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(54) **PRIMARY LENS, LIGHT-EMITTING ASSEMBLY, LIGHT-EMITTING SYSTEM, AND HEADLIGHT**

(57) Disclosed are a primary lens (100), a light-emitting assembly, a light-emitting system, and a headlight, which relate to the technical field of optical components. The primary lens (100) comprises a main body portion (110), and the main body portion (110) comprises a first optical surface (111) and a second optical surface (112), wherein a linear focus line (113) is formed on the first optical surface (111), and the height of the first optical surface (111) is gradually reduced from the focus line (113) towards two sides; and the second optical surface (112) comprises a plurality of ridges (114) arranged in

parallel, with an extension direction of the ridges (114) being perpendicular to the focus line (113), and the ridges (114) have arc-shaped convex faces. Under the conditions where the focus line (113) extends horizontally and the ridges (114) extend vertically, the primary lens (100) can converge light that is incident on the first optical surface (111) in a vertical direction and diffuse the light in a horizontal direction, thereby satisfying the illumination characteristics of a headlight of a vehicle.

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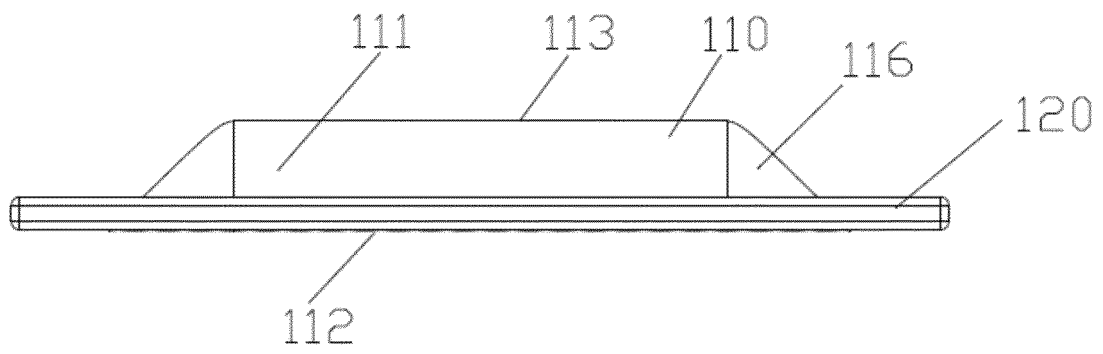


Fig. 1

Description

FIELD

[0001] The present invention relates to the technical field of optical components, in particular to a primary lens, a light-emitting assembly, a light-emitting system, and a headlight.

BACKGROUND

[0002] Illuminating headlights are important components of vehicles. With the development of vehicle intelligence, headlights are also developed towards intelligence, wherein adaptive high beam illumination technology is increasingly applied to vehicles.

[0003] In the driving process of a vehicle, the irradiation range formed by the headlight is characterized in greater dimension in the left-right direction of the vehicle and smaller dimension in the height direction of the vehicle. Accordingly, it is necessary to diffuse the light beam emitted from the light source of the headlight in the horizontal direction and converge it in the vertical direction. Therefore, it is desirable to design a lens with a special optical surface to achieve special control of the light beam of the light source of headlight and design a corresponding light-emitting structure. In addition, the light source of the headlight is composed of a plurality of LED particles, which generate great heat. The heat dissipation effect will be compromised if the LED particles are arranged too densely. Therefore, it is necessary to design a corresponding light-emitting structure.

SUMMARY

[0004] In view of the above problem, an object of the present invention is to provide a lens to realize diffusion of the light emitted from the light source in the horizontal direction and convergence of the light in the vertical direction.

[0005] To attain the object described above, the present invention employs the following technical scheme:

A primary lens, which comprises a main body portion, which comprises a first optical surface and a second optical surface, wherein a linear focus line is formed on the first optical surface, and the height of the first optical surface is gradually reduced from the focus line towards two sides; and the second optical surface comprises a plurality of ridges arranged in parallel and extending in a direction perpendicular to the focus line, and the ridges have arc-shaped convex faces.

[0006] Furthermore, adjacent ridges smoothly transit via an arc-shaped concave face. Furthermore, the arc-shaped convex faces of the ridges are identical, and the ridges are spaced apart evenly.

[0007] Furthermore, a sub-optical surface is formed respectively at each side of the focus line and comprises

a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line.

[0008] Furthermore, the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly.

[0009] Furthermore, the two sub-optical surfaces are symmetric with respect to the focus line. Furthermore, the main body portion comprises transition surfaces at the two ends of the focus line, and the transition surfaces are smoothly connected to the two sub-optical surfaces.

[0010] Furthermore, the primary lens further comprises a fixed flanged edge arranged around the edge of the main body portion, and through-holes are formed in the fixed flanged edge.

[0011] Furthermore, the primary lens is made of silicone.

[0012] Compared with the prior art, the primary lens disclosed in the present invention has the following advantages:

Under the conditions that the focus line extends horizontally and the ridges extend vertically, the primary lens disclosed in the present invention can converge light that is incident on the first optical surface in the vertical direction and diffuse the light in the horizontal direction, thereby satisfying the illumination characteristics of a headlight of a vehicle.

[0013] Another object of the present invention is to provide a light-emitting assembly capable of emitting a light beam diffused in the horizontal direction and converged in the vertical direction.

[0014] To attain the object described above, the present invention employs the following technical scheme:

A light-emitting assembly, comprising a light source portion, a primary lens and a secondary lens arranged sequentially in a first direction, wherein the light source portion comprises a plurality of lamps arranged in a second direction, the primary lens comprises a first optical surface that faces the light source portion and a second optical surface that faces the secondary lens, a linear focus line extending in the second direction is formed on the first optical surface, and the height of the first optical surface is gradually reduced from the focus line to the two sides; the second optical surface comprises a plurality of ridges arranged in a third direction, and the ridges have arc-shaped convex faces; the secondary lens is a convex lens, and the third direction, the first direction, and the second direction are perpendicular to each other.

[0015] Furthermore, the incident face of the secondary lens is a planar face, and the emergent face of the secondary lens is a spherical face.

[0016] Furthermore, the light source portion comprises a circuit board, and the lamps are LED particles and arranged on the circuit board.

[0017] Furthermore, the light source portion comprises

n lamps, the included angle of a light beam formed by any two adjacent lamps through the primary lens and the secondary lens is 2-3 degrees, and the angle of a light beam formed by n lamps is $2n-3n$ degrees. Furthermore, the arc-shaped convex faces are identical, and the ridges are spaced apart evenly.

[0018] Furthermore, adjacent ridges smoothly transit via an arc-shaped concave face. Furthermore, a sub-optical surface is formed respectively at each side of the focus line and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line.

[0019] Furthermore, the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly.

[0020] Furthermore, the light-emitting assembly comprises a housing having a light passage, the primary lens is arranged at an entry end of the housing, and the secondary lens is arranged at an exit end of the housing.

[0021] Furthermore, the light-emitting assembly comprises a heat dissipation portion engaged with the light source portion, the heat dissipation portion comprises a main plate portion attached to the light source portion and heat dissipation fins provided on the main plate portion, and the main plate portion sealingly blocks the entry end of the housing.

[0022] Compared with the prior art, the light-emitting assembly disclosed in the present disclosure has the following advantages:

Utilizing the optical effects of the primary lens and the secondary lens, the light-emitting assembly provided in the present invention can generate a light beam converged in a first direction and diffused in a second direction, satisfying the illumination characteristics of a vehicle headlight converging light in the vertical direction and diffusing light in the horizontal direction.

[0023] Another object of the present invention is to provide a light-emitting system capable of emitting a light beam diffused in the horizontal direction and converged in the vertical direction.

[0024] To attain the object described above, the present invention employs the following technical scheme:

A light-emitting system, comprising a plurality of light-emitting assemblies, each of which comprises a light source portion, a primary lens and a secondary lens sequentially arranged in a first direction, wherein the light source portion comprises a plurality of lamps spaced apart in a second direction; the plurality of light-emitting assemblies are arranged in a third direction, and can rotate with respect to each other around an axis in the third direction; the first direction, the second direction, and the third direction are perpendicular to each other; the primary lens comprises a first optical surface that faces the light source portion and a second optical surface that faces the secondary lens, a linear focus line extending

in the second direction is formed on the first optical surface, the height of the first optical surface is gradually reduced from the focus line to the two sides, the second optical surface comprises a plurality of ridges extending in the third direction and having arc-shaped convex surfaces, and the secondary lens is a convex lens.

[0025] Furthermore, each of the light-emitting assemblies comprises a housing having a light passage, the primary lens is arranged at an entry end of the housing, and the secondary lens is arranged at an exit end of the housing.

