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(54) **LIGHTING FIXTURE**

(57) A lighting fixture (1) which comprises at least one module (2) provided with at least one main body (3) having a substantially circular contour featuring at least one localized perimetric recess (4), and at least one sup-

porting plate (5) for at least one component selected from at least one lighting source and a power supply circuit, coupled at an at least partially concave region of a front face of the main body (3).

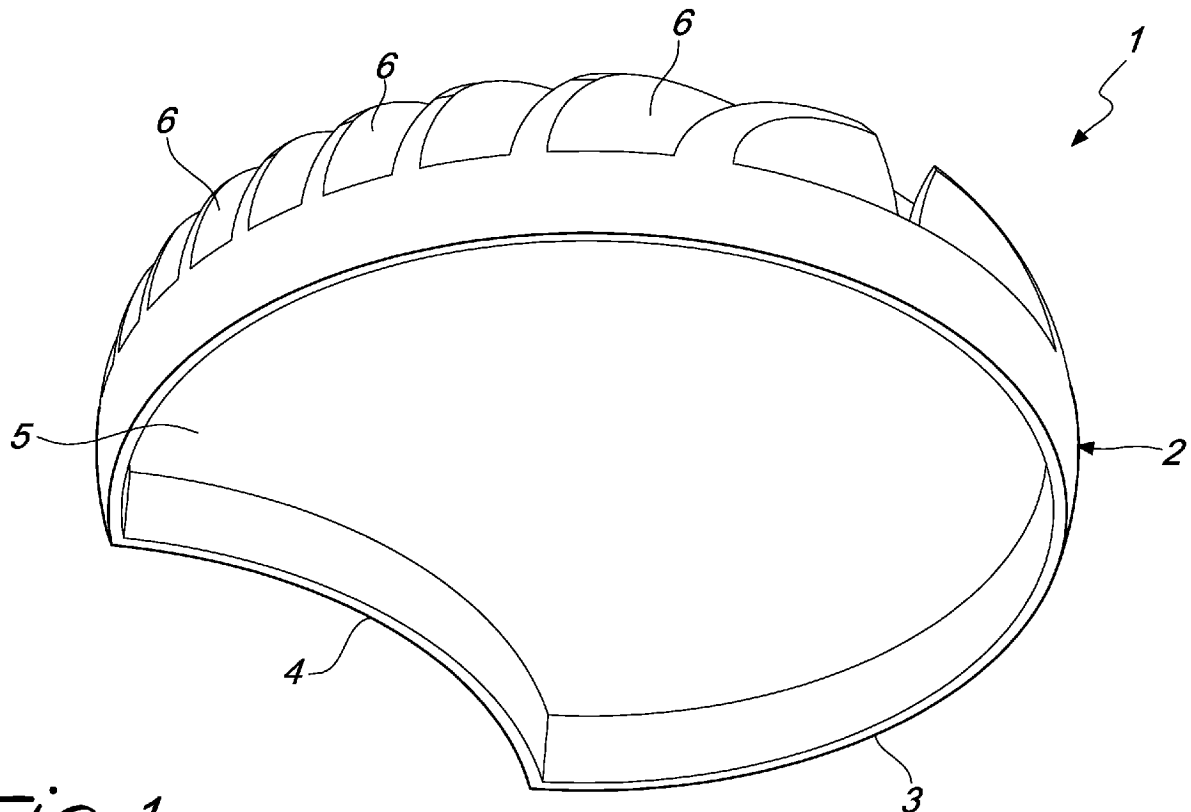


Fig. 1

Description

[0001] The present invention relates to a lighting fixture adapted for applications in residential and industrial areas.

[0002] The use is known of lighting fixtures of various dimensions, for the purpose of distributing lighting coverage over large surfaces.

[0003] In particular, lighting fixtures of the track type are known, wherein the light sources are arranged in a line, optionally for great lengths (reaching dozens of meters), making it possible to light an area of great longitudinal extension and limited transverse extension. By placing multiple tracks of lighting fixtures side by side (generally mutually parallel) it is possible to also obtain the correct level of illumination along the direction transverse to the direction of the tracks.

[0004] Lighting fixtures are also known wherein the sources are arranged side by side for the purpose of spreading the light coverage over a wide area having substantially the same dimensions longitudinally and transversely.

[0005] In all these cases it is necessary to avail of specific types of lighting fixtures with their own characteristics and dimensions.

[0006] Such a great diversification of types of lighting fixtures required to meet all the needs of the market forces makers to have very large warehouses to store the various different products, subdivided in respective areas.

[0007] Obviously, such warehouses will also need to have areas for storing the various components uniquely destined for the manufacture of specific types of products and this requires the adoption of even larger warehouses (or of additional warehouses for the raw materials and semi-finished products, separate from the warehouse containing the finished products).

[0008] Such conditions entail considerable running costs which will have repercussions on the finished product.

[0009] Furthermore, the need to have a huge number of separate raw materials and semi-finished products (necessary for producing all the types of lighting fixtures envisaged) also entails a great environmental impact, given that they in turn will need be manufactured in dedicated plants and on specific machines (the construction of which will be particularly energy-intensive, and the end-of-life disposal of which will be complex).

[0010] The trend of the market for lighting fixtures for industrial and commercial use is to have lighting appliances that are increasingly point-shaped and of small dimensions: this aspect is normally advertised as an advantage, insofar as it makes it possible to adopt minimalist designs of undoubted impact.

[0011] Actually, point-shaped light sources (or light sources that are in any case small in size) generate a high risk of glare, in that the light beam is emitted in an area of small dimensions and therefore is particularly in-

tense and concentrated. In addition to glare, high-intensity point-shaped light sources increase annoyance and constitute a source of distraction for the persons operating in the environment where they are installed. Furthermore, point-shaped light sources create beams of light that exhibit a tendency not to illuminate behind obstacles, therefore generating larger shadows on work areas which can be bothersome and even generate problems in terms of operator efficiency and safety.

[0012] All these drawbacks of point-shaped light sources are tolerated for the sake of adopting lighting fixtures that have a pleasing design, conform to current uses and of low cost.

[0013] The aim of the present invention is to solve the above-mentioned drawbacks by providing a lighting fixture that is adapted to meet a very wide variety of lighting engineering requirements.

[0014] Within this aim, an object of the invention is to provide a lighting fixture that is versatile and therefore adapted to reduce the space occupation required to store the fixtures required to meet the needs of the market.

[0015] Another object of the invention is to provide a lighting fixture capable of meeting the needs of the market with minimal environmental impact.

[0016] Another object of the invention is to provide a lighting fixture requiring a limited number of components in order to meet the needs of the market, with consequent reduced use of warehousing to store such components and low environmental impact for the production of such components.

[0017] Another object of the invention is to provide a lighting fixture which makes it possible to generate ideal photometric curves, while offering a modern and innovative design.

[0018] Another object of the invention is to provide a lighting fixture which reduces the risks of glare, while offering a modern and innovative design.

[0019] Another object of the invention is to provide a lighting fixture which minimizes the areas of shadow in the illuminated environment, while offering a modern and innovative design.

[0020] Another object of the present invention is to provide a lighting fixture which is of low cost, easily and practically implemented, and safe in use.

[0021] This aim and these objects are achieved by a lighting fixture, characterized in that it comprises at least one module provided with:

- at least one main body having a substantially circular contour, provided with at least one localized perimetric recess,
- at least one supporting plate for at least one component selected from at least one lighting source and a power supply circuit, coupled at an at least partially concave region of a front face of said main body.

[0022] Further characteristics and advantages of the invention will become better apparent from the detailed

description that follows of a preferred, but not exclusive, embodiment of the lighting fixture, which is illustrated by way of non-limiting example in the accompanying drawings wherein:

Figure 1 is a schematic perspective view from below of a possible embodiment of a modular lighting fixture according to the invention, constituted by a single module;

Figure 2 is a schematic perspective view from above of the fixture of Figure 1;

Figure 3 is a schematic perspective view from below of an additional embodiment of a modular lighting fixture according to the invention, constituted by three modules;

Figure 4 is a schematic perspective view from below of an additional embodiment of a modular lighting fixture according to the invention, constituted by four modules;

Figure 5 is a schematic perspective view from below of an additional embodiment of a modular lighting fixture according to the invention, constituted by five modules;

Figure 6 is a schematic perspective view from below of an additional embodiment of a modular lighting fixture according to the invention, constituted by six modules;

Figure 7 is a schematic perspective view from below of an additional embodiment of a modular lighting fixture according to the invention, constituted by seven modules;

Figure 8 is a schematic perspective view from below of an additional embodiment of a modular lighting fixture according to the invention, constituted by two aligned modules;

Figure 9 is a schematic perspective view from below of an additional embodiment of a modular lighting fixture according to the invention, constituted by three aligned modules;

Figure 10 is a schematic side view of a comparison of the illumination and of the shadows generated by a substantially point-shaped lighting source of small dimensions according to the prior art (PA), and by the fixture of Figure 5, for the same light emission;

Figure 11 is three charts of the light distribution of fixtures according to the invention which are constituted by a single module (chart I), by four modules (chart IV), and by five modules (chart V).

