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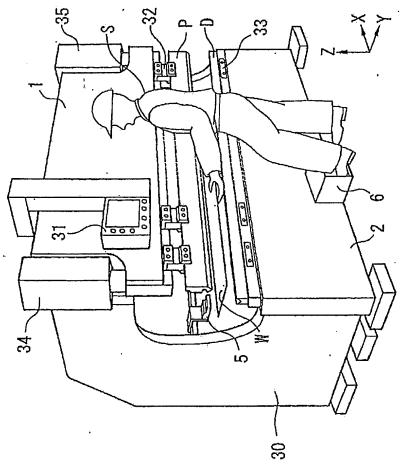
(54) Intermediate-plate mounting device of press brake

(57) An intermediate-plate (32) mounting device of a press brake which improves operability of a fastening plate (3) and also improves operability of a fine adjustment work is provided.

When an intermediate plate (32) to which an upper tool (P) of the press brake is to be attached is mounted on or removed from an upper table (1), a fastening plate (3) for fastening or releasing the intermediate plate (32) is provided, a unit configured to operate the fastening plate (3) is constituted by a cam lever (4), the fastening plate (3) is operated by use of the cam lever (4), a unit configured to finely displace the cam lever (4) is provided, and the fine displacement unit is operated to finely displace the cam lever (4) and thereby finely displace the fastening plate (3), thus finely adjusting a fastening force or a releasing force to the intermediate plate (32) by the fastening plate (3).

FIG.1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to an intermediate-plate mounting device of a press brake configured so that a fastening plate used when an intermediate plate on which an upper tool is to be attached is mounted on or removed from an upper table of the press brake is operated by use of a cam lever, and the cam lever is not directly operated but a fine displacement unit is used to finely displace the cam lever, thus finely adjusting a fastening force or a releasing force to the intermediate plate by the fastening plate 3.

Description of the Related Art

[0002] Conventionally, a device for mounting an intermediate plate on which a punch, which is an upper tool, is attached on an upper table of a press brake which is an example of a bending machine is disclosed in Japanese Utility Model Laid-Open No. 7-3821 (Patent Literature 1 which will be described later), for example.

[0003] In the above-described Patent Literature 1, the intermediate plate is mounted on the upper table by fastening the intermediate plate by the fastening plate using a bolt.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Utility Model Laid-Open No. 7-3821

SUMMARY OF THE INVENTION

[0005] However, the intermediate plate mounted on the upper table might interfere with a work while being worked depending on a machining mode, and in that case, the intermediate plate needs to be moved to another position.

[0006] However, in order to move the intermediate plate, the intermediate plate needs to be released from the fastening plate by loosening the bolt in advance and to be removed from the upper table.

[0007] As a result, labor and time were required for loosening the bolt, and operability when the intermediate plate is released from the fastening plate was low.

[0008] In other words, conventionally, when the intermediate plate is to be mounted on or removed from the upper table, the fastening plate for fastening or releasing the intermediate plate was operated by use of the bolt, and thus, operability was low.

[0009] On the other hand, the fastening force or releasing force to the intermediate plate by the fastening plate is finely adjusted in some case, and this is to hold the fastening force or releasing force constant as is well known.

[0010] Thus, conventionally (the above-described Patent Literature 1, for example), fine adjustment of a fastening force or a releasing force was made by rotating bolts provided at two spots (bolts 50, 51 in Fig. 2 in the above-described Patent Literature 1), but such a fine adjustment work is extremely cumbersome, requires attention and obviously tiring, and operability lowers similarly.

[0011] An object of the present invention is to improve operability of the fastening plate and to provide an intermediate-plate mounting device of a press brake which improves operability of a fine adjustment work.

[0012] In order to solve the above-described problems, in the present invention, as described in claim 1, an intermediate-plate mounting device of a press brake is provided, characterized in that:

when an intermediate plate 32 for attaching an upper tool of the press brake is to be mounted on or removed from an upper table 1, a fastening plate 3 for fastening or releasing the intermediate plate 32 is provided, a unit configured to operate the fastening plate 3 is constituted by cam levers 4, 4' (Fig. 2, Fig. 9), and the fastening plate 3 is operated by use of the cam levers 4, 4' (Fig. 6, Fig. 13); and
a unit 12 (13, 14) or 27, 26 configured to finely displace the cam levers 4, 4' is provided (Fig. 14, Fig. 15), and the fine displacement unit is operated to finely displace the cam lever and thereby finely displace the fastening plate 3, thus finely adjusting a fastening force or a releasing force to the intermediate plate 32 by the fastening plate 3.

[0013] According to a configuration of the above-described present invention, when the intermediate plate 32 is to be mounted on or removed from the upper table 1 of the press brake, the fastening plate 3 for fastening or releasing the intermediate plate 32 can be operated by use of the cam levers 4, 4' and thus, operability of the fastening plate 3 can be improved (Fig. 2, Fig. 9, for example) and moreover, the cam levers 4, 4' are not directly operated but the fine displacement unit 12 (13, 14) or 27, 26 is used to finely displace the cam levers 4, 4' and thereby finely displace the fastening plate 3, thus allowing to finely adjust the fastening force or the releasing force to the intermediate plate 32 by the fastening plate 3, and hence, operability of the fine adjustment work can be improved (Figs. 8, Fig. 15, for example).

[0014] Thus, according to the present invention, it is possible to achieve an effect to provide the intermediate-plate mounting device of a press brake which improves operability of the fastening plate, and improves operability of the fine adjustment work.

[0015] Moreover, in the intermediate-plate mounting device of the press brake, when the intermediate plate 32 is mounted on the upper table 1 (clamped) by fasten-

ing the intermediate plate 32 by the fastening plate 3 by operating the cam lever 4, for example (left views in Fig. 6A, Fig. 6B (clamped)), the cam lever 4 makes a horizontal turning motion toward a side of a machine body and is accommodated in the fastening plate 3 and thus, it does not constitute an obstacle, interference with a work W while being worked (Fig. 1) can be avoided, and an effect that interference with a lever 36 (left view in Fig. 6B) of the intermediate plate 32 for attaching a punch P which is an upper tool can be also avoided is obtained, and moreover, as described above, since the cam lever 4 makes the horizontal turning motion toward the machine body side and is accommodated in the fastening plate 3, the cam lever 4 can be formed larger, and therefore, the cam lever 4 can be operated more easily for the larger portion, and an effect that eventually operability of the fastening plate 3 is further improved is also obtained.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016]

[Fig. 1] Fig. 1 is an entire view illustrating an embodiment of the present invention.

[Fig. 2] Fig. 2 is a perspective view illustrating a first embodiment of an intermediate-plate mounting device of a press brake according to the present invention.

[Fig. 3] Fig. 3 is an exploded perspective view of Fig. 2.

[Fig. 4] Fig. 4 is a front view of Fig. 2.

[Fig. 5] Figs. 5A and 5B are cross sectional views of Fig. 2.

[Fig. 6] Figs. 6A and 6B are entire operation explanatory views of Fig. 2.

[Fig. 7] Figs. 7A and 7B are configuration and operation explanatory views of a cam lever 4 in Fig. 2.

[Fig. 8] Figs. 8A and 8B are configuration and operation explanatory views of a fine displacement unit 40 in Fig. 2.

[Fig. 9] Fig. 9 is a perspective view illustrating a second embodiment of an intermediate-plate mounting device of a press brake according to the present invention.

[Fig. 10] Fig. 10 is an exploded perspective view of Fig. 9.

[Fig. 11] Fig. 11 is a front view of Fig. 9.

[Fig. 12] Figs. 12A and 12B are cross sectional views of Fig. 9.

[Fig. 13] Fig. 13 is an entire operation explanatory view of Fig. 9.

[Fig. 14] Figs. 14A and 14B are configuration and operation explanatory views of a cam lever 4' in Fig. 9.

[Fig. 15] Fig. 15 is a configuration and an operation explanatory view of fine displacement units 27, 26 in Fig. 9.

DESCRIPTION OF THE EMBODIMENTS

[0017] The present invention will be explained below by referring to the attached drawings according to embodiments.

[0018] Fig. 1 is a view illustrating an embodiment of the present invention.

[0019] A press brake illustrated in Fig. 1 has side plates 30 on both sides of a machine body, a an upper table 1 which is a ram is mounted on upper parts of the side plates 30 through ram driving sources (a hydraulic cylinder, an electric motor and the like, for example) 34, 35, an intermediate plate 32 is mounted on the upper table 1 through a fastening plate 3 (Fig. 2) which will be described later, and a punch P (Fig. 1) which is an upper tool is attached to the intermediate plate 32.

[0020] On the upper table 1, an operation panel 31 connected to a control portion (not shown) is movably provided, and a bending order calculated manually by a worker S, tools composed of the punch P, a die D and the like used for each of the bending order are displayed on a screen of the operation panel 31.

[0021] Moreover, a lower table 2 is arranged on a lower part of the side plate 30, and the die D which is a lower tool is attached to the lower table 2 through a holding plate 33.

[0022] That is, the press brake in Fig. 1 is a lowering type press brake, and the worker S positions and makes a work W abut against a stop 5 of a back gauge arranged in the rear of the lower table 2 and then, steps on a foot pedal 6, the hydraulic cylinders which are above-described ram driving sources 34, 35, for example, are operated, and by lowering the upper table 1, the work W is bent by collaboration between the punch P and the die D.

[0023] Moreover, as the press brake in Fig. 1, a raising type press brake in which the work W is bent similarly by collaboration between the punch P and the die D by rise of the lower table 2 can be also used.

(1) First embodiment

[0024] Figs. 2 to 8 illustrate a first embodiment, while Figs. 9 to 15 illustrate a second embodiment, respectively, and the first embodiment will be described in detail first.

