



(86) **Date de dépôt PCT/PCT Filing Date:** 2013/03/21
(87) **Date publication PCT/PCT Publication Date:** 2013/11/07
(45) **Date de délivrance/Issue Date:** 2017/09/05
(85) **Entrée phase nationale/National Entry:** 2014/10/30
(86) **N° demande PCT/PCT Application No.:** EP 2013/000862
(87) **N° publication PCT/PCT Publication No.:** 2013/164054
(30) **Priorité/Priority:** 2012/05/02 (DE10 2012 008 637.7)

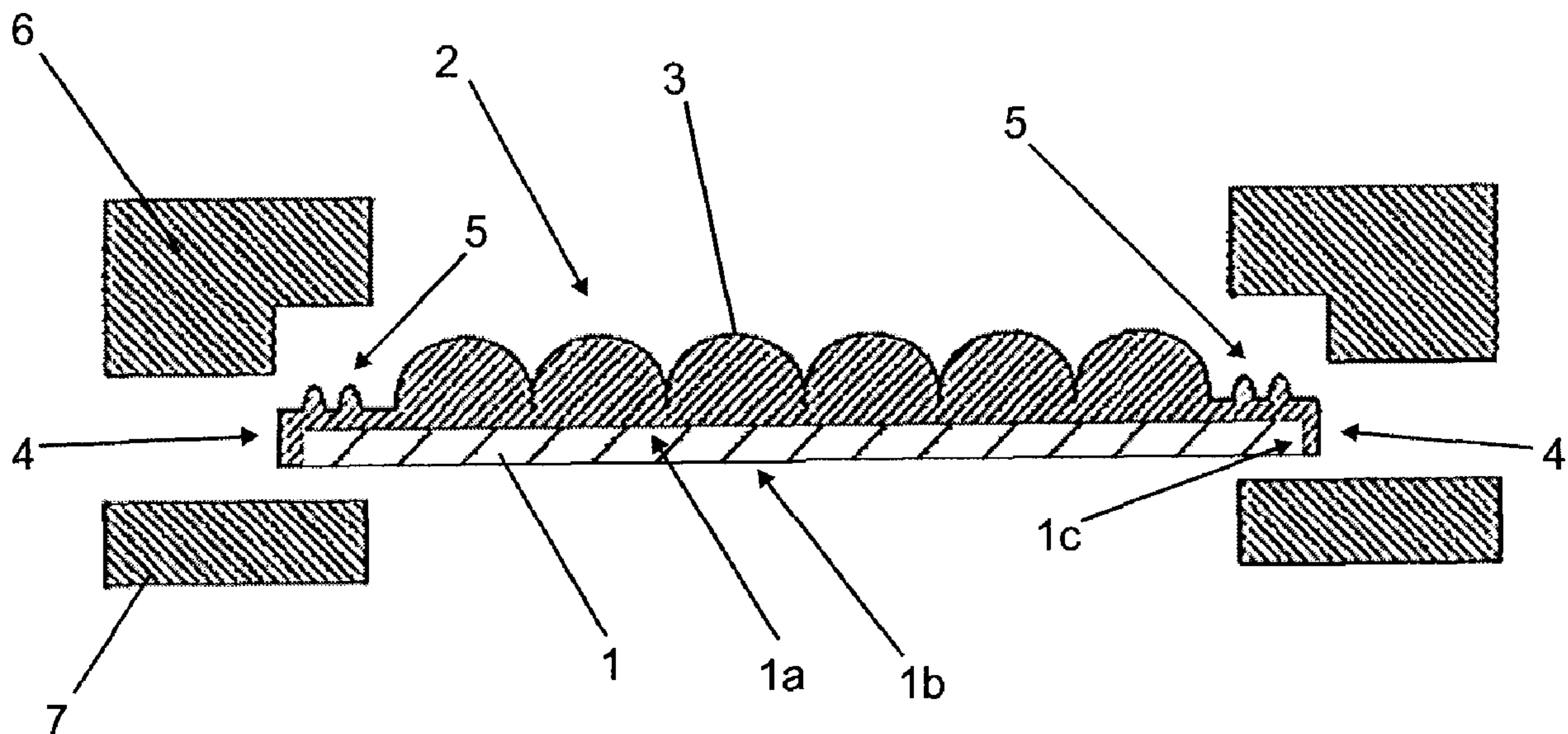
(51) **Cl.Int./Int.Cl.** *B41F 23/04* (2006.01),
F21K 9/69 (2016.01), *G02B 1/04* (2006.01),
H01L 25/075 (2006.01), *H01L 33/54* (2010.01)

