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

(11) EP 1 369 187 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.12.2003 Bulletin 2003/50

(51) Int Cl.[7]: **B21D 22/08**

(21) Application number: **02015104.9**

(22) Date of filing: **05.07.2002**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **07.06.2002 JP 2002167337**

(71) Applicant: **Umix Co., Ltd.**
Hirakata-shi, Osaka 573-0137 (JP)

(72) Inventor: **Matsuoka, Mitsuo, Umix Co., Ltd.**
Hirakata-shi, Osaka 573-0137 (JP)

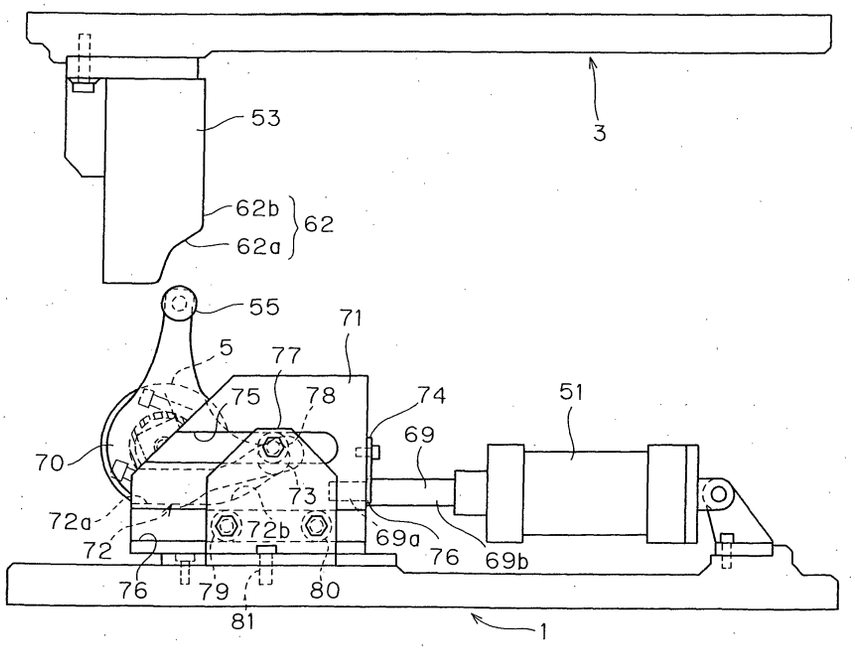
(74) Representative: **Henkel, Feiler, Hänzel**
Möhlstrasse 37
81675 München (DE)

(54) Rotary drive apparatus for rotary body

(57) A rotary drive apparatus for a rotary body for rotating a rotary body through extension and extraction of the piston rod (69) of the cylinder (51) accurately determines a rotation start and a rotation termination position, and performs intrusive forming with the rotary cam (5) being accurately positioned. As such, high-quality work processing can be implemented; and furthermore, shocks of a cylinder (51) are absorbed, and are not transferred to the rotary body.

A rotary drive apparatus for a rotary body for rotating a rotary body through extension and extraction of the piston rod of the cylinder is configured such that supporting axes are provided to respectively protrude from two ends of the rotary body, the supporting axes are held and the rotary body are rotatably provided, a central portion of a cam follower arm (70) is fixed to the supporting axis, one end of the cam follower arm and the piston rod of the cylinder are connected via a guide plate (71) provided therebetween, a guide groove (72) is carved on the guide plate to rotate the cam follower (73) separately in a stroke direction of the piston rod (69) and in a direction perpendicular thereto, and a cam follower at the end of the cam follower arm is engaged with the guide groove.

FIG. 1



EP 1 369 187 A2

Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a rotary drive apparatus for a rotary body; more specifically, the present invention relates to, for example, a rotary-cam driven apparatus for a negative-angle formation die used to form a thin metallic sheet. The "negative-angle forming die" refers to a die for performing intrusive forming of a work of the material such as to be intruded into a lower die from a linear descendent locus of an upper die.

[0002] According to a conventional method, intrusive forming for a work of a thin metallic sheet is performed in the following manner. A work is first set on a lower die, an upper die is then vertically moved downward, a passive cam of a lower die is driven using an active cam of an upper die, and the work is transversely processed. Subsequently, after the processing has been completed and the upper die has been moved up, the active cam is retracted using a spring.

[0003] In the conventional method, a forming portion of the aforementioned passive cam is operated to slide in the transverse direction from theoutside of the work to performing the forming process of the work. The forming portion of the passive cam is formed to have an integral shape that is the same as the shape of a forming portion of the work. However, since the work needs to be taken out from the lower die upon completion of the forming process, the forming portion of the lower die on which the work is mounted needs to be retracted by separating an intruding portion of the lower die. Alternatively, the forming portion needs to be formed to enable the work to be taken out in such a way that a rear portion of the intruding portion is preliminarily removed and the work is moved forward. Although the problem is not so serious when the extent of intrusion is minor, it becomes a serious when the intrusion extent is large and depending upon the type of the work. For example, suppose a long and slender frame-like vehicle component having a grooved section, such as a front pillar outer formed of a thin metallic sheet, is processed as a work. In this case, since the width of the grooved portion is small, when the intruding portion of the lower die is separated or removed, the component cannot be neatly formed in a desired shape; and in addition, since the strength of the lower die is not sufficient, the intrusive forming cannot be performed.

[0004] In addition, there are cases in which defective portions such as torsional and/or warped portions are formed in products, and correction needs to be performed therefor. However, cases occur in which even correction is practically impossible. For example, correction is practically impossible for defective portions formed on components constituting outer panel portions of a vehicle, such as a side panel, a fender, a roof, a bonnet, a trunk lid, a door panel, and a front pillar outer that have three-dimensional curved surfaces and curved lines. In assembling a product of a thin metallic sheet for a vehicle, when the product has defective portions such as torsions or warps, the product cannot be coupled to other components. Consequently, a high-quality vehicle-dedicated structure of a thin metallic sheet cannot be provided, and a predetermined product accuracy cannot be maintained for a product formed of a thin metallic sheet.

[0005] To solve the above-described problems, a negative-angle forming die having a configuration as described below has been proposed. In the configuration, a forming portion intruded into a lower die from a linear descendent locus of an upper die is formed, and a rotary cam is then rotationally retracted to be in a state where a formed work can be taken out from a lower die.

[0006] Referring to Figs. 11 to 16, the negative-angle forming die includes a lower die 102 for mounting a work W of a thin metallic sheet onto a supporting portion 101, and an upper die 103 that is descended in a linear direction towards the lower die 102 for forming the work W by hitting against the work W.

[0007] In addition, the negative-angle forming die further includes a rotary cam 106 provided on the lower die 102 to be rotatable. The rotary cam 106 includes a groove 104 that is open to an outer peripheral surface and that is carved along an axial direction, and an intrusive-forming portion 105 that is formed at an edge portion of the groove 104 which is closer to the supporting portion 101 and that is intruded from a locus of the upper die 103. In addition, the negative-angle forming die includes a slide cam 108 that includes an intrusive-forming portion 107 and that is provided to the upper die 103 to be slidable in opposition to the rotary cam 106; and an air cylinder 109 provided to the lower die 102 for rotationally retracting the rotary cam 106 to be in a state where the work W can be taken out from the lower die 102 upon completion of the forming process. In this configuration, the work W set on the supporting portion 101 of the lower die 102 is formed using the intrusive forming portion 105 of the rotary cam 106 and the intrusive forming portion 107 of the slide cam 108. In this case, the slide cam 108 slides to perform the forming process of the work W; and upon completion of the forming process, the rotary cam 106 is rotationally retracted using the air cylinder 109 to enable the formed work W to be taken out from the lower die 102.

[0008] Hereinbelow, operations of the negative-angle forming die will be described.

[0009] First, as shown in Fig. 11, the upper die 103 is positioned at a top dead center, and the work W is mounted onto the supporting portion 101 of the lower die 102. At this time, the rotary cam 106 is brought into a state of being retracted by the air cylinder 109.

[0010] Subsequently, as shown in Fig. 12, the rotary cam 106 is brought into a state of being retracted by the air cylinder 109. The upper die 103 starts to descend, and a pad 110 presses the work W mounted onto the

supporting portion 101 of the lower die 102.

[0011] Then, the upper die 103 descends, and as shown in Fig. 13, the lower face of the slide cam 108 engages a rotating plate 111. At this time, the slide com 108 operates without interfering with the intrusive-forming portion 105 of the rotary cam 106.

[0012] When the upper die 103 continues to descend, the slide cam 108 in the state of being urged outwardly of the die is transversely moved by the cam operation to the left in opposition to an urged force of a coiled spring 112. Thereby, the slide cam 108 is brought into a state shown in Fig. 14, whereby intrusive forming of the work W is performed through the intrusive-forming portion 105 of the rotated rotary cam 106 and the intrusive-forming portion 107 of the slide cam 108.

[0013] After the intrusive forming has been completed as shown in Fig. 15, the upper die 103 starts to move up.

[0014] The slide cam 108 outwardly urged by the coiled spring 112 is moved rightward in Fig. 16, the slide cam 108 rises without interfering with the work W.

[0015] The slide cam 108 thus rises, the rotary cam 106 rotates rightward according to the air cylinder 109, as shown in Fig. 16, and the work W intrusively formed is then taken out from the lower die 102. At this time, the work W can be taken out without causing interference with the intrusive-forming portion 105 of the rotary cam 106.

[0016] As described above, the air cylinder is required to rotationally return the rotary cam to enable the formed work to be taken out after completion of the intrusive forming.

[0017] Hereinbelow, referring to Figs. 17 to 20, a description will be made regarding a rotary-cam drive apparatus for a negative-angle forming die by way of an example of the rotary drive apparatus for the negative-angle forming die.

