(19) Europäisches Patentamt
European Patent Office
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(11) **EP 3 851 650 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
21.07.2021 Bulletin 2021/29

(51) Int Cl.:
F01P 7/04 *(2006.01)* ***F15B 11/16*** *(2006.01)*

(21) Application number: **21152262.8**

(22) Date of filing: **19.01.2021**

(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
KH MA MD TN

(30) Priority: **20.01.2020 IT 202000000964**

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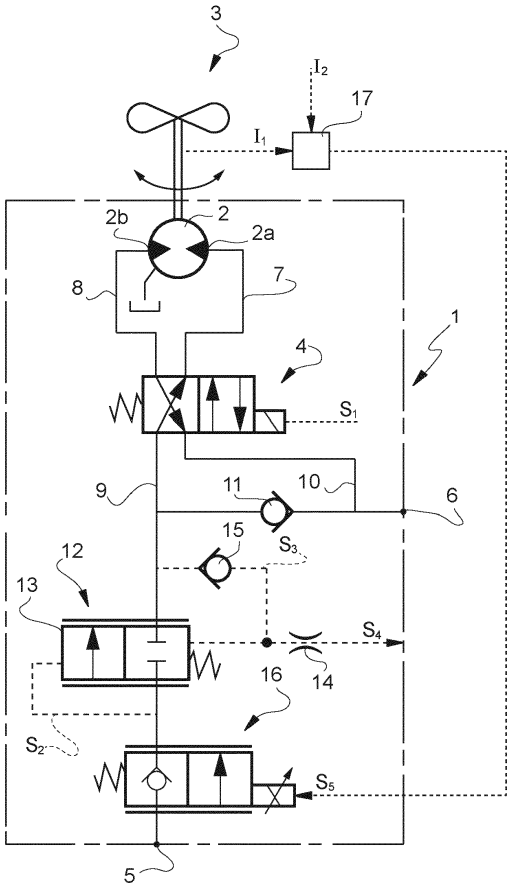
(54) HYDRAULIC ARRANGEMENT FOR CONTROLLING A FAN DRIVE SYSTEM FOR A WORK VEHICLE

(57) Hydraulic arrangement (1) for controlling ventilations means (3) for providing a flow of air to a heat exchanger of a work vehicle, comprising a hydraulic motor (2) configured to carry in rotation the ventilation means (3) in function of a flow of oil passing through the hydraulic motor (2), a post-pressure compensator module (12) fluidly interposed between the source (5) and the hydraulic motor (2) and being configured to provide a load sensing signal (S_4) configured to contribute to control the flow of oil provided by the source (5), and a control valve (16) fluidly interposed between the post-pressure compensator module (12) and the source (5) and configured to vary the flow of oil passing from the source to the post- pressure compensator module (12) in function of a control signal (S_5).

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention concerns a hydraulic arrangement, in particular a hydraulic arrangement for controlling a fan drive system for a work vehicle.

BACKGROUND OF THE INVENTION

[0002] Off-road and on-road machines such as construction and agricultural equipment are provided with cooling fans for cooling a radiator such as the oil or the engine radiator, driven by a dedicated hydraulic motor.

[0003] Usually, such hydraulic motor fan drive requires a pump controlled to adapt the fan speed, i.e. to provide a corresponding oil flow for managing the hydraulic motor; usually such pump is a variable displacement pump. However, variable displacement pump with a low maximum displacement as needed in work vehicles are very expensive.

[0004] Furthermore, such variable displacement pump and related hydraulic motor are provided with a dedicated hydraulic arrangement that it is distinct to the common pressurized oil source of the vehicle, e.g. the pressurized oil coming from a pump and configured to feed different operational elements of the work vehicle such as steering, brakes or other auxiliary hydraulic work devices.

[0005] Therefore, the need is felt to provide a hydraulic arrangement that can control in a cost-effective way the hydraulic motor driving the fan for a work vehicle in wide speed range, in particular at low speed values.

[0006] It is furthermore felt to provide a hydraulic arrangement that can use the same hydraulic power source of the work vehicle.

[0007] An aim of the present invention is to satisfy the above mentioned needs.

SUMMARY OF THE INVENTION

[0008] The aforementioned aim is reached by a hydraulic arrangement as claimed in the appended set of claims.

BRIEF DESCRIPTION OF DRAWINGS

[0009] 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 drawing, which, is a scheme disclosing a hydraulic arrangement according to the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0010] In figure 1, reference 1 discloses globally a hydraulic arrangement for managing the oil flow provided to a hydraulic motor 2 for driving ventilation means 3 configured to generate an air flow for cooling a heat exchanger (not shown) of a work vehicle (not shown).

