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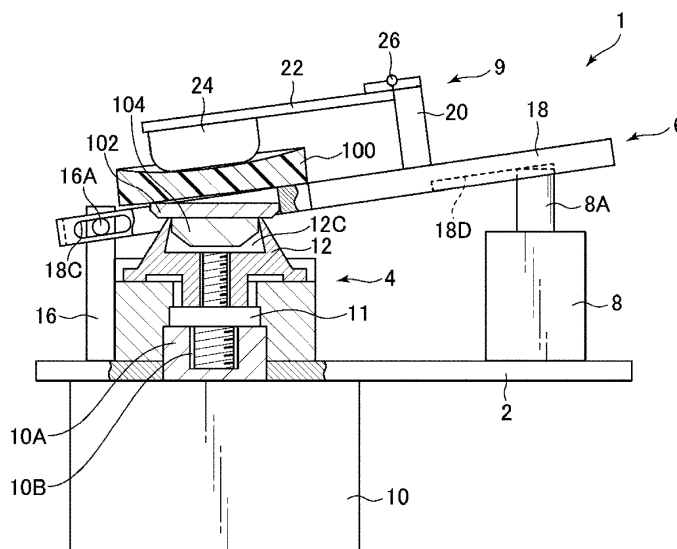
(54) **LENS SEPARATING APPARATUS AND LENS SEPARATING METHOD**

(57) Provided is an apparatus for detaching a lens from a holder, with which the lens can be detached from the holder easily and quickly without causing a problem such as cracking of the lens.

A lens separating apparatus 1 is an apparatus that separates a lens attached to a holder 104 via an alloy 102, the lens separating apparatus 1 including: a fixing mechanism 4 that fixes the holder 104; and a separating member 18 that is rotatable around a shaft 16A. A lens material 100 is attached in a state in which at least a part

of the outer periphery thereof extends out from an edge of the alloy 102, and the lens material 100 is separated from the alloy 102 by rotating the separating member 18 in a direction of separating the lens material 100 from the holder, in a state in which the holder 104 is fixed by the fixing mechanism 4 and in which the separating member 18 is in contact, from the holder 104 side, with an extended portion of the lens material 100 on the opposite side to the shaft.

FIG. 9



Description

[Technical Field]

- 5 **[0001]** The present invention relates to a lens separating apparatus and a lens separating method, and more particularly to an apparatus and a method for separating a lens attached to a holder via an alloy.

[Background Art]

- 10 **[0002]** Conventionally, when a plastic such as spectacles is polished, a holder is attached on one surface of a lens material, which is the subject of polishing, and the other surface is polished in a state in which the lens is held by the holder. To attach the holder to the lens material (hereafter called "blocking"), a low melting point alloy is filled into the space between the holder and a protective film (to prevent scratching on the blocking surface) is pasted on the surface of the lens material, and the alloy is solidified. The holder and the alloy are detached (hereafter called "deblocking") after
15 polishing. Then the protective film is peeled off from the lens material.

- [0003]** A method of deblocking disclosed in PTL 1, for example, is detaching a lens from the holder by immersing the lens, to which the holder is attached via alloy, in hot water, and dissolving the alloy. Another known method is detaching the lens from the holder by jetting hot water onto the alloy from the side, and dissolving the alloy thereby. Such deblocking methods of heating the alloy by hot water are suitable for deblocking a lens constituted by relatively fragile plastic material,
20 or a lens of which thickness at the outer periphery of the lens is very thin.

- [0004]** Another method of deblocking that is known involves using a cylindrical detaching jig 206, of which inner diameter is larger than the outer shapes of an alloy 202 and a holder 204 and the inner diameter is smaller than the outer diameter of a lens material 200, and exerting an impact on the detaching jig 206, such as causing the detaching jig 206 to collide with a base 208 in a state in which the outer periphery of the lens material 200 is in contact with the
25 upper end of the detaching jig 206, to thereby detach the lens, as illustrated in Fig. 11. The protective film 201 attached to the blocking surface prevents scratching the contacting portion of the lens material by impact.

[Citation List]

- 30 [Patent Literature]

[0005] [PTL 1] Japanese Patent Application Publication No. 2013-255956

[Summary of Invention]

35

[Technical Problem]

- [0006]** However, in the case of the deblocking method using hot water, the alloy adhering to the lens may not be completely removed, and in this case, visual defects, largely due to residue, are generated after the coating is performed.
40 Further, the lens must be soaked in hot water or hot water must be jetted onto the lens until the alloy is dissolved, which takes time and drops productivity.

- [0007]** In the case of the method of using a cylindrical jig, a problem such as cracking may be caused to the lens due to impact during deblocking. Further, an appropriate jig must be selected from a plurality of cylindrical detaching jigs, in accordance with the alloy and the diameters of the lens, which takes time, and easily causes a problem, such as cracking,
45 when an incorrect detaching jig is selected.

[0008] With the foregoing in view, an object of the invention is to provide an apparatus and a method for detaching a lens from a holder, with which the lens can be detached from the holder easily and quickly without causing a problem such as cracking of the lens.

- 50 [Solution to Problem]

- [0009]** A lens separating apparatus according to this invention is an apparatus to separate a lens attached to a holder via an alloy, having: a fixing mechanism that fixes the holder; a separating member that is rotatable around a shaft; and an actuator that drives the separating member. The lens is attached to the holder via the alloy in a state in which at least
55 a part of the outer periphery thereof extends out from an edge of the alloy, the actuator is configured to rotate the separating member in a direction of separating the lens from the holder, in a state in which the holder is fixed by the fixing mechanism and in which the separating member is in contact, from the holder side, with an extended portion of the lens on the opposite side to the shaft, such that the lens is separated from the alloy.

[0010] A lens separating method according to this invention is a lens separating method for separating a lens attached to a holder via an alloy. The lens is attached to the holder via the alloy in a state in which the outer periphery thereof extends out from an edge of the alloy. The lens separating method includes: an entering step of allowing the alloy and the holder to enter an opening, which is formed in a separating member that is rotatable around a shaft, and which faces a fixing mechanism; a fixing step of fixing the holder by the fixing mechanism; a contacting step of contacting, from the holder side, the separating member with an extended portion of the lens on the opposite side to the shaft; and a separating step of separating the lens from the alloy by rotating the separating member in a direction of separating the lens from the holder.

[0011] According to the above configuration, the separating member is rotated in a state in which the separating member is in contact with a portion of the lens extending from the alloy on the opposite side to the shaft, whereby the lens elastically deforms and the lens portion near the portion contacting the separating member is separated from the alloy first, then gradually the entire lens is separated. Therefore it is unnecessary to exert a strong force on the lens to separate the lens, and a problem such as cracking of the lens rarely occurs. Further, the lens can be separated from the alloy merely by rotating the separating member, hence deblocking can be performed easily and quickly.

[Advantageous Effects of Invention]

[0012] According to this invention, an apparatus and a method for detaching a lens from a holder, with which the lens can be detached from the holder easily and quickly without causing a problem such as cracking of the lens, are provided.

[Brief Description of Drawings]

[0013]

[Fig. 1]

Fig. 1 is a vertical cross-sectional view depicting a lens material in a state in which an alloy and a holder are attached.

[Fig. 2]

Fig. 2 is a plan view depicting a lens separating apparatus according to an embodiment of the invention.

[Fig. 3]

Fig. 3 is a front view depicting the lens separating apparatus according to the embodiment of the invention.

