the lamp chamber 5.

[0023] Aiming screws 10 are connected to be screwed to the supported portions 7a of the bracket 7, respectively. The bracket 7 is supported to be tiltable to the lamp body 2 via the aiming screws 10. If the aiming screw 10 is rotated, the bracket 7 is tilted in the left and right direction or the up and down direction with the supported portions 7a other than the support portion, to which the aiming screw 10 is screwed, as supporting points, and thus adjustment of an optical axis (aiming adjustment) is performed.

[1-2. Configuration of Light Emitting Portion]

[0024] Fig. 3 is a schematic front view of the light emitting portion 6.

[0025] The light emitting portion 6 includes a plurality of semiconductor light emitting elements 15 which are arranged in the horizontal direction H (the left and right direction). In Fig. 3, the number of the arranged semiconductor light emitting elements 15 is 9. However, the number of the arranged semiconductor light emitting elements 15 is not particularly limited thereto. For example, as the semiconductor light emitting elements 15, Light Emitting Diodes (LEDs) may be used. Each semiconductor light emitting element 15 is disposed on the front surface side of each base plate 16, and each base plate 16 is mounted on the front surface of the bracket 7 as shown in Fig. 1.

[0026] Moreover, as shown in an enlarged manner in Fig. 3, a first reflector (minute reflection surface: small reflector) 18 is formed on the front side (light emitting surface sides) of each of the semiconductor light emitting elements 15. The first reflector 18 is formed at each position of the upper, lower, left, and right in the front side of the semiconductor light emitting element 15. The first reflectors 18 in each position of the upper, lower, left, and right are indicated by a first reflector 18u, a first reflector 18d, a first reflector 18l, and a first reflector 18r, respec-

tively.

[0027] Each of the first reflectors 18u, 18d, 18l, and 18r is formed so as to reflect light emitted from the semiconductor light emitting element 15, and a light emitting unit 6A includes one semiconductor light emitting element 15 and the first reflectors 18u, 18d, 18l, and 18r of the upper, lower, left, and right which are formed on the front side of the one semiconductor light emitting element 15.

[0028] A pair of second reflectors (large reflectors) 17 are provided to be separated from each other in up and down direction in the front side of the light emitting units 6A in the light emitting portion 6. Respective reflection surfaces 17u and 17d of the second reflectors 17 positioned at upper and lower portions extend in the horizontal direction H so as to reflect the light emitted from the semiconductor light emitting elements 15.

[0029] Moreover, although it is not shown, driving currents are separately supplied from a lighting circuit to the respective semiconductor light emitting elements 15. The semiconductor light emitting elements 15 to which the driving currents are supplied are lighted and the semiconductor light emitting elements 15 to which the driving currents are not supplied are unlighted.

[0030] Moreover, current values of the driving currents supplied from the lighting circuit to the respective semiconductor light emitting elements 15 can be separately changed.

[1-3. Light Distribution Pattern]

[0031] Fig. 4 is a view schematically showing a light distribution pattern TH formed by the vehicle headlamp 1. Moreover, Figs. 4 and 5 show an example when the number of the arranged semiconductor light emitting elements 15 is 13.

[0032] In Fig. 4, distribution T0, T1r, T2r, T3r, T4r, T5r, T1l, T2l, T3l, T4l, T5l, T6l, and T7l of the light which is emitted from each light emitting unit 6A is combined to form the light distribution pattern TH, and the distribution T of the light overlaps in the horizontal direction H. Moreover, the distribution T0 means the distribution T of the light according to the light emitting unit 6A which is disposed in the position corresponding to a focus F of the projection lens 12. In addition, "r" and "l" in the ends of the distribution T mean the right side and the left side with respect to the distribution T0, respectively.

[0033] The width (the length in the horizontal direction H) of the distribution T0 is minimum with respect to the other distributions T. On the other hand, the height (the length in the vertical direction V) of the distribution T0 is maximum with respect to the other distribution T.

[0034] In addition, in the distribution T1r to T5r of the right side, the widths are sequentially increased toward the right side, and the heights are sequentially decreased toward the right side.

[0035] Similarly, also in the distribution T1l to T7l of the left side, the widths are sequentially increased toward

the left side, and the heights are sequentially decreased toward the left side.

[0036] In order to prevent occurrence of glare light given to the preceding vehicle, the oncoming vehicle, or the like in the vehicle headlamp 1, lighting-on/off control is performed as follows. This control is performed by lighting and unlighting each semiconductor light emitting element 15, and for example, if the semiconductor light emitting elements 15 corresponding to the distribution T3r and T4r respectively are lighted-off, the region between the distribution T2r and T5r becomes a dark portion (lighting-off region).

[0037] In order to make the light distribution pattern TH, as described below, it is necessary to appropriately set intervals between semiconductor light emitting elements 15 or angles of reflection surfaces of the first left and right reflectors 18l and 18r.

[0038] Fig. 5 is a horizontal cross-sectional view of the light emitting portion 6 which is shown as an explanatory view with respect to the intervals between semiconductor light emitting elements and angles of the first left and right reflectors. In addition, for convenience of illustration in Fig. 5, the semiconductor light emitting elements 15 are not shown, and the center positions of each light emitting surface are indicated by vertical dashed lines. The semiconductor light emitting element 15, in which the focus F and the horizontal position are the same as each other, is conveniently represented by "15c".

[0039] In order to make the light distribution pattern TH, as regards the interval of the semiconductor light emitting elements 15 and the angle between the first left and right reflectors 18l and 18r provided for the semiconductor light emitting element 15, the interval and the angle of the end in the horizontal direction H are set to be larger than those of the center portion (the vicinity of the focus F).

