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(71) Applicant: **SCANIA CV AB** [SE/SE]; S-151 87 Södertälje (SE).

(72) Inventors: **EKMAN, Mats**; Stallbacksvägen 6, S-155 32 Nykvarn (SE). **JAHNS, Dieter**; Karlslundsgatan 40, S-151 63 Södertälje (SE). **KÅLLBERG, Fredrik**; Telegrafgatan 5, S-169 72 Solna (SE).

(74) Agent: **FORSELL, Hans**; Scania CV AB, S-151 87 Södertälje (SE).

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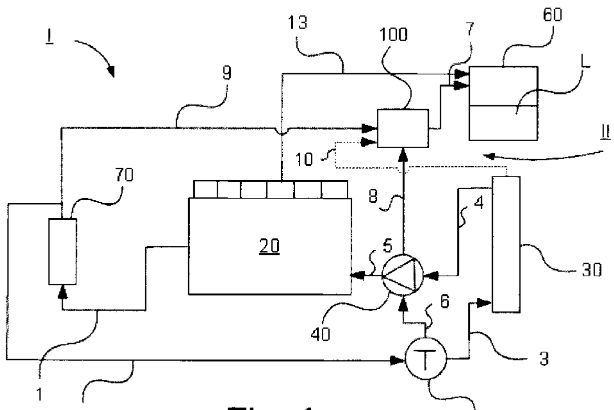

Fig. 1

(57) Abstract: The present invention concerns a method for venting a cooling system (I) for an engine (20), in which cooling system a liquid cooling medium (L) is circulated to cool said engine, and which cooling system comprises a radiator (30), a pump configuration (40) powered by means of said engine to circulate said liquid cooling medium, and an expansion tank (60) for said liquid cooling medium to which venting is intended to occur during operation of the engine, which method comprises the steps of: - when said engine is taken out of operation, venting (S1) the cooling system via a venting circuit (II) comprising a valve (100; 200: 300; 400) and said expansion tank, wherein said valve is essentially opened to supply air (A) to said expansion tank, and - when said engine is put into operation, essentially closing (S2), by means of pressure (P) generated by said pump configuration, said valve to prevent the supply of air to said expansion tank via said venting circuit. The present invention also concerns a venting circuit for venting a cooling system for an engine. The present invention also concerns an engine configuration.

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Venting circuit

TECHNICAL FIELD OF THE INVENTION

The invention concerns a venting circuit according to the preamble to claim 1. The invention concerns a method for venting a venting circuit connected to a cooling system for an engine according to the preamble to claim 13. The invention also concerns an engine configuration and a vehicle containing an engine configuration.

BACKGROUND

Cooling systems for a liquid-cooled combustion engine contain a radiator for cooling a cooling medium, a bypass line in which the cooling medium can bypass the radiator when the cooling medium temperature is low, a pump configuration for circulating the cooling medium through the radiator and/or the bypass line and the engine cooling ducts, and a thermostat for guiding the cooling medium flow to the radiator and/or the bypass line in dependence upon the temperature of the cooling medium. The cooling system also comprises an expansion tank for said liquid cooling medium, to which venting is intended to occur during engine operation. Such cooling systems commonly contain at least one additional cooled object in addition to said engine, wherein said cooled object comprises, according to one variant, a supplemental brake in the form of a hydraulic retarder. The oil in the retarder is cooled via a retarder circuit that is connected to the cooling system. Because the retarder is not used continuously, continuous cooling or venting of the retarder is not necessary either.

One problem is that, in a cooled object such as the retarder circuit, air gets left in air traps when the cooling fluid system is drained of cooling fluid and then refilled. The air collects in highly situated volumes that are not vented automatically. The air collects in highly situated volumes which, if they are not vented or cannot be transported to the expansion tank can, when the engine is operating, migrate into the cooling fluid pump, which may sustain damage. If the cooling system initially has air traps that are transported to the expansion tank, the system will need to be refilled. Continuous venting of a cooled object that does not require it results in parasitic losses, since the cooling fluid pump must be activated more than is necessary when this flow is conducted so as to bypass certain parts of the regular cooling system. Furthermore, the venting flow through the expansion tank increases, thereby degrading the venting functionality.

Another variant comprises a manual venting nipple arranged in connection to a location where an air trap may be formed. One problem with such a solution is that it requires that the operator understand that venting must occur by means of the venting nipple, and that the operator must remember to vent manually.

OBJECT OF THE INVENTION

One object of the present invention is to provide a method for venting a venting circuit connected to a cooling system for an engine that enables reliable and efficient venting of cooling circuits. The invention is intended in particular to provide such a method for cooled objects in cases where a continuous venting flow is unnecessary.

One object of the present invention is to provide a venting circuit for venting a cooling system for an engine that enables reliable and efficient venting of cooling circuits. The invention is intended in particular to provide such a method for cooled objects in cases where a continuous venting flow is unnecessary.

SUMMARY OF THE INVENTION

These and other objects, which are presented in the description below, are achieved by means of a method, a venting circuit and an engine configuration of the type described above, and which further exhibit the features specified in the characterizing portion of the independent claims. Preferred embodiments of the method and the device are defined in the non-independent claims.

According to one embodiment of the invention, these objects are achieved by means of a venting circuit II for at least one additional cooled object in a cooling system for a combustion engine according to claim 1.

Reliable and efficient as-needed venting of cooling circuits for cooled objects is hereby achieved, since venting will occur automatically only when the need exists. Consequently, the operator need not remember to vent manually as needed. This provides a simple and cost-effective solution that requires no electrical control. Such closure to prevent a supply of air to said expansion tank via said venting circuit II when the engine is in operation provides a more robust system.

According to one embodiment of the invention, the valve comprises a first inlet and an outlet wherein an airflow in the second position is prevented from passing from the first inlet to the outlet and allowed, in the first position, to pass from the first inlet to the outlet.

According to one embodiment of the invention, the valve comprises a second inlet, whereupon said pump configuration is connected to the second inlet of the valve via a pilot line for transferring pressure. Efficient control of the valve is hereby achieved so that, during operation, it closes to prevent the supply of air to said expansion tank via said venting circuit II, whereupon venting occurs only when the need exists.