[0026] Furthermore, the light-emitting system comprises two light-emitting assemblies, wherein one housing is provided with a cylindrical boss extending in the third direction, the other housing is provided with a circular hole for accommodating the cylindrical boss to be inserted, and the two housings can rotate with respect to each other; wherein one housing is provided with an angle scale dial, and the other housing is provided with an angle pointer corresponding to the angle scale dial; and wherein one housing is provided with a mounting hole, the other housing is provided with an arc-shaped hole extending around the central axis of the cylindrical boss, and the two housings are fixed by a connecting member penetrating through the mounting hole and the arc-shaped hole.

[0027] Furthermore, the light-emitting assembly comprises a heat dissipation portion engaged with the light source portion, the heat dissipation portion comprises a main plate portion attached to the light source portion and heat dissipation fins provided on the main plate portion, and the main plate portion sealingly blocks the entry end of the housing.

[0028] Furthermore, the incident face of the secondary lens is a planar face, and the emergent face of the secondary lens is a spherical face.

[0029] Furthermore, the radii of the arc-shaped convex surfaces are identical, the ridges are spaced apart evenly, and adjacent ridges smoothly transit via an arc-shaped concave surface.

[0030] Furthermore, a sub-optical surface is formed respectively at each side of the focus line and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line.

[0031] Furthermore, the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly.

[0032] Furthermore, the light source portion comprises a circuit board and n lamps, the lamps are LED particles, the included angle of a light beam formed by any two adjacent lamps through the primary lens and the secondary lens is 2-3 degrees, and the angle of a light beam formed by n lamps is $2n-3n$ degrees.

[0033] Compared with the prior art, the light-emitting system disclosed in the present disclosure has the fol-

lowing advantages:

Utilizing the optical effects of the primary lens and the secondary lens, the light-emitting system provided in the present invention can generate a light beam converged in a first direction and diffused in a third direction, satisfying the illumination characteristics of a vehicle headlight converging light in the vertical direction and diffusing light in the horizontal direction. In addition, in the light-emitting system, the light source is distributed in a plurality of light-emitting assemblies, and thereby the heat dissipation efficiency is improved.

[0034] Another object of the present invention is to provide a headlight capable of emitting a light beam diffused in the horizontal direction and converged in the vertical direction. To attain the object described above, the present invention employs the following technical scheme:

A headlight provided with the light-emitting system in the above scheme.

[0035] The headlight has the same advantages as the above light-emitting system over the prior art, and will not be detailed further here.

[0036] Other features and advantages of the present invention will be further detailed in the embodiments hereunder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037] The accompanying drawings, which constitute a part of the present invention, are provided to facilitate further understanding the present invention; the illustrative embodiments and associated description in the present invention are provided to explain the present invention, and shall not be deemed as constituting any undue limitation to the present invention. In the figures:

Fig. 1 is a front view of the primary lens according to an embodiment of the present invention;

Fig. 2 is a sectional view of the primary lens according to an embodiment of the present invention;

Fig. 3 is an enlarged view of the part A in Fig. 2;

Fig. 4 is a perspective view of the first optical surface of the primary lens according to an embodiment of the present invention;

Fig. 5 is a perspective view of the second optical surface of the primary lens according to an embodiment of the present invention;

Fig. 6 is a perspective view of the light-emitting assembly according to an embodiment of the present invention;

Fig. 7 is an exploded view of the light-emitting assembly according to an embodiment of the present invention;

Fig. 8 is a cross-sectional view of the light-emitting assembly according to an embodiment of the present invention;

Fig. 9 is a schematic structural diagram of the light source portion according to an embodiment of the

present invention;

Fig. 10 is a perspective view of the light-emitting system according to an embodiment of the present invention;

Fig. 11 is an exploded view of the light-emitting system according to an embodiment of the present invention;

Fig. 12 is an enlarged partial view of the housing according to an embodiment of the present invention.

Reference Numbers:

[0038] 2 - secondary lens, 3 - light source portion, 4 - housing, 5 - heat dissipation portion, 31 - LED particle, 32 - circuit board, 41 - angle scale dial, 42 - angle pointer, 43 - mounting hole, 44 - arc-shaped hole, 51 - main plate portion, 52 - heat dissipation fin, 100 - primary lens, 110 - main body portion, 111 - first optical surface, 112 - second optical surface, 113 - focus line, 114 - ridge, 115 - arc-shaped concave surface, 116 - transition surface, 120 - flanged edge.

DETAILED DESCRIPTION

[0039] It should be noted that the embodiments and the features in the embodiments can be combined freely, provided that there is no confliction among them.

[0040] Hereunder the present invention will be detailed in embodiments with reference to the accompanying drawings.

[0041] The present invention provides a primary lens 100, which comprises a main body portion 110, which comprises a first optical surface 111 and a second optical surface 112, wherein a linear focus line 113 is formed on the first optical surface 111, and the height of the first optical surface 111 is gradually reduced from the focus line 113 towards two sides; and the second optical surface 112 comprises a plurality of ridges 114 arranged in parallel and extending in a direction perpendicular to the focus line 113, and the ridges 114 have arc-shaped convex faces.

[0042] As shown in Fig. 4, the focus line 113 is the peak portion on the first optical surface 111, and the portions of the first optical surface 111 at the two sides of the focus line 113 are gradually reduced in height and turn into deformed convex surfaces; as shown in Figs. 3 and 5, the arc-shaped convex surface of the ridge 114 may be regarded as a part of the circumferential surface of a cylindrical structure, and the extending direction of the ridge 114 is parallel to the central axis of the cylindrical structure.

[0043] When the primary lens 100 is applied to a headlight, the primary lens 100 may be placed as follows: the focus line 113 may extend substantially in the horizontal direction, and the ridge 114 extends in the vertical direction. The light source may be placed on the side of the first optical surface 111, which may serve as an incident

surface; the second optical surface 112 may serve as an emergent surface. The first optical surface 111 may cause the incident light to converge toward the center focus line 113 in the vertical direction, and the second optical surface 112 may cause the incident light to form emergent light diffused in the horizontal direction. That is to say, utilizing the first optical surface 111 and the second optical surface 112, the light beam generated by the light source can be converged in the vertical direction and diffused in the horizontal direction, which is more suitable for the characteristic of wider horizontal irradiation range and narrower vertical irradiation range of a headlight.

[0044] In addition, adjacent ridges 114 smoothly transit via an arc-shaped concave face 115. As shown in Fig. 3, the ridge 114 itself is formed with an arc-shaped convex surface, and every two adjacent arc-shaped convex surfaces may be connected via an arc-shaped concave surface 115 so as to realize smooth transition. That is say, the tangent line of the arc-shaped convex surface and the tangent line of the arc-shaped concave surface are coincident at the connection point. The central axis of the arc-shaped concave surface 115 may be parallel to the central axis of the arc-shaped convex surface. Particularly, the diameter of the arc-shaped concave surface 115 is much smaller than the diameter of the arc-shaped convex surface, i.e., the main body portion of the second optical surface 112 is an arc-shaped convex surface, and achieves diffusion of the light in the horizontal direction; the arc-shaped concave surface 115 is only designed to connect two arc-shaped convex surfaces smoothly, the area ratio of the arc-shaped concave surface 115 is negligible, and the optical effect of it is also negligible.

[0045] Furthermore, the arc-shaped convex faces of the ridges 114 are identical, and the ridges 114 are spaced apart evenly. The plurality of ridge 114 have consistent optical performance. In addition, since the second optical surface 112 is provided with the plurality of ridge 114, the radius of the arc-shaped convex surface is smaller than the dimension of the second optical surface 112 in the horizontal direction, so that the diffused light formed by the second optical surface 112 in the lateral direction is uniform.

[0046] Specifically, a sub-optical surface is formed respectively at each side of the focus line 113 and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line 113. The arc-shaped surface may be regarded as a part of the circumferential surface of a cylinder with a central axis parallel to the focus line 113, i.e., a cylindrical arc-shaped surface (similar to the arc-shaped convex surface of the ridge 114), and the first optical surface 111 is formed as an incident surface with a convex central portion (the focus line 113 is convex), so that incident light beam can be converged in the vertical direction.

[0047] Particularly, the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus

line 113 to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly. The radius of the arc-shaped surface close to the focus line 113 is smaller, while the radius of the arc-shaped surface away from the focus line 113 is greater. Thus, adjacent arc-shaped surfaces can be smoothly connected, i.e., the tangent lines of adjacent arc-shaped surfaces coincide with each other at the connection point. At the focus line 113, the two arc-shaped surfaces of the two sub-optical surfaces are connected to each other, and the focus line 113 is at the highest position.

[0048] In addition, the two sub-optical surfaces are symmetric with respect to the focus line 113. The two symmetrical sub-optical surfaces at the two sides of the focus line 113 have the same light convergence ability, so that the light beam formed by convergence is more uniform in the vertical direction without obvious bright and dark areas. At the focus line 113, the two arc-shaped surfaces of the two sub-optical surfaces with the same radius are connected to each other to form an arc-shaped surface with a greater angle, and the focus line 113 is the highest generatrix on the arc-shaped surface.

