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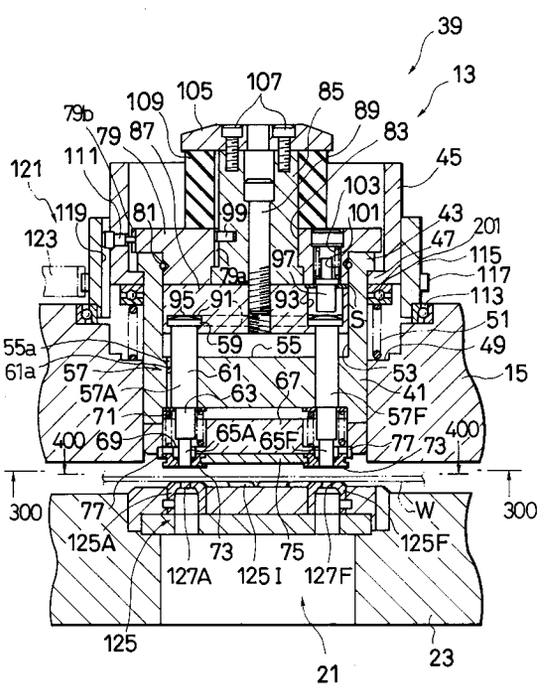
(54) Multiple tool for punch press.

(57) In a multiple tool for a punch press, a plurality of punches (57) are arranged circularly so as to be movable up and down within a stripper guide (41) provided also movably up and down in an upper die holding member (15) of the punch press (1); a punch driver (87) is disposed so as to be rotatable and movable up and down within the stripper guide (41); and a circumferential groove (91) is formed in a lower surface of the punch driver (87) for engagement with head portions (59) of the punches (57) in such a way that a plurality of punch through-spaces (93) are formed over the circumferential groove (91) except a strike portion (95) for striking any selected one of a plurality of the punches (57). Further, an indexing device (121) is mounted to rotate the punch driver (87) so that the strike portion (95) can be indexed over any required punch (57A), for instance. Since only one required punch of a plurality of the punches can be struck without moving the striker, the multiple tool is simple in structure, high in precision, and low in cost.

FIG. 1



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BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a multiple tool for a punch press, and more specifically to a multiple tool for a punch press, in which a number of tools are arranged circularly in such a way that any one of them can be struck by a striker.

Description of the Prior Art

An example of prior art multiple tool to be mounted on a turret punch press is disclosed in U.S. Patent Application No. 5,062,337, for instance. However, the prior art multiple tool is of such a duplex structure that there are provided a stripper guide linked with an indexing device so as to be rotatable and movable up and down, and a punch carrier fitted to the stripper guide also so as to be movable up and down. Further, in this prior art multiple tool, punches (not used for a punching) of a plurality of punches of the multiple tool are moved up and down whenever the punch carrier is moved up and down.

In other words, in the prior art multiple tool, since the structure is of duplex type of the stripper guide and the punch carrier, there exists a problem in that the multiple tool is complicated in structure, low in precision, and high in cost. In addition, since the punches not used for a punching are moved up and down, another problem arises in that a rather complicated mechanism is needed to precisely position the punches.

SUMMARY OF THE INVENTION

With these problem in mind, therefore, it is the primary object of the present invention to provide a multiple tool for a punch press, simple in structure, high in precision, easy to locate the punch, and low in cost.

To achieve the above-mentioned object, the present invention provides a multiple tool for a punch press, wherein: a plurality of punches (57) are arranged circularly so as to be movable up and down within a stripper guide (41) provided also movably up and down in an upper die holding member (15) of the punch press; a punch driver (87) is disposed so as to be rotatable and movable up and down within the stripper guide (41); a circumferential groove (91) is formed in a lower surface of the punch driver (87) for engagement with the head portions of the punches (57); and a plurality of punch through-spaces (93) are formed above the circumferential groove (91) except a strike portion (95) of the punch driver (87) for striking one of a plurality of the punches (57).

In the multiple tool according to the present invention, a workpiece is located above a die to be mated with any required punch of the multiple tool, and the punch driver is rotated to index the strike portion of the punch driver to above a punch. When the punch driver is struck by a striker of a punch press, the stripper guide is first moved downward to sandwich the workpiece between the stripper guide and the die. When the punch driver is further moved downward, since the strike portion strikes the punch located under the strike portion, the lower end of the punch is projected into the die to punch the workpiece. In this case, the heads of the other remaining punches are moved into the through-spaces of the punch driver, and therefore the lower ends of the other remaining punches will not project toward the die and the workpiece.

