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(54) Half-die for pressing loose materials, particularly ceramic mixes

(57) A half-die (1) for pressing loose material, particularly ceramic mixes, comprising at least one shoe assembly (2) provided with
- a substantially plate-like base body (3),
- presser means (4), which are adapted to act on the loose material to be pressed and are associated at one face (3a) of the base body (3) and can move between an inactive configuration, in which they are close to the base body (3), and at least one first active configuration, in which they are substantially spaced from the base body,
- at least one suspension cylinder (5) which uses a fluid medium and is interposed between the base body (3) and the presser means (4) and is associated with a first circuit (6) for feeding a first incompressible fluid for actuating the movement of the presser means (4) between the inactive configuration and the first active configuration,
- at least one seat (17) associated with the base body (3),
- at least one piston (18) for the return of the presser means (4) to the inactive configuration, which is accommodated slidingly in the seat (17) and is provided with at least one abutment surface (19) that is adapted to abut against corresponding stop means (20) associated with the seat (17) at the at least one active configuration and
- a second circuit (21) for sending a second incompressible fluid between the abutment surface (19) and the stop means (20) so as to actuate the return of the presser means (4) to the inactive configuration, the stop means (20) being accommodated so that they can move along the seat (17) between a first position, in which the presser means (4) can move between the inactive configuration and the first active configuration, and a second position, in which the presser means (4) move to a second active position, and comprises means (24) for adjusting the position of the stop means (20) along the seat (17).

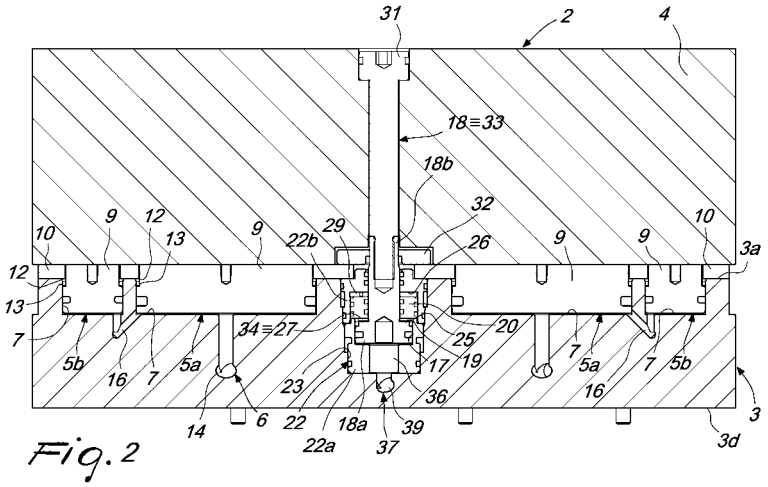

Fig. 2

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Description

[0001] The present invention relates to a half-die for pressing loose material, particularly ceramic mixes.

[0002] The technique of shaping by pressing mixes of loose materials (powders, atomized materials, granular materials and the like or mixtures thereof) within dies provided with two half-dies that can be mutually superimposed and can move alternately toward and away from each other has long been known in the ceramics sector. At least one of the half-dies, generally the lower one, is constituted substantially by a bearing plate in which one or more forming cells for respective articles are formed, its bottom wall being constituted by the end of respective shoes, which can move parallel to the direction of mutual approach and spacing.

[0003] Each pressing cycle comprises the steps of loading the ceramic mix into the cells, pressing, and unloading the articles obtained from each cell.

[0004] In order to compensate for any non-uniformities in the quantity of ceramic mix loaded into each cell, so-called isostatic dies have long been known which allow to obtain substantially homogeneous densities among the articles formed in the various cells. These dies generally entail that at least one of the half-dies is provided with mutually connected pressing chambers, formed between each shoe and the die, which during the pressing step are filled by a pressurized incompressible fluid. At the end of the pressing step it is necessary to ensure the discharge of the pressing chambers in order to position the shoes in an inactive condition at a fixed height, so as to allow correct loading of fresh ceramic mix to be pressed.

[0005] It is in fact known that the density obtained after pressing affects the linear shrinkage of the material during firing and therefore any non-uniformities after pressing entail the formation of production rejects, since as a consequence of firing the resulting articles do not comply with the required shape and size parameters.

[0006] A first type of isostatic die, for example, is known from EP 1403017 B1, which discloses a die in which at least one of the two half-dies has a bearing plate in which there are at least two seats at respective forming cells in which respective shoes are inserted so that they can slide parallel to the direction of mutual approach and spacing of the two half-dies. A pressing chamber is formed between each shoe and the bottom of the respective seat and, during pressing, is filled with an incompressible fluid, the various chambers having a mutual fluid connection. Each shoe can move between a rest position and an active position, in which it is moved away from the bottom of the seat by introducing pressurized fluid in the corresponding chamber. The die further provides for elastic means for the return of the shoes to the inactive position, at which the mix is loaded. These elastic means can be constituted for example by flexing springs interposed between the bearing plate and the shoes.

[0007] However, such isostatic die does not ensure over time correct restoration and retention of the shoes in the inactive position, in view of the structural yielding that can affect the elastic elements that are responsible for the return of the shoes to such position.

[0008] This fact makes it particularly difficult to fit such half-die in the lower position within the press. It is in fact noted that the placement of the shoes at a height that is different from the reference height, which corresponds to the inactive position, gives rise to incorrect loading of the mix to be pressed, with the inevitable formation of production rejects.

[0009] As an alternative, an isostatic die is also known which is the subject of EP 1403016 in the name of this same Applicant and uses a plurality of shoes, each of which is constituted by a plate-like body, which is adapted to be fixed to the bearing plate and in which there is a plurality of seats in which respective pistons are inserted so that they can slide, and by a surface that is adapted to act on the material to be pressed and is associated with the plate-like body at the side toward which the tops of such pistons are exposed. The half-die has a circuit for feeding a pressurized fluid which is connected to each seat for the actuation of the sliding of the corresponding piston, the circuits of each shoe being mutually connected. Each seat is further provided with at least one surface for stopping the sliding of the piston, which is adapted to abut against a corresponding shoulder that is shaped on such piston, between which return means act for moving the piston towards the inside of the seat. In particular, the return means can be of the fluid-operated type and can provide a hermetic chamber that is formed between each stop surface and the corresponding shoulder in which an incompressible pressurized fluid is fed for the actuation of the sliding of the piston toward the bottom of the seat and the subsequent retention of this position.

[0010] Although this type of die ensures correct positioning of the pistons during the step for loading the material, it is rather complicated to assemble and requires the use of workers that have experience and skill in performing the necessary operations.

[0011] Moreover, known isostatic dies allow, during pressing, a fixed margin of displacement of the shoes whose extent is equal to the thickness of the pressing chambers into which the pressurized fluid is fed. The extent of this displacement may not be sufficient to compensate for particularly substantial non-uniformities in the loading of the cells due, for example, to malfunctions of the loading system, which can entail the formation of production rejects and/or the occurrence of overpressures in the pressing chambers, such as to damage the mechanical elements of the die.

[0012] Further, known isostatic dies do not allow to vary the position of the shoes during the loading of the ceramic mix to be pressed in the cells.

[0013] The aim of the present invention is to eliminate the above-mentioned drawbacks of known dies, by providing a half-die for pressing loose material, particularly ceramic mixes, which allows to achieve an overtravel in

the movement of the shoes during pressing, so as to compensate for particularly substantial non-uniformities in loading.

[0014] Within this aim, an object of the present invention is to allow adjustment of the height of the shoes, if it is fitted in a lower region in the press, during the loading of the ceramic mix to be pressed, so as to perform a retroactive correction of the quantity of mix that is loaded into the individual cells.

[0015] Another object of the present invention is to ensure a correct positioning of the shoes when inactive which is repeatable and reliable over time.

[0016] Another object of the present invention is to allow it to be fitted both to the lower beam of the press and to the upper beam.

[0017] Another object of the present invention is to provide a half-die which is simple in manufacture and assembly and easy to install on the press.

[0018] A further object of the present invention is to be easy to install even on existing presses that are not designed specifically, without requiring particular interventions for adaptation.

[0019] Another object of the present invention is to have a structure that is simple, relatively easy to provide in practice, safe in use, effective in operation, and of relatively low cost.

[0020] This aim and these and other objects which will become better apparent hereinafter are achieved by the present half-die for pressing loose material, particularly ceramic mixes, comprising at least one shoe assembly provided with

- a substantially plate-like base body,
- presser means, which are adapted to act on the loose material to be pressed and are associated at one face of said base body and can move between an inactive configuration, in which they are close to the base body, and at least one first active configuration, in which they are substantially spaced from said base body,
- at least one suspension cylinder which uses a fluid medium and is interposed between said base body and said presser means and is associated with a first circuit for feeding a first incompressible fluid for actuating the movement of the presser means between said inactive configuration and said first active configuration,
- at least one seat associated with said base body,
- at least one piston for the return of said presser means to the inactive configuration, which is accommodated slidingly in said seat and is provided with at least one abutment surface that is adapted to abut against corresponding stop means associated with said seat at said at least one active configuration and
- a second circuit for sending a second incompressible fluid between said abutment surface and said stop means so as to actuate the return of said presser means to the inactive configuration,

characterized in that said stop means are accommodated so that they can move along said seat between a first position, in which said presser means can move between said inactive configuration and a first active configuration, and a second position, in which said presser means move to a second active position, and comprises means for adjusting the position of said stop means along said seat.

