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(54) METHOD FOR TRANSMITTING OR CONVEYING FLUID OR SEMI-FLUID MATERIALS BY MEANS OF A DOUBLE PISTON PUMP AND DOUBLE PISTON PUMP THEREFOR

VERFAHREN ZUR ÜBERTRAGUNG ODER FÖRDERUNG VON FLÜSSIGEN ODER HALBFLÜSSIGEN MATERIALIEN MIT EINER DOPPELKOLBENPUMPE UND DOPPELKOLBENPUMPE DAFÜR

PROCÉDÉ DE TRANSMISSION OU DE TRANSPORT DE MATIÈRES FLUIDES OU SEMI-FLUIDES AU MOYEN D'UNE DOUBLE POMPE À PISTON ET POMPE À PISTON DOUBLE

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Description

[0001] The present invention relates to a method for transmitting or conveying fluid or semi-fluid materials by means of a double piston pump. Furthermore, the present invention relates to a double piston pump for transmitting or conveying fluid or semi-fluid materials, in particular concrete or cement.

[0002] Double piston pumps for the above-identified purposes are well known in the art. From DE 42 15 403 C2 a double piston pump for transmitting or conveying fluid or semi-fluid materials, in particular concrete or cement is known comprising two conveying cylinders, each provided inside with a conveying piston, those conveying pistons being movable in an alternating push-pull manner. A feed hopper is provided for receiving material to be conveyed, which is fed by a material feed unit. A transfer tube system (S-Weiche) comprising a transfer tube which is connectable to a flow line or conveying pipes and is capable to connect said flow line or conveying pipes alternately with one of said conveying cylinders by means of articulation means, said articulation means comprising two swivel or plunger cylinders being hydraulically actuateable, the swivelling movement of said transfer tube being generated by said swivel or plunger cylinders.

[0003] A conveying piston drive mechanism comprising a drive piston for each conveying piston is provided in a hydraulic drive system, said drive pistons being connected to the dedicated conveying piston, wherein both drive pistons are supplied by a conveying pump, said supply being controllable by a valve. A main control valve is provided, with which alternating hydraulic supply to the corresponding drive piston is controlled. In principle, a double piston pump has the disadvantage, that during the switching movement of the transfer tube, there is a gap in transmitting or conveying the fluid or semi-fluid materials into the flow line leading to instable feeding, i. e. pulsations of the conveyed materials which is disadvantageous in many fields, in particular that of projecting concrete for covering tunnel walls.

[0004] In order to compensate the gap in conveying the required materials, the double piston pump of DE 42 15 403 C2 suggests a so called "push over"-system. This system shortly provides an additional amount of conveyed materials by increasing the speed of the acting conveying piston during the pushing cycle of the piston.

[0005] Although such a "push over"-system provides better performance of the double piston pump, some kind of pulsation still cannot be avoided. This results in particular from the fact that during switching of the transfer tube the materials are not conveyed.

[0006] DE 92 17 574 U1 also discloses a system for transmitting or conveying fluid or semi-fluid materials by means of a double piston pump, said double piston pump comprising two conveying cylinders, each provided inside with a conveying piston, said conveying pistons being movable in an alternating push-pull manner, a feed hopper for receiving material to be conveyed, which is fed by a material feed unit, a transfer tube system comprising a transfer tube, which is connectable to a flow line or conveying pipes and is capable to connect said flow line or conveying pipes alternately with one of said conveying cylinders by means of articulation means, said articulation means comprising two swivel or plunger cylinders being hydraulically actuateable, the swivelling movement of said transfer tube being generated by said swivel or plunger cylinders, a conveying piston drive mechanism comprising a drive piston for each conveying piston provided in a hydraulic drive system, said drive pistons being connected to the dedicated conveying piston, wherein both drive pistons are supplied by a conveying pump being provided in a hydraulic circuit, said supply being controllable by a valve, and a control valve with which the alternating hydraulic supply to the corresponding drive piston is controlled, wherein said control valve is adapted to short-circuit the hydraulic circuit of the conveying pump into a reservoir.

[0007] DE 43 18 267 A1 also shows a double piston pump in which the hydraulic circuit to drive the two swivel or plunger cylinders can be short-cicuited between the conveying pump and a reservoir.

[0008] It is therefore an object of the present invention to provide a method for transmitting or conveying fluid or semi-fluid materials, in particular concrete or cement by means of a double piston pump, which provides a higher performance and, in particular, a reduced switching time of the transfer tube. It is also an object of the present invention to provide a double piston pump in particular to carry out the method.

[0009] According to the present invention, during switching by swivelling movement of the transfer tube, the hydraulic supply to the drive pistons is interrupted and said hydraulic circuit of the conveying pump is short-circuited by means of said main control valve, and the delivery rate of the conveying pump is increased, so that after the swivelling movement of the transfer tube has been terminated and at the beginning of a next conveying cycle, an increased supply output of the supplying conveying cylinder is carried out for a short term leading to a short-term increase of said supplied fluid or semi-fluid materials.

[0010] In other words, due to the short-circuiting of the conveying pump, the hydraulic cylinders of the drive pistons are no longer under pressure and the switching action of the transfer tube can be carried out at a maximum speed and a minimum time and due to the increase of the delivery rate of the conveying pump, there is provided an increased supply of oil to the respective hydraulic cylinder, leading to a short-term increase of said supplied fluid or semi-fluid materials, so that in operation a pulsation of the supplied materials is avoided or almost avoided.

[0011] According to the present invention, after a short-time increase of the supply output of the conveying pump said supply output is reduced again to obtain a constant

supply of fluid or semi-fluid materials.

Furthermore, there is the advantage that by means of an auxiliary or pilot control valve said main control valve is controlled, wherein during moving of the transfer tube both said main control valve and said pilot control valve are brought into an inactive or neutral or middle position.

A further advantage is that each swivel or plunger cylinder comprises a movable drive element or plunger, which, when reaching the final movement position, is damped. Action of the swivel or plunger cylinders is carried out with a minimum time and, therefore, with maximum speed of the drive elements or plungers. This results in the need of short braking the motion of said drive elements of plungers. Due to damping movement, the risk of damaging the swivel or plunger cylinders is drastically reduced.

Furthermore, there is an advantage that when braking said movable drive element or plunger of said swivel or plunger cylinder said movable drive element or plunger is pre-stressed in the opposite direction, said pre-stress providing energy storing, in particular of kinetic energy.

Furthermore, there is the advantage that during the next forward or pushing stroke of said movable drive element or plunger of said swivel or plunger cylinder said stored energy is regained such that said regained energy additionally accelerates said movable driver element or plunger. Therefore, the time for switching the transfer tube can be further reduced leading to a drastic reduction of negative pulsation of the system.

The present invention is also directed to a double piston pump transmitting or conveying fluid or semi-fluid materials, in particular concrete or cement. According to the invention, a double piston pump is characterised in that said double piston pump is configured such that during swivelling movement of the transfer tube said main control valve interrupts the hydraulic supply to the drive pistons by short-circuiting said hydraulic circuit of the conveying pump, and that the conveying pump is configured to increase the delivery rate after termination of the swivelling movement of the transfer tube and at the beginning of a next conveying cycle for a short term.

Again, with this short-term increase of said supplied materials, the gap of conveying during the swivelling movement of the transfer tube can be filled shortly afterwards leading to a rather constant conveying of materials without pulsations.

There is the advantage that each swivel or plunger cylinder comprises a movable drive element, in particular a plunger, being movable in a forward or extracting and a backward or retracting stroke, wherein said movable drive element or plunger is damped at least when reaching its end-position of the retracting stroke.

Furthermore, each swivel or plunger cylinder comprises a piston filled with gaseous material and a spring package acting against said piston, resulting in a braking of the movable drive element or plunger, so that the movement of said drive element or plunger can be damped avoiding harm of the transfer tube system.

Furthermore, there is the advantage, that during braking of the movable drive element or plunger of said swivel or plunger cylinder, said movable drive element or plunger provides a pretension or pre-stress of said spring package and/or of the piston, wherein an energy store is carried out, in particular of kinetic energy.

This, advantageously, leads to the result that during the next forward stroke of the movable drive element or plunger of the swivel or plunger cylinder the stored energy is regained, such that said stored energy additionally accelerates said movable drive element or plunger.

[0012] Further details, features and advantages will become evident from the following specification or preferred embodiments of the present invention with reference to the enclosed drawings. In these drawings:

- Fig. 1 shows a perspective view of one embodiment of the double piston pump according to the present invention;
- Fig. 2 shows a block diagram of the hydraulic block conveying;
- Fig. 3 shows a block diagram of the hydraulic block of the transfer tube system (S-Weiche);
- Fig. 4 shows a block diagram of a conventional conveying pump system for example produced by Bosch Rexroth;
- Fig. 5 shows a back side view of the transfer tube system with two swivel or plunger cylinders, said transfer tube system being seated in a middle position during swivelling from one conveying cylinder to the other;
- Fig.6 shows a section view of the left-hand swivel or plunger cylinder of Fig. 5 at the beginning of the extension movement, i.e. the retracted position;
- Fig. 7 shows the section view of the left-hand swivel or plunger cylinder according to Fig. 6 in its most extended position;
- Fig. 8 shows the section view of the left-hand swivel or plunger cylinder according to Fig. 6 during its retracting movement just before damping; and
- Fig. 9 shows the section view of the left-hand swivel or plunger cylinder according to Fig. 6 during damping operation while retracting.

