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(54) **Fuel pump with filter control**

Brennstoffpumpe mit Filtersteuerung

Pompe à combustible avec contrôle du filtre

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(73) Proprietor: **Dresser Wayne AB**
202 15 Malmö (SE)

(72) Inventor: **Larsson, Bengt I**
274 53 Skivarp (SE)

(74) Representative: **Henriksson, Dan Ragnar Mikael**
Awapatent AB
P.O. Box 5117
200 71 Malmö (SE)

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WO-A1-99/45272 **DE-A1- 4 444 854**

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Description

Field of the invention

[0001] The present invention relates generally to fuel recirculation for reducing clogging of fuel filters. More particularly, the present invention relates to a fuel pump unit for a fuel dispensing unit comprising a pump with a suction side and a pressure side, the suction side having an inlet equipped with a fuel filter, and a bypass channel connecting the pressure side to the suction side via the fuel filter. The invention further relates to a fuel dispensing unit comprising such a fuel pump unit and to a method for reducing the clogging of a fuel filter in such a fuel pump unit for a fuel dispensing unit.

Background of the invention

[0002] Fuel dispensers that are used at gas stations for filling fuel tanks of motor vehicles commonly comprise an underground fuel tank, a pump unit, a hose, and an outlet nozzle. The pump unit pumps the fuel from the underground tank creating a flow of fuel through the hose and the outlet nozzle. The user of the fuel dispenser utilizes the outlet nozzle to fill the vehicle's fuel tank.

[0003] The pump unit is commonly equipped with a fuel filter to prevent particles to enter the pump. Clogging of the fuel filter is however a known problem and a usual cause for maintenance of the fuel dispenser.

[0004] A number of different pumps are known for use in fuel dispensers. WO 2007/036754 describes a pump that uses an occasionally reversed flow direction to cleanse the fuel filter. When the pump is stopped, the pump housing is partly emptied to create a backflow through the fuel filter. This is done by closing valves to the hose and opening other valves to provide ambient air to release the vacuum in the pump housing. The gravitational force on the fuel in the pump housing will thereby be allowed to create a backflow through the inlet of the pump, back into the fuel storage tank. The backflow will cleanse the filter from particles.

[0005] In WO 99/45272 a fuel dispenser pump is shown that has an overpressure valve to avoid excessive pressure in the pump that could lead to dangerous conditions. The pump is also equipped with a fuel filter at the pump inlet to avoid particles to enter the pump. If the pressure reaches a predetermined dangerous level, an overpressure valve is opened and fuel at the pressure side is allowed to recirculate to the suction side of the pump through a bypass passage, thereby stopping the pressure build-up. The bypass passage is located in the pump casing leading fuel from the pressure side to the suction side. The recirculated fuel enters the suction side without passing through the fuel filter.

[0006] The problem of particles clogging the fuel filter is further aggravated by congealing fuel components. Heavy fuels with a low level of refining, as e.g. diesel fuel, in particular have a problem with congealing fuel components, a problem that increases at low fuel temperatures and when the pump is not used frequently. Components of the diesel fuel form wax-like substances that deposit onto the filter. If the fuel that is pumped by the fuel dispenser is a bio fuel as e.g. bio-diesel, bacteria growth on the filter is also an issue. Also this problem is worsened if the pump is not used frequently and the fuel is left stagnant around the fuel filter. Build-up of deposits consisting of particles, wax and/or bacteria will eventually reduce the fuel flow to levels that are lower than what is acceptable.

[0007] A fuel pump according to the preamble of claim 1 is known from DE-A-44 44 854.

Summary of the invention

[0008] It is an object of the present invention to solve the above problems and to provide an improved pump unit for a fuel dispensing unit and reduce the clogging of the fuel filter by congealing fuel and/or growing bacteria. The clogging of the fuel filter by congealing fuel components is reduced by periodically recirculating fuel through the fuel filter when the fuel dispensing unit is not in use for filling the tanks of motor vehicles.

[0009] These and other objects are achieved by a fuel pump unit for a fuel dispensing unit comprising a pump with a suction side and a pressure side, where the suction side has an inlet that is equipped with a fuel filter, and where a bypass channel connects the pressure side to the suction side via the fuel filter. The fuel pump unit is **characterised in that** it further comprises a control device adapted to periodically start the pump, when the fuel flow through the fuel filter has stopped, to recirculate fuel via said bypass channel and through said fuel filter to reduce clogging of the filter.

[0010] The periodic recirculation of fuel, by starting the fuel pump, will reduce the tendency of the fuel congealing and make it harder for congealing components to adhere to the fuel filter.

[0011] Another advantage of periodic recirculation of the fuel is that the bacteria growth on the filter, which may occur when using fuels made from biological raw materials like bio-diesel, will be reduced. The adherence of bacteria to surfaces is a process that is greatly enhanced in a stagnant environment, which is only present around the filter when the fuel pump is stopped. The occasional starting of recirculation through the filter will reduce the possibilities of bacteria adhering to the fuel filter surfaces.

[0012] In an embodiment of the invention the fuel pump unit is equipped with a flow meter, adapted to measure the flow through said fuel filter. The control device may be adapted to control the time interval between said periodical recirculation of fuel through said fuel filter according to the flow through the fuel filter measured by the flow meter. The control device may further be adapted to shorten the time interval between the periodical recirculation of fuel through the fuel filter if the flow is lower than a desired value and/or increasing the time interval be-

tween the periodical recirculation of fuel through the fuel filter if the flow is higher than a desired value. The control device could even disable the periodic recirculation if the flow is high enough.

[0013] The ability to measure the flow through the filter may be used by the control device in the fuel pump unit to estimate if the filter is clogged or not. If the filter is beginning to clog, a more frequent recirculation of fuel can help reduce the clogging and dissolve what has already adhered to the filter.