[0021] Further characteristics and advantages of the present invention will become better apparent from the following detailed description of a preferred but not exclusive embodiment of a half-die for pressing loose material, particularly ceramic mixes, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic plan view of a shoe assembly of a half-die according to the invention;
Figure 2 is a schematic sectional view, taken along the line II-II of Figure 1, with the presser means in the inactive configuration;
Figure 3 is a schematic sectional view, taken along the line III-III of Figure 1, with the presser means in the inactive configuration;
Figure 4 is a schematic sectional view, taken along the line II-II of Figure 1, with the presser means in a first active configuration;
Figure 5 is a schematic sectional view, taken along the line III-III of Figure 1, with the presser means in the first active configuration;
Figure 6 is a schematic sectional view, taken along the line II-II of Figure 1, with the presser means in a second active configuration;
Figure 7 is a schematic sectional view, taken along the line III-III of Figure 1, with the presser means in the second active configuration;
Figure 8 is a schematic sectional view, taken along the line VIII-VIII of Figure 1;
Figure 9 is a schematic sectional view, taken along the line IX-IX of Figure 1;
Figure 10 is a schematic perspective view of the half-die according to the invention provided with three shoe assemblies;
Figure 11 is an enlarged-scale schematic view of a portion of Figure 3 related to the return and positioning piston.

[0022] With reference to the figures, the reference numeral 1 generally designates a half-die for pressing loose material, particularly ceramic mixes.

[0023] The half-die 1 comprises at least one shoe assembly 2, which is designed to press the loose material to be pressed that is loaded in a corresponding forming cell.

[0024] The half-die 1 can be provided with a bearing plate in which there is at least one cell in which the shoe assembly 2 is inserted so as to form its bottom wall.

[0025] It is noted that the geometry and dimensions of

the shoe assembly 2 may be many according to the characteristics of the article to be obtained by pressing.

[0026] The half-die 1 can be used in a die constituted by two half-dies, an upper one and a lower one according to the invention, or can be applied even in combination with a rigid or isostatic metallic half-die of a known type; in this last case, it is designed to be installed preferably in a lower position.

[0027] The shoe assembly 2 comprises a substantially plate-like base body 3 and presser means 4, which are adapted to act on the loose material to be pressed and are associated at a face 3a of the base body 3 and can move between an inactive configuration, in which they are close to the base body 3, optionally in contact with it, and at least one active configuration, in which they are substantially spaced from the base body during pressing. If the half-die 1 is mounted in a lower region, the inactive configuration is maintained during the step for loading the corresponding cell.

[0028] The shoe assembly 2 is provided with at least one suspension cylinder 5, which uses a fluid medium and is interposed between the base body 3 and the presser means 4 and is associated with a first circuit 6 for feeding a first incompressible fluid, such as hydraulic oil, for actuating the movement of the presser means 4 between the inactive configuration and the at least one active configuration.

[0029] The suspension cylinder 5 is constituted by a receptacle 7 associated with the base body 3, in which a suspension piston 9 is accommodated so that it can slide. The first circuit 6 is connected to a pressing chamber 8, which is formed between the suspension piston 9 and the bottom of the receptacle 7 in order to send pressurized oil during the pressing step. In the inactive configuration, the first circuit 6 is connected to the discharge and the suspension piston 9 is retracted within the receptacle 7.

[0030] In particular, the receptacle 7 is formed directly on the base body 3 and is open at the face 3a. There is, therefore, a stop plate 10, which is interposed between the base body 3 and the presser means 4 and is fixed to the base body by means of screws 11 and forms an abutment 12 for stopping the stroke of the suspension piston 9 away from the bottom of the receptacle 7, such piston being contoured so as to form a shoulder 13 that is adapted to a but against the abutment 12.

[0031] In the inactive configuration, the presser means 4 can be arranged so as to rest on the plate 10.

[0032] The first circuit 6 has a device for accumulating pressurized oil, not shown in the figures, and at least one first duct 14, which is formed in the base body 3 and has an end that is connected to the pressing chamber 8 and the opposite end that is open and faces a first side wall 3b of the base body 3.

[0033] Conveniently, the shoe assembly 2 can have a plurality of suspension cylinders 5 whose corresponding pressing chambers 8 are connected to each other and to the first circuit 6.

[0034] The figures illustrate a shoe assembly 2 provided with four central suspension cylinders 5a, which are distributed in respective quadrants of the shoe assembly, and with four corner suspension cylinders 5b, whose dimensions are smaller than the preceding ones. Two first mutually parallel ducts 14 are provided which are connected to the pressing chambers 8 of the respective central suspension cylinders 5a, each of which in turn is connected to the pressing chamber 8 of another central suspension cylinder 5a by means of a tubular portion 15 provided within the base body 3. Finally, each central suspension cylinder 5a has the corresponding pressing chamber 8 in fluid connection with the pressing chamber 8 of the corner suspension cylinder 5b that is arranged adjacent to it by means of a connecting portion 16 formed in the base body 3.

[0035] The shoe assembly 2 further has at least one seat 17, which is associated with the base body 3, at least one piston 18 for return of the presser means 4 to the inactive configuration, which is accommodated so that it can slide within the seat 17 and is provided with at least one abutment surface 19 that is adapted to abut against corresponding stop means 20 which are associated with the seat 17 at the at least one active configuration, and a second circuit 21 for sending a second incompressible fluid, such as hydraulic oil, between the abutment surface 19 and the stop means 20 so as to actuate the translational motion of the return piston 18 and the consequent return of the presser means 4 to the inactive configuration.

[0036] In the figures, the seat 17 is formed within a jacket 22, which is accommodated in a corresponding hole 23 formed in the base body 3, but it might also be provided directly on the base body. The jacket 22 is constituted by a pair of portions 22a and 22b, which are substantially cup-shaped and associated hermetically, the portion 22a being arranged at the bottom of the hole 23 and the portion 22b being arranged so that the corresponding internal cavity faces the internal cavity of the other portion 22a so as to define the seat 17 and so that the corresponding bottom is directed toward the presser means 4. The plate 10 also acts as a stop member for the positioning of the jacket 22.

[0037] The stop means 20 are accommodated so that they can move along the seat 17 between a first position, in which the presser means 4 can move between the inactive configuration (Figures 2 and 3) and a first active configuration (Figures 4 and 5), and a second position, in which the presser means 4 move to a second active configuration (Figures 6 and 7). Means 24 are further provided for adjusting the position of the stop means 20 along the seat 17 between such first and second positions.

[0038] The stop means 20 are constituted by at least one abutment plunger, against which the abutment surface 19 rests in the first and second active configurations. The plunger 20 is accommodated so that it can slide hermetically between the return piston 18 and the seat 17

and can move alternately between first and second stroke limiting shoulders, respectively 25 and 26, against which it abuts in the first and second positions, and which are associated with the seat 17. The second shoulder 26 is arranged proximate to the presser means 4, while the first shoulder 25 lies on the opposite side.

[0039] In particular, the first shoulder 25 is formed by the end portion of the portion 22a, while the second shoulder 26 is constituted by the bottom of the portion 22b.

[0040] The adjustment means 24 are adapted to act between the plunger 20 and the second shoulder 26 in order to keep the plunger in the first position at the inactive configuration and at the first active configuration.

[0041] The shoe assembly 2 provides a hermetic return chamber 27, which is formed between the plunger 20, the seat 17 and the return piston 18 and has a fluid connection to the second circuit 21 in order to send pressurized oil to actuate the movement of the return piston 18 and the consequent return of the presser means 4 to the inactive configuration. The thickness of the return chamber 27 is equal to the movement of the presser means 4 from the inactive configuration to the first active configuration during pressing.

[0042] The second circuit 21 comprises a second duct 28, which is formed in the base body 3 and has a first end connected to the return chamber 27 by means of suitable orifices formed in the portion 22a and not shown in detail, and a second end which is open and faces at a second side wall 3c of the base body 3 that lies opposite the first side wall 3b.

[0043] The figures illustrate a shoe assembly 2 which is provided with a single return piston 18 arranged in a central position; however, the shoe assembly 2 might also provide a plurality of return pistons 18 that cooperate with corresponding plungers 20, whose return chambers 27 are connected to each other and to the second circuit 21.

[0044] Preferably, the adjustment means 24 are of the fluid-operated type, but they might also be constituted by one or more elastic compression members that are suitably preloaded and interposed between the plunger 20 and the second shoulder 26.

[0045] The adjustment means 24 have a third circuit with a fluid medium for sending a third pressurized incompressible fluid, such as hydraulic oil, into a control chamber 29, which is hermetic and has a variable volume and is formed between the plunger 20, the seat 17, the return piston 18 and the second shoulder 26. When, during pressing, the reaction applied by the pressurized oil to the suspension cylinders 5 is greater than the resultant of the pressure applied by the pressurized oil in the control chamber 29 on the plunger 20, the control chamber tends to empty at least partially and the plunger 20 performs a translational motion along the seat 17 toward the second shoulder 26, optionally reaching the second position.

[0046] The thickness variation of the control chamber 29 is equal (correlated) to the movement of the presser means 4 from the first active configuration to the second active configuration during pressing.

[0047] This solution allows the presser means 4 to perform an additional stroke portion in case of overpressures within the pressing chambers 8, so as to ensure correct pressing and avoid damage to the half-die 1.

[0048] The stroke allowed to the suspension pistons 9 is therefore at least equal to the sum of the thicknesses of the return chamber 27 and of the control chamber 29.

[0049] The third circuit 24 comprises a third duct 30 that is formed in the base body 3 and has a first end which is connected to the control chamber 29 by means of suitable orifices formed in the portion 22b, which are not shown in detail, and a second open end that faces the second side wall 3c. The third duct 30 is arranged so as to be parallel to the second duct 28 and above it, with reference to the figures.

[0050] The return piston 18 is constituted by a head 18a, which is accommodated within the seat 17, and by a stem 18b, which protrudes from it through the plate 10 and is associated with the presser means 4.

[0051] The abutment surface 19 is thus formed by the face of the head 18a that connects to the stem 18b.

[0052] The plunger 20 is annular and is fitted so that it can slide hermetically along the stem 18b proximate to the head 18a.

