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

(11) **EP 4 303 438 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
10.01.2024 Bulletin 2024/02

(21) Application number: **23183000.1**

(22) Date of filing: **03.07.2023**

(51) International Patent Classification (IPC):
F04B 1/295 *(2020.01)* ***F04B 1/324*** *(2020.01)*
F04B 17/03 *(2006.01)* ***F04B 17/05*** *(2006.01)*
F04B 17/06 *(2006.01)* ***F04B 49/06*** *(2006.01)*
F04B 49/20 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F04B 1/295; F04B 1/324; F04B 17/03; F04B 17/05; F04B 17/06; F04B 49/065; F04B 49/20;
F04B 2201/1201; F04B 2203/0209;
F04B 2203/0605

(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:
KH MA MD TN

(30) Priority: **08.07.2022 IT 202200014464**

(71) Applicant: **Robert Bosch GmbH**
70442 Stuttgart (DE)

(72) Inventors:
- **Mueller, Matthias**
  89129 Langenau (DE)
- **Herrmann, Ronny**
  89129 Langenau (DE)

(54) **METHOD OF ADJUSTING A HYDROSTATIC TRACTION SYSTEM**

(57) The present invention relates to a method for adjusting a hydrostatic drive system of a mobile work machine, wherein said hydrostatic drive system comprises a drive motor and a hydraulic pump (12), the rotation of which is ensured by said drive motor, and at least one hydraulic motor (3) connected in a closed circuit to said hydraulic pump (12), wherein said hydraulic pump (12) has an adjustment unit (16) for adjusting the displacement of said hydraulic pump (12), wherein said displacement is adjustable by adjusting an angle of inclination (α_{pmp}) of an inclined element (2), said method being characterized by comprising the following steps:

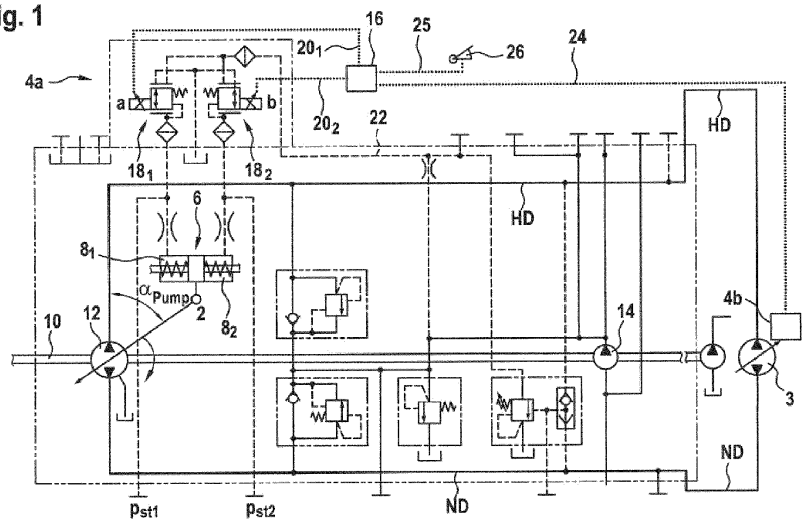
a. Receive an information regarding a desired speed (v_T) of said mobile work machine;

b. Determine (100) a minimum number of revolutions (n_{MIN}) of said drive motor capable of enabling said mobile work machine to reach said desired speed (v_T);

c. Adjust (104) said drive motor taking into consideration said calculated minimum number of revolutions (n_{MIN}).

d. .

Fig. 1



EP 4 303 438 A1

Description

TECHNICAL FIELD.

[0001] The present invention relates to the field of a method of adjusting a hydraulic pump control system for a hydrostatic traction system, a computing unit adapted to perform such a method, an working machine includes such a computing unit, a computer program that induces a computing unit to perform such a method, and a readable storage medium on which such a program is stored.

BACKGROUND

[0002] Mobile work machines with a hydrostatic drive system are commonly used in the state of the art. A drive motor (such as a diesel engine or electric motor) is configured to ensure the rotation of one or more hydraulic pumps mechanically connected to it. Such one or more hydraulic pumps enable the transformation of mechanical energy received from said drive motor into hydraulic energy, in the form of pressure. At least one hydraulic motor is hydraulically connected to said one or more hydraulic pumps so as to enable the transformation of said pressure supplied by said pump into mechanical energy.

