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(54) Benævnelse: **STABILISATORBENARRANGEMENT OG MOBIL ARBEJDSMASKINE OMFATTENDE ET SÅDANT STABILISATORBENARRANGEMENT**

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DESCRIPTION

FIELD OF THE INVENTION AND PRIOR ART

[0001] The present invention relates to a stabilizer leg arrangement according to the preamble of claim 1 for supporting a mobile working machine against the ground. The invention also relates to a mobile working machine comprising such a stabilizer leg arrangement. A device according to the prior art is disclosed in WO 2013/120118 A1.

[0002] A mobile working machine equipped with a load handling crane, such as for instance a lorry having a hydraulic loader crane mounted on its chassis, is often provided with hydraulically actuated stabilizer legs for supporting the mobile working machine against the ground to thereby improve the stability of the mobile working machine against tipping. Such a mobile working machine may be provided with means for detecting whether or not a stabilizer leg has reached an active supporting position in supporting contact with the ground.

[0003] The differential pressure in a hydraulic cylinder is defined as the hydraulic pressure on the piston side of the hydraulic cylinder minus the hydraulic pressure on the piston rod side of the hydraulic cylinder divided by the cylinder ratio, i.e. $P_{diff}=P_1-P_2/C_R$, where P_{diff} is the differential pressure, P_1 is the hydraulic pressure on the piston side, P_2 is the hydraulic pressure on the piston rod side and C_R is the cylinder ratio. The cylinder ratio C_R is in its turn defined as the effective pressure area on the piston side of the hydraulic cylinder divided by the effective pressure area on the piston rod side of the hydraulic cylinder.

[0004] For a stabilizer leg provided with a hydraulic cylinder for moving the stabilizer leg downwards into contact with the ground, the support force acting on the stabilizer leg when it is in supporting contact with the ground affects the differential pressure in the hydraulic cylinder. The differential pressure in the hydraulic cylinder of such a stabilizer leg may be determined by means of an electronic control device based on a first measuring value representing the hydraulic pressure on the piston side of the hydraulic cylinder and a second measuring value representing the hydraulic pressure on the piston rod side of the hydraulic cylinder. The electronic control device may be configured to compare the established value of the differential pressure in the hydraulic cylinder with a given threshold value and establish that the stabilizer leg is in the active supporting position if the differential pressure is higher than the threshold value. However, a high differential pressure resembling the differential pressure that is developed in the hydraulic cylinder when the stabilizer leg is pressed against the ground in the active supporting position may also be developed in the hydraulic cylinder in a situation when it has reached its advanced end position before the stabilizer leg has been pressed against the ground. Thus, in order to avoid an erroneous establishment that a stabilizer leg is in the active supporting position, a system that is configured to use the value of the differential pressure in the hydraulic cylinder of the stabilizer leg in order to establish whether or not the stabilizer leg is in the active supporting position also has to include an additional sensor for detecting

whether or not the hydraulic cylinder of the stabilizer leg is in its advanced end position. Thus, a large number of sensors is required with this previously known solution.

[0005] It is also previously known to establish whether or not a stabilizer leg is in the active supporting position based on measuring values from a load sensor located in or close to a foot plate of the stabilizer leg. A disadvantage with this type of solution is that the load sensor is located close to the ground when the stabilizer leg is in use, which implies an increased risk for damages to the load sensor.

OBJECT OF THE INVENTION

[0006] The object of the present invention is to provide a new and favourable manner of detecting whether or not a stabilizer leg is in supporting contact with the ground.

SUMMARY OF THE INVENTION

[0007] According to the present invention, said object is achieved by means of a stabilizer leg arrangement having the features defined in claim 1.

[0008] The stabilizer leg arrangement according to the present invention comprises a support structure and a stabilizer leg carried by the support structure, the stabilizer leg being provided with a hydraulic cylinder, by means of which the stabilizer leg is moveable in relation to the support structure from a raised inactive position, in which the stabilizer leg is out of contact with the ground, to an active supporting position, in which the stabilizer leg is in supporting contact with the ground, wherein the hydraulic cylinder comprises:

- a cylinder housing having an internal space,
- a piston movably received in said internal space and configured to divide this space into a first chamber on a first side of the piston and a second chamber on an opposite second side of the piston, and
- a piston rod fixed to the piston and extending through the second chamber, the piston being moveable in relation to the cylinder housing to an advanced end position, in which the piston abuts against a stop surface in the internal space and in which the second chamber has its minimum volume.

[0009] The stabilizer leg arrangement further comprises a pressure sensor configured to generate a measuring value representing the hydraulic pressure in said first chamber, and an electronic control device connected to the pressure sensor, wherein the electronic control device is configured to establish information as to whether or not the stabilizer leg is in the active supporting position while taking into account said measuring value.

[0010] Furthermore, the stabilizer leg arrangement comprises a hydraulic system with:

- a hydraulic fluid reservoir;
- a directional control valve having a pressure port, a return port connected to the reservoir and a valve spool;
- a pump for pumping hydraulic fluid from the reservoir to the pressure port of the directional control valve;
- a first hydraulic line through which the first chamber is connected to the directional control valve;
- a second hydraulic line through which the second chamber is connected to the directional control valve; and
- a load-holding valve arranged in the first hydraulic line and shiftable between a closed position, in which the load-holding valve is configured to prevent fluid flow from the first chamber to the directional control valve through the first hydraulic line, and an open position, in which the load-holding valve is configured to allow fluid flow from the first chamber to the directional control valve through the first hydraulic line,

wherein the valve spool of the directional control valve is moveable between:

- a first working position, in which the pressure port is connected to the first hydraulic line and the return port is connected to the second hydraulic line,
- a second working position, in which the pressure port is connected to the second hydraulic line and the return port is connected to the first hydraulic line, and
- a normal position, in which the pressure port is disconnected from the first and second hydraulic lines and the return port is connected to the first hydraulic line.

[0011] According to the invention, the second chamber is configured to come into fluid communication with the first chamber through at least one flow channel of the hydraulic cylinder when the piston reaches the advanced end position or is on the verge of reaching this end position, wherein the piston is configured to keep the second chamber fluidly separated from the first chamber when the piston is in any other position in relation to the cylinder housing. Thus, when the piston reaches or is on the verge of reaching the advanced end position, the first and second chambers on the opposite sides of the piston will be fluidly connected to each other and the hydraulic pressures in the first and second chambers will thereby be equalized. The effect of this pressure equalization makes it possible to avoid an erroneous detection that the stabilizer leg is in supporting contact with the ground, as explained in closer detail in the description following below, without requiring any sensor in addition to one or two pressure sensors.

[0012] According to an embodiment of the invention, the load-holding valve has the form of a pilot-operated check valve and comprises a pilot line connected to the second hydraulic line, wherein the load-holding valve is configured to assume the open position when the hydraulic pressure in the second hydraulic line, and thereby in the pilot line, exceeds a predetermined

level. In this case, the load-holding valve is automatically controlled by the hydraulic pressure in the second hydraulic line, which corresponds to the hydraulic pressure in the second chamber of the hydraulic cylinder. When the piston has reached the advanced end position and the valve spool has returned to the normal position, the hydraulic pressures in the first and second chambers of the hydraulic cylinder are equalized by the fluid communication through the above-mentioned flow channel of the hydraulic cylinder, which implies that the second chamber and the second hydraulic line will be subjected to the higher hydraulic pressure that has been generated in the first chamber. The pilot-operated check valve will assume the open position under the effect of this higher hydraulic pressure and the first chamber is thereby connected to the reservoir via the directional control valve, which will result in a release of the hydraulic pressure in the first and second chambers and a return of the pilot-operated check valve to the closed position. If the stabilizer leg is not in supporting contact with the ground in this situation, the hydraulic pressure in the first chamber will remain low and prevent an establishment that the stabilizer leg is in the active supporting position. However, there is also a possibility that the stabilizer leg has already made contact with the ground at the moment when the piston reaches the advanced end position and the valve spool returns to the normal position. If the stabilizer leg is actually in contact with the ground when the pilot-operated check valve returns to the closed position, the load acting on the stabilizer leg via the support structure may cause the generation of an increased hydraulic pressure in the first chamber and make possible an establishment that the stabilizer leg is in the active supporting position.

[0013] When the load-holding valve has the form of a pilot-operated check valve with a pilot line connected to the second hydraulic line, there is no need for the stabilizer leg arrangement to include an additional pressure sensor for measuring the hydraulic pressure in the second chamber or in the second hydraulic line. In this case, the electronic control device may be configured to establish that the stabilizer leg is in the active supporting position when the measuring value representing the hydraulic pressure in the first chamber is higher than a given threshold value. However, the stabilizer leg arrangement may as an alternative be configured to establish that the stabilizer leg is in the active supporting position when the differential pressure in the hydraulic cylinder is higher than a given threshold value. In the latter case, the stabilizer leg arrangement has to be provided with an additional pressure sensor configured to generate a measuring value representing the hydraulic pressure in the second chamber of the hydraulic cylinder.

[0014] According to another embodiment of the invention, the load-holding valve is controlled by the electronic control device, wherein the electronic control device is configured to control the load-holding valve to assume the open position when a measuring value representing the hydraulic pressure in the second chamber is equal to the measuring value representing the hydraulic pressure in the first chamber in a situation when the valve spool of the directional control valve is in the normal position. In this case, the stabilizer leg arrangement has to be provided with an additional pressure sensor configured to generate a measuring value representing the hydraulic pressure in the second chamber. When the piston has reached the advanced end position and the valve spool has returned to the normal position, the hydraulic pressures in the first and second chambers of the hydraulic cylinder are equalized by the fluid

communication through the above-mentioned flow channel of the hydraulic cylinder. As a consequence of this pressure equalization, the electronic control device will make the load-holding valve assume the open position and the first chamber is thereby connected to the reservoir via the directional control valve, which will result in a release of the pressure in the first and second chambers. In this case, the electronic control device may be configured to establish that the stabilizer leg is in the active supporting position when the measuring value representing the hydraulic pressure in the first chamber is higher than a given threshold value or, as an alternative, when the differential pressure in the hydraulic cylinder is higher than a given threshold value.

