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

(11) **EP 4 067 733 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.10.2022 Bulletin 2022/40

(21) Application number: **22165969.1**

(22) Date of filing: **31.03.2022**

(51) International Patent Classification (IPC):
F21S 43/237 *(2018.01)* ***F21S 43/245*** *(2018.01)*
F21S 43/247 *(2018.01)* ***F21S 43/251*** *(2018.01)*
F21S 43/20 *(2018.01)* ***F21S 43/239*** *(2018.01)*
F21S 43/243 *(2018.01)*

(52) Cooperative Patent Classification (CPC):
F21S 43/237; F21S 43/239; F21S 43/243; F21S 43/245; F21S 43/247; F21S 43/251; F21S 43/26

(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

(30) Priority: **31.03.2021 IT 202100008030**

(71) Applicant: **Marelli Automotive Lighting Italy S.p.A. Con Socio Unico**
10078 Venaria Reale (TO) (IT)

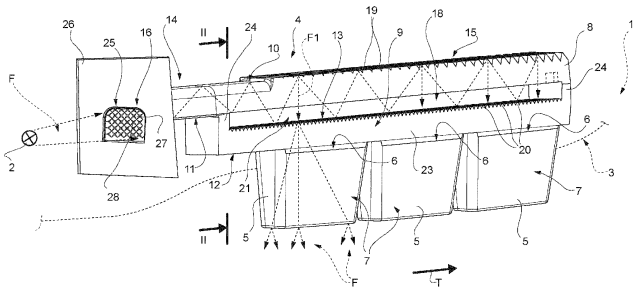
(72) Inventors:
- **CLERICI, Francesca**
  10078 VENARIA REALE (TO) (IT)
- **VAIRA, Alessandro**
  10078 VENARIA REALE (TO) (IT)
- **CERONE, Roberto**
  10078 VENARIA REALE (TO) (IT)

(74) Representative: **Studio Torta S.p.A.**
Via Viotti, 9
10121 Torino (IT)

(54) LIGHT GUIDE HYBRID SYSTEM FOR LIGHTING DEVICES FOR VEHICLES, AND ASSOCIATED LIGHTING DEVICE

(57) A lighting device (1) including a light source (2) and a hybrid optical system (4) formed by a light guide (8) and blade optics (9) combined integrally in one piece; the blade optics (9) connect together a plurality of emitting elements (5) arranged spaced from one another along a pre-set trajectory (T), and the light guide (8) extends parallel to the blade optics (9), on a side opposite to the emitting elements (5), is operatively associated with the light source (2), and is separated from the blade optics (9) by a gap (18) having a pre-set width; first light extracting optical elements (19) are carried by the light guide (8) to deflect the light towards a rear face (13) of the blade optics (9) provided with second optical elements (20) configured to diffuse the light inside the emitting elements (5).

FIG. 1



EP 4 067 733 A1

Description

Cross-reference to related applications

[0001] This patent application claims priority from Italian patent application no. 102021000008030 filed on March 31, 2021.

Technical field of the invention

[0002] The present invention relates to a light guide optical system which can be defined as "hybrid", in that it combines a proper light guide with blade optics. The invention further relates to a lighting device for vehicles, particularly but not exclusively a lamp, provided with such an optical system and wherein the light source consists of an LED or a battery of LEDs.

Prior art

[0003] As is known, on modern vehicles, in particular motor vehicles, both for technical and stylistic reasons, headlights, or more often lamps, are often used, in which the lighting body consists of a plurality of emitting elements or "gems", which are arranged spaced from one another according to a pre-set pattern (for example, along a straight or curved line) directly through the vehicle body and/or through a lamp or headlight body made of an opaque material.

[0004] Each emitting element must be provided with one or more corresponding light sources, typically LEDs, emitting a light beam perpendicular to a rear face of the emitting element.

[0005] Such a configuration, in addition to being expensive, is cumbersome and difficult to implement since the LEDs must be supported and supplied by a printed circuit which must follow the pattern formed by the emitting elements, or by a plurality of support bases electrically connected to each other, which must in some way be individually fixed to the bodywork and/or to the lamp or headlight body.

[0006] It would therefore be useful to use a light guide to bring a light beam produced by a single LED or battery of LEDs towards the emitting elements. However, this solution has the drawback that the lighting intensity of the individual emitting elements would be different and, in any case, not uniform, even over the individual emitting element.

Summary of the invention

[0007] The object of the present invention is to provide a light guide optical system, which overcomes the above-mentioned drawbacks, allowing a plurality of light emitting elements of any shape and arranged along a pre-set trajectory, separated from each other, to be lighted in a uniform manner and with the same intensity by using a single LED or battery of LEDs.

[0008] The present invention therefore relates to a light guide optical system for a vehicle lighting device made in accordance with the appended claims.

[0009] The invention also relates to an associated lighting device, provided with one or more of these light guide optical systems, as well as to a vehicle provided with such a lighting device.

