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(71) Applicant: **HUSQVARNA AB**
561 82 Huskvarna (SE)

(72) Inventors:
- **Gungl, Johannes**
  89079 Ulm (DE)
- **Drößler, Christian**
  89173 Lonsee (DE)

(74) Representative: **Finkele, Rolf**
Gardena Manufacturing GmbH
Hans-Lorenser-Straße 40
89079 Ulm (DE)

(54) **SUBMERSIBLE PUMP WITH TOUCH SENSITIVE SENSORS**

(57) A submersible pump **(100)** includes a pump body **(102).** The submersible pump **(100)** forming a main compartment **(104)** having an intake **(106)** and an output **(108)** for a liquid **(110).** The pump body **(102)** is adapted for submersion in a body of liquid **(110)** whose level is to be controlled. The submersible pump **(100)** is characterized in that the one or more sensors **(112)** enable the submersible pump **(100)** to operate within a threshold operating level **(114).** The threshold operating level **(114)** is between a lower liquid level **(116)** and an upper liquid level **(118)** set based on a user action associated with the one or more sensors **(112).** In an advantageous manner the one or more sensors of the pump are stationary touch sensitive sensors.

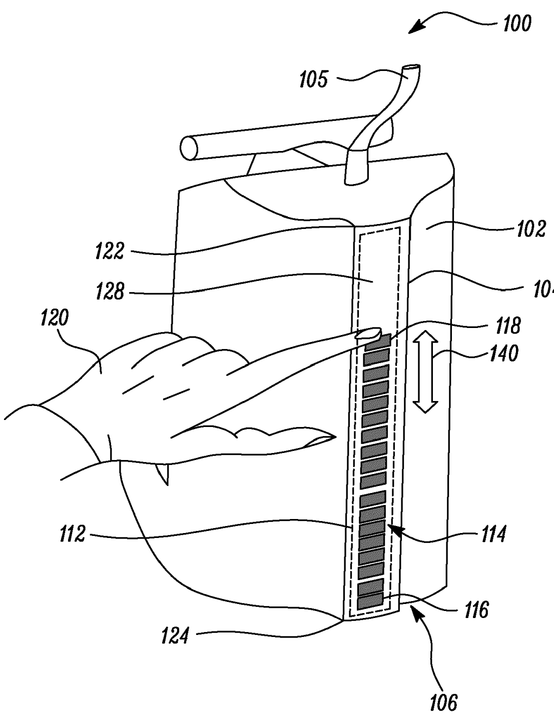

FIG. 1

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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a submersible pump. More specifically, the present disclosure relates to the submersible pump which provides integrated liquid-level sensing and control.

BACKGROUND

[0002] A submersible pump (or sub pump, or electric submersible pump (ESP)) is a device which has a hermetically sealed motor close-coupled to a pump body. The whole assembly is submerged in a fluid to be pumped. Typically, submersible pumps are used to push the fluid to desired locations.

[0003] An example of a submersible pump is provided with European Patent EP 1 929 156 B1 (hereinafter referred to as '156 reference). The '156 reference provides a submersible pump. The pump has a pump housing which is adapted for submersion in a body of liquid whose level is to be controlled. The pump has a pump body forming a main compartment and an auxiliary compartment as an integral part of the body. Upper and lower electric-field sensors are mounted in the auxiliary compartment. The upper sensor produces a signal that turns on the motor after a surface of a liquid body rises to a predetermined elevation, where the turning on of the motor is delayed by a predetermined delay interval. The lower sensor produces a signal that turns off the motor after the surface of the liquid body drops to another predetermined elevation.

SUMMARY

[0004] It is an objective of the present invention to find a more intuitive embodiment for a submersible pump which is adapted for submersion in a body of liquid whose level is to be controlled. The objective is at least partially achieved by a submersible pump that includes a pump body. The pump body forms a main compartment having an intake and an output for a liquid. The pump body is adapted for submersion in a body of liquid whose level is to be controlled. The submersible pump is provided with one or more sensors that enable the submersible pump to operate within a threshold operating level. The threshold operating level is between a lower liquid level and an upper liquid level set based on a user action associated with the one or more sensors. In an advantageous manner the one or more sensors of the pump are stationary touch sensitive sensors which are integrated in or attached to the pump body **(102)..** The stationary touch sensitive sensors help in setting a desired liquid level (i.e. the threshold operating level) of the submersible pump based upon the user action (i.e. user touch). Being stationary sensors does not allow them to move along relative the pump housing substantially perpendicular to the liquid level, while on the other hand when being realized as switches at least part of them can be pressed substantially orthogonal in respect to the pumps main compartment. Thus, the present disclosure provides a simple, efficient, and user-friendly submersible pump which allows user-action based control of the threshold operating level of the submersible pump.