[0014] Since the fuel temperature affects the congealing process of fuel substances, temperature is a variable that may be used to estimate if the filter is clogged or not. Thus, according to another embodiment the fuel pump unit may be equipped with a temperature sensor. A number of different temperatures can be measured, such as e.g. the ambient temperature, the pump temperature, the fuel temperature etc. Preferably the temperature sensor is adapted to detect the fuel temperature. This can be achieved by placing the temperature sensor in the fuel flow. The temperature sensor could, however, also be placed in the ambient air around the fuel pump unit or outside the housing of the fuel dispensing unit, to estimate the fuel temperature from the ambient air temperature. An equivalent estimation of the fuel temperature could be made by measuring the temperature of the pump casing material.

[0015] In one embodiment the control device is adapted to control the time interval between the periodical recirculation of fuel through the fuel filter according to the temperature detected by the temperature sensor. The previously mentioned control device of the fuel pump unit could be adapted to increase the time interval between the periodical recirculation of fuel through the fuel filter if the temperature is higher than a desired value. The control device could also be adapted to decrease the time interval between the periodical recirculation of fuel through the fuel filter if the temperature is lower than a desired value. If the temperature is measured to be above a certain desired value the recirculation interval is extended in time and vice versa.

[0016] The recirculation may generate friction heat in the piping that will increase the fuel temperature. The pump engine may, due to an engine efficiency below 100%, also generate heat to its surroundings. Heat, originating from the pump engine, will be absorbed by the fuel, increasing the fuel temperature. The increased temperature of the fuel will reduce the risk that components of the fuel will congeal and clog the filter.

[0017] If the heat generated by the pump and the above mentioned friction heat is considered not to be enough for reducing filter clogging, the fuel pump unit may, according to a further embodiment of the invention, be equipped with a heating member that is arranged at said fuel filter. The heating member could be an electric heating device such as a resistive heating wire. The heating member could e.g. be the filter itself. The filter could be built up by resistive heating wires, presenting an effective way of providing heat to the environment surrounding the fuel filter. The heating member could also be a part concealed in the filter or it could be attached at the filter.

[0018] The ability to adapt the time interval between the recirculation periods according to the fuel temperature to match the need of recirculation, makes it possible to avoid unnecessary circulation. Energy can be saved and the fuel pump unit will be less worn.

[0019] According to a further embodiment the bypass channel does not include any valves. A construction without valves is simple and robust and will require a minimum of maintenance. In some cases, however, valves could be required to reduce the recirculation flow through the bypass channel to affect the main flow in the fuel hose. Valves that are adjustable manually or by an electric control mechanism are then preferred. The adjustment of the valves, and thereby the recirculation flow, may be done by remote control to reduce the need of manual adjustment of the fuel pump unit at site. Adjustable valves may also be controlled by the abovementioned control device in the fuel pump unit. The control unit could then adjust the flow according to relevant input parameters available.

[0020] Another aspect of the invention relates to a fuel dispensing unit for motor vehicles, comprising a fuel pump unit according to the description above. The fuel pump unit is preferably used in a fuel dispensing unit for use at gas stations, but the concept of the invention could be used for other types of systems, where clogging of an inlet filter is a problem due to processes in the liquid that are reduced by movement and/or heat such as wax-formation and bacteria growth.

[0021] Still another aspect of the invention relates to a method for reducing the clogging of a fuel filter in a fuel pump unit for a fuel dispensing unit, where the fuel pump unit comprises a pump with a suction side and a pressure side, where the suction side has an inlet equipped with the fuel filter, and a bypass channel connecting the pressure side to the suction side via the fuel filter. The method is characterised by the step of periodically starting the pump, when the fuel flow through the fuel filter has stopped, to recirculate fuel via the bypass channel and through the fuel filter.

[0022] An embodiment comprises the step of controlling the time interval between the periodical recirculation of fuel through the fuel filter according to the flow through the fuel filter. The time interval between the periodical recirculation of fuel through the fuel filter may be increased if the flow is higher than a desired value, or the time interval between the periodical recirculation of fuel through the fuel filter may be decreased if the flow is lower than a desired value.

[0023] According to a further embodiment the method comprises the step of controlling the time interval between the periodical recirculation of fuel through the fuel filter according to the temperature. If the temperature is higher than a desired value, the time interval between the periodical recirculation of fuel through the fuel filter

may be increased. If the temperature is lower than a desired value the time interval between the periodical recirculation of fuel through the fuel filter may be decreased.

[0024] The advantages of the method of the invention are analogous to the abovementioned advantages of the device according to the invention.

[0025] Thus, to sum up the recirculation according to the present invention may be carried out in a number of different ways. In a simple embodiment the control device may be set to carry out the recirculation as a function of time only, i.e. the recirculation lasts for a certain time period with a certain time period or interval between each recirculation. The recirculation may e.g. be carried out during a period of about 1-5 minutes, preferably about 2-4 minutes, and more preferably about 3 minutes, and the interval between the recirculations may e.g. be about 10-20 minutes, preferably about 12-18 minutes, and more preferably about 15 minutes.

[0026] According to another embodiment the recirculation may be carried out as a function of the fuel flow through the fuel filter. In this case the control device is set to carry out the recirculation as a function of a target flow or desired value of fuel flow through the fuel filter. This desired value or target flow may e.g. be about 50-150 litres/minute, preferably about 80-120 litres/minute, and more preferably about 100 litres/minute. If the fuel flow is less than a certain value, e.g. less than 80% of the desired value, the time interval between the recirculations is decreased and/or the recirculation time is increased. If on the other hand the fuel flow is higher than a certain value, e.g. higher than 90% of the desired value, the time interval between the recirculations is increased and/or the recirculation time is decreased up to a point where the fuel flow is equal to the desired value when the recirculation may be discontinued.

