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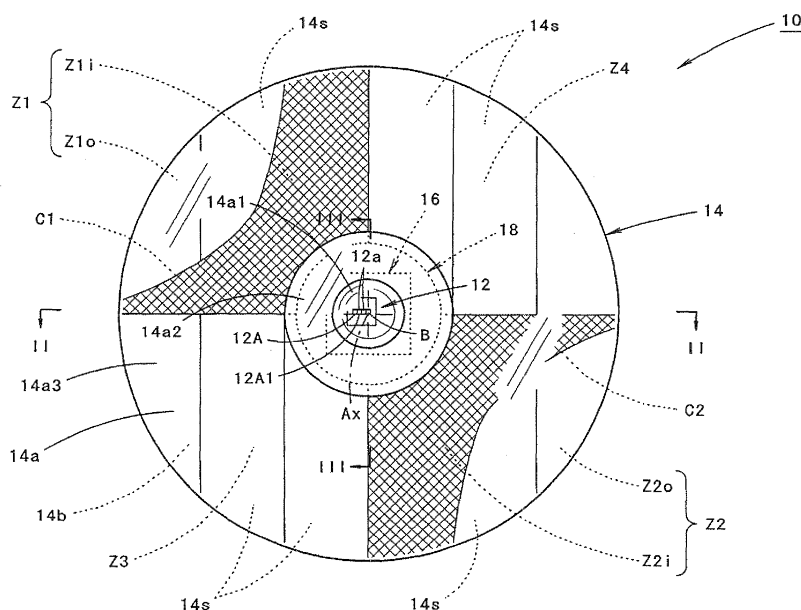
(54) **Vehicular illumination lamp**

(57) [TASK] To enable simultaneous formation of a diagonal cut-off line and a horizontal cut-off line in a vehicular illumination lamp that emits light from a light-emitting element forward using a translucent member disposed in front of the light-emitting element.

[MEANS OF SOLVING THE PROBLEM] Light from a light-emitting element is internally reflected on a front surface 14a of a translucent member 14. The light is subsequently internally reflected again on a rear surface 14b of the translucent member 14, and then emitted from the front surface 14a. In this case, a light-emitting surface

12A of the light-emitting element 12 is disposed such that a lower end edge 12A1 is positioned on a horizontal line orthogonal to an optical axis Ax, thereby enabling formation of a horizontal cut-off line. Furthermore, in first and second zones Z1, Z2 respectively positioned diagonally upward on the oncoming vehicle lane side and diagonally downward on the host vehicle lane side, inner peripheral zones Z1i, Z2i are positioned more toward the inner peripheral side than first and second curves C1, C2, which are formed so as to project toward the optical axis Ax when viewed from the lamp front, and configured as zones for forming a diagonal cut-off line.

FIG. 1



Description

[Technical Field]

5 **[0001]** The present invention relates to a vehicular illumination lamp constituted so as to emit light from a light-emitting element such as a light-emitting diode forward using a translucent member disposed in front of the light-emitting element.

[Related Art]

10 **[0002]** According to related art as described in Patent Document 1, for example, a vehicular illumination lamp is constituted so as to emit light forward from a light-emitting element that is disposed facing forward near a predetermined point on an optical axis that extends in the vehicle longitudinal direction, using a translucent member that is disposed in front of the light-emitting element.

15 **[0003]** This vehicular illumination lamp is constituted such that light emitted from the light-emitting element is incident to the translucent member and internally reflected on a front surface thereof. The light is subsequently internally reflected again on a rear surface of the translucent member, and then emitted from the front surface. In such case, a center region on the front surface of the translucent member is subjected to mirror surface processing in order to internally reflect light from the light-emitting element.

20 **[0004]** Patent Document 1 also describes a configuration in which the light-emitting element is disposed such that a lower end edge of a light-emitting surface thereof is positioned on a horizontal line that is orthogonal to the optical axis.

[Patent Document 1]

25 **[0005]** Japanese Patent Application Laid-Open (Kokai) No. 2005-11704

[Disclosure of the Invention]

[Problem to be Solved by the Invention]

30 **[0006]** By adopting the constitution described in Patent Document 1 above, the vehicular illumination lamp can be constituted thin. In such case, disposing the light-emitting element such that the lower end edge of the light-emitting surface of the light-emitting element is positioned on a horizontal line orthogonal to the optical axis enables the formation of a light distribution pattern with a horizontal cut-off line in an upper end portion thereof.

35 **[0007]** However, radiated light from the vehicular illumination lamp described in Patent Document 1 can only form a straight horizontal cut-off line.

[0008] Therefore, a problem arises when using this vehicular illumination lamp to form a low beam distribution pattern for a headlamp. As described in Patent Document 1, the vehicular illumination lamp for forming a horizontal cut-off line must be used in combination with another vehicular illumination lamp for forming a diagonal cut-off line that has the same constitution but is disposed inclined.

40 **[0009]** The present invention was devised in light of the foregoing circumstances, and it is an object of the present invention to provide a vehicular illumination lamp that is constituted such that light from a light-emitting element is emitted forward using a translucent member disposed in front of the light-emitting element, and is capable of forming a low beam distribution pattern having horizontal and diagonal cut-off lines using radiated light.

45 [Means for Solving the Problem]

[0010] The present invention accomplishes the above object by making various improvements to the structure of a rear surface of the translucent member.

50 **[0011]** Namely, the vehicular illumination lamp according to the present invention is a vehicular illumination lamp that includes a light-emitting element that is disposed facing forward near a predetermined point on an optical axis extending in a vehicle longitudinal direction; and a translucent member that is disposed in front of the light-emitting element, wherein light emitted from the light-emitting element is incident to the translucent member and internally reflected on a front surface of the translucent member, after which the light is internally reflected again on a rear surface of the translucent member and emitted from the front surface of the translucent member. The vehicular illumination lamp is **characterized in that** the light-emitting element has a light-emitting surface whose lower end edge extends in a straight line, and the light-emitting element is disposed such that the lower end edge of the light-emitting surface is positioned on a horizontal line orthogonal to the optical axis. The front surface of the translucent member is formed as a flat plane orthogonal to the optical axis, and the rear surface of the translucent member is formed by a predetermined light reflection control

surface that is formed using as a reference surface a rotational paraboloid whose focal point is a position symmetrical to the predetermined point with respect to the front surface of the translucent member. A center region on the front surface of the translucent member within a predetermined range centered on the optical axis is subjected to mirror surface processing, and the rear surface of the translucent member is subjected to mirror surface processing. On the rear surface of the translucent member, a first zone that is positioned diagonally upward on an oncoming vehicle lane side with respect to the optical axis borders a first curve formed so as to project toward the optical axis when viewed from the front of the lamp, and is divided into an inner peripheral zone and an outer peripheral zone; and a second zone that is positioned diagonally downward on a host vehicle lane side with respect to the optical axis borders a second curve formed so as to project toward the optical axis when viewed from the front of the lamp, and is divided into an inner peripheral zone and an outer peripheral zone. At least one of a vicinity region of the first curve in the inner peripheral zone of the first zone and a vicinity region of the second curve in the inner peripheral zone of the second zone is configured as a region for forming a diagonal cut-off line that extends diagonally upward toward the host vehicle lane side using reflected light from the region.

[0012] The above "light-emitting element" is not particularly limited in terms of the specific shape and size of the light-emitting surface thereof, provided that the light-emitting element has a light-emitting surface whose lower end edge extends in a straight line. The "light-emitting element" is also not particularly limited in terms of the specific position in the lateral direction, provided that the light-emitting element is disposed such that the lower end edge of the light-emitting surface thereof is positioned on a horizontal line orthogonal to the optical axis.

[0013] The above "predetermined light reflection control surface that is formed using as a reference surface a rotational paraboloid" is not particularly limited in terms of the specific shape. For example, a light reflection control surface constituted by the rotational paraboloid itself, or formed with a plurality of reflective elements on a rotational paraboloid, or constituted by a curved surface that deforms a rotational paraboloid may be adopted.

[0014] The above "mirror surface processing" refers to processing for enabling mirror reflection, and the mirror surface processing may obviously be performed using a surface treatment such as aluminization or the like. The mirror surface processing may also be performed by attaching a member with a mirror surface.

[Effects of the Invention]

[0015] As shown in the above constitution, the vehicular illumination lamp according to the present invention is constituted such that light from the light-emitting element, which is disposed facing forward near the predetermined point on the optical axis extending in the lamp longitudinal direction, is incident to the translucent member and internally reflected on the front surface. The light is subsequently internally reflected again on the rear surface, and then emitted from the front surface. The light-emitting element is disposed such that the lower end edge of the light-emitting surface is positioned on a horizontal line that intersects the optical axis. Therefore, a light distribution pattern that includes a horizontal cut-off line on an upper end portion thereof can be easily achieved.