[0003] Such a hydrostatic transmission is commonly known by the term hydrostatic continuously variable transmission (commonly called CVT transmission).

[0004] In hydraulic traction transmissions, load-sensitive axial piston swashplate hydraulic pumps (so-called ET pumps) in a closed loop are usually used. Such pumps presented the characteristic that an increase in load tends to decrease the pump's tilt angle. Therefore, if, for example, the working machine starts a climb, the load that the machine has to support will go up. This will then cause the angle of inclination of the pump to decrease. The advantage of these ET pumps is that the power and pressure controls are very simple.

[0005] In construction machines with CVT transmission, the speed (the speed) of the drive motor is set directly by the driver using a hand throttle or foot pedal.

[0006] If the speed is set via the hand throttle, the speed is typically constant; the CVT transmission is controlled in such a way that a defined vehicle speed can be set via the accelerator pedal. This solution has the disadvantage that too high speeds cause inefficiency of the system, and that for too low speeds it forces the driver to make a manual correction so as to ensure the necessary power to drive the working machine on which said hydrostatic drive system is arranged.

[0007] If the speed is set by the pedal, the variable speed serves as a reference variable for setting the transmission ratio. This solution is particularly disadvantageous in that in order to provide the necessary power required by the pedal, too high speeds are reached, which are disadvantageous both from the point of view of energy efficiency and from the point of view of the noise caused.

[0008] These strategies are implemented in different working modes, which the driver selects.

[0009] In addition, drive motor control strategies are known that set the optimal speed for consumption based on a desired driving performance, for example, based on a required torque. This solution has the disadvantage that oscillations are realized and control of the CVT transmission, which is completely disconnected from the drive motor speed, is required.

[0010] Therefore, the goal is to provide a method to solve these problems without having to resort to additional components or having particularly complex control systems.

SUMMARY

[0011] The present invention relates to a method containing the features listed in claim 1.

[0012] With the form of embodiment described in claim 1, it is indeed possible to achieve a simple Eco-Strategy without the need to calculate energy requirements and power capabilities. There is then a particular ease of parameterization, and the speed setting is particularly easy to stabilize when compared with the state of the art.

[0013] Preferable forms of implementation are given in the dependent claims.

BRIEF DESCRIPTION OF THE FIGURES

[0014] The present invention will be described with reference to the attached figures in which the same numbers and/or reference marks indicate the same and/or similar and/or corresponding parts of the system.

Figure 1 shows a hydraulic diagram of a propulsion of an working machine according to a scheme known from the state of the art;

Figure 2 shows a function for adjusting a hydrostatic drive system of a mobile work machine according to a form of embodiment of the present invention.

DETAILED DESCRIPTION

[0015] In the following, the present invention is described by referring to particular forms of embodiment as illustrated in the attached drawing plates. However, the present invention is not limited to the particular forms of embodiment described in the following detailed description and depicted in the figures, but rather the forms of embodiment described simply exemplify the various aspects of the present invention, the scope of which is defined by the claims. Further modifications and variations of the present invention will appear clear to the person in the art.

[0016] In this description, the term working machine is used to refer to any man-driven (or even remotely operated) mechanical means of transporting people, animals,

or things, whether circulating on the road or usable off the road, such as on construction sites, quarries, or mining operations, etc. Thus, an example of a vehicle may be a construction machine such as a bulldozer. In general, a vehicle is defined as any vehicle capable of performing vehicle displacement.

[0017] Figure 1 shows a hydraulic diagram of a traction system for a working machine with respect to which an adjustment method may be used according to an embodiment of the present invention. Only the components essential to the invention are described. The system has a casing 1 on which two working connections are formed to which a working line of a closed circuit, for example a hydraulic motor 3 such as that shown in the figure, is connected respectively. In this way a drive system for a mobile working machine (not shown), such as a bulldozer, is formed.

