

(19)



Europäisches Patentamt

European Patent Office

Office européen des brevets



(11)

EP 1 151 978 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

07.11.2001 Bulletin 2001/45

(51) Int Cl.7: **C06B 23/04**, C06B 45/00,
C06D 5/06, C06B 23/02

(21) Application number: **00201612.9**

(22) Date of filing: **02.05.2000**

(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

(71) Applicant: **Nederlandse Organisatie voor
toegepast-natuurwetenschappelijk Onderzoek
TNO
2628 VK Delft (NL)**

(72) Inventor: **Van den Berg, Ronald Peter
2584 AK Den Haag (NL)**

(74) Representative: **Prins, Adrianus Willem et al
Vereenigde,
Nieuwe Parklaan 97
2587 BN Den Haag (NL)**

(54) **Process for generating a gas**

(57) The present invention is directed to a process
for generating a gas, comprising providing a gas having

a temperature of at most 100°C, by using the endother-
mal decomposition of a product made of gas penetrable
solid material.

EP 1 151 978 A1

Description

[0001] The invention relates to applied chemistry, more specifically to the generation of gases of low temperature for various purposes.

[0002] Under various circumstances there exist the need for providing a gas to a system, for example for blanketing purposes, passivation, medicinal, cooling, heating and the like. Usually these systems are either based on compressed gases stored in cylinders, or on compressors driven by external power, such as gasoline or electricity. The latter approach is not useful in case the power/energy has to be provided on locations where such facilities are not available. Examples thereof can be found in all kinds of emergency systems, rescue and salvage systems and the like. Also the use of compressed gas has disadvantages, as these systems require maintenance and cannot be relied on in situations where only occasionally need exists for its use. Further, the use of compressed gases may have the disadvantage of temperature decrease due to adiabatic expansion. Especially when relatively large amounts of gas are expanded to low pressure, temperatures may drop to -50°C , with the result of icing-up, or even blocking the opening by freezing.

[0003] The weight and size of the system for providing the gas for power generation is also an important consideration.

[0004] Gas generating processes based on the decomposition or burning of chemical propellants and other compositions are frequently being used for a number of purposes. It is known that gas for inflation can be generated by decomposition or burning of solid materials, such as azides. However, these materials have the disadvantage that they generate a very hot gas, which is often unwanted, because of the hazards thereof to the environment or the object to be inflated.

[0005] Accordingly there is a need for a system for generating a gas, which system is reliable, does not require maintenance, and which can be used in isolated situations, without the need for external supervision. Further, such a system should be generating gas of a relatively low temperature, which is preferably not harmful to the environment.

[0006] The present invention is based on the use of a generator of cold gas by using the endothermal decomposition of a product made of gas penetrable solid material.

[0007] The invention accordingly provides for a process for generating a gas, comprising providing a gas having a temperature of at most 100°C , by using the endothermal decomposition of a product made of gas penetrable solid material.

[0008] The hot gas generated by the burning of a solid material passes through the porous material. The heat of decomposition needed is given off by the hot gas, which cools as a consequence thereof.

[0009] The decomposition can consist of an endother-

mal reaction, or of a phase transition of the solid porous material. Examples of phase transition are melting, evaporation and sublimation.

[0010] The present invention can be used especially for all kinds of systems, that are carried out at difficult locations, such as in unpopulated areas, on sea or under the water, for rescue and salvage operations, and the like.

[0011] More in particular it is possible to use the invention for all kinds of applications where now compressed gas, air, nitrogen, oxygen, etc, are being used.

[0012] Examples thereof are the provision of a specific gas or a gas of a specific temperature for blanketing or passivation purposes. This includes producing gases for welding, like aluminium or spot welding. The provision of lasergas, using hydrogen or deuterium, is also a possibility.

[0013] Also for removing (flushing) unwanted gases, such as in gasoline or kerosene tanks, one may use the invention. Further embodiments include the cooling or heating of materials, by flushing them with the gas generated in accordance with the invention. Examples the heating of materials in extremely cold regions, for example in polar expeditions.

[0014] Other embodiments of the invention include the generation of a specific gas or gas mixture for certain purposes. Examples of these gases are hydrogen, deuterium, oxygen, nitrogen and the like. Some of the uses thereof have already been indicated here above, but others are the provision of oxygen in emergency oxygen masks in planes, shuttles and helicopters, generally in aerospace applications.

[0015] In this respect it is to be noted that the space and weight requirements of the systems used in the present invention for storing gases can compete with the standard cryogenic storage. For hydrogen there is the further advantage that no problems arise with respect to hydrogen embrittlement due to metal-hydride forming.

