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(54) **PUMP OPERATION CONTROL**

(57) A pump (100) includes a storage tank (110) adapted to store a pressurized liquid and a pumping unit (120) configured to supply the pressurized liquid to the storage tank (110). The pump (100) further includes at least one operational parameter sensor (140) and a controller (150) communicably coupled with the pumping unit (120), and the at least one operational parameter sensor (140). The controller (150) is configured to activate at least one of a first operational mode (P1) and a second

operational mode (P2) of the pump (100) based on the communication with the at least one operational parameter sensor (140). The first operational mode (P1) corresponds to controlling an operation of the pumping unit (120) based on the one or more operational parameters. The pump (100) is characterized in that the second operational mode (P2) corresponds to controlling the operation of the pumping unit (120) irrespective of the one or more operational parameters.

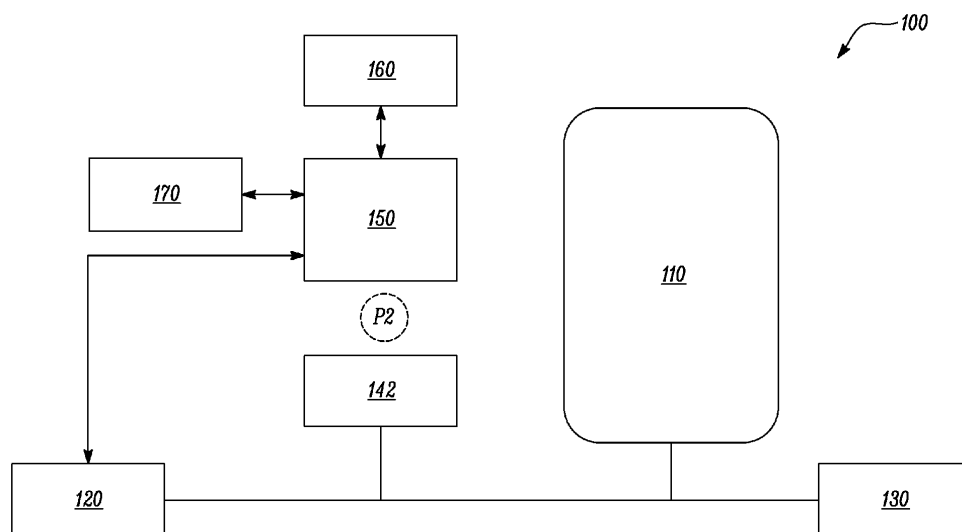


FIG. 3

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a pump. More specifically, the present disclosure relates to the pump that includes a controller for controlling an operation of the pump.

BACKGROUND

[0002] A pressure tank unit may include a pump, a pressure tank, and a pressure switch. A pressure tank may often be utilized to provide water under pressure to an irrigation system, plumbing system, and the like. The pressure tank may supplement the pump and may also allow the pump to operate intermittently. The pump may be operated intermittently because a continuously operating pump may have a shorter operational lifetime.

[0003] Further, the pressure switch may enable the pump to operate intermittently while also ensuring that the system (say irrigation system) maintains pressure. The pressure switch is a device that opens and closes an electrical contact based on a liquid pressure acting against an input of the pressure switch. The pressure switch is configured to close the electrical contact, and therefore activate the pump, when the pressure acting against the input falls to a predetermined cut-in pressure. Similarly, the pressure switch is configured to open the electrical contact (i.e. turn off the pump) when the pressure acting against the input rises to a predetermined cut-out pressure.

[0004] An example of a pressure tank unit is provided in PCT application 2020/023836 (hereinafter referred to as '836 reference). The '836 reference provides a well management system. The well management system provides an Internet-enabled monitoring, configuration, and control of a well system that includes a pump and a pressure tank. A controller is operatively coupled to the pump. The controller controls the pump based on pressure readings from a pressure sensor to maintain a configured pressure range within the system. The controller may communicate with a management system via a communications network. The management system is further in communication with one or more client devices. Via the management system, the client devices may receive information from the controller and send commands to the controller. However, there is still a need for a pressure tank unit which may provide constant liquid pressure throughout an operation of any known domestic or industrial applications such as spraying, sprinkling, and the like.

SUMMARY

[0005] In view of the above, it is an objective of the present invention to solve or at least reduce the drawbacks discussed above. The objective is at least partially

achieved by a pump. The pump includes a storage tank adapted to store a pressurized liquid and a pumping unit configured to supply the pressurized liquid to the storage tank. The pumping unit includes a drive motor. The pump further includes at least one operational parameter sensor configured to measure one or more operational parameters of the pump. Furthermore, the pump includes a controller communicably coupled with the pumping unit, and the at least one operational parameter sensor. The controller is configured to receive the one or more operational parameters of the pump from the at least one operational parameter sensor. The controller is further configured to determine an operational condition of the pump based on the received one or more operational parameters and activate at least one of a first operational mode and a second operational mode of the pump based on the determined operational condition. The first operational mode corresponds to controlling an operation of the pumping unit based on the one or more operational parameters. The pump is characterized in that the second operational mode corresponds to controlling the operation of the pumping unit irrespective of the one or more operational parameters.

[0006] Thus, the present disclosure provides a pump that is advantageously operable in two different operational modes. The two different operational modes provide a benefit of operating the pumping unit as per the requirements of an operational condition. The two different operational modes further allow a pump to selectively account for one or more operational parameters of the pump calculated by at least one operational parameter sensor.

[0007] According to an embodiment of the present disclosure, the controller is further configured to receive a user input indicative of selection of the at least one of the first operational mode and the second operational mode. The controller then activates the at least one of the first operational mode and the second operational mode based on the received user input. In some embodiments, the decision to operate the pump in the first operational mode or the second operational mode may be made and communicated to the controller by the user. The user may make the decision to select a particular operational mode of the pump based on the operational conditions, storage tank size, pump specifications among other factors.