[0040] In the example of Fig. 5, with respect to the interval between the semiconductor light emitting elements 15, the intervals of a range (nine in total) including four elements in the left and right, respectively, of the semiconductor light emitting element 15c are set to be identical and equal to "e". Moreover, the intervals of the semiconductor light emitting elements 15 outside said nine semiconductor light emitting elements 15 are set to be "f", which is larger than "e", respectively. Moreover, the interval of the semiconductor light emitting element 15 in the left outside of the element 15 of "f" is set to be "g" which is larger than "f", and the interval of the semiconductor light emitting element 15 in the left outside of the element 15 of "g" is set to be "h" which is larger than "g".

[0041] Moreover, with respect to the angle between the first left and right reflectors 18l and 18r, the setting pattern of the angles between the first left and right reflectors 18l and 18r, which are included in eleven light emitting units 6A in total including the light emitting unit 6A (represented by a light emitting unit 6Ac) having the semiconductor light emitting element 15c, five units (indicated by "E") in the right side, and five units (indicated

by "E") in the left side, is set to be left and right symmetrical.

[0042] Specifically, in the case of the present example, the angles between the first reflectors 181 and 18r of seven light emitting units 6A in total including the light emitting unit 6Ac and three light emitting units 6A in each of the left and right of the unit 6Ac are set to be identical and equal to "i". Moreover, the angles between the first reflectors 181 and 18r of the light emitting units 6A and 6A outside seven light emitting units 6A are set to be identical and equal to "j" which is larger than "i", and the angles between the first reflectors 181 and 18r of the light emitting units 6A and 6A outside of the light emitting unit 6A of "j" are set to be identical and equal to "k" which is larger than "j".

[0043] The angle between the first reflectors 181 and 18r of the light emitting unit 6A in the left outside of said eleven light emitting units 6A is set to be "l" which is larger than "k", and the angle between the first reflectors 181 and 18r of the light emitting unit 6A in the left outside of the light emitting unit 6A of "l" is set to be "m" which is larger than "l".

[0044] As shown in Fig. 5, the intervals of the semiconductor light emitting elements 15 and the angles between the first left and right reflectors 181 and 18r provided for the semiconductor light emitting elements 15 are set so that the interval and the angle of the end in the horizontal direction H are larger than those of the center portion (the vicinity of the focus F) in the horizontal direction H, and thus, as shown in Fig. 4, an improved light distribution pattern can be realized as the light distribution pattern of the vehicle headlamp 1.

[1-4. First Left and Right Reflector]

[0045] As described in the background art, the first left and right reflectors 181 and 18r are provided to prevent the dark stripes in the longitudinal direction (vertical direction V). For the prevention of the vertical dark stripes, shapes of the reflection surfaces of the first left and right reflectors 181 and 18r are important. This point will be described with reference to Figs. 6 and 7.

[0046] A horizontal cross-sectional view of Fig. 6 is an explanatory view of the background art in which the reflection surfaces of the first left and right reflectors have paraboloidal shapes, and a horizontal cross-sectional view of the Fig. 7 is an explanatory view in which the reflection surfaces of the first left and right reflectors have flat surface shapes. Moreover, as shown in Fig. 6, the first reflectors when the reflection surfaces have paraboloidal shapes are represented by 181' and 18r', respectively.

[0047] As shown in Fig. 6, when the reflection surfaces have paraboloidal shapes, the vertical dark stripes occurs on the light distribution pattern (refer to the "light distribution pattern" of Fig. 6). This is because a weak light intensity region is also formed on the focus surface Fs of the projection lens 12 as shown by "S" in Fig. 6

when the reflection surfaces have paraboloidal shapes. The light reflected by the first reflectors 181' and 18r' is indicated by dashed arrows in Fig. 6, and according to this, it can be confirmed that the reflected light does not overlap in the portion corresponding to the boundary between the adjacent light emitting units 6A and 6A on the focus surface Fs. Accordingly, the weak light intensity region S occurs on the focus surface Fs. If the projection lens 12 projects incident light in the state where the weak light intensity region S occurs, the vertical dark stripes occur in the light distribution pattern.

[0048] On the other hand, as shown in Fig. 7, in the present embodiment, the reflection surfaces of the first left and right reflectors 181 and 18r have a flat surface shape. That is, when viewed from the horizontal cross-section, the shapes of the reflection surfaces of the first left and right reflectors 181 and 18r have linear shapes.

[0049] Since the reflection surfaces of the first left and right reflectors 181 and 18r have flat surface shapes, the reflected light of the first reflectors 181 and 18r overlaps on the region between the light emitting units 6A and 6A adjacent on the focus surface Fs (dashed arrows in Fig. 7). Accordingly, occurrence of the weak light intensity region S on the focus surface Fs as shown in Fig. 6 can be prevented.

[0050] As a result, in this case, the light distribution pattern becomes an improved pattern in which the occurrence of the black stripes is prevented (see the "light distribution pattern" shown in Fig. 7).

[0051] In this way, since the reflection surfaces of the first left and right reflectors 181 and 18r have flat surface shapes, the vertical dark stripes in the light distribution pattern can be prevented.

[0052] Moreover, since the reflection surfaces of the first left and right reflectors 181 and 18r have flat surface shapes, light distribution efficiency is also improved. That is, in the first reflectors 181' and 18r' having paraboloidal shapes, since the increase of the length is difficult due to limitations of the disposition spaces and sufficient reflected light quantity cannot be obtained, the light distribution efficiency may be decreased. However, if the reflection surfaces have the flat surface shapes, since the lengths of the reflection surfaces are increased and light quantity of the reflected light can be increased, the light distribution efficiency can be improved according to the increase of the light quantity.

[1-5. Method of Setting Lengths and Angles of First Left and Right Reflectors]

[0053] A method of setting the lengths and angles of the reflection surfaces of the first left and right reflectors 181 and 18r will be described with reference to Figs. 8 and 9. The left sides of Figs. 8 and 9 mainly show a relationship between ranges of direct rays ("Dr" in Figs. 8 and 9) of the semiconductor light emitting element 15c and the range (shown by arrows outside "Dr") of the reflected light by the first reflectors 181 and 18r, and the

projection lens 12, and the right sides enlarge the vicinities of the focus surfaces Fs in the left drawings, and show the ranges (indicated by hatched lines in the Figs. 8 and 9) of the direct rays of the semiconductor light emitting element 15c and the range (indicated by dotted patterns) of the reflected light by the first reflectors 18l and 18r along with the semiconductor light emitting element 15c, the first reflectors 18l and 18r, and the focus F.

