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

(11) **EP 4 116 505 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
11.01.2023 Bulletin 2023/02

(21) Application number: **22182257.0**

(22) Date of filing: **30.06.2022**

(51) International Patent Classification (IPC):
E02F 9/20 *(2006.01)* ***E02F 9/22*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
E02F 9/2012; E02F 9/2228

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **08.07.2021 IT 202100018038**

(71) Applicant: **CNH Industrial Italia S.p.A.**
10156 Torino (IT)

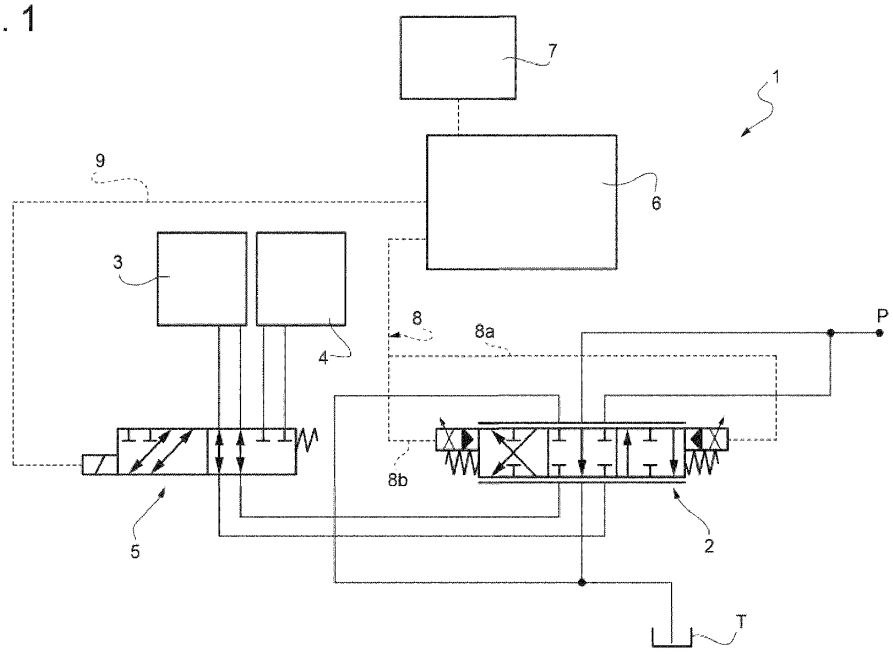
(72) Inventors:
- **GARRAMONE, Adriano**
  73100 Lecce (IT)
- **GIRARDI, Mario**
  73100 Lecce (IT)
- **GRAVILI, Andrea**
  CAP 73100 Lecce (IT)
- **LIBERTI, Stefano**
  73100 Lecce (IT)

(74) Representative: **CNH Industrial IP Department**
Leon Claeysstraat 3A
8210 Zedelgem (BE)

(54) HYDRAULIC CONTROL SYSTEM FOR CONTROLLING AN OPERATION OF A WORK VEHICLE AND RELATED METHOD

(57) Hydraulic control system (1) for controlling at least a third operation actuator (3; 4) of a work vehicle, provided with valve means (2) fluidly interposed between a third operation actuator (3; 4), a source of fluid in pressure (P) and a discharge (T) and an electronic control unit (6) comprising elaboration means configured to receive a plurality of input (7) and to provide an output signal (8) to control the valve means (2) for operating the third operation actuator (3; 4).

FIG. 1



EP 4 116 505 A1

Description

TECHNICAL FIELD

[0001] The present invention concerns a hydraulic control system and related method for a work vehicle.

[0002] The present invention finds its preferred, although not exclusive, application in control of a third operation function in earth moving machines such as wheel loaders or scrapers.

BACKGROUND OF THE INVENTION

[0003] Work vehicles such as earth moving machines are provided with a plurality of hydraulic circuits for operating their operational systems.

