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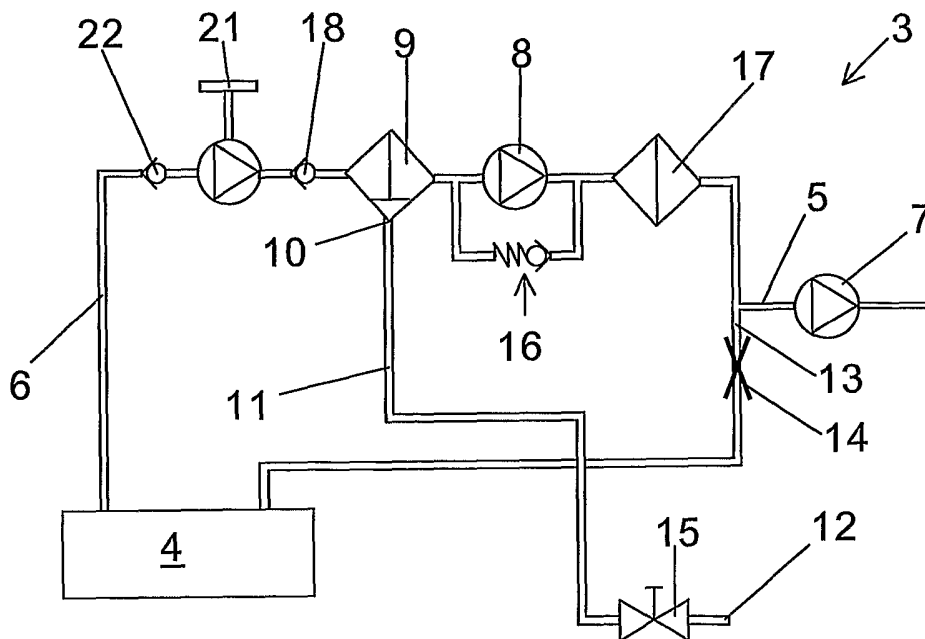
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(54) Title: MOTOR VEHICLE



(57) Abstract: A fuel system (3) and a motor vehicle (1) with such a fuel system (3) are described. The fuel system (3) comprises a fuel tank (4) which defines a fuel space, a fuel line (6) arranged between the fuel tank (4) and adapted to being connected to the engine (2), and a water separating filter (9) arranged on the fuel line (6) to separate water from the fuel, whereby the water separating filter (9) comprises a drain (10) for water. The fuel system (3) is characterised in that it comprises a drain line (11) connected to the drain, whereby the drain line (11) comprises an outlet (12) arranged below the lowest point of the fuel space, and a drain valve (15) arranged below the lowest point of the fuel space.

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Motor vehicleTechnical field

The present invention relates to a motor vehicle with a fuel system and a water
5 separating filter for separating water from fuel.

State of the art

Combustion engines in motor vehicles used in ordinary traffic are run on ordinary
commercial fuel which may contain contaminants. Contaminants in the fuel may well
10 damage the engine or at least impair its performance. The contaminants may be in
particulate, gas or liquid form. Contaminants in fuel can impair engine performance to
such an extent that the engine cannot run on it. It is known, for example, that even a
small amount of water in diesel fuel can prevent a diesel engine from functioning.
Particles in fuel damage the engine by causing increased wear or cause operational
15 stoppage of the engine by obstructing fuel ducts in the engine.

Particles in the engine can be filtered out by particle filters well-known to specialists
within the field. Particle filters become obstructed over time by the particles which
they filter out, and therefore need changing at regular intervals. Water in fuel can be
20 filtered out by a water-separating fuel filter.

US patent 5,355,860 describes a fuel system for diesel engines. The fuel system
comprises a first fuel filter means which itself comprises a particle filter and a water
separating filter. The water separating filter is provided with a valve for removal of
25 water which accumulates within the water separating filter.

With the solution according to the US patent, the water has to be removed when the
motor vehicle is not in motion. It is often desired to place the water separating filter on
the engine instead of on the motor vehicle's chassis, in order to avoid having to use
30 flexible lines between the water separating filter and the engine. Such flexible lines
need more maintenance than lines which are not flexible. It is often difficult, however,

to reach the water separating filter so that it can be drained. If the cab is tiltable, the cab often has to be tilted in order to be able to drain the water separating filter.