[0049] In addition, the main body portion 110 comprises transition surfaces 116 at the two ends of the focus line 113, and the transition surfaces 116 are smoothly connected to the two sub-optical surfaces. As shown in Figs. 1 and 4, the function of the transition surface 116 is to form smooth transition at the two ends of the first optical surface 111 to avoid sharp-angled transition and protect the main body portion 110. The effect of the transition surface 116 on the light source may be negligible, or the light source may be arranged to be aligned with the focus line 113, so that the emitted light is mainly incident on the first optical surface 111.

[0050] Furthermore, as shown in Figs. 1 and 2, the primary lens 100 further comprises a fixed flanged edge 120 arranged around the edge of the main body portion 110, and through-holes are formed in the fixed flanged edge 120. The fixed flanged flange 120 may be used to assist in fixing the primary lens 100 to prevent the related fixed structure from contacting with the main body portion 110 and affecting the function of the main body portion 110.

[0051] The primary lens 100 may be made of any transparent and light-transmissive materials, such as glass, polycarbonate, polymethyl methacrylate, and the like. Preferably, the primary lens 100 is made of silicone. Silicone has high light transmittance and excellent heat resistance properties. If the distance between primary lens 100 and the light source is small, the temperature of the primary lens 100 is high. A silicone lens has superior heat deformation resistance property, and is not aged into yellow color easily.

[0052] In addition, the invention provides a light-emitting assembly, which comprises a light source portion, a primary lens and a secondary lens, wherein the light generated by the light source portion sequentially passes

through the primary lens and the secondary lens. The light generated by the light source portion may entry into the first optical surface 111, exit from the second optical surface 112, and then pass through the secondary lens, which may be a convex lens for converging the light. The focus line 113 may extend horizontally in the lateral direction, and the ridge 114 extends in the vertical direction. The light generated by the light source portion is converged toward the focus line 113 in the vertical direction when it is transmitted through the first optical surface 111, and is diffused in the lateral direction at the second optical surface 112, and then is converged through the secondary lens 2 that serves as a convex lens.

[0053] The present invention provides a light-emitting assembly, which comprises a light source portion 3, a primary lens 100 and a secondary lens 2 arranged sequentially in a first direction, wherein the light source portion 3 comprises a plurality of lamps arranged in a second direction, the primary lens 100 comprises a first optical surface 111 that faces the light source portion 3 and a second optical surface 112 that faces the secondary lens 2, a linear focus line 113 extending in the second direction is formed on the first optical surface 111, and the height of the first optical surface 111 is gradually reduced from the focus line 113 to the two sides; the second optical surface 112 comprises a plurality of ridges 114 arranged in a third direction, and the ridges 114 have arc-shaped convex faces; the secondary lens 2 is a convex lens, and the third direction, the first direction, and the second direction are perpendicular to each other.

[0054] In the light-emitting assembly provided in the present invention, the primary lens 100 may be the primary lens 100 described in the above scheme.

[0055] The first direction, the second direction and the third direction may be regarded as the directions of three axes of a three-dimensional rectangular coordinate system, and the light-emitting assembly may be placed and used as follows: For example, when applied to the headlight of a vehicle, the first direction is the longitudinal direction, i.e., the front-rear direction of the vehicle, the second direction is the transverse direction, i.e., the left-right direction of the vehicle, and the third direction is the vertical direction. The light emitted from each of the lamps of the light source portion 3 sequentially passes through the primary lens 100 and the secondary lens 2, wherein, as shown in Fig. 4, the first optical surface 111 of the primary lens 100 is shaped to be higher at the center (at the focus line 113) and lower at the two sides, and can converge the incident light in the third direction; as shown in Figs. 3 and 5, the second optical surface 112 comprises a plurality of arc-shaped convex surfaces extending in the third direction, and can diffuse the emergent light in the second direction. The emergent light from the second optical surface 112 is converged when it passes through the secondary lens 2 that is a convex lens. Particularly, the plurality of lamps on the light source portion 3 are arranged in the second direction, and have different incident angles in the second direction. Therefore, light

beams emitted through the secondary lens 2 are at different angles, and the light spots formed by the light beams on the surface are aligned in the second direction. The light-emitting assembly may be applied to a headlight, wherein the second direction is a transverse direction, the third direction is a vertical direction, the irradiation range of the headlight is expanded in the transverse direction, and converged in the vertical direction, which is in line with the illumination characteristics of the headlight. The plurality of lamps on the light source portion 3 may be arranged closely or spaced apart evenly in the second direction, and the plurality of lamps may be selectively turned on and off. For example, a light beam irradiated on pedestrians or vehicles in front of the vehicle may be selectively turned off to avoid glare to the pedestrians or vehicles.

[0056] The secondary lens 2 is a convex lens, i.e., a lens that is thicker at the center and thinner at the edge, for example, a lens with convex spherical surfaces on both sides, which has a light convergence function. Specifically, as shown in Figs. 6, 7, and 8, the incident surface of the secondary lens 2 is a planar surface, and the emergent surface of the secondary lens 2 is a spherical surface. The incident surface is formed as a planar surface.

As described below, the light beams formed by lamps at different positions form included angles with each other. For different lamps arranged in the second direction, the included angles between the light beams with respect to the incident surface don't vary owing to the secondary lens 2.

[0057] Specifically, the light source portion 3 comprises a circuit board 32, and the lamps are LED particles 31 and arranged on the circuit board 32. As shown in Fig. 9, the LED particles 31 may be disposed on the circuit board 32 intermittently or continuously in the second direction (e.g., may be a lateral direction), the plurality of LED particles 31 may be aligned to the focus line 113 of the primary lens 100, and each LED particle 31 may be selectively turned on and off by a control circuit. The light beams formed by the LED particles 31 through the primary lens 100 and the secondary lens 2 may form a plurality of light spots arranged in the second direction in a plane to form an irradiation surface in the second direction, and one or more of the LED particles 31 may be selectively turned off, so that some irradiation positions can be avoided, such as the positions where pedestrians or vehicles are located (when the LED particles are applied to a headlight), and thereby glare resulted from irradiation of strong light on the pedestrians or vehicles can be avoided.

[0058] In addition, the light source portion 3 comprises n lamps, the included angle of a light beam formed by any two adjacent lamps through the primary lens 100 and the secondary lens 2 is 2-3 degrees, and the angle of a light beam formed by n lamps is 2n-3n degrees. The included angles between the light beams formed by the LED particles 31 and the first direction are different from each other, and the plurality of light beams emitted from

the plurality of LED particles 31 form an irradiation range similar to a sector, the included angle between the light beams emitted from every two adjacent LED particles 31 is 2-3 degrees, and the angle of the irradiation range of the entire sector is $2n-3n$ degrees.

[0059] Specifically, the arc-shaped convex faces are identical, and the ridges 114 are spaced apart evenly. The plurality of ridge 114 have consistent optical performance. In addition, since the second optical surface 112 is provided with the plurality of ridge 114, the radius of the arc-shaped convex surface is so smaller with respect to the dimension of the second optical surface 112 in the horizontal direction that the diffused light formed by the second optical surface 112 in the lateral direction is uniform.

[0060] Furthermore, adjacent ridges 114 smoothly transit via an arc-shaped concave face 115. The ridge 114 itself is formed with an arc-shaped convex surface, and every two adjacent arc-shaped convex surfaces may be connected via an arc-shaped concave surface 115 so as to realize smooth transition. That is say, the tangent line of the arc-shaped convex surface and the tangent line of the arc-shaped concave surface are coincident at the connection point. The central axis of the arc-shaped concave surface 115 may be parallel to the central axis of the arc-shaped convex surface. Particularly, the diameter of the arc-shaped concave surface 115 is much smaller than the diameter of the arc-shaped convex surface, i.e., the main body portion of the second optical surface 112 is an arc-shaped convex surface, and achieves diffusion of the light in the horizontal direction; the arc-shaped concave surface 115 is only designed to connect two arc-shaped convex surfaces smoothly, the area ratio of the arc-shaped concave surface 115 is negligible, and the optical effect of it is also negligible.

[0061] In addition, a sub-optical surface is formed respectively at each side of the focus line 113 and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line 113. The arc-shaped surface may be regarded as a part of the circumferential surface of a cylinder with a central axis parallel to the focal line 113, i.e., a cylindrical arc-shaped surface (similar to the arc-shaped convex surface of the ridge 114), and the first optical surface 111 is formed as an incident surface with a convex central portion (the focus line 113 is convex), so that incident light beam can be converged in the vertical direction.

[0062] Furthermore, the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line 113 to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly. The radius of the arc-shaped surface close to the focus line 113 is smaller, while the radius of the arc-shaped surface away from the focus line 113 is greater. Thus, adjacent arc-shaped surfaces can be smoothly connected, i.e., the tangent lines of adjacent arc-shaped surfaces coincide with each other at the con-

nection point. At the focus line 113, the two arc-shaped surfaces of the two sub-optical surfaces are connected to each other, and the focus line 113 is at the highest position.

