US 20150153744A1

(19) United States

(12) Patent Application Publication

(10) Pub. No.: US 2015/0153744 A1

(43) Pub. Date: Jun. 4, 2015

DIDION et al.

(54) **CONTROLLER FOR A FLUID DISTRIBUTION SYSTEM AND METHOD OF OPERATION THEREOF**

(71) Applicant: **Ultraflo Systems, LLC**, Toledo, OH (US)

(72) Inventors: **JOSHUA D. DIDION**, Toledo, OH (US); **Jeffrey L. Pickle**, Loveland, OH (US)

(21) Appl. No.: **14/559,964**

(22) Filed: **Dec. 4, 2014**

Related U.S. Application Data

(60) Provisional application No. 61/911,540, filed on Dec. 4, 2013.

Publication Classification

(51) **Int. Cl.**

G05D 7/06 (2006.01)

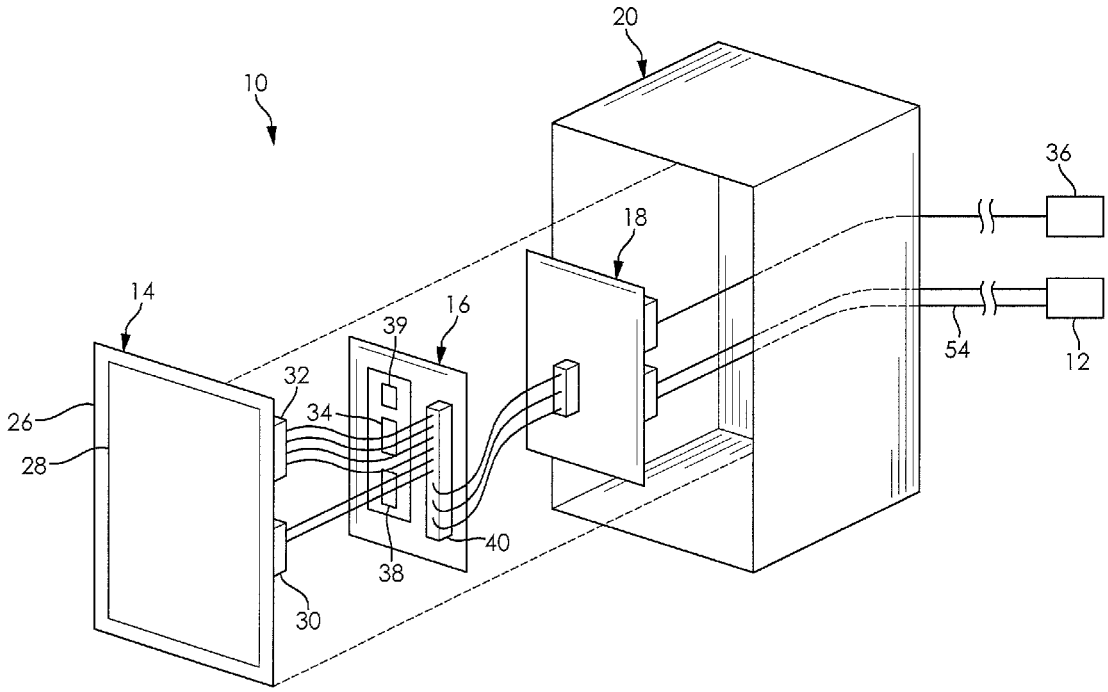
G05B 15/02 (2006.01)

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

CPC ***G05D 7/0629*** (2013.01); ***G05B 15/02*** (2013.01)

(57) **ABSTRACT**

A controller for use with a fluid distribution system and method of operation thereof is provided. The controller comprises a touch screen, a processing unit, and an output interface. The processing unit is in communication with the touch screen. The output interface is in communication with the processing unit and the fluid distribution system. In response to a touch input from a user, the processing unit accesses at least one valve profile and adjusts a state of operation of the fluid distribution system through the output interface.



