

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 030 098 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

23.08.2000 Bulletin 2000/34(51) Int Cl.7: **F17D 1/04**(21) Application number: **99830684.9**(22) Date of filing: **29.10.1999**

(84) Designated Contracting States:

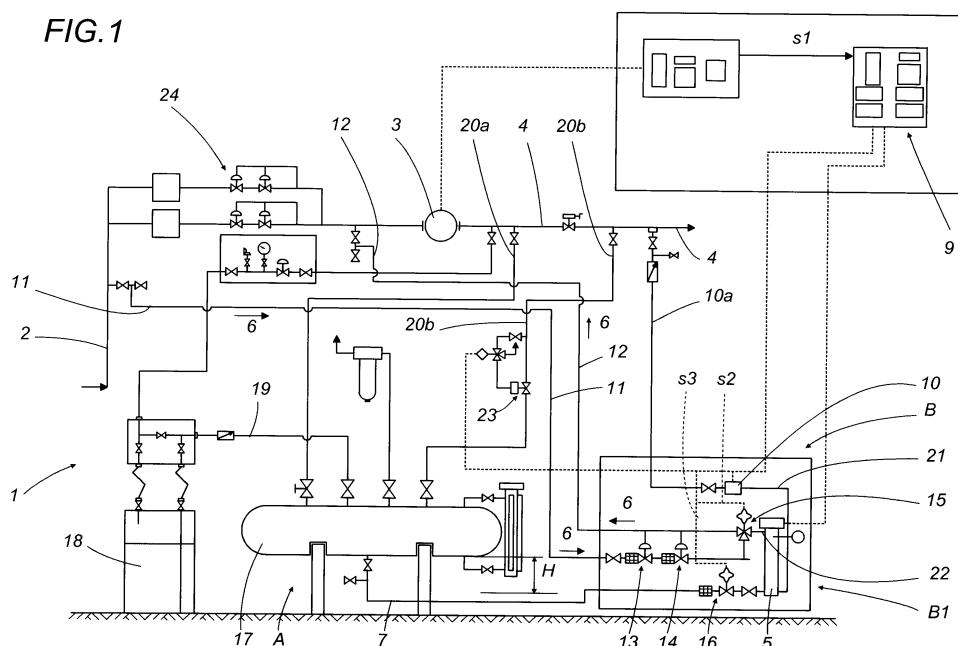
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE**

Designated Extension States:

AL LT LV MK RO SI(30) Priority: **19.02.1999 IT BO990071**(71) Applicant: **O.M.T. OFFICINA****MECCANICA TARTARINI S.p.A.****40013 Castel Maggiore (Bologna) (IT)**(72) Inventor: **Tartarini, Roberto****40013 Castel Maggiore, Bologna (IT)**(74) Representative: **Lanzoni, Luciano****c/o BUGNION S.p.A.****Via Goito, 18****40126 Bologna (IT)****(54) Injection method and apparatus for odourising a gas, in a pumping station**

(57) A method for odourising a gas in a pumping station (1) provided with an intake pipeline (2) for drawing the gas from a distribution line, with a meter (3) and with a pipeline (4) for delivering the gas towards a user, arranged in mutual succession - comprises a phase whereby an odourising liquid is dispersed into the gas transiting through the pipeline (4) for delivering the gas implemented by a controlled injector (10) of odourising liquid and further cyclical phases consisting of supplying the injector (10) with odourising liquid contained in a pres-

surisable tank (5) of pre-determined volume by means of thrust imparted on the odourising liquid by a flow (6) of gas drawn from the intake pipeline (2) and introduced into the pressurisable tank (5); of re-injecting the flow (6) of gas back into the intake pipeline (2), upstream of the meter (3); and of refilling the pressurisable tank (5) of the odourising liquid with a volume of liquid corresponding to the transferred volume. An injection apparatus (B) operating according to the method is an integral part of the invention.

FIG.1**EP 1 030 098 A2**

Description

[0001] The present invention relates to the technical field concerning the pumping and distribution of combustible gas (for residential use) and more specifically it concerns a method and an apparatus for odorising a normally odourless gas in order to allow its presence to be detected in case of any leaks into spaces occupied by persons.

[0002] At present, gas is odorised with various methods, among which the so-called lapping method is known. This method is implemented by means of plants and devices whereby the gas is conveyed to flow through a tank containing an odorising liquid in a quantity able to define an ample free surface above which the flow of gas transits. The gas, flowing above the free surface, becomes impregnated with the vapours released by the underlying liquid and in this condition it is then sent on to the distribution line.

