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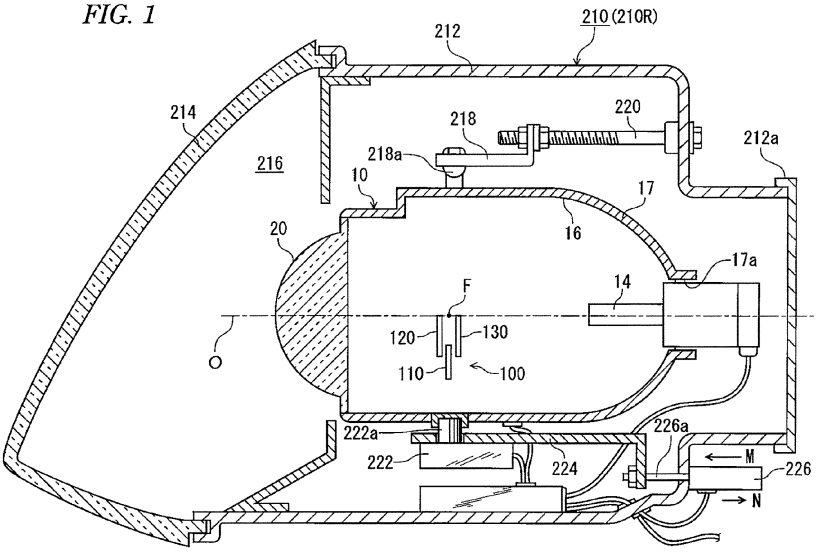
(54) **Vehicle headlamp**

(57) A lamp unit (210) includes: a projection lens (20) that radiates light from a light source (14); and a shade (110,120,130) interposed between the light source and the projection lens and for forming a light distribution pattern having a first cutoff line extending horizontally from a neighborhood of a center of the light distribution pattern and a second cutoff line extending upwardly from the neighborhood of the center. The shade includes a gradation forming portion for forming a gradation in the second cutoff line in the second cutoff line forming edge portion. The gradation is for making variations gradual in illumination in the portion of the second cutoff line than that in an area of the neighborhood of the center.

FIG. 1



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Description

FIELD

[0001] One or more embodiments of the present invention relate to a lamp unit and, specifically, to a lamp unit for use in a vehicle such as a car.

BACKGROUND

[0002] There is known a light distribution variable type vehicle lamp unit which blocks part of light from a light source using a shade to form a low beam light distribution pattern and, when not blocked by the shade, forms a high beam light distribution pattern. Also, there is proposed a lamp unit which, with the enhanced performance of a vehicle in recent years, forms a light distribution pattern different from a standard low beam or high beam according to the peripheral conditions.

[0003] For example, in JP-A-2009-227088, JP-A-2010-00957, and JP-A-2010-257909, there is disclosed a vehicle headlamp apparatus which can form a light distribution pattern including an area existing upward of the cutoff line of a low beam light distribution pattern and rightward of a vertical line, and a light distribution pattern including an area existing leftward of the vertical line. These light distribution patterns are a so called one-side light distribution pattern.

[0004] The above-mentioned one-side light distribution pattern is a light distribution pattern in which, upwardly of the cutoff line of the low beam light distribution pattern, a light radiated area and a light blocked area are lined horizontally. Therefore, the one-side light distribution pattern has a cutoff line extending upward from the neighborhood of the center of the light distribution pattern.

[0005] Generally, the forward central area of a vehicle tends to be focused by the eyes of a driver. Since the central area is an area to be focused by the driver's eyes, it is an area where the driver can easily recognize variations in the illumination. Also, the driver, generally, tends to feel a stronger strange feeling about variations in light and shade in the horizontal direction than about those in the vertical direction. Therefore, the above-mentioned one-side light distribution pattern, where an upwardly extending cutoff line overlaps on its central area, can raise the possibility of giving the driver a visually strange feeling.

SUMMARY

[0006] One or more embodiments of the invention aim at solving the above problems. Thus, an object of the embodiments is to provide a technology for forming a one-side light distribution pattern hard to give a driver a visually strange feeling.

[0007] According to an aspect of the invention, there is provided a lamp unit including: a light source; a projection lens that radiates light from the light source in a forward direction of the lamp unit; and a shade that is interposed between the light source and the projection lens and that is configured to form a light distribution pattern having a first cutoff line extending horizontally from a neighborhood of a center of the light distribution pattern and a second cutoff line extending upwardly from an end portion of the first cutoff line in the neighborhood of the center, the shade including a second cutoff line forming edge portion. The shade includes a gradation forming portion in the second cutoff line forming edge portion, wherein the gradation forming portion is for forming a gradation at least in a portion of the second cutoff line. The gradation is for making variations gradual in illumination in the portion of the second cutoff line than that in an area of the neighborhood of the center.

[0008] According to this aspect, it is possible to form a one-side light distribution pattern which is hard to give a driver a visually strange feeling.

[0009] In the above aspect, the gradation forming portion may also have an extension portion extending from the second cutoff line forming edge portion at least in one of the forward and backward directions of the lamp. This also makes it possible to form a one-side light distribution pattern hard to give a driver a visually strange feeling.

[0010] In any one of the above aspects, the gradation forming portion may also include: a first shade member and a second shade member disposed spaced from each other in an optical axis direction of the lamp unit; and, at least one of an extension portion extending in a forward direction of the lamp from the second cutoff line forming edge portion of one of the first and second shade members disposed forwardly of the lamp, and an extension portion extending in a backward direction of the lamp from the second cutoff line forming edge portion of the other disposed backwardly of the lamp. In this case as well, it is possible to form a one-side light distribution pattern hard to give a driver a visually strange feeling.

[0011] In any one of the above aspects, the gradation forming portion may also include an uneven portion formed in the second cutoff line forming edge portion. In this case as well, it is possible to form a one-side light distribution pattern hard to give a driver a visually strange feeling.

[0012] In any one of the above aspects, the gradation forming portion may also include a first shade member and a second shade member disposed spaced from each other in an optical axis direction of the lamp unit, the first and second shade members may respectively include second cutoff line forming edge portions, each including an uneven portions in their respective second cutoff line forming edge portions, and the respective uneven portions may be shifted from each other such that they alternate. In this case, since the uneven portions to be formed in the first and second shade members can be made rough, the manufacturing process can be simplified.

[0013] In any of the above aspects, the shade may

include a first cutoff line forming edge portion, and the gradation forming portion may also be formed in such portion of the second cutoff line forming edge portion as is distant by a given distance from an end portion of its first cutoff line forming edge portion side. In this case, of the second cutoff line, the given area extending from the first cutoff line side end portion can be formed as a clear cutoff line.

[0014] In any of the above aspects, the extension portion may also be formed such that, as the extension portion parts away from the first cutoff line, its extension length increases gradually or continuously. In this case, it is possible to form a second cutoff line which can be made clearer as it approaches the neighborhood of the center of the light distribution pattern where the enhanced visual confirmation property of the driver is required, and also which can be made more unclear as it approaches the outside area of the light distribution pattern where the reduced strange feeling of the driver is preferred to the enhanced visual confirmation property.

[0015] In any of the above aspects, the shade may include a first cutoff line forming edge portion, and a first cutoff line forming edge portion side end portion of the gradation forming portion may also be more distant from the first cutoff line forming edge portion than a portion of the second cutoff line forming edge portion where a second cutoff line portion that is to be contacted with the first cutoff line side end portion of a to-be-graded portion of the second cutoff line, is formed. In this case, the accuracy of the position for forming gradations can be enhanced.

[0016] In any of the above aspects, the gradation forming portion may also include a reflecting surface formed such that its diffusion and reflectance rate of the light from the light source is higher than the other surfaces of the shade. In this case as well, it is possible to form a one-side light distribution pattern hard to give a driver a visually strange feeling.

[0017] In any of the above aspects, the shade may include a first cutoff line forming edge portion, and the shade may include, in the first cutoff line forming edge portion, a gradation forming portion for forming gradation at least in a portion of the first cutoff line. In this case as well, it is possible to form a one-side light distribution pattern hard to give a driver a visually strange feeling.

[0018] According to the invention, it is possible to provide a technology which can form a one-side light distribution pattern hard to give a driver a visually strange feeling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 is a schematically vertical section view of a vehicle headlamp unit including a lamp unit according to a first embodiment.

Fig. 2A is a schematically perspective view of a shade mechanism when observed from the front and left sides of a lamp.

Fig. 2B is a schematically perspective view of the neighborhood of the second cutoff line forming edge portion of a shade when observed from the front and right sides of the lamp.

Fig. 3A is a typical front view of the shade mechanism when observed from front of the lamp.

Fig. 3B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the first embodiment.

Fig. 4A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a second embodiment, when observed from the back and right sides of the lamp.

Fig. 4B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the second embodiment.

Fig. 5A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a third embodiment, when observed from the back and right sides of the lamp.

Fig. 5B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the third embodiment.

Fig. 6A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a fourth embodiment, when observed from the front and right sides of the lamp.

Fig. 6B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the fourth embodiment.