Summary of the invention

5 One object of the present invention is to provide a motor vehicle with a fuel system comprising a water separating filter, whereby the removal of water from the water separating filter is easier to do than in the state of the art.

Another object of the present invention is to provide a fuel system for a motor vehicle,
10 which fuel system comprises a water separating filter, whereby the removal of water from the water separating filter is easier to do than in the state of the art.

These objects are fulfilled with a motor vehicle and a fuel system according to the independent claims.

15 Further advantages of the invention are achieved with the features defined in the dependent claims.

A motor vehicle according to the invention comprises an engine and a fuel system for
20 supplying the engine with fuel, whereby the fuel system comprises a fuel tank which defines a fuel space, a fuel line arranged between the fuel tank and a feed line connected to the engine, and a water separating filter arranged on the fuel line to separate water from the fuel, whereby the water separating filter comprises a drain for water. The motor vehicle is characterised in that the motor vehicle comprises a drain
25 line connected to the drain, whereby the drain line comprises an outlet arranged below the lowest point of the fuel space, and a drain valve arranged below the lowest point of the fuel space.

Lowest point of the fuel space means the lowest point at which fuel can be present. In
30 a motor vehicle according to the invention, the liquid column constituted by the difference in height between the fuel surface in the fuel tank and the outlet will drive water out from the water separating filter.

The fact that the lowest point of the fuel space is higher than the drain valve and the outlet means that there will always be a liquid column which drives water out from the water separating filter irrespective of how much fuel is still present in the fuel tank.

5

The motor vehicle may comprise a chassis and the drain valve may be arranged on the chassis. Placing the drain valve on the chassis allows the possibility of stable and readily accessible fastening of the drain valve.

10 The drain valve may be operable manually or operable electrically. A manually operable valve is less complicated than an electrically operable valve, but an electrically operable drain valve affords the possibility of remote control of the drain valve.

15 The motor vehicle may comprise a feed pump arranged on the fuel line between the water separating filter and the engine in order to supply fuel from the fuel tank to the engine when the feed pump is powered. With such a feed pump, the feeding of fuel from the fuel tank is assured.

20 The motor vehicle may comprise a first fuel check valve arranged on the fuel line between the water separating filter and the fuel tank. Fuel is allowed to flow past the feed pump in the direction from the engine towards the fuel tank when powering of the feed pump ceases, with the result that a negative pressure, relative to atmospheric pressure, is created in the water separating filter when the feed pump is powered, and
25 that a positive pressure, relative to atmospheric pressure, is created in the water separating filter when powering of the feed pump ceases. With such a motor vehicle, the result is a higher than atmospheric pressure in the water separating filter when the feed pump is switched off. This positive pressure helps to empty water from the water separating filter. After the positive pressure in the water separating filter has ceased,
30 the only cause driving water out from the water separating filter is the fuel surface level relative to the drain valve.

The motor vehicle may comprise a return line between the feed line and the fuel tank, and a constriction arranged on the return line to bring about a higher pressure in the feed line than in the fuel tank when the feed pump is powered. Such a return line makes it easier to maintain an even flow of fuel to the feed line. The constriction
5 makes it possible for the pressure in the feed line to be maintained.

The motor vehicle may further comprise a pressure regulator arranged parallel with the feed pump. A pressure regulator is an easy means of maintaining an even pressure in the feed line.

10

The motor vehicle may also comprise a high-pressure pump arranged between the feed line and the engine. Such a high-pressure pump supplies fuel at high pressure to the engine. Depending on the type of engine, the feed pump may supply fuel at sufficiently high pressure directly to the engine, but cases where the fuel needs to be at
15 very high pressure require a separate high-pressure pump. An example of such engines which need to be supplied with fuel at very high pressure is so-called "common rail" engines in which fuel at high pressure is distributed to each cylinder via so-called injectors arranged in each cylinder.

20 The motor vehicle may comprise a particle filter arranged on the fuel line to separate particles from the fuel. The particle filter allows fuel of inferior quality to be used. The particle filter may be integrated with the water separating filter but may also constitute a separate component.