[0053] In the embodiment shown, the presser means 4 have a magnetic footing that rests on the suspension cylinders 5 in order to fix, on the opposite side of the base body 3, elements designed to make contact with the loose material to be pressed, but alternative embodiments are not excluded. In this case, the stem 18b extends into a screw 31 for rigid connection of the footing to the return piston 18.

[0054] However, alternative embodiments are not excluded in which, for example, the presser means are constituted by a conventional shoe, optionally of the isostatic type.

[0055] There is further a conventional rotation-preventing device 32 for fastening the screw 31.

[0056] It is noted that in an alternative embodiment, not shown, the at least one return piston 18 can be integrated in at least one of the suspension pistons 9; in this case, the plunger would replace the fixed abutment for stopping the sliding of the suspension piston 9.

[0057] Particularly if the half-die 1 is designed to be used in the lower position in the press, means for adjusting the relative distance between the base body 3 and the presser means 4 in the inactive configuration are provided.

[0058] In this manner it is possible to act so as to perform retroactive correction of the thickness of the corresponding cell during loading and therefore of the thickness of loose material that is loaded.

[0059] These adjustment means comprise at least one double-acting positioning piston 33, which is inserted so that it can move in a corresponding hermetic receptacle that is associated with one between the base body 3 and

the presser means 4 and cooperates with the other one between the base body and the presser means to actuate their approach/spacing.

[0060] Between such receptacle and the positioning piston 33 there is a first chamber 34, which is connected to a fourth circuit 35 for sending a fourth pressurized fluid, such as hydraulic oil, to actuate the approach of the presser means 4 to the base body 3, and a second chamber 36, which is connected to a fifth circuit 37 for sending a fifth pressurized fluid, such as hydraulic oil, so as to actuate the spacing of the presser means 4 from the base body 3.

[0061] Preferably, the positioning piston 33 is inserted so that it can slide in a corresponding receptacle that is associated with the base body 3 and cooperates with the presser means 4 so as to actuate their movement.

[0062] Each shoe assembly 2 can have a plurality of positioning pistons 33, whose respective first chambers 34 are connected to each other and to the fourth circuit 35 and whose respective second chambers 36 are connected to each other and to the fifth circuit 37.

[0063] In order to automate the operation of the half-die 1, the adjustment means can have a management and control unit which is functionally associated with means for detecting the relative distance between the base body 3 and the presser means 4 and with valve means for controlling the fourth and fifth circuits, respectively 35 and 37, for the actuation of the translational motion of the positioning piston 33 during loading. Such unit is constituted by conventional electronic devices, preferably provided with means for interfacing with the user for entering the datum related to the desired distance value. The valve means can be constituted by conventional electric valves, not shown in detail.

[0064] Such sensing means can provide at least one conventional linear position transducer 38, which is interposed between the base body 3 and the presser means 4.

[0065] Advantageously, in the illustrated embodiment, the return piston 18 and the positioning piston 33 are formed integrally and therefore the first chamber 34 and the fourth circuit 35 coincide respectively with the return chamber 27 and with the second circuit 21.

[0066] The fifth circuit 37 instead has a fifth duct 39, which is formed in the base body 3 and has a first end which is connected to the second chamber 36 formed between the return piston 18 and positioning piston 33 and the bottom of the portion 22a and a second end which is open and faces the second side wall 3c.

[0067] The portion 22a has a through hole at the region that connects the fifth duct 39 to the hole 23, in order to allow the passage of pressurized oil from and toward the second chamber 36.

[0068] The fifth duct 39 is parallel and coplanar with respect to the second and third ducts, respectively 9 and 28.

[0069] The half-die 1 advantageously can have a plurality of shoe assemblies 2, in which at least the corresponding first circuits 6 are mutually connected. The number of shoe assemblies 2 provided varies according to the number of "outputs", i.e., of manufactured articles that are pressed simultaneously, within the die for which the half-die 1 is intended.

[0070] In this case, during pressing the thickness variation of the pressing chambers 8 is compensated by the movements of the presser means 4, depending on the loading conditions of the corresponding cells. Likewise, in case of overpressure the variation in the thickness of one or more control chambers 29 can be distributed in the movement of the various presser means 4 if the corresponding third circuits 24 are connected.

[0071] The first circuits 6 are connected to such pressurized oil accumulation device so as to obtain a uniform pressure in the various pressing chambers 8 during pressing.

[0072] The second and third circuits, respectively 21 and 24, of the various shoe assemblies 2 can be kept isolated so as to allow their independent operation.

[0073] If the adjustment means are provided, the second circuit and the fifth circuit, respectively 21≡35 and 37, of the various shoe assemblies 2 are preferably mutually isolated so as to allow different arrangements of the corresponding presser means 4 in the inactive configuration during loading.

[0074] The circuits 6, 21≡35, 24 and 37 are provided with elements, not shown in detail, for connection at the first and second side walls 3b and 3c.

[0075] Figure 10 illustrates a half-die 1 provided with three shoe assemblies 2. In the embodiment shown, the second and fifth circuits, respectively 21≡35 and 37, of the various shoe assemblies 2 also are mutually connected, independent positioning during loading not being provided.

[0076] Conveniently, the half-die 1 has a structure for supporting the shoe assemblies 2, which is associated with at least one duct 42a-42d for the interconnection of at least the first circuits 6 of each shoe assembly 2.

[0077] The structure can have a plate, not shown in Figure 10, on which the faces 3d of the base body 3 that lie opposite the corresponding faces 3a rest, such plate being fixed to the base bodies by means of screws 31.

[0078] In the embodiment shown, the structure comprises a pair of longitudinal crossmembers 40a, 40b, adapted to be fixed to the side walls 3b and 3c, in which there are ducts 42a-42d for the connection of the various circuits. With particular reference to Figure 10, the crossmember 40a is fixed to the side wall 3b and is provided with a duct 42a for the connection of the first circuits 6 of the three shoe assemblies 2 to each other and to the accumulation device, while the crossmember 40b is fixed to the side wall 3c and is provided with three ducts 42b, 42c, 42d for connection respectively of the second circuit 21≡35, of the third circuit 24 and of the fifth circuit 37 to the corresponding supply/discharge devices.

[0079] The operation of the device according to the present invention is as follows.

[0080] In the inactive configuration, the first circuit 6 is connected to the discharge and the presser means 4 are kept close to the base body 3 by means of the return and positioning piston 18≡33, the second circuit 21 being connected to the delivery. The plunger 20 is in the first position, since the third circuit 24 is connected to the delivery.

[0081] If one wishes to correct, on one or more of the shoe assemblies 2, the distance between the corresponding base body 3 and the presser means 4, one acts on the adjustment means so as to actuate the translational motion of the corresponding return and positioning piston 18≡33, by acting on the fifth circuit 37.

[0082] During pressing, the half-die 1 is arranged in the first active configuration: the second circuit 21 is connected to the discharge and pressurized oil is introduced in the pressing chambers 8. The presser means 4 move away from the base body 3 by way of the thrust applied by the suspension cylinders 5 until the return and positioning piston 18≡33 abuts against the plunger 20 again in the first position, with the third circuit 24 still connected to the delivery.

[0083] If overpressures occur in the pressing chambers 8 during pressing, due for example to substantial unevenness in loading the cells, the half-die 1 moves from the first active configuration toward the second active configuration, in which the plunger 20 moves into the second position.

[0084] In practice it has been found that the described invention achieves the proposed aim and objects, and in particular the fact is stressed that the half-die according to the invention ensures that a uniform density of the articles obtained by pressing is achieved even in case of nonuniform loading of the cells.

[0085] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0086] All the details may further be replaced with other technically equivalent elements.

[0087] In practice, the materials used, as well as the contingent shapes and dimensions, may be any according to requirements without thereby abandoning the scope of the protection of the appended claims.

[0088] The disclosures in Italian Patent Application No. M02008A000250 from which this application claims priority are incorporated herein by reference.

[0089] 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. A half-die (1) for pressing loose material, particularly ceramic mixes, comprising at least one shoe assembly (2) provided with

- a substantially plate-like base body (3),
- presser means (4), which are adapted to act on the loose material to be pressed and are associated at one face (3a) of said base body (3) and can move between an inactive configuration, in which they are close to the base body (3), and at least one first active configuration, in which they are substantially spaced from said base body,
- at least one suspension cylinder (5) which uses a fluid medium and is interposed between said base body (3) and said presser means (4) and is associated with a first circuit (6) for feeding a first incompressible fluid for actuating the movement of the presser means (4) between said inactive configuration and said first active configuration,
- at least one seat (17) associated with said base body (3),
- at least one piston (18) for the return of said presser means (4) to the inactive configuration, which is accommodated slidingly in said seat (17) and is provided with at least one abutment surface (19) that is adapted to abut against corresponding stop means (20) associated with said seat (17) at said at least one active configuration and
- a second circuit (21) for sending a second incompressible fluid between said abutment surface (19) and said stop means (20) so as to actuate the return of said presser means (4) to the inactive configuration,

characterized in that said stop means (20) are accommodated so that they can move along said seat (17) between a first position, in which said presser means (4) can move between said inactive configuration and said first active configuration, and a second position, in which said presser means (4) move to a second active position, and comprises means (24) for adjusting the position of said stop means (20) along said seat (17).

2. The half-die (1) according to claim 1, **characterized in that** said stop means (20) comprise at least one plunger for the abutment of said abutment surface (19) at said first and second active configurations, said plunger being inserted so that it can slide hermetically between said return piston (18) and said seat (17) and being movable alternately between a first stroke limit shoulder (25) and a second stroke limit shoulder (26) which are associated with said seat (17), and **in that** said adjustment means (24) are adapted to act between said plunger (20) and said second shoulder (26) in order to keep said

plunger in said first position at said inactive configuration and at said active configuration.