[0015] According to another embodiment of the invention, the electronic control device is configured, after said opening of the load-holding valve, to control the load-holding valve to return to the closed position when the load-holding valve has been open for a given period of time, preferably in the order of 1-3 seconds. If the stabilizer leg is not in supporting contact with the ground in this situation, the hydraulic pressure in the first chamber will remain low and prevent an establishment that the stabilizer leg is in the active supporting position. However, there is also a possibility that the stabilizer leg has already made contact with the ground at the moment when the piston reaches the advanced end position and the valve spool returns to the normal position. If the stabilizer leg is actually in contact with the ground when the load-holding valve is returned to the closed position, the load acting on the stabilizer leg via the support structure may cause the generation of an increased hydraulic pressure in the first chamber and make possible an establishment that the stabilizer leg is in the active supporting position.

[0016] Further advantageous features of the stabilizer leg arrangement according to the present invention will appear from the description following below and the dependent claims.

[0017] The invention also relates to a mobile working machine having the features defined in claim 14.

[0018] Further advantageous features of the mobile working machine according to the present invention will appear from the description following below and the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The invention will in the following be more closely described by means of embodiment examples, with reference to the appended drawings. In the drawings:

Fig 1
: is a schematic rear view of a mobile working machine provided with a hydraulic crane and a stabilizer leg arrangement according to the present invention,

Figs 2 and 3
: are longitudinal sections through a hydraulic cylinder according to a first variant, as seen with the piston in different positions,

Fig 4
: is a detail enlargement according to the circle IV in Fig 2,

Fig 5
: is a detail enlargement according to the circle V in Fig 3,

Fig 6a
: is a longitudinal section through a part of the hydraulic cylinder of Figs 2 and 3,

Fig 6b
: is a longitudinal section through a part of a hydraulic cylinder according to a second variant

Fig 7
: is a longitudinal section through a hydraulic cylinder according to a third variant, as seen with the piston in an advanced end position,

Fig 8
: is a detail enlargement according to the circle VIII in Fig 7,

Figs 9 and 10
: are longitudinal sections through a hydraulic cylinder according to a fourth variant, as seen with the piston in different positions,

Fig 11
: is a detail enlargement according to the circle XI in Fig 9,

Fig 12
: is a detail enlargement according to the circle XII in Fig 10, and

Figs 13-15
: are outline diagrams of parts included in a stabilizer leg arrangement according to different embodiments of the invention.

DETAILED DESCRIPTION OF EMBODIMENTS OF THE INVENTION

[0020] Fig 1 schematically illustrates a mobile working machine 1 provided with a stabilizer leg arrangement 2 according to an embodiment of the present invention for supporting the mobile working machine against the ground. In the illustrated example, the mobile working machine 1 is a crane vehicle comprising a vehicle 3 and a hydraulic crane 4. The crane 4 is mounted to a chassis 5 of the vehicle 3, either by being fixed directly to the chassis 5 or by being fixed to a subframe, which in its turn is fixed to the chassis 5.

[0021] The illustrated crane 4 comprises:

- a crane base 6, which is fixed to the chassis 5 of the vehicle 3;
- a crane column 7 which is rotatably mounted to the crane base 6 so as to be rotatable in relation to the crane base about an essentially vertical axis of rotation;
- a liftable and lowerable first crane boom 8, which is articulately connected to the crane column 7 in such a manner that it is pivotable in relation to the crane column about an

essentially horizontal axis of rotation;

- a first hydraulic cylinder 9 for lifting and lowering the first crane boom 8 in relation to the crane column 7;
- a liftable and lowerable second crane boom 10, which is articulately connected to the first crane boom 8 in such a manner that it is pivotable in relation to the first crane boom 8 about an essentially horizontal axis of rotation; and
- a second hydraulic cylinder 11 for lifting and lowering the second crane boom 10 in relation to the first crane boom 8.

[0022] The above-mentioned second crane boom 10 is telescopically extensible by means of a hydraulic cylinder 12 in order to enable an adjustment of the extension length thereof.

[0023] The stabilizer leg arrangement 2 comprises a support structure 20. In the embodiment illustrated in Fig 1, the support structure 20 comprises a support beam 21 and two extension arms 22 mounted to the support beam 21 on opposite sides thereof. The support beam 21 is fixedly connected to the chassis 5 of the vehicle 3. In the embodiment illustrated in Fig 1, the support beam 21 may be rigidly mounted to the crane base 6, wherein the support beam 21 is fixedly connected to the chassis 5 via the crane base 6. However, the support beam 21 may as an alternative be mounted directly to the chassis 5, i.e. not directly connected to e.g. a crane.

[0024] Each extension arm 22 is telescopically extensible in order to allow an adjustment of the horizontal extension length thereof. Each extension arm 22 is telescopically mounted to the support beam 21 so as to be axially slidable in relation to the support beam 21 in the longitudinal direction of the extension arm 22 in order to vary the horizontal extension length thereof. Each extension arm 22 is horizontally moveable in relation to the support beam 21 by means of a hydraulic cylinder 23 or any other suitable type of linear actuator.

[0025] A stabilizer leg 25 is mounted to each extension arm 22 at an outer end thereof, wherein the stabilizer leg 25 is extensible in a vertical direction in relation to the extension arm 22. Each stabilizer leg 25 comprises a foot plate 26, which is arranged at a lower end of the stabilizer leg. Furthermore, each stabilizer leg 25 comprises a hydraulic cylinder 27, by means of which the stabilizer leg is manoeuvrable in relation to the extension arm 22 between a raised inactive position, in which the stabilizer leg is raised from the ground 13, and an active supporting position, in which the stabilizer leg is in supporting contact with the ground 13. In the active supporting position, the foot plate 26 of the stabilizer leg 25 is pressed against the ground 13.

[0026] In the illustrated embodiment, the hydraulic cylinder 27 of each stabilizer leg 25 comprises a cylinder housing 30, which forms an upper part of the stabilizer leg, and a piston rod 31, which forms a lower part of the stabilizer leg. The foot plate 26 is fixed to the lower end of the piston rod 31.

[0027] Five different variants of a hydraulic cylinder 27 suitable for use in a stabilizer leg 25 of a stabilizer leg arrangement according to the present invention are illustrated in Figs 2-15. The piston rod 31 of the hydraulic cylinder 27 is at its upper end fixed to a piston 32, which is movably received in an internal space 33 of the cylinder housing 30. The piston 32 divides the internal space 33 of the cylinder housing into a first chamber 34 on a first side of the piston and a second chamber 35 on an opposite second side of the piston. An annular sealing member 36 is arranged in an annular recess 37 in the envelop surface of the piston 32, wherein this sealing member 36 is in sliding and fluid-tight contact with a cylindrical inner wall 38 of the cylinder housing 30 in order to form a sealed interface between the piston 32 and the inner wall 38 of the cylinder housing. The piston rod 31 extends through the second chamber 35, which implies that the above-mentioned second side of the piston 32 constitutes the piston rod side of the hydraulic cylinder 27 and that the above-mentioned first side of the piston 32 constitutes the piston side thereof.

[0028] The piston 32 is moveable in relation to the cylinder housing 30 to an advanced end position (see Figs 5, 6, 8 and 12), in which the piston 32 abuts against a stop surface 40 at a lower end of the internal space 33 and in which the second chamber 35 has its minimum volume. The second chamber 35 is configured to come into fluid communication with the first chamber 34 through at least one flow channel 41, 41', 41", 41‴ in the hydraulic cylinder 27 when the piston 32 reaches the advanced end position or is on the verge of reaching this end position, wherein the piston 32 is configured to keep the second chamber 35 fluidly separated from the first chamber 34 when the piston 32 is in any other position in relation to the cylinder housing 30, i.e. when the piston 32 is not in or on the verge of reaching the advanced end position.

[0029] In a first variant of the hydraulic cylinder 27 illustrated in Figs 2-6a, the above-mentioned flow channel 41 extends through the piston 32. In this case, the piston 32 is provided with a valve member 42, which is moveable between a closed position (see Fig 4, in which the valve member 42 obstructs fluid flow through the flow channel 41, and an open position (see Figs 5 and 6a), in which the valve member 42 allows hydraulic fluid to flow through the flow channel 41 from the first chamber 34 to the second chamber 35. Thus, when the valve member 42 is in the closed position, hydraulic fluid is prevented from flowing from the first chamber 34 to the second chamber 35.

[0030] The valve member 42 is configured to be automatically moved to the open position when the piston 32 reaches or is on the verge of reaching the advanced end position. In the illustrated example, the valve member 42 is moveable from the closed position to the open position against the action of a spring member 43 and from the open position to the closed position by the action of the spring member 43. The illustrated valve member 42 comprises:

- a head part 44, which is configured to be in fluid-tight contact with a valve seat 45 when the valve member 42 is in the closed position to thereby obstruct the flow channel 41 and prevent fluid flow through it; and
- an elongated stem part 46, which is fixed to the head part 44 and extends through the

flow channel 41, wherein the stem part 46 is configured to come into contact with a stop 47 at the lower end of the internal space 33 of the cylinder housing 30 when the piston 32 is on the verge of reaching the advanced end position to thereby push the head part 44 away from the valve seat 45 and open up the flow channel 41.

[0031] In the illustrated example, the stop 47 is formed by an edge on the above-mentioned stop surface 40. However, the stop 47 and the stop surface 40 may as an alternative be separated from each other.

