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(54) **BENDING PISTON**

BIEGEKOLBEN

PISTON DE CINTRAGE

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(56) References cited:
EP-A1- 0 610 706 DE-A1- 10 223 637

- **PYDE A F: "FORMING PUNCH AND DIE
FEATURING A PIVOTAL FORMING PUNCH",
TECHNICAL DIGEST,, no. 11, 1 July 1968
(1968-07-01), pages 11-12, XP001335751,**

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Description

Field of the Invention

[0001] The present invention relates to an apparatus for bending a metal blank as well as a bending piston used in such an apparatus.

Background of the Invention

[0002] In the art of shaping metal objects a number of technologies are available. One of these is to position a blank in a bending machine and by arranging a bending piston for engagement with the blank, the blank or a section of the blank may be provided with a bend such that the blank has a three-dimensional shape after being treated in the bending machine.

[0003] One particular problem arising when using this technology is the fact that for some objects to be bent the angle is very important and thereby the accuracy of the bent angle must be ensured. Often the object to be bent/ shaped is to be integrated with other parts, and therefore it is necessary to keep the tolerances as small as possible in order for the quality to be as good as possible.

[0004] Particularly when bending sheet metal it is often a problem that the blank, i.e. the sheet metal, will not remain at the angle at which it is initially bent, but will bounce back a few degrees. For this purpose it is often necessary either to bend with an angle (i.e. bend over the desired angle such that when the metal springs back, it will spring back to the intended desired angle) different from the desired angle and then hope or by trial and error determine what the correct bending angle is, in order to achieve the final and desired bending angle of that particular object in this manner compensating for the spring back of the metal. This process has built-in drawbacks as for example it may take a number of trials and errors before the correct angle is determined, which causes extended non-productive time for the machinery and may also require retuning of the tools which are involved in the bending process.

[0005] A further particular problem arises when it is desirable to bend sections of a blank to an angle which is smaller than 90°. In these instances the bending process requires two separate bending steps as it is necessary to reposition the blank to be bent in that the types of bending machines typically used for bending blank materials of this type may only bend up to 90°. This is due to the fact that during the bending process the blank to be bent is superposed an aperture in a land whereby a bending piston arranged in the aperture is moved upwards thereby engaging and bending the sheet metal. A counter land is provided in order to determine the exact position where the bend is to be achieved, such that a relatively sharp and predetermined bend may be achieved.

[0006] As the bending piston is moved perpendicular

to the land on which the blank to be bent is arranged it is only possible to bend the blank at most at an angle of 90° due to the perpendicular arrangement of the bending piston. Consequently, if an angle different from 90° is to be bent, it necessitates that the blank is repositioned as already discussed above.

[0007] As an alternative to move the blank between activation of the bending piston, the bending piston may be moved.

[0008] One example in the prior art of bending to a smaller angle than 90° is disclosed in US 5460873, which forms the basis for the preamble of claim 1.

[0009] In this device and method the bending process requires that the bending dies are movable. As the bending piston is moved downwards, thereby creating the first part of the bend, the die-parts of the tool is moved laterally relative to the movement direction of the bending piston, thereby creating the two-part bending as a one multi-movement bending operation.

[0010] A further example of how to achieve this bending action, i.e. a bend smaller than 90° is also disclosed in DE10223637. In the disclosed tool and method the bending piston is mounted in a cup-shaped member. As the bending action is performed, the first part of the bending action will be carried out with the bending piston moving linearly relative to the object to be bent. As the bending piston engages the land, the cup will be forced to rotate, thereby urging the bending piston to rotate, whereby the bend is pushed over 90°, and hence a smaller angle is achieved.

[0011] A similar principle is disclosed in EP0610706 where the bending piston likewise is mounted in a complicated rotatable manner.

Object of the Invention

[0012] Consequently, it is an object of the present invention to provide an apparatus as well as a bending piston which makes it possible to bend metal blanks in a single precise bending action, but also at angles of more than 90°, using a simple, reliable and long lasting solution.

Description of the Invention

[0013] The invention addresses this by providing an apparatus for bending a metal blank into a predetermined shape, said apparatus comprising a land having a substantially planar surface on which the blank to be bent is placed, where an aperture is provided in said land, said aperture having a size and shape allowing a bending piston to move perpendicular and through said planar surface, said bending piston being operated by a pressure plate, such that the pressure plate can exert a pressure on the bending piston thereby urging the piston through the aperture, where the bending piston engages the blank to be bent, such that the blank is deformed/bent along a first surface on a counter land positioned on the

other side of the blank, the bending piston has a longitudinal body with a cylindrical cross-section, where in a first end of the body a pressure plate engagement surface is provided and in an opposite second end a blank forming section is provided, where said blank forming section is coupled to the body by a tilting section wherein the tilting section between the blank forming section and the body is created by a slit in the piston, such that the material thickness in the cross-section of the piston is reduced due to the provision of the slit.

[0014] Particularly the feature of providing the bending piston with a tilting section separating the blank forming section from the body of the piston achieves the object of being able to bend the blank in an angle substantially different from the typically maximum angle of 90°. As the tilting section engages the blank the blank will resist the movement of the piston thereby activating the tilting section such that the blank forming section of the bending piston is brought into a position of more than 90°, i.e. bent more than what is possible due to the perpendicular movement of the traditional bending piston.

[0015] The slit will typically project more than halfway through the body leaving a limited material thickness in the tilting section such that as the blank forming section engages the blank to be bent, the elasticity of the steel from which the bending piston is manufactured will be able to elastically deform whereby the blank forming section will tilt relative to the body of the piston.

[0016] Again the tilting movement and thereby the angle which may be bent is decided by the width of the slit, i.e. the distance between the blank forming section and the body of the piston where the slit is provided.

[0017] In order to enhance the tilting action of this embodiment the invention in a further embodiment provides that the slit has a predetermined width in the longitudinal direction of the piston body, and where at the bottom of the slit a circular cylindrical cavity is provided spanning the width of the slit, said circular cylindrical cavity arranged perpendicular to the longitudinal direction of the piston.

[0018] In a still further advantageous embodiment the first surface of the counter land has an angle relative to the axis along which the bending piston moves which is negative, resulting in the blank being bent at least 90°. The counter land "stops" the movement of the blank as the counter land is a solid part of the apparatus for bending a metal blank, and as such the movement of the bending piston is also stopped upon engagement of the counter land.

[0019] In this position, depending on the amount of tilt, the tilting section of the bending piston is able to deform the blank which will be bent into the desired angle very precisely as it is in engagement with the planar surface, the bending piston and the counter land such that the blank is completely fixated in its bent position. Consequently, the angle of the surface of which the blank is to be bent along the counter land is decisive together with the tilting ability of the bending piston in deciding the exact

angle at which the blank is being bent in the one-step bending procedure according to the present invention.

