(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
3 February 2011 (03.02.2011)

PCT

(10) International Publication Number
WO 2011/012264 A1

(51) International Patent Classification:
G02B 7/00 (2006.01) *G02B 7/02* (2006.01)

(21) International Application Number:
PCT/EP2010/004515

(22) International Filing Date:
23 July 2010 (23.07.2010)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
10 2009 037 135.4 31 July 2009 (31.07.2009) DE

(71) Applicants *(for all designated States except US)*: **Carl Zeiss Laser Optics GmbH** [DE/DE]; Carl-Zeiss-Strasse 22, 73447 Oberkochen (DE). **Carl Zeiss SMT GmbH** [DE/DE]; Rudolf-Eber-Straße 2, 73447 Oberkochen (DE).

(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: **WEBER, Ulrich** [DE/DE]; Lichtensteinstrasse 1, 89075 Ulm (DE). **SCHÖPPACH, Armin** [DE/DE]; Schlehenweg 50, 73431 Aalen (DE). **HOLDERER, Hubert** [DE/DE]; Zeppelinweg 19, 73447 Oberkochen (DE).

(74) Agent: **DAUSTER, Katja**; Ruff, Wilhelm, Beier, Dauster & Partner, Postfach 10 40 36, 70035 Stuttgart (DE).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, 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, PE, PG, PH, PL, PT, RO, RS, RU, 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) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (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, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report (Art. 21(3))*

(54) Title: HOLDING ARRANGEMENT FOR AN OPTICAL ELEMENT

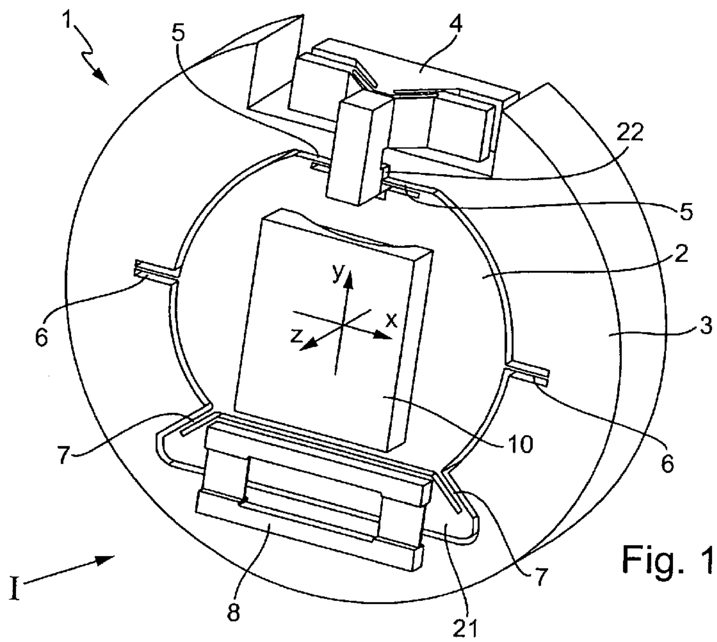

Fig. 1

(57) Abstract: The invention relates to a holding arrangement for an optical element (10), in particular for a cylindrical lens, with a basic structure (3) surrounding a received optical element (10), and a mounting device by means of which the optical element (10) is supported on the basic structure (3), the mounting device having two degrees of freedom, so that the received optical element (10) can be supported by means of the mounting device so as to be rotationally movable about an optical axis (z) and about a first axis (x) extending perpendicularly to the optical axis (z), in particular about an axis perpendicular to an axial direction of the cylindrical lens. The invention further relates to a manipulator unit for an optical system comprising a holding arrangement.

WO 2011/012264 A1

Holding arrangement for an optical element

Description

BACKGROUND OF THE INVENTION

Field of the invention

[0001] The invention relates to a holding arrangement for an optical element with a basic structure surrounding an optical element to be received, and a mounting device by means of which the optical element can be supported on the basic structure. The invention further relates to a manipulator unit for an optical system comprising a holding arrangement.

Description of the related prior art

[0002] Holding arrangements for optical elements are used in optical systems, the precision required for mounting being dependent on the respective purpose of use.

[0003] An assembly for mounting an optical component relative to a carrier via at least three articulation points arranged at the outer circumferential region of the optical element is known from WO 2007/017013 A2, the optical element being held in a force-fitting manner by elastically resilient elements via the articulation points in at least one direction. The elastically resilient elements are located in this case in mounting device which hold the optical element in a statically determined manner.

[0004] An adjustable mount for a cylindrical lens in an optical system, for example the optical system of a laser printer, is known from US 5,220,460. The mount comprises a carrier element which is arranged perpendicularly to the optical axis (z axis) and has a flat face on which the cylindrical lens rests under the action of a constant force. An axis extending parallel to an axial direction of the cylindrical lens is referred to in US 5,220,460 as the x direction. The adjustable mount is intended to allow a rotational movement about the optical axis and a translational movement in the y direction for an adjustment. For this purpose, the cylindrical lens is mounted at two corners opposing each other in the x-y plane by means of a rib acting as a joint, a spring element and two set screws. Tilting about the two axes extending perpendicularly to the optical axis is on the other hand to be sufficiently ensured by the flat face on which the cylindrical lens rests for application in a laser printer. In contrast to the terminology used in US 5,220,460, the axis extending parallel to the axial direction of a cylindrical lens will be referred to hereinafter as the y axis.

