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(71) Applicant: **Hasco Vision Technology Co., Ltd.**
Jiading District
Shanghai 201821 (CN)

(72) Inventors:
- **ZHANG, Jie**
  Shanghai 201821 (CN)
- **CHEN, Jiayuan**
  Shanghai 201821 (CN)
- **DONG, Shikun**
  Shanghai 201821 (CN)
- **ZHOU, Hao**
  Shanghai 201821 (CN)
- **SANG, Wenhui**
  Shanghai 201821 (CN)
- **ZHU, He**
  Shanghai 201821 (CN)

(74) Representative: **Loyer & Abello**
9, rue Anatole de la Forge
75017 Paris (FR)

(54) OPTICAL REFLECTION SYSTEM FOR VEHICLE LAMP LIGHTING DEVICE, AND VEHICLE LAMP LIGHTING DEVICE

(57) Provided are an optical reflecting system for a vehicle lamp illumination device and a vehicle lamp illumination device, which comprises a primary optical system having a light source (80), and the optical reflecting system is configured to receive light beams emitted from the light source (80) of the primary optical system. The optical reflecting system comprises a first reflector having a first reflecting surface (10) and a second reflector having a second reflecting surface (20), wherein the first reflecting surface (10) is configured to collimate light in a first direction, and the second reflecting surface (20) is configured to collimate light in a second direction orthogonal to the first direction. The first reflecting surface (10) and the second reflecting surface (20) have a curved shape represented by a contour line, and the curved shape is a curved surface formed by stretching the contour line along a direction normal to a plane where the contour line is located. The optical reflecting system is configured such that light beams emitted from the primary optical system having the light source (80), after being reflected by the first reflector and the second reflector, are emitted in a form of approximately parallel light beams, so as to form an illumination light pattern of the vehicle lamp illumination device.

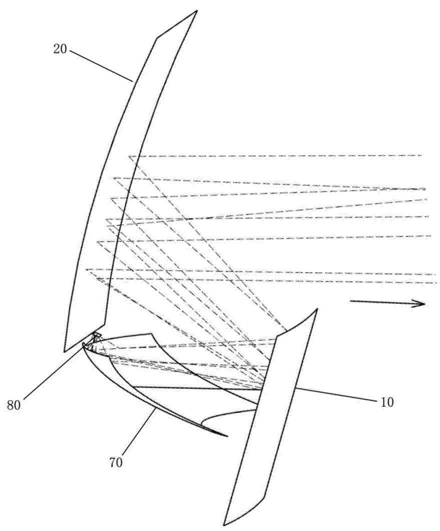

FIG. 1

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Description

Technical Field

[0001] The present disclosure relates to a vehicle lamp illumination device, and specifically, the present disclosure relates to an optical reflecting system for a vehicle lamp illumination device and a vehicle lamp illumination device.

Background Art

[0002] This section provides background information related to the present disclosure, but the information does not necessarily constitute the prior art.

[0003] In order to adapt to requirements of different vehicle lamp styles and illumination light patterns, forms of illumination devices on vehicles become more and more diversified, in which a low-beam illumination device, a high-beam illumination device, a high-beam and low-beam integrated illumination device, an auxiliary low-beam illumination device, an auxiliary high-beam illumination device, etc. appear, and new technologies regarding the vehicle lamp illumination device provided with an optical collimating element also emerge one after another in recent years.

[0004] Typically, optical collimating elements such as collimating lenses are provided in the vehicle lamp illumination device to obtain approximately parallel outgoing light beams. For example, patent application CN 1 07208859A discloses an illumination device, wherein this illumination device has at least one preferably aspherical collimating lens. In addition, patent application CN212618084U discloses a bidirectional collimating lens and a vehicle lamp system thereof.

Summary

[0005] This section provides general summary of the present disclosure, rather than comprehensive disclosure of a full scope or all features of the present disclosure.

[0006] The inventor of the present disclosure found that, in the existing vehicle lamp illumination devices using a collimating lens as an optical collimating element, a curved surface on the collimating lens is a revolving curved surface based on an optical axis of the lens, and the collimating lens has isotropic imaging characteristic. However, it is required that the illumination light pattern of the vehicle lamp illumination device is anisotropic, for example, a small up-down illumination angle and a large left-right illumination angle are required for a low-beam illumination light pattern. To this end, the vehicle lamp illumination device based on the collimating lens needs to form a basic light pattern with a certain width through an additional optical system, then the basic light pattern is imaged to a road surface through the collimating lens, which makes the vehicle lamp illumination device relatively complex in structure. In addition, for the existing vehicle lamp systems using a bidirectional collimating lens as the optical collimating element, as a certain distance exists between a light incident surface and a light emergent surface of the bidirectional collimating lens, that is, the lens has a certain thickness, when an aspect ratio (length-width ratio) of the light pattern that needs to be formed is set to be a relatively large value, a focal length of the light incident surface and a focal length of the light emergent surface have a relatively large difference. Therefore, a relatively large spacing between the light incident surface and the light emergent surface causes an enlarged volume of the lens, and relatively heavy weight. In addition, the bidirectional collimating lens is generally formed by injection molding of transparent plastic, and the thicker the thickness is, the longer the process time for the injection molding is, so that the production rate is slowed down, and it is not conducive to mass production.

[0007] Therefore, the optical collimating element of the vehicle lamp illumination device needs to be improved, so as to overcome or alleviate all or at least part of the above technical problems.

[0008] Exemplary embodiments of the present disclosure provide an optical reflecting system. The optical reflecting system is used for a vehicle lamp illumination device, the vehicle lamp illumination device may include a primary optical system having a light source, and the optical reflecting system can be configured to reflect light emitted from the light source of the primary optical system, wherein the optical reflecting system may include a first reflector having a first reflecting surface and a second reflector having a second reflecting surface, the first reflecting surface may be configured to collimate light in a first direction, and the second reflecting surface may be configured to collimate light in a second direction orthogonal to the first direction, the first reflecting surface and the second reflecting surface may have a curved shape represented by a contour line, the first reflecting surface and the second reflecting surface each may be a curved surface formed by stretching corresponding contour line along a direction normal to a plane where the contour line is located, the optical reflecting system can be configured such that light beams emitted from the primary optical system having the light source, after being reflected by the first reflector and reflected by the second reflector, may be emitted in a form of approximately parallel light, so as to form an illumination light pattern of the vehicle lamp illumination device.

[0009] In some embodiments, the contour line may include a parabola or a quasi-parabola.

[0010] In some embodiments, the first direction may be a horizontal direction or a vertical direction.

[0011] In some embodiments, a shape of the contour line of each of the first reflecting surface and the second reflecting surface may be set such that a light diffusion angle of light beams obtained after being reflected by each of the first reflecting surface and the second reflecting surface changes as the shape of the contour line of each of the first reflecting surface and the second reflecting surface changes.

[0012] In some embodiments, a focal length of the first reflecting surface may be configured to be different from a focal length of the second reflecting surface.

[0013] In some embodiments, the first reflector and the second reflector may be adjacently provided on the same side of the light source, or the first reflector and the second reflector may be provided at two opposite sides of the light source.

[0014] In some embodiments, the primary optical system may be a primary optical system having a cut-off line structure, and a focal point of the optical reflecting system may be provided at the cut-off line structure.

[0015] In some embodiments, the first reflector may include a plurality of first reflecting surfaces, the optical reflecting system may be configured such that light beams emitted from the primary optical system having the light source, after being reflected by the first reflector and reflected by the second reflector, may be emitted in a form of approximately parallel light beams, so as to form a matrix illumination light pattern of the vehicle lamp illumination device.

[0016] In some embodiments, the first reflecting surface and the second reflecting surface of the optical reflecting system may be formed by plating with a plating material.

[0017] In some embodiments, the plating material of the first reflecting surface and the second reflecting surface may be at least one of aluminum, chromium, nickel, silver, and gold.

[0018] In some embodiments, the first reflector and the second reflector may be separately manufactured and assembled in place in the vehicle lamp illumination device by fastening connectors.

[0019] In some embodiments, the first reflector and the second reflector may be integrally molded.

[0020] In some embodiments, the primary optical system may include a third reflector, and the third reflector is configured to reflect light from the light source and guide the same to the optical reflecting system.

[0021] In some embodiments, the primary optical system may include a condenser, the condenser may be configured to collimate and converge light from the light source and guide the same to the optical reflecting system, and a cut-off line structure may be provided at a lower edge of the condenser.

[0022] In some embodiments, the optical reflecting system may include an additional fourth reflector, and the first reflector, the second reflector, and the fourth reflector may be configured to jointly form a focal point or a focusing area of the optical reflecting system.

[0023] In some embodiments, the present disclosure provides a vehicle lamp illumination device including the above optical reflecting system.

[0024] The optical reflecting system including two reflectors according to the present disclosure may collimate and converge the light beams from the light source in two directions orthogonal to each other. Compared with the existing collimating lens elements, the optical reflecting system of the present disclosure has a simple and compact structure design, is easy to manufacture, further improves the production efficiency, and has significant cost effectiveness.

[0025] According to the vehicle lamp illumination device including the optical reflecting system of the present disclosure, by setting the focal length of the first reflecting surface of the first reflector to be different from the focal length of the second reflector, an illumination light pattern with a relatively large aspect ratio may be realized. The first reflector and the second reflector of the optical reflecting system of the present disclosure may be constructed relatively independently, with high design flexibility, and the light path direction and diffusion range of the light beams may be effectively controlled, so that an ideal illumination light pattern may be obtained according to needs, and meanwhile, the light distribution requirements of the national standard GB25991-2010 for vehicle lamp illumination devices may be met.

[0026] Through the detailed description of the exemplary embodiments of the present disclosure with reference to the drawings, the above features and advantages and other features and advantages of the present disclosure will be more apparent.

Brief Description of Drawings

[0027] With reference to the detailed description of the exemplary embodiments of the present disclosure in conjunction with the drawings, the above and other objectives, features, and advantages of the present disclosure can be understood more easily. Identical or corresponding technical features or components will be denoted by identical or corresponding reference signs throughout the drawings. In the drawings, dimensions and relative positions of various components are not necessarily drawn to scale. In the drawings:

FIG. 1 is a schematic diagram of a vehicle lamp illumination device according to an exemplary embodiment of the present disclosure, with the vehicle lamp illumination device including a primary optical system and an optical reflecting system;

FIG. 2 is a schematic diagram of a light path of a single rotating paraboloidal reflector;

FIG. 3 is a schematic diagram of a light path of the optical reflecting system having a first reflector and a second reflector according to an exemplary embodiment of the present disclosure;

FIG. 4 is a schematic diagram of a light path of light beams in a vertical direction of the optical reflecting system in FIG. 3 according to an exemplary embodiment of the present disclosure;

FIG. 5 is a schematic diagram of a light path of light beams in a horizontal direction of the optical reflecting system in FIG. 3 according to an exemplary embodiment of the present disclosure;

FIG. 6 is a schematic diagram of a low-beam illumination light pattern with a bright-dark cut-off line;

FIG. 7 is a schematic diagram of a high-beam illumination light pattern with a central maximum value;

FIG. 8A and FIG. 8B are schematic diagrams of light paths of the optical reflecting system according to an exemplary embodiment of the present disclosure, wherein a first reflecting surface is a paraboloid-like surface;

FIG. 9 is a schematic diagram of the light path of the optical reflecting system having the first reflector and the second reflector according to an exemplary embodiment of the present disclosure;

FIG. 10 is a schematic diagram of a light path of light beams of the optical reflecting system in FIG. 9 in a horizontal direction according to an exemplary embodiment of the present disclosure;

FIG. 11 is a schematic diagram of a light path of light beams of the optical reflecting system in FIG. 9 in a vertical direction according to an exemplary embodiment of the present disclosure;

FIG. 12 is a schematic diagram of a light path of the vehicle lamp illumination device according to an exemplary embodiment of the present disclosure;

FIG. 13 is a schematic diagram of a light path of the vehicle lamp illumination device according to another exemplary embodiment of the present disclosure;

FIG. 14 and FIG. 15 are schematic diagrams of light paths of the vehicle lamp illumination device according to an exemplary embodiment of the present disclosure, wherein the primary optical system of the vehicle lamp illumination device includes a light source and a third reflector having a plurality of reflecting surfaces;

FIG. 16 and FIG. 17 are schematic diagrams of light paths of the vehicle lamp illumination device according to an exemplary embodiment of the present disclosure, wherein a cut-off line structure is formed at a lower boundary of the third reflector of the primary optical system of the vehicle lamp illumination device;

FIG. 18 to FIG. 20 are perspective views of the vehicle lamp illumination device having the light path shown in FIG. 15 according to an exemplary embodiment of the present disclosure;

FIG. 21 is a front view of the vehicle lamp illumination device shown in FIG. 18 according to an exemplary embodiment of the present disclosure;

FIG. 22 is a cross-sectional view of the vehicle lamp illumination device shown in FIG. 18 and FIG. 19 according to an exemplary embodiment of the present disclosure;

FIG. 23 is a light path diagram of the vehicle lamp illumination device shown in FIG. 22 according to an exemplary embodiment of the present disclosure;

FIG. 24 is a front view of the second reflector according to an exemplary embodiment of the present disclosure;

FIG. 25 is a longitudinally sectional view of the second reflector according to an exemplary embodiment of the present disclosure;

FIG. 26 is a transversely sectional view of the second reflector according to an exemplary embodiment of the present disclosure;

FIG. 27 is a front view of the first reflector according to an exemplary embodiment of the present disclosure;

FIG. 28 is a longitudinally sectional view of the first reflector according to an exemplary embodiment of the present disclosure;

FIG. 29 is a transversely sectional view of the first reflector according to an exemplary embodiment of the present disclosure;

FIG. 30 is a schematic diagram of a light path of the optical reflecting system according to another exemplary embodiment of the present disclosure, wherein the optical reflecting system includes a fourth reflector;

FIG. 31 is a schematic diagram of a light pattern formed after light of an LED light-emitting chip of 1 mm x 1 mm is reflected by a single rotating paraboloidal reflector when the LED light-emitting chip is arranged at a focal point of the single rotating paraboloidal reflector; and

FIG. 32 is a schematic diagram of a light pattern formed by projecting light of the LED light-emitting chip of 1 mm x 1 mm by the optical reflecting system when the LED light-emitting chip is arranged at a focal point of the optical reflecting system of the present disclosure.

