(19) Europäisches Patentamt
European Patent Office
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(11) **EP 4 575 104 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.06.2025 Bulletin 2025/26

(21) Application number: **24220538.3**

(22) Date of filing: **17.12.2024**

(51) International Patent Classification (IPC):
E02F 9/22 *(2006.01)* ***F15B 11/17*** *(2006.01)*
F15B 1/02 *(2006.01)* ***F15B 21/14*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E02F 9/2296; E02F 9/2239; E02F 9/2242; E02F 9/2292; F15B 1/024; F15B 11/17; F15B 21/14; F15B 2211/20546; F15B 2211/20576; F15B 2211/7135

(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: **20.12.2023 IT 202300027441**

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(54) IMPROVED WORK MACHINE

(57) Work machine (1) comprising a body, a hydraulically actuated articulated arm carried by said body; a plurality of hydraulic actuators (4) configured to actuate said body and/or said hydraulically actuated articulated arm; and a hydraulic arrangement (12), which is fluidly connected to said hydraulic actuators (4) in order to actuate said hydraulic actuators (4). The hydraulic arrangement (12) comprises a first hydraulic pump (30) and a second hydraulic pump (31) arranged in parallel to each other; and a hydraulic circuit (18), which is configured to put each hydraulic pumps (30, 31) in fluid communication with the hydraulic actuators (4); and a hydraulic line (45) arranged in parallel to the hydraulic circuit (18), which is adapted to fluidly connect the outlet of both said first hydraulic pump (30) and said second hydraulic pump (31) with at least one among said hydraulic actuators (4) at the same time.

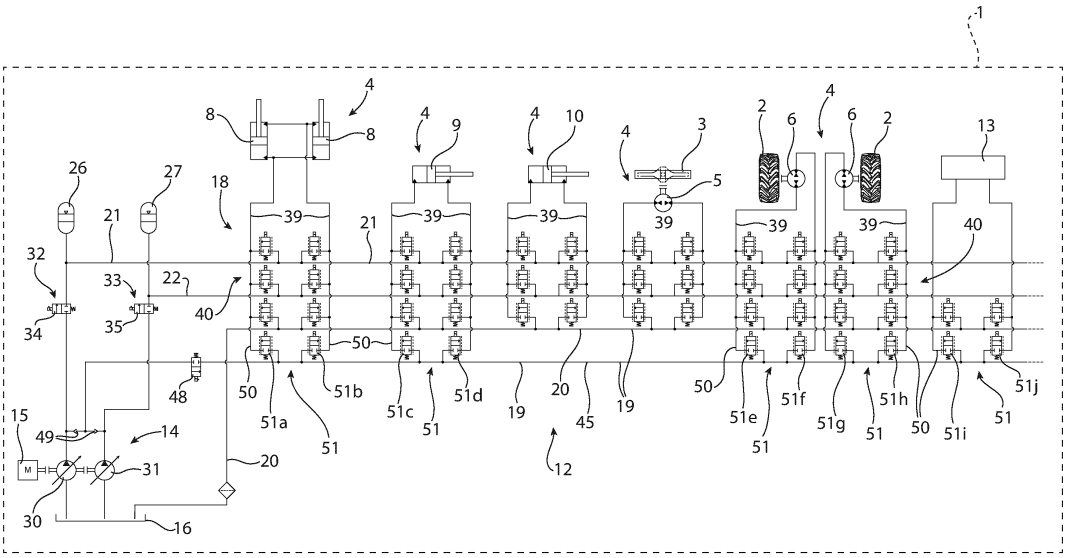

FIG. 2

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Description

TECHNICAL FIELD

[0001] The present invention relates to a work machine, in particular to an earth-moving machine such as an excavator, a digger, a mechanical shovel or the like.

[0002] The present invention finds its preferred, although not exclusive, application in a work machine, in particular an excavator, including a hydraulic arrangement provided with a common pressure rails (CPR) configuration and configured to operate the same work machine. Reference will be made to this application by way of the example below, without however losing in generality.

BACKGROUND OF THE INVENTION

[0003] As is known, work machines such as excavators, diggers and the like are provided with a hydraulically actuated articulated arm, which is carried by a body of the work machine and is configured to perform multiple earth-moving operations.

[0004] A simplified example of such hydraulic machine is illustrated in Figure 1 and is denoted as a whole with reference number 100.

[0005] Work machine 100 comprises a body movable on the ground via ground engaging wheels or tracks (not illustrated).

[0006] Such body in particular comprises: an undercarriage (not illustrated), which carries the ground engaging wheels or tracks to allow motion of the body with respect to the ground; and a superstructure 110, which is carried in a rotatable manner by the undercarriage.

[0007] Work machine 100 further comprises a hydraulic motor 120, also referred to swing motor which is configured to rotate the superstructure 110 with respect to the undercarriage.

[0008] In addition, work machine 100 comprises also at least two additional hydraulic motors 130, which are configured to drive the ground engaging wheels or tracks in rotation to allow motion of the body of the work machine 100 with respect to the ground.

[0009] Work machine 1 comprises a hydraulically actuated articulated arm, which is carried by said body and is configured to perform multiple earth moving operations, such as digging, handling earth or gravel, loading trucks and/or similar operations.

