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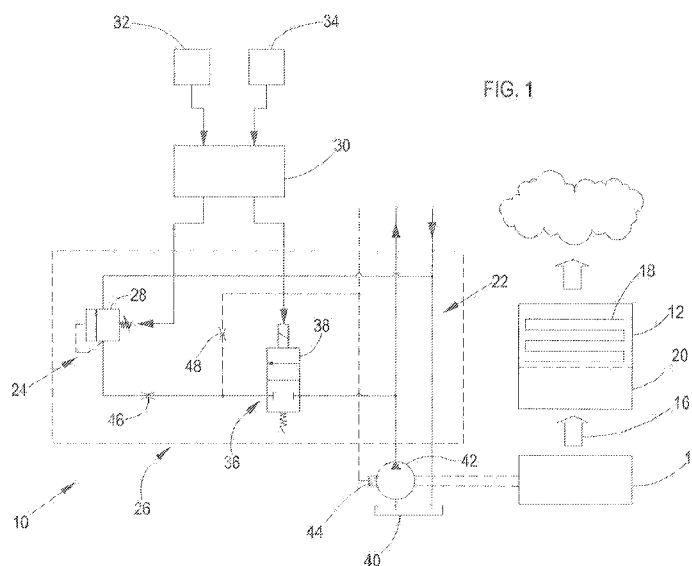
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(54) Title: A DEVICE FOR REGENERATING A SOOT PARTICLE FILTER



(57) Abstract: Disclosed Is a device for carrying out a regeneration process. The device comprises an oxidation catalyst, a soot particulate filter, a hydraulic circuit, and a second hydraulic circuit. The oxidation catalyst is configured to raise a temperature of an exhaust gas flow, and the soot particle filter is configured to remove soot particles therefrom. The soot particle filter is positioned downstream of the oxidation catalyst. The hydraulic circuit is associated with the soot particle filter and also associated with the oxidation catalyst. The secondary hydraulic circuit is fluidly coupled to the hydraulic circuit. The secondary hydraulic circuit comprises a pressure limiting valve and a pressure control valve. The pressure limiting valve is positioned downstream of the pressure control valve. The secondary hydraulic circuit is configured so as to apply a load if a trigger criterion indicating a need to regenerate the soot particle filter is satisfied.

A Device for Regenerating a Soot Particle Filter

Cross-Reference to Related Applications

[0001] This application is the National Stage of International Application Number PCT/EP2011/054245, which was filed on March 21, 2011 and claims the benefit of the German application 102010003158.5, which was filed on March 23, 2010 and is hereby incorporated by reference herein.

Field of the Disclosure

[0002] The present disclosure relates to a device for regenerating a soot particle filter.

Background of the Disclosure

[0003] The exhaust gas norms issued by the European Union provide for a stepwise reduction of the soot particles produced by diesel engines and expelled with the engine exhaust gas into the environment. The limitation of the soot particle expulsion is carried out by using soot particle filters. Exhaust gas flow exiting from the diesel engine penetrates a porous filter wall of the soot particle filter, the porous filter wall being made of, for example, a ceramic or a metal material. The soot particles entrained in the exhaust gas flow are hereby deposited both on the surface as well as the interior of the filter wall, so that the exhaust gas counter pressure rises as the degree of clogging of the filter wall increases.

[0004] To regenerate the soot particle filter (i.e., to clean it), the deposited soot particles are burned at regular time intervals, but for this to occur, the

temperature of the exhaust gas flow may need to be 500°C or greater. To reach such temperatures, an oxidation catalyst may need to be positioned upstream of the soot particle filter. An oxidation catalyst typically requires a start-up temperature of between 250°C and 300°C, but under low-load conditions, the oxidation catalyst may not reach such temperatures.

Summary of the Disclosure

[0005] Disclosed is a device for carrying out a regeneration process. The device comprises an oxidation catalyst, a soot particulate filter, a hydraulic circuit, and a second hydraulic circuit. The oxidation catalyst is configured to raise a temperature of an exhaust gas flow, and the soot particle filter is configured to remove soot particles therefrom. The soot particle filter is positioned downstream of the oxidation catalyst. The hydraulic circuit is associated with the soot particle filter and also associated with the oxidation catalyst. The secondary hydraulic circuit is fluidly coupled to the hydraulic circuit. The secondary hydraulic circuit comprises a pressure limiting valve and a pressure control valve. The pressure limiting valve is positioned downstream of the pressure control valve. The secondary hydraulic circuit is configured so as to apply a load if a trigger criterion indicating a need to regenerate the soot particle filter is satisfied.

