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

(72) Inventor: **Tanaka, Hidetada**
Shizuoka-shi, Shizuoka (JP)

(74) Representative: **Grünecker, Kinkeldey, Stockmair & Schwanhäusser**
Leopoldstrasse 4
80802 München (DE)

(54) **Vehicle headlamp**

(57) A vehicle headlamp (1) includes: a light emitting module (15) including: a plurality of semiconductor light emitting elements (18) each configured to emit light and disposed to be separated from each other in a lateral direction of the vehicle headlamp; a plurality of reflectors (22) each provided for a corresponding one of the semiconductor elements to reflect light emitted from the corresponding semiconductor light emitting element, wherein one of the reflectors located at a center position in the lateral direction is defined as a central reflector (22A); and a projector lens (29) configured to project the light

emitted from the light emitting module forward, wherein the light emitting module is disposed behind a focal plane of the projector lens. Each of the reflectors (22) other than the central reflector (22A) has an outer side (26) and an inner side (25) facing the outer side, wherein a distance between the inner side and the central reflector is smaller than a distance between the outer side and the central reflector in the lateral direction. In at least one of the reflectors (22), a first inclination angle (θ_o) of the outer side (26) with respect to an optical axis is smaller than a second inclination angle (θ_i) of the inner side (25) with respect to the optical axis.

FIG. 3

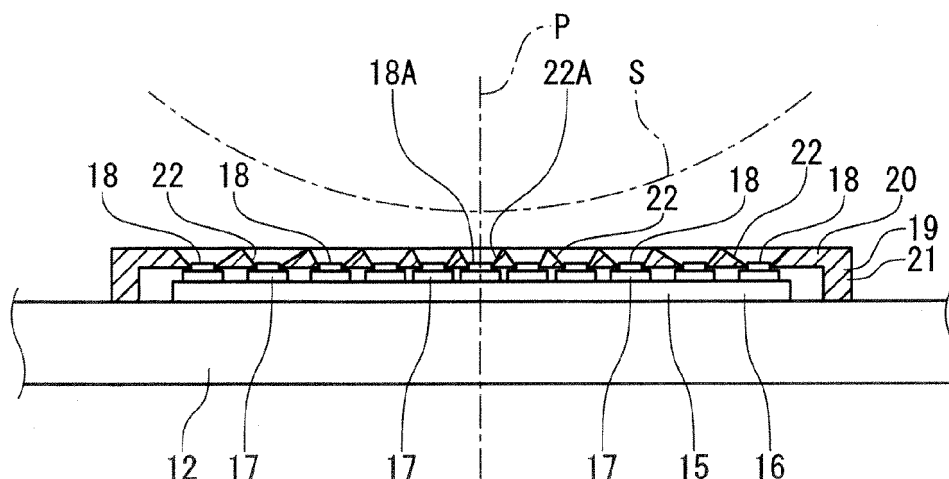


FIG. 5

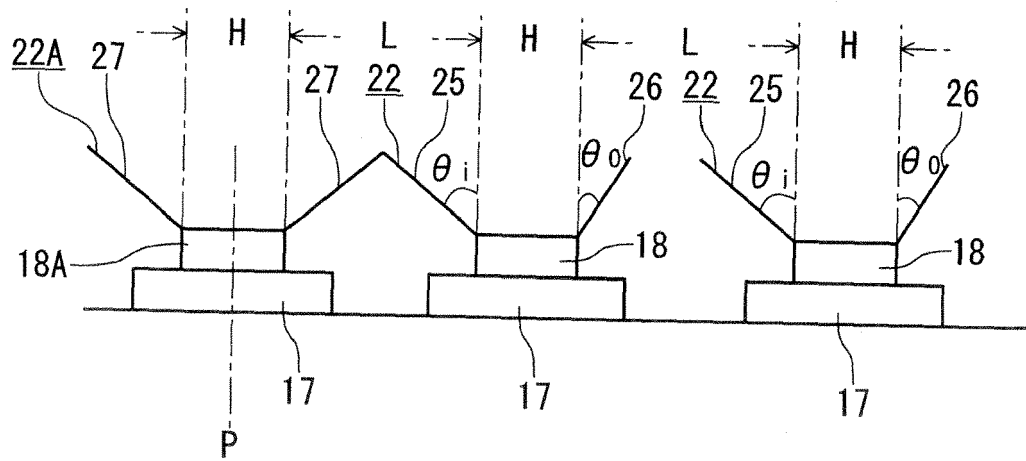
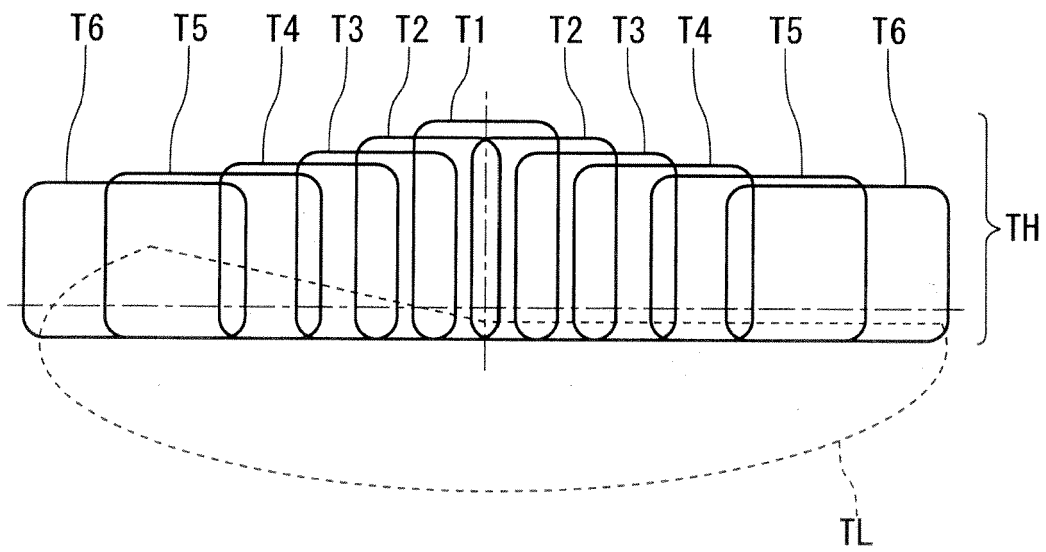


FIG. 6



Description

BACKGROUND

Technical Field

[0001] The present invention relates to a vehicle headlamp. More particularly, the present invention relates to a technique that prevents occurrence of lines of light in a light distribution pattern by setting an inclination angle of each of a plurality of reflectors, which reflect light emitted from a plurality of semiconductor light emitting elements, with respect to an optical axis to a predetermined angle.

Background Art

[0002] A vehicle headlamp has a configuration that a light emitting module, which is referred to as a so-called array (LED array) having a plurality of semiconductor light emitting elements arranged in parallel with each other in a lateral direction, is disposed within a lamp outer case formed by a cover and a lamp body (for example, see JP-A-2011-192656).

[0003] In the vehicle headlamp disclosed in JP-A-2011-192656, a light distribution pattern having a desired size or shape may be formed depending on the number of semiconductor light emitting elements, a distance between the semiconductor light emitting elements, or the like as necessary.