[0005] According to an embodiment of the present invention, the one or more sensors are capacitive touch sensors. The capacitive touch sensors allow to adjust the control system without the need for any movable components.

[0006] According to an embodiment of the present invention, the one or more sensors are switches. The use of a line of switches allow to adjust the control system without the need for any components that can be moved along the pump housing substantially perpendicular to the liquid level, while on the other hand at least part of them can be pressed substantially orthogonal in respect to the pumps main compartment.

[0007] According to an embodiment of the present invention, in case there is more than one single sensor at least some of them are arranged in a direction substantially perpendicular to the water level. This kind of arrangement of the sensors results in a very intuitive arrangement in respect to the liquid level to be controlled.

[0008] According to an embodiment of the present invention, the user action includes a preset gesture for setting the desired liquid level. The preset gesture allows to start or end the functioning (i.e. the threshold operating level) of the submersible pump.

[0009] According to an embodiment of the present invention, the user action includes swiping the one or more sensors between a top and a bottom of the pump body to set the desired liquid level. This allows to define working range for water level for the submersible pump, and as a result prevent overflow of water.

[0010] According to an embodiment of the present invention, the preset gesture includes touching the one or more sensors for a fixed time in order to set the desired liquid level. The preset gesture may be customized based upon user preferences or any other factor associated with the submersible pump.

[0011] According to an embodiment of the present invention, the preset gesture includes one or more of a swipe, a press (in particular a press of longer duration), and a double tap. The preset gesture may be selected from any known or used gesture that finds relevance for the submersible pump.

[0012] According to an embodiment of the present invention, the submersible pump includes an indicator to show the desired liquid level which is set after the user action. The indicator serves to make the user aware about the desired liquid level set for the submersible pump.

[0013] According to an embodiment of the present invention, the indicator is one or more of a LED, and a buzzer. Such indicator(s) allow to have a safe, and user-friendly working of the submersible pump.

[0014] According to an embodiment of the present invention, the upper liquid level and the lower liquid level are selected separately. Wherein preferably the separate selection occurs sequentially. In advantageous manner this separate selection process further improves the intuitively of the design.

[0015] According to an embodiment of the present invention the one or more sensors are integrated in the pump body. Thus the pump the cost for manufacturing the submersible pump decreases as there are less individual components to assemble.

[0016] According to one embodiment of the present invention the touch of the one or more touch sensitive sensors allows to adjust the operational mode of the pump . Preferably this is done by using one or more fingers of a user and touching a different combination of the touch sensitive sensors for a longer time or exhibiting multiple touches, preferably a double touch. For example, if a user touches and holds both touch sensitive sensors on the top of the pump body for five seconds the submersible pump will start to run continuously or alternatively stop immediately. In an advantageous manner this allows to avoid the need for separate buttons or knobs on the pump for adjusting its operational parameters. This reduces manufacturing costs and makes the pump more fault prove.

[0017] Other features and aspects of this invention will be apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The invention will be described in more detail with reference to the enclosed drawings, wherein:

FIG. 1 shows a perspective view of a submersible pump with sensors, in accordance with an aspect of the present disclosure;

FIG. 2 shows a perspective view of the submersible pump operating with a threshold operating level, in accordance with an aspect of the present disclosure;

FIG. 3 shows a perspective view of the submersible pump with the sensors, in accordance with another aspect of the present disclosure;

FIG. 4 shows a perspective view of the submersible pump operating with a different threshold operating level, in accordance with an aspect of the present disclosure; and

FIG. 5 shows a perspective view of the submersible pump with an authentication feature, in accordance with an aspect of the present disclosure.

DESCRIPTION OF EMBODIMENTS

[0019] The present invention will be described more fully hereinafter with reference to the accompanying drawings, in which example embodiments of the invention incorporating one or more aspects of the present invention are shown. This invention may, however, be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. For example, one or more aspects of the present invention may be utilized in other embodiments and even other types of structures and/or methods. In the drawings, like numbers refer to like elements.

[0020] Certain terminology is used herein for convenience only and is not to be taken as a limitation on the invention. For example, "upper", "lower", "front", "rear", "side", "longitudinal", "lateral", "transverse", "upwards", "downwards", "forward", "backward", "sideward", "left," "right," "horizontal," "vertical," "upward", "inner", "outer", "inward", "outward", "top", "bottom", "higher", "above", "below", "central", "middle", "intermediate", "between", "end", "adjacent", "proximate", "near", "distal", "remote", "radial", "circumferential", or the like, merely describe the configuration shown in the Figures. Indeed, the components may be oriented in any direction and the terminology, therefore, should be understood as encompassing such variations unless specified otherwise.

