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

(11) **EP 4 431 442 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.09.2024 Bulletin 2024/38

(21) Application number: **24159236.9**

(22) Date of filing: **22.02.2024**

(51) International Patent Classification (IPC):
B66F 7/04 *(2006.01)* ***F15B 15/14*** *(2006.01)*
B66F 7/28 *(2006.01)* ***B66F 7/08*** *(2006.01)*
B66F 7/20 *(2006.01)* ***B66F 7/16*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B66F 7/20; B66F 7/28; F15B 15/14

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **15.03.2023 IT 202300004872**

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(54) HANDLING SYSTEM, LIFT AND PROCESS OF LIFTING VEHICLES

(57) The present invention concerns a handling system (4) comprising: a first actuator, a second actuator and a supply circuit of said actuators. The supply circuit comprises a primary supply line (20) configured for putting in fluid communication an inlet (24) of the first actuator (22) with a source (8) of a working fluid, a secondary supply line (21) which puts in fluid communication an outlet (25) of the first actuator (22) with the second actuator (5); wherein the piston (7) of the second actuator comprises at least one through opening (8) which puts in fluid communication a first and a second chamber (C1", C2") of the second actuator (5).

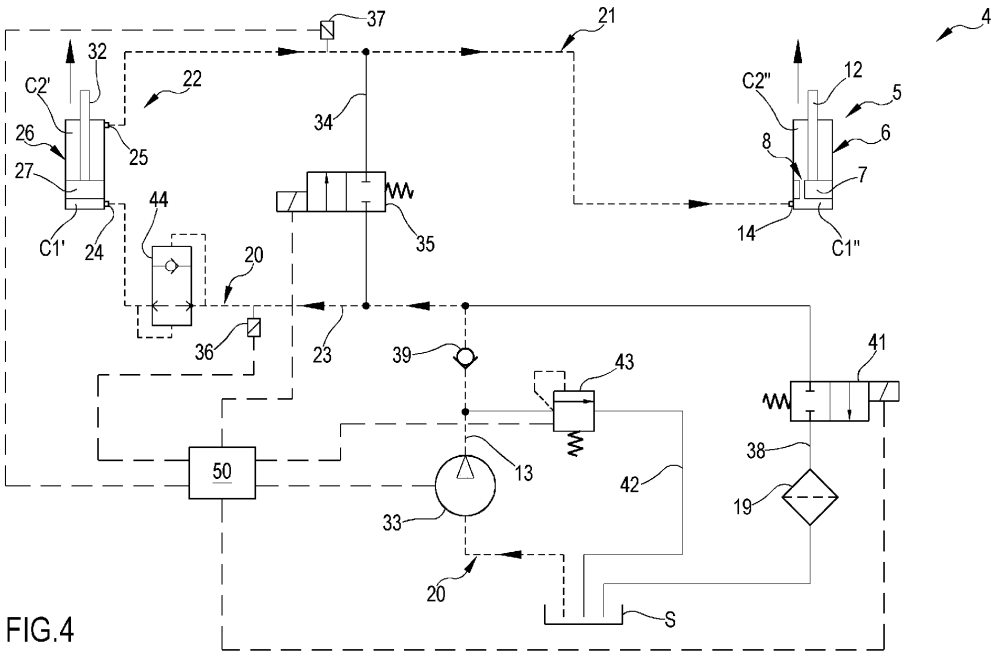

FIG.4

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to a handling system, for example for column or underground lifts of vehicles, as well as a lift and a process of lifting vehicles. The present invention may find application in the automotive sector for the assistance or lifting of vehicles, for example cars, trucks and agricultural vehicles.

BACKGROUND ART

[0002] In the field of automotive equipment there are different known typologies of lifts used for vehicle assistance; for example, are known column lifts, underground lifts and suspended lifts.

[0003] These lifts may use two or more hydraulic cylinders connected, by means of a pump, to a tank containing oil to allow the displacement of a vehicle with respect to the ground; in detail, these lifts generally comprise a main cylinder directly supplied by the pump; the main cylinder is connected to one or more auxiliary cylinders by means of an oil circuit that allows the main cylinder to supply the auxiliary cylinder. The oil circuit of known lifts comprises also a discharge line which puts in communication each auxiliary cylinder with an atmospheric-pressure oil recovery tank; see for example patents n. JP3503825B2 and US 6 279 685 B1, as well as the patent applications n. GB724273A and US4500071A.

[0004] There are also known hydraulic actuators, used for lift systems and/or directly on vehicles, constituted by a sleeve inside which it is slidingly movable a piston. The piston divides the internal volume of the sleeve into a first and a second chamber; the head of the piston is provided with one through opening which puts in communication the first and second chamber. See for example patent applications n. US 3 683 748 A and n. CN 213 899 442 U.

[0005] The Applicant has detected how the known lifts have a complex and expensive structure, that requires also various maintenance interventions, resulting then improvable under different aspects.

OBJECT OF THE INVENTION

[0006] Object of the present invention is therefore to overcome at least one of the drawbacks and/or limitations of the previous solutions.

[0007] An object of the present invention is to provide a handling system and a lift having a simple and compact structure, manufacturable then at low costs but that at the same time result structurally strong, capable of continuously, quickly and reliably carrying out the lifting of products, for example vehicles. It is also an object of the present invention to provide a handling system and a lift capable of operating effectively and safely, in particular capable of carrying out the lifting of products, for example vehicles, without damaging them or the components of the lift itself.

[0008] These objects and others, which will become more apparent from the following description, are substantially achieved by a handling system, a lift and a process of lifting vehicles according to one or more of the attached claims.

SUMMARY

[0009] In a 1st aspect it is provided an actuator (5) comprising:

a cylinder (6),
a piston (7) slidingly movable in the cylinder (6), wherein the piston (7) defines, in cooperation with the cylinder (6), a first and a second chamber (C1", C2"),

wherein the piston (7) comprises a through opening (8) which puts in fluid communication the first and the second chamber (C1", C2").

[0010] In a 2nd aspect according to the preceding aspect the piston (7) extends in thickness between a first and a second head surface (7a, 7b) respectively delimiting part of the first and second chamber (C1", C2"). In a 3rd aspect according to the preceding aspect the through opening (8) extends between said first and second head surface (7a, 7b). In a 4th aspect according to any one of the two preceding aspects the cylinder (6) comprises:

an inner lateral surface (9a),
a first surface (9b),
a second surface (9c) opposite to the first surface (9b) with respect to the inner lateral surface (9a).

[0011] In a 5th aspect according to the preceding aspect the inner lateral surface (9a), together with the first and second surface (9b, 9c), defines an internal volume of the cylinder where the piston (7) is housed. In a 6th aspect according to any one of the two preceding aspects the first head surface (7a) delimits, in cooperation with part of the inner lateral surface (9a) and the first surface (9b), the first chamber (C1"). In a 7th aspect according to any one of the three preceding aspects the second head surface (7b) delimits, in cooperation with part of the inner lateral surface (9a) and the second surface (9c), the second chamber (C2").

[0012] In an 8th aspect according to any one of the preceding aspects the cylinder (6) extends between a first and a second end (6a, 6b) along an extension direction (D"). In a 9th aspect according to any one of the preceding aspects the cylinder (6) is free of through openings that allow the expulsion of working fluid from the second chamber (C2"). In a 10th aspect according to any one of the preceding aspects the cylinder (6) comprises an inlet (14) configured for allowing the passage of a

working fluid in the first chamber (C1") (optionally the inlet of the working fluid in the cylinder and the outlet of said working fluid from the cylinder). In an 11th aspect according to the preceding aspect in combination with the 4th aspect the inlet (14) is defined on the inner lateral surface (9a) or on the first surface (9b) of the cylinder (6). In a 12th aspect according to any one of the two preceding aspects the cylinder (6) has exclusively the inlet (14), which is configured for allowing the passage of a working fluid. In a 13th aspect according to any one of the three preceding aspects in combination with the 8th aspect the inlet (14) is placed at the first end (6a). In a 13bis aspect according to any one of the preceding aspects from the 11th to the 13th the inlet (14) is configured for allowing the input of the working fluid in the cylinder (6) and the outlet of said working fluid from said cylinder (6), wherein said inlet (14) is in direct fluid communication with the first chamber (C1"). In a 13ter aspect according to any one of the preceding aspects from the 11th to the 13th or with the 13bis aspect the inlet (14) is the only passage of the cylinder (6) configured for allowing the working fluid to pass in and out through the cylinder (6). In a 13quater aspect according to any one of the preceding aspects from the 11th to the 13th or with the 13bis or 13ter aspect the second chamber (C2") is in fluid communication exclusively with the first chamber (C1") of the same cylinder (6).

[0013] In a 14th aspect according to any one of the preceding aspects the piston (7) has an outer lateral surface (10), optionally at least partly countershaped to the cylinder (6). In a 15th aspect according to the preceding aspect said outer lateral surface (10) of the piston (7) defines, in cooperation with the cylinder (6), optionally with the inner lateral surface (9a), a gap (11) which puts in fluid communication the first and the second chamber (C1", C2"). In a 16th aspect according to any one of the two preceding aspects the outer lateral surface (10) of the piston (7) connects the first and the second head surface (7a, 7b), optionally said outer lateral surface (10) is interposed between the first and the second head surface (7a, 7b). In a 17th aspect according to any one of the three preceding aspects the outer lateral surface (10) of the piston (7) is entirely countershaped to the inner lateral surface (9a) of the cylinder (6). In a 18th aspect according to any one of the four preceding aspects the at least one through opening (8)

- is spaced from the outer lateral surface (10) of the piston (7), or
- is defined on the outer lateral surface (10), optionally to define at least one recess on said outer lateral surface (10).

[0014] In a 19th aspect according to any one of the five preceding aspects the piston (7) is free of sealing elements, for example a gasket, at the gap (11). In a 20th aspect according to any one of the six preceding aspects the second chamber (C2") of the cylinder (6) is exclusively in fluid communication with the first chamber (C1") through the gap (11) and the through opening (8). In a 21st aspect according to any one of the preceding aspects the piston (7) is movable along a direction parallel to a/the extension direction (D') of the cylinder (6).

[0015] In a 22nd aspect according to any one of the preceding aspects from the 4th to the 21st the piston (7) is movable approaching and moving away with respect to the first and second surface (9b, 9c) of the cylinder (6) to allow a variation in terms of volume of the first and second chamber (C1", C2").

[0016] In a 23rd aspect according to any one of the preceding aspects, wherein the actuator (5) comprises a rod (12) partially housed in the second chamber (C2") and engaged to the piston (7). In a 24th aspect according to the preceding aspect the rod (12) extends from the second head surface (7b) of the piston (7) and protrudes from the inner volume of the cylinder (6), optionally through the second surface (9c). In a 25th aspect according to any one of the three preceding aspects the rod (12) is exclusively housed in the second chamber (C2") of the cylinder (6).

[0017] In a 26th aspect according to any one of the four preceding aspects the rod (12) does not pass through the first chamber (C1").

[0018] In a 27th aspect according to any one of the preceding aspects the through opening (8) has a passage section between 50 mm^2 and 500 mm^2. In a 28th aspect according to the preceding aspect the passage section of the through opening (8) is constant throughout theta thickness of the piston (7). In a 29th aspect according to any one of the preceding aspects the piston (7) has, in cross section, a surface size between 100 mm^2 and 1500 mm^2; wherein the cross section is defined according to a plane orthogonal to a/the extension direction (D") of the cylinder (6). In a 30th aspect according to any one of the two preceding aspects the ratio between the passage section of the at least one through opening (8) and the surface size of the piston (7) is between 0,01 and 0,2. In a 31st aspect according to any one of the three preceding aspects the rod (12) has, according to a section orthogonal to a/the extension direction (D") of the cylinder (6), a surface size between 50 mm^2 and 1000 mm^2. In a 32nd aspect according to the preceding aspect in combination with the 27th aspect the ratio between the passage section of the through opening (8) and the surface size of the rod (12) is between 0,005 and 0,2. In a 33rd aspect according to any one of the aspects from the 29th to the 32nd the ratio between the surface size of the piston (7) and the surface size of the rod (12) is between 1,1 and 3. In a 34th aspect according to any one of the preceding aspects the actuator (5) is of hydraulic or pneumatic type.

[0019] In a 35th aspect a handling system (4) is provided, the handling system comprising:

a first actuator (22) comprising:

a cylinder (26),
a piston (27) slidingly movable in the cylinder, wherein the piston (27) defines, in cooperation with the cylinder (26), a first and a second chamber (C1', C2'),
an inlet (24) defined on the cylinder (26) and in fluid communication (optionally directly) with the first chamber (C1'),
an outlet (25) defined on the cylinder (26) and in fluid communication (optionally directly) with the second chamber (C2'),

a second actuator (5) according to any one of the preceding aspects,
a supply circuit comprising:

a primary supply line (20) configured for putting in fluid communication (optionally directly) the inlet (24) of the first actuator (22) with a source (S) of a working fluid,
a secondary supply line (21) which puts in fluid communication (optionally directly) the outlet (25) of the first actuator (22) with the second actuator, optionally with the inlet (14) of the second actuator (5).

