



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.02.2020 Bulletin 2020/07

(51) Int Cl.:
B24B 13/005 (2006.01)

(21) Application number: **18306107.6**

(22) Date of filing: **10.08.2018**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **ESSILOR INTERNATIONAL (COMPAGNIE GENERALE D'OPTIQUE)**
94220 CHARENTON LE PONT (FR)

(72) Inventors:
• **MARTIN, Luc**
94220 CHARENTON-LE-PONT (FR)

- **BULTEZ, Xavier**
94220 CHARENTON-LE-PONT (FR)
- **PINAULT, Sebastien**
94220 CHARENTON-LE-PONT (FR)
- **MAUDERER, Michael**
81825 Munich (DE)
- **SCHÄFER, Holger**
6340 BAAR (CH)
- **MOINE, Jérôme**
94220 CHARENTON-LE-PONT (FR)
- **KREIS, Michael**
6340 Baar (FR)

(74) Representative: **Cabinet Novitech**
188 Grande rue Charles de Gaulle
94130 Nogent-sur-Marne (FR)

(54) **METHOD FOR MACHINING AN OPTICAL SURFACE OF AN OPTICAL LENS**

(57) Method for machining an optical surface of an optical lens, the method comprising:
- a lens blank providing step, during which a lens blank blocked on a lens blocker is provided,
- a clamping step, during which the lens blocker holding the lens blank is clamped in a lens machining device,
- a tilting step, during which the lens blank and lens blocker are tilted relative to the rotation axis of the lens machining device,
- a surface position determining step, during which the

position of the surface to be machined is determined based on the tilt angle of the lens blank and lens blocker relative to the rotation axis of the lens machining device,
- a machining tool configuration step, during which the operational parameters of the lens machining tool are configured in order to manufacture the surface to be manufactured according to the determined surface position so that the desired optical properties of the optical lens are respected.

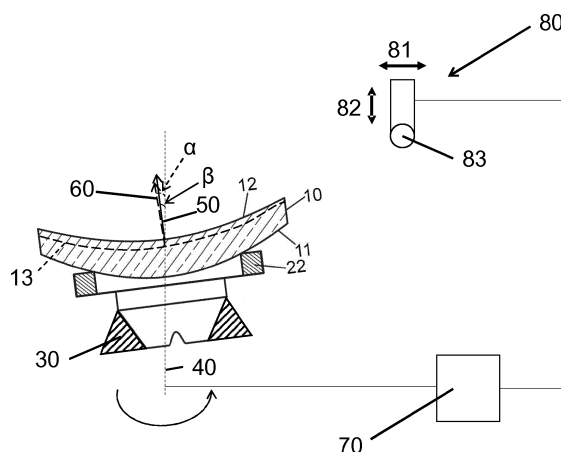


Figure 6

Description

FIELD OF THE INVENTION

[0001] The invention relates to a method for machining an optical surface of an optical lens, a machining device for machining the optical surface of an optical lens, and to a computer program product comprising one or more stored sequences of instructions corresponding to the method of the invention.

BACKGROUND OF THE INVENTION

[0002] An optical lens is typically made of plastic or glass material and generally has two opposing surfaces which co-operate with one another to converge or diverge light according to a required corrective prescription.

[0003] During the machining of an optical lens, in addition to the precision in manufacturing the surfaces, it is also essential for such surfaces to be perfectly aligned with one another both axially and angularly. Otherwise, the optical lens does not provide the optical effect for which it was designed, in particular the required corrective prescription.

[0004] Indeed, the relative positioning and shape of these surfaces has a direct impact on the effect of the optical lens on light.

[0005] Manufacturing of an optical lens to the required prescription requirements typically includes machining the surface of a semi-finished lens or lens blank. Typically, a semi-finished lens has a finished front surface and an unfinished back surface. By machining the back surface of the lens to remove material, the required shape and positioning of the back surface with respect to the front surface for the desired corrective prescription can be generated. Further surfacing operations of an optical lens can include chamfering, beveling, polishing, or coating the surface of a lens member in order to modify the optical surface.

[0006] During manufacturing of the lens, it is important that the semi-finished lens is securely maintained in a correct positioning.

[0007] In the state of the art, in order to hold in position, the semi-finished lens a lens blocker is used that is applied to the finished front surface at a precise angular and axial position.

[0008] The lens blocker acts as a gripping interface for the holding system during the manufacturing of the surface to be manufactured in particular during the cutting step and provides the semi-finished lens blank with a sufficient strength to counteract the force applied by the cutting tool.

