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

(11) EP 3 231 854 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
18.10.2017 Bulletin 2017/42

(21) Application number: **16000847.0**

(22) Date of filing: **14.04.2016**

(51) Int Cl.:
C10L 3/00 *(2006.01)* ***F17D 3/12*** *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

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(54) METHOD AND SYSTEM FOR INJECTING AN ODOURANT INTO A GAS STREAM

(57) The present invention relates to a method of injecting an odourant into a gas stream, wherein the odourant is stored in liquid form in a storage vessel (110), wherein a saturated vapour is formed from the odourant in the storage vessel (110), wherein the saturated vapour is transferred to an accumulator vessel (120) during first time intervals, and wherein the saturated vapour is injected into the gas stream from the accumulator vessel (120) during second time intervals, the first and second time intervals being alternating time intervals. A corresponding system (100) is also part of the present invention.

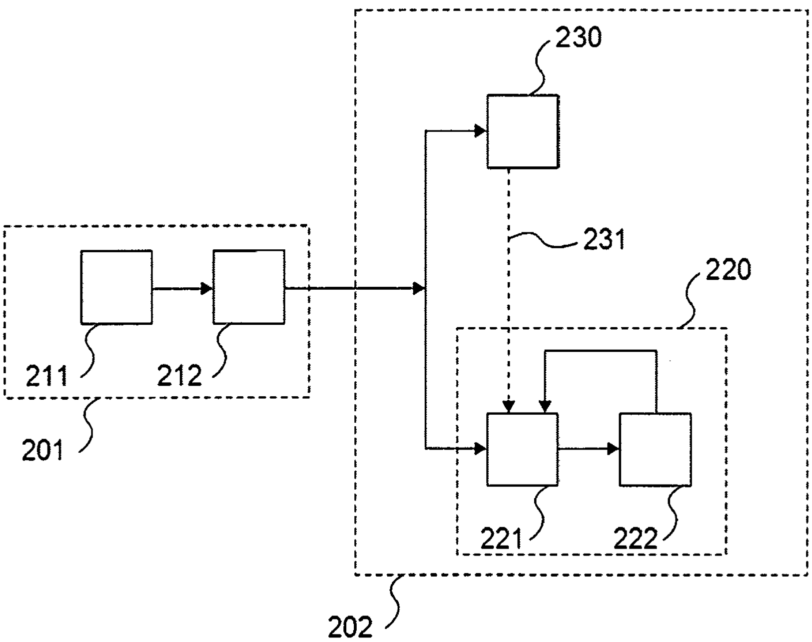

FIG. 2

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Description

[0001] The invention relates to a method of injecting an odourant into a gas stream, especially into a gas stream of an inflammable or explosive gas like natural gas, and to a system according to the pre-characterising clauses of the independent claims.

Prior art

[0002] Handling of odourless and colourless gases like natural gas can be dangerous. Since those gases usually cannot be detected without additional means, leaks or escaping gas cannot easily be detected by an operator. Thus, if those gases are flammable or explosive, handling of the gases can implicate safety risks.

[0003] In the course of gas odourisation, an odourant which has a characteristic smell, e.g. a distinctive and unpleasant odour, is added to ("injected into") the gas. Thus, leaks or escaping gas can be detected by an operator without additional means just by the smell of the odourant. The odourant can especially be added in concentrations such that the presence of gas in air in concentrations below the lower explosive limit (LEL) or a hazardous concentration is readily detectable.

[0004] The odourant is usually in the liquid phase before being added to the gas. For gas odourisation, means like pumps and/or valves are normally used in order to inject said odourant directly into the gas or gas stream. If not controlled meticulously, the odourant can easily be overdosed, i.e. a larger amount than actually needed in order to smell/detect leaking gas is added to the gas. Thus, a considerable amount of odourant is unnecessarily consumed, leading to an uneconomic situation or false positive leak detection. However, there is also the danger of underdosing. In this case, leaking gas cannot be detected any more by odour, which is a significant safety risk.

[0005] It is therefore desirable to provide a way of effectively and precisely injecting an odourant into a gas stream, in particular into a gas stream of an inflammable or explosive gas like natural gas.

Disclosure of the invention

[0006] The invention relates to a method of injecting an odourant into a gas stream, especially into a gas stream of an inflammable or explosive gas like gas, and to a corresponding system with the features of the independent claims. Further advantages and embodiments of the present invention will become apparent from the description that follows and from the appended figures.

