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

(11) Publication number: **0 673 676 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **95104134.2**

(51) Int. Cl.[6]: **B01F 3/02**

(22) Date of filing: **21.03.95**

(30) Priority: **22.03.94 US 216000**

(43) Date of publication of application:
27.09.95 Bulletin 95/39

(84) Designated Contracting States:
ES IT

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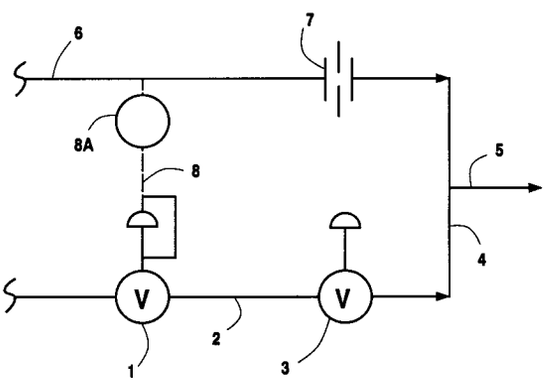
(54) Gas blending system.

(57) A tracer gas line (2) and a carrier gas line (6) are used to provide a tracer gas, such as helium, and a carrier gas, such as nitrogen, for blending. A back pressure controlling regulator (1) is positioned in the tracer gas line and is controlled by a signal from the carrier gas line, so that the tracer gas pressure matches the carrier gas pressure under varying carrier gas flow and/or downstream pressure conditions. The two gas lines are piped to a common discharge manifold (4), and contain valves or orifices (3,7) adapted to maintain the same carrier and tracer gas flow proportions independent of changes in carrier flow or pressure.



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Background of the Invention

Field of the Invention

The invention relates to a gas blending system. More particularly it relates to a system for the accurate mixing of a tracer gas with a carrier gas.

Description of the Prior Art

An important industrial service carried out in a variety of applications is a leak detection service for the detecting of leaks in pipelines or other fluid passage or storage systems. Such service typically utilizes a mass spectrometer or other devices to sample the atmosphere surrounding a point in a system suspected of containing a leak. Helium, which is commonly used for such purposes, is used because it is rare in the atmosphere and rapidly dissipates into the atmosphere. As a result, a leak in one area does not contribute to a high leak reading in other areas, as can occur when other tracer gases, such as fluorocarbons or sulfur hexafluorides are employed. However, helium is expensive to use in its pure form so an inert carrier gas, typically nitrogen, is mixed with the helium and then injected into the system to be checked. While the proportions in which the helium will be mixed with nitrogen can vary, a typical helium/nitrogen mixture will commonly be in the 1-2% range, although higher or lower proportions of helium can also be employed. Such leak detection requires the accurate mixing of a tracer gas, such as helium, with a carrier gas, such as nitrogen. Two factors complicate such accurate mixing of the leak detection gas components. First, the gas mixture is used to pressurize a system for leak testing. As a result, the pressure of said leak detection gas is constantly changing. Secondly, the carrier gas, e.g. nitrogen, is provided by a pumper unit. As a result, the flowrate of the carrier gas, e.g. nitrogen, can easily be changed. In order to maintain a desired concentration of the tracer gas in the carrier gas under such variable circumstances, it is desirable to have a mixing system that would respond to such change of carrier gas, i.e. nitrogen, flow and adjust the tracer, i.e. helium, flow without the need for operator adjustments to compensate for such variable conditions encountered in practical commercial operations.

One approach taken in the art in light of such operational problems was to provide an "automatic" control system using flow meters, control valves and feedback controllers. In this approach, the flow rate of the carrier gas is measured, and a microprocessor is used to calculate the required flow of the tracer gas. The actual flow of the tracer gas is measured and compared to said required flow. A control valve is then operated in response to a feed signal to adjust the tracer gas flow to match the required flow.

