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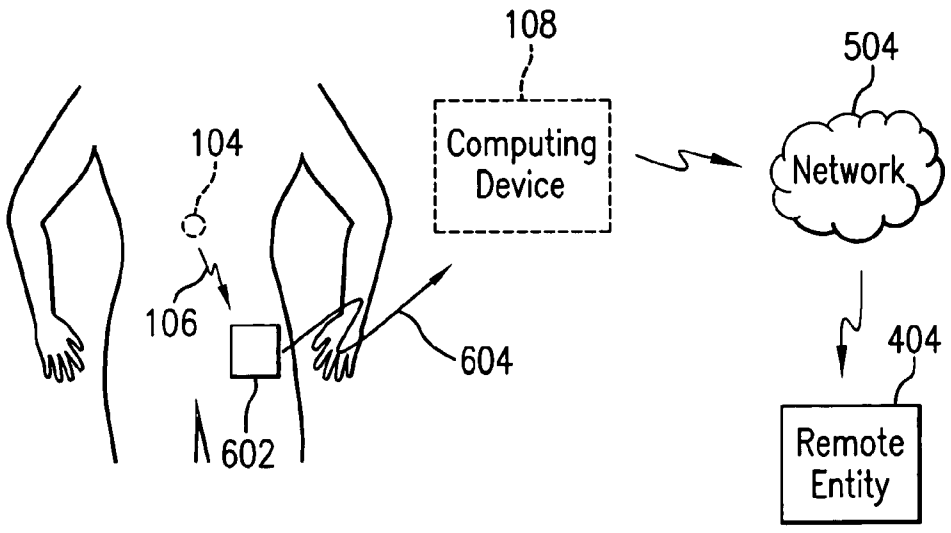
(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL,

[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR ACOUSTIC INFORMATION EXCHANGE INVOLVING AN INGESTIBLE LOW POWER CAPSULE



(57) Abstract: A method of communicating with an ingestible capsule includes detecting the location of the ingestible capsule, focusing a multi-sensor acoustic array on the ingestible capsule, and communicating an acoustic information exchange with the ingestible capsule via the multi-sensor acoustic array. The ingestible capsule includes a sensor that receives a stimulus inside the gastrointestinal tract of an animal, a bidirectional acoustic information communications module that transmits an acoustic information signal containing information from the sensor, and an acoustically transmissive encapsulation that substantially encloses the sensor and communications module, wherein the acoustically transmissive encapsulation is of ingestible size. The multi-sensor array includes a plurality of acoustic transducers that receive an acoustic signal from a movable device, and a plurality of delays, wherein each delay is coupled to a corresponding acoustic transducer. Each delay may be adjusted according to a phase of a signal received by the corresponding acoustic transducer.

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IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

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21 August 2008

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 07/19379

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A61B 8/12; A61B 5/00 (2008.04)
USPC - 600/437; 600/309; 600/476
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)
USPC - 600/437; 600/309; 600/476

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 600/437; 600/309; 600/476 (text delimited)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
WEST DB=PGPB,USPT,USOC,EPAB,JPAB; Google, Google Scholar, Yahoo
Search terms used: phase delay gain amplitude successive approximation coherent signal location tracking locating capsule ingestible acoustic ultrasound modulate adjust

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 2004/0122315 A1 (Krill) 24 June 2004 (24.06.2004), Fig. 2; para [0022], [0027-0029], [0033] -[0034]; claim 23	1, 2, 9 --- 3-8
Y	US 5,999,131 A (Sullivan) 07 December 1999 (07.12.1999), Fig 4; col 6, ln 21-39; col 7, ln 19-27; col 2, ln 51-65	3-6
Y	US 2005/0141624 A1 (Lakshmipathi et al.) 30 June 2005 (30.05.2005), para [0016], [0074]	6
Y	WO 2003/001966 A2 (Colliou et al.) 09 January 2003 (09.01.2003), pg 8, ln 16-pg 9, ln 2	7, 8
A	US 6,484,818 B2 (Alft et al.) 26 November 2002 (26.11.2002), ol 20, ln 14-21; col 20, ln 36-46; col 20, ln 55-67; col 21, ln 1-6	7, 8
A	US 6,784,826 B2 (Kane et al.) 31 August 2004 (31.08.2004), entire document	1-9
A	US 2006/0058663 A1 (Willis et al.) 16 March 2006 (16.03.2006), entire document	1-9
A	US 6,239,724 (Doron et al.) 29 May 2001 (29.05.2001), entire document	1-9

☐ 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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
07 April 2008 (07.04.2008)	14 MAY 2008
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 07/19379

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 extra box

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.:
1-9

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.