[0007] In the present invention, a saturated vapour of the odourant, which is stored in liquid form in a storage vessel, is formed. The odourant is then injected into the gas stream in form of this saturated vapour and not in form of the liquid as known from the prior art. According to the present invention, the saturated vapour is formed from the odourant in the storage vessel. The saturated vapour is transferred to an accumulator vessel during first time intervals. During second time intervals, the saturated vapour is injected into the gas stream from the accumulator vessel. As, according to the present invention, the first and second time intervals are alternating time intervals, the accumulator vessel is repeatedly filled with the saturated vapour from the storage vessel. After each filling step, the saturated vapour is released from the storage vessel and injected into the gas stream. These injections are also referred to as "injection strokes" hereinafter. The term "dose rate" refers to the rate of such injection strokes, i.e. their number per time interval. An important advantage of this method is that the amount of odourant that is actually injected into the gas stream can be easily and reliably controlled, thus avoiding the disadvantages of the prior art.

[0008] According to a particularly preferred embodiment of the present invention, a duration and/or a repetition rate of the first and/or of the second time intervals is controlled on the basis of an instantaneous vapour pressure of the odourant. This allows for an adaptation of the amount of odourant injected to the specific situation, especially a temperature the method is performed at. Knowing the instantaneous vapour pressure of the odourant, one also knows how much of the saturated vapour is present in the accumulator vessel if the accumulator vessel is filled from the storage vessel for a certain amount of time which is defined by the first time interval. This amount can thus be adapted by changing the first time interval correspondingly. It can also be adapted by changing the repetition rate, i.e. the number of first and second time intervals, i.e. accumulator vessel filling and injection steps, during a certain time period, as this also defines the length of the respective time intervals.

[0009] Preferably, the duration and/or the repetition rate of the first and/or of the second time intervals are further controlled on the basis of a property of the accumulator vessel. As a property of the accumulator vessel, especially its volume is used. By knowing the volume of the saturated vapour present in the accumulator vessel, the amount of odourant at each injection step can be derived.

[0010] The odourant stored in liquid form in the storage vessel and the saturated vapour is particularly of the same chemical composition. Inside the storage vessel, the liquid odourant and its saturated vapour are especially in thermodynamic equilibrium, i.e. a number of molecules escaping from the stored liquid and passing into the vapour phase per unit time is equal to the number of molecules returning to the liquid during the same time interval. The vapour pressure depends on the temperature.

[0011] Therefore, according to a preferred embodiment of the present invention, the instantaneous vapour pressure of the odourant is determined based on a theoretical relationship between a vapour pressure at a defined temperature and the instantaneous temperature of the odourant stored in liquid form in the storage vessel. The defined temperature can be a reference temperature for which a vapour pressure was determined experimentally. The instantaneous vapour pressure, i.e. the vapour pressure for the specific conditions the odourant is stored at, especially its temperature, may then be determined from this reference value.

[0012] The reference value for the temperature can also be a "design temperature" especially corresponding to the average or expected temperature inside the storage vessel. The accordingly derived design vapour pressure expediently describes an estimated value for vapour pressure of the liquid when stored inside the storage vessel. For example, a design temperature of 15°C can be used.

[0013] Various embodiments are contemplated in this context. For example, the duration and/or the repetition rate of the first and/or of the second time intervals, i.e. the dose rate, which is initially set for the design temperature, may be corrected according to an actual temperature of the stored liquid. Thus, the dose rate can be corrected if the actual temperature differs from the design temperature and if the actual conditions, under which the liquid is stored, differ from the theoretical expectations.

[0014] For example, a temperature correction factor can be calculated based on the difference between the actual temperature and the design temperature and the previously determined dose rate can be corrected with the temperature correction factor. It is also possible to calculate a new value for the dose rate based on the actual temperature as corresponding correction.

[0015] Particularly, the time interval between the saturated vapour injection strokes is varied according to the actual temperature of the saturated vapour as the correction of the dose rate. For actual temperatures below the design temperature the time interval is expediently reduced and vice versa.

[0016] According to a preferred embodiment, the Antoine equation is used as the theoretical relationship between the vapour pressure at a defined temperature and at the instantaneous temperature. The empirical Antoine equation reads as follows:

$$p = 10^{\left(A - \frac{B}{C+T}\right)} \qquad \text{or} \qquad \log_{10} p = A - \frac{B}{C+T}$$

with p the vapour pressure and T the temperature of the liquid odourant. A, B, and C are component-specific empirical constants. The Antoine equation allows a description of the change of the heat of vaporisation of the saturated vapour with its temperature. The constant B especially corresponds to the enthalpy of vaporisation.