According to one embodiment of the invention, the valve comprises a spring element that loads a valve body, whereupon the valve body assumes the first position when the pressure from the pump configuration is lower than the force from the spring element, and the valve body assumes the second position when the pressure from the pump configuration is greater than the force from the spring element. The valve body can be designed as a cylinder with a through-going channel which, in the first position, is in line with the first inlet and outlet of the valve to enable the passage of an airflow through the valve and, in the second position, out of line with the first inlet and outlet of the valve to prevent the passage of an airflow through the valve.

Using a spring-loaded valve body is a compact and robust way to control the valve between the first and second position with the help of the pressure that is generated by the pump configuration.

The cylinder can be designed with an inlet and an outlet that constitute the through-going channel. The cylinder can alternatively be designed with two sleeve sections and an intermediate middle section, which has a smaller diameter than the sleeve sections. An airflow is then able to flow around the middle section when it is aligned with the first inlet and outlet of the valve, while no airflow will be able to pass through the valve when either of the sleeve sections are aligned with the first inlet and outlet of the valve.

According to one embodiment, the valve comprises a membrane that, in the first position, allows the passage of an airflow through the valve. In the second position, the pressure from the pump configuration acts upon the membrane, which expands and thus blocks the passage between the first inlet and outlet of the valve. Such a solution is a compact and robust way to control the valve between the first position and the second position with the help of the pressure from the pump configuration.

According to one embodiment of the invention, said at least one additional cooled object consists of at least one of the cooled objects comprising said radiator, a retarder and an EGR radiator. This is an example of a cooled object that does not require continuous venting.

According to one embodiment of the invention, venting via the venting circuit II is arranged so as to occur in connection with the refilling of cooling medium in the cooling system. Venting will thus occur automatically in a case where there is a high risk that air will accumulate in the system, and the risk of damage to the pump configuration is thereby decreased.

According to the invention, these objects are also achieved by means of a method for venting at least one additional cooled object according to claim 13.

Reliable and efficient as-needed venting of cooling circuits for cooled objects is hereby achieved, in that venting occurs automatically only when the need exists. The operator consequently need not remember to vent manually when necessary. A simple and cost-effective solution that does not require any electrical control is hereby achieved. Such closure to prevent the supply of air to said expansion tank via said venting circuit II when the engine is in operation provides a more robust system.

The foregoing objects are also achieved by means of an engine configuration according to claim 11 and a vehicle according to claim 12.

FIGURE DESCRIPTION

The present invention will be better understood with reference to the following detailed description read along with the accompanying drawings, in which the same reference designations refer to the same parts throughout in the many views, and in which:

Fig. 1 schematically illustrates a cooling system with a device for venting the cooling system according to one embodiment of the present invention;

Fig. 2 schematically illustrates a cross-section view of a valve in said device according to one embodiment of the present invention;

Fig. 3 schematically illustrates a cross-section view of a valve in said device according to one embodiment of the present invention;

Fig. 4 schematically illustrates a cross-section view of a valve in said device according to one embodiment of the present invention;

Fig. 5 schematically illustrates a flow diagram of a method for venting a cooling system for an engine according to one embodiment of the present invention.

Fig. 6 schematically depicts a vehicle according to one embodiment of the invention.

DESCRIPTION OF EMBODIMENTS

Fig. 1 schematically illustrates a cooling system I with a device for venting the cooling system I according to one embodiment of the present invention.

The cooling system I is intended for a combustion engine 20 in a motor vehicle 1000 such as a goods vehicle, bus, car or the like.

The cooling system I comprises a cooling circuit (not shown) arranged in the vehicle engine 20, through which cooling circuit a cooling medium is arranged so as to flow in order to cool the engine 20. The cooling medium consists of a liquid, which preferably consists of a mixture of water and freezing point-lowering additives such as glycol.

The cooling system I further comprises a radiator 30 for cooling the cooling medium, a pump configuration 40 for circulating the cooling medium in the cooling circuit of the cooling system I, and a thermostat device 50 arranged downstream of the engine 20 so as to guide the cooling medium in the cooling system I in dependence upon the temperature. The pump configuration 40 is arranged so as to be powered by means of the engine 20.

The cooling system I further comprises an expansion tank 60 for said liquid cooling medium L to which venting is intended to occur during the operation of the engine 20. The expansion tank 60 is located at a high level relative to other cooling system components in order to facilitate said venting.

The cooling system I according to this embodiment further comprises an additional cooled object 70 in the form of a supplemental brake that consists of a hydraulic retarder 70. During braking with the retarder, energy of motion is converted in the retarder into thermal energy, which is transferred to the working medium for the retarder, e.g. oil. The motor vehicle cooling system I can be equipped with an extra heat exchanger to cool the retarder oil during the braking process, whereupon the cooling system I is equipped with an extra heat exchanger.

An outlet from the cooling circuit of the engine 20 is connected to an inlet of the retarder 70 via a first line 1. An outlet from the retarder 70 is connected to an inlet of the thermostat device 50 via a second line 2. A first outlet from the thermostat device 50 is in turn connected to an inlet to the radiator 30 via a third line 3. An outlet from the radiator 30 is connected to an inlet to the pump configuration 40 via a fourth line 4. A first outlet from the pump configuration is directly connected to an inlet to the cooling circuit of the engine 20 via a fifth line 5. A second outlet from the thermostat device 50 is connected to the inlet to the pump configuration 40 via a bypass line 6. The bypass line 6 makes it possible for cooling medium to bypass the radiator 30.

According to one variant, the cooling medium that flows through the radiator 30 is arranged so as to be cooled by means of air that blows against the radiator 30 when the vehicle is in motion. The cooling system can also comprise a fan (not shown) arranged so as to assist with extra cooling of the cooling medium when necessary.

A venting circuit II is connected to the cooling system I. The venting circuit II is connected to said expansion tank 60. The venting circuit II further comprises a valve 100. An outlet of said valve 100 is connected to an inlet of the expansion tank 60 via a line 7.

An outlet of the retarder 70 is connected to a first inlet of said valve 100 via a venting line 9.

Said valve 100 is connected to the pump configuration 40 via a pilot line 8. An outlet from the pump arrangement 40 is connected to a second inlet of the valve 100 via said pilot line 8.