[0016] In the translucent member, the front surface is formed using a flat plane orthogonal to the optical axis, and the rear surface is structured as a predetermined light reflection control surface that is formed using a rotational paraboloid, whose focal point is a position symmetrical to the predetermined point with respect to the front surface of the translucent member. Therefore, a particular position where the light source image of the light-emitting surface of the light-emitting element, which is formed using reflected light from the rotational paraboloid serving as the reference surface, becomes a light source image having an upper end edge that extends diagonally upward toward the host vehicle lane side can be found on the reference surface.

[0017] The results of an investigation performed by the present inventor confirmed that, specifically, this particular position is at two locations on the rear surface of the translucent member: a position on the first curve, which is formed so as to project toward the optical axis when viewed from the lamp front, among the first zone that is positioned diagonally upward on the oncoming vehicle lane side with respect to the optical axis; and a position on the second curve, which is formed so as to project toward the optical axis when viewed from the lamp front, among the second zone that is positioned diagonally downward on the host vehicle lane side with respect to the optical axis.

[0018] Based on this knowledge, in the vehicular illumination lamp according to the present invention, on the rear surface of the translucent member, at least one of the vicinity region of the first curve in the inner peripheral zone of the first zone and the vicinity region of the second curve in the inner peripheral zone of the second zone is configured as a region for forming a diagonal cut-off line that extends diagonally upward toward the host vehicle lane side using reflected light from the region. Therefore, the diagonal cut-off line can be simultaneously formed together with the horizontal cut-off line.

[0019] According to the present invention described above, in a vehicular illumination lamp constituted such that light from the light-emitting element is emitted forward using the translucent member disposed in front of the light-emitting element, radiated light therefrom can be used to form the low beam distribution pattern having the horizontal and diagonal cut-off lines.

[0020] In the above constitution, a light source image formed using reflected light from the respective outer peripheral zones of the first and second zones will be formed projecting above the horizontal and diagonal cut-off lines.

[0021] Hence, the respective outer peripheral zones of the first and second zones may be formed such that internally reflected light from the front surface of the translucent member incident to the outer peripheral zones is defectively reflected downward. There is thus no need to apply a non-reflective treatment or the like to the outer peripheral zones, and the formation of a light source image projecting above the horizontal and diagonal cut-off lines can be prevented.

[0022] In such case, the respective outer peripheral zones of the first and second zones may be formed so as to diffusely and horizontally reflect internally reflected light from the front surface of the translucent member incident to the outer peripheral zones. Therefore, it is possible to effectively prevent a light source image that has been displaced downward due to downward deflective reflection by the outer peripheral zones from causing uneven light distribution on the road surface in front of the vehicle.

[0023] In the above constitution, the light-emitting element may be disposed such that an end point on the host vehicle lane side of the lower end edge of the light-emitting surface of the light-emitting element is positioned in the vicinity of the optical axis and more toward the host vehicle lane side than the optical axis. Therefore, a light source image formed using reflected light from the region for forming the diagonal cut-off line can be formed at a position in the vicinity of the host vehicle lane side of an elbow point, which is an intersection of the horizontal cut-off line and the diagonal cut-off line. Thus, a hot zone that is a high intensity region of the low beam distribution pattern can be formed at an optimal position.

[0024] In the above constitution, the center region on the front surface of the translucent member (namely a region subjected to mirror surface processing that is within a predetermined range centered on the optical axis) may be set as a toric region centered on the optical axis. Furthermore, a region positioned more toward the inner peripheral side than the toric region on the front surface of the translucent member may be formed as a lens portion that defectively emits light from the light-emitting element that reaches the region. Therefore, a light distribution pattern formed by light emitted from the lens portion can be formed in addition to the light distribution patterns formed using light internally reflected by the rear surface of the translucent member. Thus, light flux from the light source can be effectively utilized. In such case, a relatively dark and large light distribution pattern of any size can be easily formed around the relatively bright and small light distribution patterns formed using light internally reflected by the rear surface of the translucent member. Thus, the low beam distribution pattern formed by radiated light from the vehicular illumination lamp can be formed as a light distribution pattern with little uneven light distribution.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0025]

[FIG. 1]

FIG. 1 is a frontal view that shows a vehicular illumination lamp according to one embodiment of the present invention.

[FIG. 2]

FIG. 2 is a cross-sectional view taken along a line II-II in FIG. 1.

[FIG. 3]

FIG. 3 is a detailed cross-sectional view taken along a line III-III in FIG. 1.

[FIG. 4]

FIG. 4 is a drawing that transparently shows a low beam distribution pattern formed on a virtual vertical screen positioned 25 meters in front of the vehicular illumination lamp by light that is radiated forward from the vehicular illumination lamp.

[FIG. 5]

FIG. 5 shows views of a light source image on a light-emitting surface, which are formed by repeatedly reflected light from a plurality of positions on a first zone, in a case where the first zone is on a rear surface of a translucent member of the embodiment and is formed over its entire region with a rotational paraboloid.

[Best Mode for Carrying Out the Invention]

[0026] Hereinafter, an embodiment of the present invention will be described with reference to the attached drawings.

[0027] FIG. 1 is a frontal view that shows a vehicular illumination lamp 10 according to the present embodiment. FIG. 2 is a cross-sectional view taken along a line II-II in FIG. 1, and FIG. 3 is a detailed cross-sectional view taken along a line III-III in FIG. 1.

[0028] As shown in these figures, the vehicular illumination lamp 10 according to the present embodiment includes a light-emitting element 12 that is disposed facing forward near a predetermined point A on an optical axis Ax extending in the lamp longitudinal direction; a translucent member 14 that is disposed in front of the light-emitting element 12; a support plate 16 made of metal that supports the light-emitting element 12; and a heat sink 18 made of metal that is

fixed to a rear surface of the support plate 16.

[0029] The vehicular illumination lamp 10 is used incorporated into a lamp body (not shown) or the like in a state that enables optical axis adjustment. After optical axis adjustment is complete, the optical axis Ax extends downward approximately 0.5 to 0.6 degrees with respect to the vehicle frontal direction. Using radiated light from the vehicular illumination lamp 10, a low beam distribution pattern PL for left light distribution can be formed as shown in FIG. 4.

[0030] The light-emitting element 12 is a white light-emitting diode, and is formed from four light-emitting chips 12a serially arranged in the horizontal direction, and a substrate 12b that supports the light-emitting chips 12a.

[0031] The four light-emitting chips 12a are arranged bonded close together. In this state, the front surfaces of the light-emitting chips 12a are sealed by a thin film so as to form a light-emitting surface 12A that emits light in a horizontally oblong configuration when viewed from the front of the lamp. Each light-emitting chip 12a has a square outer shape approximately 1 by 1 millimeter in size. Therefore, the light-emitting surface 12A has an outer shape approximately 1 by 4 millimeters in size.

[0032] The light-emitting element 12 is disposed such that a lower end edge 12A1 of the light-emitting surface 12A is positioned on a horizontal line orthogonal to the optical axis Ax at the predetermined point A, and an end point B on the host vehicle lane side (the right side when viewed from the lamp front) of the lower end edge 12A1 is positioned near the optical axis Ax (more specifically, at a position approximately 0.3 to 1.0 millimeters away from the optical axis Ax, for example) and more on the host vehicle lane side than the optical axis Ax.

[0033] The translucent member 14 is formed from a transparent synthetic resin molding, such as an acrylic resin molding or the like, and has a round outer shape when viewed from the lamp front. The translucent member 14 is formed such that light emitted from the light-emitting element 12 is incident to the translucent member 14 and internally reflected on a front surface 14a of the translucent member 14. The light is subsequently internally reflected again on a rear surface 14b of the translucent member 14, and then emitted from the front surface 14a.

[0034] An optical axis vicinity region on the front surface 14a of the translucent member 14 is formed as a lens portion 14a1 that defectively emits light from the light-emitting element 12, and a remaining region is formed as a flat plane orthogonal to the optical axis Ax.

[0035] A toric region 14a2 that is adjacent to the outer peripheral side of the lens portion 14a1 on the front surface 14a of the translucent member 14 is subjected to mirror surface processing by aluminization or the like.