On the other hand, after punching processing, the striker is moved upward. Then, the punch driver is moved upward by the restoration force of the stripping spring. During this upward movement of the punch driver, the punch is also moved upward since the circumferential groove formed in the punch driver catches the head portion of the punch. When the striker is moved upward, the stripper guide is also moved upward away from the workpiece by the return spring. Thus, it is possible to remove the workpiece from the punch press or to locate another workpiece for the succeeding punching processing.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a cross-sectional view showing a multiple tool for a punch press according to the present invention, in which no load is applied;

Fig. 2 is a cross-sectional view showing the multiple tool for a punch press according to the present invention, in which a load is applied;

Fig. 3 is a bottom view taken along the lines 300 - 300 in Fig. 1;

Fig. 4 is a top view taken along the lines 400 - 400 in Fig. 1; and

Fig. 5 is a front view showing an overall turret punch press as an example of the punch press on which the multiple tools is to be mounted.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

An embodiment of the multiple tool according to the present invention will be described hereinbelow with reference to the attached drawings.

Fig. 5 shows a turret punch press 1 as an example of the punch press. This turret punch press 1 is composed of a base 3, two column frames 5 and 7 provided vertically on both sides of the base 3, and an upper frame 9 provided on the

upper side of the column frames 5 and 7.

Further, a disk-shaped upper turret (upper die holding member) 15 is provided on the lower side of the upper frame 9 so as to be rotatable about an upper rotary axle 17. In the same way, a lower disk-shaped turret (lower die holding member) 23 is provided on the upper side of the base 3 so as to be rotatable about a lower rotary axle 25 in oppositional positional relationship with respect to the upper turret 15. Conventional punches 11 and a punch package (upper multiple tool) 13 including a plurality of punches arranged circularly according to the present invention are removably attached to the upper turret 15, as upper tools. Conventional dies 19 and a die package (lower multiple tool) 21 including a plurality of dies arranged circularly are removably attached to the lower turret 23, as lower tools. The upper conventional punch 11 and the lower conventional die 19 form a pair of tools, and the punches of the upper punch package 13 and the the dies of the lower die package 21 form a plurality of pairs of tools. Further, a ram 29 having a striker 27 is provided on the lower side of the upper frame 9 so as to be movable up and down, to strike the conventional punches 11 or the punch package 13.

The upper turret 15 and the lower turret 23 are both controllably rotated by a turret servomotor (not shown) mounted on the frame. Thus, a pair of any required conventional punch 11 and conventional die 19 or a pair of punch package 13 and die package 21 can be selectively located in the punching position under the striker 27.

Further, a fixed table (not shown) is provided at the middle upper portion of the base 3. A pair of movable tables 31 are supported on both sides of the fixed table in the direction perpendicular to the sheet of the drawing in Fig. 5. The pair of movable tables 31 are movable in the Y-axis direction (in the front and rear direction or the right and left direction in Fig. 5). Further, a carriage base 33 is fixed to the movable table 31 in such a way as to cross the fixed table. Further, the carriage base 33 is provided with a carriage 35 so as to be movable in the X-axis direction (perpendicular to the sheet of the drawing of Fig. 5). Further, the carriage 35 is provided with a work clamp 37 for clamping an end of a plate-shaped workpiece W.

Therefore, the workpiece W can be located between the upper turret 15 and the lower turret 23, by moving the movable table 31 in the Y-axis direction and the carriage 35 in the X-axis direction.

The workpiece W located as described above can be punched by a pair of any required conventional punch 11 and die 19, or by a pair of punch and die packages 13 and 21, which are selectively located under the striker 27 by rotating the upper turret 15 and the lower turret 23 .

With reference to Fig. 1, the multiple tool 39 for the punch press according to the present invention will be described in detail hereinbelow. The multiple tool 39 is composed of the punch package 13 and the die package 21, as already described in the above. The punch package 13 is provided with a cylindrical stripper guide 41 supported by the upper turret 15 so as to be movable only up and down. Although not shown in the drawings, the stripper guide 41 is prevented from rotating relative to the upper turret 15 by a suitable means such as a key that may be provided on the stripper guide 41 and a key way that may be formed in the upper turret 15, the key and key way being engaged with each other. The upper flange portion 43 of the stripper guide 41 is fitted to the lower flange portion 47 of a cylindrical rotary tube 45. A guide spring 51 is disposed via a thrust bearing 201 between the lower surface of the flange portion 47 of the rotary tube 45 and the bottom surface of a stepped bore 49 formed in the upper turret 15, so that the stripper guide 41 is urged upward.

The stripper guide 41 is formed with an inner bore 53 opening upward on the upper side thereof. In a bottom portion 55 of this inner bore 53, a plurality of punches 57 are arranged circularly at regular intervals along the inner circumferential surface of this inner bore 53 so as to be movable up and down. These punches 57 are designated as 57A, 57B, ..., 57J, because the end shapes thereof are all different from each other, respectively. Each of these punches 57A, 57B, ..., 57J is formed with a head portion 59, a large-diameter portion 61 serving as a guide portion, an intermediate diameter portion 63, and a small-diameter punching portion 65A, 65B, ..., 65J, respectively in order from the upper side to the lower side. The large-diameter portion 61 is supported by the bottom portion 55 so as to be slidable in the vertical direction. A key 61a provided on the large-diameter portion 61 is engaged with a key way 55a formed in the bottom portion 55, so that the punch 57 is prevented from rotating relative to the bottom portion 55. The cross section of each of these punch portions 65A, 65B, ..., 65J is different from each other in diameter size as shown in Fig. 3 or even in cross section (e.g., square, hexagonal, etc.). Therefore, it is possible to punch holes of different dimensions or shapes in a workpiece W by appropriately selecting one of the punches 57A, 57B, ..., 57J.