[0018] The axial piston pump 12 is made with an oblique disc 2 (also referred to more generally as an oblique element) whose angle of oscillation α_{pmp} can be set by means of an adjusting unit 4, so as to go to adjust the displacement of the pump itself. A double-action regulating cylinder 6 is used for this purpose, which has a first chamber 8_1 of the regulating pressure and a second chamber 8_2 of the regulating pressure acting in the opposite direction to the first chamber.

[0019] A first control pressure p_{st1} acts in the first chamber of control pressure 8_1 in the direction of an increase in swing angle α_{pmp} and thus in the direction of an increase in pump displacement 12. In the opposite direction to this, a second control pressure p_{st2} in the second chamber 8_2 acts in the direction of a reduction in the oscillation angle α_{pmp} and thus in the direction of a reduction in pump displacement 12. In this way, a difference in control pressure Δ_{pst} can be defined given by the difference of the first and second control pressures p_{st1}, p_{st2}, this difference in control pressure Δpst by definition always acts in the direction of an increase in the oscillation angle α_{pmp} and thus in the displacement itself.

[0020] Through a drive shaft 10 of the axial piston pump, its drive unit is driven and in addition also a feed pump 14. Drive shaft 10 can be driven by a diesel engine (not shown) or alternatively also by an electric motor and rotates with a variable number of revolutions. This number of revolutions acts together with the control pressure difference in the direction of an increase in the oscillation angle α_{pmp}.

[0021] In the particular example shown in the figure, the axial piston pump 12, in the case of forward travel, feeds a high pressure line HD which allows it to supply a certain pressure to the hydraulic motor 3. The high pressure HD, which is also referred to as working pressure, acts in the direction of a reduction in the oscillation angle α_{pmp}. These relationships are called axial piston pump characteristic and are stored in an electronic control unit 16 in the form of formulas and/or as characteristic diagrams and/or characteristic lines or more in general functions.

[0022] The two control pressures are controlled by two pressure reducing valves 18_1, 18_2. These respectively have an electric magnet a, b, which via a respective electrical line 20_1, 20_2 is connected with the electronic control unit 16. The two pressure reduction valves 18_1, 18_2 are designed so that the respective control pressure p_{st1}, p_{st2} is proportional to the respective current intensity (20_1, 20_2).

[0023] The two pressure reducing valves 18_1, 18_2 are supplied on the inlet side via a supply pressure line 22 from supply pump 14.

[0024] With reference to Figure 2, a method of adjusting a hydrostatic drive system of a mobile work machine such as that shown in Figure 1 will now be presented. Thus, the hydrostatic traction system comprises a drive motor and hydraulic pump 12, the rotation of which is ensured by said drive motor, and at least one hydraulic motor 3 connected in a closed circuit to said hydraulic pump 12, wherein said hydraulic pump 12 has the adjustment unit 16 for adjusting the displacement of said hydraulic pump 12, wherein said displacement is adjustable by adjusting the angle of inclination α_{pmp} of the inclined element 2.

[0025] In a first step of such a method the reception of an information regarding a desired speed v_T of said mobile working machine takes place. This desired speed may be, for example, the speed requested by a user via a foot pedal or even via a joystick.

[0026] In a second step 100 the determination of a minimum number of revolutions n_{MIN} of said drive motor capable of enabling said mobile work machine to reach said desired speed v_T takes place.

[0027] Said determination of said minimum number of revolutions n_{MIN} may be performed substantially by two alternative methods. As will be clear from the description in both methods the minimum number of revolutions is calculated. By "calculate" we mean that the desired value is the result of a mathematical operation such as using a function or a direct calculation. Therefore, in light of the two examples described, it is clear that "calculate" does not identify merely the mathematical calculation but the fact that on the basis of an input variable that desired value is derived.

[0028] According to a first form of implementation, a flow balance equation and a hydrostatic drive system efficiency criterion can be used. This is because in order to achieve a given speed of the working machine, there are infinite combinations of values of the hydrostatic transmission ratio and the speed of the traction motor, which can be determined by means of a flow balancing equation. Therefore, the "ideal" condition among the possible ones can be chosen on the basis of an efficiency criterion. Basically, on the basis of the desired speed v_T a simulation takes place, the result of which is the value of the number of revolutions capable of allowing that final speed to be reached under an ideal condition.