[0027] According to still another embodiment the recirculation may be carried out as a function of the temperature, e.g. the ambient temperature, the fuel pump unit temperature, or, most preferably the fuel temperature. In this case the control device is set to carry out the recirculation as a function of a target or desired temperature value. This desired value or target value of the temperature may e.g. be about 5-20°C, preferably about 10-15°C, and more preferably about 10°C. The desired value may differ depending on whether it relates to the ambient temperature, the fuel pump unit temperature, or the fuel temperature. If the temperature is higher than the desired value the time interval between the recirculations is increased and/or the recirculation time is decreased. Conversely, if the temperature is lower than the desired value the time interval between the recirculations is decreased and/or the recirculation time is increased.

[0028] The abovementioned ways of controlling the fuel recirculation may be used alone or in combination, i.e. the recirculation may be carried out both as a function of the fuel flow and of the temperature.

Brief description of the drawings

[0029] The present invention will now be described in more detail, with reference to the appended drawings showing a currently preferred embodiment of the invention.

Fig. 1 is a schematic drawing of fuel dispensing unit.
Fig. 2 is a cross sectional view of a preferred embodiment of the fuel pump unit for a fuel dispensing unit according to the invention.

Detailed description of a preferred embodiment of the invention

[0030] Fig. 1 illustrates an exemplary fuel dispensing unit 1, having four hose storage spaces 2 on each opposing side of the fuel dispensing unit 1, an electrical cabinet 3 containing all the electronics for the fuel dispensing unit 1 including the control device 7 of the present invention (Fig. 2), a hydraulic cabinet 4 containing fuel dispensing means (not shown), e.g. fuel metering means, valves, vapour recovery system etc, and a column 5 extending vertically between and separating the electrical cabinet 3 and the hydraulic cabinet 4 from the hose storage spaces 2. The fuel dispensing unit 1 is connected to an underground reservoir (not shown) containing fuel. When filling up the tank of a motor vehicle, the fuel is pumped from the underground reservoir by means of a pump (not shown) which is located in the hydraulic cabinet 4, and from there to the column 5 and out to a nozzle 6 via a hose.

[0031] Fig. 2 illustrates a fuel pump unit 8 in a fuel dispensing unit 1 with a pump 9, a main fuel supply pipe 10 and a dispensing hose 11. The main fuel supply pipe 10 is connected to the underground reservoir (not shown) containing fuel. The pump 9 has an engine 12 and is equipped with a flow meter 13. The pump 9 has a suction side 14, providing an underpressure to the main fuel supply pipe 10 and a pressure side 15, providing an overpressure to the dispensing hose 11. At the pump inlet 16 a fuel filter 17 is attached, through which the fuel has to pass to enter the pump 9.

[0032] At the pressure side 15 of the pump 9, a bypass channel 18, is attached, that leads from the pressure side 15 of the pump 9, to the main fuel supply pipe 10 near the pump inlet 16 and the fuel filter 17 that is attached to the inlet 16. The dimension of the bypass channel 18 is in this embodiment smaller than the fuel hose, the diameter is about a fourth of the dispensing hose 11. No valves are needed in this embodiment since the dimension of the bypass channel 18 is chosen to allow the desired amount of fuel to recirculate through the bypass channel 18. In another embodiment, however, a valve may be attached at the beginning of the bypass channel 18 to enable the possibility to reduce the recirculation flow through the bypass channel 18. The valve is preferably adjustable, as e.g. a needle valve, so as to be able to

adjust the recirculation flow in a precise manner. In one preferred embodiment it is possible to remote control the valve, e.g. via a service web interface of the fuel dispensing unit 1.

[0033] In a further embodiment, at least one heating element 19, is located near the fuel filter 17 by the pump inlet 16. Fig. 2 shows a cylindrical heating member 19 that is placed around the filter. The heating member 19 could, however, be shaped in number of ways to provide extra heat to the fuel around the filter. E.g. an immersion heater could be used for practical reasons of availability and price. The heating member 19 could, however, also be incorporated in the filter itself. A rod-shaped immersion heater could e.g. be placed in the centre of the filter. The filter mesh could also partly or entirely be built up by heat resistive wires making the filter itself a heating device.

[0034] A temperature sensor 20, is placed near the fuel filter 17 in the fuel flow. The temperature sensor 20 could however also be placed in the ambient air in the fuel pump unit housing, or it could be placed outside the fuel dispensing unit housing. In a further embodiment the sensor could be placed in the pump casing or in the pipe material. The temperature sensor 20 is preferably a resistive thermometer, a thermocouple, a silicon bandgap temperature sensor, but could be any type of thermometer.

[0035] In the following paragraphs, the method of reducing clogging of the fuel filter 17 in the fuel pump unit 8 will be discussed. The pump 9 creates an underpressure on one side 14 of the pump 9 that will suck fuel from the underground reservoir (not shown). The fuel filter 17 positioned in the pump inlet 16 will prevent particles contained in the fuel from entering the pump inlet 16 and the rest of the fuel dispensing system. Particles in the fuel will adhere to the filter surface. The amount of trapped particles will build up until the filter will have to be cleaned by maintenance of the fuel dispensing unit 1. This process is worsened due to congealing fuel components forming wax on the filter, especially in cold weather, and, in the case of bio fuels, due to bacteria growth on the filter and particles. As presented by this invention, these processes are reduced by introducing a periodical recirculation of fuel from the pressure side 15 of the pump 9 via a bypass channel 18 to a point upstream of the fuel filter 17 in the flow direction when the fuel dispensing unit 1 is not in use.

[0036] To this end the fuel pump 9 is periodically started when the fuel dispensing unit 1 is not in use. Since the nozzle 6 is closed in that situation all fuel pumped by the pump 9, will be forced to recirculate through the bypass channel 18. Additional fuel from the underground storage tank will not be added since the volume in the system is kept constant while the nozzle 6 is closed. The fuel in the recirculation process will thus be pumped in a loop from the outlet of the bypass channel 18 in the main fuel supply pipe 10, through the fuel filter 17, through the pump 9 and through the bypass channel 18. The movement of fuel through the fuel filter 17 will reduce the adherence of congealing fuel components on the filter. The recirculation will also generate heat from friction between the recirculated fuel and the walls in the piping and pump 9. Heat will also be generated from the pump engine 12, heat that will mainly be absorbed by the circulating fuel. The heating of the fuel will help reducing the congealing process, since the congealing increases at low fuel temperatures.