[0009] During the manufacturing process of an optical lens a desired prism may be introduced. The desired prism may be either a prescription prism or a thinning prism.

[0010] The prism of the optical lens can be defined by the vector (αf , βf , Zf) which is perpendicular to the tan-

gential plan at the prism reference point (PRP) of the optical lens; whereby αf corresponds to the prism amplitude, βf corresponds to the prism orientation and Zf the vertical position of the PRP.

[0011] The manufacturing of such desired prism requires that the semi-finished lens be oriented in a desired specific orientation with respect to the manufacturing tools. Such orientation is usually obtained by using a prismatic blocker enabling the semi-finished lens blank to be supported at a given inclination or tilt for the machining process.

[0012] Prismatic blockers typically require the use of resins or glues, therefore requiring long times to allow the adhesive material to set and cool down. Alternatively, the prism at blocking is applied through a lead-based low melting alloy.

[0013] Therefore, there is a need for a method of machining an optical lens that allows having a desired prism that would not present the prior art method drawbacks.

[0014] One object of the present invention is to provide such method.

SUMMARY OF THE INVENTION

[0015] To this end, the invention proposes a method for machining an optical surface of an optical lens, the method comprising:

- a lens blank providing step, during which a lens blank blocked on a lens blocker is provided,
- a clamping step, during which the lens blocker holding the lens blank is clamped in a lens machining device,
- a tilting step, during which the lens blank and lens blocker are tilted relative to the rotation axis of the lens machining device,
- a surface position determining step, during which the position of the surface to be machined is determined based on the tilt angle of the lens blank and lens blocker relative to the rotation axis of the lens machining device,
- a machining tool configuration step, during which the operational parameters of the lens machining tool are configured in order to manufacture the surface to be manufactured according to the determined surface position so that the desired optical properties of the optical lens are respected.

[0016] Advantageously, the method of the invention combines a tilting step and a surface position determining step allowing to machine an optical lens with a desired prism without the use of a prismatic blocker.

[0017] Therefore, the semi-finished lens blank may be blocked to a simple lens blocker and the desired prism may be managed entirely during the machining step and in the machining device.

[0018] According to further embodiments which can be considered alone or in combination:

- during the surface position determining step the position of the surface to be machined is determined so that the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is smaller than or equal to 3° ; and/or
- during the surface position determining step the position of the surface to be machined is determined so that the normal of the surface to be machined at the rotation axis of the lens machining device is co-linear with the rotation axis of the lens machining device; and/or
- during the tilting step the lens blank and lens blocker are tilted of an angle β with the rotation axis of the lens machining device smaller than or equal to 3° ; and/or
- the method further comprises a weight distribution determining step during which a weight distribution of the lens blank and lens blocker around the rotation axis of the lens machining device is determined based on the tilt of the lens blank and lens blocker; and/or
- the tilting step the lens blank and lens blocker are tilted so that the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is as small as possible; and/or
- during the tilting step the lens blank and lens blocker are tilted of an angle β determined so as the difference with the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is as small as possible; and/or
- the clamping and tilting steps are carried out simultaneously by having the clamping device of the machining device with a predetermined tilt relative to the rotation axis of the lens machining device; and/or
- the method further comprises a surface machining step during which the surface of the optical lens blank to be machined is machined based on the operational parameters of the lens machining tool configured during the machining tool configuration step.

[0019] The invention also relates to a machining device for machining the optical surface of an optical lens, the machining device comprising:

- a clamp configured to clamp a lens blocker with a tilt angle relative to the rotation axis of the lens machining device, and
- a processor for:
 - determining the position of the surface to be machined based on the tilt angle of the lens blank and lens blocker relative to the rotation axis of the lens machining device, and
 - configuring the operational parameters of the lens machining tool in order to manufacture the

surface to be manufactured according to the determined surface position so that the desired optical properties of the optical lens are respected.

[0020] According to further embodiments which can be considered alone or in combination:

- the clamp has a predetermined tilt angle relative to the rotation axis of the lens machining device; and/or
- the clamp is configured to tilt the lens blank and lens blocker with an angle β smaller than or equal to 3° ; and/or
- the processor is further configured to determine a weight distribution of the lens blank and lens blocker around the rotation axis of the lens machining device based on the tilt of the lens blank and lens blocker.

