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(54) **METHOD AND SYSTEM FOR THERMAL MANAGEMENT OF ENGINE OIL AND VEHICLE COMPRISING SUCH A SYSTEM**

(57) An oil system for an internal combustion engine, comprising an oil pump, an oil sump and an oil distribution system for distributing oil to engine parts, where the oil system comprises an oil container comprising a membrane delimiting the oil container in a pressure chamber and an oil chamber which is in fluid contact with the oil distribution system, where the oil container is provided with a resilient element acting on the membrane. The advantage of the invention is that the oil level in the oil sump can be reduced during normal operation of the vehicle, without affecting the lubrication of the engine during exceptional operation conditions.

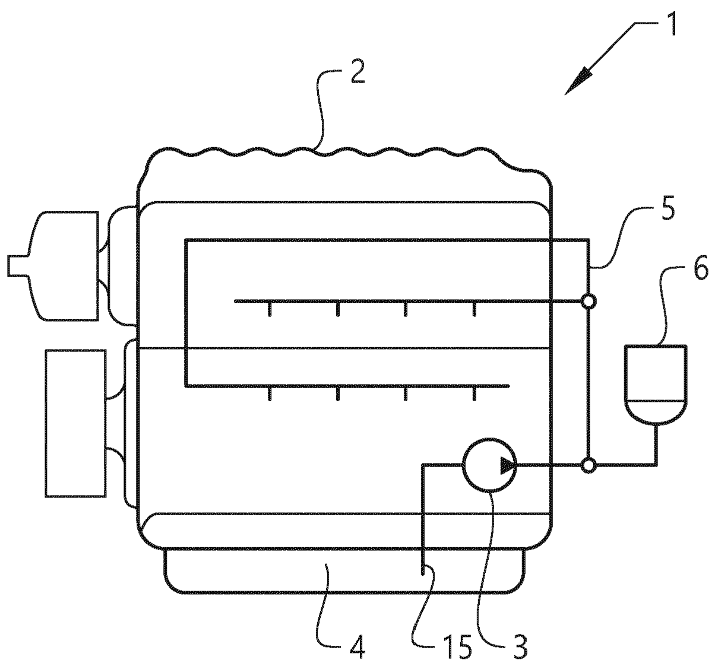

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to a method and system for thermal management of engine oil in an internal combustion engine, where part of the engine oil is stored in an oil container during normal use of the engine. The invention is e.g. suitable for the use in vehicles.

BACKGROUND ART

[0002] Vehicles comprising an internal combustion engine are subjected to a plurality of different legislative requirements and regulations. Some of these requirements and regulations are directed to fuel consumption and exhaust emission. Different countries or markets may have different requirements, but most include a specific test cycle that is supposed to give an indication of the fuel consumption and exhaust emission of the vehicle. There is further a high customer demand for vehicles having reduced fuel consumption and an improved interior comfort.

[0003] There are different ways of reducing fuel consumption of a vehicle. Weight reduction is one important factor, but may contradict safety of the vehicle. Light vehicles are often smaller and with reduced collision safety. Other factors are reduction of wind resistance, tire friction and reduction of internal friction in the engine.

[0004] In cold climates, the heat for the interior cabin is provided by the engine rejected heat. During engine warmup, a large amount of the rejected heat is used to warm up the engine itself. This heat is therefore not available for other purposes such as interior heating. In order to provide adequate interior heating, it is common to provide a vehicle with an auxiliary fuel operated heater.

[0005] One way of reducing internal losses in the engine is to reduce the amount of oil in the lubrication system of the engine. This is however not straightforward, since engine oil serves several different purposes. The main task for the oil is lubrication, but the oil will also provide cleaning of the engine, preventing oxidation and cooling of engine parts.

[0006] A small amount of oil will reduce the engine losses and will further reduce the amount of oil that has to be warmed up in the engine when the vehicle is started. A large amount of oil is however advantageous for oil wear and aging, i.e. a large oil quantity will extend the service intervals of the engine. Further, a large amount of oil in the oil sump will preserve the oil level at the oil pump suction inlet during lateral acceleration of the vehicle. With a low oil level, the oil will flow to the side of the oil sump during high lateral acceleration, which will cause the oil pump to partially suck air which will affect the lubrication of the engine negatively and which may also be detrimental for the lubrication of the engine.

[0007] It would thus be of advantage to provide an oil system in which the amount of oil is small during normal use of the engine, but which is provided with an additional supply of pressurized oil that can be used at sudden lateral accelerations. It is also of advantage to mix the entire oil supply between the uses of the engine in order to prolong the service intervals of the engine.

[0008] US 2016/0245135, US 8635983 and US 8651078 disclose various examples of engine assemblies comprising an oil pan having two compartments. The purpose is to reduce the amount of oil that has to be heated during start of the vehicle. This will minimize the time to warm the oil to a working temperature. When the oil is warm, a valve controlled by an actuator will allow the complete oil volume to flow in the lubrication system.

[0009] These systems may provide a short warm up time for the engine oil at start of the vehicle, but will utilize the complete oil volume during use of the vehicle. Further, these systems are relatively complicated and comprises actuators, sensors etc.

[0010] There is thus room for a system and method that improves the thermal management of the engine oil of a vehicle.

DISCLOSURE OF INVENTION

[0011] An object of the invention is therefore to provide an improved method for thermal management of engine oil of an internal combustion engine. A further object of the invention is to provide an improved system for thermal management of engine oil of an internal combustion engine. A further object of the invention is to provide a vehicle comprising an improved system for thermal management of engine oil.

[0012] The solution to the problem according to the invention is described in the characterizing part of claim 1 regarding the system, in claim 13 regarding the method and in claim 15 regarding the vehicle. The other claims contain advantageous further developments of the inventive system and method.

[0013] In an oil system for an internal combustion engine, comprising an oil pump, an oil sump and an oil distribution system for distributing oil to engine parts, the object of the invention is achieved in that the oil system comprises an oil container comprising a membrane delimiting the oil container in a pressure chamber and an oil chamber which is in fluid contact with the oil distribution system, where the oil container is provided with a resilient element acting on the membrane.

