

REPUBLIC OF SOUTH AFRICA
PATENTS ACT, 1978
PUBLICATION PARTICULARS AND ABSTRACT
(Section 32(3)(a) – Regulation 22(1)(g) and 31)

OFFICIAL APPLICATION NO.

LODGING DATE

ACCEPTANCE DATE

21 01 **2006/08218**

22 13 MAY 2005

43 10-4-2006

INTERNATIONAL CLASSIFICATION

NOT FOR PUBLICATION

51 F01P; F02B

CLASSIFIED BY: WIPO

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EARLIEST PRIORITY CLAIMED

COUNTRY

NUMBER

DATE

33 DE

31 10 2004 024 289.5

32 15 MAY 2004

TITLE OF INVENTION

54 COOLING SYSTEM FOR A VEHICLE

57 ABSTRACT (NOT MORE THAT 150 WORDS)

NUMBER OF SHEETS

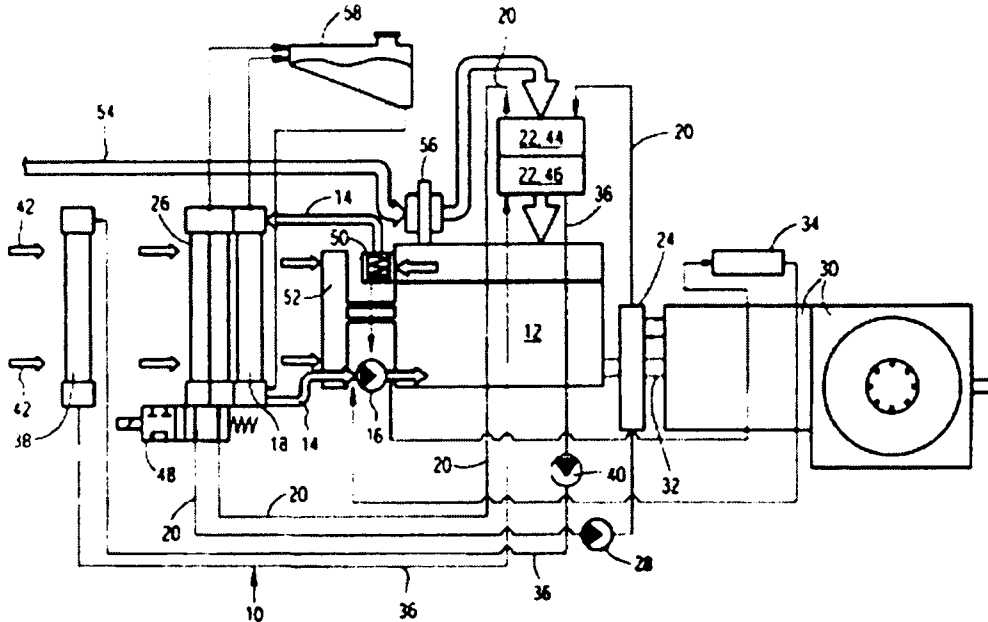
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If no classification is finished, Form P.9 should accompany this form.
The figure of the drawing to which the abstract refers is attached.

ABSTRACT

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The invention relates to a cooling system for an internal combustion engine (12) on a vehicle, preferably for an agricultural or industrial commercial vehicle, in particular, for a tractor. The cooling system (10) comprises a high temperature circuit (14) and a low-temperature circuit (20). The high temperature circuit (14) is provided for cooling the internal combustion engine (12) and comprises at least one cooler (18). The low temperature circuit (20) is provided for cooling a charge air cooler (22) and, optionally, an oil cooler (24) and comprises at least one cooler (26). The charge air cooler (22) is embodied with at least two parts or in two stages. According to the invention, the cooling system shall have an improved power capacity, whereby said cooling system (10) is characterised in that, in the direction of flow of coolant in the low temperature circuit (20), the cooler (26) is arranged after a part (46) of the charge air cooler (22), the oil cooler (24) and a further part of the charge air cooler (44). Alternatively or additionally a further cooling circuit (36) is provided, by means of which the charge air cooler (22) may be cooled and which comprises at least one cooler (38).