[0011] Hydraulic arrangement 1 comprises a control valve 4 for controlling the direction of the air flow provided by ventilation means 3. i.e. the oil flow into hydraulic motor 2; such valve 4 is interposed between a hydraulic power source 5, a discharge 6 and the hydraulic motor 2.

[0012] According to the exemplarily embodiment disclosed in figure 1, a first circulation line 7 is provided between a first opening 2a of motor 2 and control valve 4 and a second circulation line 8 is provided between a second opening 2b of motor 2 and control valve 4. A feeding line 9 is provided upstream to control valve 4 and fluidly connected the latter with the hydraulic power source 5 and a return line 10 fluidly connects control valve 4 and discharge 6.

[0013] According to a preferred embodiment, such control valve 4 may be an electrically controlled valve configured to swap the oil flow direction according to a signal S_1 provided to control valve 4.

[0014] More preferably, such control valve 4 is a four ways two positions valve configured to provide a first flow circulation into hydraulic motor 2, e.g. coming from feeding line 9, passing in a counter clockwise way into hydraulic motor 2 and then to discharge 6 via return line 10, or a second flow circulation into hydraulic motor 2, , e.g. coming from feeding line 9, passing in a clockwise way into hydraulic motor 2 and then to discharge 6 via return line 10.

[0015] Preferably, hydraulic arrangement 1 comprises a check valve 11 fluidly interposed between return line 10 and feeding line 9 to avoid cavitation during certain fan drive dynamics, e.g. motor stopping or motor speed reversing.

[0016] According to an aspect of the invention, hydraulic arrangement 1 comprises a flow regulation valve 16 fluidly interposed on feeding line 9 between hydraulic motor 2 and hydraulic power source 5 and configured to regulate the flow that can be provided from said hydraulic power source 5to hydraulic motor 2, in function of a control signal S_5 representative of a needed speed of ventilation means 3.

[0017] Preferably, such flow regulation valve 16 is a proportional valve configured to control the flow provided through feeding circuit 9 from zero to a preset maximum value.

[0018] According to a further aspect of the invention, hydraulic arrangement 1 comprises a post- pressure compensator module 12 fluidly interposed on feeding line 9 downstream flow regulation valve 16 and configured to generate a load sensing signal S_4.

[0019] Such post- pressure compensator module 12 comprises a hydraulic mechanically controlled proportional valve 13 configured to regulate the flow coming from flow regulation valve 16 toward hydraulic motor 2. Such valve 13 is controlled by a pair of hydraulic signals S_2, S_3 acting from opposite sides of proportional valve 13 and respectively picked from upstream to valve 13

and downstream to this latter.

[0020] In particular, valve 13 can regulate oil flow between a first opened position where no flow passes through the latter and a second closed position where a maximum amount of fluid passes through the latter.

[0021] Furthermore, from the side of downstream picked signal S3 an elastic element acts in favor of this latter signal to maintain the valve 13 into the aforementioned first position. Accordingly, the valve 13 is controlled to provide a constant pressure drop between this latter.

[0022] Post- pressure compensator module 12 further comprises an orifice fluidly connected to the line for picking the signal S_3 and configured to pick a load sensing signal S_4 configured to be fluidically sent to a load sensing pump of the work vehicle configured to generate the fluid of hydraulic power source 5.

[0023] A load sensing signal S_3 is picked up on feeding conduit 9 downstream to the pressure compensator 12 and coming thorough the load sense shuttle valve 15. The shuttle valve 15 allows load sense signals comparison between all load sense signals from other hydraulic functions in order to resolve the higher load sense signal to the load sense pump on the vehicle.

[0024] Advantageously, valve 16 and post- pressure compensator module 12 may be realized in a same physical cartridge.

[0025] More in particular, such control signal S_5 is an electric signal and therefore valve 16 is an electric actuated proportional valve, i.e. the oil flow is greater the more the signal S_5 is greater.

[0026] In such a case, arrangement 1 further comprises a electronic control unit 17 configured to receive a first input signal I_1 representative of a current speed of the ventilation means 3, a second input signal I_2 representative of a quantity of the heat exchanger to be ventilated by the ventilation means 2, the electronic control unit 17 is configured to elaborated such two input signals I_1, I_2 to provide the control signal S5 to control hydraulic motor 2.

[0027] Merely for sake of example, I_2 can represent a temperature of the liquid to be cooled in the heat exchanger, therefore the control unit 17 will implement known thermodynamic laws to control the ventilation means speed in function of the value of I_2.

[0028] For sake of example The control unit 17 is configured to regulate the signal S_5 to the flow control valve 16 in order to get a closed loop control of signals I_1 and I_2 or only of I_2.

[0029] The operation of the hydraulic arrangement 1 as described above is the following.