[0023] With reference to the figures, the reference numeral 1 generally designates a modular lighting fixture according to the invention.

[0024] The lighting fixture 1 according to the invention comprises at least one module 2 provided with at least one main body 3 having a substantially circular contour featuring at least one localized perimetric concave recess 4, and at least one supporting plate 5 for at least one component selected from at least one lighting source and

a power supply circuit, coupled at an at least partially concave region of a front face (intended to be directed toward the space to be illuminated) of the main body 3.

[0025] The dimensions of the single module 2 are substantially low, given that its outline can have a diameter of encumbrance comprised between 150 mm and 250 mm.

[0026] Conveniently each module 2 comprises at least one main heat sink 6 arranged on the rear face (intended to be opposite to the space to be illuminated) of the corresponding main body 3: the rear face will be arranged opposite to the front face, which accommodates the supporting plate 5 (for example a PCB plate) in which the at least one lighting source (not shown in the accompanying figures) is directed outward.

[0027] Generally each supporting plate 5 can accommodate an indefinite number of light sources which can be distributed uniformly or otherwise according to the parameters that it is intended to give to the light beam emitted by the respective module 2: the power supply circuit, which will also be adapted to control and manage the light sources, will comprise wiring and components that depend on the number, type and power of the light sources present on the plate 5.

[0028] With particular reference to the embodiments shown for the purposes of non-limiting example in the accompanying Figures from 3 to 9, the fixture 1 according to the invention can advantageously comprise an interconnection stage 7 which is configured to join together at least two modules 2.

[0029] The interconnection stage 7 will profitably be attachable to respective rear faces of each module 2 and will comprise an internal seat for housing electrical components and an additional heat sink 8 on its surface that is opposite to the surface attached to the at least two modules 2.

[0030] By virtue of the interconnection stage 7 it will therefore be possible to aggregate a predefined number of modules 2, so producing a lighting fixture 1 that is adapted to emit a beam of light made up of the combination of the beams emitted by each module 2 that goes to make it up: in this way it will be possible to obtain a light emission of the desired value which is not point-shaped.

[0031] For the same emission of light, the fixtures 1 according to the invention, constituted by at least two modules 2 and one interconnection stage 7, will offer a broader emission surface and therefore will minimize the risk of glare or of annoyance/disturbance induced by a light beam that is too intense, typical of the point-shaped light sources provided in PA fixtures according to the prior art.

[0032] In particular, with respect to PA fixtures according to the prior art, fixtures 1 according to the invention will have a different unified evaluation parameter for glare. This parameter is known as UGR, Unified Glare Rating, and is a unified factor in the international field, developed by the CIE (*Commission International de*

l'Eclairage) for evaluating direct discomfort glare.

[0033] The formula for calculating UGR is derived by simplifying an index called CGI (CIE Glare Index) which is defined in technical standards published in 1983, created with the objective of bringing together different systems of measuring discomfort glare. UGR is a derivation of this. In the standard for the lighting of interiors, UNI EN 12464-1 of 2004, the UGR parameter must be between predefined values (both for direct glare and for reflected glare). The fixture 1 according to the invention, by virtue of its particular shape, makes it possible to reduce glare, conforming to the current regulations.

[0034] In addition, as illustrated by way of non-limiting example in the accompanying Figure 10, a fixture 1 according to the invention, with respect to a traditional PA fixture (according to the prior art), having a broader light beam emission surface, for the same emission of light makes it possible to minimize the shadows S-1 projected by the objects A present in the illuminated space, compared to the shadows S-PA projected by those same objects A when the space is illuminated by a fixture according to the prior art PA (provided with substantially point-shaped light sources).

[0035] The presence of the recesses 4 in the main body 3 of each module 2 is useful because it makes it possible to identify mutual configurations of the modules 2 that make up each fixture 1 which are such as to optimize the light distribution of the overall beam emitted (as can be seen in Figure 11, the charts I, IV and V respectively show, by way of non-limiting example, the distribution curve of the light beam emitted by fixtures 1 constituted respectively by one module 2, by four modules 2, and by five modules 2).

[0036] The presence of the recesses 4 makes it possible to provide mutual configurations of the modules 2, in so doing defining fixtures 1 offering a high-quality appearance.

[0037] In particular the recess 4 can have a concave shape, although the possibility is not ruled out of making it with a straight pattern (such as a chord of the circumference of the module 2) or with an irregular pattern (a broken line, a curved line, or a combination thereof).

[0038] It is possible to see, by observing these images, that the combination of the beams emitted by each module 2 of the fixtures 1 with four modules 2 and with five modules 2 generate particularly regular distributions: this makes the fixtures 1 that are made up of two or more modules 2 easily applied in a lighting engineering project. This synergy between the light beams emitted by each individual module 2 of a fixture 1 comprising a plurality of modules 2 is obtained by virtue of the shape of the main body 3 and, in particular, by virtue of the presence of the recess 4 which makes it possible to provide mutual arrangements of the modules 2 in the fixture 1 in which such modules 2 are mutually closer together (according to geometries that would not be generally possible if the contour of the main body 3 were completely circular, i.e. if the recess 4 were not present).

[0039] Through the adoption of specially designed lenses (which face and are proximate to the light sources of each plate 5 of each module 2), it is furthermore possible to obtain light distributions that are rotationally symmetrical.

[0040] It should be noted that, according to the invention, the interconnection stage 7 can profitably be configured for connection to at least two modules 2 which are aligned with the respective perimetric recesses 4 which are arranged in a manner chosen from either an arrangement with the same orientation (a possible embodiment of which is shown by way of non-limiting example in the accompanying Figure 9) or an arrangement with mutually opposite orientations (a possible embodiment of which is shown by way of non-limiting example in the accompanying Figure 8).

[0041] The perimetric recesses 4 can be arranged in such a manner as to ensure an apparent penetration of one module 2 into the contiguous module (the recess of a first module 2 will be facing and proximate to the perimetric outer edge of a second module 2), or be mutually facing and proximate (with opposite orientation) so delimiting an area with an at least partially circular contour, or even be completely mutually opposite.

[0042] By arranging the modules 2 consecutively, so that at least two of these are aligned, it will furthermore be possible to provide fixtures 1 in which the plurality of modules is arranged in a broken line of any shape and dimensions, so as to best adapt it to the specific application requirements. In such case the interconnection stage 7 will need to be designed especially for the purpose, or multiple stages 7 will need to be used, arranged consecutively according to the geometry of interest.

[0043] According to an alternative embodiment, the interconnection stage 7 can advantageously be configured for connection to at least three modules 2 which are arranged as the vertices of a regular polygon inscribed in a circumference.

[0044] In such case, the respective perimetric recesses 5 of the modules 2 will be arranged in a manner chosen from either an arrangement with orientation in a radial direction with respect to the center of the polygon or an arrangement with orientation directed toward a vertex of the polygon.

[0045] With reference to such embodiment, it should be noted that the fixture 1 according to the invention can conveniently comprise a number of modules chosen among: three, arranged as the vertices of an equilateral triangle (embodiment shown by way of non-limiting example in the accompanying Figure 3); four, arranged as the vertices of a square (embodiment shown by way of non-limiting example in the accompanying Figure 4); five, arranged as the vertices of a regular pentagon (embodiment shown by way of non-limiting example in the accompanying Figure 5); six, arranged as the vertices of a regular hexagon (embodiment shown by way of non-limiting example in the accompanying Figure 6); seven, arranged as the vertices of a regular heptagon (embodi-

ment shown by way of non-limiting example in the accompanying Figure 7); eight, arranged as the vertices of a regular octagon; nine, arranged as the vertices of a regular nonagon; ten, arranged as the vertices of a regular decagon; eleven, arranged as the vertices of a regular hendecagon; and twelve, arranged as the vertices of a regular dodecagon.

[0046] However, the possibility is not ruled out of the modules 2 being arranged with respect to the interconnection stage 7 as irregular geometric shapes or in imaginative shapes.

