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(54) **AUTOMOTIVE LIGHTING DEVICE**

(57) The invention provides an automotive lighting device (1) comprising a light source (2), a main optical element (4) and a diffusive element (3). The light source (2) is adapted to emit light in a light cone. The main optical element (4) is arranged to receive the light cone and projecting a light pattern in a light direction. Finally, the diffusive element (3) is located outside the light cone, in such a way that the diffusive element (3) does not receive any portion of the light cone, the diffusive element being treated to provide light diffusion.

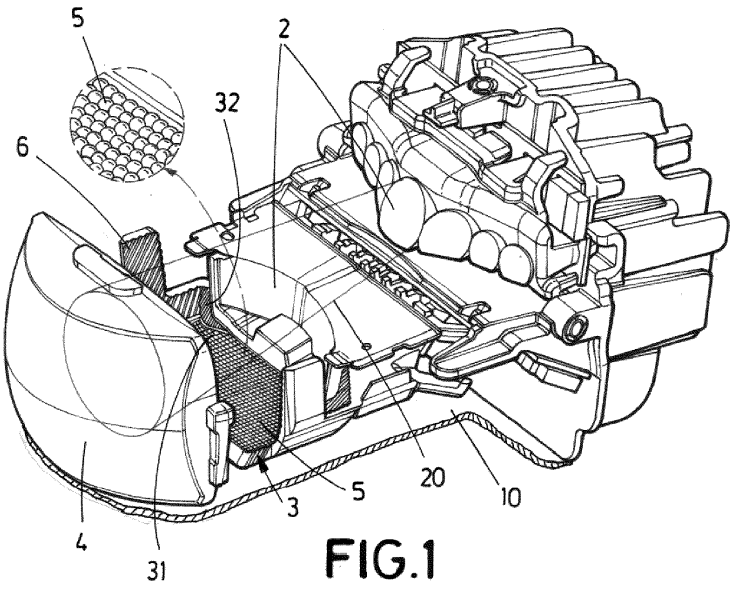

FIG.1

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Description

TECHNICAL FIELD

[0001] The present invention belongs to the field of lamps for automotive vehicles, and more specifically, to the design of headlamps with an outer lens.

STATE OF THE ART

[0002] Current headlamps usually comprise an outer lens, which is in charge of projecting the light emitted by the internal light sources to light the road in front of the vehicle.

[0003] However, with the increase in the plastic parts inside the headlamp, there is a problem when the sun rays impinge on the outer lens and the radiation is focused on a single point inside the headlamp. When this single point was made of a metallic material, the heat was quickly and easily diffused, so that no harm was made to this part. However, if this point is made of plastic, and this is a common situation in current headlamps, heat is not dissipated so easily, and degradation and deformation may occur in this point, with severe consequences in watertightness and the operation of the headlamp.

[0004] Some manufacturers put a metallic piece where this focusing is foreseen to take place, and other ones try to absorb the radiant energy so that the radiation does not cause too much harm. An alternative solution is therefore sought.

DESCRIPTION OF THE INVENTION

[0005] The invention provides a solution for this problem by the provision of an automotive lighting device according to claim 1. Preferred embodiments of the invention are defined in dependent claims.

[0006] Unless otherwise defined, all terms (including technical and scientific terms) used herein are to be interpreted as is customary in the art. It will be further understood that terms in common usage should also be interpreted as is customary in the relevant art and not in an idealised or overly formal sense unless expressly so defined herein.

[0007] In this text, the term "comprises" and its derivations (such as "comprising", etc.) should not be understood in an excluding sense, that is, these terms should not be interpreted as excluding the possibility that what is described and defined may include further elements, steps, etc.

[0008] In a first inventive aspect, the invention provides an automotive lighting device comprising

at least a light source, adapted to emit light in a light cone,

a main optical element being arranged to receive the light cone and projecting a light pattern in a light direction;

a diffusive element located outside the light cone, in such a way that the diffusive element does not receive any portion of the light cone, the diffusive element being treated to provide light diffusion.

