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(54) **AUTOMOTIVE LIGHT**

(57) Automotive light (1) having a lighting assembly (4) comprising: at least one platelike light-guide body (6) which is made of photoconductive material and is provided with a plurality of light-extracting structures (13) that are distributed on the front (7) or rear (14) face of the same platelike light-guide body (6) and each of which is structured/shaped so as to be able to divert, outside of the platelike light-guide body (6), the collimated light beams (ℓ) travelling inside the platelike light-guide body (6) and reaching/striking said light-extracting structure (13); at least one electronically-controlled active light-deflector device (8) which is arranged facing a lateral sidewall (10, 11) of the platelike light-guide body (6); and at least one electrically-powered collimated-light emitter (9) which is adapted to emit a collimated light beam (ℓ) directly towards/ against the active light-deflector device (8) that, in turn, is adapted to reflect/divert said collimated light beam (ℓ) towards the lateral sidewall (10, 11) of the platelike light-guide body (6), so that said collimated light beam (ℓ) can penetrate into the platelike light-guide body (6) and thus selectively and exclusively reach a single/respective light-extracting structure (13) of the platelike light-guide body (6) .

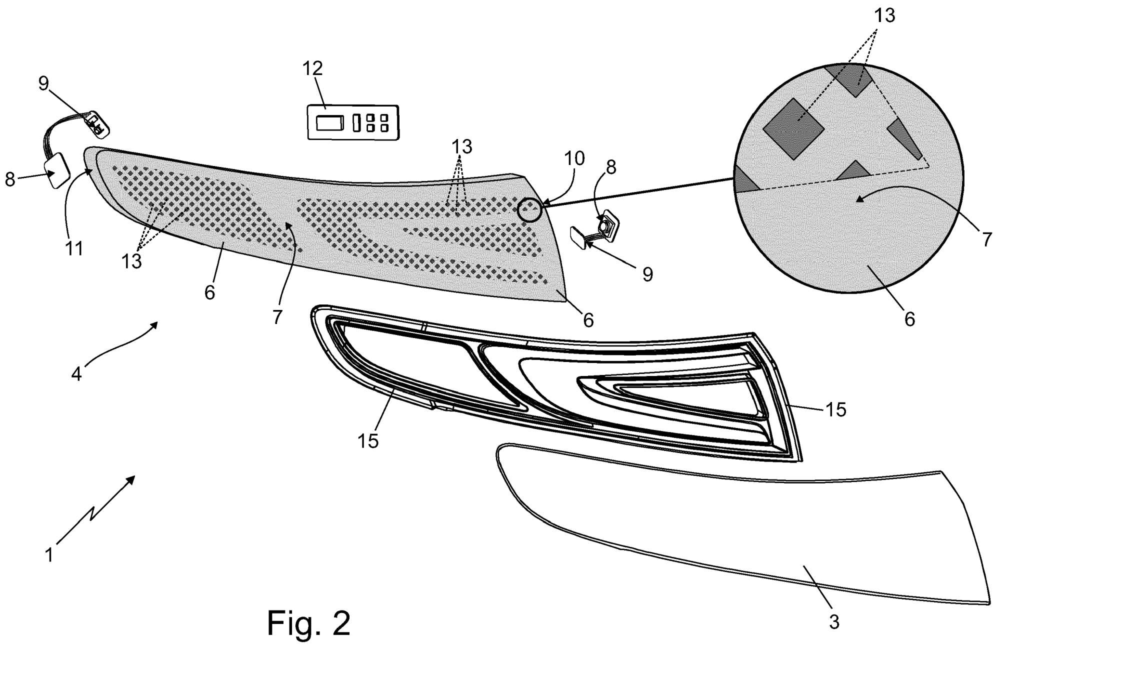

Fig. 2

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Description

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

[0002] More specifically, the present invention preferably relates to a taillight for cars and similar vehicles, i.e. a lighting device suitable for being incorporated in a motor vehicle with the function of signalling the position, sudden deceleration and/or indicating the vehicle direction of turning, and/or with the function of lighting the area around the vehicle. Uses to which the following disclosure specifically refers without however any loss of generality.

[0003] As is known, taillights for cars and similar vehicles generally comprise: a rigid and substantially basin-shaped rear casing which is structured forb being stably recessed in a compartment specially formed in the rear part of the vehicle body; a front half-shell which is arranged to close the mouth of the rear casing so as to surface outside of the vehicle body, and is provided with a plurality of transparent or semi-transparent sectors, generally of different colours from one another; and a series of lighting assemblies which are located inside the casing, each immediately underneath a respective transparent or semi-transparent sector of the front half-shell, so as to be able to selectively back-light the superjacent transparent or semi-transparent sector of the front half-shell.

[0004] Usually each transparent or semi-transparent sector of the front half-shell is moreover exclusively associated with a specific light signal adapted to signal the position of the vehicle, its sudden deceleration or the direction of turning of the vehicle while driving, and each lighting assembly is specifically structured to emit, on command, a light beam which, once it has exited from the light through the corresponding transparent or semi-transparent sector of the half-shell, meets the homologation specifications (colour and light distribution) required for such light signal.

[0005] In recent years, some car manufacturers have chosen to equip their new car models with taillights in which the front half-shell is provided with a plurality of large transparent or semi-transparent sectors.

[0006] In order to substantially evenly back-light the its own transparent or semi-transparent sector, each lighting assembly generally comprises: a light-guide plate which is made of polymethylmethacrylate (PMMA) or other photoconductive material and extends inside the casing with the front face skimming over the transparent or semi-transparent sector to be backlighted, substantially for the whole extension of the same transparent or semi-transparent sector; and a series of high-power LEDs (acronym for Light Emitting Diode) which is/are located inside the rear casing, adjacent to and directly facing at least one lateral side of the light-guide plate, so as to direct the light produced directly inside the body of the light-guide plate.

[0007] The light in question then travels inside the body of the light-guide plate by total internal reflection, and exits from the front face of the light-guide plate directed towards the front half-shell, so as to backlight the superjacent transparent or semi-transparent sector of the half-shell.