3. The half-die (1) according to one or more of the preceding claims, **characterized in that** it comprises a hermetic return chamber (27), which is formed between said stop means (20), said seat (17) and said return piston (18), with a fluid connection to said second circuit (21) in order to send said second fluid to actuate the return of the presser means (4) in the inactive configuration, the thickness of said return chamber (27) being substantially equal to the movement of the presser means (4) from the inactive configuration to a first active configuration during pressing.

4. The half-die (1) according to one or more of the preceding claims, **characterized in that** said adjustment means (24) comprise a third circuit with a fluid medium for sending a third pressurized fluid into at least one hermetic control chamber (29) which has a variable volume and is formed between said plunger (20), said seat (17), said return piston (18) and said second shoulder (26), when, during pressing, the reaction of the suspension cylinder (5) is greater than the resultant of the pressure applied by the third fluid to the plunger (20), the control chamber (29) being adapted to empty itself at least partially and the plunger (20) being adapted to perform a translational motion along the seat (17) until it reaches the second position, the variation of the thickness of the control chamber (29) being equal to the movement of the presser means (4) from said first active configuration to said second active configuration during pressing.

5. The half-die (1) according to one or more of claims 1 to 3, **characterized in that** said adjustment means (24) comprise at least one elastic compression member which is interposed between said plunger and said second shoulder.

6. The half-die (1) according to one or more of the preceding claims, **characterized in that** said return piston (18) comprises a head (18a) which is accommodated within said seat (17) and a stem (18b) which is associated with said presser means (4), and **in that** said plunger (20) has a substantially annular shape and is fitted so that it can slide hermetically along said stem (18b) proximate to said head (18a).

7. The half-die (1) according to one or more of the preceding claims, **characterized in that** said suspension cylinder (5) comprises a receptacle (7) which is associated with said base body (3) and a suspension piston (9) which is accommodated so that it can move along said receptacle (7) for a stroke that is at least equal to the sum of the thicknesses of said return chamber (27) and of said control chamber (29), the first circuit (6) being connected to a pressing chamber (8) formed at the bottom of said receptacle (7).

8. The half-die (1) according to one or more of the preceding claims, **characterized in that** said presser means (4) comprise a magnetic footing which rests on said suspension cylinder (5) and is rigidly connected to the stem (18b) of said return piston (18).

9. The half-die (1) according to one or more of the preceding claims, **characterized in that** said suspension piston (9) and said return piston (18) are provided integrally.

10. The half-die (1) according to one or more of the preceding claims, **characterized in that** it comprises means for adjusting the relative distance between said presser means (4) and said base body (3) at said inactive configuration.

11. The half-die (1) according to one or more of the preceding claims,
characterized in that said adjustment means comprise at least one double-acting positioning piston (33), which is interposed between said base body (3) and said presser means (4) and is inserted so that it can move in a corresponding hermetic receptacle that is associated with either said base body (3) or said presser means (4) so as to form a first chamber (34) that is connected to a fourth circuit (35) to send a fourth pressurized fluid so that it actuates the approach of said presser means (4) to said base body (3) and a second chamber (36) that is connected to a fifth circuit (37) to send a fifth pressurized fluid to actuate the spacing of said presser means (4) from said base body (3).

12. The half-die (1) according to one or more of the preceding claims, **characterized in that** said adjustment means comprise a management and control unit, which is functionally associated with means (38) for detecting the relative distance between said base body (3) and said presser means (4) and with valve means for controlling said fourth and fifth circuits (35, 37) to actuate the translational motion of said positioning piston (33) during loading.

13. The half-die (1) according to one or more of the preceding claims, **characterized in that** said return piston (18) and said positioning piston (33) are formed integrally, the first chamber (34) and the fourth circuit (35) coinciding respectively with the return chamber (27) and with the second circuit (21).

14. The half-die (1) according to one or more of the preceding claims, **characterized in that** said shoe assembly (2) comprises a plurality of suspension cyl-

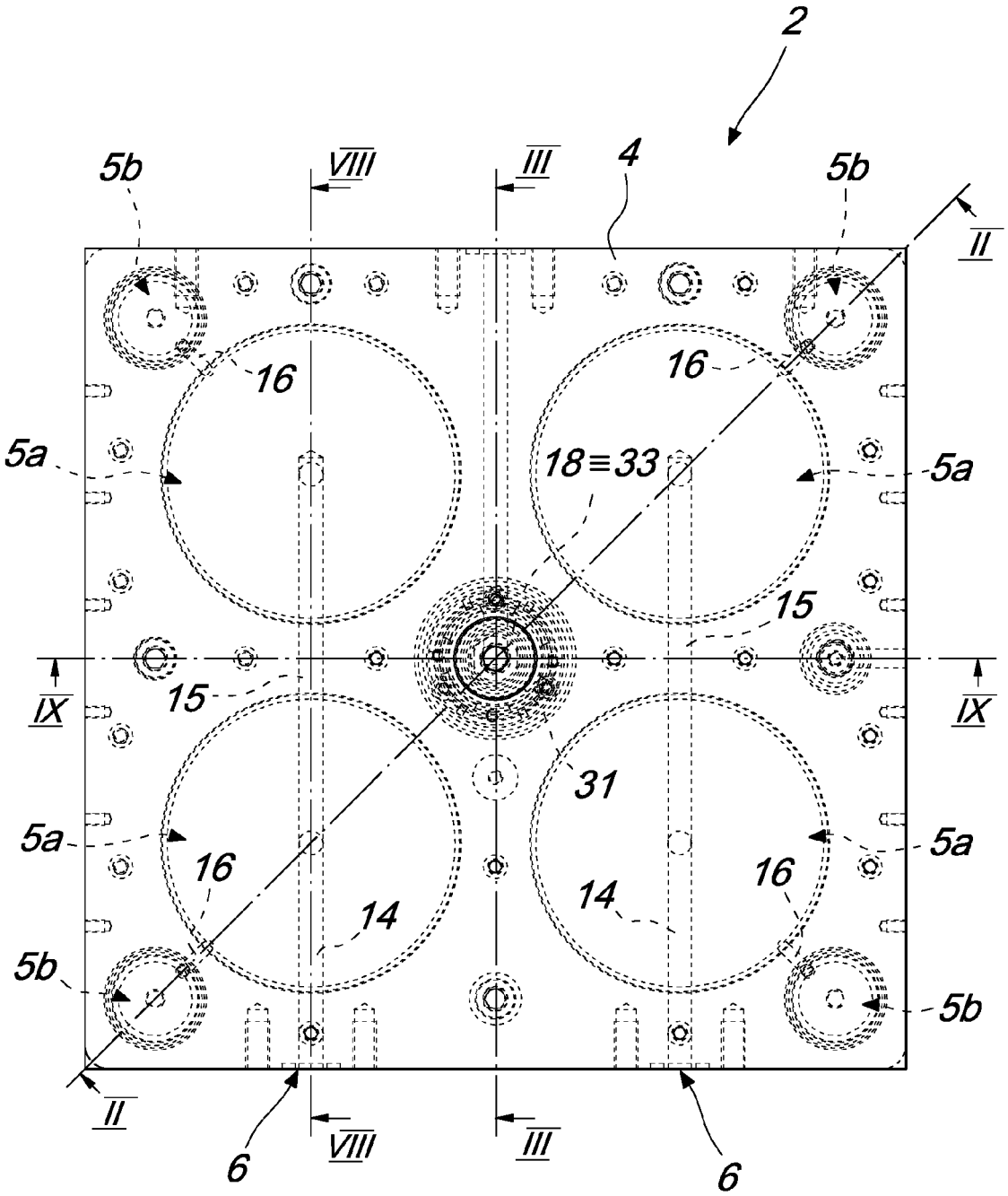
inders (5), whose corresponding pressing chambers (8) have a fluid connection to each other and to said first circuit (6).

15. The half-die (1) according to one or more of the preceding claims, **characterized in that** said shoe assembly (2) comprises a plurality of said return pistons (18), which cooperate with corresponding stop means (20), the return chambers (27) of which have a fluid connection to each other and to the second circuit (21) and whose control chambers (29) have a fluid connection to each other and to the third circuit (24).

16. The half-die (1) according to one or more of the preceding claims, **characterized in that** it comprises a plurality of said shoe assemblies (2), in which at least the corresponding first circuits (6) have a mutual fluid connection.

17. The half-die (1) according to claims 13 and 16, **characterized in that** at least the second circuit (21≡36) and the fifth circuit (37) of said shoe assemblies (2) are mutually independent so as to allow different arrangements of the respective presser means (4) in the inactive configuration.

