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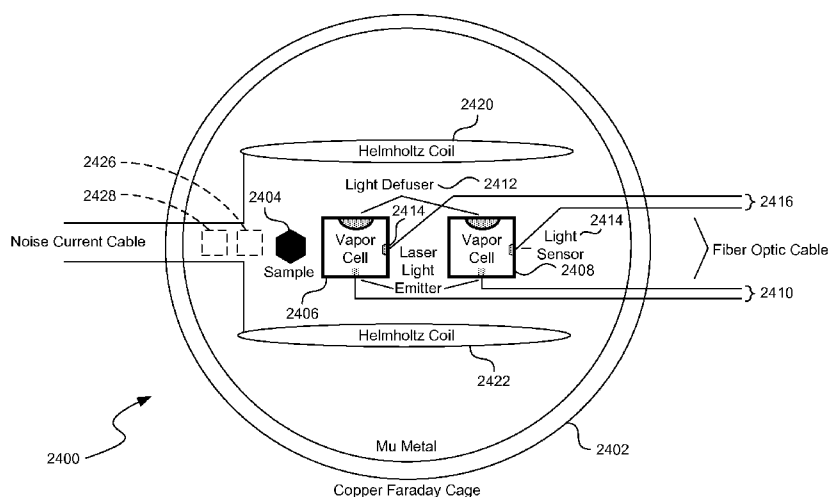
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North, Seattle, WA 98109 (US).(72) Inventors: BUTTERS, Bennett, M.; 3421 Stikes Drive,
Lacey, WA 98503 (US). BUTTERS, John, T.; 409 First
Street, c/o POB 986, Langley, WA 98260 (US).(74) Agents: BRITT, Juliene, P. et al.; Perkins Coie LLP, P.O.
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(54) Title: MINIATURIZED MOLECULAR INTERROGATION AND DATA SYSTEM

**FIG. 24**

(57) **Abstract:** A system for analyzing signals produced from a sample is described, where the system includes at least one magnetometer, where the magnetometer is capable of detecting magnetic fields produced by a sample. The magnetometer is positioned proximate to the sample, and is miniaturized (e.g. has a size less than 6 cm per side). A noise producing component is configured to uniformly produce noise surrounding the sample and the magnetometer, where the noise produced is capable of inducing stochastic resonance in the sample to amplify characteristic signals of the sample. At least one shielding structure electromagnetically shields the sample and the first magnetometer from external electromagnetic radiation

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/50165

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - G01R 33/24 (2014.01)

USPC - 324/244

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: 324/244

IPC(8): G01R 33/24 (2014.01)

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

USPC: 324/244, 244.1, 260, 261, 262, 76.19, 76.21, 76.22, 76.24

IPC(8): G01R 33/24 (2014.01) (see terms below)

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

PatBase, PubWEST, Google Scholar Search terms used: vapor, vapour, gas, chamber, cell, Helmholtz, magnetic, electromagnet, shield, Faraday cage, optic, cable, connection, wiring, fiber, fibre, magnetometer, SQUID, coil, solenoid, transformer, transducer, noise, random, stochastic, two, multiple, sample, specimen

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0156659 A1 (Butters et al.) 18 June 2009 (18.06.2009), entire document, especially claim 34, 50, 59, 61, fig. 1-2, 4-5, 29B, para [0008], [0013]-[0015], [0071]-[0086], [0091]-[0094], [0115], [0154], [0158]-[0160], [0176]-[0196], [0203], [0217]-[0219], [0231]-[0232], [0277], [0281]-[0282]	1-22
Y	US 2011/0279115 A1 (Tuchman) 17 November 2011 (17.11.2011), entire document, especially fig. 1, 5, 6B, para [0042], [0055], [0062], [0065]-[0066], [0093]-[0094], [0098]	1-22
Y	US 2007/0205767 A1 (Xu et al.) 06 September 2007 (06.09.2007), entire document, especially fig. 13A, para [0091]-[0092]	9
A	US 2012/0113423 A1 (Groswasser) 10 May 2012 (10.05.2012), entire document.	1-22
A	US 2008/0106261 A1 (Romalis et al.) 08 May 2008 (08.05.2008), entire document.	1-22
A	US 5,574,369 A (Hibbs) 12 November 1996 (12.11.1996), entire document.	1-22

☐ 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

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Lee W. Young

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 13/50165

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:

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: claims 1-18: drawn to an apparatus for analyzing molecular signals produced from a sample comprising a magnetometer capable of detecting magnetic fields produced by a sample, the magnetometer positioned proximate to the sample, wherein the magnetometer has a size less than 6 cm and/or is miniaturized; a noise producing component which is capable of inducing stochastic resonance in the sample, and a shielding structure for electromagnetically shielding the sample.

—See Extra sheet for Continuation —

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.:

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 III:

Group II: claims 19-22: drawn to a method for analyzing an effect of a chemical or biochemical agent comprising providing a sample within a shielding structure with at least one magnetometer, placing a sample in a container with both magnetic and electromagnetic shielding, injecting noise into a sample sufficient to generate stochastic resonance, detecting output radiation, repeating the injecting and detecting at each of multiple noise levels, identifying frequencies, synthesizing a response-producing signal and exposing the agent-responsive system to the synthesized response-producing signal.

The inventions listed as Groups I and II 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:

Special technical features:

Group I does not require detecting output radiation from the sample and recording an electromagnetic time domain signal and repeating the injecting and detecting and identifying frequencies representing dominant characteristics of the time-domain signal, as well as synthesizing a response-producing signal as required by group II.

Group II does not require that the magnetometer is miniaturized/less than 6 cm as required by group I.

Shared Features:

The only technical features shared by Groups I and II that would otherwise unify the groups are a sample, a first magnetometer capable of detecting magnetic fields produced by a sample in a holder and positioned proximate to the sample, a noise producing component configured to uniformly produce noise surrounding the sample and the first magnetometer, wherein the noise produced is capable of inducing stochastic resonance in the sample to amplify characteristic signals of the sample; and at least one shielding structure for electromagnetically shielding the sample and the first magnetometer from external electromagnetic radiation.

However, these shared technical features do not represent a contribution over prior art, because the shared technical features are disclosed by US 2008/0106261 A1 to Romalis et al. (hereinafter 'Romalis') 08 May 2008 (08.05.2008), which discloses a first magnetometer (FIG 1; para [0012]) capable of detecting magnetic fields produced by a sample in a holder (para [0012]) and positioned proximate to the sample (100, para [0052]-[0055], [0081]), and at least one shielding structure (180) for electromagnetically shielding the sample and the first magnetometer from external electromagnetic radiation (para [0069], [0070], [0090]) and US 5,574,369 A (Hibbs) 12 November 1996 (12.11.1996), which discloses a detecting device, comprising a magnetometer (col 4, 32-35, SQUID), a noise producing component configured to uniformly produce noise (col 3, ln 26-29; col 4, ln 24-25) surrounding the sample and the first magnetometer (col 1, ln 27-36, particle), wherein the noise produced is capable of inducing stochastic resonance in the sample to amplify characteristic signals of the sample (col 1, ln 27-36, stochastic activation...the addition of noise to the system will cause the transitions between states to become more coherent with the signal and...improve signal to noise ratio; col 1, ln 46-49). It would have been obvious to one of skill in the art to include the detector utilizing stochastic resonance, as taught by Hibbs, in the detection device, as taught by Romalis, to increase the sensitivity by increasing the signal to noise ratio (see Hibbs, col 1, ln 8-10; col 2, ln 42-50).

As the shared technical features were known in the art at the time of the invention, they cannot be considered special technical features that would otherwise unify the groups.

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