(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
07 September 2023 (07.09.2023)

WIPO | PCT

(10) International Publication Number
WO 2023/164761 A1

(51) International Patent Classification:
G01F 23/24 (2006.01) *G01F 23/00* (2022.01)

(21) International Application Number:
PCT/CA2023/050257

(22) International Filing Date:
28 February 2023 (28.02.2023)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/315,161 01 March 2022 (01.03.2022) US

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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, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, 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, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, 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,

(54) **Title:** LIQUID LEVEL SENSOR AND PROTECTIVE COVER

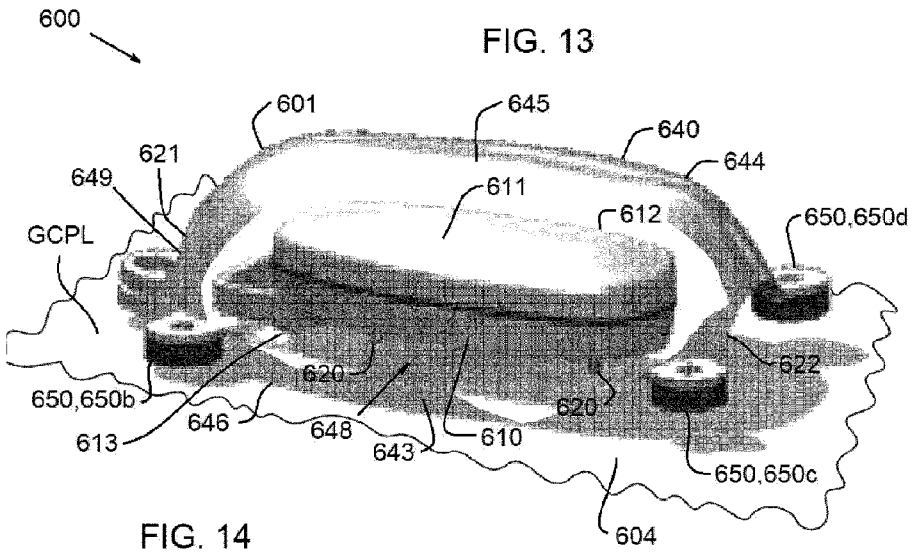

FIG. 13

FIG. 14

(57) **Abstract:** A liquid level sensor comprises a main body, a common electrical contact, a base-level electrical contact, and a first-raised-level electrical contact. The common electrical contact and the base-level electrical contact together define a base liquid sensing level. The common electrical contact and the first-raised-level electrical contact together define a first raised liquid sensing level. Electronic circuitry is responsive to a path between the common electrical contact and the base-level electrical contact being electrically closed by moisture to generate a base-level alarm signal, and responsive to a path between the common electrical contact and the first-raised-level electrical contact being electrically closed by moisture to generate a second-level alarm signal. Alternatively, a first pair of electrical contacts and a second pair of electrical contacts may be used.

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[Continued on next page]

DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, 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))*
— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*
— *in black and white; the international application as filed contained color or greyscale and is available for download from PATENTSCOPE*

LIQUID LEVEL SENSOR AND PROTECTIVE COVER

FIELD OF THE INVENTION

[0001] The present invention relates to liquid level sensors and more particularly to liquid level sensors for sensing a plurality of liquid levels, and also to protective covers therefor.

BACKGROUND OF THE INVENTION

[0002] Most prior art liquid level sensors operate by sensing low level current flow between two (2) electrical contacts when both electrical contacts are in contact with a common body of liquid, as shown in Figures 1A and 1B. The liquid, even if it is just moisture, closes a path between the two electrical contacts. Electronic circuitry responsive to the path between the two electrical contacts being electrically closed by the liquid, senses the closure of the circuit and accordingly can generate an alarm signal. The electronic circuitry is either triggered or not triggered to thereby provide an alarm. This is a well-known art and not elaborated further.

[0003] In use, with the liquid level sensor in place typically on or near a surface, when a leak is detected, audible and/or visible alarms may be generated by the device, and alarm information and/or control messages may be transmitted via wired or wireless communication means to control panels, wireless devices, and so on, and may be used to shut off liquid supply lines, among other remedial activities.

[0004] A problem with this singular response approach, or in other words sensing only one liquid level, is that the system reacts to small amounts of moisture on a floor and larger floods, possibly from a serious leak, in exactly the same way. Condensation may even trigger an alarm when no leak is present. Conventional liquid leak sensors are depicted in Figure 1A and Figure 1B.

[0005] Various prior art conventional liquid level sensors are known, and include the following devices.

[0006] One such prior art device for sensing a water level can be found in United States Patent No. 9,432,763 issued August 30, 2016, to Scharf, and entitled Water Leak Warning Device. A water leak warning device is described and taught having a hollow body having an interior space and an outer surface, the hollow body having walls comprising a bottom wall and a side wall, the bottom wall having a bottom flat surface; at least two electrodes each extending out of the bottom flat surface in a direction generally perpendicular to the bottom flat surface; a power supply enclosed in the interior space of the hollow body; and a speaker enclosed in the interior space of the hollow body; wherein the at least two electrodes, the power supply, and the speaker are operatively connected by conducting elements such that when the at least two electrodes are connected by a conductive material, an audible signal is emitted by the speaker.

[0007] The water leak warning device may also have a plurality of protruding elements having substantially equal height, being rooted on the lower end of the side wall and extending from the side wall in a direction generally perpendicular to the bottom flat surface, with gaps between the protruding elements. The protruding elements may also be rooted directly from the bottom surface. Such designs may allow any water that leaks onto the ground to flow through the gaps between the protruding elements and reach under the bottom flat surface of the water leak warning device.

[0008] The water leak warning device may further have two or more electrodes each having a first end and a second end, the first ends of the electrodes protruding out of the flat surface of the hollow body in a direction generally perpendicular to the flat surface, the length of the first ends extending out of the hollow body may be shorter than, equal to, or slightly longer than, the length of the protruding elements extending out of the peripheral edge of the bottom flat surface, the second ends of the electrodes being enclosed in the interior space of the hollow body. When the user puts the water leak warning device on the ground, the first ends of the electrodes may or may not have constant contact with the ground because the part of the electrodes extending out of the bottom flat surface may be slightly longer than, equal to, or shorter than, the length of the protruding elements extending out of the peripheral edge of the bottom flat surface. The gaps between the protruding elements ensure that leaked water can flow through to make contact with the first ends of the electrodes.

[0009] The water leak warning device further has a power supply, a speaker, and an amplifier, all of which are enclosed in the interior space of the hollow body. The electrodes, the power supply, the speaker and the amplifier are operatively connected by conducting elements such that when the first ends of the electrodes are connected by conductive material, such as water, an audible signal is emitted by the speaker. When leaked water reaches the spot where the warning device is placed, the first ends of the electrodes are connected through the water, thereby triggering an alarm. The user of the device can thus be warned and take actions to prevent further leakage and mitigate any damage.

[00010] In another embodiment there is a water leak warning device having a rectangular hollow body having an interior space, the hollow body having rigid walls comprising at least a top wall, a bottom wall, and a plurality of side walls, wherein there is an adhesive disposed on at least one of the plurality of side walls; at least two electrodes each having a first end extending out of the bottom wall in a direction generally perpendicular to the bottom wall; a power supply enclosed in the interior space of the hollow body; a speaker enclosed in the interior space of the hollow body; an aperture traversing at least one of the plurality of the side walls, wherein the at least two electrodes, the power supply, and the speaker are operatively connected by conducting elements such that when the first end of each of the at least two electrodes are connected by a conductive material, an audible signal is emitted by the speaker through the aperture traversing the at least one side wall; and a reverberating chamber partially or wholly surrounding the aperture.

[00011] Another relevant prior art patent is United States Patent No. 10,480,824, issued November 19, 2019, to Gardner *et al.*, and entitled Leak Detection Sensor Assemblies For Water Heaters. The leak detection system includes a leak sensor assembly that is disposed in a bottom pan of the water heater. The leak sensor assembly includes a sensor housing that has a sensor channel that is formed therein such that the sensor channel is disposed at an elevation from a base of the bottom pan when the sensor housing is disposed on the base of the bottom pan. Further, the leak sensor assembly includes a leak sensor that is disposed in the sensor channel of the sensor housing. The leak sensor detects water that leaks from the water heater and accumulates in the bottom pan when a level of the water in the bottom pan rises to the elevation of the sensor channel and the leak sensor that is disposed therein.

[00012] Another relevant prior art patent is United States Patent No. 11,047,761, issued June 29, 2021, to Frackelton *et al.*, and entitled Integrated Leak Detection. Exemplary systems of the invention comprise a leak detection module with a processor that processes signals from a plurality of low-cost sensors installed multiple locations throughout a fluid system, e.g., throughout a house, to determine the presence of a leak in the fluid system. An exemplary electronic plumbing fixture fitting comprises a fixture body including a discharge outlet, the discharge outlet being operable to deliver water via a fluid path; an electronically controlled valve in fluid communication with the fixture body in the fluid path upstream of the discharge outlet; at least one processor programmed to control the electronically controlled valve to selectively control a flow of fluid from the electronically controlled valve out the discharge outlet of the fixture body; and a local water sensor in electrical or optical communication with the processor, operably connected to the fixture body, and positioned to generate a local leak sensing signal having local sensed leak data imposed thereon, the local sensed leak data indicating a leak in the fluid path; and wherein the at least one processor has code causing the at least one processor to determine the presence of leaks in the fluid path using at least the local sensed leak data; and wherein the at least one processor has code causing the at least one processor to, in response to determining the presence of a leak in the fluid path using at least the local sensed leak data, perform any one of or both of the following: transmit to another processor, using communications circuitry, data indicating the presence of the detected leak in the fluid path; and automatically adjust the electronically controlled valve to adjust the flow of water flowing through the electronically controlled valve.

[00013] Another relevant prior art patent is United States Patent No. 11,378,538, issued July 5, 2022, to Lee *et al.*, and published as United States Published Patent Application No. US20200264120A1, and entitled Water Detector. A water detection device includes a pair of electrical connectors that are coupled to electrical contacts that may be mechanically biased. A water sensor circuit is configured to detect water by delivering a signal to an electrical contact. The presence of water may be determined based upon detection of the signal at the other contact. The water sensor circuit device may be configured with a comparator that uses hysteresis to provide sensitivity to the presence or absence of water. In a battery-powered water sensor, the water detection signal may be delivered as an alternating signal using, e.g., a signal modulator circuit (e.g., an oscillator circuit and gate optionally coupled to a wake-sleep controller that is coupled to a battery, which may avoid oxidation or other forms of ionic corrosion. In some examples, a water detection signal may be recurrently delivered to the first contact to conserve battery power.