[0018] A rotary cam 5 is rotatably disposed in a lower die 1. A cylinder 51 for returning the rotary cam 5 is disposed in the lower die 1. A cam follower arm 52 is mounted to the rotary cam 5. A planar driver 53 for controlling the cam follower arm 52 is provided in an upper die 3.

[0019] Supporting axes 11 are individually protrudedly provided to two ends of the axial rotary cam 5. The supporting axis 11 is internally fitted to a metal 12 of a bearing 13 (to which the cylindrical metal 12 is fixed) to be rotatable, thereby enabling the rotary cam 5 to rotate. A base plate 14 of the supporting axis 11 is fixed with a bolt to an axial end of the rotary cam 5. The bearing 13 for receiving the supporting axis 11 is fixed with a bolt 16 to the lower die 1.

[0020] An end portion 11a of the supporting axis 11 is formed as a square column to thereby enable the output of the air cylinder 51 to be securely transferred to the rotary cam 5.

[0021] The cam follower arm 52 protrudes from a disc portion, is formed of two members, receives the end portion 11a of the supporting axis 11 in the center, and is connected with bolts 54. A cam follower 55 is rotatably provided to one of the ends of the cam follower arm 52, and is fixed with a nut 56 to prevent detachment. The other end of the cam follower arm 52 is connected to the end of a piston rod 57 of the cylinder 51 with a pin 59 via a connecting member 58. A threaded rod portion 67 of the end of the piston rod 57 is inserted into a connecting member 58, a nut 68 threaded on the threaded rod portion 67 is tightened to thereby connect the connecting member 58 and the end of the piston rod 57. Because of variations in the amount of tightening the nut 68, a rotation start position and a rotation termination position of the cam follower arm is not precisely determined. As such, in a state where the rotary cam 5 cannot be accurately disposed, intrusive forming is performed, thereby disabling the implementation of high-quality work processes. The cylinder 51 is fixed to the lower die 1 with a bolt 61 via a bracket 60.

[0022] Ordinarily, the piston rod 57 of the cylinder 51 extends to thereby maintain the forming posture; and after the upper die 3 descends and intrusive forming is completed, the piston rod 57 retracts, and the rotary cam 5 rotationally retracts. Then, the work becomes ready to be taken out upwardly.

[0023] If the cylinder 51 malfunctions, the driver 53 of the upper die 3 and the cam follower arm 52 of the lower die 1 cause the rotary cam 5 to assume, for example, the forming posture and a posture enabling the rotationally retracted work to be taken out upwardly.

[0024] Specifically, the planar driver 53 is provided in a portion opposing the cam follower arm 52 of the upper die 3. The rotation of the rotary cam 5 is controlled by causing the cam follower 55 of the cam follower arm 52 to engage a cam face 62 of the driver 53. The cam face 62 is determined in consideration regarding the position where the rotary cam 5 is rotated during a descending stroke of a press, and the time of assuming a predetermined forming posture at what level of the rotation. The rotary cam 5 is rotated at a sloped portion 62a of the cam face 62, and the forming posture is maintained at a perpendicular portion 62b of the cam face 62.

[0025] The driver 53 is fixed with a bolt 63 to the upper die 3.

[0026] The cylinder 51 causes the rotary cam 5 to return when the upper die 3 rises, and the cam follower 55 is positioned not to be in contact with the cam face 62 of the driver 53.

[0027] Fig. 18 shows a state where the upper die 3 is at a top dead center, and Fig. 19 shows a state where the upper die 3 is at a bottom dead center.

[0028] When the upper die 3 descends from the state of the top dead center, the sloped portion 62a of the cam face 62 of the driver 53 of the upper die 3 engages the cam follower 55 of the cam follower arm 52 of the lower die 1. Then, when the rotary cam 5 rotates, and the cam follower 55 reaches the perpendicular portion 62b of the cam face 62, the rotary cam 5 holds the forming posture. When the intrusive forming process has been completed, the upper die 3 rises. Since nothing remains to con-

strain the cam follower arm 52, the rotary cam 5 is returned by the cylinder 51 to the original position.

[0029] Fig. 20 is a plan view of the configuration shown in Fig. 19.

[0030] The rotating apparatus for rotating the rotary body according to the extension and retraction of the piston rod of the cylinder is configured such that the supporting axes are provided to protrude from two ends of the rotary body, the supporting axes are held to rotatably provide the rotary body, the central portion of the cam follower arm is fixed to the supporting axes, the threaded rod portion that is provided at the end of the piston rod and that connects the one end of the cam follower arm and the piston rod is inserted into the connecting member, the nut threaded on the threaded rod portion is tightened, and the connecting member and the end of the piston rod is thereby connected.

[0031] However, the rotation start position and the rotation termination position of the cam follower arm are not determined because of variations in the amount of tightening the nut. As such, the rotary cam cannot be accurately positioned. When intrusive forming is performed in the above-described state, cases can occur in which high-quality work processing cannot be implemented.

SUMMARY OF THE INVENTION

[0032] In view of the above circumstances, the present invention is to provide a rotary drive apparatus for rotating a rotary body through extension and extraction of a piston rod of a cylinder, wherein a rotation start and a rotation termination position can be accurately determined. Furthermore, the invention is to provide a negative angle forming die in which intrusive forming can be performed with the rotary cam being accurately positioned, and high-quality work processing can be implemented.

[0033] The invention provides a rotary drive apparatus as defined in claim 1 and a negative angle forming die employing such drive apparatus for driving the rotary cam.

BRIEF DESCRIPTION OF THE DRAWINGS

[0034]

Fig. 1 is a side view of a state where an upper die of a negative-angle forming die provided with a rotary-cam drive apparatus according to a practical embodiment of the present invention is positioned at a top dead center;

Fig. 2 is a side view of state where the upper die shown in Fig. 1 is positioned at a bottom dead center;

Fig. 3 is a plan view of a state excluding the upper die shown in Fig. 2;

Fig. 4 is a front view of a fixing plate as one component of the present invention;

Fig. 5 is a side view of the fixing plate shown in Fig. 4;

Fig. 6 is a front view of a guide plate as one component of the present invention;

Fig. 7 is a side view of the guide plate of Fig. 6;

Fig. 8 is a front view of a guide plate support as one component of the present invention;

Fig. 9 is a side view of the guide-plate support of Fig. 8;

Fig. 10 is a plan view of the guide plate support of Fig. 8;

Fig. 11 is a vertical cross-sectional view of a state where an upper die of a conventional negative-angle forming die for performing intrusive forming is positioned at a top dead center;

Fig. 12 is a vertical cross-sectional view of a state where, in the conventional negative-angle forming die, a rotary cam is operated by an air cylinder to assume a forming posture, the upper die descends, and a work is pressed by a pad;

Fig. 13 is a vertical cross-sectional view of a state where the upper die has descended, abutted on a lower die, and begun to contact the work in the conventional negative-angle forming die;

Fig. 14 is a vertical cross-sectional view of a state where the upper die of the conventional negative-angle forming die is positioned at a bottom dead center;

Fig. 15 is a vertical cross-sectional view of a state where the intrusive forming was completed and has begun to rise in the conventional negative-angle forming die;

Fig. 16 is a vertical cross-sectional view where the conventional negative-angle forming die performed the intrusive forming, and the upper die further rose, and is positioned at the top dead center;

Fig. 17 is a schematic view showing a pattern diagrams of a rotary-cam driven apparatus for a negative-angle forming die;

Fig. 18 is a side view showing a state where an upper die of the practical example of the rotary-cam drive apparatus for the negative-angle forming die is positioned at a top dead center;

Fig. 19 is a side view of a state where the upper die shown in Fig. 18 is positioned at a bottom dead center; and

Fig. 20 is a plan view of the state shown in Fig. 19.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0035] In the following the present invention will be described in detail using an a practical embodiment thereof with reference to the accompanying drawings.

[0036] The embodiment of the present invention is shown in Figs. 1 to 10 in which the same numerals or symbols will be used to refer to the same components shown in Figs. 17 to 20.

[0037] A guide plate 71 is provided between a piston rod 69 of a cylinder 51 and a cam follower arm 70 attached to an end portion of a supporting axis of a rotary cam 5 rotatably supported in a lower die 1 of a negative angle forming die. A cam follower 73 of a cam follower arm 70 is fitted into a guide groove 72 of the guide plate 71.

[0038] The cam follower arm 70 comprises a disc portion in the center and two arm members extending therefrom. The cam follower arm 70 comprises a first cam follower 55 which is rotatably provided to an end of one of the arm members and a second cam follower 73 which is rotatably provided to an end of the other one of the two arm members and which is fitted into the guide groove 72 of the of the guide plate 71.

[0039] The guide groove 72 is provided in the guide plate 71. The guide groove 72 is formed or carved in so as to extend in regions in the direction of the stroke of the piston rod 69 and in the direction perpendicular thereto and perpendicular to the rotary cam axis to allow the cam follower 73 to rotate or pivot around the rotary cam axis. Accordingly, the cam follower 73 moves in a plane which is perpendicular to the rotary cam axis and on a locus defined by the contour of the guide groove. In the drawing the guide groove 72 is carved in upper and lower regions of the guide plate as seen in Figs. 1 and 2, thereby allowing the cam follower arm 70 as well as the rotary cam 5 connected therewith to rotate. The guide groove 72 is carved to allow the cam follower 73 to smoothly follow the groove contour and is set slightly longer than the stroke of the piston rod 69. The guide groove 72 includes an horizontal groove section 72a and a sloped groove section 72b.