[0036] The position of the outer peripheral edge of the toric region 14a2 is set to a position where an incident angle of light from the light-emitting element 12 (light from the predetermined point A to be precise) that reaches the front surface 14a of the translucent member 14 is a critical angle α . Thus, light from the light-emitting element 12 that reaches the front surface 14a of the translucent member 14 is internally reflected by the mirrorized reflective surface in the toric region 14a2, and is internally reflected by overall reflection in a surrounding region 14a3 that is positioned more toward the outer peripheral side than the toric region 14a2.

[0037] The position of the inner peripheral edge of the toric region 14a2 is set to a position where light from the light-emitting element 12 (light from the predetermined point A to be precise) that is internally reflected by the front surface 14a of the translucent member 14 is incident to a position generally directly behind the outer peripheral edge of the toric region 14a2. A surface of the lens portion 14a1 on the front surface 14a of the translucent member 14 has an ellipsoidal spherical shape. In such case, the curvature of the ellipsoidal sphere forming this surface is set such that the value for the cross-sectional shape along a horizontal plane is smaller than the value for the cross-sectional shape along a vertical plane. The lens portion 14a1 is formed so as to emit light from the light-emitting element 12 that reaches the lens portion 14a1 (light from the predetermined point A to be precise) forward as light parallel to the optical axis Ax with respect to the vertical direction, and as light that somewhat spreads toward both the right and left sides from the optical axis Ax with respect to the horizontal direction.

[0038] The rear surface 14b of the translucent member 14, with respect to the front surface 14a, is structured by a predetermined light reflection control surface (to be described later), which is formed using a rotational paraboloid P as a reference surface whose center axis is the optical axis Ax and whose focal point F is at a position plane-symmetrical to the predetermined point A. The rear surface 14b is also subjected to mirror surface processing by aluminization or the like over its entire surface except for a region surrounding the optical axis Ax.

[0039] Furthermore, the rear surface 14b of the translucent member 14 is formed so as to surround the optical axis Ax in a circular fashion. The inner peripheral side of the rear surface 14b is formed with a cavity portion 14c that surrounds the light-emitting element 12 centered therein. A concave portion 14d with a stepped configuration is formed around the cavity portion 14c.

[0040] The cavity portion 14c has a front end surface that is formed into a hemispherical shape centered on the predetermined point A. Thus, radiated light from the light-emitting element 12 (radiated light from the predetermined point A to be precise) enters the translucent member 14 without refraction. In addition, the stepped concave portion 14d has a shape that follows the shape of the support plate 16 and the heat sink 18, and positions and fixes these two. It should be noted that the heat sink 18 is formed with a plurality of heat radiation fins 18a on a rear surface thereof.

[0041] The specific structure of the rear surface 14b of the translucent member 14 as a light reflection control surface

will be described next.

[0042] As illustrated in FIG. 1, the rear surface 14b of the translucent member 14 is formed from a first zone Z1 that is positioned diagonally upward on the oncoming vehicle lane side with respect to the optical axis Ax; a second zone Z2 that is positioned diagonally downward on the host vehicle lane side with respect to the optical axis Ax; a third zone Z3 that is positioned diagonally downward on the oncoming vehicle lane side with respect to the optical axis Ax; and a fourth zone Z4 that is positioned diagonally upward on the host vehicle lane side with respect to the optical axis Ax.

[0043] The first zone Z1 is divided into an inner peripheral zone Z1i (a hatched portion in the figure) and an outer peripheral zone Z1o that border a first curve C1, which is formed so as to project toward the optical axis Ax when viewed from the lamp front. The second zone Z2 is also divided into an inner peripheral zone Z2i (a hatched portion in the figure) and an outer peripheral zone Z2o that border a second curve C2, which is formed so as to project toward the optical axis Ax when viewed from the lamp front.

[0044] Here, when the rear surface 14b of the translucent member 14 is formed using the reference surface itself (i.e., the rotational paraboloid P), the first and second curves C1, C2 are curves that are formed by connecting particular positions where a light source image of the light-emitting surface 12A of the light-emitting element 12, which is formed by reflected light from the reference surface, becomes a light source image having an upper end edge that extends diagonally upward at an inclined angle of 15 degrees toward the host vehicle lane side. In such case, the first and second curves C1, C2 become curves that resemble hyperbolic curves centered on the optical axis Ax when viewed from the lamp front, and are formed having a positional relationship of general rotation symmetry with respect to the optical axis Ax.

[0045] In other words, a portion of the first curve C1 nearest the optical axis Ax is positioned at the general center between an inner peripheral edge and an outer peripheral edge of the rear surface 14b of the translucent member 14; an end point of the first curve C1 on the upper end side that intersects the outer peripheral edge of the rear surface 14b is positioned on the oncoming vehicle lane side somewhat away from a vertical plane that includes the optical axis Ax; and an end point of the first curve C1 on the lower end side that intersects the outer peripheral edge of the rear surface 14b is positioned above and slightly away from a horizontal plane that includes the optical axis Ax. Furthermore, the first curve C1 is formed having a large curvature in proximity to the portion nearest the optical axis Ax, which gradually decreases toward the end point on the upper end side and the end point on the lower end side.

[0046] Meanwhile, a portion of the second curve C2 nearest the optical axis Ax is positioned at the general center between an inner peripheral edge and an outer peripheral edge of the rear surface 14b of the translucent member 14; an end point of the second curve C2 on the lower end side that intersects the outer peripheral edge of the rear surface 14b is positioned on the host vehicle lane side somewhat away from a vertical plane that includes the optical axis Ax; and an end point of the second curve C2 on the upper end side that intersects the outer peripheral edge of the rear surface 14b is positioned above and slightly away from a horizontal plane that includes the optical axis Ax. Furthermore, the second curve C2 is formed having a large curvature in proximity to the portion nearest the optical axis Ax, which gradually decreases toward the end point on the lower end side and the end point on the upper end side.

[0047] In the rear surface 14b of the translucent member 14, the respective inner peripheral zones Z1i, Z2i of the first and second zones Z1, Z2 are formed from the reference surface itself (i.e., the rotational paraboloid P), while the other zones have a plurality of diffuse reflection elements 14s formed on the reference surface so that internally reflected light from the front surface 14a incident to these zones is diffusely reflected toward both the right and left sides.

[0048] In such case, the third and fourth zones Z3, Z4 only diffusely reflect toward both the right and left sides internally reflected light from the front surface 14a that is incident to these zones. The outer peripheral zones Z1o, Z2o of the first and second zones Z1 and Z2 are formed so as to deflectively reflect downward internally reflected light from the front surface 14a that is incident to these zones.

[0049] FIG. 4 is a drawing that transparently shows the low beam distribution pattern PL formed on a virtual vertical screen positioned 25 meters in front of the vehicular illumination lamp 10 by light that is radiated forward from the vehicular illumination lamp 10.

[0050] The low beam distribution pattern PL is a low beam distribution pattern for left light distribution as mentioned above, and the top end edge thereof has horizontal and diagonal cut-off lines CL1, CL2. A line V-V is a vertical line passing through H-V, which is a vanishing point in the vehicle frontal direction. In such case, with respect to the line V-V, the horizontal cut-off line CL1 is formed on the oncoming vehicle lane side and the diagonal cut-off line CL2 is formed on the host vehicle lane side having an inclination angle of 15 degrees. An elbow point E that is the intersection of both cut-off lines CL1, CL2 is positioned approximately 0.5 to 0.6 degrees below H-V. A hot zone HZ that is a high intensity region is formed near the host vehicle lane side of the elbow point E. It should be noted that the elbow point E is positioned approximately 0.5 to 0.6 degrees below H-V because the optical axis As of the vehicular illumination lamp 10 extends downward approximately 0.5 to 0.6 degrees with respect to the vehicle frontal direction.

[0051] The low beam distribution pattern PL is formed as a composite distribution pattern that overlaps seven light distribution patterns PZ1i, PZ1o, PZ2i, PZ2o, PZ3, PZ4, P1.

[0052] In such case, the light distribution patterns PZ1i, PZ1o, PZ2i, PZ2o, PZ3, PZ4, are light distribution patterns formed using light repeatedly reflected and subsequently emitted by the front surface 14a and the rear surface 14b of

the translucent member 14 (which will be referred to as "repeatedly reflected light" below). The light distribution pattern P1 is a light distribution pattern formed using light directly emitted from the lens portion 14a1 on the front surface 14a of the translucent member 14 (which will be referred to as "directly emitted light" below).

[0053] The horizontal cut-off line CL1 of the low beam distribution pattern PL is mainly formed by the upper end edges of the light distribution patterns PZ3, PZ4, and the diagonal cut-off line CL2 is mainly formed by the upper end edges of the light distribution patterns PZ1i, PZ2i.