Cooling system for a motor vehicle

The present invention relates to a cooling system for an internal-combustion engine of a motor vehicle, preferably for an agricultural or industrial utility vehicle, especially for a tractor. The cooling system comprises a high-temperature circuit and a low-temperature circuit. The high-temperature circuit is provided for cooling the internal-combustion engine and comprises at least one cooler. The low-temperature circuit is provided for cooling a supercharger intercooler otherwise referred to as a charge air cooler and possibly an oil cooler and comprises at least one cooler. The supercharger intercooler is an at least two-part or two-stage cooler.

Cooling systems of the aforementioned type are known, for example, from DE 41 14 704 A1. With this cooling system, in a high-temperature circuit an internal combustion engine and the supercharger intercooler are cooled with the aid of a high-temperature re-cooler provided there. The temperature of the coolant in the high-temperature circuit is approximately 90 to 110 degrees Celsius. The coolant is a cooling liquid. In the low-temperature circuit which is separate from the high-temperature circuit the supercharger intercooler as well as an oil cooler for transmission oil is cooled with the aid of a low-temperature re-cooler provided there. The temperature of the coolant in the low-temperature circuit is approximately 45 to 90 degrees Celsius. The high-temperature as well as the low-temperature re-coolers are in the form of air/coolant heat exchangers and for the sake of simplicity will in the following be referred to as coolers.

Under some operating conditions it may happen, however, that the internal-combustion engine cooled by the high-temperature circuit is at least briefly

operated at a capacity that is higher than the maximum capacity provided for the internal-combustion engine. This is the case especially with vehicles that provide a so-called power-boost, as described for example in EP 1 239 133 A2. In this case the cooling system of the vehicle is loaded to the extreme and an overloading of the cooling system may occur, so that the internal-combustion engine may get damaged.

It is, therefore, the aim of the present invention to indicate and further develop a cooling system of the type mentioned at the outset with which the aforementioned problems are overcome. Especially the capacity of the cooling system is to be increased, in particular in such a way that also during a brief overloading of the cooling system it can be ensured that the cooling system will not be overloaded, so as to prevent damage to the internal-combustion engine.

According to the invention the aim is achieved by the teachings of claim 1. Further advantageous embodiments and further developments of the invention can be noted from the dependent claims.

According to the invention a cooling system of the type mentioned at the outset is characterised in that in the direction of flow of the coolant of the low-temperature circuit a part of the supercharger intercooler, the oil cooler and a further part of the supercharger intercooler are inserted after the cooler.

In principle it is provided to divide the supercharger intercooler into at least two parts or two stages, i.e. a high-temperature and a low-temperature stage. A multi-stage - e.g. three-stage - dividing of the supercharger intercooler would also be possible. As a result thereof the efficiency of the cooling of the air can be

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increased seeing that, for example, the air sucked up from the environment and compressed could first be cooled by the part of the supercharger intercooler corresponding to the high-temperature stage. With the part of the supercharger intercooler corresponding to the low-temperature stage, the air could then be cooled further so that in an advantageous manner an on the whole improved cooling capacity of the supercharger intercooler can be obtained. As a result thereof it is not absolutely essential to cool a stage or a part of the supercharger intercooler with the high-temperature circuit, so that by this structural measure the high-temperature circuit can be relieved, as a result of which the cooling capacity of the high-temperature circuit for the internal-combustion engine can be increased.

The coolant of the low-temperature circuit is conveyed by a coolant pump to the low-temperature stage of the supercharger intercooler. From there the coolant flows through the oil cooler, the high-temperature stage of the supercharger intercooler and the cooler of the low-temperature circuit back to the coolant pump. The cooler of the low-temperature circuit could, for example, comprise an air/coolant heat exchanger. In other words, in the direction of flow of the coolant of the low-temperature circuit, part of the supercharger intercooler, the oil cooler and a further part of the supercharger intercooler are inserted after the cooler. The two-part or two-stage supercharger intercooler is, therefore, associated with one and the same cooling circuit, i.e. the low-temperature circuit. If during a cold start of the vehicle the cooler of the low-temperature circuit is short-circuited, the low-temperature circuit can be used to convey all the thermal energy given off by the supercharger intercooler to the coolant of the low-temperature circuit to the oil cooler, as a result of which the oil flowing through the oil cooler can be warmed

up more quickly, as a result of which in a particularly advantageous manner the full operational readiness of the vehicle is produced more quickly.

