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(54) HYDRAULIC ARRANGEMENT FOR A WORK VEHICLE

(57) Hydraulic arrangement (1) for a work vehicle provided with a boom configured to be controlled via a pair of cylinders (4, 5) and an energy recovery system (7) comprising a pair of support cylinders (8, 9) configured to cooperate with the pair of cylinders (4, 5) and at least an accumulator (11),
the hydraulic arrangement (1) comprising a feeding conduit (12) fluidly connecting the accumulator (11) and the support cylinders (8, 9) and a selection module (31) fluidly interposed on the feeding conduit (12), the selection module (31) being configured to regulate the fluid passage between accumulator (11), support cylinders (8, 9) and a tank (20, 20') of the work vehicle.

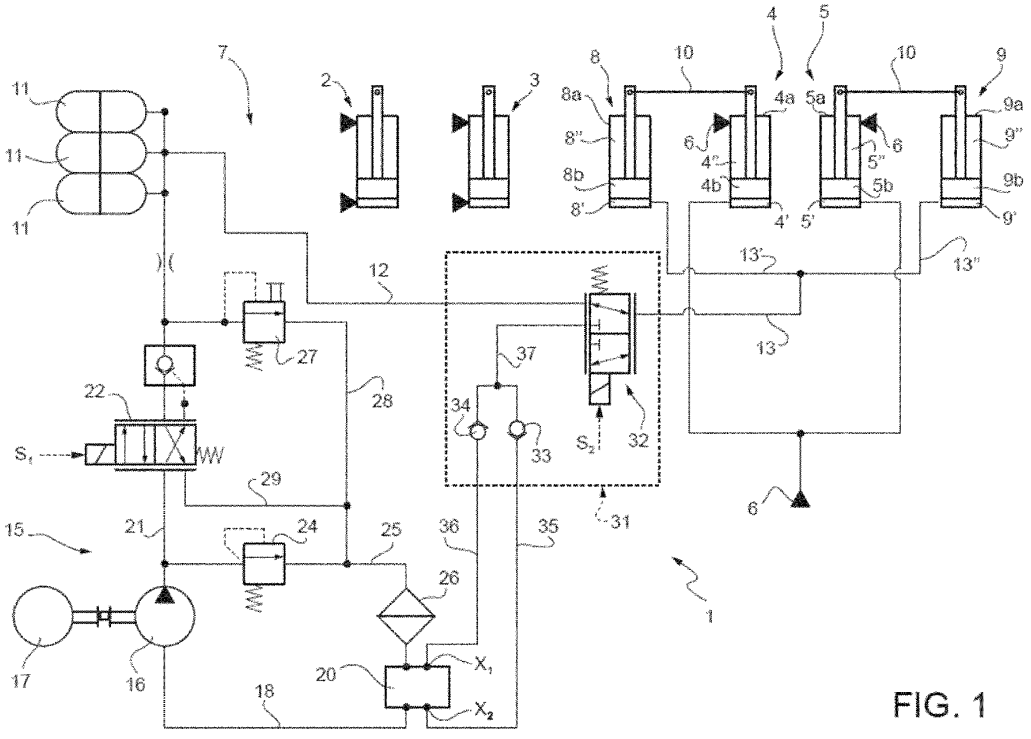

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention concerns a hydraulic arrangement, in particular hydraulic arrangement for managing a recovery hydraulic functionality of a work vehicle.

[0002] The present invention finds its preferred, although not exclusive, application in earth-moving vehicle provided with a boom such as a scraper.

BACKGROUND OF THE INVENTION

[0003] Work vehicles such as scrapers, i.e. vehicles provided with a hydraulic actuated boom, may be provided with so-called energy recovery systems.

[0004] Energy recovery systems are configured to reduce the energy consumption during the movement of a boom that is controlled via a hydraulic actuator. Indeed, when the boom is controlled to be lowered, the fluid discharged by hydraulic actuator is stored to be used then the boom is controlled to be lifted.

[0005] Such systems foresees the presence of accumulators to allow the storing of the fluid discharged by the actuator and a control block configured to manage the fluid flow between the accumulators, the tank and the actuator.

[0006] However, if a vehicle is provided with such energy recovery system it is currently impossible to avoid its use. Accordingly, it is not possible, for instance, making boom cylinders to be discharged as in standard operation.

[0007] Therefore, the need is felt to allow the use of the energy recovery system only when needed by the typology of work executed by the work vehicle.