[0013] In the drawings the same elements are referenced with the same reference signs. The drawings show a preferred embodiment of the present invention. However, the present invention is not limited to this embodiment and alternative embodiments are also covered by

the subject matter as described in the claims.

[0014] Fig. 1 shows a double piston pump 1 in schematic view, which basic configuration is known in the art. Double piston pump 1 comprises conveying cylinders 3 and 4, in which conveying pistons 5 and 6, respectively, are movable. Double piston 1 comprises a feed hopper 7 comprising a housing 10, which on the rearward side is provided with a rearward plate 8. According to material feed arrow A 9 the material which is to be distributed by the double piston pump 1 is fed into feed hopper 7. Fig. 1 does not show material fed into feed hopper 7.

[0015] Onto rearward plate 8 is fixed a transfer tube system (S-Weiche) 13 comprising transfer tube 14 to be alternately connected to opening 11 connected with conveying cylinder 3 and opening 12 connected to conveying cylinder 4. According to double arrow 16 transfer tube 14 is swivelled between openings 11 and 12 via swivel lever 15 forming part of articulation means 17 fixed to rearward plate 8. In Fig. 1 the articulation means 17 are not shown completely but are furthermore described with reference to Fig. 5 to 9.

[0016] As can be seen from Fig. 1 the material which is fed into feed hopper 7 according to arrow A is sucked into conveying cylinder 4 by retracting motion of conveying piston 6, which is schematically shown by arrow B.

[0017] At the same time swivel lever 15, which comprises a tube portion 20 is in a position before opening 11 connecting transfer tube 14 with conveying cylinder 3. Conveying piston 5 moves in forward direction to rearward plate 8 leading to forwarding material which, according to arrow C is fed into a conveying pipe (not shown) to be distributed during operation.

[0018] Conveying cylinders 3 and 4 are fixed to rearward plate 8 on one end and are housed in a housing 22 at their rearward end. As will be described below and not shown in Fig. 1, conveying pistons 5 and 6 are driven by driving pistons 19 and 21, respectively (see Fig. 2) which are driven by hydraulic system 24 as shown in Fig. 2.

[0019] The operation mould of double piston pump 1 according to Fig. 1, can be described as follows. Conveying piston 5 as shown in Fig. 1 is in its pumping or conveying stroke in forward direction to rearward plate 8 urging material, which has been sucked in into conveying cylinder 3 from the feed hopper during opening 11, into transfer tube 14 according to arrow C. In order to provide a connection between transfer tube 14 and conveying cylinder 3 articulation means 17 swivelled swivel lever 15 and in particular tube portion 20 before opening 11 to provide connection between conveying cylinder 3 and transfer tube 14.

[0020] When conveying piston 5 has reached its most forward position, i. e. all material or essentially all material provided by conveying cylinder 3 has been distributed into transfer tube 14, articulation means 17 are activated to swivel swivel lever 15 according to double arrow 16 into a position to cover opening 12 connected to conveying cylinder 4, which had been filled with material according to arrow B by suction stroke of conveying piston 6 during pumping stroke of conveying piston 5.

[0021] During swivel movement of swivel lever 15 conveying piston drive mechanism 23, which will be described in more detail with reference to Fig. 2 below, changes from suction stroke of conveying piston 6 into pushing stroke and at the same time from pushing stroke of conveying piston 5 into suction stroke of conveying piston 5. After conveying piston 5 has reached the end of the suction stroke and conveying piston 6 has reached the end of the pushing stroke, the articulation means 17 again move said swivel lever 15 from opening 12 to opening 11, in order to connect conveying cylinder 3 to transfer tube 14.

[0022] Reference is now made to Fig. 2 showing the conveying piston drive mechanism 23 comprising a hydraulic drive system 24.

[0023] As can be seen from Fig. 2 drive piston 19 as well as drive piston 21 are configured conventionally. They both have the configuration of a double acting piston. Drive piston 19 comprises a piston head 25 housed in a cylinder housing 27. From piston head 25 a piston rod 29 is protruding and is connected for example to conveying piston 5. Similarly, drive piston 21 comprises a piston head 31 housed in a cylinder housing 33. Piston head 31 is connected to a protruding piston rod 35 which is connected for example to conveying piston 6. When the hydraulic drive system 24 is actuated pistons 25 and 31 together with piston rods 29 and 35 are moved in a corresponding direction leading to movement of conveying piston 5 and conveying piston 6 as shown in Fig. 1 in the corresponding direction.

[0024] With reference to Fig. 2 the hydraulic drive system 24 of the present invention will be described in more detail. Line A is a line for feeding-in oil for conveying concrete or other materials and which is connected to the pump. Line B is the return run of oil into a (not shown) reservoir. Valve V3 is a direct acting four-way/three-position solenoid operated directional valve for piloting the four-way/three-position pilot-to-shift directional valve V5. Valve V4 is a check valve. Valve V5, which is the the main control valve, is hydraulically actuated by valve V3, and comprises a locking middle position. In this position lines A and B are short- circuited. Therefore, the maximum pump pressure delivered via line A is always present at valve V5.

[0025] Valve V6 is a check valve and acts as back flow preventer during operation of high pressure pump for rock cleaning. Valve V7 is a volume control unit for rod-side feeding-in of oil and provides that return running cylinder being a little faster than forerunning cylinder as well as a compensation of oil conveying loss. Accordingly, the sucking in stroke of the corresponding conveying piston 5 or 6 is always ended a little time earlier than the pushing stroke of the respective other conveying cylinder 6 or 5. This shows that when switching of the transfer tube system is finished the corresponding conveying cylinder is fully prepared to start the pushing stroke.

[0026] Valve V8 is a check valve and acts as a return

run block of rod-side oil feeding-in. Valve V9 is a pressure relief valve of rod-side oil feeding-in and valve V16 is a shuffle valve for feeding-in rod-side of oil A.

[0027] Main control valve V5 can be actuated very fast by solenoid valve V3, as only small pressure increase is required. Line T drains control hydraulic fluid from valve V3 to a reservoir (not shown)

[0028] When main control pilot operated valve V5 is moved to the right, then drive piston 21 is activated as piston 31 is pushed leading to a pushing stroke of the corresponding conveying piston 6. When the pushing stroke of drive piston 21 is finished, main control valve V5 is moved into the middle position thereby short-circuiting feed-in line A with line B leading to the big advantage, that full pressure in line A is available when moving main control valve V5 to the left so that oil is now fed to driving cylinder 19, immediately starting movement of driving cylinder 19. During the middle position of valve V5 hydraulic pump is switched to increased pumping power. When valve V5 is switched to the next operating position increased hydraulic pressure is delivered to the respective forerun cylinder leading in an increased driving speed of the piston. This leads to an increased feeding of material into transfer tube 14.

[0029] Fig. 4 shows a block diagram of a conventional pump mechanism 39 which is marketed by the company Bosch Rexroth. As can be seen, the pump mechanism is driven by an electric motor 41. Electric motor 41 drives a pumping action of oil into line A. As this pump system is conventional and does not form part of the present invention, further description thereof is omitted.

[0030] Reference is now made to Fig. 3 showing a hydraulic system of the transfer tube system 13 (S-Weiche) of the present invention.

[0031] Hydraulic system 43 is prepared to act on swivel or plunger cylinders 45 and 47. Those swivel or plunger cylinders 45, 47 are double acting as can be seen from Fig. 3. However, the swivel or plunger cylinders 45 and 47 are shown only schematically and are described in more detail below with respect of Figures 6 to 9.

[0032] The components of the hydraulic system 43 are as follows. Valve V2 is a check valve provided as return run blocker, which blocks reservoir drain. Valve V3 is an orifice (Blende) for controlling drain of the reservoir when switching off valve V4. Valve V4 is a solenoid valve for draining to a reservoir (not shown).

[0033] Valve V7 is a pressure reducing valve for reducing the operational pressure for acting the transfer tube system 13 as shown in Fig. 1. Valve V9 is pressure control valve for limiting maximum pressure of the transfer tube system 13. Unit V10 is a flow control or volumetric control unit for adjusting the volume of oil for cleaning operation.

[0034] Valve V12 is a solenoid valve for activating the transfer tube system 13. Valve V15 is also an orifice (Blende) for limiting volume to control valves V24 and V25, respectively. Valve V20 is an unlockable double check valve which is active during forerun of cylinder B and return run of cylinder A. Valve V21 is an unlockable double check valve, which is active during forerun of cylinder A and return run of cylinder B. Valve V22 is an unlockable double check valve, which is active during forerun of cylinder B and return run of cylinder A. Valve V23 is an unlockable double check valve, which is active during forerun of cylinder A and return run of cylinder B. Valve V24 is a solenoid valve for activating forerun of cylinder B whereas V25 is a solenoid valve for activating forerun of cylinder A.

[0035] Furthermore, there is provided a hydraulic accumulator 49 to supply a sufficient amount of instant hydraulic power when switching.

[0036] This specific configuration of all valves can be derived from the specific symbols of the systems shown in Figures 2 to 4 but are not limited thereto. Different embodiments leading to same or essentially same effects still fall under the scope of the present invention. From Fig. 2 to 4 the connecting lines between the components can clearly be derived and are not explained in more detail.

[0037] With reference to Fig. 5, the transfer tube system 13 is described in more detail. Fig. 5 is a view from behind of the feed hopper 7 showing the transfer tube system 13 in a middle position between openings 11 and 12. Tube portion 20 of swivel lever 15 is located between these openings 11 and 12 and swivel of plunger cylinders 45 and 47 are both also in a middle position. Swivel of plunger cylinders 45 and 47 will be described in more detail with reference to Figures 6 to 9.