[0063] In addition, each of the light-emitting assemblies comprises a housing 4 having a light passage, the primary lens 100 is arranged at an entry end of the housing 4, and the secondary lens 2 is arranged at an exit end of the housing 4. As shown in Figs. 6, 7 and 8, the housing 4 is generally formed into a tubular shape. Of course, the cross section of the housing 4 may be quadrangular, circular, triangular, etc., and is preferably quadrangular to accommodate the shape of the primary lens 100. Accordingly, the secondary lens 2 may also have a generally quadrangular shape.

[0064] In addition, the light-emitting assembly comprises a heat dissipation portion 5 engaged with the light source portion 3, the heat dissipation portion 5 comprises a main plate portion 51 attached to the light source portion 3 and heat dissipation fins 52 provided on the main plate portion 51, and the main plate portion 51 sealingly blocks the entry end of the housing 4. The lamps of the light source portion 3 generate great heat when they emit light. For example, LED particles generate heat when they emit light. The heat is transferred to the circuit board. Therefore, a heat dissipation portion 5 attached to the circuit board may be provided, with a main plate portion 51 attached to the circuit board for blocking the entry end of the housing 4, so that the interior of the housing 4 is hermetically sealed and isolated from the exterior. A boss may be provided on the surface of the main plate portion 51 attached to the light source portion 3. The primary lens 100 is mounted on the boss via a mounting structure to keep clearance from the light source portion 3. The primary lens 100 is located inside the housing 4 and isolated from the exterior to prevent the primary lens 100 from corroded and damaged.

[0065] The present invention provides a light-emitting system, which comprises a plurality of light-emitting assemblies, each of which comprises a light source portion 3, a primary lens 100 and a secondary lens 2 sequentially arranged in a first direction, wherein the light source portion 3 comprises a plurality of lamps spaced apart in a second direction; the plurality of light-emitting assemblies are arranged in a third direction, and can rotate with respect to each other around an axis in the third direction; the first direction, the second direction, and the third direction are perpendicular to each other; the primary lens 100 comprises a first optical surface 111 that faces the light source portion 3 and a second optical surface 112 that faces the secondary lens 2, a linear focus line 113 extending in the second direction is formed on the first optical surface 111, the height of the first optical surface 111 is gradually reduced from the focus line 113 to the two sides, the second optical surface 112 comprises a plurality of ridges 114 extending in the third direction and having arc-shaped convex surfaces, and the secondary lens 2 is a convex lens.

[0066] In the light-emitting system provided in the present invention, the light-emitting assembly may be the light-emitting assembly described in the above scheme.

[0067] The first direction, the second direction and the third direction may be regarded as the directions of three axes of a three-dimensional rectangular coordinate system, and the light-emitting assembly may be placed and used as follows: For example, when applied to the headlight of a vehicle, the third direction is the vertical direction, the first direction is the longitudinal direction, i.e., the front-rear direction of the vehicle, and the second direction is the transverse direction, i.e., the left-right direction of the vehicle. It should be noted that the first direction and the second direction are defined for a single light-emitting assembly. Since the light-emitting assemblies can rotate around an axis in the third direction, there are included angles between the first directions of the light-emitting assemblies and included angles between the second directions of the light-emitting assemblies. However, the included angles are relatively small. After the light-emitting system is installed in a vehicle, it may be deemed that the first directions of the light-emitting assemblies are the same direction, i.e., the front-rear direction of the vehicle, and the second directions of the light-emitting assemblies are also the same direction, i.e., the left-right direction of the vehicle.

[0068] In each light-emitting assembly, the light emitted from each of the lamps of the light source portion 3 sequentially passes through the primary lens 100 and the secondary lens 2, wherein, as shown in Fig. 4, the first optical surface 111 of the primary lens 100 is shaped to be higher at the center (at the focus line 113) and lower at the two sides, and can converge the incident light in the third direction; as shown in Figs. 3 and 5, the second optical surface 112 comprises a plurality of arc-shaped convex surfaces extending in the third direction, and can diffuse the emergent light in the second direction. The emergent light from the second optical surface 112 is converged when it passes through the secondary lens 2 that is a convex lens. Particularly, the plurality of lamps on the light source portion 3 are arranged in the second direction, and have different incident angles in the second direction. Therefore, light beams emitted through the secondary lens 2 are at different angles, and the light spots formed by the light beams on the surface are arranged in the second direction. The light-emitting assembly may be applied to a headlight, wherein the second direction is a transverse direction, the third direction is a vertical direction, the irradiation range of the headlight is expanded in the transverse direction, and converged in the vertical direction, which is in line with the illumination characteristics of the headlight.

[0069] Particularly, in each light-emitting assembly, the lamps are arranged at an interval, in view that the lamps generate heat when they emit light. By arranging the lamps at an interval, the heat dissipation effect can be improved, and damage to the light source portion 3 resulted from high temperature can be avoided. Accord-

ingly, in the irradiation surface formed by each light-emitting assembly, there is a dark area between two adjacent light spots formed by two lamps. Therefore, in the scheme, a plurality of light-emitting assemblies capable of rotating around an axis in the vertical direction are arranged in the third direction (i.e., the vertical direction), wherein a plurality of groups of light spots formed by the plurality of light-emitting assemblies are crossed and staggered from each other, so that the dark area of each light-emitting assembly is filled by the light spots of other light-emitting assemblies, and thus the dark area can be eliminated. It should be noted that although the plurality of light-emitting assemblies are staggered in the third direction, the light spots formed by the light-emitting assemblies can be expanded in the third direction, so that the light spots formed by the plurality of light-emitting assemblies can cross each other.

[0070] In addition, each of the light-emitting assemblies comprises a housing 4 having a light passage, the primary lens 100 is arranged at an entry end of the housing 4, and the secondary lens 2 is arranged at an exit end of the housing 4. The primary lens 100 and the secondary lens 2 are supported by the housing 4, wherein, as shown in Figs. 8, 10, 11 and 12, the housing 4 is generally formed into a tubular shape. Of course, alternatively the cross section of the housing 4 may be quadrangular, circular, triangular, etc., and is preferably quadrangular to accommodate the shape of the primary lens 100. Accordingly, the secondary lens 2 may also have a generally quadrangular shape. Furthermore, the light-emitting system comprises two light-emitting assemblies, wherein one housing 4 is provided with a cylindrical boss extending in the third direction, the other housing 4 is provided with a circular hole for accommodating the cylindrical boss to be inserted, and the two housings 4 can rotate with respect to each other; wherein one housing 4 is provided with an angle scale dial 41, and the other housing 4 is provided with an angle pointer 42 corresponding to the angle scale dial 41; and wherein one housing 4 is provided with a mounting hole 43, the other housing 4 is provided with an arc-shaped hole 44 extending around the central axis of the cylindrical boss, and the two housings 4 are fixed by a connecting member penetrating through the mounting hole 43 and the arc-shaped hole 44. For the light source portion 3 of each light-emitting assembly, when the distance between two adjacent lamps is small, the distance between the two light spots formed by the two adjacent lamps is also small, especially smaller than the size of one light spot. Therefore, only two light-emitting assemblies are required to be complementary to each other to fill the dark area between the light spots. The housings 4 of two light-emitting assemblies can rotate around an axis in the third direction to adjust the relative angle between them, so that the light spots formed by the two light-emitting assemblies are staggered with each other and complement each other to fill the dark area between the light spots. In addition, as shown in Fig. 12, the two housings are further provided

with an angle display mechanism. The angle indicated by an angle pointer 42 on the angle scale dial 41 may be utilized directly by other optical systems, thus the operation of readjusting the relative angle of the two housings 4 can be omitted. In addition, when the two housings 4 rotate with respect to each other, the mounting holes 43 are aligned with different positions of the arc-shaped holes 44, and the two housings 4 may be fixed with respect to each other by means of connecting members, such as bolts, nuts, etc.

[0071] In addition, the light-emitting assembly comprises a heat dissipation portion 5 engaged with the light source portion 3, the heat dissipation portion 5 comprises a main plate portion 51 attached to the light source portion 3 and heat dissipation fins 52 provided on the main plate portion 51, and the main plate portion 51 sealingly blocks the entry end of the housing 4. The lamps of the light source unit 3 generate great heat when they emit light. For example, LED particles generate heat when they emit light. The heat is transferred to the circuit board. Therefore, a heat dissipation unit 5 attached to the circuit board may be provided. In addition, in the scheme, a light source is provided by means of a plurality of light source portions 3 of a plurality of light-emitting assemblies, and a plurality of lamps are distributed on (the circuit board of) different light source portions 3, thereby the problem of excessively concentrated heat generation by lamps arranged closely can be avoided. A main plate portion 51 is attached to the circuit board, and configured to block the entry end of the housing 4, so that the interior of the housing 4 is sealed and isolated from the exterior. A boss may be provided on the surface of the main body plate 51 attached to the light source portion 3. The primary lens 100 is mounted on the boss via a mounting structure to keep clearance from the light source portion 3. The primary lens 100 is located inside the housing 4 and isolated from the exterior to prevent the primary lens 100 from being corroded and damaged.

