

(19)



(11)

EP 3 470 729 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
17.04.2019 Bulletin 2019/16

(21) Application number: **17382672.8**

(22) Date of filing: **10.10.2017**

(51) Int Cl.:
F21S 45/10 (2018.01) **F21S 41/19** (2018.01)
F21S 41/141 (2018.01) **F21S 43/19** (2018.01)
F21S 43/14 (2018.01) **H05K 9/00** (2006.01)
F21S 45/47 (2018.01)

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(71) Applicant: **Valeo Iluminacion**
23600 Martos (ES)

(72) Inventors:
• **PENA, Miguel-Angel**
23600 MARTOS (ES)
• **ILLAN, Antonio Domingo**
23600 MARTOS (ES)

- **SANTAELLA, Juan-Jose**
23600 MARTOS (ES)
- **LARA-CABEZA, Juan**
23009 MARTOS (ES)
- **CALMAESTRA, Manuel**
23600 MARTOS (ES)
- **ROLDAN, Jose-David**
23600 MARTOS (ES)
- **MARTINEZ-ZALDIVAR, Tomas**
23600 MARTOS (ES)
- **GALIANO, Raul**
23600 MARTOS (ES)

(74) Representative: **Valeo Vision**
IP Department
34, rue Saint André
93012 Bobigny (FR)

(54) **LIGHTING DEVICE**

(57) The invention provides a lighting device (1) comprising a printed circuit board (2), a heatsink (4) and an optical element (5). The printed circuit board (2) comprises an electronic component (3) to be protected and is connected to ground. The heatsink (4) is made out of an electrically conductive material. The optical element (5) made at least partially of an electrically conductive material. The printed circuit board (2), the heatsink (4) and the optical element (5) are attached by a conductive connector (6), the conductive material of the optical element (5) and the heatsink (4) being in electrical contact with the conductive connector (6) and the conductive material of the optical element being in electrical contact with the ground connection of the printed circuit board (2).

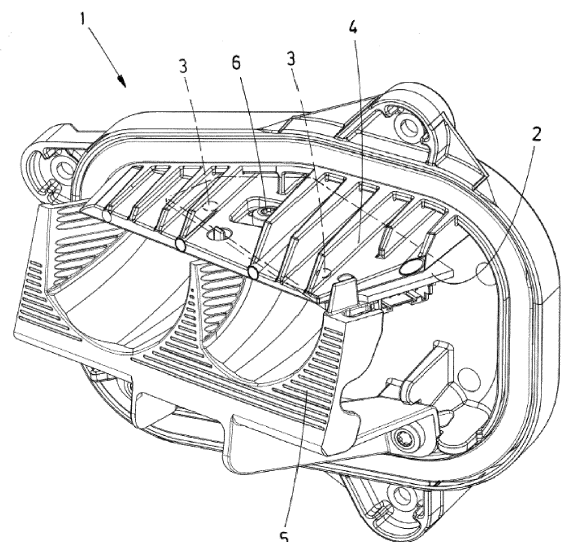


FIG.1

EP 3 470 729 A1

Description

TECHNICAL FIELD

[0001] This invention is related to the field of ground connection and electrostatic discharges (ESDs) in automotive lighting devices.

STATE OF THE ART

[0002] Electrostatic discharges (ESDs) are present in all environments. They especially affect metallic parts which are close to other elements with different charge. The heatsink located in an automotive lighting device, which is usually a metallic part, is usually connected to the ground, to avoid that an ESD may damage electronic elements present in a printed circuit board (PCB) of such a lighting device.

[0003] There are many different ways of achieving this ground connection. One is using a conductive additional piece present in the PCB, which is usually welded or anyhow fixed. This additional piece has a higher potential than the electronic element that needs to be protected (such as a LED in the PCB). When an ESD goes from the heatsink to the PCB, the additional piece absorbs the ESD and therefore the PCB is protected. Another solution is similar to a crimping process, where a pin of heatsink is pushed down to make contact with the PCB, or a specific screw is designed only for ESD connection with a special finishing to make a contact in the PCB.

[0004] An alternative solution to the aforementioned problem is sought.

DESCRIPTION OF THE INVENTION

[0005] The invention provides an alternative solution for protecting an electronic element from ESDs by means of a lighting device according to claim 1. Preferred embodiments of the invention are defined in dependent claims.