[0004] In addition, a desired plurality of light distribution patterns may also be formed in which a reduction in generation of glare light and the like is attained by individually performing light on/off control with respect to each semiconductor light emitting element and irradiating light only in a direction required according to an existing position of an oncoming vehicle, a preceding vehicle, a walker, or the like.

[0005] However, in a case where the array is used as the light emitting module in the vehicle headlamp disclosed in JP-A-2011-192656, the plural semiconductor light emitting elements are arranged at predetermined intervals. Thus, there are problems in that, in the light distribution pattern, illuminance of boundary portions which are between distributions of light emitted from each semiconductor light emitting element is decreased, illuminance of light becomes non-uniform, and the boundary portions appear as a plurality of vertically long lines of light which are spaced from each other at the left and the right.

[0006] Accordingly, there is a method of reducing non-uniformity of illuminance in such a way to provide minute reflectors having the same shape for each semiconductor light emitting element and to control the irradiation direction of light by each reflector while shading off the boundary portions by placement of the light emitting module behind a focal plane of a projector lens.

[0007] However, even in a case of placing the light

emitting module behind the focal plane of the projector lens and providing the minute reflectors for each semiconductor light emitting element, it is unsatisfactory in solving the generation of the lines of light even if the generation of the lines of light is reduced.

SUMMARY OF THE INVENTION

[0008] An object of the present invention is to provide a vehicle headlamp which prevents generation of lines of light by improving uniformity of light in a light distribution pattern.

[0009] According to one of aspects of the present invention, there is provided a vehicle headlamp (1). The vehicle headlamp comprises: a light emitting module (15) comprising: a plurality of semiconductor light emitting elements (18) each configured to emit light and disposed to be separated from each other in a lateral direction of the vehicle headlamp; a plurality of reflectors (22) each provided for a corresponding one of the semiconductor elements to reflect light emitted from the corresponding semiconductor light emitting element, wherein one of the reflectors located at a center position in the lateral direction is defined as a central reflector (22A); and a projector lens (29) configured to project the light emitted from the light emitting module forward, wherein the light emitting module is disposed behind a focal plane of the projector lens. Each of the reflectors (22) other than the central reflector (22A) has an outer side (26) and an inner side (25) facing the outer side, wherein a distance between the inner side and the central reflector is smaller than a distance between the outer side and the central reflector in the lateral direction. In at least one of the reflectors (22), a first inclination angle (θ_o) of the outer side (26) with respect to an optical axis (P) is smaller than a second inclination angle (θ_i) of the inner side (25) with respect to the optical axis (P).

[0010] Accordingly, it may be possible to increase illuminance of boundary portions which are between distributions of light emitted from each semiconductor light emitting element in a light distribution pattern. It may be possible to enhance uniformity of light in the light distribution pattern. It may be possible to prevent generation of lines of light.

[0011] According to one of aspects of the present invention, the first inclination angle (θ_o) of each of the reflectors (22) is gradually decreased from the central reflector toward the outer side in the lateral direction.

[0012] Accordingly, the uniformity of light may be further enhanced in the light distribution pattern, and the generation of the lines of light may be prevented.

[0013] According to one of aspects of the present invention, a lateral distance (L) between the adjacent semiconductor light emitting elements is larger than a lateral length (H) of each of the semiconductor light emitting elements.

[0014] Accordingly, it may be possible to reduce the number of semiconductor light emitting elements and

form the light distribution pattern. It may be possible to form an excellent light distribution pattern after securing a reduction in manufacturing costs of the vehicle headlamp.

[0015] According to one of aspects of the present invention, the vehicle headlamp further comprises a plurality of substrates (17), wherein each of the semiconductor light emitting elements is disposed on a corresponding one of the substrates.

[0016] Accordingly, it may be possible to freely set the positions of the semiconductor light emitting elements and arbitrarily set the distances between the semiconductor light emitting elements. It may be possible to attain improvement in the degree of freedom of design in regard to the positions of the semiconductor light emitting elements.

[0017] According to one of aspects of the present invention, the vehicle headlamp further comprises a base plate (16), wherein the semiconductor light emitting elements (18) or the plurality of substrates (17) on which the semiconductor light emitting elements are disposed are disposed on a mounting surface of the base plate. The base plate is formed in a stepped shape, and the thickness of a portion of the base plate through which the optical axis (P) passes is larger than or equal to those of any other portions of base plate.

[0018] Accordingly, widths in the lateral direction of the distributions of light which forms portions of both lateral end sides of the light distribution pattern are increased, and the overlap of the distributions of the light is increased. Therefore, the lines of light may be further effectively eliminated.

[0019] According to one of aspects of the present invention, in each of the reflectors (22), the first inclination angle (θ_o) is smaller than the second inclination angle (θ_i).

[0020] According to one of aspects of the present invention, the optical axis (P) passes through a semiconductor light emitting element corresponding to the central reflector (22A).

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a horizontal cross-sectional view schematically illustrating a vehicle headlamp according to the present invention;

Fig. 2 is a schematic front view of the vehicle headlamp;

Fig. 3 is an enlarged cross-sectional view of a light emitting module;

Fig. 4 is an enlarged perspective view illustrating a portion of the light emitting module;

Fig. 5 is a conceptual view illustrating a configuration of the light emitting module;

Fig. 6 is a view schematically illustrating a light distribution pattern formed by the light emitting module;

Fig. 7 is a graph illustrating distributions of light when

three semiconductor light emitting elements are turned on;

Fig. 8 is a graph illustrating distributions of light when the entire semiconductor light emitting elements are turned on;

Fig. 9 is an enlarged cross-sectional view of a light emitting module according to a first modification example of the light emitting module; and

Fig. 10 is an enlarged cross-sectional view of a light emitting module according to a second modification example of the light emitting module.

DETAILED DESCRIPTION

[0022] Hereinafter, a vehicle headlamp according to an embodiment of the present invention will be described with reference to the accompanying drawings.

[0023] In the vehicle headlamp 1, a lamp outer case 4, which is constituted by a lamp body 2 and a cover 3 attached to a front end portion of the lamp body 2, is formed as a lamp chamber 5, and a first lamp unit 6 and a second lamp unit 7 are disposed in the lamp chamber 5 so as to be separated from each other at the left and the right (see Figs. 1 and 2).

[0024] The first lamp unit 6 includes a reflective mirror 8, a light source 9 attached to the reflective mirror 8, and a shade 10 to shade a portion of light emitted from the light source 9. The first lamp unit 6 is provided to form a low beam for irradiating a short distance. For example, a discharge bulb may be used as the light source 9.

[0025] The reflective mirror 8 is provided with three connection portions 8a, 8a, and 8a which protrude to the outside.

[0026] The first lamp unit 6 is tiltably supported at the lamp body 2 through aiming shafts 11, 11, and 11 which are respectively screwed and connected to the connection portions 8a, 8a, and 8a of the reflective mirror 8. When any aiming shaft 11 is rotated, the first lamp unit 6 is tilted in a lateral direction or in an upward and downward direction about the connection portions 8a and 8a, which are used as a supporting point, except the connection portion 8a to which the associated aiming shaft 11 is screwed. Consequently, an optical axis adjustment (aiming adjustment) of the first lamp unit 6 is performed.

[0027] The second lamp unit 7 is formed in which each required portion is attached to a bracket 12 disposed in the lamp chamber 5, and is provided to form a high beam for irradiating a long distance.