[0008] Unfortunately, despite working well, the lighting assemblies described above are not very versatile, and do not allow dynamic back-lighting of the individual transparent or semi-transparent sectors of the front half-shell, or the variation at will of the shape and/or dimensions and/or colour of the backlighted areas.

[0009] Aim of the present invention is to realize an automotive light capable of overcoming the functional limitations described above.

[0010] In compliance with these aims, according to the present invention there is provided an automotive light having at least one lighting assembly that emits light on command and comprises: at least one platelike light-guide body which is made of photoconductive material and is structured to diffuse the light from its front face; at least one electronically-controlled active light-deflector device which faces a lateral sidewall of said platelike light-guide body; and at least one electrically-powered collimated-light emitter which is adapted to emit a collimated light beam directly towards/against said active light-deflector device which, in turn, is adapted to reflect/divert said collimated light beam towards the lateral sidewall of the platelike light-guide body, so that said collimated light beam can penetrate into the platelike light-guide body and then travel inside the same platelike light-guide body by total internal reflection;
the automotive light being characterized in that the platelike light-guide body is provided with a plurality of light-extracting structures that are distributed on the front or rear face of the same platelike light-guide body and each of which is structured/shaped so as to be able to divert, outside the platelike light-guide body through the front face, the collimated light beams travelling inside the platelike light-guide body and reaching/striking the same light-extracting structure; and in that the lighting assembly additionally comprises an electronic control unit which is programmed/configured to command said active light-deflector device so as to direct the collimated light beam coming from said collimated-light emitter selectively towards a single light-extracting structure of the platelike light-guide body at a time.

[0011] The present invention will now be described with reference to the appended drawings, which illustrate a nonlimiting embodiment, wherein:

- Figure 1 is a partially exploded perspective view of an automotive light made according to the teachings of the present invention, with parts removed for clarity;
- Figure 2 is an exploded perspective view of the backlighting system of the automotive light shown in Figure 1, with parts removed for clarity's sake; whereas
- Figure 3 is a cross-section view of a portion of the

Figure-1 automotive light disclosing the operation of the back-lighting system shown in Figures 1 and 2.

[0012] With reference to Figures 1 and 2, reference numeral 1 denotes as a whole an automotive light, i.e. a lighting device particularly adapted to be placed on the front or rear part of the vehicle body of a motor vehicle, with the function of emitting lighting signals suitable to signal the position of the vehicle and/or sudden deceleration of the vehicle and/or direction of turning of the vehicle while driving.

[0013] In other words, the automotive light 1 is adapted to fixed to the front or rear part of the vehicle body of a car, van, truck, motorcycle or other similar motor vehicle, to perform the function of a headlight or taillight.

[0014] 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.

[0015] In other words, the automotive light 1 is a taillight for cars and the like.

[0016] Obviously, in a different embodiment the automotive light 1 could also be structured so as to be simply fixed in cantilever manner to the rear part of the vehicle body (not shown).

[0017] With reference to Figures 1 and 2, the automotive light 1 firstly comprises: a substantially rigid and preferably made of plastic, rear casing 2 which is substantially basin-shaped and is preferably structured for being at least partially recessed inside a specially made seat realized in the rear part of the vehicle body (not shown); and a substantially rigid and preferably made of plastic, front half-shell 3, conventionally known as a lens, which is placed to close the mouth of rear casing 2, preferably so as to be able to surface outside of the vehicle body, and is provided with one or more transparent or semi-transparent sectors.

[0018] Obviously, in a different embodiment the rear casing 2 could also be structured so as to simply fixed in cantilever manner to the rear part of the vehicle body (not shown).

[0019] More specifically, in the example shown the rear casing 2 is preferably made of an opaque plastic material, preferably via an injection moulding process.

[0020] The front half-shell 3, on the other hand, is preferably made of a transparent or semi-transparent plastic material, such as for example polycarbonate, also in this case preferably via an injection moulding process.

[0021] With reference to Figures 1, 2 and 3, in addition the automotive light 1 is moreover provided with at least one electrically powered, lighting assembly 4 that emits light on command, and is located inside the rear casing 2, beneath at least one of the transparent or semi-transparent sectors of front half-shell 3, so as to be able to selectively back-light the superjacent transparent or semi-transparent sector or sectors of front half-shell 3.

[0022] In the example shown, in particular, front half-shell 3 is preferably provided with three different transparent or semi-transparent sectors arranged adjacent and not bordering each other, that are optionally also coloured.

[0023] Lighting assembly 4, in turn, is preferably located inside the rear casing 2, beneath all the three transparent or semi-transparent sectors of front half-shell 3, so as to be able to selectively back-light the same transparent or semi-transparent sectors, separately and independently from one another.

[0024] With reference to Figures 2 and 3, the lighting assembly 4 basically comprises: at least one platelike light-guide body 6 which is made of photoconductive material and is structured so as to diffuse the light from its front face 7; at least one electronically-controlled active light-deflector device 8, which faces a lateral sidewall of platelike light-guide body 6; and a corresponding electrically-powered LASER light emitting device 9 which is adapted to emit a laser beam ℓ (i.e. a coherent and monochromatic, extremely concentrated and collimated beam of light) directly towards/against the active light-deflector device 8 which, in turn, is adapted to reflect/divert said laser beam ℓ towards the lateral sidewall of platelike light-guide body 6, so that said laser beam ℓ can penetrate into the platelike light-guide body 6 and then travel inside the same platelike light-guide body 6 by total internal reflection.

[0025] In more detail, the platelike light-guide body 6 preferably extends inside the rear casing 2 locally substantially skimming the superjacent front half-shell 3, so that its front face 7 faces, substantially skimmed over and, optionally, also parallel to the corresponding transparent or semi-transparent sector or sectors of front half-shell 3, preferably substantially for the whole extension of the same transparent or semi-transparent sector or sectors of the front half-shell 3.

