(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 074 316 A1

(12) EUROPEAN PATENT APPLICATION

published in accordance with Art. 158(3) EPC

(43) Date of publication:
07.02.2001 Bulletin 2001/06

(21) Application number: **99901887.2**

(22) Date of filing: **27.01.1999**

(51) Int. Cl.[7]: **B21B 13/18**, B21D 31/06

(86) International application number:
PCT/JP99/00343

(87) International publication number:
WO 00/30777 (02.06.2000 Gazette 2000/22)

(84) Designated Contracting States:
AT DE FR GB IT

(30) Priority: **25.11.1998 JP 33347798**

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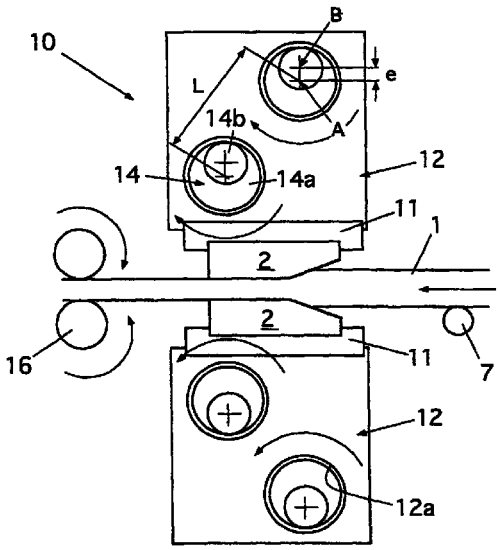
(54) METAL MOLD GAP ADJUSTER OF PLATE PRESSING DEVICE

(57) A plate thickness reduction system is provided with a pair of dies 2 provided opposite each other on the upper and lower sides of a slab 1, a swing device 10 that moves up and down the dies symmetrically of the slab via eccentric shafts or crank shafts, upper and lower bearings 21, 22 that support the rotation of the eccentric shafts or crank shafts, and a bearing moving device that moves up and down at least one of the bearings. The bearing moving device is comprised of screw jacks 27 that are fixed to a main frame 26 and drive up and down the shaft boxes 25, or a wedge plate 28 or a step plate 29 that are inserted between and held by the main frame 26 and the shaft boxes 25, thus the thickness of a slab after being highly reduced can be easily adjusted using the same dies.

FIG. 4



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Description

BACKGROUND OF THE INVENTION

Technical Field of The Invention

[0001] The present invention relates to a dies gap adjustment apparatus for a plate thickness press system, which can greatly reduce the thickness of the plate through one pass.

Prior art

[0002] As a means of one-pass, high-reduction pressing, press systems with conventional stentering press machines modified to a plate-thickness pressing system have been proposed (for example, Japanese patent publication No. 014139, 1990, unexamined Japanese patent publications No. 222651, 1986, No. 175011, 1990, etc.).

[0003] According to the unexamined Japanese patent publication No. 175011, 1990 "Flying Sizing Press Apparatus" as shown in Fig. 1, for instance, rotating axes 4 are provided at the upper and lower or left and right sides of a line Z for transferring the material to be formed, and boss portions of connecting rods 3 with a required shape are engaged with eccentric portions of the rotating axes 4, and, in addition, dies 2 are connected to the tip portions of the connecting rods 3 in opposition to the line Z for transferring the material to be formed, in which the thickness of the material 1 to be formed (slab) is reduced by rotating the axes 4 and pressing the upper and lower surfaces of the material by means of the dies 2 via the connecting rods 3 coupled with the eccentric portions of the rotating axes. At that time, an up or down stroke of the dies 2 is determined by an eccentricity of the rotating axes 4, and as long as the center of rotation of the axes 4 is stationary, the thickness h of the slab 1 after being pressed is constant.

[0004] It is also proposed to use the press as shown typically in Fig. 2, for the same purpose. This apparatus is provided with dies 2 arranged at the upper and lower sides of the slab 1, sliders 8 that correspond to the respective dies and swing the dies up and down and backwards and forwards, and a driving system that drives the sliders, and the aforementioned sliders are composed of main slider units 8a with circular holes with center axes in the lateral direction of the slab, and cranks 9 provided with first axes 9a that engage with these circular holes and second axes 9b, whose diameters are smaller than those of the first axes and whose center axes are eccentric from the centers of the first axes, in which the second axes are driven and rotated by the above-mentioned driving system.

