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# (54) Turret punch press

Revolverstanzmaschine

Poinçonneuse à tourelle revolver

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EP 0 555 604 B1

## Description

### Background of the Invention

#### Field of the Invention

The present invention relates to a turret punch press, and, in particular, to a mechanical turret punch press in which an upper tool is actuated jointly by both a mechanical striker and a hydraulic striker.

#### Description of the Prior Art

Conventionally, a commonly known turret punch press comprises a freely rotatable upper turret equipped with a plurality of freely detachable upper tools, a freely rotatable lower turret in opposition to the upper turret, and a freely vertically mobile striker which strikes the upper tool in the working area. A disk support which supports the lower turret is provided on the lower side of the lower turret in the working area for resisting the impact from a striker.

During a forming process, the upper turret and the lower turret and rotated in synchronism and a pair of dies for specific forming is positioned in the working area, a workpiece is positioned between the two dies, and the forming process is performed by pressing the upper and lower dies together using a mechanical or a hydraulic device.

However, in the above-mentioned mechanical type of punch press, because the forming die is not formed with a through hole, a forming punch (the upper die) which is moved downward, impacts a forming die (the lower die) and an excess force acts on the die, or a die holder, or on the lower turret, or the like, so that there is concern about damage or breakage thereof. For this reason, a difficult height adjustment must be scrupulously performed from time to time to change the height of the die.

In the case of a punch press using a hydraulic device, it is possible to prevent any excess force from acting on the die or the die holder, or on the lower turret, or the like, but frequent use of the hydraulic device shortens the life span of a large number of parts. In addition, the hydraulic device is expensive which is a disadvantage from the aspect of operating costs.

### Summary of the Invention

An object of the present invention is to provide, with due consideration to the drawbacks of such conventional devices, a turret punch press wherein, even when the height of the die is not adjusted with scrupulous care, there is no damage to the die or the turret.

WO 90/05601 discloses a turret punch press comprising :

a frame ;

upper and lower dies mounted on the frame in such a way to oppose each other and to perform processing on a workpiece provided therebetween ;

a striker mounted on the frame so as to move in the vertical direction and adapted to be in contact with the head of the upper die ; and

upper drive means mounted on the frame for causing the striker to move in the vertical direction, the upper drive means including a ram.

According to the present invention, the upper and lower dies are adapted to be slidable in the vertical direction so as to cooperate with each other,

the upper drive means further comprises a sub-upper-drive means mounted on the ram for moving the striker relative to the ram and adapted to fix the striker in the vertical direction at any height relatively to the ram within a predetermined interval, and

lower drive means is mounted on the frame for causing the lower die to move upward.

Preferably, the press is a turret punch press, the upper and lower dies being mounted on upper and lower turrets respectively, the striker being provided on the lower end of the ram.

In a preferred embodiment, the upper dies comprise an upper die for punching and an upper die for forming, and the lower dies comprise a lower die for punching and a lower die for forming, the press further comprising a disk support for supporting the lower dies in a processing position, and a freely movable slider provided in the disk support, said slider including,

(a) the lower drive means for pushing up the lower die for forming positioned at an operating position where the upper and lower dies work together, and
(b) a residue hole into which the residue from the punching operation drops, selectively positioned in the processing position.

The present invention also provides a method of performing a forming process on a workpiece using a press according to the invention.

In a turret punch press of the invention, the upper and lower turrets are rotated, and an upper die of a plurality of dies, positioned in the working area, is struck by a striker element of the striker mounted on the lower end of the ram when the ram descends. The sub-upper-drive means, which vertically moves the striker element with respect to the ram, is preferably a hydraulic cylinder and is mounted on the striker. The amount of stroke of the striker element with respect to the upper die is the sum of the amount of stroke of the ram and the amount of stroke of the striker element itself, which is moved vertically by the hydraulic cylinder. Accordingly, the upper dies and the lower dies come into contact and the processing occurs only when the ram and the piston rod are both at bottom dead center.

During a punching process, the striker element of the striker device is normally positioned at bottom dead center, the ram is lowered by the mechanical vertically moving means, and the punching operation is effectively performed. In addition, during a forming process, the

striker element of the striker device is first at its upper most position with respect to the ram, and after the ram is lowered by the mechanical vertically moving means, the striker element is lowered by the hydraulic cylinder and the forming operation is effectively performed.

In addition, the freely movable slider is provided in the disk support which supports the lower turret; provided in the slider is the hydraulic cylinder, which pushes up an upward-forming lower die, and the residue receiving hole into which the residue from the punching operation drops. Accordingly, when the slider is moved, the hydraulic cylinder or the residue receiving hole is selectively positioned at the working area to cope with an upward-forming operation or a punching operation. Then, the processing is carried out.

## Brief Description of the Drawings

These and other objects, features, and advantages of the present invention will become more apparent from the following description of the preferred embodiment taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a sectional view of the main parts of a first embodiment of a turret punch press of the present invention taken along the line I-I in FIG. 2.

FIG. 2 is a side elevation viewed in the direction of the arrow II in FIG. 1.

FIG. 3 is a sectional view taken along line III-III in FIG. 2.

FIG. 4 is an enlarged sectional view taken along the line IV-IV in FIG. 3.

FIG. 5 is an enlarged bottom view with one part omitted, viewed in the direction of the arrow V in FIG. 1.

FIG. 6 is a detailed sectional view of a manual valve.

FIG. 7 is a detailed sectional view of a switching valve.

FIG. 8 is a perspective view showing the hydraulic mechanism of a hydraulic cylinder used for striking.

FIG. 9 is a plan view showing a disk support.

FIG. 10 is a sectional view taken along the line X-X in FIG. 9.

FIG. 11 in an elevation showing the entire turret punch press.

FIG. 12 is a sectional view taken along the line XI-XI in FIG. 11.

FIGS. 13-18 are schematic drawings showing the operation of the punch press during upward-forming process.

FIG. 19 is a plan view showing a disc support provided in a second embodiment of the punch press of the present invention.

FIG. 20 is a section taken along the line XX-XX of FIG. 19.

FIG. 21 is a plan view showing the disc support.

FIG. 22 is a section taken along the line XXII-XXII of FIG. 21.

FIG. 23 is an enlarged section showing the upper and lower tools prior to the forming operation.

FIG. 24 is an enlarged section showing the upper and lower tools during the forming operation.

FIG. 25 is a front elevation of the punch press.

FIG. 26 is a plan view taken along the line XXVI-XXVI of FIG. 25.

## Detailed Description of the Preferred Embodiments

Other features of this invention will become apparent in the course of the following description of exemplary embodiments which are given for illustration of the invention and are not intented to be limiting thereof.

As shown in FIG. 11 and FIG. 12, a side frame 5 and a side frame 7 are erected, one on each side of a base 3 of a turret punch press 1. An upper frame 9 is provided on the upper sides of the side frame 5 and the side frame 7. A vertically movable ram 11 mounted on the upper frame 9 is moved by a mechanical vertically moving means such as a crank shaft 10. On the lower end of the ram 11, a striker device 15 having a piston rod 13 is provided as a striker element, freely movable vertically by a hydraulic mechanism which will be described in detail hereinafter.

In addition, of the lower surface of the upper frame 9, a disk-shaped upper turret 21 is rotatably supported by an upper rotary shaft 21a. Detachably mounted on the upper turret are a plurality of upper punching dies 17 and a plurality of upward-forming upper dies 19 as the upper dies. In FIG. 1, a plurality of punching upper dies 17a is mounted in the radial direction of the upper turret 21 (the A direction in the drawing). Although not shown in the drawing, a plurality of upward-forming upper dies can also be mounted in the radial direction of the upper turret 21 (the A direction in the drawing) in place of the normal upper dies 19, in exactly the same manner as for the punching dies 17a. Each of the dies 17a is vertically movable independently of each other. The dies 17a are adapted to be positioned in the operating position under the ram 11.

Again referring to FIG. 11 and FIG. 12, a lower turret 27 is rotatably supported by a lower rotary shaft 27a on the upper surface of the base 3 opposing the upper turret 21. Detachably mounted on the lower turret are a plurality of lower punching dies 23 and lower upward-forming dies 25 respectively as the lower opposing the upper punching dies 17 and the upper upward-forming dies 19. Although not shown on the drawings, when a plurality of upper dies 17a are provided in the radial direction of the upper turret 21. A plurality of lower dies (not shown) each corresponding to the upper dies 17a are provided on the lower turret 27 in the radial direction of the lower turret 27.

The upper turret 21 and the lower turret 27 are synchronized and rotatably controlled by means of, for example, a turret servo motor (omitted from the drawings) mounted on the side frame 5. As a result, during the punching process, the desired upper punching dies 17 and the lower punching dies 23, and, in addition, dur-

ing the upward forming process, the upper upward-forming dies 19 and the lower upward-forming dies 25, are selectively positioned at the working area immediately under the ram 11.

On the upper surface of the base 3, a pair of guide rails 29 each extending in the Y-axis direction are juxtaposed in the direction perpendicular to the plane of the drawing in Fig. 11 (only one of the rails 29 is shown in Fig. 11). A pair of movable tables 33, positioned one on each of the front and back sides of a fixed table 31 secured on the base 3, are movably supported on the guide rails 29. The movable tables 33 are integrally mounted on a carriage base 35 extending in the X-axis direction over the fixed table 31. In addition, a carriage 37 which moves in the longitudinal direction (the X-axis direction) crossing the direction of motion of the movable table 33 (the Y-axis direction in the drawings) is mounted on the carriage base 35. A clamp 39 which clamps one end of a plate-shaped workpiece W is movable mounted in the X-axis direction on the carriage 37.

Accordingly, to position the workpiece W, the movement of the carriage 37, on which is mounted the clamp 39 for clamping one end of a plate-shaped workpiece W, is performed in the X-axis direction along the carriage base 35, and the movement of the carriage 35 is performed in the Y-axis direction along the guide rails 29.

A shown in FIG. 1 to FIG. 3, a ram guide 41 is provided on the upper frame 9 for moving the ram 11 vertically. Furthermore, a channel-shaped guide 43 opened downward is installed on the bottom surface of the ram 11 by means of a bolt 45, extending in the radial direction of the upper turret 21 (the A direction in the drawings). A cylinder bracket 47 (Fig. 3) is installed by means of a bolt 49 on the upper end of the guide 43 in FIG. 3. A fixed hydraulic cylinder 51 is securely installed on both the cylinder bracket 47 and the guide 43 on the upper end section of the guide 43 in Fig. 3. Accordingly, the guide 43, the cylinder bracket 47, and the fixed hydraulic cylinder 51 do not move with respect to the ram 11. In addition, a movable hydraulic cylinder 53 opposing the fixed hydraulic cylinder 51 is provided in a manner allowing free movement along the guide 43. The tip of a piston rod 51a of the fixed hydraulic cylinder 51 and the tip of a piston rod 53a of the movable hydraulic cylinder 53 are linked by a joint 55. the bottom surface of the movable hydraulic cylinder 53 is secured to a connecting member 59, fastened by a bolt 57 to the left end to the striker device 15.

Accordingly, by feeding an operating fluid from a tube 61 of the fixed and movable hydraulic cylinders 51, 53 into the cylinder chamber and discharging it from a tube 63, the piston rod 51a of the fixed hydraulic cylinder 51 is projected to the left and the piston rod 53a of the movable hydraulic cylinder 53 is projected to the right in Fig. 3. As a result, the movable cylinder 53 pulls the striker device 15 to the left in FIG. 3 through the connecting member 59. Conversely, by feeding the operating fluid from the tube 63 into the cylinder chamber and discharging it from the tube 61, the piston rod 51a of the fixed hydraulic cylinder 51 is moved to the right and the piston rod 53a of the movable hydraulic cylinder 53 to the left in Fig. 3. Then, the movable cylinder 53 moves the striker device 15 to the right in FIG. 3 through the connecting member 59.

Referring to Figs. 1-3, a hydraulic cylinder 65 is provided in the striker device 15 as a hydraulic striker cylinder with a piston rod 67 projecting freely downward. As described above, the piston 67 is selectively positioned above the normal upper dies 17, 19 or above a specific upper die 17a provided in the radial direction of the upper turret 21 by moving and positioning the striker device 15. Here, because the piston rod 67 strikes the upper surface of the upper dies 17, 17a, 19 while projecting downward, the stroke length for the vertical movement of the tip of the piston rod 67 is the sum of the stroke length of the ram 11 itself and the stroke length of the piston rod 67 of the hydraulic striker cylinder 65.

An air blower 69 is provided at the center of the bottom surface of the piston rod 67. Thus, compressed air supplied from a tube d1 (see FIG. 4 and FIG. 5) is fed from the side surface of the cylinder chamber to the inside of the piston rod 67. This compressed air is blown out of discharge ports (not shown) in the lower surfaces of the upper dies 17, 19, so that the workpiece W is easily separated from the upper dies 17, 19 and the scrap is easily removed from the upper dies 17, 19.

A proximity switch 71 for detecting the vertical movement of the piston rod 67 is provided on the punching device 15 in the vicinity of the piston rod 67. The switch 71 detects the vertical position of the piston rod 67, and detects whether the piston rod 67 has reached the top and bottom dead center in the conventional manner.