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(54) **Titre : MODULE OPTIQUE A PARTIE SAILLANTE CONCUE POUR LE MONTAGE**
(54) **Title: OPTICAL MODULE COMPRISING A MOLDED PORTION FOR INSTALLATION**



(57) **Abrégé/Abstract:**

The invention relates to an optical module which comprises a substrate (1) of defined shape, the substrate having two opposite surfaces (1a, 1b) and an edge (1c), and a layer (2) applied to at least one of the surfaces (1a, 1b) to cover it. The layer (2) consists of a transparent polymeric material and has at least one optical element (3) by means of which light beams are refracted which, starting from the substrate, penetrate the optical element (3). An installation area of the layer has a molded portion for installation and/or adjustment (4, 5) of the optical module, said portion forming one piece with the layer (2) and consisting of the same material.

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES
PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

(19) Weltorganisation für geistiges

Eigentum

Internationales Büro

(43) Internationales

Veröffentlichungsdatum

7. November 2013 (07.11.2013)



(10) Internationale Veröffentlichungsnummer

WO 2013/164054 A1

(51) Internationale Patentklassifikation:

B41F 23/04 (2006.01) **H01L 25/075** (2006.01)

F21K 99/00 (2010.01) **H01L 33/54** (2010.01)

(21) Internationales Aktenzeichen: PCT/EP2013/000862

(22) Internationales Anmeldedatum:

21. März 2013 (21.03.2013)

(25) Einreichungssprache: Deutsch

(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:

10 2012 008 637.7 2. Mai 2012 (02.05.2012) DE

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(81) Bestimmungsstaaten (soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Bestimmungsstaaten (soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, RU, TJ, TM), europäisches (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:

— mit internationalem Recherchenbericht (Artikel 21 Absatz 3)