[0025] In the first embodiment, a fastening plate 3 (Fig. 3) and a hinge bracket 11 on a side of the upper table 1 in front the fastening plate 3 are supported by common support shafts 7, 8, and a cam lever 4 having a turning shaft 12 (hereinafter referred to as a first cam lever 4) is provided on the hinge bracket 11 capable of a horizontal turning motion.

[0026] The fastening plate 3 has a function of mounting (clamping) or removing (unclamping) the intermediate plate 32 with respect to the upper table 1 by fastening or releasing the intermediate plate 32 (Fig. 6).

[0027] Then, at symmetrical positions in a longitudinal direction (X-axis direction) of the fastening plate 3 (Fig.

3), through holes 3G, 3H are formed, and the support shafts 7, 8 are penetrated into the through holes 3G, 3H.

[0028] Moreover, on a front of the fastening plate 3, a cam lever accommodating portion formed of wall surfaces 3A, 3B, 3C, 3D, and 3E is formed, and the cam lever accommodating portion is capable of accommodating the first cam lever 4 (Fig. 2)

[0029] At substantially a center part in the longitudinal direction (X-axis direction) of the fastening plate 3 (Fig. 3), a cam-part accommodating portion 16 formed of wall surfaces 3A, 3B, 3C, and 3D is formed, while at a substantially right side part in the longitudinal direction, a lever-part accommodating portion 17 formed of a wall surface 3E is formed similarly, respectively.

[0030] The cam-part accommodating portion 16 accommodates a cam part 4A in the first cam lever 4, while the lever-part accommodating portion 17 accommodates a lever part 4B in the first cam lever 4.

[0031] In the wall surfaces forming the cam-part accommodating portion 16, the wall surface 3A in parallel with a longitudinal direction (Y-axis direction) is the deepest, and a depth of the wall surface 3D facing the wall surface 3A is approximately half the wall surface 3A (Fig. 5A).

[0032] Moreover, the wall surface 3E going to a right side from the wall surface 3D and in parallel with a longitudinal direction (X-axis direction) orthogonal to the wall surface 3E is provided, and as described above, the above-described lever-part accommodating portion 17 (Fig. 3) is formed by the wall surface 3E.

[0033] Therefore, on the basis of configurations of the above-described cam-part accommodating portion 16 and the lever-part accommodating portion 17, if the first cam lever 4 makes a horizontal turning motion toward the machine body side (Fig. 2, Fig. 4, Fig. 5), it is fully accommodated in the fastening plate 3 and does not constitute an obstacle, interference with the work W (Fig. 1) while being worked can be avoided, and interference with a lever 36 of the intermediate plate 32 (left view in Fig. 6B) for attaching the punch P which is an upper tool can be also avoided.

[0034] That is, the wall surface 3A (Fig. 5B) is equal to the wall surface 3D added with the lever part 4B, the first cam lever 4 (Fig. 2) is fully accommodated in the fastening plate 3 and the both are integrated, and there is nothing to protrude toward the outside.

[0035] The hinge bracket 11 (Fig. 3) supports the turning shaft 12 when the first cam lever 4 makes a horizontal turning motion and also has a function of sandwiching compression springs 9, 10 between the fastening plate 3 and itself.

[0036] The hinge bracket 11 has a projection 11E at its center part, and closed holes 11C, 11D adjacent to the projection 11E and through holes 11A, 11B on an outside thereof are formed, respectively.

[0037] The projection 11E of the hinge bracket 11 passes through a through hole 3F formed at a center part of the fastening plate 3 and enters into the above-described cam-part accommodating portion 16 and at the same time, the entire hinge bracket 11 is located on a side of the upper table 1 in front of the fastening plate 3.

[0038] With this configuration, the support shafts 7, 8 penetrate the through holes 3G, 3H of the fastening plate 3 and the through holes 11A, 11B of the hinge bracket 11 and are screwed into screw holes 1A, 1B of the upper table 1, and the hinge bracket 11 is brought into close contact with the upper table 1 by pressing forces of the support shafts 7, 8 and is firmly fixed.

[0039] Moreover, the compression springs 9, 10 are sandwiched between the fastening plate 3 and the hinge bracket 11.

[0040] That is, with the closed holes 11C, 11D of the hinge bracket 11 and similarly closed holes 3P, 3Q (Fig. 5B) facing those holes of the fastening plate 3, one ends and the other ends of the compression springs 9, 10 are brought into contact, respectively.

[0041] With this configuration, on the basis of urging forces of the compression springs 9, 10, the fastening plate 3 is urged toward a direction away from the upper table 1 (worker S (Fig. 1) side), and the fastening plate 3 is brought into contact with columnar head parts of the support shafts 7, 8, and is prevented from dropping from the support shafts 7, 8 (Fig. 5B).

[0042] As a result, the cam part 4A of the first cam lever 4 (Fig. 7) is brought into contact with this urged fastening plate 3 at all times.

[0043] Therefore, when the first cam lever 4 makes a horizontal turning motion (Fig. 7), the urged fastening plate 3 makes a reciprocating motion along axes of the support shafts 7, 8 (Fig. 5B).

[0044] On the other hand, in the projection 11E of the hinge bracket 11 having entered into the cam-part accommodating portion 16 of the fastening plate 3 (Fig. 3), a hollow portion 11F is formed, the turning shaft 12 of the first cam lever 4 is inserted into the hollow portion 11F with allowance, and the turning shaft 12 is fixed by a fixing screw 15 in the hollow portion 11F (Fig. 5B).

[0045] A set screw 13 is screwed into a top part of the turning shaft 12 (Fig. 3) and a set screw 14 into a bottom part, respectively, the set screws 13, 14 are inserted into an upper part and a lower part of the cam part 4A constituting the first cam lever 4, respectively, and the turning shaft 12 and the projection 11E are both arranged in a dent 4C of the cam part 4A.

[0046] With this configuration, the first cam lever 4 is provided capable of a horizontal turning motion around the turning shaft 12 fixed in the hollow portion 11F of the projection 11E in front of a front surface of the fastening plate 3 (Fig. 6).

[0047] During the above-described clamping (left views in Figs. 6A and 6B), the first cam lever 4 is accommodated in the fastening plate 3, but at this time, the columnar head part of the right-side support shaft 8 (Fig. 3) is closely accommodated in the through hole 4D formed in the first cam lever 4 and is configured not to project to an outside or to constitute an obstacle (Fig. 2,

Fig. 4), and this also applies to the projection 11E of the hinge bracket 11, which is accommodated in the dent 4C of the first cam lever 4.

[0048] Therefore, interference with the work W while being worked (Fig. 1) is similarly avoided, and interference with the lever 36 of the intermediate plate 32 (left view of Fig. 6B) for attaching the punch P which is an upper tool is also avoided.

[0049] The first cam lever 4 (Fig. 3) has, as described above, a function of operating the fastening plate 3 and as well known, by making a horizontal turning motion as a driver (Fig. 7), it has the fastening plate 3 as a follower make a reciprocating motion in the longitudinal direction (Y-axis direction).

[0050] The first cam lever 4 (Fig. 3) is constituted by the cam part 4A playing a substantial role of the cam and the lever part 4B applying a horizontal turning motion to the cam part 4A.

[0051] The cam part 4A (Fig. 7) is, as described above, in contact with the fastening plate 3 at all times, and in more detail, an upper rear surface of the cam part 4A (Fig. 3) is in contact with the wall surface 3B of the fastening plate 3 and a lower rear surface of the cam part 4A is in contact with the wall surface 3C of the fastening plate 3, respectively.

[0052] Assuming that a length of a distance from a cam center O (Fig. 7) to an end portion T1 of the cam part 4A is a, and a length of a distance to an end portion T2 orthogonal to the end portion T1 is b, it is assumed to be $a > b$.

[0053] With this configuration, when the first cam lever 4 makes a horizontal turning motion toward the machine body side (arrow A), as indicated by solid diagonal lines in Fig. 7A, the fastening plate 3 advances (on the basis of a position of the fastening plate 3 with which the cam part 4A inclined as indicated by a broken line is brought into contact, for example).

[0054] On the contrary, when the first cam lever 4 makes a horizontal turning motion in a direction away from the machine body side by 90°, for example (arrow B), as indicated by solid diagonal lines in Fig. 7B, the fastening plate 3 retreats (the broken line indicates the position of the fastening plate 3 in Fig. 7A).

[0055] In order to make smooth movement of the cam part 4A from the end portion T1 to the end portion T2 along with the horizontal turning motion of the first cam lever 4, a corner part 4A1 of the cam part 4A is formed into an R-shape.

[0056] Moreover, during clamping (left views in Figs. 6A and 6B) or during unclamping (right views in Figs. 6A and 6B), values of constituent members such as a thickness (Y-axis direction) of the fastening plate 3 are set in advance so that, if the fastening plate 3 makes an advancing motion or a retreating motion by a predetermined distance by an operation of the first cam lever 4, a predetermined fastening force or releasing force is applied from the fastening plate 3 to the intermediate plate 32.

[0057] An entire operation of the intermediate-plate mounting device of a press brake using the first cam lever 4 having the above-described configuration will be explained on the basis of Figs. 6A and 6B.

(A) Operation during clamping (left views in Figs. 6A, 6B)

[0058] By having the first cam lever 4 make a horizontal turning motion toward the machine body, the first cam lever 4 is accommodated in the fastening plate 3.

[0059] At that time, since the first cam lever 4 presses the fastening plate 3 toward the upper table 1, a predetermined fastening force F is applied from the fastening plate 3 to the intermediate plate 32, and thus, the intermediate plate 32 is mounted on the upper table 1 (clamping).

(B) Operation during unclamping (right views in Figs. 6A, 6B)

[0060] To the contrary to the above-described (A), by having the first cam lever 4 make a horizontal turning motion in a direction away from the machine body, the first cam lever 4 protrudes with respect to the fastening plate 3 by 90°.