[0008] An aim of the present invention is to satisfy the above mentioned needs.

SUMMARY OF THE INVENTION

[0009] The aforementioned aim is reached by a hydraulic arrangement and a work vehicle as claimed in the appended set of claims.

BRIEF DESCRIPTION OF DRAWINGS

[0010] For a better understanding of the present invention, a preferred embodiment is described in the following, by way of a non-limiting example, with reference to the attached drawings wherein:

- Figure 1 is a schematic representation of the hydraulic arrangement according to an embodiment of the invention; and
- Figure 2 is a schematic representation of the hydraulic arrangement according to an alternative embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0011] Figures 1 and 2 discloses a hydraulic arrangement 1 according to the invention for a work vehicle (not shown) comprising a boom assembly provided with an operational element such as a scraper.

[0012] Accordingly, the work vehicle may comprise an arm and an operational element that are controlled by respective hydraulic cylinders 2, 3 that will be not further described for sake of brevity.

[0013] The work vehicle advantageously comprises a pair of boom cylinders 4, 5, namely a right cylinder 4 and a left cylinder 5 configured, together, to lift or lower the boom according to the vehicle operation.

[0014] As shown in the exemplarily drawings, the cylinders 4, 5 comprise a housing 4a, 5a housing a sliding piston 4b, 5b in a tight manner thereby dividing the space defined by the housing into a piston chamber 4', 5' and a rod chamber 4", 5". Preferably, cylinders 4, 5 are double actuated cylinders i.e. the piston and rod chambers 4', 5', 4", 5" are respectively fluidly connected to a source of fluid in pressure to control the operation of the cylinders 4, 5.

[0015] The vehicle comprises an energy recovery system 7 comprising a pair of support cylinder 8, 9, i.e. a right support cylinder 8 and a left support cylinder 9. The left and right support cylinders 8, 9 are mechanically connected to, respectively, right and left cylinders 4, 5 as shown in the following.

[0016] In detail, left and right support cylinders 8, 9 are preferably single acting cylinders therefore comprising a housing 8a, 9a that accommodates a piston 8b, 9b sliding in tight manner so as to divide the housing space into a piston chamber 8', 9' and a rod chamber 8", 9".

[0017] Advantageously, the pistons 8b, 9b of left and right support cylinders 8, 9 are respectively connected to pistons 4b, 5b of the left and right cylinders 4, 5 via a mechanical link 10, schematized by a line in the figures, that may be realized of any typology provided that the movement of one of pistons 8b, 9b is transferred to the other pistons 4b, 5b and vice versa.

[0018] The energy recovery system 7 further comprises at least an accumulator 11, in the disclosed example three accumulators 11, that are fluidly connectable the left and right support cylinders 8, 9 via the hydraulic arrangement 1.

[0019] Hydraulic arrangement 1 is fluidly interposed between accumulators 11 and support cylinders 8, 9 in order to manage their operation. In particular, hydraulic arrangement 1 comprises a feeding conduit 12 that is fluidly connectable between the accumulators 11 and left and right support cylinders 8, 9.

[0020] Furthermore, hydraulic arrangement 1 comprises a balancing conduit 13 configured to fluidly connect together support cylinders 8, 9; in particular the balancing conduit 13 is fluidly connectable to the feeding conduit 12 from one side and, on the opposite side, comprises two branches 13', 13" both fluidly connected to a respec-

tive piston chamber 8', 9' of the cylinders 8, 9.

[0021] The hydraulic arrangement 1 further comprises a filling module 15 configured to manage the filling of accumulators 11, when needed.

[0022] Accordingly, the filling module 15 comprises pump means 16 preferably carried by a torque source 17 such as an electric motor. The pump means 16 are fluidly connected by a conduit 18 to a tank 20 and are configured to suck fluid from the tank and push this latter, in pressure, towards the accumulators 11.

[0023] The pump means 16 are fluidly connected to accumulators via a conduit 21. Preferably, the hydraulic arrangement 1 comprises valve means 22 configured to regulate the flow passage between the pump means 16 and the accumulators 11.

[0024] In detail, the pump means may comprise a four ways proportional valve, preferably electro actuated, configured to allow the passage of fluid between a first configuration from pump means 16 towards accumulators 11 or a second opposite configuration, as better detailed hereinafter.