[0021] **FIG. 1** illustrates a submersible pump **100.** The submersible pump **100** includes a pump body **102.** The pump body **102** forms a main compartment **104.** The pump includes a power cable **105** that serves to supply a desired electric power/current for the functioning of the submersible pump **100.** The main compartment **104** has an intake **106** (on the bottom side of the pump body **102** thus not visible with the figures showing the exemplary embodiment) and an output **108** for a liquid **110** (shown in **FIG. 2**). The liquid **110** is pumped up from the intake **106** and pumped out from the output **108.** The intake **106** may be provided around the bottom of the pump **100** while the output **108** may be behind the main compartment **104** as per application or implementation requirements. The submersible pump **100** includes one or more sensors **112.** The one or more stationary and touch sensitive sensors **112** which enable the submersible pump **100** to operate within a threshold operating level **114.** The one or more sensors **112** may be present between a top **122** and a bottom **124** of the pump body **102** and are arranged in a direction substantially normal to the water level.. In this exemplary embodiment the submersible pump **100** has a preset gesture **140** for setting a desired liquid level (i.e. the threshold operating level **114**). The preset gesture **140** is shown with a doubled-headed arrow which signifies up and/or down movement of the preset gesture **140** as per movement of a hand **120,** however actual implementation of the preset disclosure may have any other type/position/setting for the preset gesture **140.**

[0022] In some embodiments, the one or more stationary and touch sensitive sensors **112** may be integrated with the pump body **102.** The integration of the one or more sensors **112** may allow protection from impurities such as dirt, sand or any such damage known in art. This will also allow the one or more sensors **112** to remain protected from getting jammed or any otherwise adjustments. The one or more sensors **112** may be affixed at any location other than around the outer face or surface of the pump body **102** to avoid any mechanical damage or other wear associated with typical working of the submersible pumps **100.**

[0023] In some embodiments, the one or more sensors **112** may be one or more of a resistive sensor, a surface capacitive sensor, a projected capacitive sensor, a surface acoustic wave sensor, an infrared sensor and the like. It is also possible to realize the one or more stationary and touch sensitive sensors **112** as an arrangement of individual switches. The one or more sensors **112** may be touch sensitive sensors which are integrated with the pump body **102.** The touch sensitive sensors help in setting a desired liquid level (i.e. the threshold operating level **114**) of the submersible pump **100** based upon the user action (i.e. user touch) by use of the hand **120.** Moreover, the one or more sensors **112** may be capacitive touch sensors, or any other sensor as used or known in the art. The submersible pump **100** may be adjustable, operable and intuitively configurable by a finger touch by the hand **120** such as the preset gesture **140.**

[0024] In some embodiments, the capacitive sensors **112** need not to come in direct contact with the liquid **110** to be measured. The capacitive sensors **112** avoid resistance of water between electrodes of the submersible pump **100.** The capacitive sensors **112** measure the change of capacitance when the dielectric (air) is replaced by the liquid **110.** The submersible pump **100** may have low susceptibility to electro-chemical corrosion risks.

[0025] In some embodiments, the preset gesture **140** may include one or more of a tap, a double tap, a drag and drop, a flick, a touchdown and drag, a touchdown and hold, a slide to scroll, and the like. The preset gesture **140** may be selected from any known or used gesture that finds relevance for the submersible pump **100.** The preset gesture **140** may include touching the one or more sensors **112** for a fixed time in order to set the desired liquid level. The preset gesture **140** may include one or more of a swipe, a long press, and a double tap. The preset gesture **140** allows to start or end the functioning (i.e. the threshold operating level **114**) of the submersible pump **100.** The one or more sensors **112** present between the top **122** and the bottom **124** of the pump body **102** may be swiped or configured as desired to define working range for a water level **126** (shown in **FIG. 2**) for the submersible pump **100,** and as a result prevent overflow of water.

[0026] **FIG. 2** illustrates the submersible pump **100** working within the threshold operating level **114.** The threshold operating level **114** is between a lower liquid level **132** and an upper liquid level **126** set based on a user action (say by the hand **120**) associated with the one or more sensors **112.** The pump body **102** is adapted for submersion in a body of the liquid **110** whose level is to be controlled. The submersible pump **100** stops functioning as the water level falls below the lower liquid level **132.**

[0027] As illustrated in **FIG. 2,** for the selection of the switch on level controlled the upper activated sensor **118** may be done by swiping that starts around the top end of the sensor **112** down to the desired switch on level and then release the finger touch from the sensor surface **128** to confirm it. Here, the water level **126** is below the upper activated sensor **118.** The pump **100** remains in the current status, means when being currently switched on the pump **100** will continue to pump water and will switch off as soon as the water level **126** falls below the lower activated sensor 116.