[0054] Fig. 8 is an explanatory view of a first setting example with respect to the lengths and angles of the reflection surfaces of the first left and right reflectors 18l and 18r. Fig. 8 shows the setting example with respect to the semiconductor light emitting element 15c in which the horizontal position is the same as the focus F. In the setting example of Fig. 8, the light emitting surface of the semiconductor light emitting element 15c is disposed in a position which is offset by 3.0 mm from the focus surface Fs to the side opposite to a vehicle traveling direction (which is indicated by "X" in Figs. 8 and 9).

[0055] In the first setting example, an angle of each reflection surface with respect to an optical axis P in the first reflector 18l and 18r provided on the semiconductor light emitting element 15c is set to 11° , and the length in each of the first reflectors 18l and 18r in the vehicle traveling direction is set to 2 mm.

[0056] Fig. 9 is an explanatory view of a second setting example with respect to lengths and angles of the reflection surfaces of the first left and right reflectors 18l and 18r.

[0057] The difference between the first setting example and the second setting example is that the position of the light emitting surface of the semiconductor light emitting element 15c is positioned in a position which is offset by 5.0 mm from the focus surface Fs to the side opposite to the vehicle traveling direction.

[0058] Moreover, in the second setting example, the angle of each reflection surface with respect to the optical axis P in the first reflectors 18l and 18r provided on the semiconductor light emitting element 15c is set to 7° , and the length in each of the first reflectors 18l and 18r in the vehicle traveling direction is set to 4 mm.

[0059] Here, in Figs. 4 and 5 described above, the relationship between the light distribution pattern TH and the angles of the first left and right reflectors 18l and 18r is shown. However, in order to obtain the predetermined light distribution pattern TH shown in Fig. 4, certain limitations are imposed on the angle or the length of the reflection surface to be set in the first left and right reflectors 18l and 18r for each of the semiconductor light emitting elements 15 arranged in the horizontal direction H.

[0060] The angles or the lengths of the first left and right reflectors 18l and 18r may be set so that components of the direct rays of the semiconductor light emitting element 15c are incident to the projection lens 12 as much as possible while certain limitations are imposed on the angles or the lengths to obtain the improved light distribution pattern TH.

[1-6. First Upper and Lower Reflector]

[0061] The first upper and lower reflectors 18u and 18d are configured to control the light distribution pattern in the vertical direction V according to the settings of the angles or the lengths of the reflection surfaces, and when the angles or the lengths of the reflection surfaces of the first reflectors 18u and 18d are not appropriately set, it is understood that the horizontal dark stripes occur in the light distribution pattern.

[0062] According to Figs. 10 and 11, the horizontal dark stripes and the prevention method thereof will be now described.

[0063] As shown in Fig. 10, when the angles of the reflection surfaces of the first upper and lower reflectors 18u and 18d are relatively small and the lengths are relatively short, as in the light distribution pattern shown in the right side of Fig. 10, the horizontal dark stripes occur as indicated by an arrow Z in Fig. 10. It is understood that the horizontal dark stripes occur at a boundary between the pattern formed by the direct light emitted from the semiconductor light emitting element 15 and the pattern formed by the light reflected by the first reflectors 18u and 18d.

[0064] In order to prevent the occurrence of the horizontal dark stripes, in the present embodiment, as shown in Fig. 11, the angles and the lengths of the reflection surfaces of the first upper and lower reflectors 18u and 18d are further increased than those of Fig. 10.

[0065] As the specific numerical example of the angle, the angles of the reflection surfaces of the first reflector 18u and 18d with respect to the optical axis P are set to 26° , which is larger than 11° at which the horizontal dark stripes occur.

[0066] Moreover, the lengths of the reflector surfaces of the first reflectors 18u and 18d are increased to exceed the focus surface Fs as shown in Fig. 11.

[0067] In this way, the angles and the lengths of the reflection surfaces of the first upper and lower reflectors 18u and 18d are largely set, and thus, as a light distribution pattern shown in the right side of Fig. 11, the occurrence of the horizontal dark stripes can be prevented.

<2. Second Embodiment>

[0068] Next, a second embodiment of the present invention will be now described.

[0069] Moreover, a vehicle headlamp of the second embodiment is similar to the vehicle headlamp 1 of the first embodiment except that the configurations of the second reflectors 17 and the projection lens 12 are different from each other. Here, the second embodiment will be described while illustrations with respect to portions similar to the above-described portions are omitted.

[0070] Since the vehicle headlamp is used for a high beam in the present embodiment, it is necessary to widen the pattern toward the upper side in order to form the high beam. However, if the pattern is widened by increas-

ing the lengths of the second upper and lower reflectors, there is a concern that the light of the lighting-on portion may appear in the lighting-off region due to the light which is reflected by the lower large reflector during the lighting-on and lighting-off control.

[0071] That is, as shown Fig. 12, a portion "XP" of the light of the adjacent lighting-on portion appears in the lighting-off region which is indicated by "Ac".

[0072] Accordingly, in the second embodiment, as shown in Fig. 13, the appearance of a portion of light in the light-off region can be prevented by decreasing the reflection surface 17d of the second lower reflector 17 which causes the appearance, and also the light efficiency is improved by increasing the length of the reflection surface 17u of the second upper reflector 17. Thus, it is possible to prevent the appearance of the portion of light in the light-off region while improving the length of the reflection surface 17u of the second upper reflector 17.