Next, the hydraulic mechanism of the punching hydraulic cylinder 65 will be explained, referring to FIG. 4 to FIG. 7. A tube $b_1$ is provided to feed operating fluid to an upper cylinder chamber 73 of the punching hydraulic cylinder 65 to move the piston rod 67 downward. One end of the tube $b_1$ is open to the upper cylinder chamber 73 and the other end is open to the right side end surface of the striker device 15. In addition, when the operating fluid from the tube $b_1$ is fed into the upper cylinder chamber 73, the operating fluid in a lower cylinder chamber 75 is discharged by the upward movement of the piston rod 67. A tube $b_2$ is provided parallel to the tube $b_1$ to feed operating fluid to the lower cylinder chamber 75 to elevate the piston rod 67. One end of the tube $b_2$ is open to the lower cylinder chamber 75 and the other end is open to the right end surface of the striker device 15. A tube $c_2$ connected to a manual valve 77 is provided on the tube b1 in a position close to the punching hydraulic cylinder 65, extending in the direction perpendicular to the extension of the tube $b_1$. Further, a tube $a_2$ connected to a switching valve 79 is provided on the tube b1 in a position close to the vicinity of the right end surface of the device 15, extending in the direction perpendicular to the extension of the tube $b_1$. The switching valve 79 is for controlling the flow of the operating fluid. An end of the valve 79 is mounted on the right end surface of the

striker device 15 as a port $b_4$. A tube $a_1$ connected to the switching valve 79 is provided in a position close to the punching hydraulic cylinder 65 on the tube b2. A tube $b_3$ is coupled to a tube $c_1$ which is connected to the switching valve 79. One end of the tube $b_3$ opens to the right end surface of the striker device 15.

Control of the punching hydraulic cylinder 65 will now be explained with reference to the above-mentioned figures and FIG. 8. In the case where the piston rod 67 is lowered, as shown by the white arrows in FIG. 8, when operating fluid is fed from the $b_3$ port this operating fluid flows into the switching valve 79 through the tube $c_1$, and a pressure is applied to a chamber D (Fig. 7) to open a valve B (Fig. 7). As a result, the operating fluid flows from the tube $a_2$ into the tube $b_1$ and into the upper cylinder chamber 73, and the piston rod 67 is lowered. At this time, the operating fluid in the lower cylinder chamber 75 passes through the tube $b_2$ and is discharged from the $b_2$ port.

Conversely, in the case where the piston rod 67 is elevated, when operating fluid is fed from the $b_2$ port, as shown by the black arrows in FIG. 8, this operating fluid flows into the lower cylinder chamber 75 and the piston rod 67 is elevated. Because the operating fluid also flows into the tube $a_1$ at the same time, a spool A (Fig. 7) of the switching valve 79 is moved to the right and the valve B (Fig. 7) is opened. As a result, along with the elevation of the piston rod 67, the operating fluid in the upper cylinder chamber 73 is pushed out into the tube $b_1$ by back pressure, flows from the tube $a_2$ through the valve B into the tube $c_1$, passes through the tube $b_3$, and is discharged from the $b_3$ port.

In addition, where the operating fluid is fed to neither the $b_2$ port or the $b_3$ port, when an upward external force (a reaction force which strikes the upper dies 17, 19, during processing) is applied to the piston rod 67, the operating fluid in the upper cylinder chamber 73 tends to pass through the tube $b_1$ and flow into the tube $a_2$. However, no such flow will take place because the valve B of the switching valve 79 is closed. Accordingly, because the piston rod 67 is not moved vertically, the upper dies 17, 19 can be struck.

As shown in FIG. 9 and FIG. 10, a disk support 81 is secured to a section of the upper surface of the base 3 under the lower turret 27 in the working area beneath the ram 11, to prevent the lower turret 27 from vibrating during processing. This disk support 81 has a pair of support members 83 as reinforcing members and a slider 85 which moves horizontally between the support members 83.

The leading end of a piston rod 89 of a shift cylinder 87 is attached to the right end surface of the slider 85 in the Figs. 9 and 10. The slider 85 is provided on the upper surface of a guide 91 which is in turn provided on the upper surface of the base 3. The slider 85 is moved along a path between the support members 83 by the horizontal movement of the piston rod 89. A residue hole 93 through which a residue produced by the punching process is discarded, is formed at a position corresponding to the working area under the ram 11. A residue disposal guide 95 with a suitable hole for discarding the residue is provided in the left half section of the slider 85. A fluid cylinder 97 is provided as a forming cylinder in the right half section of the slider 85 for pressing the lower upward-forming die 25 upward.

The lower upward-forming die 25 includes a vertically movable die holder 99, a die tip 101 integrally provided in the die holder 99, and a workpiece ejector 103 vertically movable with respect to the die tip 101. The upper end of the die tip 102 is adapted to engage the upper upward-forming die 19 (FIG. 11). The workpiece ejector 103 is urged upward with respect to the die tip 101 by a spring 105. Thus, when the forming process has been completed and the die tip 101 is moved downward, the workpiece W is easily separated from the die tip 101 by the upward movement of the work ejector 103 relative to the die tip 101.

In addition, a piston rod 107 of the forming cylinder 97 is freely movable in the vertical direction. Therefore, by feeding operating fluid from a tube $e_1$ to an upper chamber 97a of the forming cylinder 97, the piston rod 107 is retracted into the cylinder 97 so that the upper end of the die tip 101 does not project above a pass-line L of the workpiece. On the other hand, by feeding the operating fluid from a tube e2 to a lower chamber 97b of the forming cylinder 97, the piston rod 107 is moved upward so that the die holder 99 is pressed upward and the upper end of the die tip 101 is projected above the pass-line L. Thus, a forming processing is performed. After the processing, the workpiece W which may be engaged by the die tip 101, can be removed from the die tip 101 by the upward movement of the workpiece ejector 103.

During periods other than the upward-forming process periods, the piston rod 107 is retracted into the forming cylinder 97. Therefore the piston rod 107 does not project upward from the upper surface of the slider 85. Specifically, the rotary positioning of the lower turret 27 and the movement of the slider 85 are performed while the piston rod 107 is retracted into the forming cylinder 97. Thus, there is no obstacle to the movement of the slider 85.

Now, the operations of the turret punch press will be described in detail.

Punching process:

First, as shown in FIG. 11 and FIG. 12, a workpiece W to be processed is clamped by the clamps 39 on the carriage 37. Then, the part of the workpiece W is positioned in the working area between the upper turret 21 and the lower turret 27 by controlling the movement of the carriage 37 in the X-axis direction along the carriage base 35, and by controlling the movement of the carriage base 35 in the Y-axis direction along the guide rails 29.

The upper turret 21 and the lower turret 27 are rotated in synchronism by a turret servo motor and the specified upper and lower punching dies 17, 23 are positioned in the working area. As shown in FIG. 1, in the

case where the plurality of the upper punching dies 17a provided in the radial direction of the upper turret 21 is to be used, the punching device 15 is positioned above the desired die 17a by means of the fixed hydraulic cylinder 51 and the movable hydraulic cylinder 53. The piston rod 67 of the hydraulic striker cylinder 65 is projected downward and halted at bottom dead center. The piston rod 89 of the shift cylinder 87 provided in the disk support 81 is drawn back, and the residue disposal guide 95 of the slider 85 is positioned in the working area.

Then, the ram 11 is moved downward by the action of the crank shaft 10 acting as the mechanical type of vertically moving means, and the piston rod 67 of the hydraulic striker cylinder 65 strikes the upper punching dies 17, 17a to carry out a punching process. The punched residue drops downward through the residue disposal guide 95 and the residue hole 93.

Thereafter, the workpiece W is once again positioned, the above-mentioned process is repeated, so that a required series of punching operations are performed in the workpiece. During the turrets 21, 27 being rotated for the upper punching dies 17, 17a to be used being changed, the piston rod 67 of the hydraulic striker cylinder 65 is preferably retracted; with this retraction, the piston rod 67 is prevented from being collide with by the head of an upper punching die.

The above embodiment is advantageous in that it is unnecessary to operate the hydraulic striker cylinder 65 during the punching process since the piston rod 67 of the hydraulic striker cylinder 65 is fixed at bottom dead center during the punching process. Therefore the frequency of use is reduced and the life span is increased.

Furthermore, the striker device 15 provided on the lower end of the ram 11 is freely moved and positioned in the radial direction of upper turret 21, so that a plurality of upper dies can be mounted in the radial direction on the upper turret 21. For this reason, the number of dies which can be installed is increased and the effectiveness of the operation is improved.

Upward-forming process:

When an upward-forming process is performed in the workpiece W, a part of the workpiece W to be processed is positioned in the working area between the upper turret 21 and the lower turret 27 in the same manner as for the above-described punching process. Then, by controlling the rotation of the upper turret 21 and the lower turret 27, the desired upper upward-forming die 19 and lower upward-forming die 25 are positioned in the working area. Here, if a plurality of upper upward-forming dies provided in the radial direction of the upper turret 21 are to be used, the striker device 15 is positioned directly above the desired die by the fixed hydraulic cylinder 51 and the movable hydraulic cylinder 53.

The piston rod 89 of the shift cylinder 87 is extended, and the forming cylinder 97 of the slider 85 is positioned in the working area. In this way, the workpiece W is positioned and the upper and lower dies 19, 25 are set.

As shown in FIGS. 13 and 14, the crank shaft 10 is then rotated so that the piston rod (striker element) 67 and the upper die 19 are moved downward until the lower end of the upper die 19 is positioned just above the surface of the workpiece W. Here, it is to be noted that in the press shown in FIGS. 13-18, an elastic member 201 is provided under the die holder 99 for a purpose mentioned hereinafter.

As shown in FIG. 15, subsequently, the striker cylinder 65 is energized so that the upper die 19 is further moved downward until the lower end of the upper die is in contact with the surface of the workpiece W.

As shown in FIG. 16, the lower cylinder (forming cylinder) 97 in then energized so that the lower die 25 is moved upward. As a result, an upward forming is performed in the workpiece W by the die tip 101 of the lower die 25. Here, it is to be noted that the impulse force from die tip 102 on the workpiece W is buffered by the elastic member 201.

As shown in FIG. 17, the lower cylinder 97 is then de-energized, and the lower die 25 is moved downward by the restoring force of the elastic member 201 and the spring 105 (FIG. 10).

As shown in FIG. 18, the upper die 19 is subsequently moved upward to return its original position by the rotation of the crank shaft 10 and the upward movement of the upper cylinder 65.

It is now understood that in this embodiment, the workpiece W is maintained in its original height during forming. Thus, the workpiece is prevented from being damaged during the processing.

Furthermore, in the above embodiment, since the height of the upper die 19 can be adjusted within the stroke length of the striker cylinder 65, the forming in the workpieces W with different thickness can be easily performed; this is because, the workpieces W with different workpieces can be maintained in their respective original height during forming by adjusting the height of the lower end of the upper die 19.

In the above embodiments, the forming cylinder 97 is built into the right half of the slider 85 the above-mentioned embodiment and the residue disposal guide 95 is provided on the left half. In addition, the shift cylinder 87 is provided on the right side surface of the slider 85. However, the present invention is not limited to this positional relationship. Further, although the hydraulic shift cylinder 87 is used for moving the slider 85, the present invention is not limited to this configuration. For example, a combination of a drive motor and a geared device may be used.

Because the turret punch press of the present embodiment has a configuration as explained above, and the striker device with a hydraulic cylinder equipped with a vertically movable striker element on the lower end of the ram is provided, the amount of stroke of the striker element with respect to the upper die is the sum of the amount of stroke of the ram and the amount of stroke of the hydraulic cylinder. Accordingly, the upper die contacts the lower die and processing can occur only when

the ram and the striker element of the striker device are both at bottom dead center. Accordingly, during the punching process, the striker element of the striker device is normally positioned at bottom dead center, and, if the ram is lowered by the mechanical vertically moving means, the action of the hydraulic cylinder is unnecessary. Therefore the frequency of use is reduced, and the life span is increased. In addition, after the ram is lowered by the mechanical vertically moving means during the forming process, if the striker element of the hydraulic cylinder is lowered and the forming operation is performed, even if the ram is lowered rapidly by the mechanical vertically moving means, the upper die does not reach bottom dead center, therefore there is no impact on the lower die so no breakage or damage occurs. In addition, the adjustment of the height of the upper and lower dies need not be scrupulously performed as is required conventionally so operability is improved. In addition, because the disk support is secured below the lower turret, it is possible to support the lower turret against the striking force in the conventional manner. The movably positioned slider is provided in the disk support, and because the hydraulic cylinder which presses the lower upward-forming die upward and the residue hole through which the residue from the punching operation is dropped are provided, the hydraulic cylinder during the upward-forming process, or the residue hole during the punching process, can be selectively positioned at the process position. As a result, it is possible to handle both the upward-forming process and the punching process. Here, the lower upward-forming die is normally below the pass line so that is no obstacle when the lower turret rotates or when the workpiece is introduced. Because the hydraulic cylinder projects the lower upward-forming die upward to a position of a specified height during processing, a proper upward-forming process can be performed.

FIGS. 19-26 shows the second embodiment of the present invention.