[0016] All these applications have in common that they require a relatively cold and harmless gas to be generated at short notice at locations where no external power is available. Important in these applications is also that the equipment is relatively compact and remains reliable even after long periods of storage, without maintenance or testing. Especially the use of compressed gas requires continuous maintenance activities. For example in remote locations this may be difficult to arrange.

[0017] In the present invention a method of generating cold gases, specifically nitrogen, oxygen, hydrogen, or a gas-mixture, is used, based on the endothermal decomposition of a product made of gas penetrable solid material. The gas penetrable solid material comprises a nitrogen (or other gas) source and a heat absorbing mixture, whereby the gaseous reaction products are cooled by passing the hot gases through the porous body of the product in the moving direction of the reaction front. The hot gases heat the porous body to a tem-

perature necessary to support the endothermic chemical reaction taking place. The heating of the porous body is necessary to enable the main reaction. The decomposition of the cooling agent is also an endothermic chemical reaction.

[0018] The type of gas generating material can be freely selected among the suitable propellant or other gas generating materials. Generally the gas to be generated will be nitrogen, but it is also possible to use oxygen, hydrogen or a suitable mixture of gases.

[0019] The high temperature burning gases are passed through the layer of the cooling agent or the heat exchanger and the temperature of the gases decreases as a result of the endothermal decomposition process of, or heat absorption by the cooling agent.

[0020] The degree of cooling of the generated gas depends on the nature of the cooling agent, the mass of the cooling agent, which can sometimes exceeds the mass of the gas-generating composition. Generally the gas is cooled to a temperature below 100°C, but a value within the range of 25 to 75°C is preferred.

[0021] When sodium compounds are used as the gas source for the low temperature gas production, the decomposition reaction generally results in Na and the gas. The formed gas is blown off and the slag remains. This slag comprises of the remains of cementing agent and cooling agent and metallic sodium. Under these conditions of gas generation the highly chemically reactive sodium is thus generated. This highly reactive material will accumulate in the condensed burning products and thus provides a potential hazard for persons involved. When moisture is present this can result in vigorous and dangerous reactions taking place in combination with the generation of the highly flammable and explosive hydrogen.

[0022] According to a preferred embodiment this problem can easily be overcome by the use of a gas generator comprising a first body, comprising means for the generation of gas, and a second body, comprising means for the generation of a neutralisation agent, wherein means are present for contacting the neutralisation agent with the reaction products formed in the generation of gas in the first body, and wherein means are present for operating the means in the second body at a temporal and/or spatial interval with the means in the first body.

[0023] The principle encompasses two gas generators in one housing. A first gas generator with the primary task of generating gas of low temperature, and a second gas generator with the primary task of generating neutralising compounds for the slag obtained from the first gas generator.

[0024] The first gas generator contains a composition from which gas of low temperature can be obtained by the decomposition of a gas generating composition in the form of a gas penetrable solid material wherein the generated gaseous products are passed through the porous body in the moving direction of the reaction front.

[0025] The second gas generator (the neutraliser) is another composition, comprising a gas generating composition together with an effective neutraliser compound, for instance sulphur. With the neutraliser composition gas and vaporised sulphur is generated at a time and space interval with the first gas generator. The gas and vaporised sulphur is generated at a rate and a manner that the effective neutralisation of slag is accomplished and the vaporised sulphur is not emitted. The vaporised sulphur reacts with the reaction products from the first gas generator such that the products are effectively neutralised.

Claims

1. Process for generating a gas, comprising providing a gas having a temperature of at most 100°C, by using the endothermal decomposition of a product made of gas penetrable solid material.
2. Process according to claim 1, wherein a combustible gas generating material is combusted and the generated hot gas is passed through the gas penetrable solid material.
3. Process according to claim 1 or 2, wherein a gas generator is used, comprising a first body, comprising means for the generation of gas, and a second body, comprising means for the generation of a neutralisation agent, wherein means are present for contacting the neutralisation agent with the reaction products formed in the generation of gas in the first body, and wherein means are present for operating the means in the second body at a temporal and/or spatial interval with the means in the first body.
4. Process according to anyone of the claims 1-3, wherein the gas is selected from the group of nitrogen, oxygen, hydrogen and gas-mixtures.
5. Process according to claim 1-4, wherein the gas is used for blanketing or passivation purposes.
6. Process according to claim 5, wherein the gas is used for welding of aluminium or for spot welding.
7. Process according to claim 1-4, wherein the gas is used for cooling or heating of materials.
8. Process according to claim 1-4, wherein the gas is used as lasergas.