[0014] By this first embodiment of an oil system according to the invention, an oil system comprising an oil container is provided, where the oil container is adapted to receive a quantity of oil from the oil system when the oil pump is running and creating an oil pressure, and to return the oil quantity to the oil system when the oil pump is not creating an oil pressure.

[0015] When the vehicle is started, the internal combustion engine is cranked until it runs. The oil pump is a mechanical pump, driven by a mechanical connection, e.g. a distributor shaft, from the crankshaft or the cam shaft, sometimes with a reduced pump speed. When the engine runs, the oil pump will run and will create an oil pressure in the oil system which will lubricate the engine.

[0016] The oil container may be integrated in the oil sump, but is preferably a separate oil vessel mounted external of the oil sump and in fluid connection to the oil distribution system. The oil container comprises a membrane which delimits the oil container in a pressure chamber and an oil chamber. The pressure chamber is provided with a resilient element, e.g. enclosed gas or a coil spring, which acts on one side of the membrane. The resilient element is preferably provided with a progressive spring force, and the spring force is preferably preloaded such that the minimum pressure in the pressure chamber is higher than the minimum oil pressure of the oil system during normal use. This pressure may e.g. be 0,3 bars. When there is no oil pressure in the oil system, the oil chamber will be completely drained.

[0017] When the oil pump is running, it creates an oil pressure of e.g. 3 bars, which will allow some of the oil to flow in to the oil container. When the vehicle is cold-started, the oil in the oil sump will be cold. Since oil will flow in to the oil container by the pressure created by the oil pump from the moment the engine is started, the oil that flows in to the container is cold. By selecting an oil container with a volume that can store the oil that is not needed for normal operation of the engine, a fuel saving can be achieved. In one example, the oil system contains 5 litres of oil. By storing 3 litres of oil in the oil container, some of the energy from the engine is available for other purposes. With the oil pump creating an oil pressure of 3 bars, equilibrium will be reached in the oil container when the pressure in the pressure chamber is also 3 bars. The cold oil will be stored in the oil container until the engine is shut off. With no oil pressure holding the oil in the oil container, the oil will flow back to the oil sump of the oil system. In this way, the entire oil volume will be mixed every time the vehicle is shut off. This will allow for long service intervals of the vehicle.

[0018] If the vehicle would be subjected to high lateral acceleration, e.g. when the vehicle makes a fast turn at high speed, the oil in the oil sump will flow to one side of the oil sump, away from the suction inlet of the oil pump. The oil pump will in this case partially suck air and will not be able to provide a correct oil pressure to the oil system. In a regular oil system, the engine parts will thus not receive sufficient lubrication oil which may damage bearings and other moving parts of the engine. With the inventive system, the oil container will provide pressurized oil to the oil system, such that the lubrication continues. When the turn is over and the oil level in the oil sump stabilizes, the oil pump will be able to deliver the correct oil pressure to the oil system again, and oil will flow back into the oil container until the pressure in the oil system equals the pressure in the pressure chamber in the oil container.

[0019] In one example, the oil container is a separate oil vessel mounted to the oil distribution system, externally from the oil sump or the engine. The oil vessel may e.g. resemble an ordinary oil filter. The vessel is preferably mounted in a detachable manner, e.g. by the use of a threaded flange, such that the oil vessel can easily be replaced. The oil vessel may be a pressure cartridge made from metal and may resemble a gas cartridge. The oil vessel comprises a flexible membrane made from plastic or rubber. The membrane delimits the oil vessel in a pressure chamber and an oil chamber. The pressure chamber is enclosed and is preferably provided with a slight overpressure, e.g. in the range of 0,3 bars. This will ensure that the oil vessel will be drained when the oil pump does not deliver an oil pressure. The pressure chamber is filled with a gas, e.g. air or nitrogen. The gas in the pressure chamber will provide the resilient element. The size of the oil container depends on the oil volume of the engine and on the design of the oil sump, but a size between 1 to 4 litres may be useful. The membrane of the oil container may also be a stiff membrane or a piston with a coil spring as the resilient element.

[0020] In one example, the oil container of the oil system consists of several oil vessels positioned at different positions of the engine. An oil vessel may e.g. be positioned in an existing gallery drill hole providing oil to the channels in the engine block. By positioning one oil vessel at each gallery inlet, a distributed pressure system is obtained, where each oil vessel can provide pressurized oil directly to the lubrication points if the oil pressure from the oil pump decreases. By using several oil vessels, each oil vessel can be made smaller.

[0021] In one example, the inlet of the oil container is provided with an electrically controlled valve, which can close the inlet to the oil container. The valve can be used to stop oil from flowing in to the oil container. This can be used e.g. to protect the oil container from a high start-up peak pressure when the engine is started. In this case, the valve closes the inlet for a few seconds until a steady state pressure from the oil pump is reached. The valve can also be used to block oil from draining from the oil container. One example is when the vehicle is provided with a start-stop system, where the engine is shut off at e.g. traffic lights or in queues. The oil will in this case remain in the oil container during the short stop of the engine by closing the valve when the engine is shut off. Another example, when more than one oil vessels are used, is to block the inlet of one or more of the oil vessels when the engine is shut off. In this case, the valve is opened when the engine is started and the oil vessel can deliver a high oil pressure directly, which will improve the lubrication of the engine. It is also possible to store warm oil in an isolated oil container which may be release at a later moment when the engine is started again.

[0022] In one development of the invention, the oil sump is provided with inclined side walls, at least in one direction of the oil sump. Preferably, the side walls directed in the driving direction of the vehicle in which the engine is positioned are inclined. In this way, the active volume of the oil sump can be further reduced, which allows for additional fuel savings.

[0023] In a method for thermal management of oil in an oil system for an internal combustion engine, where the oil system comprises an oil pump and an oil container, the steps of; starting the oil pump, thereby creating an oil pressure in the oil system; letting a quantity of oil into the oil container by the oil pressure created by the oil pump; storing a quantity of oil in the oil container during use of the engine; and letting oil out from the oil container by a resilient element when the oil pump does not create an oil pressure, are comprised.

