(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 074 509 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
07.02.2001 Bulletin 2001/06

(51) Int Cl.[7]: **B67D 5/04**, B67D 5/34

(21) Application number: **00850132.2**

(22) Date of filing: **04.08.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **05.08.1999 SE 9902844**

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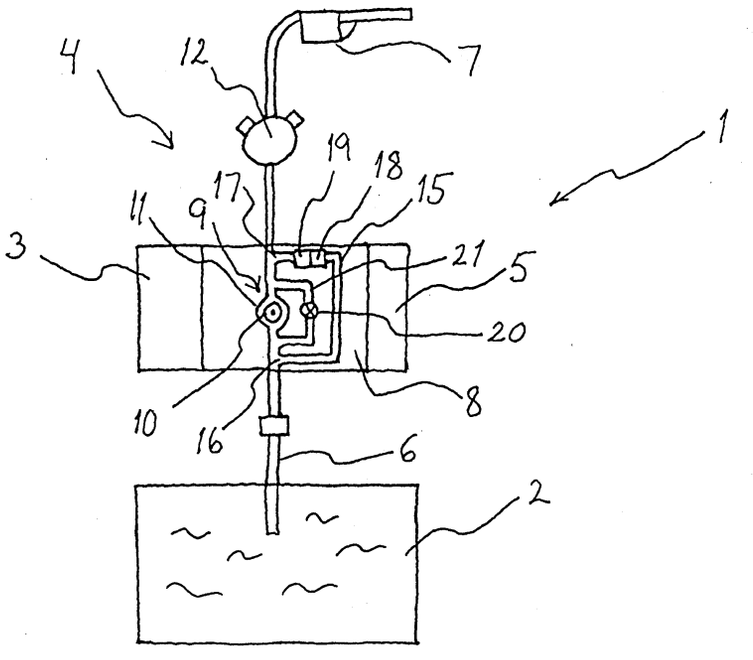
(54) Secondary valve

(57) A fuel pump unit for dispensing vehicle fuel from a fuel container (2). The fuel pump unit comprises a motor (3) which drives at least one pump assembly (4) and one gas recirculating means (5) or at least two pump assemblies (4) at the same time. Each pump assembly (4) has a primary fuel conduit (6) extending from the fuel container (2) to a delivery nozzle (7). A pump means (9) contained in a pump housing (8) is arranged in the primary fuel conduit (6). A metering means (12) is also arranged in connection with the primary fuel conduit (6) to meter the dispensed quantity of fuel. A safety valve (20) is arranged in the pump assembly (4) in connection with the primary fuel conduit (6) to reduce pressure spikes therein. In the pump assembly (4) there is also a secondary valve (18) which is arranged in a secondary fuel conduit (11) to open and close, independently of the safety valve (20), when the dispensing of fuel from the delivery nozzle (7) is finished and initiated, respectively.

Fig 1.



EP 1 074 509 A1

Description

Field of the Invention

[0001] The present invention relates to a fuel pump unit for dispensing fuel from a fuel container. A primary fuel conduit is connected to the fuel container. A motor, a pump means arranged in a pump housing and a metering means are arranged in connection with the primary fuel conduit. A delivery nozzle is arranged at the discharge end of the fuel conduit to be used when filling the tank of a vehicle. While filling a tank, the fuel is pumped through the primary fuel conduit and the metering means arranged therein, and out through the delivery nozzle. Moreover the invention relates to a method for performing circulation of fuel in a fuel pump unit according to appended claim 10.

Background Art

[0002] Fuel pump units of the type mentioned by way of introduction are today available at petrol stations to allow the tank of a vehicle to be filled. The manufacturers of such fuel pump units continuously strive to simplify the construction and minimise the costs of the fuel pump units.

[0003] With a view to checking and controlling the fuel flow rate in the fuel pump unit, various valves, such as non-return valves and solenoid valves are arranged in the primary fuel conduit of the fuel pump unit.