[0026] The active light-deflector device 8, on the other hand, is preferably arranged inside the rear casing 2 substantially facing the lateral sidewall of the platelike light-guide body 6, whereas the LASER light emitting device 9 is preferably arranged inside the rear casing 2, preferably underneath the platelike light-guide body 6.

[0027] In the example shown, in particular, the lighting assembly 4 is preferably provided with two different active light-deflector devices 8 which are preferably arranged on opposite sides of the platelike light-guide body 6, each facing a respective lateral sidewall 10, 11 of the platelike light-guide body 6; and with two different LASER light emitting devices 9, which are placed inside the rear casing 2, preferably close to the bottom of rear casing 2, and each of which is capable of emitting and directing a laser beam ℓ directly towards/against a respective active light-deflector 8.

[0028] The active light-deflector device 8 that faces the lateral sidewall 10 of the platelike light-guide body 6 is thus adapted to reflect/divert the laser beam ℓ coming from the first LASER light emitting device 9 towards the lateral sidewall 10, so that said laser beam ℓ can penetrate inside the platelike light-guide body 6 and then freely travel inside the same platelike light-guide body 6 by total internal reflection.

[0029] Similarly, the active light-deflector device 8 that faces the lateral sidewall 11 of platelike light-guide body 6 is adapted to reflect/divert the laser beam ℓ coming from the second LASER light emitting device 9 towards the lateral sidewall 11, so that said laser beam ℓ can penetrate inside the platelike light-guide body 6 and then freely travel inside the same platelike light-guide body 6 by total internal reflection.

[0030] With reference to Figures 2 and 3, the lighting assembly 4 furthermore comprises an electronic control unit 12 which is located inside the rear casing 2, preferably close to the bottom of rear casing 2, and is adapted to drive/command the active light-deflector device(s) 8 and preferably also the LASER light emitting device(s) 9.

[0031] In more detail, the platelike light-guide body 6 has a plurality of small light-extracting structures 13, which are distributed on the rear face 14 of light-guide body 6 one beside the other, preferably spaced apart to one another, and each of which is specifically structured/shaped to divert the light beams, or rather the laser beam(s) ℓ, travelling inside the platelike light-guide body 6 and reaching/ striking the same light-extracting structure 13, towards the front face 7 of platelike light-guide body 6, with an angle of incidence such that said light beams exit from an facing and corresponding limited area of the front face 7, towards the superjacent front half-shell 3.

[0032] In other words, the light beams, or rather the laser beam(s) ℓ, that strike each light-extracting structure 13 are directed towards the front face 7 of light-guide body 6, so as to exit from a corresponding and facing light-output area of front face 7, of small dimensions.

[0033] In the example shown, in particular, the light-extracting structures 13 are preferably distributed on the rear face 14 of platelike light-guide body 6 according to a predetermined regular pattern, and/or are preferably grouped /aligned beneath the various transparent or semi-transparent sectors of front half-shell 3.

[0034] Preferably each light-extracting structure 13 additionally takes up an area of rear face 14 having an extension of less than 100 mm^2 (square millimetres).

[0035] The electronic control unit 12, in turn, is programmed/ configured so as to direct the laser beam ℓ coming from the LASER light emitting device 9, selectively towards a single light-extracting structure 13 of rear face 14, so that the light comes out only from the small light-output area of the front face 7 of light-guide body 6 that is associated/ corresponds to the same light-extracting structure 13.

[0036] More specifically, with particular reference to Figure 3, the electronic control unit 12 has stored inside itself a series of distinct and different predetermined directions of reflection $d_1, d_2, d_3... d_n$, each of which forces the laser beam ℓ to reach/strike a single and respective light-extracting structure 13 of rear face 14; and is adapted to command the active light-deflector device 8 in such a way that the latter reflects the laser beam ℓ coming from the LASER light emitting device 9, towards the lateral sidewall 10, 11 of platelike light-guide body 6 selectively and solely in any of the aforementioned predetermined directions of reflection $d_1, d_2, d_3... d_n$.

[0037] In other words, each predetermined direction of reflection $d_1, d_2, d_3... d_n$ is calculated as a function of the position of the active light-deflector device 8 relative to the platelike light-guide body 6, and of the position of the light-extracting structure 13 on the rear face 14 of the platelike light-guide body 6, and carries/forces the laser beam ℓ arriving from the active light-deflector device 8 to penetrate into the platelike light-guide body 6 at a predetermined point of the lateral sidewall 10, 11, and then to travel inside the platelike light-guide body 6 up to reach/strike substantially only a corresponding light-extracting structure 13 of rear face 14. With reference to Figure 3, clearly the path inside the platelike light-guide body 6 may include one or more rebounds/deviations by total internal reflection.

[0038] The electronic control unit 12, in turn, is adapted to pilot the active light-deflector device 8 so that the latter reflects the laser beam ℓ towards the lateral sidewall 10, 11 of the light-guide body 6, selectively and solely in any one of the predetermined directions of reflection $d_1, d_2, d_3... d_n$ stored, so as to make the light exit from the front face 7 of platelike light-guide body 6 selectively and solely at a single and specific light-extracting structure 13.

[0039] Preferably the electronic control unit 12 is moreover programmed/configured to switch off/deactivate the LASER light emitting device 9 during each change/variation of the predetermined direction of reflection $d_1, d_2, d_3... d_n$.

[0040] Lastly, the electronic control unit 12 is preferably programmed/configured so as to switch from one light-extracting structure 13 to another with a given speed/ frequency higher than that perceptible by the human eye (e.g. with a frequency greater than 50hz), so as to simulate the simultaneous output of light from a plurality of limited areas of front face 7, all aligned with respective light-extracting structures 13 of the rear face 14 of platelike light-guide body 6.

[0041] In other words, the electronic control unit 12 is adapted to command the active light-deflector device 8 so as to change the predetermined direction of reflection $d_1, d_2, d_3... d_n$ with a given frequency/speed higher than that perceptible by the human eye (for example at a frequency equal to 100hz).

