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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,
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MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
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SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM,
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Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- 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))

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(54) Title: GRAPHENE-TROUGH PUMP SYSTEMS

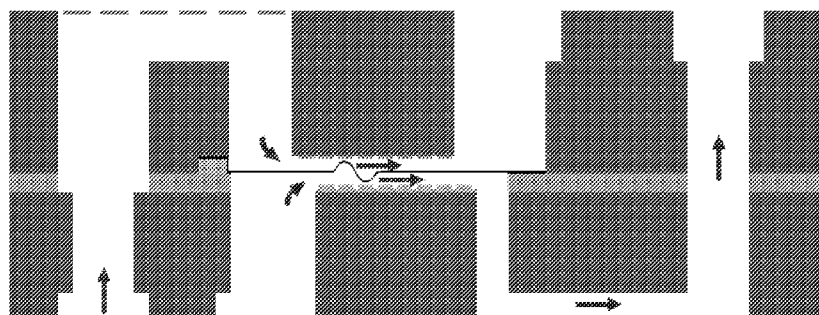


FIG. 10C

(57) Abstract: The present invention relates to pump systems having graphene or other atomically thin electrically conductive materials supported by trough-shaped cavities.



INTERNATIONAL SEARCH REPORT

International application No
PCT/US2014/026060

A. CLASSIFICATION OF SUBJECT MATTER
INV. F04B43/04
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

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	WO 2011/097390 A1 (PINKERTON JOSEPH F [US]) 11 August 2011 (2011-08-11) paragraph [0102] - paragraph [0134]; figure 9	1-41, 90-92
A	WO 2012/051053 A1 (CLEAN ENERGY LABS LLC [US]; BADGER DAVID A [US]; PINKERTON JOSEPH F [U]) 19 April 2012 (2012-04-19) paragraph [0003] - paragraph [0048]	1
A	BUNCH J S ET AL: "Impermeable atomic membranes from graphene sheets", NANO LETTERS, AMERICAN CHEMICAL SOCIETY, US, vol. 8, no. 8, 1 January 2008 (2008-01-01), pages 2458-2462, XP002637069, ISSN: 1530-6984, DOI: 10.1021/NL801457B [retrieved on 2008-07-17]	1
	- / - -	



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

25 July 2014

Date of mailing of the international search report

14/10/2014

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 2007/081681 A1 (YU XUN [US] ET AL) 12 April 2007 (2007-04-12) paragraphs [0030], [0036] -----	36,91

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/026060

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.:

1-41, 90-92

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

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

1. claims: 1-41, 90-92

A pump comprising a cavity, an inlet, an outlet, a plurality of electrically conductive traces located within the cavity and a continuous sheet of electrically conductive material wherein the plurality of electrically conductive traces are operable for creating a time-varying deflection in the electrically conductive material and the time varying deflection moves in the cavity from the inlet to the outlet.

2. claims: 42-62, 93

A communication system comprising a substrate and an array of pumps mounted on the substrate wherein the array of pumps are operable for operating at a first frequency to produce sound waves at a second frequency, and the first frequency is higher than the second frequency.

3. claims: 63-89, 94

A device comprising a mobile platform, and an array of electrostatic pumps located within or on the mobile platform, wherein the array of electrostatic pumps are operable for creating a reaction force that is sufficient to allow the mobile platform to fly.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2014/026060

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
WO 2011097390 A1	11-08-2011	EP 2531755 A1	12-12-2012
		US 2012308415 A1	06-12-2012
		US 2013195290 A1	01-08-2013
		US 2013195693 A1	01-08-2013
		WO 2011097390 A1	11-08-2011
WO 2012051053 A1	19-04-2012	EP 2628158 A1	21-08-2013
		US 2012236622 A1	20-09-2012
		WO 2012051053 A1	19-04-2012
US 2007081681 A1	12-04-2007	NONE	