[0073] On the other hand, the light reflected by the second lower reflector 17d mainly forms the upper pattern in the light distribution pattern and the light reflected by the second upper reflector 17u mainly forms the lower pattern in the light distribution pattern. Accordingly, widening of the upper pattern is insufficient if the second lower reflector 17d is short, and thus, there is a concern that realization of the light distribution pattern as the high beam may be damaged.

[0074] For the above reason, in the second embodiment, a projection lens 19 is used which includes a control surface capable of emitting the light reflected by the second upper reflector 17 upward (see Fig. 14).

[0075] As shown in Fig. 14, the projection lens 19 is configured so that the curvature of an upper portion of the radiation surface (emitting surface) thereof is gradually decreased toward the outer circumferential side, and as compared to the surface shape of the radiation surface of the projection lens 12 which is indicated by a dashed line, the curvature of the upper portion is small.

[0076] Accordingly, as shown in Fig. 14, the light reflected by the second upper reflector 17 can be emitted upward using the projection lens 19.

[0077] In this way, in the second embodiment, the length of the reflection surface 17u of the second upper reflector 17 is set to be longer than the length of the reflection surface 17d of the second lower reflector 17, the projection lens 19, which is set so that the curvature of the upper portion of the radiation surface thereof is gradually decreased toward the outside, is used. Thus, both the prevention of the appearance of the light in the lighting-off region and the suppression of the decrease in the light distribution efficiency are achieved while the light distribution pattern is used as the high beam.

[0078] The present invention is not limited to each embodiment described above, the embodiments can be combined respectively, modifications such as various design modifications can be applied based on knowledge of a person skilled in the art, and the combined embodiments or the modified embodiments are also included

in the scope of the present invention. The above-described embodiments and new embodiments generated by combining the embodiments and modifications have effects of each of the combined embodiments and modifications.

Claims

1. A vehicle headlamp (1) comprising:
 - a plurality of semiconductor light emitting elements (15) which are arranged in a left and right direction and each has a light emitting surface; a projection lens (12) which projects light emitted from the semiconductor light emitting elements (15) toward a outside region, **characterized in that** it further comprises:
 - a plurality of first reflectors each provided for corresponding one of the semiconductor light emitting elements (15), each of the first reflectors comprising:
 - a first upper reflector (18u) on an upper side of the light emitting surface;
 - a first lower reflector (18d) on a lower side of the light emitting surface;
 - a first right reflector (18r) on a right side of the light emitting surface; and
 - a first left reflector (18l) on a left side of the light emitting surface,
 - wherein a reflection surface of the first right reflector (18r) and a reflection surface of the first left reflector (18l) are formed as a flat surface.
2. The vehicle headlamp according to claim 1, wherein an interval between adjacent semiconductor light emitting elements (15) and an angle between the reflection surface of the first right reflector (18r) and the reflection surface of the first left reflector (18l) near an edge position of the array length of the plurality of semiconductor light emitting elements (15) are larger than those near a center position of the array length of the plurality of semiconductor light emitting elements (15).
3. The vehicle headlamp according to claim 1 or 2, further comprising:
 - a second upper reflector (17u) on an upper side of the first upper reflector (18u); and
 - a second lower reflector (17d) on a lower side of the first lower reflector (18d),
 - wherein the length of a reflection surface of the second upper reflector (17u) is longer than the

length of a reflection surface of the second lower reflector (17d).

4. The vehicle headlamp according to claim 3, wherein the projection lens (19) has a radiation surface, wherein the curvature of an upper portion of the radiation surface is gradually decreased toward an outer circumferential portion thereof.