Brief Description of the Drawings

[0006] The detailed description of the drawings refers to the accompanying figures in which:

[0007] FIG 1. is a schematic illustration of a device for regenerating a diesel

particulate filter.

Detailed Description of the Drawings

[0008] As shown in FIG. 1, a device 10 comprises a soot particle filter 12 for use in, for example, an agricultural vehicle or an industrial vehicle. The soot particle filter 12 may be a traditional wall flow filter. An exhaust gas flow 16 produced by a diesel engine 14 penetrates a porous filter wall 18 made of a ceramic or metal material. The soot particles, entrained in the exhaust gas flow 16, are deposited on the surface and the interior of the porous filter wall 18 of the soot particle filter 12. As the porous filter wall 18 becomes clogged, the exhaust gas counter pressure increases, requiring that the deposited soot particles be burned, at regular time intervals, for regenerating the soot particle filter 12. As such, the temperature of the exhaust gas flow 16 is periodically raised to temperatures above 500°C using an oxidation catalyst 20, which may be positioned upstream of the soot particle filter 12.

[0009] The startup temperature that is required for the operation of the oxidation catalyst 20 is typically between 250°C and 300°C. Under low-load conditions, the temperature of the exhaust gas flow 16 may not reach the start-up temperature of the oxidation catalyst 20. In response to this issue, a parasitic load 24 may be connected to a hydraulic circuit 22. The parasitic load 24 may be driven by the diesel engine 14 if a trigger criterion indicating a regeneration of the soot particle filter 12 is satisfied.

[0010] The parasitic load 24 comprises a pressure limiting valve 28 positioned in a secondary hydraulic circuit 26, which automatically assumes a permeable valve position when a limiting pressure close to the entry side is

exceeded. The pressure limiting valve 28 can be adjusted with regard to its limiting pressure, and the limiting pressure adjustment may be performed via a control unit 30 in accordance with a load coefficient indicating a momentary utilization of the diesel engine 14.

[0011] The control unit 30 determines the load coefficient by evaluating RPM data from the engine control device 32. In such an embodiment, the RPM data allows for an indirect conclusion with regard to the momentary temperature of the exhaust gas flow. Alternatively, or in addition to, the determination of the momentary temperature of the exhaust gas flow 16 may be made by, for example, using a temperature sensor 34 positioned, in the exhaust gas flow 16, upstream from the oxidation catalyst 20. The sensor data that is made available by the temperature sensor 34 may form the basis for determining a corresponding temperature. The control unit 30 may use the temperature so that it can then adjust the limiting pressure of the pressure limiting valve 28.

[0012] The momentary temperature of the exhaust gas flow 16, given by the load coefficient and/or the temperature magnitude, may be used by the control unit 30 for the determination of a possible compensating temperature difference with respect to the start-up temperature of the oxidation catalyst 20. If the control unit 30 determines that the temperature difference exceeds a prespecified threshold value, then it may increase the limiting pressure of the pressure limiting valve 28 and, therefore, the power dissipation of the diesel engine 14. The result is that the temperature of the exhaust gas flow 16 reaches the required start-up temperature of the oxidation catalyst 20, even before the beginning of the regeneration process.

[0013] In the adjustment of the limiting pressure of the pressure limiting

valve 28, the control unit 30 may consider the change over time and the momentary temperature of the exhaust gas flow 16, given by the load coefficient and/or the temperature magnitude. Thus, a prediction of the parasitic load 24, in the secondary hydraulic circuit 26, required to reach the start-up temperature of the oxidation catalyst 20 may be possible.

[0014] Connecting the pressure limiting valve 28 and the parasitic load 24 may take place via of a pressure control valve 36 located in the secondary hydraulic circuit 26. In the embodiment shown, the pressure control valve 36 is an electrically actuatable 2/2-way valve 38, wherein it is brought to a permeable valve position by the control unit 30 when the trigger criterion is satisfied. The trigger criterion may be satisfied if, for example, the control unit 30 determines, by the evaluation of the data of a time lapse control (implemented in the engine control device 32), that a regeneration of the soot particle filter 12 is imminent.