[0004] In particular, earth-moving machines such as wheel loaders or scrapers are provided with a bucket and a boom operated by a hydraulic circuit and with other essential hydraulic systems such as the hydrostatic transmission, the brake system or the steering.

[0005] In general the hydraulic circuit may be utilized also for controlling at least a further hydraulic function, that is usually known as "third function".

[0006] In order to do so, the user may control the joystick to activate such third function and maintain the latter via a mechanical detent on a control lever.

[0007] However, it is clear that such mechanical detent is costly and occupies space.

[0008] Therefore, the need is felt to provide system and method for controlling a third operation on work vehicle that is efficient and comfortable for the user.

[0009] An aim of the present invention is to satisfy the above mentioned needs in a cost effective and optimized way.

SUMMARY OF THE INVENTION

[0010] The aforementioned aim is reached by a control hydraulic system and a related method as claimed in the appended set of claims.

BRIEF DESCRIPTION OF DRAWINGS

[0011] 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 third function hydraulic control system according to the invention; and
- Figure 2 is a schematic representation of an electronic control system for the hydraulic system of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0012] Figure 1 discloses a control hydraulic system 1 of a work vehicle (not shown) comprising, inter alia, an electric valve 2 configured to control an additional function actuator, namely a so-called third function actuator 3, of the work vehicle.

[0013] With third function actuator 3 it is intended an actuator configured to control a further operational function of the vehicle such as control of an attachment, of brushes control system or anything other than the boom control or the bucket control that may be defined as first and second function.

[0014] As per se known, the first and second functions, i.e. the boom and bucket control, are controlled by related control valves that are not here described for sake of brevity.

[0015] As depicted in the disclosed embodiment it may further be present a fourth function actuator 4, that is further addition to third function and may be one of the above listed ones.

[0016] In greater detail, if the fourth function actuator 4 is present, the third and fourth actuators 3, 4 may be selected via valve means 5, as described in detail in the following.

[0017] In particular valve 2 may be a six ways proportional valve wherein the six ways are fluidly connected respectively to a tank T of the vehicle, to a source P of fluid in pressure and to valve means 5. The valve 2 may therefore assume at least the following limit positions, a first limit position wherein fluid may flow from source P to valve means 5 in a first circulation direction with respect to tank T, a second limit position opposite with respect to the preceding and a third position wherein the source P is directly connected to tank T, i.e. tank T and source P are not fluidly connected to valve means 5 (as represented in figure 1).

[0018] Valve means 5 may be realized as a diverter that is configured as a four ways-two positions electro-actuated valve. Diverter 5 may therefore assume a first position wherein the third operation actuator 3 is fluidly connected to valve 2 and the fourth operation actuator 4 is fluidly isolated and a second position wherein the fourth operation actuator 4 is fluidly connected to valve 2 and the third operation actuator 3 is fluidly isolated.

[0019] Hydraulic system 1 further comprises an electronic control unit 6 provided with elaboration means configured to elaborate a plurality of inputs 7 and to provide a first control output 8 configured to control the operation of valve 2, i.e. its passage among the first and second limit positions and third positions there between. In particular first control output 8 may comprise a first value output 8a configured to move the valve 2 towards the first limit position and a second value output 8b configured to move the valve 2 towards the second limit position.

[0020] If the fourth operation actuator 4 is present, the electronic control unit 6 may further provide a second

control output 9 configured to control the operation of valve means 5, i.e. its passage between its first and second position.

[0021] In detail, the work vehicle is provided with a joystick to control the different operational elements of the work vehicle, and it is provided with a roller configured to rotate about a rotation axis supported by joystick body and voted to control the operation of the third-fourth operation actuator. In particular, the roller may be rotated clockwise or counterclockwise to provide an opposite flow to the third-fourth operation actuator and control this latter in two different operative conditions.

[0022] Furthermore, the work vehicle is provided with selection means, such as buttons or a display, configured to collect user's inputs as listed below.