[0017] By means of the Antoine equation, the behaviour of the stored liquid odourant when brought from its liquid phase into its gaseous phase can be estimated. The properties of the accumulator vessel particularly describe the conditions under which the saturated vapour can be cached inside the accumulator vessel. By means of this information, the dose rate can particularly precisely be calculated in order to inject the saturated vapour in the desired concentration into the gas stream.

[0018] During each time interval, i.e. the "first" time intervals mentioned above, a certain amount of saturated vapour is transported from the storage vessel to the accumulator vessel. Formation of the saturated vapour may especially be promoted by sparging the odourant stored in liquid form in the storage vessel with a sparging gas stream. Preferably, the same gas as used for the gas stream to be odourised is used as the sparging gas stream, e.g. natural gas. This avoids introducing gas components that are incompatible with or contaminating the gas stream to be odourised.

[0019] The accumulator vessel is thus partially filled with the saturated vapour. The pressure inside the accumulator vessel may be increased to a predetermined value as calculated by a dosing requirement and based on the considerations explained above. The pressure in the accumulator vessel is preferably at any time at least as high as the pressure of the gas stream the odourant is to be injected into. The amount of saturated vapour inside the accumulator vessel may thus be injected into the gas stream at each injection stroke by simply opening a valve during the "second" time intervals as mentioned above, preferably until the pressure inside the accumulator has dropped to that of the gas stream. For filling the accumulator vessel from the storage vessel with the saturated vapour and for injecting the saturated vapour into the gas stream, the same valve can be used. This valve can be provided as a three-way valve, as also explained in relation to the appended Figures. It opens to the storage vessel during the first and to the gas stream during the second time intervals.

[0020] To ensure that the pressure in the accumulator vessel may be set to a pressure at least as high as the pressure of the gas stream the odourant is to be injected into, the storage vessel may be connected to a gas stream, especially to the sparging gas stream mentioned above, whose pressure is higher than the pressure of the gas stream the odourant is to be injected into. For example, the injection point of the odourant may be arranged downstream a pressure regulator reducing the pressure of the gas stream. If now some of the gas of the gas stream is branched off upstream the pressure regulator, i.e. at a higher pressure, it can be conveniently used to sparge, and thus pressurize, the storage vessel. The pressure can for example be measured upstream a gas regulator. The pressure inside the accumulator vessel can be compared with this pressure, ensuring that the saturated vapour is cached inside the accumulator at a higher pressure than at the injection point.

[0021] The invention further relates to a system for odourising a gas stream with an odourant, the system comprising a storage vessel adapted to store the odourant in liquid form, characterized by vapourisation means adapted to form a saturated vapour of the odourant in the storage vessel, an accumulator vessel, and means adapted to transfer the saturated vapour from the storage vessel to the accumulator vessel during first time intervals, and to inject the saturated vapour from the accumulator vessel into the gas stream during second time intervals, the first and second time intervals being alternating time intervals. The system is particularly adapted to perform a method as explained above and comprises means adapted thereto.

[0022] The gas stream to be odourised is provided via suitable guiding means, especially a pipe. Preferably, between the storage and the accumulator vessel a first transfer line is provided. Between the accumulator vessel and the guiding means for the gas stream to be odourised, preferably a second transfer line is provided. The first and second transfer lines are selectively blockable, especially by means of one or more valves, especially a three way or 3/2 valve. During the first time intervals, the second but not the first transfer line is blocked, allowing for saturated vapour to stream from the storage vessel to the accumulator vessel. During the second time intervals, the first transfer line but not the second transfer line is blocked, allowing for saturated vapour to stream from the accumulator vessel to the guiding means for the gas stream to be odourised.

[0023] Advantageously, as mentioned, a valve is adapted to connect the accumulator vessel with the storage vessel as well as with the guiding means through which the gas stream is conducted. This valve is preferably controlled in order to transport the saturated vapour from the storage vessel to the accumulator vessel and in order to inject the saturated vapour inside the accumulator vessel into the gas stream. The valve can particularly be constructed as a solenoid valve and/or as a 3/2 valve. Thus, the saturated vapour injection system especially comprises only one moving element and can easily and inexpensively be maintained.