[0061] At that time, the first cam lever 4 (in more detail, the cam part 4A) acts so as to be separated away from the fastening plate 3, and the fastening plate 3 makes a retreating motion to a direction away from the upper table 1 in accordance with the urging forces of the compression springs 9, 10, and thus, a predetermined releasing force F' in a direction opposite to that of the fastening force F is applied from the fastening plate 3 to the intermediate plate 32, and therefore, the intermediate plate 32 is removed from the upper table 1 (unclamping).

[0062] In that case, since a projection 3A on the fastening plate 3 side (right view in Fig. 6B) is engaged with a groove 32A on the intermediate plate 32 side, the intermediate plate 32 does not fall.

[0063] Moreover, a relationship between the first cam lever 4 and the fastening plate 3 during operation is as follows.

[0064] That is, while the first cam lever 4 makes a horizontal turning motion, the cam part 4A of the first cam lever 4 makes a sliding motion at all times along the fastening plate 3 making a reciprocating motion (Y-axis direction in Fig. 7), and the turning shaft 12 of the first cam lever 4 at that time is fixed to the hinge bracket 11 mounted on the upper table 1 (Fig. 3) and does not move.

[0065] As described above, according to the present invention, since the fastening plate 3 can be operated by use of the first cam lever 4, its operability is improved, and during clamping (left views in Figs. 6A and 6B), since the first cam lever 4 can be accommodated in the fastening plate 3, it does not constitute an obstacle, interference with a work W while being worked (Fig. 1) can be avoided, and an effect that interference with the lever 36 (left view in Fig. 6B) of the intermediate plate 32 for attaching the punch P which is an upper tool can be also

avoided is obtained, and moreover, as described above, since the first cam lever 4 makes the horizontal turning motion toward the machine body side and is accommodated in the fastening plate 3, the first cam lever 4 can be formed larger, and therefore, the first cam lever 4 can be operated more easily for the larger portion, and an effect that eventually operability of the fastening plate 3 is further improved is also obtained.

[0066] The fine displacement unit 12 (13, 14) (Figs. 8A and 8B) will be described below in detail.

[0067] Originally, during above-described clamping (left views in Figs. 6A and 6B) and unclamping (right views in Figs. 6A and 6B), values of the constituent members such as the thickness (Y-axis direction) of the fastening plate 3 are set in advance so that, if the fastening plate 3 makes a reciprocating motion by a predetermined distance by the above-described operation of the first cam lever 4, the predetermined fastening force or releasing force is applied to the intermediate plate 32 from the fastening plate 3.

[0068] However, if the thickness of the fastening plate 3 might be larger than usual or smaller to the contrary due to a working error, for example, the fastening force or releasing force to the intermediate plate by the fastening plate needs to be finely adjusted, whereby the fastening force or releasing force is to be held constant.

[0069] In the present invention, operability of the fine adjustment work is to be improved by finely displacing the fastening plate 3 by finely displacing the cam lever 4 by use of the fine displacement unit 12 (13, 14) (Fig. 8A) as described above without directly operating the cam lever in such cases and by finely adjusting the fastening force or releasing force to the intermediate plate by the fastening plate.

[0070] The fine displacement unit 12 (13, 14) in the first embodiment (Fig. 8A) is the above-described unit configured to finely displace the first cam lever 4 (Figs. 2 to 7) (hereinafter referred to as the first fine displacement unit 12 (13, 14)).

[0071] This first fine displacement unit 12 (13, 14) (Fig. 8A) is constituted by an eccentric shaft 40 (Fig. 8B) which is the turning shaft 12 of the first cam lever 4 made eccentric, and the eccentric shaft 40 is supported by the hinge bracket 11 (Fig. 3) and movable in the longitudinal direction (Y-axis direction with rotation), whereby the first cam lever 4 is finely displaced in the longitudinal direction.

[0072] That is, as described above, to the hollow portion 11F formed in the projection 11E of the hinge bracket 11 (Fig. 3), the turning shaft 12 of the first cam lever 4 is fixed by a fixing screw 15 (Fig. 5B), and the first cam lever 4 (Fig. 8A) is configured to make a horizontal turning motion with respect to this fixed turning shaft 12.

[0073] However, the fixing screw 15 (Fig. 3, Fig. 5B) is loosened so that the turning shaft 12 in the hollow portion 11F is brought into a free state, and this is used as the eccentric shaft 40 (Fig. 8B) which does not drop in the hollow portion 11F and is movable in the longitudinal direction (Y-axis direction).

[0074] The eccentric shaft 40 is, as is well known, a shaft with a core C shifted from the center, and by rotating it by using a hexagonal wrench, for example, the eccentric shaft 40 is moved in the longitudinal direction (Y-axis direction) along with the rotation.

[0075] As illustrated in Fig. 8B, for example, by accommodating the first cam lever 4 in the fastening plate 3 (Fig. 2) into a clamp state and by advancing the eccentric shaft 40 in this state (an arrow J in Fig. 8B), the eccentric shaft 40 is moved to a position 40', and the first cam lever 4 also advances along with the movement.

[0076] On the contrary, by retreating the eccentric shaft 40 in the same state (an arrow K in Fig. 8B), the position of the eccentric shaft 40 moves to a position 40'', and the first cam lever 4 also retreats with that.

[0077] As described above, according to the present invention, by using the eccentric shaft 40 (Fig. 8B) constituting the first fine displacement unit 12 (13, 14) without directly operating the first cam lever 4, the first cam lever 4 is advanced or retreated in the longitudinal direction (Y-axis direction) and finely displaced, whereby the fastening plate 3 is finely displaced, and the fastening force F (corresponding to the left view in Fig. 6B) or the releasing force F' (corresponding to the right view in Fig. 6B) to the intermediate plate by the fastening plate is finely adjusted so that operability of the fine adjustment work is improved.

(2) Second embodiment

[0078] A second embodiment illustrated in Figs. 9 to 15 will be described below in detail.

[0079] In the second embodiment, the fastening plate 3 (Fig. 10) and a plate 24 on the upper table 1 side in front of the fastening plate 3 are supported by common support shafts 20, 21, and a cam lever 4' (hereinafter referred to as a second cam lever 4') having a turning shaft 25 (a stripper bolt, for example) is provided on the fastening plate 3, capable of a horizontal turning motion.

[0080] The fastening plate 3 similarly has a function of mounting (clamping) or removing (unclamping) the intermediate plate 32 with respect to the upper table 1 by fastening or releasing the intermediate plate 32 (Fig. 13).

[0081] Then, at positions symmetrical in the longitudinal direction (X-axis direction) of the fastening plate 3 (Fig. 10), through holes 3K, 3L are formed, and the support shafts 20, 21 are penetrated into the through holes 3K, 3L.

[0082] Moreover, on an upper part of the fastening plate 3, a second cam lever accommodating portion formed of a wall surface 3H and a bottom surface 3J is formed, and the second cam lever 4' can be accommodated in the second cam lever accommodating portion (Fig. 9).

[0083] The turning shaft 25 of the second cam lever 4' (Fig. 10) is fixed to the bottom surface 3J in the upper part of the fastening plate 3 and is arranged in the second cam lever accommodating portion, and the second cam

lever 4' is capable of a horizontal turning motion in front of the upper part of the fastening plate 3.

[0084] As a result, when the second cam lever 34' makes a horizontal turning motion toward the machine body side (Fig. 9, Fig. 11, Fig. 12), it is fully accommodated in the fastening plate 3 and does not constitute an obstacle similarly, interference with the work W while being worked (Fig. 1) is avoided, and interference with the lever 3 6 (Fig. 9) of the intermediate plate 32 for attaching the punch P which is an upper tool is also avoided.

[0085] That is, similarly to the first embodiment (Fig. 2, Fig. 4, Fig. 5), the second cam lever 4' (Fig. 9) is fully accommodated in the fastening plate 3 and the both are integrated, and there is nothing to protrude toward the outside.

[0086] The plate 24 (Fig. 10) similarly has a function of sandwiching the compression springs 22, 23 between the fastening plate 3 and itself.

[0087] The plate 24 has, as illustrated in Fig. 10, inverted U-shaped through holes 24A, 24B with lower sides open at symmetrical positions in the longitudinal direction (X-axis direction).

[0088] With this configuration, the support shafts 20, 21 are penetrated into the through holes 3K, 3L of the fastening plate 3 and the inverted U-shaped through holes 24A, 24B of the plate 24 and screwed into the screw holes 1A, 1B of the upper table 1, and the plate 24 is similarly brought into close contact with the upper table 1 by pressing forces of the support shafts 20, 21 and is firmly fixed.

[0089] Moreover, the compression springs 22, 23 are sandwiched between the fastening plate 3 and the plate 24, and the compression springs 22, 23 are not provided as in the first embodiment (Fig. 3, Fig. 5B) in which the compression springs 9, 10 are provided inside, for example, adjacent to the support shafts 7, 8, but the compression springs 22, 23 are wound around the support shafts 20, 21 themselves (Fig. 10, Fig. 12B).

[0090] Moreover, head parts 20A, 21A of the support shafts 20, 21 supporting the fastening plate 3 and the plate 24 on the upper table 1 side which is in front of the fastening plate 3 are formed not into columnar shapes as in the first embodiment (Fig. 5B) but into bowl shapes (Fig. 12B), and contact surfaces of the bowl-shaped head parts 20A, 21A and the through holes 3K, 3L are formed of spherical surfaces, respectively.

[0091] With this configuration, as will be described later (Fig. 13), a swing motion (arrows H, H' in Fig. 13) of the fastening plate 3 when the second cam lever 4' makes a horizontal turning motion is performed extremely smoothly by using the bowl-shaped head parts 20A, 21A as fulcrums.

