Title: COOLING SYSTEM FOR A VEHICLE AND VEHICLE COMPRISING THE COOLING SYSTEM

Abstract: The invention relates to a cooling system (11) for a vehicle. The system comprises a first cooling circuit (14) coupled to the vehicle engine (12) for cooling the latter and a pump (15) arranged in the first cooling circuit (14) for pumping a coolant to the engine. The system further comprises a second cooling circuit (16) for cooling at least one other component in the vehicle, and means (20) for coupling the second cooling circuit (16) into the first cooling circuit (14) in order to also supply the second cooling circuit with coolant from the pump (15). The cooling system further comprises a line (21) coupled from the first cooling circuit to the second cooling circuit bypassing the coupling means (20) so that the second cooling circuit is supplied with coolant from the pump via the bypass line even when the coupling means is set to the disconnected position.
Cooling system for a vehicle and vehicle comprising the cooling system

BACKGROUND OF THE INVENTION AND PRIOR ART
The present invention relates to a cooling system for a vehicle, the system comprising a first cooling circuit coupled to the vehicle engine for cooling the latter, a pump arranged in the first cooling circuit for pumping a coolant to the engine, a second cooling circuit for cooling at least one other component in the vehicle, and means of coupling the second cooling circuit into the first cooling circuit in order to also supply the second cooling circuit with coolant from the pump.

Such a cooling system may be used, for example, in a work vehicle, such as a wheel loader, which comprises hydraulic components in the form of working cylinders, for example, for maneuvering/moving an implement. With regard to the hydraulics, it is primarily the hydraulic oil and gaskets, seals, etc. which are temperature-sensitive.

According to a previously known system the coupling means consists of a thermostat, which is operatively controlled by the engine temperature to cut in automatically when the engine temperature exceeds a certain value.

According to this previously known system just one pump is used to provide cooling both for the vehicle engine and for the hydraulic components of the vehicle. One problem with this system is that under certain conditions the thermostat will not cut in, with the result that the hydraulic components do not receive the necessary cooling. One example of this occurs in an extremely cold climate when the vehicle is used in such
a way that its hydraulic components become so hot that cooling is required, whilst the engine is not hot enough for the thermostat to cut in.

The cooling system may furthermore be designed to cool transmission components in the form of gears and shafts in the vehicle axle housings, for example, via the second cooling circuit. A problem with this system is that under certain operating conditions the thermostat will not cut in, with the result that the transmission components do not receive the necessary cooling. An example of this is in so-called leveling, when a mass of earth is pushed ahead of the vehicle. In this application the transmission becomes hot, whilst the engine is cold.

A further problem with the previously known system is that if the thermostat fails and does not or is not open, there is no cooling at all of the hydraulic or transmission components.

The temperature limit at which the thermostat cuts in is controlled by the engine exhaust. Owing to the ever more stringent requirements governing vehicle exhaust emissions, this temperature limit is also increasing. It is therefore not just simply a matter of adjusting the temperature limit for a specific vehicle to a lower value in order to also provide the second circuit with coolant.

The invention will be described below in its application to a work vehicle in the form of a wheel loader. This is to be regarded as a preferred application but is in no way limitative. The invention can be realized, for example in other types of work vehicle, such as a dumper truck or excavator-loader, for example. The invention is furthermore not confined to work vehicles, but could
also be applied to other types of vehicle, such as industrial trucks.

SUMMARY OF THE INVENTION

An object of the invention is to provide a cooling system for a vehicle, which will remedy at least one of the aforementioned problems.

This object is achieved in that the cooling system comprises a line coupled from the first cooling circuit to the second cooling circuit bypassing the coupling means, so that the second cooling circuit is supplied with coolant from the pump via the bypass line even when the coupling means is set to the disconnected position. The term disconnected position signifies that the coupling means is not set to connect the first and second circuits.

According to a preferred embodiment the coupling means is operatively controlled by the engine temperature in such a way that when the engine temperature exceeds a certain value the coupling means cuts in and connects the second cooling circuit to the first cooling circuit. The coupling means in this case consists of a thermostat.

According to another preferred embodiment said component consists of a hydraulic component in the form, for example, of a working cylinder.

According to a further preferred embodiment said component consists of a transmission component, such as a gear or shaft arranged in the vehicle transmission.

