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(54) A fuel dispensing unit, and a method for controlling such a fuel dispensing unit

(57) The invention relates to a for controlling a fuel dispensing unit, comprising detecting a malfunction in the vapour recovery system of said fuel dispensing unit, and identifying the location of the malfunction. The method is **characterized in that** after a predetermined number of successive malfunctions at the same location, at least one fuel dispensing nozzle in the fuel dispensing unit is adjusted. The invention also relates to a fuel dispensing unit having a control system (18) adapted to execute such a method.

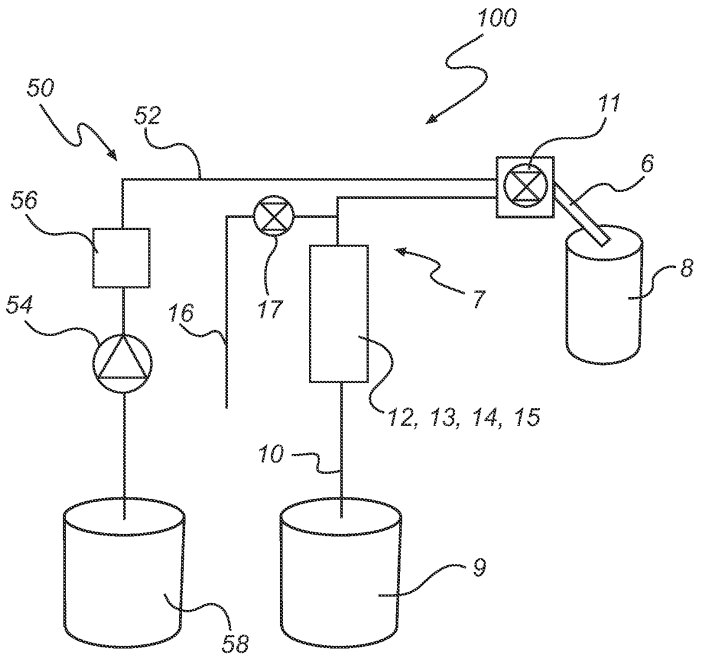

Fig. 3

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Description

Technical field

[0001] The invention relates to a fuel dispensing unit for dispensing fuel to motor vehicles. The present invention also relates to a method for controlling such a fuel dispensing unit.

Technical background

[0002] When filling the fuel tank of a motor vehicle, it is a common measure to recover the vapour escaping the tank when filling it with liquid fuel. This measure is taken for both safety and environmental reasons. The vapour recovery is achieved, for instance, by arranging a vapour suction nozzle next to the fuel dispensing nozzle of a pistol grip for filling the tank with fuel. Vapour is then removed from the tank during filling, at a certain rate, which is often controlled by the standard rate of at which fuel is dispensed to the tank. Because of the importance of having a vapour recovery system that is intact, several methods for detecting possible malfunctions within the vapour recovery system and even the location of the malfunctions are available on the market today.

[0003] EP-1,995,209 discloses a method for control of a vapour recovery system for recovering vapour from a motor vehicle tank, said method comprising the steps of measuring a vapour recovery flow rate through a first vapour path between a fuel dispensing nozzle and a vapour tank and including a vapour pump and a flow rate measuring means, **characterised in that** a second flow rate is measured through a second path one end of which is connected to the first path downstream of the fuel dispensing nozzle and upstream of the flow rate measuring means and the vapour pump, and comparing the measured vapour recovery flow rate with the second flow rate in order to detect malfunction of the vapour recovery system.

[0004] There are, however, problems with the method disclosed above as well as with other prior art available on the market today. Todays fuel dispesning units usually have several nozzle boots on each side of the unit. Each nozzle boot accomodates a pistol grip with a fuel dispensing nozzle and a vapour suction nozzle. If a malfunction is detected in the vapour recovery system of the fuel dispensing unit, all of the fuel dispensing nozzles connected to the vapour recovery system at both pump sides or at least at one of the two pump sides is shut off, thereby making a plurality of fuel dispensing nozzles unusable. This is a major inconvenience for the customers using the fuel dispensing unit and also results in large financial losses for the owner of the fuel dispensing unit.

