(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 872 395 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
01.09.2021 Bulletin 2021/35

(21) Application number: **20159862.0**

(22) Date of filing: **27.02.2020**

(51) Int Cl.:
F21S 41/141 *(2018.01)* ***F21S 41/19*** *(2018.01)*
F21S 41/39 *(2018.01)* ***F21S 45/49*** *(2018.01)*
F21S 43/14 *(2018.01)* ***F21S 43/19*** *(2018.01)*
F21S 43/37 *(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:
KH MA MD TN

(71) Applicant: **HELLA Saturnus Slovenija d.o.o.**
1000 Ljubljana (SI)

(72) Inventors:
- **Petac, Primo**
  1241 Kamnik (SI)
- **Krebelj, Denis**
  1242 Stahovica (SI)
- **Novak, Valentin**
  4207 Cerklje na Gorenjskem (SI)
- **Marolt, Jernej**
  4000 Kranj (SI)

(74) Representative: **Zacco Bremen**
Am Wall 187-189
28195 Bremen (DE)

(54) LIGHT MODULE OF A MOTOR VEHICLE LIGHTING UNIT AND METHOD FOR ASSEMBLING A LIGHT MODULE OF A MOTOR VEHICLE

(57) The invention relates to a light module (1) of a motor vehicle lighting unit, its use and a method for assembling a light module (1). The light module (1) comprises at least one light source (2) mounted on a socket (3), which is in thermal contact with a heat sink (4), and an optical element (5) for guiding light emitted by the light source (2), said optical element (5) being at least indirectly fixed on the heat sink (4) with a fastening element (6).

The technical solution is characterized in that in a mounted state the fastening element (6) is partially located in the heat sink (4) and in that between the fastening element (6) and the optical element (2) an elastic spacer (7) is arranged in such a way, that in the mounted state when the optical element (5) is fixed on the heat sink (4) a pressing force is transmitted from the fastening element (6) via said elastic spacer (7) at least into the optical element (5).

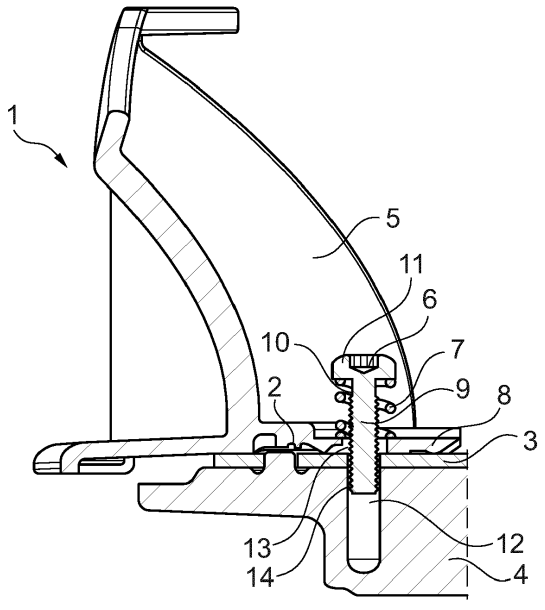

Fig. 1

EP 3 872 395 A1

Description

[0001] The present invention relates to a light module of a motor vehicle lighting unit. The light module comprises at least one light source mounted on a socket which is in thermal contact with a heat sink, and an optical element for guiding light emitted by the light source, said optical element being at least indirectly fixed to the heat sink with a fastening element.

[0002] At this time, various technical solutions for the implementation of a light module for a motor vehicle are known from the prior art. In general, these light modules are utilized for headlights as well as for the rear lights or other lighting units of a motor vehicle. Often it is necessary to adjust the light source or an optical element guiding light emitted by the light source, like a reflector, with respect to an optical axis of the lighting unit. This is important, since in many cases a particular light cone or illumination should be realized. In any case, light modules for headlights of motor vehicles must be adjusted in order to prevent oncoming drivers from being dazzled. In this context, different technical solutions for guiding light emitted by the light source and to adjust the light source as well as the optical element accordingly are known. For this purpose, usually a housing of a motor vehicle lighting unit comprises at least one adjustment element to adjust the light source and/or the optical element of the light module with respect to an optical axis and a fastening element to fix the movable components in the required position.

