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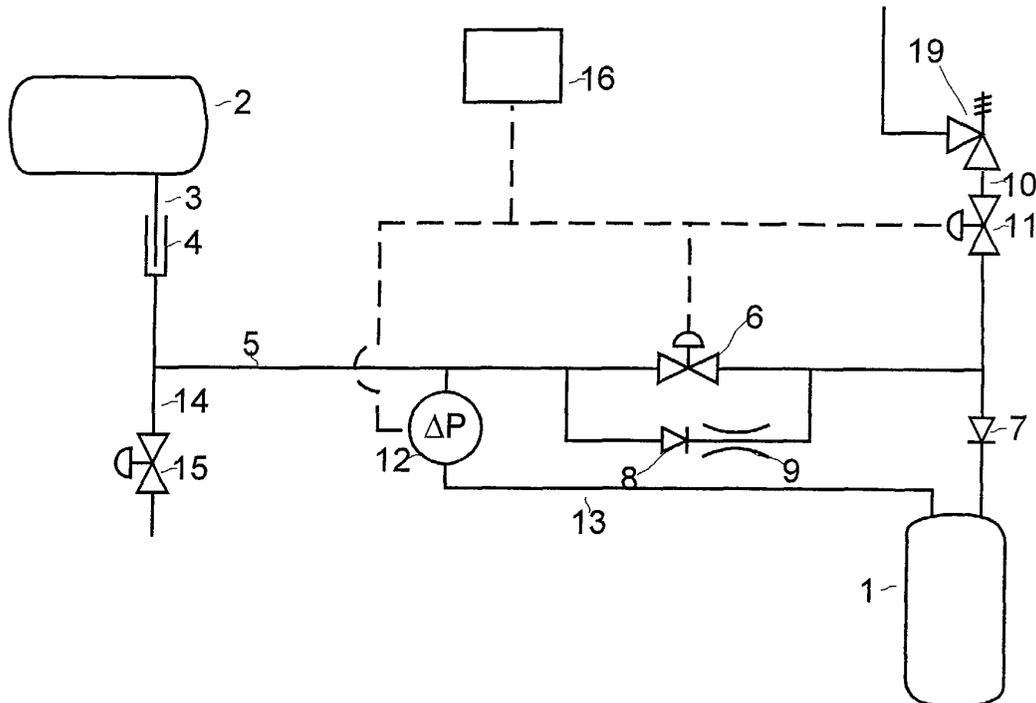
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(54) **Gas delivery system**

(57) The invention is related to a system and a method to deliver a fluid from a delivery tank (2) to a storage tank (1) through a delivery line (5) connected to said delivery tank (2) and to said storage tank (1). The pressure

difference between the pressure in said storage tank (1) and the pressure in said delivery line (5) upstream said delivery valve (6) is detected and the fluid is only delivered to the storage tank (1) if the pressure in the delivery line (5) exceeds the pressure in the storage tank (1).

**Fig. 1**



## Description

**[0001]** The present invention is related to a system to deliver a fluid from a delivery tank to a storage tank, with a delivery line connectable to said delivery tank and to said storage tank. Further the invention is directed to a method to deliver a fluid from a delivery tank to a storage tank through a delivery line connected to said delivery tank and to said storage tank.

**[0002]** Carbon dioxide is used for many different applications, some of them being more sensitive to impurities and quality than the others. For instance, carbon dioxide used in the food industry has a higher quality demand than in welding or industrial blanketing applications.

**[0003]** Carbon dioxide is normally obtained on a large scale basis when recovering waste carbon dioxide from an industrial production facility or from natural sources in the ground. The design of the quality in these plants is normally as good to be able to cover all applications. However, impurities may be introduced during the distribution of the carbon dioxide, caused by back flow from customer storage tanks into the delivery tanks of the distribution vehicles.

**[0004]** Therefore, it has up to now not been possible to first supply a customer using lower grade carbon dioxide and afterwards to supply a customer needing high grade carbon dioxide. In this case there has always been the risk that during the first delivery the remaining carbon dioxide in the delivery tank of the truck is contaminated. So it has been necessary to use separate delivery trucks for the supply of carbon dioxide of different quality.

**[0005]** It is an object of the invention to provide a method and a corresponding system to prevent back flow of a fluid during the delivery of that fluid from a delivery tank to a storage tank.

**[0006]** This object has been fulfilled by a system to deliver a fluid from a delivery tank to a storage tank, with a delivery line connectable to said delivery tank and to said storage tank, which, according to the invention, comprises a delivery valve in said delivery line, means to detect the pressure difference between the pressure at a point upstream said delivery valve and a point downstream said delivery valve, whereby said delivery valve is operable to open a flow path in said delivery line depending on the detected pressure difference.