[0009] With such an automotive lighting device, the sun radiation is not focused in any point of the headlamp, because the diffusive element causes the radiation to be diffused along a big surface inside the headlamp. As a consequence, no degradation of deformation takes place.

[0010] In this document, the light cone should be understood as the theoretical surface emitted by a light source which is intended to be received by the main optical element. Real light sources' light emission pattern does not correspond exactly with an ideal light cone, but the person skilled in the art understands what is defined in this invention as a light cone.

[0011] In some particular embodiments, the diffusive element is transparent. This is made to not alter the light pattern which is emitted from the interior of the headlamp.

[0012] In some particular embodiments, at least part of the diffusive element is superficially treated to provide light diffusion. In other embodiments, the whole diffusive element is superficially treated to provide light diffusion. This surface treatment is easy to apply and provides the required light diffusion, thus avoiding the concentration of solar radiation in a reduced area of the lighting device.

[0013] In some particular embodiments, the surface treatment comprises graining.

[0014] Graining is a particularly advantageous example of surface treatment, which is easy to apply and offers good results in diffusing the solar rays received in the optical element.

[0015] In some particular embodiments, the diffusive element comprises diffusive three-dimensional micro-structures, wherein one of their dimensions is smaller than 2 mm, each diffusive micro-structure comprising a surface with at least two different tangent planes. In more particular embodiments, these micro-structures may comprise portions of semispheres, and more particularly, with portions of semispheres with a diameter lower than 2 mm.

[0016] The provision of micro-structures is a good way of obtaining a diffusive pattern. These micro-structures are repeated along the whole diffusive element, and diffuse the light received from the outside of the lighting device which is intended to impinge on the housing. The relevant feature of these micro-structures is that at least one of their dimensions is lower than 2 mm, and that they are not plane, so that at least two different tangent planes may be provided. As a consequence, the tangent will change quickly in 2 mm and the light will be properly diffused before reaching the housing. Semispheres are a good option for the diffusive element pattern, since they involve regular but quick gradient changes, and they may be easily manufactured in a pattern arrangement. This

diameter is the maximum one that would be suitable for the present invention, since it causes a good dispersion of the solar rays.

[0017] In some particular embodiments, the diffusive element comprises a structure with portions semispheres and/or portions of ridges.

[0018] Ridges are also a good alternative, and are usually used in the boundary zones of the diffusive element, where a more complex geometry would involve some manufacturing problems.

[0019] In some particular embodiments, the main optical element is an outer lens. The outer lens of an automotive lighting device projects the light emitted by the light sources, but also projects the solar rays inside the lighting device.

[0020] In some particular embodiments, there is a light plane parallel to the light direction so that all the light sources of the automotive lighting device are at one side of the light plane and at least the 80% of the diffusive element is at the other side of the light plane.

[0021] The diffusive element would offer its best performance when it is not in the light path from the light source to the optical element. In this sense, a position at one side of the light plane would be advantageous, since the interference between the diffusive element and the light emitted by the light sources would be minimized.

[0022] In some particular embodiments, the diffusive element comprises a plane portion, wherein there is a light plane parallel to the plane portion so that all the light sources of the automotive lighting device are at one side of the light plane and the plane portion of the diffusive element is at the other side of the light plane.

[0023] A plane portion is easy to design and its behaviour is easy to foresee.

[0024] In some particular embodiments, the automotive lighting device further comprises a housing, wherein at least 80% of the diffusive element is at least 1 mm far from the housing.

[0025] This 1 mm is important so that the rays have some space to be diffused and impinge on different points of the housing.

[0026] In some particular embodiments, the diffusive element comprises two plane portions, and these plane portions form between 30º and 50º with each other.

[0027] These two plane portions are useful when the room inside the lighting device to place the diffusive element is not very large, and two planes would replace a more extended single-plane element.

[0028] In some particular embodiments, the diffusive element is made of polycarbonate. Polycarbonate is a suitable material for this part, due to its good mechanical properties, low brittleness, high transparency and acceptable maximum temperature.