[0038] As can be seen from Fig. 5 in this embodiment, the transfer tube system 13 comprises a plate 37 in which the openings 11 and 12 are located. The transfer tube system 13 comprises two arms 51 and 52. Arm 51 is provided with a bearing 54 to pivotable support swivel or plunger cylinder 45, whereas arm 52 is provided with a bearing 56 to for pivotable support swivel or plunger cylinder 47. Both swivel of plunger cylinders 45 and 47 are, at their other ends, pivotably connected to a control plate 53, which in turn is connected to swivel lever 15 in order to move swivel lever 15 from one opening 11, 12 to the other opening 12, 11. In Fig. 5 the connections of swivel or plunger cylinders 45 and 47 to the hydraulic system 43 driving both swivel or plunger cylinders 45 and 47 are not shown. Rearward plate as shown in very schematic Fig. 1 is not shown in Fig. 5

[0039] Reference is now made to Figures 6 to 9 in which swivel of plunger cylinder 47 is shown in partly cut off sectional view in different positions during movement in order to provide required movement of the swivel lever 15 to alternately connect transfer tube 14 with openings 11 and 12, respectively. Swivel or plunger cylinder 45 is configured accordingly.

[0040] Swivel or plunger cylinder 47 comprises a cylinder body or housing 55 in which a hydraulic oil inlet/outlet 57 is provided at one end of the partly hollow housing 55 of swivel or plunger cylinder 47. Within the housing 55, there is provided a plunger 59 which is movable within

housing 55.

[0041] Plunger 59 is partly formed as a hollow body housing several specific elements inside. There is provided a spring package 61 for example in form of a laminated disc spring. One aim which is realised by the present invention is to provide a swivel movement of the transfer tube system within a minimum of time which is able to last for a long time performing very high number of strokes. Within plunger 59 there is provided a gas piston 63 which can be filled via a gas inlet/outlet 65, in which a check valve 66 is provided, wherein gas is guided to the gas piston 63 via internal line 67. For sealing off the plunger 59 there is provided a sealing kit 69 and for sealing against escaping oil outside the housing 55.

[0042] Via opening 71 housing 55 of swivel or plunger cylinder 47 is able to be connected to arm 52 (see Fig. 5), whereas via opening 73 plunger 59 is able to be connected to central plate 53.

[0043] A feeding projection 60 is provided at the infeed end of plunger 59 comprising an inlet channel comprising a check valve 64. Check valve 64 is partly housed in a front plate 70 closing the the hollow plunger 59 at the hydraulic fluid or oil infeed end of plunger 59. In the retracted position of Fig. 6 between gas piston 63 and front plate, there is provided an oil chamber 68 which is filled with oil in this position. Front plate 70 is provided with openings or nuts for example like a castellated nut. To fill in oil into chamber 68 oil is fed through channel 62 over check valve 64 which prevents oil from escaping chamber 68 back into channel 62.

[0044] The swivel or plunger cylinder 47 is shown in four different positions. Fig. 6 shows the complete retracted position before a stroke of plunger 59. Fig. 7 shows the cylinder extracted position where plunger 59 has reached its maximum extracted position. Fig. 8 shows a position during retracting movement of plunger 59 just before the start of the damping operation and Fig. 9 shows the position while damping of the plunger and loading gas accumulator for energy recuperation is carried out.

[0045] In Fig. 7 plunger cylinder 47 is shown in its most extracted position. Oil is fed trough oil inlet 57 urging projection 60 to move away from its retracted position. Gas piston 63 urges oil out of chamber 68 to escape through openings (not shown) of front plate 70 into the hollow room left when plunger 59 moves away from its retracted position shown in Fig. 6. Gas piston 63 urges oil to escape from chamber 68 until it abuts against front plate 70 as is shown in Fig. 7.

[0046] From Fig. 8 there is shown plunger 47 during retracting movement in the position when damping of plunger 47 starts. Projection 70 reaches oil in inlet channel 58 and urges check valve 64 to open. Simultaneously oil in chamber 72 is urged to move through openings of front plate 70 to reinstall oil chamber 68, thereby moving gas piston 63 toward spring package 61. This increase the spring load of gas piston 63.

[0047] Fig. 9 shows the position of plunger 47 shortly before reaching retracted end position of Fig. 6. Oil chamber 68 is partly filled and oil chamber 72 is further reduced.

[0048] With plunger 47 according to the present invention, there is provided a damping system which damps plunger when moving into its retracted position and an energy stored by gas piston 63 together with the spring package 21 is used during the next stroke of plunger 47 to accelerate its movement.

[0049] With the present invention there is provided a double piston pump with which an essentially constant conveying of fluid or semi-fluid materials, in particular concrete or cement is achieved overcoming the drawbacks of the prior art. In particular, a very short movement of the swivel or plunger cylinders 45 and 47 including a damping system to prevent hard abutment of plunger 59 against housing 55.

Reference Signs:

[0050]

- 1 - double piston pump
- 3 - conveying cylinder
- 4 - conveying cylinder
- 5 - conveying piston
- 6 - conveying piston
- 7 - feed hopper
- 8 - rearward plate
- 9 - material feed arrow A
- 10 - housing
- 11 - opening
- 12 - opening
- 13 - transfer tube system (S-Weiche)
- 14 - transfer tube
- 15 - swivel lever
- 16 - double arrow
- 17 - articulation means
- 19 - drive piston
- 20 - tube portion
- 21 - drive piston
- 22 - housing
- 23 - conveying piston drive mechanism
- 24 - hydraulic drive system
- 25 - piston head
- 27 - cylinder housing
- 29 - piston rod
- 31 - piston head
- 33 - cylinder housing
- 35 - piston rod
- 37 - plate
- 39 - pump mechanism
- 41 - electric motor
- 43 - hydraulic system
- 45 - swivel or plunger cylinder
- 47 - swivel or plunger cylinder
- 49 - hydraulic accumulator to supply a sufficient amount of instant hydraulic power when switch-

ing
51 - arm
52 - arm
53 - central plate
54 - bearing
55 - cylinder body
56 - bearing
57 - hydraulic oil inlet/outlet 59 - plunger
60 - feeding and draining projection 61 - spring package
62 - inlet channel
63 - gas piston
64 - check valve
65 - gas inlet/outlet
66 - check valve
67 - internal gas line
68 - oil chamber
69 - sealing kit
70 - front plate
71 - opening
72 - oil chamber
73 - opening

List of components in hydraulic circuits:

1. Hydraulic drive mechanism (Fig. 2):

[0051]

A: feeding-in oil for conveying concrete,
B: return run of oil from conveying concrete
V3: direct acting four-way/three-position solenoid operated directional pilot valve for piloting V5
V4: check valve
V5: hydraulically activated main control four-way/three-position pilot-to-shift directional valve for conveying forerun A
V6: backflow preventer active during operation of high pressure pump for rock cleaning
V7 volume control unit for rod side feeding-in of oil (return running cylinder being little faster than forerunning cylinder as well as compensation of oil conveying loss)
V8: check valve and return run blocker of rod side oil feeding-in
V9: pressure relief of rod side oil feeding-in
V16: shuffle valve for feeding-in rod side oil of A as well as of B

2. Hydraulic drive mechanism of transfer tube system (Fig. 3):

[0052]

P: pump line and connection to fluid pump(not used in this system)
T: reservoir return connection
V2: check valve (return run blocker) blocks reservoir drain
V3: orifice (Blende) for controlled drain of reservoir when switching off valve V4
V4: solenoid valve for draining reservoir
V7: pressure reducing valve for reducing the operational pressure for acting the transfer tube system
V9: pressure control valve for limiting maximum pressure of the transfer tube system
V10: flow control or volumetric control unit for adjusting the volume of oil for cleaning operation
V12: solenoid valve for activating the transfer tube system
V15: orifice (Blende) for limiting volume to control valves V24 and V25, respectively
V20: unlockable double check valve active during forerun of cylinder B and return run of cylinder A
V21: unlockable double check valve active during forerun of cylinder A and return run of cylinder B
V22: unlockable double check valve active during forerun of cylinder B and return run of cylinder A
V23: unlockable double check valve active during forerun of cylinder A and return run of cylinder B
V24: solenoid valve for activating forerun of cylinder B
V25: solenoid valve for activating forerun of cylinder A

Claims

1. A method for transmitting or conveying fluid or semi-fluid materials, in particular concrete or cement, by means of a double piston pump (1), which comprises two conveying cylinders (3, 4), each provided inside with a conveying piston (5, 6), said conveying pistons (5, 6) being movable in an alternating push-pull manner,
a feed hopper (7) for receiving material to be conveyed, which is fed by a material feed unit,
a transfer tube system (13) comprising a transfer tube (14), which is connectable to a flow line or conveying pipes and is capable to connect said flow line or conveying pipes alternately with one of said conveying cylinders (3, 4) by means of articulation means (17), said articulation means (17) comprising two swivel or plunger cylinders (45, 47) being hydraulically actuateable, the swivelling movement of said transfer tube (14) being generated by said swivel or plunger cylinders (45, 47),
a conveying piston drive mechanism (23) comprising a drive piston (19, 21) for each conveying piston (5, 6) provided in a hydraulic drive system (24), said drive pistons (19, 21) being connected to the dedicated conveying piston (5, 6), wherein both drive pistons (19, 21) are supplied by a conveying pump (39) being provided in a hydraulic circuit, said supply being controllable by a valve, and
a main control valve (V5) with which the alternating hydraulic supply to the corresponding drive piston

(19, 21) is controlled,
characterised in that
during swivelling movement of the transfer tube (14):

- the hydraulic supply to the drive pistons (19, 21) is interrupted and said hydraulic circuit of the conveying pump is short-circuited by means of said main control valve (V5), and
- the delivery rate of the conveying pump is increased,

so that after the swivelling movement of the transfer tube (14) has been terminated and at the beginning of a next conveying cycle an increased supply output of the supplying conveying cylinder (3, 4) is carried out for a short term leading to a short-term increase of said supplied fluid or semi-fluid materials.