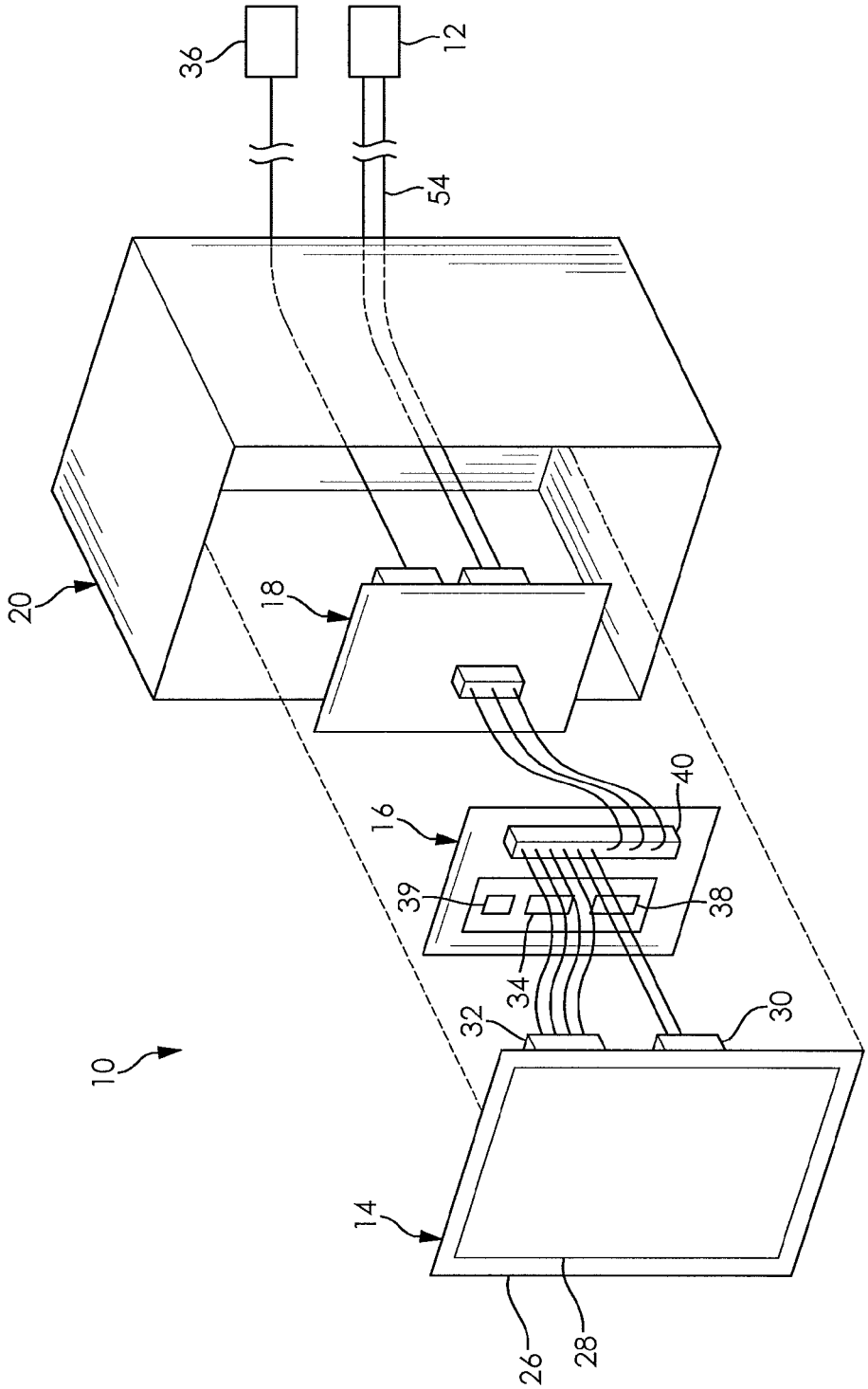


FIG. 1

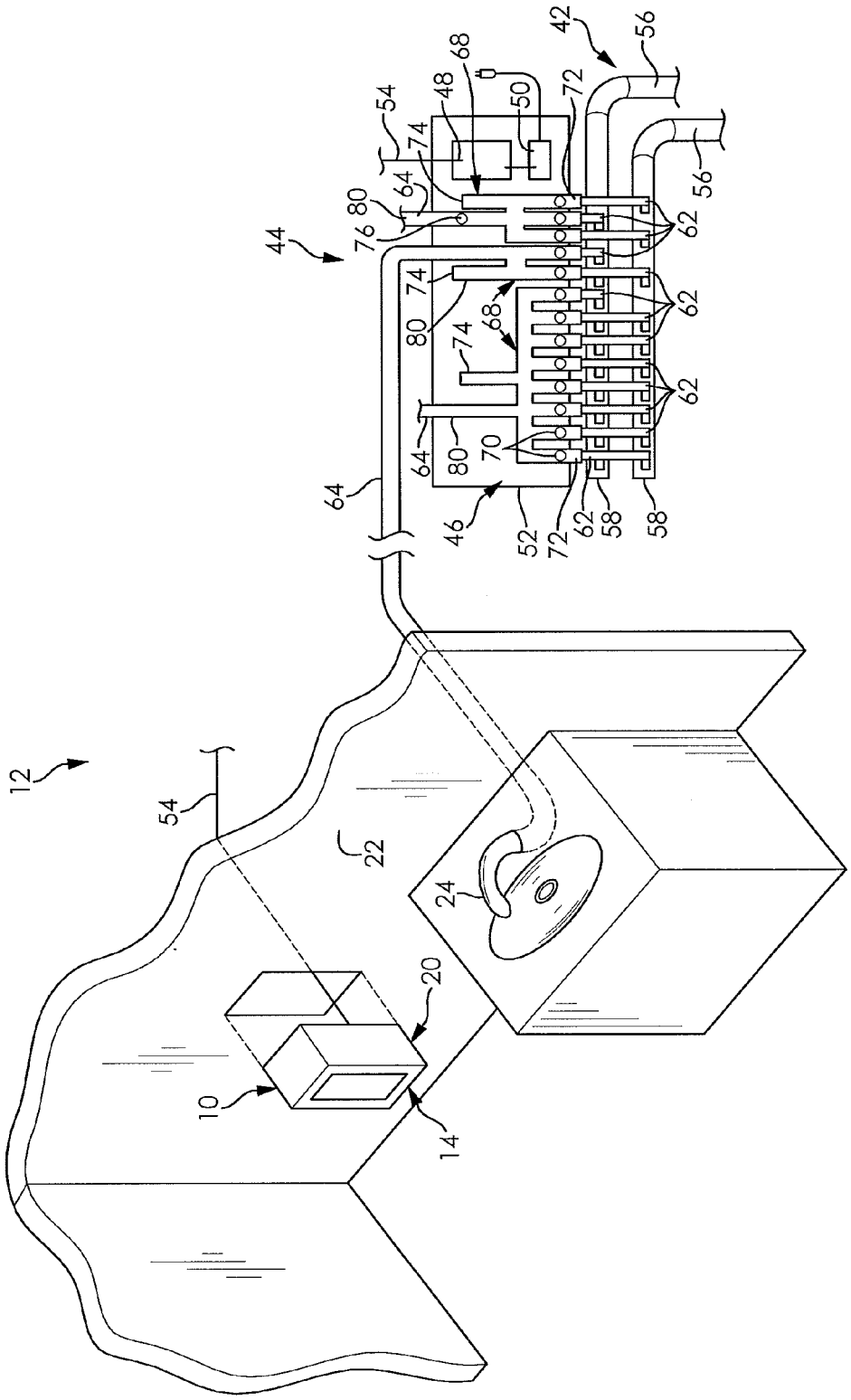


FIG. 2

