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(54) **LIGHTING MODULE, LIGHTING SYSTEM AND VEHICLE**

(57) The present application relates to vehicle lighting devices. Disclosed is a lighting module, comprising a light source, a first reflective element and a second reflective element, which are sequentially arranged; the second reflective element comprises a curved reflective component and a planar reflective component which are up-down and sequentially connected to each other, wherein the curved reflective component can receive a portion of light reflected by the first reflective element and reflect same to a light emission opening so as to form a first lighting pattern, and the planar reflective component can receive the other portion of the light reflected by the first reflective element and reflect same to the light emission opening so as to form a second lighting pattern, the first lighting pattern and the second lighting pattern being superimposed so as to form a lighting pattern. When the curved reflective component is located above the planar reflective component, the reflective surface of the first reflective element faces away from the light emission opening, and when the planar reflective component is located above the curved reflective component, the reflective surface of the first reflective element faces the light emission opening. The module can form a light pattern having high definition, and the size of the light emission opening is small. The present application further relates to a lighting system comprising the lighting module and a vehicle.

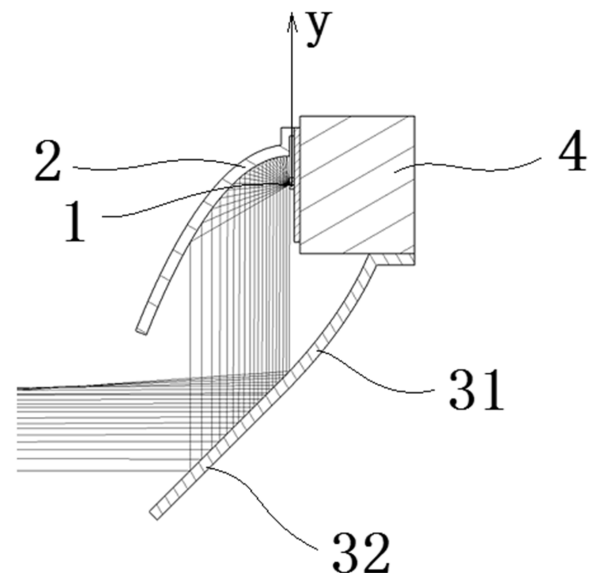


Fig. 3

Description

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims the benefits of Chinese Patent Application No. 202410001336.3 filed on Jan. 2, 2024, the content of which is incorporated herein by reference.

FIELD

[0002] The present application relates to a vehicle illumination device, in particular to a lighting module. In addition, the present disclosure further relates to a lighting system comprising the lighting module and a vehicle.

BACKGROUND

[0003] Presently, a reflective lighting system usually uses a plurality of sub-paraboloids for imaging an integrated light source with a plurality of light-emitting chips, so as to form sub-illumination light patterns, and the sub-illumination light patterns are superposed to form an illumination light pattern. An existing reflective lighting system collimates the divergent light emitted by a light source arranged at a focal point via a parabolic reflecting surface to form almost parallel illumination light rays. Owing to the use of an integrated light source with a plurality of light-emitting chips, which has a large light-emitting surface, it is necessary to image the light source with a paraboloid having a great focal length; otherwise, the imaged light pattern may have severe distortion. Consequently, in the production of a vehicle lamp, the size of the light emergent opening is increased accordingly, and the structural frame of the vehicle lamp is increased accordingly, resulting in an increased production cost. An existing reflective optical system images the same light source with a plurality of quasi-paraboloids, but steps or rounded corners may be produced between the plurality of quasi-paraboloids, resulting in stray light and light loss.

[0004] In view of the above-mentioned problems, it is desired to design a novel lighting module.

SUMMARY

[0005] A first object of the present application is to provide a lighting module, which can avoid the generation of stray light while ensuring the clarity of the light pattern formed by it, and has a light emergent opening that is reduced in size.

[0006] A second purpose of the present application is to provide a lighting system, in which the lighting module can avoid the generation of stray light while ensuring the imaging clarity of the light pattern, and the size of the light emergent opening of the lighting module is further reduced.

[0007] A third object of the present application is to

provide a vehicle, on which the lighting system has a light emergent opening that is further reduced in size while ensuring the imaging clarity of the light pattern.

[0008] In order to solve the above technical problems, in a first aspect, the present application provides an lighting module, which comprises: a light source, and at least one first reflective element and at least one second reflective element that are sequentially arranged in a light propagation direction, wherein the first reflective element is configured to receive light emitted by the light source and reflect the light to the second reflective element, and the second reflective element comprises a curved reflective component and a planar reflective component that are sequentially connected in the up-down direction, the curved reflective component is configured to receive one part of the light reflected by the first reflective element and reflect the part of the light to the light emergent opening to form a first lighting pattern, and the planar reflective component is configured to receive the other part of the light reflected by the first reflective element and reflect the part of the light to the light emergent opening to form a second lighting pattern; the first lighting pattern and the second lighting pattern can be superposed to form a lighting pattern, wherein when the curved reflective component is located above the planar reflective component, the reflecting surface of the first reflective element faces away from the light emergent opening; and when the planar reflective component is located above the curved reflective component, the reflecting surface of the first reflective element faces toward the light emergent opening.

[0009] Furthermore, when the curved reflective component is located above the planar reflective component, a focal point of the curved reflective component is located on the reflecting surface of the first reflective element.

[0010] Furthermore, the curved reflective component receives and reflects the light emitted by the light source from a plane where the light-emitting surface of the light source is located to an area within a range of rotation of the light-emitting surface by 10 to 90 degrees in a counterclockwise direction.

[0011] Furthermore, when the planar reflective component is located above the curved reflective component, an end of the first reflective element is connected to an end of the second reflective element to form an integrated structural part, and both the reflecting surface of the first reflective element and the reflecting surface of the second reflective element face toward the light emergent opening.

[0012] Furthermore, the curved reflective component receives and reflects the light emitted by the light source from a plane where the light-emitting surface of the light source is located to an area within a range of rotation of the light-emitting surface by 10 to 90 degrees in a clockwise direction.

[0013] Furthermore, the reflecting surface of the curved reflective component is a curved surface formed by a parabola stretched in a single direction; or, the

reflecting surface of the curved reflective component is a quasi-curved surface formed by a plurality of connected broken lines stretched in a single direction; or, the curved reflective component and the planar reflective component are connected via a stepped surface.

[0014] Furthermore, the reflecting surface of the planar reflective component is a planar reflecting structure formed by a plurality of parallel and non-coplanar planar reflecting surfaces connected sequentially.

[0015] Furthermore, the reflecting surface of the first reflective element is a paraboloid, a quasi-paraboloid, an ellipsoid or a quasi-ellipsoid.

[0016] Furthermore, the focal length of the first reflective element is smaller than 10 mm, preferably is 2-5 mm.

[0017] Furthermore, the plurality of first reflective elements are sequentially connected in the horizontal direction, and the first reflective elements are arranged in one-to-one correspondence with the light sources.

[0018] Furthermore, an included angle is formed between the optical axes of two adjacent first reflective elements, the opening of the included angle faces toward the light source, and the included angle is not greater than 30 degrees.

[0019] Furthermore, the plane where the light-emitting surface of the light source is at an included angle equal to or smaller than 30 degrees with respect to a light emergent direction of the first reflective element.

[0020] In a second aspect, the present application further discloses an lighting system, which comprises the lighting module described in any of the above technical schemes and a circuit board, and the light source is installed on the circuit board.

[0021] Furthermore, the lighting system further comprises a heat sink, and the circuit board is connected to the heat sink.

[0022] In a third aspect, the present application further discloses a vehicle, which comprises the lighting system described in any of the above technical schemes.

[0023] With the above technical scheme, the present application has the following beneficial effects:

The present application provides an lighting module, which comprises a light source, at least one first reflective element and at least one second reflective element that are sequentially arranged in a light propagation direction, the first reflective element is configured to receive the light emitted by the light source and reflect the light to the second reflective element, and the second reflective element comprises a curved reflective component and a planar reflective component that are sequentially connected in the up-down direction, the curved reflective component is configured to receive one part of the light reflected by the first reflective element, and reflect this part of light to a light emergent opening to form a first lighting pattern, and the planar reflective component is configured to receive the other part of the light reflected by the first reflective element and reflect this part of light to the light emergent opening to form a second lighting pattern, and the first lighting pattern and the second

lighting pattern can be superposed to form a lighting pattern, wherein when the curved reflective component is located above the planar reflective component, the reflecting surface of the first reflective element faces away from the the light emergent opening; when the planar reflective component is located above the curved reflective component, the reflecting surface of the first reflective element faces toward the light emergent opening; one or more illumination light patterns can be combined to form a low beam light pattern or a high beam light pattern. The first reflective element and the second reflective element cooperate with each other so that the light is reflected twice, thereby the loss of the light from the light source can be avoided, and the imaged light pattern is clearer. In addition, by virtue of the cooperation between the first reflective element and the second reflective element, the size of the light emergent opening can be further reduced.