[0029] According to a second form of implementation, on the other hand, the determination of the minimum

number of revolutions n_{MIN} takes place by means of a function describing for each desired speed v_T of said mobile work machine at least one value of said minimum number of revolutions n_{MIN} of said drive motor capable of allowing to reach said desired speed v_T, at a predefined condition of said mobile work machine. Said predefined condition preferably corresponds to the translation of said mobile work machine along a flat surface.

[0030] A method by which this function can be derived will be briefly presented below.

[0031] Empirically, an initial test speed is set that must be maintained by said mobile working machine during an initial test. It starts with a fairly high number of revolutions value so as to ensure that the first speed is reached. At the same time the number of revolutions of said drive motor is progressively decreased thus going to change the gear ratio accordingly, while keeping, however, both the speed and the predefined condition (e.g., movement on a flat or inclined surface) constant.

[0032] In a basically constant manner, the efficiency of said hydrostatic drive system is detected, i.e., the ratio between the output power supplied (which remains constant since the speed is constant) and the input power supplied by the drive motor.

[0033] When it is detected that the efficiency reaches an optimal value, a first number of revolutions of said drive motor is detected at which said efficiency was detected. It is clear that in the same way it is monitored that certain conditions are met, for example, the pressure within the hydrostatic drive cannot exceed a predetermined threshold value.

[0034] This method is repeated equally for at least a second test speed, obtaining a second number of revolutions of said drive motor at which said efficiency was detected.

[0035] The function is then derived by interpolating the detected values of said number of revolutions for said at least two test speeds. It is clear that, in order to improve the accuracy of said function it will be particularly advantageous to have a number of test speeds greater than two so as to have a function that better reflects the behavior at the desired speed range v_T (e.g., equal to three, four or five test speeds)

[0036] Parallel to the determination of said minimum speed n_{MIN}, according to a preferred form of realization, a comparison 101 of said desired speed v_T of said mobile working machine with a current speed va,of said mobile working machine takes place.

[0037] Based on said comparison, a correction value n_{off} of said minimum speed n_{MIN} of said drive motor is calculated. Preferably said correction value n_{off} is constantly filtered 102 before being used to adjust said drive motor.

[0038] Said correction value n_{off} is preferably added 103 to said minimum number of revolutions n_{MIN} obtaining a corrected minimum number of revolutions nT. Said drive motor is then preferably adjusted by taking into consideration said minimum corrected number of revolutions n_T.

[0039] According to a preferred embodiment, the drive motor is further adjusted by taking into consideration a minimum speed n_{WO} of said drive motor required by a work function of said mobile work machine.

[0040] Therefore, in step 104 shown in the figure, the maximum value between the minimum required speed nwo, for example due to the speed required for moving a mechanical arm by means of a hydrostatic cylinder, and minimum required speed n_T will be taken.

[0041] The present invention also describes a computational unit adapted to perform a method according to any of the forms of embodiments presented above.

[0042] In addition, the present description includes a computer program that induces a computing unit to perform a method as described in the present invention.

[0043] A readable storage medium comprising the computer program stored thereon described above is also described.

[0044] Although the present invention has been described with reference to the forms of embodiment described above, it is clear to the person skilled in the art that various modifications, variations, and improvements of the present invention in light of the teaching described above and within the scope of the appended claims are possible without departing from the subject matter and scope of protection of the invention.

[0045] Finally, those areas that are believed to be known by experts in the field have not been described to avoid overshadowing the described invention unnecessarily.

[0046] Accordingly, the invention is not limited to the forms of embodiment described above, but is only limited by the scope of protection of the appended claims.

Claims

1. A method for adjusting a hydrostatic drive system of a mobile work machine, wherein said hydrostatic drive system comprises a drive motor and a hydraulic pump (12), the rotation of which is ensured by said drive motor, and at least one hydraulic motor (3) connected in a closed circuit to said hydraulic pump (12), wherein said hydraulic pump (12) has an adjustment unit (16) for adjusting the displacement of said hydraulic pump (12), wherein said displacement is adjustable by adjusting an angle of inclination (α_{pmp}) of an inclined element (2), said method being **characterized by** comprising the following steps:

    a. Receive an information regarding a desired speed (v_T) of said mobile work machine;
    b. calculate (100) a minimum number of revolutions (n_{MIN}) of said drive motor capable of enabling said mobile work machine to reach said desired speed (v_T);
    c. Adjust (104) said drive motor taking into con-

sideration said calculated minimum number of revolutions (n_{MIN}).