[0042] In the example shown, in particular, the electronic control unit 12 is preferably programmed/configured to control/command both active light-deflector devices 8, and optionally also the respective LASER light emitting devices 9.

[0043] Preferably, the electronic control unit 12 is moreover adapted to control/command the two active light-deflector devices 8 independently of each other, so that each laser beam ℓ strikes a different light-extracting structure 13 of rear face 14.

[0044] In more detail, in the example shown, the electronic control unit 12 preferably has/carries stored inside itself two different and distinct series of predetermined directions of reflection d_1, d_2, d_3... d_n, each of which is uniquely associated with a respective active light-deflector device 8.

[0045] In other words, the first series of predetermined directions of reflection d_1, d_2, d_3... d_n is uniquely associated with the active light-deflector device 8 facing the lateral sidewall 10 of light-guide body 6, whereas the second series of predetermined directions of reflection d_1, d_2, d_3... d_n is uniquely associated with the active light-deflector device 8 facing the lateral sidewall 11 of light-guide body 6.

[0046] Preferably, each series of predetermined directions of reflection d_1, d_2, d_3... d_n furthermore includes a number of predetermined directions of reflection d_1, d_2, d_3... d_n lower than the total number of light-extracting structures 13 on the rear face 14 of platelike light-guide body 6.

[0047] In other words, each active light-deflector device 8 is preferably capable to direct its laser beam ℓ only towards a limited part/number of the light-extracting structures 13 on rear face 14.

[0048] Preferably, though not necessarily, this limited part/ number of light-extracting structures 13 furthermore includes only light-extracting structures 13 located underneath a same transparent or semi-transparent sector of front half-shell 3.

[0049] With reference to figures 1, 2 and 3, in the example shown, in particular, the platelike light-guide body 6 preferably has a substantially constant thickness, and/or preferably ranging between 7 and 40 mm (millimetres).

[0050] Preferably the platelike light-guide body 6 is furthermore made of polymethylmethacrylate (PMMA) or other photoconductive polymeric material, such as for example the transparent polycarbonate, preferably via an injection moulding process.

[0051] Alternatively, the platelike light-guide body 6 could also be made of glass.

[0052] Preferably, the light-extracting structures 13 of platelike light-guide body 6, on the other hand, take up each an area of the rear face 14 having an extension of less than 25 mm^2 (square millimetres).

[0053] In the example shown, in particular, each of the light-extracting structures 13 preferably takes up an area of the rear face 14 having an extension of less than 10 mm^2 (square millimetres).

[0054] In more detail, the light-extracting structures 13 of platelike light-guide body 6 preferably consist of small surface recesses, preferably substantially prismatic, conical or lenticular in shape, that are suitably distributed on the rear face 14 of platelike light-guide body 6.

[0055] In other words, in the example shown, the platelike light-guide body 6 is preferably provided with a series of small surface recesses 13, preferably substantially prismatic, conical or lenticular in shape, which are suitably distributed on the rear face 14 of platelike light-guide body 6.

[0056] Each recess 13 is specifically shaped so as to divert, outside of platelike light-guide body 6 and towards the superjacent front half-shell 3, the light beams, or rather the laser beams ℓ, travelling inside the platelike light-guide body 6 and reaching the same surface recess 13.

[0057] Preferably each recess 13 is furthermore shaped so as to be able to divert the light beams, or rather the laser beams ℓ, travelling inside the platelike light-guide body 6 and reaching the same surface recess 13, outside of the platelike light-guide body 6, in a direction locally substantially perpendicular to the surface of front face 7.

[0058] In addition, each recess 13 is preferably enclosed within an area having an extension of less than 10 mm^2 (square millimetres).

[0059] In other words, each recess on rear face 14 forms a respective light-extracting structure 13.

[0060] In the example shown, lastly, the surface recesses 13 are preferably distributed on the rear face 14 of platelike light-guide body 6 according to a predetermined regular pattern, and are preferably grouped beneath the various transparent or semi-transparent sectors of front half-shell 3.

[0061] Obviously, in a different embodiment, each light-extracting structure 13 could include a plurality of recesses preferably adjacent to each other.

[0062] The/each active light-deflector device 8, on the other hand, preferably consists of, or in any case includes at least one MOEMS (acronym of Micro-Opto-Electro-Mechanical System) or OPTICAL-MEMS device of the known type.

[0063] Preferably, the aforesaid MOEMS device is furthermore a DMD (acronym for Digital Micromirror Device), i.e. a miniaturized integrated circuit with thousands of adjustable micromirrors, or a scanning micro-mirror with integrated electronically-controlled movement system. DMDs and scanning micromirrors with integrated electronically-controlled movement systems are devices easily available on the market, and therefore will not be further described.

[0064] The electronic control unit 12 is thus adapted to control/command the or each MOEMS device 8 in such a way as to divert, on command, the laser beam ℓ arriving from the corresponding LASER light emitting device 9, towards the facing lateral sidewall 10, 11 of platelike light-guide body 6, selectively and alternately in any of the corresponding predetermined directions of reflection d_1, d_2, d_3... d_n.

[0065] The LASER light emitting device 9, in turn, is preferably a LASER RGB emitter of known type, which is capable of emitting a laser beam ℓ with colour and optionally also intensity variable on command.

[0066] In more detail, in the example shown the LASER light emitting device 9 preferably comprises a plurality of monochromatic laser sources, which are capable of emitting laser light with wavelengths (colours) different from each other, and are optically coupled so as to provide at output a single laser beam ℓ with colour and, optionally, also intensity variable on command.

[0067] In fact, by combining laser beams with different wavelengths, it is possible to create a mix of colours or a white light.

[0068] With reference to Figures 1, 2 and 3, preferably the lighting assembly 4 lastly also comprises an opaque spacer mask 15 preferably with a platelike structure, which is interposed between the platelike light-guide body 6 and the front half-shell 3, and is provided with one or more through openings each of which is aligned with a respective transparent or semi-transparent sector of front half-shell 3, and preferably also substantially copies the shape of the immediately superjacent, transparent or semi-transparent sector.

