(12) UK Patent Application (19) GB (11) 2 425 183 (13) A

(43) Date of A Publication 18.10.2006

(21) Application No: 0607285.4

(22) Date of Filing: 11.04.2006

(30) Priority Data:
(31) 102005017445 (32) 15.04.2005 (33) DE

(71) Applicant(s):
Dräger Safety AG & Co KGaA
(Incorporated in the Federal Republic of Germany)
Revalstrasse 1, D-23560 Lübeck,
Federal Republic of Germany

(72) Inventor(s):
Peter Tschuncky
Herbert Kiesele
Uwe Kühn
Frank Mett
Andreas Hengstenberg
Kerstein Caro

(74) Agent and/or Address for Service:
Graham Watt & Co LLP, Patent & Trade Mark Attorneys
St Botolph's House, 7-9 St Botolph's Road,
SEVENOAKS, Kent, TN13 3AJ,
United Kingdom

(51) INT CL:
G01N 33/00 (2006.01) G01N 27/416 (2006.01)
G01N 27/417 (2006.01)

(52) UK CL (Edition X):
G1N NBKT

(56) Documents Cited:
GB 2291189 A WO 1998/025139 A1
US 6632674 B1 US 6454923 B1

(58) Field of Search:
UK CL (Edition X) G1N
INT CL G01N
Other: online: WPI, EPODOC

(54) Abstract Title: **Gas Measuring System With Gas Sensor And Gas Generator**

(57) The invention relates to a gas measuring system, containing at least one gas sensor (1) and at least one gas generator (4), whereby the gas sensor (1) has at least one measuring area (3), at which a target gas concentration can be measured, the gas generator (4) has at least one exit area (5), from which a flow-proportional test gas quantity can emerge, whereby the measuring area (3) and the exit area (5) are designed in such a way and the gas sensor (1) and the gas generator (4) can be arranged in such a way that the measuring area (3) and the exit area (5) are in direct contact with the ambient atmosphere and the distance between the two areas is smaller than the extension of the smaller of the two areas. The extension of the area means, depending on the shape of the area, a characteristic length, for example the diameter or a side length which can be used to describe the size of the area.

