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(54) **ELECTRONIC FAUCET**

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E03C 1/05	(2006.01)
E03C 1/04	(2006.01)
F16K 31/02	(2006.01)
F16K 31/60	(2006.01)
F16K 31/00	(2006.01)

(52) **U.S. Cl.**

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CPC E03C 1/02; E03C 1/0412; E03C 1/0404; E03C 1/055; E03C 1/057; F16K 31/00; F16K 31/02; F16K 31/60

See application file for complete search history.

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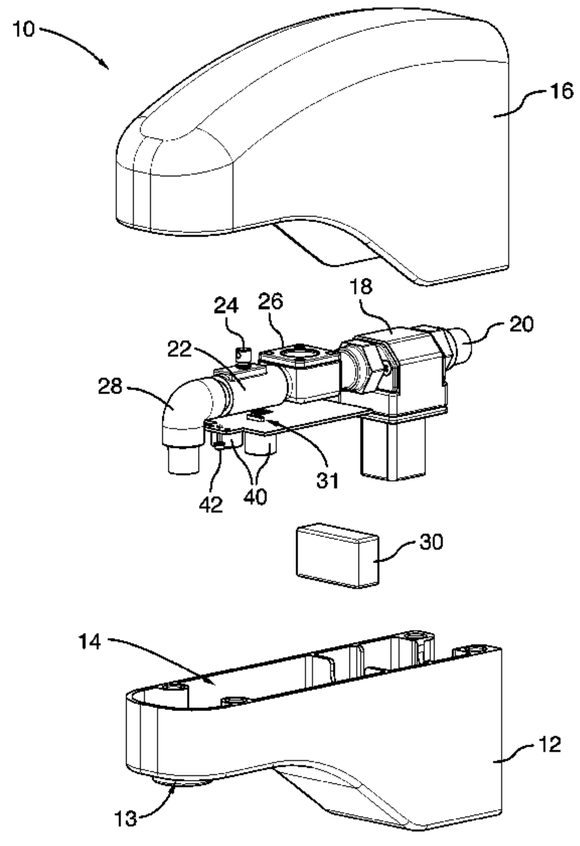
(57) **ABSTRACT**

An automated liquid delivery system comprising: a housing defining an internal chamber, the housing comprising at least one delivery hole; a flow control valve inserted into the internal chamber and connectable to a source of liquid, the flow control valve for controlling a flow of liquid coming from the source of liquid; at least one pipe inserted into the internal chamber and connected to the flow control valve for delivering the liquid coming from the flow control valve through the delivery hole of the housing; a controller inserted into the internal chamber for controlling the flow control valve, the flow control valve and the controller being powerable by a battery insertable into the housing; and a cover securable to the housing for enclosing the flow control valve, the pipe, the controller and the battery therein.

21 Claims, 4 Drawing Sheets



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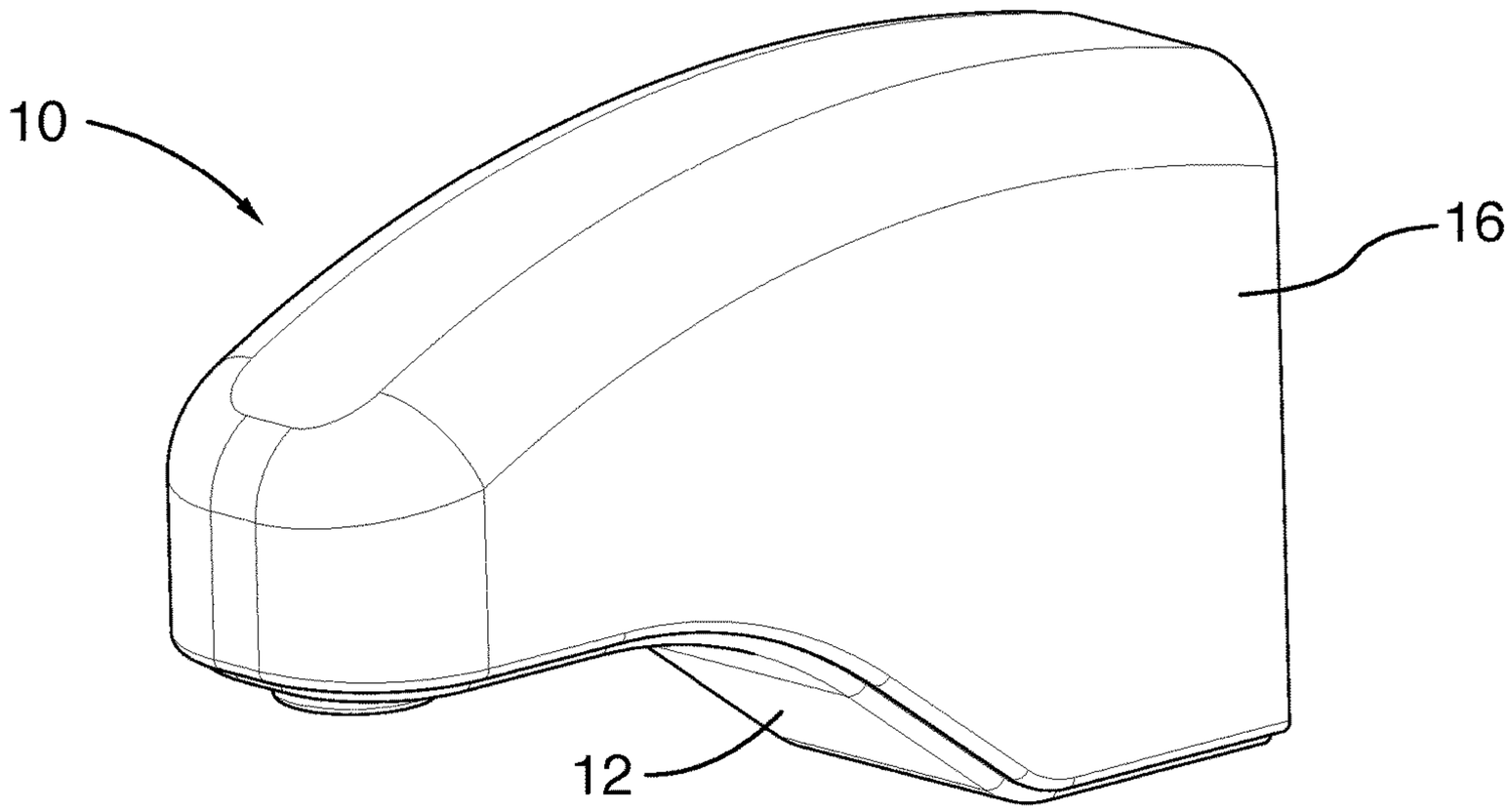