2. The method according to claim 1, **characterised in that** after short-time increase of the supply output of the conveying pump said supply output is reduced again.

3. The method according to claim 1 or 2, **characterised in that** by means of an pilot control valve (V3) said main control valve (V5) is controlled, wherein during movement of the transfer tube (14) both said main control valve (V5) and said pilot control valve (V3) are brought into an inactive or neutral or middle position.

4. The method according to one of the claims 1 to 3, **characterised in that** each swivel or plunger cylinder (45, 47) comprises a movable drive element or plunger (59), which, when reaching the final movement position, is damped.

5. The method according to claim 4, **characterised in that** when braking said movable drive element or plunger (59) of said swivel or plunger cylinder (45, 47) said movable drive element or plunger (59) is pre-stressed in the opposite direction, said pre-stress providing energy storing, in particular of kinetic energy.

6. The method according to claim 5, **characterised in that** during the next forward stroke of said movable drive element or plunger (59) of said swivel or plunger cylinder (45, 47) said stored energy is regained such that said regained energy additionally accelerates said movable drive element or plunger (59).

7. A double piston pump (1) for transmitting or conveying fluid or semi-fluid materials, in particular concrete or cement, comprising
two conveying cylinders (3, 4), each provided inside with a conveying piston (5, 6), said conveying pistons (5, 6) being movable in an alternating push-pull manner,
a feed hopper (7) for receiving material to be conveyed, which is fed by a material feed unit,
a transfer tube system (13) comprising a transfer tube (14), which is connectable to a flow line or conveying pipes and is capable to connect said flow line or conveying pipes alternately with one of said conveying cylinders (3, 4) by means of articulation means (17), said articulation means (17) comprising two swivel or plunger cylinders (45, 47) being hydraulically actuateable, the swivelling movement of said transfer tube (14) being generated by said swivel or plunger cylinders (45, 47),
a conveying piston drive mechanism (23) comprising a drive piston (19, 21) for each conveying piston (5, 6) provided in a hydraulic drive system (24), said drive pistons (19, 21) being connected to the dedicated conveying piston (5, 6), wherein both drive pistons (19, 21) are supplied by a conveying pump (39) being provided in a hydraulic circuit, said supply being controllable by a valve, and
a main control valve (V5) with which the alternating hydraulic supply to the corresponding drive piston (19, 21) is controlled,
characterised in
that said double piston pump (1) is configured such that during swivelling movement of the transfer tube (14) said main control valve (V5) interrupts the hydraulic supply to the drive pistons (19, 21) by short-circuiting said hydraulic circuit of the conveying pump, and
that the conveying pump is configured to increase the delivery rate after termination of the swivelling movement of the transfer tube (14) and at the beginning of a next conveying cycle for a short term.

8. The double piston pump according to claim 7, **characterised in that** said main control valve (V5) is hydraulically activateable by means of a pilot control valve (V3).

9. The double piston pump (1) according to claim 7 or 8, **characterised in that** each swivel or plunger cylinder (45, 47) comprises a movable drive element, in particular a plunger (59), being movable in a forward or extracting and a backward or retracting stroke, wherein said movable drive element or plunger (59) is damped at least when reaching its end-position of the retracting stroke.

10. The double piston pump (1) according to claim 9, **characterised in that** each swivel or plunger cylinder (45, 47) comprises a piston (63) filled with gaseous material and a spring package (61) acting against said piston (63), resulting in a braking of the movable drive element or plunger (59).

11. The double piston pump (1) according to claim 10,

characterised in that during braking of the movable drive element or plunger (59) of said swivel or plunger cylinder (45, 47) said movable drive element or plunger (59) provides a pretension or pre-stress of said spring package (61) and/or of said piston (63), wherein an energy store is carried out, in particular of kinetic energy.

12. The double piston pump (1) according to claim 11, **characterised in that** during the next forward stroke of the movable drive element or plunger (59) of the swivel or plunger cylinder (45, 47) the stored energy is regained, such that said stored energy additionally accelerates said movable drive element or plunger (59).

Patentansprüche

1. Verfahren zum Übertragen und Fördern von flüssigen oder halbflüssigen Materialien, insbesondere von Beton oder Mörtel, mittels einer Doppelkolbenpumpe (1), welche aufweist:

zwei Förderzylinder (3, 4), in denen jeweils ein Förderkolben (5, 6) angeordnet ist, wobei die Förderkolben (5, 6) in einer alternierenden Druck-Zieh-Weise bewegbar sind,
einen zur Aufnahme des zu fördernden Materials dienenden Fülltrichter (7), der von einer Materialzufuhreinheit gespeist wird,
ein Rohrweichensystem (13), das eine Rohrweiche (14) aufweist, die mit einer Fließleitung oder Förderrohren verbindbar ist und in der Lage ist, diese Fließleitung oder Förderrohre abwechselnd mit einem der Förderzylinder (3, 4) mittels einer Gelenkeinrichtung (17) zu verbinden, wobei die Gelenkeinrichtung (17) zwei Schwenk- oder Plungerzylinder (45, 47) aufweist, die hydraulisch betätigbar sind, wobei die Schwenkbewegung der Rohrweiche (14) durch die Schwenk- oder Plungerzylinder (45, 47) erzeugt wird,
eine Förderkolben-Antriebseinrichtung (23), die einen Antriebskolben (19, 21) für jeden Förderkolben (5, 6), angeordnet in einem hydraulischen Antriebssystem (24), aufweist, wobei die Antriebskolben (19, 21) mit dem zugeordneten Förderkolben (5, 6) verbunden sind, wobei beide Antriebskolben (19, 21) von einer Förderpumpe (39) gespeist werden, die in einem Hydraulikkreis vorgesehen ist, wobei die Zufuhr durch ein Ventil steuerbar ist, und
ein Hauptsteuerventil (V5), mit dem abwechselnd die Hydraulikzufuhr zu dem jeweiligen Antriebskolben (19, 21) gesteuert wird,
dadurch gekennzeichnet,
dass während der Schwenkbewegung der Rohrweiche (14):

- die Hydraulikzufuhr zu den Antriebskolben (19, 21) unterbrochen wird und der Hydraulikkreis mittels des Hauptsteuerventils (V5) kurzgeschlossen wird, und
- die Pumpleistung der Förderpumpe erhöht wird,

sodass nach Beendigung der Schwenkbewegung der Rohrweiche (14) und ab Beginn eines nächsten Förderzyklus kurzzeitig eine erhöhte Förderleistung des fördernden Förderzylinders (3, 4) ausgeführt wird, was zu einer kurzzeitigen Erhöhung des geförderten flüssigen oder halbflüssigen Materials führt.

2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** nach der kurzzeitigen Erhöhung der Pumpleistung der Förderpumpe die Pumpleistung wieder reduziert wird.

3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** mittels eines Führungssteuerventils (V3) das Hauptsteuerventil (V5) gesteuert wird, wobei während der Bewegung der Rohrweiche (14) sowohl das Hauptsteuerventil (V5) als auch das Führungssteuerventil (V3) in eine inaktive oder neutrale Mittenstellung gebracht werden.

4. Verfahren nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass** jeder Schwenk- oder Plungerzylinder (45, 47) ein bewegliches Antriebselement bzw. einen beweglichen Plunger (59) aufweist, das bzw. der beim Erreichen seiner Endlage gedämpft wird.

5. Verfahren nach Anspruch 4, **dadurch gekennzeichnet, dass** beim Abbremsen des beweglichen Antriebselements bzw. des Plungers (59) des Schwenk- oder Plungerzylinders (45, 47) das bewegbare Antriebselement bzw. der bewegbare Plunger (59) in die entgegengesetzte Richtung vorgespannt ist, wobei die Vorspannung eine Energiespeicherung, insbesondere von kinetischer Energie, liefert.

6. Verfahren nach Anspruch 5, **dadurch gekennzeichnet, dass** beim nächsten Ausfahren des beweglichen Antriebselements oder Plungers (59) des Schwenk- bzw. Plungerzylinders (45, 47) die gespeicherte Energie zurückgewonnen wird, derart, dass die zurückgewonnene Energie das bewegliche Antriebselement oder den Plunger (59) zusätzlich beschleunigt.