25 A second aspect of the present invention refers to a fuel system for supplying the engine of a motor vehicle with fuel, whereby the fuel system comprises a fuel tank which defines a fuel space, a fuel line connected to the fuel tank and adapted to being connected to the engine, and a water separating filter arranged on the fuel line to separate water from the fuel, whereby the water separating filter comprises a drain for
30 water. The fuel system is characterised in that the fuel system comprises a drain line connected to the drain, whereby the drain line comprises an outlet arranged below the

lowest point of the fuel space, and a drain valve arranged below the lowest point of the fuel space.

A fuel system according to the invention has corresponding advantages which have
5 been mentioned in relation to the motor vehicle according to the invention.

The features mentioned above in relation to the motor vehicle according to the invention may also be implemented in a fuel system according to the invention in appropriate cases.

10

Embodiments of the invention are described below with reference to the attached drawings.

Brief description of the drawings

15 Fig. 1 depicts schematically a motor vehicle according to an embodiment of the present invention.

Fig. 2 is a flowchart of a fuel system according to an embodiment of the present invention.

20

Description of embodiments of the invention

In the following description of embodiments of the invention, similar items in the various embodiments are denoted by the same reference notations.

25 Fig. 1 depicts schematically a motor vehicle 1 according to an embodiment of the present invention. The motor vehicle 1 comprises an engine 2 and a fuel system 3 for supplying the engine 2 with fuel. The fuel system is depicted in more detail in Fig. 2.

Fig. 2 is a flowchart of a fuel system 3 according to an embodiment of the present
30 invention. The fuel system 3 comprises a fuel tank 4, a feed line 5 and a fuel line 6 which is arranged to lead fuel between the fuel tank 4 and the feed line 5. The feed line 5 is connected to a high-pressure pump 7 adapted to supplying the engine 2 with

fuel at high pressure. The fuel from the high-pressure pump is thereafter distributed in the engine in a known manner. The fuel system 3 further comprises a feed pump 8 arranged on the fuel line 6 and adapted to pumping fuel from the fuel tank 4 to the feed line 5.

5

A water separating filter 9 is arranged on the fuel line 6 upstream from the feed pump 8 and is adapted to separating water from fuel which is fed through the water separating filter 9. The water separating filter 9 may be of any of the types of water separating filter which are previously known or are invented in the future. As the function and construction of water separating filters 9 are previously known, no further description thereof will be given here. The water separating filter 9 comprises a water drain 10 to which a drain line 11 is connected. A drain valve 15 and the outlet 12 are arranged below the lowest point in the fuel space. The drain valve may be operable manually or operable electrically. A return line 13 is arranged between the feed line 5 and the fuel tank 4, and a constriction 14 is arranged on the return line 13. The constriction 14 results in a lower pressure downstream from the constriction. A pressure regulator 16 is arranged parallel with the feed pump 8 and is adapted to regulating the pressure in the feed line 5. The fuel system 3 further comprises a particle filter 17 arranged on the fuel line between the feed pump 8 and the feed line 5 and adapted to filtering out particles from the fuel. A first check valve 18 is arranged on the fuel line 6 upstream from the water separating filter 9.

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The fuel system 3 may also comprise a manual handpump 21 and a second check valve 22. The manual handpump 21 may be used for pumping fuel manually from the fuel tank 4.

30

The function of the fuel system 3 in Fig. 2 will now be described. During operation of the engine 2, the feed pump 8 pumps fuel from the fuel tank 4 to the feed line 5. The pressure in the water separating filter 9 will then be lower than atmospheric pressure, lower than the pressure in the fuel tank 4 and lower than the pressure in the feed line 5. The pressure in the feed line 5 is determined by the pressure regulator 16 as mentioned above. The pressurised fuel is led from the feed line 8 to the particle filter 17 and

thence to the feed line 5 and the high-pressure pump 7 in order to be led on therefrom into the engine 2. Part of the pressurised fuel is led through the return line 13 and the constriction 14 back to the fuel tank 4. The pressure in the return line 13 downstream from the constriction 14 during operation is greater than or equal to atmospheric
5 pressure. Water dissolved in the fuel is drawn into the water separating filter 9, in which it is separated and accumulates. The water separating filter may function according to any of the known principles for water separating filters or according to some principle which becomes known in the future.

