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(71) Applicant: **Valeo Vision**
93012 Bobigny Cedex (FR)

(72) Inventors:
- **SANTAELLA HERNANDEZ, Juan Jose**
23600 Martos (ES)
- **CANTUDO FRANCO, Miguel Angel**
23600 Martos (ES)
- **ROLDAN ZAFRA, Jose David**
23600 Martos (ES)

(74) Representative: **Valeo Visibility**
Service Propriété Industrielle
c/o Valeo Vision
34, rue Saint André
93012 Bobigny (FR)

(54) AUTOMOTIVE LUMINOUS ARRANGEMENT

(57) The invention presents an automotive luminous arrangement comprising a first luminous device (1) comprising a first substrate (2) and a second luminous device (11) comprising a second substrate. The first substrate (2) comprises an optical element and a solid-state light source located in the focus of the optical element, and the second substrate comprises an optical element and a solid-state light source located in the focus of the optical element. The first luminous device (1) further comprises a first wavelength conversion layer (7) arranged to receive the light emitted by the solid-state light source of the first luminous device and the second luminous device (11) further comprises a second wavelength conversion layer (17) arranged to receive the light emitted by the solid-state light source of the second luminous device, wherein the light at the output of the second wavelength (17) conversion layer has a different wavelength from the light at the output of the first wavelength conversion layer (7).

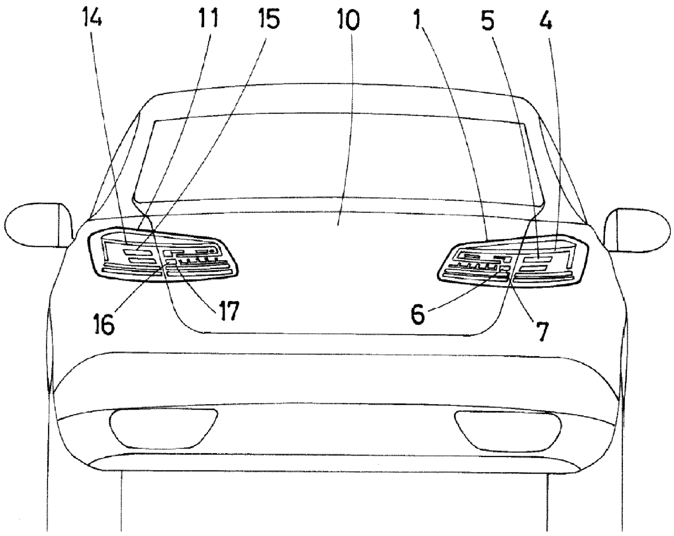

FIG. 3

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Description

TECHNICAL FIELD

[0001] This invention belongs to the field of electronic assemblies comprised within the automotive luminous devices, intended to provide luminous functions to the vehicles.

STATE OF THE ART

[0002] Automotive lighting market can be considered one of the most competitive ones and new lighting functionalities are constantly required.

[0003] In some cases, the same substrate is used in different luminous devices of the same vehicle when two different lighting functions are to be used in each side of the vehicle, and both functions require similar optical features.

[0004] Usually, both positions are provided in each of the substrates, and then, in each side, the corresponding light source is installed. This is cheap in terms of manufacturing a single model of substrate, but brings up some problems in term of optical performance, track routing, unnecessary duplication and luminous power needed to fulfil the regulations.

[0005] The present invention provides an alternative arrangement to provide a luminous assembly for an automotive vehicle, where the same substrate is used in each side for different lighting functions.