[0010] As known, said hydraulically actuated articulated arm comprises: a boom rotatably carried by the body; a pair of boom hydraulic actuators 140 configured to rotate the boom with respect to the body 110; a stick or arm or dipper rotatably carried by the boom; an arm hydraulic actuator 150 configured to rotate the arm with respect to the boom; a work implement, such as a bucket or the like rotatably carried by the arm; and a work implement hydraulic actuator 160 configured to rotate the work implement with respect to the arm.

[0011] The arm may be further configured to carry hydraulically powered work implements, such as an asphalt cutter, a mulcher head implement and/or the like.

[0012] In addition, work machine 100 comprises a hydraulic system, which is configured to provide pressurized hydraulic fluid towards at least one of the aforementioned hydraulic actuators, in order to operate the latter.

[0013] Traditionally, such hydraulic system comprises a source of pressurized hydraulic fluid and directional proportional control valves configured to throttle the flow of hydraulic fluid provided to each hydraulic actuator, to control its operation. This allows a precise control of the operation of each hydraulic actuator, but unfortunately results in a great deal of hydraulic fluid routed back to tank, with the waste in energy that this entails.

[0014] With reference to Figure 1, to reduce waste of energy and allow some energy recovery, some manufacturer recently developed a hydraulic system 170 including a source of pressurized hydraulic fluid 180, in particular one or more hydraulic pumps, and a hydraulic circuit 190 comprising a set of common pressure rails (CPR) and a set of logic on-off hydraulic valve configured to selectively fluidly connect the source of pressurized hydraulic fluid with the aforementioned hydraulic actuators.

[0015] However, during operation, only one hydraulic pump can be connected to a particular hydraulic actuator at a time, and therefore the pump must be sized according to the worst operation condition of the hydraulic actuators.

[0016] For instance, in some operation conditions, hydraulic motors 130, boom actuators 140, arm actuator 150 and/or the hydraulically powered work implement may require a very high flowrate of the hydraulic fluid.

[0017] Therefore, the single hydraulic pump must be sized to be able to meet such high flowrate request, i.e. it must have a large displacement, with the obvious drawback that this entails. In particular, large displacement hydraulic pumps are expensive, heavy, bulky and they have a very poor efficiency when providing at outlet very low flowrates of hydraulic fluid.

[0018] In view of the above, the need is felt to provide an improved hydraulic arrangement for a work machine able to overcome the aforementioned drawbacks.

[0019] Aim of the present invention is to satisfy the above-mentioned need in an optimized and cost-effective manner.

SUMMARY OF THE INVENTION

[0020] The aforementioned aims are reached by a work machine as claimed in the appended set of claims.

BRIEF DESCRIPTION OF DRAWINGS

[0021] 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 illustration of a hydraulic arrangement of a work machine as known in the art; and
- Figures 2 and 3 are schematic illustrations of a work machine realized according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0022] With reference to Figure 2, number 1 schematically denotes, as a whole, a work machine, in particular an earth-moving machine such as an excavator, a digger, a mechanical shovel or the like.

[0023] Work machine 1 comprises a body movable on the ground via ground engaging wheels or tracks 2.

[0024] In particular, said body preferably comprises: a lower frame or undercarriage (not illustrated), which carries the ground engaging wheels or tracks 2 to allow motion of the body with respect to the ground; and an upper frame 3 or superstructure, which is carried in a rotatable manner by lower frame preferably about a rotation axis orthogonal to the advancing plane of work machine 1, i.e. orthogonal to the ground.

[0025] In addition, work machine 1 comprises a hydraulically actuated work implement (not illustrated), which is carried by the body (not illustrated) of work machine 1 and is configured to perform multiple earth moving operations, such as digging, handling earth or gravel, loading trucks and/or similar operations.

[0026] In particular, said work implement is rotatably carried by the upper frame 3 of work machine 1.

[0027] In addition, work machine 1 comprises a plurality of hydraulic actuators 4, which are configured to actuate said body and/or said hydraulically actuated work implement.

[0028] More in detail, said hydraulic actuators 4 comprise at least one hydraulic motor 5, in the following referred to as "swing motor 5", which is operatively interposed between the lower frame and the upper frame 3 and is configured to rotate the upper frame 3 with respect the lower frame.

[0029] With reference to the exemplary embodiment illustrated in Figure 1, said hydraulic actuators 4 further comprise at least one hydraulic motor 6, in particular a reversible hydraulic motor 6, in the following referred to as "drive motor 6" which is configured to drive the ground engaging wheels or tracks 2 in rotation to allow motion of the work machine body with respect to the ground.

[0030] Preferably, hydraulic actuators 4 comprises a pair of drive motors 6, each operatively coupled to a corresponding wheel or track 2.

[0031] As per se known, the hydraulically actuated work implement preferably comprises: a boom rotatably carried by the body; a stick or arm or dipper rotatably carried by the boom; and a work implement, such as a bucket or the like rotatably carried by the arm.

[0032] In addition, hydraulic actuator 4 preferably comprises a plurality of hydraulic cylinders, in particular double-acting hydraulic cylinder, configured to actuate the hydraulically actuated work implement.

[0033] With reference to the exemplary embodiment illustrated in Figure 2, in particular, hydraulic actuators 4 preferably comprises at least one, and more advantageously a pair of boom actuators 8, which are operatively interposed between the work machine body and the boom and are configured to rotate the boom with respect to said body.

[0034] In addition, hydraulic actuators 4 further comprises at least one arm actuator 9, which is operatively interposed between the boom and the arm and is configured to rotate the arm with respect to the boom.