[0047] It should be noted that, according to a preferred embodiment, the at least one lighting source installed on the plate 5 of each module 2 can usefully be an illumination LED.

[0048] More specifically, the illumination LEDs on each plate 5 of each module 2 can be a plurality, distributed in conformity with the lighting requirements that it is desired to obtain on the surface of the respective supporting plate 5.

[0049] The protection offered by the present invention also extends to a method of assembling a lighting fixture 1 which consists in a series of consecutive steps.

[0050] In a first step of lighting technology design, it will be necessary to calculate the lighting technology parameters required for the correct lighting of the space/area of future installation of the at least one fixture 1 to be assembled.

[0051] Basically, once the specific requirements of the space/area (both in environmental terms and in terms of the type of activity that is to be conducted in that environment and the corresponding requirements) are known, and the reference regulatory framework is known, all the lighting technology parameters will be identified in order to obtain an ideal illumination.

[0052] In a second step it will be necessary to calculate the number of modules 2, of the type described previously, that are necessary in order to obtain the lighting technology parameters that were calculated previously for each lighting fixture 1, the light distribution curve of a single module 2 being known (and the light distribution curve of fixtures comprising multiple modules 2, arranged according to specific configurations, also being known).

[0053] In a third step it will be possible to select an interconnection stage 7 which is adapted to simultaneously support the number of modules 2 calculated in the preceding step, so as to couple thereto the number of modules 2 calculated previously, in the chosen mutual geometric configuration.

[0054] At this point it is possible to wire and connect to each other, according to predefined wiring diagrams, the electrical circuits of the modules 2 and of the stage 7, creating a single fixture 1 which has the characteristics of interest.

[0055] Therefore it has been shown that the maker does not need to have a plurality of previously-assembled fixtures of different shape and dimensions in storage (as happens with fixtures PA of the prior art), and it will in-

stead be possible to assemble the fixture 1 with the characteristics of interest, simply by obtaining the respective components (modules 2, interconnection stage 7, wires, connectors and power supply circuit devices) from storage.

[0056] This ensures that the maker can simplify the production operations, minimize the burdens and costs of warehousing, reduce the environmental impact of production operations and also the associated discards. A further benefit that cannot be ignored is the possibility for the maker to provide its customers with fixtures 1 of any shape and which comprise any number of modules 2 (mutually arranged according to a plurality of different configurations) in a short time (almost just-in-time delivery), thus better catering to urgent requests.

[0057] It should be noted that the step of acquiring and calculating the lighting technology parameters necessary for the correct lighting of the space/area can conveniently comprise a sub-step of calculating the number of fixtures 1 of the chosen type that are needed and identifying their correct arrangement in the space/area.

[0058] Advantageously the present invention solves the above-mentioned problems by providing a lighting fixture 1 which is adapted to meet a very wide variety of lighting engineering requirements. This is possible by virtue of the great versatility of the fixture 1 which can comprise an indefinite number of modules 2 arranged according to a plurality of different configurations.

[0059] Conveniently the lighting fixture 1 according to the invention is versatile, being adapted to reduce the space occupation required to store the fixtures 1 required to meet the needs of the market: in fact it will be possible to keep only the components (such as the modules 2, the interconnection stages 7, the wires, the connectors and the electric power supply circuit and control devices) in storage, proceeding with the assembly of the specific fixtures 1 required by the market (and/or by customers) when such a request materializes.

[0060] Profitably the lighting fixture 1 according to the invention is capable of meeting the needs of the market with minimal environmental impact: in fact, if a single type of modules 2 is to be produced then it is possible to optimize the machines and the processes required for their manufacture, so reducing discarded material and keeping energy consumption down.

[0061] Positively the lighting fixture 1 according to the invention requires a limited number of components in order to meet the needs of the market, with consequent reduced use of warehousing to store such components.

[0062] Advantageously the lighting fixture 1 according to the invention makes it possible to generate ideal photometric curves, while offering a modern and innovative design. Differently from what is the case for PA fixtures according to the prior art, all of which adopt light sources substantially in order to limit dimensions as far as possible and offer a design that is pleasing and innovative, the fixture 1 according to the invention offers a design that is original, pleasing and particularly distinctive, even if

the space taken up by its form is greater than that of fixtures according to the prior art.

[0063] Usefully the lighting fixture 1 according to the invention reduces the risk of glare, despite its modern and innovative design: the greater breadth of the light beam emission surface makes it possible to obtain levels of the UGR (unified glare rating) index that are lower than those of fixtures according to the prior art PA and therefore more in line with what is prescribed by current regulations, while still ensuring an optimal lighting of the space/area of installation.

[0064] Fruitfully, the lighting fixture 1 according to the invention minimizes the areas of shadow in the illuminated space/area, despite having a modern and innovative design.

[0065] Positively the lighting fixture 1 according to the invention is easily and practically implemented and is of low cost: such characteristics make the fixture 1 according to the invention an innovation that is safe in use.

[0066] The invention, thus conceived, is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims. Moreover, all the details may be substituted by other, technically equivalent elements.

[0067] In the embodiments illustrated, individual characteristics shown in relation to specific examples may in reality be interchanged with other, different characteristics, existing in other embodiments.

[0068] In practice, the materials employed, as well as the dimensions, may be any according to requirements and to the state of the art.

[0069] The disclosures in Italian Patent Application No. 102023000006261 from which this application claims priority are incorporated herein by reference.

[0070] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A lighting fixture, **characterized in that** it comprises at least one module (2) provided with:

- at least one main body (3) having a substantially circular contour featuring at least one localized perimetric recess (4),
- at least one supporting plate (5) for at least one component selected from at least one lighting source and a power supply circuit, coupled at an at least partially concave region of a front face of said main body (3).

2. The fixture according to claim 1, **characterized in**

that said module (2) comprises at least one main heat sink (6) arranged on the rear face of said main body (3), i.e., the face that is opposite to the front face which accommodates said supporting plate (5) in which said at least one lighting source is directed outward.

3. The fixture according to one or more of the preceding claims, **characterized in that** it comprises an interconnection stage (7) which is configured for joining at least two modules (2), said interconnection stage (7) being attachable to respective rear faces of each module (2) and comprises an internal seat for housing electrical components and an additional heat sink (8) on its surface that is opposite to the surface attached to said at least two modules (2).

4. The fixture according to one or more of the preceding claims, **characterized in that** said interconnection stage (7) is configured for connection to at least two modules (2) which are aligned with the respective perimetric recesses (4) which are arranged in a manner chosen from either an arrangement with the same orientation or an arrangement with mutually opposite orientations.

5. The fixture according to one or more of claims 1 to 3 and as an alternative to claim 4, **characterized in that** said interconnection stage (7) is configured for connection to at least three modules (2) which are arranged as the vertices of a regular polygon inscribed in a circumference, with the respective perimetric recesses (4) arranged in a manner chosen from either an arrangement with an orientation in a radial direction with respect to the center of said polygon or an arrangement with an orientation directed toward a vertex of said polygon.

6. The fixture according to claim 5, **characterized in that** it comprises a number of modules (2) chosen among:

- three, arranged as the vertices of an equilateral triangle;
- four, arranged as the vertices of a square;
- five, arranged as the vertices of a regular pentagon;
- six, arranged as the vertices of a regular hexagon;
- seven, arranged as the vertices of a regular heptagon;
- eight, arranged as the vertices of a regular octagon;
- nine, arranged as the vertices of a regular nonagon;
- ten, arranged as the vertices of a regular decagon;
- eleven, arranged as the vertices of a regular

hendecagon;

- twelve, arranged as the vertices of a regular dodecagon.

7. The fixture according to one or more of the preceding claims, **characterized in that** said at least one lighting source is an illumination LED. 5

8. The fixture according to claim 7, **characterized in that** said illumination LEDs are a plurality, distributed on the surface of a respective supporting plate (5). 10

9. A method of assembling a lighting fixture (1), **characterized in that** it consists in: 15
 - calculating the lighting technology parameters required for the correct lighting of the space/area of future installation of the at least one fixture (1) to be assembled,
 - calculating the number of modules (2) according to at least one of the preceding claims required to obtain the previously-calculated lighting technology parameters, the relevant light distribution curve being known, 20
 - selecting a stage (7) according to at least one of claims 3, 4, 5 and coupling the number of modules (2) previously calculated to it, 25
 - wiring and connecting to each other, according to predefined wiring diagrams, the electrical circuits of said modules (2) and of said stage (4), 30
 - creating a single fixture.