[0010] In particular, the light guide optical system comprises a plurality of light emitting elements arranged spaced from one another along a trajectory forming a pre-set design and configured to receive a light beam perpendicular to a rear face thereof and to emit such light beam through a front surface thereof opposite to and facing the rear face.

[0011] The light guide optical system according to the invention comprises blade optics made of a material pervious to light and connecting together all the emitting elements, and a total reflection light guide operatively associated with the blade optics; the blade optics extend longitudinally along the above-mentioned trajectory and define the rear face of each emitting element with part of a front face thereof, the emitting elements being obtained integrally in one piece with the blade optics and protruding in a cantilever fashion from its front face and on a side opposite to a rear face of the blade optics.

[0012] The light guide is configured to operatively cooperate with a light source and comprises a first section, a first end of which is configured to be directly facing the light source, and a second section, arranged on a side opposite to the first end and facing the blade optics, in front of and parallel to the rear face thereof and separated from the latter by means of a gap having a pre-set and constant width.

[0013] Instead, the second section of the light guide is provided, on a side opposite to the rear face of the blade optics, with a plurality of first light extracting optical elements configured to deflect the light from the inside of the light guide towards the blade optics, and the rear face of the latter is provided with a plurality of second optical elements configured to define, together with the gap, an air lens configured to uniformly diffuse the light received from the light guide inside the emitting elements.

[0014] The light guide has a preferably quadrangular, and even more preferably rectangular cross-section with at least a pair of respective rounded corners arranged on the side opposite to the blade optics; the cross-section has a substantially identical width in the first and in the second section and is delimited by a front face facing the blade optics and by an opposite rear face provided with first light extracting optical elements only along the second section.

[0015] According to a preferred embodiment of the invention, the light guide and the blade optics are formed integral with each other in a single piece and composed of a same material pervious to light, preferably consisting of a synthetic plastic material and obtained in a single piece by means of a single moulding operation.

[0016] According to a possible alternative embodi-

ment, the light guide and the blade optics are formed as two separate and independent elements, which however have been connected together integrally in a single piece, in any convenient way, for example by gluing, laser or ultrasonic welding, or snap-on.

[0017] The front face of the light guide is immediately facing the rear face of the blade optics provided with the second optical elements, is separated therefrom only by the aforementioned gap, which is preferably but not necessarily fixed and constant, and is configured as a flat and smooth face.

[0018] The blade optics comprise: a central body having a cross-section, also preferably quadrangular and provided transversely in a cantilever fashion, on the side opposite to the light guide, with emitting elements.

[0019] The central body preferably has substantially the same width as the cross-section of the light guide.

[0020] The central body ends with a pair of ends opposite to one another, obtained integrally in one piece with the central body and shaped towards the light guide as L-shaped spacing feet, these feet determining the gap between the light guide and the blade optics.

[0021] The first end of the first section of the light guide is provided integrally and in one piece with a light mixing optical element configured to be facing in use the light source; the light mixing optical element comprises a plurality of first and second cylindrical lenses, oriented at right angles to one another and arranged crosswise to one another.

[0022] Finally, the optical system according to the invention can comprise a channel-shaped support having a C-shaped cross-section, a bottom wall of which is not pervious to light.

[0023] The channel-shaped support houses, on the inside thereof, the light guide and the blade optics, the light guide on the side of the bottom wall and the blade optics on the side opposite to the bottom wall and substantially flush with respective longitudinal edges of a pair of lateral walls of the channel-shaped support; the emitting elements protrude in a cantilever fashion from the channel-shaped support, perpendicularly to the bottom wall.

[0024] Finally, the invention also extends to a lighting device comprising such an optical system and to a vehicle comprising such a lighting device.

Brief Description of the Drawings

[0025] Further features and advantages of the present invention will become clearer from the following description of a non-limiting embodiment thereof, carried out with reference to the accompanying drawings, wherein:

- Figure 1 is a schematic perspective view of a light guide optical system according to the invention and an associated lighting device;
- Figure 2 is a schematic perspective sectional view, on an enlarged scale, along a plane II-II of the optical system in Figure 1;
- Figure 3 is a schematic perspective view of a possible variant according to the invention of the light guide optical system in Figure 1;
- Figure 4 is a schematic perspective sectional view, on an enlarged scale, along a plane IV-IV of the light guide optical system in Figure 3; and
- Figure 5 schematically illustrates the light guide optical system in Figure 3 in an assembly configuration.

Detailed description

[0026] With reference to Figures 1 and 2, the reference numeral 1 indicates, as a whole, a lighting device for a vehicle (Figure 1), the vehicle being known and not shown for the sake of simplicity.

[0027] The lighting device 1 comprises a light source 2 only schematically shown and consisting of an LED or battery of LEDs, known per se, and a body or housing 3 for an optical system 4 operatively associated with the light source 2. The housing 3 can consist of a cup-shaped body of a headlight or lamp of the above-mentioned vehicle or also, directly, of a body portion of the vehicle itself.

[0028] The optical system 4 comprises a plurality of light emitting elements 5 arranged spaced from one another, therefore spaced apart, along a straight and/or curved trajectory T, configured to form a pre-set pattern on the outside of the housing 3.

