



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.07.2023 Bulletin 2023/27

(51) International Patent Classification (IPC):
F21S 43/239 ^(2018.01) **F21S 43/241** ^(2018.01)
F21S 43/243 ^(2018.01) **F21S 43/249** ^(2018.01)

(21) Application number: **21218411.3**

(52) Cooperative Patent Classification (CPC):
F21S 43/14; F21S 43/15; F21S 43/239;
F21S 43/243; F21S 43/249; F21S 43/26;
F21S 43/315; F21S 43/40; F21S 43/50

(22) Date of filing: **30.12.2021**

(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

(72) Inventors:
 • **GUTIÉRREZ, Gonzalo**
08450 Llinars del Vallès (ES)
 • **BERNADÀ, Oriol**
08450 Llinars del Vallès (ES)
 • **BROSSIER, Thibault**
78190 Trappes (FR)

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

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

(54) **AUTOMOTIVE LIGHT**

(57) An automotive light (1) provided with at least one lighting assembly (4), which is located inside the rear body (2) and is adapted to backlight a corresponding transparent or semi-transparent sector of the front half-shell (3); said lighting assembly (4) comprising: at least a first light-guide plate (10, 110) of given thickness, which is made of photoconductive material, is located inside the rear body (2) with a first face facing the front half-shell (3) and a second face facing the bottom of the rear body (2); has a perimeter light-exit band (13, 113) extending along the perimeter of the first face of the

light-guide plate (10, 110), for at least two consecutive sides of the same light-guide plate (10, 110), and is structured so as to cause the light to come out of the same light-guide plate (10, 110); and finally has, on its first or second face, also a light-distributing recess (14, 114) of given shape, which has a depth less than the local thickness (s) of the light-guide plate (10, 110), and is shaped so as to distribute the light coming from the first lateral sidewall (12, 112) of the light-guide plate (10, 110) substantially along the whole length of the perimeter light-exit band (13, 113).

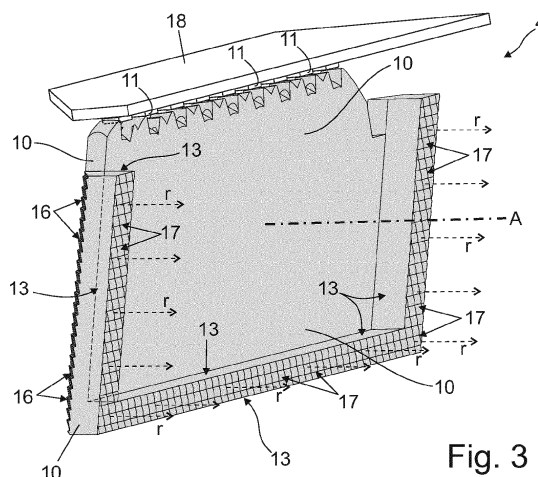


Fig. 3

Description

[0001] The present invention relates to an automotive light.

[0002] More in detail, the present invention preferably relates to a headlight or taillight for cars and similar vehicles, i.e. a lighting device suitable for being incorporated in a motor vehicle with the function of indicating the position, sudden deceleration and/or turning direction of the vehicle, and/or the function of lighting the area around the vehicle. Use to which the following disclosure will make explicit reference without thereby losing generality.

[0003] As is known, a headlight or taillight for cars and similar motor vehicles is conventionally a lighting device that is placed in the front, rear or side of the vehicle, and performs the function of lighting the area around the vehicle and/or indicating the position of the vehicle, the sudden deceleration of the vehicle and/or the turning direction of the vehicle, in accordance with certain photometric type-approval standards.

[0004] Most taillights for cars and similar motor vehicles usually comprise: a substantially basin-shaped, rigid rear body, which is structured so as to be firmly recessed in a compartment specially made in the rear part of the vehicle body; a front half-shell, which is arranged to close the mouth of the rear body so as to surface outside of the vehicle body, and generally has a plurality of transparent or semitransparent sectors, usually different in colour from one another; and a series of lighting assemblies that are located inside the rear body, each immediately beneath a respective transparent or semitransparent sector of the front half-shell, so as to selectively backlight the overlying transparent or semitransparent sector of the front half-shell.

[0005] Usually, each transparent or semitransparent sector of the front half-shell is moreover uniquely associated with a specific lighting signal, thus each lighting assembly is specifically structured to emit, on command, a light beam that, once exited from the taillight through the corresponding transparent or semitransparent sector of the half-shell, meets the type-approval specifications (colour and light distribution) for the corresponding lighting signal.

[0006] Over the last few years, many car manufacturers have chosen to equip their new car models with taillights capable of producing, at night, elaborate light effects allowing the car model to be uniquely identified.

[0007] In greater detail, some car manufacturers have equipped their car models with taillights having U- or L-shaped luminous areas, that allow the same car manufacturers to be uniquely identified.

[0008] In other words, the light effects produced by the taillights have become characteristic and distinctive elements of the individual car manufacturers.

[0009] The lighting assemblies that are used to create the ribbon-like luminous areas, and more particularly the U- or L-shaped luminous areas, usually comprise: a light-guide plate of suitable thickness, which is made of trans-

parent plastic material, is U- or L- bent so that the front sidewall of the plate substantially copies the shape of the U- or L- shaped luminous area to be realized, and is located inside the rear body with its front sidewall grazing the corresponding transparent or semi-transparent sector of the front half-shell; and a series of high power LEDs (acronym for Light Emitting Diode) that instead are located inside the rear body, close to the rear sidewall of the light-guide plate, so as to direct the light produced within the body of the light-guide plate. Once entered into the light-guide plate, the light emitted by the LEDs propagates within the body of the light-guide plate by total internal reflection, up to reach the front sidewall from where it comes out directed towards the facing transparent or semi-transparent sector of the front half-shell.

[0010] Clearly, in order to evenly backlight the facing transparent or semi-transparent sector of the front half-shell, the LEDs must be distributed in a substantially regular manner over the whole length of the rear sidewall of the light-guide plate.

[0011] Unfortunately, although working very well, the above-described backlighting system requires a large number of LEDs, with the high production costs that this entails.

[0012] In fact, in addition to the intrinsic high cost of the LEDs, the taillight must also be structured so that the considerable heat produced by the LEDs during operation can be dissipated outside.

[0013] This obligation requires to incorporate, into the taillight, heat dissipation devices that contribute to further increasing the production cost of the taillight.

[0014] Aim of the present invention is to provide a taillight, which is capable of producing U- or L-shaped luminous areas and which is more economical to produce.

[0015] In accordance with these aims, according to the present invention there is provided an automotive light as defined in Claim 1 and preferably, though not necessarily, in any one of the claims dependent thereon.

[0016] The present invention will now be described with reference to the accompanying drawings, which illustrate a non-limiting embodiment thereof, wherein:

- Figure 1 is a perspective view of an automotive light realized according to the teachings of the present invention, with parts in section and parts removed for clarity's sake;
- Figure 2 is a partially exploded, perspective view of the automotive light shown in Figure 1, with parts removed for clarity's sake;
- Figure 3 is a perspective view of a lighting assembly of the automotive light shown in the previous figures, with parts removed for clarity's sake;
- Figure 4 is a perspective view of the light-guide body of the lighting assembly shown in Figure 3;
- Figure 5 is a partially sectioned perspective view of the light-guide body shown in Figure 4;
- Figure 6 is a rear view of the light-guide body shown in Figure 5, with parts in section and parts removed

for clarity's sake;

- Figure 7 is a perspective view of a second embodiment of the lighting assembly shown in Figure 3, with parts removed for clarity's sake;
- Figure 8 is a perspective view of the light-guide body of the lighting assembly shown in Figure 7;
- Figure 9 is a perspective view of a second embodiment of the light-guide body shown in Figure 8; whereas
- Figure 10 is a perspective view of a third embodiment of the lighting assembly shown in Figure 3, with parts removed for clarity's sake.

[0017] With reference to Figures 1 and 2, number 1 denotes as a whole an automotive light, i.e. a lighting device adapted to be firmly fixed to the front or rear of the body of a motor vehicle, with the function of emitting light signals adapted to signal/indicate the position of the vehicle and/or the sudden deceleration of the vehicle and/or the turning direction of the vehicle during travel and/or with the function of lighting the area around the vehicle.

[0018] In other words, the automotive light 1 is adapted to be fixed to the front or rear part of the vehicle body of a car, van, truck, motorcycle or other similar motor vehicle, to work as a headlight or taillight.

[0019] Clearly, the automotive light 1 could also be located on a lateral side of the car or other similar motor vehicle.

[0020] Preferably, the automotive light 1 is furthermore structured so as to be stably recessed in the vehicle body (not shown) and to surface outside of the vehicle.

[0021] In the example shown, in particular, the automotive light 1 is preferably structured to be stably recessed in the rear part of the vehicle body of a car or other similar motor vehicle.

[0022] In other words, the automotive light 1 is preferably a taillight for cars and the like.

[0023] Naturally, in a different embodiment, the automotive light 1 could also be structured so as to be simply fixed cantilevered to the front, side or rear of the vehicle body (not shown).