In a particularly preferred embodiment a means is provided with which the coolant conveyed in the low-temperature circuit can be guided past the cooler of the low-temperature circuit, so that preferably in the low-temperature circuit only the supercharger intercooler and the oil cooler are operatively connected to each other. Very generally a means is provided with which the coolant conveyed in a cooling circuit can be guided past the cooler of the cooling circuit. This concerns a possible measure indicated above for bypassing or short-circuiting the cooler of the low-temperature circuit.

This means could, for example, be in the form of a change-over valve which guides the coolant to be fed to the cooler past the cooler, for example through a bypass-pipe. An operative connection between the supercharger intercooler and the oil cooler is expedient, for example, under the already mentioned operating conditions prevailing after a cold start of the vehicle. In particular, for the duration of the short-circuiting or separating of the cooler of the low-temperature circuit a specific increase in the oil temperature can be obtained, so that in an advantageous manner the oil cooled by the oil cooler can be specifically regulated to a predetermined temperature value, wherein a deviation of the predetermined temperature value can be kept small because of the regulating. In concrete terms the means for bypassing the coolant could, for example, be a change-over valve known from the prior art, which for example could be a 4/2-way valve and is arranged on a side of the cooler, wherein the coolant enters the cooler as well as exits the cooler on this side.

In this way it is possible to solve the problem occurring in the prior art with respect to the coolant circuit provided there, according to which the producing of optimal operating conditions of the vehicle, especially after a cold start, takes a relatively long time. Thus, for example, the temperature of the transmission oil is reached only after a relatively long operating time of the vehicle, as a result of which at least during the warming-up phase the hydraulic units, valves and couplings of the transmission, cannot then fully meet the predetermined reaction times.

In a preferred embodiment the supercharger intercooler, the oil cooler and the cooler of the low-temperature circuit are serially linked to one another.

To achieve the aim mentioned at the outset, the cooling capacity of a cooling system of a motor vehicle could be increased even further. This especially so since at least part of the exhaust gas coming from an internal-combustion engine could again be fed to the internal-combustion engine as combustion air. However, the exhaust gas has a higher temperature than the combustion air sucked up from the environment of the motor vehicle, so that the cooling capacity of the supercharger intercooler and also that of the high-temperature circuit for cooling the internal-combustion engine must be increased.

In principle, an increase in the cooling capacity of a cooling system of a motor vehicle could be obtained by making the coolers correspondingly larger. This again requires additional installation space which is not always available there where normally the cooler or coolers of the motor vehicle are arranged.

A cooling system of the type mentioned at the outset is also described having a further cooling circuit with which also the supercharger intercooler can be cooled and which comprises at least one cooler.

It was first of all recognised that a further increase in size of the already provided coolers of the two cooling circuits, i.e. the high-temperature circuit and the low-temperature circuit, is not possible in all cases seeing that generally only a limited installation space is available on a vehicle. Therefore, according to the invention a further cooling circuit is provided which comprises at least one cooler. The cooler of the further cooling circuit can be arranged at any place of the vehicle, so that the overall capacity of the cooling system, now consisting of the three cooling circuits with three coolers, can be increased considerably without significantly increasing the space requirements at the place of the motor vehicle where the coolers are normally arranged. However, even when the coolers of the three cooling circuits are arranged together, the cooling capacity of the cooling system can be increased as a result thereof, although in this case the three coolers take up a greater installation space. The internal-combustion engine can therefore in a particularly advantageous manner be operated at least briefly above its nominal capacity without being exposed to the risk of overheating. Possible extra costs for the components of the further cooling circuit are put up with here since with the cooling system according to the invention at least in respect of the cooling more stringent exhaust gas specifications can be met. To meet more stringent exhaust gas specifications some solution concepts indicate, as a matter of fact, the providing of a cooling system that has an increased cooling capacity compared to the state of the art.

In a very particularly preferred embodiment at least two cooling circuits are provided separate from one another, so that the coolant flowing through the one cooling circuit is not mixed with the coolant flowing through another cooling circuit. As coolant preferably a cooling liquid is used, e.g. a mixture that could contain water and antifreeze. Because of their separate arrangement the cooling circuits can be operated independently of one another, which leads to a particularly efficient cooling of the vehicle and permits a control/regulating of the cooling system that is adapted to the respective operating conditions of the vehicle.