[0008] According to an embodiment of the present disclosure, the user input is received through a user interface configured with the controller. The user interface may obtain the user input by virtue of one or more input devices and may further communicate the user input with the controller. The user interface may also include a set-up such as a display screen or a blinking light that may acknowledge the user input.

[0009] According to an embodiment of the present disclosure, the user interface is one or more of a toggle switch, a push button, a rotary button. The user interface may be commonly known and understood in the art. Fur-

ther, the user interface may be cost-effective and easy to operate.

[0010] According to an embodiment of the present disclosure, the user interface is configured with a mobile device. The user interface may be wirelessly coupled with a mobile device (say a smartphone). Thus, the pump may be easily and effectively operable from a remote location.

[0011] According to an embodiment of the present disclosure, at least one of the first operational mode and the second operational mode is activated automatically. The controller implements a process or an algorithm to automatically activate the first operational mode or the second operational mode without any human intervention.

[0012] According to an embodiment of the present disclosure, the automatic activation is governed by the operational parameter of the pump. The algorithm implemented by the controller makes use of detected operational parameters such as the pressure in the storage tank, liquid flow rate in the pump to make decision about the automatic activation of the first operational mode or the second operational mode.

[0013] According to an embodiment of the present disclosure, the operational condition is an irrigation event. Different operational conditions may demand different one or more operational parameters such as, but not limited to, liquid pressure, liquid flow rate etc., in the pump. The pump may then be selectively operated in the first operational mode or the second operational mode to meet the demand for the one or more operational parameters.

[0014] According to an embodiment of the present disclosure, the at least one operational sensor includes a pressure sensor. Pressure is one of the most important operational parameters for the operation of the pump. The pressure sensor communicates the pressure reading of the pump with the controller. The controller then controls the operation of the pump based on the pressure reading for smooth and efficient operation of the pump under different operational conditions.

[0015] According to an embodiment of the present disclosure, the operational parameter is a pressure of the storage tank. The storage tank may function to supplement the pump and may improve the durability of the pump. Further, the pump may be required to operate, or cease operating based on the pressure of the storage tank.

[0016] Other features and aspects of this invention will be apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The invention will be described in more detail with reference to the enclosed drawings, wherein:

FIG. 1 shows a schematic block diagram of a pump, in accordance with an aspect of the present disclosure;

FIG. 2 shows a schematic block diagram of a pump operating in a first operational mode, in accordance with an aspect of the present disclosure; and

FIG. 3 shows a schematic block diagram of a pump operating in a second operational mode, in accordance with an aspect of the present disclosure;

FIG. 4 shows a schematic block diagram of a controller for a pump, in accordance with an aspect of the present disclosure; and

FIG. 5 is a flowchart illustrating a process for an automatic operation of a pump, in accordance with an aspect of the present disclosure

DESCRIPTION OF EMBODIMENTS

[0018] 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.

[0019] 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.

[0020] **FIG. 1** illustrates a schematic block diagram of a pump **100**. The pump **100** includes a storage tank **110** adapted to store a pressurized liquid. The pump **100** further includes a pumping unit **120** configured to supply the pressurized liquid to the storage tank **110** and/or a distribution system **130** (e.g., a plumbing system of a structure). The pump includes a drive motor (not shown). The storage tank **110** may be a pressure vessel having an internal diaphragm that separates an interior volume into an air chamber from a liquid chamber. The air chamber may be provided with a pre-charge of air pressure so as to provide liquid under pressure to the distribution

system **130** even when the pumping unit **120** is not operating.

[0021] The pump **100** further includes at least one operational parameter sensor **140** configured to measure one or more operational parameters of the pump **100**. The one or more operational parameters of the pump **100** may be a liquid pressure, liquid flow rate, liquid level, and the like. The at least one operational parameter sensor **140** may measure one or more operational parameters of the pump **100** for an efficient operation of the pump **100**. Further, the at least one operational parameter sensor **140** may measure one or more operational parameters of the pump **100** for improving the durability of various elements or parts associated with the pump **100**.

[0022] Further, the pump **100** includes a controller **150** communicably coupled with the pumping unit **120**, the at least one operational parameter sensor **140**, a remote server **160** and a user interface **170**. The controller **150** is configured to receive the one or more operational parameters of the pump **100** from the at least one operational parameter sensor **140**. In some embodiments, the controller **150** may receive the liquid level within the storage tank **110** from a liquid level sensor (not shown) or the liquid temperature from a temperature sensor (not shown). In some embodiments, as shown in **FIGS. 2** and **3**, the controller **150** receives the pressure of the storage tank **110** from a pressure sensor **142**.

[0023] Furthermore, the controller **150** is configured to determine an operational condition of the pump **100** based on the received one or more operational parameters and activate at least one of a first operational mode "P1" and a second operational mode "P2" of the pump **100** based on the determined operational condition as shown in **FIGS. 2** and **3**. The first operational mode "P1" corresponds to controlling an operation of the pumping unit **120** based on the one or more operational parameters (as shown in **FIG. 2**). The second operational mode "P2" corresponds to controlling the operation of the pumping unit **120** irrespective of the one or more operational parameters (as shown in **FIG. 3**).