[0035] Preferably, hydraulic actuators 4 further comprise also at least one work implement actuator 10, which is operatively interposed between the arm and the bucket and is configured to rotate the bucket with respect to the arm.

[0036] With reference to the preferred embodiment illustrated in Figure 2, work machine 1 further comprise a hydraulic arrangement 12, which is fluidly connected to the aforementioned hydraulic actuators 4 and is configured to actuate this latter, in order to operate said work implement accordingly.

[0037] More in detail, hydraulic arrangement 12 is fluidly connected to swing motor 5, to drive motor or motors 6, to boom actuator 8, to arm actuator 9 and to work implement actuator 10, and is configured to provide these latter with pressurized hydraulic fluid in order to actuate these latter.

[0038] In addition, hydraulic arrangement 12 may be configured to be fluidly connected to a hydraulically powered work implements 13 adapted to be carried by work machine 1, exemplarily an asphalt cutter, a mulcher head implement and/or the like.

[0039] Hydraulic arrangement 12 comprises a source of pressurized hydraulic fluid 14, which is configured to provide at outlet a flow of pressurized hydraulic fluid.

[0040] More in detail, the source of pressurized hydraulic fluid preferably comprises pumping means 14, which are carried by an internal combustion engine 15 of the work machine 1, and are configured to suck hydraulic fluid from a tank 16 and to provide at outlet a pressurized flow of such hydraulic fluid.

[0041] With reference to the exemplary embodiment illustrated in Figure 2, hydraulic arrangement 12 further comprises a hydraulic circuit 18 which is adapted to put the source of pressurized fluid, i.e. the outlet of pumping means 14, in fluid communication with the aforementioned hydraulic actuators 4.

[0042] More in detail, the hydraulic circuit 18 is preferably provided with a common pressure rails (CPR) configuration, i.e. it comprises a plurality of separate hydraulic lines/ pipes/rails/conduits 19, which are arranged in parallel to each other and are each configured to be selectively fluidly connected between the source of pressurized fluid and the hydraulic actuators 4.

[0043] In particular, according to the CPR configuration, hydraulic lines 19 of hydraulic circuit 18 are preferably configured to operate with a pressure setting which is constant and is different to each other, in order each to be able to provide pressurized hydraulic fluid to hydraulic actuator 4 with different pressure levels.

[0044] More in detail, hydraulic circuit 18 comprises a first hydraulic line 20, in the following referred to "low-pressure hydraulic line" or "discharge hydraulic line" 20, which is configured to selectively fluidly connect hydraulic actuators 4 with tank 16.

[0045] In addition, hydraulic circuit 18 comprises a second hydraulic line 21, in the following referred to "high-pressure hydraulic line" 21, which is arranged in parallel to the low-pressure hydraulic line 20, and is configured to selectively fluidly connect the source of pressurized hydraulic fluid 14 with at least a first one among the aforementioned hydraulic actuators 4.

[0046] Furthermore, hydraulic circuit 18 comprises a second hydraulic line 22, in the following referred to "medium-pressure hydraulic line" 22, which is arranged in parallel to the low-pressure hydraulic line 20 and to the high hydraulic line 21, and is configured to selectively fluidly connect the source of pressurized hydraulic fluid 14 with at least a second one among the aforementioned hydraulic actuators 4.

[0047] Preferably, hydraulic lines 21 and 22 are fluidly separated from each other and/or from-low pressure line 20.

[0048] In addition, hydraulic circuit 18 preferably comprises at least two hydraulic accumulators 26 and 27.

[0049] Hydraulic accumulators 26 and 27 are fluidly connected respectively to high-pressure hydraulic line 21 and to medium-pressure hydraulic line 22. Accordingly, hydraulic accumulator 26 in the following will be referred also to as high-pressure hydraulic accumulator 26 and, hydraulic accumulator 27 in the following will be referred also to as medium-pressure hydraulic accumulator.

[0050] In use, high-pressure hydraulic accumulator 26 and medium-pressure hydraulic accumulator 27 are configured to store the pressurized hydraulic fluid provided by the source of pressurized hydraulic fluid 14, so as to fluidly decouple the same source of pressurized hydraulic fluid 14 from hydraulic actuators 4 and at the same time to be able to provide pressurized hydraulic fluid towards the hydraulic actuators 4.

[0051] In addition, by controlling the pressure of the hydraulic fluid contained within hydraulic high-pressure hydraulic accumulator 26 and within hydraulic medium-pressure hydraulic accumulator 27, it is possible to control the pressure level of the corresponding high-pressure hydraulic line 21 and medium-pressure hydraulic line 22, as explained more in detail in the following.

[0052] As far as the source of pressurized fluid is concerned, it comprises a pair of hydraulic pumps 30 and 31, which are preferably carried by internal combustion engine 15 in order to be driven in rotation and are arranged in parallel to each other.

[0053] The outlets of hydraulic pumps 30 and 31 are fluidly connected respectively to high-pressure hydraulic line 21 and to medium-pressure hydraulic line 22.

[0054] Hydraulic pumps 30 and 31 in use are adapted to suck hydraulic fluid from tank 16 via respective suction lines and to provide at outlet a pressurized flow of hydraulic fluid, respectively within high-pressure hydraulic line 21 and within medium-pressure hydraulic line 22.

