Title: IMPROVED DENSITY-BASED COMPACT SEPARATOR

Abstract: Apparatus and method for separating a fluid. The apparatus includes an inlet duct having an inlet flow entrance and an inlet flow exit, the inlet duct defining an inlet width that decreases between the inlet flow entrance and the inlet flow exit, and an inlet radius that increases between the inlet flow entrance and the inlet flow exit. The apparatus also includes a separating turn fluidly connected to the inlet flow exit of the inlet duct and including an outer surface defining an opening. The apparatus further includes a liquid outlet fluidly connected to the opening of the separating turn to allow a higher-density component of the flow to exit the separating turn, and an outlet duct having an outlet flow entrance connected to the separating turn, to allow a lower-density component of the flow to exit the separating turn.
Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG). Published:

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

Date of publication of the international search report: 7 July 2011
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

F15B 21/04(2006.01)i, F15D 1/04(2006.01)i, B01D 17/038(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)
F15B; B04B; B01D

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
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords:
"separation\vfluid\v inlet\v outlet\v duct\v turn\v density\v opening\v width\v radius\v liquid\v gas","return", and "cross-section"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<tr>
<th>Category*</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>X</td>
<td>JP 2004-034017 A (CNK KK) 05 February 2004</td>
<td>1-4, 17, 20</td>
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<td>Y</td>
<td>See paragraphs 17-26; claim 1; figures 1-3.</td>
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<td>JP 2007-301549 A (HAMILTON SUNDSTRAND CORP.) 22 November 2007</td>
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<td>See claims 1-20; figures 1-7.</td>
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<td>JP 2003-080114 A (IHI AEROSPACE CO., LTD.) 18 March 2003</td>
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<td>See claims 1-5; figures 1-4.</td>
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<td>JP 2007-167759 A (DAISHOWA SEIKI CO., LTD.) 05 July 2007</td>
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<td>See claims 1-4; figures 1-4.</td>
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<td>JP 2003-340225 A (KIMURA MASAAMI) 02 December 2003</td>
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<td>See claims 1-4; figures 1-8.</td>
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☐ 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
27 APRIL 2011 (27.04.2011)

Date of mailing of the international search report
28 APRIL 2011 (28.04.2011)

Name and mailing address of the ISA/KR

Korean Intellectual Property Office
Government Complex-Daejeon, 189 Cheongsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea

Facsimile No. 82-42-472-7140

Authorized officer

KIM Sung Ho

Telephone No. 82-42-481-8438

Form PCT/ISA/210 (second sheet) (July 2009)
### 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).

### 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 1-9 are directed to an apparatus for separating a fluid.
- Claims 10-16 are directed to a static separator apparatus.
- Claims 17-20 are directed to a method for separating a higher-density component from a lower-density component of a fluid.

The only common technical feature among claims 1-20 is: an apparatus for separating a fluid comprising an inlet duct; a separation turn; a liquid outlet; and an outlet duct. However this feature lacks inventive step with respect to the following document cited in ISR; JP 2004-034017 A.

Thus there is no technical relationship left over the prior art among the claimed inventions, leaving the claims without a single general inventive concept.

Hence there is a lack of unity “a posteriori” (PCT Rules 13.1 and 13.2).

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 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.
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