[0015] In satisfying the trigger criterion, a part of the volume flow that moves through the hydraulic circuit 22 is branched off into the secondary hydraulic circuit 26, wherein the hydraulic energy required for the opening of the pressure limiting valve 28 leads to an increased utilization of the diesel engine 14 and a rise in the temperature of the exhaust gas flow 16.

[0016] In the embodiment shown, the hydraulic circuit 22 is operated by means of a variable displacement pump 42, which is supplied from a hydraulic reservoir 40 and driven by the diesel engine 14. A control entry 44 of the variable displacement pump 42 may be connected to a section of the secondary hydraulic circuit 26 between the pressure control valve 36 and the pressure limiting valve 28. The pressure decline that appears with the connection of the parasitic load 24 at the control entry 44 causes the variable

displacement pump 42 to convey an increased volume flow. This causes a rapid buildup of the limiting pressure in the secondary hydraulic circuit 26, which may be required for the opening of the pressure limiting valve 28.

Throttle elements 46 and 48 may be used to ensure the formation of stable pressure conditions in the hydraulic circuit 22 or in the secondary hydraulic circuit 26.

[0017] Further embodiments of the invention may include any combination of features from one or more dependent claims, and such features may be incorporated, collectively or separately, into any independent claim. While the disclosure has been illustrated and described in detail in the drawings and foregoing description, such illustration and description is to be considered as exemplary and not restrictive in character, it being understood that illustrative embodiments have been shown and described and that all changes and modifications that come within the spirit of the disclosure are desired to be protected. It will be noted that alternative embodiments of the present disclosure may not include all of the features described yet still benefit from at least some of the advantages of such features. Those of ordinary skill in the art may readily devise their own implementations that incorporate one or more of the features of the present disclosure and fall within the spirit and scope of the present invention as defined by the appended claims.

