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[Continued on next page]

(54) Title: AUTOMATIC BUMP AND CALIBRATION IN GAS DETECTORS VIA SHORT RANGE WIRELESS COMMUNICATION

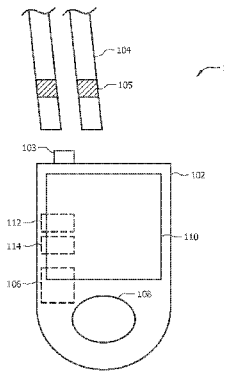


FIG. 1A

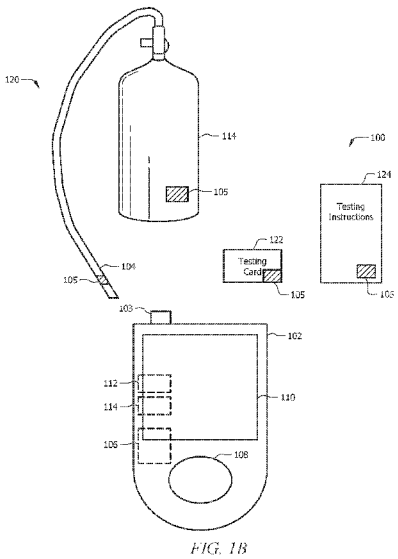


FIG. 1B

(57) Abstract: Embodiments relate generally to systems and methods for completing processes on a gas detector device using near-field communication between the gas detector device and an NFC tag. The NFC tag may communicate instructions or information to the gas detector device. The NFC tag may be located on or near a gas testing system, comprising gas deliver tube(s), gas tank(s), as well as other elements. In some embodiments, the gas detector device may comprise a single button to simplify interactions with the user.

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(81) **Designated States** *(unless otherwise indicated, for every 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, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

AUTOMATIC BUMP AND CALIBRATION IN GAS DETECTORS VIA SHORT RANGE WIRELESS COMMUNICATION

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application Serial No. 62/105,158 (entitled AUTOMATIC BUMP AND CALIBRATION IN GAS DETECTORS VIA SHORT RANGE WIRELESS COMMUNICATIONfiled January 19, 2015), which is incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

REFERENCE TO A MICROFICHE APPENDIX

[0003] Not applicable.

BACKGROUND

[0004] Gas detectors may be carried by workers in environments where there is potential for harmful gases. The gas detectors may be periodically tested and/or calibrated to ensure that the detector is working properly. This may be done using a gas testing system operable to supply a sample gas to the detector and analyze the response of the gas detector. In some workplaces, the testing may occur while a user is wearing other protective gear, such as gloves, suits, helmets, respiratory equipment, etc.

BRIEF DESCRIPTION OF THE DRAWINGS

[0005] For a more complete understanding of the present disclosure, reference is now made to the following brief description, taken in connection with the accompanying drawings and detailed description, wherein like reference numerals represent like parts.

[0006] FIG. 1A illustrates a gas detector and gas delivery tubes according to an embodiment of the disclosure;

[0007] FIG. 1B illustrates a gas detector and gas testing system according to an embodiment of the disclosure; and

[0008] FIGS. 2A-2B illustrate the operation of a gas detector and gas testing system communicating via NFC.

DETAILED DESCRIPTION

[0009] It should be understood at the outset that although illustrative implementations of one or more embodiments are illustrated below, the disclosed systems and methods may be implemented using any number of techniques, whether currently known or not yet in existence. The disclosure should in no way be limited to the illustrative implementations, drawings, and techniques illustrated below, but may be modified within the scope of the appended claims along with their full scope of equivalents.

