

(19)



(11)

EP 3 769 949 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

27.01.2021 Bulletin 2021/04

(51) Int Cl.:

B30B 7/04 (2006.01)**B30B 15/16** (2006.01)**F15B 11/02** (2006.01)**F15B 11/036** (2006.01)**B21J 9/02** (2006.01)**B30B 11/00** (2006.01)**B21J 9/12** (2006.01)(21) Application number: **20184762.1**(22) Date of filing: **08.07.2020**

(84) Designated Contracting States:

AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

Designated Extension States:

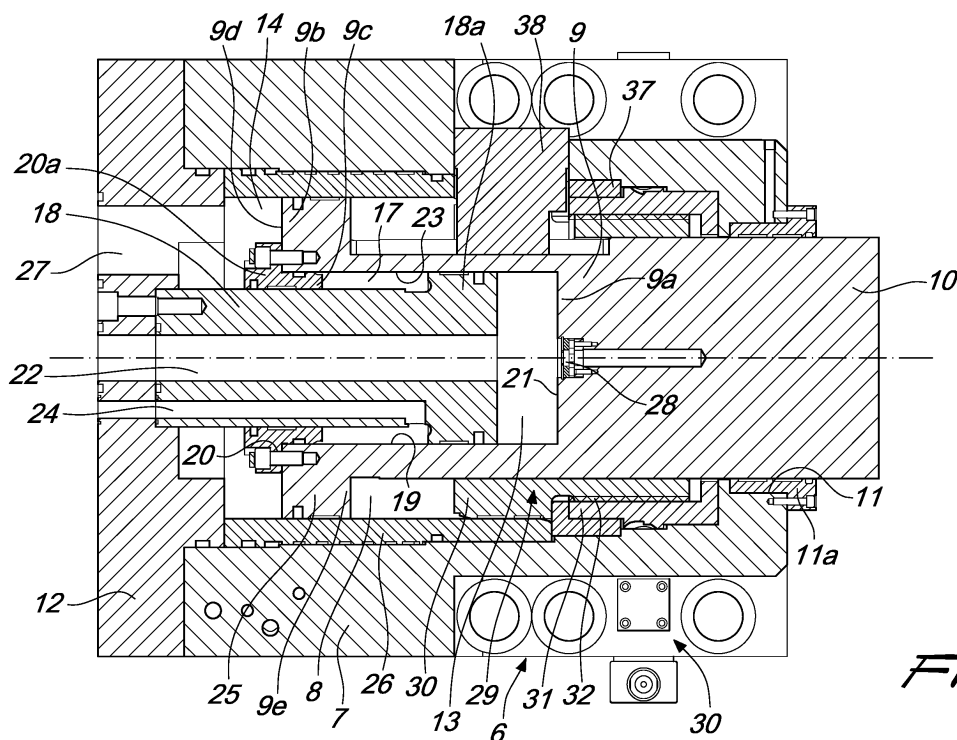
BA ME

Designated Validation States:

KH MA MD TN(71) Applicant: **Mecolpress S.p.A.****25020 Flero (BS) (IT)**(72) Inventor: **CAGGIOLI, Domenico****25100 BRESCIA (IT)**(74) Representative: **Modiano, Micaela Nadia et al****Modiano & Partners****Via Meravigli, 16****20123 Milano (IT)**(30) Priority: **26.07.2019 IT 201900012969**(54) **APPARATUS FOR MOULDING MATERIALS**

(57) An apparatus for moulding materials, comprising a base frame (2) which supports a pair of half moulds (3a, 3b) and at least one plunger (4), which can be introduced between the half moulds (3a, 3b). The plunger (4) can be actuated translationally, with respect to the half moulds (3a, 3b), by virtue of actuation means (5), which comprise at least one actuation cylinder (6) provided with a lateral jacket (7), which forms axially an internal cavity (8) within which a piston (9) which is integral with a stem (10) connected to the plunger (4) can move slidingly be-

tween a retracted position and an advanced position; at least two separate actuation chambers (13, 14) are formed between the piston (9) and a fixed head (12) of the actuation cylinder (6) and are connected to means (15) for supplying a working fluid. Means (16) for the control of the supply means (15) are provided and are adapted to activate the supply means (15) in order to supply in sequence with the pressurised working fluid the two actuation chambers (13, 14).

*Fig. 6*

Description

[0001] The present invention relates to an apparatus for molding materials.

[0002] Apparatuses for molding materials are known which are generally constituted by presses which comprise, on a supporting frame, a fixed lower base, on which a lower half mold is arranged, and an upper movable hammer, which has an upper half mold associated therewith and is connected to actuation means for its movement toward or away from the lower base in order to provide the molding of a portion of material interposed between the two half molds.

[0003] In order to provide particular shapes of the molded parts, in some apparatuses there are movable plungers which are introduced in the half molds so as to be able to penetrate into the material to be molded.

[0004] The movement of the plungers is provided, according to the background art, by means of hydraulic cylinders, each of which acts directly on a respective plunger.

[0005] This solution, while allowing the possibility to vary in an independent manner the stroke and the times of penetration of each individual plunger, requires a high-power hydraulic system for supplying the cylinders, due to the high force and movement speed required of the plungers.

[0006] In order to try and overcome these drawbacks, a press has been proposed, described in EP2210686 in the name of this same Applicant, which has means for actuating the plungers which are constituted, for each plunger, by a toggle joint lever system, acting as a force multiplier, comprising two mutually hinged levers which act between the respective plunger and a fixed point, and a hydraulic cylinder which acts in the hinge point between the two levers of the toggle joint lever system.

[0007] This solution allows, by virtue of the use of the toggle joint lever system, to multiply progressively the force applied to the plunger, reducing at the same time, in a proportional manner, the movement speed applied to said plunger, with consequent reduction of the required power levels.

[0008] In order to allow the adjustment of the stroke of the plunger, the toggle joint lever system requires, however, the presence of a second piston inside the hydraulic cylinder, the position of which can be varied by means of an electrohydraulic system, which is external to the hydraulic cylinder and is relatively complex and bulky.

[0009] The aim of the present invention is to provide an apparatus for molding materials that is capable of improving the background art in one or more of the aspects mentioned above.

[0010] Within this aim, an object of the invention is to provide an apparatus for molding materials that does not require, in the hydraulic system for supplying the means for actuating the plungers, large accumulators working at high pressures.

[0011] Another object of the invention is to provide an

apparatus for molding materials that allows in a simple and effective manner to vary the advancement and final force of the plungers.

[0012] Another object of the invention is to devise an apparatus for molding materials that allows to provide the adjustment of the stroke of the plunger, with a very simple and extremely compact system.

[0013] A further object of the present invention is to overcome the drawbacks of the background art in a manner that is alternative to any existing solutions.

[0014] Another object of the invention is to provide an apparatus for molding materials that is highly reliable and is relatively easy to provide and at competitive costs.

[0015] This aim and these and other objects which will become better apparent hereinafter are achieved by an apparatus for molding materials according to claim 1, optionally provided with one or more of the characteristics of the dependent claims.

[0016] Further characteristics and advantages of the invention will become better apparent from the description of a preferred but not exclusive embodiment of the apparatus for molding materials according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a perspective view of the apparatus according to the invention;

Figure 2 is a front elevation view of the apparatus according to the invention;

Figure 3 is a sectional view, taken along the plane II-II;

Figure 4 is a lateral elevation view of the apparatus according to the invention;

Figures 5 to 7 are longitudinal sectional views of a sequence of operating steps of an actuation cylinder of the apparatus according to the invention;

Figure 8 is a transverse sectional view of the actuation cylinder, taken along the plane VIII-VIII of Figure 5;

Figures 9 to 11 are longitudinal sectional views of a sequence of operating steps of an actuation cylinder of the apparatus according to the invention, in a possible constructive variation.

[0017] With reference to the figures, the apparatus for molding materials according to the invention, generally designated with the reference numeral 1, comprises a base frame 2 which supports a pair of half molds 3a and 3b, which can move with respect to each other and between which the material to be molded can be interposed.

[0018] The apparatus according to the invention is furthermore provided with at least one plunger 4, which can be introduced between the half molds 3a and 3b and can be actuated translationally, with respect to the half molds 3a, 3b, by virtue of actuation means 5.

[0019] In particular, the actuation means 5 comprise at least one actuation cylinder 6, which is provided with a lateral jacket 7, which forms axially an internal cavity

8, within which a piston 9 can move slidably and is integral with a stem 10 connected to the plunger 4.

[0020] The lateral jacket 7 has, at one of its ends, an opening 11, crossed by the stem 10 and, at its opposite end, a fixed head 12 for the closure of the internal cavity 8.

[0021] Conveniently, a guiding ring 11a for the stem 10 can be mounted on the lateral jacket 7 at the opening 11.

[0022] The piston 9 is, in particular, movable on command, along the internal cavity 8, between a retracted position, shown for example in Figure 5, in which the piston 9 is moved closer to the fixed head 12, and an advanced position, shown for example in Figure 7, in which the piston 9 is moved away from the fixed head 12.

[0023] According to the invention, in the internal cavity 8 of the actuation cylinder 6 there are, between the piston 9 and the fixed head 12, at least two separate actuation chambers of the piston 9, respectively a first actuation chamber 13, which is formed between a first portion 9a of the piston 9 and at least one portion of the fixed head 12, and a second actuation chamber 14, which is separated hermetically from the first actuation chamber 13 and is formed between a second portion 9b of the piston 9, which is different from the first portion 9a, and at least one portion of the fixed head 12.

