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(72) Feltaláló(k):
Sulzyc, Georg, 68305 Mannheim (DE)
Becke, Stefan, 68804 Altlussheim (DE)
Nöcker, Joachim, 69412 Eberbach (DE)
Tschöke, Tobias, 69121 Heidelberg (DE)

(73) Jogosult(ak):
Haldex Brake Products Aktiebolag, 261 24 Landskrona (SE)

(74) Képviselő:
SBGK Szabadalmi Ügyvivői Iroda, Budapest

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TECHNICAL FIELD OF THE INVENTION

The invention relates to an air suspension assembly for a commercial vehicle which allows a manual change of a level via a lifting/lowering valve construction group, for example for a loading and unloading at a ramp, and on the other hand allows an electrical level control, especially during a drive operation.

PRIOR ART

EP 0 520 148 B1 discloses an air suspension assembly in which a pressurised air source realised as a reservoir is connected pneumatically to air suspension bellows via a levelling control valve construction group and a lifting/lowering valve construction group. The levelling control valve construction group is automatically controlled into an aerating position, a shut-off position or a deaerating position by mechanical actuation corresponding to a change of the level, that is, the distance of an automotive body from a vehicle wheel or a vehicle axis. The levelling control valve construction group is used to set a desired level height during drive operation and to maintain it, which is to be done especially independently of a load, longitudinal and transverse accelerations for example in cornering and of oscillations, unevenness and slopes of the driving surface. Via the lifting/lowering valve construction group, the driver can in a discretionary way change the level for a vehicle at rest, that is, lift or lower the automotive body, which can for example be done to adapt to a ramp for loading and unloading processes. In order to accomplish this, the lifting/lowering valve construction group has a selector lever which can be pivoted around a rotational axis between pivoting positions lifting, lowering and stop with a selector shaft. The selector shaft has cams via which cam followers can be actuated dependently on the angle of rotation of the selector shaft and the selector lever, which in turn actuate inlet valves and outlet valves. In the lifting position, an inlet valve is opened which connects a port of the lifting/lowering valve construction group connected to the pressurised air source bypassing the levelling control valve construction group to an outlet to the air suspension bellows. In the lowering position, on the contrary, an outlet valve is opened which deaerates the outlet leading to the air suspension bellows. In the stop position arranged between the lifting

and lowering positions, the aforementioned inlet and outlet valves are closed, so that the pressure in the air suspension bellows is held constant. In the lifting/lowering valve construction group, a so-called deadman spring is employed which is realised as a torsion spring. The deadman spring brings the selector lever with the selector shaft back into the stop position from a manually induced lifting or lowering position when the driver does no longer exert any forces onto the selector lever. The lifting/lowering valve construction group in addition to that has a pneumatic control port which opens into a pressure chamber. The pressure chamber is limited by a control piston which is formed by a front face of the selector shaft. By presetting a pneumatic control pressure in the pressure chamber, an axial displacement of the selector shaft with the selector lever can be induced, which has as a consequence that a connecting valve is opened while the inlet valve and the outlet valve are closed. For an opened inlet valve, the levelling control valve construction group via the lifting/lowering valve construction group is connected to the air suspension bellows, so that via the levelling control valve construction group the pressure in the air suspension bellows and therefore ultimately the level can automatically be controlled. The position induced by pneumatic pressurising of the pressure chamber corresponds to a drive position which is automatically taken up via a control unit with corresponding control of a solenoid valve and correspondingly controlled control pressure when the vehicle begins its motion and for example a limiting speed is exceeded. This air suspension assembly is based on a pneumatic series connection of the lifting/lowering valve construction group, the levelling control valve construction group and the air suspension bellows (with the mentioned possibilities of bypassing). An electric level control is not possible for the embodiments known from this document.

According to EP 1 382 469 A2, between a compressed air source and air suspension bellows, a 2/2-way valve in an embodiment as a shut-off valve and a 3/2-way valve in an embodiment as an aerating and deaerating valve are interposed. In this context, the two mentioned valves can either be actuated directly and electrically via corresponding electromagnets for an electric level control or be controlled directly and manually via a cam follower each assigned to the valves to induce a lifting or lowering manually.

DE 199 44 873 C1 discloses an air suspension assembly in which in parallel line branches in a first line branch a mechanically actuated levelling control valve construction group is arranged and in a second line branch a solely electrically controlled levelling control valve construction group is arranged. The mechanical levelling control valve construction group in the first line

branch has a level sensor, the output signal of which is fed to a control unit which, also on the basis of this level signal, controls the solely electrically controlled levelling control valve construction group in the other line branch. The control unit also controls a shut-off valve arranged in the first line branch, via which this first line branch can be shut off when the solely electronic levelling control is done in the second line branch. In a further embodiment of this document, a pressurised air source is connected to air suspension bellows via a mechanical levelling control valve construction group, a lifting/lowering valve construction group, a shuttle valve and a solely electrically controlled levelling control valve construction group in a series connection. In this arrangement, the driver can manually take an influence on the level of the air suspension assembly via the lifting/lowering valve construction group as well as via an electrical selector switch via which a manually caused lifting and lowering can also be induced via the solely electronic levelling control valve construction group while there is an orderly voltage supply.

The document DE 199 16 040 B4 discloses an air suspension assembly in which between the pressurised air source and the air suspension bellows which here have two circuits a levelling control valve construction group is interposed. The levelling control valves of the levelling control valve construction group are controllable electrically and pneumatically via a manually actuated lifting/lowering valve construction group. The control units of the levelling control valves according to the DIN symbol used for them produce a control pressure for a control piston of the levelling control valve using an electrically controlled electropneumatic pilot valve from pressure which is fed to the control unit from the lifting/lowering valve construction group.

EP 1 687 159 B1 discloses the parallel arrangement of a solely electrically actuated line branch with a levelling control valve construction group with an aerating and deaerating valve in realisation as a 3/2 solenoid valve and with a shut-off valve in a realisation as a 2/2 solenoid valve and a line branch with a lifting/lowering valve construction group with two manually actuatable valves, that is, an aerating and deaerating valve in a realisation as a 3/2-way valve and a shut-off valve in a realisation as a 2/2-way valve. For a further embodiment of this document, the valves of the levelling control valve construction unit are controlled solely pneumatically, where the control pressure is set by a series connection of an electrically controlled 3/2 solenoid valve and a solely manually controlled 3/2-way valve, so that an electrical as well as a manual influencing of one and the same control pressure is possible. Pressurised air here reaches the respective control port of the levelling control valves from a

reservoir via the manually actuated 3/2-way valves only via the electrically actuated 3/2 solenoid valves.

EP 1 687 160 B1 (in addition to embodiments according to EP 1 687 159 B1) discloses an embodiment in which a reservoir is connected via a shut-off valve and an aerating and deaerating valve to air suspension bellows in a pneumatic series connection. The shut-off valve and the aerating and deaerating valve are controlled alternatively manually via actuation cam followers and solely electrically via solenoid actuators controlled electrically by a control unit.

EP 2 070 741 B1 discloses a lifting/lowering valve construction group which in addition to the manual actuation can also be brought from a passing position into a shut-off position controlled electropneumatically. While for the vehicle in motion and the lifting/lowering valve construction group in the passing position the levelling control is activated and therefore a lifting, holding constant and lowering of the level is possible according to the bringing of the levelling control valve into an aerating position, shut-off position and aerating position, by automatised switching of the lifting/lowering valve construction group into the shut-off position, the automatic levelling control is deactivated. This deactivation of the levelling control is purposely used corresponding to an acceleration of the trailer. For example, the levelling control can be activated if there is a pitching of the vehicle in a braking operation or a spring deflexion due to a transverse acceleration in cornering. If there was no deactivation of the levelling control, spring deflection processes (upward and downward) of the air suspension bellows caused by the respective acceleration would lead to unnecessary levelling control actions with increased use of pressurised air.

ES 2 277 765 A1 discloses an air suspension assembly in which in a drive operation a levelling control is done by a mechanical levelling control valve. The mechanical levelling control valve is actuated by a sensor arm which is coupled to an axis of the vehicle. Between the air suspension bellows and the mechanical levelling control valve, a switching valve is interposed which in a parked position of the vehicle decouples the mechanical levelling control valve from the air suspension bellows and instead of that couples the air suspension bellows to another pneumatic line section. Generally, the switching valve is in that position in which the mechanical levelling control valve is active, biased by a spring. By pressurising of the switching valve with a pneumatic control pressure, this switching valve can be switched into the other switching position in which the other line section is active. The control pressure is set by a manually

actuated lifting/lowering valve which in a position I (DRIVE) does not produce a control pressure so that the mechanical levelling control is active, while in positions II (STOP), IIA (LIFTING) and IIB (LOWERING) as well as III (MAINTAIN RAMP LEVEL) the control pressure is produced, in which way the other line section is active for the pressurising of the air suspension bellows. In the other line section, the aerating and deaerating and a shutting-off of the air suspension bellows can be done by pneumatically piloted 2/2-way valves. The control of the 2/2-way valves is done by the lifting/lowering valve via a first control line branch with mechanic-pneumatic pilot valves actuated via cams of the lifting/lowering valve for a guarantee of the operation states STOP, LIFTING and LOWERING. ES 2 277 765 A1 suggests an additional operating position III of the lifting/lowering valve in which a level at a ramp manually induced via the operating positions II, IIA, IIB is constantly maintained if a loading or unloading of the vehicle is done. In order to achieve this, in a second control line circuit, for the 2/2-way valves further pilot valves are arranged which are mechanically coupled to the sensor arm via a mechanical coupling. During the ramp adaption by manual actuation of the lifting/lowering valve in the operating positions II, IIA, IIB, the coupling is not closed so that the manual actuation of the lifting/lowering valve only results in the control of the 2/2-way valves via the first control line circuit. On the contrary, in the operating position III of the lifting-lowering valve the first control line circuit is deactivated with a simultaneous closing of the coupling, in which way the previously set level with an adaptation to the ramp can be maintained via the actuation of the pilot valves of the second control line circuit via the sensor arm. The two control line circuits are coupled to the respective control ports of the 2/2-way valves via switching valves each. The actuation of the coupling is done pneumatically via a control valve which is also actuated via cams of the lifting/lowering valve.

An automatic return into the operating position I (DRIVE) is enabled via an pneumatic return cylinder acting on the operating lever of the lifting/lowering valve which is actuated electro-magnetically when the beginning of the drive operation is detected.

OBJECT OF THE INVENTION

It is the object of the present invention to suggest an air suspension assembly for a commercial vehicle in which the design and/or the control possibilities for a manual as well as an electrical influencing of the level of the air suspension assembly is/are improved.

SOLUTION

According to the invention, the object of the invention is solved by the features of independent claim 1. Additional preferred embodiments according to the invention are to be seen in the dependent claims.

DESCRIPTION OF THE INVENTION

According to the invention, in the air suspension assembly a lifting/lowering valve construction group is employed with at least one arbitrarily designed, manually actuatable lifting/lowering valve. With the lifting/lowering valve construction group, no direct aerating and deaerating of air suspension bellows of the air suspension assembly is done. Rather, by means of the lifting/lowering valve construction group, a first control pressure is created which is dependent on a manual actuation of the lifting/lowering valve. While for a lifting/lowering valve construction group responsible for a direct aerating and deaerating of the air suspension bellows according to prior art, the valve cross-sections and therefore the dimensions of the valve are given by the necessary aerating and deaerating cross-sections, the constructive leeway is enlarged by using the lifting/lowering valve construction group only for the creation of at least a first control pressure.

Therefore, an electric control according to the invention is achieved by an electric control signal which is created by a suitable control unit. This electric control signal according to the invention does not necessarily act upon an actuator which directly switches an aerating and deaerating valve for the air suspension bellows, which would in itself pose high constructive requirements to the throw force, the throw path of the actuator and/or the absolute value of the electric control signal or set boundary conditions with respect to the aerating and deaerating cross-sections to be switched. Rather, the electric control signal acts upon an electropneumatic control valve which creates a second control pressure dependent on the electric control signal.

According to the invention, in two different ways control pressures are produced, that is, on the one hand a first control pressure via the lifting/lowering valve construction group and a second control pressure via the electropneumatic pilot valve.

According to the invention, a levelling control valve construction group with (at least) one levelling control valve is provided. By means of the levelling control valve, to change the level, an aerating and/or deaerating of at least one air suspension bellows is done. Preferably, the levelling control valve or even the complete levelling control valve construction group is controlled purely pneumatically, that is, not electrically and/or manually.

According to the invention, the at least one levelling control valve can be biased with the first control pressure created in dependence on a manual actuation of the lifting/lowering valve as well as with the second control pressure created by the electrically controlled pilot valve, in which way it is in the end made possible that an electrically controlled (open-loop or closed-loop) level change or maintaining the level constant with a changed load and/or in a drive operation of the commercial vehicle as well as a level change induced arbitrarily manually by a user is possible.

Especially in deviation to an embodiment known from EP 1 687 159 B1, the lifting/lowering valve and the levelling control valve are not arranged in pneumatic series connection, so that pressurised air has to pass both mentioned valves in which way possibly an increased throttle effect results.

It is possible that by the parallel arrangement of the lifting/lowering valve and the pilot valve also the operating security is increased since there is no mutual influencing of the mentioned valves at a malfunction of one of these valves.

The biasing of at least one levelling control valve with the first control pressure and the second control pressure can be done in multiple ways. For a first special embodiment of the invention, this can be provided in an especially simple way by a shuttle valve being arranged upstream of a pneumatic control port of a or the levelling control valve. An inlet of the shuttle valve is biased with the first control pressure, that is, pneumatically connected to the lifting/lowering valve, while the second inlet of the shuttle valve is biased with the second control pressure, that is, pneumatically connected to the pilot valve. The shuttle valve then feeds the higher pressure of the first control pressure and the second control pressure to the control port of the levelling control valve in a possibly constructively simple but still dependable way. Possibly, by use of a shuttle valve, a necessary line length can be decreased, since between the outlet of the shuttle valve and the control port of the levelling control valve only one line is necessary through which

depending on the position of the shuttle valve then the first control pressure or the second control pressure is fed to the control port of the levelling control valve.

For a second special embodiment of the invention, the levelling control valve has two pneumatic control ports, that is, a first control port to which the first control pressure is fed and which therefore is pneumatically coupled to the lifting/lowering valve, and a second control port, to which the second control pressure is fed, so that this second control port of the levelling control valve is pneumatically connected to the pilot valve.

For the creation of the electric control signal for the electropneumatic pilot valve for the creation of the second control pressure there are multiple possibilities. For example, a specific control unit can be provided for this. The specific control unit can be arranged separately from the mentioned construction elements of the air suspension assembly and be coupled with the electropneumatic control valve via an electric control line. It is thinkable that this control unit forms a modular or integral construction unit with at least one mentioned component of the air suspension assembly. For a special embodiment of the invention, a multifunctional control unit is employed. The multifunctional control unit creates at least one electric control signal for at least one electropneumatic pilot valve, in which way the control unit can be used for an electric level control (open-loop or closed loop). Additionally, the multifunctional control unit creates an electric control signal for an arbitrarily designed brake assembly, especially an electromechanical brake, an electropneumatic brake or a pneumatic brake with electronic brake force modulation. For this embodiment, too, the control unit can be realised separately from the mentioned components or be combined or integrated with at least one of the mentioned components into a modular or integral construction unit. To mention only an example, the control unit can be integrated into a brake assembly or a brake control device or an EBS unit.

The levelling control valve construction unit according to the invention can be realised in any way with one or several levelling control valves (of any construction with any number of ports, operating positions and similar) arranged therein. It is possible for the levelling control valves to be realised as a seat valve or as a slide valve.

For a special embodiment of the invention, a levelling control valve of the levelling control valve construction unit is an aerating and deaerating valve in an embodiment as a 3/2-way valve while another levelling control valve of the levelling control valve construction unit is a shut-off valve

realised as a 2/2-way valve. This combination of constructively comparatively simple levelling control valves in spite of this enables reliably the necessary operating positions of the levelling control valve construction unit, that is,

- a shutting-off of the air suspension bellows when the shut-off valve takes up its shut-off position, which is the case independently of the operating position of the aerating and deaerating valve,
- an aerating of the air suspension bellows when the aerating and deaerating valve takes up its aerating position and the shut-off valve takes up its passing position and
- a deaerating of the air suspension bellows when the aerating and deaerating valve takes up its deaerating position and the shut-off valve is switched into its passing position.

In this context, within the framework of the invention, there a switching between the mentioned operating positions of the levelling control valves is achieved at least partially alternatively via the first and second control pressure, while additional further possibilities of actuation shall be included by the present invention.