[0037] The recirculation will also reduce bacteria growth when dispensing bio fuel with the fuel dispensing unit. The growth of bacteria is reduced by the movement of the fuel. The bacteria adherence to the fuel filter 17 will also be reduced by the movement of the recirculated fuel.

[0038] In the embodiment shown in Fig. 2, the bypass channel 18 does not have any valves. When the fuel dispensing unit 1 is in use filling a vehicle tank through the nozzle 6, part of the flow that is induced by the overpressure produced by the pump 9, will recirculate through the bypass channel 18. Even though the recirculation is unnecessary when the fuel dispensing unit 1 is in use, such an embodiment is still preferred due to simplicity. As long as the recirculation does not affect output flow of the fuel dispensing unit 1 too much, a reduced fuel flow is accepted. If the maximum dispensing flow for a dispensing unit is 100 litres/minute, a flow loss due to recirculation of up to 10 litres/minute or 10% would typically be acceptable. The manufacturing process of the fuel pump unit 8 as well as the maintenance will also be simpler and cheaper if no valves are used in the recirculation channel.

[0039] The present invention includes a control device 7 for controlling the periodicity of the periodical recirculation process. The control device 7 starts the pump 9 after a predetermined time after the fuel dispensing unit 1 was last used for fuel dispensing. The pump 9 will, as described above, pump fuel in the recirculation loop through the bypass channel 18, to reduce clogging. The pump 9 will be run for a predetermined time period, e.g. 3 minutes. After the predetermined time period has ended, the control device 7 will shut off the pump engine 12. The control device 7 will then wait for a predetermined time, e.g. 15 minutes, before it starts the pump 9 again for the next recirculation session. The periodical recirculation in this manner will go on until the fuel dispensing unit 1 is used for fuel dispensing again.

[0040] In a preferred embodiment, a flow meter 13 is used in the control process of the periodical recirculation process. The flow meter 13 measures the flow during dispensing and adjusts the time period between the recirculation sessions and/or the recirculation session time period accordingly. If the desired flow value of the fuel dispensing unit 1 is, e.g. 100 litres/minute, an acceptable flow is approximately 80 - 100% of the desired value. A number of control scenarios are possible. In one embodiment, two flow values are predetermined, one higher value set to approximately 90% of the desired value and one lower value set to approximately 80% of the desired

value. If the measured flow value is found to lie between these two values, the periodic fuel recirculation is run with predetermined time intervals, each recirculation session running for a predetermined time period as discussed above. If the measured flow is found to be below the predetermined lower value, the time interval between each recirculation session will be decreased and/or the duration of each recirculation session will be increased. If the measured flow is found to be under a critical value, e.g. 50% of the desired value, the recirculation may be set to run constantly when the fuel dispensing unit 1 is not used. If the measured flow value is above 90% of the desired value the time interval between each recirculation session will be increased and/or the duration of each recirculation session will be decreased. Optional the recirculation could be cancelled if the measured flow is above a certain value, e.g. 98% of the desired value.

[0041] Another control scenario using the flow meter 13 input value is a linear adjustment of the recirculation time variables. A higher value is set where it is determined that the periodic recirculation is not needed, e.g. 98% of the desired value, and a lower value is set where it is determined that the flow is so low that a constant recirculation is needed, e.g. 50% of the desired value. When the measured flow is below the higher value, the periodic recirculation is started with a long time interval, e.g. 50 minutes, and a short recirculation session time duration, e.g. 1 minute. The control device 7 will set the value for the time interval and/or the recirculation session time duration according to the measured flow according to the value calculated from a linear change between the predetermined value at the start of periodic recirculation, e.g. 50 minutes and 1 minute, respectively, to the point where the recirculation is constant. The time interval and the recirculation session can be adjusted linearly one at a time according to the above method or they could be simultaneously adjusted linearly resulting in a squared relationship between recirculation time and measured flow. It should also be noted that the time variables controlling the recirculation process, as described above, can be set to follow any function of measured flow to meet the requirements of the fuel and the design of the fuel dispensing unit.

The flow meter 13 measuring the flow, as described above, can be located at different positions. In Fig. 2, a flow meter 13 is built into the pump 9. An alternative embodiment is to place the flow meter 13 directly after the pump outlet, but before the start point of the bypass channel 18. A flow meter 13 is however traditionally located after the pump 9 and after the start point of the bypass channel 18 in the flow direction, somewhere on the dispensing hose 11. The measured value from this flow meter 13 can also be used, e.g. when retrofitting a recirculation channel on an existing fuel dispensing unit 1, even though the flow meter 13 might be located after the bypass channel 18 in the flow direction. It is, however advantageous to place a flow meter 13 before the bypass channel 18, in the flow direction. One reason is that some of the flow during dispensing will flow through the bypass channel 18, and this flow will not otherwise be measured. Another reason is that the flow through the pump 9 can be measured during recirculation if the flow meter is positioned before the bypass channel 18. It is, of course, also possible to have two flow meters, one positioned by the pump 9 and one on the dispensing hose 11, or one positioned on the bypass channel 18 measuring the recirculation flow and one positioned on the dispensing hose 11 measuring dispensed fuel. If only one flow meter is positioned after the bypass channel 18, the total flow through the fuel filter 17 and the pump 9 will be estimated by adding a known estimated value of the recirculation flow. If, on the other hand, a flow meter is available that either measures the flow through the pump 9 and fuel filter 17 or through the bypass channel 18, the periodic recirculation time variables can be adjusted continuously, without depending on values that are measured during fuel dispensing. This is an advantage when a fuel dispensing unit 1 is occasionally not used for very long time periods.