[0092] Moreover, similarly in this case, the fastening plate 3 is urged toward a direction away from the upper table 1 (worker S (Fig. 1) side) on the basis of the urging forces of the compression springs 22, 23, and the fastening plate 3 is brought into contact with the bowl-shaped head parts 20A, 21A of the support shafts 20, 21 through the through holes 3K, 3L (Fig. 12B) and is prevented from dropping from the support shafts 20, 21.

[0093] As a result, a cam part 4'A (Fig. 14) of the second cam lever 4' fixes the turning shaft 25 (Fig. 14) to this urged fastening plate 3 (in more detail, an upper bottom surface 3J of the fastening plate 3 (Fig. 10)), while the cam part 4'A is in contact with the plate 24 fixed to the upper table 1 at all times.

[0094] Therefore, when the second cam lever 4' makes a horizontal turning motion (Fig. 13, Fig. 14), the urged fastening plate 3 (Fig. 13) makes a swing motion by using the bowl-shaped head parts 20A, 21A as fulcrums (arrows H, H' in Fig. 13).

[0095] The second cam lever 4' (Fig. 10) has, as described above, a function of operating the fastening plate 3 and as is well known, by making a horizontal turning motion as a driver (Fig. 14), it has the fastening plate 3 as a follower make a swing motion (arrows H, H' in Fig. 13) by using the bowl-shaped head parts 20A, 21A (Fig. 13) as fulcrum.

[0096] The second cam lever 4' (Fig. 10) is similarly constituted by the cam part 4' A playing a substantial role of the cam and a lever part 4' B applying a horizontal turning motion to the cam part 4'A.

[0097] Assuming that a length of a distance from a cam center O' (Fig. 14) to an end portion T'1 of the cam part 4'A is a', and a length of a distance to an end portion T'2 orthogonal to the end portion T'1 is b', it is similarly assumed to be a' > b'.

[0098] With this configuration, when the second cam lever 4' makes a horizontal turning motion toward the machine body side (arrow A in Fig. 14A), the fastening plate 3 is given a force G such that the turning shaft 25 fixed to the fastening plate 3 is separated away from the plate 24 and becomes a perpendicular state (left view in Fig. 13), the intermediate plate 32 is fastened by the fastening plate 3 at this time, and as indicated by solid diagonal lines in Fig. 14A, the fastening plate 3 is away from the plate 24 by a certain distance ΔY.

[0099] On the contrary, when the second cam lever 4' makes a horizontal turning motion in the direction away from the machine body side by 90°, for example (arrow B in Fig. 14B), the fastening plate 3 is given a force G' such that the turning shaft 25 fixed to the fastening plate 3 is brought close to the plate 24 and becomes a slightly inclined state (right view in Fig. 13), the intermediate plate 32 is released from the fastening plate 3 at this time, and as indicated by solid diagonal lines in Fig. 14B, the fastening plate 3 is away from the plate 24 by a certain distance $\Delta Y'$. However, $\Delta Y > \Delta Y'$ holds.

[0100] In order to make smooth movement of the cam part 4' A from the end portion T'1 to the end portion T'2 along with the horizontal turning motion of the second cam lever 4', a corner part 4'A1 of the cam part 4'A is formed into an R-shape.

[0101] An entire operation of the intermediate-plate mounting device of a press brake using the second cam lever 4' having the above-described configuration will be

explained below on the basis of Fig. 13.

(A) Operation during clamping (left view in Fig. 13)

[0102] By having the second cam lever 4' make a horizontal turning motion toward the machine body side, the second cam lever 4' is accommodated in the fastening plate 3 (left view in Fig. 13).

[0103] At that time, since the second cam lever 4' applies the force G to the upper part of the fastening plate 3 so as to be separated away from the plate 24, the fastening plate 3 makes a swing motion (arrow H in Fig. 13) using the bowl-shaped head parts 20A, 21A as fulcrums and becomes a perpendicular state as illustrated.

[0104] As a result, a predetermined fastening force is applied to the intermediate plate 32 from the fastening plate 3, and thus, the intermediate plate 32 is mounted onto the upper table 1 (clamping).

(B) Operation during unclamping (right view in Fig. 13)

[0105] To the contrary to the above-described (A), by having the second cam lever 4' make a horizontal turning motion in a direction away from the machine body side, the second cam lever 4' protrudes with respect to the fastening plate 3 by 90° (right view in Fig. 13).

[0106] At that time, since the second cam lever 4' applies the force G' to the upper part of the fastening plate 3 so as to be brought close to the plate 24, the fastening plate 3 makes a swing motion (arrow H' in Fig. 13) by using the bowl-shaped head parts 20A, 21A as fulcrums and is slightly inclined as illustrated (θ° to a perpendicular line).

[0107] As a result, a predetermined releasing force is applied from the fastening plate 3 to the intermedia plate 32, and thus, the intermediate plate 32 is removed with respect to the upper table 1 (unclamping).

[0108] Similarly in that case, since the projection 3A on the fastening plate 3 side (right view in Fig. 13) is engaged with a groove 32A on the intermediate plate 32 side, the intermediate plate 32 does not fall.

[0109] Moreover, similarly, the relationship between the second cam lever 4' during the operation and the fastening plate 3 is as follows.

[0110] That is, while the second cam lever 4' makes a horizontal turning motion (Fig. 13, Fig. 14), the cam part 4'A of the second cam lever 4' makes a sliding motion at all times along the plate 24 mounted on the upper table 1 (Fig. 12), and the turning shaft 25 of the second cam lever 4' at that time moves together with the fastening plate 3 making a swing motion (arrows H, H' in Fig. 13) (Fig. 13, Fig. 14).

[0111] As described above, according to the present invention, since the fastening plate 3 can be operated by using the second cam lever 4' similarly, its operability is improved, and since the second cam lever 4' can be accommodated in the fastening plate 3 during clamping (left view in Fig. 13), it does not constitute an obstacle, interference with the work W (Fig. 1) while being worked can be avoided, and an effect that interference with a lever 36 of the intermediate plate 32 (Fig. 9) for attaching the punch P which is an upper tool is avoided can be also obtained, and moreover, as described above, since the second cam lever 4' turns horizontally toward the machine body side and is accommodated in the fastening plate 3, the second cam lever 4' can be formed larger and therefore, the second cam lever 4' can be operated more easily for the larger portion, and thus, an effect that eventually operability of the fastening plate 3 is further improved is obtained.

[0112] The fine displacement units 27, 26 (Fig. 15) will be described below in detail, but the gist is totally the same as that of the fine displacement unit 12 (13, 14) (Fig. 8) of the first embodiment described above, and explanation will be omitted.

[0113] The fine displacement units 27, 26 (Fig. 15) in the second embodiment is the above-described units configured to finely displace the second cam lever 4' (Figs. 9 to 14) (hereinafter referred to as second fine displacement units 27, 26).

[0114] These second fine displacement units 27, 26 are constituted by a notch portion 27 formed in the cam part 4'A (Fig. 15) of the second cam lever 4' and a displacement screw 26 configured to deform the notch portion 27 and to finely displace the end portion T'1 of the cam part 4'A, the end portion T'1 of the cam part 4'A is finely displaced along with rotation of the displacement screw 26, whereby the second cam lever 4' is finely displaced in the longitudinal direction (Y-axis direction) (corresponding to Fig. 14).

[0115] In this case, since the displacement screw 26 (Fig. 15) is screwed into the cam part 4'A from the end portion T'1 side of the second cam lever 4', the plate 24 with which the end portion T'1 is in contact constitutes an obstacle if the clamped state (corresponding to Fig. 14A) remains, and the displacement screw 26 cannot be rotated by using a hexagonal wrench, for example.

[0116] Thus, the second cam lever 4' is brought into an unclamped state once (corresponding to Fig. 14B), the displacement screw 26 is exposed from the end portion T'1 (Fig. 15), and the displacement screw 26 is rotated by using the hexagonal wrench, for example, as described above.

[0117] Then, as illustrated in Fig. 15, by rotating the displacement screw 26, the notch portion 27 is deformed, and a position of the end portion T'1 is displaced such as T''1 -> T'''1 along with the deformation.

[0118] By bringing back to the clamped state after that (corresponding to Fig. 14A), the fastening plate 3 can be made to make a slight swing motion (corresponding to arrows H, H' in Fig. 13), and the fastening force G or the releasing force G' to the intermediate plate 32 by the fastening plate 3 can be finely adjusted.

[0119] On the basis of a position of T''1 (Fig. 15) in the unclamped state, for example, if displacement is made to the position of T'1, the second cam lever 4' is also

displaced along with the displacement and when it is brought into the clamped state (corresponding to Fig. 14A), the fastening plate 3 is separated away from the plate 24, and therefore, it makes a swing motion in a clockwise direction (arrow H in the left view in Fig. 13), and thus, the fastening force G to the intermediate plate 32 can be finely adjusted.

[0120] On the contrary, in the unclamped state, for example, if displacement is made to a position of T'" in an opposite direction on the basis of the position of T"1 (Fig. 15) similarly, the second cam lever 4' is also displaced along with the displacement, and when it is brought into the clamped state (corresponding to Fig. 14A), the fastening plate 3 is brought close to the plate 24, and therefore, it makes a swing motion (arrow H' in the right view in Fig. 13) in a counterclockwise direction, and thus, the releasing force G' to the intermediate plate 32 can be finely adjusted.

[0121] As described above, according to the present invention, by using the notch portion 27 (Fig. 15) and the displacement screw 26 constituting the second fine displacement units 27, 26 without directly operating the second cam lever 4', by deforming the notch portion 27 so as to finely displace the end portion T'1 (Fig. 15) of the cam part 4'A, and by finely displacing the second cam lever 4' along with the fine displacement of the end portion T'1, the fastening plate 3 is made to make a swing motion (arrows H, H' in Fig. 13) so as to be finely displaced, the fastening force G or a releasing force G' to the intermediate plate 32 by the fastening plate 3 is finely adjusted so that operability of the fine adjustment work is improved.

