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(54) **Arrangement for venting a radiator in a cooling system**

(57) The present invention relates to an arrangement for venting a radiator (8) in a cooling system in a vehicle. The arrangement comprises a venting passage which extends from an upper section of part (8a, 8c) of the radiator (8) to an expansion tank (11). The arrangement comprises a valve device (18, 23) situated in the venting passage and adapted to monitoring the level of the coolant in said part (8a, 8c) of the radiator (8) and to closing the connection in the venting passage between said part (8a, 8c) of the radiator (8) and the expansion tank (11) at times when said part (8a, 8c) of the radiator (8) is completely full of coolant.

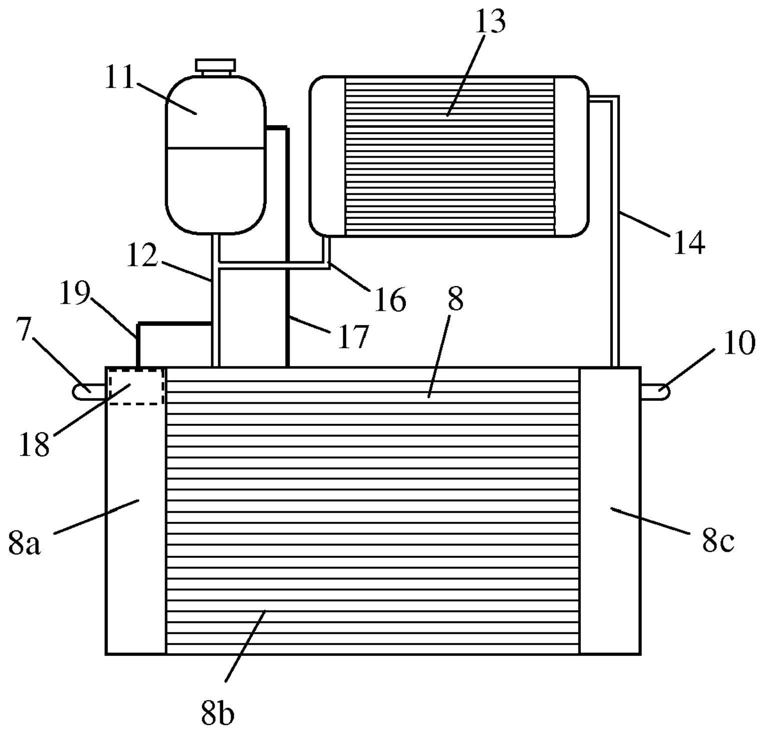


Fig 2

EP 2 599 977 A1

Description

BACKGROUND TO THE INVENTION AND PRIOR ART

[0001] The present invention relates to an arrangement for venting a radiator in a cooling system according to the preamble of claim 1.

[0002] When a cooling system in a vehicle is being replenished with coolant, it is important that all of the air in the cooling system be eliminated. A way of preventing air from remaining, particularly in parts of the cooling system which are locally high, is to use venting lines which lead the air from such parts of the cooling system to an expansion tank. In heavy vehicles there may be a venting line for the combustion engine and a venting line for the radiator. In heavy vehicles the expansion tank may be situated close to the cab. In such cases relatively long venting lines have to be run from the engine to the expansion tank and from the radiator to the expansion tank. Laying these venting lines is often complicated, particularly in cases where the cab is tiltable. They also occupy a relatively large amount of space in the vehicle.

[0003] The venting line for the radiator serves as an open connection between the expansion tank and the part of the cooling system which receives the coolant at its warmest. In situations where the cooling system is under heavy load, very warm coolant may be led from the radiator to the expansion tank via the venting line. The coolant may reach a very high temperature in heavy vehicles on long downhill runs with an activated hydraulic retarder, which involve using the coolant to cool the oil in the retarder. In such situations the warm coolant subjects the expansion tank to a thermal load which may lead to shortening of the tank's service life. To cope with such thermal loads, the expansion tank is usually made of material with good thermal characteristics.

SUMMARY OF THE INVENTION

[0004] One object of the present invention is to propose an arrangement for venting a radiator in a cooling system which is so configured as to prevent warm coolant from the radiator reaching the expansion tank during operation of the cooling system. Another object is to propose an arrangement which occupies less space than conventional venting systems but with a similar function.

