



(11)

EP 4 741 708 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
13.05.2026 Bulletin 2026/20

(21) Application number: **25736409.1**

(22) Date of filing: **03.01.2025**

(51) International Patent Classification (IPC):
F21S 41/32 ^(2018.01) **F21S 41/33** ^(2018.01)
F21S 41/36 ^(2018.01) **F21S 41/39** ^(2018.01)

(52) Cooperative Patent Classification (CPC):
F21S 41/25; F21S 41/32; F21S 41/33; F21S 41/36;
F21S 41/39; F21W 2102/13; F21W 2107/10

(86) International application number:
PCT/CN2025/070572

(87) International publication number:
WO 2025/146171 (10.07.2025 Gazette 2025/28)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **04.01.2024 CN 202420022210 U**

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

(72) Inventors:
• **WANG, Keng**
Shanghai 201821 (CN)

- **SUN, Xiaofen**
Shanghai 201821 (CN)
- **QI, Wenli**
Shanghai 201821 (CN)
- **NIE, Rui**
Shanghai 201821 (CN)
- **CAO, Li**
Shanghai 201821 (CN)
- **ZOU, Mengdi**
Shanghai 201821 (CN)
- **GUO, Haopeng**
Shanghai 201821 (CN)

(74) Representative: **Metida**
Gyneju str. 16
01109 Vilnius (LT)

(54) **VEHICLE LAMP MODULE, VEHICLE LAMP AND VEHICLE**

(57) The present application relates to the technical field of vehicle illumination. Provided are a vehicle lamp module, a vehicle lamp and a vehicle. The vehicle lamp module comprises an illumination module, wherein the illumination module comprises a light source, and a reflecting element and a lens which are sequentially arranged along a light path, such that light emitted by the light source can enter the lens after being reflected by the reflecting element, wherein the reflecting element is provided with a plurality of reflecting surfaces corresponding to the light source, such that the light emitted by the light source is reflected by the plurality of reflecting surfaces and then emits from the lens to form a plurality of light-pattern units each having a first boundary, and the plur-

ality of light-pattern units are combined to jointly form a illumination light pattern of the illumination module, so as to realize the illumination of the vehicle lamp; each reflecting surface is provided with a side edge configured to form a first boundary of each light-pattern unit; and according to the principle of the correspondence between the boundary of a pixel and the boundary of a reflecting surface, by means of configuring the side edges of the plurality of reflecting surfaces to be of an undulating structure, the plurality of first boundaries in the illumination light pattern are enabled to be flush, thereby forming the illumination light pattern, which has good brightness and a flat boundary, and enabling the vehicle lamp to have a good illumination effect.

EP 4 741 708 A1

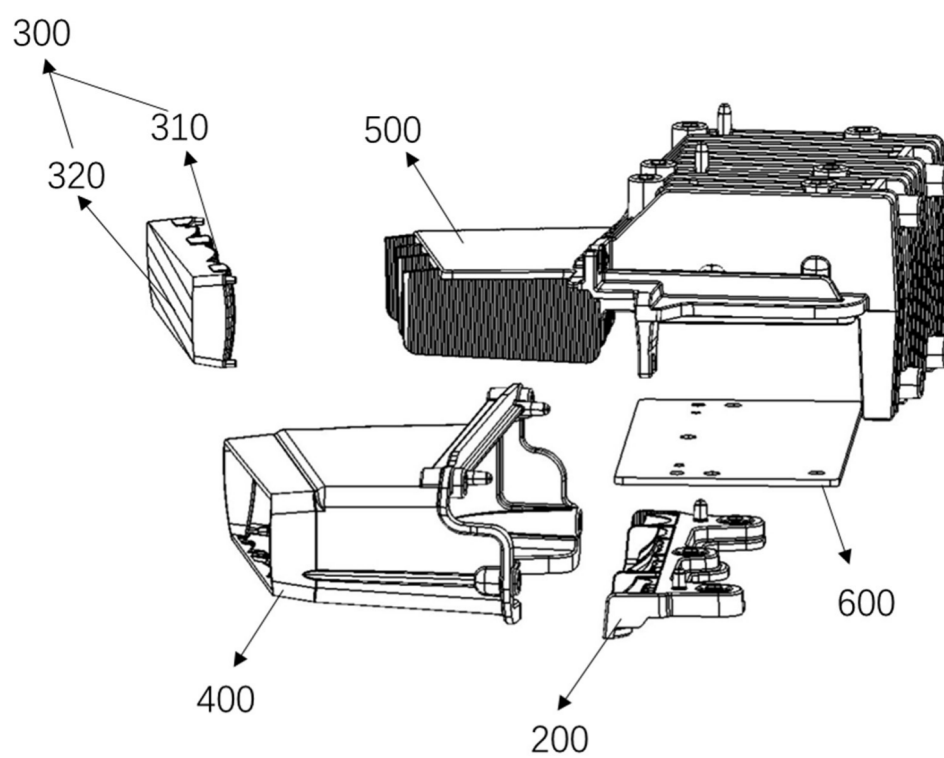


FIG. 1

Description

CROSS-REFERENCE TO THE RELATED APPLICATIONS

[0001] The present application claims priority to Application No. 202420022210X, filed with the China National Intellectual Property Administration on January 4, 2024, and entitled "VEHICLE LAMP MODULE AND VEHICLE LAMP", the contents of which are incorporated herein by reference in entirety.

TECHNICAL FIELD

[0002] The present application relates to the technical field of vehicle illumination, and specifically to a vehicle lamp module, a vehicle lamp, and a vehicle.

BACKGROUND

[0003] The vehicle lamp plays a critical role in the vehicle illumination system and vehicle performance. It is a vital component in overall vehicle functionality that must satisfy not only aesthetic requirements but also provide an effective illumination effect. With the rapid development of the automotive industry and the user demand for intelligent driving assistance functions, the adaptive high-beam system has emerged as required. The adaptive high-beam system is an intelligent high-beam control system that is capable of adaptively adjusting the high beam based on road conditions. By turning off or dimming partial high-beam illumination segments, it not only can improve the field of vision of the driver, but also can prevent glare to illuminated objects.

[0004] However, in the adaptive high-beam system, a plurality of reflecting surfaces needs to be provided. Light emitted from the light source is reflected by different reflecting surfaces to the lens. As different reflecting surfaces are located at varying distances from the focal point of the lens, boundaries of resulting light patterns formed by different reflecting surfaces are not flush, thereby compromising the illumination effect of the vehicle lamp.

SUMMARY

[0005] The present application aims at providing a vehicle lamp module, a vehicle lamp, and a vehicle, to address the above shortcomings in the prior art. The vehicle lamp module includes a light source, and a reflecting element and a lens which are sequentially arranged along a light path. The reflecting element is provided with a plurality of reflecting surfaces corresponding to the light source, such that light emitted by the light source is reflected by the plurality of reflecting surfaces and then emits from the lens to form a plurality of light-pattern units each having a first boundary. The plurality of light-pattern units are combined to form an

illumination light pattern of an illumination module. Moreover, by providing side edges of the plurality of reflecting surfaces to form an undulating structure, a plurality of first boundaries in the illumination light pattern are allowed to be flush, so as to address the problem in the prior art-non-leveled boundaries in the illumination light pattern caused by different reflecting surfaces being located at varying distances from a focal point of the lens compromise the illumination effect.

5 [0006] In order to achieve the above objectives, technical solutions employed in embodiments of the present application are as follows.