[0042] According to one embodiment the fuel pump unit 8 is equipped with valves on the bypass channel 18. The valves can be used for constantly adjusting the flow through the bypass channel 18 or for shutting the bypass channel 18 while the fuel dispensing unit 1 is used. The first alternative can be used for calibrating the flow through the bypass channel 18 to a desired value, e.g. 10 litres/minute. The valve in that case preferably is a needle valve or any other valve that can be precisely adjusted. The second alternative could be used if the necessary recirculation flow is found to affect the dispensing flow too much.

[0043] The temperature sensor 20 seen in Fig. 2 delivers temperature readings that can be used by the control device 7. A desired value of the fuel temperature could e.g. be 10°C. One control scenario is to decrease the time interval between the periodic recirculation sessions and/or increase the duration of the periodic recirculation sessions if the temperature drops below 5°C. If, on the other hand, the measured fuel temperature is above e.g. 15°C the time interval between the periodic recirculation periods can be increased and/or the duration of the recirculation sessions can be decreased. Above a certain temperature the periodic recirculation may be stopped entirely for certain fuels.

[0044] Another control scenario for the control device 7 using the temperature readings from the temperature sensor 20 to control the recirculation time variables is to linearly adjust the time variables starting from a higher temperature value, e.g. 15°C, and linearly increasing the recirculation duration time and/or linearly decrease the time interval between the recirculation sessions, until a certain predetermined lower temperature, e.g. 0°C, where the recirculation is continuously running when the fuel dispensing unit 1 is not in use.

[0045] The temperature sensor 20 is in Fig. 2 located in the fuel flow near the fuel filter 17 for accurate and

precise measurement of the temperature of the fuel near the fuel filter 17. The temperature sensor 20 could, however, also be located in the casing material of the pump 9, in the ambient air in or outside the fuel dispensing unit 1, or at another place near or in the fuel dispensing unit 1. The temperature value that is measured at another place than in the fuel flow at the fuel filter 17, can either be used directly by the control device 7, or it can be used to estimate the fuel temperature at the fuel filter 17.

[0046] If the fuel is a bio fuel, the periodic recirculation might not be controlled by temperature at all due to bacteria growth and lack of congealing fuel components. In that case the control device 7 will operate mainly from the values of the measured flow as discussed above.

[0047] In Fig. 2 a heating member 19 is also positioned near, at, or in the fuel filter 17 according to one embodiment. The heating member 19 can add heat when the natural heat originating from the recirculation is not enough to keep the fuel around the fuel filter 17 at an acceptable temperature for avoiding clogging of congealing fuel components. The heat output effect of the heating element is controlled by the control device 7, and could e.g. be linearly increased with a starting point at, e.g. 10°C to maximum effect if the temperature is below e.g. 0°C.

[0048] The person skilled in the art realizes that the present invention by no means is limited to the preferred embodiments described above. On the contrary, many modifications and variations are possible within the scope of the appended claims.

Claims

1. A fuel pump unit (8) for a fuel dispensing unit (1) comprising
   a pump (9) with a suction side (14) and a pressure side (15), said suction side (14) having an inlet (16) equipped with a fuel filter (17), and
   a bypass channel (18) connecting said pressure side (15) to said suction side (14) via said fuel filter (17),
   characterised in that
   said fuel pump unit (8) further comprises a control device (7) adapted to periodically start said pump (9), when the fuel flow through said fuel filter (17) has stopped, to recirculate fuel via said bypass channel (18) and through said fuel filter (17) to reduce clogging of the filter.

2. A fuel pump unit (8) according to claim 1, wherein said fuel pump unit (8) is equipped with a flow meter (13), adapted to measure the flow through said fuel filter (17).

3. A fuel pump unit (8) according to claim 2, wherein said control device (7) is adapted to control the time interval between said periodical recirculation of fuel through said fuel filter (17) according to the flow through said fuel filter (17) measured by said flow meter (13).

4. A fuel pump unit (8) according to any one of the preceding claims, wherein the fuel pump unit (8) is equipped with a temperature sensor (20).

5. A fuel pump unit (8) according to claim 4, wherein the control device (7) is adapted to control the time interval between said periodical recirculation of fuel through said fuel filter (17) according to the temperature detected by said temperature sensor (20).

6. A fuel pump unit (8) according any one of the preceding claims, wherein a heating member (19) is arranged at said fuel filter (17).

7. A fuel pump unit (8) according claim 6, wherein said heating member (19) is an electric heating device.

8. A fuel dispensing unit (1) for motor vehicles, comprising a fuel pump unit 8 according to any one of the preceding claims 1-7.

9. Method for reducing the clogging of a fuel filter (17) in a fuel pump unit (8) for a fuel dispensing unit (1), said fuel pump unit (8) comprising
   a pump (9) with a suction side (14) and a pressure side (15), said suction side (14) having an inlet (16) equipped with said fuel filter (17),
   a bypass channel (18) connecting said pressure side (15) to said suction side (14) via said fuel filter (17),
   characterised by the step of periodically starting said pump (9), when the fuel flow through said fuel filter (17) has stopped, by means of a control device (7) adapted to periodically start said pump (9). to recirculate fuel via said bypass channel (18) and through said fuel filter (17).

10. Method according to claim 9, further comprising the step of controlling the time interval between said periodical recirculation of fuel through said fuel filter (17) according to the flow through said fuel filter (17).

11. Method according to claim 10, further comprising the step of increasing the time interval between the periodical recirculation of fuel through said fuel filter (17) if said flow is higher than a desired value.

12. Method according to claims 10 or 11, further comprising the step of decreasing the time interval between the periodical recirculation of fuel through said fuel filter (17) if said flow is lower than a desired value.

13. Method according to any one of claims 9-12, further comprising the step of controlling the time interval between said periodical recirculation of fuel through said fuel filter (17) according to the temperature.

14. Method according to claim 13, further comprising the step of increasing the time interval between the periodical recirculation of fuel through said fuel filter (17) if said temperature is higher than a desired value.

15. Method according to claim 13 or 14, further comprising the step of decreasing the time interval between the periodical recirculation of fuel through said fuel filter (17) if said temperature is lower than a desired value.