Fig. 7A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a first modification, when observed from the front and right sides of the lamp.

Fig. 7B is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a second modification, when observed from the front and right sides of the lamp.

Fig. 7C is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a third modification, when observed from the front and right sides of the lamp.

Fig. 8A is a schematically front view of a one-side light distribution pattern forming shade used in a lamp unit according to a fourth modification, when observed from front of the lamp.

Fig. 8B is a schematically front view of a one-side light distribution pattern forming shade used in a lamp unit according to a fifth modification, when observed from front of the lamp.

Fig. 8C is a schematically front view of a one-side light distribution pattern forming shade used in a lamp unit according to a sixth modification, when observed from front of the lamp.

Fig. 9 is a schematically front view of a one-side light

distribution pattern forming shade used in a lamp unit according to a seventh modification, when observed from front of the lamp.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0020] Now, description will be given below of the preferred embodiments of the invention with reference to the accompanying drawings. The same or equivalent composing elements, members and processings illustrated in the respective drawings are given the same designations and thus the duplicate description thereof is omitted. Also, the embodiments do not limit the invention but are illustrations thereof, while all characteristics and combinations thereof described in the embodiments do not always constitute the essentials of the invention.

(First embodiment)

[0021] Fig. 1 is a schematically vertical section view of a vehicle headlamp unit including a lamp unit according to a first embodiment. This headlamp unit 210 includes a pair of symmetrically disposed headlamp units, that is, a right headlamp unit 210R and a left headlamp unit 210L. The right headlamp unit 210R is disposed on the forward right side of the vehicle, while the left headlamp unit 210L is disposed on the forward left side of the vehicle. Since the right and left headlamp units 210R and 210L have substantially the same structures except that they are right and left symmetric in position. Therefore, description will be given below of the structure of the right headlamp unit 210R, while the description of the left headlamp unit 210L is omitted properly.

[0022] The right headlamp unit 210R includes a lamp body 212 having an opening on the front side of a vehicle, and a light transmissible cover 214 for covering the opening. The lamp body 212 includes on the vehicle back side thereof a removable cover 212a which can be removed, for example, when a bulb 14 is replaced. The lamp body 212 and light transmissible cover 214 cooperate together in defining a lamp chamber 216. Within the lamp chamber 216, there is stored a lamp unit 10.

[0023] The lamp unit 10 includes in a portion thereof a lamp bracket 218 having a pivot mechanism 218a on which the lamp unit 10 can be swung vertically and horizontally. The lamp bracket 218 is threadedly engaged with an aiming adjustment screw 220 rotatably supported on the wall surface of the lamp body 212. Also, to the lower surface of the lamp unit 10, there is fixed the rotation shaft 222a of a swivel actuator 222. The swivel actuator 222 is fixed to a unit bracket 224.

[0024] To the unit bracket 224, there is connected a leveling actuator 226 disposed outside the lamp body 212. The leveling actuator 226 is constituted of, for example, a motor for expanding and contracting a rod 226a in the arrows M and N directions. As the rod 226a extends in the arrow M direction or contracts in the arrow N direction, the lamp unit 10 swings about the pivot mechanism 218a.

[0025] The lamp unit 10 includes a bulb 14 serving as a light source, a lamp housing 17 for supporting a reflector 16 on the inner wall of the lamp unit 10, a projection lens 20 and a shade mechanism 100. The bulb 14 can be constituted of, for example, an incandescent lamp, a halogen lamp, a discharge lamp or an LED. In this embodiment, the bulb 14 is constituted of a halogen lamp. At least a portion of the reflector 16 has an elliptical spherical shape, while this elliptical spherical shape is set such that its section shape including the optical axis O of the lamp unit 10 provides at least a portion of an elliptical shape. The elliptical spherical shaped portion of the reflector 16 has a first focus substantially at the center of the bulb 14 and a second focus on the rear focal plane of the projection lens 20.

[0026] The lamp housing 17 has an insertion hole 17a formed in the lamp backward end portion thereof where the reflector 16 is disposed. The light source bulb 14 is inserted through the insertion hole 17a and is fixed to the lamp housing 17. The projection lens 20 is fixed to the lamp forward end portion of the lamp housing 17. The shade mechanism 100 is stored within the lamp housing 17. Therefore, the shade mechanism 100 is interposed between the bulb 14 and projection lens 20.

[0027] The light from the bulb 14 and the light reflected by the reflector 16 are in part guided through the shade mechanism 100 to the projection lens 20. The shade mechanism 100 includes multiple plate-shaped shades 110, 120, 130 respectively near its rear focal plane which is a focal plane including the rear focus F of the projection lens 20. In the lamp unit 10 of this embodiment, the shade 110 is disposed substantially on the rear focal plane, the shade 120 is disposed more forwardly of the lamp than the rear focal plane, and the shade 130 is disposed more backwardly of the lamp than the rear focal plane. The respective shades 110, 120 and 130 can be moved onto the optical axis O, while there is formed a light distribution pattern following the shapes of the ridge portions of the shades 110, 120 and 130 moved onto the optical axis O. The specific structure of the shade mechanism 100 will be given later.

[0028] The projection lens 20 is used to radiate the light from the bulb 14 forwardly of the lamp, while it is disposed on the optical axis O. The bulb 14 is disposed backwardly of the rear focal plane of the projection lens 20. The projection lens 20 is constituted of a plano-convex aspherical lens the front side surface of which is a convex and the rear side surface of which is a plane, while it projects a light source image, which is formed on the rear focal plane of the projection lens 20, on a virtual vertical screen existing forwardly of the lamp as an inverted image.

[0029] Next, description will be given specifically of the structure of the shade mechanism 100. Fig. 2A is a schematically perspective view of the shade mechanism when observed from the front and left sides of the lamp. Fig. 2Bis a schematically perspective view of the second cut-

off line forming edge neighboring portion of a shade when observed from the front and right sides of the lamp. Fig. 3A is a typical front view of the shade mechanism when observed from front of the lamp. Fig. 3B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the first embodiment. Here, in Fig. 3A, illustration of a motor and a return spring is omitted. Also, in Fig. 3B, there is illustrated a light distribution pattern which is formed a virtual vertical screen disposed at a given position forwardly of the lamp, for example, at a position of 25 m forwardly of the lamp.

[0030] The shade mechanism 100 consists mainly of shades 110, 120, 130, motors 150, 152 and swing members 160, 162.

[0031] The shade 110 is disposed to extend substantially horizontally, while its lamp outside end portion is connected the swing member 160. In this embodiment, the shade 110 and swing member 160 are formed integrally with each other. The swing member 160 is connected to a rotation shaft 170 provided near its connected portion to the shade 110. Also, the swing member 160 has a fan-shaped vane portion 160a extending substantially vertically downward from its connected portion to the rotation shaft 170. The lower end portion of the vane portion 160a is connected to the motor 150 disposed in a lower right area within the lamp housing 17. A gear (not shown) is mounted on the leading end of the rotation shaft of the motor 150 and is engaged with a gear (not shown) formed on the lower end of the vane portion 160a.

[0032] When the motor 150 rotates, the rotational force of the motor 150 is transmitted from the gear of the motor 150 to the gear of the vane portion 160a, whereby the shade 110 is swung about the rotation shaft 170. Also, the shade 110, which has been swung by the rotation of the motor 150, can be returned to its before-swung position due to the restoring force of a return spring 180. Thus, the shade 110 can take a retreat position (a position shown in Fig. 2A, Fig. 2B and Fig. 3A) where its upper edge portion (upper end) exists apart from the optical axis O and thus does not block the light of the bulb 14, and an advance position where its upper edge portion exists on the optical axis O and thus blocks the light of the bulb 14.

[0033] The shade 120 (a first shade member) and shade 130 (a second shade member) are respectively disposed to extend substantially horizontally, while their respective lamp outside end portions are connected to the swing member 162. The shade 120 and shade 130 are disposed to be superimposed on top of each other when viewed from front of the lamp, while they are spaced from each other in the optical axis O direction. The shade 120 is fixed to the lamp front side surface of the swing member 162, while the shade 130 is fixed to the lamp rear side surface of the swing member 162. The shade 110 is inserted into a space formed by the shades 120 and 130. The lamp rear side facing main surface of the shade 120 and the lamp front side facing main surface of the shade 130 are spaced, for example, about 1.0 mm ~ about 2.0 mm. Also, a space between the lamp rear side facing main surface of the shade 120 and the rear focal plane of the projection lens 20, and a space between the lamp front side facing main surface of the shade 130 and the rear focal plane of the projection lens 20 are respectively set, for example, about 0 mm ~ about 1.0 mm.

[0034] The swing member 162 is connected to a rotation shaft 172 provided near its connected portion to the shades 120 and 130. Also, the swing member 162 has a fan-shaped vane portion 162a extending substantially vertically downward from its connected portion to the rotation shaft 172. A gear (not shown) is mounted on the leading end of the rotation shaft of the motor 152 and is engaged with a gear (not shown) formed on the lower end of the vane portion 162a.