[0024] In some embodiments, as shown in **FIG. 2**, the operational condition may be an operational condition requiring very small amount of water such as a toilet washing or a hand washing event that may generally require a less quantity of the liquid (say water). In such events, the controller **150** may activate the first operational mode "P1". By way of example, an operational configuration may include pressure setpoints and the operational parameter includes pressure reading from the pressure sensor **142**. The pressure sensor **142** is coupled to liquid flow lines between the pumping unit **120** and the storage tank **110** or the distribution system **130**. The pressure sensor **142** provides the pressure reading in the liquid flow lines and communicates the pressure reading with the controller **150**. In accordance with the first operational mode "P1", the controller **150** activates the pumping unit **120** when the pressure reading falls below a cut-in pressure and deactivates the pumping unit

120 when the pressure reading is at or above a cut-out pressure.

[0025] In some embodiments as shown in **FIG. 3**, the operational condition is an irrigation event such as a sprinkling event or a spraying event that may generally require large quantity of the liquid (say water). In such events, the pressure may be required to be continuously maintained within the pump **100**. Hence, it may not be preferable to switch the pumping unit **120** ON/OFF based on the pressure reading from the pressure sensor **142**. Thus, in such events, the controller **150** may activate the second operational mode "P2". In accordance with the second operational mode "P2", the controller **150** completely disregards or disobeys the pressure reading from the pressure sensor **142**. The pumping unit **120** then operates continuously throughout the period of the irrigation event or the operational condition.

[0026] Although the pressure sensor **142** is depicted in **FIGS. 2** and **3**, as being separate from the controller **150**, in some embodiments, as shown in **FIG. 4**, the pressure sensor **142** may be integrated with the controller **150**. For instance, the pressure sensor **142** may be at least partially integrated with a circuit board of the controller **150** and/or enclosed within a common housing. Moreover, the common housing that includes the controller **150** and/or the pressure sensor **142** may be installed on or attached to the storage tank **110**.

[0027] Further, **FIG. 4** illustrates a schematic block diagram of an exemplary, nonlimiting embodiment for the controller **150**. As shown in **FIG. 4**, the controller **150** includes one or more processor(s) **200** configured to execute computer-executable instructions **204** such as instructions composing a control and communication process for the pump **100**. Such computer-executable instructions **204** are stored on one or more computer-readable media including non-transitory, computer-readable storage media such as memory **202**. For instance, memory **202** may include non-volatile storage to persistently store the instructions **204**, settings **206** (e.g. operational configuration settings, operational parameter settings, pressure setpoints, etc.), and/or data **208** (e.g., operational data, history data, water usage data, system health data, pressure data, current data, voltage data, resistance data, user-stored data, etc.). Memory **202** may also include volatile storage that stores the instructions **204**, other data (working data or variables), or portions thereof during execution by the processor **200**.

[0028] The controller **150** further includes a communication interface **210** to couple the controller **150**, via the Internet or other communications network, to the remote server **160**. The communication interface **210** may be a wired or wireless interface such as, but not limited to, a Wi-Fi interface, an Ethernet interface, a Bluetooth interface, a fiber optic interface, a cellular radio interface, a satellite interface, etc. The communications settings, thus established, may be stored in memory **202**.

[0029] Further, a component interface **212** is also provided to couple the controller **150** to various components

of the pump **100**. For instance, the component interface **212** may connect the controller **150** to the at least one operational parameter sensor **140** such as the pressure sensor **142**, the pumping unit **120**. Via the component interface **212**, the controller **150** may activate the pumping unit **120** (i.e. close an electrical switch), deactivate the pumping unit **120** (i.e. open the electrical switch), acquire electrical properties (i.e., current, voltage, resistance, etc.) of the pumping unit **120**, acquire readings from the at least one operational parameter sensor **140**, or the like. Accordingly, the component interface **212** may include a plurality of electrical connections on the circuit board or internal bus of the controller **150** that may be further coupled to the processor **200**, memory **202**, etc. Further, the component interface **212** may implement various wired or wireless interfaces such as, but not limited to, a USB interface, a serial interface, the Wi-Fi interface, a short-range RF interface (Bluetooth), an infrared interface, a near-field communication (NFC) interface, etc.

[0030] In the operation of the pump **100**, the controller **150** determines the operational condition such as the irrigation event, the hand washing event, or any other event based on the received one or more operational parameters received from the at least one operational parameter sensor **140**. The one or more operational parameters may then be compared with the information or data stored in the memory **208** and/or the remote server **160**. The memory **208** and/or the remote server **160** may already include a database for the relationship between the operational conditions and the operational parameters. For example, on receiving the one or more operational parameters such as the flow rate of the liquid or the pressure of the liquid, the controller may check with the memory **208** and/or the remote server **160** to understand whether the received one or more operational parameters correspond to the irrigation event or some other event to accordingly activate the at least one of the first operational mode "P1" and the second operational mode "P2" of the pump **100**. Thus, the controller **150** automatically decides whether to operate the pump **100** in the first operational mode "P1" or the second operational mode "P2" without any intervention by a user.

[0031] FIG. 5 is a flowchart illustrating a process **300** for automatic operation of the pump **100** by the controller **150**, according to another embodiment of the present disclosure. The process **300** is embodied as an algorithm implemented by the controller **150** (as shown in FIG. 4) including the processor **200**. Further, the process **300** or the algorithm may be stored in the memory **202**.

[0032] At step **302**, the process **300** begins. The process **300** then moves to step **304** to turn ON the drive motor of the pumping unit **120** in order to start the operation the pumping unit **120** of the pump **100**. Once the drive motor is turned ON in step **304**, the process **300** moves to step **306** and the liquid flow rate is detected in the pump **100**. If the liquid flow rate is not detected at step **306**, the process **300** moves to step **310** to detect

if the pressure in the storage tank **110** is greater than or equal to a predetermined cut-out pressure. In an embodiment, the cut-out pressure is the maximum pressure value after which the drive motor is turned OFF.