[0055] More in detail, hydraulic pumps 30 and 31 in use are adapted to provide at outlet a pressurized flow of hydraulic fluid respectively within high-pressure hydraulic line 21 and high-pressure hydraulic accumulator 26 and within medium-pressure hydraulic line 22 and medium-pressure hydraulic accumulator 27.

[0056] With reference to the exemplary embodiment illustrated in Figure 2, hydraulic arrangement 12 preferably comprises a pair of valve means 32 and 33, which are operatively interposed between the outlet of pumping means 14, in particular respectively between the outlet of hydraulic pump 30 and hydraulic pump 31, and a respective hydraulic line 21 and 22, and are configured to regulate the flow of pressurized hydraulic fluid fed towards the same hydraulic line 21 and 22 by hydraulic pumps 30 and 31 respectively.

[0057] More in detail, valve means 32 preferably comprises a valve 34, which is operatively interposed between the outlet of hydraulic pump 30 and high-pressure hydraulic line 21.

[0058] Valve means 33, on the other hand, preferably comprises a valve 35, which is operatively interposed between the outlet of hydraulic pump 31 and medium-pressure hydraulic line 22.

[0059] Preferably, valve 34 and/or valve 35 are two-way two-position hydraulic valves, in particular solenoid-controlled two-way two-position hydraulic valves, operable between an open position and a closed position. Preferably, valves 34 and 35 are on/off hydraulic valves.

[0060] With reference to the exemplary embodiment illustrated in Figure 2, hydraulic arrangement 12 further comprises a set of hydraulic lines 39, each branching off from low-pressure hydraulic line 20, medium-pressure hydraulic line 22 or high-pressure hydraulic line 21 and fluidly connecting the latter with a corresponding hydraulic actuator 4.

[0061] More in detail, hydraulic arrangement 12 preferably comprises a plurality of pairs of hydraulic lines 39, each branching off from low-pressure hydraulic line 20, medium-pressure hydraulic line 22 or high-pressure hydraulic line 21 and fluidly connecting the latter with a respective end of a corresponding hydraulic actuator 4.

[0062] In addition, hydraulic arrangement 12 further comprises a control valve arrangement 40, which is operatively interposed between hydraulic circuit 18 and hydraulic actuators 4 and is provided with a plurality of valves each configured to selectively put the discharge hydraulic line 20, the high-pressure hydraulic line 21 and/or the medium-pressure hydraulic line in fluid communication with a corresponding hydraulic actuator 4.

[0063] Preferably, control valve arrangement 40 comprises a plurality of two-way two-position hydraulic valves, in particular two-way two position on-off hydraulic valves.

[0064] More in detail, the valves of control valve arrangement 40 are preferably solenoid-controlled valves.

[0065] With reference to the preferred embodiment illustrated in Figure 2, hydraulic arrangement 12 comprises a further hydraulic line 45, in the following referred to as "high-flowrate hydraulic line", which is arranged in parallel to high-pressure hydraulic line 21, medium-pressure hydraulic line 22 and low-pressure hydraulic line 20.

[0066] High-flowrate hydraulic line 45 is adapted to fluidly connect the outlet of both the first hydraulic pump 30 and the second hydraulic pump 31 with at least one among the hydraulic actuators 4 and/or with the hydraulically powered work implement at the same time.

[0067] In addition, hydraulic arrangement 12 comprises a flow merging line 46, which fluidly connects the outlet of both hydraulic pumps 30 and 31 with high-flowrate hydraulic line 45.

[0068] Moreover, hydraulic arrangement 12 preferably comprises a valve 48, which is operatively interposed between merging line 46 and high-flowrate hydraulic line 45.

[0069] Preferably, valve 48 is two-way two-position hydraulic valves, in particular solenoid-controlled two-way two-position hydraulic valves, operable between an open position and a closed position. Preferably, valve 48 is on/off hydraulic valves.

[0070] In addition, hydraulic arrangement 12 preferably comprises a pair of non-return valves 49, each of which is arranged along merging line 46 and is fluidly interposed between the outlet of respectively hydraulic pump 30 or 31 and high-flowrate hydraulic line 45.

[0071] Moreover, hydraulic arrangement 12 may comprise a further hydraulic accumulator (not illustrated), which is fluidly connected respectively to high-flowrate hydraulic line 45. In use, such hydraulic accumulator is configured to store the pressurized hydraulic fluid provided by the source of pressurized hydraulic fluid 14, so as to fluidly decouple the same source of pressurized hydraulic fluid 14 from hydraulic actuators 4 and at the same time to be able to provide pressurized hydraulic fluid towards the hydraulic actuators 4.

[0072] With reference to the exemplary embodiment illustrated in Figure 1, hydraulic arrangement 12 preferably comprises further hydraulic line 50 branching off from high-flowrate hydraulic line 45 and fluidly connecting the latter with at least one among hydraulic actuators 4.

[0073] More in detail, hydraulic arrangement 12 preferably comprises at least a pair of hydraulic lines 50 branching off from high-flowrate hydraulic line 45 and fluidly connecting the latter with both ends of at least one among hydraulic actuators 4.

[0074] With reference to the exemplary embodiment illustrated in Figure 1, hydraulic arrangement 12 preferably comprises a plurality of hydraulic lines 50 fluidly connecting high-flowrate hydraulic line 45 with boom actuator/s 8, arm actuator 9 and/or drive motors 6.