[Fig. 4] Fig. 4 is a plan view depicting a state of fixing a holder by a fixing mechanism based on a lens separating method using the separating apparatus according to the embodiment of the invention.

[Fig. 5]

Fig. 5 is a front view depicting a state of fixing the holder by the fixing mechanism based on the lens separating method using the separating apparatus according to the embodiment of the invention.

[Fig. 6]

Fig. 6 is a plan view (No. 1) depicting a state of moving the separating member based on the lens separating method using the separating apparatus according to the embodiment of the invention.

[Fig. 7]

Fig. 7 is a plan view (No. 2) depicting a state of moving the separating member based on the lens separating method using the separating apparatus according to the embodiment of the invention.

[Fig. 8]

Fig. 8 is a plan view (No. 3) depicting a state of moving the separating member based on the lens separating method using the separating apparatus according to the embodiment of the invention.

[Fig. 9]

Fig. 9 is a front view depicting a state of separating the lens material from the alloy based on the lens separating method using the separating apparatus according to the embodiment of the invention.

[Fig. 10]

Fig. 10 is a graph depicting a relationship of the shape of the lens and the thrust of the actuator that is required for separation, according to the separating apparatus of the embodiment of the invention.

[Fig. 11]

Fig. 11 is a diagram depicting a conventional method of detaching the alloy and the holder attached to a lens material.

[Description of Embodiments]

[0014] Embodiments of the invention will be described in detail with reference to the drawings.

[0015] In this invention, a "lens material" which refers to a state before mechanical processing, and a "lens" which refers to a state after mechanical processing, are used interchangeably. Mechanical processing is, for example, polishing.

The purpose of holding the lens by a holder (typically for polishing) is not intended to limit this invention.

[0016] A lens separating apparatus of this embodiment is an apparatus for separating an alloy and a holder from a lens material in a state in which the holder is attached to one surface of the lens via the alloy for processing the lens. Fig. 1 is a vertical cross-sectional view depicting a lens material in a state in which the alloy and the holder are attached. As depicted in Fig. 1, a protective film 101 is attached to one surface of a lens material 100, and the holder 104 is attached via an alloy 102. The protective film 101 is disposed to protect the surface of the lens material 100, and to reinforce adhesion (adhesion between the alloy 102 and the lens material 100), but may be omitted. The lens material 100 is a lens for spectacles, and is generated by molding a plastic material. In plan view, the diameters of the holder 104 and the alloy 102 are smaller than the diameter of the lens material 100 (However, the shapes of the holder 104 and the alloy 102 need not be circles in plan view, and are not especially limited. As mentioned later, if the outer peripheral surface of the alloy 102 is contacted with the arc-shaped portion of an opening 18G of a separating member 18, it is preferable that at least this contact portion of the outer peripheral surface of the alloy 102 is arc-shaped.). Here at least a part of the outer periphery of the lens material 100 extends out from the edges of the holder 104 and the alloy 102. According to an embodiment, the surface of the lens material 100, to which the holder 104 is attached, is formed to have a predetermined shape in advance, and the other surface is polished based on the design data in accordance with the prescription of the user.

[0017] Fig. 2 and Fig. 3 are diagrams depicting the lens separating apparatus according to the embodiment of this invention, where Fig. 2 is a plan view and Fig. 3 is a front view. In Fig. 2, a pressing mechanism 9 is omitted. As illustrated in Fig. 2 and Fig. 3, the lens separating apparatus 1 includes a base 2, a fixing mechanism 4 that fixes a holder secured on the lens material, a separating mechanism 6 that separates the lens material from the alloy and the holder, an actuator 8 that drives the separating mechanism 6, and the pressing mechanism 9 attached to the separating mechanism 6.

[0018] The base 2 has a rectangular plate shape. The fixing mechanism 4 is disposed on one end of the base 2 in the longitudinal direction. The fixing mechanism 4 includes a clamp cylinder 10, a connecting member 11, a clamp chuck 12 and a support member 14. The clamp cylinder 10 is a device to drive the clamp chuck 12, and is disposed beneath the base 2. The clamp cylinder 10 has a piston 10A which can vertically move up and down, and the piston 10A protrudes above the base 2 via an opening formed in the base 2. The support member 14 is approximately a rectangular-parallelepiped member, and is disposed above the base 2. An approximately cylindrical through-hole 14A is formed in the support member 14, and the piston 10A of the clamp cylinder 10 extends into the through-hole 14A.

[0019] The clamp chuck 12 includes a gripper 12A which has a truncated cone shape, and a cylindrical shaft 12B coaxially connected to the lower face of the gripper 12A. A cylindrical opening 12C is formed in the gripper 12A so as to open onto the upper surface. A screw hole 12D is formed in the gripper 12A and the shaft 12B so as to reach from the bottom surface of the opening 12C to the lower surface of the shaft 12B. In the gripper 12A, a plurality of slits 12G are radially formed. The slits 12G extend from the outer periphery of the gripper 12A to a mid-point between the peripheral surface of the opening 12C and the screw hole 12D.

[0020] An annular-shaped groove 12E is formed around the shaft 12B on the lower surface of the gripper 12A. An annular-shaped edge 12F on the outer periphery side of the groove 12E is in contact with the upper surface of the support member 14. The shaft 12B is connected with the screw hole 10B of the piston 10A of the clamp cylinder 10 via the connecting member 11.

[0021] Because of this configuration, if the piston 10A of the clamp cylinder 10 is retracted, the shaft 12B pulls the center part of the gripper 12A downward via the connecting member 11, and the upper end of the gripper 12A bends inward in a radial direction from the edge 12F (as indicated by the arrow mark A in Fig. 3). If the tensile load, which the clamp cylinder 10 applies to the shaft 12B of the clamp chuck 12, is released in this state, the clamp chuck 12 returns to the original state by elasticity, and the upper end of the gripper 12A spreads outward in the radial direction.

[0022] As experts skilled in the art know, the fixing mechanism to fix the holder in this invention can be configured in various ways besides the above mentioned configuration.

[0023] The separating mechanism 6 includes a support member 16 that is vertically disposed on the base 2, and a separating member 18 which is rotatably disposed with respect to the support member 16. The support member 16 is a plate member, and is vertically disposed on the base 2 in a position that is closer to the edge than the fixing mechanism 4 in the longitudinal direction. The support member 16 includes a pair of shafts 16A, which protrude horizontally from both sides of the upper part. In this invention, the shafts 16A need not form a pair if the separating member 18 can rotate around the shaft.

[0024] The separating member 18 includes a rectangular separating member main unit 18B, and an extended portion 18A connected to the separating member main unit 18B. This specific shape and configuration of the separating member 18 are not intended to limit this invention.

[0025] It is preferable that the separating member 18 is movable relative to a shaft 16A, so that the contact position with the lens material 100 can be changed.

[0026] In the separating member main unit 18B, an opening (through-hole) 18G is formed so as to face the fixing mechanism 4. The size of the opening 18G is set so that the holder 104 and the alloy 102 can enter. The opening 18G

has a rectangular shape on the base end side (left side in Fig. 2 and Fig. 3), and has a semicircular shape on the front end side (right side in Fig. 2 and Fig. 3). As a mechanism suitable for implementing the relative movement of the separating member 18 and the shaft 16A, a pair of long holes 18C, which reach from the opening 18G to the side surface, are formed on the base end side of the separating member 18. The long hole 18C penetrates in the horizontal direction, and has a cross-section which extends in the longitudinal direction of the separating member 18. In each of the long holes 18C forming the pair, the shaft 16A, which is formed on the side face of the support member 16, is inserted respectively. Thereby the separating member 18 can rotate around the shaft 16A with respect to the support member 16, and can slide relative to the shaft 16A in the longitudinal direction. A guide groove 18D, which extends in the longitudinal direction, is formed on the lower surface of the extended portion 18A. The long hole 18C need not be a pair if only one shaft is disposed. The slide movement may be manually performed by the operator, or may be implemented by disposing a driving mechanism.