[0010] The following brief definition of terms shall apply throughout the application:

[0011] The term "comprising" means including but not limited to, and should be interpreted in the manner it is typically used in the patent context;

[0012] The phrases "in one embodiment," "according to one embodiment," and the like generally mean that the particular feature, structure, or characteristic following the phrase may be included in at least one embodiment of the present invention, and may be included in more than one embodiment of the present invention (importantly, such phrases do not necessarily refer to the same embodiment);

[0013] If the specification describes something as "exemplary" or an "example," it should be understood that refers to a non-exclusive example;

[0014] The terms "about" or approximately" or the like, when used with a number, may mean that specific number, or alternatively, a range in proximity to the specific number, as understood by persons of skill in the art field; and

[0015] If the specification states a component or feature "may," "can," "could," "should," "would," "preferably," "possibly," "typically," "optionally," "for example," "often," or "might" (or other such language) be included or have a characteristic, that particular component or feature is not required to be included or to have the characteristic. Such component or feature may be optionally included in some embodiments, or it may be excluded.

[0016] There is a strong desire for compliance based portable gas detectors to be as user friendly as possible. One of the ways this can be accomplished is by limiting the device to a single button, reducing the interaction between the user and device. One of the issues with this arises if multiple types of user/device interactions are required, and it becomes difficult to come up with different types of single button interactions (e.g. long button press, short button press, double press, etc.) to cover all operations or interactions.

[0017] In an example, gas detectors often require regular calibration (i.e. apply a known gas, read the sensor output, and adjust gas readings as needed) and bumping (i.e. apply a known gas to make sure all user alerts are still working as intended). Usually these actions are completed within a docking station or manually. When done manually, the problem described above may arise, where if there is only one button, it may be difficult to control the device to enter calibration or bump mode.

[0018] Applicants have proposed a process using near field communication (NFC) between the gas detectors and one or more NFC tag. The tube that supplies the gas sample to the detector that is used for calibration (cal) and bumping (bump) may be redesigned to incorporate a passive NFC tag near the end of the tubeoperable to attach to the detector device. The NFC tag will contain

information such as gas type, concentration, and the action required (bump or cal). To interact with the NFC tag, an NFC reader may be incorporated into the gas detector. When the tube is in place it will be in close enough proximity of the reader that the device will automatically read the information off the tube's NFC tag and put the device in to the appropriate mode. The proposed solution requires no interaction between the user and the device other than attaching the tube, reducing the potential for error, and reducing the time required for the bump/cal process.

[0019] Referring now to FIG. 1A, a system 100 may comprise a detector device 102, such as a gas detector, one or more gas delivery tubes 104, and one or more NFC tags 105 attached to the gas delivery tubes 104. In some embodiments, the gas delivery tubes 104 may be part of a gas testing system. The detector 102 may comprise an attachment point 103 operable to connect to the gas delivery tube(s) 104 and an NFC reader 106. The NFC reader 106 may be operable to receive input from the NFC tag(s) 105. In some embodiments, the gas detector device may comprise a memory 112 and a processor 114. Additionally, the gas detector device may comprise an application stored in the memory 112, that when executed by the processor 114 receives instructions from the NFC tag 105 via the NFC reader 106, and executes an action based on the instructions from the NFC tag 105.

[0020] Referring to FIG. 1B, the system 100 may comprise a full gas testing system 120. In some embodiments, the NFC tag(s) 105 may be attached to the gas delivery tube 104 (as described above). Alternatively, the NFC tag(s) 105 may be attached to a gas tank 114 (which may deliver gas to the detector via a gas delivery tube 104). In alternative embodiments, the NFC tag(s) 105 may be attached to any part of the gas testing system 120, including the gas tank, the gas delivery tubes, and the area around the gas tank, for example. In some embodiments, the gas testing system 120 may comprise a testing card 122 comprising the NFC tag 105, wherein a user may swipe the card 122 near the gas detector device 102 to communicate the information. In some embodiments, the gas

testing system 120 may comprise a poster 124comprising the NFC tag 105, wherein a user may swipe the gas detector device 102 near the poster 124 to communicate the information.