[0025] The actuation is preferably given by a control signal S_1 that, in the disclosed embodiment is an electronic signal coming from a control unit.

[0026] The hydraulic arrangement 1 further preferably comprises a relief valve 24 fluidly interposed on a conduit 25 that is fluidly connected between tank 20 and conduit 21.

[0027] Preferably, hydraulic arrangement 1 comprises filtering means 26 fluidly interposed on conduit 25 downstream to relief valve 24 and upstream to tank 20.

[0028] The hydraulic arrangement 1 further preferably comprises a relief valve 27 fluidly interposed on a conduit 28 that is fluidly connected between conduit 21, downstream to valve means 22, and conduit 25 downstream to relief valve 24 and, preferably, upstream to filtering means 26.

[0029] Between the relief valve 27, accumulators 11 and the valve means 22 it may be provided a check valve piloted to regulate the pressure or to discharge pressure of accumulator 11 portion circuit.

[0030] According to the invention, the hydraulic arrangement 1 comprises a selection module 31 configured to partition the fluid passage between accumulators 11, support cylinders 8, 9 and tank 20 according to a user's request.

[0031] In particular, the selection module 31 comprises valve means 32 configured to regulate the fluid passage between tank 20 and support cylinders 8, 9.

[0032] Preferably, valve means 32 comprises a three ways proportional valve configured to allow the passage of fluid between a first configuration between accumulators 11 and support cylinders 8, 9 or a second opposite configuration between support cylinders 8, 9 and tank.

[0033] The actuation is preferably given by a control signal S_2 that, in the disclosed embodiment is an electronic signal coming from a control unit.

[0034] The selection module 31 further comprises a pair of check valves 33, 34 that are fluidly interposed on respective conduits 35, 36 that are both fluidly connected to tank 20, from one side and to valve means 32 on the opposite, in particular fluidly in parallel one with respect to the other.

[0035] In particular the two check valves 33, 34 are configured to allow the passage of fluid into two different opposite fluid directions.

[0036] Preferably, conduits 35, 36 are fluidly joint into a single conduit 37 towards valve means 32.

[0037] According to the embodiment of figure 1, the conduits 35, 36 are both fluidly connected to tank 20 in two different points X_1, X_2 thereof. In detail, the conduit 36 housing check valve 34 that allows the passage of fluid from valve means towards tank 20 is fluidly connected to the tank 20 in a point X_1 placed vertically above with respect the point X_2 of connection of conduit 35.

[0038] According to the embodiment of figure 2, the hydraulic arrangement 1 comprises a further, buffer, tank 20' that is fluidly connected to only the fluid selection module 31 and the conduits 35, 36 are singularly fluidly connected to such buffer tank 20' in two different points X_1, X_2 thereof. In such configuration the tank 20 is fluidly connected only to accumulators 11 to manage their pressurization.

[0039] In detail, the conduit 36 housing check valve 34 that allows the passage of fluid from valve means towards tank 20' is fluidly connected to the tank 20' in a point X_1 placed vertically above with respect the point X_2 of connection of conduit 35.

[0040] In both embodiments, advantageously, point X_1 is realized on a top wall defining tank 20, 20' and point X_2 is realized on a bottom wall defining tank 20, 20'.

[0041] The operation of the two above described embodiments according to the invention is the following.

[0042] According to a first mode of operation it is provided a signal S_2 (e.g. directly by the user via a button/display) enabling the use of the energy recovery system 7. Accordingly, valve means 22 moves to allow the passage of fluid mainly between accumulators 11 and support cylinders 8, 9. In this way, as per se known, pressurized fluid into accumulators 11 is used for helping lifting cylinders 4, 5, i.e. the lifting force of support cylinders 8, 9 is transmitted to cylinders 4, 5 via mechanical link 10.

[0043] According to a second mode of the provided signal S_2 disables the use of the energy recovery system 7. Accordingly, valve means 22 moves to allow the passage of fluid mainly between tank 20, 20' and support cylinders 8, 9. In this way, as per se known, cylinders 4, 5 are not helped in their work and excess fluid present in support cylinders 8, 9 will be discharged, when cylinders 4, 5 are lowered.

[0044] The operation in the two embodiments is similar. The difference is that in first embodiment the fluid is discharged or sucked by a single tank 20 while in the second embodiment fluid may be discharged or sucked by the buffer tank 20'.

[0045] In view of the foregoing, the advantages of a

hydraulic arrangement and a work vehicle according to the invention are apparent.

