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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
8 December 2005 (08.12.2005)

PCT

(10) International Publication Number
WO 2005/115598 A3

(51) International Patent Classification:
*B01F 3/04* (2006.01) *C02F 1/78* (2006.01)

(21) International Application Number:
PCT/US2005/018284

(22) International Filing Date: 25 May 2005 (25.05.2005)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
60/574,152 25 May 2004 (25.05.2004) US

(71) Applicant: **THE BOARD OF TRUSTEES OF THE UNIVERSITY OF ARKANSAS** [US/US]; 2404 North University Avenue, Little Rock, AR 72207 (US).

(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **OSBORN, Gregory, Scott** [US/US]; 410 E. Gunter St., Fayetteville, AR 72701 (US). **MATLOCK, Marty, D.** [US/US]; 1139 Sunset Dr., Fayetteville, AR 72701 (US). **TELTSCHIK, Shandi, S.** [US/US]; 101 Sunset Loop #1, Minot AFB, ND 58704 (US).

(74) Agent: **MEADOWS, James, H.**; 2804 Kentucky Avenue, Joplin, MO 64804 (US).

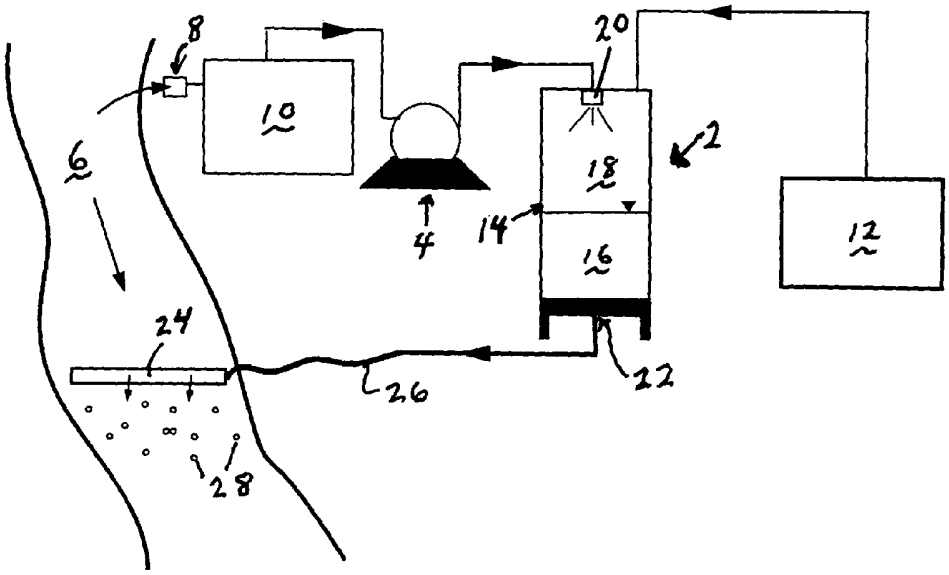
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KP, KR, KZ, LC, LK,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

*[Continued on next page]*

(54) **Title:** SYSTEM AND METHOD FOR DISSOLVING GASES IN LIQUIDS




(57) **Abstract:** Apparatus and methods for dissolving a gas into a liquid comprises a saturation tank, a high pressure liquid pump in fluid communication with the tank, and a pressurized gas source in communication with a regulated gas head space of the saturation tank. The saturation tank comprises a pressure vessel for containing the liquid and has a regulated gas head space above the liquid, contains at least one liquid spray nozzle that permits passage of liquid into the pressure vessel, and an outlet for the liquid containing dissolved gas. Upon passing the gas-containing liquid into a second fluid, the gas is released in the form of microbubbles. The microbubbles aid in flocculation of suspended particles and promote dissolution of the gas in the second fluid. Preferred gases for use with the apparatus are oxygen, air, and ozone. Anticipated uses include treatment of rivers, streams, and ponds in natural or industrial settings, as well as smaller scale applications.

WO 2005/115598 A3

**(88) Date of publication of the international search report:**
14 September 2006

*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

# INTERNATIONAL SEARCH REPORT

International application No.
PCT/US05/18284

A. CLASSIFICATION OF SUBJECT MATTER
IPC: **B01F 3/04**( 2006.01);**C02F 1/78**( 2006.01)

USPC: 210/760;261/119.1,122.1
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)
U.S. : 210/221.2, 760; 261/28, 37, 78.2, 119.1, 122.1, 124

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)
EAST Search Terms: saturation, tank, chamber, reservoir, container, vessel, pressure, gas, liquid, water, spray

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| Y | US 3,960,066 A (LAROCCO et al) 01 June 1976 (01.06.1976), fig. 1, col. 1, lines 41-43, 47-49; col. 2, lines 66-68; col. 3, lines 1-3, 29-40, 59-68; col. 4, lines 58-66. | 1-30 |
| Y | US 4,163,712 A (SMITH) 07 August 1979 (07.08.1979), fig. 1; col. 4, lines 7-17; col. 10, lines 52-68; col. 11, lines 1-2. | 1-30 |
| A | US 4,857,350 A (IWASAKI et al) 15 August 1989 (15.08.1989), fig. 1. | 1-30 |
| A | US 5,961,895 A (SANFORD) 05 October 1999 (05.10.1999), fig. 1. | 1-30 |
| A | US 6,730,232 B2 (SCHERZINGER et al) 04 May 2004 (04.05.2004), fig. 1. | 1-30 |

☐ 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 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
02 July 2006 (02.07.2006)

Date of mailing of the international search report
27 JUL 2006

Name and mailing address of the ISA/US
Mail Stop PCT, Attn: ISA/US
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450
Facsimile No. (571) 273-3201

Authorized officer
Scott Bushey
Telephone No. 571 272-1153

Form PCT/ISA/210 (second sheet) (April 2005)