[0020] In a 36th aspect according to the preceding aspect the secondary supply line (21) is exclusively in fluid communication (optionally directly) with the outlet (25) of the second actuator (22). In a 37th aspect according to any one of the three preceding aspects the piston (27) of the first actuator extends in thickness between a first and a second head surface (27a, 27b) respectively delimiting part of the first and second chamber (C1', C2') of the cylinder (26) of the first actuator (22). In a 38th aspect according to any one of the four preceding aspects the cylinder (26) of the first actuator (22) comprises:

an inner lateral surface (29a),
a first surface (29b),
a second surface (29c) opposite to the first surface (29b) with respect to the inner lateral surface (29a).

[0021] In a 39th aspect according to the preceding aspect the inner lateral surface (29a), together with the first and second surface (29b, 29c), defines an internal volume of the cylinder (26) where it is housed the piston (27) of the first actuator (22).

[0022] In a 40th aspect according to any one of the two preceding aspects in combination with the 37th aspect the first head surface (27a) of the piston (27) of the first actuator (22) delimits, in cooperation with part of the inner lateral surface (29a) and the first surface (29b), the first chamber (C1') of the first actuator (22). In a 41st aspect according to any one of the three preceding aspects in combination with the 37th aspect the second head surface (27b) of the piston (27) of the first actuator (22) delimits, in cooperation with part of the inner lateral surface (29a) and the second surface (29c), the second chamber (C2') of the first actuator (22). In a 42nd aspect according to any one of the preceding aspects from the 35th to the 41st the cylinder (6) of the first actuator (22) extends between a first and a second end (26a, 26b) along an extension direction (D'). In a 43rd aspect according to any one of the preceding aspects from the 35th to the 42nd the first chamber (C1') of the cylinder (26) of the first actuator (22) is exclusively in fluid communication (optionally directly) with the primary supply line (20) through the inlet (24) of the first actuator (22). In a 44th aspect according to any one of the preceding aspects from the 36th to the 43rd the second chamber (C2') of the cylinder (26) of the first actuator (22) is exclusively in fluid communication (optionally directly) with the secondary supply line (21) through the outlet (25) of the first actuator (22).

[0023] In a 45th aspect according to any one of the preceding aspects the piston (27) of the first actuator (22) has an outer lateral surface (30) at least partly counter-shaped to the cylinder (26) of the first actuator (22). In a 46th aspect according to the preceding aspect the first actuator (22) has at least one sealing element (28) interposed between said outer lateral surface (30) of the piston (27) and the inner lateral surface (29a) of the cylinder (26) of the first actuator (22), said sealing element (28) being configured for preventing a fluid passage between the first and the second chamber (C1', C2') of the cylinder (26) of the first actuator (22). In a 47th aspect according to any one of the preceding aspects from the 35th to the 46th the piston (27) of the first actuator (22) is movable along a direction parallel to a/the extension direction (D') of the cylinder (26) of the first actuator (22). In a 48th aspect according to any one of the preceding aspects from the 38th to the 47th the piston (27) of the first actuator (22) is movable approaching and moving away with respect to the first and second surface (29b, 29c) of the cylinder (26) to allow a variation in terms of volume of the first and second chamber (C1', C2') of the first actuator (22). In a 49th aspect according to any one of the preceding aspects from the 35th to the 48th the first actuator (22) comprises a rod (32) partially housed in the second chamber (C1') and engaged to the piston (27) of the first actuator (22). In a 50th aspect according to the preceding aspect in combination with the 38th aspect the rod (32) of the first actuator (22) extends from the second head surface (27b) of the piston (27) and protrudes from the inner volume of the cylinder (26) through the second surface (29c). In a 51st aspect according to any one of the two preceding aspects the rod (22) is exclusively housed in the second chamber (C2') of the first actuator (22). In a 52th aspect according to any one of the three preceding aspects the rod (22) does not pass through the first chamber (C1') of the first actuator (22).

[0024] In a 53rd aspect according to any one of the preceding aspects from the 35th to the 52th the supply circuit comprises:

a source (S) of a working fluid,

a non-return valve (39) active on the primary supply line (20) and configured for preventing the fluid passage toward the source (S).

[0025] In a 54th aspect according to the preceding aspect the primary supply line (20) comprises:

a first section (13) interposed between the source (S) and the non-return valve (39),
a second section (23) interposed between the non-return valve (39) and the inlet (24) of the first actuator (22).

[0026] In a 55th aspect according to any one of the preceding aspects from the 35th to the 54th the supply circuit comprises a pump (33) active on the primary supply line (20), optionally on the first section (13), and configurable between:

an activation condition wherein the pump is configured for sending working fluid from the source (S) to the inlet (24) of the first actuator (22),
a deactivation condition.

[0027] In a 56th aspect according to the preceding aspect the handling system comprises a control unit (50) operatively connected to the pump (33) and configured for commanding the activation condition and the deactivation condition of the pump (33). In a 57th aspect according to any one of the preceding aspects from the 35th to the 56th the supply circuit comprises a bypass line (34) which puts in fluid communication the primary supply line (20), optionally the second section (23), with the secondary supply line (21).

[0028] In a 58th aspect according to the preceding aspect the supply circuit comprises a balance valve (35) active on the bypass line (34) and configurable between:

a closing position wherein the balance valve (35) is configured for preventing the fluid passage along the bypass line (34),
an opening position wherein the balance valve (35) is configured for allowing the fluid passage along the bypass line (34).

[0029] In a 59th aspect according to the preceding aspect the supply circuit comprises a first pressure sensor (36) connected to the primary supply line (20), optionally to the second section (23), and configured for generating a signal representative of the fluid pressure upstream of the balance valve (35). In a 60th aspect according to any one of the two preceding aspects the supply circuit comprises a second pressure sensor (37) connected to the secondary supply line (21) and configured for generating a signal representative of the fluid pressure downstream of the balance valve (35). In a 61th aspect according to any one of the two preceding aspects theta control unit (50) is operatively connected to the first and second pressure sensor (36, 37) and configured for:

receiving the signal from the first pressure sensor (36),
determining, as a function of the signal emitted by the first sensor, one or more measured values of the pressure of the working fluid in the primary supply line (20),
receiving the signal from the second pressure sensor (37),
determining, as a function of the signal emitted from the second sensor, one or more measured values of the pressure of the working fluid in the secondary supply line (21).

[0030] In a 62th aspect according to the preceding aspect the control unit (50) is configured for:

determining one or more values of a control parameter representative of a difference or a ratio between the measured value of the pressure of the working fluid in the primary supply line (20) and the measured value of the pressure of the working fluid in the secondary supply line (21). In a 63th aspect according to the preceding aspect the control unit (50) is configured for carrying out a balancing procedure comprising the steps of:

comparing one or more values of the control parameter with a threshold value, optionally equal to 0.5 bar,
commanding, as a function of the comparison of one or more values of the control parameter, the opening position or the closing position of the balance valve (35).

[0031] In a 64th aspect according to any one of the two preceding aspects the control parameter is representative of a difference of pressure between the primary supply line (20) and the secondary supply line (21). In a 65th aspect according to any one of the three preceding aspects the control unit (50) is configured for commanding the opening position of the balance valve (35) if one or more pressure values of the control parameter are higher than the threshold value. In a 66th according to any one of the preceding aspects from the 35th to the 65th the supply circuit comprises a parachute valve (44) sensitive to a variation of pressure of the working fluid on the primary supply line (20) upstream of the inlet (24) of the first actuator (22). In a 67th aspect according to the preceding aspect the parachute valve (44) is configurable between:

an opening condition wherein it allows the passage of the working flow through the primary supply line (20); and
a closing condition wherein it prevents the passage of the working flow in the primary supply line (20).

[0032] In a 67bis aspect according to any one of the two preceding aspects the parachute valve (44) is configured for passing from the opening condition to the closing condition if an increase of the working flow is detected in the primary supply line (20), optionally creating a pressure variation between an upstream and a downstream section of the parachute valve itself higher than a predefined threshold value, for example between 5 bar and 20 bar.

[0033] In a 68th aspect according to any one of the preceding aspects from the 54th to the 67bis aspect the supply circuit comprises a return line (38) which puts in fluid communication the second section (23) of the primary supply line (20) with the source (S). In a 69th aspect according to the preceding aspect the supply circuit comprises a discharge valve (41) active on the return line (38) and configurable between:

a closing position in which the discharge valve is configured for preventing the fluid passage through the return line (38),
an opening position in which the discharge valve is configured for allowing the fluid passage through the return line (38), putting in fluid communication the inlet of the first actuator with the source (S).

[0034] In a 70th aspect according to the preceding aspect theta control unit (50) is active on the discharge valve (41) and configured for commanding the closing position and the opening position. In a 71th aspect according to any one of the preceding aspects from the 54th to the 70th the supply circuit comprises a safety line (42) which puts in fluid communication the first section (13) of the primary supply line (20) with the source (S). In a 72th aspect according to the preceding aspect the supply circuit comprises an overpressure valve (43) active on the safety line (42) and configured for allowing selectively the passage of fluid through the safety line (42) as a function of a pressure of the working fluid in the first section (13) of the primary supply line (20). In a 73th aspect according to the preceding aspect theta control unit (50) is operatively connected to the overpressure valve (43) and is configured for:

detecting and determining one or more measured values of pressure of the working fluid on the first section (13) of the primary supply line (20),
comparing said one or more measured values of pressure of the working fluid on the first section (13) of the primary supply line (20) with a reference value, optionally between 50 and 300 bar,
commanding, as a function of said comparison, the overpressure valve (43) during the opening for allowing the passage of fluid in the safety line (42), optionally if said one or more measured values of pressure of the working fluid on the first section (13) are higher than the reference value.

[0035] In a 74th aspect it is provided a lift (1) of vehicles comprising:

a first and a second column (2', 2"),
at least one carriage slidingly movable along at least one of the first and the second column (2', 2"),
a handling system (4) according to any one of the preceding aspects from the 35th to the 73th,
wherein the first actuator (22) of the handling system (4) is linked to the first column (2') while the second actuator (5) is linked to the second column (2"),
wherein said first and second actuator (22, 5) of the handling system (4) are configured for allowing the displacement of said at least one carriage along at least one of said first and second columns (2', 2").

[0036] In a 75th aspect according to the preceding aspect the lift comprises at least one lifting arm carried by the at least one carriage. In a 75bis aspect according to the preceding aspect the at least one lifting arm is configured for contacting a vehicle, optionally the body of the vehicle, for allowing its lifting. In a 75ter aspect according to the 74th or 75th or 75bis aspect the at least one carriage comprises:

a first carriage (3') slidingly movable along the first column (2'),
a second carriage (3") slidingly movable along the second column (2").

[0037] In a 76th aspect according to any one of the two preceding aspects the first actuator (22) is housed in the first column (2'). In a 77th aspect according to any one of the aspects from the 74th and the 76th aspect the second actuator (5) is housed in the second column (2"). In a 78th aspect according to any one of the four preceding aspects the first carriage (3') carried by the first column (2') is engaged to the first actuator (22), optionally to the rod (32) or to the cylinder (26) of the first actuator (22). In a 79th aspect according to any one of the five preceding aspects the second carriage (3") carried by the second column (2") is engaged to the second actuator (5), optionally to the rod (12) or to the cylinder (6) of the second actuator (5). In a 79bis aspect according to any one of the aspects from the 75ter to the 79th aspect each of said first and second carriage comprises at least one respective lifting arm, optionally a pair of connection arms hinged to the carriage, even more optionally rotatable with respect to the carriage. In an 80th aspect according to any one of the preceding aspects from the 75th to the 79bis aspect each column extends between a respective base (2a', 2a") and a respective top (2b', 2b"). In an 81st aspect according to the preceding aspect the first and the second actuator (22, 15) are respectively placed at their respective bases (2a', 2a") of the first and of the second column (2', 2").

[0038] In an 82th aspect according to any one of the preceding aspects from the 75th to the 81st the first col-

umn (2') comprises:

a base plate (45'),
a frame (46') protruding from the base plate (45') and defining within itself a space (V) where it is housed the first actuator (22).

[0039] In an 83rd aspect according to any one of the preceding aspects from the 75th to the 82nd the second column (2") comprises:

a base plate (45"),
a frame (46") protruding from the base plate (45") and defining within itself a space (V) in which it is housed the second actuator (5).