[0024] The first actuation chamber 13 and the second actuation chamber 14 are connected to means 15 for supplying a working fluid, which comprise, conveniently, a fluid-operated circuit which may be of the open circuit type or of the closed circuit type.

[0025] Also according to the invention, there are means 16 for the control of the supply means 15 which are designed to activate the supply means 15 in order to supply in sequence with the pressurized working fluid the first actuation chamber 13, in order to produce a movement of the piston 9, for at least one first part of its stroke from the retracted position to the advanced position, with the generation of a first value of the force applied to the plunger 4, and the second actuation chamber 14, in order to produce a movement of the piston 9, for at least one second part of its stroke from the retracted position to the advanced position, with the generation of a second value, which is greater than the above mentioned first value, of the force applied to the plunger 4.

[0026] In greater detail, said first part of the stroke of the piston 9 is extended preferably between the retracted position and an intermediate position of the stroke, interposed between the retracted position and the advanced position, while said second part of the stroke of the piston 9 is extended between the intermediate position and the advanced position.

[0027] Conveniently, a third actuation chamber 17 is formed in the internal cavity 8, between a third portion 9c of the piston 9, directed toward the opening 11 of the lateral jacket 7, and at least one portion of the fixed head 12 or at least one portion that is integral therewith and with the lateral jacket 7.

[0028] In particular, the control means 16 are designed

to activate the supply means 15 in order to supply with the pressurized working fluid the third actuation chamber 17, in order to produce a movement of the piston 9 from the advanced position toward the retracted position.

[0029] Advantageously, the surface of the third portion 9c of the piston 9 on which the working fluid acts in the third actuation chamber 17 can have a smaller extension than the one of the first and second portions 9a and 9b of the piston 9 on which the working fluid acts respectively in the first and second actuation chambers 13 and 14, so that the piston 9 can perform a low force return step from the advanced position to the retracted position, i.e., with the generation of a value of the force applied by the piston 9 that is lower than the values of the force applied by the piston in the movement steps of the piston 9 from the retracted position to the advanced position, thus avoiding the risk of any breakage of the components mounted on the piston 9.

[0030] Conveniently, the first portion 9a of the piston 9 is formed in a central region of said piston, with respect to its axis, while the second portion 9b of the piston 9 is formed in a peripheral region of the piston 9, again with respect to its own axis.

[0031] Advantageously, according to the illustrated embodiment, a fixed piston 18 is fixed integrally to the fixed head 12, has an elongated extension and is extended axially, in the internal cavity 8, from the fixed head 12 toward the opening 11 of the lateral jacket 7.

[0032] As shown in Figures 5-7, a longitudinal recess 19 is axially formed in the piston 9, accommodates the fixed piston 18 and in particular has, at one of its ends arranged substantially at a face 9d of the piston 9 that is directed toward the fixed head 12, an inlet 20 crossed by the fixed piston 18.

[0033] More particularly, in the embodiment of Figures 5-7, the first actuation chamber 13 is formed between the end of the fixed piston 18 that is opposite to the one fixed to the fixed head 12 and a bottom wall 21 of the longitudinal recess 19 that is located at the end of the longitudinal recess that is opposite to the one in which the inlet 20 is formed and which, in practice, forms the first portion of the piston 9.

[0034] Conveniently, the fixed piston 18 is crossed longitudinally by at least one first channel 22 which connects the supply means 15 to the first actuation chamber 13.

[0035] In the embodiment shown in Figures 5-7, the third actuation chamber 17 is provided by an annular interspace 23 formed between at least one portion of the outer lateral surface of the fixed piston 18 and at least one portion of the internal lateral surface of the longitudinal recess 19.

[0036] Again with reference to the embodiment of Figures 5-7, the fixed piston 18 is crossed longitudinally by at least one second channel 24 which communicates with the annular interspace 23 and with the supply means 15.

[0037] In greater detail, in the embodiment of Figures 5-7, the fixed piston 18 conveniently has, at its end that is opposite with respect to the end that is fixed to the fixed

head 12, a wider head 18a, which engages hermetically the internal lateral surface of the longitudinal recess 19, with the possibility of the piston 9 to slide with respect to the fixed piston 18.

[0038] Advantageously, in the embodiment of Figures 5-7, a guiding bush 20a is fixed to the piston 9 at the inlet 20 of the longitudinal recess 19 and engages hermetically the outer lateral surface of the fixed piston 18, with the possibility of the piston 9 to slide with respect to the fixed piston 18.

[0039] With this structure, the annular interspace 23 that provides the third actuation chamber 17 is delimited axially between a region of the wider head 18a of the fixed piston that is directed oppositely with respect to the opening 11 and a region of the guiding bush 20a that is directed toward the opening 11 which, in practice, forms the above mentioned third portion 9c of the piston 9.

[0040] It should be noted that in the embodiment shown in Figures 5-7 the second portion 9b of the piston 9 comprises a region of the face 9d of the piston 9 that is located around the inlet 20 of the longitudinal recess 19.

[0041] Conveniently, again in the embodiment shown in Figures 5-7, the second portion 9b of the piston is formed at a radial head expansion 25 of the piston 9, which has larger diametrical dimensions than the remaining part of the piston 9, which is arranged at the end of the piston 9 that is directed toward the fixed head 12 and engages hermetically the side wall of the internal cavity 8, on which a cooling jacket 26 can be advantageously arranged.

[0042] Conveniently, at least one third channel 27, which connects the supply means 15 to the second actuation chamber 14, is formed in the fixed head 12.

[0043] Advantageously, the piston 9 axially accommodates, substantially at the bottom wall 21 of the longitudinal recess 19, a transducer 28 of the stroke of the piston 9.

[0044] It should be noted that inside the lateral jacket 7 there can be at least one abutment element 29 which can be engaged by the piston 9 and can be moved adjustably by virtue of means for movement 30 along the axis of the lateral jacket 7 in order to vary the extension of the stroke of the piston 9 between the retracted position and the advanced position.

[0045] In particular, the abutment element 29 comprises, conveniently, a sleeve-like stroke limiter body 29a, which is movable along the axis of the lateral jacket 7 and is arranged coaxially to the lateral jacket 7 between the opening 11 and an abutment portion 9e of the piston 9, which is arranged, advantageously, in the case of the embodiment of Figures 5-7, on the side of the radial head expansion 25 of the piston 9 that is directed toward the opening 11.

[0046] As shown in Figure 8, the movement means 30 comprise, advantageously, a movement ring 31, which is mounted so that it can rotate with respect to the lateral jacket 7 and is arranged around the stroke limiter body 29a, inside the lateral jacket 7. The movement ring 31 is

provided internally with a thread 32, which engages a corresponding complementary thread formed on the stroke limiter body 29a, and an external set of teeth 33 which engages a worm screw 34, which is extended substantially at right angles to the axis of the movement ring 31 and can be actuated rotationally by a motor 35 controlled by means of an encoder 36.

[0047] The movement ring 31 is axially locked by means of an abutment ring 37.

[0048] It should be noted that conveniently the rotation of the piston 9 about its own axis is prevented by at least one rotation-preventing element 38, constituted, for example, by a tab which acts on the piston 9.

[0049] Advantageously, the rotation-preventing element 38 allows moreover to provide the rotational locking of the abutment element 29.

[0050] It should be noted that the apparatus according to the invention may be provided with multiple plungers 4, each of which is functionally connected to a respective actuation cylinder 6.

[0051] The operation of the apparatus, according to the invention, is as follows.

[0052] The material to be molded is interposed between the half molds 3a and 3b and then the approach of the two half molds 3a and 3b is actuated.

[0053] One or more plungers 4 are then inserted into the half molds 3a and 3b by means of the activation of the respective actuation cylinders 6.

[0054] The activation of each actuation cylinder 6 is managed by the control means 16 of the supply means 15 according to the following steps.

[0055] Starting from the situation of Figure 5, in which the piston 9 is in a retracted position, in a first step that corresponds to a step of high speed advancement and with low force of the piston 9, the control means 16 actuate the activation of the supply means 15 in order to send, via the first channel 22, pressurized working fluid into the first actuation chamber 13, so as to cause the movement of the piston 9 in the direction of the advanced position for the first part of its stroke, i.e., until it reaches the intermediate position, which can be set by the user by means of a control panel. In this step, the working fluid present in the third actuation chamber 17 returns, through the second channel 24, to the supply means 15 and working fluid at low pressure is introduced in the second actuation chamber 14 via the third channel 27.

[0056] When the piston 9 reaches the intermediate position along its stroke, a second step or step of high force advancement of the piston 9 starts in which, while the piston 9 travels along a second part of its stroke toward the advanced position, the control means 16 actuate the supply means 15 to send, via the third channel 27, the pressurized working fluid into the second actuation chamber 14 so as to obtain the generation of a greater working force by the piston 9.

[0057] The stroke of the piston 9 ends when the piston 9 comes into contact with the abutment element 29, previously positioned by virtue of its movement means 30,

thus allowing to adjust in a precise manner the extension of the stroke of the piston 9.

[0058] In the third step or low force return step, the control means 16 actuate the supply means 15 to send the pressurized working fluid into the third actuation chamber 17, so as to obtain the movement of the piston 9 from the advanced position to the retracted position, with return of the working fluid present in the first and second actuation chambers 13 and 14 into the supply means 15 via the first and third channels 22 and 27.

