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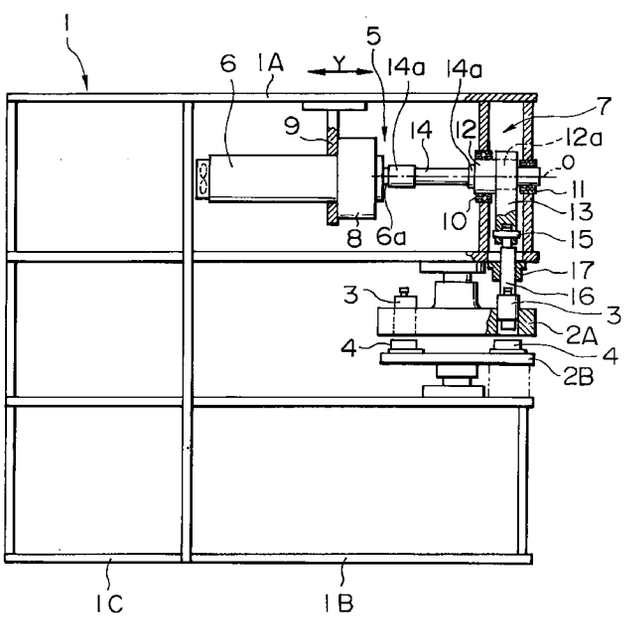
(54) Servo-motor driven press device

(57) A press device directly driven by a servo-motor (6) where a relatively large servo-motor is contained within a narrow frame (1A) without it projecting to the exterior.

A servo-motor having a rectangular shape, a rotating shaft that transmits that rotation and a conversion system of the rotation and linear reciprocal movement are arranged in series. These members are contained within the upper frame (1A) of the C-shaped frame. The conversion system is an eccentric cam type.

FIG. 1



EP 0 834 394 A1

Description

Field of the Invention

The present invention relates to a servo-motor driven press device, such as a turret punch press device and others.

Background of the Invention

On conventional motor driven punch press devices, the driving of a punch tool and that control is performed using a crank system, flywheel and clutch brake. However, on devices such as these which use a flywheel, controlling the punch speed mid-stroke is difficult as is decreasing the noise level and the like.

Due to this, a hydraulic punch press is generally used for processing where changing the punch speed mid-stroke is required. The stroke speed of hydraulic type punch driving devices may be freely changed by using a hydraulic servo-valve or the like a hydraulic unit is necessary for this, the equipment increases in cost and space is needed for storing the hydraulic unit. Furthermore, even if a hydraulic servo-valve is used, there is delay in the response and it is difficult to obtain the responsivity as with direct driving by a servo-motor.

In order to solve these problems, a device has been proposed that drive a punch tool by a servo-motor via a power increasing system using a toggle system. However, the speed difference of the punch tool due to the toggle angle is great on a toggle system and control is difficult.

Thus, a device that directly drives a punch tool by a servo-motor has also been tried. In this case, it is difficult to obtain a large punch force but the punch force necessary for general punch processing may be obtained using a servo-motor having a suitable large output. However, when using a servo-motor having this kind of large output, the outer dimensions of the motor increase thus if arranged in the narrow compact press frame, a part of the servo-motor projects out from the press frame, is detrimental to the outer appearance and obstructs the positioning of peripheral devices such as loading devices and the like. Conversely, in comparison with normal motor driven or hydraulically driven punch press devices, the punch force of a punch press device directly driven by a servo-motor is small thus a small entire system is preferable. Due to this, solving the problems of a projecting servo-motor are difficult and moreover, these kind of problems are not limited to a punch press device and generally arise on servo-motor driven press devices.

Summary of the Invention

In order to solve these problems, it is an object of the present invention to propose a servo-motor driven press device that is able to contain the servo-motor inside a narrow frame without it projecting to the exterior.

The servo-motor driven press device of the present invention is arranged in series with a servo-motor having a rectangular shape, a rotating shaft that transmits the rotation of that servo-motor and a conversion system that converts the rotational movement of that rotating shaft into a linear reciprocal movement. Due to this arrangement, as a servo-motor having a rectangular shape, a rotating shaft that transmits that rotation and a conversion system that converts the rotational movement of that rotating shaft into a linear reciprocal movement are arranged in series, a relatively large sized servo-motor may be contained inside a narrow frame without it projecting to the exterior.