Further, a guide plate 67 is provided at the lower end of the stripper guide 41, and stepped holes 69 are formed circularly in the guide plate 67. A hold spring 71 is disposed between the bottom surface 69 of each of the stepped holes and the lower end of the large diameter portion 61

of each of the punches 57 via a washer 203, respectively, in order to always urge the respective punches 57A, 57B, ..., 57J upward. Further, a plurality of circular stripper plates 73 are disposed circularly, at the lower end of the guide plate 67 to guide the punching portions 65A, 65B, ..., 65J of the punches 67 by a plurality of holes formed in the stripper plates 73, respectively. Specifically, a retaining plate 75 is fixed to the lower surface of the guide plate 67, and the stripper plates 73 are engaged with circular-arc-shaped recesses 75a (see Fig. 3) formed in the outer circumferential surface of the retaining plate 75. Lock pins 77 (see also Fig. 3) are provided on the guide plate 67 to fix the stripper plate 73 relative to the guide plate 67.

A ring-shaped rotary plate 79 is fitted to the upper portion of the stripper guide 41 via a ring 81 so as to be rotatable but not to be movable up and down relative to the stripper guide 41.

A central hole 83 is formed at the center of the rotary plate 79 to guide a first punch driver 85 so as to be movable up and down. A key 99 fixed to the first punch driver 85 is engaged with a key way 79a formed in the rotary plate 79, so that a rotation of the first punch driver 85 relative to the rotary plate 79 is prevented. To the lower end of the first punch driver 85, a flange-shaped second punch driver (punch driver) 87 is fixed with a bolt 89. The second punch driver 87 is formed with a T-shaped cross-section circumferential groove 91 on the lower surface thereof, in such a way that the head portions 59 of the punches 57 can be caught by this T-shaped circumferential groove 91. In a section of the second punch driver 87 above the circumferential groove 91, a plurality of punch through-spaces 93 are formed circularly at the regular intervals that correspond to the intervals at which the the plurality of punches 57 is arranged on the bottom portion 55, except at a position 95 in Fig. 1. A portion of the second punch driver 87 at the position 95 will be called a strike portion 95 hereinafter. This strike portion 95 can be indexed to over any one of a plurality of punches 57, for instance to over the punch 57A by rotating the second punch driver 87 relative to the stripper guide 41.

A plurality of backup pins 97 are arranged in a the through-spaces 93 via washer S, respectively so as to be movable up and down relative to the second punch driver 87. It is to be noted that the backup pins 97 are designed such that the lower end thereof are slightly above the head of the punch 57B, 57C, ..., 57J so as not to contact those heads. With this arrangement, the second punch driver 87 is rotatable relative to the punches 57A, 57B,..., 57J. The rotary plate 79 is formed with a plurality of inner holes 101 opening downward and arranged so as to face the backup pins 97, respectively. The head of the backup pin 97 is therefore disposed in each of the inner hole 101. A backup spring 103 is provided in each of the inner holes 101 to urge backup pin 97 downward. As will be described in detail in the following, the backup pins 97 and the backup springs 103 serve to suppress vibrations of the punches 57 not used during a punching, and further to allow the punches 57 to move upward for relief where necessary.

A head plate 105 is fixed to the upper end surface of the first punch driver 85 with a plurality of bolts 107. A stripping spring 109 formed of an elastic material such as urethane rubber, for instance is interposed between the lower surface of the head plate 105 and the upper surface of the rotary driver 79.

The rotary plate 79 and the afore-mentioned rotary tube 45 are coupled to each other by a key 111 fixed to the rotary tube 45 and a key way 79b formed in the rotary plate 79. Thus, the rotary plate 79 is movable up and down, but is prevented from rotating relative to the rotary plate 45. Further, a gear tube 115 is rotatably supported by a bearing 113 on the upper side of the upper turret 15 so as to enclose the outer circumferential surface of the rotary tube 45. This gear tube 115 is formed with a gear 117 on the outer circumferential surface thereof and with a key groove 119 on the inner circumferential surface thereof. A head portion of the key 111 of the rotary tube 45 is engaged with this key groove 119. A gear 123 rotated by a suitable servo motor through a suitable gear transmission mechanism (indexing device) 121 is in mesh with the gear 117.

On the other hand, on the lower turret 23, a die package 21 is disposed in oppositional positional relationship with respect to the punch package 13. A plurality of dies 125 are arranged on the die package 21. In more detail, a plurality of dies 125A, 125B, ..., 125J are arranged so as to face the punches 57A, 57B, ..., 57J, as shown in Fig. 4. The dies 125A, 125B, ..., 125J are formed with die holes 127A, 127B, ..., 127J, respectively; the die holes 127A, 127B, ...127J are adapted to be fitted to the to-be-mated punching portions 65A, 65B, ..., 65J of the punches 57, respectively.

