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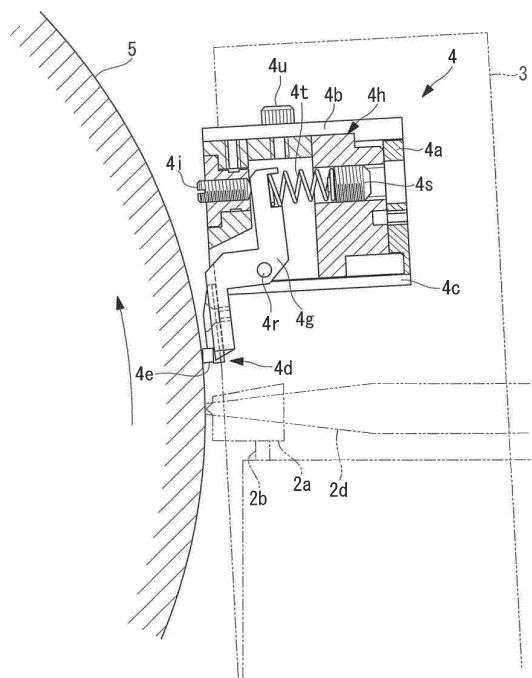
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(54) **BURR CUTTER AND GRAVURE ENGRAVING DEVICE PROVIDED WITH BURR CUTTER**

(57) Provided is a burr cutter capable of well removing burrs without damaging a surface of a gravure cylinder. A burr cutter (4) is provided which includes a body portion (4a) fixed to an engraving mechanism including an engraving needle configured to engrave a surface of a gravure cylinder (5) in a circular cylindrical shape; and a cutter portion (4d) fixed to the body portion (4a) and configured to remove burrs caused due to engraving by the engraving mechanism. A surface of the cutter portion (4d) facing the surface of the gravure cylinder (5) is substantially in a planar shape.

FIG. 5



Description

{Technical Field}

[0001] The present disclosure relates to a burr cutter and a gravure engraving device including the burr cutter.

{Background Art}

[0002] Conventionally, gravure engraving devices have been known, which are configured to engrave cells on a surface of a gravure cylinder in a circular cylindrical shape. The gravure engraving devices change the magnitude of vibration of an engraving needle to change the volume of each recessed dent formed on the surface of the gravure cylinder and called the "cell." In gravure printing, the gravure cylinder is filled with ink in an amount corresponding to the volume of the cells, and shading is produced on a printing target medium according to the amount of ink.

[0003] On the surface of the gravure cylinder engraved with the engraving needle, rough edges (burrs) of a copper piece on the surface of the gravure cylinder might remain around the cell formed using the engraving needle. In order to remove such burrs, a device has been known, which is configured to cause a cutter portion to contact the surface of the gravure cylinder (see, e.g., PTL 1).

[0004] The cutter portion of the device disclosed in PTL 1 is substantially in a semicircular cylindrical shape having a curvature in a rotation direction of the gravure cylinder as illustrated in Figure 13 of PTL 1. In addition, the cutter portion of PTL 1 can swing about a swing shaft. In engraving using the gravure engraving device, the cutter portion swings about the swing shaft according to the circumferential length of the gravure cylinder, and a circular cylindrical portion of the cutter portion contacts the surface of the gravure cylinder.

{Citation List}

{Patent Literature}

[0005] {PTL 1}
Japanese Unexamined Patent Application, Publication No. 2004-34568

{Summary of Invention}

{Technical Problem}

[0006] However, the cutter portion of PTL 1 is substantially in the semicircular cylindrical shape having the curvature in the rotation direction of the gravure cylinder. Due to the curvature of the cutter portion, the clearance between a surface of the cutter portion and the surface of the gravure cylinder gradually becomes larger from the contact position between the cutter portion and the

gravure cylinder toward the upstream side of the gravure cylinder in the rotation direction thereof. For such a reason, burrs easily enter the above-described clearance at an end portion of the cutter portion on the upstream side of the gravure cylinder in the rotation direction thereof. The burrs having entered the clearance are pressed against the gravure cylinder at the contact position between the cutter portion and the gravure cylinder, leading to damage of the surface of the gravure cylinder. The gravure cylinder whose surface is damaged cannot be used for printing, and another gravure cylinder needs to be engraved again.

[0007] In addition, since the cutter portion of PTL 1 is substantially in the semicircular cylindrical shape, the contact area between the cutter portion and the surface of the gravure cylinder is small, and therefore, burrs around the cells cannot be sufficiently removed. Due to insufficient removal of the burrs, the volume of each cell becomes smaller than a desired volume, and the amount of ink with which each cell is filled in printing decreases.

[0008] The present disclosure has been made in view of the above-described problem, and is intended to provide a burr cutter capable of well removing burrs without damaging a surface of a gravure cylinder and a gravure engraving device including the burr cutter.

{Solution to Problem}

[0009] In order to accomplish the above-described objective, the present disclosure provides the following solutions.

[0010] A burr cutter of the present disclosure includes a body portion fixed to an engraving mechanism configured to engrave a surface of a gravure cylinder in a circular cylindrical shape, and a cutter portion fixed to the body portion and configured to remove a burr caused due to engraving by the engraving mechanism. An opposing surface of the cutter portion facing the surface of the gravure cylinder is substantially in a planar shape.

[0011] Of the cutter portion configured to remove burrs, the opposing surface facing the surface of the gravure cylinder is substantially in the planar shape according to the burr cutter of the present disclosure. Thus, burrs do not easily enter the clearance between the surface of the cutter portion and the surface of the gravure cylinder, and scratches are less formed on the surface of the gravure cylinder due to pressing of burrs against the gravure cylinder. Moreover, a sufficient contact area between the cutter portion and the gravure cylinder is ensured, and the pressure of the cutter portion against the gravure cylinder is well dispersed.

[0012] Thus, according to the burr cutter of the present disclosure, the burr cutter can be provided, which is capable of well removing burrs without damaging the surface of the gravure cylinder.

[0013] The burr cutter of a first aspect of the present disclosure further includes an arm portion configured to be swingable about a swing shaft extending substantially

parallel to a rotary shaft of the gravure cylinder, the cutter portion being fixed to the arm portion at a first end portion thereof, the rotary shaft being fixed to the body portion, and a contact angle adjuster configured to swing the arm portion to adjust the contact angle between the surface of the gravure cylinder and the opposing surface.

[0014] According to the burr cutter of the first aspect of the present disclosure, if a gravure cylinder having a different circumferential length is attached as a replacement, the arm portion swings to adjust the contact angle between the opposing surface of the cutter portion and the surface of the gravure cylinder. Thus, such a contact angle can be adjusted to an angle suitable for the gravure cylinder.

[0015] Thus, regardless of the circumferential length of the gravure cylinder engraved by the gravure engraving device, the burr cutter can be provided, which is capable of well removing burrs without damaging the surface of the gravure cylinder.

[0016] The burr cutter of the first aspect of the present disclosure may be configured such that the contact angle adjuster receives adjustment operation performed by an operating person and adjusts the contact angle according to the adjustment operation.

[0017] Thus, if a gravure cylinder having a different circumferential length is attached as a replacement, the contact angle between the opposing surface of the cutter portion and the surface of the gravure cylinder is adjusted according to the adjustment operation performed by the operating person, and therefore, such a contact angle can be adjusted to an angle suitable for the gravure cylinder.

[0018] The burr cutter having the above-described configuration, the contact angle adjuster may include a biasing member configured to provide biasing force to a second end portion of the arm portion in a swing direction, and a pressing member configured to change the position thereof relative to the body portion according to the adjustment operation, the pressing member being pressed against the second end portion from a direction facing the biasing force of the biasing member.

[0019] Thus, the position of the pressing member relative to the body portion changes according to the adjustment operation performed by the operating person, and accordingly, the arm portion swings. Then, by swinging of the arm portion, the contact angle between the opposing surface of the cutter portion and the surface of the gravure cylinder is adjusted, and therefore, such a contact angle can be adjusted to an angle suitable for the gravure cylinder.

[0020] In the above-described configuration, the pressing member may include an external thread portion configured to be fastened to an internal thread portion formed at the body portion, and an identifier configured to allow the operating person to identify the fastening state of the external thread portion to the internal thread portion.

[0021] Thus, while identifying the fastening state of the

external thread portion of the pressing member by the identifier, the operating person can properly adjust the contact angle between the opposing surface of the cutter portion and the surface of the gravure cylinder. For example, the operating person memorizes the relationship between the circumferential length of the gravure cylinder and the fastening state of the external thread portion identified by the identifier, and therefore, can easily perform the suitable adjustment operation according to the circumferential length of the gravure cylinder.

[0022] The burr cutter of the first aspect of the present disclosure may be configured such that the arm portion is turnable about a turning axis perpendicular to the swing shaft and substantially parallel to the opposing surface in the direction in which the angle between the surface of the gravure cylinder and the opposing surface changes, and the burr cutter further comprising a turning angle adjuster configured to turn the arm portion to adjust the turning angle of the opposing surface relative to the surface of the gravure cylinder is provided.

