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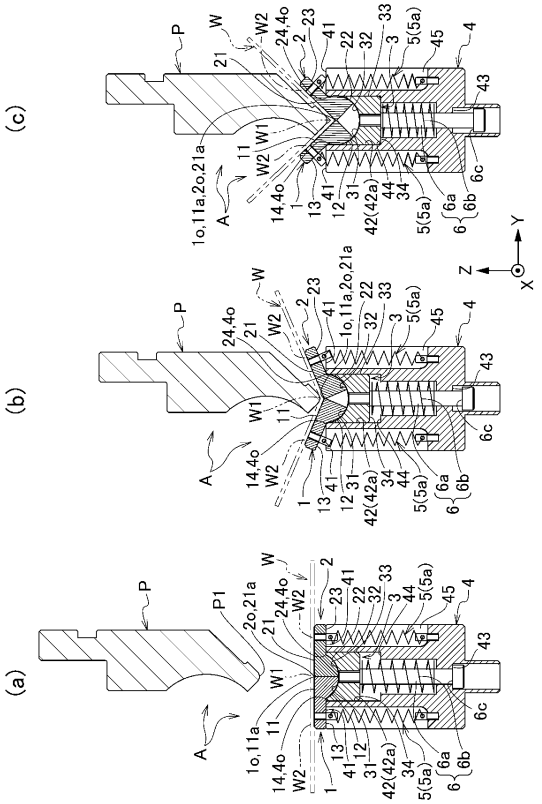
(54) BENDING DEVICE

(57) Workpieces are reliably bent by a simple configuration. A bending tool of the present invention includes: a pair of movable dies arranged such that a bending line of a punch and a workpiece is interposed therebetween; a support member for supporting the pair of movable dies in a manner rotatable into directions opposite to each other in accordance with bending of the workpiece by the punch; and a body for supporting the support member in a manner reciprocatable in a movement direction of the punch in accordance with bending of the workpiece by the punch, in which the pair of movable dies have respective reception faces for the workpiece, respective bending side end portions formed on the respective reception faces in such a manner as to face the bending line of the workpiece, and respective convex circular faces formed to face the support member, and the support member has respective concave circular faces which slidably fit respectively with the convex circular faces, while the bending side end portions of the pair of movable dies are joined to or fit with each other in accordance with bending of the workpiece by the punch, and a sliding portion which moves in a pressing direction of the punch relative to the body in accordance with bending of the workpiece by the punch.

FIG. 1



EP 3 744 437 A1

Description

Technical Field

[0001] The present invention relates to a bending tool, such as a press brake, which is used to bend a plate-shaped workpiece made of sheet metal or the like into a V shape or the like using a die.

Background Art

[0002] Hitherto, as a bending tool of this type, there has been provided a die for bending a metal plate, including a base, a pair of die members having a reception face for receiving a metal plate and capable of rocking while distal ends of the reception faces are joined to each other, and a synchronization mechanism for synchronizing and rocking the pair of die members, in which a metal plate is placed on the reception plate in a horizontal position of the pair of die members, and a portion to be bent of the metal plate is pressed by a punch, whereby the pair of die members are moved into an inclined position so that the metal plate is bent (e.g. see Patent Literature 1).

[0003] The base is provided with fulcrum portions which serve as a fulcrum on which the pair of die members rock, a slider block for supporting a back face side of the pair of die members, and a slider guide hole for reciprocatably guiding the slider block.

[0004] On the back face side of the pair of die members, one projecting portion is provided, with respect to the fulcrum portion of the base, on each of a distal end side and a proximal end side of the die member (four projecting portions in total) .

[0005] Further, the base is provided with two guide recessed portions on each of the distal end side and the proximal end side which correspond to the projecting portion on the distal end side and the projecting portion on the proximal end side, respectively, and slidably guide an outer face of the respective projecting portions (four guide recessed portions in total).

[0006] Further, the synchronization mechanism is configured to include a guide pin provided to project at positions symmetrical to each other on each of both side face sides of the pair of die members, a guide plate provided along side face sides of the base and having a long hole into which the guide pin is inserted, a cover plate on the surface of the guide plate to stop the guide pin, and the like.

[0007] To bend a metal plate, if a portion to be bent of the metal plate is pressed by a punch in a horizontal position where, in the pair of die members, the projecting portion on the proximal end side is in contact with the guide recessed portion on the proximal end side of the base and the projecting portion on the distal end side is separate from the guide recessed portion on the distal end side, the pair of die members are rocked from the horizontal position where the reception faces form a plane into a predetermined angle inclined position where the reception faces are inclined mirror-symmetrically to each other with respect to a joined line of the distal ends so that the reception faces form an angle. In accordance with this rock, in the pair of die members, the projecting portion on the distal end side approaches the guide recessed portion on the distal end side and the projecting portion on the proximal end side separates from the guide recessed portion on the proximal end side, whereby the die members on the distal end side lowers. Consequently, the slider block descends in the slider guide hole.

Prior Art Document

Patent Literature

[0008] Patent Literature 1: JP2011-206823A

Summary of Invention

Technical Problem

[0009] However, there has been a problem that such a conventional bending tool has a configuration in which the projecting portions (four projecting portions in total) of the pair of die members are made to separate from or approach the guide recessed portions (four guide recessed portions in total) of the base, whereby the pair of die members rock about the fulcrum portions so that the guide recessed portions have a complicated curved surface shape and are difficult to be manufactured, and allowing the pair of die members to rock with high accuracy results in increased costs.

[0010] There has been also a problem that the projecting portion on the proximal end side of the pair of die members is made to slide along the guide recessed portion on the proximal end side of the base so that a bending angle of a metal plate cannot be made small, which results in a larger size of the pair of die members in the orientation direction and increased sizes.

[0011] Further, there has been a problem that in addition to the base and the pair of die members, as the synchronization mechanism, the guide plate into which the guide pin of the pair of die members are inserted and the cover plate, etc. are required to be provided so that the number of components increases, which requires time, efforts, and labors in assembling and disassembling the whole tool and results in increased costs.