[0028] The bracket 12 is formed of a metal material having high heat conductivity, and is provided, at both upper and lower end portions thereof, with supported portions 12a, 12a, and 12a. A heat sink (heat radiation fin) 13 is attached on a rear surface of the bracket 12. A heat radiation fan 14 is attached on a rear surface of the heat sink 13.

[0029] A light emitting module 15 is attached to a central portion on a front surface of the bracket 12. As shown in Fig. 3, the light emitting module 15 includes a base

plate 16 attached on the front surface of the bracket 12, substrates 17 which are disposed on a front surface of the base plate 16 to be separated from each other in the lateral direction, and semiconductor light emitting elements 18 which are respectively mounted on front surfaces of the substrates 17.

[0030] Each semiconductor light emitting element 18 includes a semiconductor layer 18a located at a rear side thereof, and a phosphor layer 18b laminated on a front surface of the semiconductor layer 18a. The semiconductor light emitting element 18, which is located at a central portion in the lateral direction among the semiconductor light emitting elements 18 is provided as a central semiconductor light emitting element 18A.

[0031] For example, LEDs (Light Emitting Diodes) are used as the semiconductor light emitting elements 18.

[0032] The semiconductor light emitting elements 18 are individually supplied with a drive current from a lighting circuit (not shown). Consequently, the semiconductor light emitting elements 18 which are supplied with the drive current are turned on, whereas the semiconductor light emitting elements 18 which are not supplied with the drive current are maintained in a state of being turned off.

[0033] In addition, control to change the current value of the drive current supplied from the lighting circuit may be individually performed with respect to the semiconductor light emitting elements 18.

[0034] A reflective member 19 is attached on the front surface of the bracket 12. The reflective member 19 is constituted of a reflector formation portion 20 having a plate shape, which is located on front surface sides of the semiconductor light emitting elements 18 in a front and rear direction, and an attached portion 21 which protrudes rearwards from an outer periphery portion of the reflector formation portion 20. The attached portion 21 is attached to the bracket 12.

[0035] The reflector formation portion 20 is formed with a plurality of reflectors 22 which are arranged in parallel with each other in the lateral direction. Each of the reflectors 22 are located to face a corresponding one of the semiconductor light emitting elements 18, 18, etc. (see Figs. 3 and 4). The reflector 22, which is located according to the central semiconductor light emitting element 18A, is provided as a central reflector 22A.

[0036] Each reflector 22 is formed by four reflective portions, namely, an upper side reflective portion 23 located at an upper side, a lower side reflective portion 24 located at a lower side, an inner side reflective portion 25 (an inner side) which is located at an inner side in the lateral direction based on the central reflector 22A, and an outer side reflective portion 26 (an outer side) which is located at an outer side in the lateral direction based on the central semiconductor light emitting element 18A.

[0037] The central reflector 22A is formed by the upper side reflective portion 23, the lower side reflective portion 24, and lateral side reflective portions 27 and 27 located at the left and the right.

[0038] The upper side reflective portion 23, the lower side reflective portion 24, the inner side reflective portion 25, the outer side reflective portion 26, and the lateral side reflective portions 27 and 27 are formed, for example, to have a parabolic surface.

[0039] A lens holder 28 is attached on the front surface of the bracket 12 (see Fig. 1). The lens holder 28 is formed in a substantially cylindrical shape which penetrates in the front and rear direction, and is attached to the bracket 12 so as to cover the light emitting module 15.

[0040] A projector lens 29 is attached to a front end portion of the lens holder 28. The projector lens 29 is formed in a substantially convex and semi-spherical shape in a front direction, and includes a focal plane S having a rear focus, and projects light emitted from the semiconductor light emitting elements 18, 18, etc.

[0041] The light emitting module 15 is located behind the focal plane S.

[0042] The second lamp unit 7 is tiltably supported at the lamp body 2 through aiming shafts 30, 30, and 30 which are respectively screwed and connected to the supported portions 12a, 12a, and 12a of the bracket 12. When any aiming shaft 30 is rotated, the second lamp unit 7 is tilted in the lateral direction or in the upward and downward direction about the supported portions 12a and 12a, which are used as a supporting point, except the supported portion 12a to which the aiming shaft 30 is screwed. Consequently, an optical axis adjustment (aiming adjustment) of the second lamp unit 7 is performed.

[0043] Furthermore, the vehicle headlamp 1 is provided with a leveling actuator (not shown). Each of the first and second lamp units 6 and 7 is tilted in the upward and downward direction by the drive of the leveling actuator. Leveling adjustment may also be performed to adjust a direction of the optical axis depending on a weight of a vehicle load.

[0044] Hereinafter, a specific configuration of the above light emitting module 15 will be described (see Figs. 5 and 6).

[0045] For example, eleven semiconductor light emitting elements 18 are disposed to be separated from each other at the left and the right. Distances L between the semiconductor light emitting elements 18 located adjacent to each other are longer than lengths H of the semiconductor light emitting elements 18 in the lateral direction thereof (see Fig. 5). In addition, the distances L are regular or become gradually larger from the central semiconductor light emitting element 18A toward the outside in the lateral direction.

[0046] In each of the reflectors 22, an inclination angle θ_o with respect to the optical axis P of the outer side reflective portion 26 is smaller than an inclination angle θ_i with respect to the optical axis P of the inner side reflective portion 25. Inclination angles with respect to the optical axes P of the lateral side reflective portions 27 and 27 in the central reflector 22A are equal to each other.

[0047] Furthermore, in both end portions of the reflector

tive member 19 in the lateral direction or the reflectors 22 located near both the end portions, the inclination angle θ_o may also be equal to or more than the inclination angle θ_i with respect to the optical axis P of the inner side reflective portion 25 in order to further increase a diffusion angle of light emitted from the semiconductor light emitting elements 18.

[0048] In addition, in the reflectors 22, the inclination angles θ_o with respect to the optical axes P of the outer side reflective portions 26 become gradually smaller from the central reflector 22A toward the outside in the lateral direction.

[0049] Furthermore, in both end portions of the reflective member 19 in the lateral direction or the reflectors 22 located near both the end portions, the inclination angle θ_o may also be equal to or more than an angle θ_o of the inner side thereof in order to further increase the diffusion angle of light emitted from the semiconductor light emitting elements 18.

[0050] When light is emitted from each of the semiconductor light emitting elements 18 of the light emitting module 15 as configured above, the emitted light is reflected from the reflectors 22 or is incident upon the projector lens 29 without reflection from the reflectors 22. Here, when the light is projected by the projector lens 29 and is irradiated to the outside, a light distribution pattern for high beam TH is formed (see Fig. 6). In addition, when light is emitted from light source 9 of the first lamp unit 6, a light distribution pattern for low beam TL is formed.

[0051] The light distribution pattern for high beam TH is formed by a combination of distributions T1, T2, etc. of light emitted from each of the semiconductor light emitting elements 18. The distributions T1, T2, etc. of the light overlapped with each other in the lateral direction.

[0052] In the distributions T1, T2, etc. of the light, a horizontal width at a central portion in the lateral direction is smallest, and horizontal widths are gradually increased from the distribution T1 toward the outside in the lateral direction. In addition, in the distributions T1, T2, etc. of the light, a vertical width at the central portion in the lateral direction is largest, and vertical widths are gradually decreased from the distribution T1 toward the outside in the lateral direction.