[0023] The work vehicle may furthermore be provided with visual output means, such as lights or a display, configured to provide visual signaling or representation of such outputs. The same display that works as selection means may further operate as output means.

[0024] Making reference to figure 2, the electronic control unit 6 is electrically connected to retrieve the following data as inputs 7:

- A first input 7a coming from the roller and detecting the angular run of this latter about its support axis (from 0° to a maximum angular value less than 360°) that is representative of a request of activation to be provided to third-fourth operation actuators 3, 4;
- A second input 7b coming from joystick position sensors and representing other operative circuits of the work vehicle;
- A third input 7e coming from a control unit of the engine of the work vehicle and representing its speed;
- A fourth input 7d coming from selection means of the work vehicle that represents the choice of the user to use the memorization option of the third-fourth operation actuator 3, 4;
- A fifth input 7e representative of the enabling of the hydraulic function of the work vehicle; and
- A sixth input 7f representative of the status of a quick coupler of the work vehicle.
- If present a fourth operation actuator, a seventh input 7g coming from selection means of the work vehicle that represents the choice of the user to use the third-fourth operation actuator 3, 4;

[0025] The outputs provided by control unit 6 may further comprise, in addition to outputs 8, and if present output 9, a third output signal 10 configured to be sent to visual output means to signal to the user the actuators that are in functions.

[0026] The operation of the above disclosed hydraulic control system, making reference to the described embodiment, is the following.

[0027] The electronic control unit 6 send control signal 9 to valve means 5 to selectively put in fluidic communication third or fourth actuators 3, 4 with valve 2 ports.

[0028] Then, the electronic control unit 6 controls via signals 8a, 8b the actuation of valve 2 between the two limits positions to provide fluid between source P, tank T and third/fourth functions actuators 3, 4.

[0029] In particular, when a request of activation is provided to actuator 3, 4 via signals 8a, 8b such activation may be memorized as outlined below.

[0030] The electronic control unit 6 is configured to provide the output signals 8, 9 in function of the inputs 7 according to the below steps:

- Step 1: Detecting that the engine is ON, its speed and that the hydraulic function of the vehicle is enabled;
- Step 2: Controlling the operation of the third actuator 3 in function of the speed of the engine and the position of the roller;
- Step 3: Detecting that the memorizing function of the third function actuator 3 is requested;
- Step 4: Detect the position of the roller;
- Step 5: If the roller is maintained over a preset angular position of its possible rotation for at least a preset time, then enable the memorizing function; and
- Step 6: Maintain the provided operation of the third actuator 3 elaborated at step 2 till a disabling condition of the memorizing function is detected.

[0031] In particular, if at least one among a plurality of conditions, that are continuously detected during the operation of step 2, is verified, then the control of third operation actuator is aborted, the conditions comprising:

- Detecting that a quick coupler of the vehicle is enabled; or
- Detecting that engine is OFF; or
- Detecting that hydraulic function is disabled.

[0032] If a fourth function actuator 4 is present, then the following additional step is present between steps 1 and step 2:

- Step 1.1 Detecting the choice between the third or fourth function actuators 3, 4 to provide output 9 to valve means 5;

then, the steps 2 to 6 will refer to the fourth or third function actuators 3, 4 according to step 1.1

[0033] In particular, the disabling condition may be at least one among the following that are continuously detected during the operation of step 6:

- Detecting that the memorizing function of the third function actuator 3 has been disabled; or

- Detecting a request to activate a fourth request actuator (if present).

[0034] Preferably the above defined step 2 comprises the following sub-steps:

- Step 2.1 Detecting the movement of the roller;
- Step 2.2 Elaborate the value of speed of the engine, and the roller position to provide outputs 8a, 8b to valve 2.

[0035] Preferably, the above defined time is 3 seconds and the preset angular position is a stroke position zone of the roller, e.g. starting from three quarters of the possible angle rotation till its end.

