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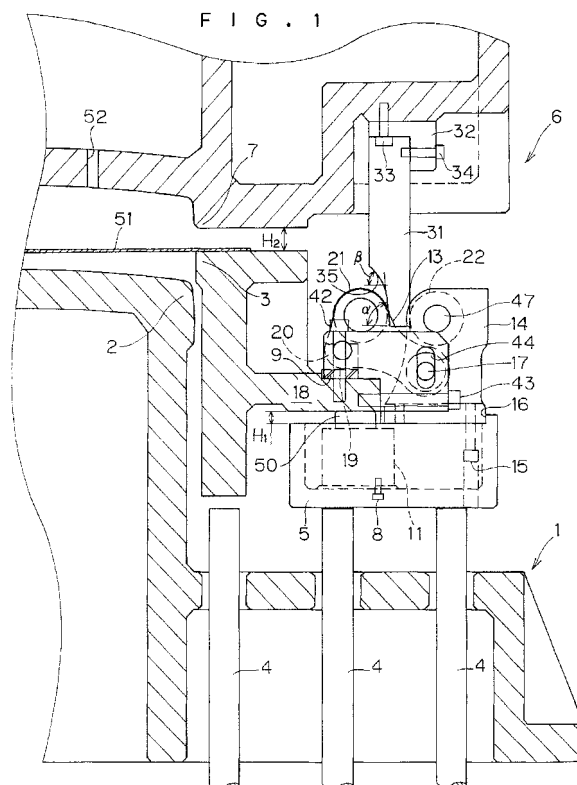
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(54) **Drawing die with stabilizer**

(57) An object of the invention is to standardize a stabilizer of a drawing die, to easily manufacture and to achieve a cost reduction. The invention provides a stabilizer of a drawing die that includes a punch (2), a blank holder (3) outside fitted to the punch (2) and supported by a cushion pin (4) and provided so as to freely move upward and downward, and a die (7) arranged so as to face to the punch (2) and moves upward and downward, and with which a thin plate (51) mounted on the blank holder (3) moved upward by the cushion pin (4) and pinched between the blank holder (3) and the die (7) by moving the die (7) downward is drawn by the punch (2), wherein a plurality of boxes (5) are arranged around the blank holder (3) between the cushion pin (4) and the blank holder (3) so as to be freely moved upward and downward by the cushion pin, a buffer gas spring (11) is interposed between the boxes (5) and the blank holder (3) so as to form a run-up gap of the blank holder (3) between the boxes (5) and the blank holder (3), a run-up lever (13) pressing the blank holder (3) so as to make the blank holder (3) run up before the die (7) comes into collision with the thin plate (51) on the blank holder (3) is rotatably provided in the boxes (5), and a driver (31) driving the run-up lever (13) is arranged at a position facing to the run-up lever (13) of the die (7), whereby the die (7) comes into collision with the thin plate (51) on the blank holder (3) after the blank holder (3) runs up.



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a drawing die having a stabilizer.

[0002] A known drawing die is shown in Fig. 5. This drawing die comprises a punch 101 positioned at a center, a blank holder 103 which is fitted peripherally outside to the punch 101, is supported by a cushion pin 102 and is provided so as to freely move upward and downward, and a die 104 arranged so as to face the punch 101 and so as to be able to move upward and downward. Reference numeral 105 denotes an air vent.

[0003] A lower die structure 109 comprising the punch 101 and the blank holder 103 is fixed to a bolster 106 of a press machine, an upper die structure 110 comprising the die 104 is fixed to a ram 107 of the press machine, and the upper die structure 110 in operation is moved upward and downward by driving the press machine. Further, the blank holder 103 which is supported by the cushion pin 102 moves upward and downward in that the cushion pin 102 is moved upward and downward by a cushion apparatus of the press machine.

[0004] A description will now be given of a drawing process:

[0005] First, the blank holder 103 is moved upward by the cushion pin 102 to a position shown by a double-dashed line.

[0006] Next, as shown by a double-dashed line, a thin plate 108 of process material, i.e. a work piece to be formed, is mounted on the blank holder 103 and the punch 101.

[0007] Thereafter, when moving the upper die structure 110 downward, the die 104 collides with the thin plate 108 on the blank holder 103 in an entire outer periphery of the punch 101 so as to pinch the thin plate 108 by the blank holder 103 and the die 104.

[0008] Subsequently, when the upper die structure 110 moves further downward, the thin plate 108 pinched by the blank holder 103 and the die 104 is drawn by the punch 101. Further, when the upper die structure 110 reaches an illustrated bottom dead center, the thin plate 108 is finally formed into a work W.

[0009] When the upper die structure 110 moves upward, the blank holder 103 is moved upward to a state shown by a double-dashed line on the basis of an ascending force of the cushion pin 102, and the work W is taken off from the punch 101. The upper die structure 110 has the air vent 105 provided in the die 104 so as to prevent a negative pressure from being generated between the work W and the die 104 when the work W slides downward by its own weight. Alternatively, the work W is actively moved to the side of the lower die structure by an extrusion pin (not shown) energized by a spring, the work W is taken off from the die 104, and the work W picked up from the press machine is transferred to another press machine in the next step.

