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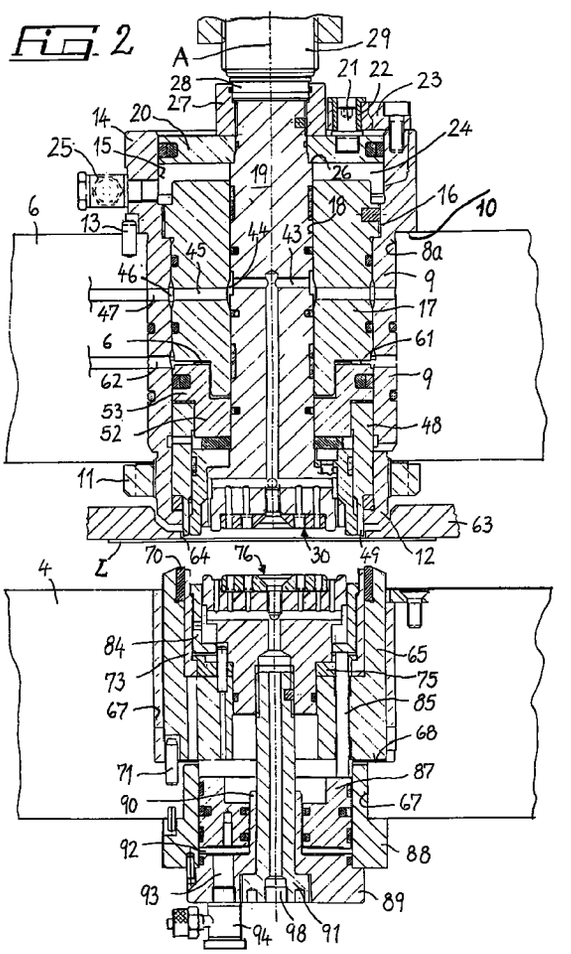
(54) Press for blanking metal sheets and for forming cup-shaped items such as caps, closures, and lids for closing bottles, cans, jars, and the like

(57) A press for blanking metal sheets and for forming items such as caps, closures, and the like, including an upper movable beam (7) and a lower beam (4) between which a fixed beam (6) is arranged. The die (65) and the counterpunches (76) are mounted on the lower movable beam (4). The blanking rings (49) and the punches (30) are mounted on the fixed beam (6) and cooperate with the dies (65) and with the counterpunches (76) respectively. Blocks (29) are adjustably mounted on the upper movable beam (7) and act on the punches (30) to form the items.



EP 0 732 162 A2

Description

The present invention relates to a press for blanking metal sheets and for forming cup-shaped items such as caps, closures, and lids for closing bottles, jars, cans, and the like.

Presses of the described type are already commercially available. They comprise at least one annular blanking element that is actuated with a reciprocating motion and cuts a disk of metal from a sheet or strip. A forming punch runs inside the annular blanking element and, by advancing with respect to the blanking element, said punch draws the disk inside a die, forming a cup.

In some of these presses, when the punch has arrived proximate to its stroke limit inside the die, a collar of the punch, provided with a cutting edge, in cooperation with a complementary cutting edge of the die, trims the cup by cutting its rim.

Conventional blanking presses have the main drawback that they do not allow to adjust the stroke of the punch according to the actual drawing requirement; therefore, excessive strokes of the punch may occur, with consequent wear effects and increase in press downtime.

A principal aim of the present invention is to provide a press that allows to obviate substantially the above drawbacks, i.e., that can be adapted to the formation of sheet metal items having any shape.

This aim is achieved by a press for blanking a metal sheet and for forming drawn cup-shaped items such as caps, closures, and lids for closing bottles, jars, cans, and the like, characterized by: a fixed beam, in which a first part of at least one forming unit is supported, said first part comprising a sleeve that is supported in the beam and has a seat in which a stem is slidingly guided, said stem having, at one end, a forming punch, the opposite end being instead subjected to the action of return means for the return of said stem, said punch being guided in a blanking ring whereon a fluid-actuated actuator connected to a pressure source acts; a first movable beam, in which a second part of said forming unit is supported, said second part comprising a die that is coaxial to said stem and has a seat for receiving said blanking ring and a rim that forms, with said ring, the means for blanking the metal sheet, a contrast bush for said blanking ring, a counterpunch that cooperates with said punch, and means for expelling the drawn item from said cavity being arranged inside said die and coaxially thereto; a second movable beam provided with adjustable means adapted to act on said stem; means for actuating said first movable beam relative to said fixed beam so that, during the stroke for approaching the movable beam towards the fixed beam, said metal sheet is first blanked due to the penetration of said blanking ring in said die, so as to form a disk that is then clamped perimetrically between said blanking ring and said contrast bush by activating said actuator that acts on said blanking ring, means being furthermore provided for actuating said second movable beam at the end of the step for blanking said disk, so as to cause the engagement of said adjustable means on said stem and of said punch on said disk and the formation of a drawn item, at the end whereof said movable beams are again moved away from the fixed beam and said punch is again returned by said return means into the position for disengagement from the drawn item and said drawn item is expelled from said die.

Further characteristics and advantages of the present invention will become apparent from the following detailed description of a preferred but not exclusive embodiment thereof, illustrated in the accompanying drawings, wherein:

figure 1 is a schematic front view of a blanking and forming press according to the invention;
figure 2 is a sectional view, taken along the plane II-II of figure 1, of a forming unit;
figure 3 is an enlarged-scale view of a portion of figure 2;
figures 4, 5, and 6 are views of the forming region of the forming unit in successive operating situations;
figure 7 is a view of adjustment means acting on the stem of the punch;
figure 8 is a sectional view of a different embodiment of the press.

With reference to the above figures, the press comprises a frame 1 having two pairs of parallel posts 2 connected by a fixed beam 3 (hereinafter termed upper beam). A movable beam 4, termed lower beam, slides on the posts 2 and is actuated reciprocatingly by eccentric elements 5 mounted on a rotating shaft 5a and acting on the beam 4 by means of bearings 5b.

An intermediate fixed beam 6 is arranged above the movable beam 4 and an additional movable beam 7 is guided on the posts 2 between the fixed beams 3 and 6.

The activation of the upper movable beam 7 is actuated by two connecting rods 7a that connect the upper beam 7 to respective eccentric elements 8 that are keyed to the shaft 5a outside the posts 2. The eccentric elements 8 are offset with respect to the eccentric elements 5, so as to produce a movement of the upper beam 7 towards the fixed beam 6 when the stroke for approaching the lower movable beam 4 towards said beam 6 has ended.

