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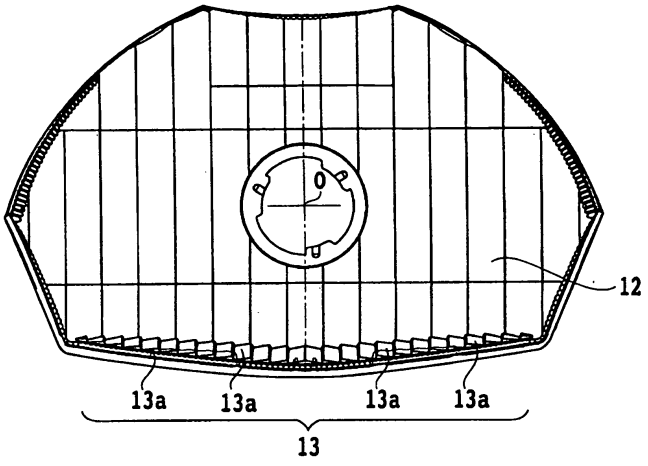
(54) Vehicle headlight

(57) A vehicle headlight (10) with a simple configuration is provided which can suppress or prevent the generation of any glare light occurring due to the reflection by a second reflecting surface (13) provided near the lower area of a first reflecting surface (12). The vehicle headlight (10) includes a light source (11), a first reflecting surface (12) disposed behind the light source (11) so as to reflect light from the light source (11) to an illumination direction, the first reflecting surface (12) having a focus (F) at or near the position of the light source (11) and a center axis (O) along the illumination direction and being concave toward the illumination direction; and a second reflecting surface (13, 13a) extending at least adjacent to an edge of the first reflecting surface (12). At least part of the second reflecting surface (13, 13a) is inclined in right and left directions so as to reflect and diffuse light (L2), that is emitted from the light source (11) frontward and downward and incident thereon, in right and left directions to the outside.

Fig. 9A



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Description

BACKGROUND OF THE INVENTION

1. Technical Field of the Invention

[0001] The present invention relates to a vehicle headlight to be used as a main headlight or an auxiliary headlight provided onto the front part of an automobile, for example.

2. Description of the Related Art

[0002] Figs. 1A and 1B show a conventional vehicle headlight of this type. As shown in Figs. 1A and 1B, the vehicle headlight 1 is configured to include a bulb 2 serving as a light source and a reflecting surface 3 configured to reflect light from the bulb 2 in an illumination direction (forward).

[0003] The bulb 2 can be any bulb for use in a general vehicle headlight, an auxiliary headlight, or the like. For example, a halogen bulb with a commonly known configuration can be used as the bulb 2.

[0004] The bulb 2 is disposed horizontally so that its optical axis O is arranged horizontally in the illumination direction. The bulb 2 can be energized by power supplied from an external drive electrical power source (not shown).

[0005] The reflecting surface 3 is composed of a parabolic reflecting surface whose center axis extends horizontally in the illumination direction (forward). The reflecting surface 3 is disposed behind the bulb 2 so that its focus F is located at or near the light emission center of the bulb 2. In this instance, the reflecting surface 3 may be any parabolic reflecting surface including a revolved paraboloid and a free curved parabolic surface.

[0006] In the vehicle headlight 1 as configured described above, the bulb 2 is supplied with power from an external drive electrical power source (not shown) to emit light. The light emitted from the bulb 2 is directly projected in the illumination direction or enters the reflecting surface 3 and is reflected by the same to become parallel light L1 and to be directed in the illumination direction.

[0007] In the vehicle headlight 1 with the above configuration, the reflecting surface 3 can have a circular outer shape having its center at the optical axis O when viewed from its front side, as shown by a solid bold line in Fig. 1B.

[0008] In this instance, the radius of the reflecting surface 3 can be set to twice the focal distance f (namely, 2f) or larger so that the reflecting surface 3 extends just below the light emission center of the bulb 2.

[0009] Accordingly, the light L2 emitted from the bulb 2 rearward and downward can properly enter the reflecting surface 3 and can be reflected in the illumination direction. This means that the light L2 does not become glare light which may be obstructive light for a driver in an opposite vehicle.

[0010] Variations of the headlight includes a vehicle headlight with an abnormal profile, for example, with a first reflecting surface 3 of a horizontally elongated rectangular shape as shown by a thin solid line in Fig. 1B. In this headlight, the vertical size is smaller than the other types. For example, the distance from the center axis O to one of the upper and lower rims is less than 2f (the normal radius of the first reflecting surface 3 being equal to twice the focal distance f). That is, in this structure of the headlight, the first reflecting surface 3 does not extend just below the light emitting center of the bulb 2. Accordingly, the light L2 emitted from the bulb 2 rearward and downward is not incident on the first reflecting surface 3.

[0011] In order to cut the light L2, a second reflecting surface 3a should be provided near the lower area of the first reflecting surface 3 (see Fig. 1A).

[0012] In some headlights with a circular first reflecting surface 3, the vertical size thereof, or the distance from the center axis to the vertical rim, is less than 2f. In this case, such a second reflecting surface 3a is also provided near the lower area of the first reflecting surface 3 in order to cut the light L2 which otherwise becomes glare light.

[0013] When such a second reflecting surface 3a is formed in a planar shape, as shown in Fig. 2, the light L2 emitted from the bulb 2 frontward and downward is incident on the second reflecting surface 3a to be reflected therefrom in the forward direction. In this case, the reflected light travels upward more than the illumination direction that is substantially horizontal, resulting in the generation of glare light L2'.

[0014] Fig. 3 is a graph illustrating a specification for a vehicle headlight with regard to glare light as measured at a position 25 m ahead of the vehicle. In accordance with this specification with regard to glare light, it is required that an intensity of such glare light should be regulated to be 0.15 lx or less within a certain area (so-called "Zone 3") which is defined by a horizontal angle range of $\pm$10 degrees and vertical angle range of 7 to 90 degrees. Accordingly, the generation of such glare light L2' as described above may not comply with the specification.

[0015] To cope with this, at least part of the second reflecting surface within a predetermined range "a" can be formed to have an appropriate arc section 3a' being convex upward, for example, as shown in Fig. 2 by a solid line. The resulting second reflecting surface 3a' can reflect and diffuse light to generate the diffused light L3 within a predetermined range in the front-to-rear direction. The diffused light L3 can have a reduced intensity at respective portions, whereby the headlight can comply with the specification with regard to glare light.

[0016] For example, as shown in Figs. 4A and 4B, a vehicle headlight 1 with a second reflecting surface 3a' having a convex arc section with a large radius of curvature can be designed. In this case, the light distribution pattern of this vehicle headlight 1 is shown in Fig. 5 as a simulation result. This simulation result shows that glare light is generated in an area defined by a horizontal angle

range of ±30 degrees in the right and left directions and a vertical angle range of 50 to 75 degrees. In addition to this, within the Zone 3, the calculated value of the intensity is 0.18 lx when compared with the value of 0.15 lx or less that is regulated under a certain specification.