Continuation of Box No. III -- Observations where unity of invention is lacking

Seven claim groups were found:
Group 1: Claims 1-9
Group 2: Claims 10-13
Group 3: Claims 14-22
Group 4: Claims 23-25
Group 5: Claims 26-33
Group 6: Claims 34-42
Group 7: Claims 43-57

Group 1: Claims 1-9, having independent claim 1, are directed to a method of communicating with an ingestible capsule, comprising: detecting the location of the ingestible capsule; focusing a multi-sensor acoustic array on the ingestible capsule; and communicating an acoustic information exchange with the ingestible capsule via the multi-sensor acoustic array. Claim 1 does not comprise a special technical feature that provides a contribution of the prior art. Specifically, US 2004/0122315 A1 (Krill), Krill teaches a method of communicating with an ingestible capsule, comprising: detecting the location of the ingestible capsule (para [0016]); focusing a multi-sensor acoustic array on the ingestible capsule; and communicating an acoustic information exchange with the ingestible capsule via the multi-sensor acoustic array (para [0033]-[0034]).

Group 2: Claims 10-13 having independent claim 10 are directed to a sensor array configured to communicate with a movable object, comprising a plurality of acoustic transducers configured to receive an acoustic signal from the movable object; and a plurality of delays, each delay coupled to a corresponding one of the plurality of acoustic transducers, wherein each delay is adjusted according to a phase of an information signal received by the corresponding acoustic transducer. Therefore, the special technical feature is the plurality of delays, each delay coupled to a corresponding one of the plurality of acoustic transducers.

Group 3: Claims 14-22, having independent claim 14, are directed to an ingestible capsule, comprising: a sensor that receives a stimulus inside the gastrointestinal tract of an animal; a bi-directional acoustic information communications module that transmits an acoustic information signal containing information from the sensor; and an acoustically transmissive encapsulation configured to have a size that is ingestible, wherein the acoustically transmissive encapsulation substantially encloses the sensor and communications module.
The special technical feature is the acoustically transmissive encapsulation, which substantially encloses the sensor and communications module.

Group 4: Claims 23-25, having independent claim 23, are directed to a method of transmitting information acoustically, comprising: applying a base voltage to a piezoelectric device to cause the piezoelectric device to ring at a drone frequency; applying a voltage higher than the base voltage to the piezoelectric device to cause the piezoelectric device to ring at a first frequency that is different from the drone frequency; and applying a voltage lower than the base voltage to the piezoelectric device to cause the piezoelectric device to ring at a second frequency that is different from the first frequency and the drone frequency, wherein the first frequency represents a "1" bit and the second frequency represents a "0" bit in the transmitted information signal. The special technical feature is the applying a base voltage to a piezoelectric device to cause the piezoelectric device to ring at a drone frequency.

Group 5: Claims 26-33, having independent claim 26, are directed to a method for communicating from an ingestible capsule, comprising: modulating data from the ingestible capsule according to a modulation scheme; spreading the modulated data according to a spreading code; and acoustically transmitting the modulated and spread data through a body of an animal. The special technical feature is the modulating data from the ingestible capsule according to a modulation scheme.

Group 6: Claims 34-42, having independent claim 34, are directed to a system for communicating information, comprising: an ingestible capsule comprising: a modulator that modulates data according to a modulation scheme, a spreader that spreads the modulated data according to a spreading code, and an acoustic transmitter that acoustically transmits the modulated and spread data through a body of an animal. The special technical feature is the modulator that modulates data according to a modulation scheme, a spreader that spreads the modulated data according to a spreading code.

Group 7: Claims 43-57, having independent claims 43 and 51, are directed to a method for communicating with an ingestible capsule, comprising: selecting one or more carrier frequencies associated with one or more frequency channels based on a hopping pattern; and encoding data from the ingestible capsule based upon the one or more carrier frequencies; and acoustically transmitting the encoded data through a body of an animal. Further includes decoding the encoded data based upon the one or more carrier frequencies. The special technical feature is the selecting one or more carrier frequencies associated with one or more frequency channels based on a hopping pattern.

Claim groups 1-7, therefore, do not share a special technical feature that would otherwise provide a unifying contribution over the prior art. Therefore, unity, as required by PCT Rule 13.1, is lacking.