18. The half-die (1) according to one or more of the preceding claims, **characterized in that** it comprises a structure for supporting said shoe assemblies (2), which is associated with at least one duct (42a-42d) for the interconnection of at least said first circuits (6) of each shoe assembly (2).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5b
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6
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6

Fig. 1

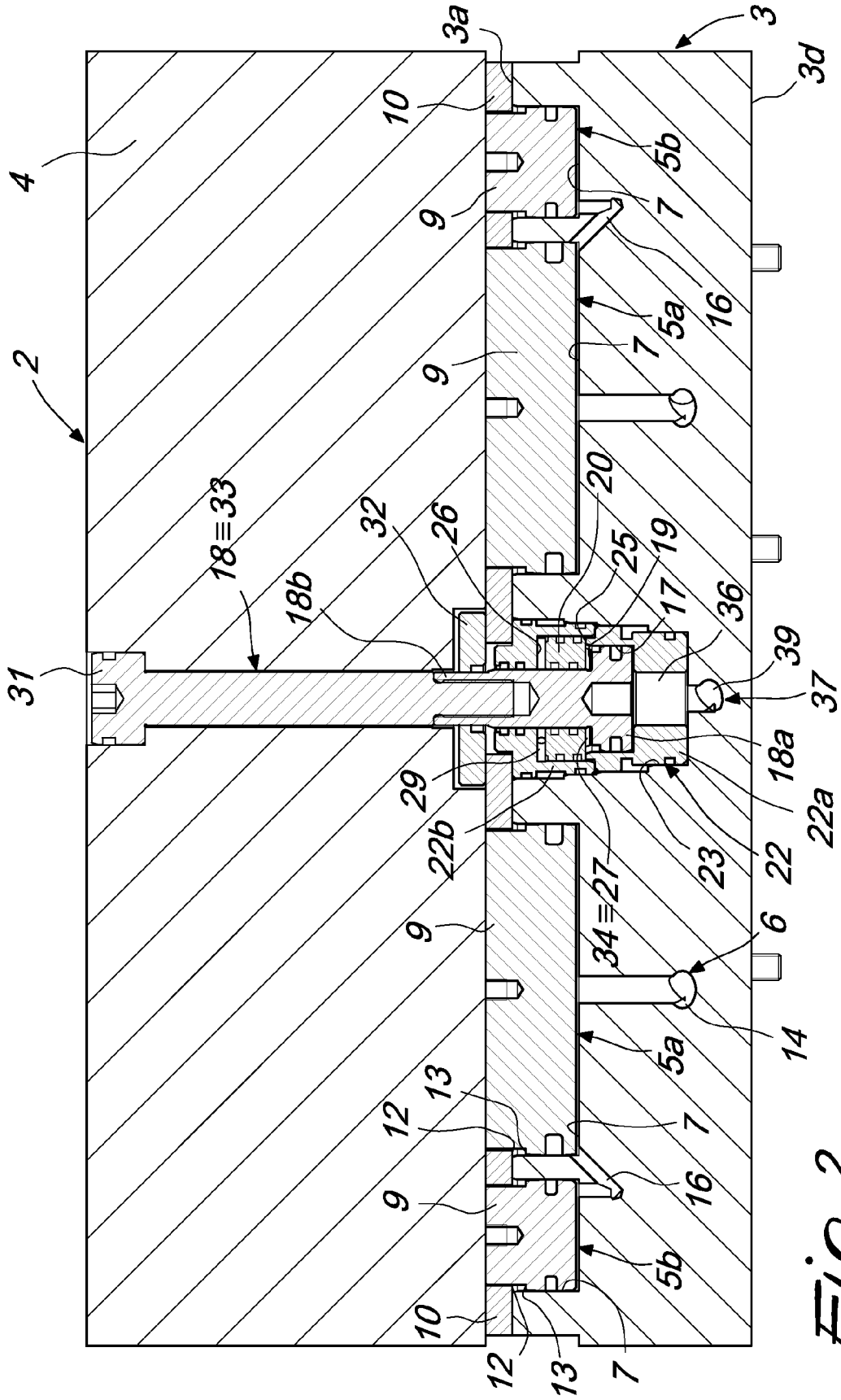
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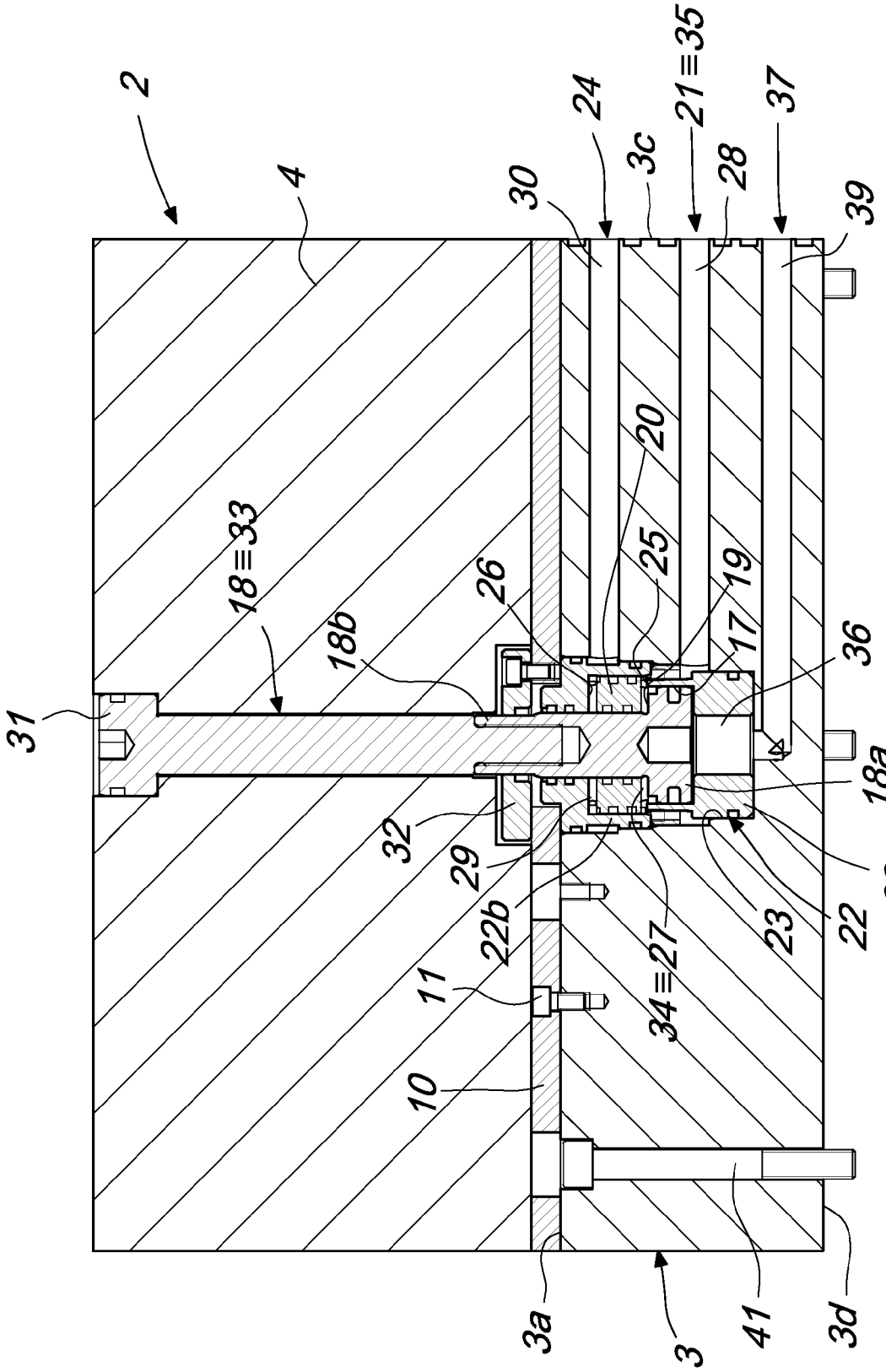
Fig. 2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22b
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3a
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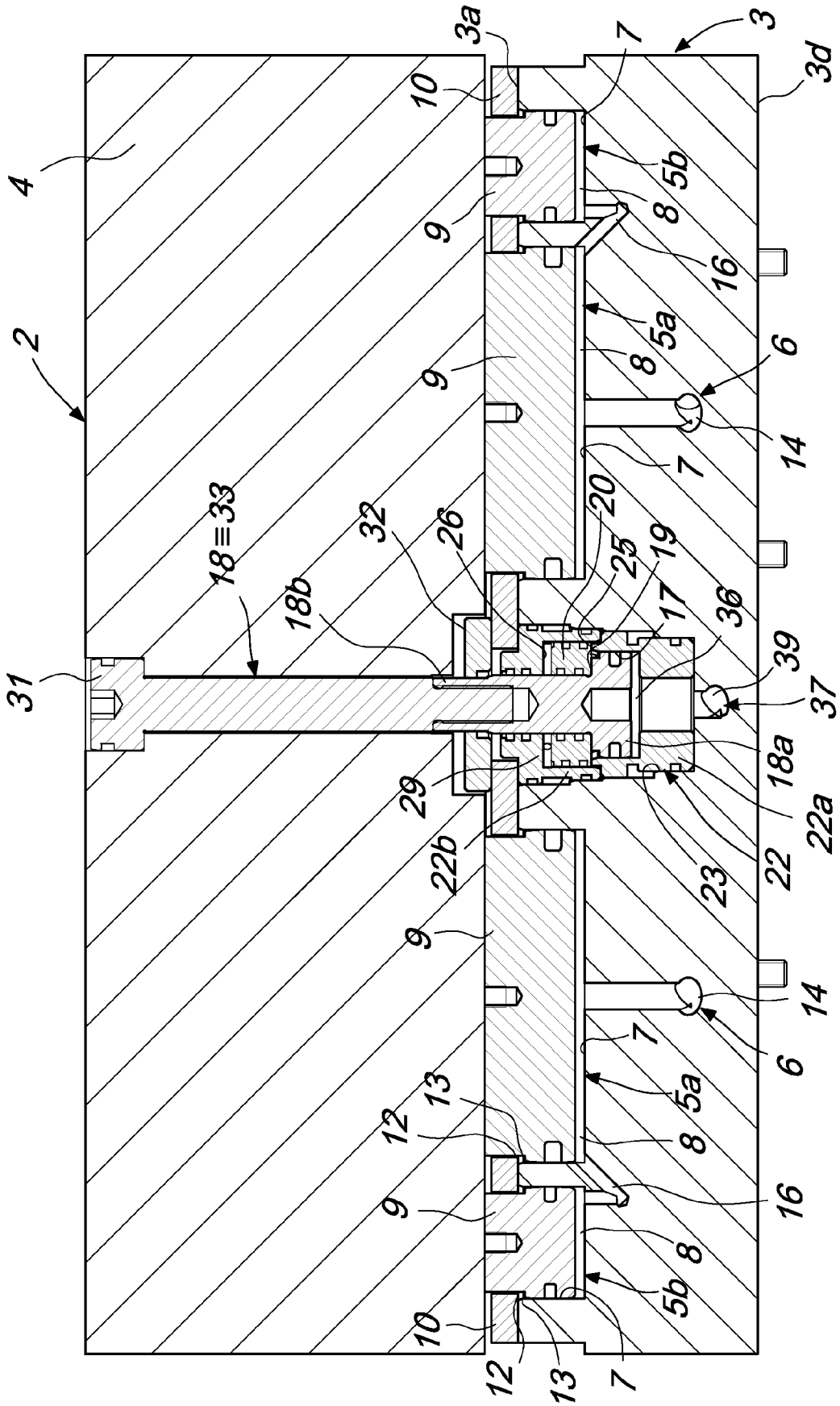
3d