As shown in FIGS. 25 and 26, a turret punch press 201 of the second embodiment is generally similar to that of the first embodiment. That is to say, the press 201 comprises a base 203, side frames 205, 207 provided on both sides of the base 203, and an upper frame 209 provided on the side frames 205, 207. A disk-like upper turret 211 is rotatably supported by an upper rotation axis 215a under the upper frame 209. A plurality of upper tools 211 for punching a workpiece W and upper tools 213 for forming of the workpiece W are removably installed on the upper turret 211. A disk-like lower turret 221 is rotatably supported by an lower rotation axis 221a in a way opposing the upper turret 211 and above the base 203. A plurality of lower tools 217 for punching the workpiece W and lower tools 219 for forming of the workpiece W are removably installed on the lower turret 221. A disc support 223 is secured on the base 203 under the lower turret 221. A ram 227 having a striker 225 for striking the upper tools 211, 213 is provided on the upper frame 209.

The upper and lower turrets 215, 217 are synchronously rotated by a servo motor (not shown) installed on the frames. Thus, during a punching operation, the desired upper and lower tools 211, 217 for punching are positioned in a working area where the workpiece W is processed. During a forming operation, the desired upper and lower tools 213, 219 for forming are positioned in the working area.

A pair of guide rails 229 extending in the Y direction (FIG. 25) are provided on the base 203. A pair of movable tables 233 are positioned, one on each side of a fixed table 231, and supported on the guide rails 229. The movable tables 233 are attached to a carriage base 235 extending in the X direction (FIG. 26) bridging the fixed table 231. A carriage 237 movable in the X direction perpendicular to the moving direction of the movable table 233 (Y direction) is provided on the carriage base 235. The carriage 237 is provided with a clamp device 239 for clamping an edge of the workpiece W.

Thus, positioning of the workpiece W is controlled by moving the carriage 237 in the X direction and by moving the carriage 237 on the guide rail 229 in the Y direction.

As shown in FIGS. 23 through 26, a plurality of upper tools 211 for punching are removably installed on the upper turret 215, and a plurality of upper tools 213 for forming are removably installed in tool installation holes 241 in the upper turret 215. The configuration of the upper tool 211 for punching is well known in the art, and therefore will not be described in detail. The upper tool 213 for forming is provided with a punch body 243 with a recess 245 at its lower end. The punch body 243 has a flange 247 at its upper end. A spring 249 which normally presses the flange 247 upward is provided between the flange 247 and the upper turret 215. The punch body 243 is slidably installed in a punch guide 251 mounted on the upper turret 215. The punch body 243 is supported by a spring 253 at the upper end of the punch guide 251. The spring constant of the spring 253 is larger than that of the spring 249. A flange 255 is formed in a way projecting outward from the upper end of the punch guide 251 to keep the punch guide 251 from dropping through the hole 241.

A plurality of lower tools 217 for punching are removably installed on the lower turret 221; a plurality of lower tools 219 for forming are removably installed in tool installation holes 257 in the lower turret 221. The configuration of the lower tool 217 for punching is well known in the art, and therefore will not be described in detail. The lower tool 219 for forming comprises a die holder 259, a die chip 261 integrally formed on the die holder and adapted to be inserted into the recess 245 of the punch body 243, and a work ejector 263 vertically movable with respect to the die chip 261. A spring 267 is provided between the work ejector 263 and the die holder 259 to push up the ejector 263. A spring 269 is provided between the die holder 259 and a flange 265 formed in the tool installation hole 257, to push down the die holder

259. Thus, the lower tool 219 in a normal state is below the pass line PL (the feed line for the workpiece W).

As shown in FIGS. 19 through 22, the disc support 223 includes a hollow rectangular parallelepiped block with apertures on the right side and on the upper and lower sides. Both side walls 223a and 223b mainly support the lower turret 221 from the underside. The thickness of the side walls 223a and 223b is determined so that the cross-sectional area thereof is larger than a predetermined area subject to pressure.

The disc support 223 contains a freely reciprocating movable block 271. The left end of the movable block 271 is connected to a piston rod 275 of a slide cylinder 273. The movable block 271 is formed as a rectangular parallelepiped to fit the inside configuration of the disc support 223. A through hole 277, through which punched scraps are dropped, is provided on the right half of the movable block 271. A press cylinder 279 with a piston rod 281 is embedded in the left half of the movable block 271 as means for pushing up the lower tool 219 for forming. A top 281a of the piston rod 281 pushes up the die holder 259, causing the lower tool 219 to project above the pass line PL (FIG. 24). During the punching operation, the piston rod 281 is retracted into the press cylinder 279, so that the lower tool 219 does not project above the pass line PL (FIG. 23).

In operation, as shown in FIGS. 25 and 26, the carriage 237 clamping the workpiece W moves in the X direction on the carriage base 235. In addition, the carriage base 235 moves on the guide rails 229 in the Y direction, so that the part of the workpiece W to be processed is positioned in the working area between the upper lower turrets 215 and 221.

In the punching operation, as shown in FIGS. 19 and 20, the desired upper and lower tools 211, 217 are positioned in the working area by synchronously rotating the upper and lower turrets 215, 221 by means of servo motors (not shown). The piston rod 275 of the slide cylinder 273 is then retracted to move the movable block to position the through hole 277 in the working area, after which the striker 225 (FIG. 25) strikes the upper tool 211 to perform the punching in a workpiece. The punched scraps drop down through the through hole 277.

In the forming operation, as shown in FIGS. 21 and 22, the part of the workpiece W to be processed is positioned in the working area between the upper and lower turrets 215, 221 in the same manner as for the punching. The desired upper and lower tools are positioned in the working area by rotating the upper and lower turrets 215, 221 by means of the servo motors.

The piston rod 275 of the slide cylinder 273 is extended to move the movable block 271 to position the press cylinder 279 in the working area.

The right end of the movable block 271 projects from the aperture at the right side of the disc support 223 (FIGS. 21 and 22).

At this stage, the piston rod 281 of the press cylinder 279 is retracted so that the lower tool 219 does not project above the pass line PL, as shown in FIG. 23. The piston rod 281 is then extended to push up the die holder 259, as shown in FIG. 24, so that the lower tool 219 projects above the pass line PL. The striker 225 strikes the upper end of the punch body 243 which descends accordingly together with the punch guide 251. The spring 253 also descends and is not compressed until the flange 255 of the punch guide 251 comes into contact with the upper face of the upper turret 215. When the striker 225 further descends, the punch body 243 descends compressing the spring 253, and a forming is performed in the workpiece.

After completion of the forming process, the striker 225 is elevated and the spring 253 extends by its restoring force to press up the punch body 243. The striker 225 further ascends and then the spring 249 extends to raise the punch body 243 with the punch guide 251. On the other hand, the piston rod 281 of the press cylinder 279 is retracted and the die holder 259 with the die chip 261 is pressed down by the restoring force of the spring 269. Consequently, the work ejector 263 is raised with respect to the die holder 259 by the restoring force of the spring 267, thereby pushing up the workpiece W and releasing it from the die chip 261.

Alternatively, it is to be understood that after positioning the upper and lower tools 213, 219, the striker 225 can descend to the original bottom dead point so that the upper tool 213 abuts the upper surface of the upper turret 215. Thereafter the piston rod 281 of the press cylinder 279 can be extended to push up the die holder 259 to perform forming of the workpiece W. That is, pushing up the lower tool 219 for forming is equivalent to lowering the striker 225 with respect to the lower tool 219. The striker 225 is vertically actuated by a hydraulic cylinder.

According to the above embodiment, the disc support 223 is secured to the base 203 in the working area and the thickness of the side walls 223a, 223b is determined so that the cross-sectional area is greater than the predetermined area subject to pressure. Accordingly, the upper turret 221 is reliably supported during striking. Further, since the position of the lower tool is not changed with respect to the upper turret 215 and the upper tools 211, 213, high-precision processing can be achieved.

The upper and lower turrets 215, 221 are provided with tools for punching and forming, thus the tools can be readily changed only by rotating the turrets 215, 221. Further, the disc support 223 contains the movable block 271 having the press cylinder 279 to push up the lower tool 219, and the through hole 277 through which punched scraps are discharged. This means that the disc support 223 functions as both a support for the lower turret and a push-up means for the lower tool. If a support for the lower turret and a push-up means for the lower tool were provided separately, a changing operation would be required. According to the invention, however, punching and forming can be performed without such a changing operation.

The workpiece W can be processed without damage since the lower tool 219 for the forming, is normally below

the path line PL and therefore does not interfere with the positioning operation of the workpiece W. When the turrets rotate after positioning the workpiece W in the working area, the workpiece W does not interfere with the lower tool for forming. Accordingly, the workpiece remains level, thus the workpiece W is properly processed.

While the above embodiment has been described with the movable block 271 with the through hole 277 on its right and the press cylinder on its left, and with the slide cylinder 273 at the left side, it should be understood that any other arrangement can be employed. Further, while the slide cylinder 273 is used to move the movable block 271, any other suitable means to control the positioning of the movable block 271, for example, a drive motor combined with a gear assembly could be employed.

## Claims

1. A turret punch press comprising :
   a frame (5,7,9) ;
   upper and lower dies (17,19;23,25) mounted on the frame (5, 7, 9) in such a way to oppose each other and to perform processing on a workpiece provided therebetween ;
   a striker (67) mounted on the frame so as to move in the vertical direction and adapted to be in contact with the head of the upper die (17,19) ; and
   upper drive means mounted on the frame for causing the striker (67) to move in the vertical direction, the upper drive means including a ram (11), characterised in that
   the upper and lower dies (17,19;23,25) are adapted to be slidable in the vertical direction so as to cooperate with each other, in that
   the upper drive means further comprises a sub-upper-drive means (65) mounted on the ram (11) for moving the striker (67) relative to the ram and adapted to fix the striker (67) in the vertical direction at any height relatively to the ram (11) within a predetermined interval, and in that
   lower drive means (97) is mounted on the frame for causing the lower die to move upward.

2. The press of claim 1, wherein the upper drive means includes a crank shaft (10) mounted on the frame (5,7,9), the ram (11) being vertically slidably mounted on the frame (5,7,9) and coupled to the crank shaft (10) so as to be driven by the crank shaft (10).

3. The press of claim 1 or 2, wherein at least one of the lower drive means (97) and the sub-upper-drive means (65) includes a hydraulic cylinder.

4. The press of any one of claims 1 to 3, wherein upper drive means is adapted to fix the striker (67) in the vertical direction at a height corresponding to the height of the upper die (17,19) and where the lower end of the upper die (17,19) is on the pass-line of the workpiece (w).

5. The press of any one of claims 1 to 4, wherein the lower drive means (97) is adapted to be horizontally movable so that the lower drive means (97) can be positioned horizontally away from the processing position under the ram.

6. The press of any one of claims 1 to 5, wherein the press is a turret punch press, the upper and lower dies (17,19;23,25) being mounted on upper and lower turrets (21,27) respectively, the striker (67) being provided on the lower end of the ram (11).

7. The press of claim 6, wherein said upper dies (17,19) comprise an upper die for punching (17) and an upper die for forming (19), and said lower dies (23,25) comprise a lower die for punching (23) and a lower die for forming (25) ; and wherein during a punching process said striker (67) is positioned at its bottom dead centre, and during a forming process said striker is initially positioned at its top dead centre and then extended to form the workpiece (w) until it reaches the bottom dead centre.

8. The press of claim 7, wherein the striker (67) is movable in the radial direction of the upper turret (21), the press further comprising means for moving the striker (67) in the radial direction of the upper turret (21).

9. The press of any one of claims 1 to 6, in which the upper dies (17,19) comprise an upper die (17) for punching and an upper die (19) for forming ; and the lower dies (23,23) comprise a lower die for punching (23) and a lower die for forming (25), the press further comprising a disk support (81) for supporting the lower dies (23,25) in a processing position ; and
   a freely movable slider (85) provided in the disk support (81), said slider (85) including,

   (a) the lower drive means (97) for pushing up the lower die for forming (23) positioned at an operating position where the upper and lower dies (17,19;23,25) work together, and
   (b) a residue hole (93) into which the residue from the punching operation drops, selectively positioned in the processing position.

10. A method of performing a forming process on a workpiece (w) using a press according to any preceding claim, the method comprising the steps of:
    moving the upper die (23,25) downward to an operating height, by operating the striker by means of the upper drive means until the lower end of the upper die (23,25) is in contact with the upper surface of the workpiece (w);

fixing the upper die at the operating height by fixing the striker at a corresponding height; and

moving the lower die (23,25) upward by means of the lower drive means (97).

**Patentansprüche**

1. Eine Revolverstanzpresse umfassend:
einen Rahmen (5,7,9);
einen oberen und einen unteren Stempel (17,19;23,25), die an dem Rahmen (5,7,9) derart angebracht sind, daß sie einander gegenüberliegen und eine Bearbeitung an einem Werkstück durchführen, das dazwischen vorgesehen ist;
ein Schlagteil (67), das an dem Rahmen so angebracht ist, daß es sich in der vertikalen Richtung bewegt und mit dem Kopf des oberen Stempels (17,19) in Berührung sein kann; und
eine obere Antriebsvorrichtung, die an dem Rahmen angebracht ist, damit sich das Schlagteil (67) in der vertikalen Richtung bewegt, wobei die obere Antriebsvorrichtung einen Stößel (11) einschließt, **dadurch gekennzeichnet,** daß
der obere und der untere Stempel (17,19;23,25) in der vertikalen Richtung so verschiebbar sind, daß sie miteinander zusammenarbeiten, daß
die obere Antriebsvorrichtung ferner eine zusätzliche obere Antriebsvorrichtung (65) umfaßt, die an dem Stößel (11) angebracht ist, um das Schlagteil (67) relativ zu dem Stößel zu bewegen, und das Schlagteil (67) in der vertikalen Richtung auf irgendeiner beliebigen Höhe in bezug auf den Stößel (11) innerhalb eines vorbestimmten Intervalls befestigen kann, und daß
eine untere Antriebsvorrichtung (97) an dem Rahmen angebracht ist, um zu bewirken, daß der untere Stempel aufwärtsbewegt wird.