Said valve 100 is configured so as, in a first venting position, to allow air to flow in the venting line 9 through the valve 100 to said expansion tank 60. Said valve 100 is further arranged so as, in a second shutoff position, to prevent air from flowing through the valve 100 when the engine 20 is in operation. Said valve 100 is arranged so as to be set to its second position via pressure generated by means of said pump configuration 40 via said pilot line 8.

Venting of the cooling system I is arranged so as to occur via said venting circuit II when said engine 20 is taken out of operation. Said valve 100 is thus arranged so as to be opened essentially to supply air to said expansion tank 60. During venting of the retarder 70, air is thus arranged so as to flow in said venting line 9 through the valve 100 to said expansion tank 60.

Venting of the cooling system I is arranged so as, when said engine 20 is placed into operation, not to occur via said venting circuit II. Said valve 100 is thus arranged, by means of pressure generated by said pump configuration 40, so as to essentially close in order to prevent the supply of air to said expansion tank 60 via said venting circuit During operation of the engine 20, said pump configuration 40 is consequently arranged so as to transfer pressure via said pilot line 8 to said valve 100 so that said first inlet of the valve is closed in order to prevent the supply of air in said venting line 9 and consequently said venting circuit II. No venting of an additional cooled object, such as the retarder 70, will occur via the venting circuit II during operation of the engine 20.

The pilot line 8 is arranged so as to control the valve 100 so that, when the engine 20 and consequently the pump configuration 40 are in operation, the valve 100 will be set to its second position and thus close off the passage of an airflow via the venting circuit II to said expansion tank 60. The valve 100 is set to the second position by means of pressure generated in the cooling system I by the pump configuration 40. According to the embodiment illustrated in Fig. 1, the pilot line 8 is directly connected to the pump configuration 40. The pilot line 8 can be connected to any arbitrary connection in the cooling system I where the pressure during operation of the engine 20 and the pump configuration 40 is sufficient to close the valve 100. According to an alternative variant, the pilot line 8 is connected to an outlet of the engine 20 where pressure generated during operation of the engine 20 and the pump configuration 40 is sufficient to close the valve 100.

According to one variant, the cooling system I comprises an additional venting line 10 (dotted line in Fig. 1) arranged so as to be connected to an outlet of the radiator 30 and further connected to an inlet of the valve 100 for venting to the expansion tank 60 via said valve 100. Said additional venting line 10 is incorporated in said venting circuit.

Venting via said venting circuit II is also intended to be used in connection with refilling of cooling medium in the cooling system. Refilling of cooling medium can occur at any arbitrary point in the cooling system.

An outlet from the cooling circuit of the engine 20 is connected to an inlet of the expansion tank via a venting line 13, whereupon venting consequently occurs during operation as well.

According to one variant (not shown), the cooling system could contain an additional one or more valves in the venting circuit II connected to the expansion tank for venting an additional cooled object, a so-called EGR (Exhaust Gas Recirculation) radiator.

Said cooling system I with said engine 20 constitutes an engine configuration.

Fig. 2 schematically illustrates a cross-section view of a valve 200 in said device according to one embodiment of the present invention.

The valve 200 comprises a first inlet 202 that is intended to be connected via a venting line 9 of a venting loop II to a cooled object (not shown) such as a retarder, e.g. a retarder 70 according to Fig. 1.

The valve 200 further comprises an outlet 204 that is intended to be connected via a line 7 of the venting circuit II to an expansion tank (not shown), e.g. an expansion tank 60 according to Fig. 1.

The valve 200 comprises a second inlet 206 that is intended to receive, via a pilot line 8, pressure P transferred from a pump configuration (not shown), e.g. a pump configuration 40 according to Fig. 1.

The valve 200 further comprises a closure mechanism in the form of a membrane 210 arranged so as, in a first position, to allow flow A through the valve 200 in through said first inlet 202 and out through said outlet 204 so as to vent a cooled object in the venting circuit. The membrane 210 of the valve 200 is, in a second position, arranged so as to close said first inlet 202 so as to prevent the supply of air to said expansion tank via said venting circuit II as described above with reference to Fig. 1.

Said membrane 210 is arranged so as to assume said second position during operation of an engine (not shown) by means of pressure P generated by the pump configuration and transferred in said pilot line 8. The membrane 210 is thus here arranged so as to assume said second position by means of pressure P generated by said pump configuration during operation, whereupon the membrane 210 closes said first inlet 202 by means of pressure P transferred in said pilot line 8. The membrane 210 is thus fixedly arranged at said second inlet 206. The membrane 210 is arranged so as to expand upon the application of said pressure P transferred in the pilot line 8.

One advantage of using a valve 200 with a membrane 210 according to the embodiment illustrated in Fig. 2 is that a simple design with few parts is made possible.

Fig. 3 schematically illustrates a cross-section view of a valve 300 in said device according to one embodiment of the present invention.

The valve 300 according to the embodiment in Fig. 3 differs from the valve 200 according to the embodiment in Fig. 2 essentially in term of the design of its closure mechanism.

The valve 300 comprises a first inlet 302 that is intended so as to be connected via a venting line 9 of the venting circuit II to an outlet of a cooled object (not shown) such as a retarder, e.g. a retarder according to Fig. 1.

The valve 300 further comprises an outlet 304 that is intended so as to be connected via a line 7 of the venting circuit II to an expansion tank (not shown), e.g. an expansion tank 60 according to Fig. 1.

The valve 300 comprises a second inlet 306 intended so as to receive, via a pilot line 8, pressure P transferred from a pump configuration (not shown), e.g. a pump configuration 40 according to Fig. 1.

The valve 300 further comprises a closure mechanism in the form of a spring-loaded cylinder 310 arranged between said first inlet 302 and said outlet 304. Said cylinder 310 is reciprocatingly movably arranged in the axial direction of the cylinder 310. Said cylinder 310 has a pressure side 316 in connection to said second inlet 306 and arranged so as to receive pressure P from the pump configuration 40 via said pilot line 8.

The cylinder 310 moves in the spaces in the valve 300 that consist of the second inlet 306 and a space 340 that will be described in detail below.

Said valve 300 further comprises a spring element 320 arranged on a spring side 318 facing the pressure side 316 of said cylinder 310. The spring element 320 is arranged in a space 340 in the valve 300 between a spring side 318 of the valve 300 and an opposing wall of the space 340.