Fig. 3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5b
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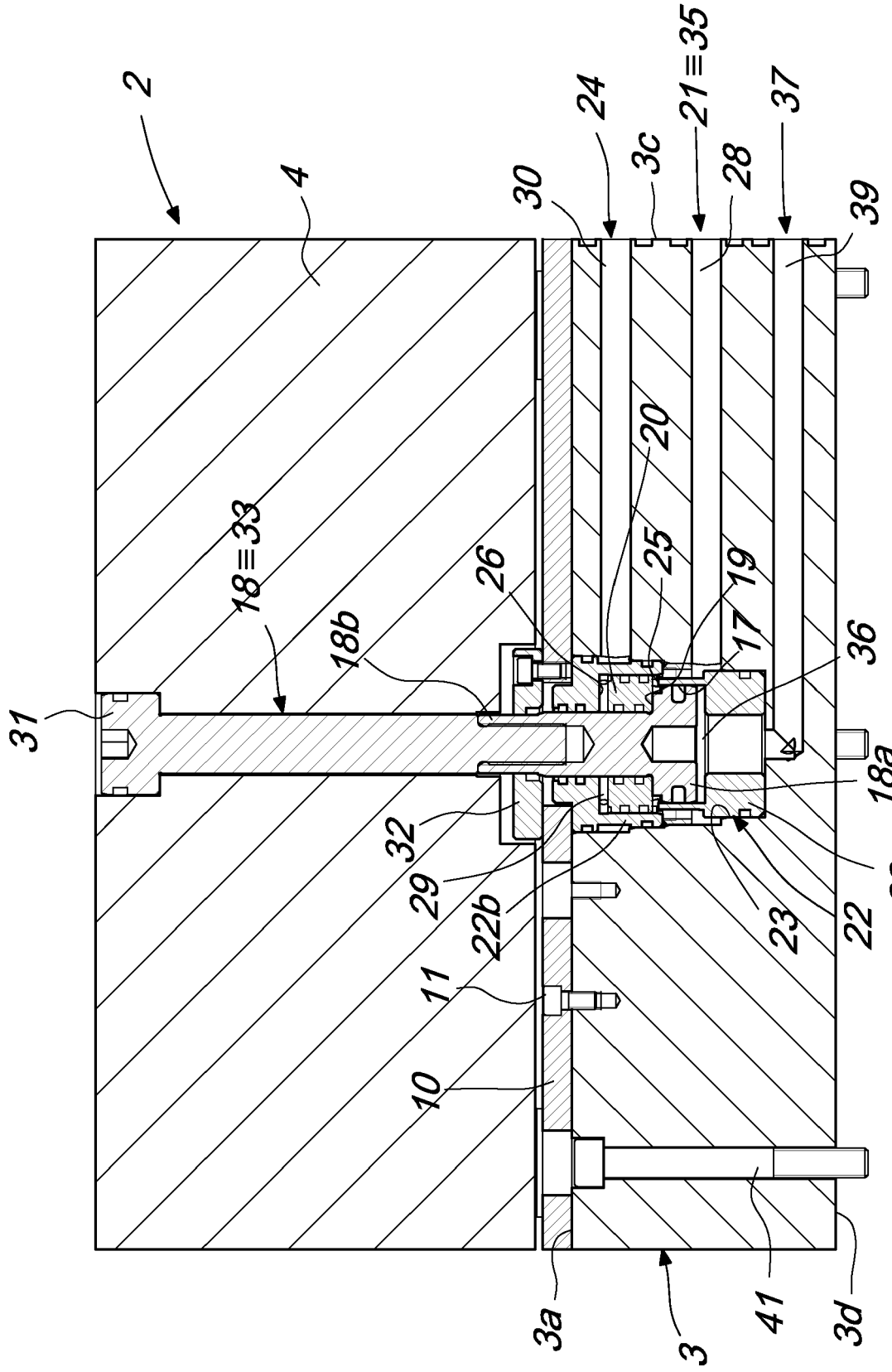
Fig. 4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3d

Fig. 5

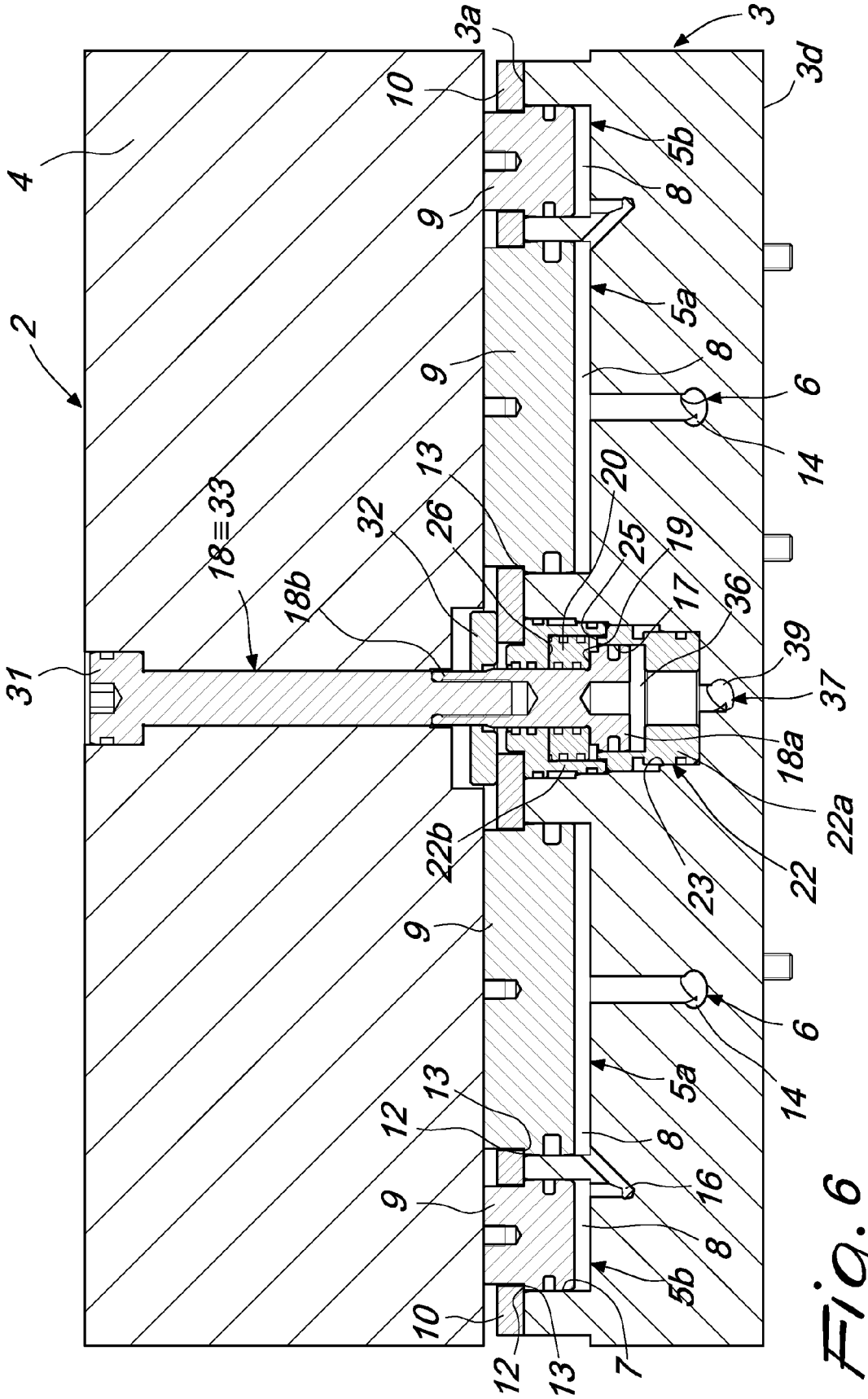
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Fig. 6