[0007] An embodiment of the present application provides a vehicle lamp module, including an illumination module, where the illumination module includes a light source, and a reflecting element and a lens which are sequentially arranged along a light path. The reflecting element is provided with a plurality of reflecting surfaces corresponding to the light source, light emitted by the light source is reflected by the plurality of reflecting surfaces and then emits from the lens to form a plurality of light-pattern units each having a first boundary. The plurality of light-pattern units are combined to form an illumination light pattern of the illumination module. Each reflecting surface is provided with a side edge configured to form the first boundary of the light-pattern unit. The side edges of the plurality of reflecting surfaces form an undulating structure, so as to allow a plurality of first boundaries in the illumination light pattern to be flush.

20 [0008] Optionally, the vehicle lamp module includes a plurality of illumination modules arranged in a horizontal direction or a vertical direction. The plurality of illumination modules include a matrix illumination module and an auxiliary illumination module, and first boundaries of an illumination light pattern of the matrix illumination module and an illumination light pattern of the auxiliary illumination module are flush.

25 [0009] Optionally, a light incident surface of a lens in the matrix illumination module is provided with a first patterned structure; and/or a light incident surface of a lens in the auxiliary illumination module is provided with a first patterned structure.

30 [0010] Optionally, a light emitting surface of the lens is provided with a second patterned structure.

35 [0011] Optionally, a light-blocking structure is provided between two adjacent illumination modules.

[0012] Optionally, the light-blocking structure includes a baffle rib, a groove, and/or a third patterned structure.

40 [0013] Optionally, the matrix illumination module is a matrix high-beam module, and the auxiliary illumination module is an auxiliary high-beam module.

45 [0014] Optionally, the vehicle lamp module further includes a heat sink, and the light sources and the reflecting elements are fixed to the heat sink. The heat sink is provided with a first baffle. The first baffle is located between two adjacent illumination modules, and the first baffle extends from the reflecting elements towards the lenses.

[0015] Optionally, a fourth patterned structure is provided on a surface of the first baffle.

[0016] Optionally, a second baffle is further provided on the heat sink, and the second baffle is located in front of the light sources.

[0017] Optionally, a vertical width of a lens is less than or equal to 20 mm.

[0018] Optionally, the first patterned structure is a grid pattern.

[0019] Optionally, the second patterned structure is horizontal stripes.

[0020] Optionally, the fourth patterned structure includes serrated stripes and/or vertical stripes.

[0021] Optionally, a distance from the second baffle to an optical center of each of the light sources ranges from 3 mm to 10 mm; and/or

in a direction perpendicular to a light emitting plane of each of the light sources, a distance from a side of the second baffle away from the light source to the light emitting plane of the light source ranges from 0.5 mm to 2 mm.

[0022] An embodiment of the present application further provides a vehicle lamp, including the vehicle lamp module according to any one of the above.

[0023] An embodiment of the present application further provides a vehicle, including the vehicle lamp according to any one of the above.

[0024] The present application includes beneficial effects as follows.

[0025] The present application provides a vehicle lamp module, a vehicle lamp, and a vehicle, including the illumination module, where the illumination module includes a light source, and a reflecting element and a lens which are sequentially arranged along the light path, such that light emitted by the light source can be reflected by the reflecting element and then enter the lens. Herein, the reflecting element is provided with a plurality of reflecting surfaces corresponding to the light source, such that the light emitted by the light source is reflected by the plurality of reflecting surfaces and then emits from the lens to form a plurality of light-pattern units each having the first boundary. The plurality of light-pattern units are combined to collectively form the illumination light pattern of the illumination module, thus realizing illumination of the vehicle lamp. As can be seen from the principle of optics, a size of the reflecting surface corresponds to a size of the light-pattern unit, and a boundary of the reflecting surface determines a boundary of the light-pattern unit. That is, each reflecting surface is provided with the side edge configured to form the first boundary of the light-pattern unit. Since different reflecting surfaces are located at varying distances from the focal point of the lens, the focal point of the lens can only fall on one specific reflecting surface or between two adjacent reflecting surfaces. As a result, the first boundaries of the light-pattern units formed by different reflecting surfaces may not be flush. In this case, the first boundary of the light-pattern unit formed by reflection of the reflecting surface

located in a focal point region can be taken as reference, to adjust the side edges of other reflecting surfaces configured to form the first boundaries of the light-pattern units, so as to allow the side edges of the plurality of reflecting surfaces to form the undulating structure, further enabling the first boundaries of the light-pattern units formed by reflection of other reflecting surfaces to be aligned with the first boundary of the light-pattern unit formed by the reflection of the reflecting surface located in the focal point region. That is, the plurality of first boundaries in the illumination light pattern become flush, thereby forming the illumination light pattern with good brightness and a leveled boundary, and rendering a favorable illumination effect of the vehicle lamp.

BRIEF DESCRIPTION OF THE DRAWINGS

[0026] In order to more clearly illustrate technical solutions of embodiments of the present application, drawings which need to be used in the embodiments will be briefly introduced below. It should be understood that the drawings merely show some embodiments of the present application, and thus should not be construed as limitation to the scope. Those ordinarily skilled in the art still could obtain other relevant drawings according to these drawings, without making any inventive efforts.

FIG. 1 is an exploded view of a vehicle lamp module provided in an embodiment of the present application;

FIG. 2 is a schematic diagram of light source arrangement of a vehicle lamp module provided in an embodiment of the present application;

FIG. 3 is a first schematic diagram of arrangement of a vehicle lamp module provided in an embodiment of the present application;

FIG. 4 is a second schematic diagram of arrangement of a vehicle lamp module provided in an embodiment of the present application;

FIG. 5 shows an illumination light pattern of a first matrix high-beam module provided in an embodiment of the present application;

FIG. 6 shows an illumination light pattern of a second matrix high-beam module provided in an embodiment of the present application;

FIG. 7 shows an illumination light pattern of a third matrix high-beam module provided in an embodiment of the present application;

FIG. 8 shows an illumination light pattern of a first auxiliary high-beam module provided in an embodiment of the present application;

FIG. 9 shows an illumination light pattern of a second auxiliary high-beam module provided in an embodiment of the present application;

FIG. 10 shows an illumination light pattern of a matrix high-beam module provided in an embodiment of the present application;

FIG. 11 shows an illumination light pattern of an

auxiliary high-beam module provided in an embodiment of the present application;

FIG. 12 shows an illumination light pattern of a vehicle lamp module provided in an embodiment of the present application;

FIG. 13 is a first schematic structural diagram of a plurality of lenses as an integrated structure provided in an embodiment of the present application;

FIG. 14 is a second schematic structural diagram of a plurality of lenses as an integrated structure provided in an embodiment of the present application;

FIG. 15 is a schematic structural diagram of a plurality of reflecting elements as an integrated structure provided in an embodiment of the present application; and

FIG. 16 is an enlarged view of A in FIG. 15.

[0027] Reference signs: 11-first matrix high-beam module; 12-second matrix high-beam module; 13-third matrix high-beam module; 14-first auxiliary high-beam module; 15-second auxiliary high-beam module; 100-light source; 200-reflecting element; 210-reflecting surface; 211-side edge; 221-baffle rib; 222-groove; 223-third patterned structure; 230-handling structure; 300-lens; 310-light incident surface; 311-first patterned structure; 320-light emitting surface; 321-second patterned structure; 400-lens holder; 500-heat ink; 510-first baffle; 511-fourth patterned structure; 520-second baffle; and 600-circuit board.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0028] In order to make the objectives, technical solutions, and advantages of the embodiments of the present application clearer, the technical solutions in the embodiments of the present application will be described clearly and completely below in combination with the drawings in the embodiments of the present application. Obviously, the described embodiments are only some, and not all of the embodiments of this application. Generally, components in the embodiments of the present application described and shown in the drawings herein may be arranged and designed in various different configurations.