[0035] When the motor 152 rotates, the rotational force of the motor 152 is transmitted from the gear of the motor 152 to the gear of the vane portion 162a, whereby the shades 120 and 130 are swung about the rotation shaft 172 respectively. Also, the shades 120 and 130, which have been swung due to the rotation of the motor 152, can be returned to their before-swing positions due to the restoring force of a return spring 182. Thus, the shades 120 and 130 can take their retreat positions where their respective upper edge portions exist apart from the optical axis O and thus do not block the light of the bulb 14, and their advance positions (positions shown in Fig. 2A, Fig. 2B and Fig. 3A) where their respective upper edge portions exist on the optical axis O and thus block the light of the bulb 14.

[0036] In this embodiment, the shades 110, 120 and 130 are respectively moved from their advance positions to their retreat positions due to the rotational movements of the motors 150 and 152, while they are moved from the retreat positions to their advance positions due to the restoring forces of the return springs 180 and 182. Alternatively, by rotating the motors 150 and 152 in the opposite direction, the shades 110, 120 and 130 may be moved from the retreat positions to the advance positions. Also, the shade 110 may also be structured such that it can be moved from the advance position to the retreat position due to the rotation of the motor 150 and can be moved from the retreat position to the advance position due to the restoring force of the return spring 180; and, the shades 120 and 130 may also be structured such that they can be moved from the retreat positions to the advance positions due to the rotation of the motor 152 and can be moved from the advance positions to the retreat positions due to the restoring force of the return spring 182.

[0037] The shade 110 is a low beam shade used to form a low beam light distribution pattern. Since the shape of the low beam light distribution pattern is known, the description of the low beam light distribution pattern is omitted here. The upper edge portion of the shade 110 constitutes a low beam cutoff line forming edge portion 110a and, when the shade 110 exists at the advance

position, the low beam light distribution pattern can be formed.

[0038] The shades 120 and 130 are one-side shades for forming a so called one-side light distribution pattern. As shown in Fig. 3B, a one-side light distribution pattern P formed by the lamp unit 10 of this embodiment is a light distribution pattern for forming a so called "left-side high beam which includes a light radiation area P1 existing upward and leftward of a horizontal line H and a light block area S existing upward and rightward of the horizontal line H. The one-side light distribution pattern P includes a first cutoff line CL1 extending horizontally from the neighborhood of the center of the one-side light distribution pattern P and a second cutoff line CL2 extending upwardly from the first cutoff line CL1 existing the center neighborhood side of the one-side light distribution pattern P.

[0039] The first cutoff line CL1 is the boundary between the light block area S and such portion of the one-side light distribution pattern P as exists downward and rightward of the horizontal line H. The second cutoff line CL2 is the boundary between the light radiation area P1 and light block area S. In this embodiment, the first cutoff line CL1 extends downward and rightward of the horizontal line H and the second cutoff line CL2 overlaps with a vertical line V. However, their respective positions are not limited to this. The above-mentioned expression "the neighborhood of the center of the one-side light distribution pattern P" is, for example, the hot zone HZ (high luminosity area) of the one-side light distribution pattern P, or an area containing a point of intersection (a vanishing point) between the horizontal line H and vertical Line V.

[0040] The upper edge portions of the shades 120 and 130 constitute first cutoff line forming edge portions 120a and 130a respectively. Such side edge portions of the shades 120 and 130 as face the swing member 160 constitute first cutoff line forming edge portions 120b and 130b respectively. When the shades 120 and 130 exist at their advance positions and the shade 110 exists at its retreat position, there is formed the one-side light distribution pattern P. Here, when the shades 110, 120 and 130 exist at their retreat positions respectively, there is formed a high beam light distribution pattern. Since the shape of the high beam light distribution pattern is known, the description of the high beam light distribution pattern is omitted here.

[0041] The second cutoff line forming edge portion 120b of the shade 120 includes a gradation forming portion for forming gradations in the second cutoff line CL2. The term "gradations" means that variations in the illumination of the second cutoff line CL2 are made more gradual than variations in the illumination of an area CL1x of the first cutoff line CL1 existing in the neighborhood of the center of the one-side light distribution pattern P. In the lamp unit 10 of this embodiment, the gradation forming portion is constituted of such extension portion 122 of the shade 120, which is disposed more forwardly of the lamp than the shade 130, as extends forwardly of the lamp from the second cutoff line forming edge portion 120b.

[0042] In the case of the lamp longitudinal direction distance from the rear focal plane, the distance from the leading end of the extension portion 122 is longer than that from the second cutoff line forming edge portion 120b. Therefore, of the second cutoff line CL2, an area (an area corresponding to the extension portion 122) to be formed by a portion where the extension portion 122 of the second cutoff line forming edge portion 120b is formed is out of focus. Also, the light to be radiated near the second cutoff line CL2 by the extension portion 122 is blocked in part. Therefore, in the area corresponding to the extension portion 122, the illumination difference between the light radiation area P1 and light shade area S is reduced. Further, part of the light passing through a light passage area R to be touched by the second cutoff line forming edge portions 120b and 130b is reflected by the surface 122a of the extension portion 122 exposed to the light passage area R. Thus, in the area corresponding to the extension portion 122, there is formed a low illumination pattern.

[0043] Consequently, of the second cutoff line CL2, the area to be formed by the portion where the extension portion 122 of the second cutoff line forming edge portion 120b provides a gradation cutoff line CL2a whose illumination variation is gradual than illumination variation of the second cutoff line side end portion area of the first cutoff line CL1. The extension length of the extension portion 122 is, for example, about 1.0 mm to about 4.0 mm.

[0044] The extension portion 122 serving as the gradation forming portion is disposed in such portion of the second cutoff line forming edge portion 120b as is distant by a given distance from its first cutoff line forming edge portion 120a side end portion. Therefore, of the second cutoff line CL2, a given area from the first cutoff line CL1 side end portion provides a clear portion CL2b the illumination variation of which is substantially at the same level as that of the area CL1x of the first cutoff line CL1. Generally, the neighborhood of the center of the one-side light distribution pattern P is an area where the driver's high visual confirmation property is required. Therefore, in the case that the extension portion 122 is formed while it is spaced by a given distance from the first cutoff line forming edge portion 120a, there can be formed the second cutoff line CL2 where the clear portion CL2b extends in the area requiring the driver's high confirmation property and the gradation cutoff line CL2a extends upwardly of the clear portion CL2b.

[0045] Also, as the extension portion 122 becomes distant from the first cutoff line forming edge portion 120a, its extension length increases continuously. That is, the lamp longitudinal direction length of the extension portion 122 gradually increases from its first cutoff line forming edge portion 120a side end portion (upper end portion) toward the opposite end portion (lower end portion) .

Thus, the gradation cutoff line CL2a formed by the extension portion 122 has a shape the horizontal direction length of which gradually increases from the first cutoff line CL1 side toward the outside of the one-side light distribution pattern P. This makes it possible to form the second cutoff line CL2 which can be clearer as it approaches the neighborhood of the center of the one-side light distribution pattern P requiring the driver's high visual confirmation property and also can be more unclear as it approaches the outside area of the one-side light distribution pattern P where the reduced strange feeling of the driver is preferred to the enhanced driver's visual confirmation property. Here, variations in the extension length of the extension portion 122 may also be gradual. The extension lengths of the upper end portion and lower end portion of the extension portion 122, for example, may be set to gradually increase from the upper end portion toward the lower end portion within the range of about 1.00 mm ~ about 4.0 mm that is the above-mentioned extension length of the extension portion 122.

[0046] The surface 122a of the extension portion 122 is a diffusing and reflecting surface having a higher diffusion reflectance of the light from the bulb 14 than the other surfaces of the shade 120. To form this diffusing and reflecting surface, the surface 122a of the extension portion 122 may be treated with a surface treatment such as scribing, painting or embossing which can increase the diffusion reflectance of the surface 122a. Thus, in the case that the light of the light source is diffused and reflected by the thus roughened surface 122a of the extension portion 122 in contact with the light passage area R, the degree of the gradation of the gradation cutoff line CL2a can be enhanced. Also, by adjusting the diffusion reflectance of the surface 122a, the degree of the gradation of the gradation cutoff line CL2a can be controlled.

[0047] In this embodiment, the extension portion 122 is formed by bending the leading end of the shade 120 forwardly of the lamp. This makes it possible to form the extension portion 122 simply. Also, this can avoid an increase in the number of parts in providing the extension portion 122.

[0048] As has been described heretofore, the lamp unit 10 of this embodiment includes the gradation forming portion in the second cutoff line forming edge portion 120b of the shade 120 for forming the second cutoff line CL2 extending upwardly from the neighborhood of the center of the one-side light distribution pattern P. Therefore, at least a portion of the second cutoff line CL2 can be formed as the gradation cutoff line CL2a, thereby being able to form the one-side light distribution pattern P which is difficult to give the driver a visual strange feeling. Also, in the lamp unit 10 of this embodiment, the gradation forming portion is provided by the extension portion 122 formed in the second cutoff line forming edge portion 120b. Therefore, by adjusting the extension length, extension angle, forming position or the like of the extension portion 122, the gradient, width or the like of the illumination variation of the gradation cutoff line CL2a can be controlled simply. Further, in the shade 130, there is not formed the extension portion 122. The thus simplified structure of the shade 130 can reduce the complication of the lamp unit 10 manufacturing process.