[0040] In an 84th aspect according to any one of the two preceding aspects each frame, respectively of the first and of the second column (2', 2"), has, along its entire extension, a constant-profile transversal section, optionally having a substantially "C"-shaped profile. In an 85th aspect according to any one of the three preceding aspects the frame of the first column (2') comprises:

a first through access (48a) near the base (2a') of the first column (2'), for allowing the access of the primary supply line (20) in the space (V),
a second through access (48b) near the top (2b') of the first column (2'), for allowing the outlet of the secondary supply line (21) from the first column (2').

[0041] In an 86th aspect according to any one of the four preceding aspects the frame of the second column (2") comprises a respective access (49) near the top (2b") of the second column (2"), configured for allowing the inlet of the secondary supply line (21) in the space (V) of the second column (2"). In an 87th aspect according to any one of the aspects from the 82th to the 86th the secondary supply line (21) extends at least partly in the spaces of the frame of the first and second column. In an 88th aspect according to any one of the aspects from the 82nd to the 87th the secondary supply line extends also at least partly outside the frames of the first and second column, optionally said secondary supply line, in use, extends at least partly above the columns. In an 89th aspect according to any one of the preceding aspects from the 74th to the 88th the lift comprises a user interface (UI) manually operated by a user and configured for:

generating an ascent signal for the lifting of the at least one carriage, optionally of the first and of the second carriage (3', 3"),
generating a descent signal for the lowering of the at least one carriage, optionally of the first and of the second carriage (3', 3"),

[0042] In a 90th aspect according to the preceding aspect theta control unit (50) is connected to the user interface (UI) and is configured for:

receiving at least one of the ascent signal and the descent signal from the user interface (UI), and further
commanding, upon receipt of the ascent signal, the pump (33) for the lifting of the carriage, optionally of the first and of the second carriage (3', 3"), or
commanding, upon receipt of the descent signal, the discharge valve (41) for allowing the lowering of the carriage, optionally of the first and of the second carriage (3', 3").

[0043] In a 91st aspect it is provided a process of lifting vehicles using a lift (1) according to any one of the preceding aspects from the 74th to the 90th. In a 92nd aspect according to the preceding aspect the process comprises the following steps:

arranging the at least one carriage near the ground,
arranging a vehicle above the at least one carriage, optionally the at least one lifting arm,
supplying working fluid to the first and second actuator (26, 5) through the primary supply line and the secondary supply line for displacing said at least one carriage along the first and second column (2', 2") moving away from the ground.

[0044] In a 92bis aspect according to the preceding aspect the step of supplying working fluid comprises the sub-step of activating the pump (33) of the supply circuit for displacing said at least one carriage along the first and second column (2', 2") moving away from the ground. In a 93rd aspect according to the preceding aspect the step of activating the pump (33) provides the steps of:

moving a working fluid from the source (S) to the first actuator (22) through the primary supply line (20),
moving working fluid from the first actuator (22) to the second actuator (5) through the secondary supply line (21). In a 94th aspect according to the preceding aspect the step of moving a working fluid from the source (S) to the first actuator (22), provides the sub-steps of:
moving the working fluid along the first and the second section (13, 23) of the primary supply line (20) accessing the first chamber (C1') of the first actuator (22).

[0045] In a 95th aspect according to any one of the two preceding aspects the step of moving fluid from the first actuator (22) to the second actuator (5) provides the sub-steps of:

moving the piston (27) of the first actuator (22) approaching to the second end (26b) of the cylinder (26) of the first actuator (22),
moving the working fluid accessing the first chamber

(C1") of the second actuator (5).

[0046] In a 95bis aspect according to the preceding aspect during the step of moving working fluid accessing the first chamber (C1") of the second actuator (5), part of the working fluid passes from the second to the first chamber (C2", C1") of the cylinder (6) of the second actuator (5).

[0047] In a 96th aspect according to the preceding aspect the step of moving working fluid from the second to the first chamber of the second actuator (5) provides the sub-step of:

moving the piston (7) of the second actuator (5) approaching to the second end (6b) of the cylinder (6) of the second actuator (5),
moving the working fluid from the second to the first chamber of the second actuator (5) through the through opening (8) of the piston (7).

[0048] In a 97th aspect according to any one of the preceding aspects from the 91st to the 96th comprising a step of balancing comprises the sub-steps of:

determining one or more measured values of pressure of the working fluid on the second section (23) of the primary supply line (20) through the first sensor (36),
determining one or more measured values of pressure of the working fluid on the secondary supply line (21) through the second sensor (37),
determining one or more values of a control parameter representative of a difference or a ratio between the measured value of the pressure of the working fluid on the second section (23) and the measured value of the pressure of the working fluid on the secondary supply line (21),
comparing one or more values of the control parameter with a threshold value, optionally equal to 0.5 bar,
commanding, as a function of the comparison of one or more values of the control parameter, the opening position or the closing position of the balance valve (35).

[0049] In a 98th aspect according to the preceding aspect wherein the step of balancing provides for commanding the opening position of the balance valve (35) if one or more pressure values of the control parameter are higher than the threshold value.

[0050] In a 99th aspect according to any one of the preceding aspects from the 91st to the 98th the process comprising a safety procedure comprising a step of moving fluid along the safety line (42) as a function of a value of pressure of the fluid in the first section (13) of the primary supply line (20).

[0051] In a 100th aspect according to the preceding aspect the step of the safety procedure of moving fluid along the safety line (42), comprises the sub-steps of:

determining one or more measured values of pressure of the working fluid on the first section (13) of the primary supply line (20),
comparing said one or more measured values of pressure of the working fluid on the first section (13) of the primary supply line (20) with a reference value, optionally equal from 50 to 300 bar,
commanding, as a function of said comparison, the overpressure valve (43) during the opening for allowing the passage of fluid in the safety line (42), optionally if said one or more measured values of pressure of the working fluid on the first section (13) are higher to the reference value.

[0052] In a 101st aspect is provided a process of lowering vehicles using a lift (1) according to any one of the preceding aspects from the 74th to the 90th. In a 102nd aspect according to the preceding aspect the process comprises the steps of:

arranging the at least one carriage spaced from the ground,
arranging the discharge valve (41) of the supply circuit in opening position for displacing said carriage along said first and second column (2', 2") approaching to the ground.

[0053] In a 103rd aspect according to the preceding aspect the step of arranging the discharge valve (41) in opening position allows the working fluid to:

pass from the second actuator (5) to the first actuator (22) through the secondary supply line (21),
pass from the first actuator (22) to the source (S) along the second section (23) of the primary supply line (20) and the return line (38).

[0054] In a 104th aspect according to the preceding aspect during the passage from the second actuator (5) to the first actuator (22) through the secondary supply line (21) the working fluid passes, also, from the first to the second chamber (C1", C2") of the second actuator (5) through the through opening (8) of the piston (7), optionally through the gap (11) of the second actuator (5).

[0055] In a 105th aspect according to the preceding aspect during the passage of the working fluid from the first to the second chamber (C1", C2") of the second actuator (5):

the piston (7) of the second actuator (5) moves approaching to the first end (6a) of the cylinder (6) of the second actuator (5),
the working fluid passes from the first chamber (C1") of the second actuator (5) accessing the second chamber (C2') of the first actuator (22).

[0056] In a 106th aspect according to any one of the three preceding aspects during the passage of the working fluid from the first actuator (22) to the source (S):

the piston (27) of the first actuator (22) moves approaching to the first end (29b) of the cylinder (26) of the first actuator (22),
the working fluid passes through the second section (23) of the primary supply line (20) exiting from the first chamber (C1') of the first actuator (22),
the working fluid passes through the return line (38) and moves towards the source (S).

BRIEF DESCRIPTION OF FIGURES

[0057] Some embodiments and aspects of the invention will be described herein with reference to the attached exemplificative, and therefore not limiting, figures wherein:

figure 1 is a perspective view of a lift according to the present invention;
figure 2 is a schematic lateral view of a lift according to the present invention;
figure 3 is a schematic view of a first and second actuator of a lift according to the present invention;
figures 4 and 5 are respective schematic views of a supply circuit for the first and second actuator of figure 3.

DEFINITIONS AND CONVENTIONS

[0058] In the present description, corresponding parts shown in the various figures are indicated with the same numerical references. Figures may show the object of the invention by means of non-scaled representations; therefore, parts and components shown in the figures relative to the object of the invention may relate exclusively to schematic representations.

[0059] The terms *"vertical" and "horizontal"* used in relation to components of the lift, refer to a condition of its use during which the lift carries out, or is usable for, a lifting/lowering procedure of a vehicle with respect to the ground.

[0060] The handling system and/or the lift described and claimed below may comprise/use at least one control unit in charge of the control of the operating conditions put in place by the lift itself and/or to the control of the steps of the process of lifting of a vehicle. The control unit may be a single unit or be formed by a plurality of distinct control units depending on design choices and operational requirements. With control unit it is intended an electronic type component which may comprise at least one among: a digital processor (CPU), an analogue type circuit, or a combination of one or more digital processors with one or more analogue type circuits. The control unit may be "*configured*" or "*programmed*" to perform certain steps: this may be realized in practice with any means that allow to configure or program the control unit. For example, in case of a control unit comprising one or more CPUs and one or more memories, one or more programs may be stored in appropriate memory banks connected to the CPU or CPUs; the program or programs contain instructions which, when performed by the CPU or CPUs, program or configure the control unit to perform the operations described in relation to the control unit. Alternatively, if the control unit is or comprises analogue type circuitry, the circuit of the control unit may be then designed to include circuitry configured, in use, for processing electrical signals so as to perform the steps relative to the control unit.

[0061] Parts of the described process may be realized by means of a data processing unit or control unit, technically replaceable with one or more computers designed to carry out a portion of a software program or firmware loaded onto a storage medium. This software program may be written in any known programming language. The electronic processors, if equal to two or more in number, may be connected to each other by means of a data connection such that their computing powers are shared in any way whatsoever; the same electronic processors may thus be installed in even geographically different locations, realizing through the above-mentioned data connection a distributed computing environment.

[0062] The data processing unit, or control unit, may be a general-purpose processor configured for carrying out one or more parts of the process identified in the present disclosure through the software or firmware program, or be an ASIC or dedicated processor or FPGA, specifically programmed to carry out at least part of the operations of the process described herein.

[0063] The storage medium may be non-transitory and may be internal or external to the processor, or control unit, or data processing unit, and may - specifically - be a memory geographically located remote with respect to the electronic processor. The storage medium may also be physically divided into multiple portions, or in the form of a cloud, and the software or firmware program may physically provide for portions stored on geographically divided portions of memory between them.

DETAILED DESCRIPTION

Actuator

[0064] With the reference 5 it has been indicated an actuator, for example usable for vehicle lifts. The actuator 5 may be of pneumatic type using as working fluid a gas, for example air, or of hydraulic type, using a hydraulic oil.

[0065] As shown in figure 3, the actuator 5 has a cylinder 6 comprising a hollow body extending longitudinally along an extension direction D" between a first and a second end 6a, 6b. In detail, the cylinder 6 comprises an inner lateral surface 9a which connects a first surface 9b - defining, in use, an inner base surface of the actuator 5 - with a second surface 9c opposite to the first surface

9b, defining, in use, an inner top surface of the cylinder 6. The inner lateral surface 9a, together with the first and to the second surface 9b, 9c, delimit the space of the cylinder 6 having a predetermined inner volume.

[0066] The inner lateral surface 9a has, according to a section orthogonal to the extension direction D", a circular shape; consequently, the first and the second surface 9b, 9c, placed at the end of the inner lateral surface 9a, have a circular shape. In terms of size, the inner lateral surface 9a defines a passage section between 100 mm^2 and 1500 mm^2, optionally between 100 mm^2 and 1400 mm^2; this passage section is measured according to a plane orthogonal to the extension direction D" of the cylinder 6. Furthermore, the inner lateral wall 9a has a length, measured along the extension direction D" higher than 150 mm, optionally between 500 mm and 3000 mm. Actually, the length of the inner lateral surface 9a is defined by the distance present between the first and the second surface 9b, 9c which substantially coincides with the length of the cylinder 6.

[0067] As it will be better described below, in the space of the cylinder 6 is housed a piston 7 slidingly movable along the extension direction D" approaching and moving away with respect to the first and second surface 9b, 9c.

[0068] The cylinder 6 may comprise an inlet 14 defined on the inner lateral surface 9a at the first end 6a, or on the first surface 9b, for allowing the passage of the working fluid from or to the inner volume of the cylinder 6: the inlet 14 defines the only opening of the cylinder 6 that allows the passage of the working fluid: the cylinder 6 is free of additional openings or accesses defined on the inner lateral surface 9a or on the first or second surface 9b, 9c, which allow the passage of the working fluid.