The blanking and forming units are mounted on the intermediate beam 6 and on the lower beam 4 and are arranged on two parallel rows; one of said units is shown in detail in figures 2 and 3.

Said figures show the movable beam 4 and the intermediate beam 6, each whereof supports part of the blanking and forming unit.

In particular, the reference numeral 8a designates a seat of the beam 6 wherein a sleeve 9 is centered; said sleeve is locked between a shoulder 10 and a ring 11 that is screwed on a threaded portion 12 lying below the beam 6.

The sleeve 9 is prevented from rotating by a pin 13 driven into the beam 6 and protrudes, with a portion 14, above the beam 6 so as to form a cylindrical seat 15.

The portion 14 has a threaded internal portion 16 wherein a tubular body 17 is screwed; said body forms an axial sliding seat 18 for a stem 19 having an axis A.

A piston 20 is fixed in the upper end of the stem 19, is hermetically guided in the seat 15, and is prevented from rotating by a pin 21 that is fixed thereon and slidingly engages a bush 22 supported by an arm 23 that is fixed on the portion 14.

The piston 20 encloses, together with the cylindrical portion 14 and the tubular body 17, a chamber 24 that can be connected to a source of compressed air by a union 25 and by valve means that are not shown.

The piston 20 is locked between a shoulder 26 of the stem 19 and a nut 27 screwed on a threaded portion of said stem. The nut 27 protrudes partially from the top of the stem, so as to form a cavity wherein a pad 28 is inserted; a respective block 29 acting on said pad is mounted adjustably on the movable beam 7 (reference should be made to the following description relating to figure 7).

A forming punch 30 is shaped at the end of the stem 19 that lies opposite to the pad 28 and is composed of a cylindrical expansion 31 (see figure 3) that is provided, at the front, with an annular ridge 32 and is surrounded by a sort of cup 33. The cup 33 has an internal flange 34 that is crossed by bolts 35 for fixing to the expansion 31. The rim of the cup 33 forms an annular ridge 36 that is concentric to the ridge 32 and protrudes from the plane of a central region constituted by a bottom plate 37 fixed by a screw 38.

The ridges 32 and 36 delimit a groove 39 into which a plurality of holes 40 formed in the expansion 31 lead.

The holes 40 lead, together with other holes 41 that pass through the expansion 31 and the bottom plate 37, into a channel 42 running axially inside the stem 19. The channel 42, at the level of the tubular body 17, branches radially into a plurality of channels 43 that lead into an annular groove 44 formed between the adjacent surfaces of the stem and of the tubular body. Additional channels 45 extend from the groove 44 and connect it to a groove 46 lying between the outside surface of the tubular body 17 and the inside surface of the sleeve 9. A duct 47 branches off from the groove 46 and, after passing through the sleeve 9, it continues through the fixed beam 6 for connection to the outside environment or, as an alternative, to a compressed air source. The purpose of the compressed air is to keep the forming region clean.

Sealing rings are provided to prevent the compressed air from seeping between the contacting surfaces of the sleeve 9 and the tubular body 17 and the contacting surfaces of said tubular body 17 and of the stem 19, said rings being shown in the drawings but not designated by reference numerals for reasons of clarity.

The portion 12 of the sleeve 9 and the cup 33 externally and internally delimit an annular compartment inside which a tubular element 48 is inserted; a ring 49 extends from said tubular element and constitutes the sheet metal blanking ring.

The ring 49 forms, together with the tubular element 48, a step 50 which, with the interposition of a shim ring 51, rests on a collar lying inside the portion 12. When the blanking ring 49 wears out and is sharpened, the ring 51 is lowered or replaced with another thinner ring, so as to compensate for the reduction undergone by the blanking ring due to sharpening.

The tubular element 48 is inserted on a tang 52 of a piston 53 that is sealingly guided in the sleeve 9 below the tubular body 17 and rests on the piston 53 with the interposition of a swivel ring 54.

A compartment 55 is enclosed between the stem 52 and the punch 30 and is connected to the outside environment by means of openings 56 of the tubular element 48, an annular groove 57, and passages 58 of the sleeve 9.

An abutment ring 59 made of elastic material is accommodated in the compartment 55, rests on the punch 30, and is adapted to abut against the tang 52 when the punch 30 is raised.

Raised portions 60 are formed above the piston 53 and keep the surface of the piston spaced from the surface of the tubular body 17, forming a narrow chamber 61 that is constantly connected to the compressed air duct by radial holes 62 of the sleeve 9. It should be noted that the action of the compressed air on the piston 53 produces only a minimal stroke of the piston that is substantially equal to the small distance between the raised portions 60 and the face of the tubular body 17 against which they abut.

The sheet presser plate 63 is arranged below the fixed plate 6 and has, at the forming units, circular openings 64 that are concentric to the axis A and have a diameter that is slightly larger than the outside diameter of the blanking ring 49, so that said blanking ring can pass therethrough. The sheet presser plate 63 is guided by secondary posts that are guided in the fixed beam 6 so that it can move parallel to itself towards the fixed beam 6 when it abuts against the part of the forming unit that is supported in the movable lower beam 4. The return of the sheet presser plate to a position spaced from the fixed beam is achieved by means of return springs. The guiding and return elements of the sheet presser plate are not shown in the drawing because they are fully conventional.

The elements that form the part of the forming unit that is supported in the lower movable beam 4 comprise a die 65 constituted by a bush inserted in a tubular segment 66 that is accommodated in a cylindrical seat 67 of the beam 4 the axis whereof is A and is therefore coaxial to the seat 8 of the beam 6.

The die 65 rests on a shoulder 68 of the seat 67 that surrounds an opening 69 which is open towards the lower face of the beam 4. At the top of the die a seat is provided for accommodating a ring 70 the inside edge whereof constitutes a cutter that cooperates with the

external cutter of the ring 49 to blank the metal sheet, designated by L in the figures.

The die 65 is prevented from rotating by a pin 71 that is driven into the shoulder 68, and is internally provided with a step 72 acting as a support for a bush 73, the top whereof reaches below the cutter of the ring 70 and forms, therewith, a seat 74 wherein the cutting rim of the blanking ring 49 can engage. The bush 73 has a rounded inner edge so as to allow the wrinkle-free stretching of the sheet metal during the drawing of the cup.