[0021] In FIGS. 1A-1B, the detector 102 may comprise a single button 108 for interaction with a user. This may simplify the interactions required by a user, which may be hindered by a user wearing protective gear, such as gloves. In some embodiments, the detector 102 may also comprise a user interface 110, which may include a screen, a microphone, a speaker, etc., for interaction between the user and the detector 102.

[0022] Referring to FIGS. 2A-2B, the gas delivery tube 104 may attach to the detector 102, and the NFC reader 106 of the detector 102 may interact with one of the NFC tags 105 to execute different actions, operations, or processes on the detector 102, as described above. In FIG. 2A the NFC tag 105 may initiate a bump process, by prompting the device to enter bump mode. In FIG. 2B the NFC tag 105 may initiate a calibration, by prompting the device to enter calibration mode. In other embodiments, additional NFC tags 105 may be used to initiate different actions on the detector 102.

[0023] Embodiments of the disclosure may comprise a gas detector device comprisinga processor;a memory;a near field communication (NFC) reader; an attachment point operable to attach to one or more gas delivery tubes, wherein the gas delivery tube comprises an NFC tag operable to interact with the NFC reader of the gas detector to give instructions to the detector; andan application stored in the memory, that when executed by the processor receives instructions from the NFC tag via the NFC reader, and executes an action based on the instructions from the NFC tag.

[0024] In some embodiments, the NFC tag may instruct the detector to enter bumping mode. In some embodiments, the NFC tag may instruct the detector to enter calibration mode. In some embodiments, the gas delivery tube delivers gas to the gas detector to complete the action executed

by the detector. In some embodiments, the gas detector is operable to attach to a plurality of gas delivery tubs and complete a plurality of actions. In some embodiments, the gas detector comprises a single button for interaction between a user and the detector. In some embodiments, the gas detector comprises a user interface for interaction between a user and the detector.

[0025] Embodiments of the disclosure may comprise a gas detector device comprisinga processor;a memory;a near field communication (NFC) reader; an attachment point operable to attach to a gas testing system, wherein the gas testing system comprises an NFC tag operable to interact with the NFC reader of the gas detector to give instructions to the detector; andan application stored in the memory, that when executed by the processor receives instructions from the NFC tag via the NFC reader, and executes an action based on the instructions from the NFC tag.

[0026] In some embodiments, the gas detector device may comprise a gas sensor. In some embodiments, the gas sensor may receive the gas delivered by the gas delivery tube. In some embodiments, the gas testing system comprises a gas delivery tube operable to deliver gas to the gas detector to complete the action executed by the detector. In some embodiments, the gas testing system comprises one or more gas delivery tubes and one or more gas tank.

[0027] Additional embodiments of the disclosure may comprise a method for completing an action on a gas detector device comprising:connecting, by the gas detector device, to a gas delivery tube of a gas testing system, wherein the gas delivery tube comprises a near field communication (NFC) tag;receiving, via an NFC reader of the gas detector device, instructions from the NFC tag for completing an action on the gas detector device;executing, by the gas detector device, the instructions received from the NFC tag via the NFC reader to complete the action on the gas detector device; andreceiving sample gas output from the gas delivery tube to complete the action on the gas

detector device. In some embodiments, the sample may be received by a sensor of the gas detector device.

[0028] In some embodiments, the method may further comprise connecting, by the gas detector device, to a second gas delivery tube of the gas testing system, wherein the gas testing system comprises a second NFC tag;receiving, via the NFC reader of the gas detector device, instructions from the second NFC tag for completing a second action on the gas detector device;executing, by the gas detector device, the instructions received from the second NFC tag via the NFC reader to complete the second action on the gas detector device; andreceiving sample gas output from the second gas delivery tube to complete the second action on the gas detector device. In some embodiments, the action comprises entering into bumping mode. In some embodiments, the method may further comprise completing a bump process by the gas detector. In some embodiments, the action comprises entering into calibration mode. In some embodiments, the method may further comprise completing a calibration process by the gas detector. In some embodiments, the NFC tag may be located on the gas delivery tube. In some embodiments, the gas detector comprises a single button for interaction between a user and the detector.