FIG.1

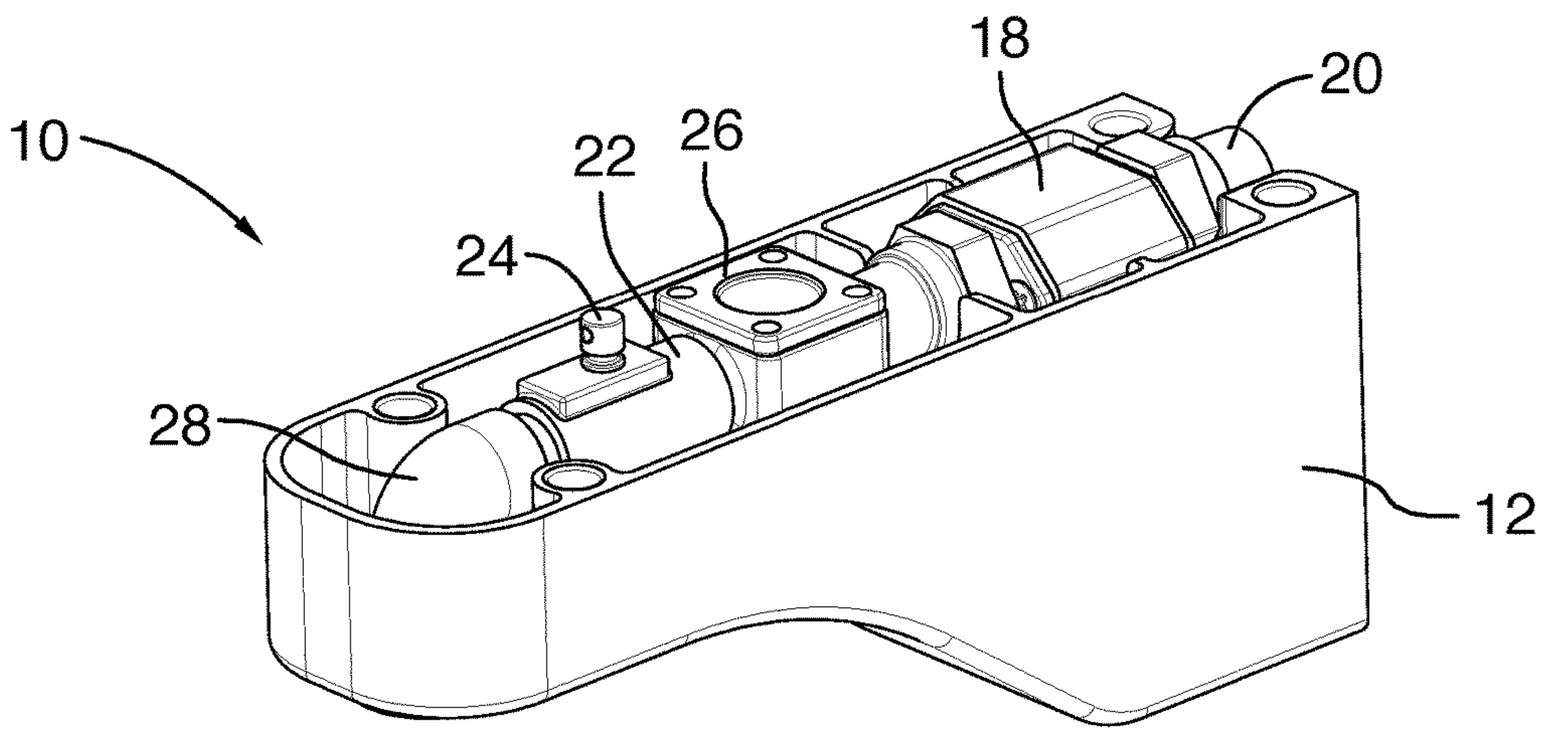

FIG.2

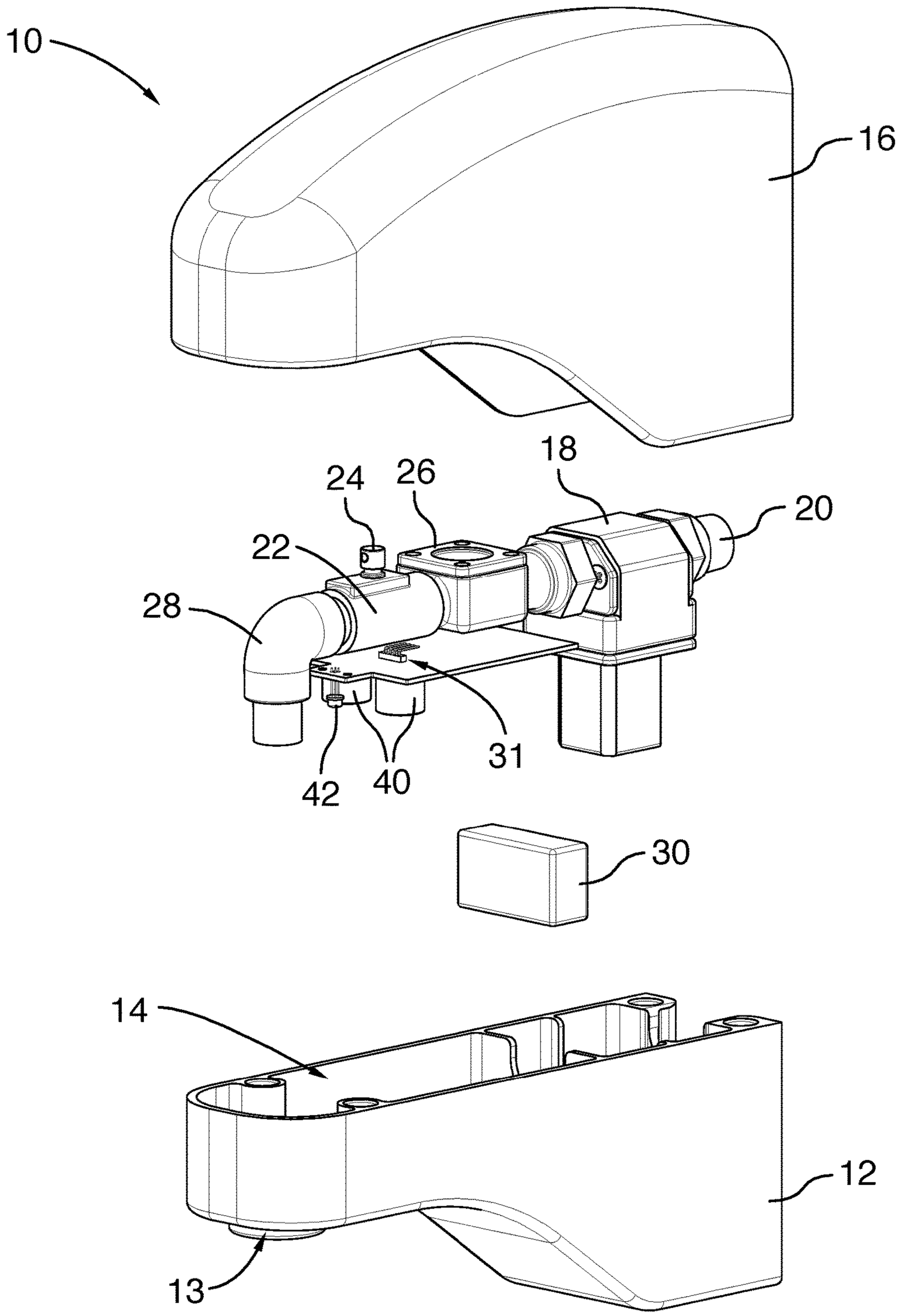