[0027] The actuator 8 is disposed in the end on the opposite side to the fixing mechanism 4 in the longitudinal direction of the base 2. The actuator 8 includes a retractable piston 8A. The front end of the piston 8A of the actuator 8 is disposed inside the guide groove 18D of the separating member 18. As an expert skilled in the art knows, the actuator 8 to rotate the separating member 18 in this invention is not limited to the above mentioned specific configuration.

[0028] The pressing mechanism 9 includes a support member 20 that is vertically disposed on the upper surface of the separating member 18, a rotating member 22 that is connected to the support member 20 via a hinge member 26, and a pressing member 24 attached to one surface of the rotating member 22. The rotating member 22 can rotate from a state of extending in parallel with the separating member 18 from the upper end of the support member 20 toward the actuator 8 as illustrated in Fig. 3, to a state of extending from the support member 20 to the fixing mechanism 4. The pressing member 24 is a member having elasticity, such as a sponge.

[0029] A lens separating method using the above mentioned separating apparatus 1 will be described.

[0030] Fig. 4 and Fig. 5 are diagrams depicting a state of fixing the holder by the fixing mechanism in the lens separating method using the separating apparatus according to an embodiment of this invention. Fig. 4 is a plan view and Fig. 5 is a front view. First, as illustrated in Fig. 4 and Fig. 5, the holder 104 attached to the lens material 100 is fixed by the fixing mechanism 4. In concrete terms, the lens material 100 is disposed such that the holder 104 is located beneath the lens material 100, and the lower surface of the lens material 100 contacts the upper surface of the separating member 18. In this state, the holder 104 and the alloy 102 enter the opening 18G of the separating member 18, and at least a part of the holder 104 passes through the opening 18G, and is disposed in the opening 12C of the clamp chuck 12. Then the piston 10A of the clamp cylinder 10 is retracted. Thereby the gripper 12A bends so that the upper end of the gripper 12A bends inward in the radial direction from the edge 12F, and the holder 104 attached to the lens material 100 is gripped and fixed by the gripper 12A. In this case, it is preferable that the lens material 100 is disposed so that the thickest part of the portion of the lens material 100 extending from the alloy 102 is located on the front end side (right side in Fig. 2 and Fig. 3) of the separating member 18 (the reason for this will be explained later). This operation of disposing the lens material 100 may be manually performed by the operator or may be performed by a robot arm.

[0031] Then the separating member 18 is moved to a predetermined position with respect to the alloy 102. Fig. 6 to Fig. 8 are plan views depicting the state of moving the separating member based on the lens separating method using the separating apparatus according to the embodiment of this invention. As illustrated in Fig. 6, the separating member 18 is moved toward the shaft 16A in the longitudinal direction (in the arrow B direction), and preferably the outer peripheral surface of the alloy 102, attached to the lens material 100, is contacted with the arc-shaped portion on the edge of the opening 18G. Thereby the separating member 18 contacts, from the holder 104 side, a portion of the lens material 100 extending from the alloy 102 on the opposite side to the shaft 16A. If the alloy 102 is thick, the upper surface of the separating member 18 may not be in contact with the lens material 100 in the state of contacting the outer peripheral surface of the alloy 102 with the arc-shaped portion on the edge of the opening 18G, but as mentioned later, the separating member 18 contacts the lens material 100 in a direction from the side of the holder 104 if the separating member 18 is rotated. Then the rotating member 22 of the pressing mechanism 9 is rotated so as to extend toward the fixing mechanism 4, whereby the pressing member 24 contacts the upper surface of the lens material 100.

[0032] Further, as illustrated in Fig. 7, even if the diameter of the alloy 112 is small, the arc-shaped edge of the opening 18G of the separating member 18 can be disposed beneath the portion of the lens material 110 extending from the edge of the alloy 112 (preferably disposed on the edge of the alloy 112) by moving the separating member 18 toward the shaft 16A in the longitudinal direction.

[0033] Furthermore, as illustrated in Fig. 8, even if the lens material 120 is not circular-shaped, the arc-shaped edge of the opening 18G of the separating member 18 can be disposed beneath the portion of the lens material 110 extending from the edge of the alloy 102 (preferably disposed on the edge of the alloy 102) by moving the separating member 18 toward the shaft 16A in the longitudinal direction.

[0034] In this case, it is preferable to dispose the lens material 100, 110 or 120 so that the arc-shaped edge of the opening 18G of the separating member 18 is located beneath the thickest portion of the lens material 100, 110 or 120 extending from the alloy 102 or 112 (preferably located on the edge of the alloy). The thickest portion of the lens material

100, 110 or 120 extending from the alloy 102 or 112 can be determined based on the design data. Therefore when the holder 104 is fixed by the clamp chuck 12, the robot arm may control such that the thickest portion is located on the front end side (right side in Fig. 6 to Fig. 8), then the arc-shaped edge of the opening 18G of the separating member 18 can be disposed beneath the thickest portion.

[0035] Then the actuator 8 is driven and the lens material 100 is separated from the alloy. Fig. 9 is a front view depicting the state of separating the lens material from the alloy by the lens separating method using the separating apparatus according to the embodiment of this invention. As illustrated in Fig. 9, when the actuator 8 is driven and the piston 8A is extended, the separating member 18 rotates upward around the shaft 16A, because the front end of the piston 8A is in contact with the guide groove 18D of the separating member 18. When the separating member 18 rotates, the separating member 18 contacts, from the holder 104 side, the portion of the lens material 100 extending from the alloy 102 on the opposite side to the shaft 16A. When the separating member 18 rotates further, the portion of the lens material 100 contacting the separating member 18 (in the preferred embodiment, this portion is a lens portion from the position at the edge of the alloy 102 to the outer edge of the lens, since the arc-shaped edge of the opening 18G is in contact with the edge of the alloy 102) is lifted up because the holder 104 is held by the fixing mechanism 4. The lens material 100 is constituted by a plastic material and has elasticity, therefore the front end side (right side in Fig. 9) portion of the separating member 18 of the lens material 100 is separated first from the alloy 102 by the above operation. When the piston 8A of the actuator 8 extends further, the separation expands toward the shaft 16A, and the entire lens material 100 is separated from the alloy 102. In the case of a lens material of which outer periphery is thick, the portion with which separating member 18 is in contact does not elastically deform very much, and the separation toward the shaft 16A suddenly progresses, and the lens material 100 may be suddenly released from the separating member 18. To prevent this sudden release from the separating member 18, the lens material 100 is pressed down by the pressing member 24 of the pressing mechanism 9 in this embodiment.

[0036] Thus the lens material 100 can be separated from the holder 104 and the alloy 102.

