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

(11) **EP 2 045 514 B2**

(12) **NEW EUROPEAN PATENT SPECIFICATION**
After opposition procedure

(45) Date of publication and mention of the opposition decision:
16.02.2022 Bulletin 2022/07

(45) Mention of the grant of the patent:
09.12.2015 Bulletin 2015/50

(21) Application number: **07425625.6**

(22) Date of filing: **05.10.2007**

(51) International Patent Classification (IPC):
F21V 7/00 *(2006.01)* ***F21S 8/10*** *(2006.01)*
F21Y 101/02 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F21V 7/0025; F21S 41/148; F21S 41/24; F21S 41/336; F21S 43/14; F21S 43/251; F21S 43/30; F21S 43/31; F21S 41/153; F21S 43/235; F21Y 2115/10

(54) **Modular reflective optical lighting system and lighting device equipped therewith, in particular for vehicles**

Modulares reflektierendes optisches Beleuchtungssystem und Beleuchtungsvorrichtung, insbesondere für Fahrzeuge

Système d'éclairage optique réflectif modulaire et dispositif d'éclairage équipé de celui-ci, en particulier pour véhicules

(84) Designated Contracting States:
DE FR IT

(43) Date of publication of application:
08.04.2009 Bulletin 2009/15

(73) Proprietor: **Marelli Automotive Lighting Italy S.p.A.**
10078 Venaria Reale (TO) (IT)

(72) Inventors:
- **Pairetti, Alberto**
  10064 Pinerolo (IT)
- **Pierro, Salvatore**
  10100 Torino (IT)

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

(56) References cited:
EP-A1- 1 912 018
EP-A2- 1 388 707
DE-A1-102004 025 699
US-A- 5 396 407
US-A1- 2005 068 787
US-A1- 2005 088 758

EP 2 045 514 B2

Description

[0001] The present invention relates to a modular reflective optical lighting system, and a lighting device equipped therewith, in particular a vehicle light or headlight, wherein the desired brightness distribution is achieved, among other things, by juxtaposing inside a single body two or more modular optical systems comprising the same "basic" components, the latter being more or less identical to one another.

[0002] It is known that the lighting devices used in vehicles, especially motor vehicles, are required to perform increasingly complex and demanding functions, for example daytime lighting, or DRL (the Daytime Running Light function) and progressive illumination of bends (cornering) while at the same time they must be smaller in size, in order to reduce their overall dimensions and weight. One solution offered by modern technology consists for example of using solid-state light sources or LEDs, which reduce both the amount of energy that is used and the amount of heat that is generated during their use, which is one of the greatest limits of traditional incandescent light sources (bulbs).

[0003] WO2007069123 for example relates to a vehicle dipped-beam headlight that is provided with a solid-state light source (LED).

[0004] Here and in the following description, the term "light source" refers to any light source (LED, incandescent lamp, discharge lamp, etc.) in which the light rays that are emitted can be approximated as ideally radiating from a single point, for example, in case of incandescent lamps, from the middle of the filament. This definition therefore excludes light sources such as neon tubes, in which the light rays are radiated from a plurality of adjacent points arranged along an axis.

[0005] The headlight described in WO2007069123, while using a LED as the light source, is relatively large and complex, due to the need to overcome a series of practical design problems associated with the use of a single solid-state light source that is sufficiently powerful to achieve the brightness distribution required by a headlight.

[0006] DE19820267 describes a reflective optical lighting system that uses a LED light source and achieves uniform distribution of the emitted light in a system with limited overall dimensions; said optical system is based on the connection of the light source with a reflector consisting of a convex element the convexity of which lies in the main direction of emission of the light source; the convex element can consist of a curved surface or of two reflecting surfaces of any shape (flat, concave or convex) joined together at an angle. This type of optical system, conceived for the rear illumination of a display, for example a liquid crystal display, can in theory also be used for vehicle lighting devices, but in that case its use would clearly be limited to lamps only.

[0007] The purpose of the present invention is therefore to provide a reflective optical lighting system with reduced overall dimensions that is suitable to use light sources consisting of LEDs, as in the case of the optical system described in DE19820267, but which is more versatile and in particular can be used indifferently to produce lamps and headlights and can therefore be used in the manufacture of indicator and lighting devices for vehicles that are cheap to produce, light in weight, have reduced overall dimensions and low electricity consumption, possibly with a single device incorporating a multitude of different optical functions, thus overcoming the limits of the prior art. DE102004025699 does not solve this problem.

[0008] According to the present invention a reflective optical system is provided as set forth in claim 1.

[0009] In particular, the reflective optical lighting system according to the invention comprises at least one light source having a first optical axis defining a main direction of radiation of light rays emitted by said source and at least a first and a second reflecting surface operationally associated with the light source to intercept the light rays and arranged so as to form between them a first pre-defined angle of a size other than 180°; unlike in DE19820267, however, the first and second reflecting surfaces delimit, between them, a concavity oriented towards the light source and are shaped so that, when in use, said concavity receives a substantial portion of said light rays emitted by the source to reflect them in a direction forming with the first optical axis a second angle of a pre-defined size, so that the reflected rays present a main direction of radiation defined by a second optical axis essentially perpendicular to the first.

[0010] The light source that is used is a Lambertian light source and in that case the concavity defined between the first and the second reflecting surfaces and oriented towards the light source occupies a solid angle greater than π steradians, i.e. greater than a quarter of the solid spherical angle, and in any case such that at least 30% of the light rays emitted by the source are intercepted by the first and second reflecting surfaces.

[0011] The optical system according to the invention can also comprise at least one bright, clear or coloured secondary optical element, operationally associated with the first and second reflecting surfaces in the direction defined by the second optical axis and consisting of at least a lens or a matrix of micro-optics arranged transversely to the second optical axis.

[0012] Lastly, the optical system according to the invention can comprise a plurality of light sources, each operationally associated with a first and second reflecting surface to form therewith a single lighting module so that said system consists of a plurality of lighting modules mutually juxtaposed in a one-dimensional or two-dimensional matrix arrangement.

[0013] The invention also relates to a lighting device comprising a cup-shaped element, preferably made of plastic or metal and fixable to the body of a vehicle, and at least a transparent fluid-tight sealing element to close an opening in the cup-shaped element in which said op-

tical system is arranged and housed in a position oriented towards the opening and such that the second optical axis intercepts the transparent closing element and when used is directly parallel to a direction in which the vehicle is travelling.

[0014] Thus, a similar process can be used to produce both headlights (in particular those intrinsically incorporating a bright-dark or cut-off line such as main-beam headlights or fog lights, in which the light source, in particular a LED light source, is assembled face-down - hereinafter referred to as DLA, for "Down LED Assembly" - so that the parasite rays illuminate the road and are not dispersed upwards), and indicator lights (position or direction indicators, etc.)

[0015] It is also possible to produce lighting devices that consist of a single "basic" optical module, comprising a light source and the two reflecting surfaces associated therewith joined at an angle of approximately 90° depending on the desired brightness distribution (symmetric or asymmetric). A "basic" module can be connected vertically or horizontally to one or more identical or similar modules, in order to obtain a complex system, which allows the use of particular types of activation logic, for example to activate the different modules gradually as a function of the steering angle of the vehicle (the "Static Bend Lighting" function).

[0016] The light sources can be incandescent lamps or solid-state sources (LEDs). The LEDs can be SMDs (Surface Mounted Devices) or dies (semiconductors only), possibly in a matrix arrangement. If several chips are used in the same basic module for example, different coloured lights can be obtained, using the same pair of angled reflecting surfaces for different functions, by appropriately mixing the contributions deriving from different monochromatic LED sources. For example, using RGB (Red Green Blue) LEDs, the same function can be used for the direction indicator, DRL and particular sectors of the dipped-beam / main-beam functions.

[0017] Possible fields of application for the present invention are therefore headlights or lamps for cars, both to implement indicator functions (direction indicators, DRL, position indicators, side markers) and lighting functions (dipped-beam, main-beam, fog lights, SBL).

[0018] Further characteristics and advantages of the present invention will become clear from the following description of the non-limiting embodiments thereof, with reference to the drawings attached hereto, in which:

- figure 1a schematically illustrates a front three-quarter perspective view of the structure of a "basic" optical system according to the present invention;
- figure 1b shows the same view as figure 1a, but in case of a complex optical system, consisting of several juxtaposed modules each consisting of a "basic" system;
- figure 2 shows the same view as figure 1a in case of a "basic" indirect or "remote" lighting system;
- figures 3a and 3b schematically illustrate possible alternative configurations of the "basic" system in figure 1a and the relative symmetric or asymmetric brightness distribution that can be obtained on a screen 10 m away in the standard photometric test;
- figures 4a and 4b are schematic orthogonal elevations of two alternative embodiments of the luminous source of the optical system according to the invention;
- figure 5 is an elevation and longitudinal section view along the optical axis of the basic optical system in figure 1a; and
- figure 6 illustrates a front three-quarter perspective view of a vehicle headlight incorporating an optical lighting system according to the invention.

[0019] With reference to figure 1a, reference number 1 indicates a reflective optical lighting system comprising at least one light source 2 and at least a first reflecting surface 3 and a second reflecting surface 4 operationally associated with the light source 2 and arranged obliquely in relation to one another; in particular, the light source 2 has a first optical axis A defining a main direction of radiation of light rays R emitted by said source 2 and the reflecting surfaces 3 and 4, which may be flat, concave or convex and can be defined by a single equation or by a complex series of equations, are oriented with respect to the axis A to intercept the light rays R and are in particular arranged to form between them a preset first angle β of a size other than 180°.