[0005] The first object indicated above is achieved with the arrangement of the kind mentioned in the introduction which is characterised by the features indicated in the characterising part of claim 1. The arrangement thus comprises a valve device in the venting passage. When the cooling system is being replenished with coolant, the valve device will be in an open position so that air can pass from the radiator to the expansion tank via the venting passage. When the radiator has been vented and the cooling system has been replenished with coolant, the valve device automatically goes into a closed state, breaking the connection between the radiator and the expansion tank. During subsequent operation of the cooling system, the closed valve device prevents warm coolant from the radiator reaching the expansion tank via the venting passage. The thermal load on the expansion tank will thus be quite small during operation of the cooling system, making it possible for the tank to be made of a less temperature-resistant material than that used in conventional expansion tanks. The cost of the expansion tank may thus be reduced.

[0006] In one embodiment of the invention the valve device comprises a float unit which monitors the level of the coolant in said part of the radiator and a valve disc which closes the venting passage between said part of the radiator and the expansion tank when the float unit reaches a level which indicates that said part of the radiator is completely full of coolant. In this case the valve disc may be connected to the float unit so that it accompanies the latter's upward movement towards the closed state as the coolant level in the radiator rises. The valve disc may for example be situated on top of the float unit. Such a float unit and valve disc may be of quite simple but functional configuration. The valve disc may be situated in a tubular element or similar guide element which guides it along a specific upward path towards the closed state. Alternatively, the float unit and the valve disc may constitute a single component. If the valve disc is made of material which is of lower density than the coolant, it will be able to move in a vertical direction upwards in conjunction with the coolant level in the radiator when the cooling system is being replenished with coolant.

[0007] In another preferred embodiment of the invention, said part of the radiator is an inlet tank or an outlet tank. Many radiators have an inlet tank which receives the warm coolant. The coolant is led from the inlet tank to a radiator section in which the coolant undergoes its main cooling. The cooling section usually comprises a number of flanged parallel tubes situated at short distances from one another. The coolant is cooled in the parallel tubes by a cooling air flow. After it has been cooled in the cooling section, the coolant is received by an outlet tank before proceeding through the cooling system to components which require cooling. There are high parts of the inlet tank and the outlet tank which may serve as suitable locations for venting the radiator.

[0008] In another preferred embodiment of the invention, the valve device is so situated relative to the radiator that the valve disc is within said part of the radiator. The valve disc and any float unit provided may thus be in direct contact with the coolant within the radiator. When all of the air has been evacuated from said part of the radiator, the valve disc will reach the closed position. The valve disc may be spherical and move to a closed position in which it closes an aperture in an upper wall section of the radiator inlet tank or outlet tank. Alternatively, the valve device may be so situated relative to the radiator that the valve disc is in a separate space which is in communication with the coolant within said part of the radiator. This results in the same coolant level within the separate space as in said part of the radiator. The valve device will thus be at a height such that the valve disc reaches the closed position and closes automatically when all of the air has been separated from the radiator.

[0009] In another preferred embodiment, the venting passage comprises a venting line connected to said part of the radiator and a static line of the expansion tank. Connecting the venting line of the radiator to the static line of the expansion tank makes it possible for the radiator to be vented without its venting line having to run as far as the expansion tank. There will thus also be no need for the venting line to have a connection of its own in the expansion tank. The radiator's venting line may therefore be shortened and also occupy less space in the vehicle. The expansion tank may also be made simpler. Alternatively, the radiator's venting line may be connected to the static line via a return line for coolant from a warming element provided for heating the air in a cab space of the vehicle. Many vehicles have a cab warming element situated above the radiator. It is thus possible to connect the venting line of the radiator to the return line of the warming element if it leads into the static line.

[0010] In another preferred embodiment, the venting passage comprises a venting line for the radiator which extends from an upper section of part of the radiator to a venting line for a combustion engine which is connected to the expansion tank. Here again the radiator's venting line may be shortened and also occupy less space in the vehicle. In this case the expansion tank likewise needs no separate connection for the radiator's venting line. The valve device may be situated between a first section of the venting line and a second section of the venting line and be so configured as to prevent any flow between said sections when it is in the closed position and there are different pressures in said sections. During operation of the engine a raised pressure may occur in its venting line. The valve device will prevent this overpressure from causing air and coolant to reach the radiator.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Preferred embodiments of the invention are described below by way of examples with reference to the attached drawings, in which