[0037] The present inventors measured the thrust of the actuator 8, which is required for separation of the lens depending on the shape of the lens. Fig. 10 is a graph depicting the relationship between the shape of the lens and the required thrust of the actuator, based on the separating apparatus according to the embodiment of this invention. As depicted in Fig. 10, the thrust required to separate the lens material from the holder and the alloy is determined by the lens thickness. In other words, as the power of the lens material is lower (as the lens material is thinner), the lens material can be separated at a lower thrust. Further, as depicted in Fig. 10, in the case of a (+) power lens, which is thick at the center but thin at the peripheral edge, separation can be generated at the periphery at a low thrust. In the case of a (-) power lens, on the other hand, thickness is small at the center but large at the peripheral edge. Therefore a strong thrust is needed to cause separation at the peripheral edge. Thus a strong thrust for separation is applied in the case of the (-) power lens, hence the lens material is suddenly released after separation. Therefore the pressing mechanism 9 is very effective when a (-) power lens is separated from the holder and the alloy.

[0038] The present inventors separated the lens materials from the alloy and the holder using the above mentioned separating apparatus and the separating method, and evaluated the quality of the separated lens. To evaluate quality, it was checked whether there was no deformation generated inside the lens material immediately after separation from the alloy and the holder. Then in order to check the influence of stress (e.g. ultrasound, heat) in the coating process, the final product lens, generated after the coating process is performed on the lens material, was inspected using a mercury lamp. Further, the lens material was dyed and the generation of color loss and uneven color during drying was checked. Table 1 shows the result of the quality evaluation.

[Table 1]

Lens Material (index)	Internal Deformation		Dying
	After Separation	Finished Product	Color Loss / Uneven Color
1.50	No	No	No
1.53	No	No	No
1.60	No	No	No
1.67	No	No	No
1.70	No	No	No
1.74	No	No	No

[0039] As Table 1 shows, in the lenses separated from the alloy and the holder by the separating apparatus and the separating method of this invention, internal deformation was not detected in either after separation or in the finished

product, and color loss and uneven color during dying were not discovered as well, regardless of the lens material. Thereby it was confirmed that the separating apparatus and the separating method according to this invention allows separating the lens material from the alloy and the holder without diminishing the performance of the lens material.

[0040] As described above, the following effects are implemented according to this embodiment.

[0041] In this embodiment, the lens material 100 is separated from the alloy 102 by rotating the separating member 18 in the direction of separating the lens material 100 from the holder 104, in a state in which the holder 104 is fixed by the fixing mechanism 4 and in which the separating member 18 is in contact, from the holder 104 side, with an extending portion of the lens material 100 on the opposite side to the shaft 16A. Therefore the lens material 100 elastically deforms, and the portion of the lens material 100 contacting the separating member 18 is separated from the alloy 102 first, then gradually the entire lens material 100 is separated. As a result it is unnecessary to exert a strong force on the lens to separate the lens material 100, and a problem such as cracking of the lens material 100 can be prevented. Further, the lens material 100 can be separated from the alloy 102 merely by rotating the lens while the separating member 18 is in contact with the lens material 100, hence detaching (deblocking) of the lens can be performed easily and quickly.

[0042] In this embodiment, the separating member 18 can be moved with respect to the shaft 16A of the support member 16, so as to change a position (portion) in which the separating member 18 is in contact with the lens material 100. Therefore, even if the shape of the lens material 100 is different, or if the size of the alloy 102 is different, the separating member 18 can be moved, so as to contact with or be close to the alloy 102. This allows exerting a force to separate the lens material 100 to a position closer to the center of the lens material 100, and as a result, the generation of cracking or chipping of the outer periphery of the lens material can be prevented.

[0043] Further, in this embodiment, the long hole 18C is formed in the separating member 18, and the shaft 16A is inserted into the long hole 18C. Thereby the separating member 18 can be rotated with respect to the shaft 16A, and the separating member 18 can be moved in a direction departing from or approaching to the shaft 16A (in other words, the shaft 16A can relatively slide in the longitudinal direction of the long hole 18C), so as to change a position (portion) in which the separating member 18 is in contact with the lens material 100.

[0044] Further, in this embodiment, the opening (through-hole) 18G is formed in the separating member 18 so as to face the fixing mechanism 4, and the portion of the opening 18G that is on the opposite side to the shaft 16A is formed in an arc shape. The outer peripheral surface of the alloy 102, which entered the opening 18G, contacts the portion formed in the arc shape. Since a part of the opening 18G is formed in an arc shape and the outer peripheral surface of the alloy 102 contacts this portion, a region where force is exerted from the separating member 18 to the lens material 100 can be increased, and generation of scratches and chipping of the lens material 100 can be prevented.

[0045] Further, in this embodiment, the separating member 18, which is rotatable around the shaft 16A, is contacted with a thickest part of the extended portion of the lens material 100. If the separating member 18 is contacted with the thin part of the lens material 100, cracking or chipping may be generated in the lens material 100, but according to this embodiment, such generation of cracking and chipping can be prevented.

[0046] In this embodiment, the axial direction of the shaft 16A is approximately parallel with the surface direction of the surface of the separating member 18, which is in contact with the lens material 100 (vertical direction to the paper surface in Fig. 5 and Fig. 9). However, the axial direction is not limited to this, as an expert skilled in the art knows. The axial direction (that is, the relationship between the axial direction and the contact surface) is arbitrary, as long as the pressing force of the separating member 18 is applied to the lens material 100, so that the contact surface of the separating member 18 with the lens material 100 separates the lens material 100 from the alloy 102 by rotation.

[0047] The invention will be summarized with reference to the drawings.

[0048] The lens separating apparatus 1 of this invention is an apparatus to separate a lens attached to the holder 104 via the alloy 102, having, as illustrated in Fig. 1: the fixing mechanism 4 that fixes the holder 104; and the separating member 18 that is rotatable around the shaft 16A. The lens material 100 is attached in a state in which at least a part of the outer periphery thereof extends out from the edge of the alloy 102. As illustrated in Fig. 9, the lens material 100 is separated from the alloy 102 by rotating the separating member 18 in a direction of separating the lens material 100 from the holder 104, in a state in which the holder 104 is fixed by the fixing mechanism 4 and in which the separating member 18 is in contact, from the holder 104 side, with the extended portion of the lens material 100 on the opposite side to the shaft.

[0049] The lens separating method according to this invention is a separating method for separating the lens material 100 attached to the holder 104 via the alloy 102. The lens material 100 is attached in the state in which the outer periphery thereof extends out from the edge of the alloy 102. The lens separating method includes: the fixing step of fixing the holder 104 by the fixing mechanism 4; the contacting step of contacting, from the holder 104 side, the separating member 18, which is rotatable around the shaft 16A, with the extended portion of the lens material 100 on the opposite side to the shaft 16A; and the separating step of separating the lens material 100 from the alloy 102 by rotating the separating member 18 in a direction of separating the lens material 100 from the holder 104.

[0050] The embodiments disclosed here are exemplary in all aspects, and should not limit the invention. The scope of this invention is indicated by the Claims, not by the above description, and includes equivalent meanings of the Claims

and all modifications within the scope.

