



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
18.11.2020 Bulletin 2020/47

(51) Int Cl.:
B30B 1/26 (2006.01) **B21D 28/34** (2006.01)
B30B 15/06 (2006.01)

(21) Application number: **19738962.0**

(86) International application number:
PCT/JP2019/000450

(22) Date of filing: **10.01.2019**

(87) International publication number:
WO 2019/139064 (18.07.2019 Gazette 2019/29)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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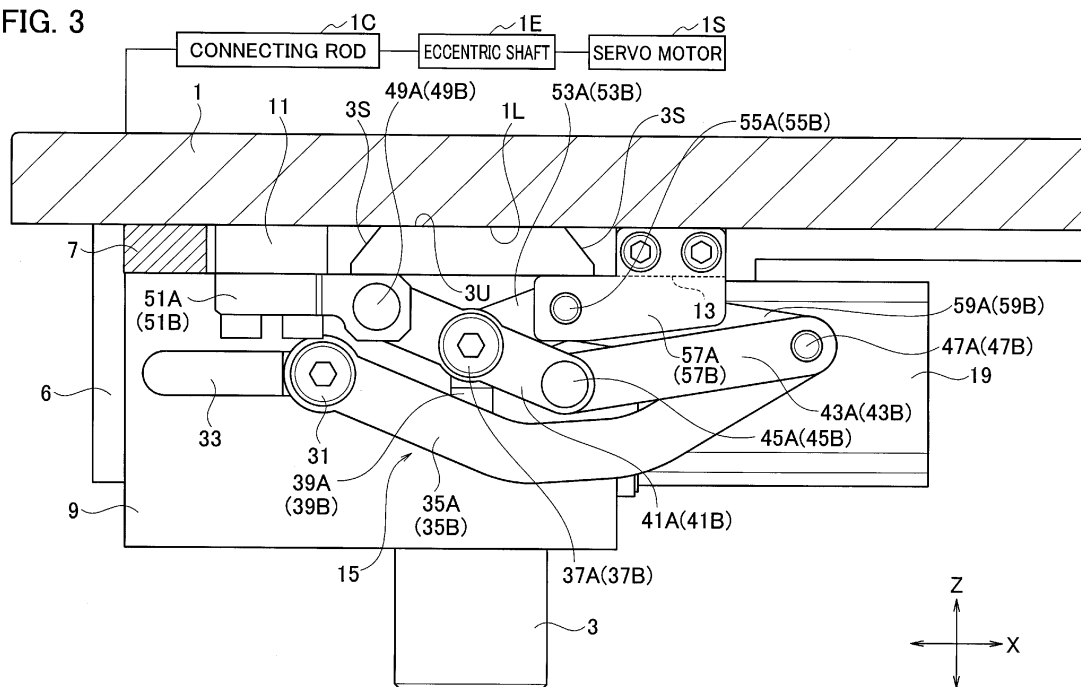
(30) Priority: **11.01.2018 JP 2018002471**

(54) **PRESS MACHINE AND PRESS-WORKING METHOD**

(57) In a press machine, a ram (1) is vertically moved by rotations of an eccentric shaft. The press machine includes a striker housing (9) provided beneath the ram (1) and vertically moved together with the ram (1), a striker (3) vertically movable with respect to the striker housing (9), and a hold mechanism (11, 13, 15, 19, 21, 25)

for holding the striker (3) at a lift-up position and a lift-down position. According to the press machine, press working can be done surely even when reciprocating rotations of the eccentric shaft are done in a vicinity of a rotational angle 90° (or 270°) of the eccentric shaft.

FIG. 3



Description

TECHNICAL FIELD

[0001] The present invention relates to a press machine and to a method for press working.

BACKGROUND ART

[0002] In a press machine, when an eccentric shaft (a crank shaft) rotates, a ram moves downward from a top dead center toward a bottom dead center and then moves upward from the bottom dead center toward the top dead center. In a case of press working (e.g. punching) a sheet-shaped workpiece by an upper tool as a punch and a lower tool as a die, it is general to rotate the eccentric shaft within a rotational angle 90° - 180° (or 180° - 270°) (0° is a top dead center position).

Prior Art Document

Patent Document

[0003]

Patent Document 1: Japanese Granted Patent Publication No. 3802513

Patent Document 2: Japanese Patent Application Publication No. 2007-185667

SUMMARY OF INVENTION

[0004] In a press machine(s) disclosed in the Patent Documents 1 and 2, an eccentric shaft is rotated positively and negatively by using a servo motor as a drive source. Along with the positive and negative rotations of the eccentric shaft, a ram is moved in vertical reciprocating motions. During the vertical motions of the ram, the eccentric shaft is not rotated continuously in a constant rotational direction, but rotated in reciprocating rotations within a predetermined range of a rotational angle. As the result, speeding-up of the vertical motions of the ram can be achieved. In the Patent Document 1, it is disclosed that a ram is moved vertically by rotating an eccentric shaft positively and negatively with a rotational angle range (reciprocating rotating angle: operational angle range) about 40° - 60° .

[0005] In a case of the vertical motions of the ram by rotating the eccentric shaft positively and negatively with the rotational angle 90° - 180° (or 180° - 270°), a stroke of the ram by rotating the eccentric shaft positively and negatively in a vicinity of the rotational angle 180° is smaller than a stroke of the ram by rotating the eccentric shaft positively and negatively in a vicinity of the rotational angle 90° (270°). Namely, when upward and downward strokes of the ram are constant, the rotational angle range of the ram can be made smaller in the vicinity of the rotational angle 90° (270°), and thereby high-speed work-

ing can be realized. However, a stroke position of the ram in the vicinity of the rotational angle 90° (270°) is higher than that in the vicinity of the rotational angle 180° , so that punching may become impossible.

[0006] An object of the present invention is to provide a press machine and a method for press working by which press working can be done even when reciprocating rotations of an eccentric shaft are done in a vicinity of a rotational angle 90° (or 270°) of the eccentric shaft.

[0007] Namely, an aspect of the present invention provides a press machine in which a ram is moved vertically by rotations of an eccentric shaft, the machine comprising: a vertically movable striker provided in a striker housing provided beneath the ram, wherein the striker is capable of being fixed at a lift-up position and a lift-down position.

BRIEF DESCRIPTION OF DRAWINGS

[0008]

[Fig. 1] Fig. 1 is an explanatory diagram showing a relation between a rotational angle of an eccentric shaft and a vertical stroke of a ram in a press machine.

[Fig. 2] Fig. 2 is a perspective view of a striker assembly to be installed in the ram of the press machine according to an embodiment (a striker is almost at its lift-up position).

[Fig. 3] It is a side view of the striker assembly (the striker is at its lift-up position).

[Fig. 4] It is a cross-sectional side view of the striker assembly (the striker is at its lift-up position).

[Fig. 5] It is a cross-sectional plan view of the striker assembly (the striker is almost at its lift-up position).