[0033] If the pressure in the storage tank **110** turns out to be greater than or equal to the predetermined cut-out pressure in step **310**, then the process **300** moves to step **312** and the drive motor is turned OFF. The process **300** then moves to step **314** to detect if the pressure in the storage tank **110** is less than or equal to a predetermined cut-in pressure after turning OFF the drive motor at step **312**. The cut-in pressure is the minimum pressure value below which the drive motor is turned ON.

[0034] If the pressure in the storage tank **110** does not turn out to be less than or equal to the predetermined cut-in pressure, then the process **300** moves to step **332** to detect if the liquid flow rate in the pump **100** is greater than a pre-determined threshold value. If the liquid flow rate turns out to be greater than the predetermined threshold value, then the process **300** moves to step **304** to start the drive motor else the process **300** moves back to step **314**. Further, if the pressure in the storage tank **110** as detected in the step **314** turns out to be less than or equal to the predetermined cut-in pressure, then the process **300** moves to step **304** and the drive motor starts.

[0035] If the pressure in the storage tank **110** turns out to be less than the predetermined cut-out pressure at step **310**, then the process **300** moves to step **316**. At step **316**, the pressure in the storage tank **110** is again detected or measured after a pre-determined time period. In an embodiment, the pre-determined time period is 1 minute. In other embodiments, the pre-determined time period may be any other suitable time period as per application requirements.

[0036] If the detected pressure is still less than the predetermined cut-out pressure then the process **300** moves to step **318** to verify if there is an error and then further moves to step **320** to confirm the error. However, if the detected pressure reaches the predetermined cut-out pressure after the pre-determined time period, then the process **300** moves to step **322** to verify if the value of the detected pressure is less than or equal to a pre-determined pressure value. In an embodiment, the predetermined pressure value is 0.5 bar. In other embodiments, the pre-determined pressure value may be any other suitable pressure value as per application requirements.

[0037] If the detected pressure in step **322** is less than or equal to the predetermined pressure value then the process **300** moves to step **324** to verify if there is an error and then further moves to step **320** to confirm the error. If the detected pressure in step **322** is greater than the pre-determined pressure value, then the process **300** moves to step **306**.

[0038] At step **306**, the liquid flow rate is again detected. If at step **306**, the liquid flow rate is detected, then the process **300** moves to step **308**. At step **308**, the pump system checks if the second operational mode

(that is the so called PowerBoost mode) is selected, then the process 300 moves to step 326 else the process 300 moves to step 310. At step 326, two conditions are tested. First condition is if the pressure in the storage tank 110 is greater than or equal to the cut-off pressure of the second operational mode and second condition is if the pressure in the storage tank 110 was detected before the pre-determined time period.

[0039] If both the conditions at step 326 are not met simultaneously, then the process 300 moves to step 306 else the process 300 moves to step 328. At step 328, the drive motor is turned OFF. Thus any flow in the pump results from the water in the pressure tank. The process 300 then moves to step 330 to detect if the liquid flow rate in the pump 100 is greater than the pre-determined threshold value. If the liquid flow rate in the pump 100 turns out to be greater than the predetermined threshold value, then the process 300 moves to step 304 else the process 300 moves to step 314.

[0040] The process 300 is repeated at regular intervals to detect the operational state of the pump 100 and thereby automatically and selectively operates the pump 100 in the at least one of the first operational mode "P1" and the second operational mode "P2".

[0041] Thus, the controller 150 determines the characteristic curve range in which the pumping unit 120 works in coordination with the pressure of the storage tank 110. In the event that the pressure of the storage tank 110 is below the cut-out pressure, a power off of the pumping unit 120 is prevented and the pumping unit 120 remains in continuous operation. If cut-out pressure is reached, the pumping unit 120 switches off. The liquid flow rate is then calculated by the pressure change in the storage tank 110 over the time. This flow rate is used for further decision making. If this flow rate falls below the pre-determined threshold value, the pumping unit 120 operates in the first operational mode "P1" and remains in the power off state until the cut-in pressure of the pumping unit 120 is reached. However, if the algorithm running in the controller 150 detects the liquid flow rate above the pre-determined threshold value, the pumping unit 120 remains in continuous operation and operates in the second operational mode "P2".

[0042] In some embodiments, the user may opt to disregard or disobey the judgement or the decision of the controller 150 to activate the at least one of the first operational mode "P1" and the second operational mode "P2" of the pump 100. The user may do so by switching OFF a switch (not shown) provided with the controller 150 or with the help of a voice command to the controller 150, or any other means to provide user input without limiting the present disclosure in any manner.

[0043] In this embodiment, the controller 150 may be configured to receive a user input indicative of selection of the at least one of the first operational mode "P1" and the second operational mode "P2". The controller 150 may then activate the at least one of the first operational mode "P1" and the second operational mode "P2" based

on the received user input. In this embodiment, the decision to operate the pump 100 in the first operational mode "P1" or the second operational mode "P2" may be made and communicated to the controller 150 by the user. The user may make the decision to select the at least one of the first operational mode "P1" and the second operational mode "P2" of the pump 100 based on the operational conditions, storage tank size, pump specifications among other factors. In some embodiments, the user may bias the decision of selection of the operational mode between the at least one of the first operational mode "P1" and the second operational mode "P2" of the pump 100 based on the operational parameters such as liquid pressure in the storage tank 120 being displayed on a display screen (not shown) provided with the controller 150.

[0044] In some embodiments, the user input is received through the user interface 170 configured with the controller 150. The user interface 170 may obtain the user input by virtue of one or more input devices and may further communicate the user input with the controller 150. The user interface 170 may also include a set-up such as the display screen (which is different from the display screen provided with the controller 150) or a blinking light that may acknowledge the user input.