Thus, for example, during a cold start of the vehicle the further cooling circuit can at first be deactivated, so that the heat given off to the supercharger intercooler by the compressed air can be evacuated via the low-temperature circuit and fed directly to the oil cooler, which then in turn warms up the oil flowing through the oil cooler. Under these operating conditions of the vehicle the supercharger intercooler is, as a matter of fact, one of the first units that warms up very quickly as a result of the air that must be compressed. This heat can, however, be evacuated via the direct connection to the oil cooler and be used to warm up the oil flowing through the oil cooler. As a result thereof the oil can be brought more quickly to its operating temperature, so that after a cold start of the vehicle at least the relevant units are fully operational. This permits in a particularly advantageous manner a rapid warming up to its operating temperature of the oil flowing through the oil cooler. In any case, under these operating conditions of the vehicle it is not necessary to activate the further cooling circuit, since the heat evacuated from the supercharger intercooler can be used practically exclusively for warming up the oil flowing through the oil cooler.

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Especially when at least two cooling circuits are provided separate from one another, it is necessary that each cooling circuit comprises a coolant pump. Also this extra expense in respect of components provides advantages. Thus, for example, a cooling circuit can very easily be activated or deactivated by, for example, activating or deactivating the coolant pump in question. Particularly when an activation and deactivation of a coolant pump is provided, it becomes possible to drive the coolant pump electrically. An electrically driven coolant pump can also be arranged in a spot far removed from the internal-combustion engine seeing that no mechanical power transport, for example by a V-belt drive, is required. This results in a particularly advantageous manner in flexibilities with respect to the available installation space in the design of the vehicle's cooling system. Activation can in this case take place by producing a suitable electrical contact, so that no mechanical coupling need be provided which, for example, disconnects the coolant pump from a V-belt drive. Finally, by the separate arrangement of the coolant circuits, an efficient cooling adapted to the respective operating conditions of the vehicle can take place in a particularly advantageous manner, which can also react to rapid changes in temperature of the units of the vehicle that must be cooled. However, also configurations of cooling systems are conceivable where only one coolant pump is provided, which however has separate pump chambers with which the coolant of the two separate cooling circuits can be conveyed simultaneously.

A cooler could comprise an air/coolant heat exchanger, through which preferably air coming from the environment can flow. Insofar such a cooler is as such a conventional air/coolant heat exchanger known from the state of the art, which gives off the thermal energy of the coolant supplied to it at least for the greater part to the air flowing through or around it.

In a preferred embodiment one part of the at least two-part supercharger intercooler can be connected to the low-temperature circuit and another part of the supercharger intercooler can be connected to another cooling circuit. When the supercharger intercooler is connected to the further cooling circuit, as a result thereof the air flowing through the supercharger intercooler can be cooled to an even lower temperature than is the case when the supercharger intercooler is cooled only with the low-temperature circuit. To this end it could be provided that the further cooling circuit comprises only one part of the supercharger intercooler, the cooler of the further cooling circuit and a coolant pump. Insofar, with such an arrangement the exhaust gas emitted by the internal-combustion engine, which has a very high temperature, could be cooled and fed back again as combustion air. By this measure furthermore the temperature of the air charge for the internal-combustion engine can be flexibly regulated to an optimal value in dependence on the momentary load of the internal-combustion engine or of the vehicle.

In a corresponding manner the oil cooler could consist of at least two parts for connection to two different cooling circuits. Preferably one part of the oil cooler can be connected to the low-temperature circuit and another part of the oil cooler can be connected to another cooling circuit, preferably to the further cooling circuit. As a result thereof the oil can in a particularly advantageous manner be cooled or heated also with the mixed temperatures corresponding to the splitting-up ratio of the oil cooler, permitting an even more flexible temperature regulation of the oil adapted to the respective operating conditions of the vehicle. Expediently the one part of the oil cooler could comprise one third and the second part two thirds of the oil cooler volume, wherein the one as well as the other part

of the oil cooler could in each instance also be connected to the high-temperature circuit.