[0029] Therefore, the following detailed description of the embodiments of the present application provided in the drawings is not intended to limit the claimed scope of the present application, but merely represents chosen embodiments of the present application. It should be noted that various features in the embodiments of the present application may be combined with each other without conflict, and the combined embodiments still fall within the scope of protection of the present application.

[0030] It should be noted that like reference signs and letters represent like items in the following drawings, and thus, once a certain item is defined in one drawing, it is unnecessary to further define and explain the same in subsequent drawings.

[0031] In the description of the present application, it should be noted that the orientation or positional relationships indicated by the terms such as "upper" and "lower" are based on orientation or positional relationships as shown in the drawings, or orientation or positional relationships of a product of the present disclosure when being conventionally placed in use, merely for facilitating describing the present application and simplifying the description, rather than indicating or implying that referred devices or elements have to be in a specific orientation or configured and operated in a specific orientation, and thus they should not be construed as limitation to the present application. Besides, the terms such as "first", "second", and "third" are merely for distinguishing the description, but should not be construed as indicating or implying importance in the relativity.

[0032] In the description of the present application, it should be further noted that, unless otherwise specifically specified and defined, the terms "set", "mount", "link", and "connect" should be understood in a broad sense. For example, a connection may be a fixed connection, a detachable connection, or an integrated connection; it may be a mechanical connection or an electrical connection; it may be direct connection or indirect connection through an intermediate medium; and it also may be inner communication between two elements. The specific meanings of the above terms in the present application could be understood by those skilled in the art according to specific situations.

[0033] An embodiment of the present application provides a vehicle lamp module, as shown in FIG. 1, FIG. 2, and FIG. 15, including an illumination module, where the illumination module includes a light source 100, and a reflecting element 200 and a lens 300 which are sequentially arranged along a light path. The reflecting element 200 is provided with a plurality of reflecting surfaces 210 corresponding to the light source 100. Light emitted by the light source 100 is reflected by the plurality of reflecting surfaces 210 and then emits from the lens 300 to form a plurality of light-pattern units each having a first boundary. The plurality of light-pattern units are combined to form an illumination light pattern of the illumination module. Each reflecting surface 210 is provided with a side edge 211 configured to form the first boundary of the light-pattern unit. The side edges 211 of the plurality of reflecting surfaces 210 form an undulating structure, so as to allow a plurality of first boundaries in the illumination light pattern to be flush.

[0034] Specifically, as shown in FIG. 1 and FIG. 2, by arranging the reflecting element 200 and the lens 300 sequentially along the light path, the light emitted by the light source 100 can be reflected by the reflecting element 200 and then enter the lens 300. Herein, the reflecting element 200 is provided with a plurality of reflecting surfaces 210 corresponding to the light source 100, such that the light emitted by the light source 100 is reflected by the plurality of reflecting surfaces 210 and then emits from the lens 300 to form a plurality of light-pattern units.

Each light-pattern unit has the first boundary. The plurality of light-pattern units are combined to collectively form the illumination light pattern of the illumination module, thus realizing illumination of the vehicle lamp. As can be seen from the principle of optics, a size of the reflecting surface 210 corresponds to a size of the light-pattern unit, and a boundary of the reflecting surface 210 determines a boundary of the light-pattern unit. That is, the reflecting surface 210 is provided with the side edge 211 configured to form the first boundary of the light-pattern unit, and thus the side edge 211 determines the first boundary of the light-pattern unit corresponding to the reflecting surface 210 where the side edge 211 is located. Since different reflecting surfaces 210 are located at varying distances from a focal point of the lens 300, the focal point of the lens 300 can only fall on one specific reflecting surface 210 or between two adjacent reflecting surfaces 210. As a result, the first boundaries of the light-pattern units formed by different reflecting surfaces 210 may not be flush, which prevents the combined light-pattern units from forming an illumination light pattern that meets regulatory requirements. In this case, the first boundary of the light-pattern unit formed by reflection of the reflecting surface 210 located in a focal point region can be taken as reference, to adjust the side edges 211 of other reflecting surfaces 210 configured to form the first boundaries of the light-pattern units, so as to allow the side edges 211 of the plurality of reflecting surfaces 210 to form the undulating structure, further enabling the first boundaries of the light-pattern units formed by reflection of other reflecting surfaces 210 to be aligned with the first boundary of the light-pattern unit formed by the reflection of the reflecting surface 210 located in the focal point region. That is, the plurality of first boundaries in the illumination light pattern become flush, thereby forming the illumination light pattern with good brightness and a leveled boundary, meeting the regulatory requirements, and rendering a favorable illumination effect of the vehicle lamp.

[0035] It should be understood that, the plurality of reflecting surfaces 210 should be arranged in a horizontal direction or a vertical direction. In this way, the first boundaries of the plurality of corresponding light-pattern units are also arranged in the horizontal direction or the vertical direction. That is, the whole illumination light pattern presents a narrow and elongated shape in the horizontal direction or the vertical direction. In embodiments of the present application, the vertical direction is a vehicle height direction, and the horizontal direction is a vehicle width direction. In order to meet illumination requirements during vehicle running, optionally, the plurality of reflecting surfaces 210 should be arranged in the horizontal direction, so as to form the illumination light pattern in a narrow and elongated shape in the horizontal direction, thereby meeting the illumination requirements of vehicles. It should also be understood that, when opposite sides of the reflecting surface 210 are at varying distances from the light source 100, the first boundary may be a boundary of a side of the reflecting surface 210

close to the light source 100, or a boundary of a side of the reflecting surface 210 away from the light source 100. By adjusting the side edges 211 of different sides of the reflecting surface 210, the boundaries of different sides of the light-pattern units can become flush.

[0036] Optionally, the vehicle lamp module includes a plurality of illumination modules arranged in the horizontal direction or the vertical direction, where the plurality of illumination modules include a matrix illumination module and an auxiliary illumination module, and first boundaries of an illumination light pattern of the matrix illumination module and an illumination light pattern of the auxiliary illumination module are flush.

[0037] Specifically, the vehicle lamp module includes a plurality of illumination modules arranged in the horizontal direction or the vertical direction. The plurality of illumination modules collectively achieves the illumination function of the vehicle lamp module. Moreover, the plurality of illumination modules are arranged in the horizontal direction or the vertical direction, so that a dimension of the vehicle lamp module in the vertical direction or the horizontal direction is reduced, enabling it to meet the requirements of the vehicle lamp market for a narrow-aperture light emitting styling. In the plurality of illumination modules, the first boundaries in the illumination light patterns of at least some illumination modules can be flush. For example, the plurality of illumination modules includes matrix illumination modules and an auxiliary illumination module, wherein there are a plurality of matrix illumination modules and at least one auxiliary illumination module, and the illumination light patterns across different illumination modules are staggered and superimposed, which can mutually compensate for energy deficit in gaps between different light-pattern units, thereby achieving bright and clear vehicle lamp illumination. It should also be noted that the first boundaries in the illumination light patterns of the matrix illumination modules and the illumination light pattern of the auxiliary illumination module should be flush. In this way, when different illumination modules are used in combination, an elongated light pattern with a leveled boundary can be formed, thereby further improving the illumination effect. It should be understood that the matrix illumination module and the auxiliary illumination module can be used in combination, or separately, and the driver can select different illumination modules according to actual road conditions.