[00014] It is an object of the present invention to provide a liquid level sensor for sensing at least a base liquid sensing level and generating a base-level alarm signal, and sensing a first raised liquid sensing level and generating a first-level alarm signal.

[00015] It is an object of the present invention to provide a liquid level sensor that eliminates false alarms.

[00016] It is an object of the present invention to provide a liquid level sensor that identifies the presence of moisture on a surface.

[00017] It is an object of the present invention to provide a liquid level sensor that identifies various water levels.

[00018] It is an object of the present invention to provide a liquid level sensor that identifies various water levels, such as a drip (perhaps 2mm of water), a leak (perhaps 4mm of water), or a flood (perhaps 6mm of water).

[00019] It is an object of the present invention to provide a liquid level sensor that allows a user to make decisions with confidence regarding water levels.

[00020] It is an object of the present invention to provide a liquid level sensor, wherein the sensor is protected from the environment.

[00021] It is an object of the present invention to provide a liquid level sensor, wherein the sensor is protected from external forces.

[00022] It is an object of the present invention to provide a liquid level sensor, wherein the sensor is protected from external impacts.

[00023] It is an object of the present invention to provide a liquid level sensor, wherein the sensor is precluded from being readily moved once installed.

[00024] It is an object of the present invention to provide a liquid level sensor, wherein the sensor is precluded from being readily moved once installed, and therefore is pet-safe and child-safe.

[00025] It is an object of the present invention to provide a liquid level sensor, wherein the senor has several installation options.

[00026] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover for sensing at least a base liquid sensing level and generating a base-level alarm signal, and sensing a first raised liquid sensing level and generating a first-level alarm signal.

[00027] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover that eliminates false alarms.

[00028] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover that identifies the presence of moisture on a surface.

[00029] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover that identifies various water levels.

[00030] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover that identifies various water levels, such as a drip (perhaps 2mm of water), a leak (perhaps 4mm of water), or a flood (perhaps 6mm of water).

[00031] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover that allows a user to make decisions with confidence regarding water levels.

[00032] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover, wherein the sensor is protected from the environment.

[00033] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover, wherein the sensor is protected from external forces by the protective cover.

[00034] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover, wherein the sensor is protected from external impacts by the protective cover..

[00035] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover, wherein the sensor and protective cover are precluded from being readily moved once installed.

[00036] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover, wherein the sensor and protective cover are precluded from being readily moved once installed, and therefore is pet-safe and child-safe.

[00037] It is an object of the present invention to provide a combination of a liquid level sensor and a protective cover, wherein the senor and protective cover have several installation options.

SUMMARY OF THE INVENTION

[00038] In accordance with one aspect of the present invention there is disclosed a novel liquid level sensor comprising a main body, a common electrical contact, and a base-level electrical contact. The common electrical contact and the base-level electrical contact together define a base liquid sensing level. The liquid level sensor also comprises a first-raised-level electrical contact. The common electrical contact and the first-raised-level electrical contact together define a first raised liquid sensing level. Electronic circuitry is responsive to a path between the common electrical contact and the base-level electrical contact being electrically closed by moisture and to generate a base-level alarm signal, and responsive to a path between the common electrical contact and the first-raised-level electrical contact being electrically closed by moisture and to generate a second-level alarm signal. In use, when moisture closes a path between the common electrical contact and the base-level electrical contact, the base-level alarm signal is generated to thereby indicate the base liquid sensing level, and

when moisture closes a path between the common electrical contact and the first-raised-level electrical contact, the second-level alarm signal is generated.

[00039] In accordance with one aspect of the present invention there is disclosed a novel liquid level sensor comprising a main body and a first pair of electrical contacts. The first pair of electrical contacts defines a base liquid sensing level. The liquid level sensor also comprises a second pair of electrical contacts. The second pair of electrical contacts defines a first raised liquid sensing level. Electronic circuitry responsive to a path between the first pair of electrical contacts being electrically closed by moisture and to generate a base-level alarm signal, and responsive to a path between the second pair of electrical contacts being electrically closed by moisture and to generate a second-level alarm signal. In use, when moisture closes a path between the first pair of electrical contacts, the base-level alarm signal is generated to thereby indicate the base liquid sensing level, and when moisture closes a path between the second pair of electrical contacts, the second-level alarm signal is generated.

[00040] In accordance with one aspect of the present invention there is disclosed a novel protective cover for use with a liquid level sensor. The protective cover comprises a main shell body extending between a first end and a second end, between a first side and a second side, and between and top portion and a bottom edge. The main shell body defines an open cavity defined by a bottom edge and open to the bottom of the main shell body. There is a ground contact portion disposed at the bottom of the main shell body to define a ground contact plane.

[00041] In accordance with one aspect of the present invention there is disclosed a novel combination of a liquid level sensor and a protective cover comprising a liquid level sensor having a main body and a liquid level sensing mechanism, and defining a ground contact plane; and a main shell body extending between a first end and a second end, between a first side and a second side, and between and top portion and a bottom edge, and defining an open cavity extending upwardly from a bottom edge and open to the bottom of the main shell body, and a ground contact portion disposed at the bottom of the main shell body to define a ground contact plane. In use, the liquid level sensor rests on a receiving surface at the ground contact plane and the main shell body rests on the receiving surface at the ground contact plane.

[00042] In accordance with one aspect of the present invention there is disclosed a novel combination of a liquid level sensor and a protective cover comprising a liquid level sensor having a main body with an upper body portion and a liquid level sensing mechanism; and a main shell body. The upper body portion of the liquid level sensor and the main shell body are similar in shape each to the other.

[00043] In accordance with one aspect of the present invention there is disclosed a novel combination of a liquid level sensor and a protective cover comprising a liquid level sensor having a main body with an upper body portion and a liquid level sensing mechanism; and a main shell body having a sensor-receiving cavity.

[00044] In accordance with one aspect of the present invention there is disclosed a novel combination of a liquid level sensor and a protective cover comprising a liquid level sensor having a main body, a ground contact portion, and a liquid level sensing mechanism; and a main shell body having a ground contact portion. In use, the ground contact portion of the main shell body peripherally surrounds the ground contact portion of the liquid level sensor.

[00045] In accordance with one aspect of the present invention there is disclosed a novel combination of a liquid level sensor and a protective cover comprising a liquid level sensor having a main body, a ground contact portion, and a liquid level sensing mechanism; and a main shell body having a ground contact portion. The ground contact portion of the main shell body defines a larger ground contact area than the contact portion of the liquid level sensor.

[00046] In accordance with one aspect of the present invention there is disclosed a novel combination of a liquid level sensor and a protective cover comprising a liquid level sensor having a main body, a ground contact portion, and a liquid level sensing mechanism; and a main shell body having a ground contact portion. In use, the main shell body is disposed in overlying relation to the liquid level sensor.

BRIEF DESCRIPTION OF THE DRAWINGS

[00047] The novel features which are believed to be characteristic of the present invention, as to its structure, organization, use and method of operation, together with further objectives and advantages thereof, will be better understood from the following drawings in which a first illustrated embodiment of the invention will now be illustrated by way of example. It is expressly understood, however, that the drawings are for the purpose of illustration and description only, and are not intended as a definition of the limits of the invention. In the accompanying drawings:

[00048] **Figure 1** is diagrammatic view of the overall liquid level sensor system;

[00049] **Figure 2** is a perspective view from the side of the first illustrated embodiment of the liquid level sensor according to the present invention;

[00050] **Figure 3** is a top plan view of the first illustrated embodiment of the liquid level sensor of Figure 2;

[00051] **Figure 4** is a perspective view from the side of the second illustrated embodiment of the liquid level sensor according to the present invention;

[00052] **Figure 5** is top plan view of the third illustrated embodiment of the liquid level sensor according to the present invention;

[00053] **Figure 6** is a bottom plan view of the third illustrated embodiment of the liquid level sensor of Figure 5;

[00054] **Figure 7** is a side elevational view of the third illustrated embodiment of the liquid level sensor of Figure 5;

[00055] **Figure 8** is a rear elevational view of the third illustrated embodiment of the liquid level sensor of Figure 5;

[00056] **Figure 9** is a front elevational view of the third illustrated embodiment of the liquid level sensor of Figure 5;

[00057] **Figure 10** is side elevational view of the fourth illustrated embodiment of the liquid level sensor according to the present invention;

[00058] **Figure 11** is top plan view of the illustrated embodiment of the protective cover according to the present invention;

[00059] **Figure 12** is perspective view of the illustrated embodiment of the protective cover according to the present invention shown in Figure 11;

[00060]of the present invention that comprises a combination of a liquid level sensor and a protective cover;

[00061] **Figure 13** is top plan view of the illustrated embodiment of the liquid level sensor and a protective cover according to the present invention; and,

[00062] **Figure 14** is a partially cut-away perspective view of the illustrated embodiment of the liquid level sensor and a protective cover according to the present invention as shown in Figure 13.

LIST OF COMPONENTS AND REFERENCE NUMERALS

100	liquid level sensor
102	overall liquid level sensor system
120	main body
121	first end
122	second end
123	top
124	bottom
125	first side
126	second side

127	ground contact portion
128	foot portion
129	downwardly sloped portion
130	“U”-shaped grasping handle
132	securing clip
140b	base-level electrical contact
140c	common electrical contact
141	first-raised-level electrical contact
141c,141b	outer ends
142	second-raised-level electrical contact
143	third-raised-level electrical contact
150	electronic circuitry
152	battery
154	antenna
BL	base liquid sensing level
GCPL	ground contact plane
L	line
1SL	first raised liquid sensing level
2SL	second raised liquid sensing level
1OD	first offset distance
2OD	second offset distance
3OD	third offset distance
4OD	fourth offset distance
200	liquid level sensor
220	main body
222	second end
224	bottom
228	foot portion
229	downwardly sloped portion
240b	base-level electrical contact
240c	common electrical contact
241	first-raised-level electrical contact
242	second-raised-level electrical contact

A	arrows
300	liquid level sensor
320	main body
340b	base-level electrical contact
340c	common electrical contact
400	liquid level sensor
420	main body
427	ground contact portion
441	first pair of electrical contacts
442	second pair of electrical contacts
443	third pair of electrical contacts
500	protective cover
502	liquid level sensor
503	grasping handle
504	receiving surface
520	thin curved main shell body
521	first end
522	second end
523	first side
524	second side
525	top portion
526	bottom edge
528	space
540	open cavity
550	ground contact portion
550a,550b,550c,550d	plurality of feet comprises four feet
600	combination liquid level sensor and protective cover
601	protective cover
604	receiving surface
610	liquid level sensor
611	upper body portion
612	main body
613	contact portion

620 electrical contacts

640 main shell body

641 first end

642 second hand

643 first side

644 second side

645 top portion

646 bottom edge

648 open cavity

649 space

650 ground contact portion

1SL first raised liquid sensing level

BL base liquid sensing level

GCPL ground contact plane

650a,650b,650c,650d plurality of feet comprises four feet

DETAILED DESCRIPTION OF THE ILLUSTRATED EMBODIMENTS

[00063] Reference will now be made to Figures 1 through 12, which show the illustrated embodiments of the liquid level sensor and protective cover according to the present invention, and the overall liquid level sensor system.