Patentansprüche

1. Brennstoffpumpeneinheit (8) für eine Brennstoffabgabeeinheit (1), die
eine Pumpe (9) mit einer Ansaugseite (14) und einer Förderseite (15) aufweist, wobei die Ansaugseite (14) einen Einlass (16) hat, der mit einem Brennstofffilter (17) versehen ist, und
einen Bypasskanal (18), der die Förderseite (15) mit der Ansaugseite (14) über das Brennstofffilter (17) verbindet,
dadurch gekennzeichnet, dass
die Brennstoffpumpeneinheit (8) ferner eine Steuervorrichtung (7) aufweist, die angepasst ist, um die Pumpe (9) periodisch zu starten, wenn der Brennstoffdurchfluss durch das Brennstofffilter (17) gestoppt ist, um Brennstoff über den Bypasskanal (18) und durch das Brennstofffilter (17) zurückzuführen, um das Verstopfen des Filters zu verringern.

2. Brennstoffpumpeneinheit (8) nach Anspruch 1, wobei die Brennstoffpumpeneinheit (8) mit einem Durchflussmesser (13) ausgerüstet ist, der angepasst ist, um den Durchfluss durch das Brennstofffilter (17) zu messen.

3. Brennstoffpumpeneinheit (8) nach Anspruch 2, wobei die Steuervorrichtung (7) angepasst ist, um das Zeitintervall zwischen der periodischen Rezirkulation des Brennstoffs durch das Brennstofffilter (17) gemäß dem Durchfluss durch das Brennstofffilter (17), gemessen von dem Durchflussmesser (13) zu steuern.

4. Brennstoffpumpeneinheit (8) nach einem der vorhergehenden Ansprüche, wobei die Brennstoffpumpeneinheit (8) mit einem Temperaturfühler (20) ausgerüstet ist.

5. Brennstoffpumpeneinheit (8) nach Anspruch 4, wobei die Steuervorrichtung (7) angepasst ist, um das Zeitintervall zwischen der periodischen Rezirkulation des Brennstoffs durch das Brennstofffilter (17) gemäß der Temperatur, die von dem Temperaturfühler (20) erfasst wird, zu steuern.

6. Brennstoffpumpeneinheit (8) nach einem der vorhergehenden Ansprüche, wobei ein Heizelement (19) an dem Brennstofffilter (17) eingerichtet ist.

7. Brennstoffpumpeneinheit (8) nach Anspruch 6, wobei das Heizelement (19) ein elektrisches Heizelement ist.

8. Brennstoffabgabeeinheit (1) für Kraftfahrzeuge, die eine Brennstoffpumpeneinheit (8) nach einem der vorhergehenden Ansprüche 1 bis 7 aufweist.

9. Verfahren zum Verringern des Verstopfens eines Brennstofffilters (17) in einer Brennstoffpumpeneinheit (8) für eine Brennstoffabgabeeinheit (1), wobei die Brennstoffpumpeneinheit (8) aufweist
eine Pumpe (9) mit einer Ansaugseite (14) und einer Förderseite (15), wobei die Ansaugseite (14) einen Einlass (16) hat, der mit dem Brennstofffilter (17) ausgerüstet ist,
einen Bypasskanal (18), der die Förderseite (15) mit der Ansaugseite (14) über das Brennstofffilter (17) verbindet,
gekennzeichnet durch den Schritt des periodischen Startens der Pumpe (9), wenn der Brennstoffdurchfluss **durch** das Brennstofffilter (17) gestoppt ist, mittels einer Steuervorrichtung (7), die angepasst ist, um die Pumpe (9) periodisch zu starten, um Brennstoff über den Bypasskanal (18) und **durch** das Brennstofffilter (17) zu rezirkulieren.

10. Verfahren nach Anspruch 9, das ferner den Schritt des Steuerns des Zeitintervalls zwischen der periodischen Rezirkulation von Brennstoff durch das Brennstofffilter (17) je nach dem Durchfluss durch das Brennstofffilter (17) umfasst.

11. Verfahren nach Anspruch 10, das ferner den Schritt des Erhöhens des Zeitintervalls zwischen der periodischen Rezirkulation des Brennstoffs durch das Brennstofffilter (17) aufweist, wenn der Durchfluss größer ist als ein gewünschter Wert.

12. Verfahren nach einem der Ansprüche 10 oder 11, das ferner den Schritt des Verringerns des Zeitintervalls zwischen der periodischen Rezirkulation des Brennstoffs durch das Brennstofffilter (17) aufweist, wenn der Durchfluss niedriger ist als ein gewünschter Wert.

13. Verfahren nach einem der Ansprüche 9 bis 12, das ferner den Schritt des Steuerns des Zeitintervalls zwischen der periodischen Rezirkulation des Brennstoffs durch das Brennstofffilter (17) in Abhängigkeit von der Temperatur aufweist.

14. Verfahren nach Anspruch 13, das ferner den Schritt des Erhöhens des Zeitintervalls zwischen der peri-

odischen Rezirkulation des Brennstoffs durch das Brennstofffilter (17) aufweist, wenn die Temperatur höher ist als ein gewünschter Wert.

15. Verfahren nach Anspruch 13 oder 14, das ferner den Schritt des Verringerns des Zeitintervalls zwischen der periodischen Rezirkulation des Brennstoffs durch das Brennstofffilter (17) aufweist, wenn die Temperatur niedriger ist als ein gewünschter Wert.

Revendications

1. Unité de pompe à combustible (8) pour une unité de distribution de combustible (1), comprenant :

une pompe (9) avec un côté d'aspiration (14) et un côté de pression (15), ledit côté d'aspiration (14) ayant une entrée (16) munie d'un filtre à combustible (17) et
un canal de dérivation (18), raccordant ledit côté de pression (15) au dit côté d'aspiration (14) par ledit filtre à combustible (17),
caractérisé en ce que
ladite unité de pompe à combustible (8) comprend en outre un dispositif de contrôle (7) adapté pour démarrer périodiquement ladite pompe (9), quand le débit de combustible par ledit filtre à combustible (17) est arrêté, pour recirculer le combustible par ledit canal de dérivation (18) et par ledit filtre à combustible (17) pour réduire l'encrassement du filtre.