[0024] Other features and advantages of the present application will be further detailed below in embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] The accompanying drawings are provided herein to facilitate further understanding on the present application, and constitute a part of the specification. They are used in conjunction with the following embodiments to explain the present application, but shall not be comprehended as constituting any limitation on the present application. In the figures:

Fig. 1 is a first schematic structural diagram of an embodiment of the lighting module in the present application;

Fig. 2 is a second schematic structural diagram of the embodiment of the lighting module in the present application;

Fig. 3 is a schematic diagram of the light path of the embodiment of the lighting module in the present application;

Fig. 4 is a schematic diagram of an example of focal point arrangement for the curved reflective component in Fig. 3;

Fig. 5 is a schematic structural diagram of an embodiment of the connection between the curved reflective component and the planar reflective component in the lighting module in the present application;

Fig. 6 is a screen illumination diagram of a second lighting pattern corresponding to the planar reflective component in the lighting module in the present application;

Fig. 7 is a screen illumination diagram of a first

lighting pattern corresponding to the curved reflective component in the lighting module in the present application;

Fig. 8 is a screen illumination diagram of an illumination light pattern formed by superposing the first lighting pattern and the second lighting pattern;

Fig. 9 is a first schematic structural diagram of the arrangement of a plurality of first reflective elements in the lighting module in the present application;

Fig. 10 is a second schematic structural diagram of the arrangement of a plurality of first reflective elements in the lighting module in the present application;

Fig. 11 is a schematic diagram of a complete high beam light pattern formed in an embodiment of the lighting module in the present application;

Fig. 12 is a schematic structural diagram of another embodiment of the lighting module in the present application;

Fig. 13 is a schematic diagram of the light path in another embodiment of the lighting module in the present application;

Fig. 14 is a schematic structural diagram of a third embodiment of the lighting module in the present application; and

Fig. 15 is a schematic structural diagram of an embodiment of light source arrangement in the lighting module in the present application.

Reference Numerals

[0026] 1 - light source; 2 - first reflective element; 3 - second reflective element; 31 - curved reflective component; 32 - planar reflective component; 4 - heat sink.

DETAILED DESCRIPTION

[0027] Some embodiments of the present application will be described in detail below with reference to the accompanying drawings. However, it may be understood that the embodiments described herein are only intended to explain and interpret the present application, and the scope of protection of the present application is not limited to those embodiments.

[0028] Furthermore, in the present application, it may be noted that the terms "arrange", "provide", "install", "configure" and "connect" shall be interpreted in their general meanings, for example, a connection may be may be a direct connection or an indirect connection via an intermediate medium, may be a fixed connection, a

detachable connection, or an integral connection, and may be internal communication between two elements or interaction between two elements, unless otherwise specified and defined explicitly. Those having ordinary skills in the prior art can understand the specific meanings of the terms in the present application in their contexts.

[0029] In addition, the terms "first" and "second", etc. are only used for a descriptive purpose, and can't be understood as indicating or implying relative importance or implicitly indicating the number of indicated technical features. Therefore, features defined with "first" and "second" may explicitly or implicitly include one or more of the features.

[0030] In the present application, unless otherwise stated, orientational words such as "upper" and "lower" are defined in terms of the upper part and lower part of the corresponding component, and "face toward" and "opposite to" are defined in terms of the direction in which the reflective element is used; besides, "in the light propagation direction" is defined in terms of the direction of arrangement of the light source 1 provided in the present application, and can be understood as the propagation direction of the light that is emitted from the light source 1, passes through the elements, and then emerges through the light emergent opening. Specifically, orientational or positional relations used in the drawings provided in the present application are based on the orientational or positional relations in the drawings and used only to ease and simplify the description of the present application, rather than indicating or implying that the involved device or component may be in a specific orientation or may be constructed and operated in a specific orientation. Therefore, the use of these terms shall not be deemed as constituting any limitation on the present application; the orientational terms in the present application may be comprehended in connection with the actual installation state.

[0031] As shown in Figs. 1 to 3, in a first aspect, the present application provides an lighting module, which comprises a light source 1, and at least one first reflective element 2 and at least one second reflective element 3 that are sequentially arranged in a light propagation direction. The first reflective element 2 is configured to receive the light emitted from the light source 1 and reflect the light to the second reflective element 3, and the second reflective element 3 receives the light reflected by the first reflective element 2 and further reflects the light toward a light emergent opening to achieve light pattern imaging, wherein the second reflective element 3 comprises a curved reflective component 31 and a planar reflective component 32 that are sequentially connected in the up-down direction, and the curved reflective component 31 is configured to receive one part of the light reflected by the first reflective element 2 and reflect this part of light toward the light emergent opening to form a first lighting pattern; the planar reflective component 32 is configured to receive the other part of the light reflected by the first reflective element 2 and reflect this part of light

toward the light emergent opening to form a second lighting pattern; the first lighting pattern and the second lighting pattern are superposed to form a lighting pattern, wherein when the curved reflective component 31 is located above the planar reflective component 32, the reflecting surface of the first reflective element 2 faces away from the light emergent opening; when the planar reflective component 32 is located above the curved reflective component 31, the reflecting surface of the first reflective element 2 faces toward the light emergent opening.

[0032] As shown in Fig. 7, it can be understood that the first lighting pattern formed after the part of light reflected by the first reflective element 2 is reflected by the curved reflective component 31 to the light emergent opening can ensure the broadening of the illumination light pattern; as shown in Fig. 6, the second lighting pattern formed after the other part of light reflected by the first reflective element 2 is reflected by the planar reflective component 32 to the light emergent opening can ensure the luminance of a central region of the illumination light pattern; the light pattern shown in Fig. 8 is a desired light pattern formed by superposition of the first lighting pattern and the second lighting pattern.

[0033] It may be noted that the light source 1 used in the present application may be single-chip LEDs or a multi-chip LED, and each single-chip LED has a corresponding light-emitting position, thus, each single-chip LED is provided with a first reflective element 2; as for the multi-chip LED, since it has many light-emitting positions, a corresponding first reflective element 2 may be provided for each light-emitting position, or a first reflective element 2 capable of reflecting the light emitted from all light-emitting positions may be provided correspondingly.

[0034] As shown in Fig. 9, as a specific embodiment of the present application, a plurality of first reflective elements 2 may be connected sequentially in the horizontal direction or the vertical direction, so that several sub-illumination light patterns can be formed after the secondary reflection of the light, wherein the first reflective elements 2 are arranged in one-to-one correspondence with the light sources 1, and the "one-to-one correspondence" here may be understood as that a light source 1 is arranged at the focal point of each first reflective element 2, and each light source 1 may be a single-chip LED; alternatively, the light source 1 may be a multi-chip LED, which can also achieve one-to-one correspondence. It may be noted that a plurality of first reflective elements 2 are provided in this embodiment, and each first reflective element 2 is correspondingly configured with a light source 1 capable of emitting light, and the plurality of first reflective elements 2 reflect the light emitted by the corresponding light sources 1, and the light reflected by the first reflective elements 2 is reflected again by the second reflective elements 3. In that process, The light reflected by each first reflective element 2 can form a first lighting pattern and a second lighting pattern after being reflected by the second reflective element 3, a complete

illumination light pattern can be formed by superposing the first lighting pattern and the second lighting pattern, and a complete illumination light pattern may be understood as a sub-illumination light pattern; the number of the first reflective elements 2 may be determined according to the actual installation requirement, then the number of complete sub-illumination light patterns that can be formed can be confirmed. As shown in Fig. 11, a plurality of sub-illumination light patterns can be superposed to form a final illumination light pattern, which, in connection with other components, can form a low beam light pattern or a high beam light pattern.

[0035] It may be noted that "in the horizontal direction or in the vertical direction" in the above embodiment can be understood as follows: as shown in Fig. 9, in the case that the light-emitting positions of the light source 1 are sequentially arranged in the horizontal direction, the first reflective elements 2 corresponding to each light-emitting position are also sequentially connected in the horizontal direction, and correspondingly, the curved reflective components 31 and the planar reflective components 32 in the second reflective elements 3 are sequentially arranged in the vertical direction; in addition, as another embodiment of the present application, in the case that the light-emitting positions of the light source 1 are sequentially arranged in the vertical direction, the first reflective elements 2 corresponding to the light-emitting positions are also sequentially connected in the vertical direction, and correspondingly, the curved reflective components 31 and the planar reflective components 32 in the second reflective elements 3 are sequentially arranged in the horizontal direction.