[0005] In this configuration, when the second axes 9b rotate, the first axes 9a carry out a crank motion with the centers of the second axes, and give the main slider units 8a up, down, backward, and forward motions through the circular holes in engagement. In this way, the sliders 8 press the dies and can give the dies a forward motion during a pressing period, therefore, the slab 1 is driven forwards (in the direction of flow of the slab) while being pressed, so the pressing operation is activated continuously. In addition, because the dies 2 press the slab 1 from both upper and lower sides of the slab, a large reduction can be achieved. In Fig. 2, 6 and 7 represent pinch rolls and transfer tables, respectively.

[0006] Fig. 3 shows an example using cranks and connecting rods; cranks 4 are connected to dies 2 equipped on the upper and lower parts of a slab 1 and the dies 2 press the slab when swinging up and down. In this case, too, the up/down stroke of the dies 2 is determined by the eccentricity of the cranks 4, and as far as the rotating center of the cranks 4 is fixed, the thickness h of the slab after being pressed is constant.

[0007] Furthermore, various means to sharply reduce thickness have been proposed for plate thickness reduction press apparatus that can greatly reduce work through one pass, by the inventors of the present invention, etc.

[0008] As described above, however, with a plate thickness reduction press apparatus that can greatly reduce work through one pass, cams or cranks are used to drive upper and lower dies upwards and downwards, therefore, the pressing stroke of the upper and lower dies remains constant at all times. Accordingly, one of the problems with such an apparatus was that the thickness of a plate after being pressed is constant as long as the same dies are used, so the thickness of the plate after a sharp reduction is difficult to adjust.

BRIEF DESCRIPTION OF THE INVENTION

[0009] The present invention has been achieved to solve the problem described above, and the object of the invention is to provide a dies gap adjustment apparatus for a plate thickness reduction press system, with which using the same dies, the thickness of a plate after being highly pressed can be easily adjusted.

[0010] The dies gap adjustment apparatus provided according to the present invention for a plate thickness reduction press system is provided with a pair of dies (2) equipped opposite each other on upper and lower sides of a slab (1) and a swing device (10) that moves the upper and lower dies symmetrically up and down with respect to the slab, via eccentric shafts or crank shafts, in which are provided upper and lower bearings (21, 22) that support the aforementioned eccentric shafts or crank shafts during rotation and a bearing moving device (24) that drives up and down at least one of the above-mentioned bearings.

[0011] Using this configuration, it is possible to change the spacing between rotation centers of the upper and lower eccentric shafts or crank shafts by moving up and down at least one of the upper and lower bearings (21, 22) that support the eccentric shafts or

crank shafts during rotation, using the bearing moving device (24). Consequently, even when pressing strokes of the upper and lower dies are constant and the same dies are used, the thickness of a plate after being pressed can be adjusted freely because each stroke range varies. In other words, the thickness of the plate after being highly pressed can be made smaller by narrowing the spacing between rotation centers of the upper and lower eccentric shafts or crank shafts, and it can also be made thicker after a sharp reduction conversely by widening the spacing between the rotation centers.

[0012] According to a preferred embodiment of the present invention, the aforementioned bearing moving device (24) is composed of bearing boxes (25) supporting the bearings and screw jacks (27) that are installed on a main frame (26) and drive up and down the above-mentioned bearing boxes. In this configuration, the gap of the dies can be adjusted by moving up and down the bearing boxes using screw jacks.

[0013] In addition, the aforementioned bearing moving device (24) can be configured with bearing boxes (25) that support the bearings and wedge plates (28) or step plates (29) that are sandwiched between and held by the main frame and the above-mentioned bearing boxes. This configuration provides a simple, light structure in which the bearing boxes are moved up and down and the gap between the dies can be adjusted as well as reducing the cost.

[0014] The other objects and advantages of the present invention are revealed and understood by the following description referring to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a configuration of a plate thickness reduction press system using connecting rods and eccentric shafts.

Fig. 2 shows a configuration of a plate thickness reduction press system using cranks and sliders.

Fig. 3 is a configuration of a plate thickness reduction press system using cranks and connecting rods.

Fig. 4 is a configuration of the plate thickness reduction press system provided with the dies gap adjustment apparatus according to the present invention.

Fig. 5 is a general configuration showing the dies gap adjustment apparatus according to the present invention.