[0024] By this first embodiment of the method, the method is able to reduce the amount of oil that has to be warmed up during start of an engine. In this way, fuel savings are possible. Further, crank case pumping losses are also reduced, due to the reduced oil volume in the oil sump.

[0025] In a development of the method, the method further comprises the step of blocking the inlet to the oil container with an electrically operated valve. In this way, it is possible to either block the oil flow in to the oil container, or to block the oil flow out of the pressurized oil container. This is e.g. advantageous for a vehicle provided with a start-stop system, where the engine is shut off at e.g. traffic lights.

BRIEF DESCRIPTION OF DRAWINGS

[0026] The invention will be described in greater detail in the following, with reference to the attached drawings, in which

Fig. 1 shows a schematic oil system according to the invention,

Fig. 2 shows an oil container according to the invention,

Fig. 3 shows an oil sump and an oil container according to the invention in an idle state,

Fig. 4 shows an oil sump and an oil container according to the invention in an active state,

Fig. 5 shows an oil sump with inclined side walls and an oil container according to the invention in an active state,

Fig. 6 shows a schematic vehicle comprising an oil system according to the invention, and

Fig. 7 shows a schematic flow chart of an inventive method for thermal management of oil in a vehicle.

MODES FOR CARRYING OUT THE INVENTION

[0027] The embodiments of the invention with further developments described in the following are to be regarded only as examples and are in no way to limit the scope of the protection provided by the patent claims.

[0028] Figure 1 shows a schematic oil system 1 for an internal combustion engine 2. The oil system 1 comprises an oil pump 3, an oil sump 4 and an oil distribution system 5 for distributing oil to the various lubrication points for the engine parts. The oil pump is a mechanical pump, driven by a mechanical connection, e.g. a distributor shaft, from the crankshaft or the cam shaft, sometimes with a reduced pump speed. The oil pump is preferably arranged inside of the engine, in the oil sump. The oil sump is arranged at the lowest point of the engine, under the engine block, and is adapted to hold the oil of the engine and to collect the oil that returns from the lubrication points of the engine. The oil sump is arranged to hold the complete oil volume of the engine. When the engine is shut off, all the oil of the engine will drain to the oil sump, such that the oil level in the oil sump can be controlled by an oil stick in order to determine if the oil level in the engine is within predefined limits. The oil system preferably also comprises an oil filter (not shown) adapted to remove small particles in the oil.

[0029] The oil in the oil system circulates constantly when the engine is running in order to distribute oil to the lubrication points of the engine. The main purpose of the oil is to lubricate the engine parts, but the oil will also provide cleaning of the engine by collecting and transporting particles to the oil filter. The oil will further prevent oxidation of metal parts and will help the cooling of engine parts.

[0030] The oil volume of an engine is a compromise between several factors. A small amount of oil will reduce the engine losses and will further influence the thermal management of the engine, especially when the engine is warmed up when the vehicle is started. A large amount of oil is however advantageous for oil wear and aging, i. e. a large oil quantity will extend the service intervals of the engine. Further, a large amount of oil in the oil sump will preserve the oil level at the oil pump suction inlet during lateral acceleration of the vehicle. During high lateral acceleration, the oil in the oil sump will flow to the side of the oil sump which may cause the oil pump to suck air which in turn will affect the lubrication of the engine. A high oil level in the oil sump will reduce this problem. Thus, during normal driving conditions, it would be possible to use a relatively small amount of oil. On the other hand, to increase the service intervals for the engine, a large amount of oil is of advantage.

[0031] With the inventive oil system, an oil system that uses as little oil as necessary at normal operating conditions, and which has a larger oil quantity available when required, i.e. when the operating conditions are not considered to be normal. Such an operating condition is high lateral accelerations of the vehicle. At the same time, the oil system is provided with a large oil quantity which increases the service interval of the engine. Further advantages of the inventive oil system are a lower engine loss, improved crank case ventilation, faster oil warm up and a lower friction at engine start. The oil system can be used for all types of internal combustion engines having a wet oil sump, both stationary engines and engines used in vehicles.

[0032] For this purpose, the oil system is provided with an oil container 6 arranged in fluid connection with the oil system. The oil container is preferably a separate oil vessel mounted external of the oil sump and in fluid connection with the oil system. It is also possible to integrate the oil container in the oil sump or in the motor block of the engine. The oil container is provided with a membrane or a piston that delimits the oil container in a pressure chamber and an oil chamber. If the oil container is provided with a piston, the pressure chamber is preferably provided with a resilient element in the form of a coil spring, even if other types of resilient elements are also possible to use. The spring force of the coil spring is preferably progressive.

[0033] If the oil container is provided with a flexible membrane, the resilient element of the pressure chamber is a gas spring which acts on one side of the membrane. In this case, the pressure chamber is hermetically closed such that a gas spring is created. With a gas spring, a progressive spring force is obtained. The resilient element is preferably pre-loaded such that the minimum pressure in the pressure chamber is higher than the minimum oil pressure of the oil system during normal use. This pressure may e.g. be 0,3 bars. When there is no oil pressure in the oil system, the oil chamber will be completely drained.

[0034] Regardless of the actual design of the oil container, the oil container will be drained when the oil pump is not delivering an oil pressure, and will be partly or completely filled when the oil pump delivers an oil pressure. The exact amount of oil in the oil container depends mainly on the oil pressure delivered by the oil pump. The temperature in the container will affect the counter pressure of the pressure chamber somewhat. The inlet opening of the oil container is adapted to let oil in to the oil container without affecting the lubrication of the engine. The oil flow into the oil container may thus be set to correspond to the flow of oil to the engine. It is important that the flow of oil out of the oil container is not restricted when the oil pressure from the oil pump is reduced. The oil flow will also depend on the viscosity of the oil, even if the viscosity temperature dependency of synthetic oil is less than for mineral oil.

[0035] When the engine is started and the oil pump is running, the oil pump will deliver an oil pressure of e.g. 3 bars, which will allow some of the oil to flow in to the oil container. When the vehicle is cold-started, the oil in the oil sump will be cold. Oil will flow in to the oil container by the pressure created by the oil pump from the moment the engine is started. In this way, the oil that flows in to the container will be cold. By selecting an oil container with a volume that can store the oil that is not needed for normal operation of the engine, most of the oil volume must not be warmed up by the engine. This will allow the remaining oil to be warmed up faster, which at the same time will improve the lubrication of the engine, since the lubrication is optimised for warm oil.