[0024] With reference to Figures 1 and 2, in particular, the automotive light 1 comprises: a substantially rigid and preferably made of plastic material, concave rear body 2 which is substantially basin-shaped and is structured so as to be firmly fixed to the vehicle body (not shown); and a substantially rigid and preferably made of plastic material, front half-shell 3, traditionally designated as a lens, which is arranged to close the mouth of the rear body 2 preferably so as to surface outside of the vehicle body, and has one or more transparent or semitransparent sectors, which are optionally also coloured.

[0025] In addition, the automotive light 1 also comprises one or more electrically-powered lighting assemblies, each of which emits light on command and is located inside the rear body 2, underneath a corresponding transparent or semi-transparent sector of the front half-shell

3, so as to selectively backlight the same transparent or semitransparent sector of the front half-shell, preferably separately and independently of the other lighting assemblies of the automotive light.

[0026] Preferably, the lighting assembly or at least one of the lighting assemblies of automotive light 1 is moreover structured so as to direct the light towards the corresponding facing transparent or semitransparent sector of front half-shell 3, with a prevalent component of the light beam substantially parallel to a predetermined reference optical axis, which is preferably substantially parallel to the longitudinal axis of the vehicle when the automotive light 1 is correctly mounted/placed on the vehicle body.

[0027] In greater detail, the rear body 2 is preferably made of an opaque plastic material and is preferably structured so as to be at least partially recessed within a seat specially made in the rear part of the vehicle body.

[0028] Obviously, in a different embodiment, the rear body 2 could also be structured so as to be at least partially recessed within a seat specially made in the front or lateral part of the vehicle body (not shown), or so as to be simply fixed cantilevered on the front, side or rear part of the vehicle body.

[0029] The front half-shell 3, in turn, is preferably made of a transparent or semi-transparent plastic material, such as for example polymethylmethacrylate (PMMA) or polycarbonate (PC), and is preferably provided with a plurality of adjacent transparent or semi-transparent sectors, each of which is separately backlit by a corresponding lighting assembly.

[0030] Clearly, front half-shell 3 may additionally include also opaque sectors.

[0031] With reference to Figures 1, 2 and 3, in addition, the or at least one of the lighting assemblies of the automotive light is moreover structured so as to backlight, on command, the corresponding transparent or semi-transparent sector of front half-shell 3 creating a substantially U-shaped luminous area.

[0032] In greater detail, in the example shown, the automotive light 1 is provided with a first lighting assembly 4 structured so as to backlight the facing transparent or semi-transparent sector of front half-shell 3 creating a substantially U-shaped luminous area, and optionally also with a second lighting assembly 5.

[0033] Preferably, the lighting assembly 4 is moreover structured so as to direct the light towards the facing transparent or semi-transparent sector of the front half-shell 3, with a prevalent component of the light beam substantially parallel to a first reference optical axis A, which is preferably substantially parallel to the vehicle longitudinal axis when the automotive light 1 is correctly mounted/placed on the vehicle body.

[0034] Similarly, the lighting assembly 5 is preferably structured so as to direct the light towards the facing transparent or semi-transparent sector of the front half-shell 3, with a prevalent component of the light beam substantially parallel to a second reference optical axis,

which is preferably substantially parallel to the vehicle longitudinal axis when the automotive light 1 is correctly mounted/placed on the vehicle body.

[0035] With reference to Figures 1 to 6, the lighting assembly 4 firstly comprises: a light-guide plate 10 of suitable thickness, which is made of photoconductive material and is arranged within the rear body 2 with a first face, hereinafter referred to as the front face, grazing or in any case facing the front half-shell 3, and with a second face, hereinafter referred to as the rear face, facing the bottom of rear body 2; and a series of LEDs 11 (acronym for Light Emitting Diode) that are located inside the rear body 2, close to a first side of the light-guide plate 10, and are oriented so as to direct the light produced into the body of light-guide plate 10, through the facing lateral sidewall 12 of the same light-guide plate 10. This light then propagates within the body of the light-guide plate 10 by total internal reflection.

[0036] Therefore, the lateral sidewall 12 is the light-entry sidewall of the light-guide plate 10.

[0037] In greater detail, the light-guide plate 10 is preferably substantially quadrilateral in shaped and is preferably arranged inside the rear body 2 so as to be substantially perpendicular to the optical axis A of lighting assembly 4.

[0038] In the example shown, in particular, the light-guide plate 10 is preferably provided with four main sides, preferably substantially straight and in pairs substantially parallel to each other.

[0039] Furthermore, the LEDs 11 are arranged inside the rear body 2 close to a sole/single main side of the light-guide plate 10, so as to light up a sole lateral sidewall of the same light-guide plate 10.

[0040] In addition, the light-guide plate 10 has a substantially ribbon-like light-exit band that extends along the perimeter of the front face of light-guide plate 10, adjacent to the three remaining consecutive and mutually inclined sides of the same light-guide plate 10, and is overall structured so as to cause the light propagating inside itself to come out solely from said perimeter light-exit band.

[0041] In other words, the perimeter light-exit band of light-guide plate 10 is substantially U-shaped, and the light emitted by the LEDs 11 enters the light-guide plate 10 through the lateral sidewall 12 and exits the light-guide plate 10 only along the perimeter light-exit band.

[0042] Furthermore, the lateral sidewall 12 of light-guide plate 10 is aligned with and opposite to the central segment of the perimeter light-exit band of the plate.

[0043] In greater detail, with reference to Figures 2, 3, 4 and 5, the remaining second, third and fourth sides of light-guide plate 10, i.e. the sides of light-guide plate 10 not directly lighted up by the LEDs 11, are preferably L-bent toward the front half-shell 3 so as to form, along the perimeter of the front face of light-guide plate 10, a long protruding perimeter rib or shoulder 13 which is substantially U-shaped and extends cantilevered from the edge of the front face of light-guide plate 10, towards the front

half-shell 3.

[0044] Therefore the top of protruding perimeter shoulder or rib 13 is substantially grazing, or in any case facing, the front half-shell 3 and is structured so as to allow the light propagating within the plate to freely come out of the plate and backlight the front half-shell 3.

[0045] With reference to Figures 4, 5 and 6, the light-guide plate 10 moreover has, on one of its two larger faces, also a large light-distributing recess 14 of given shape, which has a depth less than the thickness s of the light-guide plate 10 and is shaped so as to distribute the light coming from the lateral sidewall 12 of light-guide plate 10, in a predetermined and controlled manner along the whole length of the protruding perimeter rib or shoulder 13. This light then comes out of the light-guide plate 10 from the top of the same protruding perimeter rib or shoulder 13.

[0046] Therefore, the top of the protruding perimeter shoulder or rib 13 forms the perimeter light-exit band of the light-guide plate 10.

[0047] In greater detail, the light-distributing recess 14 is located in front of the lateral sidewall 12 of light-guide plate 10 and is adapted to distribute a part of the light coming from the lateral sidewall 12 of light-guide plate 10 and directed towards the portion of the protruding perimeter rib or shoulder 13 immediately aligned with and opposite to the lateral sidewall 12, towards the other portions of the protruding perimeter rib or shoulder 13.

[0048] In other words, the light-distributing recess 14 is adapted to distribute a part of the light coming from the lateral sidewall 12 of light-guide plate 10 and directed towards the segment of the perimeter light-exit band of the light-guide plate 10 immediately aligned with and opposite the lateral sidewall 12, towards the other segments of the same perimeter light-exit band.

[0049] In addition, the light-distributing recess 14 is preferably shaped and dimensioned so as to distribute the light coming from the lateral sidewall 12 of light-guide plate 10 in a substantially even manner along the whole length of the protruding perimeter rib or shoulder 13.

[0050] Once entered into the light-guide plate 10 through the lateral sidewall 12 of the plate, therefore, the light emitted by the LEDs 11 propagates within the body of light-guide plate 10 by total internal reflection, up to reach the crest or top of the protruding perimeter shoulder or rib 13 from where it comes out freely, directed towards the front half-shell 3.

[0051] In other words, the light emitted by the LEDs 11 enters the light-guide plate 10 through the lateral sidewall 12 and exits the light-guide plate 10 only along the perimeter rib or shoulder 13.

[0052] The light coming out from the top of the protruding perimeter shoulder or rib 13 thus backlights the facing transparent or semi-transparent sector of the front half-shell 3, creating a substantially U-shaped luminous area.

[0053] In the example shown, in particular, the light-guide plate 10 preferably has a monolithic structure and is preferably made of polymethylmethacrylate (PMMA)

or other transparent plastic material, advantageously via an injection moulding process.

[0054] Preferably, the light-guide plate 10 moreover has a nominal thickness ranging between 3 and 30 mm (millimetres).

[0055] With reference to Figures 3 to 6, in addition, the lateral sidewall 12 of light-guide plate 10 is preferably substantially straight and is preferably provided with a series of small grooves or indentation 15, each of which accommodates a respective LED 11 and is preferably shaped so as to concentrate the light beam coming out of the same LED 11.

[0056] The protruding perimeter shoulder or rib 13 of light-guide plate 10, on the other hand, is longitudinally divided into three consecutive segments that are substantially straight and are preferably joined to one another substantially seamlessly.

[0057] The central segment of protruding perimeter shoulder 13 is located on the opposite side of light-guide plate 10 with respect to the lateral sidewall 12 and is preferably also substantially parallel to the same lateral sidewall 12. The two end segments of protruding perimeter shoulder 13, on the other hand, extend towards the lateral sidewall 12, on opposite sides thereof, preferably while remaining substantially parallel to each other.