The use of the invention within the framework of an arbitrarily designed air suspension assembly is possible, which therefore can for example be realised with one or two circuits. In the case of a one-circuit air suspension assembly, the use of a single shut-off valve together with an aerating and deaerating valve can be sufficient. For a two-circuit air suspension assembly, the invention suggests that a port of the aerating and deaerating valve is pneumatically connected to two shut-off valves via a branching. In this way, the two circuits of the air suspension assembly can be shut off separately so that a different aerating and deaerating of the air suspension bellows in the two circuits of the air suspension assembly is made possible. A common control of the two shut-off valves is also possible, however (at least in partial operation regions).

A strict separation of the two circuits is possible in such a way that a change of the pneumatic conditions in the air suspension bellows of the single circuits is only possible via the levelling control valve construction group, for example via the aerating and deaerating valve and the two shut-off valves. If a coupling of the two circuits is desired, between the two circuits a throttle can be interposed which couples the two circuits with each other. Via the throttle characteristics it can be set with which speed pressure differences in the two circuits are balanced or levelled. It

is also possible that instead of the throttle a switchable throttle valve in employed which is switchable by means of pneumatic control, preferably, however, electric control, for example by the control unit. Such a switchable throttle valve is understood to be a throttle valve which has different throttle positions which in the extreme case can mean that the switchable throttle valve has a shut-off position and a throttled coupling position, where a multi-step or continuous change of the throttle characteristics is intended to be also comprised by the invention.

If the operating security is to be considered even at a temporary or permanent drop in the electric power supply, it can be advantageous if in the current-less state of the at least one electromagnetic pilot valve the levelling control valve or the levelling control valve construction group takes up a shut-off position. This results in the pressure biasing of the air suspension bellows being "conserved" for the case of a drop in the electric power supply, in which way especially an undesired aerating or deaerating of the air suspension bellows due to the electric power drop is dependably avoided.

The lifting/lowering valve construction group, too, can be realised in any way with any number of integrated lifting/lowering valves of any construction, any number of the switching positions and any number of the ports.

For a special embodiment of the invention, the lifting/lowering valve construction group has two lifting/lowering valves which each are manually actuatable. One of the lifting/lowering valve creates a first control pressure for the aerating and deaerating valve of the levelling control valve construction group, while the other lifting/lowering valve creates a first control pressure for the shut-off valve (or the several shut-off valves for a multi-circuit air suspension assembly).

In an alternative embodiment, the lifting/lowering valve construction group has a single manually actuatable lifting/lowering valve. This lifting/lowering valve then creates a control pressure for the aerating and deaerating valve as well as a control pressure for the shut-off valve or the shut-off valves. To mention only some examples, a lifting/lowering valve can be realised in such a way that with a manual actuation of an actuation organ the lifting/lowering valve is shifted in a translatory way into different operating positions.

Preferably, the manually actuatable lifting/lowering valve, especially for the case that it creates the control pressure for the aerating and deaerating valve as well as a control pressure for the

shut-off valve or the shut-off valves, is a so-called rotary slide valve, in which via a rotation of an actuation organ several switching positions are taken up; cp. also the prior art mentioned in the beginning.

It is possible that the lifting/lowering valve construction group is equipped with a deadman spring so that after manual induction of a lifting and/or lowering position, an automatic return into a stop position occurs when no manual forces are applied to the actuation organ of the lifting/lowering valve construction group. An integration of a so-called reset-to-ride function into the lifting/lowering valve construction group is also possible. According to a further suggestion of the invention, the lifting/lowering valve construction group is equipped with a latching or locking unit via which a manually induced position (especially a lifting and/or lowering position) can be locked or latched. This has the advantage that for example at a change of a switching position of the lifting/lowering valve construction group against the effect of a spring, the actuation organ does not have to be continuously held by the user but for permanent lifting or lowering processes a once induced switching position can be maintained by means of the latching or locking. Furthermore, a latching or locking can also be advantageous in the transport of a commercial vehicle on a ship where a lowering of the automotive body may be desired permanently.

In a further embodiment of the invention, the latching or locking unit can be latched, unlatched, locked and/or unlocked electrically, electropneumatically or pneumatically so that a lifting or lowering process can for example be automatically ended by unlatching or unlocking of the latching or locking unit, especially when a minimum or maximum level height has been reached. A switching position can also be unlatched or unlocked within the framework of a reset-to-hide function when it is detected that a drive operation of the commercial vehicle is to occur.

An especially compact embodiment of the invention can result if a pneumatic latching, unlatching, locking or unlocking occurs. According to a suggestion of the invention, the second control pressure is used for this which is controlled from the electrically controlled pilot valve and with which the levelling control valve can also be biased so that here the second control pressure is used in a multifunctional way.

While it is possible that at least one shuttle valve, at least one levelling control valve and/or at least one pilot valve is manufactured in a seat construction, a further aspect of the invention suggests to construct one or more of the mentioned valves in a slide construction.

In this respect, preferably a so-called sleeve technology as exemplarily described in the document DE 10 2009 045 734 A1 can also be used.

For the case that the first and second control pressure are fed two different control ports of the levelling control valve, a valve slide of this levelling control valve can be actuated via a first piston which is biased with the first control pressure and via a second piston which can be biased with the second control pressure.

For the further constructive realisation of this idea of a solution there are multiple possibilities. To mention only an example, the valve slide itself can be realised as a kind of stepped piston or realised with such a stepped piston, which therefore integrally forms the first piston and the second piston with two piston surfaces which then can be biased with the respective control pressure. According to a special suggestion of the invention, really two pistons formed separately from each other are employed, however, which actuate the valve slide. The first piston and the second piston are guided displaceably relative to each other, for example against each other. A stop is present via which for a defined relative displacement of the two pistons a movement of the two pistons can be coupled with each other.

According to a special suggestion of the invention, a construction unit is formed with the lifting/lowering valve construction group, the at least one electropneumatic pilot valve, the at least one levelling control valve, the throttle or the switchable throttle valve and/or the control unit, which can be realised as modular or have a common housing. The person skilled in the art will understand that any combination of the aforementioned components is possible in a single construction unit.

"Construction groups" mentioned within the framework of the invention can be formed with one construction element or with several construction elements realised separately from each other, which are coupled with each other via line connections. It is also possible, however, that the individual components of the construction unit are formed in a modular way and can be

connected with each other, for example by flanges. Construction groups in which the individual components are integrated in at least one common housing are also comprised.

Advantageous developments of the invention result from the claims, the description and the drawings. The advantages of features and of combinations of a plurality of features mentioned at the beginning of the description only serve as examples and may be used alternatively or cumulatively without the necessity of embodiments according to the invention having to obtain these advantages. Without changing the scope of protection as defined by the enclosed claims, the following applies with respect to the disclosure of the original application and the patent: Further features may be taken from the drawings, in particular from the illustrated designs and the dimensions of a plurality of components with respect to one another as well as from their relative arrangement and their operative connection. The combination of features of different embodiments of the invention or of features of different claims independent of the chosen references of the claims is also possible, and it is motivated herewith. This also relates to features which are illustrated in separate drawings, or which are mentioned when describing them. These features may also be combined with features of different claims. Furthermore, it is possible that further embodiments of the invention do not have the features mentioned in the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

In the following, the invention is further explained and described with respect to preferred exemplary embodiments illustrated in the drawings.

Fig. 1 - Fig. 6 schematically show different embodiments of an air suspension assembly according to the invention.

Fig. 7 schematically shows a construction group with a 3/2-way valve and a shuttle valve that can be used within the framework of the invention, where the 3/2-way valve has been manual switched into a deaerating position.

Fig. 8 shows the construction unit according to Fig. 7 in an aerating position of the 3/2-way valve.

Fig. 9 schematically shows a construction group with a 2/2-way valve and a shuttle valve that can be used within the framework of the invention, where the 2/2-way valve is in the shut-off position.

Fig. 10 shows the construction group according to Fig. 9, where the 2/2-way valve is in its passing position.

Fig. 11 schematically shows a construction group with a 3/2-way valve that can be used within the framework of the invention, where the 3/2-way valve is in its deaerating position.

Fig. 12 shows the construction group according to Fig. 11 in an electrically controlled aerating position.

Fig. 13 shows the construction group according to Figs. 11 and 12 in a manually controlled aerating position.

Fig. 14 schematically shows a construction unit that can be used within the framework of the invention with a 2/2-way valve in its shut-off position.

Fig. 15 shows the construction group according to Fig. 14 in the electrically controlled passing position.

Fig. 16 shows the construction unit according to Figs. 14 and 15 in the manually controlled passing position.

DESCRIPTION OF THE DRAWINGS

The figures relate to an air suspension assembly 1 for a commercial vehicle, especially a tractor or a trailer. In the figures, pneumatic construction elements with at least partially corresponding function and/or constructive realisation are marked with the same reference signs. Furthermore, pneumatic construction elements corresponding to each other in a figure with respect to constructive realisation and/or function are marked with the same reference signs, where these then are distinguished from each other by the addition of a, b, ... It is also possible that in single

figures a component is marked with a reference sign without a letter, while in another figure, in which a corresponding component has been used multiply, this component is marked with the same reference sign but with the added lower-case letter a, b, ...

According to **Fig. 1**, the air suspension assembly has a reservoir 2, a lifting/lowering valve construction group 3, a construction group 4 and air suspension bellows 5a, 5b, which for the embodiment according to Fig. 1 are assigned to different circuits of the air suspension assembly that here has two circuits. Furthermore, an electrically controlled (open loop or closed-loop) pneumatic brake assembly 6 is shown in Fig. 1. The mentioned components as shown are coupled with each other via electrical and pneumatic line connections, which in the following will be explained in more detail.

The lifting/lowering valve construction group 3 serves to enable an arbitrary induction of a level change with a change of the pneumatic biasing of the air suspension bellows 5a, 5b by the user by means of manual manipulation in order to hold a level at a change of load and/or for arbitrary lifting or lowering of the automotive body with the commercial vehicle at rest. For the embodiment shown, the lifting/lowering valve construction group 3 has two lifting/lowering valves 7a, 7b, which here are each realised as an aerating and deaerating valve 9a, 9b in a realisation as 3/2-way valves actuatable via an actuation organ 8a, 8b. The lifting/lowering valve construction group 3 comprises a port 11 which is directly coupled to the reservoir 2. Furthermore, the lifting/lowering valve construction group 3 comprises a deaerating port 12 and two further ports 64, 65. The lifting/lowering valves 7a, 7b each comprise a port 13a, 13b which are connected to the port 11 and therefore the reservoir 2, a port 14a, 14b which are connected to the deaerating port 12, and ports 15a, 15b of which the port 15a of the lifting/lowering valve 7a is connected to the port 64 and the port 15b of the lifting/lowering valve 7b is connected to the port 65. Without the application of manual actuation forces onto the actuation organs 8a, 8b, the lifting/lowering valves 7a, 7b are in the deaerating position active in Fig. 1, in which the lifting/lowering valves 7a, 7b connect the ports 14a, 14b to the ports 15a, 15b so that the ports 64, 65 are connected to the deaerating port 12, while the ports 13a, 13b are shut off. With the application of manual actuation forces, the lifting/lowering valves 7a, 7b can be individually or together and arbitrarily be brought into a different switching position by the user, in which the lifting/lowering valves 7a, 7b can connect the port 13a, 13b to the port 15a, 15b.

The construction group 4 has a port 16, which is directly coupled to the reservoir 2. Furthermore, the construction group 4 has ports 17, 18 which are each directly and pneumatically connected to a port 64, 65. The construction group 4, too, has a deaerating port 19. Furthermore, the construction group 4 has ports 20, 21 which are each connected with air suspension bellows 5a, 5b of the two circuits.

Integrated into the construction group 4 is a levelling control valve construction group 22. The levelling control valve construction group 22 serves for the controlled (open-loop or closed-loop) shutting-off, aerating and deaerating of the ports 20, 21 and therefore of the air suspension bellows 5a, 5b for the maintaining of a level, for lifting and/or for lowering. For the embodiment shown, the levelling control valve construction group 22 has an aerating and deaerating valve 23 in a realisation as a 3/2-way valve 24, downstream of which at least one shut-off valve 25 in a realisation as a 2/2-way valve 26 is arranged. For the two-circuit realisation of the air suspension assembly 1 according to Fig. 1, two corresponding shut-off valves 25a, 25b are provided. The 3/2-way valve 24 comprises a port 27 which is directly connected to the port 16 and therefore the reservoir 2, while a port 28 is connected to the deaerating port 19. A further port 29 is connected to a port 30, which here is realised as the ports 30a, 30b of the shut-off valves 25a, 25b, including branching of the line coming from the port 29. Along with the ports 30a, 30b, the shut-off valves 25a, 25b each have a port 31a, 31b, which are connected to a port 20, 21 and therefore an air suspension bellows 5a, 5b of one of the two circuits. The levelling control valve construction group 22, that is, the aerating and deaerating valve 23 as well as the shut-off valves 25a, 25b are purely pneumatically controlled, in order to do which the aerating and deaerating valve 23 comprises a control port 32 and the shut-off valves 25a, 25b comprise control ports 33a, 33b. Without (sufficient) pneumatic biasing of the control ports 32, 33a, 33b, due to the biasing of the valves 22, 25a, 25b by a spring each, these valves 22, 25a, 25b are in the switching positions active in Fig. 1, that is, the aerating and deaerating valve 23 is in the deaerating position, while the shut-off valves 25a, 25b are in their shut-off position. At biasing of the control port 32 with a sufficient control pressure, the aerating and deaerating valve 23 is switched into the aerating position, while with a sufficient pressure biasing of the control ports 33a, 33b of the shut-off valves 25a, 25b these are switched into the passing position.

The levelling control valve construction group 22 operates as follows:

Depending on the switching position of the aerating and deaerating valve 23, the port 29 is connected to the deaerating port 19 or the reservoir 2. In the shut-off position of the shut-off valves 25a, 25b, without regard for the switching position of the aerating and deaerating valve 23, the air suspension bellows 5a, 5b are shut off. With the bringing of the shut-off valves 25a, 25b into the passing position, the air suspension bellows 5a, 5b are connected to the aerating and deaerating valve 23, so that - depending on the switching position of the aerating and deaerating valve 23 - the aerating or deaerating of the air suspension bellows 5a, 5b can occur. Generally, for the shut-off valves 25a, 25b, the air suspension bellows 5a, 5b of the different circuits can be pneumatically fully separated from each other. For the embodiment shown in Fig. 1, between the ports 20, 21 a throttle 34 is interposed which connects the air suspension bellows 5a, 5b of the two circuits. While it is generally possible that the throttle 34 is constantly interposed between the air suspension bellows 5a, 5b, Fig. 1 shows an embodiment in which the throttle 34 is part of a switchable throttle valve 35. According to Fig. 1, the throttle valve 35 is realised as a 2/2-solenoid valve 36, where to two ports of the throttle valve 35 are each coupled with a port 20, 21 and in one switching position of the throttle valve 35 the throttle 34 comes into effect while in the other switching position the connection of the air suspension bellows 5a, 5b of the two circuits is shut off. For the embodiment according to Fig. 1, the throttle valve 35 has an electric control port 37. The throttle 34 or the throttle valve 35 is also integrated into the construction group 4.

Additionally integrated into the construction group 4, there is an electropneumatic pilot valve 38. Here, this function is fulfilled by two pilot valves 38a, 38b realised as aerating and deaerating valves 39a, 39b, which here take the shape of 3/2-solenoid valves 40a, 40b with electric control ports 41a, 41b. The pilot valves 38a, 38b each have a port 42a, 42b which is directly connected to the reservoir 2 via the port 16, a port 43a, 43b which are each connected to the aerating port 19, and a port 44a, 44b. Without a (sufficient) electric control signal to the control ports 41a, 41b, the pilot valves 38a, 38b due to a spring are in the switching position active in Fig. 1 in which the port 44a, 44b are connected to the ports 43a, 43b and are therefore being deaerated. At a (sufficient) pressurising of the control ports 41a, 41b with the respective electric control signals, a switching of the pilot valves 38a, 38b from the deaerating position into the aerating position can be done in which the ports 44a, 44b are connected to the ports 42a, 42b and therefore the reservoir 2. Since the control ports 41a, 41b are fed separate electrical control signals, the pilot valves 38a, 38b can be switched together or separately.