[0010] In the drawing process mentioned above, when the die 104 collides with the thin plate 108 mounted on the blank holder 103, the thin plate 108 extending around an entire surface of an entire outer periphery of the punch 101 (that is, the thin plate 108 on the blank holder 103) and the die 104 are simultaneously brought into contact and worked by impact. Accordingly, it is necessary to use a high-quality thin plate which can sustain the impact. Further, the service life of the press die and the press machine is shortened due to the impact process.

[0011] Even when low quality process material is used, it is required that the finished product has the same quality as when high quality process material is used, and that the product cost is reduced.

[0012] In the drawing die, a great impact is generated at the time when the die collides with the thin plate on the blank holder. In order to prolong the service life of the drawing die and the press machine, it is desired to make the impact as small as possible.

[0013] If a stabilizer of the drawing die could be standardized, it is more easy to manufacture and a cost reduction could be achieved.

[0014] Further, at a time of executing the drawing process, a loud noise is generated at a time when the upper die and the lower die collide.

[0015] Further, when the blank holder finishes the upward movement after the drawing process is executed, a vibration is frequently generated in the work on the blank holder.

[0016] In view of the above noted problems, the present invention is made in order to make the impact generated in the drawing die as small as possible. A further aspect is to provide a drawing die with which it is possible to make a processed product from a low quality process material with the same quality as when high quality process material is used, thereby achieving a cost reduction of the product. A still further aspect is to prolong the service life of the drawing die and of the press machine and to standardize the stabilizer of the drawing die in order to simplify the manufacture and to achieve a cost reduction.

[0017] To this end, the present invention provides a drawing die with a stabilizer as defined in claim 1. Preferred embodiments are defined in the dependent claims.

[0018] The present invention accordingly provides a drawing die comprising a punch, a blank holder fitted outside the punch and supported by a cushion pin and provided so as to be able to freely move upward and downward, a die arranged so as to face the punch and able to move upward and downward, whereby in operation of the die a thin plate mounted on the blank holder is pinched between the blank holder and the die and is drawn by the punch by moving the die downward, and a stabilizer unit comprising a plurality of boxes peripherally arranged around the blank holder between the cushion pin and the blank holder so as to be freely movable upward and downward by the cushion pin, a buffer gas spring interposed between each box and the blank holder

so as to define a run-up gap for the blank holder between the boxes and the blank holder, and a run-up lever rotatably provided in each box and arranged to cooperate with a driver for driving the run-up lever, said driver being arranged at a position of the die facing the run-up lever, wherein the run-up lever is adapted to press the blank holder in operation of the die so as to make the blank holder run up against the operation of the buffer gas springs before the die collides with the thin plate on the blank holder.

[0019] In a preferred embodiment the driver is provided with a cam surface with portions having a changing angle of inclination for changing a driving speed of the run-up lever.

[0020] In another preferred embodiment an operation starting gap height between the blank holder and the die is set larger than the run-up gap height for the blank holder between the boxes and the blank holder in order to make the blank holder run up before it collides with the boxes.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021]

Fig. 1 is a vertical cross sectional view of a main portion of the drawing die in accordance with the present invention showing a state in which an operation of a run-up lever is started;

Fig. 2 is a side elevational view of a stabilizer of the drawing die in Fig. 1;

Fig. 3 is a vertical cross sectional view of the main portion of the drawing die in accordance with the present invention showing a state in which a blank holder runs up and is brought into contact with a box and a die is joined to a thin plate on the blank holder; Fig. 4 is a vertical cross sectional view of the main portion showing a state of a bottom dead center in which an upper die moves further downward from the state in Fig. 3, and the drawing process is finished; and

Fig. 5 is a vertical cross sectional view of a conventional drawing die.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0022] A description of the present invention will be given in detail below on the basis of a particular embodiment shown in the accompanying drawings.

[0023] In Fig. 1, a lower die structure 1 comprises a punch 2, a blank holder 3 fitted peripherally outside the punch 2 and provided so as to be freely movable upward and downward by a cushion pin 4, and a plurality of boxes 5 arranged peripherally outside the punch 2 and around the blank holder 3 and supported by the cushion pin 4 in a manner similar to the blank holder 3. An upper die structure 6 comprises a die 7 arranged so as to face the punch 2.

[0024] It is to be noted that the cushion pin (4) can comprise a plurality of pins driven by a common structure as shown in the drawing or even a plurality of independently driven cushion pins.

[0025] Conventionally, a sub blank holder constituted by an integrally formed annular ring-like member fitted outside to the punch 2 has been used. However, a drawing die becomes large by using the sub blank holder and the cost is increased. Therefore, in accordance with the present invention, the structure is made such that the plurality of standardized boxes 5 are arranged only at necessary positions below the blank holder 3 around the periphery of the punch 2. The number of the boxes needed is determined according to the size of the drawing die, and normally, four to six boxes are arranged around the periphery. The size of the box can be for example 150 mm x 275 mm x 120 mm height.