[0023] Thus, the burr cutter can be provided, which is capable of properly adjusting the turning angle of the opposing surface of the cutter portion relative to the surface of the gravure cylinder and well removing burrs.

[0024] The burr cutter of the first aspect of the present disclosure may be configured such that the cutter portion is detachably attached to the arm portion.

[0025] Thus, if the cutter portion is replaced in order to re-sharpen the cutter portion, the contact angle between the opposing surface of the cutter portion and the surface of the gravure cylinder can be maintained before and after replacement. Consequently, the process of re-adjusting the contact angle upon replacement of the cutter portion is not required, or is facilitated.

[0026] A gravure engraving device of the present disclosure includes an engraving mechanism configured to engrave a surface of a gravure cylinder in a circular cylindrical shape, a holding member configured to hold the engraving mechanism, and the above-described burr cutter fixed to the holding member.

[0027] Thus, the gravure engraving device can be provided, which includes the burr cutter capable of well removing burrs without damaging the surface of the gravure cylinder.

{Advantageous Effects of Invention}

[0028] According to the present disclosure, the burr cutter capable of well removing burrs without damaging the surface of the gravure cylinder and the gravure engraving device including the burr cutter can be provided.

{Brief Description of Drawings}

[0029]

{Figure 1}

Figure 1 is a front view illustrating a gravure engraving

ing device of an embodiment of the present disclosure.

{Figure 2}

Figure 2 is a front view illustrating a burr cutter of the embodiment of the present disclosure.

{Figure 3A}

Figure 3A is an upper view of the burr cutter of Figure 2, and illustrates the state in which an upper plate is detached.

{Figure 3B}

Figure 3B is an upper view of the burr cutter of Figure 2, and illustrates the state in which the upper plate is attached.

{Figure 4}

Figure 4 is a cross-sectional view of the burr cutter of Figure 2 along an A-A line.

{Figure 5}

Figure 5 is a cross-sectional view of the burr cutter of Figure 2 along the A-A line.

{Figure 6A}

Figure 6A is a right side view illustrating the gravure engraving device of the embodiment of the present disclosure, and illustrates the case of a gravure cylinder having a long circumferential length.

{Figure 6B}

Figure 6B is a right side view illustrating the gravure engraving device of the embodiment of the present disclosure, and illustrates the case of a gravure cylinder having a short circumferential length.

{Figure 7}

Figure 7 is a front view illustrating a cutter portion of another embodiment.

{Description of Embodiments}

[0030] A burr cutter and a gravure engraving device according to an embodiment of the present disclosure will be described below with reference to drawings.

[0031] Figure 1 is a front view illustrating the gravure engraving device of the embodiment of the present disclosure.

[0032] A gravure engraving device 1 of the present embodiment includes, as illustrated in Figure 1, an engraving head 2, a head bracket 3, a burr cutter 4, and a moving mechanism (not shown) configured to linearly move an engraving mechanism including the engraving head 2 and the head bracket 3 in the direction toward a gravure cylinder 5 or the direction away from the gravure cylinder 5. Moreover, the gravure engraving device 1 includes a rotation mechanism configured to hold both end portions of the gravure cylinder 5 in a circular cylindrical shape to rotate the gravure cylinder 5 about a rotary shaft.

[0033] The engraving head 2 includes a stylus 2a, a vibration shaft 2b serving as a center shaft for vibration of the stylus 2a, a sliding shoe 2d, an engraving head body 2e, an engraving head support 2f, and a suction duct 2g. An engraving needle 2c made of diamond is fixed to a tip end of the stylus 2a. The stylus 2a is vibrated

about the vibration shaft 2b by a vibration mechanism (not shown), and accordingly, the engraving needle 2c vibrates in such a direction that the engraving needle 2c contacts the gravure cylinder 5 rotated by the rotation mechanism or separates from the gravure cylinder 5.

[0034] The later-described gravure cylinder 5 illustrated in Figures 4 and 5 is a circular cylindrical member onto which copper plating is applied to a thickness of about 50 μm to 200 μm . The gravure engraving device 1 causes the engraving needle 2c to contact the rotating gravure cylinder 5 to carve out part of the copper plating applied onto a surface of the gravure cylinder 5, thereby forming, at the surface of the gravure cylinder 5, a recessed dent called a "cell."

[0035] The gravure engraving device 1 changes the magnitude of vibration of the engraving needle 2c to change the volume of each cell formed at the surface of the gravure cylinder 5. In gravure printing, the gravure cylinder 5 is filled with ink in an amount corresponding to the volume of the cells, and shading is produced on a printing target medium according to the amount of ink.

[0036] The sliding shoe 2d is a member configured to maintain a constant distance between the engraving head body 2e and the gravure cylinder 5. Since the stylus 2a is fixed to the vibration shaft 2b, the sliding shoe 2d maintains the constant distance between the stylus 2a and the gravure cylinder 5. In engraving using the stylus 2a, the gravure engraving device 1 first causes the rotation mechanism (not shown) to rotate the gravure cylinder 5 with the engraving head body 2e being separated from the gravure cylinder 5.

[0037] Then, while the gravure cylinder 5 is rotating, the gravure engraving device 1 causes the moving mechanism (not shown) to move the engraving head body 2e in the direction toward the gravure cylinder 5. When a tip end of the sliding shoe 2d comes into contact with the gravure cylinder 5 by the moving mechanism, the gravure engraving device 1 stops the engraving head body 2e moved by the moving mechanism.

[0038] As described above, the gravure engraving device 1 controls the moving mechanism such that the engraving needle 2c is positioned with a certain distance from the surface of the gravure cylinder 5. Subsequently, the vibration shaft 2b to which the stylus 2a is fixed is vibrated by the vibration mechanism, thereby engraving the gravure cylinder 5 with the engraving needle 2c. As a result, a cell is formed at the surface of the gravure cylinder 5.

[0039] The engraving head body 2e is detachably supported by the engraving head support 2f. Thus, the engraving head body 2e can be detached from the engraving head support 2f so that the stylus 2a can be replaced, for example.

[0040] The suction duct 2g is configured to suck burrs carved out by the engraving needle 2c or the burr cutter 4. The suction duct 2g is connected to a not-shown suction device, and sucks, together with the burrs, air around the engraving needle 2c and the burr cutter 4.

[0041] Next, the burr cutter 4 of the present embodiment will be described with reference to Figures 1 to 3.

[0042] Figure 2 is a front view illustrating the burr cutter 4, and illustrates the state in which a later-described cutter portion 4d is detached. Figures 3A and 3B are upper views of the burr cutter 4 illustrated in Figure 2. Figure 3A illustrates the state in which a later-described upper plate 4b is detached. Figure 3B illustrates the state in which the later-described upper plate 4b is attached.

[0043] As illustrated in Figure 1, the burr cutter 4 is fastened with fastening bolts 8, 9 such that an upper surface of the burr cutter 4 contacts a lower surface of an upper portion of the head bracket 3. As will be described later, the head bracket 3 is attached to the engraving head 2 so as to swing about a swing shaft 6. Thus, the burr cutter 4 fixed to the head bracket 3 is also swingable about the swing shaft 6 relative to the engraving head 2.

[0044] As illustrated in Figure 2, the burr cutter 4 includes a body portion 4a, the upper plate 4b fastened to an upper surface of the body portion 4a with fastening screws, and a lower plate 4c fastened to a lower surface of the body portion 4a with fastening screws.

[0045] Moreover, the burr cutter 4 includes the cutter portion 4d detachably fastened, with fastening screws, to an arm portion 4g swinging about a later-described swing shaft 4r.

[0046] The cutter portion 4d includes a base 4f and a cylinder contact member 4e bonded to the base 4f with an adhesive. The cutter portion 4d is detachably attached to one end portion of the arm portion 4g. A semicircular cutout 4w is formed at the base 4f. The cutter portion 4d is positioned relative to the arm portion 4g in such a manner that the cutout 4w comes into contact with a raised portion 4v formed at one end portion of the arm portion 4g and formed in a circular shape as viewed in the plane.

[0047] As illustrated in Figure 2, the cylinder contact member 4e is a member formed in a fan shape as viewed in the plane and having a center angle of about 90°. In addition, the surface of the cylinder contact member 4e facing the surface of the gravure cylinder 5 defines substantially a flat surface as illustrated in Figures 4 and 5. The cylinder contact member 4e is formed of a member having a higher hardness than that of the copper on the surface of the gravure cylinder, and is preferably a member made of, e.g., diamond.

[0048] Note that the cylinder contact member 4e is the member formed in the fan shape as viewed in the plane and having a center angle of about 90°, but may have another center angle. For example, the center angle may be an optional angle within a range of equal to or higher than 85° and equal to or lower than 120°. In the case where the center angle is 90°, there is an advantage that four cylinder contact members can be manufactured from a cylinder contact member formed in a circular shape as viewed in the plane by a relatively-easy process of dividing such a circular cylinder contact member into four members.