A further component of the construction group 4 is a shuttle valve 45, which here is realised by two shuttle valves 45a, 45b. The shuttle valves 45a, 45b each comprise inlet ports 46a, 46b and 47a, 47b and an outlet port 48a, 48b. The inlet ports 46a, 46b each are connected with a port 17, 18 and therefore connected via the ports 64, 65 with the lifting/lowering valve construction group 3; here they are connected with the ports 15a, 15b of the lifting/lowering valves 7a, 7b. The inlet ports 47a, 47b, on the contrary, within the construction group 4 are connected with the ports 44a, 44b of the pilot valves 38a, 38b. The outlet ports 48a, 48b are connected to the pneumatic control ports 32, 33a, 33b of the levelling control valve construction group 22, where the outlet port 48a is connected to the control port 32 of the aerating and deaerating valve 23, while the outlet port 48b is directly connected to both pneumatic control ports 33a, 33b of the shut-off valves 25a, 25b via a branching.

The air suspension assembly 1 has a control unit 49. A measuring signal of a sensor 50, which can be integrated into the construction group 4, is fed to the control unit 49. The sensor 50 preferably is a path sensor for detecting the level of the automotive body, where alternatively or cumulatively a pressure sensor for detecting a pressure, for example in at least one of the circuits, can be present. Furthermore, a measuring signal of a sensor 51 is fed to the control unit 49, where the sensor 51 preferably is a wheel revolution speed sensor. The control unit 49 determines electric control signals which, as shown with dash-dotted lines, are fed to the construction group 4 via electric control ports 52 and there are fed to the control ports 41a, 41b and 37. The invention also comprises a control of the electric biasing of the control ports 41a, 41b, 37 in this context.

Furthermore, the control unit 49 is responsible for the control of electric or electropneumatic components of the brake assembly 6. For the embodiment shown, a brake control device 53 in the brake assembly 6 is provided, to which an electric control signal of the control unit 49 is fed. Furthermore, a supply pressure is fed to the brake control device 53 via a supply line 54 and a pneumatic brake control pressure of a brake line 56 is fed to a pneumatic control port 55. Alternatively or cumulatively, a brake control can also be achieved via an electric brake signal of a brake line 57, where the pneumatic and electric brake control can be realised as redundant with priority of the electric brake control. It is also possible that via the electric control functions only a brake modulation, an ABS control or similar is done. The brake control device 53 controls pressures for a spring brake chamber and for an operating brake chamber of a combined spring brake cylinder 58.

Without limiting the invention to the functions mentioned in an exemplary way in the following, the air suspension assembly 1 according to the invention can be operated as follows:

a) During drive operation, the lifting/lowering valve construction group 3 is in the switching position active in Fig. 1. This results in the inlet ports 46a, 46b of the shuttle valves 45a, 45b being deaerated, so that the outlet ports 48a, 48b for pressure-less inlet ports 47a, 47b are deaerated in any case and for pressurised inlet ports 47a, 47b are biased with the pressures on the inlet ports 47a, 47b. Accordingly, via the pilot valve 38a, a control pressure 59 in the following referred to as "second control pressure", which is dependent on the switching position of the pilot valve 38a, can be fed to the control port 32 of the aerating and deaerating valve 23. Correspondingly, a second control pressure 60 can be fed to the control ports 33a, 33b of the shut-off valves 25a, 25b via the outlet port 48b and the inlet port 47b from the pilot valve 38b. In this way, dependent on the electric biasing of the electric control ports 41a, 41b of the pilot valves 38a, 38b, a pneumatic control of the levelling control valve construction group 22 for a shutting-off of the air suspension bellows 5a, 5b, an aerating or a deaerating can be achieved.

b) Generally, it is possible that for the vehicle at rest, too, for example during a loading and unloading of the vehicle, a levelling control is done by the control unit 49, which can for example be done with the aim of holding constant a level during loading and unloading or an automatic level change, especially for an automatic ramp adaption or for a lowering of the automotive body on a ship or similar.

c) If there is a manual actuation of the lifting/lowering valve construction group 3, the pilot valves 38a, 38b are in the deaerating position active in Fig. 1, where a deactivation of the electric control of the control ports 41a, 41b can be done by the control unit 49, especially with a detecting of the manual actuation of the lifting/lowering valve unit via a suitable sensor or with detecting a (longer) time of the vehicle remaining at rest, the deactivating of the ignition or similar. Therefore, the inlet ports 47a, 47b of the shuttle valves 45a, 45b, too, are deaerated. This results in the shuttle valves 45a, 45b leaving the position active in Fig. 1 at the actuation of the lifting/lowering valve construction group 3. With the actuation of the lifting/lowering valve 7a into the aerating position, the pressure of the reservoir 2 is fed to the control port 32 as a first control pressure 61 via the ports 11, 13a, 15a, 64, 17, 46a, 48a, in which way the aerating and deaerating valve

23 according to the manual actuation of the lifting/lowering valve 7a can be manually switched from the aerating position into the deaerating position. Correspondingly, with a manually switching of the lifting/lowering valve 7b into the aerating position, pressurised air from the reservoir via the port 11, 13b, 15b, 65, 18, 46b, 48b is fed to the pneumatic control ports 33a, 33b as a second control pressure 62, in which way these pneumatic control ports 33a, 33b with manual actuation of the lifting/lowering valve 7b can be switched into the passing position. Without actuation of the actuation organs 8a, 8b of the lifting/lowering valves 7a, 7b the air suspension bellows 5a, 5b are shut off. If only the actuation organ 8b is actuated, this results in the air suspension bellows 5a, 5b being deaerated. If, on the contrary, both actuation organs 8a, 8b are actuated, aerating of the air suspension bellows 5a, 5b occurs.

Additionally, according to demand, the throttle valve 35 can be switched from the throttle position into the passing position by electric biasing of the control port 37 via the control unit 49.

For the embodiment shown, the levelling control valve construction group 22, the shuttle valves 45a, 45b, the pilot valves 38a, 38b, the path sensor 50 and the throttle valve 36 are integrated into a common housing 63 of the construction group 4, where at least one of the mentioned construction elements may be arranged outside such a housing 63 and integrated via line connections. A modular design of the construction unit 4 is also thinkable.

For the embodiment according to Fig. 1, the aerating and deaerating valve 23 on the one hand and the shut-off valves 25a, 25b on the other hand each have a single control port 32, 33a, 33b, to which alternatively either the first control pressure 61 or 62 or the second control pressure 59 or 60 can be fed, which is made possible by the use of the shuttle valves 45a, 45b. With an embodiment that in all other aspects is equivalent, for the embodiment according to Fig. 2, the shuttle valves 45a, 45b have been dispensed with. For this embodiment, the aerating and deaerating valve 23 and the shut-off valves 25a, 25b each have two pneumatic control ports 66, 67 or 68a, 68b and 69a, 69b. The port 15a of the lifting/lowering valve 7a here is directly connected to the pneumatic control port 66 of the aerating and deaerating valve 23, so that the first control pressure 61 is fed to this pneumatic control port 66. The other control port 67 is directly connected with the port 44a of the pilot valve 38a, so that the second control pressure 59 is fed to this control port 67. The control ports 68a, 68b of the shut-off valves 25a, 25b are directly connected to the port 44b of the pilot valve 38b, so that to these control ports 68a, 68b

(via a branching) the second control pressure 60 is fed. The control ports 69a, 69b of the shut-off valves 25a, 25b are directly connected to the port 15b of the lifting/lowering valve 7b (with a corresponding branching), so that these control ports 69a, 69b are biased with the first control pressure 62. Eventually, in spite of dispensing with the two shuttle valves 45a, 45b, the same functions as have been described for Fig. 1 can be guaranteed by equipping the valves 23, 25 with two control ports.

For the embodiment shown in **Fig. 3**, with a realisation that in all other aspects generally corresponds to Fig. 1, the lifting/lowering valve construction group 3 is realised in a different way, in that instead of two lifting/lowering valves 7a, 7b only one single lifting/lowering valve 7 is employed. The lifting/lowering valve 7 is realised as a manually actuatable 4/3-way valve 70, which has the ports 13a, 14a, 15a, 15b. In a first switching position active in Fig. 3, the lifting/lowering valve 7 connects the port 13a to the port 15b and the port 14a to the port 15a, which results in the first control pressure 61 corresponding to the atmospheric pressure, while the first control pressure 62 corresponds to the pressure in the reservoir. In a second switching position, the lifting/lowering valve 7 connects both ports 15a, 15b with the deaeration 12 so that both first control pressures 61, 62 correspond to the atmospheric pressure. In a third switching position of the lifting/lowering valve 7, both ports 15a, 15b are connected to the port 13a, so that the first control pressures 61, 62 correspond to the pressure in the reservoir 2. In the second switching position, which preferably is taken up without manual biasing of the actuation organ 8 of the lifting/lowering valve 7, the control ports 33a, 33b of the shut-off valves 25a, 25b are not pressurised, so that the levelling control valve construction group 22 is in a shut-off position, in which way a change of the pressurised air level in the air suspension bellows 5a, 5b is prevented. If by manual actuation of the actuation organ 8 the lifting/lowering valve 7 is brought into the first switching position, this results in the control ports 33a, 33b being pressurised while the control port 32 is pressureless. This leads to a deaeration of the air suspension bellows 5a, 5b due to the manual actuation of the actuation organ 8. If, however, the moving of the lifting/lowering valve 7 into the third switching position is done manually, the control ports 33a, 33b as well as the control port 32 are pressurised, which results in the air suspension bellows 5a, 5b being aerated. The functions of the construction group 4 and the arbitrary passing on of the first control pressures 61, 62 and the second control pressures 59, 60 correspond to the embodiment shown in Fig. 1. Without this necessarily having to be the case, in Fig. 3 the lifting/lowering valve 7 is realised as a rotary slide valve in which the actuation organ 8 can be realised as a pivoting lever.

As an optional special characteristic, for the embodiment according to Fig. 3, the lifting/lowering valve construction group 3 is realised with a latching, snapping or locking unit. With respect to the realisation of such latching, snapping or locking units 71 it is referred to the multitudinous prior art with regard to such latching, snapping or locking units. For example, the actuation organ 8 can comprise a latching, snapping or locking notch with which at the choice of a latching, snapping or locking position to be secured a spring-biased latching element engages, in which way this switching position of the lifting/lowering valve 7 can be secured. Such a latching or locking position can be left again by "overpressing" by the user and/or be left by corresponding automatised control of the latching, snapping or locking unit 71. For the embodiment shown, a pneumatic unlatching, unsnapping or unlocking of the latching, snapping or locking unit 71 occurs by the latching element being brought out of engagement with the latching notch in a latching, snapping or locking position by pneumatic pressurising of an unlatching, unsnapping or unlocking piston. For the embodiment shown in Fig. 3, for example, the latching or locking unit 71 secures the first-mentioned switching position and the third-mentioned switching position of the lifting/lowering valve 7 against the effect of a return spring into the second switching position. It is understood that the latching or locking unit 71 can also be electrically controlled directly by the control unit 49 or be electropneumatically controlled by the control unit 49. Fig. 3 here shows a special realisation for the control of the latching, snapping or locking unit 71, in that for the unlatching, unsnapping or unlocking the second control pressure 59 is used which is controlled by the pilot valve 38a, so that for this embodiment the pilot valve 38a can be used multifunctionally. This can for example be done when the shut-off valves 25a, 25b are controlled into their shut-off position so that with a change of the second control pressure 59 the aerating and deaerating valve 23 is switched from the deaerating position into the aerating position but taking into regard the shut-off position of the shut-off valves 25a, 25b there is no passing-on of the aerating pressure to the air suspension valves 5a, 5b, while the produced second control pressure 59 can then be used for the unlatching, unsnapping or unlocking of the latching, snapping or locking unit 71. In order to do this, the construction group 4 has an additional port 72 which via a branching is connected to the port 44a of the pilot valve 38a. The port 72 then is connected with a port 73 of the lifting/lowering valve construction unit 3 via a connecting line, where the port 73 feeds the second control pressure 59 to the latching, snapping or locking unit 71.

Fig. 4 shows a combination of a lifting/lowering valve construction group 3 according to Fig. 3 with a construction group 4 according to Fig. 2 without shuttle valves 45a, 45b, where the

aerating and deaerating valve 23 and the shut-off valves 25a, 25b here are each equipped with two control ports according to Fig. 2.

Fig. 5 shows an embodiment that generally corresponds to Fig. 3, where in the embodiment according to Fig. 5, however, the air suspension assembly 1 is realised with one circuit. In this way, instead of the two shut-off valves 25a, 25b only a single shut-off valve 25 can be arranged downstream of the aerating and deaerating valve 23, the port 31 of which then (via corresponding branchings) is connected to all air suspension bellows 5a, 5b. Therefore, the outlet port 48b of the shuttle valve 45b here is only connected to a pneumatic control port 33. A throttle 34 or a throttle valve 35 are not employed here.

The embodiment of the air suspension assembly 1 shown in **Fig. 6** generally corresponds to the embodiment according to Fig. 4. However, the coupling of the two circuits of the air suspension assembly 1 via the throttle valve 35 has been dispensed with. Furthermore, two sensors 50a, 50b are employed here via which the level of the two circuits can separately be detected. For the two-circuit embodiments of the air suspension assemblies 1 shown in Figs. 1-4 and 6, the two circuits generally are pneumatically separated from each other, where selectively a coupling via the throttle valve 35 is possible. For the embodiments shown, there is always a common aerating and deaerating of the air suspension bellows 5a, 5b of the two circuits, however. If the possibility of a separate aerating and deaerating of the air suspension bellows 5a, 5b is desired, another pilot valve 38c would have to be provided, where then via pilot valves 38b, 38c the control ports 33a, 33b would be separately controllable. Possibly, two aerating and deaerating valves 23a, 23b have to be provided then which are each pneumatically connected to one of the two shut-off valves 25a, 25b. In this case, a further pilot valve would have to be provided, so that the aerating and deaerating valves 23a, 23b are also separately controllable.

Fig. 7 shows a construction group 74 into which the shuttle valve 45a and the aerating and deaerating valve 23 are integrated. A housing 75 is formed with a base body 76, into which from a front face 77 two blind-hole bores 78, 79 have been made. The blind-hole bores 78, 79 are closed with a lid 80.

For forming the shuttle valve 45a, into the blind-hole bore 78 a slide 81 has been inserted, which forms three control edges 82, 83, 84 with notch-like or hollow cylinder-shaped transition regions 85, 86 arranged between them. For the embodiment shown, the control edges 82, 83,

84 are formed with sealing rings 87, 88, 89 accommodated in circumferential notches of the slide 81, which come to rest sealingly against the blind-hole bore 78.

The construction group 74 has a port 46a, which is pneumatically connected to the port 15a of the lifting/lowering valve construction group, and a port 47a, which is pneumatically connected to the port 44a of the pilot valve 38a. The port 46a is pneumatically connected via a branching formed in the base body 76 with a control bore 90 which permanently opens into a pressure chamber 91 arranged on the one front face of the slide 81 and with a control bore 92 which independently of the position of the slide 81 opens into the transition region. The port 47a is connected to control bores 93, 94, where the control bore 94 opens into a pressure chamber 95, which is arranged on the side of the slide 81 arranged opposite from the pressure chamber 91, while the control bore 93 permanently opens into the transition region 86. For the switching position of the shuttle valve 45a active in Fig. 7, a pneumatic connection is made from the transition region 85 to the outlet port 48a of the shuttle valve 48a. With a biasing of the pressure chamber 95, the slide 81 can be slid upwards in Fig. 7 until the upper front face of the slide 81 comes to rest against the lid 80. During this motion, the control edge 83 or the sealing ring 88 travels over the port 48a or a corresponding control bore, in which way then the pneumatic connection between the transition region 85 and the port 48 is interrupted, while a connection of the transition region 86 with the outlet port 48a is made. While in the first-mentioned position the port 48a is connected to the port 46a, the explained switching of the shuttle valve 45a leads to a connection between the port 47a and the outlet port 48a being made.