[0046] Thanks to the selection module 31, it is possible to select the recovery system 7 only when needed. Otherwise, the boom is operated only by cylinders 4, 5 as in vehicle that are not provided with a recovery system 7.

[0047] In this way, the proposed work vehicle is more versatile with respect to existing system that are or provided with a recovery system either not.

[0048] Moreover, the provided arrangement of check valves with two different coupling points X_1, X_2 optimizes the sucking and the filling of the tank 20.

[0049] Furthermore, if the oil volume is too great for a single tank, the system may be used with two different tanks, wherein one is a buffer for the great oil volume.

[0050] Furthermore, in case of failure of accumulators 11 or of any other system of the recovery system 7, the vehicle may be operated in standard way, i.e. the work vehicle can continue its operation without interruption.

[0051] Moreover, the use of a proportional valve 32 is particularly advantageous since its control may be designed to decreased pump load when the boom lowers with better efficiency of the system. Accordingly, the work vehicle would decrease its fuel consumption. It is clear that modifications can be made to the described hydraulic arrangement and work vehicle which do not extend beyond the scope of protection defined by the claims.

[0052] For example, the proposed valve means and the topology of conduits may be varied.

[0053] Furthermore, the filling module 15 may be realized in different ways, such as the number of accumulators 11 or the typology of cylinders may be varied.

Claims

1. Hydraulic arrangement (1) for a work vehicle provided with a boom configured to be controlled via a pair of cylinders (4, 5) and an energy recovery system (7) comprising a pair of support cylinders (8, 9) configured to cooperate with said pair of cylinders (4, 5) and at least an accumulator (11),
said hydraulic arrangement (1) comprising a feeding conduit (12) fluidly connecting said accumulator (11) and said support cylinders (8, 9) and a selection module (31) fluidly interposed on said feeding conduit (12), said selection module (31) being configured to regulate the fluid passage between said accumulator (11), said support cylinders (8, 9) and a tank (20, 20') of said work vehicle.

2. Hydraulic arrangement according to claim 1, wherein said selection module (1) comprises valves means (32) fluidly interposed on said feeding conduit (12) and said tank (20, 20'), said valve means(32) comprising an electro-actuated valve.

3. Hydraulic arrangement according to claim 1 or 2, wherein said selection module (1) comprises valves means (32) fluidly interposed on said feeding conduit (12) and said tank (20, 20'), said valve means(32) comprising a proportional valve.

4. Hydraulic arrangement according to claims 2 or 3, wherein said selection module (31) comprises pair of check valves (33, 34) fluidly interposed on respective conduits (35, 36), said conduits (35, 36) being fluidly in parallel between said tank (20,20') and said valve means (32), said check valves (33, 34) allowing the passage of fluid each in a direction opposite with respect to the other.

5. Hydraulic arrangement according to claim 4, wherein said conduits (35, 36), opposite to said tank (20, 20') are joint into a common conduit (37) that is fluidly connected to said valve means (32).

6. Hydraulic arrangement according to claims 4 or 5, wherein one of said conduits (36) carries a check valve (34) configured to allow the passage of fluid only from said valve means (32) to said tank (20, 20') and the other of said conduits (35) carries a check valve (33) configured to allow the passage of fluid only from said tank (20, 20') to said valve means (32), said one conduit (36) being connected to tank (20, 20') in a first position (X_1) and said other conduit (35) being connected to tank (20, 20') in a second position (X_2), said first position (X_1) being vertically upper with respect to said second position (X_2).

7. Hydraulic arrangement according to claim 6, wherein said first position (X_1) being realized on a top wall of said tank (20, 20') and said second position (X_2) being realized on a bottom wall of said tank (20, 20').