[0004] In the fuel pump unit the fuel flow rate is checked and pressure spikes are prevented, which arise owing to quick regulation of the delivery nozzle, in the primary fuel conduit by arranging a pressure-controlled safety valve in connection with the primary fuel conduit. The safety valve is arranged in a secondary fuel conduit also called bypass conduit and connected to the primary fuel conduit to enable circulation of fuel about the pump means as the pressure in the fuel conduit becomes too high when dispensing fuel. The bypass is normally connected to a chamber down stream of the fuel pump in which chamber fuel is gathered after the removal of air.

[0005] In EP-0 440 845-A1 a fuel pump unit is described. In this fuel pump unit one fuel pump serves two or more delivery nozzle assemblies. The fuel pump with a motor is dimensioned to be able to provide all the delivery nozzle assemblies with fuel during dispensing. If not all pump assemblies are used for dispensing fuel the pumping capacity of the fuel pump is altered to avoid large volumes of fuel being circulated through the fuel pump via the bypass and a safety valve. To use a fuel pump with an adjustable capacity makes the construction complex and costly.

[0006] In FR 2 527 195 another fuel pump unit is described. A by-pass with a pressure-controlled valve is arranged in conjunction with a fuel pump, which eliminates any build up of pressure when the dispensing of fuel is stopped. The fuel pump with motor is only in a conventional manner connected to one pump assembly.

[0007] One of the applicant's not yet published patent applications, claiming priority from the provisional US Patent Application (Serial No. 60/087,273), discloses a fuel pump unit with a plurality of pump assemblies directly connected to a common motor for simultaneous operation. The pump assemblies have a pump means, pump housing, primary fuel conduit and safety valve as stated above. Simultaneous operation means that fuel must be circulated in the pump assembly/pump assemblies that are not used for filling the tank of a vehicle. The fuel is circulated through the safety valve for the pressure in the primary fuel conduit not to be too high.

[0008] In the above application, an embodiment is illustrated, in which the safety valve is pressure-controlled and arranged in a short bypass conduit. The bypass conduit is formed in the pump housing and extends from the pump means to a point upstream of the pump means.

[0009] US Patent 4,223,706 discloses how a Vapour Recovery System (VPR system) in the fuel pump unit is connected to a pump assembly by means of the shaft of the pump means. As soon as the VPR system and its gas recirculating means are operated, this results in operation of the pump means as well.

[0010] A drawback of the technique described above is that the fuel which is not dispensed and instead is circulated is heated during circulation. If the temperature of the fuel rises too much, there is a risk of the fuel gasifying or being ignited. Especially in the warm months of the year, heating of the fuel causes problems. Moreover much power is required to circulate the fuel.

[0011] Since the number of fuel pump units manufactured each year is very large, any improvement of the unit is usually very important to the manufacturer in economic terms.

Summary of the Invention

[0012] One object of the present invention is to provide an improved fuel pump unit and an improved method of pumping fuel in a fuel pump unit, which obviate the above problems.

[0013] A further object of the present invention is to achieve a lower temperature in the fuel pump unit.

[0014] These and other objects which will appear from the following specification are achieved by a fuel pump unit and a method of the types stated by way of introduction being given the features as defined in the appended claims 1 and 10. Preferred embodiments of the invention are stated in the dependent claims.

[0015] The invention is based on, inter alia, a plurality of pump assemblies or one pump assembly and one gas recirculating means in a fuel pump unit being directly connected to a common motor. A secondary valve in each pump assembly is arranged in a secondary fuel conduit to be opened and closed, respectively, when the

dispensing of fuel from the delivery nozzle is finished and initiated, respectively. The secondary valve is controlled independently of the state of a safety valve, which is connected to the primary fuel conduit to eliminate pressure spikes therein.

[0016] This makes it possible to carry out the circulation through the pump at a small pressure drop. The small pressure drop through the secondary valve and the secondary fuel conduit causes a low consumption of power when circulating fuel, which results in a small increase in temperature in the pump housing and the circulated fuel. Moreover, the motor will have a low consumption of power owing to its direct connection. Further economy in space is achieved when only one motor is used in a fuel pump unit. In this way, a more reliable and cost-effective fuel pump unit has been achieved than before.

[0017] Preferably the first connection of the secondary conduit is connected at a distance from the pump housing. In the same manner, the second connection can advantageously be connected at a distance from the pump housing. This means in both cases that the length of the secondary conduit increases, which results in improved cooling of the pump means since a large volume of fuel passes through the pump means.