(54) Title: OPTICAL MODULE COMPRISING A MOLDED PORTION FOR INSTALLATION

(54) Bezeichnung : OPTISCHES MODUL MIT AUSFORMUNG ZUR MONTAGE

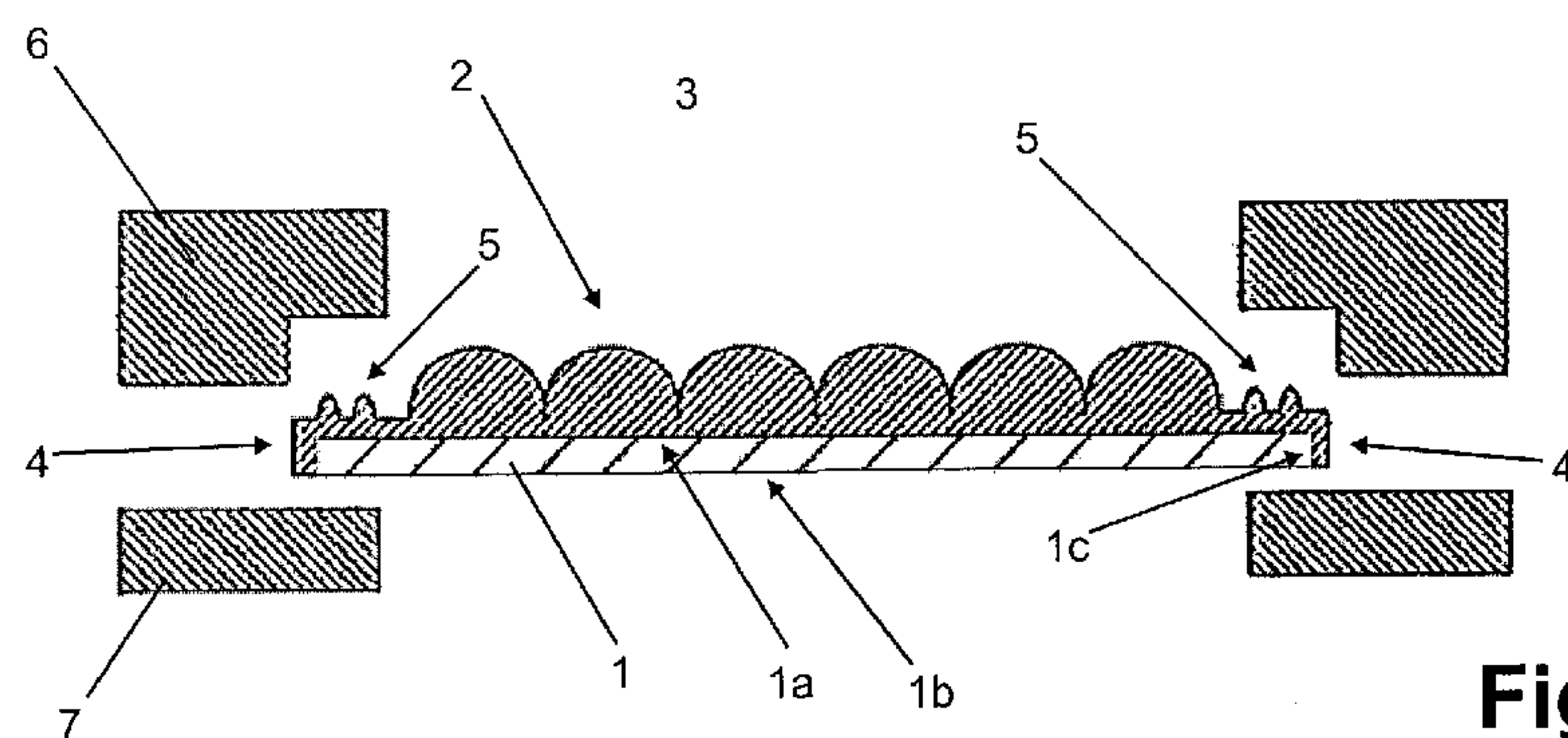


Fig. 1

(57) **Abstract:** The invention relates to an optical module which comprises a substrate (1) of defined shape, the substrate having two opposite surfaces (1a, 1b) and an edge (1c), and a layer (2) applied to at least one of the surfaces (1a, 1b) to cover it. The layer (2) consists of a transparent polymeric material and has at least one optical element (3) by means of which light beams are refracted which, starting from the substrate, penetrate the optical element (3). An installation area of the layer has a molded portion for installation and/or adjustment (4, 5) of the optical module, said portion forming one piece with the layer (2) and consisting of the same material.

(57) **Zusammenfassung:** Die Erfindung betrifft ein optisches Modul, umfassend ein Substrat (1) von definierter Form, wobei das Substrat zwei gegenüberliegende Oberflächen (1a, 1b) und einen Rand (1c) aufweist, und eine auf zumindest einer der Oberflächen (1a, 1b) überdeckend aufgebrachte Schicht (2), wobei die Schicht (2) aus einem transparenten, polymeren Material besteht und zumindest ein optisches Element (3) aufweist, mittels dessen Lichtstrahlen, die von dem Substrat ausgehend das optische Element (3) durchlaufen, eine

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Brechung erfahren, wobei in einem Montagebereich der Schicht eine Ausformung zur Montage und/oder Justage (4, 5) des optischen Moduls vorgesehen ist, die materialeinheitlich einstückig mit der Schicht (2) ausgebildet ist.

OPTICAL MODULE COMPRISING A MOLDED PORTION FOR INSTALLATIONTechnical Field and Background

The invention relates, generally, to an optical module, specifically comprising a substrate of a defined shape, whereby the substrate has two surfaces opposite from each other and an edge, and a layer that is applied to at least one of the surfaces such as to cover it, whereby the layer consists of a transparent polymeric material and has at least one optical element which scatters rays of light which originate from the substrate and pass through the optical element.

WO 2012/031703 A1 describes a production method for chip-on-board modules, in which a substrate comprises a plate-shaped carrier having multiple LEDs, whereby a surface of the substrate is provided, in an open casting mould, with a cover made up of a layer for providing an optical system.

Summary of the Invention

It is the object of the invention to devise an optical module that is easy to mount.

Said object is solved according to the invention by an optical module, comprising a substrate of a defined shape, whereby the substrate has two surfaces opposite from each other and an edge, and a layer that is applied to at least one of the surfaces such as to cover it, whereby the layer consists of a transparent polymeric material and has at least one optical element which scatters rays of light which originate from the substrate and pass through the optical element,

whereby a design feature for mounting and/or aligning of the optical module is provided in a peripheral region of the layer such as to be the same material and the same part as the layer.

An optical module in the scope of the invention shall be understood to be any component which either emits light actively or has a defined passive influence on a beam of light by means of scattering. In this context, the scattering proceeds, at least in part, by means of the optical element that is provided in the transparent layer. Particularly preferred embodiments can have the optical element specifically be a lens, for example collecting lens, dispersing lens, cylinder lens, Fresnel lens or the like. In other embodiments, the scattering by means of the optical element can just as well consist of light scattering, diffraction by means of a prism or the like. The poly-

meric layer with the optical element formed therein forms an optical system that is arranged right on the substrate.