**[0007]** According to a second aspect of the present invention, there is provided a method to deliver a fluid from a delivery tank to a storage tank through a delivery line connected to said delivery tank and to said storage tank, whereby the pressure difference between the pressure at a point upstream said delivery valve and a point downstream said delivery valve is detected and the fluid is only delivered to the storage tank if the pressure at said point upstream said delivery valve exceeds the pressure at said point downstream said delivery valve.

**[0008]** As used herein the term "fluid" means any kind of gaseous or liquid material and mixtures thereof. The expression "fluid" includes gases, as for example oxygen, nitrogen and carbon dioxide, further liquids, in particular liquified gases, and gas-liquid-mixtures, especially a two-phase flow of a substance in its gaseous and its liquid state.

**[0009]** As used herein the terms "upstream" and "downstream" are based on the regular flow of fluid from said delivery tank to said storage tank.

**[0010]** The invention discloses a system and a method to be able to use a higher grade fluid to distribute into a lower grade application where impurities may be added to the fluid. The risk that back flow from the storage tank may cause impurities to be added into the delivery tank is avoided.

**[0011]** According to the invention the delivery valve is only opened if the pressure in the delivery line upstream the delivery valve exceeds the pressure downstream the delivery valve. Such a pressure gradient assures that there is no flow of fluid, that may be contaminated, back to the delivery tank. If the pressure in the storage tank is higher than the pressure in the delivery tank, said delivery valve will remain closed.

**[0012]** For safety purposes it has been found advantageous to provide a delivery check valve located in said delivery line downstream said delivery valve. This redundant check valve gives an additional protection against back flow of contaminated fluid in case of a failure of the delivery valve. The delivery check valve has preferably a low opening pressure of less than 1 bar, more preferred less than 0,1 bar and most preferred close to 0 bar.

**[0013]** The term "opening pressure" of a check valve means the minimum pressure difference between upstream and downstream the check valve which causes the check valve to open. That means in this particular case that as soon as the pressure in the delivery line downstream the delivery valve reaches the pressure in the storage tank, the fluid will start flowing through the delivery check valve into said storage tank.

**[0014]** After completion of the delivery some fluid may remain in the delivery line upstream the delivery valve. If cold liquified gases, as for example liquid carbon dioxide, remain in the delivery line, the liquified gases will evaporate. Therefore, it is preferred to have a bypass conduit between the inlet and the outlet of the delivery valve, said bypass conduit comprising a check valve. The bypass conduit allows fluid to flow in the direction to the storage tank to avoid any undesired pressure rise in the delivery line upstream the delivery valve. It thus works as a safety valve. On the other hand, the bypass check valve prevents any flow of fluid in the wrong direction.

**[0015]** If the bypass is used, its restriction should be small enough to allow for pressure buildup upstream the delivery valve. Namely, if the bypass restriction is too big, there will be an important flow through the bypass

and pressure conditions, which cause the delivery valve to open, might never occur.

**[0016]** It has been found that another way of overcoming this problem is to install a safety relief valve on the delivery line upstream the delivery valve. The safety relief valve allows pressure upstream said delivery valve to build above the pressure in the storage tank when said delivery line is connected to said storage tank and to said delivery tank. The safety relief valve is preferably vented to the atmosphere. Of course it is also possible to combine the bypass solution with said safety relief valve.

**[0017]** Preferably the system further comprises a venting line with a venting valve connected to said delivery line downstream said delivery valve, said venting valve operable depending on the detected pressure difference. The venting line with the venting valve eliminates the risk of back-flow that may arise if the delivery valve, the delivery check valve and / or the check valve in the bypass conduit do not function properly. In such a case the back-flow of contaminated fluid to the delivery tank is prevented by venting the fluid through said venting valve and venting line.

**[0018]** It is further advantageous to provide a relief valve in said venting line and in particular it is preferred to locate said relief valve in said venting line downstream said venting valve.

**[0019]** In a preferred embodiment said venting valve and / or said delivery valve are solenoid valves. In this case the status of these valves can be easily controlled depending on the detected pressure difference.

**[0020]** It has been found advantageous to have switch means that allow to actuate the delivery valve and / or the venting valve and / or the means to detect the pressure difference. That switch can be used to open and close these valves or to switch off the pressure detecting means. The flow path through the delivery line is only open when said switch is switched on and when the difference between the pressure upstream and the pressure downstream the delivery valve is positive. It thus takes two conditions to be fulfilled at the same time to open the flow path and to make a delivery of fluid possible. Thus the risk that any contaminated fluid flows the wrong way into the delivery tank is further reduced. The same applies if the means to detect the pressure difference are switched off. In this case the output of said means to detect the pressure difference does not cause said delivery valve to open.