2. Method according to claim 1, wherein the calculation of said number of revolutions in said step b. is carried out by using a flow balancing equation and an efficiency criterion of said hydrostatic drive system.

3. Method according to claim 1, wherein the calculation of said number of revolutions in said step b. is carried out by using a function describing for each desired speed (v_T) of said mobile work machine at least a value of said minimum number of revolutions (n_{MIN}) of said drive motor capable of allowing said desired speed (v_T) to be reached, corresponding to a predefined condition of said mobile work machine.

4. Method according to claim 3, wherein said predefined condition corresponds to a translation of said mobile work machine along a flat surface.

5. Method according to claim 2 or 3, wherein said function is derived by repeating for at least two different test speeds the following steps:

- Maintain a constant speed equal to a test speed the speed of said mobile work machine and at the same time gradually decrease the speed of said drive motor;
- Substantially constant detect the efficiency of said hydrostatic drive system;
- Detect the number of revolutions of said drive motor at which said efficiency reaches a predetermined value;

wherein said function is derived by interpolating the detected values of said number of revolutions for said at least two test speeds.

6. A method according to any one of claims 1 to 5, wherein said method further comprises the following steps:

d. Compare (101) said desired speed (v_T) of said mobile work machine with a current speed (v_A) of said mobile work machine,
e. Calculate a correction value (n_{off}) of said minimum speed (n_{MIN}) of said drive motor calculated in said step b based on said comparison of step d.;

wherein in said step c. said drive motor is further adjusted on the basis of said correction value (n_{off}) calculated in said step e..

7. Method according to claim 6, wherein said correction value (n_{off}) is continuously filtered (102) before being used to adjust said drive motor in said step c.

8. Method according to any one of claims 6 or 7, wherein said correction value (n_{off}) is added (103) to said minimum number of revolutions (n_{MIN}) calculated in said step b. resulting in a corrected minimum number of revolutions (n_T) and wherein in said step c. said drive motor is adjusted taking said corrected minimum number of revolutions (n_T) into consideration.

9. A method according to any one of claims 1 to 8, wherein said drive motor is adjusted by further considering a minimum speed (n_{WO}) of said drive motor required by a work function of said mobile work machine.

10. A method according to any one of claims 1 to 8, wherein said regulating unit has a regulating cylinder (6) with a first regulating pressure chamber (8_1) in which, by means of a first valve (18_1), a first regulating pressure (p_{st1}) can be set which depends on a first current intensity (I_1) of the first valve (18_1) and which is configured to affect the inclination (α_{pmp}) of said inclined element (2), in which said control unit (4) is configured so that an increase in the delivery pressure of the hydraulic pump (2) tends to cause a reduction in the displacement of the hydraulic pump (12).

11. A calculation unit containing means for performing a method according to any of the preceding claims.

12. An working machine comprising a hydrostatic drive system, wherein said hydrostatic drive system comprises said hydraulic pump (12), the rotation of which is provided by a drive motor, and at least one hydraulic motor connected in a closed circuit to said hydraulic pump (12), wherein said hydraulic pump (12) has an adjusting unit (4) for adjusting the displacement of said hydraulic pump, wherein said displacement is adjustable by adjusting an angle of inclination (α_{pmp}) of an inclined element (2), wherein said adjusting unit (4) has an adjusting cylinder (6) with a first adjusting pressure chamber (8_1) in which, by means of a first valve (18_1) a first regulating pressure can be set which depends on a first current intensity (I_1) of the first valve (18_1) and which is configured to affect the inclination (α_{pmp}) of said inclined element (2), wherein said regulating unit (4) is configured such that an increase in the delivery pressure of the hydraulic pump (2) tends to cause a reduction in the displacement of the hydraulic pump (12), wherein said working machine comprises a calculation unit according to claim 11.

