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INTERNATIONAL SEARCH REPORT

International application No

PCT/US2009/041294

A. CLASSIFICATION OF SUBJECT MATTER

INV. B01D53/86 C01B17/04 C01B3/04

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

B01D C01B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 962 409 A (KOTERA YOSHIHIDE ET AL) 8 June 1976 (1976-06-08) column 1, lines 8-11, 21-25 column 2, lines 5-7, 29-34, 52-62 column 3, lines 41-50 column 4, lines 3-22 column 5, lines 55-62 column 6, lines 3-7 figure 1	1, 4-6, 24
X	FR 2 903 976 A (INST FRANCAIS DU PETROLE [FR]) 25 January 2008 (2008-01-25) page 1, lines 1-4, 16, 17 page 2, line 29 - page 3, line 6 page 5, lines 13-24 page 8, line 15 - page 9, line 16 figure 3 -/-	11, 23



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation, or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *G* document member of the same patent family

Date of the actual completion of the international search

20 August 2009

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Name and mailing address of the ISA/

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International application No.

PCT/US2009/041294

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 979 384 A (WEINER JOSEPH G ET AL) 11 April 1961 (1961-04-11) column 1, lines 15-38 column 2, line 65 - column 3, line 72 -----	11,23
X	EP 1 411 029 A (DAVID SYSTEMS & TECHNOLOGY S L [ES]) 21 April 2004 (2004-04-21) paragraphs [0001], [0002], [0011], [0013], [0017], [0020], [0024] - [0026], [0030], [0031] -----	1-8,11, 23
X	US 5 397 556 A (TOWLER GAVIN P [US] ET AL) 14 March 1995 (1995-03-14) column 1, lines 5-9 column 2, lines 1-42 column 3, lines 28-41 column 3, line 67 - column 4, line 4 column 4, lines 26-29,51-53 column 7, lines 35-38 column 7, line 61 - column 8, line 65 -----	1,4,6,9, 12,15, 17,19
A	RU 2 239 594 C1 (AS SIBE CATALYSIS INST) 10 November 2004 (2004-11-10) abstract -----	1-19,23, 24
A	JP 53 130291 A (KOGYO GIJUTSUIN) 14 November 1978 (1978-11-14) abstract -----	1-19,23, 24
A	AL-SHAMMA L M ET AL: "The production and separation of hydrogen and sulfur from thermal decomposition of hydrogen sulfide over vanadium oxide/sulfide catalysts". INTERNATIONAL JOURNAL OF HYDROGEN ENERGY, ELSEVIER SCIENCE PUBLISHERS B.V., BARKING, GB, vol. 15, no. 1, 1 January 1990 (1990-01-01), pages 1-5, XP025640247 ISSN: 0360-3199 [retrieved on 1990-01-01] the whole document -----	1-19,23, 24
A	CHIVERS T ET AL: "The thermal decomposition of hydrogen sulfide over vanadium and molybdenum sulfides and mixed sulfide catalysts in quartz and thermal diffusion column reactors". INTERNATIONAL JOURNAL OF HYDROGEN ENERGY, ELSEVIER SCIENCE PUBLISHERS B.V., BARKING, GB, vol. 12, no. 4, 1 January 1987 (1987-01-01), pages 235-243, XP025450409 ISSN: 0360-3199 [retrieved on 1987-01-01] the whole document -----	1-19,23, 24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/041294

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers allsearchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-19, 23, 24

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-19,23,24

claims 1-10 and 12-19 refer to a process for eliminating contaminants from a gas containing H₂S and hydrocarbon by passing the gas through a heated area having a temperature of about 50-700°C, the heated area being produced by a heating element comprising at least one of a catalyst and a resistance wire, converting the H₂S into H₂ and S, and separating the sulfur from the gas

claims 11 and 23 refer to a gas produced by the process of claim 1

claim 24 refers to a system for eliminating contaminants from gas containing H₂S and hydrocarbon comprising a reactor for receiving the gas and a heating element comprising at least one of a catalyst and a resistance wire within the reactor that contacts the gas

The problem to be solved is to eliminate contaminants (H₂S, CO₂) from a gas mixture). The underlying principle is that the catalytic decomposition of hydrogen sulfide not only allows to remove the hydrogen sulfide from the product gas, but also to recover valuable byproducts to lower the overall process costs.

2. claims: 20-22

these claims refer to a process for providing hydrogen as a fuel comprising storing a gas containing H₂S as a liquefied gas in a container, providing a reactor connected to the container, the reactor having a heating element, comprising at least one of a catalyst or a resistance wire, passing the gas from the container through the heated area having a temperature of about 50-700°C produced by the heating element, converting gas released from the container into H₂ and S and separating the sulfur from the gas

The problem to be solved is to provide an efficient source of (pure) hydrogen as a fuel. The underlying principle is that low pressure liquefied hydrogen sulfide has a higher storage capacity for hydrogen than low pressure liquefied hydrogen itself while being less flammable and reactive.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2009/041294

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