[0003] In this context, EP 3 428 512 A1 describes a light module of a motor vehicle lighting unit which comprises at least one light source mounted and electrically contacted on a circuit board. Furthermore, the light module comprises an optical element for guiding light emitted by the light source. The light source and the optical element are attached to a heat sink serving as a cooling element to dissipate heat generated by the light source. According to the technical solution described, the heat sink comprises a sheet metal part bent around at least one banding axis as a cooling body. This sheet metal consists of a stationary and a movable part and the light source as well as the optical element are mounted on the movable part, which can be moved relative to the stationary part in order to adjust the light source and the optical element. The adjustment element comprises a screw with a coil spring to adjust the orientation of the cooling body by deformation of the sheet metal part.

[0004] In addition, US 2014/0268834 A1 describes a device for mounting light sources on a substrate. The device includes a mounting frame having a general channel-like shape and defines a cavity in which the light source is mounted. The frame with the light source is attached to a substrate by a fastening element comprising preferably four screws extending from the frame to engage a threaded hole provided on the surface of the substrate. According to one particular solution described in this document the screws are arranged in coil springs in such a way that the force pressing the frame against the substrate can be regulated. Thus, according to the technical solution described a frame holding a light source can be attached to a substrate using a screw as well as a screw in order to realize a more uniform distribution of pressure between the frame and the substrate.

[0005] In consideration of the technical solutions described above, it is still a problem to connect a light source of a motor vehicle lighting unit as well as an optical element guiding light emitted by this light source with a heat sink without applying tensions into these components. In this context, it is necessary to consider the heat load which is introduced by the light source and which can cause heat stresses and movements of the different components relative to each other. In this regard, the technical solutions known from the prior art are often problematic, because during the use of a motor vehicle changes of the beam direction of the light beam emitted by lighting units should be avoided and therefore, rigid connections are used for fixing a light source and the adjacent optical element to a heat sink. Conventional solutions are based on rigid screw connections for fixing the optical element to the heat sink. Because of these rigid connections, pressing forces can vary due to thermal loads and appropriate movements of the components. In addition, there is a risk of deforming the optical element because of the friction under the screw head. Consequently, the area of movement of the optical element is limited and therefore, the relative position of the optical surface with respect to the light source can change. This results in a negative effect on the optical performance.

[0006] Taking the technical solutions known from the prior art as well as the aforementioned problems into account it is an object of the invention to provide a fixation for the light source and the optical element of a motor vehicle lighting unit which allows a free movement of the optical element caused by thermal loads which are generated by the light source. Furthermore, it should be ensured that the optical element is not deformed, when the fastening element is tightened.

[0007] Another important object of the invention refers to the adjustment of the optical element. With the help of a light module according to the invention, especially by utilizing a specific fastening element, it should be ensured, that during use of a motor vehicle the optical element is always in the correct position as well with regard to the light source as to the optical axis off the lighting unit. Moreover, another important object of the invention is to make sure, that the lighting unit of a motor vehicle emits light along its optical axis in order to prevent oncoming drivers from being dazzled.

[0008] All objections described above are accomplished by a light module according to claim 1. In addition, claim 11 provides an implementation of a light module according to the invention in a motor vehicle lighting unit. Furthermore, the invention is realized by a method for assembling a light module according to claim 12.

[0009] According to the invention a light module of a

motor vehicle lighting unit comprises at least one light source mounted on a socket, which is in thermal contact with a heat sink, and an optical element for guiding light emitted by the light source, said optical element being at least indirectly fixed to the heat sink by a fastening element. The proposed light module is characterized in that the fastening element is in a mounted state partially located in the heat sink and in that between the fastening element and the optical element an elastic spacer is arranged in such a way, that in the mounted state, when the optical element is fixed to the heat sink, a pressing force is transmitted from the fastening element via said elastic spacer into the optical element and the socket.

[0010] The invention is based on the main idea, that there is a connection between the optical element of a light module and the heat sink without any direct contact between these elements. The elastic spacer is arranged between the fastening element and the optical element as to make sure that a pressing force, which is transmitted from the fastening element into the optical element, is not directly introduced into the optical element. According to this technical solution the optical element is not deformed even if the fastening element is overtightened. Furthermore, the optical element is fastened to the heat sink in such a way, that the position of the optical element relative to the light source remains unchanged. This is achieved because the pressing force is transmitted from the fastening element via the optical element into the socket, which is on the opposite side in contact with the heat sink. Preferably, the fastening element extends as well through the optical element as the socket on which the light source is mounted and fixes both components to the heat sick in a defined position. With its surface being opposite to the optical element the socket is in contact with the heat sink.