[0036] The lighting module provided in the first aspect of the present application has a simple structure. In an existing reflective lighting system, in order to ensure the luminance of the light pattern, long-focus reflectors are selected for reflection. In the reflection process, the reflected light rays will interfere with each other and generate stray light; in addition, the long-focus reflectors occupy a large installation space and require a large light emergent opening. In the present application, through the cooperation between the first reflective elements 2 and the second reflective elements 3, in which the first reflective elements have a focal length smaller than 10 mm, preferably 2-5 mm respectively, the light reflection distance can be shortened, the mutual interference of light and the stray light can be avoided, and the light emitted by the light source 1 can be fully utilized and the loss of light can be avoided. In addition, since the light reflection distance is shortened, the size of the installation space required for the first reflective elements 2 and the second reflective elements 3 can be further reduced, and the size of the light emergent opening can be further reduced.

[0037] Furthermore, the second reflective element 3 comprises a planar reflective component 32 and a curved reflective component 31. After the first reflective element 2 reflects the light emitted from the light source 1, the

curved reflective component 31 in the second reflective element 3 can reflect the light again in a shorter reflection distance, and the planar reflective component 32 in the second reflective element 3 can reflect the light again in a longer reflection distance. Thus, the central area of a sub-illumination light pattern formed by the superposition of the first lighting pattern and the second lighting pattern can have sufficient luminance, and the broadening of the sub-illumination light pattern can be ensured; moreover, by virtue of the secondary reflection of the light, the focal length of the first reflection element 2 can be further reduced, thereby the broadening and the luminance of the formed light pattern are ensured, the imaging clarity of the light pattern is improved, and the size of the light emergent opening is further reduced. Even if the light source 1 is an integrated light source with multiple light-emitting chips, a plurality of first reflective elements 2 can be arranged and cooperate with second reflective elements 3 to achieve secondary reflection, so as to ensure the clarity and luminance of imaging. It can be understood that the "reflection distance" refers to the distance between the light source 1 and the reflecting surface of a first reflective element 2.

[0038] Furthermore, as shown in Fig. 3, as an embodiment of the second reflective element 3 in the present application, the curved reflective component 31 and the planar reflective component 32 are connected in the up-down direction, the curved reflective component 31 is located above the planar reflective component 32, and the reflecting surface of the first reflective element 2 faces away from the light emergent opening, in order to adapt to the light emergent direction of the light source 1. If the light emergent direction of the light source 1 is consistent with the direction of the light emergent opening, the curved reflective component 31 may be arranged below the planar reflective component 32 in the design, so as to avoid light loss or stray light; thus, a clearer light pattern with high luminance can be formed, and the light can be further reflected by the second reflective element 3 before mutual interference or divergence of the light rays occur. In that way, light loss or stray light can be avoided, while the light propagation path can be shortened and the size of the light emergent opening can be reduced.

[0039] As shown in Fig. 4, when the curved reflective component 31 is arranged, the focal point of the curved reflective component 31 is located on the reflecting surface of the first reflective element 2 or at the outer side of the reflecting surface of the first reflective element 2. Specifically, the focal point A can be understood as the focal point of the curved reflective component 31 located on the first reflective element 2, so as to ensure that the curved reflective component 31 receives a part of the light reflected by the first reflective element 2, thereby a first lighting pattern can be formed; on the premise of forming the first lighting pattern, light loss and waste can be avoided. It may be noted that the focal point of the curved reflective component 31 may be located on the reflecting surface of the first reflective element 2 or at the outer side

of the reflecting surface of the first reflective element 2, and arranged near the light source 1, according to the actual condition of use, in order to avoid light loss and waste. As shown in Figs. 4 and 5, it can be understood that the spacing between the reflecting surface of the first reflective element 2 and the light source 1 is increased gradually from top to bottom, and "near" means that the focal point of the curved reflective component 31 may be arranged at a small spacing from the light source 1 on the reflecting surface of the first reflective element 2 or at the outer side of the reflecting surface of the first reflective element 2.

[0040] In the present application, as shown in Figs. 1 and 3, as some embodiments of the first reflective element 2, the reflecting surface of the first reflective element 2 may be a paraboloid, a quasi-paraboloid, an ellipsoid or a quasi-ellipsoid. In the case that the reflecting surface of the first reflective element 2 is a parabolic reflecting surface or a quasi-parabolic reflecting surface, the light source 1 may be arranged at the focal point of the parabolic reflecting surface or the quasi-parabolic reflecting surface. In the case that the reflecting surface of the first reflective element 2 is an ellipsoidal reflecting surface or a quasi-ellipsoidal reflecting surface, the light source 1 may be arranged at a first focal point of the ellipsoidal reflecting surface or the quasi-ellipsoidal reflecting surface. Thus, the light emitted by the light source 1 can be reflected by the first reflective element 2 to form parallel light or quasi-parallel light. Since a planar reflective component 32 is arranged in the second reflective element 3, when the light is reflected by the planar reflective component 32 again, the light emitted by the first reflective element 2 and the light reflected by the planar reflective component 32 are symmetrical about the normal of the reflecting surface of the planar reflective component 32. Thus, the position of projection of the second lighting pattern can be adjusted by altering the included angle between the planar reflective component 32 and the horizontal direction.

[0041] Furthermore, since the first lighting pattern formed by the light reflected by the curved reflective component 31 is used to ensure that the illumination light pattern has great breadth, the curved surface reflecting element 31 receives and reflects the light emitted by the light source 1 from a plane where the light-emitting surface of the light source 1 is located to an area within a range of rotation of the light-emitting surface by 10 to 90 degrees in a counterclockwise direction. As shown in Fig. 3, it can be understood that when the plane where the light-emitting surface of the light source 1 is located is used as a reference plane, a rectangular plane coordinate system is established in the plane, a y-axis is arranged in the vertical direction in the plane where the light-emitting surface of the light source 1 is located, the light source 1 is located at the origin of the rectangular plane coordinate system, and the y-axis is rotated by 0 to 90 degrees in a counterclockwise direction, all light in the area within the range of rotation will be received and

reflected by the curved reflective component 31. Thus, light loss and waste can be avoided on the premise of ensuring the breadth of the illumination light pattern. As a preferred embodiment, the curved reflective component 31 can reflect the light emitted from the plane where the light-emitting surface of the light source 1 is located to an area with the range of rotation of the light-emitting surface by 10 to 90 degrees in a counterclockwise direction. Specifically, in the establishment of a coordinate system, the focal point of the first reflective element 2 is used as an origin, a y-axis is formed by extending upward from the origin, then the light emitted by the light source 1 in an area with a range of rotation of the y-axis by 10 to 90 degrees in a counterclockwise direction with the origin as a vertex is received and reflected by the curved reflective component 31. It may be noted that the light reflected by the curved reflective component 31 may alternatively be the light emitted from the plane where the light-emitting surface of the light source 1 is located to an area within a range of rotation of the light-emitting surface by 0 to 10 degrees in a counterclockwise direction. It can be understood that the area where the light reflected by the curved reflective component 31 is located can be selected according to the specific environment of use, as long as it ensures that this part of light is emitted from the plane where the light-emitting surface of the light source 1 is located to an area with a range of rotation of the light-emitting surface by 10 to 90 degrees in a counterclockwise direction.

[0042] As shown in Figs. 12 and 13, as another embodiment of the second reflective element 3 in the present application, the curved reflective component 31 and the planar reflective component 32 are connected in the up-down direction, the planar reflective component 32 is located above the curved reflective component 31, and the reflecting surface of the first reflective element 2 faces toward the light emergent opening. In the case that the light emergent direction of the light source 1 is opposite to the direction of the light emergent opening, the first reflective element 2 still can fully reflect the light emitted by the light source 1, and the second reflective element 3 still can receive the light reflected by the first reflective element 2 and reflect the light, thereby a first lighting pattern and a second lighting pattern are formed.

[0043] Furthermore, as shown in Fig. 13, in the case that the light emergent direction of the light source 1 is opposite to the direction of the light emergent opening, an end of the first reflective element 2 is connected to an end of the second reflective element 3 to form an integrated structural part, wherein both the reflecting surface of the first reflective element 2 and the reflecting surface of the second reflective element 3 face toward the light emergent opening, and the first reflective element 2 is connected with the second reflective element 3 to form an integrated structural part. Thus, the structure is simpler, the overall structure of the lighting module is more stable, and the production cost can be reduced; moreover, with the integrated structural part, the installation is more

convenient, and the efficiency of subsequent installation can be improved.

[0044] It may be noted that in the case that the first reflective element 2 and the second reflective element 3 are an integrated structural part, a plurality of first reflective elements 2 are provided and arranged in a structural form as shown in Fig. 12, the plurality of first reflective elements 2 are connected in the horizontal direction, and the first reflective elements 2 are connected at one end with the second reflective elements 3, and they are further formed into an integrated structural part.