[0040] The piston rod 69 of the cylinder 51 and the guide plate 71 are connected by turning a threaded end portion of the piston rod 69 into the guide plate 71, and a fixing plate 74 shown in Figs. 4 and 5 is used to lock rotation of the piston rod 69. As shown in Figs. 2 and 4, two plane portions or grooves 76a formed by cutting two sides are provided between a small-diameter end portion 69a and a large-diameter base end portion 69b of the piston rod 69. In addition, a cutout 76 of the fixing plate 74 is externally fitted to the two plane portions or grooves 76a, and the fixing plate 74 is fixed to the fixing plate 74 with a bolt 78.

[0041] As shown in Figs. 6 and 7, the guide groove 72 is on the reverse side of a portion of the guide plate 71 shown in Figs. 1 and 2, and the cam follower 73 of the cam follower arm 70 is engaged therewith. On the obverse side, horizontal guide grooves 75 and 76 are carved to correspond to the horizontal extension and extraction stroke movement of the piston rod 69 of the cylinder 51. In addition, a roller 78 and rollers 79 and 80 of a guide-plate support 77 shown in Figs. 8 to 10 are engaged with the horizontal guide groove 75 and the horizontal guide groove 76, respectively. The guide-plate support 77 is fixed with a bolt 81 to the lower die 1. The guide grooves 75 and 76 in cooperation with the guide-plate support 77 guide the guide plate 71 for movement in the stroke direction of the piston rod 69 and prevent tilting of the guide plate 71.

[0042] Fig. 1 shows a state where the upper die 3 is positioned at a top dead center, and Fig. 2 shows a state where the upper die 3 is positioned at a bottom dead center. Fig. 3 is a plan view showing a state excluding the upper die 3 shown in Fig. 2.

[0043] When the upper die 3 descends from the state of the top dead center, the sloped portion 62a of the cam face 62 of the driver 53 of the upper die 3 abuts against the cam follower 55 of the cam follower arm 70 of the lower die 1. Then, when the rotary cam 5 rotates and the cam follower 55 reaches the perpendicular portion 62b of the cam face 62, the rotary cam is not further rotated and maintains the forming posture. When an intrusive forming process for a work has been completed, the upper die 3 rises. In this case, when the movement of the cam follower arm 70 is no longer restrained, the rotary cam 5 is returned by the operation of the cylinder 51 to its original position.

[0044] In the state of the top dead centers shown in Fig. 1, the cam follower 73 of the cam follower arm 70 in the guide groove 72 of the guide plate 71 is positioned in the sloped groove section 72b. As the upper die 3 descends, the cam follower 73 moves from the sloped groove section 72b to the linear groove section 72a. When the cam follower 73 is positioned in the linear groove section 72a, the cam follower 55 is positioned at the perpendicular portion 62b of the driver 53 where the rotary cam 5 assumes the forming posture.

[0045] Conventionally, when the piston rod of the cylinder is directly connected to the cam follower arm by tightening the threaded portion, because of variations in the amount of tightening the threaded portion and of play, a rotation start position and a rotation termination position of the rotary cam has not been able to be precisely determined. As such, when intrusive forming is performed in the above-described state, high-quality work processes have not been able to be implemented. However, the present invention is arranged such that the linear piston stroke of the cylinder 51 is transferred to the rotary cam through the intermediate engagement between the cam follower 73 of the cam follower arm 70 and the guide groove 72 of the guide plate 71 connected with the piston rod 69, no influences are caused on the rotation start and the rotation termination of the rotary cam and high-quality work processing can therefore be implemented.

[0046] As described above, according to the present invention, the rotary drive apparatus for rotating the rotary body through extension and extraction of a piston rod of a cylinder is arranged such that supporting axes are provided to individually protrude from two ends of the rotary body, the supporting axes are held and the rotary body is rotatably provided, a central portion of a cam follower arm is fixed to the supporting axis, one end of one of the cam follower arm members and the piston

rod of the cylinder are connected via the guide plate provided therebetween in that a guide groove is carved into the guide plate, a cam follower at the end of the cam follower arm is engaged with the guide groove and the guide groove is formed and positioned such that the cam follower is rotated separately in a stroke direction of the piston rod and in a direction perpendicular thereto. As such, in the rotary drive apparatus for rotating the rotary body through extension and extraction of the piston rod of the cylinder a rotation start and a rotation termination position can be accurately determined and intrusive forming can be performed with the rotary cam being accurately positioned if the drive apparatus is employed in a negative angle forming die press, thereby enabling high-quality work processing to be implemented.

[0047] In other words, the present invention is a rotary-cam drive apparatus for a negative-angle forming die comprising a lower die for mounting a work of a thin metallic sheet onto a supporting portion, an upper die that is linearly descended to the lower die for forming the work by hitting against the work, a rotary cam rotatably provided in the lower die to comprise an intrusive-forming portion that is formed at an edge portion closer to a supporting portion and that is intruded from a locus of the upper die, a slide cam that comprises an intrusive-forming portion and that is provided to the upper die to be slidable in opposition to the rotary cam, and an automatic returning tool provided to the lower die for rotationally retracting the rotary cam to be in a state where the work can be taken out from the lower die upon completion of the forming process, wherein the slide cam performs the forming process of the work set on the supporting portion of the lower die by using the intrusive forming portion of the rotary cam, and the rotary cam is rotationally retracted by the automatic returning tool to enable the formed work to be taken out from the lower die; wherein the rotary-cam driven apparatus is configured such that supporting axes are provided to individually protrude from two ends of the rotary body, the supporting axes are held by the lower die and the rotary body are rotatably provided, a central portion of a cam follower arm is fixed to the supporting axis, one end of the cam follower arm and the piston rod of the cylinder are connected via a guide plate provided therebetween, a guide groove is carved on the guide plate to rotate the cam follower separately in a stroke direction of the piston rod and in a direction perpendicular thereto, and a cam follower at the end of the cam follower arm is engaged with the guide groove. Conventionally, when the cylinder is directly connected to the rotary body, the power of the cylinder is abruptly transferred with shocks. However, according to the present invention, since the cylinder and the rotary body are connected via the guide groove, shocks in abrupt movements of the cylinder and the piston rod are absorbed by the guide groove. As such, no shocks are transferred to the rotary body.

Claims

1. A rotary drive apparatus for rotating a rotatably supported rotary body (5) comprising:

a cylinder (51) with a piston rod (69) that can be linearly extended and retracted in a stroke direction,
a cam follower arm (70) fixed to a supporting axis of said rotary body (5) and having an arm section to which a cam follower (73) is provided;
a guide plate (71) connected with said piston rod (69) and provided with a guide groove (72) receiving said cam follower (73), wherein said guide groove (72) is formed and arranged such that it guides said cam follower (73) in the stroke direction of the piston rod (69) and in a direction perpendicular to the stroke direction and perpendicular to said supporting axis of said rotary body (5), thereby rotating said rotary body (5) via said cam follower arm (70).

2. A negative-angle forming die comprising:

a lower die (1) with a supporting portion for mounting a work of a thin metallic sheet,
an upper die (3) that is adapted to linearly descend towards said lower die (1) for forming the work mounted on said supporting portion by joining up against the work,
a rotary cam (5) rotatably supported in the lower die (1) and including an intrusive-forming portion which is adapted to cooperate with an intrusive-forming portion of a slide cam to form said work; and
an automatic returning tool provided to the lower die (1) for rotationally retracting the rotary cam (5) to a position where the work can be taken out from the lower die (1) after the forming process;

wherein said automatic returning tool comprises a rotary drive apparatus as defined in claim 1 for rotating said rotary cam (5).

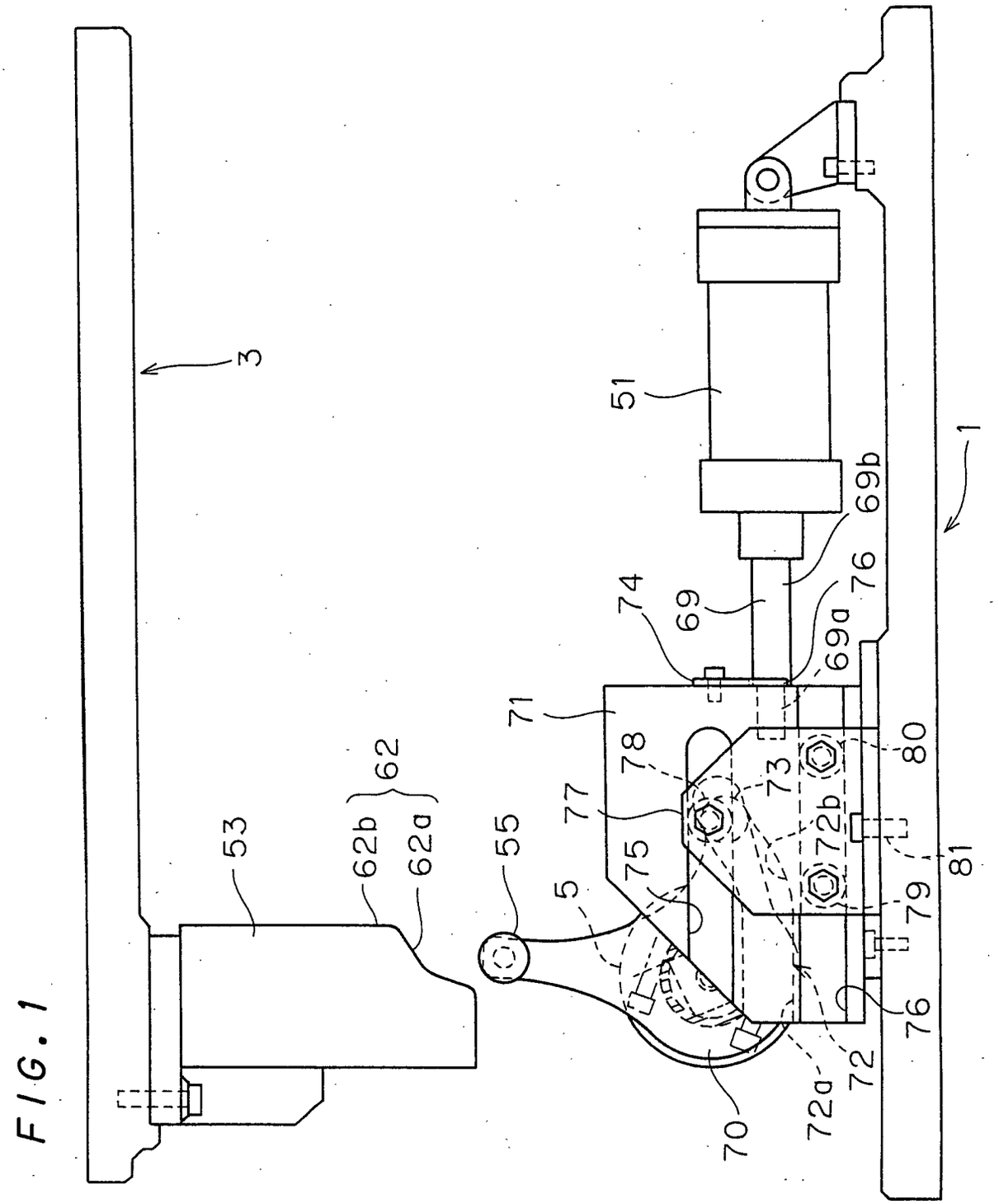

3
51
1
69b
76
74
69
69a
71
78
73
80
62
77
72b
81
53
62b
62a
55
75
5
79
76
72
72a
70