According to the scope of the invention, a design feature for mounting and/or aligning of the module shall be understood to be any structuring of the layer which directly serves to affix the module, for example by clamping the structure in a holder, or serves directly for positioning of the module.

In many cases, the substrate has a plate-shaped structure. This structure can have, for example, a rectangular, circular or polygonal circumference. In plate-shaped structure of this type, the two surfaces extend parallel to each other. A plate-shaped structure with parallel surfaces is evident according to the scope of the invention also if a surface shows certain uneven places, for example due to LEDs or other components applied to it.

In a generally preferred embodiment, the invention provides the optical element and the design feature for mounting and/or aligning to be formed in a casting process in the course of the application of the layer onto the substrate such as to be the same material and the same part as the layer. A production of a layer of this type with an optical element in a casting process is described, for example, in WO 2012/031703 A1, reference to which shall thus be made. In this context, the additional design feature according to the invention can be made by modifying the casting mould appropriately. It is particularly preferred that the casting proceeds by immersing the substrate into an open casting mould, as described in WO 2012/031703 A1.

In a preferred refinement of the invention, the layer consists of a silicone. This can concern, in particular, highly pure silicone that comprises high resistance to UV radiation. A highly pure silicone shall be understood to be a silicone that contains less than 1 per mille, in particular less than 10 ppm, of contaminations and foreign substances. This also includes carbon, which is not present in a highly pure silicone according to the scope of the invention.

In an optional embodiment of the invention, the design feature for mounting and/or aligning of the module comprises at least one projection beyond a surface of the layer, whereby a clamping jaw of a holding device for the optical module is placed on the projection. Projections of this type are easy means of providing good bracketing, whereby a defined contact surface is provided.

This allows accurate positioning to be attained and enables clamping without damage. The dimensioning of the projections can be matched to the materials properties of the polymeric layer, such as hardness and elasticity. This can concern, for example, nubs, beads or the like. The size of the individual design features can typically be in the range from 10 μm to approx. 1 mm for a module with lateral lengths on the order of magnitude of 1 cm to 100 cm.

If the module is clamped by means of the projections, these can be squeezed or elastically impressed in defined manner by the clamping jaws.

In an alternative or additional embodiment, the design feature comprises a limit stop that positions such as to attain dimensional stability in an aligning direction. This means, in particular, that the layer itself provides the defined reference points when the module is incorporated in a defined position. This advantageously means that the spatial positioning in the respective aligning direction proceeds in defined manner with respect to the position of the optical element. The positioning of the substrate with respect to the layer can be within wider tolerances that are defined by the application on hand.

In an advantageous detailed design, the layer covers the edge of the substrate, whereby the aligning direction extends at least approximately parallel to the surfaces of the substrate. This allows for accurate positioning in a direction in space transverse to the emission direction, in which accurate positioning of the optical element often is particularly important. Advantageously, the accuracy of a position of the limit stop in the aligning direction is no more than 20 per mille, particularly preferably no more than 5 per mille, of a dimension of the optical module in the aligning direction. If the material of the polymeric layer is relatively soft, it is advantageous to keep an eye on the contact forces during the mounting process in order not to falsify the limit stop position by compressing the layer. Combining a dimensionally stable limit stop and the manufacture of the module in an, in particular, open casting mould is particularly advantageous, since casting moulds of this type can usually be made at high accuracy. Accordingly, the provision of a mould for the accurately positioned limit stop can easily be integrated into the design of the casting mould.

In another alternative or additional embodiment of the invention, the design feature for mounting and/or aligning is provided for notching, in a form-fitting manner at least in one direction, with a

design feature of another optical module. This allows multiple modules to be joined directly in one or more directions in space. Due to the form-fit, a bracketing and/or at least relative positioning in at least one direction in space is provided. For example modules that are arranged in series right next to each other in a longitudinal direction can comprise design features of the tongue-and-groove-type, which prevent at least a slipping with respect to each other in a transverse direction. The design features can just as well comprise a form-fitting notching in multiple directions in space, for example pegs and receptacles analogous to the design of pieces of a puzzle. Depending on the requirements, this allows a serial or two-dimensional connection of immediately adjacent optical modules in fixed position to be generated. The modules can, in particular, be structurally identical.