[0018] By advantageously connecting the second connection of the secondary fuel conduit upstream of the metering means, only the quantity of fuel during dispensing is metered.

[0019] By the secondary valve preferably having a smaller pressure drop in relation to the safety valve as fuel passes therethrough, a low power consumption is achieved when circulating the fuel.

[0020] In one embodiment, a control device is connected to the secondary valve to open and close it owing to a change in, for instance, temperature, flow rate, pressure or the position of the delivery nozzle in the fuel pump unit.

[0021] By arranging the secondary fuel conduit in a heat exchanging relationship with a pump housing or primary fuel conduit of a neighbouring second pump assembly, a cooling effect on the circulated fuel is advantageously achieved. The cooling effect is obtained as the cold fuel from the tank is dispensed from the second pump assembly.

Brief Description of the Drawings

[0022] The invention will now be described in more detail for the purpose of exemplification by way of preferred embodiments with reference to the accompanying drawing.

[0023] Fig. 1 is a schematic view of a fuel pump unit according to a first embodiment of the invention.

[0024] Fig. 2 is a schematic view of a fuel pump unit according to a second embodiment of the invention.

[0025] Fig. 3 is a schematic view of a portion of a fuel pump unit according to a third embodiment of the invention.

Description of Preferred Embodiments

[0026] The fuel pump unit 1 according to the first embodiment has, as shown in Fig. 1, a fuel container 2. It also has a motor 3 which simultaneously operates at least two pump assemblies 4, or one pump assembly 4 and one gas recirculating means 5. In each pump assembly 4, a primary fuel conduit 6 extends from the container 2 to at least one delivery nozzle 7. In the primary fuel conduit 6 there is a pump means 9 arranged in a pump housing 8, which also belong to the pump assembly 4. The pump means 9 is directly connected to the motor 3 via a shaft which is common to a plurality of pump assemblies 4 or one pump assembly 4 and one gas recirculating means 5. In this embodiment, pump means relates to a rotor 10 and the inner surface 11 of the pump housing 8 round the rotor 10.

[0027] Downstream of the pump means 9, at least one metering means 12 is arranged in connection with the primary fuel conduit 6 which can be branched, to meter the dispensed volume of fuel from the pump assembly 4. A so-called filter element 13 is arranged between the fuel container 2 and the pump means 9 to filter the fuel. A non-return valve (not shown) can also be arranged in the primary fuel conduit 6 downstream of the pump means to prevent the fuel from flowing back to the container 2.

[0028] A safety valve 20 is arranged in connection with the primary fuel conduit 6 to absorb great pressure surges caused in the pump assembly 4 in case of quick changes in the dispensing capacity. The safety valve 20 is pressure-controlled and arranged, for instance, in a separate bypass duct 21. By the safety valve 20 being pressure-controlled, it has very short reaction times and opens as soon as the pressure in the assembly 4 exceeds a predetermined level. The separate duct 21 can be connected to the primary fuel conduit 6 upstream and downstream of the pump means 9.

[0029] In simultaneous operation of a plurality of pump assemblies 4, fuel must be circulated in the assemblies 4 where a maximum dispensed volume of fuel is not desired. In the assemblies 4 where dispensing of fuel is carried out, the problem of circulated fuel being heated is not significant since new fuel from the container flows past the pump means 9 and has a cooling effect. In the pump assemblies 4 where no fuel is dispensed from the delivery nozzle 7, the fuel is circulated in a secondary fuel conduit 15 so as to minimise the heating of the fuel and enable efficient simultaneous operation of the pump assemblies 4.

[0030] The secondary fuel conduit 15 is connected to the primary fuel conduit 6 by means of a first connection 16 upstream of the pump means 9 and a second connection 17 downstream of the pump means 9. The secondary fuel conduit 15 can be arranged, for instance, in the pump housing 8.

[0031] A secondary valve 18 is arranged in the secondary fuel conduit 15 to allow or prevent the flow of fuel therein. The secondary valve 18 is controlled with the aid of intelligent control based on, for example, the flow in the fuel conduit 3 from the container and out through the delivery nozzle 7.