[0053] Fig. 7 is a graph illustrating the light distribution in the light distribution pattern when the three semiconductor light emitting elements, which are located at the center in the lateral direction, are turned on. The horizontal axis represents a position, "0" represents a center in the lateral direction, and the vertical axis represents illuminance. The solid line represents the distributions of light emitted from each semiconductor light emitting element, and the broken line represents the combined distribution of the light emitted from the three semiconductor light emitting elements.

[0054] The upper graph represents a light distribution pattern when the light is emitted from a prior-art light emitting module in which an inclination angle of each reflective portion of a reflector is the same with respect to an

optical axis. The lower graph represents a light distribution pattern when the light is emitted from the light emitting module 15 of the vehicle headlamp 1 according to the present invention.

[0055] As shown in Fig. 7, in the prior-art vehicle headlamp, the illuminance is non-uniform, and lines of light occur as indicated by portions A. Thus, irregularities of the illuminance are generated. On the other hand, in the reflectors 22 of the vehicle headlamp 1, the inclination angles θ_o of the outer side reflective portions 26 with respect to the optical axes P are smaller than the inclination angles θ_i of the inner side reflective portions 25 with respect to the optical axes P, respectively. Thus, uniformity of the illuminance can be achieved, and lines of light can be eliminated.

[0056] Fig. 8 is a graph illustrating a light distribution pattern when the entirety of the eleven semiconductor light emitting elements is turned on. The horizontal axis represents a position, "0" represents a center in the lateral direction, and the vertical axis represents illuminance. The solid line represents the distributions of light emitted from each semiconductor light emitting element, and the broken line represents the combined illuminance distribution of the light emitted from the eleven semiconductor light emitting elements.

[0057] Furthermore, in Fig. 8, the largest drive current is supplied to the semiconductor light emitting element located at the center, and the current value of the drive current to be supplied to the semiconductor light emitting elements is gradually decreased toward the semiconductor light emitting elements located at the outside in the lateral direction. Thus, the illuminance is also decreased toward the outside.

[0058] The upper graph represents a light distribution pattern when the light is emitted from the prior-art light emitting module of the vehicle headlamp in which the inclination angle of each reflective portion of the reflector is the same with respect to the optical axis. The lower graph represents a light distribution pattern when the light is emitted from the light emitting module 15 of the vehicle headlamp 1 according to the present invention.

[0059] As shown in Fig. 8, in the prior art vehicle headlamp, the illuminance is non-uniform, and lines of light tend to occur as indicated by portions B. Thus, irregularities of the illuminance are generated. On the other hand, in the reflectors 22 of the vehicle headlamp 1, the inclination angles θ_o of the outer side reflective portions 26 with respect to the optical axes P are smaller than the inclination angles θ_i of the inner side reflective portions 25 with respect to the optical axes P, respectively. Thus, uniformity of the illuminance can be achieved, and lines of light can be eliminated.

[0060] Hereinafter, a first modification example and a second modification example of the light emitting module will be described (see Figs. 9 and 10).

[0061] A light emitting module 15A according to the first modification example has a difference only in that the substrates 17 are not provided on the base plate 16,

as compared to the above-mentioned light emitting module 15. Accordingly, the light emitting module 15A will be described in detail only with respect to configurations different from the light emitting module 15, and other configurations identical to those as the above-mentioned light emitting module 15 are given using the same reference numerals and the description thereof will be omitted herein.

[0062] As shown in Fig. 9, the light emitting module 15A according to the first modification example includes the base plate 16 attached on the front surface of the bracket 12, and the semiconductor light emitting elements 18 which are mounted on the front surface of the base plate 16 to be separated from each other in the right and left direction. The front surface of the base plate 16 is formed with a predetermined conductive circuit. The semiconductor light emitting elements 18 are mounted on each connection portion of the conductive circuit. The semiconductor light emitting elements 18 are individually supplied with the drive current from the lighting circuit through the conductive circuit.

[0063] Since such a light emitting module 15A is not provided with the substrates 17, a simple and small structure may be realized.

[0064] A light emitting module 15B according to the second modification example has a difference only in that the base plate 16 has a different configuration, as compared to the above-mentioned light emitting module 15. Accordingly, the light emitting module 15B will be described in detail only with respect to configurations different from the light emitting module 15, and other configurations identical to those as the above-mentioned light emitting module 15 are given using the same reference numerals and the description thereof will be omitted herein.

[0065] As shown in Fig. 10, the light emitting module 15B according to the second modification example includes a base plate 16B attached on the front surface of the bracket 12, the substrates 17 which are disposed on a front surface of the base plate 16B to be separated from each other in the right and left direction, and the semiconductor light emitting elements 18 which are respectively mounted on the front surfaces of the substrates 17.

[0066] The base plate 16B is formed in a stepped shape in which a central portion in the lateral direction is located at the most front side and both lateral end portions are located at the most rear sides. Front surfaces located between respective steps 16a of the base plate 16B are formed as mounting surfaces 16b.

[0067] The substrates 17 are separated from each other in the left and the right direction and one or a plurality of substrates 17 are disposed on each of the mounting surfaces 16b.

[0068] Furthermore, the number of steps of the base plate 16B may be plural. As shown in Fig. 10, the number of steps may also be three, or two or four or more.

[0069] A reflective member 19B is attached on the front

surface of the bracket 12. The reflective member 19B includes: a reflector formation portion 20B having a plate shape which is located on the front surface sides of the semiconductor light emitting elements 18 in the front and rear direction; and the attached portion 21 which protrudes rearwards from an outer periphery portion of the reflector formation portion 20B. The attached portion 21 is attached to the bracket 12.

[0070] Similarly to the base plate 16B, the reflector formation portion 20B is formed in a stepped shape in which a central portion is located at the most front side and both lateral end portions are located at the most rear sides.

[0071] Since the above light emitting module 15B is formed in a stepped shape in which the central portion in the lateral direction of the base plate 16B is located at the most front side, the distances between the semiconductor light emitting elements 18 located at both end sides in the lateral direction and the focal plane S of the projector lens 29 are increased.

[0072] Accordingly, the widths in the lateral direction of light distribution which forms portions of both lateral end sides of the light distribution pattern are increased, and the overlapping region of the light distributions is increased. Therefore, the lines of light may be further effectively eliminated.

[0073] In addition, although high illuminance needs to be secured at the central portion in the light distribution pattern, high illuminance of light distribution as obtained in the central portion does not need to be secured at the outer peripheral side in the lateral direction. Hence, the distances between the semiconductor light emitting elements 18 located at both end sides in the lateral direction may be larger than the distances between the semiconductor light emitting elements 18 located at the central portion.

[0074] It may be possible to reduce the number of semiconductor light emitting elements 18 and form the light distribution pattern of the high beam by increasing such distances between the semiconductor light emitting elements 18 located at both end sides in the lateral direction. Also, it may be possible to form the excellent light distribution pattern while reducing the manufacturing costs of the vehicle headlamp 1.

[0075] Meanwhile, in the above light emitting module 15B, an example has been described in which the substrates 17 are disposed on the front surface of base plate 16B and the semiconductor light emitting elements 18 are mounted on the front surfaces of the substrates 17. However, similarly to the light emitting module 15A, even in the light emitting module 15B, the semiconductor light emitting elements 18 may also be mounted on the front surface of base plate 16B.

[0076] Even in the light emitting module 15B, a simple and small structure may be realized by not providing the substrates 17.