[0058] With reference to Figures 4, 5 and 6, the light-distributing recess 14, in turn, is interposed between the lateral sidewall 12 of light-guide plate 10, i.e. the lateral sidewall lighted up by the LEDs 11, and the central segment of the protruding perimeter rib or shoulder 13, so that its lateral walls extend obliquely in front of the lateral sidewall 12 of light-guide plate 10 and can deflect/reflect the light coming from the lateral sidewall 12 towards the two end segments of the protruding perimeter rib or shoulder 13.

[0059] Preferably, the reflecting lateral walls of the light-distributing recess 14 moreover are substantially perpendicular to the laying plane of the central flat sector of light-guide plate 10 and/or are substantially straight.

[0060] In greater detail, the light-distributing recess 14 is preferably substantially V-shaped and is preferably formed on the rear face of light-guide plate 10, with the vertex of the V facing the lateral sidewall 12 of light-guide plate 10, i.e. the lateral sidewall lighted up by the LEDs 11, and with the two arms of the V facing each a respective end segment of the protruding perimeter rib or shoulder 13.

[0061] The two lateral walls of the light-distributing recess 14 that converge towards the lateral sidewall 12 of light-guide plate 10, i.e. towards the lateral sidewall lighted up by the LEDs 11, hereinafter denoted by the numbers 14a and 14b, are interposed between the lateral sidewall 12 of the plate and the central segment of the protruding rib or shoulder 13 and are adapted to deflect/reflect the incident light towards the two sides of the light-guide plate 10 where the end segments of the protruding perimeter rib or shoulder 13 are located.

[0062] In addition, the reflecting lateral wall 14a is pref-

erably substantially straight, whereas the reflecting lateral wall 14b preferably has a sawtooth profile.

[0063] In greater detail, the vertex of the V is preferably located close to the midpoint of the lateral sidewall 12 of light-guide plate 10.

[0064] In the example shown, in particular, the light-distributing recess 14 preferably consists of a depression substantially polygonal in shape, and more specifically substantially triangular in shape, which is formed on the rear face of light-guide plate 10, so that a first vertex of the triangle faces the light-entry lateral sidewall 12 of the plate, i.e. the lateral sidewall lighted up by the LEDs 11, and that the two sides of the triangle converging towards the same first vertex face each a respective end segment of the protruding perimeter rib or shoulder 13.

[0065] Preferably, the side of the triangle opposite said first vertex is moreover substantially parallel and opposite to the overlying central segment of the protruding perimeter rib or shoulder 13.

[0066] Preferably, the light-distributing recess 14, or rather the substantially triangular-shaped depression, moreover has a depth which is substantially constant and/or ranges between 25% and 75% of the local thickness s of the light-guide plate 10.

[0067] Clearly, the light-distributing recess 14, or rather the substantially triangular-shaped depression, could also be formed on the front face of light-guide plate 10.

[0068] With reference to Figures 3 to 6, in addition, the edges of the rear face of light-guide plate 10 that are aligned with the various segments of the perimeter light-exit band, or rather with the various segments of the protruding perimeter rib or shoulder 13, are preferably bevelled.

[0069] In addition, the edges of the rear face of light-guide plate 10 that are aligned with the various segments of the perimeter light-exit band, or rather with the various segments of the protruding perimeter rib or shoulder 13, preferably also have, on the bevel, a series of reflecting surface structures, which are shaped so as to deflect, towards the top of the protruding perimeter shoulder 13, the light rays r that propagate within the central flat sector of the light-guide plate 10 and reach the same reflecting surface structures.

[0070] In greater detail, the bevelled edges of the rear face of light-guide plate 10 preferably have, on the bevel, a multitude of small deflector prisms 16 which are shaped so as to deflect, by total internal reflection and towards the top of the protruding perimeter shoulder 13, the light rays r that propagate within the central flat sector of light-guide plate 10 and reach the same deflector prisms 16.

[0071] Moreover, the deflector prisms 16 are shaped so as to deflect the incident light rays r towards the top of the protruding perimeter rib or shoulder 13, with an incidence angle such that the light can freely come out of the light-guide plate 10 along the entire crest/top of the protruding perimeter rib or shoulder 13, and then reach the front half-shell 3.

[0072] With reference to Figure 3, in addition, the light-

guide plate 10 preferably also has, on the top of the protruding perimeter rib or shoulder 13, an optics 17 preferably with pillow geometry, which is advantageously distributed in a substantially even manner over the entire top of the protruding perimeter rib or shoulder 13, and is preferably shaped so as to diffuse/scatter the light rays coming out of the protruding perimeter shoulder 13.

[0073] Clearly, the optics 17 could also be shaped so as to collimate the light rays coming out of the protruding perimeter shoulder 13 in a given direction that is preferably substantially perpendicular to the front face of the light-guide plate 10 and/or substantially parallel to the optical axis A of lighting assembly 4.

[0074] With reference to Figures 2 and 3, the row of LEDs 11, on the other hand, is preferably arranged astride of the laying plane of the central flat sector of light-guide plate 10.

[0075] Preferably, the LEDs 11 are moreover arranged side by side to one another on a preferably oblong-shaped, platelike printed circuit 18 which is preferably located inside the rear body 2 locally substantially grazing the lateral sidewall 12 of light-guide plate 10.

[0076] With reference to Figures 1 and 2, preferably the automotive light 1 additionally also includes a shielding mask 6 with a substantially rigid and opaque structure, which is preferably made of plastic material, preferably has a shape substantially complementary to the mouth of the rear body 2, and is located inside the rear body 2 immediately beneath the front half-shell 3.

[0077] The shielding mask 6 is provided with a pass-through opening 6a that has a shape substantially complementary to that of the perimeter light-exit band of light-guide plate 10, i.e. it's U-shape, and is aligned with the same perimeter light-exit band.

[0078] In greater detail, the pass-through opening 6a of the shielding mask 6 is adapted to be engaged by the protruding perimeter rib or shoulder 13 of the light-guide plate 10.

[0079] With reference to Figures 1 and 2, preferably the second lighting assembly 5 in turn comprises: a filament or gas discharge lamp 20, which is at least partially located inside the rear body 2; and a concave reflector body 21 with a substantially rigid and opaque cup-like structure, which is preferably made of plastic material, is located within the rear body 2, and is structured so as to surround at least the bulb of lamp 20. The reflector body 21, in addition, is provided with an inner reflecting surface that is shaped so as to direct the light emitted by the lamp 20 towards the corresponding and facing transparent or semi-transparent sector of the front half-shell 3.

[0080] The shielding mask 6, in turn, is preferably additionally provided with a second pass-through opening 6b, which is complementary in shape to the mouth of the reflector body 21 and is adapted to be stably engaged by the mouth of said reflector body 21.

[0081] In a different embodiment, however, the concave reflector body 21 may be incorporated into the shielding mask 6.

[0082] The general operation of automotive light 1 is easily inferable from the above description and requires no further explanation.

[0083] On the other hand, as regards operation of lighting assembly 4, with reference to Figure 6, the light rays r emitted by the LEDs 11 enter the light-guide plate 10 via the lateral sidewall 12 of the same plate.

[0084] In the absence of the light-distributing recess 14, all the light entering from the lateral sidewall 12 of light-guide plate 10 would be directed towards the central segment of the protruding perimeter rib or shoulder 13, or rather towards the deflector prisms 16 located beneath the central segment of the protruding perimeter rib or shoulder 13.

[0085] The light-distributing recess 14 modifies the propagation of the light in the light-guide plate 10.

[0086] More in detail, since the light-distributing recess 14 does not take up the entire thickness of the light-guide plate 10, the light rays r that propagate within the central flat sector of light-guide plate 10 and do not intersect the light-distributing recess 14, directly reach the deflector prisms 16 located beneath the central segment of the protruding rib or shoulder 13 of light-guide plate 10, and are there deflected towards the top of the central segment of the protruding perimeter rib or shoulder 13.

[0087] The light rays r, in fact, strike the deflector prisms 16 with an incidence angle greater than the critical angle (also known as the limit angle) and are reflected by total internal reflection towards the top of the overlying central segment of the protruding rib or shoulder 13.

[0088] The light rays r propagating within the central flat sector of light-guide plate 10 and striking the reflective lateral walls 14a and 14b of light-distributing recess 14, on the other hand, are deflected/reflected towards the deflector prisms 16 located beneath the two opposite end segments of the protruding perimeter rib or shoulder 13, and are there deflected/reflected towards the top of the same end segments of the protruding perimeter rib or shoulder 13.

[0089] The light rays r reaching the lateral walls 14a and 14b of light-distributing recess 14, in fact, strike the lateral walls 14a and 14b with an incidence angle greater than the critical angle (also known as the limit angle) and therefore undergo a total internal reflection.

[0090] In both cases, the light rays r reach the top of the protruding perimeter rib or shoulder 13 with an angle of incidence such that they can freely come out of the light-guide plate 10 and proceed towards the front half-shell 3, thereby creating a substantially U-shaped luminous area.

[0091] The advantages connected to the particular structure of the lighting assembly 4 are noteworthy.

[0092] The lighting assembly 4 can backlight the front half-shell 3 creating a substantially U-shaped luminous area with the aid of a very small number of LEDs 11, with the drastic reduction in production costs that this entails.