[00064] Reference will now be made to Figures 1 through 3, which illustrate a first embodiment of the liquid level sensor according to the present invention, as indicated by the general reference numeral 100 and the overall liquid level sensor system as indicated by the general reference numeral 102.

[00065] Reference will now be made to Figure 1, which shows one possible embodiment of the the overall liquid level sensor system 102, according to the present invention. The overall liquid level sensor system 102 may generate various types of alarm signals in response to detecting liquid, which may be known as a “liquid sensing event”.

[00066] The response to an alarm signal from the overall liquid level sensor system 102 is definable, selectable, and/or customizable by a user, based on severity of a liquid sensing event. In the present system, four (4) graduated "liquid sensing event” (which may also be considered as “liquid levels”) may be defined and monitored. These four (4) graduated liquid sensing events may include, but are not limited to, moisture, leak, flood and catastrophe. Leak detection can further be qualified by pressure, temperature, and flow characteristics.

[00067] The overall liquid level sensor system 102 would monitor water temperature, pressure and flow, possibly as follows.

Pressure – when there is a leak, the line water pressure would drop slightly, especially if a major pipe burst or the like. The overall liquid level sensor system 102 monitors the line water pressure, and can correlate pressure drop with known water pressure values that might occur in a flood. Some toilet leak sensors use pressure differential to determine if there is sustained pressure drop, indicative of a slow leak.

Temperature – line water temperature could change quickly with high flow.

Water flow – a sustained leak would result in a sustained flow and if both are present, the invoking automatic shutoff would make sense, bypassing human intervention.

[00068] Various outputs can be generated by the system in response to a liquid sensing event.

- Audio / Visual (AV) alerts can be presented on-site in the form of bells, horns, flashing lights, and the like.
- Text message alerts can be sent to specified phones or computers. These text message alerts can include the severity of the liquid sensing event, and other relevant information.
- Email message alerts can be sent to specified phones or computers. These text message alerts can include the severity of the liquid sensing event, and other relevant information.
- Immediate water shutoff signals can be sent to the system to be used to shut off one or more water valves. This would typically only be used for the more significant liquid sensing events, such as leak, flawed and catastrophe.
- Water shutoff signals can be sent to the system to be used to shut off one or more water valves after a specified period of time if there is no response to a text message or an email message.
- Automatic dispatch alerts, possibly in the form of text messages and or email messages, can be sent to plumbers, contractors and other trades who might help remedy the situation.

[00069] The system may also include other user defined action(s), for example:

- Automatic shutoff after "no flow" for 48 hours.
- Certain rules for day-time, other rules for off-hours, weekends and holidays.
- All actions are user customizable.

[00070] Other features:

- Continuous battery and power consumption monitoring.
- Automatic inherent tamper detection.
- Hourly sensor and system health verification.
- Automatic recognition of self-test mode, anytime and anywhere with no setup.
- Occupancy sensors indicate if, for example, whether is it safe to shutoff water, whether a manual response should be expected, whether local alarms likely to be effective and so on.
- Security Sensors alert building managers whenever restricted areas are accessed.
- Security sensors with NFC provide unparalleled credential verification through to biometrics.

[00071] In brief, the first illustrated embodiment liquid level sensor 100 comprises a main body 120, a common electrical contact 140c, a base-level electrical contact 140b, a first-raised-level electrical contact 141, a second-raised-level electrical contact 142, a third-raised-level electrical contact 143, and electronic circuitry 150.

[00072] More specifically, the first illustrated embodiment liquid level sensor 100 comprises a main body 120 that extends between a first end 121 and a second end 122, a top 123, a bottom 124, a first side 125 and a second side 126, and with an upper body portion 120u. The main body 120 also comprises a ground contact portion 127. As illustrated, the ground contact portion 127 is disposed adjacent the first end 121 of the main body 120. As illustrated, the ground contact portion 127 comprises a foot portion 128 disposed at the first end 121 of the main body 120.

[00073] The liquid level sensor 100 further comprises a substantially "U"-shaped grasping handle 130 extending outwardly from the main body 120. The grasping handle 130 is disposed adjacent the first end of the main body 120, and more specifically is disposed at the first end of the main body 120 and extends outwardly from the foot portion 128. A securing clip 132 may be placed in surrounding relation around the handle and used to secure the liquid level sensor 100 to a surface such as a floor.

[00074] A common electrical contact 140c projects externally to the main body 120, and more specifically extends downwardly from the bottom of the main body 120. Similarly, a base-level electrical contact 140b projects externally to the main body 120, and more specifically extends downwardly from the bottom of the main body 120. The common electrical contact 140c and the base-level electrical contact 140b together define a base liquid sensing level BL. As can be readily seen, the base liquid sensing level BL is at the outer ends 141c,141b, of the common electrical contact 140c and the base-level electrical contact 140b, respectively.

[00075] Further, the common electrical contact 140c, the base-level electrical contact 140b, and the ground contact portion 127 of the main body 120 together define a ground contact plane GCPL. The ground contact plane GCPL is at ground level when the liquid level sensor 100 is in place. Accordingly, the base liquid sensing level BL is at the ground contact plane GCPL, or in other words at ground level. Such positioning of the base liquid sensing level BL allows a small amount of moisture on the ground to be sensed, such as from perhaps small-size leaks and the like.

[00076] A first-raised-level electrical contact 141 also projects externally to the main body 120. The common electrical contact 140c and the first-raised-level electrical contact 141 together define a first raised liquid sensing level 1SL. The first-raised-level electrical contact 141 is disposed in offset relation from the ground contact plane GCPL by a first offset distance 1OD. In the first illustrated embodiment, the first offset distance 1OD is about 2 (two) centimeters, which can allow for the detection of liquid from perhaps mid-size leaks and the like.

[00077] The liquid level sensor 100 further comprises a second-raised-level electrical contact 142 projecting externally to the main body 120. The second-raised-level electrical contact 142 is disposed in offset relation from the ground contact plane GCPL by a second offset distance 2OD. In the first illustrated embodiment, the second offset distance 2OD is about 4 (four) centimeters, which can allow for the detection of liquid from perhaps large-size leaks and the like.

[00078] It can also be considered that the first-raised-level electrical contact 141 is disposed in offset relation from a line L extending between the common electrical contact 140c and the base-level electrical contact 140b by a third offset distance 3OD. If both of the base-level electrical contact 140b and the first-raised-level electrical contact 141 are in the

ground contact plane GCPL, the third offset distance 3OD would be the same as the first offset distance 1OD. Accordingly, as illustrated, the third offset distance 3OD is about 2 (two) centimeters.

[00079] Similarly, the second-raised-level electrical contact 142 is disposed in offset relation from the line L extending between the common electrical contact 140c and the base-level electrical contact 140b by a fourth offset distance 4OD. If both of the base-level electrical contact 140b and the second-raised-level electrical contact 142 are in the ground contact plane GCPL, the fourth offset distance 4OD would be the same as the second offset distance 2OD. Accordingly, as illustrated, the fourth offset distance is about 4 (four) centimeters.

[00080] There may also be a third-raised-level electrical contact 143 projecting externally to the main body 120 and disposed in offset relation from the ground contact plane GCPL and from the line "L" extending between the common electrical contact 140c and the base-level electrical contact 140b.

[00081] A portion 129 of the bottom 124 of the main body 120 is sloped downwardly from the foot portion 128 to the second end 122 of the main body 120. The common electrical contact 140c, the base-level electrical contact 140b, the first-raised-level electrical contact 141 and the second-raised-level electrical contact 142 are all on the downwardly sloped portion 129 of the bottom 124 of the main body 120.

[00082] The first illustrated embodiment liquid level sensor 100 also comprises electronic circuitry 150 responsive to a path between the common electrical contact 140c and the base-level electrical contact 140b being electrically closed by moisture and to generate a base-level alarm signal, and responsive to a path between the common electrical contact 140c and the first-raised-level electrical contact 141 being electrically closed by moisture and to generate a first-level alarm signal, and responsive to a path between the common electrical contact 140c and the second-raised-level electrical contact 142 being electrically closed by moisture and to generate a second-level alarm signal.

[00083] A battery 152 and an antenna 154 are included with the electronic circuitry 150. In order to help maximize the effectiveness of the electronic circuitry 150, the battery 152 is located adjacent the bottom 124 of the main body 120 and the antenna 154 is located adjacent the top 123 of the main body 120.

[00084] In use, when moisture closes a path between the common electrical contact 140c and the base-level electrical contact 140b, the base-level alarm signal is generated to thereby indicate the base liquid sensing level BL, when moisture closes a path between the common electrical contact 140c and the first-level electrical contact 141, the first-level alarm signal is generated to thereby indicate the first raised liquid sensing level 1SL, and when moisture closes a path between the common electrical contact 140c and the second-raised-level electrical contact 142, the second-level alarm signal is generated, to thereby indicate the second raised liquid sensing level 2SL.

[00085] It should be understood that any of the various types of alarm signals that are generated in response to detecting liquid, which may be known as a "liquid sensing event", may represent any of the base liquid sensing level BL, the first raised liquid sensing level 1SL, the second raised liquid sensing level 2SL, or any other levels as suitably determined.

[00086] Reference will now be made to Figure 4, which shows a second illustrated embodiment of the liquid level sensor 200 according to the present invention. The second illustrated embodiment liquid level sensor 200 is similar to the first illustrated embodiment of the liquid level sensor 100 except that the angle of the foot portion 228 is selectively adjustable with respect to the rest of the main body 220, as indicated by arrows A, to thereby allow the first offset distance 1OD, the second offset distance 2OD, the third offset distance 3OD, and the fourth offset distance 4OD to be selectably adjusted.

