(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 383 107 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
02.11.2011 Bulletin 2011/44

(21) Application number: **11161928.4**

(22) Date of filing: **11.04.2011**

(51) Int Cl.:
B30B 1/24 *(2006.01)* ***B30B 1/32*** *(2006.01)*
B30B 15/16 *(2006.01)*

(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

(30) Priority: **28.04.2010 IT MI20100727**

(71) Applicant: **LDP Italia S.r.l.**
20085 Locate di Triulzi (MI) (IT)

(72) Inventor: **Brasca, Daniele**
20085, LOCATE DI TRIULZI MI (IT)

(74) Representative: **Modiano, Micaela Nadia**
Dr. Modiano & Associati SpA
Via Meravigli 16
20123 Milano (IT)

(54) Electrohydraulically-operated press head with reduced energy consumption

(57) An electrohydraulically-operated press head with reduced energy consumption comprising a body (2) that internally defines a substantially cylindrical main chamber (3) that accommodates, so that it can slide along an axial direction, a main piston (5) which is provided with a stem (6) that protrudes from an axial end of the main chamber (3), the main piston (5) divides the main chamber (3) into two parts, the second part (8) is connected, by means of a connecting passage (9), to a service chamber (10). The press head further comprises a power element (12), which can be inserted on command in the second part (8) of the main chamber (3) in order to increase the pressure in the second part (8) of the main chamber (3) when the connecting passage (9) is closed. The press head further comprises a first actuator (11), which is connected to the main piston (5), and a second actuator (13), which is connected to the power element (12), at least one between the first actuator (11) and the second actuator (13) is constituted by an actuator of the electric type.

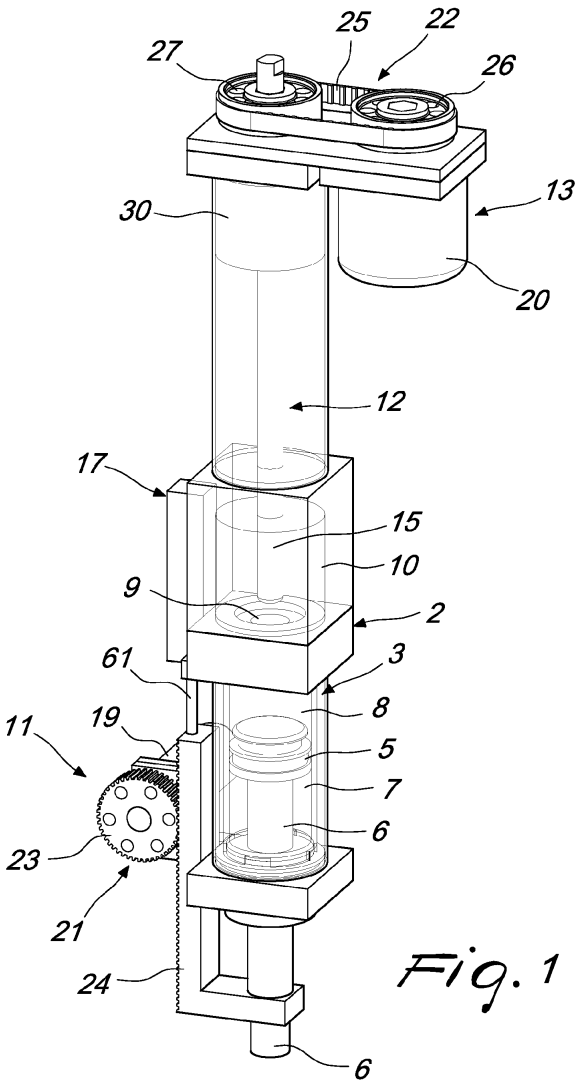

Fig. 1

EP 2 383 107 A1

Description

[0001] The present invention relates to an electrohydraulically-operated press head with reduced energy consumption.

[0002] Several types of press are known, such as for example mechanically-operated presses, hydraulically-operated presses, pneumatically-operated presses and pneumohydraulically-operated presses.

[0003] Pneumohydraulically-operated presses are based on the principle of the hydraulic press and their head substantially comprises a body that defines, internally, a substantially cylindrical main chamber, which accommodates, so that it can slide axially, a main piston which is provided with a stem that protrudes from an axial end of the main chamber. Such stem constitutes the press head element which, when associated with different kinds of tools, performs the various processes for which presses are usually used, such as for example clamping, shearing, marking, straightening, riveting, caulking, minting, bending, deep drawing, keying, etc.

[0004] In these press heads, the main piston divides the main chamber into two parts, respectively: a first part, which accommodates the stem of the piston, and a second part, which is opposite to the first part with respect to the main piston and is filled with a liquid. The second part of the main chamber is connected, by means of a connecting passage, to a service chamber. The service chamber can be connected, above the free surface of the liquid, to a source of pressurized air or to the atmosphere and the first part of the main chamber can also be connected to a source of pressurized air or to the atmosphere in order to produce the translational motion, in one direction or in the opposite direction, of the main piston in relation to the body of the press head. Such translational motion is used in order to actuate a quick motion of approach or spacing, with a reduced force, of the stem of the main piston to or from the working surface on which the piece to be worked is arranged.

[0005] These press heads also comprise a pneumatic cylinder with a corresponding piston which is provided with a stem that can be inserted in the second part of the main chamber through the connecting passage that exists between the second part of the main chamber and the service chamber, so as to increase the pressure inside the second part of the main chamber, i.e., the pressure applied to the main piston.

[0006] The assembly constituted by the second part of the main chamber, the main piston and the stem of the piston of the pneumatic cylinder constitutes a hydraulic press in which the actuating force of the stem that is inserted in the second part of the main chamber is multiplied and transmitted to the main piston in order to obtain a suitable force during the working step.

[0007] Pneumohydraulically-operated presses have the advantage that they can be actuated with lower power levels but have the drawback of not allowing actuation of the stem of the main piston with high precision and control, again with high precision, of the working process during its execution.

[0008] Recently, electrically-operated presses have been introduced on the market and are increasingly in demand because of their precision and the possibility to manage them in a completely automated manner. Such presses are derived from so-called "electrical axes", i.e., they are composed substantially of an electric motor, with a corresponding electronic actuation and control system, which is connected to a stem, which performs a translational motion, by way of a worm screw drive. Generally, the worm screw drive used in these presses has a plurality of starts, with recirculating ball bearings or recirculating roller bearings, so as to adequately increase the axial force that is transmitted by the motor to the translationally-moving stem on which the tool that has to interact with the piece being worked is mounted.

[0009] These types of presses are generally provided with an actuation and control element of the programmable electronic type, which by way of an adapted software, as well as extremely precise detectors of the translational motion of the stem and of the force applied to the stem proper, is capable of controlling the match between the parameters that are actually detected and the parameters that are programmed for the work cycle in progress, so as to promptly stop the operation of the press in the event of a mismatch between the detected parameters and the set parameters.

[0010] Thanks to their high precision, such presses make it possible to significantly reduce work errors and thus to reduce the number of rejected pieces and increase safety for the operators assigned to these machines.

[0011] In contrast with these advantages, these presses suffer the problem of requiring the use of high-power electric motors that have relatively high power consumptions.

[0012] The aim of the present invention is to solve the above mentioned problems, by providing a press head which, for the same work cycle, has a lower energy consumption than electrically-operated presses of the known type, while still ensuring a high working precision.

[0013] Within this aim, an object of the invention is to provide a press head that can operate at a high speed of approach to the piece to be worked, so as to reduce the time required for the completion of a work cycle.

[0014] Another object of the invention is to provide a press head that gives adequate assurances of safety for the user.

[0015] A further object of the invention is to provide a press head that can be manufactured at very low cost.

[0016] Another object of the invention is to provide a press head that ensures high reliability in use.

[0017] This aim and these and other objects which will become better apparent hereinafter are achieved by an electrohydraulically-operated press head, comprising a body that internally defines a substantially cylindrical main chamber that accommodates, so that it can slide

along an axial direction, a main piston which is provided with a stem that protrudes from an axial end of said main chamber, said main piston dividing said main chamber into two parts, respectively: a first part, which accommodates the stem of said main piston, and a second part, which lies opposite said first part with respect to said main piston and is filled with a liquid, said second part being connected, by means of a connecting passage, to a service chamber, a power element being provided which can be inserted on command in said second part of the main chamber in order to increase the pressure in said second part of the main chamber when said connecting passage is closed, characterized in that it comprises a first actuator, which is connected to said main piston and can be operated in order to actuate the axial movement of said main piston along said main chamber when said connecting passage is open, and a second actuator, which is connected to said power element and can be operated in order to actuate the insertion of said power element in said second part of the main chamber or the extraction of said power element from said second part of the main chamber, at least one between said first actuator and said second actuator being constituted by an actuator of the electric type.

[0018] Further characteristics and advantages of the invention will become better apparent from the description of some preferred but not exclusive embodiments of the press head according to the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a schematic perspective view of the press head according to the invention, in a first embodiment;

Figure 2 is a schematic sectional view of the press head of Figure 1, taken along a plane that passes through the longitudinal axis of the main piston, in the inactive step;

Figure 3 is a schematic sectional view of the press head of Figure 1, taken along the same plane as Figure 2, at the end of the step of approach to a piece to be worked;

Figure 4 is a schematic sectional view of the press head of Figure 1, taken along the same plane as Figure 2 and Figure 3, in the working step;

Figure 5 is a schematic perspective view of the press head according to the invention in the first embodiment, with the addition of a frame for fixing to a press load-bearing structure;

Figure 6 is a schematic perspective view of the press head according to the invention in the first embodiment, with an external tank mounted thereon;

Figure 7 is a schematic perspective view of the press head according to the invention, in the first embodiment, with an external membrane tank mounted thereon;

Figure 8 is a schematic perspective view of the press head according to the invention in the first embodiment, with an external tank, which is provided with a movable piston, mounted thereon;

Figure 9 is a schematic perspective view of the press head according to the invention in the first embodiment, with the addition of a first security device;

Figure 10 is an enlarged-scale sectional view, taken along a plane that passes through the longitudinal axis of the main piston, of a detail of Figure 9;

Figure 11 is a schematic perspective view of the press head according to the invention in the first embodiment, with the addition of a second security device;

Figure 12 is an enlarged-scale sectional view, taken along a plane that passes through the main piston axis, of a detail of Figure 11;

Figure 13 is a schematic perspective view of the press head according to the invention in a second embodiment;

Figure 14 is a schematic perspective view of the press head according to the invention in a third embodiment;

Figure 15 is a schematic perspective view of the press head according to the invention in a fourth embodiment;

Figure 16 is a schematic perspective view of the press head according to the invention in a fifth embodiment;

Figure 17 is a schematic perspective view of the press head according to the invention in a sixth embodiment;

Figure 18 is a schematic perspective view of the press head according to the invention in a seventh embodiment;

Figure 19 is a schematic perspective view of the press head according to the invention in an eighth embodiment;

Figure 20 is a schematic sectional view, taken along a plane that passes through the longitudinal axis of the main piston, of the press head according to the invention in a ninth embodiment.

[0019] In the figures, which illustrate the press head in a perspective view, some elements of the press head have been illustrated in phantom lines for the sake of greater clarity and some elements have been omitted for the sake of simplicity.

[0020] With reference to the figures, the press head according to the invention, in the different embodiments, comprises a body 2, which internally defines a substantially cylindrical main chamber 3, which accommodates, so that it can slide along its axis 4, a main piston 5, which is provided with a stem 6 that protrudes from an axial end of the main chamber 3.

[0021] The main piston 5 divides the main chamber 3 into two parts, respectively: a first part 7, which accommodates the stem 6 of the main piston 5, and a second part 8, which lies opposite the first part 7 with respect to the main piston 5 and is filled with a liquid. The second

part 8 is connected, by means of a connecting passage 9, to a service chamber 10.

[0022] In the second part 8 of the main chamber 3 a power element 12 can be inserted on command, so as to increase the pressure in the second part 8 of the main chamber 3 when the connecting passage 9 is closed.

[0023] According to the invention, the press head comprises a first actuator 11, which is connected to the main piston 5 and can be operated in order to actuate the axial movement of the main piston 5 along the main chamber 3 when the connecting passage 9 is open. The power element 12 is connected to a second actuator 13, which can be operated in order to actuate the insertion of the power element 12 in the second part 8 of the main chamber 3 or the extraction of the power element 12 from the second part 8 of the main chamber 3.

[0024] At least one between the first actuator 11 and the second actuator 13 is constituted by an actuator of the electric type.

[0025] More precisely, the second part 8 of the main chamber 3 is separated from the service chamber 10 by a partition 14, which is crossed by the connecting passage 9. The power element 12 is constituted by a power stem 15, which can be inserted in the second part 8 of the main chamber 3 through the connecting passage 9 so as to also actuate, upon insertion in the second part 8 of the main chamber 3, the closure of the connecting passage 9.

[0026] At the connecting passage 9 a sealing gasket 16 is provided, which can be engaged with the power stem 15 when it is inserted in the connecting passage 9, so as to ensure the liquid-tight separation between the second part 8 of the main chamber 3 and the service chamber 10.

[0027] Advantageously, the press head according to the invention also comprises means 17 for controlling the axial movement of the main piston 5 with respect to the body 2 and/or means 18 for detecting the force applied by the main piston 5 to the piece being worked.

[0028] More precisely, in the first embodiment, illustrated in a number of variations from Figure 1 to Figure 12, the above mentioned actuator of the electric type comprises an electric motor 19, 20 of the rotary type and a mechanical transmission 21, 22, which connects the shaft of the electric motor 19, 20 to the stem 6 of the main piston 5 or to the power element 12 and is adapted to convert the rotary motion of the shaft of the electric motor 19, 20 into a translational motion of the stem 6 of the main piston 5 or of the power element 12.