10. The method according to claim 9, **characterized in that** said step of acquiring the parameters required for the correct lighting of the space comprises a sub-step of calculating the number of fixtures (1) of the chosen type that are needed and their arrangement. 35

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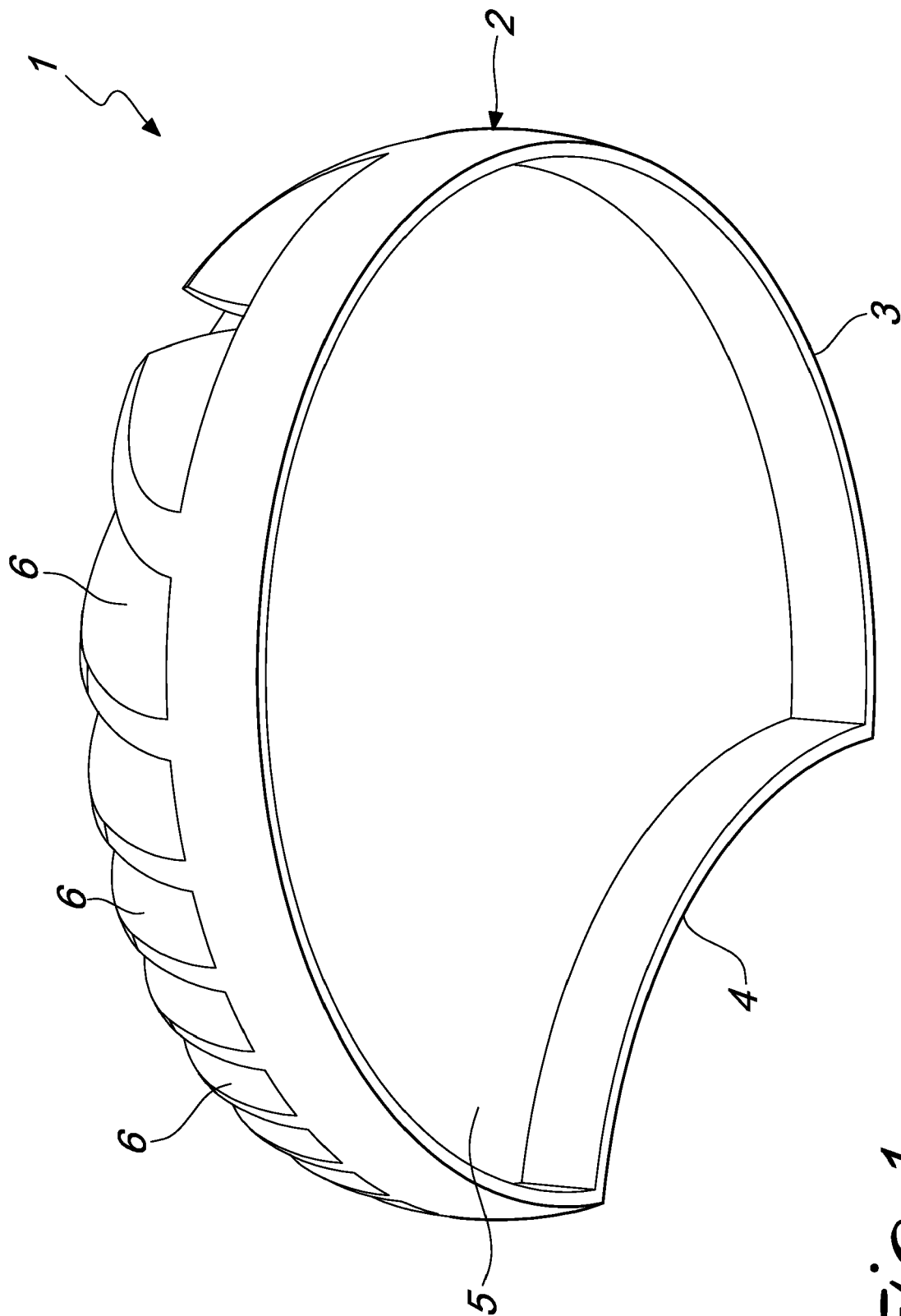