[0059] Since the portion of the surface of the piston 9 on which the working fluid acts in the third actuation chamber 17 has a much smaller extension than the portions of the piston 9 on which the working fluid acts in the first and second chambers 13, 14, the return step of the piston 9 to the retracted position occurs with low force, and this allows to avoid breakage of the plunger 4 connected to the piston 9.

[0060] In order to adjust the stroke of the piston 9 between the retracted position and the advanced position it is possible to act, by virtue of the worm screw 34, on the movement ring 31, which allows to move the stroke limiter body 29a, so as to vary the position in which the piston 9 comes into contact with the stroke limiter body 29a.

[0061] In practice it has been found that the invention achieves the intended aim and objects.

[0062] In particular, it is stressed that the invention allows the elimination of accumulators of large size operating at high pressures, by virtue of the possibility to use a closed circuit without an oil tank to provide the means for supplying the actuation cylinder of the plungers.

[0063] Another achieved advantage of the invention is constituted by the possibility to vary in a simple and effective manner the advancement and final force without having to adjust valves and/or preload accumulators.

[0064] Another advantage of the invention is to allow an adjustment of the exit level of the piston that actuates the plunger, by virtue of means incorporated in the lateral jacket of the actuation cylinder.

[0065] The invention, thus conceived, is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0066] Thus, for example, Figures 9-11 show a possible constructive variation of the actuation cylinder 6, in which components and elements similar to those of the embodiment of Figures 5-7 have been designated by the same reference numeral for the sake of simplicity.

[0067] In this embodiment, the piston 9 has an axial extension 40 that extends from the piston 9 in the direction of the fixed head 12 and in which the longitudinal recess 19 that accommodates the fixed piston 18 is formed, said piston in this case being crossed longitudinally by a receptacle 41 for a rod, not shown for the sake of simplicity, that is designed to interact with the transducer 28 of the stroke of the piston 9 arranged at the bottom wall 21 of the longitudinal recess 19.

[0068] In particular, in the embodiment of Figures 9-11,

the first actuation chamber 13 is formed between the fixed head 12 and the free end of the axial extension 40 of the piston 9 and, more particularly, between the fixed head 12 and a collar 42 which is fixed around a portion of the axial extension 40 proximate to its free end and forms, with its portion directed toward the fixed head 12, the first portion 9a of the piston 9.

[0069] Conveniently, the collar 42 engages slidingly and hermetically the inner side wall of a sleeve-like body 43, which is accommodated, integrally with the fixed head 12 and the lateral jacket 7, in an axial part of the internal cavity 8 of the lateral jacket 7 of the actuation cylinder 6.

[0070] More particularly, the sleeve-like body 43 in turn axially accommodates with play in its internal axial cavity 43a the axial extension 40 and, inside it there is, in practice, the first actuation chamber 13, which in this case communicates with the supply means 15 via a duct 44 that passes through the fixed head 12.

[0071] Again with reference to the embodiment of Figures 9-11, the second actuation chamber 14 is formed externally to the axial extension 40 of the piston 9 and more particularly is defined conveniently in a portion of space substantially comprised radially between the external lateral surface of the axial extension 40 of the piston 9 and the internal surface of the lateral jacket 7 and axially between a peripheral portion of the piston 9 that extends around the axial extension 40 and forms the second portion 9b of the piston 9 and the end of the sleeve-like body 43 directed toward the opening 11 of the lateral jacket 7.

[0072] In this case, the second actuation chamber 14 communicates with the supply means 15 via the third channel 27 formed in the fixed head 12 and a connecting duct 45, which is extended longitudinally in the sleeve-like body 43 and is arranged laterally with respect to the internal axial cavity 43a of said sleeve-like body.

[0073] It should be noted that a tubular extension 43b of the sleeve-like body 43 extends axially from the end of the sleeve-like body 43 directed toward the opening 11 of the lateral jacket 7, at the external edge of the sleeve-like body 43, and is engaged slidingly and hermetically, on its internal lateral surface, by the piston 9 and is in contact, with its external lateral surface, with the internal surface of the lateral jacket 7.

[0074] Conveniently, the cooling jacket 26 is, in this case, formed between the lateral jacket 7 and the external lateral surface of the sleeve-like body 43 and of its tubular extension 43b.

[0075] In the embodiment of Figures 9-11, the third actuation chamber 17 can be conveniently defined in a region of the internal axial cavity 43a of the sleeve-like body 43 that is separated hermetically with respect to the first actuation chamber 13 by the collar 42.

[0076] More particularly, in this case, the third actuation chamber 17 is formed in a portion of space 47, located inside the internal axial cavity 43a of the sleeve-like body 43, that is comprised radially between the internal lateral wall of the internal axial cavity 43a of the

sleeve-like body 43 and the external lateral surface of the axial extension 40 of the piston 9 and, axially, between a portion of the collar 42 directed toward the opening 11, which defines in practice the third portion 9c of the piston 9, and an annular wall 46, which is extended radially from the internal lateral wall of the internal axial cavity 43a of the sleeve-like body 43 and engages slid-
 5 ingly hermetically the external lateral surface of the axial extension 40 of the piston 9. Said portion of space 47 communicates with the supply means 15, for example, by means of a radial duct 48 which crosses the lateral jacket 7 and the sleeve-like body 43.

[0077] Again with reference to Figures 9-11, the third actuation chamber 17 may also optionally be formed in a portion of space of the internal cavity 8 of the lateral jacket 7 that is comprised axially between the opening 11 and the piston 9.

[0078] More particularly, in this case, the third actuation chamber 17 may be formed between the abutment element 29 and the abutment portion 9e of the piston 9, which therefore also defines the third portion 9c of said piston, and can be arranged in communication with the supply means 15 by virtue of a radial channel 49, which is formed in the lateral jacket 7 and communicates with an aperture 50 formed in the axial extension 43b of the sleeve-like body 43.

[0079] It should be noted that in the embodiment of Figures 9-11, the first actuation chamber 13 might also be in communication with the inside of the longitudinal recess 19 that accommodates the fixed piston 18 via a passage 51 left open between a portion of the internal lateral surface of the longitudinal recess 19 and the external lateral surface of the fixed piston 18 and, more particularly, between the rotation-preventing element 38, in this case inserted in the longitudinal cavity 19 and fixed to the axial extension 40 of the piston 9, and the external lateral surface of the fixed piston 18.

[0080] All the details may furthermore be replaced with other technically equivalent elements.

[0081] In practice, the materials used, so long as they are compatible with the specific use, as well as the contingent shapes and dimensions, may be any according to the requirements and the state of the art.

[0082] The disclosures in Italian Patent Application No. 102019000012969 from which this application claims priority are incorporated herein by reference.

[0083] 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. An apparatus for molding materials, comprising a

base frame (2) which supports a pair of half molds (3a, 3b), which can move with respect to each other and between which the material to be molded can be interposed, and at least one plunger (4), which can be introduced between said half molds (3a, 3b) and can be actuated translationally, with respect to said half molds (3a, 3b), by virtue of actuation means (5), said actuation means (5) comprising at least one actuation cylinder (6) which is provided with a lateral jacket (7), which forms axially an internal cavity (8) within which a piston (9) can move slid-
 10 ingly which is integral with a stem (10) connected to said at least one plunger (4), said lateral jacket (7) having, at one of its ends, an opening (11), crossed by said stem (10), and, at its opposite end, a fixed head (12) for the closure of said internal cavity (8), said piston (9) being movable on command, along said internal cavity (8), between a retracted position, in which said piston (9) is moved closer to said fixed head (12), and an advanced position, in which it is moved away from said fixed head (12), **characterized in that** in said internal cavity (8) there are, between said piston (9) and said fixed head (12), at least two separate actuation chambers (13, 14) of said piston (9), respectively a first actuation chamber (13), which is formed between a first portion (9a) of said piston (9) and at least one portion of said fixed head (12), and a second actuation chamber (14), which is separated hermetically from said first actuation chamber (13) and is formed between a second portion (9b) of said piston (9), which is different from said first portion (9a), and at least one portion of said fixed head (12), said first and second actuation chambers (13, 14) being connected to means (15) for supplying a working fluid, means (16) for the control of said supply means (15) being provided and being adapted to activate said supply means (15) in order to supply in sequence with said pressurized working fluid said first actuation chamber (13), in order to produce a movement of said piston (9), for at least one first part of its stroke from said retracted position to said advanced position, with the generation of a first value of the force applied to said at least one plunger (4), and said second actuation chamber (14), in order to produce a movement of said piston (9), for at least one second part of its stroke from said retracted position to said advanced position, with the generation of a second value, which is greater than said first value, of the force applied to said at least one plunger (4).

2. The apparatus according to claim 1, **characterized in that** in said internal cavity (8), between a third portion (9c) of said piston (9), directed toward said opening (11), and at least one portion that is integral with said fixed head (12), there is a third actuation chamber (17), said control means (16) being adapted to activate said supply means (15) in order to

supply with said pressurized working fluid said third actuation chamber (17), in order to produce a movement of said piston (9) from said advanced position toward said retracted position.