[Fig. 6] It is a side view of the striker assembly (the striker is at its lift-down position).

[Fig. 7] It is a cross-sectional side view of the striker assembly (the striker is at its lift-down position).

DESCRIPTION OF EMBODIMENTS

[0009] With respect to a press machine, known is a configuration for rotating an eccentric shaft (crank shaft) by using a servo motor as a drive source (e.g. see the Patent Documents 1 and 2). In the press machine with the servo motor as the drive source, it is possible to control the rotations of the eccentric shaft. Therefore, reciprocating rotations of the eccentric shaft can be done with a desired range of a rotational angle. A top dead center position of the eccentric shaft is denoted as a rotational angle 0° , and a bottom dead center position thereof is denoted as 180° . The eccentric shaft is rotated positively and negatively in turns (rotated reciprocatingly) with a rotational angle 90° - 180° (or 180° - 270°). Since the eccentric shaft is not rotated by 360° , high-speed press working (e.g. nibbling) can be achieved.

[0010] Relation between a vertically movable ram 1

and a rotational angle of an eccentric shaft (not shown in the drawings) in a press machine (not shown in the drawings) is shown in Fig. 1 schematically. In a vicinity of a rotational angle 180° (180° includable), a stroke S for punching (nibbling) a sheet-shaped workpiece W by striking a striker 3 of the ram 1 against a punch 5 as an upper tool requires a rotational angle range θ_1 . On the other hand, an equivalent stroke S in a vicinity of a rotational angle 90° (90° includable) requires a rotational angle range θ_2 . Here, $\theta_1 > \theta_2$. Therefore, it is desired to rotate the eccentric shaft reciprocatingly in the vicinity of the rotational angle 90° (or 270°) in order to get improvement of working efficiency with high-speed reciprocating vertical motions of the ram 1 achieved by the reciprocating rotations (positive and negative rotations) of the eccentric shaft.

[0011] However, as shown in Fig. 1, the ram 1 moves vertically at a high position in the vicinity of the rotational angle 90° . Therefore, a length of the striker 3 of the ram 1 is short by a length L in order to strike the punch 5. In addition, a striking force of the striker 3 is weak in the vicinity of the rotational angle 90° (or 270°), and thereby a thickness of a workpiece W capable of being punched is small. Thus, in a case where the eccentric shaft is rotated in a desired rotational angle range within the rotational angle $90^\circ - 180^\circ$ (or $180^\circ - 270^\circ$), the striker 3 is desired to cope with both cases of the vicinity of the rotational angle 90° (or 270°) and the vicinity of the rotational angle 180° . A press machine according to the present embodiment is configured to be capable of coping with the above-mentioned both cases.

[0012] A striker assy (configurations in and around the striker 3) in the press machine according to the present embodiment will be explained with reference to Figs. 2 to 6. Note that, in the press machine according to the present embodiment, configurations other than the striker assy are equivalent to whole configurations of a known press machine, and thereby their detailed explanations are omitted. The configurations other than the striker assy are disclosed in the above-mentioned Patent Documents 1 and 2. Namely, the striker assy shown in Figs. 2 to 6 is attached to a bottom face 1L of the vertically movable ram 1 that is held by a ram guide, and the ram 1 is moved vertically by an eccentric shaft 1E via a connecting rod 1C. The eccentric shaft 1E is rotated reciprocatingly by a servo motor 1S.

[0013] Fig. 2 to Fig. 5 show the striker assy in a state where the striker 3 is lifted up with respect to a striker housing 9. In Fig. 3 and Fig. 4, shown is a state where an upper face 3U of the striker 3 contacts with the bottom face 1L of the ram 1 (lift-up position). Fig. 2 and Fig. 5 show a state where the striker 3 positions almost at the lift-up position. Fig. 6 and Fig. 7 show a state where the striker 3 is lifted down (lift-down position). In addition, as a matter of convenience for explanations, an X-axis, a Y-axis and a Z-axis are defines as shown in the drawings. Further, Fig. 5 shows a cross-sectional plane, with respect to an after-explained sync-motion mechanism (link

mechanism) 15, including a sync-motion member (sync-motion shaft) 31, a (center) hinge pin 37A (37B) and a (second) hinge pin 47A (47B), and shows a cross-sectional plane, with respect to an after-explained operational rod (a piston rod 21 and a slide rod 25), including their center axes.

[0014] As shown in Figs. 3 and 4, a pair of brackets 6 facing to each other in a Y-axis direction is provided on the bottom face of the ram 1 that is moved vertically due to the rotations of the eccentric shaft (only one of the brackets 6 is shown in Figs. 2 and 3). Then, the paired brackets 6 are connected integrally with each other by a connecting member 7 extending in the Y-axis direction. A box-shaped striker housing 9 is attached integrally to the connecting member 7. The striker 3 is provided in the striker housing 9 so as to be movable vertically.

[0015] As shown in Fig. 2 to Fig. 5, while the upper face 3U of the striker 3 contacts with the bottom face 1L of the ram 1, the striker 3 is held (fixed) in a lift-up state with respect to the striker housing 9. On the other hand, when the striker 3 is lifted down with respect to the striker housing 9 as shown in Fig. 6 and Fig. 7, a pair of pressure-receive plates 11 and 13 facing to each other in an X-axis direction enters into a gap between the upper face 3U of the striker 3 and the bottom face 1L of the ram 1, and thereby the striker 3 is held (fixed) in a lift-down state.

[0016] The sync-motion mechanism 15 is provided for synchronizing the vertical motion of the striker 3 with the entrance/removal motion of the pressure-receive plates 11 and 13 with respect to the gap between the upper face 3U and the bottom face 1L. Specifically, the striker 3 is held in a vertical pass-through hole 17 (see Fig. 4) formed in the striker housing 9 so as to be capable of moving vertically. An actuator 19 for operating the sync-motion mechanism 15 is provided on one side of the striker housing 9 (one side in the X-axis direction). Although the actuator 19 in the present embodiment is a fluid pressure cylinder such as an air cylinder, it may be configured by another type actuator, such as an electromagnetic solenoid, a rotary motor and a linear motor.

[0017] The actuator 19 includes a piston rod 21 movable reciprocatingly in the X-axis direction. One end of a slide rod 25 is jointed integrally with a distal end of the piston rod 21 by a joint member 23 such as a joint screw. An operational rod is configured of the piston rod 21 and the slide rod 25. The slide rod 25 (operational rod) passes through an elongated hole 27 formed in the striker 3 so as to be long in a vertical direction. The elongated hole 27 passes through the striker 3 in the X-axis direction. Therefore, the slide rod 25 is slidable in the X-axis direction with respect to the striker 3, and the striker 3 is slidable in a Z-axis direction with respect to the slide rod 25. The other end of the slide rod 25 is slidably supported by a penetrating hole (first guide hole) 29 formed in the X-axis direction in the striker housing 9 (see Fig. 4). Thus, the striker 3 is vertically movable with respect to the striker housing 9 regardless of the existence of the slide rod 25.