[0038] Optionally, the matrix illumination module is a matrix high-beam module, the auxiliary illumination module is an auxiliary high-beam module, and the matrix high-beam module and the auxiliary high-beam module can collectively achieve a high-beam illumination function of the vehicle lamp module.

[0039] As shown in FIG. 3 and FIG. 4, in the present embodiment, the vehicle lamp module includes five illumination modules arranged in the horizontal direction, where there are three matrix high-beam modules, and two auxiliary high-beam modules. Specifically, the light

source 100 of the illumination modules is LED, the reflecting element 200 of each matrix high-beam module includes four or three reflecting surfaces 210 arranged in the horizontal direction, and the reflecting element 200 of each auxiliary high-beam module includes one or two reflecting surface 210 arranged in the horizontal direction. The light source 100 performs primary energy distribution through the reflecting element 200, and then realizes matrix high beam and auxiliary high beam functions through the lens 300. Subsequently, by adjusting the boundary of one side of each reflecting surface 210 that is close to the light source 100, a lower boundary of the illumination light pattern of each illumination module is enabled to be leveled. Moreover, the lower boundary of the illumination light pattern from superimposition of the five illumination modules should also be leveled. Specifically, taking a pixel at a grid center as reference, as shown in FIG. 5, it can be seen that an illumination light pattern of a first matrix high-beam module 11 shifts to the left of a centerline; as shown in FIG. 6, an illumination light pattern of a second matrix high-beam module 12 is closer to the centerline than the illumination light pattern of the first matrix high-beam module 11; as shown in FIG. 7, an illumination light pattern of a third matrix high-beam module 13 is closer to the centerline than the light pattern of the second matrix high-beam module 12; as shown in FIG. 8 and FIG. 9, an illumination light pattern of a first auxiliary high-beam module 14 and an illumination light pattern of a second auxiliary high-beam module 15 are positioned near the centerline, but with relatively small illuminated areas. As shown in FIG. 10, staggering and superimposing the illumination light patterns of three matrix high-beam modules can compensate for the energy deficit in the gaps between different light-pattern units, which enhances the clarity of the illumination light patterns, and also increases the illuminated area. FIG. 11 shows an illumination light pattern from superimposition of two auxiliary high-beam modules. FIG. 12 shows a vehicle lamp light pattern formed by the combined use of three matrix high-beam modules and two auxiliary high-beam modules. It can be seen that the combination can achieve bright and clear vehicle lamp illumination with a large illuminated area, suitable for illumination in a variety of road conditions.

[0040] Optionally, a vertical width of the lens 300 is less than or equal to 20 mm.

[0041] Specifically, as can be seen from the above, by arranging the plurality of reflecting surfaces 210 in the horizontal direction, the vehicle lamp light pattern obtained upon superimposition of the illumination light patterns of each illumination module presents a narrow and elongated shape, consequently, the lens 300 can be designed as a narrow and elongated lens 300 having a small vertical width and a large horizontal width, which not only can meet the light pattern and brightness requirements of the vehicle lamp, but also can reduce an occupied space. In embodiments of the present application, the vertical width of the lens 300 is less than or equal

to 20 mm. It should also be understood that, by arranging the plurality of illumination modules in the horizontal direction, that is, for different illumination modules, by arranging the light sources 100 in the horizontal direction, arranging the reflecting elements 200 in the horizontal direction, and arranging the lenses 300 in the horizontal direction, the illumination light patterns of the plurality of illumination modules can collectively form a light pattern in a narrow and elongated shape, and the whole vehicle lamp module also presents a vertically flattened shape, which not only can reduce the mounting space, but also can meet the requirements of the vehicle lamp market for the narrow-aperture styling.

[0042] Optionally, a light incident surface 310 of the lens 300 in the matrix illumination module is provided with a first patterned structure 311; and/or the light incident surface 310 of the lens 300 in the auxiliary illumination module is provided with the first patterned structure 311.

[0043] Specifically, as shown in FIG. 13, the light incident surface 310 of the lens 300 can be provided with the first patterned structure 311, or kept smooth. In order to achieve a smoother boundary transition between adjacent light-pattern units and enable more uniform superimposition of the light-pattern units, the light incident surface 310 of the lens 300 of the illumination module having a plurality of reflecting surfaces 210 can be provided with the first patterned structure 311. In order to ensure maximum brightness of the light-pattern units, the light incident surface 310 of the lens 300 of the illumination module having one reflecting surface 210 is kept smooth. Herein, the first patterned structure 311 can be a grid pattern, where a size and height of the grid pattern are related to uniformity achieved when adjacent light-pattern units are superimposed, and the size and height of the grid can be adjusted according to the uniformity achieved when different light-pattern units are superimposed. In the present embodiment, the grid is a rectangular structure with a size of approximately 2 mm × 2 mm.

[0044] Optionally, a light emitting surface 320 of the lens 300 is provided with a second patterned structure 321.

[0045] Specifically, as shown in FIG. 14, the light emitting surface 320 of the lens 300 can be provided with the second patterned structure 321, or kept smooth. In order to enable smoother superimposition and uniform transition of the high-beam illumination light pattern in the embodiments of the present invention with a low-beam illumination light pattern in the prior art, the second patterned structure 321 can be provided on the light emitting surface 320 of the lens 300. Herein, the second patterned structure 321 can be horizontal stripes, and spacing and stripe height of the horizontal stripes should be adjusted according to uniformity of the transition when the high-beam illumination light pattern is superimposed with different low-beam illumination light patterns.

[0046] It should also be noted that the lens 300 can be made of a transparent plastic material, typically PMMA or PC, and is relatively thin as a whole. As shown in FIG. 13

and FIG. 14, the light incident surface 310 of each lens 300 is a convex surface, the light emitting surface 320 of each lens 300 is a planar surface. Moreover, the lenses 300 in the plurality of illumination modules should be formed as an integrated structure, where a light incident side of the integrated structure includes a plurality of convex surfaces arranged side by side, and a light emitting side includes one planar surface.

[0047] Optionally, as shown in FIG. 1, a plurality of lenses 300 as an integrated structure are provided within a lens holder 400, thus being capable of providing a certain supporting and protecting effect on the lenses 300, while allowing the lenses 300 and the lens holder 400 to be mounted in combination with remaining components, thereby enhancing the connection stability of the vehicle lamp module while simplifying the mounting process and improving the mounting efficiency.

[0048] Optionally, a light-blocking structure is provided between two adjacent illumination modules.

[0049] Specifically, as shown in FIG. 15 and FIG. 16, in order to reduce stray light caused by crosstalk between the reflecting elements 200 of different illumination modules and ensure the independence of functionality of each reflecting element 200, the light-blocking structure can be provided in a gap between the reflecting elements 200 of two adjacent illumination modules, so as to eliminate stray light. Different light-blocking structures can be used individually or in combination, and when used, an appropriate light-blocking structure should be selected based on comprehensive consideration of light distribution requirements and impact on optical performance.

[0050] Optionally, as shown in FIG. 15, the light-blocking structure includes, but is not limited to, a baffle rib 221, a groove 222, and a third patterned structure 223, where the third patterned structure 223 includes, but is not limited to, vertical stripes and/or horizontal stripes.

[0051] Optionally, as shown in FIG. 15, the reflecting elements 200 in the plurality of illumination modules present an integrated structure. As the reflecting surfaces 210 of the reflecting elements 200 are clean surfaces, in order to prevent contamination to the reflecting surfaces 210 when handling or mounting the reflecting elements 200, a handling structure 230 is provided on the integrated structure. The handling structure 230 is located in a central position among the plurality of reflecting elements 200, so as to facilitate handling of the reflecting elements 200, without affecting functionality of the reflecting surfaces 210. Herein, the handling structure 230 has a length ranging from 10 mm to 30 mm, a width ranging from 5 mm to 10 mm, and a shape including, but not limited to, rectangle and triangle.