[0032] In the illustrated example, the above-mentioned spring member 43 has the form of a helical compression spring, which at a first end abuts against a shoulder 48 on the head part 44 and at an opposite second end abuts against an end cap 49 that is fixed to a sleeve-shaped part 50 at an upper end of the flow channel 41. Hydraulic fluid is allowed to flow into the flow channel 41 through a passage 51 in the end cap 49.

[0033] The valve member 42 may of course also have any other suitable design in addition to the design illustrated in Figs 4-6a.

[0034] In the variant illustrated in Fig 6b, the hydraulic cylinder is provided with a valve member 42' resembling the valve member illustrated in Fig 6a. This valve member 42' is moveable to the open position in the same manner as the valve member 42 illustrated in Fig 6a. However, this valve member 42' is not configured to co-operate with any spring member. The valve member 42' illustrated in Fig 6b is provided with an axial channel 63, which is open at both ends and extends inside the valve member from the lower end of the valve member to the upper end thereof. A piston 64 is provided at the upper end of the valve member 42', wherein this piston 64 is slidably received in an inner space of a valve housing 65 formed by a sleeve-shaped part 50 and an associated end cap 49. The piston 64 divides this inner space into an upper chamber 66 and a lower chamber 67, wherein the upper chamber 66 is in fluid communication with the second chamber 35 through the channel 63 and the lower chamber 67 is in fluid communication with the first chamber 34 through a radially extending through hole 68 in the sleeve-shaped part 50 of the valve housing 65. When the piston 32 of the hydraulic cylinder is to be moved upwards in relation to the cylinder housing 30 under the effect of hydraulic fluid fed into the second chamber 35, hydraulic fluid will flow into the upper chamber 66 of the valve housing through the channel 63 in the valve member 42' and the piston 64 of the valve member is thereby pushed downwards in relation to the valve housing 65, whereby the valve member 42' is made to assume its closed position with the head part 44 in fluid-tight contact with the associated valve seat 45.

[0035] In a third variant of the hydraulic cylinder 27 illustrated in Figs 7 and 8, the above-mentioned flow channel 41' is formed as an axial groove in the cylindrical inner wall 38 of the cylinder housing 30. This axial groove 41' has a larger extension in the axial direction of the cylinder housing 30 than the sealing member 36 to thereby allow the sealing member 36 to

assume a position between the upper and lower ends of the groove 41' when the piston 32 is in the advanced end position, as illustrated in Fig 8. Thus, when the piston 32 is in the advanced end position, the upper end of the groove 41' is in fluid communication with the first chamber 34 and the lower end of the groove 41' in fluid communication with the second chamber 35. When the piston 32 is at a distance from the advanced end position with the sealing member 36 overlapping or being positioned above the upper end of the groove 41', there is no fluid communication between the first chamber 34 and the groove 41' and consequently no fluid communication between the first and second chambers 34, 35 via this groove 41'.

[0036] In a fourth variant of the hydraulic cylinder 27 illustrated in Figs 9-12, hydraulic fluid is supplied to and discharged from the second chamber 35 through a feed and discharge channel 55 in an elongated and rigid pipe 56, which is fixed to the cylinder housing 30 at an upper end thereof and which extends axially through the first chamber 34. In this variant, an internal space 53 of the piston rod 31 is in fluid communication with the second chamber 35 through radially extending through holes 54 at the upper end of the piston rod. The pipe 56 extends through an axial through hole 57 in the piston 32 and an inlet and outlet opening 58 is provided at the lower end of the pipe 56. The pipe 56 has such a length that the inlet and outlet opening 58 is located in the internal space 53 of the piston rod 31 in all possible positions of the piston 32, i.e. also when the piston is in the advanced end position illustrated in Fig 12. Thus, the feed and discharge channel 55 is always in fluid communication with the second chamber 35 via the inlet and outlet opening 58 and the through holes 54 in order to allow hydraulic fluid to be fed into the second chamber 35 via the pipe 56 when the piston rod 31 and the foot plate 26 at the lower end of the piston rod are to be moved upwards in relation to the cylinder housing 30 and allow hydraulic fluid to be discharged from the second chamber 35 via the pipe 56 when the piston rod 31 and the foot plate 26 are to be moved upwards in relation to the cylinder housing. In this variant of the hydraulic cylinder 27, the above-mentioned flow channel 41'' is formed by a section 59 of the feed and discharge channel 55 at the lower end thereof and by at least one through hole 60 in the wall 61 of the pipe 56 at the upper end of this channel section 59. The through hole 60 has such a position in the axial direction of the pipe 56 that it is received in the first chamber 34 when the piston 32 is in the advanced end position, as illustrated in Fig 12. Thus, when the piston 32 is in the advanced end position, the feed and discharge channel 55 is in fluid communication with the first chamber 34 via the through hole 60 in the pipe 56 and in fluid communication with the second chamber 35 via the inlet and outlet opening 58 in the pipe 56 and the through holes 54 in the piston rod 31, which implies that the first and second chambers 34, 35 are in fluid communication with each other via the above-mentioned section 59 of the feed and discharge channel 55. When the piston 32 is at a distance from the advanced end position and overlaps or is positioned above the through hole 60, there is no fluid communication between the first chamber 34 and the feed and discharge channel 55 and consequently no fluid communication between the first and second chambers 34, 35 via this channel.

[0037] In a fifth variant of the hydraulic cylinder 27 schematically illustrated in Fig 14, the above-mentioned flow channel 41''' has the form of a hydraulic line arranged on the outside of

the cylinder housing 30. This hydraulic line 41‴ is at a first end connected to the internal space 33 of the cylinder housing 30 via a first fluid port 69a in the cylindrical inner wall 38 of the cylinder housing and at a second end connected to the internal space 33 of the cylinder housing 30 via a second fluid port 69b in the cylinder housing 30. The second fluid port 69b has such a position in the cylinder housing 30 that it is always in fluid communication with the second chamber 35 in all possible positions of the piston 32, whereas the first fluid port 69a has such a position on the cylindrical inner wall 38 of the cylinder housing 30 that it is in fluid communication with the first chamber 34 when the piston 32 is in the advanced end position and disconnected from the first chamber 34 when the piston 32 is in any other position in relation to the cylinder housing 30. When the piston 32 is at a distance from the advanced end position with the sealing member 36 of the piston overlapping or being positioned above the first fluid port 69a, there is no fluid communication between the first chamber 34 and the hydraulic line 41‴ and consequently no fluid communication between the first and second chambers 34, 35 via this hydraulic line 41‴. Thus, there is only fluid communication between the first and second chambers 34, 35 via the hydraulic line 41‴when the piston 32 is in the advanced end position.

[0038] The stabilizer leg arrangement 2 comprises a pressure sensor 70 (very schematically illustrated in Figs 13-15) configured to generate a measuring value V1 representing the hydraulic pressure in the first chamber 34 of the hydraulic cylinder 27. In the following, this pressure sensor 70 is denominated first pressure sensor and the measuring value V1 is denominated first measuring value. The stabilizer leg arrangement 2 also comprises an electronic control device 72. The electronic control device 72 is connected to the first pressure sensor 70 in order to receive information about said first measuring value V1 from this sensor, wherein the electronic control device 72 is configured to establish information as to whether or not the stabilizer leg 25 is in the active supporting position while taking into account this measuring value V1. The possibility for the electronic control device 72 to establish this information based on the first measuring value V1 from the first pressure sensor 70, without any additional measuring value from e.g. a length sensor, is due to the fact that the hydraulic pressures in the first and second chambers 34, 35 of the hydraulic cylinder 27 are equalized by the fluid communication through the above-mentioned flow channel 41, 41', 41", 41‴ when the piston 32 reaches the advanced end position or is on the verge of reaching this end position.

[0039] The electronic control device 72 may be implemented by one single electronic control unit or by two or more mutually cooperating electronic control units.

[0040] The manner in which the electronic control device 72 is configured to use the first measuring value V1 in order to establish the above-mentioned information depends on the layout of the hydraulic system 80 to which the hydraulic cylinder 27 is connected. Alternative variants of this hydraulic system 80 are illustrated in Figs 13-15. In all variants, the hydraulic system 80 comprises a hydraulic fluid reservoir 81, a pump 82 and a directional control valve 83, wherein the directional control valve is provided with a pressure port P and a return port R. The pump 82 is configured to pump hydraulic fluid from the reservoir 81 to the pressure port P. The return port R is connected to the reservoir 81 in order to allow hydraulic fluid to be

returned from the directional control valve 83 to the reservoir via the return port. The first chamber 34 of the hydraulic cylinder 27 is connected to the directional control valve 83 through a first hydraulic line 84 and the second chamber 35 is connected to the directional control valve 83 through a second hydraulic line 85.

[0041] The directional control valve 83 is provided with a valve spool 88, which is moveable between:

- a first working position, in which the pressure port P is connected to the first hydraulic line 84 and the return port R is connected to the second hydraulic line 85,
- a second working position, in which the pressure port P is connected to the second hydraulic line 85 and the return port R is connected to the first hydraulic line 84, and
- a normal position, in which the pressure port P is disconnected from the first and second hydraulic lines 84, 85 and the return port R is connected to the first hydraulic line 84.

[0042] In Figs 13-15, the valve spool 88 is shown in the normal position. In the examples illustrated in Figs 13-15, the valve spool 88 will be moved from the normal position to the first working position by being moved to the left under the effect of an actuating force acting on the valve spool 88 in a first direction, and from the normal position to the second working position by being moved to the right under the effect of an actuating force acting on the valve spool 88 in an opposite second direction. The valve spool 88 is configured to automatically return to the normal position on removal of the actuating force. An operator may control the directional control valve 83 and thereby the movement of the stabilizer leg 25 in a conventional manner by actuating a manoeuvring member of a manoeuvring unit.