[0005] Optical elements are also used in material processing devices, for example in laser annealing devices. An optical system of this type is described for example in WO 2006/066706. In devices of this type, a laser beam is used in order to fuse a layer for example, in particular a silicon layer, onto a substrate. The laser beam falls in this case as a very narrow line beam onto the layer to be fused. The layer and the laser beam are displaced relative to each other transversely to a line formed by the laser beam, so that the laser beam is guided in a planar manner over the substrate, which is known as the "panel".

[0006] As these devices illuminate the panel with a long, but very narrow field, cylindrical lenses, i.e. lenses having just one direction of curvature, are used.

SUMMARY OF THE INVENTION

[0007] It is the object of the invention to provide an arrangement for mounting an optical element, in particular a cylindrical lens, which device ensures precise and adjustable mounting at least in sensitive centring directions of the optical element.

[0008] This object is achieved by a holding arrangement according to Claim 1 and a manipulator unit according to Claim 14. Advantageous developments are specified in the dependent claims. The wording of all of the claims is incorporated into the description by reference.

[0009] According to one aspect of the invention, a holding arrangement for an optical element, in particular for a cylindrical lens, is provided with a basic structure surrounding a received optical element, and a mounting device via which the received optical element can be supported on the basic structure, the mounting device having two degrees of freedom, so that the optical element is mounted by means of the mounting device so as to be rotationally movable about an optical axis (z axis) and about a first axis extending perpendicularly to the optical axis, in particular about an axis (x axis) extending perpendicularly to an axial direction of the cylindrical lens.

[0010] A rigid body movement can be described by six degrees of freedom. In the case of a mounting device with two degrees of freedom, movements along the four remaining directions of rigid body movement are blocked. A mounting device of this type with two degrees of freedom allows precise mounting of the optical element and permits exact adjustment of the mounted optical element about the optical axis and also a second axis perpendicular thereto. The basic structure surrounding the optical element prevents the mounting device from reaching into an optical beam path.

[0011] In the context of the invention, an axis extending perpendicularly to the optical axis and perpendicularly to the cylinder axis or axial direction is referred to as the transverse axis. Optical elements such as cylindrical lenses have four sensitive centring directions, namely a direction of rotation or a tilting direction about the optical axis, a direction of translation along the transverse axis, i.e. in a direction extending perpendicularly to the optical axis and if applicable to a cylindrical axis, a direction of rotation or tilting direction about this transverse axis and a direction of translation along the optical axis. According to the invention, the optical element is mounted in such a way that merely degrees of rotational freedom can be adjusted, the mounting device further preventing the optical element from becoming maladjusted in the two relevant directions of translation during an adjustment of the degrees of rotational freedom.

[0012] An inner structure, which carries the optical element and on which the mounting device acts, is preferably provided. A connection between the inner structure and the optical element is preferably substantially rigid, so that the optical element and the inner structure act as a common component for adjustment and/or mounting. The inner structure preferably has a face which is substantially circular when viewed from above and is arranged in a complementary receiving opening of the basic structure. This allows a good rotational movement about the optical axis in the case of a simple geometrical shape and thus cost-effective manufacture.

[0013] According to a further aspect, the mounting device has two articulation points arranged in the region of the first axis at opposing sides of the basic structure. The received optical element is mounted by means of the inner structure between the articulation points at the first axis. In one configuration, the articulation points each have at least three degrees of freedom, a translational movement of the optical element in relation to the basic structure in the direction of the optical axis and a rotational movement about a second axis (y axis) which lies perpendicularly on the optical axis and the first axis and intersects the optical axis and the first axis at a common point each being blocked via the articulation points. In addition, in one configuration, a translational movement is blocked in the direction of the first axis. In other words, the articulation points support the optical element at least against a translational movement parallel to the direction of the optical axis. In one configuration, a movement parallel to the direction of the first axis (x axis) is likewise blocked. In other configurations, a movement parallel to the direction of the first axis (x axis) is admissible in order to allow an expansion owing to heating. A translational movement parallel to the direction of the second axis (y axis), which extends perpendicularly to the optical axis and the first axis, is on the other hand not blocked, so that the articulation points do not obstruct rotation about the optical axis which is set apart from the articulation points.

[0014] The articulation points have preferably at least one fixed body joint, in particular a leaf spring joint. A plane of the leaf spring joints coincides in this case preferably with a plane spanned by the optical axis and the first axis, a longitudinal direction of the leaf spring joints extending parallel to the first axis. Torsion of the leaf spring joints allows in this case a rotational movement or a tilting of the received optical element about the first axis. Bending, for example in the shape of an S, of the leaf spring joints allows displacement at the articulation points parallel to the direction of the second axis and thus a rotational movement of the optical element about the optical axis. Translational movements along the first axis and/or along the optical axis are on the other hand blocked. In one configuration, the fixed body joints are in this case configured in one piece with the inner structure. Preferably, the basic structure and the articulation points are positioned substantially in a plane perpendicular to the optical axis. In other configurations, an inner structure and the basic structure are arranged offset with respect to the optical axis, a connecting articulation point extending in the direction of the optical axis.

[0015] Preferably, the mounting device also has at least a first coupling unit which is arranged between the articulation points and via which the optical element is supported in the direction of the second axis. The coupling unit is arranged on the basic structure between the articulation points. In one configuration, the coupling unit is arranged substantially symmetrically between the articulation points. The coupling unit is thus positioned symmetrically to the second axis. In other configurations, the coupling unit is offset in the direction of one of the articulation points.