[0075] In addition, hydraulic arrangement 12 preferably comprises a control valve arrangement 51, which is arranged along the at least one hydraulic line 50, is operatively interposed between the high-flowrate hydraulic line 45 and the corresponding hydraulic actuator 4.

[0076] More in detail, control valve arrangement 51 comprises a plurality of valves, each arranged along a corresponding hydraulic line 50 and configured to selectively fluidly connect high-flowrate hydraulic line 45 with the corresponding hydraulic actuator 4.

[0077] Preferably, control valve arrangement 51 comprises a plurality of two-way two-position solenoid-controlled hydraulic valves, in particular two-way two position on-off hydraulic valves.

[0078] More in detail, the valves of control valve arrangement 51 are preferably solenoid-controlled valves.

[0079] With reference to the exemplary embodiment illustrated in Figure 2, control valve arrangement 51 preferably comprises two valves 51a and 51b, each respectively fluidly interposed between high-flowrate hydraulic line 45 and a respective end/chamber of boom actuator/s 8.

[0080] In addition, control valve arrangement 51 preferably comprises two valves 51c and 51d, each respectively fluidly interposed between high-flowrate hydraulic line 45 and a respective end/chamber of arm actuator 9.

[0081] Preferably, control valve arrangement 51 comprises four additional valves 51e-51h, each respectively fluidly interposed between high-flowrate hydraulic line 45 and a respective end of a corresponding hydraulic motors 6.

[0082] With reference to the exemplary embodiment illustrated in Figure 1, control valve arrangement 51 preferably comprises two valves additional valves 51i and 51j, which in use are configured to respectively fluidly interposed each between high-flowrate hydraulic line 45 and a respective end/chamber of the hydraulically powered work implement 13 carried by work machine 1.

[0083] The operation of the above-described work machine 1 is the following.

[0084] In use, both hydraulic pumps 30 and 31 are operated to provide pressurized hydraulic fluid within hydraulic line assembly 21 and medium-pressure hydraulic line 22.

[0085] Control valve arrangement 40 selectively actuated to operate the respective hydraulic actuator 4.

[0086] In addition, should one of the hydraulic actuators 4 and/or hydraulically-powered work implement 13 require a high flowrate, superior to the one that each single hydraulic pump 30 or 31 is able to provide at outlet, valves 34 and 35 close and valve 48 opens, so as to merge all the pressurized hydraulic fluid provided at outlet by both hydraulic pumps 30 and 31 within high-flowrate hydraulic line 45.

[0087] In addition, control valve arrangement 51 are operated to selectively power the desired one between hydraulic actuators 4 and/or hydraulically powered work implement 13.

[0088] In view of the foregoing, the advantages of a hydraulic arrangement 12 according to the present invention are considerable and apparent.

[0089] As a matter of fact, it is apparent that the high-flowrate hydraulic line 45 and the flow merging line 46 allows to maximize the flowrate provided to the hydraulic actuators 4 and/or to the hydraulically powered work implement 13 carried by the work machine and at the same time to optimize the layout and the design of the hydraulic arrangement 12.

[0090] In particular, the high-flowrate hydraulic line 45 and the flow merging line 46 allows to meet the high flowrate request of such equipment without necessarily oversizing the hydrostatic pumps carried by the internal combustion engine, with the obvious advantages that this entails.

[0091] Indeed, small displacement hydraulic pumps are lighter, less expensive and have generally a better efficiency and a better dynamic with respect to larger ones.

[0092] It is clear that modifications can be made to the described hydraulic arrangement 12, which do not extend beyond the scope of protection defined by the claims.

[0093] For instance, Figure 3 illustrates a more sophisticated embodiment of the present invention, wherein similar parts are denoted with corresponding reference numbers.

[0094] The embodiment illustrated in Figure 3 differs from the one illustrated in Figure 2 in that high-pressure hydraulic line and medium-pressure hydraulic line comprises each a plurality, in particular at least two different hydraulic lines/conduit arranged in parallel to each other.

[0095] Similarly, the hydraulic arrangement 12 illustrated in Figure 3 is provided with a plurality of hydraulic accumulators, each associated with a different hydraulic line and each configured to set the pressure at the corresponding hydraulic line. Control valve arrangement 40 comprises a plurality of valve as, each fluidly interposed between a corresponding hydraulic line of the hydraulic circuit 18 and a corresponding hydraulic actuator 4.

[0096] Lastly, the number of different hydraulic lines, the number of different hydraulic line assemblies and/or the number of different accumulators may be varied, for instance it may be greater than the one described in the exemplary embodiment illustrated in Figure 2.

Claims

1. A work machine (1) comprising:

- a body movable on the ground by means of ground engaging means (2);
- a hydraulically actuated articulated arm carried by said body;
- plurality of hydraulic actuators (4) configured to actuate said body and/or said hydraulically actuated articulated arm; and
- a hydraulic arrangement (12), which is fluidly connected to said hydraulic actuators (4) in order to actuate said hydraulic actuators (4);

said hydraulic arrangement (12) comprising:

