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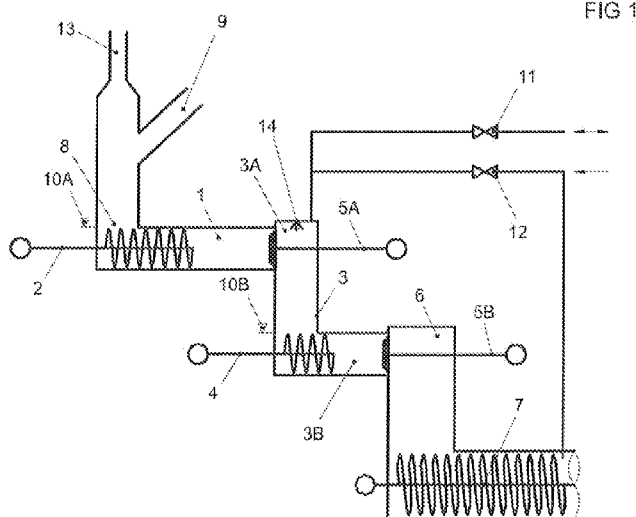
- (81) **Designated States (unless otherwise indicated, for every kind of national protection available):** AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, 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, PE, PG, PH, PL, PT, RO, RS, RU, 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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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- of inventorship (Rule 4.17(iv))

[Continued on next page]

(54) Title: PARTICLE PUMP METHODS AND DEVICES



(57) **Abstract:** Methods and devices are provided for transfer of particulate material, such as biomass feedstocks, into and out of pressurized reactors. Improved sluice devices have an L-shaped sluice chamber having an upper, vertical component in communication with a horizontal loading chamber and a lower component in communication with a vertical reactor inlet or outlet. Piston valves seal the sluice inlet and outlet by axial displacement across the vertical component of the sluice chamber and across the vertical reactor inlet or outlet. Relative to other methods for reactor unloading, these devices consume less steam and significantly reduce furfural content of unloaded, pretreated biomass. An optional hybrid plug/sluice method of biomass feeding using the devices permits biomass loading at sluice pressures intermediate between atmospheric and reactor pressure, thereby reducing "pump cycle" time and increasing biomass throughput capacity.

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5 May 2011

INTERNATIONAL SEARCH REPORT

International application No PCT/IB2010/053864
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A. CLASSIFICATION OF SUBJECT MATTER INV. B01J8/00 C10J3/50 C10J3/48 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) B01J C10J				
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				
C. DOCUMENTS CONSIDERED TO BE RELEVANT				
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.		
A	EP 0 431 639 A1 (AHLSTROEM OY [FI]) 12 June 1991 (1991-06-12) column 1, lines 1-26 column 5, line 36 - column 6, line 49; figures 1, 2	1-16		
A	----- WO 03/013714 A1 (SICCO K S [DK]; CHRISTENSEN BOERGE HOLM [DK]) 20 February 2003 (2003-02-20) cited in the application page 1, lines 7-19	1-16		
A	----- DE 37 05 275 A1 (HOELTER HEINZ [DE]) 1 September 1988 (1988-09-01) the whole document -----	1-16		

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<table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none;"><input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.</td> <td style="width: 50%; border: none;"><input checked="" type="checkbox"/> See patent family annex.</td> </tr> </table>			<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> See patent family annex.
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/> 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. "&" document member of the same patent family			
Date of the actual completion of the international search	Date of mailing of the international search report			
8 February 2011	14/02/2011			
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Buesing, Guenter			

INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2010/053864

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/IB2010/053864

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 544 374 A (MALLEK HEINZ [DE] ET AL) 1 October 1985 (1985-10-01) column 5, line 4 - column 6, line 11; figures 1, 2 -----	17-24
A,P	WO 2009/147512 A2 (INBICON AS [DK]; VIBE-PEDERSEN JAKOB [DK]; IVERSEN FRANK KROGH [DK]) 10 December 2009 (2009-12-10) page 1, lines 20-30 page 2, lines 16-26 page 4, lines 15-27 page 5, lines 10-18; figure 1 -----	17-24
A	US 6 506 282 B2 (HU SHENG-HSIN [US] ET AL) 14 January 2003 (2003-01-14) claim 1 -----	17-24

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/IB2010/053864

Patent document cited in search report	Publication date	Patent family member(s)	Publication date	
EP 0431639	A1	12-06-1991	DE 69005273 D1	27-01-1994
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			US 2001020520 A1	13-09-2001

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 17-24

Independent claims 17 and 21 relate to an apparatus and method, respectively, for removing pretreated biomass from a pressurized hydrothermal reactor. Different to claims 1 and 10, respectively, these claims are not restricted to an L-shaped sluice or to piston valves but concentrate on the use of a sluice instead of the conventional use of a hydrocyclone system. The use of a sluice is said to be advantageous in view of a reduction of furfural levels obtainable thereby; cf. page 4, line 27 - page 5, line 10.

2. claims: 1-16

Claims 1 and 10 relate to an apparatus and method, respectively, for loading particulate matter into a pressurized reactor wherein an L-shaped sluice chamber with an upper vertical component and a lower horizontal component. According to the apparatus claim, piston valves are provided at the inlet and outlet of the sluice. The problem to be solved in view of D1 was to develop a system which can be scaled up to larger capacity with high operational safety and efficiency (cf. page 2, lines 24/25 of the description). This problem is solved by the provision of the L-type sluice in connection with the piston valves.