DESCRIPTION OF THE INVENTION

[0006] The invention provides an alternative solution for managing the needs of the light sources of an automotive luminous device by an automotive luminous arrangement comprising a first luminous device comprising a first substrate and a second luminous device comprising a second substrate, wherein

the first substrate comprises an optical element and a solid-state light source located in the focus of the optical element, the solid-state light source being arranged to emit light

the second substrate comprises an optical element and a solid-state light source located in the focus of the optical element, the solid-state light source being arranged to emit light

the first luminous device further comprises a first wavelength conversion layer arranged to receive the light emitted by the solid-state light source of the first luminous device; and

the second luminous device further comprises a second wavelength conversion layer arranged to receive the light emitted by the solid-state light source of the second luminous device;

the light at the output of the second wavelength conversion layer has a different wavelength from the light at the output of the first wavelength conversion layer.

[0007] 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 lifespan 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.

[0008] An optical element is an element that has some optical properties to receive a light beam and emit it in a certain direction and/or shape, as a person skilled in automotive lighting would construe without any additional burden. Reflectors, collimators, light guides, projection lenses, etc., or the combination thereof are some examples of these optical elements which are useful for transforming the light beams emitted by the light source into an acceptable light pattern for the functionality chosen for the lighting device. All of these optical elements define a focus, which is the point where the light emitted by the light source is most effectively transmitted by the optical element.

[0009] The wavelength conversion layers are only in charge of providing the suitable colour for the lighting functionality, but do not provide the luminous flux necessary to fulfil the regulations. The light power is provided by the light sources, not by the wavelength conversion layer. However, the wavelength conversion layer may introduce some power losses when converting the light to a different wavelength, depending on the nature of the chosen layer.

[0010] With this arrangement, different lighting functions may be carried out by similar luminous devices, just by customizing the colour of the projected light by the wavelength conversion layer. Further, since each solid-state light source is located in their respective focus, the power needed to perform the corresponding lighting functionality is lower: the operation of this solid-state light source is optimized in terms of power.

[0011] In some particular embodiments, the first solid-state light source is intended to contribute to a first luminous function and the second solid-state light source is intended to contribute to a second luminous function different from the first luminous function.

[0012] Since the colours may be different, the luminous functions may be different, and associated to different colours.

[0013] In some particular embodiments, the first luminous function comprises a fog lamp function and the second luminous function comprises a reverse lamp function.

[0014] This is a clear example of different luminous functions which may be arranged symmetrically in the rear part of a vehicle. Both fog and reverse lamps only require a single light source to perform the lighting functionality. Hence, the fog lamp may be located in one device and the reverse lamp may be located in the device of the other side of the vehicle. The rest of the lighting functionalities (stop lamp, direction indicator, etc) are duplicated, and are therefore part of the same design. The difference between the rear left and the rear right devices will be that in one there is a fog lamp and in the other one there is a reverse lamp. This is a design commonly used by automotive manufacturers, but the fact that, in this design, both lamps are located in the focus of their respective optical element are completely new and advantageous.

[0015] In some particular embodiments, the first substrate and the second substrate are printed circuit boards and the arrangement of the first substrate is symmetrical with respect to the arrangement of the second substrate.

[0016] Following with the previous paragraph, in a design where the rear lighting devices are symmetrical (as in the vast majority of the vehicles), the substrates are also symmetrical (i.e., the left substrate is a symmetrical design with respect of the right substrate, taking a central plane extending from the front part to the rear part of the vehicle as the symmetry plane).

[0017] In some particular embodiments, the first luminous device comprises a driver element configured to control the operation of the solid-state light source of the first automotive luminous device and the second luminous device comprises a driver element configured to control the operation of the solid-state light source of the second automotive luminous device.

[0018] With this invention, only a single driver element for the corresponding function is needed, there is no need to provide space and track routing for an additional driver which is not used, as in the case of the state of the art.

[0019] In some particular embodiments, the first and/or second wavelength conversion layers comprises quantum dots located to receive light emitted by the light sources.