Summary of the invention

[0005] It is an object of the present invention to provide an improvement of the prior art methods. More particularly, it is an object of the present invention to provide a more reliable and financially superior fuel dispensing unit. Further, it is an object of the present invention to provide a method for controlling such a fuel dispensing unit.

[0006] These and other objects as well as advantages that will be apparent from the following description of the present invention are achieved by a method for controlling a fuel dispensing unit and a fuel dispensing unit according to the independent claims.

[0007] Thus, a method is provided for controlling a fuel dispensing unit having at least two fuel dispensing nozzles which are connected to a vapour recovery system, comprising detecting a malfunction in the vapour recovery system of said fuel dispensing unit, and identifying the location of the malfunction. The method is **characterized in that** after a predetermined number of successive malfunctions at the same location, at least one fuel dispensing nozzles in the fuel dispensing unit is adjusted. This is advantageous in that since only the fuel dispensing nozzles affected by the malfunction are shut off, the fuel dispensing unit may still function in a satisfying manner while the malfunction is attended. In this way, the customers will be satisfied and the financial losses for the owner of the fuel dispensing unit are minimized.

[0008] The at least one fuel dispensing nozzle effected by the successive malfunctions may be adjusted by a rectified vapour recovery regulation. This is advantageous in that the entire fuel dispensing unit will still be usable for a customer during this adjustment. Another advantagous is that if only one fuel dispensing nozzle is affected by the successive malfunctions, then only this one fuel dispensing nozzle is adjusted while the remaining nozzles of the fuel dispensing unit are left unadjusted.

[0009] The at least one fuel dispensing nozzle effected by the successive malfunctions may be adjusted by being shut off. If the at least one fuel dispensing nozzle effected by the successive malfunctions cannot be adjusted in a simple manner, it will be shut off in order to prevent fuel vapour from leaking out into the surronding environment. This is a way to ensure a safe and reliable fuel dispensing unit with regard to the surronding environment.

[0010] One fuel dispensing nozzle may be shut off if the successive malfunctions are located at this fuel dispensing nozzle. This is advantageous in that the entire fuel dispensing unit will be functioning as usual, except for this one fuel dispensing nozzle which is shut off under a short period until being cleaned or repaired. The inconveniences for the customers using the fuel dispensing unit and the financial losses for the owner due to the shut off fuel dispensing nozzle are thus minimized.

[0011] A plurality of fuel dispensing nozzles may be shut off if the successive malfunctions are located downstream from the fuel dispensing nozzles. By downstream from the fuel dispensing nozzles is meant further down in the vapour recovery system at a location where all of the fuel dispensing nozzles connected to the vapour recovery system are affected by the malfunction, e.g. by a vapour pump. If the malfunction is located in a part within

the vapour recovery system concerning a plurality of fuel dispensing nozzles, accordingly, all of the effected fuel dispensing nozzles will be shut off until the malfunction has been attended to.

[0012] The predetermined number of successive malfunctions may be 5-15, preferably 8-12, and more preferable about 10. This is advantageous in that the malfunction will established in a certain and reliable manner.

[0013] According to a second aspect of the present invention, the invention relates to a fuel dispensing unit for dispensing fuel to motor vehicles, comprising at least two fuel dispensing nozzles for dispensing fuel to a motor vehicle tank, a vapour recovery system connected to the fuel dispensing nozzles for recovering fuel vapour from the motor vehicle tank, and a control system for detecting a malfunction and identifying its location in said vapour recovery system. The fuel dispensing unit is **characterized in that** said control system is adapted to execute the method described above. This is advantageous in that since only the fuel dispensing nozzles affected by the malfunction are shut off, the fuel dispensing unit may still function in a satisfying manner while the malfunction is attended to. In this way, the customers stay satisfied and the financial losses for the owner of the fuel dispensing unit are minimized.