[0029] In this first embodiment, the first actuator 11 comprises an electric motor 19 of the rotary type, which is connected, by means of its shaft, to a pinion 23 that meshes with a rack 24, which in turn is fixed to the stem 6 of the main piston 5. In this manner, the actuation of the electric motor 19, in one direction or in the opposite direction, causes the translational motion of the main piston 5 along its axis 4 in relation to the body 2.

[0030] In this first embodiment, the second actuator 13 comprises an electric motor 20 of the rotary type and a transmission 22 with a toothed belt 25 which connects a pulley 26 which is keyed on the output shaft of the electric motor 20 to a pulley 27 which is keyed on a threaded shaft 28 which is supported, so that it can rotate about its own axis, by the body 2.

[0031] The threaded shaft 28 is supported, so that it can rotate about its own axis, by the body 2 and is coupled to a female thread 29 which is defined inside a cylindrical body 30, which is supported, so that it can slide axially, by the body 2. The cylindrical body 30 is prevented from rotating about its own axis in relation to the body 2 and is fixed coaxially to an axial end of the power stem 15. In this manner, an actuation of the electric motor 20 produces the translational motion of the power stem 15 along its axis, which obtains the insertion of the power stem 15 in the second part 8 of the main chamber 3 through the connecting passage 9, or the extraction of the power stem 15 from the second part 8 of the main chamber 3.

[0032] In the embodiment shown in Figures 1 to 5, the service chamber 10 constitutes *per se* a tank for liquid with a free surface. In the embodiment shown in Figures 6 to 8, the service chamber 10 is instead connected to an external tank, which can be constituted by a tank for liquid with a free surface 31, as shown in Figure 6, or by a membrane tank 32, as shown in Figure 7, or by a tank 33 with a movable piston, as shown in Figure 8, so as to compensate for the variations in volume of the liquid contained in the service chamber 10 during the operation of the press head.

[0033] Optionally, these solutions, described with reference to an external tank, could also be used if the tank were placed inside the body 2.

[0034] In the first embodiment shown in Figures 1 to 12, the main chamber 3, the main piston 5, the service chamber 10 and the power stem 15 are arranged coaxially with respect to each other and the electric motor 20 that actuates the power stem 15 is arranged so that its axis is parallel to the axis 4.

[0035] In the second embodiment, shown in Figure 13, the first actuator 11, similarly to the first embodiment, comprises an electric motor 19 of the rotary type, which is connected, by means of its shaft, to a pinion 23, which meshes with a rack 24, which, in turn, is fixed to the stem 6 of the main piston 5.

[0036] In this second embodiment, the second actuator 13 comprises an electric motor 34 of the rotary type, which is also connected, by means of its own shaft, to a pinion 35, which meshes with a rack 36, which, in turn, is connected to the power stem 15. In this manner, an actuation of the electric motor 34 produces a translational motion of the power stem 15 along its own axis so as to actuate its insertion in the second part 8 of the main chamber 3 through the connecting passage 9 or its extraction from the second part 8 of the main chamber 3.

[0037] In the third embodiment, shown in Figure 14, the first actuator 11 comprises an electric motor 37 of the rotary type, which is connected, by means of its shaft, to

a threaded shaft 38, which engages with a female thread which is defined inside a cylindrical body 39 which is provided with a stem 40 which is fixed to the stem 6 of the main piston 5. In this manner, an actuation of the electric motor 37 produces, as a consequence of the screw-and-nut connection that exists between the threaded shaft 38 and the cylindrical body 39, a translational motion of the main piston 5 along its axis 4 in relation to the body 2.

[0038] In this third embodiment, the second actuator 13 comprises an electric motor 41 of the rotary type, which is connected, by means of its shaft, to a threaded shaft, which engages with a female thread which is defined inside a cylindrical body 42 that is fixed coaxially to an axial end of the power stem 15. In Figure 14, the threaded shaft, which is connected to the shaft of the electric motor 41, and the female thread which is defined inside the cylindrical body 42 are not visible, but are similar to the threaded shaft 28 and the female thread screw 29 which are shown in Figures 2 to 4.

[0039] In the third embodiment, the electric motor 37 is arranged so that its axis is parallel to the axis 4 of the main piston 5, while the electric motor 41 is arranged coaxially to the main piston 5.

[0040] In the fourth embodiment, shown in Figure 15, the first actuator 11 comprises an electric motor 43 of the rotary type, which is connected, by means of a toothed belt transmission 44, to a threaded shaft 45, which is engaged with a female thread which is defined inside a cylindrical body 46 which is provided with a stem 47 which is fixed to the stem 6 of the main piston 5. More precisely, the transmission 44 comprises a first pulley 48, which is keyed on the shaft of the electric motor 43, and a second pulley 49, which is keyed on the threaded shaft 45; the pulleys 48, 49 are mutually connected by a toothed belt 50. In this manner, an actuation of the electric motor 43 produces, as a consequence of the kinematic connection that exists between its shaft and the main piston 5, a translational motion of the main piston 5 along its axis 4 with respect to the body 2.

[0041] In this fourth embodiment, the second actuator 13 is implemented substantially similarly to the second actuator described previously with reference to the third embodiment and, for this reason, its components have been designated by the same reference numerals used in Figure 14.

[0042] In the fifth embodiment, shown in Figure 16, the first actuator 11 and the second actuator 13 are constituted by electric motors 51, 52 of the linear type, the translationally-moving shafts of which are fixed coaxially respectively to the stem 6 of the main piston 5 and to the power stem 15.

[0043] In the sixth embodiment, shown in Figure 17, the first actuator 11 and the second actuator 13 are constituted by electric motors 53, 54 of the linear type, which are supported by the body 2 and the translationally-moving shafts of which are arranged parallelly to the axis 4 of the main piston 5 and are connected respectively to the stem 6 of the main piston 5 and to the power stem 15.

[0044] In the seventh embodiment, shown in Figure 18, the first actuator 11 comprises an electric motor 19 of the rotary type, which is connected, with its own shaft, to a pinion 23, which meshes with a rack 24, which, in turn, is fixed to the stem 6 of the main piston 5. In this manner, the actuation of the electric motor 19, in one direction or in the opposite direction, produces the translational motion of the main piston 5 along its axis 4 with respect to the body 2.

[0045] In this seventh embodiment, the second actuator 13 is constituted by a pneumatic cylinder 55, which is arranged coaxially to the main piston 5. More precisely, the pneumatic cylinder 55 is fixed with its body to the body 2 and is provided with a piston 56 the stem of which is fixed to the power stem 15 or itself directly constitutes the power stem 15, as illustrated. In this manner, an actuation of the pneumatic cylinder 55 produces the insertion of the power stem 15 in the second part 8 of the main chamber 3 or the extraction of the power stem 15 from the second part 8 of the main chamber 3.

[0046] In the eighth embodiment, shown in Figure 19, the first actuator 11 is constituted by a pneumatic cylinder 58, which is arranged coaxially to the main piston 5 and is provided with a piston 59 which is connected to the stem 6 of the main piston 5. In this manner, an actuation of the pneumatic cylinder 58 produces the axial translational motion, in one direction or in the opposite direction, of the main piston 5. In this eighth embodiment, the second actuator 13 is implemented substantially similarly to the second actuator described previously with reference to the first embodiment and for this reason has been designated by the same reference numerals.

[0047] In the ninth embodiment, shown in Figure 20, the first actuator 11 and the second actuator 13 are provided as shown in the first embodiment, except that the service chamber 10 and the power stem 15, instead of being arranged coaxially, are arranged along an axis 60 that is oriented at right angles to the axis 4 of the main piston 5. In this ninth embodiment, the elements that correspond to those described previously with reference to the first embodiment have been designated by the same reference numerals.

[0048] It should be noted that, depending on the requirements, the service chamber 10 and the power stem 15 can be arranged along an axis which is oriented according to any inclination with respect to the axis 4 of the main piston 5.

[0049] The means 17 for controlling the axial movement of the main piston 5 in relation to the body 2 are preferably constituted by a conventional encoder, for example a linear encoder, which is connected, with its movable element 61, to the stem 6 of the main piston 5.

[0050] The means 18 for detecting the force applied by the main piston 5 to the piece 62 being worked can be constituted by a conventional load cell 63 which is interposed between the stem 6 of the main piston 5 and the tool 64 that is designed to work the piece 62.

[0051] The control means 17 and the detection means

18, as well as the first actuator 11 and the second actuator 13, are preferably connected to an actuation and control element 65 of the programmable electronic type, which supervises the operation of the press head. In the actuation and control element 65 it is possible to store different work cycles and the values relating to the axial movement of the main piston 5 and to the force applied to the tool 64, which are set in the different steps of each cycle. In this manner, the actuation and control element 65, by means of an adapted software, can compare, during the execution of a work cycle, the values actually detected of the axial movement of the main piston 5 and of the force applied to the tool 64 with the stored values for the work cycle in progress and optionally correct the actuation of the press head or stop its actuation in order to avoid the execution of defective work.

[0052] In this manner, the press head according to the invention is capable of performing work with high precision, thus reducing the quantity of unacceptable pieces.

[0053] Preferably, in the different embodiments shown, the first part 7 of the main chamber 3, too, is filled with the same liquid with which the second part 8 of the main chamber 3 and the service chamber 10 are filled. Moreover, the first part 7 of the main chamber 3 is connected to an interspace 66 which is defined by an external jacket 67 that coaxially surrounds the side wall of the body 2 that delimits the main chamber 3.

[0054] Conveniently, safety means 68 are provided to allow, in the event of an emergency, the manual performance of the axial movement of the main piston 5 along its axis 4 in relation to the body 2 when the power stem 15 is inserted in the second part 8 of the main chamber 3, i.e., when the connecting passage 9 between the second part 8 of the main chamber 3 and the service chamber 10 is obstructed.

[0055] As shown in Figures 9 and 10, the safety means 68 comprise a bypass duct 69, which connects the second part 8 of the main chamber 3 to the service chamber 10 in addition to the connecting passage 9. A flow control valve 70 is arranged on the bypass duct 69 and can be actuated manually or by means of a servomotor in order to open the bypass duct 69 in emergency situations.

[0056] To facilitate the manual movement of the main piston 5 in such a situation, the first actuator 11 can be disengaged from the main piston 5, for example by disengaging the pinion 23 from the rack 24 or by manually actuating the shaft of the motor which is connected to the pinion 23.

[0057] Conveniently, safety means 71 are provided in order to prevent the main piston 5, owing to an anomalous operation of the press head, from translationally-moving axially in an unpredictable manner, and particularly from descending if the press head is arranged with the axis 4 of the main piston 5 in the vertical position. The safety means 71, as shown particularly in Figures 11 and 12, are constituted by a bypass duct 72, which connects the first part 7 of the main chamber 3 to the service chamber 10, through the interspace 66, and on which a flow control valve 73 is arranged which can be actuated in order to close the bypass duct 72 so as to prevent, owing to the liquid that is blocked in the first part 7 of the main chamber 3, the translational motion of the main piston 5 along its axis 4 in relation to the body 2.

[0058] Again in order to achieve high safety in the use of the press head according to the invention, the second actuator 13 could be actuated manually, for example by providing the threaded shaft 28 or the shaft of the electric motor which is connected thereto with an axial end that is accessible so as to allow, in emergency situations, it to be turned manually in order to actuate the extraction of the power stem 15 from the second part 8 of the main chamber 3. But if, as in the second embodiment shown in Figure 12, the second actuator 13 comprises an electric motor 34 of the rotary type which is connected to the power stem 15 by means of a rack-and-pinion transmission 35-36, then the pinion 35 could be disengaged from the rack 36 in order to allow the rack 36, and thus the power stem 15 connected thereto, to be moved manually.

[0059] The press head according to the invention can be integrated in the supporting structure of a press during the production of the press or it can be mounted on a supporting structure of an existing press, for example by providing a fixing frame 74 in order to connect the body 2 to the supporting structure of the press, as shown particularly in Figure 5, with reference to the first embodiment and in Figure 19 with reference to the eighth embodiment.

[0060] Operation of the press head according to the invention is as follows.

[0061] For the sake of simplicity and greater clarity, the operation of the press head according to the invention will be described with reference to the first embodiment, but what will be stated applies to the other embodiments as well.

[0062] Starting from the inactive position, in which the axial end of the stem 6 of the main piston 5 that protrudes from the main chamber 3 and to which the tool 64 is connected is moved away from the piece 62 to be worked, as shown particularly in Figure 2, the first actuator 11 is actuated and produces its fast approach, with a reduced force, to the piece 62 to be worked, as shown in Figure 3. The approach stroke of the tool 64 to the piece 62 can be controlled by the actuation and control element 65, with high precision, by way of the control means 17, which are connected to the stem 6 of the main piston 5, and by way of the means 18 for detecting the force applied by the main piston 5 to the piece 62.

[0063] Subsequently, the second actuator 13 is actuated and causes the insertion of the power stem 15 in the second part 8 of the chamber 3, thus obstructing the connecting passage 9 and increasing the pressure that acts on the main piston 5 and is transmitted to the tool 64 that is applied to the stem 6 of the main piston 5, as shown in Figure 4, thus performing the step for working the piece 62. In this step, in addition to the axial translational motion of the stem 6 of the main piston 5 and thus of the tool 64 applied thereto, which is controlled by way

of the control means 17, the force applied to the tool 64 can also be controlled, with high precision, by the actuation and control element 65 by way of the detection means 18 which are constituted by the load cell 63 which is applied to the stem 6 of the main piston 5.

[0064] At the end of the work process, the second actuator 13 is actuated so as to extract the power stem 15 from the second part 8 of the main chamber 3 and the first actuator 11 is actuated in order to rapidly move the stem 6 of the main piston 5 away from the worked piece 62, thus returning the press head to the inactive position shown in Figure 2.