Fig. 1

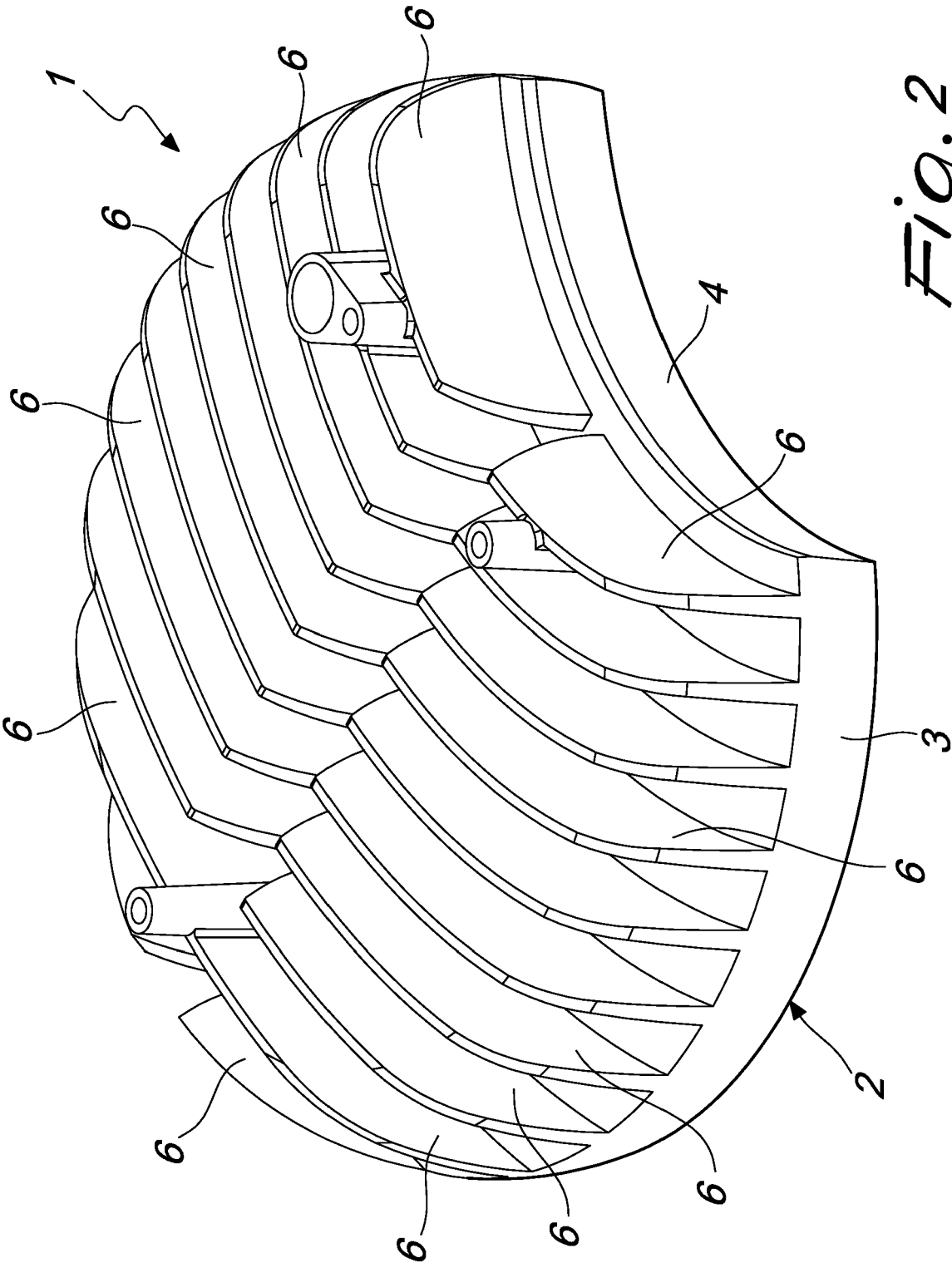


Fig. 2

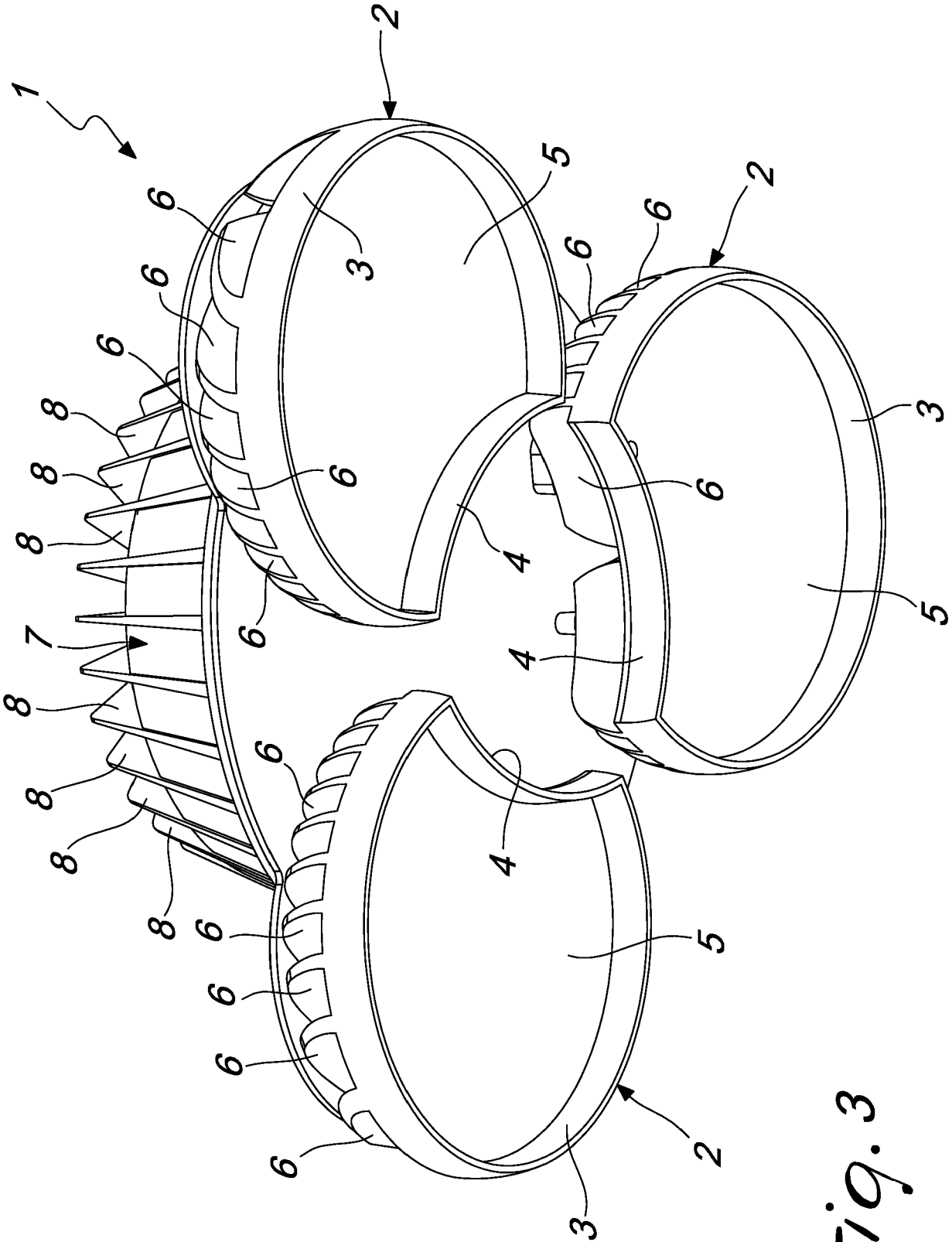
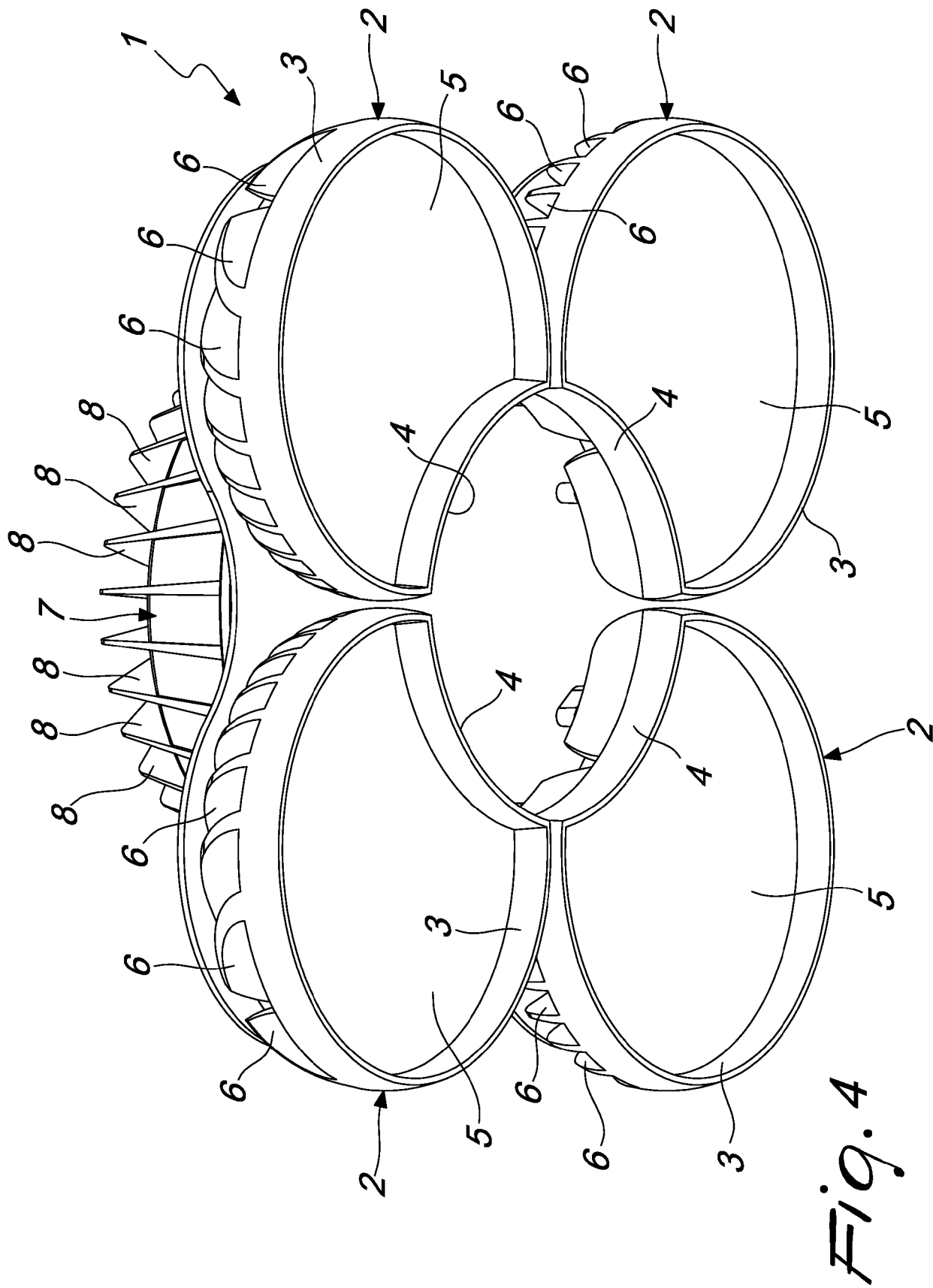