Furthermore, apart from the servo-motor, as only the rotating shaft and conversion system are positioned in the frame as a drive transmission system, there is obstruction to positioning of the drive transmission system even if a rectangular servo-motor is positioned in a narrow frame as described previously.

On the aforementioned arrangement, the conversion system may comprise an eccentric cam system. If this kind of eccentric cam system is used, the rotation of the motor may be converted to a linear reciprocal movement by a compact arrangement and the entire device may made more compact.

Furthermore, the following arrangement is possible as structure realizing this. In short, on a turret punch press device having a C-shaped or gate shaped frame, a turret is positioned in the space between the upper frame part and lower frame part of this frame and the servo-motor is stored in the longitudinal direction of the upper frame. The conversion system is positioned in the tip of the upper frame such that the direction of the linear reciprocal movement is vertical. In the case of a turret punch press device, it is preferable for the upper frame part to be narrow and compact but the present invention is able to efficiently contain the servo-motor in that narrow frame.

Brief Description of the Drawing

Figure 1 is a sectional side view showing the main part of the servo-motor driven press device being one embodiment of the present invention.

Figure 2A is a plan view of the same part of Figure 1, Figure 2B is a front view of the same part of Figure 1 and Figure 2C is enlarged front view of the conversion system on the same part of Figure 1.

Figure 3 is a side view of the entire servo-motor driven press device being one embodiment of the present invention.

Figure 4 is a plan view of the entire servo-motor driven press device being one embodiment of the present invention.

Detailed Description of the Preferred Embodiments

Hereafter, a first embodiment of the present invention will be described using Figures 1 through 4. This servo-motor driven press device is utilized on a turret punch press device.

A frame 1 comprises an upper frame part 1A, a lower frame part 1B and a column 1C each having a box-shaped cross section and forms a C-shape from the side. A lower and upper turrets 2A,2B are positioned in the space between the upper and lower frame parts 1A,1B of the frame 1 and are supported on each of those upper and lower frame parts 1A,1B so as to be able to freely rotate. A plurality of press tools 3 being a punch tool are arranged on the upper turret 2A around the periphery and a plurality of die 4 are arranged in the lower turret 2B around the periphery. The upper and lower turrets 2A,2B are rotated by a turret drive device (not shown in the drawings) arranged on the frame 1.

The punch drive device 5 of the press tool 3 comprises a servo-motor 6 arranged inside the upper frame part 1A and a conversion system 7 that converts the rotation of that servo-motor 6 to a linear reciprocal movement in the vertical direction. The servo-motor 6 has a rectangular outer appearance which extends lengthwise in the motor shaft direction and incorporates a speed reduction device 8 in the tip and is stored along the longitudinal direction Y of the upper frame part 1A inside the upper frame part 1A. The longitudinal direction Y of the upper frame part 1A is the same as the longitudinal direction of the entire frame 1.

Furthermore, the servomotor 6 is positioned in the upper frame part 1A towards the tip via a motor 9 and the tip faces the tip of the upper frame part 1A. The length of the servo-motor 6 including the speed reduction device 8 is approximately half the length of the part that projects along one am of the column 1C of the upper frame part 1A.

The conversion system 7 comprises an eccentric cam system and an eccentric cam 12 is supported so as to freely rotate by a pair of bearings 10,11 of the tip pof the upper frame part 1A on a center of rotation O being the same as for a motor shaft 6a of the servo-motor 6. The eccentric cam 12 and motor shaft 6a of the servo-motor 6 are connected via a rotating shaft 14 having a coupling 14a on each end. In short, the servo-motor 6, rotating shaft 14 and eccentric cam 12 of the conversion system 7 are arranged in series inside the upper frame part 1A in the longtudinal direction.

An eccentric shaft part 12a of the eccentric cam 12 is fitted so as to freely rotate in a hole in the upper end of a crank arm 13 via a bearing (not shown in the drawings). The ram 16 is connected to the lower end of the crank arm 13 via a pin 15 and the ram 16 is supported so as to be able to freely move vertically on a ram guide 17 arranged on the end of the lower surface of the upper frame part 1A. A T-groove shaped head connection part connected with the head of the press tool 3 held in the upper turret 2A is present in the tip of the ram 16.

As shown in Figure 2, the frame 1 is positioned on the floor surface of the plant via legs 18 projecting at both sides at the front and rear edges.