[0049] The surface of the cylinder contact member 4e

facing the surface of the gravure cylinder 5 is in such a shape that burrs do not easily enter the clearance between a surface of the cutter portion 4d and the surface of the gravure cylinder. Specifically, the shape of the surface of the cylinder contact member 4e facing the surface of the gravure cylinder 5 is the shape not having a curvature in a rotation direction of the gravure cylinder 5, or the shape (the substantially planar shape) having such a curvature that burrs do not enter the above-described clearance.

[0050] In addition, the surface of the cylinder contact member 4e facing the surface of the gravure cylinder 5 is in such a shape that a sufficient area of contact in the direction perpendicular to the rotation direction of the gravure cylinder 5 can be ensured. Specifically, the shape of the surface of the cylinder contact member 4e facing the surface of the gravure cylinder 5 is the shape not having a curvature in the direction perpendicular to the rotation direction of the gravure cylinder 5, or the shape (the substantially planar shape) having such a curvature that the above-described contact area is not decreased.

[0051] The cutter portion 4d including the cylinder contact member 4e is fixed to the body portion 4a through an arm support 4h, and is configured to remove burrs caused by carving out with the engraving needle 2c and remaining on the surface of the gravure cylinder 5.

[0052] When the cutter portion 4d is positioned relative to the arm portion 4g, a through-hole 4y formed at the base 4f and a fastening hole 4x formed at the arm portion 4g are positioned coincident with each other. A fastening screw (not shown) is fastened into the fastening hole 4x in the above-described arrangement state, thereby fixing the cutter portion 4d to the arm portion 4g.

[0053] The arm support 4h is a member configured to support the arm portion 4g, and is turnable about a turning axis C illustrated in Figures 3A and 3B in the direction indicated by arrows in Figures 3A and 3B. The turning axis C is substantially parallel to the surface (the opposing surface) of the cylinder contact member 4e facing the surface of the gravure cylinder 5, the opposing surface being perpendicular to the later-described swing shaft 4r.

[0054] As illustrated in Figure 3A, a pair of side members 4l, 4m are fixed to the arm support 4h. A counterbore hole is formed on a rear side of the side member 4l, and one end of a coil spring 4q is fixed to the counterbore hole. On the other hand, the other end of the coil spring 4q is fixed to a counterbore hole formed at the body portion 4a. The force generated by contraction of the coil spring 4q provides the arm support 4h with turning force about the turning axis C in the counterclockwise direction as viewed in Figures 3A and 3B.

[0055] An internal thread hole is formed at the side member 4m. An adjustment rod 4p with an external thread formed on an outer peripheral surface is inserted into the internal thread hole. The adjustment rod 4p is a member configured to receive adjustment operation (the operation of rotating the adjustment rod 4p) performed by an operating person, and a tip end portion of the ad-

justment rod 4p is pressed against the body portion 4a. The operating person performs the adjustment operation for the adjustment rod 4p, thereby moving the side member 4m upward as viewed in Figure 3A. When the side member 4m moves upward as viewed in Figure 3A, the arm support 4h turns about the turning axis C in the clockwise direction as viewed in Figure 3.

[0056] As described above, the force generated by contraction of the coil spring 4q provides the arm support 4h with the turning force in the counterclockwise direction, and the adjustment rod 4p provides the arm support 4h with the turning force in the clockwise direction. Thus, the operating person performs the adjustment operation of rotating the adjustment rod 4p, thereby adjusting the turning angle of the arm support 4h about the turning axis C to a desired angle. Note that after the turning angle of the arm support 4h about the turning axis C is adjusted, a fastening bolt 4u illustrated in Figures 4 and 5 is fastened into a fastening hole (not shown) formed at the arm support 4h, and therefore, the arm support 4h can be fixed such that the adjusted turning angle does not change in engraving.

[0057] As described above, the coil spring 4q, the adjustment rod 4p, the side member 4l, and the side member 4m function as a turning angle adjuster configured to adjust the turning angle of the opposing surface relative to the surface of the gravure cylinder 5.

[0058] An external thread portion 4i illustrated in Figure 2 is a member to be fastened to an internal thread portion formed at the arm support 4h. A groove (an identifier) is formed at an end portion of the external thread portion 4i illustrated in Figure 2. The operating person rotates the external thread portion 4i with a flat-blade screwdriver being inserted into the groove, thereby adjusting the state of fastening to the internal thread portion formed at the arm support 4h. An identification seal 4j with scale marks is bonded to the arm support 4h so as to surround the internal thread portion fastened to the external thread portion 4i.

[0059] The identification seal 4j is configured to assist the operating person to identify the state of fastening of the external thread portion 4i to the internal thread portion. The operating person can identify the state of fastening of the external thread portion 4i to the internal thread portion from the relationship between the direction of the groove formed at the external thread portion 4i and the scale mark.

[0060] Marks "S" and "L" are carved on the arm support 4h. The mark "S" means "Small," and indicates that the external thread portion 4i rotates counterclockwise to adjust a contact angle to an angle suitable for a small-diameter gravure cylinder 5. On the other hand, the mark "L" means "Large," and indicates that the external thread portion 4i rotates clockwise to adjust the contact angle to an angle suitable for a large-diameter gravure cylinder 5.

[0061] A ventilation groove 4K is a groove formed at the upper plate 4b, the body portion 4a, and the lower

plate 4c, and functions as a flow path for circulating air sucked together with burrs into the suction duct 2g of the gravure engraving device 1. As illustrated in Figure 2, a suction port of the suction duct 2g is disposed on a line extending from the ventilation groove 4K. The ventilation groove 4K rectifies the flow of air to the flow in a direction suitable for suction of burrs.

[0062] In Figure 3, each of internal thread holes 4n, 4o is a hole which is formed at an upper surface of the head bracket 3 and to which a corresponding one of the fastening bolts 8, 9 inserted respectively into through-holes is fastened. The fastening bolts 8, 9 are fastened respectively into the internal thread holes 4n, 4o, thereby fixing the burr cutter 4 including the body portion 4a to the head bracket 3. Thus, the body portion 4a is fixed to the engraving mechanism including the head bracket 3 and the engraving head 2.

[0063] As illustrated in Figures 2 and 3B, a triangular cutout as viewed in the plane is formed at a front portion of the upper plate 4b. When the upper plate 4b is viewed from the above, the arm support 4h can be viewed through the cutout. A groove 4z is formed at upper and front surfaces of the arm support 4h viewed through the cutout.

[0064] In adjustment performed by the above-described turning angle adjuster (the coil spring 4q, the adjustment rod 4p, the side member 4l, and the side member 4m), the positional relationship between the triangular cutout and the groove 4z changes depending on the turning angle. Thus, while visually checking the positional relationship between the triangular cutout and the groove 4z, the operating person can properly adjust the turning angle.

[0065] Next, adjustment of the contact angle between the surface of the gravure cylinder 5 and the opposing surface of the cutter portion (the cylinder contact member 4e) will be described with reference to Figures 4 and 5. Figures 4 and 5 are cross-sectional views of the burr cutter 4 along an A-A line of Figure 2. In Figures 4 and 5, an arrow illustrated in the gravure cylinder 5 indicates the rotation direction of the gravure cylinder 5.

[0066] Figure 4 illustrates the burr cutter 4 when a gravure cylinder 5 having a long circumferential length is attached to the gravure engraving device 1. Figure 5 illustrates the burr cutter 4 when a gravure cylinder 5 having a short circumferential length is attached to the gravure engraving device 1. Although gravure cylinders 5 having various circumferential lengths are attachable to the gravure engraving device 1, the circumferential length is typically within a range of 400 mm to 1500 mm.

[0067] In Figures 4 and 5, the swing shaft 4r is a shaft fixed to the arm support 4h, and is inserted into a through-hole (not shown) formed at the arm portion 4g. The swing shaft 4r is substantially parallel to a rotary shaft (not shown) of the gravure cylinder. Thus, the arm portion 4g swings about the swing shaft 4r, thereby adjusting the contact angle between the surface of the gravure cylinder 5 and the opposing surface (the surface facing the sur-

face of the gravure cylinder 5) of the cylinder contact member 4e.

[0068] As described above, the cutter portion 4d is fixed to one end (a first end) of the arm portion 4g. On the other hand, a counterbore hole is formed at the other end (a second end) of the arm portion 4g, and one end of a coil spring 4t (a biasing member) is inserted into the counterbore hole. The other end of the coil spring 4t is inserted into a through-hole formed at the arm support 4h. An internal thread portion is formed at an inner peripheral surface of the through-hole, and an external thread portion 4s is fastened to the internal thread portion. The end of the coil spring 4t inserted into the through-hole is pressed against a tip end of the external thread portion 4s. Note that the operating person can adjust the fastening state of the external thread portion 4s to adjust the magnitude of biasing force provided from the coil spring 4t to the arm portion 4g.

[0069] As described above, the biasing force for swinging the arm portion 4g about the swing shaft 4r in the counterclockwise direction is provided to the second end of the arm portion 4g. The second end of the arm portion 4g to which the biasing force is provided from the coil spring 4t is pressed against a tip end of the external thread portion 4i (a pressing member). The operating person can perform the adjustment operation of rotating the external thread portion 4i to move the external thread portion 4i in the right-left direction as viewed in Figure 4. When the external thread portion 4i moves to the right as viewed in Figures 4 and 5, swing force about the swing shaft 4r in the clockwise direction as viewed in Figures 4 and 5 is provided to the arm portion 4g.

