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

HYDRAULISCHE ANORDNUNG ZUR STEUERUNG EINES LÜFTERANTRIEBSSYSTEMS FÜR EIN
ARBEITSFAHRZEUG

AGENCEMENT HYDRAULIQUE POUR COMMANDER UN SYSTÈME D'ENTRAÎNEMENT DE
VENTILATEUR POUR UN VÉHICULE DE TRAVAIL

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**WO-A1-00/05490 US-A1- 2006 196 179
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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] Known hydraulic arrangement for controlling ventilation means of a work vehicle are disclosed in documents WO200005490 A1, US2006196179 A1 or US6848255 B2

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 5 to 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 propor-

tional 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 S_3 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] According to the present invention, 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 S_5 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 I_2 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.

Claims

1. Hydraulic arrangement (1) for controlling ventilation 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 hydraulic power 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 hydraulic power source (5), and said hydraulic arrangement (1) being **characterized by** comprising an electro-actuated control valve (16) fluidly interposed between said post- pressure compensator module (12) and said hydraulic power source (5) and configured to vary the flow of oil passing from said hydraulic power source (5) to said post- pressure compensator module (12) in function of an electric control signal (S_5), and an electronic control unit (17) configured to receive as input a first signal (I_1) representative of a speed of said ventilation means (3) a second signal (I_2) representative of an operative condition of an element to be provided with an air flow by said ventilation means (3) or of said work vehicle,
 said electronic control unit (17) being configured to elaborate said input signals (I_1 , I_2) and provide as output said control signal (S_5) to control said control valve (16).
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_2) 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 pre-

ceding claims, wherein said control valve (16) is a proportional valve.

7. 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.

Patentansprüche

1. Hydraulikanordnung (1) zum Steuern einer Belüftungseinrichtung (3) zur Versorgung eines Wärmetauschers eines Arbeitsfahrzeugs mit einem Luftstrom, wobei die Hydraulikanordnung (1) aufweist:

einen Hydraulikmotor (2), der dazu eingerichtet ist, die Belüftungseinrichtung (3) abhängig von einem Ölfluss, der den Hydraulikmotor (2) durchströmt, anzutreiben, wobei der Ölfluss von einer Hydraulik-Energiequelle (5) bereitgestellt wird,

ein Nach-Druckkompensationsmodul (12), das zwischen der Hydraulik-Energiequelle (5) und dem Hydraulikmotor (2) fluidisch eingefügt ist, wobei das Nach-Druckkompensationsmodul (12) dazu eingerichtet ist, ein Lasterkennungs-signal (S_4) bereitzustellen, das dazu eingerichtet ist, zur Steuerung des von der Hydraulik-Energiequelle (5) bereitgestellten Ölflusses beizutragen, und

wobei die Hydraulikanordnung (1) **dadurch gekennzeichnet ist, dass** sie ein elektrisch betätigtes Steuerventil (16) aufweist, das fluidisch zwischen dem Nach-Druckkompensationsmodul (12) und der Hydraulik-Energiequelle (5) eingefügt ist und dazu eingerichtet ist, den von der Hydraulik-Energiequelle (5) zu dem Nach-Druckkompensationsmodul (12) strömenden Ölfluss in Abhängigkeit von einem elektrischen Steuersignal (S_5) zu variieren, und wobei eine elektrische Steuereinheit (17) dazu eingerichtet ist, als Eingabe

ein erstes Signal (I_1), das kennzeichnend für eine Geschwindigkeit der Belüftungseinrichtung (3) ist, und

ein zweites Signal (I_2), das kennzeichnend für einen Betriebszustand eines Elements ist, das mit einem Luftstrom der Belüftungseinrichtung (3) oder des Arbeitsfahrzeugs versorgt werden soll, zu empfangen,

wobei die elektronische Steuereinheit (17) dazu eingerichtet ist, die Eingangssignale (I_1 , I_2) zu verarbeiten und als Ausgang das Steuersignal (S_5) zur Steuerung des Steuerventils (16) bereitzustellen.