[0029] In some particular embodiments, the light source comprises a solid-state light source and a primary optical element, such as a collimator.

[0030] The term "solid state" refers to light emitted by solid-state electroluminescence, which uses semiconductors to convert electricity into light. Compared to incandescent lighting, solid state lighting creates visible light with reduced heat generation and less energy dissipation. The typically small mass of a solid-state electronic lighting device provides for greater resistance to shock and vibration compared to brittle glass tubes/bulbs and long, thin filament wires. They also eliminate filament evaporation, potentially increasing the life span of the illumination device. Some examples of these types of lighting comprise semiconductor light-emitting diodes (LEDs), organic light-emitting diodes (OLED), or polymer light-emitting diodes (PLED) as sources of illumination rather than electrical filaments, plasma or gas.

[0031] The primary optical element is intended to project the light cone which is suitable for being projected by the main optical element.

[0032] In some particular embodiments, the primary optical element is a collimator. A collimator provides an optimal optical behaviour for this application. The collimator is able to transform the divergent beams of light coming from a unique light source into a parallel distribution of light beams.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033] To complete the description and in order to provide for a better understanding of the invention, a set of drawings is provided. Said drawings form an integral part of the description and illustrate an embodiment of the invention, which should not be interpreted as restricting the scope of the invention, but just as an example of how the invention can be carried out. The drawings comprise the following figures:

Figure 1 shows a perspective view of the interior of an automotive lighting device according to the invention.

Figure 2 shows a lateral view of this automotive lighting device.

Figure 3 shows a lighting device according to the invention which has been installed in an automotive vehicle.

DETAILED DESCRIPTION OF THE INVENTION

[0034] The example embodiments are described in sufficient detail to enable those of ordinary skill in the art to embody and implement the systems and processes herein described. It is important to understand that embodiments can be provided in many alternate forms and should not be construed as limited to the examples set forth herein.

[0035] Accordingly, while embodiment can be modified in various ways and take on various alternative forms, specific embodiments thereof are shown in the drawings and described in detail below as examples. There is no

intent to limit to the particular forms disclosed. On the contrary, all modifications, equivalents, and alternatives falling within the scope of the appended claims should be included. Elements of the example embodiments are consistently denoted by the same reference numerals throughout the drawings and detailed description where appropriate.

[0036] Figure 1 shows a perspective view of the interior of an automotive lighting device according to the invention, which comprises the following elements:

a group of light sources 2, each one being adapted to emit light in a light cone,
a projecting lens 4 being arranged to receive the light cones and projecting a light pattern in a light direction;
a diffusive element 3 located outside the light cones, in such a way that the diffusive element 3 does not receive any portion of any light cone.

[0037] The light sources 2 comprise a plurality of LEDs and collimators. The collimators project the light emitted by the LEDs to create the light cones which will be received by the projecting lens 4. This figure shows a plurality of light sources 2, and each one is configured to emit a light cone. However, for clarity purposes, only one light cone 20 is shown in this figure.

[0038] This diffusive element 3 is a transparent part, made of polycarbonate, which is arranged in the bottom part of the lighting device, outside any light cone, and has been superficially treated to provide light diffusion. In this case, this superficial treatment comprises the modification of its surface to include a semispheres pattern. These semispheres 5 have a diameter of 1 mm. The boundary zones of the diffusive element comprise ridges 6, which are easier to manufacture and also cause a diffusing effect in the light received from the outside of the lighting device.

[0039] The light diffusion offered by this diffusion element is not intended to affect the light cones emitted by any of the light sources but is intended to affect the solar rays received from the outside of the lighting device.

[0040] This diffusive element 3 comprises two plane portions 31, 32. The plane portions 31, 32 form 40º with each other, to receive the maximum range of solar rays without increasing the size of the diffusing element.

[0041] Figure 2 shows a lateral view of this automotive lighting device, where the light rays received from the outside of the automotive lighting device are simulated.