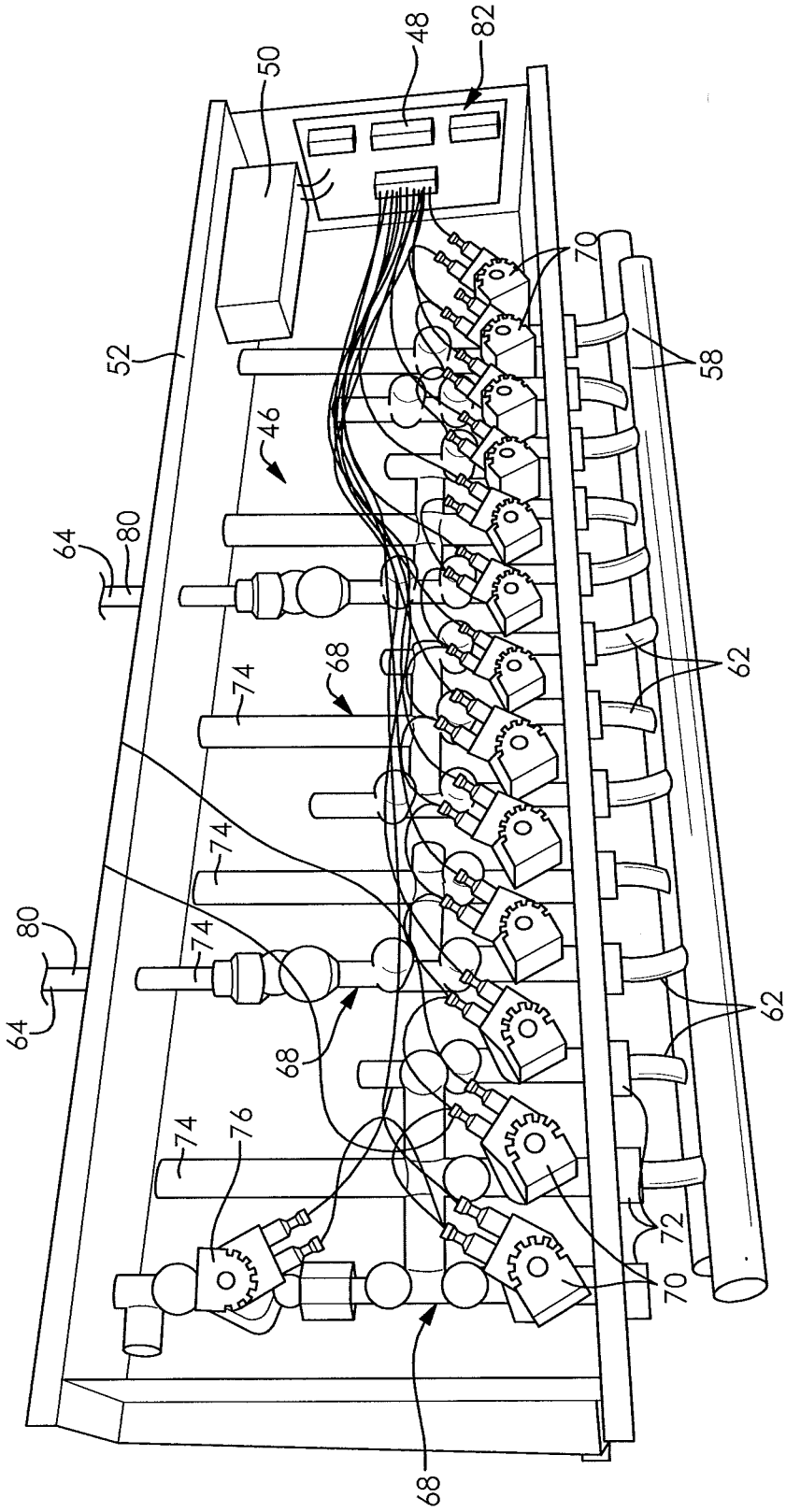


FIG. 3

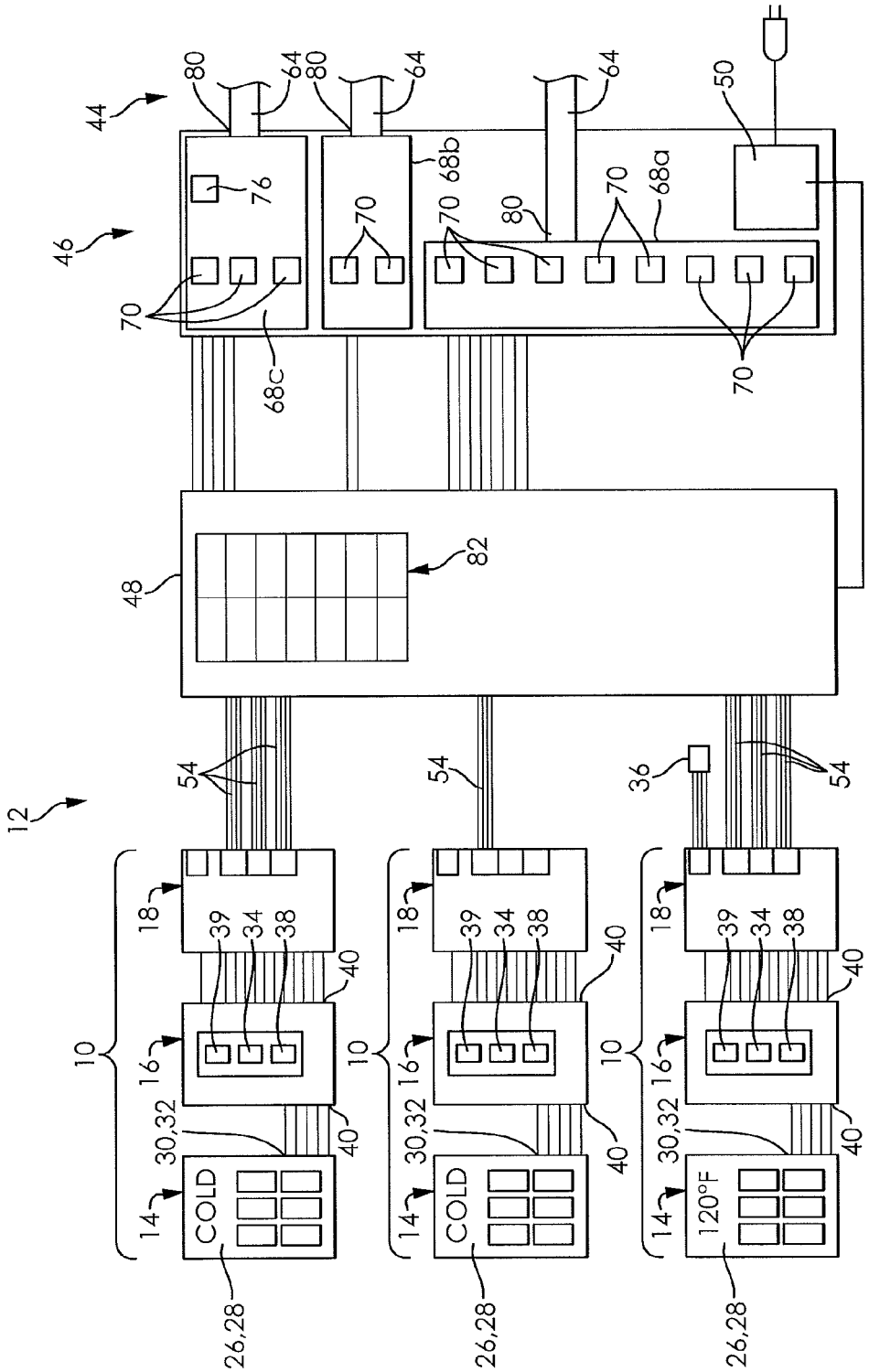

12
10
14
16
18
26,28
30,32
34
36
38
39
40
44
46
48
50
54
64
68a
68b
68c
70
76
80
82
COLD
COLD
120°F