[0003] The plants and devices operating with the lapping technique allow a rather inaccurate control of the concentration of the odorising agent; moreover, the concentration of odorising agent in them is prone to vary even significantly depending on the flow rate of the gas.

[0004] A different odorising technique instead entails the injection and dispersion of the odorising liquid in controlled quantities which are injected directly into the flow of gas being pumped.

[0005] A method for implementing this technique, substantially corresponding to the preamble to claim 1, is effected directly in the gas pumping station - which is notoriously provided with a pipeline for drawing the gas from a distributing line, with a meter and with a pipeline for delivering the gas towards a user, arranged in mutual succession and comprises a phase whereby the odorising liquid is dispersed into the gas transiting into the gas delivery pipeline by a controlled odorising liquid injector.

[0006] The odorising liquid injector is associated, in this case, to an electronically controlled pump.

[0007] Control over the concentration of odorising agent is, in this case, more accurate with respect to the lapping system, as it can also be correlated, to some extent, with the flow rate of gas actually transiting along the delivery pipeline. The devices used to implement this technique, however, are constructively complex, require a more complex electrical power supply system and are delicate to manage; moreover, the accuracy with which the concentration odorising agent is determined is heavily dependent on the actual operating range of the pump. Their reliability, moreover, is relatively low.

[0008] All this entails several drawbacks, such as that of requiring frequent maintenance operations and, in case of improper operation, of negatively impacting on the level of environmental safety in the spaces wherein the equipment using the pumped gas are situated. In particular regard to maintenance operations, to the ob-

vious drawbacks deriving from the costs and service outages arising from the idleness of the machinery, it is necessary to add the further disadvantages deriving from the discomfort felt by maintenance personnel as a consequence of the unpleasant smell emanated by the parts that have come in contact with the odorising liquid.

[0009] A first aim of the present invention is to enable to obtain high conditions of environmental safety in the field of natural gas distribution for residential purposes, which in practice translate into the re-creation of the conditions which make the presence of gas detectable even in the presence of leaks of minimal quantities of gas. This aim is attained by maintaining at a constant value the concentration of odorising agent for any value of gas flow rate pumped in the distribution station: even with extremely modest and/or extremely variable flow rates.

[0010] A second aim of the invention is to increase the reliability of the plants and to reduce the number of maintenance operations, simplifying and speeding their execution when it becomes necessary.

[0011] A third aim is to have apparatuses that are simple to operate and offer certain reliability under all actual operating conditions.

[0012] According to the invention, such aims are reached by a method, according to the preamble of claim 1, characterised in that it comprises the cyclical phases of supplying the injector with odorising liquid contained in a pressurisable tank of pre-determined volume by means of thrust imparted on the odorising liquid by a flow of gas drawn from the intake pipeline and introduced into the pressurisable tank; re-injecting the flow of gas back into the intake pipeline, upstream of the meter; and refilling the pressurisable tank of the odorising liquid with a volume of liquid corresponding to the transferred volume.

[0013] The aforesaid aims are also reached by an apparatus for implementing the aforesaid method which is realised according to the preamble to claim 4 and comprises: a pressurisable tank, of pre-determined volume, connected to the injector; a first pipe which conveys into the pressurisable tank a flow of gas drawn from the intake pipeline of the pumping station, upstream of the meter; a second pipe which connects the pressurisable tank to the intake pipeline and which re-injects the flow of gas therein, upstream of the meter.

[0014] The method according to the invention allows to realise apparatuses able to attain all the aforesaid aims with volumetric physical devices which are easier to construct and offer excellent reliability and which, if combined with suitable management and control means constituted for instance by a microprocessor electronic unit, allow to obtain odorising plants with high operating precision and excellent self-regulating capabilities. The devices implementing the method described above require minimal maintenance interventions, at widely separated time intervals, and very rapidly executed when they are required.

[0015] A further advantage of the invention is also rep-

resented by the extreme ease with which it can be associated to traditional lapping devices which can advantageously coexist with the apparatuses according to the invention, serving as devices for supplying the odorising liquid and at the same time as auxiliary systems which can be activated if the operation of the main apparatuses should be interrupted.