[0020] In a still further advantageous embodiment of the invention the tilting section is created by the blank forming section being a separate part, pivotably attached to the body of the piston.

[0021] The separate part being attached to the body of the piston is guided by the construction of the apparatus in that the aperture in the land constituting the substantial planar surface on which the blank to be bent is placed will guide and maintain the separate part in a more or less fixed position relative to the rest of the body of the piston. Only as the separate part engages the blank to be bent will it tilt out of alignment with the rest of the body in order to provide the bending action to which the bending piston is designed.

[0022] In the case where the tilting section is created by a separate part the pivotable connection may be provided by a construction where the pivotable connection between the blank forming end section and the body of the piston is created by one part having a ball structure and the opposite part having a cavity suitable to accommodate and retain the ball structure, such that the ball structure may tilt/move inside the cavity.

[0023] This is a relatively simple construction which is also easy to assemble and disassemble such that the body of the piston may be used for a number of blank forming end sections simply by sliding the blank forming end section off the ball structure and fitting another blank forming end section on the body part of the bending piston.

[0024] Furthermore, the pivotable connection provided with the ball and cavity allows the design of the tilting action to be decided very precisely as the separate part may be spaced, the desired distance from the upper part of the body on which the ball part is provided such that the spacing between the separate part and the body of the piston constitutes the distance at which the separate part is able to tilt relative to the body of the piston. The larger the distance, the more tilt is possible.

[0025] Particularly, the cylindrical cavity enhances the ability of the piston material next to the slit to be deformed elastically such that a reliable tilting action may be obtained. Tests with regular bending pistons being provided with a slit as described above, have successfully withstood tens of thousands of bending motions without deteriorating functionality.

[0026] In a further advantageous embodiment the apparatus according to the invention is constructed such that between the first end of the body and the pressure plate an adjustment mechanism is provided, said adjustment mechanism comprising an adjustment body, which adjustment body is adjustably arranged in an aperture in the pressure plate, and where through an aperture through the adjustment body a bolt may attach the bending piston to the adjustment body.

[0027] This feature of having an adjustment possibility is advantageous in order to take into account smaller

deviations. The body length of the bending piston is initially decided by the overall construction, i.e. the desired bending length, pressure plate thicknesses and other conditions. The further adjustment possibility provided by the adjustment body allows for finer adjustment taking account of smaller variations. Such smaller variations may arise due to variations in material characteristics, for example bending strength - which may vary between for example 250 N/mm² to 550 N/mm² between coils, or material thickness which may vary by tenths of millimeters. These variations influence the spring back tendency of the metal, and thereby the necessary bending angle in order to achieve the desired resulting design bending angle (after spring back of the metal). The adjustment mechanism provides an easy way to adjust for these minor variations, such that a perfect resulting bend may be achieved. This is even more so in a further embodiment where the adjustment body, is provided with an exterior thread, and where the aperture in the pressure plate accommodates said adjustment body, where said aperture is provided with a corresponding thread, such that the adjustment body threadily engages the thread in the aperture of the pressure plate. Hence, by simply loosening the bolt, and rotating the adjustment body relative to the pressure plate the engaging threads will provide the desired adjustment.

[0028] Naturally, the apparatus as discussed above may be provided with plurality of pistons each provided with their own aperture in the land such that as the pressure plate moves upwards, a plurality of bending pistons and thereby blank forming sections are elevated from the planar surface of the land engaging a blank position on top of the blank with a corresponding counter land such that a plurality of formed sections may be achieved in a single movement of the apparatus.

[0029] The invention is also directed at a bending piston per se, where the bending piston has a longitudinal body with a cylindrical cross-section, where in a first end of the body a pressure plate engagement surface is provided and in an opposite second end a blank forming section is provided, where said blank forming section is coupled to the body by a tilting section.

[0030] Naturally, when the bending piston according to the present invention is used in an apparatus as discussed above, the advantages as already mentioned above are applied when using the bending piston as set out in these embodiments and the embodiments of the further dependent claims.

Description of the Drawing

[0031] The invention will now be described with reference to the accompanying drawing, wherein

Figure 1a illustrates a first embodiment of the bending piston according to the invention,
 Figure 1b illustrates a cylindrical cross-section

of the bending piston,
 Figure 2 illustrates an alternative embodiment of the top part of the bending piston according to the present invention,
 5 Figures 3 and 4 illustrate a view of the bending piston depicted in figure 2 from an orthogonal angle
 Figure 5 illustrates an apparatus for bending a metal blank into a predetermined shape
 10 Figures 6 and 7 illustrate a bending cycle
 Figure 8 illustrates schematically an apparatus comprising a plurality of pistons
 Figure 9 illustrates a further embodiment of the invention

Detailed Description of the Invention

[0032] In figure 1a is illustrated a first embodiment of the bending piston 1 according to the invention. The bending piston has a cylindrical cross-section as illustrated in figure 1b which in this example is substantially quadratic with rounded-off corners. Naturally, the cross-section of the bending piston 1 may have any geometrical shape as desired.

[0033] The bending piston 1 has a body section 2, a tilting section 3 and a blank forming section 4. The blank forming section 4 is in this embodiment provided with a curvature 5 such that as the piston engages the blank, the blank will be forced to follow the curvature thereby bending the blank as will be explained below.

[0034] The tilting section 3 is provided with a slit 6 as well as a circular cylindrical cavity 7. In this manner the cross-section of the piston 1 has been weakened such that the remaining material 8 in the tilting section will be able to deform as the curvature 5 of the blank forming section 4 engages a blank (and a counter-land as will be explained further below).

[0035] The slit 6 determines the amount of tilt the tilting section will allow the blank forming section to perform, and consequently the distance "a", i.e. the width of the slit, is determined for the movement of the blank forming section relative to the body of the piston.

[0036] In the opposite end of the bending piston 1 to the blank forming section is provided a substantially planar surface 9 suitable to engage a pressure plate in the apparatus for bending a metal blank.

[0037] In figure 2 is illustrated an alternative embodiment of the top part of the bending piston according to the present invention. In this alternative embodiment the bending piston 10 also has a body portion 2', a tilting section 3' and a blank forming section 4'. The difference compared to the embodiment described above is the fact that the blank forming section 4' in this embodiment is a separate part which is pivotally attached to the body portion 2' of the bending piston 10. The tilting section 3' is created by providing the upper part of the body portion 2' with a ball structure 11 accommodated in a cavity 12

where the cavity 12 is formed such that the ball structure 11 holds the blank forming section 4' such that the separate 4' can pivot around the ball structure 11 in order to deform the blank as described above.

[0038] The tilting section 3' will therefore be able to tilt due to the distance "a'" between the blank forming section 4' and the body portion 2'.