[0020] A quantum dot is an electronic structure obtained out of a semiconductor nanocrystal, with a size such that their electrons and holes are confined in all three spatial dimensions. Depending on the particular sizes of the quantum dots, they emit light in a particular wavelength (bandgap) when they are excited, either electrically or luminescently. As a consequence, "red" quantum dots would be quantum dots which emit light in the red bandgap when excited, "green" quantum dots would be quantum dots which emit light in the green bandgap when excited, etc. However, when they are not excited, they may not be visible. This is because quantum dots are deposited in a nanometric layer using a thin film deposition technology. By controlling the amount and density of the quantum dots, this layer could be not visible when not excited either by an electric or by a luminescent stimulator.

[0021] These quantum dots are an advantageous solution since they provide flexibility in the design of the automotive lighting devices, allowing new ways of designing the different functionalities of a lighting device: lighting, indicating, signalling.

[0022] In some particular embodiments, the quantum dots are deposited on a substrate, which is located between the output surfaces of the folder and the main optical element.

[0023] This substrate is easy to install, or even to attach to the folder or to the optical element, since quantum dot films are easily to obtain and to handle.

[0024] In some particular embodiments, the quantum dots are deposited on a substrate layer.

[0025] These embodiments, despite being a little more complicated to obtain, allow a better accuracy in the installation, since the size and shape of the layer is carefully designed, and the installation of pieces on the surfaces involve a cleaner design.

[0026] In some particular embodiments, each automotive luminous device comprises a main transparent cover and the quantum dots are deposited on an input surface of the main transparent cover.

[0027] Direct deposition on the main transparent cover of the automotive luminous device is an alternative to obtain a cleaner design.

[0028] In some particular embodiments, the substrate layer is deposited on a reflector or on a bezel.

[0029] These elements are common in automotive manufacturing, and the deposition of the substrate layer in these elements is advantageous.

[0030] In some particular embodiments, at least some of the light sources are configured to emit in a blue, deep blue or ultraviolet wavelength, and the wavelength conversion layer comprises red and green quantum dots.

[0031] With this arrangement, light is emitted in a first wavelength, instead of a mixture of different wavelengths such as a white light. Blue is a common option, but other wavelengths such as deep blue or even ultraviolet could also be used without any issue. Even if this light is diffracted, due to the fact that the source light is emitted in a single wavelength, the resulting beam pattern is not an uncontrolled mixture of different colours. The wavelength conversion layer modifies the wavelength of this resulting beam pattern so that it complies with the automotive regulations of the specific functionality. When blue light sources are used and a white light is required, red and green quantum dots are used, but depending on the wavelength of the light source and the desired final colour, different quantum dots will be used.

[0032] In some particular embodiments, the solid-state light source of the first automotive luminous device and the solid-state light source of the second automotive luminous device are configured to emit light in the same wavelength.

[0033] With this embodiment, the concept of manufacturing two symmetrical substrates is reinforced, since the different colour is provided by the wavelength conversion layer.

[0034] 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.

[0035] 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.

BRIEF DESCRIPTION OF THE DRAWINGS

[0036] 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 scheme of some elements of an automotive luminous arrangement according to known practice.

Figure 2 presents a scheme of some elements of an automotive luminous arrangement according to the invention.

Figure 3 presents a particular embodiment of an automotive luminous arrangement according to the invention.

[0037] In these figures, the following reference numbers have been used:

1 First automotive lighting device
2 First PCB
3 Housing for the LED of the reverse lamp function
4 Turning indicator lamp
5 Stop lamp
6 Reverse lamp
7 First quantum dot layer
8 Driver for reverse lamp function
10 Automotive vehicle
11 Second automotive lighting device
14 Turning indicator lamp
15 Stop lamp
16 Rear fog lamp
17 Second quantum dot layer
90 PCB of the state of the art
91 Housing for LED of the stop lamp in the state of the art
92 Housing for LED of the direction indicator lamp in the state of the art
93 Housing for LED of the rear position lamp in the state of the art
94 Housing for LED of the reverse lamp in the state of the art
95 Housing for LED of the rear fog lamp in the state of the art
96 Focus of the reflector

DETAILED DESCRIPTION OF THE INVENTION

[0038] 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.