**[0021]** The means to detect the pressure difference preferably comprise a differential pressure transmitter which is in fluid communication, for example via sensor tubes, with both a point upstream and a point downstream said delivery valve, for example with the delivery line upstream the delivery valve and the storage tank.

**[0022]** It is sufficient if the output of the differential pressure transmitter, or in general the output of the means to detect the pressure difference, switches between two levels depending on which of the detected

pressures is the higher one. However, it is advantageous if the output of the means to detect the pressure difference is proportional to the pressure difference itself. The higher the output signal, the higher is the pressure difference. Thus, it is for example possible to actuate the delivery valve only if a predetermined pressure difference is exceeded.

**[0023]** Most preferably there is provided pressure detecting means that detect the absolute pressure at a point downstream said delivery valve, for example in said storage tank, and the absolute pressure in said delivery line upstream said delivery valve. In this case it is not only possible to determine the pressure difference but also the absolute values. The risk of back flow of fluid to the delivery tank is further decreased, since it is possible to open the delivery valve only if both the pressure difference and the absolute pressure in the delivery line exceed predetermined values.

**[0024]** The pressure detecting means may be a single instrument which is in fluid communication with the storage tank and the delivery line or may comprise two separate pressure detectors. In the later case the output signals of these pressure detectors are then further processed to determine which of the detected pressures is the higher one or to obtain the absolute value of the pressure difference.

**[0025]** In another embodiment the invention further comprises an additional venting line with an additional venting valve connected to said delivery line upstream said delivery valve. This feature allows to vent the delivery line upstream the delivery valve to assure that no contaminated fluid has accumulated.

**[0026]** The invention is of particular importance in the supply of liquid or liquified gases to storage tanks, especially of liquid carbon dioxide. As stated earlier carbon dioxide is used in different qualities, for example high grade carbon dioxide in the food and beverage industry and low grade carbon dioxide in inerting processes or in heat treatment applications. The invention allows to first deliver liquid gas to a customer with a lower grade carbon dioxide application and then supply a second customer with high grade carbon dioxide from the same delivery tank. In the prior art there was always the risk that back flow from the tank of the first customer may cause impurities to be added into the delivery tank. A preferred application of the invention is the supply of liquid carbon dioxide to dry-cleaning installations.

**[0027]** In applications where the fluid is contaminated and the contaminated fluid is recovered after the process, there are normally separate tanks for the storage of fresh fluid and for the storage of recovered fluid to avoid contaminated fluid flowing back to the delivery tank during deliveries. An advantage of the invention is that it is possible to have only one tank to store fresh and recovered fluid instead of a storage tank and a separate recovery tank. For example a dry-cleaning facility is normally provided with a storage tank for fresh carbon dioxide and a recovery tank for recovered carbon diox-

ide from the dry-cleaning process. The invention allows to store fresh and recovered carbon dioxide in the same tank.

**[0028]** The invention will now be illustrated in greater detail with reference to the appended drawings. It is obvious for the man skilled in the art that the invention may be modified in many ways and that the invention is not limited to the specific embodiments described in the following examples.

Figure 1 shows a system according to the invention to supply liquid carbon dioxide to a dry-cleaning facility.

Figure 2 shows an alternative embodiment of the inventive system.

**[0029]** In dry-cleaning a mixture of liquid carbon dioxide and additives as detergents, surfactants or fragrances is used to clean for example workpieces, textiles or garments. The carbon dioxide solvent and the additives can be premixed and then shipped to the dry-cleaning facility or the dry-cleaning mixture can be prepared on site. The latter is especially advantageous when the carbon dioxide is reused after cleaning.

**[0030]** During the cleaning process both additives and of course dirt are contaminating the carbon dioxide which is then cleaned by filters and distillation to be used again. As the storage tank of the dry-cleaning facility is permanently in connection by pipes with the dry-cleaning machine, normally an industrial grade carbon dioxide is sufficient for this application.

**[0031]** Figure 1 shows a system to be able to use a higher grade carbon dioxide, for example food grade carbon dioxide, to distribute into the storage tank 1 of a dry-cleaning facility where impurities may be added to the carbon dioxide avoiding risk that back flow from the storage tank 1 may cause impurities to be added into the delivery tank 2 of the distribution vehicle.

**[0032]** The delivery hose 3 of the delivery tank 2 is connected to the delivery line 5 of the dry-cleaning facility. The delivery hose 3 and the delivery line 5 have spring loaded devices 4 at their respective ends which are closed when not connected and open when connected. Of course, instead of spring loaded devices 4 any other suitable types of connection can be used. The delivery line 5 comprises a delivery valve 6 which is operable to open or close the flow path from the delivery tank 2 to the storage tank 1.