[0016] The coupling unit has preferably at least two degrees of freedom, so that the coupling unit does not obstruct at least rotational movements of the optical element about the optical axis and about the first axis, whereas a translational movement of the received optical element in relation to the basic structure in the direction of the second axis is supported or blocked via the coupling unit.

[0017] In an advantageous configuration, the coupling unit has an intermediate element, the optical element being coupled to the intermediate element via at least a first connecting structure and the intermediate element being coupled to the basic structure via at least a second connecting structure. The connecting structures have preferably fixed body joints, in particular leaf spring joints. In this case, in one configuration, the intermediate element is shaped in one piece with the inner structure, a separation being carried out by fixed body joints, in particular by leaf spring joints. The combination of the intermediate element and the two connecting structures provides a cost-effective and compact coupling unit having two degrees of translational freedom in the region of the coupling unit, whereas the third degree of translational freedom is blocked. In one configuration, a plane of the leaf spring joints of the first connecting structure lies perpendicularly on a plane spanned by the first and the second axis. The plane of the leaf spring joints encloses in this case an angle of between 0° and 90° with the plane spanned by the first axis and the optical axis, the orientation of the plane of the leaf spring joints preferably being selected in such a way that the optical axis lies in the extension of the plane of the leaf spring joints. In the case of deformation, for example in the shape of an S, of the leaf spring joints, a rotational movement of the optical element about the optical axis is thus possible. A plane of the leaf spring joints of the second connecting structure extends preferably parallel to the plane spanned by the first and the second axis. In the case of deformation, for example in the shape of an S, of the leaf spring joints, a translational movement along the optical axis in the region of the coupling unit, and thus a rotational movement of the optical element about the first axis, is in this way possible.

[0018] In a further configuration, at least one adjusting unit, which can be used to stimulate a translatory movement in the direction of the optical axis and a translatory movement in the direction of the first axis, is provided between the articulation points, so that the received optical element is adjustable via a rotational movement about the first axis and/or about the optical axis. For good supporting and optimized utilization of the overall space, the adjusting unit and the coupling unit are arranged preferably opposing each other at two sides of the optical element, in particular mirror-symmetrically to the second axis.

[0019] According to a further aspect of the invention, the adjusting unit has a stationary part arranged on the basic structure and an output part, the stationary part and the output part being joined together via at least one, preferably two setting levers. Preferably, the setting levers are connected to the stationary part and/or to the output part by means of fixed body joints, in particular by means of leaf spring joints.

[0020] The output part is preferably coupled to the inner structure by means of at least one fixed body joint, in particular a leaf spring joint. A plane of this leaf spring joint extends preferably parallel to a plane spanned by the optical axis and the first axis. The leaf spring joint allows in this way a local compensating movement by rotational movements about an axis parallel to the first axis and an axis parallel to the optical axis.

[0021] The object is also achieved by a manipulator unit for an optical system comprising a holding arrangement according to the invention. A manipulator unit of this type can for example advantageously be used in an optical system according to WO 2006/066706.

[0022] The foregoing and further features emerge not only from the claims but also from the description and the drawings, wherein the individual features can each be realized in isolation or jointly in the form of sub-combinations in embodiments of the invention and in other fields and can represent advantageous and also independently patentable embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] Fig. 1 is a schematic, perspective view of a manipulator unit;

[0024] Fig. 2 is a schematic, perspective view of the manipulator unit according to Fig. 1, looking onto an adjusting unit;

[0025] Fig. 3 is a schematic, perspective view of the manipulator unit according to Fig. 1 during a rotational movement about an optical axis;

[0026] Fig. 4 is a schematic, perspective view of the manipulator unit according to Fig. 1 during a rotational movement about an optical axis;

[0027] Fig. 5 is a schematic, perspective view of a first variant of an articulation point for a manipulator unit according to Fig. 1;

[0028] Fig. 6 is a schematic view of a second variant of an articulation point for a manipulator unit according to Fig. 1; and

[0029] Fig. 7 is a schematic, perspective view of a variant of a connecting point for an adjusting unit of a manipulator unit according to Fig. 1.

[0030] Fig. 1 shows schematically a manipulator unit 1 with a holding arrangement according to the invention for an optical element 10. In the illustrated exemplary embodiment, the optical element 10 is configured as a cylindrical lens.

[0031] The Cartesian coordinates x, y and z are also illustrated in Fig. 1. A direction of light or optical axis is in this case referred to as the z axis. An axis extending parallel to the axial direction of the cylindrical lens (cylinder axis) is referred to as the y axis. An axis extending perpendicularly to the axial direction and the direction of light is referred to as the transverse axis or x axis.

[0032] In the illustrated exemplary embodiment, the holding arrangement comprises an inner structure 2 which carries the optical element 10. The holding arrangement further comprises an outer structure or basic structure 3 and a mounting device by means of which the inner structure 2, and thus the optical element 10, is supported on the basic structure 3. The optical element 10 is supported by the illustrated mounting device in such a way as to allow rotational adjustment of the optical element about the z axis and/or about the x axis. At the same time, the mounting device prevents the optical element 10 from being displaced along the x axis or the z axis during rotational movements about the z axis and/or about the x axis.

[0033] An adjusting unit 4, which is connected to the inner structure 2 via leaf spring joints 5, is provided in order to cause an adjusting movement of the optical element 10 for adjustment.