13. A computer program comprising instructions which, when the program is executed by a computer, cause the computer to perform the steps of the method of any one of claims 1 to 10.

14. A computer-readable storage medium comprising instructions which, when executed by a computer, cause the computer to execute the method steps of any one of claims 1 to 10.

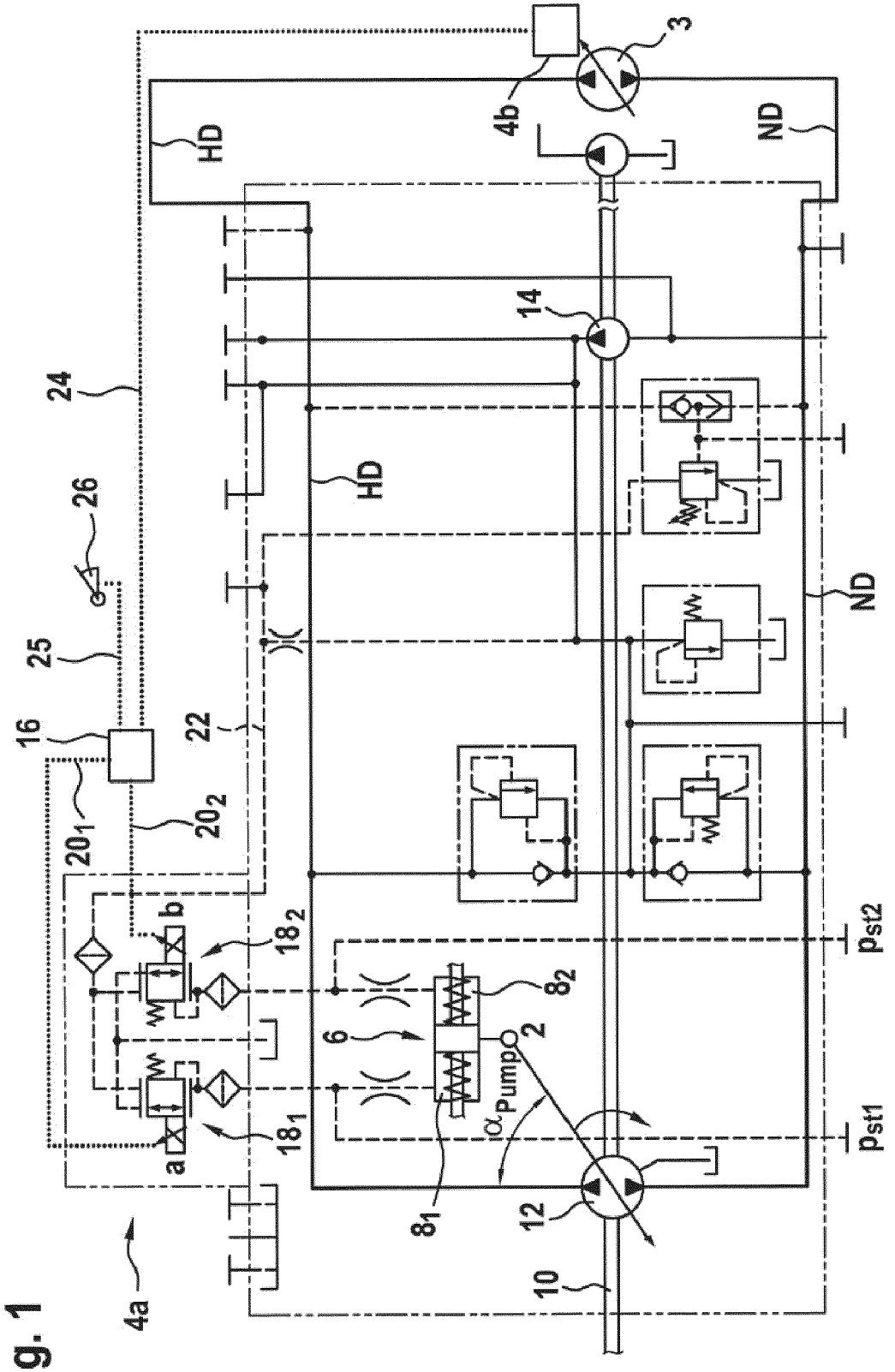

3
4b
HD
ND
14
24
26
25
16
22
20_1
20_2
18_2
18_1
8_2
8_1
6
2
α_{Pump}
12
10
4a
a
b
p_{st2}
p_{st1}