The aerating and deaerating valve 23 is formed by using a so-called sleeve technology, in which into a recess control edge units 96, 97, 98 are inserted which are held at a set distance from each other by especially sleeve-like or cage-like spacers 99, 100, 103, also cp. DE 100 2009 045 734 A1. In the present case, the three control edge units 96, 97, 98 have been inserted into the blind-hole bore 79 and held at a set distance from each other by interspersed spacers 99, 100. The lower control edge unit 98 is supported on a ledge 101 of the floor 102 of the blind-hole bore 79 arranged ahead of the same. On the ledge 101, a pot-like sleeve 105 realised to be fitting accurately to the blind-hole bore 79 is supported via the control edge units 96, 97, 98 and the interspersed spacers 99, 100 via another spacer 103 - possibly by interspersing a support disc 104 -, where the sleeve 105 is axially tensioned, fixed in position and sealed by the lid 80, for which a sealing element 106 can be employed. In the interior of the blind-hole bore 79, a valve slide 107 extends which in the end region turned towards the lid 80

forms a control piston 108 and starting from there extends through a bore 109 and the control edge units 96, 97, 98. On the front face of the valve slide 107 turned towards the floor 102, sufficient free space remains, so that the valve slide at pressurising of the control piston 108 can move axially in the direction of the floor 102, cp. the transition from Fig. 7 to Fig. 8. The control edge units 96, 97, 98 limit three control chambers 110, 111, 112 which are limited on their radial outer sides by the blind-hole bore 79 and on their radial inner sides by the valve slide 107. In the control chambers 110-112, the radially permeable spacers 99, 100, 103 extend. The port 28 opens into the control chamber 110, while the port 27 opens into the control chamber 112 and the port 29 is pneumatically connected to the control chamber 111. The valve slide 107 has a control notch 113. If the control notch 113 is in the region of the control edge unit 96 or the control edge unit 97, the control notch 113 forms a bypass, via which a pneumatic connection is established between the control chamber 110 and the control chamber 111 or between the control chamber 111 and the control chamber 112.

Without pneumatic biasing of the control port 32 of the aerating and deaerating valve 23, this aerating and deaerating valve 23 is in the switching position shown in Fig. 7. In this position, the control edge unit 97 shuts off the passage from the control chamber 111 into the control chamber 112, in which way the connection of the ports 27, 29 is shut off. The control notch 113, however, connects the control chambers 110, 111, in which way a pneumatic connection of the ports 28, 29 is realised.

With a pneumatic biasing of the control port 32, there is a switching of the aerating and deaerating valve 23 into the switching position shown in **Fig. 8**. In this switching position, the control edge unit 96 shuts off the passage from the control chambers 110, 111, so that the ports 28, 29 are shut off with respect to one another. On the contrary, in this switching position the control notch 113 establishes a pneumatic connection between the control chambers 111, 112, so that the ports 27, 29 are pneumatically connected to each other.

The biasing of the control piston 108 is done against the biasing by a pressure spring 114 which ensures that at a pressure drop at the control port 32 the aerating and deaerating valve 23 from the switching position according to Fig. 8 returns to the switching position according to Fig. 7.

The control piston 108 via a sealing ring 115 is sealed against the interior surface 116 of the sleeve 105. The pressure chamber 117 biasing the control piston 108, into which the port 23

opens, is limited by the control area of the control piston 108, the interior surface 116 of the sleeve 105 and the lid 80. The pressure spring 114 with a base point is supported on the side of the control piston 108 lying opposite the pressure chamber 117, while the other base point of the pressure spring 114 is supported on a ring surface 118 surrounding the bore 109. The control edge units 96, 97, 98 are especially realised as modular with a sealing element 119, which in a first approximation is dumbbell-shaped in half section and which comes to a sealing rest against the outer surface of the valve slide 107 on the radially inner side and on the radially outer side comes to rest sealingly against the blind-hole bore 79, and two circular disc bodies 120, 121 between which the sealing element 119 is held and possibly tensioned. It is also possible, however, that the disc bodies 120, 121 are integral parts of the spacers 99, 100, 103.

A connection of the ports 48a and 32 is done in the interior of the housing 75 by a connection line which extends through the base body 76 as well as through the lid 80. A sealing in the necessary places can be achieved by additional sealing elements between the lid 80 and the base body 76.

The mode of operation of the shuttle valve 54a working together with the aerating and deaerating valve 23 corresponds to the mode of operation described with regard to Fig. 1.

In **Figs. 9 and 10**, a construction group 74 is shown, which has been manufactured with a high number of identical components or a corresponding constructive realisation with regard to the embodiment according to Figs. 7 and 8. However, the construction group 74 according to Figs. 9 and 10 relates to the combination of a shuttle valve 45b with a shut-off valve 25, for which modifications are necessary. The shuttle valve 45b here is realised as identical to the shuttle valve 45a according to Figs. 7 and 8. However, from the lid 80 a protrusion 122 interspersed by the port 32 extends from the lid 80 through the pressure chamber 117, which results in the control piston 108 being displaced more towards the bottom than in Fig. 7 in the non-pressurised switching position. This, in turn, results in the control notch 113 for a pressureless control port 32 according to Fig. 9 not forming a bypass for the control edge unit 96, but rather being arranged in the region of the control chamber 111. In this switching position, the control chambers 111, 112 are shut off against each other via the control edge unit 97. If, however, there is a pressure-biasing of the pressure chamber 117, a displacement of the control piston 108 with the valve slide 107 from the switching position according to Fig. 9 into the switching position according to Fig. 10 occurs. This switching position with regard to the

cooperation of the valve slide 107 with the control edge units 96-98 corresponds to the switching position according to Fig. 8. In other words, the protrusion 122 of the lid 80 according to Figs. 9 and 10 limits the displacement path of the valve slide 107 to the last partial half of the displacement path of the valve slide 107 according to Figs. 7 and 8. For the embodiment according to Figs. 9 and 10 no port 28 is provided, in order to do which according to choice a housing for the different embodiments according to Figs. 7, 8 and Figs. 9 and 10 can be equipped with or without a port and a bore for the port 28. It is also possible that while using a housing 75 produced in a standardized way for the different embodiments, in a use situation according to Figs. 9 and 10 the port 78 is stoppered with a blind stopper.

For the embodiment according to Figs. 9 and 10 the port 30 opens into the control chamber 111, while into the control chamber 112 the port 31 opens. In the switching position according to Fig. 9, the ports 30, 31 are shut off against each other by the control edge unit 97, while in the switching position according to Fig. 10, the passing position of the shut-off valve 25 has been assumed by the control notch 113 bridging the control edge unit 97.

In **Figs. 11 to 13**, an aerating and deaerating valve 23 with two control ports 66, 67, for exampie according to Fig. 2, is shown.

In this context, the ports 27, 28, 29, the blind-hole bore 79, the control chambers 110, 111, 112, the control edge units 96, 97, 98, the valve slide 107 in the lower half are realised with a control notch 113 corresponding to the aerating and deaerating valve 23 according to Fig. 7. However, the blind-hole bore 79 in the end regions turned towards the lid 80 has a stepped increase of its cross-section to a cylindrical outer surface 123. The sleeve 105 in the end region turned towards the lid 80 has an annular collar 124 turned towards the outside, which is form-fittingly accommodated in the outer surface 123 and onto which the lid 80 comes to a rest. The control piston 108 and the valve slide 107 have a blind-hole bore 125. In this blind-hole bore 125, a guiding rod 126 is slidingly guided while enabling an axial relative movement between the valve slide 107 and the guiding rod 126. The guiding rod protrudes from the valve slide 107 and the control piston 108 in the direction of the lid 80 where a ledge 127 of the guiding rod 126 in the switching position according to Fig. 11 rests against the front face of the control piston 108. With a distance from the ledge 127, the guiding rod 126 has a control piston 128 which corresponding to the control piston 108 comprises a sealing ring 129, which sealingly comes to a rest against the interior surface 116 of the sleeve 105. The control piston 128 with the sealing

ring 129 has the same diameter as the control piston 108 with the sealing ring 115. For this embodiment, the pressure chamber 117 is only limited by the annular surface of the control piston 108, while this control piston 108 on the opposite side is limited by a corresponding annular surface of the control piston 128, on the radially inner side by the ledge 127 and on the radially outer side by the interior surface 116 of the sleeve 105. On the side turned towards the lid 80, the control piston 128 limits a further pressure chamber 130, which is additionally limited by the lid 80 and the interior surface 116 of the sleeve 105. The control port 66 opens into the pressure chamber 130, while the control port 67 is pneumatically connected to the pressure chamber 117 via a channel reaching through the lid 80, the collar 124 and the sleeve 105. The mode of operation of the aerating and deaerating valve 23 according to Figs. 11 to 13 is as follows:

a) If both the first control pressure 61 on the control port 66 and the second control pressure 59 on the control port 67 correspond to the atmospheric pressure, the aerating and deaerating valve 23 takes up the switching position according to Fig. 11, in which the pressure spring 114 can press the control piston 108 and therefore the valve slide 107 upwards so that the front face of the control piston 108 is pressed against the ledge 127 and in this way the control piston 128 is pressed upwards so that this control piston 128 comes to a rest against the lid 80. In this switching position, via the control notch 113 the ports 28, 29 are connected to each other, which corresponds to the aerating position of the aerating and deaerating valve 23.

b) If the control port 67 is biased with the second control pressure 59, this second control pressure 59 reaches the pressure chamber 117. The pressurising of the pressure chamber 117 has as a result that the control piston 128 is pressed upwards against the lid 80, while the control piston 108 is pressed downwards against the biasing by the pressure spring 114 and is moved into the switching position according to Fig. 12. The mentioned movement results in the control notch 113 moving into the region of the control edge unit 97, in which way a connection is made between the ports 27, 29, which corresponds to the aerating position of the aerating and deaerating valve 23.

c) If, on the contrary, starting from the switching position according to Fig. 10, the control port 66 is biased with the first control pressure 61, this leads to the first control pressure 61 being present in the pressure chamber 130. This results in the control piston 128

being biased downwards. The pressure force produced in the pressure chamber 130 via the ledge 127 is transmitted to the control piston 108 so that the control piston 128 and the control piston 108 together are moved into the switching position according to Fig. 13, biasing the spring 114. In this way, a connection of ports 27, 29 with each other can also be achieved, so that the aerating position is taken up - however, this is now achieved by manual actuation of the lifting/lowering valve unit 3.

In **Figs. 14 to 16**, a shut-off valve 25 with two control ports 68, 69 is shown which can be manufactured with many identical constructive characteristics or a high number of identical parts to the embodiment according to Figs. 11 to 13. The ledge 127 here is realised with an enlarged axial extension, which for atmospheric pressure on the control ports 68, 69 results in the valve slide 107 in the switching position according to Fig. 14 being displaced downwards by half the displacement path of the embodiment according to Figs. 11 to 13, which results in the control notch being placed between the two control units 96, 97. The port 28 according to Fig. 11 for the embodiment according to Figs. 14 to 16 is not present. Rather than that, in the switching position according to Fig. 14 the port 30 opens into the control chamber 111, while the port 31 opens into the control chamber 112 and the two ports 30, 31 are shut off with respect of each other by the control edge unit 97. With a mode of operation basically corresponding to the embodiment according to Figs. 11 to 13, by feeding the second control pressure 60 to the control port 68 the switching position according to 15 can be induced, while by feeding the first control pressure 62 to the control port 69, the switching position according to Fig. 16 can be induced. Both switching positions according to Figs. 15 and 16 correspond to the passing position of the shut-off valve 25 in which the control notch 113 realises a connection of the ports 30, 31.

LIST OF REFERENCE NUMERALS

1	air suspension assembly
2	reservoir
3	lifting/lowering valve construction group
4	construction group
5	air suspension bellows
6	brake assembly
7	lifting/lowering valve
8	actuation organ
9	aerating and deaerating valve
10	3/2-way valve
11	port
12	deaerating port
13	port
14	port
15	port
16	port
17	port
18	port
19	deaerating port
20	port
21	port
22	levelling control valve construction group
23	aerating and deaerating valve
24	3/2-way valve
25	shut-off valve
26	2/2-way valve
27	port
28	port
29	port
30	port
31	port
32	control port

SZTNH-100038624

33 control port
34 throttle
35 throttle valve
36 2/2-solenoid valve
37 control port
38 pilot valve
39 aerating and deaerating valve
40 3/2-solenoid valve
41 control port
42 port
43 port
44 port
45 shuttle valve
46 inlet port
47 inlet port
48 outlet port
49 control unit
50 sensor
51 sensor
52 control port
53 brake control device
54 supply line
55 control port
56 brake line
57 brake line
58 combined spring brake cylinder
59 second control pressure
60 second control pressure
61 first control pressure
62 first control pressure
63 housing
64 port
65 port
66 control port

67 control port
68 control port
69 control port
70 4/3-way valve
71 Latching, snapping or locking unit
72 port
73 port
74 construction unit
75 housing
76 base body
77 front face
78 blind-hole bore
79 blind-hole bore
80 lid
81 slide
82 control edge
83 control edge
84 control edge
85 transition region
86 transition region
87 sealing ring
88 sealing ring
89 sealing ring
90 control bore
91 pressure chamber
92 control bore
93 control bore
94 control bore
95 pressure chamber
96 control edge unit
97 control edge unit
98 control edge unit
99 spacer
100 spacer

101 ledge
102 floor
103 spacer
104 support disc
105 sleeve
106 sealing element
107 valve slide
108 control piston
109 bore
110 control chamber
111 control chamber
112 control chamber
113 control notch
114 pressure spring
115 sealing ring
116 interior surface
117 pressure chamber
118 ring surface
119 sealing element
120 disc body
121 disc body
122 protrusion
123 outer surface
124 collar
125 blind-hole bore
126 guiding rod
127 ledge
128 control piston
129 sealing ring
130 pressure chamber

SZTNH-100038625

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LÉGRUGÓZÁS-BERENDEZÉS HASZONJÁRMŰHÖZ

SZABADALMI IGÉNYPONTOK

1. Légrugózás-berendezés (1) haszonjárműhöz

a) egy emelő-süllyesztő szelepes szerkezeti egységgel (3), ami előállít legalább egy emelő-süllyesztő szelep (7; 7a, 7b) manuális működtetésétől függő első vezérlőnyomást (61, 62),

b) legalább egy elektropneumatikus elővezérlő szeleppel (38; 38a, 38b) előállít egy elektromos vezérlőjeltől függő második vezérlőnyomást (59, 60),

c) egy szintszabályozó szelepes szerkezeti egységgel (22), amely magában foglal legalább egy szintszabályozó szelepet, amelynek útján szintváltoztatás és menetüzemben a szint állandó értéken tartása céljából legalább egy légrugó-harmonikába (5a, 5b) levegőbebocsátás és/vagy legalább egy légrugó-harmonikából levegőkieresztés történik, és ahol

d) a manuálisan működtethető emelő-süllyesztő szelep (7; 7a, 7b) és az elektropneumatikus elővezérlő szelep (38; 38a, 38b) párhuzamos vezetékágakban van elhelyezve, és

e) a legalább egy szintszabályozó szelepre

ea) mind az első vezérlőnyomás (61, 62),

eb) mind a második vezérlőnyomás (59, 60)

ráadható.

2. Az 1. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy egy szintszabályozó szelep pneumatikus vezérlőcsatlakozása (32; 33a, 33b) előtt egy váltószelep (45a; 45b) van elhelyezve,

a) az első bemenetére (46a, 46b bemeneti csatlakozás) ráadható az első vezérlőnyomás (61, 62), és

b) a második bemenetére (47a, 47b bemeneti csatlakozás) ráadható a második vezérlőnyomás (59, 60).

3. Az 1. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy a legalább egy szintszabályozó szelepnek

a) van egy első pneumatikus vezérlőcsatlakozása (66, 69a, 69b), amelyhez oda van vezetve az első vezérlőnyomás (61; 62), és

b) van egy második vezérlőcsatlakozása (67, 68a, 68b), amelyhez oda van vezetve a második vezérlőnyomás (59; 60).

4. Az előző igénypontok egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy magában foglal egy többfunkciós vezérlőegységet (49), ami előállít

a) legalább egy elektromos vezérlőjelet legalább egy elektropneumatikus elővezérlő szelep (38a, 38b) számára, és

b) legalább egy elektromos vezérlőjelet egy fékberendezés (6) számára.

5. Az előző igénypontok egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy

a) a szintszabályozó szelepes szerkezeti egység (22) egyik szintszabályozó szelepe 3/2-utas szelepként (24) kialakított levegőbebocsátó és -kieresztő szelep (23), és

b) a szintszabályozó szelepes szerkezeti egység (22) egyik szintszabályozó szelepe 2/2-utas szelepként (26, 26a, 26b) kialakított zárószelep (25; 25a, 25b).

6. Az 5. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy a levegőbebocsátó és -kieresztő szelep (23) egyik csatlakozása (29) egy elágazáson keresztül össze van kötve a légrugózás-berendezés (1) két köréhez alkalmazott zárószeleppel (25a, 25b).

7. A 6. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy a két kör egy fojtáson (34) vagy kapcsolható fojtószelepen (35) keresztül egymással csatolásba van hozva vagy csatolásba hozható.

8. Az előző igénypontok egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy a legalább egy elektropneumatikus elővezérlő szelep (38a, 38b) árammentes állapotában legalább egy szintszabályozó szelep záróhelyzetet vesz fel.