[0054] The light distribution patterns PZ3, PZ4 will be explained first.

[0055] The light distribution pattern PZ3 is a light distribution pattern formed using repeatedly reflected light from the third zone Z3, and the light distribution pattern PZ4 is a light distribution pattern formed using repeatedly reflected light from the fourth zone Z4. These are both formed as generally the same light distribution pattern.

[0056] The light distribution patterns PZ3, PZ4 are formed as light distribution patterns that extend long in the horizontal direction along the horizontal cut-off line CL1, and have a clear light-dark boundary line at their upper end edges.

[0057] This is because among repeatedly reflected light from the third and fourth zones Z3, Z4, as shown in FIG. 3 with respect to the vertical direction, light from the lower end edge 12A1 of the light-emitting surface 12A is parallel to the optical axis Ax and light from other regions of the light-emitting surface 12A faces downward with respect to the optical axis Ax; and as shown in FIG. 2 with respect to the horizontal direction, light from the light-emitting surface 12A diffuses to both the right and left sides due to the plurality of diffuse reflection elements 14s.

[0058] In such case, the center positions in the lateral direction of the light distribution patterns PZ3, PZ4 are somewhat displaced toward the host vehicle lane side with respect to the line V-V. However, this is because the light-emitting surface 12A is disposed at a position displaced toward the oncoming vehicle lane side with respect to the optical axis Ax.

[0059] As described above, the upper end edges of the light distribution zones PZ3, PZ4 form a main portion of the horizontal cut-off line CL1.

[0060] The light distribution patterns PZ1 i, PZ2i will be explained next.

[0061] The light distribution pattern PZ1i is a light distribution pattern formed using repeatedly reflected light from the inner peripheral zone Z1i of the first zone Z1, and the light distribution pattern PZ2i is a light distribution pattern formed using repeatedly reflected light from the inner peripheral zone Z2i of the second zone Z2. These are both formed as generally the same light distribution pattern.

[0062] The light distribution patterns PZ1i, PZ2i are formed as generally fan-shaped light distribution patterns that extend along the diagonal cut-off line CL2, and the upper end edges thereof are formed as clear light-dark boundary lines. The reason for this will be explained based on FIG. 5.

[0063] FIG. 5 shows views of a light source image on the light-emitting surface 12A, which are formed by repeatedly reflected light from a plurality of positions on the first zone Z1, in a case where the first zone Z1 is formed over its entire region with the rotational paraboloid P.

[0064] FIGS. 5A to 5C are frontal views that focus on portions of the first zone Z1, where FIG. 5A shows the positions of four reflection points R1, R2, R3, R4 in an upper level portion of the first zone Z1; FIG. 5B shows the positions of four reflection points R5, R6, R7, R8 in an intermediate level portion thereof; and FIG. 5C shows the positions of four reflection points R9, R10, R11, R12 in a lower level portion thereof.

[0065] FIG 5D is a drawing that shows light source images 11, 12, 13, 14 of the light-emitting surface 12A that are formed by repeatedly reflected light from the positions of the four reflection points R1, R2, R3, R4 shown in FIG. 5A.

[0066] As shown in FIG. 5D, the light source images 11 to 14 are formed as long images that extend diagonally upward toward the host vehicle lane side from a vicinity below the elbow point E.

[0067] Upper end edges of the light source images 11 to 14 are formed as light source images of the lower end edge 12A1 of the light-emitting surface 12A, and the lower end edge 12A is positioned on a horizontal line that intersects with the optical axis Ax at the predetermined point A. Therefore, the upper end edges of the light source images I1 to I4 are formed as relatively clear light-dark boundary lines that pass through the elbow point E.

[0068] End edges on the oncoming vehicle lane side of the light source images I1 to I4 are positioned somewhat more toward the oncoming vehicle lane side than the line V-V. This is because the end point B of the lower end edge 12A1 of the light-emitting surface 12A is positioned in the vicinity of the optical axis Ax and more toward the host vehicle lane side than the optical axis Ax.

[0069] Consequently, the light source image I1 that is formed by repeatedly reflected light from the reflection point R1 positioned farthest on the oncoming vehicle lane side is the most inclined image, and the degree of inclination of the light source images I2, I3, I4 gradually lessens in line with displacement toward the host vehicle lane side in the order of the reflection points R2, R3, R4.

[0070] In such case, the upper end edge of the light source image I2 that is formed by repeatedly reflected light from the reflection point R2 positioned on the first curve C1 has an inclination angle of 15 degrees, and coincides with the diagonal cut-off line CL2 that extends from the elbow point E toward the host vehicle lane side at an inclination angle of 15 degrees. The upper end edge of the light source image I1 that is formed by repeatedly reflected light from the reflection point R1 positioned on the outer peripheral zone Z1o has an inclination angle larger than 15 degrees. Meanwhile, the

upper end edges of the light source images I3, I4 that are formed by repeatedly reflected light from the reflection points R3, R4 positioned on the inner peripheral zone Z1i have inclination angles smaller than 15 degrees.

[0071] FIG. 5E is a drawing that shows light source images I5, I6, I7, I8 of the light-emitting surface 12A that are formed by repeatedly reflected light from the positions of the four reflection points R5, R6, R7, R8 shown in FIG. 5B.

[0072] As shown in FIG. 5E, the light source images I5 to I8 are formed as long images that extend diagonally upward toward the host vehicle lane side from a vicinity below the elbow point E. The upper end edges of the light source images I5 to I8 are formed as relatively sharp light-dark boundary lines that pass through the elbow point E, and the end edges on the oncoming vehicle lane side are positioned somewhat more toward the oncoming vehicle lane side than the line V-V.

[0073] Consequently, the light source image I5 that is formed by repeatedly reflected light from the reflection point R5 positioned farthest on the oncoming vehicle lane side is the most inclined image, and the degree of inclination of the light source images I6, I7, I8 gradually lessens in line with displacement toward the host vehicle lane side in the order of the reflection points R6, R7, R8.

[0074] In such case, the upper end edge of the light source image I6 that is formed by repeatedly reflected light from the reflection point R6 positioned on the first curve C1 has an inclination angle of 15 degrees, and coincides with the diagonal cut-off line CL2 that extends from the elbow point E toward the host vehicle lane side at an inclination angle of 15 degrees. The upper end edge of the light source image I5 that is formed by repeatedly reflected light from the reflection point R5 positioned on the outer peripheral zone Z1o has an inclination angle larger than 15 degrees. Meanwhile, the upper end edges of the light source images I7, I8 that are formed by repeatedly reflected light from the reflection points R7, R8 positioned on the inner peripheral zone Z1i have inclination angles smaller than 15 degrees.

[0075] FIG. 5F is a drawing that shows light source images I9, I10, I11, I12 of the light-emitting surface 12A that are formed by repeatedly reflected light from the positions of the four reflection points R9, R10, R11, R12 shown in FIG. 5C.

[0076] As shown in FIG. 5F, the light source images I9 to I12 are formed as long images that extend diagonally upward toward the host vehicle lane side from a vicinity below the elbow point E. The upper end edges of the light source images I9 to I12 are formed as relatively sharp light-dark boundary lines that pass through the elbow point E, and the end edges on the oncoming vehicle lane side are positioned somewhat more toward the oncoming vehicle lane side than the line V-V.

[0077] Consequently, the light source image I9 that is formed by repeatedly reflected light from the reflection point R9 positioned farthest on the oncoming vehicle lane side is the most inclined image, and the degree of inclination of the light source images I10, I11, I12 gradually lessens in line with displacement toward the host vehicle lane side in the order of the reflection points R10, R11, R12.

[0078] In such case, the upper end edge of the light source image I10 that is formed by repeatedly reflected light from the reflection point R10 positioned on the first curve C1 has an inclination angle of 15 degrees, and coincides with the diagonal cut-off line CL2 that extends from the elbow point E toward the host vehicle lane side at an inclination angle of 15 degrees. The upper end edge of the light source image I9 that is formed by repeatedly reflected light from the reflection point R9 positioned on the outer peripheral zone Z1o has an inclination angle larger than 15 degrees. Meanwhile, the upper end edges of the light source images I11, I12 that are formed by repeatedly reflected light from the reflection points R11, R12 positioned on the inner peripheral zone Z1i have inclination angles smaller than 15 degrees.