[0077] In addition, the light emitting module 15B which has the steps in the lateral direction has been described. However, for example, the light emitting module 15B may

also be formed with the steps in the upward and downward direction, and the substrates and the semiconductor light emitting elements or the semiconductor light emitting elements may be disposed on the mounting surfaces which are directed frontwards and located between the steps formed in the upward and downward direction.

[0078] It may also be possible to form a so-called light distribution pattern for overhead signature in order to be irradiated on an upper sign and the like by disposing the substrates and the semiconductor light emitting elements or the semiconductor light emitting elements on the mounting surfaces which are located at the upper and lower portions of the steps formed in the upward and downward direction, for example, by light emitted from the semiconductor light emitting elements disposed at any one of the upper and lower portions.

[0079] AS described above, in the vehicle headlamp 1, the light emitting modules 15, 15A, and 15B are located behind the focal plane of the projector lens 29. Also, in at least a portion of the reflectors 22, the inclination angles θ_o of of the outer side reflective portions 26 with respect to the optical axes P are smaller than the inclination angles θ_i of of the inner side reflective portions 25 with respect to the optical axes P.

[0080] Accordingly, the illuminance of boundary portions, which are between the distributions of light emitted from each of the semiconductor light emitting elements 18, may be increased, the illuminance of the light distribution may become uniform, and the generation of the lines of light may be prevented.

[0081] In addition, since the inclination angles θ_o of the outer side reflective portions 26 with respect to the optical axes P become gradually smaller toward the outside in the lateral direction, the uniformity of light distribution pattern may be further enhanced, and the generation of the lines of light may be prevented.

[0082] Moreover, the distances between the semiconductor light emitting elements 18 are longer than the lengths of the semiconductor light emitting elements 18 in the lateral direction thereof. Therefore, it may be possible to reduce the number of semiconductor light emitting elements 18 in forming the light distribution pattern. Also, it may be possible to form the excellent light distribution pattern while reducing the manufacturing costs of the vehicle headlamp 1.

[0083] Furthermore, the plurality of substrates 17 on which the plural semiconductor light emitting elements 18 are respectively mounted are provided, it is possible to freely set the positions of the semiconductor light emitting elements 18 and arbitrarily set the distances between the semiconductor light emitting elements 18.

[0084] Accordingly, it may be possible to increase the degree of freedom of design in regard to the positions of the semiconductor light emitting elements.

[0085] The shape and structure of each portion exhibited in the above-mentioned embodiment have been illustrated as only an example which specifies the embodiments of the present invention, and thus it should not be

construed as limiting the scope or spirit of the present invention.

5 Claims

1. A vehicle headlamp (1) comprising:

a light emitting module (15) comprising:

a plurality of semiconductor light emitting elements (18) each configured to emit light and disposed to be separated from each other in a lateral direction of the vehicle headlamp;

a plurality of reflectors (22) each provided for a corresponding one of the semiconductor elements to reflect light emitted from the corresponding semiconductor light emitting element, wherein one of the reflectors located at a center position in the lateral direction is defined as a central reflector (22A);

and

a projector lens (29) configured to project the light emitted from the light emitting module forward, wherein the light emitting module is disposed behind a focal plane of the projector lens, wherein each of the reflectors (22) other than the central reflector (22A) has an outer side (26) and an inner side (25) facing the outer side, wherein a distance between the inner side and the central reflector is smaller than a distance between the outer side and the central reflector in the lateral direction, and wherein, in at least one of the reflectors (22), a first inclination angle (θ_o) of the outer side (26) with respect to an optical axis (P) is smaller than a second inclination angle (θ_i) of the inner side (25) with respect to the optical axis (P).

2. The vehicle headlamp of claim 1, wherein the first inclination angle (θ_o) of each of the reflectors (22) is gradually decreased from the central reflector toward the outer side in the lateral direction.

3. The vehicle headlamp of claim 1 or 2, wherein a lateral distance (L) between the adjacent semiconductor light emitting elements is larger than a lateral length (H) of each of the semiconductor light emitting elements.

4. The vehicle headlamp of any one of claims 1 to 3, further comprising:

a plurality of substrates (17), wherein each of the semiconductor light emitting elements is dis-

posed on a corresponding one of the substrates.

5. The vehicle headlamp of any one of claims 1 to 4, further comprising:

a base plate (16), wherein the semiconductor light emitting elements (18) or the plurality of substrates (17) on which the semiconductor light emitting elements are disposed are disposed on a mounting surface of the base plate, wherein the base plate is formed in a stepped shape, and wherein the thickness of a portion of the base plate through which the optical axis (P) passes is larger than or equal to those of any other portions of base plate.

6. The vehicle headlamp of claim 1, wherein, in each of the reflectors (22), the first inclination angle (θ_o) is smaller than the second inclination angle (θ_i).

7. The vehicle headlamp of claim 1, wherein the optical axis (P) passes through a semiconductor light emitting element corresponding to the central reflector (22A).