9. Az 5–8. igénypont egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy az emelő-süllyesztő szelepes szerkezeti egység (3) rendelkezik

a) egy manuálisan működtethető emelő-süllyesztő szeleppel (7a), amely egy első vezérlőnyomást (61) állít elő a levegőbebocsátó és -kieresztő szelep (23) számára, valamint

b) egy manuálisan működtethető emelő-süllyesztő szeleppel (7b), amely egy első vezérlőnyomást (62) állít elő a zárószelep (25) vagy a zárószelepek (25a, 25b) számára.

10. Az 5–8. igénypont egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy az emelő-süllyesztő szelepes szerkezeti egység (3) rendelkezik egy manuálisan működtethető emelő-süllyesztő szeleppel (7), ami előállít mind egy első vezérlőnyomást (61) a leve-

gőbebocsátó és -kieresztő szelep (23) számára, mind egy első vezérlőnyomást (62) a zárószelep (25) vagy a zárószelepek (25a, 25b) számára.

11. A 10. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy az emelő-süllyesztő szelepnek (7)

a) van egy csatlakozása (15a), ami a levegőbebocsátó és -kieresztő szelep (23) vezérlőcsatlakozásával (32) van összekötve,

b) van egy csatlakozása (15b), ami a zárószelep (25a, 25b) vezérlőcsatlakozásával (33a, 33b) van összekötve,

c) van egy csatlakozása (14), ami egy levegőkieresztéssel (12) van összekötve, és

d) van egy csatlakozása (13), ami egy tárolótartállyal (2) van összekötve, továbbá

e) az emelő-süllyesztő szelep (7) egyik kapcsolási helyzetében a levegőbebocsátó és -kieresztő szelep (23) vezérlőcsatlakozásával (32) összekötött csatlakozás (15a) a levegőkieresztéssel (12) vagy a tárolótartállyal (2) van összekötve, míg a zárószelep (25a, 25b) vezérlőcsatlakozásával (33a, 33b) összekötött csatlakozás (15b) a levegőkieresztés (12) és a tárolótartály (2) közül a másikkal van összekötve,

f) az emelő-süllyesztő szelep (7) egyik kapcsolási helyzetében a levegőbebocsátó és -kieresztőszelep (23) vezérlőcsatlakozásával (32) összekötött csatlakozás (15a) és a zárószelep (25a, 25b) vezérlőcsatlakozásával (33a, 33b) összekötött csatlakozás (15b) a levegőkieresztéssel (12) van összekötve, és

g) az emelő-süllyesztő szelep (7) egyik kapcsolási helyzetében a levegőbebocsátó és -kieresztő szelep (23) vezérlőcsatlakozásával (32) összekötött csatlakozás (15a) és a zárószelep (25a, 25b) vezérlőcsatlakozásával (33a, 33b) összekötött csatlakozás (15b) a tárolótartállyal (2) van összekötve.

12. Az előző igénypontok egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy az emelő-süllyesztő szelepes szerkezeti egységnek (3) vagy az emelő-süllyesztő szelepes szerkezeti egység (3) legalább egy emelő-süllyesztő szelepének (7; 7a, 7b) manuálisan létrehozott helyzete egy becsappanó- vagy reteszelőegységgel (71) fixálható vagy reteszelhető.

13. A 12. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy a becsappanó- vagy reteszelőegység (71) elektromosan, elektropneumatikusan vagy pneumatikusan becsappantható, kicsappantható, bereteszelhető és/vagy kireteszelhető.

14. A 13. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy a becsappanó- vagy reteszelőegység (71) azzal vagy egy második vezérlőnyomással (59), amely a

szintszabályozó szelepre is ráadható, pneumatikusan becsappantható, kicsappantható, bereteszelhető és/vagy kireteszelhető.

15. Az előző igénypontok egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy legalább egy váltószelep (45a, 45b), legalább egy szintszabályozó szelep és/vagy legalább egy elővezérlő szelep (38a, 38b) tolattyús konstrukcióként van kialakítva.

16. A 15. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy legalább egy váltószelep (45a, 45b), legalább egy szintszabályozó szelep és/vagy legalább egy elővezérlő szelep (38a, 38b) olyan tolattyús konstrukcióként van kialakítva, amelynél hüvelytechnikával vannak vezérlőélek képezve.

17. A 3. igénypont szerinti vagy a 3. igénypontra visszautalóan a 4–16. igénypont egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy a szintszabályozó szelepben egy szeleptolattyú (107) működtethető egy első dugattyú (128) útján, amire ráadható az első vezérlőnyomás (61; 62), valamint egy második dugattyú (108) útján, amire ráadható a második vezérlőnyomás (59; 60).

18. A 17. igénypont szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy az első dugattyú (128) és a második dugattyú (108) egymáshoz képest eltolható, és van egy ütköző (127 vállrész), amin keresztül a két dugattyú (128, 108) mozgása egymással csatolásba hozható.

19. Az előző igénypontok egyike szerinti légrugózás-berendezés (1), **azzal jellemezve**, hogy

– az emelő-süllyesztő szelepes szerkezeti egységgel (3),
– a legalább egy elektropneumatikus elővezérlő szeleppel (38a, 38b),
– a legalább egy szintszabályozó szeleppel,
– a fojtással (34) vagy a kapcsolható fojtószeleppel (35) és/vagy
– a vezérlőegységgel (49)

egy szerkezeti csoport vagy szerkezeti egység van kialakítva.

SZTNH-100038626

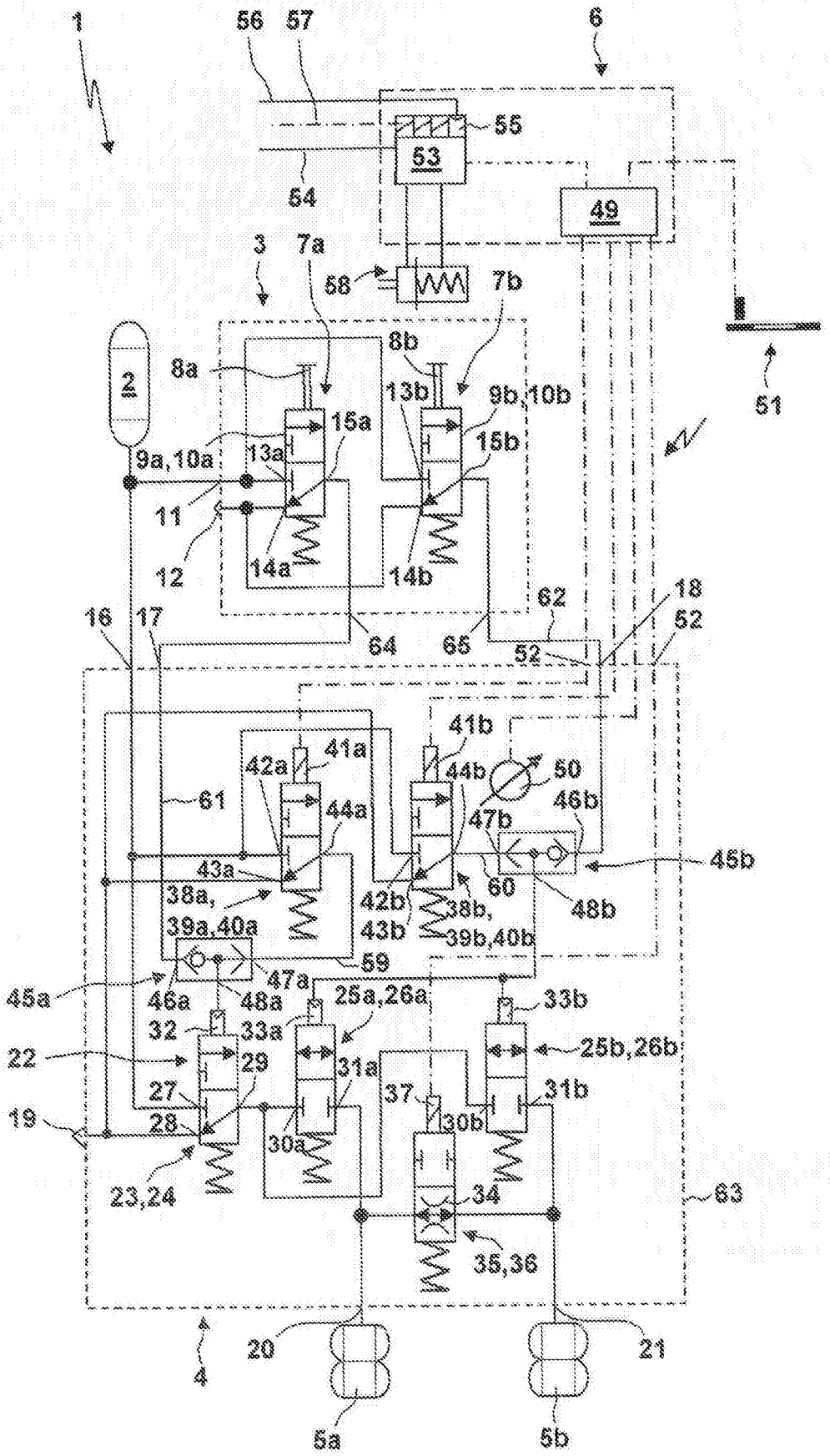
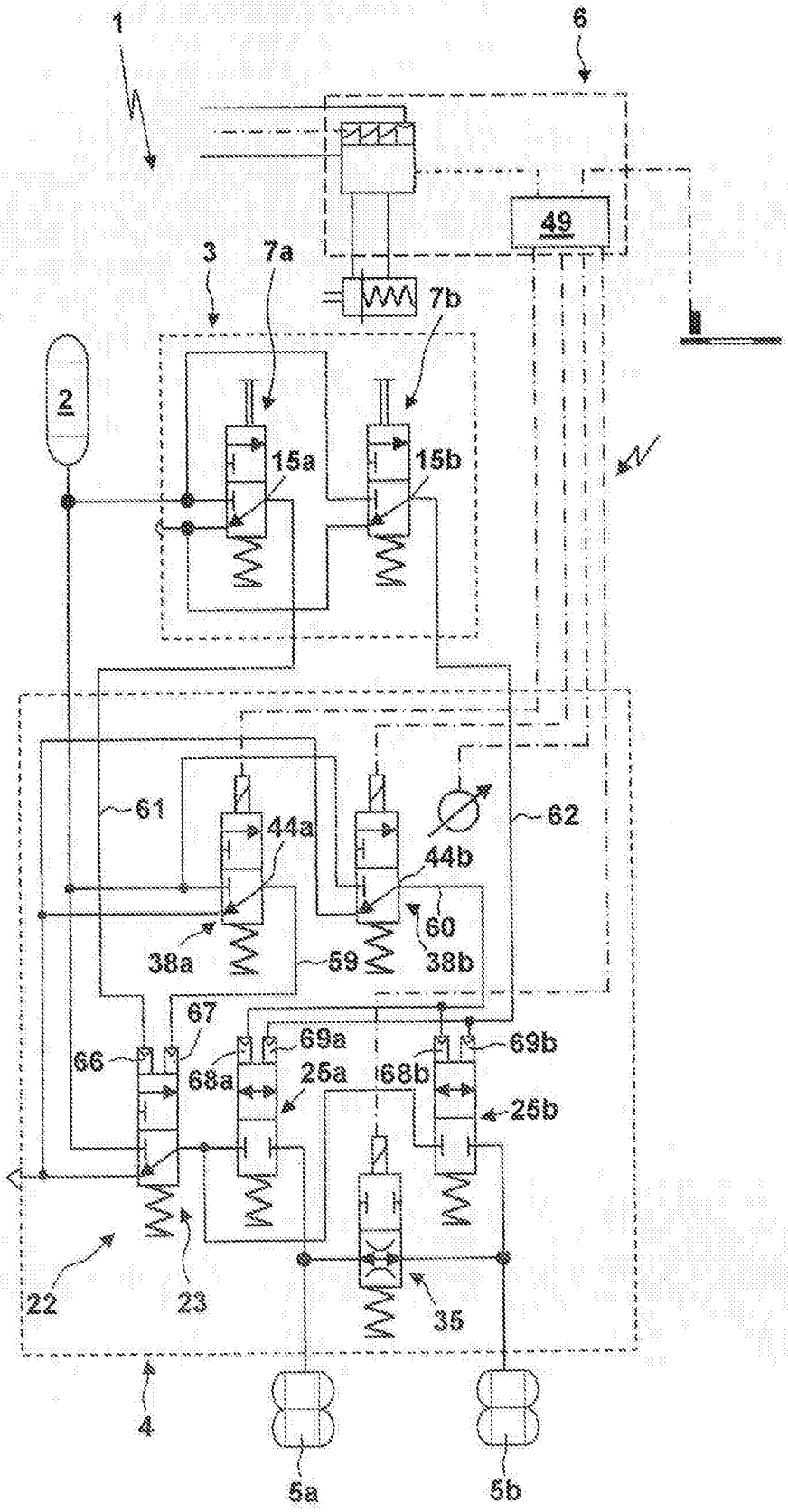


Fig. 1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3
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7b
2
15a
15b
61
62
44a
44b
60
38a
59
38b
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25a
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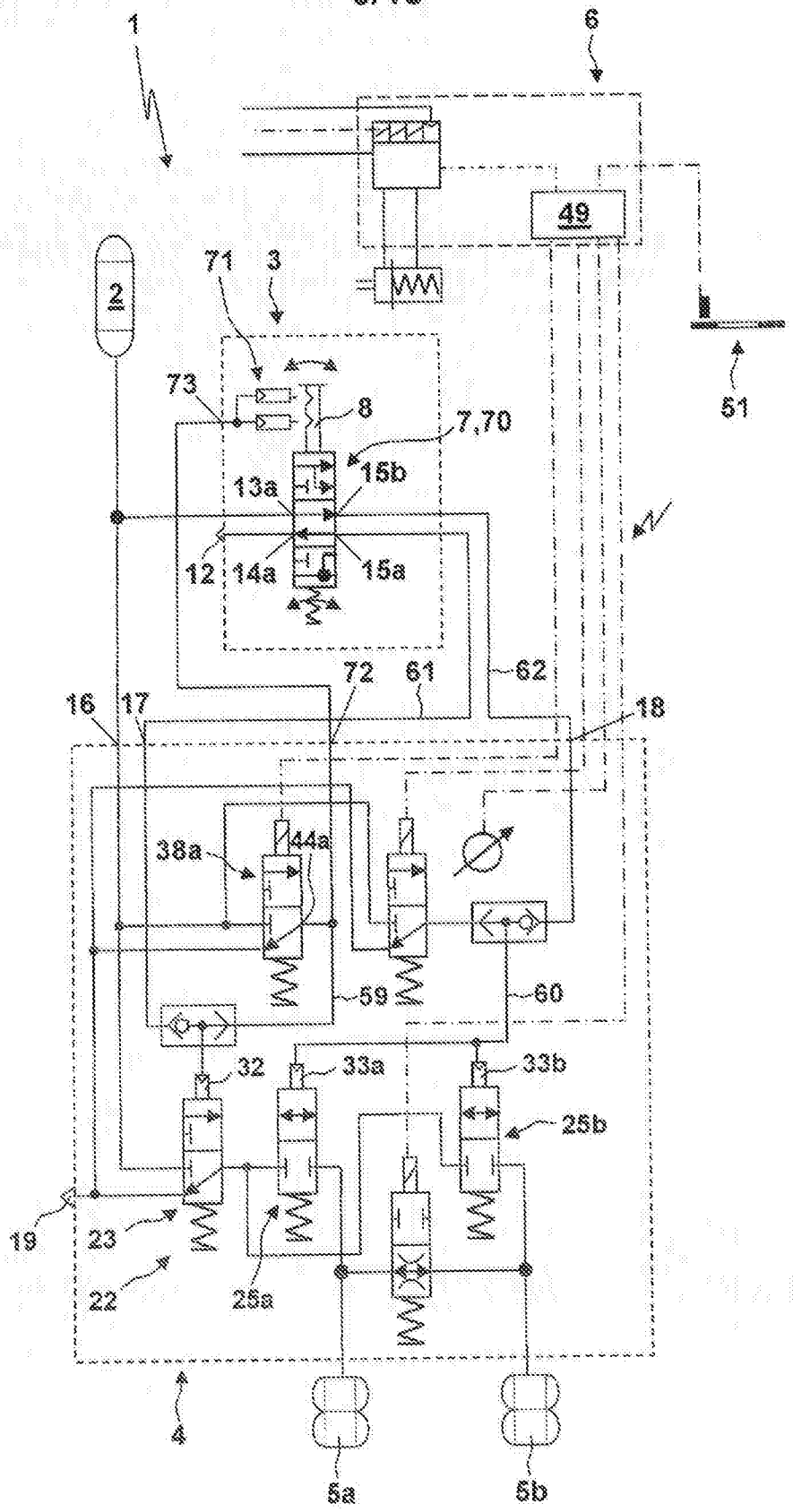
Fig. 2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5a
5b