FIG. 1

FIG.2

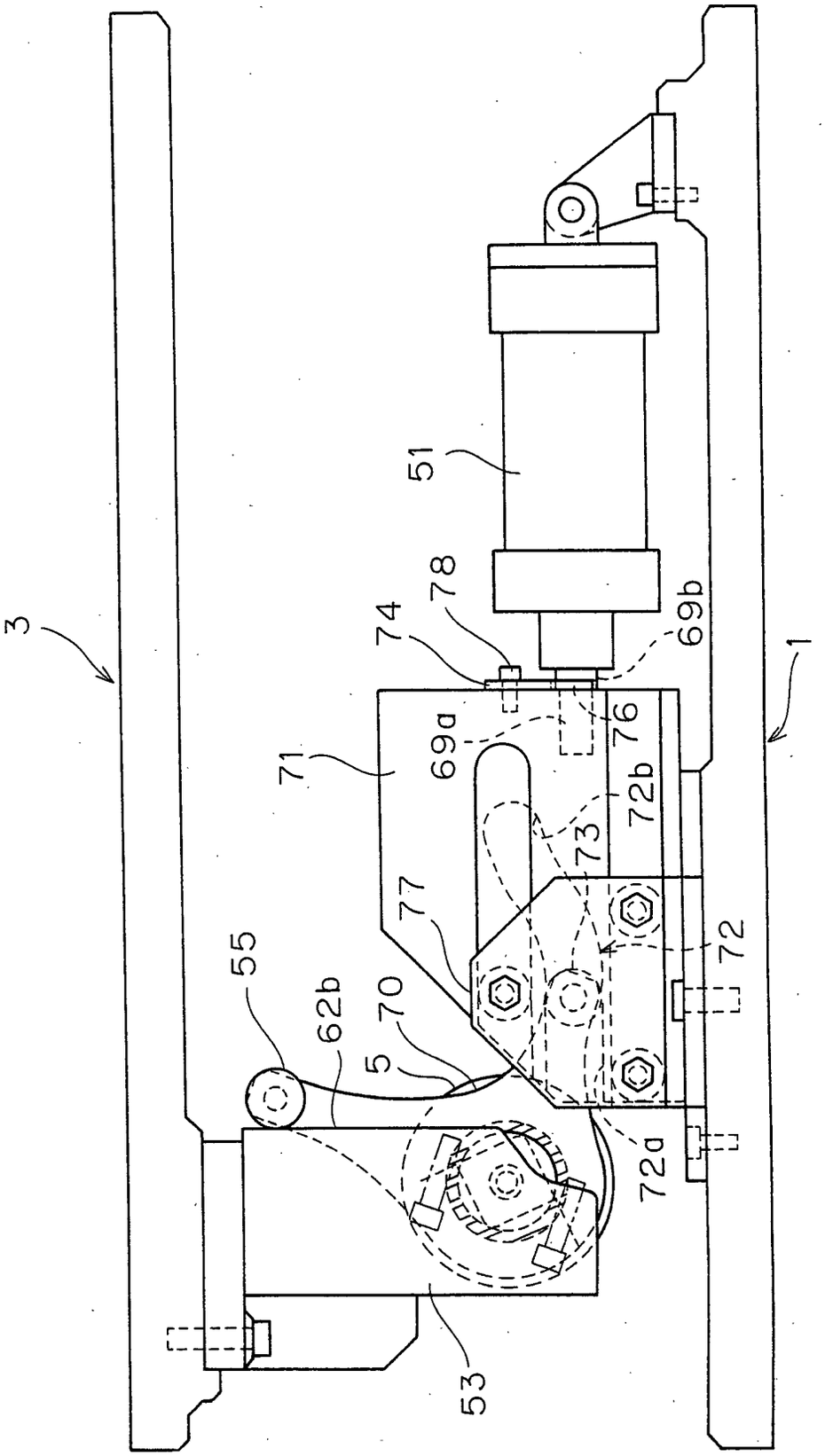


FIG. 3

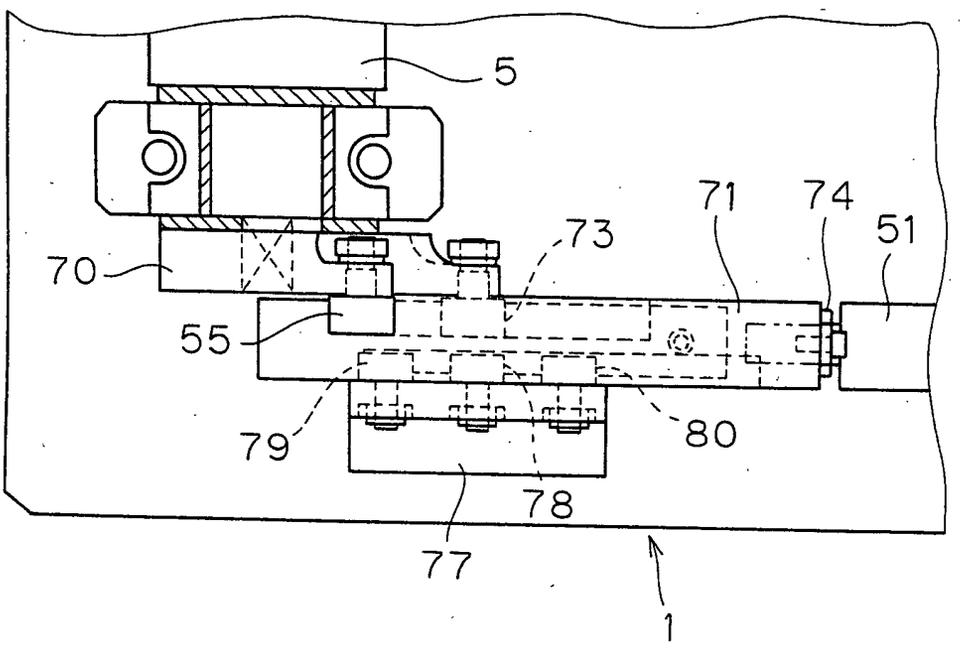


FIG. 4

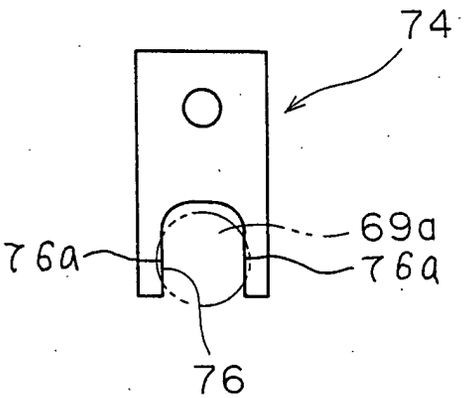


FIG. 5