[0018] A sync-motion member 31 that penetrates the striker housing 9 in the Y-axis direction is attached integrally to a distal end of the slide rod 25. A through hole 33 orthogonally crossing the penetrating hole 29 is formed in the striker housing 9 so as to be long in the X-axis direction. The through hole 33 passes through the striker housing 9 in the Y-axis direction. The sync-motion member 31 is movable in the X-direction within the through hole 33. Both ends of the sync-motion member 31 extending in the Y-axis direction pivotally coupled with one ends of the sync-motion links 35A and 35B, respectively. A link mechanism including the sync-motion link 35A of the sync-motion mechanism 15 is provided symmetrically (with respect to an XY plane including a center axis of the slide rod 25) on the opposite side of the striker housing 9 in the Y-axis direction, and the opposite-side link mechanism includes the sync-motion link 35B. Component elements of the paired link mechanisms of the sync-motion mechanism 15 are differentiated from each other by being labeled with suffixes A and B, and only one of the link mechanisms (with the suffix A) will be explained hereinafter. But, the other of the link mechanisms (with the suffix B) also configured symmetrically and operates symmetrically.

[0019] As shown in Fig. 5, a (center) hinge pin 37A penetrating the striker housing 9 in the Y-axis direction toward the vertical pass-through hole 17 is disposed on one side of the striker 3 in the Y-axis direction. Threads are formed on a distal end of the hinge pin 37A, and screw-fitted with the striker 3 in the vertical pass-through hole 17. The hinge pin 37A passes through a through hole (second guide hole) 39A formed on a side face of the striker housing 9 so as to be long in the vertical direction, and is movable vertically in the through hole 39A. The hinge pin 37A pivotally supports the center of a link (center link) 41A so as to allow a rotational motion thereof.

[0020] One end of a (first) intermediate link 43A is pivotally coupled with one end of the link 41A via a (first) hinge pin 45A. The other end of the intermediate link 43A is pivotally coupled with the other end of the sync-motion link 35A via a (second) hinge pin 47A. The other end of the link 41A is pivotally coupled with a (first) connecting bracket 51A via a (third) hinge pin 49A. The connecting bracket 51A is attached integrally to a bottom face of an end of the (first) pressure-receive plate 11.

[0021] A (scissors) link 53A is disposed on an inner side of the link 41A in the Y-axis direction. A base end of the link 53A is pivotally supported by the hinge pin 37A. A distal end of the link 53A is pivotally coupled with a (second) connecting bracket 57A via a (fourth) hinge pin 55A. The connecting bracket 57A is attached integrally to the (second) pressure-receive plate 13. An axis distance between the hinge pin 37A and the hinge pin 45A, an axis distance between the hinge pin 37A and the hinge pin 49A, and an axis distance between the hinge pin 37A and the hinge pin 55A are equal to each other (see Fig. 3).

[0022] A (second) intermediate link 59A whose both

ends are pivotally coupled respectively with the hinge pins 47A and 55A is provided between the hinge pin 47A and the hinge pin 55A. An axis distance between the hinge pin 45A and the hinge pin 47A are equal to an axis distance between the hinge pin 47A and the hinge pin 55A (see Fig. 3).

[0023] While the striker 3 positions at the lift-up position and the upper face 3U of the striker 3 contacts with the bottom face 1L of the ram 1 as shown in Fig. 3 and Fig. 4, the paired pressure-receive plates 11 and 13 are distanced from each other in the X-axis direction and the striker 3 are protruded upward therebetween. In this state, the piston rod 21 of the actuator 19 is moved in a rightward direction in Fig. 4. Namely, the striker 3 is lifted up via the hinge pins 37A and 37B of the sync-motion mechanism 15, and thereby held at the lift-up position.

[0024] When the piston rod 21 of the actuator 19 is protruded by being moved leftward as shown Fig. 7 from the lift-up state of the striker 3 shown in Fig. 3 and Fig. 4, the sync-motion member 31 is also moved leftward in an integrated manner. When the sync-motion member 31 is moved leftward, the sync-motion link 35A is moved leftward from the position shown in Fig. 3 to the position shown in Fig. 6. Along with this, the link 41A is rotated clockwise about the hinge pin 37A via the intermediate link 43A. As the result, the pressure-receive plate 11 is move rightward. Here, displacement of the pressure-receive plate 11 in the vertical direction is restricted by the upper face of the striker housing 9 and the bottom face 1L of the ram 1.

[0025] In addition, the hinge pin 37A moves downward by being guided by the through hole 39A extending in the vertical direction concurrently while the pressure-receive plate 11 is moved rightward. Since the hinge pin 37A is fixed with the striker 3, the striker 3 also moves downward (Fig 4 to Fig. 7). When the hinge pin 37A moves downward, the pressure-receive plate 13 is moved leftward via the link 53A and the intermediate link 59A.

[0026] Namely, the paired pressure-receive plates 11 and 13 move so that they are made closer to each other from both sides in the X-axis direction to be positioned above the striker 3 that is moved downward by the sync-motion mechanism 15, and thereby contact with the upper face 3U of the striker 3. That is, the paired pressure-receive plates 11 and 13 can enter a gap between the bottom face 1L of the ram 1 and the upper face 3U of the striker 3 from the opposite sides, respectively. Note that, a pair of sloped surfaces 3S is formed at an upper portion of the striker 3 in order to assist the movements of the pressure-receive plates 11 and 13 and the lift-down of the striker 3 even if the paired pressure-receive plates 11 and 13 contact with the striker 3 while they moves. In this manner, the pressure-receive plates 11 and 13 can be set quickly above the striker 3. The paired pressure-receive plates 11 and 13 are positioned between the upper face 3U of the striker 3 and the bottom face 1L of the ram 1 to keep the striker 3 in the lift-down state.

[0027] When the piston rod 21 is retracted to be moved rightward as shown Fig. 4 from the lift-down state of the striker 3 shown in Fig. 6 and Fig. 7, the hinge pin 37A moves upward by being guided by the through hole 39A extending in the vertical direction. Since the hinge pin 37A is fixed with the striker 3, the striker 3 also moves upward (Fig. 7 to Fig. 4). Concurrently, the paired pressure-receive plates 11 and 13 are also moved by the sync-motion mechanism 15 so as to be made distanced from each other. Namely, the paired pressure-receive plates 11 and 13 can be removed from the gap between the bottom face 1L of the ram 1 and the upper face 3U of the striker 3 toward the opposite both sides, respectively. As the result, they are made returned into the initial state shown in Fig. 3 and Fig. 4.