[0034] The mounting device comprises two articulation points 6 which are implemented in the illustrated exemplary embodiment as leaf spring joints and couple the inner structure 2 to the basic structure 3 in the region of the x axis. As a result of the articulation points 6, which are implemented as leaf spring joints, the inner structure 2 is supported in relation to the basic structure 3 against translations parallel to the x axis and/or parallel to the z axis.

[0035] Furthermore, a coupling unit I comprising a first connecting structure 7 implemented by means of leaf spring joints, an intermediate element 21 and a second connecting structure 8 likewise having leaf spring joints, is provided in the illustrated exemplary embodiment. The inner structure 2 is supported by means of the coupling unit I in relation to the basic structure 3 against translational movements parallel to the y axis.

[0036] In connections by means of leaf spring joints, a relative movement of the coupled components is achieved by deformation of the joint region as a whole. Deformation is in this case possible both by bending about axes parallel to the narrow sides of the leaf spring joints and by torsion about axes parallel to the longitudinal sides of the leaf spring joints.

[0037] In the illustrated exemplary embodiment, a plane of the articulation points 6, which are configured as leaf spring joints, coincides with the plane spanned by the z axis and the x axis. The leaf spring joints of the articulation points 6 thus prevent a translational movement of the inner structure 2 relative to the basic structure 3 parallel to the x axis and parallel to the z axis. In addition, the leaf spring joints prevent a rotational movement of the inner structure 2 relative to the basic structure 3 about the y axis. The leaf spring joints of the articulation points 6 allow on the other hand a torsional movement, a tilting movement or movement of rotation of the inner structure 2 about the x axis relative to the basic structure 3 being possible during a torsional movement of the leaf spring joints. In addition, the leaf spring joints 6 are deformable in the shape of an S on account of external loading. The S-shaped bending of the leaf spring joints of the articulation points 6 allows a translational movement of the inner structure 2 at the articulation points 6 parallel to the y axis and thus a rotational movement of the optical element 10 about the z axis in relation to the basic structure 3.

[0038] The optical element 10 is supported in the y direction by the coupling unit I. The leaf spring joints of the connecting structure 7 separate in this case the intermediate region 21 from the inner structure 2. The intermediate region 21 is connected to the basic structure 3 by means of the connecting structure 8. The leaf spring joints of the first connecting structure 7 are oriented in such a way that their plane lies perpendicularly on a plane spanned by the x axis and the y axis. The plane of the leaf spring joints encloses in this case an angle, for example an angle of between approx. 10° and approx. 70°, with a plane spanned by the x axis and the z axis. The plane of the leaf spring joints is in this case oriented in such a way that the z axis lies in the extension of the plane. S-shaped bending of the leaf spring joints of the first connecting structure 7 thus allows a rotational movement of the inner structure 2 about the z axis in relation to the intermediate region 21. A plane of the leaf spring joints of the second connecting structure 8 extends parallel to a plane spanned by the x axis and the y axis. S-shaped bending of the leaf spring joints thus allows displacement of the intermediate region 21 relative to the basic structure 3 parallel to the z axis. This displacement allows a rotational movement of the inner structure 2, which is mounted at the articulation points 6 so as to be rotatable about the x axis, and thus of the optical element 10 about the x axis relative to the basic structure 3. In combination, the leaf spring joints of the first connecting structure 7 and the leaf spring joints of the second connecting structure 8 thus cause supporting of the inner structure 2 in relation to the basic structure 3 parallel to the direction of the y axis without a rotational movement of the inner structure 2 about the x axis or about the z axis being obstructed.

[0039] In the illustrated exemplary embodiment, the inner structure 2, and thus the optical element 10, is moved in relation to the basic structure 3, for adjustment, by means of the adjusting unit 4.

[0040] Fig. 2 is a perspective view, looking onto the adjusting unit 4. As may be seen in Fig. 2, the adjusting unit 4 comprises a stationary part 41 which is securely connected to the basic structure 3. The adjusting unit 4 further comprises an output part 42 which is coupled to the inner structure 2. The output part 42 is rigidly connected to a region 22 which may be seen in Fig. 1 and is coupled to the inner structure 2 via leaf spring joints 5. The adjusting unit 4 further comprises setting levers 43, 44 which are connected to the stationary part 41 via first leaf spring joints 431, 441 and to the output part 42 via second leaf spring joints 432, 442. The setting levers 43, 44 are adjustable by means of setting drives 430, 440, an adjusting of the setting levers 43, 44 being transmitted to the output part 42 by means of the leaf spring joints 431, 441, 432, 442. In relation to the invention, the term "setting drives" refers to any desired manually, force and/or motor-actuated element including set screws, motor-operated pistons and the like.

[0041] Fig. 3 shows schematically a drive of the setting drives 430, 440 for displacement of the output part 42 in the z direction. The displacement of the output part 42 in the z direction causes tilting of the inner structure 2 and thus the optical element 10 about the x axis. As may be seen in Fig. 3, the setting drives 430, 440 are operated in parallel for this purpose, so that both setting levers 43, 44 are displaced in the positive z direction. A tilting angle, which is undesirable during the adjusting movement, at a linking point of the adjusting unit 4 is compensated for in this case by torsion of the leaf spring joints 5.

[0042] Fig. 4 shows a drive of the setting drives 430, 440 for a rotational movement of the optical element 10 about the z axis. For this purpose, a setting drive, in the illustrated exemplary embodiment the setting drive 430, is operated in such a way that the associated setting lever 43 is displaced in the positive z direction. The second setting drive 440 is on the other hand operated in such a way that the setting lever 44 is moved in the negative z direction. The combination of the movement of the setting levers 43, 44 causes displacement of the output part 42 in the x direction, in the illustrated exemplary embodiment in the negative x direction.