A disk 75 furthermore rests on the shoulder 72 and is provided with a peripheral lip adapted to retain the bush 73; the counterpunch 76 rests on said disk and cooperates with the punch 30 to form the item.

The counterpunch 76 is frontally provided with a perimetric ridge 77 that is shaped complementarily to the groove 39 of the punch 30. The ridge 77 in turn surrounds a groove 78 that is shaped complementarily to the ridge 32 of the punch.

A bottom plate 79 is recessed in the central region of the counterpunch 76 and is fixed by a central screw 80 that delimits the groove 78 internally.

The counterpunch 76 has a tang 81 that is inserted in the central opening 82 of the die 65 and is prevented from rotating by an axial pin 83 driven into the shoulder 72 through the disk 75.

An annular compartment is formed between the bush 73 and the outside surface of the counterpunch 76 and has a complementary cross-section with respect to the ridge 36 of the punch 30, so as to receive it during the step for forming the item.

The element for expelling the formed item is arranged slidingly in the annular compartment and is constituted by a sleeve 84 which is fixed on secondary posts 85 that are parallel to the axis A and are slidingly driven through the disk 75 and through guides 86 of the die 65.

The ends of the secondary posts lying opposite to the sleeve 84 are fixed in a piston 87 that is sealingly guided in a cylinder 88 which is centered in the opening 69 and is closed by a disk 89 centered on the cylinder 88. The disk 89 has a central sleeve 90 running axially inside the cylinder 88 and whereon the piston 87 is sealingly slideable.

The stem of a bolt 91 is driven through the sleeve 90, and said bolt is screwed into the counterpunch 76; the head of said bolt is recessed in a hollow of the disk 89.

The bolt 91 secures against the beam 4 the disk 89 and the cylinder 88 on one side and the punch 76, the disk 75, and the die 65 on the other side.

The piston 87, together with the cylinder 88 and the disk 89, encloses a chamber 92 that is connectable, through a hole 93 of the disk 89 and a union 94, to a compressed air source.

The feeding of compressed air into the chamber 92 and the consequent movement of the piston 87 cause a stroke of the sleeve 84 until the counterpunch abuts against the step 95, whereat the top of the sleeve protrudes from the counterpunch, thus allowing to remove the formed item from the forming seat.

However, suction may form between the front face of the counterpunch 76 and the corresponding region of the formed item, thus hindering the removal of said item by the sleeve 84. To avoid the formation of this suction, a plurality of axial holes 96 is provided in the counterpunch 76, said holes leading into the groove 78 and into the surface of the bottom plate 79 and being connected to the outside environment by radial channels 97 and by an axial channel 98 running along the bolt 91. The radial channels 97 also lead into the compartment wherein the sleeve 84 is slidingly accommodated, so as to avoid the formation of counterpressure during the activation of the piston 87.

The operation of the described press is as follows.

In the initial condition (see figure 2), the beam 4 is lowered with respect to the fixed beam 6 and the punch 30 is spaced from the counterpunch 76. The punch 30 is furthermore raised in the position for resting on the piston 52, whereas the sheet presser plate 63, through the action of the springs, is lowered so as to keep the metal sheet L below the blanking ring 49. In this open position of the forming unit, the counterpunch 76 and the sleeve 84 are lowered so that their upper edge lies below the edge of the contrast bush 73. The metal sheet is normally held against the lower face of the sheet presser plate 63 by appropriately provided strips that pass between the various forming units.

The blanking and forming steps entail at this point the rise of the beam 4 by virtue of the action of the eccentric elements 5 up to a level at which the die 65 first locks the metal sheet L against the sheet presser plate 63 and then, as its rising stroke continues, causes the blanking of a disk D of sheet metal in cooperation with the ring 49 that enters the seat 74.

The blanked disk D remains accommodated inside the seat 74 and rests on the top of the bush 73 (see figure 4).

At this point, compressed air is fed into the chamber 61 and, by acting on the piston 53, it causes the descent of the ring 49 and the locking of the peripheral region of the blanked disk D between the oppositely arranged ends of the ring 49 and of the bush 73.

During the subsequent step, the descent of the upper movable beam 7 is actuated, and its blocks 29, by acting on the stems 19, cause the descent of the punches 30.

During said descent stroke, first of all the ridge 36 of the punches 30 engages on the disk and a cup S (see figure 5) is formed which has a cylindrical wall obtained by stretching and drawing the region of the disk that is secured between the ring 49 and the bush 73.

When the wall of the disk S has been formed between the outside wall of the ridge 36 and the inside wall of the bush 73, the further descent of the punch 30 causes the stretching of the bottom of the cup and the formation of concentric corrugations caused by the pen-

etration of the ridges 32 and 77 in the grooves 78 and 39.

It should be noted that the outside diameter of the punch 30 at the ridge 36 is smaller than the inside diameter of the upper portion of the bush 73 so that, when the ridge 36 has entered the bush 73, an interspace remains wherein the cylindrical wall of the cup S can be accommodated. Subsequently, the lower beam 4 is again lowered and the upper beam is raised, while the punch 30 is raised by feeding compressed air into the chamber 24.

When the punch 30 rises, the cup remains rested on the counterpunch 76, wherefrom it is removed by activating the piston 87 which, by lifting the sleeve 84, disengages the cup S from the die, so that it can be removed by auxiliary means that are not shown.

After the cup S has been removed, the forming region is cleaned of any residues by feeding compressed air through the holes 40 and 41. The metal sheet is moved forwards by one pitch and the operating steps are repeated in the above described manner.

A fundamental prerogative of the present invention is the fact that the blanking movement is separate from the forming movement. Accordingly, the stroke of the moving lower beam 4, by virtue of which the metal sheet is blanked, is fixed and very small in view of the thickness of the metal sheet.

At the same time, the drawing depth can be adjusted by moving the block 29 with respect to the beam 7, the stroke whereof can remain constant.

For this purpose, the block 29 is screwed into a tubular body 99 fixed below the beam 7 and provided with a tang 100 that runs inside the body 99 to be associated, by virtue of a prismatic coupling 101, with an element 102 the actuation whereof causes the screwing or unscrewing of the block 29 and therefore a movement of the point of impact on the pad 28.

The tang 100 is diametrically crossed by a pin 103 the opposite ends whereof engage in notches of a swivel ring 104, so that said swivel ring too is rotationally coupled to the tang 100.

A spring 106 acts on the swivel ring 104 by virtue of a ring 105 and rests on a ring 107 supported by a shoulder 108 lying inside the tubular body.