[0045] In some embodiments, the user interface 170 may be one or more of a toggle switch, a push button, a rotary button. The user interface 170 such as the toggle switch, the push button and the rotary button may be commonly known and understood in the art. Further, they may be cost-effective and easy to operate. In some embodiments, the user interface 170 may be configured with a mobile device (say a smartphone). The user interface 170 may be wirelessly coupled with a mobile device using any known technology such as the Bluetooth, Wi-Fi, among others. Thus, the pumping unit 120 may be easily and effectively operable from a remote location.

[0046] Thus, the present disclosure provides the pump 100 that is advantageously operable in two different operational modes "P1, P2". The two different operational modes "P1, P2" provide a benefit of operating the pump 100 as per the requirements of the operational condition such as the irrigation event, hand washing event among others. The two different operational modes "P1, P2" further allow the pumping unit 120 to selectively obey one or more operational parameters of the pump 100 calculated by at least one operational parameter sensor 140.

[0047] 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

[0048]

100 Pump
110 Storage Tank
120 Pumping unit
130 Distribution System
140 Operational Parameter Sensor
142 Pressure Sensor
150 Controller
160 Remote Server
170 User Interface
200 Processors
202 Memory
204 Instructions
206 Settings
208 Data
210 Communication Interface
212 Component Interface
P1 First Operational Mode
P2 Second Operational Mode
300 Process
302 Step
304 Step
306 Step
308 Step
310 Step
312 Step
314 Step
316 Step
318 Step
320 Step
322 Step
324 Step
326 Step
328 Step
330 Step
332 Step

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determine an operational condition of the pump (**100**) based on the received one or more operational parameters; and activate at least one of a first operational mode (**P1**) and a second operational mode (**P2**) of the pump (**100**) based on the determined operational condition; wherein the first operational mode (**P1**) corresponds to controlling an operation of the pumping unit (**120**) based on the one or more operational parameters; **characterized in that:**

the second operational mode (**P2**) corresponds to controlling the operation of the pumping unit (**120**) irrespective of the one or more operational parameters.

2. The pump (**100**) of claim **1**, wherein the controller (**150**) is further configured to:

receive a user input indicative of selection of the at least one of the first operational mode (**P1**) and the second operational mode (**P2**); and activate the at least one of the first operational mode (**P1**) and the second operational mode (**P2**) based on the received user input.

3. The pump (**100**) of claim **2**, wherein the user input is received through a user interface (**170**) configured with the controller (**150**).

4. The pump (**100**) of claim **3**, wherein the user interface (**170**) is one or more of a toggle switch, a push button, a rotary button.

5. The pump (**100**) of claim **3**, wherein the user interface (**170**) is configured with a mobile device.

6. The pump (**100**) of claim **1**, wherein at least one of the first operational mode (**P1**) and the second operational mode (**P2**) is activated automatically.

7. The pump (**100**) of claim **6**, wherein the automatic activation is governed by the operational parameter of the pump (**100**).

8. The pump (**100**) of any of the preceding claims, wherein the operational condition is an irrigation event.

9. The pump (**100**) of any of the preceding claims, wherein the at least one operational sensor (**140**) includes a pressure sensor (**142**).

10. The pump (**100**) of claim **9**, wherein the operational parameter is a pressure of the storage tank (**110**).

Claims

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

a storage tank (**110**) adapted to store a pressurized liquid;
 a pumping unit (**120**) configured to supply the pressurized liquid to the storage tank (**110**), wherein the pumping unit (**120**) includes a drive motor;
 at least one operational parameter sensor (**140**) configured to measure one or more operational parameters of the pump (**100**); and
 a controller (**150**) communicably coupled with the pumping unit (**120**), and the at least one operational parameter sensor (**140**), the controller (**150**) configured to:

receive the one or more operational parameters of the pump (**100**) from the at least one operational parameter sensor (**140**);