Detailed Description of Embodiments

[0028] The present disclosure will be described in detail by means of exemplary embodiments with reference to the drawings. It is to be noted that exemplary embodiments of the present disclosure are intended to enable those ordinarily skilled in the art to easily carry out the present disclosure, and various embodiments of the present disclosure may be embodied in many different forms and should not be construed as being limited to the embodiments illustrated in the present disclosure. Correspondingly, the following detailed description of the present disclosure is merely for illustrative purpose, but is in no way limitation to the present disclosure. Besides, the same reference signs are used to denote the same components in various drawings.

[0029] It should also be noted that, for the sake of clarity, not all of the features of actual specific embodiments are described and shown in the description and drawings, and furthermore, in order to avoid obscuring the technical solutions focused in the present disclosure with unnecessary details, only device structures closely related to the technical solutions of the present disclosure are described and shown in the drawings and the description, while other details that are not relevant to the technical contents of the present disclosure and are known to those skilled in the art are omitted.

[0030] A vehicle lamp illumination device, in particular a headlamp of a vehicle, usually includes a primary optical system having a light source and an optical collimating element so as to achieve a satisfactory illumination light pattern. In some existing vehicle lamp illumination devices, a bidirectional collimating lens is used as an optical collimating element, but in cases where the vehicle lamp illumination device needs to obtain an illumination light pattern having a relatively large aspect ratio, the bidirectional collimating lens is generally manufactured to have a large volume and a relatively heavy weight, thereby resulting in low production efficiency and a relatively high cost.

[0031] In view of the above problems, the present disclosure provides an optical reflecting system for a vehicle lamp illumination device, and an exemplary embodiment of the vehicle lamp illumination device having the optical reflecting system according to the present disclosure is described below with reference to FIG. 1.

[0032] FIG. 1 is a schematic diagram of a vehicle lamp illumination device according to an exemplary embodiment of the present disclosure, with the vehicle lamp illumination device including a primary optical system and an optical reflecting system. The primary optical system has a light source 80, and the optical reflecting system is configured to reflect light of the light source 80 emitted via the primary optical system. The primary optical system may include a third reflector 70, and light beams emitted from the light source 80, after being reflected by the third reflector 70, can be received and reflected by the optical reflecting system to form an illumination light pattern of the vehicle lamp illumination device. The third reflector 70 in the primary optical system may be a paraboloid or paraboloid-like reflecting mirror, and a focal point of the optical reflecting system may be provided on a reflecting surface of the third reflector 70. In the shown exemplary embodiment, the optical reflecting system includes a first reflector having a first reflecting surface 10 and a second reflector having a second reflecting surface 20. The first reflecting surface 10 is configured to collimate light in a first direction, and the second reflecting surface 20 is configured to collimate light in a second direction orthogonal to the first direction. The first reflecting surface 10 and the second reflecting surface 20 have a curved shape represented by a contour line. The first reflecting surface 10 and the second reflecting surface 20 are each a curved surface formed by stretching corresponding contour line along a direction normal to a plane where the contour line is located. The optical reflecting system is configured such that light emitted from the primary optical system having the light source, after being reflected by the first reflector and the second reflector, is emitted in a form of approximately parallel light beams, so as to form the illumination light pattern of the vehicle lamp illumination device.

[0033] In the context of the present disclosure, the "light source" may denote, in particular, a source of light (e.g., a light-emitting device or apparatus). For example, the light source may be a light-emitting diode (LED) that emits light when activated. In the context of the present disclosure, the light source may be substantially any light source or light emitter, which includes but is not limited to the light-emitting diode (LED), the laser, the fluorescent lamp, the incandescent lamp, etc.

[0034] In the context of the present disclosure, the primary optical system is configured to receive light from the light source and to guide and transmit the received light so as to form primary light distribution, and the primary light distribution forms a desired illumination light pattern after being projected by the optical reflecting system.

[0035] In some embodiments, the first reflector may be a first reflecting mirror and the second reflector may be a second reflecting mirror. In some embodiments, either of the first reflector and the second reflector may be paraboloidal reflector. In the context of the present disclosure, the "paraboloidal reflector" means, in particular, a reflector having a reflecting surface with a cross-sectional shape that is paraboloidal in profile, wherein the reflecting surface is a curved surface formed by stretching a parabola along a direction normal to a plane where the parabola is located. In other words, a generatrix forming the reflecting surface is a parabola, and the reflecting surface of the paraboloidal reflector is a paraboloid formed by unidirectionally stretching a parabola. Each section line of the reflecting surface taken along a plane perpendicular to a stretching direction is corresponding to one focal point, and the reflecting surface is corresponding to one focal line.

[0036] In some embodiments, the illumination light pattern formed by the optical reflecting system shown in FIG. 1 may be a high-beam illumination light pattern having a central maximum value as shown in FIG. 7. The focal point of the optical reflecting system shown in FIG. 1 can be arranged on the reflecting surface of the third reflector 70, so as to form the high-beam light pattern as shown in FIG. 7, and the high-beam illumination light pattern has a light intensity central position (generally, a light-intensity central maximum value region), so as to comply with the light distribution requirement of having sufficiently large luminous intensity for high beam (referring to relevant regulations of national standard "Automobiles Headlamps with LED light sources and/or LED modules" (GB25991-2010)).

[0037] FIG. 2 shows a schematic diagram of a light path of the single rotating paraboloidal reflector. This single rotating paraboloidal reflector 50 is an axisymmetric secondary-curved reflecting mirror, and when the light source is located at a focal point 501, light beams emitted from the light source are reflected by the rotating paraboloidal reflector 50 to obtain parallel light beams.

[0038] Next, a basic configuration of the optical reflecting system according to the present disclosure is specifically described with reference to FIG. 3 to FIG. 7. FIG. 3 shows a schematic diagram of a light path of the optical reflecting system having the first reflector and the second reflector according to an exemplary embodiment of the present disclosure. FIG. 4 is a schematic diagram of a light path of light beams of the optical reflecting system in FIG. 3 in a vertical direction according to an exemplary embodiment of the present disclosure. FIG. 5 is a schematic diagram of a light path of light beams of the optical reflecting system in FIG. 3 in a horizontal direction according to an exemplary embodiment of the present disclosure.

[0039] In embodiments of the present disclosure, the light beams are collimated in two directions that are generally orthogonal to a propagation direction of the light beams. In addition, two collimating directions are orthogonal to each other. For example, the light beams can be collimated in a horizontal direction (e.g., x-y plane of coordinate system shown in FIG. 4) and in a vertical direction (e.g., z-direction). In the context of the present disclosure, for example, the horizontal direction and the vertical direction can be determined with respect to an arbitrary frame of reference, and the parallel light beams provided by the optical reflecting system are referred to as being horizontally collimated and vertically collimated.

[0040] As an example, the description will be made below with the first direction being the horizontal direction and the second direction being the vertical direction (i.e., the first reflecting surface 10 is configured to collimate the light beams in the horizontal direction and the second reflecting surface 20 is configured to collimate the light beams in the vertical direction).

[0041] In the context of the present disclosure, "collimation in the horizontal direction" can in particular mean that, with reference to FIG. 5, the first reflecting surface 10 exerts a convergence effect on the light beams in a horizontal section (i.e., a section taken along the horizontal direction), that is, being capable of having a certain collimating effect on the light beams, and compared with FIG. 4, the first reflecting surface 10 has no collimating effect on the light beams in a vertical section (i.e., a section taken along the vertical direction) (a section curve of the first reflecting surface 10 in the section taken along the vertical direction is a straight line), and the first reflecting surface 10 has a collimating effect on the light beams in a single direction within a horizontal sectional range, that is to say, a collimating direction of the first reflecting surface 10 is limited in the horizontal direction. "Collimation in the vertical direction" can in particular mean that, with reference to FIG. 4, the second reflecting surface 20 exerts a convergence effect on the light beams in a vertical section, that is, being capable of having a certain collimating effect on the light beams, and compared with FIG. 5, the second reflecting surface 20 has no collimating effect on the light beams in a horizontal section, and the second reflecting surface 20 has a collimating effect on the light beams in a single direction within a vertical sectional range, that is to say, a collimating direction of the second reflecting surface 20 is limited in the vertical direction. The second reflecting surface 20 has an optical characteristic of unidirectionally collimating the light beams emitted from the light source similar to that of the first reflecting surface 10.

[0042] As shown in FIG. 3, in some embodiments according to the present disclosure, the first reflecting surface 10 of the optical reflecting system can be configured to be capable of collimating light in the horizontal direction (see FIG. 5), and the second reflecting surface 20 can be configured to collimate light in the vertical direction (see FIG. 4). In cases where a focal length of the first reflecting surface 10 is smaller than a focal length of the second reflecting surface 20, according to the principle that the larger the focal length is, the smaller the formed image is, the optical reflecting system shown in FIG. 3 makes a degree of diffusion of the light beams in the horizontal direction greater than a degree of diffusion in the vertical direction, and an illumination light pattern that is relatively wide in the horizontal direction and relatively narrow in the vertical direction can be obtained, that is, an illumination light pattern that is wide left and right and narrow up and down can be formed. In some examples, the LED light-emitting chip of 1 mm x 1 mm is placed at a focal point of the single rotating paraboloid (such as a single rotating paraboloid 50 shown in FIG. 2) to form a square light spot as shown in FIG. 31. When the LED light-emitting chip of 1 mm x 1 mm is placed at a focal point of a bidirectional collimating optical reflecting system shown in FIG. 3 of the present disclosure, a rectangular asymmetric light spot shown in FIG. 32 is formed, and as the focal length of the first reflecting surface is smaller than that of the second reflecting surface, the length of the light spot shown in FIG. 32 in the horizontal direction is greater than that in the vertical direction.

[0043] As shown in FIG. 4 and FIG. 5, in some exemplary embodiments according to the present disclosure, the first reflecting surface 10 is a curved surface formed by stretching a paraboloid-shaped generatrix (a first contour line 15) along a direction (a first stretching direction A) normal to a plane where the generatrix is located, and the second reflecting surface 20 is a curved surface formed by stretching a paraboloid-shaped generatrix (a second contour line 25) in a direction (a second stretching direction B) normal to a plane where the generatrix is located. Specifically, the generatrix of the first reflecting surface 10 of the first reflector is the first contour line 15, the generatrix of the second reflecting surface 20 of the second reflector is the second contour line 25, and the direction normal to the plane where the first contour line 15 of the first reflecting surface 10 is located is the first stretching direction A, that is, the plane where the first contour line 15 of the first reflecting surface 10 is located is perpendicular to the first stretching direction A. The direction normal to the plane where the second contour line 25 of the second reflecting surface 20 of the second reflector is located is the second stretching direction B, that is, the plane where the second contour line 25 of the second reflecting surface 20 is located is perpendicular to the second stretching direction B. The second reflecting surface 20 has one focal line, and an intersection point of a vertical plane passing through a focal point 300 of the optical reflecting system and the focal line of the second reflecting surface 20 is a first focal point 200, the focal point 300 of the optical reflecting system and the first focal point 200 of the second reflecting surface 20 can be mirrored about a first stretching guide line 101 (see FIG. 4), and the first stretching guide line 101 is an intersection line of the vertical plane passing through the focal point 300 of the optical reflecting system and the first reflecting surface 10.