[0026] The drawing die of the invention is provided with a stabilizer unit which is attached to the box 5 and the die 7 and is adapted to make the blank holder 3 collide with the box 5 after the blank holder 3 is made to run up. An example thereof will be illustrated and described in the following.

[0027] A buffer gas spring 11 is interposed between each box 5 and the blank holder 3 of the lower die structure 1 so as to form a gap between the blank holder 3 and each box 5. Accordingly, the blank holder 3 in the starting position before the processing stroke is started floats over the box 5, and the gap is set to a run-up gap height H_1 . In this case, the buffer gas spring 11 is fastened in the box 5 by one or more bolt(s) 8.

[0028] The buffer gas spring 11 employs a gas-pressure/hydraulic cylinder, and a operational stroke and an output of a piston 12 of the buffer gas spring 11 are determined in correspondence to the drawing die. The buffer gas spring 11 is preferably a standardized element. Although an output of one cushion pin 4 is normally about 100 ton, one buffer gas spring 11 has an output of 6 ton and a stroke of about 15 mm.

[0029] A run-up lever 13 is formed approximately in a triangular shape and is rotatably provided in a bracket 14 so as to be able to press the blank holder 3 in operation to make the blank holder 3 run up, i.e. to start moving in a downward direction. The bracket 14 is fixed to the box 5 by one or more bolt(s) 15, and a positioning groove 16 is provided for accurately defining an attaching position of the bracket 14.

[0030] The run-up lever 13 is provided so as to be rotatable around a rotary shaft 17 provided in the bracket 14 and to press a flange 18 of the blank holder 3. A pressing surface 19 of the run-up lever 13 is provided with a hardened pressing member 20, and a hardened pressure receiving member 9 is provided at the part of the flange 18 where the pressing member 20 is brought into contact.

[0031] A first roller 21 is rotatably provided in an upper portion of the run-up lever 13, and a second roller 22 is provided at a position facing the first roller 21 in the bracket 14 and so as to be rotatable around a rotary shaft 47.

[0032] A driver 31 is provided at a position of the die 7 between the first roller 21 and the second roller 22. The driver 31 is attached to the die 7 via a support table 32. The support table 32 is fastened to the die 7 by one or more bolt(s) 33, and the driver 31 is fastened to the support table 32 by one or more bolt(s) 34. The driver 31 and the support table 32 may be manufactured as an integral member.

[0033] The driver 31 has a cam surface 35 including a portion with a low speed angle of inclination α and a portion with a middle speed angle of inclination β that are provided continuously. The low speed angle of inclination α is such that it creates a small downward component of movement when a part of the upper die structure 6 is brought into contact with the first roller 21 at an initial time when the upper die structure 6 moves downward. A connection portion between the portion with the low speed angle of inclination α and the portion with the middle speed angle of inclination β is formed to provide a smooth connection in the form of a circular arc. It is possible to control downward moving speeds of the run-up lever 13 and the blank holder 3 by changing the low speed angle of inclination α and the middle speed angle of inclination β of the driver 31.

[0034] Fig. 2 shows a side view of the stabilizer unit of the drawing die in Fig. 1.

[0035] An appropriate number of boxes 5 are arranged in a standardized manner in the lower portion of the blank holder 3 around the punch 2, and are movable upward and downward by the cushion pin(s) 4.

[0036] The bracket 14 is firmly fixed to each box 5 by the bolt(s) 15, and side plates 41 are arranged at both outer sides of the bracket 14. Further, the side plates 41 are fastened to the flange 18 of the blank holder 3 by bolts 42 and 43.

[0037] The rotary shaft 17 is extended through a base end portion of the run-up lever 13, the base end portion of the run-up lever 13 is received within the bracket 14, and each end portion of the rotary shaft 17 is inserted through a long hole 44 of each side plate 41 and is fastened by a bolt 46 via a washer 45.

[0038] The second roller 22 that is provided rotatable around the rotary shaft 47 is received in the upper portion of the bracket 14. Both ends of the rotary shaft 47 are supported by the bracket 14, both end surfaces are fixed by stop plates 48, and each stop plate 48 is fastened to the bracket 14 for example by one or more bolt(s) 49.

[0039] The buffer gas spring 11 is fastened to the box 5 by the bolt(s) 8, and a piston 50 of the buffer gas spring 11 is brought into contact with a lower surface of the flange 18 of the blank holder 3. The flange 18 of the blank holder 3 is lifted up from the upper surface of the box 5 on the basis of the output of the buffer gas spring 11 to create a run-up gap height H_1 of for example 15 mm.

[0040] Next, a description will be given of an operation of the drawing die of the invention including the stabilizer unit.

[0041] A thin plate 51 of a process material, i.e. a work

piece to be formed in the drawing die is mounted on the punch 2 and the blank holder 3.