[0069] The cylinder 6 has however an auxiliary opening, optionally with a circular section, defined on the second surface 9b of the cylinder 6, which allows exclusively the passage of a rod 12 of the piston 7. The cylinder 6 comprises furthermore a gasket, for example an O-ring, engaged at the auxiliary opening of the cylinder 6; the gasket is countershaped to the rod 12 of the piston 7 and configured for allowing the sliding of said rod 12 with respect to the gasket itself, avoiding substantially the passage of the working fluid, avoiding so the leakage of said working fluid from the space of the cylinder 6. Excluding the inlet 14, the cylinder 6 is therefore free of additional openings that allow the passage of fluid through the cylinder 6.

[0070] As mentioned, the actuator 5 comprises a piston 7. The piston 7 divides the inner volume of the cylinder 6 in a first and a second chamber C1", C2", which show a variable volume, as a function of the position of the piston 7 in relation to the cylinder 6. The piston 7 is delimited in thickness by a first and a second head surface 7a, 7b, respectively faced to the first and the second end 6a, 6b of the cylinder 6 and delimiting at least partly, the first and the second chamber C1", C2". In detail, the first head surface 7a delimits, in cooperation with part of the inner lateral surface 9a and the first surface 9b of the cylinder 6, the first chamber C1", while the second head surface 7b delimits, in cooperation with part of the inner lateral surface 9a and the second surface 9c of the cylinder 6, the second chamber C2". From the dimensional point of view, the piston 7 has, in cross section, a surface size between 100 mm^2 and 1500 mm^2; wherein the cross section is defined according to a plane orthogonal to the extension direction D" of the cylinder 6. The thickness of the piston 7 is defined by the maximum distance present between said first and second head surface 7a, 7b; in terms of size, the ratio between the thickness of the piston 7 and the length of the inner lateral surface 9a of the cylinder 6 is between 0,01 and 0,3, optionally between 0,01 and 0,1.

[0071] The piston 7 has also an outer lateral surface 10 interposed between the first and the second head surface 7a, 7b and delimiting perimetrically the piston itself. In fact, the outer lateral surface 10 of the piston 7 connects the first and second head surface 7a, 7b and defines the surface size of the piston 7. The outer lateral surface 10 is at least partly, optionally entirely, countershaped to the inner lateral surface of the cylinder 6. For example, the outer lateral surface 10 of the piston 7 may have an outer perimeter having a substantially circular shape, entirely countershaped to the inner lateral surface 9a. In terms of size, the outer lateral surface 10 of the piston has, in section, a smaller size with respect to the passage section defined by the inner lateral wall 9a of the cylinder; in detail, the smaller size of the outer lateral surface 10 with respect to the inner lateral surface 9a of the cylinder allows to define, between said surfaces, a gap 11 which allows to put in fluid communication the first and the second chamber C1", C2". In detail, the piston 7 is free of sealing elements, for example gaskets, housed in the gap 11 to prevent an exchange of working fluid between the first and the second chamber C1", C2".

[0072] As shown in figures 2 and 3, the piston 7 has also at least one through opening 8 which extends between the first and the second head surface 7a, 7b: the through opening 8 extends thus for the whole thickness of the piston 7 and is configured for putting in fluid communication the first and the second chamber C1", C2". In the attached figures has been shown, in a non-limiting way, only one through opening 8; the possibility of providing two or more through openings 8 is not excluded. The at least one through opening 8 may be defined at a radially inner zone of the piston spaced from the outer lateral surface 10, optionally interposed between the outer lateral surface 10 and the rod 12; in this condition, the through opening 8 is delimited by a closed perimeter, for example having circular shape. Of course, the possibility of providing one or more through openings 8 defined on the outer lateral surface 10 of the piston 7 is not excluded; in this condition, the through opening 8 would have an open type perimeter, for example having an arcuate shape, essentially defining, on the outer lateral surface 10 of the piston 7, one or more recesses. The possibility

of one two or more of said through openings 8 spaced from the outer lateral surface 10 of the piston 7 and one or more of said through openings 8 defined on the outer lateral surface (i.e. to define recesses of the outer lateral surface 10) is not excluded. In particular, the at least one through opening 8 may have a constant passage section, between 50 mm^2 and 500 mm^2. With passage section it is intended the section defined by the at least one passage opening 8; if there are two or more through openings 8, this passage section is intended as the sum of the passage sections of all the through openings 8. Of course, the possibility of realizing one through opening 8 having a passage section having different shape and/or a passage section having a variable size along the thickness of the piston 7 is not excluded.

[0073] Still in terms of size, the surface size of the piston 7 is higher than the passage section of the through opening 8; in detail, the ratio between the passage section of the through opening 8 and the surface size of the piston 7 the surface size of the piston and the passage section of the through opening 8 may be between 0,01 and 0,2; with surface size of the piston 7 it is intended the maximum area defined by the outer lateral surface 10 of the piston 7. The through opening 8 and the gap 11 define thus respective passages which put in fluid communication the first and the second chamber C1", C2" for allowing, during the handling of the rod 12 in the cylinder 6 the passage of the working fluid from the first to the second chamber C1", C2".

[0074] As mentioned, the actuator 5 comprises a rod 12 partially housed in the second chamber C2" and engaged to the piston 7. As shown in figure 2, the rod 12 extends from the second head surface 7b of the piston 7, externally to the cylinder 6 passing through the auxiliary opening defined on the second end 6b of the cylinder 6. Therefore, the rod 12 is exclusively housed in the second chamber C2", without passing through the first chamber C1". From the dimensional point of view, the rod 12 has an elongated body, optionally of cylindrical shape, which, according to a section orthogonal to the extension direction D" of the cylinder 6, has a surface size between 50 mm^2 and 1000 mm^2. The surface size of the piston 7 is higher than the surface size of the rod 12; in greater detail, the dimensional ratio between the surface size of the piston 7 (maximum area defined by the outer lateral surface 10) and the surface size of the rod 12 is between 1,1 and 10. Furthermore, the ratio between the passage section of the through opening 8 (optionally the passage section defined by all of the through openings 8 present on the piston 7) and the surface size of the rod 12 may be between 0,005 and 0,2.

[0075] Precisely because of the presence of the rod 12, the second head surface 7b has a surface extension (i.e. the area defined by the surface 7b) smaller than the surface extension of the first head surface 7a. In fact, the sum of the surface extension of the second head surface 7b and the surface size of the rod 12 define substantially the same surface extension of the first head surface 7a. In terms of size, the ratio between the surface extension of the first head surface and the surface extension of the second head surface may be between 1,05 and 1,25. Thanks to the difference between the surface extensions (areas) of said first and second head surface 7a, 7b of the piston 7, the actuator 5 allows the input of the working fluid in the first chamber C1" (input which may occur exclusively through the inlet 14, unique opening of passage for the working fluid entering and exiting the actuator 5) and the consequent displacement of the piston 7 approaching to the second surface 9c of the cylinder 6; during the input of the working fluid in the first chamber C1", the through opening 8 (or the plurality of openings 8) puts in fluid communication the first chamber C1" and the second chamber C": the through opening 8 ensures thus that the working fluid present in said first and second chamber C1", C2" has substantially the same pressure. It is thus thanks to the difference of surface extension between the first and second head surface of the piston 7 that said piston, in the step of input the working fluid in the first chamber C1", may be displaced toward the second end 6b of the cylinder; the first head surface 7a, precisely because of its greater surface extension with respect to the second head surface, allows to generate (at equal pressure of the working fluid present in the first and second chamber C1", C2") a thrust on the piston 7 greater than the one generable by the second head surface 7b. In this condition, the working fluid, during the handling of the piston 7 approaching to the second end 6b, may flow through the at least one through opening 8 for passing from the second chamber C2" to the first chamber C1". Acting instead in thrust on the rod 12 to force the displacement of the piston 7 toward the first end 6a it is possible to generate the passage of fluid from the first chamber C1" to the second chamber C2".

Handling system

[0076] It is object of the present invention a handling system 4, for example for lifts of vehicles, comprising a first actuator 22 and a second actuator 5 according to the above-described actuator 5. The first actuator 22 may be a double-effect pneumatic or hydraulic actuator. The first actuator 22 comprises a cylinder 26 whose structure is similar to the one of the above-described cylinder 6 for the actuator 5, i.e. the second actuator 5.

[0077] The cylinder 26 of the first actuator is hollow and longitudinally extending along an extension direction D' between a first and a second end 26a, 26b. In detail, the cylinder 26 of the first actuator comprises an inner lateral surface 29a that connects a first surface 29b - defining, in use, an inner base surface of the first actuator 22 - with a second surface 29c opposite to the first surface 29b, defining, in use, an inner top surface of the cylinder 26. The inner lateral surface 29a, together with the first and to the second surface 29b, 29c, delimit the space of the cylinder 26 having a predetermined inner volume.

[0078] The inner lateral surface 29a has, according to

a section orthogonal to the extension direction D', a circular shape; consequently, the first and the second surface 29b, 29c, placed at the end of the inner lateral surface 29a, have a circular shape. In terms of size, the inner lateral surface 29a defines a passage section which may be between 100 mm^2 and 1500 mm^2; this passage section is measured according to a plane orthogonal to the extension direction D' of the cylinder 26 of the first actuator. Furthermore, the inner lateral wall 29a has a length, measured along the extension direction D' higher than 150 mm, optionally between 500 mm and 3000 mm. In fact, the length of the inner lateral surface 29a is defined by the distance present between the first and the second surface 29b, 29c which substantially coincides with the length of the cylinder 26 of the first actuator 22.

[0079] Actually, the cylinder 26 of the first actuator 22 may be substantially identical in shape and in size to the cylinder 6 of the second actuator 5. Also in the space of the cylinder 26 of the first actuator 22 it is housed a piston 27 slidingly movable along the extension direction D' of the cylinder 26 approaching and moving away with respect to the first and second surface 29b, 29c.

[0080] The cylinder 26 may comprise an inlet 24 defined on the inner lateral surface 29a at the first end 26a, or on the first surface 29b, for allowing the passage of the working fluid from or toward the inner volume of the cylinder 26: the inlet 24 defines an opening of the cylinder 26 which allows the passage of the working fluid. The cylinder 26 of the first actuator 22 may furthermore comprise an outlet 25, spaced from the inlet 24 and defined on the inner lateral surface 29a, at the second end 26b, or on the second surface 29c; the outlet 25 defines too one through opening configured for allowing the passage of the working fluid from or toward the inner volume of the cylinder. The cylinder 26 has also an auxiliary opening, optionally with circular section, defined on the second surface 29b of the cylinder 26, which allows exclusively the passage of a rod 32 of the piston 27. The cylinder 26 of the first actuator 22 comprises furthermore a gasket, for example an O-ring, engaged at the auxiliary opening of the cylinder 26; the gasket is countershaped to the rod 32 of the piston 27 and configured for allowing the sliding of said rod 32 with respect to the gasket itself, substantially preventing the passage of the working fluid, thus avoiding the leakage of said working fluid from the space of the cylinder 26.

[0081] Actually, unlike the cylinder 6 of the second actuator 5, the cylinder 26 of the first actuator 22 comprises two through openings (the inlet 24 and the outlet 25) which allow the passage of the working fluid for the input and leakage of the working fluid from the cylinder 26.

[0082] As mentioned, the first actuator 22 comprises a piston 27. The piston 27 divides the inner volume of the cylinder 26 of the first actuator 22 in a respective first and second chamber C1', C2', which have a variable volume, as a function of position of the piston 27 relative to the cylinder 26.

[0083] The piston 27 of the first actuator 22 is delimited in thickness a first and a second head surface 27a, 27b, respectively faced to the first and to the second end 26a, 26b of the cylinder 26 of the first actuator 22 and delimiting at least partly, the first and the second chamber C1', C2'. In detail, the first head surface 27a delimits, in cooperation with part of the inner lateral surface 29a and the first surface 29b of the cylinder 26, the first chamber C1', while the second head surface 27b delimits, in cooperation with part of the inner lateral surface 29a and the second surface 29c of the cylinder 26, the second chamber C2'. From the dimensional point of view, the piston 27 has, according to a section orthogonal to the extension direction D' of the cylinder 26, a surface size between 100 mm^2 and 1000 mm^2.

[0084] The thickness of the piston 27 is defined by the maximum distance present between said first and second head surface 27a, 27b; in terms of size, the ratio between the thickness of the piston 27 and the length of the inner lateral surface 29a of the cylinder 6 is between 0,01 and 0,3, optionally between 0,01 and 0,1.