The ring 105 is rotationally rigidly coupled to the tubular body 99, so that a friction coupling occurs between the swivel ring 104 and the ring 105, thus preventing the block 29 from rotating.

Another considerable advantage of the present invention resides in the tubular structure of the expulsion device. The sleeve 84 in fact allows to arrange the counterpunch 76 so as to cooperate with the punch 30 for shaping the central region of the cup.

Further modifications and variations may be possible in the practical embodiment of the invention, all of which are within the scope of the inventive concept.

Figure 8 is a view of a different embodiment provided to protect the elements of the forming die from excessive loads. In this embodiment, a cylinder 106 is rigidly coupled to the piston 20 and is closed at the top by a lid 107. The cylinder 106 is sealingly guided in an appropriately elongated portion 14 of the sleeve 9 and has a plurality of radial openings 108 proximate to the piston 20. A piston 109 is slideable in the cylinder 106, and its stem 110 passes through the lid 107 to cooperate with the block 29. The cylinder 106, together with the pistons 20 and 109, forms a chamber 111 which, by means of the openings 108, the interspace 112 formed between the cylinder 106 and the portion 14, as well as by means of further openings 113 of the portion 14, is connected to a channel 114 formed in a ring 115 that surrounds the portion 14. The channel 114 is connected to a pressurized manifold 116 by means of an accumulator that is appropriately pre-loaded.

A seat is formed in the lid 107 and leads into the chamber 111; a ball 117 is accommodated in said seat, acts as a transducer, and is capable of descending from a position in which it is retracted in the seat of the lid to a position in which it protrudes into the chamber 111 to cooperate with the piston 109. The position of the ball 117 can be detected by a sensor 118 capable of making the press stop when the pressure with which the block 29 acts on the stem 110 exceeds a preset value. In normal operating conditions, the pressure in the chamber 111 is such as to keep the piston 109 in abutment against the lid 107, so that the ball is within its own seat and the sensor 118 remains inactive, ensuring the operation of the press. Vice versa, if for any reason, for example due to jamming in the forming dies, the block 29 generates in the chamber 11 a pressure that is higher than the set value, the piston 109 separates from the lid 107, allowing the ball 117 to descend, consequently changing the state of the sensor 118. This change of state of the sensor is followed by the opening of the quick venting valve, which allows the block 29 to complete its stroke without causing excessive efforts on the forming dies.

Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. Press for blanking a metal sheet and for forming drawn cup-shaped items such as caps, closures, and lids for closing bottles, jars, cans, and the like, characterized by: a fixed beam (6), in which a first part of at least one forming unit is supported, said first part comprising a sleeve (9) that is supported in the beam (6) and has a seat (18) in which a stem (19) is slidingly guided, said stem (19) having, at one end, a forming punch (30), the opposite end being instead subjected to the action of return means for the return of said stem (19), said punch

(30) being guided in a blanking ring (49) whereon a fluid-actuated actuator (53) connected to a pressure source acts; a first movable beam (4), in which a second part of said forming unit is supported, said second part comprising a die (65) that is coaxial to said stem (19) and has a seat (74) for receiving said blanking ring (49) and a rim that forms, with said ring (49), the means for blanking the metal sheet (L), a contrast bush (73) for said blanking ring (49), a counterpunch (76) that cooperates with said punch (30), and means (84) for expelling the drawn item from said seat (74) being arranged inside said die (65) and coaxially thereto; a second movable beam (7) provided with adjustable means (29,100,102) that are adapted to act on said stem (19); means (5) for actuating said first movable beam (4) relative to said fixed beam (6) so that during the stroke for approaching the movable beam (4) towards the fixed beam (6) said metal sheet (L) is first blanked due to the penetration of said blanking ring (49) in said die (65), so as to form a disk (D) that is then clamped perimetrically between said blanking ring (49) and said contrast bush (73) by activating said actuator (53) that acts on said blanking ring (49), means (8) being furthermore provided for actuating said second movable beam (7) at the end of the step for blanking said disk (D), so as to cause the engagement of said adjustable means (29,100,102) on said stem (19) and of said punch (30) on said disk (D) and the formation of a drawn item, at the end whereof said movable beams (4,7) are again moved away from the fixed beam (6) and said punch (30) is again returned by said return means into the position for disengagement from the drawn item and said drawn item is expelled from said die (65).

2. Press according to claim 1, characterized in that said first part of the forming unit comprises a sleeve (9) that is fixed in a seat (8a) of the fixed beam (6) and has an internal tubular body (17) that forms, at the opposite ends of said sleeve (9), two respective chambers (24,61) that are connectable to a compressed air source and are closed by a first piston (20) that is rigidly coupled to said stem (19) and, respectively, by a second piston (53) that acts on said blanking ring (49), said first piston (20) being adapted to move said stem (19) into the position for disengagement from said formed item and said second piston (53) being adapted to secure the edge of said blanked disk (D) against said contrast bush (73).

3. Press according to claim 1 or 2, characterized in that said means for the expulsion of the formed item comprise a sleeve (84) that is guided in an annular seat (74) formed between said contrast bush (73) and said counterpunch (76), said sleeve (84) being actuated between a position for contrasting said punch (30) during the step for forming the item and a position for the expulsion of the formed item by means of a pneumatic actuator (87) accommodated in a seat of the movable beam (4) and coaxial to said counterpunch (76), said pneumatic actuator comprising a piston (87) that is connected to said sleeve (84) by coaxial secondary posts (85).

4. Press according to claim 1, 2, or 3, characterized in that said first movable beam (4) is actuated by eccentric elements (5) rigidly coupled on a shaft (5a) that rotates between a position for spacing the die (65) from the blanking ring (49) and an approach position, in which the blanking ring (49) engages the die (65) and retains said blanked disk (D) on said contrast bush (73); in that said second movable beam (7) is connected, by means of connecting rods (7a), to eccentric elements (8) mounted on said shaft (5a); and in that said adjustable means acting on the punch comprise a block (29) that is screwed in a tubular body (99) rigidly coupled to the second movable beam (7).

5. Press according to one of claims 1 to 4, characterized in that said punch (30) has, on its front face, a plurality of holes (40,41) that can be connected to the outside environment or to a compressed air source that can be activated to clean the forming region, and in that said counterpunch (76) has, on its front face, a plurality of holes (96) that are connected to the outside environment.