FIG.3

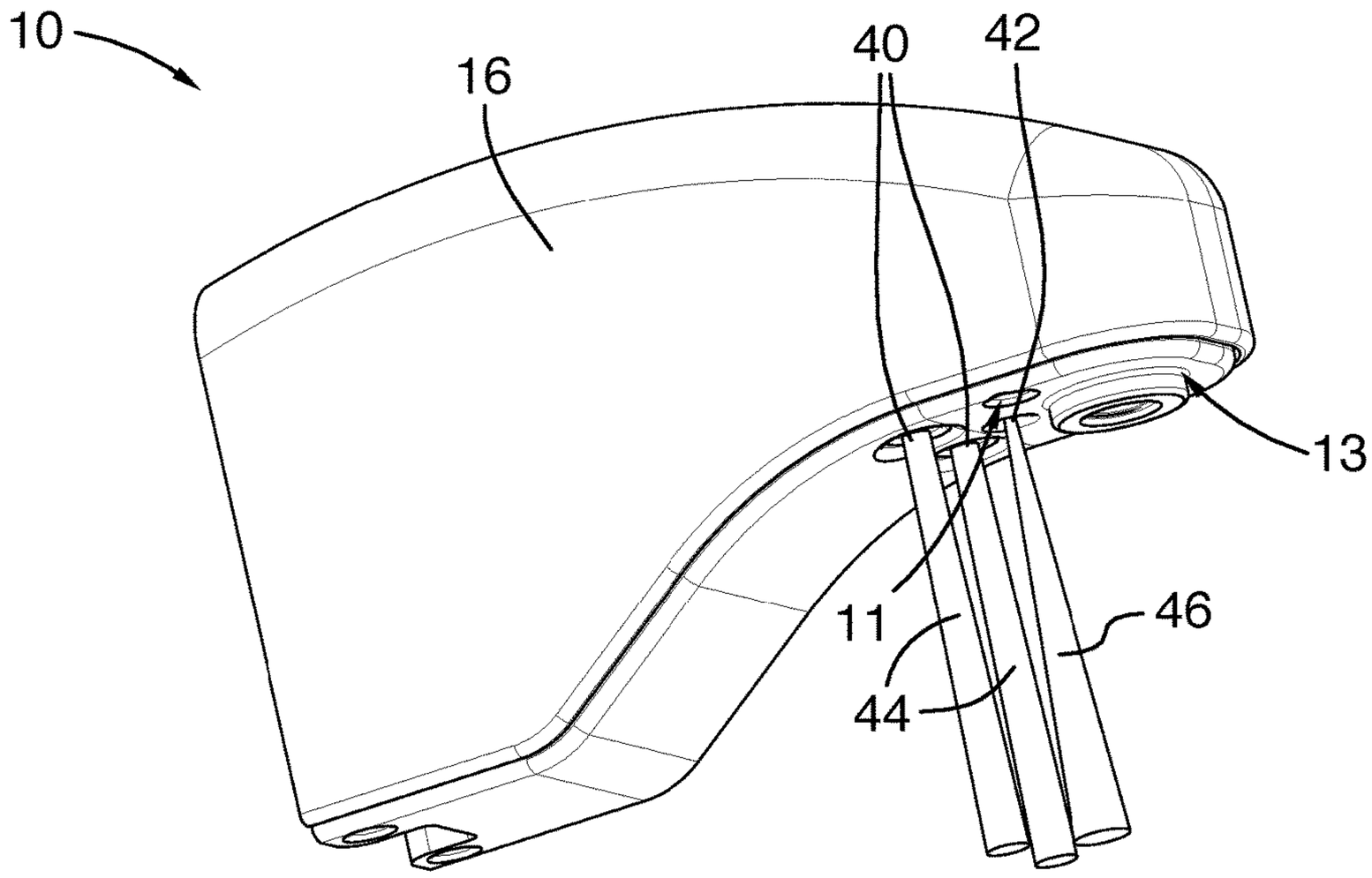
10
16
40
42
13
11
46
44

FIG.4