Said cylinder 310 further comprises an inlet 312 and an outlet 314, which form a through-going channel in the cylinder 310. Said cylinder 310 is, in a first position of the valve 300, arranged so that said inlet 312 and outlet 314 of the cylinder 310 are brought into alignment with said first inlet 302 and outlet of 304 [sic] the valve 300 so that an airflow A is made possible. In the first position, the first inlet 302 and outlet 304 of the valve 300 will stand in flow communication with the through-going channel of the cylinder formed by its inlet 312 and outlet 314. The airflow A can, in the first position, pass in through said first inlet 302 in the valve 300 via the inlet 312 and the outlet 314 of the cylinder 310, and out through said outlet 304 so as to vent a cooled object in the venting circuit. The inlet 312 and outlet 314 of the cylinder 310 thus make it possible for an airflow A to pass transverse to the direction of motion of the cylinder 300.

Said cylinder 310 is, in a second position of the valve 300, arranged so that said inlet 312 and outlet 314 of the cylinder 310 are brought out of alignment with said first inlet 302 and outlet 304 of the valve 300, so that said first inlet 302 is closed to the passage of an airflow A to said expansion tank 60 via said venting circuit. In the second position, the inlet 312 and outlet 314 of the cylinder 310 do not enable an airflow A to pass from the first inlet 302 of the valve to the first outlet 304 and on to the expansion vessel 60, since no flow communication exists between the first inlet 302 of the valve and the through-going channel that is defined by the inlet 312 and outlet 314 of the cylinder 310.

Said cylinder 310 is arranged so as to assume said second position during operation of the engine by means of a pressure P generated in the pump configuration 40 and transferred in said pilot line 8. When the pump configuration 40 generates pressure P during operation of the engine, said pressure P will be transferred via the pilot line 8 and act on the pressure side 316 of the cylinder 310. When the pressure P is greater than the spring force generated by the spring element 320 and acts on the spring side 318 of the cylinder 310, the cylinder 310 will move in the space 340 and compress the spring element 320. The cylinder inlet 312 and outlet 314 will then come to be out of alignment with the first inlet 302 and first outlet 304 of the valve so that no airflow A can pass through the cylinder 310, and thus no airflow A is allowed to flow through the valve from the venting line 9 to the line 7 that leads to the expansion vessel 60.

When the engine is not in operation, no pressure is transferred via the pilot line 8 to the cylinder 310, whereupon the spring force of the spring element 320 will be greater than the force on the pressure side 316 of the cylinder 310, so that the spring element 320 will move the cylinder 310. The inlet 312 and outlet 314 of the cylinder 310 are then brought into alignment with the first inlet 302 and the outlet 304 of the valve 300 so that an airflow A through the valve 300 is enabled, and venting can occur.

According to one variant, the valve 300 comprises a stop element 330 that is internally arranged in the second inlet 306. The stop element 330, which can consist of a stop lug, constitutes one end position for the movement of the cylinder 310 in the valve 300. The movement of the cylinder 310 in the valve 300 will be limited by the stop element 330 in the one direction, and by the spring element 320 in the other direction. The end position that the spring element 320 constitutes in the valve depends on the degree of compression of the spring element 320, and is thus not a static end position.

The placement of the stop element 330 in the second inlet 306 is adapted so that, when the cylinder 310 is resting against the stop element 330, its inlet

312 and outlet 314 are in alignment with the first inlet 302 and first outlet 304 of the valve 300 so as to enable the passage of an airflow A through the valve 300.

The cylinder 310 is arranged in sealed fashion in the valve 300 so that the play between the exterior wall of the cylinder 310 and the part of the interior surface where the cylinder runs, i.e. the second inlet 306 and the walls that delimit the space 340, will yield minimal leakage flow, so that no additional sealing element is necessary.

Fig. 4 schematically illustrates a cross-section view of a valve 400 of said device according to one embodiment of the present invention.

The valve 400 according to the embodiment in Fig. 4 differs from the valve 300 according to the invention in Fig. 3 essentially with respect to the design of the closure mechanism.

The valve 400 comprises a first inlet 402 that is intended to be connected, via a venting line 9 of a venting circuit II, to an outlet of a cooled object (not shown) such as a retarder, e.g. a retarder 70 according to Fig. 1.

The valve 400 further comprises an outlet 404 that is intended be connected, via a line 7 of the venting circuit II, to an expansion tank (not shown), e.g. an expansion tank 60 according to Fig. 1.

The valve 400 comprises a second inlet 406 that is intended to receive, via a pilot line 8, pressure P generated by means of a pump configuration (not shown), e.g. a pump configuration according to Fig. 1.

The valve 400 further comprises a closure mechanism in the form of a spring-connected cylinder 410 arranged between said first inlet 402 and said outlet 404. Said cylinder 410 is reciprocatingly arranged in the axial direction of the cylinder 410. Said cylinder 410 has a pressure said arranged in connection to said second inlet 406 and so as to receive a pressure P from the pump configuration 40 via said pilot line 8.

Said valve 400 further comprises a spring element 420 arranged on and acting against a spring side 418 and in resistance to the pressure side 416 of said cylinder 410.

Said cylinder 410 has an essentially H-shaped cross-section. The cylinder 410 thus has a first sleeve section 417 running axially from the pressure side 416 of the cylinder 410 toward the center line of the cylinder 410 and a second sleeve section 419 running axially from said spring side 418 toward the center line of the cylinder 410.

The cylinder 410 moves in the spaces in the valve 400 that consist of the second inlet 406 and a space 440 that will be described in detail below.

Said cylinder 410 has a middle section 412 arranged centrally around its axis. The diameter of the cylinder 410 is smaller in the middle section than the diameter of the first 417 and the second 419 sleeve sections. The diameter of the first 417 and the second 419 sleeve sections corresponds essentially to the inner diameter of the second inlet 406 and the inner walls of the space 440. Said cylinder 410 is, in a first position of the valve 400, arranged so that said middle section 412 of the cylinder 410 is brought to the level of said first inlet 402 and outlet 404 of the valve 400, so that an airflow A in through said first inlet 402 is enabled via said middle section 412 surrounding the cylinder 410 and out through said outlet 404 so as to vent a cooled object in the venting circuit. The airflow A will thus flow around the middle section 412 and transverse to the direction of movement of the cylinder 410 and, according to this embodiment, it is the middle section 412 that consists of the through-going channel in the cylinder 410 that, in the second position, is in flow communication with the first inlet 402 and outlet 404 of the valve 400.