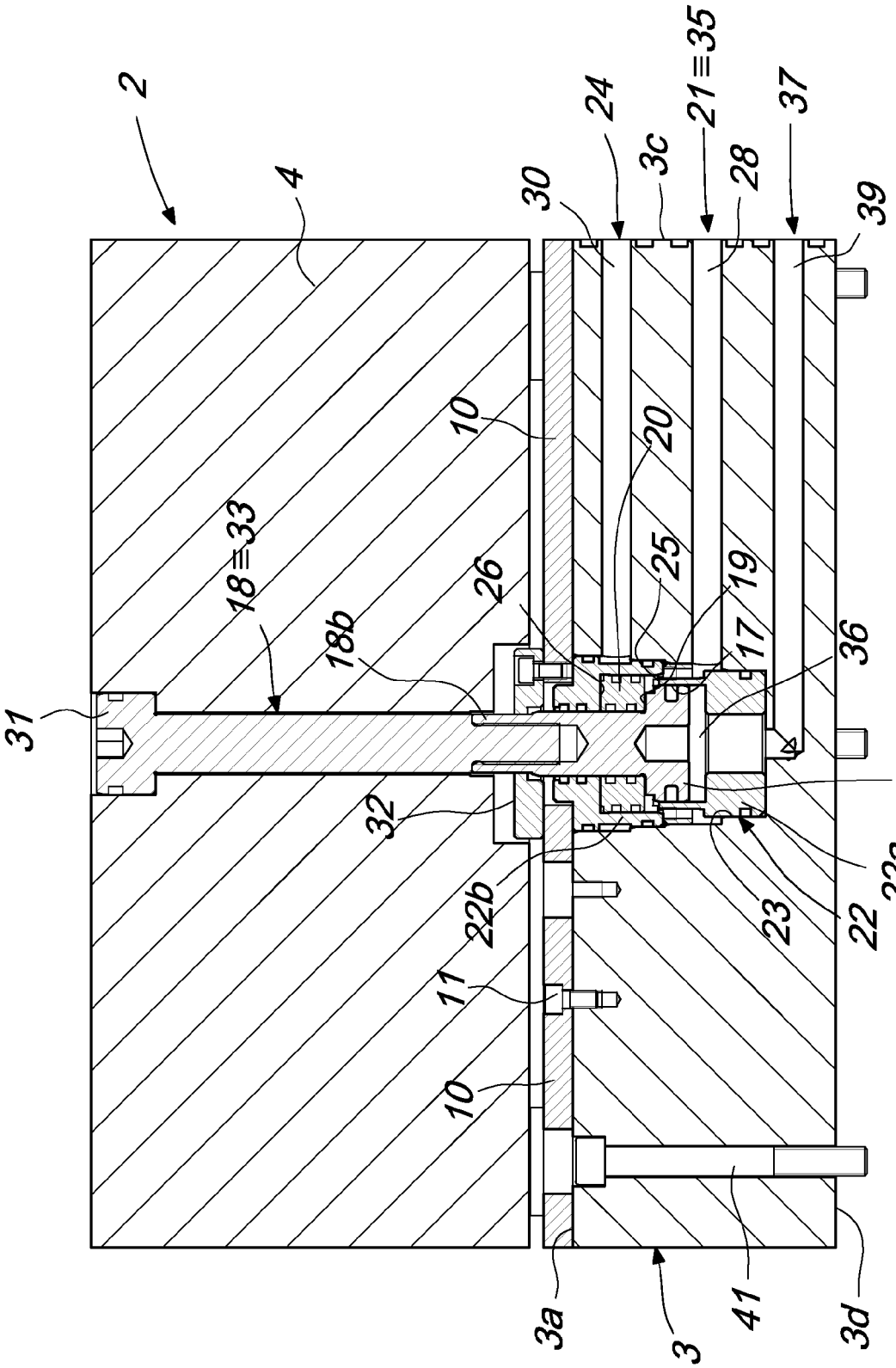
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Fig. 7

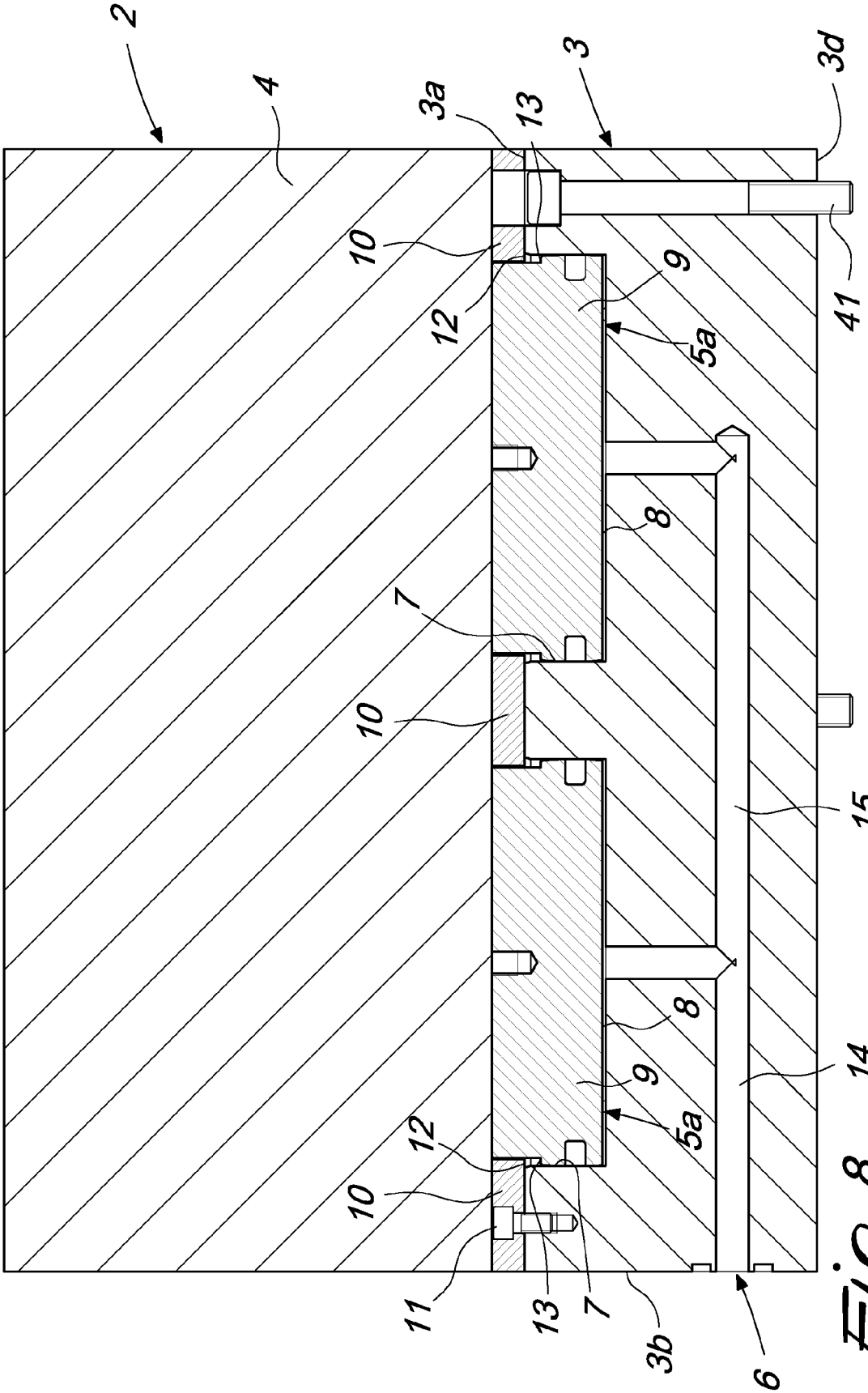

Fig. 8

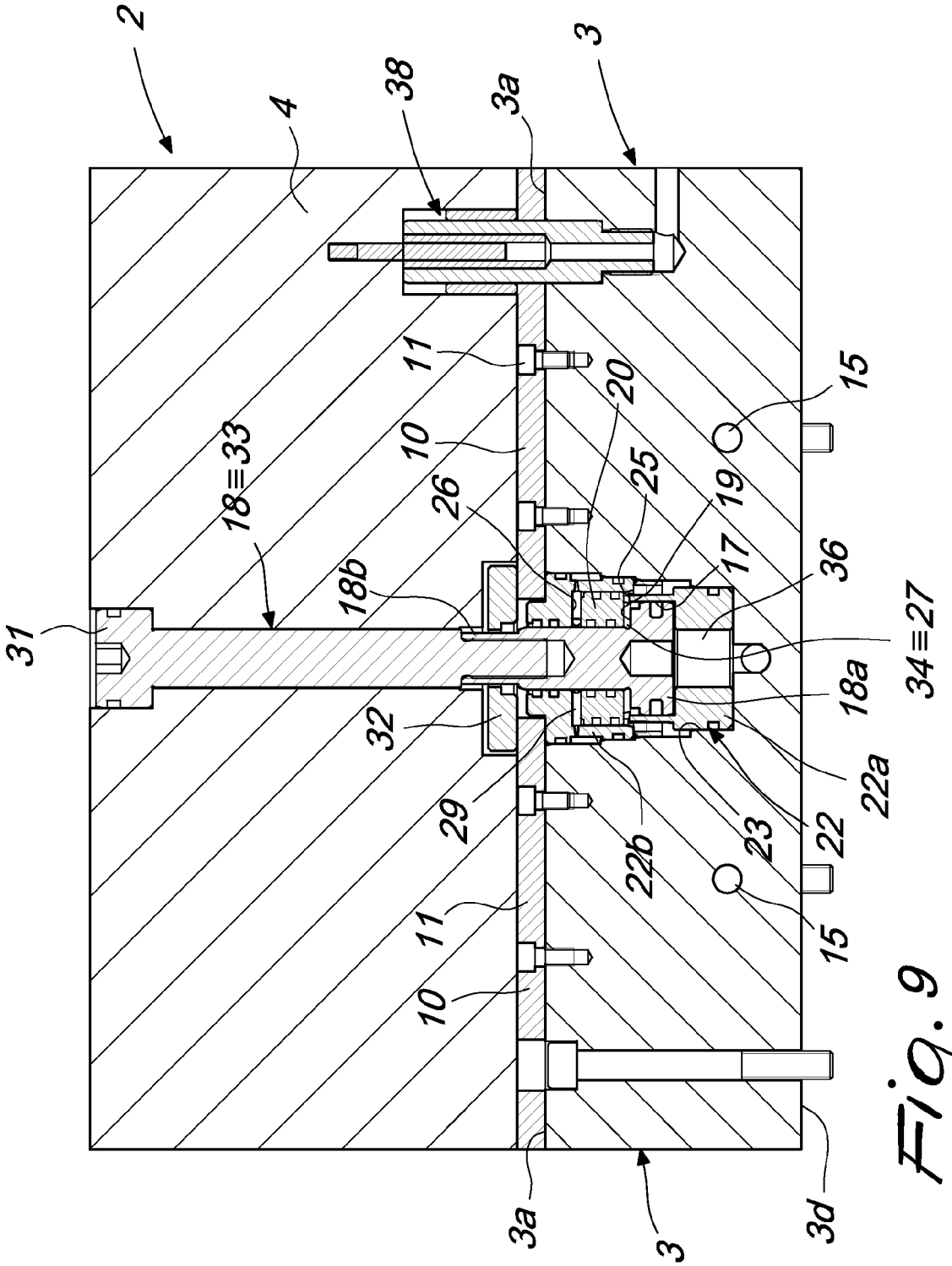
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Fig. 9