[0085] The piston 27 has also an outer lateral surface 30 which extends between the first and the second head surface 27a, 27b, perimetrally delimiting the piston itself. In fact, the outer lateral surface 30 of the piston 27 connects the first and second head surface 27a, 27b and defines the surface size of the piston 27. The outer lateral surface 30 is at least partly, optionally entirely, countershaped to the inner lateral surface of the cylinder 26. For example, the outer lateral surface 30 of the piston 27 may have an outer perimeter having substantially circular shape, entirely countershaped to the inner lateral surface 29a. In terms of size, the outer lateral surface 30 of the piston has, in cross section, a lower size with respect to the passage section defined by the inner lateral wall 29a of the cylinder; in detail, the smaller size of the outer lateral surface 30 with respect to the inner lateral surface 29a of the cylinder allows to define, between said surfaces, a gap 11 in which it is housed at least one sealing element 28: the sealing element 28 is interposed between the outer lateral surface 30 of the piston 27 and the inner lateral surface 29a of the cylinder 26 of the first actuator 22, in such a way as to prevent a passage of fluid between the first and the second chamber C1', C2' of the cylinder 26 of the first actuator 22. Unlike what has been previously described about the second actuator 5, the first and the second chamber C1', C2' of the first actuator 22 are between them isolated, resulting exclusively in fluid communication respectively with the inlet 24 and the outlet 25 of the cylinder 26 of the first actuator 22. Unlike the piston 7 of the second actuator, the piston 27 of the first actuator 22 is free of through openings capable of putting in fluid communication the first and the second chamber C1', C2' of the cylinder 26.

[0086] The first actuator 22 comprises also a rod 32 partially housed in the second chamber C2' and engaged to the piston 27. As shown in figure 3, the rod 32 extending from the second head surface 27b of the piston 27, externally to the cylinder 26 passing through the auxiliary

opening defined on the second end 26b of the cylinder 26. Therefore, the rod 32 is exclusively housed in the second chamber C2' of the cylinder 26 of the first actuator 22, without passing through the first chamber C1'. From the dimensional point of view, the rod 32 has an elongated body, optionally of cylindrical shape, which, according to a section orthogonal to a/the extension direction D' of the cylinder 26, has a surface size between 50 mm^2 and 1000 mm^2.

[0087] Passing now to a dimensional comparison between the components of the above described first actuator 22, it should be noted how the surface size of the piston 27 is higher to the surface size of the rod 32, wherein the dimensional ratio between said values is between 1, 1 and 3.

[0088] The first and second actuator may be identical in terms of size, i.e. have an internal volume of the cylinder, a size of the piston and of the rod having the same size. As it may be seen from the above-mentioned description, the first and second actuator differ in that:

the cylinder 6 of the second actuator 5 has exclusively the inlet 14 (unique through opening of the cylinder suitable for allowing the passage of working fluid) while the cylinder 26 of the first actuator 22 has both the inlet 24 and the outlet 25; also
the piston 7 of the second actuator 5 has the at least one through opening 8 which puts in fluid communication the first and the second chamber C1", C2" of the cylinder 26 while the piston 27 of the first actuator 22 is free of through openings.

[0089] The handling system 4 may comprise a supply circuit for the first and second actuator 22, 5. In detail, the supply circuit comprises a primary supply line 20 configured for putting in fluid communication the inlet 24 of the first actuator 22 with a source S of a working fluid, for example defined by a tank configured for containing a predetermined quantity of working fluid, as well as a secondary supply line 21 which puts in fluid communication the outlet 25 of the first actuator 22 with the inlet 14 of the second actuator 5.

[0090] Passing now to describe the active components on the primary and secondary supply lines 20, 21 with reference to the figures 4 and 5, the handling system 4 may comprise a non-return valve 39 active on the primary supply line 20, configured for preventing the passage of fluid toward the source S. The non-return valve 39 defines a first section 13 of the primary supply line 20 interposed between the source S and the non-return valve 39 and a second section 23 of the primary supply line 20, interposed between the non-return valve 39 and the inlet 24 of the first actuator 22. The supply circuit may comprise a pump 33 active on the first section 13 of the primary supply line, configurable between an active condition wherein it moves the working fluid accessing to the first actuator 22 and a deactivated condition wherein it does not act on the working fluid. In detail, during the active condition, the pump 33 is configured for moving the working fluid from the source S, through the non-return valve 39, accessing to the cylinder 26 of the first actuator through the inlet 24. As it will be described later, the pump 33 is in the active condition if there is a need to lift a vehicle through the lift 1, vice versa, the pump 33 is in the deactivated condition in case of lowering of the vehicle.

[0091] The handling system 4 may comprise a control unit 50 operatively connected to the pump 33 and configured for commanding the activation and deactivation conditions of the pump 33 on the base of commands inserted by a user through a subsequently described UI user interface.

[0092] The supply circuit may comprise a parachute valve 44 active on the second section 23 of the primary supply line 20 and sensitive to a pressure variation and/or flow rate of the working fluid in the second section 23, i.e. upstream of the inlet 24 of the first actuator 22. In detail, the parachute valve 44, if it is detected an undesirable increase of pressure and/or of flow rate of the working fluid in the second section 23 is configured for passing from an opening condition (condition of normal operation of the handling system) to a closing condition in which the valve 44 prevents the passage of working fluid. In other words, the parachute valve 44 allows to prevent the uncontrolled descent of the first and of the second actuator 22, 5 in case of breakage of the primary supply line 20 or of the secondary supply line 21, providing the passage of working fluid in the second section 23 of the primary supply line 20. It should be noted that the described parachute valve 44 is a purely mechanical valve, capable of operating without the aid of electronic devices. However, the possibility of using an electronically controlled valve, for example an electromechanical valve of known type, appropriately controlled from the control unit 50 as a function of a measurement of a value of pressure and/or flow rate of the working fluid sampled by a sensor active on the primary supply line 20 is not excluded.

[0093] The supply circuit may comprise a bypass line 34 which puts in fluid communication the second section 23 of the primary supply line 20 with the secondary supply line 21, as well as a balance valve 35 active on the same bypass line, which is configured for compensating an eventual pressure difference between the primary and secondary supply line 20, 21. The balance valve 25 is thus configurable between opening and closing conditions, wherein respectively allows and prevents the passage of working fluid on the bypass line 34, as a function of a pressure gap. The handling system 4 may comprise a first and a second pressure sensor 36, 37 respectively active on the second section 23 of the primary supply line 20 and on the secondary supply line 21, configured for generating signals representative of the pressure of the working fluid present in the respective supply lines. The control unit 50 is operatively connected to the first and to the second pressure sensor 36, 37, configured for

receiving the pressure signals emitted by each sensor and determining one or more measured values of pressure of the working fluid, respectively in the second section 23 of the primary supply line 20 and in the secondary supply line 21. The control unit 50 is then configured for commanding the balance valve 35 as a function of one or more values of a control parameter. In detail, the control unit 50 is configured for:

determining one or more values of the control parameter representative of a difference or a ratio between the measured value of the pressure of the working fluid in the second section 23 of the primary supply line 20 and the measured value of the pressure of the working fluid in the secondary supply line 21,
comparing one or more values of the control parameter with a threshold value, and finally
commanding the opening position or the closing position of the balance valve 35 if one or more pressure values of the control parameter are higher than the threshold value.

[0094] The supply circuit may furthermore comprise a discharge line 38 which puts in fluid communication the second section 23 of the primary supply line 20 with the source S, as well as a discharge valve 41 active on the same discharge line 38, for allowing the passage of fluid toward the source S as a function of a command entered by a user. The discharge valve 41 is thus configurable between respective opening and closing conditions wherein respectively allows and prevents the passage of working fluid along the discharge line 38. The control unit 50 is operatively connected to the discharge valve 41 and is configured for commanding it during the opening or closing as a function of a command entered by a user through the user interface UI. Unlike what is described for the pump 33, the discharge valve 41 is in the opening condition if there is a need to lower a vehicle through the lift 1 (figure 5), while it is in the closing condition in case of lifting of the vehicle (figure 4). The control unit 50 is thus configured for commanding in an asynchronous way the discharge valve 41 and the pump 33, in such a way that to the activation condition of the pump 33 corresponds the closing condition of the discharge valve 41 and, vice versa, to the deactivation condition of the pump 33 corresponds the opening condition of the discharge valve 41.

[0095] The supply circuit may also comprise a filter 14 active on the discharge line 38 for filtering the working fluid accessing the source S.

[0096] The supply circuit may furthermore comprise a safety line 42 which puts in fluid communication the first section 13 of the primary supply line 20 with the source S, as well as an overpressure valve 43 active on the same safety line 42, for allowing the passage of fluid toward the source S if the pressure of the working fluid in the first section 13 is higher than a predetermined reference value. The overpressure valve 43 may be of a fully mechanical type, capable of passing from a closing condition to an opening condition if it detects and determines pressure values of the working fluid in the first section 13 higher than the reference value. Alternatively the overpressure valve 43 may be opportunely connected and commanded by the control unit 50, which would be configured for:

detecting and determining one or more measured values of pressure of the working fluid on the first section 13 of the primary supply line 20,
comparing said one or more measured values of pressure of the working fluid on the first section 13 of the primary supply line 20 with a reference value,
commanding, as a function of said comparison, the overpressure valve 43 during the opening for allowing the passage of fluid in the safety line 42, optionally if said one or more measured values of pressure of the working fluid on the first section 13 are higher to the reference value.

[0097] It should be noted how, during the active condition of the pump 33, it sends a predetermined quantity of working fluid to the first actuator 22; the handling of the piston 27 of the first actuator 22 determines the handling of the working fluid present in the second chamber C2' of the cylinder 26 and of the working fluid present in the secondary supply line 21, toward the cylinder 6 of the second actuator and in particular the input of working fluid in the first chamber C1" of the second actuator 5 through the inlet 14. The inlet of the working fluid in the first chamber C1" allows to displace the piston 7 toward the second surface 9c of the cylinder 6.

[0098] As above specified, precisely thanks to the dimensional difference of the first and second head surface 7a, 7b of the piston 7, the second actuator 5 allows the input of the working fluid in the first chamber C1" (input that exclusively occurs through the inlet 14) and the subsequent displacement of the piston 7 approaching to the second surface 9c of the cylinder 6; during the input of the working fluid in the first chamber C1", the through opening 8 puts in fluid communication the first chamber C1" and the second chamber C": the through opening 8 ensures thus that the working fluid present in said first and second chamber C1", C2" have substantially the same pressure. It is thus thanks to the dimensional difference (surface extension) between the first and second head surface of the piston 7 that the piston 7, in the step of input the working fluid in the first chamber C1", may be displaced toward the second end 6b of the cylinder; the first head surface 7a, precisely thanks to its surface extension greater with respect to the second head surface, allows to generate (at equal pressure of the working fluid present in the first and second chamber C1", C2") a thrust on the piston 7 greater than the one that may be generated from the second head surface 7b. In this condition, the working fluid, during the handling of the piston

7 approaching to the second end 6b, may flow through the at least one through opening 8 for passing from the second chamber C2" to the first chamber C1". While instead the pump 33 is in the deactivated condition and the discharge valve 41 is in the opening condition, it is obtained the handling of the working fluid toward the source; in particular,
the working fluid present on the secondary supply line 21, moves from the cylinder 6 of the second actuator 5 toward the cylinder 26 of the first actuator 22, accessing the second chamber C2' through the outlet 25,
the working fluid present on the primary supply line 20 moves from the cylinder 26 of the first actuator 22, exiting from the inlet 24 and along the discharge line 38, toward the source S.

Lift

[0099] It is object of the present invention a lift 1, for example of vehicles, comprising the above-described handling system 4. The lift 1 may comprise a first and a second column 2', 2" between them spaced and extending, in use, along a vertical direction between a respective base 2a', 2a" and a respective top 2b', 2b". The columns define the supporting vertical element of the lift 1, configured for supporting a hanging vehicle with respect to the ground; the columns 2 are fixable to the ground, for example by means of screw-bolt systems.

[0100] In detail, the first column 2' may comprise a base plate 45', optionally in metallic material, configured for being fixed to the ground and from which protrudes, for the whole extension of the first column, a frame 46'. As visible in figure 1, the base plate 45' of the first column 2' may comprise a plurality of holes configured for receiving a screw to fasten the base plate 45' and consequently the entire first column 2', to the ground. The frame 46' of the first column 2' is engaged to the base plate 45' and has, along its whole extension, a "C" or "V" shaped constant profile transversal section defining within it a space V'. For example, the frame 46 is realized through one or more layers of sheet metal in metallic material.

[0101] In the space V' of the first column is housed the first actuator 22 of the handling system 4. In particular, the first actuator 22 is fixed to the frame 46' and/or to the base plate 45' of the first column 2', at the base 2a'. In particular, the first end 26a of the cylinder 26 of the first actuator is placed near the base 2a' of the first column; the piston 27, along with to the rod 32 of the first actuator 22 are configured for moving approaching and moving away with respect to the top 2b'. In still greater detail, the part of rod 32 of the first actuator that protrudes from the cylinder 26 results faced to the top 2b', spaced from the base 2a' (see for example the diagram of figure 2).