[0042] There is a light plane 30 parallel to the first plane portion 31 so that all the light sources 2 of the automotive lighting device are at one side of the light plane 30 and the first plane portion 31 of the diffusive element 3 is at the other side of the light plane 30. The first plane portion 31 is therefore independent from the light path that comes from the light sources 2 and does not modify the main light cones which are emitted by those light sources 2. This first plane 31 is attached to some attachment points on the housing 10 of the automotive lighting device, ensuring that the rest of the first plane 31 is at least 2 mm from this housing 10, so that the solar rays which are diffused by the diffusing element are sufficiently far from the housing 10 to be properly scattered along the surface 7 on the housing 10.

[0043] The first plane 31 of the diffusive element 3 receives most of the rays, and, as has been previously shown, due to its superficial treatment and to the distance between said first plane 31 and the housing 10, these rays are conveniently diffused and scattered along the surface 7 in the housing 10, thus avoiding that these rays focus on a reduced region in this housing 10.

[0044] Figure 3 shows a lighting device 1 according to the invention which has been installed in an automotive vehicle 100.

[0045] Due to the aforementioned improvements of invention, plastic elements may be used inside the automotive lighting device without the risk that solar rays may be focused and cause deformations or degradations in said plastic parts.

Claims

1. Automotive lighting device (1) comprising

   at least a light source (2), adapted to emit light in a light cone,
   a main optical element (4) being arranged to receive the light cone and projecting a light pattern in a light direction;
   a diffusive element (3) located outside the light cone, in such a way that the diffusive element (3) does not receive any portion of the light cone, the diffusive element being treated to provide light diffusion.

2. Automotive lighting device (1) according to claim 1, wherein the diffusive element (3) is transparent.

3. Automotive lighting device (1) according to any of the preceding claims, wherein at least part of the diffusive element (3) is superficially treated to provide light diffusion.

4. Automotive lighting device (1) according to claim 3, wherein the whole diffusive element (3) is superficially treated to provide light diffusion.

5. Automotive lighting device (1) according to any of claims 3 or 4, wherein the surface treatment comprises graining.

6. Automotive lighting device (1) according to any of the preceding claims, wherein the diffusive element (3) comprises diffusive three-dimensional microstructures, wherein one of their dimensions is small-

er than 2 mm, each diffusive micro-structure comprising a surface with at least two different tangent planes.

7. Automotive lighting device (1) according to any of the preceding claims, wherein the diffusive element comprises a structure with portions of semi-spheres and/or portions of ridges (6).

8. Automotive lighting device (1) according to any of the preceding claims, wherein the main optical element (4) is an outer lens.

9. Automotive lighting device (1) according to any of the preceding claims, wherein there is a light plane (30) parallel to the light direction so that all the light sources (2) of the automotive lighting device are at one side of the light plane (30) and at least the 80% of the diffusive element (3) is at the other side of the light plane (30).

10. Automotive lighting device (1) according to claim 9, wherein the diffusive element (3) comprises a plane portion (31), wherein there is a light plane (30) parallel to the plane portion (31) so that all the light sources (2) of the automotive lighting device (1) are at one side of the light plane (30) and the plane portion (31) of the diffusive element (3) is at the other side of the light plane (30).

11. Automotive lighting device (1) according to any of the preceding claims, further comprising a housing (10), wherein at least 80% of the diffusive element is at least 1 mm far from the housing (10).

12. Automotive lighting device (1) according to any of the preceding claims, wherein the diffusive element (3) comprises two plane portions (31, 32), and these plane portions (31, 32) form between 30º and 50º with each other.

13. Automotive lighting device (1) according to any of the preceding claims, wherein the diffusive element (3) is made of polycarbonate.

14. Automotive lighting device (1) according to any of the preceding claims, wherein the light source comprises a solid-state light source and a primary optical element, such as a collimator.

