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(54) SPUD CARRIAGE BIASING SYSTEM, SPUD CARRIAGE, APPARATUS FOR ACCOMMODATING A WORKING SPUD OF A VESSEL, AND VESSEL

PFAHLWAGENFAHRWEG-VORSPANNUNGSSYSTEM, PFAHLWAGENFAHRWEG, VORRICHTUNG ZUR AUFNAHME EINES ARBEITSPFAHLWAGEN EINES SCHIFFES UND SCHIFF

SYSTÈME DE SOLLICITATION POUR CHARIOT D'ANCRAGE, CHARIOT D'ANCRAGE, APPAREIL POUR LOGER UN ANCRAGE DE TRAVAIL D'UNE CUVE, ET CUVE

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Description

[0001] The invention relates to a spud carriage biasing system for biasing a spud carriage of a vessel, for instance a dredging vessel, especially a cutter suction dredging vessel, and for absorbing at least a portion of a moment on the spud carriage.

[0002] During use, dredging vessels are often exposed to conditions such as for instance wind, waves and/or water flows, for example when they are used on unsheltered waters. Therefore, and due to the fact that dredging action can cause a vessel to move with respect to the bed or bottom of the water, a dredging vessel is normally kept substantially in place by means of a working spud inserted partly into the bed during use. Generally, the working spud is accommodated in a spud carriage which is normally mounted to the hull of the vessel in a manner that it can be moved backward an forward with respect to the hull, such that the vessel can be relocated to some extent without pulling the working spud out of the bed and relocating said spud. Hence, dredging action can for example start when the working spud is placed partly in the bed and the spud carriage is temporarily fixed in its front working position. After a while, the vessel may be moved forwardly, e.g. by pushing the spud carriage rearwardly, and the spud carriage may then be temporarily fixed in a second working position, such that dredging work can be performed at a bed or bottom area located further forward then the initial working area. Since relatively large forces can be exerted on a fixing coupling between the spud carriage and the vessel, the spud carriage is during use normally not rigidly fixed in its working position in which it is fixed temporarily. Normally, the spud carriage is mounted in such a manner that it can rotate to some extent around a substantially horizontal axis, which axis extends substantially transverse to the longitudinal direction of the vessel and/or the direction in which the spud carriage can be moved forward and rearward. Hence, the vessel can pitch to some extent around said horizontal axis. Further, the vessel can have a spud carriage biasing system for biasing the spud carriage in a neutral position and for absorbing at least a portion of a moment on the spud carriage.

[0003] For example, European patent publication EP 1 888 849 describes a spud carriage biasing system. Said publication describes an apparatus for accommodating a substantially vertical spud of a dredging vessel with a longitudinal direction, comprising a spud carriage which is mounted for limited rotation around a horizontal transverse axis, wherein a first and a second steel wire are arranged under bias between vessel and spud in the longitudinal direction for the purpose of absorbing a moment on the spud carriage, which first and second steel wires compensate each other in the non-loaded situation of the spud, and wherein the wires are connected to the vessel at least partly by means of respectively a first and second hydraulic cylinder for the purpose of applying bias. Said European patent publication EP 1 888 849 further describes that the pistons of the first and second hydraulic cylinder are provided with a respective tensioning cylinder, and that each of said tensioning cylinders is connected to a respective co-acting accumulator in order to work as a spring tensioning means for the respective steel wire, thereby counteracting that a respective wire becomes slack when said wire loses tension due to pitching, or so-called tilting, of the vessel, while the other wire tensions.

[0004] A disadvantage of such conventional spud carriage biasing system may be formed by the tensioning cylinders provided in the pistons of the hydraulic cylinders. For example, such an arrangement, including a cylinder within a cylinder, can be relatively vulnerable, relatively difficult to maintain, and/or relatively complex.

[0005] An object of the present disclosure is to provide an alternative spud carriage biasing system. It is an alternative object of the present invention to alleviate or solve at least one disadvantage of prior art systems. In embodiments, the invention aims at providing a spud carriage biasing system which is relatively invulnerable, relatively easily to maintain, and/or of relatively simple or uncluttered design. In particular, the invention may aim at providing a spud carriage biasing system arranged for counteracting that a respective wire - of two wires compensating each other in a non-loaded situation of the spud - becomes slack when said wire loses tension due to pitching of the vessel, while another wire tensions, preferably without providing pistons of hydraulic cylinders of the system with tensioning cylinders within said hydraulic cylinders.

[0006] In a first aspect of the present disclosure, the disclosure provides for a spud carriage biasing system for biasing a spud carriage of a vessel in a position in which the spud carriage accommodates a working spud of the vessel in a substantially vertical direction and for absorbing at least a portion of a moment on the spud carriage, comprising: a first hydraulic tensioning cylinder; a first low pressure tensioning accumulator in fluid communication with a first pressure chamber comprised in the first cylinder; a second hydraulic tensioning cylinder; and a second low pressure tensioning accumulator in fluid communication with a second pressure chamber comprised in the second cylinder; wherein the biasing system further comprises two sets of two connected hydraulic cylinders, the first set comprising a third hydraulic cylinder and a fourth hydraulic cylinder, wherein a piston rod of the third hydraulic cylinder is connected with a piston rod of the fourth hydraulic cylinder, the second set comprising a fifth hydraulic cylinder and a sixth hydraulic cylinder, wherein a piston rod of the fifth hydraulic cylinder is connected with a piston rod of the sixth hydraulic cylinder, wherein a third pressure chamber, which is part of the third hydraulic tensioning cylinder, and a fifth pressure chamber, which is part of the fifth cylinder are in fluid communication with the first pressure chamber, which is part of the first cylinder, and wherein a fourth pressure chamber, which is part of the fourth cylinder

and a sixth pressure chamber, which is part of the sixth cylinder are in fluid communication with the second pressure chamber, which is part of the second cylinder, wherein the third cylinder comprises a seventh pressure chamber provided with a pressure fluid for biasing a piston of the third cylinder toward the third pressure chamber, and wherein the sixth cylinder comprises a eighth pressure chamber provided with a pressure fluid for biasing a piston of the sixth cylinder toward the sixth pressure chamber.

[0007] By providing the arrangement with the two sets of two connected hydraulic cylinders, pressure fluid can be pushed from the fourth pressure chamber toward the second pressure chamber when the coupled piston rods of the third and fourth hydraulic cylinder moves as a result of pressure fluid of the first cylinder being pushed into the third cylinder when the pressure in the fluidly interconnected first and third pressure chambers exceeds the initial counter pressure of the pressure fluid provided in the seventh pressure chamber due to an increased pressure which a first wire is exerting onto the piston of the first cylinder. As a result of the pressure fluid which is pushed from the fourth pressure chamber toward the second pressure chamber, the second cylinder can then exert additional pressure to a wire connected to said second cylinder. Hence, the arrangement with the two sets of two connected hydraulic cylinders may not only counteract that the pressure in the pressure chamber of the first cylinder, and thus the pressure in a connected first wire, will exceed a certain value when the vessel pitches to a relatively large extent with respect to its working spud, but will also counteract that the second wire becomes slack, because said arrangement also counteracts that the pressure in the pressure chamber of the second chamber will drop too low. Hence, the spud carriage biasing system having said arrangement with the two sets of two connected hydraulic cylinders can provide that a respective wire becomes slack when said wire loses tension due to pitching of the vessel, while another wire - of two wires compensating each other in a non-loaded situation of the spud - tensions, without providing tensioning cylinders within the pistons of the first and second hydraulic cylinders of the system.

[0008] In embodiments, the pressure fluid of the seventh and/or eighth pressure chamber can be formed by a substantially compressible fluid, e.g. a gas or gas mixture.

[0009] However, in preferred embodiments, the pressure fluid of the seventh and/or eighth pressure chamber may be a substantially non-compressible hydraulic fluid, especially oil. The system can then be arranged to allow the fluid of the seventh pressure chamber to be pressed out of the seventh pressure chamber at least partly when the pressure in the third pressure chamber reaches a predetermined upper threshold value. Further, the system can be arranged to push at least part of said fluid back into the seventh pressure chamber when the pressure in the third pressure chamber drops below said upper threshold value. Additionally, or alternatively, the system can further be arranged to allow the fluid of the eighth pressure chamber to be pressed out of the eighth pressure chamber at least partly when the pressure in the sixth pressure chamber reaches a predetermined upper threshold value, wherein said system can further be arranged to push at least part of said fluid back into the eighth pressure chamber when the pressure in the sixth pressure chamber drops below said upper threshold value. As a result, the system may be arranged to bring the piston of the third cylinder or the piston of the sixth cylinder, respectively, back toward its respective initial position, while it pushes pressure fluid out of the third or sixth pressure chamber toward the first or second pressure chamber, respectively, when the pressure in said first or second pressure chamber, respectively, drops due to the vessel pitching back toward its initial substantially horizontal position.

[0010] In preferred embodiments, the seventh and/or eighth pressure chambers can be in fluid communication with a respective high pressure limitation accumulator or said pressure chambers can both be in fluid communication with a shared high pressure limitation accumulator, especially one or multiple compressed gas accumulators or so-called hydro-pneumatic accumulators. By providing a high pressure limitation accumulator, a substantially passive system may be provided which does not need to be actively controlled, which system may therefore be relatively simple and/or reliable.

[0011] Advantageously, the seventh pressure chamber can be in fluid connection with the eighth pressure chamber, such that the seventh and eighth pressure chamber can then thus be in fluid communication with the same high pressure limitation accumulator. As a result, the system can be relatively simple and/or can be balanced relatively easily because the counter pressure provided to the pressure fluid in the fourth and fifth pressure chamber, respectively, can be practically the same. By connecting the first high pressure limitation accumulator and/or a further high pressure limitation accumulator to a respective pump, the system can be arranged to adjust the counter pressure provided by the pressure fluid in the seventh and/or eighth pressure chamber in a relatively easy manner.