2. Hydraulikanordnung nach Anspruch 1, wobei das Nach-Druckkompensationsmodul (12) ein Proportionalventil (13) aufweist, das dazu eingerichtet ist, den Ölfluss von Null bis zu einem vorbestimmten Maximalwert zu regeln, wobei das Proportionalventil (13) von dem Gleichgewicht aus dem Druck, der von einem ersten hydraulischen Signal (S_2) geliefert wird, das stromaufwärts des Ventils (13) aufgenommen wird, und der Summe des Drucks, der von einem zweiten hydraulischen Signal (S_3) geliefert wird, das stromabwärts des Ventils aufgenommen wird, zusammen mit der Kraft, die von einem elastischen Element übermittelt wird, geregelt wird. 5 10
3. Hydraulikanordnung nach Anspruch 2, wobei das Lasterkennungssignal (S_2) von der Leitung entnommen wird, die das zweite Signal (S_3) entnimmt. 15
4. Hydraulikanordnung nach einem der vorhergehenden Ansprüche, die des Weiteren ein Ventil (4) aufweist, das fluidisch zwischen dem Nach-Druckkompensationsmodul (12) und dem Hydraulikmotor (2) eingefügt ist, wobei das Ventil (4) dazu eingerichtet ist, die Flussrichtung in den Hydraulikmotor (2) umzukehren. 20 25
5. Hydraulikanordnung nach Anspruch 4, wobei das Ventil (4) ein elektrisch betätigtes Ventil ist.
6. Hydraulikanordnung nach einem der vorhergehenden Ansprüche, wobei das Steuerventil (16) ein Proportionalventil ist. 30
7. Arbeitsfahrzeug mit einem Wärmetauscher und einer Belüftungseinrichtung (3) zur Versorgung eines Wärmetauschers mit einem Luftstrom, wobei das Arbeitsfahrzeug eine Hydraulikanordnung (1) zur Steuerung der Belüftungseinrichtung (3) nach einem der vorhergehenden Ansprüche aufweist. 35 40

Revendications

1. Dispositif hydraulique (1) pour commander des moyens de ventilation (3) afin de fournir un flux d'air à un échangeur de chaleur d'un véhicule de travail, ledit dispositif hydraulique (1) comprenant 45
 - un moteur hydraulique (2) configuré pour entraîner lesdits moyens de ventilation (3) en fonction d'un débit d'huile traversant ledit moteur hydraulique (2), ledit débit d'huile étant fourni par une source d'énergie hydraulique (5), 50
 - un module compensateur de post-pression (12) fluidement interposé entre ladite source d'énergie hydraulique (5) et ledit moteur hydraulique (2), ledit module compensateur de post-pression (12) étant configuré pour fournir un signal 55

de détection de charge (S_4) configuré pour contribuer à commander le débit d'huile fourni par ladite source d'énergie hydraulique (5), et ledit dispositif hydraulique (1) étant **caractérisé en ce qu'il** comprend une vanne de commande électro-actionnée (16) fluidement interposée entre ledit module compensateur de post-pression (12) et ladite source d'énergie hydraulique (5) et configuré pour faire varier le débit d'huile passant de ladite source d'énergie hydraulique (5) vers ledit module compensateur de post-pression (12) en fonction d'un signal de commande électrique (S_5) et une unité de commande électronique (17) configurée pour recevoir un premier signal d'entrée (I_1) représentant la vitesse desdits moyens de ventilation (3) un second signal (I_2) représentant un état de fonctionnement d'un élément devant recevoir un flux d'air par lesdits moyens de ventilation (3) ou dudit véhicule de travail, ladite unité de commande électronique (17) étant configurée pour élaborer lesdits signaux d'entrée (I_1 , I_2) et fournir en sortie ledit signal de commande (S_5) pour commander ladite vanne de commande (16).

2. Dispositif hydraulique selon la revendication 1, dans lequel ledit module compensateur de post-pression (12) comprend une vanne proportionnelle (13) configurée pour réguler le débit d'huile de zéro à une valeur maximale prédéfinie, ladite vanne proportionnelle (13) étant commandée par l'équilibre de la pression fournie par un premier signal hydraulique (S_3) prélevé en amont de ladite vanne (13) et la somme de la pression fournie par un second signal hydraulique (S_3) prélevé en aval de ladite vanne ainsi que la force impartie par un élément élastique.
3. Dispositif hydraulique selon la revendication 2, dans lequel ledit signal de détection de charge (S_2) est prélevé sur la ligne qui prélève ledit second signal (S_3).
4. Dispositif hydraulique selon l'une quelconque des revendications précédentes, comprenant en outre une vanne (4) interposée fluidement entre ledit module compensateur de post-pression (12) et ledit moteur hydraulique (2), ladite vanne (4) étant configurée pour inverser le sens du flux entrant dans ledit moteur hydraulique (2).
5. Dispositif hydraulique selon la revendication 4, dans lequel ladite vanne (4) est une vanne électro-actionnée.
6. Dispositif hydraulique selon l'une quelconque des revendications précédentes, dans lequel ladite vanne de commande (16) est une vanne proportionnelle.