[0045] It may be further noted that, as shown in Fig. 10, the spacing between the illumination light patterns can be adjusted by adjusting the included angle between the optical axes of the first reflective elements 2, so as to obtain illumination light patterns with sufficient luminance. For example, the symbol 'b' in Fig. 10 represents the included angle between the optical axes of two adjacent first reflective elements 2, and the opening direction of the included angle faces the light source 1. In the manufacturing and arrangement of the first reflective elements 2, the included angle 'b' can be selected to be not greater than 30 degrees according to the design requirements for the vehicle lamp.

[0046] It can also be understood that, as a specific embodiment, as shown in Fig. 10, in the case that the lighting module has a plurality of first reflective elements 2 and the number of the first reflective elements 2 is odd, the end of each first reflective element 2 away from the light source 1 closes up to the first reflective element 2 in the middle, so that the optical axis of the first reflective element 2 at either side of the first reflective element 2 in the middle forms an included angle not greater than 30 degrees with respect to the optical axis of the first reflective element 2 in the middle, so as to obtain an illumination light pattern with sufficient luminance.

[0047] Furthermore, as shown in Figs. 13 and 15, in the above embodiment, the curved reflective component 31 is located below the planar reflective component 32, and the light emergent direction of the light source 1 faces away from the light emergent opening; thus, the curved reflective component 31 receives and reflects the light emitted by the light source 1 from the plane where the light-emitting surface of the light source 1 is located to an area within a range of rotation of the light-emitting surface by 10 to 90 degrees in a clockwise direction. It can be understood that when the plane where the light-emitting surface of the light source 1 is located is used as a reference plane, a rectangular plane coordinate system is established in the plane, the y-axis is the same as that in Fig. 3 and located in the plane where the light-emitting surface of the light source 1 is located and arranged in the vertical direction, and the light source 1 is located at the origin of the rectangular plane coordinate system, then all the light in an area within a range of rotation of the y-axis by 90 degrees in a clockwise direction will be received and reflected by the curved reflective component 31. Thus, the illumination light pattern can avoid light loss

and waste on the premise of ensuring that the illumination light pattern has sufficient breadth. Furthermore, as shown in Fig. 15, suppose that the height of the first reflective element 2 is d , the height of the planar reflective component 32 is d , or the planar reflective component 32 extends to the right to have height greater than d , so as to improve the luminance in the central area of the light pattern. It may be noted that, in this embodiment, the light source 1 is at the focal point of the first reflective element 2. In the case that the light source 1 and the focal point of the first reflective element 2 are not coincident, when a coordinate system is established with the cross section as a plane, the focal point of the first reflective element 2 is used as an origin, extending upwards from the origin to form a y -axis, then the light emitted by the light source 1 in an area within a range of rotation of the y -axis by 10 to 90 degrees in a clockwise direction with the origin as a vertex is received and reflected by the curved reflective component 31. In addition, for example, in Fig. 15, the light source 1 is located at the focal point of the first reflective element 2, the scope of light that can be received by the curved reflective component 31 and the planar reflective component 32 are defined according to the actually required breadth and luminance of the illumination light pattern, as shown in Fig. 15, in the area c , the light emitted by the light source 1 can be received by the curved reflective component 31; when a vertical line perpendicular to the horizontal direction is plotted downward at a lower intersection between the boundary of the area c and the first reflective element 2, the intersection between the vertical line and the second reflective element 3 is the junction between the curved reflective component 31 and the planar reflective component 32.

[0048] As an embodiment of the curved reflective component 31 in the present application, the reflecting surface of the curved reflective component 31 may be a curved surface formed by a parabola stretched in a single direction. By using a curved surface formed by a stretched parabola, the part of light reflected by the first reflective element 2 can be effectively received and reflected. By adjusting the length or curvature of the parabola, the broadening of the first lighting pattern formed after the light is reflected by the curved reflective component 31 can be further adjusted, to ensure the broadening of a sub-illumination light pattern formed by superposition of the first lighting pattern and the second lighting pattern.

[0049] As shown in Fig. 14, as another embodiment of the curved reflective component 31 in the present application, the reflecting surface of the curved reflective component 31 may alternatively be a quasi-curved surface formed by a plurality of connected broken lines stretched in a single direction. As shown in Fig. 14, the point B is the end point of each broken line, the length of each broken line is a , and each broken line is stretched in a single direction to form a small reflecting surface; then, the light is reflected by several quasi-curved reflecting surfaces formed by a combination of these small reflect-

ing surfaces formed by stretching. Thus, the uniformity of the light pattern can be adjusted, and problems such as dark spots or the like can be avoided. It may be noted that a "quasi-curved surface" refers to a surface spliced from planar surfaces, which has a curvature similar to the curvature of a curved surface but doesn't have a smooth and continuous curved surface shape.

[0050] In the present application, as shown in Fig. 14, as an embodiment of the planar reflective component 32, the reflecting surface of the planar reflective component 32 is formed a plurality of parallel and non-coplanar planar reflecting surfaces connected sequentially, and the resultant planar reflecting structure can adjust the light pattern that requires secondary reflection, so that the resultant light pattern is more uniform and the imaging is clearer.

[0051] In addition, there are many ways to connect the planar reflective component 32 with the curved reflective component 31 in the present application. As an embodiment, as shown in Fig. 1, the curved reflective component 31 and the planar reflective component 32 can be directly connected, for example, in point continuity or tangent continuity at the connection, so that there is a smooth transition between the curved reflective component 31 and the planar reflective component 32. In such a design, the structure of the second reflective element 3 is simpler, and the subsequent installation is more convenient.

[0052] As shown in Fig. 5, as an embodiment of another method of connection between the curved reflective component 31 and the planar reflective component 32, the curved reflective component 31 and the planar reflective component 32 can be connected via a stepped surface. In that way, the interference between the curved reflective component 31 and the planar reflective component 32 in the reflection of corresponding parts of the light can be avoided, thereby stray light can be avoided.

[0053] It may be noted that the planar reflective component 32 and the curved reflective component 31 may be directly connected after the position is determined. Here, "determination of position" means that the focal point of the curved reflective component 31 is located on the reflecting surface of the first reflective element 2 and near the light source 1, or it is located at the outer side of the reflecting surface of the first reflective element 2 and near the light source 1; and the planar reflective component 32 is located below or above the curved reflective component 31, and is configured to reflect light to form a second lighting pattern, and the second lighting pattern is located in a central area of the first lighting pattern, so that the central area of the finally formed illumination light pattern has higher luminance.

[0054] It may be further noted that some of the above embodiments are only some specific embodiments of the second reflective element 3 in the present application, but the embodiments of the second reflective element 3 in the present application are not limited to those specific embodiments. Other technical schemes that can achieve a similar technical effect and involve simple modifications

also fall in the scope of protection of the present application.

[0055] Furthermore, since the second reflective element 3 is provided in the present application for secondary light reflection, the first reflective element 2 may be a reflecting element having a small focal length. The focal length of the first reflective element 2 may be smaller than 10 mm. Since the light is reflected twice and the luminance is ensured, it is unnecessary to use a reflecting element with a great focal length for the first reflective element 2 to ensure the luminance of imaging. Thus, the size of the light emergent opening can be reduced as far as possible.

[0056] Preferably, through the cooperation between the first reflective element 2 and the second reflective element 3, the light emitted from the light source 1 can be reflected twice, and a sub-illumination light pattern can be formed. Several sub-illumination light patterns can be combined and superposed to form a low beam light pattern or a high beam light pattern. Therefore, the focal length of the first reflective element 2 is preferably 2 mm to 5 mm, thereby the light emergent opening can be further reduced.

[0057] In the present application, as an embodiment of the light source 1, as shown in Figs. 3 and 15, the plane where the light-emitting surface of the light source 1 is located forms an included angle within 30 degrees with respect to the light emergent direction of the first reflective element 2. Specifically, the plane where the light-emitting surface of the light source 1 is arranged in the vertical direction is used as a reference plane, and the plane where the light-emitting surface of the light source 1 is located can be rotated with respect to the reference plane according to the specific position of the first reflective element 2, so that the plane where the light-emitting surface of the light source 1 is located forms an included angle equal to or smaller than 30 degrees with respect to the light emergent direction of the first reflective element 2, so as to improve the light efficiency. The angle of rotation is indicated by the symbol 'e' in Fig. 15. In addition, as another embodiment of the present application, in order to improve the light efficiency and meet the requirement for elongated vehicle lamps on the market at present, the first reflective element 2 and the second reflective element 3 as shown in Fig. 15 may be arranged respectively at the two sides of the light source 1. In that way, the requirement for elongated vehicle lamps can be met, and the illumination effect and the length of the light pattern can be ensured. The lighting module provided in the first aspect of the present application can reflect the light of the light source 1 twice through the cooperation between the first reflective element 2 and the second reflective element 3, thereby the imaging clarity is improved, light loss and waste are avoided, and stray light is avoided. Moreover, by means of twice light reflections, the imaging luminance is ensured, and long-focus reflectors used in existing reflecting lighting modules can be avoided, and the size of the light emergent opening is

reduced.