[0042] Fig. 1 shows a state in which the upper die structure 6 moves downward, and the run-up lever 13 starts being brought into contact with an upper surface of the flange 18 of the blank holder 3 by engagement with the driver 31. An operation starting gap height H_2 between the blank holder 3 and the die 7 in Fig. 1 is set larger than the run-up gap height H_1 in order to make the blank holder 3 run up first, and then collide with the box 5. The run-up gap height H_1 , the operation starting gap height H_2 , and a relation between the run-up gap height H_1 and the operating starting gap height H_2 (a factor by which the operation starting gap height H_2 is larger than the run-up gap height H_1) are set to values that are sufficient to avoid an impact work, i.e. a simultaneous contact between the die and the blank holder and a start of drawing on the punch.

[0043] After the blank holder 3 is made to run up by the run-up lever 13 and presses the piston 50 of the buffer gas spring 11, thereby making the blank holder run up against the operation of the buffer gas springs before the die collides with the thin plate on the blank holder, and after the lower surface of the flange 18 of the blank holder 3 is brought into contact with the upper surface of the box 5, the die 7 is brought into contact with the thin plate 51 on the blank holder 3. The state at this point is shown in Fig. 3. In the case of $H_1 = 15$ mm, for example, a relation that $H_1 = 0$ mm is established when the contact portion of the run-up lever 13 with the flange 18 of the blank holder 3 moves downward by a distance of 15 mm. The die 7 is accordingly brought into contact with the thin plate 51 on the blank holder 3 that is running up, i.e. is not in a resting state. Since the die 7 is brought into contact with the thin plate 51 that is running up and is not coming in static condition, a strong impact is hardly generated.

[0044] Thereafter, the upper die 6 continuous to move downward and the drawing process is finished in a state when the die has reached a bottom dead center shown in Fig. 4 where the work W is finally formed. In the case of the present embodiment, the cushion pin 4 moves downward for example by a distance of 65 mm.

[0045] When the upper die 6 moves upward, the work W is taken out of the punch 2 by the blank holder 3, and an air vent 52 is provided in the die 7 so as to prevent a negative pressure from being generated between the work W and the die 7 at a time when the work W slides down due to its own weight. Alternatively, the work W may be actively discharged out of the die 7 by an extrusion pin (not shown) energized by a spring.

[0046] If the box 5, the run-up lever 13, the bracket 14, the driver 31 and the like (including the first roller 21, the second roller 22, the rotary shaft 17, the buffer gas spring 11, and the support table 32) are formed as standardized parts and different parts are provided essentially only in correspondence to the size, it is possible to easily modify an existing drawing die to the die having the buffer structure.

[0047] In accordance with the present invention, since the components of the stabilizer of the drawing die such as the box are provided in a standardized manner, the buffer structure can be easily provided for any drawing die. Even when low quality process material is used, it is possible to make the processed product to have the same quality as when high quality process material is used, and it is possible to achieve a cost reduction of the product.

[0048] Further, in accordance with the present invention, since the die comes into collision with the thin plate on the running up blank holder, a noise can be reduced.

[0049] Further, in accordance with the present invention, since the blank holder executes the drawing process via the stabilizer unit, it moves upward step by step by the stabilizer unit and it is possible to reduce a vibration of the finished work on the blank holder.

[0050] In accordance with the present invention, it is further possible to make the impact generated in the drawing die as small as possible and to thus prolong the service life of the drawing die and the press machine.

[0051] By standardizing the elements of the stabilizer of the drawing die, the same can be easily manufactures and a cost reduction can be achieved.

[0052] Further, in accordance with the present invention, by providing the cam surface with portions having a changing angle of inclination, it is possible to control and change the run-up speed of the blank holder.

[0053] Further, in accordance with the present invention, since the stabilizer unit of the drawing die is structured such as to be attached to the boxes and the die and collide with the boxes after making the blank holder run up, it is possible to easily improve an existing drawing die.

[0054] The present invention is described about the drawing die, however, may be applied to a forming die.

movable upward and downward by the cushion pin (4),

a buffer gas spring (11) interposed between each box (5) and the blank holder (3) so as to define a run-up gap for the blank holder (3) between the boxes (5) and the blank holder (3), and a run-up lever (13) rotatably provided in each box (5) and arranged to cooperate with a driver (31) for driving the run-up lever (13), said driver (31) being arranged at a position of the die (7) facing the run-up lever (13), wherein the run-up lever (13) is adapted to press the blank holder (3) in operation of the die so as to make the blank holder (3) run up against the operation of the buffer gas springs (11) before the die (7) collides with the thin plate (51) on the blank holder (3).

2. The drawing die as claimed in claim 1, wherein the driver (31) is provided with a cam surface with portions having a changing angle of inclination for changing a driving speed of the run-up lever (13).