[0012] Further, there has been a problem that a guide pin provided to project from each of both the side face sides of the pair of die members is inserted into the long hole of the guide plate provided along the side face sides of the base, and the cover plate stops the guide pin so as to cause not only a larger size in a width direction intersecting the orientation of the pair of die members and sizes to increase but also severe abrasions due to abutting between the guide pin and the long hole, which results in a decreased working ratio due to the inopera-

bility for a long period.

Solution to Problem

[0013] To solve such a problem, a bending tool of the present invention includes: a pair of movable dies arranged such that a bending line of a punch and a workpiece is interposed therebetween; a support member for supporting the pair of movable dies in a manner rotatable into directions opposite to each other in accordance with bending of the workpiece by the punch; and a body for supporting the support member in a manner reciprocatable in a movement direction of the punch in accordance with bending of the workpiece by the punch, in which the pair of movable dies have respective reception faces for the workpiece, respective bending side end portions formed on the respective reception faces in such a manner as to face the bending line of the workpiece, and respective convex circular faces formed to face the support member, and the support member has respective concave circular faces which slidably fit respectively with the convex circular faces, while the bending side end portions of the pair of movable dies are joined to or fit with each other in accordance with bending of the workpiece by the punch, and a sliding portion which moves in a pressing direction of the punch relative to the body in accordance with bending of the workpiece by the punch.

Brief Description of Drawings

[0014]

FIG. 1 is an explanatory diagram illustrating an entire configuration of a bending tool according to an embodiment of the present invention, in which FIG. 1a is a longitudinal sectional front view prior to bending; FIG. 1b is a longitudinal sectional front view where a workpiece is bend by 135°; and FIG. 1c is a longitudinal sectional front view where the workpiece is bent by 90°.

FIG. 2 is a perspective view of a lower die, in which FIG. 2a is a perspective view prior to bending; FIG. 2b is a longitudinal sectional front view where a workpiece is bend by 135°; and FIG. 2c is a longitudinal sectional front view where the workpiece is bent by 90°.

FIG. 3 is a perspective view illustrating a workpiece bending state in cooperation with a punch, in which FIG. 3a is a reduced perspective view prior to bending; FIG. 3b is a reduced perspective view where a workpiece is bend by 135°; and FIG. 3c is a reduced perspective view where the workpiece is bent by 90°.

FIG. 4 is an explanatory view illustrating a modification example of the bending tool according to an embodiment of the present invention (perspective view of the lower die), in which FIG. 4a is a perspective view prior to bending; and FIG. 4b is a perspective view where a workpiece is bend by 135°. Description of Embodiments

[0015] Hereinafter, embodiments of the present invention will be described in detail in conjunction with the drawings.

[0016] As illustrated in FIGS. 1-4, a bending tool A according to an embodiment of the present invention is a bending press for bending a plate-shaped workpiece W into a V shape or the like in cooperation with a punch P which is an upper die and a pair of movable dies 1, 2 which serve as a lower die.

[0017] As the workpiece W, for example, a sheet metal of steel, stainless steel, aluminum, etc. or a thin plate similar thereto is used, and both flat plate portions W2, W2 are pushed to be bent (thrusted to be bent), such that a bending line W1 is interposed therebetween, to a certain angle by abutting against a blade portion P1 of the punch P.

[0018] The bending tool A is preferably used to be incorporated in a press brake (unillustrated) or the like. When the bending tool A is incorporated in a press brake, a bending angle of the workpiece W is detected during a workpiece W bending process and this bending angle is fed back to a numerical control (NC) wirelessly or wiredly so that the bending angle of the workpiece W can be automatically modified by adjusting a movement amount of the punch P.

[0019] In more detail, the bending tool A according to an embodiment of the present invention includes as main components: a pair of movable dies 1, 2 arranged such that the bending line W1 of the punch P and the workpiece W is interposed therebetween; a support member 3 for supporting the pair of movable dies 1, 2 in a manner rotatable in directions opposite to each other in accordance with bending of the workpiece W by the punch P; and a body 4 for supporting the support member 3 in a manner reciprocatable in a movement direction of the punch P in accordance with bending of the workpiece W by the punch P.

[0020] Further, preferably, an elastic member 5 for restoring the pair of movable dies 1, 2 to rotate in directions each opposite to the respective directions of rotation in accordance with bending of the workpiece W by the punch P, and an urging member 6 for urging the support member 3 in a direction opposite to a pressing direction of the workpiece W by the punch P are provided.

[0021] Note that the punch P and the pair of movable dies 1, 2 are typically arranged in such a manner as to face each other in a vertical direction, and the movement direction of the punch P will be hereinafter referred to as "Z direction". A width direction of the pair of movable dies 1, 2 intersecting Z direction will be referred to as "X direction", and an arrangement direction (alignment direction) of the pair of movable dies 1, 2 intersecting Z direction will be referred to as "Y direction".

[0022] The pair of movable dies 1, 2 are formed of a hard material, such as metal, and in a belt shape and

have respective reception faces 11, 21 which come into contact with both the flat plate portions W2, W2 of the workpiece W placed thereon. In the pair of movable dies 1, 2, the reception faces 11, 21 have respective bending side end portions 11a, 21a formed on a front side to face both the flat plate portions W2, W2 of the workpiece W in Z direction and facing the bending line W1 of the workpiece W in Z direction.

[0023] In the first movable die 1, the bending side end portion 11a of the reception face 11 is formed over the entirety of the reception face 11 in X direction. In the second movable die 2, the bending side end portion 21a of the reception face 21 is formed over the entirety of the reception face 21 in X direction.

[0024] Further, the pair of movable dies 1, 2 have respective convex circular faces 12, 22 which protrude toward the support member 3 described below, and respective stoppers 13, 23 which abut against a stopping portion 41 of the body 4 described below.

[0025] The convex circular faces 12, 22 and the stoppers 13, 23 are formed in the pair of movable dies 1, 2 on a back side facing the support member 3 and the body 4 described below in Z direction.