Fig. 6 A is an embodiment of the dies gap adjustment apparatus using wedge plates according to the present invention, and Fig. 6 B shows an embodiment of the dies gap adjustment apparatus using step plates according to the present invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

[0016] The preferred embodiments of the present invention are described as follows referring to the drawings. Portions in common with all drawings are identified with the same numbers, and no duplicate description is given.

[0017] Fig. 4 is a configuration of the plate thickness reduction press system equipped with the dies gap adjustment apparatus according to the present invention. As shown in Fig. 4, the plate thickness reduction press system equipped with the dies gap adjustment apparatus according to the present invention is provided with a pair of dies 2 arranged opposite each other on the upper and lower sides of the slab 1, and a swing device 10 that is provided for each of the upper and lower dies 2 and moves the die 2 backwards and forwards of the slab 1.

[0018] In Fig. 4, the swing device 10 is provided with a slider 12 equipped with a pair of circular holes 12a that are positioned obliquely to the feeding direction of the slab with a spacing L between each other, and eccentric shafts 14 that rotate inside the circular holes 12a.

[0019] The eccentric shaft 14 is composed of a first shaft 14a that rotates in the circular hole with the center axis A of the circular hole 12a, and a second shaft 14b that is driven and rotates with the center axis B displaced by an eccentricity e from the first axis 14a. The second shaft 14b is supported by bearings, not illustrated, for rotation, and driven and rotated by a rotation driving device also not illustrated.

[0020] The dies 2 are mounted on the sliders 12, which are detachable through die holders 11. On the downstream side of the dies 2, pinch rolls 16 are provided and control a transfer speed of the slab 1 on the inlet or outlet side of the pinch rolls 16, a table roller 7 is equipped and transports a material to be pressed. In Fig. 4, A and B represent the centers of the first and second shafts, respectively.

[0021] Fig. 5 is a view of general configuration of the dies gap adjustment device according to the present invention. As shown in Fig. 2, the dies gap adjustment apparatus 20 according to the present invention is equipped with upper and lower bearings 21, 22 that support rotation of the above-mentioned second shaft 14b, and a bearing moving device 24 that moves up and down at least one of these bearings.

[0022] In Fig. 5, the bearing moving device 24 is comprised of upper and lower bearing boxes 25 for supporting bearings 21, 22, and screw jacks 27 that move up and down a bearing box 25 installed on the main frame 26 of the plate thickness reduction press machine. In Fig. 5, two upper screw jacks are provided, however, one screw jack or three or more screw jacks may also be incorporated. Although the lower shaft box 25 is supported by a load cell 30 in Fig. 5, a dummy member can also support the box.

[0023] Using this configuration, the shaft boxes 25 can be moved up and down and a gap between the dies can be adjusted by means of the screw jacks 27.

[0024] Figs. 6A and 6B show another embodiment of the dies gap adjustment apparatus according to the present invention. Figs. 6A and 6B relate to a wedge-plate type and a step-plate type, respectively.

[0025] More explicitly, as shown in Fig. 6A, one wedge-shaped plate 28 or a plurality of them is inserted between and supported by the main frame 26 and the shaft box 25, and the wedge plate 28 is moved horizontally in this view, thus, the shaft box is moved up and down and a gap between the dies can be adjusted using a simple, light structure.

[0026] With another example shown in Fig. 6B, a step plate 29 whose thickness varies stepwise is inserted between and supported by the main frame 26 and the shaft box 25, and by moving the step plate 29 horizontally in this view, a gap between the dies can be adjusted while moving the shaft box up and down using the similar simple, light structure.

[0027] However, the construction of the dies gap adjustment apparatus according to the present invention is not limited to that of the plate thickness reduction press system shown in Fig. 4, but the pair of circular holes 12a of the slider 12 can also be positioned vertically to the feeding direction of a slab, therefore, the pair of eccentric shafts 14 can also be vertically located in the feeding direction of the slab. In addition, any of the plate thickness reduction press systems shown in Figs. 1 through 3 can also apply. At this time, the upper and lower bearings 21, 22 support the rotation of eccentric shafts or crank shafts other than the second shafts 14b in Fig. 4.

[0028] Needless to say, the present invention is also not limited only to the aforementioned embodiments, but can be modified within the range of the claims of the present invention.