[0012] The present disclosure also relates to a spud carriage for accommodating a working spud.

[0013] Further, the disclosure relates to an apparatus for accommodating a working spud of a vessel, such as a dredging vessel.

[0014] The disclosure also relates to a vessel, preferably a dredging vessel, especially a cutter suction dredging vessel.

[0015] Advantageous embodiments of the disclosure and the invention are described below and in the appended claims.

[0016] By way of non-limiting examples only, embodiments of the present invention will now be described with reference to the accompanying figures in which:

Figure 1a shows a schematic side view of an embodiment of a vessel according to an aspect of the invention;
Figure 1b shows a schematic top view of the dredging vessel shown in Figure 1a;
Figure 2 shows a schematic view of a wire system for biasing a spud carriage;
Figure 3 shows a schematic view of an embodiment of a spud carriage biasing system according to an aspect of the invention in a first position;
Figure 4 shows a schematic view of the spud carriage biasing system of Figure 3 in a second position; and
Figure 5 shows a schematic view of the spud carriage biasing system of Figures 3 and 4 in a third position.

[0017] The embodiments disclosed herein are shown as examples only and should by no means be understood as limiting the scope of the claimed invention in any way. In this description the same or similar elements have the same or similar reference signs.

[0018] Figures 1a and 1b show schematic side and top views of an embodiment of a vessel 100, e.g. a ship, boat or pontoon, according to an aspect of the invention. For instance, the vessel can be a dredging vessel 100, especially a cutter suction dredging vessel provided with a cutter suction head 101.

[0019] During dredging action, the vessel 100 may be kept substantially in place by means of a working spud 3, which can be lowered partly into a so-called bed 102, such as a seabed or riverbed. The working spud 3 can be accommodated in a spud carriage 2. Preferably, the carriage 2 may be mounted to the hull 103 of the vessel 100 in a manner that it can be moved with respect to the hull, preferably moved backward and forward with respect to the hull 103. For instance, the spud carriage 2 and/or the hull 103 can therefore be provided with guiding means, preferably corresponding guiding means, such as for example slide shoes or wheels guided through or along a corresponding rail or guide beam. Additionally or alternatively, one or more driving means 8, such as one or more driving cylinder 8, for moving the spud carriage 2 with respect to the hull, preferably in a substantially horizontal direction, may be provided, such as for instance can be seen in Figure 2.

[0020] The vessel can be relocated to some extent by relocating the spud carriage with respect to the hull, and thus without pulling the working spud 3 out of the bed 102 and relocating said spud 3 with respect to the bed before starting dredging action at an adjacent working location. For example, dredging action can start when the working spud 3 is inserted in the bed 102 and the spud carriage 2 is temporarily fixed in its front working position 2a as shown in Figs. 1a and 1b. For example when dredging action is finished at the first working location, the vessel can be moved forward, e.g. by pushing the spud carriage 2 rearward with respect to the hull 103. Subsequently, the spud carriage 2 may be temporarily fixed in a second working position 2b, as is shown in Fig. 1b by means of a dotted line, such that dredging work can be performed at a bed or bottom area 104b located further forward than the initial working area 104a.

[0021] Further, the vessel 100 may be provided with an auxiliary spud 105, which can be inserted partly into the bed before hoisting the working spud 3. Subsequently, the spud carriage 2 may be moved from a rearmost working position 2c back to its initial or front working position 2a in which it can be temporarily fixed, at least in the longitudinal direction 106 of the vessel 100, and in which position of the carriage 2 the working spud 3 can be inserted into the bed 102. Subsequently, the auxiliary spud 105 can be hoisted before moving the vessel 100 further forward by pushing the spud carriage 2 rearward.

[0022] When the spud carriage 2 is temporarily fixed in a respective working position 2a, 2b, 2c, it is not rigidly fixed, but is fixed in a manner in which it can at least move to some extent around a rotation axis 108 extending substantially transverse to a substantially vertical direction in which the working spud 3 extends during use and substantially transverse to a direction 107 in which the spud carriage 2 can be moved with respect to the hull 103 when it is not fixed, which direction of movement 107 may be substantially parallel and/or in line with the longitudinal direction 106 of the vessel 100. As a result, the vessel can pitch to some extent around said axis 108, without skewing the working spud 3 placed in the bed 102 or at least while counteracting that the working spud 3 skews.

[0023] Figure 2 shows a schematic view of a wire system 5 for biasing the spud carriage 2. Said system 5 and/or the spud carriage 2 may be provided at the vessel 100 of Figs. 1a and 1b. Here in Fig. 2, only one wire system 5 is shown, but in preferred embodiments, the spud carriage 2 may be provided with at least two of such wire systems 5, e.g. one located at a starboard side and one provided at a port side of the spud carriage 2.

[0024] For example, as shown in Figure 2, the wire system 5 may comprise a first wire 6 and a second wire 7, which wires may compensate each other in a neutral or non-loaded situation of the spud carriage 2, which situation may correspond with a substantially vertical position of the working spud 3 and/or the spud carriage 2 accommodating it.

[0025] The first wire 6 may be attached with a first end portion 6a to the vessel at a position located at the rearward side of the spud carriage 2 and may extend, e.g. at least partly laterally and/or substantially horizontally, toward a first wire guide 71, e.g. a wire guiding wheel, attached to the spud carriage 2. Said first wire 6 may then be guided around said guide 71 and extend, e.g. at least partly laterally and/or substantially horizontally, toward at least one second wire guide 72 located at the vessel 100 behind the spud carriage 2. Subsequently, said first wire 6 may be guided around the second guide 72 and extends - for instance via an intermediate wire guide 73a - toward a third wire guide 73b attached to the vessel at a location in front of the spud carriage 2. The first wire

can be guided around said third wire guide 73b and can extend backward toward a fourth wire guide 74 attached to the spud carriage 2, for instance in a substantially horizontal manner. The first wire can then be guided around said fourth guide 74 and can be attached with a second end portion 6b to the vessel 100 at a position located at the front side of the spud carriage 2. The second wire 7 may be provided in a substantially mirrored manner. For example, the second wire 7 may be attached with a first end portion 7a to the vessel at a position located at the front side of the spud carriage 2 and may extend, e.g. at least partly laterally and/or substantially horizontally , toward a fifth wire guide 75 attached to the spud carriage 2. Said second wire 7 may then be guided around said guide 75 and extend, e.g. at least partly laterally and/or substantially horizontally, toward at least one sixth wire guide 76 located at the vessel 100 in front of the spud carriage 2. Subsequently, said second wire 7 can be guided around the sixth guide 76 and extends - for instance via an intermediate wire guide 77a - toward a seventh wire guide 77b attached to the vessel at a location behind the spud carriage 2. The second wire 7 can be guided around said seventh wire guide 77b and can extend backward toward an eighth wire guide 78 attached to the spud carriage 2, for instance in a substantially horizontal manner. The second wire 7 can then be guided around said eighth guide 78 and can be attached with a second end portion 7b to the vessel 100 at a position located at the rear side of the spud carriage 2.

[0026] For example, wire guides can be formed by guiding discs, preferably rotatably mounted guiding discs. In embodiments, such as for instance shown in Fig. 2, the first and fifth wire guide 71, 75 may be integrated, e.g. being integrated into a double guiding disc 71, 75, and/or may be provided at a single rotation axis. Additionally or alternatively, the fourth and eighth wire guide 74, 78 may be integrated, e.g. being integrated into a double guiding disc 74, 78, and/or may be provided at a single rotation axis.

[0027] Preferably, the wires 6, 7 can be steel wires and/or may be stretchable to some extent, e.g. by providing them with an integrated spring element. Hence, by stretching, the respective wire 6, 7 can absorb at least a part of a moment the vessel 100 is exerting on the spud carriage.

[0028] During use, the working spud 3 and the carriage 2 housing it may tend to tilt with respect to the longitudinal direction 106 of the vessel 100, e.g. due to waves, wind and/or dredging action. For example, if the front side of the vessel tends to pitch or tilt upwardly, the carriage 2 tends to tilt around its rotation axis 108 with respect to the vessel 100 in a clockwork motion when seen from the right side or so-called port side of the vessel 100, as shown in Fig. 2. On the other hand, as can be understood when observing Fig. 2, the first guide 71 will then tend to move away from the second guide 72, and the fourth guide 74 will tend to move away from the third wire guide 73b. Hence, the first wire 6 will tend to stretch. On the other hand, the fifth guide 75 will then tend to move toward the sixth guide 76, and the eighth guide 78 will tend to move toward the seventh wire guide 77b. Hence, the second wire 7 will tend to slack. It will be apparent that in case the spud carriage 2 will tend to tilt the other direction, the first wire 6 will tend to slack and the second wire 7 will tend to stretch.

[0029] In an aspect, the present disclosure also relates to a spud carriage biasing system 1 suitable for holding the wires 6, 7 under bias and/or for limiting tension in the respective wire, preferably by moving at least one 72, 76 of the wire guides in order to reduce the length of the path along which the respective wire 6, 7 extends, when said path length tends to increase due to tilting of the spud carriage 2 with respect to the vessel's hull 103.

[0030] As can be seen in Fig. 2, the wires 6, 7 may be held under bias by means of respectively a first and second hydraulic tensioning cylinder 10, 20. The first cylinder 10, preferably its piston rod 13, may engage a first tensioning guide 72, which can be the second wire guide 72, which is associated with the first wire 6. The second cylinder 20, preferably its piston 23, may engage a second tensioning guide 76, which can be the sixth wire guide 76, which sixth guide 76 is associated with the second wire 7. For example, distal ends of the first and second piston rod 13, 23 may extend from the cylinder head of the respective cylinder and may be connected to and/or being arranged to be connected to respectively the first and the second tensioning guide 72, 76 around which the respective first and second biasing wire 6, 7 can be guided during use.