[00087] A portion 229 of the bottom 224 of the main body 220 is sloped downwardly from the foot portion 228 to the second end 222 of the main body 220. The common electrical contact 240c, the base-level electrical contact 240b, the first-raised-level electrical contact 241 and the second-raised-level electrical contact 242 are all on the downwardly sloped portion 229 of the bottom 224 of the main body 220.

[00088] Reference will now be made to Figures 5 through 9, which show a third illustrated embodiment of the liquid level sensor 300 according to the present invention. The third illustrated embodiment liquid level sensor 300 is similar to the first illustrated embodiment of the liquid level sensor 100 except that the common electrical contact 340c and the base-level electrical contact 340b together define a ground contact plane GCPL, without the inclusion of a portion of the main body 320.

[00089] Reference will now be made to Figure 10, which shows a fourth illustrated embodiment of the liquid level sensor 400 according to the present invention. The fourth illustrated embodiment liquid level sensor 400 is similar to the first illustrated embodiment of the liquid level sensor 100 except that the common electrical contact 140c and the base-level electrical contact 140b are replaced by a first pair of electrical contacts 441 projecting externally to the main body 420. The pair of electrical contacts 441 with each other defines a base liquid sensing level BL.

[00090] The fourth illustrated embodiment liquid level sensor 400 further comprises a ground contact portion 427 of the main body 420. The first pair of electrical contacts 441 and the ground contact portion 427 of the main body together define a ground contact plane GCPL.

[00091] Further, there is a second pair of electrical contacts 442 projecting externally to the main body 420. The second pair of electrical contacts 442 defines a first raised liquid sensing level 1SL. The second pair of electrical contacts 442 is disposed in offset relation from the ground contact plane GCPL by a first offset distance 1OD. In the fourth illustrated embodiment, the first offset distance 1OD is about 2 (two) centimeters, which can allow for the detection of liquid from perhaps mid-size leaks and the like.

[00092] Also, there is a third pair of electrical contacts 443 projecting externally to the main body 420. The third pair of electrical contacts 443 defines a second raised liquid sensing level 2SL. The third pair of electrical contacts 443 is disposed in offset relation from the ground contact plane GCPL by a second offset distance 2OD. In the fourth illustrated embodiment, the second offset distance 2OD is about 4 (four) centimeters, which can allow for the detection of liquid from perhaps large-size leaks and the like.

[00093] Reference will now be made to Figures 11 and 12, which show an illustrated embodiment of the protective cover according to the present invention, as indicated by the general reference numeral 500. The protective cover 500 is for

use with a liquid level sensor 502. The protective cover 500 comprises a thin curved main shell body 520 extending between a first end 521 and a second end 522, between a first side 523 and a second side 524, and between and top portion 525 and a bottom edge 526. The bottom edge 526 of the main shell body 520 defines a space 528 between a portion the bottom edge 526 of the main shell body 520 at each end 521,522 thereof, and a ground contact plane GCPL. The space 528 is for receiving a portion of a liquid level sensor 502 therethrough, specifically the grasping handle 503. The space 528 is disposed adjacent the first end 521 of the main shell body 520.

[00094] The main shell body 520 defines an open cavity 540 extending upwardly from the bottom edge 526 and open to the bottom of the main shell body 520.

[00095] There is a ground contact portion 550 disposed at the bottom of the main shell body 520 to define the ground contact plane GCPL. The ground contact portion 550 comprises at least one foot, and in the fifth illustrated embodiment, the at least one foot comprises a plurality of feet. More specifically, the plurality of feet comprises four feet 550a, 550b, 550c, and 550d disposed two at each end of the main shell body 520. The bottom edge 526 is raised between adjacent feet 550a, 550b, 550c, and 550d to permit liquid to flow under the main shell body 520 to the liquid level sensor 502.

[00096] It will be readily understood that there is a variety of options for attachment of the protective cover 500 to a receiving surface such as a floor. These options include:

1. No secure attachment, just placement
2. Hook-and-Loop fasteners (VelcroTM)
3. Threaded fasteners
4. Adhesives
5. Any combination of 2), 3) 4)

[00097] In another aspect, the present invention comprises a combination of a liquid level sensor and a protective cover, as indicated by the general reference numeral 600. More specifically, the combination 600 comprises a liquid level sensor 610 and a protective cover 601. The liquid level sensor 610 has a main body 612 with a ground contact portion 613 that defines a ground contact plane GCP. There are electrical contacts 620 projecting externally to the main body 610 and defining a base liquid sensing level BL and a first raised liquid sensing level 1SL. The protective cover 601 comprises a main shell body 640. The upper body portion 611 of the liquid level sensor 610 and the main shell body 640 of the protective cover 601 are similar in shape each to the other. In this manner, the protective cover 601 can have a low profile and a curved shape to make it more difficult for pets to chew on.

[00098] The main shell body 640 extends between a first end 641 and a second end 642, between a first side 643 and a second side 644, and between and top portion 645 and a bottom edge 646, and defines an open cavity 648 extending upwardly from the bottom edge 646 and open to the bottom of the main shell body 640. The open cavity 648 is a sensor-receiving cavity, and in the illustrated embodiment is a sensor-receiving concavity. The main shell body 640 has a ground contact portion 650 is disposed at the bottom of the main shell body 640 to define the ground contact plane GCPL. The ground contact portion 650 of the main shell body 640 defines a larger ground contact area than the ground contact portion 613 of the main body 612 of the liquid level sensor 610. The ground contact portion 650 comprises at least one foot, and in

Figure 13 and 14, the at least one foot comprises a plurality of feet. More specifically, the plurality of feet comprises four feet 650a, 650b, 650c, and 650d disposed two at each end of the main shell body 620. The bottom edge 646 is raised between adjacent feet 650a, 650b, 650c, and 650d to permit liquid to flow under the main shell body 640 to the liquid level sensor 610.

[00099] In use, the liquid level sensor 610 rests on a receiving surface 602 at the ground contact plane GCPL and the main shell body 640 rests on the receiving surface 602 at the ground contact plane GCPL in overlying protective relation to the liquid level sensor 610. Further, the ground contact portion 650 of the main shell body 640 peripherally surrounds the ground contact portion 613 of the main body 612 of the liquid level sensor 610. Also, the main shell body 640 is disposed in overlying relation to the liquid level sensor 610.

[000100] The bottom edge 646 of the main shell body 640 is shaped to define a space 649 between the bottom edge 646 of the main shell body 640 and the ground contact plane GCPL. The space 649 is for receiving a portion of a liquid level sensor 610 therethrough, if desired.

[000101] In use, the liquid level sensor 610 rests on a receiving surface 604 at the ground contact plane GCPL and the main shell body 640 rests on the receiving surface 604 at the ground contact plane GCPL in overlying protective relation to the liquid level sensor 610.

[000102] In the present invention, the following is also contemplated.

[000103] One or more electronic reset contacts could be included. The electronic reset contacts could have a different input impedance then the liquid level sensing contacts such that even salty water would not induce a sensor reset. The impedance of reset contacts might be such that shorting the pins with a paperclip, coin or other metallic object would induce a sensor reset.

[000104] The electronic system that responds to changes of impedance between the common and a plurality of sensing pins, and an electronic system that is capable of periodically energizing the sensing pins in a way that if a product was immersed in water, and as such would induce a current in all sensing pins, the periodic energizing of the sensing pins would prevent premature battery drain. (I.e., the CPU only energizes the sensing contacts periodically, for example 10 ms per 1000 ms, or 2 ms in every 200 ms, either resulting in a 1% duty cycle. This provides for full functionality while protecting battery life of up to 10 years from a coin cell battery.

[000105] The electronic system that capacitively connects the reset contacts to the reset function in order to protect from battery drain. The electronic system that protects the system from accidental reset if the applied impedance to the reset contacts changes slowly (i.e. the reset pulse will only reset the CPU in response to an instantaneous short via paperclip or coin for example).

[000106] Other variations are within the spirit of the present invention. Thus, while the invention is susceptible to various modifications and alternative constructions without departing from the spirit of the inventions disclosed and claimed, only a limited number of embodiments or variations thereof have been illustrated or otherwise disclosed herein by way of

non-limiting example. It should be understood, however, that there is no intention to limit the invention to the specific form or forms disclosed, but on the contrary, the intention is to cover all modifications, alternative constructions, and equivalents falling within the spirit and scope of the invention, as defined in the appended claims broadly construed.

[000107] The use of the terms "a" and "an" and "the" and similar referents in the context of describing the invention (especially in the context of the following claims) are to be construed to cover both the singular and the plural, unless otherwise indicated herein or clearly contradicted by context. The terms "comprising," "having," "including," and "containing" are to be construed as open-ended terms (i.e., meaning "including, but not limited to,") unless otherwise noted. The term "connected" is to be construed as partly or wholly contained within, attached to, or joined together, even if there is something intervening. Recitation of ranges of values herein are merely intended to serve as a shorthand method of referring individually to each separate value falling within the range, unless otherwise indicated herein, and each separate value is incorporated into the specification as if it were individually recited herein. The use of any and all examples, or exemplary language (e.g., "such as", or, “for example”) provided herein, is intended merely to better illuminate embodiments of the invention and does not pose a limitation on the scope of the invention unless otherwise claimed. No language in the specification should be construed as indicating any non-claimed element as essential to the practice of the invention.

[000108] Currently preferred embodiments of this invention are described herein. Variations of those preferred embodiments may become apparent to those of ordinary skill in the art upon reading the foregoing description. The inventors expect skilled artisans to employ such variations as appropriate, and the inventors intend for the invention to be practiced otherwise than as specifically described herein. Accordingly, this invention includes all modifications and equivalents of the subject matter recited in the claims appended hereto as permitted by applicable law. Moreover, any combination of the above-described elements in all possible variations thereof is encompassed by the invention unless otherwise indicated herein or otherwise clearly contradicted by context.