[0058] In a second aspect, the present application provides an lighting system. As shown in Fig. 1, the lighting system comprises the lighting module provided in the first aspect and a circuit board, and the light source 1 is installed on the circuit board. Owing to the fact that the light emergent opening of the lighting module in the lighting system is smaller, the installation space required for the lighting system is reduced accordingly.

[0059] Further, the lighting system further comprises a heat sink 4, the circuit board is connected to the heat sink 4, and the heat sink 4 can dissipate the heat of the lighting system.

[0060] In a third aspect, the present application provides a vehicle, which employs the above-mentioned lighting system, and the lighting system has the lighting module provided in the first aspect of the present application. Owing to the existence of the lighting module, the size of the light emergent opening can be reduced, thereby the shape of the vehicle lamp can be diversified. For example, a head lamp may be in an elongated shape.

[0061] In the description of the present application, the expressions of reference terms "an embodiment", "some embodiments", "a specific embodiment" or the like mean that the specific features, structures, materials or characteristics described in the embodiments or examples are included in at least one embodiment or example of the present application. In the present application, the exemplary expressions of the above terms may not necessarily refer to the same embodiment or example. Moreover, the specific features, structures, materials, or characteristics described can be combined appropriately in any one or more embodiments or examples.

[0062] While some preferred embodiments of the present application are described above with reference to the accompanying drawings, the present application is not limited to the details in those embodiments. Those skilled in the art can make various simple modifications and variations to the technical scheme of the present application without departing from the technical concept of the present application. However, all these simple modifications and variations shall be deemed as falling in the scope of protection of the present application.

[0063] In addition, it may be noted that the specific technical features described in the above embodiments can be combined in any suitable way, provided that there is no contradiction among them. To avoid unnecessary repetitions, various possible combinations are not described specifically in the present application.

[0064] Moreover, different embodiments of the present application may also be combined freely as required, as long as the combinations don't deviate from the ideal of the present application. However, such combinations shall also be deemed as being disclosed in the present application.

Claims

1. An lighting module, comprising: a light source (1), and at least one first reflective element (2) and at least one second reflective element (3) that are sequentially arranged in a light propagation direction, wherein the first reflective element (2) is configured to receive light emitted by the light source (1) and reflect the light to the second reflective element (3), and the second reflective element (3) comprises a curved reflective component (31) and a planar reflective component (32) that are sequentially connected in the up-down direction, the curved reflective component (31) is configured to receive one part of the light reflected by the first reflective element (2) and reflect the part of the light to the light emergent opening to form a first lighting pattern, and the planar reflective component (32) is configured to receive the other part of the light reflected by the first reflective element (2) and reflect the part of the light to the light emergent opening to form a second lighting pattern; the first lighting pattern and the second lighting pattern can be superposed to form a lighting pattern, wherein when the curved reflective component (31) is located above the planar reflective component (32), the reflecting surface of the first reflective element (2) faces away from the light emergent opening; and when the planar reflective component (32) is located above the curved reflective component (31), the reflecting surface of the first reflective element (2) faces toward the light emergent opening.
2. The lighting module of claim 1, wherein when the curved reflective component (31) is located above the planar reflective component (32), a focal point of the curved reflective component (31) is located on the reflecting surface of the first reflective element (2).
3. The lighting module of claim 2, wherein the curved reflective component (31) receives and reflects the light emitted by the light source (1) from a plane where the light-emitting surface of the light source (1) is located to an area within a range of rotation of the light-emitting surface by 10 to 90 degrees in a counter clockwise direction.
4. The lighting module of claim 1, wherein when the planar reflective component (32) is located above the curved reflective component (31), an end of the first reflective element (2) is connected to an end of the second reflective element (3) to form an integrated structural part, and both the reflecting surface of the first reflective element (2) and the reflecting surface of the second reflective element (3) face toward the light emergent opening.
5. The lighting module of claim 4, wherein the curved reflective component (31) receives and reflects the light emitted by the light source (1) from a plane where the light-emitting surface of the light source (1) is located to an area within a range of rotation of the light-emitting surface by 10 to 90 degrees in a clockwise direction.
6. The lighting module of any of claims 1 to 5, wherein the reflecting surface of the curved reflective component (31) is a curved surface formed by a parabola stretched in a single direction.
7. The lighting module of any of claims 1 to 5, wherein the reflecting surface of the curved reflective component (31) is a quasi-curved surface formed by a plurality of connected broken lines stretched in a single direction.
8. The lighting module of any of claims 1 to 5, wherein the reflecting surface of the planar reflective component (32) is a planar reflecting structure formed by a plurality of parallel and non-coplanar planar reflecting surfaces connected sequentially.
9. The lighting module of any of claims 1 to 5, wherein the curved reflective component (31) and the planar reflective component (32) are connected via a stepped surface.
10. The lighting module of any of claims 1 to 5, wherein the reflecting surface of the first reflective element (2) is a paraboloid, a quasi-paraboloid, an ellipsoid or a quasi-ellipsoid.
11. The lighting module of claim 10, wherein the focal length of the first reflective element (2) is smaller than 10 mm, preferably is 2-5 mm.
12. The lighting module of any of claims 1 to 5, wherein the plurality of first reflective element (2) are sequentially connected in the horizontal direction, and the first reflective element (2) are arranged in one-to-one correspondence with the light sources (1).
13. The lighting module of claim 12, wherein an included angle is formed between the optical axes of two adjacent first reflective element (2), the opening of the included angle faces toward the light source (1), and the included angle is not greater than 30 degrees.
14. The lighting module of any of claims 1 to 5, wherein the plane where the light-emitting surface of the light source (1) is at an included angle equal to or smaller than 30 degrees with respect to a light emergent direction of the first reflective element (2).
15. An lighting system comprising the lighting module of

any of claims 1 to 14 and a circuit board, on which the light source (1) is installed.

16. The lighting system of claim 15, further comprising a heat sink (4), to which the circuit board is connected. 5

17. A vehicle comprising the lighting system of claim 15 or 16.

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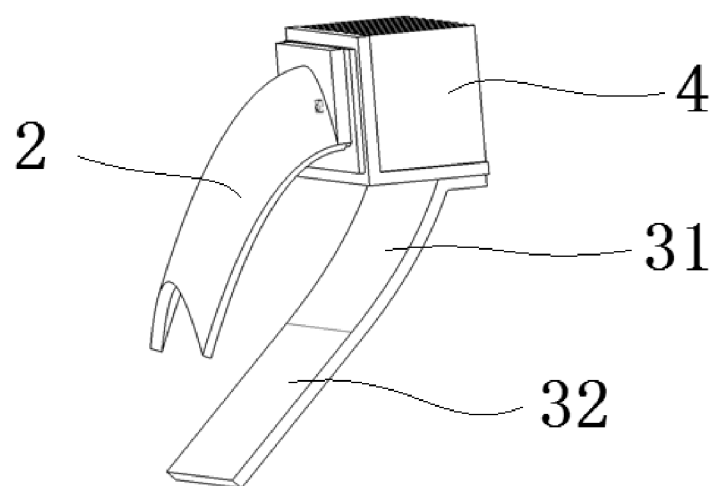