6. Press according to one of claims 2 to 5, characterized in that a chamber (111) is provided above said first piston (20) and that an additional piston (109) slides therein, said additional piston (109) being rigidly coupled to said stem (19), said chamber (111) being connected to a accumulator that is pressurized at a preset pressure that is slightly higher than the pressure for forming an item, said additional piston (109) cooperating with sensor means (118) adapted to actuate the venting of said chamber (111) when, during the forming step, the pressure in said chamber exceeds the pressurization pressure.

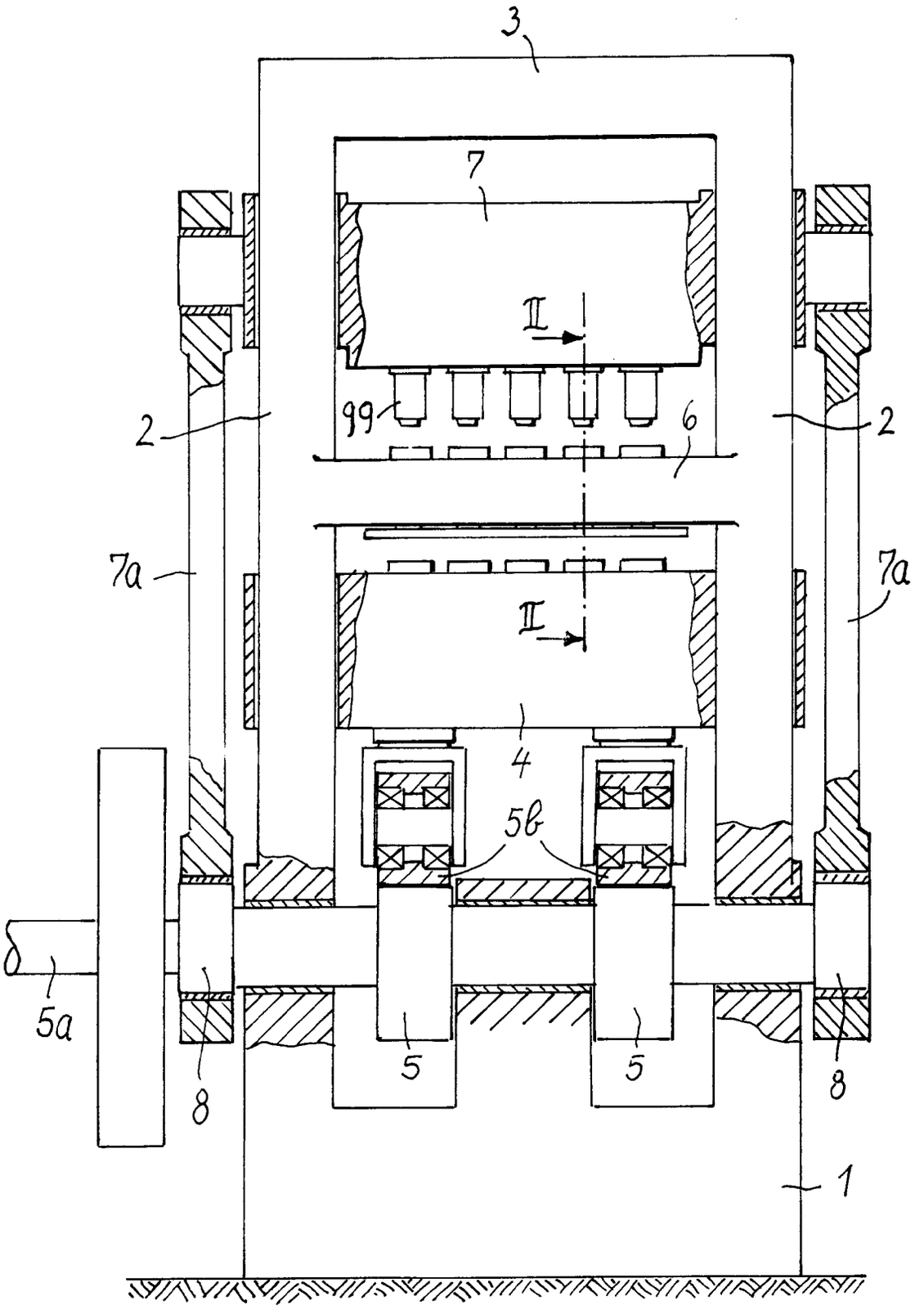


Fig. 1

Fig. 2

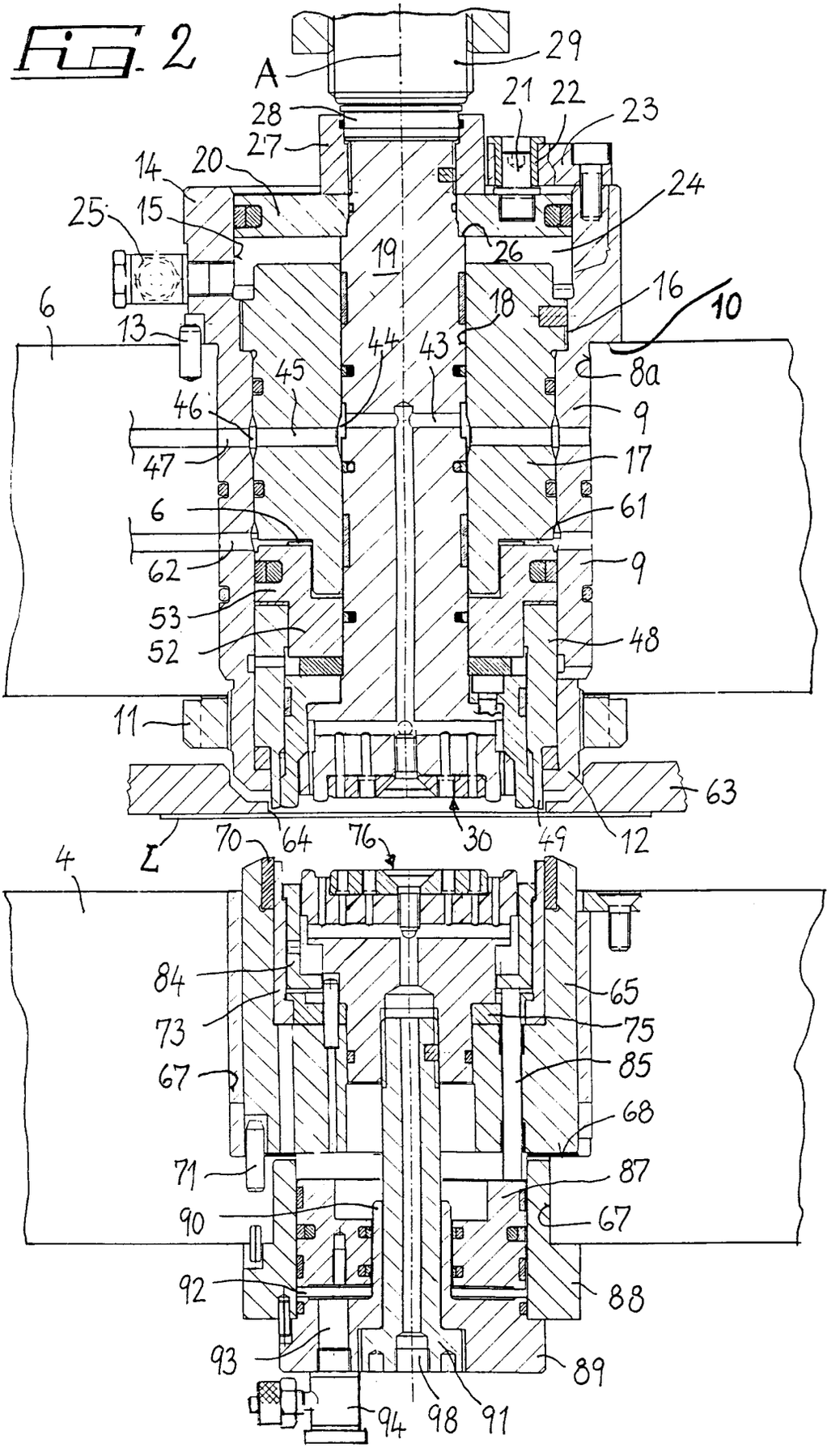

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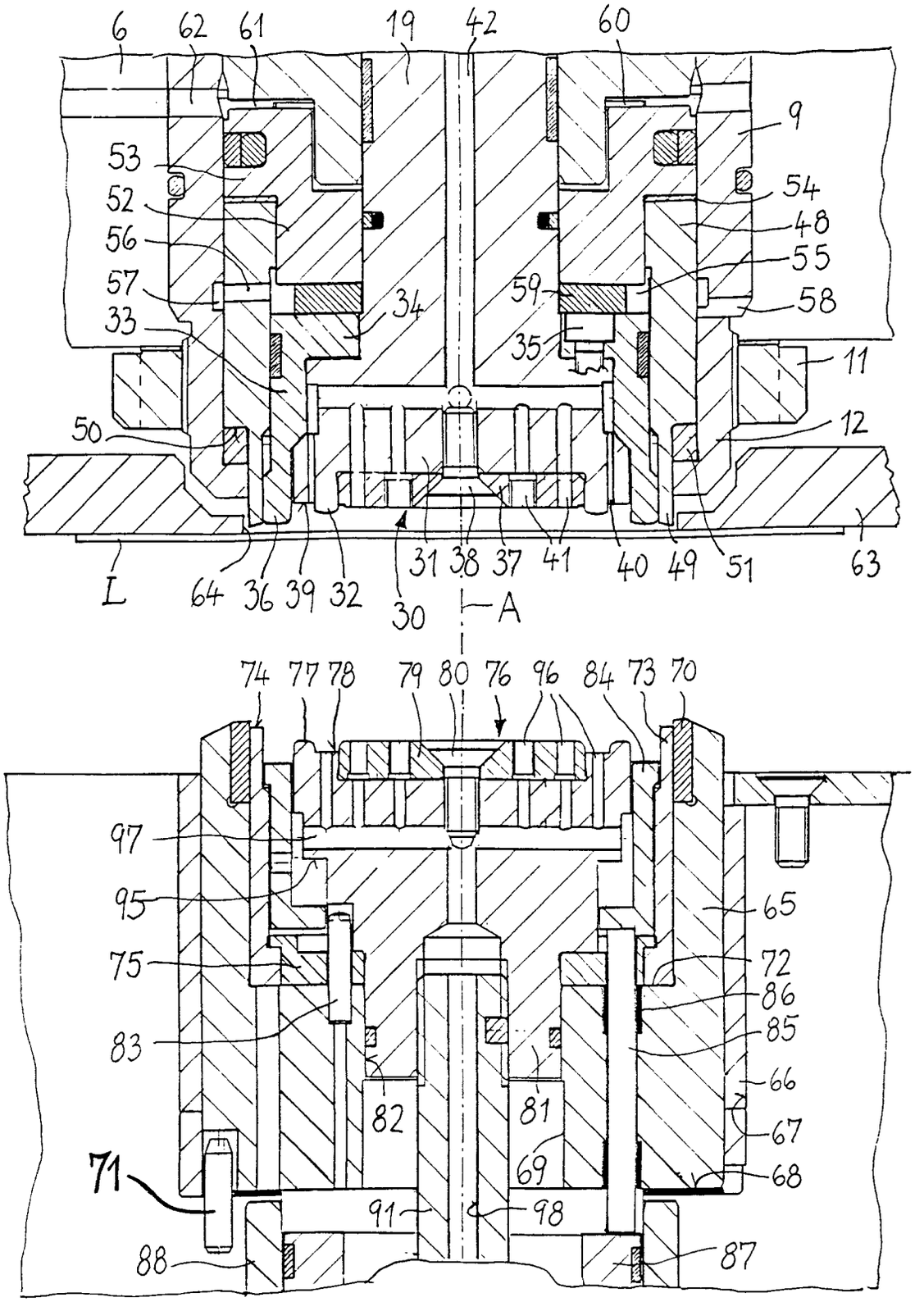
Fig. 3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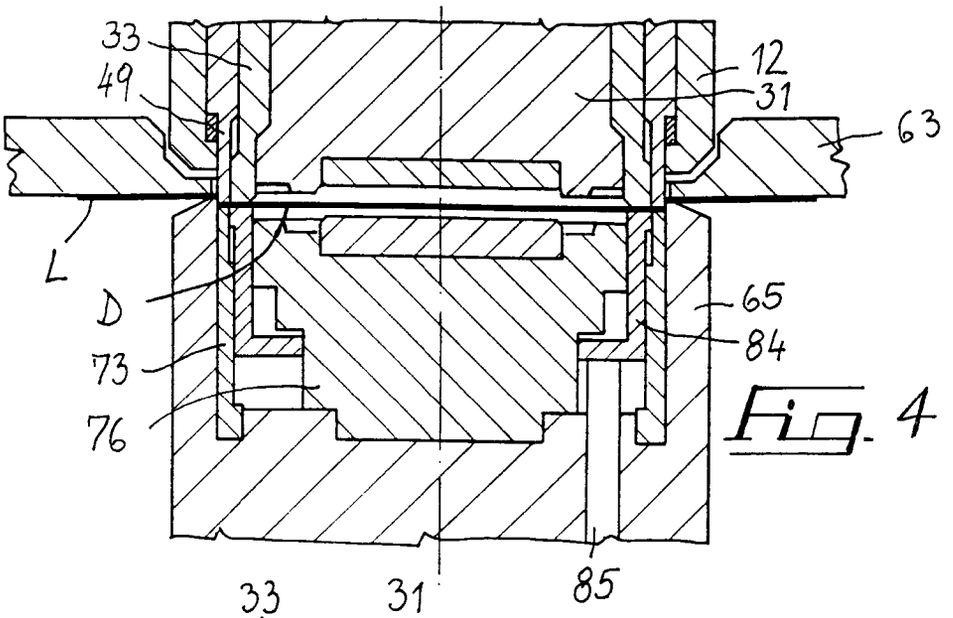