[0028] The link 41A and the link 53A configure a sort of cross-link, and rotate in opposite directions to each other about the hinge pin 37A. Due to their rotation, the paired pressure-receive plates 11 and 13 move in synchronization with each other so as to be made closer to each other or to be made distanced from each other. The sync-motion link 35A and the intermediate links 43A and 59A and so on (including the sync-motion member 31 and the hinge pins) configure a transferring link for transferring strokes (reciprocating motions) of the operational rod (the piston rod 21 and the slide rod 25) to the cross-link (the link 41A and 53A and the hinge pin 37A).

[0029] The striker 3 of the ram 1 can be set at the two positions, the lift-up position and the lift-down position, with respect to the striker housing 9. The height difference between the lift-up position and the lift-down position can be brought by the height of the pressure-receive plates 11 and 13, and this difference corresponds to the length L in Fig. 1. Note that the length L may be determined according to specification of the press machine or the punching force of a workpiece as a work object. Therefore, it is possible to cope with press working in which an eccentric shaft is rotated positively and negatively with a rotational angle $90^\circ - 180^\circ$ (or $180^\circ - 270^\circ$). In addition, it is possible to cope with press working in which an eccentric shaft is rotated positively and negatively with a rotational angle range set in a vicinity of a rotational angle 90° (or 270°) (90° (or 270°) includable).

[0030] Note that a hold mechanism for holding the striker 3 at the lift-up position and the lift-down position is configured by the paired pressure-receive plates 11 and 13, the sync-motion mechanism 15 for synchronizing the pressure-receive plates 11 and 13 with the striker 3, the actuator 19 and the operational rod (the piston rod 21 and the slide rod 25). In addition, although the sync-motion mechanism 15 is configured by the pair of the link mechanisms in the present embodiment, only a single link mechanism may be provided as long as its operation doesn't cause a failure.

[0031] For example, in a case of punching a thin sheet material that requires a small punching force, high-speed press working (punching) can be done by rotating the eccentric shaft positively and negatively with a rotational

angle range set in a vicinity of a rotational angle 90° (270°). On the other hand, in a case of punching a thick sheet material that requires a large punching force, the thick sheet material can be pressed (punched) by rotating the eccentric shaft positively and negatively with a rotational angle range set in a vicinity of a rotational angle 180° (180° includable). Namely, since it is possible to hold the striker 3 at the lift-up position and the lift-down position with respect to the striker housing 9, it becomes possible to cope with both cases of the high-speed working in which the rotational angle range is set in the vicinity of rotational angle 90° (270°) and the large punching-force working in which the rotational angle range is set in the vicinity of rotational angle 180° .

[0032] The present invention may be defines as follows.

1. A press machine whose ram is vertically moved by rotations of an eccentric shaft, the machine comprising:

- a striker housing provided beneath the ram to be moved vertically together with the ram;
- a striker provided in the striker housing and vertically movable with respect to the striker housing;
- a holding mechanism that holds the striker at a lift-up position and a lift-down position with respect to the striker housing.

2. The press machine according to the above 1, wherein

the holding mechanism includes a pair of pressure-receive plates capable of entering into a gap between a bottom face of the ram and an upper face of the striker from opposing both sides and capable of being removed from the gap between the bottom face of the ram and the upper face of the striker to the opposing both sides.

3. The press machine according to claim 2, wherein the holding mechanism includes a sync-motion mechanism for synchronizing the entrance motion and the removal motion of the pair of pressure-receive plates with the vertical motion of the striker.

4. The press machine according to claim 3, wherein the sync-motion mechanism includes

an operational rod that is capable of reciprocating in a vertically elongated hole formed in the striker in a radial direction of the striker,

an actuator for stroking the operational rod,

a cross-link whose one end side is pivotally coupled with the pair of pressure-receive plates for the entrance motion and the removal motion of the pressure-receive plates, and

a transferring link for transferring the stroke of the operational rod to the cross-link.

5. A method for press working by using a press machine according to any one of claims 1 to 4, the meth-

od comprising:

setting a rotational angle range of the eccentric shaft in a vicinity of a rotational angle 90° or 270° when a top dead center of the eccentric shaft is a rotational angle 0°;
 5 vertically reciprocating the ram by reciprocatingly rotating the eccentric shaft within the rotational angle range; and
 10 repeating strikes of the striker of the press machine by the vertical reciprocating motions of the ram.

the reciprocating motions of the operational rod to the cross-link.

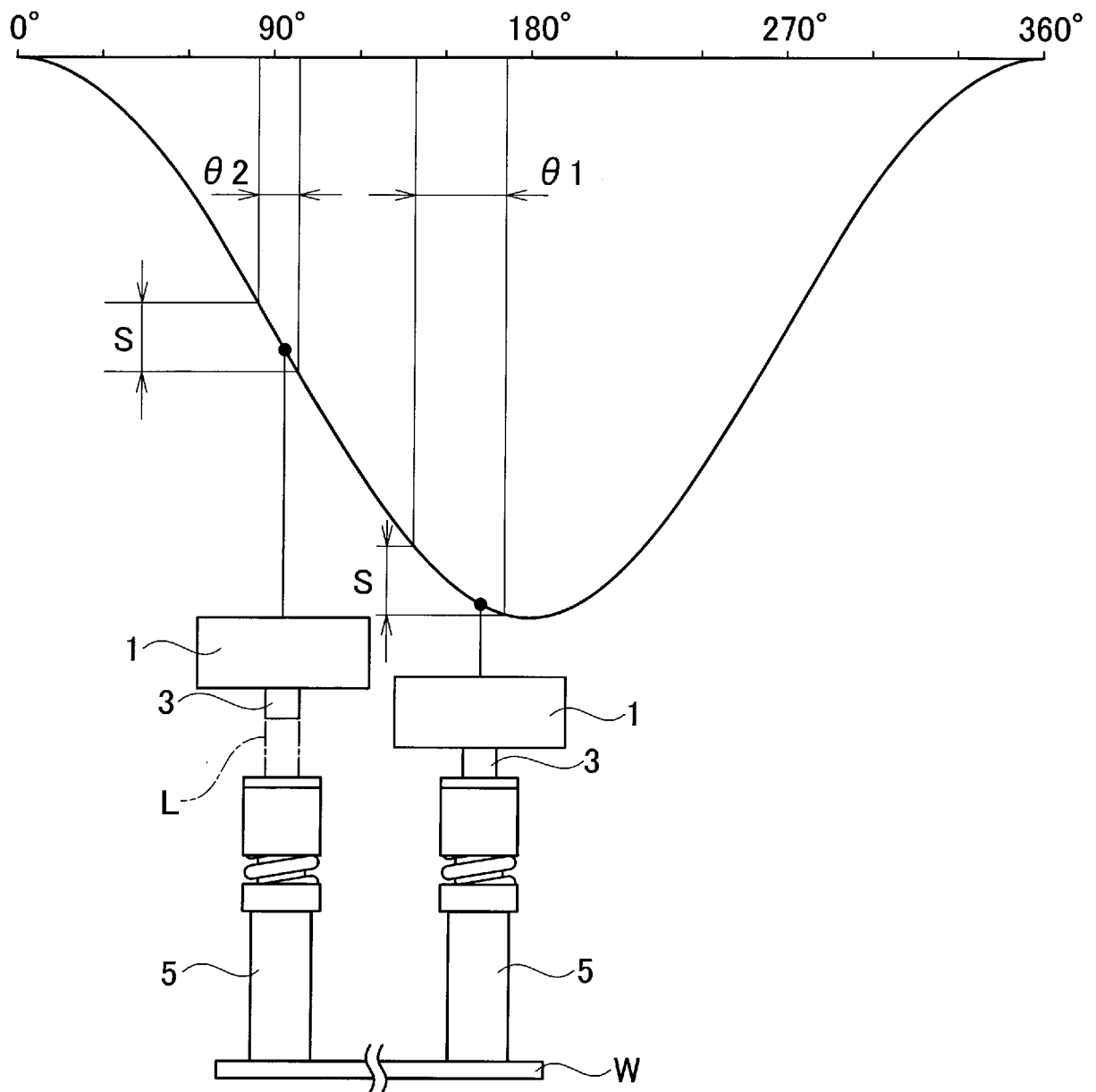
5. A method for press working by a press machine according to any one of claims 1 to 4, the method comprising:
 repeating vertical motions of the ram by repeating a positive rotation and a negative rotation of the eccentric shaft within a preset angle range in a vicinity of a rotational position 90° or 270° of the eccentric shaft; and repeating strikes of a punch provided in the press machine by the vertical motions of the ram.