**[0033]** Downstream said delivery valve 6 a check valve 7 is provided which allows carbon dioxide to flow only in the direction to the storage tank 1. A bypass conduit parallel to the delivery valve 6 comprises another check valve 8 and a throttle 9. Downstream the delivery valve 6 a venting line 10 with a venting valve 11 is branching. Downstream venting valve 11 a relief valve 19 is provided. In this particular case of carbon dioxide delivery the opening pressure of relief valve 19 is set to about 5 to 6 bar, that is to about triple point pressure or

slightly above triple point pressure. Preferably relief valve 19 is provided downstream venting valve 11 to avoid trapped liquid. Instead of using relief valve 19 venting valve 11 may have an opening pressure greater than zero, thus working as a combined venting and relief valve.

**[0034]** Another venting tube 14 with a venting valve 15 is connected to the delivery line 5 upstream the delivery valve 6. Check valve 8 and relief valve 19 are spring loaded with an opening pressure of about the triple point pressure of carbon dioxide. The opening pressure of delivery check valve 7 is close to zero.

**[0035]** A differential pressure transmitter 12 is connected to the delivery line 5 upstream the delivery valve 6. The differential pressure transmitter 12 further reads the pressure in the storage tank 1 via a sensor tube 13. The ports of the pressure transmitter 12, which are connected to the delivery line 5 and the storage tank 1, respectively, do not allow a fluid flow between each other. A contamination of the delivery tank 2 via a gas flow through the pressure transmitter 12 is thus prevented. The operation of delivery valve 6 as well as venting valve 11 depends on the output of the differential pressure transmitter 12 and is controlled by means receiving the output signal from the differential pressure transmitter 12. Such means that receive the output signal from the differential pressure transmitter 12 and that control valves 6 and 11 are preferably a control unit comprising a programmable logical controller and an electrical relay.

**[0036]** Delivery valve 6 and venting valve 11 are also in communication with switch means 16 which control the function of delivery valve 6 and venting valve 11. Delivery valve 6 is a normally closed valve which will only open when said switch means 16 are switched to the ON status and the output of the pressure transmitter 12 shows that the correct pressure conditions are fulfilled. On the other hand, venting valve 11 is a normally open valve which will only close when both above mentioned conditions are fulfilled.

**[0037]** Figure 2 shows an alternative embodiment of the inventive system. In both figures 1 and 2 same reference numbers refer to same details. The system according to figure 2 differs from the system of figure 1 in the feature that instead of bypass 8, 9 an additional safety line 17 with a safety relief valve 18 is provided. The set pressure of safety relief valve 18 is in this case set between 20 and 40 bar, preferably about 30 bars. But a man skilled in the art will adapt the set pressure to the situation, for example depending on the delivery pressure and the storage pressure.

**[0038]** The function of the inventive systems will now be described in detail.

**[0039]** Normally, that is when delivery hose 3 is not connected to delivery line 5, the pressure in delivery line 5 upstream delivery valve 6 is less than the pressure in the storage tank 1, if venting line 15 has been used to vent delivery line 5 upstream delivery valve 6. As there

is no carbon dioxide delivery the switch means 16 are in the OFF position, causing delivery valve 6 and venting valve 11 to be in their normal status, that is causing delivery valve 6 to remain closed and venting valve 11 to remain open.

**[0040]** Spring load device 4 at the end of the delivery line 5 and venting valve 15 are closed. In the embodiment according to figure 1 any liquid carbon dioxide left in the delivery line 5 between spring load device 4 and delivery valve 6 is evaporating and flows through check valve 8 and throttle 9. The gas will then go through venting valve 11 and venting line 10 to the atmosphere since delivery check valve 7 will close the flow path to the storage tank 1 because the pressure inside the storage tank 1 is above atmospheric pressure, normally between 15 and 20 bar, for example 17 bar.

**[0041]** In the embodiment according to figure 2 any liquid carbon dioxide left in the delivery line 5 between spring load device 4 and delivery valve 6 will evaporate and cause a pressure increase in that part of delivery line 5 upstream delivery valve 6. As soon as pressure exceeds the set pressure of the safety relief valve 18, safety valve 18 will open and gaseous carbon dioxide will flow into venting line 10 and further on to the atmosphere.