FIG. 4

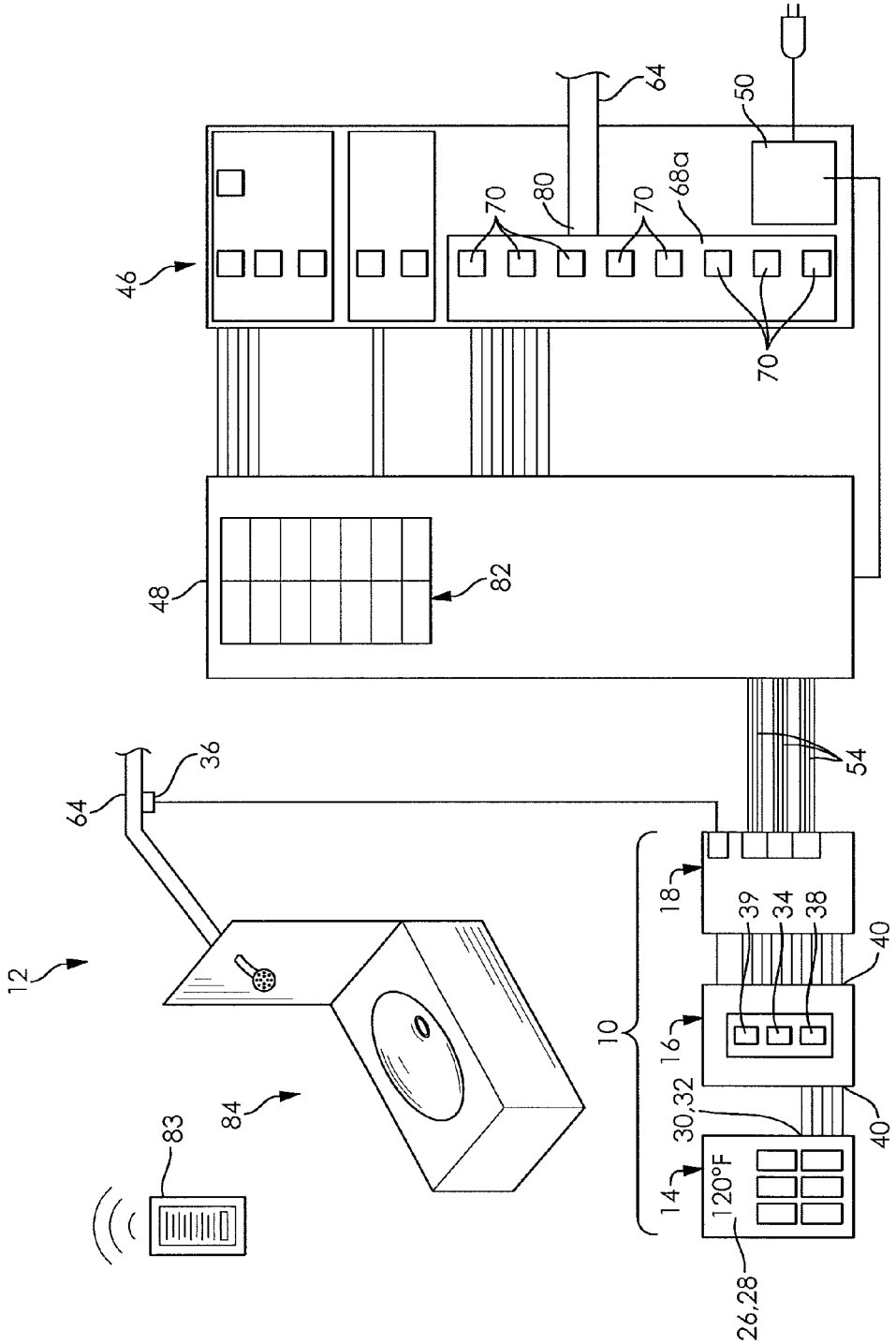

64
50
70
80
70
68a
46
70
48
82
54
64
36
12
18
39
34
38
40
10
16
30,32
40
84
83
14
120°F