- Fig. 1 depicts an arrangement for venting a radiator in a cooling system according to a first embodiment of the invention,
- Fig. 2 depicts the arrangement in Fig. 1 in more detail,
- Fig. 3a-b depict the valve device in Fig. 1 in respective open and closed positions,
- Fig. 4 depicts an arrangement according to a second embodiment of the invention and
- Fig. 5a-b depict the valve device in Fig. 4 in respective open and closed positions.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0012] Fig. 1 depicts schematically a vehicle 1 powered by a combustion engine 2. The vehicle is with advantage a heavy vehicle. The engine may be a supercharged diesel engine. It is cooled by coolant which is circulated in a cooling system by a coolant pump 3 from which it circulates to the engine. The coolant circulates through cooling ducts in the engine. It is thus led inter alia past the engine's cylinders and cylinder heads. After it has passed through the engine, the coolant is led out to a line 4 which in this case comprises a cooler 5 for retarder oil. Heavy vehicles are often equipped with a hydraulic retarder. When the retarder is activated, the retarder oil is cooled in the cooler 5 by the coolant in the cooling system.

[0013] The coolant then passes through the line 4 to a thermostat 6. When the coolant has reached its intended operating temperature in the cooling system, the thermostat directs it via a line 7 to a radiator 8 fitted in a forward portion of the vehicle. The radiator comprises an inlet tank 8a to receive warm coolant, a cooling section 8b in which the coolant is cooled by an air flow forced through the cooling section by a cooling fan 9, and an outlet tank 8c to receive the cooled coolant before it returns to the coolant pump 3 via a line 10. At times when the coolant has not reached its operating temperature, the thermostat directs it straight to a line 10a and the coolant pump 3 without any cooling in the radiator 8.

[0014] The cooling system comprises an expansion tank 11 connected via a static line 12 to the line 10 at a location relatively close to the coolant pump 3. The coolant pump is normally situated at the lowest point in the cooling system. The static line 12 provides assurance that the pressure of the coolant on the inlet side of the coolant pump will be such as to prevent cavitation. The expansion tank 11 needs to be situated relatively high, e.g. in the vehicle's cab. A warming element 13 is provided to heat the air in the cab. A line 14 is adapted to receiving warm coolant from a line 4a and leading it to the warming element 13. The line 14 comprises a valve 15 by means of which the coolant flow to the warming element can be regulated. A return line 16 is provided to lead coolant from the warming element 13 to the static line 12. A fan 13a forces an air flow through the warming element to boost the heating of the air in the cab.

[0015] The coolant system comprises a venting line 17 for the engine 2. This venting line connects to the expansion tank 11 a section of the cooling system which is in contact with the engine's cylinder heads. The radiator inlet tank 8a is provided with a valve device 18 for venting. This valve device is connected via a venting line 19 for the radiator to the static line 12 and thereby to the expansion tank 11. In this case the radiator is thus provided with a venting passage which comprises the valve device 18, the venting line 19 and the static line 12. In heavy vehicles the expansion tank 11 and the warming element 13 may be at substantially the same height level close to the cab as depicted in Fig. 2 and thus be substantially vertically above the radiator 8. In this case the static line 12 extends downwards at a relatively short distance from the radiator, making it possible to connect the warming element 13 to the static line 12 by means of a relatively short return line 16. Here again the venting line 17 for the engine will have an extent at a relatively short distance from the radiator.

[0016] The valve device 18 situated in an upper portion of the radiator inlet tank 8a is depicted in more detail in Figs. 3a-b. It comprises a float unit 20 adapted to being in contact with the coolant in the inlet tank. In this case the float unit is fastened in a guide means in the form of a tubular element 21 which encloses a spherical valve disc 22 situated on top of the float unit 20. An aperture 19a to the venting line 19 is provided in an upper surface of the radiator inlet tank 8a. Fig. 3a depicts the valve device 18 when the inlet tank is not completely full of coolant. The float unit 20 and the valve disc 22 are here at the level of the coolant in the inlet tank at a distance from the aperture 19a. Fig. 3b depicts the valve device 18 when the inlet tank 8a is completely full of coolant. In this situation the float unit 20 has lifted the valve disc 22 to a position at which it closes the aperture 19a to the venting line 19.

