



- (51) International Patent Classification:  
*F04B 15/02* (2006.01)
- (21) International Application Number:  
PCT/US2013/027393
- (22) International Filing Date:  
22 February 2013 (22.02.2013)
- (25) Filing Language:  
English
- (26) Publication Language:  
English
- (30) Priority Data:  
61/603,217 24 February 2012 (24.02.2012) US  
61/719,486 28 October 2012 (28.10.2012) US  
61/751,919 13 January 2013 (13.01.2013) US  
61/764,611 14 February 2013 (14.02.2013) US  
61/765,402 15 February 2013 (15.02.2013) US

(74) Agent: **SISSON, Edwin, A.**; Edwin A. Sisson, Attorney At Law, LLC, 1332 Sharon Copley Road, PO Box 603, Sharon Center, OH 44274 (US).

(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, 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, 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.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

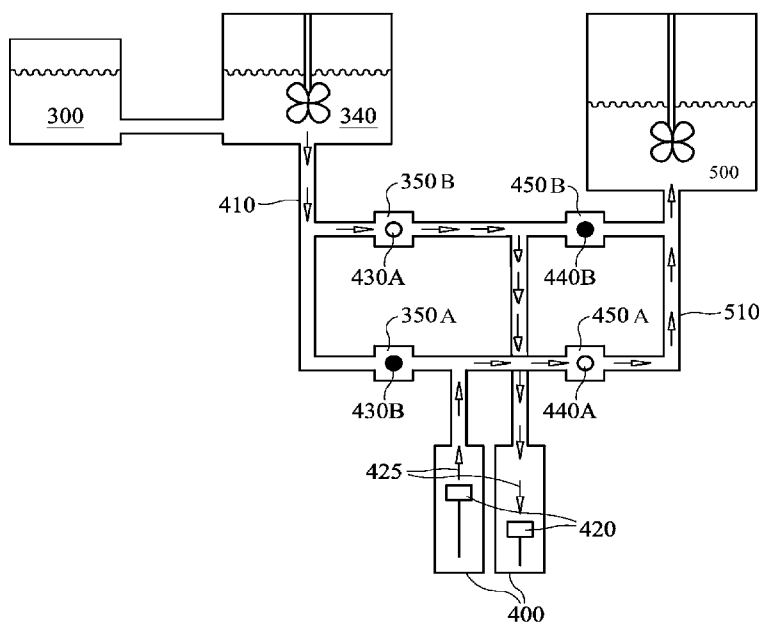
(71) Applicant: **BIOCHEMTEX S.P.A.** [—/IT]; Strada Ribrocca 11, I-15057 Tortona (IT).

(72) Inventors; and

(71) Applicants (for US only): **GASTALDO, Dan** [US/US]; 16441 Barriermore Avenue, Middleburg Heights, OH 44130 (US). **RYBA, Steven** [US/US]; 2680 S Medina Line Road, Wadsworth, OH 44281 (US). **MURRAY, Aaron** [US/US]; 316 South Street, Chardon, OH 44024 (US). **ELLIOTT, Guliz, Arf** [US/US]; 7250 Honeydale Drive, Northfield Center, OH 44067 (US).

[Continued on next page]

(54) Title: CONTINUOUS PROCESS FOR CONVERSION OF LIGNIN TO USEFUL COMPOUNDS



(57) Abstract: A process for introducing a slurry comprised of lignin into a lignin conversion reactor by pressurizing the slurry comprised of lignin using a pump having an inlet valve which can be present in an inlet valve position selected from the group consisting of open, closed and at least partially open, an outlet valve which can be present in an outlet valve position selected from the group consisting of open, closed and at least partially open, and a pump cavity, said pressurizing step comprising: Passing the slurry comprised of lignin through the inlet valve which is in the inlet valve position selected from the group consisting of at least partially open and open into the pump cavity, with said outlet valve in the closed outlet valve position and the pump cavity being at an inlet pump cavity pressure; Changing the inlet valve position to closed; Increasing the pressure of the pump cavity to a discharge pressure; Discharging at least a portion of the slurry comprised of lignin from the pump cavity into the lignin conversion reactor by changing the outlet valve position to a position selected from the group consisting of at least partially open and

open and forcing at least a portion of the slurry comprised of lignin through the outlet valve; wherein the inlet valve and the outlet valve both provide for unrestricted and unobstructed flow of the slurry comprised of lignin.





**Declarations under Rule 4.17:**

- *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*
- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*
- *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))*

**(88) Date of publication of the international search report:**  
3 January 2014

**Published:**

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

INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2013/027393

A. CLASSIFICATION OF SUBJECT MATTER  
INV. F04B15/02  
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)  
F04B C10G

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Ip_1027-: "IP 1027-5 GB KOV piston pumps with ball valves For high-pressure slurry pumping", 1 January 2010 (2010-01-01), pages 47-1, XP055086660, Retrieved from the Internet: URL:http://www.pmw.co.in/pm_india/data/IP_1027_GB.pdf [retrieved on 2013-11-04]	1-9, 13-18
A	the whole document	19
Y,P	WO 2012/174429 A1 (CHEMTEX ITALIA S P A [IT]; MURRAY AARON [US]; RYBA STEVEN [US]) 20 December 2012 (2012-12-20)	10-12
A,P	the whole document	1-9, 13-19
	----- -/--	

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  4 November 2013	Date of mailing of the international search report  21/11/2013
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  Cagnoli, Michele

## INTERNATIONAL SEARCH REPORT

International application No  
PCT/US2013/027393

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 2011/117705 A2 (ENI SPA [IT]; DELLEDONNE DANIELE [IT]; BUZZONI ROBERTO [IT]; BIANCHI D) 29 September 2011 (2011-09-29)	10-12
A	the whole document  -----	1-9, 13-19

# INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2013/027393

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2012174429	A1	20-12-2012	NONE
-----			
WO 2011117705	A2	29-09-2011	EP 2550344 A2 30-01-2013
			US 2013060071 A1 07-03-2013
			WO 2011117705 A2 29-09-2011
-----			