Fig. 1

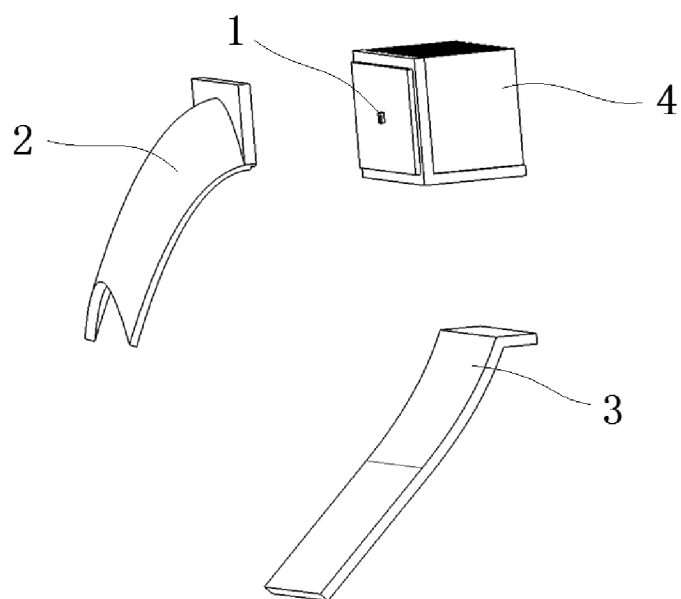


Fig. 2

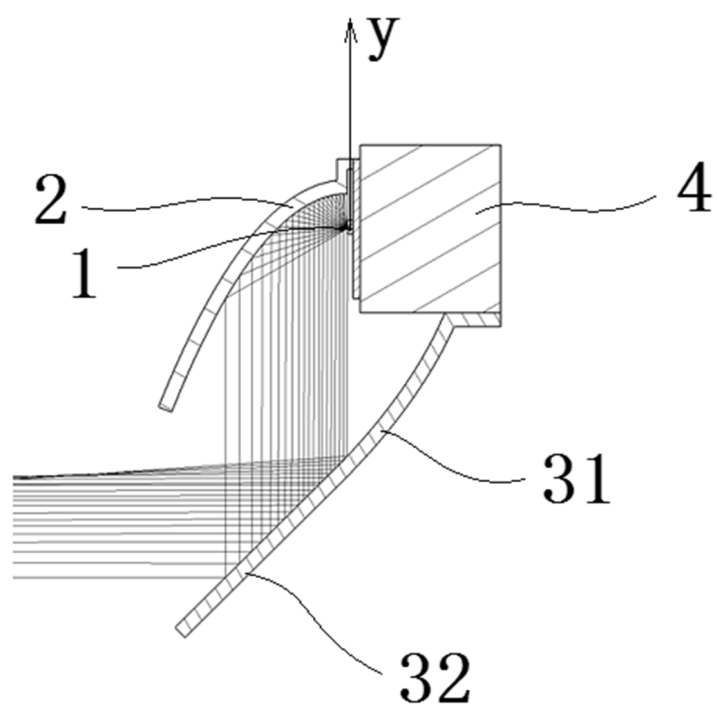


Fig. 3

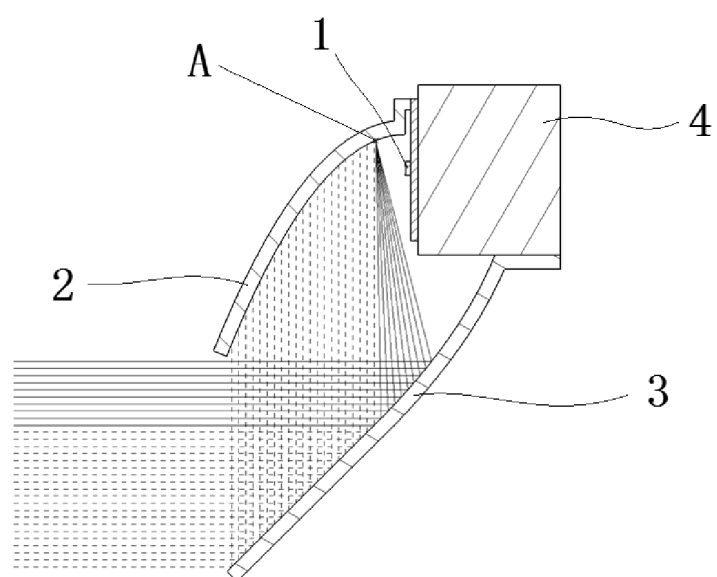


Fig. 4

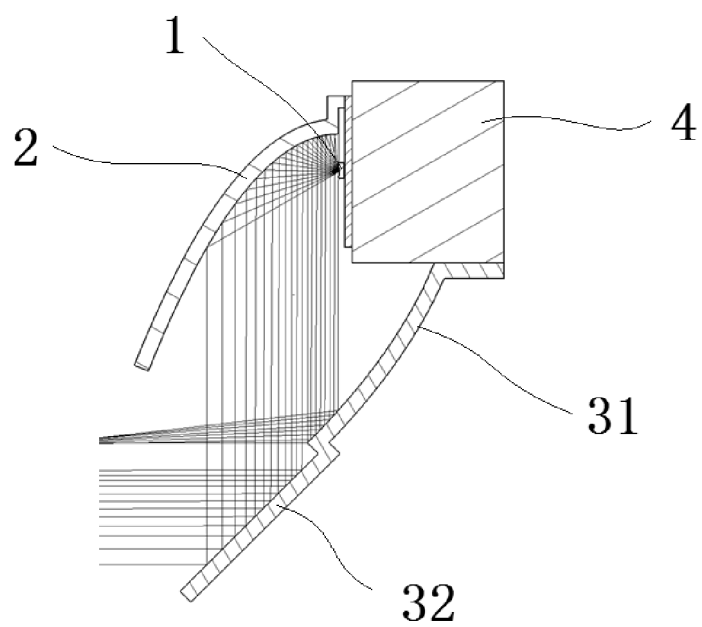


Fig. 5

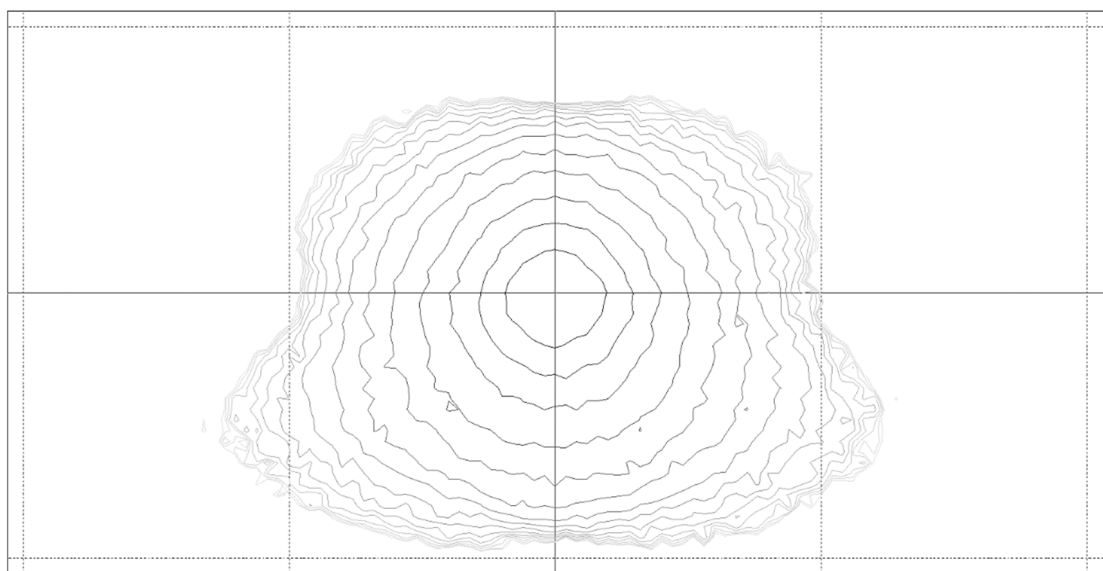


Fig. 6

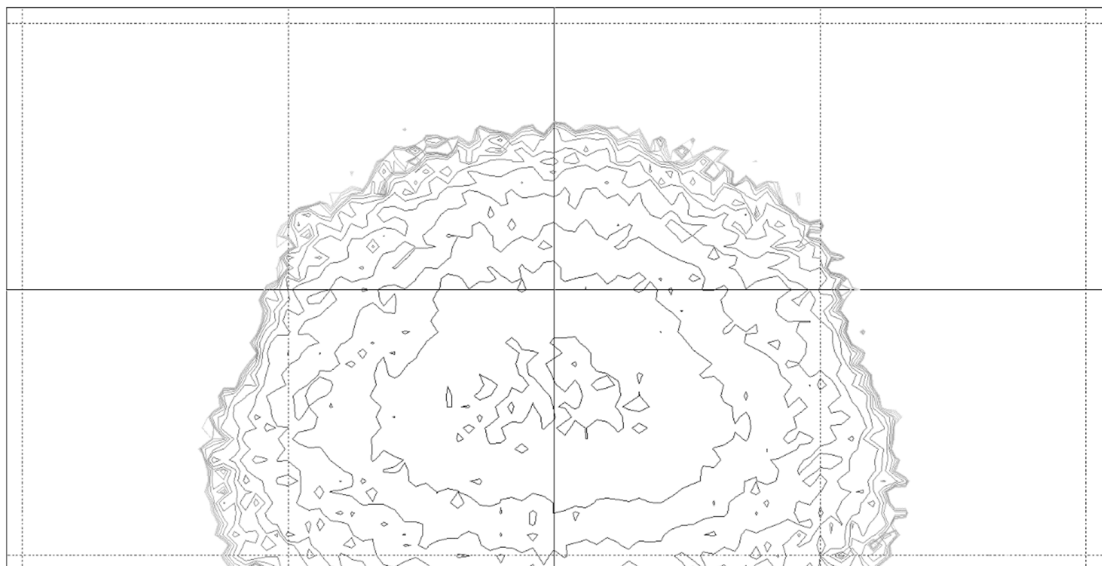


Fig. 7

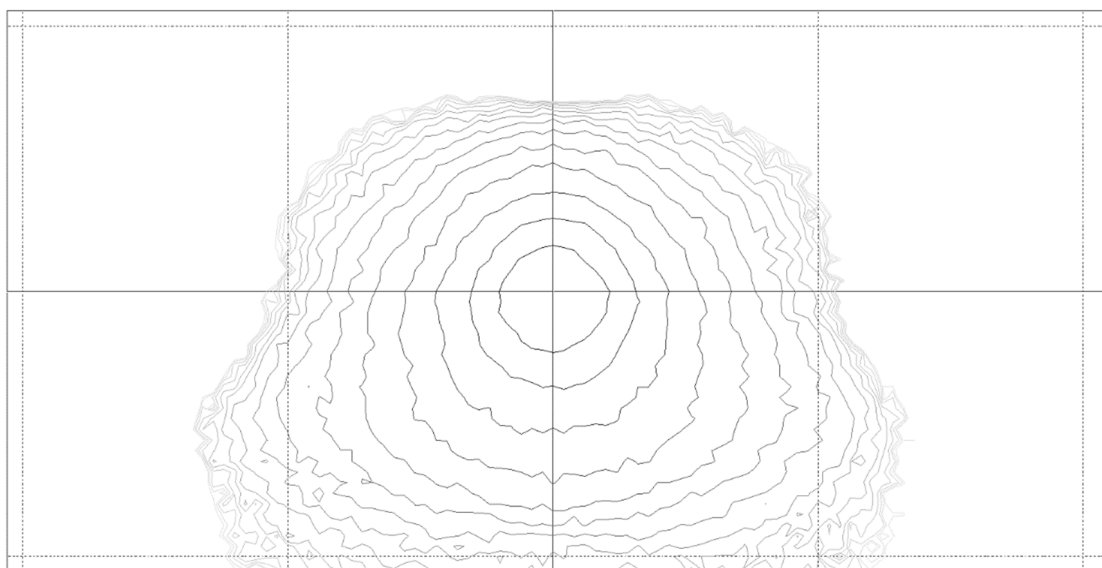


Fig. 8

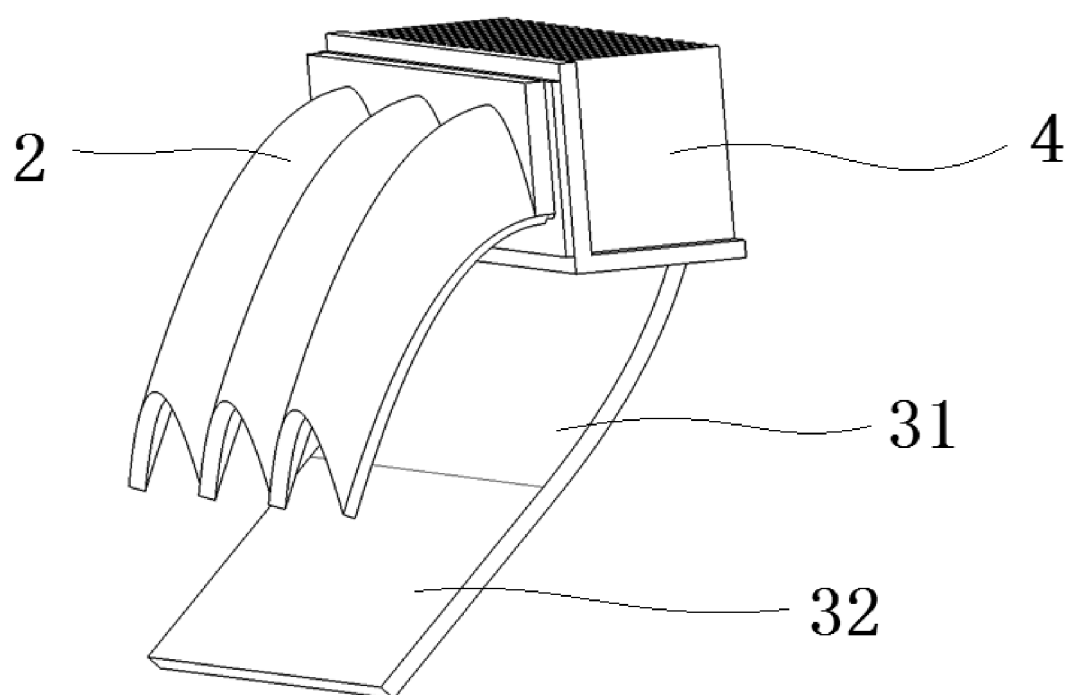


Fig. 9

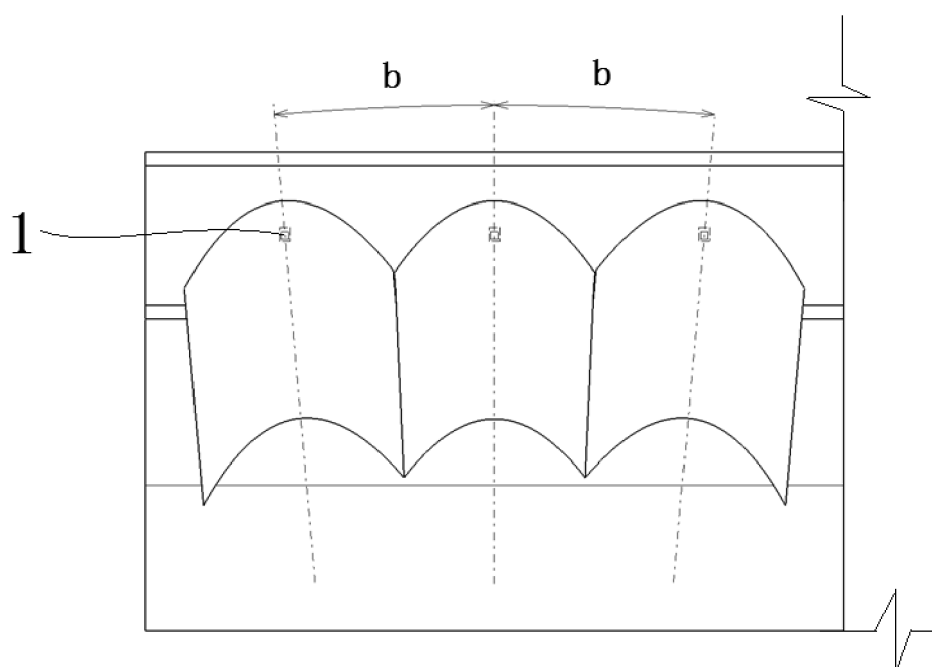


Fig. 10

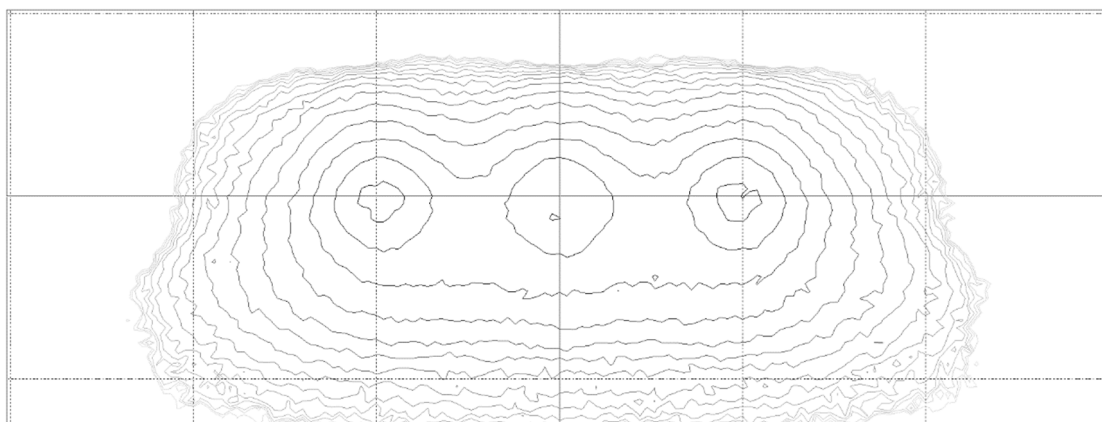


Fig. 11

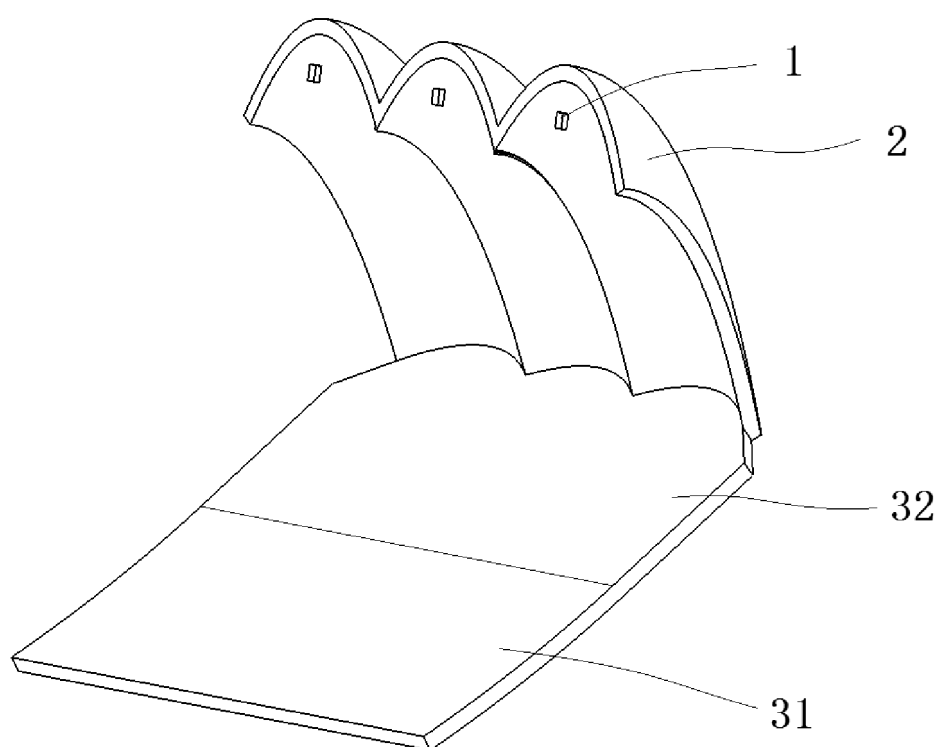


Fig. 12

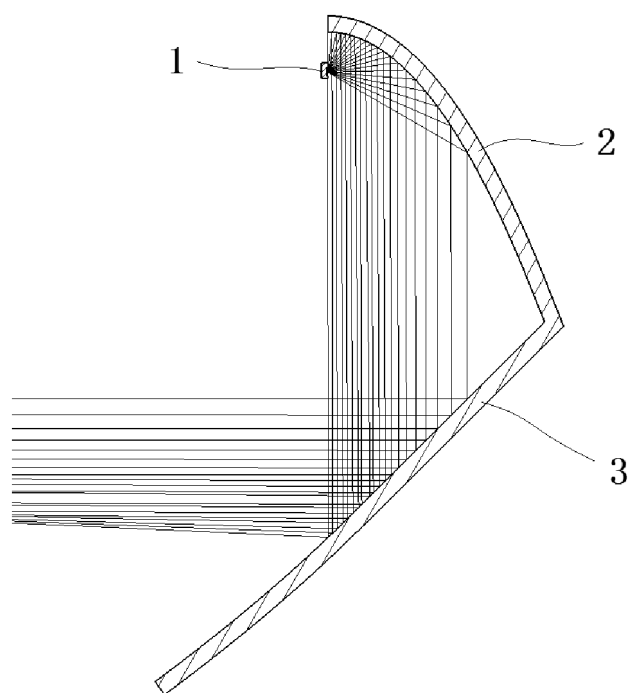


Fig. 13

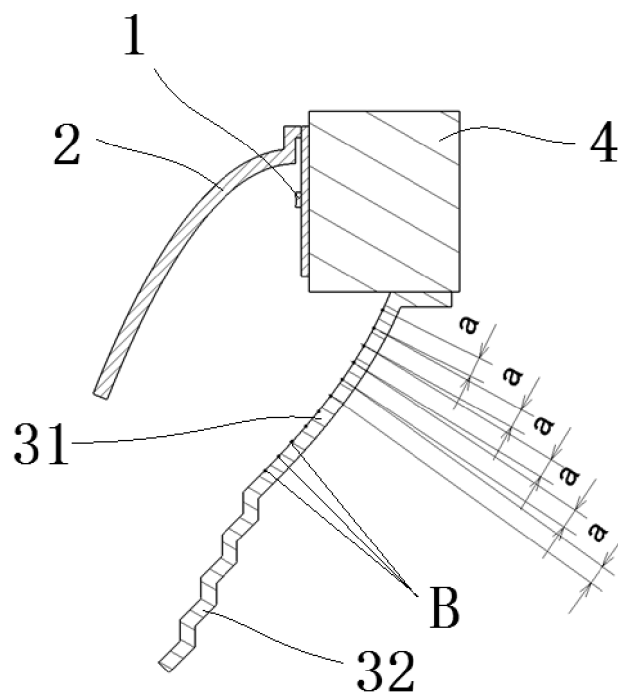


Fig. 14

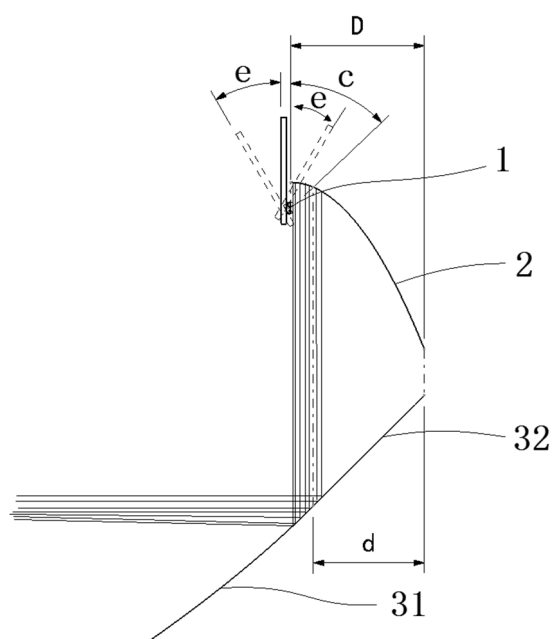


Fig. 15

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/119677

A. CLASSIFICATION OF SUBJECT MATTER

F21V7/00(2006.01)i; F21S41/30(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)

IPC: F21

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)

CNABS, CNTXT, CNKI: 第二, 另一, 反射, 反光, 分区, 分块, 第二部, 下端, 下段, 下部, 子区, 子单元, 抛物, 曲, 弧, 椭, 平面, 中心, 中间, 中部, 周边, 外围, 周缘, 外缘, 车灯, 汽车照明; VEN, EPTXT, WOTXT, USTXT, WEB OF SCIENCE: two, second, other, another, reflect, mirror, up, down, top, part, element, sub, zone, arc, curve, parabola, elliptic, center, centre, middle, around, peripheral, car, vehicle.