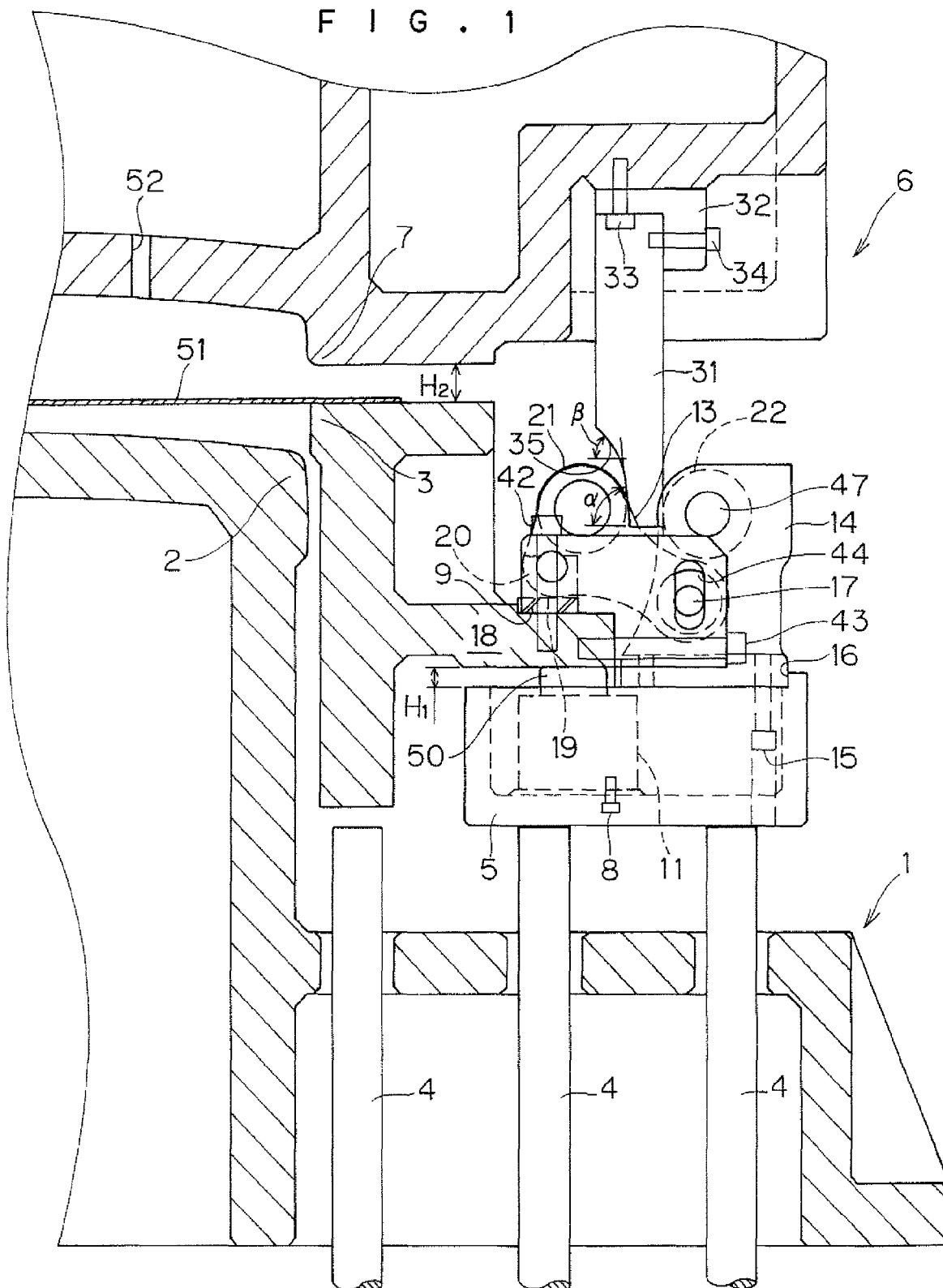
3. The drawing die as claimed in claim 1 or 2, wherein an operation starting gap height (H_2) between the blank holder (3) and the die (7) is set larger than the run-up gap height (H_1) for the blank holder (3) between the boxes (5) and the blank holder (3) in order to make the blank holder (3) run up before it collides with the boxes (5).