[0011] In a specific embodiment of the invention at least an area of the optical element in a mounted state is directly pressed against one surface of the socket. In accordance with this technical solution there is a direct contact between the optical element and the socket. Alternatively, it is conceivable that at least one additional component and/or layer is arranged between the optical element and the socket. In any case a pressing force introduced in a mounted state from the fastening element is transmitted from the optical element into the socket.

[0012] According to another embodiment of the invention the elastic spacer comprises a spring element, preferably a coil spring or a cup spring. In an alternative technical solution, the elastic element comprises an elastic sleeve or foam, which is arranged between the fastening element and the optical element and which is in a mounted state at least partially compressed due to the pressing force applied thereto. In general, the elastic element can be fixed to the fastening element or be realized as a separate part.

[0013] According to a very specific embodiment of the invention the elastic spacer which is arranged between the fastening element and the optical element comprises a coil spring which is at least partially compressed, when the fastening element is tightened, whereby at least one portion of the fastening element extend through the interior cavity of the coil spring. As well when the fastening element is tightened as in mounted state the pressing force caused by the fastening element is transmitted from the fastening element into the optical element via said coil spring.

[0014] In another preferred embodiment the fastening element is a rivet or a screw, which can be inserted at least partially into the heat sink. If the fastening element comprises a screw this screw engages a threaded hole located in the heat sink while it is tightened and/or in a mounted state. According to this technical solution the pressing force is transmitted from the screw head to the elastic spacer, which then is at least partially compressed.

[0015] According to another embodiment of the invention the light source comprises at least one semiconductor light source. Preferably this light source comprises at least one LED, one OLED and/or one laser diode. In addition it is possible that the light source comprises at least one optical waveguide or is connected to an optical waveguide which directs light from a luminaire, which for example could be located somewhere else in a motor vehicle, to the light source emitting the light to the surroundings, especially via the optical element. In this case, preferably a waveguide output is utilized as light source of the light module. Advantageously the optical element is a reflector which redirects light emitted by the light source and ensures that at least most of the light emitted by the light source is directed to the road in front of the motor vehicle. In accordance with this embodiment of the invention the waveguide can either be fastened to the socket or be integrated into the socket.

[0016] Moreover, it is conceivable that the socket comprises at least one circuit board, advantageously a printed circuit board (PCB). The light source arranged on such a circuit board is as well attached to the circuit board as optically and/or electrically contacted on the circuit board. Advantageously, the light source is a semiconductor light source, like a LED or an OLED, which is integrated into an electronic circuit arranged on said circuit board. Alternatively, or in addition at least one optical wave guide can be arranged on the circuit board and at least partially direct light to the light source. Furthermore, it is conceivable that an optical waveguide is at least partially integrated into the circuit board of the light module for motor vehicle lighting.

[0017] The invention further relates to a lighting unit of a motor vehicle comprising at least one light module, which is realized in accordance with at least one of the previously described embodiments. In this context, it is conceivable that a light module according to the invention is implemented in a headlight, a rear light, a turn-signal light and/or a reversing light of a motor vehicle.

[0018] Another aspect of the invention relates to a method for assembling a light module of a motor vehicle.

Under this method at least one light source is mounted on a socket, said socket is brought in contact with a heat sink and an optical element for guiding light emitted by the light source together with the socket is fixed to the heat sink with the help of a fastening element. The method according to the invention is characterized in that an elastic spacer is arranged between the fastening element and the optical element and in that the optical element is fixed to the heat sink as the fastening element is partially inserted into the heat sink in such a way that the pressing force is transmitted from the fastening element via said elastic spacer into the optical element and the socket. With the help of this assembling method a light module suitable for a motor vehicle is manufactured without the risk, that the optical element is damaged or is not in a correct position with respect to the light source and/or the optical axis of the light module. In addition, as well the optical element as the light source of the light module mounted on the socket are attached to the heat sink in such a way, that their relative position remains unchanged although heat load and/or thermal or mechanical stresses are introduced into these elements.

[0019] According to a specific embodiment of the invention the assembling method is characterized in that a shaft of a screw which is utilized as fastening element is put through the interior of a coil spring used as elastic spacer before said screw is screwed into the heat sink. Again, a connection between the fastening element and the optical element is realized although there is no direct contact between the fastening element and the optical element. In fact, by arranging an elastic spacer between the fastening element and the optical element pressing forces transmitted from the fastening element into the optical element are distributed evenly over the surface of the optical element. Therefore, the risk of causing mechanical damage to the surface of the optical element is excluded, at least considerably minimized.