Fig. 3

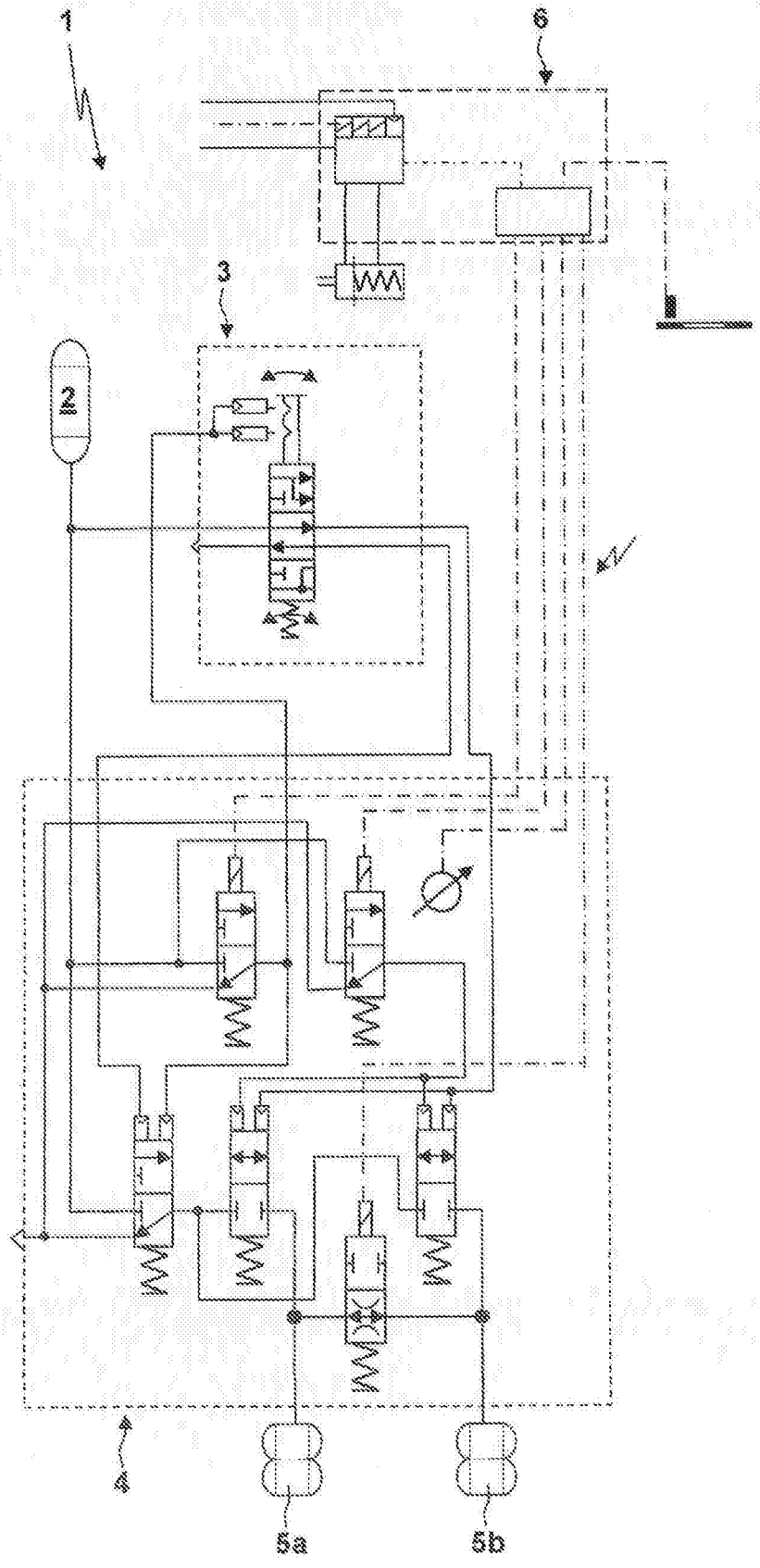

Fig. 4

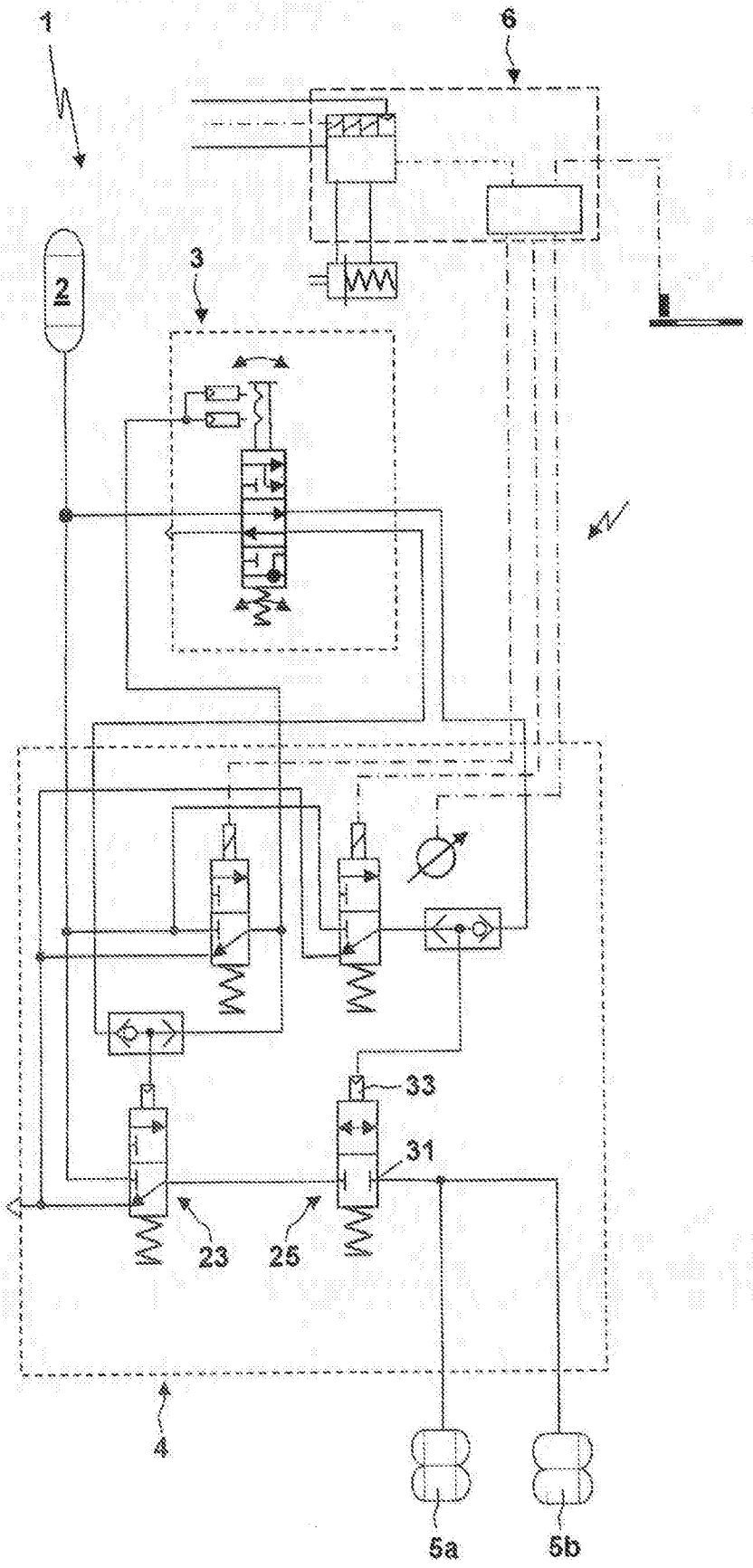

Fig. 5

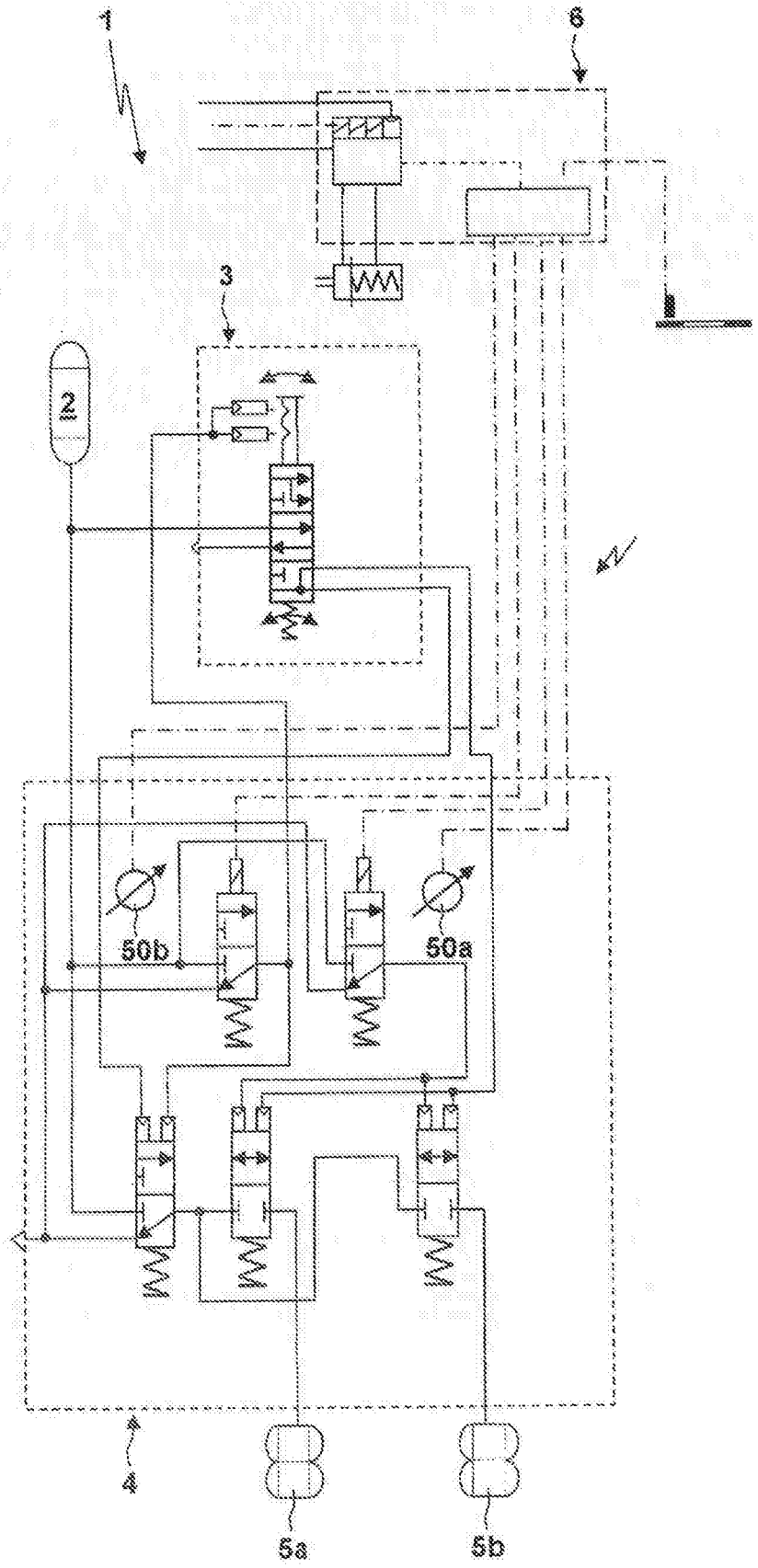

Fig. 6

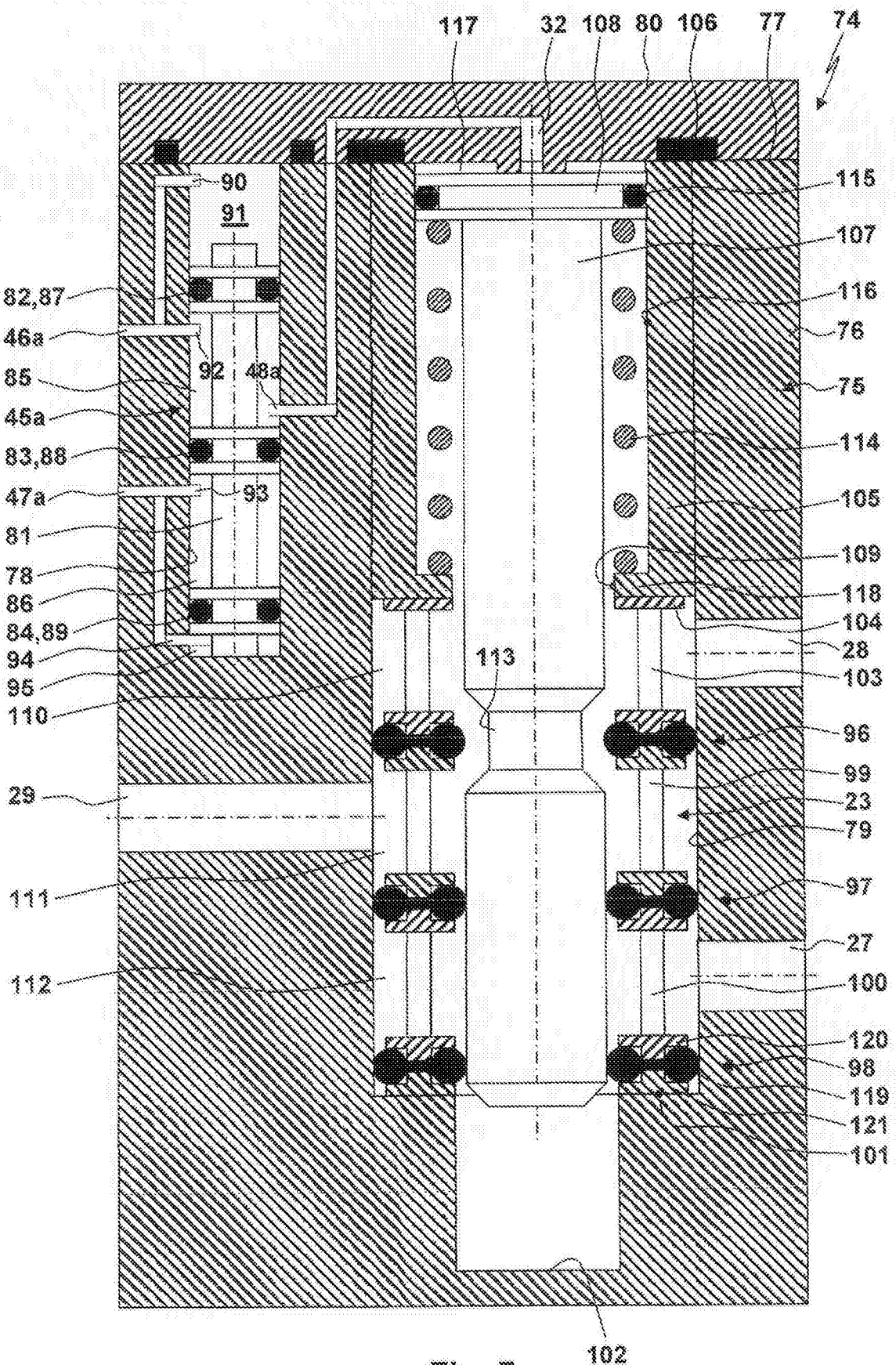
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Fig. 7