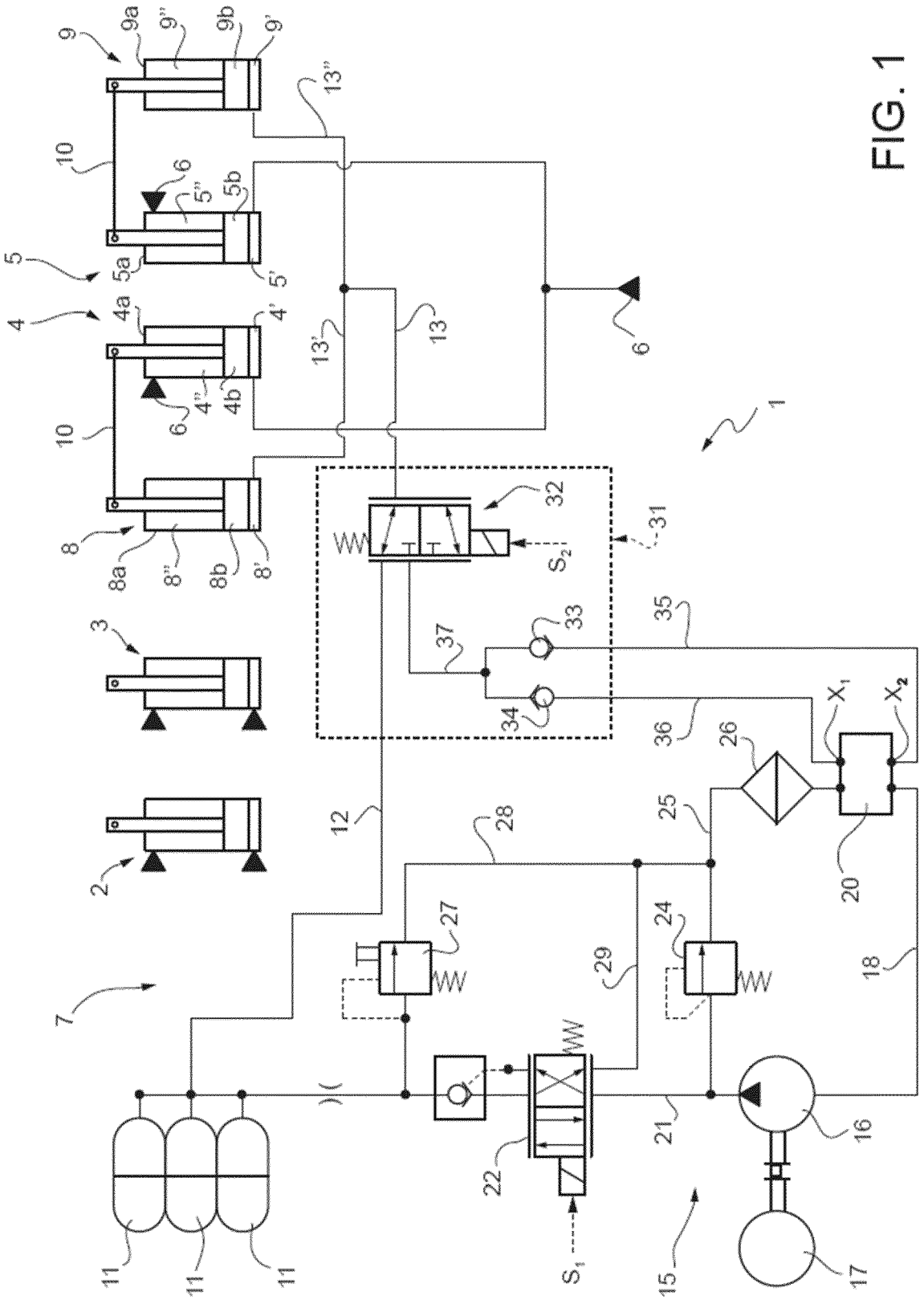
8. Hydraulic arrangement according to any of the preceding claims, wherein said work vehicle comprises a tank (20) fluidly connected to said accumulators (11) and a buffer tank (20') distinct with respect to said tank (20), said buffer tank (20') being fluidly connected only to said selection module (31).

9. Hydraulic arrangement according to claim 8 when depending on claim 6, wherein said conduits (35, 36) are fluidly connected to said buffer tank (20').

10. Hydraulic arrangement according to any of said preceding claims comprising a filling module (15) fluidly interposed between said tank (20, 20') and said accumulator (11), said filling module (15) being configured to charge said accumulators (11).