[0026] The convex circular faces 12, 22 have a substantially quarter circular side shape as seen from X direction and are formed in a continuous manner in the same shape over the entirety of the pair of movable dies 1, 2 in X direction, respectively.

[0027] By way of specific example, as illustrated in FIGS. 1a, 1b, and 1c to 4a and 4b, the convex circular faces 12, 22 are formed in a substantially quarter circular shape about a rotation fulcrum portions 1o, 2o, respectively, and are configured to have the same size such that respective rotation radii are equal to each other.

[0028] Further, although other examples are unillustrated, the convex circular faces 12, 22 may be formed in a substantially quarter circular shape such that respective rotation radii are different from each other (have different sizes), and may be modified to a configuration other than that as illustrated in the figures.

[0029] In an initial state prior to bending of a workpiece as illustrated in FIGS 1a, 2a, 3a, and 4a, the stopper 13, 23 are configured such that the reception faces 11, 21 are disposed in a horizontal position to form a continuous plane by abutting the stoppers 13, 23 against the stopping portion 41 of the body 4 described below.

[0030] The support member 3 is formed of a hard material, such as metal, and in a prismatic shape, etc. including a square pole and has respective concave circular faces 31, 32 which constantly slidably fit with the convex circular faces 12, 22 of the pair of movable dies 1, 2.

[0031] The concave circular faces 31, 32 have a substantially quarter circular side shape as seen from X direction in such a manner as to slidably fit in a concavo-convex manner with the convex circular faces 12, 22, and are formed in a continuous manner in the same shape over the entirety of the support member 3 in X direction, respectively. Thus, it is a configuration that the convex circular faces 12, 22 are made to slide along the concave circular faces 31, 32, whereby the pair of movable dies 1, 2 as a whole rotate (rock) simultaneously about the rotation fulcrum portions 1o, 2o, respectively, in directions opposite to each other. The rotation fulcrum portions 1o, 2o are parallel axial lines each extending in X direction. In other words, the support member 3 has a synchronization mechanism for synchronizing and rotating (rocking) the pair of movable dies 1, 2.

[0032] Further, as illustrated in FIGS. 1-4, the concave circular faces 31, 32 are preferably formed in a continuous manner in a substantially semicircular side shape as seen from X direction.

[0033] By way of specific example, as illustrated in FIGS. 1a, 1b, and 1c to 4a and 4b, the concave circular faces 31, 32 are formed in a substantially quarter circular shape such that respective rotation radii are equal to each other (have the same size) and the concave circular faces 31, 32 are configured to be continuous to have a substantially semicircular shape.

[0034] Accordingly, the rotation fulcrum portions 1o, 2o of the pair of movable dies 1, 2 are disposed in such a manner as to be substantially in agreement with each other at corner positions or at positions adjacent to the corner positions of the bending side end portions 11a, 21a, respectively.

[0035] Further, although other examples are unillustrated, in accordance with the convex circular faces 12, 22, the concave circular faces 31, 32 may be formed in a substantially quarter circular shape such that respective rotation radii are different from each other (have different sizes), and may be modified to a configuration other than that as illustrated in the figures.

[0036] Further, the support member 3 has a sliding portion 33 which moves in the pressing direction of the punch P relative to the body 4 in accordance with bending of the workpiece W by the punch P.

[0037] The sliding portion 33 is formed on an outer face of the support member 3 in such a manner as to face a guide portion 42 described below in XY direction in a certain area of the body 4 described below in Z direction.

[0038] By way of example, with respect to the pair of movable dies 1, 2 and the support member 3, as illustrated in FIGS. 1a, 1b, and 1c to 3a, 3b and 3c, the rotation fulcrum portions 1o, 2o of the pair of movable dies 1, 2 are disposed at the corner positions of the bending side end portions 11a, 21a, respectively, the corner portions of the bending side end portions 11a, 21a are linearly joined to each other along the bending line W1 of the workpiece W in X direction, and while this joined state is maintained, the reception faces 11, 21 rotate (rock) in directions opposite to each other from the horizontal position toward an inclined position.

[0039] Further, by way of another example, with respect to the pair of movable dies 1, 2 and the support member 3, as illustrated in FIGS. 4a and 4b, at the bending side end portions 11a, 21a of the pair of movable dies 1, 2, rugged portions 11b, 21b are provided on a more

distal end side than the rotation fulcrum portions 1o, 2o. Accordingly, the rugged portions 11b, 21b of the bending side end portions 11a, 21a fit with each other along the bending line W1 of the workpiece W in X direction, and while this fitted state is maintained, the reception faces 11, 21 rotate (rock) in directions opposite to each other from the horizontal position toward the inclined position.

[0040] In the illustrated examples, the bending side end portions 11a, 21a of the pair of movable dies 1, 2 are provided with the plural rectangular rugged portions 11b, 21b at certain intervals in X direction, respectively, and these plural rectangular rugged portions 11b, 21b are made to movably fit with each other in Z direction.

[0041] Note that, although other modification examples are unillustrated, such a modification that the bending side end portions 11a, 21a of the pair of movable dies 1, 2 are provided with the plural triangular rugged portions 11b, 21b at certain intervals in X direction, respectively, and these plural triangular rugged portions 11b, 21b are made to movably fit with each other in Z direction, etc., are possible.

[0042] The body 4 is formed of a hard material, such as metal, and in a hexahedral shape, etc. including a rectangular prism and has the stopping portion 41 to face the stoppers 13, 23 of the pair of movable dies 1, 2 in Z direction, and the guide portion 42 for supporting the support member 3 in a manner reciprocatable in a certain area within the body 4 in Z direction.

[0043] The stopping portion 41 is formed in a surface shape on an upper surface of the body 4 or the like.

[0044] The guide portion 42 is formed on an inner face of the body 4 in such a manner as to abut against or engage with the sliding portion 33 of the support member 3 at least into Y direction in a certain area of the body 4 in Z direction. Thus, the guide portion 42 is configured such that the support member 3 is not caused by bending of the workpiece W by the punch to be displaced at least in Y direction and movably supported in a certain area of the body 4 in Z direction.