[0039] Figures 3 and 4 illustrate a view of the bending piston depicted in figure 2 from an orthogonal angle in order to illustrate that the ball structure 11 as illustrated with reference to figure 3 may be shaped as a ridge 11' accommodated in a groove 12' such that it is possible to slide the blank forming section 4" right or left in relation to the body portion 2'. In this manner it is possible to exchange the blank forming section 4", for example with another blank forming section having a different curvature 5'.

[0040] In figure 4 is illustrated an embodiment where the ball structure 11 is a ball on a stem 13. The length of the stem decides the distance A which in turn as already discussed above determines how much tilting action is allowed by the tilting section 3'.

[0041] Turning to figure 5 an apparatus for bending a metal blank into a predetermined shape is illustrated. Only the parts of the apparatus 20 having influence or being directly involved in the actions of the bending piston will be mentioned as apparatuses of this type are well-known in the technical field. The bending piston 1 is arranged inside the apparatus 20 such that a lower end of the piston 1 is in contact with a pressure plate 31.

[0042] In the illustrated position of the apparatus the pressure plate 31 is closest in position relative to a land 32. The land 32 is provided with a planar surface 33 which planar surface 33 is supposed to receive the blank to be bent. In the land 32 is provided an aperture 34 through which the bending piston 1 may move upwards and downwards due to the action of the pressure plate 31 which can move away from the land 32 in order to withdraw the piston 1 from the position it is illustrated in.

[0043] With reference to figures 6 and 7 a bending cycle will be described in more detail.

[0044] In order to control the bending action of the bending piston 1 and in particular the movement of the blank forming section 4 a counter-land 35 is provided. Between the lower surface 36 of the counter-land 35 and the planar surface 33 is provided space for the blank to be bent. As the piston moves upwards into the position illustrated in figure 5 the blank forming section 4 will engage the blank and bend initially upwards and once the tilting section 3 is activated due to the piston's engagement with the blank and the counter land the blank forming section will tilt thereby forcing the blank into a position or an angle different from 90° parallel to the surface 37 of the counter land 35.

[0045] Turning to figures 6 and 7 a single cycle of a blank forming process in an apparatus according to the present invention is schematically illustrated. In figure 6 the pressure plate 31 is in its lowermost position with

respect to the land 32. A bending piston 1 is arranged in an aperture 34. On the planar surface 33 of the land 32 is arranged a blank 50 which is to be provided with a bend. In order to bend the blank 50 a counter-land 35 is provided with a bending surface 37 such that as the piston 1 moves upwards the blank 50 will also be urged upwards and due to the curvature 5 on the blank forming section 4 of the piston 1 the blank will be bent up to a position where it is adjacent the surface 37.

[0046] This position is illustrated in figure 7 where the blank has been provided with an at least 90° bend 51 caused by the piston 1 having moved upwards due to the pressure from the pressure plate 31 such that the curvature 5 of the blank forming section 4 has come into contact with the blank and urged the blank against the surface 37 of the counter-land 35.

[0047] Due to the piston's 1 engagement with the blank and the counter land the slit 6 has been closed whereby the tilting section has been activated allowing the blank forming section 4 to tilt towards the blank and the surface 37 and thereby making it possible to create a bend 51 where the angle between the two flanges of the blank is less than 90°.

[0048] In figure 8 is schematically illustrated an apparatus comprising a plurality of pistons 1 such that as the pistons engage a blank 50' arranged on the planar surface 33 of the land 32 the blank forming sections 4 of the pistons 1 will engage the blank 50' thereby creating bent sections for a number of sections due to the plurality of pistons 1 arranged in the apparatus.

[0049] Although the piston in figure 1b and 8 is illustrated as being substantially quadratic, the pistons may have any desirable cross-section, for example they may be rectangular in order to be able to bend longer sections of blanks or any other desirable cross-section.

[0050] In figure 9 is a further embodiment of the invention illustrated. In this embodiment the slit 6' is provided with a substantial extend in the pistons' longitudinal direction, thereby creating a relative slender portion 8', which during the bending action of the blank (not illustrated) will be slightly deformed, allowing the blank forming section 4' to bend the blank beyond the 90° (into a smaller angle). The blank forming sections' 4 ability to bend out relative to the longitudinal axis 50, is decided by the size of the slit 6'. The larger the slit (in the direction of the axis 52) the more rotation the bending section 4' is allowed.

[0051] Opposite the bending section 4' the bending piston 1 is fixed to an adjustment body 54, by means of a bolt 56. On the outside of the adjustment body 54 a fine thread 58 is provided. A corresponding thread 60 is provided in an aperture in the pressure plate 62. By releasing the bolt 56, the adjustment body 54 may be rotated in the thread 58,60, such that the adjustment body 54 is displaced along the axis 52. As the bending piston 1 is connected to the adjustment body, also the blank forming section 4' is displaced relative to the pressure plate's lower surface 64. In this manner it is possible to relatively

easily adjust the bending piston's 1 extent, relative to the surface 64 of the pressure plate 62. This is important in order to be able to control how far the blank is bent, in order to exactly adjust the bending tool, such that the desired angle is obtained after spring back of the metal. This adjustment is advantageous as the metal coils from which the metal blanks are manufactured may vary, both with respect to thickness, where variations of 1/10 mm or more is not unusual as also the strength may vary from coil to coil, typically between 300 N/mm² to 500 N/mm². These material characteristics influence the bending action and create more or less spring back, and hence the desire to be able to easily adjust the bending angle performed by the bending tool.

Claims

1. Apparatus for bending a metal blank (50) into a predetermined shape, said

apparatus comprising a land (32), a bending piston (1) and a pressure plate (31), the land (32) having a substantially planar surface (33) on which the blank (50) to be bent is placed, where an aperture (34) is provided in said land (32), said aperture (34) having a size and shape allowing said

bending piston (1) to move perpendicular and through said planar surface (33), said bending piston (1) being operated by said pressure plate (31), such

that the pressure plate (31) can exert a pressure on the bending piston (1) thereby urging the piston (1) through the aperture (34), where the bending piston (1) engages the blank (50) to be bent, such that the blank (50) is deformed/bent along a first surface (37) on a counter land (35) positioned on the other side of the blank (50), the bending piston (1) has a longitudinal body (2) with a cylindrical cross-section, where in a first end (9) of the body (2) a pressure plate engagement surface (9) is provided and in an opposite second end a blank forming section (4) is provided, where said blank forming section (4) is coupled to the body (2) by a tilting section (3) **characterized in that** the tilting section (3) between the blank forming section (4) and the body (2) is created by a slit (6) in the piston (1), such that the material thickness in the cross-section of the piston is reduced due to the provision of the slit (6).

2. Apparatus according to claim 1, wherein the first surface (37) on the counter land (35) has an angle relative to the axis along which the bending piston (1) moves which is negative, resulting in the blank being bent at least 90°.