[0102] The first column 2' has also a top plate 47', opposite to the base plate 45' with respect to the frame 46', which vertically delimits the first column 2'.

[0103] As visible for example from figure 2, the frame 46' of the first column 2' comprises also a first through access 48a defined near the base 2a', which allows the passage of the primary supply line 20 in the space V for connecting to the inlet 24 of the first actuator 22. The frame 46' of the first column 2' comprises also a second through access 48b, for example, defined on the top plate 47' or on the frame 46' at the top 2b', for allowing the passage of the secondary supply line 21 in the space V of the first column 2' engaging to the second chamber C2' of the first actuator 22. In fact, the second through access 48b allows to the secondary supply line 21 to connect to the outlet 25 of the cylinder 26 of the first actuator 22 and to exit from the space V' of the first column 2' for reaching the second column 2". In figure 2 it has been shown, in a non-limiting way, a secondary supply line placed, at least for a section, above the columns 2', 2"; in this it is possible to avoid the positioning of the secondary supply line 21 at the ground where it could be more subject to damages causable by the passage of the vehicle and thus to breakages of the entire lift. however, the possibility of providing a passage of such secondary supply line 21 at the ground, for example by arranging a sub-passage for such a line that connects at the base of the two columns is not excluded.

[0104] The second column 2" has a structurally identical structure to the first column 2'. In detail, the second column 2" comprises a base plate 45" configured for being fixed to the ground and from which protrudes a frame 46". The base plate 45" of the second column 2", comprises a plurality of holes configured for receiving a screw to fix the base plate 45" and consequently the entire second column 2", to the ground. The frame 46" of the second column 2" is engaged to the base plate 45" and has, along its whole extension, a "C" or "V" shaped constant profile transversal section, defining within it a space V" in which it is housed the second actuator 5. In particular, the second actuator 5 is fixed to the frame 46" and/or to the base plate 45" of the second column 2". The frame 46" of the second column 2" has also a top plate 47", opposite to the base plate 45", that vertically delimits the second column 2".

[0105] The frame 46" of the second column 2" comprises a respective access 49, for example defined on the top plate 47" of the second column 2", configured for allowing the inlet of the secondary supply line 21 in the space V of the second column 2" for engaging to the inlet 14 of the second actuator 5. It should be noted how the secondary supply line 21 is housed, partly externally to the frames 46', 46" of the first and second column 2, 2" and partly inside the spaces V', V" of the respective frames 46', 46" of the first column and second column 2', 2".

[0106] The lift 1 may comprise a single carriage or, as for example shown in figures 1 and 2, may comprise a first carriage 3' carried by the first column 2' and a second carriage 3" carried by the second column 2". In other words, the lift 1 may comprise two columns and a carriage for each column. In the attached figures it has been shown, in a non-limiting way, a lift 1 of column type i.e.

configured for being fixed or leaned to the ground and completely protruding with respect to the ground: in the column type lift each column slidingly carries a carriage. The possibility of realizing a lift 1 according to the present invention wherein the at least one column is housed at least partly in a pit obtained in the ground for defining an underground type, or a suspended type lift is not excluded. The underground or suspended lifts too may also comprise a first and a second column 2', 2" and one or more carriages (a single carriage for each column or a single carriage carried both by the first and by the second column).

[0107] In the following description it will be made a reference, in a non-limiting way, to the lift 1 of column type; it is understood that the aspects of the invention hereinafter described are not limited to the column lift of figure 1 but are applicable to lifts of the suspended or underground type (not shown).

[0108] As, for example, shown in figures 1 and 2, the first and a second carriage 3', 3" of the lift 1 are respectively displaced from the first and second actuator 22, 5 of the previously described handling system 4. In detail, as visible from figure 2, the first carriage 3' is engaged to the rod 32 of the first actuator 22, while the second carriage 3" is engaged to the rod 12 of the second actuator 5; the handling of the respective pistons 27, 7 of the first and of the second actuator 22, 5 allow the displacement of rods 32, 12 which, consequently, move the carriages 3', 3" along the respective columns.

[0109] Each carriage comprises at least one lifting arm configured for contacting a vehicle, optionally the body of the vehicle, for allowing its lifting; the arm of the carriage lies substantially along a plane orthogonal to an extension direction of the column. The arm may be of swiveling type, i.e. movable by rotation around an axis parallel to the extension direction of the column. In addition or alternatively, the arm may be of the extendable type, i.e. configured for varying its length.

[0110] In detail, the carriage may comprise a first and a second lifting arm 3a, 3b (figure 1) both configured for contacting a vehicle, optionally the body of the vehicle, for allowing its lifting. The lifting arms 3a, 3b lie substantially on a single plane orthogonal to the extension direction E of the column. At least one of said lifting arms may be of swiveling type, i.e. movable by rotation around a respective axis parallel to the extension direction of the column.

[0111] As visible from the attached figures, each lifting arm 3a, 3b may carry at its end a supporting foot configured for directly contacting the body of the vehicle; in particular, the first and second arm 3a, 3b carry respective height-adjustable feet.

[0112] The lift 1 may comprise a user interface UI (figure 1) manually operable by a user and configured for:

- generating an ascent signal for the lifting of the first and of the second carriage 3', 3",
- generating a descent signal for the lowering of the first and of the second carriage 3', 3".

[0113] The control unit 50 of the handling system 4 is connected to the user interface UI and configured for:

- receiving at least one of the ascent signal and the descent signal from the user interface UI, and furthermore
- commanding, upon receipt of the ascent signal, the pump 33 for the lifting of the first and of the second carriage 3', 3", or
- commanding, upon receipt of the descent signal, the discharge valve 41 for allowing the lowering of the first and of the second carriage 3', 3".

Process of lifting vehicles

[0114] It is an object of the present invention a process of lifting vehicles using a lift 1 according to the above-mentioned description.

[0115] The process may use the above-described handling system 4, which allows the handling of working fluid (for example hydraulic oil) accessing the first chambers C1', C1", respectively of the first and of the second actuator 22, 5, through the first and the second section 13, 23 of the primary supply line 20 and through the secondary supply line 21.

[0116] In detail, the process provides the steps of:

- arranging the at least one carriage (optionally the first and second carriage 3', 3") near the ground,
- arranging a vehicle above the at least one lifting arm of the carriage,
- activating the pump 33 of the supply circuit for displacing said at least one carriage along the first and second column 2', 2" moving away from the ground.

[0117] During the activation of the pump 33, the process provides moving working fluid from the source S accessing the first chamber C1' of the first actuator 22, through the first and the second section 13, 23 of the primary supply line 20.

[0118] Contextually to the step of actuating of the pump 33, the process provides moving the working fluid exiting from the second chamber C2' of the first actuator 22 and accessing the first chamber C1" of the second actuator 5 subordinately to the handling of the piston 27 of the first actuator 22 approaching to the second end 26b of the cylinder 26 of the first actuator 22.

[0119] At a displacement of the piston 27 of the first actuator 22, corresponds an analogous movement of the piston 7 of the second actuator 5 approaching to the second end 6b of the cylinder 6. The handling of the piston 7 of the second actuator 5 may occur at the same time with the handling of the working fluid accessing the first chamber C1" of the second actuator 5 and subsequently to the passage of the working fluid between the second to the first chamber C2", C1" of the second actuator 5

through the through opening 8 and optionally through the gap 11. It should be noted how the pressure of the working fluid in the first and second chamber C1", C2" of the second actuator 5 is the same and the handling of the piston 7 approaching to the second end 6b of the cylinder, occurs as the working fluid in the first chamber C1" applies a thrust on the first head surface 7a of the piston 7 directed toward the second end 6b of the cylinder, higher with respect to a thrust applied by the working fluid in the second chamber C2" and directed toward the first end 6a. In other words, the lifting of the piston 7 occurs since the working fluid in the first chamber C1" acts on a surface (i.e. the first head surface 7a) higher with respect to the surface upon which the working fluid in the second chamber C2" (i.e. the second head surface 7b) acts.

[0120] It should also be noted that for the entire duration of the process, the discharge valve 41 is in closing position, preventing the passage of fluid along the discharge line 38.

[0121] The process of lifting may provide the execution of a balancing procedure with the purpose of compensating an eventual pressure difference between the primary and secondary supply line 20, 21, which provides the following steps:

determining one or more measured values of pressure of the working fluid on the second section 23 of the primary supply line 20 through the first sensor 36,
determining one or more measured values of pressure of the working fluid on the secondary supply line 21 through the second sensor 37,
determining one or more values of a control parameter representative of a difference or a ratio between the measured value of the pressure of the working fluid on the second section 23 and the measured value of the pressure of the working fluid on the secondary supply line 21,
comparing one or more values of the control parameter with a threshold value, optionally equal to 0.5 bar,
commanding the opening position of the balance valve 35 if one or more pressure values of the control parameter are higher to the threshold value.

[0122] The process of lifting also comprises, in case of use of an overpressure valve 43 electromechanically controllable by the control unit 50, the execution of a safety procedure which provides the discharge of working fluid from the first section 13 of the primary supply line 20 to the source S. In particular, the safety procedure may provide the steps of:

determining one or more measured values of pressure of the working fluid on the first section 13 of the primary supply line 20,
comparing said one or more measured values of pressure of the working fluid on the first section 13 of the primary supply line 20 with a reference value,
commanding, as a function of said comparison, the overpressure valve 43 during the opening for allowing the passage of fluid in the safety line 42 if said one or more measured values of pressure of the working fluid on the first section 13 are higher than a threshold value, for example between 50 and 300 bar.

Process of lowering vehicles

[0123] It is also object of the present invention a process of lowering vehicles using a lift according to the above indicated description and/or according to the attached claims.

[0124] With reference to figure 5, the process provides the lowering of vehicles using the handling system 4 and, in particular, commanding the handling of working fluid exiting the first chambers C1', C1", respectively of the first and of the second actuator 22, 5, through the secondary supply line 21, the second section 23 of the primary supply line 20 and through the discharge line 38.

[0125] In detail, the process provides the steps of:

arranging the at least one carriage spaced from the ground,
arranging the discharge valve 41 of the supply circuit in opening position for moving said carriage along said first and second column 2', 2" approaching to the ground.

[0126] During the step of arranging the discharge valve 41 in opening position, the working fluid passes from the first chamber C1" of the second actuator 5, toward the second chamber C2' of the first actuator 22, through the secondary supply line 21. During this step, the working fluid passes between the first and the second chamber C1", C2" of the second actuator 5 through the through opening 8 and the gap 11. During the passage of the working fluid from the first to the second chamber of the second actuator 5, the piston 7 of the second actuator 5 moves approaching to the first end 6b of the cylinder 6 of the second actuator 5. At a displacement of the piston 7 of the second actuator 5, corresponds an analogous movement of the piston 27 of the first actuator 22 approaching to the first end 26a of the cylinder 26. Alternatively to this latter step, the working fluid passes from the first chamber C1' of the first actuator 22, to the source S, along the second section 23 of the primary supply line 20 and the return line 38, thus allowing the lowering of each carriage of the lift and consequently the lowering of the vehicle.

ADVANTAGES

[0127] The present invention involves, with respect to state-of-the-art solutions, considerable advantages. In fact, the presence of one through opening 8 on the piston 7 of the actuator 5 allows the actuator to provide only one

inlet 14 for the passage of fluid. In fact, the working fluid may enter and exit through the cylinder thanks to the unique passage defined by the inlet 14, without the need to provide an additional passage on the cylinder for the discharge of the working fluid, at least when the piston is displaced toward the second end 9c. In other words, the presence of the through opening 8 allows to provide a cylinder 6 having a simplified structure. It is also to be considered that, thanks to the structure of the piston 7 having the through opening 8, it is possible to provide a piston 7 free of gaskets; in fact, the through opening 8 allows to simplify also the structure of the piston 7 which does not require complex machining to achieve the tolerances necessary for working at closure with the inner surface of the cylinder 6. Furthermore, the presence of the at least one through opening allows to realize a piston 7 with different dimensions (no specific dimensions required), not being necessary gaskets.

[0128] The use of the actuator 5 in handling systems 4 for lifts allows also to greatly simplify the structure of the circuit for the passage of the working fluid and consequently the structure of the entire lift, which will certainly be less complex and more economical.

Claims

1. Handling system (4), for example for vehicle lifts, said handling system (4) comprising:

   a first actuator (22) comprising:

   a cylinder (26),
   a piston (27) slidingly movable in the cylinder, wherein the piston (27) defines, in cooperation with the cylinder (26), a first and a second chamber (C1', C2'),
   an inlet (24) defined on the cylinder (26) and in fluid communication with the first chamber (C1'),
   an outlet (25) defined on the cylinder (26) and in fluid communication with the second chamber (C2'),

   a second actuator (5) comprising:

   a cylinder (6),
   a piston (7) slidingly movable in the cylinder (6), wherein the piston (7) defines, in cooperation with the cylinder (6), a first and a second chamber (C1", C2"),

   a supply circuit comprising:

   a primary supply line (20) configured for putting in fluid communication the inlet (24) of the first actuator (22) with a source (S) of a working fluid,

   a secondary supply line (21) which puts in fluid communication the outlet (25) of the first actuator (22) with the second actuator (5),

   characterized by the fact that the piston (7) of the second actuator (5) comprises at least one through opening (8) which puts in fluid communication the first and the second chamber (C1", C2") of said second actuator (5).