In generally preferred embodiments, the layer has a hardness in the range of 10 to 90 Shore A, particularly preferably 50 to 75 Shore A. Due to this relatively low hardness, special polymers can be used as the medium forming the optical element, for example highly pure silicones. The preferred hardness range is sufficient to provide for sufficiently accurate positioning and/or bracketing by means of the design features of the layer when needed. For example in the case of a clamping-type bracketing on projections according to the invention, largely elastic deformation of the projections in said hardness range may be evident. Altogether, this provides good protection against shocks, vibrations and/or mechanical tension, e.g. due to thermal expansions.

In one possible embodiment of the invention, the substrate comprises a chip-on-board module with a carrier and at least one LED that is arranged on the carrier. Said modules are described, for example, in WO 2012/031703 A1.

Advantageously, at least 50% of the light emitted by the LEDs is in a wavelength range below 470 nm. This allows the lamp to be designed as an UV emitter, at least mainly. Further combination of features according to the invention allows the UV emitter to be flexibly integrated into a technical device, for example a printing machine.

Alternatively, at least 50% of the light emitted by the LEDs is in a wavelength range above 780 nm. This allows the lamp to be designed as an IR emitter, at least mainly. Further combination

of features according to the invention allows the IR emitter to be flexibly integrated into a technical device, for example a printing machine.

In another embodiment, the substrate comprises an optically transparent or optically reflective carrier, whereby an optical system for specific scattering of rays of light is formed by the carrier and the layer acting in concert. Said optical systems are preferably manufactured like in the method described in WO 2012/031703 A1, whereby the chip-on-board module is replaced by the optically transparent or reflective, i.e. optically effective, carrier. The carrier can just as well be covered with a polymeric layer and optical elements on two sides that are opposite to each other. Depending on the requirements, each of the layers can comprise a design feature according to the invention. A simple example of a carrier is a glass plate to which one or more optical elements, such as, e.g., lenses, are applied by means of the polymeric layer.

The object of the invention is also solved through an apparatus for drying a coating, comprising a lamp having an optical module according to the invention. The module according to the invention is particularly well-suited for a lamp and/or apparatus of this type, since it combines high irradiation intensities and a flexible and, in particular, compact design.

In a preferred refinement, a two-dimensional substrate bearing the coating to be dried and the lamp can be moved towards each other in a conveying direction, whereby the lamp extends at least partly over a width of the substrate in a transverse direction and is arranged at a defined distance above the substrate. This shall include scanning of the substrate surface in multiple runs. The substrate can, for example, be printed matter that is coated with lacquer or another substance being printed on it in a printing machine.

The object of the invention is also met through the use of an optical module according to the invention for drying a coating, preferably in a printing procedure.

Further advantages and features of the invention are evident from the exemplary embodiment described in the following.

Brief Description of the Drawings

One preferred exemplary embodiment of the invention is described in the following and illustrated in more detail based on the appended drawings. In the figures:

Fig. 1 shows an optical element according to the invention in the process of being inserted into a bracketing.

Fig. 2 shows the element from Fig. 1 fixed in position between clamping jaws.

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Detailed Description of the Preferred Embodiments

The optical element shown in Fig. 1 comprises a plate-shaped substrate and/or a carrier 1 having two parallel surfaces 1a, 1b. Presently, the carrier has an edge 1c that is rectangular in shape. Shown only schematically, the carrier 1 is an LED module configured to bear a multiplicity of LEDs arranged in an array according to the modules described in WO 2012/031703 A1. Said modules are also called chip-on-board modules and contain not only LEDs, but also connecting lines and, if applicable, further electronic components for triggering the LEDs.

The carrier 1 is provided with a layer 2 that consists of highly pure, UV-translucent and UV-resistant silicone. The layer covers one of the surfaces 1a. The LEDs are arranged on the surface 1a such that the surface 1a is only approximately even. However, in the scope of the invention, the two surfaces 1a, 1b are considered to be parallel.

The layer is formed from the same material and in one piece and comprises a multiplicity of design features 3 that are provided as optical elements, i.e. as planar-convex focusing lens in the present case. The focusing lenses each are situated above an LED (not shown) in order to focus the emitted LED light and/or in order to transport the largest possible opening angle of the light.

The layer 2 also covers the edge 1c of the plate-shaped carrier 1 such that the layer 2 forms peripheral external surfaces 4 of the module. Concurrently with the external surfaces 4, accurately positioned limit stops are formed that enable forming a design feature for aligning the module at least in a transverse direction. The transverse direction extends in the horizontal line of the plane of the drawing of Fig. 1. The position of the limit stops and/or surfaces 4 in the transverse direction is defined at an accuracy of less than 10 per mille of a diameter of the module in the transverse direction. This accuracy applies, in particular, to a position of the limit stops 4 with respect to the positions of the optical elements 3.