3. Apparatus according to claim 1 wherein the tilting section (4',5, 5') is created by the blank forming section being a separate part, pivotably attached to the body (2) of the piston (1).

4. Apparatus according to claim 3 where the pivotable connection between the blank forming end section (4',5,5') and the body (2) of the piston is created by one part having a ball structure (13) and the opposite part having a cavity (11) suitable to accommodate and retain the ball structure (13), such that the ball structure (13) may tilt/move inside the cavity (11).

5. Apparatus according to claim 1, where the slit (6) has a predetermined width in the longitudinal direction of the piston body, and where at the bottom of the slit a circular cylindrical cavity (7) is provided spanning the width of the slit (6), said circular cylindrical cavity (7) arranged perpendicular to the longitudinal direction of the piston (1).

6. Apparatus according to claim 1, where between the first end of the body (2) and the pressure plate (31) an adjustment mechanism is provided, said adjustment mechanism comprising an adjustment body (54), which adjustment body is adjustably arranged in an aperture in the pressure plate (31), and where through an aperture through the adjustment body (54) a bolt (56) may attach the bending piston (1) to the adjustment body (54).

7. Apparatus according to claim 6, where the adjustment body (54), is provided with an exterior thread (60), and where the aperture in the pressure plate accommodates said adjustment body (54), where said aperture is provided with a corresponding thread (58), such that the adjustment body (54) threadily engages the thread in the aperture of the pressure plate.

8. Apparatus according to any preceding claim wherein a plurality of bending pistons (1) are provided with a corresponding number of apertures in the land (32).

9. Bending piston (1) for use in an apparatus according to any of claims 1 to 8, wherein the bending piston (1) has a longitudinal body (2) with a cylindrical cross-section, where in a first end of the body a pressure plate engagement surface (9) is provided and in an opposite second end a blank forming section (4) is provided, where said blank forming section (4) is coupled to the body (2) by a tilting section (3) and wherein the tilting section (3) between the blank forming section (4) and the body (2) is created by a slit (6) in the piston (1), such that the material thickness in the cross-section of the piston is reduced due to the provision of the slit (6).

10. Bending piston according to claim 9 wherein the width of the slit (6) in the direction of the longitudinal body (2) limits the tilt of the blank forming section (4) relative to the longitudinal body (2).
11. Bending piston according to claim 9 or 10 where the blank forming section (4) is integral with the longitudinal body (2).
12. Bending piston according to claim 9 where the blank forming section (4) is a separate member pivotably attached to the longitudinal body (2).
13. Bending piston according to claim 9 where the tilting section (3), is made from a different material than the blank forming section (4) and/or the body section (2), where the material is resilient and/or flexible.
14. Bending piston according to claim 9 where the cross-section of the longitudinal body (2) is quadratic, rectangular, oval, or elliptical.

Patentansprüche

1. Einrichtung zum Biegen eines Metallrohrlings (50) in eine vorgegebene Form, wobei die Einrichtung eine Abquetschfläche (32), einen Biegekolben (1) und eine Druckplatte (31) umfasst, wobei die Abquetschfläche (32) eine im Wesentlichen ebene Oberfläche (33) aufweist, worauf der zu biegende Rohling (50) platziert wird, wobei eine Öffnung (34) in der Abquetschfläche (32) vorgesehen ist, wobei die Öffnung (34) eine Größe und Form aufweist, die ermöglichen, dass sich der Biegekolben (1) senkrecht und durch die ebene Oberfläche (33) bewegt, wobei der Biegekolben (1) durch die Druckplatte (31) betätigt wird, sodass die Druckplatte (31) einen Druck auf den Biegekolben (1) ausüben kann, wodurch der Kolben (1) durch die Öffnung (34) getrieben wird, wobei der Biegekolben (1) in den zu biegenden Rohling (50) eingreift, sodass der Rohling (50) entlang einer ersten Oberfläche (37) auf einer Gegenabquetschfläche (35) verformt/gebogen wird, die auf der anderen Seite des Rohlings (50) positioniert ist, wobei der Biegekolben (1) einen länglichen Körper (2) mit einem zylindrischen Querschnitt aufweist, wobei in einem ersten Ende (9) des Körpers (2) eine Druckplatteneingriffsfläche (9) vorgesehen ist und in einem gegenüberliegenden zweiten Ende ein Rohlingformabschnitt (4) vorgesehen ist, wobei der Rohlingformabschnitt (4) an den Körper (2) durch einen neigbaren Abschnitt (3) gekoppelt ist, **dadurch gekennzeichnet, dass** der neigbare Abschnitt (3) zwischen dem Rohlingformabschnitt (4) und dem Körper (2) durch einen Schlitz (6) in dem Kolben (1) erzeugt wird, sodass die Materialdicke in dem Querschnitt des Kolbens aufgrund der Bereit-

stellung des Schlitzes (6) verringert ist.

2. Einrichtung nach Anspruch 1, wobei die erste Oberfläche (37) auf der Gegenabquetschfläche (35) einen Winkel in Bezug auf die Achse aufweist, entlang welcher sich der Biegekolben (1) bewegt, der negativ ist, was dazu führt, dass der Rohling um mindestens 90° gebogen wird.
3. Einrichtung nach Anspruch 1, wobei der neigbare Abschnitt (4', 5, 5') durch den Rohlingformabschnitt gebildet wird, wobei es sich um ein separates Teil handelt, der schwenkbar an dem Körper (2) des Kolbens (1) angebracht ist.
4. Einrichtung nach Anspruch 3, wobei die schwenkbare Verbindung zwischen dem Rohlingformabschnitt (4', 5, 5') und dem Körper (2) des Kolbens durch ein Teil erzeugt wird, das eine Kugelstruktur (13) aufweist und das gegenüberliegende Teil, das einen Hohlraum (11) aufweist, der dazu geeignet ist, die Kugelstruktur (13) aufzunehmen und zurückzuhalten, sodass sich die Kugelstruktur (13) in dem Hohlraum (11) neigen/bewegen kann.
5. Einrichtung nach Anspruch 1, wobei der Schlitz (6) in der Längsrichtung des Kolbenkörpers eine vorgegebene Breite aufweist, und wobei an der Unterseite des Schlitzes ein kreisförmiger zylindrischer Hohlraum (7) vorgesehen ist, der die Breite des Schlitzes (6) überspannt, wobei der kreisförmige zylindrische Hohlraum (7) senkrecht zu der Längsrichtung des Kolbens (1) angeordnet ist.
6. Einrichtung nach Anspruch 1, wobei zwischen dem ersten Ende des Körpers (2) und der Druckplatte (31) ein Einstellmechanismus vorgesehen ist, wobei der Einstellmechanismus einen Einstellkörper (54) umfasst, wobei der Einstellkörper einstellbar in einer Öffnung in der Druckplatte (31) angeordnet ist, und wobei durch eine Öffnung durch den Einstellkörper (54) eine Schraube (56) den Biegekolben (1) an dem Einstellkörper (54) anbringen kann.
7. Einrichtung nach Anspruch 6, wobei der Einstellkörper (54) mit einem Außengewinde (60) versehen ist, und wobei die Öffnung in der Druckplatte den Einstellkörper (54) aufnimmt, wobei die Öffnung mit einem entsprechenden Gewinde (58) versehen ist, sodass der Einstellkörper (54) gewindemäßig in das Gewinde in der Öffnung der Druckplatte eingreift.
8. Einrichtung nach einem vorhergehenden Anspruch, wobei eine Vielzahl von Biegekolben (1) mit einer entsprechenden Anzahl von Öffnungen in der Abquetschfläche (32) versehen ist.
9. Biegekolben (1) zur Verwendung in einer Einrich-