[0043] A load-holding valve 86, 86' is arranged in the first hydraulic line 84 and shiftable between a closed position, in which the load-holding valve 86, 86' prevents fluid flow from the first chamber 34 to the directional control valve 83 through the first hydraulic line 84, and an open position, in which the load-holding valve 86, 86' allows fluid flow from the first chamber 34 to the directional control valve 83 through the first hydraulic line 84.

[0044] In the embodiments illustrated in Figs 13 and 14, the load-holding valve 86 has the form of a pilot-operated check valve and comprises a pilot line 87 connected to the second hydraulic line 85. In this case, the load-holding valve 86 is configured to assume the open position and allow discharge of hydraulic fluid from the first chamber 34 when the hydraulic pressure in the second hydraulic line 85, and thereby in the pilot line 87, exceeds a predetermined level. When the piston 32 has reached the advanced end position and the valve spool 88 has returned to the normal position, the hydraulic pressures in the first and second chambers 34, 35 are equalized by the fluid communication through the above-mentioned flow channel 41, 41‴ and the pilot-operated check valve 86 will assume the open position under the effect of the hydraulic pressure in the second hydraulic line 85. The opening of the pilot-operated check valve 86 will bring the first chamber 34 in fluid communication with the reservoir 81, which in its turn will result in a release of the hydraulic pressure in the first and

second chambers 34, 35 and a return of the pilot-operated check valve 86 to the closed position.

[0045] In the embodiment illustrated in Fig 13, the electronic control device 72 is configured to compare the above-mentioned first measuring value V1 with a given threshold value, wherein a measuring value V1 lower than the threshold value implies that the stabilizer leg 25 is not in the active supporting position. Thus, the electronic control device 72 is in this case configured to establish that the stabilizer leg 25 is in the active supporting position if it is established by the electronic control device that the first measuring value V1 is higher than the threshold value.

[0046] In the embodiment illustrated in Fig 14, a second pressure sensor 71 is configured to generate a second measuring value V2 representing the hydraulic pressure in the second chamber 35 of the hydraulic cylinder 27, wherein the electronic control device 72 is connected to the second pressure sensor 71 in order to receive information about said second measuring value V2 from this sensor. In this embodiment, the electronic control device 72 is configured to establish the magnitude of the differential pressure P_{diff} in the hydraulic cylinder 27 based on the first and second measuring values V1, V2 from the first and second pressure sensors 70, 71 and compare the established value of the differential pressure P_{diff} in the hydraulic cylinder 27 with a given threshold value, wherein a differential pressure P_{diff} lower than the threshold value implies that the stabilizer leg 25 is not in the active supporting position. Thus, the electronic control device 72 is in this case configured to establish that the stabilizer leg 25 is in the active supporting position if it is established by the electronic control device that the differential pressure P_{diff} is higher than the threshold value.

[0047] In the embodiment illustrated in Fig 15, the load-holding valve 86' has the form of an electrically controlled valve that is controlled by the electronic control device 72. A second pressure sensor 71 is configured to generate a second measuring value V2 representing the hydraulic pressure in the second chamber 35 of the hydraulic cylinder 27, wherein the electronic control device 72 is connected to the second pressure sensor 71 in order to receive information about said second measuring value V2 from this sensor. In this case, the electronic control device 72 is configured to compare the first and second measuring values V1, V2 and control the load-holding valve 86' to assume the open position if it is established by the electronic control device 72 that the second measuring value V2 is equal to the first measuring value V1 in a situation when the valve spool 88 of the directional control valve 83 is in the normal position. The electronic control device 72 is preferably configured, after said opening of the load-holding valve 86', to control the load-holding valve 86' to return to the closed position when the load-holding valve 86' has been open for a given period of time, for instance in the order of 1-3 seconds.

[0048] In the embodiment illustrated in Fig 15, the electronic control device 72 may be configured to compare the first measuring value V1 with a given threshold value, wherein a measuring value V1 lower than the threshold value implies that the stabilizer leg 25 is not in the active supporting position. Thus, the electronic control device 72 is in this case configured to

establish that the stabilizer leg 25 is in the active supporting position if it is established by the electronic control device that the first measuring value V1 is higher than the threshold value. In the embodiment illustrated in Fig 15, the electronic control device 72 may, as an alternative, be configured to establish the magnitude of the differential pressure P_{diff} in the hydraulic cylinder 27 based on the first and second measuring values V1, V2 and compare the established value of the differential pressure P_{diff} with a given threshold value, wherein a differential pressure P_{diff} lower than the threshold value implies that the stabilizer leg 25 is not in the active supporting position. Thus, the electronic control device 72 is in the latter case configured to establish that the stabilizer leg 25 is in the active supporting position if it is established by the electronic control device that the differential pressure P_{diff} is higher than the threshold value.

[0049] In the embodiments illustrated in the drawings, the stabilizer leg arrangement 2 is provided with a stabilizer leg 25 of telescopic type where the hydraulic cylinder 27 is configured to move the stabilizer leg between the raised inactive position and the active supporting position by extending and retracting the stabilizer leg vertically in the axial direction of the stabilizer leg. However, the stabilizer leg included in the stabilizer leg arrangement of the present invention may as an alternative be a so-called flap-down stabilizer leg, for instance of the type disclosed in GB 2 388 582 A or GB 1 099 147 A, where the hydraulic cylinder of the stabilizer leg is configured to move the stabilizer leg from the raised inactive position to the active supporting position by deploying the stabilizer leg downwards and from the active supporting position to the raised inactive position to by folding the stabilizer leg upwards.

[0050] The invention is of course not in any way limited to the embodiments described above. On the contrary, several possibilities to modifications thereof should be apparent to a person skilled in the art without thereby deviating from the basic idea of the invention as defined in the appended claims.

REFERENCES CITED IN THE DESCRIPTION

Cited references

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Patent documents cited in the description

- WO2013120118A1 **[0001]**
- GB2388582A **[0049]**
- GB1099147A **[0049]**

Patentkrav

1. Et stabilisatorbenarrangement omfattende:

- en bærende konstruktion (20);
- et stabilisatorben (25) båret af den bærende konstruktion (20), stabilisatorbenet (25) er forsynet med en hydraulisk cylinder (27), hvorved stabilisatorbenet (25) er bevægeligt i forhold til støttestrukturen (20) fra en hævet inaktiv position, hvor stabilisatorbenet (25) er ude af kontakt med jorden, til en aktiv støtteposition, hvor stabilisatorbenet (25) er i støttende kontakt med jorden, hvori den hydrauliske cylinder (27) omfatter:

  • et cylinderhus (30) med et indre rum (33),
  • et stempel (32) bevægeligt modtaget i det indre rum (33) og konfigureret til at opdele dette rum (33) i et første kammer (34) på en første side af stemplet (32) og et andet kammer (35) på en modsat anden side af stemplet (32), og
  • en stempelstang (31) fastgjort til stemplet (32) og strækker sig gennem det andet kammer (35), stemplet (32) er bevægeligt i forhold til cylinderhuset (30) til en fremrykket endeposition, hvor stemplet (32) støder op mod en stopflade (40) i det indre rum (33), og hvor det andet kammer (35) har sit mindste volumen;

- en tryksensor (70) konfigureret til at generere en måleværdi (V1), der repræsenterer det hydrauliske tryk i det første kammer (34);
- en elektronisk styreanordning (72) forbundet til tryksensor (70), hvori den elektroniske styreanordning (72) er konfigureret til at fastslå oplysninger om, hvorvidt stabilisatorbenet (25) er i aktiv støtningsposition mens at der tages hensyn til måleværdien (V1);
- et hydraulisk system (80) omfattende en retningsventil (83), hvortil det første og andet kammer (34, 35) er forbundet, et hydraulisk væskereservoir (81), en pumpe (82) til pumpning af hydraulisk væske fra reservoiret (81) til en afgangsåbning (P) i retningsventilen (83), en første hydraulisk ledning (84), gennem hvilken det første kammer (34) er forbundet til retningsventilen (83) og en anden hydraulisk ledning (85), gennem hvilken det andet kammer (35) er forbundet til retningsventilen (83), hvori retningsventilen (83) har en returport (R) forbundet til reservoiret (81) og er forsynet med en stempelventil (88), som kan flyttes mellem:

• en første arbejdsstilling, hvor afgangsåbningen (P) er forbundet til den første hydrauliske ledning (84), og returporten (R) er forbundet til den anden hydrauliske ledning (85),

• en anden arbejdsstilling, hvor afgangsåbningen (P) er forbundet til den anden hydrauliske ledning (85), og returporten (R) er forbundet til den første hydrauliske ledning (84), og

• en normal position, hvor afgangsåbningen (P) afbrydes fra den første og anden hydrauliske linje (84, 85); og

- en overcenterventil (86; 86') anbragt i den første hydrauliske ledning (84) og kan forskydes mellem en lukket position, hvor overcenterventilen (86; 86') er konfigureret til at forhindre væskestrømning fra det første kammer (34) til retningsventilen (83) gennem den første hydrauliske ledning (84), og en åben position, hvor overcenterventilen (86; 86') er konfigureret til at tillade væskestrømning fra det første kammer (34) til retningsventilen (83) gennem den første hydrauliske ledning (84),

kendetegnet ved:

- **at** returporten (R) for retningsventilen (83) er forbundet til den første hydrauliske ledning (84) i den normale position af stempelventilen (88); og
- **at** den hydrauliske cylinder (27) er tilvejebragt med mindst en strømningskanal (41; 41'; 41"; 41‴), hvorigennem det andet kammer (35) er konfigureret til at komme i væskeforbindelse med det første kammer (34), når stemplet (32) når den fremrykkede endeposition eller er på randen af at nå denne endeposition, hvori stemplet (32) er konfigureret til at holde det andet kammer (35) flydende adskilt fra det første kammer (34), når stemplet er i en hvilken som helst anden position i forhold til cylinderhuset (30).