[0032] The secondary valve 18 has a small pressure drop in its open state. Owing to the small pressure drop in the secondary valve 18, a small amount of power is required to circulate the fuel through the secondary conduit 15, which results in a smaller amount of energy being supplied to the fuel that is being circulated. In its fully closed state, the secondary valve 18 does not allow fuel to pass into the secondary fuel conduit 15. Fuel is then dispensed through the delivery nozzle at a maximum capacity. In case of a pump assembly 4 idling, which means that fuel is merely circulated and not dispensed, the secondary valve 18 is essentially fully open. When fuel has begun to flow in the primary fuel conduit 6 downstream of the second connection 17, the secondary valve 18 closes.

[0033] According to the second embodiment as shown in Fig. 2, the first and/or the second connection 16, 17 are connected at a distance from the pump housing 8 to increase the length of the secondary fuel conduit 15. Preferably the first and the second connection 16, 17 are connected to the primary fuel conduit 6 at a maximum distance from the pump means 9. For example, the length of the conduit between the second connection 17 and the metering means 12 can be smaller than the length of the conduit between the second connection 17 and the pump means 9. The second connection 17 is advantageously arranged just before the metering means 12. The first connection 16 can be connected immediately downstream of the filter element 13 so as to prevent the fuel from being filtered once more. The increased length of the secondary conduit 15 implies that an increased amount of fuel is circulated, which results in a low average temperature of the circulated fuel.

[0034] In a third embodiment as shown in Fig. 3, the secondary conduit 15 or the pump housing 8 in a first pump assembly 4a is arranged in a heat exchanging relationship with the primary fuel conduit or the pump housing in a neighbouring second pump assembly 4b. This results in a cooling effect on the circulated fuel in the first pump assembly 4a from a fuel that is being dispensed through the second pump assembly 4b.

[0035] In connection with the secondary valve 18 there is arranged in the embodiments a control device 19 to control the secondary valve 18. By using transducers, which are connected to the primary fuel conduit 6 for detecting, for instance, the flow rate, the pressure change or the temperature thereof, the control device 19 can, for instance, by means of mechanical motions or electrical signals control the secondary valve 18.

[0036] The control device 19 is in the preferred embodiment connected to the secondary valve 18 to open and close the valve 18 in dependence on the flow rate in the primary fuel conduit 6 downstream of the second connection 17, the valve 18 opening in case of a decreased dispensing flow rate and closing in case of an increased dispensing flow rate. When the flow of fuel in the primary fuel conduit 6 ceases, the control device 19 transmits an opening signal to the secondary valve 18. This opening of the secondary valve 18 enables circulation of the fuel in the secondary fuel conduit 15 at a small pressure drop. When the flow of fuel in the primary fuel conduit 6 is begun, the control device 19 transmits a closing signal to the secondary fuel conduit 15 and, consequently, the supply of fuel to the secondary fuel conduit 15 decreases.

[0037] If a pilot-controlled solenoid is used as the secondary valve 18, the control device 19 may comprise a pilot magnet 22 arranged in the primary fuel conduit. The pilot magnet 22 is displaced because of the flow of fuel in the primary fuel conduit 6.

[0038] If a bimetal valve is used as the secondary valve 18, a change in temperature would change the position/ size of a component in the control device 19 and result in opening or closing of the valve 18.

[0039] It will be appreciated that a number of modifications of the above embodiment of the invention are possible within the scope of the invention as defined by the appended claims. For instance, also the secondary fuel conduit 15 with the secondary valve 18 can be used to control the dispensed flow from the primary fuel conduit 6 since the pump means 9 is usually operated at a constant speed. Then the opening and closing of the secondary valve 18 is controlled continuously so as to obtain the desired dispensed flow out of the delivery nozzle 7.

[0040] It would also be possible to control the control device 19 by the regulation of the delivery nozzle 7 by means of logical signals in a manner known to a person skilled in the art. Alternatively, the control device 19 could control the secondary valve 18 depending on whether the delivery nozzle 7 is used or not, i.e. whether the nozzle is raised from its resting position in the fuel pump unit 1 or not.