[0024] For the selective blocking of the first and second transfer lines, preferably a control unit is provided. This control unit can particularly be constructed as a programmable logic controller (PLC). It is preferably adapted to perform the method as indicated above.

[0025] Further aspects of the present invention, relating both to the inventive method and to the inventive system and the embodiments, are summarised below.

[0026] The gas to be odourised is especially odourless, colourless, flammable, and/or explosive. Especially natural gas is used as the gas. The saturated vapour is especially injected into the gas stream for safety reasons, in order to make the gas detectable by an operator without any facilities. Thus, leaks or escaping gas, respectively, can easily be detected. Expediently, a chemical or an odourant can be injected into the gas stream as the saturated vapour and a gas odourisation can be conducted. Particularly, the odourant is stored as liquid inside the storage vessel. By evaporation of the liquid odourant a saturated vapour of the odourant is created, which is transported to the accumulator vessel and injected into the gas stream.

[0027] Preferably, natural gas, methane, butane, propane, hydrogen and/or acetylene or mixtures thereof are used as the gas. Natural gas can for example be used as energy supply, especially in order to replace diesel, liquefied petroleum gas (LPG), pipeline gas, or biofuel. Natural gas can thus be used for power generation, e.g. in power plants, in generator assemblies, or for offshore power generation. Moreover, natural gas can especially be used for gas blending, e.g. for blending of biogas.

[0028] Preferably, tetrahydrothiophene (THT) and/or tert-butyl mercaptan (TBM) is used as odourant. Tetrahydrothiophene (THT) is an organosulfur compound with the formula $(CH_2)_4S$. Tert-butyl mercaptan (TBM) is an organosulfur compound with the formula $(CH_3)_3CSH$ and is also known as 2-methylpropane-2-thiol, 2-methyl-2-propanethiol, tert-butylthiol, and t-BuSH. The compound may be selected based on strength of odour and/or vapour pressure to suit the particular application. The predetermined concentration of the saturated vapour to be injected can particularly be chosen considering the lower explosive limit in order to ensure that the presence of the gas in air in concentrations below the lower explosive limit of the gas can easily be detected.

[0029] The invention provides a precise and effective way of injecting a chemical via saturated vapour into a gas stream. The saturated vapour can particular be injected into the gas stream without the use of a pump but only by means of charging the accumulator vessel with saturated vapour and releasing it into the gas stream. Particularly, only valves connecting the storage vessel with the accumulator vessel and the accumulator vessel with the corresponding gas stream are controlled in order to inject the saturated vapour in the desired concentration into the gas stream. The accumulator vessel can be constructed and its dimensions can be chosen according to the flowrate of the gas and the amount of saturated vapour to be injected into the gas stream.

[0030] Conventional means to inject an odourant into a gas stream, especially an odourant in the course of gas odourisation, can usually comprise pressure bypass systems, e.g. a needle valve. These conventional means usually lack a dosing control, especially when the flowrate of the gas stream is variable. Thus, the danger of overdosing as well as underdosing arises. For example when the storage vessel storing the liquid and its saturated vapour or the odourant, respectively, is exposed to high temperatures and/or direct sunlight, a rapid boiling of the stored liquid, saturated vapour or odourant, respectively, can occur. With the lack of a dosing control, this can cause significant overdosing of the injected saturated vapour or odourant, respectively. Thus, considerable amounts of saturated vapour or odourant, respectively, are misspent and the stored liquid, saturated vapour or odourant, respectively, stored in the storage tank possibly does not last for a designed period of time.

[0031] By the method and the system according to the invention it can especially be guaranteed that essentially a predetermined amount of saturated vapour or odourant, respectively, is injected into the gas stream and not a too large amount or a too small amount. Thus, overdosing and underdosing can be prevented. Accordingly, the saturated vapour or odourant, respectively, is not unnecessarily misspent and it can be assured that no danger due to underdosing can arise.

[0032] It is especially possible to precisely inject comparatively large amounts of the saturated vapour as well as comparatively small amounts. Particularly, small amounts can exactly be injected into gas streams with comparatively low flowrates, e.g. below 100 kg/h. Conventional methods of injecting a saturated vapour, especially an odourant, into a gas stream are usually designed for gas streams with much larger flowrates. By the method and system according to the invention, saturated vapour or odourant, respectively, can precisely be injected into gas streams with comparatively low flowrates. The higher the flow rate of the gas stream (and thus the higher the amount of saturated vapour to be injected) the larger the accumulator vessel can be constructed. Vice versa, for comparatively low flow rates and amounts of saturated vapour to be injected, the accumulator can be constructed comparatively small. For example an accumulator vessel with a volume of 0.5 l can be chosen for a gas stream with a flowrate of 100 kg/h.