[0044] Since the focal point 300 of the optical reflecting system and the first focal point 200 of the second reflecting surface 20 are mirrored with respect to the first stretching guide line 101, a position of the focal point 300 of the optical reflecting system can be adjusted by adjusting a position of the first stretching guide line 101 with respect to the first focal point 200 of the second reflecting surface. In some embodiments, in cases where a contour line shape of the second reflecting surface 20 is determined, the position of the focal line of the second reflecting surface can be determined. A connecting line between the focal point 300 of the optical reflecting system and the first focal point 200 of the second contour line of the second reflecting surface 20 and the first stretching guide line 101 can form an angle b. Therefore, the angle b can be changed by changing a position of the first reflecting surface 10, so as to adjust the position of the focal point 300 of the optical reflecting system.

[0045] According to the configuration of the above exemplary embodiments of the present disclosure, as it is possible to adjust the position of the focal point 300 of the optical reflecting system by adjusting relative position of the first reflecting surface 10 with respect to the first focal point 200 of the second contour line of the second reflecting surface 20, flexible spatial structure arrangement of the two reflecting surfaces can be achieved while keeping a light-exiting direction unchanged, thus further improving applicability of the optical reflecting system on a vehicle.

[0046] In some embodiments, the contour line of each reflecting surface may include a parabola or a quasi-parabola. For example, as shown in FIG. 5, in some embodiments according to the present disclosure, the first contour line of the first reflecting surface 10 and the second contour line of the second reflecting surface 20 are both parabolas. If the light source is arranged at the focal point 300 of the optical reflecting system, the light beams emitted from the light source can achieve collimation in the horizontal direction after being reflected by the first reflecting surface 10, and then can achieve collimation in the vertical direction after being reflected by the second reflecting surface 20.

[0047] FIG. 8A is a schematic diagram of a light path of light beams of the optical reflecting system in the vertical direction according to another exemplary embodiment of the present disclosure, and FIG. 8B is a schematic diagram of a light path of light beams of the optical reflecting system in the horizontal direction according to another exemplary embodiment of the present disclosure. As shown in FIG. 8A and FIG. 8B, in some embodiments according to the present disclosure, the first contour line of the first reflecting surface 10 may be a quasi-parabola, and the second contour line of the second reflecting surface 20 may be a parabola. Shapes of the contour lines of the reflecting surfaces of the reflectors are configured such that the light beams reflected by the reflecting surfaces exhibit a light diffusion angle. In the embodiment where the first reflecting surface 10 is a quasi-parabola as shown in FIG. 8, the optical reflecting system is configured such that parallel light beams are converged to a line segment or an area near the line segment after being reflected by the first reflecting surface 10 and the second reflecting surface 20. In other words, if the light source is arranged near the focal point 300 of the optical reflecting system, i.e., the light beams emitted from the light source, after being reflected by the first reflecting surface 10, can be diffused in the horizontal direction, for example, diffused at a certain diffusion angle (for example, see an angle a in FIG. 8), and then can achieve collimation in the vertical direction after being reflected by the second reflecting surface 20. Preferably, the diffusion angle in the horizontal direction is in a range between 5 ° and 60 °.

[0048] The shape of the contour line of each of the first reflecting surface and the second reflecting surface can be set such that the light diffusion angle of the light beams obtained after being reflected by each of the first reflecting surface and the second reflecting surface changes as the shape of the contour line of each of the first reflecting surface and the second reflecting surface changes. Therefore, by changing the shape of the first contour line of the first reflecting surface, the diffusion angle of the light beams reflected by the first reflecting surface in the horizontal direction can be adjusted, and/or by changing the shape of the second contour line of the second reflecting surface, the diffusion angle of the light beams reflected by the second reflecting surface in the vertical direction can be adjusted.

[0049] According to the configuration of the above exemplary embodiments of the present disclosure, by changing the shape of the contour line of one or both of the first reflecting surface and the second reflecting surface, the light diffusion angle of the light beams reflected by corresponding reflecting surfaces can be adjusted. Therefore, the shapes of the first reflecting surface and the second reflecting surface can be separately set according to requirements of a light diffusion range of a specific illumination light pattern in the horizontal direction and the vertical direction, thus improving the design flexibility.

[0050] FIG. 9 to FIG. 11 are schematic diagrams of light paths of the optical reflecting system according to another exemplary embodiment of the present disclosure. FIG. 9 is a schematic diagram of the light path of the optical reflecting system having the first reflector and the second reflector according to an exemplary embodiment of the present disclosure. FIG. 10 is a schematic diagram of the light path of light beams of the optical reflecting system in FIG. 9 in the horizontal direction according to an exemplary embodiment of the present disclosure. FIG. 11 is a schematic diagram of the light path of light beams of the optical reflecting system in FIG. 9 in the vertical direction according to an exemplary embodiment of the present disclosure. Hereinafter, differences between the optical reflecting system shown in FIG. 3 and the optical reflecting system shown in FIG. 9 are described.

[0051] Compared with the exemplary embodiment shown in FIG. 3, the first reflecting surface 10 of the optical reflecting system shown in FIG. 9 is configured to be capable of collimating light in the vertical direction, and the second reflecting surface 20 is configured to collimate light in the horizontal direction. In cases where the focal length of the first reflecting surface is smaller than the focal length of the second reflecting surface, according to the principle that the larger the focal length is, the smaller the formed image is, the optical reflecting system shown in FIG. 9 makes a degree of diffusion of the light beams in the horizontal direction smaller than a degree of diffusion in the vertical direction, and an illumination light pattern that is relatively narrow in the horizontal direction and relatively wide in the vertical direction can be obtained, that is, an illumination light pattern that is narrow left and right and wide up and down can be formed.

[0052] In some other embodiments, the focal length of the first reflecting surface can be set to be greater than the focal length of the second reflecting surface.

[0053] Therefore, according to the optical reflecting system of the present disclosure, by setting the focal length of the first reflecting surface of the first reflector to be different from the focal length of the second reflector, an illumination light pattern with a relatively large aspect ratio can be realized. The first reflector and the second reflector of the optical reflecting system of the present disclosure can be constructed and arranged relatively independently, with high design flexibility, and the light path direction and diffusion range of the light beams in the horizontal direction and the vertical direction can be effectively controlled, so that an ideal illumination light pattern can be obtained according to needs, and meanwhile, the light distribution requirements of the national standard GB25991-2010 for vehicle lamp illumination devices can be met.

[0054] FIG. 12 is a schematic diagram of a light path of the vehicle lamp illumination device according to an exemplary embodiment of the present disclosure. As shown in FIG. 12, in some embodiments according to the present disclosure, the primary optical system includes a light source 80 and a third reflector (e.g. third reflecting mirror) 701, the third reflector 701 of the primary optical system shown in FIG. 12 can be an ellipsoid or ellipsoid-like reflecting mirror, a light shielding plate is provided in front of the reflecting mirror, and the light shielding plate includes a cut-off line structure 60. This cut-off line structure 60 is configured to form an illumination light pattern having a bright-dark cut-off line. The focal point of the optical reflecting system can be disposed on the cut-off line structure 60, and the vehicle lamp illumination device correspondingly forms a low-beam illumination light pattern having the bright-dark cut-off line as shown in FIG. 6. Preferably, the cut-off line structure 60 is provided between the third reflector 701 and the optical reflecting system including the first reflector and the second reflector. The primary optical system is configured to substantially converge the light beams emitted from the light source 80 to the focal point or a focusing area of the optical reflecting system through the third reflector 701, and the focal point of the optical reflecting system can be provided on the cut-off line structure 60, such that the illumination light pattern having the bright-dark cut-off line can be formed.

[0055] FIG. 13 is a schematic diagram of a light path of the vehicle lamp illumination device according to another exemplary embodiment of the present disclosure, and as shown in FIG. 13, in some embodiments according to the present disclosure, the primary optical system of the vehicle lamp illumination device includes a light source 80 and a condenser 702. The condenser 702 may be a transparent light guide body, and the condenser 702 can be configured to receive light emitted from the light source 80, collimate and concentrate the received light, and guide it to the optical reflecting system. A cut-off line structure 600 is provided at a lower edge of a light emergent surface of the condenser 702, the focal point of the optical reflecting system can be provided on the cut-off line structure 600, and the vehicle lamp illumination device shown in FIG. 13 can form the low-beam illumination light pattern having the bright-dark cut-off line as shown in FIG. 6.

[0056] In the context of the present disclosure, the bright-dark cut-off line refers to a dividing line where a significant change in brightness is visually perceived when light beams are transmitted to a light distribution screen. Therefore, by making the focal point of the optical reflecting system to be provided on the cut-off line structure 60 or 600, a low-beam illumination light pattern with a clear bright-dark cut-off line can be obtained. It can be seen from FIG. 6 that, when the vehicle lamp illumination device including the optical reflecting system according to the present disclosure performs a light distribution test, a low-beam light pattern projected on the light distribution screen has an obvious bright-dark cut-off line, which complies with relevant regulations of the current national standard "Automobiles Headlamps with LED light sources and/or LED modules" (GB25991-2010): there is no situation where multiple bright-dark cut-off lines are visually visible.

[0057] As shown in FIG. 14, in some exemplary embodiments of the present disclosure, the vehicle lamp illumination device includes the primary optical system and the optical reflecting system, wherein the primary optical system includes a plurality of light sources 800 and the third reflector 703 having a plurality of reflecting surfaces, for example, this primary optical system includes 5 light sources 800 and the third reflector 703 having 5 reflecting surfaces. The optical reflecting system includes the first reflecting surface 10 and the second reflecting surface 20, the focal point of the optical reflecting system can be provided on the third reflector 703 having 5 reflecting surfaces, and the vehicle lamp illumination device can form an ADB light patterns having five light spots, thus, high-beam ADB illumination is achieved.

[0058] As shown in FIG. 15, in some exemplary embodiments of the present disclosure, the vehicle lamp illumination device may include the primary optical system and the optical reflecting system, wherein the primary optical system includes a plurality of light sources 800 and a third reflector 704 having a plurality of reflecting surfaces, and the optical reflecting system includes a plurality of first reflecting surfaces and one second reflecting surface 20. For example, as shown in FIG. 15, this primary optical system includes 20 light sources 800 and the third reflector 704 having 20 reflecting surfaces, and the optical reflecting system includes four first reflecting surfaces 11, 12, 13, and 14 and one second reflecting surface 20. The vehicle lamp illumination device shown in FIG. 15 can form an illumination area having 20 light spots (four groups in total, and five light spots in each group), and the 4 groups of illumination areas are superposed in an alternating manner to form an ADB light pattern with narrower pixels, so that the high-beam ADB illumination can be achieved and the control accuracy of the light pattern is higher. Compared with the vehicle lamp illumination device shown in FIG. 14, the vehicle lamp illumination device shown in FIG. 15 can form multiple sets of matrix light patterns, and a plurality of pixels arranged side by side and connected to each other can be formed after the multiple sets of matrix light patterns are superposed, so that the control accuracy of the high-beam ADB light pattern is higher. In some embodiments, the primary optical system can be configured to cooperate with the optical reflecting system so as to form multiple sets of matrix illumination light patterns.

[0059] As shown in FIG. 16, in some exemplary embodiments of the present disclosure, the vehicle lamp illumination device may include the primary optical system and the optical reflecting system, wherein the primary optical system may include the light source 800 and a third reflector 705, and a cut-off line structure 600 is formed at a lower boundary of the third reflector 705. The optical reflecting system can include the first reflecting surface 10 and the second reflecting surface 20, and the focal point of the optical reflecting system can be provided on the cut-off line structure 600. The vehicle lamp illumination device can form the low-beam illumination light pattern having the bright-dark cut-off line as shown in FIG. 6.