[0030] Thanks to signal S_5, valve 16 is controlled to increase or decrease the oil flow into hydraulic motor 2. The generation of signal S_5 may be realized in different manner, as described above thanks to a control loop control based on the velocity of ventilation means 3 or can be selected between a plurality of ventilation modes, e. g. "low" or "high" speed, by pushing a specific button/symbol on a display. In such a case, only signal 12 would be sufficient to control ventilation means speed 3.

[0031] The flow of oil admitted by valve 16 will then pass to valve 4, which can be controlled to define the rotation direction of ventilation means 4, and then to hydraulic motor 2 which carried the ventilation means 3.

[0032] During the passage into compensation module 12, the load signal S_4 is generated and sent to a load sensing pump shared with other hydraulic devices of the work vehicle. Therefore, the oil flow provided by hydraulic power source 5 is regulated in function of the value of load sensing signal S_5.

[0033] In view of the foregoing, the advantages of a hydraulic arrangement 1 for managing the oil flow provided to a hydraulic motor 2 for controlling the speed of ventilation means 3 according to the invention are apparent.

[0034] Thanks to the use of a post- pressure compensator module 12 ventilation means can be controlled without a dedicated pump but with picking oil form a common pressure source of the work vehicle, thanks to the load sensing signal generated by such post- pressure compensator module 12.

[0035] According to the above, the hydraulic arrangement 1 can share its operation with multiple operative hydraulic devices of the work vehicle.

[0036] The use of a control valve 16 controlled to regulate the speed of ventilation means 3 allows a wide range, quick and simple regulation of such speed. Furthermore, the control valve can be physically integrated into the post- pressure compensator module 12.

[0037] Furthermore, the fact that control valve 16 is electrically controlled by an electronic control unit 17 allows a quick and continuous control of the ventilation means 3 in function of the operative conditions of the heat exchanger/ vehicle's conditions.

[0038] It is clear that modifications can be made to the described hydraulic arrangement 1 which do not extend beyond the scope of protection defined by the claims.

[0039] For example, it is clear that the proposed valves 4, 12 and 16 and the proposed line topology is merely an example between all the possible covered by the appended claims.

[0040] Similarly, it's clear that signal S_5 can be a hydraulic signal and that the control of ventilation means 2 can be achieved in different equivalent ways according to the limit defined by the below claims.

Claims

1. Hydraulic arrangement (1) for controlling ventilations means (3) for providing a flow of air to a heat exchanger of a work vehicle, said hydraulic arrangement (1) comprising
   a hydraulic motor (2) configured to drive said ventilation means (3) in function of a flow of oil passing through said hydraulic motor (2), said flow of oil being

provided by a hydraulic power source (5),
a post- pressure compensator module (12) fluidly interposed between said source (5) and said hydraulic motor (2), said post- pressure compensator module (12) being configured to provide a load sensing signal (S_4) configured to contribute to control the flow of oil provided by said source (5), and
a control valve (16) fluidly interposed between said post- pressure compensator module (12) and said source (5) and configured to vary the flow of oil passing from said source to said post- pressure compensator module (12) in function of a control signal (S_5).

2. Hydraulic arrangement according to claim 1, wherein said post- pressure compensator module (12) comprises proportional valve (13) configured to regulate oil flow from zero to a maximum preset value, said proportional valve (13) being controlled by the equilibrium of the pressure provided by a first hydraulic signal (S_2) picked upstream to said valve (13) and the sum of the pressure provided by a second hydraulic signal (S_3) picked downstream to said valve together with the force imparted by an elastic element.

3. Hydraulic arrangement according to claim 2, wherein said load sensing signal (S_5) is picked from the line picking said second signal (S_3).

4. Hydraulic arrangement according to any of the preceding claims, further comprising a valve (4) fluidly interposed between said post- pressure compensator module (12) and said hydraulic motor (2), said valve (4) being configured to reverse the direction of the flow into said hydraulic motor (2) .