[0070] As described above, the force of extending the coil spring 4t provides the arm portion 4g with the swing force in the counterclockwise direction, and the external thread portion 4i provides the arm portion 4g with the swing force in the clockwise direction. Thus, the operating person can perform the adjustment operation of rotating the external thread portion 4i to adjust the swing angle of the arm portion 4g about the swing shaft 4r to a desired angle. Since the cutter portion 4d is fixed to the first end of the arm portion 4g, the contact angle between the surface of the gravure cylinder 5 and the opposing surface of the cylinder contact member 4e can be adjusted.

[0071] That is, the coil spring 4t (the biasing member) and the external thread portion 4i (the pressing member) function as a contact angle adjuster configured to adjust the contact angle. When receiving the adjustment operation (the operation of rotating the external thread portion 4i) performed by the operating person, the external thread portion 4i adjusts the contact angle according to the adjustment operation.

[0072] Although gravure cylinders 5 having different circumferential lengths are attachable to the gravure engraving device 1, the rotary shaft of the gravure cylinder 5 is fixed to a certain position regardless of the circumferential length. The contact position between the gra-

vure cylinder 5 and the opposing surface of the cylinder contact member 4e in the height direction is the same among the cases of different circumferential lengths. As described above, the circumferential length of the gravure cylinder 5 illustrated in Figure 5 is shorter than that of the gravure cylinder 5 illustrated in Figure 4.

[0073] Thus, in order to maintain a constant contact angle (a substantially parallel state) between the surface of the gravure cylinder 5 and the opposing surface of the cylinder contact member 4e, it is necessary to swing the arm portion 4g according to the circumferential length of the gravure cylinder 5. The arm portion 4g swings to adjust the contact angle between the surface of the gravure cylinder 5 and the opposing surface of the cylinder contact member 4e.

[0074] In the present embodiment, the contact position between the gravure cylinder 5 and the opposing surface of the cylinder contact member 4e is above the rotary shaft of the gravure cylinder 5. Thus, the opposing surface of the cylinder contact member 4e needs to be closer to the gravure cylinder 5 relative to the position of the engraving needle 2c as the circumferential length of the gravure cylinder 5 decreases. Moreover, the opposing surface of the cylinder contact member 4e needs to be more inclined with respect to the surface of the gravure cylinder 5 as the circumferential length of the gravure cylinder 5 decreases.

[0075] As illustrated in Figure 5, if the circumferential length of the gravure cylinder 5 is short in the present embodiment, the arm portion 4g swings counterclockwise to incline the opposing surface of the cylinder contact member 4e with respect to the surface of the gravure cylinder 5. Thus, regardless of the circumferential length of the gravure cylinder 5, the contact angle between the surface of the gravure cylinder 5 and the opposing surface of the cylinder contact member 4e can be maintained constant (the substantially parallel state can be maintained).

[0076] As illustrated in Figure 1, the positional relationship in the height direction between the engraving needle 2c and the cutter portion 4d is fixed. Thus, in order to properly contact the cylinder contact member 4e to the surface of the gravure cylinder 5, it is necessary to properly adjust, in the direction perpendicular to the surface of the gravure cylinder 5, the position of the burr cutter 4 relative to the engraving head 2. Specifically, if the gravure cylinder 5 is replaced with a gravure cylinder 5 having a shorter circumferential length, the position of the burr cutter 4 relative to the engraving head 2 needs to be moved in the direction toward the gravure cylinder 5.

[0077] Adjustment of the position of the burr cutter 4 relative to the engraving head 2 will be described with reference to Figures 6A and 6B. Figures 6A and 6B are right side views illustrating the gravure engraving device 1 of the embodiment of the present disclosure. Figure 6A illustrates the case of a gravure cylinder 5 having a long circumferential length, and Figure 6B illustrates the case of a gravure cylinder 5 having a short circumferential

length.

[0078] As illustrated in Figures 6A and 6B, the head bracket 3 to which the burr cutter 4 is fixed is swingable about the swing shaft 6 in the direction indicated by an arrow in Figures 6A and 6B. A biasing member (not shown) provides the head bracket 3 with the biasing force of swinging the head bracket 3 about the swing shaft 6 in the counterclockwise direction as viewed in Figures 6A and 6B.

[0079] A through-hole 3a is formed at the head bracket 3, and a fastening bolt 7 is inserted into the through-hole 3a. The fastening bolt 7 is fastened into a fastening hole 2h formed at the engraving head 2, or is not fastened into the through-hole 3a. A bolt head of the fastening bolt 7 and a portion of the engraving head 2 in the vicinity of the fastening hole 2h function as a restriction member configured to restrict a swing range when the head bracket 3 swings about the swing shaft 6. When the engraving mechanism including the engraving head 2 and the head bracket 3 is separated from the gravure cylinder 5, the head bracket 3 swings counterclockwise, and is restricted by the bolt head of the fastening bolt 7.

[0080] When the moving mechanism moves the engraving mechanism in the direction toward the gravure cylinder 5 in order to engrave the gravure cylinder 5, the cylinder contact member 4e of the burr cutter 4 first comes into contact with the surface of the gravure cylinder 5. At this point, the tip end of the sliding shoe 2d does not contact the surface of the gravure cylinder 5, and the engraving mechanism further moves in the direction toward the gravure cylinder 5. With such movement, force is provided from the surface of the gravure cylinder 5 to the cylinder contact member 4e, thereby swinging the head bracket 3 in the clockwise direction as viewed in Figures 6A and 6B.

[0081] Subsequently, the tip end of the sliding shoe 2d comes into contact with the surface of the gravure cylinder 5, and then, movement of the engraving mechanism is stopped. In the case of the gravure cylinder 5 having the short circumferential length as illustrated in Figure 5, the tip end of the sliding shoe 2d comes into contact with the surface of the gravure cylinder 5 in the state illustrated in Figure 6B. On the other hand, in the case of the gravure cylinder 5 having the long circumferential length as illustrated in Figure 4, the tip end of the sliding shoe 2d comes into contact with the surface of the gravure cylinder 5 in the state illustrated in Figure 6A. Then, in the states illustrated in Figures 6A and 6B, the position of the burr cutter 4 relative to the engraving head 2 is adjusted.

[0082] As described above, the burr cutter 4 of the present embodiment includes the body portion 4a fixed to the engraving mechanism including the engraving needle 2c configured to engrave the surface of the gravure cylinder 5 in the circular cylindrical shape, and the cutter portion 4d fixed to the body portion 4a and configured to remove burrs caused due to engraving by the engraving mechanism. The surface of the cylinder contact member 4e of the cutter portion 4d facing the surface of the gra-

vure cylinder 5 is substantially in the planar shape.

[0083] Of the cylinder contact member 4e configured to remove burrs, the surface facing the surface of the gravure cylinder 5 is substantially in the planar shape according to the burr cutter 4 of the present embodiment. Thus, burrs do not easily enter the clearance between the surface of the cylinder contact member 4e and the surface of the gravure cylinder 5, and scratches are less formed on the surface of the gravure cylinder 5 due to pressing of burrs against the gravure cylinder 5. Moreover, a sufficient contact area between the cylinder contact member 4e and the gravure cylinder 5 is ensured, and the pressure of the cylinder contact member 4e against the gravure cylinder 5 is well dispersed. Thus, burrs can be well removed without damaging the surface of the gravure cylinder 5.

[0084] In addition, the burr cutter 4 of the present embodiment further includes the arm portion 4g fixed, at the first end portion thereof, to the cutter portion 4d and being swingable about the swing shaft 4r extending substantially parallel to the rotary shaft of the gravure cylinder 5 and fixed to the body portion 4a, and the external thread portion 4i and the coil spring 4t (the contact angle adjuster) configured to swing the arm portion 4g to adjust the contact angle between the surface of the gravure cylinder 5 and the opposing surface.

[0085] According to the burr cutter 4 of the present embodiment, if a gravure cylinder 5 having a different circumferential length is attached as a replacement, the arm portion 4g swings to adjust the contact angle between the opposing surface of the cylinder contact member 4e of the cutter portion 4d and the surface of the gravure cylinder 5. Thus, such a contact angle can be adjusted to an angle suitable for the gravure cylinder 5.

[0086] Thus, regardless of the circumferential length of the gravure cylinder 5 engraved by the gravure engraving device 1, the burr cutter 4 capable of well removing burrs without damaging the surface of the gravure cylinder 5 can be provided.

[0087] Further, the burr cutter 4 of the present embodiment is configured such that when receiving the adjustment operation performed by the operating person, the external thread portion 4i adjusts the contact angle according to the adjustment operation. Thus, if a gravure cylinder 5 having a different circumferential length is attached as a replacement, the contact angle between the opposing surface of the cylinder contact member 4e of the cutter portion 4d and the surface of the gravure cylinder 5 is adjusted according to the adjustment operation performed by the operating person, and therefore, such a contact angle can be adjusted to an angle suitable for the gravure cylinder.