[0017] In this vehicle headlight 1 having the second reflecting surface 3a' with an arc section, the light L2 which otherwise becomes glare light L2' can be diffused and therefore regulated by the arc section of the second reflecting surface 3a' only in the front-to-rear direction. Accordingly, if the degree of diffusion is not enough for the purpose, as shown in Fig. 5, for example, the diffused light L3 cannot be emitted outside the area that is specified according to the specification with regard to glare light, but is diffused within the area. In this case, an additional counter measure should be taken, for example, the provision of shielding members such as a hood 4.

[0018] As shown in Fig. 6, a known vehicle headlight 1 has a bulb 2 and a hood 4 disposed just below the bulb 2. In this case, the hood 4 can prevent the light L2, which otherwise becomes glare light, from entering the second reflecting surface 3a, meaning the generation of the glare light can be reliably suppressed. In the vehicle headlight 1 as shown in Fig. 4, for example, such glare light L2' shown in Fig. 5 can be prevented from being generated.

[0019] If such a hood 4 is required, the hood 4 is provided as an additional component to a normal type vehicle headlight 1 including a bulb 2 and a reflecting surface 3. Accordingly, the parts number increases and the parts and assembly costs also increase.

[0020] In addition, an attachment member is required to firmly hold the hood 4 in position. In this case, the attachment member can be observed externally, resulting in deterioration of outer appearance of the vehicle headlight.

[0021] In view of the foregoing conventional problems, an object of the present invention is to provide a vehicle headlight with a simple configuration which can suppress or prevent the generation of any glare light occurring due to the reflection by a second reflecting surface provided near the lower area of a first reflecting surface.

[0022] In order to achieve the above object of the present invention, one aspect of the present invention is a vehicle headlight including: a light source; a first reflecting surface disposed behind the light source so as to reflect light from the light source to an illumination direction, the first reflecting surface having a focus at or near the position of the light source and a center axis along the illumination direction and being concave toward the illumination direction; and a second reflecting surface extending at least adjacent to an edge of the first reflecting surface, the vehicle headlight being characterized in that at least part of the second reflecting surface is inclined in right and left directions so as to reflect and diffuse light, that is emitted from the light source frontward and downward and incident thereon, in right and left directions to the outside.

[0023] In the vehicle headlight according to the present invention, the at least part of the second reflecting surface can reflect and diffuse the light to the outside by an angle of more than 10 degrees in right and left directions of the vehicle with respect to the vertical axis.

[0024] In the vehicle headlight according to the present invention, the at least part of the second reflecting surface can be inclined in right and left directions of the vehicle from its center by an inclined angle of $\theta 2$ such that $\theta 1 + 2x\theta 2 \geq 10$ degrees is satisfied wherein $\theta 1$ is an angle by which light emitted from the light source travels downward and outward in right or left direction with respect to the vertical axis when viewed from its front.

[0025] According to the above configuration, when supplied with power from an external drive electrical power source, the light source is driven to emit light. The light emitted from the light source is directly projected in the illumination direction or is reflected by the first reflecting surface to become parallel light so as to be projected in the illumination direction.

[0026] In the configuration of the present invention, part of the light emitted from the light source may include the light directed frontward and downward. This light can enter the second reflecting surface and is reflected by the same to be directed upward with respect to the illumination direction.

[0027] At that time, at least part of the second reflecting surface is formed to be inclined in the right and left directions. Accordingly, when being incident on the inclined area of the second reflecting surface, the light is reflected by the same to be diffused to the outside in the right and left directions with respect to the illumination direction.

[0028] In this configuration, the light emitted from the light source forward and downward and directed to the second reflecting surface can enter the inclined second reflecting surface to be reflected and diffused in the right and left directions even when it is directed upward with respect to the illumination direction.

[0029] Accordingly, even when the first reflecting surface is formed to have a horizontally elongated rectangular shape and a second reflecting surface is provided near the lower area of the first reflecting surface, part of the light which is emitted from the light source and is directed to the second reflecting surface is reflected and diffused by the same so that the light cannot be projected at the center and upward area in the illumination direction. Accordingly, the present invention can prevent the light from becoming glare light or can reduce the generation of the glare light. This configuration can eliminate any separate parts for preventing glare light such as a hood so that the parts number can be reduced as well as the parts cost and assembly cost can also be reduced when compared with the vehicle headlight with such a hood. Furthermore, there is no separate attachment member for attaching and/or supporting a separate shielding member such as a hood which may be observed externally, and accordingly, the outer appearance of the vehicle headlight does not deteriorate.

[0030] In the present invention, the at least part of the

second reflecting surface can reflect and diffuse the light by an angle of more than 10 degrees in the right and left directions of the vehicle with respect to the vertical axis. In another aspect of the present invention, the at least part of the second reflecting surface can be inclined in the right and left directions of the vehicle from its center by an inclined angle of $\theta 2$ such that $\theta 1 + 2x\theta 2 \geq 10$ degrees is satisfied wherein $\theta 1$ is an angle by which light emitted from the light source travels downward and outward in right or left direction with respect to the vertical axis when viewed from its front. In the vehicle headlight of the present invention with the above configurations, it is ensured to prevent light directed to the area (Zone 3) which is defined by a horizontal angle range of ± 10 degrees and vertical angle range of 7 to 90 degrees in accordance with the specification with regard to the vehicle headlight. This means that the generation of glare light can be surely suppressed.

[0031] Accordingly, the present invention can prevent the light that is reflected by the second reflecting surface provided near the lower area of the first reflecting surface from becoming glare light or can reduce the generation of the glare light.

BRIEF DESCRIPTION OF THE DRAWINGS

[0032] These and other characteristics, features, and advantages of the present invention will become clear from the following description with reference to the accompanying drawings, wherein:

Fig. 1A is a schematic cross-sectional view showing one exemplary configuration of a conventional vehicle headlight, and Fig. 1B is a front view of the vehicle headlight of Fig. 1A;

Fig. 2 is a schematic cross-sectional view showing the state where glare light is generated in a conventional vehicle headlight with a second reflecting surface provided near the lower area of a first reflecting surface;

Fig. 3 is a graph illustrating a specification for a vehicle headlight with regard to glare light as measured at a position 25 m ahead of the vehicle

Figs. 4A and 4B show the exemplary configuration of the first reflecting surface of the vehicle headlight of Fig. 2, Fig. 4A being a schematic front view thereof and Fig. 4B being a schematic cross-sectional view thereof;

Fig. 5 is a graph showing the light distribution pattern of the vehicle headlight with the first reflecting surface of Fig. 4 as a result of simulation;

Fig. 6 is a schematic cross-sectional view showing one exemplary configuration of a conventional vehicle headlight with a hood for suppressing the generation of glare light;

Fig. 7 is a schematic cross-sectional view showing the configuration of a first exemplary embodiment of a vehicle headlight according to the present invention;

Fig. 8 is a partial enlarge front view showing the second reflecting surface of the vehicle headlight of Fig. 7;

Figs. 9A and 9B show the exemplary configuration of the first reflecting surface of the vehicle headlight of Fig. 7, Fig. 9A being a schematic front view and Fig. 9B being a schematic cross-sectional view; and

Fig. 10 is a graph showing the light distribution pattern of the vehicle headlight with the first reflecting surface of Fig. 9 as a result of simulation.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0033] A description will now be given below to a vehicle headlight of the present invention with reference to the accompanying drawings in accordance with exemplary embodiments.