[0031] Here, the first and second cylinders 10, 20 are located between the respective guide and the spud carriage, and may thus be arranged to bias the guides in an outward direction away from the spud carriage 2, by means of a pressure fluid provided in a pressure chamber 11, 21 located at a cylinder base side of the respective cylinder 10, 20. However, in alternative embodiments, the cylinders 10, 20 may be directed substantially oppositely, i.e. with a distal end engaging the respective guide 72, 76 pointing toward the spud carriage 2. In that case, the cylinders 10, 20 may for instance be arranged to bias the respective guides 72, 76 in an outward direction by pulling the piston rods 13, 23 into the cylinder barrels.

[0032] Figures 3-5 show schematic views of an embodiment of a spud carriage biasing system 1 according to an aspect of the invention in three different positions. The spud carriage biasing system 1 may be arranged for biasing a spud carriage 2 of a vessel 100 in a position in which the spud carriage 2 accommodates a working spud 3 of the vessel 100 in a substantially vertical direction and/or for absorbing at least a portion of a moment which during use may be working on the spud carriage 2. Said spud carriage biasing system 1 comprises a first hydraulic tensioning cylinder 10 having a first pressure chamber 11 in fluid communication with a first low pressure tensioning accumulator 15 and a second hydraulic tensioning cylinder 20 having a second pressure chamber 21 in

fluid communication with a second low pressure tensioning accumulator 25.

[0033] Preferably, said first pressure chamber 11 may be located at the cylinder base side of the first hydraulic tensioning cylinder 10, e.g. in case when the first tensioning guide 72, e.g. formed by the second wire guide 72, is biased in an outward direction with respect to the spud carriage 2. Besides, said second pressure chamber 21 may be located at the cylinder base side of the second hydraulic tensioning cylinder 20 e.g. in case when the second tension guide 76, e.g. being formed by the sixth wire guide 76, is biased in an outward direction with respect to the spud carriage 2.

[0034] It is noted that the pressure fluid in the first and second pressure chambers 11, 21 and in the connected first and second low pressure tensioning accumulators 15, 25, respectively, may be a substantially non-compressible hydraulic fluid, preferably oil.

[0035] The spud carriage biasing system 1 further comprises two sets of two connected hydraulic cylinders 30, 40; 50, 60. The first set 30, 40 comprises a third hydraulic cylinder 30 and a fourth hydraulic cylinder 40, wherein a piston rod 33 of the third hydraulic cylinder 30 is connected with a piston rod 43 of the fourth hydraulic cylinder 40. The second set 50, 60 comprises a fifth hydraulic cylinder 50 and a sixth hydraulic cylinder 60, wherein a piston rod 53 of the fifth hydraulic cylinder 50 is connected with a piston rod 63 of the sixth hydraulic cylinder 60. The respective piston rods may be connected in such a way that when the piston of one cylinder moves in a direction from the cylinder base side toward the cylinder head side of said cylinder, the piston of a connected or so-called coupled cylinder moves in a direction from the cylinder head side toward the cylinder base side of said coupled cylinder. Preferably, the respective piston rods 33, 43; 53, 63 and/or pistons can be rigidly coupled together, e.g. by integrating the third and fourth piston rod 33, 43 and/or by integrating the fifth and sixth piston rod 53, 63.

[0036] Further, a third pressure chamber 31, which is part of the third hydraulic tensioning cylinder 30, and a fifth pressure chamber 51, which is part of the fifth cylinder 50 are in fluid communication with the first pressure chamber 11, which is part of the first cylinder 10. Additionally, a fourth pressure chamber 41, which is part of the fourth cylinder 40 and a sixth pressure chamber 61, which is part of the sixth cylinder 60 are in fluid communication with the second pressure chamber 21, which is part of the second cylinder 20. Furthermore, the third cylinder 30 comprises a seventh pressure chamber 32 provided with a pressure fluid for biasing a piston 34 of the third cylinder 30 toward the third pressure chamber 31, and the sixth cylinder 60 comprises a eighth pressure chamber 62 provided with a pressure fluid for biasing a piston 64 of the sixth cylinder 60 toward the sixth pressure chamber 61.

[0037] In embodiments, the fluid of the seventh pressure chamber 32 and/or the fluid of the eighth pressure chamber 62 is formed by a substantially compressible fluid, e.g. a gas or gas mixture. However, in preferred embodiments the fluid of the seventh and eight pressure chamber is formed by a substantially non-compressible hydraulic fluid, e.g. oil.

[0038] Advantageously, especially in case when the fluid of the seventh pressure chamber 32 is formed by a substantially non-compressible hydraulic fluid such as oil, the spud carriage biasing system 1 can further be arranged to allow the fluid of the seventh pressure chamber 32 to be pressed out of the seventh pressure chamber 32 at least partly when the pressure in the third pressure chamber 31 reaches a predetermined upper threshold value, and can also be arranged to push at least part of said fluid back into the seventh pressure chamber 32 when the pressure in the third pressure chamber 31 drops below said upper threshold value. For example thereto, the seventh pressure chamber 32 can be in fluid communication with a high pressure limitation accumulator 80. However, in alternative embodiments, the system 1 may comprise alternative means for allowing fluid to be pressed out of and into the seventh pressure chamber 32. For example, the seventh pressure chamber 32 may be in fluid communication with a catching reservoir for catching fluid pressed out of the seventh pressure chamber 32, preferably through a pressure relief valve, and the system may further comprises a pump for pumping fluid back from said catching reservoir toward the seventh pressure chamber, e.g. when the pressure in the third pressure chamber 31 drops below said upper threshold value.

[0039] Additionally or alternatively, especially in case when the fluid of the eighth pressure chamber 62 is formed by a substantially non-compressible hydraulic fluid such as oil, the spud carriage biasing system 1 may further be arranged to allow the fluid of the eighth pressure chamber 62 to be pressed out of the eighth pressure chamber at least partly when the pressure in the sixth pressure chamber 61 reaches a predetermined upper threshold value, and may be arranged to push at least part of said fluid back into the eighth pressure chamber 62 when the pressure in the sixth pressure chamber 61 drops below said upper threshold value. For example thereto, the eighth pressure chamber 62 can be in fluid communication with said high pressure limitation accumulator 80 and/or in fluid communication with a further high pressure limitation accumulator. However, in alternative embodiments, the system 1 may comprise alternative means for allowing fluid to be pressed out of and into the eighth pressure chamber 62. For instance, the eighth pressure chamber 62 may be in fluid communication with the catching reservoir for catching fluid of the seventh pressure chamber or in fluid communication with a further catching reservoir, the respective reservoir can be arranged for catching fluid pressed out of the eighth pressure chamber, and the system 1 can further be arranged such that said pump of the first reservoir or a further pump associated with the further catching reser-

voir can pump fluid back from the respective catching reservoir toward the eighth pressure chamber 62, e.g. when the pressure in the sixth pressure chamber 61 drops below said upper threshold value.

[0040] In embodiments, such as for instance in the exemplary embodiment of Figs. 3, 4 and 5, the seventh pressure chamber 32 can be in fluid connection with the eighth pressure chamber 62, and the seventh and eighth pressure chamber can thus be in fluid communication with the same high pressure limitation accumulator 80. Hence, the counter pressures provided by the fluid in the seventh and eight pressure chamber can be substantially equally.

[0041] Preferably, the high pressure limitation accumulator 80 and/or the further high pressure limitation accumulator, and/or the first and/or second low pressure tensioning accumulators 15, 25 can be formed by a compressed gas accumulator, or a so-called hydro-pneumatic accumulator. In alternative embodiments, other high pressure limitation accumulators can be used. For instance, the substantially non-compressible hydraulic fluid in the third pressure chamber 31 and/or sixth pressure chamber 61 can be held under pressure by a spring or a raised weight.

[0042] Although one or more compressed gas accumulators may preferably be formed by a respective membrane accumulator, one or more compressed gas accumulators may alternatively be formed by a piston accumulator.

[0043] As shown in the exemplary embodiment of Figs. 3-5, the gas volume of the high pressure limitation accumulator 80 may be increased by coupling it to a gas reservoir 81, e.g. formed by one or more gas bottles 81. It is apparent that one or both low pressure accumulators may alternatively or additionally be coupled to a respective gas reservoir.

[0044] Advantageously, the first high pressure limitation accumulator 80 and/or the further high pressure limitation accumulator 80 can be connected to one or more pumps 82. As a result, the counter pressure provided by the gas side of the respective high pressure limitation accumulator 80 may be adjusted. It is apparent that one or both low pressure accumulators may alternatively or additionally also be coupled to a respective pump for setting or adjusting the system.

[0045] Preferably, a neutral or so-called non-loaded situation of the wire system 5 of the spud carriage 2, e. g. such as shown in Fig. 2, may correspond with a substantially vertical position of the working spud 3 and/or the spud carriage 2 accommodating it. In said non-loaded situation, the first and second wire 6, 7 of the wire system 5 may compensate each other, and/or said wires 6, 7 may be substantially equally biased, especially outwardly. Said non-loaded situation of the wire system 5 may correspond with an initial, neutral or non-loaded situation of the spud carriage biasing system 1, as shown in Fig. 3. Preferably, the high pressure limitation accumulator 80 provides for counter pressure in the seventh and eighth pressure chambers 32, 62 which is so high that the pistons 34, 64 of the corresponding third and sixth cylinder 30, 60 are pushed to their outermost positions in the initial position of the spud carriage biasing system 1, as shown in Fig. 3, wherein the pistons limit the volume of the corresponding third and sixth pressure chambers 31, 61 to their minimum in said outermost positions. Preferably, in the initial position of the biasing system 1, the first and second low pressure tensioning accumulators 15, 25 provide for a relatively low pressure, wherein said relatively low pressure is not high enough to move the respective pistons 34, 64 of the two sets of two connected hydraulic cylinders against the counter pressure provided by the fluid of the seventh and eighth pressure chamber, e.g. pressurized by means of the high pressure limitation accumulator 80, but wherein said relatively low pressure can be high enough to provide for a biasing force pretensioning the wires 6, 7 of the wire system 5.