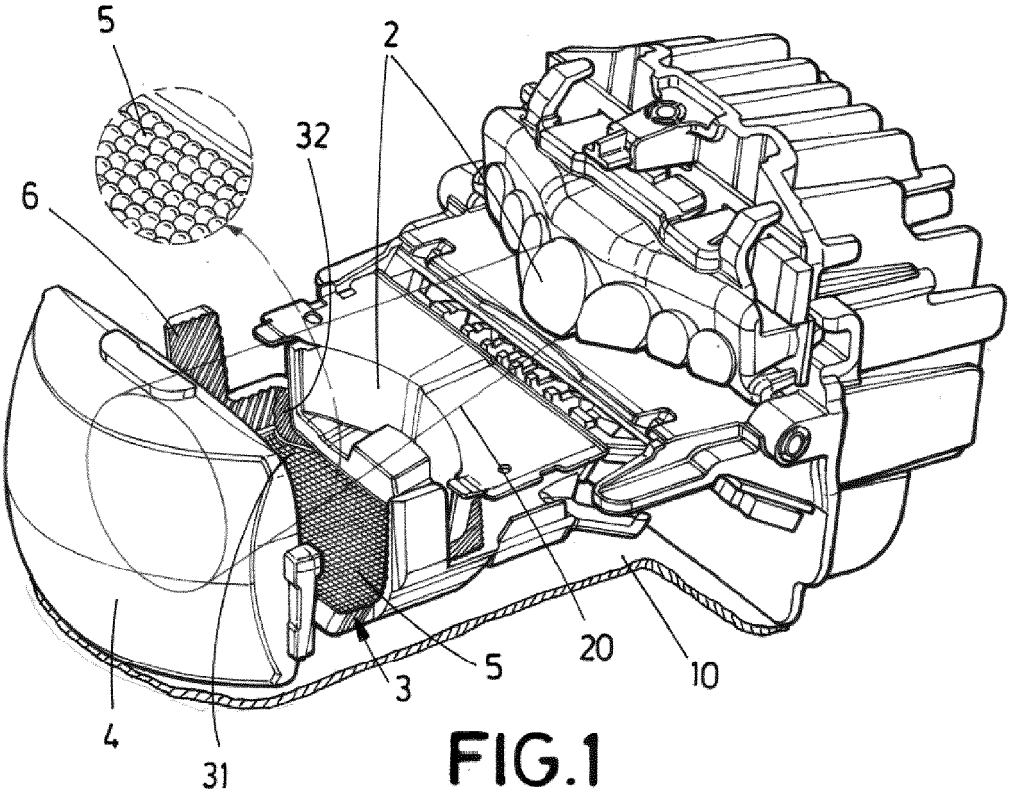

FIG.1

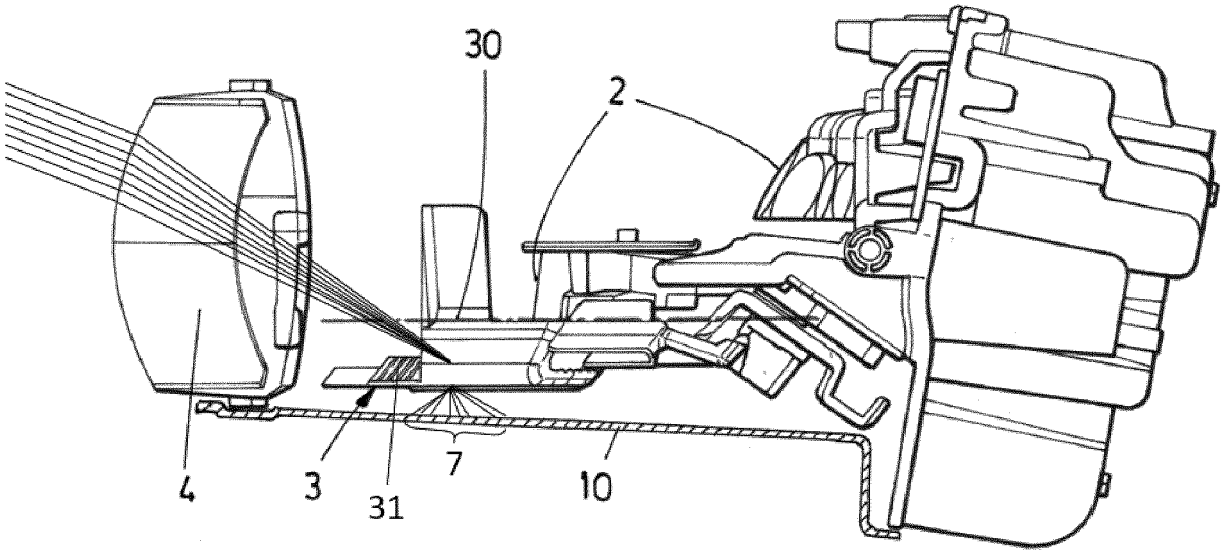

FIG.2

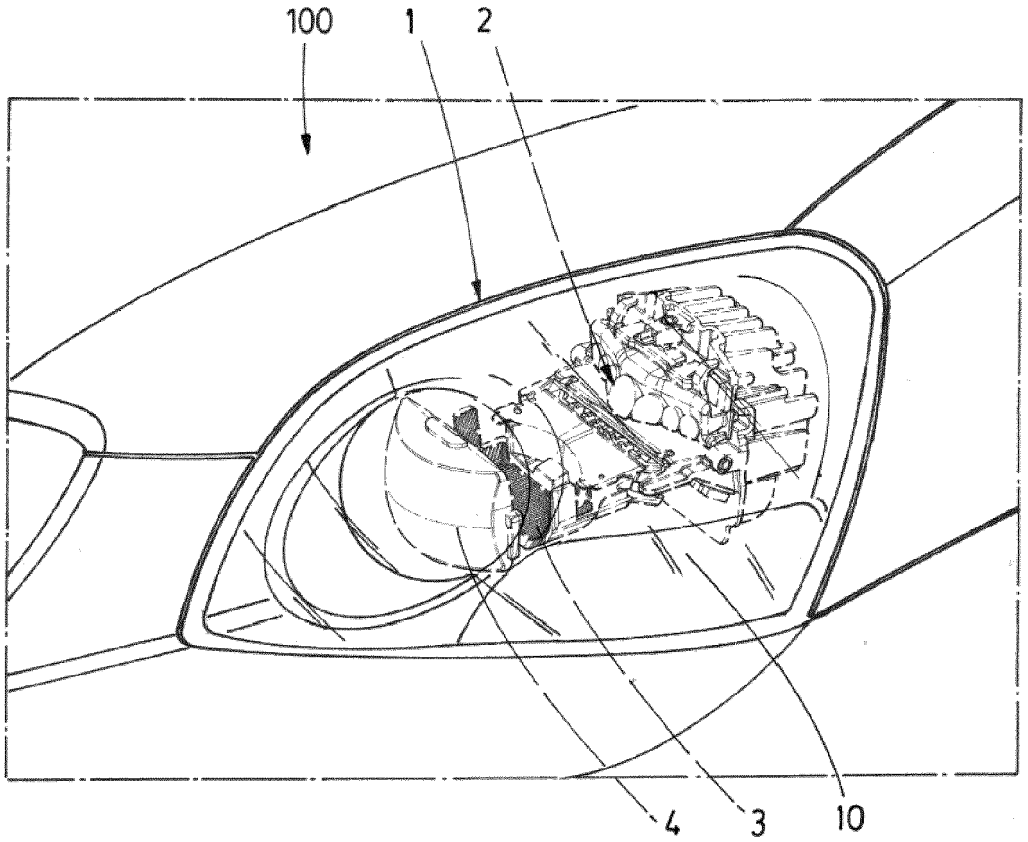

FIG.3

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EUROPEAN SEARCH REPORT

Application Number
EP 18 38 2881

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	20 May 2019	Giraud, Pierre

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
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