2. Handling system according to claim 1, wherein the piston (7) of the second actuator extends in thickness between a first and a second head surface (7a, 7b) respectively delimiting part of the first and second chamber (C1", C2") of said second actuator, wherein the through opening (8) extends between said first and second head surface (7a, 7b).

3. Handling system according to any one of the preceding claims, wherein the cylinder (6) of the second actuator comprises an inlet (14) configured for allowing the input of a working fluid in the cylinder (6) itself and the output of said working fluid from said cylinder (6), wherein said inlet (14) is in direct fluid communication with the first chamber (C1") of said second actuator (5).

4. Handling system according to the preceding claim, wherein the inlet (14) defined on the cylinder of the second actuator is the only passage of the cylinder (6) configured for allowing the working fluid to pass in and out through the cylinder (6) of the second actuator.

5. Handling system according to any one of the preceding claims, wherein the second chamber (C2") of the second actuator (5) is in fluid communication exclusively with the first chamber (C1") of the cylinder (6) of the same second actuator (5).

6. Handling system according to any one of claims from 2 to 5, wherein the piston (7) of the second actuator (5) has an outer lateral surface (10) which connects the first and the second head surface (7a, 7b), wherein the at least one through opening (8) defined on said piston is:

   spaced from the outer lateral surface (10) of the piston (7), or
   defined on the outer lateral surface (10), optionally to define at least one recess on said outer lateral surface (10).

7. Handling system according to any one of claims from 2 to 6, wherein the cylinder (6) of the second actuator (5) extends along an extension direction (D"), wherein the piston (7) of said second actuator (5) is mov-

able in the cylinder (6) along a direction parallel to the extension direction (D") of said cylinder (6),

wherein the piston (7) of the second actuator has, in cross section according to a plane orthogonal to the extension direction (D") of the cylinder (6), a predetermined surface size,
wherein the through opening (8) has, in cross section according to a plane orthogonal to the extension direction (D") of the cylinder (6) of the second actuator, a predetermined through section,
wherein the ratio between the passage section of the through opening (8) and said surface size of the piston (7) is between 0,01 and 0,2.

8. Handling system according to any one of the preceding claims, wherein the secondary supply line (21) puts in direct fluid communication the outlet (25) of the first actuator (22) with the inlet (14) of the second actuator (5).

9. Handling system according to any one of the preceding claims, wherein the secondary supply line (21) is exclusively in fluid communication with the outlet (25) of the second actuator (22).

10. Handling system according to any one of the preceding claims, wherein the first chamber (C1') of the cylinder (26) of the first actuator (22) is exclusively in fluid communication, optionally directly, with the primary supply line (20) by the inlet (24) of the first actuator (22).

11. Handling system according to any one of the preceding claims, wherein the second chamber (C2') of the cylinder (26) of the first actuator (22) is exclusively in fluid communication, optionally directly, with the secondary supply line (21) by the outlet (25) of the first actuator (22).

12. Handling system according to any one of the preceding claims, wherein the supply circuit comprises:

a source (S) of a working fluid,
a non-return valve (39) active on the primary supply line (20) and configured for preventing the passage of fluid toward the source (S),

wherein the primary supply line (20) comprises:

a first section (13) interposed between the source (S) and the non-return valve (39),
a second section (23) interposed between the non-return valve (39) and the inlet (24) of the first actuator (22), wherein the supply circuit comprises a pump (33) active on the first section (13) of the primary supply line (20), wherein said pump (33) is configurable between:

an activation condition wherein the pump is configured for sending working fluid from the source (S) to the inlet (24) of the first actuator (22),
a deactivation condition.

13. Handling system according to the preceding claim, wherein the supply circuit comprises a return line (38) which puts in fluid communication, optionally directly, the second section (23) of the primary supply line (20) with the source (S).

14. Lift (1), optionally of vehicles, comprising:

a first and a second column (2', 2"),
at least one carriage slidingly movable along at least one of the first and the second column (2', 2"),
a handling system (4) according to any one of the preceding claims, wherein the first actuator (22) of the handling system (4) is linked to the first column (2') while the second actuator (5) is linked to the second column (2"),
wherein said first and second actuator (22, 5) of the handling system (4) are configured for allowing the displacement of said at least one carriage along at least one of said first and second column (2', 2").

15. Process of lifting vehicles using a lift (1) according to the preceding claim, wherein the process comprises the following steps:

arranging the at least one carriage near the ground,
arranging a vehicle above the at least one carriage, optionally above at least one lifting arm carried by the carriage,
supplying working fluid to the first and second actuator (26, 5) through the primary supply line and the secondary supply line for displacing said at least one carriage along the first and second column (2', 2") moving away from the ground.

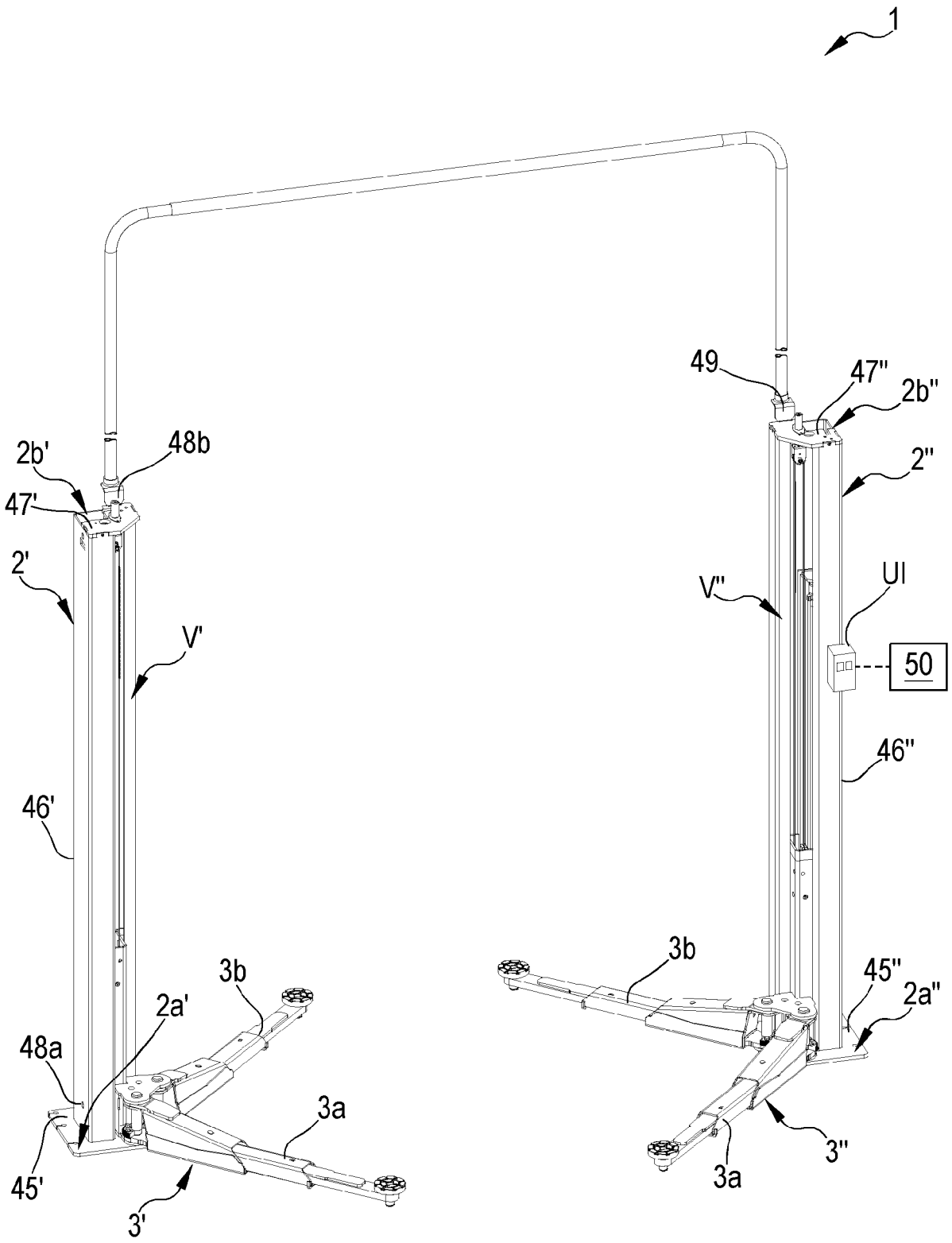
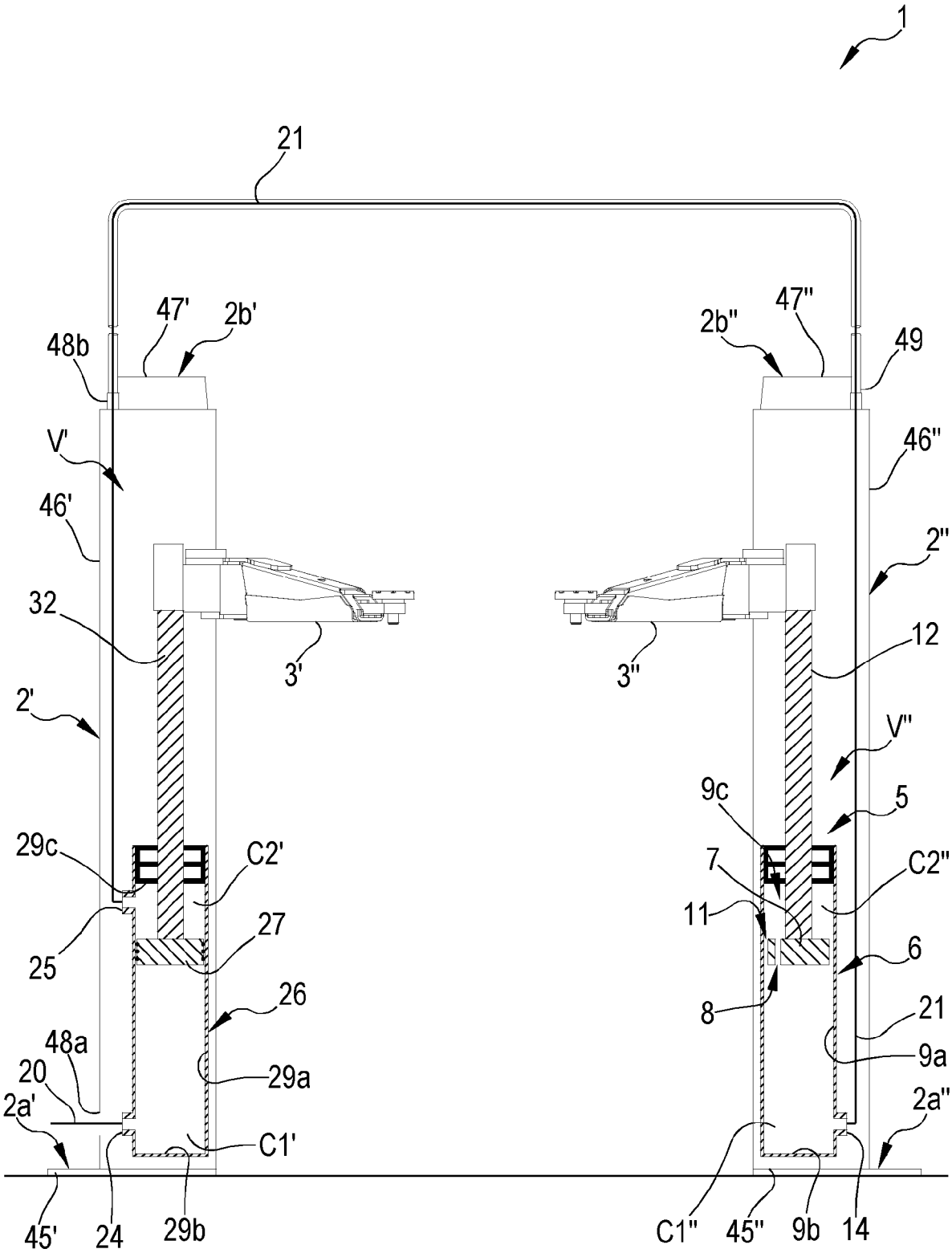