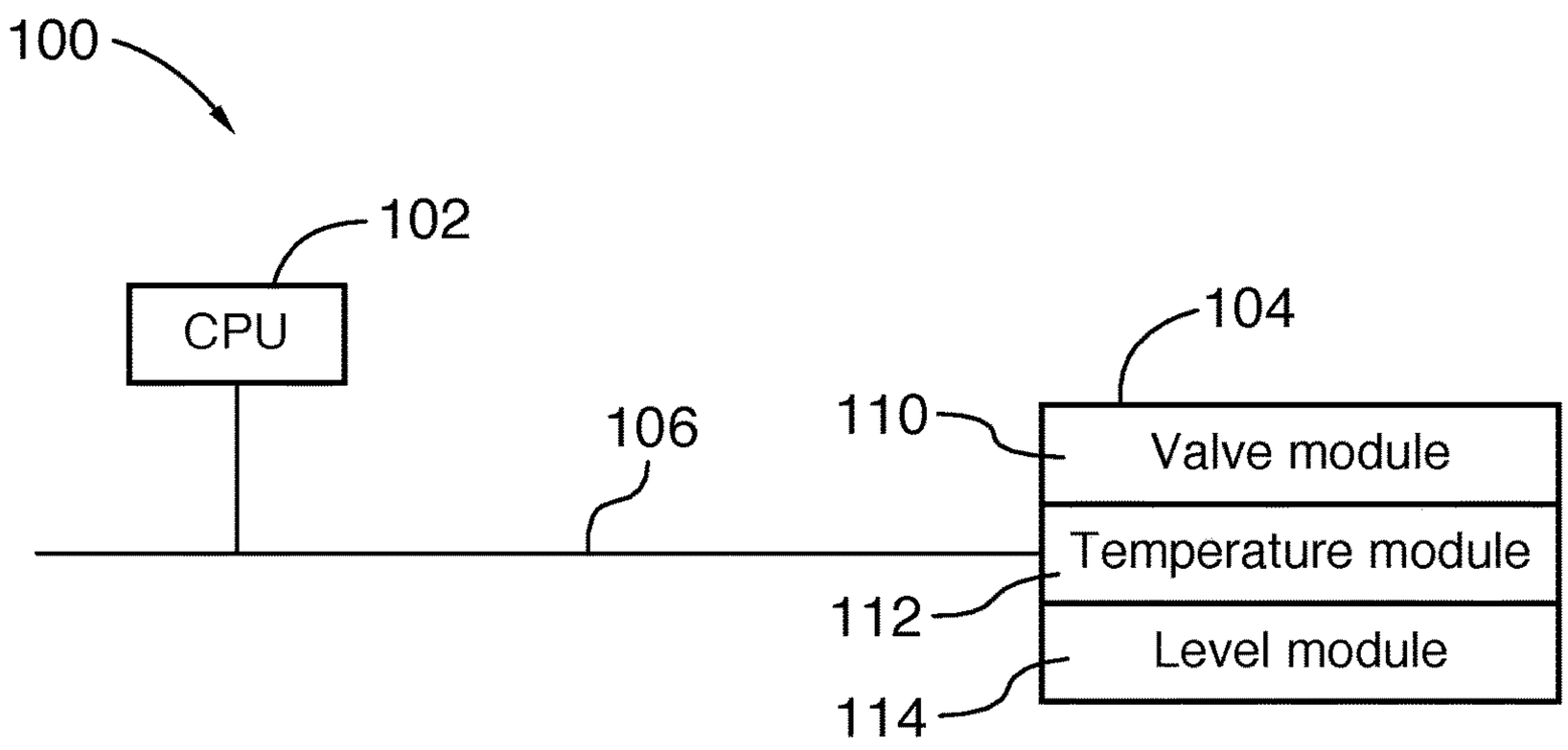
100
102
CPU
104
106
110
Valve module
Temperature module
112
Level module
114