As a result, the inner structure 2, and thus the optical element 10, is rotated about the z axis in the positive direction. The rotational movement between the inner structure 2 and the adjusting unit 4 is in this case compensated for in the linking region of the adjusting unit by the leaf spring joints 5.

[0043] Fig. 5 is a schematic, perspective view of a first variant of an articulation point 106, which is provided instead of the articulation point 6 according to Fig. 1 to 4, for a manipulator unit according to Fig. 1. The articulation point 106 according to Fig. 5 comprises two leaf spring joints 106a, 106b which are coupled to each other via an intermediate body 106c. The intermediate body 106c has slots 106d allowing a compensating movement in the direction of the x axis. In one configuration, the connection to the adjusting unit 4, the connecting structure 7 and/or the connecting structure 8 are, like the articulation point 106, implemented via a plurality of leaf spring joints connected in series.

[0044] In the embodiments according to Fig. 1 to 4, the basic structure 3 and the inner structure 2 are positioned substantially in a plane perpendicular to the optical axis z. In an alternative configuration, the inner structure 2 is offset with respect to the basic structure 3 parallel to the direction of the optical axis z.

[0045] Fig. 6 is a schematic view of a variant of an articulation point 206 for a manipulator unit according to Fig. 1, the inner structure 2 being arranged offset with respect to the basic structure 3 parallel to the direction of the optical axis z. The articulation point 206, which is embodied as a leaf spring joint, likewise allows a relative displacement between the basic structure 3 and the inner structure 2 in the direction of the second axis y and tilting or rotation of the components 2, 3 about the first axis x. The articulation point 206 thus has the same degrees of freedom as the articulation point 6 according to Fig. 1 to 4.

[0046] Fig. 7 is a schematic view of a variant of a connection of the adjusting unit 4 to the inner structure 2, a part 22 for linking to the adjusting unit being arranged offset with respect to the inner structure 2 parallel to the direction of the optical axis z. In the illustrated exemplary embodiment, the connection is in this case implemented via a leaf spring joint 105. The leaf spring joint 105 allows a tilting movement between the part 22 and the inner structure 2 about an axis extending parallel to the optical axis z, so that tilting of the adjusting unit 4 is compensated for when movement is introduced.

Patent claims

1. Holding arrangement for an optical element (10), in particular for a cylindrical lens, with a basic structure (3) surrounding a received optical element (10), and a mounting device by means of which the optical element (10) can be supported on the basic structure (3), characterized in that the mounting device has two degrees of freedom, so that the optical element (10) can be supported by means of the mounting device so as to be rotationally movable about an optical axis (z) and about a first axis (x) extending perpendicularly to the optical axis (z), in particular about an axis perpendicular to an axial direction of the cylindrical lens.

2. Holding arrangement according to Claim 1, characterized in that an inner structure (2), which carries an optical element (10) to be received and on which the mounting device acts, is provided.

3. Holding arrangement according to Claim 1 or 2, characterized in that the mounting device has two articulation points (6, 106, 206) arranged in the region of the first axis (x) at opposing sides of the basic structure (3).

4. Holding arrangement according to Claim 3, characterized in that the articulation points (6) each have at least three degrees of freedom, a translational movement of the received optical element (10) in relation to the basic structure (3) parallel to the direction of the optical axis (z) and a rotational movement about a second axis (y) which lies perpendicularly on the optical axis (z) and the first axis (x) and intersects the optical axis (z) and the first axis (x) at a common point each being blocked via the articulation points (6, 106, 206).

5. Holding arrangement according to Claim 3 or 4, characterized in that the articulation points (6, 106, 206) have at least one fixed body joint, in particular a leaf spring joint.

6. Holding arrangement according to Claim 3, 4 or 5, characterized in that the mounting device has at least a first coupling unit (I) which is arranged between the articulation points (6, 106, 206) and via which the received optical element (10) can be supported in the direction of the second axis.

7. Holding arrangement according to Claim 6, characterized in that the coupling unit (I) has at least two degrees of freedom, a translational movement of the received optical element (10) in relation to the basic structure (3) being blockable in the direction of the second axis (y) via the coupling unit (I).

8. Holding arrangement according to Claim 6 or 7, characterized in that the coupling unit (I) has an intermediate element (21), the optical element (10) being coupled to the intermediate element (21) via at least a first connecting structure (7) and the intermediate element (21) being coupled to the basic structure (3) via at least a second connecting structure (8).

9. Holding arrangement according to Claim 8, characterized in that the connecting structures (7, 8) have fixed body joints, in particular leaf spring joints.

10. Holding arrangement according to one of Claims 3 to 9, characterized in that at least one adjusting unit (4), which can be used to stimulate a translatory movement in the direction of the optical axis (z) and a translatory movement in the direction of the first axis (x), is provided between the articulation points (6, 106, 206), so that the received optical element (10) is adjustable via a rotational movement about the first axis (x) or about the optical axis (z).

11. Holding arrangement according to Claim 10, characterized in that the adjusting unit (4) has a stationary part (41) arranged on the basic structure (3) and an output part (42), the stationary part and the output part being joined together via at least one, preferably two setting levers (43, 44).

12. Holding arrangement according to Claim 11, characterized in that the at least one setting lever (43, 44) is connected to the stationary part (41) and/or to the output part (42) by means of fixed body joints, in particular by means of leaf spring joints.