APPENDIX

Gateway and or cloud processes

Key system features:

- User definable / selectable / customizable response based on severity of leak event
- Four (4) graduated leak events are readily possible and useful - moisture, leak, flood and catastrophe
- Leak detection can be further qualified by pressure, temperature and flow characteristics
- In response to an event:
    - Audio visual (AV) alerts on site
    - Text message alert - with severity
    - E-mail message alert - with severity
    - Immediate water shut off
    - Water shut-off after timed “No response to text or e-mail”
    - Automatic dispatch to plumbers, contractors and other trades
- Other user defined action(s), for example, automatic shut-off after “no flow” for 48 hours
- Certain rules for day-time, other rules for off-hours, weekends and holidays
- All actions are user customizable

Other features:

- Continuous battery and power consumption monitoring
- Automatic inherent tamper detection
- Hourly sensor and system health verification
- Automatic recognition of self-test mode, anytime and anywhere with no set-up
- Occupancy sensors indicate if, for example, is it safe to shut off water, should a manual response expected, and local alarms likely to be effective and soon
- Security sensors alert building managers whenever restricted areas are accessed
- Security sensors with NFC provide unparalleled credential verification through biometrics

CLAIMS:

1. A liquid level sensor comprising:

a main body;

a common electrical contact;

a base-level electrical contact;

wherein said common electrical contact and said base-level electrical contact together define a base liquid sensing level;

a first-raised-level electrical contact;

wherein said common electrical contact and said first-raised-level electrical contact together define a first raised liquid sensing level; and,

electronic circuitry responsive to a path between said common electrical contact and said base-level electrical contact being electrically closed by moisture and to generate a base-level alarm signal, and responsive to a path between said common electrical contact and said first-raised-level electrical contact being electrically closed by moisture and to generate a second-level alarm signal;

wherein, in use, when moisture closes a path between said common electrical contact and said base-level electrical contact, said base-level alarm signal is generated to thereby indicate said base liquid sensing level, and when moisture closes a path between said common electrical contact and said first-raised-level electrical contact, said second-level alarm signal is generated.

2. A liquid level sensor according to claim 1, further comprising a ground contact portion of said main body, and wherein said common electrical contact, said base-level electrical contact, and said ground contact portion of said main body together define a ground contact plane.

3. A liquid level sensor according to claim 2, wherein said first-raised-level electrical contact is disposed in offset relation from said ground contact plane by a first offset distance.

4. A liquid level sensor according to claim 3, wherein said first offset distance is about 2 (two) centimeters.

5. A liquid level sensor according to claim 3, further comprising a second-raised-level electrical contact, and wherein said second-raised-level electrical contact is disposed in offset relation from said ground contact plane by a second offset distance.

6. A liquid level sensor according to claim 5, wherein said second offset distance is about 4 (four) centimeters.

7. A liquid level sensor according to claim 2, wherein said main body extends between a first end and a second end.

8. A liquid level sensor according to claim 7, wherein said ground contact portion is disposed adjacent said first end of said main body.

9. A liquid level sensor according to claim 8, wherein said ground contact portion comprises a foot portion disposed adjacent said first end of said main body.

10. A liquid level sensor according to claim 9, wherein said ground contact portion comprises a foot portion disposed at said first end of said main body.

11. A liquid level sensor according to claim 9, further comprising a grasping handle extending outwardly from said main body.

12. A liquid level sensor according to claim 11, wherein said grasping handle is substantially “U”-shaped.

13. A liquid level sensor according to claim 12, wherein said grasping handle is disposed adjacent said first end of said main body.

14. A liquid level sensor according to claim 13, wherein said grasping handle is disposed at said first end of said main body.

15. A liquid level sensor according to claim 14, wherein said grasping handle extends outwardly from said foot portion.

16. A liquid level sensor according to claim 1, wherein said first-raised-level electrical contact is disposed in offset relation from a line extending between said common electrical contact and said base-level electrical contact by a third offset distance.

17. A liquid level sensor according to claim 16, wherein said third offset distance is about 2 (two) centimeters.

18. A liquid level sensor according to claim 16, wherein said second-raised-level electrical contact is disposed in offset relation from a line extending between said common electrical contact and said base-level electrical contact by a fourth offset distance.

19. A liquid level sensor according to claim 18, wherein said fourth offset distance is about 4 (four) centimeters.

20. A liquid level sensor according to claim 9, wherein the angle of said foot portion is selectively adjustable with respect to the rest of said main body, to thereby allow said first offset distance and said second first offset distance.

21. A liquid level sensor according to claim 1, wherein said common electrical contact and said base-level electrical contact together define a ground contact plane.

22. A liquid level sensor according to claim 9, wherein a portion of the bottom of said main body is sloped downwardly from said foot portion to said second end of said main body.

23. A liquid level sensor according to claim 22, wherein said common electrical contact, said base-level electrical contact, said first-raised-level electrical contact and said second-raised-level electrical contact are all on said downwardly sloped portion of the bottom of said main body.

24. A liquid level sensor according to claim 1, wherein said a common electrical contact projects externally to said main body, said base-level electrical contact projects externally to said main body, said first-raised-level electrical contact projects externally to said main body, and said second-raised-level electrical contact projects externally to said main body.

25. A liquid level sensor comprising:

a main body;

a first pair of electrical contacts;

wherein said first pair of electrical contacts defines a base liquid sensing level;

a second pair of electrical contacts;

wherein said second pair of electrical contacts defines a first raised liquid sensing level; and,

electronic circuitry responsive to a path between said first pair of electrical contacts being electrically closed by moisture and to generate a base-level alarm signal, and responsive to a path between said second pair of electrical contacts being electrically closed by moisture and to generate a second-level alarm signal;

wherein, in use, when moisture closes a path between said first pair of electrical contacts, said base-level alarm signal is generated to thereby indicate said base liquid sensing level, and when moisture closes a path between said second pair of electrical contacts, said second-level alarm signal is generated.

26. A liquid level sensor according to claim 25, further comprising a ground contact portion of said main body, and wherein said first pair of electrical contacts and said ground contact portion of said main body together define a ground contact plane.

27. A liquid level sensor according to claim 26, wherein said second pair of electrical contacts is disposed in offset relation from said ground contact plane by a first offset distance.

28. A liquid level sensor according to claim 25, wherein said first offset distance is about 2 (two) centimeters.

29. A liquid level sensor according to claim 25, further comprising a third pair of electrical contacts, and wherein said third pair of electrical contacts is disposed in offset relation from said ground contact plane by a second offset distance.

30. A liquid level sensor according to claim 27, wherein said second offset distance is about 4 (four) centimeters.

31. A liquid level sensor according to claim 27, wherein said main body extends between a first end and a second end.

32. A liquid level sensor according to claim 27, wherein said ground contact portion is disposed adjacent said first end of said main body.

33. A liquid level sensor according to claim 32, wherein said ground contact portion comprises a foot portion disposed adjacent said first end of said main body.

34. A liquid level sensor according to claim 33, wherein said ground contact portion comprises a foot portion disposed at said first end of said main body.

35. A liquid level sensor according to claim 34, further comprising a grasping handle extending outwardly from said main body.

36. A liquid level sensor according to claim 35, wherein said grasping handle is substantially "U"-shaped.

37. A liquid level sensor according to claim 36, wherein said grasping handle is disposed adjacent said first end of said main body.

38. A liquid level sensor according to claim 37, wherein said grasping handle is disposed at said first end of said main body.

39. A liquid level sensor according to claim 38, wherein said grasping handle extends outwardly from said foot portion.

40. A liquid level sensor according to claim 25, wherein said second pair of electrical contacts is disposed in offset relation from a line extending between said first pair of electrical contacts by a third offset distance.

41. A liquid level sensor according to claim 40, wherein said third offset distance is about 2 (two) centimeters.

42. A liquid level sensor according to claim 40, further comprising a third pair of electrical contacts, and wherein said third pair of electrical contacts is disposed in offset relation from a line extending between said first pair of electrical contacts by a fourth offset distance.

43. A liquid level sensor according to claim 42, wherein said fourth offset distance is about 4 (four) centimeters.

44. A liquid level sensor according to claim 33, wherein the angle of said foot portion is selectively adjustable with respect to the rest of said main body, to thereby allow said first offset distance and said second first offset distance.

45. A liquid level sensor according to claim 25, said first pair of electrical contacts together define a ground contact plane.

46. A liquid level sensor according to claim 33, wherein a portion of the bottom of said main body is sloped downwardly from said foot portion to said second end of said main body.

47. A liquid level sensor according to claim 25, wherein said first pair of electrical contacts and said second pair of electrical contacts projects externally to said main body.

48. A protective cover for use with a liquid level sensor, said protective cover comprising:

a main shell body extending between a first end and a second end, between a first side and a second side, and between and top portion and a bottom edge;

wherein said main shell body defines an open cavity defined by a bottom edge and open to the bottom of said main shell body.

49. A protective cover according to claim 48, further comprising a ground contact portion disposed at the bottom of said main shell body to define a ground contact plane.

50. A protective cover according to claim 48, wherein said ground contact portion comprises at least one foot.

51. A protective cover according to claim 50, wherein said at least one foot comprises a plurality of feet, and wherein said bottom edge is raised between adjacent feet to permit liquid to flow under the main shell body.

52. A protective cover according to claim 50, wherein said plurality of feet comprises four feet disposed two at each end of said main shell body.

53. A protective cover according to claim 48, wherein said bottom edge of said main shell body defines a space between said bottom edge of said main shell body and said ground contact plane, wherein said space is for receiving a portion of a liquid level sensor therethrough.

54. A protective cover according to claim 53, wherein said space is disposed adjacent one end of said main shell body.

55. A protective cover according to claim 48, wherein said main shell body is thin.

56. A protective cover according to claim 48, wherein said main shell body is curved.

57. A protective cover according to claim 47, wherein said first pair of electrical contacts, said second pair of electrical contacts, and said third pair of electrical contacts each project externally to said main body.

58. A protective cover for use with a liquid level sensor, said protective cover comprising:

a main shell body having width and length and having a curved shape defining a lateral compound curve along its width and a longitudinal compound curve along its length, and wherein the maximum radius of the longitudinal compound curve is greater than the maximum radius of the lateral compound curve.

59. A combination of a liquid level sensor and a protective cover comprising:

a liquid level sensor having a main body and a liquid level sensing mechanism, and defining a ground contact plane; and,

a main shell body extending between a first end and a second end, between a first side and a second side, and between and top portion and a bottom edge, and defining an open cavity extending upwardly from a bottom edge and open to the bottom of said shell, and a ground contact portion disposed at the bottom of said main shell body to define a ground contact plane;

wherein, in use, said liquid level sensor rests on a receiving surface at said ground contact plane and said main shell body rests on said receiving surface at said ground contact plane.

60. A combination of a liquid level sensor and a protective cover according to claim 59, wherein said main shell body has a bottom edge shaped to define a space between said bottom edge of said main shell body and said ground contact plane, wherein said space is for receiving a portion of a liquid level sensor therethrough.