7. Doppelkolbenpumpe (1) zum Übertragen oder Fördern von flüssigen oder halbflüssigen Materialien,

insbesondere von Beton oder Mörtel, welche aufweist
zwei Förderzylinder (3, 4), in denen jeweils ein Förderkolben (5, 6) angeordnet ist, wobei die Förderkolben (5, 6) in einer alternierenden Druck-Zieh-Weise bewegbar sind,
einen Fülltrichter (7) zur Aufnahme von zu förderndem Material, der von einer Materialzufuhreinheit gespeist wird,
ein Rohrweichensystem (13), das eine Rohrweiche (14) aufweist, die mit einer Fließleitung oder Förderrohren verbindbar ist und in der Lage ist, diese Fließleitung oder Förderrohre abwechselnd mit einem der Förderzylinder (3, 4) mittels einer Gelenkeinrichtung (17) zu verbinden, wobei die Gelenkeinrichtung (17) zwei Schwenk- oder Plungerzylinder (45, 47) aufweist, die hydraulisch betätigbar sind, wobei die Schwenkbewegung der Rohrweiche (14) durch die Schwenk- oder Plungerzylinder (45, 47) erzeugt wird,
eine Förderkolben-Antriebseinrichtung (23), die einen Antriebskolben (19, 21) für jeden Förderkolben (5, 6), angeordnet in einem hydraulischen Antriebssystem (24), aufweist, wobei die Antriebskolben (19, 21) mit dem zugeordneten Förderkolben (5, 6) verbunden sind, wobei beide Antriebskolben (19, 21) von einer Förderpumpe (39) gespeist werden, die in einem Hydraulikkreis vorgesehen ist, wobei die Zufuhr durch ein Ventil steuerbar ist, und
ein Hauptsteuerventil (V5), mit dem abwechselnd die Hydraulikzufuhr zu dem jeweiligen Antriebskolben (19, 21) gesteuert wird,
dadurch gekennzeichnet,
dass die Doppelkolbenpumpe (1) derart ausgebildet ist, dass während des Schwenkens der Rohrweiche (14) das Hauptsteuerventil (V5) die Hydraulikzufuhr zu den Antriebskolben (19, 21) durch Kurzschließen des Hydraulikkreises der Förderpumpe unterbricht, und
dass die Förderpumpe derart ausgestaltet ist, dass sie die Zufuhrrate nach Beenden der Schwenkbewegung der Rohrweiche (14) und am Beginn eines nächsten Förderzyklus kurzzeitig erhöht.

8. Doppelkolbenpumpe nach Anspruch 7, **dadurch gekennzeichnet, dass** das Hauptsteuerventil (V5) durch ein Führungssteuerventil (V3) hydraulisch aktivierbar ist.

9. Doppelkolbenpumpe (1) nach Anspruch 7 oder 8, **dadurch gekennzeichnet, dass** jeder Schwenk- bzw. Plungerzylinder (45, 47) ein bewegliches Antriebselement, insbesondere einen Plunger (59) aufweist, das bzw. der in einem Vorwärts- oder Ausfahrhub und einem Rückwärts- oder Einfahrhub bewegbar ist, wobei das bewegliche Antriebselement oder Plunger (59) wenigstens wenn es bzw. er seine Endlage im Einfachhub erreicht, gedämpft wird.

10. Doppelkolbenpumpe (1) nach Anspruch 9, **dadurch gekennzeichnet, dass** jeder Schwenk- bzw. Plungerzylinder (45, 47) einen mit gasförmigem Material gefüllten Kolben (63) und ein Federpaket (61) aufweist, das gegen den Kolben (63) wirkt, was zu einer Abbremsung des beweglichen Antriebselements oder Plungers (59) führt.

11. Doppelkolbenpumpe (1) nach Anspruch 10, **dadurch gekennzeichnet, dass** beim Abbremsen des beweglichen Antriebselements oder Plungers (59) des Schwenk- bzw. Plungerzylinders (45, 47) das bewegliche Antriebselement oder der Plunger (59) eine Vorgespanntheit oder eine Vorspannung des Federpakets (61) und/oder des Kolbens (63) erzeugt, wobei eine Energiespeicherung, insbesondere an kinetischer Energie, erfolgt.

12. Doppelkolbenpumpe (1) nach Anspruch 11, **dadurch gekennzeichnet, dass** während des nächsten Vorwärtshubs des beweglichen Antriebselements oder Plungers (59) des Schwenk- oder Plungerzylinders (45, 47) die gespeicherte Energie zurückgewonnen wird, derart, dass die gespeicherte Energie das bewegliche Antriebselement oder den Plunger (59) zusätzlich beschleunigt.

Revendications

1. Procédé pour conduire ou transférer des matières fluides ou semi-fluides, en particulier béton ou ciment, au moyen d'une pompe à double piston (1), qui comprend
deux cylindres de transfert (3, 4), pourvus chacun intérieurement d'un piston de transfert (5, 6), lesdits pistons de transfert (5, 6) étant déplaçables suivant un mode en tandem alternatif,
une trémie d'alimentation (7) pour recevoir de la matière à transférer, qui est alimentée par une unité d'alimentation en matière,
un système (13) à tube de transfert comprenant un tube de transfert (14), qui peut être connecté à une ligne d'écoulement ou à des tuyaux de transfert et qui est capable de connecter ladite ligne d'écoulement ou lesdits tuyaux de transfert alternativement à l'un desdits cylindres de transfert (3, 4) à l'aide de moyens d'articulation (17), lesdits moyens d'articulation (17) comprenant deux vérins plongeurs ou oscillants (45, 47) actionnables hydrauliquement, le mouvement d'oscillation dudit tube de transfert (14) étant produit par lesdits vérins plongeurs ou oscillants (45, 47),
un mécanisme de commande de piston de transfert (23), comprenant un piston de commande (19, 21) pour chaque piston de transfert (5, 6), pourvu d'un système de commande hydraulique (24), lesdits pistons de commande (19, 21) étant reliés au piston de

transfert (5, 6) associé, les deux pistons de commande (19, 21) étant alimentés par une pompe de transfert (39) pourvue d'un circuit hydraulique, ladite alimentation pouvant être commandée par une soupape, et
un distributeur de commande principal (V5) par lequel l'alimentation hydraulique alternée au piston de commande (19, 21) correspondant est commandée, **caractérisé en ce que**,
pendant un mouvement d'oscillation du tube de transfert (14) :

- l'alimentation hydraulique aux pistons de commande (19, 21) est interrompue et ledit circuit hydraulique de la pompe de transfert est mis en dérivation au moyen dudit distributeur de commande principal (V5), et
- le débit de la pompe de transfert est augmenté,

de sorte que, une fois que le mouvement d'oscillation du tube de transfert (14) est terminé et au début du cycle de transfert suivant, un débit d'alimentation augmenté du cylindre de transfert d'alimentation (3, 4) est réalisé pendant un court délai conduisant à une augmentation à court terme desdites matières fluides ou semi-fluides alimentées.

2. Procédé suivant la revendication 1, **caractérisé en ce que**, après une brève augmentation du débit d'alimentation de la pompe de transfert, ledit débit d'alimentation est réduit à nouveau.

3. Procédé suivant la revendication 1 ou 2, **caractérisé en ce qu'**au moyen d'un distributeur de commande pilote (V3), ledit distributeur de commande principal (V5) est commandé, et **en ce que**, pendant un mouvement du tube de transfert (14), à la fois ledit distributeur de commande principal (V5) et ledit distributeur de commande pilote (V3) sont amenés dans une position inactive ou neutre ou centrale.

4. Procédé suivant l'une des revendications 1 à 3, **caractérisé en ce que** chaque vérin plongeur ou oscillant (45, 47) comprend un plongeur ou élément de commande mobile (59) qui, lorsqu'il atteint la position finale de mouvement, est amorti.

5. Procédé suivant la revendication 4, **caractérisé en ce que**, lors d'un freinage dudit plongeur ou élément de commande mobile (59) dudit vérin plongeur ou oscillant (45, 47), ledit plongeur ou élément de commande mobile (59) est soumis à une précontrainte dans la direction opposée, ladite précontrainte assurant un stockage d'énergie, en particulier d'énergie cinétique.

6. Procédé suivant la revendication 5, **caractérisé en ce que**, pendant la course avant suivante dudit plongeur ou élément de commande mobile (59) dudit vérin plongeur ou oscillant (45, 47), ladite énergie stockée est récupérée de façon telle que ladite énergie récupérée applique une accélération additionnelle audit plongeur ou élément de commande mobile (59).

7. Pompe à double piston (1), pour conduire ou transférer des matières fluides ou semi-fluides, en particulier béton ou ciment, comprenant
deux cylindres de transfert (3, 4), pourvus chacun intérieurement d'un piston de transfert (5, 6), lesdits pistons de transfert (5, 6) étant déplaçables suivant un mode en tandem alternatif,
une trémie d'alimentation (7) pour recevoir de la matière à transférer, qui est alimentée par une unité d'alimentation en matière,
un système (13) à tube de transfert comprenant un tube de transfert (14), qui peut être connecté à une ligne d'écoulement ou à des tuyaux de transfert et qui est capable de connecter ladite ligne d'écoulement ou lesdits tuyaux de transfert alternativement à l'un desdits cylindres de transfert (3, 4) à l'aide de moyens d'articulation (17), lesdits moyens d'articulation (17) comprenant deux vérins plongeurs ou oscillants (45, 47) actionnables hydrauliquement, le mouvement d'oscillation dudit tube de transfert (14) étant produit par lesdits vérins plongeurs ou oscillants (45, 47),
un mécanisme de commande de piston de transfert (23), comprenant un piston de commande (19, 21) pour chaque piston de transfert (5, 6), pourvu d'un système de commande hydraulique (24), lesdits pistons de commande (19, 21) étant reliés au piston de transfert (5, 6) associé, les deux pistons de commande (19, 21) étant alimentés par une pompe de transfert (39) pourvue d'un circuit hydraulique, ladite alimentation pouvant être commandée par une soupape, et
un distributeur de commande principal (V5) par lequel l'alimentation hydraulique alternée au piston de commande (19, 21) correspondant est commandée, **caractérisée**
en ce que ladite pompe à double piston (1) est configurée de façon telle que, pendant un mouvement d'oscillation du tube de transfert (14), ledit distributeur de commande principal (V5) interrompt l'alimentation hydraulique aux pistons de commande (19, 21) par une mise en dérivation dudit circuit hydraulique de la pompe de transfert, et
en ce que la pompe de transfert est configurée de façon à augmenter le débit, une fois le mouvement d'oscillation du tube de transfert (14) terminé et au début d'un cycle de transfert suivant, pendant un court délai.