2. Unité de pompe à combustible (8) selon la revendication 1, où ladite unité de pompe à combustible (8) est munie d'un débitmètre (13) adapté pour mesurer le débit par ledit filtre à combustible (17).

3. Unité de pompe à combustible (8) selon la revendication 2, où ledit dispositif de contrôle (7) est adapté pour contrôler l'intervalle de temps entre ladite recirculation périodique du combustible par ledit filtre à combustible (17) selon le débit par ledit filtre à combustible (17) mesuré par ledit débitmètre (13).

4. Unité de pompe à combustible (8) selon l'une quelconque des revendications précédentes, où l'unité de pompe à combustible (8) est munie d'un capteur de température (20).

5. Unité de pompe à combustible (8) selon la revendication 4, où le dispositif de contrôle (7) est adapté pour contrôler l'intervalle de temps entre ladite recirculation périodique du combustible par ledit filtre à combustible (17) selon la température détectée par ledit capteur de température (20).

6. Unité de pompe à combustible (8) selon l'une quelconque des revendications précédentes, où un élément de chauffage (19) est disposé sur ledit filtre à combustible (17).

7. Unité de pompe à combustible (8) selon la revendication 6, où l'élément de chauffage (19) est un dispositif de chauffage électrique.

8. Unité de distribution de combustible (1) pour véhicules à moteur, comprenant une unité de pompe à combustible (8) selon l'une quelconque des revendications précédentes 1-7.

9. Procédé pour réduire l'encrassement d'un filtre à combustible (17) dans une unité de pompe à combustible (8) pour une unité de distribution de combustible (1), ladite unité de pompe à combustible (8) comprenant
une pompe (9) avec un côté d'aspiration (14) et un côté de pression (15), ledit côté d'aspiration (14) ayant une entrée (16) munie dudit filtre à combustible (17),
un canal de dérivation (18), raccordant ledit côté de pression (15) au dit côté d'aspiration (14) par ledit filtre à combustible (17), **caractérisé par** l'étape de démarrage périodique de ladite pompe (9), quand le débit de combustible par ledit filtre à combustible (17) est arrêté, au moyen d'un dispositif de contrôle (7) adapté pour démarrer périodiquement ladite pompe (9), pour recirculer le combustible par ledit canal de dérivation (18) et par ledit filtre à combustible (17).

10. Procédé selon la revendication 9, comprenant en outre l'étape de contrôle de l'intervalle de temps entre ladite recirculation périodique du combustible par ledit filtre à combustible (17) selon le débit par ledit filtre à combustible (17).

11. Procédé selon la revendication 10, comprenant en outre l'étape d'augmentation de l'intervalle de temps entre la recirculation périodique du combustible par ledit filtre à combustible (17) si ledit débit est supérieur à une valeur souhaitée.

12. Procédé selon les revendications 10 ou 11, comprenant en outre l'étape de diminution de l'intervalle de temps entre la recirculation périodique du combustible par ledit filtre à combustible (17) si ledit débit est inférieur à une valeur souhaitée.

13. Procédé selon l'une quelconque des revendications 9-12, comprenant en outre l'étape de contrôle l'intervalle de temps entre ladite recirculation périodique du combustible par ledit filtre à combustible (17) selon la température.

14. Procédé selon la revendication 13, comprenant en

outre l'étape d'augmentation de l'intervalle de temps entre la recirculation périodique du combustible par ledit filtre à combustible (17) si ladite température est supérieure à une valeur souhaitée.

15. Procédé selon les revendications 13 ou 14, comprenant en outre l'étape de diminution de l'intervalle de temps entre la recirculation périodique du combustible par ledit filtre à combustible (17) si ladite température est inférieure à une valeur souhaitée.