[0036] The above mentioned steps may be executed automatically by elaborations means of the electronic control unit 6.

[0037] In view of the foregoing, the advantages of the hydraulic control system and method according to the invention are apparent.

[0038] Thanks to the provided system it is avoided to use a mechanical detent to memorize the requested activation of third/fourth functions actuator/s.

[0039] Indeed, the detection of a specific angular position of the roller for a preset time substitutes the presence of the mechanical detent. Furthermore, the specific preset time allows to select the memorization of the requested activation without misleading with random short utilization of the actuator.

[0040] Accordingly, the comfort of the operator is increased.

[0041] Furthermore, the costs and space due to the presence of the mechanical detent are avoided.

[0042] It is clear that modifications can be made to the described hydraulic control system and method which do not extend beyond the scope of protection defined by the claims.

[0043] For example, as said, only third function may be present.

[0044] Moreover, valve means 2, and 5 may be substituted by equivalent valve means.

[0045] Furthermore, the preset angular position and time may be varied according to the typology of vehicle and of actuator.

Claims

1. Hydraulic control system (1) for controlling at least a third operation actuator (3; 4) of a work vehicle provided with a joystick and a roller for controlling said third operation actuator (3, 4), said hydraulic control system (1) comprising valve means (2) fluidly interposed between a third operation actuator (3; 4), a source of fluid in pressure (P) and a discharge (T) of said work vehicle, said hydraulic control system (1) comprising an electronic control unit (6) comprising elaboration means configured to receive a plurality of input (7) and to provide an output signal (8) to control said valve means (2) for operating said third operation actuator (3; 4), said input data comprising the following data:

- A first input (7a) coming from said roller and detecting the angular run of this latter about its support axis (from 0° to a maximum angular value less than 360°) that is representative of a request a request activation to be provided to said third operation actuator (3; 4)
- A second input (7b) coming from joystick position sensors and representing a desired actuation of other operative circuits of the work vehicle;
- A third input (7c) coming from a control unit of the engine of the work vehicle and representing its speed;
- A fourth input (7d) coming from selection means of the work vehicle that represents the choice of the user to use the memorization option of said third operation actuator (3; 4)
- A fifth input (7e) representative of the enabling of the hydraulic function of the work vehicle; and
- A sixth input (7f) representative of the status of a quick coupler of the work vehicle.

2. - Hydraulic control circuit according to claim 1, further comprising valve means (5) fluidly interposed between said valve means (2), said third operation actuator (3) and a fourth operation actuator (4) of said work vehicle, said electronic control unit (6) being configured to provide a further output signal (9) to control said valve means (5), said inputs (7) further comprising:

- A seventh input (7g) coming from selection means of the work vehicle that represents the choice of the user to use the third-fourth operation actuator 3, 4.

3. - Hydraulic control circuit according to claim 1 or 2, wherein said valve means (2) comprise a six ways proportional valve configured to assume first limit position wherein fluid may flow from said source (5) towards said third operation actuator (3, 4) in a first circulation direction with respect to said discharge (T), a second limit position opposite with respect to the preceding and a third position wherein said source (P) is directly connected to said discharge (T).

4. - Hydraulic control circuits according to claim 3, wherein said valve means (2) are electro-actuated by said control signal (8), said control signal (8) providing a first value (8a) and a second value (8b) to move, respectively said valve means (2) towards said limit positions.

5. - Hydraulic control circuit according to claim 2, wherein said valve means (5) comprise a four ways-

two positions valve configured to assume a first position wherein only said third operation actuator (3) is fluidly connected to said valve means (2) and a second position wherein only said fourth operation actuator (4) is fluidly connected to said valve means (2).

6. - Hydraulic control circuit according to claim 2, wherein said valve means (5) comprise an electro actuated valve, said output signal (9) moving said valve between said two positions.