[0033] The entire contents of a Japanese Patent Application No. 2018-2471 (filed on January 11, 2018) are incorporated herein by reference. Although the invention has been described above by reference to a certain embodiment of the invention, the invention is not limited to the embodiment described above. Scope of the present invention is determined in the context of the claims. 20

Claims

1. A press machine in which a ram is moved vertically by rotations of an eccentric shaft, the machine comprising:
 25
 a vertically movable striker provided in a striker housing provided beneath the ram,
 30 wherein the striker is capable of being fixed at a lift-up position and a lift-down position.
2. The press machine according to claim 1, further comprising
 35 a pair of pressure-receive plates that are capable of entering into a gap between a bottom face of the ram and an upper face of the striker from opposing both sides and capable of being removed from the gap.
 40
3. The press machine according to claim 2, further comprising
 45 a sync-motion mechanism for synchronizing the entrance/removal motion of the pressure-receive plates with the vertical motion of the striker.
4. The press machine according to claim 3, wherein the sync-motion mechanism includes an operational rod that passes through a vertically elongated hole provided in the striker so as to be capable of reciprocating therewithin in a radial direction of the striker, an actuator for reciprocating the operational rod, a cross-link whose one end side is pivotally coupled with the pair of pressure-receive plates for entering the pressure-receive plates into the gap between the
 50 bottom face of the ram and the upper face of the striker from the opposing both sides and removing from the gap, and a transferring link for transferring
 55