[0039] 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.

[0040] Figure 1 shows an arrangement of a printed circuit board 90 of an automotive luminous device of an automotive luminous arrangement according to known practice.

[0041] This printed circuit board 90 is used, together with the symmetrical design, to provide the rear lighting devices of a vehicle.

[0042] In this figure, the printed circuit board corresponding to the right device is shown. In this printed circuit board, there are a few of details which are commented below.

[0043] Firstly, this printed circuit board 90 corresponds to a lighting device which is intended to provide the luminous functions of stop lamp, direction indicator lamp, rear position lamp and reverse lamp. Hence, it has a housing 91 for the LEDs which contribute to the stop lamp function, a housing 92 for the LEDs which contribute to the direction indicator function, a housing 93 for the LEDs which contribute to the rear position lamp function and a housing 94 for the LEDs which contribute to the reverse lamp function However, this printed circuit board also has a housing 95 intended to receive a LED for rear fog lamp. This is because the symmetrical printed circuit board, which will be used in the left device, is intended to provide the same functionalities, except for the fact that it provides the rear fog lamp instead of the reverse lamp. To save costs, both printed circuit boards, left and right, has both the reverse lamp space and the rear fog lamp space. The result is that neither of these two lamps are located in the exact focus 96 of the corresponding reflector.

[0044] Further, track routing and driver elements are provided for both functionalities in both printed circuit boards. This makes the printed circuit board wider, heavier and with a worse design in terms of electro-static discharge risk.

[0045] Figure 2 shows the printed circuit board 2 of the right side of an automotive luminous arrangement according to the invention.

[0046] The main difference of the solution proposed by the invention with respect to the board illustrated in Figure 1 is that, for this right side, there are LEDs and arrangement only for these functionalities that are being effectively used.

[0047] In this case, there is no provision for a rear fog lamp, since this functionality is not provided by the right side. The housing 3 of the LED which contributes to the reverse lamp function is, as a consequence, located in the focus of the reflector. This makes that the light emitted by the LED which contributes to the reverse lamp is more effectively transmitted to the exterior of the lighting device.

[0048] Further, there is no need to provide any track routing or driver elements for the functionality which is not provided, which improves the design, size, weight and electro-static discharge result of the printed circuit board.

[0049] Hence, this right printed circuit board 2 contains the LED which cooperates with the corresponding reflector to provide the reverse lamp functionality. This LED is located on the precise focus of the corresponding reflector. The left printed circuit board, which is not illustrated, also comprises the corresponding driver elements and track routings, but only for those LEDs which are in fact actively contributing to perform a lighting function.

[0050] Figure 3 shows a scheme of an automotive luminous arrangement according to the invention.

[0051] This automotive luminous arrangement comprises the two rear lighting devices 1, 11 of an automotive vehicle 10. These devices have a symmetrical design: both of them have a turning indicator lamp 4, 14 and a stop lamp 5, 15. The left one 11 has a fog lamp 16 and the right one has a reverse lamp 6. The fog lamp 16 and the reverse lamp 6 are arranged in symmetrical locations.

[0052] Each luminous function is provided by a LED and an optical element. In the event of the fog and reverse functionalities, each one is provided by a LED and a reflector. The LED contributing to the fog lamp function is located on the focus of the corresponding reflector and the same happens with the reverse lamp.

[0053] Furthermore, each lighting device comprises a main transparent cover, and there is a quantum dot layer 7, 17 arranged in a specific portion of each main transparent cover. This quantum dot layer contributes to provide the suitable final colour to the light projected outside the corresponding lighting device. For example, the LED of the left device, which contributes to the fog lamp functionality, emits in a blue wavelength, but, due to the interposition of the quantum dot layer, the light which is finally projected outside the device has the regulatory red colour. The same happens with the LED of the right device, which contributes to the reverse lamp functionality. This LED also emits in a blue wavelength, but, due to the interposition of the corresponding quantum dot layer, the light which is finally projected outside the device has the regulatory white colour.