[0079] Among the twelve light source images I1 to I12, the light source images I2 to I4, I6 to I8, I10 to I12 formed by repeatedly reflected light from the reflection points R2 to R4, R6 to R8, R10 to R12 positioned in the inner peripheral zone Z1i (i.e., the light source images whose upper end edges have an inclination angle of 15 degrees or less) are overlapped in order to form the light distribution pattern PZ1i.

[0080] The light distribution pattern PZ2i, which is formed by repeatedly reflected light from the inner peripheral zone Z2i of the second zone Z2, is also formed in a manner similar to the light distribution pattern PZ1i.

[0081] As described above, the upper end edges of the light distribution patterns PZ1i, PZ2i form the diagonal cut-off line CL2.

[0082] The light distribution patterns PZ1o, PZ2o will be explained next.

[0083] The light distribution pattern PZ1o is a light distribution pattern formed using repeatedly reflected light from the outer peripheral zone Z1o of the first zone Z1, and the light distribution pattern PZ2o is a light distribution pattern formed using repeatedly reflected light from the inner peripheral zone Z2o of the second zone Z2. These are both formed as generally the same light distribution pattern.

[0084] The light distribution patterns PZ1o, PZ2o are formed as light distribution patterns that extend long in the horizontal direction generally along the horizontal cut-off line CL1.

[0085] In such case, the light source images I1, I5, I9 formed by repeatedly reflected light from the reflection points R1, R5, R9 positioned in the outer peripheral zone Z1o of the first zone Z1 (i.e., the light source images whose upper end edges have inclination angles of more than 15 degrees) are respectively displaced downward and diffused to both the right and left sides. These light source images are overlapped to form the light distribution pattern PZ1o. The light distribution pattern PZ2o is also formed in a similar manner.

[0086] The center positions in the lateral direction of the light distribution patterns PZ1o, PZ2o are somewhat displaced toward the host vehicle lane side with respect to the line V-V. However, this is because the light-emitting surface 12A

is disposed at a position displaced toward the oncoming vehicle lane side with respect to the optical axis Ax.

[0087] The light distribution pattern P1 will be described next.

[0088] The light distribution pattern P1 is a light distribution pattern formed by directly emitted light from the lens portion 14a1 on the front surface 14a of the translucent member 14.

[0089] The light distribution patterns P1 is formed as a large oblong light distribution pattern that extends long in the horizontal direction along the horizontal cut-off line CL1, and has a light-dark boundary line at its upper end edge.

[0090] This is because the light-emitting surface 12A is formed into a horizontally oblong shape, and directly emitted light from the lens portion 14a1 spreads somewhat toward both the right and left sides.

[0091] In such case, the center position in the lateral direction of the light distribution pattern P1 is somewhat displaced toward the host vehicle lane side with respect to the line V-V. However, this is because the light-emitting surface 12A is disposed at a position displaced toward the oncoming vehicle lane side with respect to the optical axis Ax.

[0092] As described in detail above, the vehicular illumination lamp 10 according to the present embodiment is constituted such that light from the light-emitting element 12, which is disposed facing forward near the predetermined point A on the optical axis Ax extending in the lamp longitudinal direction, is incident to the translucent member 14 and internally reflected on the front surface 12a. The light is subsequently internally reflected again on the rear surface 14b, and then emitted from the front surface 14a. The light-emitting element 12 is disposed such that the lower end edge 12A1 of the light-emitting surface 12A is positioned on a horizontal line that intersects the optical axis Ax. Therefore, a light distribution pattern that includes the horizontal cut-off line CL1 on an upper end portion thereof can be easily achieved.

[0093] In the translucent member 14, the front surface 14a is formed using a flat plane orthogonal to the optical axis Ax, and the rear surface 14b is structured as a predetermined light reflection control surface that is formed using a rotational paraboloid P, whose focal point is a position symmetrical to the predetermined point A with respect to the front surface 14a of the translucent member 14. Therefore, a particular position where the light source image of the light-emitting surface 12A of the light-emitting element 12, which is formed using reflected light from the rotational paraboloid P serving as the reference surface, becomes a light source image having an upper end edge that extends diagonally upward toward the host vehicle lane side can be found on the reference surface.

[0094] The results of an investigation performed by the present inventor confirmed that, specifically, this particular position is at two locations on the rear surface 14b of the translucent member 14: a position on the first curve C1, which is formed so as to project toward the optical axis Ax when viewed from the lamp front, among the first zone Z1 that is positioned diagonally upward on the oncoming vehicle lane side with respect to the optical axis Ax; and a position on the second curve C2, which is formed so as to project toward the optical axis Ax when viewed from the lamp front, among the second zone Z2 that is positioned diagonally downward on the host vehicle lane side with respect to the optical axis Ax.

[0095] Based on this knowledge, in the vehicular illumination lamp 10 according to the present embodiment, the respective inner peripheral zones Z1i, Z2i of the first and second zones Z1, Z2 on the rear surface 14b of the translucent member 14 are configured as regions for forming the diagonal cut-off line CL2 that extends diagonally upward toward the host vehicle lane side using reflected light from the inner peripheral zones Z1i, Z2i. Therefore, the diagonal cut-off line CL2 can be simultaneously formed together with the horizontal cut-off line CL1.

[0096] According to the present embodiment described above, light from the light-emitting element 12 can be emitted forward using the translucent member 14 disposed in front of the light-emitting element 12, and the low beam distribution pattern PL formed having the horizontal and diagonal cut-off lines CL1, CL2 using such radiated light.

[0097] In the present embodiment, the respective outer peripheral zones Z1o, Z2o of the first and second zones Z1, Z2 on the rear surface 14b of the translucent member 14 are configured such that internally reflected light from the front surface 14a of the translucent member 14 incident to the outer peripheral zones Z1o, Z2o is defectively reflected downward. There is thus no need to apply a non-reflective treatment or the like to the outer peripheral zones Z1o, Z2o, and the formation of a light source image projecting above the horizontal and diagonal cut-off lines CL1, CL2 can be prevented.

[0098] In such case, the outer peripheral zones Z1o, Z2o are formed so as to diffusely and horizontally reflect internally reflected light from the front surface 14a of the translucent member 14 incident to the outer peripheral zones Z1o, Z2o. Therefore, it is possible to effectively prevent a light source image that has been displaced downward due to downward deflective reflection by the outer peripheral zones Z1o, Z2o from causing uneven light distribution on the road surface in front of the vehicle.

[0099] In the present embodiment, the light-emitting element 12 is disposed such that the end point B on the host vehicle lane side of the lower end edge 12A1 of the light-emitting surface 12A is positioned in the vicinity of the optical axis Ax and more toward the host vehicle lane side than the optical axis Ax. Therefore, a light source image formed by reflected light from the respective inner peripheral zones Z1i, Z2i of the first and second zones Z1, Z2, which are zones for forming the diagonal cut-off line CL2, can be formed at a position on the host vehicle lane side near the elbow point E. Thus, the hot zone HZ of the low beam distribution pattern PL can be formed at an optimal position.

[0100] In the present embodiment, the center region of the front surface 14a of the translucent member 14 is set as the toric region 14a2 centered on the optical axis Ax. The optical axis vicinity region positioned more toward the inner

peripheral side than the toric region 14a2 is formed as the lens portion 14a1, which defectively emits light from the light-emitting element 12 that reaches this region. Therefore, the light distribution pattern P1 formed by light emitted from the lens portion 14a1 can be formed in addition to the light distribution patterns PZ1i, PZ1o, PZ2i, PZ2o, PZ3, PZ4, which are formed using light internally reflected by the rear surface 14b of the translucent member 14. Thus, light flux from the

light source can be effectively utilized.

[0101] In such case, the lens portion 14a1 is formed so as to emit light from the light-emitting element 12 as laterally diffused light. Therefore, a relatively dark and large light distribution pattern P1 is formed as an oblong light distribution pattern around the relatively bright and small light distribution patterns PZ1i, PZ1o, PZ2i, PZ2o, PZ3, PZ4, which are formed using light internally reflected by the rear surface 14b of the translucent member 14. Thus, the low beam distribution pattern PL formed by radiated light from the vehicular illumination lamp 10 can be formed as a light distribution pattern with little uneven light distribution.

[0102] In the present embodiment, the entire regions of the respective inner peripheral zones Z1i, Z2i of the first and second zones Z1, Z2 on the rear surface 14b of the translucent member 14 were described as being configured as zones for forming the diagonal cut-off line CL2. However, the entire region of either one of these zones may be configured as a zone for forming the diagonal cut-off line CL2, or only a vicinity region of the first and second curves C1, C2 in either or both the inner peripheral zones Z1i, Z2i may be configured as a zone for forming the diagonal cut-off line CL2.