[0041] The safety valve 20 could be arranged in parallel with the secondary valve 18 in the secondary fuel conduit 15.Moreover, the safety valve 20 need not be a valve but can consist of a damper such as a chamber having a yieldable wall which can absorb pressure surges but at the same time not independently allow circulation of the fuel. Many types of valves which have a small pressure drop in their open state other than those described above could be used to utilise the present invention. It goes without saying that pump means 9 can be arranged in series after the motor 3 or on both sides of the motor 3, or be arranged in independent or common pump housings to achieve the desired effects according to the invention.

Claims

1. A fuel pump unit for dispensing vehicle fuel from a fuel container (2), comprising a motor (3) which drives at least one pump assembly (4) and one gas recirculating means (5) or at least two pump assemblies (4) at the same time, said pump assemblies (4) each comprising a primary fuel conduit (6) extending from the fuel container (2) to a delivery nozzle (7), a pump means (9) contained in a pump housing (8) and arranged in the primary fuel conduit (6), a metering means (12) arranged in connection with the primary fuel conduit (6) to meter the dispensed quantity of fuel, a secondary fuel conduit (11) connected to the primary fuel conduit (6) by means of a first connection (12) upstream of the pump means (9), and a second connection (13) downstream of the pump means (9), and a safety valve (20) which is arranged in connection with the primary fuel conduit (6) to reduce pressure spikes therein, a secondary valve (18) being arranged in the secondary fuel conduit (11) to open and close, respectively, independently of the safety valve (20) when the dispensing of fuel from the delivery nozzle (7) is finished and initiated, respectively.

2. A fuel pump unit as claimed in claim 1, **characterised** in that the first connection (16) is connected to the primary fuel conduit (6) at a distance from the pump housing (8).

3. A fuel pump unit as claimed in claim 1 or 2, **characterised** in that the second connection (17) is connected to the primary fuel conduit (6) at a distance from the pump housing (8).

4. A fuel pump unit as claimed in claim 1, 2 or 3 **characterised** in that the metering means (12) is connected to the primary fuel conduit (6) downstream of the pump housing (8) and the second connection (17) of the secondary fuel conduit (15) is connected to the primary fuel conduit (6) upstream of the metering means (12).

5. A fuel pump unit as claimed in any one of the preceding claims, **characterised** in that the secondary valve (18) has a smaller pressure drop than the safety valve (20) as fuel passes therethrough.

6. A fuel pump unit as claimed in any one of the preceding claims, **characterised** in that a control device (19) is connected to the secondary valve (18) and is adapted to open or close the secondary valve (18) owing to a change in, for instance, temperature, flow rate, pressure or the position of the delivery nozzle (7) in the fuel pump unit (1).

7. A fuel pump unit as claimed in claim 6, **characterised** in that the control device (19) has a pilot magnet (22) which is arranged in the primary fuel conduit (6) to be displaced depending on the quantity of fuel passing therethrough, and that the open and closed position of the secondary valve (18) are adapted to be actuated by the displacement of the pilot magnet (22).

8. A fuel pump unit as claimed in claim 6, **characterised** in that the secondary valve (18) is a solenoid valve, and that the control device (19) is electric and has intelligence for opening or closing the secondary valve (18).

9. A fuel pump unit as claimed in any one of the preceding claims, **characterised** in that the secondary fuel conduit (15) is arranged in a heat exchanging relationship with the pump housing (8) or primary fuel conduit (6) of a neighbouring pump assembly.

10. A method of performing circulation of fuel in a fuel pump unit, **characterised** by the steps of

    finishing the dispensing of fuel,
    transmitting an opening signal from a control device (19) to a secondary valve (18) arranged in a secondary fuel conduit (15),
    circulating the fuel through the secondary fuel conduit (15), and
    beginning the dispensing of fuel through the primary fuel conduit (6) and simultaneously transmitting a closing signal from the control device (19) to the secondary valve (18) and, thus, reducing the supply of fuel to the secondary fuel conduit (15).