[0033] The present invention is further explained with reference to the appended drawings illustrating preferred embodiments of the present invention.

Short description of the Figures

[0034] The present invention will now be described further, by way of example, with reference to the accompanying drawings, in which

FIG. 1 schematically shows a preferred embodiment of a saturated vapour injection system according to the invention, which is adapted to conduct a preferred embodiment of a method according to the invention.

FIG. 2 schematically shows a preferred embodiment of a method according to the invention as a block diagram.

Detailed description

[0035] In FIG. 1, a preferred embodiment of a gas odourisation system 100 according to a preferred embodiment of the invention is schematically shown.

[0036] A gas stream of natural gas is conducted through guiding means in form of a pipeline 101. The gas stream can for example be conducted through the pipeline in the course of power generation in a power plant. In order to make the odourless and colourless natural gas detectable by an operator by smell without any additional means or facilities, a gas odourisation is conducted, i.e. an odourant is injected into the gas stream of natural gas inside the pipeline 101. The odourant, particularly Tetrahydrothiophene (THT) or tert-butyl mercaptan (TBM), is stored in a storage vessel 110. Particularly, the odourant is stored as a liquid in the storage vessel 110. By evaporation of the liquid odourant, a corresponding saturated vapour of the odourant is created inside the storage vessel 110.

[0037] For injecting the odourant into the gas stream, the odourant injection system 100 is provided, comprising an accumulator vessel 120 which is connected with the storage vessel 110 via a valve 123 and a pipe 121 as well as with the pipeline 101 via the valve 123 and a pipe 122. The valve 123 is preferably constructed as a 3/2 solenoid valve. The storage vessel 110 is connected with the pipeline 101 via another pipe 111 and another valve 112.

[0038] A gas regulator 140 can be provided to control flowrate and/or pressure of the gas stream inside the pipeline 101. Pressure sensors 131, 132 can be provided to measure the pressure of the gas stream inside the pipeline 101. By means of a first pressure sensor 131 the gas stream's pressure can be measured upstream the gas regulator. The gas stream's pressure downstream the gas regulator 140 can be measured with a second pressure sensor 132. Another pressure sensor 133 can be provided to measure the pressure inside the accumulator vessel 120.

[0039] A flow meter 150, for example an orifice plate flow meter, can be provided to measure a flowrate of the gas stream inside the pipeline 101. The flowmeter 150 can comprise an orifice plate 151 placed in the gas stream, which constricts the gas stream. By a differential pressure sensor 152 a first pressure upstream the orifice plate 151 and a second pressure downstream the orifice plate 152 is measured. By the pressure difference between the firsts and the second pressure the flowrate of the gas stream inside the pipeline 101 can be determined.

[0040] A control unit 130, for example a programmable logic controller (PLC), is adapted to control the 3/2 solenoid valve 123 as well as the valve 112. Moreover, the control unit 130 can be connected with the pressure sensors 131, 132, 133 as well as with the flowmeter 150 and can especially also control the gas regulator 140.

[0041] The programmable logic controller 130 is particularly adapted to conduct a preferred embodiment of a method according to the invention, which is schematically shown in FIG. 2 as a block diagram.

[0042] In step 211 a vapour pressure of the odourant is calculated according to a predetermined theoretical relationship between vapour pressure and temperature of the liquid odorant stored inside the storage vessel 110. Preferably the Antoine equation is used as this theoretical relationship. Particularly a design vapour pressure at a design temperature of e.g. 15°C is calculated.

[0043] This design vapour pressure is used in step 212 to determine a dose rate. The dose rate is calculated based on the design vapour pressure as well as on the volume and the pressure of the accumulator vessel 120.