Accordingly, the limit stops 4 thus form design features for alignment and/or mounting in the scope of the invention.

Further design features according to the invention for aligning and/or mounting are formed by
5 projections 5 that project in an upward direction beyond the surface of the layer 2. The projections are provided at the edge 1c above the surface 1a of the carrier. Depending on requirements, they comprise multiple individual nubs or fins.

Presently, both design features 4, 5 are provided in a mounting region that is provided in the
10 vicinity of the edge 1c of the carrier. However, in other embodiments, the mounting region can just as well be arranged differently, for example about a central bore hole or the like.

Presently, the optical module is held in an apparatus by clamping by means of upper clamping
jaws 6 and lower clamping jaws 7. In this context, the upper clamping jaws 6 do not press di-
15 rectly onto the free, planar surface of the layer 2, but rather press only on the projections 5. This generates a defined bracketing that can compensate well for mechanical tensions, for example due to thermal expansion.

Presently, one of the clamping jaws 6 defines the assembled position and/or the exact align-
20 ment of the module such that the corresponding limit stop surface 4 touches against a corresponding design feature of the clamping jaw 6 and/or bracketing.

The lower clamping jaw 7 touches against the lower surface 1b of the carrier 1. However, in
other embodiments, the lower surface 1b of the carrier can just as well be covered by a layer 2
25 and design features according to the invention can be present on said side as well.

In the mounted condition according to Fig. 2, the clamping jaws 6, 7 touch against each other
and are affixed by means of a screw 8. The width of a fastening gap 9 between the clamping
jaws, in which the module is accommodated, is pre-determined such that the module 1 cannot
30 be damaged by over-tightening a fastening member.

Presently, the layer 2 consists of a silicone with a hardness of approx. 50 Shore A. Since this is a relatively soft material, clamping by means of the projections is particularly favourable as it prevents significant elastic deformation of the layer 2 and/or of the optical elements 3.

- 5 The manufacture of the module with the layer 2 on the carrier 1 proceeds essentially as described in WO 2012/031703 A1 by immersing the carrier into an open casting mould that is filled with a silicone starting material. The low-viscosity starting material has a viscosity of less than 1,000 mPa*s, preferably of less than 100 mPa*s. In addition, design features according to the invention for aligning and/or mounting are provided on the casting mould.

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In a further exemplary embodiment that is not shown, the carrier 1 can be coated on both sides, in particular by means of the method described above. In this context, the substrate can be provided, in particular, to be transparent, for example in the form of a glass plate.

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Claims

1. An optical module, comprising
a substrate (1) having two surfaces (1a, 1b) opposite from each other and an edge (1c),
and
5 a layer (2) that is applied to at least one of the surfaces (1a, 1b) to cover it,
whereby the layer (2) consists of a transparent polymeric material and has at least one
optical element (3) which scatters rays of light which originate from the substrate and
pass through the optical element (3),
characterised in that
10 a design feature for mounting and/or aligning (4, 5) of the optical module is provided in a
mounting region of the layer to be the same material and the same part as the layer (2),
wherein the design feature for mounting and/or aligning comprises at least one projection
(5) beyond a surface of the layer (2), whereby a clamping jaw (6, 7) of a holding device
for the optical module is placed on the projection (5).
15
2. The optical module according to claim 1, characterised in that the optical element (3) and
the design feature for mounting and/or aligning (4, 5) are formed in a casting process in
the course of the application of the layer (2) onto the substrate to be the same material
and the same part as the layer (2).
20
3. The optical module according to claim 2, characterised in that the casting proceeds by
immersing the substrate into an open casting mould.
4. The optical module according to either one of the claims 2 or 3, characterised in that the
25 layer (2) consists of a silicone.
5. The optical module according to any one of claims 1 to 4, characterised in that the design
feature for mounting and/or aligning comprises a limit stop (4) that positions to attain
dimensional stability in an aligning direction.
30
6. The optical module according to claim 5, characterised in that the layer (2) forms the limit
stop (4) at a covering of the edge (1c) of the substrate, whereby the aligning direction
extends at least approximately parallel to the surfaces of the substrate.