[0029] Other embodiments of the disclosure may include a system for providing automatic interaction with gas detectors comprising: a gas testing system comprising one or more gas tanks containing sample gas for testing a gas detector device; one or more gas delivery tubes operable to attach to a gas detector device; and an NFC tag attached to each of the one or more gas delivery tubes. The system may also comprise a gas detector device comprising:a processor;a memory;a near field communication (NFC) reader, wherein the NFC tag of the gas delivery tubes is operable to interact with the NFC reader of the gas detector device to communicate instructions to the gas detector device; an attachment point operable to attach to the one or more gas delivery tubes; andan

application stored in the memory, that when executed by the processor receives instructions from the NFC tag via the NFC reader, and executes an action based on the instructions from the NFC tag.

[0030] In some embodiments, the NFC tag instructs the detector to enter bumping mode. In some embodiments, the NFC tag instructs the detector to enter calibration mode. In some embodiments, the gas delivery tube delivers gas to the gas detector to complete the action executed by the detector. In some embodiments, the gas detector is operable to attach to a plurality of gas delivery tubs and complete a plurality of actions. In some embodiments, the gas detector comprises a single button for interaction between a user and the detector, and a user interface for interaction between a user and the detector.

[0031] While various embodiments in accordance with the principles disclosed herein have been shown and described above, modifications thereof may be made by one skilled in the art without departing from the spirit and the teachings of the disclosure. The embodiments described herein are representative only and are not intended to be limiting. Many variations, combinations, and modifications are possible and are within the scope of the disclosure. Alternative embodiments that result from combining, integrating, and/or omitting features of the embodiment(s) are also within the scope of the disclosure. Accordingly, the scope of protection is not limited by the description set out above, but is defined by the claims which follow, that scope including all equivalents of the subject matter of the claims. Each and every claim is incorporated as further disclosure into the specification and the claims are embodiment(s) of the present invention(s). Furthermore, any advantages and features described above may relate to specific embodiments, but shall not limit the application of such issued claims to processes and structures accomplishing any or all of the above advantages or having any or all of the above features.

[0032] Additionally, the section headings used herein are provided for consistency with the suggestions under 37 C.F.R. 1.77 or to otherwise provide organizational cues. These headings shall not limit or characterize the invention(s) set out in any claims that may issue from this disclosure. Specifically and by way of example, although the headings might refer to a "Field," the claims should not be limited by the language chosen under this heading to describe the so-called field. Further, a description of a technology in the "Background" is not to be construed as an admission that certain technology is prior art to any invention(s) in this disclosure. Neither is the "Summary" to be considered as a limiting characterization of the invention(s) set forth in issued claims. Furthermore, any reference in this disclosure to "invention" in the singular should not be used to argue that there is only a single point of novelty in this disclosure. Multiple inventions may be set forth according to the limitations of the multiple claims issuing from this disclosure, and such claims accordingly define the invention(s), and their equivalents, that are protected thereby. In all instances, the scope of the claims shall be considered on their own merits in light of this disclosure, but should not be constrained by the headings set forth herein.

[0033] Use of broader terms such as "comprises", "includes", and "having" should be understood to provide support for narrower terms such as "consisting of", "consisting essentially of", and "comprised substantially of". Use of the term "optionally," "may," "might," "possibly," and the like with respect to any element of an embodiment means that the element is not required, or alternatively, the element is required, both alternatives being within the scope of the embodiment(s). Also, references to examples are merely provided for illustrative purposes, and are not intended to be exclusive.

[0034] While several embodiments have been provided in the present disclosure, it should be understood that the disclosed systems and methods may be embodied in many other specific forms

without departing from the spirit or scope of the present disclosure. The present examples are to be considered as illustrative and not restrictive, and the intention is not to be limited to the details given herein. For example, the various elements or components may be combined or integrated in another system or certain features may be omitted or not implemented.