[0069] The spacer mask 15 is preferably adapted to conceal from view the active light-deflector device(s) 8 and optionally also other components of the lighting assembly 4 and/or of the automotive light 1.

[0070] Preferably, the spacer mask 15 is furthermore adapted to directly support the platelike light-guide body 6 and/or the active light-deflector device(s) 8 of lighting assembly 4 .

[0071] In the example shown, in particular, the spacer mask 15 is preferably made of opaque plastic material and is preferably structured so as to fit/couple with the mouth of rear casing 2, underneath the front half-shell 3.

[0072] General operation of the automotive light 1 is easily inferable from the above.

[0073] With regard instead to the operation of lighting assembly 4, the electronic control unit 12 uses the individual light-extracting structures 13 present on the rear face 14 of light-guide body 6 to create, on front face 7, luminous macropixels (the small light-output areas) which are "switched on" on command to create/compose, on front face 7, luminous areas that have shape and/or dimensions and/or colours that vary dynamically as desired.

[0074] In more detail, following an appropriate sequence of selective lighting of the individual light-extracting structures 13 on the rear face 14 of light-guide body 6 and switching from one light-extracting structure 13 to another at a frequency/speed higher than that perceptible by the human eye, the electronic control unit 12 is capable of creating/simulating/composing, on front face 7 of platelike light-guide body 6, one or more light areas that have shapes and/or dimensions and/or colours that vary dynamically as desired, and that are capable of back-lighting all or part of the superjacent transparent or semi-transparent sector of front half-shell 3.

[0075] In addition, the lighting assembly 4, or rather the electronic control unit 12, could turn on the light-output areas so as to compose, on front face 7, written text and/or luminous logos.

[0076] The advantages associated with the particular structure of the lighting assembly 4 are remarkable.

[0077] Firstly, the lighting assembly 4 is capable of independently back-lighting the individual transparent or semi-transparent sectors of front half-shell 3, while also creating luminous areas that move inside the transparent or semi-transparent sector of front half-shell 3, and/or dynamically vary the shape and/or colour as desired.

[0078] In addition, by selectively lighting some areas of the front face 7, the lighting assembly 4 is capable of creating, on command, written texts and/or luminous logos on the single transparent or semi-transparent sectors of the front half-shell 3.

[0079] Lastly, the lighting assembly 4 has significantly smaller dimensions than those of the lighting assemblies currently used to perform the same functions, and thus allows a reduction in the overall depth of the automotive light 1.

[0080] It is finally clear that modifications and varits may be made to the automotive light 1 and to the lighting assembly 4 described above without departing from the scope of the present invention.

[0081] For example, instead of being fixed or recessed into the vehicle body, the automotive light 1 could be integrated into the structure of rear windscreen of the vehicle.

[0082] In other words, the front half-shell 3 could be replaced by a part of the rear windscreen of the car or similar vehicle.

[0083] In an alternative embodiment, in addition, the active light-deflector devices 8 could also be more than two in number, each paired with a respective LASER light emitting device 9.

[0084] In a constructional variation, in addition, electronic control unit 12 could be fixed to the rear casing 2, outside of the latter.

[0085] In a second constructional variation, moreover, the light-extracting structures 13 could be distributed on the front face 7 of the light-guide body 6.

[0086] Furthermore, the light-extracting structures 13 could alternatively consist of small surface protrusions, preferably of a substantially prismatic, conical or lenticular shape, obviously distributed on the front 7 or rear face 14 of platelike light-guide body 6.

[0087] In a more sophisticated embodiment, moreover, the active light-deflector device 8, or one of the active light-deflector devices 8, could be combined with two or more LASER light emitting devices 9.

[0088] In other words, the lighting assembly 4 may be provided with two or more electrically-powered LASER light emitting devices 9, which are arranged inside the rear casing 2, preferably side by side to one another, and are adapted to emit and direct their laser beam ℓ towards/against the same active light-deflector device 8 which, in turn, is adapted to reflect/divert such laser beams ℓ towards the lateral sidewall of the platelike light-guide body 6.

[0089] The various LASER light emitting devices 9 operate alternately under the control of the electronic control unit 12, and are preferably adapted to generate respective laser beams ℓ of different colours.

[0090] In this case, the electronic control unit 12 has stored inside itself a plurality of series of predetermined directions of reflection d_1, d_2, d_3... d_n towards the light-extracting structures 13 on the front 7 or rear 14 face of light-guide body 6, each of which is uniquely associated with a respective LASER light emitting device 9.

[0091] In a further alternative embodiment, moreover, one or more of the LASER light emitting devices 9 of lighting assembly 4 may be replaced by electrically-powered LED collimated light-emitting devices. The or each LED collimated light-emitting device is placed inside the rear casing 2, preferably beneath the platelike light-guide body 6, and is able to emit and direct a collimated light beam (i.e. a series of light rays collimated in a same direction) directly towards/against the active light-deflector device 8 which, in turn, is able to divert/reflect said collimated light beam towards the lateral sidewall of the platelike light-guide body 6, selectively and alternatively in any one of the aforementioned predetermined directions of reflection d_1, d_2, d_3... d_n.

Claims

1. A automotive light (1) provided with at least one lighting assembly (4) that emits light on command and comprises: at least one platelike light-guide body (6) which is made of photoconductive material and is structured to diffuse the light from its front face (7); at least one electronically-controlled active light-deflector device (8) which faces a lateral sidewall (10, 11) of said platelike light-guide body (6); and at least one electrically-powered collimated-light emitter (9) which is adapted to emit a collimated light beam (ℓ) directly towards/against said active light-deflector device (8) which, in turn, is adapted to reflect/divert said collimated light beam (ℓ) towards the lateral sidewall (10, 11) of the platelike light-guide body (6), so that said collimated light beam (ℓ) can penetrate into the platelike light-guide body (6) and then travel inside the same platelike light-guide body (6) by total internal reflection;
the automotive light (1) being **characterized in that** the platelike light-guide body (6) is provided with a plurality of light-extracting structures (13) that are distributed on the front (7) or rear (14) face of the same platelike light-guide body (6) and each of which is structured/shaped so as to be able to divert, outside the platelike light-guide body (6) through the front face (7), the collimated light beams (ℓ) travelling inside the platelike light-guide body (6) and reaching/striking the same light-extracting structure (13); **and in that** the lighting assembly (4) additionally comprises an electronic control unit (12) which is programmed/configured to command said active light-deflector device (8) so as to direct the collimated light beam (ℓ) coming from said collimated-light emitter (9) selectively towards a single light-extracting structure (13) of the platelike light-guide body (6).