tung nach einem der Ansprüche 1 bis 8, wobei der Biegekolben (1) einen länglichen Körper (2) mit einem zylindrischen Querschnitt aufweist, wobei in einem ersten Ende des Körpers eine Druckplatteneingriffsfläche (9) vorgesehen ist und in einem gegenüberliegenden zweiten Ende ein Rohlingformabschnitt (4) vorgesehen ist, wobei der Rohlingformabschnitt (4) an den Körper (2) durch einen neigbaren Abschnitt (3) gekoppelt ist und wobei der neigbare Abschnitt (3) zwischen dem Rohlingformabschnitt (4) und dem Körper (2) durch einen Schlitz (6) in dem Kolben (1) erzeugt wird, sodass die Materialdicke in dem Querschnitt des Kolbens aufgrund der Bereitstellung des Schlitzes (6) verringert ist.

10. Biegekolben nach Anspruch 9, wobei die Breite des Schlitzes (6) in der Richtung des länglichen Körpers (2) die Neigung des Rohlingformabschnitts (4) in Bezug auf den länglichen Körper (2) begrenzt.
11. Biegekolben nach Anspruch 9 oder 10, wobei der Rohlingformabschnitt (4) in den länglichen Körper (2) integriert ist.
12. Biegekolben nach Anspruch 9, wobei der Rohlingformabschnitt (4) ein separates Element ist, das schwenkbar an dem länglichen Körper (2) angebracht ist.
13. Biegekolben nach Anspruch 9, wobei der neigbare Abschnitt (3) aus einem anderen Material hergestellt wird als der Rohlingformabschnitt (4) und/oder der Körperabschnitt (2), wobei das Material elastisch und/oder biegsam ist.
14. Biegekolben nach Anspruch 9, wobei der Querschnitt des länglichen Körpers (2) quadratisch, rechteckig, oval oder elliptisch ist.

Revendications

1. Appareil permettant de cintrer une ébauche (50) métallique en une forme prédéterminée, ledit appareil comprenant un méplat (32), un piston (1) de cintrage et un serre-flan (31), le méplat (32) ayant une surface (33) sensiblement plane sur laquelle l'ébauche (50) devant être cintrée est placée, où une ouverture (34) est fournie dans ledit méplat (32), ladite ouverture (34) ayant une taille et une forme permettant audit piston (1) de cintrage de se déplacer perpendiculairement et à travers ladite surface (33) plane, ledit piston (1) de cintrage étant mis en fonctionnement par ledit serre-flan (31), de sorte que le serre-flan (31) puisse exercer une pression sur le piston (1) de cintrage poussant ainsi le piston (1) à travers l'ouverture (34), où le piston (1) de cintrage met en prise

l'ébauche (50) devant être cintrée, de sorte que l'ébauche (50) soit déformée/cintrée le long d'une première surface (37) sur un contre-méplat (35) positionné sur l'autre côté de l'ébauche (50), le piston (1) de cintrage a un corps (2) longitudinal avec une coupe transversale cylindrique, où dans une première extrémité (9) du corps (2) une surface de mise en prise de serre-flan (9) est fournie et dans une seconde extrémité opposée une section de formation d'ébauche (4) est fournie, où ladite section de formation d'ébauche (4) est accouplée au corps (2) par une section d'inclinaison (3) **caractérisé en ce que** la section d'inclinaison (3) entre la section de formation d'ébauche (4) et le corps (2) est créée par une fente (6) dans le piston (1), de sorte que l'épaisseur de matériau dans la coupe transversale du piston soit réduite en raison de la fourniture de la fente (6).

2. Appareil selon la revendication 1, dans lequel la première surface (37) sur le contre-méplat (35) a un angle par rapport à l'axe le long duquel le piston (1) de cintrage se déplace qui est négatif, ce qui a pour résultat que l'ébauche est cintrée à au moins 90°.
3. Appareil selon la revendication 1 dans lequel la section d'inclinaison (4', 5, 5') est créée par la section de formation d'ébauche qui est une partie distincte, attachée de manière pivotante au corps (2) du piston (1).
4. Appareil selon la revendication 3 où la liaison pouvant pivoter entre la section d'extrémité de formation d'ébauche (4', 5, 5') et le corps (2) du piston est créée par une partie ayant une structure de bille (13) et la partie opposée ayant une cavité (11) appropriée pour recevoir et retenir la structure de bille (13), de sorte que la structure de bille (13) puisse s'incliner/se déplacer dans la cavité (11).
5. Appareil selon la revendication 1, où la fente (6) a une largeur prédéterminée dans la direction longitudinale du corps de piston, et où au fond de la fente une cavité cylindrique circulaire (7) est fournie s'étendant sur la largeur de la fente (6), ladite cavité cylindrique circulaire (7) étant agencée perpendiculairement à la direction longitudinale du piston (1).
6. Appareil selon la revendication 1, où entre la première extrémité du corps (2) et le serre-flan (31) un mécanisme de réglage est fourni, ledit mécanisme de réglage comprenant un corps de réglage (54), lequel corps de réglage est agencé de manière réglable dans une ouverture dans le serre-flan (31), et où à travers une ouverture à travers le corps de réglage (54) un boulon (56) peut attacher le piston (1) de cintrage au corps de réglage (54).
7. Appareil selon la revendication 6, où le corps de ré-

glage (54) est doté d'un filet extérieur (60), et où l'ouverture dans le serre-flan reçoit ledit corps de réglage (54), où ladite ouverture est dotée d'un filet correspondant (58), de sorte que le corps de réglage (54) mette en prise par filetage le filet dans l'ouverture du serre-flan. 5