Especially during the warming-up phase of the internal-combustion engine of the vehicle, in one embodiment the oil cooler could be connected exclusively to the high-temperature circuit. This concerns in particular the oil cooler which ensures the cooling of the transmission oil, as especially hydraulic units, valves and couplings can meet the predetermined reaction times then when the transmission oil has its optimal operating temperature. Preferably, under these operating conditions the cooler of the high-temperature circuit can be separated from the high-temperature circuit, so that the coolant of the high-temperature circuit which has not yet reached its operating temperature is not still additionally cooled by the cooler. Accordingly, under these operating conditions of the vehicle the high-temperature circuit is used above all for warming the components connected to it and thus constitutes an alternative for the short-circuiting between supercharger intercooler and oil cooler.

To achieve a rapid disconnecting or connecting of the units to be cooled from or to at least one cooling circuit, the pipe connections of the internal-combustion engine, of the oil cooler, possibly of the supercharger intercooler and/or at least one cooler of a cooling circuit, can be connected and/or disconnected by means of at least one valve. This valve or these valves are expediently arranged in the cooling system in such a way that on the one hand the shortest possible piping arrangement is ensured, but on the other hand a flexible connection at least of the supercharger intercooler and/or the oil cooler to the respective cooling circuits is possible.

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Such a valve could comprise a thermostat and/or could be made to switch electrically or hydraulically. Finally, valves can be used here that are known from the state of the art, in which connection for a rapid regulating electrically or hydraulically operated valves are preferred.

In a very particularly preferred embodiment, for the control or regulating of the cooling system a control unit is provided and at least one temperature sensor for detecting the temperature of the coolant flowing through a cooling circuit. Thus, for example, a temperature sensor could be arranged on the internal-combustion engine, i.e. there where the coolant of the high-temperature circuit leaves the internal-combustion engine. A further temperature sensor could, for example, be provided on the oil cooler, wherein this temperature sensor preferably detects the oil temperature directly and not the temperature of the coolant that flows through the oil cooler. Furthermore a temperature sensor could be arranged on the supercharger intercooler, which also preferably detects directly the temperature of the air charge.

The temperature sensor produces - preferably electrical - signals, which depend on the temperature of the cooling liquid or the detected temperature. These signals are fed by the temperature sensor to the control unit. The control unit could, for example, be formed by a single-disk computer. The control unit carries out a comparison of the detected temperature with a predetermined temperature or a predetermined temperature range and controls the valve or valves and/or at least one coolant pump in such a way that a predetermined temperature range or a predetermined temperature value is maintained.

In principle it is provided that the coolers of the cooling circuits are arranged together in one place of the vehicle. Especially, according to a preferred embodiment the coolers of at least two cooling circuits are arranged spatially essentially behind one another. Air flows through these coolers in accordance with their arrangement sequence, wherein the air preferably comes from the environment. Accordingly, the coolers of the high-temperature circuit and of the low-temperature circuit can, for example, be arranged together in one place of the vehicle and spatially essentially behind one another. Only the cooler of the further cooling circuit is then arranged in another place of the vehicle.

In a very particularly preferred embodiment the sequence of the arrangement of the coolers of at least two cooling circuits and the connection of these coolers to a unit to be cooled takes place in such a way that the two cooling circuits at least with respect to this unit form a counter-flow heat exchanger or operate according to the counter-flow principle. With this the coolers of the further cooling circuit and of the low-temperature circuit can, for example, be arranged in such a way that the cool ambient air first flows through the cooler of the further cooling circuit and, after the ambient air has absorbed the warmth of the cooler of the further cooling circuit, it then flows through the cooler of the low-temperature circuit. Accordingly - at least in thermodynamic respect with regard to the cooling capacity of the ambient air - the coolant cooled by the cooler of the further cooling circuit has a lower temperature than the coolant cooled by the cooler of the low-temperature circuit. When now the low-temperature circuit cools the part of the supercharger intercooler which with respect to the direction of flow of the air is arranged upstream, and when the further cooling circuit cools the part of the supercharger intercooler which with respect to the direction of flow of the air is

arranged downstream, then this configuration forms a counter-flow heat exchanger.

In case the coolers of the cooling circuits cannot be arranged in a common place of the vehicle, when for example insufficient installation space is available at this place of the vehicle, the coolers of at least two cooling circuits could be arranged in different places of the vehicle. In this case the air flows passing through the coolers can flow spatially separate from one another.