[0017] During for example servicing or repairs, the cooling system may be emptied of coolant. It has thereafter to be replenished via a filling nipple or the like situated at a low level in the cooling system, e.g. below the radiator 8. When a low coolant level occurs during operation of the vehicle, the cooling system is replenished with coolant via the expansion tank 11. Whenever it is being replenished with coolant, it is important that air be evacuated from the cooling system. It is particularly important to vent parts of the cooling system which are locally high in the engine 2 and in the radiator 8. When the coolant is being replenished, its level in the radiator inlet tank 8a rises. The float unit 20 and the valve disc 22 accompany the coolant level upwards in the inlet tank. The space above the coolant level is occupied by air which is progressively evacuated from the inlet tank via the open valve device 18, the venting line 19 for the radiator, the static line 12 and the expansion tank 11 as the coolant level rises in the inlet tank. When the coolant level in the cooling system rises, air is simultaneously evacuated to the expansion tank 11 from the part of the cooling system which cools the engine via the venting line 17. When all of the air has left the inlet tank, the float unit 20 will have lifted the valve disc 22 to a position at which it closes the aperture 19 and thus shuts off the connection between the valve device 18 and the venting line 19. The cooling system is replenished with coolant until a marked maximum level is reached in the expansion tank 11, after which the cover of the expansion tank is screwed on.

[0018] Starting the engine 2 sets the coolant pump 3 running to cause coolant circulation in the cooling system. So long as the coolant is at a temperature below the desired operating temperature, the thermostat 6 will not direct any coolant through the radiator 8. The result in the static line 12 and the return line 16 is a relative negative pressure which leads to the valve means 22 also closing the aperture 19a by a suction force which further provides assurance that no coolant from the inlet tank 8a will enter the venting line 19 and cause a backflow of coolant through the radiator 8. When the coolant reaches the desired operating temperature, the thermostat opens and the warm coolant is led through the radiator.

[0019] At times when the retarder is activated, the coolant may undergo considerable warming in the cooler 5, in which case the coolant reaching the radiator 8 may be at a very high temperature. During operation of the engine, the valve device 18 keeps the venting passage 19 between the radiator 8 and the expansion tank 11 closed, providing assurance that no warm coolant can make its way up through the venting passage 19 and reach the expansion tank 11. This means that the expansion tank may be made of a less temperature-resistant material and at lower cost. Another advantage here is that the venting line 19 for the radiator 8 does not extend all the way from the radiator to the expansion tank. In this case the venting line 19 is connected to the static line 12, so the number of lines leading to the expansion tank can be reduced. The venting line 19 may be made relatively short and occupy less space.

[0020] Fig. 4 depicts an alternative valve device 23 situated on the outside of an upper portion of the radiator outlet tank 8c. A venting line for the radiator 8 comprises here a first line section 24a and a second line section 24b. The valve device 23 is situated between these first and second line sections. The first line section serves as a connection between an upper internal space in the outlet tank 8c and the valve device 23. The second line section 24b serves as a connection between the valve device 23 and the engine venting line 17. The result is a venting passage from the radiator 8 to the expansion tank 11 which comprises the first line section 24a, the valve device 23, the second line section 24b and the venting line 17 for the engine. The valve device 23 is depicted in more detail in Figs. 5a, b. It comprises a first space 25a connected to the first line section 24a via an upper aperture $25a_1$. A first spherical valve disc 26a is situated in this first space and made of material such that it is buoyant in coolant. The valve device 23 comprises a second space 25b connected to the second line section 24b via an upper aperture $25b_1$. A second spherical valve disc 26b is situated in this second space and is likewise made of material such that it float units in coolant.

[0021] The first space 25a and the second space 25b have a floor 27 which is in the form of a grid or the like and has the characteristic of stopping the valve discs 26a, b at a lower position by allowing air and coolant to pass through. The valve device 23 has an aperture 29 connecting the first space 25a and the second space 25b to one another. The fact that the valve device is connected to the outlet tank 8c via the aperture 24a means that the coolant level will be the same in the spaces 25a, b as in the outlet tank. The valve device is fastened in a height position such that the coolant level in said spaces 25a, b reaches the apertures $25a_1$, $25b_1$ when the outlet tank is completely full of coolant.