[0072] The secondary lens 2 is a convex lens, i.e., a lens that is thicker at the center and thinner at the edge, for example, a lens with convex spherical surfaces on both sides, which has a light convergence function. Specifically, the incident face of the secondary lens 2 is a planar face, and the emergent face of the secondary lens 2 is a spherical face. The incident surface is formed as a planar surface. As described below, the light beams formed by lamps at different positions form included angles with each other. For different lamps arranged in the first direction, the included angles between the light beams with respect to the incident surface don't vary owing to the secondary lens 2. Specifically, the radii of the arc-shaped convex surfaces are identical, the ridges 114 are spaced apart evenly, and adjacent ridges 114 smoothly transit via an arc-shaped concave surface 115. The plurality of ridges 114 have consistent optical performance. In addition, since the second optical surface 112 is provided with the plurality of ridge 114, the radius of the arc-shaped convex surface is smaller than the di-

mension of the second optical surface 112 in the horizontal direction, so that the diffused light formed by the second optical surface 112 in the lateral direction is uniform. The ridge 114 itself is formed with an arc-shaped convex surface, and every two adjacent arc-shaped convex surfaces may be connected via an arc-shaped concave surface 115 so as to realize smooth transition. That is say, the tangent line of the arc-shaped convex surface and the tangent line of the arc-shaped concave surface are coincident at the connection point. The central axis of the arc-shaped concave surface 115 may be parallel to the central axis of the arc-shaped convex surface. Particularly, the diameter of the arc-shaped concave surface 115 is much smaller than the diameter of the arc-shaped convex surface, i.e., the main body portion of the second optical surface 112 is an arc-shaped convex surface, and achieves diffusion of the light in the horizontal direction; the arc-shaped concave surface 115 is only designed to connect two arc-shaped convex surfaces smoothly, the area ratio of the arc-shaped concave surface 115 is negligible, and the optical effect of it is also negligible.

[0073] In addition, a sub-optical surface is formed respectively at each side of the focus line 113 and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line 113. The arc-shaped surface may be regarded as a part of the circumferential surface of a cylinder with a central axis parallel to the focal line 113, i.e., a cylindrical arc-shaped surface (similar to the arc-shaped convex surface of the ridge 114), and the first optical surface 111 is formed as an incident surface with a convex central portion (the focus line 113 is convex), so that incident light beam can be converged in the vertical direction.

[0074] Furthermore, the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line 113 to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly. The radius of the arc-shaped surface close to the focus line 113 is smaller, while the radius of the arc-shaped surface away from the focus line 113 is greater. Thus, adjacent arc-shaped surfaces can be smoothly connected, i.e., the tangent lines of adjacent arc-shaped surfaces coincide with each other at the connection point. At the focus line 113, the two arc-shaped surfaces of the two sub-optical surfaces are connected to each other, and the focus line 113 is at the highest position.

[0075] Specifically, as shown in Fig. 9, the light source portion 3 comprises a circuit board 32 and n lamps, the lamps are LED particles 31, the included angle of a light beam formed by any two adjacent lamps through the primary lens 100 and the secondary lens 2 is 2-3 degrees, and the angle of a light beam formed by n lamps is 2n-3n degrees. The included angles between the light beams formed by the LED particles 31 and the third direction are different from each other, and the plurality of light beams emitted from the plurality of LED particles 31

form an irradiation range similar to a sector, the included angle between the light beams emitted from every two adjacent LED particles 31 is 2-3 degrees, and the angle of the irradiation range of the entire sector is $2n-3n$ degrees.

[0076] In another aspect, the present invention provides a headlight, which is provided with the light-emitting system described in the above scheme. When the light-emitting system is installed in a vehicle, the third direction is the vertical direction, the first direction is the front-rear direction of the vehicle, and the second direction is the left-right direction of the vehicle, and the angles between the light-emitting assemblies are fixed. In addition, the headlight may be provided with other control devices to cooperate with the light-emitting system. For example, a light sensor may be provided to sense the light reflected by obstacles (e.g., pedestrians, vehicles, etc.) in front of the vehicle and judge the positions of the obstacles, so that the lamps corresponding to the obstacles can be turned off and glare resulted from light irradiation on the pedestrians and vehicles can be avoided.

[0077] While the present invention is described above in some preferred embodiments, the present invention is not limited to those preferred embodiments. Any modification, equivalent replacement, and improvement made without departing from the spirit and principle of the present invention shall be deemed as falling into the scope of protection of the present invention.

Claims

1. A primary lens (100), comprising a main body portion (110), which comprises a first optical surface (111) and a second optical surface (112), wherein a linear focus line (113) is formed on the first optical surface (111), and the height of the first optical surface (111) is gradually reduced from the focus line (113) towards two sides; and the second optical surface (112) comprises a plurality of ridges (114) arranged in parallel and extending in a direction perpendicular to the focus line (113), and the ridges (114) have arc-shaped convex faces.
2. The primary lens according to claim 1, wherein adjacent ridges (114) smoothly transit via an arc-shaped concave face (115).
3. The primary lens according to claim 2, wherein the arc-shaped convex faces of the ridges (114) are identical, and the ridges (114) are spaced apart evenly.
4. The primary lens according to claim 1, wherein a sub-optical surface is formed respectively at each side of the focus line (113) and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the

focus line (113).

5. The primary lens according to claim 4, wherein the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line (113) to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly.
6. The primary lens according to claim 4, wherein the two sub-optical surfaces are symmetric with respect to the focus line (113).
7. The primary lens according to claim 4, wherein the main body portion (110) comprises transition surfaces (116) at the two ends of the focus line (113), and the transition surfaces (116) are smoothly connected to the two sub-optical surfaces.
8. The primary lens (100) according to claim 1, further comprising a fixed flanged edge (120) arranged around the edge of the main body portion (110), with through-holes formed in the fixed flanged edge (120).
9. The primary lens (100) according to any of claims 1-8, made of silicone.
10. A light-emitting assembly, comprising a light source portion (3), a primary lens (100) and a secondary lens (2) arranged sequentially in a first direction, wherein the light source portion (3) comprises a plurality of lamps arranged in a second direction, the primary lens (100) comprises a first optical surface (111) that faces the light source portion (3) and a second optical surface (112) that faces the secondary lens (2), a linear focus line (113) extending in the second direction is formed on the first optical surface (111), and the height of the first optical surface (111) is gradually reduced from the focus line (113) to the two sides; the second optical surface (112) comprises a plurality of ridges (114) arranged in a third direction, and the ridges (114) have arc-shaped convex faces; the secondary lens (2) is a convex lens, and the third direction, the first direction, and the second direction are perpendicular to each other.
11. The light-emitting assembly according to claim 10, wherein the incident face of the secondary lens (2) is a planar face, and the emergent face of the secondary lens (2) is a spherical face.
12. The light-emitting assembly according to claim 10, wherein the light source portion (3) comprises a circuit board (32), and the lamps are LED particles (31) and arranged on the circuit board (32).
13. The light-emitting assembly according to claim 12,