[0029] Each light emitting element 5 is configured to receive transversely to a rear face 6 thereof, as will be seen, a light beam F (Figure 1) emitted by the light source 2, and to emit said light beam F (or a portion thereof) through a front surface 7 thereof, opposite to and facing the rear face 6.

[0030] According to one aspect of the invention, the optical system 4 is a light guide optical system, since it comprises a light guide 8 operatively associated with blade optics 9.

[0031] The blade optics 9 are made of a material pervious to light and are configured to connect together, mechanically and optically, all the emitting elements 5.

[0032] The light guide 8 is also made of a light-pervious material and is of the total reflection type, i.e., it is configured to collect the light beam F emitted by the source 2 and transport it along the longitudinal extension of the light guide 8, causing it to "bounce" in a known manner between a rear face 10 thereof and a front face 11 thereof.

[0033] The blade optics 9 extend longitudinally along the trajectory T and define the rear face 6 of each emitting element 5 with part of a front face 12 thereof; in fact, the emitting elements 5 are obtained integrally in one piece with the blade optics 9 made of the same material and protrude in a cantilever fashion from the front face 12 of the latter, on a side opposite to a rear face 13 of the blade optics 9, opposite to and facing the face 12.

[0034] In particular, the light guide 8 is configured to operatively cooperate with the light source 2 and comprises a first, longitudinal section 14 and a second, longitudinal section 15 arranged immediately downstream

of section 14 with respect to the trajectory T and the direction of emission of the light beam F.

[0035] The first section 14 comprises a first end 16 which is configured to be arranged in use directly facing the light source 2; the second section 15 is arranged on a side opposite to the first end 16 and is entirely arranged facing and parallel to the blade optics 9, in front of and parallel to the rear face 13 thereof.

[0036] According to one aspect of the invention, the second section 15 of the light guide 8 is separated from the rear face 13, thus facing it through a gap or empty space 18 having a pre-set and constant width, said gap 18 being therefore filled with ambient air.

[0037] According to a further aspect of the invention, the second section 15 of the light guide 8 is also provided, on a side opposite to the rear face 13 of the blade optics 9, therefore, at the rear face 10 thereof, with a plurality of first optical elements 19, in this case, of the light extracting type, such as prisms, micro-prisms, holograms, etc., configured to deflect the light from the inside of the light guide 8 towards the blade optics 9 and the rear face 13 of the latter.

[0038] In combination with the above, the rear face 13 of the blade optics 9 is provided with a plurality of second optical elements 20, preferably consisting of cylindrical optics, configured to define, also together with the gap 18, an air lens 21 designed to uniformly diffuse the light received from the light guide 8 inside the emitting elements 5.

[0039] Basically, thanks to the configuration described, the light beam F emitted by the source 2 is collected by the light guide 8 at its end 16 and is uniformly diffused along the sections 14 and 15 of the light guide 8, according to a trajectory schematically shown with dashed lines in a purely pictorial way in Figure 1; when the light beam F reaches the section 15, during its "bounces" it is partially intercepted by the optical elements 19 which send parts F1 of the beam F out of the light guide 8, perpendicular to the face 11 of the latter and to the face 13 of the blade optics 9.

[0040] At this point, the beams F1 are intercepted by the second optical elements 20, which "open them" dispersing them uniformly inside each emitting element 5, which in turn diffuses them to the outside through the surface 7.

[0041] According to a further aspect of the invention, it has been experimentally found that in order to further improve the uniformity of lighting of the emitting elements 5, the light guide 8 preferably has a substantially quadrangular and even more preferably rectangular cross-section with at least one pair (Figure 2) of its respective corners 22 which are rounded; in particular, the rounded corners 22 are opposite to the blade optics 9.

[0042] Moreover, the cross-section of the light guide 8 has a substantially identical width (area) both in the first section 14 and in the second section 15 thereof and is delimited by the front face 11 facing the blade optics 9 and by the rear face 10 opposite to the front face 11 and carrying the optical elements 19.

[0043] In particular, the rear face 10 of the light guide 8 is only provided with the light extracting optical elements 19 along the second section 15, so that all the light energy from the beam F hits the blade optics 9 without being first dispersed.

[0044] The light guide 8 and the blade optics 9 are preferably formed integral with each other in a single piece and composed of a same material pervious to light, preferably consisting of a synthetic plastic material, and obtained in a single piece by means of a single moulding operation, for example, injection moulding.

[0045] According to a possible variant, however, the light guide 8 and the blade optics 9 could be formed as two separate and independent elements, which have been then connected together integrally in a single piece in any convenient way, for example, by welding (laser or ultrasonic welding), gluing, snap-on, etc.

[0046] The front face 11 of the light guide 8 is immediately facing the rear face 13 of the blade optics 9 provided with the second optical elements 20, is separated therefrom only by the gap 18, which is preferably but not necessarily fixed and constant, and is configured, according to one aspect of the invention, as a flat and smooth face. In fact, it has been found that the best results as regards the uniform and identical lighting of all the emitting elements 5 are obtained by making the face 11 flat and smooth in combination with optical elements 20 consisting of cylindrical optics.