[0035] Also, techniques, systems, subsystems, and methods described and illustrated in the various embodiments as discrete or separate may be combined or integrated with other systems, modules, techniques, or methods without departing from the scope of the present disclosure. Other items shown or discussed as directly coupled or communicating with each other may be indirectly coupled or communicating through some interface, device, or intermediate component, whether electrically, mechanically, or otherwise. Other examples of changes, substitutions, and alterations are ascertainable by one skilled in the art and could be made without departing from the spirit and scope disclosed herein.

CLAIMS

What is claimed is:

1. A gas detector device (102) comprising:

a processor (114);

a memory (112);

a near field communication (NFC) reader (106);

an attachment point (103) operable to attach to a gas testing system (120), wherein the gas testing system(120) comprises an NFC tag (105) operable to interact with the NFC reader (106) of the gas detector (102) to give instructions to the detector (102); and

an application stored in the memory (112), that when executed by the processor (114) receives instructions from the NFC tag (105) via the NFC reader (106), and executes an action based on the instructions from the NFC tag (105).

2. The device (102) of claim 1, wherein the NFC tag (105) instructs the detector (102) to enter bumping mode.

3. The device (102) of claim 1, wherein the NFC tag (105) instructs the detector (102) to enter calibration mode.

4. The device (102) of claim 1, wherein the gas testing system (120) comprises a gas delivery tube (104) operable to deliver gas to the gas detector (102) to complete the action executed by the detector (102).

5. The device (102) of claim 4, wherein the gas detector (102) is operable to attach to a plurality of gas delivery tubes (104) and complete a plurality of actions.

6.The device (102) of claim 1, wherein the gas detector (102) comprises a single button (108) for interaction between a user and the detector (102).

7.The device (102) of claim 1, wherein the gas testing system (120) comprises one or more gas delivery tubes (104) and one or more gas tank (114).

8. A method for completing an action on a gas detector device comprising:

connecting, by the gas detector device, to a gas delivery tube of a gas testing system, wherein the gas testing system comprises a near field communication (NFC) tag;

receiving, via an NFC reader of the gas detector device, instructions from the NFC tag for completing an action on the gas detector device;

executing, by the gas detector device, the instructions received from the NFC tag via the NFC reader to complete the action on the gas detector device; and

receiving sample gas output from the gas delivery tube to a sensor of the gas detector device to complete the action on the gas detector device.

9. The method of claim 8 further comprising:

connecting, by the gas detector device, to a second gas delivery tube of the gas testing system, wherein the gas testing system comprises a second NFC tag;

receiving, via the NFC reader of the gas detector device, instructions from the second NFC tag for completing a second action on the gas detector device;

executing, by the gas detector device, the instructions received from the second NFC tag via the NFC reader to complete the second action on the gas detector device; and

receiving sample gas output from the second gas delivery tube to a sensor of the gas detector device to complete the second action on the gas detector device.

10.The method of claim 8, wherein the action comprises entering into bumping mode.

11. The method of claim 10 further comprising completing a bump process by the gas detector.

12.The method of claim 8, wherein the action comprises entering into calibration mode.

13. The method of claim 12 further comprising completing a calibration process by the gas detector.

14.The method of claim 8,wherein the NFC tag is located on the gas delivery tube.

15.The method of claim 8, whereinthe gas detector comprises a single button for interaction between a user and the detector.