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FIG. 1

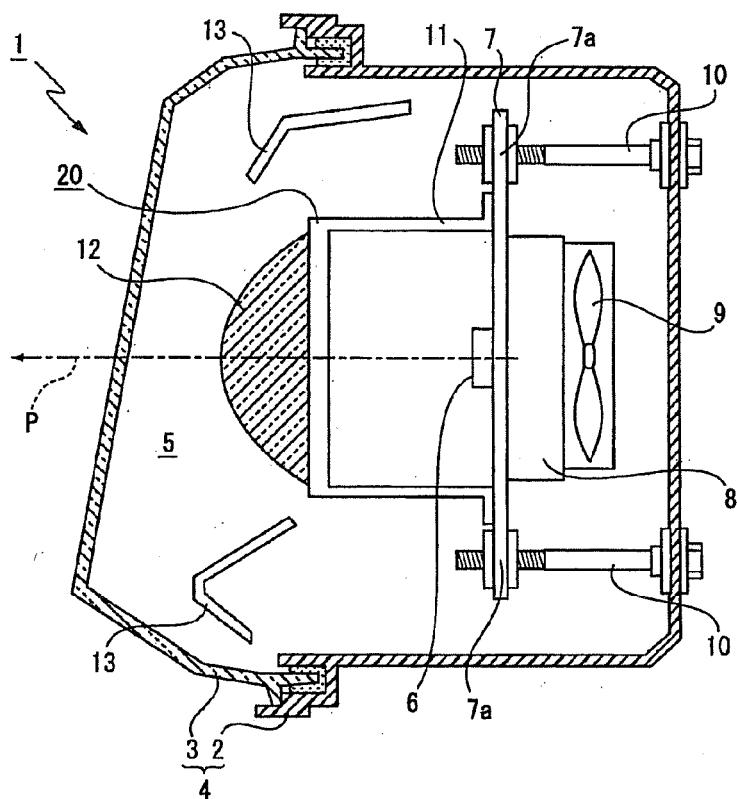


FIG. 2

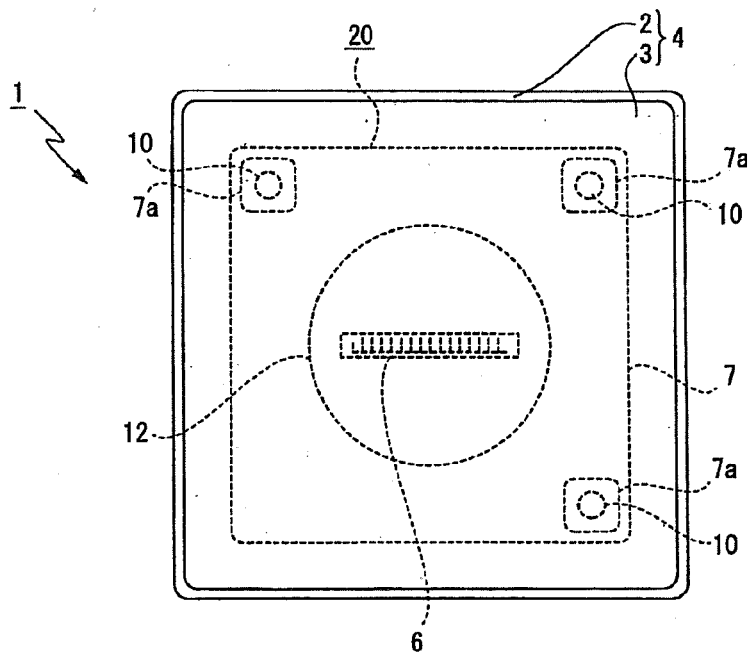


FIG. 3

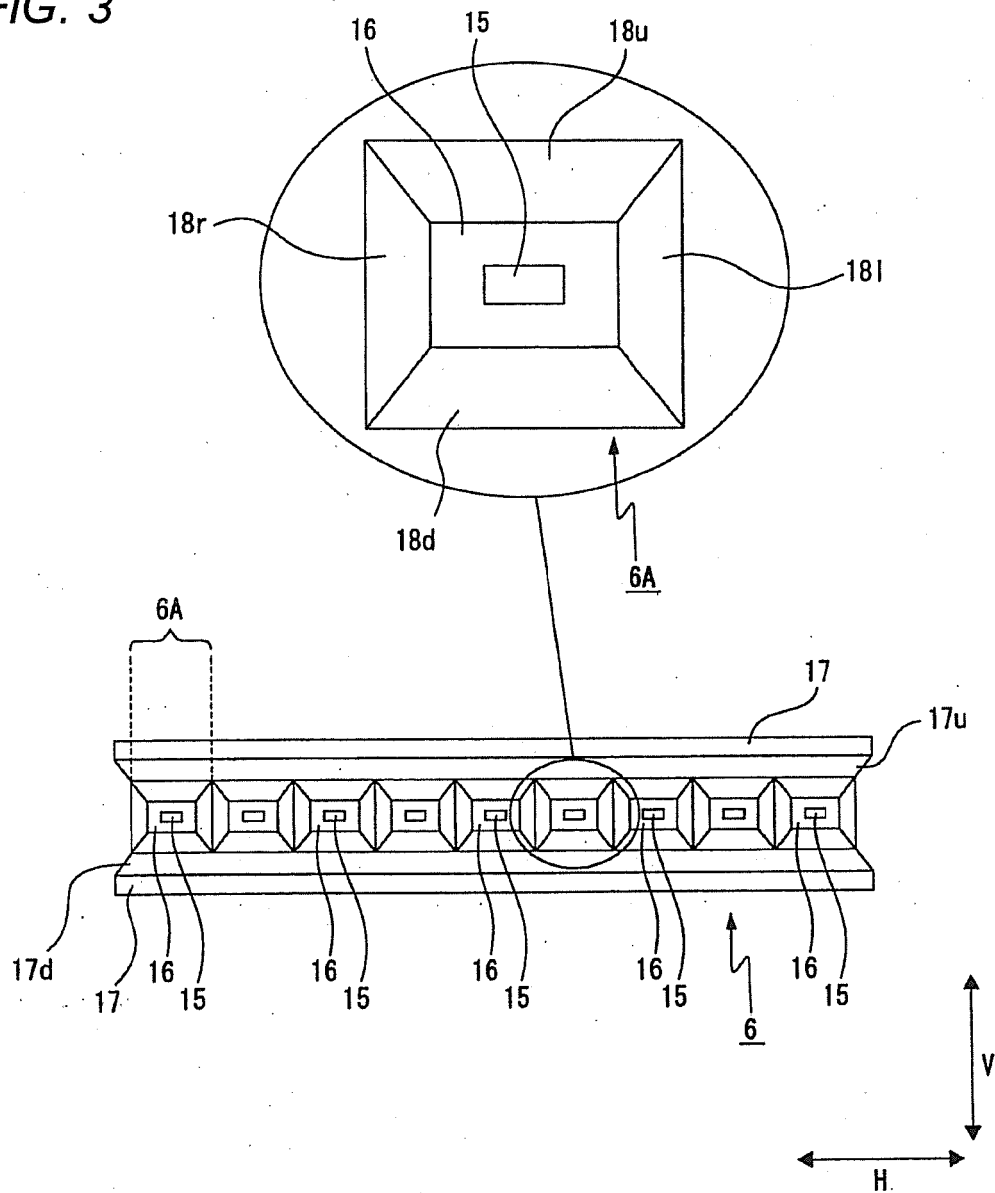


FIG. 4