[0088] Moreover, the burr cutter 4 of the present embodiment includes the coil spring 4t configured to provide the biasing force to the second end portion of the arm portion 4g, and the external thread portion 4i pressed against the second end portion to which the biasing force is provided by the coil spring 4t to change the position of

the external thread portion 4i relative to the body portion 4a according to the adjustment operation.

[0089] As described above, the position of the external thread portion 4i relative to the body portion 4a changes according to the adjustment operation performed by the operating person, and accordingly, the arm portion 4g swings. Then, by swinging of the arm portion 4g, the contact angle between the opposing surface of the cylinder contact member 4e of the cutter portion 4d and the surface of the gravure cylinder 5 is adjusted, and therefore, such a contact angle can be adjusted to an angle suitable for the gravure cylinder 5.

[0090] In addition, the burr cutter 4 of the present embodiment includes, at the external thread portion 4i, the groove (the identifier) allowing the operating person to identify the fastening state of the external thread portion 4i to the internal thread portion of the body portion 4a.

[0091] Thus, while identifying the fastening state of the external thread portion 4i by the groove of the external thread portion 4i, the operating person can properly adjust the contact angle between the opposing surface of the cylinder contact member 4e of the cutter portion 4d and the surface of the gravure cylinder 5. For example, the operating person memorizes the relationship between the circumferential length of the gravure cylinder 5 and the fastening state of the external thread portion 4i, and therefore, can easily perform the suitable adjustment operation according to the circumferential length of the gravure cylinder 5.

[0092] Moreover, the burr cutter 4 of the present embodiment is configured such that in the direction in which the angle between the surface of the gravure cylinder 5 and the opposing surface changes, the arm portion 4g is turnable about the turning axis C perpendicular to the swing shaft 4r and substantially parallel to the opposing surface and that the mechanism configured to turn the arm portion 4g to adjust the turning angle of the opposing surface relative to the surface of the gravure cylinder 5 is provided.

[0093] Thus, the burr cutter 4 can be provided, which is capable of properly adjusting the turning angle of the opposing surface of the cutter portion 4d relative to the surface of the gravure cylinder 5 and well removing burrs.

[0094] The burr cutter 4 of the present embodiment is configured such that the cutter portion 4d is detachably attached to the arm portion 4g.

[0095] Thus, if the cutter portion 4d is replaced in order to re-sharpen the cutter portion 4d, the contact angle between the opposing surface of the cylinder contact member 4e of the cutter portion 4d and the surface of the gravure cylinder 5 can be maintained before and after replacement. Consequently, the process of re-adjusting the contact angle upon replacement of the cutter portion 4d is not required.

{Other Embodiments}

[0096] In the above-described embodiment, when the

moving mechanism moves the engraving mechanism in the direction toward the gravure cylinder 5, the cylinder contact member 4e of the burr cutter 4 first comes into contact with the surface of the gravure cylinder 5. However, other aspects may be employed. For example, after the tip end of the sliding shoe 2d contacts the surface of the gravure cylinder 5, the cylinder contact member 4e may come into contact with the surface of the gravure cylinder 5.

[0097] In the above-described embodiment, the cylinder contact member 4e formed in the fan shape as viewed in the plane and having a center angle of about 90° as illustrated in Figure 2 is used. However, other aspects may be employed. For example, as illustrated in Figure 7, a cylinder contact member 4'e formed substantially in a rectangular shape as viewed in the plane may be used.

[0098] Figure 7 is a front view illustrating a cutter portion 4'd of another embodiment. In Figure 7, the configuration other than the cylinder contact member 4'e is similar to that illustrated in Figure 2, and therefore, the description thereof will not be repeated.

[0099] The cylinder contact member 4'e illustrated in Figure 7 is configured such that the surface thereof facing the surface of the gravure cylinder 5 is substantially in a planar shape. The cylinder contact member 4'e is formed of a member having a higher hardness than that of the copper applied on the surface of the gravure cylinder, and such a member is preferably a member made of diamond, for example.

[0100] As illustrated in Figure 7, in the cylinder contact member 4'e, a straight portion extending from a P1 to a P2 removes burrs remaining on the surface of the gravure cylinder 5. A PO positioned between the P1 and the P2 is a middle point of a line segment extending from the P1 to the P2. In the cylinder contact member 4'e, the length of the burr removing portion along the rotation direction of the gravure cylinder 5 is an "L2" illustrated in Figure 7. On the other hand, in the cylinder contact member 4e illustrated in Figure 2 and indicated by a chain double-dashed line illustrated in Figure 7, the length along the rotation direction of the gravure cylinder 5 is an "L1." As illustrated in Figure 7, the L2 is longer than the L1.

[0101] Since the cylinder contact member 4'e has a longer length L2 along the rotation direction of the gravure cylinder 5, the frequency of the adjustment operation of the contact angle by the contact angle adjuster can be lower in the cylinder contact member 4'e than in the cylinder contact member 4e illustrated in Figure 2. This is because the longer length L2 along the rotation direction of the gravure cylinder 5 allows proper removal of burrs from gravure cylinders 5 having a wide variety of circumferential length.

[0102] For example, in the case where the cylinder contact member 4'e contacts, at the position PO thereof, a gravure cylinder 5 having a certain circumferential length, if such a gravure cylinder 5 is replaced with another gravure cylinder 5 having a different circumferential length in the state in which the contact angle determined

by the contact angle adjuster is maintained, the contact position between the gravure cylinder 5 and cylinder contact member 4'e changes. Specifically, when the gravure cylinder 5 is replaced with a gravure cylinder 5 having a longer circumferential length, the contact position moves from the position PO in a P2 direction. On the other hand, when the gravure cylinder 5 is replaced with a gravure cylinder 5 having a shorter circumferential length, the contact position moves from the position PO in a P1 direction.

[0103] In this case, although the contact position changes, burrs can be properly removed without performing the adjustment operation of the contact angle by the contact angle adjuster.

[0104] Thus, the cylinder contact member 4'e illustrated in Figure 7 is employed instead of the cylinder contact member 4e illustrated in Figure 2, and therefore, the frequency of the adjustment operation of the contact angle by the contact angle adjuster can be reduced if the gravure cylinder 5 is replaced with a gravure cylinder 5 having a different circumferential length. Various lengths may be employed as the length L2 of the cylinder contact member 4'e along the rotation direction of the gravure cylinder 5. For example, if the circumferential length of the gravure cylinder 5 contacting the cylinder contact member 4'e at the PO is D mm, the L2 is preferably set such that the position where a gravure cylinder 5 having a circumferential length of D + 200 mm contacts the cylinder contact member 4'e is "P2" and that the position where a gravure cylinder 5 having a circumferential length of D - 200 mm contacts the cylinder contact member 4'e is "P1."

{Reference Signs List}

[0105]

1	gravure engraving device
2	engraving head
2a	stylus
2b	vibration shaft
2c	engraving needle
2d	sliding shoe
3	head bracket
4	burr cutter
4a	body portion
4d, 4'd	cutter portion
4e, 4'e	cylinder contact member
4g	arm portion
4i	external thread portion (pressing member)
4j	identification seal
4r	swing shaft
4t	coil spring (biasing member)
5	gravure cylinder
6	swing shaft
7, 8, 9	fastening bolt
C	turning axis

Claims

1. A burr cutter comprising:

5 a body portion fixed to an engraving mechanism configured to engrave a surface of a gravure cylinder in a circular cylindrical shape; and
 10 a cutter portion fixed to the body portion and configured to remove a burr caused due to engraving by the engraving mechanism,
characterized in that an opposing surface of the cutter portion facing the surface of the gravure cylinder is substantially in a planar shape.

15 2. The burr cutter of claim 1, further comprising:

20 an arm portion configured to be swingable about a swing shaft extending substantially parallel to a rotary shaft of the gravure cylinder, the cutter portion being fixed to the arm portion at a first end portion thereof, the rotary shaft being fixed to the body portion; and
 25 a contact angle adjuster configured to swing the arm portion to adjust a contact angle between the surface of the gravure cylinder and the opposing surface.

3. The burr cutter of claim 2, **characterized in that** the contact angle adjuster receives adjustment operation performed by an operating person and adjusts the contact angle according to the adjustment operation.

35 4. The burr cutter of claim 3, **characterized in that** the contact angle adjuster includes

40 a biasing member configured to provide biasing force to a second end portion of the arm portion in a swing direction, and
 a pressing member configured to change a position thereof relative to the body portion according to the adjustment operation, the pressing member being pressed against the second end portion from a direction facing the biasing force of the biasing member.

45 5. The burr cutter of claim 4, wherein the pressing member includes

50 an external thread portion configured to be fastened to an internal thread portion formed at the body portion, and
 an identifier configured to allow the operating person to identify a fastening state of the external thread portion to the internal thread portion, and
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a tip end of the external thread portion is pressed

against the second end portion.

6. The burr cutter of any one of claims 2 to 5, **characterized in that**
 - the arm portion is turnable about a turning axis perpendicular to the swing shaft and substantially parallel to the opposing surface in a direction in which the angle between the surface of the gravure cylinder and the opposing surface changes, and
 - the burr cutter further comprising a turning angle adjuster configured to turn the arm portion to adjust a turning angle of the opposing surface relative to the surface of the gravure cylinder.