FIG.5

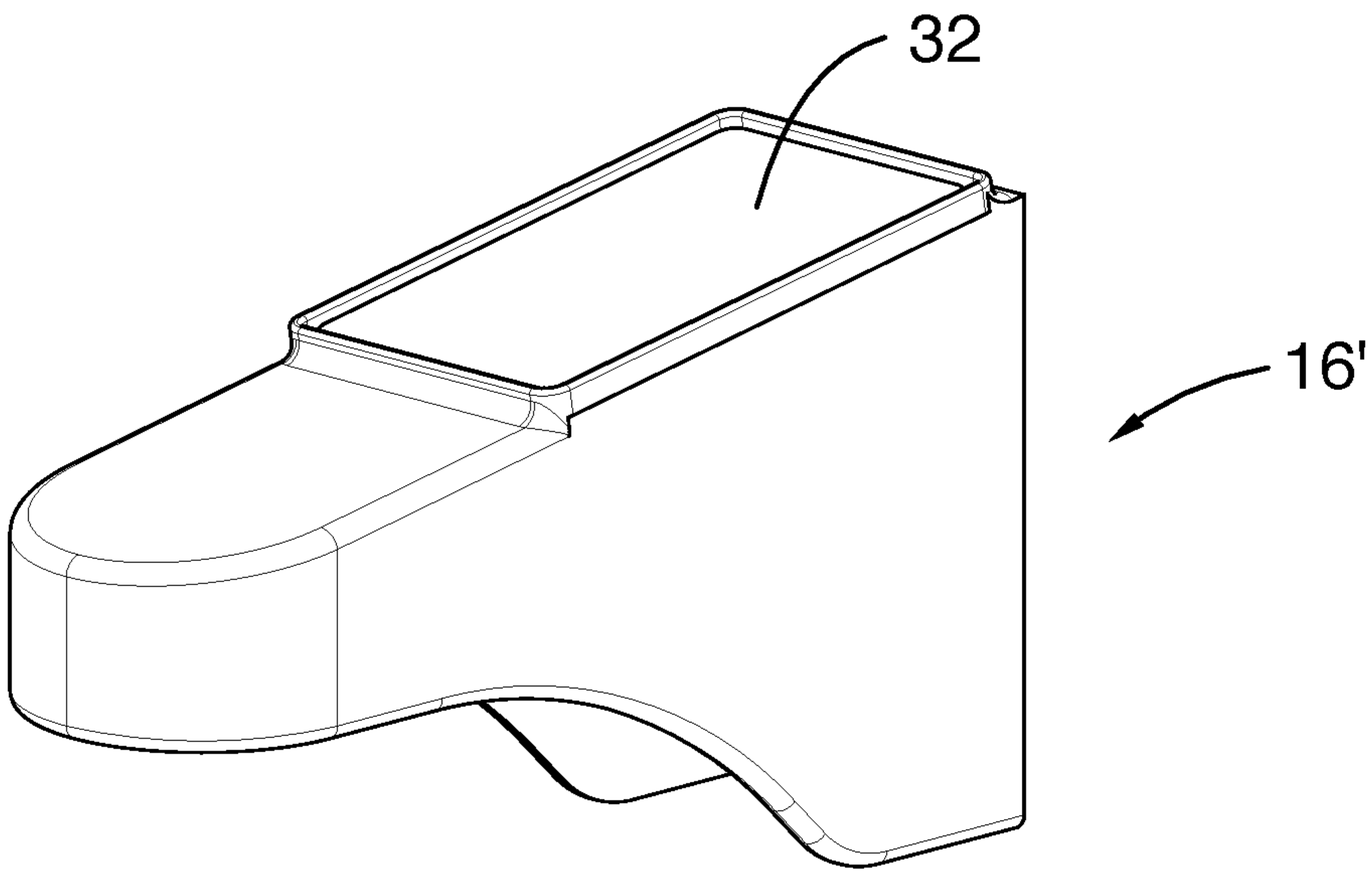

FIG.6

ELECTRONIC FAUCET

TECHNICAL FIELD

The present invention relates to the field of faucets, and more particularly to electronic faucets.

BACKGROUND

In order to provide an automated water delivery system to a container such as an automated bathtub or shower, an electronic faucet or shower head is required. Such an automated water delivery system may be remotely controlled to remotely control the flow of water. Therefore, electrical power must be provided to the automated water delivery system. Connecting the automated water delivery system to the power grid may require construction work such as removing the bathtub or making holes in a wall to electrically connect the automated water delivery system to the power grid, which is time-consuming and expensive.

Therefore, there is a need for an improved automated liquid delivery system.

SUMMARY

According to a broad aspect, there is provided an automated liquid delivery system comprising: a housing defining an internal chamber, the housing comprising at least one delivery hole; a flow control valve inserted into the internal chamber and connectable to a source of liquid, the flow control valve for controlling a flow of liquid coming from the source of liquid; at least one pipe inserted into the internal chamber and connected to the flow control valve for delivering the liquid coming from the flow control valve through the delivery hole of the housing; a controller inserted into the internal chamber for controlling the flow control valve, the flow control valve and the controller being powerable by a battery insertable into the housing; and a cover securable to the housing for enclosing the flow control valve, the pipe, the controller and the battery therein.

In one embodiment, the automated liquid delivery system further comprises the battery.

In one embodiment, the battery comprises a rechargeable battery.

In one embodiment, the automated liquid delivery system further comprises a solar panel for charging the rechargeable battery.

In one embodiment, the solar panel is secured to the cover.

In one embodiment, the automated liquid delivery system further comprises a communication unit inserted into the internal chamber for at least receiving activation commands.

In one embodiment, the communication unit comprises a wireless communication unit.