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 117515468 A (HASCO VISION TECHNOLOGY (SHANGHAI) CO., LTD.) 06 February 2024 (2024-02-06) description, paragraphs 31-60, and figures 1-15	1-17
A	JP 2012099228 A (KOITO MANUFACTURING CO., LTD.) 24 May 2012 (2012-05-24) description, paragraphs 33-111, and figures 1-11	1-17
A	JP 2011249184 A (KOITO MANUFACTURING CO., LTD.) 08 December 2011 (2011-12-08) description, paragraphs 13-31, and figures 1-2	1-17
A	DE 102016105594 A1 (ZIZALA LICHTSYSTEME GMBH) 29 September 2016 (2016-09-29) entire document	1-17
A	CN 219976209 U (HASCO VISION TECHNOLOGY (SHANGHAI) CO., LTD.) 07 November 2023 (2023-11-07) entire document	1-17

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

* Special categories of cited documents:	"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
"A" document defining the general state of the art which is not considered to be of particular relevance	"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
"D" document cited by the applicant in the international application	"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
"E" earlier application or patent but published on or after the international filing date	"&" document member of the same patent family
"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	

Date of the actual completion of the international search 08 December 2024	Date of mailing of the international search report 16 December 2024
Name and mailing address of the ISA/CN China National Intellectual Property Administration (ISA/CN) China No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 2022)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2024/119677

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	117515468	A	06 February 2024	CN	117515468	B	12 April 2024
JP	2012099228	A	24 May 2012	JP	5529708	B2	25 June 2014
JP	2011249184	A	08 December 2011	None			
DE	102016105594	A1	29 September 2016	AT	516974	A1	15 October 2016
				AT	516974	B1	15 August 2017
				DE	102016105594	B4	21 January 2021
CN	219976209	U	07 November 2023	None			

REFERENCES CITED IN THE DESCRIPTION

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