- a source of pressurized hydraulic fluid (14), which is configured to suck a hydraulic fluid from a tank (16) and to provide at outlet a flow of the pressurized hydraulic fluid, and comprises a first hydraulic pump (30) and a second hydraulic pump (31) arranged in parallel to each other;
- a hydraulic circuit (18) which is configured to put said source of pressurized fluid (14) in fluid communication with said hydraulic actuators (4) and comprises:
  - o a discharge hydraulic line (20), which is adapted to fluidly connect said hydraulic actuators (4) with said tank (16);
  - o a first hydraulic line (21), which is arranged in parallel to said discharge hydraulic line (20), and is adapted to fluidly connect the outlet of said first hydraulic pump (30) with at least one among said hydraulic actuators (4);
  - o a second hydraulic line (22), which is arranged in parallel to said discharge hydraulic line (20) and to said first hydraulic line assembly (21), and is adapted to fluidly connect the outlet of said second hydraulic pump (31) with at least one among said hydraulic actuators (4); and
- a first control valve arrangement (40), which is operatively interposed between said hydraulic circuit (18) and said hydraulic actuators (4) and is provided with a plurality of valves, each configured to selectively put said discharge hydraulic line (20), said first hydraulic line (21) and/or said second hydraulic line (22) in fluid communication with a corresponding hydraulic actuator (4);

said hydraulic arrangement (12) further comprising:

- a third hydraulic line (45), which is arranged in parallel to said discharge hydraulic line (20), said first hydraulic line assembly (21) and said second hydraulic line (22), and is adapted to fluidly connect, at the same time, the outlet of both said first hydraulic pump (30) and said

second hydraulic pump (31) with at least one among said hydraulic actuators (4).

2. Work machine according to claim 1, wherein said hydraulic arrangement (12) comprises a flow merging line (46), which fluidly connects the outlet of both said first hydraulic pump (30) and said second hydraulic pump (31) with said third hydraulic line (45).

3. Work machine according to claim 2, wherein said hydraulic arrangement (12) comprises non-return valves (49) arranged along said flow merging line (46), respectively downstream the outlet of said first hydraulic pump (30) and said second hydraulic pump (31).

4. Work machine according to claim 2 or 3, wherein said hydraulic arrangement further comprises a hydraulic valve (48), which is operatively interposed between said flow merging line (46) and said third hydraulic line (45) and is configured to selectively fluidly connected said flow merging line (46) with said third hydraulic line (45).

5. Work machine according to claim 4, wherein said hydraulic valve (48) is a two-way two-position valve operable between an open position and a closed position.

6. Work machine according to any of the preceding claims, wherein said hydraulic arrangement (12) further comprises a hydraulic accumulator fluidly connected to said third hydraulic line (45).

7. Work machine according to any of the preceding claims, wherein said hydraulic arrangement (12) further comprises:

- at least one auxiliary hydraulic line (50) branching off from said third hydraulic line (45) and adapted to fluidly connect at least one among said hydraulic actuators (4) with said third hydraulic line (45); and
- a second control valve arrangement (51), which is arranged along said least one auxiliary hydraulic line (50) and is operatively interposed between said third hydraulic line (45) and the corresponding hydraulic actuator (4).

8. Work machine according to claim 7, wherein said hydraulic arrangement (12) comprises a plurality of said auxiliary hydraulic lines (50), each branching off from said third hydraulic line (45) and adapted to fluidly connect a corresponding hydraulic actuator (4) with said third hydraulic line (45).

9. Work machine according to claim 8, wherein said second control valve arrangement (51) comprises a plurality of valves (51a-51j), each arranged along a corresponding auxiliary hydraulic line (50) and configured to selectively fluidly connect said third hydraulic line (45) with the corresponding hydraulic actuator (4).

10. Work machine according to any of the preceding claims, wherein said hydraulically actuated articulated arm is further configured to carry a hydraulically powered work implement (13) and said third hydraulic line (45) is configured to be fluidly connected also to said hydraulically powered work implement (13).

11. Work machine according to any of the preceding claims, wherein said hydraulic circuit (18) has a common pressure rail configuration.