(Second embodiment)

[0049] A lamp unit 10 according to a second embodiment is different from the first embodiment in the shape of the shade 120. Now, description will be given below of this embodiment. Here, since the main structures of the headlamp unit 210 and lamp unit 10 are similar to the first embodiment, the structures similar to the first embodiment are given the same designations and thus the description and illustration thereof will be omitted properly.

[0050] Fig. 4A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to the second embodiment, when observed from the back and right sides of the lamp. Fig. 4B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the second embodiment. Here, Fig. 4B shows a light distribution pattern formed on a virtual vertical screen disposed at a given position existing forwardly of the lamp, for example, at a position 25 m forwardly of the lamp.

[0051] As shown in Fig. 4A, in the lamp unit 10 of this embodiment, a shade 120 for forming a one-side light distribution pattern P includes an extended portion 120c in its leading end portion (the opposite end portion to the end portion connected to the swing member 162). The extended portion 120c projects toward the light passage area R (see Fig. 2A) and its side edge portion forms a portion of the second cutoff line forming edge portion 120b. Also, the extended portion 120c is formed in an area distant a given distance from the first cutoff line forming edge portion 120a. The extended portion 120c includes an extension portion 122 in its side edge portion.

[0052] Therefore, as shown in Fig. 4B, in a one-side light distribution pattern P formed by the lamp unit 10 of this embodiment, a gradation cutoff line CL2a is shifted toward the light radiation area P1 from the position CL2' of the second cutoff line CL2 to be taken originally (in Fig. 4A, a position shown by a broken line) . That is, the illumination of the light radiation area P1 in the extending area of the gradation cutoff line CL2a has reached 0 before the position CL2' where the second cutoff line CL2 is to be formed. Therefore, even when the extension portion 122 is formed in the second cutoff line forming edge portion 120b, a portion of the one-side light distribution pattern P can be prevented from spreading out from an area where it should be originally formed. Or, the amount of spreading out from the originally formed area of a portion of the one-side light distribution pattern P can be reduced.

[0053] As described above, the lamp unit 10 of this embodiment includes the extended portion 120c projecting toward the light passage area R, while the extension

portion 122 is formed in the extended portion 120c. Therefore, even when gradations are formed in the second cutoff line CL2, the one-side light distribution pattern P can be stored within the range where it should be originally formed. Also, in this embodiment, the extended portion 120c is provided in an area distant by a given distance from the first cutoff line forming edge portion 120a. Therefore, the second cutoff line forming edge portion 120b of the shade 120 and the third cutoff line forming edge portion 130b of the shade 130 are the same in shape from the first cutoff line forming edge portion 120a to the given distance. Thus, a clear portion CL2b to be formed near the first cutoff line CL1 can be made clearer. Also, in the shade 130, there is not formed the extended portion 120c nor extension portion 122. The thus simplified structure of the shade 130 can reduce the complication of the lamp unit 10 manufacturing process.

(Third embodiment)

[0054] A lamp unit 10 according to a third embodiment is different from the embodiments 1 and 2 in the shape of the shade 120 for forming a one-side light distribution pattern. That is, the shade 120 of this embodiment is different in structure from the embodiments 1 and 2 in the position of the first cutoff line forming edge portion side end portion of the extension portion 122. Now, description will be given below of this embodiment. Here, since the main structures of the headlamp unit 210 and lamp unit 10 are similar to those of the embodiments 1 and 2, the similar structures to the embodiments 1 and 2 are given the same designations and thus the description and illustration thereof will be omitted properly.

[0055] Fig. 5A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to the third embodiment, when observed from the back and right sides of the lamp. Fig. 5B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the third embodiment. Here, Fig. 5B shows a light distribution pattern formed on a virtual vertical screen disposed at a given position existing forwardly of the lamp, for example, at a position 25 m forwardly of the lamp. In Figs. 5A and 5B, a position Is on the second cutoff line forming edge portion 120b shown in Fig. 5A corresponds to a position Ip on the second cutoff line CL2 shown in Fig. 5B. Similarly, a position IIs corresponds to a position IIp, a position IIIs to a position IIIp, and a position IVs to a position IVp, respectively.

[0056] As shown in Fig. 5A, in this embodiment, the shade 120 for forming a one-side light distribution pattern, similarly to the shade 120 of the second embodiment, includes an extended portion 120c, while the extension portion 122 is formed in the side edge portion of the extended portion 120c. In the extension portion 122, its first cutline forming edge portion side end portion 122b (position IIIs) is more distant from the first cutoff line forming edge portion 120a than a portion (position IIs) for forming the second cutoff line portion (position IIp) in contact with the first cutoff line side end portion of the gradation cutoff line CL2a in the second cutoff line forming edge portion 120b.

[0057] In the case that the extension portion 122 is formed in the second cutoff line forming edge portion 120b, a portion of the light is reflected toward the first cutoff line forming edge portion by the end portion 122b of the extension portion 122. This reflected light can extend the gradation cutoff line CL2a toward the first cutoff line CL1. That is, the end portion of the gradation cutoff line CL2a can be shifted toward the first cutoff line from the position IIIp on the second cutoff line CL2 corresponding to the position IIIs of the end portion 122b on the second cutoff line forming edge portion.

[0058] Therefore, the end portion 122b is set not at the position IIs on the second cutoff line forming edge portion 120b corresponding to the position IIp of the cutoff line CL2a to be formed but at the position IIIs distant by a given distance from the position IIs with the extension amount of the gradation cutoff line CL2a taken into consideration.

[0059] Thus, the portion of the second cutoff line forming edge portion 120b ranging from the position Is to the position IIs provides a portion for forming a clear portion CL2b (from the position Ip to the position IIp) . Also, a portion ranging from the position IIIs to the position IVs with the extension portion 122 formed therein provides a portion for forming a gradation cutoff line CL2a (from the position IIp to the position IVp) . Further, a portion ranging from the position IIs to the position IIIs provides an offset portion corresponding to the extended portion of the gradation cutoff line CL2a (from the position IIp to the position IIIp).

[0060] Thus, even when the gradation cutoff line CL2a is extended by the light reflected by the end portion 122b of the extension portion 122, the gradation cutoff line CL2a can be formed at a proper position. That is, the accuracy of the position for forming gradations can be enhanced.

(Fourth embodiment)

[0061] A lamp unit 10 according to a fourth embodiment includes a gradation forming portion in the first cutoff line forming edge portion 120a. Now, description will be given below of this embodiment. Here, since the main structures of the headlamp unit 210 and lamp unit 10 are similar to those of the first embodiment, the similar structures to the first embodiment are given the same designations and thus the description and illustration thereof will be omitted properly.

[0062] Fig. 6A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to the fourth embodiment, when observed from the front and right sides of the lamp. Fig. 6B is a typical view to explain a one-side light distribution pattern to be formed by the lamp unit according to the

fourth embodiment. Here, Fig. 6B shows a light distribution pattern formed on a virtual vertical screen disposed at a given position existing forwardly of the lamp, for example, at a position 25 m forwardly of the lamp.

[0063] As shown in Fig. 6A, in a lamp unit 10 according to this embodiment, a gradation forming portion for forming gradations in at least a portion of the first cutoff line CL1 is formed in the first cutoff line forming edge portion 120a in the shade 120 for forming a one-side light distribution pattern. In this embodiment, the gradation forming portion is constituted of an extension portion 123 extending forwardly of the lamp from the first cutoff line forming edge portion 120a of the shade 120. The extension portion 123 is formed in such portion of the first cutoff line CL1 as is distant by a given distance from its second cutoff line CL2 side end portion.

[0064] Thus, as shown in Fig. 6B, in the case of a one-side light distribution pattern P to be formed by the lamp unit 10 of this embodiment, a gradation cutoff line CL1a is formed in a portion of the first cutoff line CL1. In this embodiment, a clear portion CL1b is formed in an area near the center of the one-side light distribution pattern P requiring a driver's high visual confirmation property, while a gradation cutoff line CL1a is formed in an area near the outside of the one-side light distribution pattern P where the reduced strange feeling of the driver is preferred to the enhanced visual confirmation property for the driver.

[0065] As described above, the lamp unit 10 of this embodiment includes, in the first cutoff line forming edge portion 120a, the extension portion 123 serving as the gradation forming portion. Therefore, a portion of the first cutoff line CL1 can be graded. This can reduce the strange feeling of the driver.

[0066] The invention is not limited to the above-mentioned respective embodiments but the respective embodiments can be combined together or various modifications such as the change of the design can be added thereto based on the knowledge of persons skilled in the art. Other various embodiments based on the above combinations or with the above modifications added also fall under the scope of the invention. New embodiments provided by the combinations of the above embodiments and by the combinations of the above embodiments with the following modifications respectively provide the effects of the embodiments and modifications combined.