[0052] Optionally, the vehicle lamp module further includes a heat sink 500. The light sources 100 and the reflecting elements 200 are fixed to the heat sink 500. The heat sink 500 is provided with a first baffle 510, where the first baffle 510 is located between two adjacent illumination modules, and the first baffle 510 extends from the reflecting elements 200 towards the lenses 300.

[0053] Specifically, as shown in FIG. 1 and FIG. 2, the vehicle lamp module further includes the heat sink 500. The heat sink 500 is configured to achieve a heat dissipation function of the vehicle lamp module. The vehicle lamp module further includes a circuit board 600, where the circuit board 600 is connected to the light sources 100, so as to realize light emission of the light sources 100. By fixing the circuit board 600 to the heat sink 500, the light sources 100 of the plurality of illumination modules are all fixed to the heat sink 500. Moreover, by fixing the plurality of reflecting elements 200 as an integrated structure to the heat sink 500, and by connecting the lens holder 400 to the heat sink 500, the lenses 300 of the plurality of illumination modules are also connected to the heat sink 500, thus enhancing the connection stability of the vehicle lamp module, resulting in a simple structure, and simplifying a mounting process, which can improve the mounting efficiency, and reduce the structural and mounting costs.

[0054] It should also be noted that, in order to better meet the independent optical functionality of each reflecting element 200, and prevent stray light due to crosstalk of light from the same reflecting element 200, the first baffle 510 can be provided on the heat sink 500. The first baffle 510 is located between two adjacent illumination modules. The first baffle 510 extends from the reflecting elements 200 towards the lenses 300. An extension length of the first baffle 510 should be relatively large, reaching close to the lenses 300, which thus can effectively prevent crosstalk between different reflecting elements 200, thus ensuring the optical functionality of each reflecting element 200.

[0055] Optionally, as shown in FIG. 2, a fourth patterned structure 511 is provided on a surface of the first baffle 510. The fourth patterned structure 511 includes, but is not limited to, serrated stripes and/or vertical stripes, thus preventing light emitted from the light sources 100 from being reflected by the first baffle 510 and causing stray light upon secondary reflection.

[0056] Optionally, as shown in FIG. 2, a second baffle 520 is further provided on the heat sink 500. The second baffle 520 is located in front of the light sources 100, and thus can block direct light or large-angle light emitted by the light sources 100, and prevent occurrence of unsharp light (vignetting) at a lower boundary of the illumination light pattern, so that effective light of the light sources 100 can be subjected to sufficient energy distribution via the reflecting elements 200, thereby forming a bright and clear light pattern. Herein, a distance from the second baffle 520 to an optical center of each light source 100 ranges from 3 mm to 10 mm, and a height of the second baffle 520 is higher than a light emitting plane of each light source 100 by 0.5 mm-2 mm. In other words, taking a direction perpendicular to the light emitting plane of the light source as a first direction (for example, the vertical direction in the preceding), in the first direction, a distance from a side of the second baffle away from the light source (for example, a top side of the second baffle in FIG. 2) to

the light emitting plane of the light source ranges from 0.5 mm to 2 mm.

[0057] Embodiments of the present application further provide a vehicle lamp, including the vehicle lamp module according to any one of the above. The vehicle lamp allows formation of a light pattern of the vehicle lamp with good brightness and a leveled boundary, thus improving the illumination effect.

[0058] Embodiments of the present application further provide a vehicle, including the vehicle lamp according to any one of the above. The vehicle lamp allows formation of a light pattern of the vehicle lamp with good brightness and a leveled boundary, thus improving the illumination effect.

[0059] The above-mentioned are merely for preferred embodiments of the present application, but are not intended to limit the present application. For those skilled in the art, various modifications and changes could be made to the present application. Any modifications, equivalent substitutions, improvements and so on made within the spirit and principle of the present application should be covered within the scope of protection of the present application.

INDUSTRIAL APPLICABILITY

[0060] For the vehicle lamp module and the vehicle lamp in the present application, by taking the first boundary of the light-pattern unit formed by the reflection of the reflecting surface located in the focal point region as reference, the side edges of other reflecting surfaces configured to form the first boundaries of the light-pattern units are adjusted, so as to allow the side edges of the plurality of reflecting surfaces to form the undulating structure, further enabling the first boundaries of the light-pattern units formed by the reflection of other reflecting surfaces to be aligned with the first boundary of the light-pattern unit formed by the reflection of the reflecting surface located in the focal point region. That is, the plurality of first boundaries in the illumination light pattern become flush, thereby forming the illumination light pattern with good brightness and a leveled boundary, and rendering a favorable illumination effect of the vehicle lamp.

Claims

1. A vehicle lamp module, **characterized by** comprising an illumination module, wherein the illumination module comprises a light source, and a reflecting element and a lens which are sequentially arranged along a light path, wherein the reflecting element is provided with a plurality of reflecting surfaces corresponding to the light source, light emitted by the light source is reflected by the plurality of reflecting surfaces and then emits from the lens to form a plurality of light-pattern units each having a first boundary, the

plurality of light-pattern units are combined to form an illumination light pattern of the illumination module, the reflecting surfaces are each provided with a side edge configured to form the first boundary of each of the light-pattern units, and the side edges of the plurality of reflecting surfaces form an undulating structure, so as to allow a plurality of first boundaries in the illumination light pattern to be flush.

2. The vehicle lamp module according to claim 1, **characterized in that** the vehicle lamp module comprises a plurality of illumination modules arranged in a horizontal direction or a vertical direction, wherein the plurality of illumination modules comprise a matrix illumination module and an auxiliary illumination module, and first boundaries of an illumination light pattern of the matrix illumination module and an illumination light pattern of the auxiliary illumination module are flush.
3. The vehicle lamp module according to claim 2, **characterized in that** a light incident surface of a lens in the matrix illumination module is provided with a first patterned structure; and/or a light incident surface of a lens in the auxiliary illumination module is provided with a first patterned structure.
4. The vehicle lamp module according to any one of claims 1 to 3, **characterized in that** a light emitting surface of the lens is provided with a second patterned structure.
5. The vehicle lamp module according to claim 2 or 3, **characterized in that** a light-blocking structure is provided between two adjacent illumination modules.
6. The vehicle lamp module according to claim 5, **characterized in that** the light-blocking structure comprises a baffle rib, a groove, and/or a third patterned structure.
7. The vehicle lamp module according to claim 2 or 3, **characterized in that** the matrix illumination module is a matrix high-beam module, and the auxiliary illumination module is an auxiliary high-beam module.
8. The vehicle lamp module according to claim 2 or 3, **characterized in that** the vehicle lamp module further comprises a heat sink, wherein the light sources and the reflecting elements are fixed to the heat sink, and the heat sink is provided with a first baffle, wherein the first baffle is located between two adjacent illumination modules, and the first baffle extends from the reflecting elements towards the lenses.