3. The apparatus according to one or more of the preceding claims, **characterized in that** said first part of the stroke of said piston (9) is extended between said retracted position and an intermediate position, which is interposed between said retracted position and said advanced position, said second part of the stroke of said piston (9) being extended between said intermediate position and said advanced position.
4. The apparatus according to one or more of the preceding claims, **characterized in that** said first portion (9a) of said piston (9) is formed in a central region of said piston (9), with respect to its axis, said second portion (9b) of said piston (9) being formed in a peripheral region of said piston (9) with respect to its own axis.
5. The apparatus according to one or more of the preceding claims, **characterized in that** a fixed piston (18) is fixed to said fixed head (12), has an elongated extension and extends axially, in said internal cavity (8), from said fixed head (12) toward said opening (11), a longitudinal recess (19) for accommodating said fixed piston (18) being formed axially in said piston (9).
6. The apparatus according to one or more of the preceding claims, **characterized in that** said longitudinal recess (19) has, at one of its ends arranged substantially at a face (9d) of said piston (9) that is directed toward said fixed head (12), an inlet (20) crossed by said fixed piston (18), said first actuation chamber (13) being formed between the end of said fixed piston (18) that is opposite to the one fixed to said fixed head (12) and a bottom wall (21) of said longitudinal recess (19) that is located at the end of said longitudinal recess (19) that is opposite to the one in which said inlet (20) is formed and forms said first portion (9a) of said piston (9), said fixed piston (18) being crossed longitudinally by at least one first channel (22) which connects said supply means (15) to said first actuation chamber (13).
7. The apparatus according to one or more of the preceding claims, **characterized in that** said piston (9) has an axial extension (40) in the direction of said fixed head (12), said first actuation chamber (13) being formed between a free end of said axial extension (40) and said fixed head (12).
8. The apparatus according to one or more of the preceding claims, **characterized in that** said third ac-

tuation chamber (17) comprises an annular interspace (23) formed between at least one portion of the outer lateral surface of said fixed piston (18) and at least one portion of the internal lateral surface of said longitudinal recess (19), said fixed piston (18) being crossed longitudinally by at least one second channel (24) which communicates with said annular interspace (23) and with said supply means (15).

9. The apparatus according to one or more of the preceding claims, **characterized in that** said third actuation chamber (17) is formed in a region of the internal axial cavity (43a) of a sleeve-like body (43), which is accommodated in said internal cavity (8) and axially accommodates with play said axial extension (40).
10. The apparatus according to one or more of the preceding claims, **characterized in that** said fixed piston (18) has, at its end that is opposite with respect to the end that is fixed to said fixed head (12), a wider head (18a), which engages hermetically the internal lateral surface of said longitudinal recess (19), with the possibility to slide said piston (9) with respect to said fixed piston (18), a guiding bush (20a) being fixed to said piston (9) at said inlet (20) and engaging hermetically the outer lateral surface of said fixed piston (18), with the possibility of said piston (9) to slide with respect to said fixed piston (18), said annular interspace (23) being delimited axially between a region of said wider head (18a) that is directed oppositely with respect to said opening (11) and a region of said guiding bush (20a) that is directed toward said opening (11) which forms said third portion (9c) of said piston (9).
11. The apparatus according to one or more of the preceding claims, **characterized in that** said second portion (9b) of said piston (9) comprises a region of said face (9d) of said piston (9) that is located around said inlet (20).
12. The apparatus according to one or more of the preceding claims, **characterized in that** said second portion (9b) of said piston (9) comprises a peripheral portion of said piston (9) that is extended around said axial extension (40).
13. The apparatus according to one or more of the preceding claims, **characterized in that** said fixed head (12) is crossed by at least one third channel (27) which mutually connects said supply means (15) and said second actuation chamber (14).
14. The apparatus according to one or more of the preceding claims, **characterized in that** said piston (9) axially accommodates, substantially at said bottom wall (21) of said longitudinal recess (19), a transduc-

er (28) of the stroke of said piston.

15. The apparatus according to one or more of the preceding claims, **characterized in that** it comprises, inside said lateral jacket (7), at least one abutment element (29) that can be engaged by said piston (9) and can be moved adjustably by virtue of movement means (30) along the axis of said lateral jacket (7) in order to vary the extension of the stroke of said piston (9) between said retracted position and said advanced position. 5 10
16. The apparatus according to one or more of the preceding claims, **characterized in that** said at least one abutment element (29) comprises a sleeve-like stroke limiter body (30) which is arranged coaxially to said lateral jacket (7) between said opening (11) and an abutment portion (9e) of said piston (9) and can move along the axis of said lateral jacket (7), said movement means (15) comprising a movement ring (31) which is arranged around said stroke limiter body (30) and is provided internally with a thread (32), which engages a corresponding thread formed on said stroke limiter body (30), and an external set of teeth (33) which engages a worm screw (34), which is extended substantially at right angles to the axis of said movement ring (31) and can be actuated rotationally by a motor (35). 15 20 25
17. The apparatus according to one or more of the preceding claims, **characterized in that** it comprises at least one rotation-preventing element (38) which is adapted to prevent the rotation of said piston (9) about its own axis. 30 35

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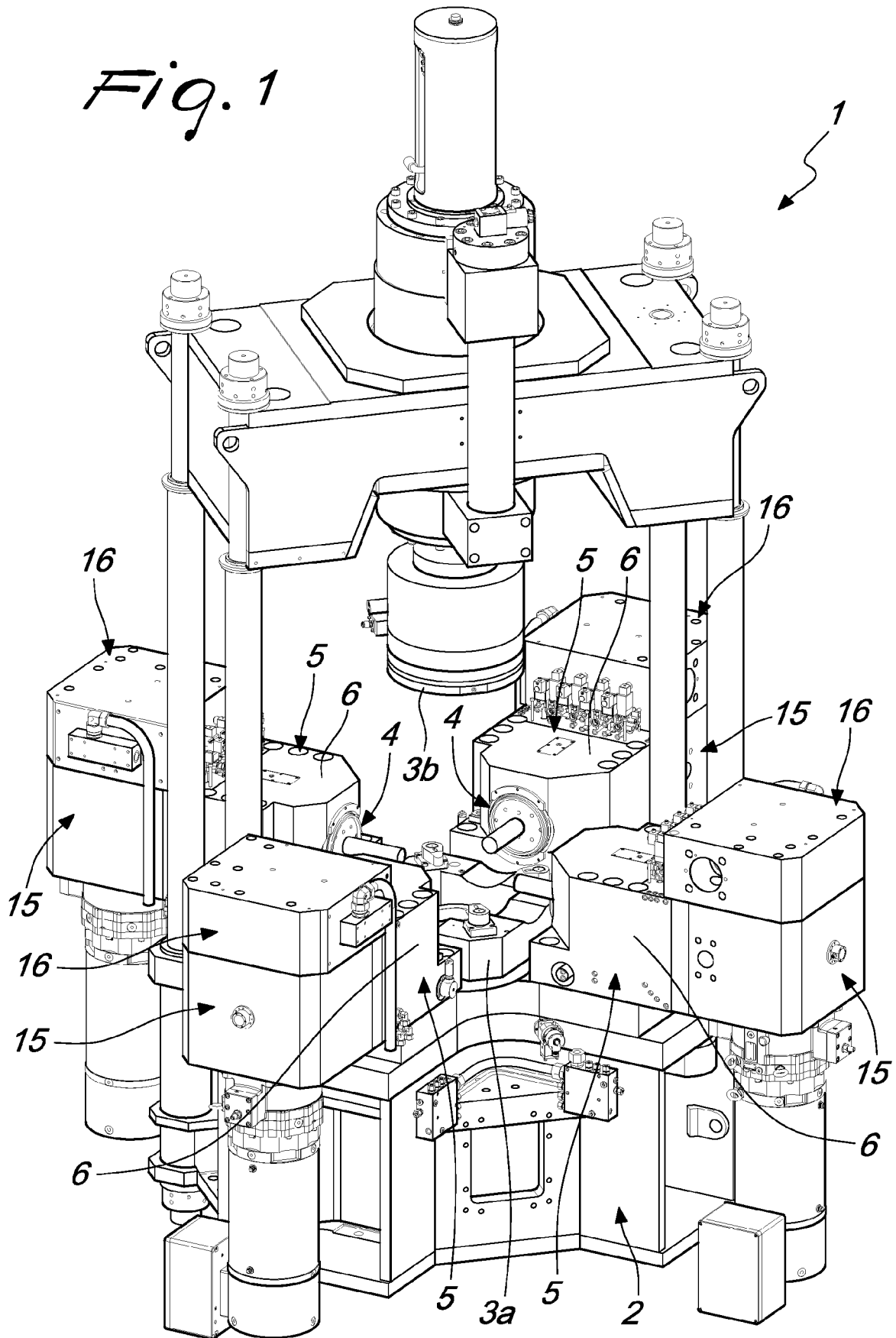
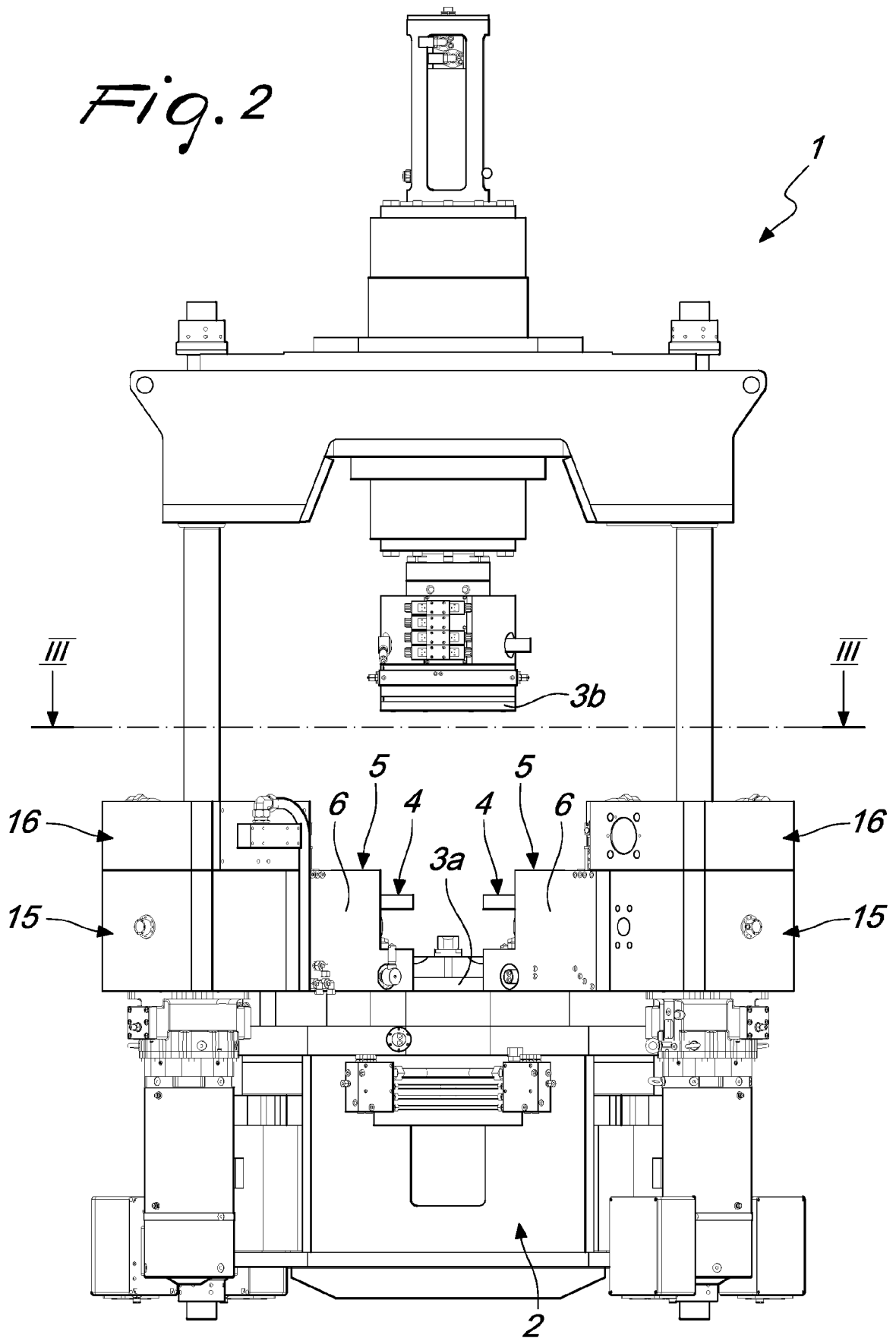