[0036] In one example, the oil system contains 5 litres of oil. By storing 3 litres of oil in the oil container, the oil system will use 2 litres of oil during normal operation. This will minimise the oil level in the oil sump and may save energy. With the oil pump creating an oil pressure of 3 bars, equilibrium will be reached in the oil container when the pressure in the pressure chamber is also 3 bars. The cold oil will be stored in the oil container until the engine is shut off. With no oil pressure holding the oil in the oil container, the oil will flow back to the oil sump of the oil system. In this way, the entire oil volume will be mixed every time the vehicle is shut off, which allows for a long service interval of the vehicle.

[0037] When the vehicle is subjected to high lateral acceleration, e.g. when the vehicle makes a fast turn at high speed, the oil in the oil sump will flow to one side of the oil sump, away from the suction inlet of the oil pump. The oil pump will in this case partially suck air and will not be able to deliver a correct and stable oil pressure to the oil system. In this case, the oil container will provide pressurised oil to the oil system, since the oil stored in the oil container is pressurised. The pressure in the pressure chamber will now push oil out of the oil container such that the lubrication of the engine continues. When the turn is over and the oil level in the oil sump stabilizes, the oil pump will be able to deliver an oil pressure to the oil system again, and oil will flow back into the oil container until the pressure in the oil system equals the pressure in the pressure chamber in the oil container.

[0038] In the example shown in Fig. 2, the oil container 6 is a separate oil vessel 11 mounted to the oil system, externally from the oil sump or the engine. The oil vessel 11 is mounted in a detachable manner to the oil system by the use of a threaded flange 12, such that the oil vessel can easily be replaced. The oil container may also be mounted in a fixedly manner. The oil vessel may be a pressure cartridge made from metal or a composite material and may resemble a gas cartridge. The oil vessel 11 comprises a flexible membrane 7 made from plastic or rubber. The membrane delimits the oil vessel in a pressure chamber 8 and an oil chamber 9. The pressure chamber is enclosed and is preferably provided with a slight overpressure, e.g. in the range of 0,3 bars. This will ensure that the oil vessel will be drained when the oil pump is shut off. The pressure chamber is filled with a gas, e.g. air or nitrogen. The gas in the pressure chamber will provide the resilient element 10. The size of the oil vessel depends on the oil volume of the engine and on the design of the oil sump, but a size between 1 to 4 litres may be useful. The area of the inlet opening 13 is calibrated with regards to the oil pressure of the oil system and the volume of the oil container, in order to obtain a predefined flow into and out of the oil container. The oil chamber may also be integrated in the engine block and could have an enclosed bladder or balloon acting as the pressure chamber.

[0039] In Fig. 3, part of the oil system 1 is shown. The oil sump 4 is here full with oil and the oil system is in an initial state. The oil chamber 9 of the oil vessel 11 is completely empty, since there is a pressure of e.g. 0,3 bars in the pressure chamber 8. This pressure will drain the oil vessel from oil when the oil pump is shut off.

[0040] In Fig. 4, the oil system 1 is in an active state. The oil pump 3 delivers an oil pressure and the oil level in the oil sump 4 is here at its lowest level. The oil chamber 9 of the oil vessel 11 is here filled with oil, since the oil pump delivers a pressure of e.g. 3 bars. The pressure in the pressure chamber 8 will in this case also be 3 bars. There will be a steady state balance between the oil pressure delivered from the oil pump and the pressure in the pressure chamber. If the oil pressure increases somewhat, e.g. due to a higher engine speed, some more oil will flow into the oil chamber and the pressure in the pressure chamber will equal that of the oil system. If the oil pressure decreases somewhat, e.g. due to a lower engine speed, some oil will flow out of the oil chamber and the pressure in the pressure chamber will equal that of the oil system. A further advantage of the reduced oil volume in the oil sump during use is that the oil sump can be made lower, which allows an engine arrangement of a vehicle to be lower. One advantage of mounting the engine in a lower position is that exterior design constraint can be reduced, and that pedestrian safety can be increased with a lower bonnet and/or an increased distance between the engine and the bonnet.

[0041] In Fig. 5, the oil system 1 is in an active state. In this example, the oil sump 4 is provided with inclined side walls 14. The side walls may be inclined in one or more directions of the oil sump. Preferably, the side walls directed in the driving direction of the vehicle in which the engine is positioned are inclined. All side walls may also be inclined, such that all collected oil returns to the bottom of the oil sump. In this way, the active volume of the oil sump can be further reduced, which allows for additional fuel savings. The oil pump 3 delivers an oil pressure and the oil level in the oil sump 4 is here at its lowest level. The oil chamber 9 of the oil vessel 11 is here filled with oil, since the oil pump delivers a pressure of 3 bars and the pressure in the pressure chamber 8 is also 3 bars.

[0042] In a further example, the oil container of the oil system consists of several oil vessels positioned at different positions of the engine. An oil vessel may e.g. be positioned in an existing gallery drill hole providing oil to the channels in the engine block. By positioning one oil vessel at each gallery inlet, either as a separate oil vessel or integrated in the engine block, a distributed pressure system is obtained, where each oil vessel can provide pressurized oil directly to the lubrication points if the oil pressure from the oil pump decreases or disappears. By using several oil vessels, each oil vessel can also be made smaller which may improve safety.

[0043] In a further example, the inlet opening 13 of the oil container is provided with an electrically controlled valve 16, which can close the inlet to the oil container. The valve can be used to stop oil from flowing in to the oil container. This can be used e.g. to protect the oil container from a high start-up peak pressure when the engine is started. In this case, the valve closes the inlet for a few seconds until a steady state pressure from the oil pump is reached. The valve can also be used to block oil from draining from the oil container. One example is when the vehicle is provided with a start-stop system, where the engine is shut off at e.g. traffic lights or in queues. The oil will in this case remain in the oil container during the short stop of the engine by closing the valve when the engine is shut off. Another example, when more than one oil vessels are used, is to block the inlet of one of the oil vessels when the engine is shut off. In this case, the valve is opened when the engine is started and the oil vessel can deliver a high oil pressure directly, which will improve the lubrication of the engine.