[0044] The dose rate is especially calculated using the ideal gas equation $PV = nRT$ to determine the accumulator volume, then using the law of partial pressures $p_x = P*x$. The partial pressure of the odourant compound is especially determined by the saturation pressure as determined by the Antoine equation (affected by temperature). In this way the mass of odourant delivered per saturated vapour injection stroke is known, and the interval can be determined by the following:

$$dose\ rate\ per\ hour = \frac{(gas\ volume\ flowrate)*(odourant\ concentration)}{(calculated\ accumulator\ odourant\ dose)}$$

[0045] The dose rate defines time intervals between saturated vapour injection strokes or saturated vapour injection pulses, in the course of which an amount of saturated vapour is injected from the accumulator vessel 120 into the pipeline 101. By these injections the gas stream is enriched with the odourant according to a predetermined concentration, e.g. in the range between 1 mg/m^3 and 10 mg/m^3.

[0046] The steps 211 and 212 can for example be performed before the gas stream is conducted through the pipeline 101, e.g. during a calibration phase 201 of the control unit 130.

[0047] When natural gas is conducted through the pipeline 101 during regular operation 202, the odourant is injected according to the determined dose rate. For this purpose in each time interval 220 between the saturated vapour injection strokes, the accumulator vessel 120 is charged.

[0048] In the course of each time interval 220, saturated vapour is transported in step 221 from the storage vessel 110 to the accumulator vessel 120. For this purpose, natural gas is conducted from the pipeline 101 via the pipe 111 and valve 112 to the storage vessel 110 and via pipe 121 and valve 123 from the storage vessel 110 into the accumulator vessel 120. The natural gas picks up odourant inside the storage vessel 110 according to the determined design vapour pressure. Control unit 130 operates the valves 112 and 123 accordingly in order to transport a corresponding amount of odourant into the accumulator vessel 120.

[0049] Hence, the pressure inside the accumulator vessel 120 is increased; particularly until it reaches a predetermined value at least as large as the measured pressure of the gas flow downstream the gas regulator 140. For this purpose, the control unit 130 compares the pressure values measured via the sensors 133 and 132.

[0050] When the pressure inside the accumulator vessel 120 reaches the corresponding value and when the time interval is expired, the content inside the accumulator vessel 120 is injected into the gas stream in step 222. The control unit 130 controls the valve 123 accordingly.

[0051] Moreover, a correction of the dose rate is determined according to an actual temperature of the odourant based on the Antoine equation. For this purpose, a temperature correction factor is calculated in step 230 according to the actual temperature of the odourant.

[0052] For example, using a design temperature or basis temperature of e.g. 15°C as a basis, the temperature correction factor at an actual temperature or 15°C is 1. The vapour pressure at a certain temperature (at x degrees) is calculated using a curve generated by the Antoine equation. It is then converted to a temperature correction factor especially by using the following relation:

$$temperature\ correction\ factor = \frac{vapour\ pressure\ at\ x\ degrees}{vapour\ pressure\ at\ design\ temperature}$$

[0053] The dose rate is then corrected using:

$$\textit{corrected dose interval} = \frac{\textit{flowrate}}{\textit{coefficient at reference temperature}} * (\textit{temperature correction factor})$$

[0054] The temperature correction factor especially states, whether the time interval of the dose rate has to be increased or reduced based on a difference between the actual temperature and the design temperature used in step 211. The temperature correction is applied to the dose rate, implied by reference sign 231, and the time intervals 220 is accordingly increased or reduced, if necessary.

Reference list

[0055]

100	saturated vapour injection system
101	transfer means, means, pipeline
110	storage vessel (including dip line and vapour outlet)
111	pipe
112	valve (pressure reducing)
120	accumulator vessel
121	pipe
122	pipe
123	valve, 3/2 solenoid valve
130	control unit, programmable logic controller
131	pressure sensor
132	pressure sensor
133	pressure sensor
140	gas regulator
150	flowmeter
151	orifice plate
152	differential pressure sensor

201 to 232	steps of the method
201	calibration phase
202	regular operation
220	time interval
230	temperature correction

Claims

1. A method of injecting an odourant into a gas stream, wherein the odourant is stored in liquid form in a storage vessel (110), **characterized in that** a saturated vapour is formed from the odourant in the storage vessel (110), **in that** the saturated vapour is transferred to an accumulator vessel (120) during first time intervals, and **in that** the saturated vapour is injected into the gas stream from the accumulator vessel (120) during second time intervals, the first and second time intervals being alternating time intervals.

2. The method according to claim 1, wherein a duration and/or a repetition rate of the first and/or of the second time intervals is controlled on the basis of an instantaneous vapour pressure of the odourant.