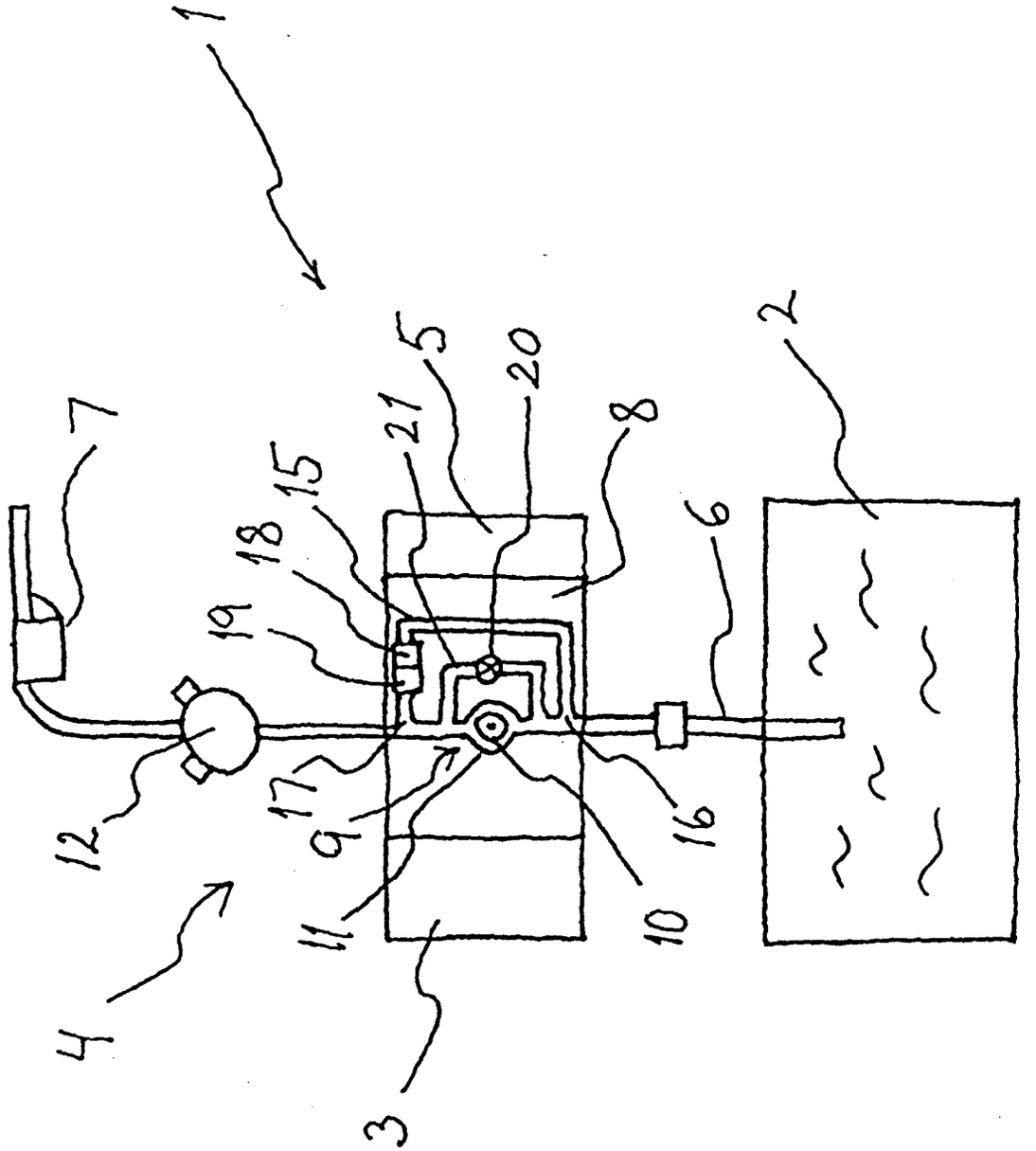


Fig 1.