2. Automotive light according to Claim 1, wherein said electronic control unit (12) has stored inside itself at least a series of predetermined directions of reflection (di, d_2, d_3... d_n) distinct and different from one another, each of which forces the collimated light beam (ℓ) to reach/ strike a single and respective light-extracting structure (13) of the platelike light-guide body (6).

3. Automotive light according to Claim 1 or 2, wherein the electronic control unit (12) commands also said collimated-light emitter (9).

4. Automotive light according to Claim 3, wherein the electronic control unit (12) is programmed/configured to switch off/deactivate said collimated-light emitter (9) during each change of said predetermined direction of reflection (d_1, d_2, d_3... d_n).

5. Automotive light according to any one of the preceding claims, wherein the electronic control unit (12) is programmed/configured to switch from one light-extracting structure (13) to another with a predetermined speed/ frequency higher than that perceptible by the human eye.

6. Automotive light according to any one of the preceding claims, wherein the lighting assembly (4) comprises a plurality of active light-deflector devices (8), each paired with a respective collimated-light emitter (9).

7. Automotive light according to any one of the preceding claims, wherein the or each active light-deflector device (8) comprises a MOEMS or OPTICAL-MEMS device.

8. Automotive light according to claim 7, wherein said MOEMS device is a DMD (Digital Micromirror Device), or a scanning micro-mirror with an integrated electronically-controlled movement system.

9. Automotive light according to any one of the preceding claims, wherein said collimated-light emitter (9) is a LASER light emitting device or a LED collimated-light emitting device.

10. Automotive light according to any one of the preceding claims, wherein the light-extracting structures (13) of the platelike light-guide body (6) are distributed on the front (7) or rear (14) face of the platelike light-guide body (6) according to a predetermined regular pattern.

11. Automotive light according to any one of the preceding claims, wherein the light-extracting structures

(13) of the platelike light-guide body (6) are recesses made on the front (7) or rear (14) face of the platelike light-guide body (6).

12. Automotive light according to Claim 12, wherein said recesses are substantially prismatic, conical or lenticular in shape.

13. Automotive light according to any one of the preceding claims, wherein each light-extracting structure (13) takes up an area of the front (7) or rear (14) face of the platelike light-guide body (6) having an extension of less than 100 mm^2.

14. Automotive light according to any one of the preceding claims, wherein the light additionally comprises a substantially basin-shaped, rear casing (2) and a front half-shell (3) which is placed to close the mouth of the rear casing (2); said lighting assembly (4) being located inside the rear casing (2) so as to selectively back-light one or more transparent or semi-transparent sectors of said front half-shell (3).

15. Automotive light according to Claim 14, wherein said platelike light-guide body (6) extends inside the rear casing (2) with the front face (7) facing and substantially skimmed over one or more of the transparent or semi-transparent sectors of the front half-shell (3); and wherein said active light-deflector device (8) and said collimated-light emitter (9) are located inside the rear casing (2).

16. Automotive light according to Claim 15, wherein the light-extracting structures (13) of the platelike light-guide body (6) are grouped beneath said one or more transparent or semi-transparent sectors of the front half-shell (3).