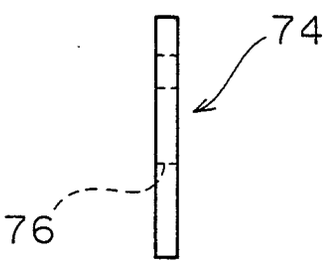


FIG. 6

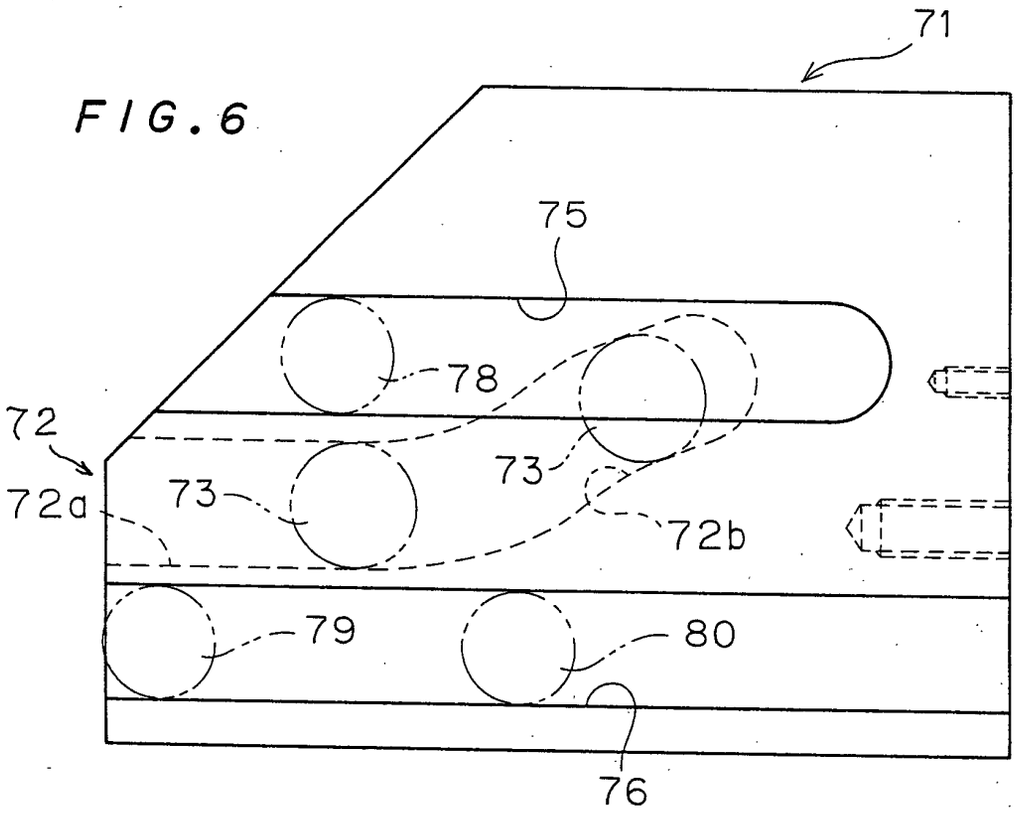


FIG. 7

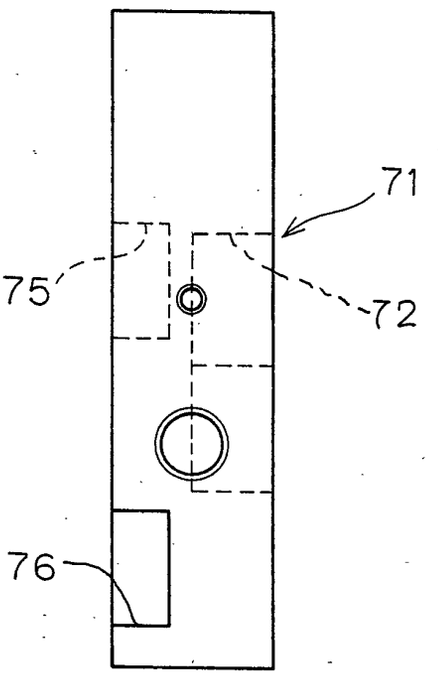


FIG. 8

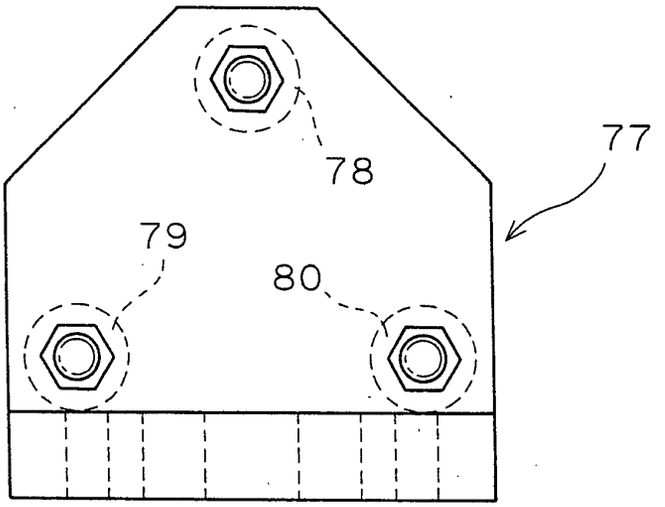


FIG. 9