[0006] In a first inventive aspect, the invention provides a lighting device comprising

- a printed circuit board comprising an electronic component to be protected, the printed circuit board being connected to ground;
- a heatsink made out of an electrically conductive material; and
- an optical element made at least partially of an electrically conductive material;

wherein the printed circuit board, the heatsink and the optical element are attached by a conductive connector, the conductive material of the optical element and the heatsink being in electrical contact with the conductive connector and the conductive material of the optical element being in electrical contact with the ground connection of the printed circuit board.

[0007] The electronic component to be protected is an electronic component which is sensitive to ESDs, so that it is intended to be protected against them.

[0008] The attachment between the printed circuit board, the heatsink and the optical element is advantageously used for connecting the heatsink to ground without any additional element fixed to the PCB or with any additional process undergone by the PCB, thus resulting in a less expensive solution, compared to the ones known in the state of art. Hence, in the event of an ESD, the heatsink and the PCB are connected to ground, so the electronic elements located in said PCB will not be affected.

[0009] An advantageous way of obtaining the ground path for connecting the heatsink to ground is by putting a ground portion of the optical element in electrical connection with the face of the PCB which is connected to ground.

[0010] In some particular embodiments, the ground portion of the optical element is metallized, this metallized surface comprising the conductive material of the optical element.

[0011] Metallization is an easy way of providing an electrical conductive surface for providing the required electrical path between the heatsink and the ground connection.

[0012] In some particular embodiments, each one of the printed circuit board and the heatsink comprises a through hole to receive the conductive connector.

[0013] The common through hole for receiving the conductive connector provides an easy and inexpensive way of creating the electrical path between the ground connection and the heatsink.

[0014] In some particular embodiments, the electronic component is a semiconductor light source.

[0015] A semiconductor light source is an element which is present in almost every current automotive lighting device, and is very sensitive to ESDs, so these embodiments provide a particularly advantageous element to be protected from ESDs.

[0016] In some particular embodiments, the printed circuit board is located between the heatsink and the optical element.

[0017] The printed circuit board is located adjacent to the optical element, so that it is easier to achieve the lighting functionality.

[0018] In some particular embodiments, the optical element is metallized in one of its surfaces. It is not required by the invention that the whole surface is metallized; only that the conductive material present in the optical element be in electrical contact with the conductive connector. However, it is easier to metallize the whole surface.

[0019] This metallization makes electrical contact easier between the optical element and the printed circuit board. Further, this metallization does not usually involve any additional cost, and may be achieved easily during manufacturing process, just by avoiding the use of a mask during metallization process.

[0020] In some particular embodiments, the optical element comprises a counterpart for receiving the conductive connector.

[0021] A counterpart located in the conductive connector ensures that the attachment between the printed circuit board, the heatsink and the optical element is achieved in a secure way.

[0022] In some particular embodiments, the counterpart is part of the optical element.

[0023] The optical element is usually made out of plastic or a soft metal, so it is easy to deform said optical element to create a counterpart for the conductive connector.

[0024] In some particular embodiments, the conductive connector is a bolt and the counterpart is a nut.

[0025] The connection between a bolt and a nut is especially advantageous in automotive parts. In some particular embodiments, the nut is a special nut which is integrated in the optical element.

[0026] In some particular embodiments, the optical element is a reflector.

[0027] A reflector particularly suits this invention in an advantageous manner, since the position of the semiconductor light source adjacent to the reflector is present in almost every automotive lighting device.

[0028] In some particular embodiments, the conductive material of the optical element and the PCB are in electric contact in more than one portion.

[0029] These portions are designed to maximize the contact with the optical element surface. Advantageously, they are close to the through hole, to reduce the electrical path for an ESD between the heatsink and the PCB.

BRIEF DESCRIPTION OF THE DRAWINGS

[0030] 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 an embodiment of a lighting device according to the invention.

Figure 2 shows a detail of a reflector of a lighting device according to the invention before being assembled to the rest of said lighting device.

Figure 3 shows a detail of a printed circuit board of a lighting device according to the invention before being assembled to the rest of said lighting device.

Figure 4 shows a detail of the connection between the printed circuit board, the heatsink and the reflector of a lighting device according to the invention.

Figure 5 shows a lighting device according to the invention installed in an automotive vehicle.

DETAILED DESCRIPTION OF THE INVENTION

[0031] Figure 1 shows an embodiment of a lighting device 1 according to the invention.