2. Et stabilisatorbenarrangement ifølge krav 1, **kendetegnet ved, at** overcenterventilen (86) har form af en pilotstyret kontraventil og omfatter en pilotledning (87) forbundet til den anden hydrauliske ledning (85), hvori overcenterventilen (86) er konfigureret til at antage den åbne position, når det hydrauliske tryk i den anden hydrauliske ledning (85) og derved i pilotledningen (87) overstiger en forudbestemt niveau.

3. Et stabilisatorbenarrangement ifølge krav 1 eller 2, **kendetegnet ved, at** den elektroniske styreanordning (72) er konfigureret til at fastslå, at stabilisatorbenet (25) er i den aktive støtningsposition, hvis det af den elektroniske styreanordning fastslås, at måleværdien (V1), der repræsenterer det hydrauliske tryk i det første kammer (34), er højere end en given tærskelværdi.

4. Et stabilisatorbenarrangement ifølge krav 1 eller 2, **kendetegnet ved, at** stabilisatorbenarrangementet (2) omfatter en anden tryksensor (71), der er konfigureret til at generere en måleværdi (V2), der repræsenterer det hydrauliske tryk i det andet kammer (35), hvori den elektroniske styreanordning (72) er forbundet til denne tryksensor (71) og konfigureret til at fastslå, at stabilisatorbenet (25) er i den aktive støttende position, hvis det er etableret af den elektroniske styreanordning, at differenstrykket (Pdiff) i den hydrauliske cylinder (27) er højere end en given tærskelværdi.

5. Et stabilisatorbenarrangement ifølge krav 1, **kendetegnet ved**:

- **at** stabilisatorbenarrangementet (2) omfatter en anden tryksensor (71), konfigureret til at generere en måleværdi (V2), der repræsenterer det hydrauliske tryk i det andet kammer (35), hvori den elektroniske styreanordning (72) er forbundet til denne tryksensor (71); og
- **at** overcenterventilen (86') styres af den elektroniske styreanordning (72), hvori den elektroniske styreanordning (72) er konfigureret til at styre overcenterventilen (86') til at antage den åbne position, hvis det af den elektroniske styreanordning (72) fastslås, at den måleværdi (V2), der repræsenterer det hydrauliske tryk i det andet kammer (35), er lig med måleværdien (V1), der repræsenterer det hydrauliske tryk i det første kammer (34) i en situation, når stempelventilen (88) af retningsventilen (83) er i den normale position.

6. Et stabilisatorbenarrangement ifølge krav 5, **kendetegnet ved, at** den elektroniske styreanordning (72) er konfigureret, efter åbningen af overcenterventilen (86'), til at styre overcenterventilen (86') til at vende tilbage til den lukkede position, når overcenterventilen (86') har været åben i en given periode, fortrinsvis i størrelsesordenen 1-3 sekunder.

7. Et stabilisatorbenarrangement ifølge krav 5 eller 6, **kendetegnet ved, at** den elektroniske styreanordning (72) er konfigureret til at fastslå, at stabilisatorbenet (25) befinder sig i aktiv støtningsposition, hvis det af den elektroniske

styreanordning fastslås, at måleværdien (V1), der repræsenterer det hydrauliske tryk i det første kammer (34), er højere end en given tærskelværdi.

8. Et stabilisatorbenarrangement ifølge krav 5 eller 6, **kendetegnet ved, at** den elektroniske styreanordning (72) er konfigureret til at fastslå, at stabilisatorbenet (25) er i den aktive støtteposition, hvis det af den elektroniske styreanordning fastslås, at differenstrykket (Pdiff) i den hydrauliske cylinder (27) er højere end en given tærskelværdi.

9. Et stabilisatorbenarrangement ifølge ethvert af kravene 1-8, **kendetegnet ved, at** strømningskanalen (41) strækker sig gennem stemplet (32), og at stemplet (32) er tilvejebragt med en ventildel (42), som er bevægelig mellem en lukket position, hvor ventildelen (42) er konfigureret til at forhindre væskestrømning gennem strømningskanalen (41), og en åben position, hvor ventildelen (42) er konfigureret til at tillade væskestrømning gennem strømningskanalen (41), hvori ventildelen (42) er konfigureret til automatisk at blive flyttet til den åbne position, når stemplet (32) når eller er på randen af at nå den fremrykkede endeposition.

10. Et stabilisatorbenarrangement ifølge krav 9, **kendetegnet ved, at** ventildelen (42) er bevægelig fra den lukkede position til den åbne position mod virkningen af en fjederdel (43) og fra den åbne position til den lukkede position ved virkningen af fjederdelen (43).

11. Et stabilisatorbenarrangement ifølge krav 9 eller 10, **kendetegnet ved, at** ventildelen (42) omfatter:

- en hoveddel (44), som er konfigureret til at være i væsketæt kontakt med et ventilsæde (45), når ventildelen (42) er i lukket stilling og derved forhindrer væskestrømning gennem strømningskanalen (41); og
- en langstrakt stængel (46), som er fastgjort til hoveddelen (44) og strækker sig gennem strømningskanalen (41), hvori stængelen (46) er konfigureret til at komme i kontakt med et stop (47) i det indre rum (33), når stemplet (32) er på randen af at nå den fremrykkede endeposition for derved at skubbe hoveddelen (44) væk fra ventilsædet (45).

12. Et stabilisatorbenarrangement ifølge ethvert af kravene 1-8, **kendetegnet ved, at** strømningskanalen (41') er udformet som en aksial rille i en indre væg (38) af cylinderhuset (30).

13. Et stabilisatorbenarrangement ifølge ethvert af kravene 1-8, **kendetegnet ved, at** strømningskanalen (41‴) har form af en hydraulisk linje anbragt på ydersiden af cylinderhuset (30).

14. En mobil arbejdsmaskine med et chassis (5), **kendetegnet ved, at** den mobile arbejdsmaskine (1) omfatter et stabilisatorbenarrangement (2) ifølge ethvert af kravene 1-13, hvori den bærende konstruktion (20) af stabilisatorbenarrangement (2) er forbundet til chassiset (5).

15. En mobil arbejdsmaskine ifølge krav 14, **kendetegnet ved, at** den mobile arbejdsmaskine (1) omfatter en hydraulisk kran (4) monteret på chassiset (5).