[0034] Fig. 7 shows the configuration of the first exemplary embodiment of the vehicle headlight according to the present invention.

[0035] As shown in Fig. 7, the vehicle headlight 10 is configured to include a bulb 11 serving as a light source and a first reflecting surface 12 configured to reflect light from the bulb 11 in an illumination direction (forward).

[0036] The bulb 11 can be any bulb for use in a general vehicle headlight, an auxiliary headlight, or the like. For example, a halogen bulb with a commonly known configuration can be used as the bulb 11. The bulb 11 is disposed horizontally so that its optical axis O is arranged horizontally in the illumination direction. The bulb 11 can be energized by power supplied from an electrical power source.

[0037] The first reflecting surface 12 is composed of a parabolic reflecting surface whose center axis extends horizontally in its illumination direction (forward). The first reflecting surface 12 is disposed behind the bulb 11 so that its focus F is located at or near the light emission center of the bulb 11. It should be noted that the reflecting surface may be any parabolic reflecting surface including a revolved paraboloid and a free curved parabolic surface.

[0038] The first reflecting surface 12 has its lower edge at a distance from the center axis equal to or less than twice the focal distance f. From the lower edge thereof a second reflecting surface 13 is provided to extend horizontally.

[0039] As shown in the drawing, although the second reflecting surface 13 is formed as a flat surface in a front-to-rear direction, it may have an appropriate arc section being convex upward within a predetermined range, as shown by a chain double-dashed line in Fig. 7.

[0040] In the exemplary embodiment of the present invention, the second reflecting surface 13 is formed to be inclined in the right and left directions with respect to the vertical plane passing through the optical axis O as a symmetry plane when viewed from its front side, as

shown in Fig. 8.

[0041] A detailed description will be given of the reflection light path with reference to Fig. 8. In Fig. 8, the angle by which the light emitted from the bulb 11 with respect to the vertical plane (vertical axis V) in the right or left direction is denoted by $\theta 1$, and the angle by which the second reflecting surface 13 is inclined with respect of the horizontal plane (horizontal axis H) is denoted by $\theta 2$. The light L2 emitted from the bulb 11 by the angle $\theta 1$ is incident on the point Pi of the second reflecting surface 13. In Fig. 8, there are some additional lines including a vertical line V' which is parallel with the vertical axis V, a horizontal line H' which is parallel with the horizontal axis H, a normal n with respect to the second reflecting surface 13 while the point Pi serves as the center. Accordingly, the angle between the incident light L2 and the vertical line V' is $\theta 1$. The angle between the vertical line V' and the normal n is $\theta 2$. Then, the light L2 is reflected by the second reflecting surface 13 by an angle of $\theta 1 + \theta 2$ with respect to the normal n. Therefore, the angle of reflection of the light L2 with respect to the vertical axis V (or V') is $\theta 1 + 2x\theta 2$.

[0042] Accordingly, the inclined angle $\theta 2$ is preferably set such that $\theta 1 + 2x\theta 2 \geq 10$ degrees is satisfied when the light L2 is emitted from the light emission center of the bulb 11 (bulb center) downward in the right or left direction.

[0043] According to this structure, when the light L2 emitted from the bulb 11 by the angle $\theta 1$ with respect to the vertical plane (or vertical axis) is incident on the inclined second reflecting surface 13, the light L2 is reflected to the outside by an angle of 10 degrees or more in the right or left direction of the vehicle with respect to the vertical plane with reliably.

[0044] The vehicle headlight 10 according to the exemplary embodiment of the present invention is configured as described above, and when the bulb 11 serving as a light source is supplied with power from an external drive electrical power source, the bulb 11 is driven to emit light. The light emitted from the bulb 11 is directly projected in the illumination direction or is reflected by the first reflecting surface 12 to become parallel light L1 so as to be projected in the illumination direction.

[0045] In this case, part of the light emitted from the bulb 11 includes the light L2 directed frontward and downward with respect to the light emission center of the bulb 11. This light can enter the second reflecting surface 13 and is reflected by the same to be directed upward with respect to the illumination direction.

[0046] In the present exemplary embodiment, at least part of the second reflecting surface 13 is formed to be inclined in the right and left directions (sideward) so that the foregoing conditions are satisfied. Accordingly, when being incident on the inclined second reflecting surface 13, the light L2 is reflected by the same to be diffused to the outside in the right and left directions with respect to the illumination direction by the angle of 10 degrees or more with respect to the vertical plane.

[0047] The inclined second reflecting surface 13 can reflect and diffuse the light L2, which otherwise becomes glare light by the conventional second reflecting surface, to be directed outside the Zone 3, thereby preventing the light from becoming glare light or reducing the generation of the glare light.

[0048] Figs. 9A and 9B show another exemplary embodiment of the first reflecting surface and the second reflecting surface of the vehicle headlight 1, which serves as a concrete exemplary configuration.

[0049] In Figs. 9A and 9B, the second reflecting surface 13 is integrally formed with the first reflecting surface 12. In this exemplary embodiment, the second reflecting surface 13 includes a number of (26 in the shown example) divided' reflecting portions 13a in the right and left directions.

[0050] The respective reflecting portions 13a of the second reflecting surface 13 divided in the right and left directions are inclined sideward and downward by the angle $\theta 2$ with respect to the horizontal axis.

[0051] In this case, the light entering the respective portions 13a of the second reflecting surface 13 can be reflected and diffused by the angle of 10 degrees or more with respect to the vertical plane to the outside.

[0052] Fig. 10 is the light distribution pattern with respect to the specification for a vehicle headlight with regard to glare light as measured at a position 25 m ahead of the vehicle. Specifically, Fig. 10 is a graph showing the light distribution pattern of the vehicle headlight 10 with the first reflecting surface 12 and the second reflecting surface 13 (including the reflecting portions 13a) of Fig. 9 as a result of simulation.

[0053] As clearly understood from the result shown in Fig. 10, the glare light L3 can be diffused to the outside by an angle of 10 degrees or more in the right or left direction of the vehicle with respect to the vertical plane with reliably by means of the inclined second reflecting surface 13. This can effectively reduce the generation of the glare light directed within the Zone 3 of the light distribution pattern.

[0054] According to the text result, the calculated value of the intensity of generated glare light is 0.11 lx or less when compared with the value of 0.15 lx or less that is regulated under a certain specification with regard to glare light. Accordingly, the vehicle headlight of the present invention can satisfy the specification.