[0022] When the cooling system is being replenished with coolant, the coolant level rises in the radiator outlet tank 8c and in said spaces 25a, b. The valve discs 26a, 6 accompany the coolant level upwards in the respective spaces 25a, 6. The air in the upper portion of the outlet tank 8c is evacuated progressively to the expansion tank 11 via the first line section 24a, the first space 25a, the aperture 29, the second space 25b, the second line section 24b and the engine's venting line 17. When all of the air has left the outlet tank, the valve discs 26a, b will have reached an upper position in the respective spaces 25a, b at which they close the apertures $25a_1$, $25b_1$, thereby breaking the connection between the first and second line sections. Coolant replenishment proceeds until a maximum coolant level is reached in the expansion tank.

[0023] Starting the engine sets the coolant pump 3 running to cause coolant circulation in the cooling system. So long as the coolant is at a temperature below the desired operating temperature, the thermostat 6 will direct no coolant through the radiator 8, potentially resulting in a positive pressure in the engine's venting line 17 and hence in the second line section 24b. This positive pressure will exert a pressure force on the second valve disc 26b in the second space 25b. This second valve disc may thus be moved downwards from the closed position, causing in the second space 25b a positive pressure which is propagated to the first space 25a via the aperture 29. This positive pressure in the second space 25b pushes the first valve disc 26a upwards so that it closes the aperture $25a_1$ with a raised pressure, thereby providing assurance that no air will be led from the venting line 17 to the radiator 8. When the coolant exceeds the desired operating temperature, the thermostat 6 will open and warm coolant will circulate through the radiator 8.

[0024] The invention is in no way restricted to the embodiment to which the drawing refers but may be varied freely within the scopes of the claims.

Claims

1. An arrangement for venting a radiator (8) in a cooling system in a vehicle, which arrangement comprises a venting passage which extends from an upper section of part (8a, 8c) of the radiator (8) to an expansion tank (11), **characterised in that** the arrangement comprises a valve device (18, 23) situated in the venting passage and adapted to monitoring the level of the coolant in said part (8a, 8c) of the radiator (8) and to closing the connection in the venting passage between said part (8a, 8c) of the radiator (8) and the expansion tank (11) at times when said part (8a, 8c) of the radiator (8) is completely full of coolant.

2. An arrangement according to claim 1, **characterised in that** the valve device (18, 23) comprises a float unit (20, 26a, 26b) which monitors the level of the coolant in said part (8a, 8c) of the radiator (8), and a valve disc (22, 26a, 26b) which closes the venting passage between said part (8a, 8c) of the radiator (8) and the expansion tank (11) at times when the float unit (20, 26a, 26b) reaches a level which indicates that said part (8a, 8c) of the radiator (8) is completely full of coolant.

3. An arrangement according to claim 2, **characterised in that** the float unit and the valve disc constitute a single component (26a, 26b).

4. An arrangement according to any one of the foregoing claims, **characterised in that** said part (8a, 8c) of the radiator (8) is an inlet tank (8a) or an outlet tank (8c).

5. An arrangement according to any one of claims 2 to 4 above, **characterised in that** the valve device (18) is so situated relative to the radiator that the float unit (20) is within said part (8a) of the radiator.

6. An arrangement according to any one of claims 2 to 4 above, **characterised in that** the valve device (23) is so situated relative to the radiator that the float unit (20) is in a separate space (25a, 25b) which is in communication with the coolant within said part (8a) of the radiator.

7. An arrangement according to any one of the foregoing claims, **characterised in that** the venting passage comprises a venting line (19) connected to said part (8a, 8c) of the radiator (8) and a static line (12) of the expansion tank (11).

8. An arrangement according to claim 7, **characterised in that** the venting line (19) is connected to the static line (12) via a return line (16) for coolant from a warming element (13) which is adapted to heating the air in a cab space in the vehicle.

9. An arrangement according to any one of claims 1 to 6 above, **characterised in that** the venting passage comprises a venting line (24a, 24b) which extends from an upper section of part (8c) of the radiator (8) and a venting line (17) for a combustion engine which is connected to the expansion tank (11).

10. An arrangement according to any one of the foregoing claims, **characterised in that** the valve device is situated between a first section (24a) of the venting line and a second section (24b) of the venting line and is so configured as to prevent any flow between said sections (24a, 24b) of the venting line when it is in the closed state and there are different pres-

sures in said sections (24a, 24b).