[0046] During use of the spud carriage biasing system 1, the spud carriage 2 may be temporarily fixed in a working position 2a, 2b, 2c such that it can temporarily not be moved substantially forwardly or rearwardly. As described above, the respective wire 6, 7 can be stretchable and may absorb at least a part of forces associated with a moment working on a coupling between a vessel's hull 103 and the spud carriage 2, when said spud carriage 2 tilts with respect to the hull 103 around its substantially vertical rotation axis 108. When forces working on the working spud 3 and/or working on the spud carriage 2 increase, a force the respective wire 6 exerts on the respective hydraulic tensioning cylinder 10, e.g. via a respective wire guide 72, may increase to such extent that said force becomes greater than a force exerted by the hydraulic fluid in the first pressure chamber 11 located in said first cylinder 10. As a result, as shown in Figure 4, a portion of the fluid is pushed out of said first chamber 11 toward the associated first low pressure tensioning accumulator 15, thereby absorbing at least a part of the increased forces and/or moment working on the spud carriage 2 and/or spud 3. At the same time, as described above, the other wire 7 tends to slack. When the first low pressure tensioning accumulator 15 is absorbing a part of the forces exerted on the first wire 6, the second low pressure tensioning accumulator 25 can cause that the second wire 7 is kept under enough tension by pushing additional hydraulic fluid into the second pressure chamber 21 as the tension the second wire 7 exerts on the second cylinder 20 decreases.

[0047] When the force exerted on the respective hydraulic tensioning cylinder 10 by the respective wire, e. g. the first wire 6, decreases, the pressure exerted by the respective low pressure tensioning accumulator 15 will cause that the piston of the first cylinder 12 will be moved back toward its initial position, thereby counteracting that the first wire 6 will slack or slack too much. Simultaneously, when the force exerted on the respective first tensioning cylinder 10 by the first wire 6 decreases, the force exerted by the second wire 7 on the second tensioning

cylinder 20 will increase, thereby pushing the piston 24 of the second cylinder back toward its initial position. When the moment exerted on the coupling between the vessel and spud carriage disappears, the spud carriage biasing system 1 will thus move back to its initial position as shown in Fig. 3.

[0048] On the other hand, when the force exerted on the respective hydraulic tensioning cylinder 10 by the respective wire, e.g. the first wire 6, increases further, e.g. due to an increasing moment, the pressure in the respective pressure chamber, e.g. the first pressure chamber 11, and the hydraulic fluid side of the respective low pressure tensioning accumulator 15 fluidly connected therewith increases. At a certain point, said fluid pressure exceeds the counter pressure applied by the fluid in the seventh pressure chamber 32. Then, the fluid in the third pressure chamber 21 moves the piston 34 of the third cylinder 30 toward the seventh pressure chamber 32 until the pressures in the third cylinder 30 are balanced, as can be seen in Figure 5. By moving the piston 34 of the third cylinder 30, the coupled piston 44 of the fourth cylinder moves as well, thereby increasing the fluid pressure in the fourth pressure chamber 41 and the interconnected second pressure chamber 21. As a result, the increased force exerted on the first hydraulic tensioning cylinder 10 by the first wire 6 causes the second hydraulic tensioning cylinder 20 to exert a greater force on the second wire 7, thereby counteracting that said second wire 7 can slack too much.

[0049] When the increased force exerted on the first cylinder 10 by the first wire 6 decreases, the pressure fluid in the seventh pressure chamber 32 can cause the third piston 34 to move back to at least some extent, thereby pushing fluid back from the third pressure chamber 31 toward the first pressure chamber 11, thereby causing that the first tensioning guide 72, e.g. formed by the second wire guide 72, can keep enough tension on the first wire 6. Simultaneously, the movement of the third piston 34 causes the connected piston 44 of the fourth pressure cylinder to move, thereby increasing the volume of the fourth pressure chamber and decreasing the fluid pressure in the second pressure chamber, such that can be counteracted that second tensioning guide 76, e.g. formed by the sixth wire guide 76, tensions the second wire 7 to a too great extent. When the force exerted on the first cylinder 10 by the first wire 6 decreases even further, the interconnected pistons 34, 44 of the third and fourth cylinder can be moved back into their initial positions, as shown in Fig. 4. When said force decreases further, the wires 6, 7 can mainly be tensioned by means of the first and second low pressure tensioning accumulators 15, 25 and the first and second cylinders 10, 20 connected with the respective accumulators 15, 25.

[0050] On the other hand, in case the force exerted by the first wire 6 on the first hydraulic tensioning cylinder increases even further with respect to the situation shown in Figure 5, the first low pressure tensioning accumulator 15 and the high pressure limitation accumulator 80 may absorb at least a part of said additional force. It is noted that the spud carriage biasing system can advantageously comprise one or multiple safety valves, which may counteract that pressures in the system 1 reaches critical values. For example, a first safety valve 16 may be provided in fluid communication with the first pressure chamber 11 and/or a second safety valve 26 in fluid communication with the second pressure chamber 21. Preferably, the respective pressure valve can be fluidly connected to a storage container, e.g. in order to counteract that pressure fluid pollutes the water and/or environment.

[0051] The invention is not restricted to the embodiments described above. It will be understood that many variants are possible.

[0052] For the purpose of clarity and a concise description features are described herein as part of the same or separate embodiments, however, it will be appreciated that the scope of the invention may include embodiments having combinations of all or some of the features shown and/or described.

[0053] These and other embodiments will be apparent to the person skilled in the art . The protected scope is defined by the appended claims 1-15.

Claims

1. Spud carriage biasing system (1) for biasing a spud carriage of a vessel in a position in which the spud carriage accommodates a working spud of the vessel in a substantially vertical direction and for absorbing at least a portion of a moment on the spud carriage, comprising:

   a first hydraulic tensioning cylinder (10);
   a first low pressure tensioning accumulator (15) in fluid communication with a first pressure chamber (11) comprised in the first cylinder (10);
   a second hydraulic tensioning cylinder (20); and
   a second low pressure tensioning accumulator (25) in fluid communication with a second pressure chamber (21) comprised in the second cylinder (20);
   characterized in that the biasing system (1) further comprises:
   two sets of two connected hydraulic cylinders (30, 40, 50, 60), the first set comprising a third hydraulic cylinder (30) and a fourth hydraulic cylinder (40), wherein a piston rod (33) of the third hydraulic cylinder (30) is connected with a piston rod (43) of the fourth hydraulic cylinder (40), the second set comprising a fifth hydraulic cylinder (50) and a sixth hydraulic cylinder (60), wherein a piston rod (53) of the fifth hydraulic cylinder (50) is connected with a piston rod (63) of the sixth hydraulic cylinder (60), wherein a third pressure chamber (31), which is part of the third hydraulic tensioning cylinder (30), and a fifth

pressure chamber (51), which is part of the fifth cylinder (50) are in fluid communication with the first pressure chamber (11), which is part of the first cylinder (10), and wherein a fourth pressure chamber (41), which is part of the fourth cylinder (40) and a sixth pressure chamber (61), which is part of the sixth cylinder (60) are in fluid communication with the second pressure chamber (21), which is part of the second cylinder (20), wherein the third cylinder (30) comprises a seventh pressure chamber (32) provided with a pressure fluid for biasing a piston (34) of the third cylinder (30) toward the third pressure chamber (31), and wherein the sixth cylinder (60) comprises a eighth pressure chamber (62) provided with a pressure fluid for biasing a piston (64) of the sixth cylinder (60) toward the sixth pressure chamber (61).

2. Spud carriage biasing system (1) according to claim 1, wherein the system (1) is further arranged to allow the fluid of the seventh pressure chamber (32) to be pressed out of the seventh pressure chamber (32) at least partly when the pressure in the third pressure chamber (31) reaches a predetermined upper threshold value, and wherein the system is arranged to push at least part of said fluid back into the seventh pressure chamber (32) when the pressure in the third pressure chamber (31) drops below said upper threshold value.

3. Spud carriage biasing system (1) according to claim 1 or 2, wherein the system (1) is further arranged to allow the fluid of the eighth pressure chamber (62) to be pressed out of the eighth pressure chamber at least partly when the pressure in the sixth pressure chamber (61) reaches a predetermined upper threshold value, and wherein the system (1) is arranged to push at least part of said fluid back into the eighth pressure chamber (62) when the pressure in the sixth pressure chamber (61) drops below said upper threshold value.

4. Spud carriage biasing system (1) according to any of the preceding claims, wherein the seventh pressure chamber (32) is in fluid communication with a high pressure limitation accumulator (80).

5. Spud carriage biasing system (1) according to claim 4, wherein the eighth pressure chamber (62) is in fluid communication with said high pressure limitation accumulator (80) and/or in fluid communication with a further high pressure limitation accumulator.

6. Spud carriage biasing system (1) according to claim 4 and 5, wherein the seventh pressure chamber (32) is in fluid connection with the eighth pressure chamber (62), and wherein the seventh and eighth pressure chamber are thus in fluid communication with the same high pressure limitation accumulator (80).

7. Spud carriage biasing system according to claim 1 or 2, wherein the first high pressure limitation accumulator (80) and/or the further high pressure limitation accumulator is connected to a respective pump (82).