DRAWINGS

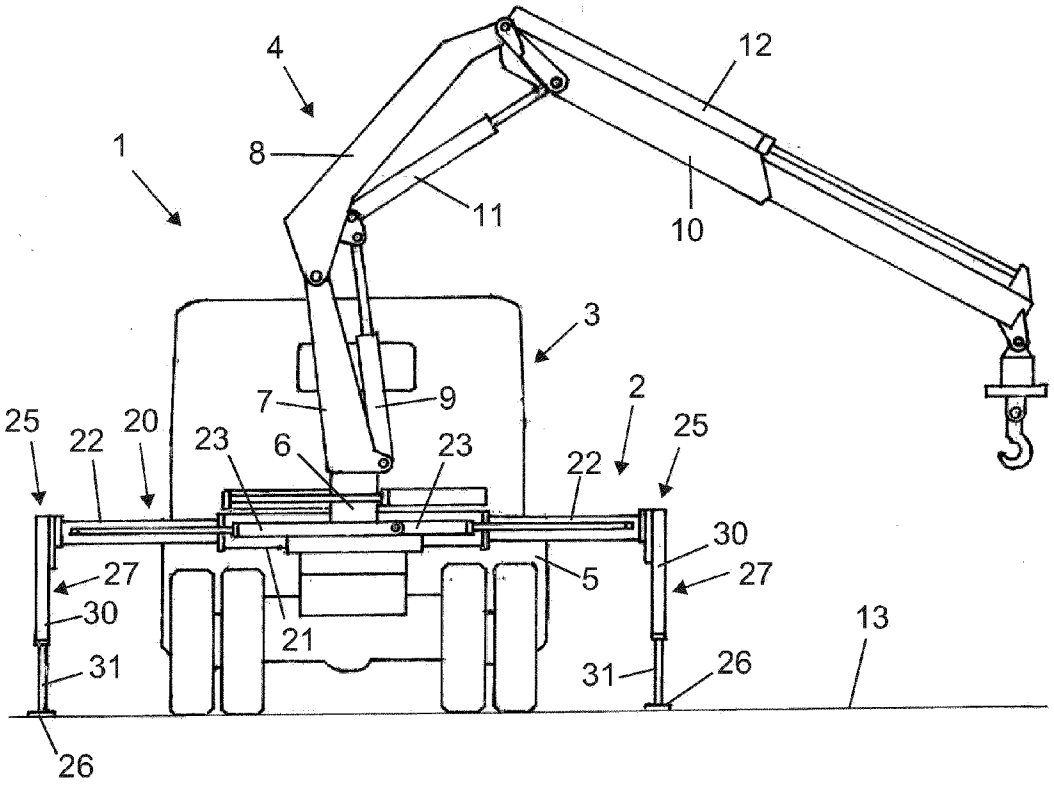


Fig 1

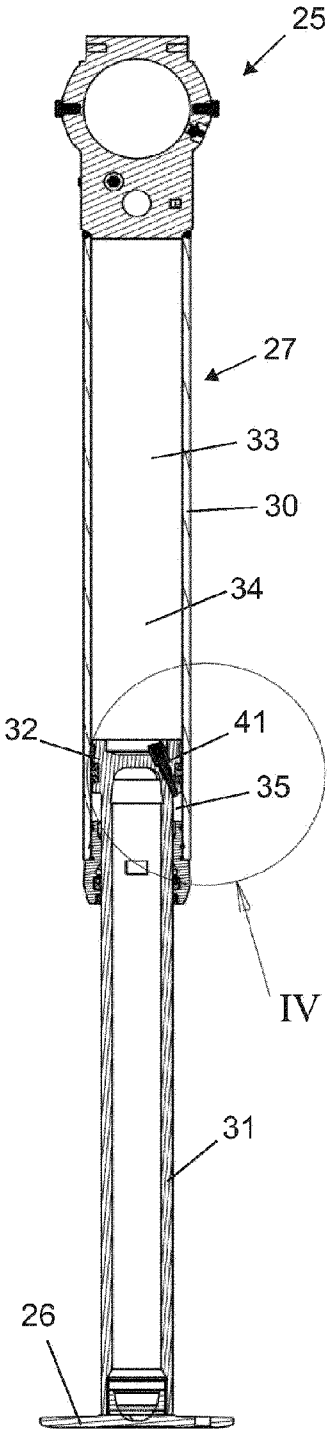


Fig 2

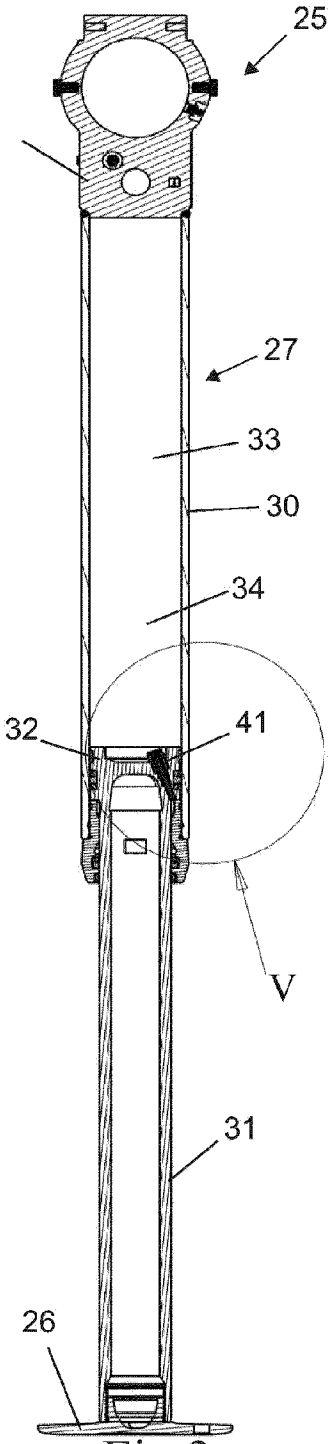


Fig 3

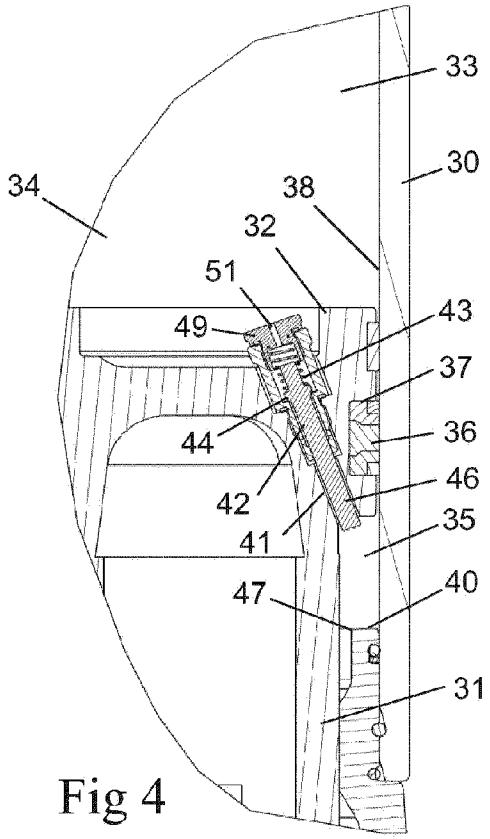


Fig 4

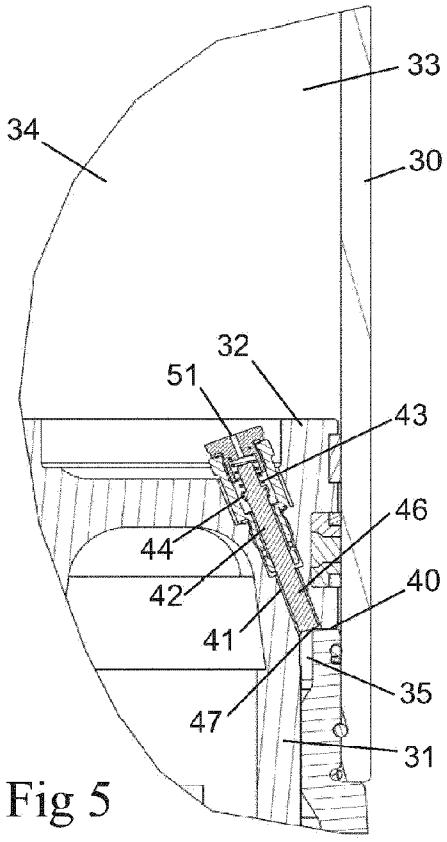


Fig 5

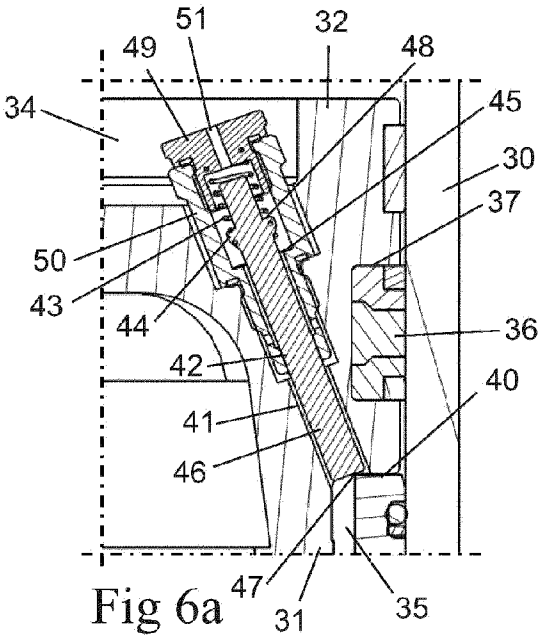


Fig 6a

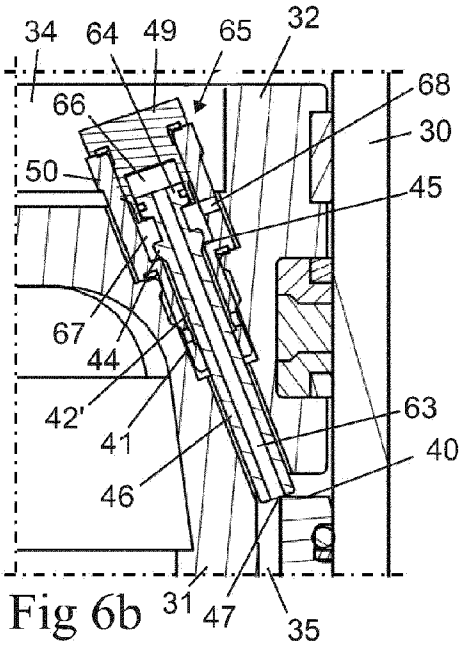


Fig 6b

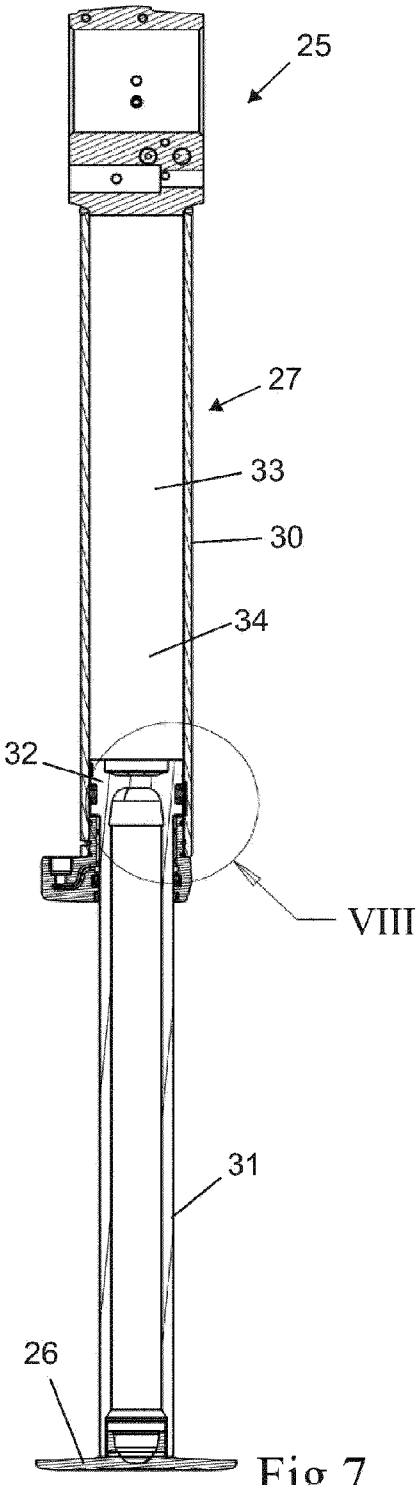


Fig 7

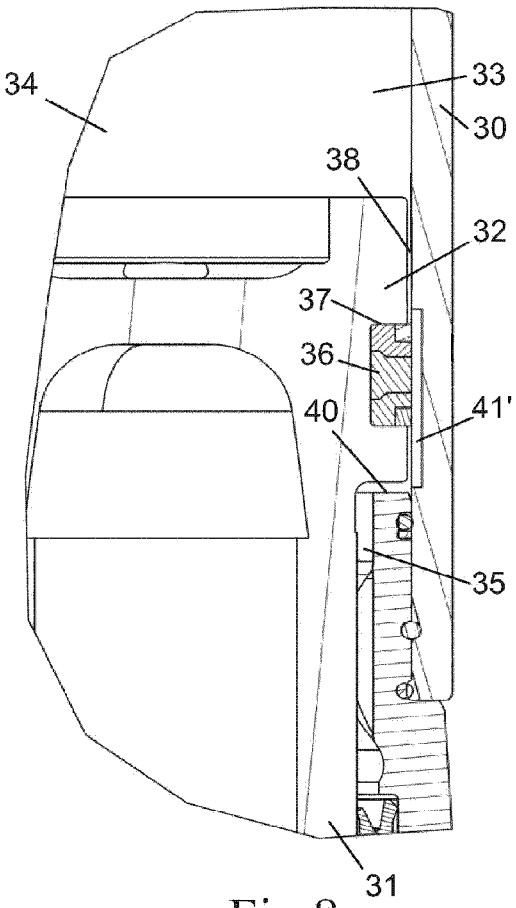


Fig 8

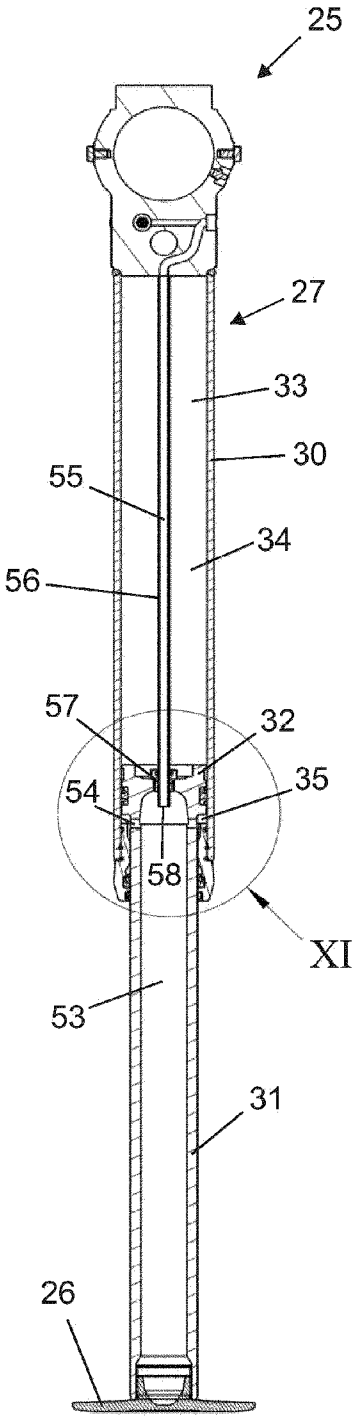

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35
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XI
53
31
26

Fig 9

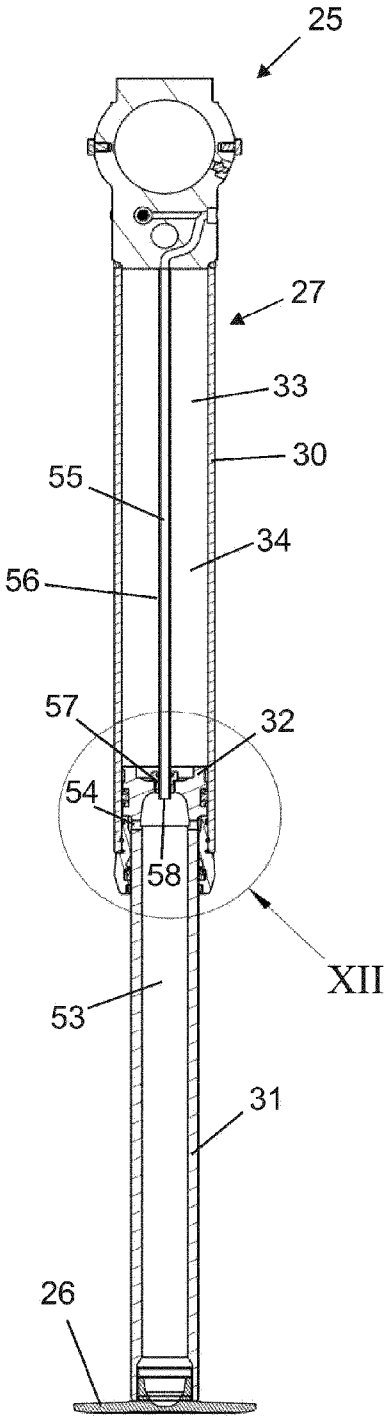

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XII