[0065] If the detections performed by way of the control means 17 and by way of the detection means 18 should report values that differ from those stored in the actuation and control element 65, then the actuation and control element 65 can intervene by modifying the actuation of the first actuator 11 and/or of the second actuator 13, so as to return the work process in progress within the limits of acceptability, or it can completely stop the actuation of the press head in order to avoid performing defective work process, which would lead to the rejection of the finished piece, or in order to avoid creating dangerous situations for the operators assigned to the machine.

[0066] In emergency conditions, if the main piston 5 should be locked in the working position after the power stem 15 has already been inserted in the second part 8 of the main chamber 3, it is possible to intervene manually, as explained above, in order to extract the power stem 15 from the second part 8 of the main chamber 3 and/or in order to connect the second part 8 of the main chamber 3 to the service chamber 10, through the bypass duct 69, so as to allow the stem 6 of the main piston 5, and therefore of the tool 64, to be moved away manually from the piece 62 being worked.

[0067] In practice it has been found that the press head according to the invention fully achieves the intended aim since, although having a performance that is comparable, in terms of precision and safety, with that of presses of the electric type, it can be actuated with considerably lower power and thus, for the same working cycle, it has a lower energy consumption.

[0068] The press head thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims; all the details may further be replaced with other technically equivalent elements.

[0069] In the exemplary embodiments described above, individual characteristics, given in relation to specific examples, may in reality be interchanged with other different characteristics that exist in other exemplary embodiments.

[0070] In practice, the materials used, as well as the dimensions, may be any according to requirements and to the state of the art.

[0071] The disclosures in Italian Patent Application No. MI2010A000727 from which this application claims priority are incorporated herein by reference.

[0072] 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 electrohydraulically-operated press head, comprising a body (2) that internally defines a substantially cylindrical main chamber (3) that accommodates, so that it can slide along an axial direction, a main piston (5) which is provided with a stem (6) that protrudes from an axial end of said main chamber (3); said main piston (5) dividing said main chamber (3) into two parts, respectively: a first part (7), which accommodates the stem (6) of said main piston (5), and a second part (8), which lies opposite said first part (7) with respect to said main piston (5) and is filled with a liquid; said second part (8) being connected, by means of a connecting passage (9), to a service chamber (10); a power element (12) being provided which can be inserted on command in said second part (8) of the main chamber (3) in order to increase the pressure in said second part (8) of the main chamber (3) when said connecting passage (9) is closed, **characterized in that** it comprises a first actuator (11), which is connected to said main piston (5) and can be operated in order to actuate the axial movement of said main piston (5) along said main chamber (3) when said connecting passage (9) is open, and a second actuator (13), which is connected to said power element (12) and can be operated in order to actuate the insertion of said power element (12) in said second part (8) of the main chamber (3) or the extraction of said power element (12) from said second part (8) of the main chamber (3), at least one between said first actuator (11) and said second actuator (13) being constituted by an actuator of the electric type.

2. The press head according to claim 1, **characterized in that** said power element (12) comprises a power stem (15), which can be inserted in said second part (8) of the main chamber (3) through said connecting passage (9) in order to actuate, upon insertion in said second part (8) of the main chamber (3), the closure of said connecting passage (9).

3. The press head according to claim 1, **characterized in that** said first actuator (11) and said second actuator (13) are constituted by actuators of the electrical type.

4. The press head according to one or more of the pre-

ceding claims, **characterized in that** it comprises means (17) for controlling the axial movement of said main piston (5) with respect to said body (2).

5. The press head according to one or more of the preceding claims, **characterized in that** it comprises means (18) for detecting the force applied by said main piston (5) to the piece (62) being worked.

6. The press head according to one or more of the preceding claims, **characterized in that** said actuator of the electrical type comprises an electric motor (19, 20, 34, 37, 41, 43) of the rotary type and a mechanical transmission that connects the shaft of said electric motor (19, 20, 34, 37, 41, 43) to the stem (6) of said main piston (5) or to said power element (12) and is adapted to convert the rotary motion of the shaft of said electric motor (19, 20, 34, 37, 41, 43) into a translational motion for said stem (6) of the main piston (5) or for said power element (12).

7. The press head according to one or more of the preceding claims, **characterized in that** said actuator of the electrical type is constituted by an electric motor (51, 52, 53, 54) of the linear type, which is connected by means of its shaft to said power element (12) or to the stem (6) of said main piston (5).

8. The press head according to one or more of the preceding claims, **characterized in that** said electric motor (41, 51, 52) is arranged coaxially to said main piston (5).

9. The press head according to one or more of the preceding claims, **characterized in that** one between said first actuator (11) and said second actuator (13) is constituted by an actuator of the pneumatic type (55, 58).

10. The press head according to one or more of the preceding claims, **characterized in that** at least one between said first actuator (11) and said second actuator (13) can be disengaged from said main piston (5) or from said power element (12) for the manual movement of said main piston (5) or of said power element (12) in an emergency.

11. The press head according to one or more of the preceding claims, **characterized in that** it comprises a bypass duct (69), which connects said second part (8) of the main chamber (3) to said service chamber (10) in addition to said connecting passage (9), a flow control valve (70) being arranged on said bypass duct (69) and being capable of being actuated in order to open said bypass duct (69) in an emergency.

12. The press head according to one or more of the preceding claims, **characterized in that** said first part (7) of the chamber (3) is filled with a liquid and can be connected to said service chamber (10) through a bypass duct (72) on which a flow control valve (73) is arranged which can be actuated in order to close said bypass duct (72) in order to contrast the axial movement of said main piston (5) along said chamber (3).

13. The press head according to one or more of the preceding claims, **characterized in that** said mechanical transmission comprises a transmission of the screw-and-nut type.

14. The press head according to one or more of the preceding claims, **characterized in that** said mechanical transmission is constituted by a transmission of the rack-and-pinion type.

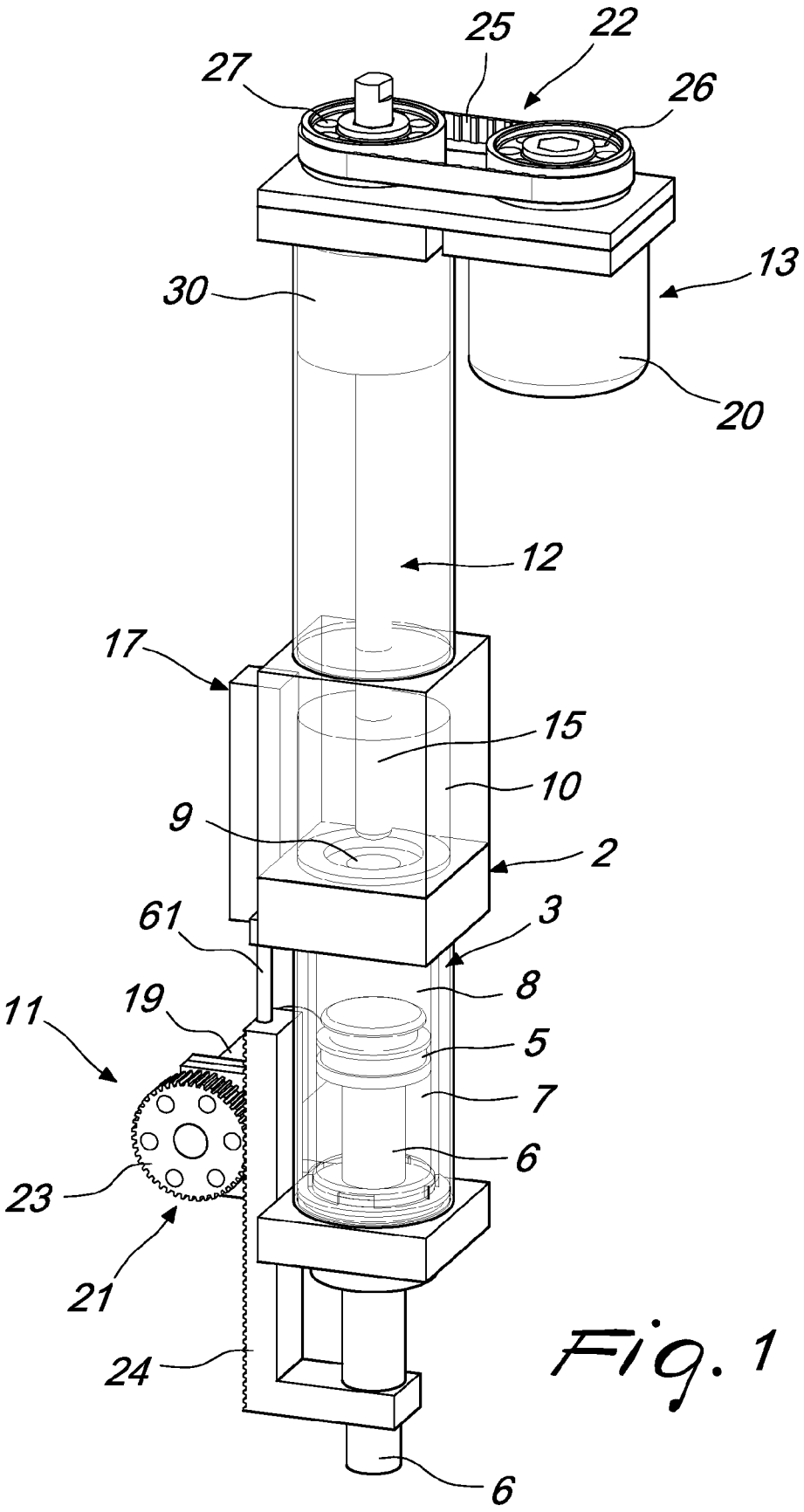

Fig. 1

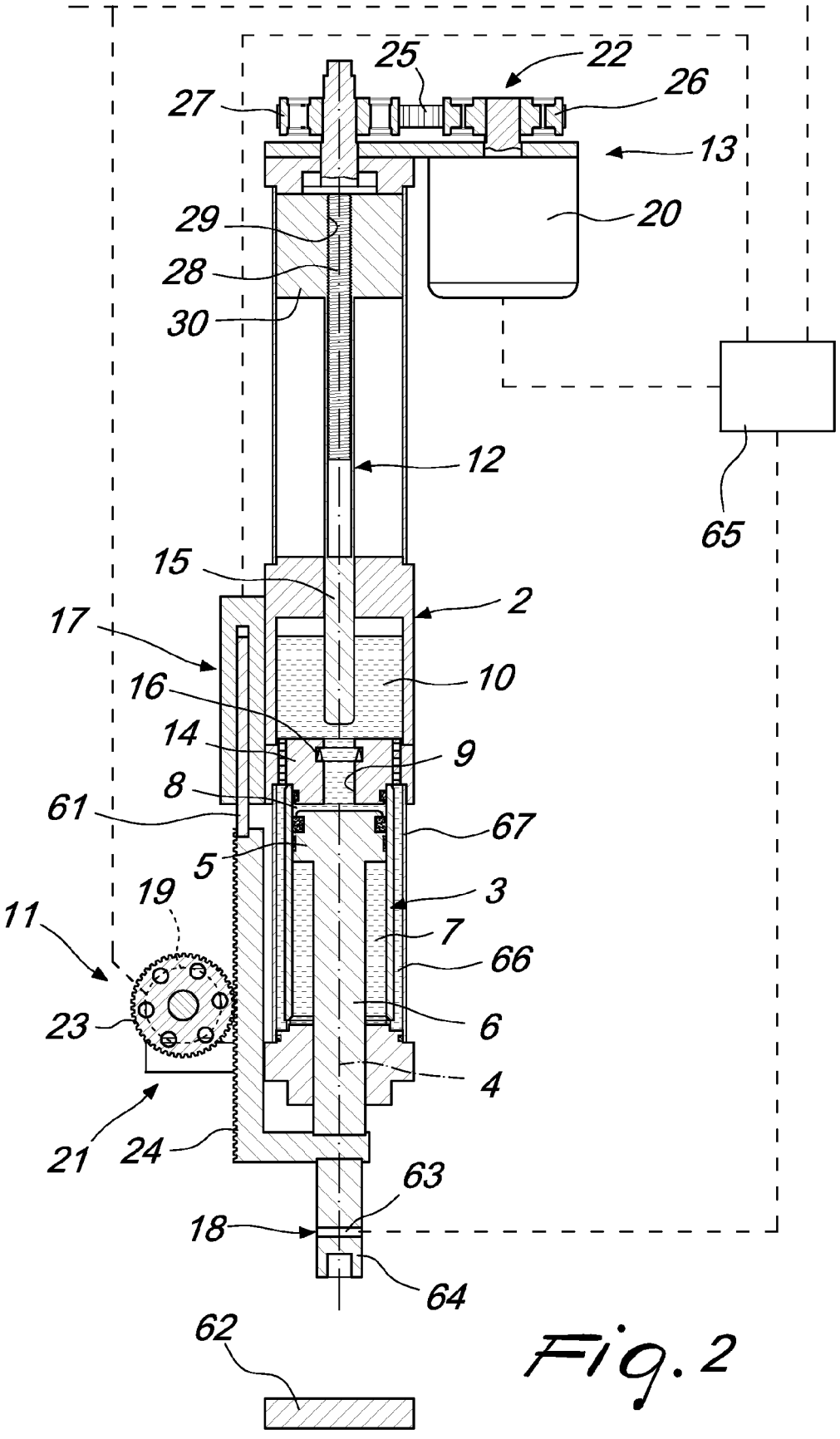
25
22
26
27
13
20
29
28
30
12
65
15
2
17
10
16
14
9
8
61
67
5
3
19
7
11
66
23
6
4
21
24
63
18
64
62