[Reference Signs List]

5 **[0051]**

	1	Lens separating apparatus
	2	Base
	4	Fixing mechanism
10	6	Separating mechanism
	8	Actuator
	8A	Piston
	9	Pressing mechanism
	10	Clamp cylinder
15	10A	Piston
	11	Connecting member
	12	Clamp chuck
	12A	Gripper
	12B	Shaft
20	12C	Opening
	12D	Screw hole
	12E	Groove
	12F	Edge
	12G	Slit
25	14	Support member
	14A	Through-hole
	16	Support member
	16A	Shaft
	18	Separating member
30	18A	Extended portion
	18B	Separating member main unit
	18C	Long hole
	18D	Guide groove
	18G	Opening
35	20	Support member
	22	Rotating member
	24	Pressing member
	26	Hinge member
	100	Lens material
40	101	Protective film
	102	Alloy
	104	Holder
	110	Lens material
	112	Alloy
45	120	Lens material
	200	Lens material
	201	Protective film
	202	Alloy
	204	Holder
50	206	Detaching jig
	208	Base

Claims

- 55
1. A lens separating apparatus that separates a lens (100; 110; 120) attached to a holder (104) via an alloy (102; 112), the lens separating apparatus comprising:
a fixing mechanism (4) that fixes the holder (104);

a separating member (18) that is rotatable around a shaft (16A); and
 an actuator (8) that drives the separating member (18), wherein
 the lens is attached to the holder (104) via the alloy (102; 112) in a state in which at least a part of the outer periphery
 thereof extends out from an edge of the alloy (102; 112),
 5 an opening (18G), through which the alloy (102; 112) and the holder (104) can enter, is formed in the separating
 member (18) so as to face the fixing mechanism (4), and
 the actuator (8) is configured to rotate the separating member (18) in a direction of separating the lens (100; 110;
 120) from the holder (104), in a state in which the holder (104) is fixed by the fixing mechanism (4) and in which the
 separating member (18) is in contact, from the holder (104) side, with an extended portion of the lens on the opposite
 10 side to the shaft (16A), such that the lens (100; 110; 120) is separated from the alloy (102; 112).

2. The lens separating apparatus according to Claim 1, wherein
 the separating member (18) is movable relative to the shaft (16A), so as to change a position in which the separating
 member (18) is in contact with the lens portion.

3. The lens separating apparatus according to Claim 2, wherein
 a long hole (18C) is formed in the separating member (18) and the shaft (16A) is inserted into the long hole (18C),
 such that the separating member (18) can slide relative to the shaft (16A) in the longitudinal direction of the long
 hole (18C).

4. The lens separating apparatus according to Claim 2 or 3, wherein
 a portion of the opening (18G) that is on the opposite side to the shaft (16A) is formed in an arc shape, and
 the separating member 18 is configured to be movable relative to the shaft (16A) until an outer peripheral surface
 of the alloy (102; 112) contacts with the portion formed in the arc shape.

5. A lens separating method for separating a lens (100; 110; 120) attached to a holder (104) via an alloy (102; 112),
 wherein
 the lens (100; 110; 120) is attached to the holder (104) via the alloy (102; 112) in a state in which the outer periphery
 thereof extends out from an edge of the alloy (102; 112), the lens separating method comprising:

an entering step of allowing the alloy (102; 112) and the holder (104) to enter an opening (18G), which is formed
 in a separating member (18) that is rotatable around a shaft (16A), and which faces a fixing mechanism (4);
 a fixing step of fixing the holder (104) by the fixing mechanism (4);
 a contacting step of contacting, from the holder (104) side, the separating member (18) with an extended portion
 of the lens (100; 110; 120) on the opposite side to the shaft (16A); and
 a separating step of separating the lens (100; 110; 120) from the alloy (102; 112) by rotating the separating
 member (18) in a direction of separating the lens (100; 110; 120) from the holder (104).

6. The lens separating method according to Claim 5, wherein in the contacting step, the separating member (18) is
 contacted with a thickest part of the extended portion of the lens (100; 110; 120).

7. The lens separating method according to Claim 5 or 6, wherein
 in the contacting step, the separating member (18) is moved relative to the shaft (16A) so as to adjust a position in
 which the separating member (18) is in contact with the lens (100; 110; 120).