FIG. 1



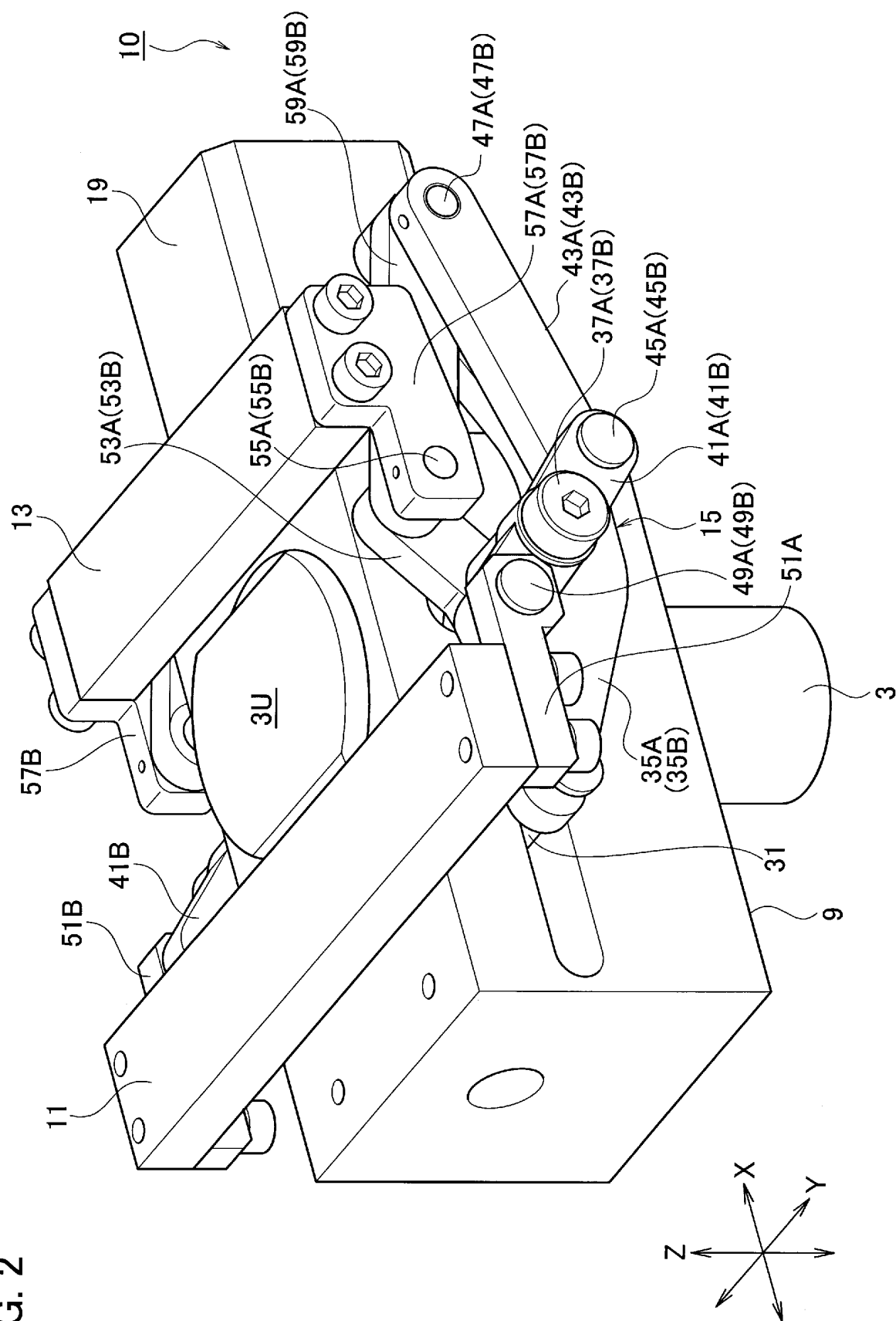


FIG. 3

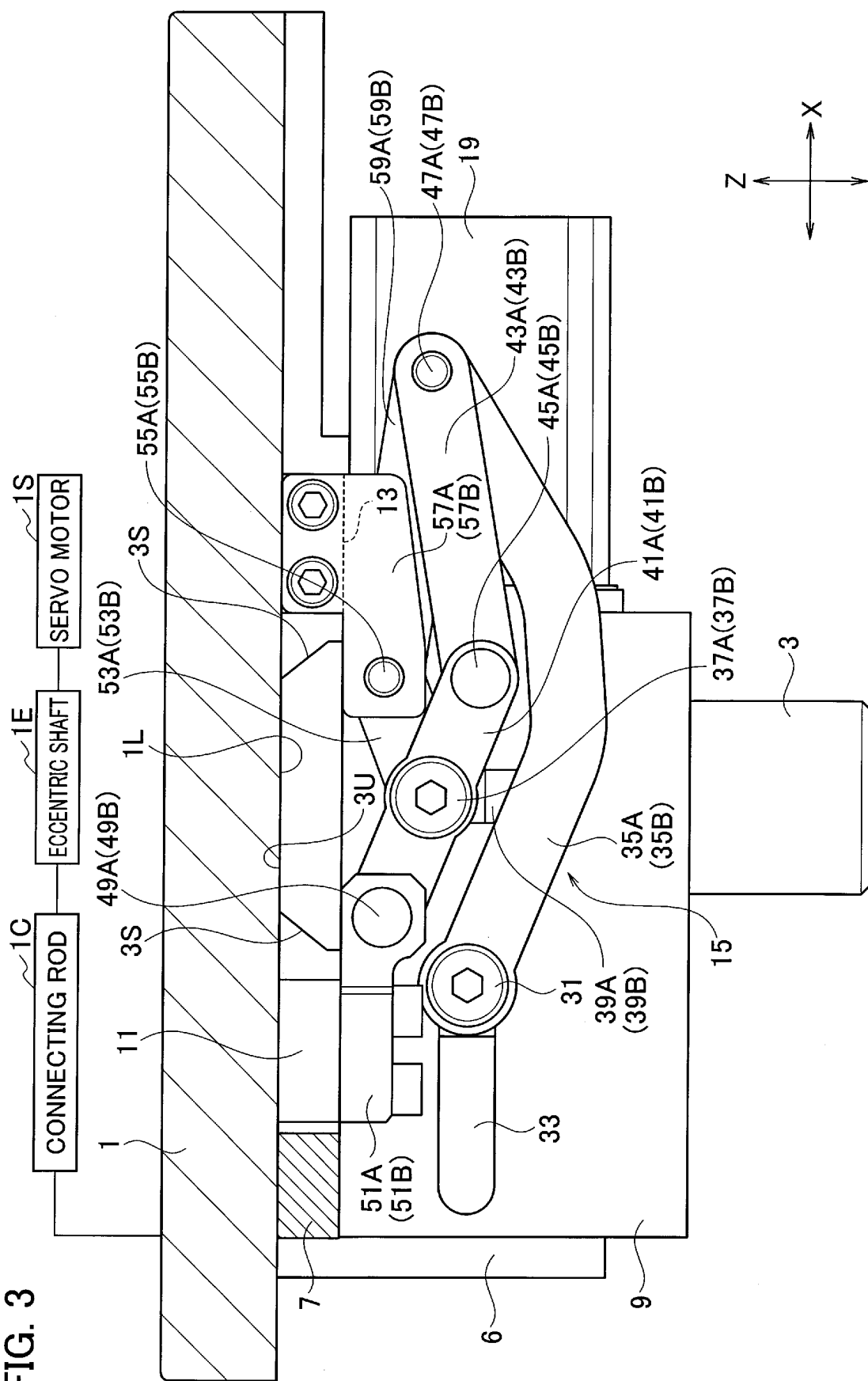