2. Die Presse des Anspruchs 1, in der die obere Antriebsvorrichtung eine Kurbelwelle (10) einschließt, die an dem Rahmen (5,7,9) angebracht ist, wobei der Stößel (11) vertikal verschiebbar an dem Rahmen (5,7,9) angebracht und mit der Kurbelwelle (10) so gekoppelt ist, daß sie durch die Kurbelwelle (10) angetrieben wird.

3. Die Presse des Anspruchs 1 oder 2, in der mindestens die untere Antriebsvorrichtung (97) oder die zusätzliche Antriebsvorrichtung (65) einen hydraulischen Zylinder einschließt.

4. Die Presse nach irgendeinem der Ansprüche 1 bis 3, in der die obere Antriebsvorrichtung das Schlagteil (67) in der vertikalen Richtung auf einer Höhe befestigen kann, die der Höhe des oberen Stempels (17,19) entspricht, und wo das untere Ende des oberen Stempels (17,19) auf der Durchgangsbahn des Werkstücks (w) ist.

5. Die Presse nach irgendeinem der Ansprüche 1 bis 4, in der die untere Antriebsvorrichtung (97) horizontal so bewegbar ist, daß die untere Antriebsvorrichtung (97) horizontal von der Bearbeitungsposition unter dem Stößel fort positioniert werden kann.

6. Die Presse nach irgendeinem der Ansprüche 1 bis 5, in der die Presse eine Revolverstanzpresse ist, wobei der obere und der untere Stempel (17,19;23,25) an einem oberen bzw. unteren Revolverkopf (21,25) angebracht sind, wobei das Schlagteil (67) an dem unteren Ende des Stößels (11) vorgesehen ist.

7. Die Presse des Anspruchs 6, in der die genannten oberen Stempel (17,19) einen oberen Stempel zum Stanzen (17) und einen oberen Stempel zum Formen (19) umfassen und die genannten unteren Stempel (23,25) einen unteren Stempel zum Stanzen (23) und einen unteren Stempel zum Formen (25) umfassen; und in der während eines Stanzvorgangs das genannte Schlagteil (67) an seinem unteren Totpunkt positioniert ist, und während eines Formungsvorgangs das genannte Schlagteil anfangs an seinem oberen Totpunkt positioniert wird und dann fortgesetzt wird, um das Werkstück (w) zu formen, bis es den unteren Totpunkt erreicht.

8. Die Presse des Anspruchs 7, in der das Schlagteil (67) in der radialen Richtung des oberen Revolverkopfes (21) bewegbar ist, wobei die Presse ferner eine Vorrichtung umfaßt, um das Schlagteil (67) in der radialen Richtung des oberen Revolverkopfes (21) zu bewegen.

9. Die Presse nach irgendeinem der Ansprüche 1 bis 6, in der die oberen Stempel (17,19) einen oberen Stempel (17) zum Stanzen und einen oberen Stempel (19) zum Formen umfassen; und die unteren Stempel (23,25) einen unteren Stempel zum Stanzen (23) und einen unteren Stempel zum Formen (25) umfassen, wobei die Presse ferner eine Scheibenhalterung (81) umfaßt, um die unteren Stempel (23,25) in einer Bearbeitungsposition zu halten; und ein frei bewegbares Gleitteil (85), das in der Scheibenhalterung (81) vorgesehen ist, wobei das genannte Gleitteil (85) einschließt,

(a) die untere Antriebsvorrichtung (97), um den unteren Stempel zum Formen (23) nach oben zu drücken, wobei er in einer Arbeitsposition angeordnet ist, wo die oberen und unteren Stempel (17,19;23,25) zusammenarbeiten, und

(b) ein Abfalloch (93), in das der Abfall von dem Stanzvorgang hineinfällt, das wahlweise in der Bearbeitungsposition angeordnet ist.

10. Ein Verfahren zum Durchführen eines Formungsvorgangs an einem Werkstück (w), wobei eine Presse gemäß irgendeinem der vorhergehenden Ansprüche verwendet wird, wobei das Verfahren die Schritte umfaßt:
Bewegen des oberen Stempels (23,25) nach unten auf eine Arbeitshöhe, indem das Schlagteil mittels der oberen Antriebsvorrichtung betätigt wird, bis das untere Ende des oberen Stempels (23,25) mit der oberen Oberfläche des Werkstücks (w) in Berührung ist;
Befestigen des oberen Stempels auf der Arbeitshöhe durch Befestigen des Schlagteils auf einer entsprechenden Höhe; und
Bewegen des unteren Stempels (23,25) mittels der unteren Antriebsvorrichtung (97) nach oben.

**Revendications**

1. Poinçonneuse à tourelle revolver comportant :
un bâti (5, 7, 9);
des matrices supérieures et inférieures (17, 19; 23, 25) montées sur le bâti (5, 7, 9) de manière à être opposée l'une à l'autre et à réaliser un traitement sur une pièce prévue entre elles;
un percuteur (67) monté sur le bâti de façon à se déplacer dans la direction verticale et prévu pour être en contact avec la tête de la matrice supérieure (17, 19); et
des moyens d'entraînement supérieur montés sur le bâti afin d'amener le percuteur (67) à se déplacer dans la direction verticale, les moyens d'entraînement supérieur comprenant un vérin (11), caractérisée en ce que
les matrices supérieures et inférieures (17, 19; 23, 25) sont prévues pour pouvoir coulisser dans la direction verticale de façon à coopérer l'une avec l'autre, en ce que
les moyens d'entraînement supérieur comportent des moyens secondaires d'entraînement supérieur (65) montés sur le vérin (11) afin de déplacer le percuteur (67) par rapport au vérin et prévus pour fixer le percuteur (67) dans la direction verticale à une hauteur quelconque par rapport au vérin (11) dans un intervalle prédéterminé, et en ce que
des moyens d'entraînement inférieur (97) sont montés sur le bâti afin d'amener la matrice inférieure à se déplacer vers le haut.

2. Poinçonneuse selon la revendication 1, dans laquelle les moyens d'entraînement supérieur comportent un vilebrequin (10) monté sur le bâti (5, 7, 9), le vérin (11) étant monté de façon verticalement coulissante sur le bâti (5, 7, 9) et relié au vilebrequin (10) de façon à être entraîné par le vilebrequin (10).

3. Poinçonneuse selon la revendication 1 ou 2, dans laquelle au moins un des moyens d'entraînement inférieur (97) et des moyens secondaires d'entraînement supérieur (65) comprend un vérin hydraulique.

4. Poinçonneuse selon l'une quelconque des revendications 1 à 3, dans laquelle des moyens d'entraînement supérieur sont prévus pour fixer le percuteur (67) dans la direction verticale à une hauteur correspondant à la hauteur de la matrice supérieure (17, 19) et où l'extrémité inférieure de la matrice supérieure (17, 19) est sur l'axe de la pièce (W).

5. Poinçonneuse selon l'une quelconque des revendications 1 à 4, dans laquelle les moyens d'entraînement inférieur (97) sont prévus pour être mobiles horizontalement de telle sorte que les moyens d'entraînement inférieur (97) peuvent être positionnés horizontalement à l'écart de la position de traitement sous le vérin.

6. Poinçonneuse selon l'une quelconque des revendications 1 à 5, dans laquelle la poinçonneuse est une poinçonneuse à tourelle revolver, les matrices supérieures et inférieures (17, 19; 23, 25) étant montées sur des tourelles supérieure et inférieure (21, 27) respectivement, le percuteur (67) étant prévu sur l'extrémité inférieure du vérin (11).

7. Poinçonneuse selon la revendication 6, dans laquelle lesdites matrices supérieures (17, 19) comportent une matrice supérieure pour le poinçonnage (17) et une matrice supérieure pour le formage (19), et lesdites matrices inférieures (23, 25) comportent une matrice inférieure pour le poinçonnage (23) et une matrice inférieure pour le formage (25); et dans laquelle, pendant le processus de poinçonnage, ledit percuteur (67) est positionné au niveau de son point mort bas, et pendant un processus de formage, ledit percuteur est positionné initialement au niveau de son point mort haut et s'étend ensuite afin de former la pièce (W) jusqu'à ce qu'il atteigne le point mort bas.

8. Poinçonneuse selon la revendication 7, dans laquelle le percuteur (67) est mobile dans la direction radiale de la tourelle supérieure (21), la poinçonneuse comportant en outre des moyens destinés à déplacer le percuteur (67) dans la direction radiale de la tourelle supérieure (21).

9. Poinçonneuse selon l'une quelconque des revendications 1 à 6, dans laquelle les matrices supérieures (17, 19) comportent une matrice supérieure (17) pour le poinçonnage et une matrice supérieure (19) pour le formage; et les matrices inférieures (23, 25) comportent une matrice inférieure pour le poinçonnage (23) et une matrice inférieure pour le formage (25), la poinçonneuse comportant en outre un support de disque (81) destiné à supporter les matrices inférieures (23, 25) dans une position de traitement;

et

un coulisseau librement mobile (85) prévu dans le support de disque (81), ledit coulisseau (85) comprenant,

(a) les moyens d'entraînement inférieur (97) destinés à pousser vers le haut la matrice inférieure pour le formage (23) positionnée dans une position de travail où les matrices supérieures et inférieures (17, 19; 23, 25) travaillent ensemble; et

(b) un trou pour résidu (93) dans lequel tombe le résidu de l'opération de poinçonnage, positionné de manière sélective dans la position de traitement.

**10.** Procédé de mise en oeuvre d'un processus de formage sur une pièce (W) en utilisant une poinçonneuse selon l'une quelconque des revendications précédentes, le procédé comportant les étapes consistant à :

déplacer vers le bas la matrice supérieure (23, 25) jusqu'à une hauteur de travail, en actionnant le percuteur à l'aide des moyens d'entraînement supérieur jusqu'à ce que l'extrémité inférieure de la matrice supérieure (23, 25) soit en contact avec la surface supérieure de la pièce (W);

fixer la matrice supérieure à une hauteur de travail en fixant le percuteur à une hauteur correspondante; et

déplacer vers le haut la matrice inférieure (23, 25) à l'aide des moyens d'entraînement inférieur (97).