Because of such a middle section 412, no circumferential orientation of the cylinder 410 is needed, since there is no inlet or outlet of the cylinder 410 that has to fit into the first inlet 402 and the first outlet 404 of the valve 400. This enables simpler design and installation of the valve 400.

Said cylinder 410 is, in a second position of the valve 400, arranged so that said middle section 412 of the cylinder 410 is brought out of level with said first inlet 402 and outlet 404 of the valve 400, so that said first inlet 402 is closed to prevent an airflow A from passing to said expansion tank 60 via said venting circuit. The first sleeve section 417 will thus block the airflow A.

Said cylinder 410 is arranged so as to assume said second position during operation of the engine by means of pressure P generated by the pump configuration 40 and transferred in said pilot line 8. When the pressure P is greater than the spring force that is generated by the spring element 420 and acts on the spring side 418 of the cylinder 410, the cylinder 410 will move in the space 400 and compress the spring element 420. The middle section 412 of the cylinder will then be brought out of alignment with the first inlet 402 and first outlet of the valve 400 so that no airflow A can pass through the cylinder 410, and no airflow A is consequently allowed to flow through the valve 400 from the venting line 9 to the line 7 that leads to the expansion vessel 60.

When the engine is not in operation, no pressure is transferred via the pilot line 8 to the cylinder 410, whereupon the spring force of the spring element 420 is greater than the force on the pressure side 416 of the cylinder 410, so that the spring element 420 will move the cylinder 410 so that the middle section 412 of the cylinder 10 is brought into level with the first inlet 402 and the outlet 404 of the valve 400. An airflow A through the valve 400 is thus enabled for said venting.

According to one variant, the cylinder 410 comprises a stop element 430 arranged in the second inlet 406. The stop element 430, which can consist of a stop lug, constitutes one end position for the movement of the cylinder 410 in the valve 400. The movement of the cylinder 410 in the valve 400 will be limited by the stop element 430 in the one direction and the spring element

420 in the other direction. The end position that the spring element 420 constitutes in the valve depends on the degree of compression of the spring element 420, and is thus not a static end position.

The placement of the stop element 430 in the second inlet is adapted so that, when the cylinder 410 rests against the stop element 430, its middle section 412 is aligned with the first inlet 402 and first outlet 404 of the valve 400 so as to enable the passage of an airflow A through the valve 400.

The spring element 420 is arranged in a space 440 in the valve 400 between the spring side 418 of the cylinder 410 and an opposing wall of the space 440. Because the cylinder 410 is, according to the embodiment in Figure 4, designed with a H-shaped cross-section, the spring element 420 is partially arranged in the cylinder 410.

Designing the cylinder 410 with an H-shaped cross-section and said first and second sleeve sections 417, 419 makes it possible to design a more compact valve 400, in that the spring element 420 is partially arranged in said second sleeve section 419.

The cylinder 410 is arranged in sealed fashion in the valve 400 so that the play between the exterior surface of the first 417 and the second 419 sleeve section and that part of the interior surface of the valve body where the cylinder runs, i.e. the second outlet 406 and the walls that delimit the space 440, will yield minimal leakage flow, so that no additional sealing elements are necessary.

Fig. 5 schematically illustrates a flow diagram of a method for venting a cooling system for an engine according to one embodiment of the present invention.

According to one embodiment, the method for venting a venting circuit II for an engine 20 comprises a first step S1. A detection of whether or not the engine is in operation occurs in this step. This occurs in a manner that will be familiar to one skilled in the art, e.g. by analyzing signals from various sensors on the engine 20.

If it is detected that the engine 20 is in operation, the method proceeds to a second step S2. In this step said valve is, when the engine is placed into operation, essentially closed by means of pressure generated by a pump configuration in order to prevent the supply of air to said expansion tank via said venting circuit.

If it is detected in the first step S1 that the engine 20 is not in operation, the method proceeds to step S3. In this step the cooling system is, when the engine is taken out of operation, vented via a venting circuit II comprising a valve and said expansion tank, wherein said valve is thus essentially opened to supply air to said expansion tank.

Fig. 6 schematically depicts a vehicle 1000 with a combustion engine 20 comprising a cooling system according to the invention.

The foregoing description of the preferred embodiments of the present invention has been provided for illustrative and descriptive purposes. It is not intended to be exhaustive, or to limit the invention to the described variants. Many modifications and variations will obviously be apparent to one skilled in the art. The embodiments have been chosen and described so as to best clarify the principles of the invention and its practical applications, and to thereby enable one skilled in the art to comprehend the invention for various embodiments and with the various modifications that are suitable for the intended use.

CLAIMS

1. A venting circuit (II) for at least one additional cooled object (70, 30) in a cooling system (I) for a combustion engine (20), in which cooling system (I) a liquid cooling medium (L) is arranged so as to be circulated to cool said engine (20) and the at least one additional cooled object (70, 30), and which cooling system (I) comprises a radiator (30), a pump configuration (40) powered by said engine (20) and arranged so as to circulate said liquid cooling medium (L), and an expansion tank (60) for said liquid cooling medium (L) to which venting of the engine (20) is intended to occur during operation of the engine (20), **characterized in that** the venting circuit (II) comprises a valve (100; 200; 300; 400) connected to said expansion tank (60), which valve has a first position in which an airflow (A) can pass through the valve (100; 200; 300; 400) to vent the at least one additional cooled object (70, 30) via the venting circuit (II), and a second position in which an airflow (A) is prevented from passing through the valve (100; 200; 300; 400), wherein the valve (100; 200; 300; 400) is set to the second position by means of a pressure (P) generated by the pump configuration (40) during operation of the engine (20).

2. A venting circuit (II) according to claim 1, **characterized in that** the valve (100; 200; 300; 400) comprises a first inlet (202, 302, 402) and an outlet (204, 304, 404) wherein an airflow (A) is, in the second position, prevented from passing from the first inlet (202, 302, 402) to the outlet (204, 304, 404) and, in the first position, allowed to pass from the first inlet (202, 302, 402) to the outlet (204, 304, 404).

3. A venting circuit (II) according to claim 1 or 2, **characterized in that** the valve (100; 200; 300; 400) comprises a second inlet (206, 306, 406), wherein said pump configuration (40) is connected to the second inlet (206, 306, 406) of the valve (100; 200; 300; 400) via a pilot line (8) for pressure transference.