3. The method according to claim 2, wherein the duration and/or the repetition rate of the first and/or of the second time intervals is further controlled on the basis of a property of the accumulator vessel.

4. The method according to claim 3, wherein the instantaneous vapour pressure of the odourant is determined (212) based on a theoretical relationship between a vapour pressure at a defined temperature and at the instantaneous temperature of the odourant stored in liquid form in the storage vessel (110).

5. The method according to claim 4, wherein as the theoretical relationship between the vapour pressure at a defined temperature and at the instantaneous temperature, the Antoine equation is used.

7. The method according to any one of the preceding claims, wherein a formation of the saturated vapour in the storage vessel is promoted by sparging the odourant stored in liquid form in the storage vessel (119) with a sparging gas stream.

8. The method according to any one of the preceding claims, wherein a valve (123) is controlled in order to transport the saturated vapour from the storage vessel (110) to the accumulator vessel (120) and in order to inject the saturated vapour inside the accumulator vessel (120) into the gas stream.

9. The method according to any one of the preceding claims, wherein a pressure of the saturated vapour inside the accumulator vessel (120) is set to a value at least as high as that of the gas stream to be odourised.

10. A system (100) for odourising a gas stream with an odourant, the system (100) comprising a storage vessel (100) adapted to store the odourant in liquid form, **characterized by** vapourisation means adapted to form a saturated vapour of the odourant in the storage vessel (100), an accumulator vessel (120), and means adapted to transfer the saturated vapour from the storage vessel (100) to the accumulator vessel (120) during first time intervals, and to inject the saturated vapour from the accumulator vessel into the gas stream during second time intervals, the first and second time intervals being alternating time intervals.

11. A system according to claim 10, further comprising a guiding means for the gas stream to be odourised, a first transfer line between the storage vessel (110) and the accumulator vessel (120), and a second transfer line between the accumulator vessel (120) and the guiding means for the gas stream to be odourised, the first and second transfer lines being selectively blockable.

12. A system according to claim 11, wherein selective blocking of the first and second transfer lines, a control unit is provided.

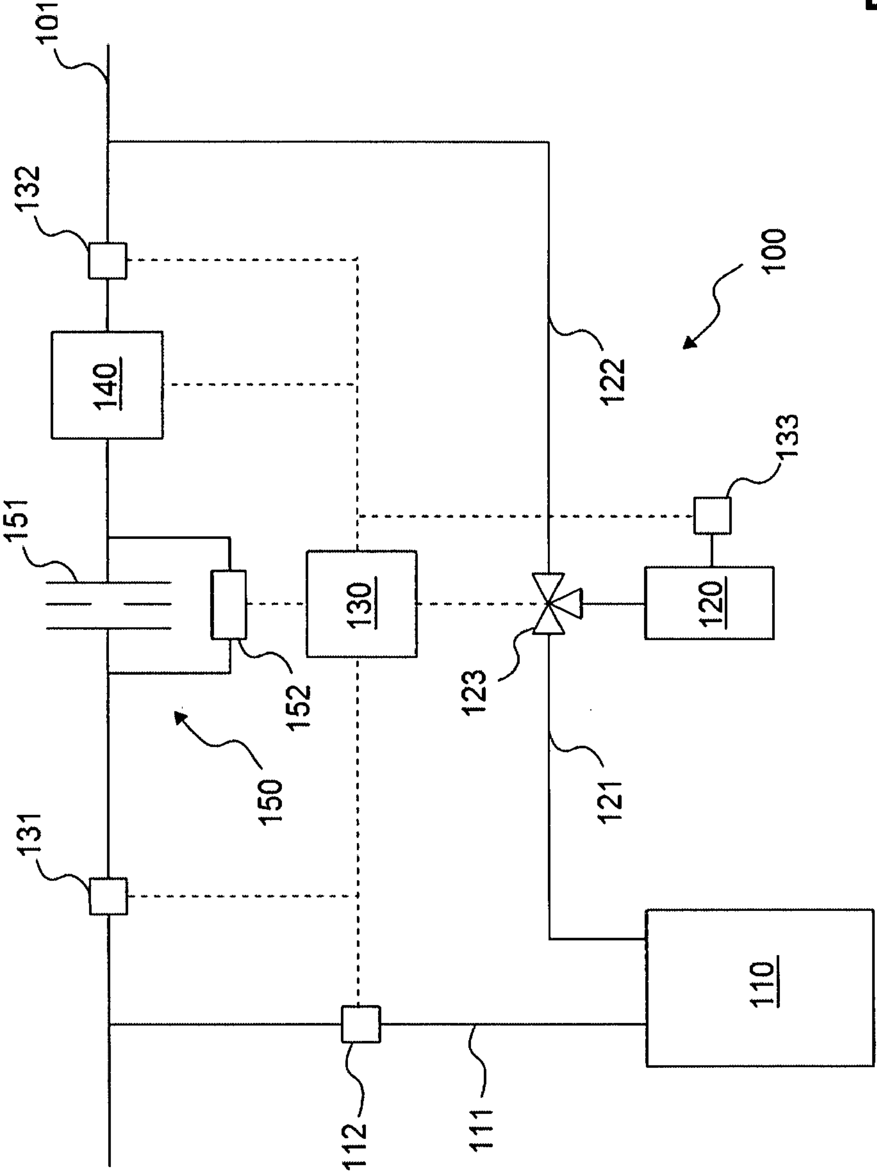
101
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FIG. 1