FIG.1

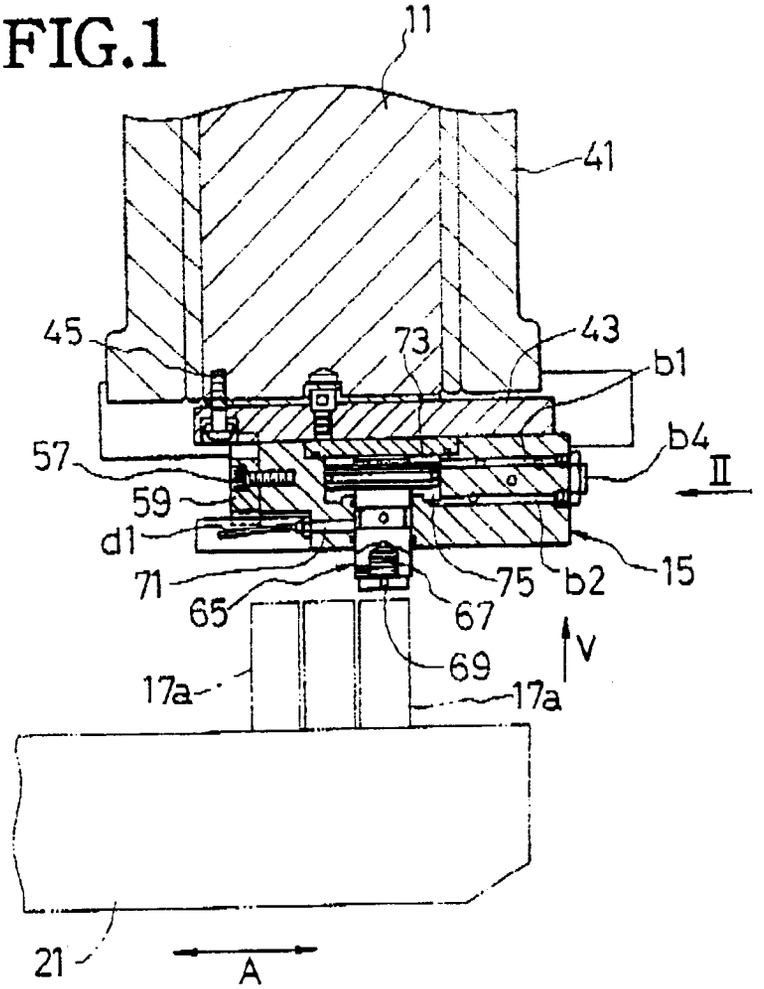

11
41
45
73
43
b1
57
b4
II
59
d1
15
71
75
b2
65
67
V
69
17a
17a
21
A

FIG.2

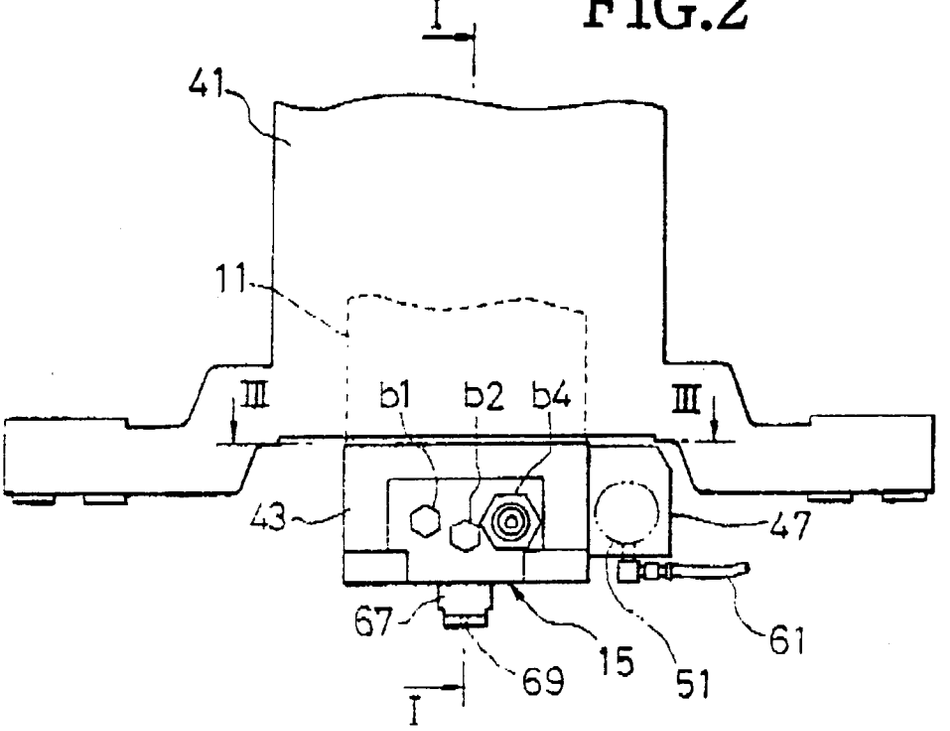

I
41
11
III
b1
b2
b4
III
43
47
67
61
15
69
51
I

FIG.3

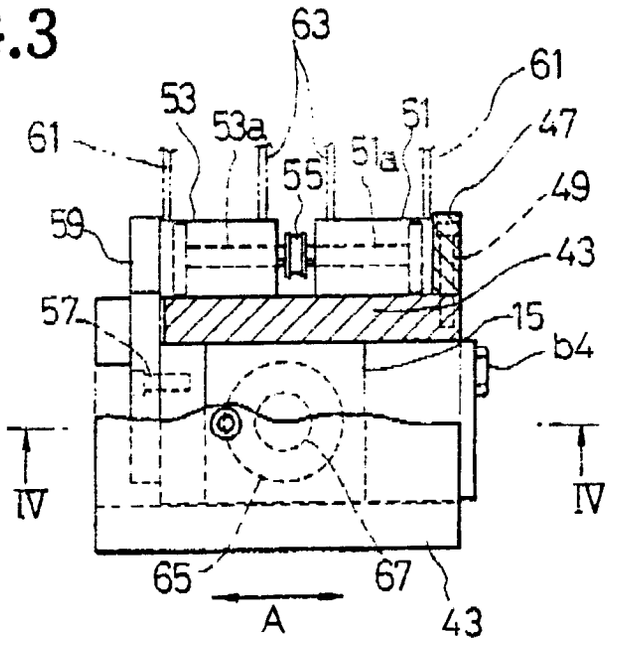

63
61
53
53a
61
51
47
55
51a
49
59
43
57
15
b4
IV
IV
65
67
A
43

FIG.6

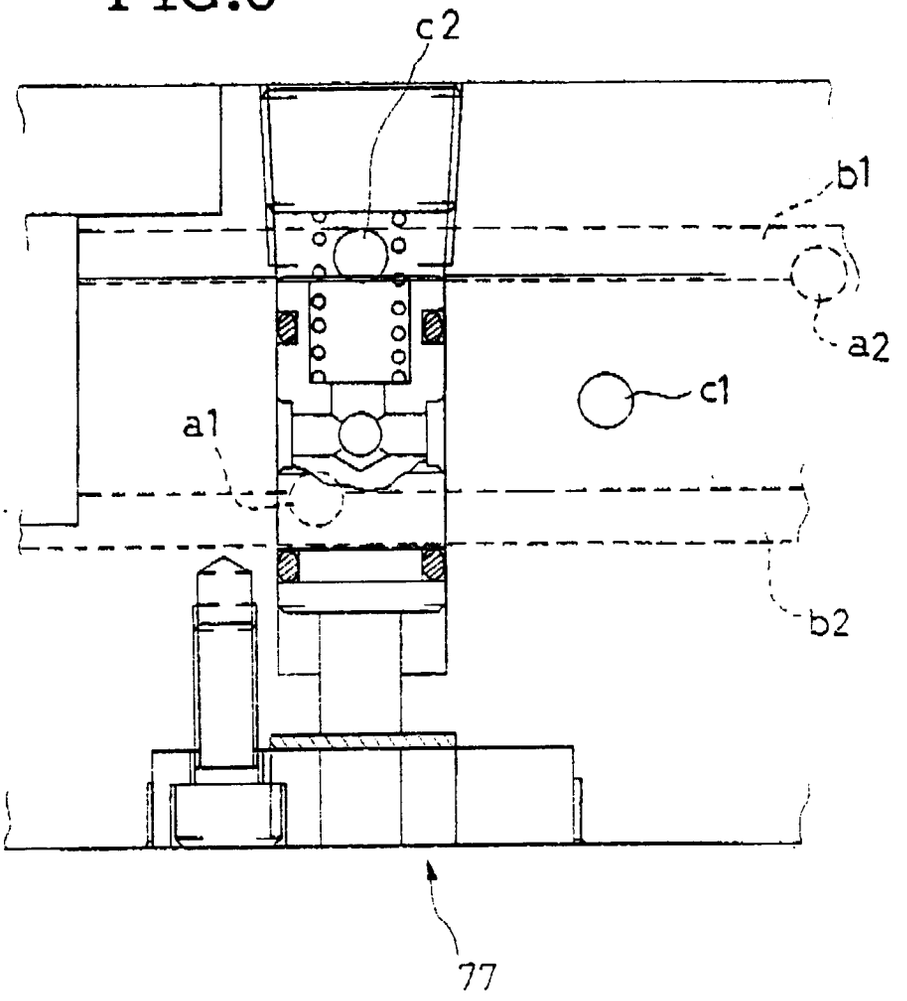

c2
b1
a2
c1
a1
b2
77

FIG.4

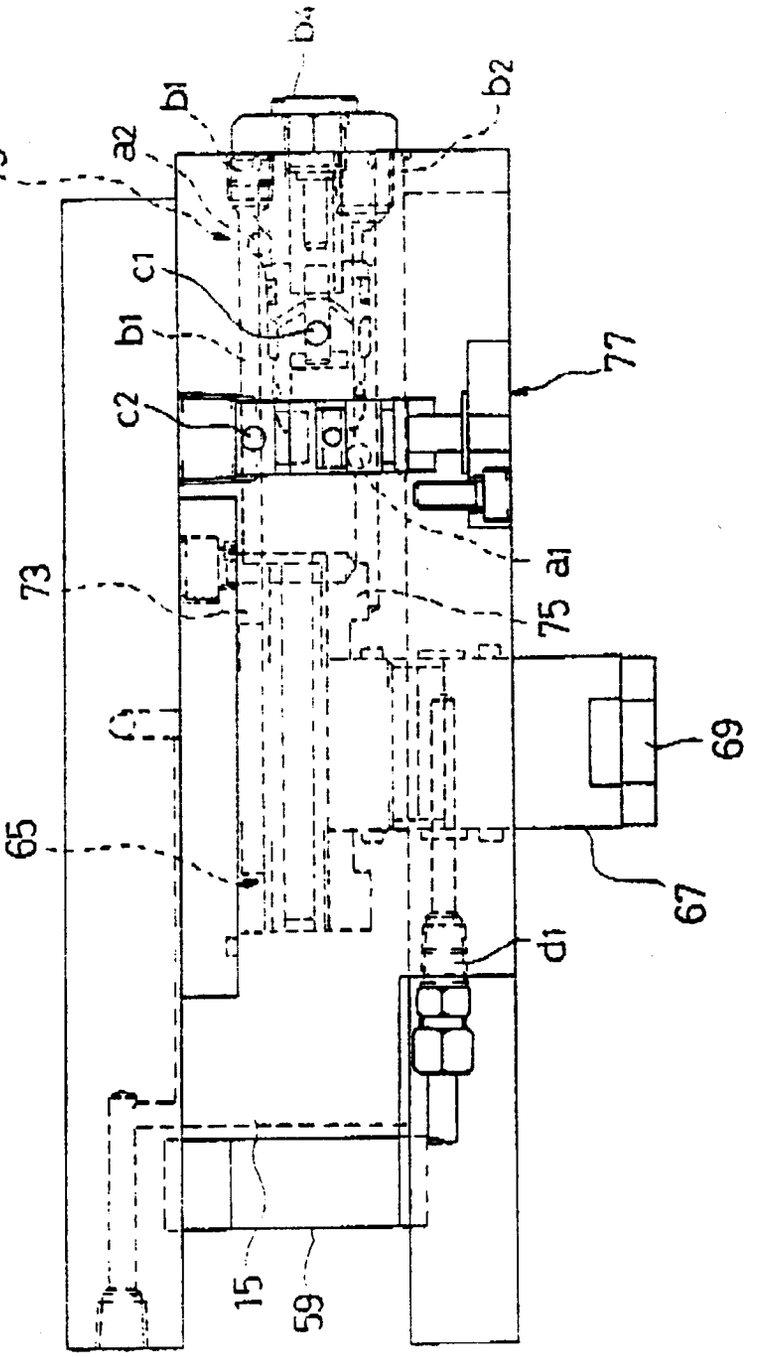


FIG.5

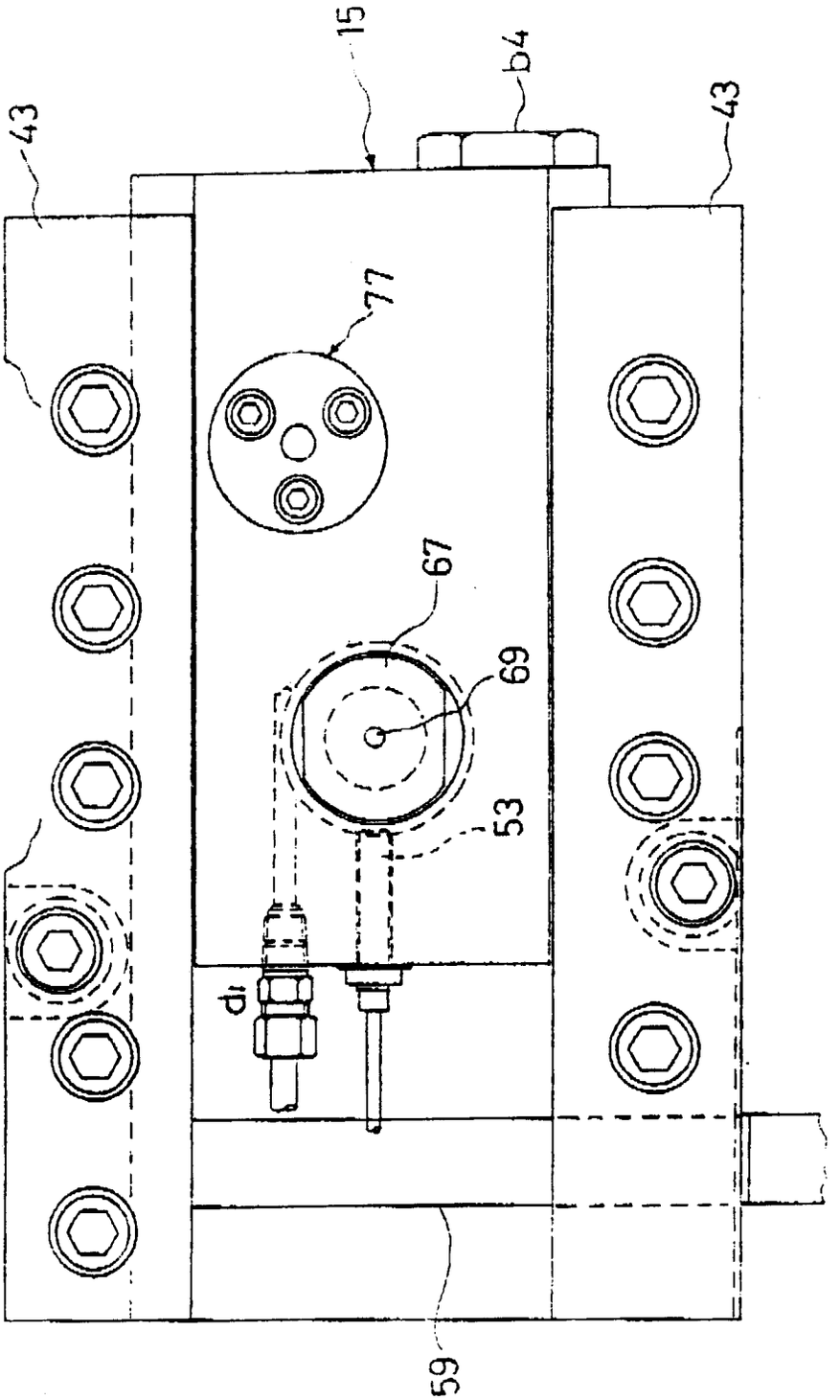


FIG.7

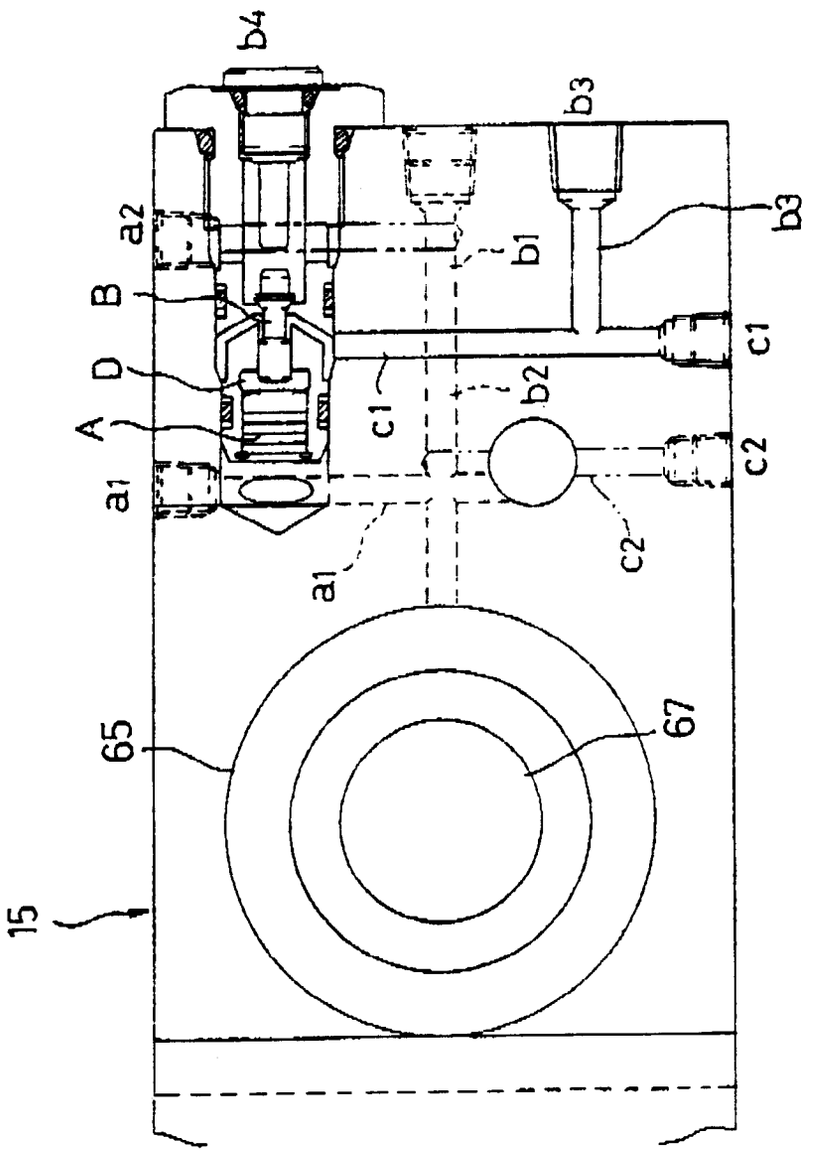


FIG.8