Fig 2

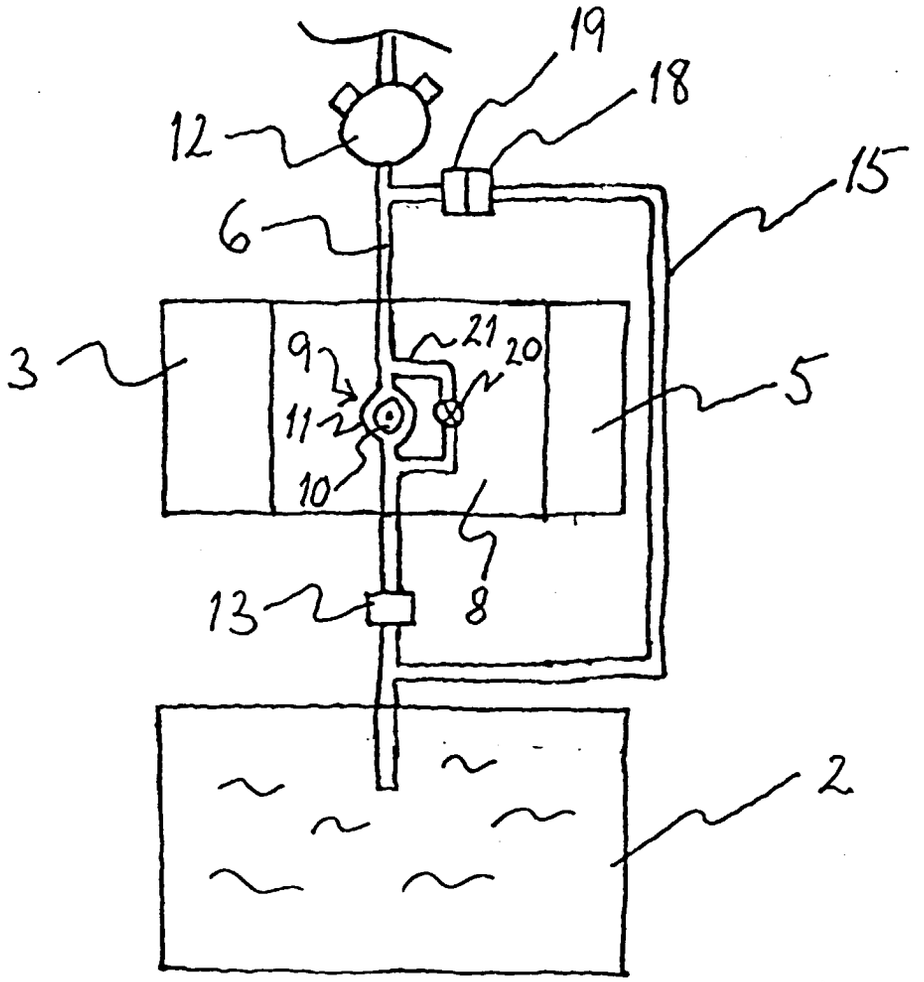
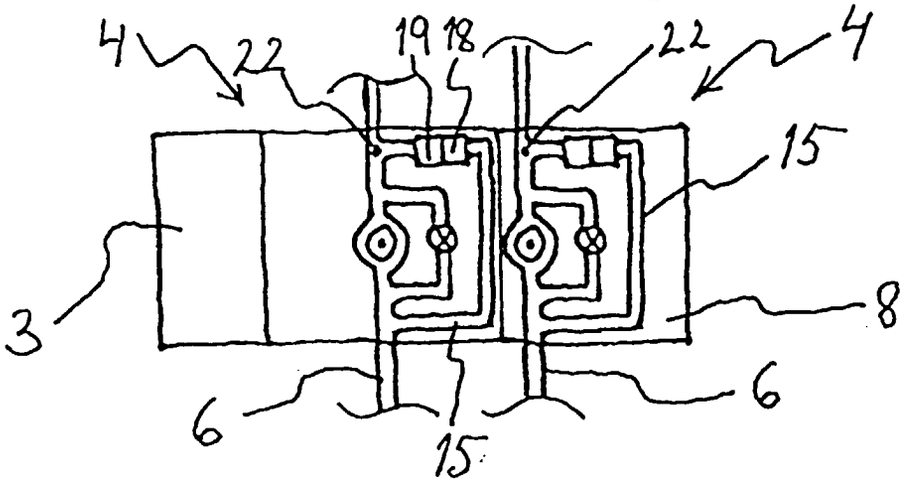


Fig 3



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EUROPEAN SEARCH REPORT

Application Number
EP 00 85 0132

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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A	* column 5, line 3 - line 11; figure 1 *	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	23 October 2000	Martínez Navarro, A.

CATEGORY OF CITED DOCUMENTS

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