7. The optical module according to claim 5 or 6, characterised in that the accuracy of a position of the limit stop (4) in the aligning direction is no more than 20 per mille of a dimension of the optical module in the aligning direction.
- 5 8. The optical module according to any one of claims 1 to 7, characterised in that the design feature for mounting and/or aligning is provided for notching, in a form-fitting manner at least in one direction, with a design feature of another optical module.
- 10 9. The optical module according to any one of claims 1 to 8, characterised in that the layer has a hardness in the range of 10 to 90 Shore A.
- 15 10. The optical module according to any one of claims 1 to 9, characterised in that the substrate comprises a chip-on-board module with a carrier (1) and at least one LED that is arranged on the carrier.
- 20 11. The optical module according to any one of claims 1 to 9, characterised in that the substrate comprises an optically transparent or optically reflective carrier (1), whereby an optical system for specific scattering of rays of light is formed by the carrier and the layer (2) acting in concert.
- 25 12. A device for drying a coating, comprising a lamp having an optical module according to any one of claims 1 to 11.
- 30 13. The device according to claim 12, characterised in that a two-dimensional substrate bearing the coating to be dried and the lamp are moved towards each other in a conveying direction, whereby the lamp extends at least partly over a width of the substrate in a transverse direction and is arranged at a defined distance above the substrate.
14. Use of an optical module according to any one of claims 1 to 11, for drying a coating in a printing procedure.