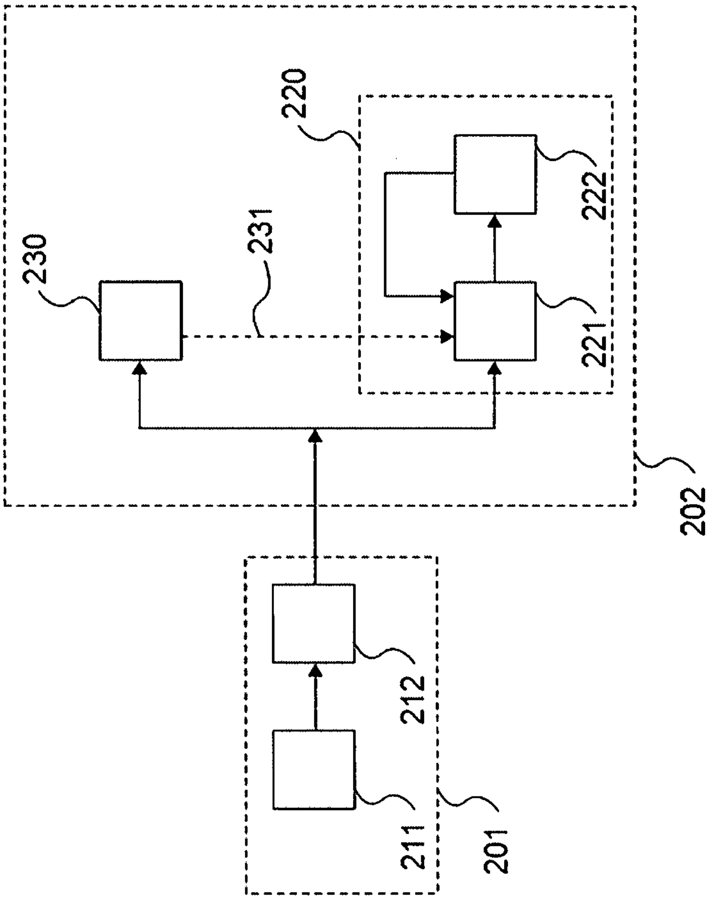

FIG. 2

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Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 16 00 0847

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 97/19746 A1 (AGA AB [SE]; SVENSSON ORVAR [SE]) 5 June 1997 (1997-06-05) * the whole document * -----	1-12	INV. C10L3/00 F17D3/12
A	WO 95/33020 A1 (ERIK SMAARS KONSULT AKTIEBOLAG [SE]; SMAARS ERIK [SE]) 7 December 1995 (1995-12-07) * claim 1; figure 1 * -----	1-12	
A	DATABASE WPI Week 197447 Thomson Scientific, London, GB; AN 1974-82113V XP002760246, & SU 416 378 A (BEZSHTANKOVSKII P E ET A) 25 June 1974 (1974-06-25) * abstract * -----	1-12	
A	Daniel Tenkrat ET AL: "Natural gas odorization 87, Natural gas odorization", , 1 August 2010 (2010-08-01), XP055291350, ISBN: 978-953-30-7112-1 Retrieved from the Internet: URL:http://cdn.intechopen.com/pdfs/11460.pdf [retrieved on 2016-07-26] * pages 93-97 * -----	1-12	TECHNICAL FIELDS SEARCHED (IPC) C10L

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	26 July 2016	Greß, Tobias

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
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