[0020] According to a first and fundamental aspect of the invention, the reflecting surfaces 3 and 4 between them delimit a concavity 5 oriented towards the light source 2 and are shaped so that when in use said concavity 5 receives a substantial portion of the light rays R emitted by the source 2 to reflect them in a direction forming with the optical axis A an angle α (figure 5) of a preset size, so that the reflected rays r present a main direction of radiation defined by a second optical axis B, essentially perpendicular to the optical axis A.

[0021] According to the invention, the angle β between the two reflecting surfaces 3,4 arranged obliquely in relation to one another is 90° or in the region of 90°, for example (figures 3a and 3b) said angle is respectively less than 90° (figure 3b) or more than 90° (figure 3a), thus achieving a respectively asymmetric and symmetric brightness distribution of the reflected rays r with respect to the optical axis B.

[0022] With reference to figure 5, the size of the angle α can be between 50° and 150° and, more preferably, it is between the values $\alpha 1$ of 85° and $\alpha 2$ of 100°. Moreover, the reflective optical system 1 described herein preferably comprises, for each first and second reflecting surface 3 and 4, associated with a single light source 2, at least a third reflecting surface 10 (figure 5) and/or 11 (figure 1a) oriented towards the concavity 5 and in any case arranged essentially perpendicularly to the optical axis A, in order to also produce in the direction defined by the optical axis B reflected rays r' (figure 5) which have un-

dergone a double reflection, for example so as to send almost all of the light rays R emitted by the source 2 below a bright-dark cut-off mark L (figure 3).

[0023] The light source 2 is a Lambertian light source and the concavity 5 defined between the reflecting surfaces 3 and 4 and oriented towards the light source 2 occupies a solid angle greater than π steradians, i.e. greater than a quarter of the solid spherical angle, and in any case such that at least 30% of the light rays R emitted by the source 2 are intercepted by the reflecting surfaces 3,4 and re-directed as rays r (or r').

[0024] Lastly, the optical system 1 described herein can also comprise (figure 1a) at least one bright, clear or coloured secondary optical element 20, operationally associated with the reflecting surfaces 3,4 in the direction defined by the second optical axis B and consisting of at least a lens or a matrix of micro-optics 21 arranged transversely to the axis B.

[0025] According to the possible and preferred embodiment illustrated in figure 1b, a reflective optical system 100 according to the invention can be achieved by combining several "elementary" optical systems 1, which can be identical or not to one another.

[0026] In particular, figure 1b shows a reflective optical system 100 of the "complex" type comprising a plurality of light sources 2a,2b,2c, each operationally associated with a first reflecting surface, respectively 3a,3b,3c and with a second reflecting surface 4a,4b,4c, to form therewith a single lighting "module" 1a,1b,1c, so that the optical system 100 is made up of a plurality of lighting modules 1a,1b,1c, mutually juxtaposed in a mono-dimensional matrix arrangement (i.e. along an axis X or an axis Y only of a three-dimensional orthogonal reference system X,Y,Z, in which the axis Z is oriented so as to be parallel to the optical axis B - pairs 1a,1c or 1a,1b, respectively), or even a two-dimensional matrix arrangement (i.e. along both the axes X and Y - matrix 1a,1b,1c).

[0027] Clearly, in that case, the reflecting surfaces 3a,b,c, and 4a,b,c can be identical or, generally, not identical but with different equations and shapes, depending on the desired brightness distribution, and, likewise, the angles $\beta 1$ and $\beta 2$ can be identical or different.

[0028] In all cases, the sources 2 that are used comprise photoemitting means 30 selected from the group comprising: incandescent lamps; gas discharge lamps; monochromatic LEDs; polychromatic LEDs; and preferably consist of LEDs 30 suitable to emit a luminous flux of at least 10 lumens for a white light LED and 3 lumens for a red or orange light LED, mounted on at least one printed circuit board 31.

[0029] According to a further alternative embodiment of the invention, instead of consisting of one or more "basic" modules 1 possibly connected in a matrix arrangement, as illustrated in figure 1b, it can consist of one or more "basic" modules 200 (figure 2), in which the reflecting surfaces 3 and 4 which are arranged obliquely in relation to one another at an angle (3 such as to subtend a concavity 5 delimited between said surfaces 3 and 4, are associated with a light source 202 comprising photoemitting means such as a LED 30 borne by a relative printed circuit board 31 and a light guide 203 (for example consisting of a fiber optic or a fiber optic bundle), of which a first end 204 is arranged on a axis with the optical axis A and of which a second end 205 is arranged remotely in relation to the first and is connected to the photoemitting means 30.

[0030] The "basic modules" or systems 200 can of course also be connected to one another (or to basic modules 1) to form complex systems of the type of system 100 in figure 1b.

[0031] With reference to figure 6, one or more reflective optical systems 1, 100 and/or 200 can be incorporated into a lighting device 400 generally comprising an element 401 made of a synthetic plastic material or metal and fixable in a known way to the body of a vehicle (or to the inside of the body of a headlight), for example a motor vehicle which is not illustrated for the sake of simplicity, and at least one transparent fluid-tight sealing element 402 to close an opening 404 of the cup-shaped element 401, in which the optical system 1 and/or 100 and/or 200 is arranged and housed inside the cup-shaped element 401 in a position oriented towards the opening 404 and such that the optical axis B intercepts the transparent closing element 402 and when in use is directly parallel to a direction in which the vehicle is travelling.

[0032] Depending on the type of optical system 1, 100, or 200 that is used, the printed circuit board 31 is provided, on-board, with a single LED 30 (figure 4a) or with a plurality of LEDs 30b,30c,30d (figure 4b) which are possibly selectively activatable; in any case the printed circuit board 31 is attached to a mounting surface 405 of the cup-shaped element 401, which is generally obtained on a side wall, preferably an upper wall 406 of said cup-shaped element 401 and so that the first optical axis A is arranged perpendicularly to the mounting surface 405 (clearly, in case of the system 200, an optical axis C of the LED 30 is perpendicular to the mounting surface 405).

[0033] Moreover, according to an alternative and preferred embodiment, (figure 4) the generic light source 2 (or 202) also comprises electronic control means 500, preferably mounted directly on-board the printed circuit board 31, suitable to selectively activate/deactivate the single LED 30 (in case of the source 2 - figure 4a) or one LED 30b,30c,30d at a time (in case of a source 2' - figure 4b) of said plurality of selectively activatable LEDs 30.

[0034] In particular, the light source 2,2',202 is produced in such a way that said first and second surfaces 3,4 of a "basic module" 1 or 200 can be operationally associated, selectively, with different LEDs, for example 30b,30c,30d; and in such a way that, in case of a lighting device 400 such as that illustrated in figure 6, in which a single cup-shaped element 401 contains a plurality of first and second surfaces, respectively 3a,3b and 4a,4b, each operationally associated with a different LED 30a,30b, each LED 30 can be selectively activated ac-

cording to a previously defined sequence. In the example illustrated in figure 6, the device 400 is a headlight and, in this case, the association of a pair of basic optical systems 1a,1b in a single element 401 with suitable electronic control means 500 is used to progressively illuminate different angular sectors (for example of a bend in the road) in relation to the direction in which the vehicle is travelling (SBL function).

[0035] The gradual activation or deactivation of the lighting element and the possibility of obtaining different brightness levels can also be achieved by using a PWM signal to modulate the current absorbed by the lighting module.

[0036] Clearly, on the basis of the description herein, it is possible to produce lighting devices of the type of the device 400, but which are multifunction devices, capable of being used indifferently as headlights or lamps (for example rear lights), depending on the shape and position of the pairs of reflecting surfaces arranged at an oblique angle in relation to one another that are used each time in association with a single LED (or a plurality or battery of LEDs mounted adjacently on a single printed circuit board, as in figure 4b).

[0037] According to a final but equally important characteristic of the invention, the printed circuit board 31 is in all versions of the system 1, 100, 200 associated with heat dissipation means 550 (figure 6), preferably mounted on the outside, for example above and to the rear, of the cup-shaped element 401.

[0038] In particular the LEDs 30 are preferably mounted "face-down" or in a DLA arrangement, as schematically illustrated in figures 4a and 4b, in which the printed circuit board 31 is mounted on an upper side surface 406 of the cup-shaped element 401, with the single LED 30 or battery of LEDs 30b,30c,30d face-down and so as in any case to distribute brightness with a bright-dark cut-off line L, as illustrated in figure 3; in this way the optical system according to the invention is used to perform functions that require a well-defined cut-off line, such as dipped-beam headlights or fog lights, or with a dual function (dipped-beam and fog lights).

[0039] Said "face-down" or DLA arrangement of the LEDs 30 also means that the optical system according to the invention can be used with the printed circuit board 31 mounted on the upper side surface 406 of the cup-shaped element 401, with the single LED 30 or battery of LEDs 30b,30c,30d face-down and associated with heat dissipation means 550 arranged on the rear of the cup-shaped element 401 and directly connected to at least one component element 560 (figure 4) of the printed circuit board 31 made of a material with relatively high thermal conductivity.