Fig. 2

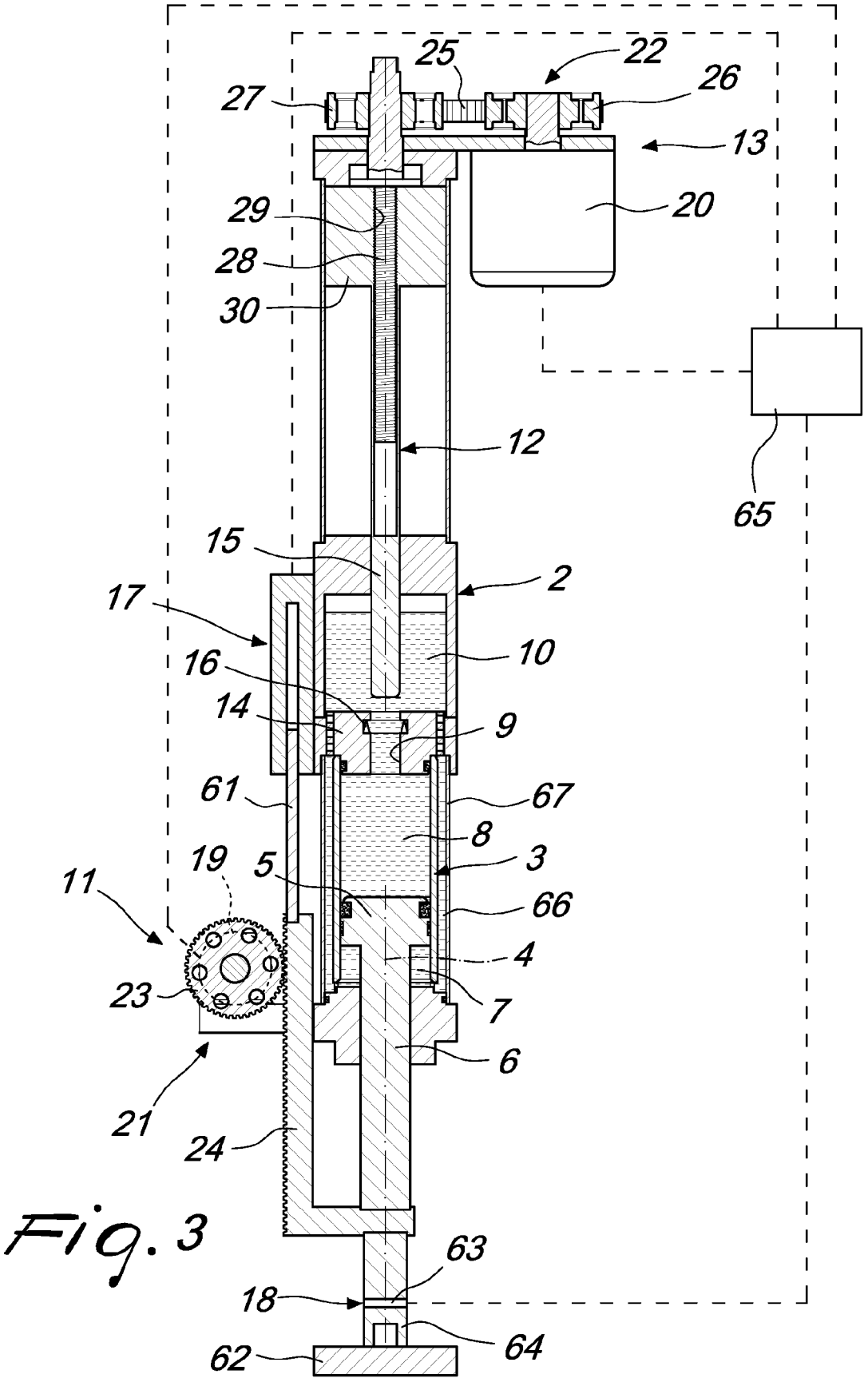
25
22
26
27
13
20
29
28
30
12
65
15
2
17
10
16
14
9
61
67
8
19
5
3
11
66
4
23
7
6
21
24
63
18
64
62

Fig. 3

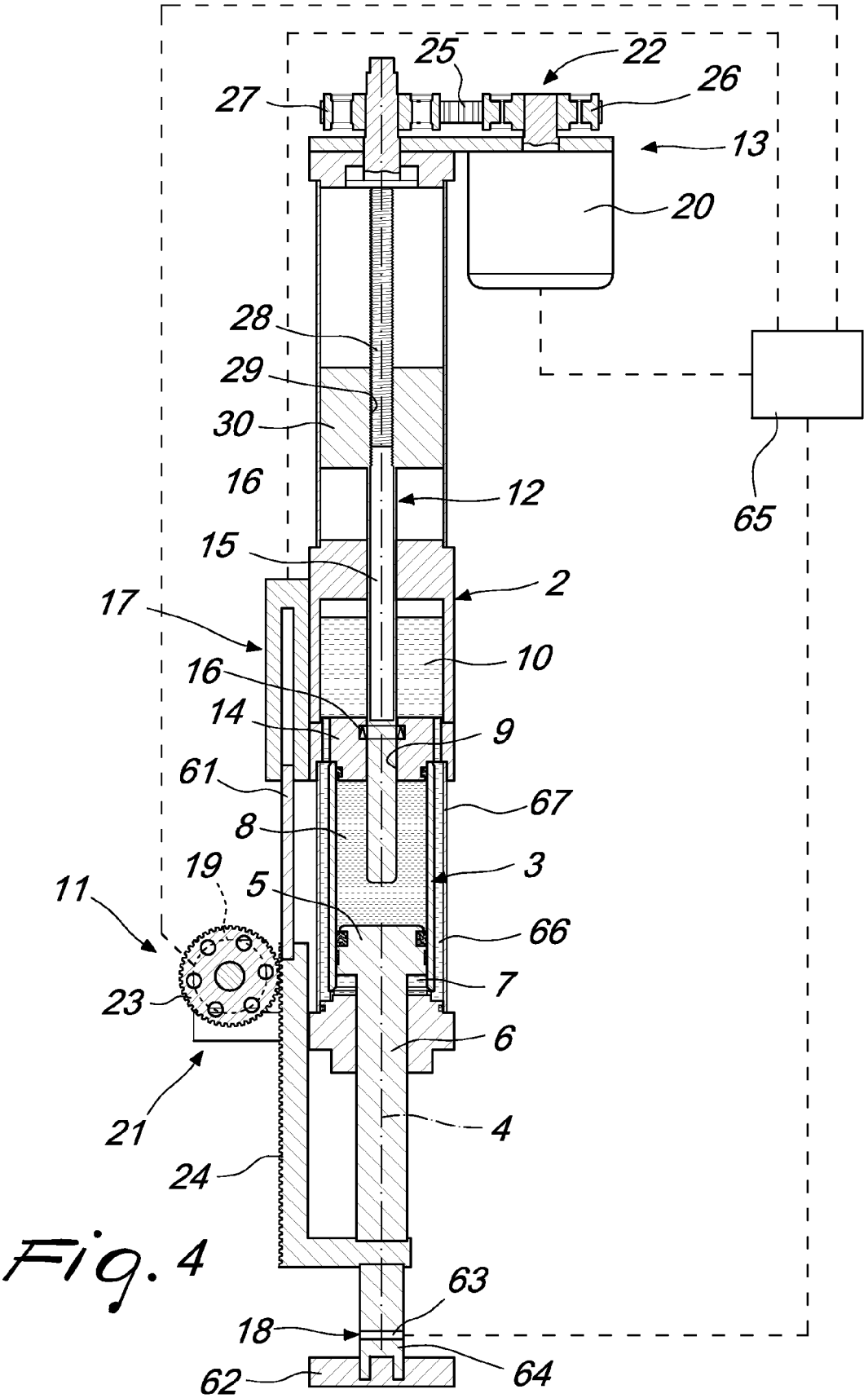
25
22
26
27
13
20
28
29
30
16
12
65
15
2
17
10
16
14
9
61
67
8
3
19
5
11
66
7
23
6
21
4
24
63
18
64
62