[0032] This lighting device 1 comprises

a printed circuit board 2 comprising a semiconductor light source (not seen), intended to be protected against ESDs, the printed circuit board 2 being connected to ground;

a heatsink 4 made out of an electrically conductive material; and

a reflector 5 metallized in one of its surfaces;

wherein the printed circuit board 2, the heatsink 4 and the reflector 5 are attached by a conductive connector 6.

[0033] This conductive connector 6 is primarily intended to ensure the physical attachment of the printed circuit board 2 and the reflector 5, preventing relative movement between them. The ground connection of the PCB 2 is made in contact with the metallization of the reflector 5. Hence, the metallization of the reflector 5 is electrically connected to ground.

[0034] But in this invention, the conductive connector 6 also attaches the heatsink 4 to the PCB 2 and to the reflector 5. Since the conductive connector 6 is in electrical contact with the metallized part of the reflector 5 and is also in contact with the heatsink 4, an electric connection is created between the ground connection of the printed circuit board 2 and the heatsink 4 by means of the metallization of the reflector 5. Since the PCB 2 is connected to ground, the heatsink 4 is thereby connected to ground without using any additional element to do so.

[0035] The PCB 2 is located between the heatsink 4 and the reflector 5, so that optical performance of the semiconductor light sources 3 located in the printed circuit board 2 is not jeopardized by the location of the heatsink 4.

[0036] Figure 2 shows a detail of this metallized surface of the reflector 5 before being assembled to the rest of the lighting device 1.

[0037] This metallized surface comprises a counterpart 7 to receive the conductive connector. This counterpart is also metallized, and puts the conductive connector and the metallized surface of the reflector 5 in electrical contact. Since the metallized surface of the reflector 5 is also in electrical contact with the ground connection of the PCB, the conductive connector, when contacting the counterpart 7, is also connected to ground.

[0038] This metallized surface also comprises some zones or portions which are also in contact with the ground connection of the PCB. The fact that the ground connection of the PCB and the reflector have several zones or portions in contact helps to distribute an ESD, avoiding the PCB and their components being damaged.

[0039] Figure 3 shows a detail view of the first face of the PCB 2 before being assembled to the rest of the lighting device 1.

[0040] This first face has several portions 21 which are connected to ground and which are intended to contact the metallized portions of the reflector 5, thus increasing contact points and reducing the harmful consequences of an ESD. Since there are many contact points between the PCB and the reflector, the discharge has many short paths to reach the ground level, and it does not become a threaten for the electronic components of the PCB 2.

[0041] Figure 4 shows a detail of the connection between the printed circuit board 2, the heatsink 4 and the reflector 5.

[0042] The reflector 5 comprises a counterpart 7, to receive the conductive connector 6. This counterpart 7 is part of the reflector 5. In the embodiment shown in this figure, the conductive connector 6 is a bolt, and the counterpart 7 located in the reflector 5 is a nut. This nut 7 is part of the reflector 5, created during the manufacturing process of this reflector 5.

[0043] Figure 5 shows a lighting device 1 according to the invention installed in an automotive vehicle 100.

Claims

1. Lighting device (1) comprising

a printed circuit board (2) comprising an electronic component (3) to be protected, the printed circuit board (2) being connected to ground;
a heatsink (4) made out of an electrically conductive material; and
an optical element (5) made at least partially of an electrically conductive material;

wherein the printed circuit board (2), the heatsink (4) and the optical element (5) are attached by a conductive connector (6), the conductive material of the optical element (5) and the heatsink (4) being in electrical contact with the conductive connector (6) and the conductive material of the optical element being in electrical contact with the ground connection of the printed circuit board (2).

2. Lighting device (1) according to claim 1, wherein a surface of the optical element (5) is metallized, this metallized surface comprising the conductive material of the optical element.

3. Lighting device (1) according to any of the preceding claims, wherein each one of the printed circuit board (2) and the heatsink (4) comprises a through hole to receive the conductive connector (6).

4. Lighting device (1) according to any of the preceding claims, wherein the electronic component (3) is a

semiconductor light source.

5. Lighting device (1) according to any of the preceding claims, wherein the printed circuit board (2) is located between the heatsink (4) and the optical element (5).

6. Lighting device (1) according to any of the preceding claims, wherein the optical element (5) comprises a counterpart (7) for receiving the conductive connector (6).

7. Lighting device (1) according to claim 6, wherein the counterpart (7) is part of the optical element (5).

8. Lighting device (1) according to any of claims 6 or 7, wherein the conductive connector (6) is a bolt and the counterpart (7) is a nut.