[0047] The blade optics 9 (Figure 2) comprise a central body 23 having preferably but not necessarily a quadrangular cross-section as that of the light guide 8, preferably but not necessarily also having substantially the same width (area).

[0048] The central body 23 is provided transversely in a cantilever fashion, on the side opposite to the light guide 8, with the emitting elements 5 extending perpendicularly to the face 12.

[0049] The blade optics 9 further comprise a pair of opposite ends 24 with which the central body 23 ends and which are obtained integrally in one piece with the central body 23.

[0050] The ends 24 are shaped towards the light guide 8 as L-shaped spacing feet, and their shape, therefore in their function as spacing feet, defines the gap 18 between the light guide 8 and the blade optics 9 and, in particular, between the face 11 and the optics 20.

[0051] Also, with reference now to Figures 3 and 4, a variant 4b of the optical system 4 described so far is shown therein. Details similar or identical to those described are indicated for simplicity with the same reference numbers.

[0052] The optical system 4b of Figures 3 and 4 differs from the previous one only in the shape and length of a first section 14b of the light guide 8 thereof; this section 14b is longer than the section 14 and curved at the end 16, so that the emitting elements 5 can also be installed at a considerable distance from the light source 2.

[0053] Finally, in both embodiments 4 and 4b, the first end 16 of the first section 14 of the light guide 8 is integral in one piece with a light mixing optical element 25 configured to be facing, in use, the light source 2.

[0054] In the illustrated non-limiting example, the light mixing optical element 25 is preferably but not exclusively shaped like a plate 26 and in any case is configured to be facing, in use, a light source and is provided with a plurality of first cylindrical lenses 27 and second cylindrical lenses 28.

[0055] The cylindrical lenses 27 and 28 are oriented at right angles to each other (at 90°) and arranged crosswise to one another, so as to make the beam F enter the light guide 8 as uniformly as possible, in particular, to compensate for the fact that normally the end 16 is not exactly in the focus of the light source 2, particularly when the latter consists of a battery of LEDs.

[0056] In order to easily assemble the optical system 4 (or 4b) according to the invention, this comprises (Figure 5) a channel-shaped support 29 having a C-shaped cross-section, a bottom wall 30 of which is not pervious to light.

[0057] The channel-shaped support 29, for example made by moulding a synthetic plastic material not pervious to light, opaque or glossy, houses on the inside thereof both the light guide 8 and the blade optics 9.

[0058] The light guide 8 is arranged on the side of the bottom wall 30, for example against the latter, whereas the blade optics 9 are arranged on the side opposite the bottom wall 30 and substantially flush with respective longitudinal edges 31 of a pair of lateral walls 32 of the channel-shaped support 29.

[0059] The emitting elements 5 protrude in a cantilever fashion from the channel-shaped support 29, perpendicularly to the bottom wall 30.

[0060] In this way, it is possible to pre-assemble the light guide 8 with the blade optics 9 integral therewith in the support 29 and then, through the latter, to fix the optical system 4/4b on the vehicle, directly to the bodywork or within a housing 3 of a headlight or lamp.

[0061] Therefore, all the objects of the invention are achieved.

Claims

1. A light guide optical system (4; 4b) for a lighting device (1) for vehicles, the optical system comprising a plurality of light emitting elements (5) arranged spaced from one another along a trajectory (T) that forms a pre-set design and configured to receive a light beam (F) transversely to a rear face (6) thereof and to emit said light beam through a front surface (7) thereof opposite to and facing the rear face; **characterised in that** it comprises: blade optics (9) made of a material pervious to light and connecting together all the emitting elements (5), and a total reflection light guide (8) operatively associated with the blade optics (9); the blade optics (9) extending longitudinally along said trajectory (T) and defining the rear face (6) of each emitting element with part of its front face (12), the emitting elements (5) being obtained integrally in one piece with the blade optics (9) and protruding in a cantilever fashion from said front face (12) of the latter and on a side opposite to a rear face (13) of the same; the light guide (8) being configured to operatively cooperate with a light source (2) and comprising a first section (14), a first end (16) of which is configured to be directly facing the light source, and a second section (15), arranged on a side opposite to the first end (16) and facing the blade optics (9), in front of, and parallel to, the rear face (13) of the same and separate from the latter by means of a gap (18) having a pre-set width; the second section (15) of the light guide being provided, on the side opposite to the rear face (13) of the blade optics (9), with a plurality of first light extracting optical elements (19) configured to deflect the light from the inside of the light guide (8) towards the blade optics (9) and the rear face (13) of the latter being provided with a plurality of second optical elements (20) configured to define, together with said gap (18), an air lens (21) designed to diffuse the light received from the light guide (8) inside the emitting elements (5).