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FIG. 1

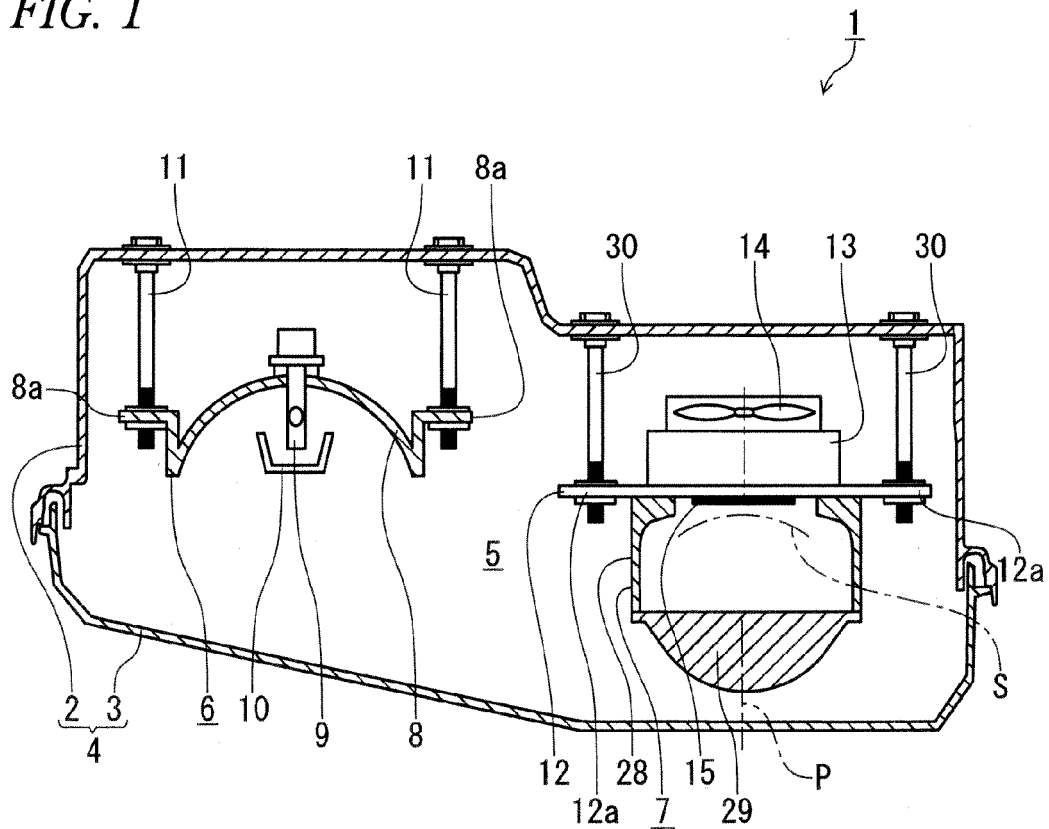


FIG. 2

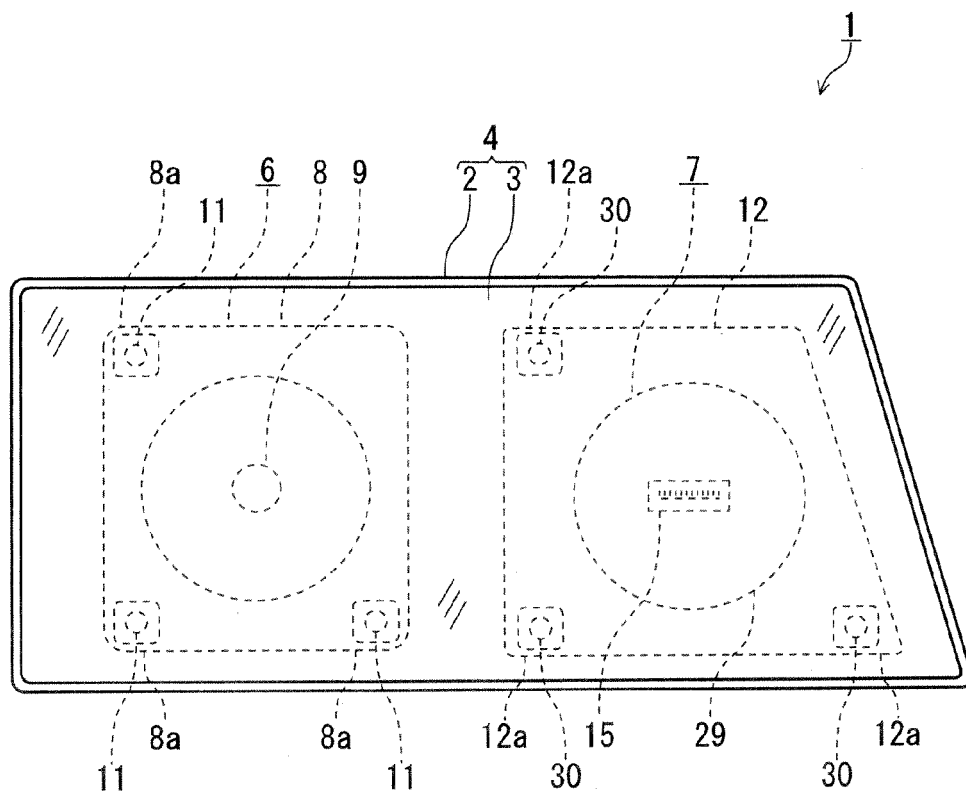


FIG. 3

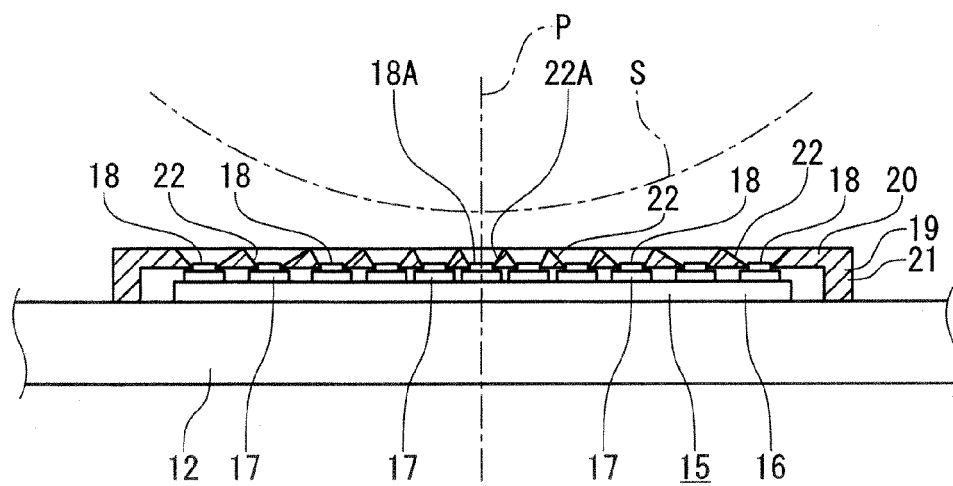


FIG. 4