[0021] The invention further relates to a computer program product comprising one or more stored sequences of instructions that are stored, for instance, on a non-transitory computer memory and that are accessible to a processor and which, when executed by the processor, causes the processor to carry out at least the steps of the method according to the invention.

[0022] The invention also relates to a computer-readable storage medium having a program recorded thereon; where the program makes the computer execute at least the steps of the method of the invention.

[0023] The invention further relates to a device comprising a processor adapted to store one or more sequence of instructions and to carry out at least steps of the method according to the invention.

[0024] The invention further relates to a computer readable medium comprising one or more stored sequences of instruction of a computer program product, wherein the one or more sequences of instructions are accessible to a processor and which, when executed by the processor, causes the processor to carry out the steps of the method according to the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025] Embodiments of the invention will now be described, by way of example only, and with reference to the following drawings in which:

- Figure 1 is a flow chart representing a method according to the invention,
- Figure 2 is a perspective view of a lens blank to be machined,
- Figure 3 is a planar view of a preformed surface of a lens blank to be machined,
- Figure 4 is a cross-sectional view of a lens blank blocked on a lens blocker,
- Figure 5 is a cross-sectional view of a lens blank blocked on a lens blocker and clamped in a lens machining device, and
- Figure 6 is a schematic representation of a machin-

ing device adapted to move a machining tool so that it cooperates in a turning operation with lens blank that is driven in rotation.

[0026] Elements in the figures are illustrated for simplicity and clarity and have not necessarily been drawn to scale. For example, the dimensions of some of the elements in the figure may be exaggerated relative to other elements to help improve the understanding of the embodiments of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

[0027] The invention relates to a method for machining an optical surface of an optical lens starting from a lens blank.

[0028] As illustrated on figure 1, the method of the invention comprises at least:

- a lens blank providing step S1,
- a clamping step S2,
- a tilting step S3,
- a surface position determining step S4, and
- a machining tool configuration step S5.

[0029] During the lens blank providing step S1 a lens blank blocked on a lens blocker is provided.

[0030] The lens blank may be a semi-finished optical lens member. Alternatively, the lens blank may require that both surfaces be machined.

[0031] As illustrated on figure 2, a semi-finished lens member 10 has a preformed front surface 11 that, in use of the resulting finished optical lens, is disposed nearest the object being viewed and an opposing surface 12 to be modified by the manufacturing process to provide the back surface 13 of the finished optical lens, represented by the dotted line.

[0032] Opposing surface 12 is machined by a machining tool so that the back surface 13 is orientated with respect to and distanced from the front surface 11, according to the required optical prescription.

[0033] While in this embodiment of the invention, the back surface of the optical lens is formed by the machining process, it is to be understood, that in alternative embodiments of the invention both or either surfaces of the lens may be formed by the machining process.

[0034] Moreover, although the optical surface 13 to be manufactured is represented in Figure 2 as concave, it is to be appreciated that the optical surface 13 could equally well be convex or any other curved surface

[0035] With reference to Figure 3, reference manufacturing markings 111 may be provided on the preformed front surface 11 of the semi-finished lens member 10 as reference features for positioning purposes. The manufacturing markings 111 are visible through the semi-finished lens member 10 from the opposing side 12 of the lens member 10.

[0036] Referring now to Figure 4 and 5, a lens blocking device 20 for blocking lens member 10 in the correct positioning for manufacturing processes comprises a blocker 21, a blocking ring 22. A protection film, not represented, may be placed between the front surface 11 of the lens member 10 and the blocking device 20. Blocking cast material 24 is poured into the cavity defined by the lower front surface 11 of the optical lens 10, the blocker 21 and the blocking ring 22. The blocking cast material 24 cools to solidify in order to provide a blocking support for the optical lens 10 at the desired positioning for machining. The lower surface or bearing surface 241 of blocking material 241 acts as a reference surface for determining the thickness at the center of the lens member 10.

[0037] The lens blocking device may also be a vacuum blocking device wherein the semi-finished lens member is blocked against a blocking device using a vacuum.

[0038] Typically, the blocking device comprises a suction device. Such a device preferably comprises a first rotary shaft or rear mandrel ending with a suction chamber at the end intended to come into contact with the front surface of the semi-finished optical lens member blank. The suction chamber is connected to a suction group for generating the vacuum and comprises a gasket or other type of sealing elements capable of making a fluid tight coupling once such sealing elements are rested onto the front surface of the semi-finished optical lens member.