4. A venting circuit (II) according to any of claims 1-3, **characterized in that** the valve (100; 200; 300; 400) comprises a spring element (320; 420) that loads a valve body (310; 410), wherein the valve body (310; 410) assumes the first position when the pressure (P) from the pump configuration (40) is lower than the force from the spring element (320; 420) and the valve body (310; 410) assumes the second position when the pressure (P) from the pump configuration (40) is greater than the force from the spring element (320; 420).

5. A venting circuit (II) according to claim 4, **characterized in that** the valve body (310; 410) is a cylinder (310; 410) that is designed with a through-going channel (312, 314; 412), which channel is, in the closed position, out of flow communication with the first inlet (302; 402) and the outlet (304; 404) and is, in the open position, in flow communication with the first inlet (302; 402) and the outlet (304; 404).

6. A venting circuit (II) according to claim 5, **characterized in that** the valve body (310) is designed with an inlet (312) and an outlet (314) that constitute a through-going channel.

7. A venting circuit (II) according to claim 5, **characterized in that** the valve body (410) is designed with two sleeve sections (417, 419) and a middle section (412) between same, wherein the middle section (412) has a smaller diameter than the sleeve sections (417, 419), which middle section (412) constitutes a through-going channel.

8. A venting circuit (II) according to any of claims 1-3, **characterized in that** the valve (200) comprises a membrane (210) which, in the first position, permits passage of an airflow (A) through the valve (200) and, in the second position, blocks the airflow (A) by expanding.

9. A venting circuit (II) according to any of the preceding claims. **characterized in that** said at least one additional cooled object is at least

any of the objects consisting of said radiator (30), a retarder (70) and an EGR radiator.

10. A venting circuit (II) according to any of the preceding claims, **characterized in that** venting via said venting circuit (II) is intended to be activated in connection with refilling of cooling medium in the cooling system (I).

11. An engine configuration comprising a device according to any of claims 1-10

12. A vehicle (1000) comprising an engine configuration according to claim 11.

13. A method for venting of a venting circuit (II) connected to a cooling system (I) for an engine (20), in which cooling system (I) a liquid cooling medium (L) is circulated so as to cool said engine (20) and at least one additional cooled object (70, 30), and which cooling system (I) comprises a radiator (30), a pump configuration (40) powered by means of said engine (20) so as to circulate said liquid cooling medium, and an expansion tank (60) for said liquid cooling medium to which venting of the venting (20) is intended to occur during operation of the engine (20), **characterized by** the steps of:

- detecting (S1) whether the engine (20) is in operation
- if said engine is not in operation, venting (S3) the at least one additional cooled object (70, 30) via the venting circuit (II) to the expansion tank (60) by opening a valve (100; 200; 300; 400) to enable the passage of an airflow (A) through the valve (100; 200; 300; 400) and,
- if said engine (20) is in operation, closing (S2), by means of pressure (P) generated by said pump configuration (40), said valve (100; 200; 300; 400) to prevent the passage of an airflow (A) to said expansion tank (60) via said venting circuit (II).

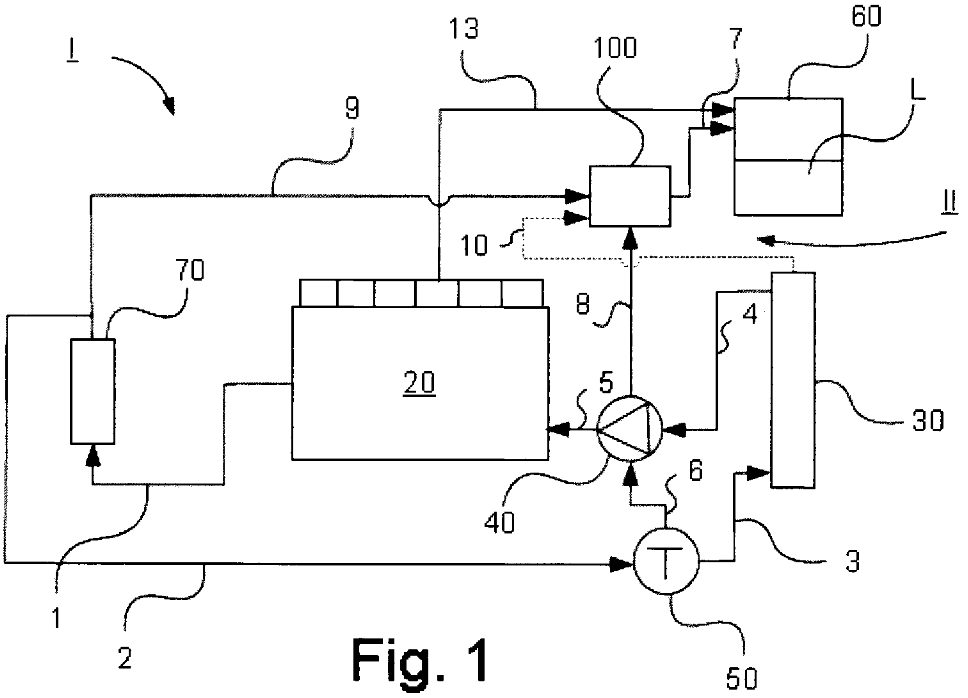
I
13
100
7
60
L
9
II
10
70
8
4
20
5
30
40
6
1
2
3
50