[0020] In a light module assembled according the method described above again the main aspect of the invention is realized. Again, a connection between the fastening element and the optical element of the lighting module is provided in such a way that although the optical element is well fastened to some extend movements of the optical element relative to the fastening element are still possible.

[0021] The following detailed description refers to the accompanying drawing that show, by way of illustration, specific details and embodiments in which the disclosure may be practiced. This description of specific details and embodiments of the invention should not be understood as a limitation of the abstract idea according to the invention.

[0022] In the drawings, reference characters generally refer to the same parts throughout the different views. In the following description various embodiments of the invention are described with reference to the following drawings, in which shows:

Fig. 1: a sectional view of a light module which is used in a motor vehicle lighting unit and

Fig. 2: a detailed view of a fastening element implemented in a light module according to the invention.

[0023] Fig. 1 shows a sectional view of a light module 1 according to the invention, which is utilized for the headlight of a motor vehicle. The main components of the light module1 are a light source 2 mounted on a socket 3, an optical element 5 in form of a reflector for guiding light emitted by the light source 2, a heat sink 4 for dissipating heat generated by the light source 2 and a fastening element 6 for fixing the optical element 5 on the heat sink 4. The heat sink 4 avoids overheating and therefore a heat-related reduction of the efficiency of the light module 1. According to this embodiment the socket 3 is made as a circuit board, arranged between the fastening area 8 of the optical element 5 and the heat sink 4.

[0024] The fastening element 6 comprises a screw 9, which extends through a hole 13, 14 as well in the optical element 5 as in the circuit board and which engages into a thread hole 12 in the surface of the heat sink 4.

[0025] Since, according to the embodiment shown in Fig. 1 the socket 3 is made as circuit board, also called printed circuit board (PCB), a light emitting diode (LED) as light source 2 is mounted on the circuit board, which is arranged directly on the heat sink 4 in order to ensure a good thermal contact between the circuit board and the heat sink 4. On top of the circuit board the fastening area 8 of the optical element 5 is arranged, which according to this embodiment is a reflector of a motor vehicle headlight. For fixing the optical element 5 and the circuit board on the heat sink 4 a screw 9 as fastening element 6 is provided. For the fixation of the optical element 5 and the circuit board, the screw 9 is screwed into the threaded hole 12 of the heat sink 4. According to the invention an elastic spacer 7 realized by a coil spring is arranged between the screw head 11 of the screw 9 and the top side of the fastening area 8 of the optical element 5. When the screw 9 is tightened it is compressed and an increasing pressing force is transmitted from the screw head 11 via the coil spring into the top surface of the optical element 5. A final pressing force is achieved, when the screw shaft 10 gets in contact with the heat sink 4.

[0026] Initially, the use of the coil spring as an elastic spacer 7 between the screw head 11 and the optical element 5 ensures that the optical element 5 as well as the circuit board are well fixed on the heat sink 4. In addition, in case thermal loads caused by the light source 2 are introduced into the optical element 5 sufficient movements of the optical element 5 are still possible whereby thermal stress and appropriate damage to the optical element 5 are avoided. In addition, even if the screw 9 is overtightened the optical element 5 would not be damaged.

[0027] Furthermore, Fig. 2 shows a detailed view of the fastening according to the invention. Here, a reflector,

which is a typical optical element 5 of a light module 1 for a motor vehicle headlight is fixed on a heat sink 4. Again, a screw 9 is utilized as a fastening element 6, whereby according to fig. 2 the screw 9 is tightened so that the screw 9 as well as the reflector, the circuit board and the heat sink 4 are shown in a mounted state. The screw 9 has been screwed into the threaded hole 12 which is located inside the heat sink 4 and therefore the coil spring is pressed together.

[0028] In the mounted state the shaft 10 of the screw 9 is arranged as well inside a through hole 14 of the circuit board, as a through hole 13 in the fastening area 8 of the optical element 5. Furthermore, according to the invention between the screw head 12 and the fastening area 8 of the optical element 5 a compressed coil spring as elastic spacer 7 is arranged in such a way, that a pressing force is transmitted from the screw head 11 via the coil spring into the optical element 5. The coil spring acts as an elastic element 7 which, in the mounted state, is compressed. Since, as shown in Fig. 2, the screw shaft 10 is in contact with the heat sink 4 the final and maximum pressing force is achieved.