Fig. 2



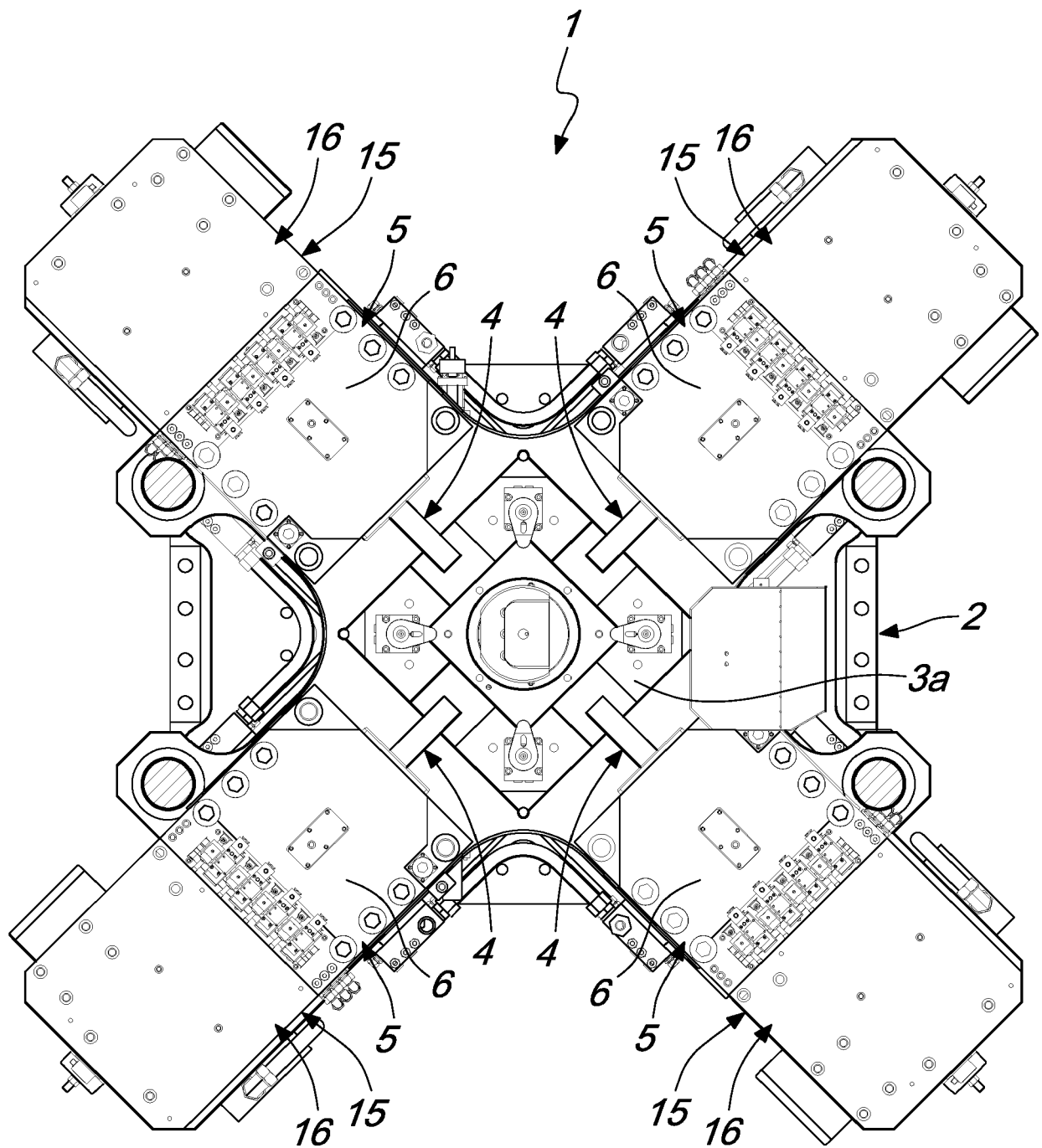
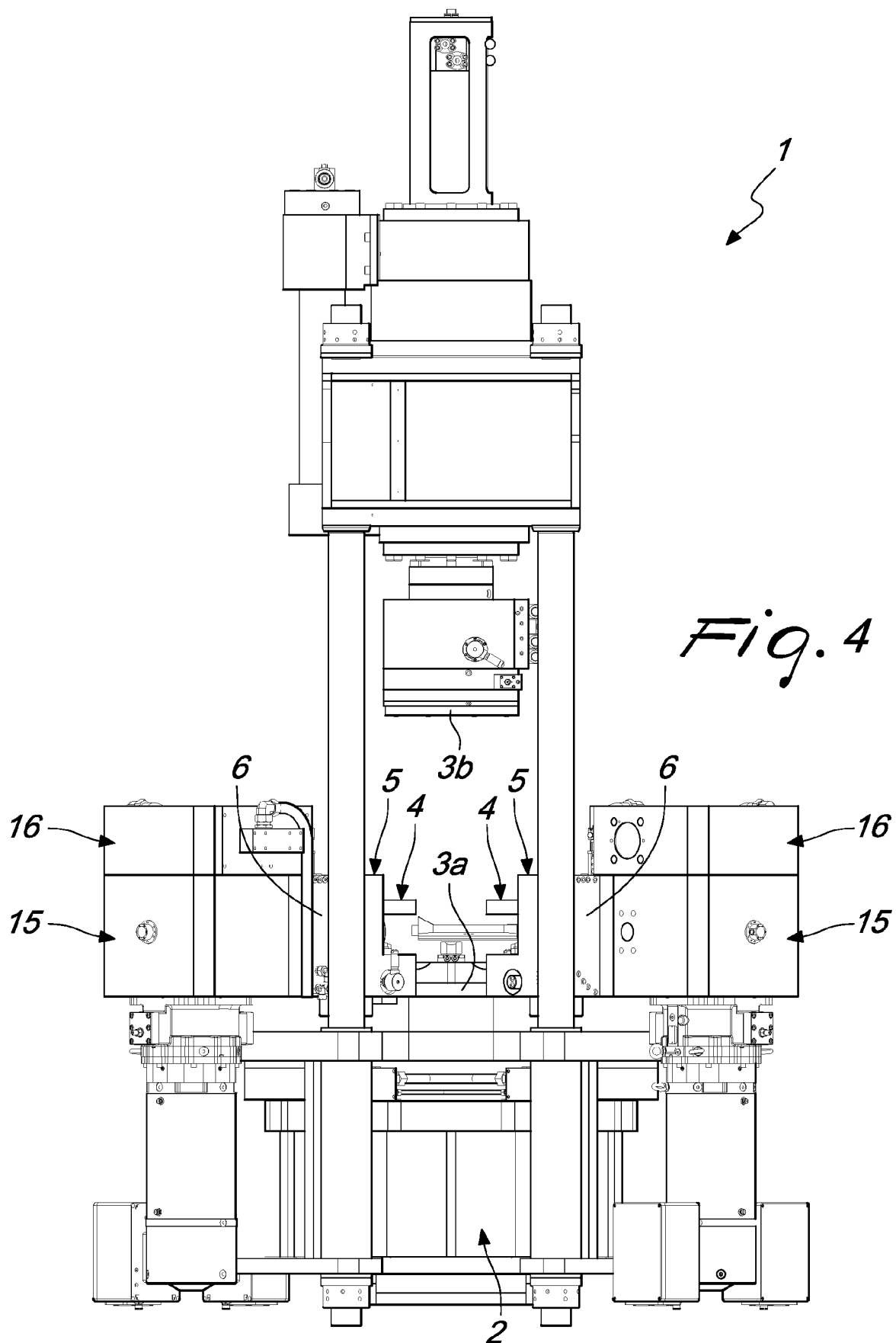
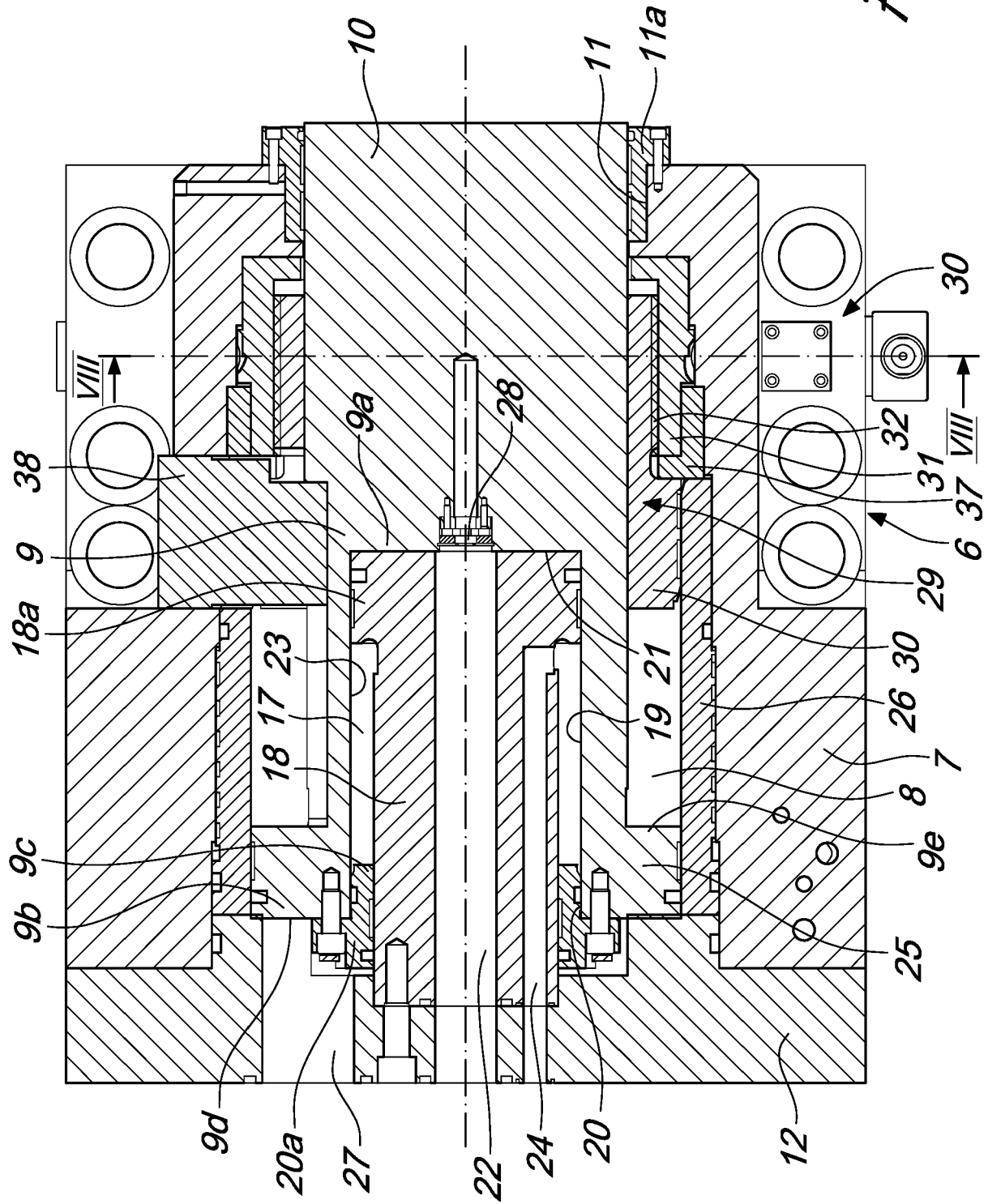