8. Spud carriage biasing system according to any one of claims 1-3, wherein the seventh pressure chamber (32) is in fluid communication with a catching reservoir for catching fluid pressed out of the seventh pressure chamber (32) and the system (1) further comprises a pump for pumping fluid back from the catching reservoir toward the seventh pressure chamber (32), and/or wherein the eighth pressure chamber (62) is in fluid communication with the catching reservoir or a further catching reservoir for catching fluid pressed out of the eighth pressure chamber (62) and the system (1) is arranged such that said pump or a further pump can pump fluid back from the first catching reservoir or the further catching reservoir toward the eighth pressure chamber (62).

9. Spud carriage biasing system (1) according to any of the preceding claims, the system comprising a first safety valve in fluid communication with the first pressure chamber.

10. Spud carriage biasing system (1) according to any of the preceding claims, the system comprising a second safety valve in fluid communication with the second pressure chamber.

11. Spud carriage biasing system (1) according to any of the preceding claims, wherein the first and second cylinder (10, 20) comprise respectively a first and second piston rod (13, 23) having a distal end extending from a cylinder head of the respective cylinder, the distal ends being connected to and/or being arranged to be connected to respectively a first and a second tensioning guide (72, 76) around which a respective first and second biasing wire (7) can be guided during use.

12. Spud carriage (2) for accommodating a working spud (3), wherein the carriage is provided with spud carriage biasing system (1) according to any one of the preceding claims.

13. Spud carriage (2) according to claim 12, wherein the spud carriage is mounted to a vessel, especially a dredging vessel, in such a manner that the spud carriage can rotate to some extent around a substantially horizontal axis, preferably wherein said axis extends substantially transverse to a longitudinal direction of the vessel and/or a direction in which the spud

carriage can be moved, especially forward and/or rearward, in order to move it from one working position into another working position of said spud carriage.

14. Apparatus (4) for accommodating a working spud (3) of a vessel (100), such as a dredging vessel, comprising:

a spud carriage (2) for accommodating a working spud (3); and
a spud carriage biasing system (1) according to any one of claims 1-11.

15. Vessel (100), preferably a dredging vessel, especially a cutter suction dredging vessel, wherein the vessel (100) is provided with a spud carriage biasing system (1) according to any one of claims 1-11, a spud carriage(2) according to claim 12 or 13, and/or an apparatus (4) according to claim 14.

Patentansprüche

1. Pfahlwagen-Vorspannsystem (1) zum Vorspannen eines Pfahlwagens eines Schiffes in einer Position, in der der Pfahlwagen einen Arbeitspfahl des Schiffes in einer im Wesentlichen vertikalen Richtung aufnimmt, und zum Absorbieren wenigstens eines Teils eines Moments auf dem Pfahlwagen, umfassend:

einen ersten hydraulischen Spannzylinder (10);
einen ersten Niederdruck-Spannungsspeicher (15), der in Fluidverbindung mit einer ersten Druckkammer (11) steht, die in dem ersten Zylinder (10) enthalten ist;
einen zweiten hydraulischen Spannzylinder (20); und
einen zweiten Niederdruck-Spannungsspeicher (25), der in Fluidverbindung mit einer zweiten Druckkammer (21) steht, die in dem zweiten Zylinder (20) enthalten ist;
dadurch gekennzeichnet, dass das Vorspannsystem (1) ferner umfasst:
zwei Sätze von zwei verbundenen hydraulischen Zylindern (30, 40, 50, 60), wobei der erste Satz einen dritten hydraulischen Zylinder (30) und einen vierten hydraulischen Zylinder (40) umfasst, wobei eine Kolbenstange (33) des dritten hydraulischen Zylinders (30) mit einer Kolbenstange (43) des vierten hydraulischen Zylinders (40) verbunden ist, der zweite Satz einen fünften hydraulischen Zylinder (50) und einen sechsten hydraulischen Zylinder (60) umfasst, wobei eine Kolbenstange (53) des fünften hydraulischen Zylinders (50) mit einer Kolbenstange (63) des sechsten hydraulischen Zylinders (60) verbunden ist, wobei eine dritte Druckkammer (31), die Teil des dritten hydraulischen Spannzylinders (30) ist, und eine fünfte Druckkammer (51), die Teil des fünften Zylinders (50) ist, in Fluidverbindung mit der ersten Druckkammer (11) stehen, die Teil des ersten Zylinders (10) ist, und wobei eine vierte Druckkammer (41), die Teil des vierten Zylinders (40) ist, und eine sechste Druckkammer (61), die Teil des sechsten Zylinders (60) ist, mit der zweiten Druckkammer (21), die Teil des zweiten Zylinders (20) ist, in Fluidverbindung stehen, wobei der dritte Zylinder (30) eine siebte Druckkammer (32) umfasst, die mit einem Druckfluid zum Vorspannen eines Kolbens (34) des dritten Zylinders (30) in Richtung der dritten Druckkammer (31) versehen ist, und wobei der sechste Zylinder (60) eine achte Druckkammer (62) umfasst, die mit einem Druckfluid zum Vorspannen eines Kolbens (64) des sechsten Zylinders (60) in Richtung der sechsten Druckkammer (61) versehen ist.

2. Pfahlwagen-Vorspannsystem (1) nach Anspruch 1, wobei das System (1) ferner so eingerichtet ist, dass es dem Fluid der siebten Druckkammer (32) erlaubt, wenigstens teilweise aus der siebten Druckkammer (32) herausgedrückt zu werden, wenn der Druck in der dritten Druckkammer (31) einen vorbestimmten oberen Schwellenwert erreicht, und wobei das System so eingerichtet ist, dass es wenigstens einen Teil des Fluids zurück in die siebte Druckkammer (32) drückt, wenn der Druck in der dritten Druckkammer (31) unter den oberen Schwellenwert fällt.

3. Pfahlwagen-Vorspannsystem (1) nach Anspruch 1 oder 2, wobei das System (1) ferner so eingerichtet ist, dass es dem Fluid der achten Druckkammer (62) erlaubt, wenigstens teilweise aus der achten Druckkammer herausgedrückt zu werden, wenn der Druck in der sechsten Druckkammer (61) einen vorbestimmten oberen Schwellenwert erreicht, und wobei das System (1) so angeordnet ist, dass es wenigstens einen Teil des Fluids zurück in die achte Druckkammer (62) drückt, wenn der Druck in der sechsten Druckkammer (61) unter den oberen Schwellenwert fällt.

4. Pfahlwagen-Vorspannsystem (1) nach einem der vorhergehenden Ansprüche, wobei die siebte Druckkammer (32) in Fluidverbindung mit einem Hochdruckbegrenzungsspeicher (80) steht.

5. Pfahlwagen-Vorspannsystem (1) nach Anspruch 4, wobei die achte Druckkammer (62) in Fluidverbindung mit dem Hochdruckbegrenzungsspeicher (80) und/oder in Fluidverbindung mit einem weiteren Hochdruckbegrenzungsspeicher steht.

6. Pfahlwagen-Vorspannsystem (1) nach Anspruch 4 und 5, wobei die siebte Druckkammer (32) in Fluidverbindung mit der achten Druckkammer (62) steht, und wobei die siebte und die achte Druckkammer somit in Fluidverbindung mit demselben Hochdruckbegrenzungsspeicher (80) stehen.

7. Pfahlwagen-Vorspannsystem nach Anspruch 1 oder 2, wobei der erste Hochdruckbegrenzungsspeicher (80) und/oder der weitere Hochdruckbegrenzungsspeicher mit einer jeweiligen Pumpe (82) verbunden ist.

8. Pfahlwagen-Vorspannsystem nach einem der Ansprüche 1 bis 3, wobei die siebte Druckkammer (32) in Fluidverbindung mit einem Auffangreservoir zum Auffangen von aus der siebten Druckkammer (32) herausgedrücktem Fluid steht und das System (1) ferner eine Pumpe zum Zurückpumpen von Fluid aus dem Auffangreservoir in Richtung der siebten Druckkammer (32) umfasst, und/oder wobei die achte Druckkammer (62) in Fluidverbindung mit dem Auffangreservoir oder einem weiteren Auffangreservoir zum Auffangen von aus der achten Druckkammer (62) herausgedrücktem Fluid steht und das System (1) so eingerichtet ist, dass die Pumpe oder eine weitere Pumpe Fluid aus dem ersten Auffangreservoir oder dem weiteren Auffangreservoir in Richtung der achten Druckkammer (62) zurückpumpen kann.

9. Pfahlwagen-Vorspannsystem (1) nach einem der vorhergehenden Ansprüche, wobei das System ein erstes Sicherheitsventil in Fluidverbindung mit der ersten Druckkammer umfasst.

10. Pfahlwagen-Vorspannsystem (1) nach einem der vorhergehenden Ansprüche, wobei das System ein zweites Sicherheitsventil in Fluidverbindung mit der zweiten Druckkammer umfasst.

11. Pfahlwagen-Vorspannsystem (1) nach einem der vorhergehenden Ansprüche, wobei der erste und der zweite Zylinder (10, 20) jeweils eine erste und eine zweite Kolbenstange (13, 23) umfassen, die ein distales Ende aufweisen, das sich von einem Zylinderkopf des jeweiligen Zylinders erstreckt, wobei die distalen Enden mit einer ersten und einer zweiten Spannführung (72, 76) verbunden und/oder so angeordnet sind, dass sie mit diesen verbunden werden können, um die ein jeweiliger erster und zweiter Vorspanndraht (7) während der Verwendung geführt werden kann.

12. Pfahlwagen (2) zur Aufnahme eines Arbeitspfahls (3), wobei der Wagen mit einem Pfahlwagen-Vorspannsystem (1) nach einem der vorhergehenden Ansprüche versehen ist.