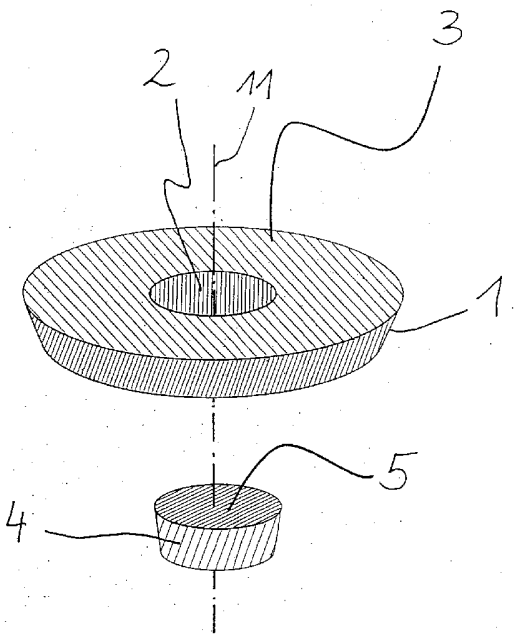

Fig. 1

GB 2 425 183 A

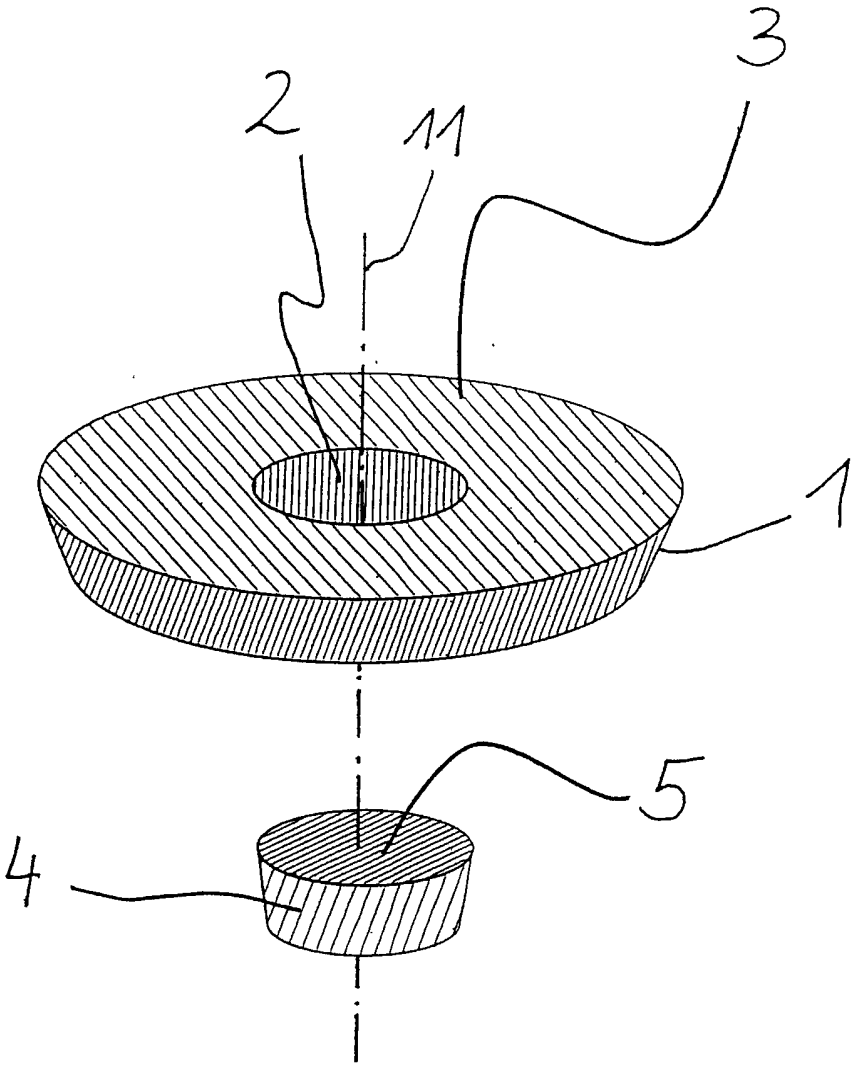

Fig. 1

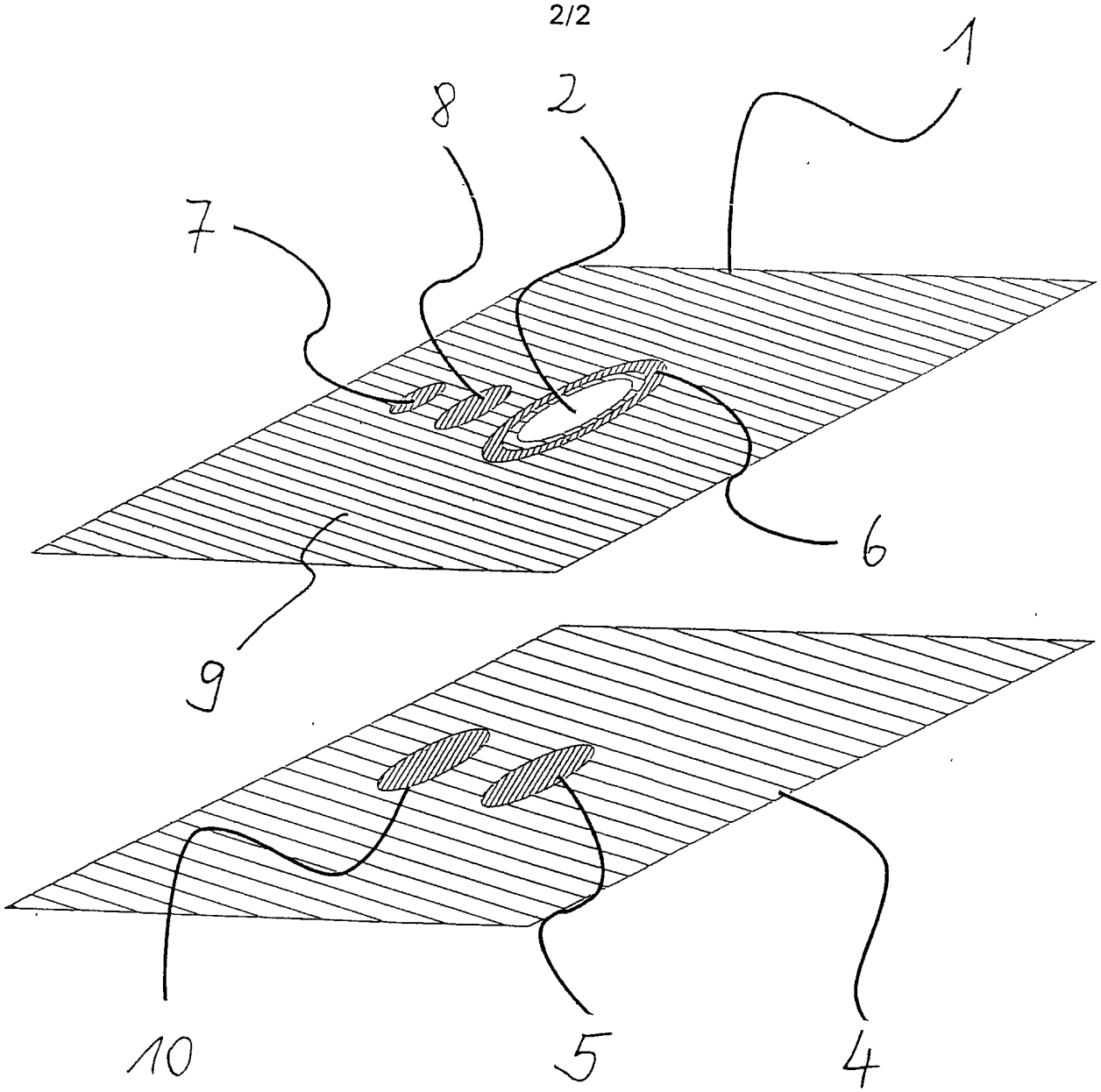

Fig. 2

Gas measuring system with gas sensor and gas generator

The invention relates to a gas measuring system with a gas sensor and a gas generator. To advantage, such systems can be used wherever the readiness for operation of gas measuring systems has to be guaranteed over a lengthy period. This is the case for example with the use of gas warning devices installed fixed or mobile gas measuring devices in use over a lengthy period.

When gas warning devices are used, there are essentially two reasons for the requirement that the gas sensors used should respond in a selective manner. In the first place, an undiagnosed failure of a gas sensor, e.g. due to blocking of the gas admission or inactivation of the detector element, can lead to safety risks in a monitored area. The sensor therefore has to be subjected to a functional test at short intervals. In the second place, gas sensors available commercially exhibit a drift in the sensitivity of the sensor in respect of the species to be detected. This behaviour of the sensor cannot be described or predicted my mathematical formulae. It is therefore necessary to calibrate sensors with a target gas of known concentration within specific time intervals. The length of the calibration intervals is determined by the requirements on the desired accuracy of the sensor. Guidelines for dealing with this problem are summarised for example in leaflet T021 of the professional association of the chemical industry.