FIG. 4

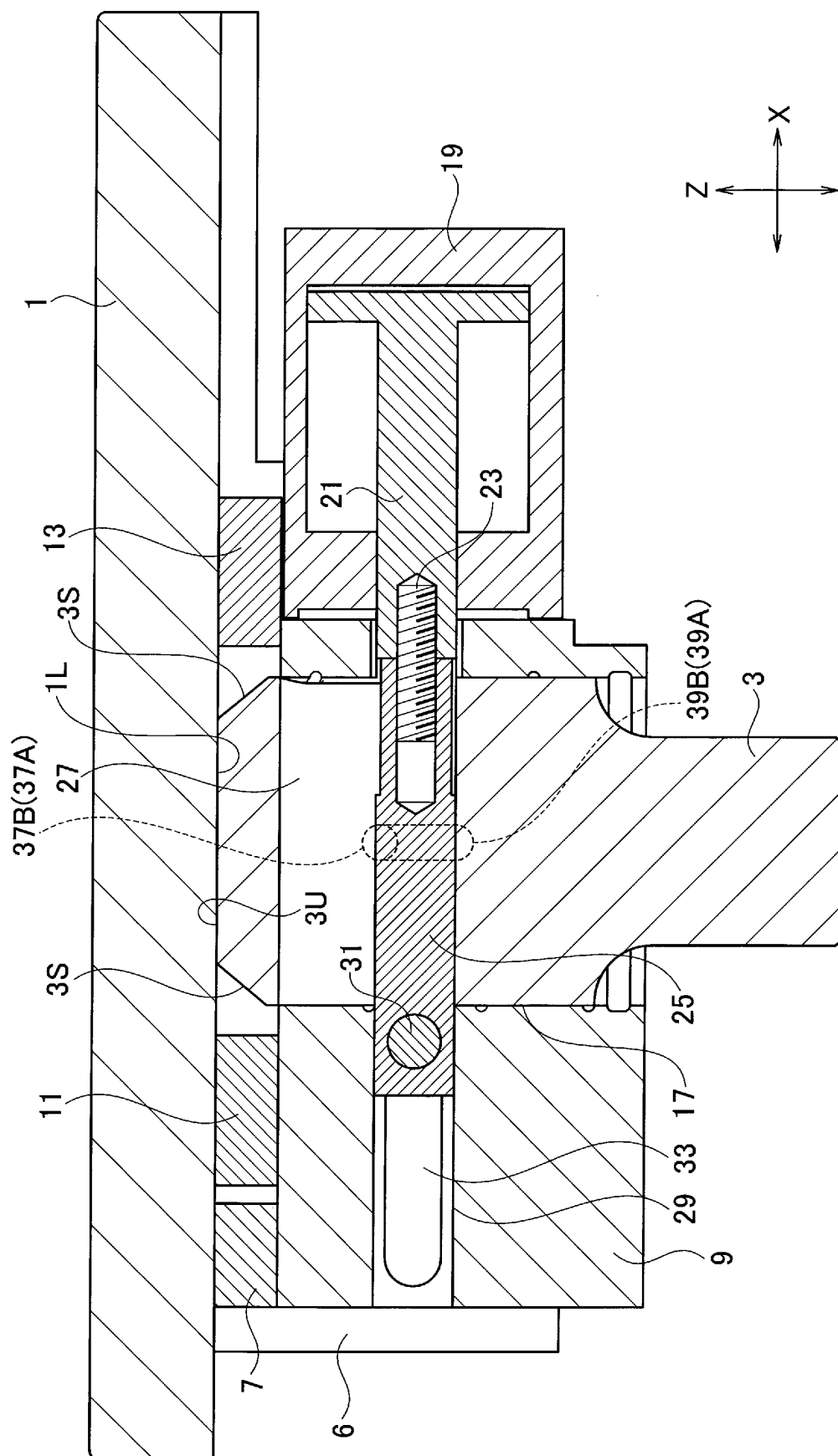
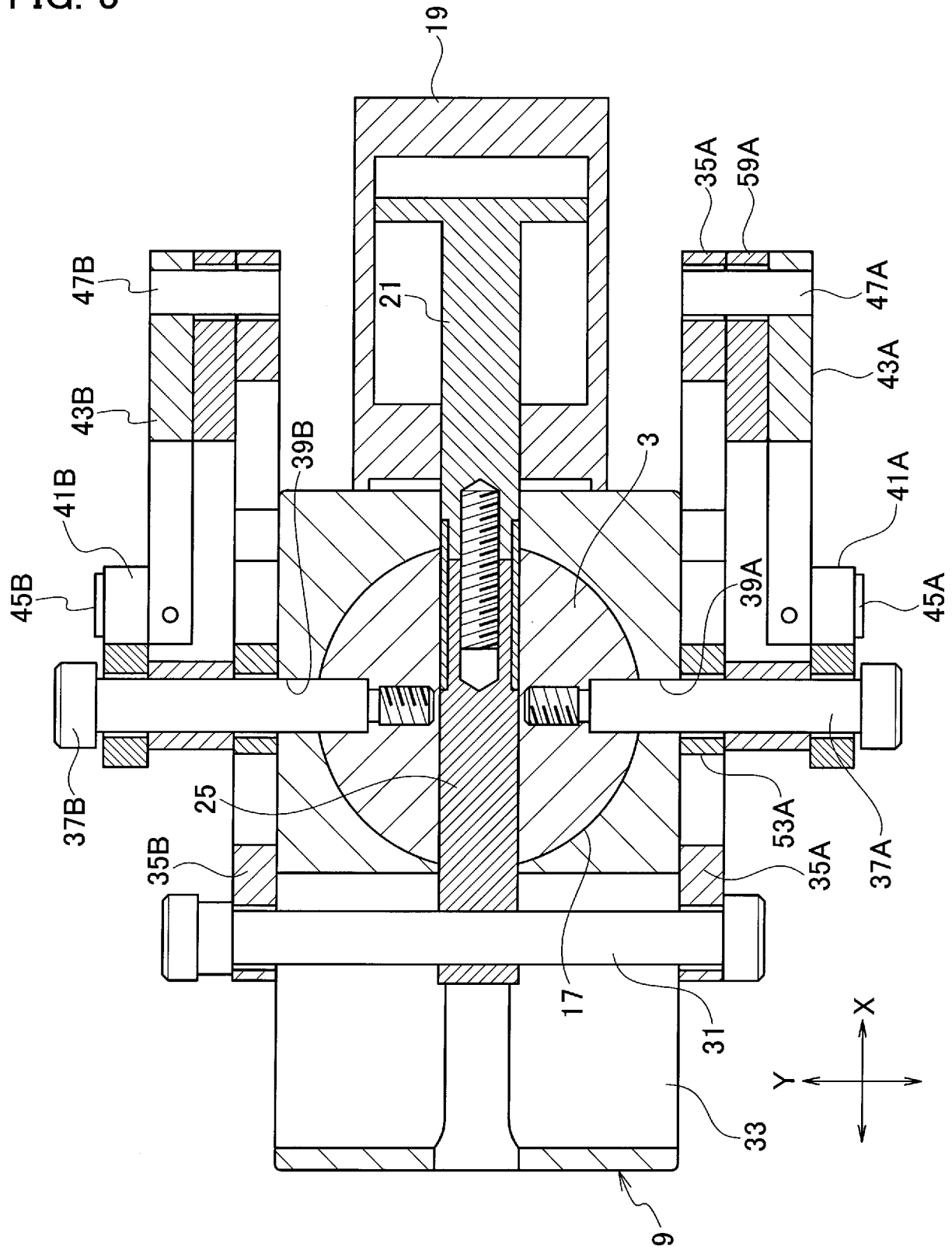