Fig. 1

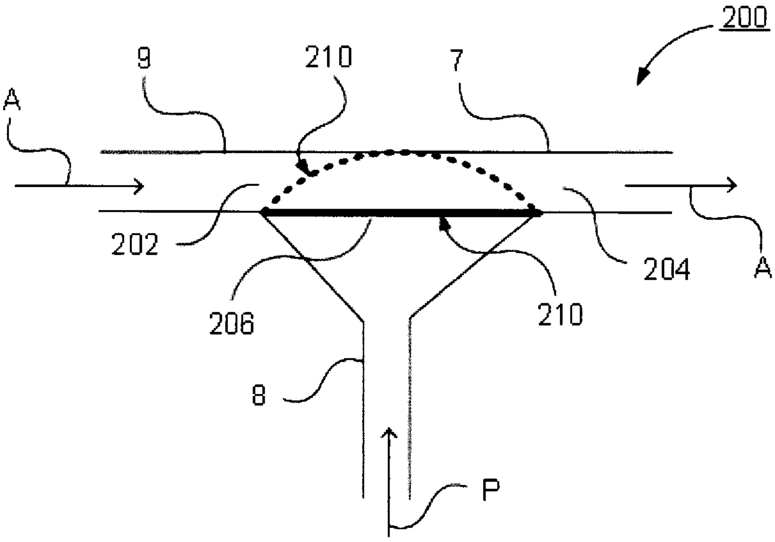
200
9
210
7
A
202
204
A
206
210
8
P

Fig. 2

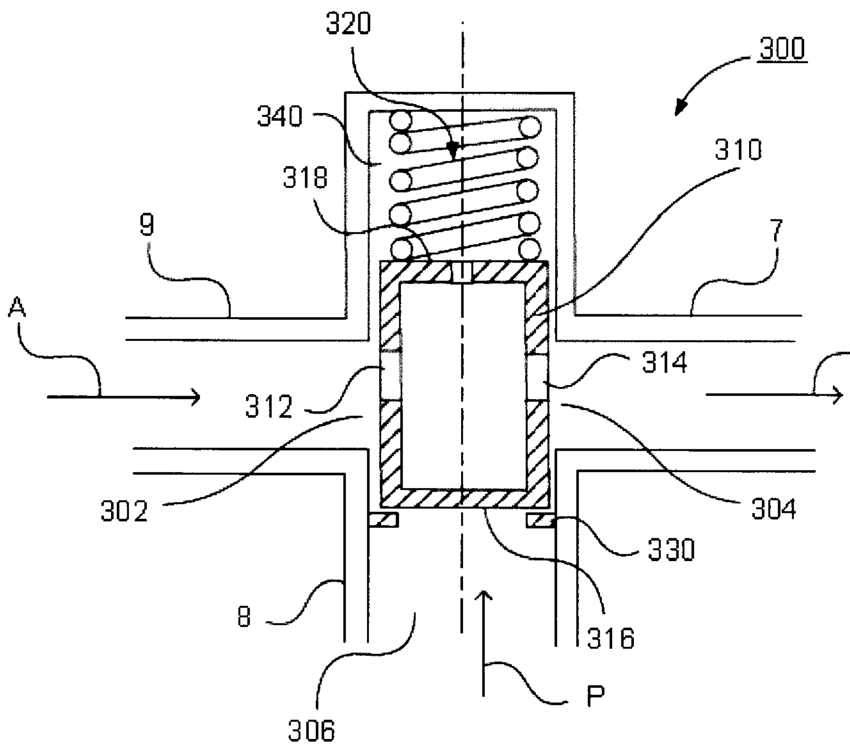
320
300
340
310
318
9
7
A
A
314
312
302
304
330
8
316
306
P

Fig. 3

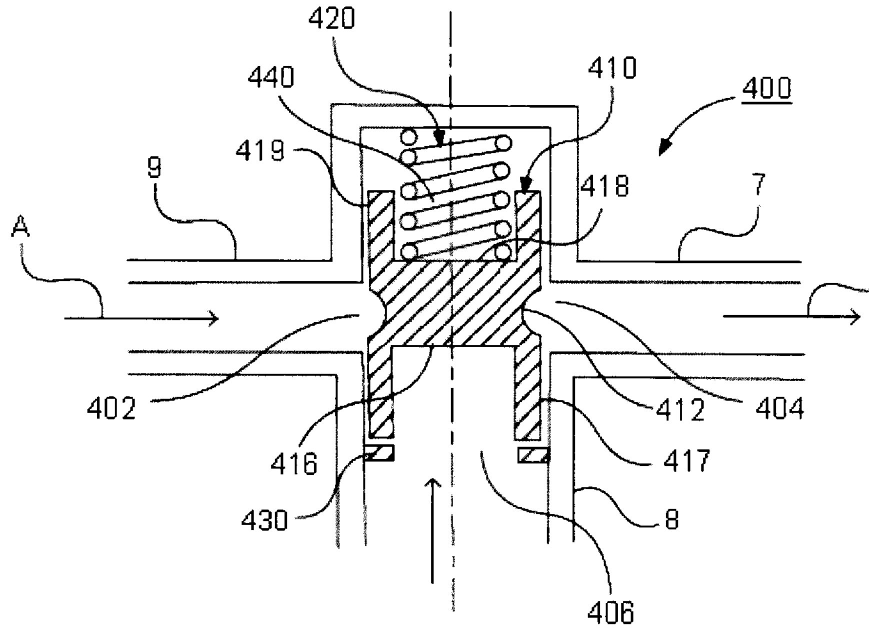
420
410
440
400
419
418
9
7
A
A
402
412
404
416
417
430
8
406