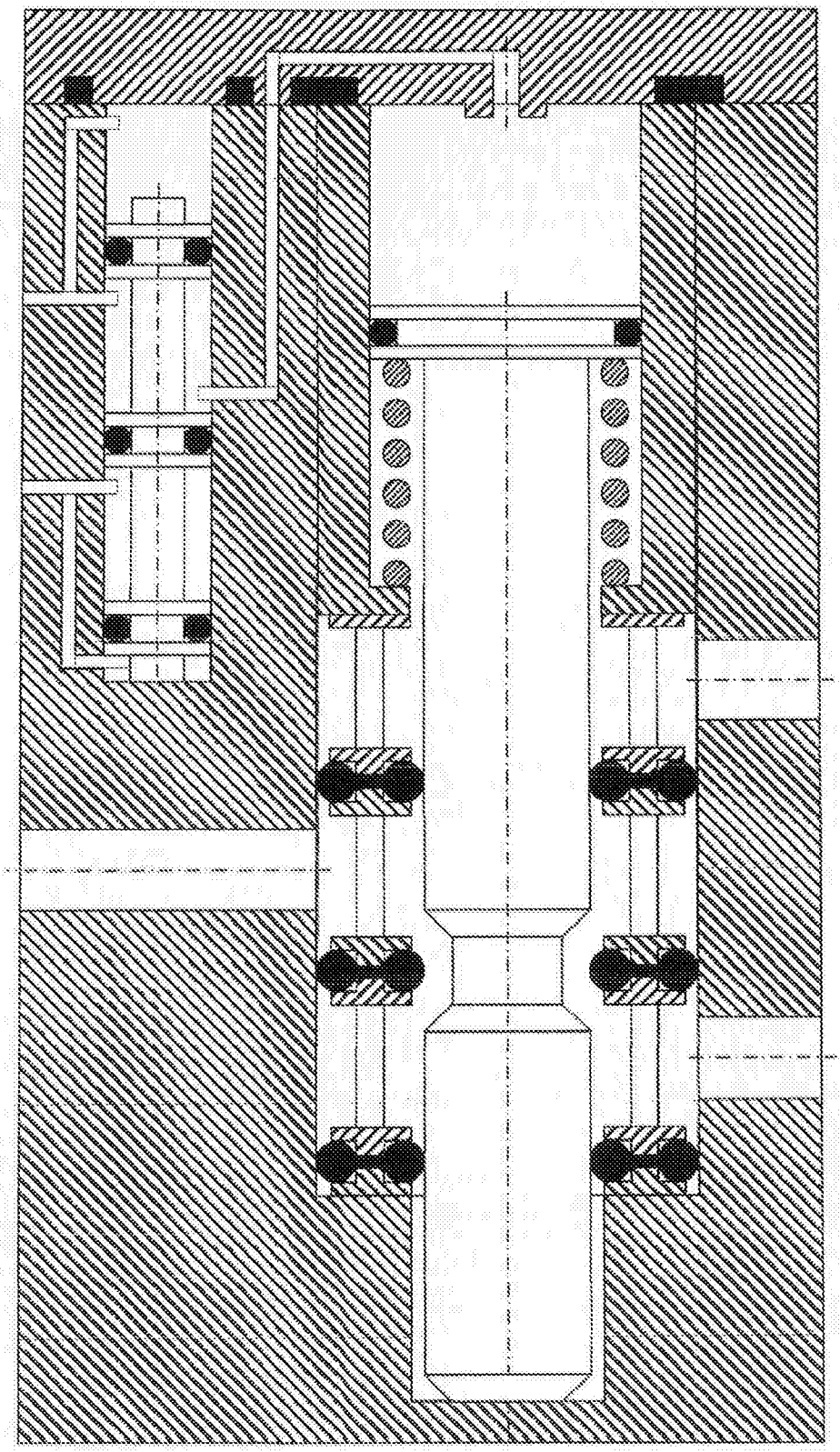

Fig. 8

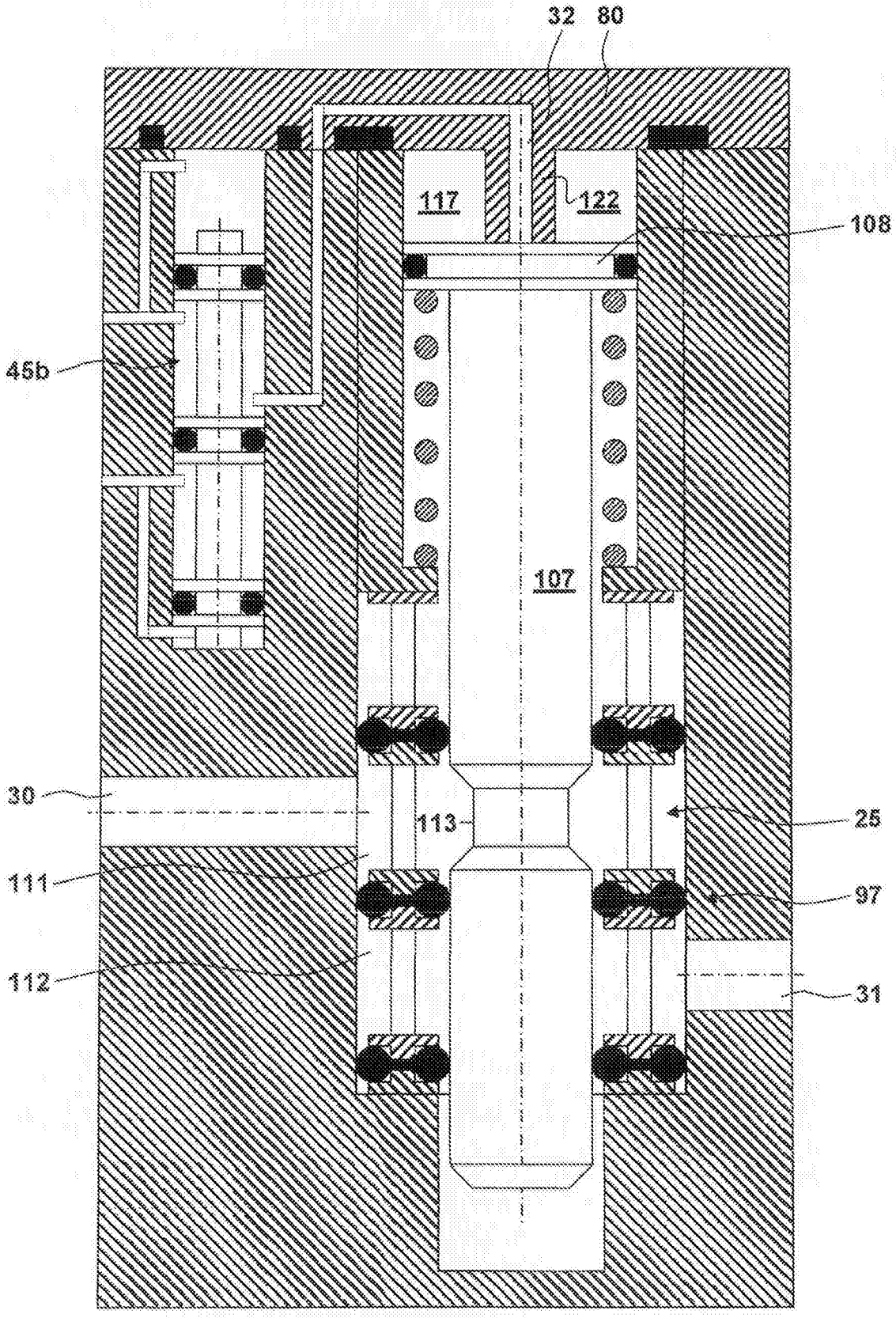

Fig. 9

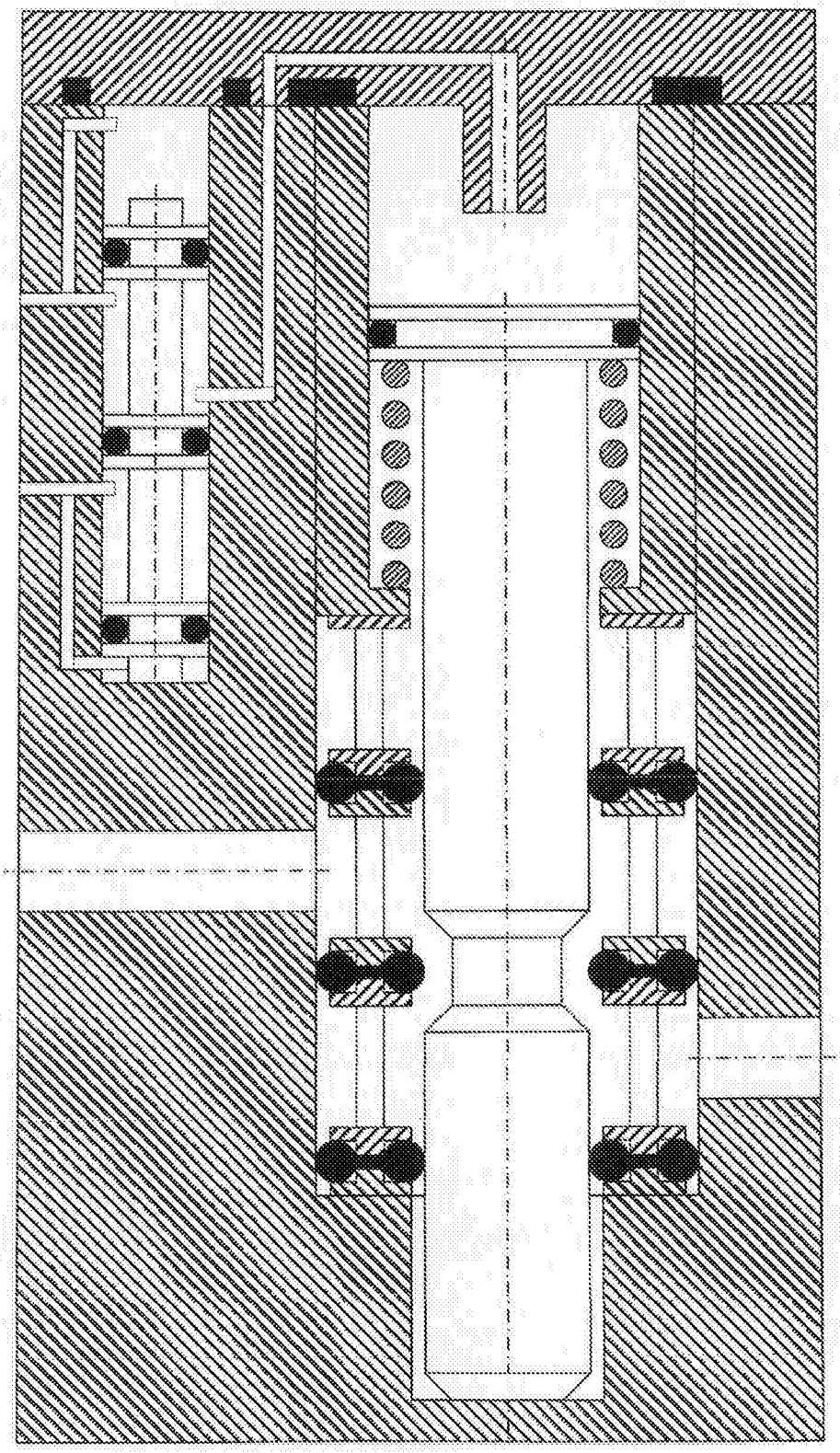

Fig. 10

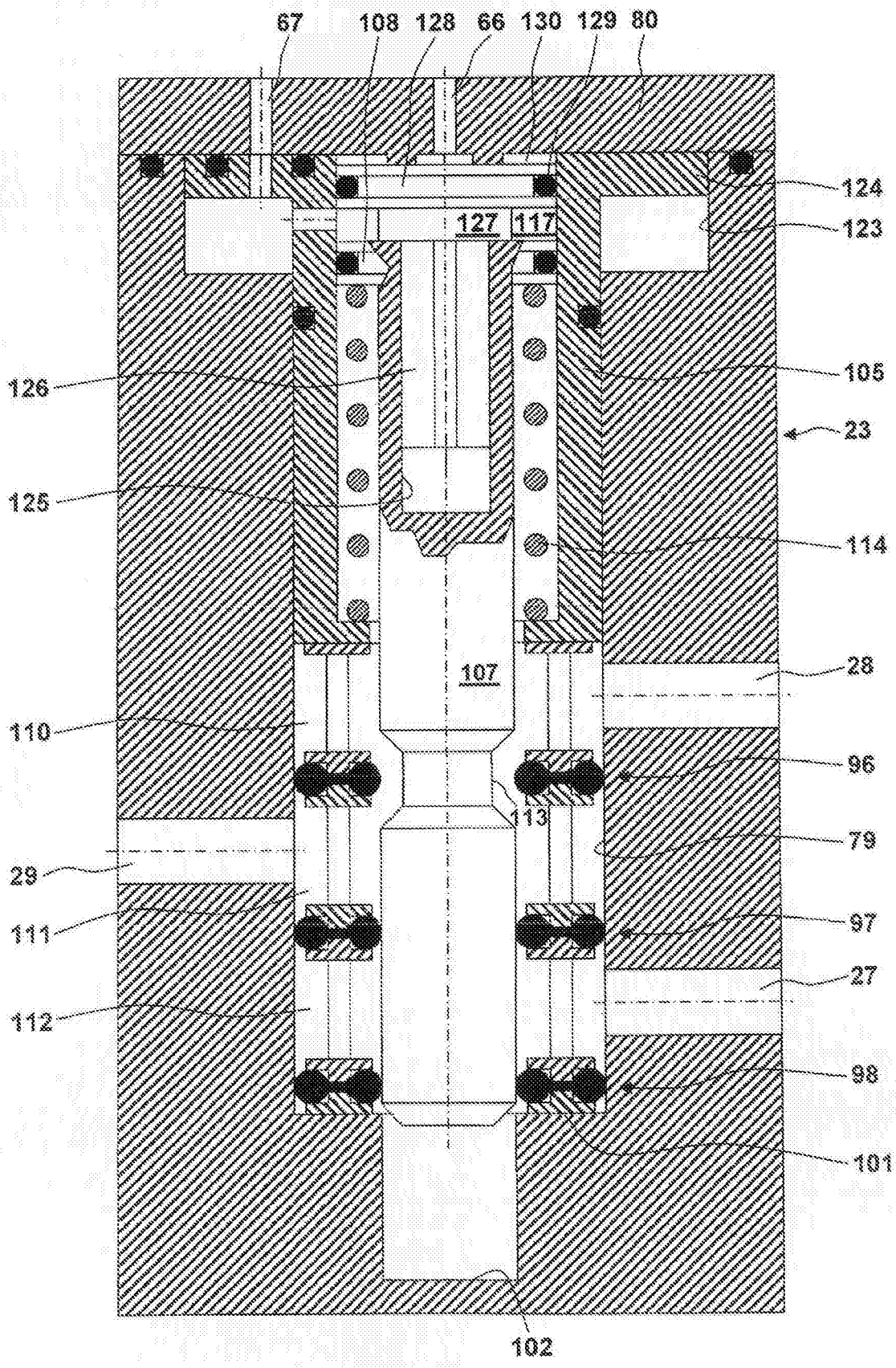
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Fig. 11