[0103] In the above embodiment, the light-emitting element 12 was described as having a light-emitting surface 12A with a horizontally oblong shape. However, a constitution having a light-emitting surface 12A with a different shape is obviously also acceptable.

[0104] The values shown as specifications in the above embodiment are merely examples, and these values may obviously be set to other values as appropriate.

[Description of the Reference Numerals]

[0105]

10	VEHICULAR ILLUMINATION LAMP
12	LIGHT-EMITTING ELEMENT
12A	LIGHT-EMITTING SURFACE
12A1	LOWER END EDGE
12a	LIGHT-EMITTING CHIP
12b	SUBSTRATE
14	TRANSLUCENT MEMBER
14a	FRONT SURFACE
14a1	LENS PORTION
14a2	TORIC REGION
14a3	SURROUNDING REGION
14b	REAR SURFACE
14c	CAVITY PORTION
14d	CONCAVE PORTION
16	SUPPORT PLATE
18	HEAT SINK
18a	HEAT RADIATION FIN
A	PREDETERMINED POINT
Ax	OPTICAL AXIS
B	END POINT ON HOST VEHICLE LANE SIDE OF LOWER END EDGE
CL1	HORIZONTAL CUT-OFF LINE
CL2	DIAGONAL CUT-OFF LINE
C1	FIRST CURVE
C2	SECOND CURVE
E	ELBOW POINT
F	FOCAL POINT
I1, I2, I3, I4, I5, I6, I7, I8, I9, I10, I11, I12	LIGHT SOURCE IMAGE
HZ	HOT ZONE
P	ROTATIONAL PARABOLOID
PZ1i, PZ1o, PZ2i, PZ2o, PZ3, PZ4, P1	LIGHT DISTRIBUTION PATTERN
PL	LOW BEAM DISTRIBUTION PATTERN
R1, R2,	R3, R4, R5, R6, R7, R8, R9, R10, R11, R12 REFLECTION POINT

Z1	FIRST ZONE
Z1i, Z2i	INNER PERIPHERAL ZONE
Z1o, Z2o	OUTER PERIPHERAL ZONE
Z2	SECOND ZONE
5 Z3	THIRD ZONE
Z4	FOURTH ZONE

Claims

1. A vehicular illumination lamp comprising a light-emitting element that is disposed facing forward near a predetermined point on an optical axis extending in a vehicle longitudinal direction; and a translucent member that is disposed in front of the light-emitting element, wherein light emitted from the light-emitting element is incident to the translucent member and internally reflected on a front surface of the translucent member, after which the light is internally reflected again on a rear surface of the translucent member and emitted from the front surface of the translucent member, the vehicular illumination lamp **characterized in that** the light-emitting element has a light-emitting surface whose lower end edge extends in a straight line, and the light-emitting element is disposed such that the lower end edge of the light-emitting surface is positioned on a horizontal line orthogonal to the optical axis, the front surface of the translucent member is formed as a flat plane orthogonal to the optical axis, and the rear surface of the translucent member is formed by a predetermined light reflection control surface that is formed using as a reference surface a rotational paraboloid whose focal point is a position symmetrical to the predetermined point with respect to the front surface of the translucent member, a center region on the front surface of the translucent member within a predetermined range centered on the optical axis is subjected to mirror surface processing, and the rear surface of the translucent member is subjected to mirror surface processing, on the rear surface of the translucent member, a first zone that is positioned diagonally upward on an oncoming vehicle lane side with respect to the optical axis borders a first curve formed so as to project toward the optical axis when viewed from the front of the lamp, and is divided into an inner peripheral zone and an outer peripheral zone; and a second zone that is positioned diagonally downward on a host vehicle lane side with respect to the optical axis borders a second curve formed so as to project toward the optical axis when viewed from the front of the lamp, and is divided into an inner peripheral zone and an outer peripheral zone, and at least one of a vicinity region of the first curve in the inner peripheral zone of the first zone and a vicinity region of the second curve in the inner peripheral zone of the second zone is configured as a region for forming a diagonal cut-off line that extends diagonally upward toward the host vehicle lane side using reflected light from the region.
2. The vehicular illumination lamp according to claim 1, **characterized in that** the respective outer peripheral zones of the first and second zones are formed such that internally reflected light from the front surface of the translucent member that is incident to the outer peripheral zone is defectively reflected downward.
3. The vehicular illumination lamp according to claim 2, **characterized in that** the respective outer peripheral zones of the first and second zones are formed such that internally reflected light from the front surface of the translucent member that is incident to the outer peripheral zone is diffusely reflected in the horizontal direction.
4. The vehicular illumination lamp according to any one of claims 1 to 3, **characterized in that** the light-emitting element is disposed such that an end point on the host vehicle lane side of the lower end edge of the light-emitting surface of the light-emitting element is positioned in the vicinity of the optical axis and more toward the host vehicle lane side than the optical axis.
5. The vehicular illumination lamp according to any one of claims 1 to 4, **characterized in that** the center region on the front surface of the translucent member is set as a toric region centered on the optical axis, and a region positioned more toward the inner peripheral side than the toric region on the front surface of the translucent member is formed as a lens portion that defectively emits light from the light-emitting element that reaches the region.