Fig. 1

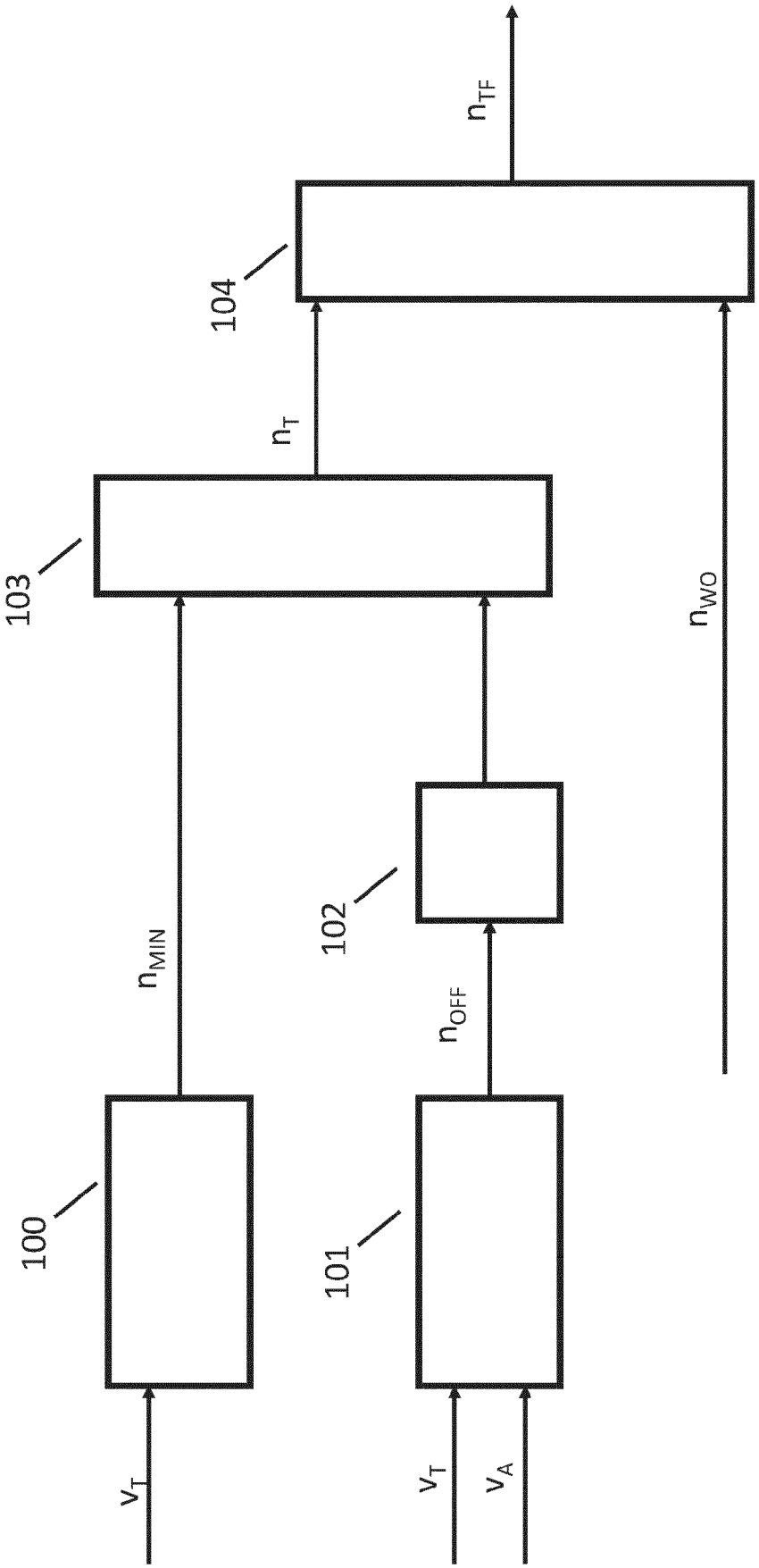


Fig. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 23 18 3000

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	EP 0 908 564 A2 (HITACHI CONSTRUCTION MACHINERY [JP]) 14 April 1999 (1999-04-14) * figures 1-7 * * paragraph [0013] - paragraph [0087] *	1-14	INV. F04B1/295 F04B1/324 F04B17/03 F04B17/05
X A	US 2020/003301 A1 (MUELLER MATTHIAS [DE] ET AL) 2 January 2020 (2020-01-02) * figures 1-4 * * paragraph [0047] - paragraph [0069] *	1-8, 10-14 9	F04B17/06 F04B49/06 F04B49/20
A	US 2006/113140 A1 (NAKAMURA TSUYOSHI [JP] ET AL) 1 June 2006 (2006-06-01) * figures 1-14 * * paragraph [0045] - paragraph [0129] *	1-14	
A	US 11 002 266 B2 (BRAHMER BERT [DE]) 11 May 2021 (2021-05-11) * figures 1-6 * * column 6, line 8 - column 12, line 10 *	1-14	
A	US 2020/332891 A1 (BENDER FRANK [DE] ET AL) 22 October 2020 (2020-10-22) * figures 1-4 * * paragraph [0051] - paragraph [0073] *	1-14	TECHNICAL FIELDS SEARCHED (IPC) F04B
A	US 2021/382444 A1 (BRIX NORMAN [DE] ET AL) 9 December 2021 (2021-12-09) * figures 1-2 * * paragraph [0035] - paragraph [0073] *	1-14	
A	US 2014/180550 A1 (VORA KUSHAN [US] ET AL) 26 June 2014 (2014-06-26) * figures 1-3 * * paragraph [0017] - paragraph [0032] *	1-14	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	30 August 2023	Ricci, Saverio

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 18 3000

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-08-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0908564 A2	14-04-1999	CN 1213728 A	14-04-1999