Claims

1. Automotive luminous arrangement comprising a first luminous device (1) comprising a first substrate (2) and a second luminous device (11) comprising a second substrate, wherein

    the first substrate (2) comprises an optical element and a solid-state light source located in the focus of the optical element, the solid-state light source being arranged to emit light
    the second substrate comprises an optical element and a solid-state light source located in the focus of the optical element, the solid-state light source being arranged to emit light
    the first luminous device (1) further comprises a first wavelength conversion layer (7) arranged to receive the light emitted by the solid-state light source of the first luminous device; and
    the second luminous device (11) further comprises a second wavelength conversion layer (17) arranged to receive the light emitted by the solid-state light source of the second luminous device;
    the light at the output of the second wavelength (17) conversion layer has a different wavelength from the light at the output of the first wavelength conversion layer (7).

2. Automotive luminous arrangement according to claim 1, wherein the first solid-state light source is intended to contribute to a first luminous function (6) and the second solid-state light source is intended to contribute to a second luminous function (16) different from the first luminous function (6).

3. Automotive luminous arrangement according to claim 2, wherein the first luminous function comprises a fog lamp function and the second luminous function comprises a reverse lamp function.

4. Automotive luminous arrangement according to any of the preceding claims, wherein the first substrate (2) and the second substrate are printed circuit

boards and the arrangement of the first substrate is symmetrical with respect to the arrangement of the second substrate.

5. Automotive luminous arrangement according to any of the preceding claims, wherein the first luminous device comprises a driver element configured to control the operation of the solid-state light source of the first automotive luminous device and the second luminous device comprises a driver element configured to control the operation of the solid-state light source of the second automotive luminous device.

6. Automotive luminous arrangement according to any of the preceding claims, wherein the first and/or second wavelength conversion layers comprises quantum dots arranged to receive light projected by the optical elements.

7. Automotive luminous arrangement according to claim 6, wherein the quantum dots are deposited on a substrate layer.

8. Automotive luminous arrangement according to claim 7, wherein each automotive luminous device comprises a main transparent cover and the quantum dots are deposited on an input surface of the main transparent cover.

9. Automotive luminous arrangement according to claim 7, wherein the substrate layer is deposited on a reflector or on a bezel.

10. Automotive luminous arrangement according to any of the preceding claims, wherein at least some of the light sources are configured to emit light in a blue, deep blue or ultraviolet wavelength, and the wavelength conversion layer comprises at least red and green quantum dots.

11. Automotive luminous arrangement according to any of the preceding claims, wherein the solid-state light source of the first automotive luminous device and the solid-state light source of the second automotive luminous device are configured to emit light in the same wavelength.