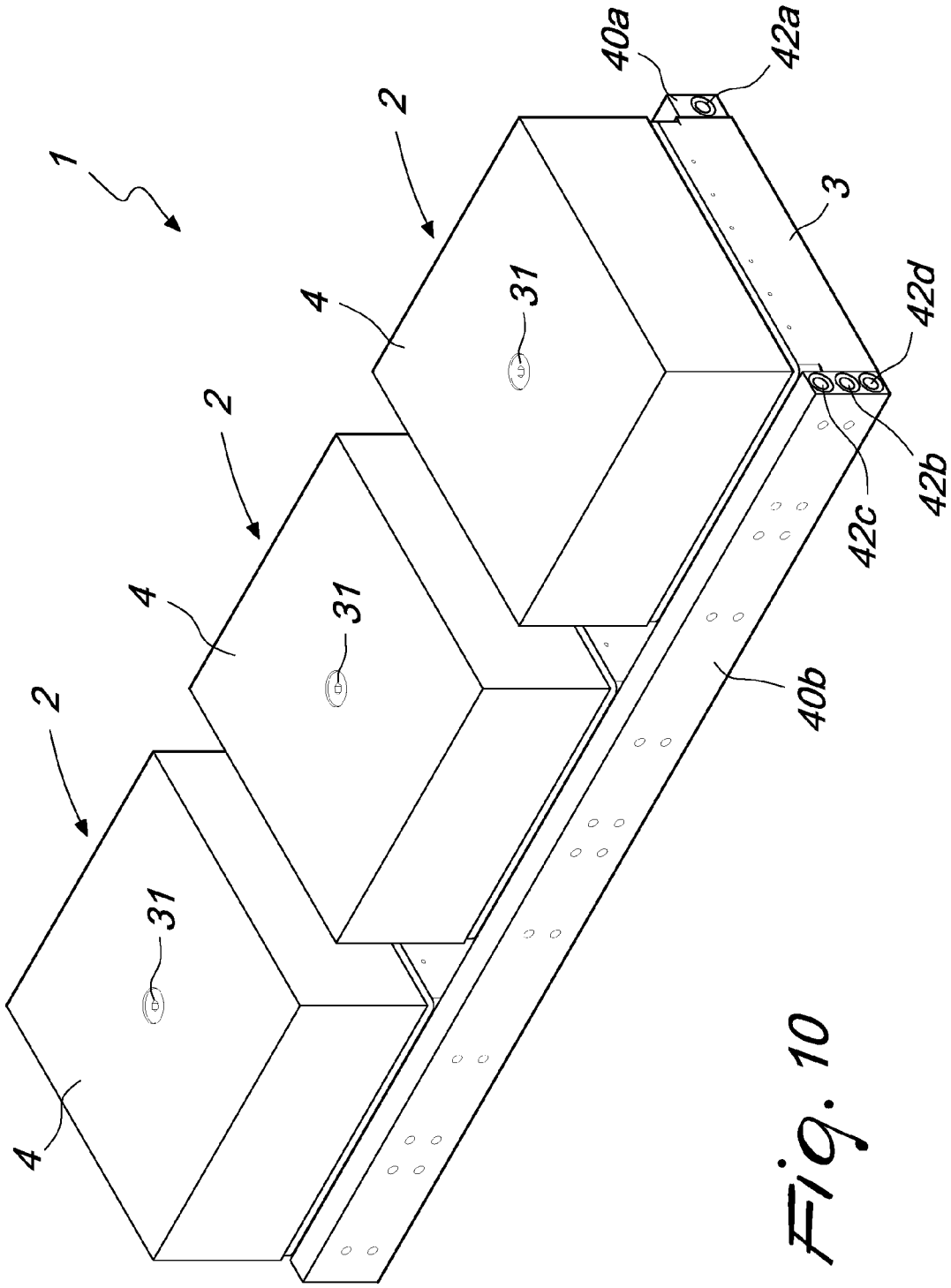

Fig. 10

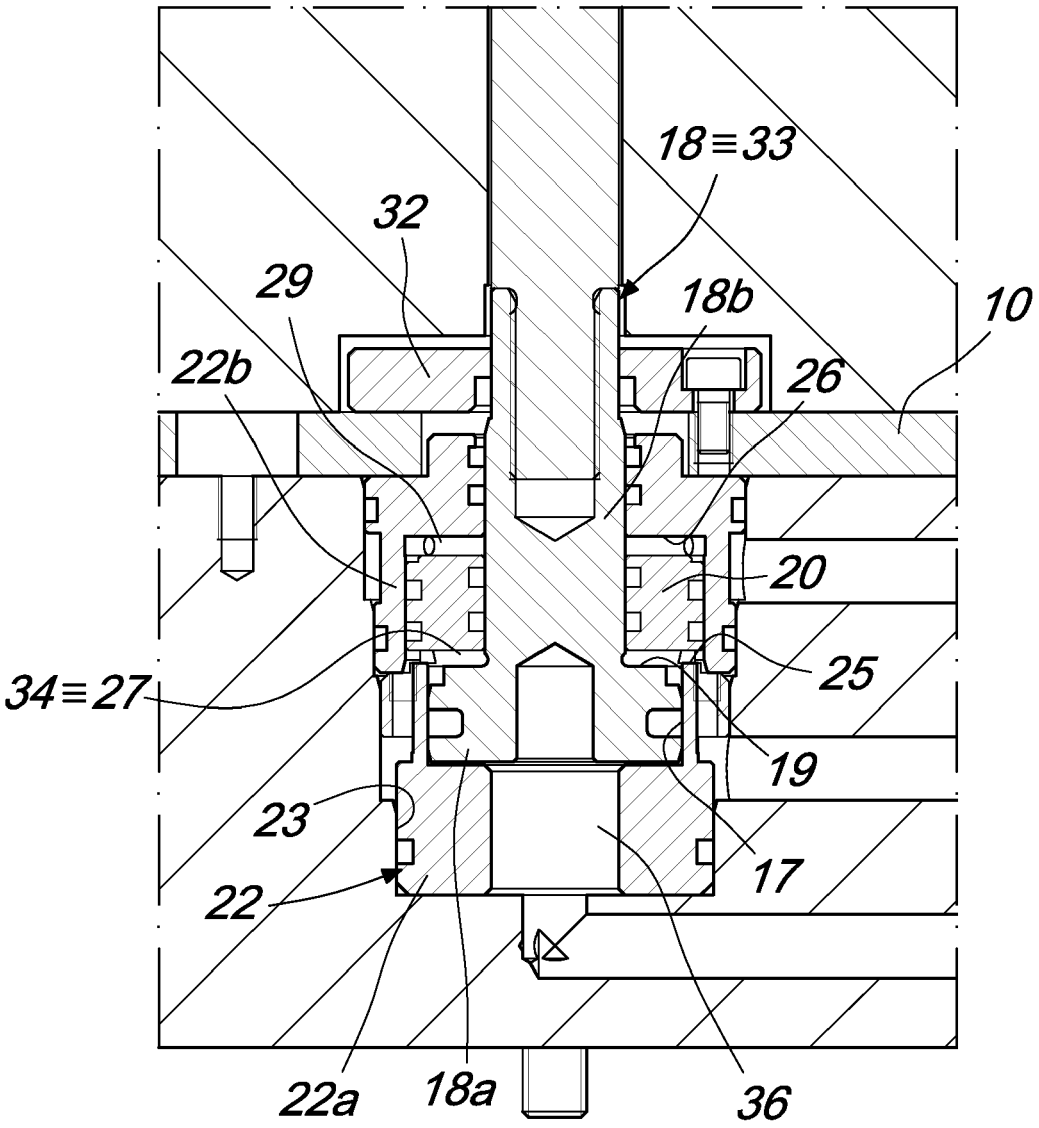

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 09 17 1324

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	US 2002/030298 A1 (CASSANI GIUSEPPE [IT]) 14 March 2002 (2002-03-14) * claims 1-3; figures 1-6 *	1	INV. B28B3/00
A	EP 0 894 588 A (SACMI [IT]) 3 February 1999 (1999-02-03) * claim 1; figures 1-6 *	1	
A	GB 1 284 714 A (MAXWELL DAVIDSON LTD [GB]) 9 August 1972 (1972-08-09) * claims 1-3; figure 1 *	1	
A	EP 0 780 202 A (F D S S R L [IT] F D S S R L) 25 June 1997 (1997-06-25) * claims 1,2; figures 5,6 *	1	

TECHNICAL FIELDS SEARCHED (IPC)
B28B
B29C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	27 January 2010	Boone, John

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27-01-2010

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002030298 A1	14-03-2002	NONE	
EP 0894588 A	03-02-1999	BR 9803357 A	16-11-1999
		DE 69811789 D1	10-04-2003
		DE 69811789 T2	02-10-2003
		ES 2189082 T3	01-07-2003
		IT RE970059 A1	01-02-1999
		PT 894588 E	31-07-2003
		US 6030576 A	29-02-2000
GB 1284714 A	09-08-1972	NONE	
EP 0780202 A	25-06-1997	DE 69603568 D1	09-09-1999
		ES 2136966 T3	01-12-1999
		IT 1279893 B1	18-12-1997
		US 5786003 A	28-07-1998

EPO FORM P0459

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Patent documents cited in the description

- EP 1403017 B1 **[0006]**
- EP 1403016 A **[0009]**
- IT M02008000250 A **[0088]**