8. Appareil selon une quelconque revendication précédente dans lequel une pluralité de pistons (1) de cintrage sont dotés d'un nombre correspondant d'ouvertures dans le méplat (32) . 10
9. Piston (1) de cintrage pour une utilisation dans un appareil selon l'une quelconque des revendications 1 à 8, dans lequel le piston (1) de cintrage a un corps (2) longitudinal avec une coupe transversale cylindrique, où dans une première extrémité du corps une surface de mise en prise de serre-flan (9) est fournie et dans une seconde extrémité opposée une section de formation d'ébauche (4) est fournie, où ladite section de formation d'ébauche (4) est accouplée au corps (2) par une section d'inclinaison (3) et dans lequel la section d'inclinaison (3) entre la section de formation d'ébauche (4) et le corps (2) est créée par une fente (6) dans le piston (1), de sorte que l'épaisseur de matériau dans la coupe transversale du piston soit réduite en raison de la fourniture de la fente (6). 15
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10. Piston de cintrage selon la revendication 9 dans lequel la largeur de la fente (6) dans la direction du corps (2) longitudinal limite l'inclinaison de la section de formation d'ébauche (4) par rapport au corps (2) longitudinal. 30
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11. Piston de cintrage selon la revendication 9 ou 10 où la section de formation d'ébauche (4) est d'un seul bloc avec le corps (2) longitudinal. 40
12. Piston de cintrage selon la revendication 9 où la section de formation d'ébauche (4) est un élément distinct attaché de manière pivotante au corps (2) longitudinal. 45
13. Piston de cintrage selon la revendication 9 où la section d'inclinaison (3) est fabriquée à partir d'un matériau différent de la section de formation d'ébauche (4) et/ou de la section corps (2), où le matériau est élastique et/ou flexible. 50
55
14. Piston de cintrage selon la revendication 9 où la coupe transversale du corps (2) longitudinal est quadratique, rectangulaire, ovale ou elliptique.