[0093] In addition, the lighting assembly 4 is particularly thin and compact and therefore can be accommo-

dated inside a shallow rear body 2.

[0094] It is finally clear that modifications and variations may be made to the automotive light 1 without however departing from the scope of the present invention.

[0095] For example, the perimeter light-exit band of light-guide plate 10 may also be substantially flush/co-planar with the front face of the same light-guide plate 10.

[0096] In a not-shown embodiment variation, moreover, the light-distributing recess 14 may consist of a substantially V-shaped surface groove, which is formed on the front or rear face of the light-guide plate 10 and is oriented so that the vertex of the V faces the lateral sidewall 12 of the plate, i.e. the lateral sidewall lighted up by the LEDs 11, and that the two arms of the V face each a respective end segment of the protruding perimeter shoulder 13.

[0097] Clearly, the substantially V-shaped groove has a depth locally lower than the thickness *s* of light-guide plate 10.

[0098] In addition, the LEDs 11 may be replaced by OLEDs (acronym for Organic Light Emitting Diode) or other electrically-powered light sources preferably of optoelectronic type.

[0099] With reference to Figures 7 and 8, in a different embodiment, moreover, the lighting assembly 4 can be also structured so as to backlight, on command, the facing transparent or semi-transparent sector of front half-shell 3, creating a substantially L-shaped luminous area.

[0100] More in detail, in this embodiment the light-guide plate 10 is replaced by a light-guide plate 110 preferably having four main sides, which is provided with a substantially L-shaped, perimeter light-exit band that extends along the perimeter of the front face of the plate, adjacent solely to two consecutive and mutually inclined sides of the same light-guide plate 110.

[0101] Even more in detail, two main and consecutive sides of the light-guide plate 110 are L-bent toward the front half-shell 3, so as to form, along the perimeter of the front face of light-guide plate 110, a long protruding rib or shoulder 113, which is substantially L-shaped and extends cantilevered from the edge of the front face of light-guide plate 110, towards the front half-shell 3.

[0102] In other words, the protruding perimeter rib or shoulder 113 is longitudinally divided into two consecutive segments, which are substantially straight and inclined relative to each other.

[0103] The LEDs 11, in turn, are located inside the rear body 2 so as to light up a first side of the light-guide plate 110 opposite one of the segments of the protruding perimeter rib or shoulder 113.

[0104] In other words, similarly to the first embodiment, the light produced by the LEDs 11 enters the light-guide plate 110 via a lateral sidewall 112 of the plate opposite one of the two segments of the protruding perimeter rib or shoulder 113.

[0105] In addition, the light-guide plate 110 has, on one of its two larger faces, a large light-distributing recess 114 of given shape, which has a depth less than the thick-

ness *s* of the light-guide plate 110 and is shaped so as to distribute the light coming from the lateral sidewall 112 of light-guide plate 110 in a predetermined and controlled manner along the whole length of the protruding perimeter rib or shoulder 113.

[0106] Also in this embodiment, therefore, once it has entered the light-guide plate 110 via the lateral sidewall 112 of the plate, the light emitted by the LEDs 11 propagates within the body of the light-guide plate 110 by total internal reflection, up to reach the crest or top of the protruding perimeter shoulder or rib 113 from where it comes out freely, directed towards the front half-shell 3.

[0107] In greater detail, with reference to Figure 8, the light-distributing recess 114 is interposed between the lateral sidewall 112 of light-guide plate 110, i.e. the lateral sidewall lighted up by the LEDs 11, and one of the two segments of the protruding perimeter rib or shoulder 113, and its lateral wall facing the lateral sidewall 112 of light-guide plate 110 is adapted to deflect/reflect the incident light towards the other segment of the protruding rib or shoulder 113.

[0108] In other words, the reflecting lateral wall 114a of the light-distributing recess 114 extends over the rear face of light-guide plate 110 along a straight line which roughly connects the elbow of the L-shaped protruding perimeter rib or shoulder 113 with the opposite end/vertex of the lateral sidewall 112 of light-guide plate 110. Preferably, the reflecting lateral wall 114a of the light-distributing recess 114 is moreover substantially straight.

[0109] In the example shown in Figure 8, in particular, the light-distributing recess 114 preferably consists of a substantially triangular-shaped depression, which is formed on the rear face of light-guide plate 110 so that a first vertex of the triangle is located close to one of the ends/vertices of the lateral sidewall 112 of light-guide plate 110, and so that one of the two sides of the triangle converging towards the same first vertex extends obliquely in front of the lateral sidewall 112 of light-guide plate 110.

[0110] Alternatively, the light-distributing recess 114 may consist of a substantially straight surface groove, which has a depth less than the thickness *s* of the light-guide plate 110 and extends obliquely in front of the lateral sidewall 112 of light-guide plate 110.

[0111] Also in this embodiment, the edges of the rear face of light-guide plate 110 that are aligned to the two segments of the protruding perimeter rib or shoulder 113, are preferably bevelled and are preferably provided, on the bevel, with a multitude of small deflector prisms 116 or other reflecting surface structures that are shaped so as to deflect, towards the top of the protruding perimeter shoulder 113, the light rays *r* propagating inside the central flat sector of light-guide plate 110 and reaching the same deflector prisms 116.

[0112] Also the light-guide plate 110, moreover, is preferably provided, on the top of the L-shaped protruding rib or shoulder 113, with an optics 117 preferably with pillow geometry, which is advantageously distributed in

a substantially even manner over the entire top of the protruding perimeter rib or shoulder 113, and is preferably shaped so as to diffuse/scatter the light rays coming out of the protruding perimeter shoulder 113.

[0113] Clearly, also in this case, the optics 117 may be shaped so as to collimate the light rays coming out of the protruding perimeter shoulder 113 in a given direction that is preferably substantially perpendicular to the front face of light-guide plate 10 and/or substantially parallel to the optical axis A of lighting assembly 4.

[0114] With reference to Figure 9, as an alternative, the light-distributing recess 114 may be formed by a succession of small straight grooves, which have a depth less than the thickness s of the light-guide plate 110 and extend over the rear face of the light-guide plate 110 spaced one after the other, aligned along the straight line connecting the elbow of the L-shaped protruding perimeter rib or shoulder 113 with the opposite end/vertex of the lateral sidewall 112 of light-guide plate 110.

[0115] Preferably, said straight grooves are additionally staggered and partially superimposed on each other so as to form a sawtooth profile.

[0116] With reference to Figure 10, in a more sophisticated embodiment, lastly, the lighting assembly 4 can also be structured so as to backlight, on command, the facing transparent or semi-transparent sector of the front half-shell 3, creating a substantially E-shaped luminous area.

[0117] More in detail, the lighting assembly 4 includes a light-guide plate 10 and a light-guide plate 110 arranged adjacent and substantially coplanar to each other, so that one of the two straight segments of the protruding perimeter rib or shoulder 113 is aligned and adjacent to the central straight segment of the protruding perimeter rib or shoulder 13, thereby forming a substantially E-shaped protruding rib.

[0118] In other words, the light-guide plate 10 and the light-guide plate 110 are arranged adjacent and substantially coplanar to each other, so that one of the two straight segments of the L-shaped perimeter light-exit band is aligned with and adjacent to the central straight segment of the U-shaped perimeter light-exit band, thereby forming a substantially E-shaped perimeter light-exit band.

[0119] Clearly, in this last embodiment, the lighting assembly 4 is provided with two different and distinct rows of LEDs 11 (acronym for Light Emitting Diode) that are arranged inside the rear body 2 so as to light up one the light-entry sidewall 12 of light-guide plate 10 and the other the light-entry sidewall 112 of light-guide plate 110.

Claims

1. An automotive light (1) comprising: a rear body (2) adapted to be fixed to the vehicle; a front half-shell (3) arranged to close the mouth of said rear body (2); and at least one lighting assembly (4) that is located inside the rear body (2) and is adapted to back-

light a corresponding transparent or semi-transparent sector of the front half-shell (3);