Fig. 3



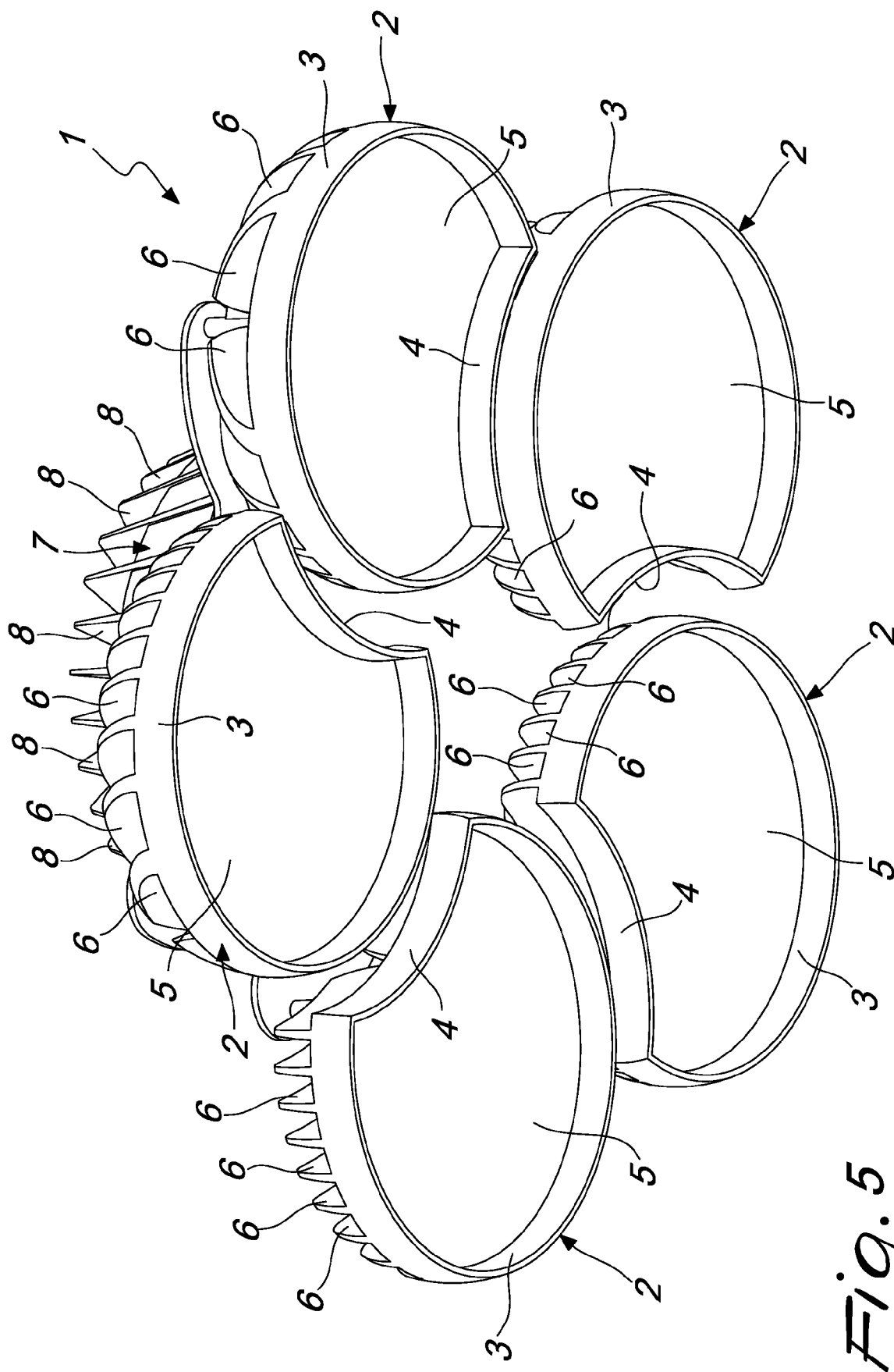


Fig. 5

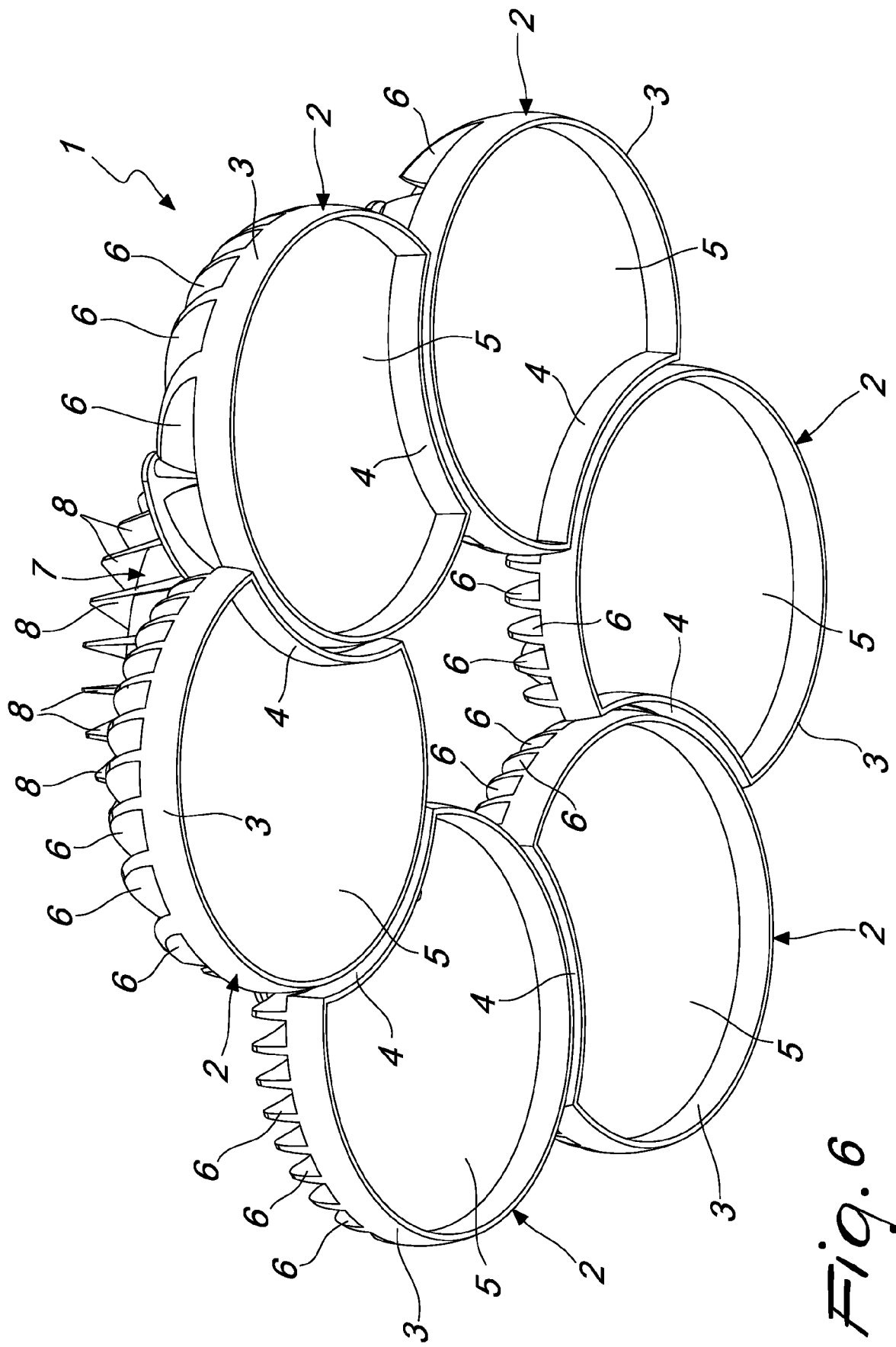