[0045] In other words, the body 4 is provided with a movement restriction means for restricting a movement range of the support member 3.

[0046] By way of specific example, with respect to the body 4, as illustrated in FIGS. 1a, 1b, and 1c to 4a and 4b, the guide portion 42 is formed in a recessed shape at an upper side center of the body 4, and the support member 3 is movably supported at an inner side of the guide portion 42 by the guide portion 42 in such a manner as to be not rotatable in X and Y directions and to be movable in Z direction. As the movement restriction means of the support member 3 relative to the body 4, an upper restriction of the support member 3 is made by abutting in Z direction between a follower portion 6a (braking portion 6c) described below which is provided to the support member 3 and reciprocatable in Z direction and a braking face 43 of the body 4. A lower restriction of the support member 3 is made by abutting in Z direction between a bottom face 34 of the support member 3 and a recessed bottom face 44 of the body 4.

[0047] Further, the body 4 is provided with rock fulcrum portions 4o which abut against or is in sliding contact with the pair of movable dies 1, 2, respectively. The rock fulcrum portions 4o are parallel axial lines extending in X direction to face boundary portions 14, 24 between the convex circular faces 12, 22 and the stoppers 13, 23 of the pair of movable dies 1, 2, respectively. In the illustrated examples, corner portions composed of guide faces 42a of the guide portion 42 in X direction which the sliding portion 33 of the support member 2 abut against or engage with and the stopping portion 41 serve as the rock fulcrum portions 4o.

[0048] Further, although other examples are unillustrated, the guide portion 42 may be modified to have a shape other than that as illustrated in the figures and the movement restriction means of the support member 3 relative to the body 4 may be modified to a configuration other than that as illustrated in the figures.

[0049] In addition, preferably, with respect to the body 4, a width (X direction) of the body 4 corresponding to the workpiece W in the width direction is modularized and the plural bodies 4 can be set in alignment in X direction.

[0050] Consequently, in bending of the workpiece W having a width greater than the width of the body 4, the entirety of the workpiece W in the width direction can be bent at a time in cooperation with the plural set of movable dies 1, 2 aligned in the width direction in X direction in accordance with the width of the workpiece W and the punch P greater than the width of the workpiece P.

[0051] The elastic members 5 are made of an elastic material and provided over the pair of movable dies 1, 2 and the body 4, and configured to urge the pair of movable dies 1, 2 constantly toward the body 4 to restore the reception faces 11, 21 from the inclined position to the horizontal position, respectively.

[0052] By way of specific example, as illustrated in FIGS. 1a, 1b, and 1c to 4a and 4b, the elastic members 5 extend over from the back side of the pair of movable dies 1, 2 to recessed portions 45 of the body 4 and is elastically provided with spring members 5a in Z direction, respectively. In the illustrated examples, the spring members 5a are a coil spring, and the spring members 5a are respectively provided to the pair of movable dies 1, 2.

[0053] Further, although other examples are unillustrated, the spring members 5a may be modified to that other than a coil spring and the plural elastic members 5 (spring members 5a) may be respectively provided to the pair of movable dies 1, 2.

[0054] The urging member 6 is provided over the support member 3 and the body 4 and configured to urge the support member 3 constantly toward the pair of movable dies 1, 2.

[0055] By way of specific example, as illustrated in FIGS. 1a, 1b, and 1c to 4a and 4b, the urging member 6 includes the follower portion 6a provided to the support

member 3 and supported reciprocatably in Z direction relative to the body 4 and an elastic member 6b elastically provided around the follower portion 6a and elastically deformable in Z direction. In the illustrated examples, the follower portion 6a is a stripper bolt and a head portion thereof has the braking portion 6c, and the elastic member 6b is a coil spring.

[0056] Further, although other examples are unillustrated, the urging member 6 may be modified to a configuration other than the follower portion 6a and the elastic member 6b, the follower portion 6a and the elastic member 6b may be modified to have a shape other than that as illustrated in the figures, and the elastic member 6b may be modified to that other than a coil spring.

[0057] Next, operations of the bending tool A according to an embodiment of the present invention will be described.

[0058] First, in an initial state prior to bending of a workpiece as illustrated in FIGS. 1a, 2a, 3a, and 4a, the elastic members 5 allow the stoppers 13, 23 of the pair of movable dies 1, 2 to abut against the stopper portion 41 of the body 4 to temporarily fix the reception faces 11, 21 in the horizontal position, respectively.

[0059] In the subsequent workpiece W bending process, the punch P relatively approaches the workpiece W placed on the reception faces 11, 21 of the pair of movable dies 1, 2, respectively, the blade portion P1 of the punch P thrusts against the workpiece W to press the bending side end portions 11a, 21a side of the pair of movable dies 1, 2 in Z direction, respectively.

[0060] As illustrated in FIGS. 1b, 1c, 2b, 2c, 3b, 3c, and 4b, in accordance with pressing by the punch P, while the convex circular faces 12, 22 of the pair of movable dies 1, 2 fit with and slide along the concave circular faces 31, 32 of the support member 3, the pair of movable dies 1, 2 as a whole rotate (rock) against the elastic force by the elastic member 5 about the rotation fulcrum portions 1o, 2o, respectively, in directions opposite to each other. Accordingly, the reception faces 11, 21 move from the horizontal position to the inclined position.

[0061] Simultaneously, in accordance with the inclination of the reception faces 11, 21, the sliding portion 33 of the support member 3 for supporting the pair of movable dies 1, 2 move (descend) relative to the guide portion 42 of the body 4 against the urging force by the urging member 6 in the pressing direction of the punch P (Z direction).

[0062] In accordance with the inclination of the reception faces 11, 21 and the movement of the support member 3, the bending line W1 of the workpiece W moves in the pressing direction of the punch P and bending into a V shape is performed.

[0063] Then, after bending of the workpiece W, the punch P is relatively separated from the workpiece W in Z direction, whereby due to the elastic force by the elastic member 5, the pair of movable dies 1, 2 as a whole rotate (rock) about the rotation fulcrum portions 1o, 2o, respectively, in directions opposite to each other, and the reception faces 11, 21 restore from the inclined position to the horizontal position. Simultaneously, due to the urging force by the urging member 6, the support member 3 returns (ascends) relative to the body 4 in the movement direction of the punch P (Z direction).