FIG. 1

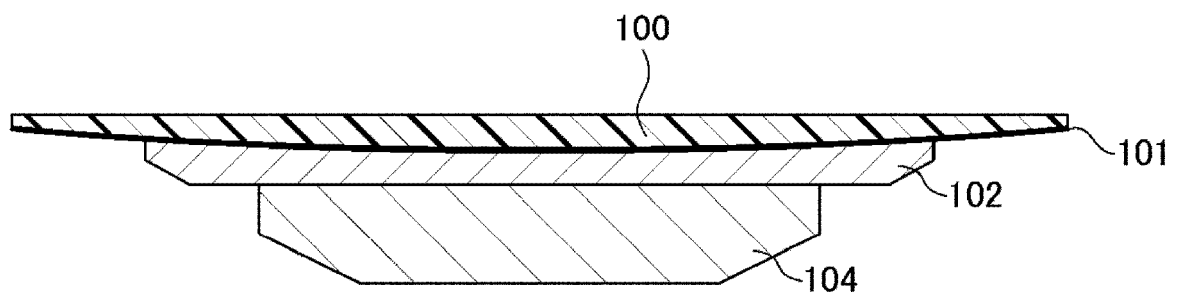


FIG. 2

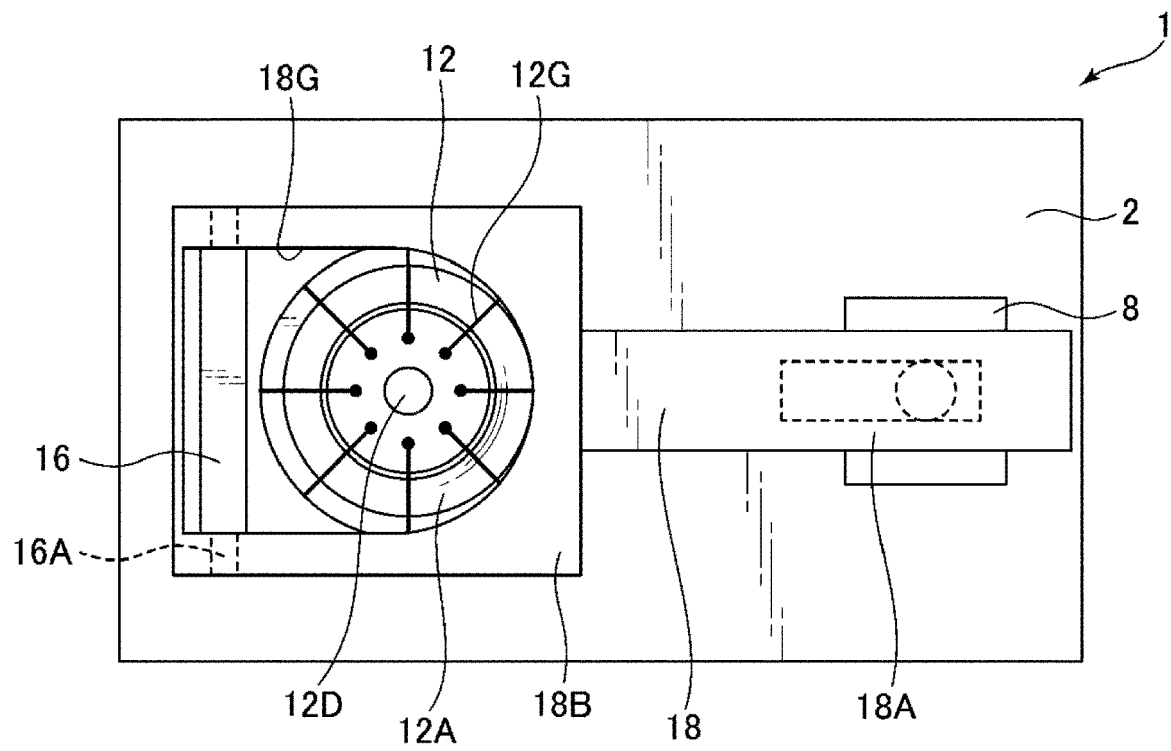


FIG. 3

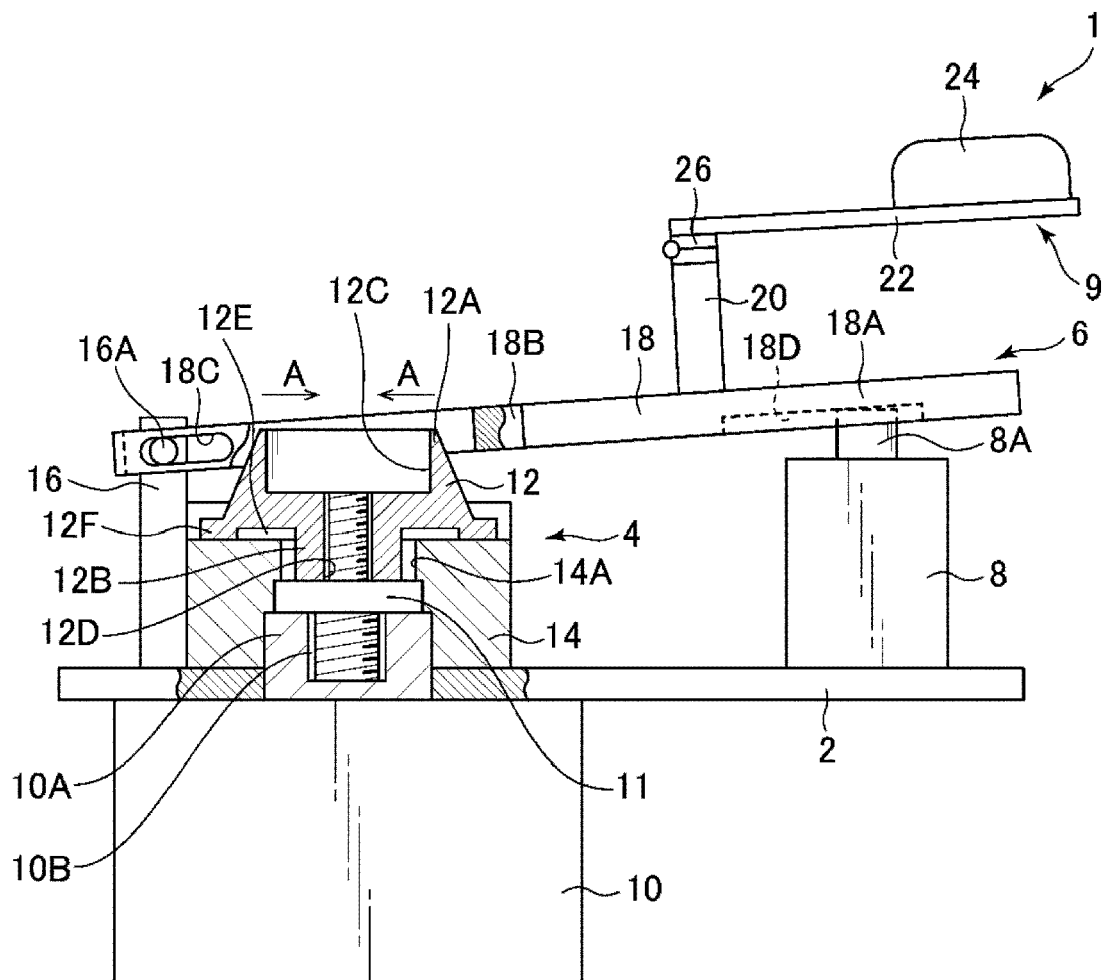


FIG. 4

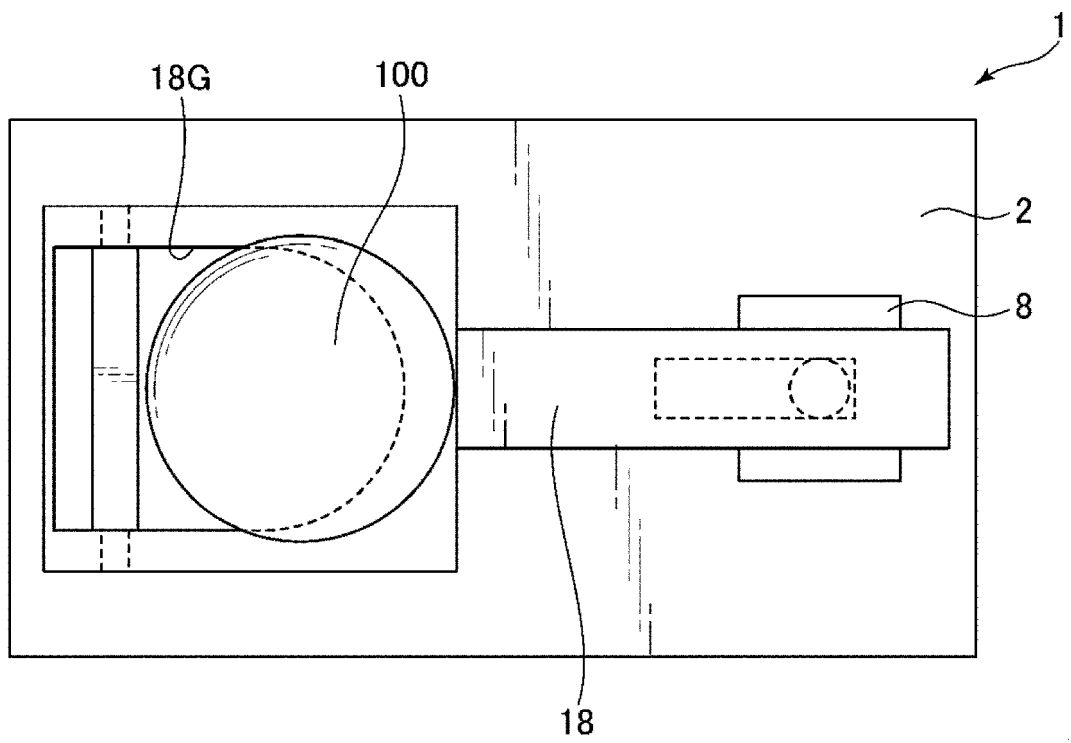


FIG. 5

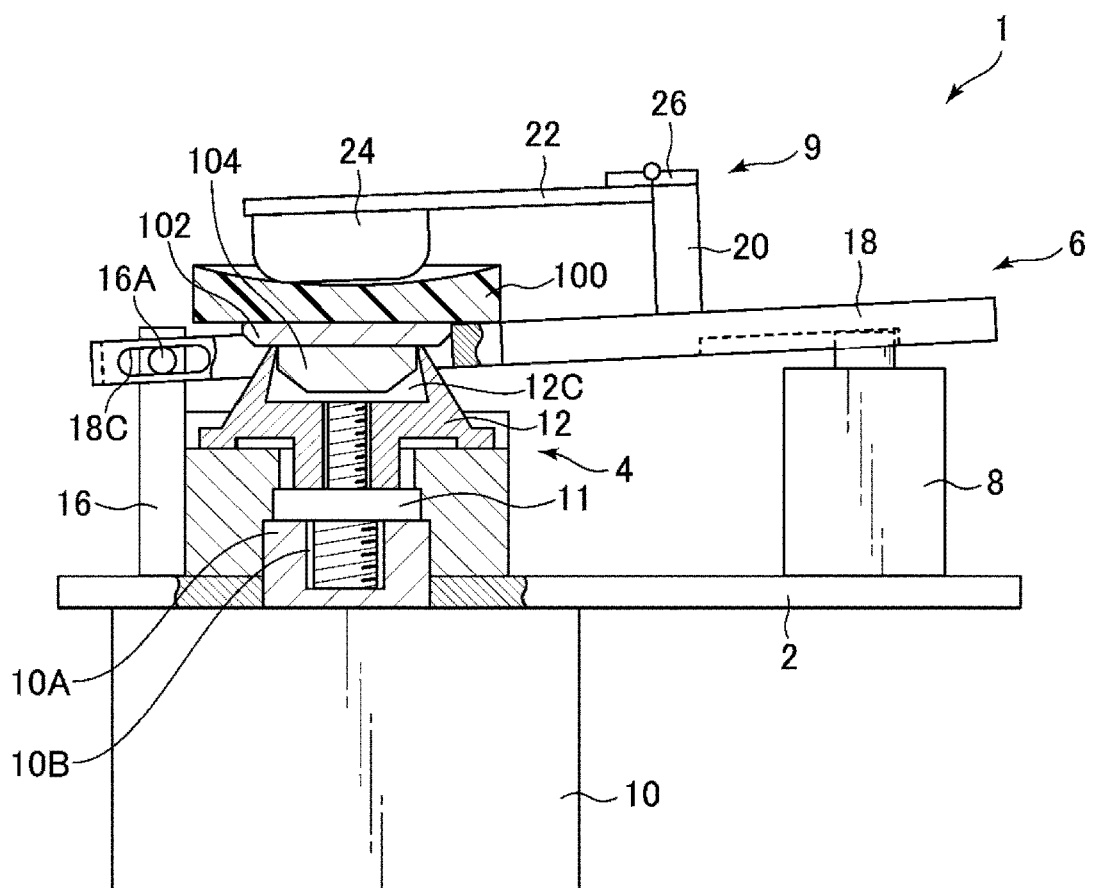


FIG. 6

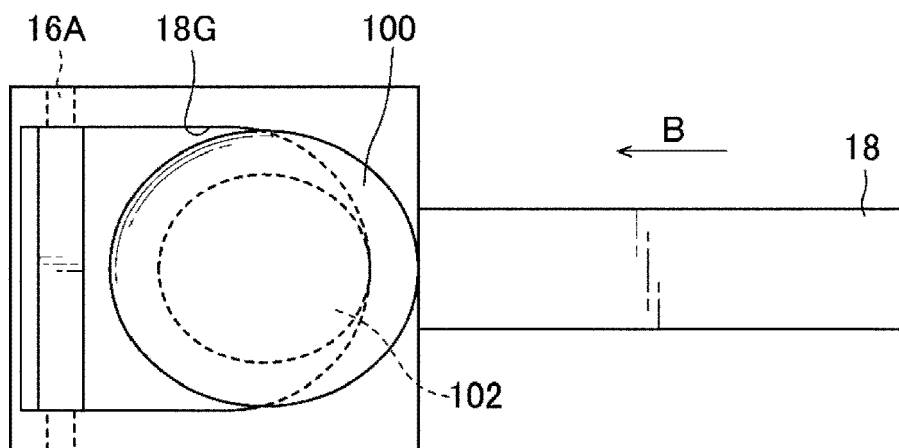


FIG. 7

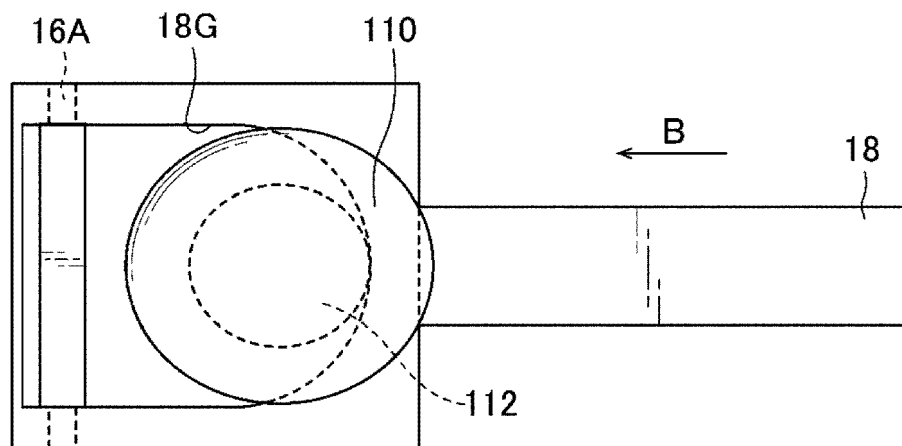