[0028] **FIG. 3** illustrates the submersible pump **100** which includes an indicator **114** to show the desired liquid level (i.e. the threshold operating level **114**) which is set after the user action (say by the hand **120**). The indicator **114** is one or more of a LED, and a buzzer. The possible indicator **114** (e.g. LED behind a half transparent surface) shows dynamically the currently adjusted level and makes the adjusted level more visible, noticeable for the user. The LED indicator may make it possible to check the switching points, which may be programmed before by a check function. So, it may not be necessary to repeat different steps of the programming procedure. Such indicator(s) **114** allow to have a safe, and user-friendly working of the submersible pump **100.**

[0029] **FIG. 4** illustrates the submersible pump **100** with a lower liquid level **132** below the lower activated sensor **116** of the threshold operating level **114.** The submersible pump **100** may not work when the water level **132** point is below the lower activated sensor **116.** For a start level point adjustment, swiping by the preset gesture **140** may be started at the bottom **124** (for the lower activated sensor **116**) of the one or more sensors **112** towards the upper activated sensor **118** and release the sensor surface **128** to confirm the threshold operating level **114.**

[0030] In some embodiments, the submersible pump **100** may be set according to need of the user. The threshold operating level **114** may be varied multiple times. During application of the submersible pump **100** there may be change in volume (and thereby the level) of the liquid **110,** the level of the liquid **110** may reduce or come below the water level **132** point leading to switching off of the submersible pump **100.** In some embodiments, the submersible pump **100** may be configured to prompt a user (such as smart notifications to smartphone and the like) or take any other action whenever the level of the liquid **110** goes above the activated sensor **118** or significant below the lower activated sensor **116.** Additionally, or alternatively, the submersible pump **100** prompt the user and inform him about successful pumping action whenever the level of the liquid **110** comes to an acceptable level i.e. between the upper activated sensor **118** and the lower activated sensor **116.**

[0031] **FIG. 5** illustrates the submersible pump **100** with an authentication feature **130.** Herein, the authentication feature **130** refers to a program field, or any used or known authentication means of the relevant art. The preset gesture **140** may be started, changed, or controlled by the authentication feature **130.** The authentication feature **130** may be touched (before the adjustment) to start or end the adjustment process or by multiple touch (such as double touch) on the sensor surface **128.** In some embodiments, the authentication feature **130** allows multiple user profiles or settings to be stored by the submersible pump **100.**

[0032] In some embodiments, the submersible pump **100** casing may include different kinds of metals, like chrome, stainless steel, polymers and the like. Preferably the casing is that it is hermetically sealed. This prevents high repair costs and prevents motor from issues related to the liquid **110** leakage, among others.

[0033] In the drawings and specification, there have been disclosed preferred embodiments and examples of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for the purpose of limitation of the scope of the invention being set forth in the following claims.

LIST OF ELEMENTS

[0034]

100	Submersible Pump
102	Pump Body
104	Main Compartment
105	Power Cable
106	Intake
108	Output
110	Liquid
112	Sensors
114	Threshold operating level / Indicator
116	Lower Activated Sensor
118	Upper Activated Sensor
120	Hand
122	Top
124	Bottom
126	Upper Liquid Level
128	Sensor Surface
130	Authentication Feature
132	Lower Liquid Level
140	Preset Gesture

Claims

1. A submersible pump **(100)** comprising:

a pump body **(102)** forming a main compartment **(104)** having an intake **(106)** and an output **(108)** for a liquid **(110),** where the pump body **(102)** is adapted for submersion in a body of liquid **(110)** whose level is to be controlled;

the submersible pump **(100)** configured with one or more sensors **(112)** such that the submersible pump **(100)** is enabled to operate within a threshold operating level, wherein the threshold operating level is between a lower liquid level **(132)** and an upper liquid level **(126)** set based on a user action associated with the one or more sensors **(112),**

characterized in that:

the one or more sensors **(112)** are stationary touch sensitive sensors which are integrated in or attached to the pump body **(102).**

2. The submersible pump **(100)** of claim 1, wherein the one or more sensors **(112)** are capacitive touch sensors.

3. The submersible pump **(100)** of claims 1 or 2, wherein the one or more sensors are switches.

4. The submersible pump **(100)** of claim 3, wherein in case there is more than one sensor **(112)** at least some of them are arranged in a direction substantially normal to the water level.