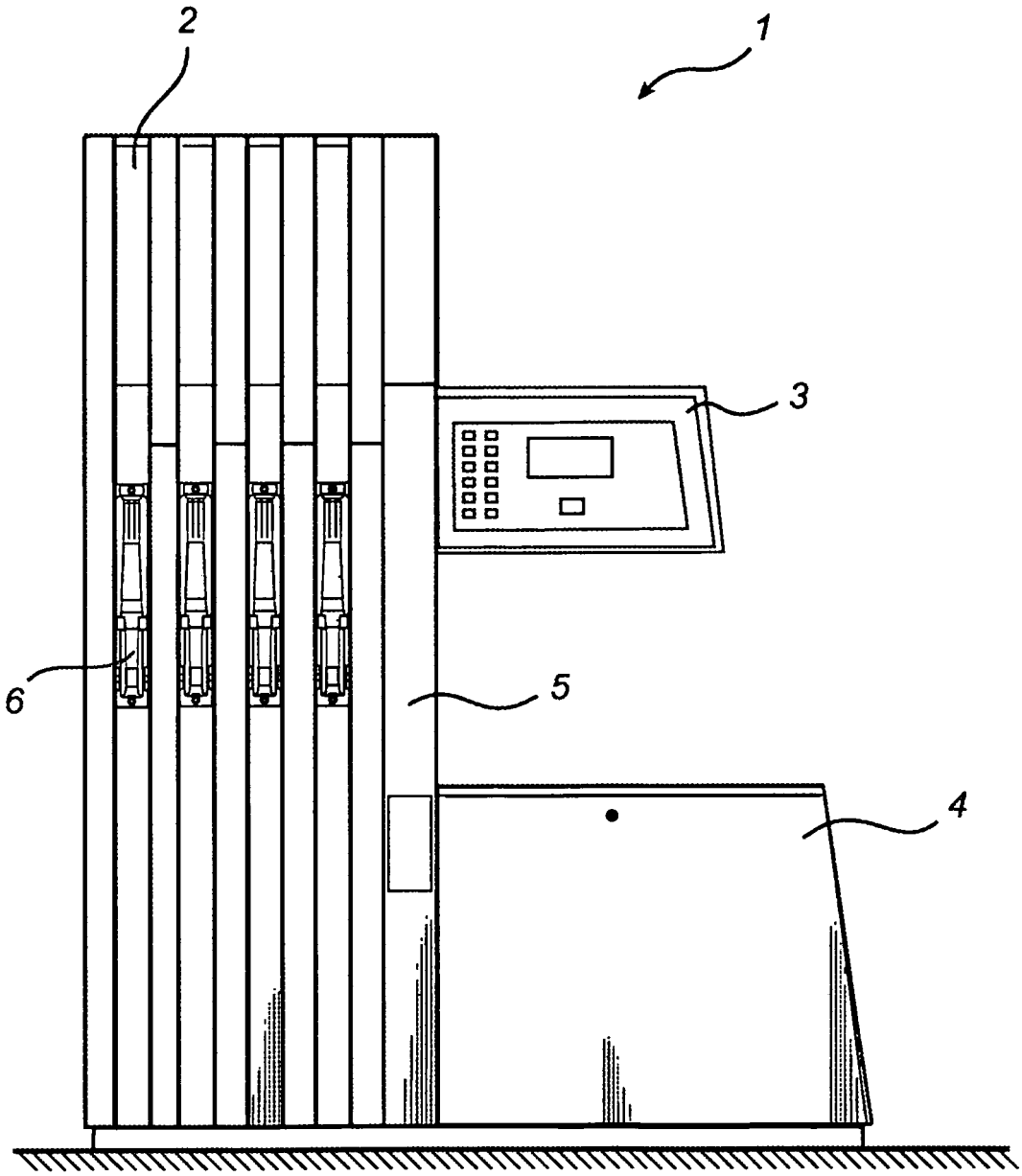

Fig. 1

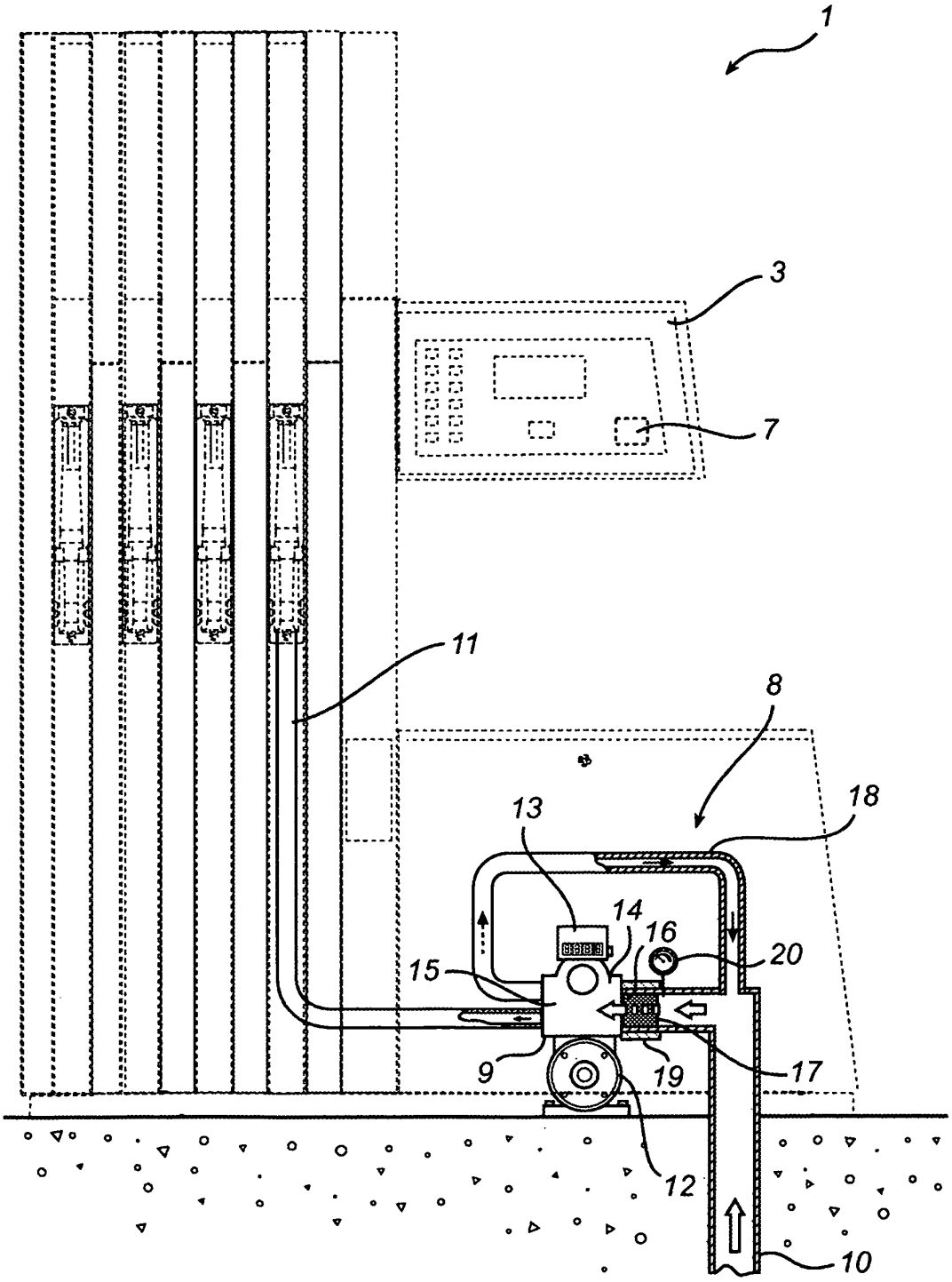

Fig. 2

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2007036754 A **[0004]**
- WO 9945272 A **[0005]**
- DE 4444854 A **[0007]**