26,28

FIG. 5

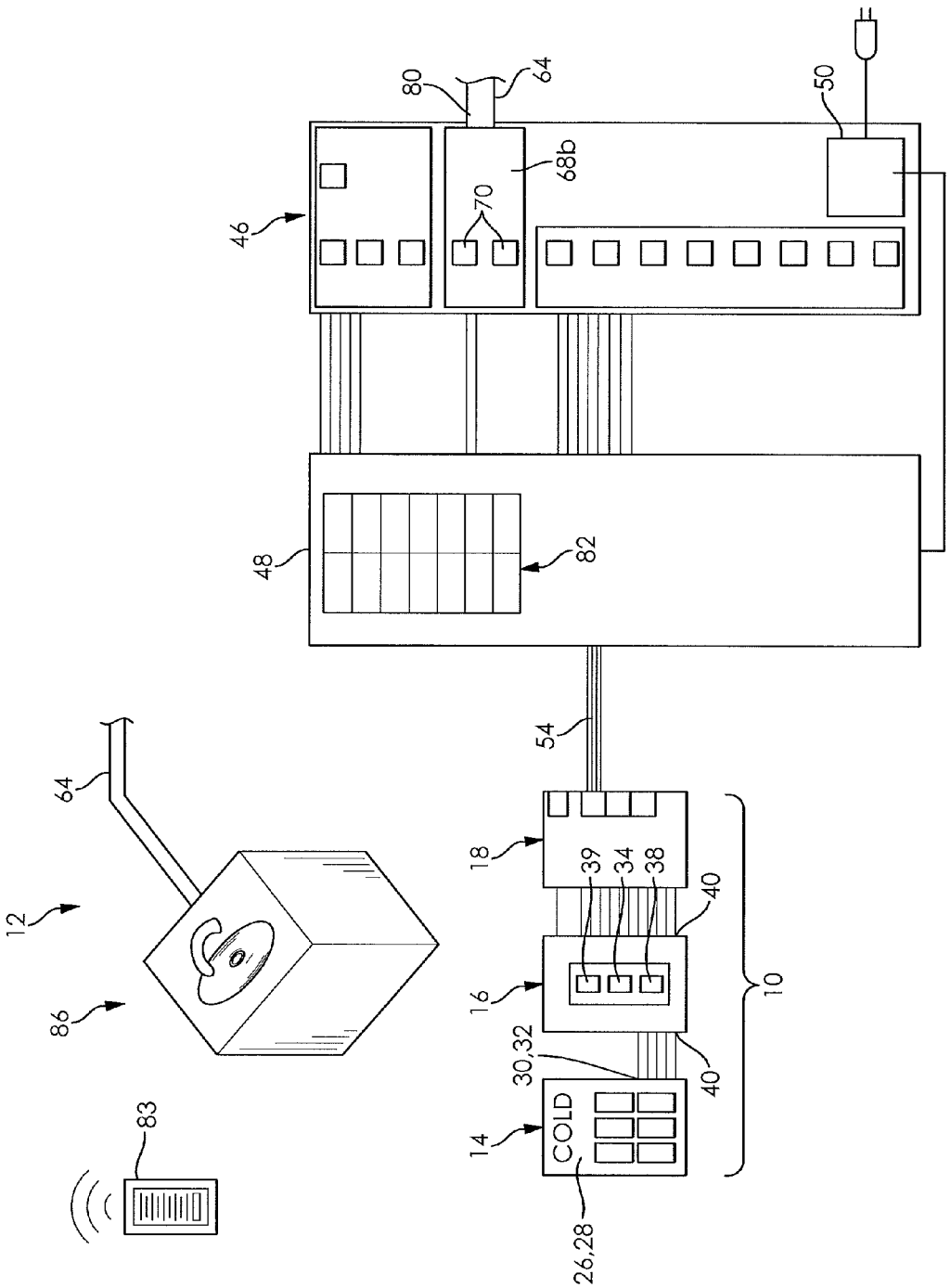

80
64
50
68b
70
46
48
82
54
64
12
86
18
39
34
38
40
16
30,32
40
10
14
COLD
26,28
83