Fig. 4

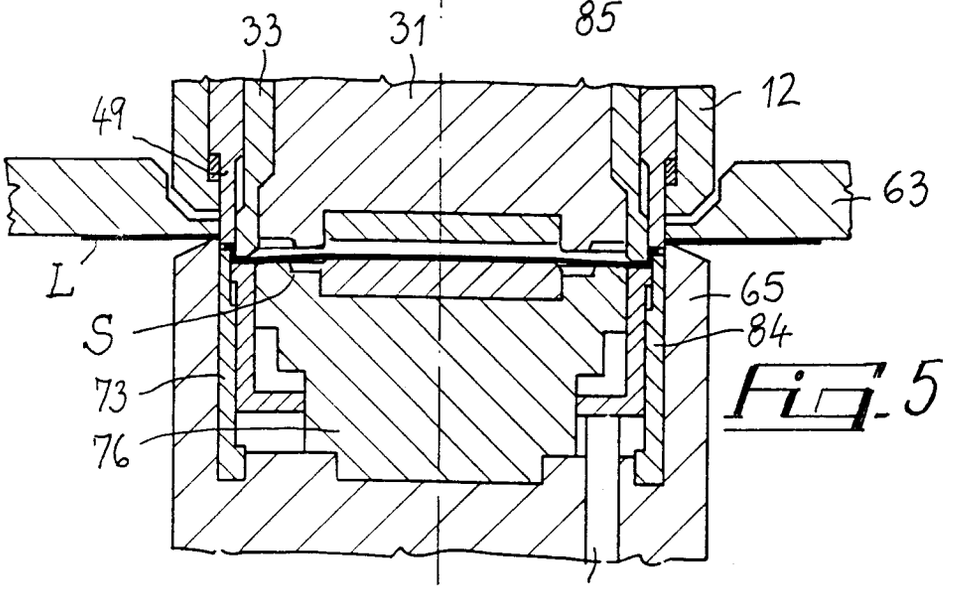


Fig. 5

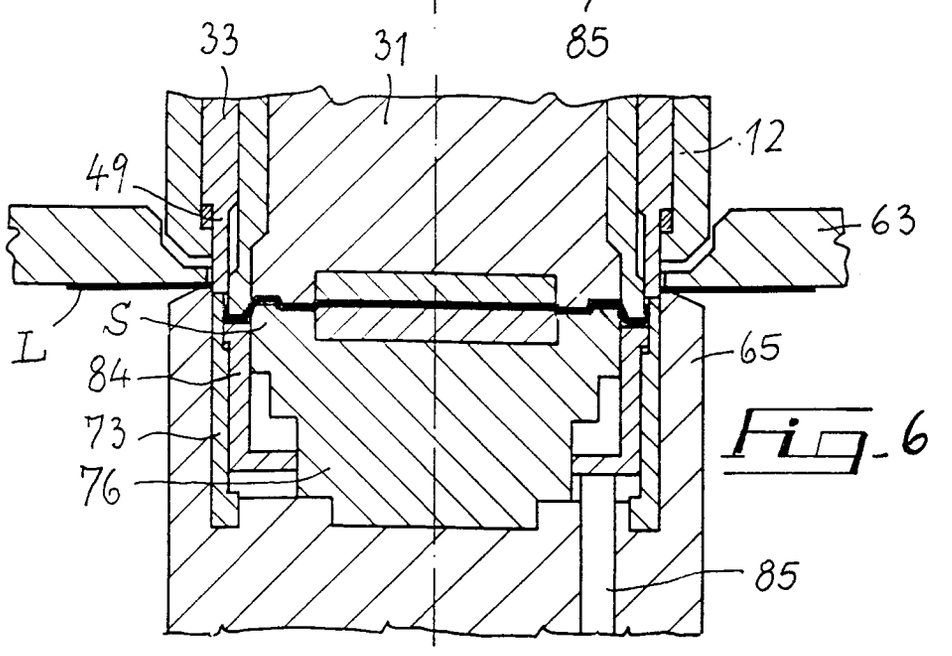


Fig. 6