		DE 69830633 T2	04-05-2006
		EP 0908564 A2	14-04-1999
		JP 3511453 B2	29-03-2004
		JP H11108003 A	20-04-1999
		KR 19990036896 A	25-05-1999
		US 5911506 A	15-06-1999
US 2020003301 A1	02-01-2020	CN 110657234 A	07-01-2020
		DE 102018210685 A1	02-01-2020
		EP 3587794 A1	01-01-2020
		US 2020003301 A1	02-01-2020
US 2006113140 A1	01-06-2006	CN 1756900 A	05-04-2006
		CN 101387116 A	18-03-2009
		CN 101387117 A	18-03-2009
		EP 1650418 A1	26-04-2006
		EP 2119836 A1	18-11-2009
		JP 4484467 B2	16-06-2010
		JP 2005054414 A	03-03-2005
		KR 20060025127 A	20-03-2006
		US 2006113140 A1	01-06-2006
		WO 2005012711 A1	10-02-2005
US 11002266 B2	11-05-2021	CN 110959071 A	03-04-2020
		DE 102017117595 A1	07-02-2019
		DE 112018003927 A5	30-04-2020
		US 2020166029 A1	28-05-2020
		WO 2019025478 A1	07-02-2019
US 2020332891 A1	22-10-2020	CN 111828622 A	27-10-2020
		DE 102019205505 A1	22-10-2020
		EP 3726053 A1	21-10-2020
		US 2020332891 A1	22-10-2020
US 2021382444 A1	09-12-2021	DE 102020206874 A1	09-12-2021
		FR 3111156 A1	10-12-2021
		US 2021382444 A1	09-12-2021
US 2014180550 A1	26-06-2014	EP 2746467 A1	25-06-2014
		EP 2746468 A1	25-06-2014
		EP 2746469 A1	25-06-2014
		EP 2746470 A1	25-06-2014
		US 2014174066 A1	26-06-2014
		US 2014174067 A1	26-06-2014
		US 2014180542 A1	26-06-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 23 18 3000

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

30-08-2023

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		US 2014180550 A1	26-06-2014

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82