[0039] During the clamping step S2, the lens blocker holding the lens blank is clamped in a lens machining device. As illustrated on figure 5, the lens blocker 21 holding the lens blank 10 may be clamped using a clamping device 30, such as a clamp so as to allow the rotation of the lens blocker holding the lens blank about a rotation axis of the machining device.

[0040] As illustrated on figure 6, the lens blank 10 and the lens blocker are tilted relative to the rotation axis 40 of the lens machining device during the tilting step S3.

[0041] Advantageously, tilting the lens blocker in the lens machining device allows machining a desired prism without having to carry out a complex blocking process. Indeed, the lens blank may be blocked without considering a desired prism. Thus, making the blocking step much easier and allowing an easy use of for example vacuum blocking devices.

[0042] During the tilting step S3, the lens blank and lens blocker are tilted of a tilt angle β with the rotation axis of the lens machining device. According to an embodiment of the invention, the angle β is smaller than or equal to 3° .

[0043] The position of the surface 13 to be machined is determined during the surface position determining step S4. The position of the surface 13 to be machined is determined based on the tilt angle β of the lens blank and the lens blocker relative to the rotation axis of the lens machining device.

[0044] According to a preferred embodiment of the invention, during the surface position determining step S4,

the position of the surface to be machined is determined so that the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is smaller than or equal to 3° .

[0045] So as to facilitate the machining of the surface and to increase the quality of the machined surface, the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is to be as small as possible.

[0046] Therefore, according to an embodiment of the invention, during the surface position determining step the position of the surface to be machined is determined so that the normal of the surface to be machined at the rotation axis of the lens machining device is co-linear with the rotation axis of the lens machining device.

[0047] In addition, or alternatively, during the surface position determining step the position of the surface 13 to be machined is positioned so that the angle β is as small as possible. For example, the surface 13 to be machined is positioned so that the normal of the surface to be machined 60 at the rotation axis of the lens machining device is co-linear with the rotation axis of the lens machining device.

[0048] According to an embodiment of the invention, during the tilting step the lens blank and lens blocker are tilted of an angle β determined so as the difference with the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is as small as possible.

[0049] The method of the invention may comprise an optimization process so as to determine the tilt angle and the position of the surface to be machined so that both angles α and β to be both as small as possible and as close as possible one from the other.

[0050] During the machining tool configuration step, the operational parameters of the lens machining tool are configured in order to manufacture the surface to be machined according to the determined surface position so that the desired optical properties of the optical lens are respected.

[0051] The skilled person may use any know method to determine the operational parameters depending on the type and shape of the machining tool.

[0052] As illustrated on figure 1, the method according to the invention may further comprise a surface machining step S6.

[0053] During the surface machining step S6, the surface of the optical lens blank to be machined is machined based on the operational parameters of the lens machining tool configured during the machining tool configuration step.

[0054] According to an embodiment of the invention, the clamping and tilting steps may be carried out simultaneously by having the clamping device of the machining device with a predetermined tilt relative to the rotation

axis of the lens machining device. Advantageously, such embodiment is easier to implement for the machining operator.

[0055] The desired prism may then be adjusted by positioning the surface 13 to be machined during the surface positioning step S4.

[0056] As illustrated on figure 1, the method of the invention may further comprise a weight distribution determining step S31.

[0057] During the weight distribution determining step S31, a weight distribution of the lens blank and lens blocker around the rotation axis of the lens machining device is determined based on the tilt of the lens blank and lens blocker. Preferably the weight distribution is determined so as to reduce the effect of the centrifugal force that may apply to the lens blank when rotated about the rotation axis 40 when the weight distribution is not homogeneous.

[0058] According to an embodiment of the invention, during the weight distribution determining step S31, a weight distribution of the lens blank and lens blocker around the rotation axis of the lens machining device is determined so as to have a weight distribution as homogeneous as possible around the rotation axis 40 of the machining device.

[0059] For example, depending on the tilt angle and the surface to be machined, addition weights may be added to the lens blocker to as to homogenize the weight distribution around the axis of rotation reducing the stress applied to the rotation axis.

[0060] The invention further relates to a machining device for machining the optical surface of an optical lens. As illustrated on Figure 6, the machining device comprising at least a clamp 30, a processor 70 and a machining tool 80.

[0061] The machining device represented diagrammatically in figure 6 is adapted to drive in rotation about an axis 40 a lens blank 10 that is blocked on a lens blocker. The lens blocker is held by a clamp 30 and tilted relative to the axis 40.