Fig. 4

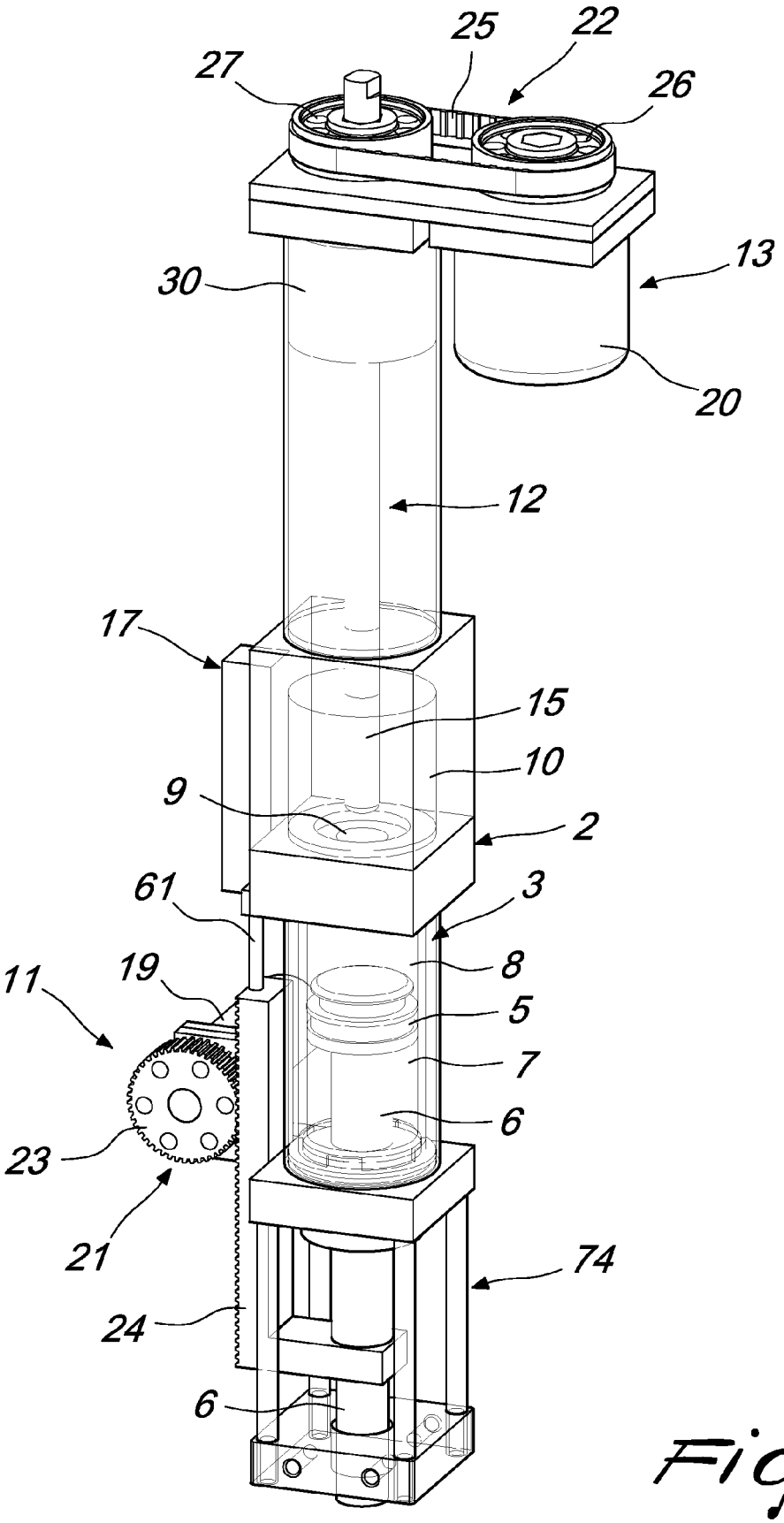

Fig. 5

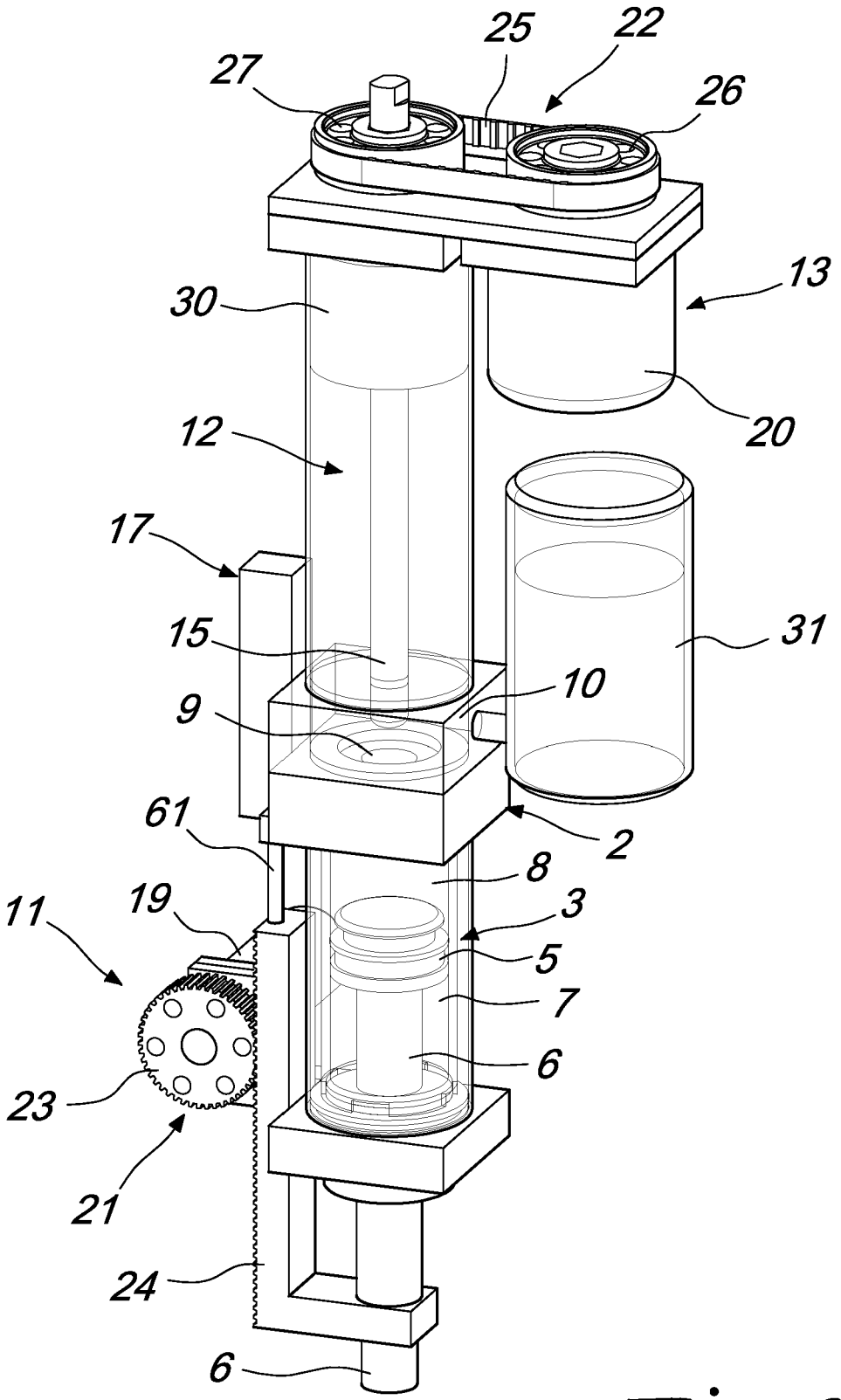

Fig. 6

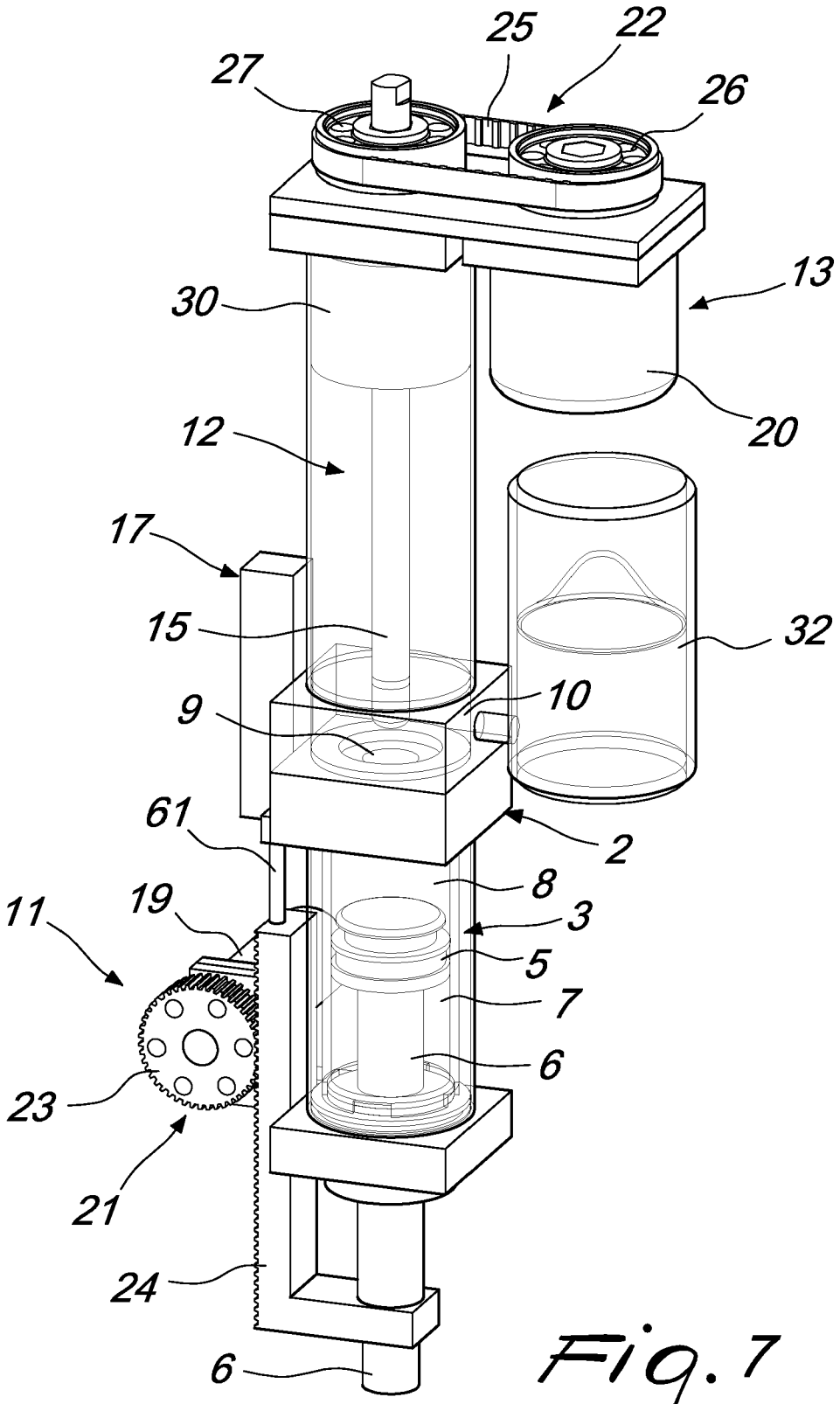

Fig. 7

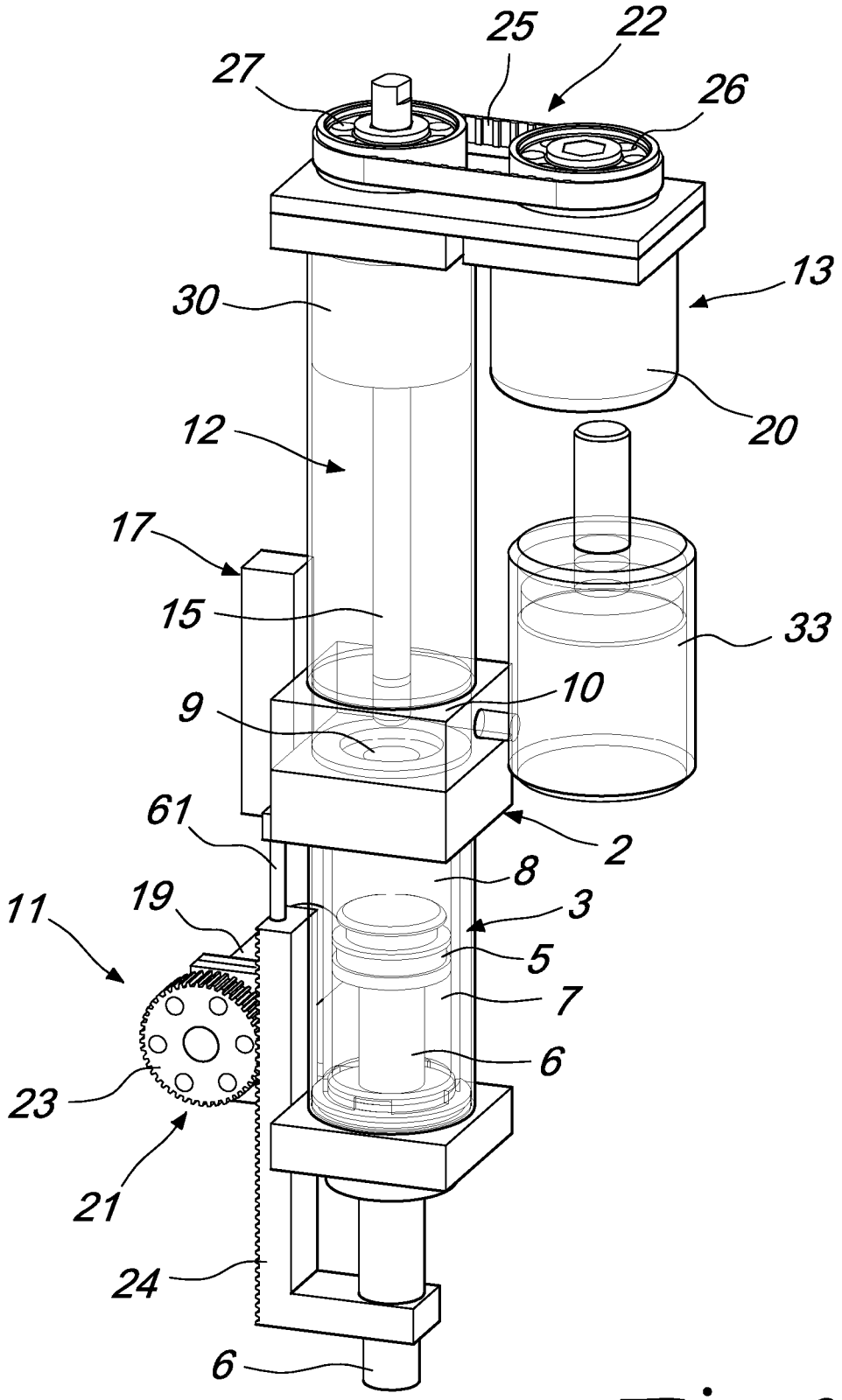

Fig. 8

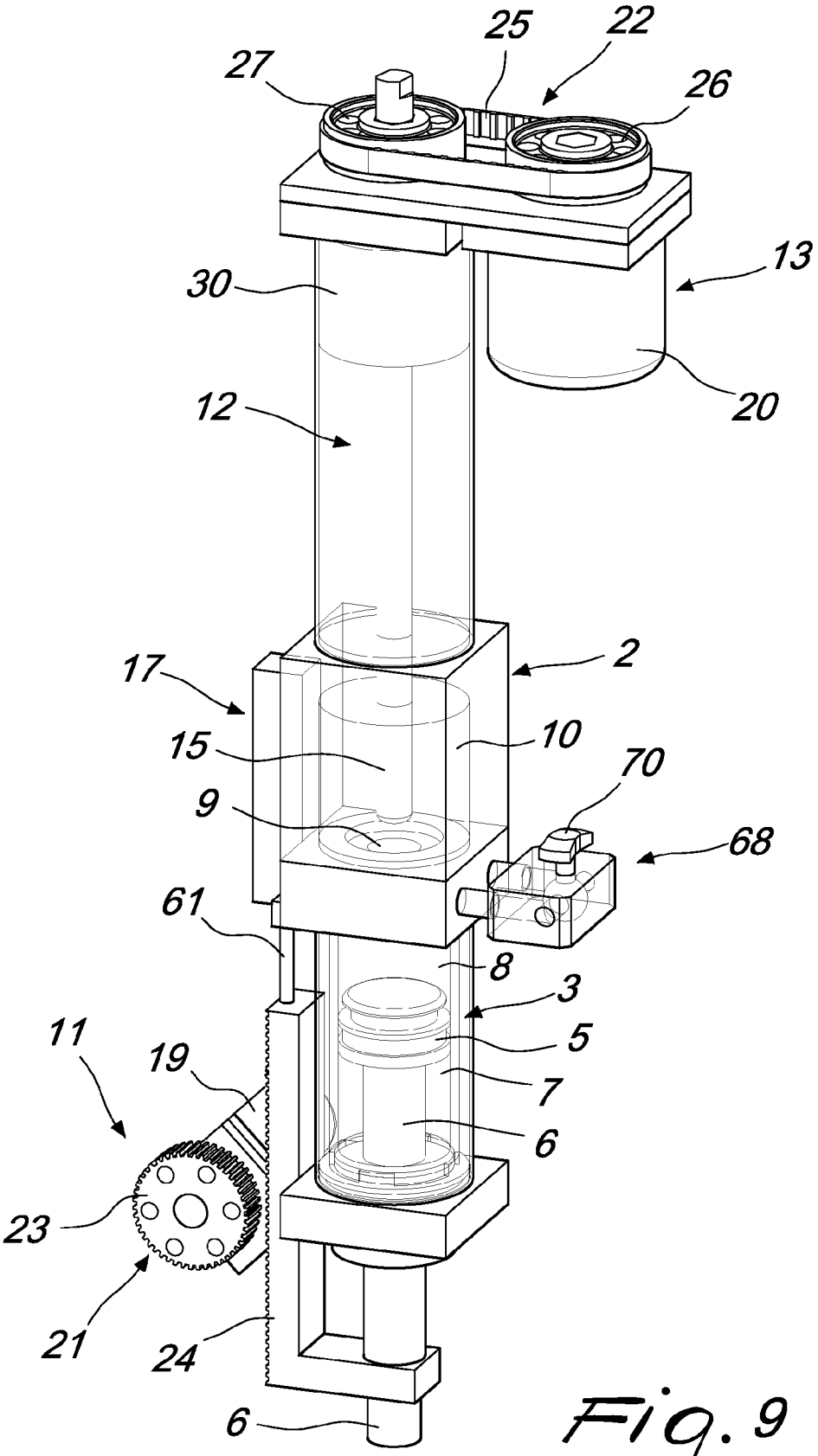

Fig. 9

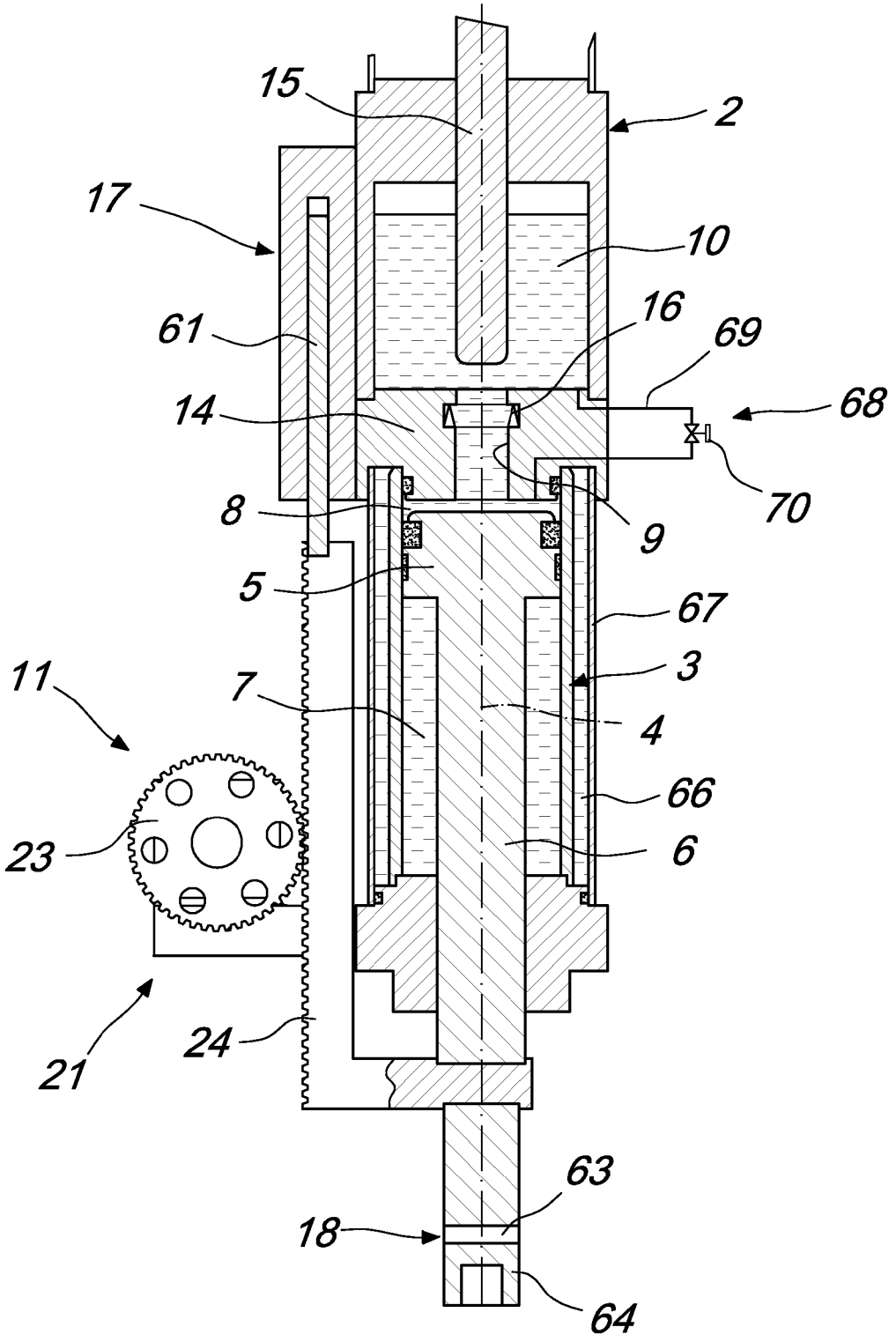

Fig. 10

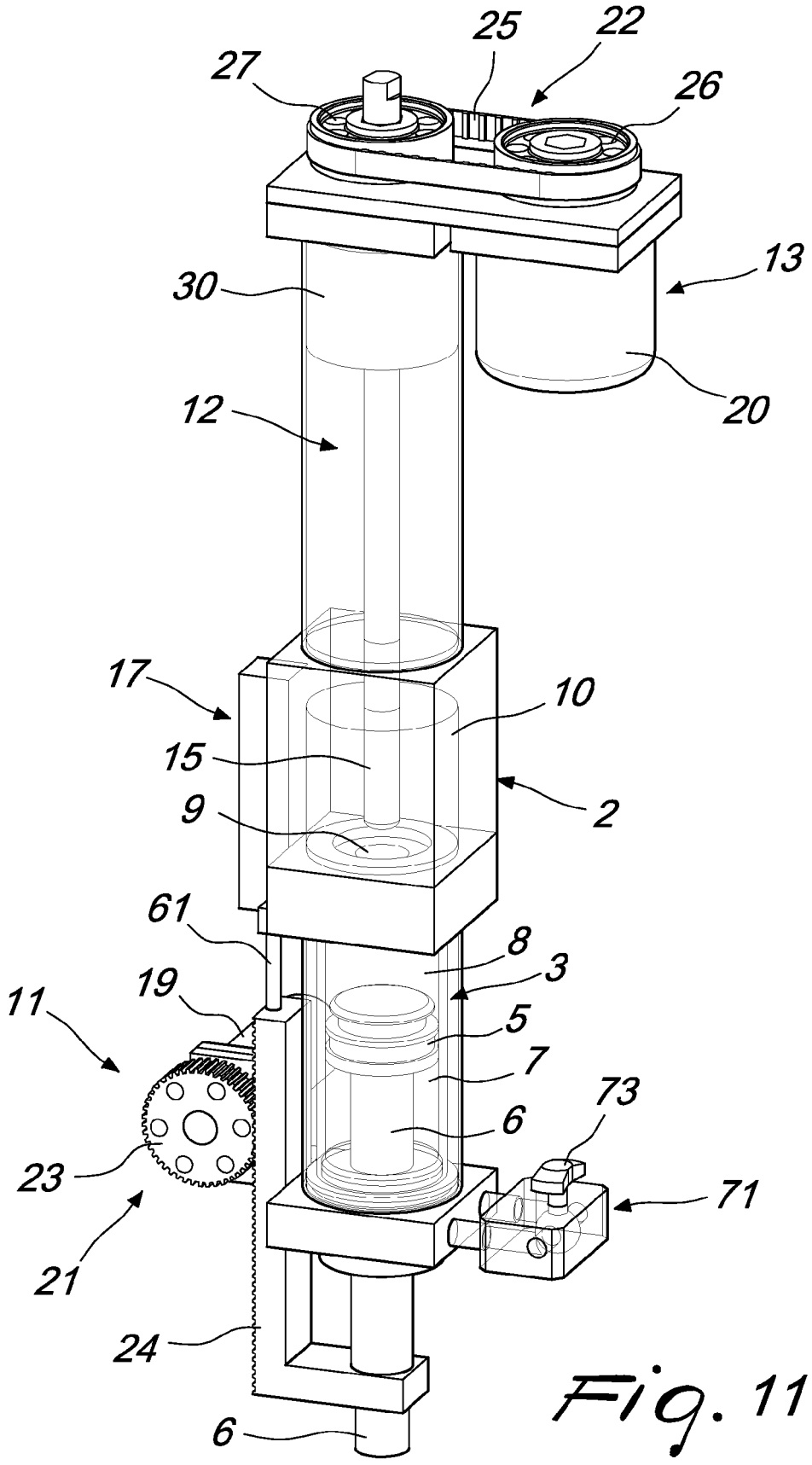

Fig. 11

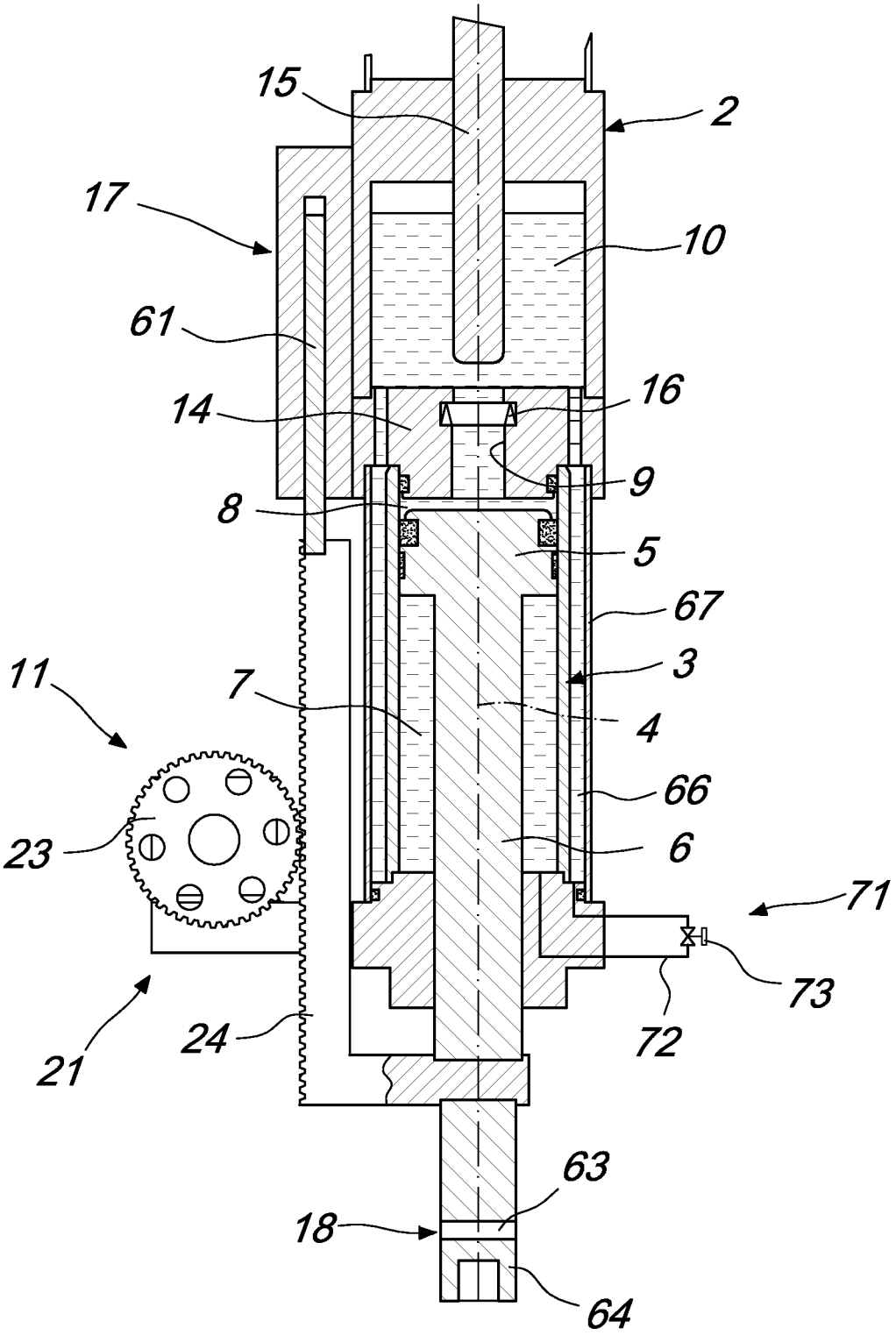

Fig. 12

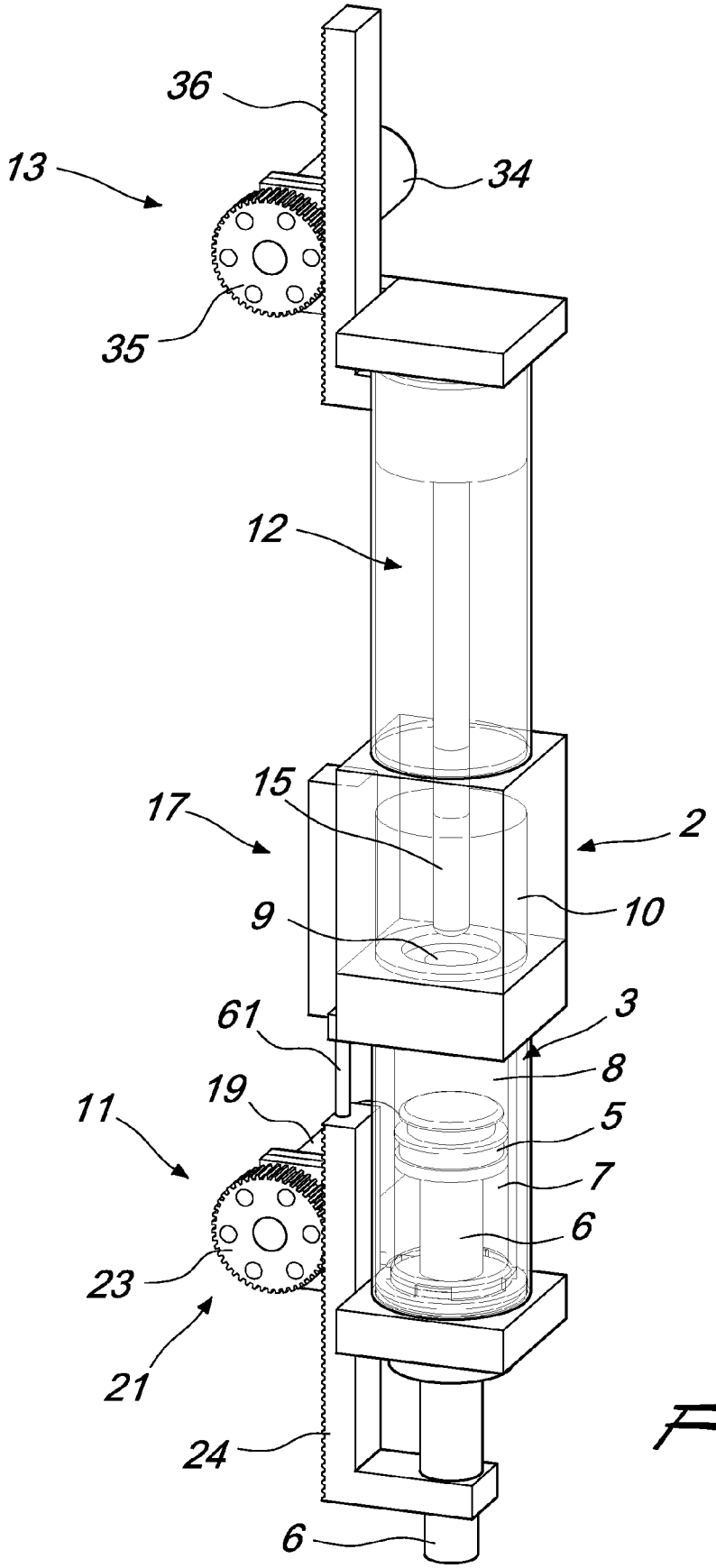

Fig. 13

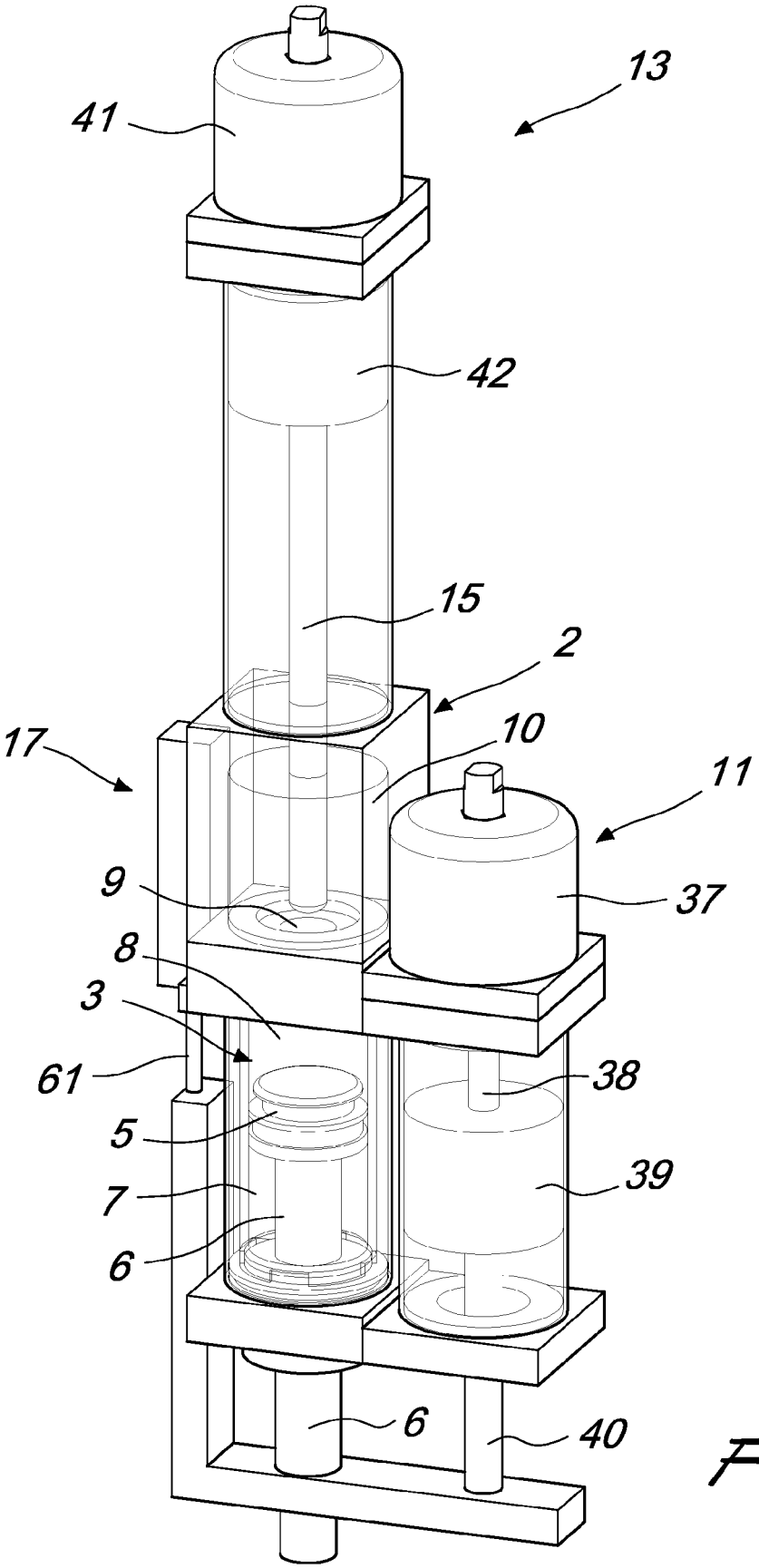

Fig. 14

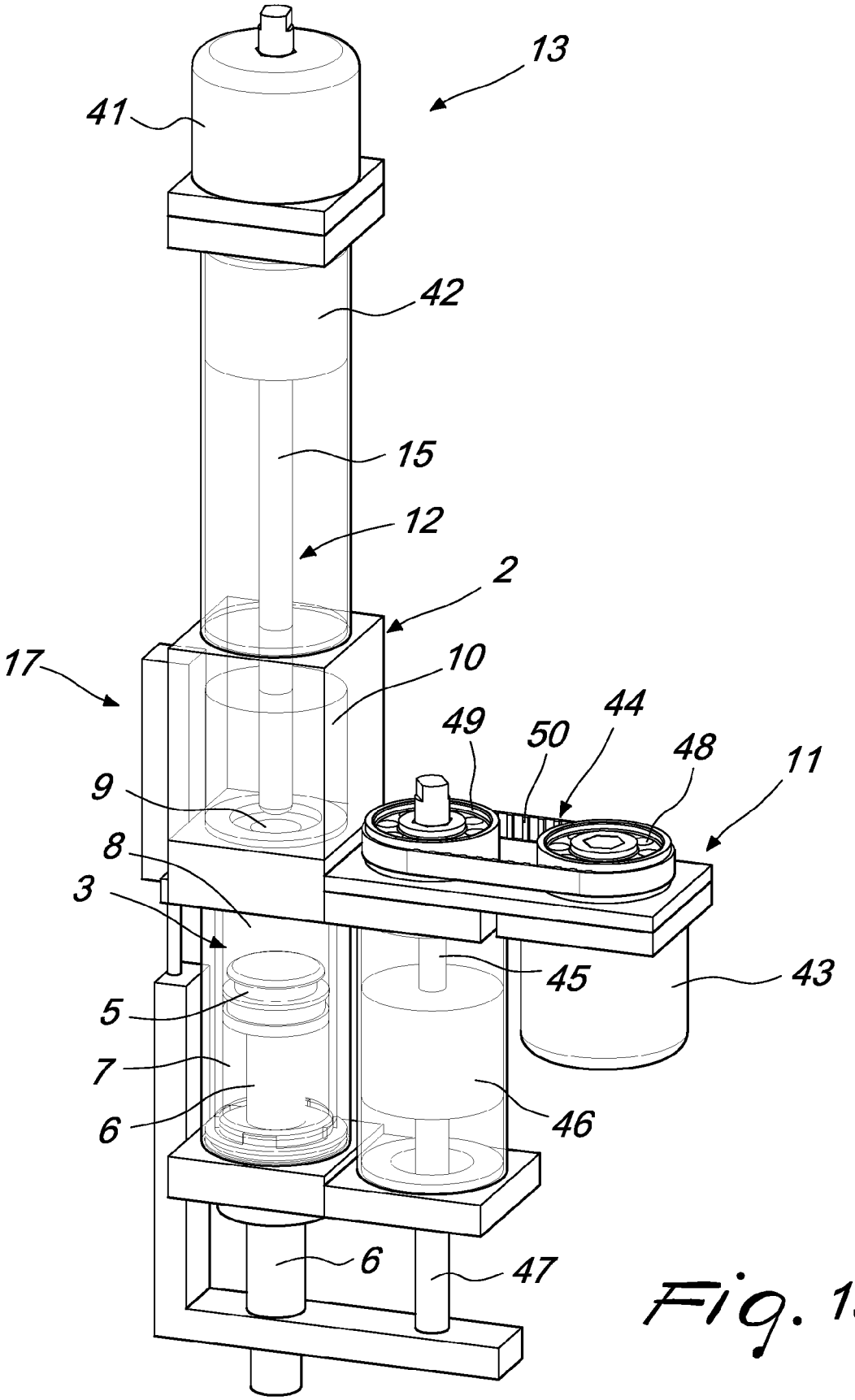

Fig. 15

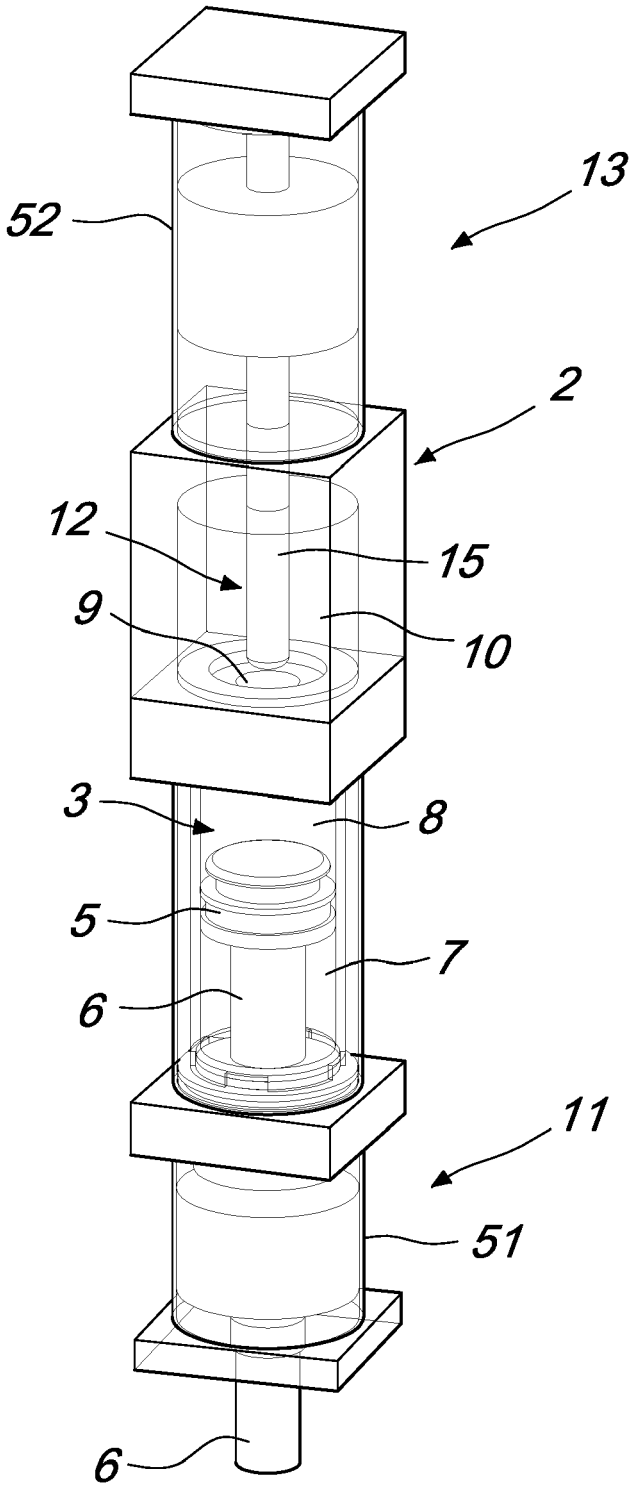