Claims

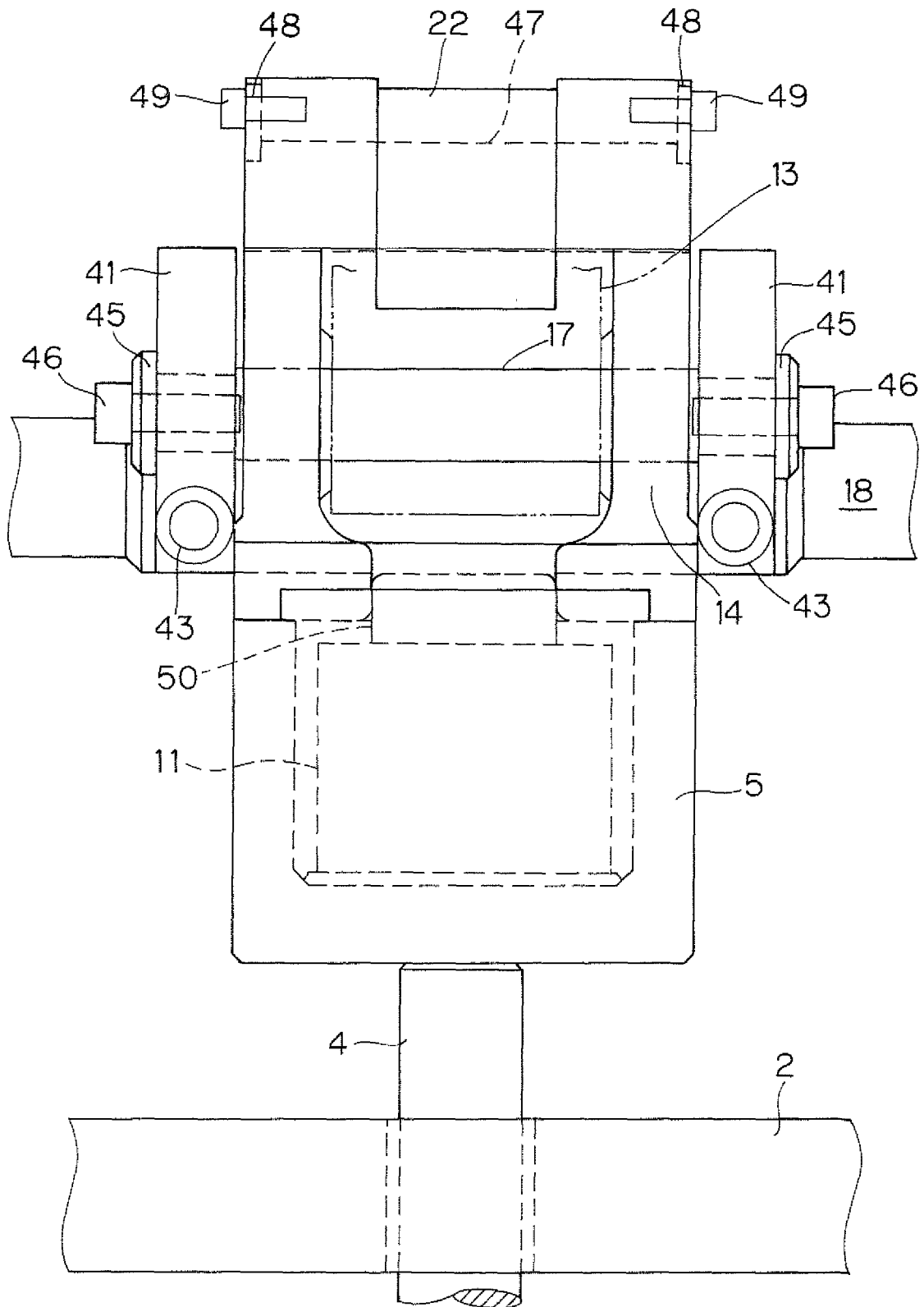
1. A drawing die comprising:

a punch (2),
a blank holder (3) fitted outside the punch (2) and supported by a cushion pin (4) and provided so as to be able to freely move upward and downward,
a die (7) arranged so as to face the punch (2) and able to move upward and downward, whereby in operation of the die a thin plate (51) mounted on the blank holder (3) is pinched between the blank holder (3) and the die (7) and is drawn by the punch (2) by moving the die (7) downward, and
a stabilizer unit comprising
a plurality of boxes (5) peripherally arranged around the blank holder (3) between the cushion pin (4) and the blank holder (3) so as to be freely