10 When the feed pump 8 stops, which happens when the engine 2 is switched off, the pressure in the feed line will be equalised via feed pump 8, with the result that the pressure in the water separating filter 9 becomes greater than the pressure in the fuel tank 4. A user opening the drain valve 15 makes it possible for water from the water separating filter 9 to pass through the drain line 7 and the drain valve 15 to the outlet
15 12. Water will continue to pass through the drain line 11 so long as there is still any water in the water separating filter 9, since the fuel level in the fuel tank 4 will be higher than the drain valve 15 and the outlet 12 irrespective of how much fuel is still present in the fuel tank. Such is the case even if the first check valve 18 and the second check valve 22 and the manual hand pump 21 are excluded.

20

If the drain valve 15 is opened shortly after the feed pump 8 is switched off, the higher pressure which occurs in the water separating filter 9 after the feed pump 8 is switched off will help to drive water out from the water separating filter 9.

25 The invention is not limited to the embodiment described above but may be modified in many ways without departing from the spirit and scope of the invention.

It is of course possible for the particle filter 17 and the water separating filter 9 to be integrated in the same component.

30

It is possible to arrange the feed pump 8 before the water separating filter 9 or to omit the feed pump 8. In the latter case the fuel tank 4 has to be arranged higher than the

water separating filter 9, so that fuel runs down from the fuel tank 4 to the water separating filter 9.

CLAIMS

1. A motor vehicle (1) comprising an engine (2) and a fuel system (3) for supplying the engine (2) with fuel, whereby the fuel system (3) comprises a fuel tank (4) which
5 defines a fuel space, a fuel line (6) arranged between the fuel tank (4) and a feed line (5) connected to the engine (2), and a water separating filter (9) arranged on the fuel line (6) to separate water from the fuel, whereby the water separating filter (9) comprises a drain (10) for water, **characterised** in that the motor vehicle comprises a drain line (11) connected to the drain, whereby the drain line (11) comprises an outlet
10 (12) arranged below the lowest point of the fuel space, and a drain valve (15) arranged below the lowest point of the fuel space.
2. A motor vehicle (1) according to claim 1, comprising a chassis (23), whereby the drain valve (15) is arranged on the chassis.
- 15 3. A motor vehicle (1) according to claim 1, whereby the drain valve (15) is operable manually.
4. A motor vehicle (1) according to claim 1, 2 or 3, comprising a feed pump (8)
20 arranged on the fuel line (6) between the water separating filter (9) and the engine (2) to feed fuel from the fuel tank (4) to the engine (2) when the feed pump (8) is powered.
5. A motor vehicle (1) according to claim 4, comprising a first fuel check valve (18) arranged on the fuel line (6) between the water separating filter (9) and the fuel tank
25 (4), whereby fuel is allowed to flow past the feed pump (8) in the direction from the engine (2) towards the fuel tank (4) when powering of the feed pump (8) ceases, with the result that a negative pressure, relative to atmospheric pressure, is created in the water separating filter (9) when the feed pump (8) is powered, and that a positive pressure, relative to atmospheric pressure, is created in the water separating filter (9)
30 when powering of the feed pump (8) ceases.

6. A motor vehicle (1) according to claim 4 or 5, further comprising a return line (13) between the feed line (6) and the fuel tank (4), and a constriction (14) arranged on the return line (13) to bring about a higher pressure in the feed line (5) than in the fuel tank (4) when the feed pump (8) is powered.

5

7. A motor vehicle (1) according to claim 4, 5 or 6, further comprising a pressure regulator (16) arranged parallel with the feed pump (8).

8. A motor vehicle (1) according to any one of the foregoing claims, comprising a high-pressure pump (7) arranged between the feed line (5) and the engine (2).

10

9. A motor vehicle (1) according to any one of the foregoing claims, comprising a particle filter (17) arranged on the fuel line (6) to separate particles from the fuel.

15 10. A fuel system (3) for supplying the engine (2) of a motor vehicle (1) with fuel, whereby the fuel system (3) comprises a fuel tank (4) which defines a fuel space, a fuel line (6) connected to the fuel tank (4) and adapted to being connected to the engine (2), and a water separating filter (9) arranged on the fuel line (6) to separate water from the fuel, whereby the water separating filter (9) comprises a drain (10) for water,

20 **characterised** in that the fuel system (3) comprises a drain line (11) connected to the drain, whereby the drain line (11) comprises an outlet (12) arranged below the lowest point of the fuel space, and a drain valve (15) arranged below the lowest point of the fuel space.