FIG. 5



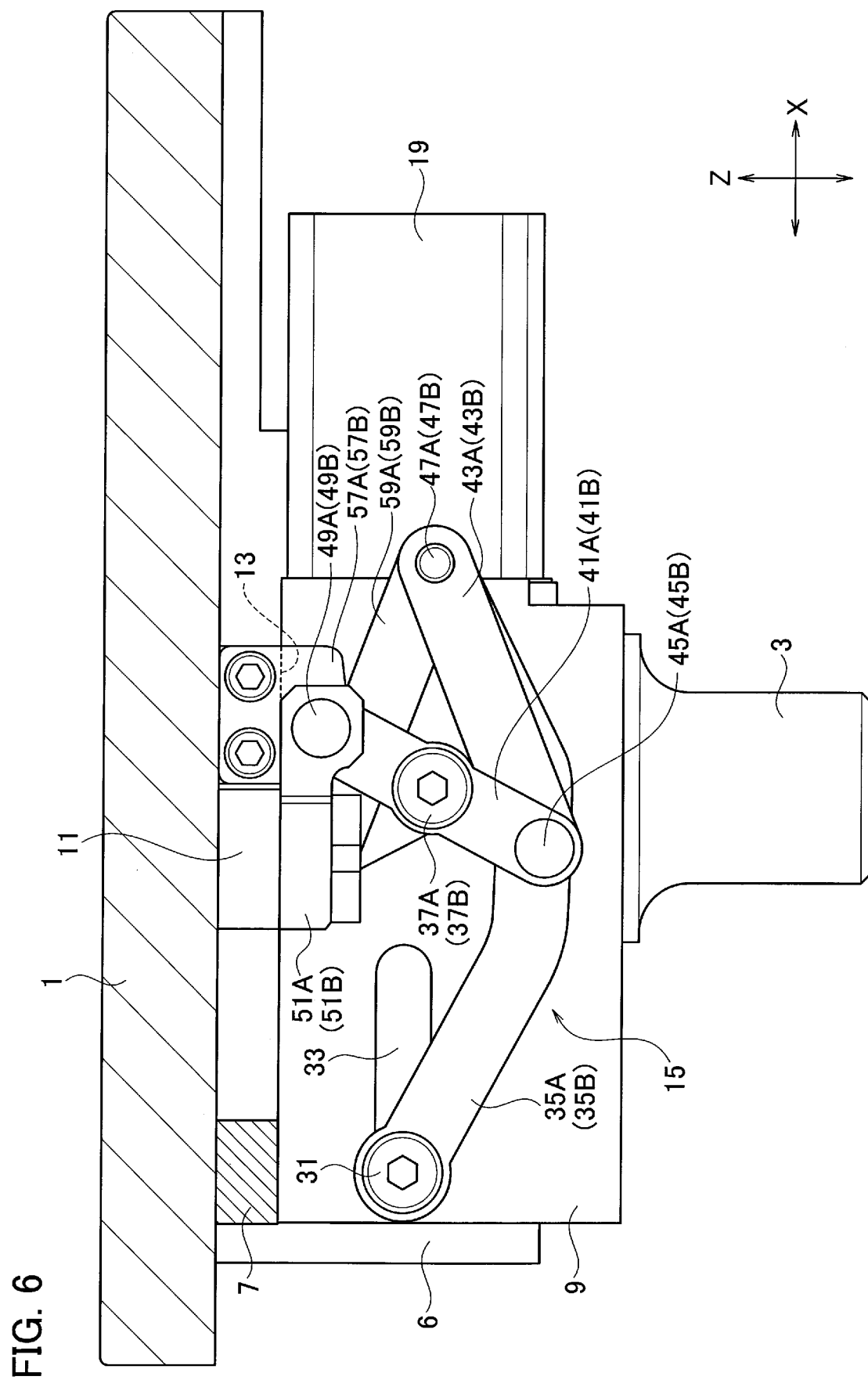
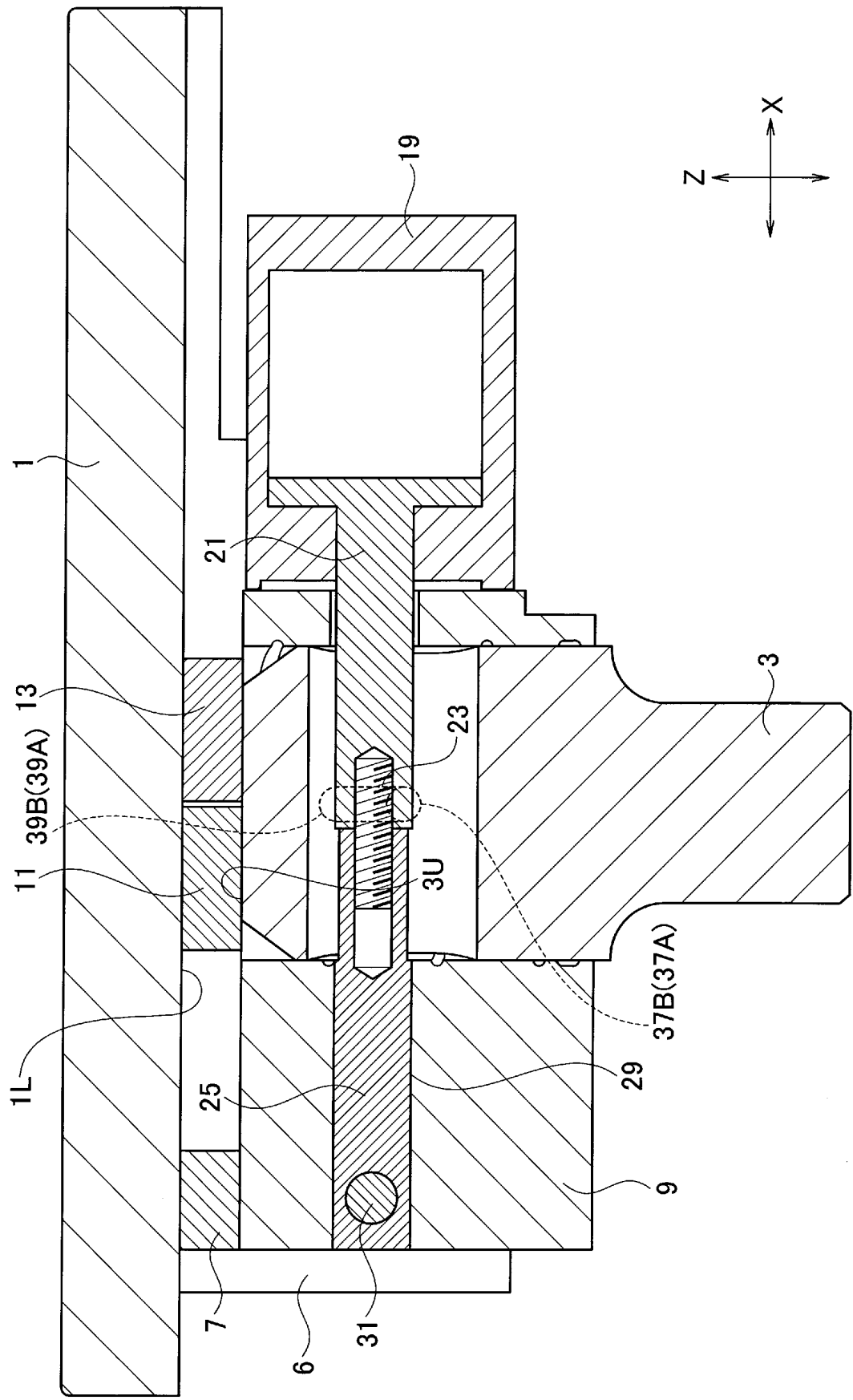


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2019/000450

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. B30B1/26 (2006.01) i, B21D28/34 (2006.01) i, B30B15/06 (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. B30B1/26, B21D28/34, B30B15/06

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	1971-2019
Registered utility model specifications of Japan	1996-2019
Published registered utility model applications of Japan	1994-2019

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-24729 A (AMADA CO., LTD.) 25 January 2000, paragraphs [0009]-[0016], fig. 1-2 (Family: none)	1-5
A	JP 2003-340599 A (TAMAGAWA SEIKI CO., LTD.) 02 December 2003, paragraphs [0006]-[0013], fig. 1-2 (Family: none)	1-5
A	DE 102007012638 A1 (HEIDELBERGER DRUCKMASCHINEN AG) 18 September 2008, paragraph [0027], fig. 2 & EP 1970173 A1 & CN 101264609 A	1-5
A	JP 2004-122172 A (AMADA CO., LTD.) 22 April 2004, paragraph [0023], fig. 2 (Family: none)	1-5



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

20 March 2019 (20.03.2019)

Date of mailing of the international search report

02 April 2019 (02.04.2019)

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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- JP 2007185667 A [0003]
- JP 2018002471 A [0033]