Fig. 16

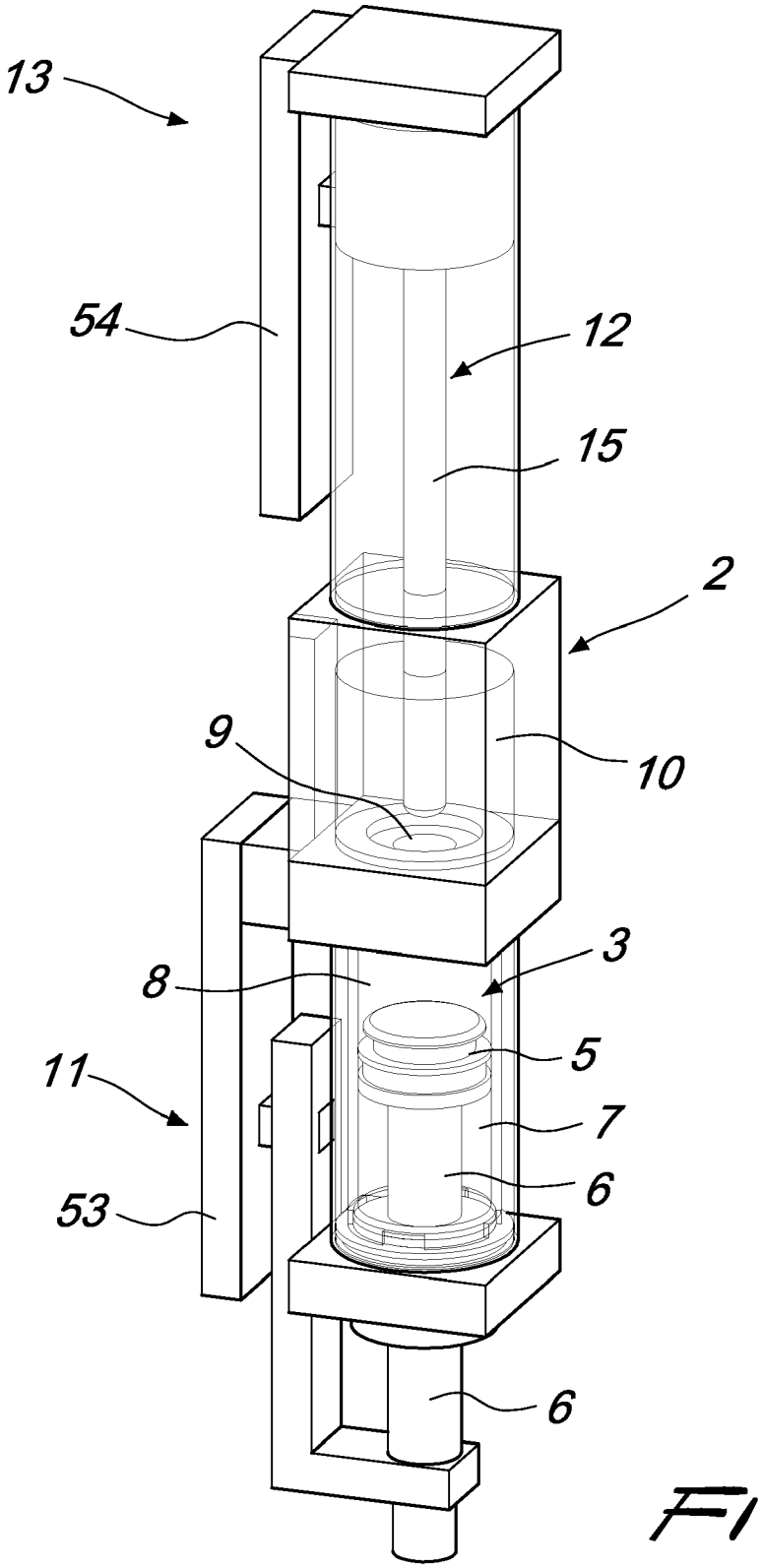

Fig. 17

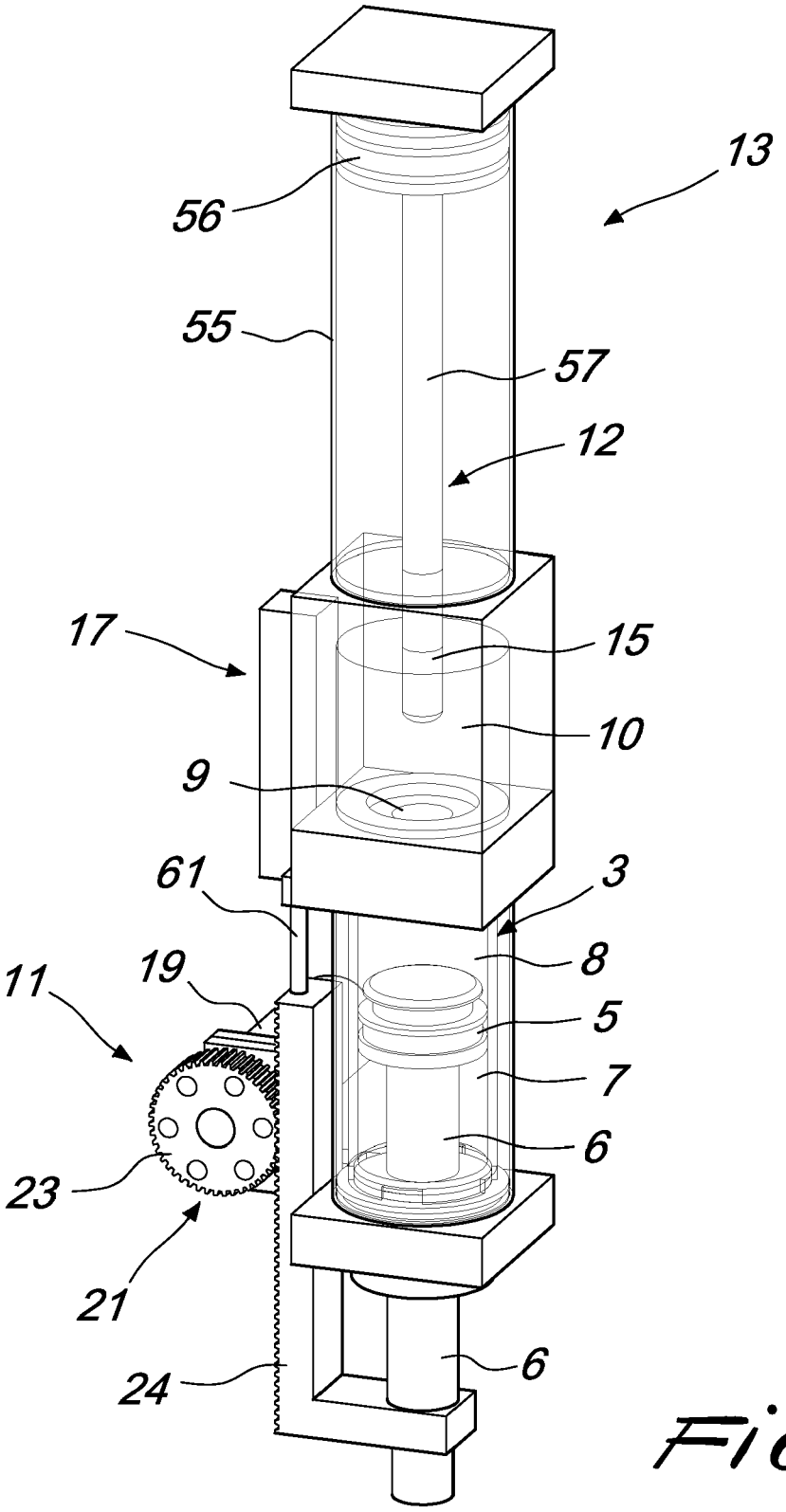

Fig. 18

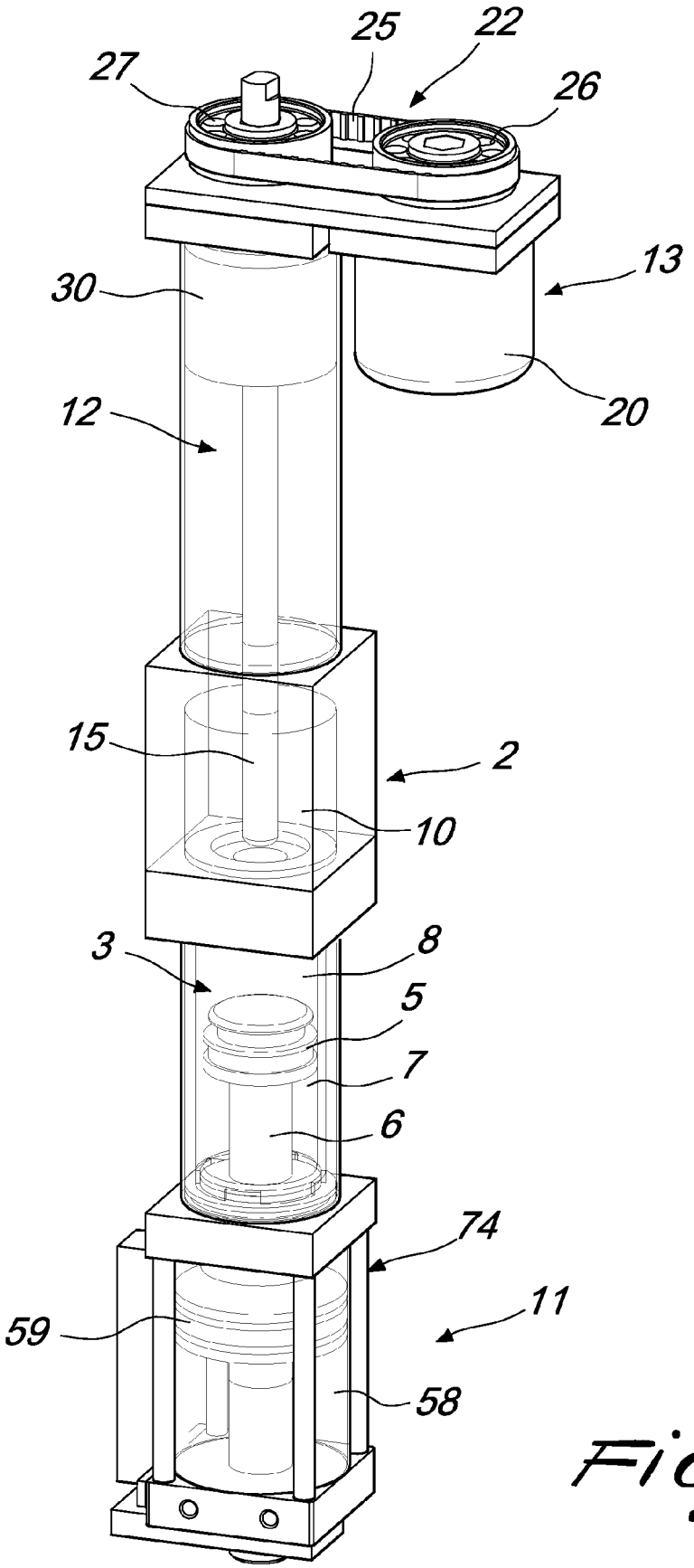

Fig. 19

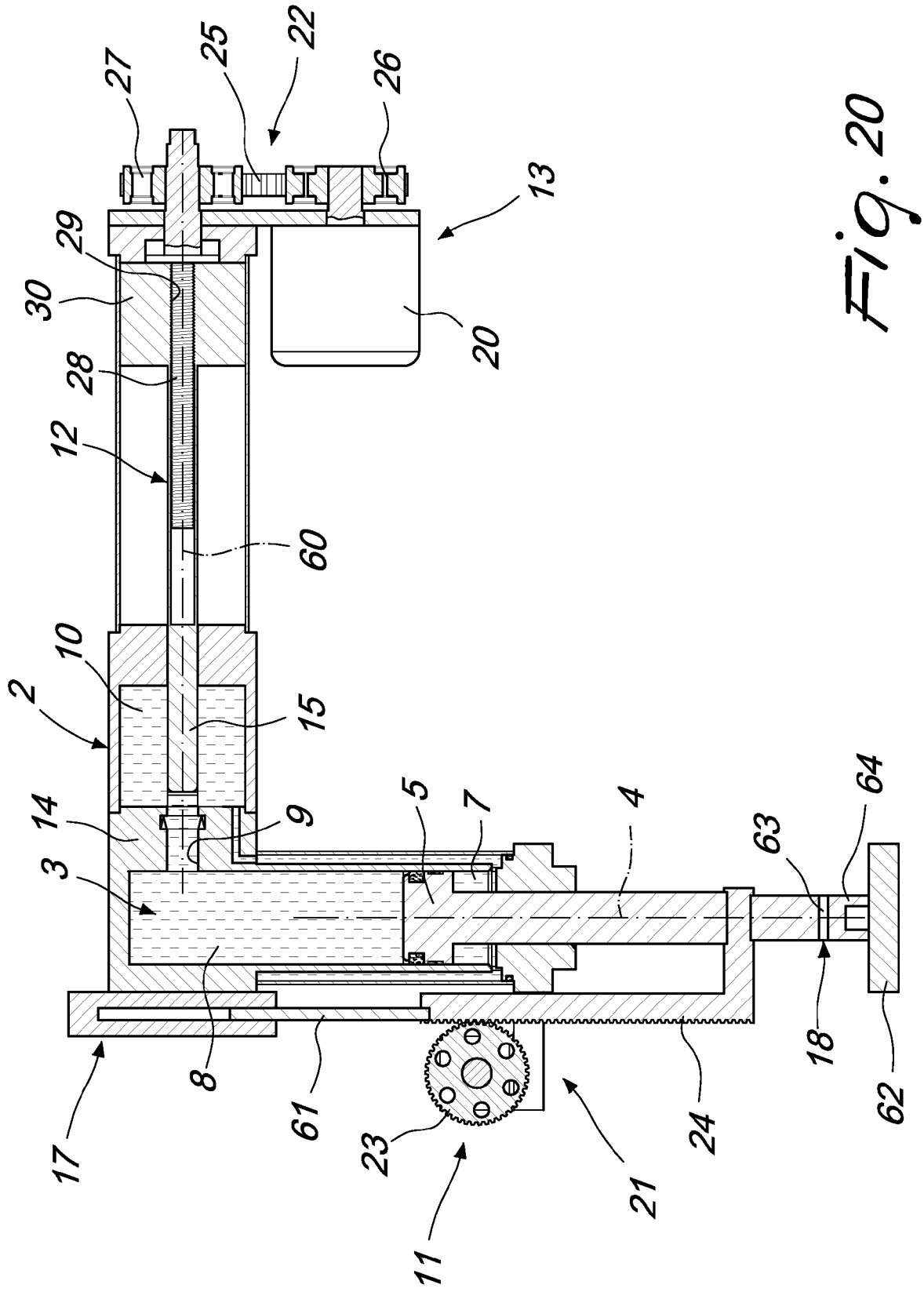
27
25
22
26
13
29
30
20
28
12
60
10
2
15
14
9
5
7
4
63
64
3
18
62
8
61
23
24
17
21
11

Fig. 20

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 16 1928

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	GB 1 578 697 A (SMG SUEDDEUTSCHE MASCHINENBAU) 5 November 1980 (1980-11-05)	1,2	INV. B30B1/24
A	* page 1, lines 12-19 * * page 2, line 47 - line 90; figure 1 *	3-14	B30B1/32 B30B15/16