9. Lighting device (1) according to any of the preceding claims, wherein the optical element (5) is a reflector.

10. Lighting device (1) according to any of the preceding claims, wherein the conductive material of the optical element and the PCB are in electric contact in more than one portion.

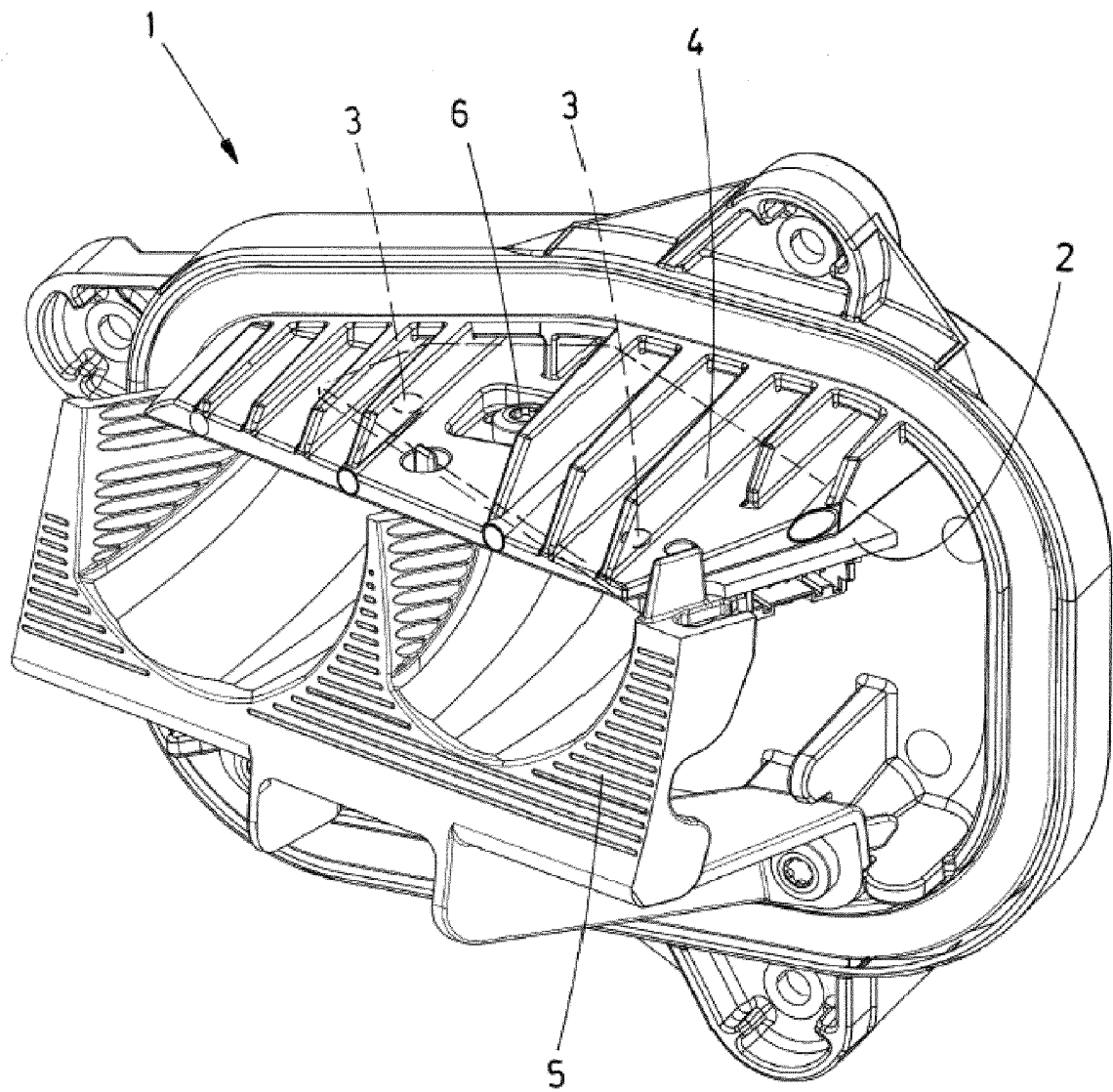


FIG.1

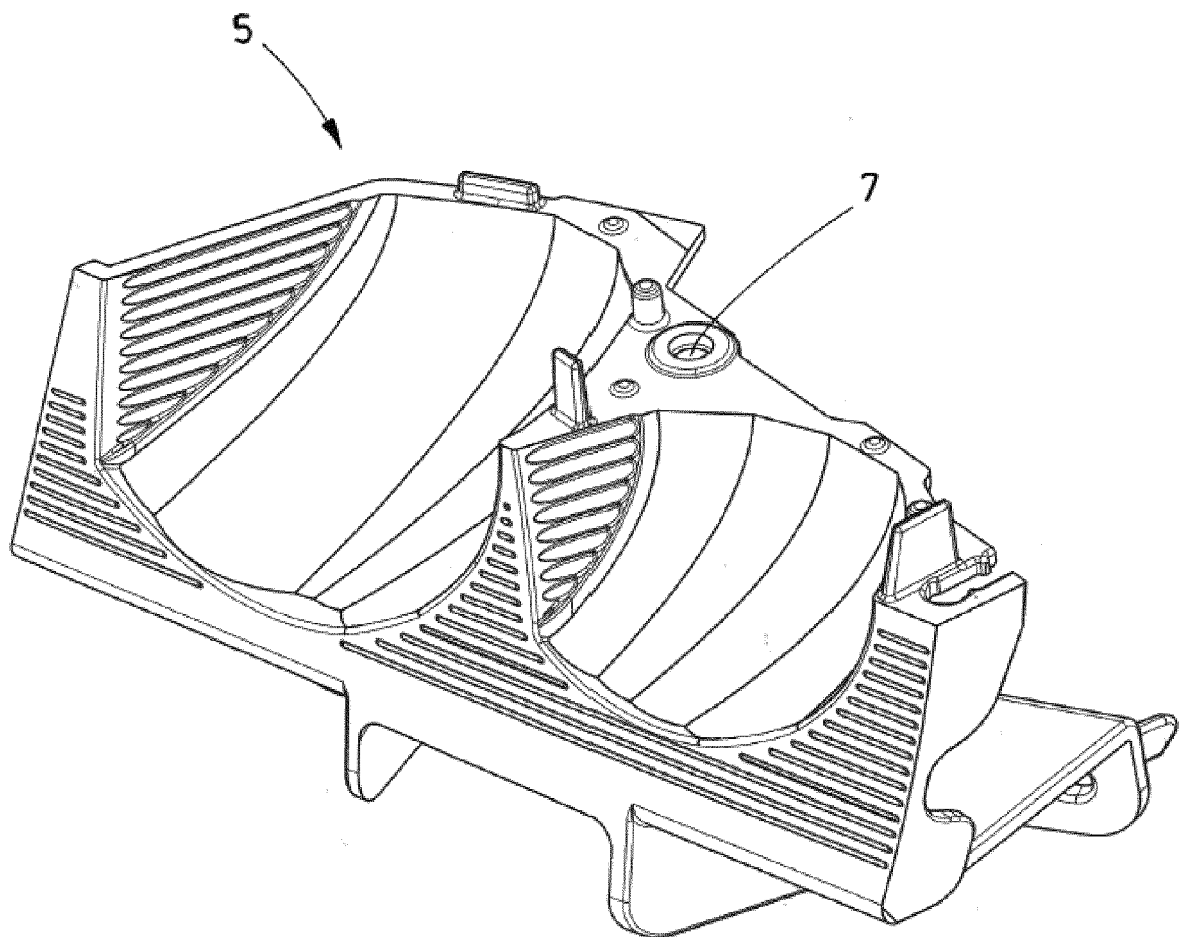


FIG.2

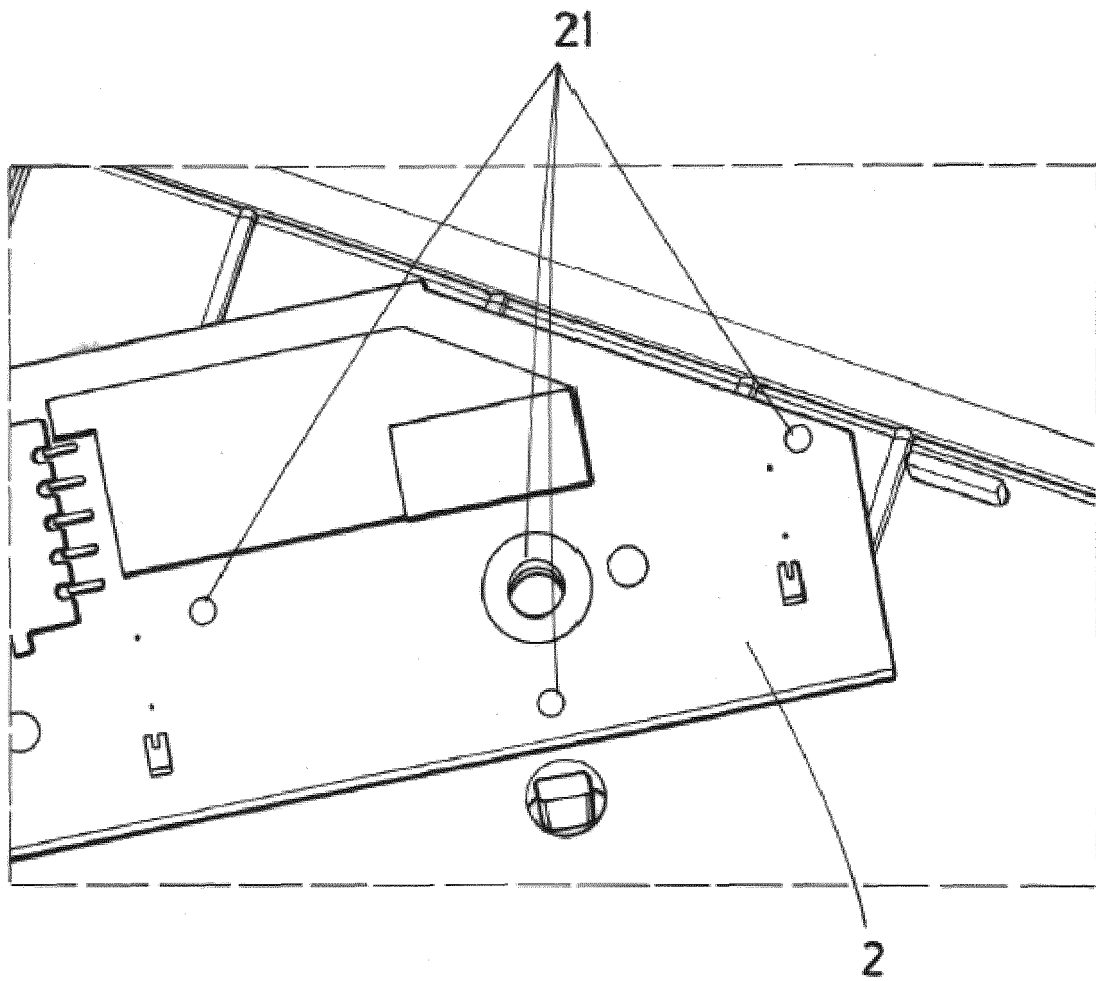


FIG.3

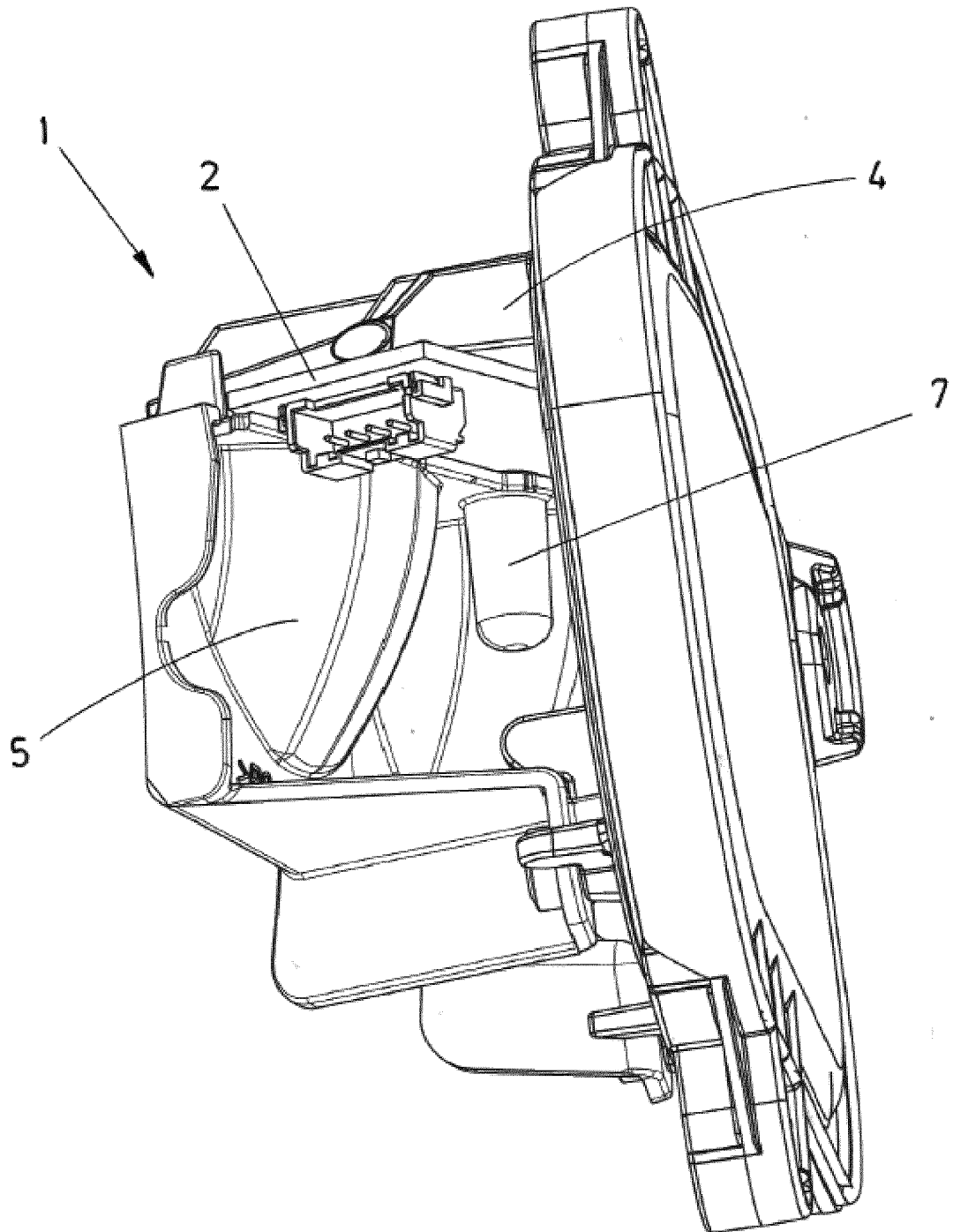


FIG.4

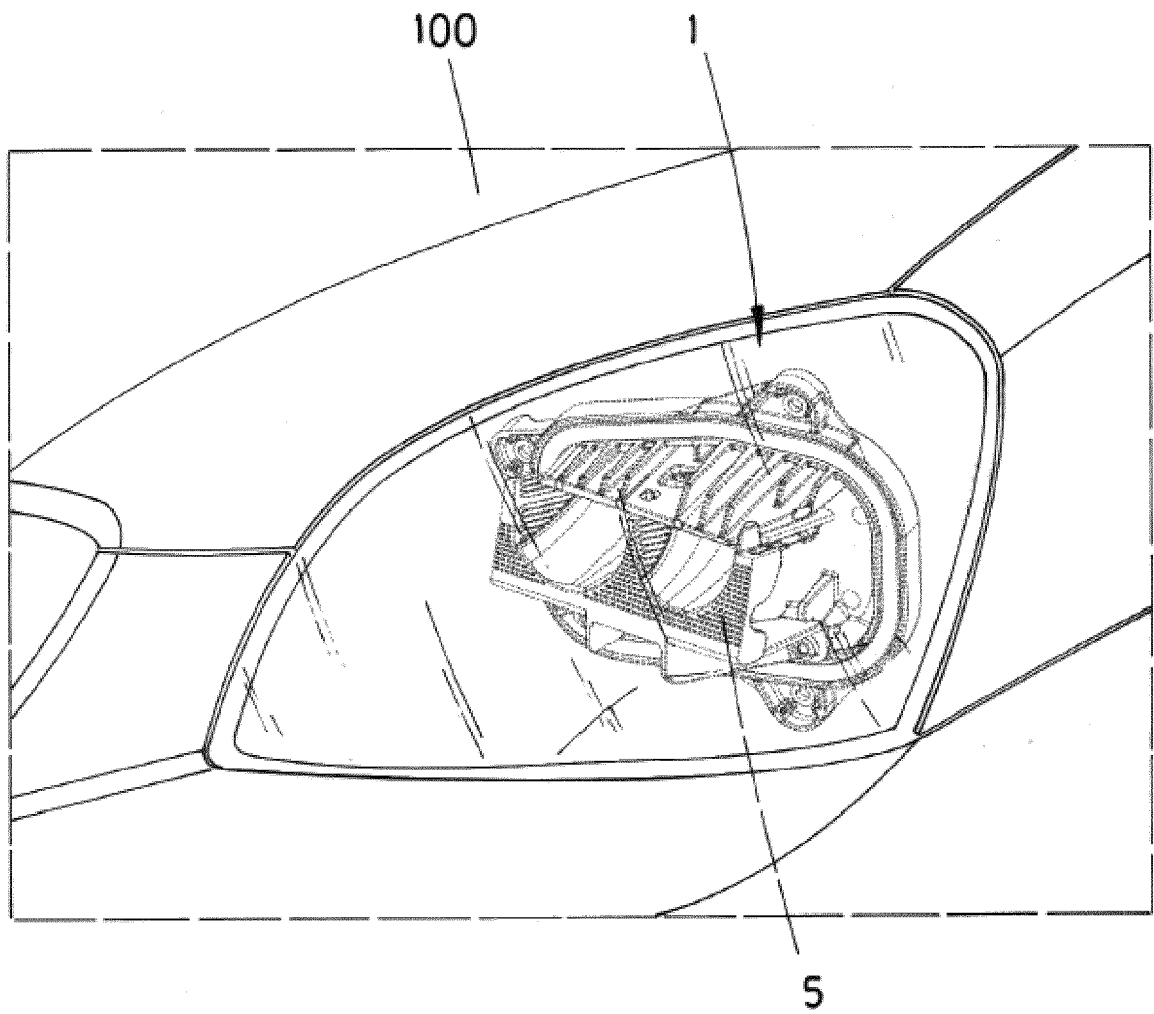


FIG.5