The proper functioning of the sensor is best tested by admitting the target gas to the sensor. Only in this way can the whole functional chain from the gas supply up to the signal generation be tested. It is usual, therefore, to keep calibration means in reserve, e.g. in the form of compressed gas containers, often with toxic gases, to transport said calibration means to the sensor and there finally to apply the test gas into the gas admission of the given sensor by means of suitable devices, such as for example pumps, valves and/or mass flow-rate controllers. The cost of carrying out these functional tests and calibration procedures is high.

In order to avoid this expenditure, it is known to accommodate a gas generator together with a gas sensor in a common housing (GB 2254696). The common housing is bounded towards the measuring gas by a gas-permeable membrane. Occasional activation of the gas generator thus permits the sensor function to be tested, but it does not give any information as to the state of the transport paths via which the admission of the target gas takes place in the regular measuring operation. These transport paths are determined for example by a gas-permeable membrane, through which the target gas can pass into the vicinity of a detector electrode.

It is further known to convey test gas in a similar manner through a membrane connected both to a gas generator and a sensor (EP 0744620 B1). There too, it is difficult to draw conclusions about the state of the external membrane allowing the gas admission to the detector electrode.

It is further known to inject a test gas into a test gas chamber via detector electrodes in the interior of the sensor housing. The test gas chamber is located downstream of the external gas admission (US6635160). However, the gas admission from the exterior to this chamber and thus also to the detector electrode of the sensor also remains untested in this design.

Diagnostic procedures for sensors are also known, in which test gas is pressed mechanically through an aperture to a sensor, conveyed by the addition of a propellant and moved by thermal expansion to the sensor (US4151739). This method, too, has the drawback that the path of the ambient gas to the detector electrode is not tested under realistic conditions.

The present invention is as claimed in the claims.

Embodiments of the present invention provide a reliable testing and calibration capability which, with little outlay, enables a complete functional test and/or calibration of gas sensors.

Advantageous developments of the invention are specified in the dependent claims.

A gas measuring system according to the invention includes at least one gas sensor and one gas generator. The invention can in principle be performed with gas sensors and gas generators, whereby it is less a matter of the functional principle of the elements used than their geometrical structure. Gas sensor within the meaning of the

invention, therefore, is understood to mean any subassembly which, in the presence of a detectable concentration of a target gas, delivers a signal which can be evaluated. Gas generator within the meaning of the invention is understood to mean any subassembly which can deliver a defined quantity of this target gas. Typical gas sensors are electro-chemical gas sensors.

The invention comprises a gas measuring system, which contains at least one gas sensor and at least one gas generator, whereby the gas sensor has at least one measuring area, at which a target gas concentration can be measured, the gas generator has at least one exit area, from which a flow-proportional test gas quantity can emerge, whereby the measuring area and the exit area are designed in such a way and the gas sensor and the gas generator can be arranged in such a way that the measuring area and the exit area are in direct contact with the ambient atmosphere and the distance between the two areas is smaller than the extension of the smaller of the two areas. Extension of the area is understood to mean, depending on the shape of the area, a characteristic length, for example the diameter or a side length, which can be used to describe the size of the area. The distance between the measuring area and the exit area is preferably at least an order of magnitude smaller than this characteristic length.

Advantageously, the invention comprises a gas measuring system, which contains at least one gas sensor and at least one gas generator, whereby the gas sensor has at least one measuring area, at which a target gas concentration can be measured, the gas generator has at least one exit area, from which a flow-proportional test gas

quantity can emerge, whereby the measuring area and the exit area are designed in such a way and the gas sensor and the gas generator can be arranged in such a way that the measuring area and the exit area have a common axis of symmetry, both areas are in direct contact with the ambient atmosphere and the distance between the two areas is smaller than the smallest distance between the edge of one of the two areas and the axis of symmetry.

The gas sensor may be formed for example by a standard gas-permeable membrane, through which a target gas enters into the interior of an electro-chemical sensor. A change in the concentration of the target gas at this measuring area can be quantified as a change in the output signal of the gas sensor.