[0055] In the above described exemplary embodiments, the bulb 11 is used as the light source, although the present invention is not limited thereto. The present invention can employ other types of light sources as long as the effects of the present invention cannot be hindered.

[0056] In the above described exemplary embodiments, the frontal shape of the first reflecting surface 12 is formed as a horizontally elongated rectangle, although the present invention is not limited thereto. The present invention can be applied to such vehicle headlights with a first reflecting surface having any shape wherein the

distance from the center to the lower edge of the first reflecting surface is equal to or less than twice the focal distance.

[0057] In the described exemplary embodiments, the vehicle headlights 10 are configured as a main headlight, although the present invention is not limited thereto. The present invention can be applied to an auxiliary headlight or the like.

[0058] As described above, the present invention can provide a vehicle headlight with a simple configuration which can suppress or prevent the generation of any glare light occurring due to the reflection by a second reflecting surface provided near the lower area of the first reflecting surface.

Claims

1. A vehicle headlight (10) comprising:

a light source (11);
a first reflecting surface (12) disposed behind the light source (11) so as to reflect light from the light source (11) to an illumination direction, the first reflecting surface (12) having a focus (F) at or near the position of the light source (11) and a center axis (O) along the illumination direction and being concave toward the illumination direction; and
a second reflecting surface (13, 13a) extending at least adjacent to an edge of the first reflecting surface (12), the vehicle headlight (10) being **characterized in that** at least part of the second reflecting surface (13, 13a) is inclined in right and left directions so as to reflect and diffuse light (L2), that is emitted from the light source (11) frontward and downward and incident thereon, in right and left directions to the outside.

2. The vehicle headlight according to claim 1, **characterized in that** the at least part of the second reflecting surface (13, 13a) reflects and diffuses the light (L2) to the outside by an angle of more than 10 degrees in right and left directions of the vehicle with respect to the vertical axis (V).

3. The vehicle headlight according to claim 1 or 2, **characterized in that** the at least part of the second reflecting surface (13, 13a) is inclined in right and left directions of the vehicle from its center by an inclined angle of $\theta 2$ such that $\theta 1 + 2x\theta 2 \geq 10$ degrees is satisfied wherein $\theta 1$ is an angle by which light emitted from the light source (11) travels downward and outward in right or left direction with respect to the vertical axis when viewed from its front.

4. The vehicle headlight according to any one of claims 1 to 3, **characterized in that** the at least part of the second reflecting surface (13, 13a) includes a number of divided reflecting portions (13a) each of which is inclined in right and left directions so as to reflect and diffuse light (L2), that is emitted from the light source (11) frontward and downward and incident thereon, in right and left directions to the outside.