[0122] The present invention is extremely advantageous when used in the intermediate-plate mounting device of a press brake which improves operability of the fastening plate and improves operability of the fine adjustment work and moreover, when used both for a lowering press brake and a rising press brake regardless of the form of the press brake.

DESCRIPTION OF THE NUMERALS

NUMERALS COMMON TO FIRST EMBODIMENT AND SECOND EMBODIMENT

[0123]

1	upper table
2	lower table
5	stop
6	foot pedal
30	side plate
31	operation panel
32	intermediate plate
33	holding plate
34, 35	ram driving source
36	lever of intermediate plate 32
P	punch
D	die
W	work

NUMERALS USED IN FIRST EMBODIMENT

[0124]

3	fastening plate
4	first cam lever
7, 8	support shaft
9, 10	compression spring
11	hinge bracket
12	turning shaft
13, 14	set screw
15	fixing screw
40	eccentric shaft (first fine displacement unit)

NUMERALS USED IN SECOND EMBODIMENT

[0125]

3	fastening plate
4'	second cam lever
20, 21	support shaft
22, 23	compression spring
24	plate
25	turning shaft
26	adjustment screw (second fine displacement unit)
27	notch portion (second fine displacement unit)

Claims

1. An intermediate-plate mounting device of a press brake, **characterized in that**:

when an intermediate plate for attaching an upper tool of the press brake is to be mounted on or removed from an upper table, a fastening plate for fastening or releasing the intermediate plate is provided, a unit configured to operate the fastening plate is constituted by a cam lever, and the fastening plate is operated by use of the cam lever; and

a fine displacement unit configured to finely displace the cam lever is provided, and the fine displacement unit is operated to finely displace the cam lever and thereby finely displace the fastening plate, thus finely adjusting a fastening force or a releasing force to the intermediate plate by the fastening plate.

2. The intermediate-plate mounting device of a press brake according to claim 1, wherein

the cam lever is capable of a horizontal turning motion and of being accommodated in the fastening plate;

the cam lever is constituted by a first cam lever capable of being accommodated in a first cam lever accommodating portion formed on a front of the fastening plate or a second cam lever capable of being accommodated in a second cam lever accommodating portion formed on an upper part of the fastening plate.

3. The intermediate-plate mounting device of a press brake according to claim 1 or 2, wherein
a turning shaft of the first cam lever is fixed to a hinge bracket mounted on the upper table and is arranged in the first cam lever accommodating portion formed on the front of the fastening plate, and the first cam lever makes a horizontal turning motion in front of the front surface of the fastening plate.

4. The intermediate-plate mounting device of a press brake according to claim 1, 2 or 3, wherein
an urging spring is sandwiched between the hinge bracket to which the turning shaft of the first cam lever is fixed and the fastening plate, the fastening plate and the hinge bracket are supported by a common support shaft, and when the first cam lever makes a horizontal turning motion, the urged fastening plate makes a reciprocating motion along an axis of the support shaft.

5. The intermediate-plate mounting device of a press brake according to claim 1, 2, 3 or 4, wherein
while the first cam lever makes a horizontal turning motion, a cam part of the first cam lever makes a sliding motion at all times along the fastening plate making a reciprocating motion, and the turning shaft of the first cam lever at that time is fixed to the hinge bracket mounted on the upper table and does not move.

6. The intermediate-plate mounting device of a press brake according to claim 1 or 2, wherein
a turning shaft of the second cam lever is fixed to the upper part of the fastening plate and arranged in the second cam lever accommodating portion formed on the upper part, and the second cam lever makes a horizontal turning motion in front of the upper part of the fastening plate.

7. The intermediate-plate mounting device of a press brake according to claim 1, 2 or 6, wherein
an urging spring is sandwiched between the fastening plate to which the turning shaft of the second cam lever is fixed and a plate mounted on the upper table, the fastening plate and the plate are supported by a common support shaft, and when the second cam lever makes a horizontal turning motion, the urged fastening plate makes a swing motion using a head part of the support shaft as a fulcrum.

8. The intermediate-plate mounting device of a press brake according to claim 1, 2, 6 or 7, wherein
while the second cam lever makes a horizontal turning motion, a cam part of the second cam lever makes a sliding motion at all times along a plate mounted on the upper table, and the turning shaft of the second cam lever at that time moves with the fastening plate making a swing motion.

9. The intermediate-plate mounting device of a press brake according to claim 1 or 2, wherein
a unit configured to finely displace the cam lever is constituted by a first fine displacement unit configured to finely displace the first cam lever or a second fine displacement unit configured to finely displace the second cam lever, the first fine displacement unit is constituted by an eccentric shaft which is the turning shaft of the first cam lever made eccentric, and the second fine displacement unit is constituted by a notch portion formed on a cam part of the second cam lever and a displacement screw for deforming the notch portion and finely displacing an end portion of the cam part.

FIG. 1

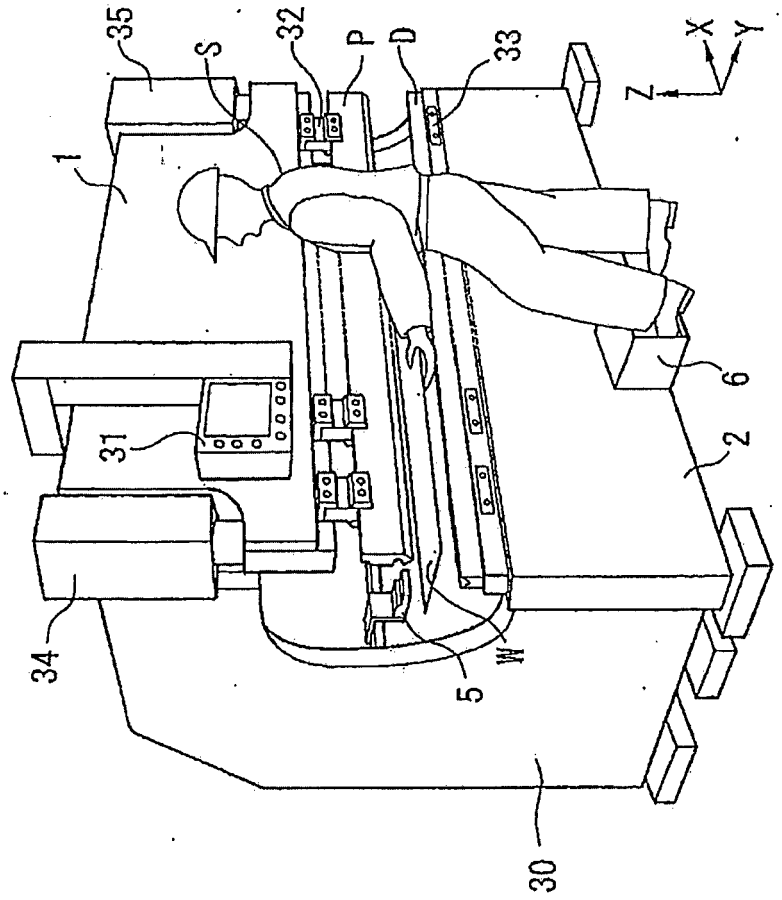


FIG.2

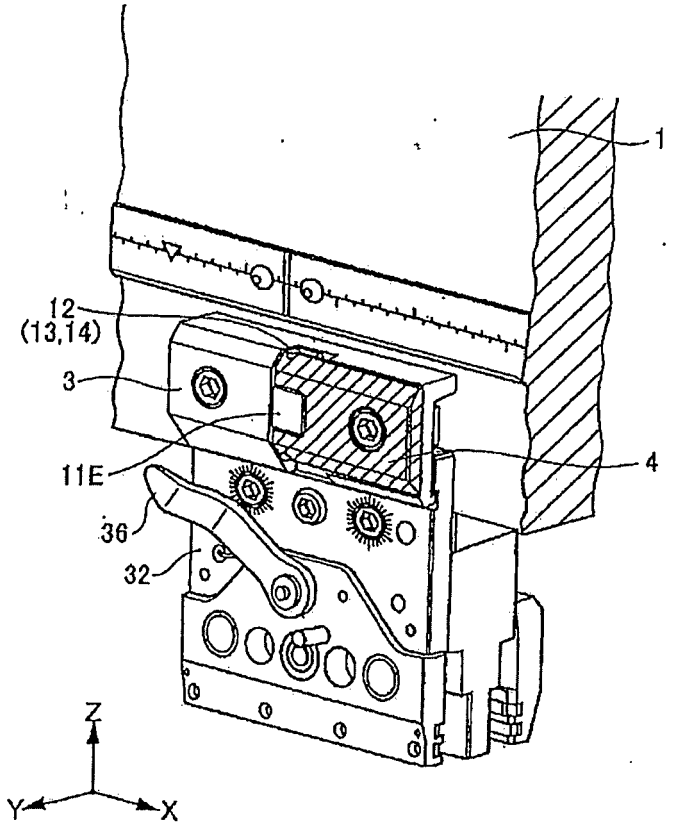
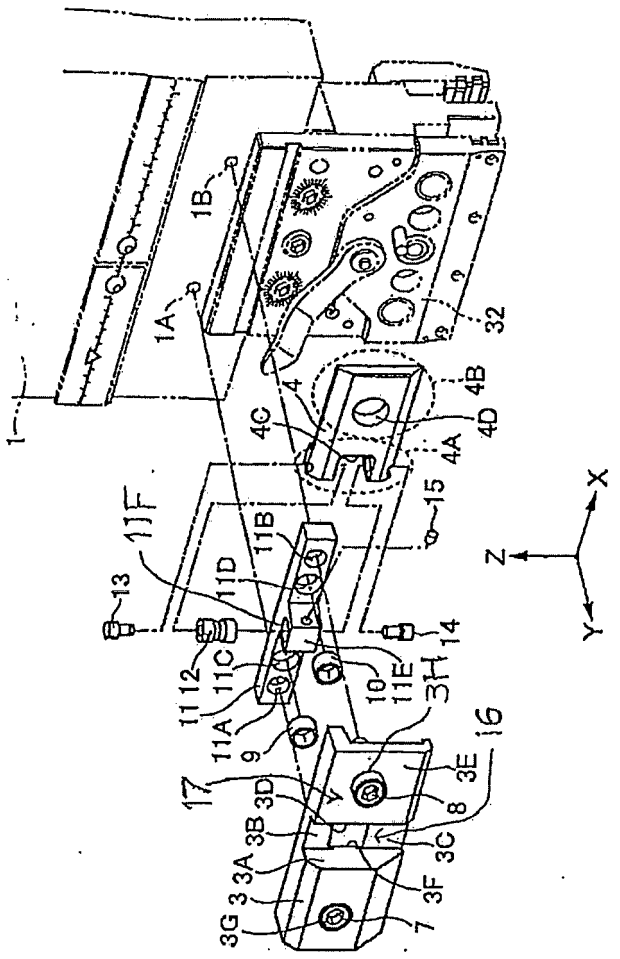