61. A combination of a liquid level sensor and a protective cover according to claim 59, wherein said liquid level sensing mechanism comprises electrical contacts that define a base liquid sensing level and a first raised liquid sensing level.

62. A combination of a liquid level sensor and a protective cover according to claim 61, wherein said electrical contacts projecting externally to said main body

63. A combination of a liquid level sensor and a protective cover comprising:

a liquid level sensor having a main body with an upper body portion and a liquid level sensing mechanism; and,

a main shell body;

wherein said upper body portion of said liquid level sensor and said main shell body are similar in shape each to the other.

64. A combination of a liquid level sensor and a protective cover comprising:

a liquid level sensor having a main body with an upper body portion and a liquid level sensing mechanism; and,

a main shell body having a sensor-receiving cavity for receiving said liquid level sensor therein.

65. A combination of a liquid level sensor and a protective cover according to claim 64, wherein said sensor-receiving cavity comprises a sensor-receiving concavity.

66. A combination of a liquid level sensor and a protective cover comprising:

a liquid level sensor having a main body, a ground contact portion, and a liquid level sensing mechanism; and,

a main shell body having a ground contact portion;

wherein, in use, said ground contact portion of said main shell body peripherally surrounds said ground contact portion of said liquid level sensor.

67. A combination of a liquid level sensor and a protective cover comprising:

a liquid level sensor having a main body, a ground contact portion, and a liquid level sensing mechanism; and,

a main shell body having a ground contact portion;

wherein said ground contact portion of said main shell body defines a larger ground contact area than said contact portion of said liquid level sensor.

68. A combination of a liquid level sensor and a protective cover comprising:

a liquid level sensor having a main body, a ground contact portion, and a liquid level sensing mechanism; and,

a main shell body having a ground contact portion;

wherein, in use, said main shell body is disposed in overlying relation to said liquid level sensor.

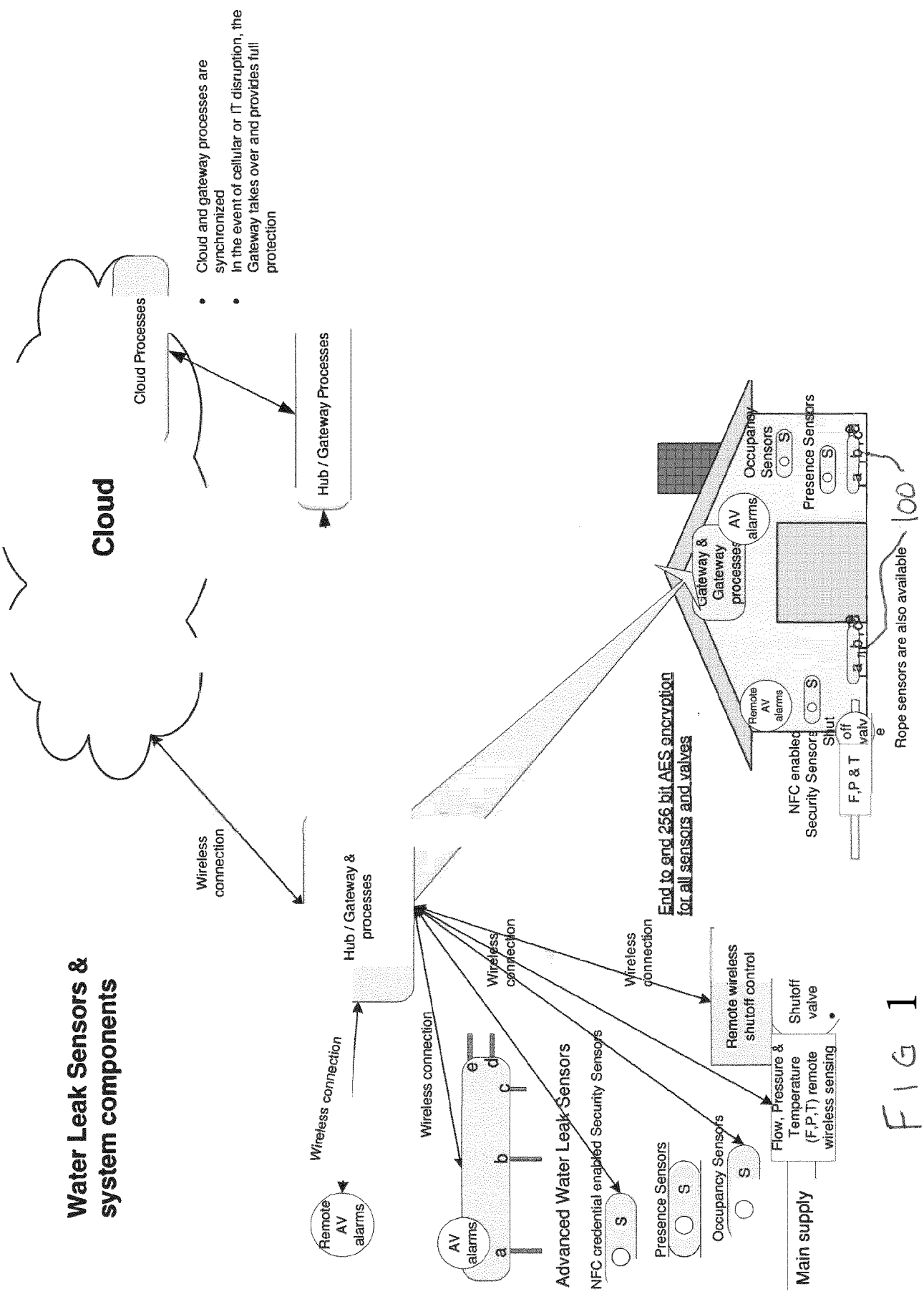

Water Leak Sensors & system components
Cloud
Cloud Processes
Cloud and gateway processes are synchronized
In the event of cellular or IT disruption, the Gateway takes over and provides full protection
Hub / Gateway Processes
Wireless connection
Hub / Gateway & processes
Wireless connection
Remote AV alarms
AV alarms
Advanced Water Leak Sensors
NFC credential enabled Security Sensors
Presence Sensors
Occupancy Sensors
Flow, Pressure & Temperature (F,P,T) remote wireless sensing
Shutoff valve
Main supply
Remote wireless shutoff control
End to end 256 bit AES encryption for all sensors and valves
Gateway & Gateway processes
AV alarms
Occupancy Sensors
Presence Sensors
Remote AV alarms
NFC enabled Security Sensors
Shut off valve
F,P & T
Rope sensors are also available
100