[0040] In particular, the "face-down" or DLA arrangement of the LEDs 30 makes it possible to obtain a better thermal coupling between the printed circuit board 31 and the passive dissipation element 550, when the printed circuit board 31 is produced with an appropriate layout (single face), said thermal coupling comprising conductive tracks 562 on which the dissipation part of the LEDs 30 is mounted and which are attached to an aluminium base 565, with an intermediate heat conducting layer 566 in the form of tape or liquid adhesive, whether the passive dissipation element 550 is arranged close to (figure 4b) or at a distance from (figure 4a) the tracks 562; the dissipation element 550 can be a specific, finned element, as in figure 6, or (alternatively or in addition) it can be said reflector 600 (figure 6) consisting of a single piece (or several pieces assembled together).

[0041] A lighting device according to the invention, such as the device 400, is thus characterized by the presence of at least one reflector the whole of which is oriented towards a transparent closing element 402, which may or may not have optical functions and is possibly provided with an intermediate auxiliary optical element 20, divided along at least a meridian thereof and by means of at least one edge in at least a pair of adjacent reflecting surfaces arranged at an oblique angle in relation to one another so as to between them delimit a dihedral angle and having a structure such as to define an optical axis B of the reflector arranged essentially perpendicularly to a plane through which the optical axis (A) of the light source used each time passes.

[0042] On the basis of the description herein, there is no need to use printed circuit boards with high thermal properties even for the electronic power components, in particular LEDs. Any control electronics (such as the control means 500) can be mounted on the printed circuit board 31 on which the LEDs are mounted, in order to implement a highly compact plug&play system.

[0043] In conclusion, the system according to the invention is characterized by the following elements:

- the optical axis A of the sources used is perpendicular to the mounting surface 405 of the printed circuit board 31, which forms an angle of between $\alpha 1$ (50°) and $\alpha 2$ (150°), in particular between 85° and 100°, in relation to the main direction (B) of emission of the reflector;
- the coupling between the passive heat dissipation element 550 and the weld side of the printed circuit board 31, on which the LED sources are mounted, which allows low-cost power LEDs and printed circuit boards to be used (such as the single-face type in FR4, CEM, etc,).

Claims

1. Reflective optical lighting system (1;100;200) comprising at least one light source (2) having a first optical axis (A) defining a main direction of radiation of light rays emitted by said source and at least a first (3) and a second (4) reflecting surface operationally associated with the light source (2) to intercept said light rays and arranged so as to form between them a first preset angle (β) of a size other than 180°,

wherein the first and second reflecting surfaces (3,4) between them delimit a concavity (5) oriented towards the light source and are shaped so that, when in use, said concavity receives a substantial portion of said light rays emitted by said source to reflect them in a direction forming with the first optical axis (A) a second angle (α) of a preset size, **characterized in that** said first and second angle are such that the reflected rays present a main direction of radiation defined by a second optical axis (B) essentially perpendicular to the first; **wherein said light source (2) is a Lambertian source and** said concavity (5) defined between said first and second reflecting surfaces (3,4) and oriented towards said light source (2) occupies a solid angle greater than π steradians, i.e. greater than a quarter of the solid spherical angle, and in any case such that at least 30% of the light rays emitted by said source are intercepted by said first and second reflecting surfaces (3,4).

2. Optical system according to claim 1, **characterized in that** said first angle of a preset size (β) is 90° or in the region of 90°.

3. Optical system according to claim 1, **characterized in that** said first angle of a preset size (β) is less than 90°.

4. Optical system according to claim 1, **characterized in that** said first angle of a preset size (β) is more than 90°.

5. Optical system according to any of the previous claims, **characterized in that** said first and second reflecting surfaces (3,4) are shaped so as to distribute the reflected light rays symmetrically in relation to said second optical axis (B).

6. Optical system according to any of the claims from 1 to 4, **characterized in that** said first and second reflecting surfaces (3,4) are shaped so as to distribute the reflected light rays asymmetrically in relation to said second optical axis (B).

7. Optical system according to any of the previous claims, **characterized in that** said second angle (α) of a preset size is preferably between 50° and 150° and, more preferably, between 85° and 100°.

8. Optical system according to any of the previous claims, **characterized in that** it comprises, for each first and second reflecting surface (3,4) associated with a said light source, at least a third reflecting surface (10;11) oriented towards said concavity (5) and arranged essentially perpendicularly to said first optical axis (A).

9. Optical system according to any of the previous claims, **characterized in that** it also comprises at least one bright, clear or coloured secondary optical element (20), operationally associated with said first and second reflecting surfaces (3,4) in the direction defined by said second optical axis (B); said at least one secondary optical element (20) consisting of at least a lens or a matrix of micro-optics.

10. Optical system (100) according to any of the previous claims, **characterized in that** it comprises a plurality of light sources (2a,b,c), each operationally associated with one of said first (3a,b,c) and second (4a,b,c) reflecting surfaces so as to form therewith a single lighting module (1a,b,c) so that said optical system is made up of a plurality of said lighting modules (2a,b,c) mutually juxtaposed in a one-dimensional (X,Y) or two-dimensional (XY) matrix arrangement.

11. Optical system according to any of the previous claims, **characterized in that** said light source (2) comprises photoemitting means chosen from the group consisting in: incandescent lamps; gas discharge lamps, monochromatic LEDs; polychromatic LEDs.

12. Optical system according to claim 11, **characterized in that** said light source (2) comprises at least one LED (30) suitable to emit a luminous flux of at least 10 lumens for a white light LED and 3 lumens for a red or orange light LED.

13. Optical system (200) according to claim 11 or 12, **characterized in that** said light source also comprises a light guide (203) of which a first end (204) is arranged on-axis with said first optical axis and of which a second end (205) is arranged remotely in relation to the first and is connected to said photoemitting means.

14. Lighting device (400) comprising a cup-shaped element (401), preferably made of a synthetic plastic material and fixable to the body of a vehicle or to the inside of the body of a headlight also made of synthetic material, at least one transparent fluid-tight sealing element (402) to close an opening (404) of the cup-shaped element and a reflective optical lighting system (1;100;200) comprising at least one light source (2) having a first optical axis (A) defining a main direction of radiation of light rays emitted by said source and at least a first (3) and a second (4) reflecting surface operationally associated with the light source (2) to intercept said light rays and arranged so as to form between them a first preset angle (β) of a size other than 180°, wherein the first and second reflecting surfaces (3,4) between them delimit a concavity (5) oriented towards the light source and are shaped so that, when in use, said

concavity receives a substantial portion of said light rays emitted by said source to reflect them in a direction forming with the first optical axis (A) a second angle (α) of a preset size, and wherein said first and second angle are such that the reflected rays present a main direction of radiation defined by a second optical axis (B) essentially perpendicular to the first; **characterized in that** the optical system (1;100;200) is arranged and housed inside the cup-shaped element (401) in a position oriented towards the opening (404) and such that the second optical axis (B) intercepts said transparent closing element (402) and when in use is directly parallel to a direction in which the vehicle is travelling; said at least one light source comprising a printed circuit board (31) provided on-board with a single LED (30) or a plurality of selectively activatable LEDs (30a,b,c); the printed circuit board (31) being attached to a mounting surface (405) of the cup-shaped element; said mounting surface (405) being obtained on a side wall (406), preferably an upper wall, of said cup-shaped element and in such a way that said first optical axis (A) is arranged perpendicularly to said mounting surface (405).

15. Lighting device according to claim 14, **characterized in that** said at least one light source (2) also comprises electronic control means (500), preferably mounted directly on-board said printed circuit board (31).

16. Lighting device according to claim 15, **characterized in that** said electronic control means (500) are suitable to selectively activate/deactivate said single LED (30) or one LED (30a,b,c) at a time of said plurality of selectively activatable LEDs, so that said first and second surfaces (3a,3b;4a,4b) can be operationally associated, selectively, with different LEDs (30a,b); and in such a way that, in case of the presence in a single element (401) of a plurality of first and second surfaces (3,4) each operationally associated with a different LED, each LED (30) can be selectively activated according to a previously defined sequence, for example to progressively illuminate different angular sectors with respect to the direction in which the vehicle is travelling.

17. Lighting device according to claim 15 or 16, **characterized in that** said printed circuit board (31) is associated with heat dissipation means (550) provided on said cup-shaped element.

18. Use of a lighting device (400) according to claim 14 as a vehicle headlight.

19. Use of a lighting device (400) according to claim 14 as a lamp, in particular the rear light of a vehicle.

20. Use according to claim 19, wherein said printed circuit board (31) is mounted on an upper side surface (406) of the cup-shaped element, with said single LED (30) or plurality of LEDs (30a,b,c,) face-down and so as to distribute brightness with a bright-dark cut-off line.

21. Use according to claim 19 or 20, wherein said printed circuit board (31) is mounted on an upper side surface (406) of the cup-shaped element, with said single LED (30) or plurality of LEDs (30a,b,c) face-down, and is associated with heat dissipation means (550) arranged on the rear of the cup-shaped element and directly connected to a component element (560) of said printed circuit board made of a material with relatively high thermal conductivity.

22. Use according to claim 18, **characterized in that** said printed circuit board (31) is a single-face circuit and is thermally coupled to a passive dissipation element (550) between a weld side of the printed circuit board (30) and the passive dissipation element (550) by means of a thermal interface (566) in the form of tape or liquid adhesive.