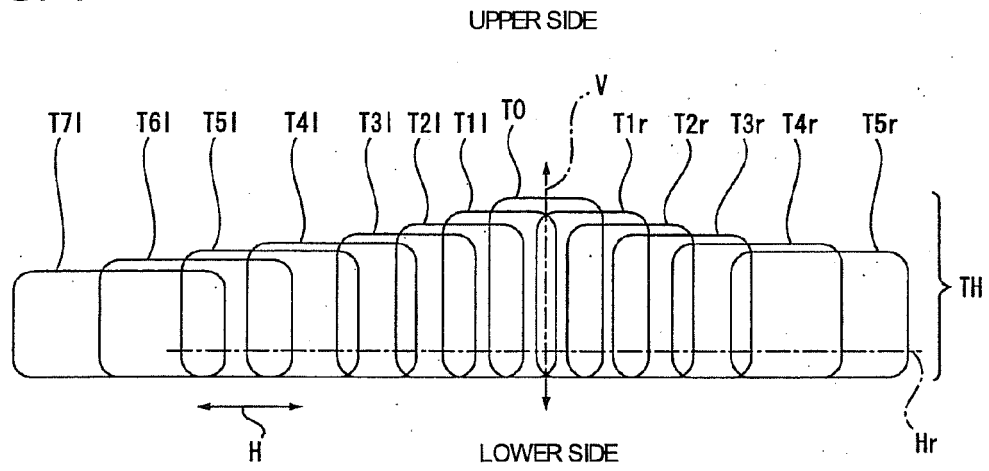


FIG. 5

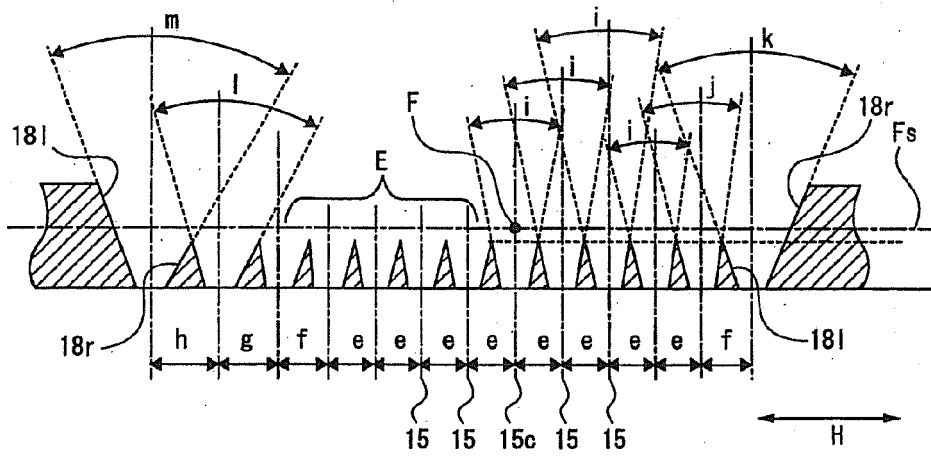


FIG. 6

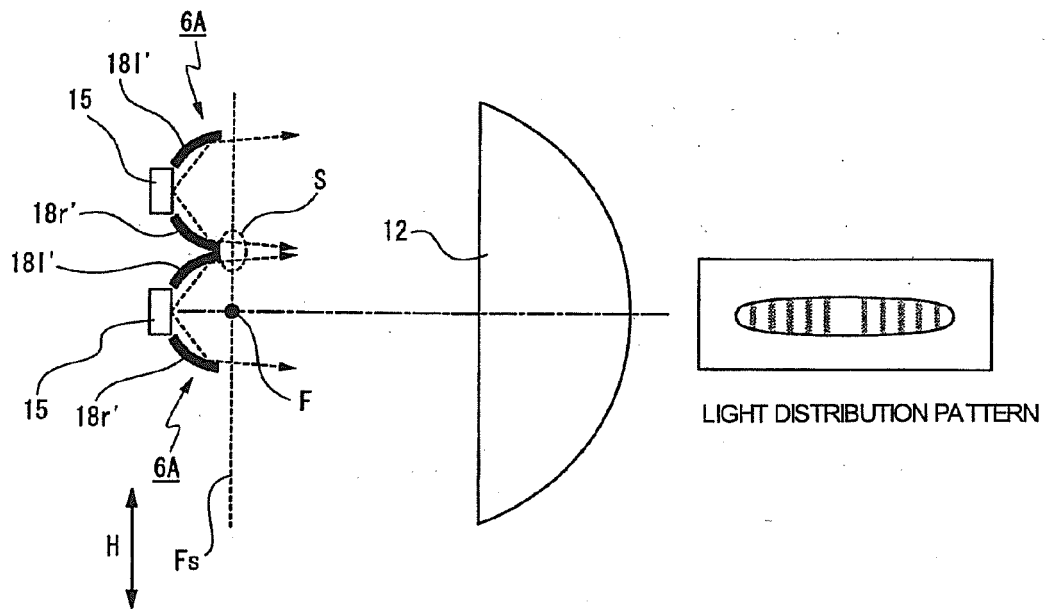


FIG. 7

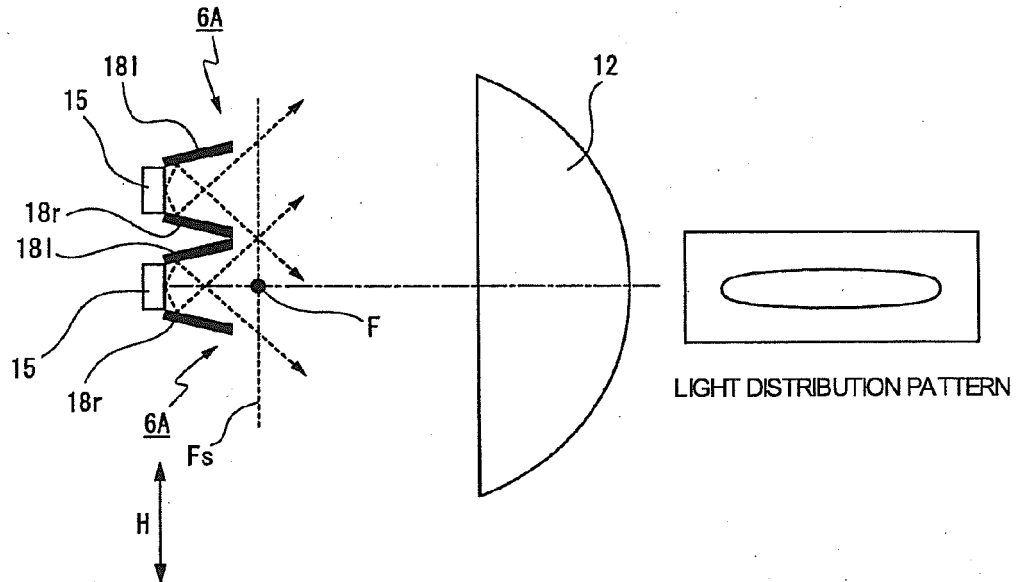


FIG. 8