5. The submersible pump **(100)** of any of the preceding claims, wherein the user action includes a preset gesture **(140)** for setting the desired liquid level.

6. The submersible pump **(100)** of claim 5, wherein the user action includes swiping the one or more sensors **(112)** between a top **(122)** and a bottom **(124)** of the pump body **(102)** to set the desired liquid level.

7. The submersible pump **(100)** of claim 5, wherein the preset gesture **(140)** includes touching the one or more sensors **(112)** for a fixed time in order to set the desired liquid level.

8. The submersible pump **(100)** of claim 5, wherein the preset gesture **(140)** includes one or more of a swipe, a press, and a double tap.

9. The submersible pump **(100)** of any of the preceding claims, wherein the submersible pump **(100)** includes an indicator **(114)** to show the desired liquid level which is set after the user action.

10. The submersible pump **(100)** of claim 9, wherein the indicator **(114)** is one or more of a LED, and a buzzer.

11. The submersible pump **(100)** of any of the preceding claims, wherein the upper liquid level **(132)** and the lower liquid level **(132)** are selected separately.

12. The submersible pump **(100)** of any of the preceding claims, wherein the separate selection occurs sequentially.

13. The submersible pump **(100)** of any of the preceding claims, wherein the one or more sensors are integrated in the pump body.

14. The submersible pump **(100)** of any of the preceding claims, wherein the touch of the one or more sensors **(112)** allows to adjust the operational mode of the pump **(100).**

15. The submersible pump **(100)** of claim 14, wherein the adjustment of the operational mode of the pump **(100)** is with the help of one or more fingers of a user by touching a different combination of the sensors **(112)** for a longer time or by multiple touches, preferably a double touch.

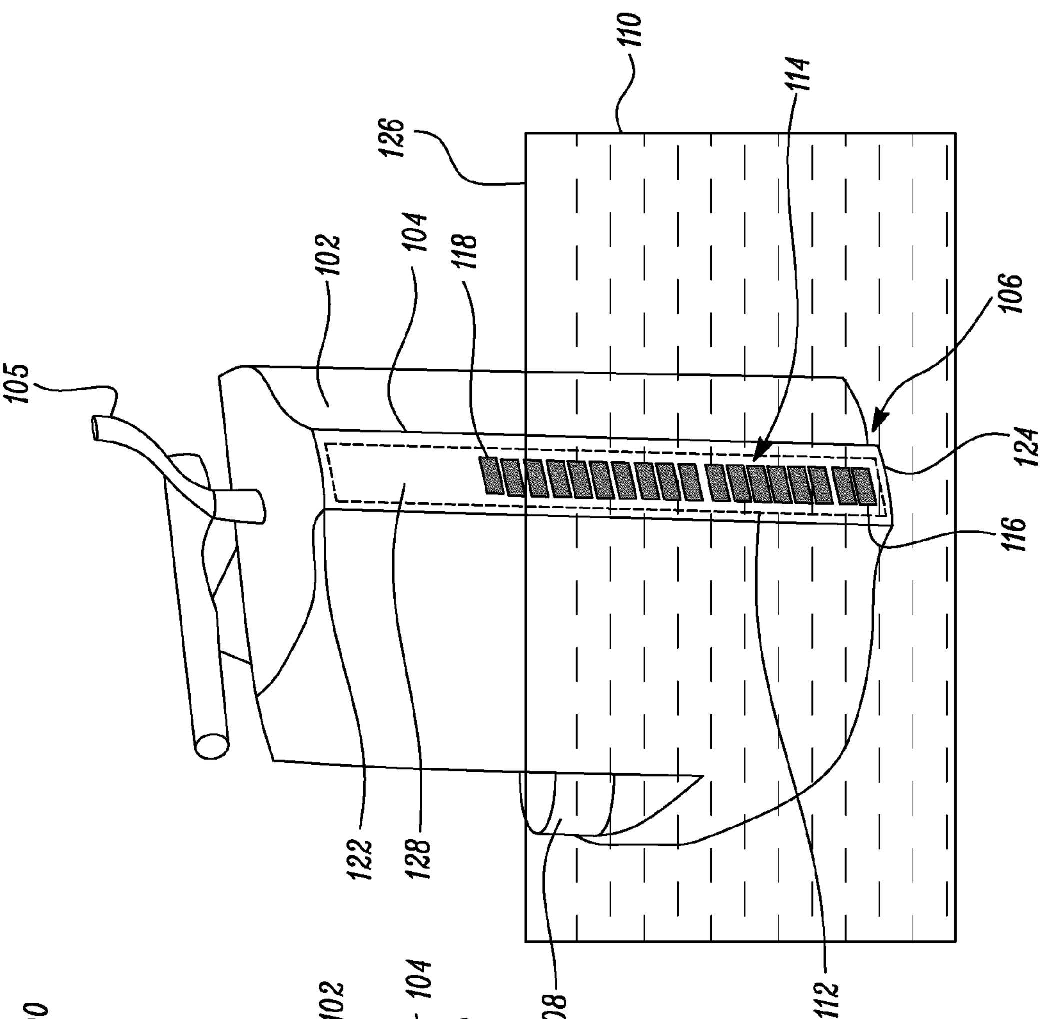
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FIG. 2