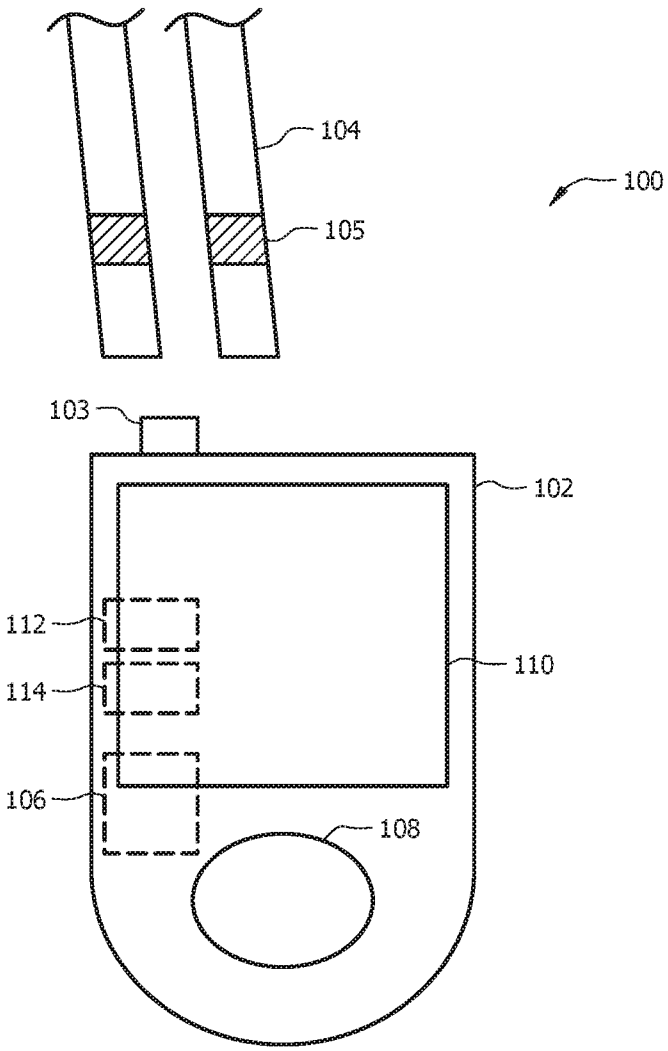


FIG. 1A

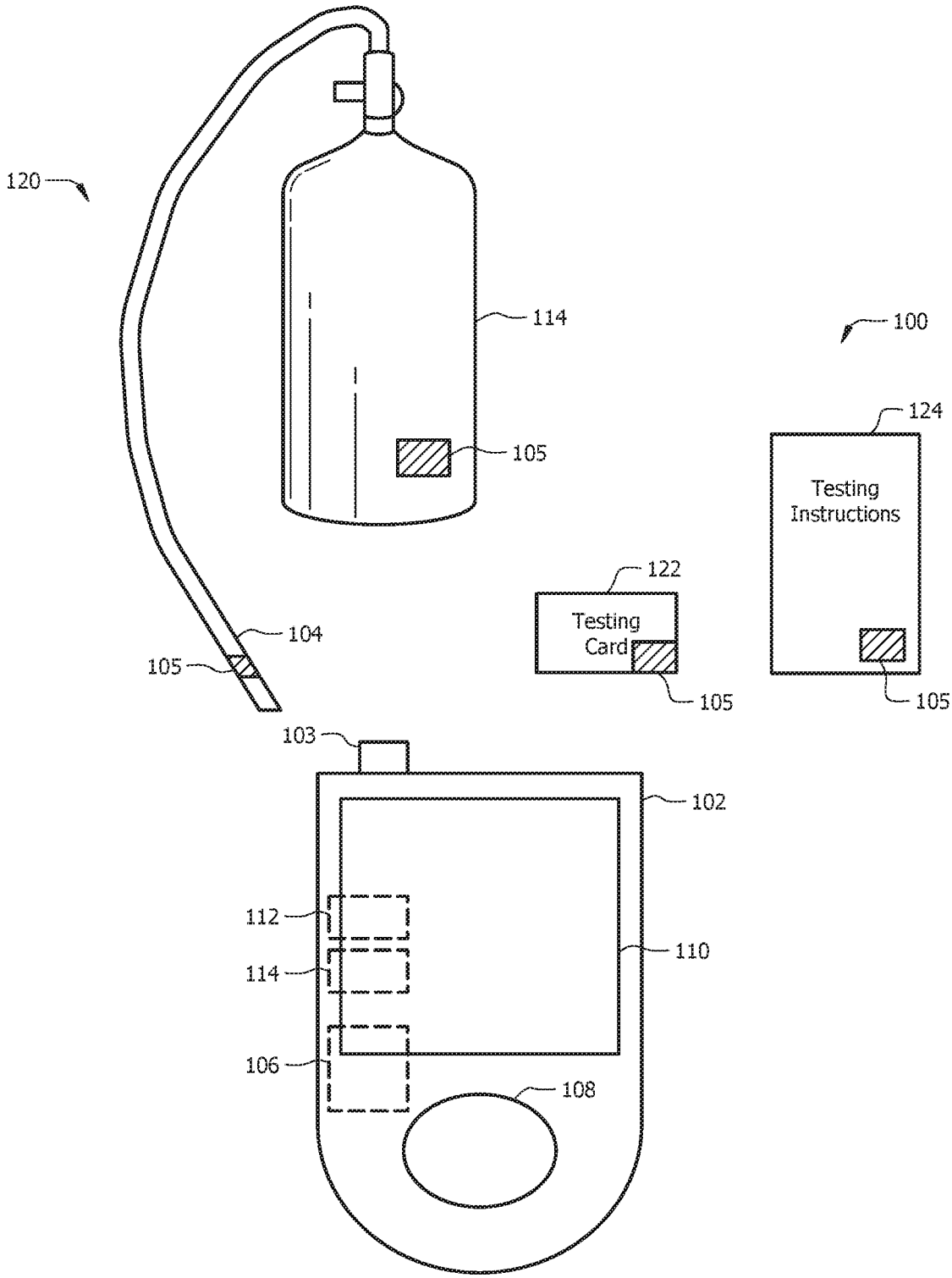

120
114
105
100
124
Testing Instructions
105
122
Testing Card
105
104
105
103
102
112
114
110
106
108