2. The optical system according to claim 1, **characterised in that** the light guide (8) has a preferably quadrangular cross-section, more preferably rectangular, and with at least a pair of respective rounded corners (22) opposite to the blade optics (9), having a substantially identical width in the first (14) and in the second (15) section and delimited by a front face (11) facing towards the blade optics (9) and by a rear face (10), opposite to its front face (11).

3. The optical system according to claim 2, **characterised in that** the rear face (10) of the light guide (8) is provided, only along said second section (15), with said first light extracting optical elements (19).

4. The optical system according to any one of the preceding claims, **characterised in that** the light guide (8) and the blade optics (9) are obtained integral, in a single piece, being composed of a same material pervious to light, preferably consisting of a synthetic plastic material, and being obtained in a single piece by means of a single moulding operation.

5. The optical system according to one of the claims from 1 to 3, **characterised in that** the light guide (8) and the blade optics (9) are obtained as two separate and independent elements, which have been connected integrally in a single piece in any suitable manner.

6. The optical system according to one of the preceding claims, **characterised in that** the front face (11) of the light guide is immediately facing the rear face (13) of the blade optics (9) provided with said second optical elements (20), is separated therefrom only by said gap (18), which is preferably constant, and is configured as a flat and smooth face.

7. The optical system according to one of the preceding claims, **characterised in that** the blade optics (9) comprise: a central body (23) having a cross-section that is also quadrangular and provided transversely in a cantilever fashion, on the side opposite to the light guide (8), with said emitting elements (5), said central body (23) substantially having the same width as the cross-section of the light guide (8); and a pair of ends (24) opposite to one another, obtained integrally in one piece with the central body (23) and shaped, towards the light guide (8), as L-shaped spacing feet, these feet determining said gap (18) between the light guide and the blade optics.

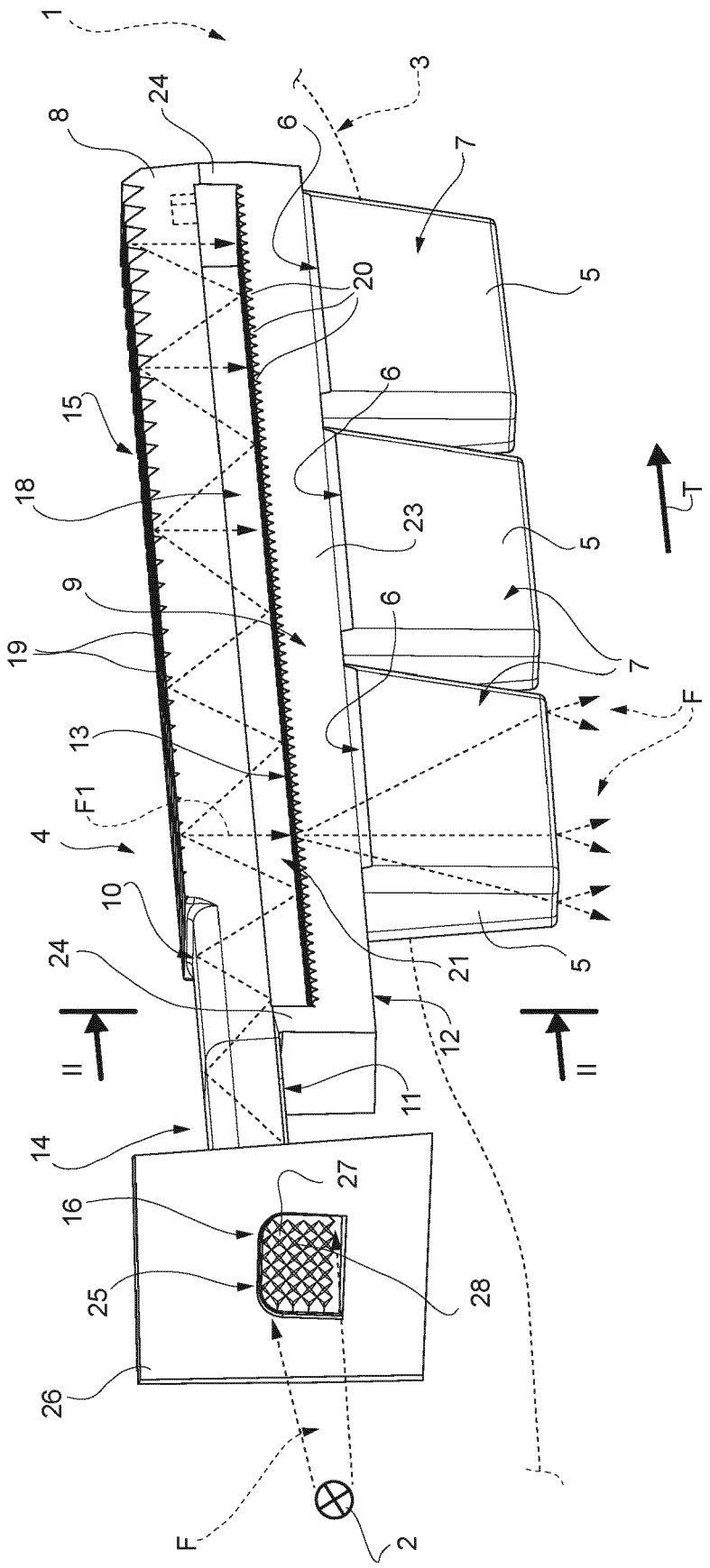
8. The optical system according to one of the preceding claims, **characterised in that** the first end (16) of the first section (14) of the light guide (8) is provided integrally and in one piece with a light mixing optical element (25) configured to be facing in use towards a light source (2); the light mixing optical element (25) preferably comprising a plurality of first (27) and second (28) cylindrical lenses (28), oriented at right angles to one another and arranged crosswise to one another.