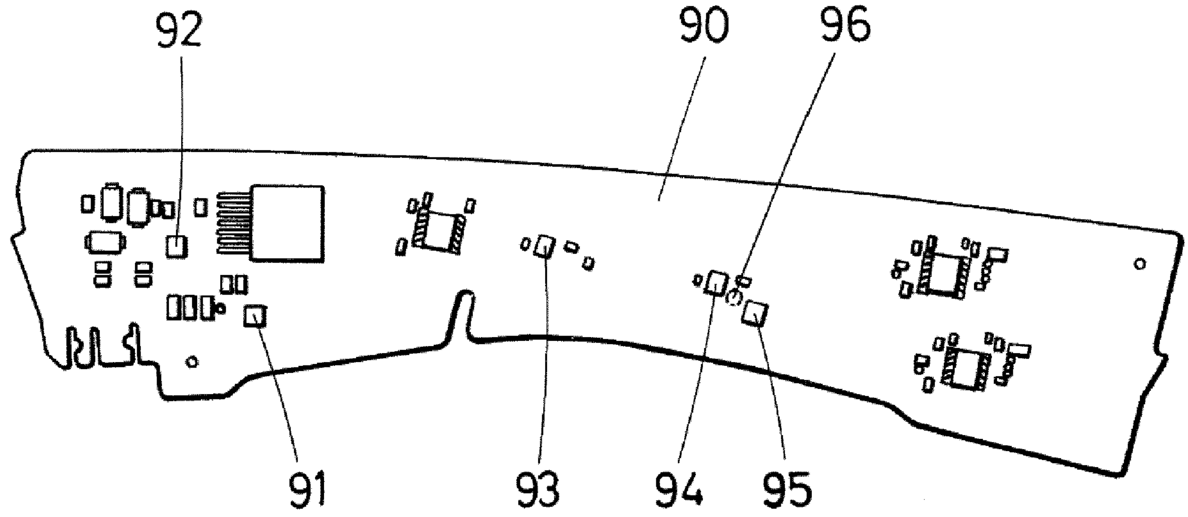

FIG. 1

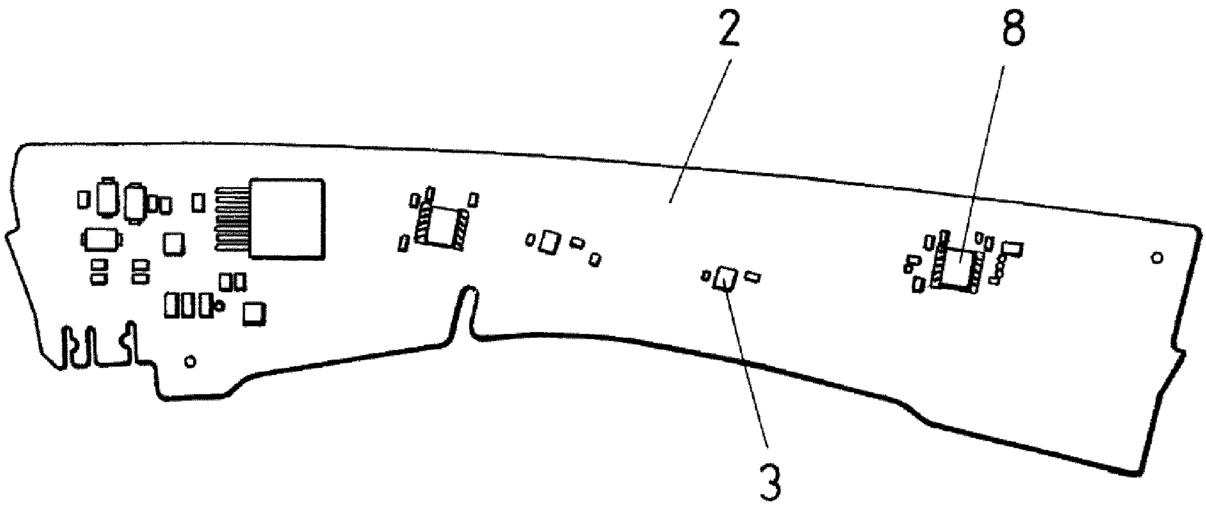

FIG. 2

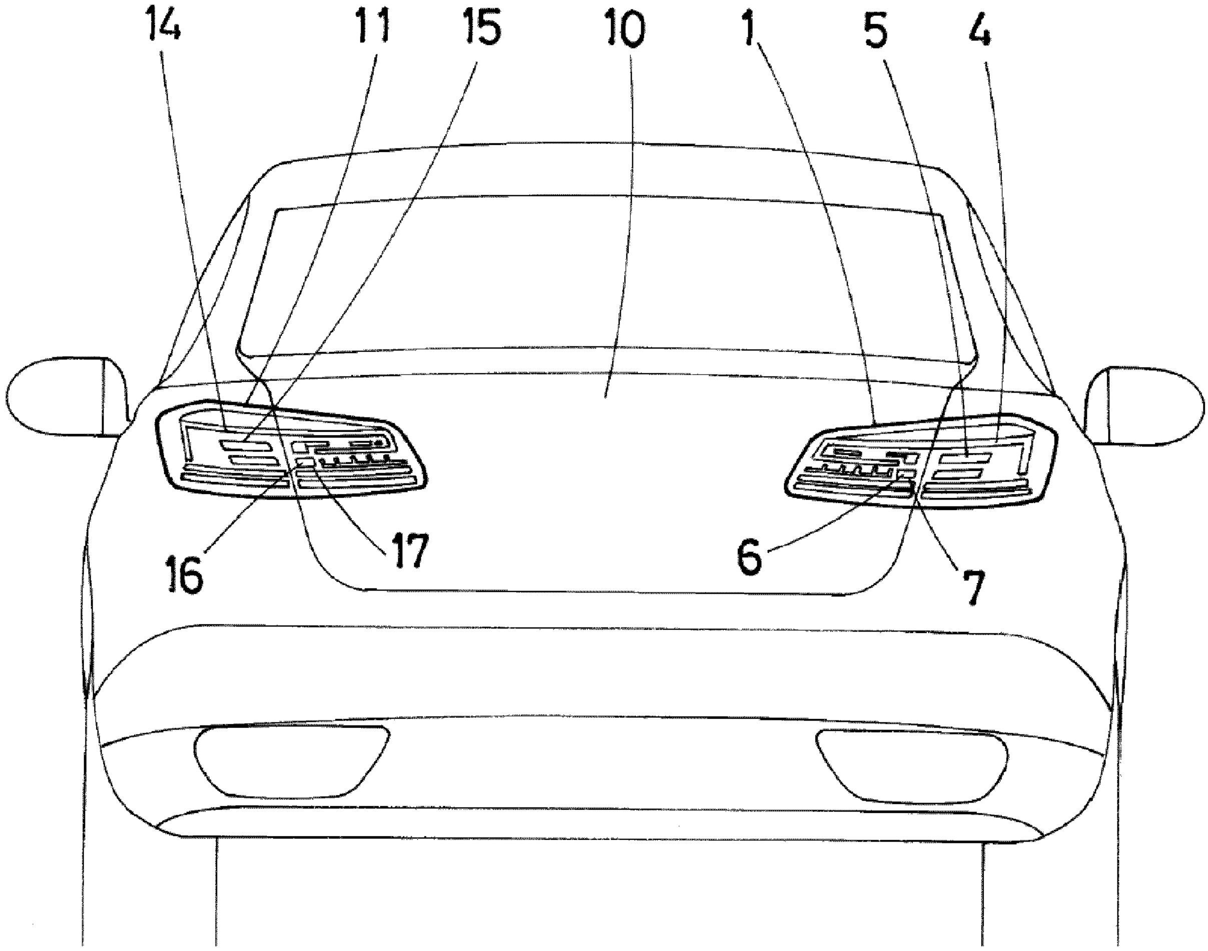

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 22 16 5637

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 10 2014 203245 A1 (AUTOMOTIVE LIGHTING REUTLINGEN [DE]) 27 August 2015 (2015-08-27) * paragraphs [0003] - [0050]; figures 1-4 *	1-11	INV. F21S43/16
X	DE 10 2013 205836 A1 (OSRAM OPTO SEMICONDUCTORS GMBH [DE]) 9 October 2014 (2014-10-09) * paragraphs [0004] - [0075]; figures 1-8 *	1-11	
X	DE 10 2015 202745 A1 (HYUNDAI MOTOR CO LTD [KR]) 21 April 2016 (2016-04-21) * paragraphs [0009] - [0058]; figures 1-5 *	1-11	

TECHNICAL FIELDS SEARCHED (IPC)
F21S
F21W

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	9 September 2022	Sarantopoulos, A

CATEGORY OF CITED DOCUMENTS

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