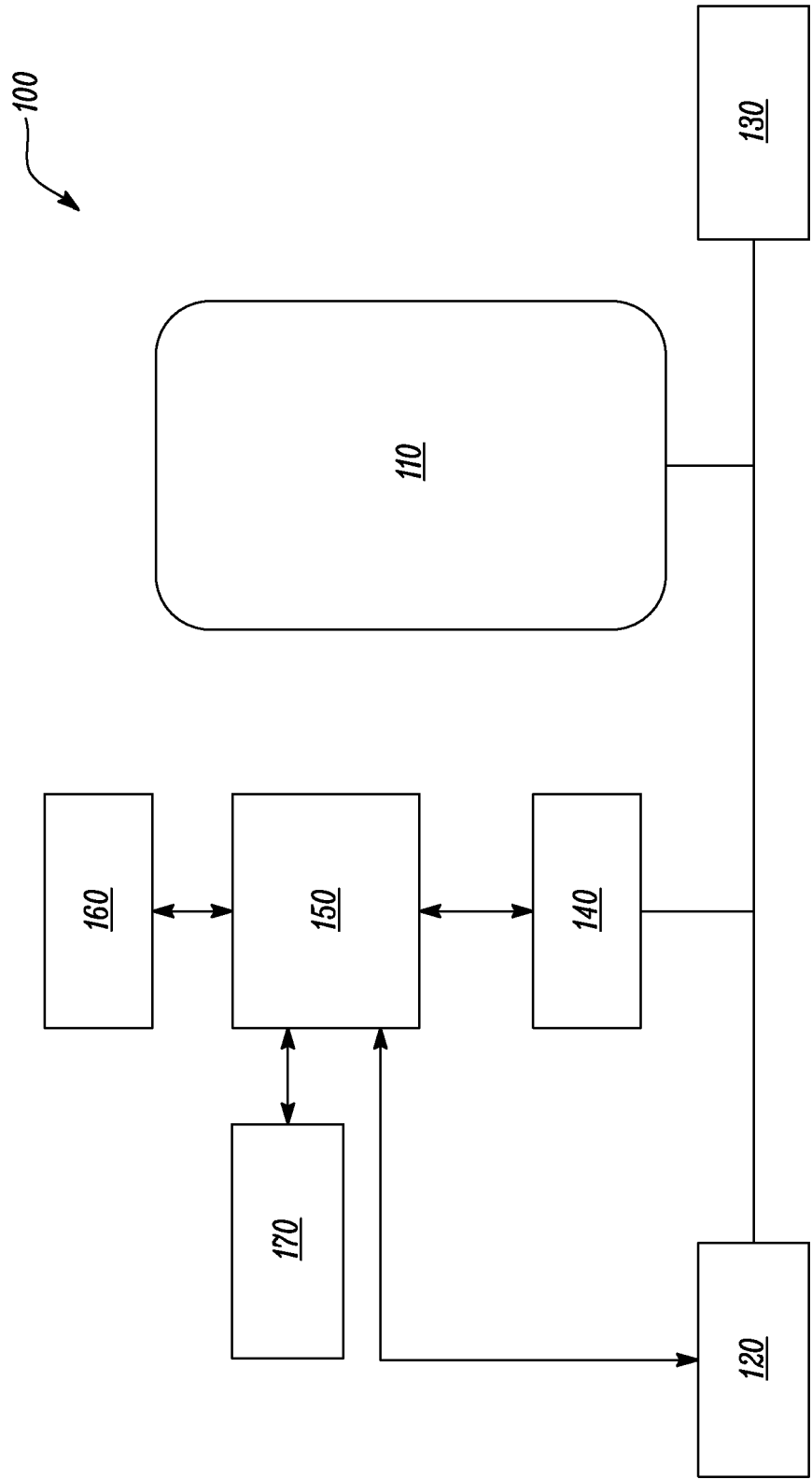


FIG. 1

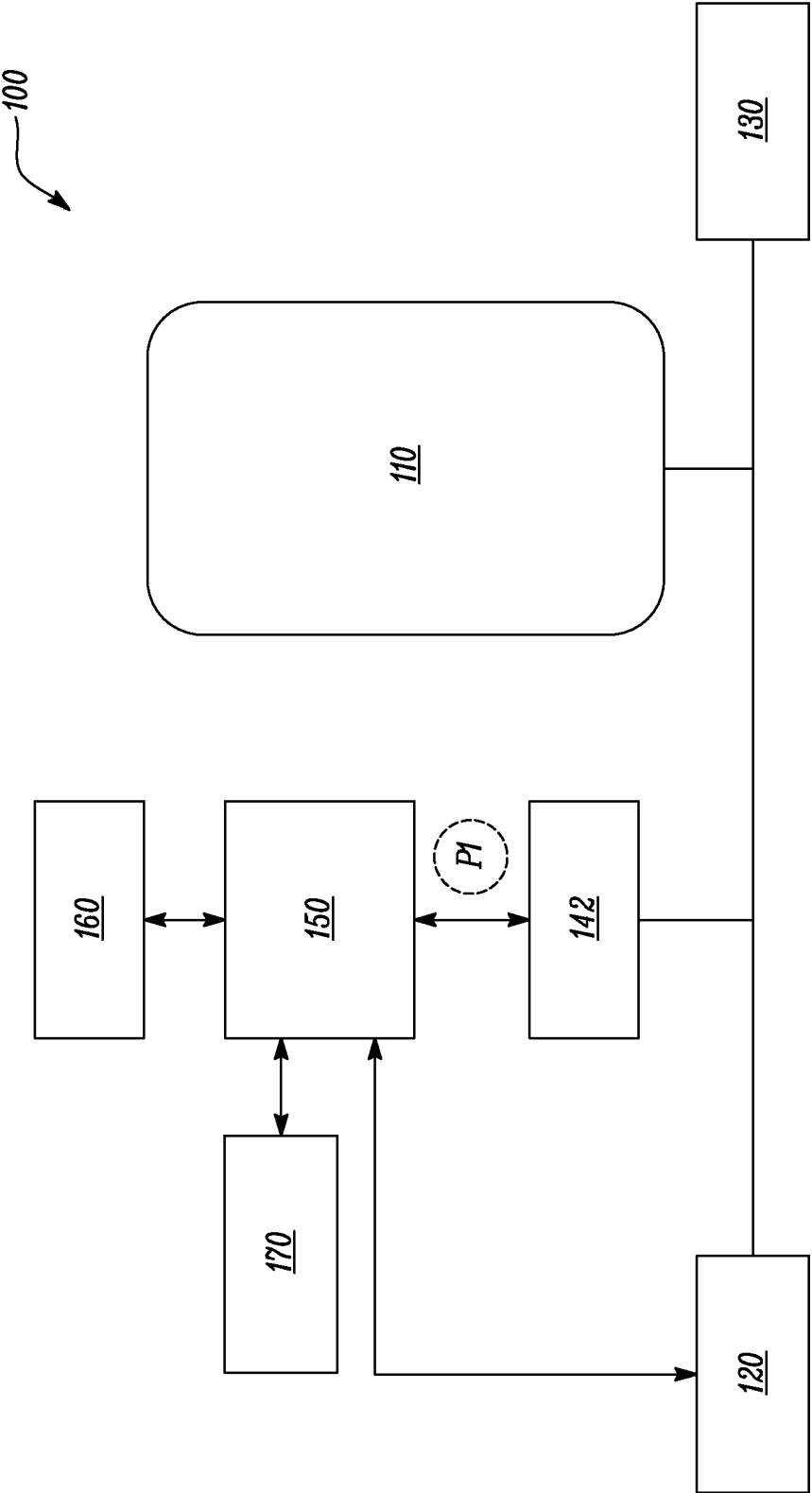


FIG. 2