The operation of the multiple tool 39 for the punch press according to the present invention will be described hereinbelow with reference to further Figs. 1 and 2.

First, the upper and lower turrets 15 and 23 are rotated to index any required punch package 13 and the die package 21 to under the striker 27. Further, the movable table 31 and the carriage 35 are moved to locate the workpiece W to above the required die 125A, for instance. When the indexing device 121 is actuated, the gear tube 115 is rotated

so that the rotation thereof is transmitted from the rotary tube 45 to the rotary plate 79 and further to the first punch driver 85. Therefore, it is possible to index the strike portion 95 of the second punch driver 87 to over the required punch 57A corresponding to required die 125A, for instance.

After the strike portion 95 has been indexed, the ram 29 of the punch press is actuated to move down the striker 27 for striking the head plate 105. Under these conditions, the rotary plate 79, the stripper guide 41, the rotary tube 45, and the first and second punch drivers 85 and 87 are moved down together against the urging force of the guide spring 51, without compressing the stripping spring 109. Accordingly, the stripper plates 73 are brought into contact with the workpiece W, and the workpiece W is sandwiched between the die 125 and the stripper guide 41. Thereafter, when the striker 27 is further moved downward, only the first and second punch drivers 85 and 87 are further moved downward by compressing the stripping spring 109.

Under these conditions, the strike portion 95 strikes the head portion 59 of the punch 57A. Thus, the punch 57A is moved downward by compressing the hold spring 71, so that the punching portion 65A of the punch 57A projects from the lower surface of the stripper plate 73 to punch out the workpiece W and further into the die hole 127A of the die 125A, and punching processing being completed as shown in Fig. 2.

Here, when the second punch driver 87 is moved downward after the stripper plate 73 comes into contact with the workpiece W, the punches 57B, 57C,..., 57J not used for the punching are moved upward relative to the second punch driver 87. Thus, the backup pins 97 urged by the backup springs 103, respectively are brought into contact with the head portions 59 of the punches 57B, ..., 57J, so that these punches 57B, ..., 57J are not jumped upward due to a shock of the punching processing. Further, the elastic force of the hold spring 71 is determined stronger than that of the backup spring 103; thus, the other remaining punches 57B, ..., 57J not used are not projected downward out of the lower surface of the stripper plates 73.

Successively, when the ram 29 is actuated to move the striker 27 upward, the first and second punch drivers 85 and 87 are first moved upward by a restoration force of the stripping spring 109. Then, the punch 57A whose punching portion 65A was inserted into the die hole 127A is moved upward to the position flush with the other remaining punches 57B, .., 57J because the head portion 59 of the punch 57A is caught by the circumferential groove 91 formed in the second punch driver 87.

When the striker 27 and the first and second punch drivers 85 and 87 are further moved upward, the stripper guide 41, the rotary tube 45 and the rotary plate 79 all move upward by the restoration force of the guide spring 51; thus, the stripper plate 73 is also moved away from the workpiece W.

Thereafter, when the striker 27 is further moved upward to an upper dead point, the striker 27 is moved away from the head plate 105.

Here, the upper surface of the second punch driver 87 is in contact with the lower surface of the rotary plate 79 by the restoration force of the stripping spring 109. Under these conditions, the punches 57B, 57C,..., 57J is located in the original positions in the vertical direction relative to the second punch driver 87, and the backup pins 97 are in contact with the washers S located at the upper surface of the second punch driver 87, respectively; therefore the lower ends of the backup pins 97 are away from the head portions 59 of the punches 57B, 57C,...., 57J, respectively, as shown in Fig. 1. Therefore, it is possible to rotate the second punch driver 87 to further index the strike portion 95 to any required one of the punches 57A, 57B, ..., 57J, without any interference. Here, it is also to be noted that since the circumferential groove 91 engaged with the head portions 59 of the punches 57 is of circular shape, the second punch driver 87 can rotate relative to the punches 57.

Further, since the final gear 123 of the indexing device 121 is in mesh with the gear 117 of the gear tube 115, it is possible to index the strike portion 95 to over any required punch 57A, for instance by rotating the second punch driver 87.

As described above, in the multiple tool according to the present invention, since a plurality of punches 57 are housed in the punch package (upper multiple tool) 13 and further arranged circularly within the stripper guide 41 fitted to the upper turret (upper die holding member) 15 so as to be movable up and down, the multiple tool is simple in structure and easy to secure the processing precision, thus improving the punching quality. Further, since the structure is simple, the manufacturing cost can be reduced.

In addition, since the punching processing can be made by indexing only the strike portion 95 of the second punch driver 87 to any required punch (e.g., 57A) by use of the indexing device 121, to strike only the required punch, without moving the other remaining punches up and down within the stripper guide 41, it is possible to locate the workpiece W accurately at only the required punch position accurately, irrespective of the positions of the other remaining punches, thus improving the working efficiency of the punching processing.