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1612

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	FR 1 099 904 A (ETAT FRANCAIS) 14 September 1955 (1955-09-14) * page 1, left-hand column, line 30 - page 2, left-hand column, line 43 * * page 4, left-hand column, line 37 - page 5, right-hand column, line 3 *	1,2,4-8	C06B23/04 C06B45/00 C06D5/06 C06B23/02
Y	WO 00 06424 A (AUTOLIV ASP, INC.) 10 February 2000 (2000-02-10) * page 13, line 12 - line 27 * * page 18, line 15 - line 35 * * page 20, line 5 - line 20; claims *	1,2,4-8	
Y	US 4 298 412 A (R.A. BIDDLE ET AL.) 3 November 1981 (1981-11-03) * column 1, line 21 - line 44 *	1,2,4-8	
Y	US 2 744 816 A (A. CANTLAY HUTCHISON) 8 May 1956 (1956-05-08) * column 5, line 22 - line 43 *	4-8	
Y	CHEMICAL ABSTRACTS, vol. 132, no. 7, 12 February 2000 (2000-02-12) Columbus, Ohio, US; abstract no. 80495x, V.A. SHANDAKOV ET AL.: "Cold gas generators multiple use in hazardous situations" page 845; XP002140538 * abstract * & NATO Sci. Ser., I 1999, 26(Prevention of Hazardous Fires and Explosions), 341-346 --- -/--	1-8	TECHNICAL FIELDS SEARCHED (Int.Cl.7) C06B C06D
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 21 June 2000	Examiner Schut, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.02 (P4/C01)



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1612

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
Y	DATABASE WPI Section Ch, Week 199847 Derwent Publications Ltd., London, GB; Class E36, AN 1998-554999 XP002140541 & RU 2 108 282 C (ALTAI SCI PRODN ASSOC), 10 April 1998 (1998-04-10) * abstract *	1-8	
A	EP 0 767 155 A (MORTON INTERNATIONAL, INC.) 9 April 1997 (1997-04-09) * page 3, line 14 - line 47 * * page 5, line 9 - line 30; claims *	1-4	
A	WO 96 40541 A (TAKATA MOSES LAKE, INC.) 19 December 1996 (1996-12-19) * page 9, line 4 - line 16; claims *	1-4	
A	DE 43 18 883 A (TRW INC.) 9 December 1993 (1993-12-09) * column 13, line 55 - column 14, line 41 *	1-4	
A	US 4 758 287 A (J.F. PIETZ) 19 July 1988 (1988-07-19) * column 10, line 14 - line 30 * * column 11, line 21 - line 35; claims *	1,2	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
Place of search THE HAGUE		Date of completion of the search 21 June 2000	Examiner Schut, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03.82 (P04C01)



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 20 1612

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
A	CHEMICAL ABSTRACTS, vol. 132, no. 1, 3 January 2000 (2000-01-03) Columbus, Ohio, US; abstract no. 4539z, A.M. TELEGATOR ET AL.: "Ignition analysis of a porous energetic material: II. Ignition at a closed heated end." page 525; XP002140539 * abstract * & COMBUST. THEORY MODELL. , vol. 3, no. 3, 1999, pages 433-445,	1-4	
A	DATABASE COMPENDEX 'Online! ENGINEERING INFORMATION, INC., NEW YORK, NY, US KOMAROV V F ET AL: "Propellants, their properties, and regions of application" Database accession no. EIX99464805134 XP002140540 * abstract * & FIZ GORENIYA VZRYVA;FIZIKA GORENIYA I VZRYVA MAR-APR 1999 MEZHDUNARODNAYA KNIGA, MOSCOW, RUSSIA, vol. 35, no. 2, March 1999 (1999-03), pages 30-34,	1-4	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
Place of search THE HAGUE		Date of completion of the search 21 June 2000	Examiner Schut, R
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/92 (P04C01)

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

EP 00 20 1612

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

21-06-2000

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
FR 1099904 A	14-09-1955	NONE	
WO 0006424 A	10-02-2000	US 6051158 A	18-04-2000
US 4298412 A	03-11-1981	US 4407119 A	04-10-1983
US 2744816 A	08-05-1956	NONE	
RU 2108282 C		NONE	
EP 767155 A	09-04-1997	US 5670740 A JP 9118582 A	23-09-1997 06-05-1997
WO 9640541 A	19-12-1996	NONE	
DE 4318883 A	09-12-1993	JP 6048880 A US 5507890 A	22-02-1994 16-04-1996
US 4758287 A	19-07-1988	DE 3820443 A FR 2616428 A GB 2205826 A,B IT 1226696 B JP 1052485 A JP 2824769 B	29-12-1988 16-12-1988 21-12-1988 04-02-1991 28-02-1989 18-11-1998

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82