**[0042]** It is known that when liquid carbon dioxide is expanded into a volume with a pressure below the triple point of carbon dioxide, there will be a formation of carbon dioxide dry ice and snow. These particles may cause plugs in tubes and valves. In the embodiment according to figure 1 the opening pressure of bypass check valve 8 is set to a value between 5 and 6 bar, preferably about 5,2 bar. The set pressure of safety valve 18 in the embodiment of figure 2 is set to about 30 bars. Therefore, in both cases it is assured that the pressure in delivery line 5 upstream delivery valve 6 after the pressurization is above the triple point of carbon dioxide. Thus when liquid carbon dioxide is delivered from the delivery tank 2 into delivery line 5, formation of carbon dioxide dry ice and snow is prevented.

**[0043]** Before connecting delivery hose 3 to the spring load connection device 4 venting valve 15 is opened for a few seconds to make sure that no contaminated carbon dioxide has accumulated in this part of the delivery line 5. Then delivery hose 3 is connected to delivery line 5 and delivery line 5 upstream delivery valve 6 is pressurized with gaseous carbon dioxide from the delivery tank 2.

**[0044]** The method to first deliver only gaseous carbon dioxide has the advantage that delivery line 5 downstream delivery valve 6 will be pressurized by that gas as soon as delivery valve 6 has been opened, even if for any reason bypass 8 is blocked or if bypass 8 does not exist at all. In this way, ice formation is avoided downstream delivery valve 6.

**[0045]** Then switch means 16 are flipped in the ON position. In regular operation the pressure in the delivery line 5 increases to a value which exceeds the pressure

inside storage tank 1. Due to these pressure conditions differential pressure transmitter 12 provides a signal which causes venting valve 11 to switch to the closed state.

5 **[0046]** It is advantageous to wait for 1 to 5 seconds, preferably about 2 seconds, before venting valve 11 is closed to make sure that the positive pressure difference between the pressure in the delivery line 5 and the storage tank 1 was not only an accidental pressure peak.

10 **[0047]** After a certain time delay delivery valve 6 is opened. It has been found that this time delay should be at least 5 seconds, preferably more than 10 seconds. Closing venting valve 11 five seconds before opening delivery valve 6 avoids losses of carbon dioxide through venting valve 11 once the delivery starts.

15 **[0048]** When the bypass solution according to figure 1 is used, the time delay further assures pressurization of the delivery line 5 downstream delivery valve 6 by carbon dioxide gas, prior to liquid carbon dioxide entering delivery line 5 downstream delivery valve 6. Said carbon dioxide gas upstream delivery valve 6, which flows via the bypass conduit 8, 9 and which is used to increase the pressure downstream delivery valve 6, comes either

20 from evaporating liquid carbon dioxide already present in delivery line 5 upstream delivery valve 6 or gaseous carbon dioxide from the delivery tank 2 is used to pressurize delivery line 5.

25 **[0049]** In figure 1 as well as in figure 2 check valve 7, a pressurized storage tank 1 and closed venting valve 11 make sure that pressure is built up in delivery line 5 downstream delivery valve 6. Relief valve 19 has an opening pressure of about the triple point pressure of carbon dioxide. Between two subsequent deliveries, when delivery valve 6 is closed and venting valve 11 is open, pressure in delivery line 5 downstream delivery valve 6 does not decrease below the opening pressure of relief valve 19. Therefore, it is always guaranteed that there will be no formation of ice when liquid carbon dioxide enters delivery line 5 downstream delivery valve 6.

30 **[0050]** After opening delivery valve 6 the flow path from the delivery tank 2, which contains high quality liquid carbon dioxide, to the storage tank 1, containing carbon dioxide which might be contaminated, is open. Due to the positive pressure drop liquid carbon dioxide is delivered to the storage tank 1.

35 **[0051]** There may occur different situations which might cause a back flow of carbon dioxide to the delivery tank 2 thus contaminating tank 2.

40 **[0052]** At the initial moment of connecting delivery hose 3 to delivery line 5 gas left in the delivery line 5 might flow to the delivery tank 2, if the pressure in the delivery line 5 is higher than in the delivery tank 2.

45 **[0053]** According to figure 1 such a back flow is prevented by bypass check valve 8 which is provided parallel to the delivery valve 6. Any gas remaining in the delivery line 5 will flow via bypass 8, 9 into the storage tank 1. So under normal conditions in the delivery line

5 pressure will always be less than the pressure in the delivery tank 2.

**[0054]** If check valve 8 fails or as it is the case in the embodiment according to figure 2 if bypass 8 does not exist at all, remaining gas in delivery line 5 cannot flow to the storage tank 1 and the pressure in the delivery line 5 might increase to a value which at the moment of connection causes gas to flow back to the delivery tank 2. To avoid such a situation venting valve 15 is opened before the delivery hose 3 is connected to the delivery line 5. By venting of the delivery line 5 prior to connecting the delivery hose 3, there is no excess pressure in delivery line 5.