13. Holding arrangement according to Claim 10, 11 or 12, characterized in that the output part (42) is supported in relation to the inner structure (2) by means of at least one fixed body joint (5, 105), in particular by means of a leaf spring joint.

14. Manipulator unit for an optical system comprising a holding arrangement according to one of Claims 1 to 13.

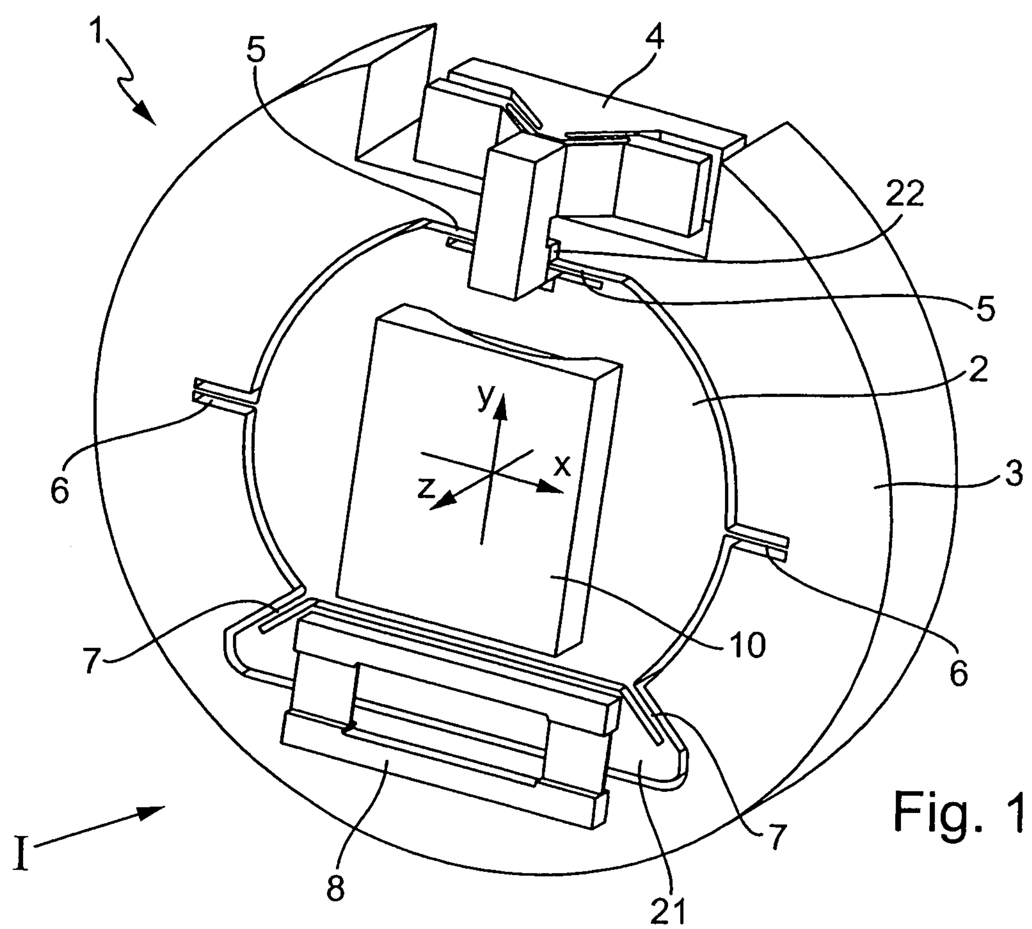
1
5
4
22
5
2
3
6
y
x
z
6
7
10
6
I
8
21
7

Fig. 1

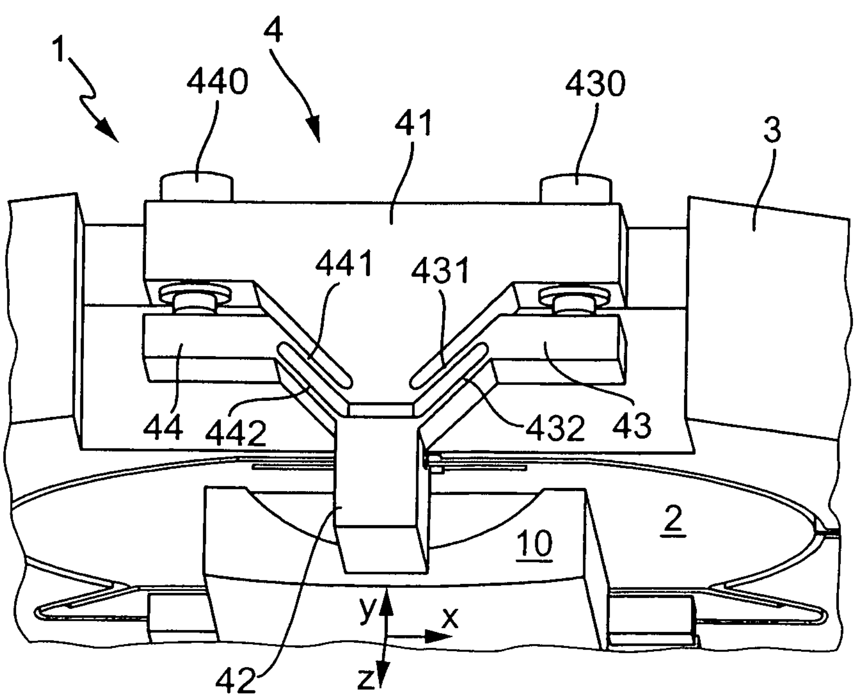
1
4
440
41
430
3
441
431
44
442
432
43
2
10
y
x
42
z