8. Pompe à double piston (1) suivant la revendication 7, **caractérisée en ce que** ledit distributeur de com-

mande principal (V5) peut être actionné hydrauliquement au moyen d'un distributeur de commande pilote (V3).

9. Pompe à double piston (1) suivant la revendication 7 ou 8,
caractérisée en ce que chaque vérin plongeur ou oscillant (45, 47) comprend un élément de commande mobile, en particulier un plongeur (59), mobile suivant une course avant ou d'extraction et une course arrière ou de rétraction, et **en ce que** ledit plongeur ou élément de commande mobile (59) est amorti au moins lorsqu'il atteint sa position extrême de la course de rétraction.

10. Pompe à double piston (1) suivant la revendication 9, **caractérisée en ce que** chaque vérin plongeur ou oscillant (45, 47) comprend un piston (63) rempli de matière gazeuse et un moyen de rappel élastique (61) agissant à l'encontre dudit piston (63), entraînant un freinage du plongeur ou élément de commande mobile (59).

11. Pompe à double piston (1) suivant la revendication 10,
caractérisée en ce que, pendant un freinage du plongeur ou élément de commande mobile (59) dudit vérin plongeur ou oscillant (45, 47), ledit plongeur ou élément de commande mobile (59) fournit une pré-tension ou précontrainte dudit moyen de rappel élastique (61) et/ou dudit piston (63), et **en ce qu'**un stockage d'énergie est réalisé, en particulier d'énergie cinétique.

12. Pompe à double piston (1) suivant la revendication 11,
caractérisée en ce que, pendant la course avant suivante du plongeur ou élément de commande mobile (59) du vérin plongeur ou oscillant (45, 47), l'énergie stockée est récupérée, de sorte que ladite énergie stockée applique une accélération additionnelle audit plongeur ou élément de commande mobile (59).