An essential advantage of the invention is the fact that the test gas does not have to be conveyed actively to the sensor and a minimum susceptibility of the arrangement to interference from ambient influences exists due to the spatial proximity of gas generator and detector. The adjacent arrangement of measuring area and exit area makes it possible to admit very small target gas quantities to the gas sensor. It has been shown that, especially if the advantageous symmetry condition described above is adhered to, a configuration results which operates surprisingly stably and which even permits undisturbed and reliable operation in the presence of extreme external air flows.

According to the invention, the gas sensor and the gas generator can be designed as subassemblies which are separate and capable of functioning independently of one

another. The structural shapes of the subassemblies are of lesser importance. They must be designed, however, in such a way that the inventive, closely adjacent arrangement of the measuring area of the gas sensor and the exit area of the gas generator is possible for testing and calibration purposes. Arrangements are deemed to be closely adjacent in which the spacing according to the invention can be adhered to and no flow obstructions are present on the direct path between the measuring area and the exit area. It has proved to be particularly advantageous if both areas are exposed to the same flow conditions during the testing and/or calibration. This can be achieved, for example, by a radially symmetric arrangement, in which the measuring area and the exit area lie in a plane. The measuring area can either surround the exit area in a radially symmetric manner or vice versa.

Embodiments of the invention will now be explained, by way of example only, with reference to the accompanying drawings of which:

Fig. 1 is a schematic diagram of a gas measuring system according to the present invention, which can be arranged according to the key-lock principle; and

Fig. 2 is a schematic drawing of a gas measuring system according to the invention, which includes a gas sensor and a gas generator in the form of planar subassemblies, which can be brought into contact with one another over a two-dimensionally extending area.

Fig. 1 shows a gas measuring system according to the invention. It includes an electro-chemical three-electrode sensor as gas sensor 1, such as can be used for the detection of hydrogen sulphide. This particular sensor contains a working electrode made of iridium, a secondary electrode made of platinum and a platinum/platinum oxide reference electrode. Sulphuric acid is used as an electrolyte. The housing of the sensor has the shape of a flat truncated cone and has an opening 2 in the centre. The base area is closed with a gas-permeable membrane and functions, within the meaning of the invention, as measuring area 3 at which a target gas concentration can be measured. This gas measuring system also includes a tablet-shaped hydrogen sulphide generator as gas generator 4. A base area of the generator serves as exit area 5 within the meaning of the invention, from which a quantity of hydrogen sulphide proportionate to the resulting current flow emerges when a voltage is applied.

The gas sensor and gas generator are designed as completely separate subassemblies. The diameter of the tablet-shaped hydrogen sulphide generator is selected such that it fits into central opening 2 of the sensor. It is thus possible for gas sensor 1 and gas generator 4 to be jointed into one another according to the key-lock principle, i.e. one subassembly surrounds the other in a radially symmetric manner in the testing and calibration mode. At the same time, measuring area 3 and exit area 5 are located in a plane when gas sensor 1 and gas generator 4 are jointed into one another.

Both subassemblies are also capable of functioning individually as a sensor or as a gas generator, but become a complete system capable of analysis as a result of the jointing together described above. In a geometrical modification, both the sensor and the gas generator can assume the function of the key or the function of the lock. In the jointed-together state, gas sensor 1 and gas generator 4 have a common axis of symmetry 11.

Fig. 2 shows a gas measuring system according to the invention which includes a gas sensor 1 and a gas generator 4 in the form of planar subassemblies, which are brought into contact with one other over a three-dimensionally extending area. Gas sensor 1 and gas generator 4 are again designed as completely separate, planar subassemblies. Gas sensor 1 is also designed as a three-electrode sensor and contains the same electrode and electrolyte materials as the sensor in figure 1. Working electrode 6 is annular and arranged in a plane with secondary electrode 7 and reference electrode 8. The electrodes are located in a flat electrolyte reservoir, which is surrounded by a flexible housing 9. It is ensured that the measuring gas can reach annular working electrode 6. This can be achieved for example by means of a gas-permeable membrane which enables access of the measuring gas to working electrode 6. Annular working electrode 6 surrounds a circular opening 2 which runs through the sensor housing.