7. The burr cutter of any one of claims 2 to 6, **characterized in that**
 - the cutter portion is detachably attached to the arm portion.

8. A gravure engraving device comprising:
 - an engraving mechanism configured to engrave a surface of a gravure cylinder in a circular cylindrical shape;
 - a holding member configured to hold the engraving mechanism; and
 - the burr cutter of any one of claims 1 to 7, the burr cutter being fixed to the holding member.

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FIG. 1

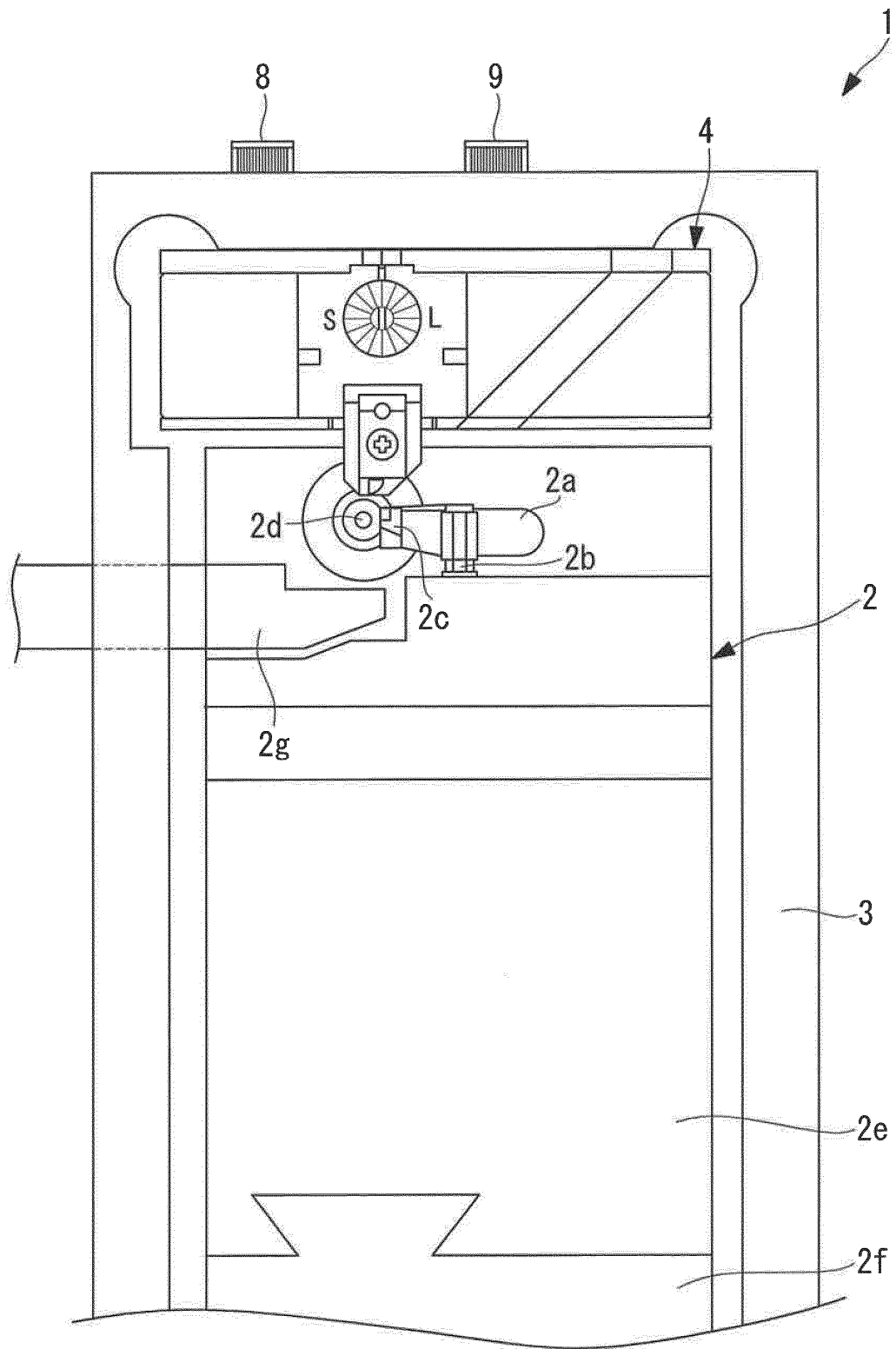


FIG. 2

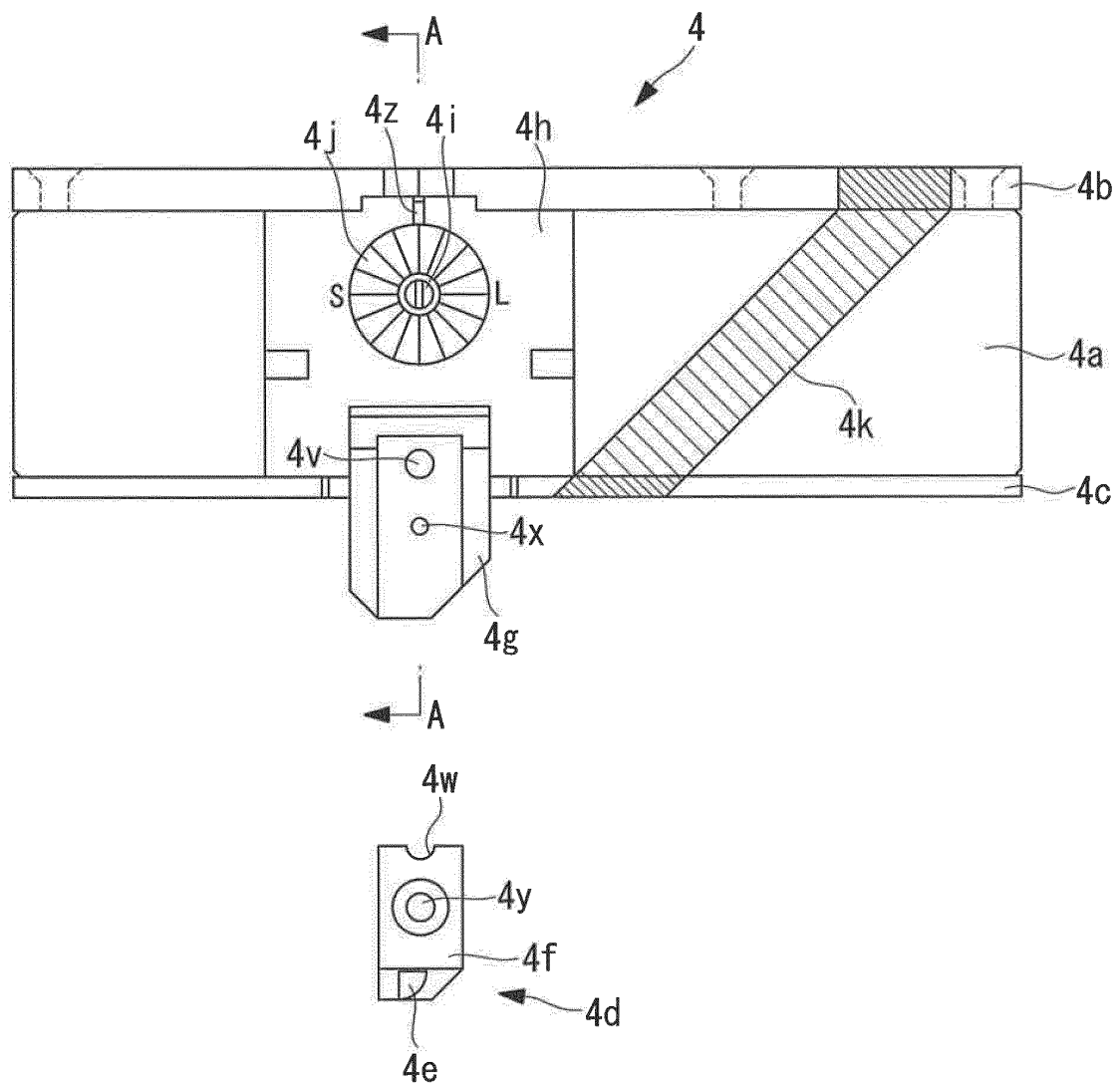
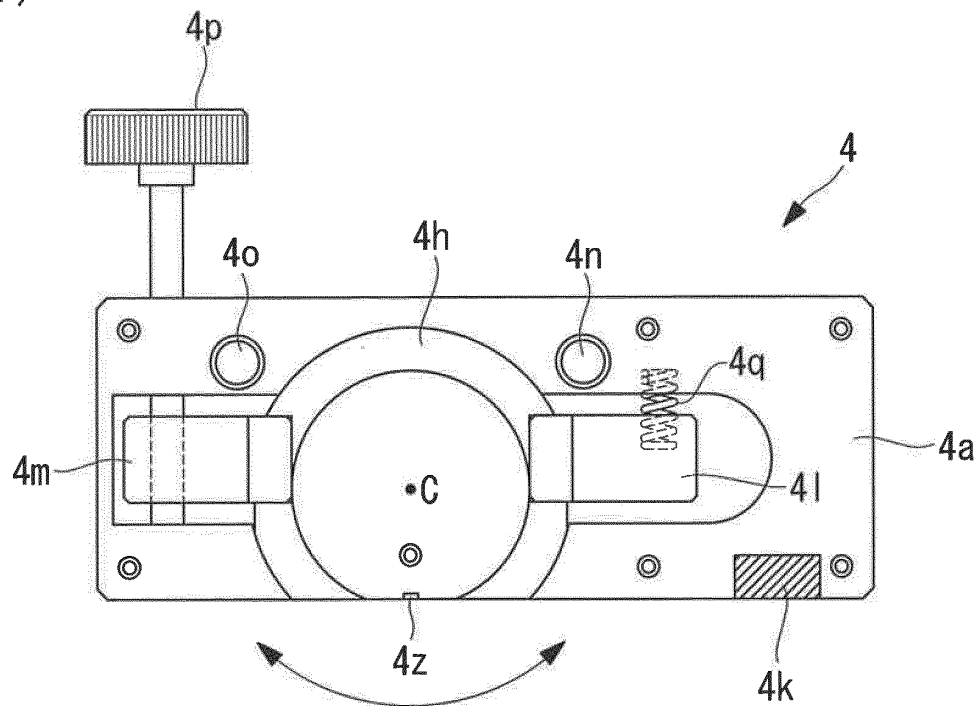


