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B81B 7/00 (2006.01)(74) Agent: **STALFORD, Terry J.**; Fish & Richardson P.C.,
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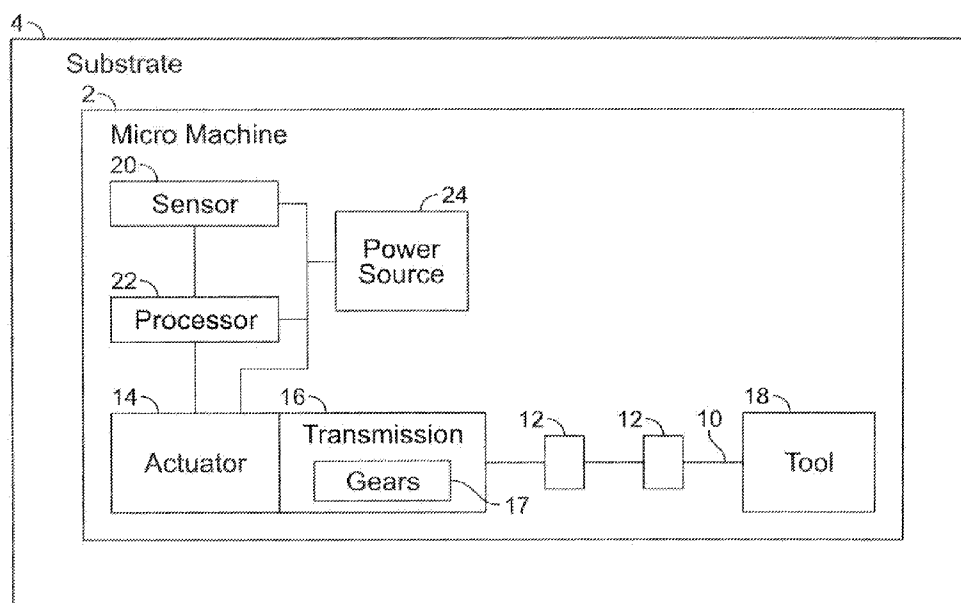
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[Continued on next page]

(54) Title: METHODS AND SYSTEMS FOR MICRO MACHINES



(57) Abstract: A micro machine may be in or less than the micrometer domain. The micro machine may include a micro actuator and a micro shaft coupled to the micro actuator. The micro shaft is operable to be driven by the micro actuator. A tool is coupled to the micro shaft and is operable to perform work in response to at least motion of the micro shaft. In accordance with other aspects of the disclosure methods and systems for micro transmissions for micro machines may be provided. Micro machines may include micro structures configured to move into engagement with other micro structures. A micro drive assembly may comprise a substrate, a micro shaft oriented in-plane with the substrate and at least one micro bearing to support rotation of the shaft. For example micro machines may include micro rotary machines and micro transport machines.

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see Notice of 17 July 2008

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/070359**A. CLASSIFICATION OF SUBJECT MATTER****B81B 7/00(2006.01)i**

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 : B81B 7/00, B81B 3/00, B81B 5/00, G02B 6/26, G02B 6/35, B41J 2/04, G02B 6/38, H02K 5/16, F16C 32/06

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

Korean Utility models and applications for Utility Models since 1975

Japanese Utility models and applications for Utility Models since 1975

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

data base : eKIPASS (KIPO internal), www.ndsl.or.kr

keywords: "mems", "actuator", "shaft", "transmission", "bearing", "transport"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	LEGTENBERG, ROB et al. 'Electrostatic microactuators with integrated gear linkages for mechanical power transmission.' In: MEMS '96, Proceedings. 'An Investigation of Micro Structures, Sensors, Actuators, Machines and Systems'. IEEE, The Ninth Annual International Workshop on 11-15 Feb. 1996, pp. 204 - 209. See abstract; Figs.8, 9.	1-3,5-8,10,26-29,42-43
Y		4, 9
A		11-25,30-41, 44-122
Y	SZABO, F. R. and KLADITIS, P. E. 'Design, Modeling and Testing of Polysilicon Optothermal Actuators for Power Scavenging Wireless Microrobots.' MEMS, NANO and Smart Systems, ICMENS 2004. Proceedings of International Conference on 25-27 Aug. 2004. pp. 446 - 452. See abstract; Figs.1, 12.	4, 9
A		1-3, 5-8, 10-65
A	US 2002-0041729 A1 (MASTROMATTEO, U. et al.) 11 APRIL 2002 See abstract; Fig.7; claims.	1-65
A	US 2006-0098047 A1 (Silverbrook, K.) 11 MAY 2006 See abstract; Figs.1-2.	1-65

☒ 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 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

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Date of mailing of the international search report

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Name and mailing address of the ISA/KR

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2007/070359

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 2002-0181886 A1 (FISCHER, K.J. et al.) 5 DECEMBER 2002 See abstract; Figs.1-3; claims.	21-23, 66-122
A	US 2004-0119354 A1 (TAKADA A. et al.) 24 JUNE 2004 See the whole document.	66-122

INTERNATIONAL SEARCH REPORTInternational application No.
PCT/US2007/070359**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:

Claims 1-16, 42-65 are directed to micro machines and the methods of fabrication. The micro machines comprise: a micro actuator; a micro shaft coupled to the micro actuator; the micro shaft operable to be driven by the micro actuator; and a tool

Claims 21-23 are directed to micro jacking systems

Claims 17-20, 24-25 are directed to micro actuators to provide reciprocating rectilinear motion and the methods for providing the motion.

Claims 26-41 are directed to transmissions for micro machines

Claims 66-112 are directed to micro transport machines and micro vehicles and the methods of fabrication.

Claims 113-122 are directed to micro bearings and the methods of fabrication.

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.:

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

Information on patent family members

International application No.

PCT/US2007/070359

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