EUROPEAN SEARCH REPORT

Application Number
EP 17 38 2672

5

10

15

20

25

30

35

40

45

50

55

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	US 2015/224915 A1 (SAZUKA KIYOSHI [JP]) 13 August 2015 (2015-08-13) * paragraphs [0003], [0006], [0030] - [0058], [0067]; figures 1-12 *	1-10	INV. F21S45/10 F21S41/19 F21S41/141 F21S43/19 F21S43/14 H05K9/00 F21S45/47
Y	DE 20 2007 011255 U1 (HELLA KGAA HUECK & CO [DE]) 29 November 2007 (2007-11-29) * paragraphs [0019] - [0035]; figures 1-4 *	1-10	
Y	EP 3 057 389 A1 (VALEO VISION [FR]) 17 August 2016 (2016-08-17) * paragraphs [0029], [0030], [0032]; figure 2 *	1-10	
A	JP 2014 203532 A (KOITO MFG CO LTD) 27 October 2014 (2014-10-27) * see attached machine translation; paragraphs [0021], [0028], [0029]; figures 1-3 *	1,2,4,9,10	
A	EP 2 442 018 A2 (ODELO GMBH [DE]) 18 April 2012 (2012-04-18) * paragraphs [0001], [0011] - [0014], [0017], [0019], [0020], [0022], [0023], [0025], [0029] - [0038], [0053] - [0066]; figures 1-5 *	1,2,4,6,9,10	TECHNICAL FIELDS SEARCHED (IPC) F21S H05K
A	US 2010/053962 A1 (MO CI-JIN [CN] ET AL) 4 March 2010 (2010-03-04) * paragraphs [0002], [0006], [0015] - [0021]; figures 1-4 *	1-10	