7. Method for controlling a third function operation in a hydraulic control system for a work vehicle as claimed in any of the preceding claims comprising the following steps:

- Step 1: Detecting that the engine of said work vehicle is ON, the speed of said engine and that the hydraulic function of said work vehicle is enabled;
- Step 2: Controlling the operation of the third actuator 3 in function of said speed of the engine and the position of the roller;
- Step 3: Detecting that the memorizing function of the third function actuator 3 is requested;
- Step 4: Detect the position of the roller;
- Step 5: If the roller is maintained over a preset angular position of its possible rotation for at least a preset time, then enable the memorizing function; and
- Step 6: Maintain the provided operation of the third actuator 3 elaborated at step 2 till a disabling condition of the memorizing function is detected.

8. Method according to claim 7 wherein, if at least one among a plurality of conditions, that are continuously detected during the operation of step 2, is verified, then the control of third operation actuator is aborted, the conditions comprising:

- Detecting that a quick coupler of the vehicle is enabled; or
- Detecting that engine is OFF; or
- Detecting that hydraulic function is disabled.

9. Method according to claim 7 or 8, when depending on claims 2, 5 or 6, wherein if a fourth function actuator 4 is present, then the following additional step is present between steps 1 and step 2:

- Step 1.1 Detecting the choice between the third or fourth function actuators 3, 4 to provide output 9 to valve means 5;

then, the steps 2 to 6 will refer to the fourth or third function actuators 3, 4 according to detection of step 1.1.

10. Method according to claim 7 to 9, wherein the disabling condition may be at least one among the following conditions that are continuously detected during the operation of step 6:

- Detecting that the memorizing function of the third function actuator 3 has been disabled; or
- Detecting a request to activate a fourth request actuator (if present).

11. Method according to claim 7 to 10, wherein the above defined step 2 comprises the following sub-steps:

- Step 2.1 Detecting the movement of the roller;
- Step 2.2 Elaborate the value of speed of the engine, and the roller position to provide outputs 8a, 8b to valve 2.

12. Method according to claim 7 to 11, wherein the above defined time is 3 seconds

13. Method according to claim 7 to 12, wherein the preset angular position is three quarters of the possible rotation of the roller.