[0060] The vehicle lamp illumination device of an exemplary embodiment of the present disclosure shown in FIG. 17 is substantially the same as the vehicle lamp illumination device of the exemplary embodiment of the present disclosure shown in FIG. 16, except that the first reflecting surface 10 and the second reflecting surface 20 of the optical reflecting system of the vehicle lamp illumination device of the exemplary embodiment of the present disclosure shown in FIG. 17 are provided at different positions with respect to the light source. Specifically, in the embodiment shown in FIG. 16, both the first reflector and the second reflector can be provided on an upper side of the light source 800 in the vertical direction, and light is emitted from above the light source after being collimated and reflected by the first reflector and the second reflector. While in the embodiment shown in FIG. 17, both the first reflector and the second reflector can be provided on a lower side of the light source 800 in the vertical direction, and light is emitted below the light source after being collimated and reflected by the first reflector and the second reflector. Therefore, positions of the first reflector and the second reflector with respect to the light source can be designed according to a space inside a specific vehicle lamp body, thus increasing the adaptability of the vehicle lamp illumination device including the optical reflecting system and being applicable to various types of vehicle lamps.

[0061] In some embodiments, two reflectors can be adjacently provided on the same side of the light source (see FIG. 12 or FIG. 13). In some embodiments, the two reflectors can be provided at two opposite sides of the light source (see FIG. 17), thereby significantly saving installation space, improving space utilization rate, reducing the overall size of the optical reflecting system, and thus greatly improving the applicability of the vehicle lamp illumination device including the optical reflecting system on vehicles.

[0062] Therefore, relative positions of the first reflecting surface 10 of the first reflector and the second reflecting surface 20 of the second reflector in the optical reflecting system can be flexibly adjusted and changed, so as to better adapt to an installation space of the vehicle lamp illumination device.

[0063] In some embodiments of the present disclosure, the optical reflecting system for a vehicle lamp illumination device further may include a plurality of additional reflectors, for example, in some embodiments, the optical reflecting system further may include a fourth reflector configured to adjust parameters such as direction of light, and the fourth reflector includes a fourth reflecting surface 400. In some embodiments, the fourth reflector is a plane reflecting mirror configured to change only the light direction. In some other embodiments, the fourth reflector also may be configured to be of a curved-surface shape, and the fourth reflector of a curved surface shape not only can change the light direction, but also can perform light distribution again on the light, so that the light pattern effect is better.

[0064] In the context of the present disclosure, the light emitted from the light source can exit via the optical reflecting system along the light path direction.

[0065] In some embodiments, the fourth reflector can be provided downstream of the light source and upstream of the first reflector along the light path direction and configured to receive light emitted from the light source of the primary optical system and reflect the received light to the first reflector.

[0066] In some embodiments, the fourth reflector can be provided between the first reflector and the second reflector, and is configured to receive and reflect the light collimated by the first reflector to the second reflector, and the fourth reflector, as an additional light distribution element for further adjusting parameters such as the direction of the light, is conducive to re-distribution of the light collimated and reflected by the first reflector and then reflection of the light to the second reflecting mirror, so as to form an ideal illumination light pattern that meets the illumination requirements.

[0067] In some other embodiments, as shown in FIG. 30, the fourth reflector can be provided downstream of the second reflector along the light path direction, that is, the fourth reflecting surface 400 of the fourth reflector can be provided downstream of the second reflecting surface 20 along the light path direction and configured to receive and reflect the light collimated and reflected by the second reflecting surface 20 to form the illumination light pattern. Therefore, the fourth reflector, as an additional light distribution element, is conducive to re-distribution of the light collimated and reflected by both the first reflector and the second reflector, so as to form the ideal illumination light pattern that meets the illumination requirements.

[0068] The optical reflecting system according to the above embodiments may include the first reflector, the second reflector, and the additional fourth reflector, wherein the first reflector, the second reflector, and the additional fourth reflector can be used to collectively form the focal point of the optical reflecting system. By means of the configuration of the optical reflecting system of the above embodiments, an emergent direction of light emitted from the light source can be better adjusted through multi-level reflection, thereby better forming a desired light pattern. It should be understood that the number of reflectors and the relative positions of various reflectors can be chosen according to the light pattern desired to be formed and light distribution requirements.

[0069] The vehicle lamp illumination device of an exemplary embodiment of the present disclosure having the light path shown in FIG. 15 is described with reference to FIG. 18 to FIG. 29.

[0070] As shown in FIG. 18 to FIG. 29, in some embodiments according to the present disclosure, the vehicle lamp illumination device includes the primary optical system and the optical reflecting system, wherein the primary optical system includes the light source 800 and the third reflector 700 having a plurality of reflecting surfaces, and the optical reflecting system includes a plurality of first reflecting surfaces 10 (e.g. having 6 first reflecting surfaces) and one second reflecting surface 20. Referring to FIG. 19, the first reflecting surface 10 of the first reflector 110 is of a linear shape in a section taken along a longitudinal direction (a vertical direction) (see FIG. 28), and the first reflecting surface 10 of the first reflector 110 is of a parabola shape in a section taken along a transverse direction (a horizontal direction) (see FIG. 29). In other words, the first reflecting surface 10 of the first reflector 110 has a curved shape characterized by a parabola, wherein the curved shape is a curved surface of the parabola which is stretched along a direction normal to a plane where the parabola is located. Therefore, the first reflector 110 is a paraboloidal reflector and is configured to collimate light in the horizontal direction.

[0071] Referring to FIG. 19, the second reflector 210 includes the second reflecting surface 20. The second reflecting surface 20 of the second reflector 210 is of a parabola shape in a section taken along a longitudinal direction (a vertical direction) (see FIG. 25), and the second reflecting surface 20 of the second reflector 210 is of a linear shape in a section taken along a transverse direction (a horizontal direction) (see FIG. 26). In other words, the second reflecting surface 20 of the second reflector 210 has a curved shape characterized by a parabola, wherein the curved shape is a curved surface of the parabola which is stretched along a direction normal to a plane where the parabola is located. Therefore, the second reflector 210 is a paraboloidal reflector and is configured to collimate light in the vertical direction.

[0072] According to the above configurations of the exemplary embodiments of the present disclosure, as two reflectors are employed to collimate and converge the light beams emitted from the light source in two directions substantially orthogonal to each other, compared with the existing collimating lens elements, the optical reflecting system of the present disclosure has a simple and compact structure design, is easy to manufacture, further improves the production efficiency, and has significant cost effectiveness.

[0073] As shown in FIG. 18 to FIG. 29, in some embodiments according to the present disclosure, the first reflecting surface 10 of the first reflector 110 and the second reflecting surface 20 of the second reflector 210 of the optical reflecting system are achieved by plating with a plating material. In some examples, the first reflecting surface 10 and the second reflecting surface 20 are achieved by plating aluminum or silver. In some embodiments, the plating material of the first reflecting surface 10 of the first reflector 110 and the second reflecting surface 20 of the second reflector 210 of the optical reflecting system may include, but not limited to, aluminum, chromium, nickel, silver, and gold.

[0074] Referring to FIG. 20, the first reflector 110 and the third reflector 700 can be formed as one piece, the first reflector 110 and the second reflector 210 are separately manufactured, and the first reflector 110 and the second reflector 210 are detachably assembled in place in the vehicle lamp illumination device by fastening connectors (for example, screws) 33. In some embodiments, the first reflector 110 and the second reflector 210 are assembled in place in the vehicle lamp illumination device by means of snap-fit connection, bonding, riveting, welding, etc., so as to ensure that the optical reflecting system, as a whole, is accurately positioned in a lamp body, is well fixed, and avoids movement. In some other embodiments, the first reflector 110 and the second reflector 210 can be integrally formed. It should be appreciated that in some embodiments, various reflectors selected can be constructed in pairs as one piece depending on an actual lamp body space while meeting the illumination requirements.

[0075] Referring to FIG. 18 to FIG. 20, the vehicle lamp illumination device further includes a circuit board 31 for installing the light source 800, the circuit board 31 is provided thereon with a radiator 32, the radiator 32 can improve heat dissipation performance of the circuit board 31, prevent the temperature of the light source 800 from being too high, and improve the stability of the light source 800. The third reflector 700 provided below the light source of the primary optical system and the first reflector 110 having the first reflecting surface 10 form an integral structure, and the integral structure formed by the third reflector 700 and the first reflector 110 is connected to the second reflector 210 having the second reflecting surface 20, the circuit board 31, and the radiator 32 through the fastening connectors 33. Referring to exemplary light path diagram shown in FIG. 23, the light beams emitted from the light source 800 first are partially converged by the third reflector 700, after being reflected by the first reflecting surface 10 of the first reflector 110, collimation in the horizontal direction can be achieved, and after being reflected by the second reflecting surface 20 of the second reflector 210, collimation in the vertical direction can be achieved. By setting the focal length of the first reflecting surface 10 to be different from the focal length of the first reflecting surface 20, an ideal illumination light pattern with a relatively large aspect ratio can be formed according to actual requirements.

[0076] The present disclosure has been described above with reference to the drawings and the description of the embodiments, but the present disclosure is not limited to the above embodiments. Those skilled in the art could understand that modifications and variations could be made without departing from the technical idea of the present disclosure, and these modifications and variations are also included in the scope of protection of the present disclosure.

Industrial Applicability

[0077] The present disclosure provides the optical reflecting system for a vehicle lamp illumination device, wherein the optical reflecting system can realize collimation and convergence of light beams from the light source in two directions substantially orthogonal to each other. Compared with the existing collimating lens element, the optical reflecting system of the present disclosure has a simple and compact structure design, is easy to manufacture, further improves production efficiency, and has significant cost effectiveness. According to the vehicle lamp illumination device including the optical reflecting system of the present disclosure, by setting the focal length of the first reflecting surface of the first reflector to be different from the focal length of the second reflector, the illumination light pattern having a relatively large aspect ratio can be obtained.

[0078] Besides, it can be understood that the optical reflecting system and the vehicle lamp illumination device in the present disclosure may be reproduced, and may be used in a variety of industrial applications. For example, the optical reflecting system in the present disclosure can be applied to vehicle lamp illumination devices that need to form an illumination light pattern with a relatively large aspect ratio.

Claims

1. An optical reflecting system, applicable for a vehicle lamp illumination device, the vehicle lamp illumination device comprising a primary optical system having a light source, and the optical reflecting system being configured to reflect a light emitted from the light source of the primary optical system, **charac-**

terized in that
the optical reflecting system comprises a first reflector having a first reflecting surface and a second reflector having a second reflecting surface, the first reflecting surface is configured to collimate the light in a first direction, and the second reflecting surface is configured to collimate the light in a second direction orthogonal to the first direction, the first reflecting surface and the second reflecting surface have a curved shape represented by a contour line, the first reflecting surface and the second reflecting surface are each a curved surface formed by stretching a corresponding contour line along a direction normal to a plane where the contour line is located, and the optical reflecting system is configured such that light beams emitted from the primary optical system having the light source, after being reflected by the first reflector and reflected by the second reflector, are emitted in a form of approximately parallel light beams, so as to form an illumination light pattern of the vehicle lamp illumination device.

2. The optical reflecting system according to claim 1, wherein the contour line comprises a parabola or a quasi-parabola.

3. The optical reflecting system according to claim 2, wherein the first direction is a horizontal direction or a vertical direction.

4. The optical reflecting system according to claim 1, wherein a shape of the contour line of each of the first reflecting surface and the second reflecting surface is set such that a light diffusion angle of a light obtained after being reflected by each of the first reflecting surface and the second reflecting surface changes as the shape of the contour line of each of the first reflecting surface and the second reflecting surface changes.

5. The optical reflecting system according to claim 4, wherein a focal length of the first reflecting surface is configured to be different from a focal length of the second reflecting surface.

6. The optical reflecting system according to any one of claims 1 to 5, wherein the first reflector and the second reflector are adjacently provided on the same side of the light source, or the first reflector and the second reflector are provided at two opposite sides of the light source.

7. The optical reflecting system according to any one of claims 1 to 5, wherein the primary optical system is a primary optical system having a cut-off line structure, and a focal point of the optical reflecting system is provided at the cut-off line structure.

8. The optical reflecting system according to any one of claims 1 to 5, wherein the first reflector comprises a plurality of first reflecting surfaces, the optical reflecting system is configured such that a light emitted from the primary optical system having the light source, after being reflected by the first reflector and reflected by the second reflector, is emitted in a form of approximately parallel light beams, so as to form a matrix illumination light pattern of the vehicle lamp illumination device.

9. The optical reflecting system according to any one of claims 1 to 5, wherein the first reflecting surface and the second reflecting surface of the optical reflecting system are formed by plating with a plating material.

10. The optical reflecting system according to claim 9, wherein the plating material of the first reflecting surface and the second reflecting surface is at least one of aluminum, chromium, nickel, silver, and gold.

11. The optical reflecting system according to any one of claims 1 to 5, wherein the first reflector and the second reflector are separately manufactured and are assembled in place in the vehicle lamp illumination device by fastening connectors.

12. The optical reflecting system according to any one of claims 1 to 5, wherein the first reflector and the second reflector are integrally molded.