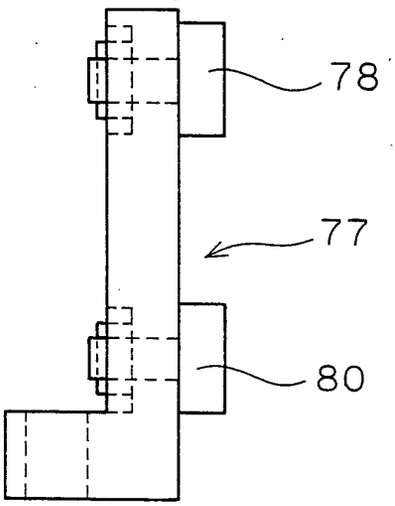


FIG. 10

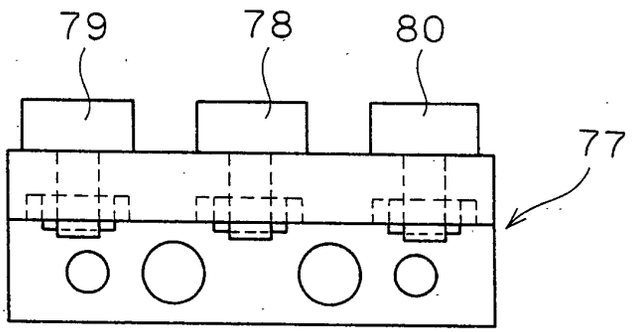


FIG. 11

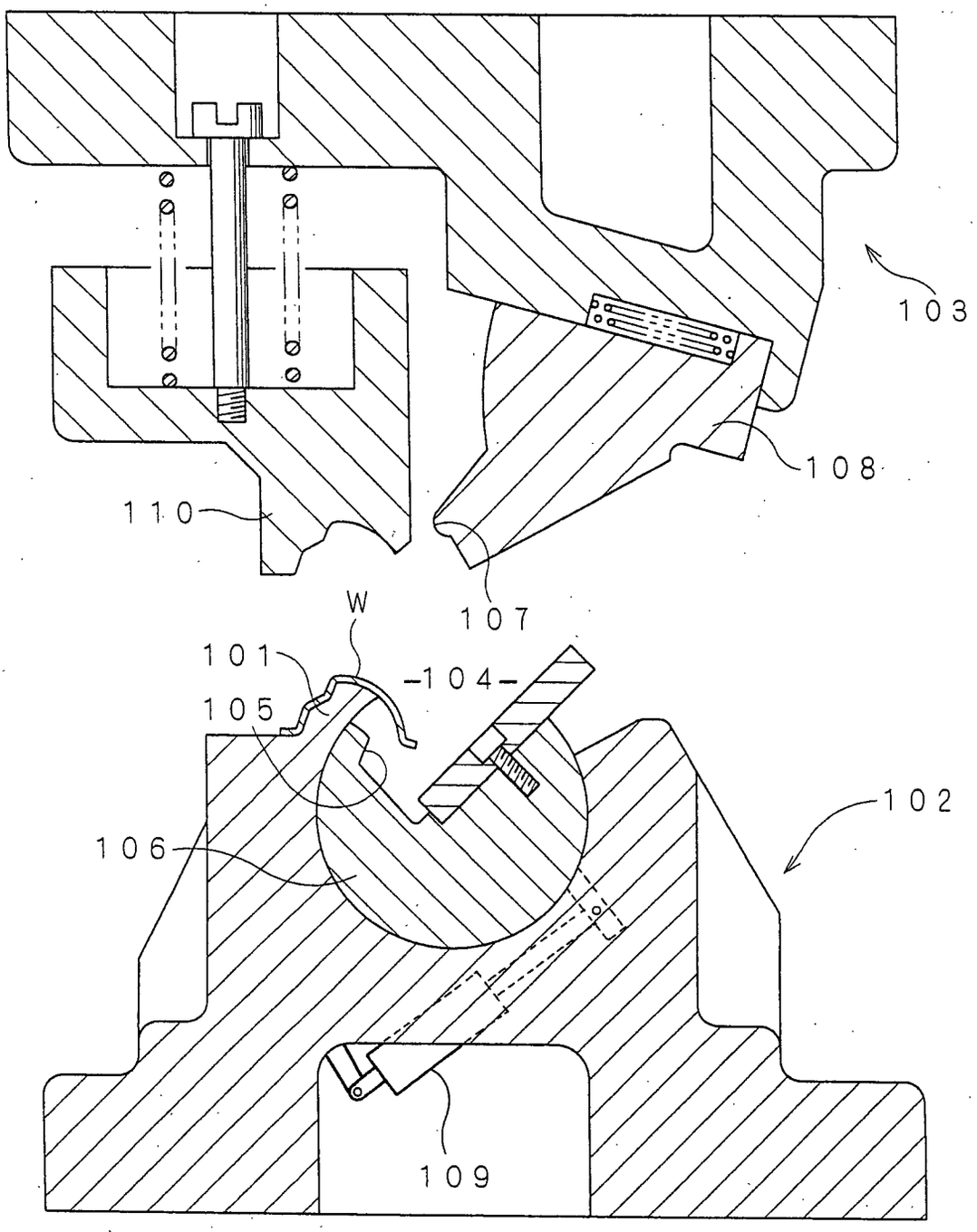


FIG. 12

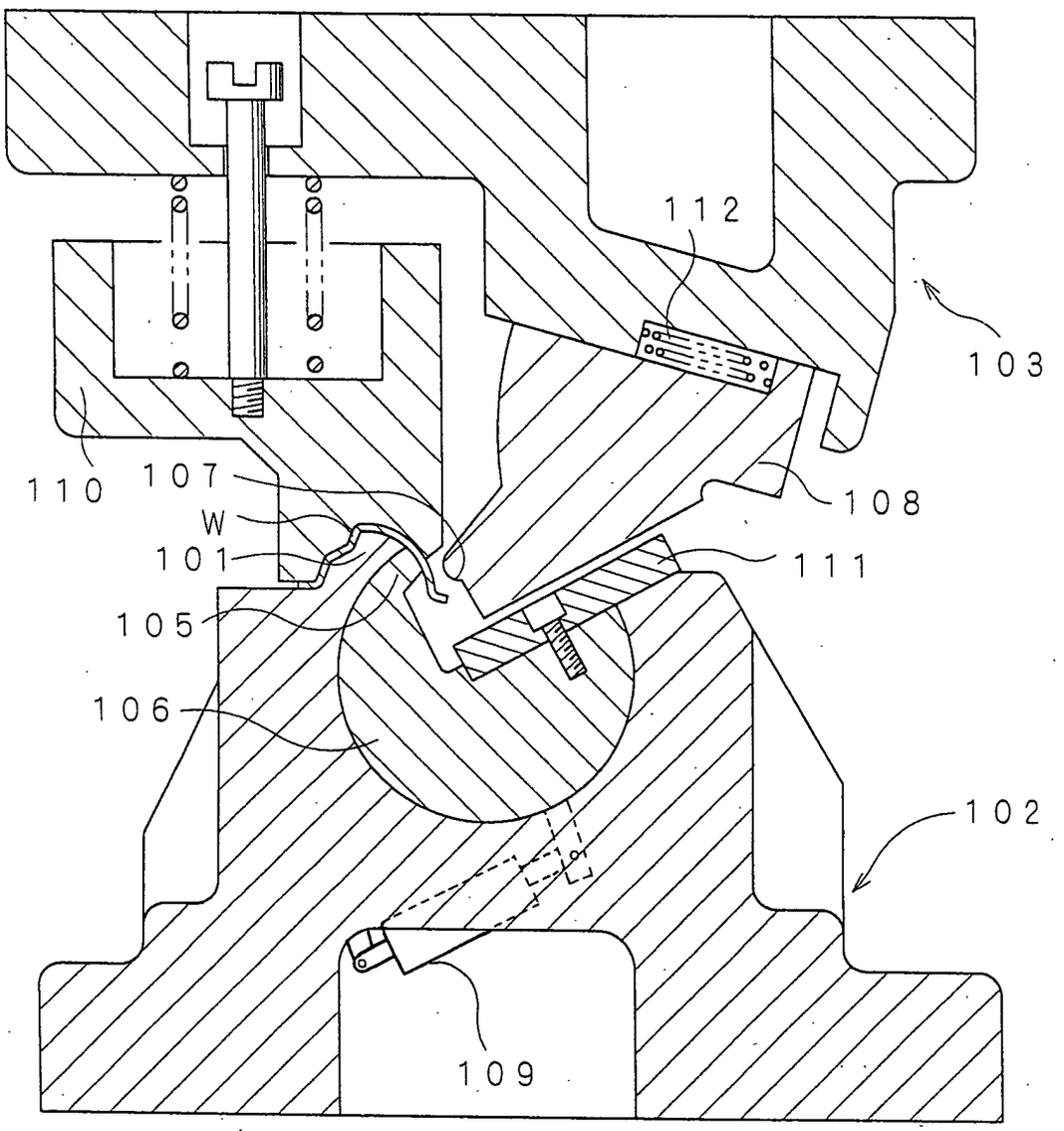