Further preferred embodiments and advantages of the invention are set forth in the further subordinate claims and in the following description.
BRIEF DESCRIPTION OF THE DRAWINGS
The invention will be described in more detail below with reference to the embodiment shown in the drawings attached, in which:

FIG 1 shows a side view of a wheel loader, and
FIG 2 shows a schematic diagram of the cooling system according to the invention.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

Fig. 1 shows a wheel loader 1. The body of the wheel loader 1 comprises a front body part 2 and a rear body part 3, these parts being joined to one another by an articulated connection. The body parts 2,3 can be rotated in relation to one another about an articulated joint by means of two hydraulic components in the form of working cylinders 4,5 arranged between the two parts. The working cylinders 4,5 are therefore designed for turning the wheel loader 1.

The wheel loader 1 furthermore has a load unit 6 and an implement in the form of a shovel 7 arranged on the load unit. The load unit 6 can be raised and lowered in relation to the front part 2 of the vehicle by means of two hydraulic components in the form of two working cylinders 8,9, each of which is connected at one end to the front part of the vehicle 2 and at its other end to the load unit 6. The shovel 7 can be tilted in relation to the load unit 6 by means of a further hydraulic component in the form of a working cylinder 10, which is connected by one end to the front part of the vehicle 2 and by its other end to the shovel 7.

Fig. 2 shows a schematic diagram of a cooling system 11 for the wheel loader 1. The wheel loader 1 has an engine 12, which is designed to drive at least one rear drive axle 13. The engine 12 consists of an internal combustion engine in the form of a diesel engine.
The cooling system 11 comprises a first cooling circuit 14 coupled to the vehicle engine 12 for cooling the latter. The first cooling circuit 14 here consists of a type of internal circuit in the engine. A pump 15 is arranged in the first cooling circuit 14 for pumping a coolant to the engine 12.

The cooling system 11 further comprises a second cooling circuit 16 for increased cooling of the engine 12 and for cooling the vehicle hydraulic components 4, 5, 8, 9, 10. The cooling system 11 comprises a radiator 22 arranged in the second cooling circuit 16 for increased cooling of the engine 12. A hydraulic motor 26 is connected to the hydraulic circuit 18 and designed to drive a fan in order to produce an air flow through the radiator 22.

A first heat-exchanger 27 is arranged in the second circuit 16 for an exchange of heat between the hydraulic oil in a first hydraulic circuit 18, which is in turn coupled to said hydraulic components (not shown in Fig. 2), and the coolant in the second cooling circuit 16. Cooling of the engine and the hydraulic components is therefore integrated into a single system, with a single pump.

The cooling system 11 comprises a second heat-exchanger 28, which is integrated with the first heat exchanger 27 in a single component 17. The second heat exchanger is designed for an exchange of heat between transmission oil in a second hydraulic circuit 19, which is in turn coupled to a transmission component (not shown in Fig. 2), and the coolant in the second cooling circuit 16. The transmission component may consist, for example, of a part that is intended to rotate, such as a shaft and/or a gear in a gearbox in the vehicle. Alternatively or in addition, the transmission component may consist of a part in one of the vehicle wheel axles. Cooling of the engine, the hydraulic components and the
transmission components is therefore integrated in a single system, with a single pump.

The cooling system 11 further comprises means 20 for coupling the second cooling circuit 16 into the first cooling circuit 14 in order to also provide the second cooling circuit with coolant from the pump 15. The coupling means 20 here consists of a thermostat. The thermostat is controlled by the engine temperature, and more specifically by the coolant temperature. The thermostat is designed to cut in, thereby bringing the second cooling circuit 16 into operation when the engine temperature exceeds a certain value.

The cooling system 11 further comprises a line 21 coupled from the first cooling circuit 14 to the second cooling circuit 16 bypassing the thermostat 20 and the engine 12, so that the second cooling circuit is supplied with coolant from the pump via the bypass line 21 even when the thermostat is in the disconnected position. The bypass line 21 is therefore arranged in parallel with the thermostat 20 and the engine 12.