A second approach suggested in the art was to provide a "manual" control system to achieve a steady state gas mixture. If the carrier gas flow rate changes, the system is adjusted to change the tracer gas flow rate. Such a system would require the use of two flow regulators and two back pressure regulators in conjunction with control valves to provide steady state conditions during the desired gas blending operation.

There remains, however, a desire in the art for further advancement in the gas blending field. Thus, a lower cost, less complex and more reliable system is desired than is provided by said "automatic" control system or by said "manual" control system. Increased reliability, decreased maintenance and the absence of a power source requirement vis-a-vis the characteristics of said "automatic" control system would be advantageous, particularly for the intended portable use in the field of such gas blending system for leak detection services. The greater reliability of the "manual" control system is desired, but with simpler operation providing automatic adjustment of tracer gas flow in response to varying carrier gas flow and/or downstream pressure conditions.

It is an object of the invention to provide an improved gas blending system.

It is another object of the invention to provide a gas blending system capable of accurately mixing tracer gas with a carrier gas, under gas supply flow and pressure conditions subject to fluctuations, without the need for complex and expensive control systems.

With these and other objects in mind, the invention is hereinafter described in detail, with the novel features thereof being particularly pointed out in the appended claims.

Summary of the Invention

The invention employs a back pressure regulator on the tracer gas line, with the control signal therefor coming from the carrier gas line. As a result, the tracer gas pressure will match the carrier gas pressure. Upon being piped into a common discharge manifold, with properly sized orifices or valves in each line supplying the manifold, the carrier gas and the tracer gas flows will always remain in the same proportion independent of flow or pressure.

Brief Description of the Drawing

The invention is hereinafter described in detail with reference to the accompanying single figure

drawing that is a schematic flow diagram of an embodiment of the gas blending system thereof.

Detailed Description of the Invention

The objects of the invention are accomplished by a low-cost gas blending system, as herein described and claimed, that is less complex and more reliable than the "automatic" control system referred to above. It provides all the advantages thereof without the cost and complexities of the flow meters, control valves and microprocessor based control utilized in said "automatic" control system. The gas blended system of the invention is intended for portable use in leak detection industrial service activities carried out at job sites in the field. For such purposes, it offers the added advantages of increased reliability, decreased maintenance and no source of power requirement.

While the gas blending system of the invention has the reliability of the "manual" system, it is a simpler, less complex system than said prior art system, and is a full automatic system. Thus, while it is simpler than the manual system, it provides automatic adjustment of tracer gas flow in response to varying carrier gas flow and/or downstream pressure.

The essence of the invention, as indicated above, is the use of a back pressure regulator on the tracer, i.e. helium, gas line, with the signal therefore coming from the carrier, i.e. nitrogen, gas line. In the drawing, said back pressure controlling regulator, represented by the numeral 1, is positioned in tracer gas line 2 having a downstream flow control valve 3. Tracer gas line 2 is piped for flow into the common discharge manifold 4 from which blended gas is removed in line 5. Carrier gas line 6 containing fixed orifice 7 is also piped for flow into said manifold 4. Back pressure controlling regulator 1 is controlled by signal 8 from pressure sensor 8A capable of sending a control signal corresponding to the pressure m the flow line of said carrier gas upstream of the positioning of flow control means, e.g. fixed orifice 7, in the flow line for said second gas. As arranged, said back pressure controlling regulator 1 in tracer gas line 2 senses the carrier gas pressure in line 6 upstream of carrier gas orifice 7.

It will be understood that the relative flow coefficient of valve 3 in tracer gas line 2 and of orifice 1 in carrier gas line 6 determine the proportion of carrier gas and tracer gas in the resulting blended mixture. Control valve 3 is adjustable so as to enable the proportion of tracer gas to carrier gas to be adjusted to any desired proportion of the gases for any particular gas blending operation. However, once set, the proportions of said gases will remain the same as flow and pressure conditions change over the course of a given gas blending operation.