[0029] Advantageously there is no rigid connection between the screw 9 and the optical element 5. Therefore, as well deformations of the optical element 5 due to turning the screw head on the surface of the optical element 5, as damages caused by thermal stress are avoided.

List of reference characters

[0030]

1	light module
2	light source
3	socket
4	heat sink
5	optical element
6	fastening element
7	elastic spacer
8	fastening area of the optic element
9	screw
10	screw shaft
11	screw head
12	threaded hole
13	through hole of the optical element
14	through hole of the socket

Claims

1. Light module (1) of a motor vehicle lighting unit, comprising at least one light source (2) mounted on a socket (3), which is in thermal contact with a heat sink (4), and an optical element (5) for guiding light emitted by the light source (2), said optical element (5) being at least indirectly fixed to the heat sink (4) with a fastening element (6),
characterized in that in a mounted state the fastening element (6) is partially located in the heat sink (4) and **in that** between the fastening element (6) and the optical element (5) an elastic spacer (7) is arranged in such a way, that in the mounted state when the optical element (5) is fixed to the heat sink (4) a pressing force is transmitted from the fastening element (6) via said elastic spacer (7) at least into the optical element (5).

2. Light module according to claim 1,
characterized in that a fastening area (8) of the optical element (5) is in contact with the socket (3).

3. Light module according to claim 1 or 2,
characterized in that the spacer (7) comprises a coil spring or a cup spring.

4. Light module according to one of the preceding claims,
characterized in that the fastening element (6) comprises a screw with a screw head, said screw head in mounted state being in contact with the spacer (7).

5. Light module according to one of the preceding claims,
characterized in that the light source (2) is a semiconductor light source.

6. Light module according to claim 5,
characterized in that the semiconductor light source comprises at least one LED, one OLED and/or one laser diode.

7. Light module according to one of the preceding claims,
characterized in that the light source (2) comprises at least one optical waveguide or is connected to an optical waveguide.

8. Light module according to claim 7,
characterized in that the at least one optical waveguide is at least indirectly fastened to the socket (3) and/or to the heat sink (4).

9. Light module according to one of the preceding claims,
characterized in that the socket (3) comprises at least one circuit board.

10. Lighting unit of a motor vehicle comprising at least one light module (1) according to one of the preceding claims.

11. Utilization of a light module (1) according to one of the claims 1 to 10 in a headlight, a rear light, a turn-signal light or a reversing light of a motor vehicle.

12. Method for assembling a light module (1) of a motor vehicle whereby at least one light source (2) is mounted on a socket (3), said socket (3) is brought in contact with a heat sink (4), and whereby an optical element (5) for guiding light emitted by the light source (2) together with the socket (3) is fixed on the heat sink (3) by a fastening element (6),
characterized in that an elastic spacer (7) is arranged between the fastening element (6) and the optical element (5) and **in that** to fix the optical element (5) on the heat sink (4) the fastening element (6) is partially inserted into the heat sink (4) in such a way, that a pressing force is transmitted from the fastening element (6) via said elastic spacer (7) at least into the optical element (5).

13. Method according to claim 12,
characterized in that a shaft (9) of a screw, which is utilized as fastening element (6), is put through the interior of a coil spring used as elastic spacer (7) before said screw is screwed into the heat sink (4).