FIG 1

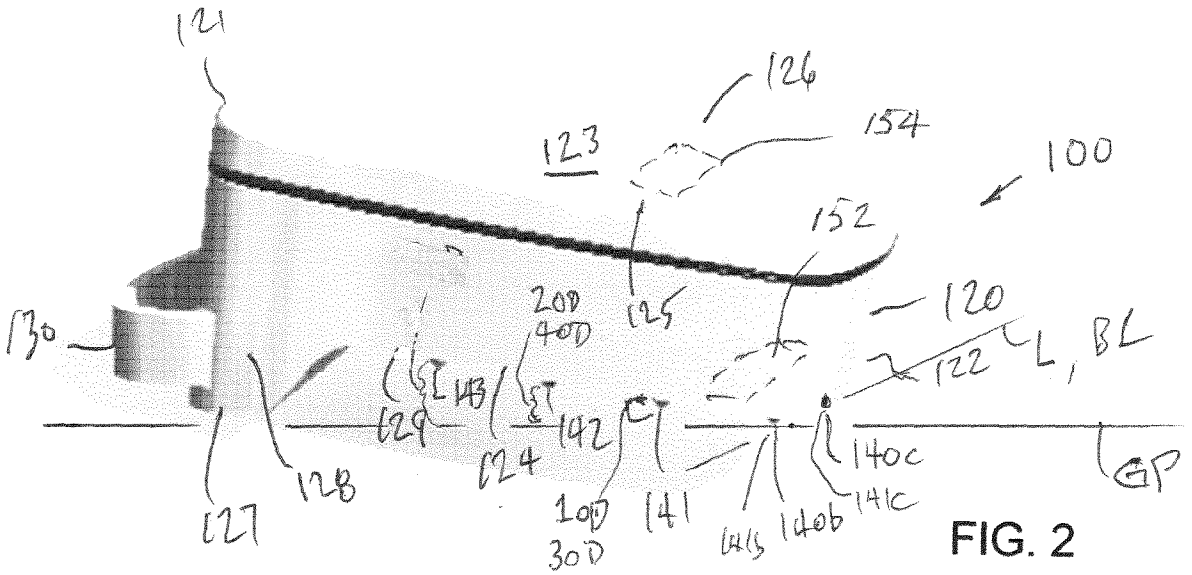


FIG. 2

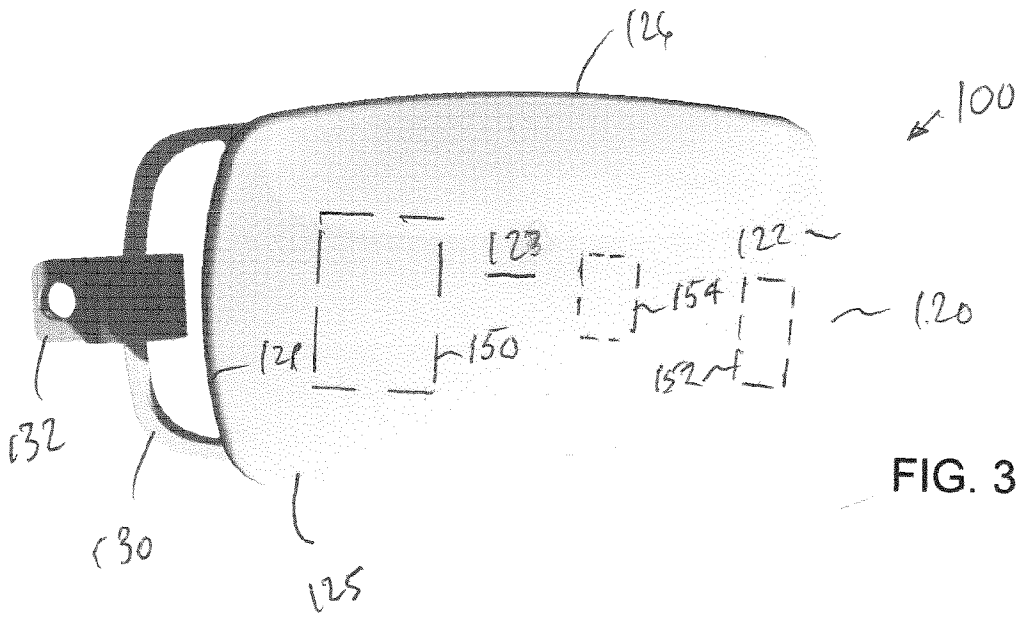


FIG. 3

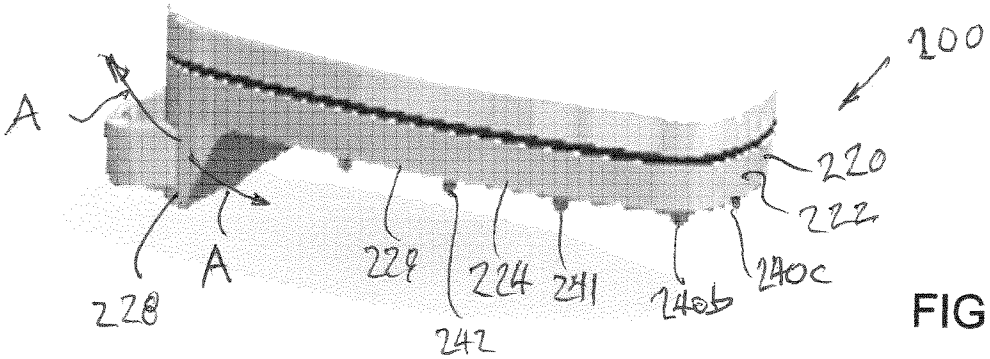


FIG. 4

Top View

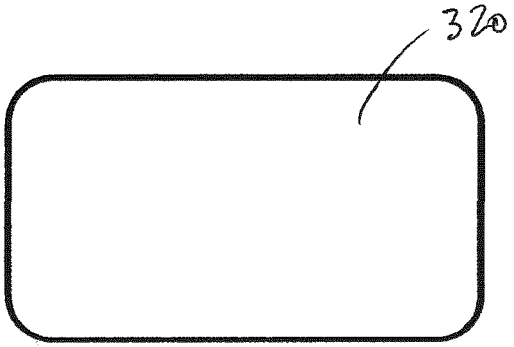


FIG. 5

Bottom View

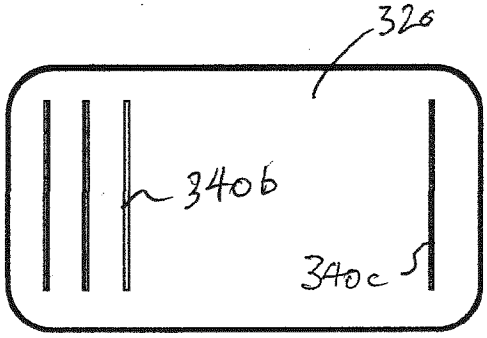
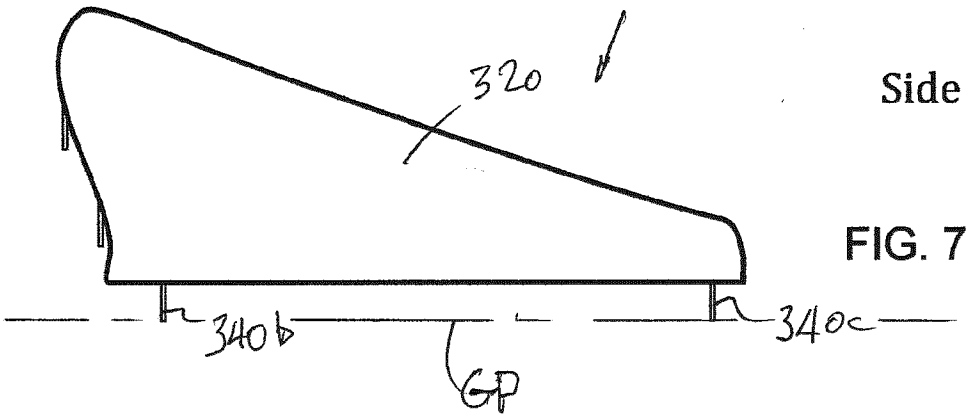


FIG. 6



Side View

FIG. 7

Back View

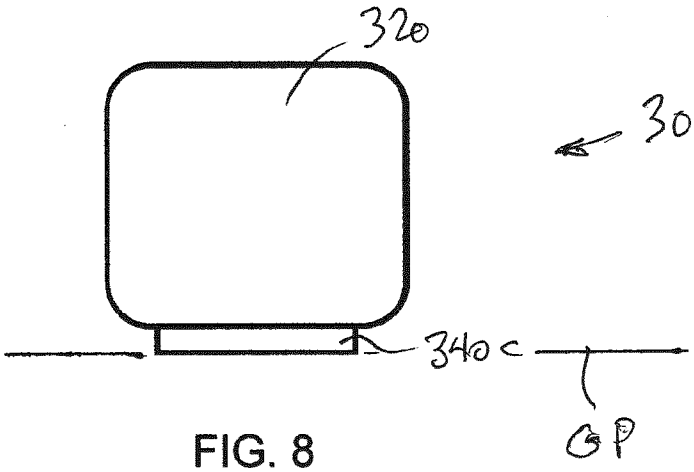


FIG. 8

Front View

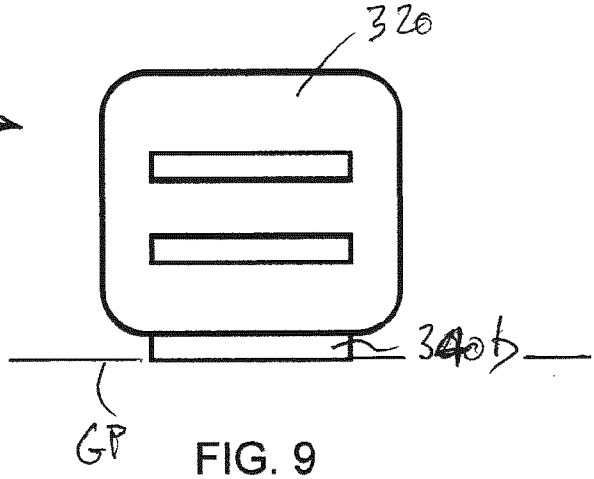
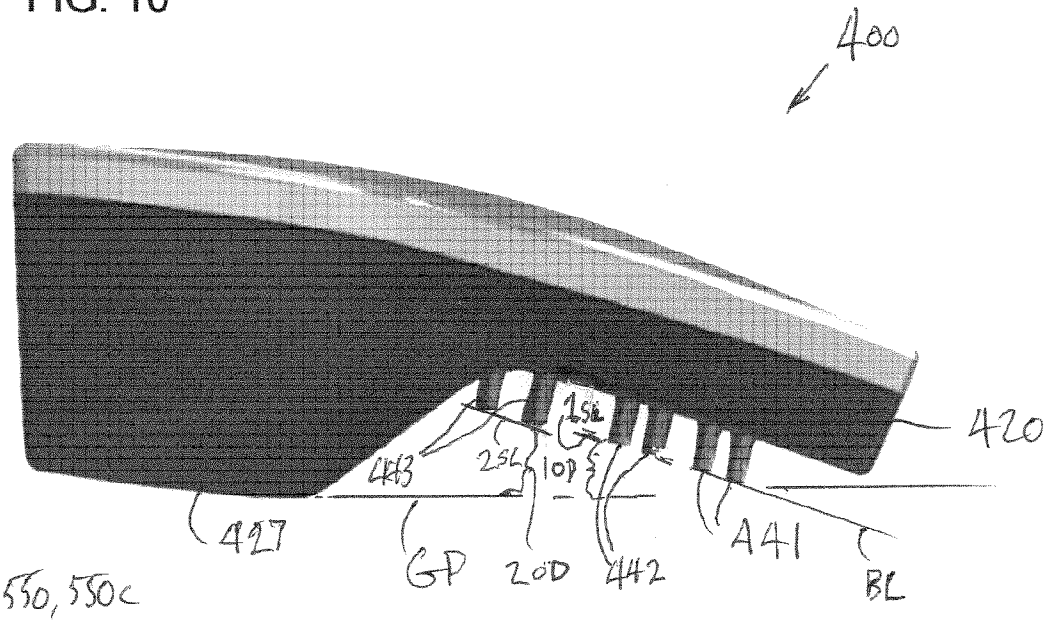