Patentansprüche

1. Reflektierendes optisches Beleuchtungssystem (1; 100; 200), das mindestens eine Lichtquelle (2) mit einer ersten optischen Achse (A), die eine Hauptstrahlungsrichtung von Lichtstrahlen, die von der Quelle ausgesendet werden, festlegt, und mindestens eine erste (3) und eine zweite (4) reflektierende Oberfläche, die mit der Lichtquelle (2) in Wirkbeziehung stehen, um jene Lichtstrahlen abzuschneiden, und so angeordnet sind, dass sie zwischen sich einen ersten vorgegebenen Winkel (β) von einer anderen Größe als 180° bilden, aufweist, wobei die erste und die zweite reflektierende Oberfläche (3, 4) zwischen sich eine in Richtung der Lichtquelle ausgerichtete Höhlung (5) begrenzen und so geformt sind, dass bei der Verwendung die Höhlung einen wesentlichen Anteil der von der Quelle ausgesendeten Lichtstrahlen empfängt, um sie in eine Richtung, die mit der ersten optischen Achse (A) einen zweiten Winkel (α) einer vorgegebenen Größe bildet, zu reflektieren, **dadurch gekennzeichnet, dass** der erste und der zweite Winkel dergestalt sind, dass die reflektierten Strahlen eine Hauptstrahlungsrichtung haben, die durch eine zweite optische Achse (B), die im Wesentlichen senkrecht zur ersten ist, festgelegt wird, wobei die Lichtquelle (2) ein Lambert-Strahler ist und die zwischen der ersten und der zweiten reflektierenden Oberfläche (3,4) festgelegte Höhlung (5) in Richtung der Lichtquelle (2) ausgerichtet ist und einen Raumwinkel von mehr als π Steradiant, d.h. mehr als ein Viertel des Kugelraumwin-

kels, einnimmt, und in jedem Fall dergestalt, dass mindestens 30% der von der Quelle ausgesendeten Lichtstrahlen von der ersten und der zweiten reflektierenden Oberfläche (3, 4) abgeschnitten werden.

2. Optisches System nach Anspruch 1, **dadurch gekennzeichnet, dass** der erste Winkel einer vorgegebenen Größe (β) 90° beträgt oder im Bereich von 90° liegt.

3. Optisches System nach Anspruch 1, **dadurch gekennzeichnet, dass** der erste Winkel einer vorgegebenen Größe (β) weniger als 90° beträgt.

4. Optisches System nach Anspruch 1, **dadurch gekennzeichnet, dass** der erste Winkel einer vorgegebenen Größe (β) mehr als 90° beträgt.

5. Optisches System nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** die erste und die zweite reflektierende Oberfläche (3, 4) so geformt sind, dass sie die reflektierten Lichtstrahlen symmetrisch in Bezug auf die zweite optische Achse (B) verteilen.

6. Optisches System nach einem der Ansprüche 1 bis 4, **dadurch gekennzeichnet, dass** die erste und die zweite reflektierende Oberfläche (3, 4) so geformt sind, dass sie die reflektierten Lichtstrahlen asymmetrisch in Bezug auf die zweite optische Achse (B) verteilen.

7. Optisches System nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** der zweite Winkel (α) einer vorgegebenen Größe vorzugsweise zwischen 50° und 150° und, mehr vorzuziehen, zwischen 85° und 100° liegt.

8. Optisches System nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** es jeweils für die erste und die zweite reflektierende Oberfläche (3, 4), die mit einer besagten Lichtquelle in Beziehung steht, mindestens eine dritte reflektierende Oberfläche (10; 11) aufweist, die in Richtung der Höhlung (5) ausgerichtet und im Wesentlichen senkrecht zur ersten optischen Achse (A) angeordnet ist.

9. Optisches System nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** es auch mindestens ein helles, klares oder farbiges, sekundäres optisches Element (20), das in der von der zweiten optischen Achse (B) festgelegten Richtung mit der ersten und der zweiten reflektierenden Oberfläche (3, 4) in Wirkbeziehung steht, aufweist; wobei das mindestens eine sekundäre optische Element (20) aus mindestens einer Linse oder einer Matrix aus Mikrooptiken besteht.

10. Optisches System (100) nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** es eine Vielzahl von Lichtquellen (2a, b, c) aufweist, die jeweils mit einer der reflektierenden Oberflächen, der ersten (3a, b, c) und der zweiten (4a, b, c), in Wirkbeziehung stehen, um damit ein einziges Leuchtmodul (1a, b, c) zu bilden, sodass das optische System aus einer Vielzahl der Leuchtmodule (2a, b, c) aufgebaut ist, die in einer eindimensionalen (X,Y) oder einer zweidimensionalen (XY) Matrix nebeneinander angeordnet sind.

11. Optisches System nach einem der vorangegangenen Ansprüche, **dadurch gekennzeichnet, dass** die Lichtquelle (2) Licht aussendende Mittel aufweist, die aus der Gruppe, die aus Glühlampen; Gasentladungslampen, monochromatischen LEDs; polychromatischen LEDs besteht, gewählt werden.

12. Optisches System nach Anspruch 11, **dadurch gekennzeichnet, dass** die Lichtquelle (2) mindestens eine LED (30) aufweist, die geeignet ist, einen Lichtstrom von mindestens 10 Lumen für eine Weißlicht-LED und 3 Lumen für eine Rot- oder Orangelicht-LED auszusenden.

13. Optisches System (200) nach Anspruch 11 oder 12, **dadurch gekennzeichnet, dass** die Lichtquelle auch einen Lichtleiter (203) aufweist, von dem ein erstes Ende (204) auf einer Achse mit der ersten optischen Achse angeordnet ist und von dem ein zweites Ende (205) in Bezug auf die erste entfernt angeordnet ist und mit den Licht aussendenden Mitteln verbunden ist.

14. Beleuchtungsvorrichtung (400), aufweisend ein napfförmiges Element (401), das vorzugsweise aus einem synthetischen Kunststoffmaterial hergestellt und an der Karosserie eines Fahrzeugs oder an der Innenseite des Körpers eines Scheinwerfers, ebenfalls aus synthetischem Material hergestellt, befestigbar ist, mindestens ein transparentes, fluiddichtes Abdichtelement (402), um eine Öffnung (404) des napfförmigen Elements zu schließen, und ein reflektierendes optisches Beleuchtungssystem (1; 100; 200), das mindestens eine Lichtquelle (2) mit einer ersten optischen Achse (A), die eine Hauptstrahlungsrichtung von Lichtstrahlen, die von der Quelle ausgesendet werden, festlegt, und mindestens eine erste (3) und eine zweite (4) reflektierende Oberfläche,
die mit der Lichtquelle (2) in Wirkbeziehung stehen, um jene Lichtstrahlen abzuschneiden, und so angeordnet sind, dass sie zwischen sich einen ersten vorgegebenen Winkel (β) von einer anderen Größe als 180° bilden, aufweist, wobei die erste und die zweite reflektierende Oberfläche (3, 4) zwischen sich eine in Richtung der Lichtquelle ausgerichtete Höhlung

(5) begrenzen und so geformt sind, dass bei der Verwendung die Höhlung einen wesentlichen Anteil der von der Quelle ausgesendeten Lichtstrahlen empfängt, um sie in eine Richtung, die mit der ersten optischen Achse (A) einen zweiten Winkel (α) einer vorgegebenen Größe bildet, zu reflektieren, und wobei der erste und der zweite Winkel dergestalt sind, dass die reflektierten Strahlen eine Hauptstrahlungsrichtung aufweisen, die durch eine zweite optische Achse (B), die im Wesentlichen senkrecht zur ersten ist, festgelegt wird; **dadurch gekennzeichnet, dass** das optische System (1; 100; 200) innerhalb des napfförmigen Elements (401) in einer in Richtung der Öffnung (404) ausgerichteten Stellung angeordnet und untergebracht ist und dergestalt, dass die zweite optische Achse (B) das transparente schließende Element (402) schneidet und bei der Verwendung direkt parallel zu einer Richtung, in die das Fahrzeug gerade fährt, verläuft; wobei mindestens eine Lichtquelle eine Leiterplatte (31) aufweist, die darauf mit einer einzelnen LED (30) oder einer Vielzahl selektiv aktivierbarer LEDs (30a, b, c) versehen ist; wobei die Leiterplatte (31) an einer Montageoberfläche (405) des napfförmigen Elements angebracht ist; wobei die Montageoberfläche (405) an einer Seitenwand (406), vorzugsweise einer oberen Wand, des napfförmigen Elements und in einer solchen Weise erhalten wird, dass die erste optische Achse (A) senkrecht zur Montageoberfläche (405) ist.

15. Beleuchtungsvorrichtung nach Anspruch 14, **dadurch gekennzeichnet, dass** die mindestens eine Lichtquelle (2) auch elektronische Steuerungsmittel (500), vorzugsweise direkt auf der Leiterplatte (31) montiert, aufweist.

16. Beleuchtungsvorrichtung nach Anspruch 15, **dadurch gekennzeichnet, dass** die elektronischen Steuerungsmittel (500) geeignet sind, die einzelne LED (30) oder jeweils eine LED (30a, b, c) aus der Vielzahl selektiv aktivierbarer LEDs selektiv zu aktivieren/deaktivieren, sodass die erste und die zweite Oberfläche (3a, 3b; 4a, 4b) selektiv mit unterschiedlichen LEDs (30a, b) in Wirkbeziehung gesetzt werden können; und in einer solchen Weise, dass im Fall des Vorhandenseins einer Vielzahl erster und zweiter Oberflächen (3, 4), von denen jede mit einer anderen LED in Wirkbeziehung steht, in einem einzelnen Element (401) jede LED (30) gemäß einer zuvor festgelegten Reihenfolge selektiv aktiviert werden kann, zum Beispiel um unterschiedliche Winkelsektoren in Bezug auf die Richtung, in die das Fahrzeug gerade fährt, fortschreitend zum Leuchten zu bringen.