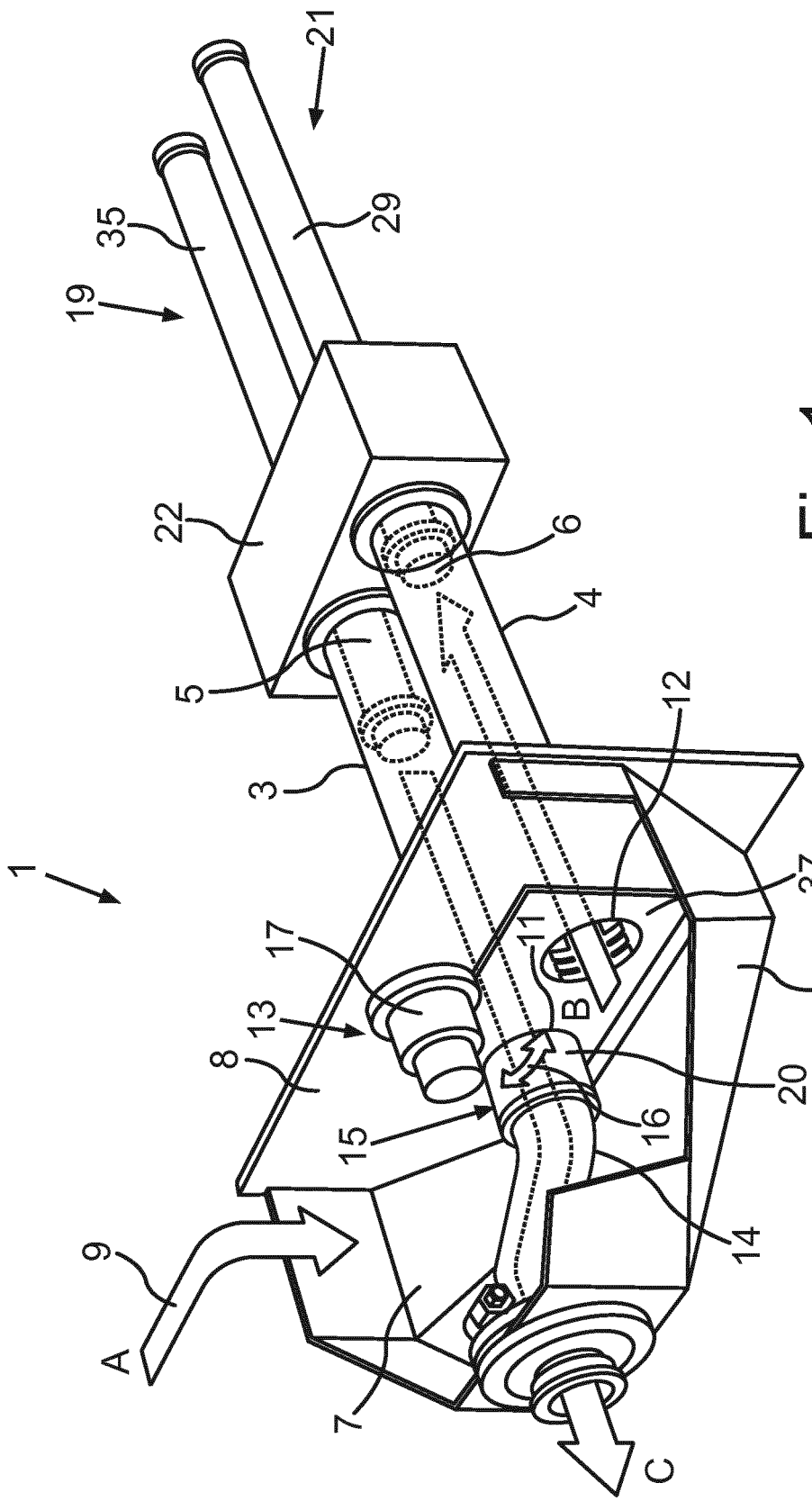

Fig.1

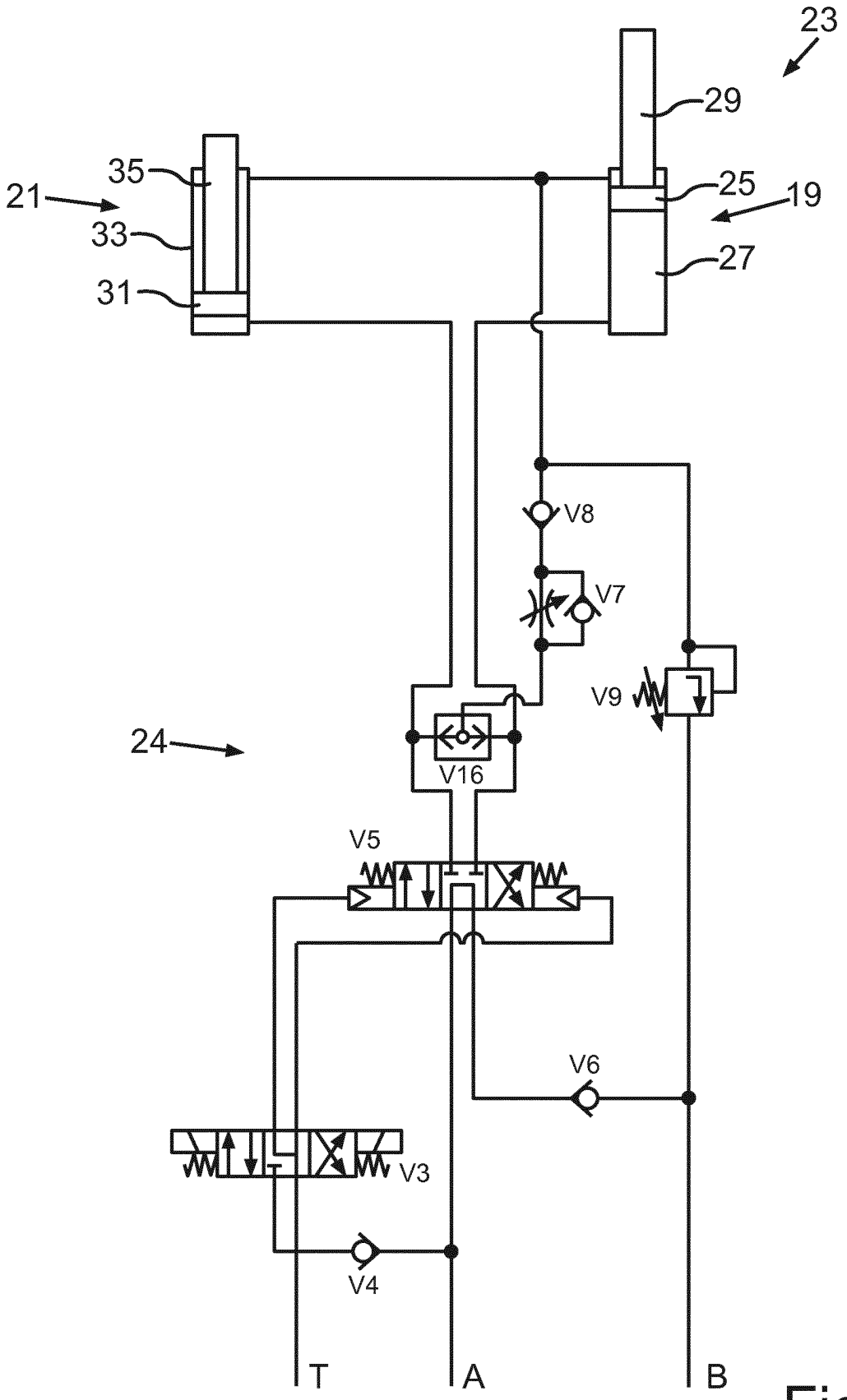

Fig.2

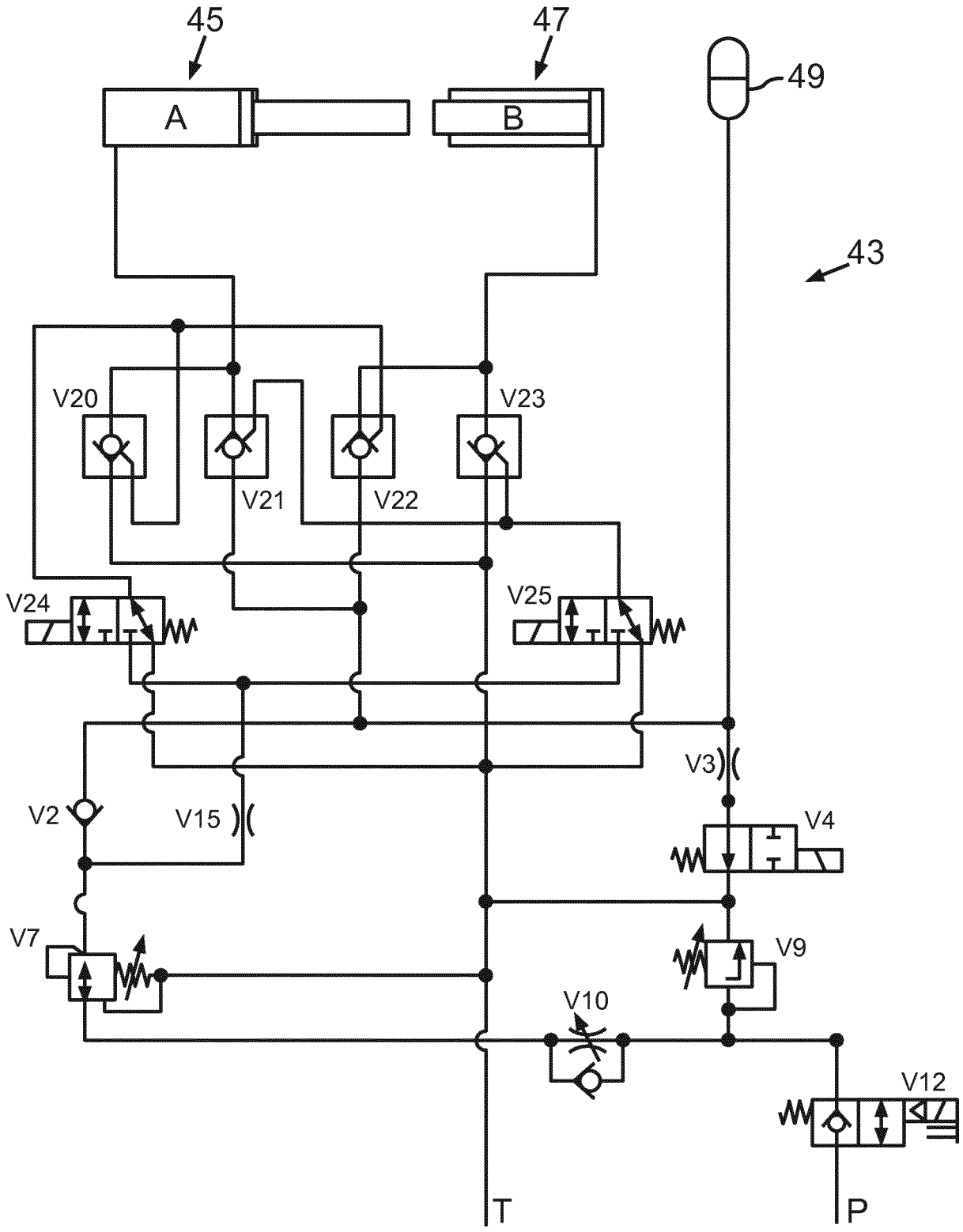

Fig.3

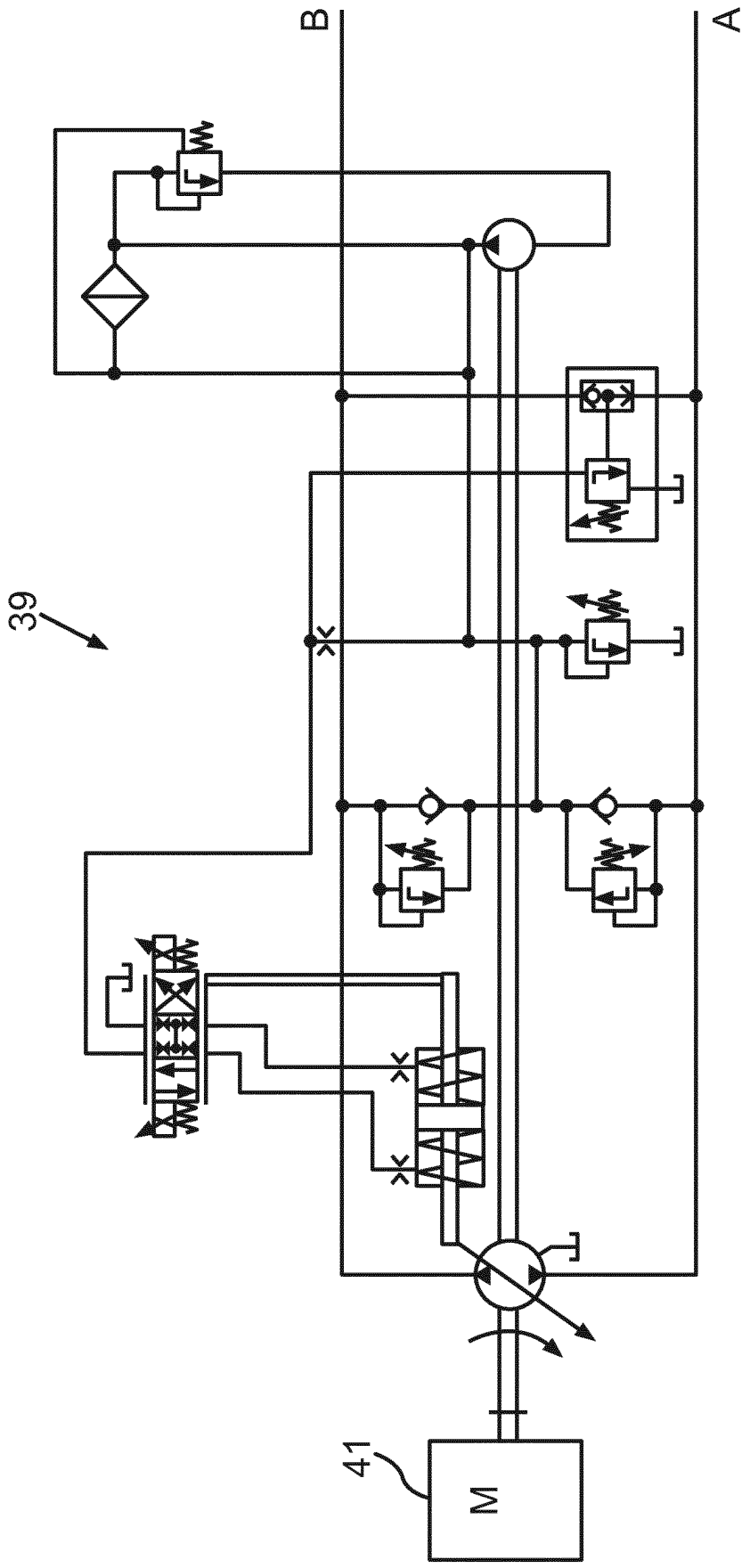

Fig.4

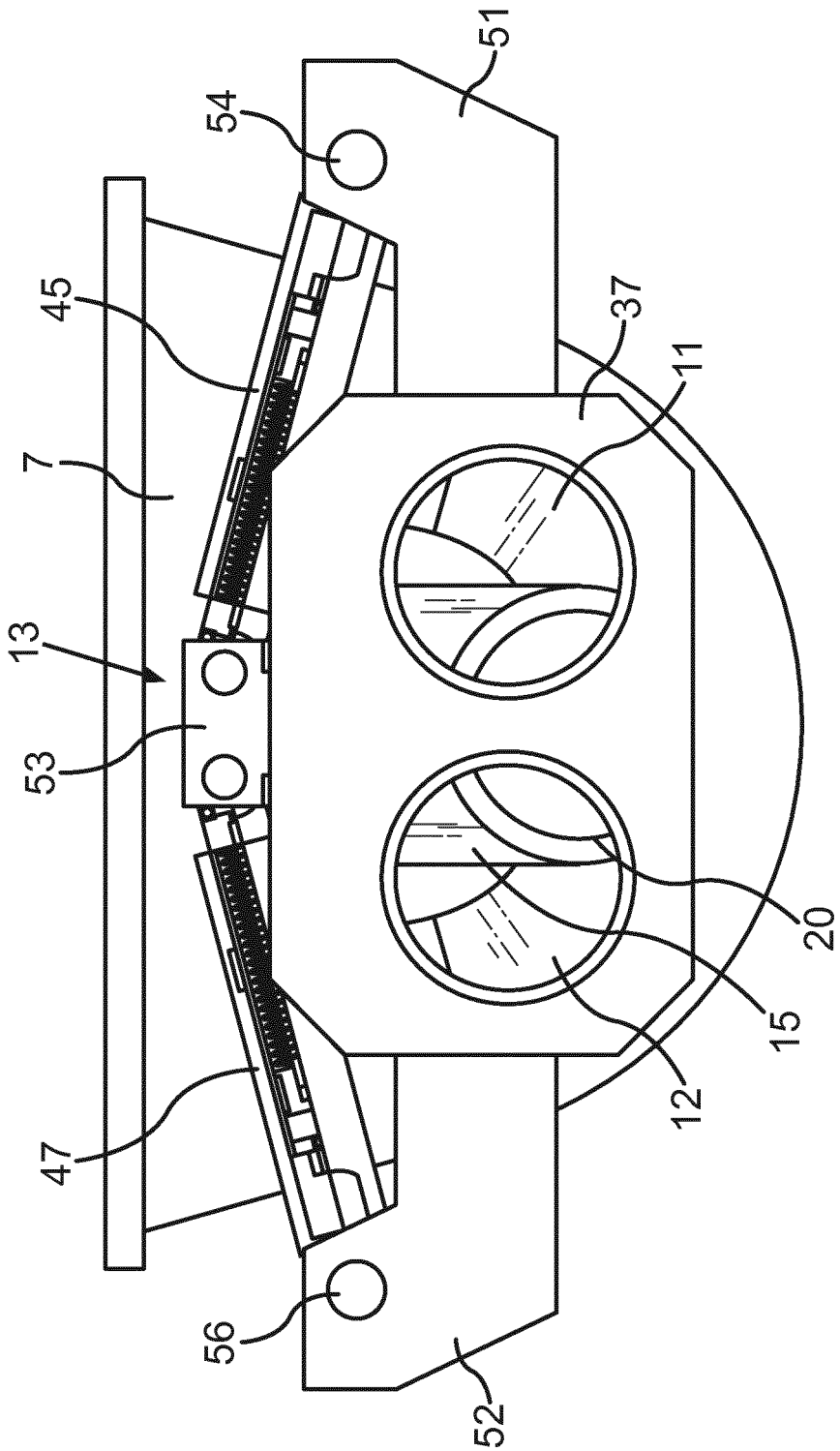

Fig.5

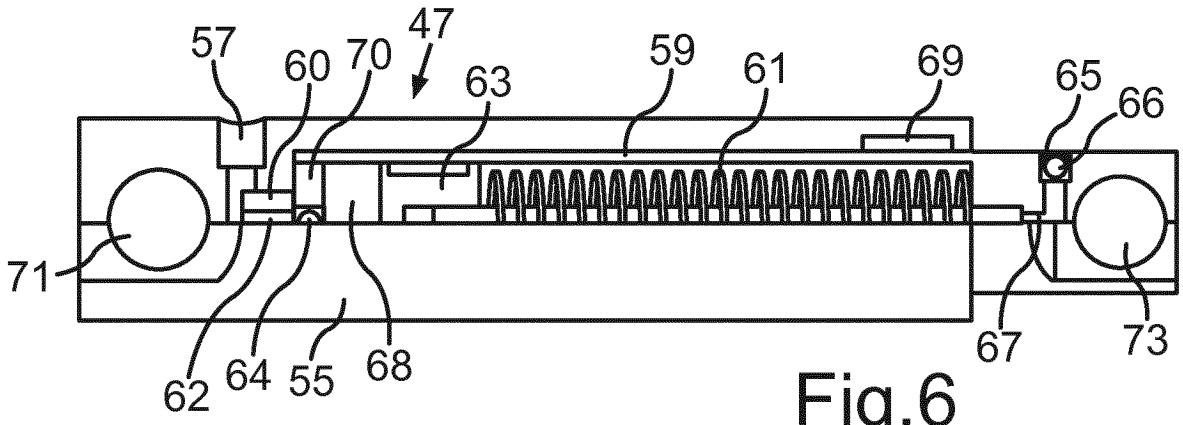

Fig.6