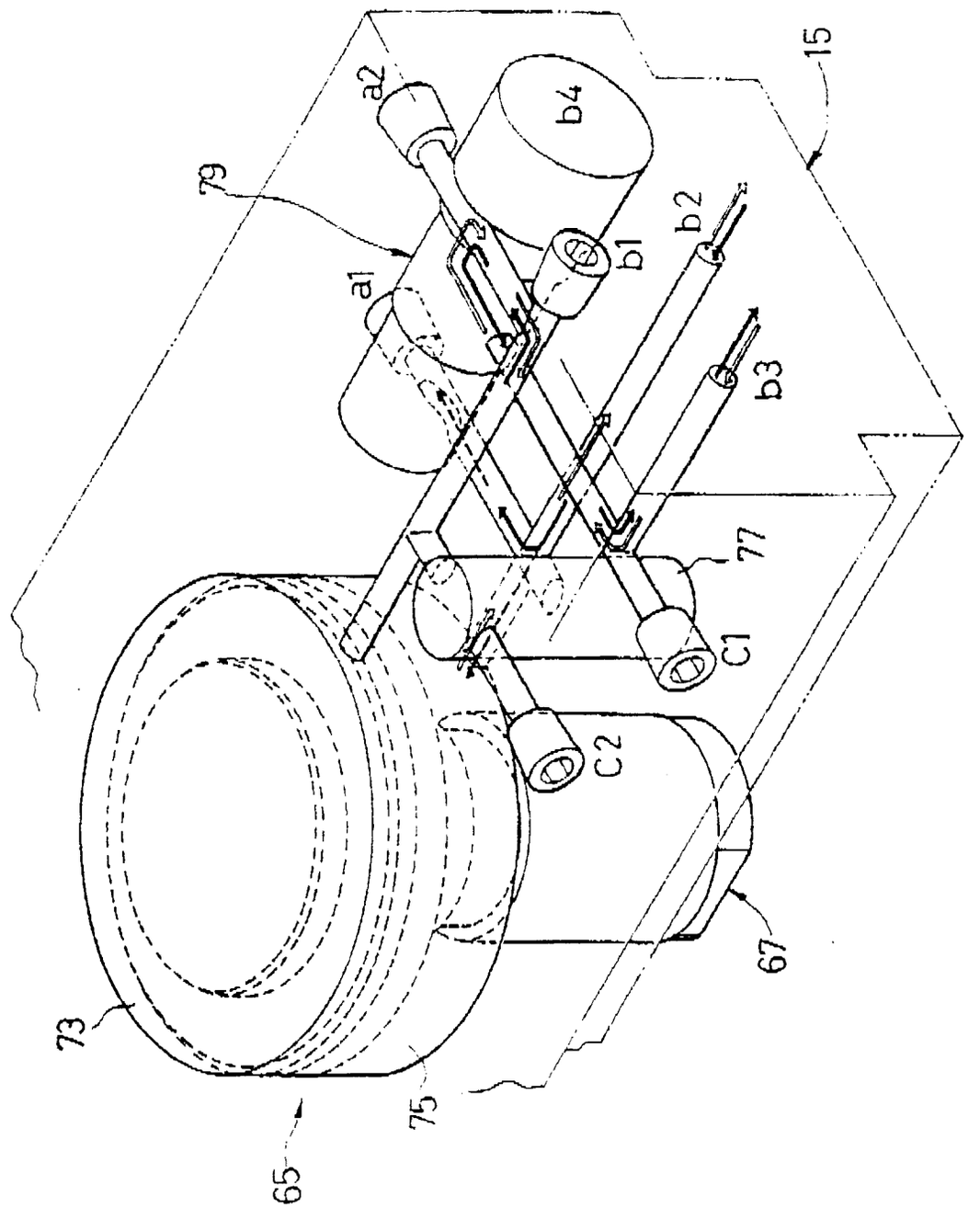


FIG.9

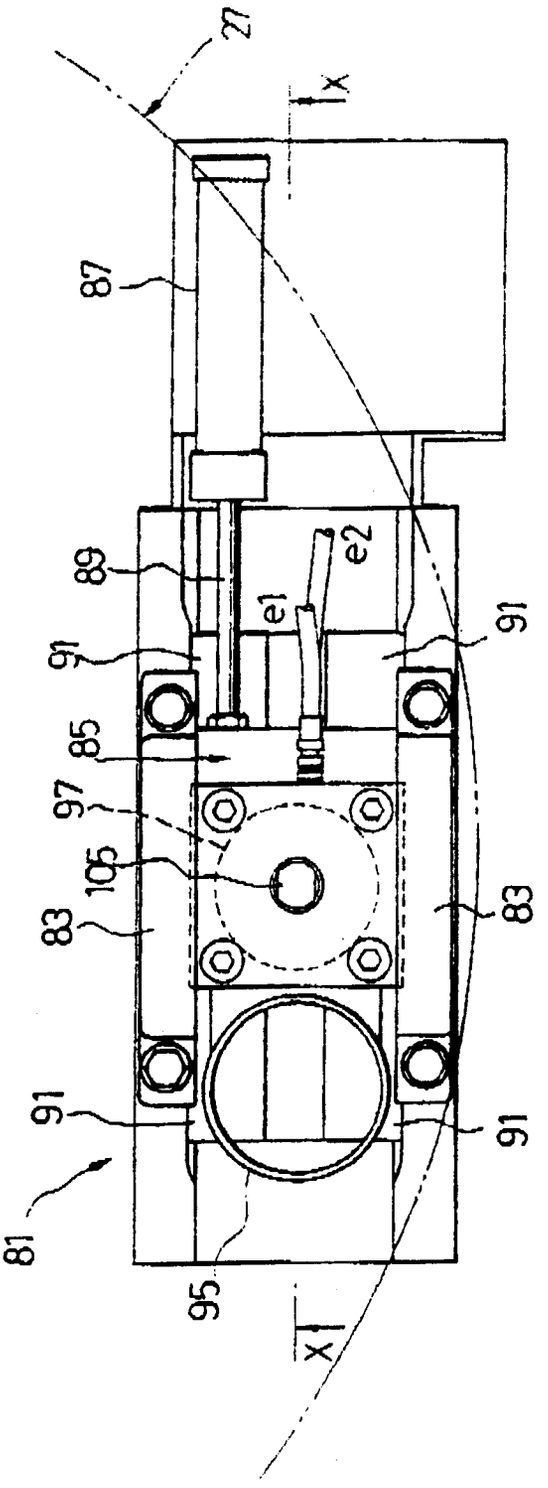


FIG.10

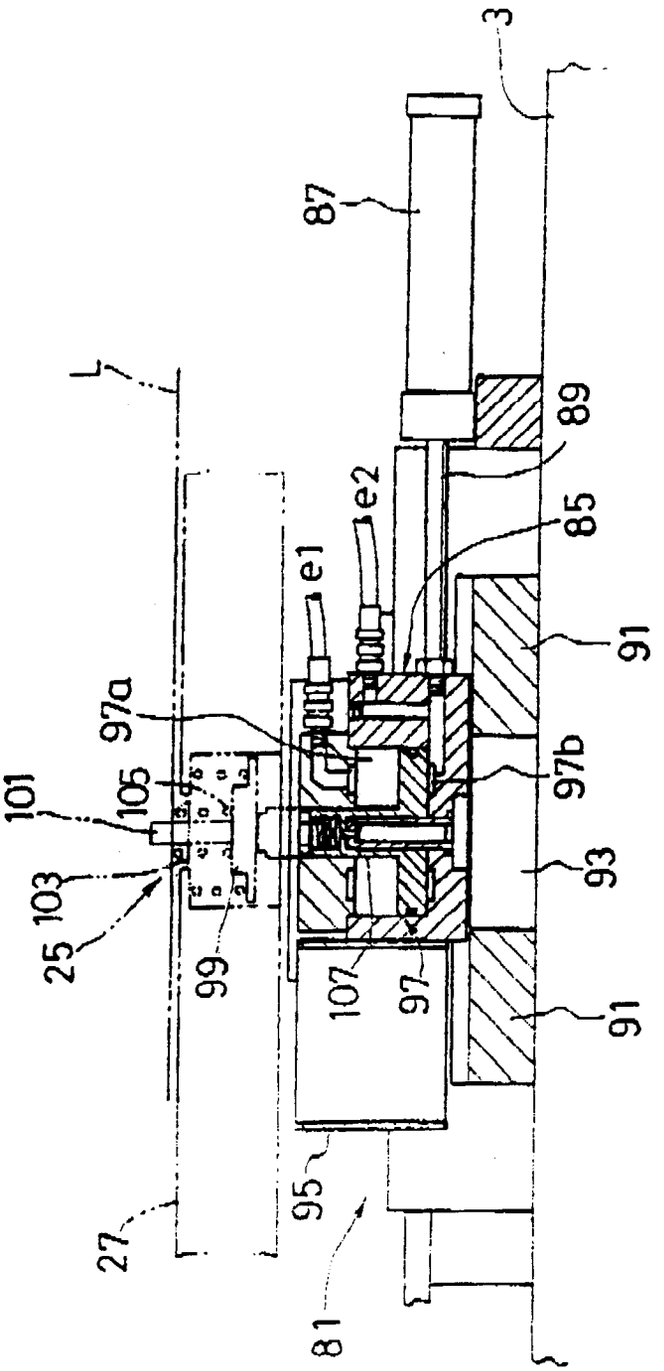


FIG.11

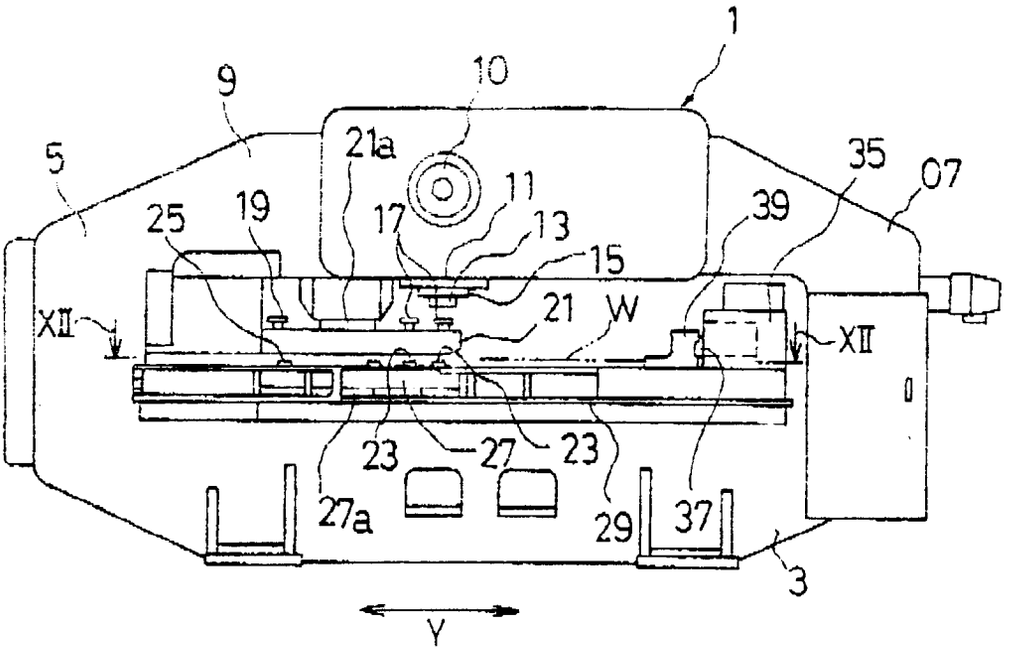

1
9
10
21a
5
35
07
11
25
19
17
13
39
15
XII
21
W
XII
23
27
23
27a
29
37
3
Y

FIG.12

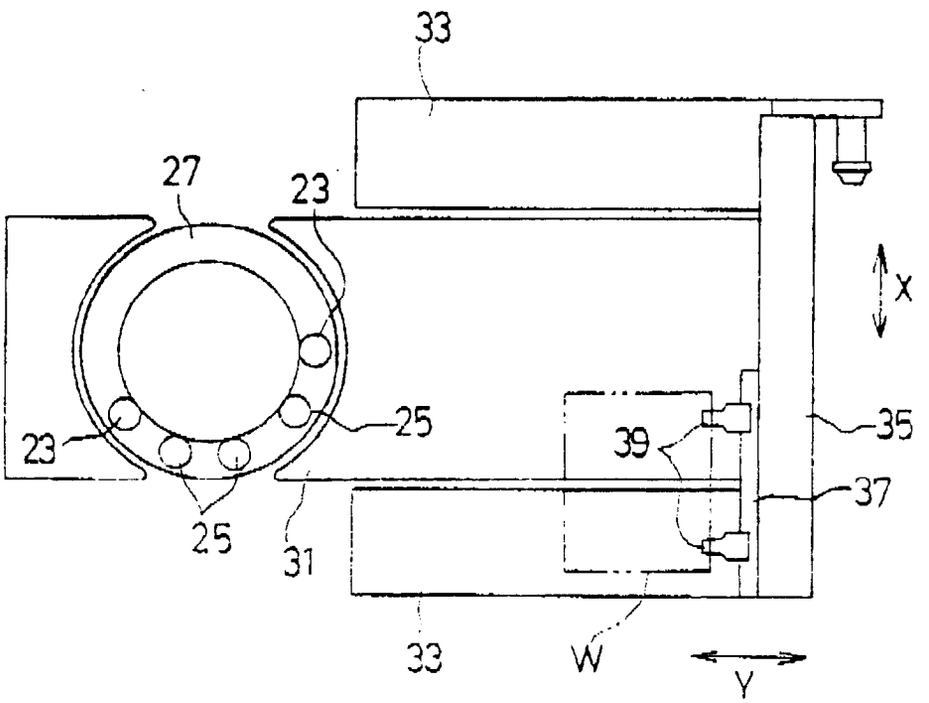

33
27
23
X
25
35
23
39
37
25
31
33
W
Y

FIG.13

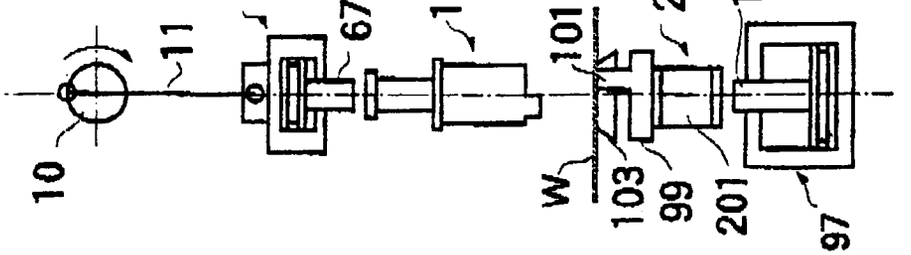



FIG.14

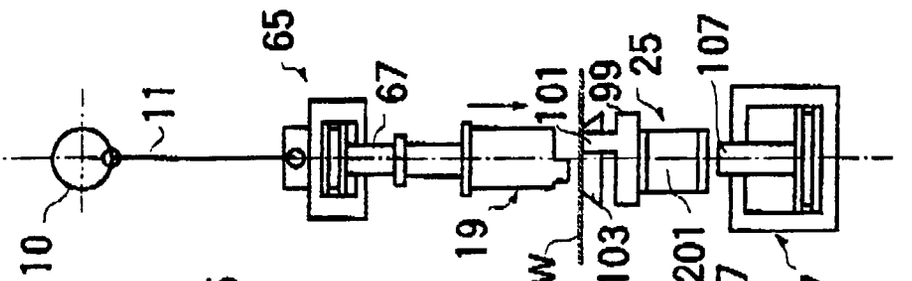



FIG.15

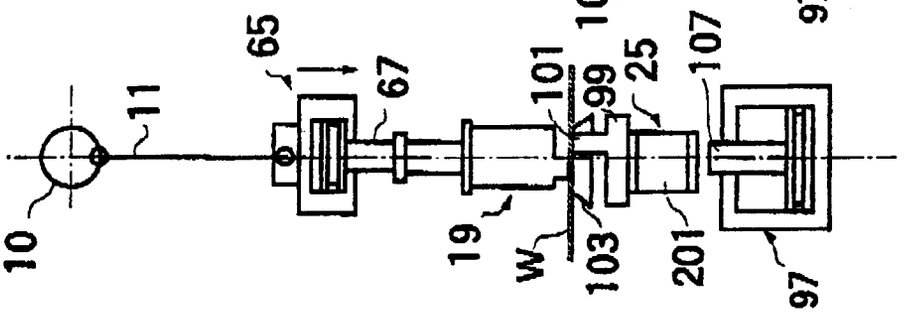



FIG.16

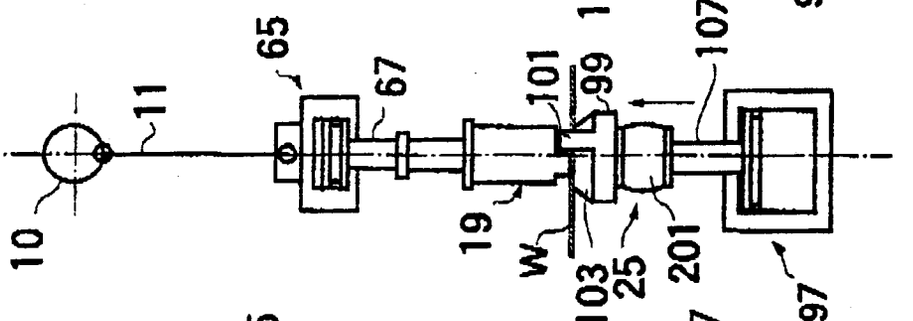



FIG.17