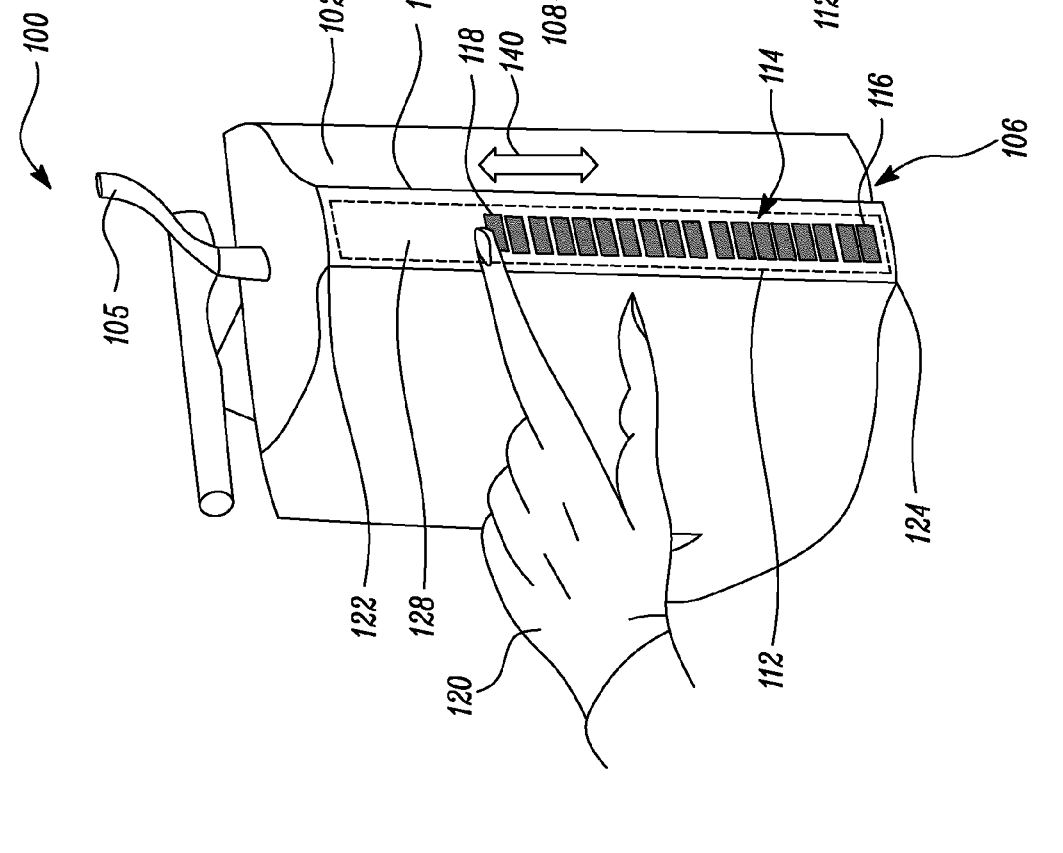
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FIG. 1