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 14 March 2018	Examiner Goltes, Matjaz
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 17 38 2672

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2018

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2015224915 A1	13-08-2015	CN 104832854 A	12-08-2015
		DE 102015202519 A1	13-08-2015
		FR 3017444 A1	14-08-2015
		JP 2015167123 A	24-09-2015
		KR 20150095206 A	20-08-2015
		US 2015224915 A1	13-08-2015

DE 202007011255 U1	29-11-2007	CN 101808855 A	18-08-2010
		DE 112008002760 A5	08-07-2010
		DE 202007011255 U1	29-11-2007
		EP 2178722 A1	28-04-2010
		US 2010202151 A1	12-08-2010
		WO 2009021482 A1	19-02-2009

EP 3057389 A1	17-08-2016	CN 105889838 A	24-08-2016
		EP 3057389 A1	17-08-2016
		FR 3032664 A1	19-08-2016
		US 2016238212 A1	18-08-2016

JP 2014203532 A	27-10-2014	JP 6247013 B2	13-12-2017
		JP 2014203532 A	27-10-2014

EP 2442018 A2	18-04-2012	DE 102010048236 A1	12-04-2012
		EP 2442018 A2	18-04-2012
		SI 2442018 T1	30-04-2015

US 2010053962 A1	04-03-2010	NONE	