13. The optical reflecting system according to any one of claims 1 to 5, wherein the primary optical system comprises a third reflector, and the third reflector is configured to reflect a light from the light source and guide the light to the optical reflecting system.

14. The optical reflecting system according to any one of claims 1 to 5, wherein the primary optical system comprises a condenser, the condenser is configured to collimate and converge a light from the light source and guide the light to the optical reflecting system, and a cut-off line structure is provided at a lower edge of a light emergent surface of the condenser.

15. The optical reflecting system according to any one of claims 1 to 5, wherein the optical reflecting system comprises an additional fourth reflector, and the first reflector, the second reflector, and the fourth reflector are configured to jointly form a focal point or a focusing area of the optical reflecting system.

16. A vehicle lamp illumination device, **characterized in that** the vehicle lamp illumination device comprises the optical reflecting system according to any one of claims 1 to 15.

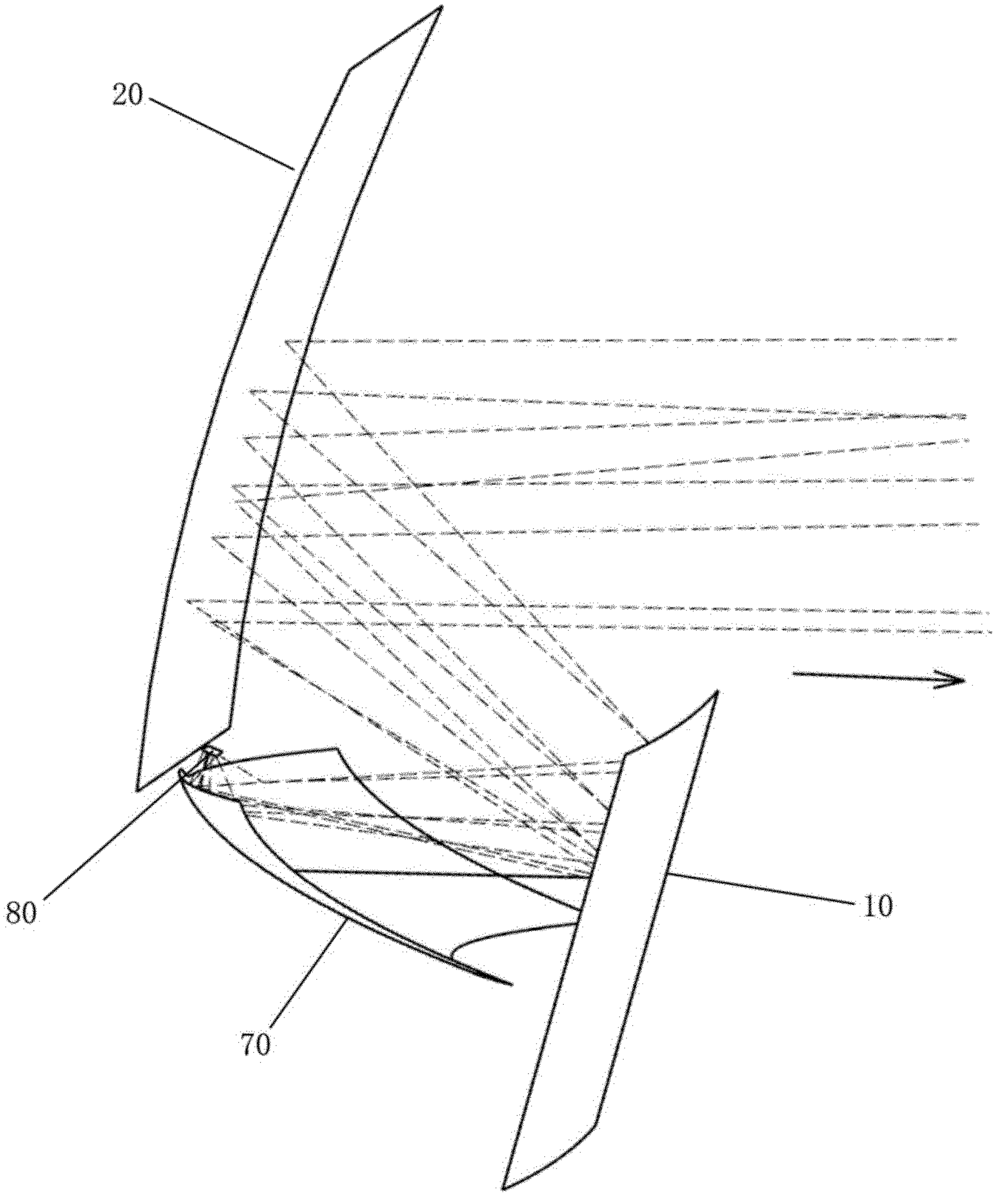

FIG. 1

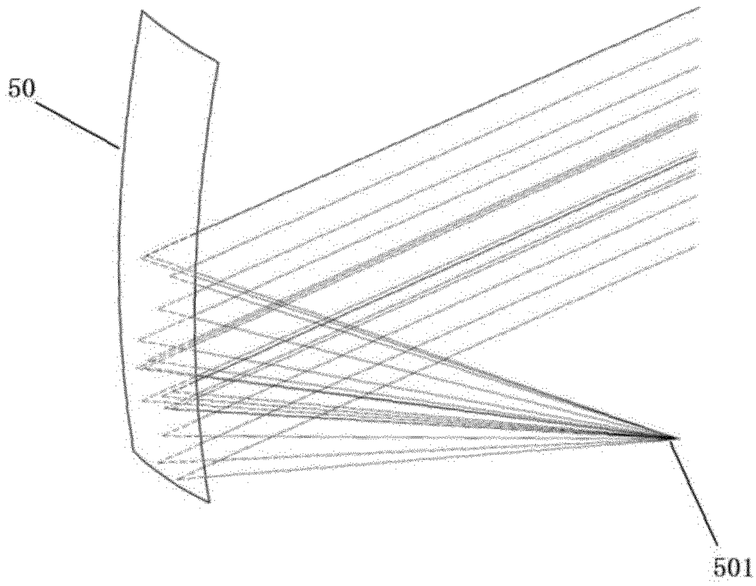

FIG. 2

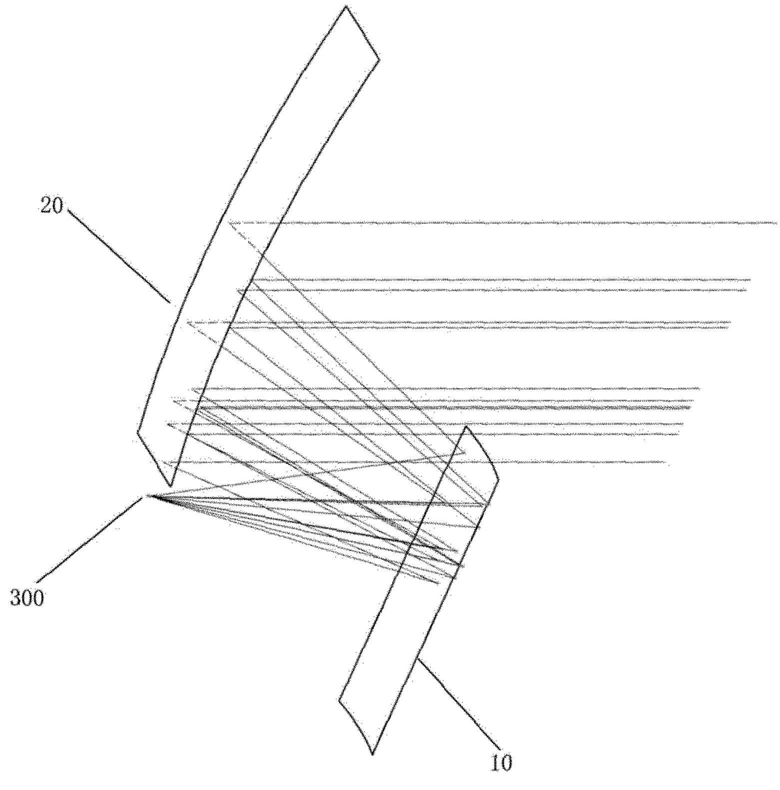

FIG. 3