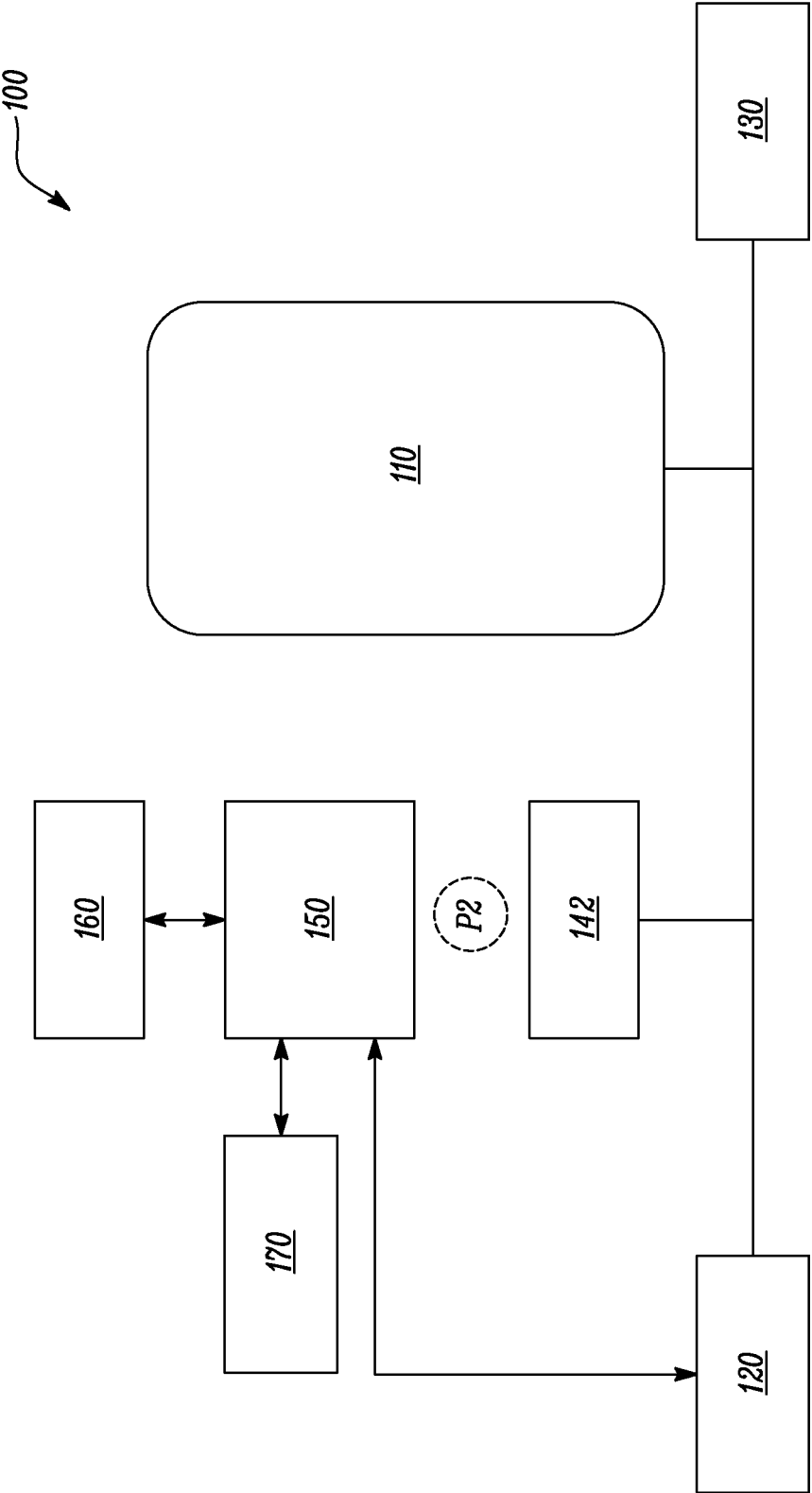


FIG. 3

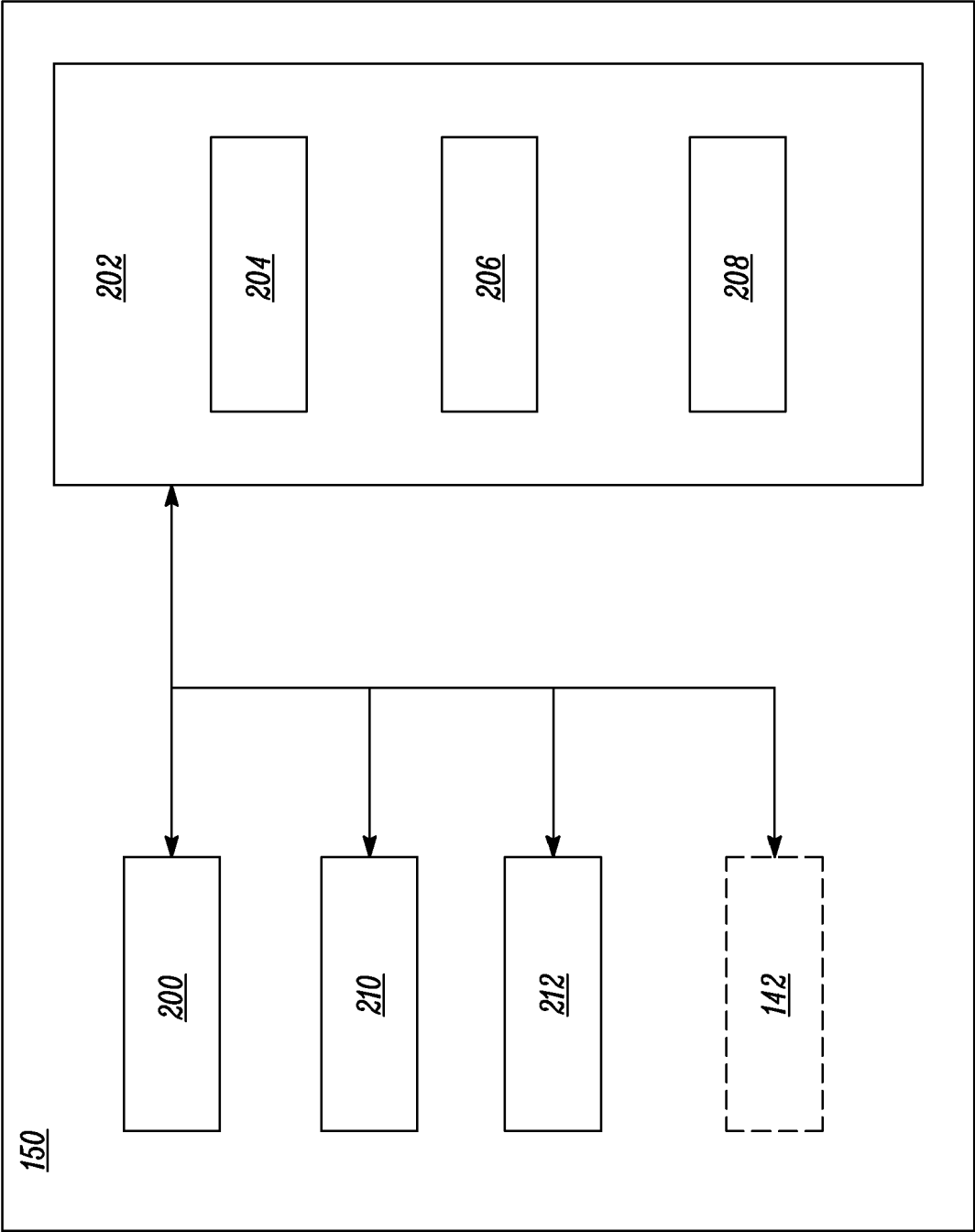


FIG. 4

300