[0016] The technical features of the invention, according to the aforesaid aims, can clearly be noted from the content of the claims that follow and its advantages shall become more readily apparent from the detailed description that follows, made with reference to the accompanying drawings, which represent an embodiment provided purely by way of non limiting example, wherein:

- Figure 1 schematically shows an odorising apparatus, to implement the method according to the invention also constituting the subject of the invention and inserted in a conventional gas pumping station.

[0017] In Figure 1 of the accompanying drawing, a station 1 for pumping methane gas (prevalently for urban use) is shown, essentially comprising: an intake pipeline 2 for drawing gas from a methane gas distribution line; a meter 3 for measuring the gas flow rate; and a pipeline 4 for delivering the gas towards a user, arranged in mutual succession and connected in loops with two distinct gas odorising apparatuses operating in parallel and constituted respectively by a conventional lapping apparatus - visible in the central part of the figure - globally indicated with the letter "A" and by an apparatus injecting the odorising liquid globally indicated with the letter "B" and visible in the right part of the figure.

[0018] The lapping apparatus "A" which is structured and operates in a wholly conventional manner and which operatively coexists with the injection apparatus B as an auxiliary, emergency, apparatus, comprises: a horizontal cylindrical tank 17; a container 18 for refilling odorising liquid connected by means of a feeding pipe 19 to the cylindrical tank 17 and pipelines 20a, 20b and 7 which, respectively, connect the cylindrical tank 17 to the gas delivery pipeline 4 of the pumping station 1 and to the injection odorising apparatus "B".

[0019] The apparatus "B" which in particular represents a preferable embodiment of the present invention, comprises a first pneumatic loop part B1, serving the operation of an injector 10, connected by means of a related pipe 10a to the delivery pipeline 4 and mounted on a panel, and management and control means, situated in a position that is remote with respect to the panel and intrinsically safe, and represented by an electronic unit 9 functionally interconnected with the meter 3 and with the pneumatic loop part B1. The apparatus B comprises a pressurisable tank 5, of pre-determined volume, which is connected on one side to the injector 10 - which it feeds with a related feeding pipe 21 - and on the other side to three additional pipes 11, 12 and 7.

[0020] A first pipe 11 draws from the intake pipeline 2

of the pumping station 1, upstream of the meter 3, a flow 6 of gas and conveys it into the pressurisable tank 5. A second pipe 12 connects the pressurisable tank 5 to the intake pipeline 2, also upstream of the meter 3, and re-injects the gas flow 6 therein, fully returning it to the delivery pipeline 4. The third pipe 7 is a pipe for loading the odorising liquid serving to fill the pressurisable tank 5.

[0021] The first pipe 11 is provided, more specifically, with pressure reducing means 13, 14 which reduce the pressure of the incoming gas received down to a pre-determined pressure value of the outgoing gas, exceeding by a pre-set difference the pressure of the gas that travels through the delivery pipe 4 and which, opposing the injection of the odorising liquid into the gas, must be overcome by the injector 10 at the moment of the injection of the liquid.

[0022] The pressure reducing means are constituted by two reducing filters 13, 14 arranged in mutual succession on the first pipe 11. The first reducing filter 13 reduces the pressure of the gas from a pressure value P1 near, for instance, 100 bar down to an output pressure P2 corresponding to the pressure of the gas in the delivery pipeline 4 increased by a value Δp near 3 bar. The second reducing filter 14 instead reduces the pressure P2 of the gas received at the input down to an output pressure P3 corresponding to the pressure of the gas transiting in the delivery pipeline 4, increased by a value of pressure Δp_1 near 0.6 bar.

[0023] A 3-way switching valve 15 connects the first pipe 11 and the second pipe 12 with an inlet pipe 22 of the pressurisable tank 5. The switching valve 15 intercepts the gas exiting from the pressure reducing means 13, 14 and, in one of its operating conditions, as shall become more readily apparent from the operating description provided below, allows the pressurisation of the pressurisable tank 5 containing the odorising liquid under normal operating conditions. Such function is suspended during the recharging phase of the pressurisable tank 5. In this phase the gas present in the pressurisable tank 5 flows out through the pipe 22, the valve 15 and the pipe 12 upstream of the meter 3. The pipe 7 for loading the odorising liquid is provided with a valve 16, also controlled by the electronic unit 9, whose opening allows to feed by natural gravity, and thanks to the principle of communicating vessels, odorising liquid between the horizontal tank 17 of the lapping apparatus A and the pressurisable tank 5 of the injection apparatus B. The closing of the valve 16 allows instead to pressurise the pressurisable tank 5 and to transfer the odorising liquid therein contained into the delivery pipeline 4 of the pumping station 1.