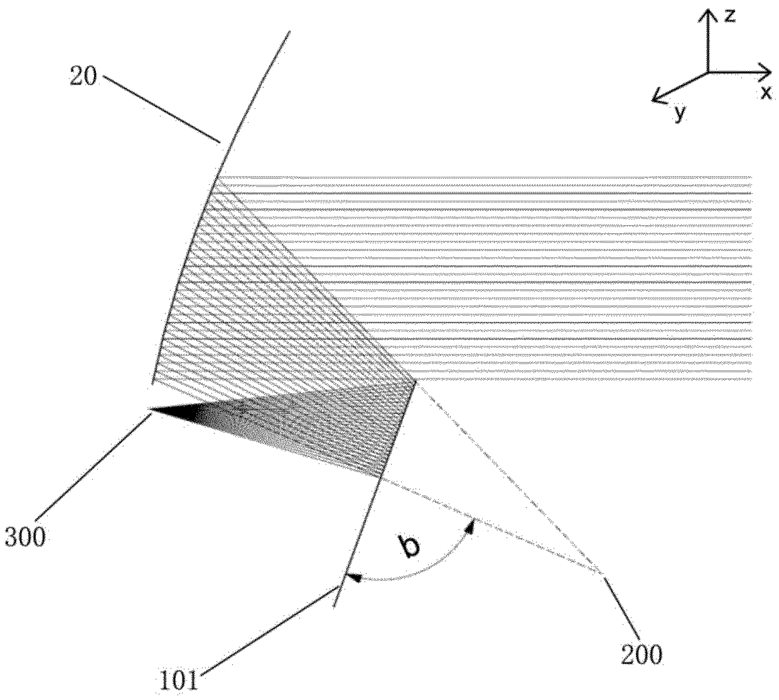

FIG. 4

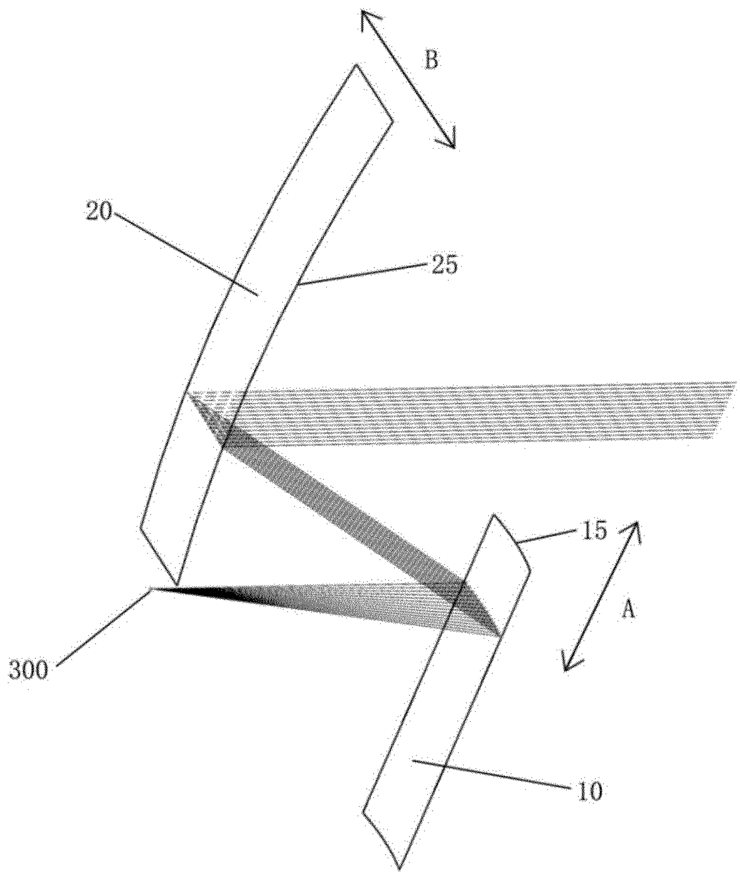

FIG. 5

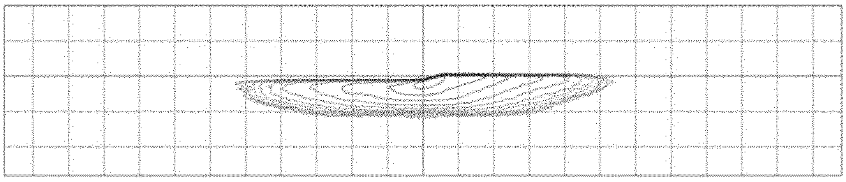

FIG. 6

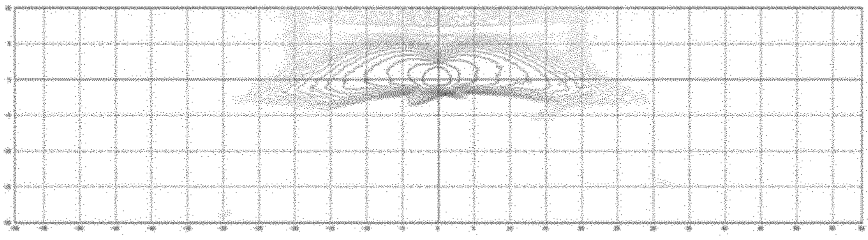

FIG. 7

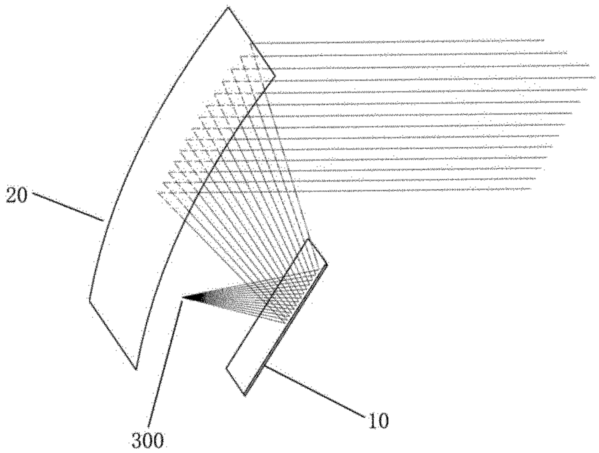

FIG. 8A

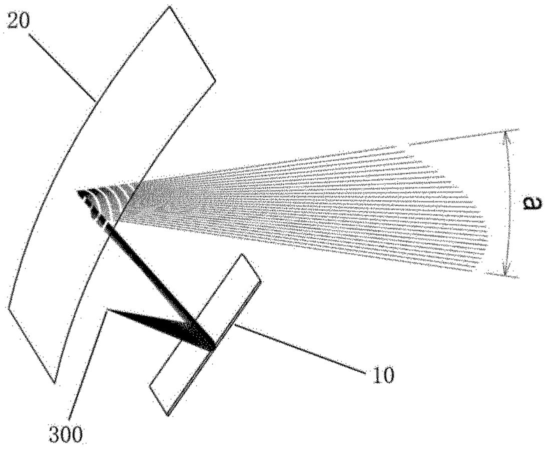

FIG. 8B

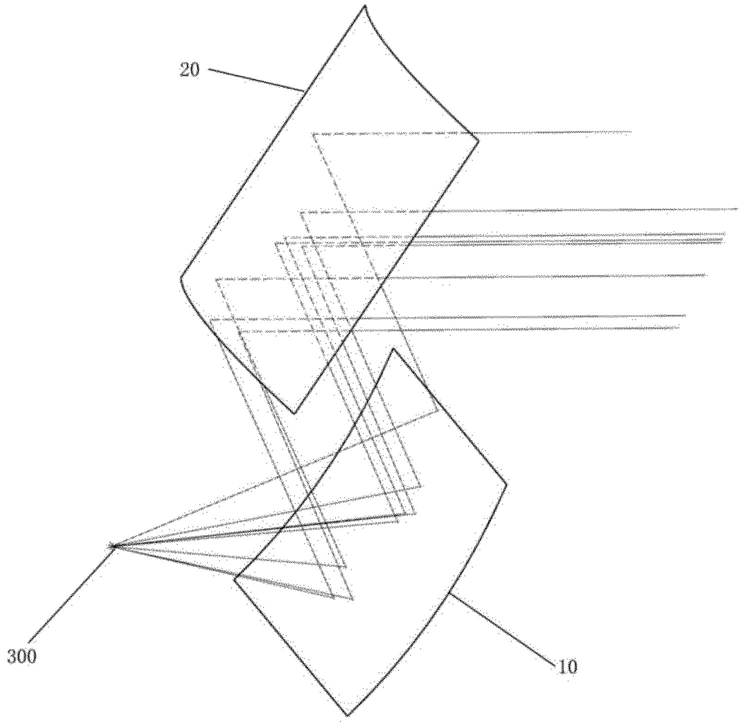

FIG. 9

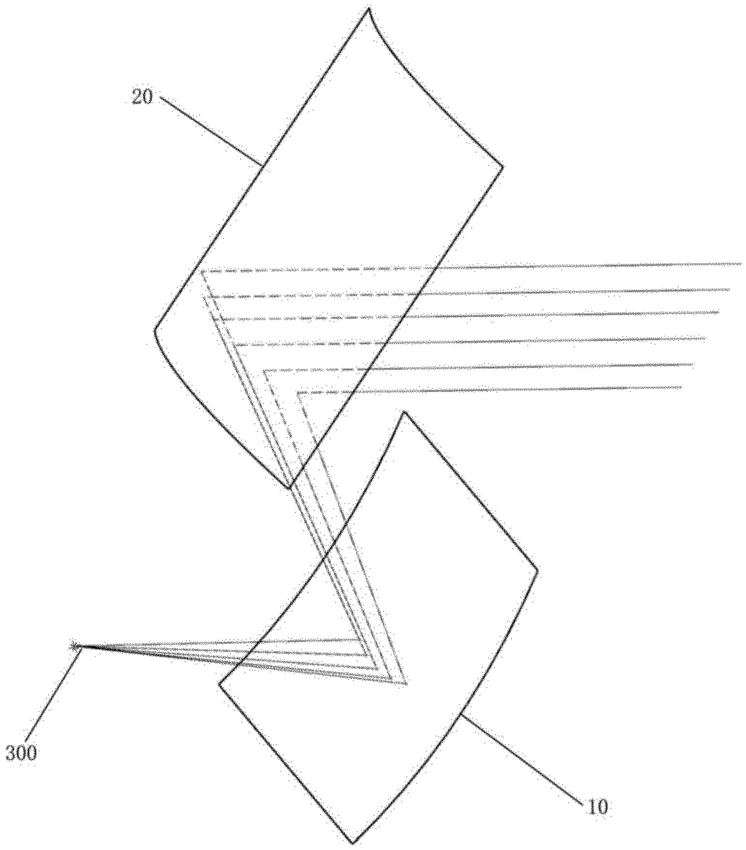

FIG. 10

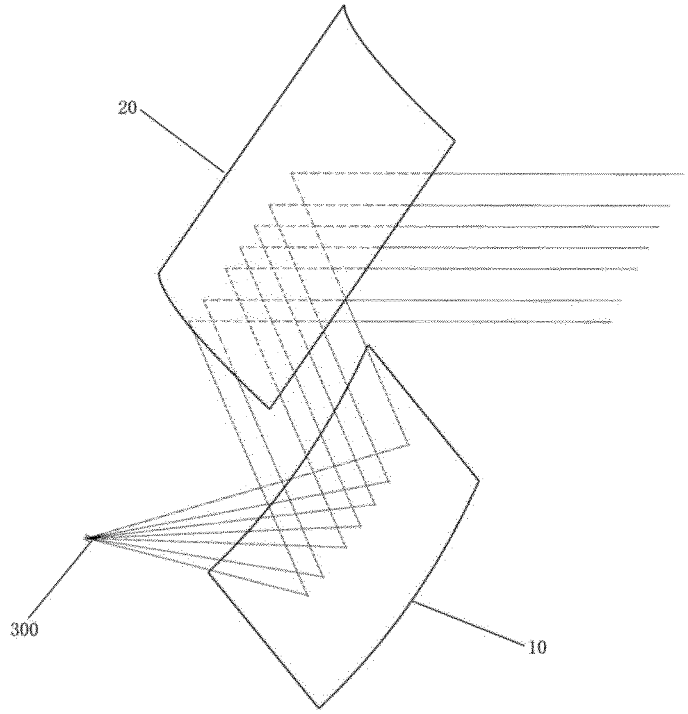

FIG. 11

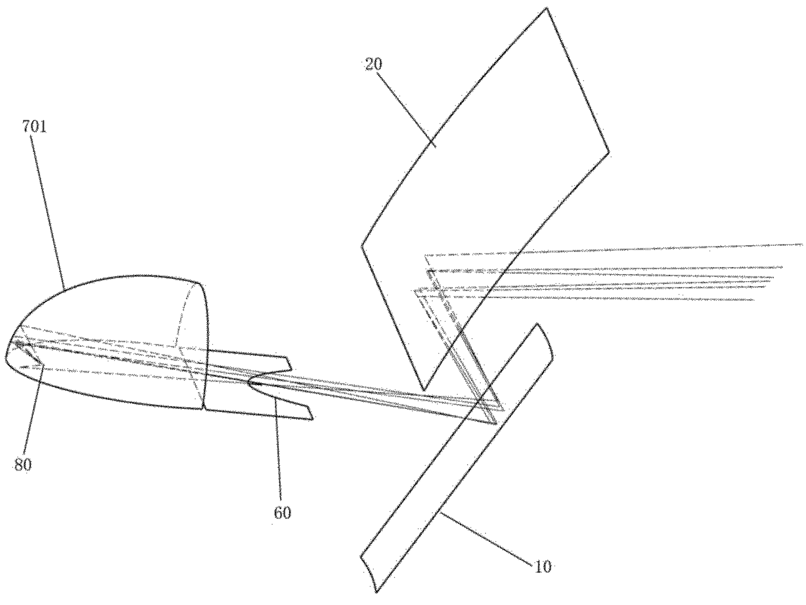

FIG. 12

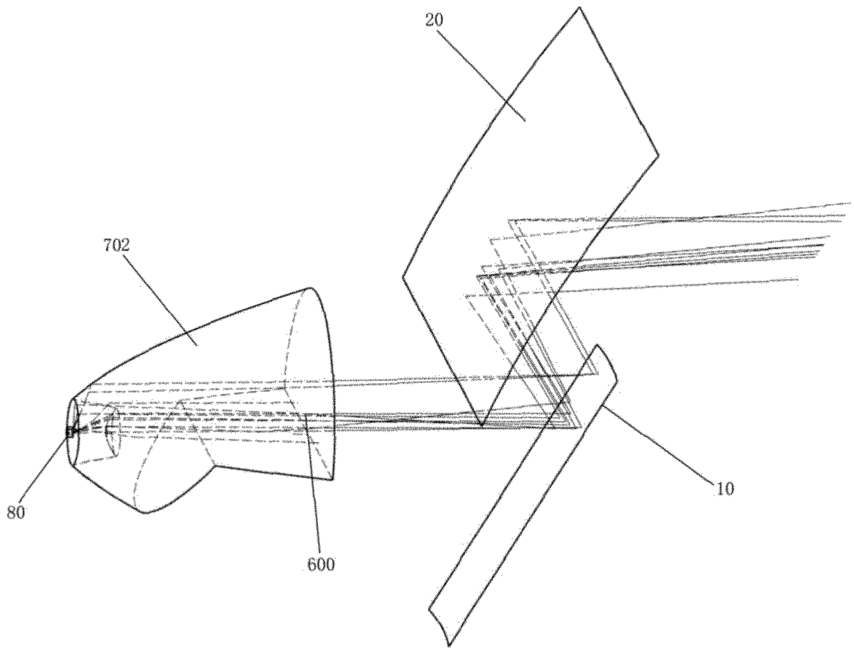

FIG. 13

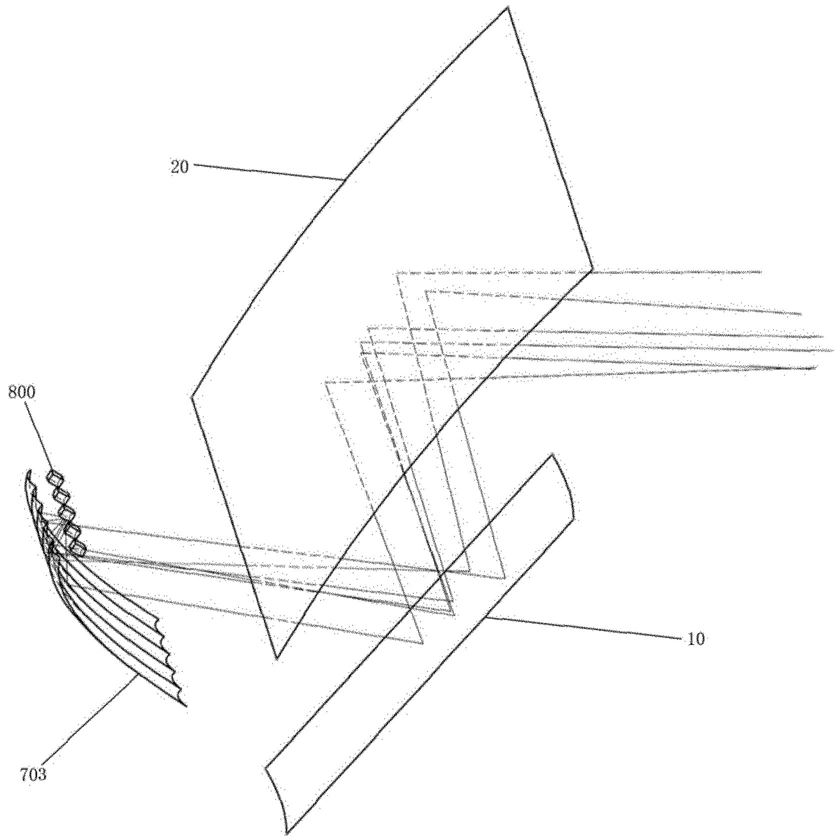

FIG. 14

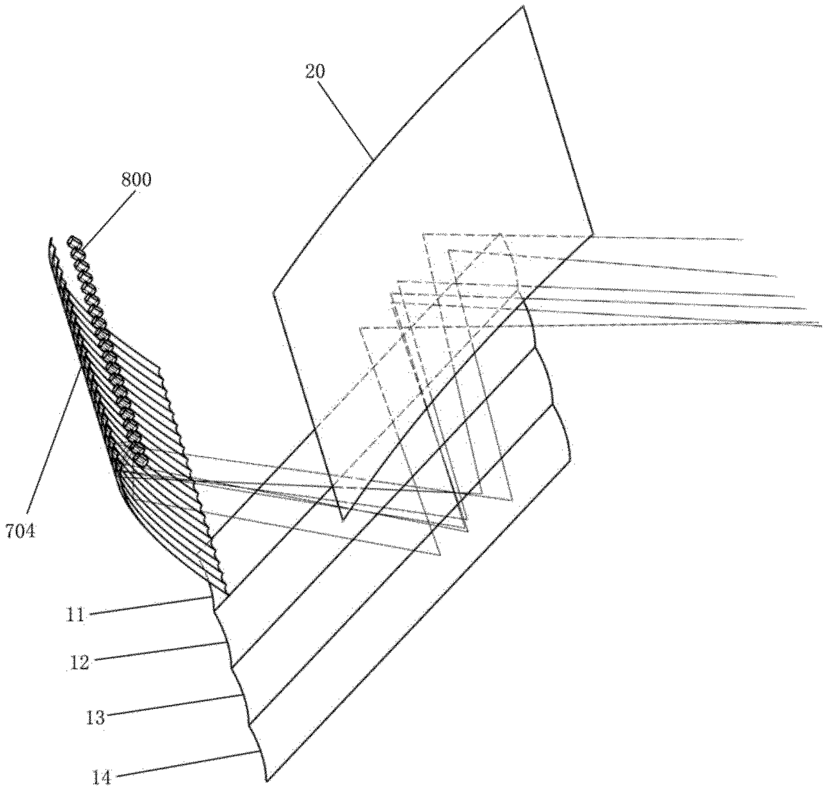

FIG. 15

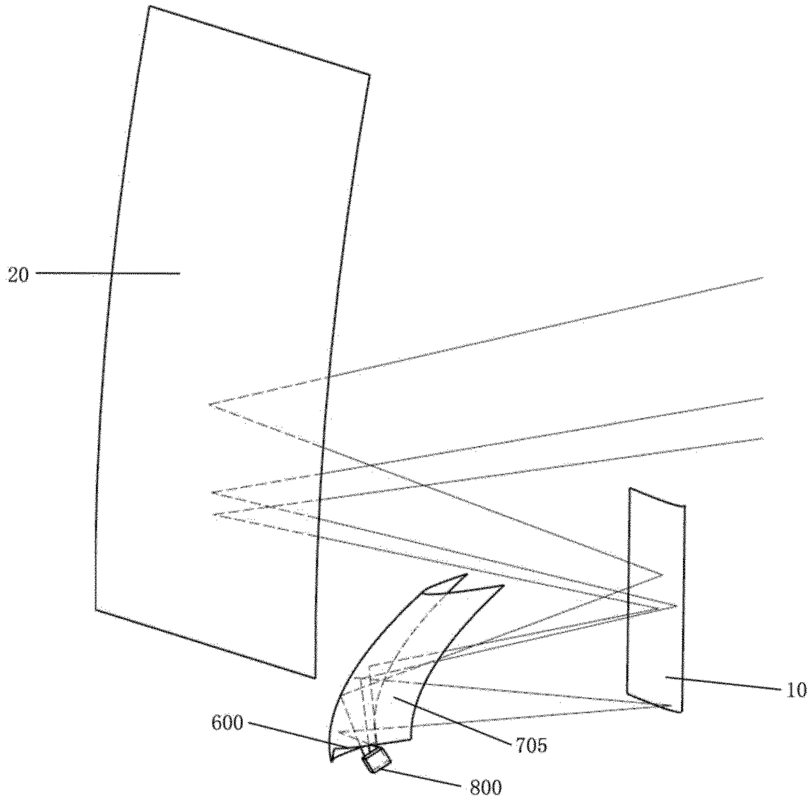

FIG. 16

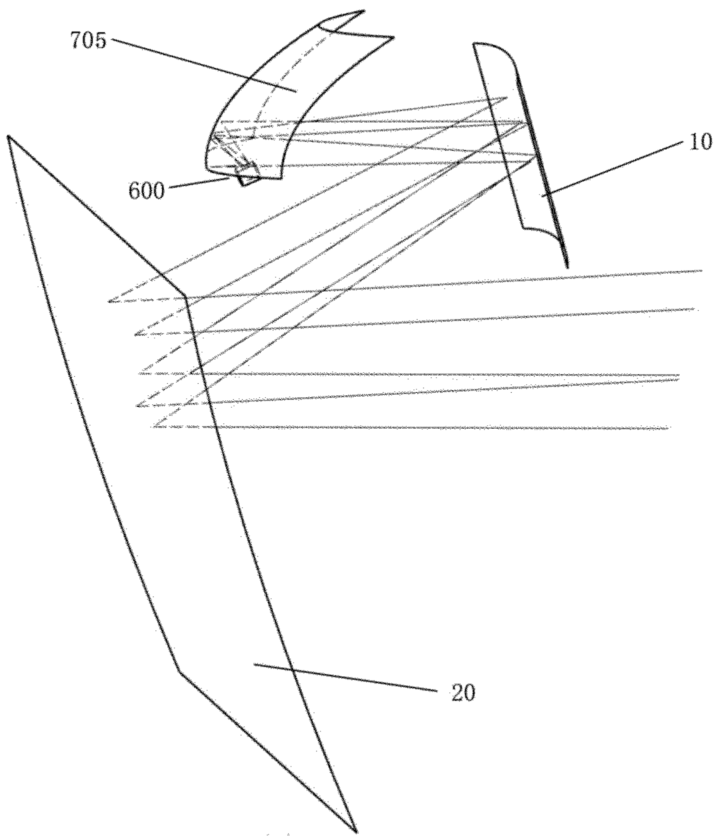

FIG. 17

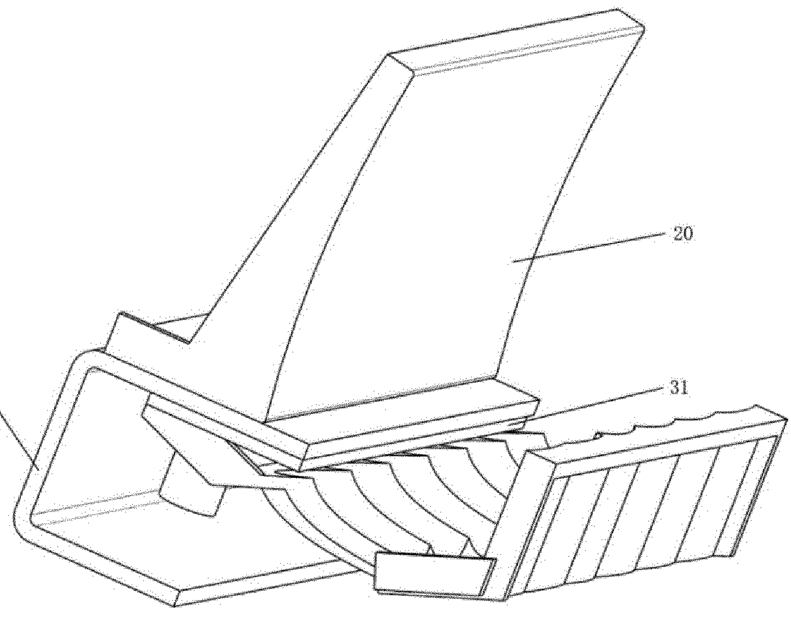

FIG. 18

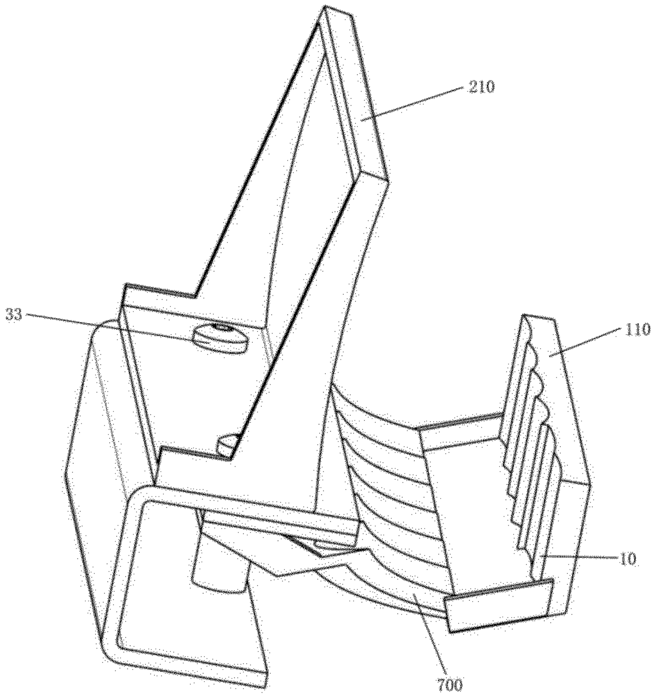

FIG. 19

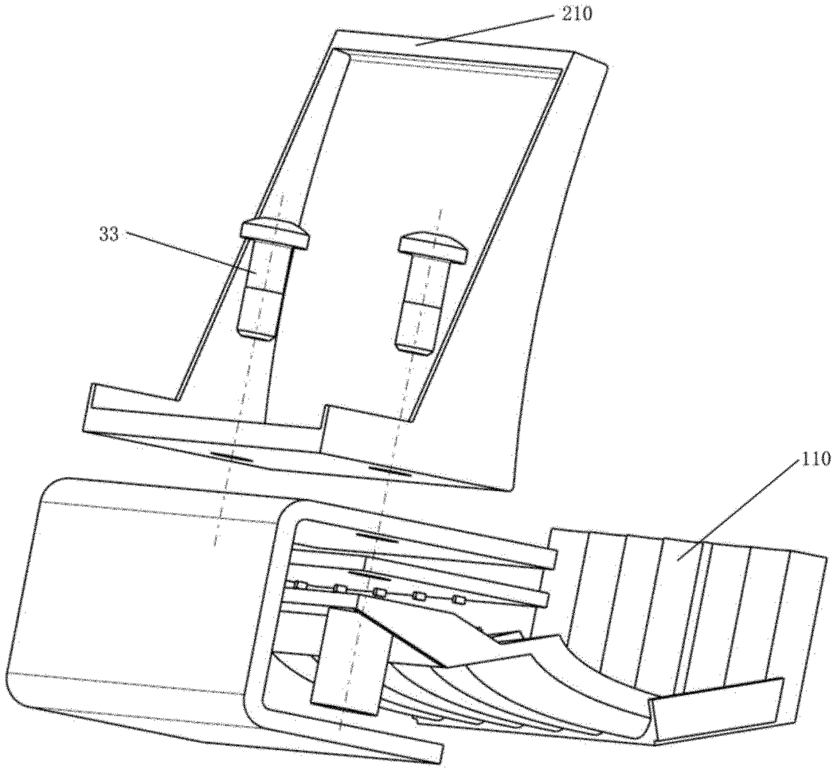

FIG. 20

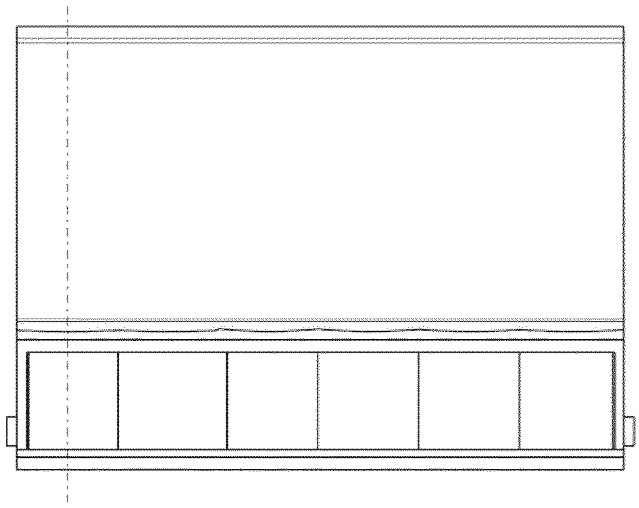

FIG. 21

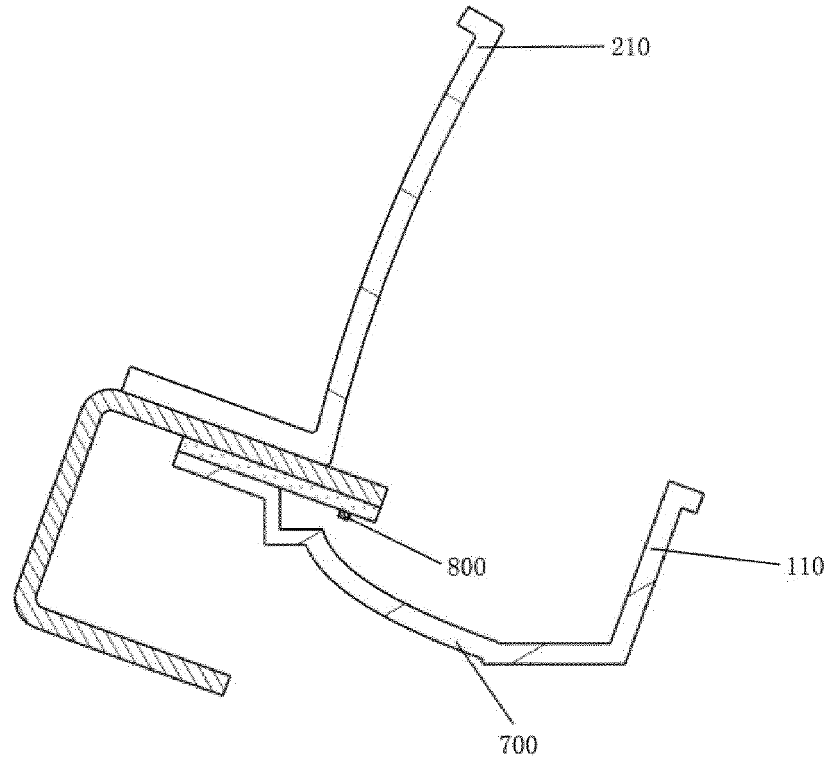

FIG. 22

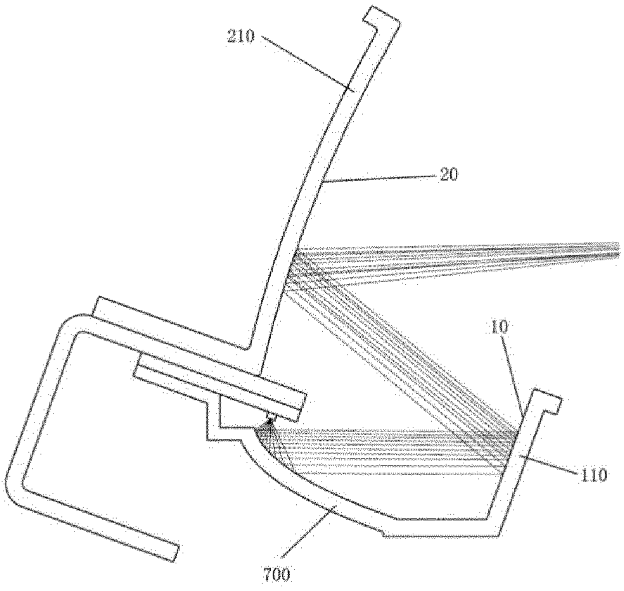

FIG. 23

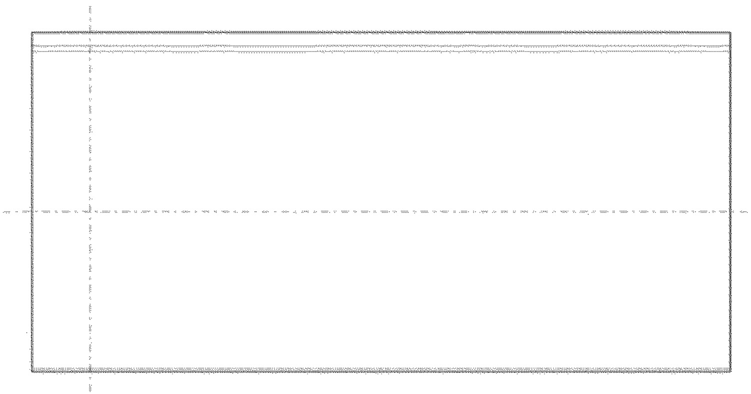

FIG. 24

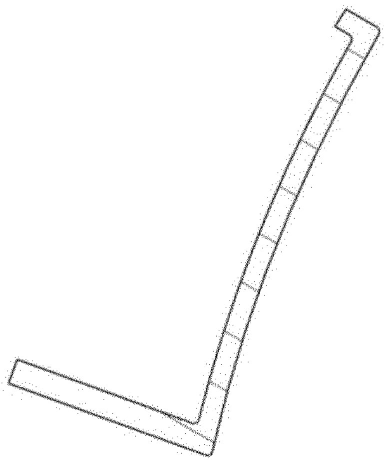

FIG. 25

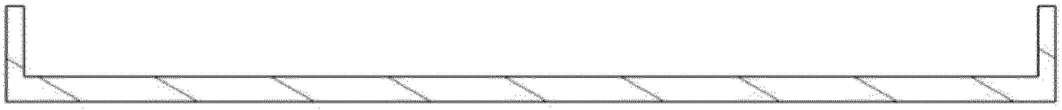

FIG. 26

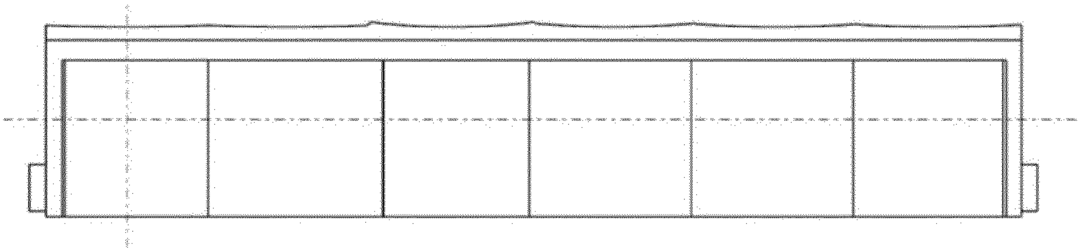

FIG. 27

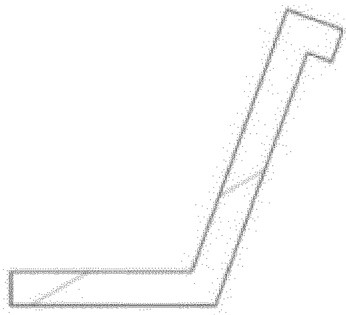