Furthermore, as shown in Figures 3 and 4, a table device 19 is arranged continuous with the front of the frame 1. The table device 19 is provided with a central fixed table 21a arranged on a bed 20 and a movable table 21b each side of that. The movable table 21b is driven forwards and backwards (Y direction) together with a carriage 23 along rails 22 on the bed 20. A cross slide 25 having a work holder 24 is arranged on the carriage 23 so as to be able to freely move to the left and right (X direction) and the work W held in the work holder 24 is delivered in the X and Y directions with respect to a ram position P by the movement of the carriage 23 and cross slide 25.

Due to the servo-motor driven press device of the aforementioned arrangement, as the press tool 3 is directly driven by the servo-motor 6 via only the speed reduction system 7 comprising the speed reduction device 8 and eccentric cam system attached to the servo-motor 6, the control of the stroke speed and position of the press tool 3 is accurately performed by a simple control. Driving is performed by the servo-motor 6 without the use of a flywheel or power increase system or the like but the majority of required punch processing may be performed without an inadequate punch force by using a servo-motor with a sufficiently large output.

As driving is performed directly by this kind of servo-motor 6, a large servo-motor 6 is arranged comprising half the length of the upper frame part 1A of the frame 1 as shown in Figure 1. However, as the servo-motor 6 is stored inside the upper frame part 1A along the longitudinal direction of the upper frame part 1A, a relatively large servo-motor 6 may be contained within the narrow upper frame part 1A without it projecting to the exterior.

Furthermore, apart from the servo-motor 6, only an eccentric cam type conversion system 7 and speed reduction device 8 attached to the motor are positioned inside the upper frame part 1A as a drive transmission system thus there is no obstruction to the positioning of each of the drive transmission components even if a rectangular servo-motor 6 is positioned along the longitudinal direction inside the narrow upper frame part 1A. In this way, as the rectangular servo-motor 6, the rotating shaft 14 and eccentric cam 12 of the conversion system 7 are contained inside the frame 1 by being positioned in series, each member 6,14,7 may be efficiently positioned inside the frame 1 producing a compact apparatus. Furthermore, as the conversion system 7 is of an eccentric cam type, it may have a compact arrangement and the compactness of the entire system is more easily achieved.

It should be noted that the aforementioned embodiment describes the application on a turret punch press device but the present invention may be used on a gen-

eral punch press device driven by a servo-motor. Furthermore, the frame 1 is not limited to a C-shape and may be gate shaped.

As the servo-motor driven press device of the present invention is arranged in series with a servo-motor having a rectangular shape, a rotating shaft that transmits the rotation of that servo-motor and a conversion system that converts the rotational movement of that rotating shaft into a linear reciprocal movement and these members are covered by the frame, the servo-motor may be contained within a narrow frame without projecting to the exterior.

When the conversion system is an eccentric cam system, the entire device may be made more compact.

As the turret punch press device having a C-shaped or gate shaped frame and being a press device of the present invention is positioned with a turret in the space between the upper frame part and the lower frame part of the frame, contains the servo-motor in the longitudinal direction of the upper frame part inside the upper frame part and is arranged with the conversion system in the end of the upper frame such that the direction of the linear reciprocal movement is vertical, a relatively large output servo-motor may be contained inside an upper frame needing a small size without projecting to the exterior even on this kind of turret punch press device.

Claims

1. A servo-motor driven press device, having

   a servo-motor forming a rectangular shape, a rotating shaft that transmits therotation of the servo-motor, and a conversion system that converts the rotational movement of the rotating shaft into a linear reciprocal movement,
   and
   where these members are covered by a frame.

2. A servo-motor driven press device as in claim 1, wherein the conversion system comprises an eccentric cam system.

3. A servo-motor driven press device as in claims 1 or 2, wherein the frame has a C-shape or gate shape comprising an upper frame part, lower frame part and a column frame part that connects by the ends, the upper and lower frame parts, and the servo-motor is contained along the longitudinal direction of the upper frame part inside the upper frame part.

4. A servo-motor driven press device as in claim 3, wherein the conversion system is arranged at the end of the upper frame part and converts the rotational movement of the servo-motor to a linear reciprocal movement of the vertical direction.

5. A servo-motor driven press device as in claim 4, wherein a turret provided with a plurality of tools is positioned in the space between the upper frame part and lower frame part and one of the plurality of tools is moved vertically by the linear reciprocal movement in the vertical direction.