Fig. 1A

Conventional Art

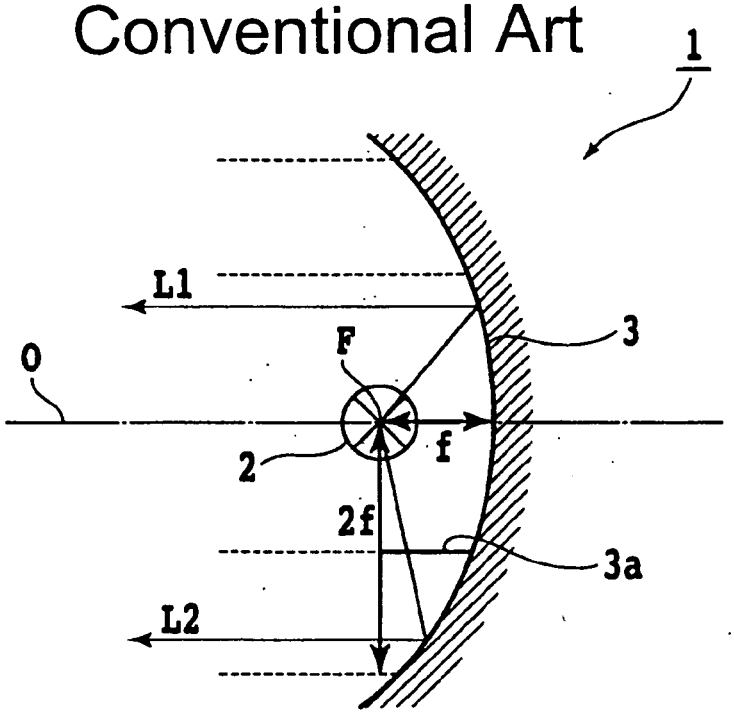


Fig. 1B

Conventional Art

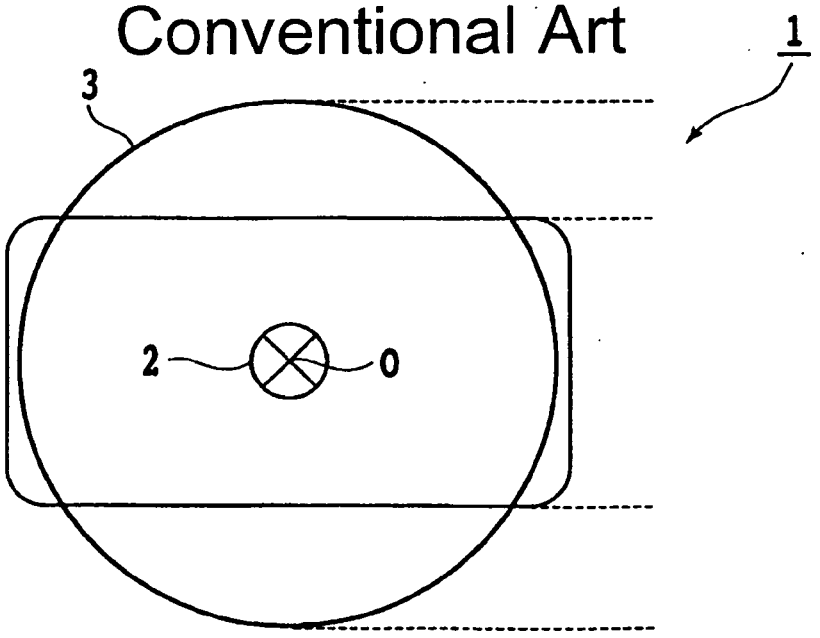


Fig. 2

Conventional Art

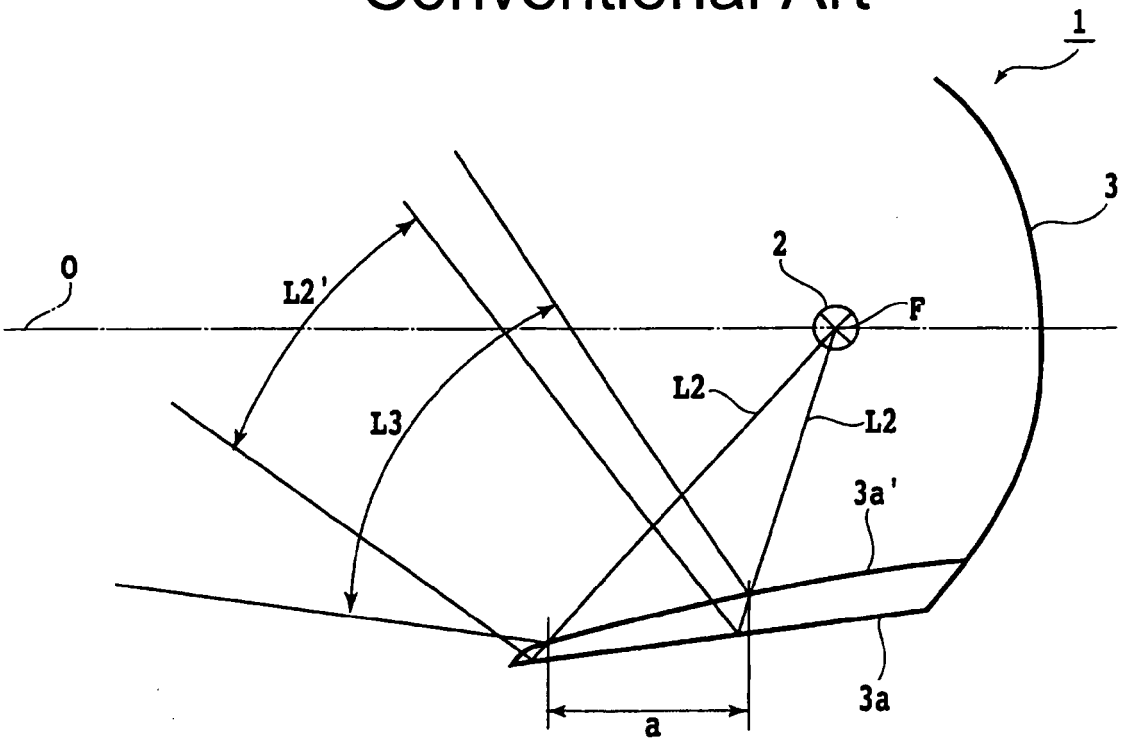


Fig. 3

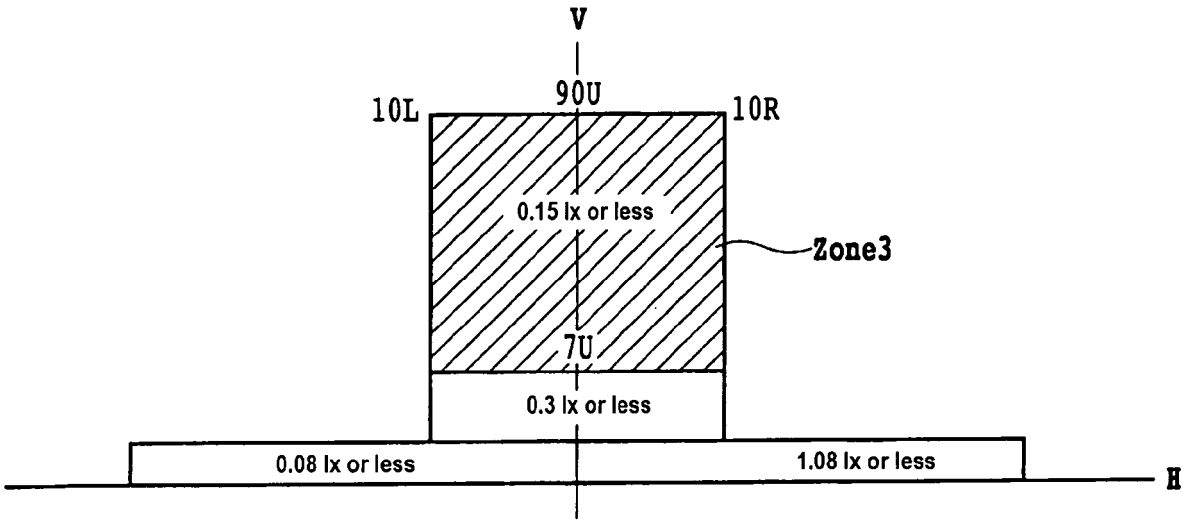

V
90U
10L
10R
0.15 lx or less
Zone3
7U
0.3 lx or less
0.08 lx or less
1.08 lx or less
H