(First modification)

[0067] Fig. 7A is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a first modification, when observed from the front and right sides of the lamp. As shown in Fig. 7A, in a lamp unit 10 according to the first modification, an extension portion 132 is formed in the shade 130 as well. The extension portion 132 extends backwardly of the lamp from the second cutoff line forming edge portion 130b of the shade 130 disposed more backwardly of the lamp than the shade 120.

(Second modification)

[0068] Fig. 7B is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a second modification, when observed from the front and right sides of the lamp. As shown in Fig. 7B, in a lamp unit 10 of the second modification, a gradation forming portion is constituted of thick plate portions 124 and 134. The thick plate portions 124 and 134 are thicker in the lamp longitudinal direction than such portions 120ax and 130ax of the first cutoff line forming edge portions 120a and 130a of the shades 120 and 130 as are in contact with the second cutoff line forming edge portions 120b and 130b. The portions 120ax and 130ax respectively form the areas existing near the center of the one-side light distribution pattern P in the first cutoff line CL1. Here, diffusing and reflecting surfaces may also be formed on the surfaces of the thick plate portions 124 and 134.

(Third modification)

[0069] Fig. 7C is a schematically perspective view of a one-side light distribution pattern forming shade used in a lamp unit according to a third modification, when observed from the front and right sides of the lamp. As shown in Fig. 7C, in a lamp unit 10 of the third modification, a gradation forming portion is constituted of sticking-out portions 125 and 135. The sticking-out portions 125 and 135 are spaced in the optical axis direction more widely than such portions 120ax and 130ax of the first cutoff line forming edge portions 120a and 130a as are in contact with the second cutoff line forming edge portions 120b and 130b. To form sticking-out portions 125 and 135, for example, the lower end portion of the shade 120 may be bent forwardly of the lamp and the lower end portion of the shade 130 may be bent backwardly of the lamp.

(Fourth modification)

[0070] Fig. 8A is a schematic front view of a one-side light distribution pattern forming shade used in a lamp unit according to a fourth modification, when observed from front of the lamp. As shown in Fig. 8A, in a lamp unit 10 of the fourth modification, a gradation forming portion is constituted of uneven portions 126 and 136 respectively formed in the second cutoff line forming edge portions 120b and 130b. Since, due to provision of the uneven portions 126 and 136, the light of low luminosity can be radiated onto the neighborhood of the second cutoff line CL2, a gradation cutoff line CL2a can be formed. Also, such provision can avoid the increased weight of a shade which can occur when an extension portion is formed or when a thick plate portion is formed.

(Fifth modification)

[0071] Fig. 8B is a schematically front view of a one-side light distribution pattern forming shade used in a lamp unit according to a fifth modification, when observed from front of the lamp. As shown in Fig. 8B, in a lamp unit 10 of the fifth modification, uneven portions 126 and 136 are formed in the second cutoff line forming edge portions 120b and 130b, while the uneven portions 126 and 136 are shifted from each other such that they alternate, thereby constituting a gradation forming portion. In this modification, the uneven portions 126 and 136 respectively have a triangular wave shape and are disposed such that they are out of phase. In this modification, a gradation cutoff line CL2a similar to the fourth modification can be formed by the uneven portions 126 and 136 which are rougher than the fourth modification, thereby being able to reduce the complication of the process for manufacturing the shades 120 and 130.

(Sixth modification)

[0072] Fig. 8C is a schematically front view of a one-side light distribution pattern forming shade used in a lamp unit according to a sixth modification, when observed from front of the lamp. As shown in Fig. 8C, in a lamp unit 10 of the sixth modification, a gradation forming portion is constituted of rectangular-shaped uneven portions 127 and 137 with their corner portions cut out respectively formed in the second cutoff line forming edge portions 120b and 130b. The uneven portions 127 and 137 are shifted from each other such that they alternate. Even the uneven portions having such shape can form gradations in the second cutoff line CL2. Here, the shape of uneven portions to be formed in the shades 120 and 130 of the modifications 4 to 6 can be set properly according to the shape or the like of the gradation cutoff line CL2a to be formed.

(Seventh modification)

[0073] Fig. 9 is a schematically front view of a one-side light distribution pattern forming shade used in a lamp unit according to a seventh modification, when observed from front of the lamp. As shown in Fig. 9, in a lamp unit 10 of the seventh modification, a gradation forming portion is constituted of multiple penetration holes 128, 138 which are formed along the second cutoff line forming edge portions 120b and 130b and are penetrated through the shades in the lamp longitudinal direction. Since provision of the penetration holes 128, 138 makes it possible to radiate the light of low luminosity onto the neighborhood of the second cutoff line CL2, a gradation cutoff line CL2a can be formed.

[0074] Here, the above-mentioned respective embodiments and modifications include two shades 120 and 130 as a shade for forming the one-side light distribution pattern P. However, a single shade may also be used to form the one-side light distribution pattern P. In this case, the extension portion may extend forwardly or backwardly of the lamp.

[0075] Also, in the above-mentioned respective embodiments and modifications, the gradation forming portion is spaced by a given distance from the first cutoff line forming edge portion 120a. However, a range where the gradation forming portion is formed is not limited to this but can be changed properly according to the shape of the one-side light distribution pattern P to be formed. For example, the gradation forming portion may also be formed on the whole of the second cutoff line forming edge portions 120b and 130b.

[0076] Also, in the case that a sufficient area can be secured, the gradation forming portion can be constituted of only a diffusing and reflecting surface. In the above-mentioned respective embodiments and modifications, there is formed the left-side light distribution pattern. However, the one-side light distribution pattern P may also be a right-side light distribution pattern which includes a light radiation area P1 upward and rightward of the horizontal line H and a light block area S on the left side.

Claims

1. A lamp unit comprising:

a light source;
a projection lens that radiates light from the light source in a forward direction of the lamp unit; and
a shade that is interposed between the light source and the projection lens and that is configured to form a light distribution pattern having a first cutoff line extending horizontally from a neighborhood of a center of the light distribution pattern and a second cutoff line extending upwardly from an end portion of the first cutoff line in the neighborhood of the center, the shade comprising a second cutoff line forming edge portion,

wherein the shade comprises a gradation forming portion in the second cutoff line forming edge portion,
wherein the gradation forming portion is for forming a gradation at least in a portion of the second cutoff line, and
wherein the gradation is for making variations gradual in illumination in the portion of the second cutoff line than that in an area of the neighborhood of the center.

2. The lamp unit of Claim 1, wherein the gradation forming portion includes an extension portion extending from the second cutoff line forming edge portion at least in one of forward and backward directions of the lamp.

3. The lamp unit of Claim 1 or 2, wherein the gradation forming portion includes:

a first shade member and a second shade member disposed spaced from each other in an optical axis direction of the lamp unit; and,
at least one of an extension portion extending in a forward direction of the lamp from the second cutoff line forming edge portion of one of the first and second shade members disposed forwardly of the lamp, and an extension portion extending in a backward direction of the lamp from the second cutoff line forming edge portion of the other disposed backwardly of the lamp.

4. The lamp unit of any one of Claims 1 to 3, wherein the gradation forming portion includes an uneven portion formed in the second cutoff line forming edge portion.

5. The lamp unit of any one of Claims 1 to 4,
wherein the gradation forming portion includes a first shade member and a second shade member disposed spaced from each other in an optical axis direction of the lamp unit,
wherein the first and second shade members respectively include second cutoff line forming edge portions, each including an uneven portion, and
wherein the respective uneven portions are shifted from each other such that they alternate.

6. The lamp unit of any one of Claims 1 to 5,
wherein the shade includes a first cutoff line forming edge portion, and
wherein the gradation forming portion is formed in such portion of the second cutoff line forming edge portion as is distant by a given distance from an end portion of its first cutoff line forming edge portion side.

7. The lamp unit of Claim 2 or 3, wherein the extension portion is formed such that, as the extension portion parts away from the first cutoff line, its extension length increases gradually or continuously.

8. The lamp unit of any one of Claims 1 to 7,
wherein the shade includes a first cutoff line forming edge portion, and
wherein a first cutoff line forming edge portion side end portion of the gradation forming portion is more distant from the first cutoff line forming edge portion than a portion of the second cutoff line forming edge portion where a second cutoff line portion that is to be contacted with the first cutoff line side end portion of a to-be-graded portion of the second cutoff line is formed.

9. The lamp unit of any one of Claims 1 to 8, wherein the gradation forming portion includes a reflecting surface formed such that its diffusion and reflectance rate of the light from the light source is higher than the other surfaces of the shade.

10. The lamp unit of any one of Claims 1 to 9,
wherein the shade includes a first cutoff line forming edge portion, and
wherein the shade includes, in the first cutoff line forming edge portion, a gradation forming portion for forming the gradation at least in a portion of the first cutoff line.