FIG. 13

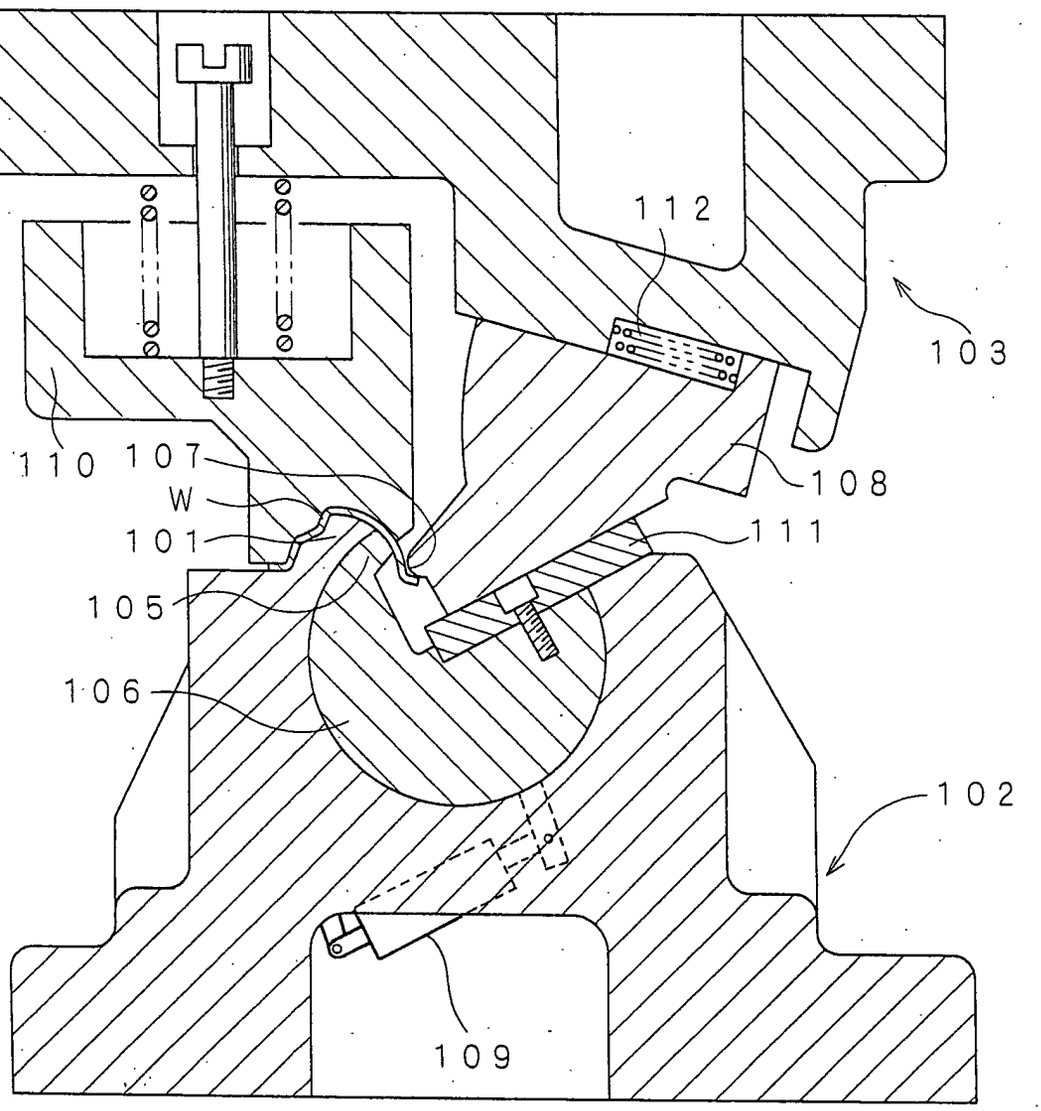


FIG. 14

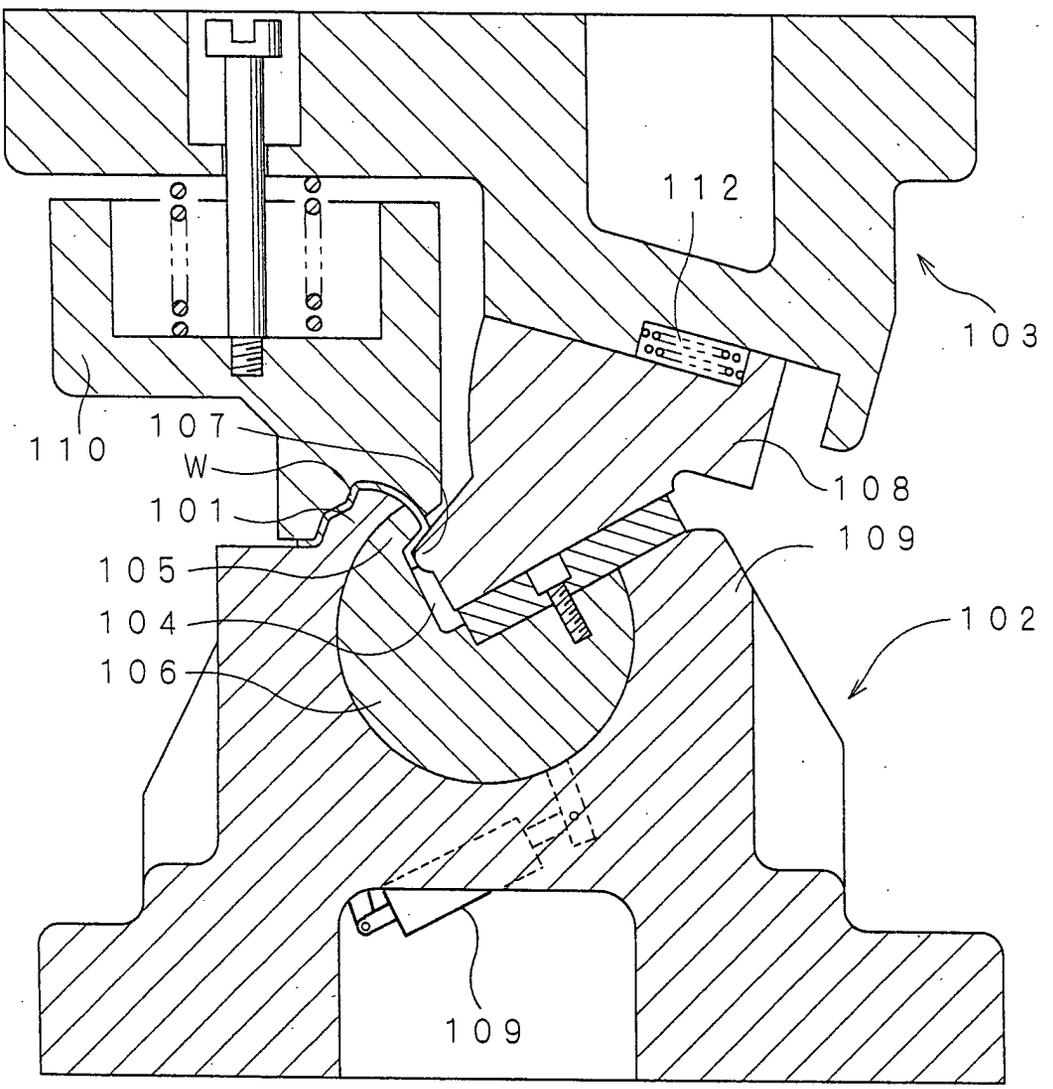


FIG. 15

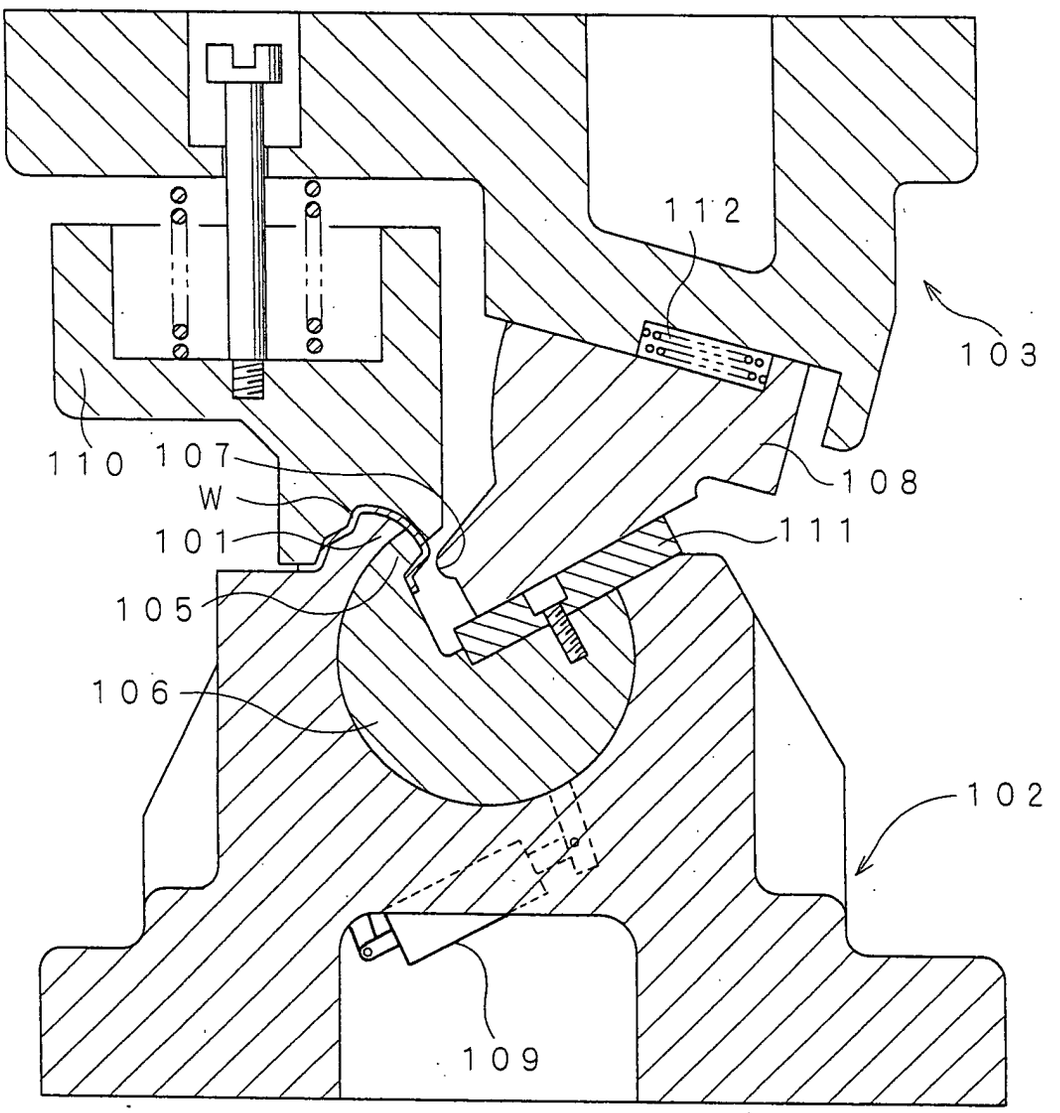


FIG. 16