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Fig 10

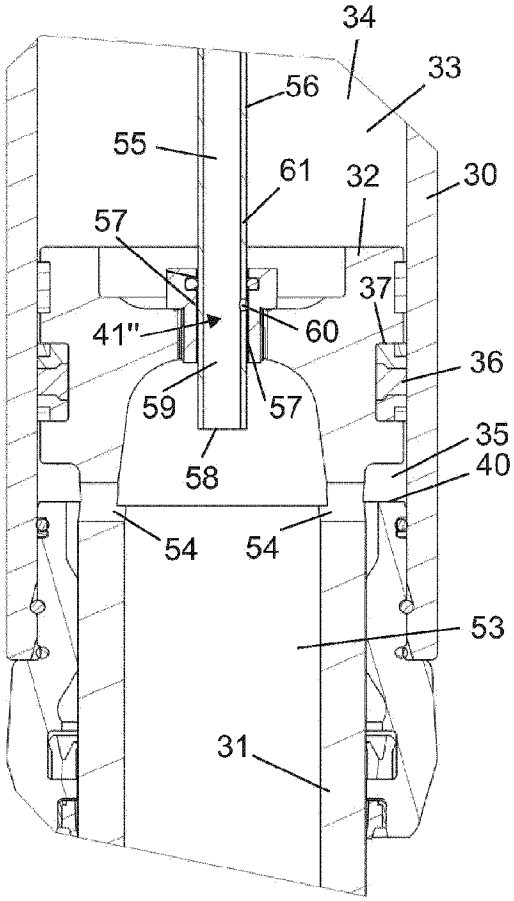

34
33
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61
32
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57
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41"
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36
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57
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53
31

Fig 11

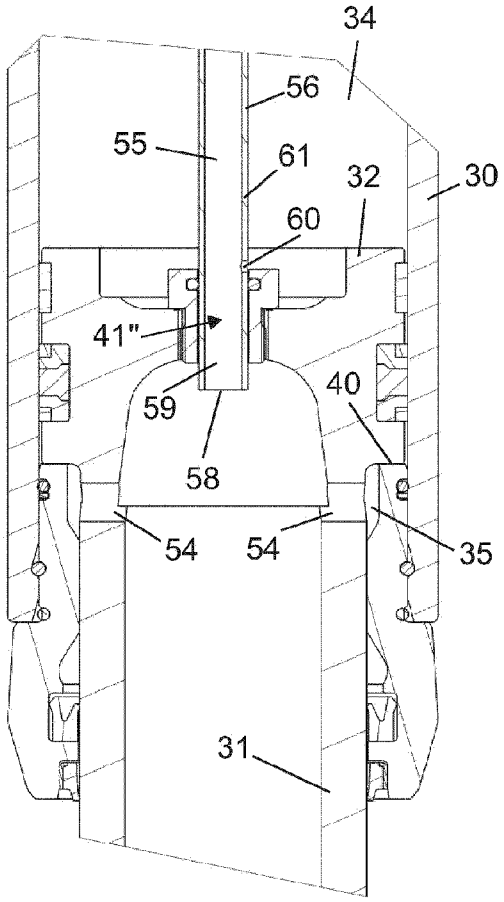

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32
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41"
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Fig 12