[0014] Generally, all terms used in the claims are to be interpreted according to their ordinary meaning in the technical field, unless explicitly defined otherwise herein. All references to "a/an/the [element, device, component, means, unit, etc]" are to be interpreted openly as referring to at least one instance of said element, device, component, means, unit, etc., unless explicitly stated otherwise. The steps of any method disclosed herein do not have to be performed in the exact order disclosed, unless explicitly stated.

Brief description of the drawings

[0015] The above, as well as additional objects, features and advantages of the present invention, will be better understood through the following illustrative and non-limiting detailed description of preferred embodiments of the present invention, with reference to the appended drawings, where the same reference numerals will be used for similar elements, wherein:

Fig. 1 is a schematic view of an exemplary fuel dispensing unit,
Fig. 2 is a schematic view of an exemplary vapour recovery system.

Detailed description of preferred embodiments of the invention

[0016] Fig. 1 illustrates a 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, 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 fuel dispensing nozzle 6 via a hose (not shown). When filling-up does not take place, the hose is accommodated in a hose storage place 2 and the fuel dispensing nozzle 6 is inserted in a nozzle boot (not shown).

[0017] Below, exemplary methods for detecting a malfunction and its location within a vapour recovery system will be discussed.

[0018] In Fig. 2, a first embodiment of a vapour recovery system 7 is shown. The vapour recovery system 7 conveys fuel vapour from a motor vehicle tank 8 to a vapour tank 9 along a first vapour path 10. One end of the vapour path 10 is arranged via a valve 11 within a fuel dispensing nozzle 6. Each fuel dispensing nozzle 6 comprises a valve 11. A vapour pump 12, a valve 13, a damper 14 and a flow rate measuring means 15 are arranged in the first vapour path 10. A second path 16 is at one end connected to the first vapour path 10, and the other end is an open end connected to the atmosphere. A valve 17 is arranged in the second path 16. The damper 14 is preferably incorporated in the first vapour path 10 in order to reduce variations in vapour flow so that the vapour pump 12 is exposed to a uniform vapour flow. The damper 14 can be of a simple construction, e.g. a fixed volume.

[0019] During the filling-up of a vehicle, the valve 17 is closed. The valve 11 belonging to the fuel dispensing nozzle 6 being used as well as valve 13 are open and the vapour pump 12 is activated. Vapour is thereby drawn from the motor vehicle tank 8 through the valve 11. The vapour enters the flow rate measuring means 15, flows through the damper 14 and is accumulated in the vapour tank 9. The flow rate measuring means 15 measures the flow rate of vapour.

[0020] According to a first method, the measured flow rate is compared to a reference flow rate corresponding to the actual speed of the vapour pump 12. Thus, a comparing means (not shown) is connected to the flow rate measuring means 15 and the vapour pump 12 so that a specific pump speed corresponds to a specific reference flow rate. After filling-up, the valve 11 is closed and the fuel dispensing nozzle 6 is detached from the motor vehicle tank 8. If the measured vapour flow rate equals the reference flow rate, or lies within a predetermined interval from the reference volume, the vapour recovery system 7 is considered to operate satisfactory and no further action is needed. If the measured flow rate lies outside the predetermined range, the vapour recovery system 7

is considered to malfunction and the built-in control of the vapour recovery system 7 is activated. The valve 17 is opened, and the vapour pump 12 draws air from the open end of the second path 16 through the second path 16, the flow rate measuring means 15, the damper 14, the valve 13 and down to the vapour tank 9. The flow rate measuring means 15 measures a new flow rate of air, and the measured new flow rate is compared to a new reference flow rate corresponding to the actual speed of the vapour pump 12. If the measured new flow rate lies within a predetermined range, the vapour recovery system 7 is considered to malfunction upstream of where the second path 16 connects to the first path 10. If the measured new flow rate lies outside the predetermined range, the vapour recovery system 7 is considered to malfunction downstream of where the second path 16 connects to the first path 10. Information related to any of these conclusions is e.g. stored in a control system 18 electrically connected (as indicated by the dashed line in Fig. 2) to the flow rate measuring means 15. Further equipment (not shown) is used to let an operator receive said information. Such equipment may e.g. enable wireless transmission of the information to a server. Malfunction as described above may e.g. be a result of dust particles which have been drawn into the first vapour path 10 via the fuel dispensing nozzle 6. The flow rate measuring means 15, the damper 14, the valve 13 and the fuel pump 12 may be arranged in another order along the first vapour path 10 than is shown in Fig. 2. Further components may also be arranged in the first vapour path 10 in order to enhance the function or efficiency of the vapour recovery system 7.