In a preferred embodiment at least two coolers each have a fan, wherein a fan moves, e.g. blows or sucks air through its associated cooler. The providing of a fan for in each instance one cooler should be considered especially when the coolers of at least two cooling circuits are arranged in different places of the vehicle. Preferably the fan is electrically driven, wherein a temperature-controlled activation of the fan can be provided. When providing an electric drive for the fan it is not necessary to provide a mechanical drive, e.g. a V-belt, for driving the fan.

There are various possibilities for embodying and further developing the teachings of the present invention in an advantageous manner. In this connection reference is made on the one hand to the claims following claim 1 and on the other hand to the following explanation of the preferred exemplified embodiment of the invention with reference to the drawing. In connection with the explanation of the preferred exemplified embodiment of the invention with reference to the drawing, also generally preferred embodiments and further developments of the teachings are explained.

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In the drawing in a diagrammatic illustration the only

Fig. 1 illustrates an exemplified embodiment of a cooling system according to the invention and

Fig. 2 illustrates a second exemplified embodiment of a cooling system according to the invention.

In the figures identical or similar components have been marked with the same reference numerals. The cooling system 10 illustrated in Fig. 1 and 2 is intended for a vehicle which is not shown in Fig. 1 and 2. In concrete terms the vehicle is an agricultural utility vehicle, i.e. a tractor.

The vehicle comprises an internal-combustion engine 12 which is connected to a high-temperature circuit 14 of the cooling system 10. The high-temperature circuit 14 furthermore comprises a coolant pump 16 and a cooler 18. The vehicle comprises a low-temperature circuit 20, which includes a supercharger intercooler 22, an oil cooler 24, a cooler 26 and a coolant pump 28.

Also shown is a transmission unit 30, to which the torque produced by the internal-combustion engine 12 is transmitted via the shaft 32. Indicated only diagrammatically is that the heating unit 34 serves to heat the vehicle cab not illustrated in Fig. 1 and which is connected to the high-temperature circuit 14.

According to the invention a further cooling circuit 36 is provided, with which also the supercharger intercooler 22 is cooled. The further cooling circuit 36 includes a cooler 38. Also the further cooling circuit 36 comprises a coolant pump 40.

The high-temperature circuit 14, the low-temperature circuit 20 and the further cooling circuit 36 are made separate from one another, i.e. no mixing of the coolant of the cooling circuits 14, 20 and 36 takes place. Accordingly, for each cooling circuit 14, 20, 36 a coolant pump 16, 28 and 40 respectively is provided.

The coolers 18, 26 and 38 of the cooling circuits 14, 20 and 36 are each designed as air/coolant heat exchangers, through which air coming from the environment can flow. The direction of flow of the air coming from the environments is indicated by the arrows 42.

For the connection to different cooling circuits 20, 36, the supercharger intercooler 22 is divided into two parts. The upper part 44 of the supercharger intercooler 22 is connected to the low-temperature circuit 20. The bottom part 46 of the supercharger intercooler 22 is connected to the further cooling circuit 36. The upper part 44 of the supercharger intercooler 22, the cooler 26, the coolant pump 28 and the oil cooler 24 are serially connected to one another to the low-temperature circuit 20.

A 4/2-way valve 48 is provided, by which the cooler 26 of the low-temperature circuit 20 can be bypassed. This is the case when the left part of the 4/2-way valve is in the active position. In the position of the valve 48 illustrated in Fig. 1, the cooler 26 is connected to the low-temperature circuit 20. In the same manner, with the aid of the thermostat valve 50 the cooler 18 of the high-temperature circuit 14 can be separated or short-circuited. In this case, especially after a cold start of the vehicle, no cooling of the internal-combustion engine 12 by the cooler 18 takes place.

The coolers 38, 26 and 18 are arranged spatially behind one another and air coming from the environment flows through them - according to the direction of flow 42 - in accordance with their arrangement sequence. To this end the air is sucked by the fan 52 through the coolers 38, 26 and 18.

The sequence of the arrangement of the coolers 38 and 26 as well as the connection or cooling sequence of the two-part supercharger intercooler 22 takes place in such a way that with regard to the supercharger intercooler 22 the two cooling circuits 20, 36 form a counter-flow heat exchanger.