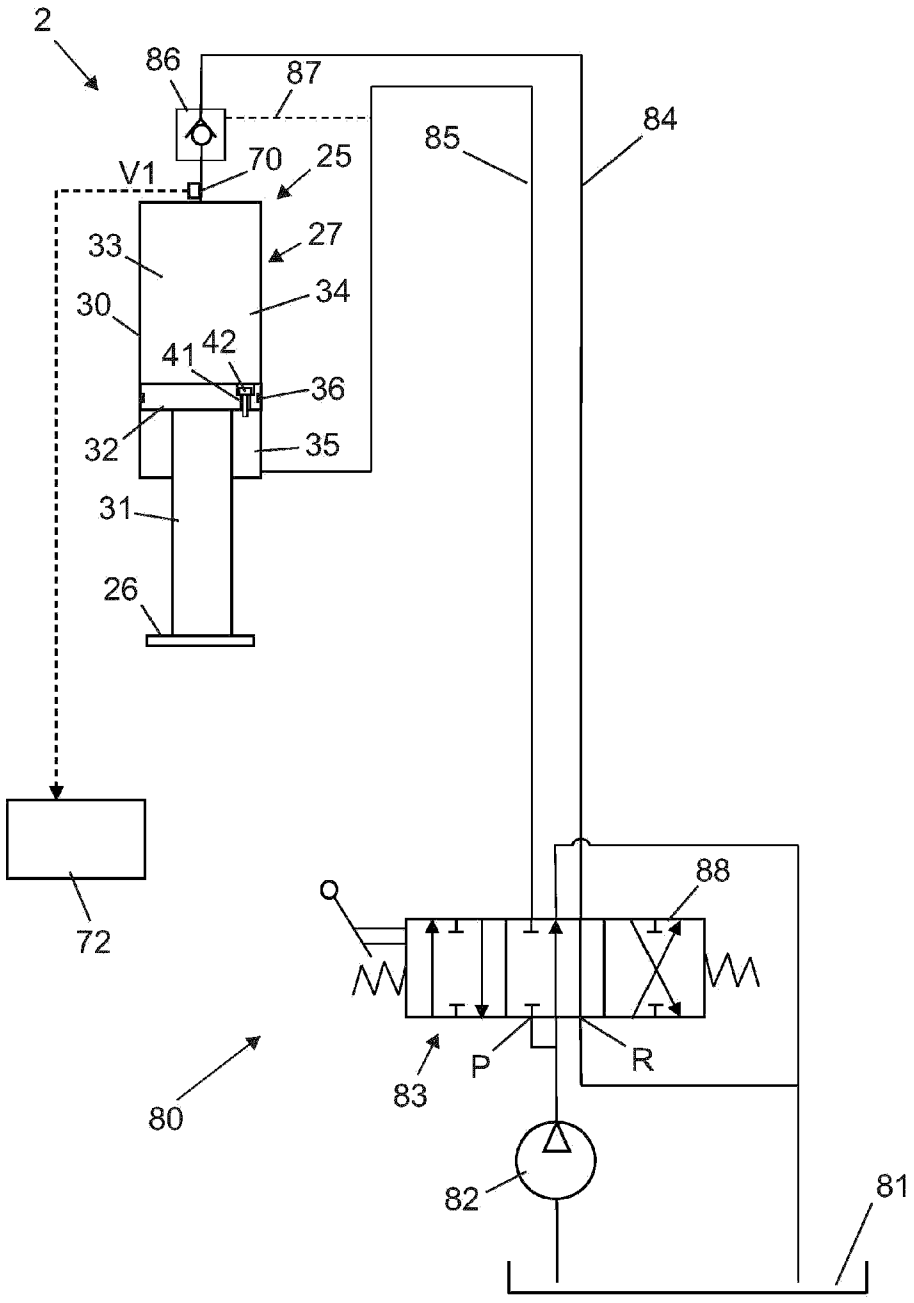

2
86
87
84
85
V1
70
25
27
33
34
30
41
42
36
32
35
31
26
72
88
P
R
83
80
82
81

Fig 13

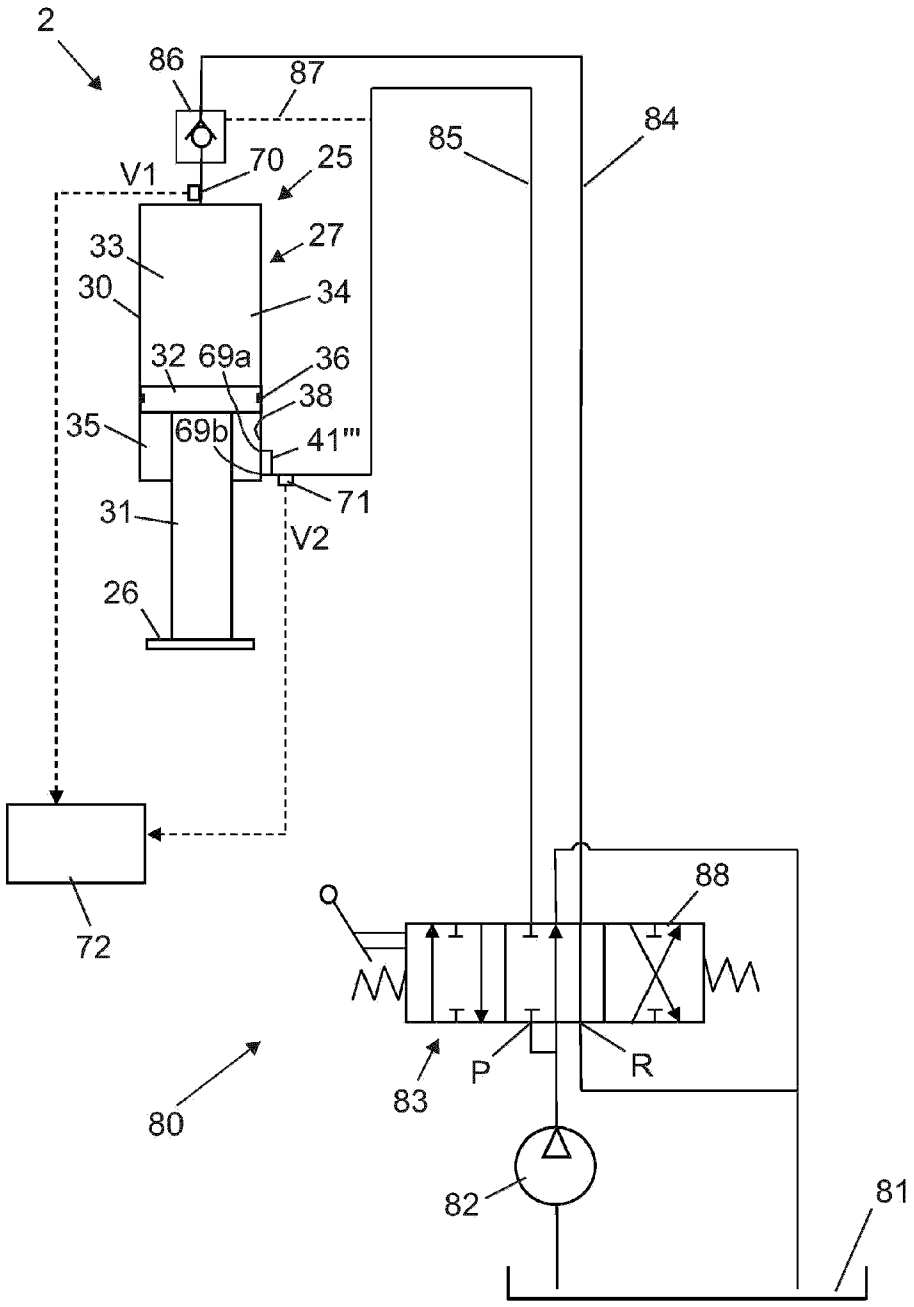

2
86
87
84
85
V1
70
25
27
33
30
34
32
69a
36
38
35
69b
41'''
71
31
V2
26
72
88
P
R
83
80
82
81

Fig 14

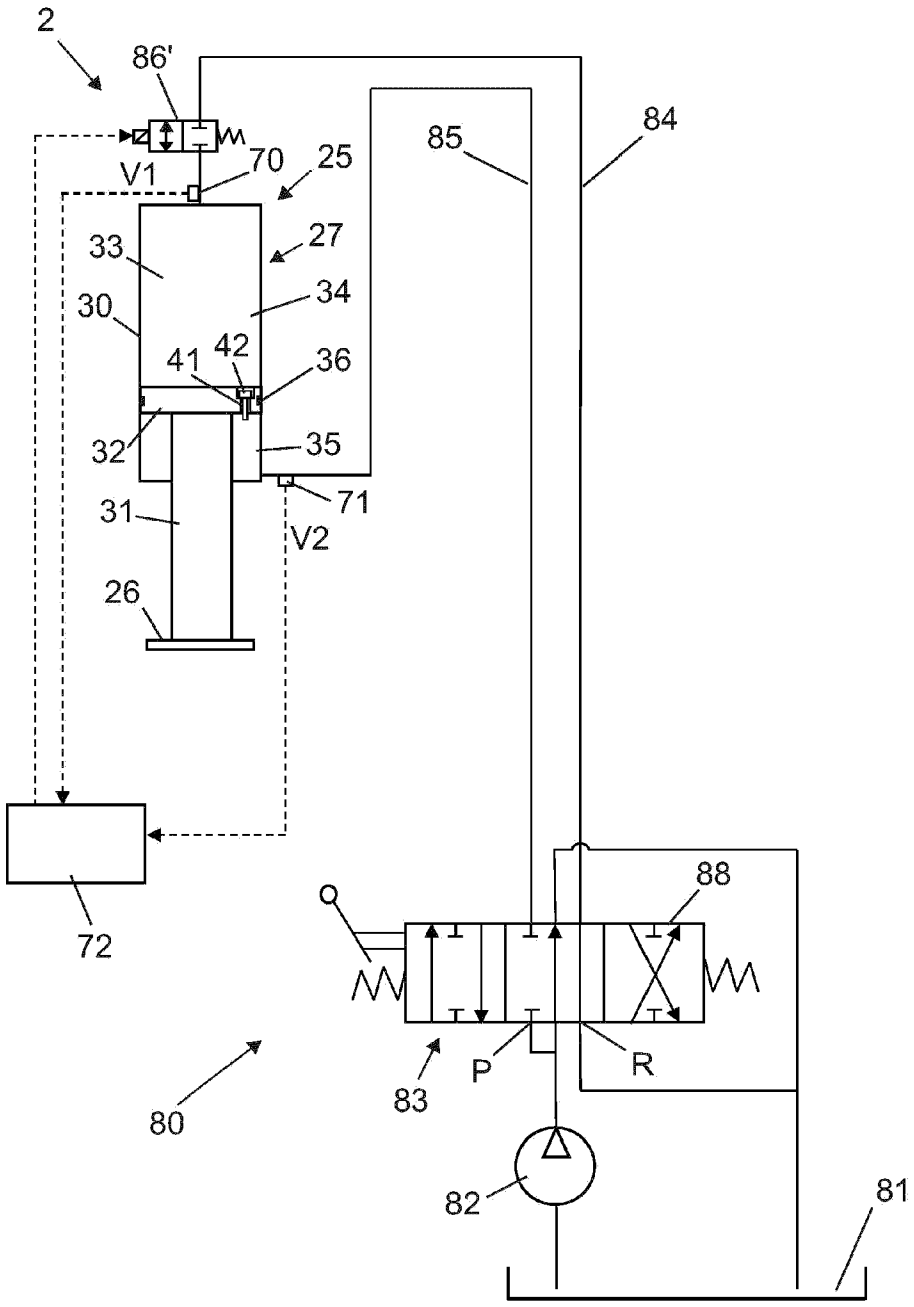

2
86'
84
85
V1
70
25
27
33
34
30
41
42
36
32
35
71
31
V2
26
72
88
P
R
83
80
82
81

Fig 15