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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, BN, BR, BW, BY, BZ, CA, CH, CL, 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, KN, KP, KR, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
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[Continued on next page]

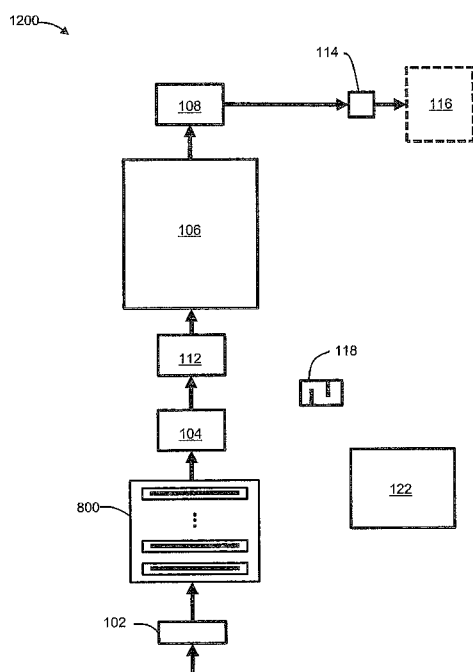
(54) **Title:** SYSTEM AND METHOD FOR CONCENTRATING GAS

Fig. 12

(57) **Abstract:** Systems and methods for producing a product gas are provided. In one embodiment, a plurality of gas separation assemblies separate adsorbable components from a gas source using a plurality of micro-pumps to create gas flow through the gas separation assemblies. Various embodiments include implementation of various pressure swing adsorption (PSA), vacuum swing adsorption (VSA), and vacuum pressure swing adsorption (VPSA) systems utilizing the gas separation assemblies with micro-pumps. In other embodiments, micro-pumps and micro-pump assemblies are arranged in various configurations capable of providing a range of pressures and flow rates.



Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Published:

— *with international search report (Art. 21(3))*

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27 February 2014

INTERNATIONAL SEARCH REPORT

International application No
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A. CLASSIFICATION OF SUBJECT MATTER
INV. B01D53/04 F04B19/00 F04B43/04
ADD.

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 F04B

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 practicable, 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 2003/180164 A1 (BUNNER BERNARD [US] ET AL) 25 September 2003 (2003-09-25) paragraph [0064]; figures 1-3 -----	1-3,17
X	US 6 106 245 A (CABUZ CLEOPATRA [US]) 22 August 2000 (2000-08-22) column 7, line 1 - line 36; figures 1,3,6 -----	1-3,17
X	US 2003/231967 A1 (NAJAFI KHALIL [US] ET AL) 18 December 2003 (2003-12-18) paragraphs [0004], [0074], [0080]; figures 6,9a -----	1-3,17
X	US 2003/215342 A1 (HIGASHINO KUSUNOKI [JP] ET AL) 20 November 2003 (2003-11-20) paragraphs [0003], [0113], [0138], [0169]; figures 5a-5b,16 ----- -/-	1-3,17



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 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

"&" document member of the same patent family

Date of the actual completion of the international search

5 December 2013

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12/12/2013

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/046086

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 all searchable 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.:

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

International application No

PCT/US2013/046086

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 2006/174872 A1 (JAGGER THEODORE W [US] ET AL) 10 August 2006 (2006-08-10) paragraph [0052]; figures 2,5,6,10 -----	4-16, 18-20
A	US 6 517 610 B1 (DE LA HOUSSAYE PAUL R [US]) 11 February 2003 (2003-02-11) column 1 -----	4

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/046086

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		WO 2006086432 A2	17-08-2006
US 6517610 B1	11-02-2003	NONE	

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-3, 17

a pump assembly comprising micro-pumps, valves, etc.

2. claims: 4-16, 18-20

a gas separator comprising a micro-pump