FIG.1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21
47'
2b'
48b
V'
46'
32
3'
2'
29c
C2'
25
27
26
48a
20
29a
2a'
C1'
45'
24
29b
47"
2b"
49
46"
2"
12
3"
V"
9c
5
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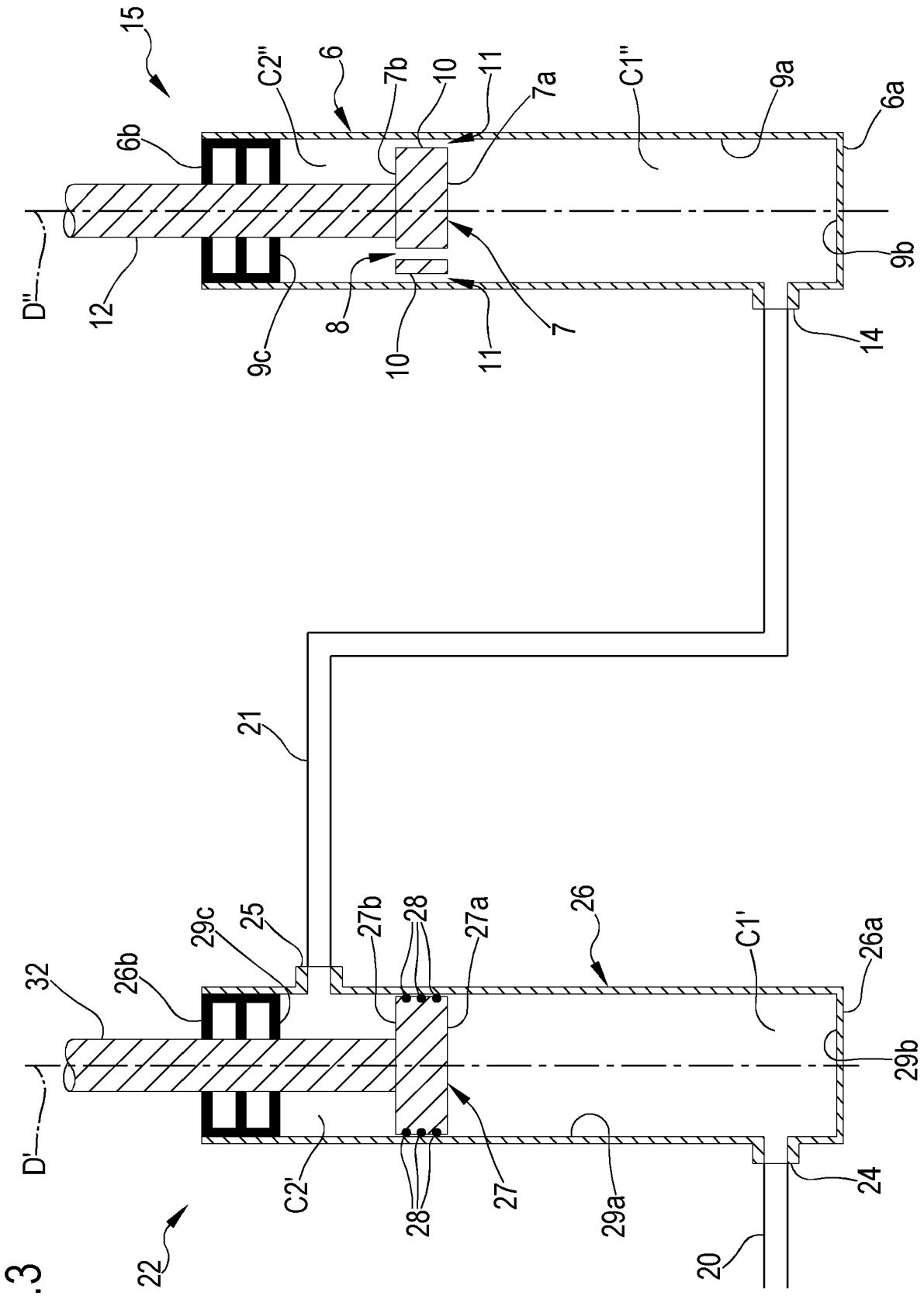
9a
2a"
C1"
45"
9b
14

FIG.2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C2"
6
7b
10
11
7a
C1"
9a
6a
6b
D"
12
8
9c
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11
7
14
9b
21
29c
25
27b
28
27a
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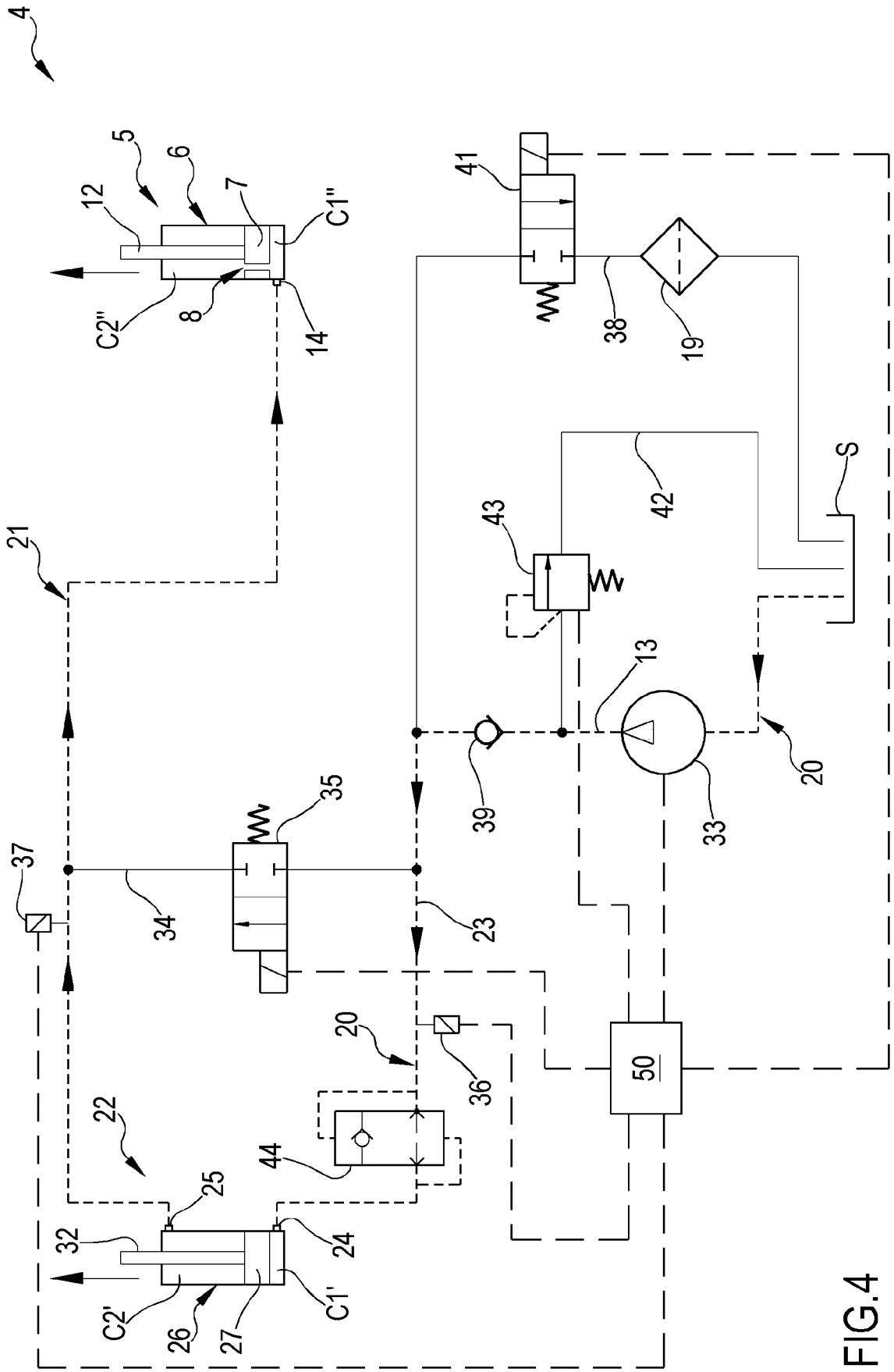
C1'
26a
32
26b
29b
D'
C2'
28
27
29a
24
22
20

FIG.3


4
5
6
7
12
C1"
C2"
8
14
41
38
19
S
42
43
21
13
39
20
33
35
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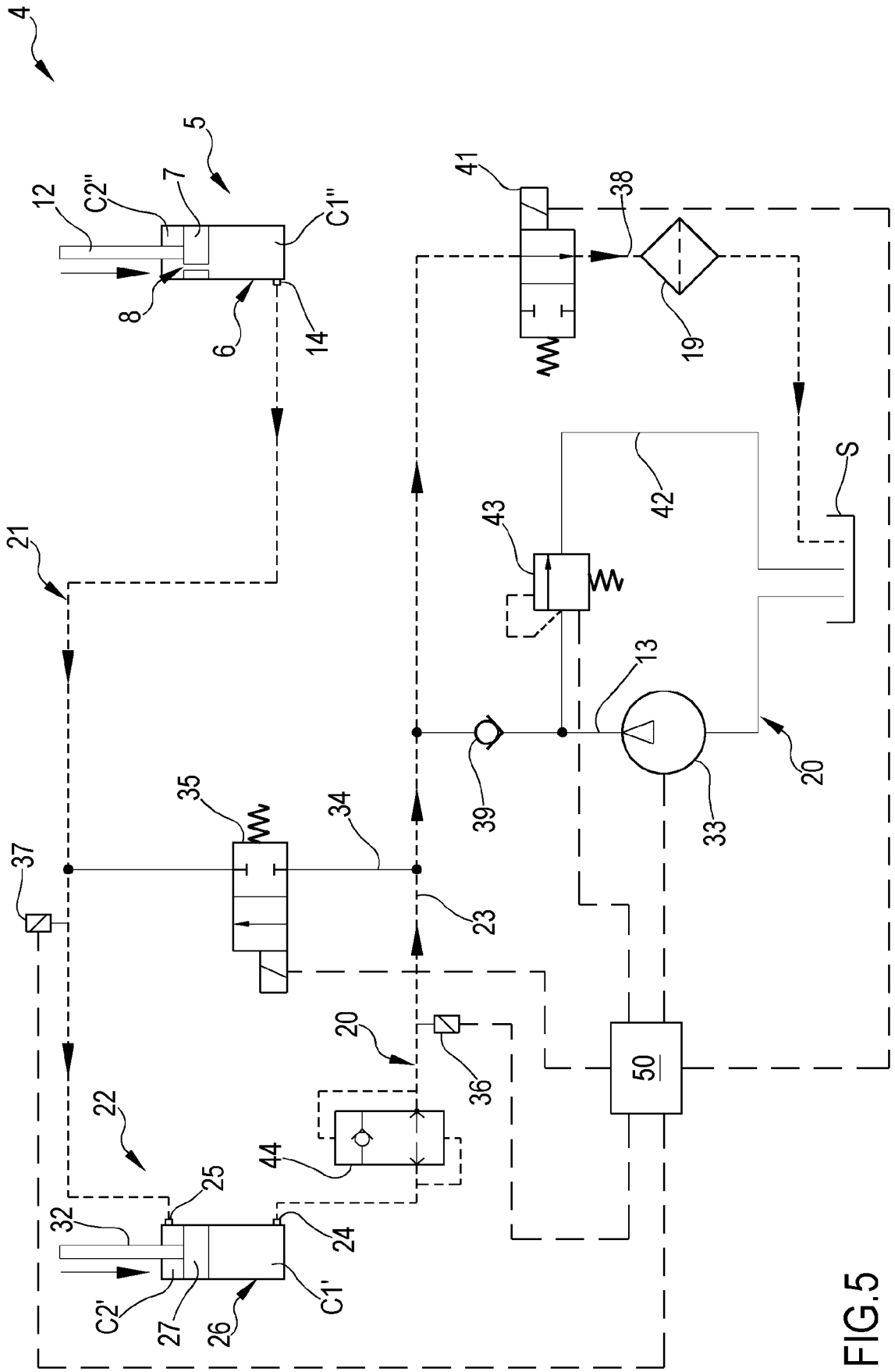
23
20
36
50
22
44
25
24
32
C2'
26
27
C1'

FIG.4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C1"
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21
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S
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13
39
20
33
35
34
37
23
20
36
50
22
44
25
32
24
C2'
27
26
C1'

FIG.5

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European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 24 15 9236

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	KR 2013 0001079 A (HESBON MACHINE LTD [KR]; KIM JONG GEUN [KR]) 3 January 2013 (2013-01-03) * abstract; figures 1-7 *	1-15	INV. B66F7/04 F15B15/14 B66F7/28 B66F7/08
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B66F
F15D
F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	2 July 2024	Serafeim, Athanasios

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 24 15 9236

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REFERENCES CITED IN THE DESCRIPTION

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