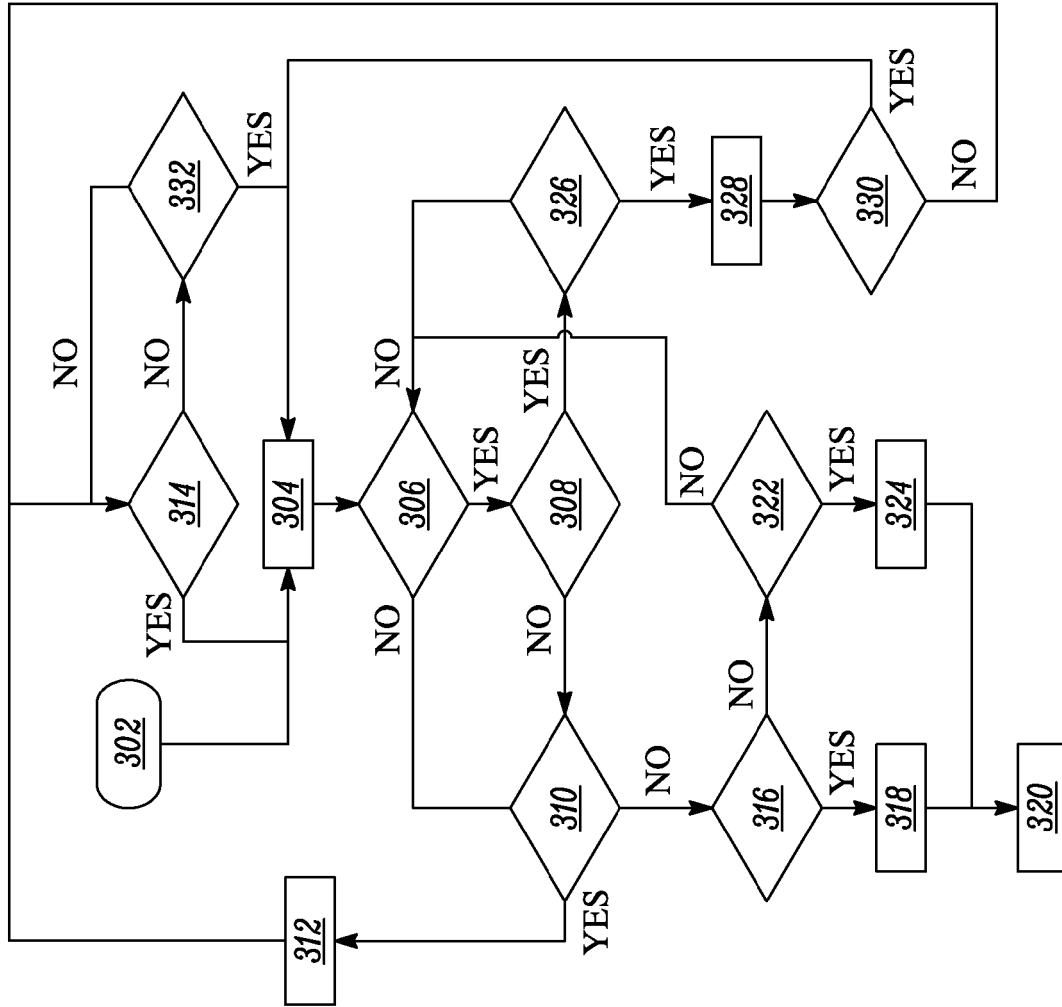


FIG. 5



EUROPEAN SEARCH REPORT

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