**[0055]** During delivery, i.e. when delivery valve 6 is already open, the pressure in the delivery tank 2 and thus the pressure in delivery line 5 might break down. The differential pressure monitoring means 12 will note that break down. If the correct pressure conditions are not fulfilled, the flow path between the delivery tank 2 and the storage tank 1 will automatically be closed and the delivery will be stopped. It is further advantageous to provide in such a situation signal means that inform, e. g. by optical or acoustical signals, that a delivery failure has occurred.

**[0056]** When pressure conditions are fulfilled again, delivery of carbon dioxide will be restarted automatically. Venting valve 11 will be closed and some time later delivery valve 6 will be opened. The difference between the initial start situation and the restart situation is that before the start situation gaseous carbon dioxide can be supplied into delivery line 5. But at restart liquid carbon dioxide is already present in delivery line 5 upstream delivery valve 6.

**[0057]** For that reason relief valve 19 is provided in venting line 10. The set pressure of relief valve 19 is about the triple point pressure of carbon dioxide. Thus the pressure in delivery line 5 downstream delivery valve 6 will never decrease below the triple point pressure of carbon dioxide. When opening delivery valve 6 liquid carbon dioxide enters delivery line 5 with a pressure above triple point pressure of carbon dioxide and therefore there is no risk of ice formation.

**[0058]** The invention is not only useful in the delivery of carbon dioxide to a dry-cleaning facility as described above. There are also big advantages in other processes where gas is used and recovered. Further the invention is not limited to carbon dioxide, but also advantageous in supplying other fluids, in particular liquified gases, e.g. liquid nitrogen, to storage tanks. It is obvious for a man skilled in the art that in such cases the opening and set pressures of the check and relief valves used in the inventive system are adapted to the changed conditions.

## Claims

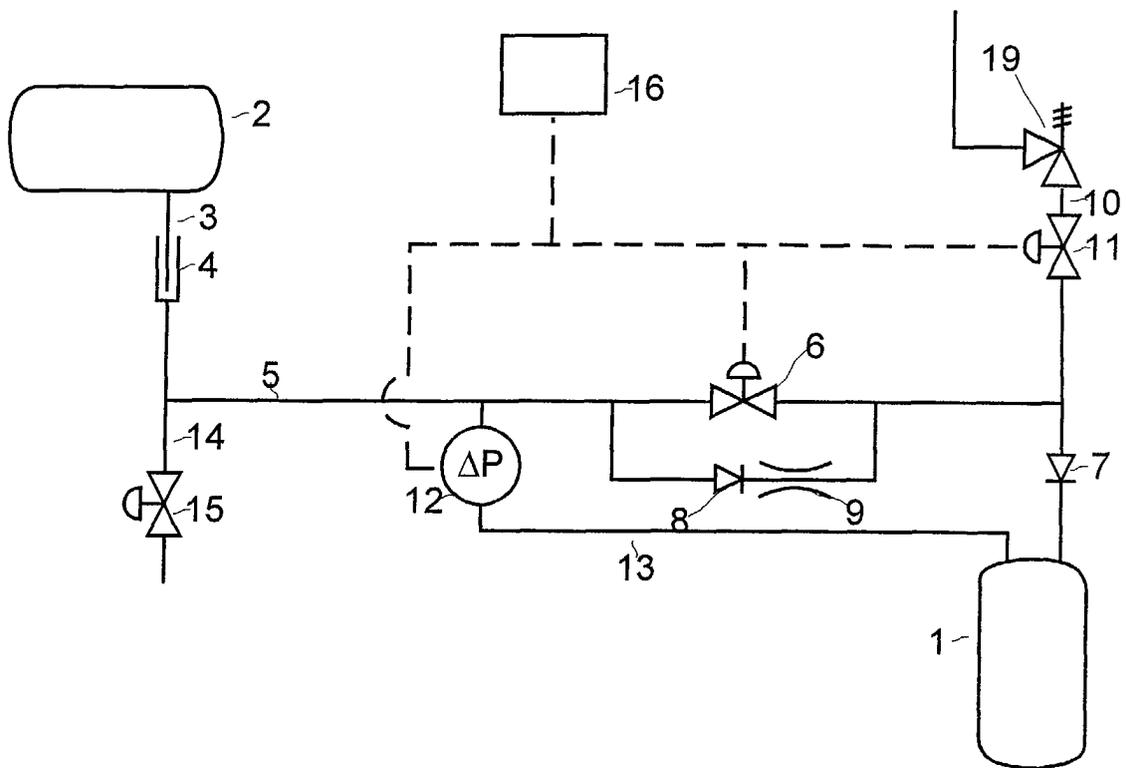
1. System to deliver a fluid from a delivery tank to a

storage tank, with a delivery line connectable to said delivery tank and to said storage tank, **characterized by** a delivery valve (6) in said delivery line (5) and means (12) to detect the pressure difference between the pressure at a point upstream said delivery valve (6) and a point downstream said delivery valve (6), wherein said delivery valve (6) is operable to open a flow path in said delivery line (5) depending on said detected pressure difference.