FIG.3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11A
9
10
11E
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Y

FIG.4

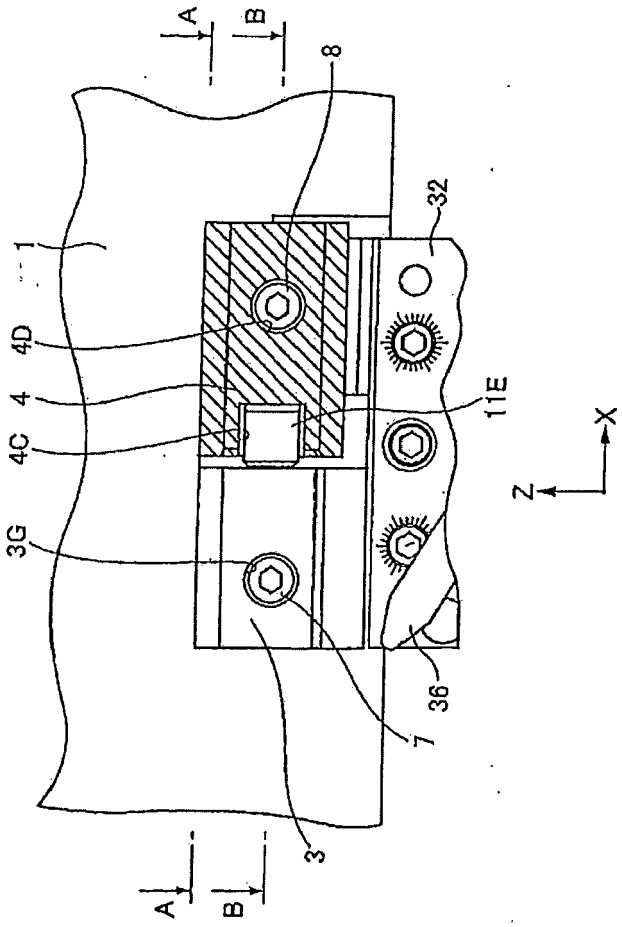
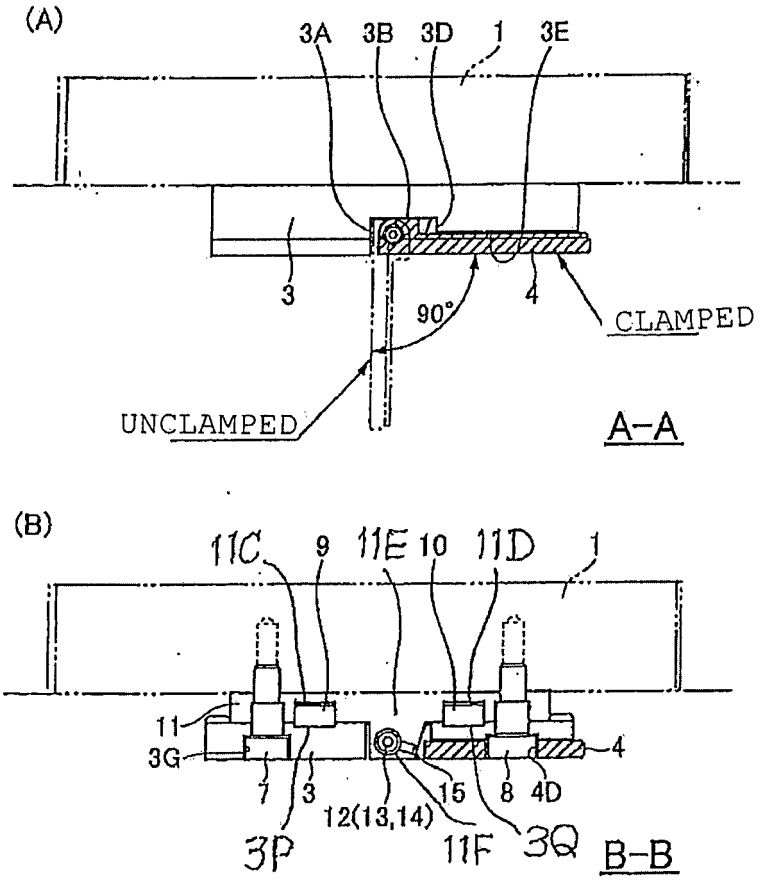


FIG.5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3B
3D
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3E
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CLAMPED
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(B)
11C
9
11E
10
11D
1
11
3G
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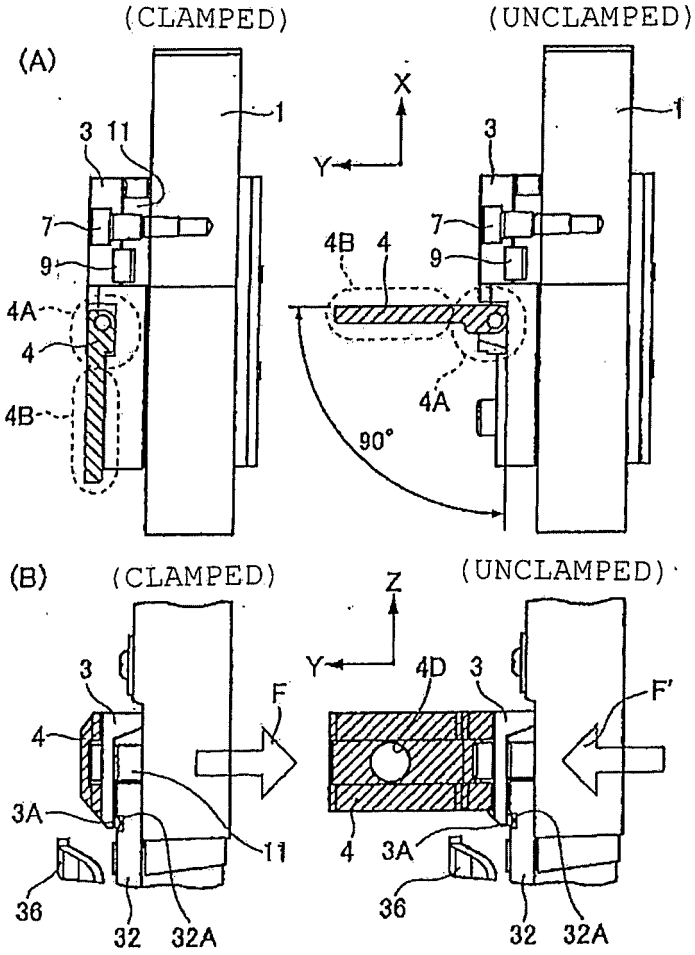
12(13,14)
15
8
4D
4
3P
11F
3Q
B-B

FIG.6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F
F'
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32
32A
4D