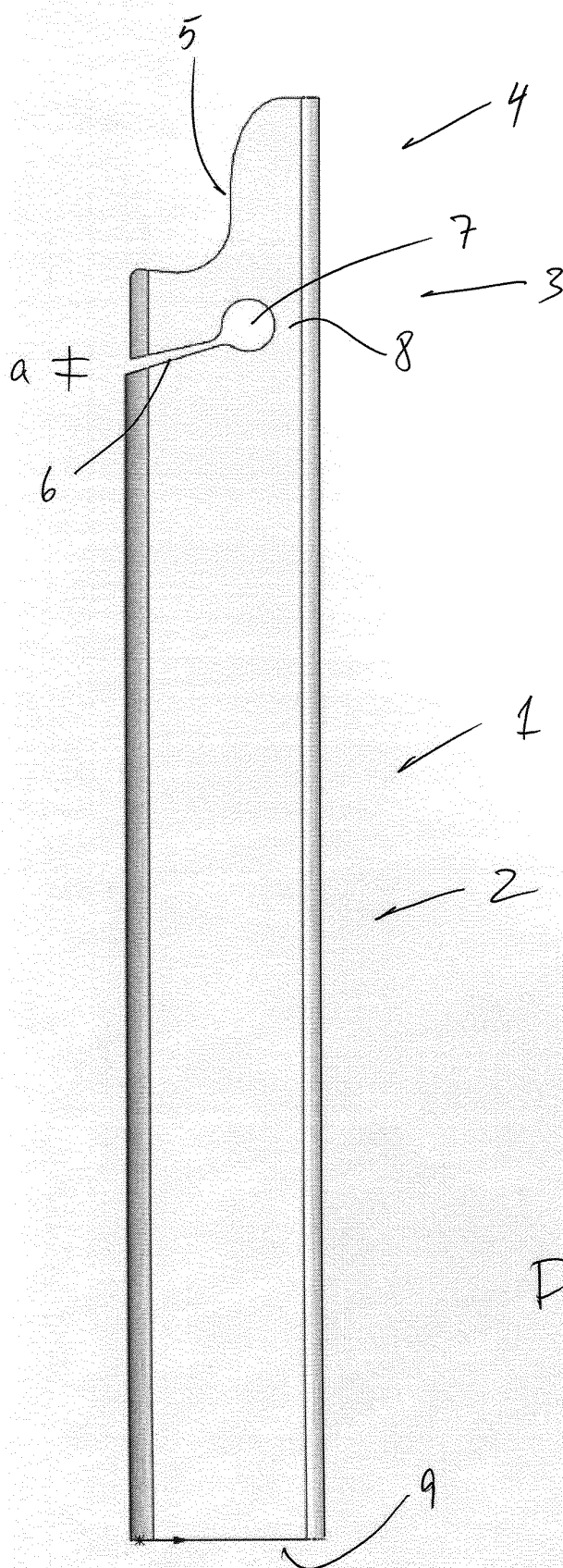


Fig. 1a

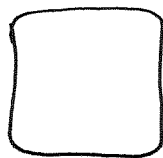


Fig. 1b

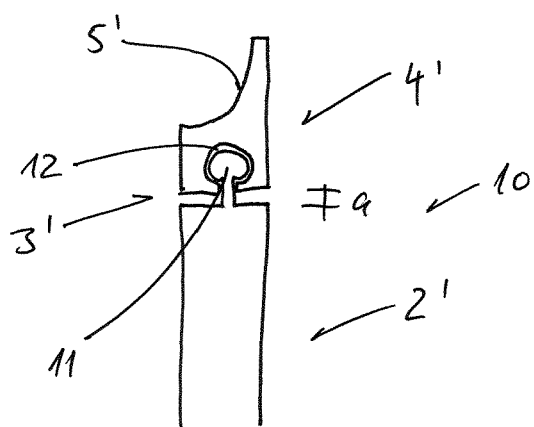


Fig. 2

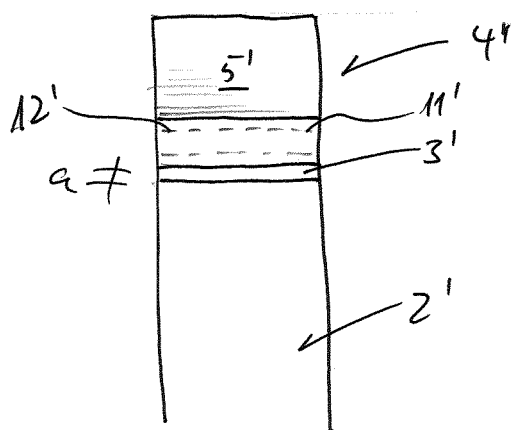


Fig. 3

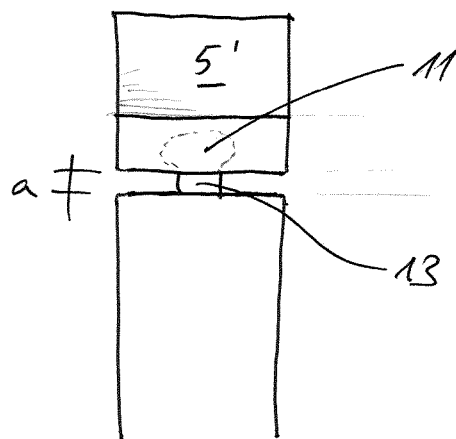
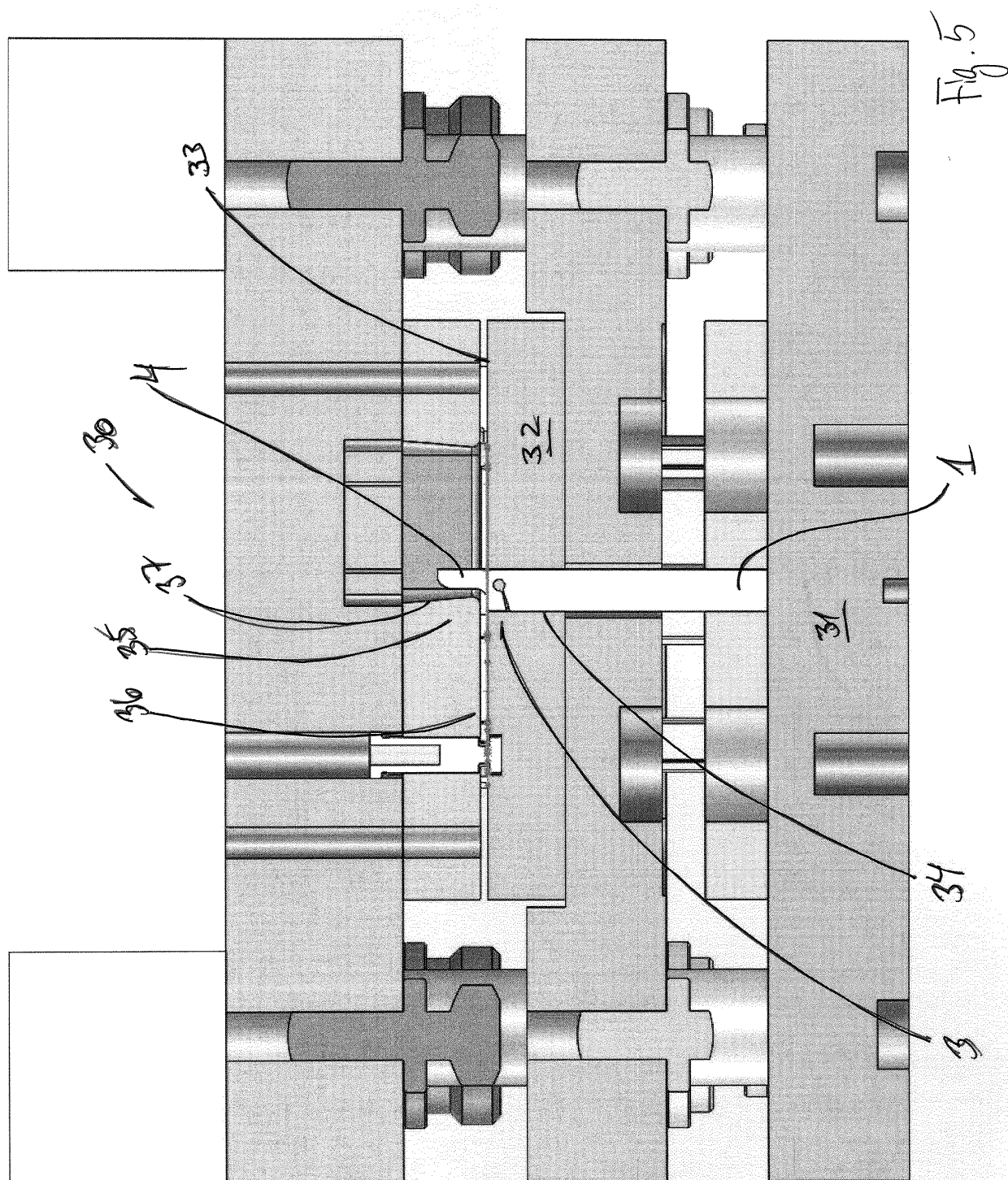
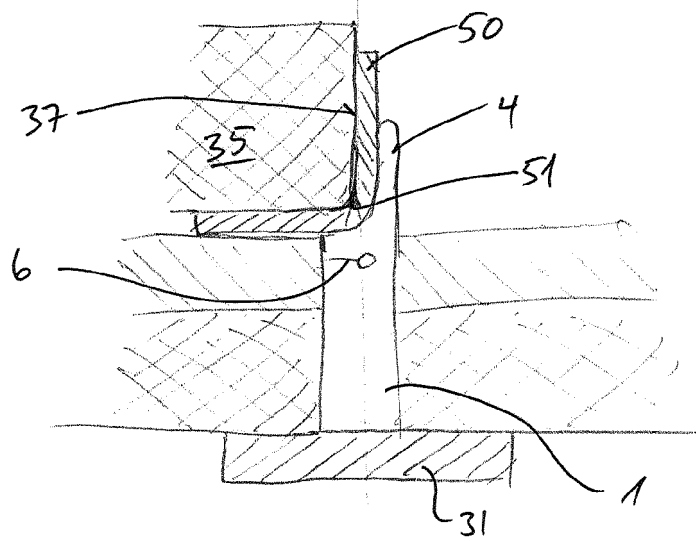
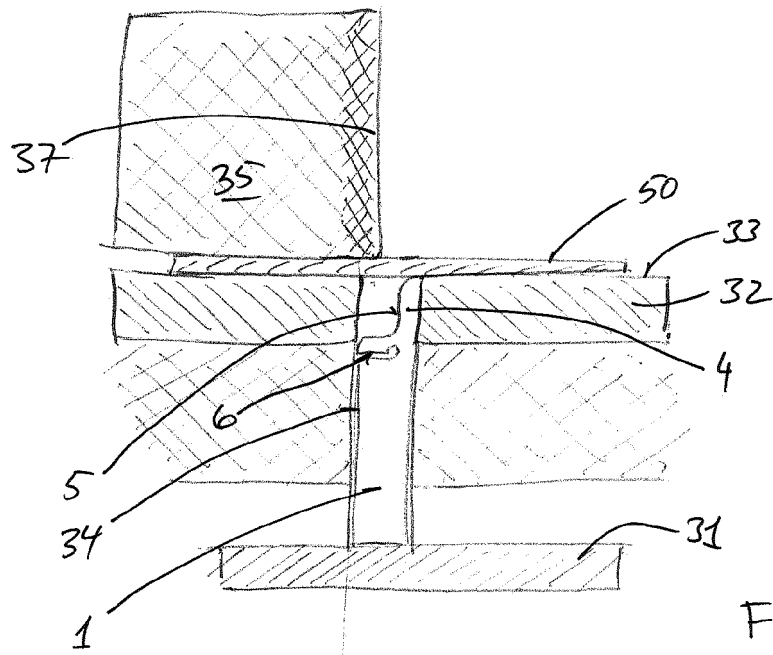
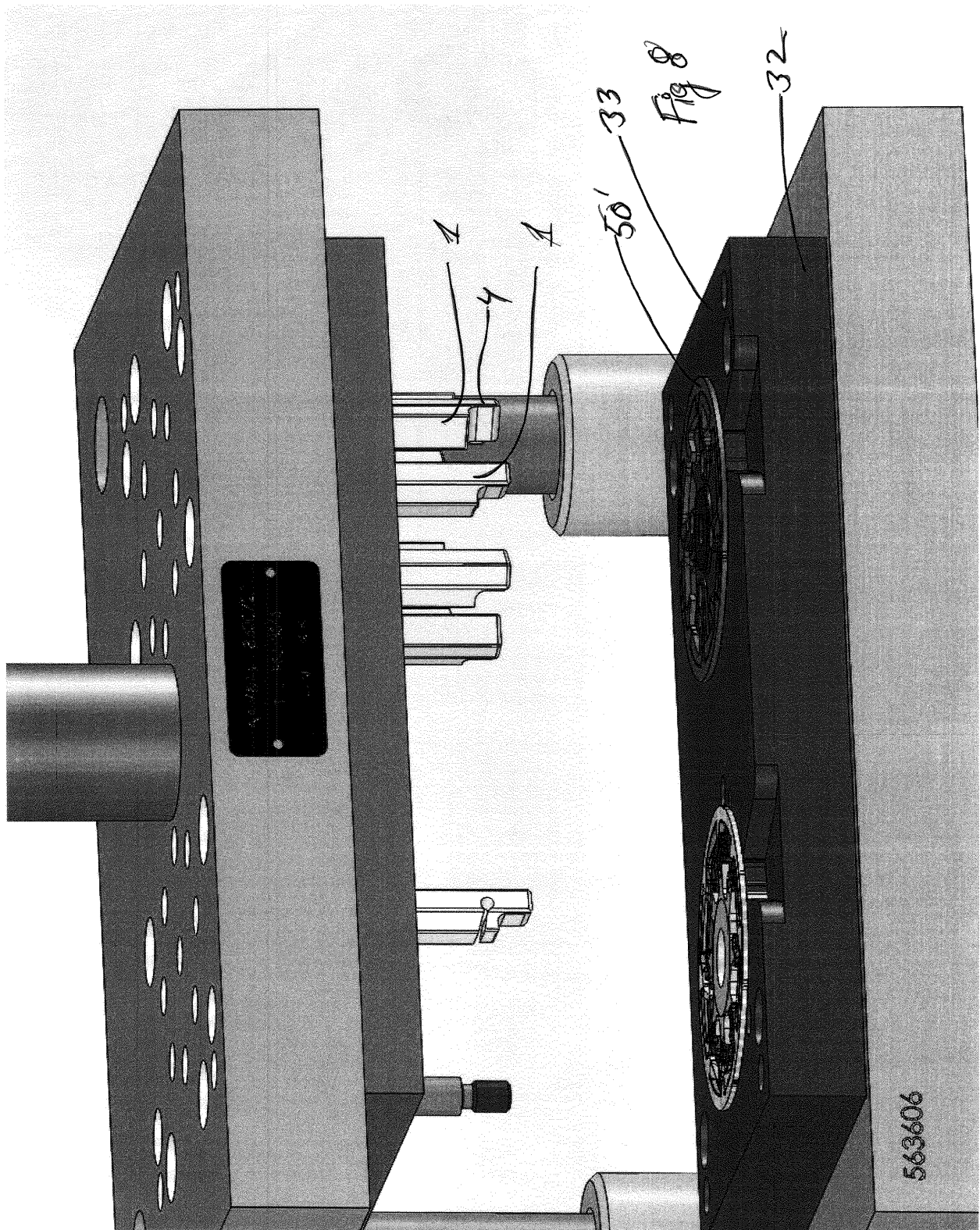


