(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 May 2009 (07.05.2009)

PCT

(10) International Publication Number
WO 2009/057939 A3

(51) International Patent Classification:
C01B 3/24 (2006.01)

(21) International Application Number:
PCT/KR2008/006373

(22) International Filing Date: 29 October 2008 (29.10.2008)

(25) Filing Language: Korean

(26) Publication Language: English

(30) Priority Data:
10-2007-0111068
1 November 2007 (01.11.2007) KR

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

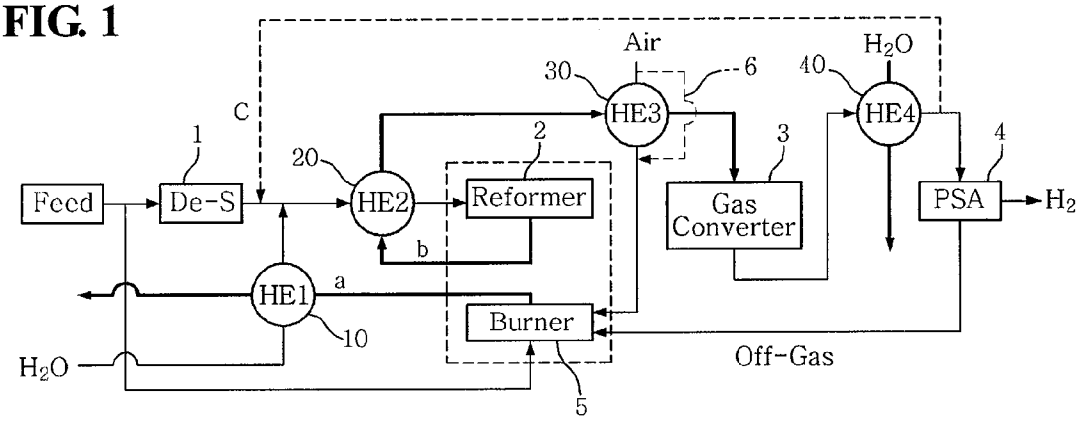
(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:
— *with international search report*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

(88) Date of publication of the international search report:
16 July 2009

(54) Title: HYDROGEN GENERATOR WITH EASY START-UP AND STABLE OPERATION AND HIGH EFFICIENCY

FIG. 1



(57) Abstract: The present invention provides a hydrogen generator for generating hydrogen through a steam-reforming process using hydrocarbons as a raw material and a method of operating the same, and, more particularly, provides a hydrogen generator for generating hydrogen through a steam reforming process, which can be stably operated because water is introduced into the hydrogen generator in the form of single phase vapor, and which can achieve high thermal efficiency using a proper heat exchanging method, and to a method of operating the same. According to the present invention, there is provided a heat exchanger network, in which heat necessary for a reforming reaction are obtained by the heat exchange of high-temperature exhaust gas or reformed gas, and in which, in a water gas converting reaction and a PSA reaction conducted at low temperatures compared to the reforming reaction, heat exchange is performed by low-temperature air or water, and the heat-exchanged air and the residual gas in the PSA reaction are used as a heat supply source for the reforming reactor together with fuel hydrocarbons, thereby minimizing the thermal loss of the hydrogen generator.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/006373

A. CLASSIFICATION OF SUBJECT MATTER

C01B 3/24(2006.01)i

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)

IPC C01B 3/24, C01B 3/34, C01B 3/38, H01M 8/04

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

Korean Utility models and applications for Utility models since 1975.
Japanese Utility models and applications for Utility models since 1975.

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

eKIPASS (KIPO internal) & keyword : steam reforming, flame, heat exchanger, pressure swing absorption, generation of hydrogen

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	KR 10-1999-0014655 A (SUNG BEUM JEUN et al.) 25 February 1999 See the abstract, page 4 lines 10 - page 5 line 19 and figure 1	1 - 7
Y	KR 10-2006-0108039 A (SK CORP.) 17 October 2006 See the abstract, page 4 lines 4 - page 7 line 3 and figures 1-2	1 - 7
A	KR 10-0674622 B1 (RESEARCH INSTITUTE OF INDUSTRIAL SCIENCE & TECHNOLOGY and KOREA ELECTRIC POWER CORP.) 19 January 2007 See the abstract, page 3 lines 24 - page 5 line 4 and figure 2	1 - 7
A	JP 2005-019245 A (ELECTRIC POWER DEV CO., LTD) 20 January 2005 See the abstract, paragraphs [10]-[17] and figure 1	1 - 7
A	JP 10-273301 A (DAIDO HOXAN INC) 13 October 1998 See the abstract, paragraphs [22]-[27] and figure 1	1 - 7

☐ 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 application or patent 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 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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
27 MAY 2009 (27.05.2009)	**27 MAY 2009 (27.05.2009)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer LEE Sung Reol Telephone No. 82-42-481-5598

Form PCT/ISA/210 (second sheet) (July 2008)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/006373

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:

Claims 1-5 are directed to a hydrogen generator using a steam reforming.
Claims 6-7 are directed to a method of operating the steam-reforming hydrogen generator

The only common technical feature between claims 1-7 is a hydrogen generator using a steam reforming. However, this feature lacks inventive step with respect to the following documents cited in this ISR. KR 10-1999-0014655 A (SUNG BEUM JEUN et al.) 25 February 1999, KR 10-2006-0108039 A (SK CORP.) 17 October 2006

Thus there is no technical relationship left over the prior art among the claimed invention, leaving the claims without a single general inventive concept. Hence there is lack of unity "a posteriori"(PCT Rules 13.1 and 13.2).

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

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

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.:

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.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/006373

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
KR 10-1999-0014655 A	25.02.1999	None	
KR 10-2006-0108039 A	17.10.2006	CN 101155752	02.04.2008
		JP 2008-535766 A	04.09.2008
		US 2008-0219901 A1	11.09.2008
		WO 2006-109972 A1	19.10.2006
KR 10-0674622 B1	19.01.2007	None	
JP 2005-019245 A	20.01.2005	None	
JP 10-273301 A	13.10.1998	None	