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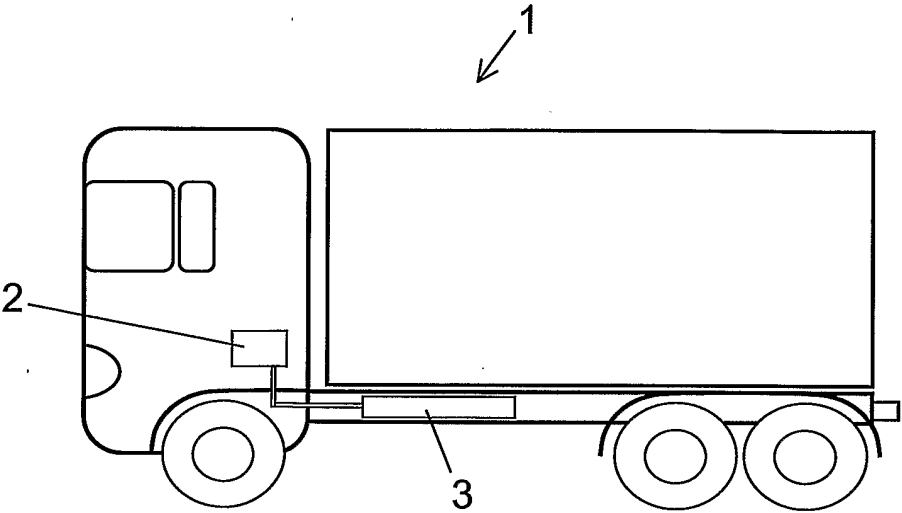


Fig 1

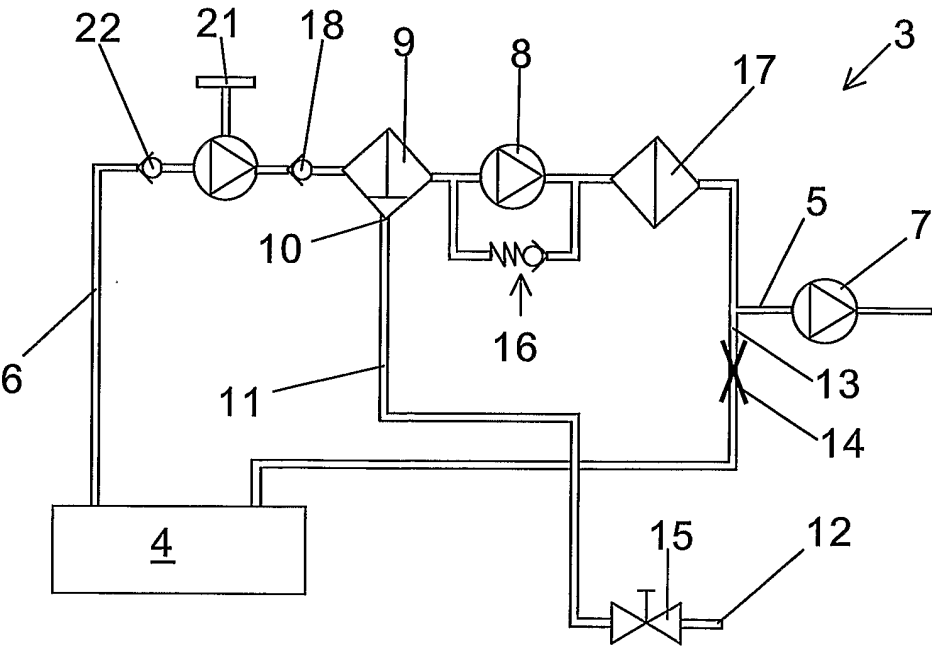


Fig 2

INTERNATIONAL SEARCH REPORT

International application No.

PCT/SE2006/000053

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: F02M

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, WPI DATA, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4898140 A (PAGES), 6 February 1990 (06.02.1990), figures 1,2, abstract --	
A	DE 3701259 A1 (VOLKSWAGEN AG), 30 July 1987 (30.07.1987), figure 1, abstract --	
A	US 5355860 A (EKSTAM), 18 October 1994 (18.10.1994), figure 1, abstract -----	

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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Date of the actual completion of the international search

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

04/03/2006

International application No.

PCT/SE2006/000053

US	4898140	A	06/02/1990	DE	68901575	D	00/00/0000
				EP	0337861	A,B	18/10/1989
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DE	3701259	A1	30/07/1987	NONE			
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