[0062] The machining device also drives movement in the directions 81 and 82 of a tool-carrier 80 to which a machining tool 83 is fixed.

[0063] According to an embodiment, the machining device may be adapted to machine with the tool 83 a surface with a constant depth of pass over the surface 12 of the lens blank. To this end, the machining device may synchronize the position of the tool 83 and the angular position of the lens blank in the direction 82 to follow the shape of the surface 12 and to apply the required depth of pass to it, in addition to its forward movement in the direction 81.

[0064] The clamp 30 is configured to clamp a lens blocker with a tilt angle relative to the rotation axis of the lens machining device.

[0065] According to an embodiment, the clamp may have a predetermined tilt angle relative to the rotation axis of the lens machining device, for example smaller than or equal to 3° .

[0066] Alternatively, the clamp may be configured to tilt the lens blank and lens blocker with an angle β , for example smaller than or equal to 3° .

[0067] The processor 70 is configured to determine the position of the surface to be machined based on the tilt angle of the lens blank and lens blocker relative to the rotation axis of the lens machining device.

[0068] Furthermore, the processor 70 is configured to determine the operational parameters of the lens machining tool 80 in order to manufacture the surface to be manufactured according to the determined surface position so that the desired optical properties of the optical lens are respected.

[0069] According to an embodiment of the invention, the processor 70 may further be configured to determine a weight distribution of the lens blank and lens blocker around the rotation axis of the lens machining device based on the tilt of the lens blank and lens blocker.

[0070] The invention has been described above with the aid of embodiments without limitation of the general inventive concept.

[0071] Many further modifications and variations will suggest themselves to those skilled in the art upon making reference to the foregoing illustrative embodiments, which are given by way of example only and which are not intended to limit the scope of the invention, that being determined solely by the appended claims.

[0072] In the claims, the word "comprising" does not exclude other elements or steps, and the indefinite article "a" or "an" does not exclude a plurality. The mere fact that different features are recited in mutually different dependent claims does not indicate that a combination of these features cannot be advantageously used. Any reference signs in the claims should not be construed as limiting the scope of the invention.

Claims

1. Method for machining an optical surface of an optical lens, the method comprising:

- a lens blank providing step, during which a lens blank blocked on a lens blocker is provided,
- a clamping step, during which the lens blocker holding the lens blank is clamped in a lens machining device,
- a tilting step, during which the lens blank and lens blocker are tilted relative to the rotation axis of the lens machining device,
- a surface position determining step, during which the position of the surface to be machined is determined based on the tilt angle of the lens blank and lens blocker relative to the rotation axis of the lens machining device,
- a machining tool configuration step, during which the operational parameters of the lens machining tool are configured in order to man-

ufacture the surface to be manufactured according to the determined surface position so that the desired optical properties of the optical lens are respected.

2. The method according to claim 1, wherein during the surface position determining step the position of the surface to be machined is determined so that the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is smaller than or equal to 3° .
3. The method according to claim 1 or 2, wherein during the surface position determining step the position of the surface to be machined is determined so that the normal of the surface to be machined at the rotation axis of the lens machining device is co-linear with the rotation axis of the lens machining device.
4. The method according to any of the preceding claims, wherein during the tilting step the lens blank and lens blocker are tilted of an angle β with the rotation axis of the lens machining device smaller than or equal to 3° .
5. The method according to any of the preceding claims, wherein the method further comprises a weight distribution determining step during which a weight distribution of the lens blank and lens blocker around the rotation axis of the lens machining device is determined based on the tilt of the lens blank and lens blocker.
6. The method according to any of the preceding claims, wherein during the tilting step the lens blank and lens blocker are tilted so that the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is as small as possible.
7. The method according to any of the preceding claims, wherein during the tilting step the lens blank and lens blocker are tilted of an angle β determined so as the difference with the angle α between the normal of the surface to be machined at the rotation axis of the lens machining device and the rotation axis of the lens machining device is as small as possible.
8. The method according to any of claims 1 to 5, wherein the clamping and tilting steps are carried out simultaneously by having the clamping device of the machining device with a predetermined tilt relative to the rotation axis of the lens machining device.
9. The method according to any of the preceding

claims, further comprising a surface machining step during which the surface of the optical lens blank to be machined is machined based on the operational parameters of the lens machining tool configured during the machining tool configuration step.