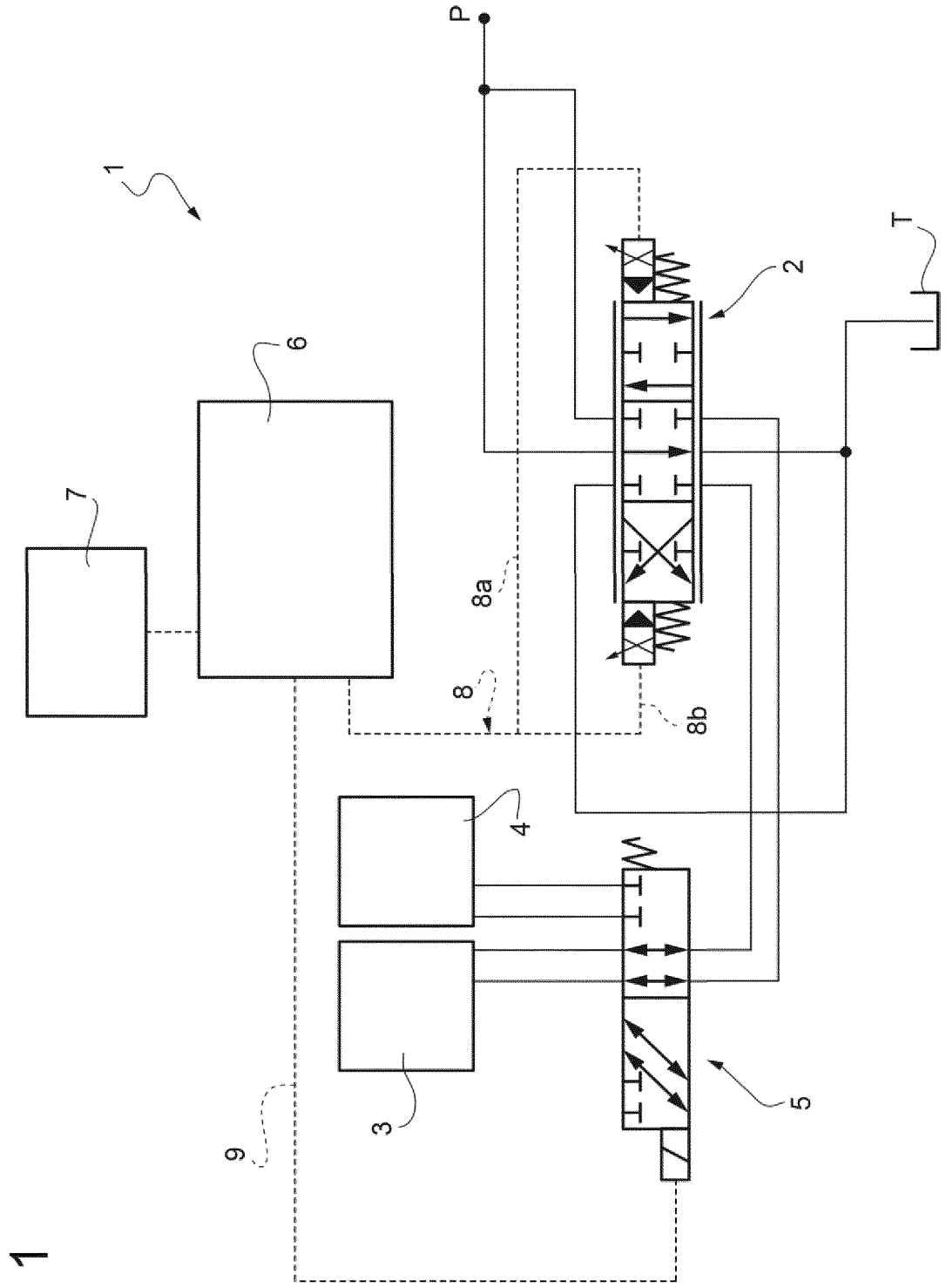


FIG. 1

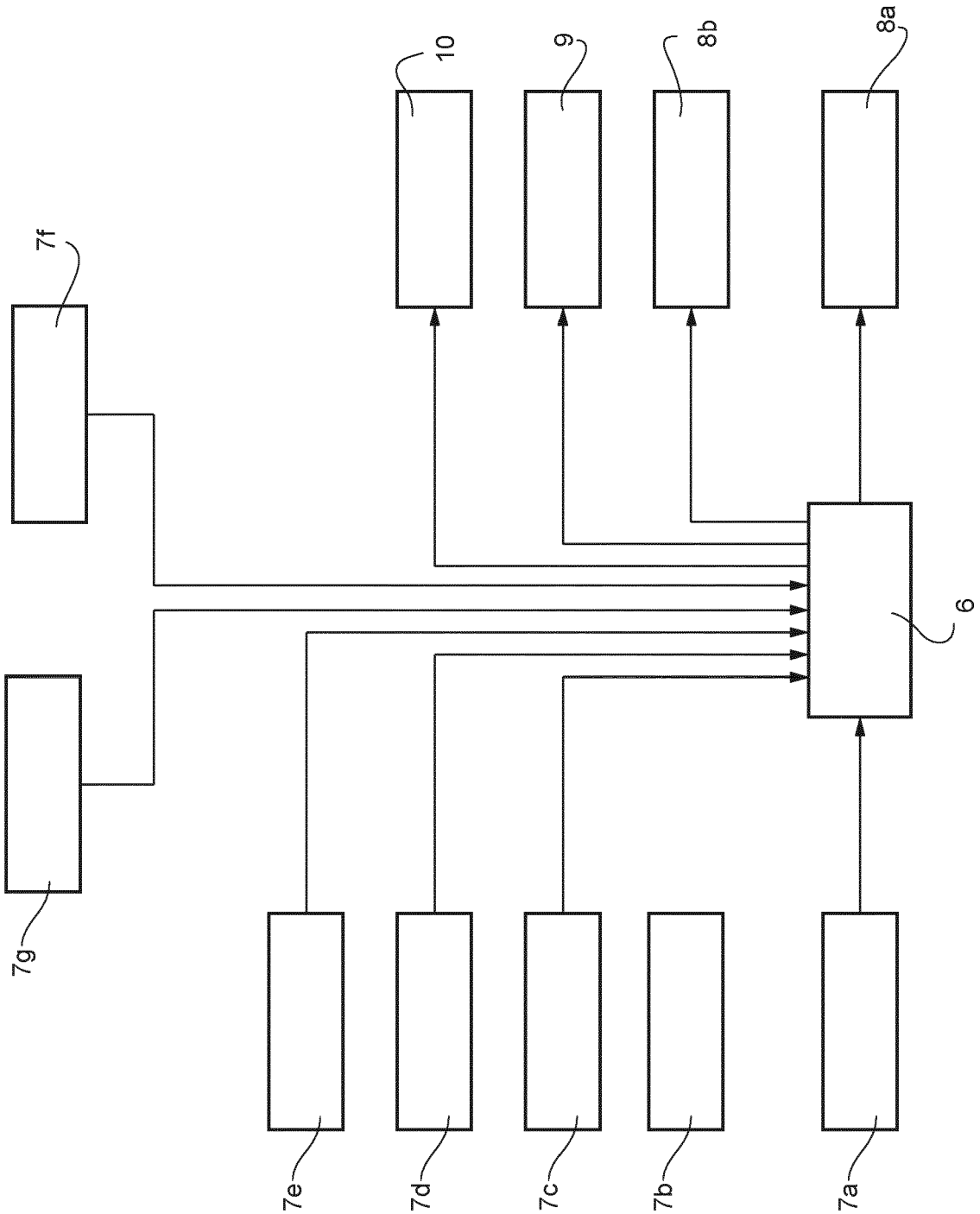


FIG. 2

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 22 18 2257

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y A	EP 3 719 212 A1 (HEXAGON TECHNOLOGY CT GMBH [CH]) 7 October 2020 (2020-10-07) * abstract; figures 1-9 * * paragraphs [0020] - [0029] *	1-6 7-13	INV. E02F9/20 E02F9/22
Y A	EP 2 805 910 A1 (BAMFORD EXCAVATORS LTD [GB]) 26 November 2014 (2014-11-26) * abstract; figures 1-6 * * paragraph [0054]; figure 2 *	1-6 7-13	
A	US 2020/181878 A1 (MAHRENHOLZ JOHN [US] ET AL) 11 June 2020 (2020-06-11) * abstract; figures 1-2b,8 * * paragraphs [0023] - [0050] *	7-13	

TECHNICAL FIELDS SEARCHED (IPC)
E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	31 October 2022	Ferrien, Yann

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 22 18 2257

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.

31-10-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3719212 A1	07-10-2020	CN 111794298 A	20-10-2020
		EP 3719212 A1	07-10-2020
		US 2020318316 A1	08-10-2020
EP 2805910 A1	26-11-2014	AU 2014202689 A1	04-12-2014
		CN 104179217 A	03-12-2014
		EP 2805910 A1	26-11-2014
		EP 3909907 A1	17-11-2021
		ES 2900625 T3	17-03-2022
		GB 2514346 A	26-11-2014
		JP 2014227828 A	08-12-2014
		US 2014343804 A1	20-11-2014
		US 2017016207 A1	19-01-2017
US 2020181878 A1	11-06-2020	AU 2019275647 A1	25-06-2020
		CN 111335376 A	26-06-2020
		DE 102019219159 A1	10-06-2020
		US 2020181878 A1	11-06-2020

EPO FORM P0459

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