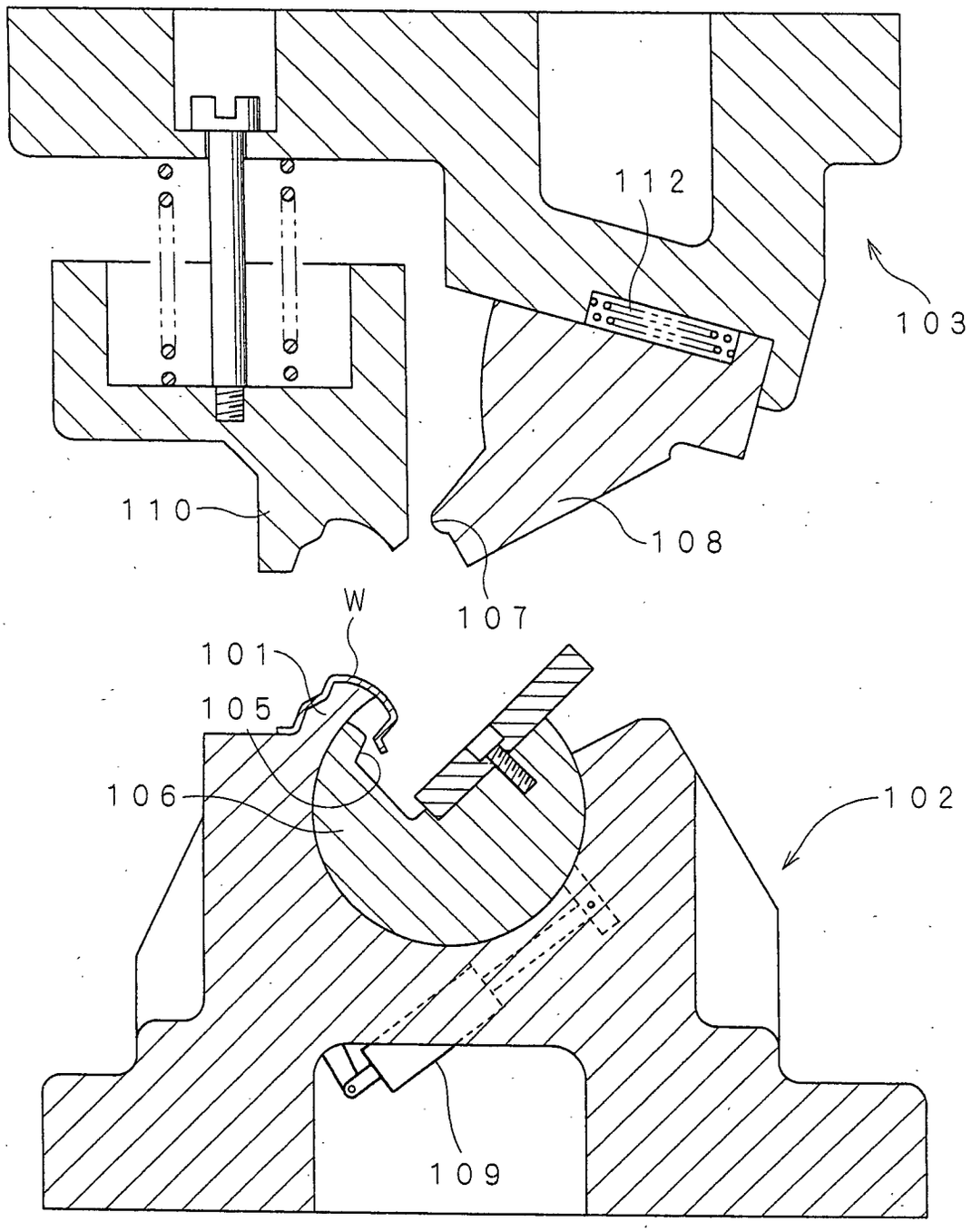


FIG. 17

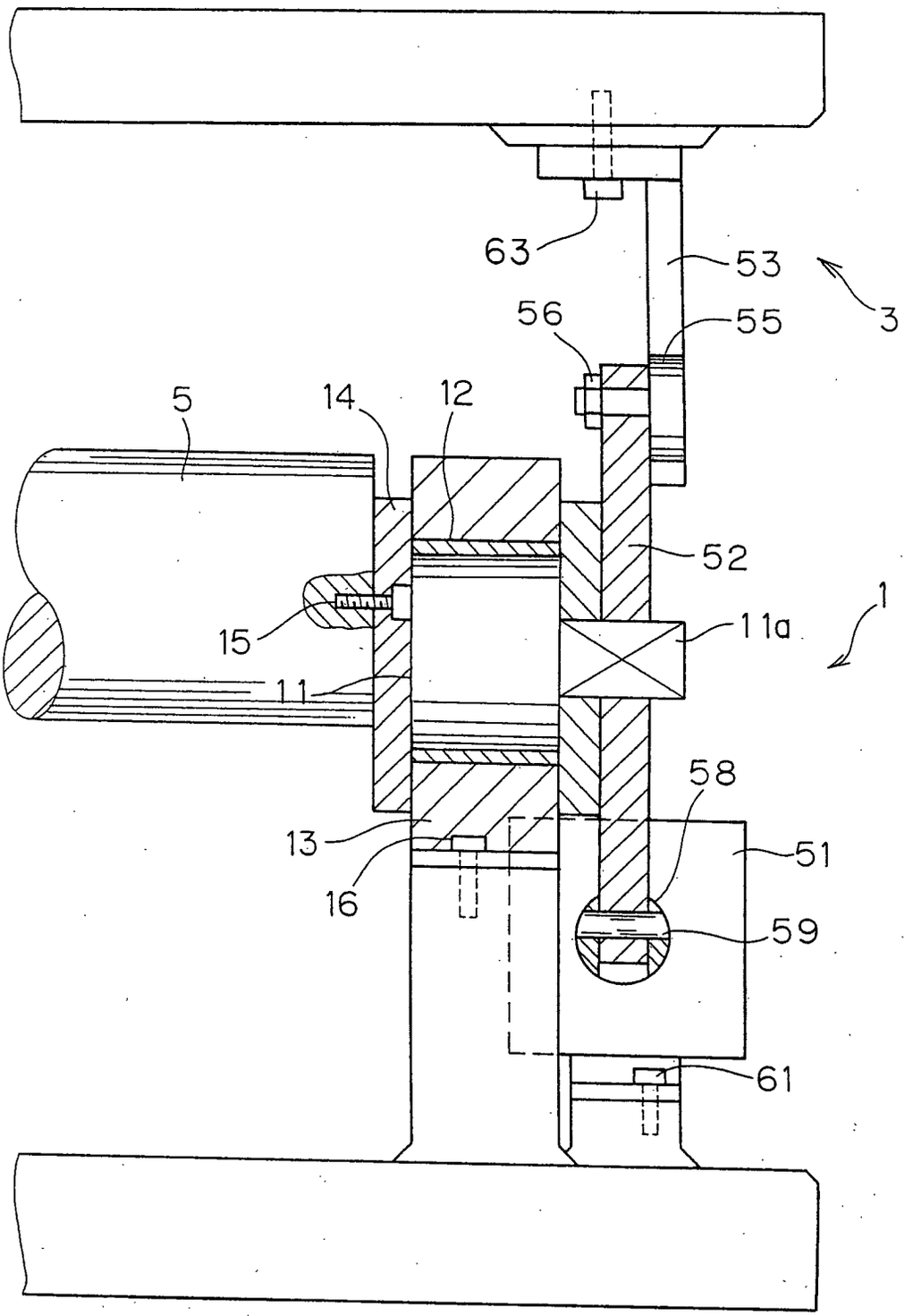


FIG. 18

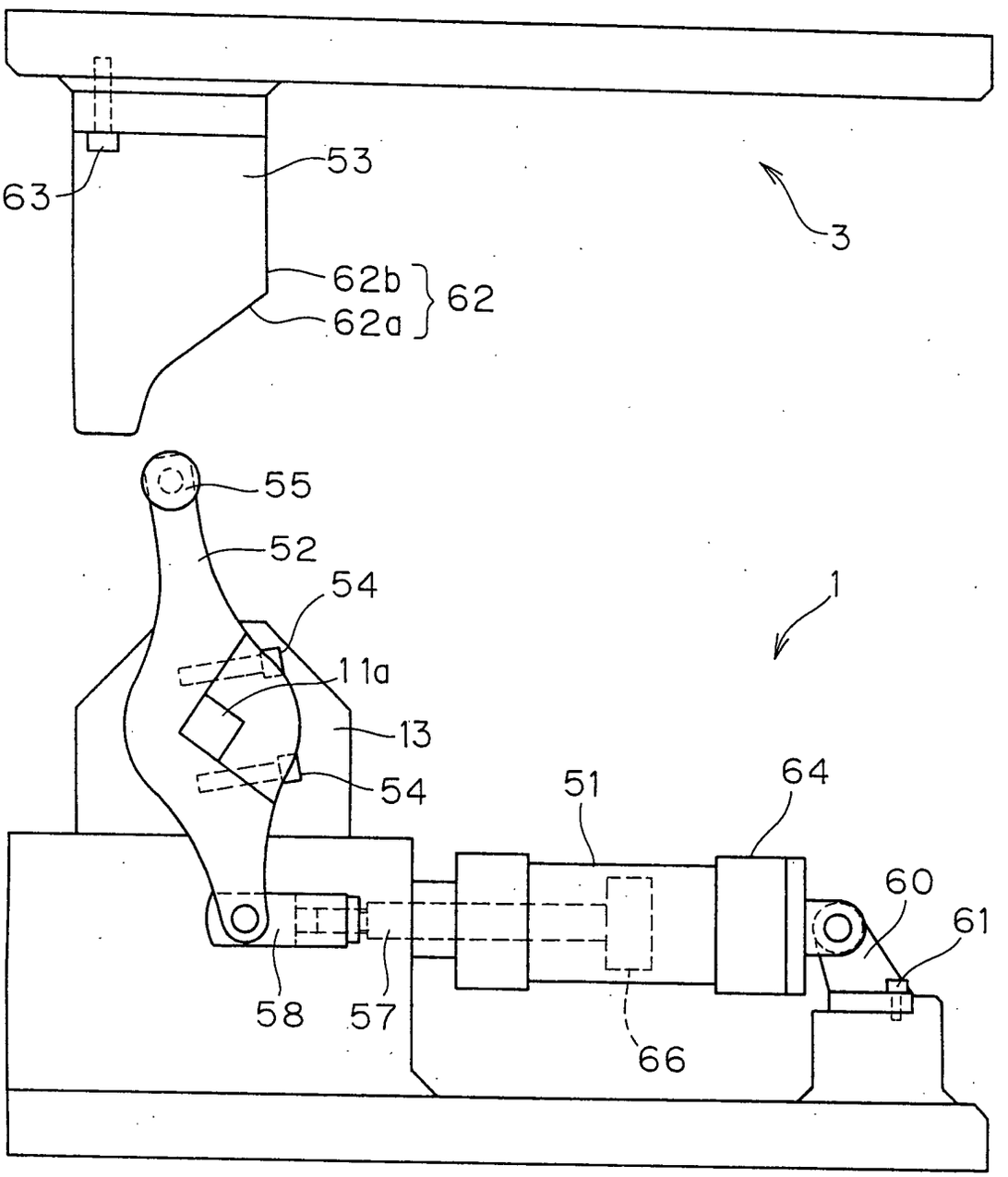


FIG. 19

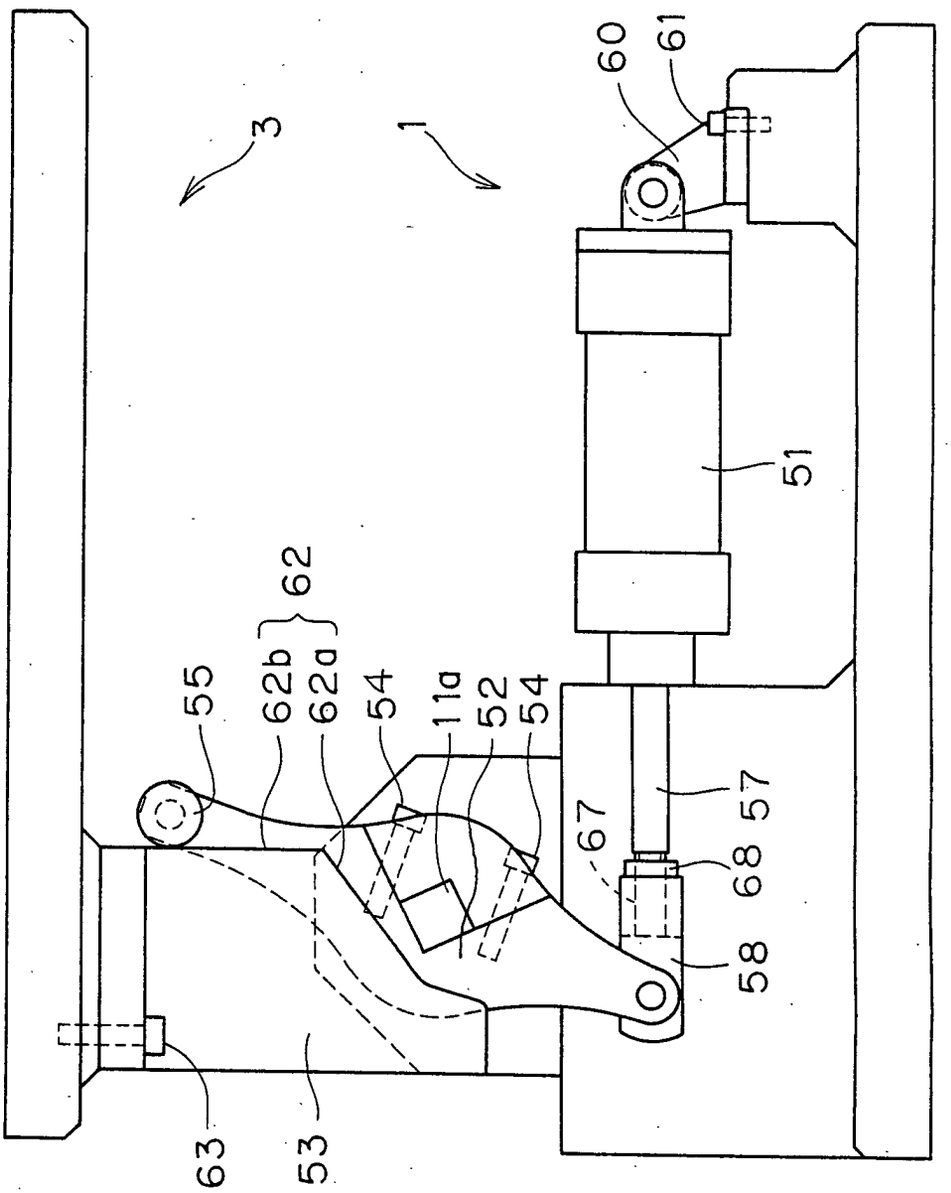


FIG.20