In one embodiment, the automated liquid delivery system further comprises an activation key for activating the flow control valve.

In one embodiment, the activation key comprises one of a press button and a motion sensor.

In one embodiment, the automated liquid delivery system further comprises a temperature sensor inserted into the internal chamber for monitoring a temperature of the liquid to be delivered by the pipe.

In one embodiment, the temperature sensor comprises a thermistor secured to an outer surface of the pipe.

In one embodiment, the temperature sensor is inserted into the flow control valve.

In one embodiment, the automated liquid delivery system further comprises a flow meter for monitoring a flow rate of the liquid.

In one embodiment, the control flow valve comprises a mixing valve fluidly connectable to two sources of liquid.

In one embodiment, the automated liquid delivery system further comprises a level sensor for monitoring a level of liquid in a container in which the automated liquid delivery system is to deliver the liquid.

In one embodiment, the level sensor comprises an ultrasonic level sensor.

In one embodiment, the automated liquid delivery system further comprises a contactless temperature sensor for monitoring a temperature of the liquid when contained in a container in which the automated liquid delivery system is to deliver the liquid.

In one embodiment, the contactless temperature sensor comprises an infrared temperature sensor.

In one embodiment, the housing comprises a faucet housing, the automated liquid delivery system corresponding to an electronic faucet.

In another embodiment, the housing comprises a shower head housing, the automated liquid delivery system corresponding to an electronic shower head.

In another embodiment, the housing comprises a shower head housing, the automated liquid delivery system corresponding to an electronic shower head.

BRIEF DESCRIPTION OF THE DRAWINGS

Further features and advantages of the present invention will become apparent from the following detailed description, taken in combination with the appended drawings, in which:

FIG. **1** is a perspective view of an electronic faucet comprising a cover, in accordance with a first embodiment;

FIG. **2** is a perspective view of the electronic faucet of FIG. **1** with the cover omitted, in accordance with an embodiment;

FIG. **3** is an exploded view of the electronic faucet of FIG. **1**, in accordance with an embodiment;

FIG. **4** is a perspective view of an electronic faucet provided with a level sensor and a contactless temperature sensor, in accordance with a second embodiment;

FIG. **5** is a block diagram illustrating a controller for an electronic faucet, in accordance with an embodiment;

FIG. **6** illustrates a cover for an electronic faucet provided with a solar panel, in accordance with an embodiment.

It will be noted that throughout the appended drawings, like features are identified by like reference numerals.

DETAILED DESCRIPTION

Referring to FIGS. **1** to **3**, there is illustrated an electronic faucet **10** that may be used in connection with a bathtub, a sink, or the like. The electronic faucet **10** comprises a housing **12** defining an internal chamber **14** and a cover **16** that is removably securable to the housing **12**. The housing **12** and the cover **16** are shaped so that the housing with the cover secured thereto has the shape of a faucet.

The electronic faucet **10** further comprises a flow control valve for receiving water from a source of water and controlling the flow of water to be delivered by the electronic faucet. The input of the flow control valve **18** is fluidly connected to a first pipe **20** in which water flows from the source of water. The output of the flow control valve **18** is fluidly connected to the input of a second pipe **22**. A

temperature sensor **24** such as a thermistor is secured to the outer surface of the pipe **22** in order to measure the temperature of the water flowing into the pipe **22**. The output of the second pipe **22** is fluidly connected to the input of a flow meter **26** that is adapted to monitor the flow of the water flowing therethrough. The output of the flow meter **26** is fluidly connected to a water delivery pipe **28** which may have a curved shape as illustrated in FIG. **3**. The water is delivered via the output of the pipe **28**. It should be understood that the housing **12** comprises a water delivery hole **13** on its bottom face to allow the water delivered by the pipe **28** to fall into the bathtub. In one embodiment, the output of the pipe **28** is inserted into the water delivery hole **13**.

The electronic faucet **10** further comprises a battery **30** and a controller (not shown). The battery **30** is used for powering at least the controller and the flow control valve **18**. The battery may also be used for powering other components such as temperature sensors, flow rate sensors, etc.

In one embodiment, the battery **30** is a rechargeable battery.

As illustrated in FIG. **2**, the internal chamber **14** may extend from the top of the housing **12** and the cover **16** is then securable on the top of the housing **12** as illustrated in FIG. **1**. The flow control valve **18**, the second pipe **22**, the temperature sensor **24**, the flow meter **26**, the pipe **28**, and the battery **30** are received within the internal chamber **14** of the housing **12**.

In one embodiment, the flow control valve **18** is directly connected to a single source of water. In this case, the temperature sensor **24** may be omitted.

In another embodiment, the flow control valve **18** is fluidly connected to a mixing valve that is fluidly connected to a source of hot water and a source of cold water. The controller may be adapted to control the operation of the mixing valve in order to control the temperature of the water to be delivered by the electronic faucet **10**.

In a further embodiment, the flow control valve **18** may be a mixing valve fluidly connected to both a source of hot water and a source of cold water. In this case, the controller is adapted to control the flow control valve **18** to adjust the flow of hot water and the flow of cold water flowing therethrough and adjust the temperature of the water delivered by the electronic faucet **10**.

In one embodiment, the electronic faucet **10** further comprises a communication unit **31** such as a wireless communication unit for receiving commands for the activation of the electronic faucet. For example, the electronic faucet **10** may be remotely controlled by a user using a remote control such as a mobile device. In this case, when the user inputs a command for opening the electronic faucet **10**, the remote control sends a command indicative of the opening for the electronic faucet to the electronic faucet **10**. The controller of the electronic faucet **10** receives the command via the communication unit **31** and opens the flow control valve according to the received command to deliver water. Similarly, when the user inputs a command for closing the electronic faucet **10**, the remote control sends a command indicative of the closing for the electronic faucet to the electronic faucet **10**. The controller of the electronic faucet **10** receives the command via the communication unit **31** and closes the flow control valve according to the received command to deliver water.