FIG. 6

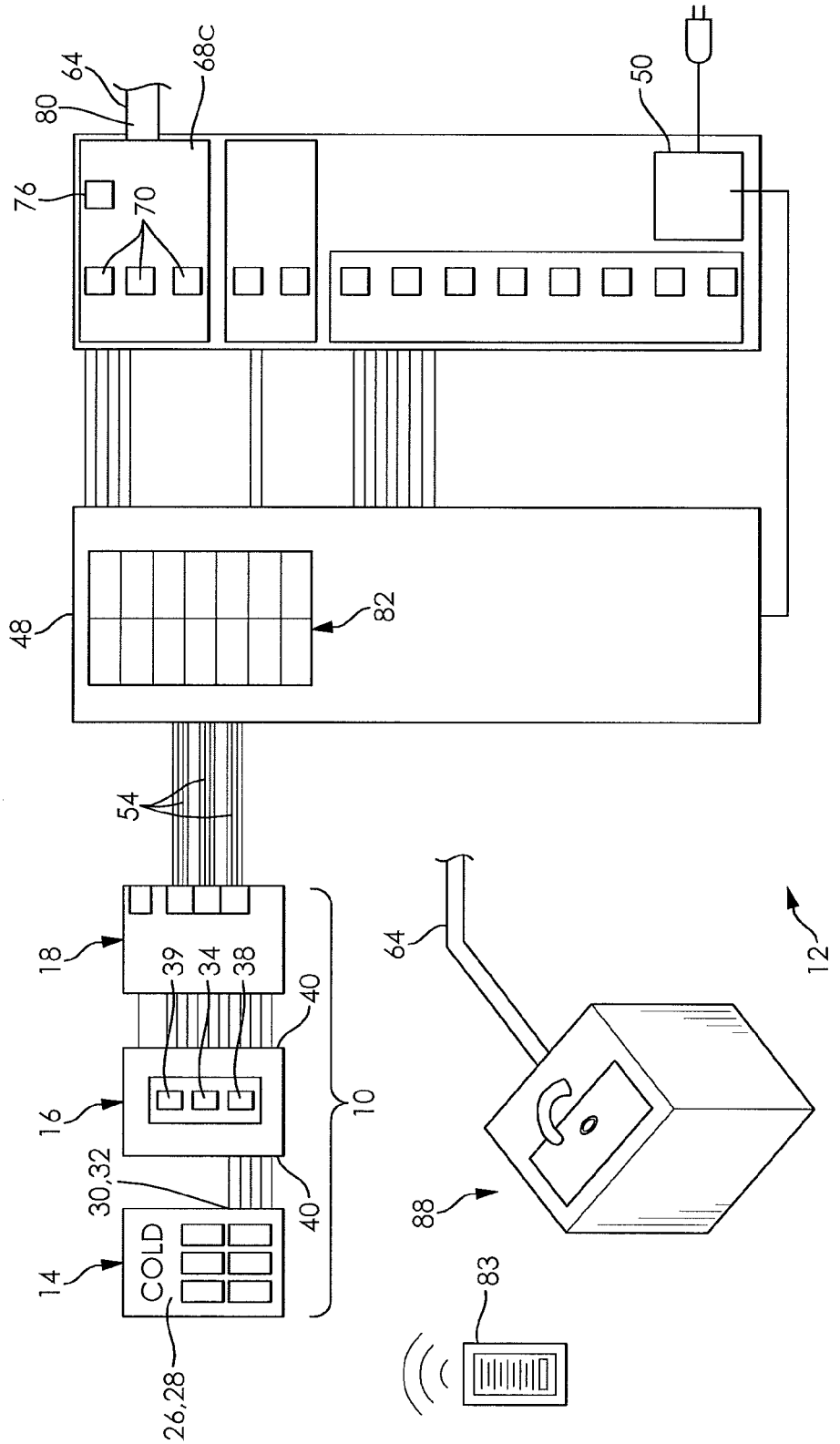

64
68c
80
50
76
70
48
82
54
18
39
34
38
40
16
30,32
40
10
14
COLD
26,28
64
12
88
83