Further, since the punching processing can be made by indexing the strike portion 95 of the second punch driver 87 to any required punch (e.g., 57A), by use of the indexing device 121, without moving the striker and the die package 21, the structure is further simplified for further reduction of manufacturing cost.

Claims

1. A multiple tool for a punch press, the punch press including a upper tool holding member (15), comprising:

   a stripper guide (41) adapted to be mounted on the upper tool holding member (15) so as to be movable up and down;

   a plurality of punches (57) arranged circularly on the stripper guide (41, 55) so as to be movable up and down; and

   a punch driver (87) disposed above the punches (57) for selectively striking one (57A) of the plurality of punches (57), the punch driver (87) being rotatable and movable up and down in the stripper guide (41), and the punch driver (87) being formed with a plurality of punch through-spaces (93) that allows heads (59) of the punches (57) except the one punch (57A) selected to pass therethrough.

2. The multiple tool for a punch press of claim 1, wherein the punch driver (87) is further formed with a circumferential groove (91) engageable with the head (59) of the one punch (57A) selected.

3. The multiple tool for a punch press of claim 2, further comprising:

   a plurality of backup pins (93) each provided in the punch through space (93) via a washer (S), such that the lower end of each backup pin (93) is located just above the head of the punches (57);

   a rotary plate (79) engaged with the punch driver (87) in such a way as to rotate together with the punch driver (87) and move up and down independently of the punch driver (87); and

   a plurality of backup spring (103) provided on the rotary plate (79) for urging the backup pins (93) downward.

4. The multiple tool for a punch press of claim 3, wherein the rotary plate (79) is engaged with the stripper guide (41) in such a way as to move up and down together with the stripper guide (41) and rotate independently of the stripper guide (41).

5. The multiple tool for a punch press of claim 4, further comprising a plurality of hold springs (71) provided in the stripper guide (41, 67) for urging the punches (57) upward, wherein the spring constant of the hold spring (71) is larger than that of the backup spring (103).

6. The multiple tool for a punch press of claim 4, further comprising the guide spring (51) provided operationally between the the upper tool holding member (15) and the stripper guide (51), for urging the stripper guide (41) upward, and the stripping spring (109) provided between the rotary plate (79) and the punch driver (87), for urging the punch driver (87) upward relative to the stripper guide (41). wherein the elastic constant of the stripping spring (109) is larger than that of the guide spring (51).

7. The multiple tool for a punch press of claim 6, further comprising a rotary tube (45) engaged with the rotary plate (79) in such a way as to rotate together with the rotary plate (79), the rotary tube (45) being engaged with the stripper guide (41) so as to be prevented from moving upward to a height above a predetermined height relative to the stripper guide (41), and the guide spring (51) being provided between the upper tool holding member (15) and the rotary tube (45).

8. The multiple tool for a punch press of claim 7, further comprising a gear tube (119) rotatably mounted on the upper tool holding member (15) and engaged with the rotary tube (45) for causing the rotary tube (45) to rotate relative to the upper tool holding member (15).

9. The multiple tool for a punch press of claim 6, wherein the rotary tube (45) is movable up and down relative to the rotary plate (79).