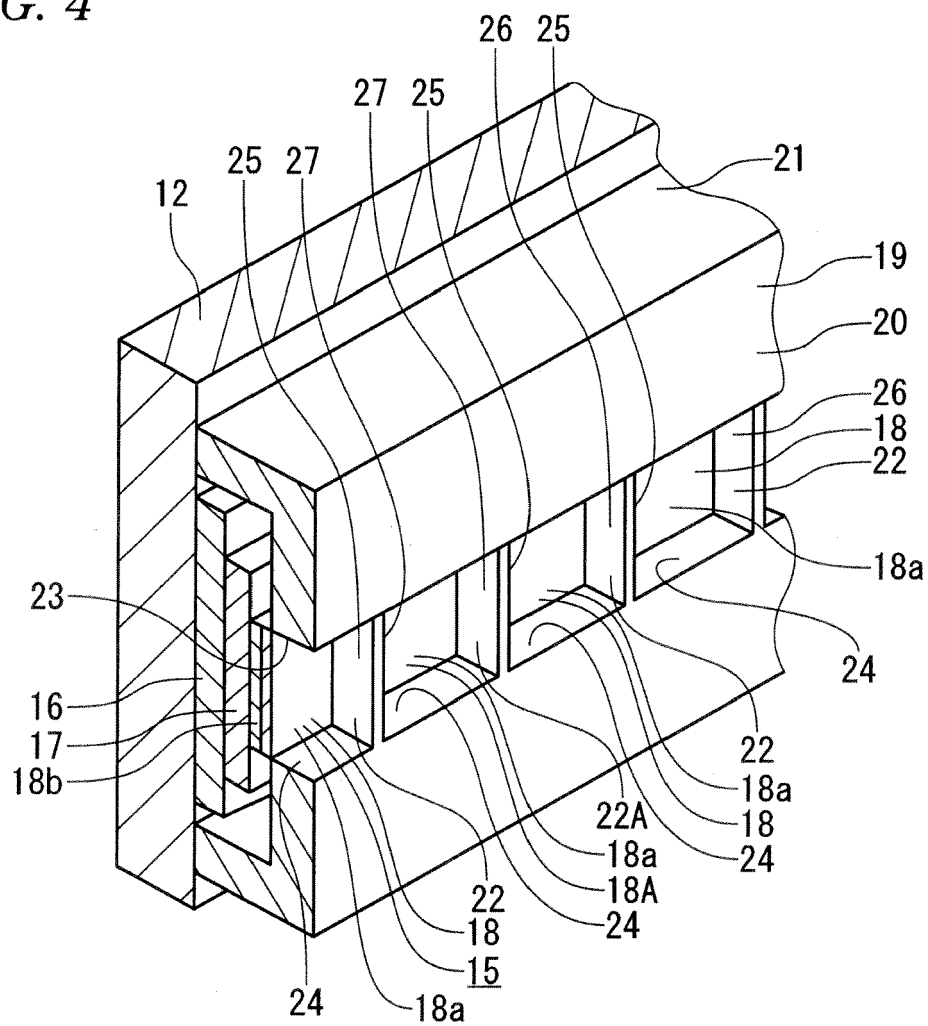


FIG. 5

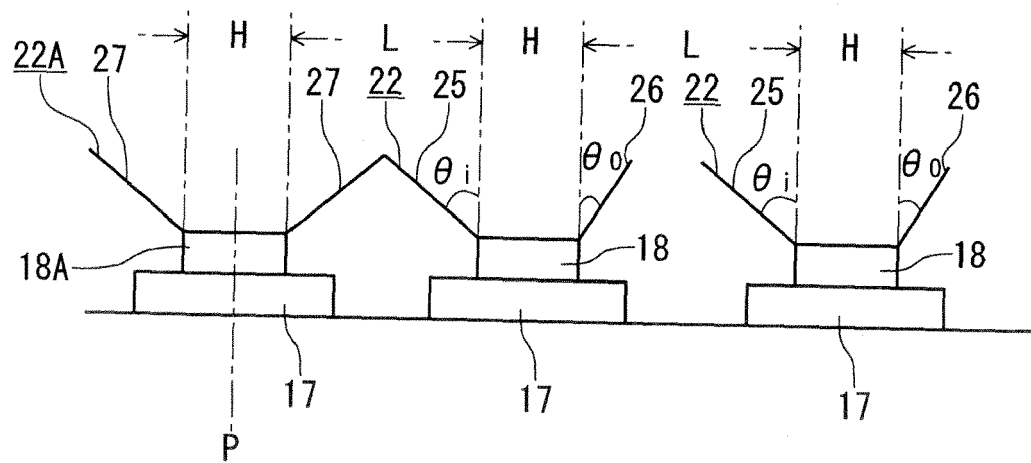


FIG. 6

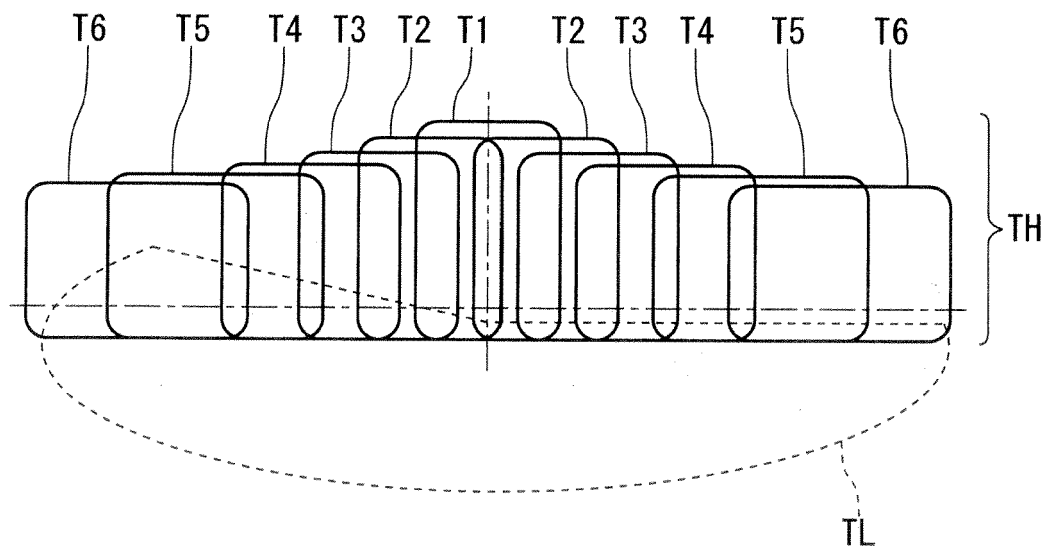
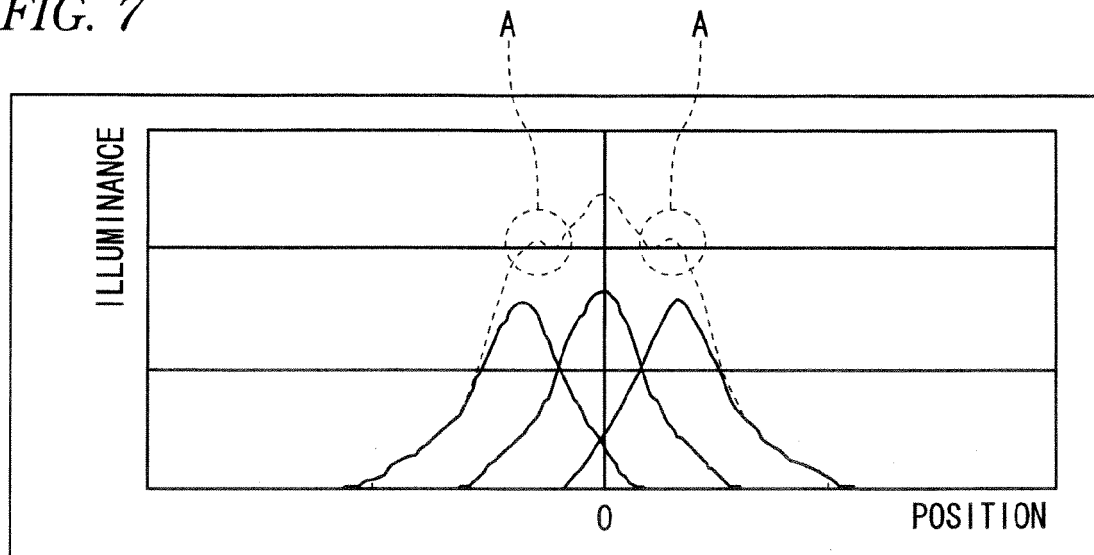
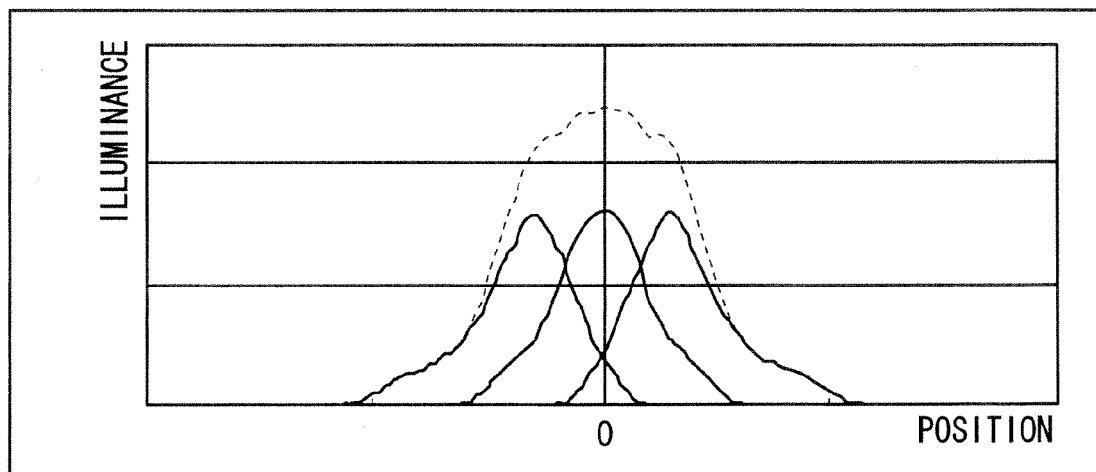