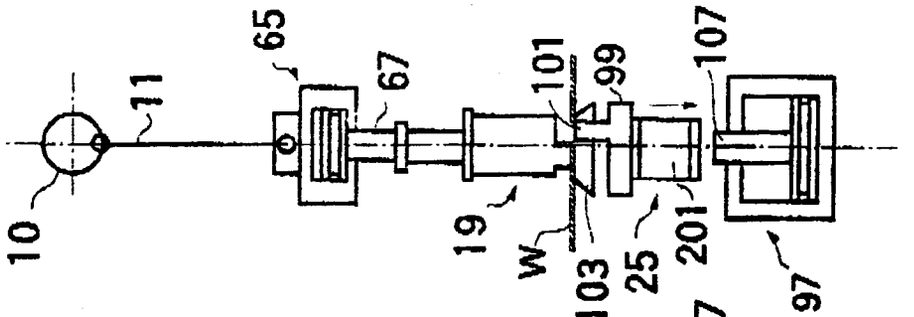



FIG.18

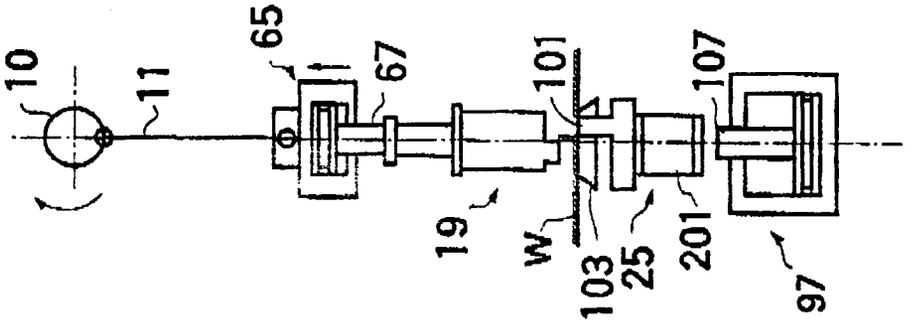


FIG.19

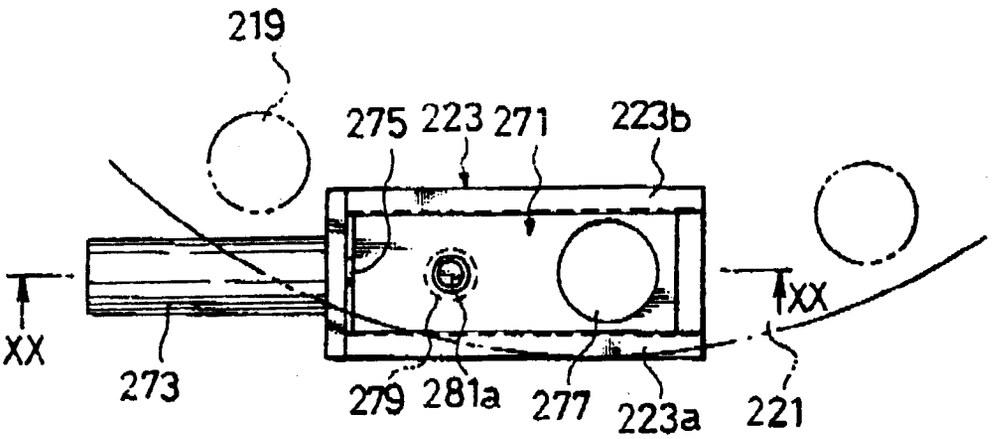

219
275
223
271
223b
XX
XX
273
279
281a
277
223a
221

FIG.20

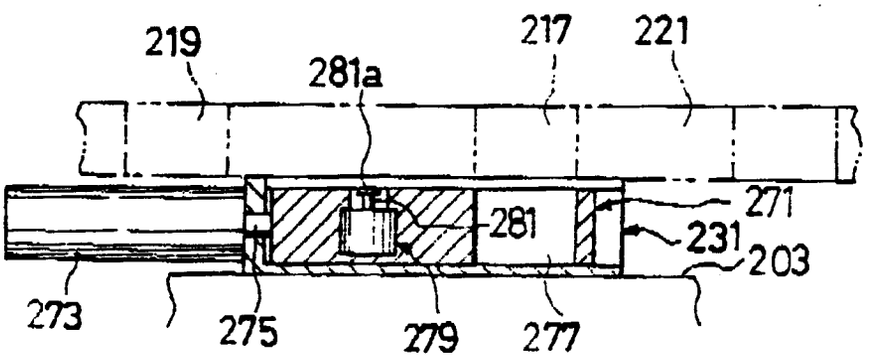

219
281a
217
221
271
281
231
203
273
275
279
277

FIG.21

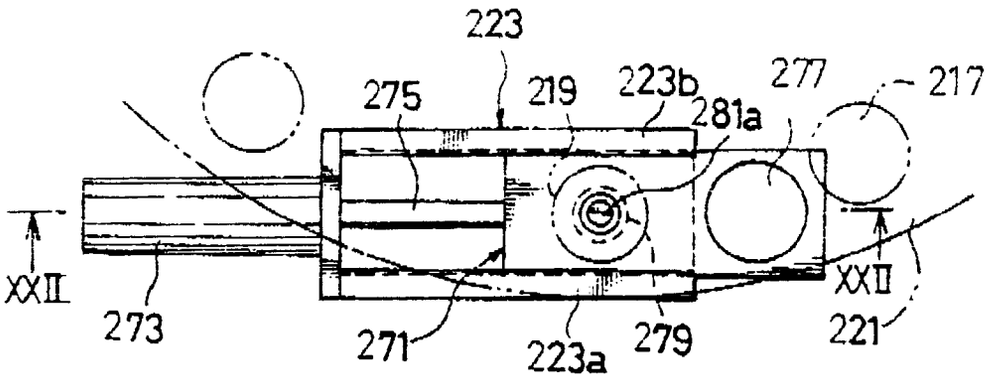

223
275
219
223b
277
217
281a
XXII
XXII
273
271
223a
279
221

FIG.22

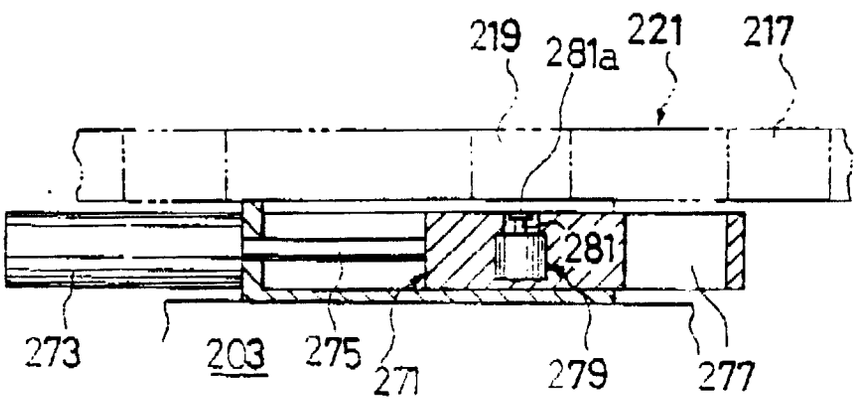

219
281a
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217
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FIG.23