FIG. 1

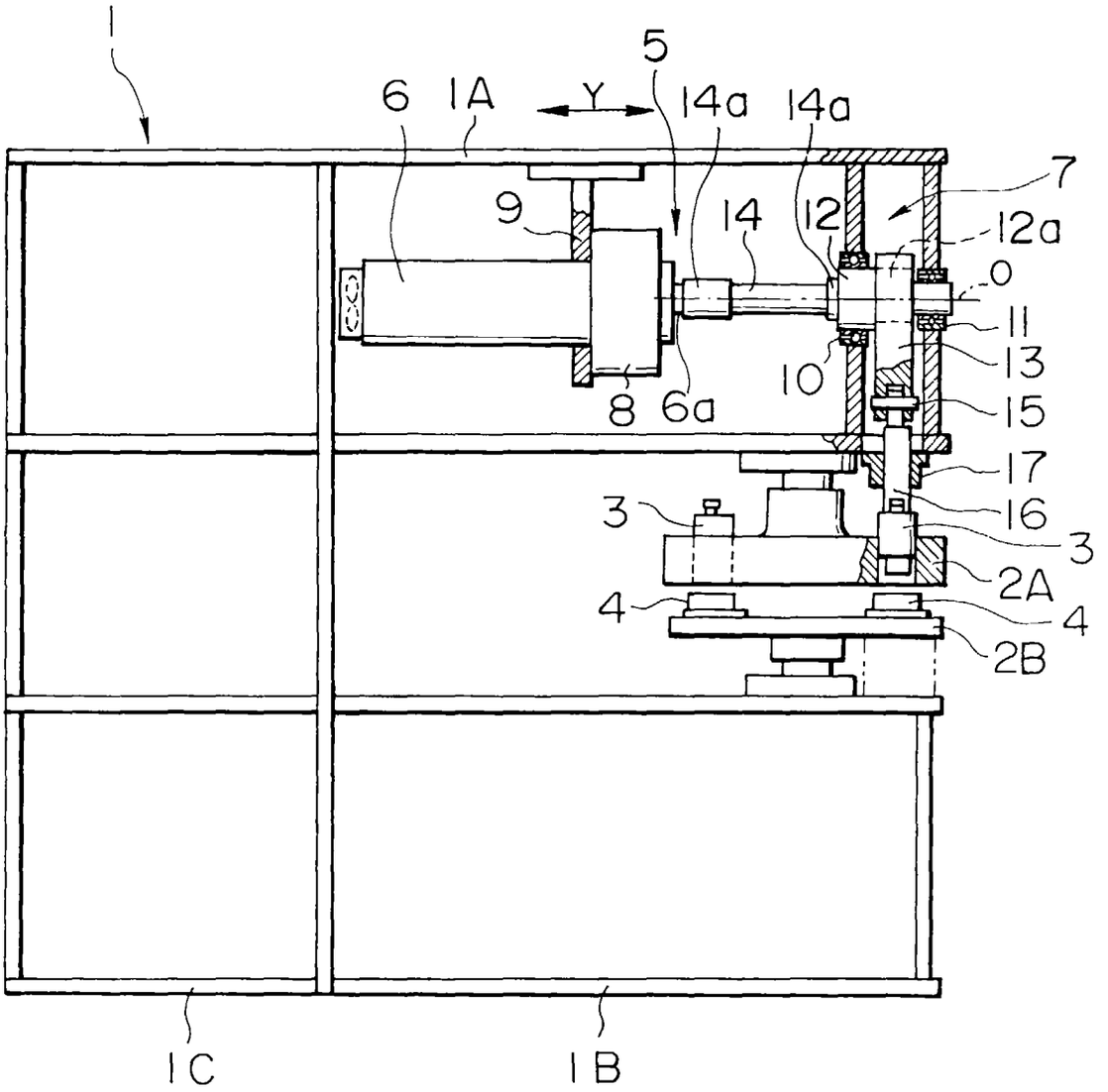


FIG. 2A

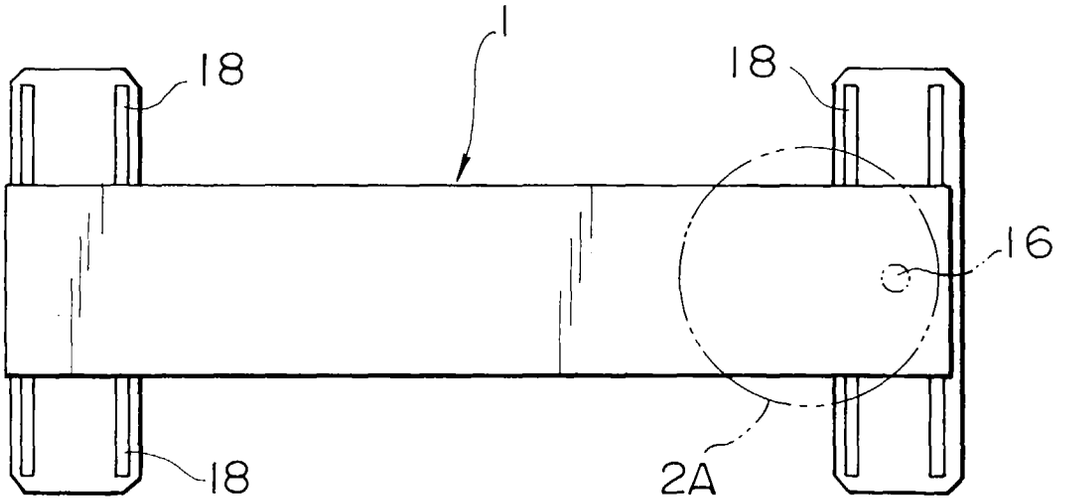


FIG. 2B