17. Beleuchtungsvorrichtung nach Anspruch 15 oder 16, **dadurch gekennzeichnet, dass** die Leiterplatte (31) mit auf dem napfförmigen Element vorgesehenen, Wärme abführenden Mitteln (550) in Beziehung steht.

18. Verwendung einer Beleuchtungsvorrichtung (400) nach Anspruch 14 als Fahrzeugscheinwerfer.

19. Verwendung einer Beleuchtungsvorrichtung (400) nach Anspruch 14 als Lampe, insbesondere das Rücklicht eines Fahrzeugs.

20. Verwendung nach Anspruch 19, wobei die Leiterplatte (31) an einer oberseitigen Oberfläche (406) des napfförmigen Elements montiert ist, während die einzelne LED (30) oder Vielzahl von LEDs (30a, b, c) abwärts gerichtet ist, und um Helligkeit mit einer Hell-Dunkel-Trennlinie zu verteilen.

21. Verwendung nach Anspruch 19 oder 20, wobei die Leiterplatte (31) an einer oberseitigen Oberfläche (406) des napfförmigen Elements montiert ist, während die einzelne LED (30) oder Vielzahl von LEDs (30a, b, c) abwärts gerichtet ist, und mit Wärme abführenden Mitteln (550) in Beziehung steht, die an der Rückseite des napfförmigen Elements angeordnet und mit einem Komponentenelement (560) der Leiterplatte, hergestellt aus einem Material mit relativ hoher Wärmeleitfähigkeit, direkt verbunden sind.

22. Verwendung nach Anspruch 18, **dadurch gekennzeichnet, dass** die Leiterplatte (31) ein einseitig bestückter Schaltkreis ist und an ein passives Abführungselement (550) mittels einer thermischen Schnittstelle (566) in Form von Band oder flüssigem Klebemittel zwischen einer Lötseite der Leiterplatte (30) und dem passiven Abführungselement (550) thermisch gekoppelt ist.

Revendications

1. Système d'éclairage optique réfléchissant (1 ; 100 ; 200) comprenant au moins une source lumineuse (2) ayant un premier axe optique (A) définissant une direction principale de rayonnement de rayons lumineux émis par ladite source et au moins une première surface réfléchissante (3) et une deuxième surface réfléchissante (4) associées opérationnellement à la source lumineuse (2) pour intercepter lesdits rayons lumineux et agencées de manière à former entre elles un premier angle préréglé (β) d'une taille autre que 180°, dans lequel les première et deuxième surfaces réfléchissantes (3, 4) délimitent entre elles une concavité (5) orientée vers la source lumineuse et sont façonnées de sorte que, en utilisation, ladite concavité reçoive une portion substantielle desdits rayons lumineux émis par ladite source pour les réfléchir dans une direction formant, avec le pre-

mier axe optique (A), un deuxième angle (α) d'une taille préréglée, **caractérisé en ce que** lesdits premier et deuxième angles sont tels que les rayons réfléchis présentent une direction principale de rayonnement définie par un deuxième axe optique (B) sensiblement perpendiculaire au premier; dans lequel ladite source lumineuse (2) est une source lambertienne et ladite concavité (5) définie entre lesdites première et deuxième surfaces réfléchissantes (3, 4) et orientée vers ladite source lumineuse (2) occupe un angle solide supérieur à π stéradians, c'est-à-dire supérieur à un quart de l'angle sphérique solide, et dans tous les cas de sorte qu'au moins 30% des rayons lumineux émis par ladite source soient interceptés par lesdites première et deuxième surfaces réfléchissantes (3, 4).

2. Système optique selon la revendication 1, **caractérisé en ce que** ledit premier angle d'une taille préréglée (β) est 90° ou de l'ordre de 90°.

3. Système optique selon la revendication 1, **caractérisé en ce que** ledit premier angle d'une taille préréglée (β) est inférieur à 90°.

4. Système optique selon la revendication 1, **caractérisé en ce que** ledit premier angle d'une taille préréglée (β) est supérieur à 90°.

5. Système optique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** lesdites première et deuxième surfaces réfléchissantes (3, 4) sont façonnées de manière à répartir les rayons lumineux réfléchis symétriquement par rapport audit deuxième axe optique (B).

6. Système optique selon l'une quelconque des revendications 1 à 4, **caractérisé en ce que** lesdites première et deuxième surfaces réfléchissantes (3, 4) sont façonnées de manière à répartir les rayons lumineux réfléchis asymétriquement par rapport audit deuxième axe optique (B).

7. Système optique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ledit deuxième angle (α) d'une taille préréglée est de préférence entre 50° et 150° et, avec plus de préférence, entre 85° et 100°.

8. Système optique selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend, pour chacune parmi les première et deuxième surfaces réfléchissantes (3, 4) associée à une dite source lumineuse, au moins une troisième surface réfléchissante (10; 11) orientée vers ladite concavité (5) et agencée sensiblement perpendiculairement audit premier axe optique (A).

9. Système optique selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend également au moins un élément optique secondaire brillant, clair ou coloré (20) associé opérationnellement auxdites première et deuxième surfaces réfléchissantes (3, 4) dans la direction définie par ledit deuxième axe optique (B); ledit au moins un élément optique secondaire (20) se composant d'au moins une lentille ou une matrice de microoptique.

10. Système optique (100) selon l'une quelconque des revendications précédentes, **caractérisé en ce qu'**il comprend une pluralité de sources lumineuses (2a, b, c), chacune d'elles étant associée opérationnellement à l'une desdites première (3a, b, c) et deuxième surfaces réfléchissantes (4a, b, c) de manière à former avec celles-ci un module d'éclairage unique (1a, b, c) de sorte que ledit système optique soit constitué d'une pluralité desdits modules d'éclairage (2a, b, c) mutuellement juxtaposés dans un agencement de matrice unidimensionnelle (X, Y) ou bidimensionnelle (XY).

11. Système optique selon l'une quelconque des revendications précédentes, **caractérisé en ce que** ladite source lumineuse (2) comprend des moyens de photoémission choisis dans le groupe se composant de : lampes incandescentes; lampes à décharge de gaz; DEL monochromatiques; DEL polychromatiques.

12. Système optique selon la revendication 11, **caractérisé en ce que** ladite source lumineuse (2) comprend au moins une DEL (30) apte à émettre un flux lumineux d'au moins 10 lumens pour une DEL de lumière blanche et 3 lumens pour une DEL de lumière rouge ou orange.

13. Système optique (200) selon la revendication 11 ou 12, **caractérisé en ce que** ladite source lumineuse comprend également un guide lumineux (203) dont une première extrémité (204) est agencée sur ledit premier axe optique et dont une deuxième extrémité (205) est agencée à distance de la première extrémité et est reliée auxdits moyens de photoémission.

14. Dispositif d'éclairage (400) comprenant un élément cupuliforme (401), constitué de préférence d'une matière plastique synthétique et fixable au corps d'un véhicule ou à l'intérieur du corps d'un phare également constitué d'une matière synthétique, d'au moins un élément transparent étanche aux fluides (402) pour fermer une ouverture (404) de l'élément cupuliforme et d'un système d'éclairage optique réfléchissant (1; 100 ; 200) comprenant au moins une source lumineuse (2) ayant un premier axe optique (A) définissant une direction principale de rayonnement de rayons lumineux émis par ladite source et

au moins une première surface réfléchissante (3) et une deuxième surface réfléchissante (4) associées opérationnellement à la source lumineuse (2) pour intercepter lesdits rayons lumineux et agencées de manière à former entre elles un premier angle préréglé (β) d'une taille autre que 180°, dans lequel les première et deuxième surfaces réfléchissantes (3, 4) délimitent entre elles une concavité (5) orientée vers la source lumineuse et sont façonnées de sorte que, en utilisation, ladite concavité reçoive une portion substantielle desdits rayons lumineux émis par ladite source pour les réfléchir dans une direction formant, avec le premier axe optique (A), un deuxième angle (α) d'une taille préréglée, et dans lequel lesdits premier et deuxième angles sont tels que les rayons réfléchis présentent une direction principale de rayonnement définie par un deuxième axe optique (B) sensiblement perpendiculaire au premier; **caractérisé en ce que** le système optique (1; 100; 200) est agencé et logé à l'intérieur de l'élément cupuliforme (401) à une position orientée vers l'ouverture (404) et de sorte que le deuxième axe optique (B) intercepte ledit élément de fermeture transparent (402) et, en utilisation, est directement parallèle à une direction dans laquelle le véhicule se déplace ; ladite au moins une source lumineuse comprenant une carte de circuit imprimé (31) pourvue à bord d'une DEL unique (30) ou d'une pluralité de DEL sélectivement activables (30a, b, c) ; la carte de circuit imprimé (31) étant raccordée à une surface de montage (405) de l'élément cupuliforme ; ladite surface de montage (405) étant obtenue sur une paroi latérale (406), de préférence une paroi supérieure dudit élément cupuliforme et de telle manière que ledit premier axe optique (A) soit agencé perpendiculairement à ladite surface de montage (405).

15. Dispositif d'éclairage selon la revendication 14, **caractérisé en ce que** ladite au moins une source lumineuse (2) comprend également des moyens de commande électroniques (500), montés de préférence directement sur ladite carte de circuit imprimé (31).