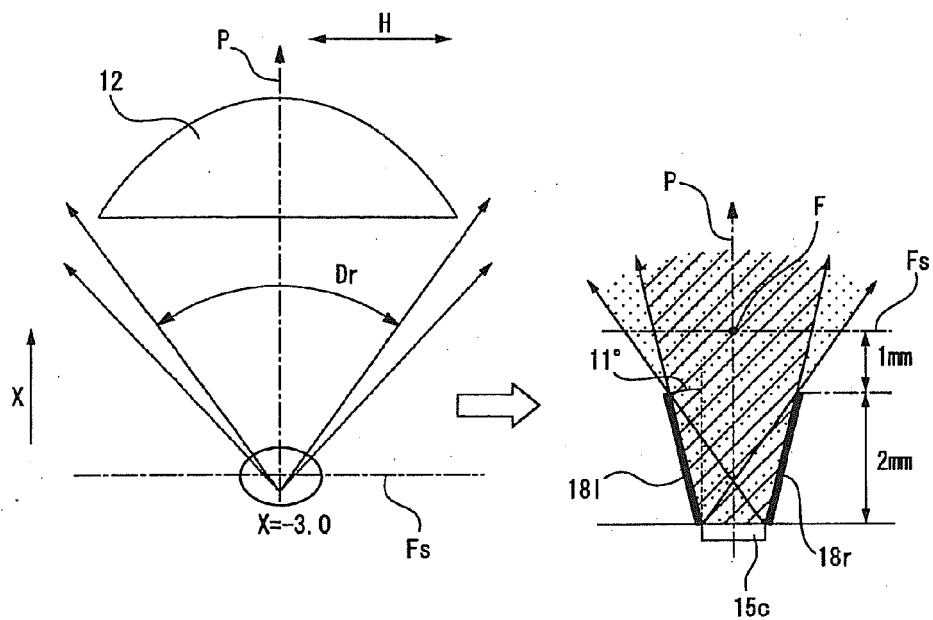


FIG. 9

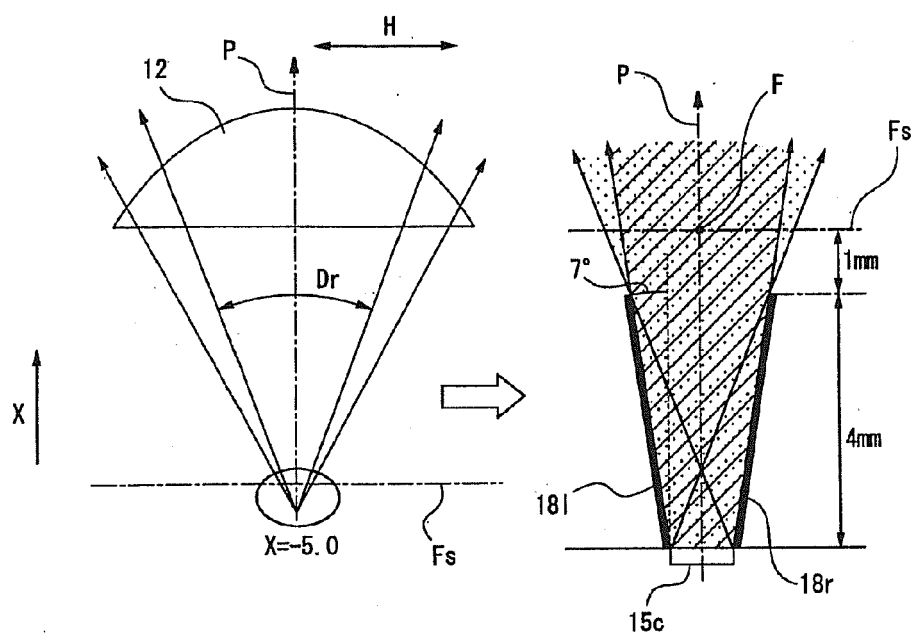


FIG. 10

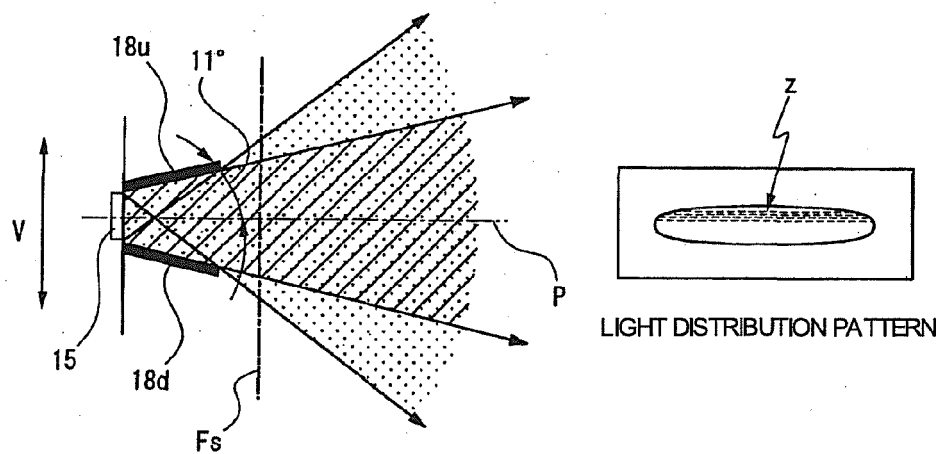


FIG. 11

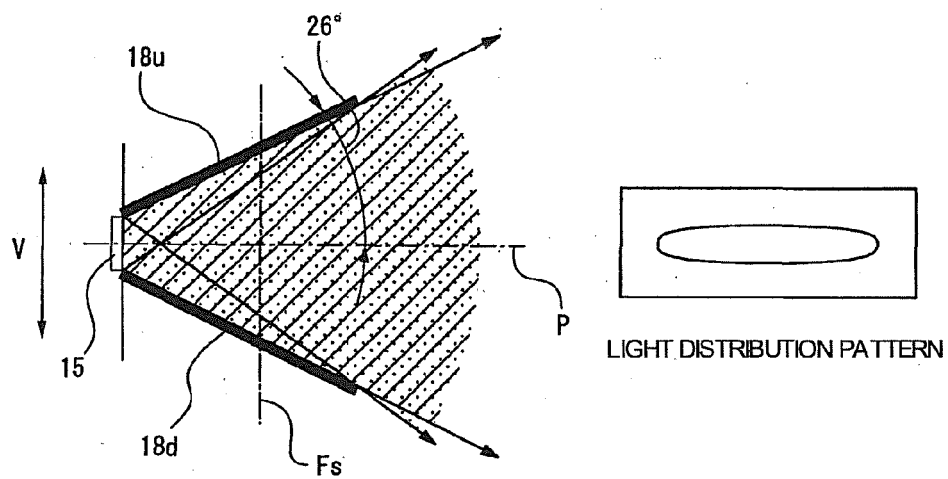


FIG. 12

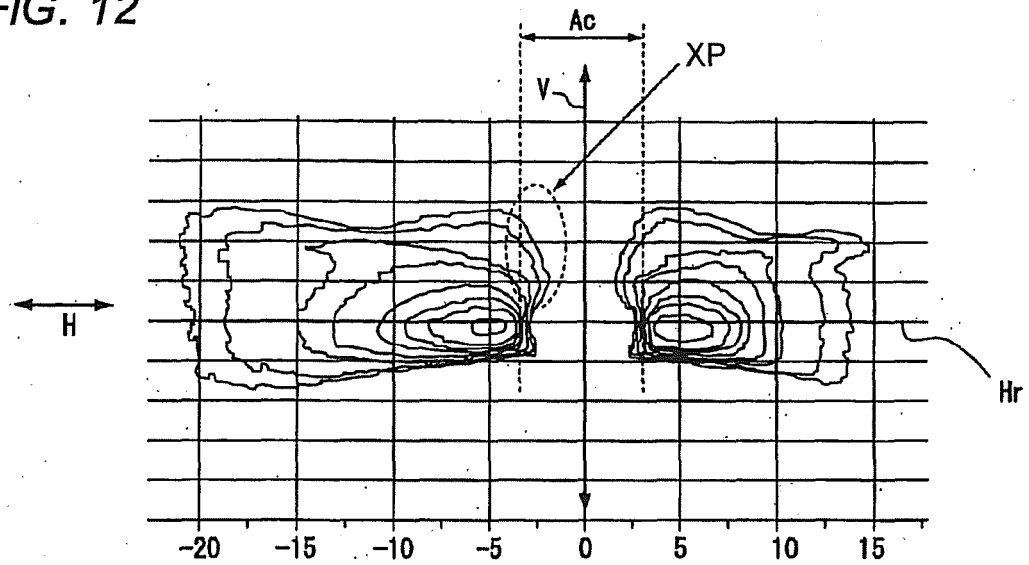