11. Work vehicle provided with a boom configured to be controlled via a pair of cylinders (4, 5) and an energy recovery system (7) comprising a pair of support cylinders (8, 9) configured to cooperate with said pair

of cylinders (4, 5) and at least an accumulator (11), said work vehicle comprising at least one tank (20, 20') and a hydraulic arrangement according to any of the preceding claims.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9a
9''
9b
9'
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5''
5b
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4'
13'
13
6
4''
4b
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8a
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8b
8'
1
32
31
S_2
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36
X_1
X_2
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S_1
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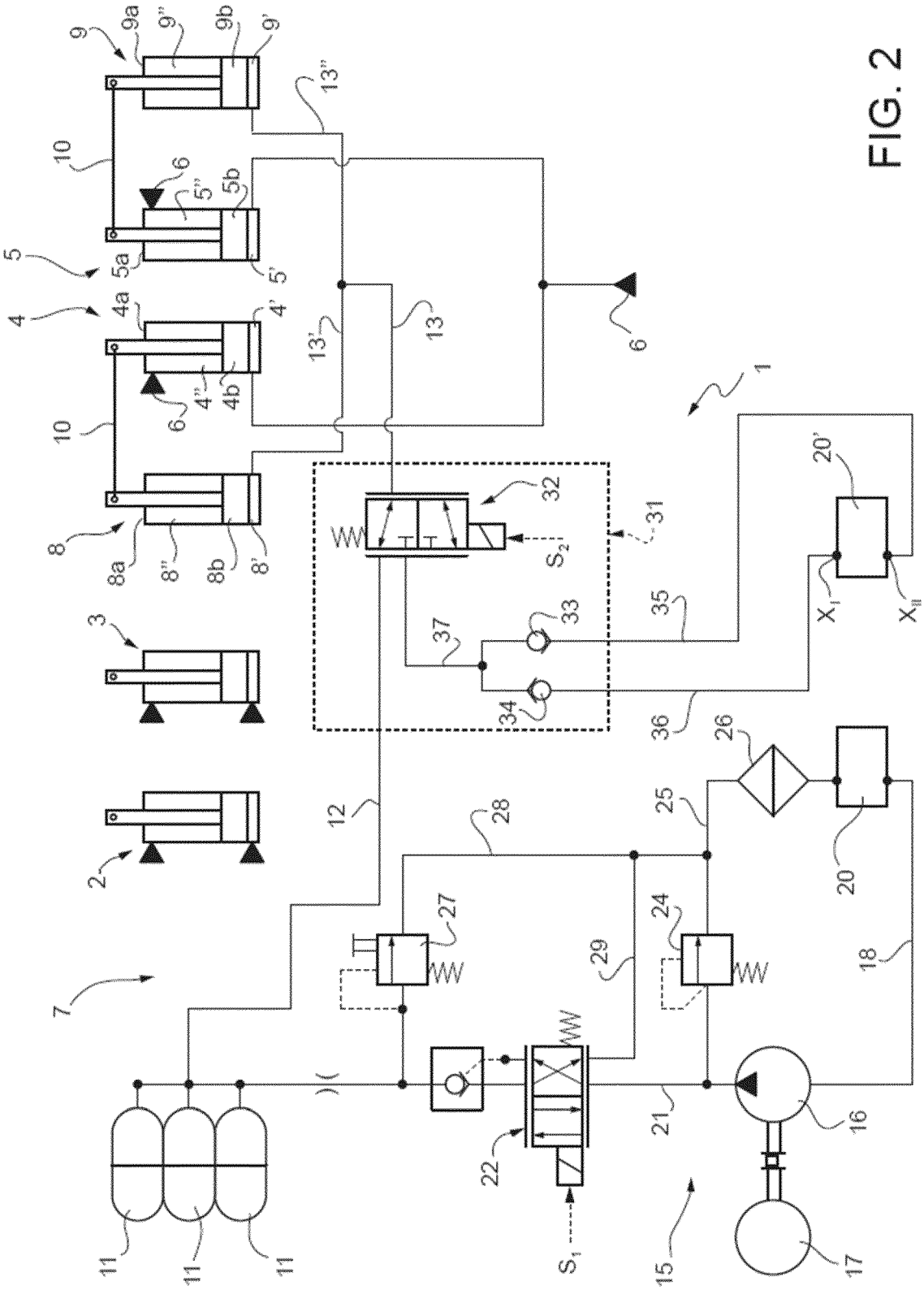
FIG. 1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5''
5b
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5a
5'
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4a
4'
13'
13
6
4''
4b
6
1
10
20'
32
8
31
S_2
8a
8''
8b
8'
X_I
X_{II}
3
37
33
35
34
36
26
12
28
25
2
20
27
24
7
29
18
22
16
21
11
11
11
S_1
15
17

FIG. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 0245

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F15B
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	9 November 2022	Dreyer, Christoph

CATEGORY OF CITED DOCUMENTS

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