FIG. 7



PRIOR ART



PRESENT INVENTION

FIG. 8

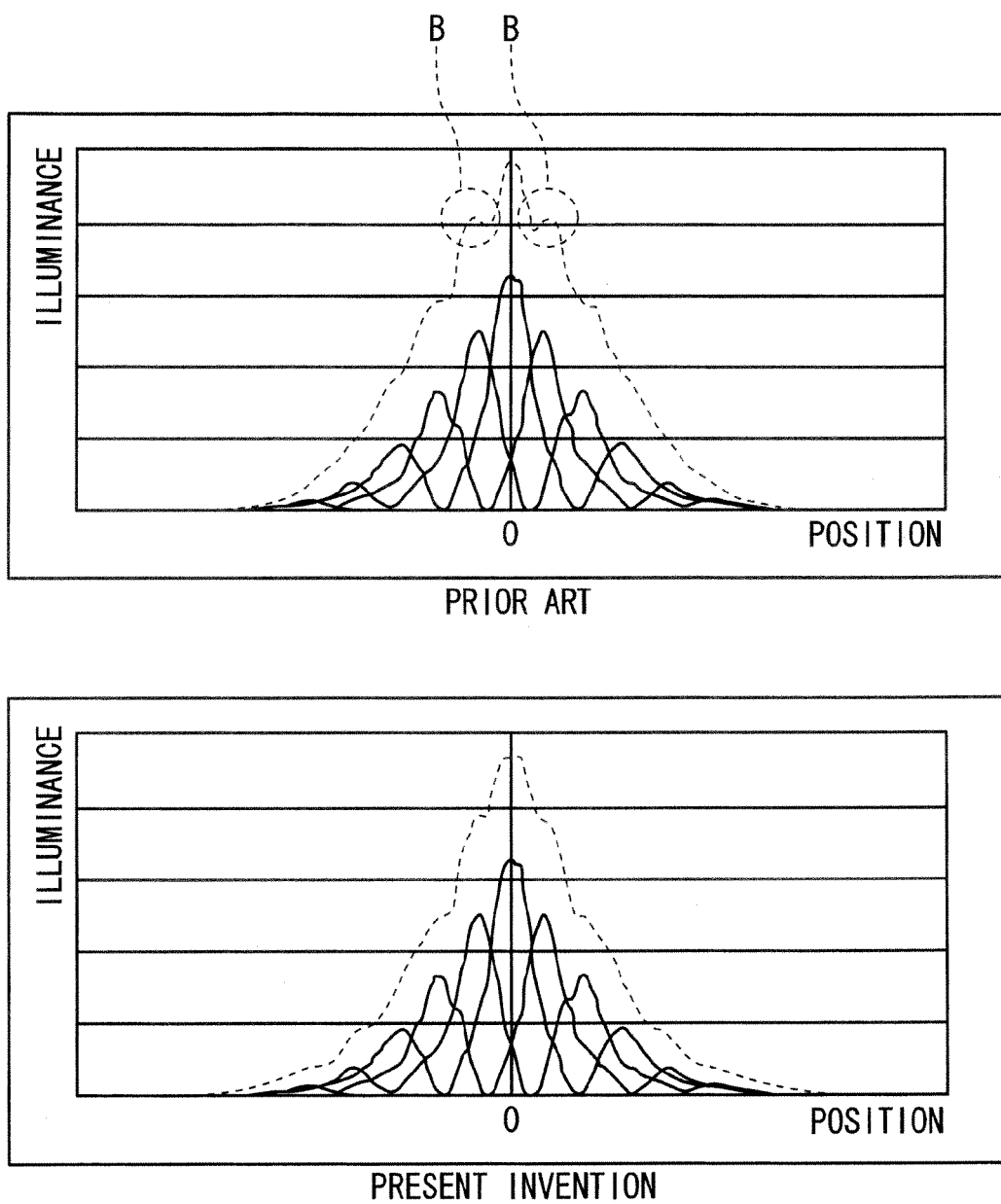


FIG. 9

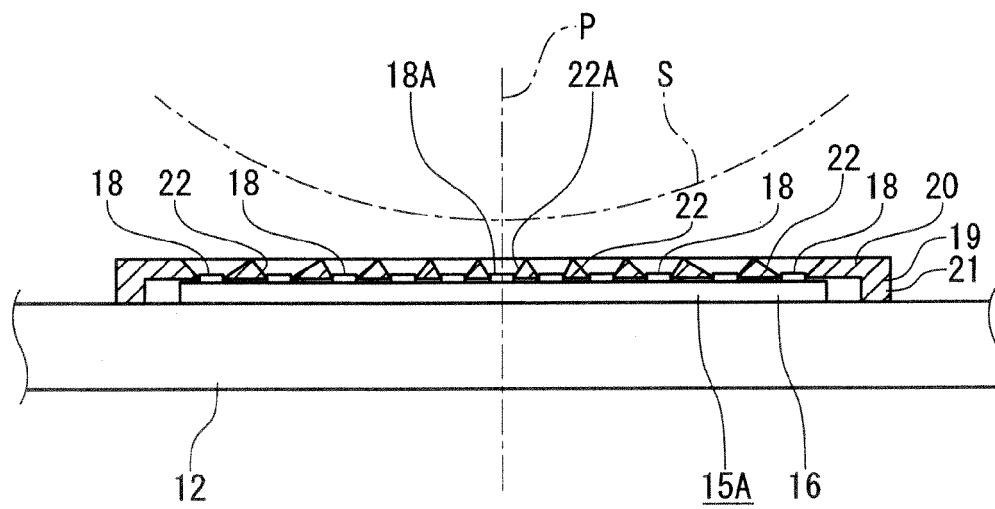
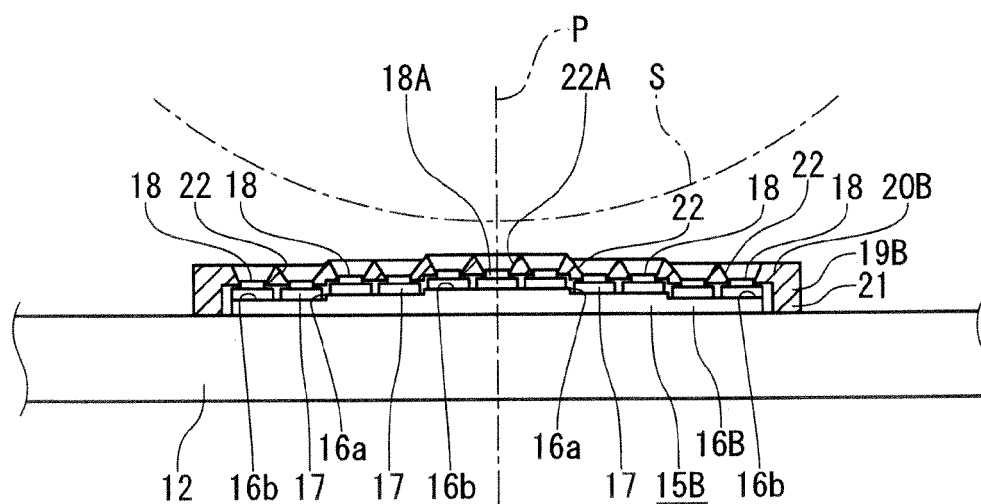


FIG. 10



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2011192656 A [0002] [0003] [0005]