FIG. 13

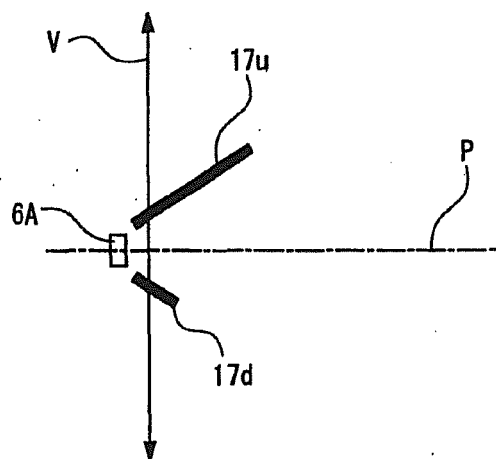
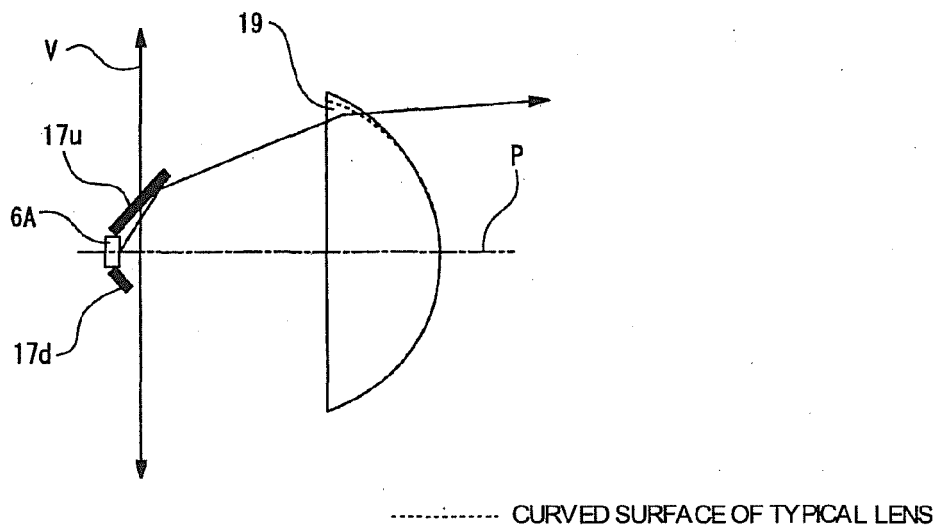


FIG. 14



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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