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[Continued on next page]

(54) Title: METHOD FOR CONTROLLING AN ACOUSTIC CELL

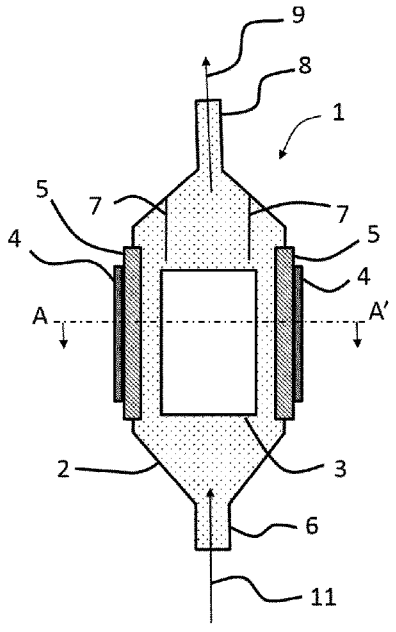

Fig. 1

A-A' cross section

(57) Abstract: The present invention is related to an iterative method for controlling an acoustic cell (1) separating dispersed particles in a liquid medium, said acoustic cell (1) comprising two opposed plates (5) delimiting a resonating cavity filled with said liquid medium, at least one of the opposed surfaces (4) comprising a piezoelectric transducer (4) coupled to an electrical power generator for producing ultrasonic waves in said resonating cavity, said method comprising the steps of: a. applying an ultrasonic sound field by applying a periodic electrical potential of initial resonant frequency fi and initial power Pi to said piezoelectric transducer (5); b. measuring the cosine of the resulting phase shift phi (cos(phi)) between the electric current and the electric potential applied to the transducer (5); c. if the cos(phi) is lower than a predetermined threshold, increasing the power Pi, else decreasing the power Pi; d. determining the sign of the gradient of cos(phi) as a function of the frequency; e. varying the frequency in the gradient direction thereby maximising cos(phi); f. getting to step (b).

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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))*

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))*

(88) Date of publication of the international search report:
26 March 2015

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2014/057685

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.:

1-6

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/EP2014/057685

A. CLASSIFICATION OF SUBJECT MATTER
INV. B06B1/02
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)
B06B B01J C02F B01D

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.
Y	US 5 711 888 A (TRAMPLER FELIX [AT] ET AL) 27 January 1998 (1998-01-27) abstract column 3, lines 25-31 column 9, lines 16-22 column 27, lines 19-23 figure 1 -----	1-6
Y	US 5 892 315 A (GIPSON LAMAR HEATH [US] ET AL) 6 April 1999 (1999-04-06) abstract column 3, lines 63-65 column 4, lines 7-10, 42-51 column 10, lines 47-66 column 11, lines 1-8 column 15, lines 7-12 figure 5 -----	1-6

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[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
20 November 2014	04/02/2015

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Mirkovic, Olinka

2

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

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 4 689 515 A (BENNDORF GERALD [DE] ET AL) 25 August 1987 (1987-08-25) column 4, lines 8-15	4,5
A	EP 1 195 460 A2 (KAO CORP [JP]) 10 April 2002 (2002-04-10) the whole document	1-4
A	US 2011/254519 A1 (HASEGAWA HIROSHI [JP] ET AL) 20 October 2011 (2011-10-20) the whole document	1-4

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2014/057685

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5711888 A	27-01-1998	AU 684284 B2	11-12-1997
		AU 6760594 A	12-12-1994
		BR 9406396 A	27-02-1996
		CA 2137699 A1	24-11-1994
		US 5711888 A	27-01-1998
		WO 9426390 A1	24-11-1994
US 5892315 A	06-04-1999	AU 3576997 A	14-01-1998
		CA 2257811 A1	31-12-1997
		US 5892315 A	06-04-1999
		US 5900690 A	04-05-1999
		WO 9749500 A1	31-12-1997
US 4689515 A	25-08-1987	AT 68111 T	15-10-1991
		DE 3534853 A1	02-04-1987
		DE 3681871 D1	14-11-1991
		EP 0219693 A1	29-04-1987
		US 4689515 A	25-08-1987
EP 1195460 A2	10-04-2002	EP 1195460 A2	10-04-2002
		US 2002036444 A1	28-03-2002
US 2011254519 A1	20-10-2011	JP 5015124 B2	29-08-2012
		JP 2010131477 A	17-06-2010
		US 2011254519 A1	20-10-2011
		WO 2010064461 A1	10-06-2010

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-6

minimising the injected power, and optimising resonance conditions, by measuring the cosine of the phase shift between the electric current and the electric potential applied to the transducer, and adjusting power and frequency according to the measured value

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2. claims: 7-14

obtaining a better coupling between the transducer and the liquid to be filtered, by using a material having a Knopp hardness HK 0.1/20 of 300 or more, to make the opposed plates of the acoustic cell

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