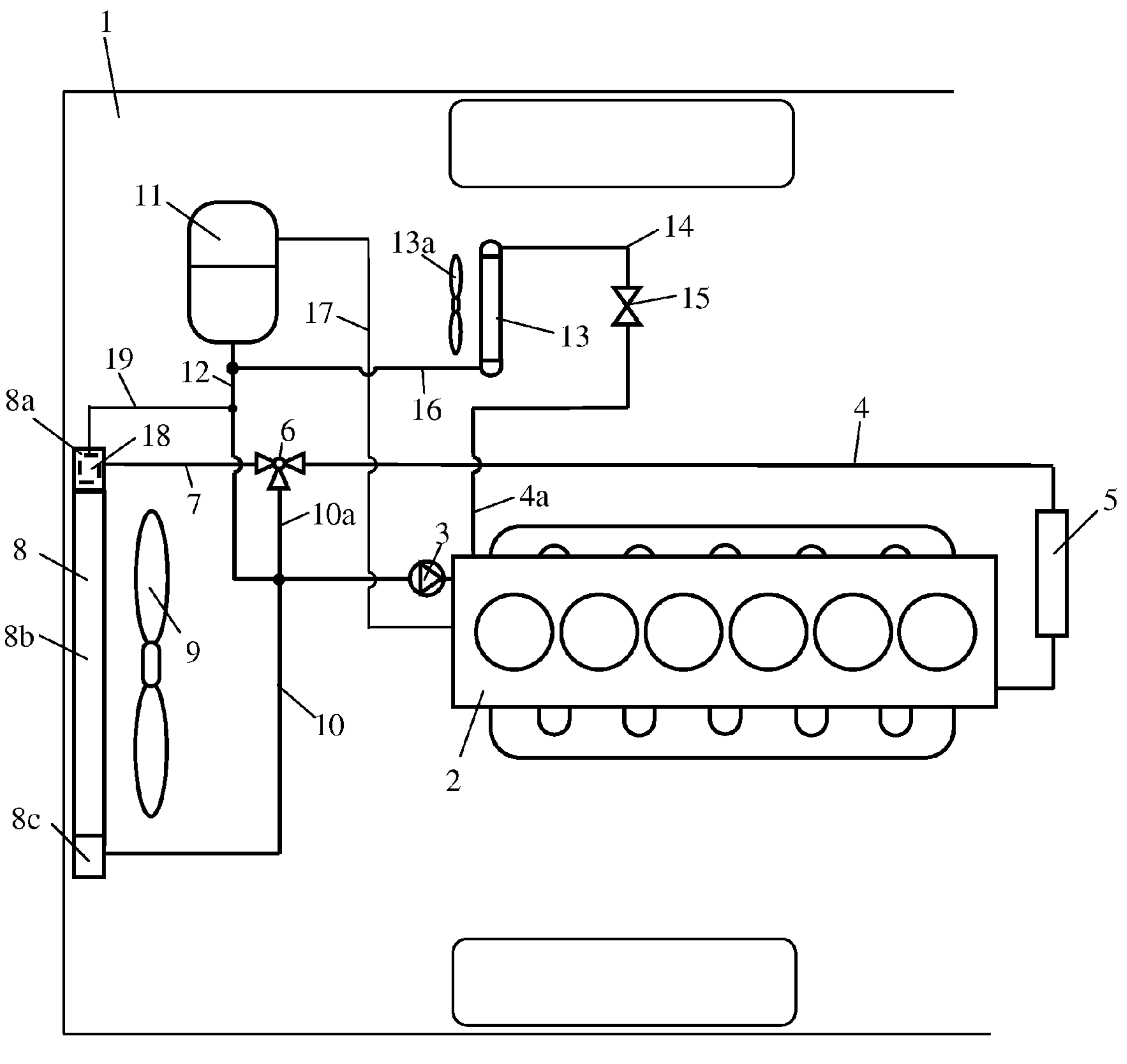


Fig 1

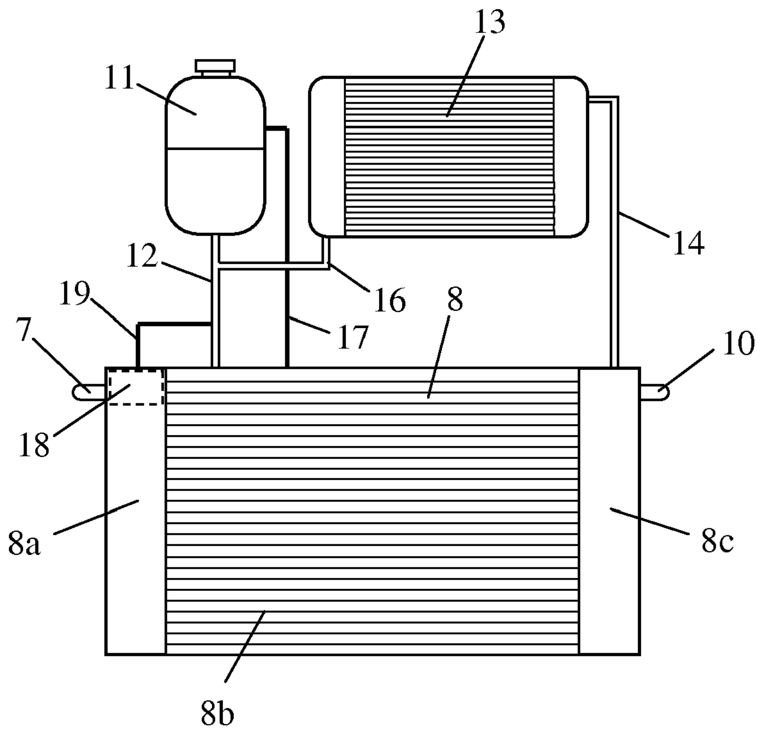


Fig 2

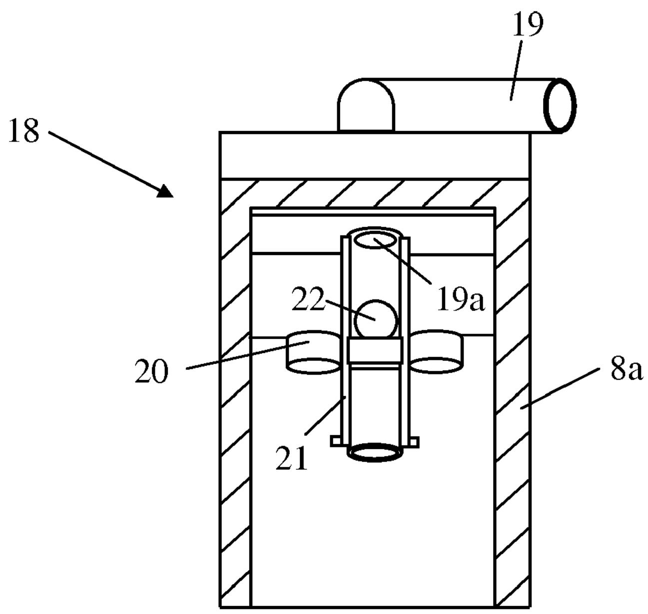


Fig 3a

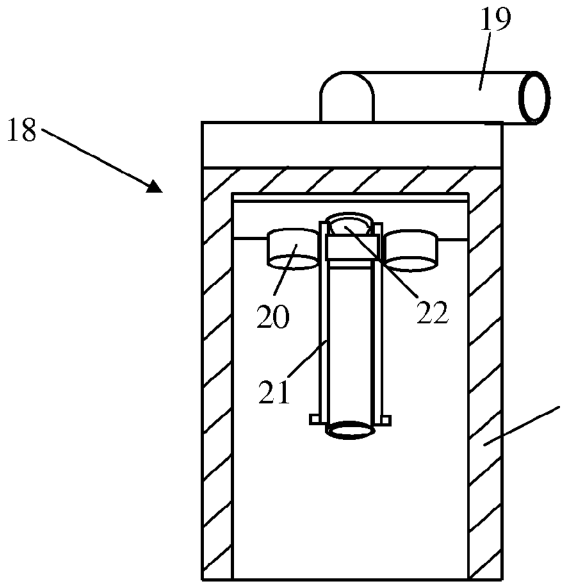


Fig 3b

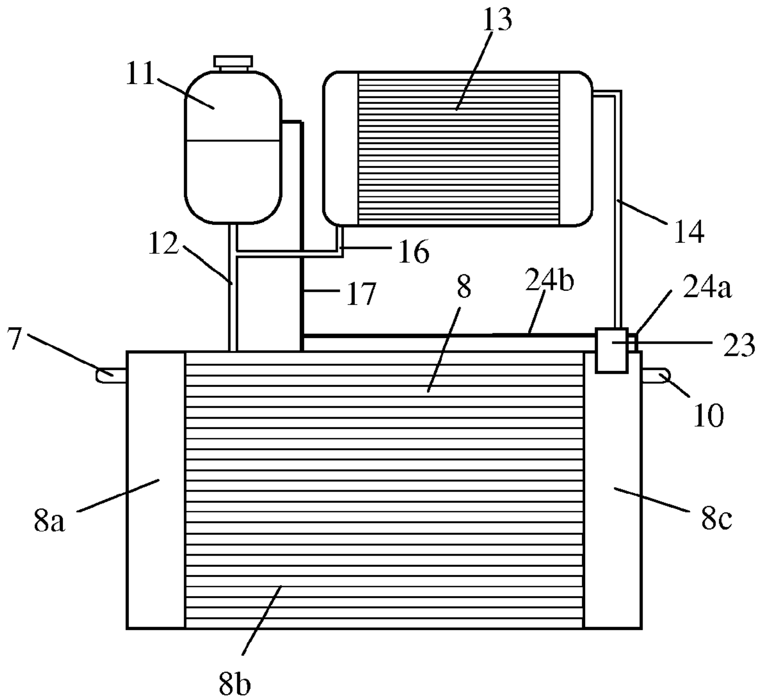
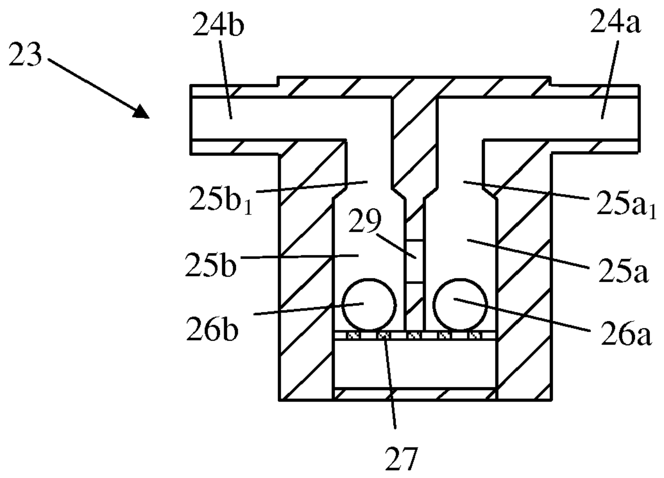
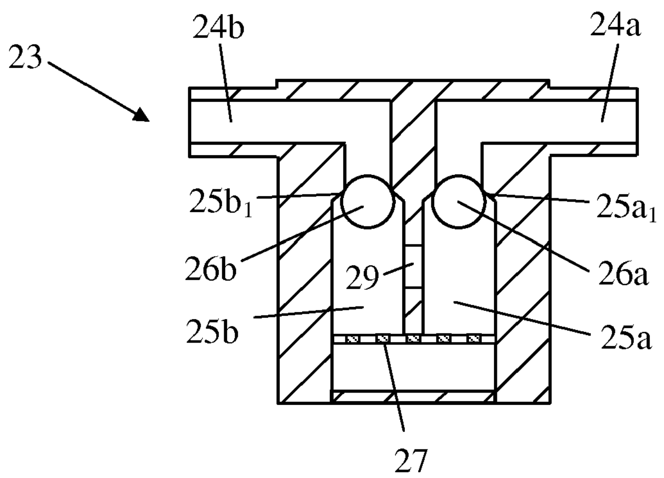


Fig 4



23
24b
24a
25b1
25a1
29
25b
25a
26b
26a
27

Fig 5a



23
24b
24a
25b1
25a1
26b
26a
29
25b
25a
27

Fig 5b

EUROPEAN SEARCH REPORT

Application Number
EP 12 18 8985

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	FR 2 530 289 A1 (BAYERISCHE MOTOREN WERKE AG [DE]) 20 January 1984 (1984-01-20) * page 5, line 30 - page 6, line 26 * * page 8, line 11 - page 9, line 14; figures 1,3 * -----	1-5,7,9	INV. F01P11/02
X	DE 28 21 872 A1 (AUDI NSU AUTO UNION AG) 22 November 1979 (1979-11-22) * page 12, lines 1-10 * * page 12, lines 21-20; figures 1,3 * -----	1-5,7,9	

TECHNICAL FIELDS SEARCHED (IPC)

F01P

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	25 April 2013	Luta, Dragos

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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25-04-2013

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82