Those skilled in the art will appreciate that various changes and modifications can be made in the details of the invention without departing from the scope of the invention as set forth in the appended claims. Thus, orifice 7 in carrier gas line 6 can be replaced by a variable orifice, i.e. control valve. If control valve 3 in tracer line 2 is employed, however, then the use of a variable orifice in carrier gas line 6 offers no real advantage. If control valve 3 is changed to a fixed orifice in other embodiments of the invention, then the use of a variable orifice, i.e. control valve, in carrier gas line 6 in place of fixed orifice 7, would enable the tracer gas/carrier gas mixture ratio to be adjusted for different application needs. However, the installing of a variable orifice in place of fixed orifice 7, in line 6, and a fixed orifice in place of flow control valve 3 in line 2, would increase the overall cost of the system, since the carrier gas is usually employed at higher flow rates than pertain to said tracer gas level, hence, would require a larger and more expensive variable orifice to be used in line 6 than would be the case for the preferred practice, as illustrated in the drawing, of using a variable orifice in tracer gas flow line 2.

It will be appreciated that valve 3 can be replaced by a fixed orifice so that both lines 2 and 6 contain fixed orifices. The use of such embodiments would reduce the cost of the gas blending system, but would eliminate the adjustability feature of the mixture proportions unless, in conjunction therewith, fixed orifice 7 in line 6 were changed to a variable orifice as referred to above. The use of valves in both lines 2 and 6 is also within the scope of the invention, but is not necessary for the reasons above.

While this invention has been described with respect to the blending of helium and nitrogen as a commonly employed, desirable and conveniently detectable tracer gas and inert carrier gas combination, the invention can also be employed using other tracer gas/carrier gas combinations, if convenient at a desired job site, and for other purposes than for the leak detection services referred to herein.

The invention provides a low cost, reliable means for accurately mixing a tracer gas with a carrier gas or carrying out other desirable gas blending operations. The system of the invention provides a reliable system that, due to its less complex nature than previous alternatives, is well suited for portable use in providing accurately mixing of a tracer gas in a carrier gas for use of commercially important leak detection operations.

Claims

1. An improved gas blending system for the accurate mixing of a desired proportion of a first gas into a second gas under variable second gas flow and/or downstream pressure conditions, comprising:
   (a) a flowline for said first gas;
   (b) a flow line for said second gas;
   (c) a common discharge manifold in flow communication with the discharge ends of said flow lines for the first gas and the second gas;
   (d) a discharge line for removing mixed first gas and second gas from said common discharge manifold;
   (e) flow control means in said flow line for said first gas and in said flow line for said second gas; and
   (f) pressure sensing means capable of transmitting a control signal corresponding to the pressure in the flow line of said second gas upstream of the positioning of flow control means in the flow line for said second gas;
   (g) a back pressure controlling regulator positioned in the flow line for said first gas, Upstream of the positioning of the flow control means therein, said back pressure controlling regulator being adapted (1) to receive said control signal corresponding to the pressure in the flow line for said second gas, and (2) to match the pressure in the flow line for said first gas to the pressure in the flow line for said second gas;
   whereby said gas blending system constitutes a reliable, low cost, fully automatic means for accurately mixing the first gas with the second gas under varying second gas flow and downstream pressure conditions.

2. The gas blending system of Claim 1 in which the flow control means in the flow line of the first gas comprises a valve, and the flow control means in the flow line of the second gas comprises a fixed orifice.

3. The gas blending system of Claim 1 in which the flow control means in the flow line of the first gas comprises a fixed orifice, and the flow control means in the flow line of the second gas comprises a valve.

4. The gas blending system of Claim 1 in which the flow control means in said flow line for said first gas and in said flowline for said second gas each comprise a fixed orifice.