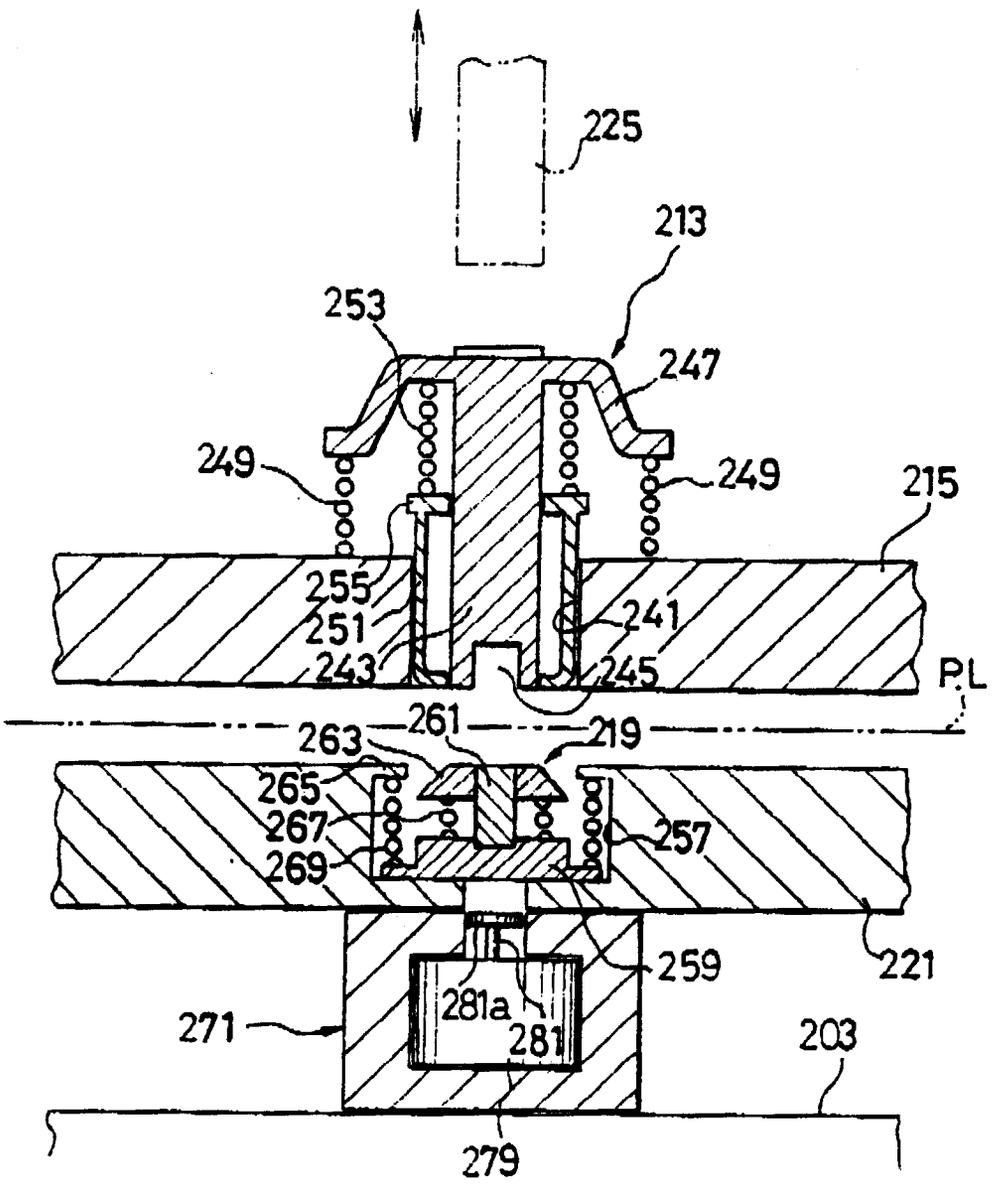

225
213
253
247
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215
255
251
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241
245
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263
261
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257
259
221
271
281a
281
203
279

FIG.24

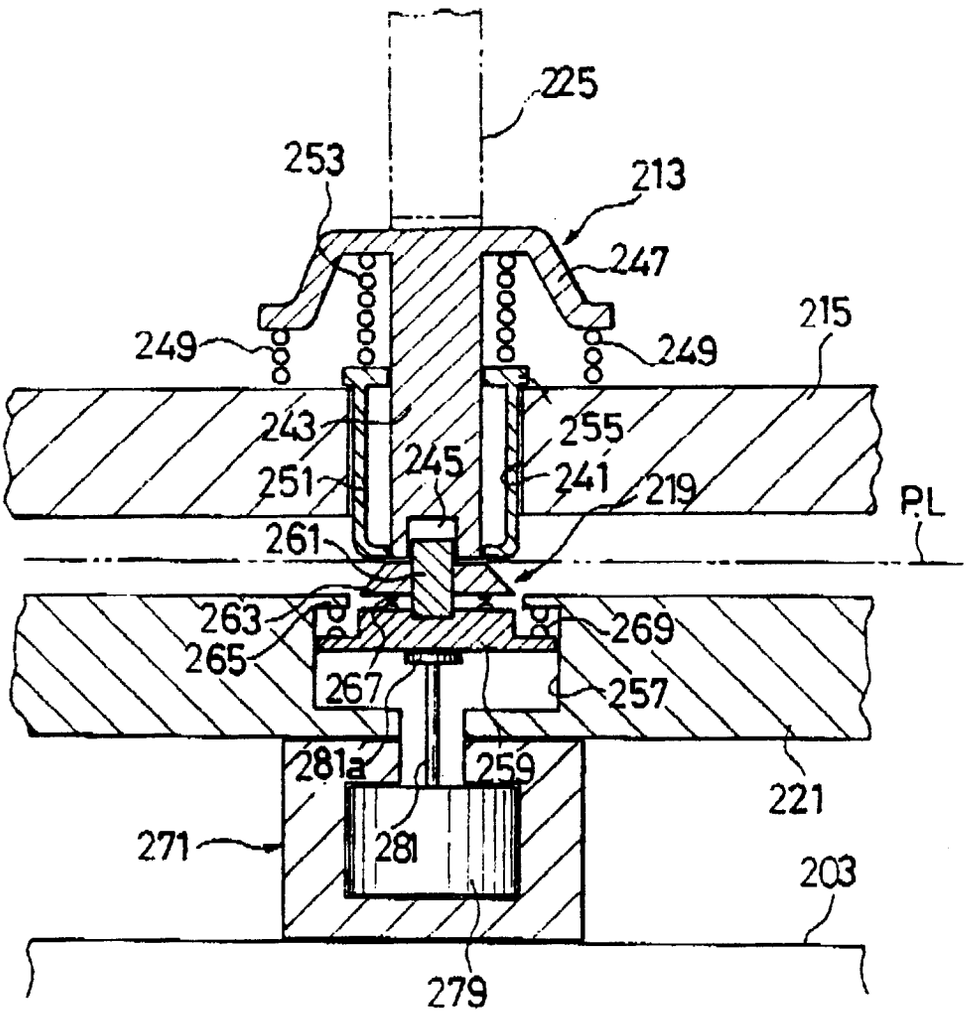

225
253
213
247
215
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249
243
255
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281a
259
221
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281
203
279

FIG.25

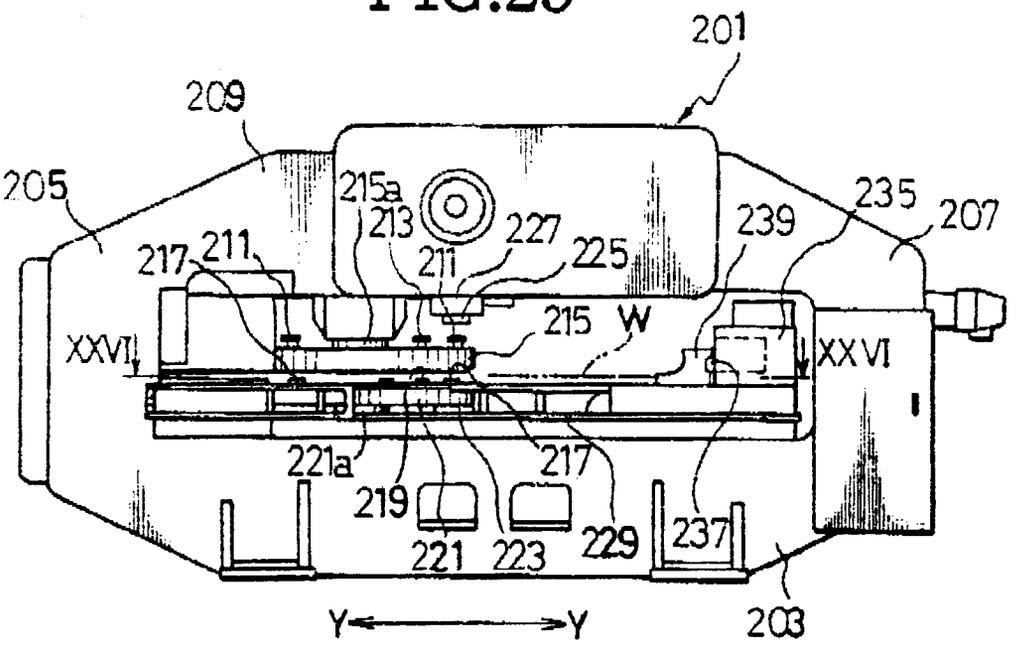
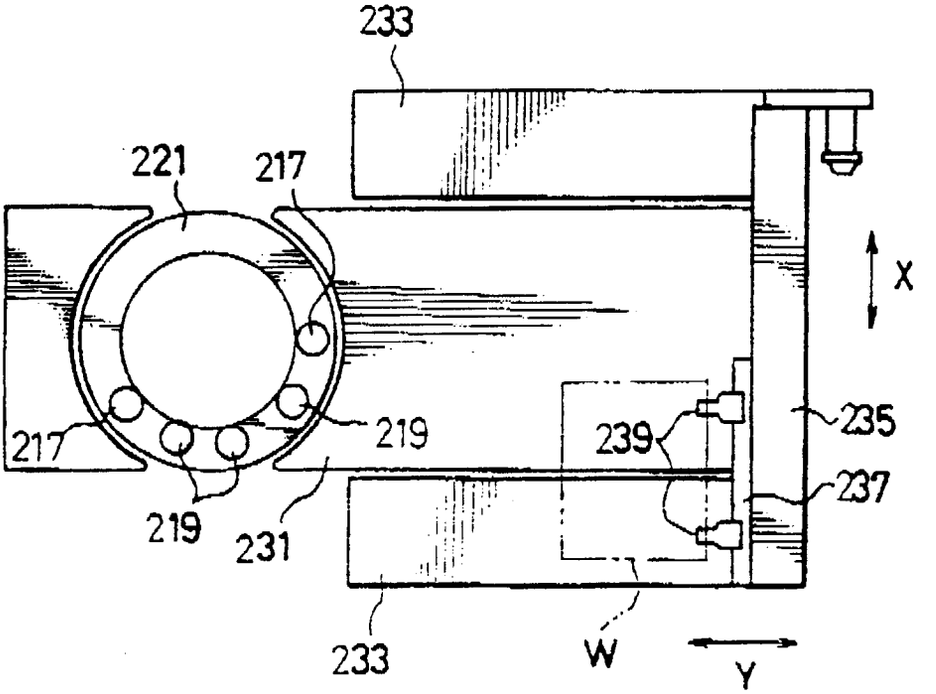

201
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207
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XXVI
XXVI
221a
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217
221
223
229
237
203
Y
Y

FIG.26


233
221
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X
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235
219
231
237
233
W
Y