9. The vehicle lamp module according to claim 8, **characterized in that** a fourth patterned structure is provided on a surface of the first baffle.
10. The vehicle lamp module according to claim 8, **characterized in that** a second baffle is further provided on the heat sink, and the second baffle is located in front of the light sources. 5
11. The vehicle lamp module according to any one of claims 1 to 3, **characterized in that** a vertical width of the lens is less than or equal to 20 mm. 10
12. The vehicle lamp module according to claim 3, **characterized in that** the first patterned structure is a grid pattern. 15
13. The vehicle lamp module according to claim 4, **characterized in that** the second patterned structure is horizontal stripes. 20
14. The vehicle lamp module according to claim 9, **characterized in that** the fourth patterned structure comprises serrated stripes and/or vertical stripes. 25
15. The vehicle lamp module according to claim 10, **characterized in that** a distance from the second baffle to an optical center of each of the light sources ranges from 3 mm to 10 mm; and/or in a direction perpendicular to a light emitting plane of each of the light sources, a distance from a side of the second baffle away from the light sources to the light emitting plane of the light source ranges from 0.5 mm to 2 mm. 30
35
16. A vehicle lamp, **characterized by** comprising the vehicle lamp module according to any one of claims 1 to 15.
17. A vehicle, **characterized by** comprising the vehicle lamp according to claim 16. 40