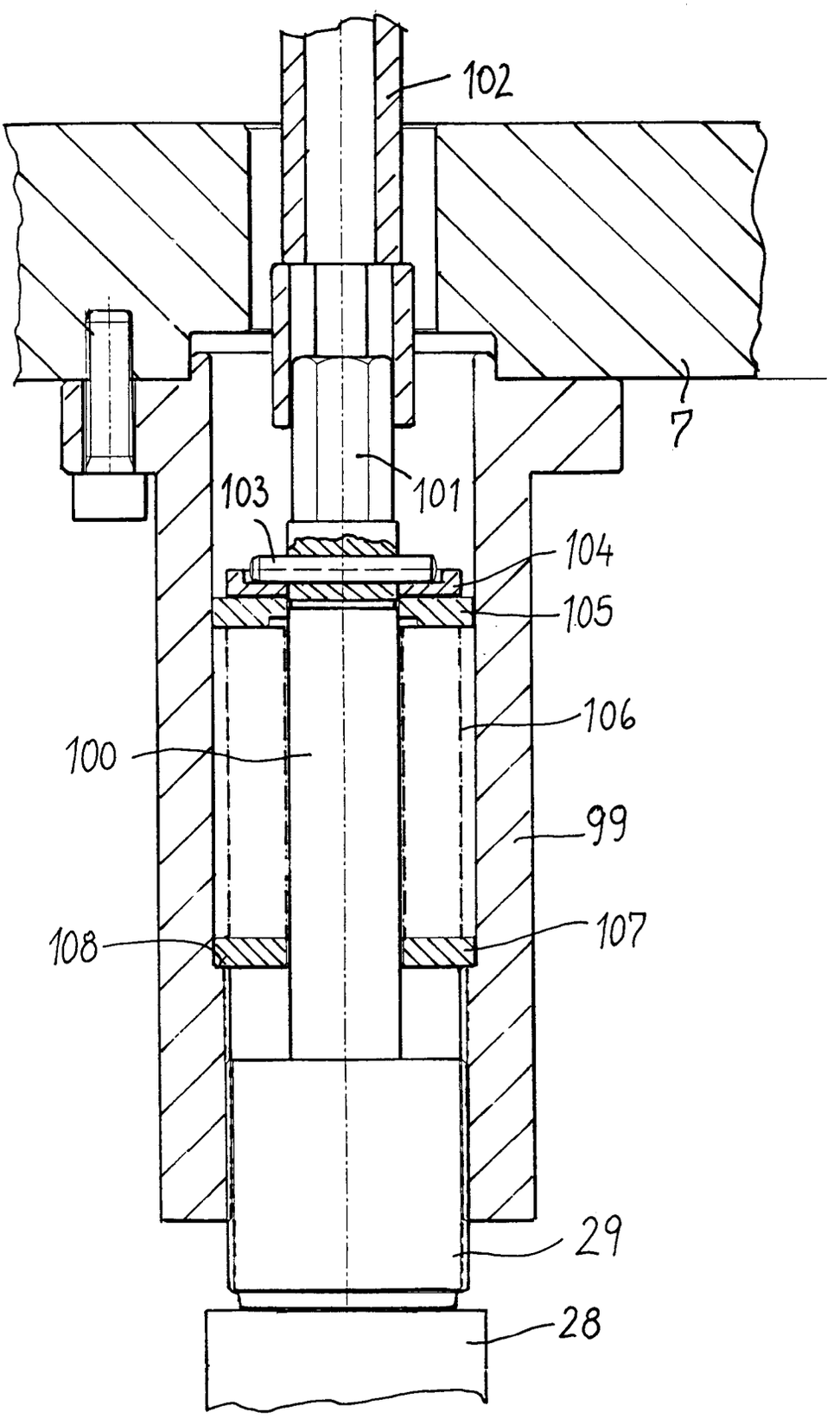
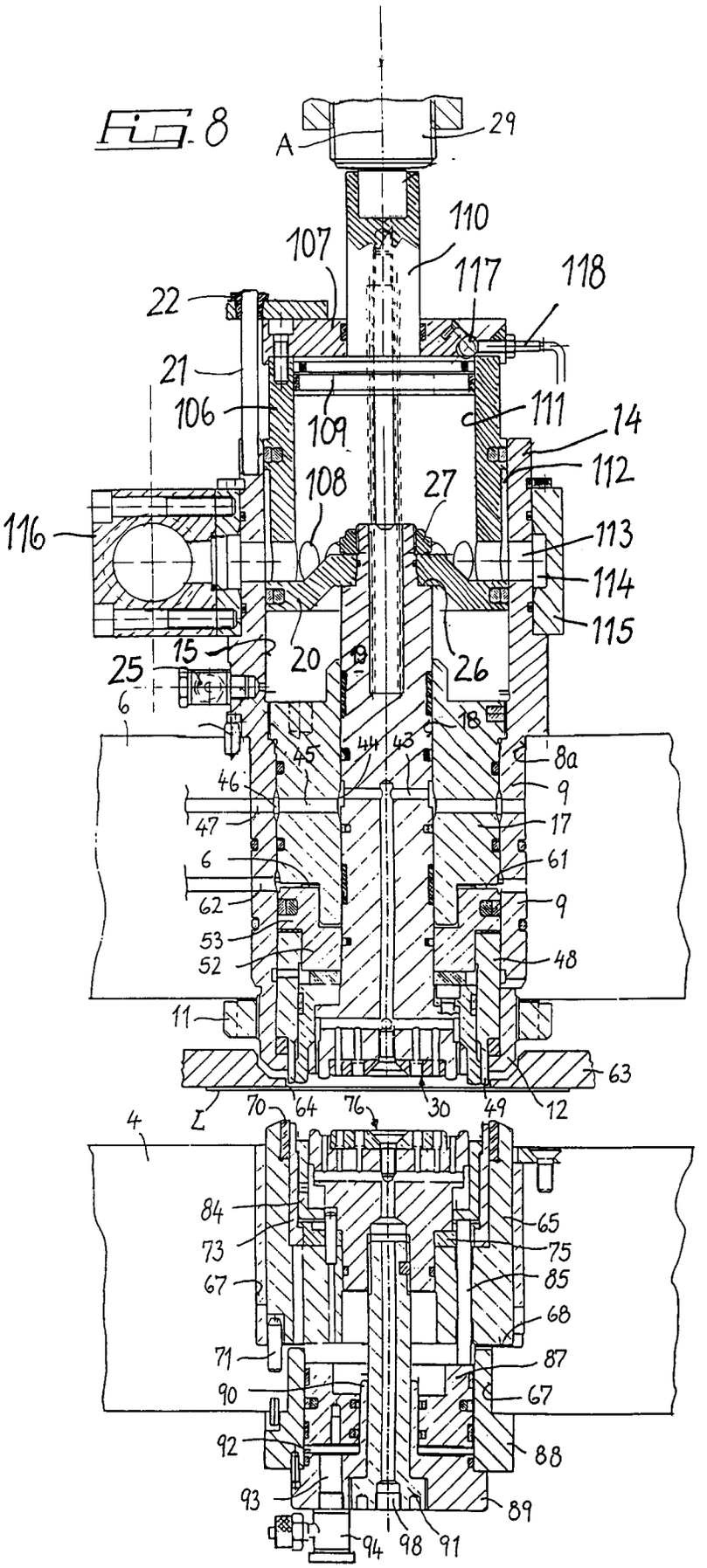


Fig. 7

Fig. 8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