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[Continued on next page]

(54) Title: DROPLET DISPENSING DEVICE AND METHODS

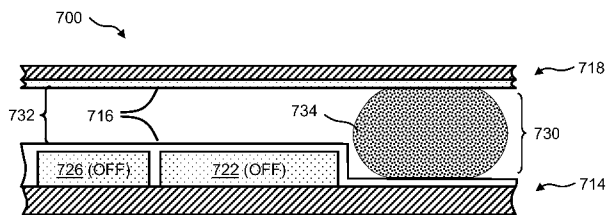


Figure 7A

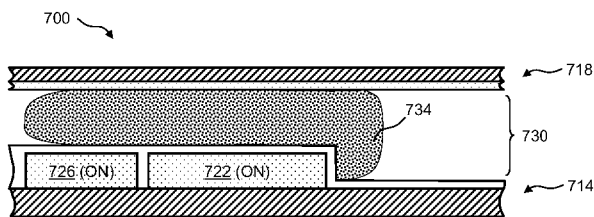


Figure 7B

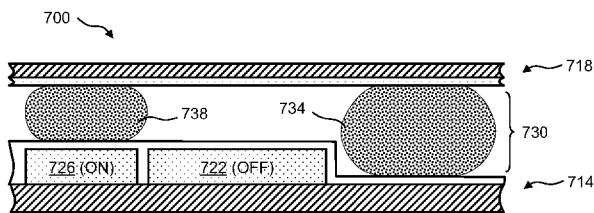


Figure 7C

(57) Abstract: The invention provides nonlimiting examples of structures for and methods of dispensing droplets in a droplet actuator. The droplet actuator structures and methods of the invention exhibit numerous advantages over droplet actuators of the prior art. In various embodiments, the structures and methods of the invention provide, among other things, improved efficiency, throughput, scalability, and/or droplet uniformity, as compared with existing droplet actuators. Further, in some embodiments, the droplet actuators provide configurations for improved methods of loading and/or unloading fluid and/or droplets. In yet other embodiments, the droplet actuators provide fluid loading configurations for loading numerous fluid reservoirs in a substantially simultaneous and/or substantially sequential manner.

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TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, 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/US 08/59955

## A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - C40B 60/14; B01L 3/02; G01N 1/10 (2009.01)

USPC - 506/40; 422/100; 436/180

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)

IPC(8)-C40B 60/14; B01L 3/02; G01N 1/10 (2009.01)

USPC-506/40; 422/100; 436/180

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

USPC- 506/7, 506/16, 506/18, 506/40; 427/2.1; 239/690.1; 347/47

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST(PGPB,USPT,USOC,EPAB,JPAB); Google Patents; Google Scholar: droplet, actuator, electrode, circumferential, segment\$, cell, radial, biological, sorter, pressur\$, Vamsee, Pollack, microsphere, bead, annular, controller

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X ----- Y	US 2004/0055891 A1 (PAMULA et al.) 25 Mar 2004 (25.03.2004) para [0018], [0023]-[0028], [0031]-[0036], [0043]-[0044], [0083], [0086], [0095], [0101]-[0108], [0113], [0118], [0158]-[0159], [0177]	1, 4-6, 9-11, 14-17, 20, 31- 33, 36-39, 48-51, 54-60, 68-73, 76-80 and 83-87 ----- 2-3, 7-8, 12-13, 18-19, 21-25, 34-35, 40-47, 52-53, 61-67, 74-75, 81-82, 88-89, and 114-123
Y	US 2002/0051971 A1 (STUELPNAGEL et al.) 02 May 2002 (02.05.2002) para [0008]-[0009], [0161], [0226]-[0227]	2-3, 7-8, 12-13, 18-19, 21-22, 24-25, 34-35, 46-47, 52-53, 61-67, 74-75, 81-82, 88-89 and 114-123
Y	US 6,331,045 B1 (HARVEY et al.) 18 Dec 2001 (18.12.2001) col 1 ln 40-65; col 6 ln 5-35; Fig 1c	23-25 and 40-45

 Further documents are listed in the continuation of Box C.

\* 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

"&amp;" document member of the same patent family

Date of the actual completion of the international search

28 August 2009 (28.08.2009)

Date of mailing of the international search report

04 SEP 2009

Name and mailing address of the ISA/US

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## \*\*\*\*\* SUPPLEMENTAL BOX \*\*\*\*\*

Continuation of Box No. III. Lack of Unity:

The inventions listed as Groups I-IV do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Groups I-III do not include the inventive concept of analyzing a supernatant, as required by Group IV.

Groups I-II do not include the inventive concept of a magnetic droplet actuator, as required by Group III.

Groups I-II share the technical feature of a droplet actuator. However, this shared technical feature does not represent a contribution over the prior art. Specifically, US 5,028,936 A to BARTKY et al. (hereinafter "Bartky") discloses a droplet actuator (col 1 In 64-67) comprising a base substrate comprising (col 3 In 10-30, opposed top and base walls):

(a) droplet operation electrodes configured for conducting one or more droplet operations (col 3 In 10-30, actuator walls of piezo electric material, electrode means),

(b) a perimeter barrier surrounding the electrodes comprising multiple openings, each opening approximately adjacent to one or more electrodes of the droplet operation electrodes (col 3 In 10-30, actator walls to define a plurality of separated liquid channels); and

(c) a flow path formed in the perimeter barrier and arranged to flow fluid through the multiple openings into proximity with the one or more electrodes (col 3 In 10-30, nozzle means, liquid supply means for supplying liquid to said channels). As the above droplet actuator was known at the time of the invention, this cannot be considered a special technical feature that would otherwise unify the groups.

Groups I-IV therefore lack unity under PCT Rule 13 because they do not share a same or corresponding special technical feature.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 08/59955

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:

- Group I: claims 1-25, 31-89, 114-123, drawn to a method of using a droplet actuator.
- Group II: claims 26-30, drawn to a droplet actuator.
- Group III, claims 90-113, 124-164, drawn to a method of using a magnetic droplet actuator.
- Group IV, claims 165-173, drawn to a method of analyzing a supernatant.

\*\*\*\*\*SEE SUPPLEMENTAL 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 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.:  
  
Group I: claims 1-25, 31-89, 114-123

- 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.