[0064] Accordingly, the stoppers 13, 23 of the pair of movable dies 1, 2 abut against the stopping portion 41 of the body 4, which returns to the initial state. Thereafter, the above operations are repeated.

[0065] In such a bending tool A according to an embodiment of the present invention, in accordance with pressing of the workpiece W by the punch P, the convex circular faces 12, 22 of the pair of movable dies 1, 2 fit with and slide along the concave circular faces 31, 32 of the support member 3, respectively, the pair of movable dies 1, 2 as a whole accordingly rotate (rock) in directions opposite to each other. Thereby, while the bending side end portions 11a, 21a of the pair of movable dies 1, 2 are joined to or fit with each other, the reception faces 11, 21 are inclined.

[0066] Simultaneously, the inclination of the reception faces 11, 21, allows the sliding portion 33 of the support member 3 for supporting the pair of movable dies 1, 2 to move relative to the body 4 in the pressing direction of the punch P. Accordingly, the bending line W1 of the workpiece W moves in the pressing direction of the punch P and bending into a V shape, etc. is performed.

[0067] Thus, the workpiece W can be reliably bent by a simple configuration.

[0068] Consequently, compared with conventional ones having a configuration in which the projecting portions (four projecting portions in total) of the pair of die members are made to separate from or approach the guide recessed portions (four guide recessed portions in total) of the base, whereby the pair of die members rock about the fulcrum portions, the simplicity of shapes of the convex circular faces 12, 22 of the pair of movable dies 1, 2 and the concave circular faces 31, 32 of the support member 3 which fit with each other and slide along with respect to each other comparatively facilitates manufacture, allows the pair of movable dies 1, 2 to reversely rotate with high accuracy, and can contribute to decreasing costs.

[0069] Compared with conventional ones in which the projecting portion on the proximal end side of the pair of die members is made to slide along the guide recessed portion on the proximal end side of the base, the decrease in the number of the convex circular faces 12, 22 of the pair of movable dies 1, 2 and the concave circular faces 31, 32 of the support member 3 allows the convex circular faces 12, 22, the concave circular faces 31, 32 and a bending angle of the workpiece W to be greatly smaller and allows the entirety of the toll to be made compact in the arrangement direction of the pair of movable dies 1, 2

[0070] Further, compared with conventional ones in which in addition to the base and the pair of die members, as the synchronization mechanism, the guide plate into which the guide pin of the pair of die members are insert-

ed and the cover plate, etc. are required to be provided, main components are the four parts which are the pair of movable dies 1, 2, the support member 3, and the body 4, which can significantly decrease the number of parts, greatly reduce time in assembling and disassembling the whole tool, improve work efficiency, and contribute to further decreasing costs.

[0071] Further, compared with conventional ones in which a guide pin provided to project from each of both the side face sides of the pair of die members is inserted into the long hole of the guide plate provided along the side face sides of the base, and the cover plate stops the guide pin, no portion projecting from the pair of movable dies 1, 2, such as a pin, is provided in the width direction (X direction), which allows the whole tool to be made compact in the width direction (X direction) , and there is no abutting between a projecting portion, such as a pin, and a recessed portion, such as a long hole, which causes less abrasions, allows operations over a long time, and contributes to improving a working ratio.

[0072] Particularly, the concave circular faces 31, 32 of the support member 3 are preferably formed in a continuous manner. In this case, the concave circular faces 31, 32 can be manufactured at the same time.

[0073] Thus, the concave circular faces 31, 32 can be easily manufactured at the same time.

[0074] Consequently, compared with conventional ones requiring the base to be provided with the guide recessed portions (four in total), the concave circular faces 31, 32 can be manufactured with high manufacturing accuracy and manufacturing costs can be decreased.

[0075] Further, preferably, the elastic member 5 for restoring the pair of movable dies 1, 2 to rotate in directions each opposite to the respective directions of rotation in accordance with bending of the workpiece W by the punch P, and the urging member 6 for urging the support member 3 in a direction opposite to the pressing direction of the workpiece W by the punch P are provided.

[0076] In this case, after bending of the workpiece, pressing by the punch P is cancelled, whereby using the elastic member 5, the pair of movable dies 1, 2 as a whole rotate (rock) in directions opposite to each other, and the reception faces 11, 21 restore from the inclined position to the horizontal position, while using the urging member 6, the support member 3 returns relative to the body 4. Accordingly, the pair of movable dies 1, 2 return to the initial state.

[0077] Thus, after bending of the workpiece W, the pair of movable dies 1, 2 can be smoothly restored.

[0078] Consequently, bending of the workpiece W can be repeatedly carried out at a high speed and a manufacturing speed can be improved.

[0079] Note that in the above embodiments, the reception faces 11, 21 are returned from the inclined position to the horizontal position using the elastic member 5, which is, however, not limitative, but the pair of movable dies 1, 2 may be configured such that the pair of movable dies 1, 2 automatically rotate (rock) in opposite directions in accordance with cancellation of pressing by the punch P by adjusting the gravitational center balance of the pair of movable dies 1, 2.

[0080] Further, the width of the body 4 is modularized, which is, however, not limitative, but the width of the body 4 may be configured to be greater than the width of the workpiece W to be bent.