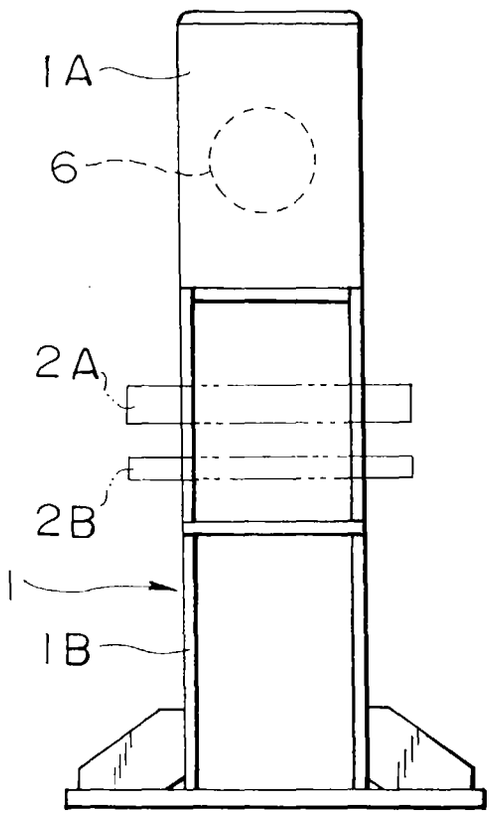


FIG. 2C

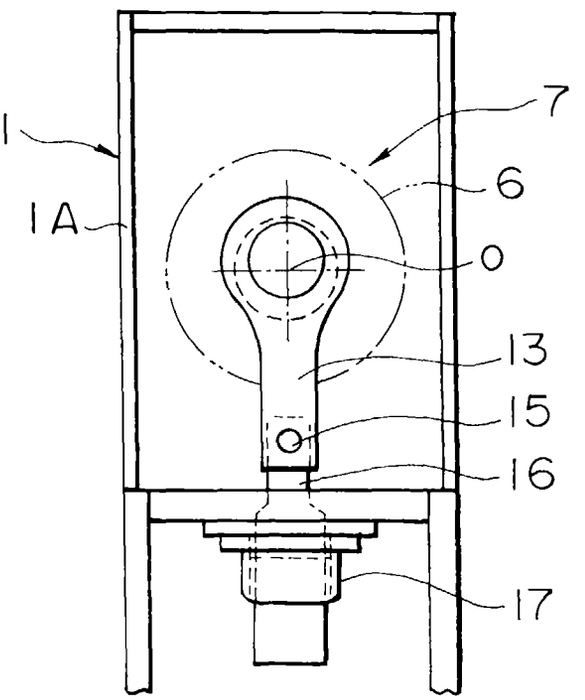
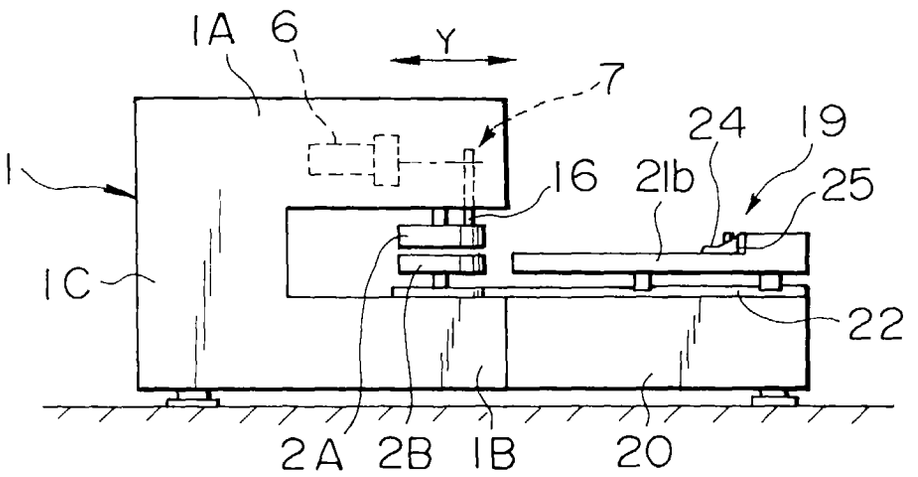