[0024] In regard to the management and control means, Figure 1 shows that the electronic unit 9 is connected with the meter 3 in such a way as to receive as an input a signal s1 corresponding to the flow rate of the gas actually transiting through the meter 3 itself and to send as an output regulating signals s2, s3 which allow

advantageously to control the valves 15 and 16 which in turn enable respectively to pressurise and depressurise the tank 5 by means of the flow of gas 6 and the appropriate interconnection of the pipelines 11, 12 and 22.

[0025] In the practical operation of the injection apparatus B, the electronic unit 9 processes the proper electrical signal to be sent to the injector 10 in order to maintain the concentration ratio of the odourising liquid constant even with variations in the digital input signal s1 from the meter 3 which measures, instant by instant, the volumetric flow rate of the transiting gas.

[0026] The unit 9 also provides the various equipment items with the appropriate voltages and currents, contains separation barriers for intrinsic safety and, in case of malfunction or electrical power outage, retains programming data by means of a buffer battery; lastly, it commands a relay to activate a possible emergency device which, in the indicative and non-limiting embodiment described herein, is preferably constituted by the lapping apparatus A.

[0027] In use, the operation of the distribution station 1 is described with respect solely to the injection apparatus B. The description of the operation of the lapping apparatus A is omitted as it is fully known to those versed in the art. In regard to the interaction of the latter apparatus with the injection apparatus B it is sufficient to note - with reference to the Figure - that, by means of a pneumatic valve 23 situated on the pipe 20b which connects the cylindrical tank 17 to the delivery pipeline 4 of the distribution station 1, the electronic unit 9 can activate or de-activate the operation of the lapping apparatus A in case of anomalous operation on the part of the injection B or of electrical power outage.

[0028] Returning to the description of the operation of the injection apparatus B, it should be premised that said apparatus odourises the gas by means of a cyclical sequence of phases which essential entail: supplying the injector 10 with odourising liquid contained in the pressurisable container 5 by means of a thrust imparted on the odourising liquid by the flow 6 of gas which is drawn from the intake pipeline 2 and is introduced into the pressurisable tank 5; to re-inject the flow 6 of gas back into the intake pipeline 2, upstream of the meter 3; and refilling the pressurisable tank 5 of the odourising liquid with a volume of liquid corresponding to the transferred volume by drawing it directly from the tank 17 of the lapping apparatus A, which in this context serves as a storage container of the odourising liquid.

[0029] During this operation the pressurisable tank 5 is cyclically and alternatively filled and emptied of odourising liquid by the flow of gas 6 which provides the energy needed to support the injection process.

[0030] More specifically, through the activation of the injector 10, the odourising liquid is injected into the delivery pipeline 4 of the distribution station 1 and its volume is replaced with an identical quantity of natural gas which takes its place inside the pressurisable tank 5.

Once the necessary quantity of liquid has been injected according to the actual flow rate of the gas transiting in the delivery pipeline 4, the injection phase is interrupted, the solenoid valves 15 and 16 are opened and consequently the 0.6 bar overpressure Δp_1 present inside the pressurisable tank 5 is unloaded into the delivery pipeline 4: downstream of a pressure regulating apparatus 24 with which the delivery pipeline 4 is provided, but upstream of the meter 3, hence remaining regularly and properly accounted for.

[0031] At this point, since the pressurisable tank 5 of the injection apparatus B and the horizontal tank 17 of the lapping apparatus are at the same pressure and since between the two tanks 5 and 17 a certain difference in level H is provided, the odourising liquid flows out through the valve 16 and progressively fills the pressurisable tank 5 of the injection apparatus B. The gas contained therein is thus forced to exit the pressurisable tank 5 and to move into the delivery pipeline 4 through the pipe 12.

[0032] In the filling phase of the pressurisable tank 5, a corresponding volume of liquid will progressively be emptied from the tank 17 of the lapping apparatus A, which is refilled with an identical volume of gas drawn from the intake pipeline 4, upstream of its interconnection with the injection apparatus B.

[0033] Once the set volume of liquid has been loaded, the two solenoid valves 15 and 16 are brought back into their resting position, the pressurisable tank 5 is pressurised anew, and the injection apparatus B resumes injecting the computed quantities.