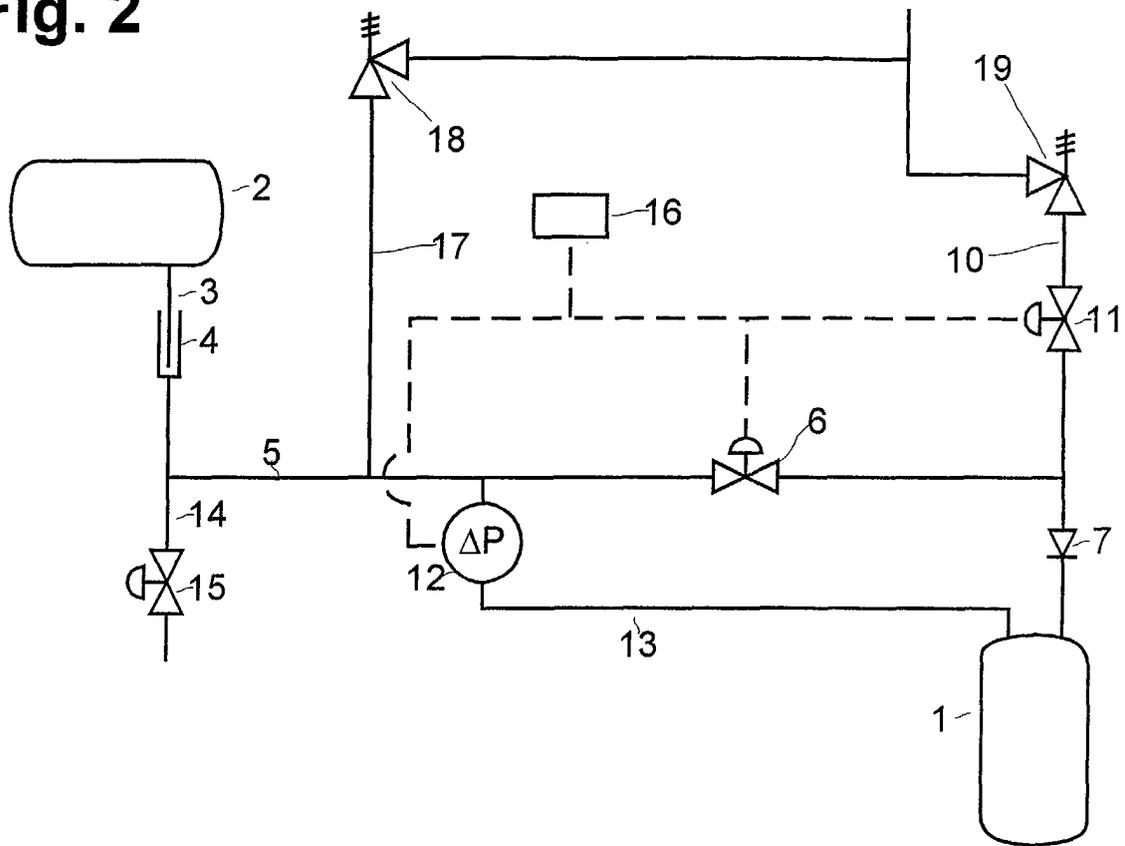
2. System according to claim 1, further comprising a venting line (10) with a venting valve (11) connected to said delivery line (5) downstream said delivery valve (6), wherein said venting valve (11) is operable depending on said detected pressure difference.
3. System according to claim 2, further comprising a relief valve (19) in said venting line (10), said relief valve (19) preferably located downstream said venting valve (11).
4. System according to any of claims 1 to 3, wherein said venting valve (11) and / or said delivery valve (6) are solenoid valves.
5. System according to any of claims 1 to 4, further comprising switch means to actuate said delivery valve and / or said venting valve and / or said means to detect said pressure difference.
6. System according to any of claims 1 to 5, further comprising a delivery check valve (7) located in said delivery line (5) downstream said delivery valve (6).
7. System according to claim 6, wherein the opening pressure of said delivery check valve (7) is less than 1 bar, preferably less than 0,1 bar.
8. System according to claim 6 or 7, wherein said delivery check valve (7) is located downstream the branch of said venting line (10) from said delivery line (5).
9. System according to any of claims 1 to 8, further comprising a bypass conduit between the inlet and the outlet of said delivery valve (6), said bypass conduit comprising a bypass check valve (8).
10. System according to claim 9, wherein the opening pressure of said bypass check valve (8) and / or of said venting valve (11) is more than 5 bar, preferably between 5 and 10 bar.
11. System according to any of claims 1 to 10, further comprising a safety venting line (17) with a safety relief valve (18) connected to said delivery line (5) upstream said delivery valve (6).