10. The multiple tool for a punch press of claim 6, wherein the stripping spring (109) is made of urethane.

FIG. 1

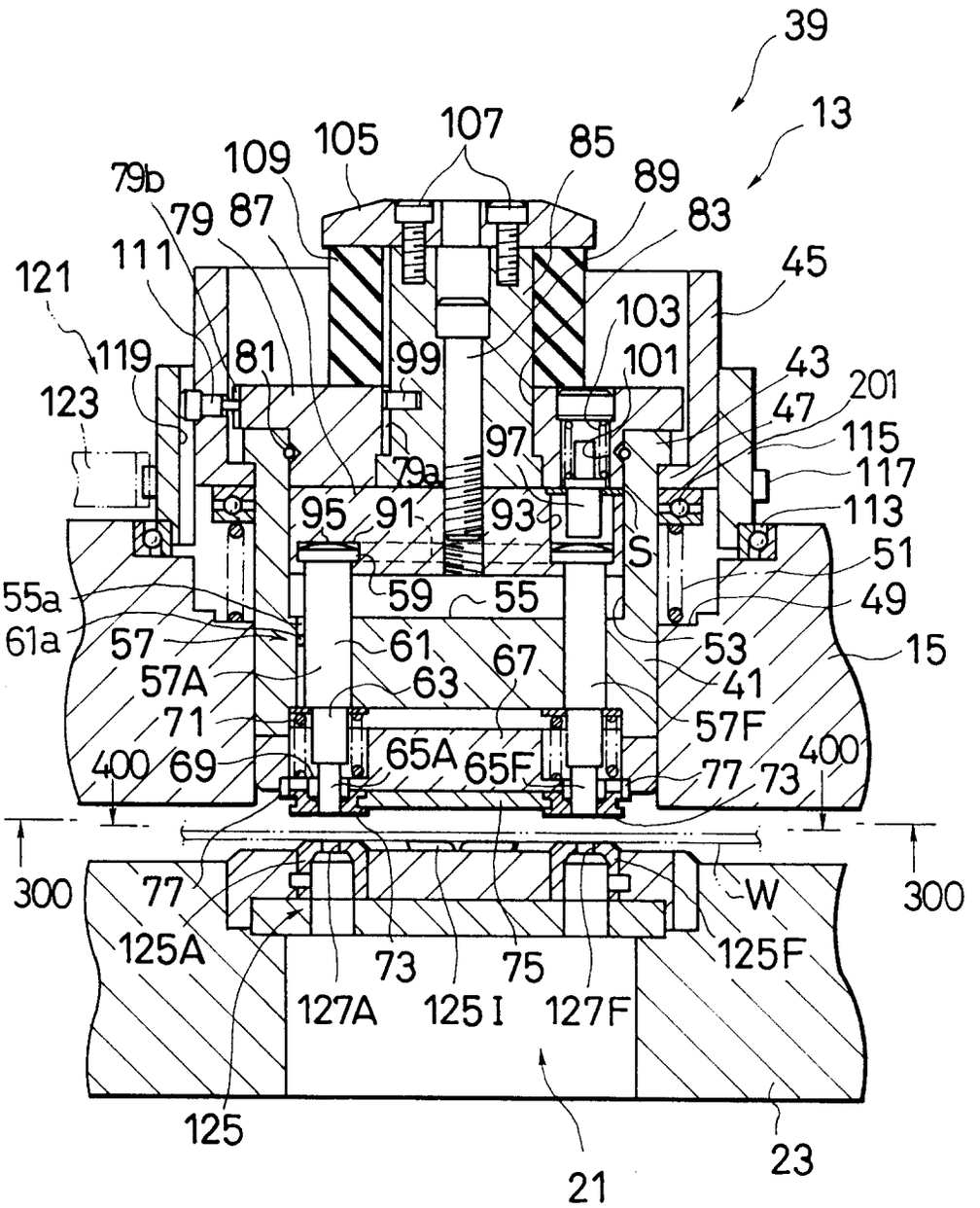
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FIG. 2

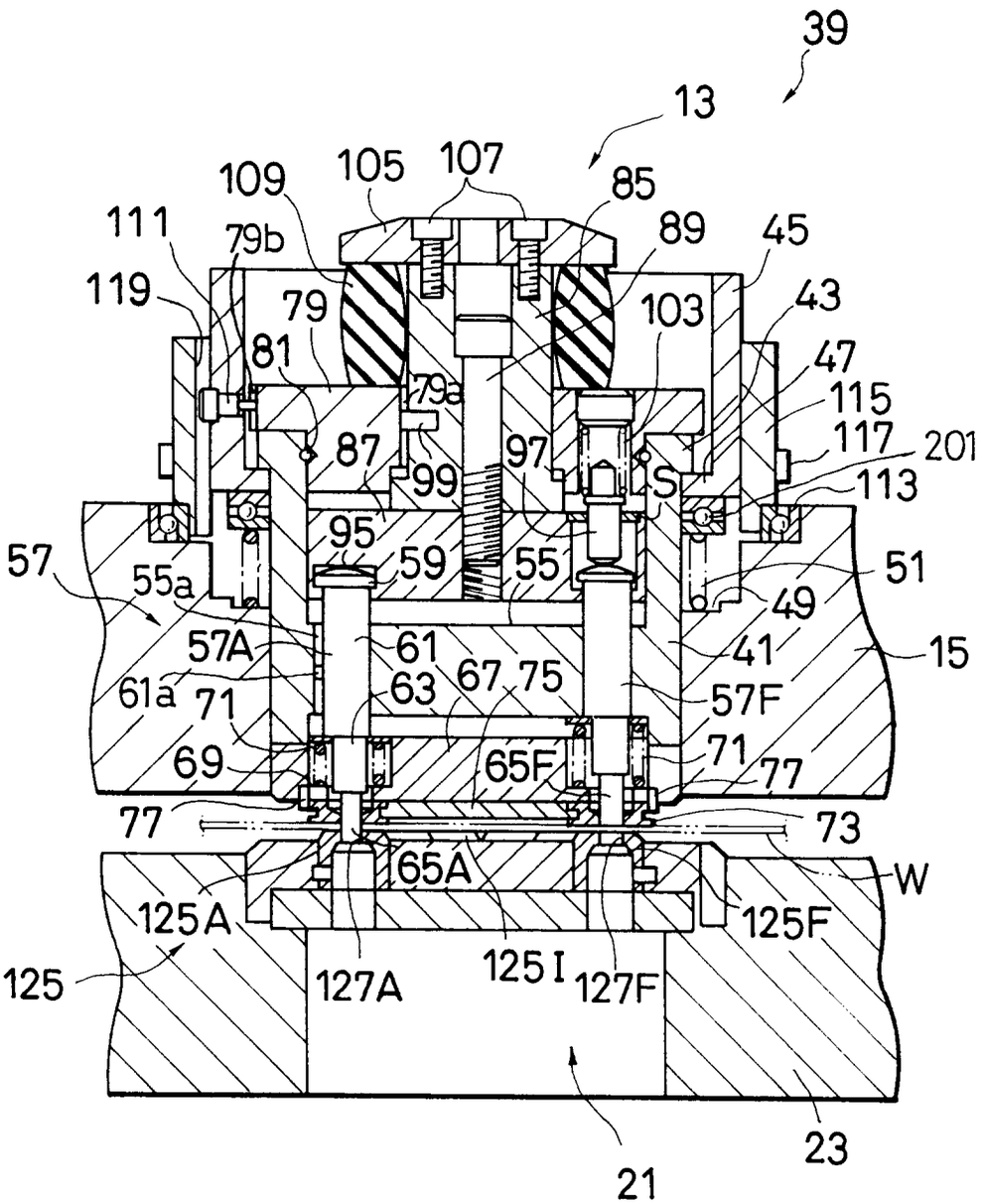
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FIG. 3