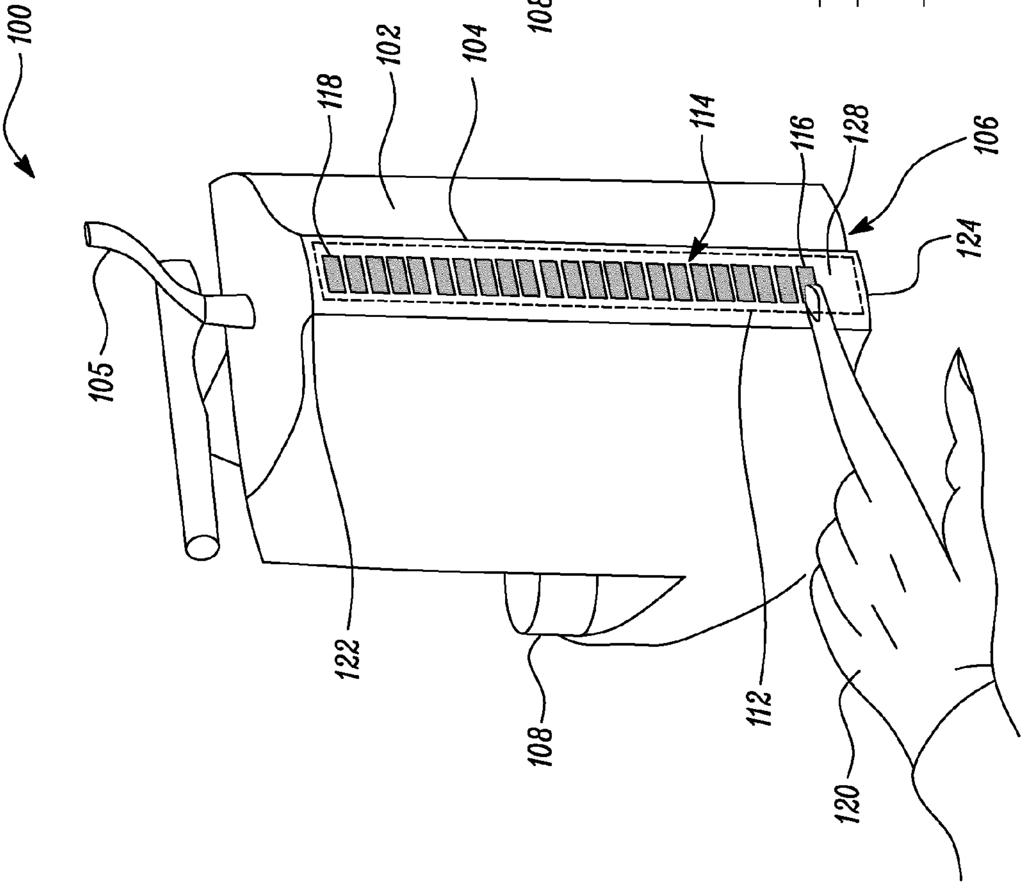
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FIG. 3

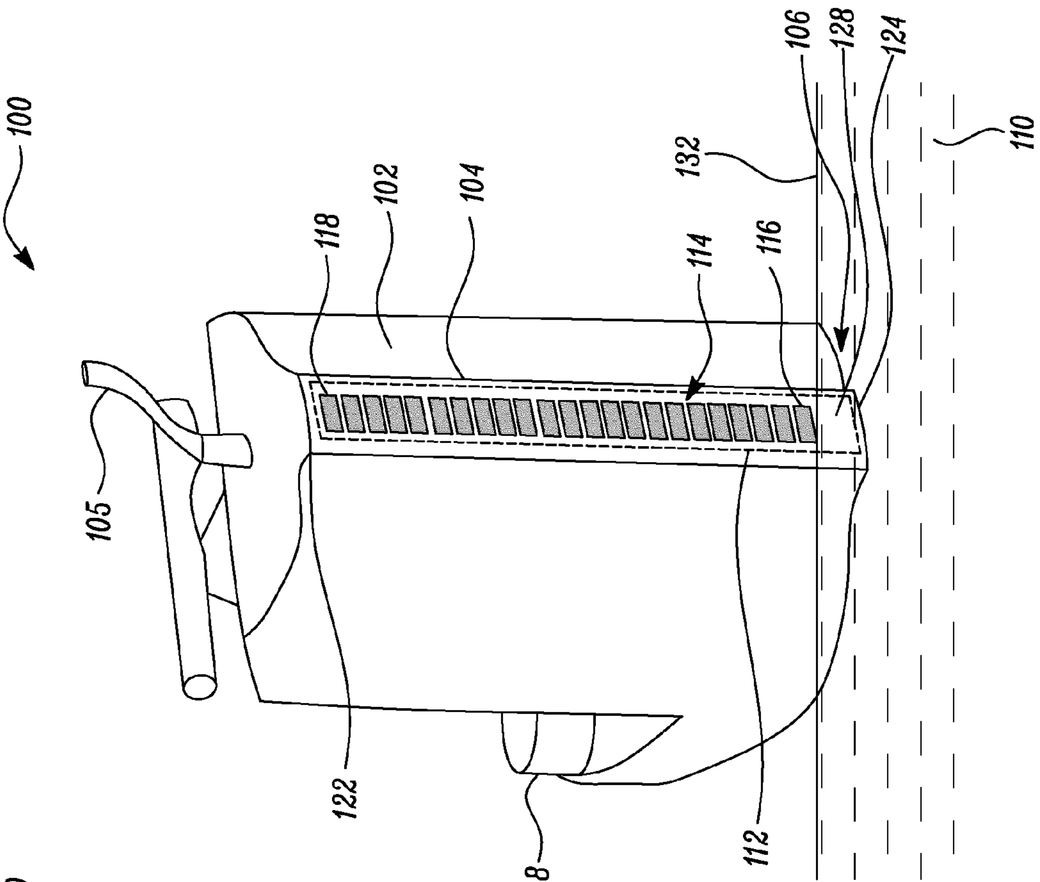
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FIG. 4