In an embodiment in which the electronic faucet **10** comprises a temperature sensor **24**, the controller may be adapted to receive the measured temperature of the water flowing into the pipe **22** from the temperature sensor **24** and transmit the measured temperature via the communication unit **31**.

In an embodiment in which the electronic faucet comprises a flow meter **26**, the controller may be adapted to receive the flow of the water measured by the flow meter **26** and transmit the measured flow via the communication unit **31**.

In an embodiment in which the electronic faucet **10** comprises a temperature sensor **24**, the controller may be adapted to receive from a remote control a desired temperature for the water to be delivered via the communication unit **31**. In this case, the controller may be adapted to adjust the flows of hot and cold water by controlling the mixing valve so that the temperature measured by the temperature sensor **24** substantially corresponds to the temperature desired by the user.

In one embodiment, the electronic faucet **10** comprises no temperature sensor **24** and the controller comprises a database containing mixing valve setting conditions for different water temperatures. In this case, upon receiving a desired temperature for the water, the controller retrieves from the database the mixing valve setting conditions that correspond to the received desired temperature and applies the retrieved mixing valve setting conditions to the mixing valve in order to obtain water having the desired temperature.

In another embodiment in which the faucet **10** is provided with the temperature sensor **24**, the controller may apply a feedback loop control method to obtain the desired temperature. In this case, the controller receives the temperature measured by the temperature sensor **24** and adjusts the mixing valve setting conditions until the desired temperature is obtained.

In the same or another embodiment in which the electronic faucet **10** comprises a flow meter for measuring water flow rates, the controller may be adapted to receive from a remote control a desired flow for the water to be delivered via the communication unit **31**. In this case, the controller may be adapted to adjust the flow of water by controlling the control flow valve **18** so that the flow measured by the temperature sensor **24** substantially corresponds to the received desired flow.

In another embodiment, the electronic faucet **10** may be provided with an activation device for opening and closing the faucet **10**. For example, the electronic faucet may be provided with an activation key **11** such as a press button for opening and closing the electronic faucet. In another example, the activation device may be a motion sensor.

In one embodiment, the electronic faucet **10** further comprises a level senor such as a contactless level senor for measuring the level of water in the container with which the electronic faucet **10** is used. For example, the electronic faucet **10** may comprise a dual ultrasonic sensor **40** adapted to measure the distance between the water within the bathtub and the sensor **40**. The dual ultrasonic sensor **40** is adapted to emit two ultrasound wave beams **44** which reflected by the surface of the liquid, e.g. water, and to detect the reflected ultrasound wave beams to measure the distance between the surface of the liquid and the dual ultrasonic sensor **40**. The controller may then determine the level of liquid within the container or the volume of liquid in the container using from the measured distance between the surface of the liquid and the dual ultrasonic sensor **40**.

In one embodiment the controller is adapted to receive a command indicative of a desired level of water within the bathtub. In this case, the controller is adapted to receive the measured level of water from the level sensor **40** close the

control flow valve **18** when it determines that the measured level substantially corresponds to the desired level.

In the same or another embodiment, the electronic faucet further comprises a contact less temperature sensor **42** for remotely measuring the temperature of the liquid contained in the container. For example, the contactless temperature sensor may be an infrared temperature sensor **42**. The infrared temperature sensor **42** is adapted to emit a beam **46** of infrared light which is reflected by the surface of the liquid contained in the container, and to detect the reflected light beam to measure the temperature of the liquid.

In one embodiment, the controller is adapted to receive a command indicative of a desired temperature for the water in the bathtub and the measured temperature from the contactless temperature sensor **42**. The controller then compares the measured temperature to the desired temperature and controls the mixing valve to add water having an adequate temperature until the measured temperature substantially corresponds to the desired temperature. If the measured temperature is less than the desired temperature, the controller is adapted to control the mixing valve so as to add hot water. If the measured temperature is greater than the desired temperature, the controller is adapted to control the mixing valve so as to add cold water.

It should be understood that the contactless level sensor **40** and the contactless temperature sensor **42** may be positioned at any adequate location on the housing **12** of the electronic faucet **10** as long as they can sense the water contained in the bathtub. In the illustrated embodiment the housing comprises holes on its wall that faces the bottom of the bathtub once installed, adjacent to the output of the pipe **28**. As a result, the contactless level sensor **40** and the contactless temperature sensor **42** face the bottom of the bathtub.

FIG. **5** is a block diagram illustrating an exemplary controller contained in the electronic faucet **10**, in accordance with some embodiments. The processing module **100** typically includes one or more Computer Processing Units (CPUs) or Graphic Processing Units (GPUs) **102** for executing modules or programs and/or instructions stored in memory **104** and thereby performing processing operations, memory **104**, and one or more communication buses **106** for interconnecting these components. The communication buses **106** optionally include circuitry (sometimes called a chipset) that interconnects and controls communications between system components. The memory **104** includes high-speed random access memory, such as DRAM, SRAM, DDR RAM or other random access solid state memory devices, and may include non-volatile memory, such as one or more magnetic disk storage devices, optical disk storage devices, flash memory devices, or other non-volatile solid state storage devices. The memory **104** optionally includes one or more storage devices remotely located from the CPU(s) **102**. The memory **104**, or alternately the non-volatile memory device(s) within the memory **104**, comprises a non-transitory computer readable storage medium. In some embodiments, the memory **104**, or the computer readable storage medium of the memory **104** stores the following programs, modules, and data structures, or a subset thereof:

- a valve module **110** for controlling the operation of the control flow valve and/or the mixing valve;
- a level module **112** for determining if a desired level has been reached; and
- a temperature module **114** for determining if a desired temperature has been reached.