12. System according to claim 11, wherein the opening pressure of said safety relief valve (18) is between 20 and 40 bar, preferably between 25 and 35 bar.
13. System according to any of claims 1 to 12, wherein said means (12) to detect said pressure difference comprise a first pressure detector to detect the absolute pressure in said delivery line (5) downstream said delivery valve (6), preferably in said storage tank, and a second pressure detector to detect the absolute pressure in said delivery line (5) upstream said delivery valve (6).
14. System according to any of claims 1 to 13, further comprising an additional venting line (14) with an additional venting valve (15) connected to said delivery line (5) upstream said delivery valve (6).
15. Method to deliver a fluid from a delivery tank to a storage tank through a delivery line connected to said delivery tank and to said storage tank, wherein said delivery line comprises a delivery valve, **characterized in that** the pressure difference between the pressure at a point upstream said delivery valve (6) and a point downstream said delivery valve (6) is detected and said fluid is only delivered to said storage tank (1) if the pressure at said point upstream said delivery valve (6) exceeds the pressure at said point downstream said delivery valve (6).
16. Method according to claim 15, wherein said delivery valve (6) is controllable by a switch and said fluid is only delivered to said storage tank (1) when said switch is switched on.
17. Method according to any of claims 15 or 16, wherein fluid in said delivery line (5) downstream said delivery valve (6) is vented out of said delivery line (5) through a venting line (10) if the pressure in said delivery line (5) upstream said delivery valve (6) is lower than the pressure in said delivery line (5) downstream said delivery valve (6).
18. Method according to claim 17, wherein, if the pressure in said delivery line (5) upstream said delivery valve (6) increases above the pressure downstream said delivery valve (6), first said venting valve (11) is closed and afterwards said delivery valve (6) is opened.
19. Method according to claim 18, wherein said venting valve (11) is kept open for 1 to 5 seconds, preferably 2 to 4 seconds, after the pressure in said delivery line (5) upstream said delivery valve (6) has exceeded the pressure downstream said delivery valve (6).
20. Method according to any of claims 18 or 19, wherein said delivery valve (6) is opened 3 to 10 seconds, preferably 5 to 7 seconds, after said venting valve (11) has been closed.
21. Method according to any of claims 15 to 20, wherein first a gaseous fluid and afterwards a liquid fluid is delivered from said delivery tank (2) to said delivery line (5)
22. Method according to any of claims 15 to 21, wherein carbon dioxide, in particular liquid carbon dioxide, is delivered from said delivery tank (2) to said storage tank (1).
23. Method according to claim 22, wherein carbon dioxide is delivered from said delivery tank (2) to a storage tank (1) of a dry-cleaning facility.

**Fig. 1**



**Fig. 2**





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)
X	EP 1 055 766 A (MVE INC) 29 November 2000 (2000-11-29)  * column 6, line 11 - line 23; figures 1F,4,5 * * column 6, line 54 - column 7, line 3 * * column 10, line 25 - line 47 * ----	1-8,13, 15,16, 21-23	F17C13/02 F17C5/06 F17C5/02 F17C7/04
X	EP 1 146 277 A (AIR LIQUIDE) 17 October 2001 (2001-10-17) * paragraph '0011!; figure 1 * * paragraph '0023! - paragraph '0030! * ----	1,4,5, 13,15,16	
X	EP 1 043 540 A (MESSER GRIESHEIM GMBH) 11 October 2000 (2000-10-11) * column 9, line 1 - line 15; figure 1 * ----	1,15	
A	US 5 628 349 A (DIGGINS DAVID A ET AL) 13 May 1997 (1997-05-13) * column 6, line 36 - line 47; figures 1,8 * * column 6, line 66 - column 7, line 6 * ----	1-23	
			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
A	EP 0 877 195 A (PRAXAIR TECHNOLOGY INC) 11 November 1998 (1998-11-11) * column 7, line 10 - line 39; figure 1 * * column 7, line 52 - column 8, line 18 * * column 8, line 55 - column 9, line 6 * ----	1-23	F17C
A	US 4 887 857 A (VANOMMEREN JAMES) 19 December 1989 (1989-12-19) * column 3, line 48 - line 62; figures 1,2 * -----	1-23	
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
THE HAGUE		16 April 2002	Bertin-van Bommel, S
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons ----- & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT  
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 12 7588

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on  
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