Fig. 3





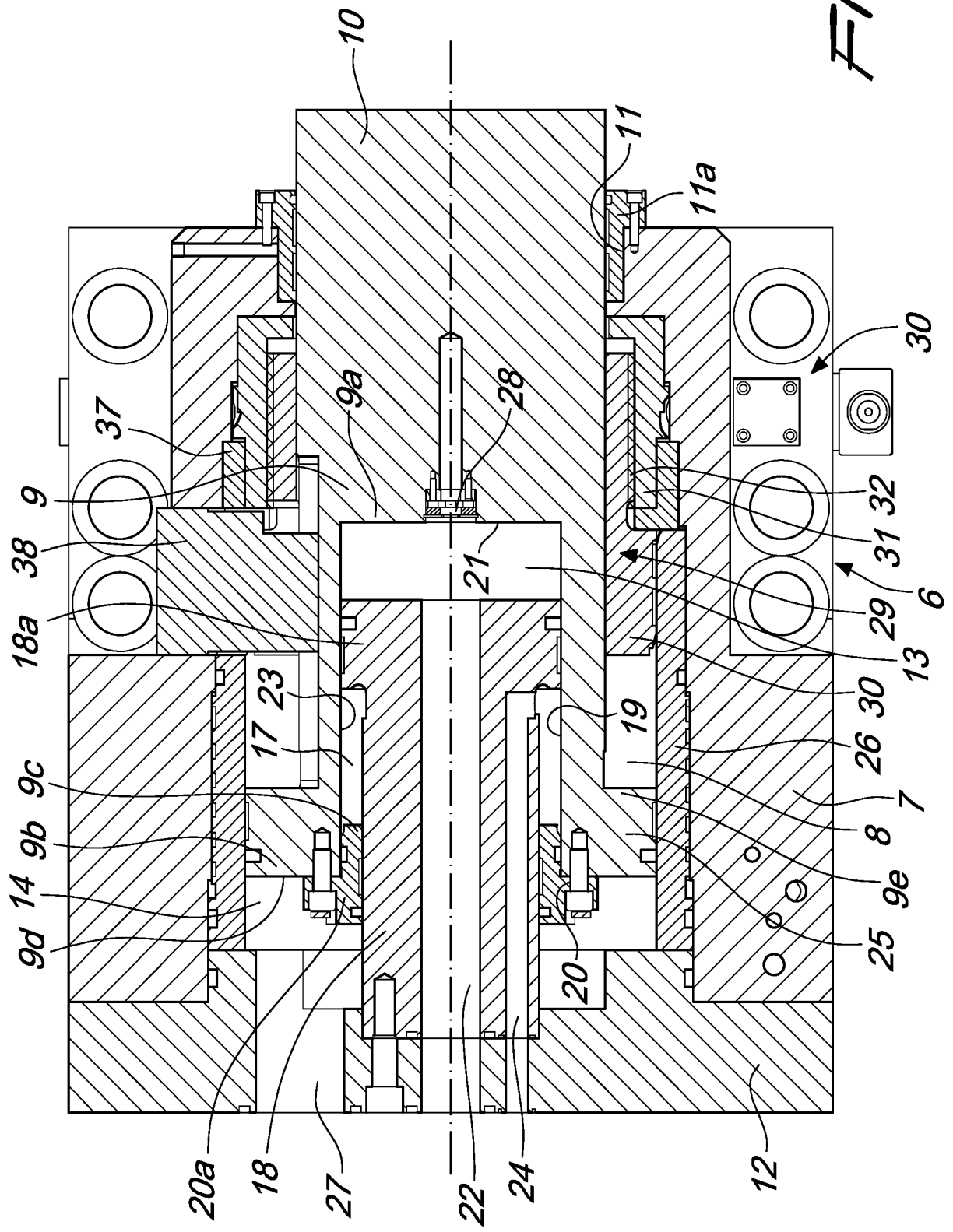
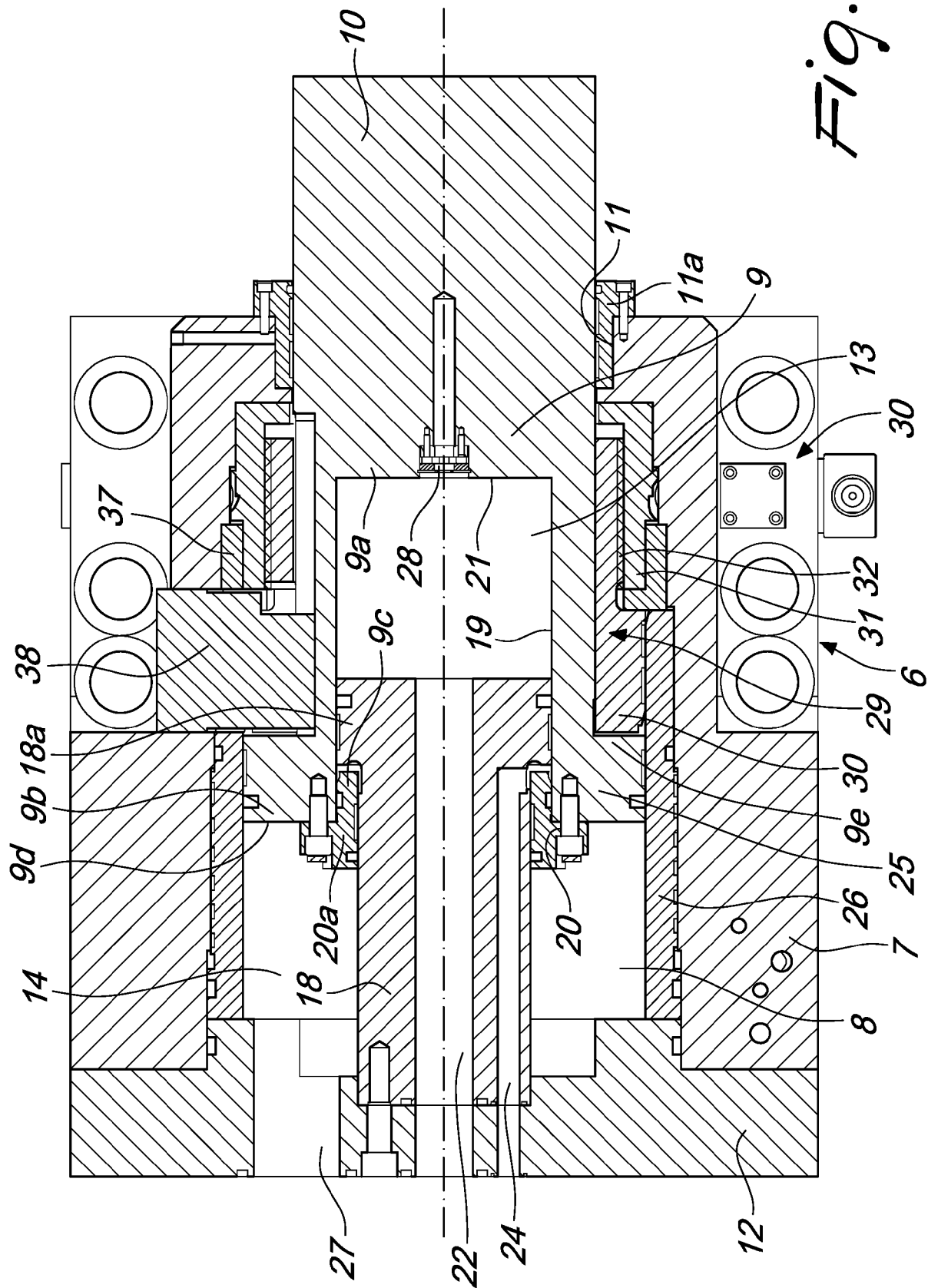