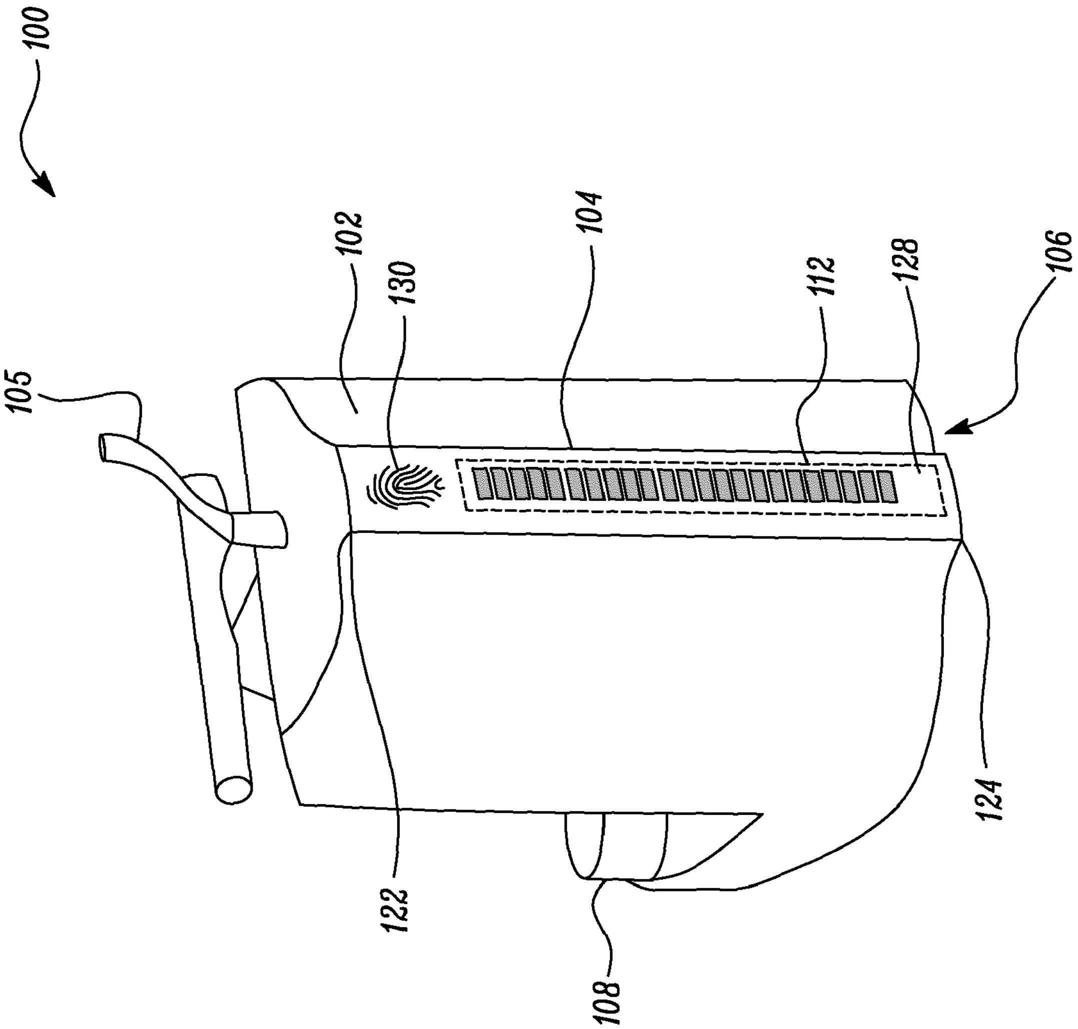

FIG. 5

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EUROPEAN SEARCH REPORT

Application Number
EP 20 16 0303

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F04D
G01F
G06F

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	21 August 2020	Oliveira, Damien

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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