FIG. 28

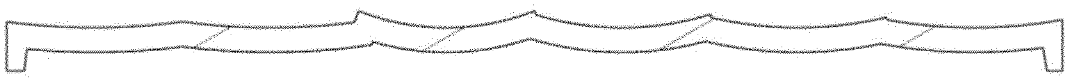

FIG. 29

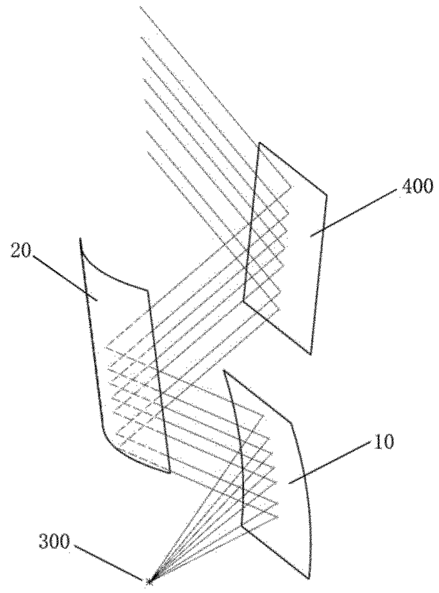

FIG. 30

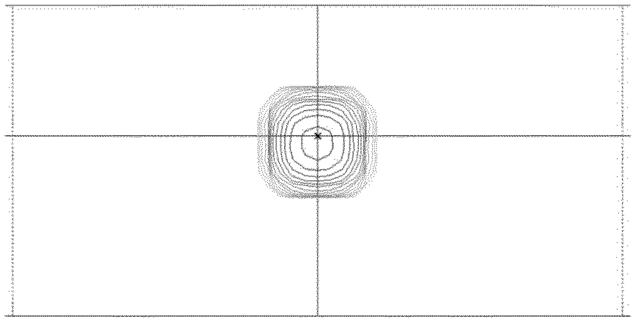

FIG. 31

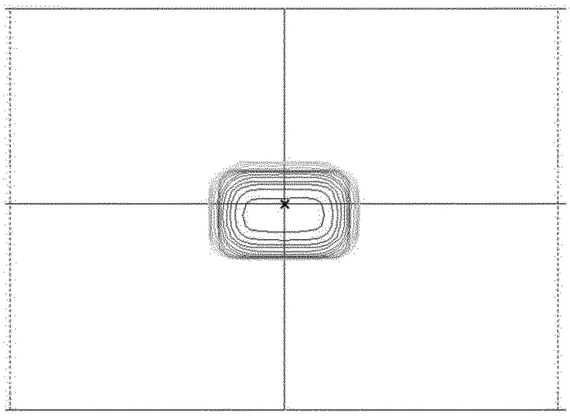

FIG. 32

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2021/119443

A. CLASSIFICATION OF SUBJECT MATTER

F21V 7/00(2006.01)i; F21S 8/00(2006.01)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)

F21V; F21S; G02B

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)

CNTXT; ENTXT; ENTXTC; VEN: 准直, 车, 柱面, 平行, 反射, 反光, 廓, 灯, reflect+, profile, collimat+, lamp, second, vehicle, car, light, parall+

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	CN 107208859 A (OSRAM GMBH) 26 September 2017 (2017-09-26) description, paragraphs [0019]-[0030], and figure 1	1-16
Y	CN 2086843 U (YU ZHONGHUA) 16 October 1991 (1991-10-16) description, page 3, paragraph 5 to page 4, paragraph 1, and figures 1-2	1-16
Y	CN 111373195 A (BAYERISCHE MOTOREN WERKE AG) 03 July 2020 (2020-07-03) description, embodiments, and figure 1	1-16
Y	JP 2015185400 A (STANLEY ELECTRIC CO., LTD.) 22 October 2015 (2015-10-22) description, embodiments, and figures 1-4	1-16
Y	JP 2008218146 A (STANLEY ELECTRIC CO., LTD.) 18 September 2008 (2008-09-18) description, embodiments, and figures 1-3	1-16

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

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- "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
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- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
15 June 2022	**22 June 2022**

Name and mailing address of the ISA/CN	Authorized officer
China National Intellectual Property Administration (ISA/CN) **No. 6, Xitucheng Road, Jimenqiao, Haidian District, Beijing 100088, China**	
Facsimile No. **(86-10)62019451**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2021/119443

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)			Publication date (day/month/year)
CN	107208859	A	26 September 2017	EP	3234451	A1	25 October 2017
				WO	2016096234	A1	23 June 2016
				DE	102014226646	A1	23 June 2016
				US	2017343179	A1	30 November 2017
CN	2086843	U	16 October 1991	None			
CN	111373195	A	03 July 2020	US	2021033254	A1	04 February 2021
				WO	2019154587	A1	15 August 2019
				DE	102018201980	A1	08 August 2019
JP	2015185400	A	22 October 2015	None			
JP	2008218146	A	18 September 2008	None			

Form PCT/ISA/210 (patent family annex) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 107208859 A **[0004]**
- CN 212618084 U **[0004]**
- GB 259912010 A **[0025] [0036] [0053] [0056]**