- wherein the light source portion (3) comprises n lamps, the included angle of a light beam formed by any two adjacent lamps through the primary lens (100) and the secondary lens (2) is 2-3 degrees, and the angle of a light beam formed by n lamps is $2n-3n$ degrees.
14. The light-emitting assembly according to claim 10, wherein the radii of the arc-shaped convex faces are identical, and the ridges (114) are spaced apart evenly.
 15. The light-emitting assembly according to claim 14, wherein adjacent ridges smoothly transit via an arc-shaped concave face (115).
 16. The light-emitting assembly according to claim 10, wherein a sub-optical surface is formed respectively at each side of the focus line (113) and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line (113).
 17. The light-emitting assembly according to claim 16, wherein the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line (113) to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly.
 18. The light-emitting assembly according to any of claims 10-17, comprising a housing (4) having a light passage, the primary lens (100) is arranged at an entry end of the housing (4), and the secondary lens (2) is arranged at an exit end of the housing (4).
 19. The light-emitting assembly according to claim 18, comprising a heat dissipation portion (5) engaged with the light source portion (3), wherein the heat dissipation portion (5) comprises a main plate portion (51) attached to the light source portion (3) and heat dissipation fins (52) provided on the main plate portion (51), and the main plate portion (51) sealingly blocks the entry end of the housing (4).
 20. A light-emitting system, comprising a plurality of light-emitting assemblies, each of which comprises a light source portion (3), a primary lens (100) and a secondary lens (2) sequentially arranged in a first direction, wherein the light source portion (3) comprises a plurality of lamps spaced apart in a second direction; the plurality of light-emitting assemblies are arranged in a third direction, and can rotate with respect to each other around an axis in the third direction; the first direction, the second direction, and the third direction are perpendicular to each other; the primary lens (100) comprises a first optical surface (111) that faces the light source portion (3) and a second optical surface (112) that faces the secondary lens (2), a linear focus line (113) extending in the second direction is formed on the first optical surface (111), the height of the first optical surface (111) is gradually reduced from the focus line (113) to the two sides, the second optical surface (112) comprises a plurality of ridges (114) extending in the third direction and having arc-shaped convex surfaces, and the secondary lens (2) is a convex lens.
 21. The light-emitting system according to claim 20, wherein each of the light-emitting assemblies comprises a housing (4) having a light passage, the primary lens (100) is arranged at an entry end of the housing (4), and the secondary lens (2) is arranged at an exit end of the housing (4).
 22. The light-emitting system according to claim 21, comprising two light-emitting assemblies, wherein one housing (4) is provided with a cylindrical boss extending in the third direction, the other housing (4) is provided with a circular hole for accommodating the cylindrical boss to be inserted, and the two housings (4) can rotate with respect to each other, wherein one housing (4) is provided with an angle scale dial (41), and the other housing (4) is provided with an angle pointer (42) corresponding to the angle scale dial (41), wherein one housing (4) is provided with a mounting hole (43), the other housing (4) is provided with an arc-shaped hole (44) extending around the central axis of the cylindrical boss, and the two housings (4) are fixed by a connecting member penetrating through the mounting hole (43) and the arc-shaped hole (44).
 23. The light-emitting system according to claim 21, wherein the light-emitting assembly comprises a heat dissipation portion (5) engaged with the light source portion (3), the heat dissipation portion (5) comprises a main plate portion (51) attached to the light source portion (3) and heat dissipation fins (52) provided on the main plate portion (51), and the main plate portion (51) sealingly blocks the entry end of the housing (4).
 24. The light-emitting system according to claim 20, wherein the incident face of the secondary lens (2) is a planar face, and the emergent face of the secondary lens (2) is a spherical face.
 25. The light-emitting system according to claim 20, wherein the radii of the arc-shaped convex surfaces are identical, the ridges (114) are spaced apart evenly, and adjacent ridges (114) smoothly transit via an arc-shaped concave surface (115).

26. The light-emitting system according to claim 25, wherein a sub-optical surface is formed respectively at each side of the focus line (113) and comprises a plurality of convex arc-shaped surfaces, and the central axis of each of the arc-shaped surfaces is parallel to the focus line (113). 5
27. The light-emitting system according to claim 26, wherein the radii of the arc-shaped surfaces are increased sequentially in a direction from the focus line (113) to either side in each of the sub-optical surfaces, and the plurality of arc-shaped surfaces are sequentially connected smoothly. 10
28. The light-emitting system according to any of claims 20-27, wherein the light source portion (3) comprises a circuit board (32) and n lamps, the lamps are LED particles (31), the included angle of a light beam formed by any two adjacent lamps through the primary lens (100) and the secondary lens (2) is 2-3 degrees, and the angle of a light beam formed by n lamps is $2n-3n$ degrees. 15 20
29. A headlight provided with the light-emitting system according to any of claims 20 to 28. 25

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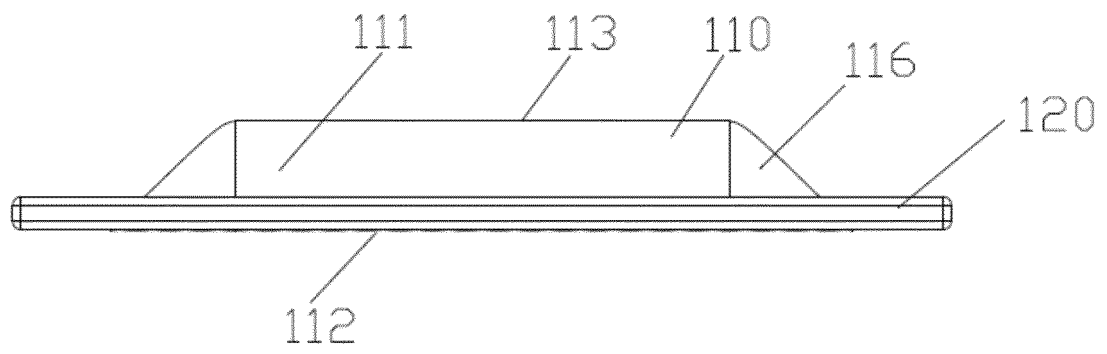