Fig. 2

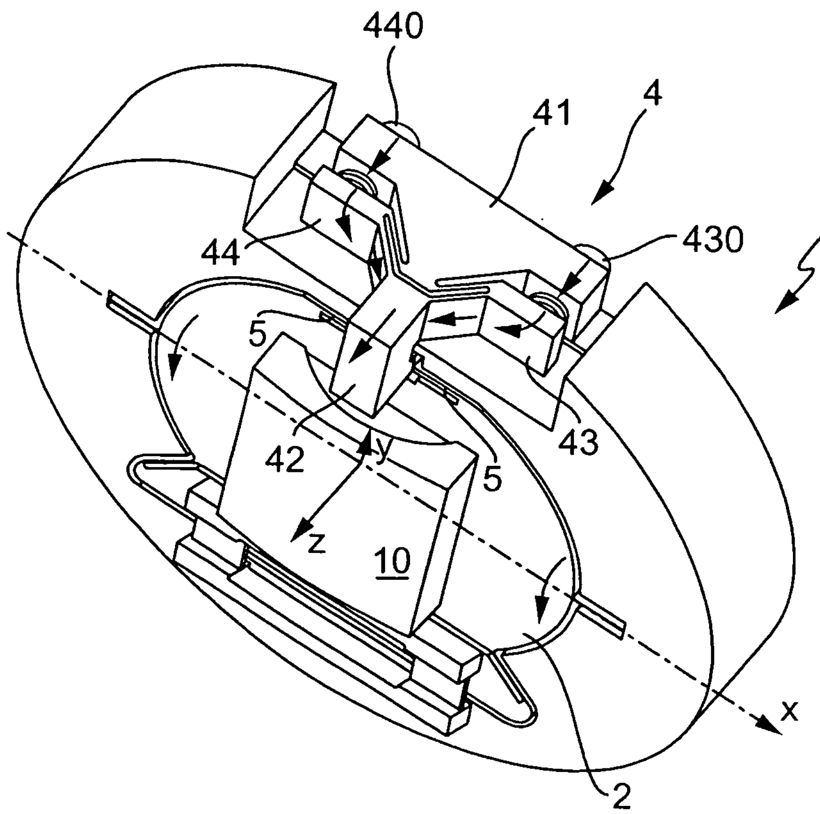

Fig. 3

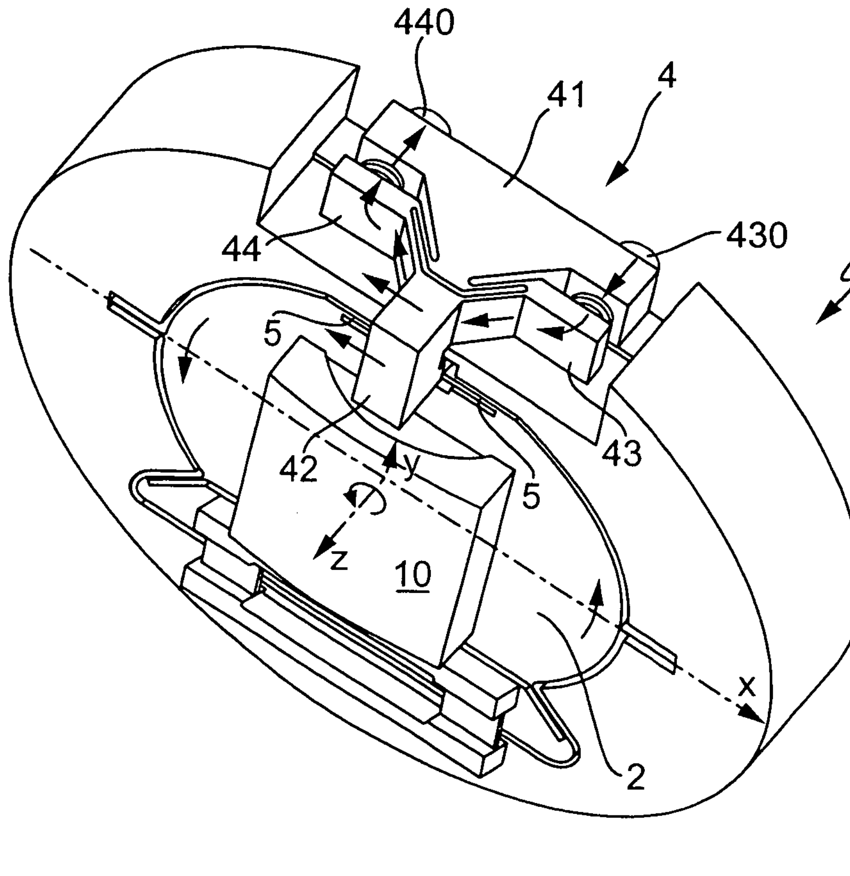

Fig. 4

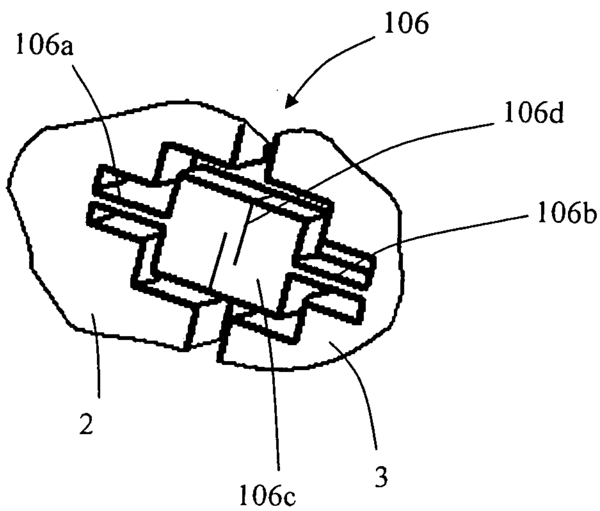

Fig. 5

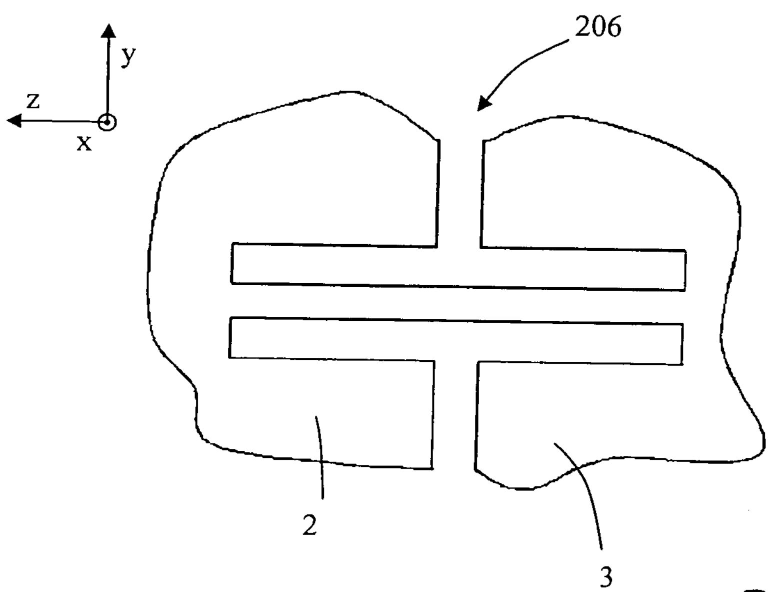

Fig. 6

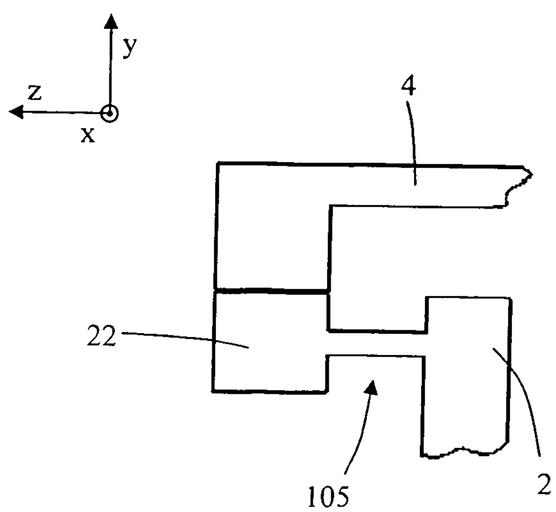

Fig. 7

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/004515

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B7/00 G02B7/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X A	US 6 115 166 A (KOTAKI NORIAKI [JP]) 5 September 2000 (2000-09-05) column 3, line 46 - column 4, line 28; figure 8	1,2,14 3-13
X	US 5 694 257 A (ARNONE DAVID F [US] ET AL) 2 December 1997 (1997-12-02) column 2, lines 44-56; figure 1	1,14
X	US 6 320 707 B1 (KHOSHNEVISAN MOHSEN [US] ET AL) 20 November 2001 (2001-11-20) column 2, lines 9-28	1,14
X	DE 10 2008 040218 A1 (ZEISS CARL SMT AG [DE]) 15 January 2009 (2009-01-15) paragraphs [0090] - [0103]	1,14

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 September 2010	22/09/2010

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Stemmer, Michael

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2010/004515