Reference Signs List

[0081]

A	bending tool
P	punch
1, 2	movable die
11, 21	reception face
11a, 21a	bending side end portion
12, 22	convex circular face
3	support member
31, 32	concave circular face
33	sliding portion
4	body
5	elastic member
6	urging member
W	workpiece
W1	bending line

Claims

1. A bending tool, comprising:

a pair of movable dies arranged such that a bending line of a punch and a workpiece is interposed therebetween;

a support member for supporting the pair of movable dies in a manner rotatable into directions opposite to each other in accordance with bending of the workpiece by the punch; and

a body for supporting the support member in a manner reciprocatable in a movement direction of the punch in accordance with bending of the workpiece by the punch,

wherein the pair of movable dies have respective reception faces for the workpiece, respective bending side end portions formed on the respective reception faces in such a manner as to face the bending line of the workpiece, and respective convex circular faces formed to face the support member, and

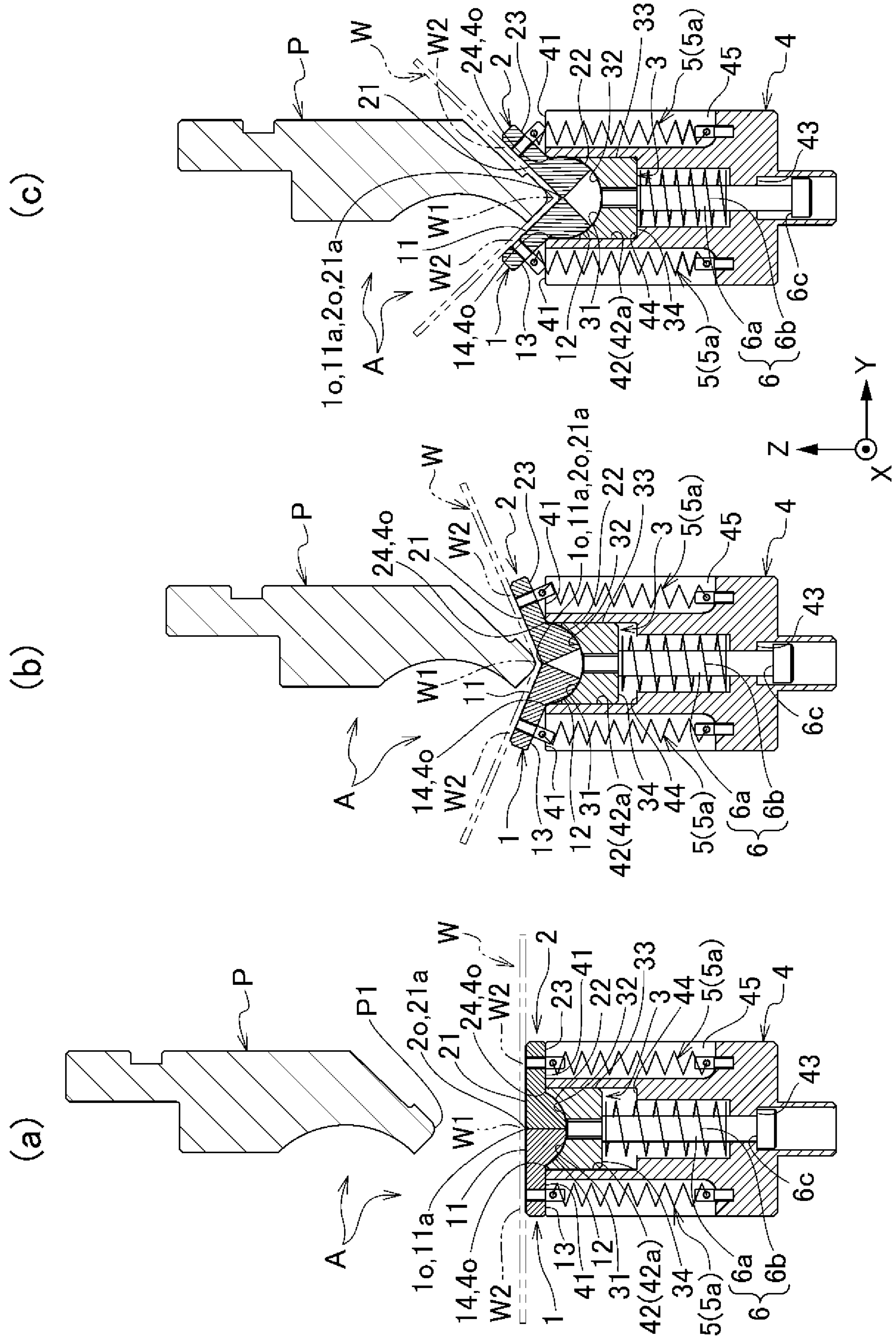
the support member has respective concave circular faces which slidably fit respectively with the convex circular faces, while the bending side end portions of the pair of movable dies are joined to or fit with each other in accordance with bending of the workpiece by the punch, and a sliding portion which moves in a pressing direction of the punch relative to the body in accord-

ance with bending of the workpiece by the punch.

2. The bending tool according to claim 1, wherein the concave circular faces of the support member are formed in a continuous manner.

3. The bending tool according to claim 1 or 2, further comprising an elastic member for restoring the pair of movable dies to rotate in directions each opposite to the respective directions of rotation in accordance with bending of the workpiece by the punch, and an urging member for urging the support member in a direction opposite to the pressing direction of the workpiece by the punch.