[0029] According to the configuration of the present invention as described above, the spacing between rotation centers of upper and lower eccentric shafts or crank shafts can be changed by moving up and down at least one of the upper and lower bearings 21, 22 that support rotation of the eccentric shafts or crank shafts, using the bearing moving device 24. Therefore, even when a pressing stroke of the upper and lower dies is constant and the same dies are used, the stroke range of each die varies, so that the thickness of a plate after being pressed can be adjusted freely. That is, by narrowing the space between rotation centers of the upper and lower eccentric shafts or crank shafts, the thickness of the plate after being highly pressed can be reduced, and conversely by widening the spacing between the rotation centers, the thickness of the sharply reduced plate can be made greater.

[0030] Consequently, the dies gap adjustment apparatus of the present invention provides various advantages such as easy adjustment of the thickness of a plate after being highly pressed, using the same dies.

[0031] Although the present invention has been explained referring to several preferred embodiments, it can be understood that the scope of rights covered by the present invention is not limited to these embodiments. Instead, the scope of the rights of the present invention include all modifications, corrections, and similar amendments included in the scope of the attached claims.

Claims

1. In the plate thickness reduction system comprising a pair of dies (2) opposed to each other on the upper and lower sides of a slab (1) and a swing device (10) that drives up and down the upper and lower dies symmetrically from the slab, via eccentric shafts (14) or crank shafts,

   a dies gap adjustment apparatus comprising upper and lower bearings (21, 22) that support rotation of the said eccentric shafts or crank shafts and a bearing moving device (24) for moving up and down at least one of the said bearings.

2. The dies gap adjustment apparatus specified in Claim 1, comprising shaft boxes (25) for supporting bearings, and screw jacks (27) that are fixed to a main frame (26) and drive the said shaft boxes up and down.

3. The dies gap adjustment apparatus specified in Claim 1, in which the said bearing moving device (24) comprises bearing boxes (25) for supporting bearings and a wedge plate (28) or a step plate (29) that are inserted between and supported by a main frame (26) and the said shaft boxes.