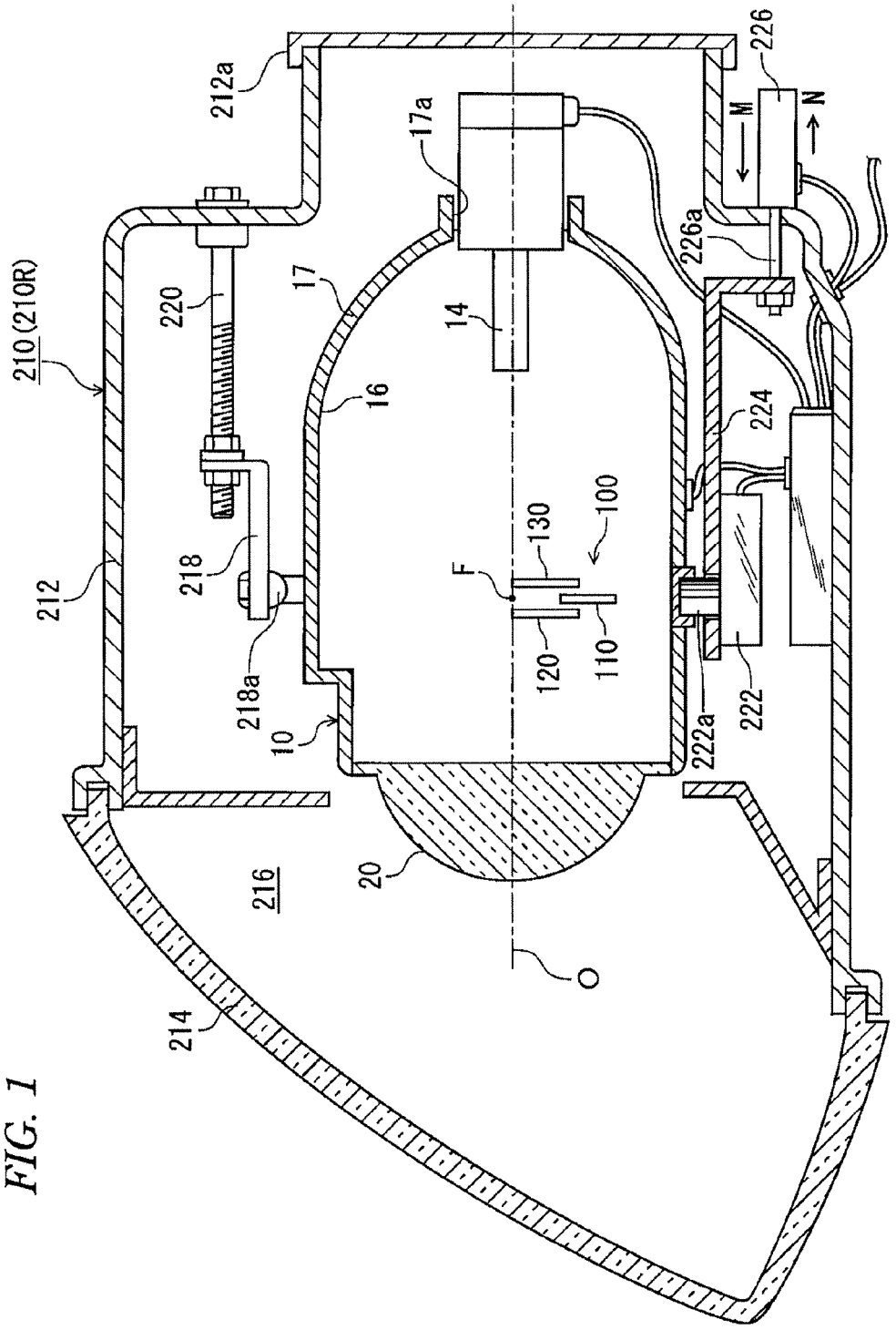

212a
17a
226
M
N
226a
210 (210R)
220
17
14
16
224
212
218
130
100
F
120
110
218a
10
222
222a
216
20
O
214

FIG. 1

FIG. 2A

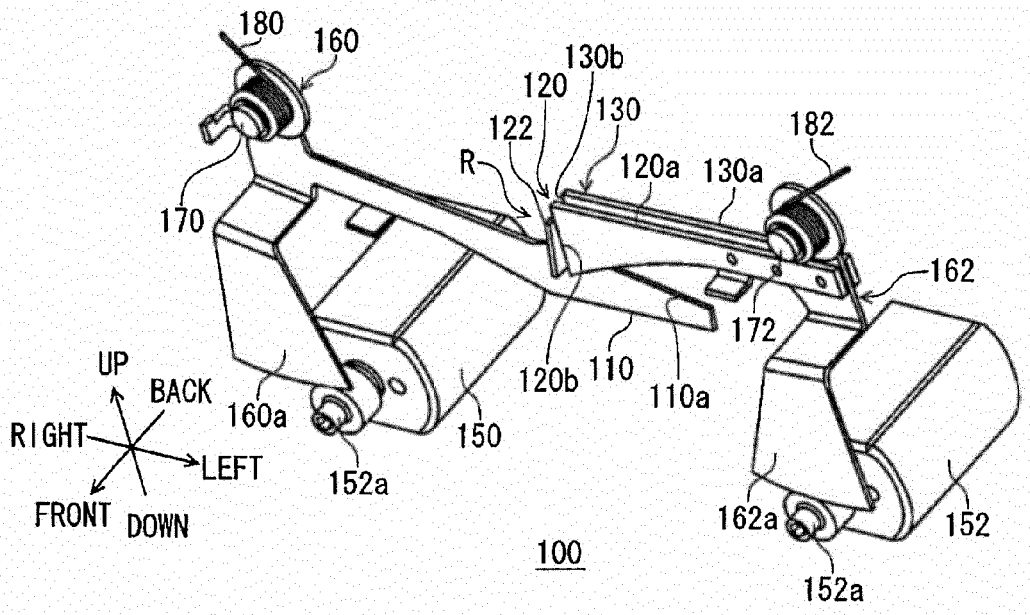

180
160
130b
120
130
122
182
R
120a
130a
170
162
172
UP
BACK
120b
110
110a
160a
150
RIGHT
LEFT
152a
FRONT
DOWN
162a
152
100
152a