Y	DE 12 84 303 B (NEMETZ JOSEF) 28 November 1968 (1968-11-28)	1,2	
A	* the whole document *	3-14	
A	US 5 247 871 A (BRASCA CARLO [IT] ET AL) 28 September 1993 (1993-09-28) * column 1, line 5 - column 2, line 4 * * column 5, line 48 - column 6, line 33 *	1-14	
A	JP 10 148201 A (KOYO SEIKO CO) 2 June 1998 (1998-06-02) * abstract; figure 1 *	3	

TECHNICAL FIELDS SEARCHED (IPC)

B30B
F15B
B21J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	1 July 2011	Petrucci, Luigi

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

1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 16 1928

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

01-07-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 1578697 A	05-11-1980	BR 7802079 A	21-11-1978
		DE 2715188 A1	12-10-1978
		FR 2386414 A1	03-11-1978
		IT 1093989 B	26-07-1985
		JP 53125678 A	02-11-1978
		SE 7802772 A	06-10-1978
		US 4155300 A	22-05-1979
DE 1284303 B	28-11-1968	NONE	
US 5247871 A	28-09-1993	DE 69214699 D1	28-11-1996
		DE 69214699 T2	28-05-1997
		EP 0507070 A2	07-10-1992
		IT 1247263 B	12-12-1994
JP 10148201 A	02-06-1998	JP 3688831 B2	31-08-2005

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- IT MI20100727 A **[0071]**