FIG. 1

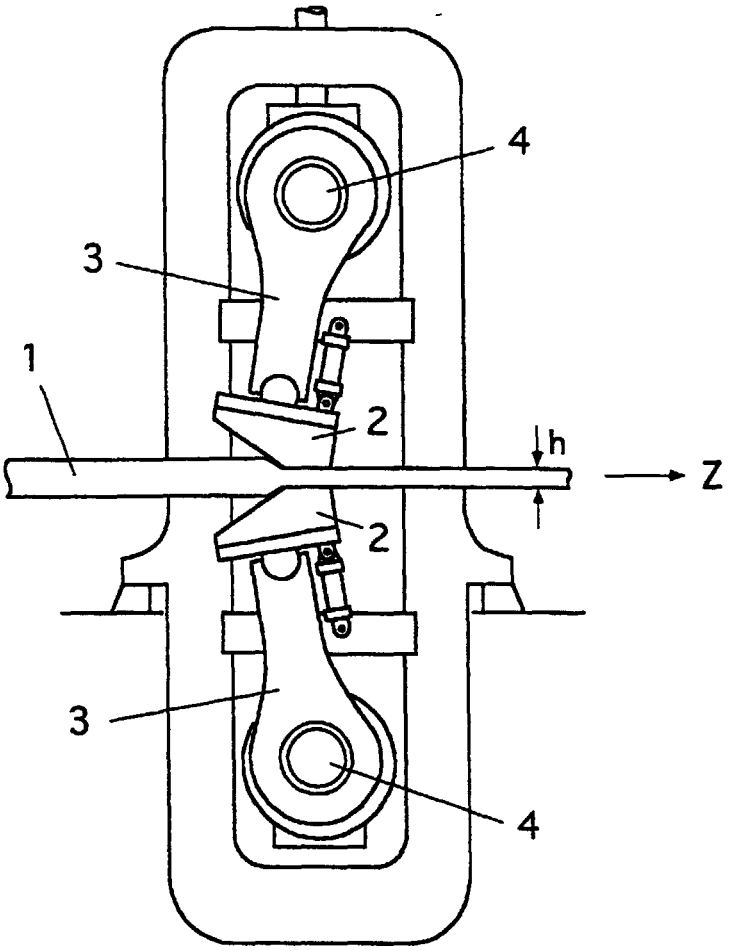


FIG. 2

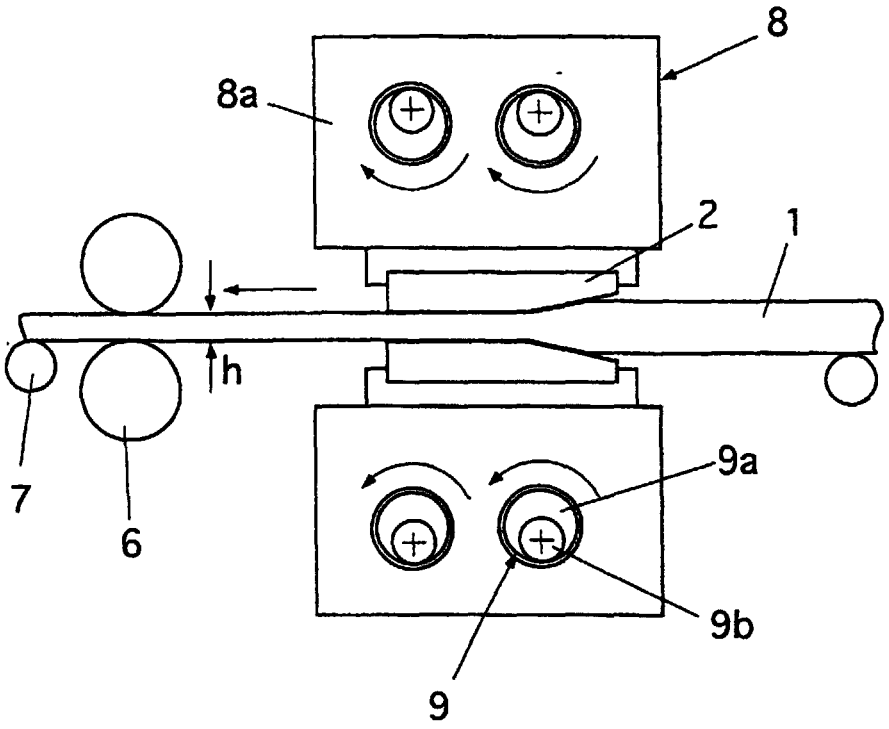


FIG. 3

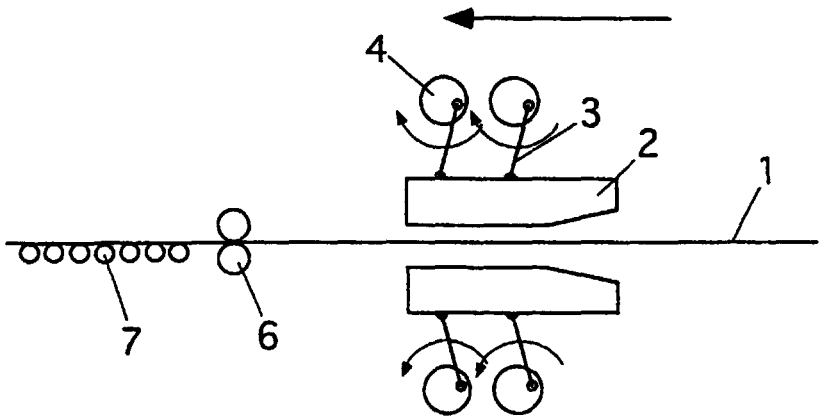


FIG. 4

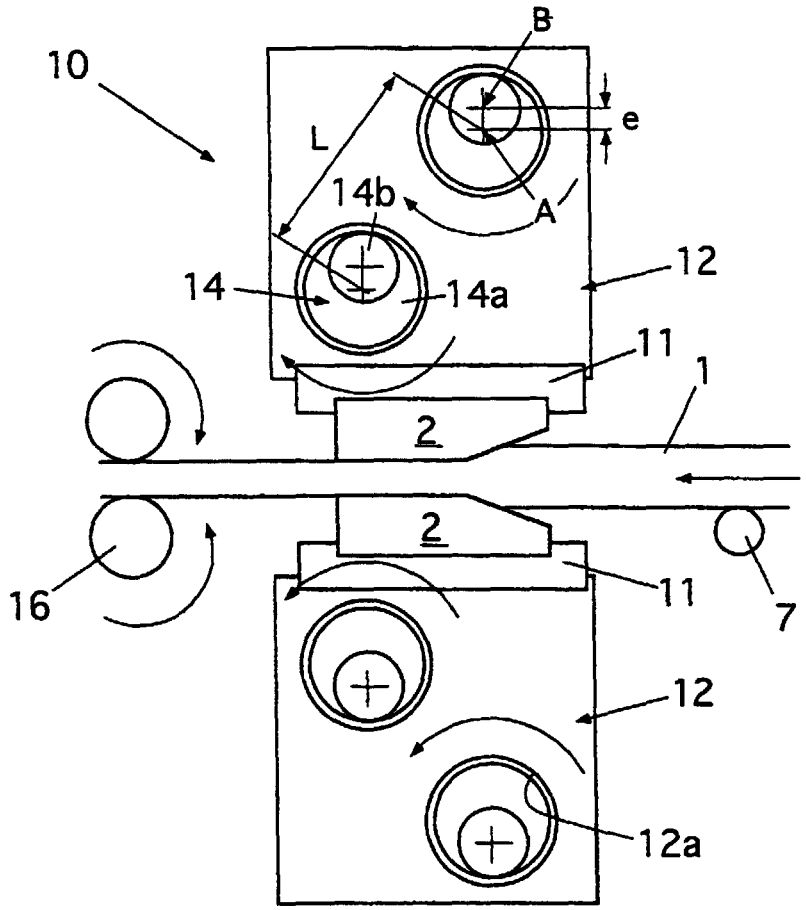


FIG. 5

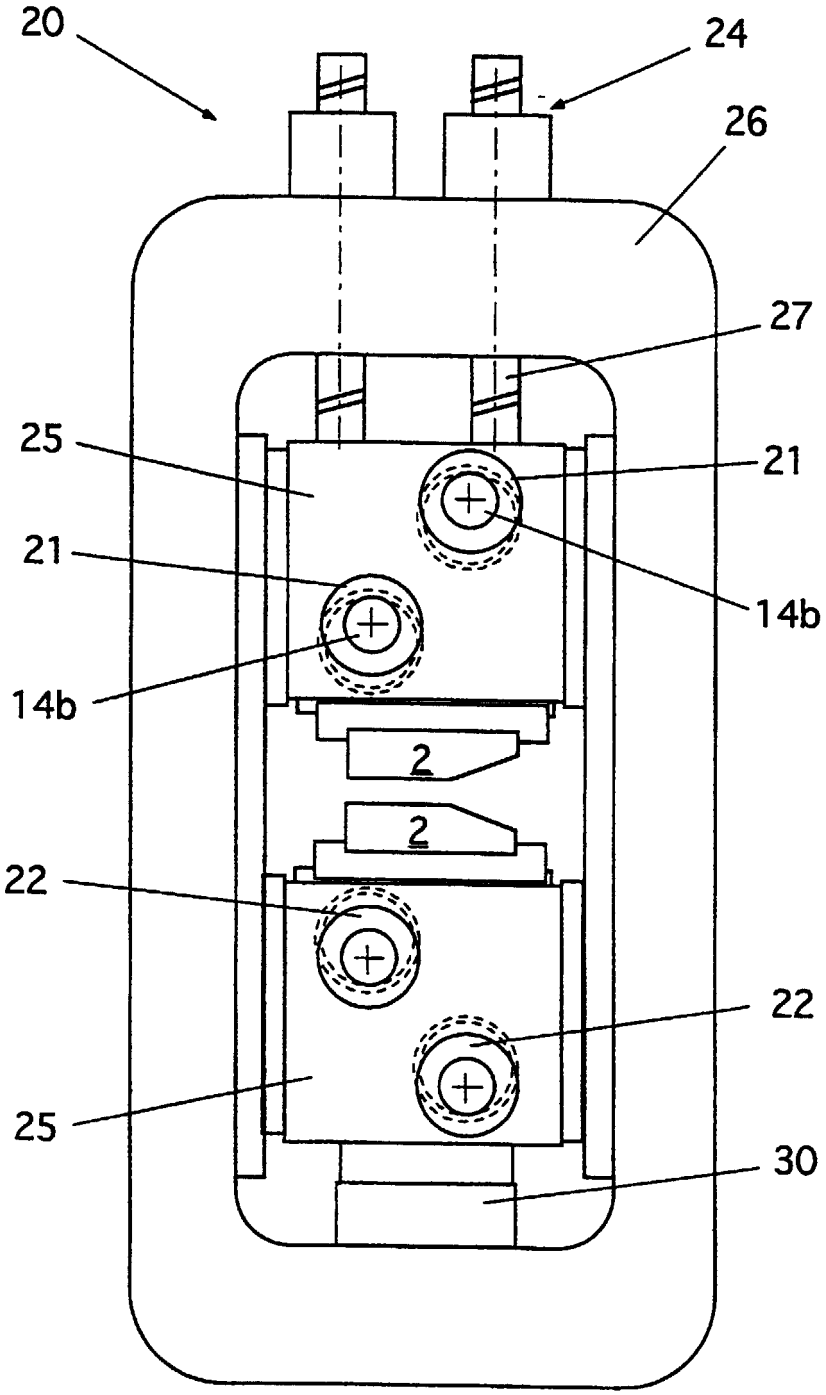


FIG. 6A

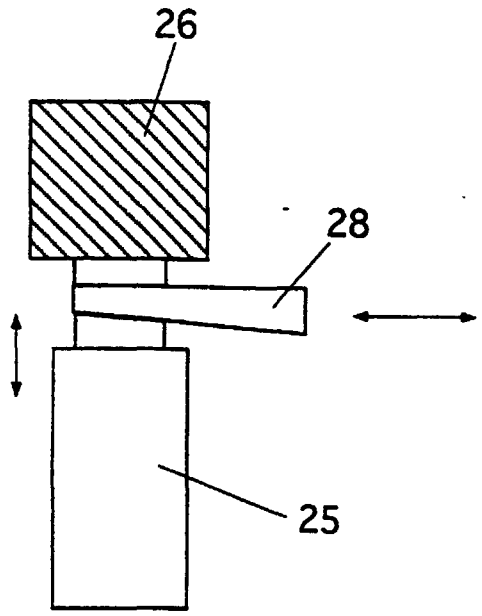
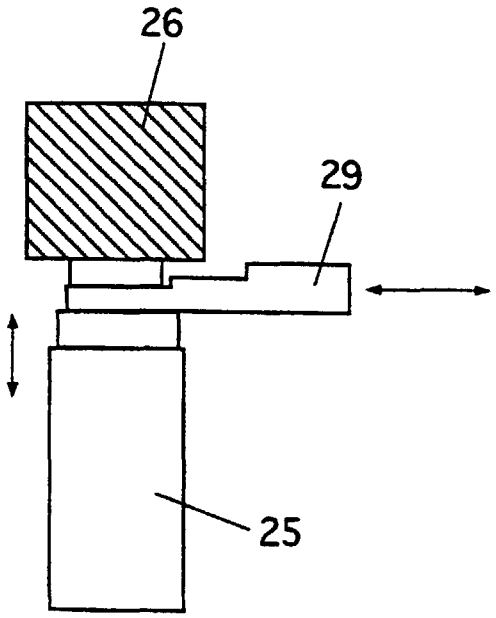


FIG. 6B



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP99/00343

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[6] B21B13/18, B21D31/06

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[6] B21B13/18, 15/00, B21D31/06, 37/02, B21J, B30B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-1999
Kokai Jitsuyo Shinan Koho 1971-1999 Jitsuyo Shinan Toroku Koho 1996-1999

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.
X Y	JP, 61-222651, A (Ishikawajima-Harima Heavy Industries Co., Ltd.), 3 October, 1986 (03. 10. 86), Page 2, upper right column, lines 5 to 16 ; Fig. 1 (Family: none)	1 2, 3
X Y	JP, 2-175011, A (Ishikawajima-Harima Heavy Industries Co., Ltd.), 6 July, 1990 (06. 07. 90), Page 2, lower right column, line 14 to page 3, upper right column, line 6 ; Fig. 4 (Family: none)	1 2, 3
Y	JP, 61-273229, A (Hitachi,Ltd.), 3 December, 1986 (03. 12. 86), Fig. 2 (Family: none)	2
Y	JP, 57-177900, A (Sumitomo Heavy Industries,Ltd.), 1 November, 1982 (01. 11. 82), Fig. 1 (Family: none)	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	Date of mailing of the international search report
16 March, 1999 (16. 03. 99)	23 March, 1999 (23. 03. 99)
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Form PCT/ISA/210 (second sheet) (July 1992)