[0021] According to a second method of the present invention, no reference flow rate is provided. After filling-up, the valve 11 is closed and the fuel dispensing nozzle 6 is detached from the motor vehicle tank 8. The built-in control of the vapour recovery system is activated whereby the valve 17 is opened, and the vapour pump 12, operating at the same speed as during the previously performed filling-up, draws air from the open end of the second path 16 through the second path 16, the flow rate measuring means 15, the damper 14, the valve 13 and down to the vapour tank 9. The flow rate measuring means 15 measures a new flow rate of air. If the measured flow rate does not equal the measured vapour flow rate, or lies outside a predetermined range from the measured vapour flow rate, a malfunction of the vapour recovery system is considered to be present somewhere in the first path upstream of where the second path is connected. Such malfunction may e.g. be an effect of a constriction in the first vapour path, e.g. in the fuel dispensing nozzle. The built-in control is activated after each filling-up, or after a predetermined number of filling-ups. In one method, the built-in control is activated when necessary, i.e. after an indication of a malfunction in the vapour recovery system 7. In fig. 3, a fuel dispensing unit 100 is shown schematically. The fuel dispensing unit 100 has a fuel dispensing means 50 and a vapour recovery system 7. The fuel dispensing means 50 has a fuel pump 54 that draws fuel from a fuel tank 58, via a fuel path 52 through a flow meter 56 and to a fuel dispensing nozzle 6. During the filling-up of a vehicle, the fuel dispensing nozzle 6 is connected to a motor vehicle tank 8. The fuel pump 54 is activated, and the flow meter 56 measures a volume of dispensed fuel. The flow meter 56 and the fuel pump 54 are connected to control means (not shown) for adjusting the speed of the fuel pump 54. The measured volume of dispensed fuel is transmitted to a second control means (not shown) for adjusting the speed of the vapour pump 12. The vapour recovery system 7, having the valve 17 closed, operates so that vapour is recovered from the motor vehicle tank 8. The fuel tank 58 and the vapour tank 9 can be arranged as one single unit. Naturally, a plurality of fuel dispensing nozzles 6, each having a valve 11, may be connected to the fuel dispensing means 50 and the vapour recovery system 7.

[0022] The valve 11 has two separate valves, one positioned inside the fuel path 52 and one positioned inside the vapour path 10. The two valves arranged in the valve 11 are automatically closed when the fuel dispensing nozzle 6 is put in a vertical direction, i.e. after filling-up is finished. The vapour recovery system 7 enables the built-in control to be performed when said valves 11 are closed i.e. at any time before or after filling-up.

[0023] When a malfunction has been detected and located in the vapour recovery system 7 according to one of the methods above, or another suitable method, information regarding the malfunction is stored in the control system 18 which is electrically connected to the flow rate measuring means 15. If a predetermined number of successive malfunctions, e.g. 10, are detected at the same location, the fuel dispensing nozzles 6 affected by the malfunction will be adjusted. Accordingly, if the successive malfunctions are located at one fuel dispensing nozzle 6 or its valve 11, thereby only affecting this one fuel dispensing nozzle 6, it will be adjusted while the other fuel dispensing nozzles 6 of the fuel dispensing unit 1 remain unadjusted. A malfunction considered to be located at the fuel dispensing nozzle 6 could actually depend on a clogging of the coaxial vapour recovery path within the fuel dispensing hose. However, if the successive malfunctions are located downstream of the second path 16 and thereby affects a plurality of fuel dispensing nozzles 6, they will all be adjusted. The fuel dispensing nozzles 6 may be adjusted by a rectified vapour recovery regulation or by being shut off. The vapour recovery system 7 may e.g. be regulated by means of the pump 12 or the valve 13, e.g. by the speed of the pump 12 being increased or the opening of the valve 13 being increased so that the vapour flow rate is increased. The predetermined number of successive malfunctions may be 5-15, preferably 8-12, and more preferable about 10.