FIG. 1B

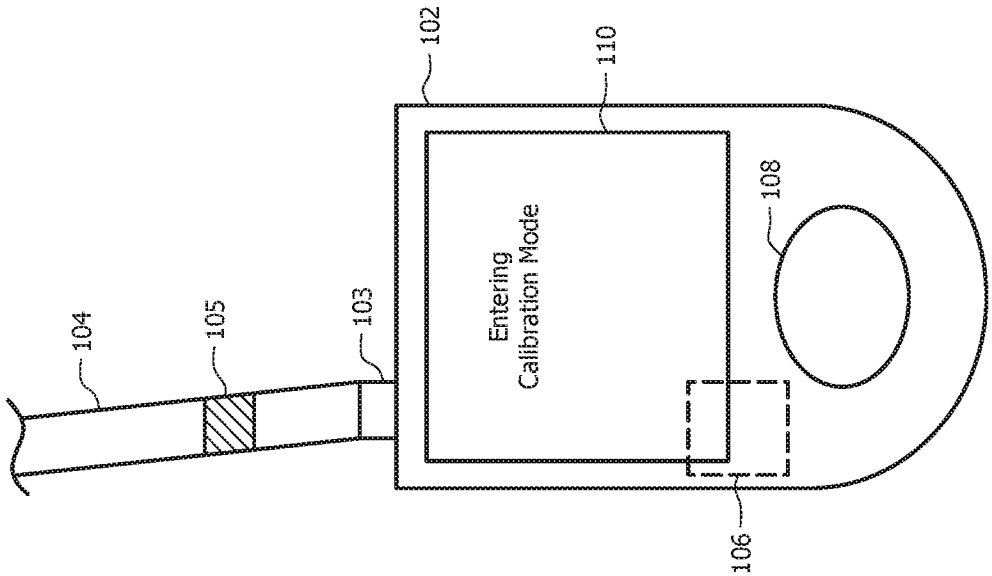

102
110
Entering
Calibration Mode
108
104
105
103
106

FIG. 2B

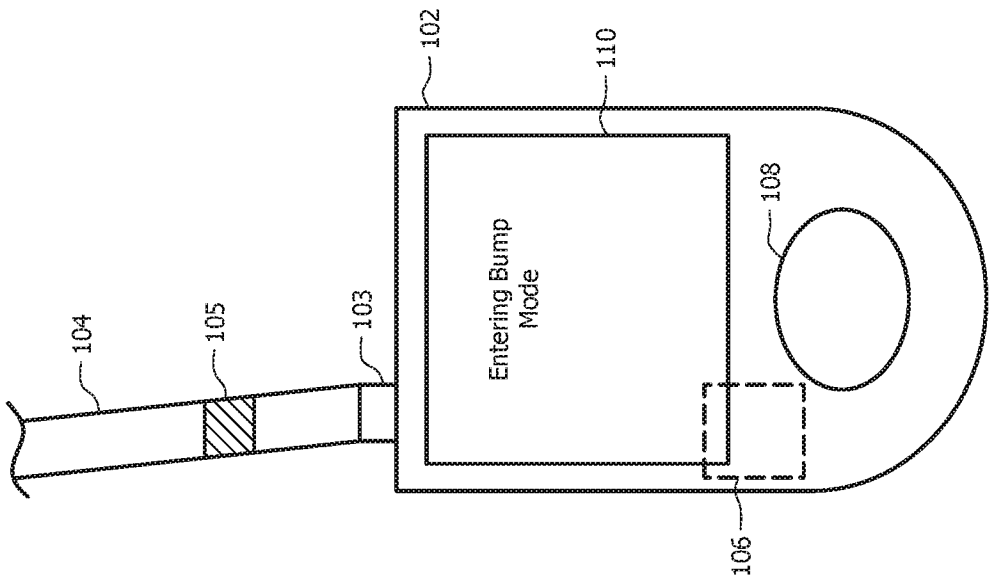

102
110
Entering Bump
Mode
108
104
105
103
106

FIG. 2A

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/012942

A. CLASSIFICATION OF SUBJECT MATTER
INV. H04Q9/00 G01N33/00 G08B21/12 H04B5/00
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)
G08B H04B G01N H04Q

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, INSPEC, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 92/07261 A1 (SPACELABS INC [US]) 30 April 1992 (1992-04-30)	1-4,6,8, 10-15
Y	page 1, lines 6-9 page 1, lines 26-34 page 3, lines 11-22 page 5, lines 17-33 page 7, lines 13-28 page 11, lines 18-28 page 15, lines 14-22 page 1 page 16, line 3 - page 17, line 2 claims 1, 30, 31, 37 ----- -/--	5,7,9

[X] Further documents are listed in the continuation of Box C.

[X] 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	Date of mailing of the international search report
21 March 2016	05/04/2016

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Barbelanne, Alain

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Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2016/012942

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2012/063956 A1 (TRUEX BRYAN I [US] ET AL) 15 March 2012 (2012-03-15) paragraph [0002] paragraph [0014] paragraph [0018] paragraph [0049] claim 1	5,7,9
A	US 2014/349707 A1 (BANG YOUNG-KI [KR]) 27 November 2014 (2014-11-27) paragraph [0003] paragraph [0015] - paragraph [0016] paragraph [0020] paragraph [0025] claim 1	1,8
A	US 2013/002405 A1 (PESONEN MIKA [US] ET AL) 3 January 2013 (2013-01-03) paragraph [0001] paragraph [0009] - paragraph [0011] column 24 paragraph [0028] claims 1-3	1,8
A	US 2009/231099 A1 (HYDE RODERICK A [US] ET AL) 17 September 2009 (2009-09-17) paragraph [0001] paragraph [0018] column 57 - column 60 paragraph [0065]	1,8

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2016/012942

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WO 9207261 A1	30-04-1992	CA 2071634 A1	12-04-1992
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