16. Dispositif d'éclairage selon la revendication 15, **caractérisé en ce que** lesdits moyens de commande électroniques (500) sont aptes à activer/désactiver sélectivement ladite DEL unique (30) ou une DEL (30a, b, c) à la fois parmi ladite pluralité de DEL sélectivement activables, de sorte que lesdites première et deuxième surfaces (3a, 3b ; 4a, 4b) puissent être opérationnellement associées sélectivement à différentes DEL (30a, b) ; et de telle manière que, dans le cas de la présence, dans un élément unique (401), d'une pluralité de première et deuxième surfaces (3, 4), chacune d'elles étant opérationnellement associée à une DEL différente, chaque DEL (30) puisse être activée sélectivement selon une séquence préalablement définie, par exemple pour éclairer progressivement différents secteurs angulaires par rapport à la direction dans laquelle le véhicule se déplace.

17. Dispositif d'éclairage selon la revendication 15 ou 16, **caractérisé en ce que** ladite carte de circuit imprimé (31) est associée à des moyens de dissipation de chaleur (550) prévus sur ledit élément cupuliforme.

18. Utilisation d'un dispositif d'éclairage (400) selon la revendication 14 en tant qu'un phare de véhicule.

19. Utilisation d'un dispositif d'éclairage (400) selon la revendication 14 en tant qu'une lampe, en particulier un feu arrière d'un véhicule.

20. Utilisation selon la revendication 19, dans laquelle ladite carte de circuit imprimé (31) est montée sur une surface de côté supérieur (406) de l'élément cupuliforme, avec ladite DEL unique (30) ou ladite pluralité de DEL (30a, b, c) face vers le bas et de manière à répartir une luminosité avec une ligne de coupure clair-obscur.

21. Utilisation selon la revendication 19 ou 20, dans laquelle ladite carte de circuit imprimé (31) est montée sur une surface de côté supérieur (406) de l'élément cupuliforme, avec ladite DEL unique (30) ou ladite pluralité de DEL (30a, b, c) face vers le bas, et est associée à des moyens de dissipation de chaleur (550) agencés à l'arrière de l'élément cupuliforme et directement reliés à un élément composant (560) de ladite carte de circuit imprimé constitué d'une matière avec une conductivité thermique relativement élevée.

22. Utilisation selon la revendication 18, **caractérisée en ce que** ladite carte de circuit imprimé (31) est un circuit à face unique et est thermiquement couplée à un élément de dissipation passive (550) entre un côté de soudage de la carte de circuit imprimé (30) et l'élément de dissipation passive (550) au moyen d'une interface thermique (566) sous la forme d'un ruban adhésif ou d'un adhésif liquide.

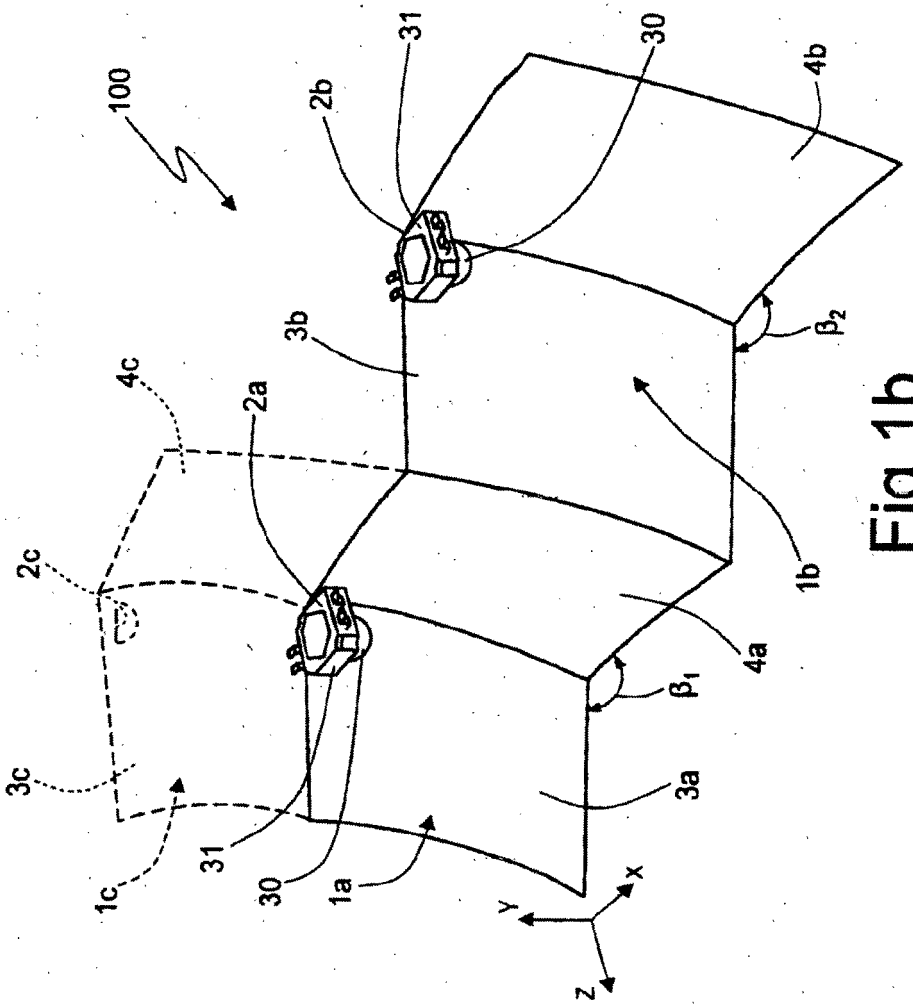
100
2b
31
30
4b
3b
β_2
4c
2a
1b
2c
4a
β_1
3c
3a
1c
31
30
1a
x
y
z