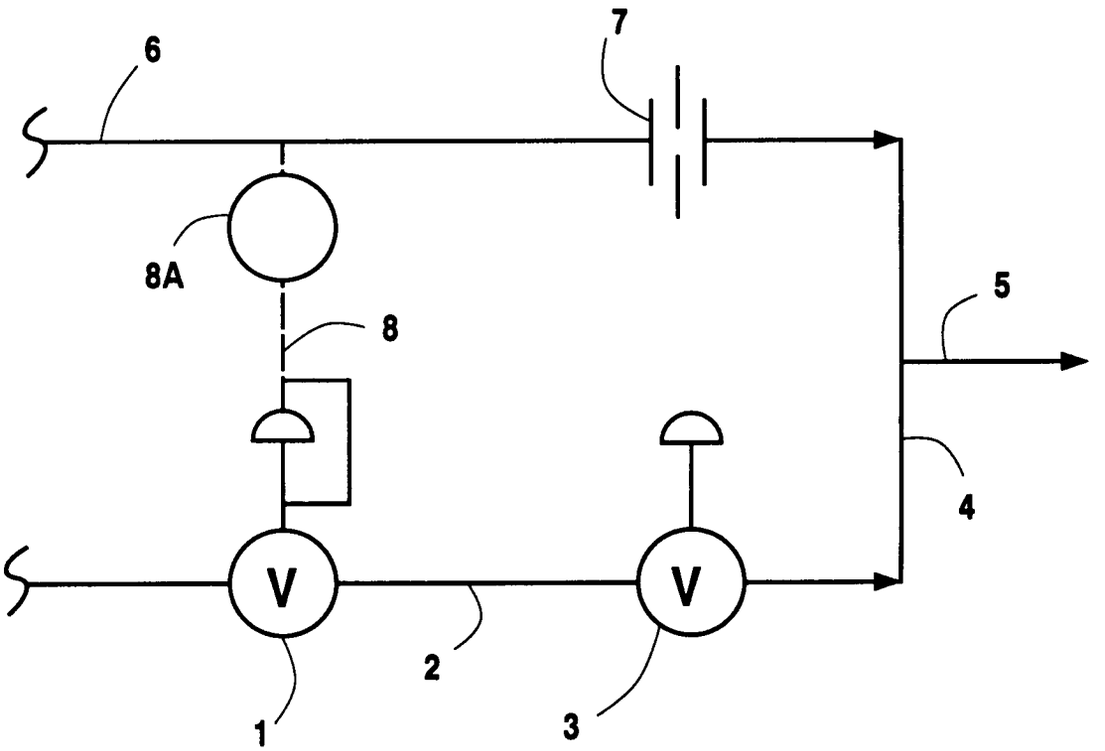
5. The gas blending system of Claim 1 and including a source of tracer gas as said first gas and a source of carrier gas as said second gas, said gas blending system being adapted to accurately mix a desired amount of said tracer gas in said carrier gas.

6. The gas blending system of Claim 5 in which said source of tracer gas comprises a source of helium, and said source of carrier gas comprises a source of nitrogen.

7. The gas blending system of Claim 6 in which the flow control means for the flow line of the helium tracer gas comprises a valve, and the flow control means in the flow line of the nitrogen carrier gas comprises a fixed orifice.

8. The gas blending system of Claim 6 in which the flow control means in the flow line of the helium tracer gas comprises a fixed orifice, and the flow control means in the flow line of the nitrogen carrier gas comprises a valve.

9. The gas blending system of Claim 6 in which the flow control means in the flow line of said helium tracer gas and in said flow line of the nitrogen carrier gas each comprise a fixed orifice.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EUROPEAN SEARCH REPORT

Application Number
EP 95 10 4134

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.6)
X	GB-A-K27703 (FABRICATION DES COMTEURS) &GB-A-27703 A.D. 1910	1-9	B01F3/02
X	GB-A-743 655 (KEITH BLACKMAN)	1-9	
X	GB-A-2 202 459 (DISTILLERS)	1-9	
A	EP-A-0 578 578 (SELAS CORPORATION)		
A	US-A-3 221 757 (NEWTON)		
A	DE-A-42 25 981 (LINDE)		

TECHNICAL FIELDS SEARCHED (Int.Cl.6)
B01F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	10 July 1995	Peeters, S

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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