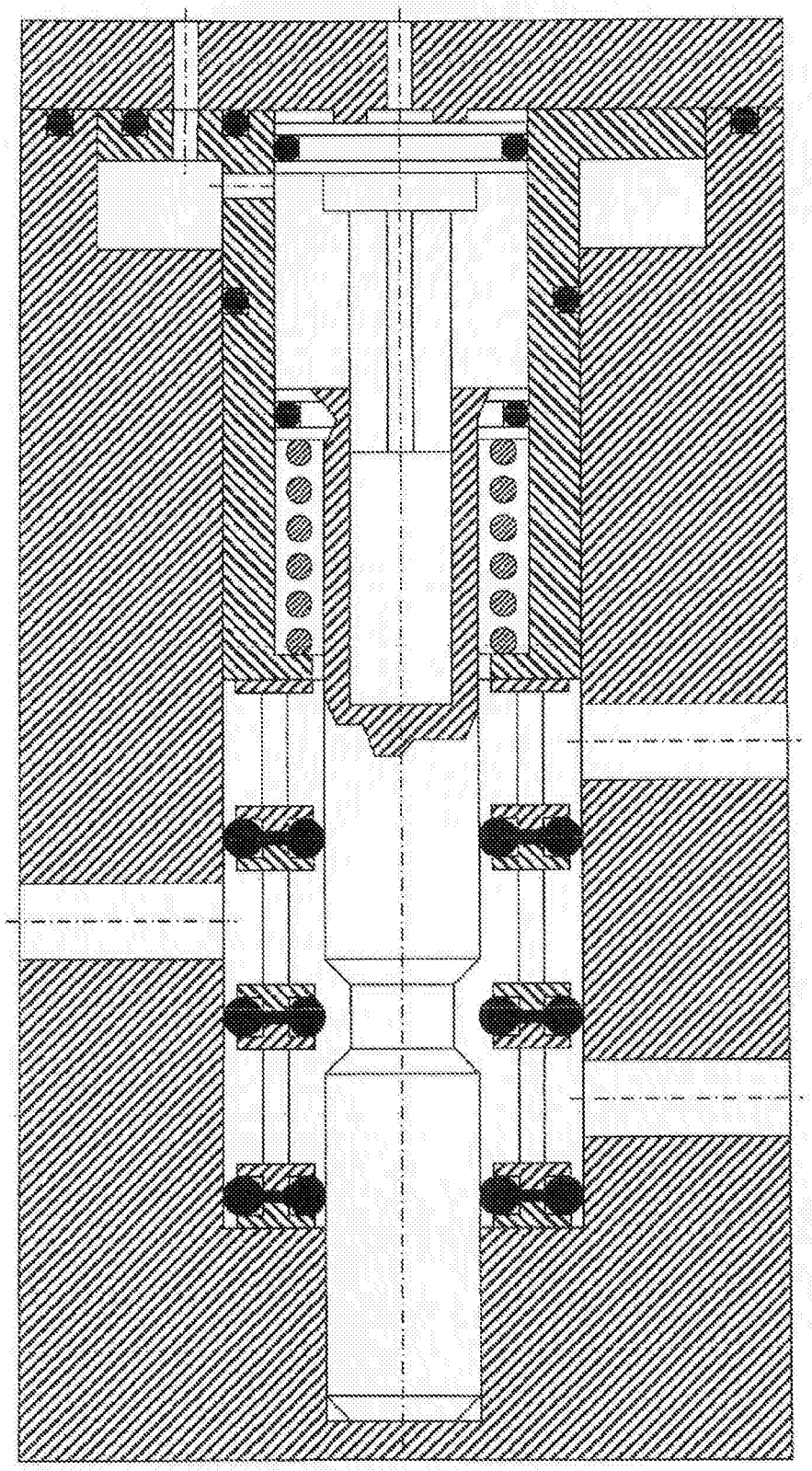

Fig. 12

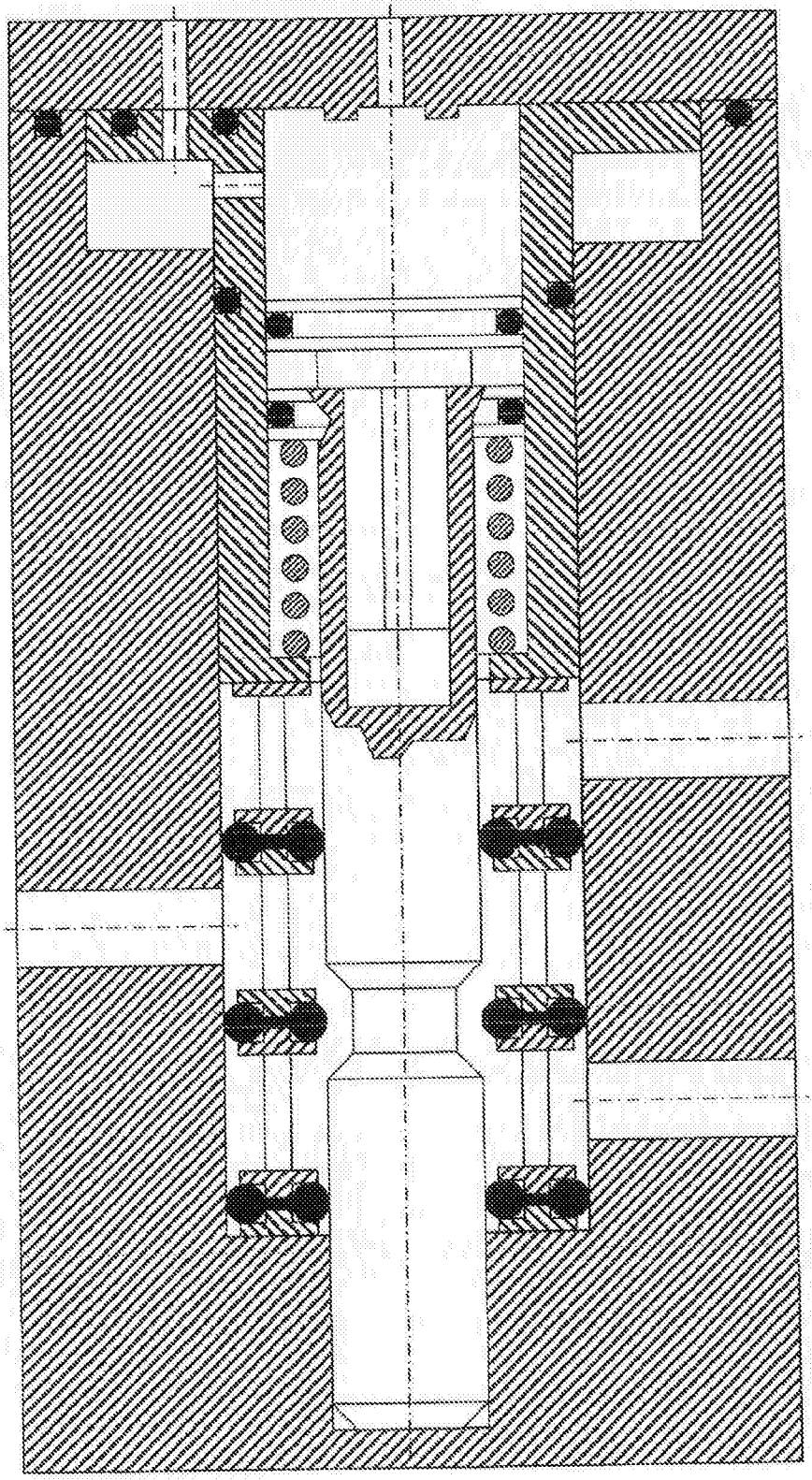

Fig. 13

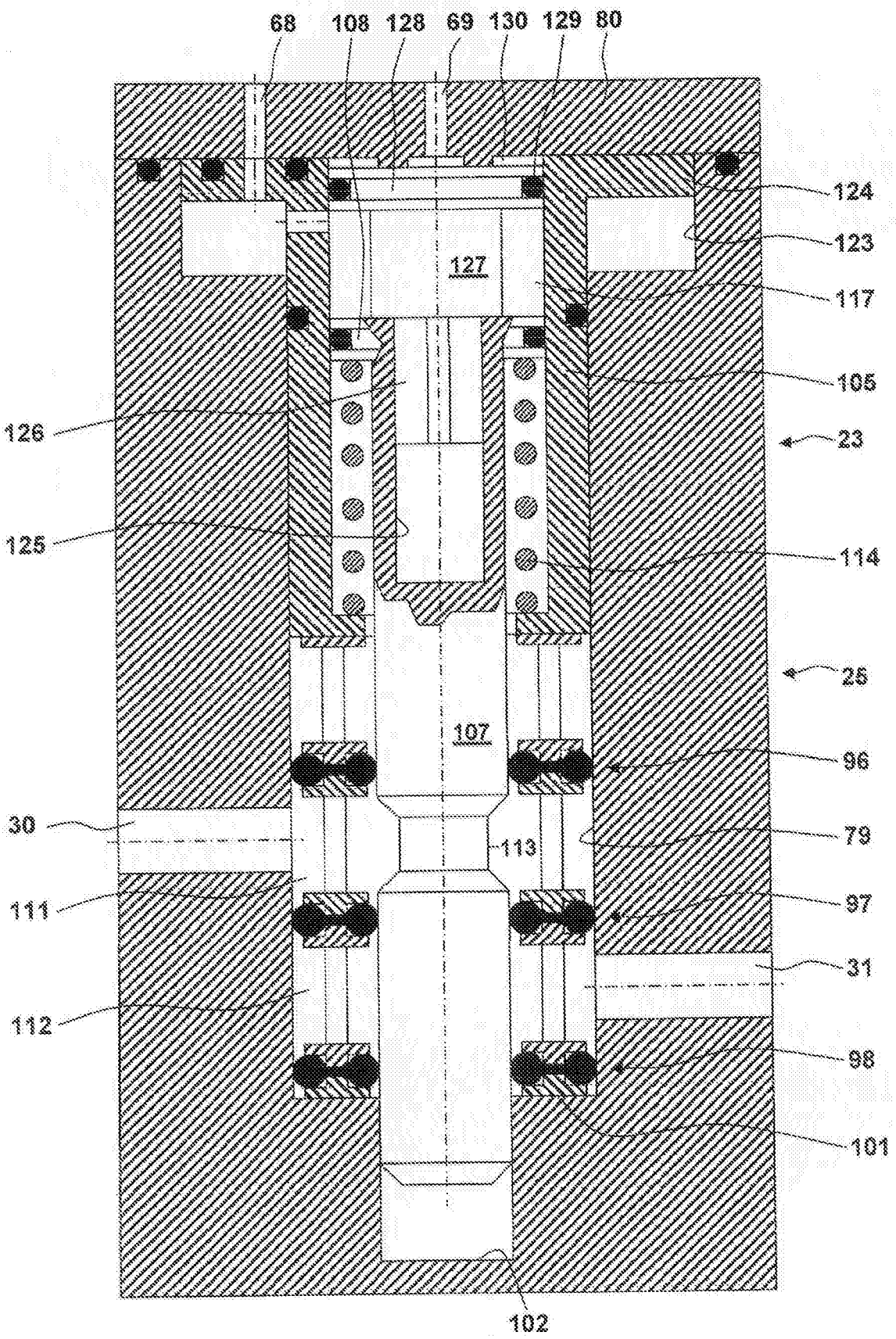
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Fig. 14

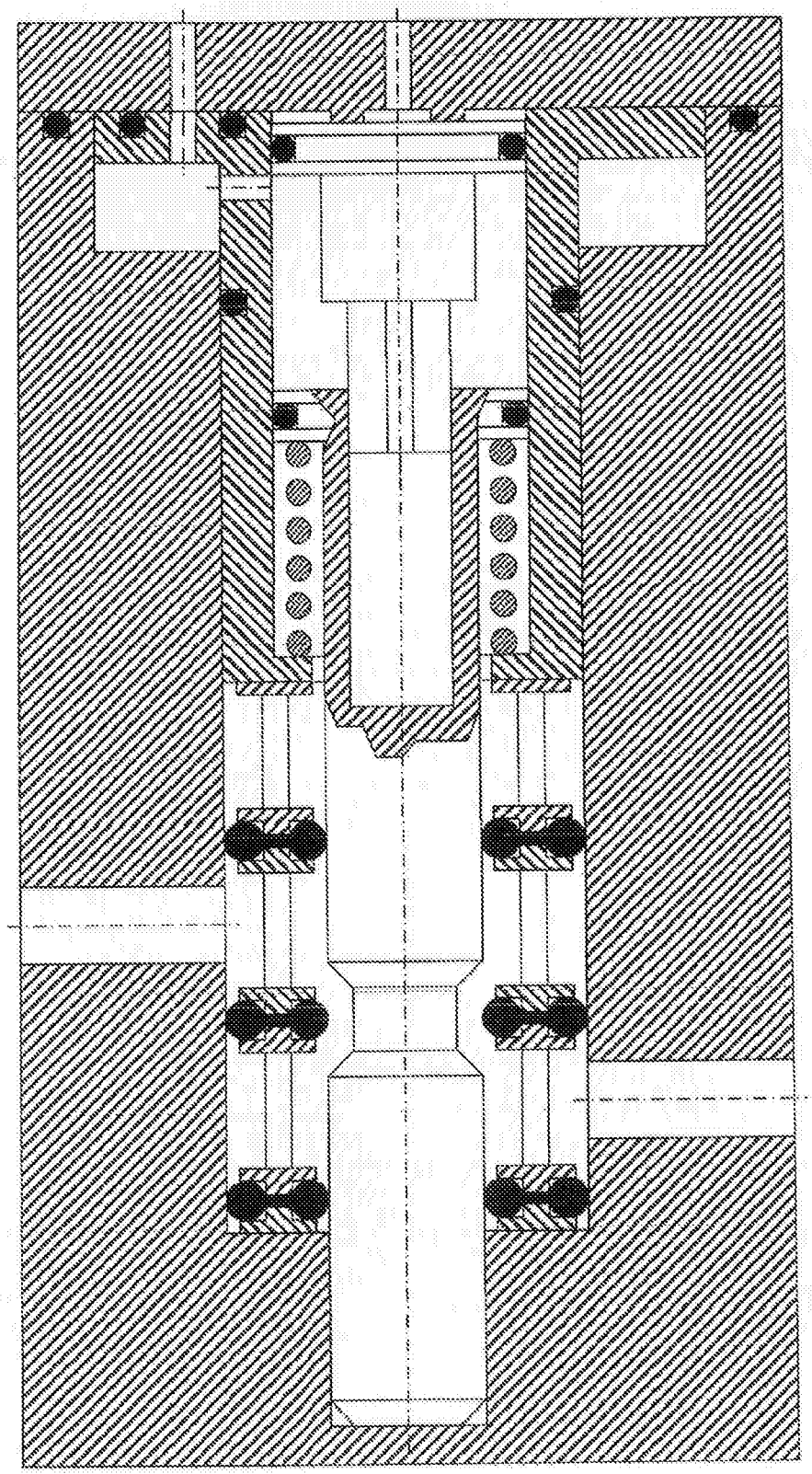

Fig. 15

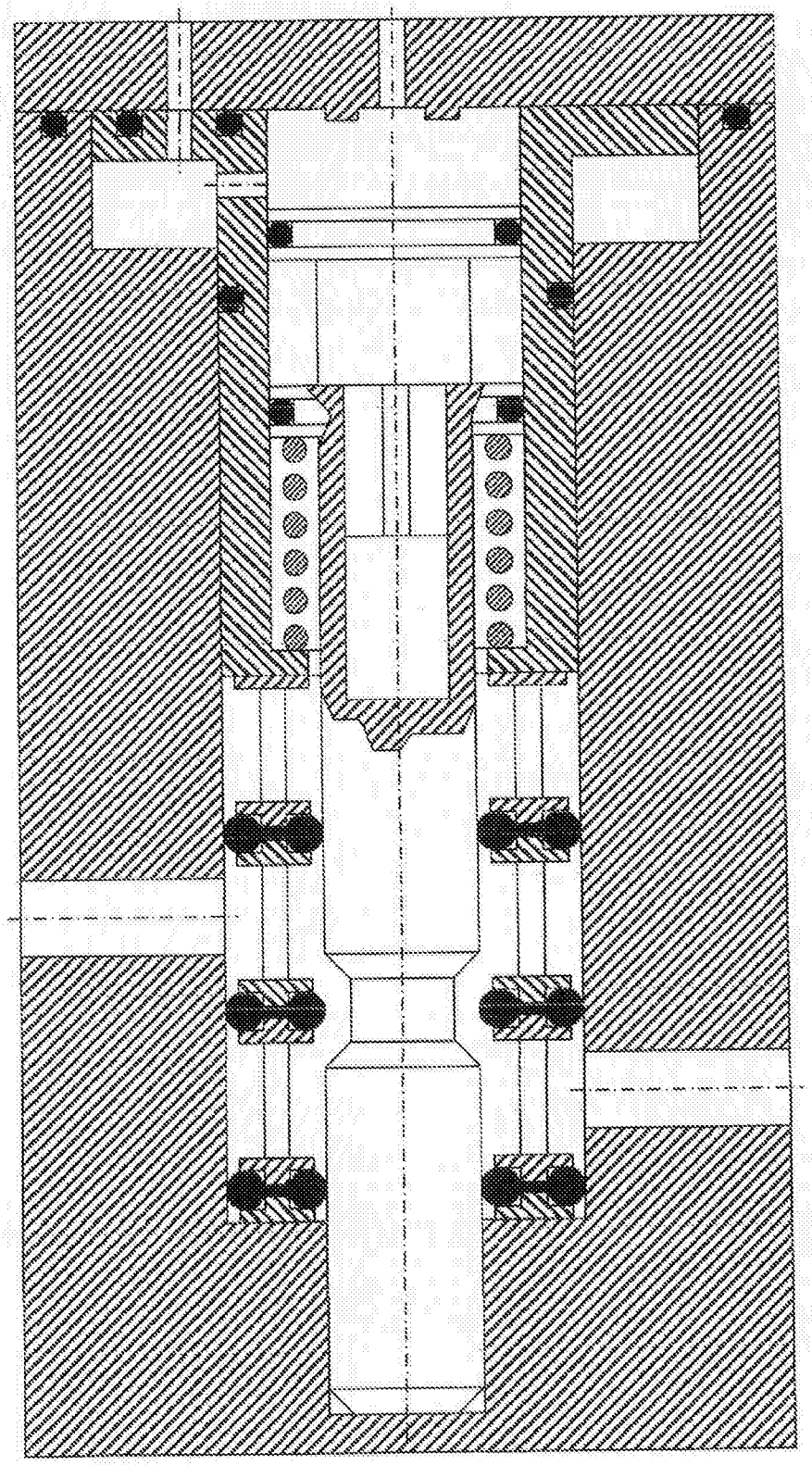

Fig. 16