FIG. 3

(a)



(b)

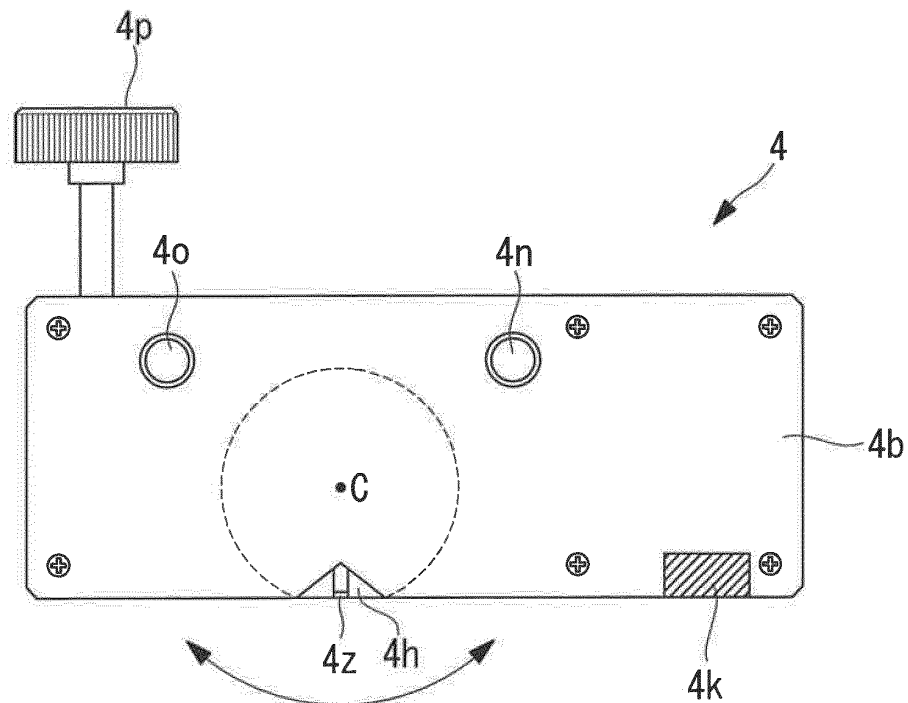


FIG. 4

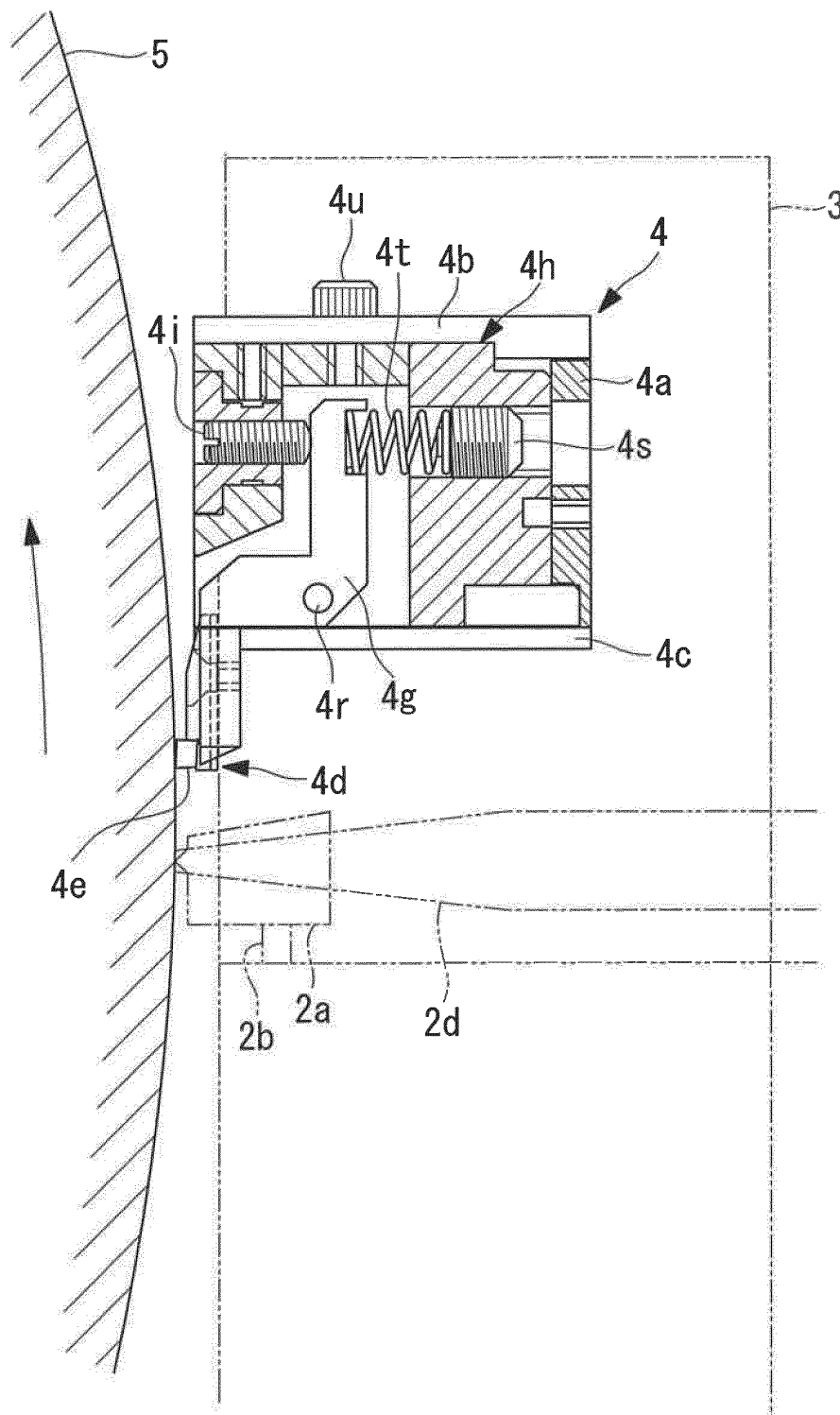


FIG. 5

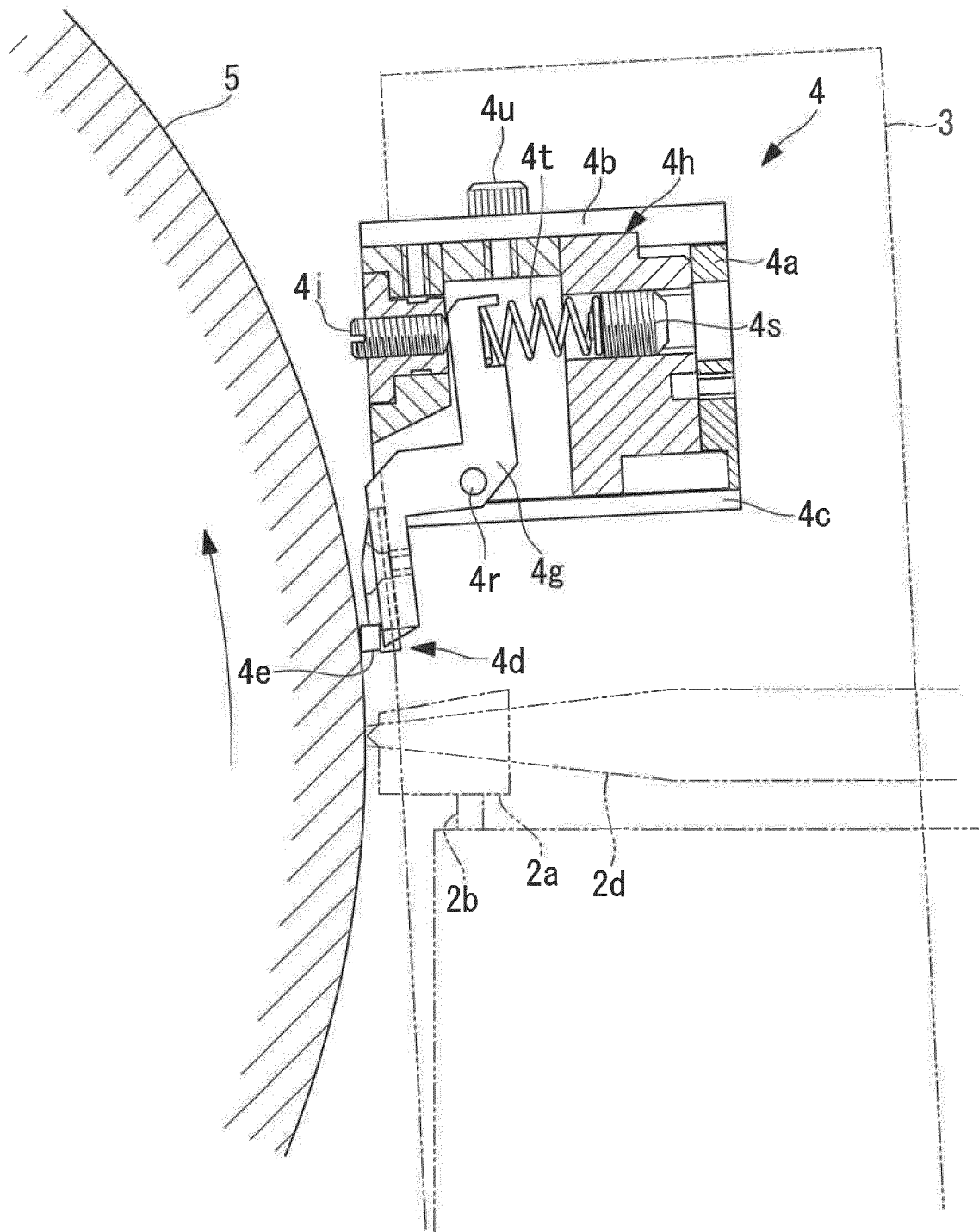


FIG. 6

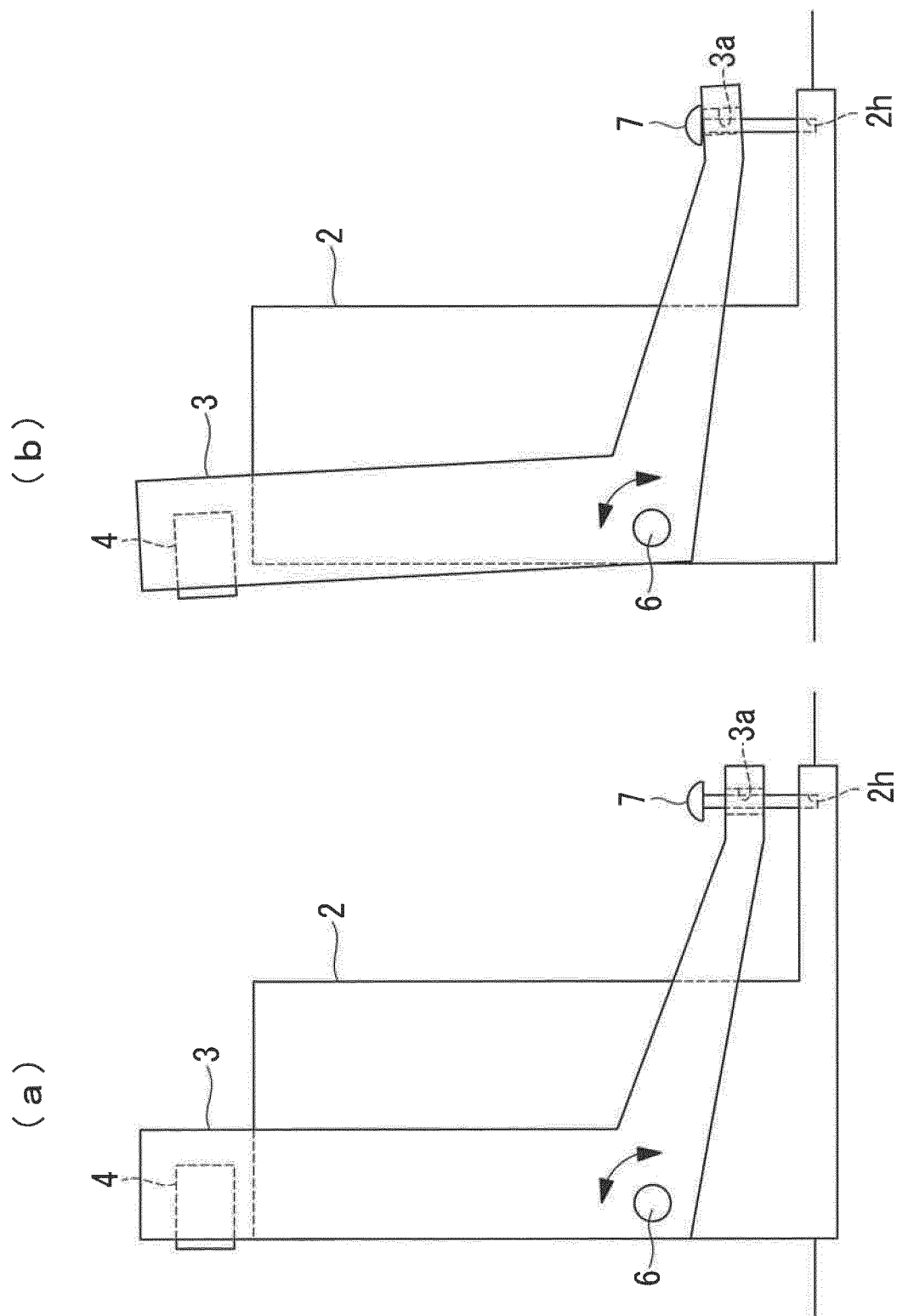
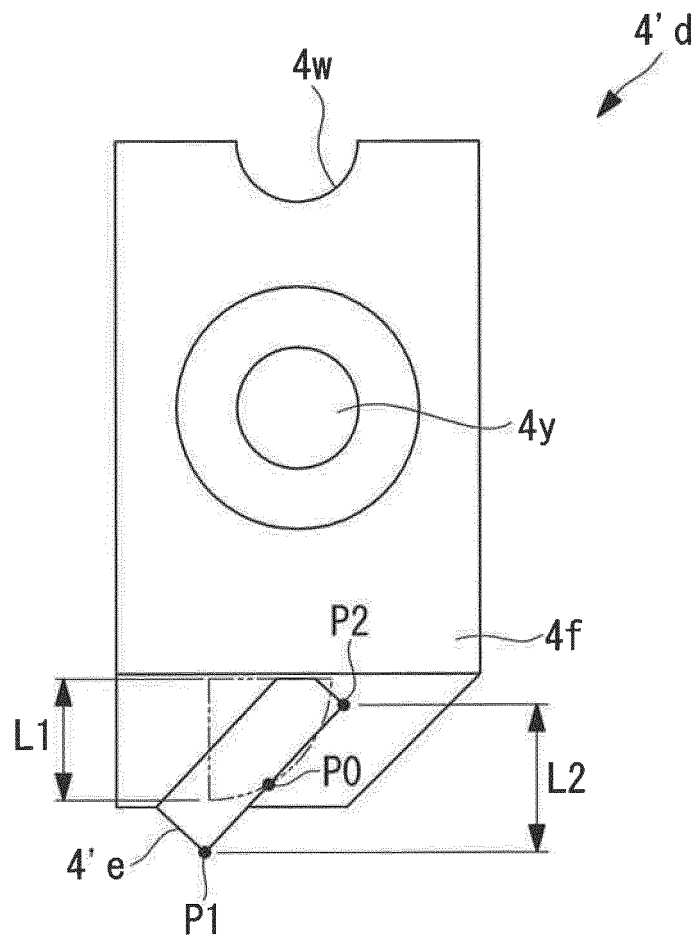


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2013/085154

A. CLASSIFICATION OF SUBJECT MATTER

B41C1/045(2006.01) i, B24B9/00(2006.01) i

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)

B41C1/045, B24B9/00

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2014

Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2004-34568 A (Dainippon Screen Mfg. Co., Ltd.), 05 February 2004 (05.02.2004), entire text; all drawings (Family: none)	1-8
A	JP 2001-62980 A (Dainippon Screen Mfg. Co., Ltd.), 13 March 2001 (13.03.2001), entire text; all drawings (Family: none)	1-8
A	JP 10-202820 A (Ohio Electronic Engravers, Inc.), 04 August 1998 (04.08.1998), entire text; all drawings & US 5867280 A & EP 739272 A1	1-8

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search
20 January, 2014 (20.01.14)Date of mailing of the international search report
28 January, 2014 (28.01.14)Name and mailing address of the ISA/
Japanese Patent Office

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Facsimile No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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