FIG. 8

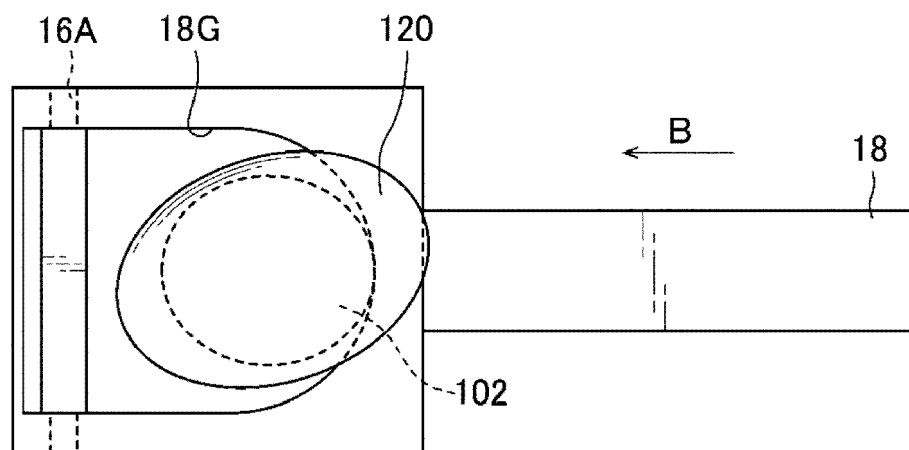


FIG. 9

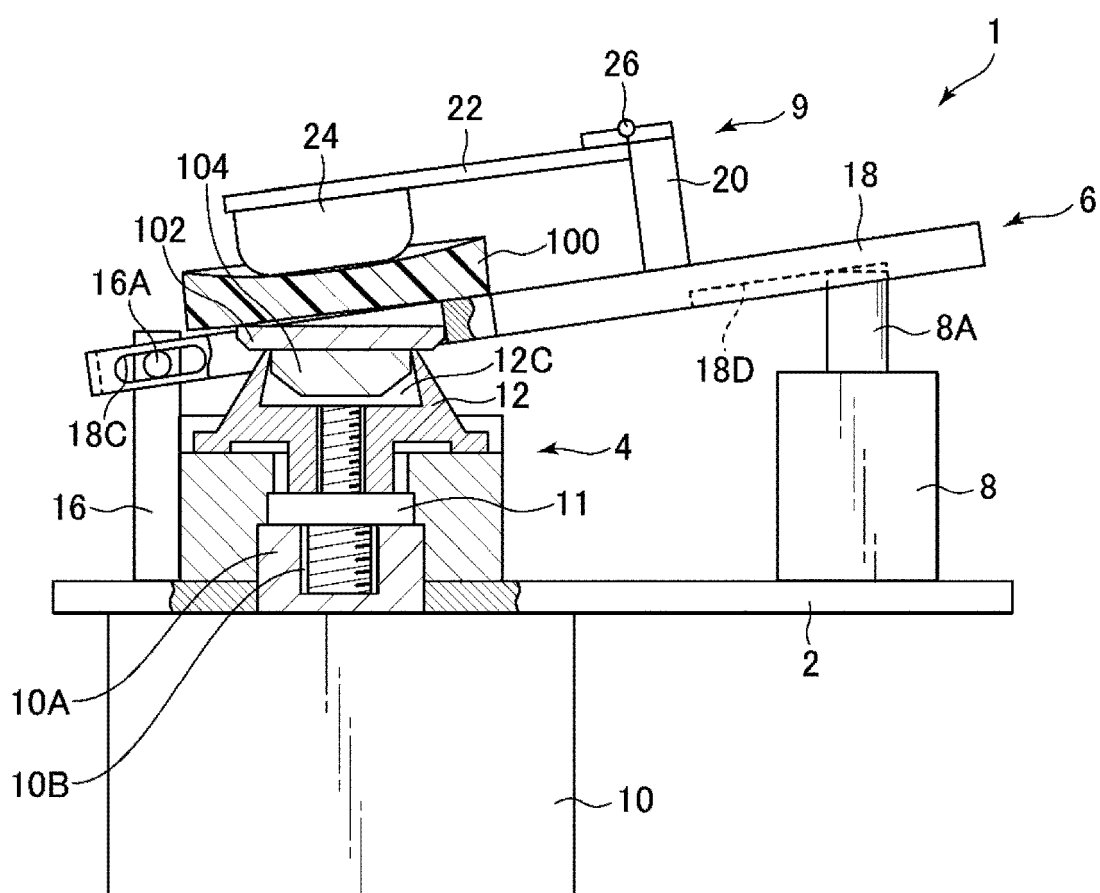


FIG. 10

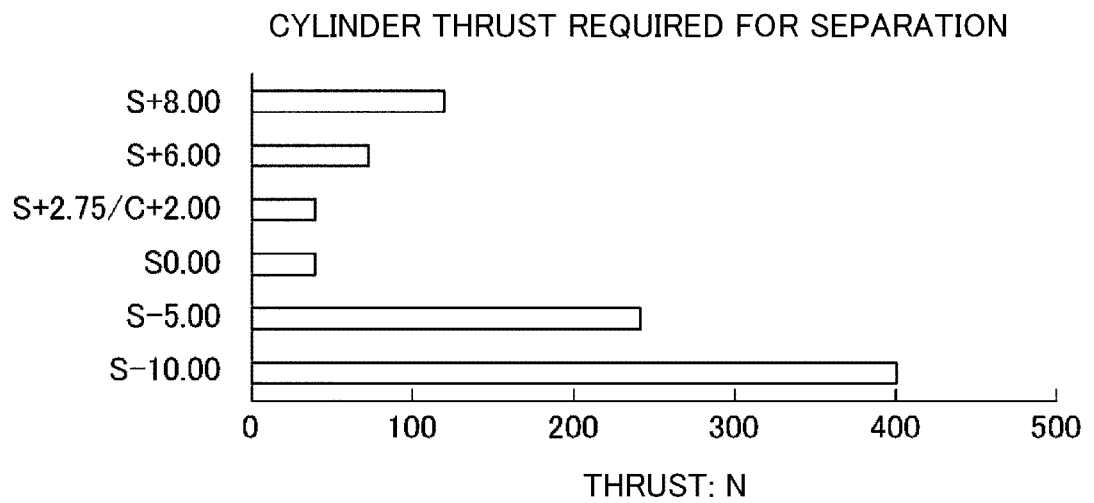
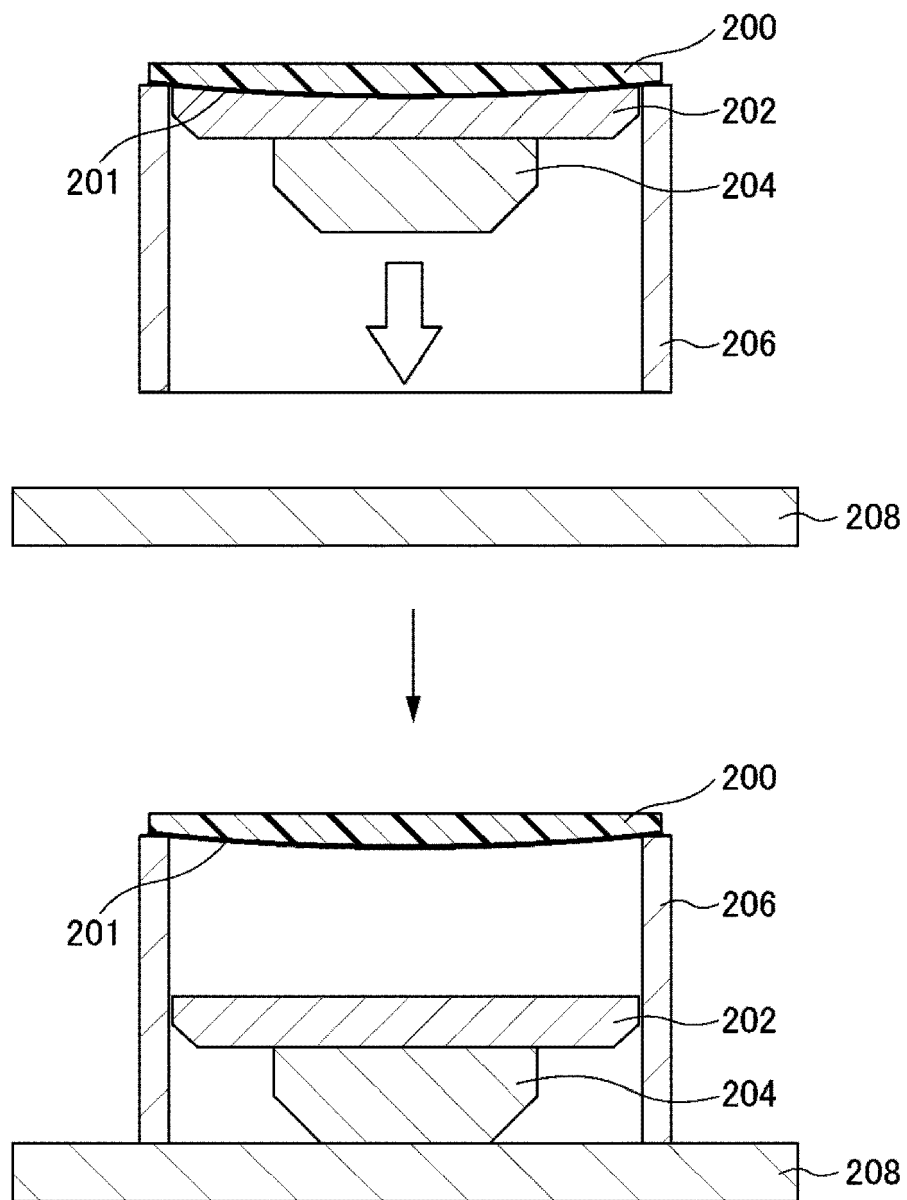


FIG. 11





EUROPEAN SEARCH REPORT

Application Number
EP 17 20 9241

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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 3 091 062 A (SUDDARTH JACK M) 28 May 1963 (1963-05-28) * the whole document * -----	1-7	INV. B24B13/005
			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 16 May 2018	Examiner Watson, Stephanie
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- JP 2013255956 A [0005]