[0044] Fig. 5 shows a schematic vehicle 20 provided with an inventive oil system 1. The vehicle is here a passenger car, but the oil system can be used in any vehicle comprising an internal combustion engine having a wet sump, such as trucks and busses.

[0045] Fig. 6 shows a schematic flow chart of the method for thermal management of oil in an oil system for an internal combustion vehicle. The method is performed when the vehicle is used.

[0046] In step 100, the oil pump is started by starting the engine. The oil pump delivers an oil pressure to the oil system.

[0047] In step 110, a quantity of oil flows in to an oil container due to the pressure created by the oil pump.

[0048] In step 120, the quantity of oil is stored in the oil container during use of the engine, when the oil pump delivers an oil pressure.

[0049] In step 130, oil is drained from the oil container when the oil pump does not deliver an oil pressure. A resilient element in the pressure chamber of the oil container pushes the oil out of the oil chamber of the oil container.

[0050] The invention is not to be regarded as being limited to the embodiments described above, a number of additional variants and modifications being possible within the scope of the subsequent patent claims.

REFERENCE SIGNS

[0051]

1: Oil system
2: Combustion engine
3: Oil pump
4: Oil sump
5: Oil distribution system
6: Oil container
7: Membrane

8: Pressure chamber
9: Oil chamber
10: Resilient element
11: Oil vessel
12: Thread
13: Inlet opening
14: Side wall
15: Pump inlet
16: Valve
20: Vehicle

Claims

1. Oil system (1) for an internal combustion engine (2), comprising an oil pump (3), an oil sump (4) and an oil distribution system (5) for distributing oil to engine parts, **characterized in that** the oil system comprises an oil container (6) comprising a membrane (7) delimiting the oil container (6) in a pressure chamber (8) and an oil chamber (9) which is in fluid contact with the oil distribution system (5), where the oil container (6) is provided with a resilient element (10) acting on the membrane (7).

2. Oil system according to claim 1, wherein the spring force of the resilient element (10) is progressive.

3. Oil system according to claim 1 or 2, wherein the resilient element (10) is a gas spring.

4. Oil system according to any of claim 1 to 3, wherein the membrane (7) is an elastic membrane made from plastic or rubber.

5. Oil system according to any of claim 1 to 2, wherein the resilient element (10) is a coil spring.

6. Oil system according to claim 5, wherein the membrane (7) is a piston comprising a sealing between the piston and the oil container (6).

7. Oil system according to any of claims 1 to 6, wherein the oil container (6) is a separate oil vessel (11) attached to the oil distribution system externally from the oil sump (4).

8. Oil system according to any of claims 1 to 7, wherein the oil container (6) comprises a plurality of separate oil vessels (11) arranged at different positions of the oil system (1).

9. Oil system according to any of claims 1 to 8, wherein the inlet opening (13) of the oil container (6) is provided with an electrically operated valve (16).

10. Oil system according to any of claims 1 to 9, wherein an oil container (6) is attached to the oil system (1) in a replaceable manner.

11. Oil system according to claim 10, wherein the oil container (6) is attached to the oil system (1) with a threaded flange (12).

12. Oil system according to any of claims 1 to 11, wherein the oil sump (4) is provided with inclined side walls (14).

13. A method for thermal management of oil in an oil system (1) for an internal combustion engine (2), where the oil system comprises an oil pump (3) and an oil container (6), comprising the following steps:

- starting the oil pump, thereby creating an oil pressure in the oil system,
- letting a quantity of oil into the oil container by the oil pressure created by the oil pump,
- storing a quantity of oil in the oil container during use of the engine, and
- letting oil out from the oil container by a spring element when the oil pump does not create an oil pressure.

14. Method according to claim 11, **characterized in that** the method further comprises the step of blocking the inlet opening to the oil container with an electrically operated valve when the oil pump does not create an oil pressure.