9. The optical system according to one of the preceding claims, **characterised in that** it comprises a channel-shaped support (29) having a C-shape in cross-section and a bottom wall (30) of which is not pervious to light, the channel-shaped support (29) housing, on the inside thereof, the light guide (8) and the blade optics (9), the light guide (8) on the side of the bottom wall (30) and the blade optics (9) on the side opposite to the bottom wall and substantially flush with respective longitudinal edges (31) of a pair of lateral walls (32) of the channel-shaped support (29); the emitting elements (5) protruding in a cantilever fashion from the channel-shaped support (29), perpendicularly to the bottom wall (30).

10. A lighting device (1) comprising an optical system (4; 4b) according to any one of the claims from 1 to 9.

11. A vehicle comprising a lighting device (1), headlights or lamps, according to claim 10.

FIG. 1


1
3
24
8
6
7
20
5
15
18
23
9
19
13
F1
4
10
21
12
11
14
27
16
25
28
26
F
2
II
II
T
F

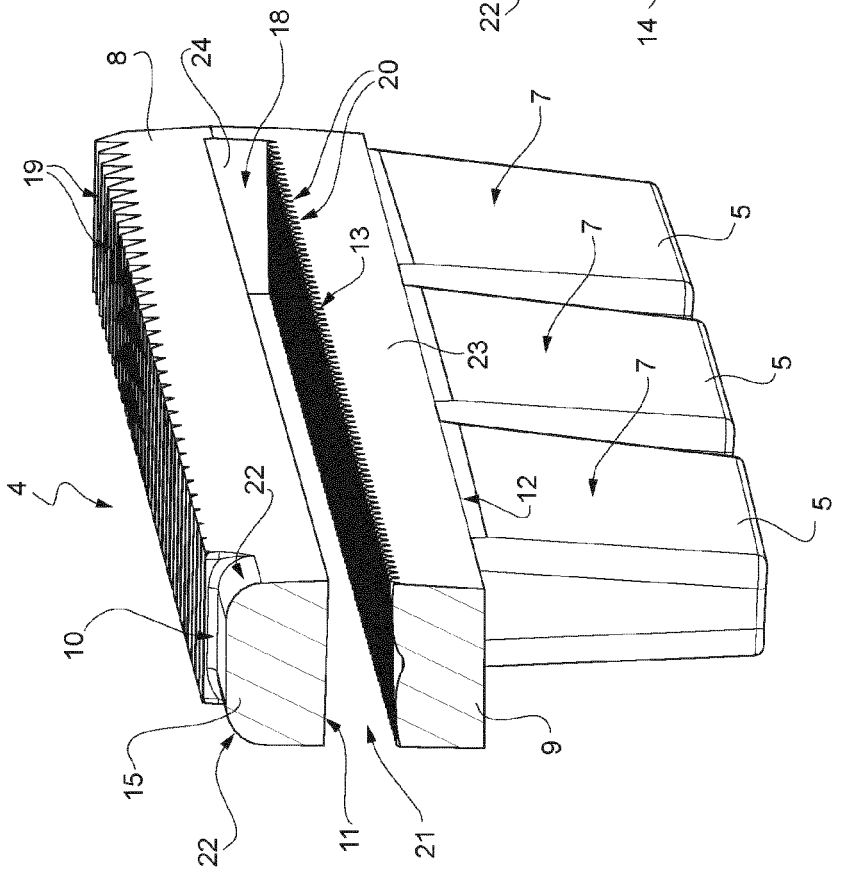

4
8
24
18
20
19
13
7
5
22
10
15
22
11
21
9
23
12

FIG. 4

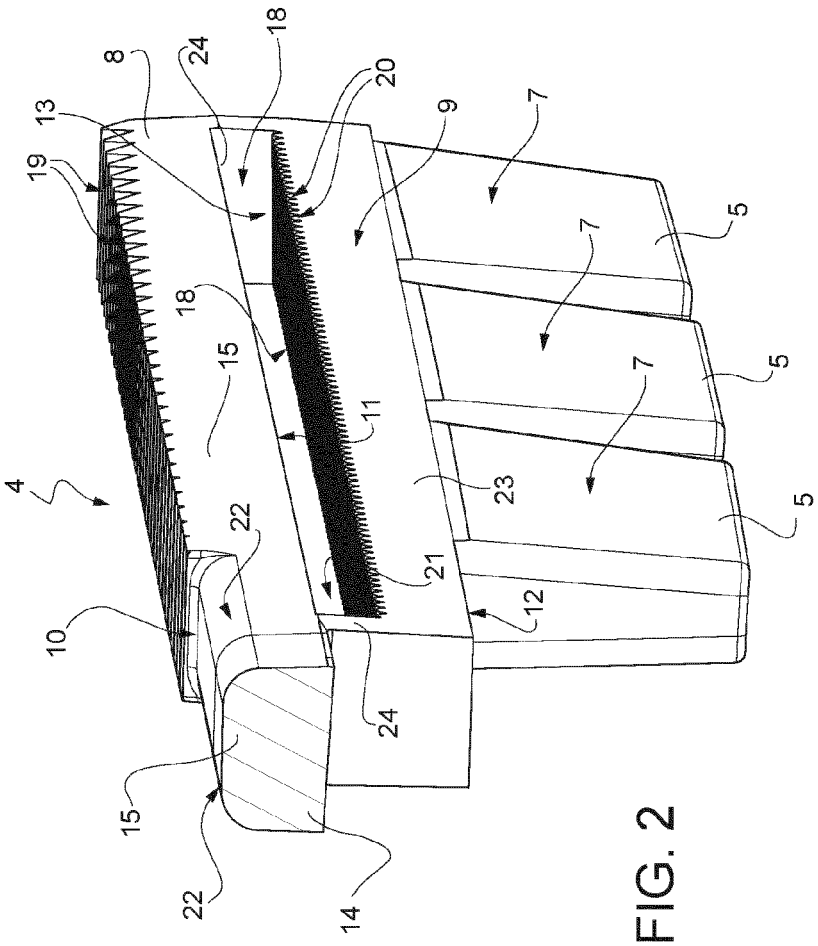

4
8
24
18
20
19
13
9
7
5
18
15
11
23
22
10
21
12
24
15
22
14

FIG. 2

FIG. 3

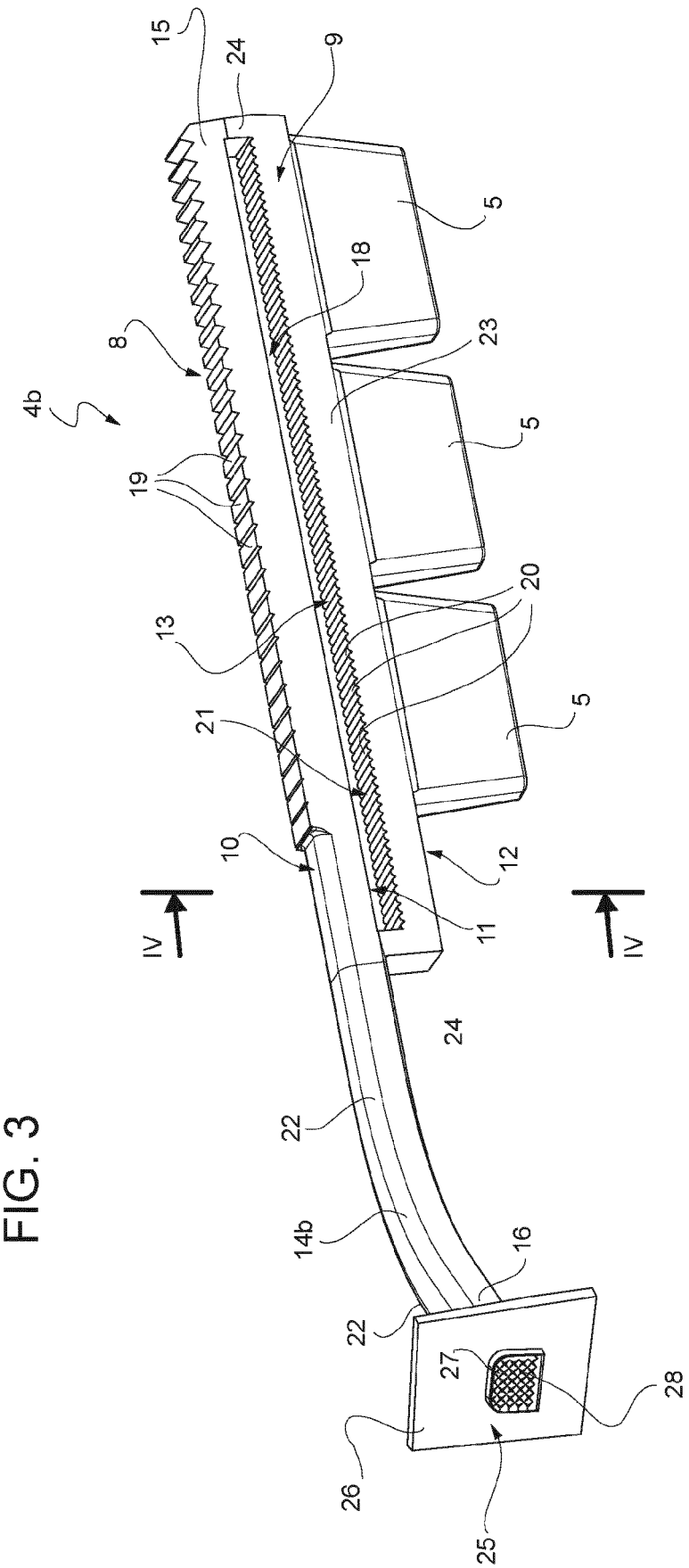
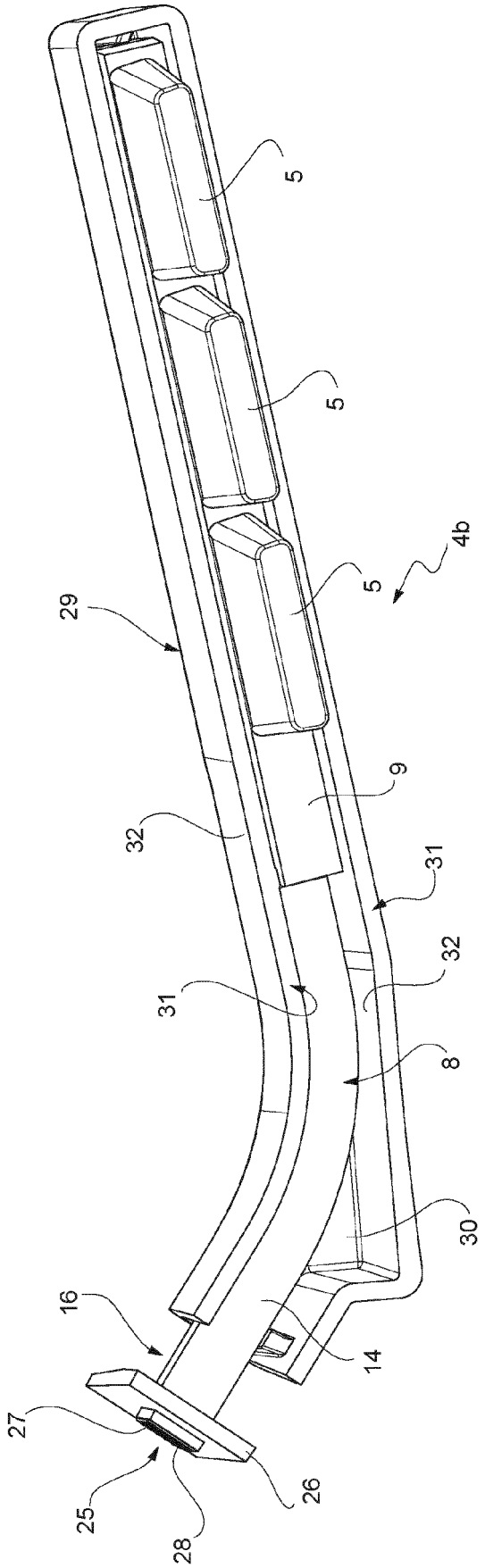