Claims

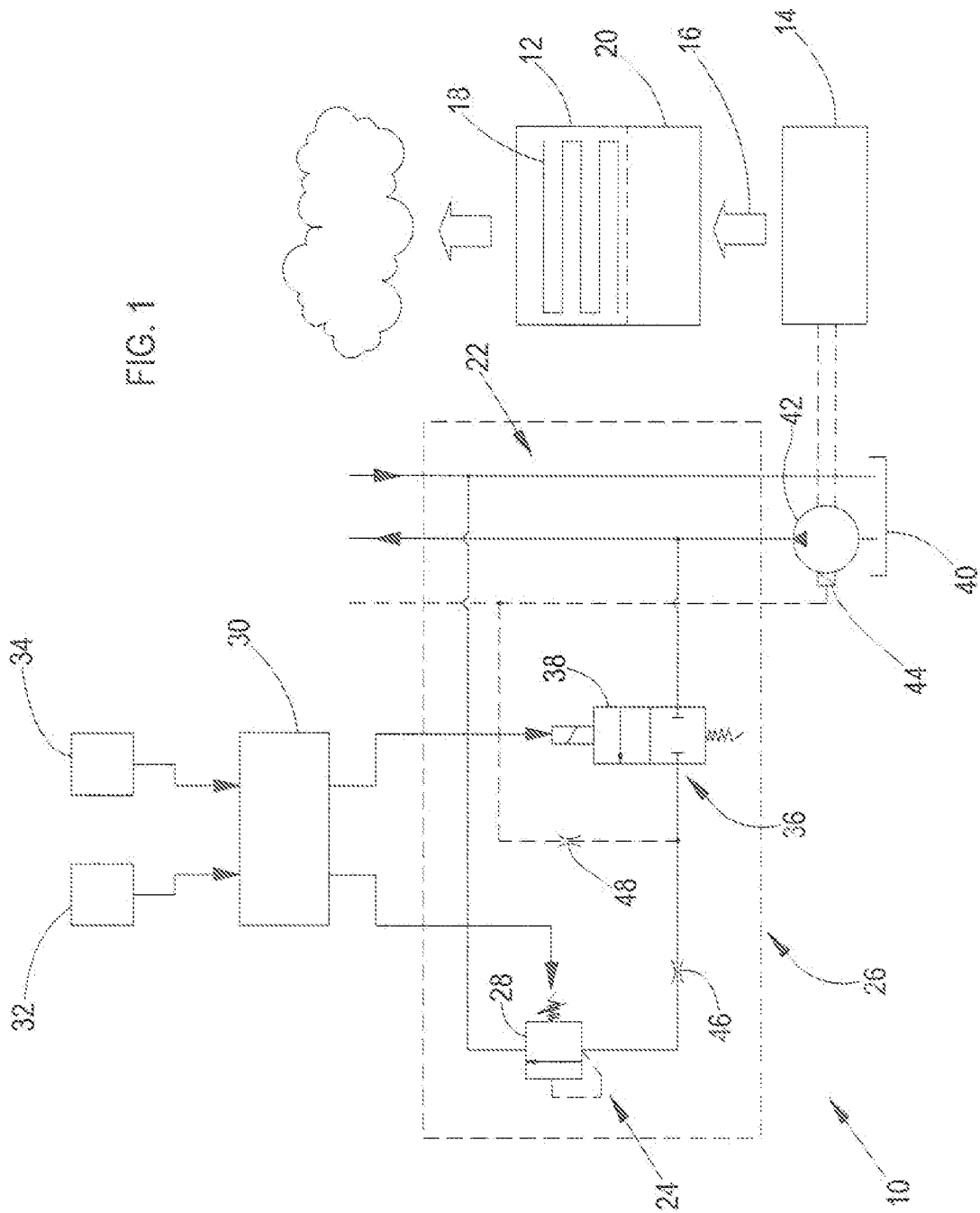
1. A device for carrying out a regeneration process, comprising:
an oxidation catalyst configured to raise a temperature of an exhaust gas flow;
a soot particle filter configured to remove soot particles from the exhaust gas flow, the soot particulate filter positioned downstream of the oxidation catalyst;
a hydraulic circuit associated with the soot particle filter and associated with the oxidation catalyst; and
a secondary hydraulic circuit fluidly coupled to the hydraulic circuit, the secondary hydraulic circuit comprising a pressure limiting valve and a pressure control valve, the pressure limiting valve positioned downstream of the pressure control valve, the secondary hydraulic circuit is configured so as to apply a load if a trigger criterion indicating a need to regenerate the soot particle filter is satisfied.
2. The device of claim 1, wherein the pressure limiting valve is configured to be adjusted with respect to a limiting pressure, and the limiting pressure occurs in accordance with a load coefficient that indicates a momentary utilization of one of a diesel engine and a temperature indicative of a momentary temperature of the exhaust gas flow.
3. The device of claim 2, wherein the hydraulic circuit comprises a variable displacement pump and a hydraulic reservoir, the variable displacement pump is configured to pump a fluid from the hydraulic reservoir, the variable displacement pump comprises a control entry, and the control entry is fluidly coupled with a portion of the secondary hydraulic circuit.
4. The device of claim 3, wherein the portion of the hydraulic circuit is positioned between the pressure control valve and the pressure limiting valve.

5. A work machine, comprising a device as claimed in claim 1.

6. The device of claim 1, wherein the hydraulic circuit comprises a variable displacement pump and a hydraulic reservoir, the variable displacement pump is configured to pump a fluid from the hydraulic reservoir, the variable displacement pump comprises a control entry, and the control entry is fluidly coupled with a portion of the secondary hydraulic circuit.

7. The device of claim 6, wherein the portion of the hydraulic circuit is positioned between the pressure control valve and the pressure limiting valve.

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2012/056448

A. CLASSIFICATION OF SUBJECT MATTER

INV. F02D29/04 F02D41/02 F01N3/023
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F02D F01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X,P	WO 2011/117188 A1 (DEERE & CO [US]; BACK PETER [DE]; WAHL MARKUS [DE]; LANG MATTIAS [DE];) 29 September 2011 (2011-09-29) claims 1-6 figure 1	1-7
X	----- EP 1 553 267 A1 (TOYOTA JIDOSHOKKI KK [JP]) 13 July 2005 (2005-07-13) paragraphs [0011] - [0023]	1-3,6
X	----- WO 2009/060719 A1 (HITACHI CONSTRUCTION MACHINERY [JP]; TSUKADA HIDENOBU [JP]; NAKAMURA K) 14 May 2009 (2009-05-14) the whole document figures 9,10	1,2,4,6
X,P	paragraphs [0055] - [0061] & EP 2 208 872 A1 (HITACHI CONSTRUCTION MACHINERY [JP]) 21 July 2010 (2010-07-21) ----- -/-	1,2,4,6

☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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