The combustion air 54 sucked up from the environment is compressed with the aid of the turbocharger 56 and cooled by the supercharger intercooler 22 to a temperature of approximately 45 degrees Celsius. The coolant tank 58 serves to fill and vent the high-temperature circuit 14 and the low-temperature circuit 20.

Fig. 2 shows in a second exemplified embodiment a cooling system for a vehicle, which comprises a high-temperature circuit 14 and a low-temperature circuit 20. The high-temperature circuit 14 of Fig. 2 in the main corresponds to that of Fig. 1. The low-temperature circuit 20 of Fig. 2 comprises a cooler 26, a coolant pump 28, a first part 46 of the supercharger intercooler 22, the oil cooler 24 and a second part 44 of the supercharger intercooler 22. Here, by means of the coolant pump 28 the coolant cooled by the cooler 26 of the low-temperature circuit 20 is fed to the first part 46 of the supercharger intercooler 22, which forms the low-temperature stage of the supercharger intercooler 22. The coolant warmed up as a result thereof passes through the oil cooler 24 and the further warmed-up coolant passes through the high-temperature stage or the second part 44 of the supercharger intercooler 22, and is then passed on to the cooler 26 for cooling.

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In conclusion it must be pointed out quite particularly that the exemplified embodiments explained in the foregoing only serve to describe the claimed teachings, but do not limit same to the exemplified embodiments.

* * *

Claims

1. Cooling system for an internal-combustion engine of a vehicle, wherein the cooling system has a high-temperature circuit and a low-temperature circuit, wherein the high-temperature circuit is provided for cooling the internal-combustion engine and has at least one cooler, wherein the low-temperature circuit is provided for cooling a charge air cooler and has at least one cooler, and wherein the charge air cooler is divided into at least two sections or constructed in two stages, characterised by the fact that the low temperature circuit is also provided for cooling an oil cooler, wherein the coolant of the low temperature circuit serially flows through a section of the charge air cooler, the oil cooler and another section of the charge air cooler.
2. The cooling system according to claim 1, characterised by the fact that a means is provided that enables the coolant in the low-temperature circuit to bypass the cooler of the low-temperature circuit so that only the charge air cooler and the oil cooler are functionally connected to one another in the low-temperature circuit.
3. The cooling system according to claim 1 or 2, characterised by the fact that the cooling circuits are realized separately from one another such that the coolant flowing through one cooling circuit is not mixed with the coolant flowing through the other cooling circuit.

4. The cooling system according to any one of claims 1 to 3, characterised by the fact that one respective coolant pump is provided for each cooling circuit.
5. The cooling system according to any one of claims 1 to 4, characterised by the fact that one cooler has an air cooled heat exchanger, wherein air that originates from the surroundings flows through said heat exchanger.
6. The cooling system according to any one of claims 1 to 5, characterised by the fact that the oil cooler is provided for cooling the engine oil and/or the transmission fluid.
7. The cooling system according to any one of claims 1 to 6, characterised by the fact that the oil cooler can be connected to the high-temperature circuit only, wherein the cooler of the high-temperature circuit can be isolated from the high-temperature circuit.
8. The cooling system according to any one of claims 1 to 7, characterised by the fact that conduit connections of the internal-combustion engine, the charge air cooler and the oil cooler and/or at least one cooler of a cooling circuit can be connected and/or disconnected by means of at least one valve.
9. The cooling system according to claim 8, characterised by the fact that the at least one valve has a thermostat and/or can be actuated electrically or hydraulically.

10. The cooling system according to claim 4 in connection with claim 8 or 9, characterised by the fact that a control device and at least one temperature sensor for detecting the temperature of the coolant flowing through a cooling circuit are provided, wherein the temperature sensor generates signals that depend on the temperature of the coolant, wherein these signals can be forwarded to the control device, and wherein the at least one valve and/or one of the coolant pumps can be actuated by the control device.
11. The cooling system according to any one of claims 1 to 10, characterised by the fact that the coolers of the cooling circuits are arranged substantially in series, and air that originates from the surroundings flows through the coolers in the sequence in which they are arranged.
12. The cooling system according to any one of claims 1 to 11, characterised by the fact that the coolers of the cooling circuits are arranged at different locations of the vehicle, wherein the air currents flowing through the coolers are separated from one another.
13. The cooling system according to claim 12, characterised by the fact that one respective fan is assigned to the coolers, wherein a fan moves air through the cooler assigned thereto, and wherein the fan can be actuated in a temperature-controlled fashion.