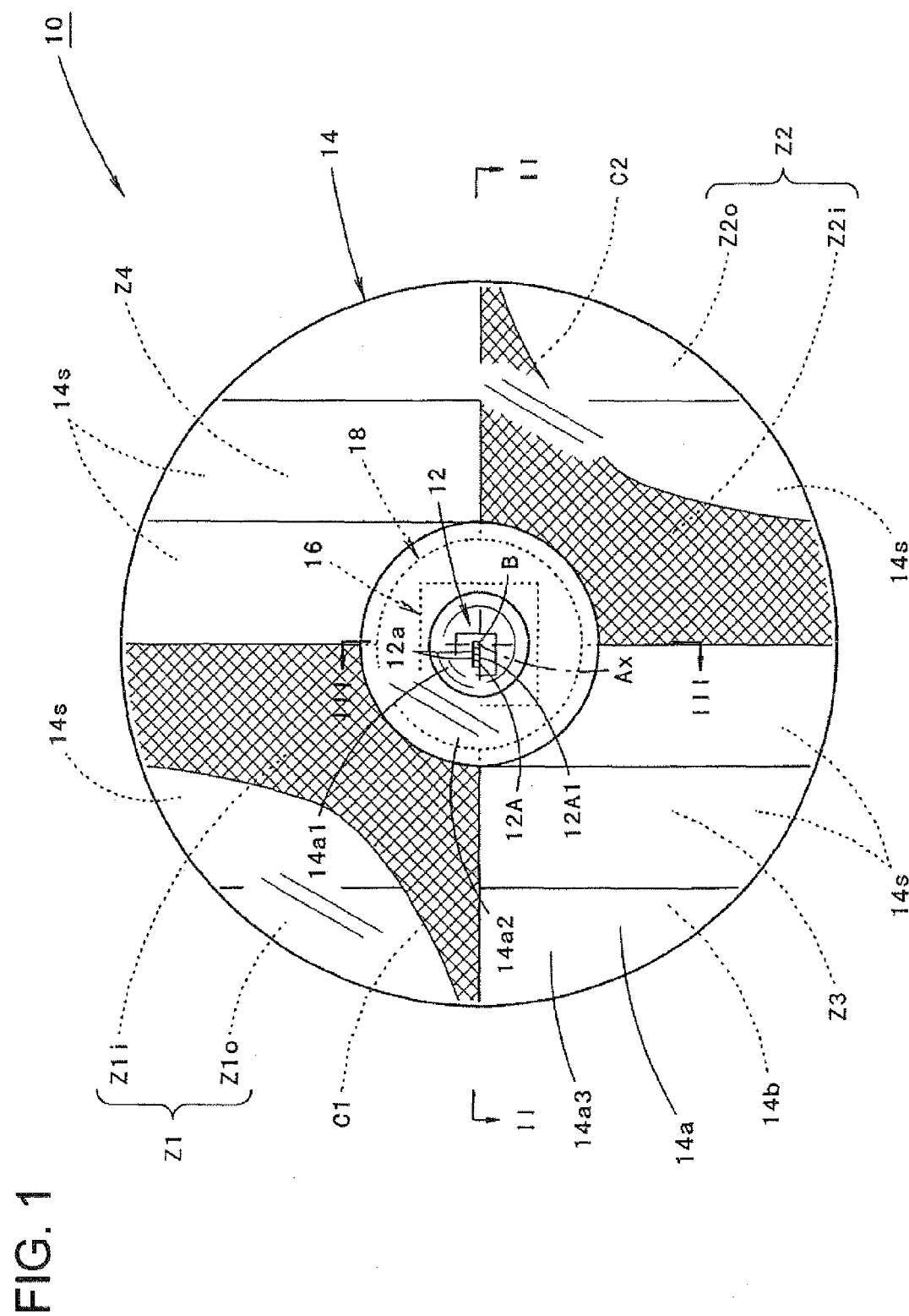
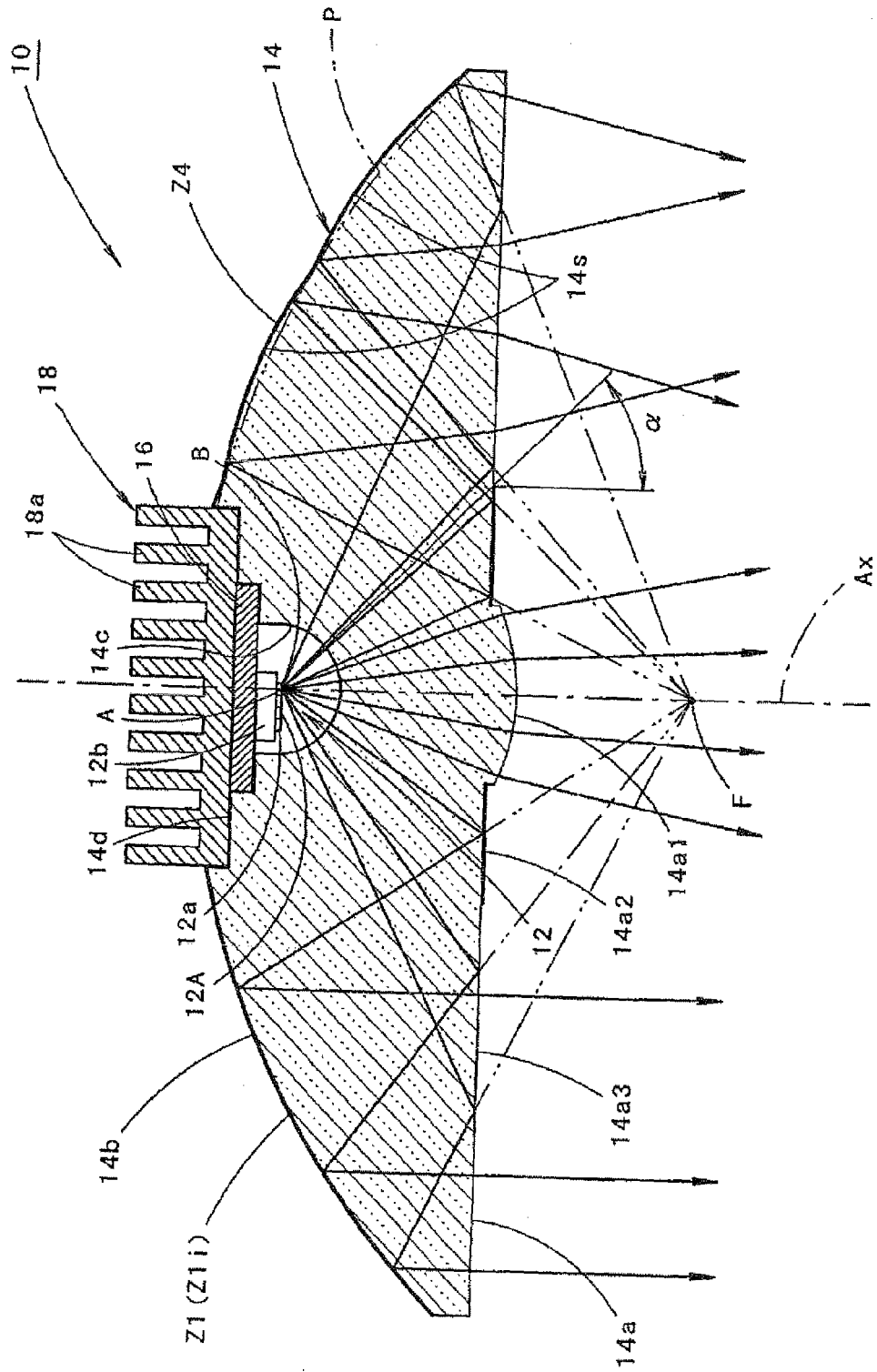