13. Pfahlwagen (2) nach Anspruch 12, wobei der Pfahlwagen an einem Schiff, insbesondere einem Baggerschiff, derart montiert ist, dass sich der Pfahlwagen in gewissem Umfang um eine im Wesentlichen horizontale Achse drehen kann, wobei sich die Achse vorzugsweise im Wesentlichen quer zu einer Längsrichtung des Schiffes und/oder einer Richtung erstreckt, in der der Pfahlwagen bewegt werden kann, insbesondere vorwärts und/oder rückwärts, um ihn von einer Arbeitsposition in eine andere Arbeitsposition des Pfahlwagens zu bewegen.

14. Vorrichtung (4) zur Aufnahme eines Arbeitspfahls (3) eines Schiffes (100), wie eines Baggerschiffes, umfassend:

einem Pfahlwagen (2) zur Aufnahme eines Arbeitspfahls (3); und
ein Pfahlwagen-Vorspannsystem (1) nach einem der Ansprüche 1- bis 11.

15. Schiff (100), vorzugsweise ein Baggerschiff, insbesondere ein Schneid- und Saugkopf-Baggerschiff, wobei das Schiff (100) mit einem Pfahlwagen-Vorspannsystem (1) nach einem der Ansprüche 1 bis 11, einem Pfahlwagen (2) nach Anspruch 12 oder 13 und/oder einer Vorrichtung (4) nach Anspruch 14 versehen ist.

Revendications

1. Système de sollicitation de chariot porte-pieu (1) destiné à solliciter un chariot porte-pieu d'un navire dans une position dans laquelle le chariot porte-pieu accueille un pieu d'ancrage du navire dans une direction sensiblement verticale et à absorber au moins une partie d'un moment sur le chariot porte-pieu, comprenant :

un premier vérin de tension hydraulique (10) ;
un premier accumulateur de tension basse pression (15) en communication fluidique avec une première chambre de pression (11) comprise dans le premier vérin (10) ;
un second vérin de tension hydraulique (20) ; et
un second accumulateur de tension basse pression (25) en communication fluidique avec une seconde chambre de pression (21) comprise dans le second vérin (20) ;
caractérisé en ce que le système de sollicitation (1) comprend en outre :

deux ensembles de deux vérins hydrauliques reliés (30, 40, 50, 60), le premier ensemble comprenant un troisième vérin hydraulique (30) et un quatrième vérin hydraulique (40), dans lequel une tige de piston

(33) du troisième vérin hydraulique (30) est reliée à une tige de piston (43) du quatrième vérin hydraulique (40), le second ensemble comprenant un cinquième vérin hydraulique (50) et un sixième vérin hydraulique (60), dans lequel une tige de piston (53) du cinquième vérin hydraulique (50) est reliée à une tige de piston (63) du sixième vérin hydraulique (60), dans lequel une troisième chambre de pression (31), qui fait partie du troisième vérin de tension hydraulique (30), et une cinquième chambre de pression (51) qui fait partie du cinquième vérin (50) sont en communication fluidique avec la première chambre de pression (11), qui fait partie du premier vérin (10), et dans lequel une quatrième chambre de pression (41), qui fait partie du quatrième vérin (40) et une sixième chambre de pression (61), qui fait partie du sixième vérin (60) sont en communication fluidique avec la seconde chambre de pression (21), qui fait partie du second vérin (20),
dans lequel le troisième vérin (30) comprend une septième chambre de pression (32) pourvue d'un fluide de pression pour solliciter un piston (34) du troisième vérin (60) vers la troisième chambre de pression (31), et dans lequel le sixième vérin (60) comprend une huitième chambre de pression (62) pourvue d'un fluide de pression pour solliciter un piston (64) du sixième vérin (60) vers la sixième chambre de pression (61).

2. Système de sollicitation de chariot porte-pieu (1) selon la revendication 1, dans lequel le système (1) est en outre agencé pour permettre au fluide de la septième chambre de pression (32) d'être comprimé hors de la septième chambre de pression (32) au moins en partie quand la pression dans la troisième chambre de pression (31) atteint une valeur de seuil supérieure prédéterminée, et dans lequel le système est agencé pour repousser au moins une partie dudit fluide dans ladite septième chambre de pression (32) quand la pression dans la troisième chambre de pression (31) tombe sous ladite valeur de seuil supérieure.

3. Système de sollicitation de chariot porte-pieu (1) selon la revendication 1 ou 2, dans lequel le système (1) est en outre agencé pour permettre au fluide de la huitième chambre de pression (62) d'être comprimé hors de la huitième chambre de pression au moins en partie quand la pression dans la sixième chambre de pression (61) atteint une valeur de seuil supérieure prédéterminée, et dans lequel le système (1) est agencé pour repousser au moins en partie ledit fluide dans ladite huitième chambre de pression (62) quand la pression dans la sixième chambre de pression (61) tombe sous ladite valeur de seuil supérieure.

4. Système de sollicitation de chariot porte-pieu (1) selon l'une quelconque des revendications précédentes, dans lequel la septième chambre de pression (32) est en communication fluidique avec un accumulateur de limitation haute pression (80).

5. Système de sollicitation de chariot porte-pieu (1) selon la revendication 4, dans lequel la huitième chambre de pression (62) est en communication fluidique avec ledit accumulateur de limitation haute pression (80) et/ou en communication fluidique avec un autre accumulateur de limitation haute pression.

6. Système de sollicitation de chariot porte-pieu (1) selon la revendication 4 et 5, dans lequel la septième chambre de pression (32) est en communication fluidique avec la huitième chambre de pression (62), et dans lequel la septième et la huitième chambre de pression sont ainsi en communication fluidique avec le même accumulateur de limitation haute pression (80).

7. Système de sollicitation de chariot porte-pieu (1) selon la revendication 1 ou 2, dans lequel le premier accumulateur de limitation haute pression (80) et/ou l'autre accumulateur de limitation haute pression (80) est connecté à une pompe (82) respective.

8. Système de sollicitation de chariot porte-pieu (1) selon l'une quelconque des revendications 1-3, dans lequel la septième chambre de pression (32) est en communication fluidique avec un réservoir de récupération pour récupérer du fluide comprimé hors de la septième chambre de pression (32) et le système (1) comprend en outre une pompe pour repomper du fluide du réservoir de récupération vers la septième chambre de pression (32), et/ou dans lequel la huitième chambre de pression (62) est en communication fluidique avec le réservoir de récupération ou un autre réservoir de récupération pour récupérer du fluide comprimé hors de la huitième chambre de pression (62) et le système (1) est agencé de telle manière que ladite pompe ou une autre pompe peut repomper du fluide depuis le premier réservoir de récupération ou l'autre réservoir de récupération vers la huitième chambre de pression (62).

9. Système de sollicitation de chariot porte-pieu (1) selon l'une quelconque des revendications précédentes, le système comprenant une premier soupape de sécurité en communication fluidique avec la première chambre de pression.

10. Système de sollicitation de chariot porte-pieu (1) selon l'une quelconque des revendications précédentes, le système comprenant une seconde soupape de sécurité en communication fluidique avec la seconde chambre de pression.

11. Système de sollicitation de chariot porte-pieu (1) selon l'une quelconque des revendications précédentes, dans lequel les premier et second vérin (10, 20) comprennent respectivement une première et seconde tige de piston (13, 23) ayant une extrémité distale s'étendant depuis une tête de vérin du vérin respectif, les extrémités distales étant connectées à et/ou étant agencées pour être connectées à respectivement un premier et un second guide de tension (72, 76) autour duquel un premier et un second câble de sollicitation (7) respectifs peuvent être guidés pendant l'utilisation.

12. Chariot porte-pieu (2) pour accueillir un pieu d'ancrage (3) dans lequel le chariot est pourvu d'un système de sollicitation de chariot porte-pieu (1) selon l'une quelconque des revendications précédentes.

13. Chariot porte-pieu (2) selon la revendication 12, dans lequel le chariot porte-pieu est monté sur un navire, spécialement un navire de dragage, de telle manière que le chariot porte-pieu peut tourner sur une certaine étendue autour d'un axe sensiblement horizontal, de préférence dans lequel ledit axe s'étend sensiblement transversal à une direction longitudinale du navire et/ou une direction dans laquelle le chariot porte-pieu peut être déplacé, spécialement vers l'avant et/ou vers l'arrière, afin de le déplacer d'une position de travail vers une autre position de travail dudit chariot porte-pieu.

14. Dispositif (4) pour accueillir un pieu d'ancrage (3) d'un navire (100), comme un navire de dragage, comprenant :

un chariot porte-pieu (2) pour accueillir un pieu d'ancrage (3) ; et
un selon l'une quelconque des revendications 1-11.

15. Navire (100), de préférence un navire de dragage, spécialement une drague désagrégatrice, dans lequel le navire (100) est pourvu d'un système de sollicitation de chariot porte-pieu (1) selon l'une quelconque des revendications 1-11, d'un chariot porte-pieu (2) selon la revendication 12 ou 13, et/ou d'un dispositif (4) selon la revendication 14.