15. Vehicle, comprising an oil system according to any of claims 1 to 12.

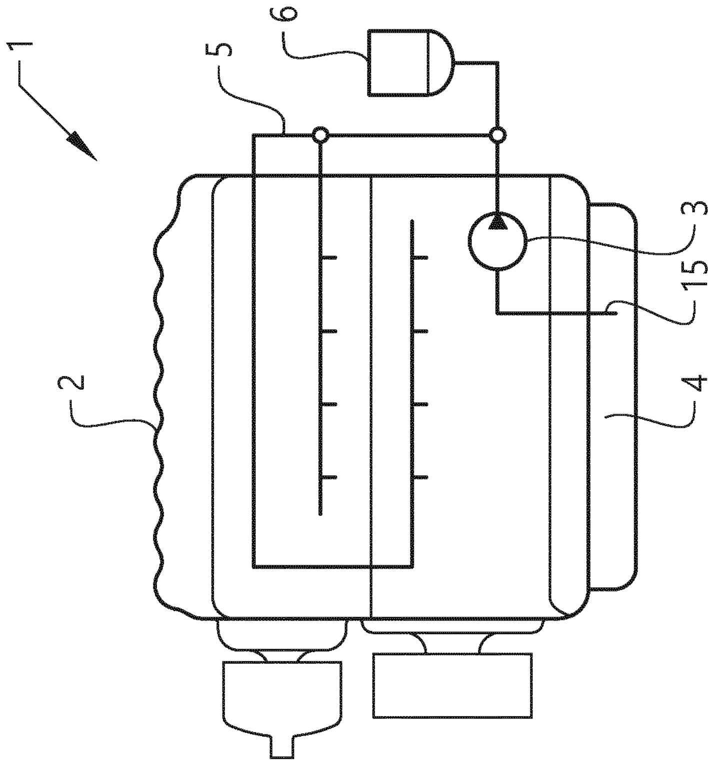

FIG. 1

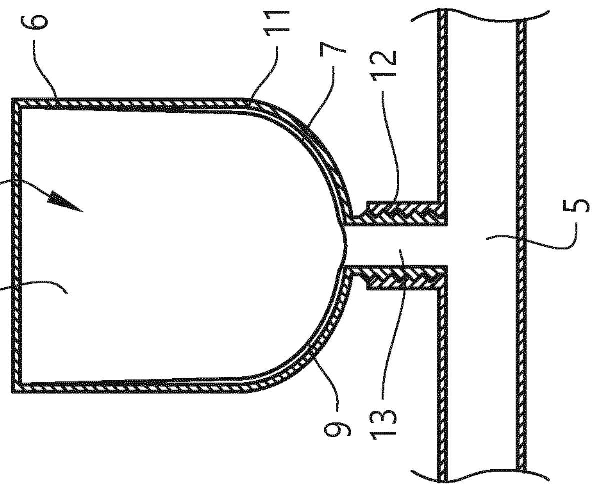

FIG. 2

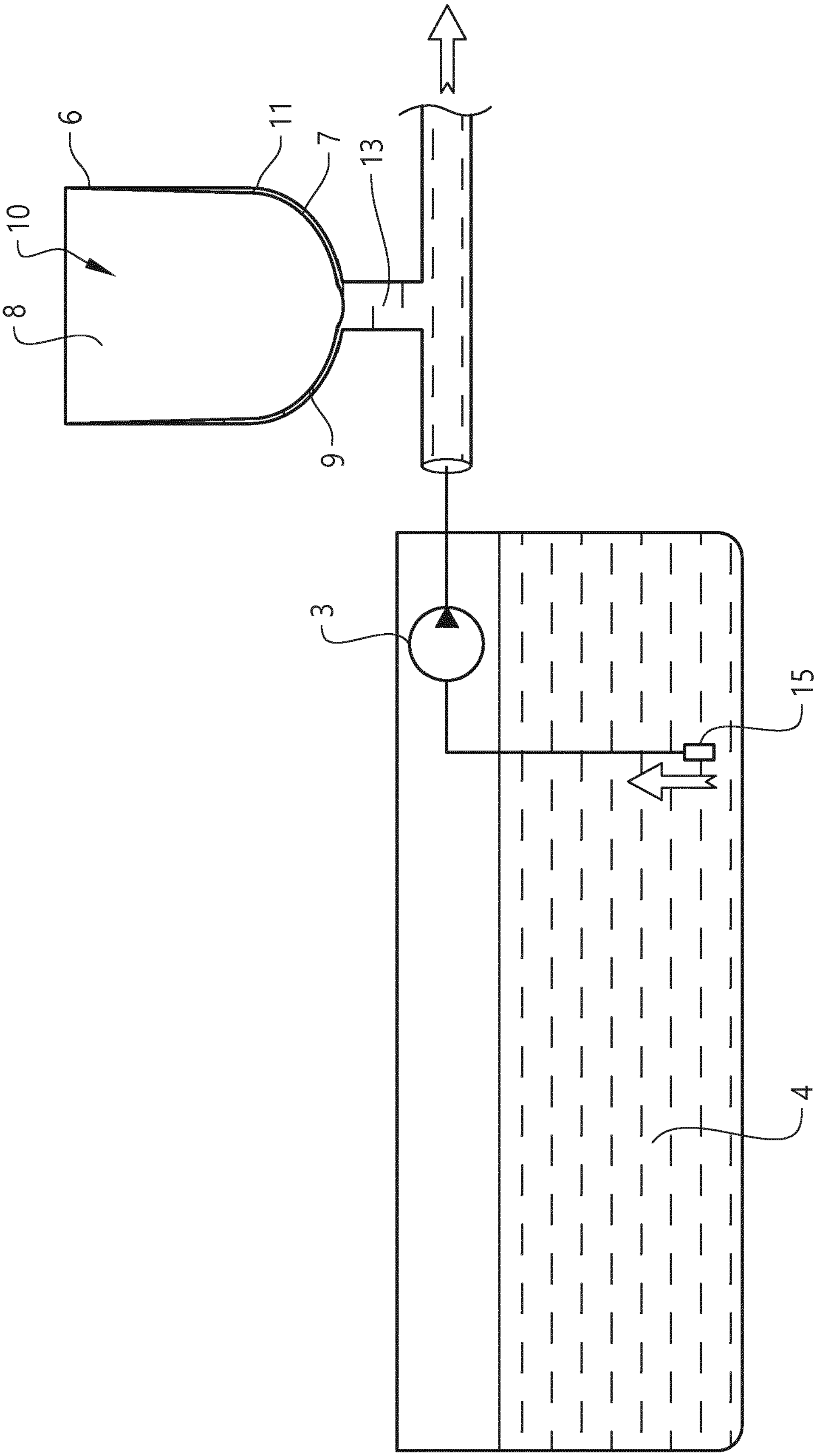

FIG. 3

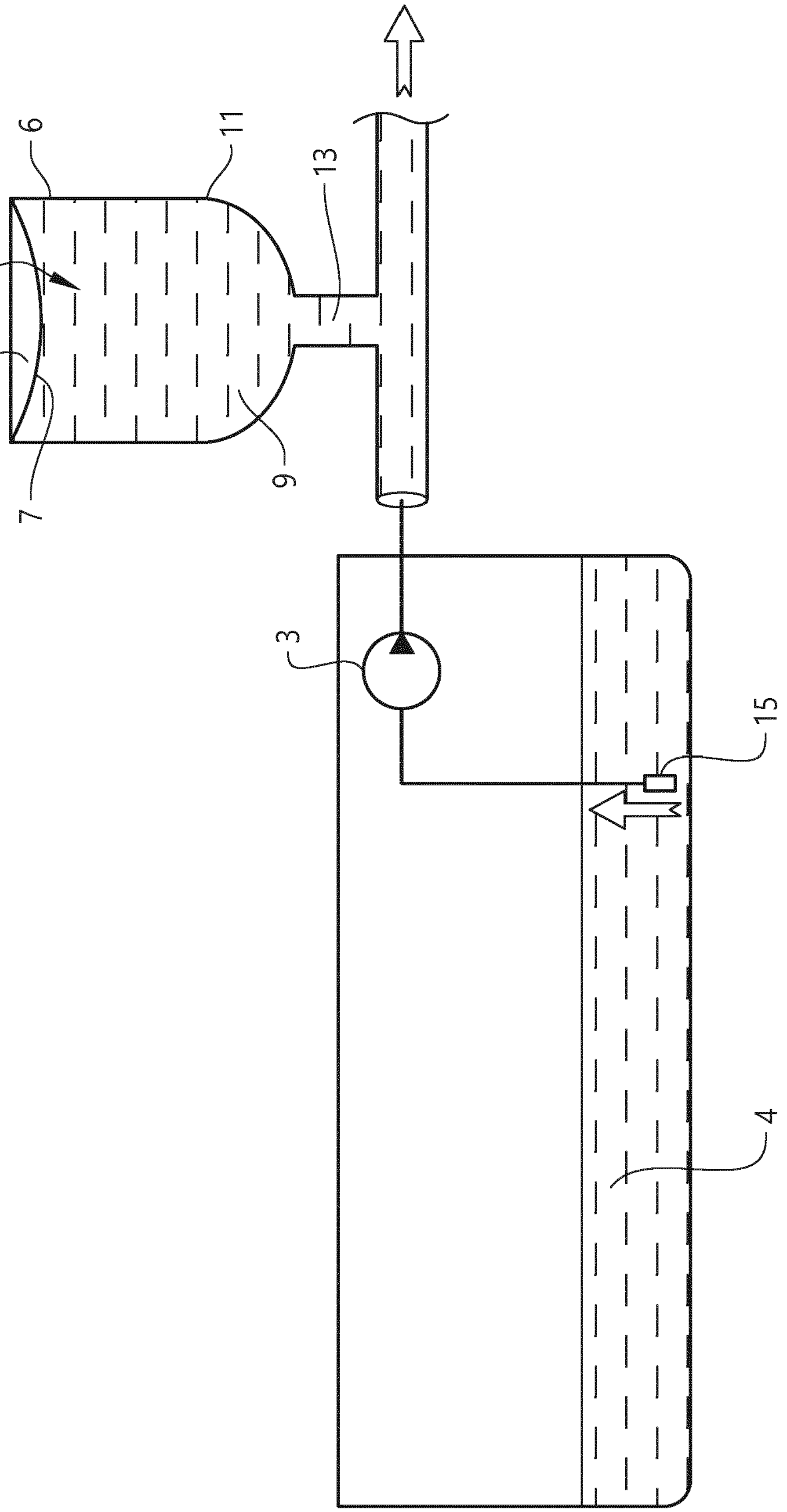