FIG.7

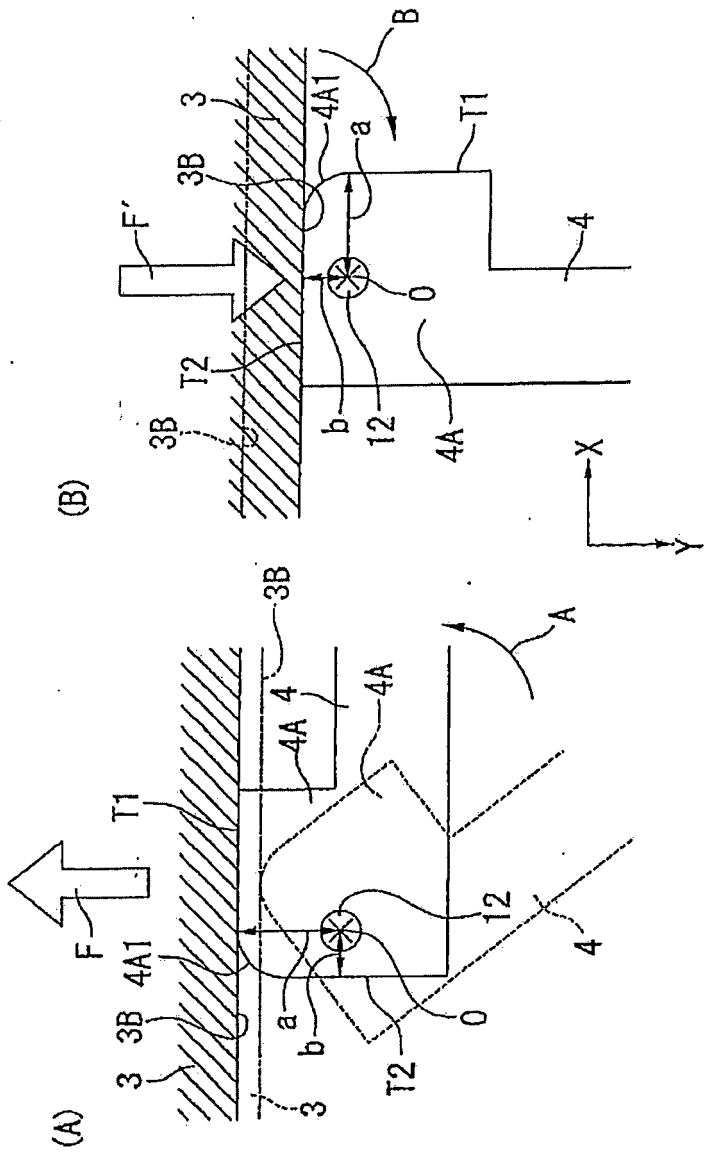


FIG.8

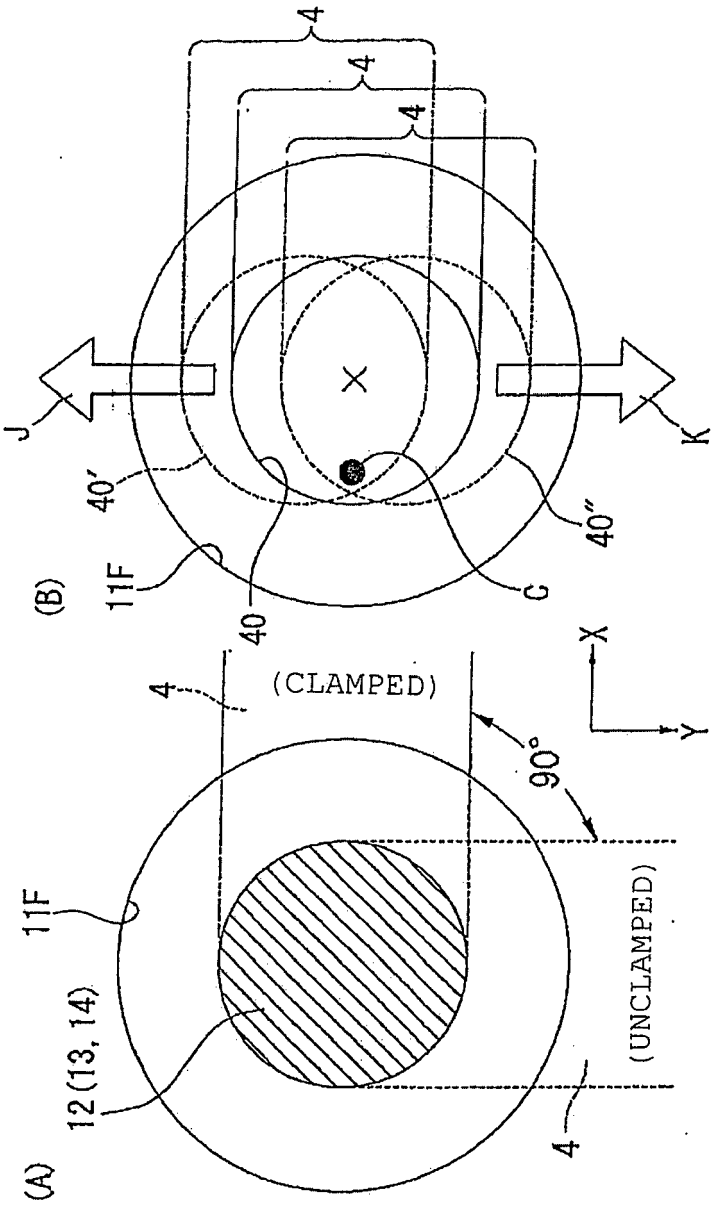


FIG.9

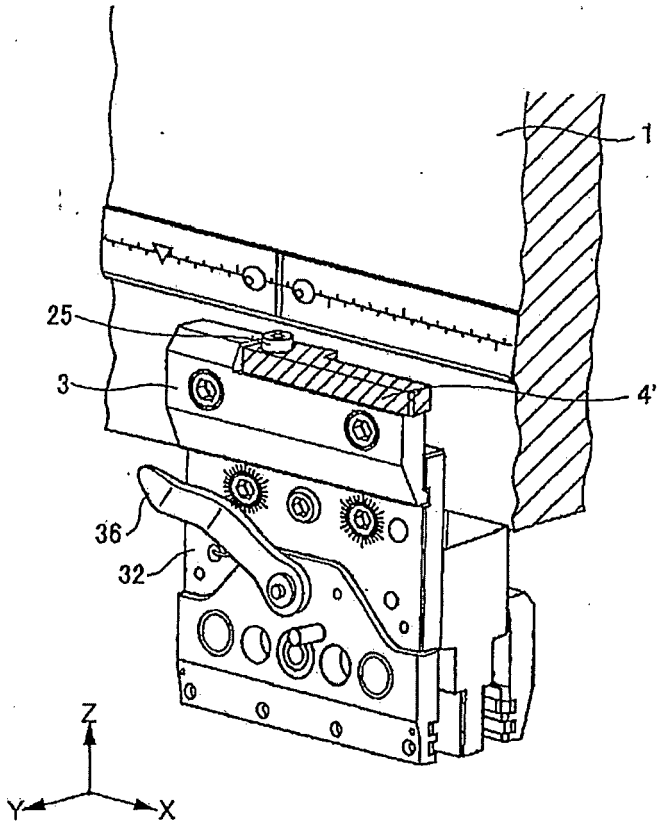


FIG.10

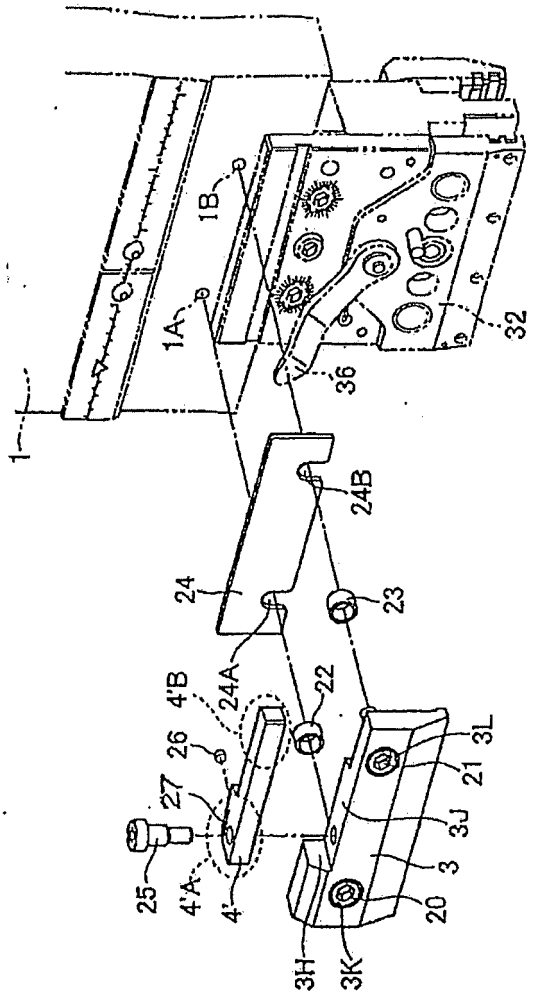


FIG.11

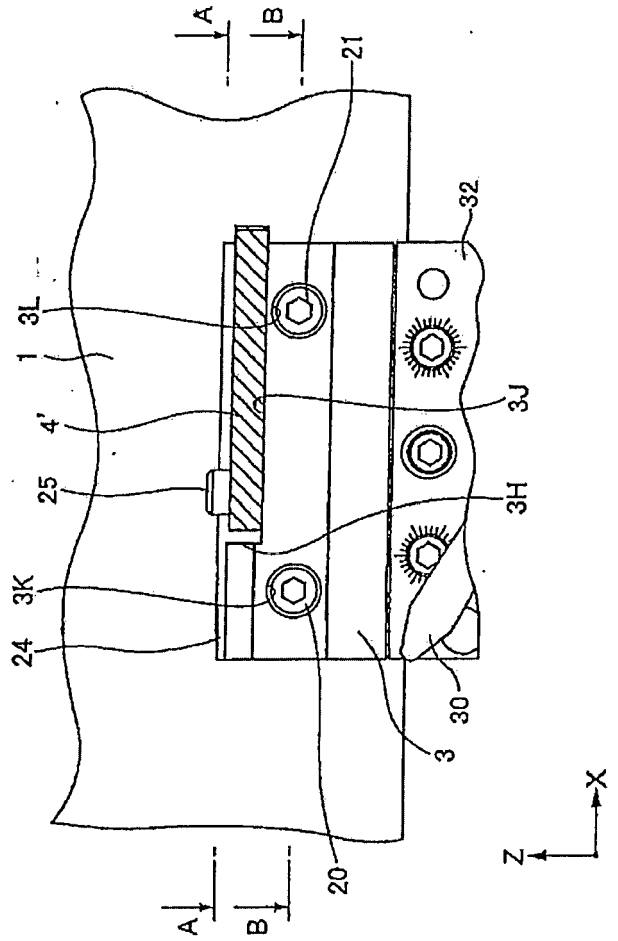
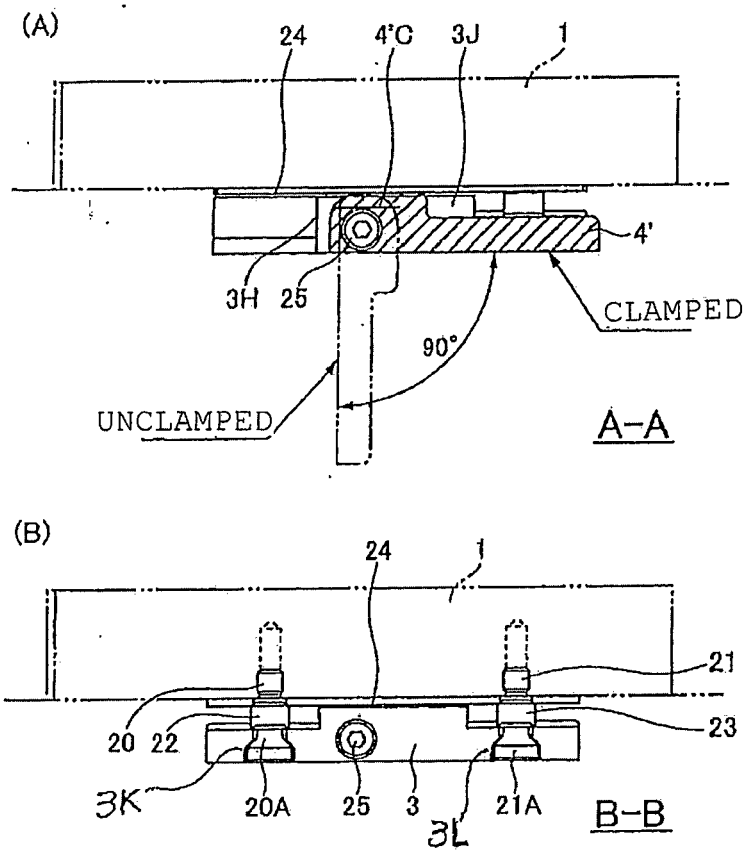