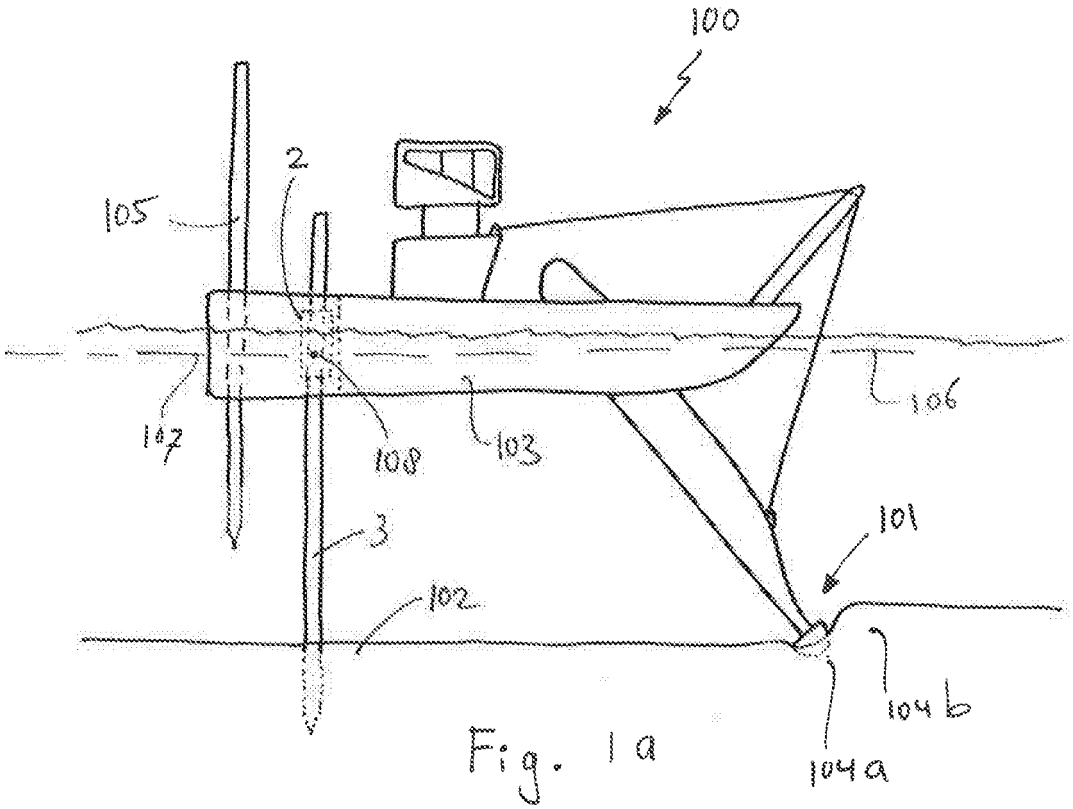

100
105
2
106
107
108
103
3
101
102
104b
104a

Fig. 1a

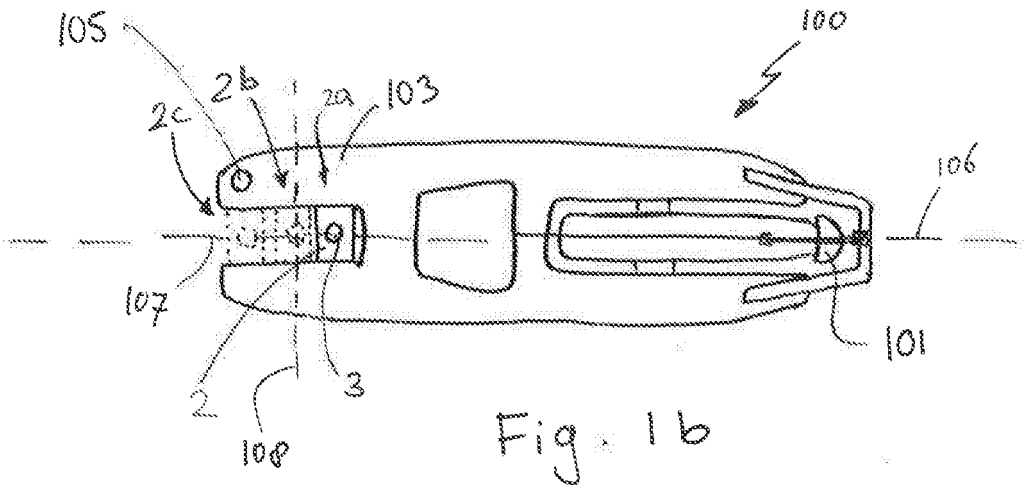

105
100
2b
2a
103
2c
106
107
101
2
3
108

Fig. 1b

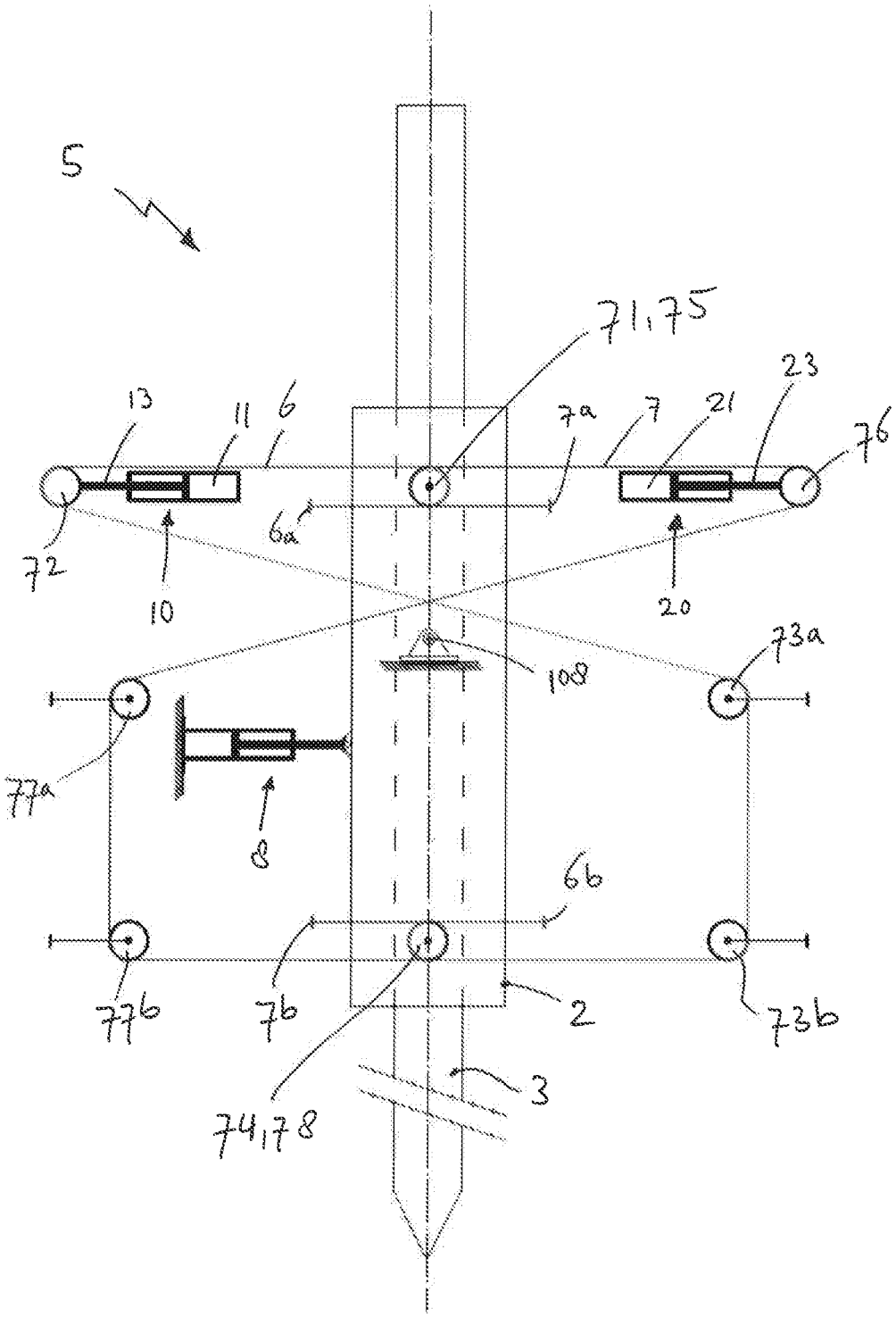
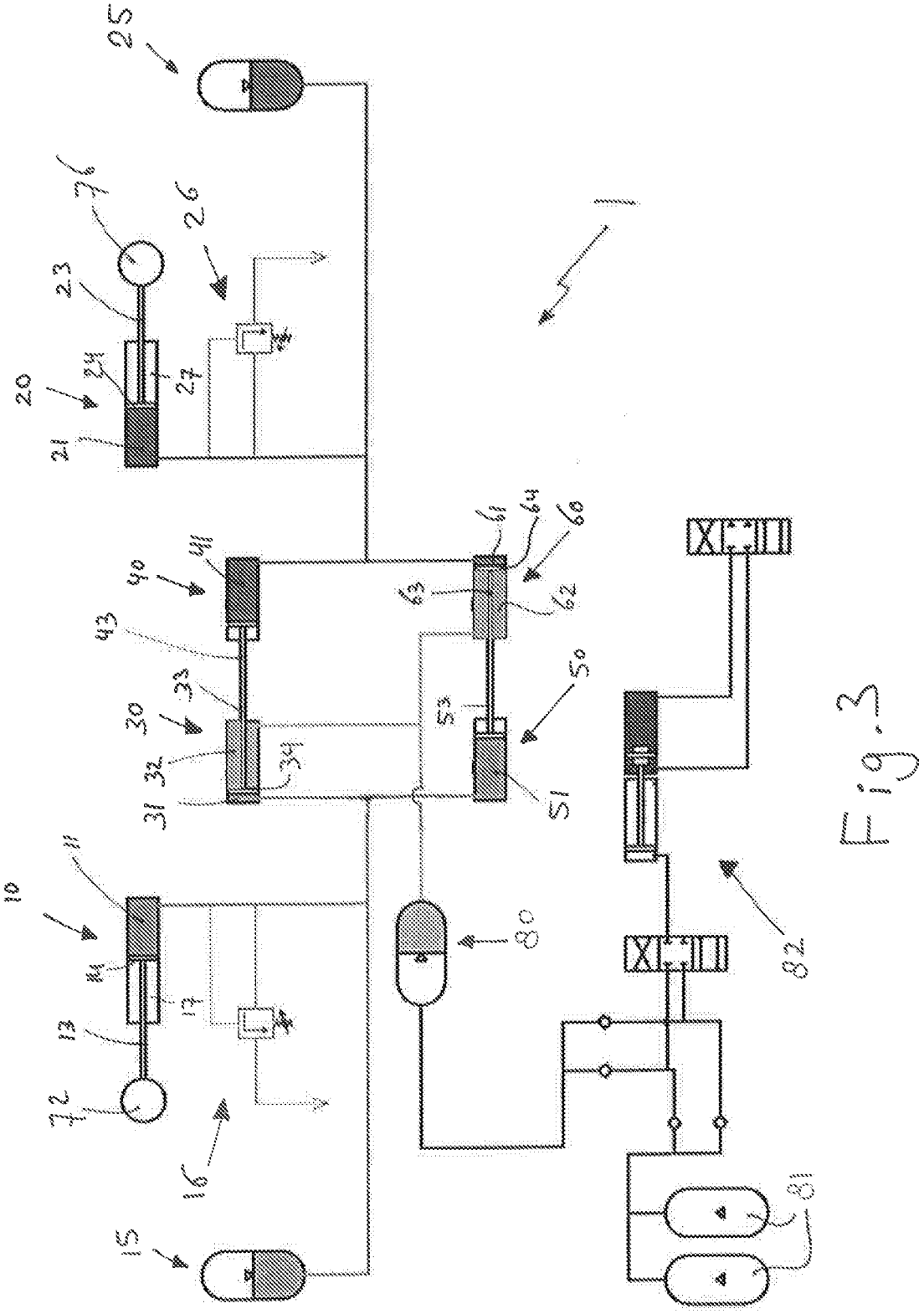