[0024] In one preferred embodiment of the invention, each vapour recovery system 7 is connected to four different fuel dispensing nozzles 6, respectively (see Fig. 2). If a malfunction is detected concerning one of the fuel

dispensing nozzles 6 or its valve 11, i.e. upstream of the second path 16, a predetermined number of times, e.g. 3 times, the fuel dispensing nozzle 6 will be adjusted by means of a rectified vapour recovery regulation. The vapour recovery regulation is rectified by means of the valve 13, which is opened to a larger extent than the default value such that the suction from the pump 12 increases when the affected fuel dispensing nozzle 6 is used. Accordingly, the adjustment will only apply for this one fuel dispensing nozzle 6 affected by the detected malfunction. However, if the malfunction remains so that a predetermined number, e.g. 10, of successive malfunctions eventually are detected at this one fuel dispensing nozzle 6, it will be shut off. The same principle also applies for a malfunction detected downstream of the second path 16, thereby affecting all of the four fuel dispensing nozzles 6. However, in this case all of the fuel dispensing nozzles 6 will be adjusted or shut off.

[0025] If a malfunction is detected in the vapour recovery system 7 downstream of the second path 16, one possible cause may be liquid in the vapour recovery system 7. Since all of the fuel dispensing nozzles 6 connected to the vapour recovery system 7 will be affected by such an event, an indication of liquid in the vapour recovery system 7 could be that all of its connected fuel dispensing nozzles 6 starts to malfunction. When suspecting liquid in the vapour recovery system 6, the built-in control of the vapour recovery system 7 is activated. The valve 17 is opened, and the vapour pump 12 draws air from the open end of the second path 16 through the second path 16, the flow rate measuring means 15, the damper 14, the valve 13 and down to the vapour tank 9. This way, the vapour recovery system 7 will be emptied from possible liquids.

[0026] According to a second aspect of the invention a fuel dispensing unit is provided, which is adapted to execute the method according the above described features.

[0027] The invention has mainly been described above with reference to a few embodiments. However, as is readily appreciated by a person skilled in the art, other embodiments than the ones disclosed above are equally possible within the scope of the invention, as defined by the appended claims.

Claims

1. A method for controlling a fuel dispensing unit having at least two fuel dispensing nozzles which are connected to a vapour recovery system, comprising
   detecting a malfunction in the vapour recovery system of said fuel dispensing unit, and
   identifying the location of the malfunction,
   characterized in that
   after a predetermined number of successive malfunctions at the same location, at least one fuel dispensing nozzle in the fuel dispensing unit is adjusted.

2. A method according to claim 1, wherein the at least one fuel dispensing nozzle affected by the successive malfunctions is adjusted by a rectified vapour recovery regulation.

3. A method according to claim 1 or 2, wherein the at least one fuel dispensing nozzle affected by the successive malfunctions is adjusted by being shut off.

4. A method according to any one of claims 1-3, wherein one fuel dispensing nozzle is shut off if the successive malfunctions are located at this fuel dispensing nozzle.

5. A method according to any one of the preceding claims, wherein a plurality of fuel dispensing nozzles are shut off if the successive malfunctions are located downstream from the fuel dispensing nozzles.

6. A method according to any one of the preceding claims, wherein the predetermined number of successive malfunctions is 5-15, preferably 8-12, and more preferable about 10.