FIG. 2



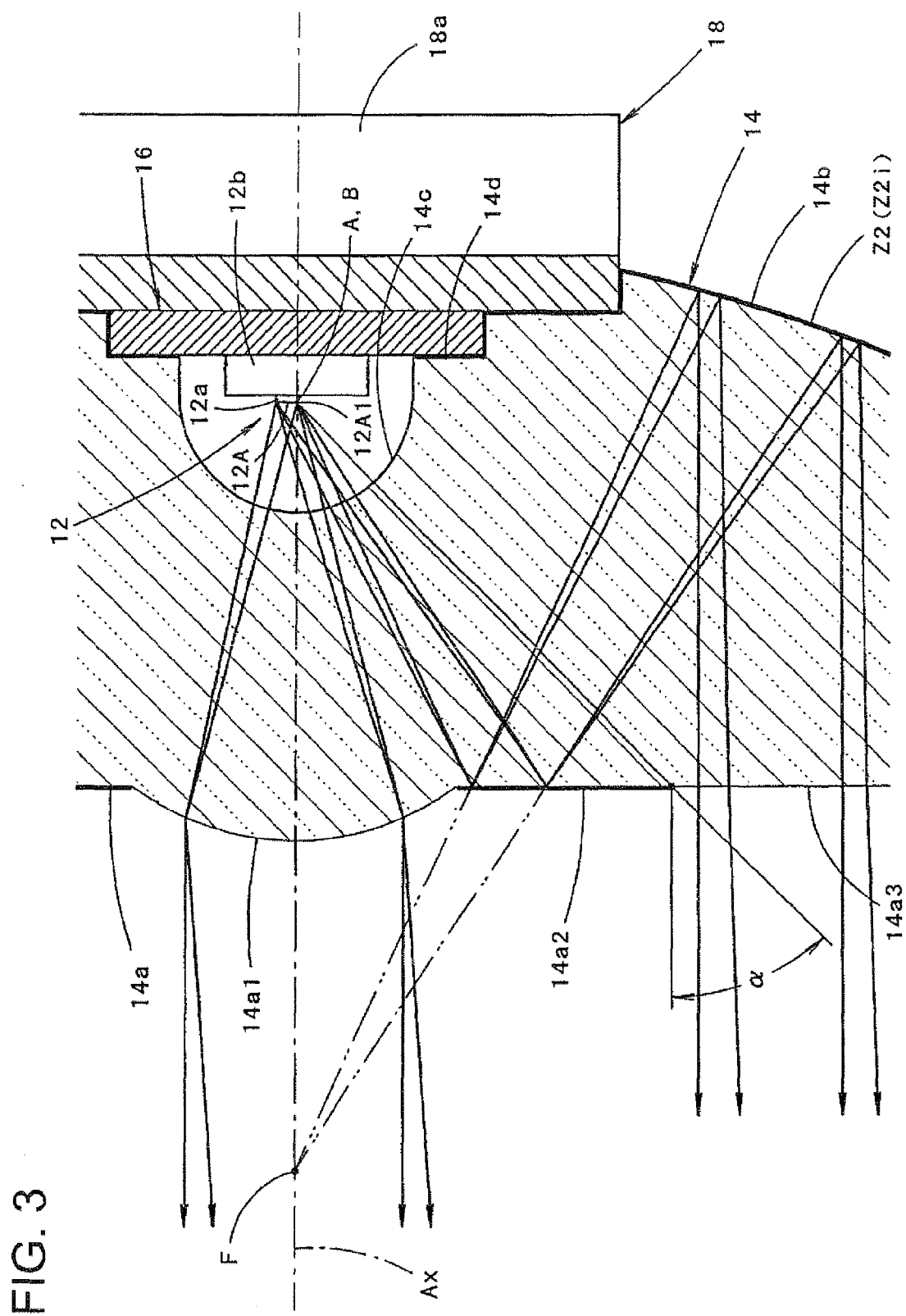


FIG. 4

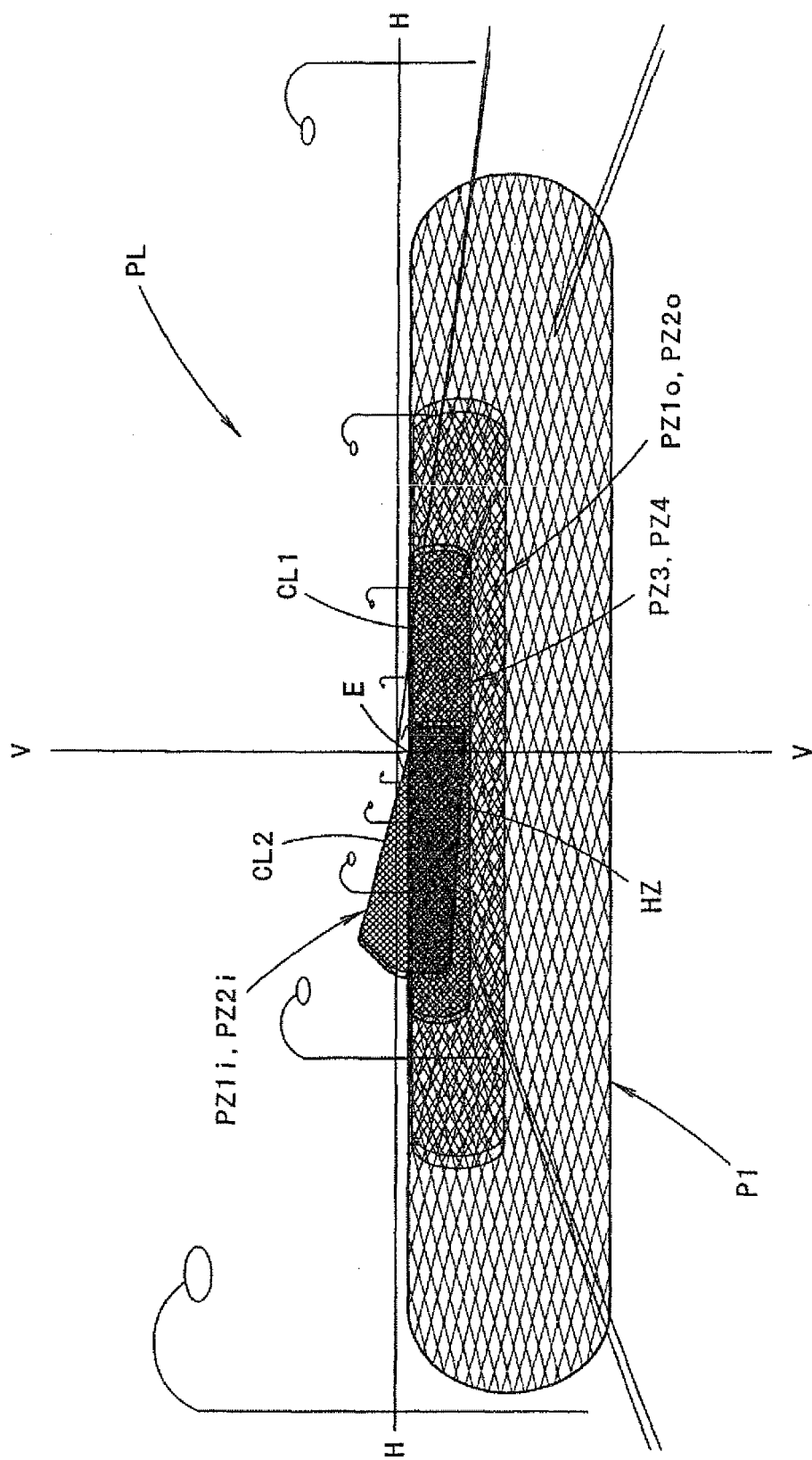


FIG. 5A

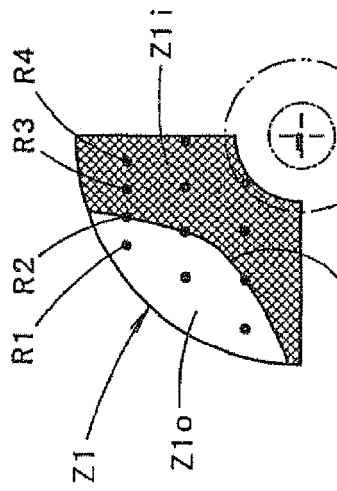


FIG. 5B

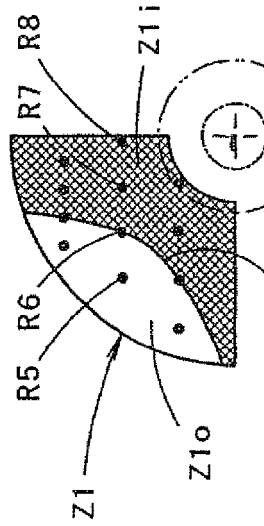


FIG. 5C

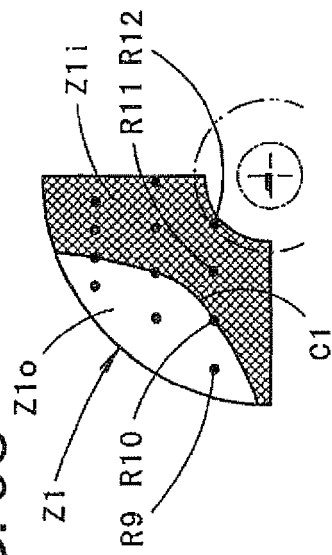


FIG. 5D

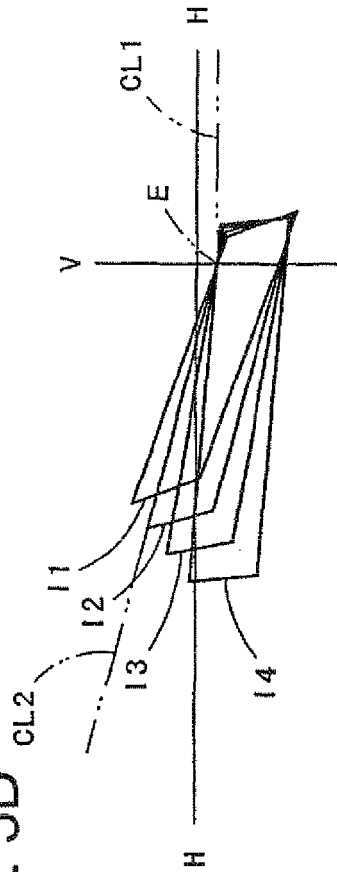


FIG. 5E

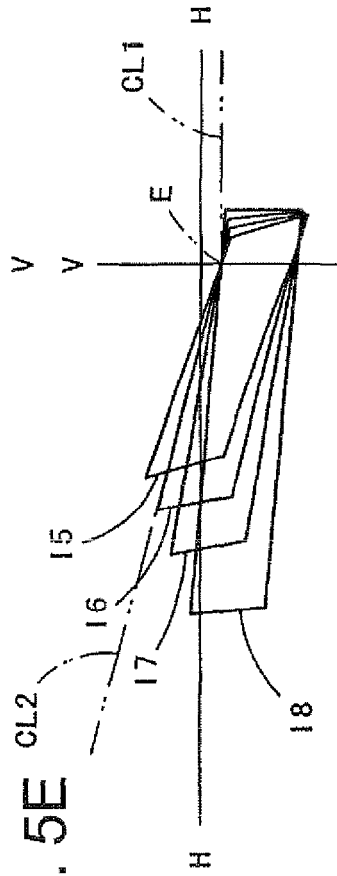
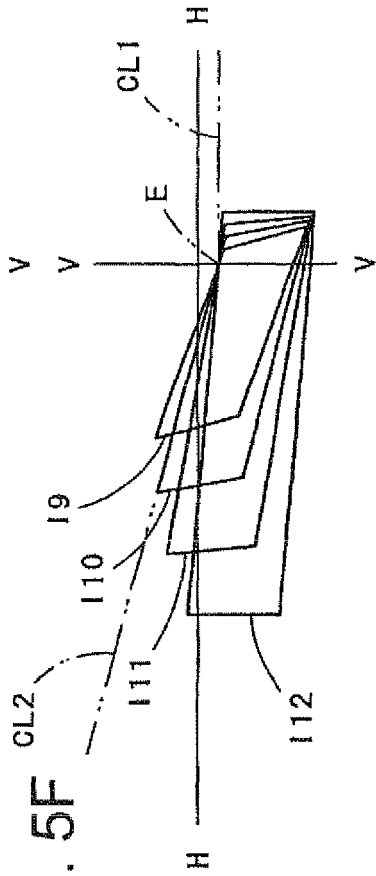


FIG. 5F



REFERENCES CITED IN THE DESCRIPTION

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