Fig. 4

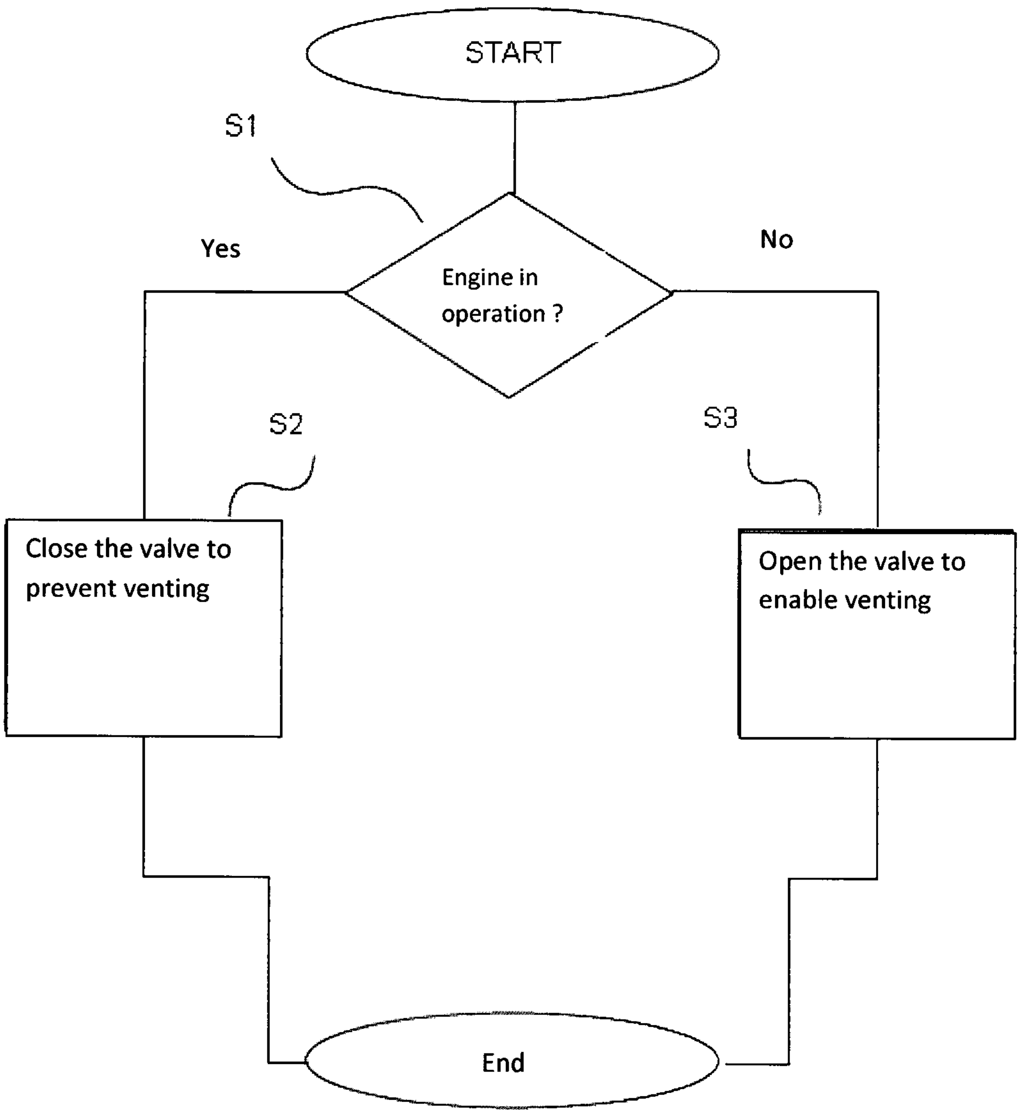
START
S1
Yes
No
Engine in operation ?
S2
S3
Close the valve to prevent venting
Open the valve to enable venting
End

Fig.5

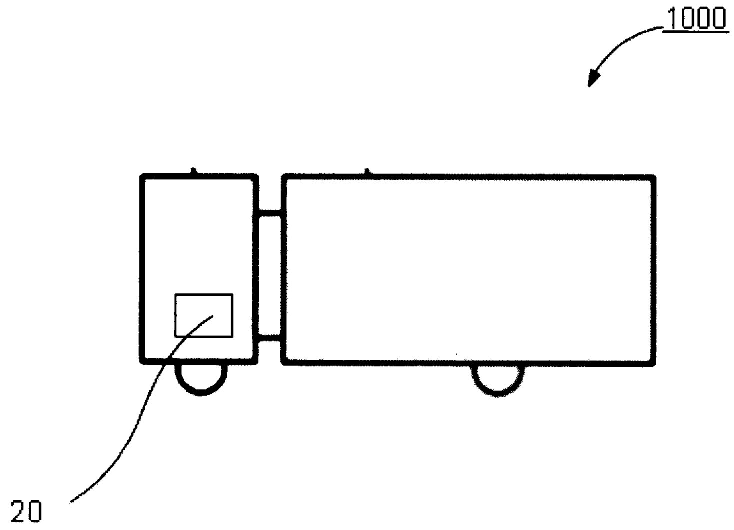

Fig.6

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2014/051108

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

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)

IPC: F01P, F16K

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, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 20120006286 A1 (BRINKMANN BERND ET AL), 12 January 2012 (2012-01-12); abstract; paragraphs [0002], [0029], [0030], [0040]; figure 1; claims 1-4, 6, 8, 10-14, 17, 18, 20 --	1, 2, 4, 9-13
Y	DE 202006008695 U1 (REUTTER HEINRICH), 27 September 2007 (2007-09-27); abstract; paragraphs [0001], [0003], [0014], [0019], [0020]; figures 2A, 2B --	1, 2, 4, 9-13
A	EP 1832730 A2 (GM GLOBAL TECH OPERATIONS INC), 12 September 2007 (2007-09-12); paragraphs [0040]-[0042]; figures 2,3; claims 1, 11; NB: Entgasungsdrossel (44) --	1-13

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

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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	Date of mailing of the international search report
09-02-2015	09-02-2015

Name and mailing address of the ISA/SE
Patent- och registreringsverket
Box 5055
S-102 42 STOCKHOLM
Facsimile No. + 46 8 666 02 86

Authorized officer
Niels Rasmussen
Telephone No. + 46 8 782 25 00

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2014/051108

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5353751 A1 (EVANS JOHN W), 11 October 1994 (1994-10-11); column 3, line 39 - column 4, line 27; NB: flow restrictor (67) --	1-13
A	EP 1283334 A1 (DEERE & CO), 12 February 2003 (2003-02-12); abstract; paragraphs [0026]-[0028]; figures; NB: Drosselstellen (54, 56) --	1-13
A	DE 202010011025 U1 (HEINRICH REUTTER GMBH & CO KG), 17 November 2011 (2011-11-17); abstract; paragraphs [0013]-[0018]; figures -- --------	1-13

Continuation of: second sheet

International Patent Classification (IPC)

F01P 11/02 (2006.01)
F01P 3/20 (2006.01)
F01P 7/14 (2006.01)
F16K 24/04 (2006.01)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/SE2014/051108

US	20120006286	A1	12/01/2012	CN	102312717	A	11/01/2012
				DE	102010017766	B4	14/11/2013
				US	8851026	B2	07/10/2014
DE	202006008695	U1	27/09/2007	NONE			
EP	1832730	A2	12/09/2007	AT	510115	T	15/06/2011
				DE	102006010470	A1	20/09/2007
US	5353751	A1	11/10/1994	NONE			
EP	1283334	A1	12/02/2003	DE	10139314	A1	06/03/2003
				US	20030029167	A1	13/02/2003
DE	202010011025	U1	17/11/2011	WO	2012016774	A1	09/02/2012