FIG. 2B

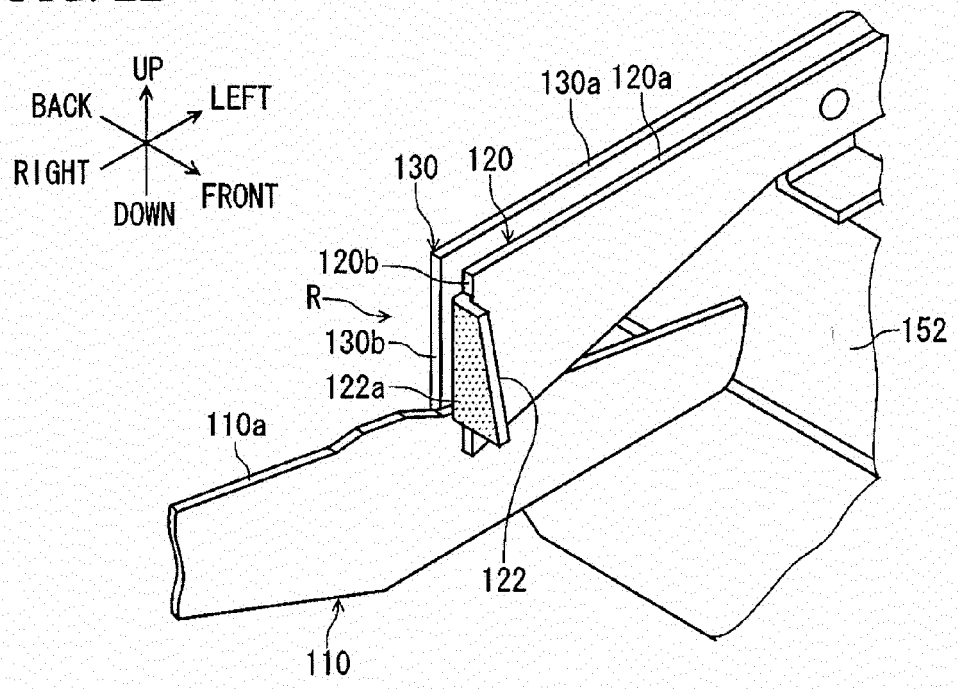

UP
BACK
LEFT
RIGHT
FRONT
DOWN
130a
120a
130
120
120b
R
130b
122a
152
110a
122
110

FIG. 3A

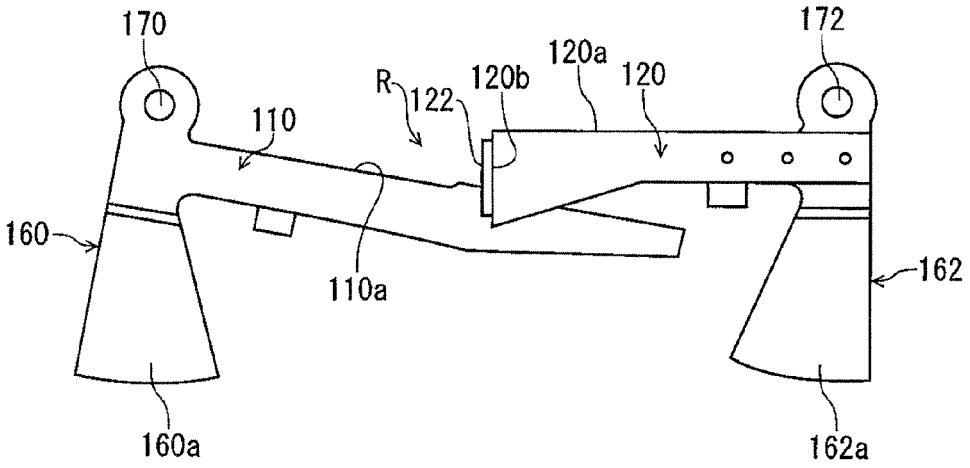

170
172
120a
R
122
120b
120
110
160
110a
162
160a
162a

FIG. 3B

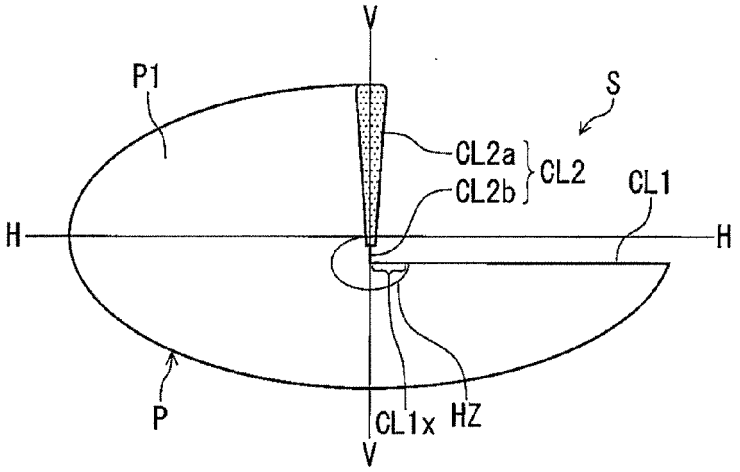

V
P1
S
CL2a
CL2
CL2b
CL1
H
H
P
CL1x
HZ
V

FIG. 4A

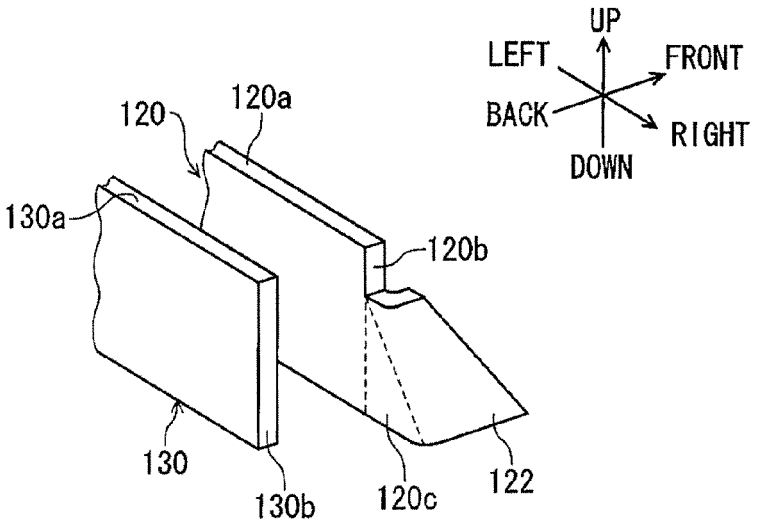

UP
LEFT
FRONT
BACK
RIGHT
DOWN
120
120a
130a
120b
130
130b
120c
122

FIG. 4B

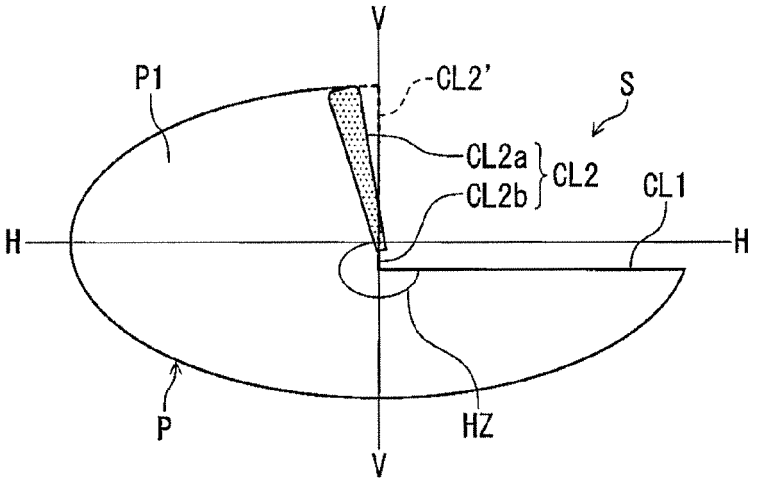

V
P1
CL2'
S
CL2a
CL2b
CL2
CL1
H
H
P
HZ
V

FIG. 5A

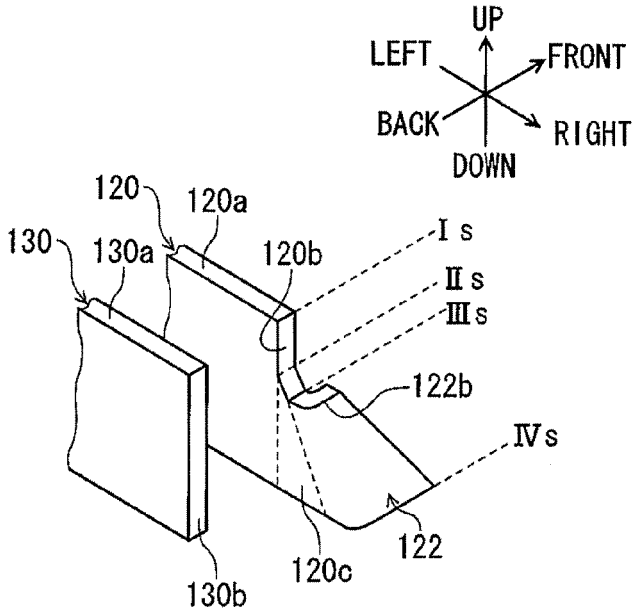

UP
LEFT
FRONT
BACK
RIGHT
DOWN
120
120a
130
130a
120b
Is
IIs
IIIs
122b
IVs
122
120c
130b