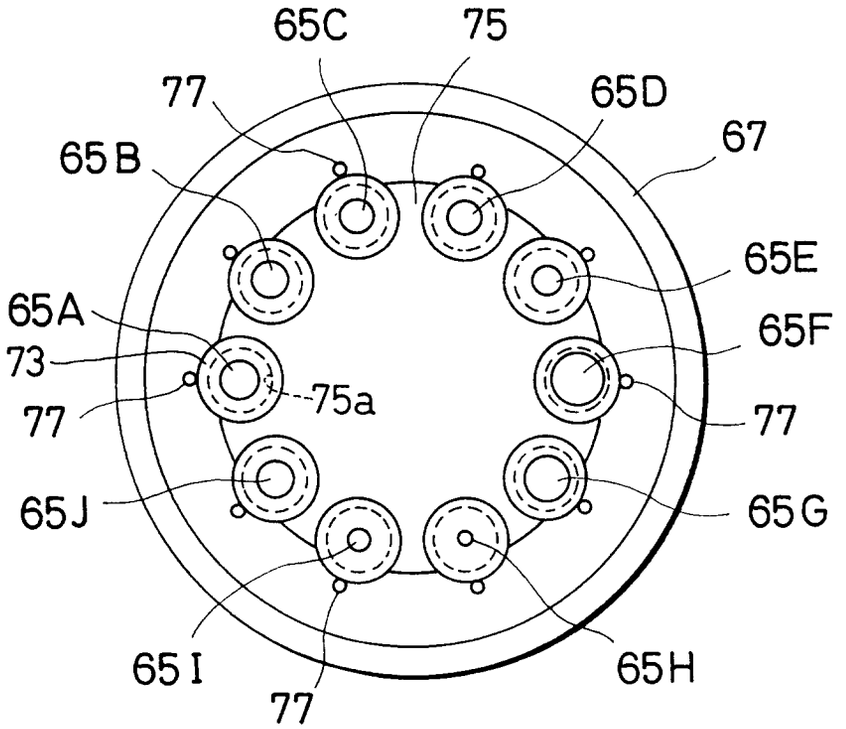
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FIG. 4