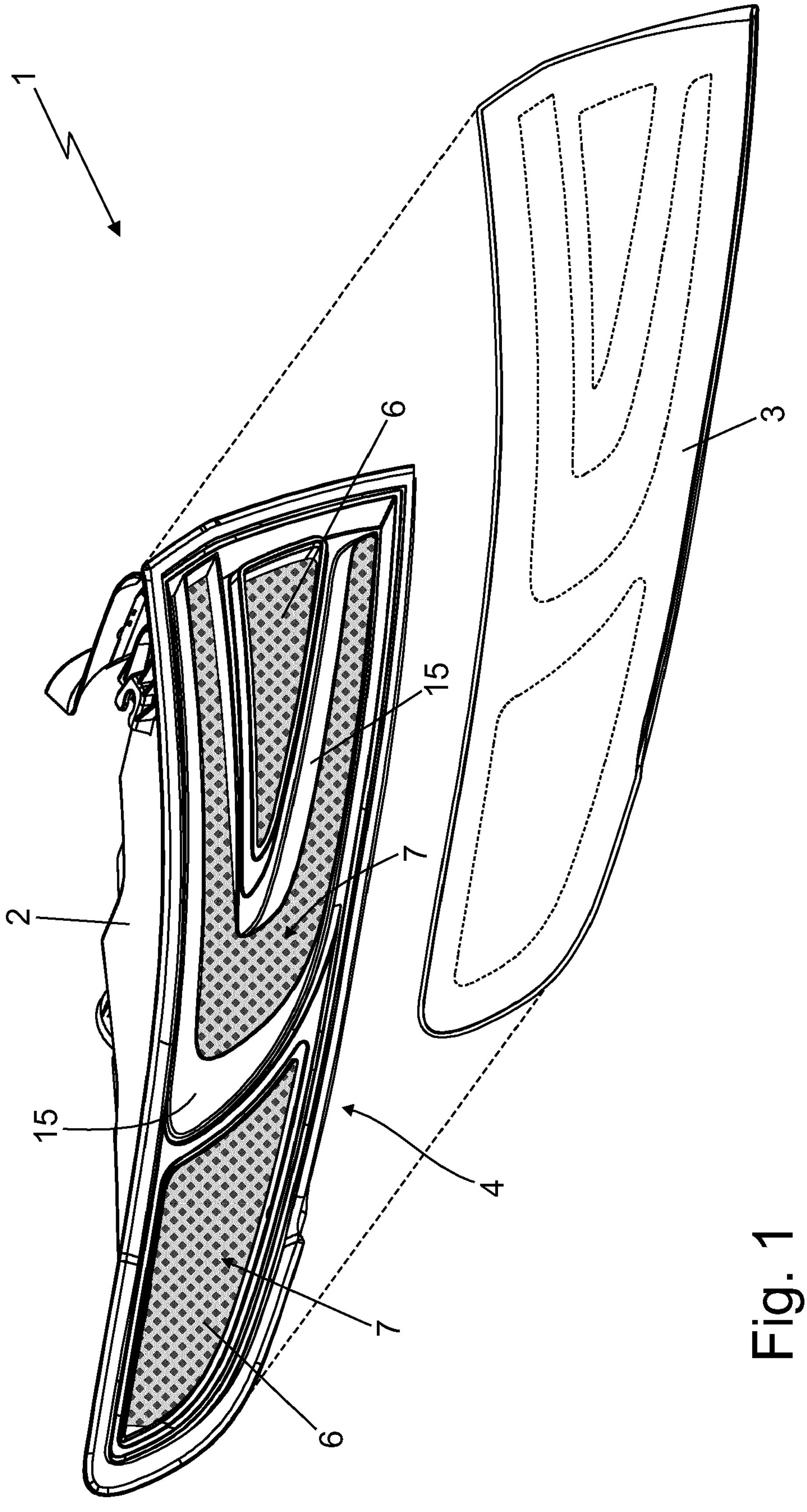


Fig. 1

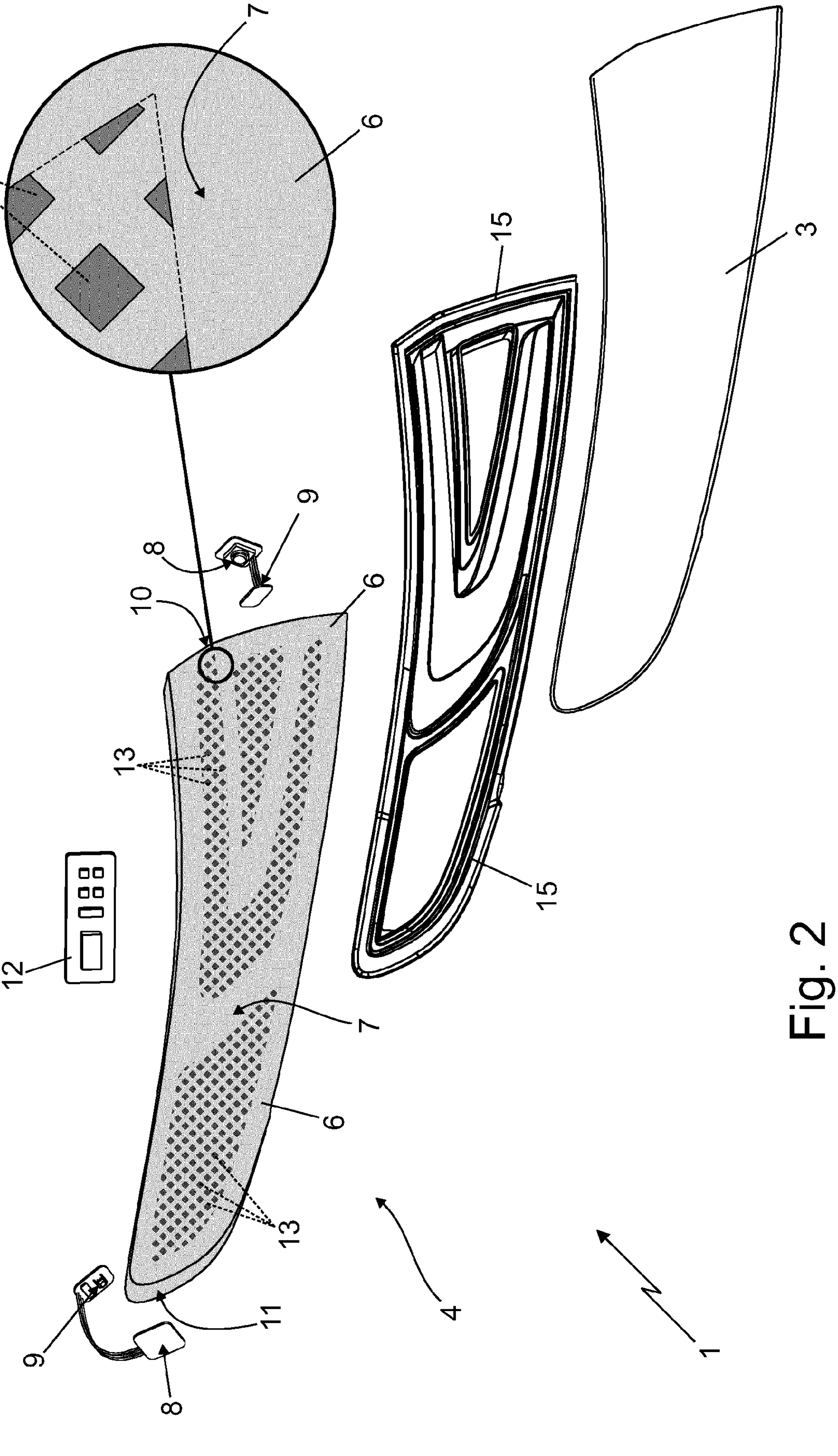
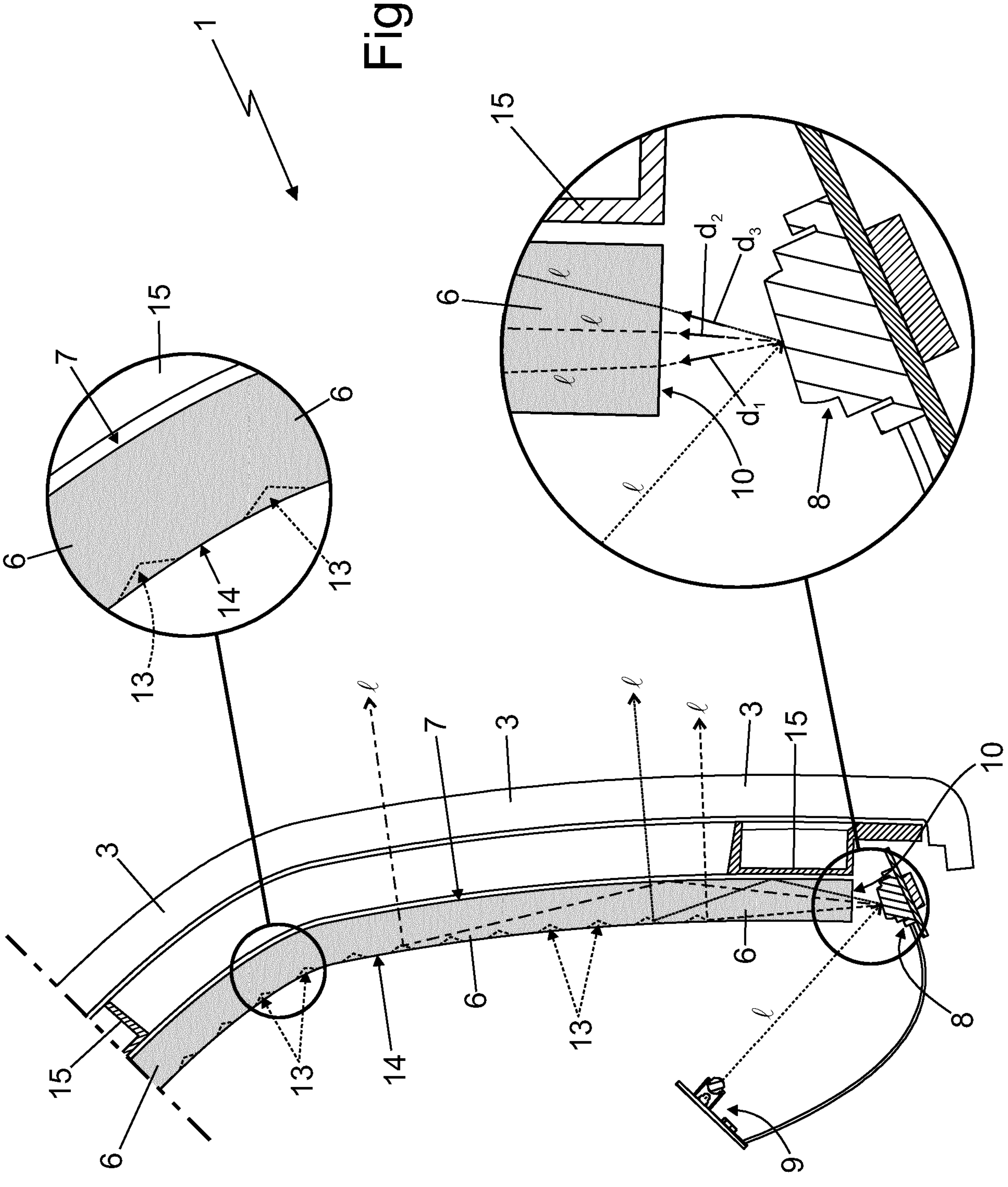