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5 210 648 A (BEDZYK MARK [US]) 11 May 1993 (1993-05-11) column 4, line 67 - column 6, line 32 -----	1-14
A	US 6 388 823 B1 (GABER ERWIN [DE] ET AL) 14 May 2002 (2002-05-14) column 3, lines 4-28; figure 1 -----	1,14
A	US 2004/095657 A1 (TAKANASHI TATSUO [JP] ET AL) 20 May 2004 (2004-05-20) paragraphs [0064] - [0068] -----	1-14

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2010/004515

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 6115166 A	05-09-2000	JP 11160595 A	18-06-1999
US 5694257 A	02-12-1997	NONE	
US 6320707 B1	20-11-2001	NONE	
DE 102008040218 A1	15-01-2009	NONE	
US 5210648 A	11-05-1993	DE 69215208 D1	19-12-1996
		DE 69215208 T2	22-05-1997
		EP 0558735 A1	08-09-1993
		JP 6502936 T	31-03-1994
		WO 9306515 A1	01-04-1993
US 6388823 B1	14-05-2002	DE 19827603 A1	23-12-1999
		WO 9967683 A2	29-12-1999
		EP 1015931 A2	05-07-2000
		JP 4357117 B2	04-11-2009
		JP 2002519843 T	02-07-2002
		KR 20000005738 A	25-01-2000
		TW 253509 B	21-04-2006
US 2004095657 A1	20-05-2004	NONE	