Fig.1b

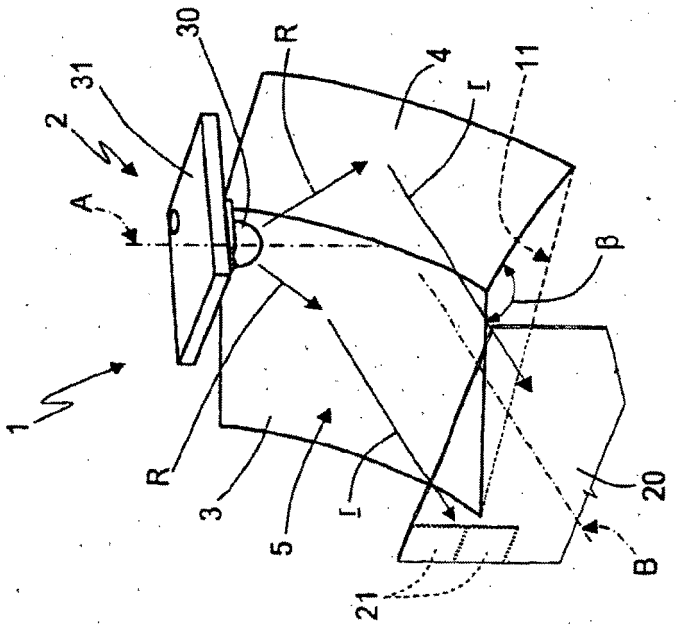
30
R
4
11
31
2
r
A
β
1
R
3
5
r
20
B
21

Fig.1a

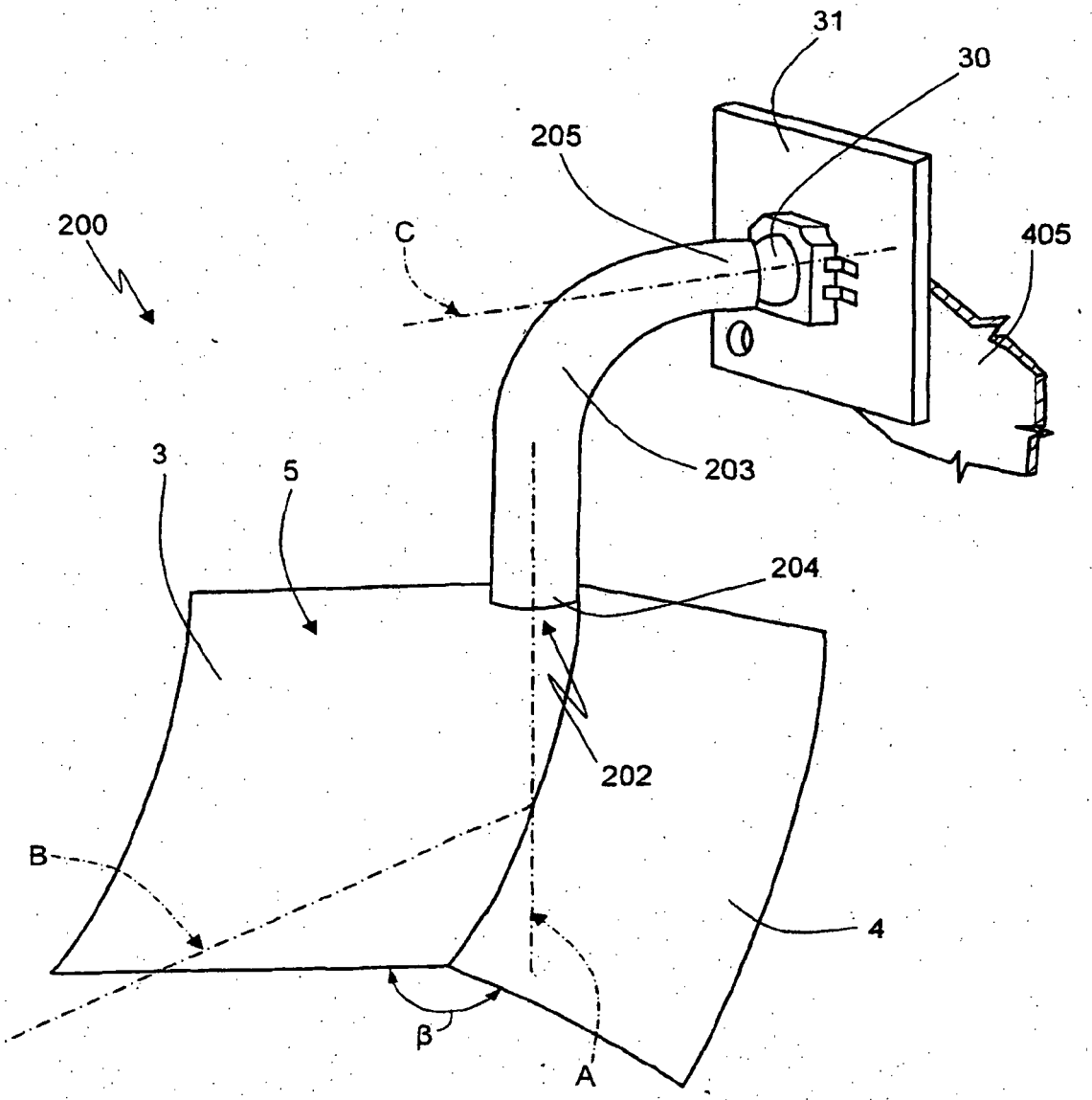

Fig.2

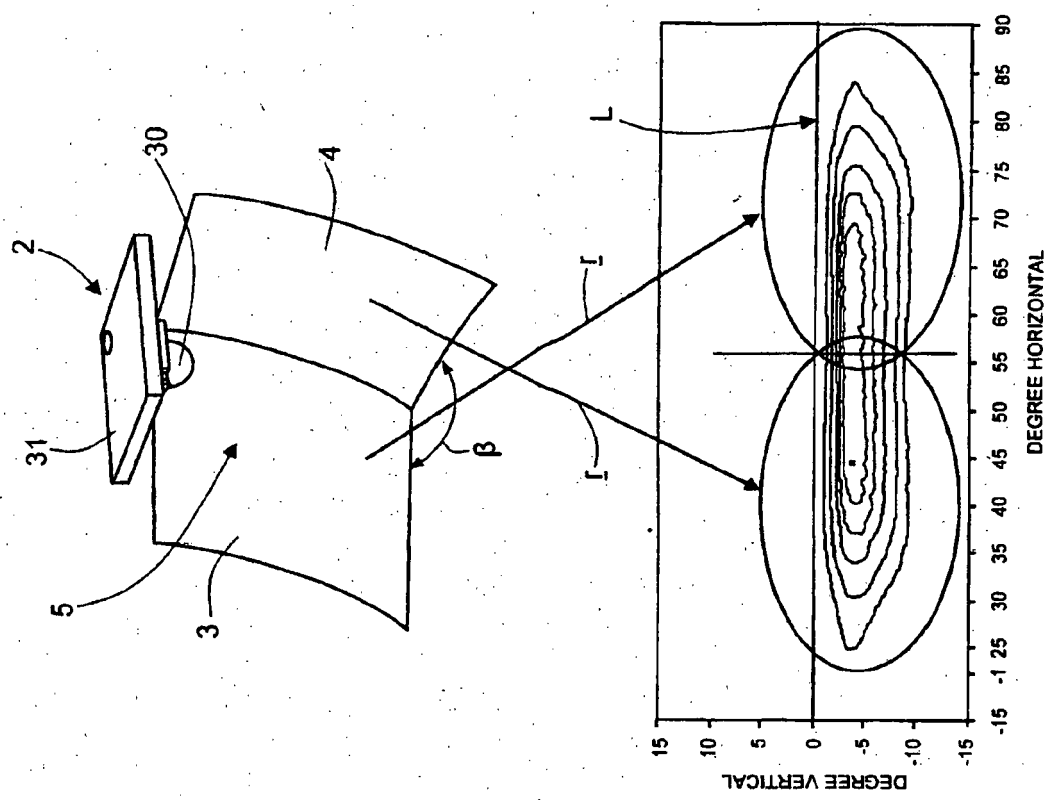
2
30
4
31
5
3
β
r
r
L
DEGREE VERTICAL
DEGREE HORIZONTAL

Fig.3b

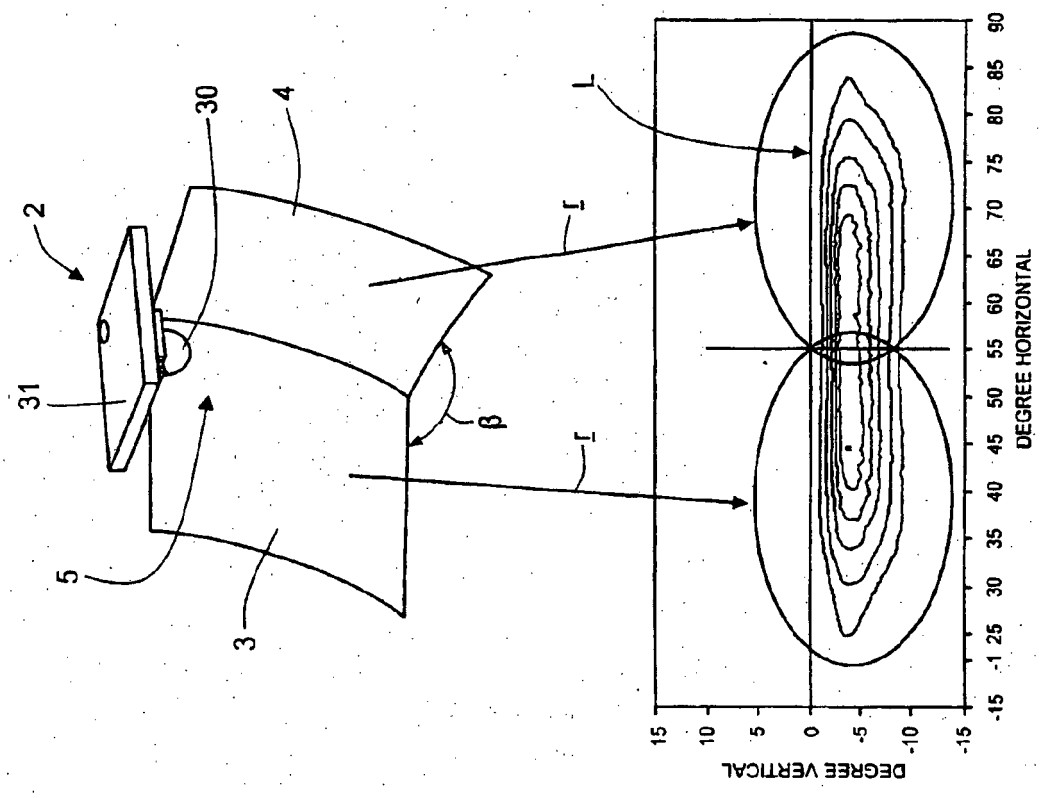
2
30
4
31
5
3
β
r
r
L
DEGREE VERTICAL
DEGREE HORIZONTAL