Gas generator 4 with a disc-shaped generator electrode 10 and a gas outlet membrane as exit area 5 can be positioned behind the gas sensor during operation, in such a way that exit area 5 from which the test gas emerges completely fills circular

opening 2 in the centre of annular working electrode 6 of gas sensor 1, but without being covered.

In this embodiment, too, it does not matter in which subassembly an opening is arranged. It is only important that one of the two subassemblies has an opening (hole), which is designed in such a way that the function-bearing element of the other subassembly fits as precisely as possible into this opening. The two subassemblies can then be brought into close spatial proximity by means of an arrangement in which the subassembly with the opening is arranged in front of the subassembly without the opening and thus make it possible to house the detector element in the "sphere of influence" of the test gas generator.

CLAIMS

1. A gas measuring system containing at least one gas sensor and at least one gas generator and in which the gas sensor has at least one measuring area at which a target gas concentration can be measured, the gas generator has at least one exit area from which a flow-proportional test gas quantity can emerge, and the measuring area and the exit area are designed in such a way and the gas sensor and the gas generator can be arranged in such a way that the measuring area and the exit area are in direct contact with the ambient atmosphere and the distance between the two areas is smaller than the extension of the smaller of the two areas.

2. The gas measuring system according to claim 1, in which the measuring area and the exit area are designed in such a way and the gas sensor and the gas generator can be arranged in such a way that the measuring area and the exit area have a common axis of symmetry, both areas are in direct contact with the ambient atmosphere and the distance between the two areas is smaller than the smallest distance between the edge of one of the two areas and the axis of symmetry.

3. The gas measuring system according to claim 2, in which the measuring area surrounds the exit area in a radially symmetric manner.

4. The gas measuring system according to claim 2, in which the exit area surrounds the measuring area in a radially symmetric manner.

5. The gas measuring system according to any one of claims 1 to 4, in which the external shape of the gas sensor and the gas generator enables them to be jointed into one another according to the key-lock principle.

6. The gas measuring system according to claim 5, in which the measuring area and the exit area lie in a plane when the gas sensor and the gas generator are jointed into one another.

7. The gas measuring system according to any one of claims 1 to 4, in which the gas sensor and the gas generator form planar subassemblies which can be brought into contact with one another over a three-dimensionally extending area.

8. The gas measuring system according to claim 7, in which the measuring area is arranged in an annular manner around an opening in the gas sensor and the exit area is arranged behind this opening when the gas sensor and the gas generator are brought into three-dimensionally extending contact with one another.

9. The gas measuring system according to claim 8, in which the exit area is arranged in an annular manner around an opening in the gas generator and the measuring area is arranged behind this opening when the gas sensor and the gas generator are brought into three-dimensionally extending contact with one another.

10. A gas measuring system substantially as hereinbefore described with reference to, and/or as shown in, the accompanying drawings.

The Patent Office

For Innovation

12

Application No:	GB0607285.4	**Examiner:**	Mr Daniel Jones
Claims searched:	1-10	**Date of search:**	26 July 2006

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1	US 6454923 B1 (DODGSON et al.) See fig. 10 and col. 14 lines 4-17.
X	1	WO 98/25139 A1 (CENTRAL RESEARCH LABORATORIES LIMITED) See abstract and figs.
X	1	US 6632674 B1 (WARBURTON) See figs 3 and 10.
X	1	GB 2291189 A (COMPUR MONITORS SENSOR TECHNOLOGY) See abstract.

Categories:

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.

Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

G1N

Worldwide search of patent documents classified in the following areas of the IPC

G01N

The following online and other databases have been used in the preparation of this search report

WPI, EPODOC