5

10. Machining device for machining the optical surface of an optical lens, the machining device comprising:

- a clamp configure to clamp a lens blocker with a tilt angle relative to the rotation axis of the lens machining device, and
- a processor for

10

determining the position of the surface to be machined based on the tilt angle of the lens blank and lens blocker relative to the rotation axis of the lens machining device, and configuring the operational parameters of the lens machining tool in order to manufacture the surface to be manufactured according to the determined surface position so that the desired optical properties of the optical lens are respected.

15

20

25

11. The machining device according to claim 10, wherein the clamp has a predetermined tilt angle relative to the rotation axis of the lens machining device.

12. The machining device according to claim 10, wherein the clamp is configured to tilt the lens blank and lens blocker with an angle β smaller than or equal to 3° .

30

13. The machining device according to any of claims 10 to 12, wherein the processor is further configured to determine a weight distribution of the lens blank and lens blocker around the rotation axis of the lens machining device based on the tilt of the lens blank and lens blocker.

35

40

14. A computer program product for a data processing device, the computer program product comprising a set of instructions which, when loaded into the data processing device, causes the data processing device to perform at least the surface position and machining steps of the method of any one of claims 1 to 9.

45

15. A computer readable medium carrying one or more sequences of instructions of the computer program product of claim 14.

50

55

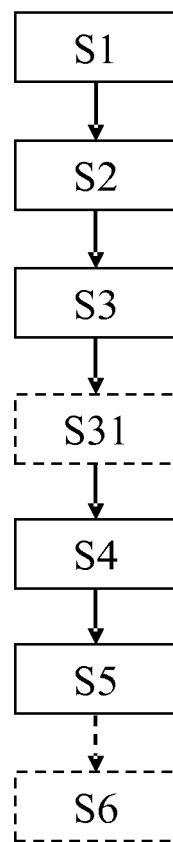


Figure 1

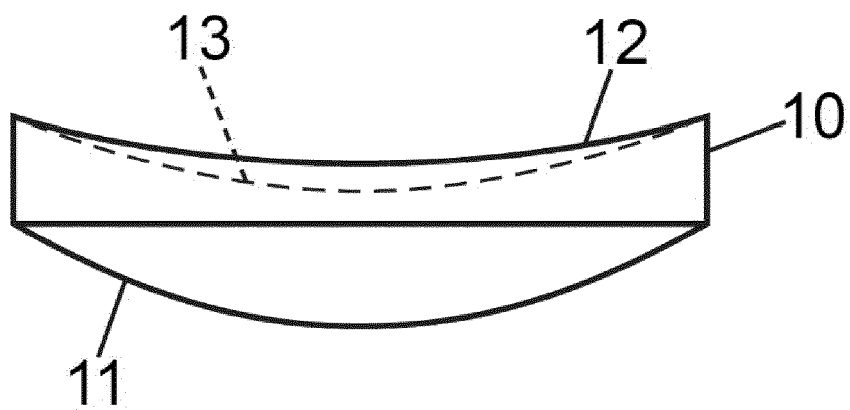


Figure 2

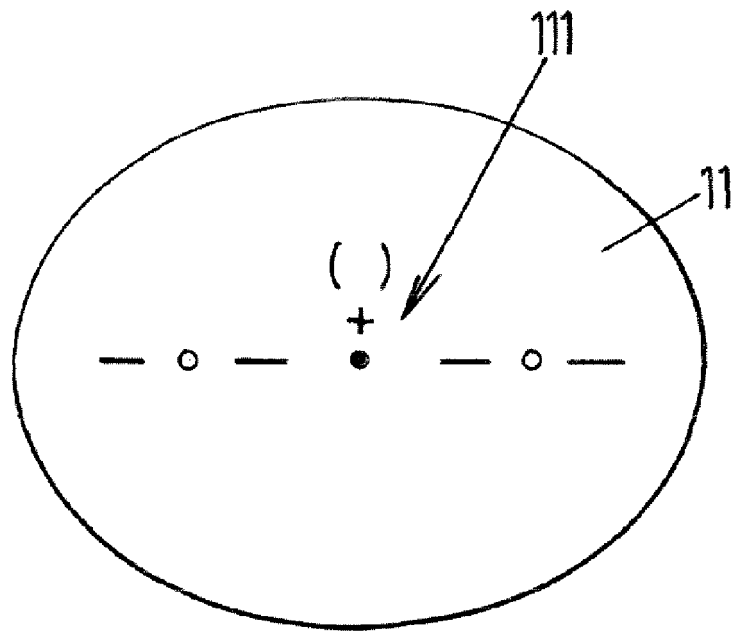


Figure 3

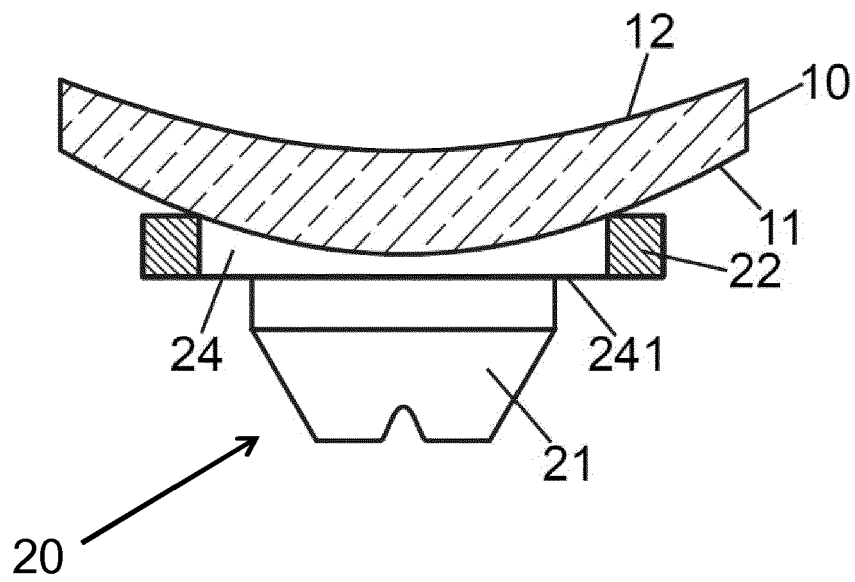


Figure 4

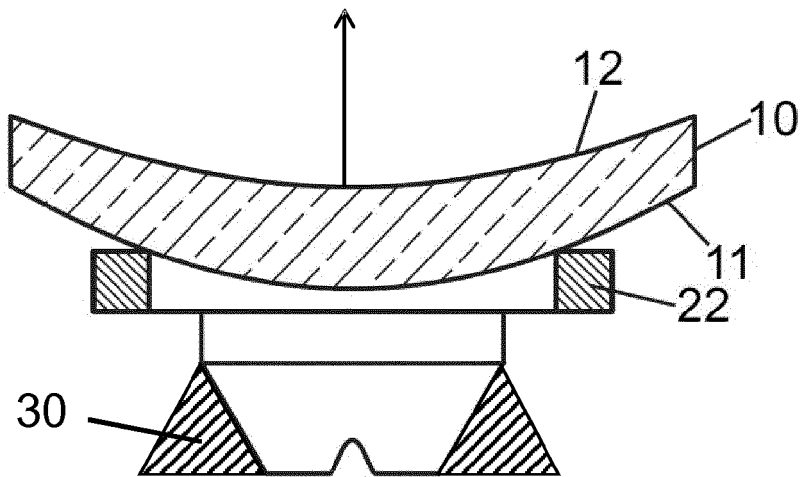


Figure 5

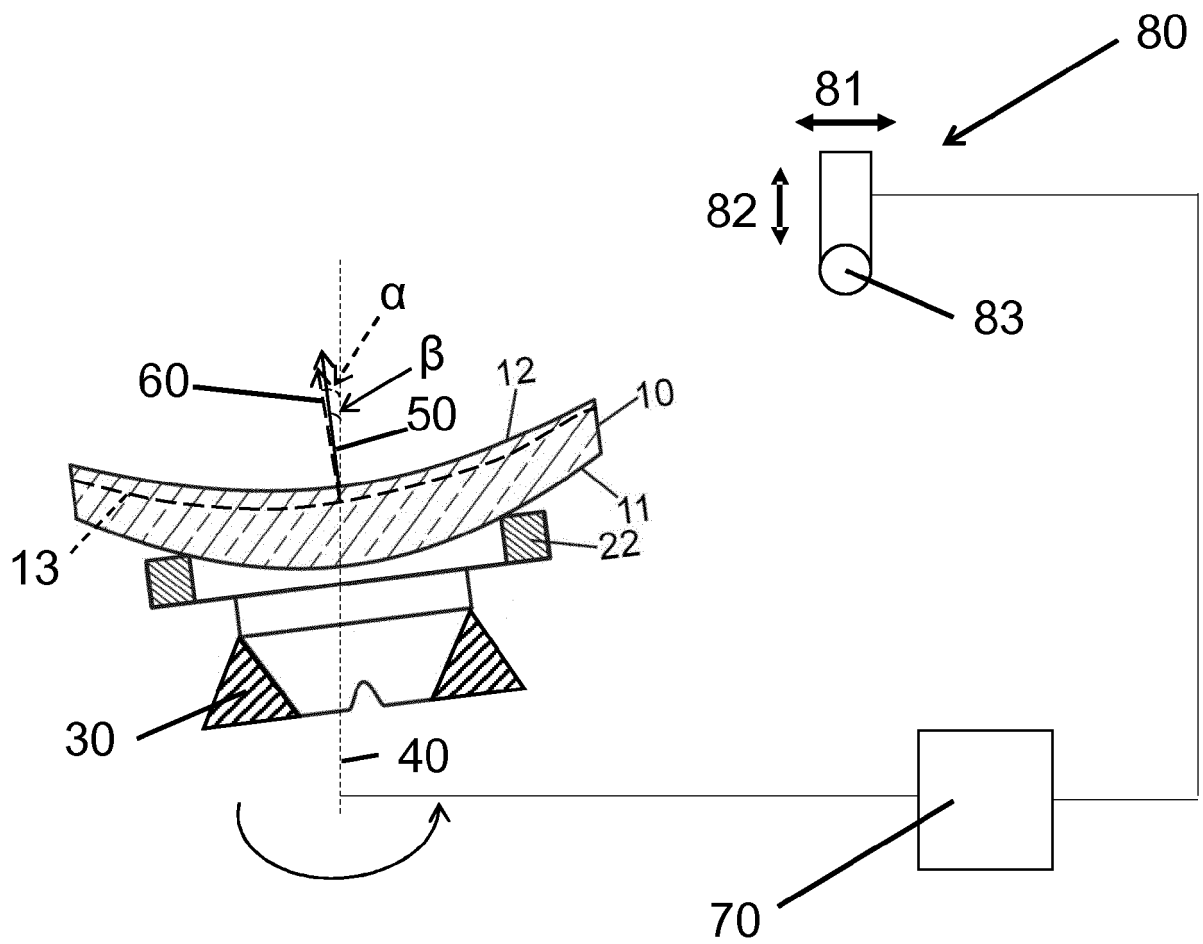


Figure 6



EUROPEAN SEARCH REPORT

Application Number
EP 18 30 6107

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 6 382 790 B1 (GIROD DENIS [FR]) 7 May 2002 (2002-05-07)	1-4, 6-12,14, 15	INV. B24B13/005
Y	* column 9, line 51 - column 13, line 51; claims; figures 8A,8B,9 *	5,13	
Y	US 5 611 252 A (HATTORI KENSHIRO [JP] ET AL) 18 March 1997 (1997-03-18) * the whole document *	5,13	