FIG. 5B

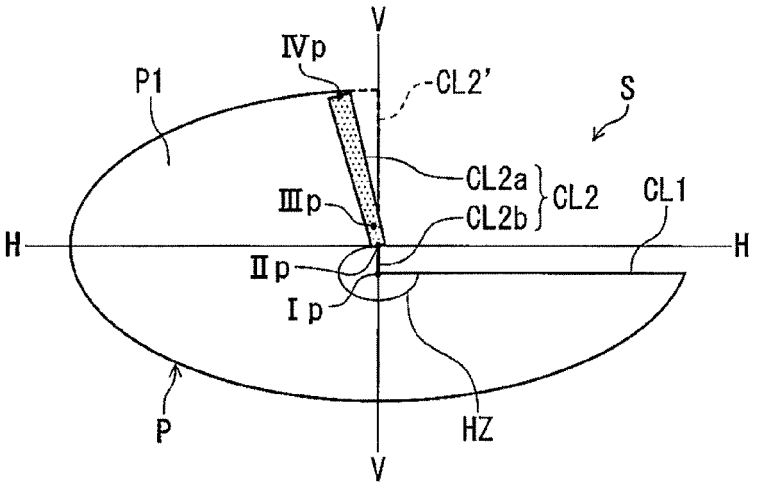

V
IVp
P1
CL2'
S
CL2a
CL2
CL1
IIIp
CL2b
H
H
IIp
Ip
P
HZ
V

FIG. 6A

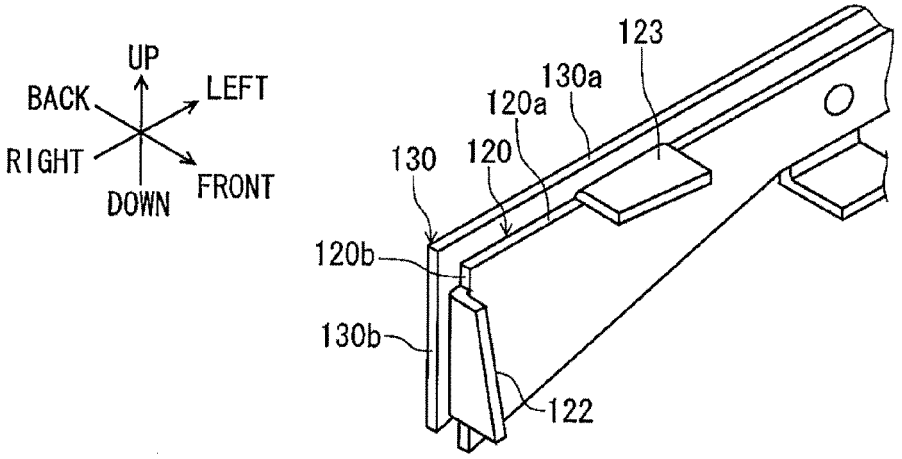

UP
BACK
LEFT
RIGHT
FRONT
DOWN
123
130a
120a
130
120
120b
130b
122

FIG. 6B

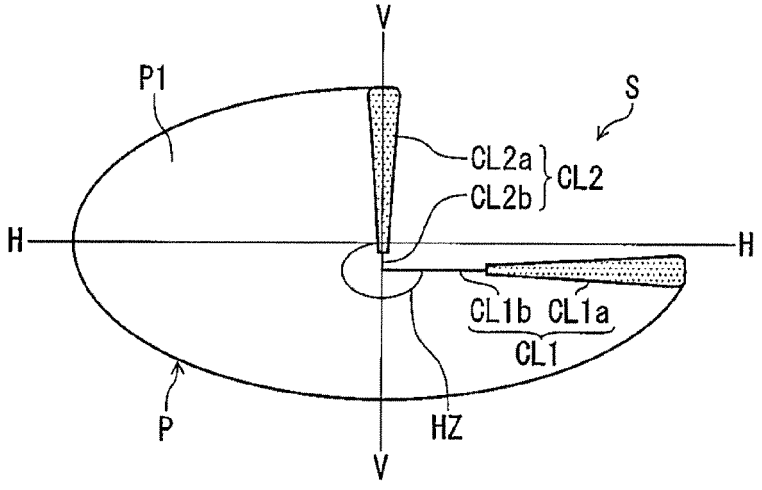

V
P1
S
CL2a
CL2b
CL2
H
H
CL1b
CL1a
CL1
P
HZ
V

FIG. 7A

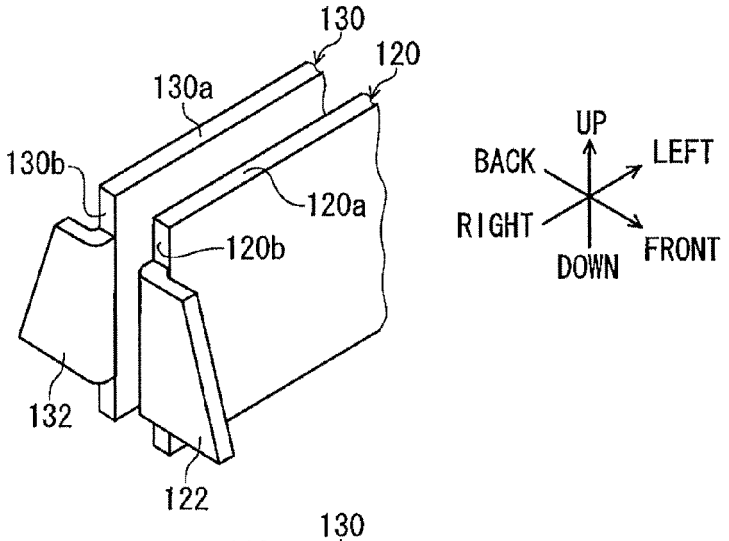


FIG. 7B

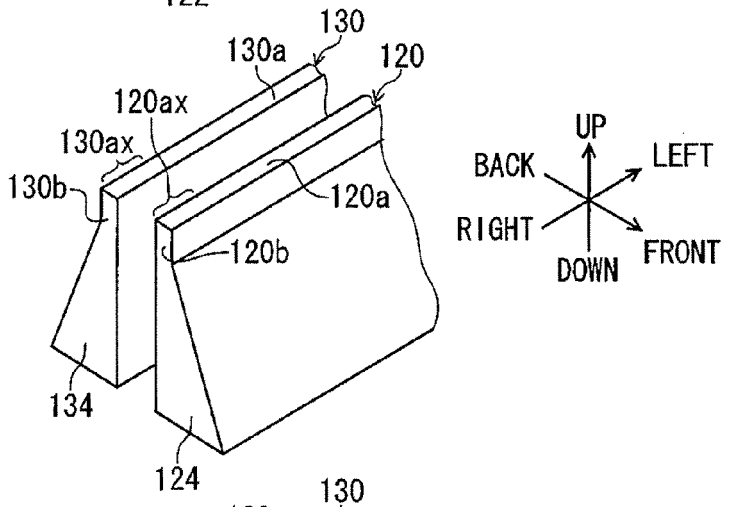


FIG. 7C

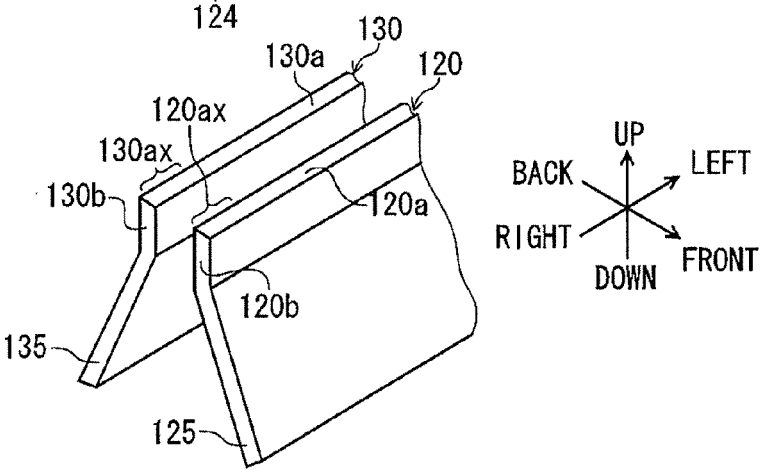


FIG. 8A

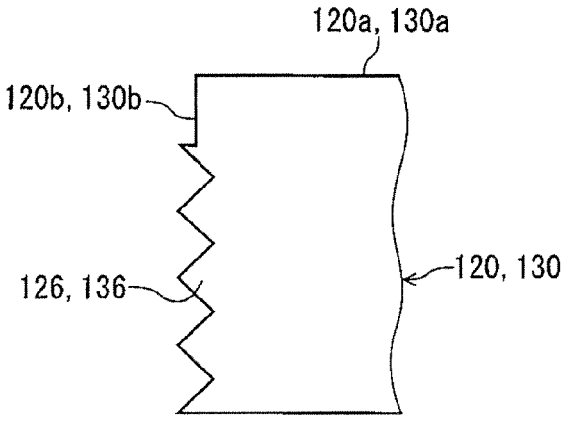


FIG. 8B

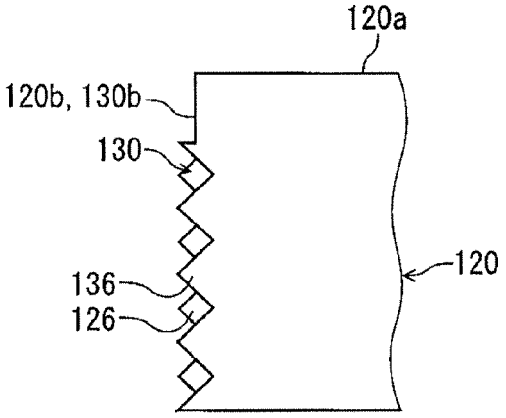


FIG. 8C

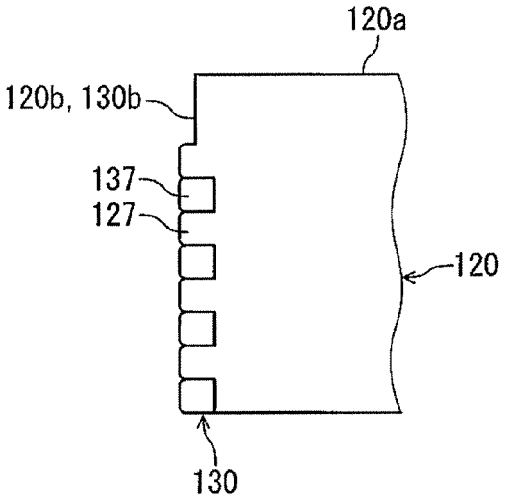
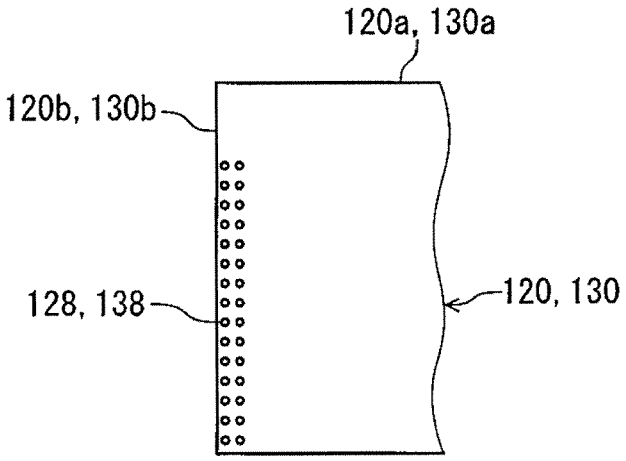


FIG. 9



REFERENCES CITED IN THE DESCRIPTION

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- JP 2010000957 A **[0003]**
- JP 2010257909 A **[0003]**