Fig. 4A

Conventional Art

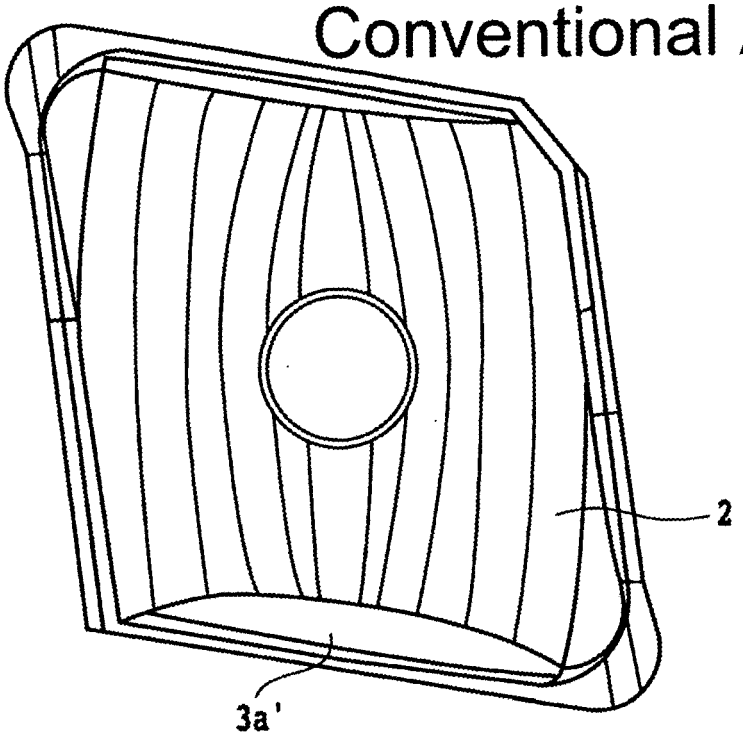


Fig. 4B

Conventional Art

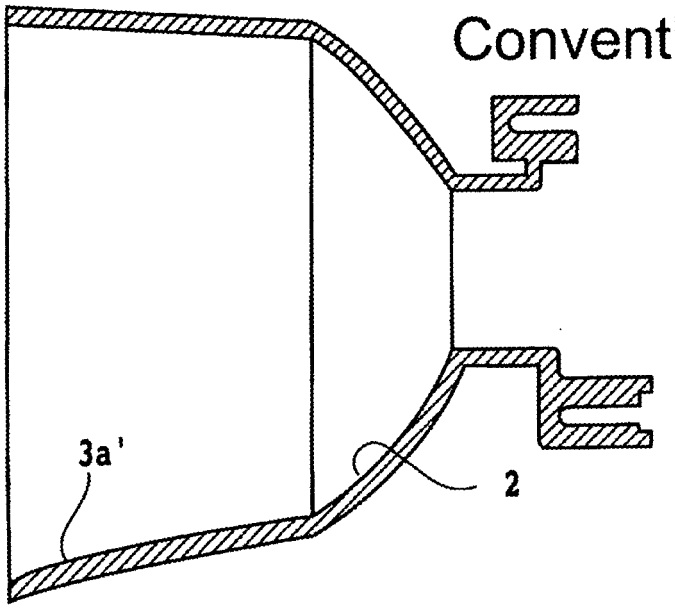


Fig. 5

Conventional Art

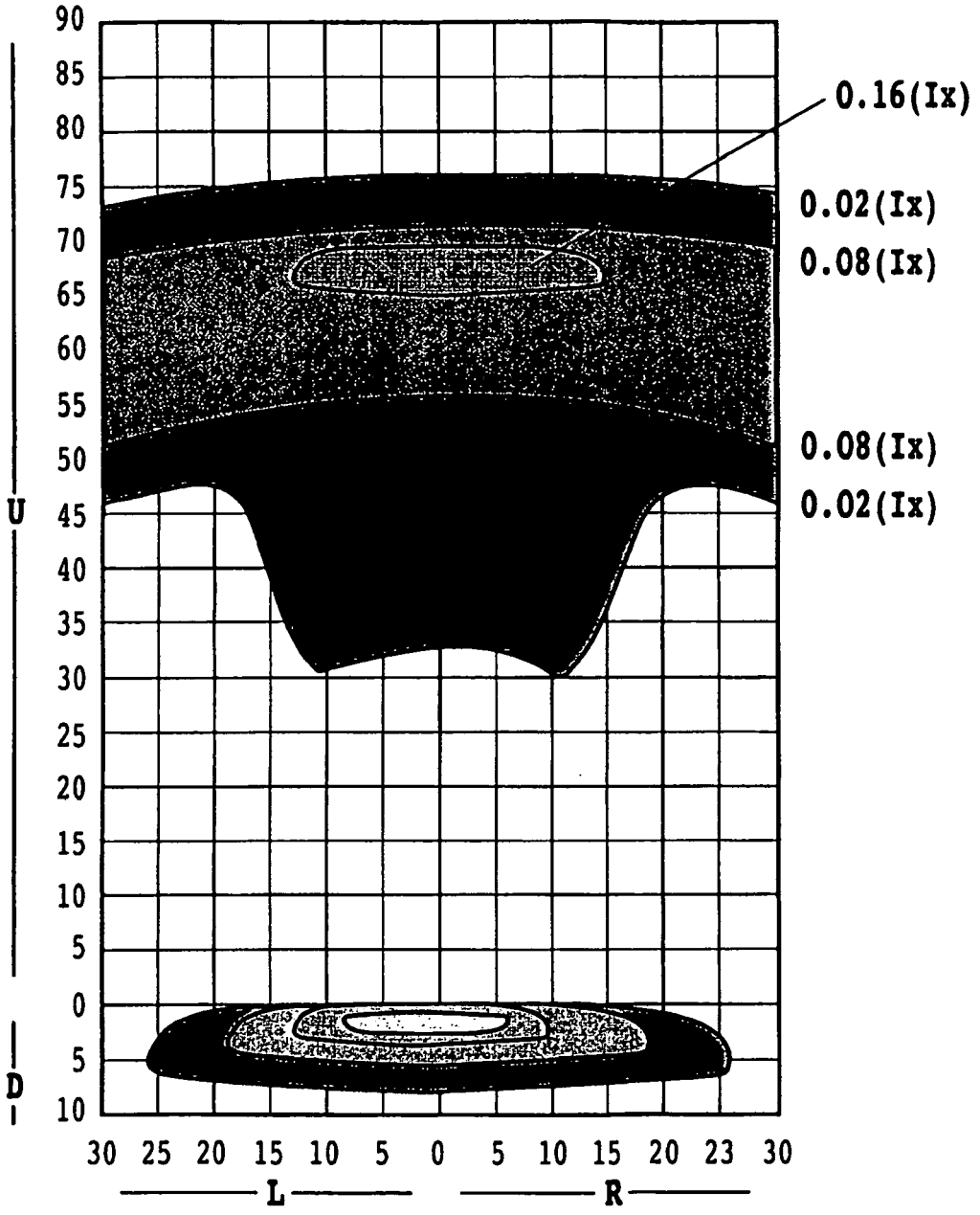


Fig. 6

Conventional Art

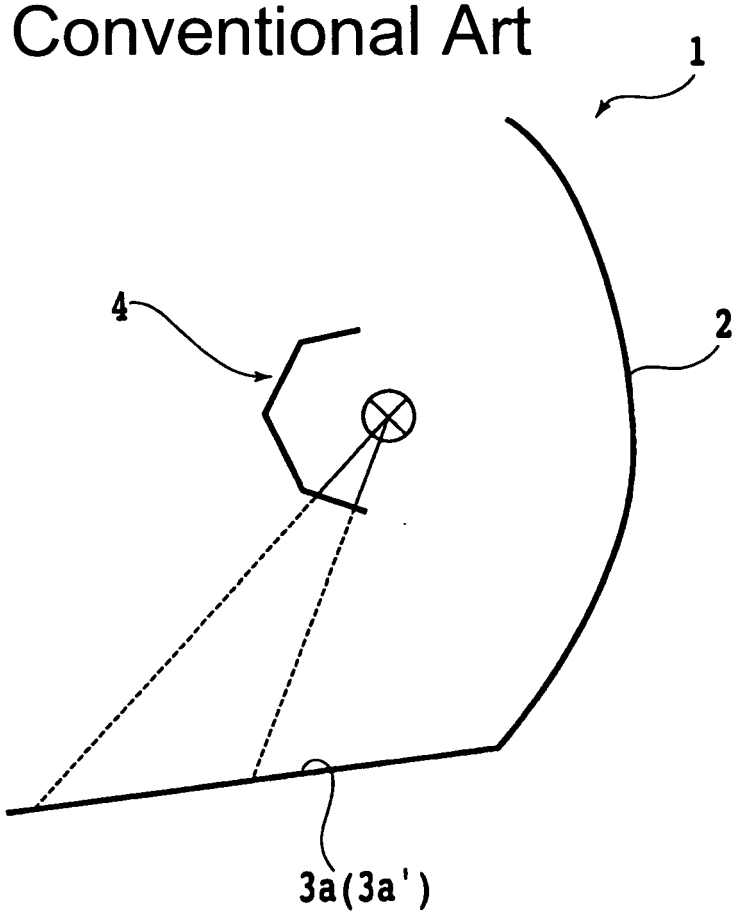


Fig. 7

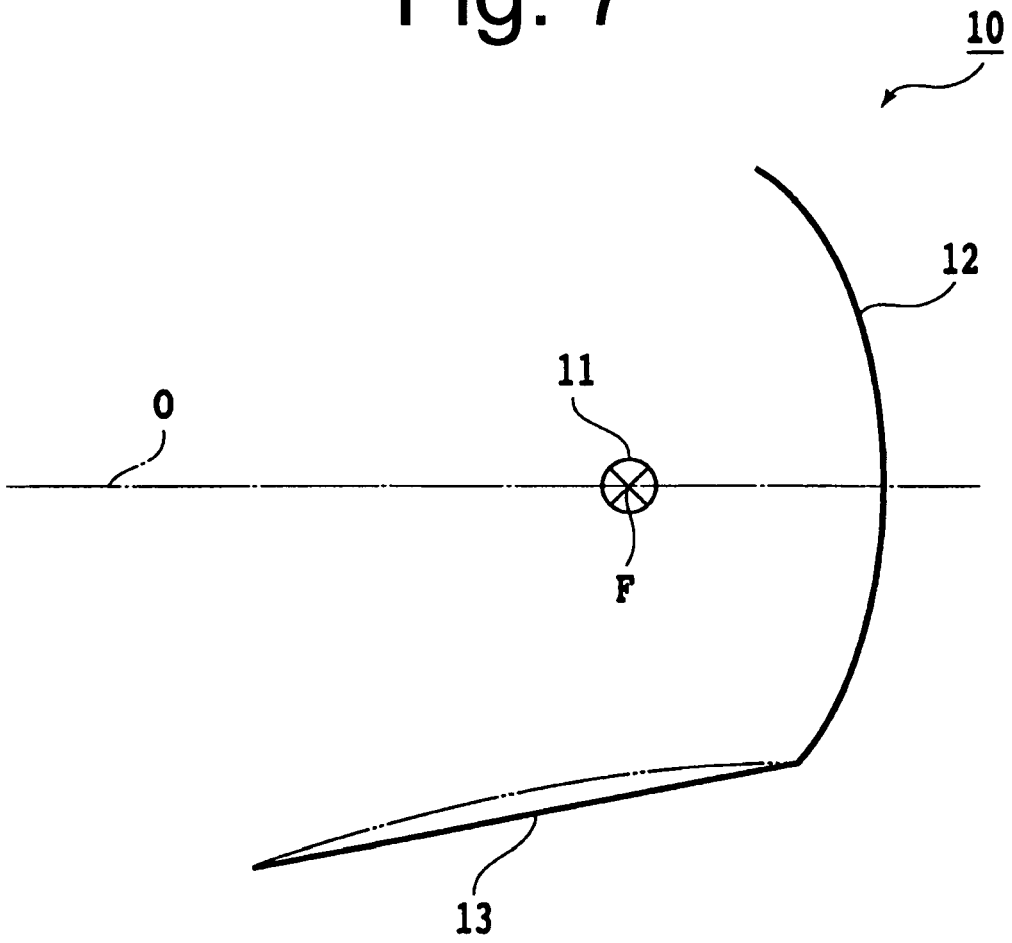


Fig. 8

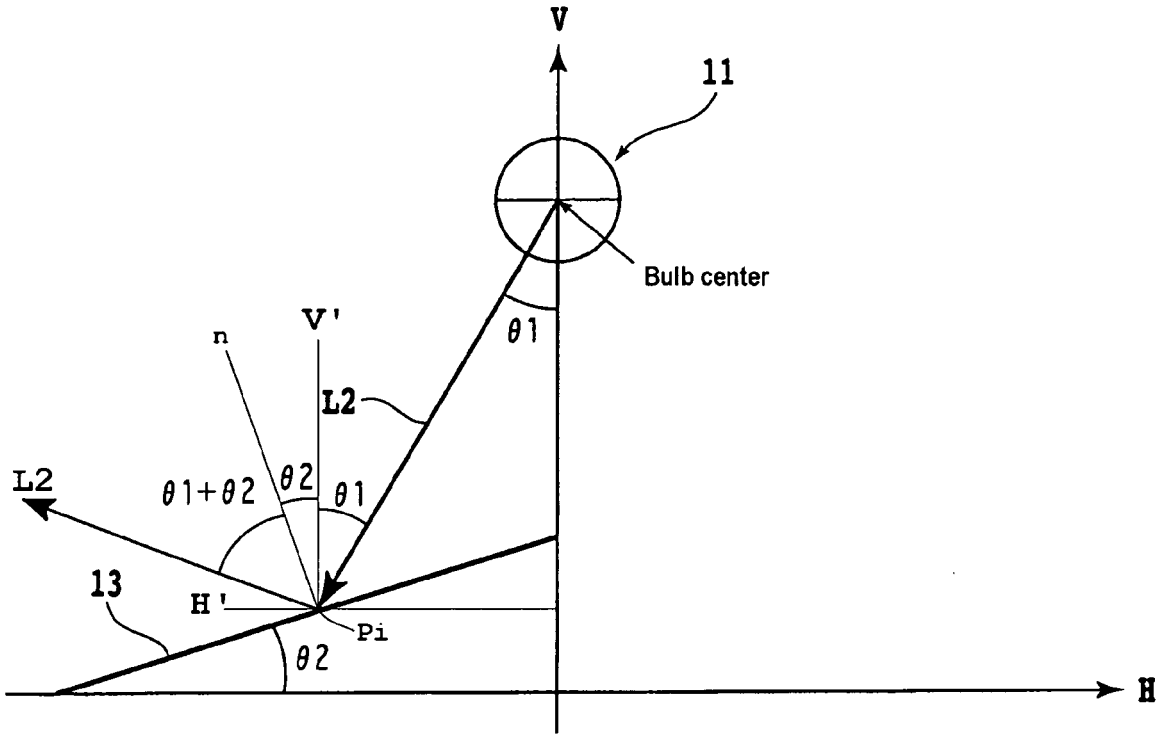