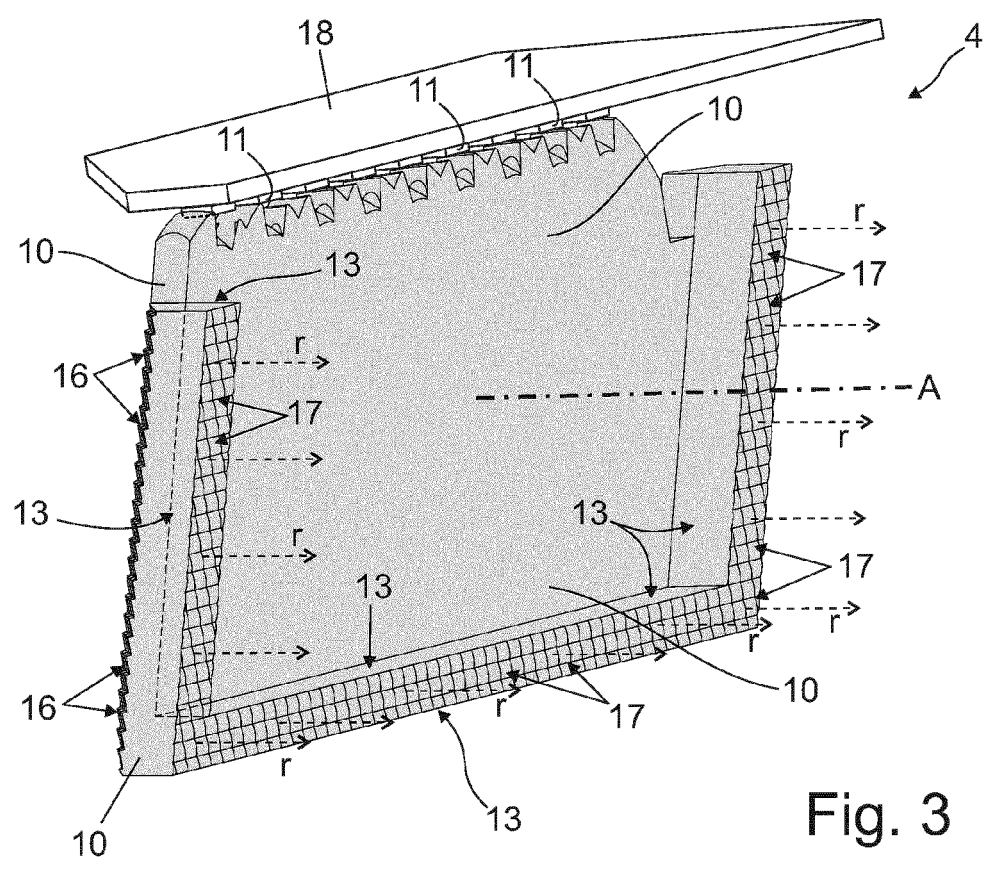
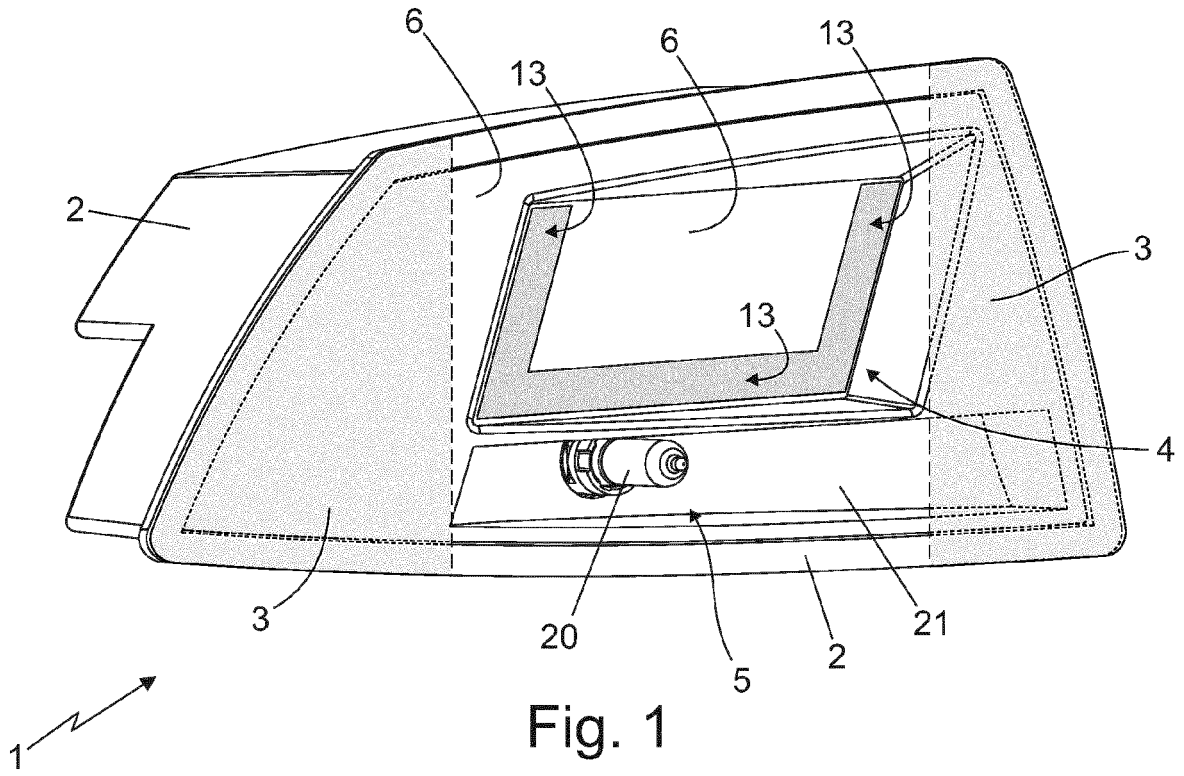
said lighting assembly (4) comprising: at least one light-guide plate (10, 110) of suitable thickness, which is made of photoconductive material; and a set of electrically -powered light sources (11) that are located close to a first side of the light-guide plate (10, 110) and direct the light produced into the body of the same light-guide plate (10, 110) via a facing first lateral sidewall (12, 112) of the same plate so that said light propagates within the body of the light-guide plate (10, 110) by total internal reflection;

said automotive light (1) **being characterized in that** said light-guide plate (10, 110) is located inside the rear body (2) with a first face facing the front half-shell (3) and a second face facing the bottom of the rear body (2); **in that** said light-guide plate (10, 110) has a perimeter light-exit band (13, 113) extending along the perimeter of the first face of the light-guide plate (10, 110), for at least two consecutive sides of the same light-guide plate (10, 110), and is structured so as to cause the light to come out of the same light-guide plate (10, 110); **in that** the first lateral sidewall (12, 112) of said light-guide plate (10, 110) is opposite to a first segment of said perimeter light-exit band (13, 113); **and in that** said light-guide plate (10, 110) also has, on its first or second face, a light-distributing recess (14, 114) of given shape, which has a depth less than the local thickness (s) of the light-guide plate (10, 110), is interposed between said first lateral sidewall (12, 112) and said first segment of the perimeter light-exit band (13, 113), and is shaped so as to distribute the light coming from the first lateral sidewall (12, 112) of the light-guide plate (10, 110) substantially along the whole length of said perimeter light-exit band (13, 113).

2. The automotive light according to Claim 1, wherein said light-distributing recess (14, 114) is provided with at least one reflecting lateral wall (14a, 14b, 114a) extending obliquely in front of said first lateral sidewall (12, 112) of the light-guide plate (10, 110), so as to deflect/reflect a part of the light coming from the same first lateral sidewall (12, 112) toward at least a further segment of said perimeter light-exit band (13, 113).

3. The automotive light according to Claim 2, wherein said at least one reflecting lateral wall (14a, 14b, 114a) of the light-distributing recess (14) is substantially perpendicular to the laying plane of the central flat sector of said light-guide plate (10).

4. The automotive light according to Claim 2 or 3, wherein said at least one reflecting lateral wall (14a, 14b, 114a) of the light-distributing recess (14) is substantially straight or has a sawtooth profile.
5. The automotive light according to any one of the preceding claims, wherein the light-distributing recess (14) includes at least one surface groove or a depression substantially polygonal in shape.
6. The automotive light according to any one of the preceding claims, wherein the perimeter light-exit band (13, 113) of said light-guide plate (110) is substantially U- or L- shaped.
7. The automotive light according to Claim 6, wherein the light-guide plate (10, 110) has at least two consecutive sides L-bent toward the front half-shell (3), so as to form, along the perimeter of the first face of the plate, a protruding rib or shoulder (13, 113) that extends cantilevered from the edge of the first face of the plate towards the front half-shell (3); the perimeter light-exit band of the light-guide plate (110) being defined by the top of said protruding rib or shoulder (13, 113).
8. The automotive light according to Claim 7, wherein the light-guide plate (10) has three consecutive sides L-bent toward the front half-shell (3), so as to form, along the perimeter of the first face of the same light-guide plate (10), a substantially U-shaped protruding rib or shoulder (13).
9. The automotive light according to Claim 8, wherein the light-distributing recess (14) is interposed between said first lateral sidewall (12) of the light-guide plate (10) and the central segment of the substantially U-shaped perimeter light-exit band (13), and it is substantially V-shaped.
10. The automotive light according to any one of the preceding claims, wherein the edges of the second face of the light-guide plate (10, 110) that are aligned to the segments of said perimeter light-exit band (13, 113), are bevelled.
11. The automotive light according to Claim 10, wherein said light-guide plate (10, 110) has, on the bevelled edges of its second face, a series of deflector prisms or other reflecting surface structures (16, 116) that are shaped so as to deflect the incident light toward said perimeter light-exit band (13, 113).
12. The automotive light according to any one of the preceding claims, wherein said light-guide plate (10, 110) is provided with four main sides, in pairs substantially parallel to each other.
13. The automotive light according to any one of the preceding claims, wherein the light sources (11) are LEDs.
14. The automotive light according to any one of the preceding claims, wherein said light-distributing recess (14) has a depth substantially constant and/or ranging between 25% and 75% of the local thickness (s) of the light-guide plate (10, 110).
15. The automotive light according to any one of the preceding claims, wherein said lighting assembly (4) comprises: a first light-guide plate (10) having, along the perimeter of the first face of the same first light-guide plate (10), a first, substantially U-shaped, perimeter light-exit band (13); a second light-guide plate (110) having, along the perimeter of the first face of the same second light-guide plate (110), a second, substantially L-shaped, perimeter light-exit band (13); a first set of electrically-powered light sources (11) that are arranged close to a first side of the first light-guide plate (10), so as to light up a facing lateral sidewall (12) of the first light-guide plate (10); a second set of electrically-powered light sources (11) that are arranged close to a first side of the second light-guide plate (110), so as to light up a facing lateral sidewall (112) of the second light-guide plate (110); said first (10) and second (110) light-guide plates being arranged adjacent and substantially coplanar to each other, so that one of the two straight segments of the second perimeter light-exit band (113) is aligned and adjacent to the central straight segment of the first perimeter light-exit band (13), thereby realizing a substantially E-shaped perimeter light-exit band.
16. The automotive light according to any one of the preceding claims, **characterized by** additionally including an opaque shielding mask (6) that is arranged inside the rear body (2) underneath the front half-shell (3), and has a pass-through opening, which is shaped substantially complementary to the perimeter light-exit band (13, 113) of said at least one light-guide plate (10, 110), and is aligned with the same perimeter light-exit band (13, 113).