FIG. 1


(a)
(b)
(c)
P
P1
W
W1
W2
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2
2o,21a
3
4
5(5a)
6
6a
6b
6c
11
12
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14,4o
21
22
23
24,4o
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32
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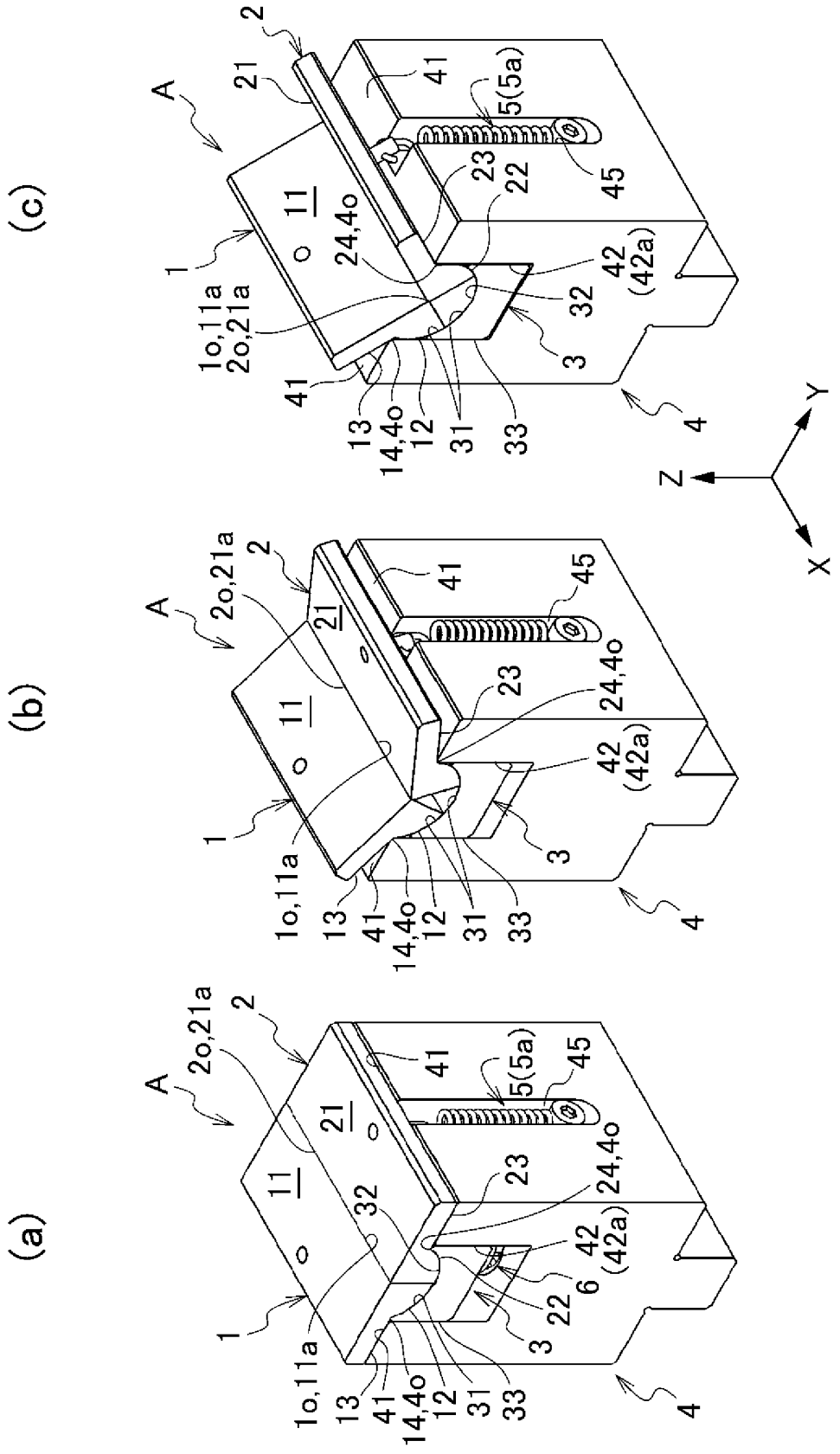
34
41
42(42a)
43
44
45
1o,11a,2o,21a
Z
Y
X

FIG. 2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(c)
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(42a)
6
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14,4o
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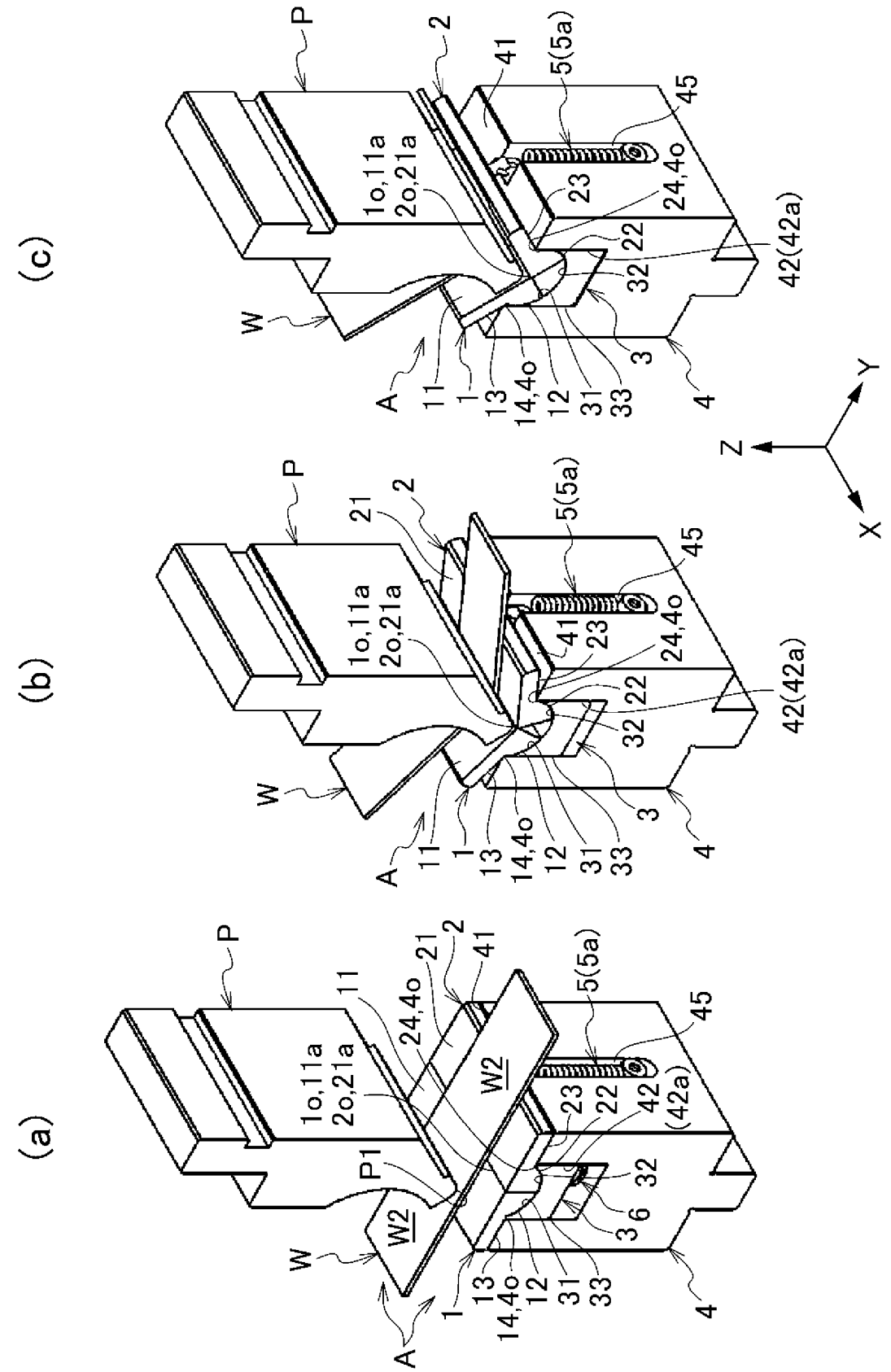
33
4
Y
Z
X

