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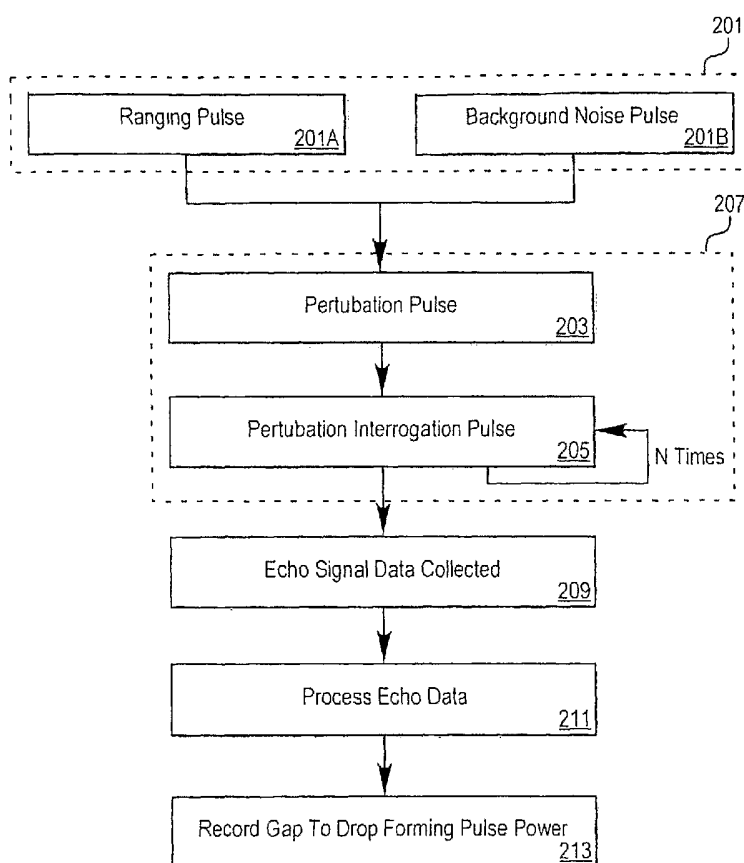
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[Continued on next page]

(54) Title: ACOUSTIC ASSESSMENT OF CHARACTERISTICS OF A FLUID RELEVANT TO ACOUSTIC EJECTION



(57) Abstract: Methods are provided for analyzing characteristics of fluids in the context of an acoustic ejection system. Such a system has a controller (38), an acoustic radiation generator (35), and a coupling medium (25) coupling the radiation to a reservoir (13, 15) holding fluid (14, 16). The methods can use acoustic radiation to both perturb a surface of the fluid in the reservoir and analyze the effect of the perturbation. The methods may use information about prior fluids. The methods of the invention can determine physical characteristics such as speed of sound and viscosity. The methods also include ways to determine a level of acoustic energy suitable to eject a droplet. Preferably the methods are executed automatically under control of programming of a controller of an acoustic ejection system.



European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IS, IT, LT, LU, LV, 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).

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INTERNATIONAL SEARCH REPORT

International application No
PCT/US2005/035683

A. CLASSIFICATION OF SUBJECT MATTER
INV. B41J2/14

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)
B41J

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)

EP0-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2002/064809 A1 (MUTZ MITCHELL W ET AL) 30 May 2002 (2002-05-30)	1,2, 9-29,32, 33,36, 39-48
Y	paragraph [0071] paragraph [0088] - paragraph [0089] -----	3,5
X	US 2003/150257 A1 (MUTZ MITCHELL W ET AL) 14 August 2003 (2003-08-14)	30,31, 49-82
Y	claim 1; figure 1a; example 1 -----	3,5
A	US 2004/009611 A1 (WILLIAMS ROGER O ET AL) 15 January 2004 (2004-01-15) paragraph [0038] - paragraph [0041] -----	1-82

☐ 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 document but published on or after the international filing date

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"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

23 February 2006

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

In tional application No.
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Box 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 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 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.:

1-82

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-82

A method and an apparatus for acoustically ejecting fluid droplets based on determining the waveform of a pulse which travels to a site near the surface of the fluid

2. claims: 83-118,140-148

A set of methods related to ejecting fluid droplets based on processing the reflected acoustic energy

3. claims: 119-131,137-139

A set of methods related to determining droplet volumes based on ejecting droplets from a first to a second reservoir

4. claims: 132-136

A method of determining characteristics of a fluid based on analyzing oscillations in a free surface of the fluid

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2005/035683

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2002064809 A1	30-05-2002	AU 1995902 A CA 2429813 A1 EP 1423502 A2 JP 2004535764 T WO 0244319 A2 US 2002064808 A1 US 2002142286 A1	11-06-2002 06-06-2002 02-06-2004 02-12-2004 06-06-2002 30-05-2002 03-10-2002
US 2003150257 A1	14-08-2003	AU 2002346653 A1 EP 1451569 A2 WO 03052403 A2 US 2003101819 A1	30-06-2003 01-09-2004 26-06-2003 05-06-2003
US 2004009611 A1	15-01-2004	AU 2908202 A CA 2430422 A1 EP 1349661 A2 WO 0247820 A2 US 2003133842 A1 US 2003186459 A1 US 2003203505 A1 US 2003203386 A1 US 2003186460 A1 US 2003211632 A1 US 2002094582 A1	24-06-2002 20-06-2002 08-10-2003 20-06-2002 17-07-2003 02-10-2003 30-10-2003 30-10-2003 02-10-2003 13-11-2003 18-07-2002