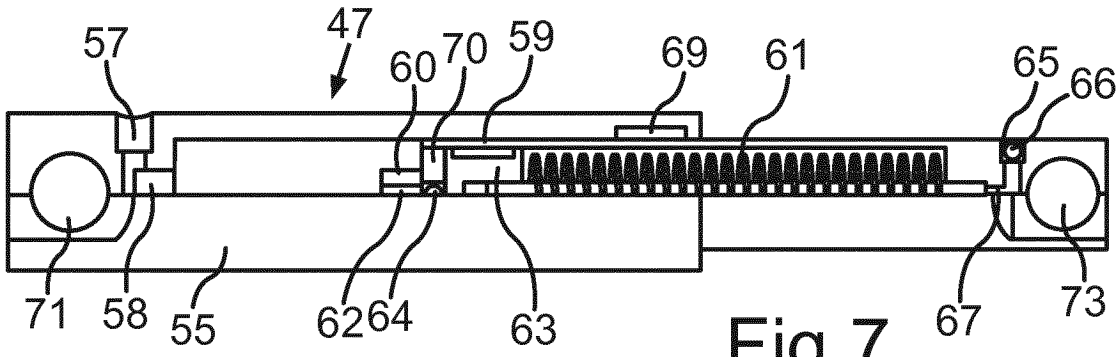

Fig.7

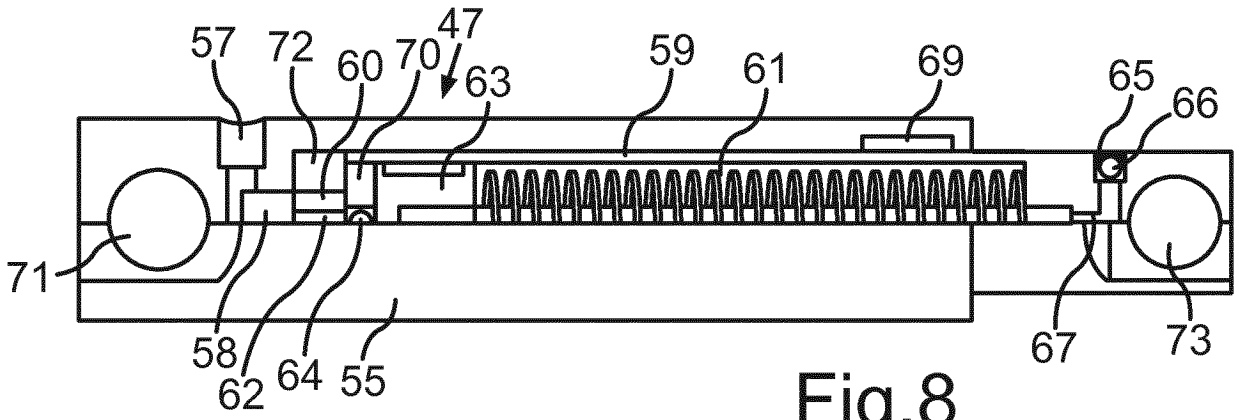

Fig.8

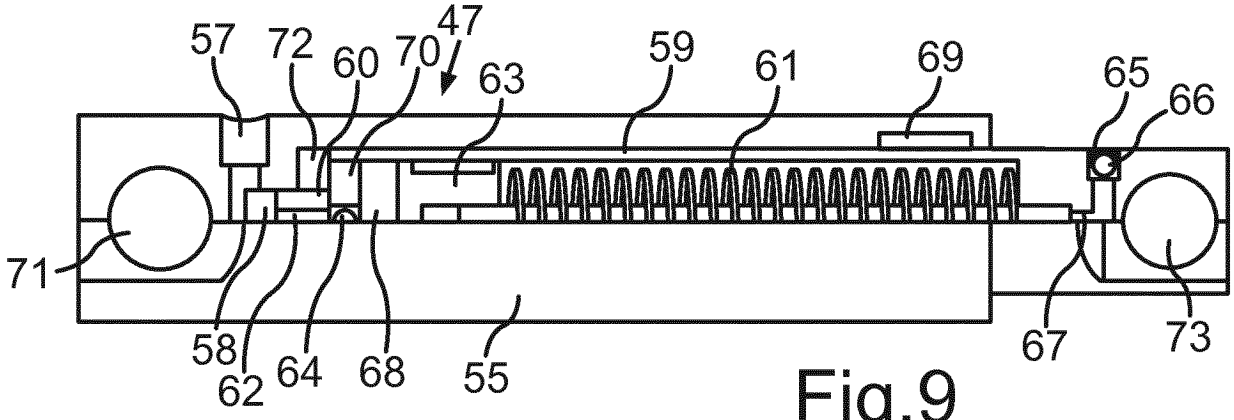

Fig.9

REFERENCES CITED IN THE DESCRIPTION

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- DE 9217574 U1 **[0006]**
- DE 4318267 A1 **[0007]**