7. Véhicule de travail comprenant un échangeur de chaleur et des moyens de ventilation (3) afin de fournir un flux d'air audit échangeur de chaleur, ledit véhicule de travail comprenant un dispositif hydraulique (1) pour commander lesdits moyens de ventilation (3) selon l'une quelconque des revendications précédentes.

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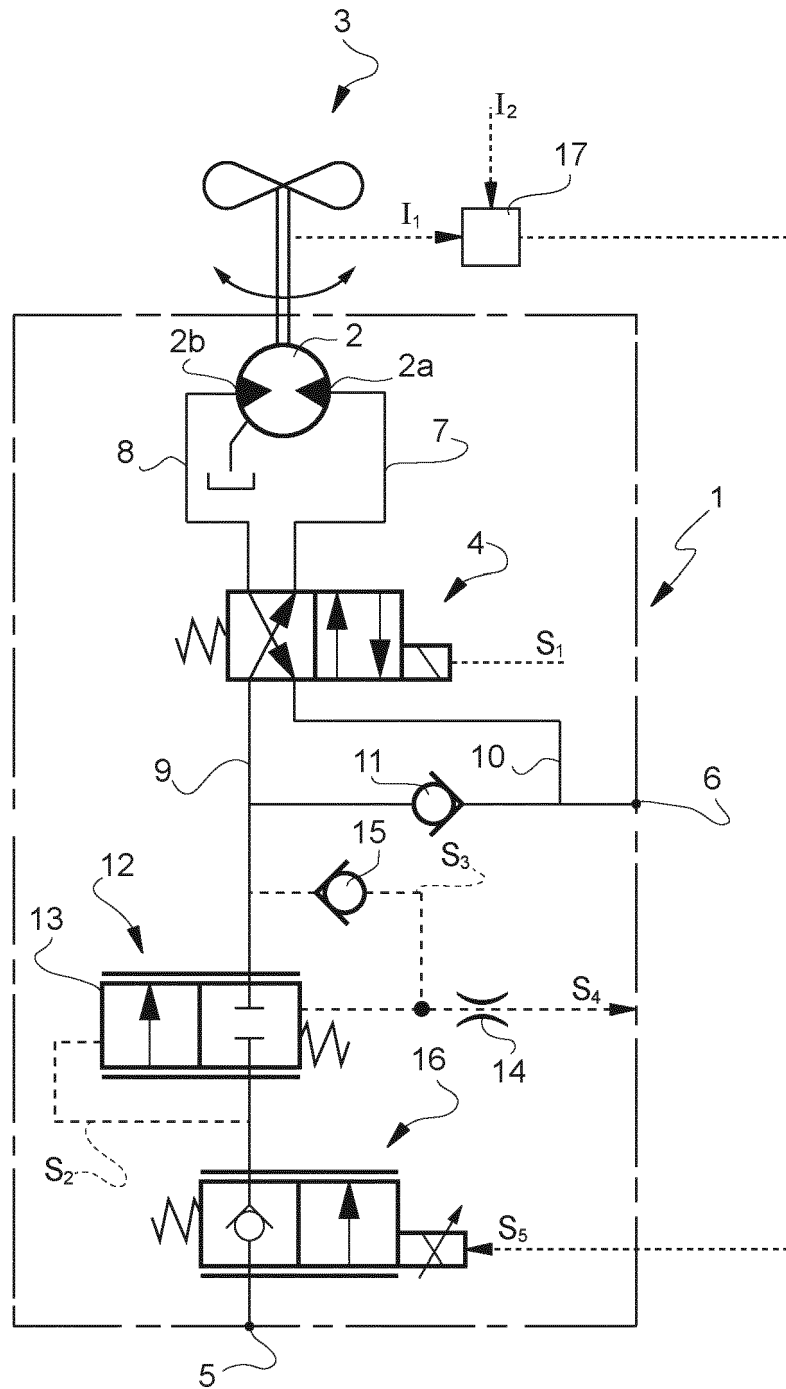
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FIG. 1



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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