Fig. 4







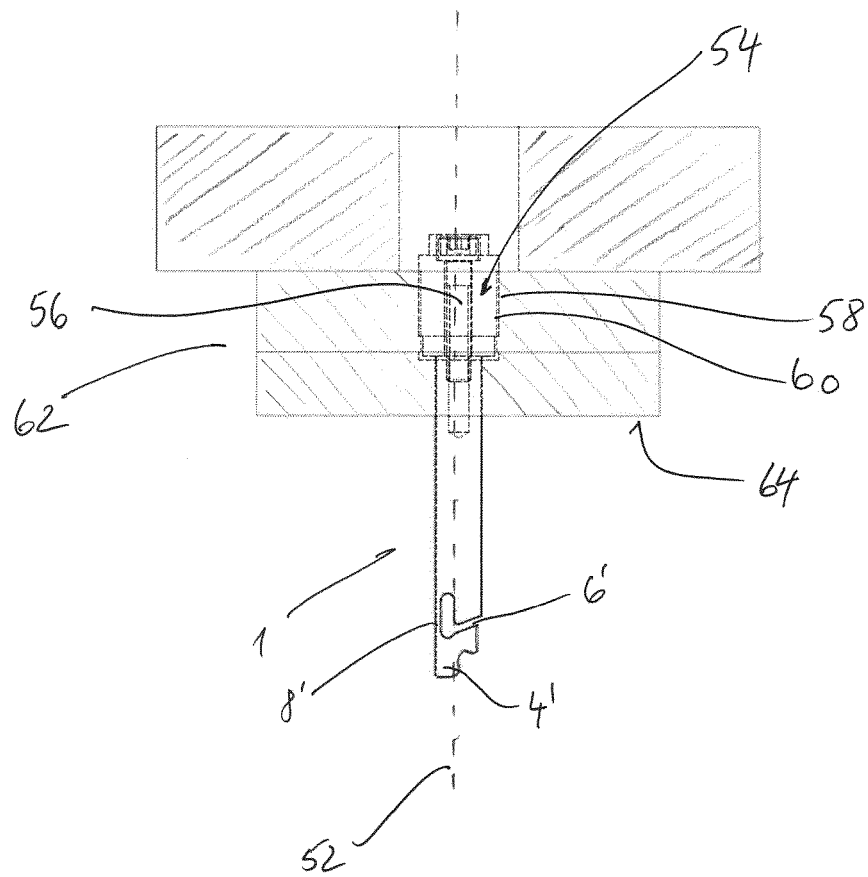


Fig. 9

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 5460873 A [0008]
- DE 10223637 [0010]
- EP 0610706 A [0011]