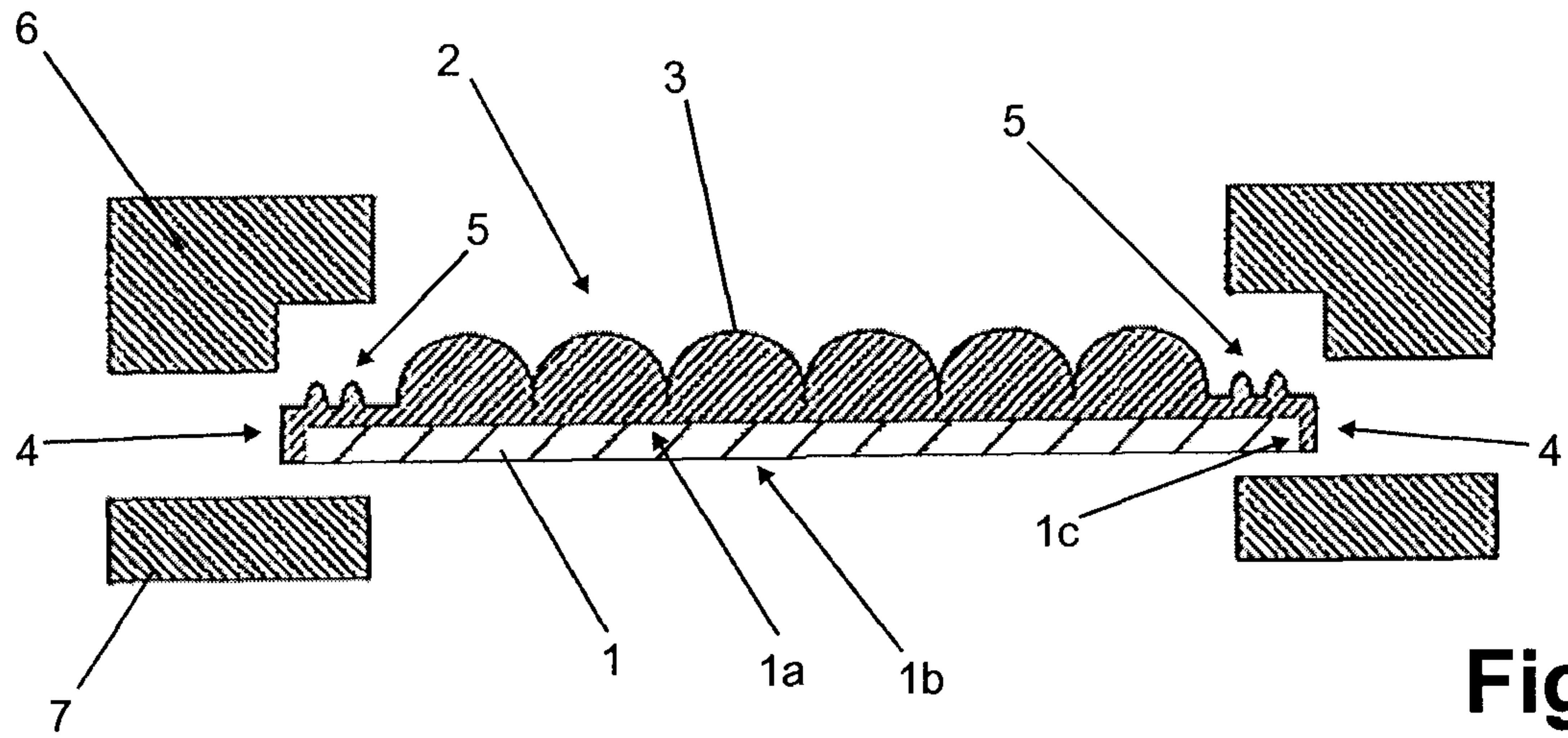


Fig. 1

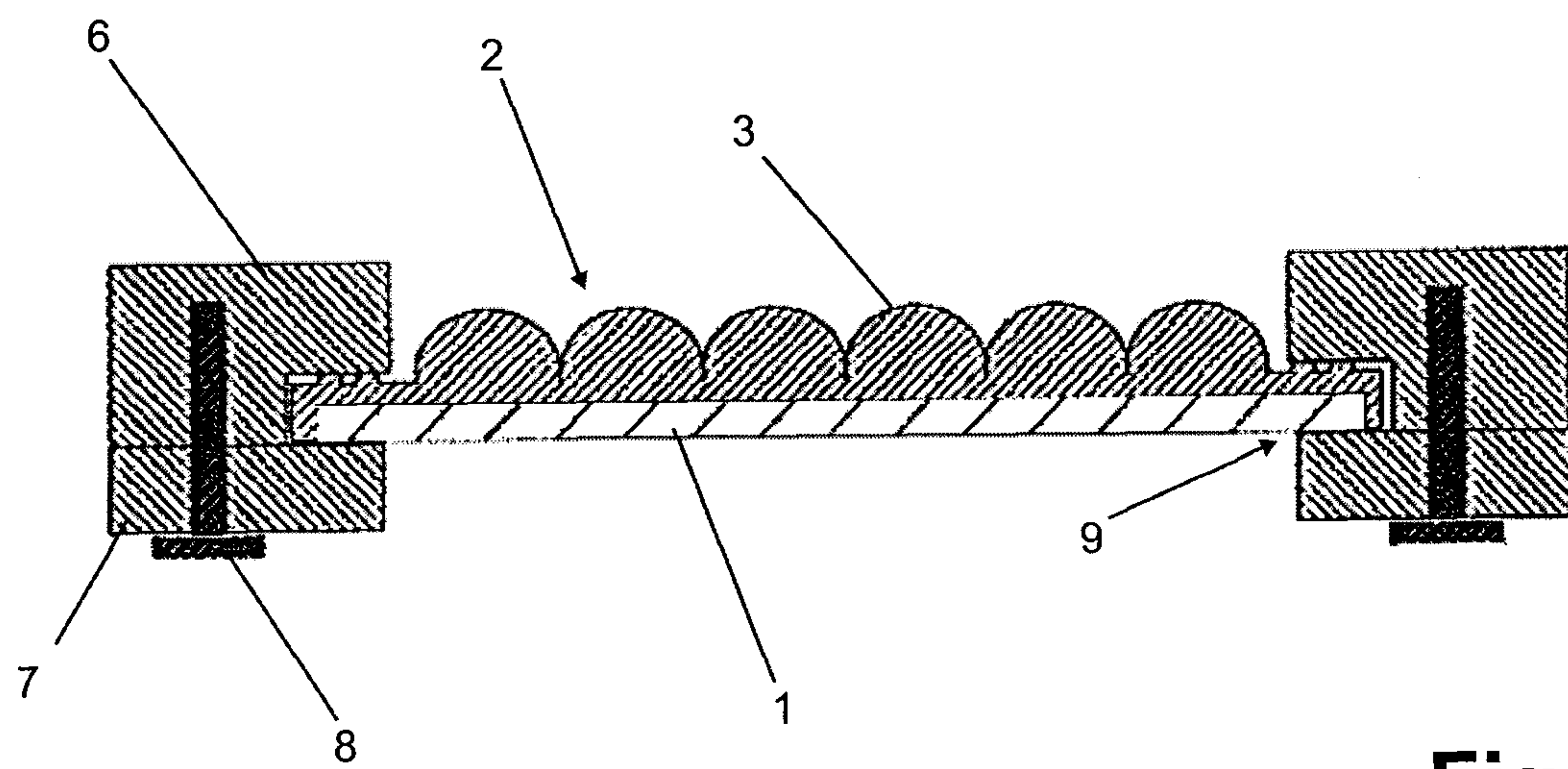


Fig. 2