15
24
9
5
18
8
23
4b
5
19
20
13
5
21
10
12
IV
IV
11
24
22
14b
16
22
27
28
26
25

FIG. 5



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 16 5969

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 Y	CN 104 197 263 B (GREAT WALL MOTOR CO LTD) 27 July 2016 (2016-07-27) * see attached machine translation; figures 1-9 *	1-3,5,6, 9-11 4,7,8	INV. F21S43/237 F21S43/245 F21S43/247 F21S43/251
Y	US 2018/038569 A1 (HANULAK PATRIK [SK] ET AL) 8 February 2018 (2018-02-08) * figures 1-8 *	4,7	F21S43/20 F21S43/239 F21S43/243
Y	EP 3 415 814 A1 (FOSHAN ICHIKOH VALEO AUTO LIGHTING SYSTEMS CO LTD [CN]) 19 December 2018 (2018-12-19) * paragraph [0024]; figures 1,2,6 *	8	
A	JP 2017 195134 A (KOITO MFG CO LTD) 26 October 2017 (2017-10-26) * see attached machine translation; paragraphs [0001] - [0085]; figures 1-6 *	1-3,5-7, 10,11	
A	JP 2018 073525 A (KOITO MFG CO LTD) 10 May 2018 (2018-05-10) * see attached machine translation; paragraph [0043]; figures 1,2,5,6 *	1,5,6, 10,11	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	20 July 2022	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 22 16 5969

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.

20-07-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 104197263 B	27-07-2016	NONE	
US 2018038569 A1	08-02-2018	DE 102017117596 A1	08-02-2018
		US 2018038569 A1	08-02-2018
EP 3415814 A1	19-12-2018	CN 109143449 A	04-01-2019
		EP 3415814 A1	19-12-2018
		US 2018364406 A1	20-12-2018
JP 2017195134 A	26-10-2017	NONE	
JP 2018073525 A	10-05-2018	JP 6835531 B2	24-02-2021
		JP 2018073525 A	10-05-2018

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

- IT 102021000008030 **[0001]**