[0034] The invention fully attains its aims and it is suitable for industrial application in a relatively simple and economical manner. The invention thus conceived can also be subject to numerous modifications and variations, without thereby departing from the scope of the inventive concept; moreover, all details can be replaced by technically equivalent elements.

Claims

1. Method for odourising a gas, in a pumping station (1) provided with an intake pipeline (2) for drawing the gas from a distributing line, with a meter (3) and with a pipeline (4) for delivering the gas towards a user, arranged in mutual succession; method which comprises a phase whereby an odourising liquid is dispersed into the gas transiting in the gas delivery pipeline (4) by a controlled injector (10) of odourising liquid, characterised in that it comprises the cyclical phases of supplying the injector (10) with odourising liquid contained in a pressurisable tank (5) of predetermined volumes by means of the thrust imparted on the odourising liquid by a flow (6) of gas drawn from the intake pipeline (2) and introduced into the pressurisable tank (5); re-injecting the flow (6) of gas back into the intake pipeline (2), upstream of

the meter (3); and refilling the pressurisable tank (5) of the odourising liquid with a volume of liquid corresponding to the transferred volume.

2. Method according to claim 1, characterised in that the phase whereby the pressurisable tank (5) is re-filled with odourising liquid is implemented via natural gravity through a loading pipe (7) connecting a storage tank (17) of the odourising liquid with the pressurisable tank (5). 5
3. Method according to one of the previous claims, characterised in that said phases are controlled in sequence and duration by management and control means (9) which receive as an input a signal (s1) corresponding to the flow rate of gas transiting through the meter (3) and send as outputs signals (s2, s3) for regulating respectively the flow rate of the gas (6) drawn from and re-injected into the pipeline (2) for drawing the gas and of the flow rate of the odourising liquid that flows through the loading tube (7). 10
4. Apparatus for odourising a gas, in a pumping station (1) provided with an intake pipeline (2) for drawing the gas from a distributing line, with a meter (3) and with a pipeline (4) for delivering the gas towards a user, arranged in mutual succession, characterised in that it comprises at least an injector (10) of the odourising liquid connected with the delivery pipeline (4); a pressurisable tank (5) of pre-determined volume, connected to the injector (10); a first pipe (11) which conveys into the pressurisable tank (5) a flow (6) of gas drawn from the intake pipeline (2), upstream of the meter (3); a second pipe (12) which connects the pressurisable tank (5) to the intake pipeline (2) and which re-injects the flow (6) of gas thereinto, upstream of the meter (3). 15
5. Apparatus according to claim 4, characterised in that the first pipe (11) is provided with pressure reducing means (13, 14) which reduce the pressure of the incoming gas received down to a value of pressure of the outgoing gas which is pre-determined and exceeds by a pre-set different the pressure of the gas that flows through the delivery pipe (4) and which opposes the injection of the odourising liquid into the gas. 20
6. Apparatus according to claim 5, characterised in that the pressure reducing means comprise a first and a second reducing filter (13, 14) arranged in mutual succession. 25
7. Apparatus according to claim 6, characterised in that the first reducing filter (13) reduces the pressure of the gas by an input pressure value (P1) down to an output pressure (P2) corresponding to 30

the pressure of the gas in the delivery pipeline (4) increased by a value (Δp).

8. Apparatus according to claim 6, characterised in that the second reducing filter (14) reduces the pressure (P2) of the gas received at the input down to an output pressure (P3) corresponding to the pressure of the gas flowing in the delivery pipeline (4) increased by a value of pressure (Δp_1). 35
9. Apparatus according to one of the previous claims from 5 through 8, characterised in that it comprises a switching valve (15) which allows to depressurise the pressurisable tank (5) making the flow of gas (6) flow through the pipe (22) towards the pipe (12) upstream of the meter (3). 40
10. Apparatus according to claim 9, characterised in that the switching valve (15) is a 3-way valves that intercepts the gas flowing out of the pressure reducing means (13, 14) and, in one of its operating conditions, allows to pressurise the pressurisable tank (5) containing the odourising liquid. 45
11. Apparatus according to claim 10, characterised in that the pipe (7) for loading the odourising liquid is provided with a valve (16) whose closure allows to pressurise the pressurisable tank (5) and to transfer the odourising liquid contained therein. 50

FIG.1