Fig. 6



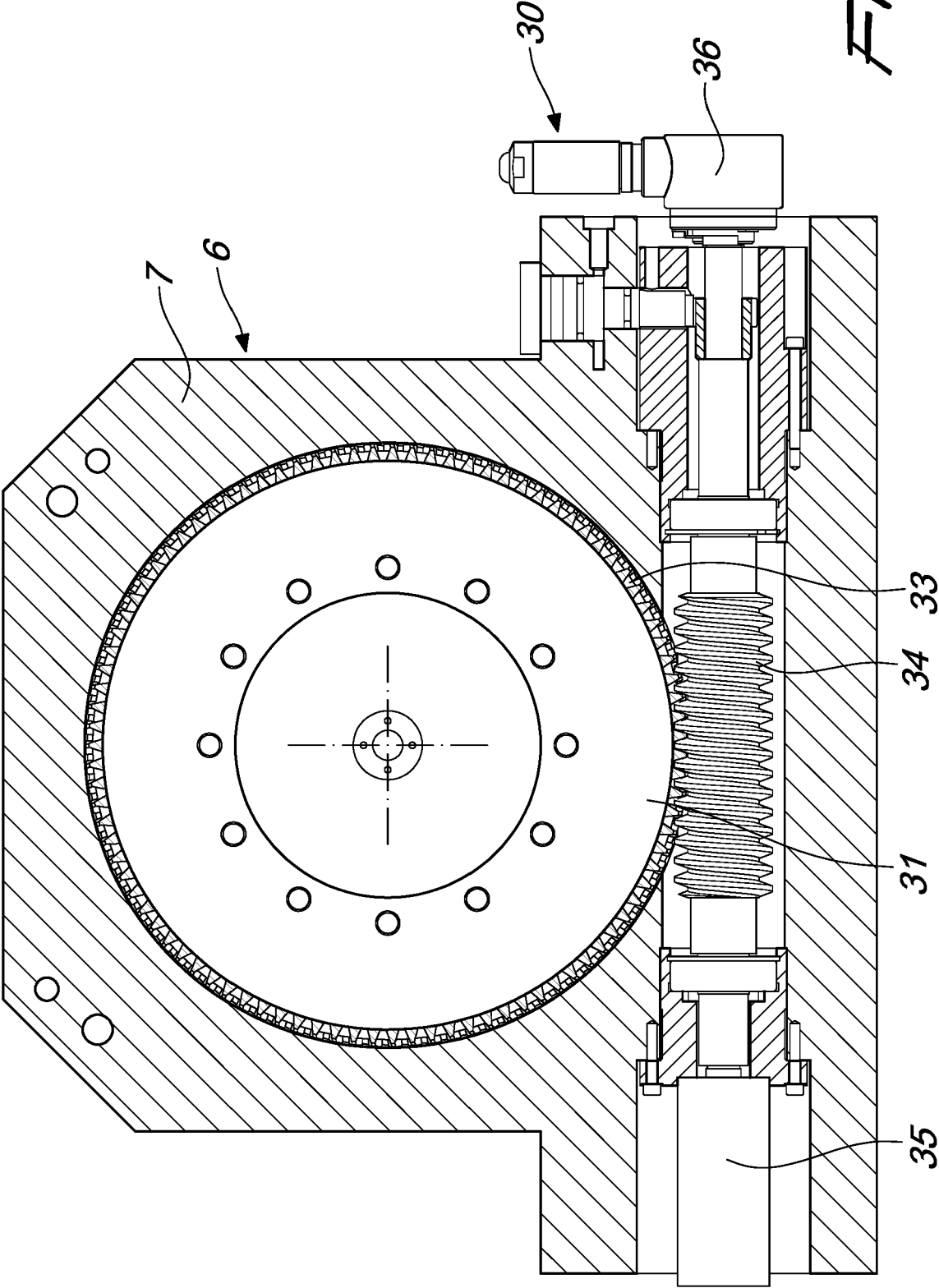
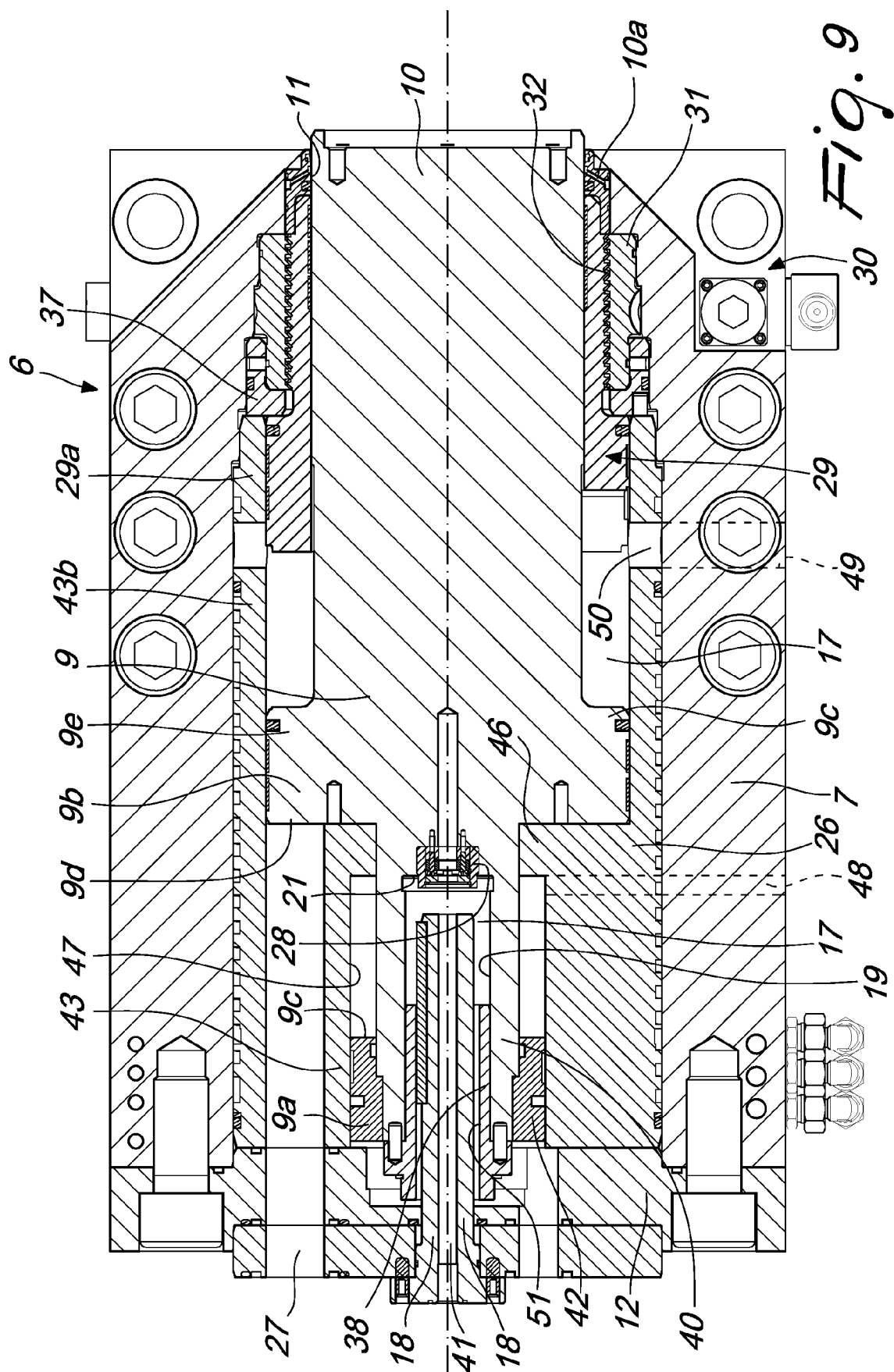
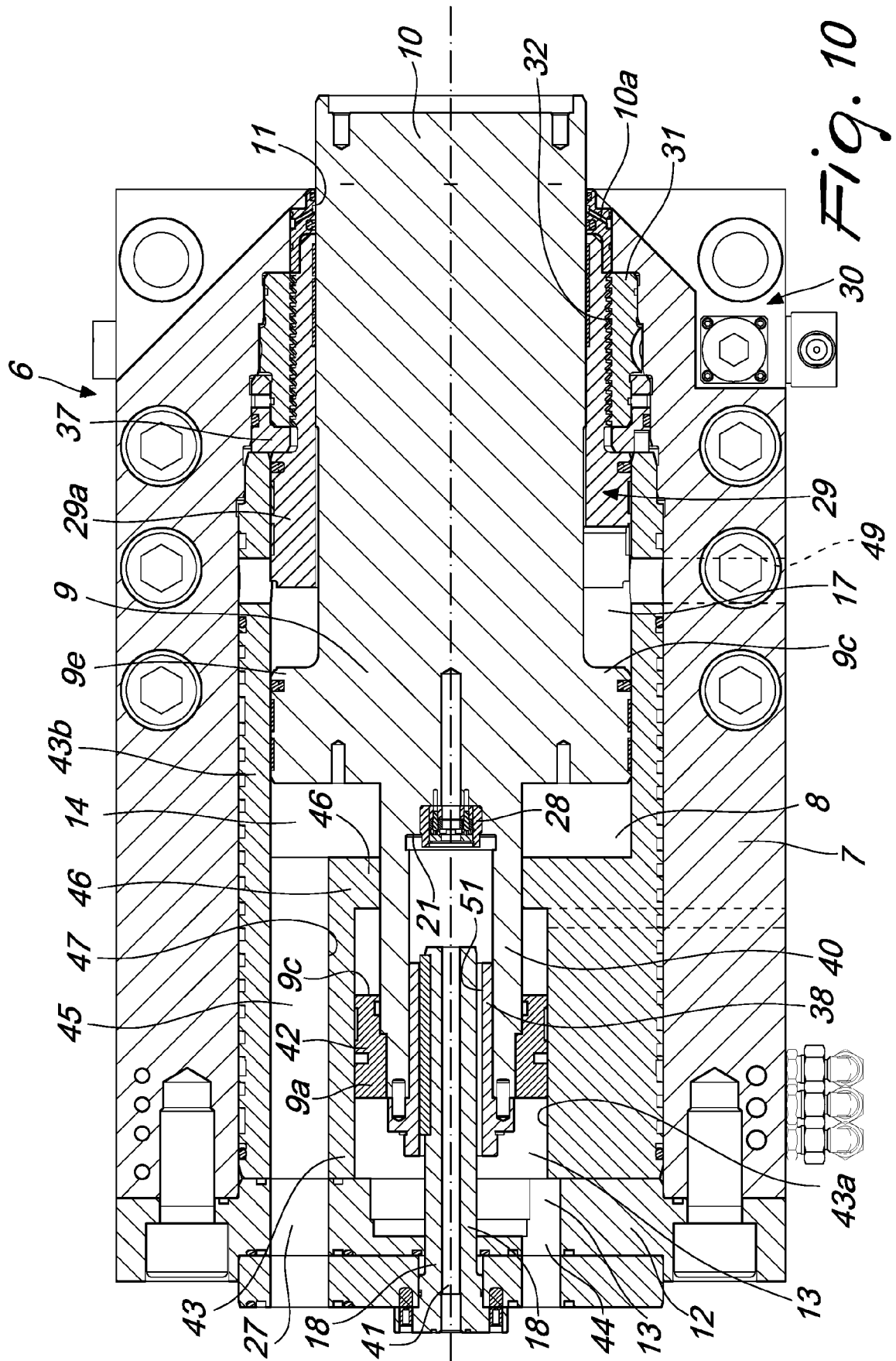
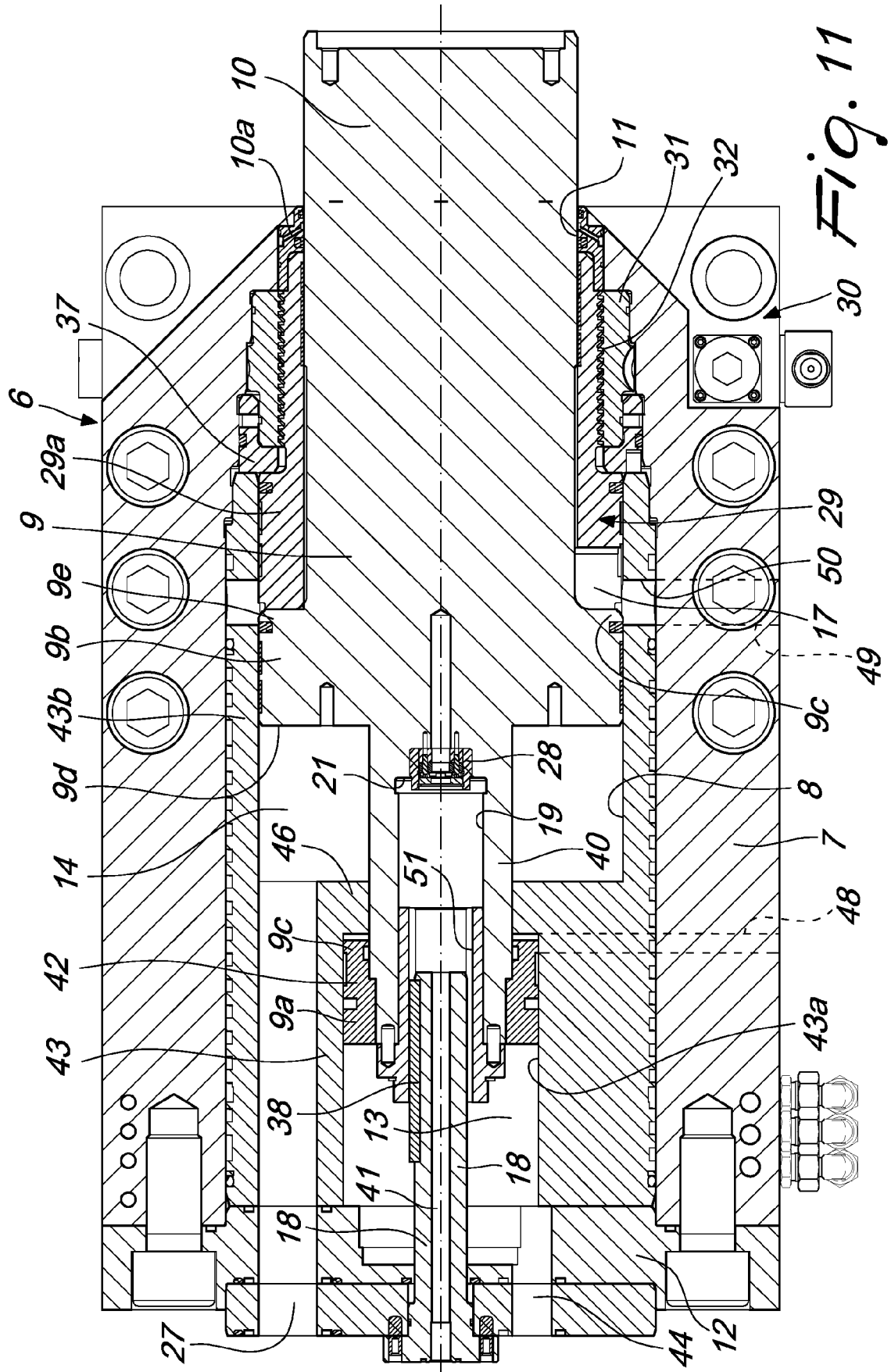


Fig. 8









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Place of search		Date of completion of the search	Examiner
The Hague		24 August 2020	Papakostas, Ioannis
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Place of search The Hague		Date of completion of the search 24 August 2020	Examiner Papakostas, Ioannis
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