Each of the above identified elements may be stored in one or more of the previously mentioned memory devices, and corresponds to a set of instructions for performing a function described above. The above identified modules or programs (i.e., sets of instructions) need not be implemented as separate software programs, procedures or modules, and thus various subsets of these modules may be combined or otherwise rearranged in various embodiments. In some embodiments, the memory **104** may store a subset of the modules and data structures identified above. Furthermore, the memory **104** may store additional modules and data structures not described above.

Although FIG. **5** shows a processing module **100**, FIG. **3** is intended more as functional description of the various features which may be present in a management module than as a structural schematic of the embodiments described herein. In practice, and as recognized by those of ordinary skill in the art, items shown separately could be combined and some items could be separated.

FIG. **6** illustrates an alternate cover **16'** which may be used when the battery **30** is a rechargeable battery. The cover **16'** is provided with a solar panel **32** comprising photovoltaic cells for charging the rechargeable battery. The solar panel **32** is electrically connected to the battery **30** via a permanent electrical connection or a disconnectable electrical connector. It should be understood that the solar panel **32** may be secured at any adequate position on the housing **12** or the cover **16'**. For example, the solar panel **32** may be secured on the top face of the cover **16'** as illustrated in FIG. **6**.

While in the present description there is described an electronic faucet, it should be understood that the housing and the cover may be chosen so that the present system applies to any adequate type of automated liquid delivery systems. For example, the automated liquid delivery system may be shower head. In this case, the housing is shaped and sized to correspond to a shower head housing and the cover is chosen so as to correspond to a shower head cover.

The embodiments of the invention described above are intended to be exemplary only. The scope of the invention is therefore intended to be limited solely by the scope of the appended claims.

We claim:

1. An automated liquid delivery system comprising:

a housing defining an internal chamber, the housing comprising at least one delivery hole;

a flow control valve inserted into the internal chamber and connectable to a source of liquid, the flow control valve for controlling a flow of liquid coming from the source of liquid;

at least one pipe inserted into the internal chamber and connected to the flow control valve for delivering the liquid coming from the flow control valve through the delivery hole of the housing;

at least one temperature sensor for monitoring both a temperature of the liquid to be delivered by the automated liquid delivery system and a temperature of the liquid when contained in a container;

a controller inserted into the internal chamber for controlling the flow control valve and for receiving information from the at least one temperature sensor, wherein the controller receiving information from the at least one temperature sensor controls the flow control valve by adjusting the flow of hot and cold liquid flowing therethrouqh to obtain a desired temperature of the liquid contained in a container, the flow control valve and the controller being powerable by a battery insertable into the housing; and

a cover securable to the housing for enclosing the flow control valve, the pipe, the controller and the battery therein.

2. The automated liquid delivery system of claim **1**, further comprising the battery.

3. The automated liquid delivery system of claim **2**, wherein the battery comprises a rechargeable battery.

4. The automated liquid delivery system of claim **3**, further comprising a solar panel for charging the rechargeable battery.

5. The automated liquid delivery system of claim **4**, wherein the solar panel is secured to the cover.

6. The automated liquid delivery system of claim **1**, further comprising a communication unit inserted into the internal chamber for at least receiving activation commands.

7. The automated liquid delivery system of claim **6**, wherein the communication unit comprises a wireless communication unit.

8. The automated liquid delivery system of claim **1**, further comprising an activation key for activating the flow control valve.

9. The automated liquid delivery system of claim **8**, wherein the activation key comprises one of a press button and a motion sensor.

10. The automated liquid delivery system of claim **1**, further comprising a temperature sensor inserted into the internal chamber for monitoring a temperature of the liquid to be delivered by the pipe.

11. The automated liquid delivery system of claim **10**, wherein the temperature sensor comprises a thermistor secured to an outer surface of the pipe.

12. The automated liquid delivery system of claim **10**, wherein the temperature sensor is inserted into the flow control valve.

13. The automated liquid delivery system of claim **1**, further comprising a flow meter for monitoring a flow rate of the liquid.

14. The automated liquid delivery system of claim **1**, wherein the flow control valve comprises a mixing valve fluidly connectable to two sources of liquid.

15. The automated liquid delivery system of claim **1**, further comprising a level sensor for monitoring a level of liquid in a container in which the automated liquid delivery system is to deliver the liquid.

16. The automated liquid delivery system of claim **15**, wherein the level sensor comprises an ultrasonic level sensor.

17. The automated liquid delivery system of claim **1**, wherein the housing comprises a faucet housing, the automated liquid delivery system corresponding to an electronic faucet.

18. The automated liquid delivery system of claim **1**, wherein the housing comprises a shower head housing, the automated liquid delivery system corresponding to an electronic shower head.

19. The automated liquid delivery system of claim **1**, wherein the at least one temperature sensor comprises a first temperature sensor for monitoring the temperature of the liquid to be delivered by the automated liquid delivery system and a second temperature sensor for monitoring the temperature of the liquid when contained in a container.

20. The automated liquid delivery system of claim **19**, wherein the second temperature sensor for monitoring the temperature of the liquid when contained in a container comprises a contactless temperature sensor.

21. The automated liquid delivery system of claim **20**, wherein the contactless temperature sensor comprises an infrared temperature sensor.

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