The bypass line 21 is designed for a substantially smaller flow than the first cooling circuit, with the object of ensuring that the second circuit 16 is supplied with a certain quantity of coolant even if the engine temperature does not reach the said value at which the thermostat cuts in. The bypass line 21 is therefore designed for a smaller flow than the main line 16. This means that a greater flow of coolant goes to the second cooling circuit 16 after the thermostat has cut in than before it cuts in. In this way a certain cooling/heating of the said hydraulic and/or transmission components is obtained throughout when in operation.
Besides a working cylinder, the said hydraulic component may also consist, for example, of a hydraulic motor or a hydraulic pump.

The cooling system 11 comprises a further heat-exchanger 23, which can be connected to the first hydraulic circuit 18 for an exchange of heat with air. A means 24 is designed for automatically bringing the further heat exchanger into operation when the hydraulic oil temperature exceeds a specific value. The coupling means 24 consists of a temperature-controlled valve. This coupling means 24 is intended to cut in before the engine thermostat 20 cuts in.

One advantage with the cooling system 11 described above, which is designed for cooling/heating multiple different sub-systems (engine, hydraulics, transmission) is that heat differentials can be utilized in order to cool a specific sub-system or to heat another sub-system.

The coolant consists at least substantially of water.

The invention must not be regarded as being limited to the examples of embodiment described above, a number of further variants and modifications being feasible within the scope of the following patent claims.
CLAIMS

1. A cooling system (11) for a vehicle (1), the system comprising a first cooling circuit (14) coupled to the vehicle engine (12) for cooling the latter, a pump (15) arranged in the first cooling circuit for pumping a coolant to the engine, a second cooling circuit (16) for cooling at least one other component (4,5,8,9,10,13,25) in the vehicle, and means (20) for coupling the second cooling circuit into the first cooling circuit in order to also supply the second cooling circuit with coolant from the pump, characterized in that the cooling system comprises a line (21) coupled from the first cooling circuit to the second cooling circuit bypassing the coupling means (20), so that the second cooling circuit is supplied with coolant from the pump via the bypass line even when the coupling means is set to the disconnected position.

2. The cooling system as claimed in claim 1, characterized in that the bypass line (21) is designed for a substantially smaller flow than the line in the first cooling circuit (14).

3. The cooling system as claimed in claim 1 or 2, characterized in that the coupling means (20) is operatively controlled by the engine temperature in such a way that when the engine temperature exceeds a certain value the coupling means is brought into operation and connects the second cooling circuit (16) to the first cooling circuit (14).

4. The cooling system as claimed in any one of claims 1 to 3, characterized in that
the system comprises a radiator (22), which is arranged in the second cooling circuit (16) and is designed for an exchange of heat with air for cooling the coolant.

5. The cooling system as claimed in any one of claims 1 to 4, characterized in that said component (4,5,8,9,10) consists of a hydraulic component.

6. The cooling system as claimed in claim 5, characterized in that said hydraulic component (4,5,8,9,10) consists of a working cylinder.

7. The cooling system as claimed in claim 5 or 6, characterized in that the cooling system comprises a first heat-exchanger (27) which is arranged in the second circuit for an exchange of heat between hydraulic oil in a first hydraulic circuit (18), which is in turn coupled to said hydraulic component, and the coolant in the second cooling circuit.

8. The cooling system as claimed in any one of claims 1 to 4, characterized in that said component consists of a transmission component (13,25) arranged in the vehicle transmission.

9. The cooling system as claimed in claim 8, characterized in that the cooling system comprises a second heat-exchanger (28), which is arranged in the second circuit for an exchange of heat between transmission oil in a second hydraulic circuit (19), which is in turn coupled to said transmission component (13,25), and the coolant in the second cooling circuit.
10. The cooling system as claimed in claim 7 and 9, **characterized in that**
said first and second heat-exchanger (27,28) are
integrated into a single component (17).

11. The cooling system as claimed in any one of the
preceding claims, **characterized in that**
the system comprises a further heat-exchanger (23),
which can be connected to the first hydraulic circuit
(18), for an exchange of heat with air, and that the
system comprises means (24) for automatically bringing
the further heat exchanger into operation when the
hydraulic oil temperature exceeds a specific value.

12. Vehicle **characterized in that**
the vehicle comprises a cooling system (11) according to
any one of the preceding claims.
INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 03/01158

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: F01P 3/20
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)

IPC7: F01P

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

SE, DK, FI, NO classes as above

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

EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Further documents are listed in the continuation of Box C.

See patent family annex.

Date of the actual completion of the international search: 8 Sept 2003
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