5
71,75
23
13
11
6
7a
7
21
76
72
10
6a
20
108
73a
77a
8
6b
77b
76
2
73b
74,78
3

Fig. 2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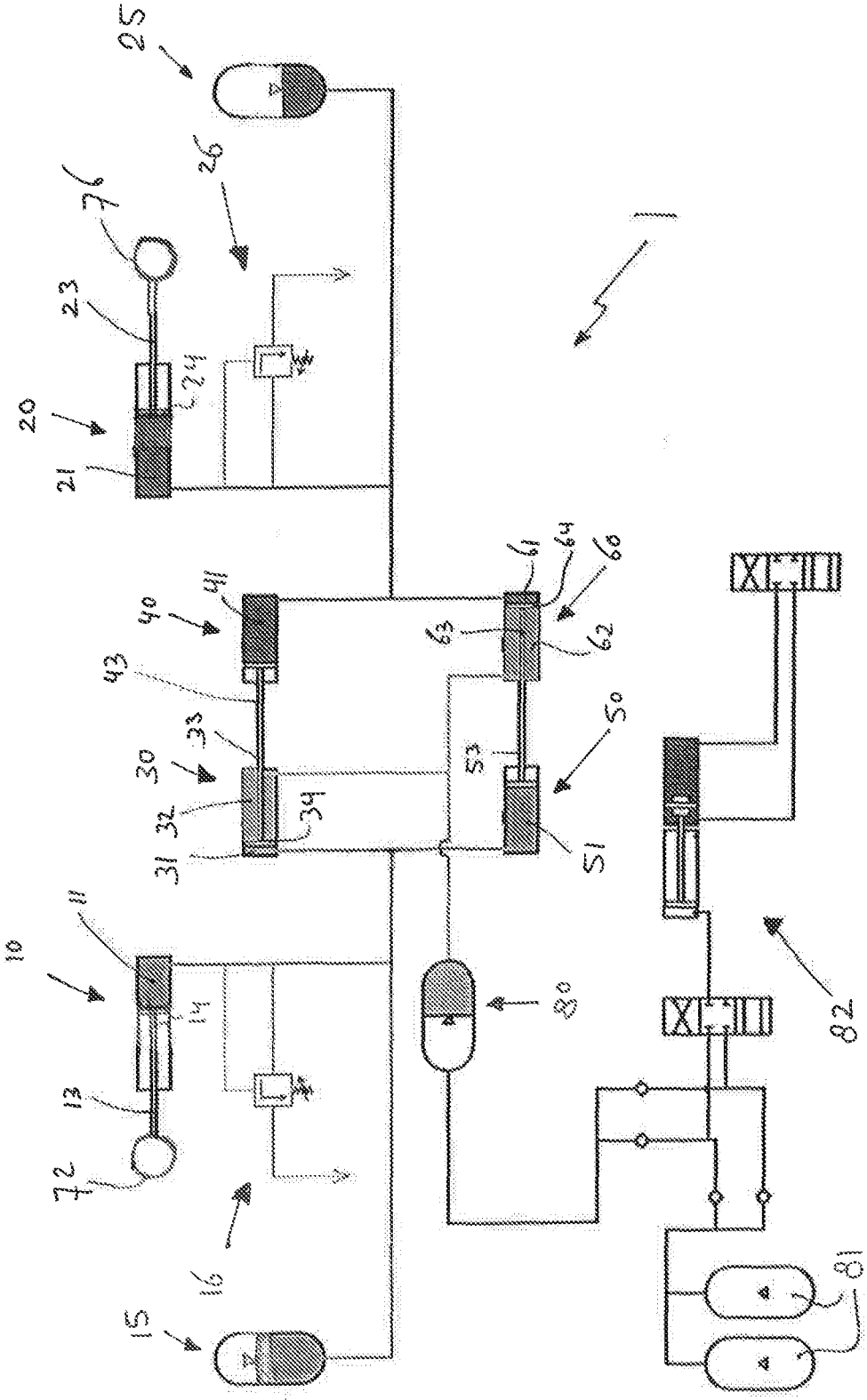
76
26
23
24
27
20
21
1
40
41
43
30
33
32
34
31
61
64
60
62
63
50
53
51
10
11
14
17
13
12
16
15
80
82
81

Fig. 3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23
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31
32
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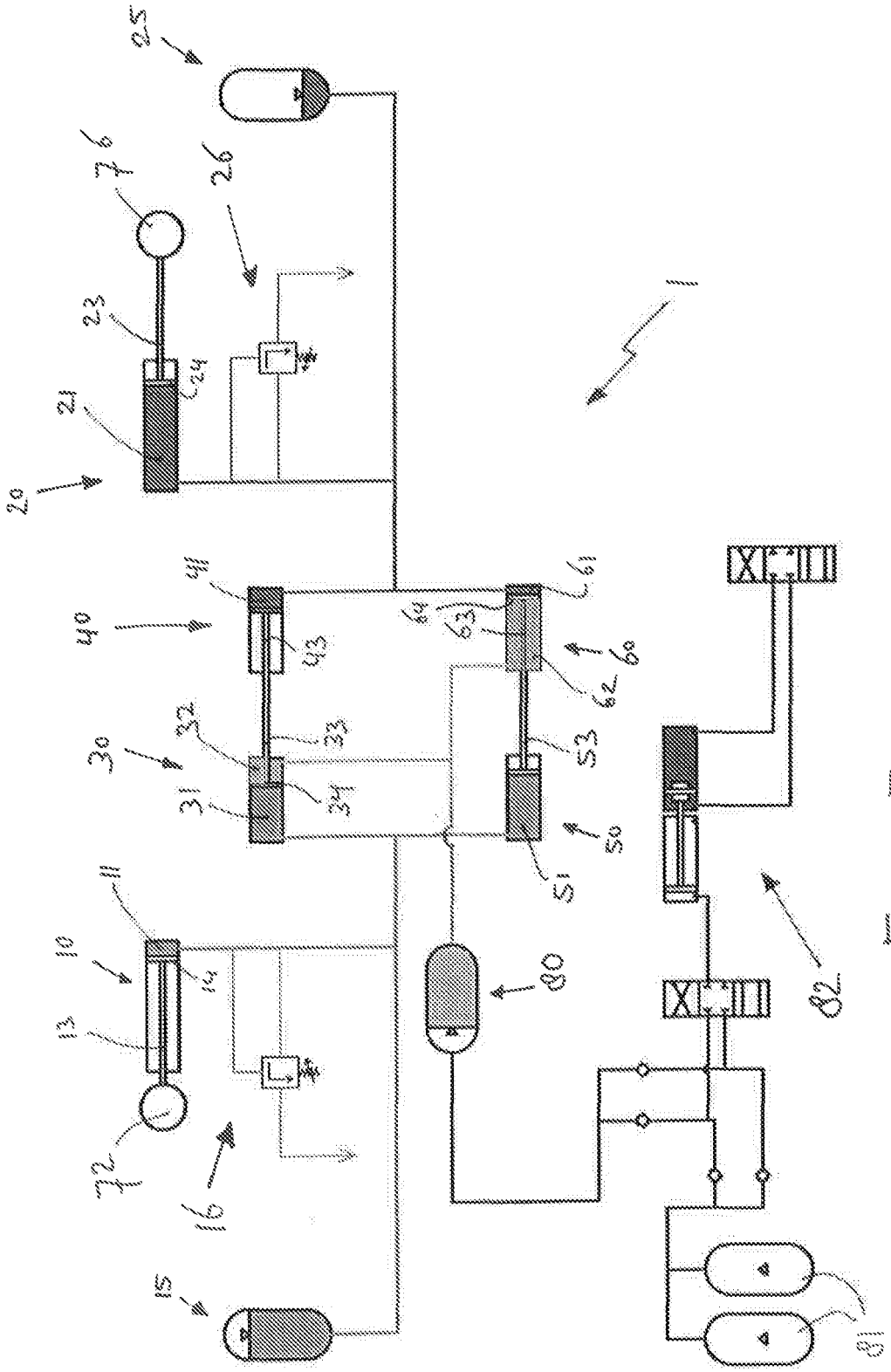
43
50
51
53
60
61
62
63
64
70
72
76
80
81
82

Fig. 4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61
68
62
32
33
53
30
31
34
50
51
11
10
14
13
72
16
15
80
82
81

Fig. 5

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- EP 1888849 A **[0003]**