A	US 2 573 668 A (LONG ELI M ET AL) 30 October 1951 (1951-10-30) * the whole document *	1-15	
A	US 4 277 916 A (BUHLER RATO R) 14 July 1981 (1981-07-14) * the whole document *	1-15	
A	GB 656 875 A (AMERICAN OPTICAL CORP) 5 September 1951 (1951-09-05) * the whole document *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			B24B
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 19 February 2019	Examiner Watson, Stephanie
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03.82 (P04C01)

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

EP 18 30 6107

5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-02-2019

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6382790 B1	07-05-2002	AT 244618 T	15-07-2003
		AU 5426499 A	21-03-2000
		CA 2341584 A1	09-03-2000
		DE 69909489 D1	14-08-2003
		EP 1107849 A1	20-06-2001
		FR 2782663 A1	03-03-2000
		US 6382790 B1	07-05-2002
		WO 0012261 A1	09-03-2000

US 5611252 A	18-03-1997	DE 69405296 D1	09-10-1997
		DE 69405296 T2	08-01-1998
		EP 0628380 A1	14-12-1994
		JP 2826042 B2	18-11-1998
		JP H06344210 A	20-12-1994
		US 5520078 A	28-05-1996
		US 5611252 A	18-03-1997

US 2573668 A	30-10-1951	GB 678256 A	27-08-1952
		US 2573668 A	30-10-1951

US 4277916 A	14-07-1981	NONE	

GB 656875 A	05-09-1951	NONE	