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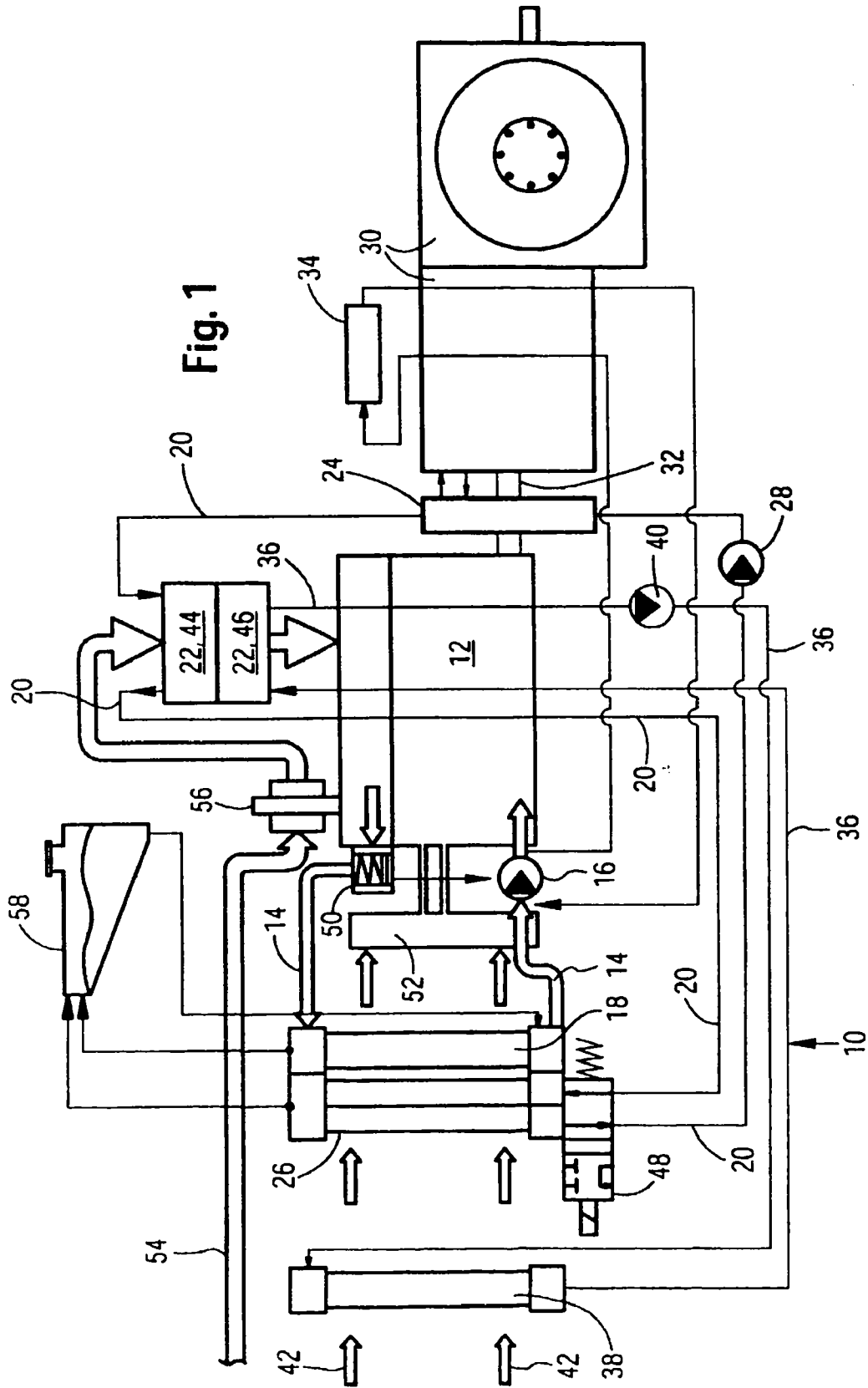


Fig. 1

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