45

50

55

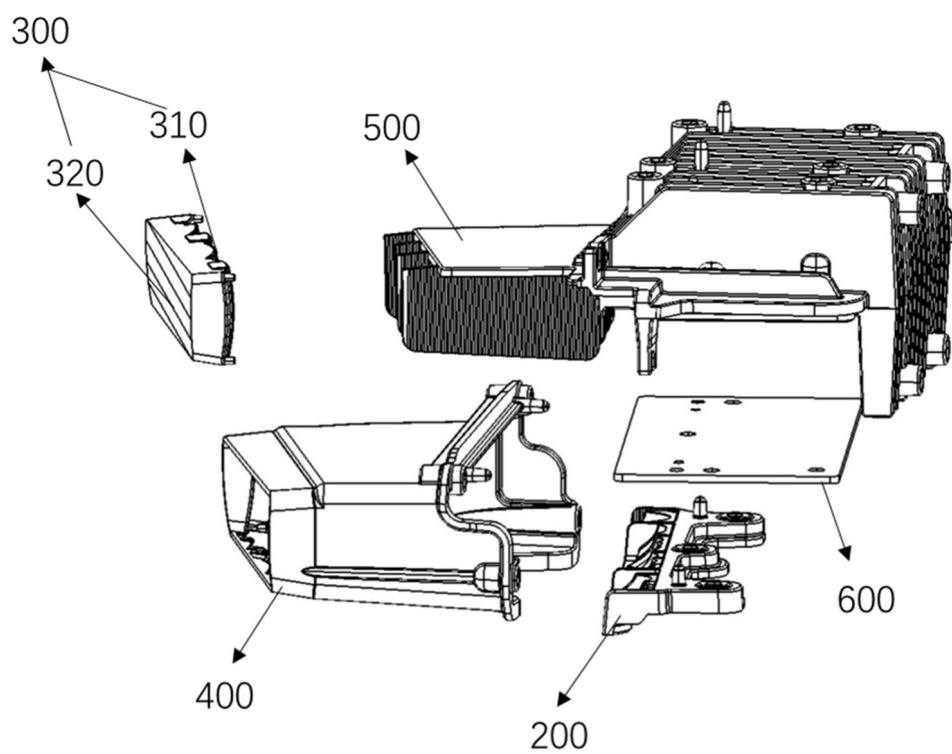


FIG. 1

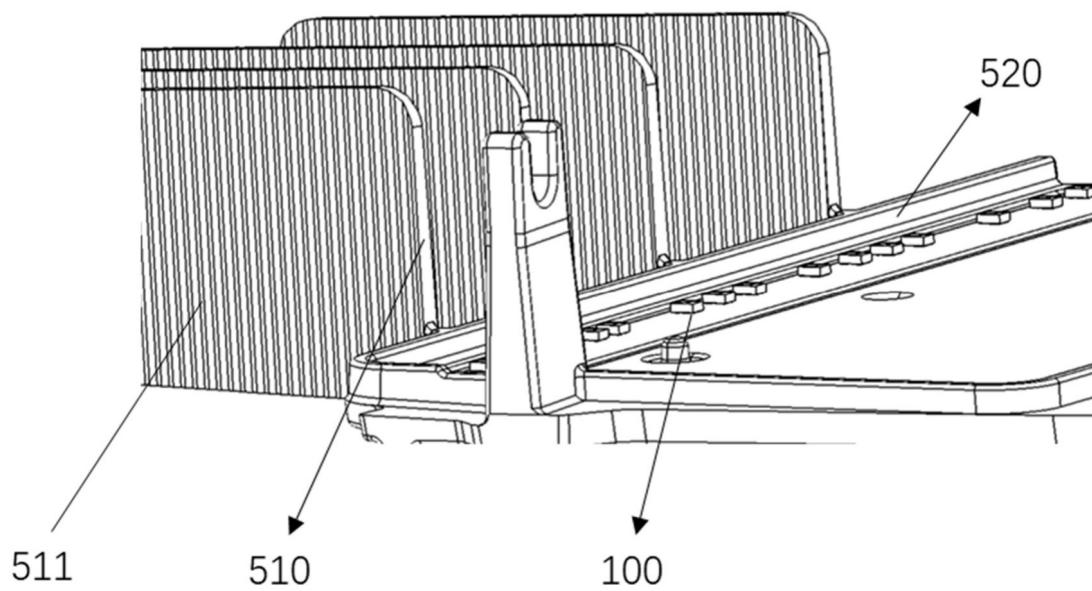


FIG. 2

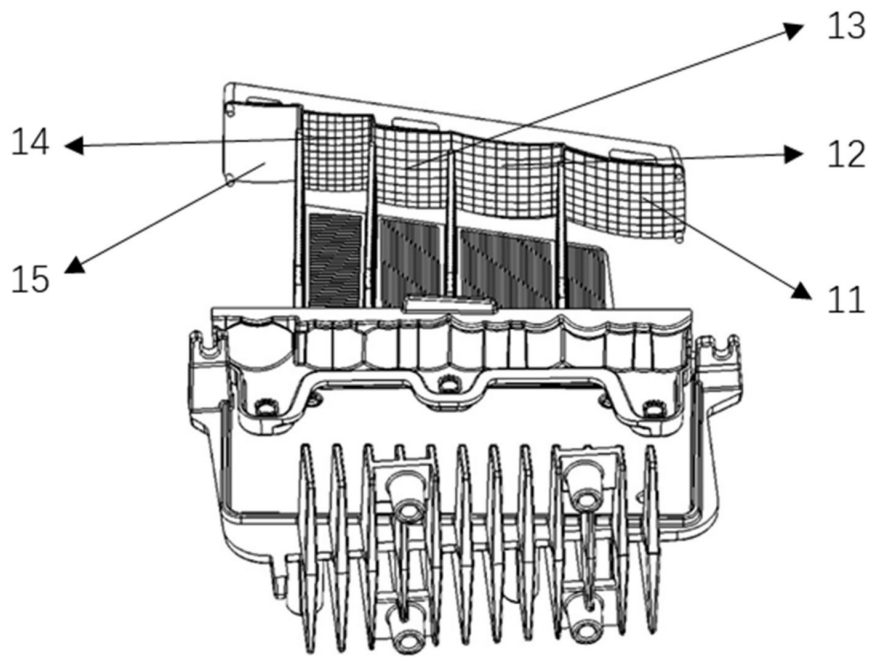


FIG. 3

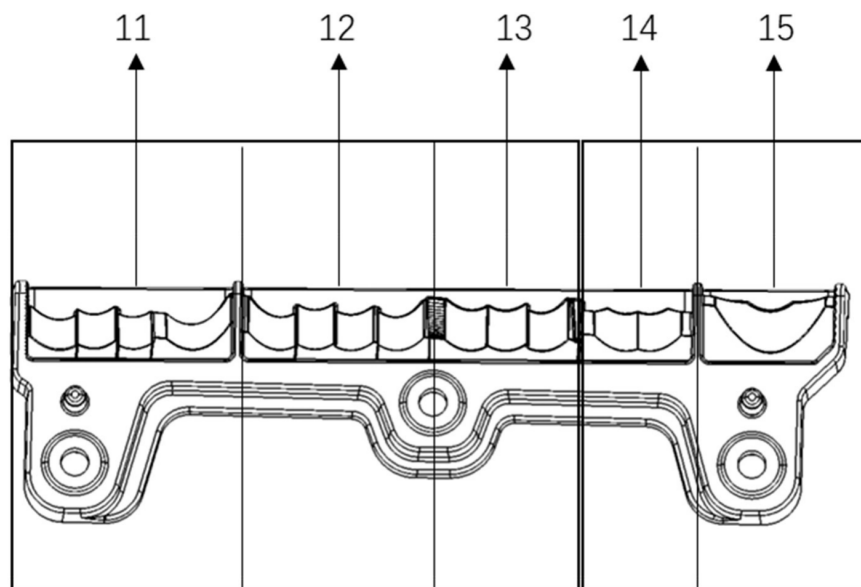


FIG. 4

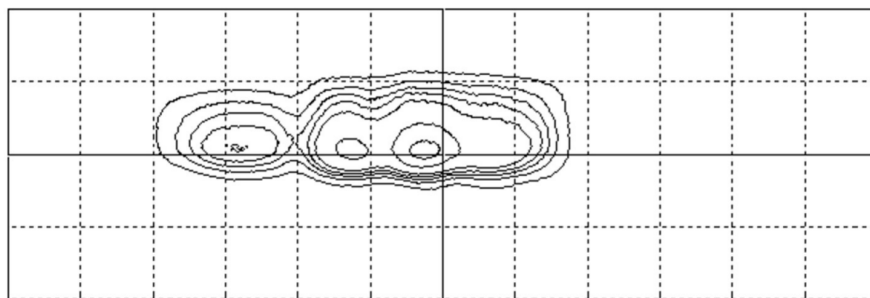


FIG. 5

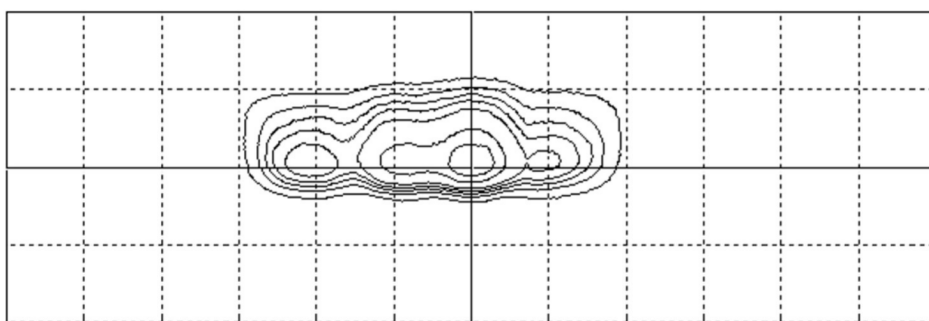


FIG. 6

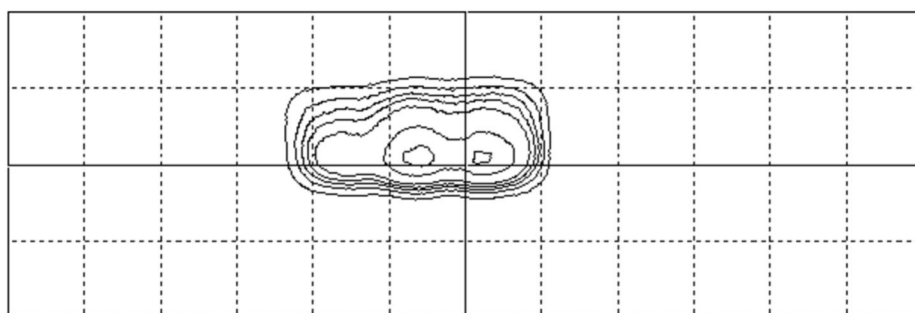


FIG. 7

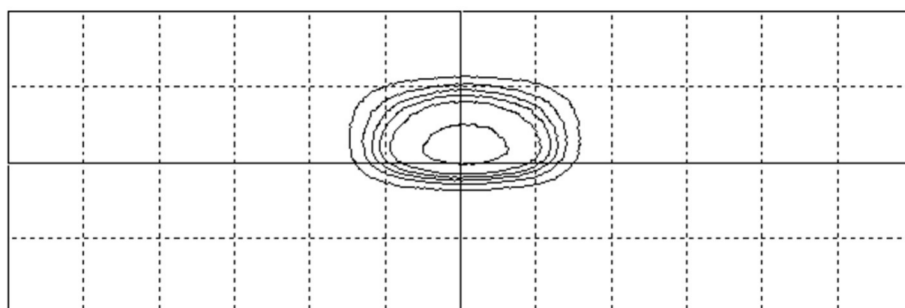


FIG. 8

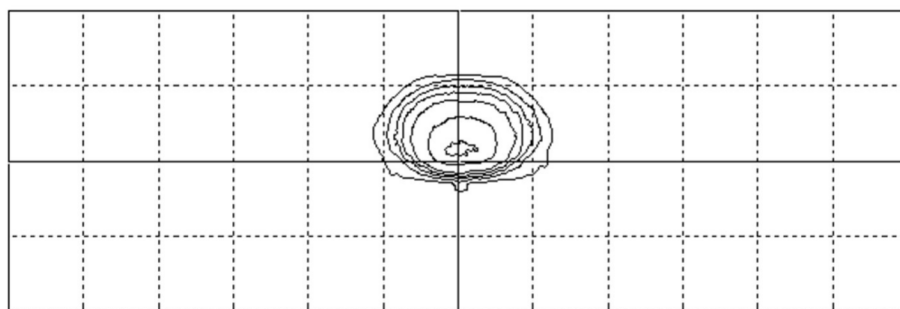


FIG. 9

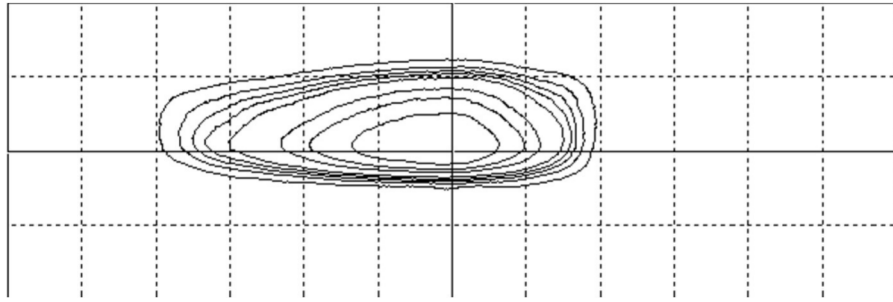


FIG. 10

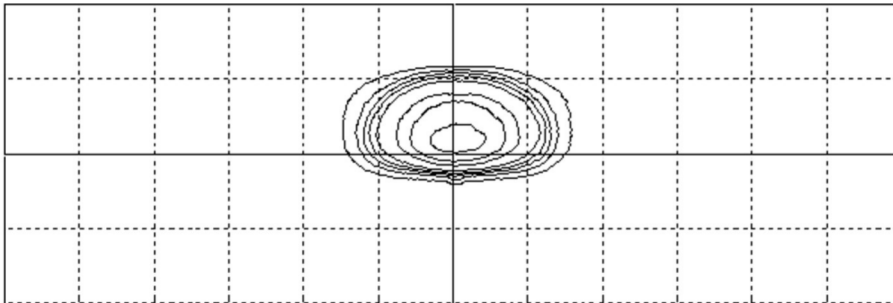


FIG. 11

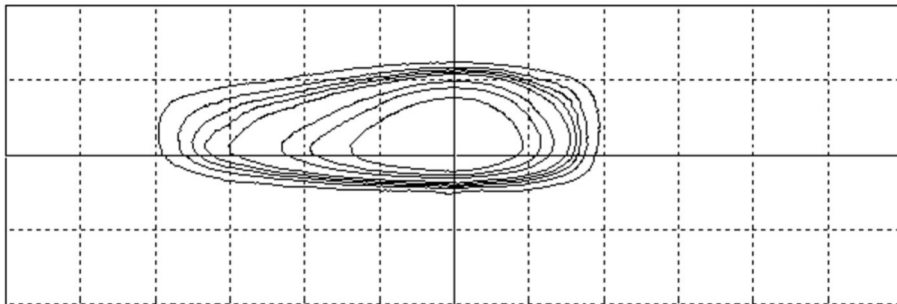


FIG. 12

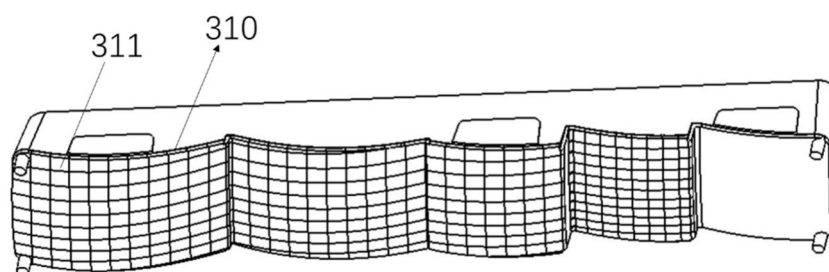


FIG. 13

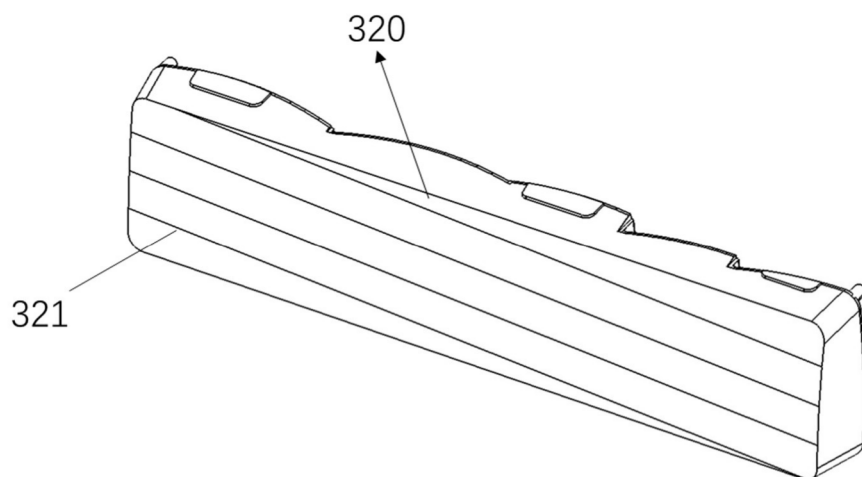


FIG. 14

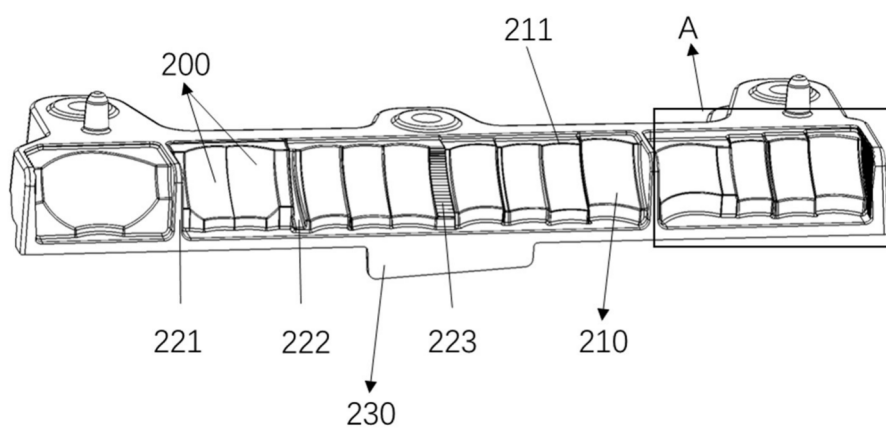


FIG. 15

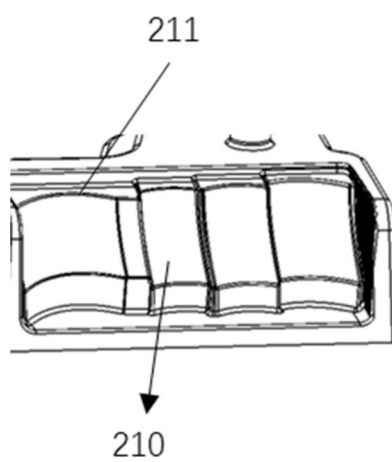


FIG. 16

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2025/070572

A. CLASSIFICATION OF SUBJECT MATTER

F21S41/32(2018.01)i; F21S41/33(2018.01)i; F21S41/36(2018.01)i; F21S41/39(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: F21S

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, ENTXTC, DWPI: 车, 车灯, 照明, 反射, 反光, 边界, 平整, 平齐, 花纹, 消光, 散热, 挡板, 网格, vehicle, lamp, illuminat
+, reflect+, boundary, flat, stripe, extinction, heat dissipation, barrier, net