5. Hydraulic arrangement according to claim 4, wherein said valve (4) is an electro-actuated valve.

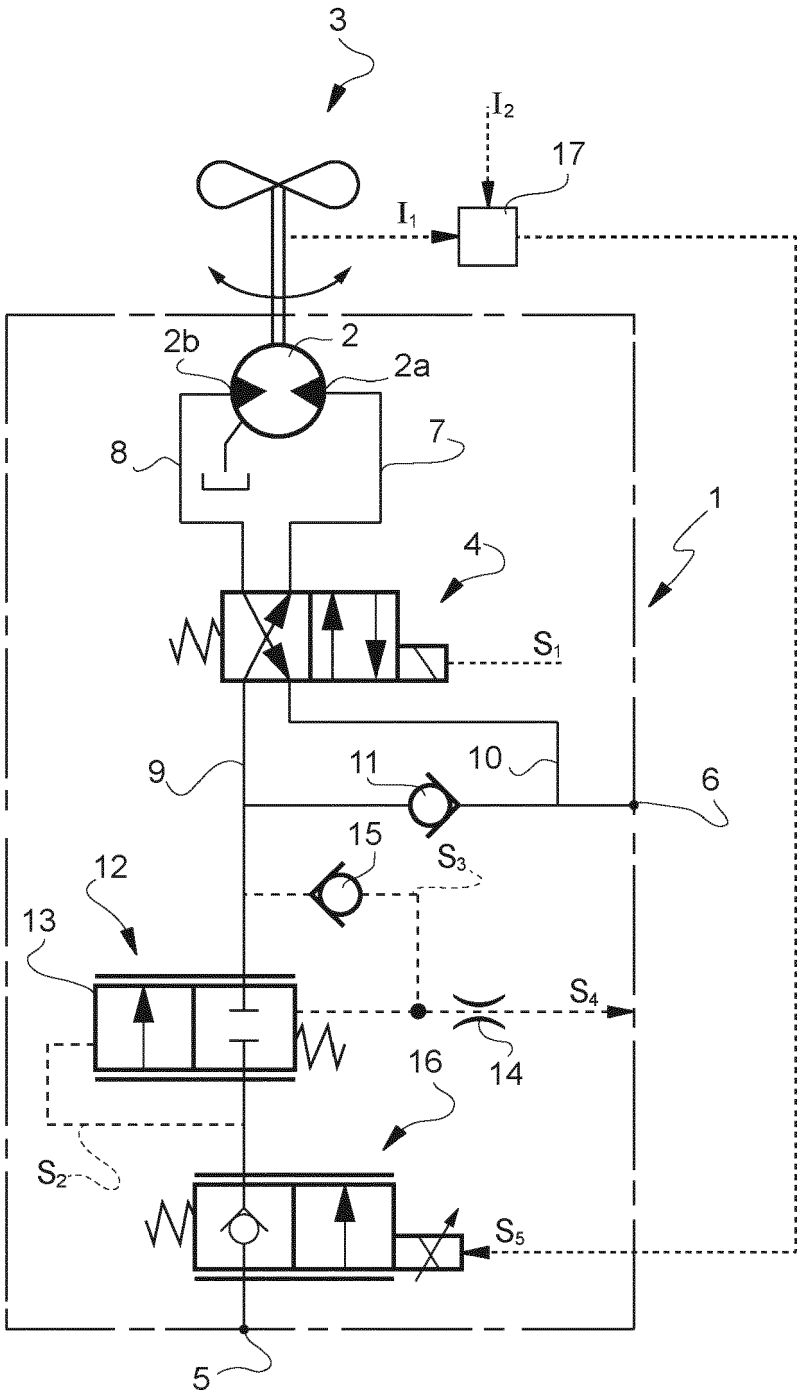
6. Hydraulic arrangement according to any of the preceding claims, wherein said control valve (16) is a proportional valve.

7. Hydraulic arrangement according to any of the preceding claims, wherein said control valve (16) is an electro-actuated valve.

8. Hydraulic arrangement according to claim 7, further comprising an electronic control unit (17) configured to receive as input a first signal (I_1) representative of a speed of said ventilation means (4) a second signal (I_2) representative of an operative condition of an element to be provided with an air flow by said ventilation means (2) or of said work vehicle, said electronic control unit (17) being configured to elaborate such input signals (I_1, I_2) and provide as output said control signal (S_5) to control said control valve (16).

9. Work vehicle comprising a heat exchanger and ventilation means (3) for providing a flow of air to said heat exchanger, said work vehicle comprising a hydraulic arrangement (1) for controlling said ventilation means (3) according to any of the preceding claims.

FIG. 1



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EUROPEAN SEARCH REPORT

Application Number
EP 21 15 2262

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	WO 00/05490 A1 (SAUER INC [US]; CRULL STANLEY W [US]; PETERSON MARK A [US]) 3 February 2000 (2000-02-03) * page 2, lines 20-31; figure 1 * * page 2, lines 12-14 * * page 5, lines 11-16 * * page 5, lines 17-23 * * page 6, lines 14-22 * * page 6, lines 7-13 * * page 1, line 29 - page 2, line 6 * -----	1-3,6-9	INV. F01P7/04 F15B11/16
X	US 2006/196179 A1 (KESAVAN ARUN [US] ET AL) 7 September 2006 (2006-09-07) * paragraphs [0012] - [0016], [0018], [0020] - [0023], [0029], [0030], [0032]; figure 3 * -----	1-9	
X	US 6 848 255 B2 (CATERPILLAR INC [US]) 1 February 2005 (2005-02-01) * column 3, line 2 - column 4, line 55; figure 1 * * column 5, line 62 - column 6, line 65; figures 2,3 * -----	1-9	

TECHNICAL FIELDS SEARCHED (IPC)

F01P
F15D
F15B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	11 May 2021	Luta, Dragos

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