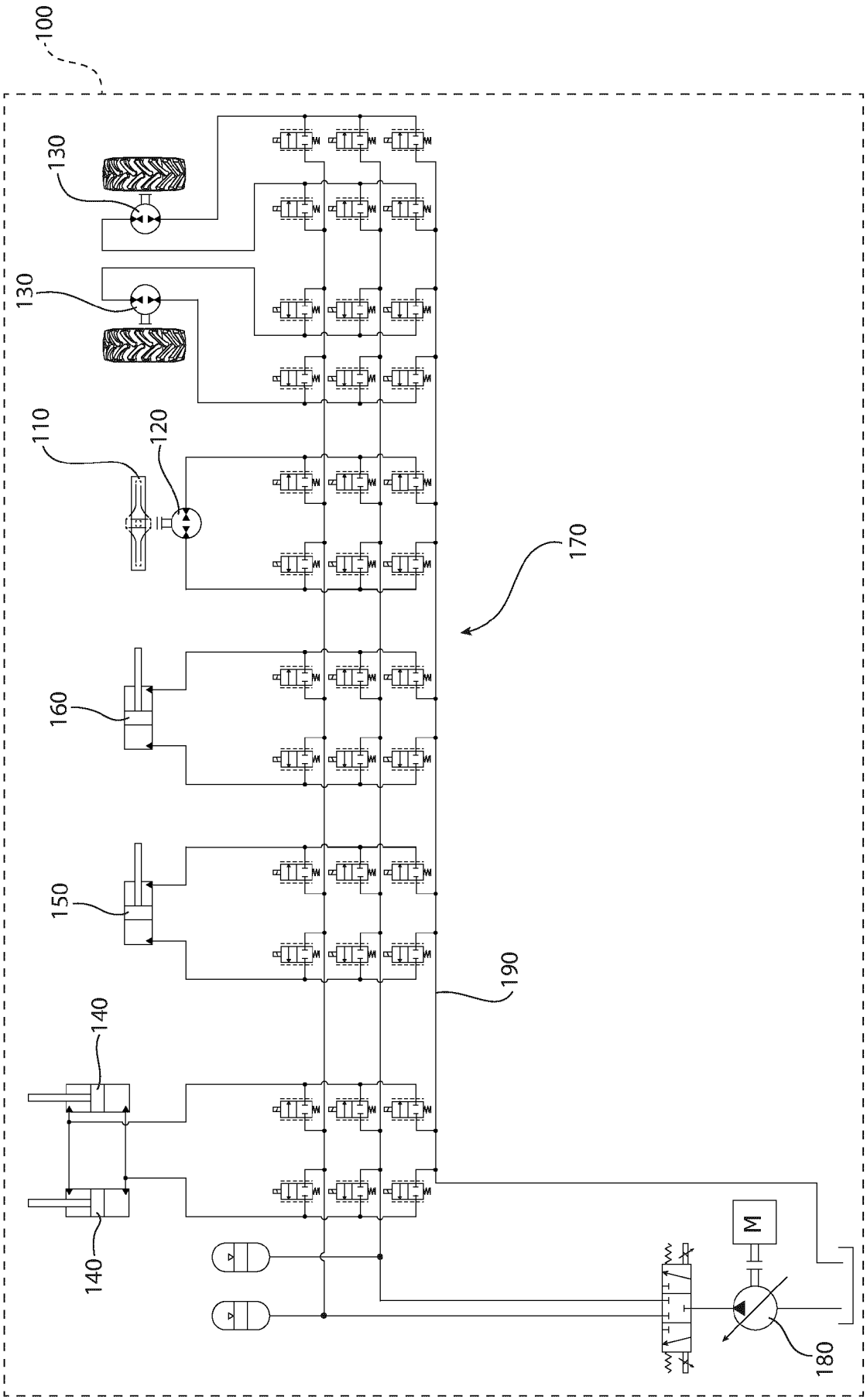

FIG. 1

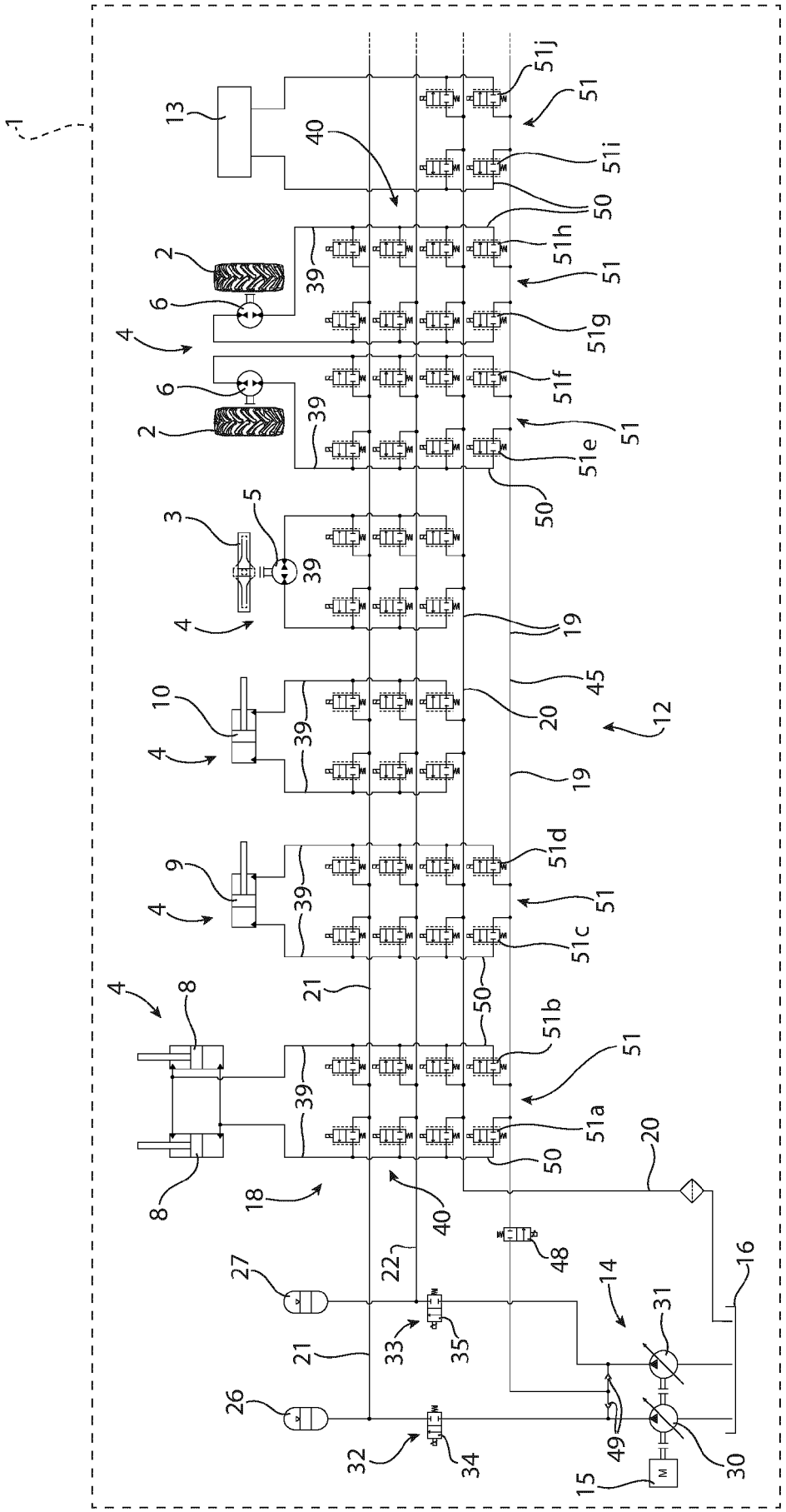
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FIG. 2