FIG. 4

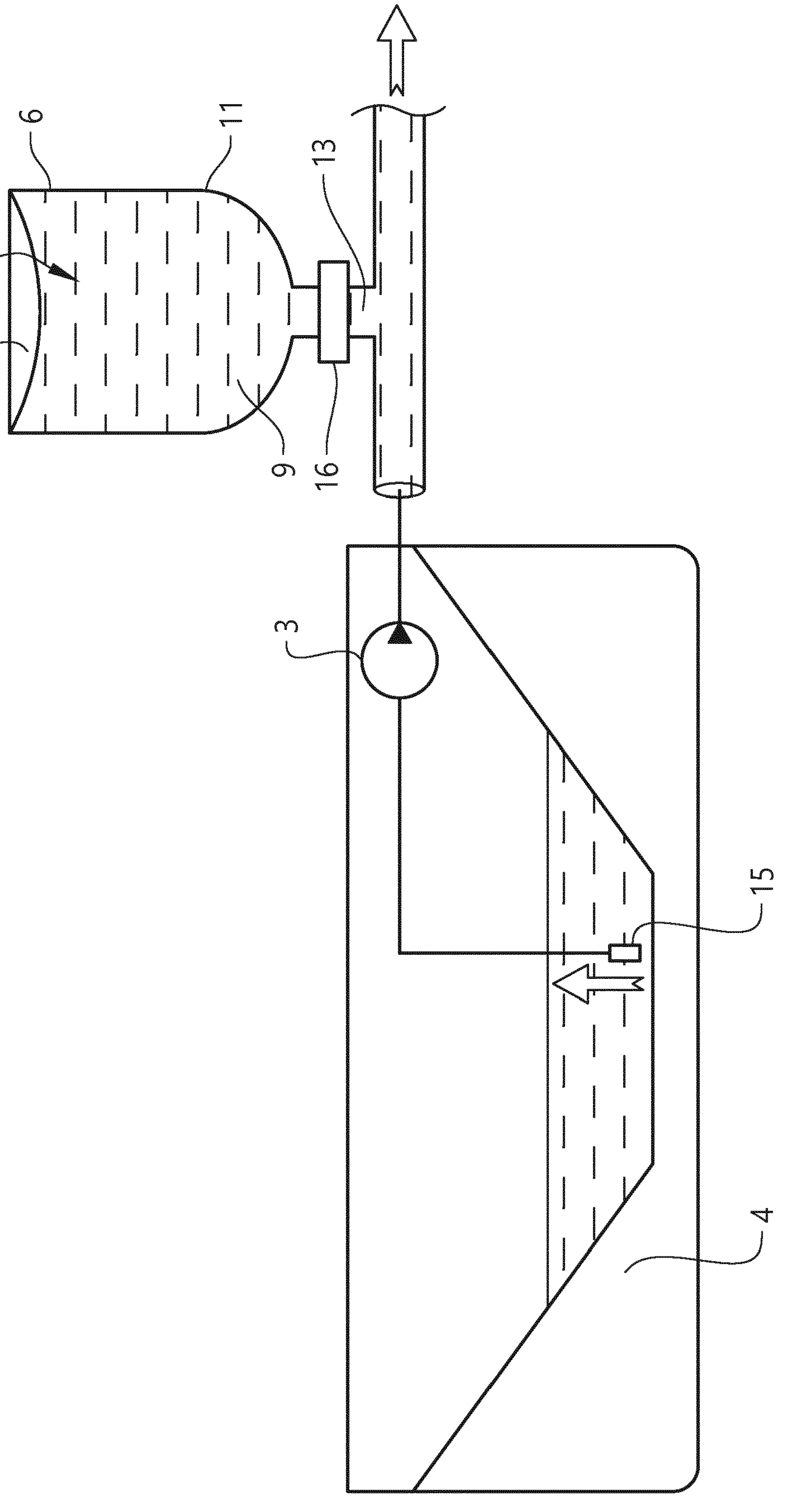

FIG. 5

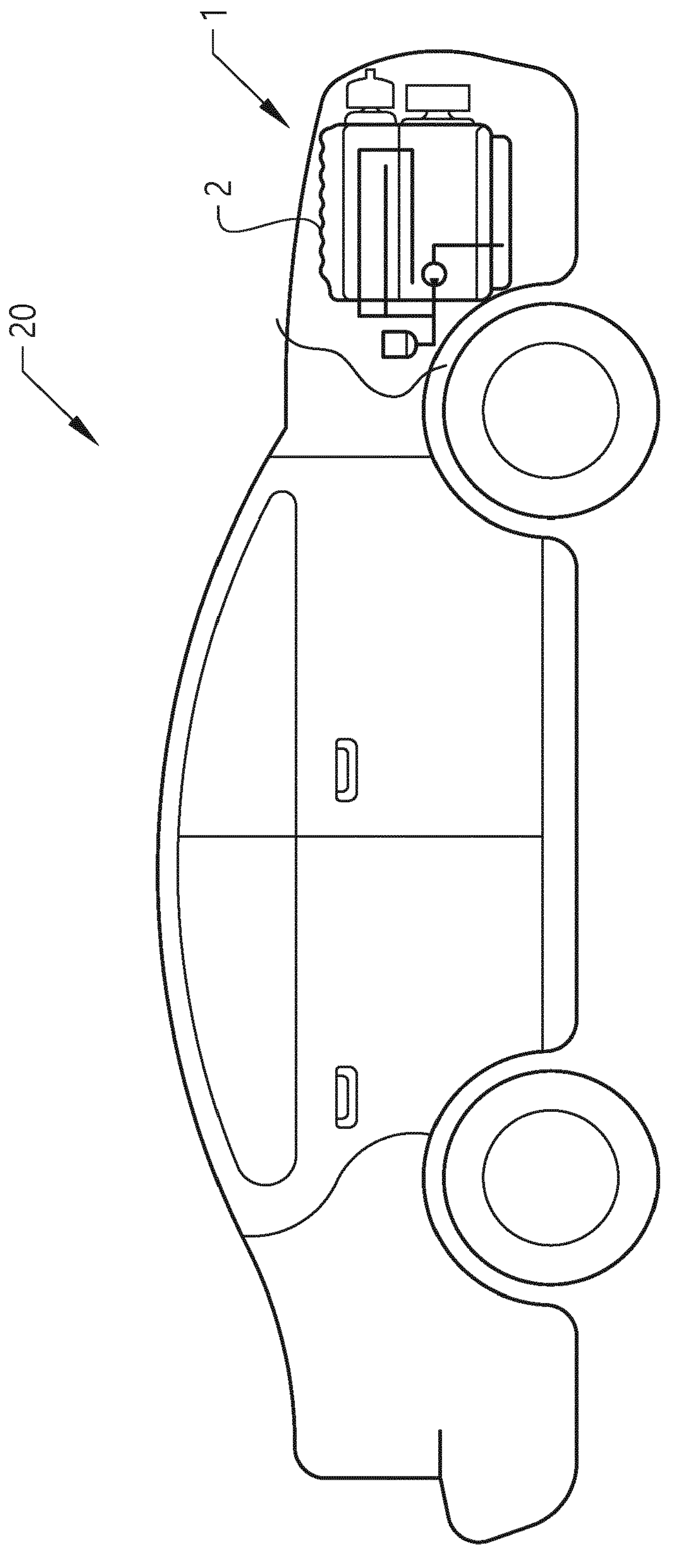

FIG.6

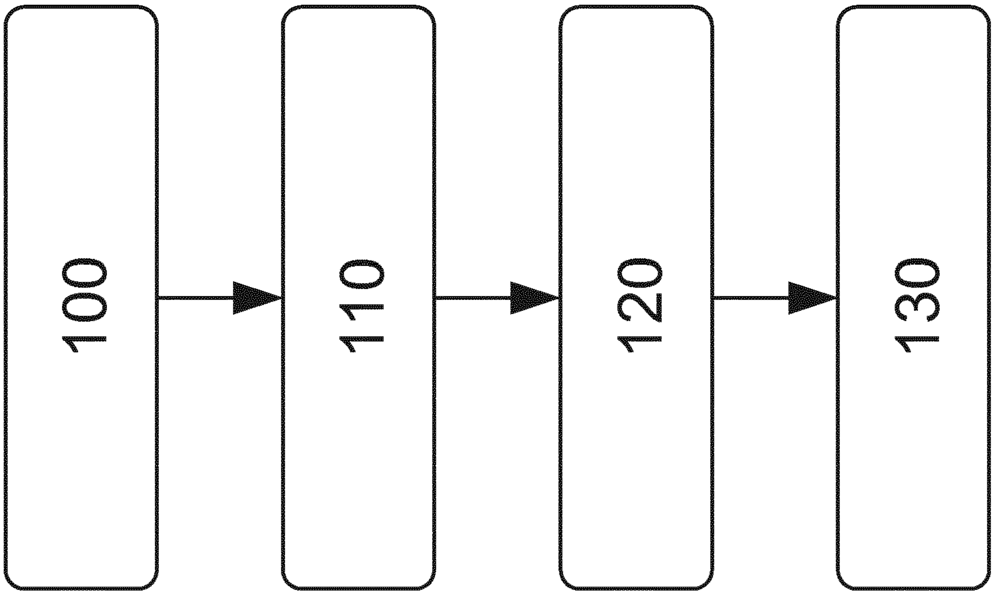

FIG.7

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EUROPEAN SEARCH REPORT

Application Number
EP 17 15 5539

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TECHNICAL FIELDS SEARCHED (IPC)

F01M

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	18 August 2017	Van Zoest, Peter

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