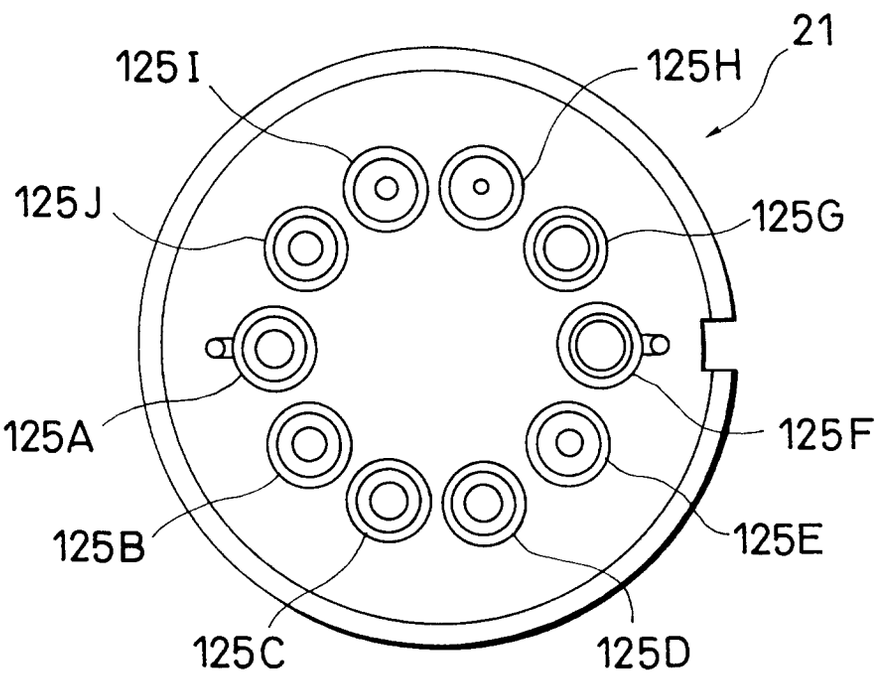
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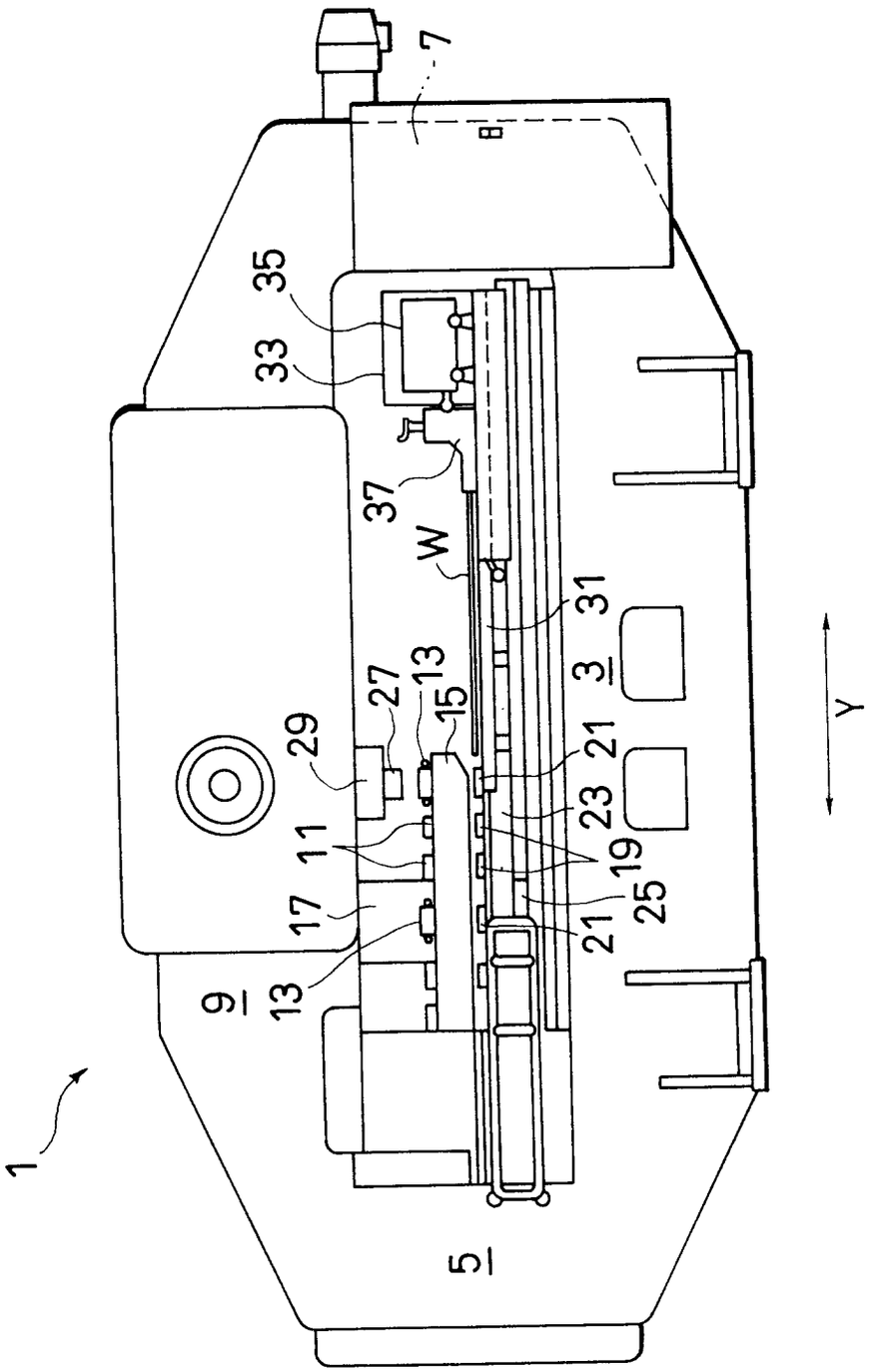
FIG. 5



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 11 1604

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.5)
D,X	EP-A-0 396 817 (STRIPPIT) * column 5, line 37 - column 8, line 13; figure 4 *	1	B21D28/12
Y		2,3	
A		5	
	& US-A-5 062 337		

Y	EP-A-0 399 338 (MURATA-WIEDEMANN INC.) * column 4, line 20 - line 42; figure 1 *	2,3	
A		4,7	

A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 226 (M-412)(1949) 12 September 1985 & JP-A-60 082 231 (MURATA) * abstract *	2	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)
B21D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	29 SEPTEMBER 1993	GERARD O.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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A : technological background
O : non-written disclosure
P : intermediate document

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E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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