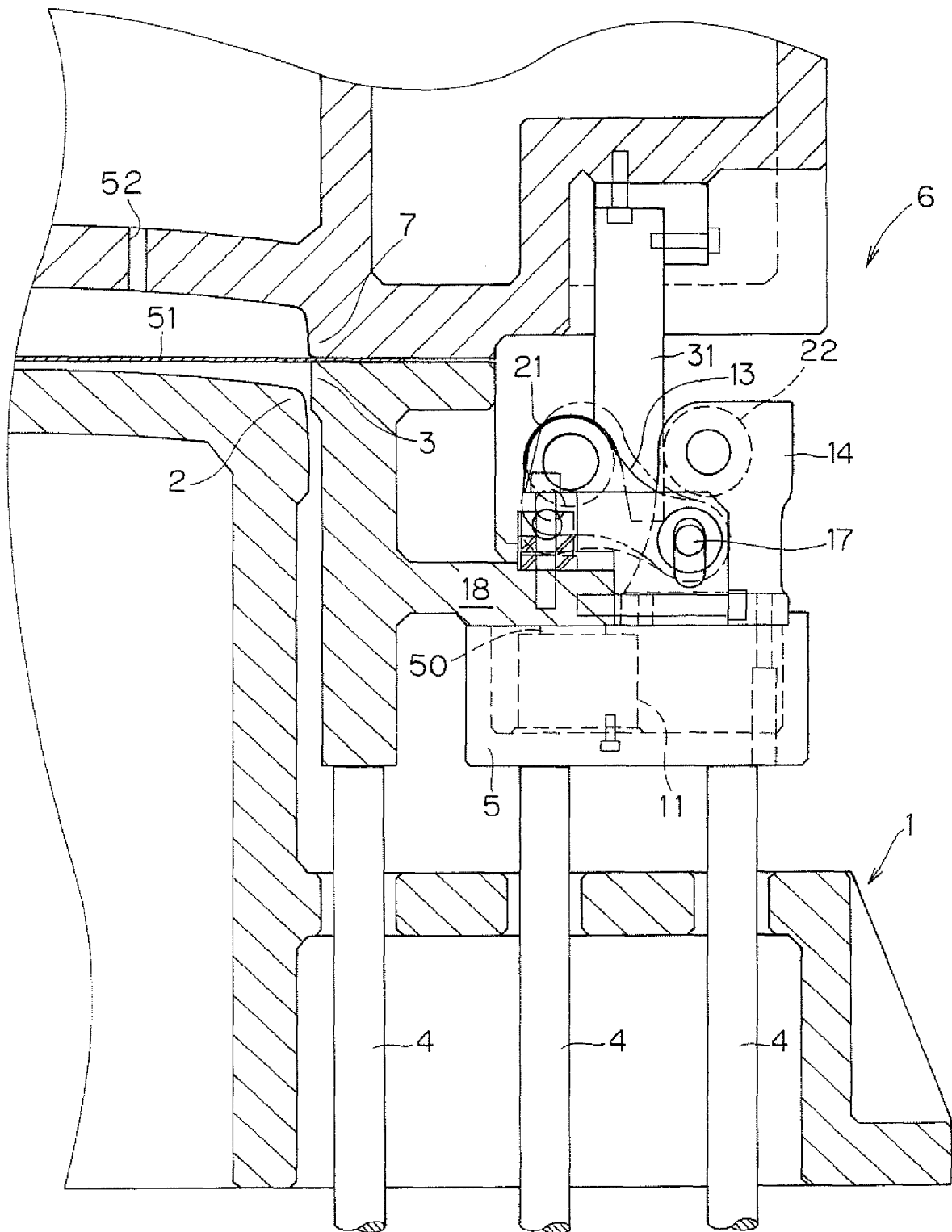
F I G . 1



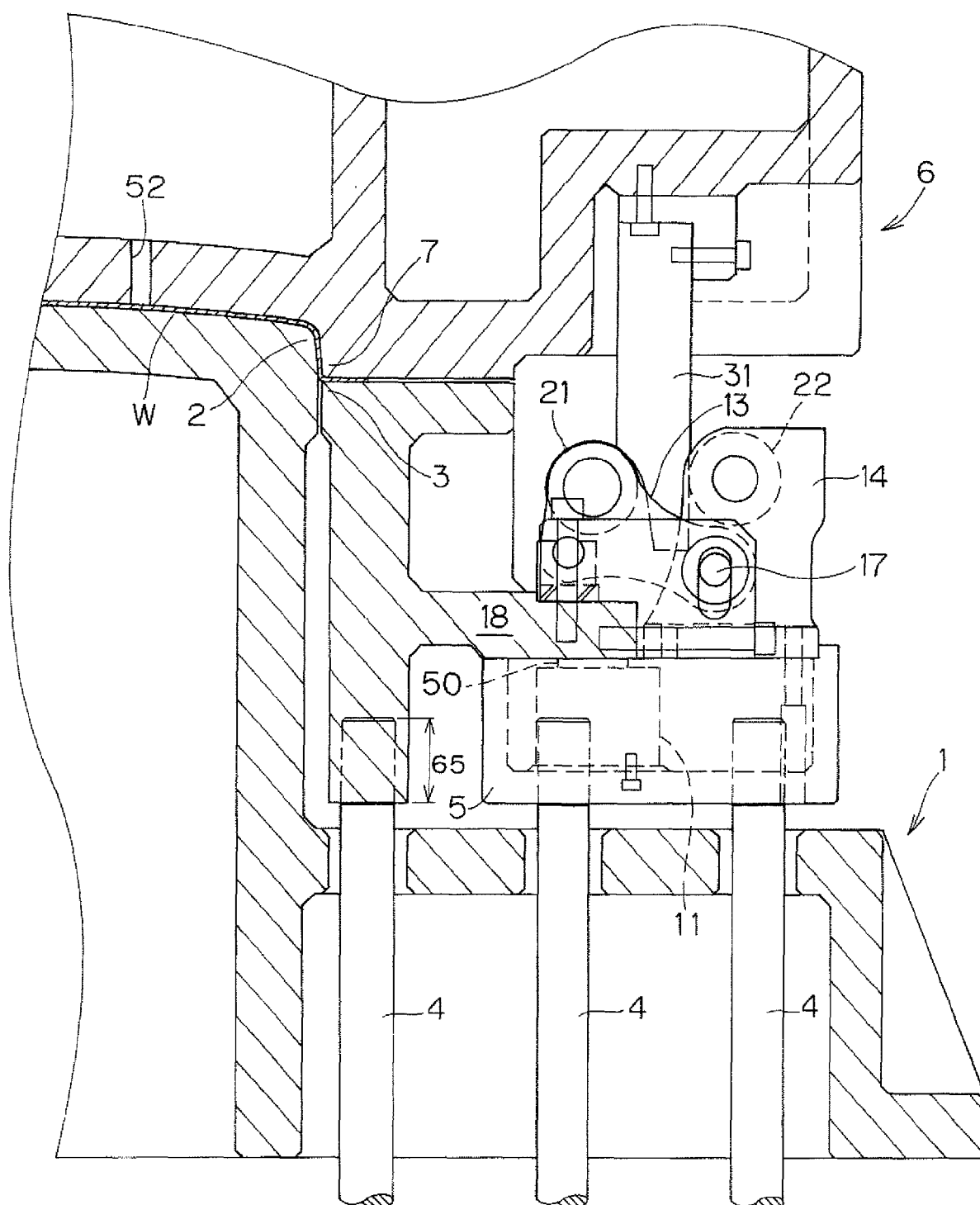
F I G . 2



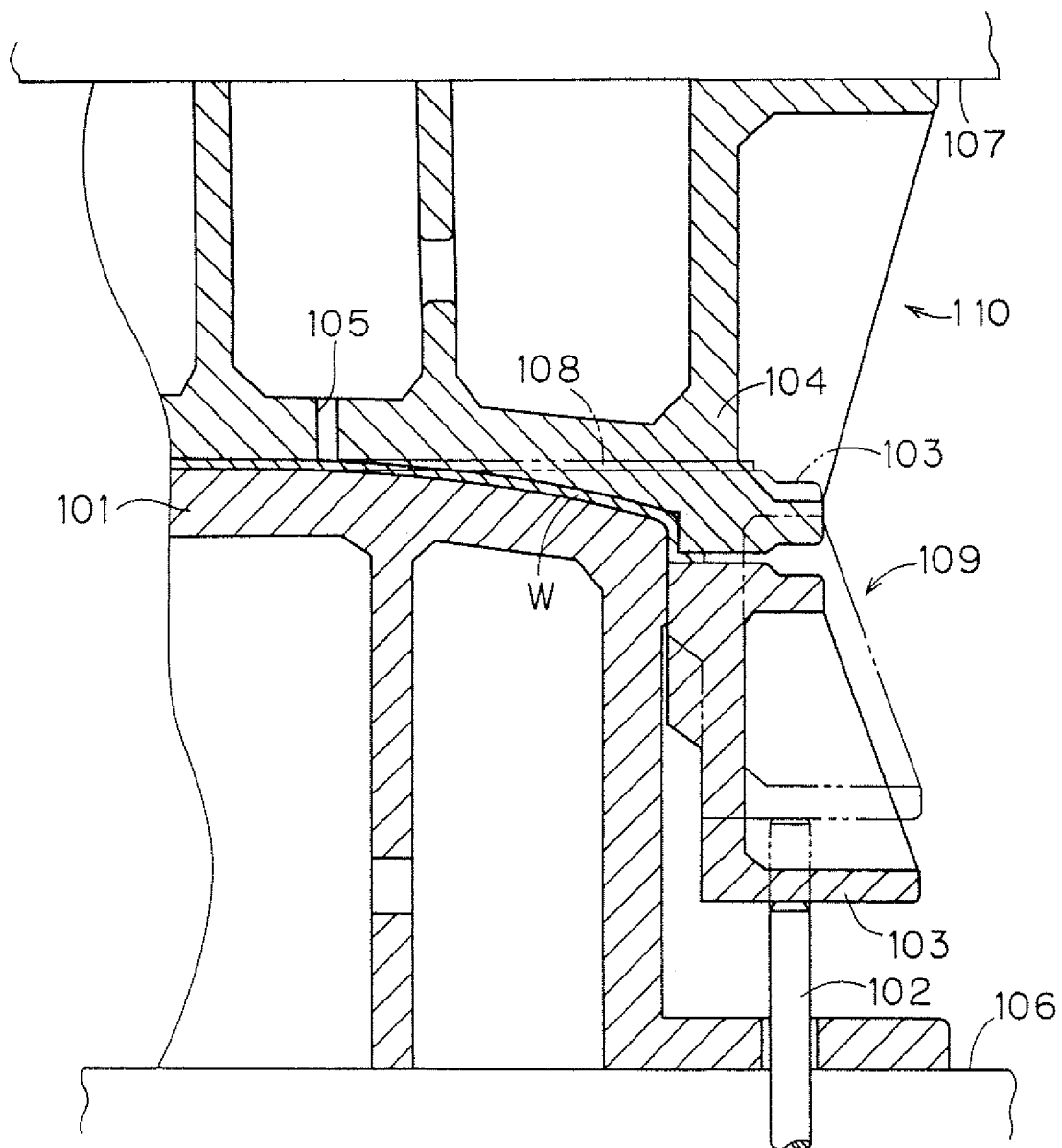
F I G . 3



F I G . 4



F I G . 5





European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 11 0559

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 0 956 913 A (UMIX CO., LTD; JCM CO., LTD) 17 November 1999 (1999-11-17) * figures 1-5 *	1-3	B21D24/02 B21D24/12
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A	----- DE 36 23 188 C1 (DAIMLER-BENZ AG, 7000 STUTTGART, DE) 10 September 1987 (1987-09-10) * figures 1-4 *	1-3	

			TECHNICAL FIELDS SEARCHED (IPC)
			B21D B21B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		20 December 2005	Vinci, V
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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EPO FORM 1503 03.02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 11 0559

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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