Fig. 6

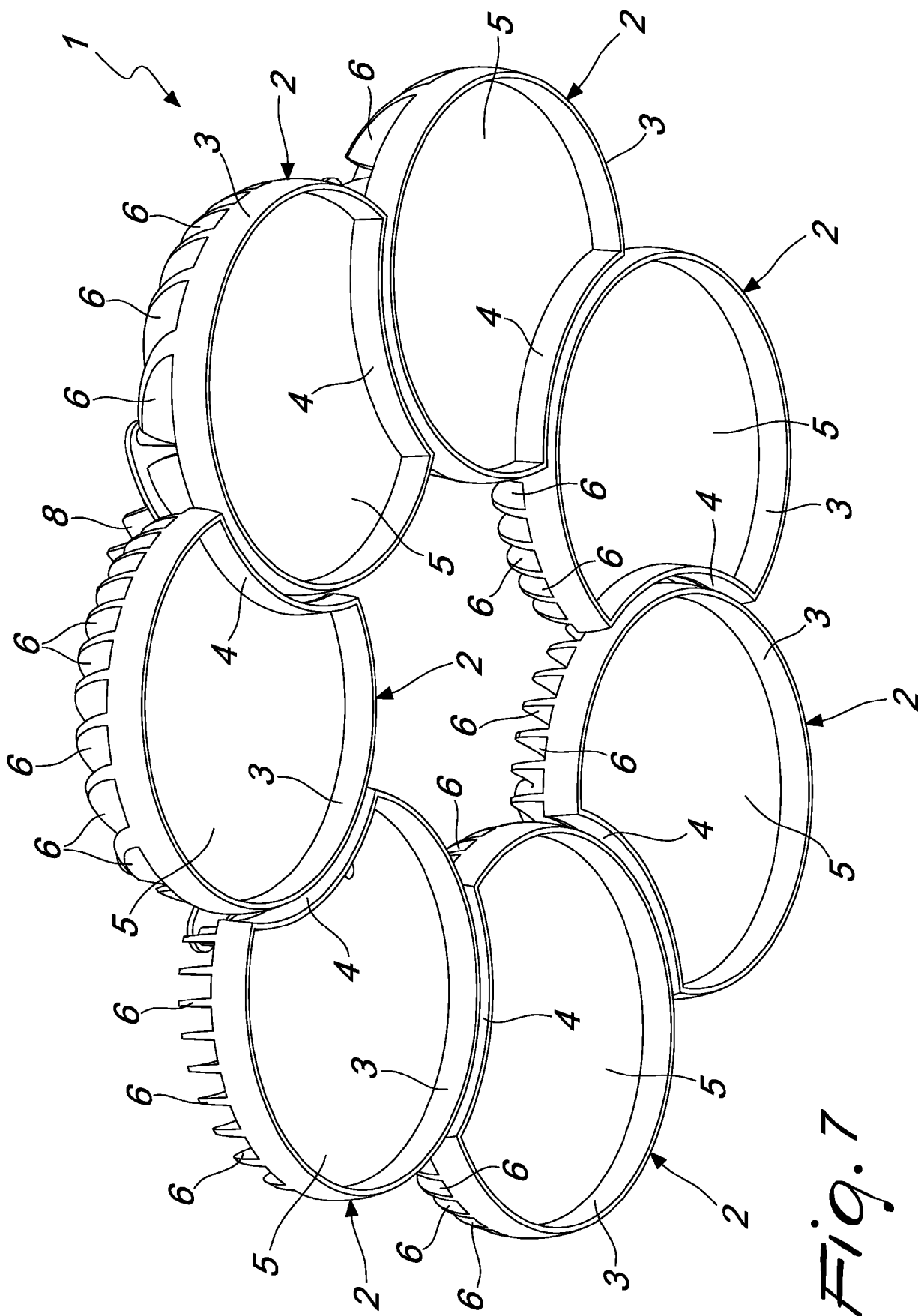
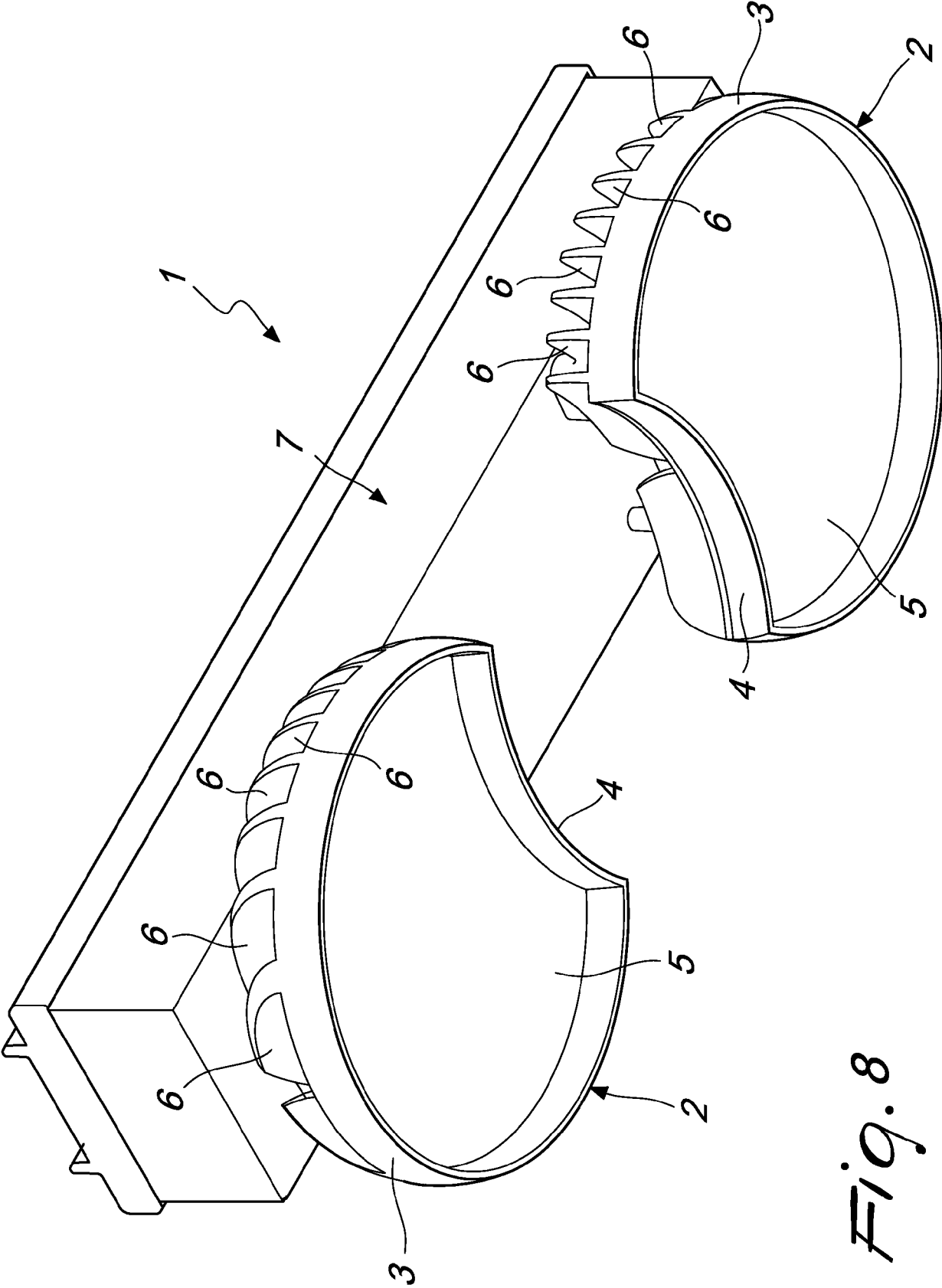