7. A fuel dispensing unit (1) for dispensing fuel to motor vehicles, comprising
   at least two fuel dispensing nozzles (6) for dispensing fuel to a motor vehicle tank (8),
   a vapour recovery system (7) connected to the fuel dispensing nozzles for recovering fuel vapour from the motor vehicle tank (8), and
   a control system (18) for detecting a malfunction and identifying its location in said vapour recovery system (7),
   characterized in that said control system (18) is adapted to execute the method according to claims 1-6.

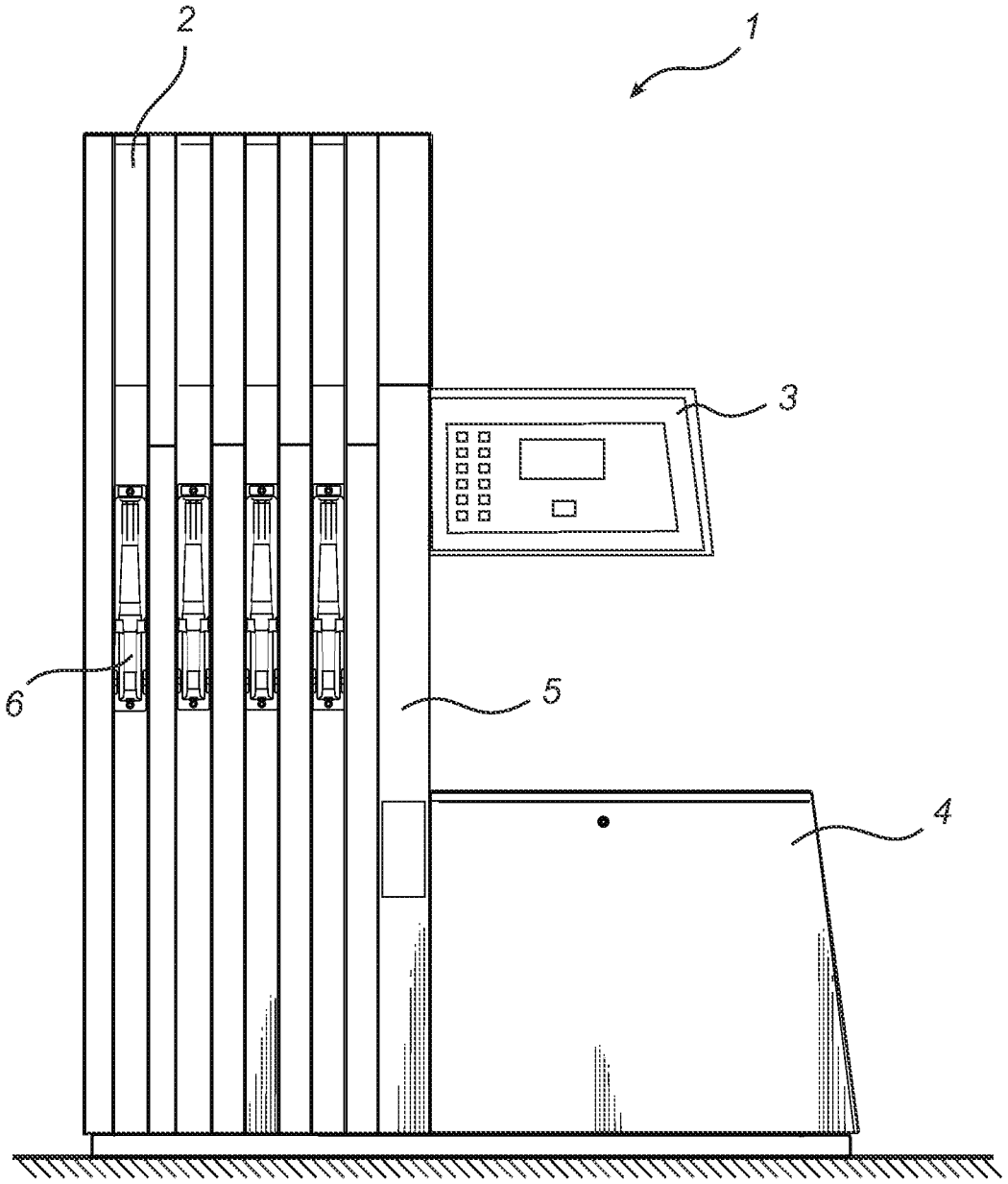

Fig. 1

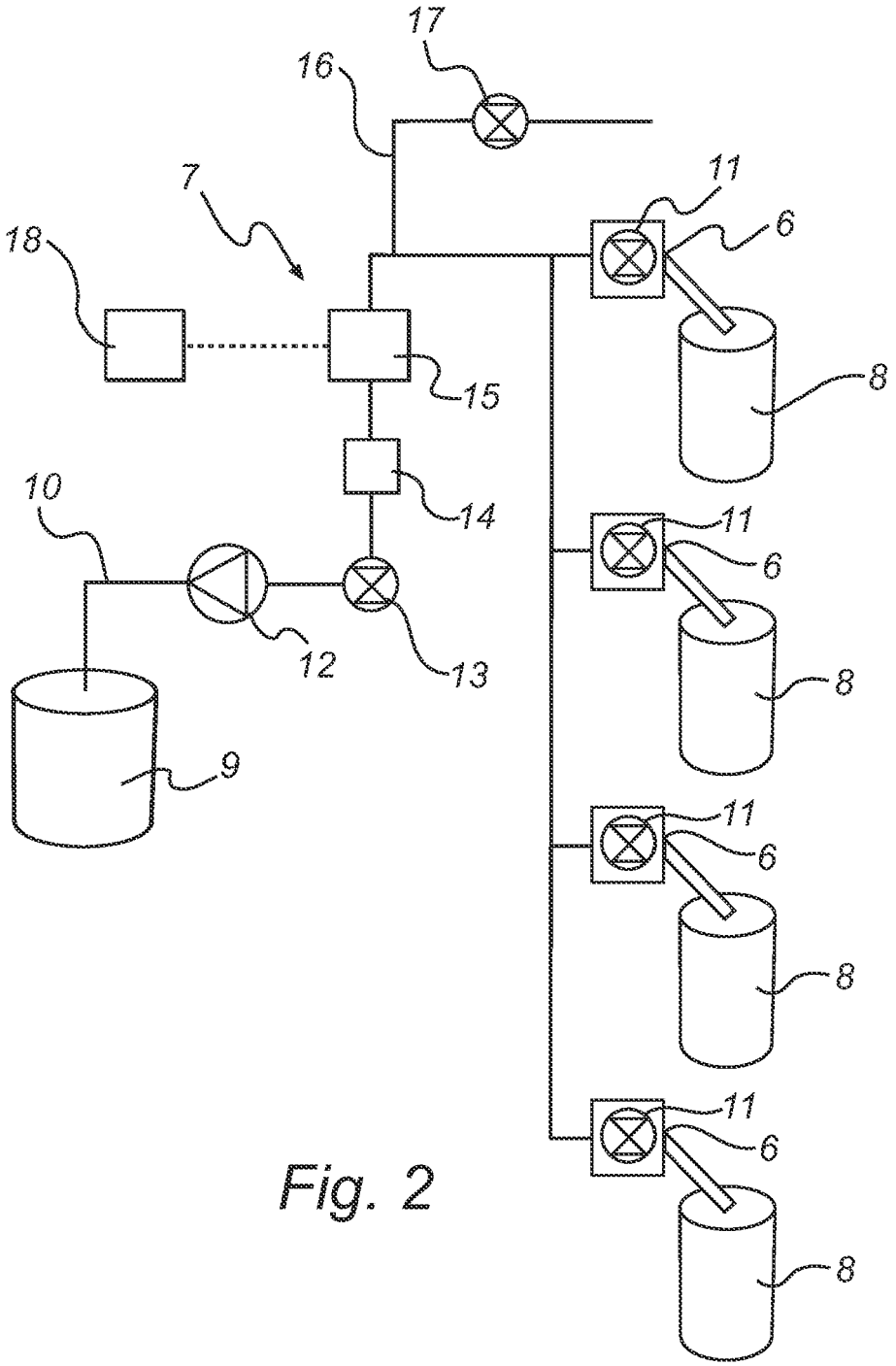

Fig. 2

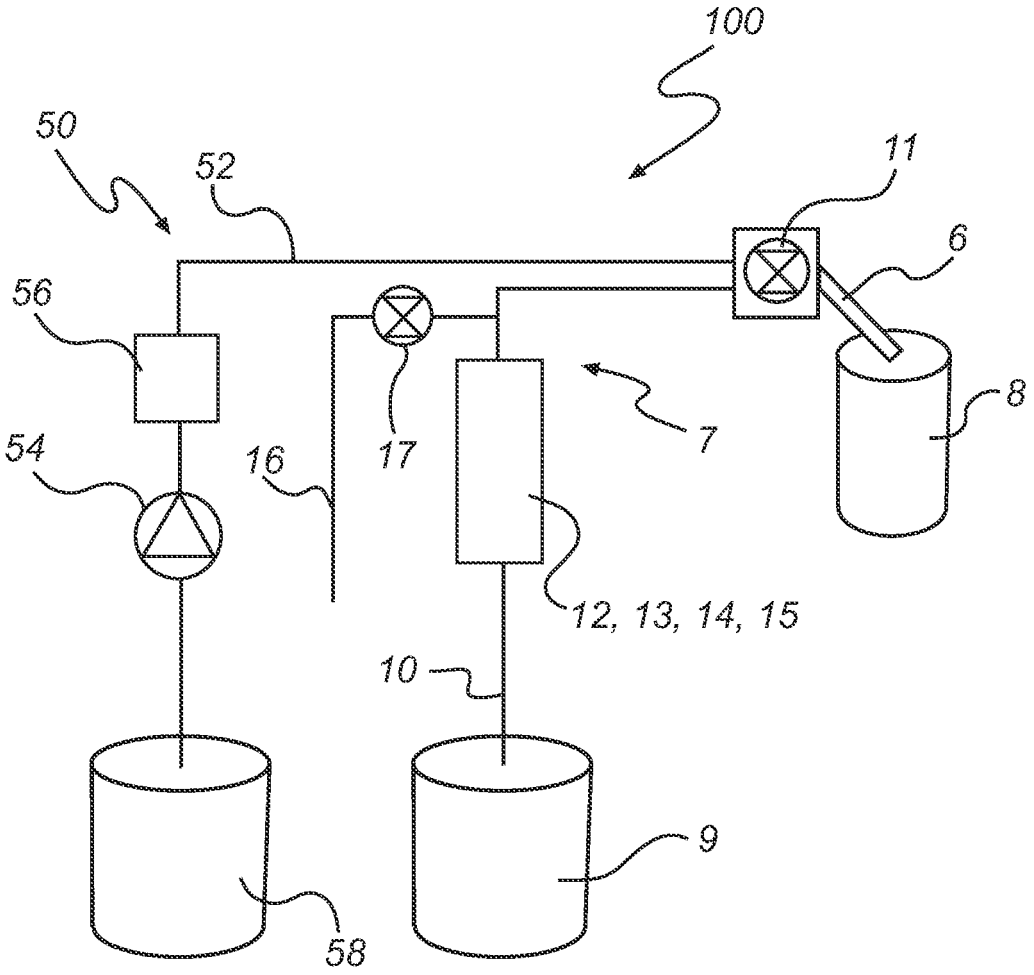

Fig. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 09 15 7988

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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TECHNICAL FIELDS SEARCHED (IPC)

B67D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	24 March 2010	Müller, Claus

CATEGORY OF CITED DOCUMENTS

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24-03-2010

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