Fig. 1

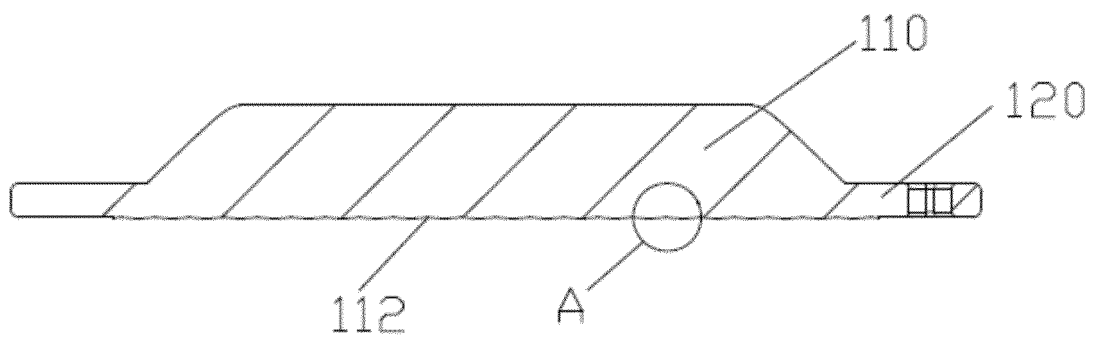


Fig. 2

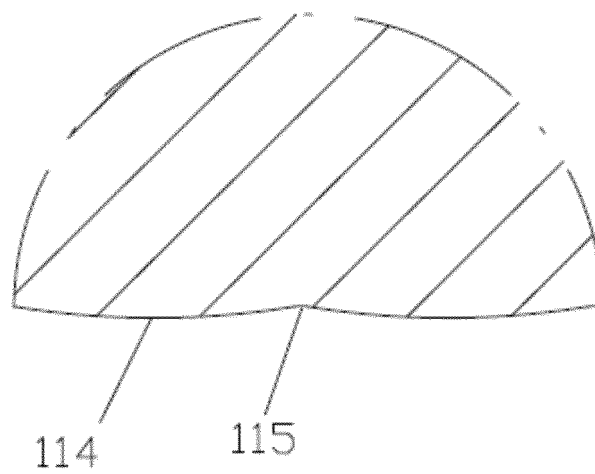


Fig. 3

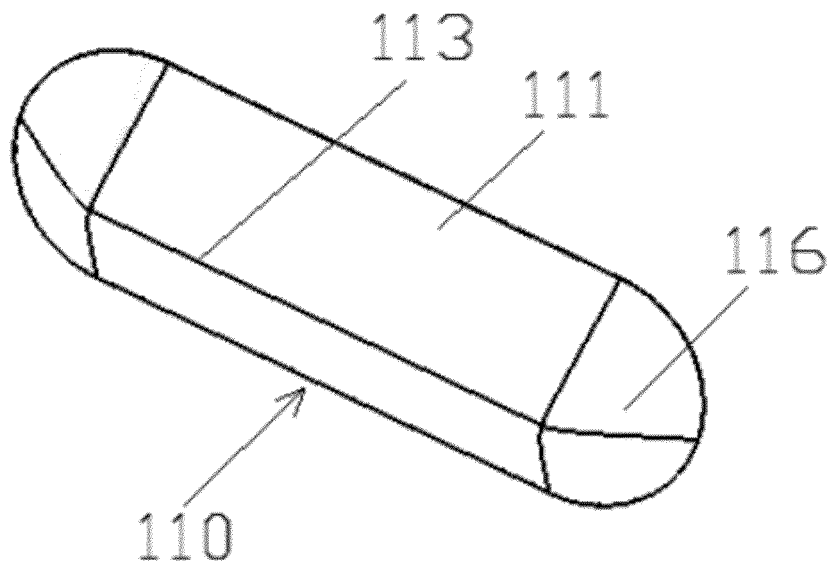


Fig. 4

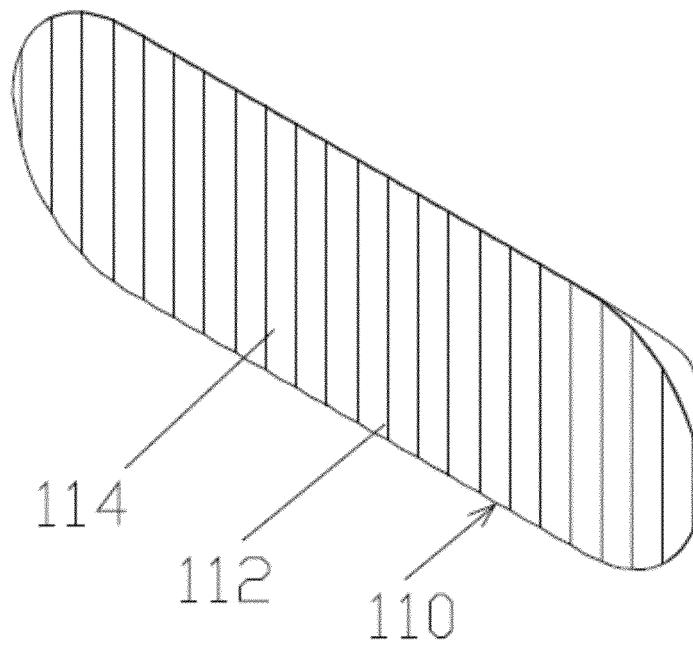


Fig. 5

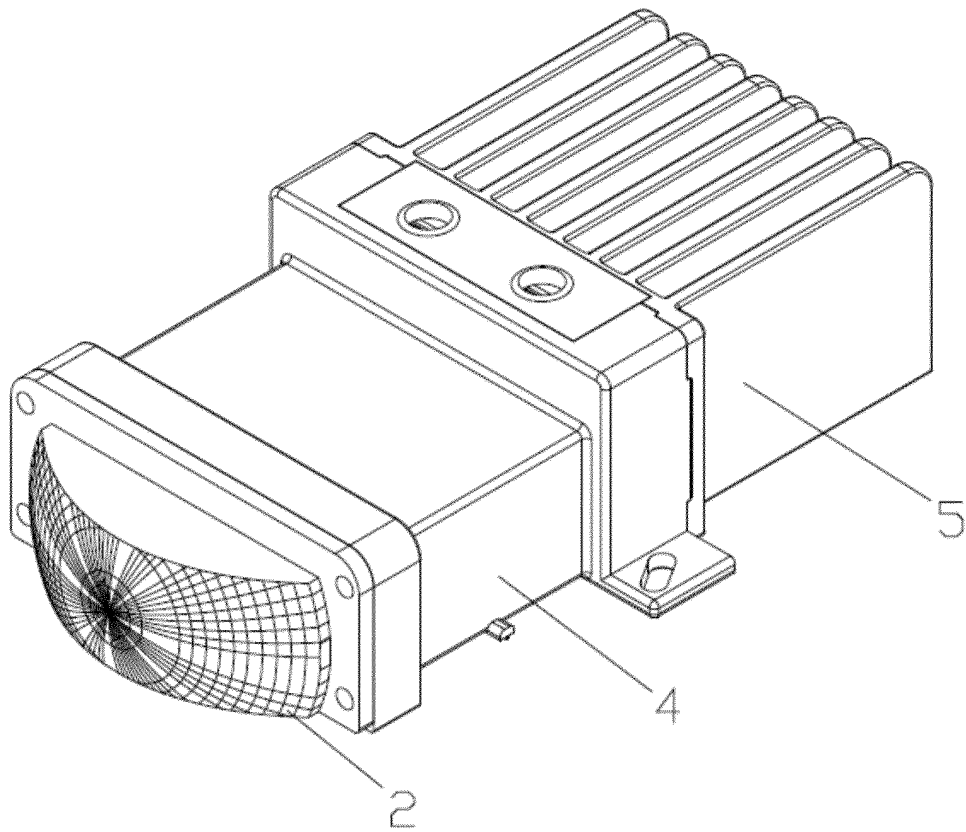


Fig. 6

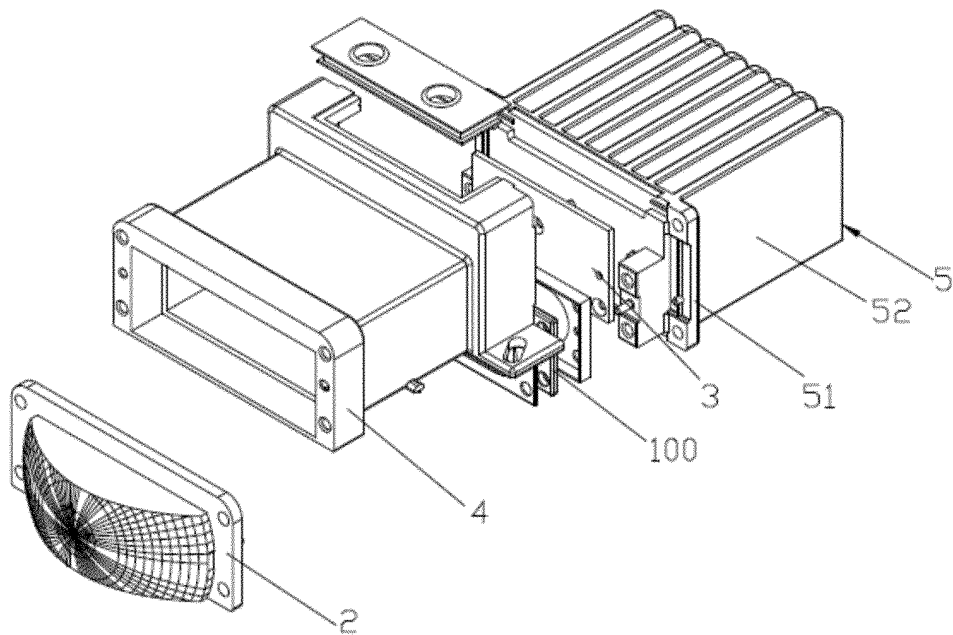


Fig. 7

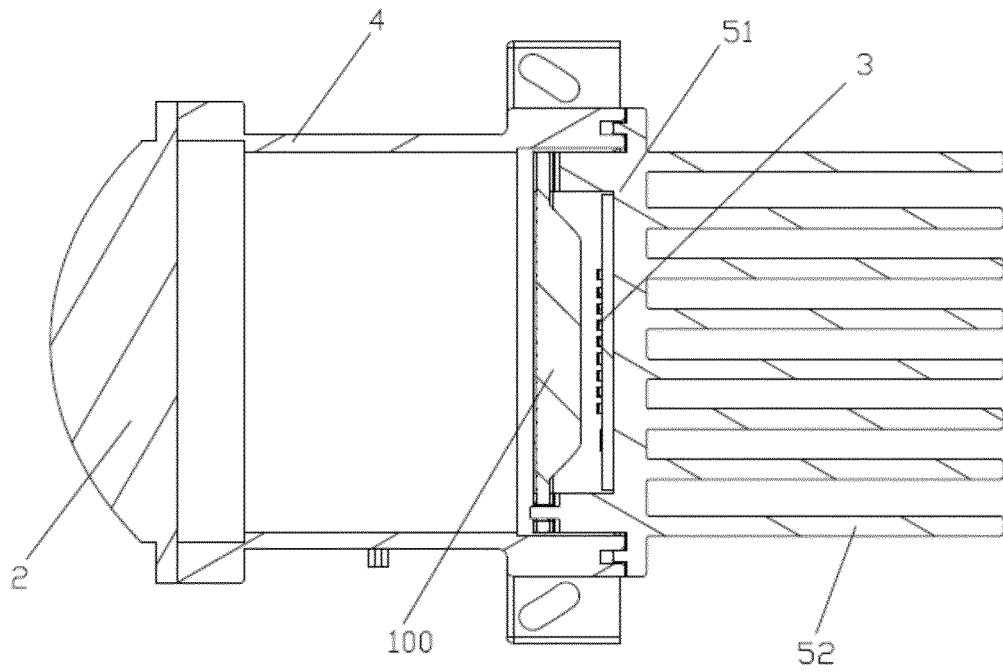


Fig. 8

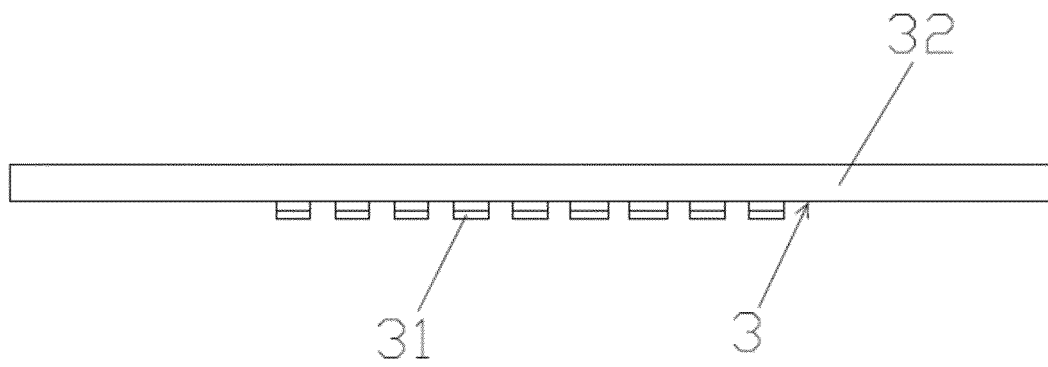


Fig. 9

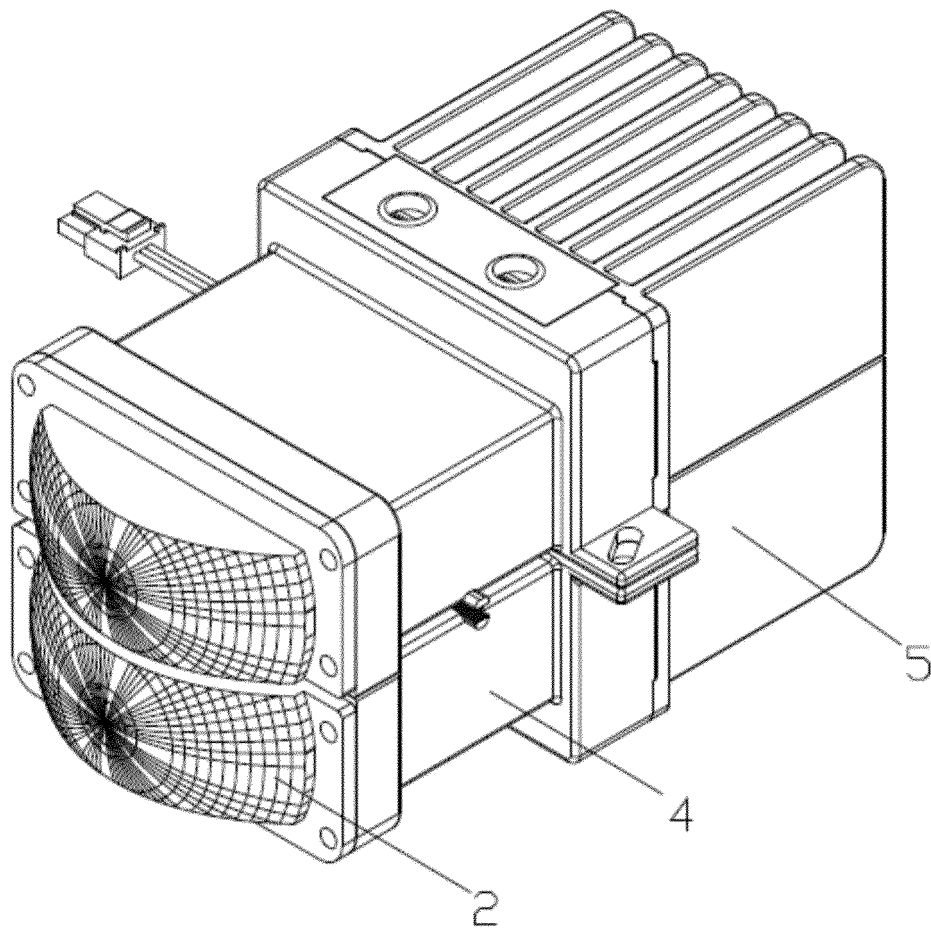


Fig. 10

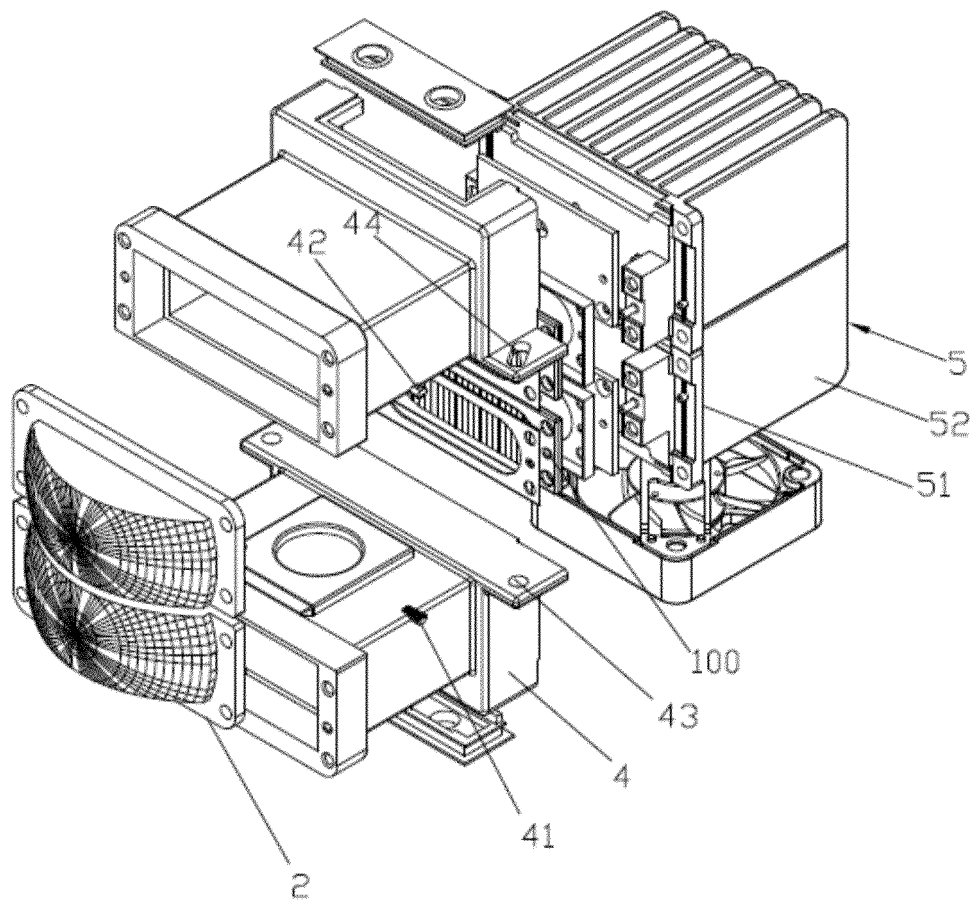


Fig. 11

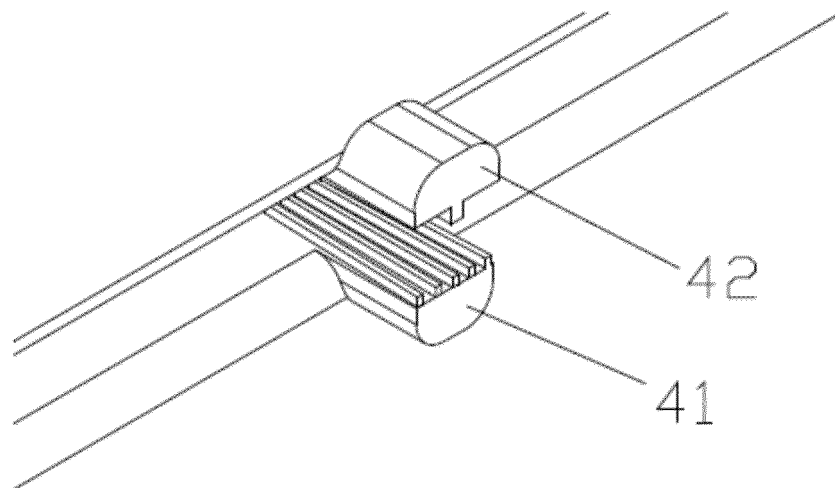


Fig. 12

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2018/109506

A. CLASSIFICATION OF SUBJECT MATTER

F21S 41/25(2018.01)i; F21S 41/141(2018.01)i; F21W 102/13(2018.01)i; F21W 107/10(2018.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F21S; F21V; F21W; F21Y

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI; EPODOC; CNPAT; CNKI: 车灯, 车辆, 照明, 灯, 透镜, 焦点, 凸棱, 棱, 垂直, 汇聚, 聚焦, 水平, 扩散, 散射; automotive, light+, vehicle, lamp, LED, lens, focos+, prism?, flange, rib, vertical, perpendicular, gather+, horizon+, diffus+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 207198431 U (GREAT WALL MOTOR COMPANY LIMITED) 06 April 2018 (2018-04-06) description, paragraphs [0031]-[0041], and figures 1-7	1-9
A	CN 203605147 U (DONGGUAN OUKE OPTOELECTRONICS TECHNOLOGY CO., LTD.) 21 May 2014 (2014-05-21) description, paragraphs [0020]-[0023], and figures 1-3	1-29
A	CN 203868944 U (LIU, WEIBIN) 08 October 2014 (2014-10-08) entire document	1-29
A	CN 101285561 A (KOITO MANUFACTURING CO., LTD.) 15 October 2008 (2008-10-15) entire document	1-29
A	CN 103968326 A (OSRAM GMBH.) 06 August 2014 (2014-08-06) entire document	1-29
A	WO 2017159189 A1 (HONDA MOTOR CO., LTD.) 21 September 2017 (2017-09-21) entire document	1-29

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

04 December 2018

Date of mailing of the international search report

29 December 2018

Name and mailing address of the ISA/CN

State Intellectual Property Office of the P. R. China (ISA/
CN)
No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing
100088
China

Authorized officer

Facsimile No. (86-10)62019451

Telephone No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.

PCT/CN2018/109506

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
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		EP 1980787 B1	26 November 2014
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		US 9671088 B2	06 June 2017
		EP 2951494 A1	09 December 2015
		US 2015362153 A1	17 December 2015
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