Fig. 7



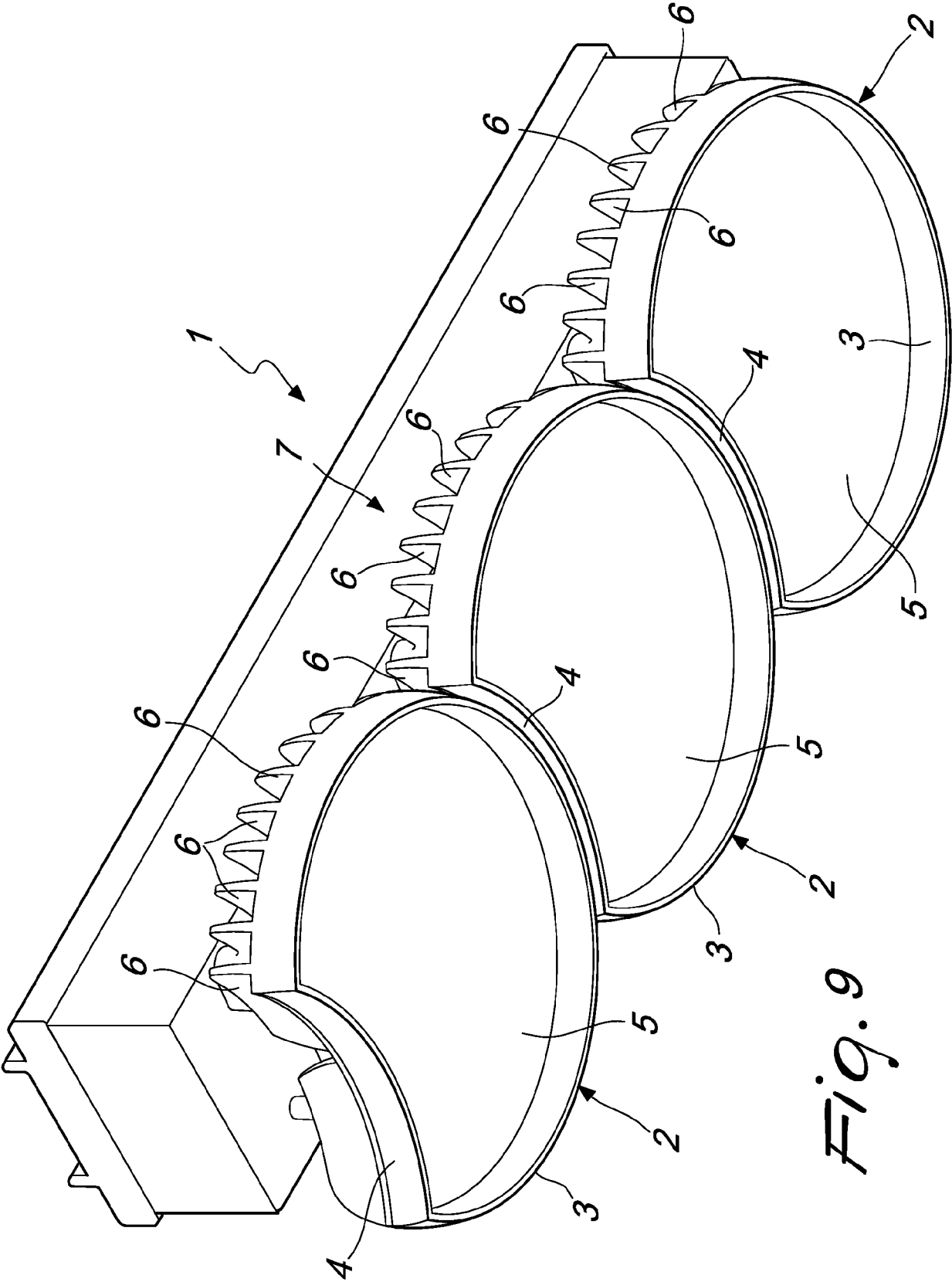


Fig. 9

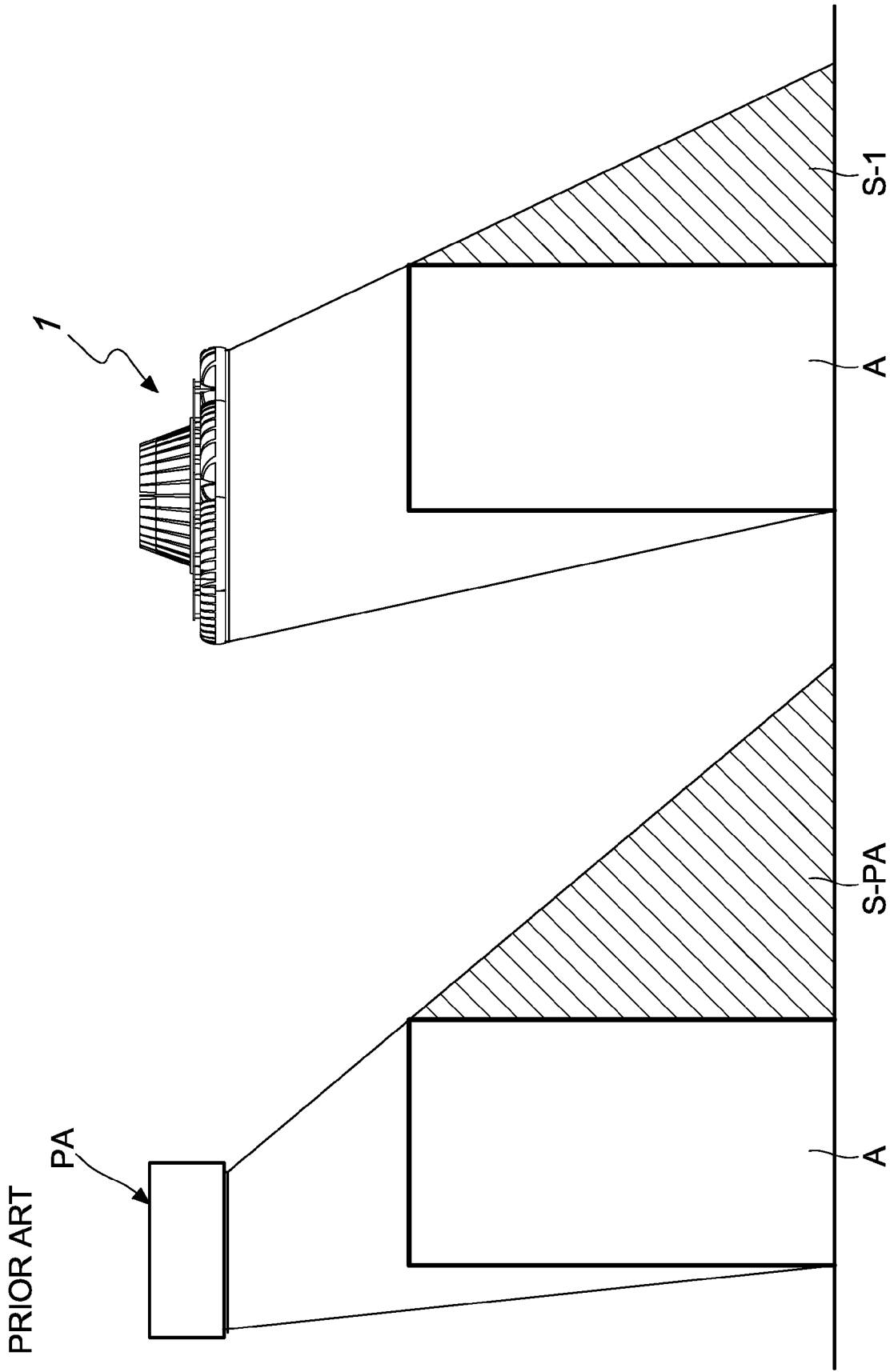


Fig. 10

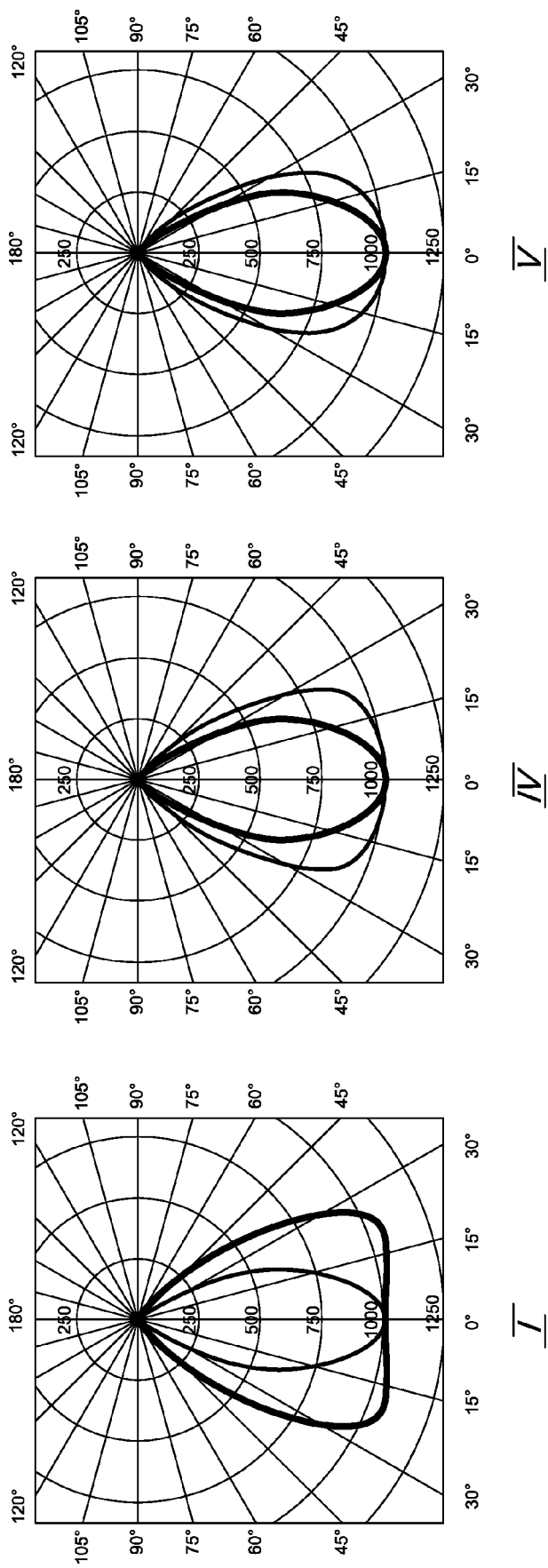


Fig. 11



EUROPEAN SEARCH REPORT

Application Number

EP 24 15 6106

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EPO FORM 1503 03:82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	DE 101 10 835 A1 (OSRAM OPTO SEMICONDUCTORS GMBH [DE]) 19 September 2002 (2002-09-19) * paragraph [0002] * * paragraphs [0029] - [0035] * * figures 3,4 *	1,2,7,8	INV. F21S2/00 F21S8/04 F21V29/76 ADD. F21Y115/10 F21Y105/10
X	US D 942 053 S1 (TIAN ZHENGCAI [CN]) 25 January 2022 (2022-01-25)	1-3,7-10	
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The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 28 June 2024	Examiner Demirel, Mehmet
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