Fig. 2

Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 19 15 5099

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2018/245763 A1 (OSHIMA RITSUYA [JP] ET AL) 30 August 2018 (2018-08-30) * paragraphs [0024], [0030], [0057], [0061], [0064], [0180], [0275]; figures 6,9,10 *	1-16	INV. F21S43/10 F21S43/239 F21S43/245 F21S43/249 F21S43/20 F21S43/31 F21S43/40 F21S43/50 F21W103/20 F21W103/35 F21W103/10 F21Y115/30
X	WO 2013/051296 A1 (HARISON TOSHIBA LIGHTING CORP [JP]; KINOSHITA JUNICHI [JP] ET AL.) 11 April 2013 (2013-04-11) * paragraphs [0042], [0043], [0048]; figure 9a *	1-4, 7-10, 14-16	
A	US 5 506 929 A (TAI PING-KAUNG [US] ET AL) 9 April 1996 (1996-04-09) * figures 8D,9 *	1-16	
A	FR 3 000 569 A1 (PEUGEOT CITROEN AUTOMOBILES SA [FR]) 4 July 2014 (2014-07-04) * the whole document *	1-16	
A	JP 2014 017060 A (KOITO MFG CO LTD) 30 January 2014 (2014-01-30) * the whole document *	1-16	TECHNICAL FIELDS SEARCHED (IPC) F21S F21W F21V F21Y

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	3 July 2019	Guénon, Sylvain

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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
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03-07-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2018245763 A1	30-08-2018	CN 107923593 A	17-04-2018
		DE 112016003811 T5	24-05-2018
		JP 6400216 B2	03-10-2018
		JP WO2017033820 A1	01-03-2018
		US 2018245763 A1	30-08-2018
		WO 2017033820 A1	02-03-2017
WO 2013051296 A1	11-04-2013	JP 2013080638 A	02-05-2013
		WO 2013051296 A1	11-04-2013
US 5506929 A	09-04-1996	US 5506929 A	09-04-1996
		US 5668913 A	16-09-1997
		US 5835661 A	10-11-1998
FR 3000569 A1	04-07-2014	CN 105074329 A	18-11-2015
		EP 2941590 A1	11-11-2015
		ES 2685373 T3	08-10-2018
		FR 3000569 A1	04-07-2014
		WO 2014106706 A1	10-07-2014
JP 2014017060 A	30-01-2014	JP 6087525 B2	01-03-2017
		JP 2014017060 A	30-01-2014

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