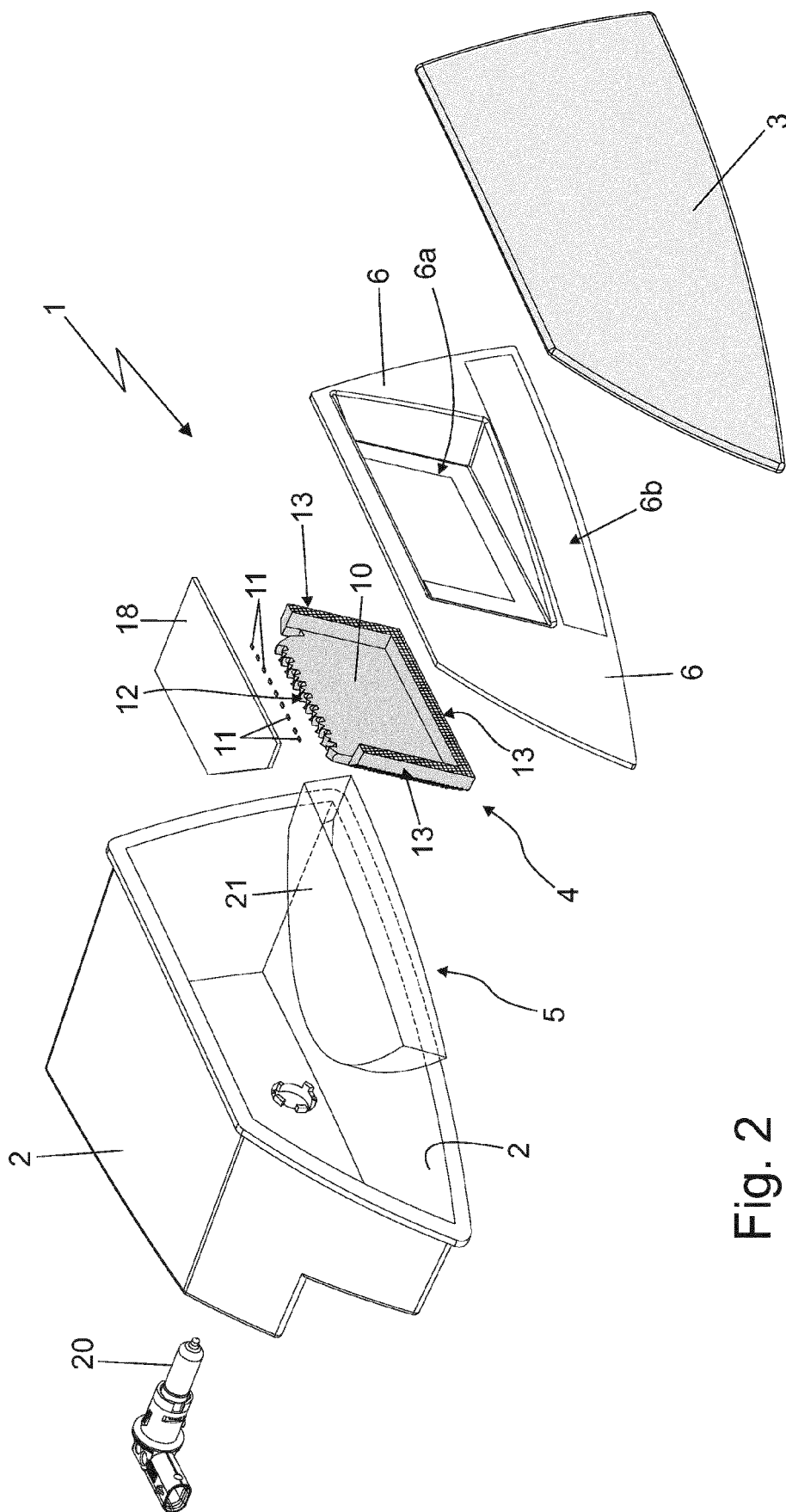


Fig. 2

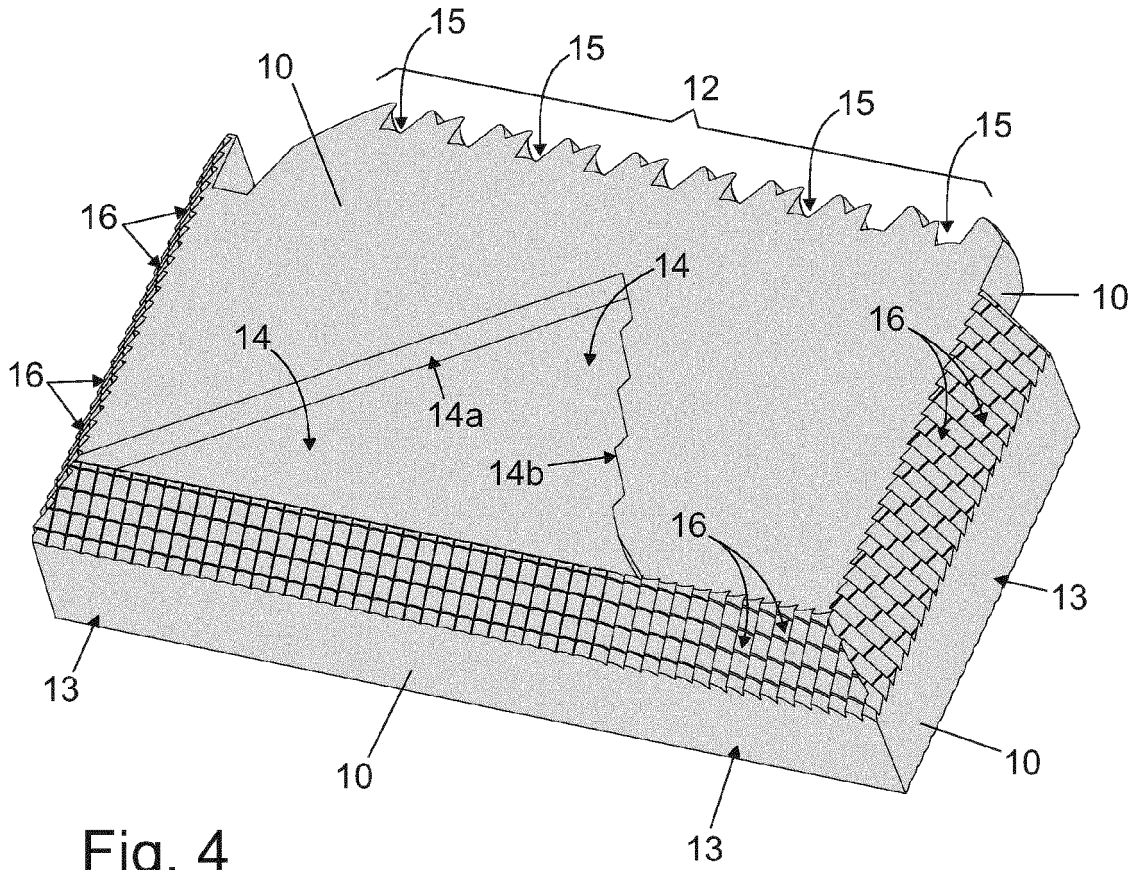


Fig. 4

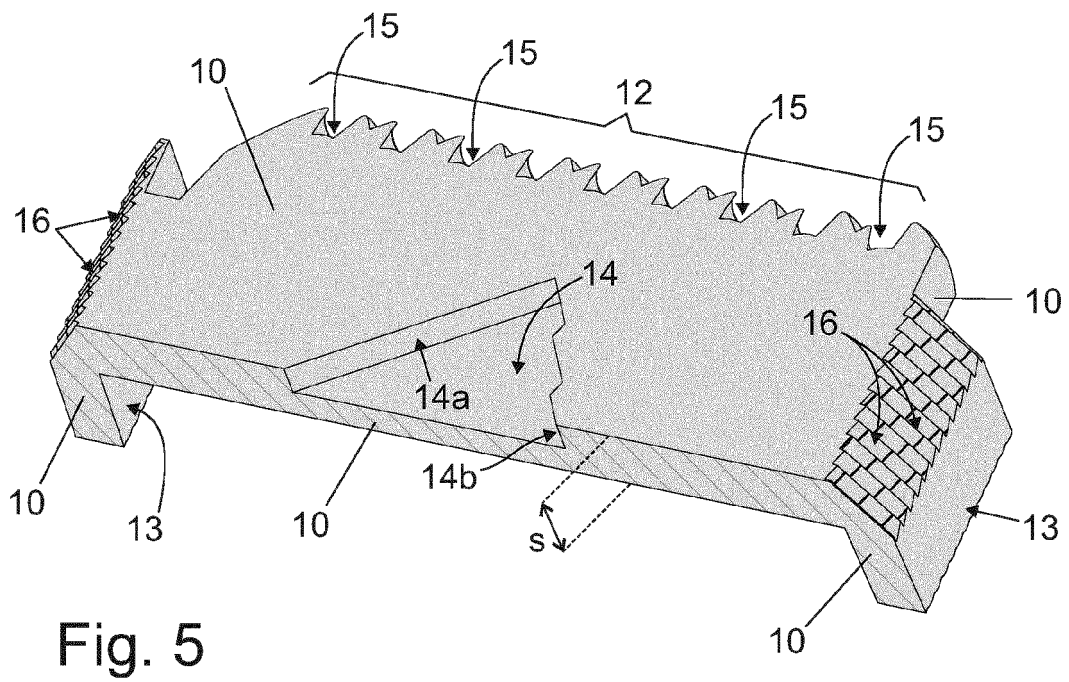


Fig. 5

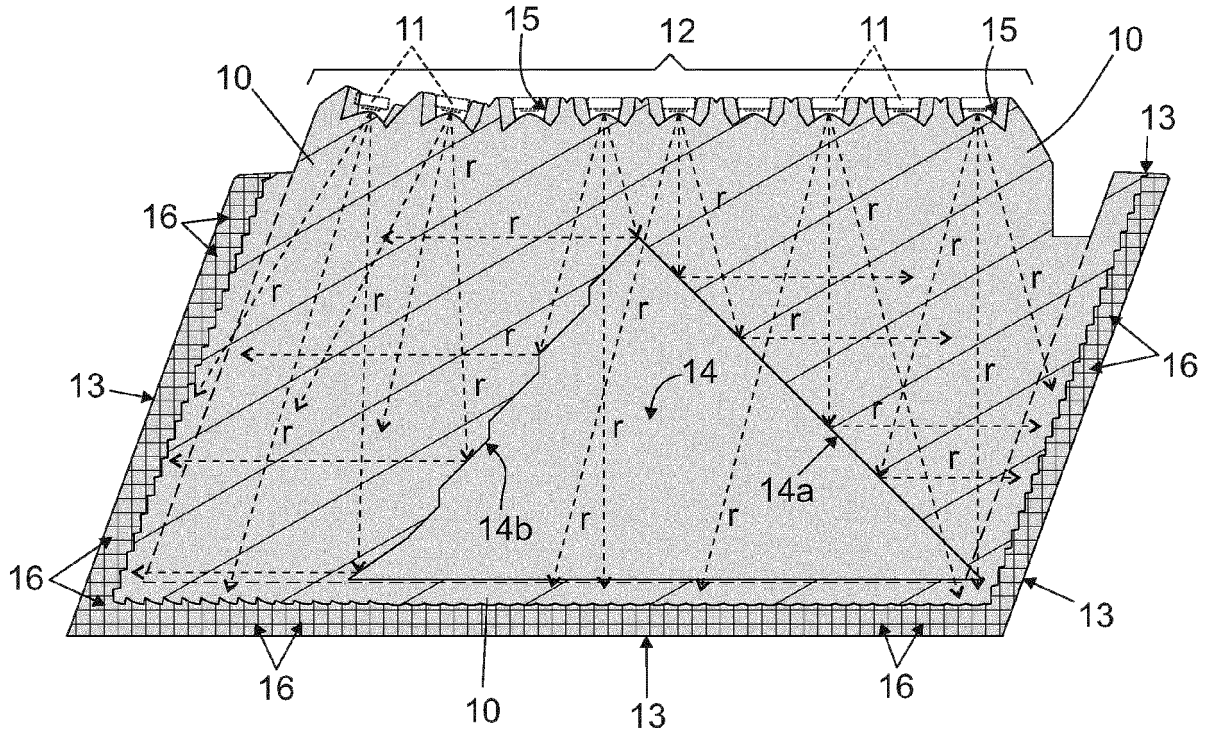


Fig. 6

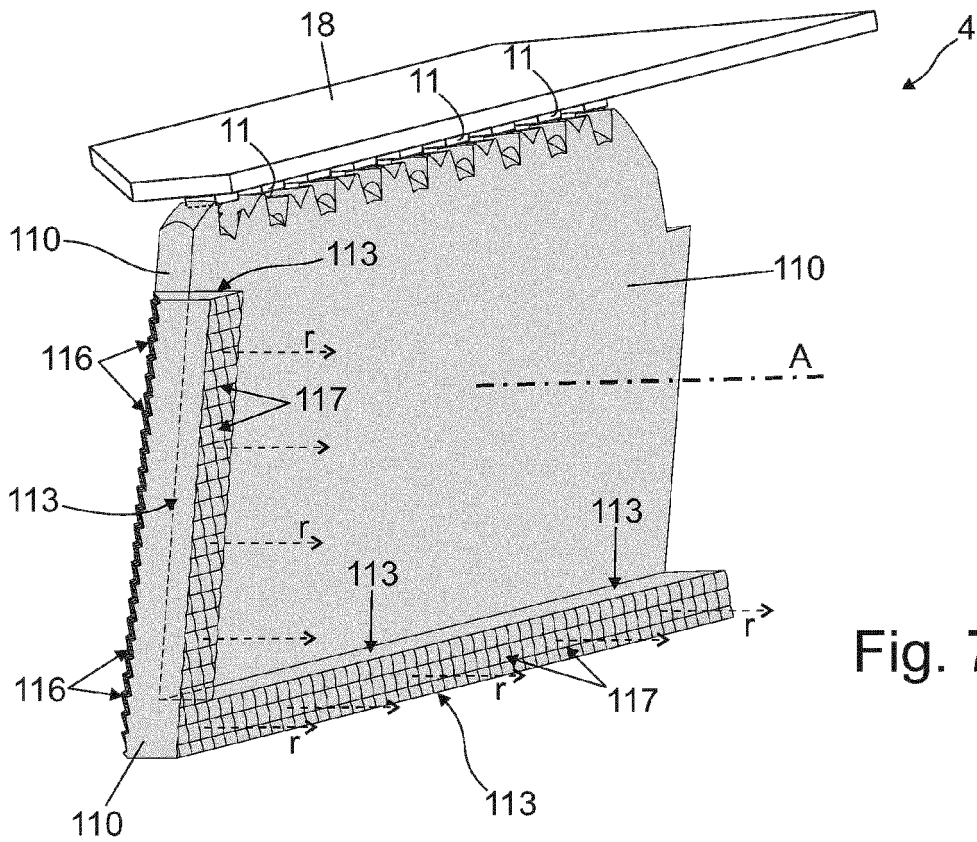


Fig. 7

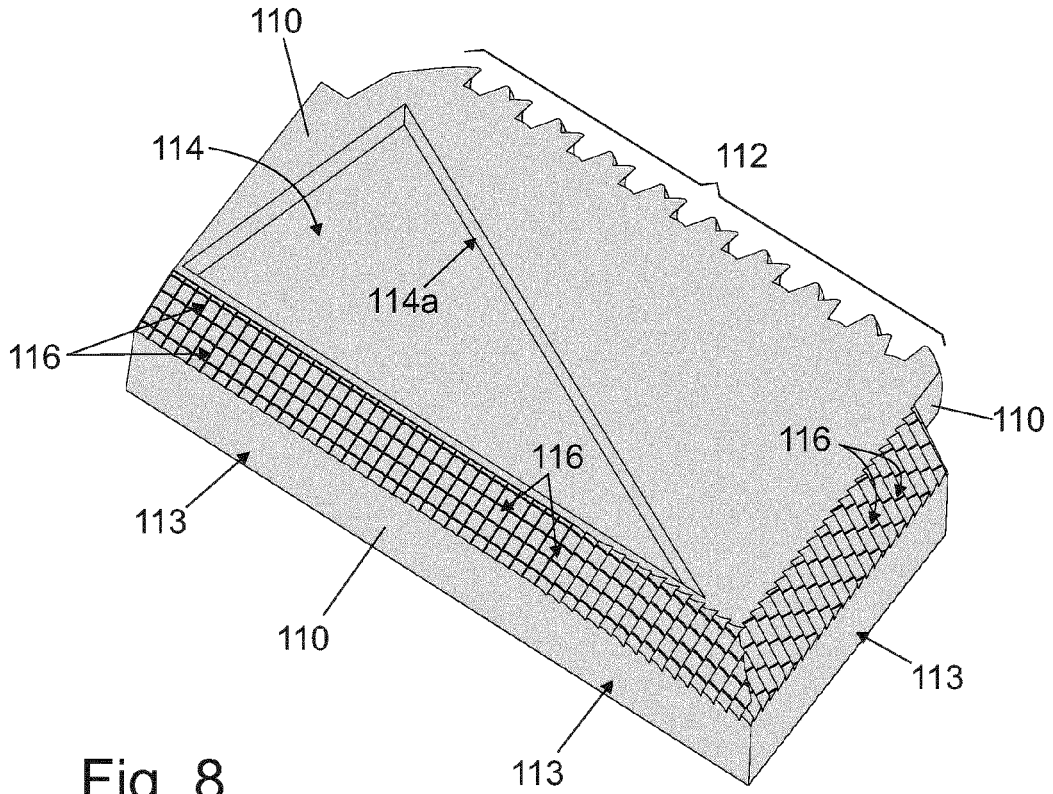


Fig. 8

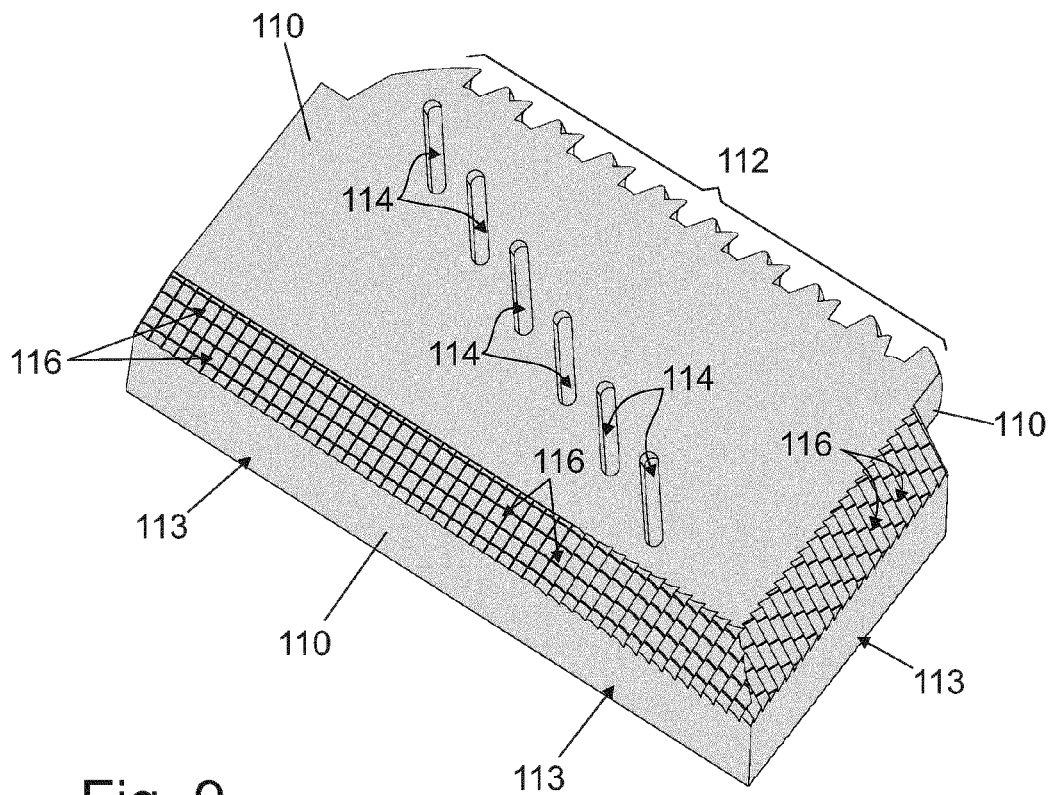


Fig. 9

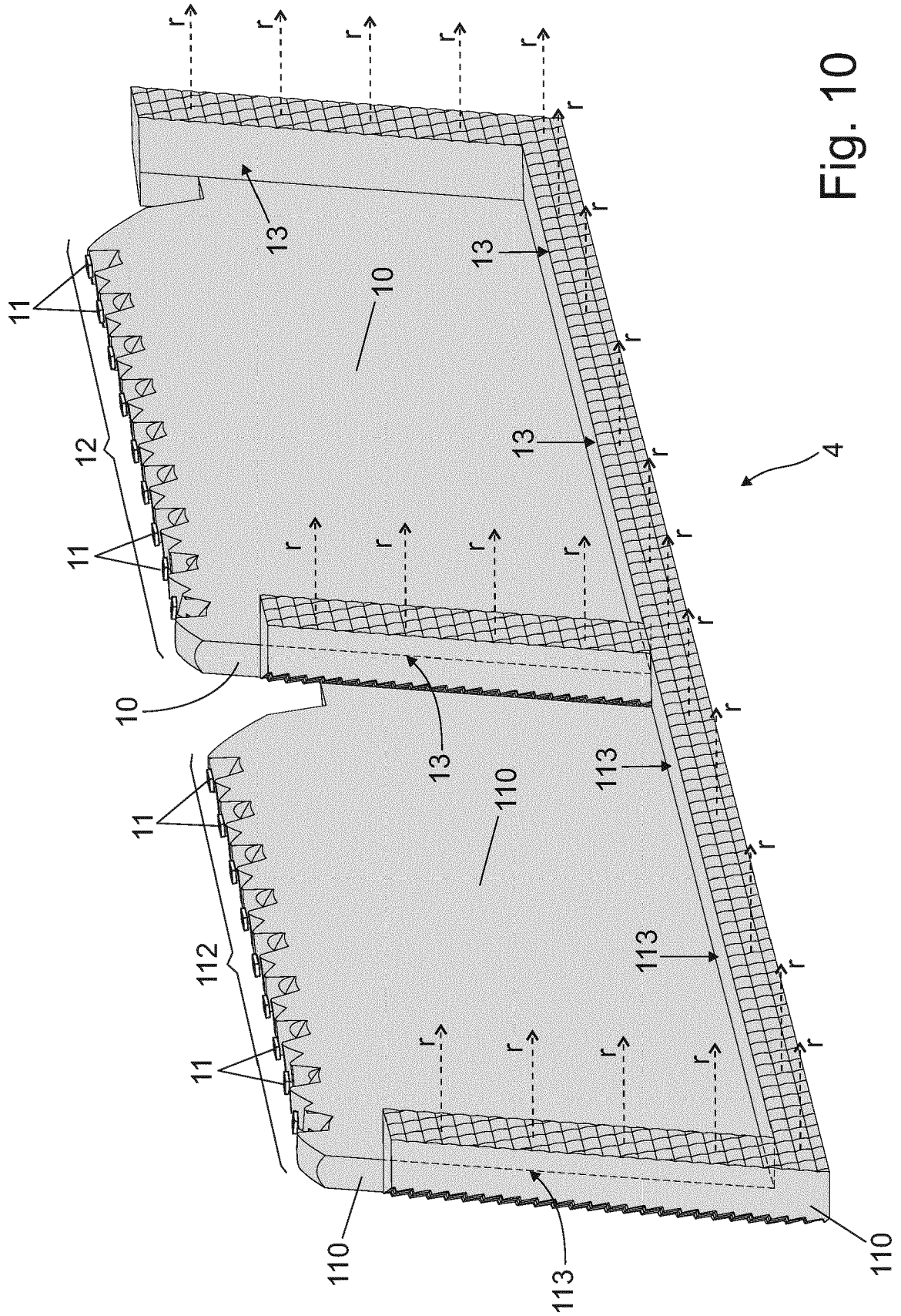


Fig. 10



EUROPEAN SEARCH REPORT

Application Number

EP 21 21 8411

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)
A	WO 2015/011377 A1 (RENAULT [FR]) 29 January 2015 (2015-01-29) * page 6, line 16 - line 26 * * page 6, line 30 - line 37 * * figure *	1-16	INV. F21S43/239 F21S43/241 F21S43/243 F21S43/249