FIG. 9

FIG. 10



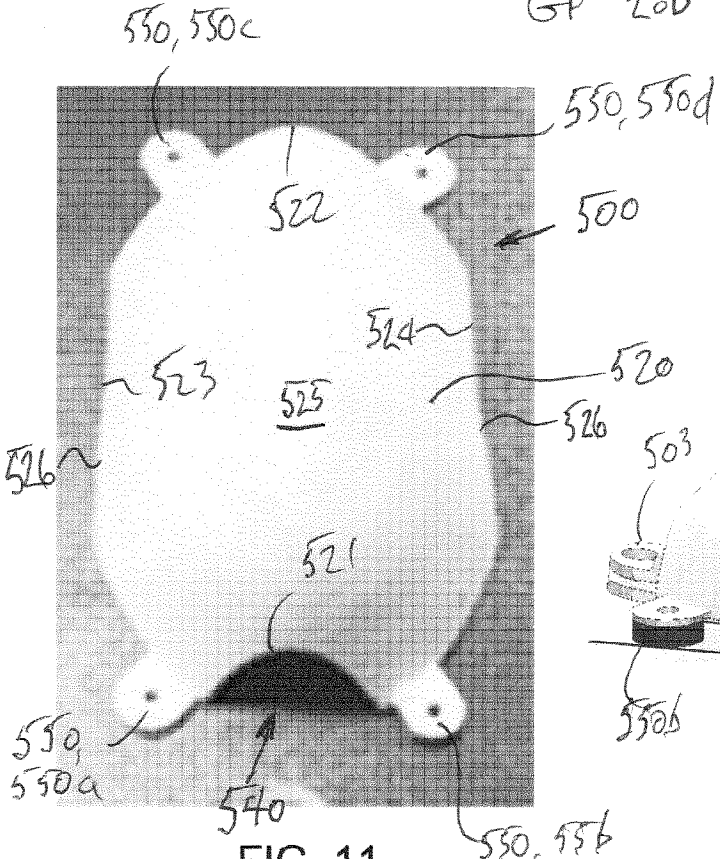


FIG. 11

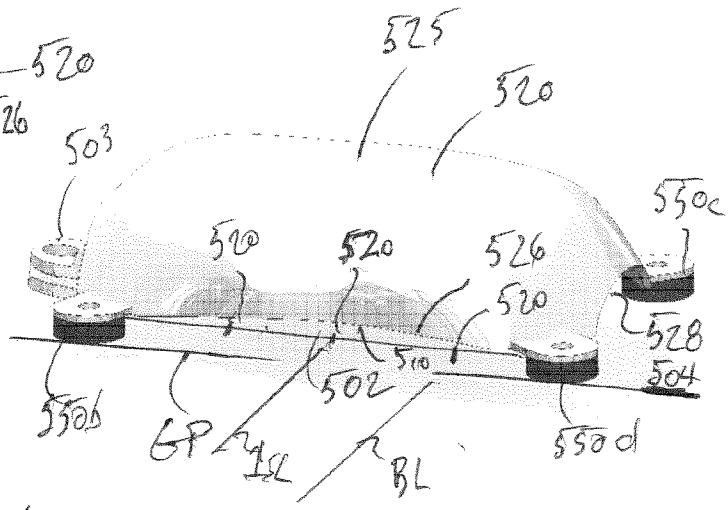
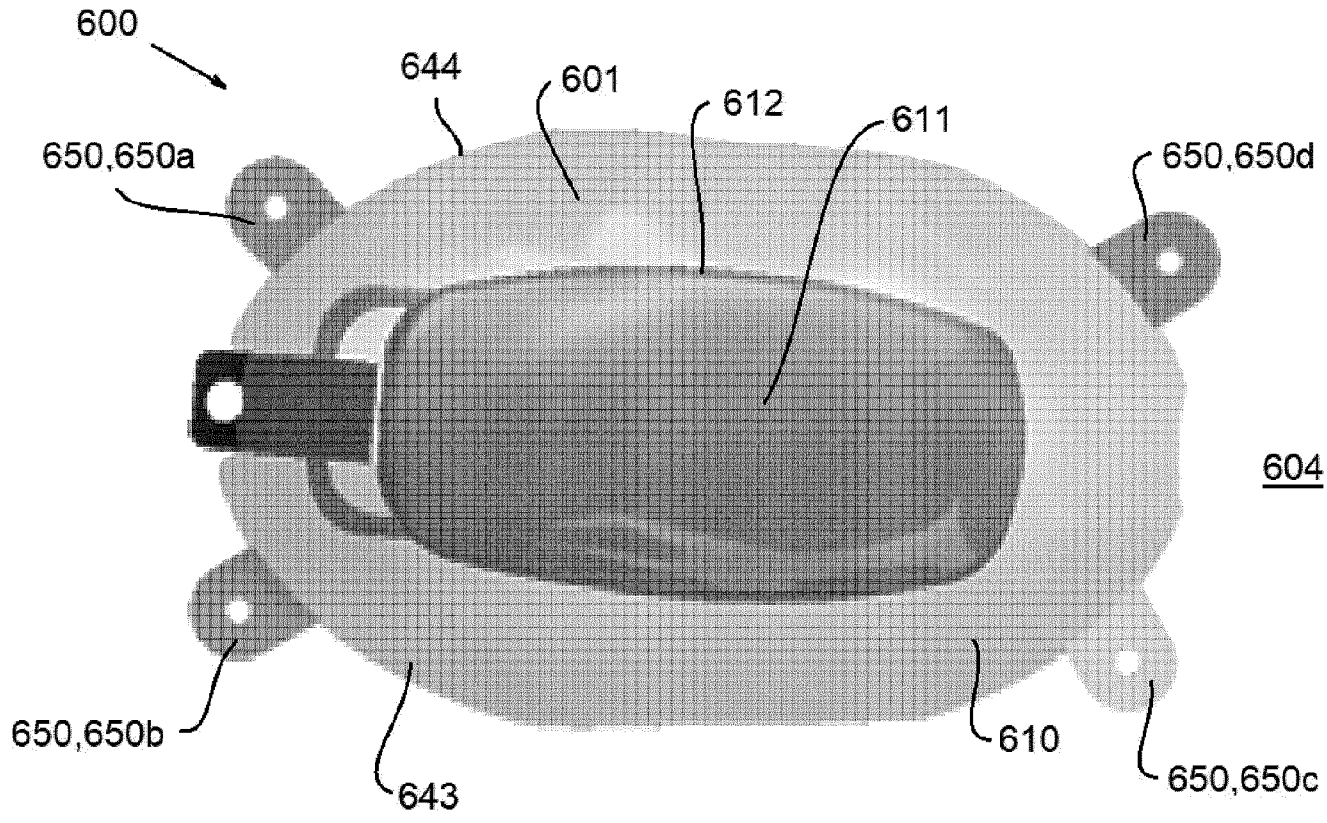


FIG. 12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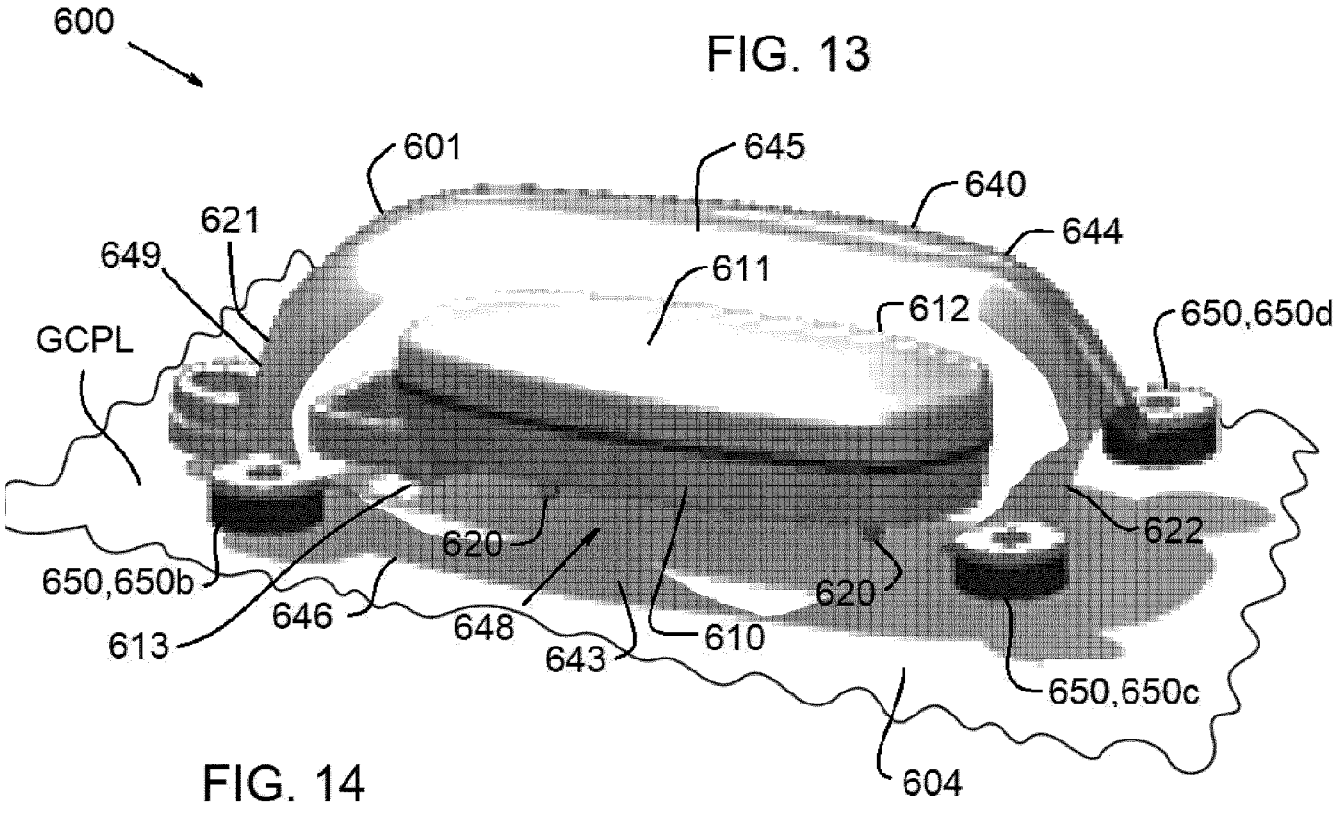
650,650c

FIG. 13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650,650c
604

FIG. 14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2023/050257

A. CLASSIFICATION OF SUBJECT MATTER

IPC: ***G01F 23/24*** (2006.01) , ***G01F 23/00*** (2022.01)

CPC: **G01F 23/241** (2020.01) , G01F 23/00 (2022.01)

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)
Keywords used across the whole IPC

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

Electronic database(s) consulted during the international search (name of database(s) and, where practicable, search terms used)
Databases: Questel Orbit
Keywords: liquid, moisture, sensor, multiple, levels, flood, leak, liquid leak detector, heights, severity, resistance, water detector, house, building, electrical contact, cover, housing

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US2006007008 A1 (KATES, LAWRENCE) 2006-01-12 *Paragraphs [0036], [0096], [0098], figures 10A-10F	1-47
---		---
Y		48-68
Y	US9432763 B2 (SCHARF, JOSHUA) 2016-08-30 Figures 2, 7	48-68

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

*	Special categories of cited documents:	"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
"A"	document defining the general state of the art which is not considered to be of particular relevance		
"D"	document cited by the applicant in the international application	"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
"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)	"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
"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	"&"	document member of the same patent family

Date of the actual completion of the international search 11 August 2023 (11-08-2023)	Date of mailing of the international search report 18 August 2023 (18-08-2023)
Name and mailing address of the ISA/CA Canadian Intellectual Property Office Place du Portage I, C114 - 1st Floor, Box PCT 50 Victoria Street Gatineau, Quebec K1A 0C9 Facsimile No.: 819-953-2476	Authorized officer Brandon Wich, Tel: (873) 354-3046

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CA2023/050257

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of the 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. ☐ Claim Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claim 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. ☐ Claim 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:

The claims are directed to a plurality of inventions as follows:

Group A: Claims 1-47 are directed to a liquid sensor including a main body and a plurality of probes or contacts arranged at different heights set to provide alarms when liquid is detected at different heights.

Group B: Claims 48-68 are directed to a protective cover for use with a liquid sensor, said cover having an open cavity defined by a bottom edge.

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 claim 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 claim 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.

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