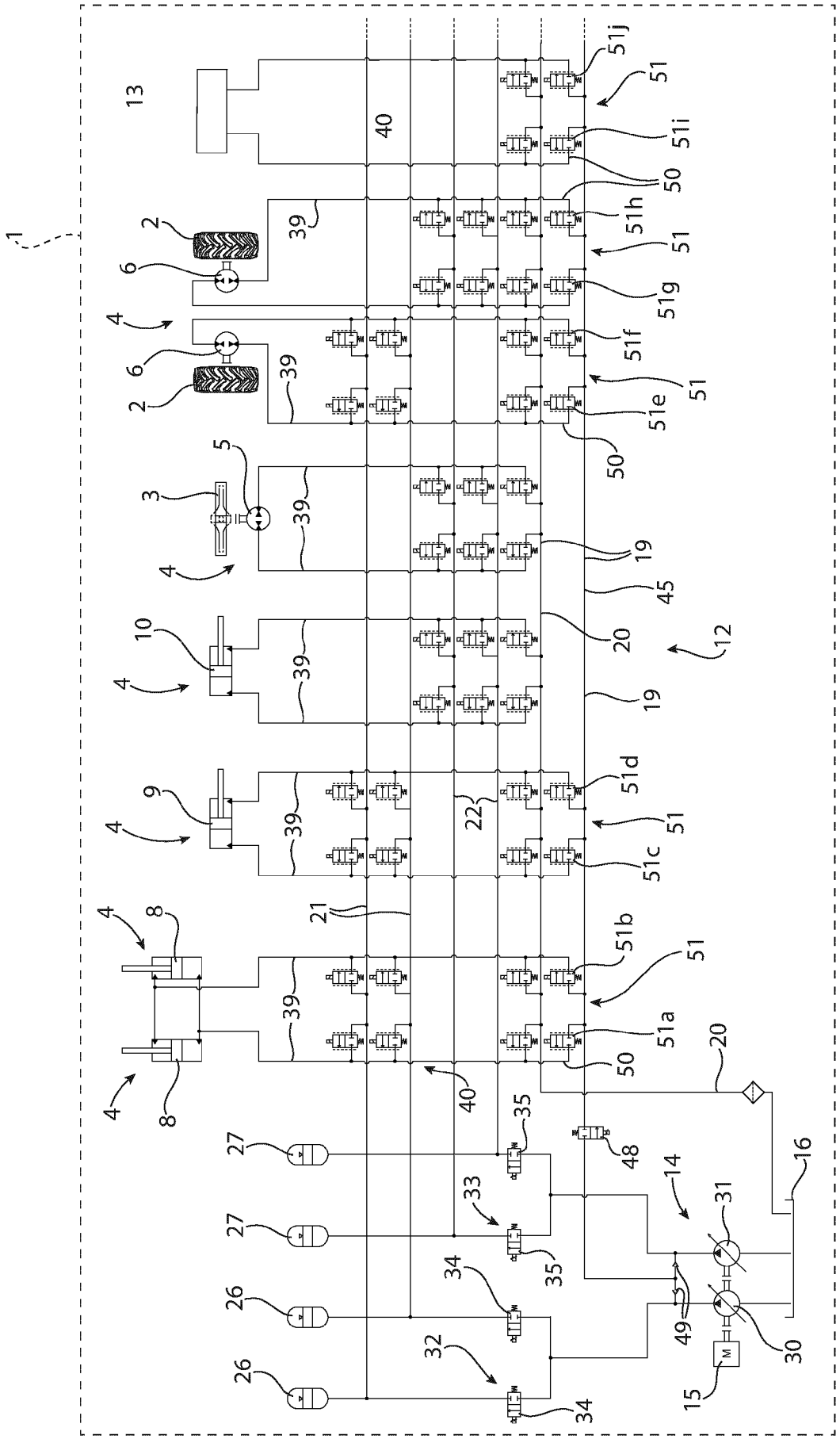
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FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 24 22 0538

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 4 224 019 A1 (DANFOSS SCOTLAND LTD [GB]) 9 August 2023 (2023-08-09) * the whole document *	1-11	INV. E02F9/22 F15B11/17 F15B1/02
A	GUO XIAOFAN ET AL: "A Variable Pressure Multi-Pressure Rail System Design for Agricultural Applications", ENERGIES, vol. 15, no. 17, 25 August 2022 (2022-08-25), page 6173, XP093178907, CH ISSN: 1996-1073, DOI: 10.3390/en15176173 * page 6, paragraph 2.2; figure 5 *	1-11	F15B21/14

TECHNICAL FIELDS SEARCHED (IPC)

E02F
F15D
F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	13 May 2025	Kühn, Thomas

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