FIG. 3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24,4o
23
22
42
(42a)
42(42a)
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W2
P1
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14,4o
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33
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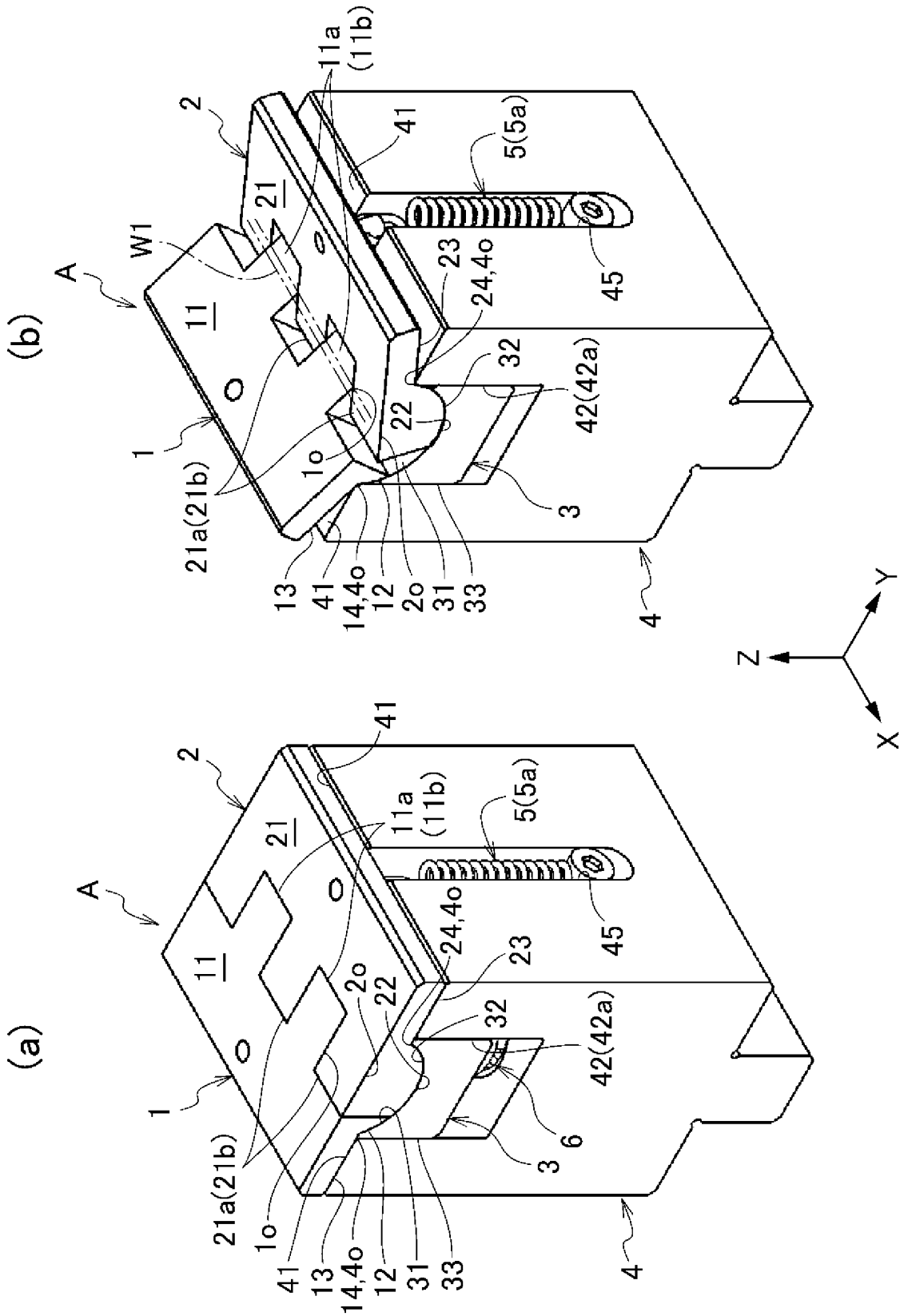
4
Z
Y
X

FIG. 4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(11b)
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13
14,4o
21
21a(21b)
22
23
24,4o
31
32
33
41
42(42a)
45
X
Y
Z

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2018/010825

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. B21D5/02(2006.01)i, B21D5/01(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)
Int.Cl. B21D5/02, B21D5/01

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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.
Y	JP 4698799 B2 (TIGER KOSAN KK) 08 June 2011, paragraphs [0030]-[0033], all drawings & US 2002/0104363 A1, paragraphs [0054]-[0057] & WO 2001/097993 A1	1-3
Y A	JP 3001907 B2 (AMADA METRECS CO., LTD.) 24 January 2000, column 3, lines 14-22, all drawings (Family: none)	1, 3 2
Y	JP 57-18011 Y2 (NIIGATA TSUSHINKI KK) 15 April 1982, column 3, lines 19-39, column 4, lines 28-42, fig. 4 (Family: none)	1-3

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

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Date of the actual completion of the international search 24.04.2018	Date of mailing of the international search report 15.05.2018
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

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Patent documents cited in the description

- JP 2011206823 A **[0008]**