Fig.3a

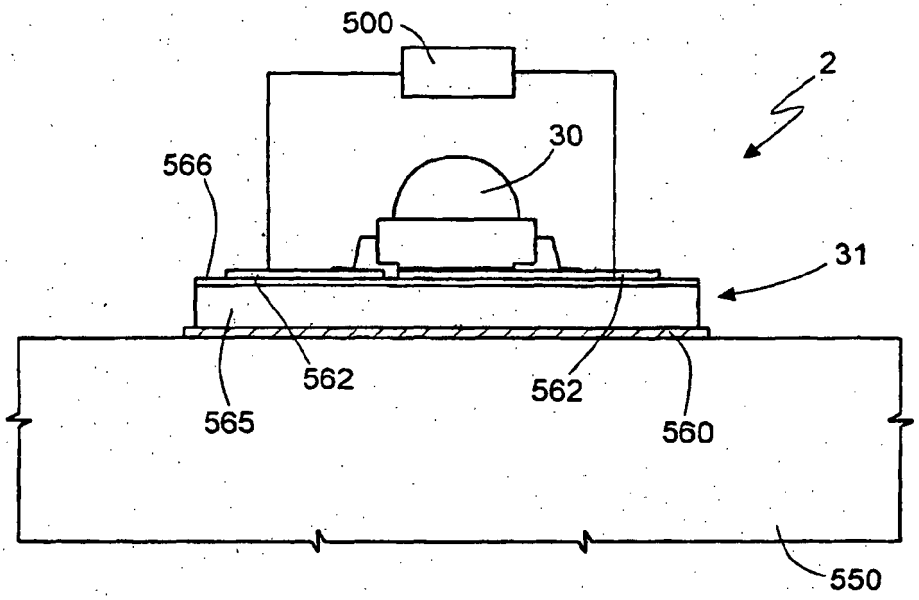
500
2
30
566
31
562
562
565
560
550

Fig. 4a

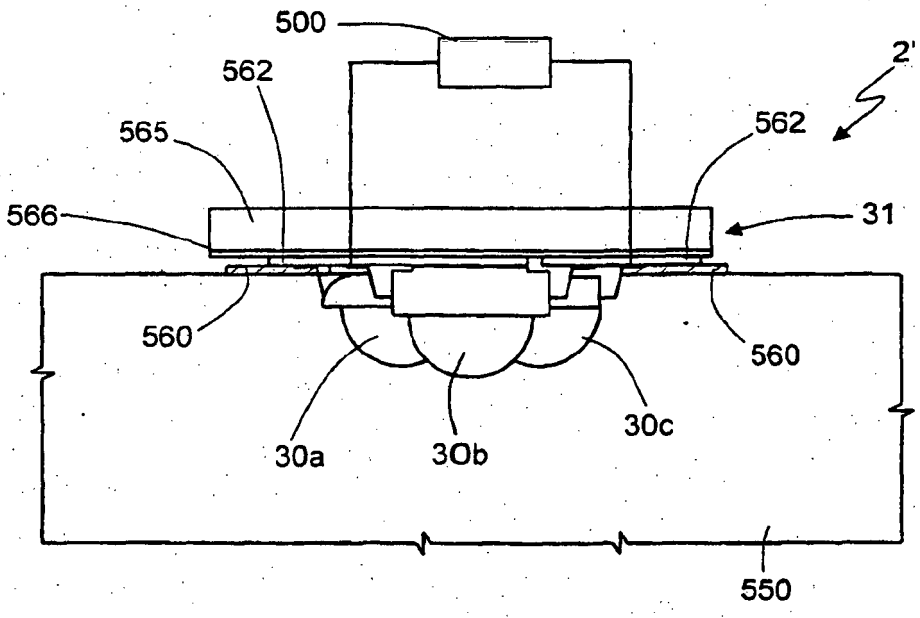
500
2'
562
565
562
566
31
560
560
30a
30b
30c
550

Fig.4b

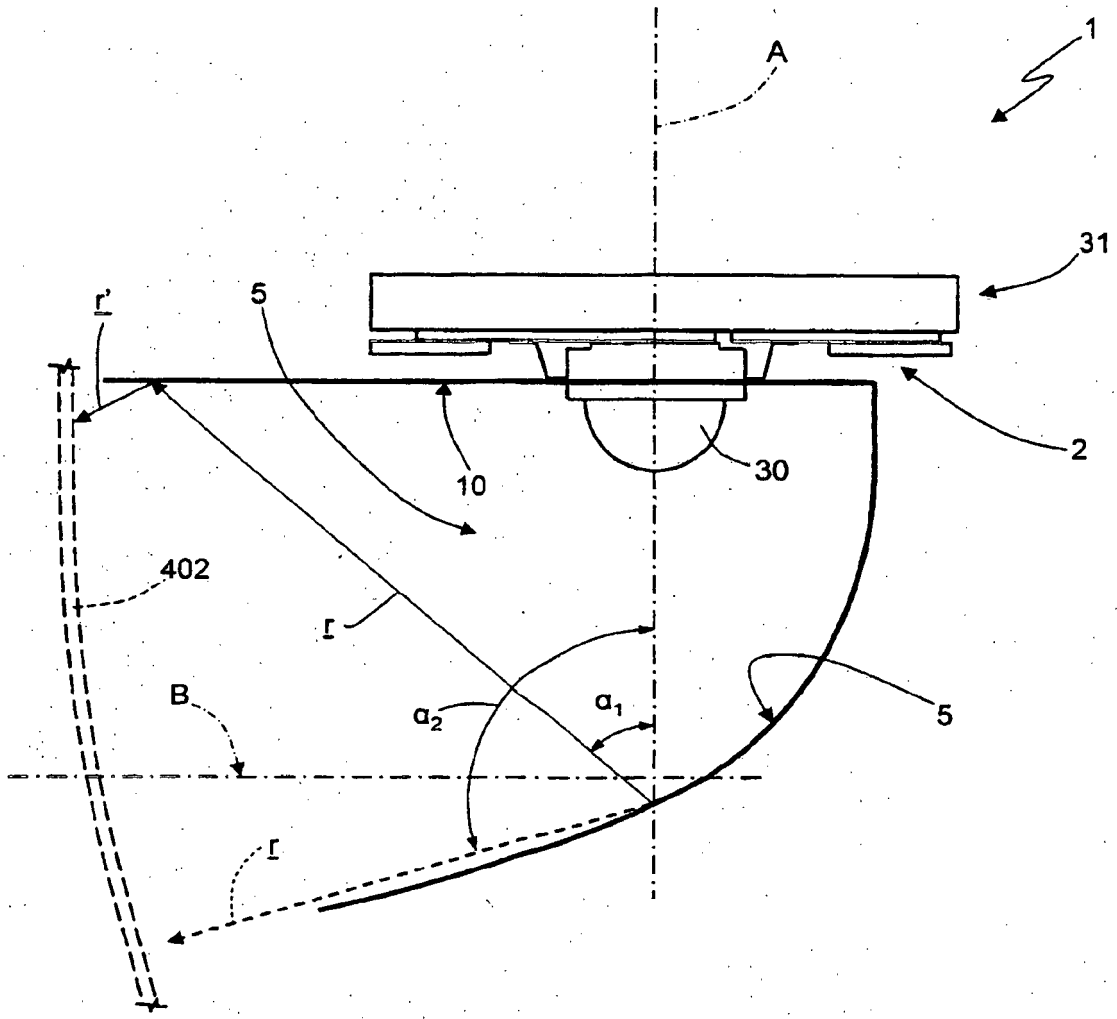

Fig.5

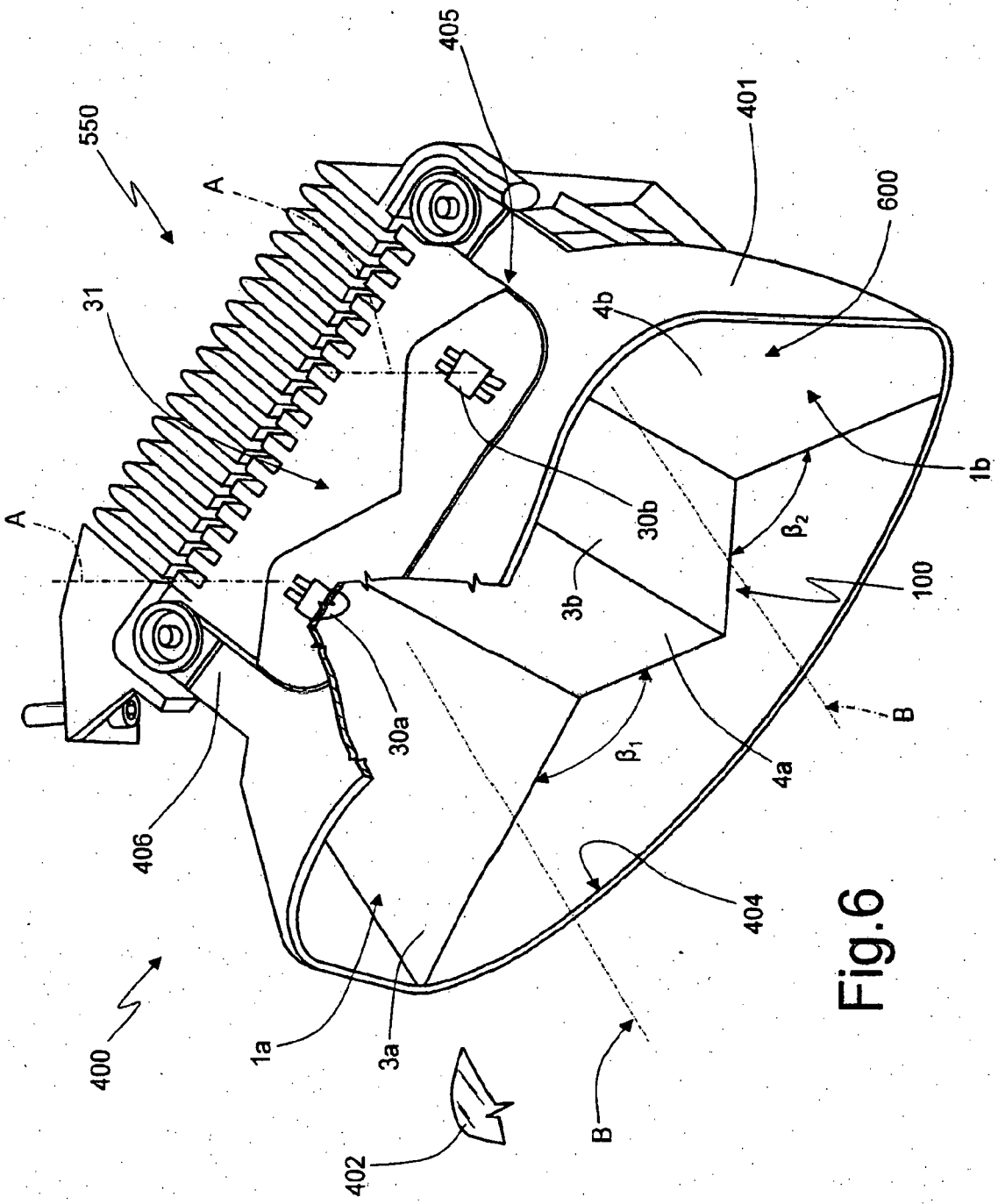
550
A
405
401
600
31
4b
1b
A
30b
β_2
3b
100
30a
B
β_1
4a
406
404
400
1a
3a
402
B

Fig.6

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2007069123 A **[0003] [0005]**
- DE 19820267 **[0006] [0007] [0009]**
- DE 102004025699 **[0007]**