FIG. 3


1A
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Y
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24
19
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16
21b
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1C
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2B
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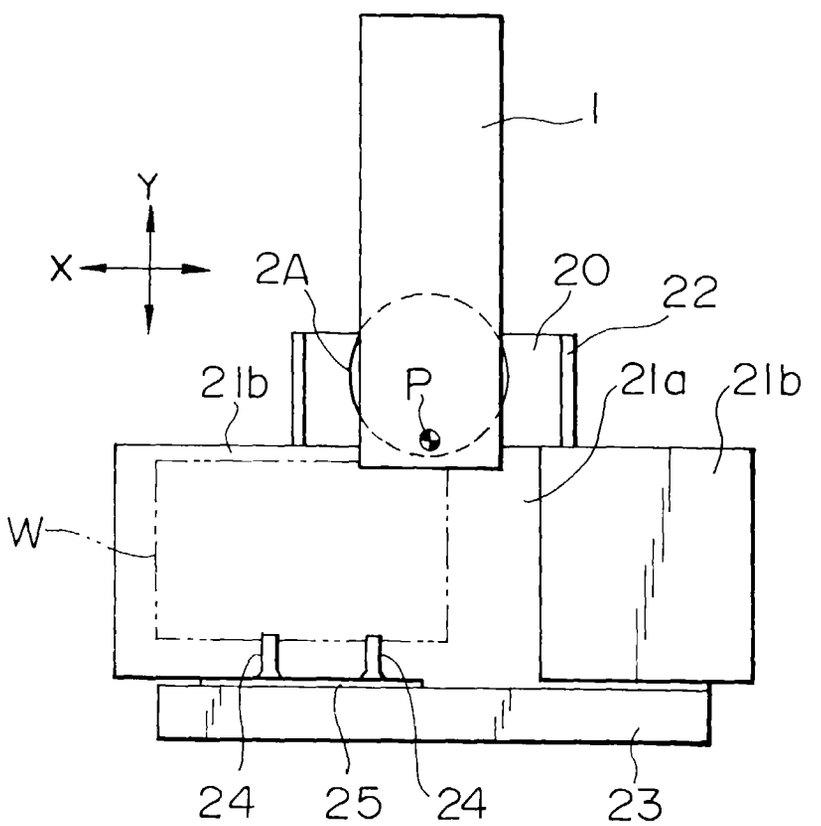
FIG. 4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EUROPEAN SEARCH REPORT

Application Number
EP 97 11 6496

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	DE 195 36 727 A (MURATA MACHINERY LTD) 4 April 1996 * abstract; figures 1,2 *	1,3-5 2	B30B1/26 B21D28/12 B21D28/20
Y	DE 41 09 796 A (BURGER GEORG) 1 October 1992 * abstract; figure 1 *	2	
X A	DE 195 36 728 A (MURATA MACHINERY LTD) 11 April 1996 * column 3, line 49 - line 54; figures 1,4 *	1 3-5	
A	PATENT ABSTRACTS OF JAPAN vol. 096, no. 002, 29 February 1996 & JP 07 276096 A (KOOTAKI SEIKI KK), 24 October 1995, * abstract *	1,2	
P,A	US 5 588 344 A (CHUN VICTOR L) 31 December 1996 * figures *	1,2	TECHNICAL FIELDS SEARCHED (Int.Cl.6)
A	GB 2 042 387 A (KLAUSSNER H) 24 September 1980 * abstract; figure 1 *	1,2	B30B B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	8 January 1998	Belibel, C

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