A	US 2014/160779 A1 (PUSCH FRANK [DE] ET AL) 12 June 2014 (2014-06-12) * paragraph [0018] - paragraph [0019] * * paragraph [0022] - paragraph [0029] * * figures 1,2 *	1-16	
A	DE 10 2017 105838 A1 (AUTOMOTIVE LIGHTING REUTLINGEN GMBH [DE]) 20 September 2018 (2018-09-20) * abstract; figures 1,8,12 *	1-16	
A	EP 2 548 769 A1 (AUTOMOTIVE LIGHTING ITALIA SPA [IT]) 23 January 2013 (2013-01-23) * abstract; figures *	1-16	TECHNICAL FIELDS SEARCHED (IPC)
A	US 2019/023176 A1 (ISHIZAKA KAZUYO [JP]) 24 January 2019 (2019-01-24) * figures 1,2,3 * * paragraph [0043] *	1-16	F21S
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 June 2022	Examiner Prévot, Eric
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	

1
EPO FORM 1503 03:82 (P04C01)

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

EP 21 21 8411

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.

14-06-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2015011377 A1	29-01-2015	CN 105531151 A	27-04-2016
		EP 3024696 A1	01-06-2016
		FR 3008774 A1	23-01-2015
		JP 2016527685 A	08-09-2016
		KR 20160039222 A	08-04-2016
		US 2016195230 A1	07-07-2016
		WO 2015011377 A1	29-01-2015

US 2014160779 A1	12-06-2014	CN 203848147 U	24-09-2014
		DE 102012112151 A1	12-06-2014
		US 2014160779 A1	12-06-2014

DE 102017105838 A1	20-09-2018	NONE	

EP 2548769 A1	23-01-2013	EP 2548769 A1	23-01-2013
		ES 2793964 T3	17-11-2020
		PL 2548769 T3	07-09-2020
		US 2014247616 A1	04-09-2014
		WO 2013011468 A1	24-01-2013

US 2019023176 A1	24-01-2019	JP 6975571 B2	01-12-2021
		JP 2019023965 A	14-02-2019
		US 2019023176 A1	24-01-2019