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 222256201 U (HASCO VISION TECHNOLOGY (SHANGHAI) CO., LTD.) 27 December 2024 (2024-12-27) claims 1-12	1-17
Y	CN 218819889 U (HASCO VISION TECHNOLOGY (SHANGHAI) CO., LTD.) 07 April 2023 (2023-04-07) description, paragraphs 0032-0039, and figures 1-4	1-17
Y	CN 112097215 A (MAGNETI MARELLI AUTOMOTIVE COMPONENTS (WUHU) CO., LTD.) 18 December 2020 (2020-12-18) description, specific embodiments, and figure 9	1-17
A	CN 219693013 U (HASCO VISION TECHNOLOGY (SHANGHAI) CO., LTD.) 15 September 2023 (2023-09-15) entire document	1-17
A	JP 2022189607 A (ICHIKOH INDUSTRIES LTD.) 22 December 2022 (2022-12-22) entire document	1-17
A	JP 2013058488 A (STANLEY ELECTRIC CO., LTD.) 28 March 2013 (2013-03-28) 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 18 March 2025	Date of mailing of the international search report 24 March 2025
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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/CN2025/070572

Patent document cited in search report			Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
CN	222256201	U	27 December 2024	None	
CN	218819889	U	07 April 2023	None	
CN	112097215	A	18 December 2020	None	
CN	219693013	U	15 September 2023	None	
JP	2022189607	A	22 December 2022	None	
JP	2013058488	A	28 March 2013	JP	5515191 B2 11 June 2014

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- CN 202420022210X [0001]