FIG.12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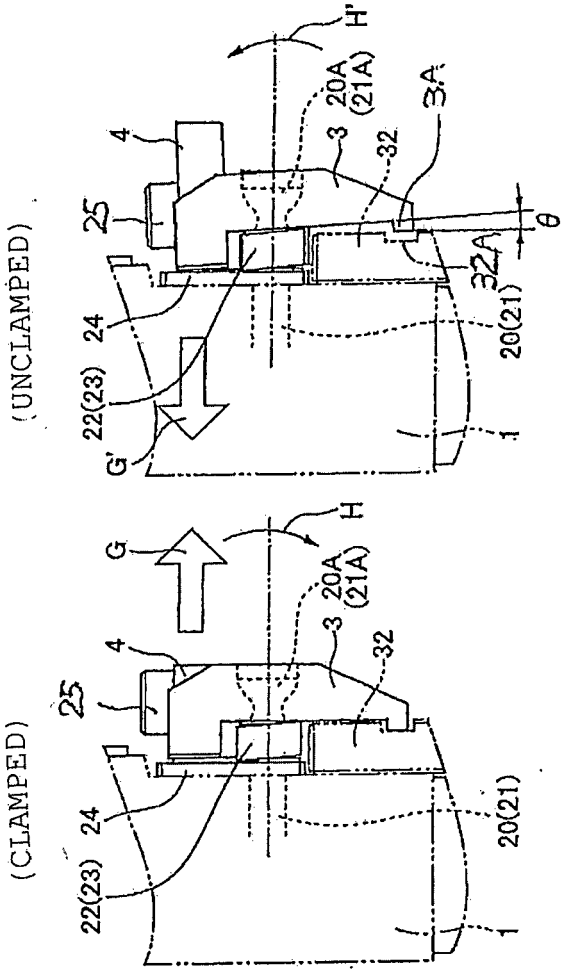
3L
21A
B-B

FIG.13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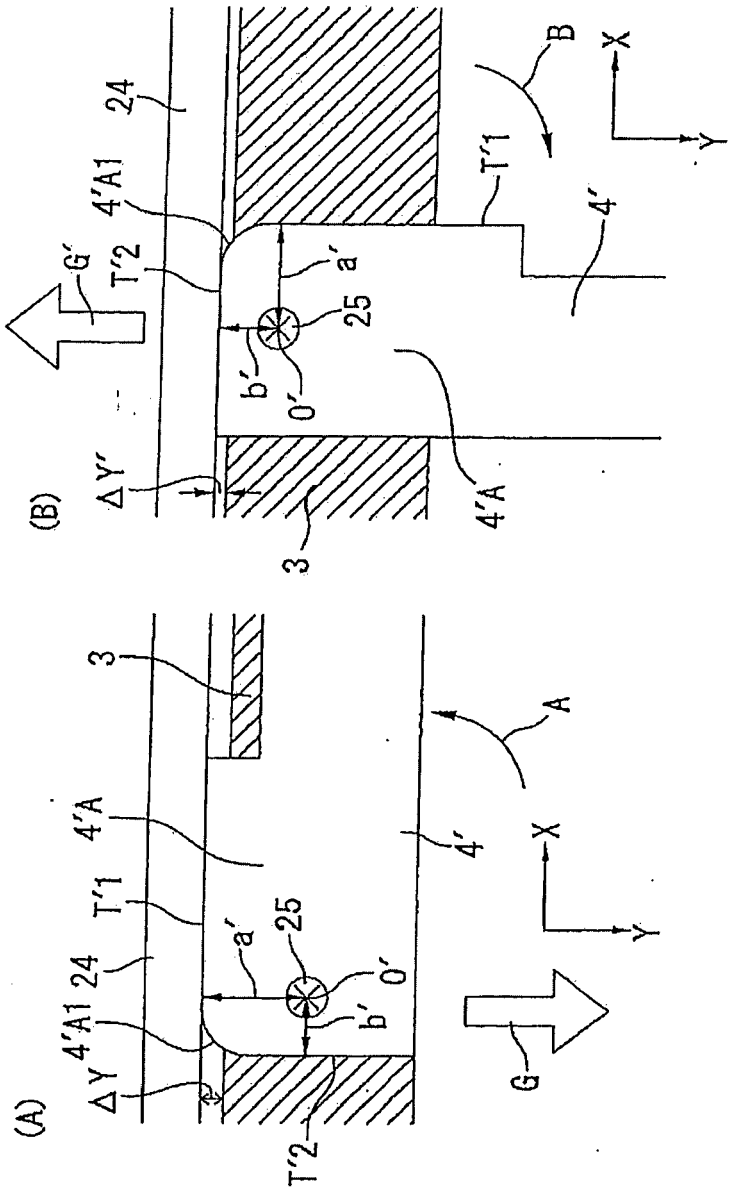
1

FIG.14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(A)
ΔY
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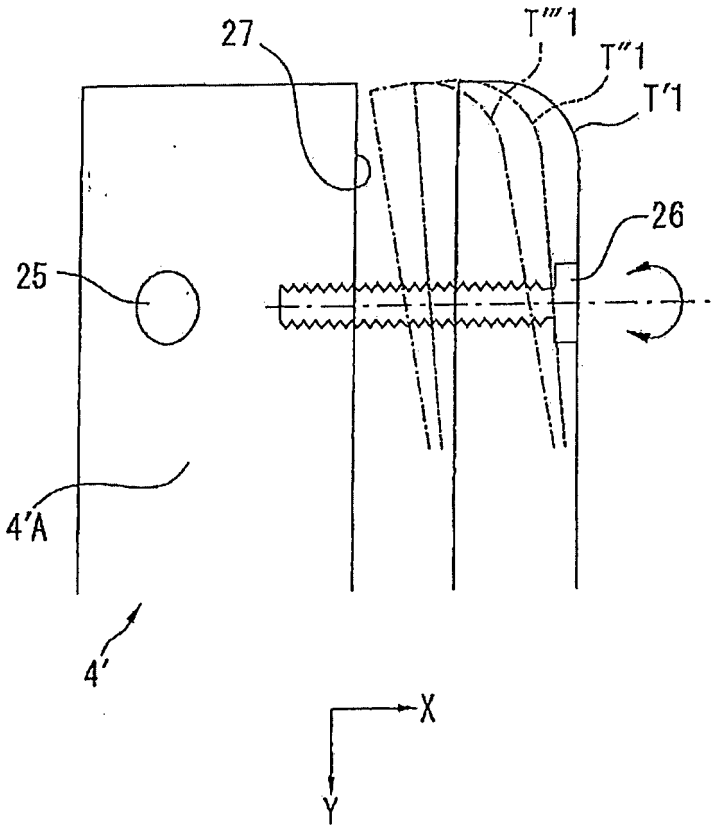
Y
G

FIG.15



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EUROPEAN SEARCH REPORT

Application Number
EP 14 00 4364

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP H07 3821 A (THINK LABS KK) 6 January 1995 (1995-01-06) * abstract; figures *	1	INV. B21D5/02
A	JP 2002 282946 A (AMADA CO LTD) 2 October 2002 (2002-10-02) * abstract; figures *	1	
A	JP H05 111718 A (AMADA CO LTD) 7 May 1993 (1993-05-07) * abstract; figures *	1	
A	EP 0 934 782 A2 (TECNOSTAMP SRL [IT]) 11 August 1999 (1999-08-11) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (IPC) B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 May 2015	Pieracci, Andrea

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07-05-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H073821 A	06-01-1995	JP H073821 A	06-01-1995
		JP H0742705 B2	10-05-1995
JP 2002282946 A	02-10-2002	NONE	
JP H05111718 A	07-05-1993	JP 3242681 B2	25-12-2001
		JP H05111718 A	07-05-1993
EP 0934782 A2	11-08-1999	EP 0934782 A2	11-08-1999
		IT MI980155 A1	28-07-1999

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Patent documents cited in the description

- JP 7003821 A **[0002] [0004]**