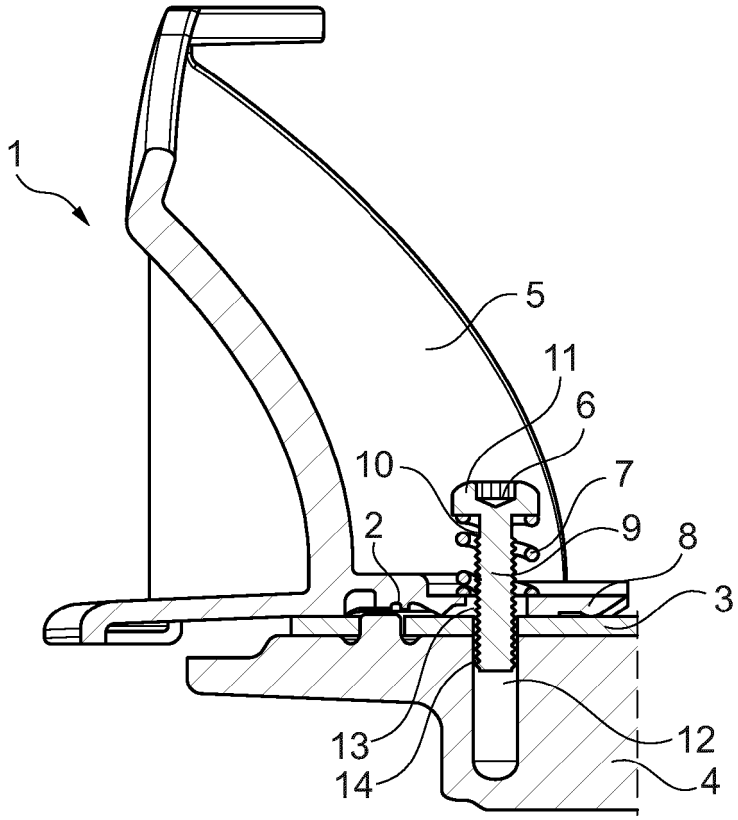

Fig. 1

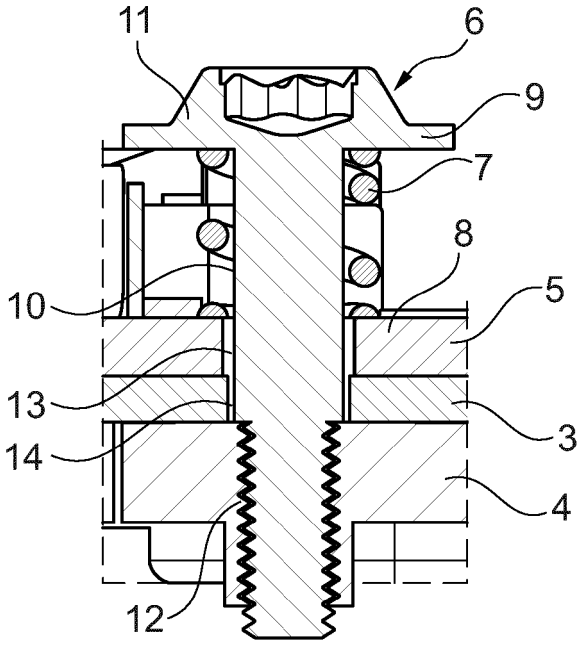

Fig. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 20 15 9862

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 2016 120431 A1 (HELLA GMBH & CO KGAA [DE]) 26 April 2018 (2018-04-26) * paragraphs [0001] - [0027]; figures 1-4 * -----	1-3,5,6, 9-12	INV. F21S41/141 F21S41/19 F21S41/39 F21S45/49
X Y	WO 2019/194276 A1 (KOITO MFG CO LTD [JP]) 10 October 2019 (2019-10-10) * see attached machine translation; paragraphs [0465] - [0546]; figures 29-36 * -----	1-4,9-13 7,8	F21S43/14 F21S43/19 F21S43/37
Y	DE 10 2014 109114 A1 (HELLA KGAA HUECK & CO [DE]) 31 December 2015 (2015-12-31) * paragraphs [0001], [0017] - [0025]; figure 1 * -----	7,8	
X	WO 2014/190368 A1 (ZIZALA LICHTSYSTEME GMBH [AT]) 4 December 2014 (2014-12-04) * pages 8-15; figures 1-12 * -----	1,2,4-6, 9-12	
X	EP 3 021 044 A1 (HELLA KGAA HUECK & CO [DE]) 18 May 2016 (2016-05-18) * paragraphs [0001] - [0022]; figures 1-4 * -----	1-3,5,6, 9-12	TECHNICAL FIELDS SEARCHED (IPC) F21S

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	25 May 2020	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 20 15 9862

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.

25-05-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 102016120431 A1	26-04-2018	NONE	
WO 2019194276 A1	10-10-2019	NONE	
DE 102014109114 A1	31-12-2015	CN 105276551 A	27-01-2016
		DE 102014109114 A1	31-12-2015
		US 2015377448 A1	31-12-2015
WO 2014190368 A1	04-12-2014	AT 514403 A1	15-12-2014
		CN 105452757 A	30-03-2016
		EP 3004724 A1	13-04-2016
		ES 2716273 T3	11-06-2019
		JP 6192814 B2	06-09-2017
		JP 2016524285 A	12-08-2016
		US 2016131324 A1	12-05-2016
		WO 2014190368 A1	04-12-2014
EP 3021044 A1	18-05-2016	CN 105605435 A	25-05-2016
		EP 3021044 A1	18-05-2016
		US 2016138786 A1	19-05-2016

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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

- EP 3428512 A1 **[0003]**
- US 20140268834 A1 **[0004]**