Fig. 9A

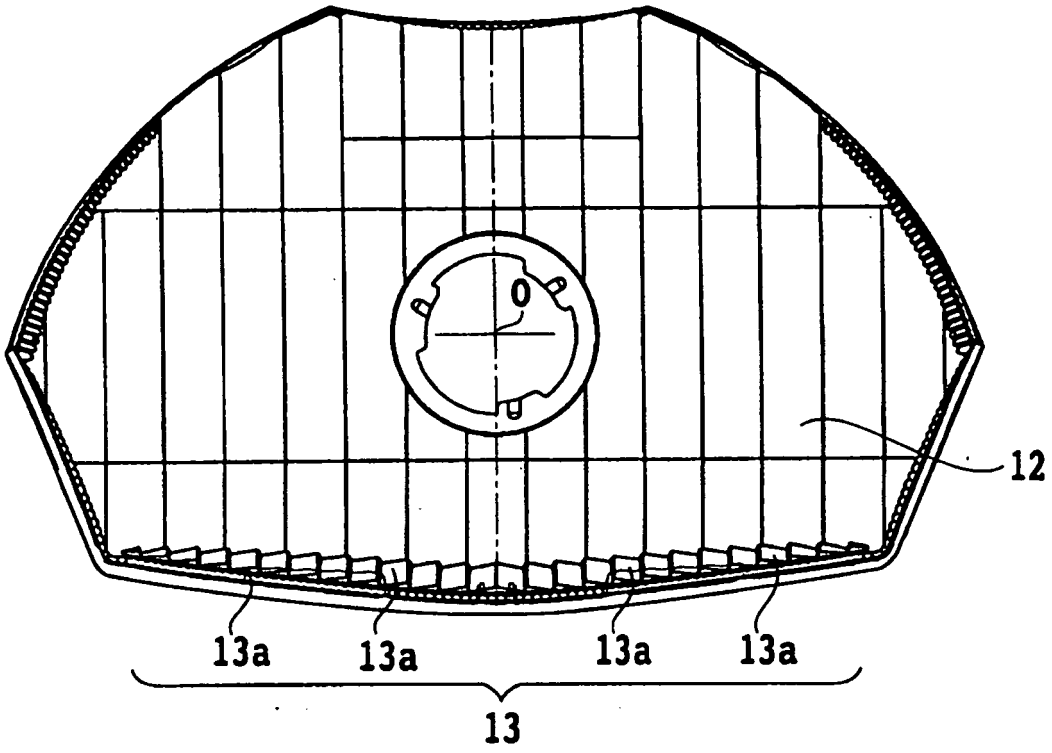


Fig. 9B

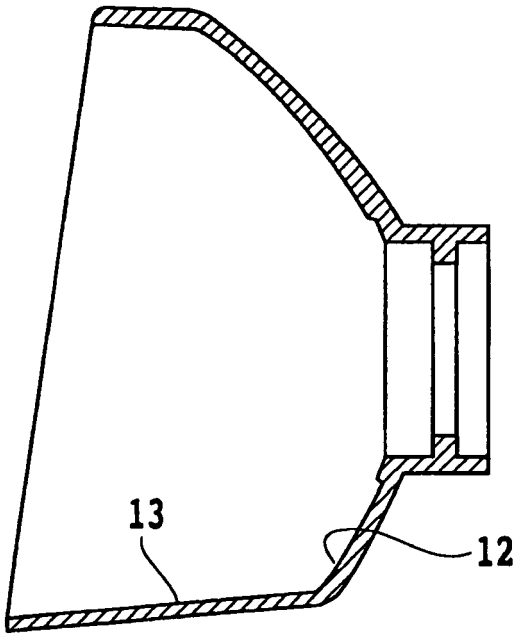
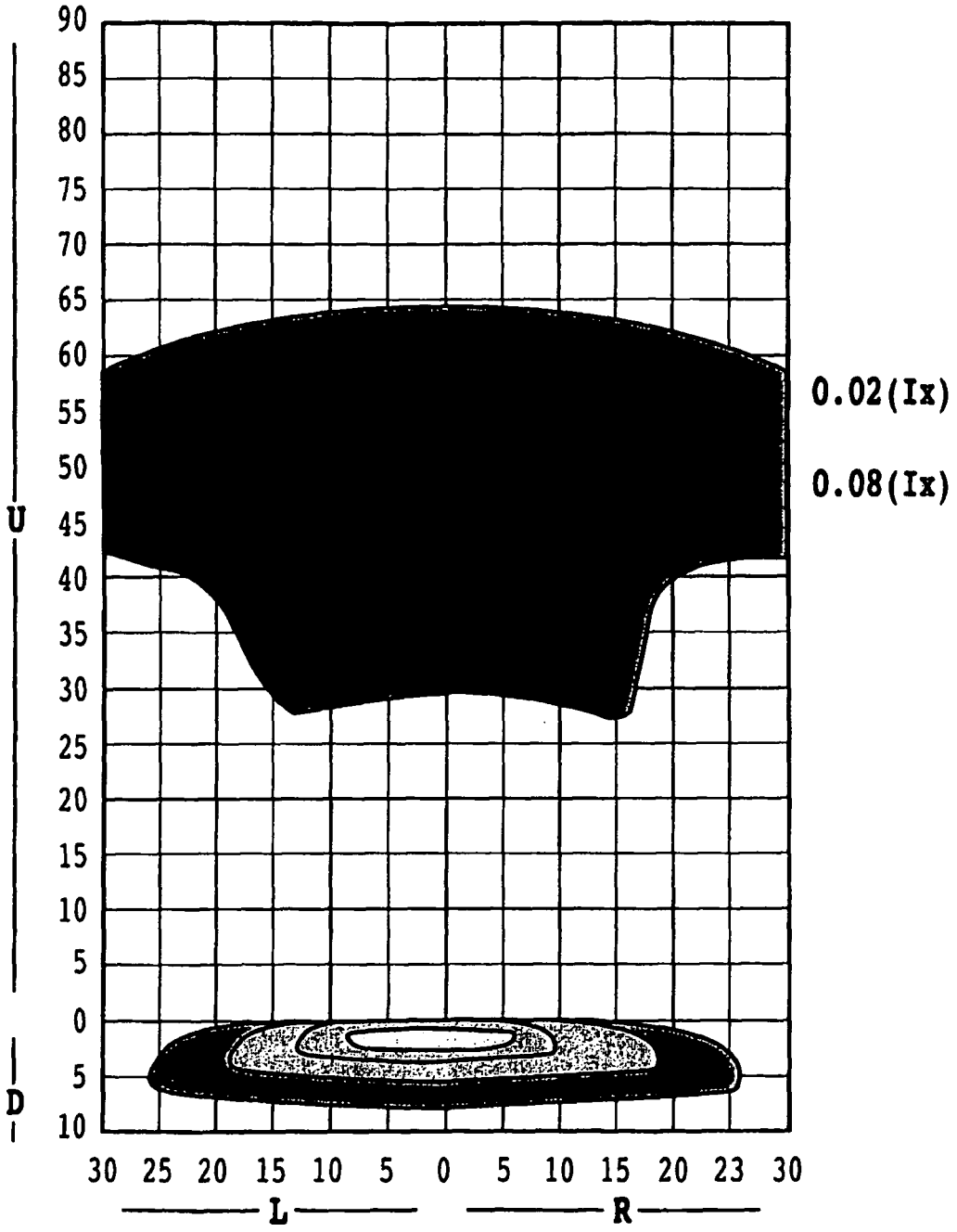


Fig. 10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EUROPEAN SEARCH REPORT

Application Number
EP 08 01 8412

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 055 981 A (NINO NAOHI [JP]) 8 October 1991 (1991-10-08) * column 9, line 54 - line 62 * * column 10, line 3 - line 5 * * figure 17 * -----	1,2,4	INV. F21V7/00 F21S8/10
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TECHNICAL FIELDS SEARCHED (IPC)

F21V
F21S

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 December 2008	Amerongen, Wim

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