FIG. 7

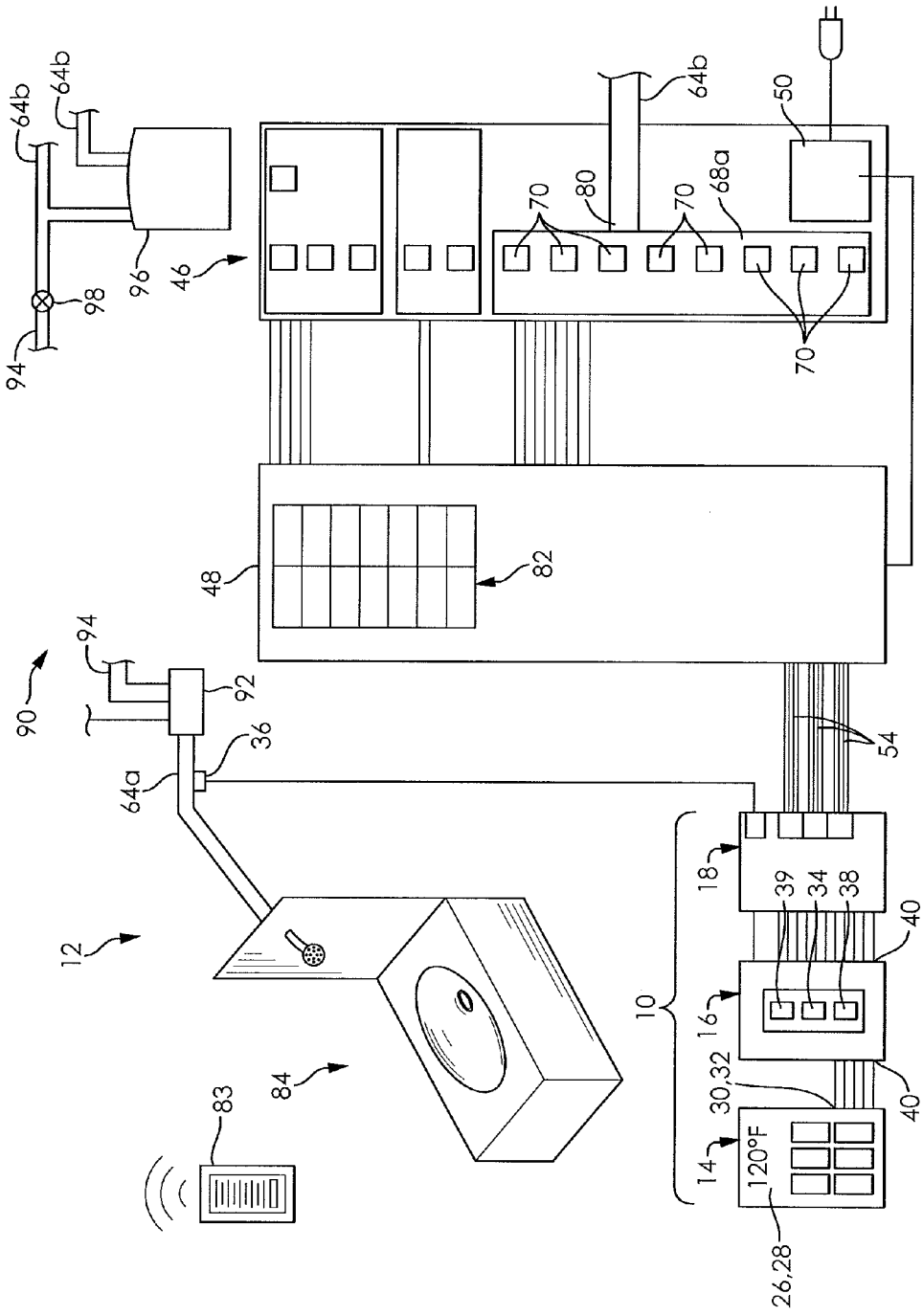

64b
64b
64b
50
70
80
70
68a
70
94
98
96
46
48
82
94
92
90
36
64a
54
18
39
34
38
40
12
10
16
30,32
40
84
83
14
120°F
26,28

FIG. 8

CONTROLLER FOR A FLUID DISTRIBUTION SYSTEM AND METHOD OF OPERATION THEREOF

RELATED APPLICATIONS

[0001] The present application claims the benefit of U.S. Provisional Application No. 61/911,540 filed on Dec. 4, 2013, which is incorporated herein in its entirety by reference.

FIELD OF THE INVENTION

[0002] The invention relates to fluid distribution systems and, more particularly, to a controller for operating a fluid distribution system and a method of operation thereof.

BACKGROUND OF THE INVENTION

[0003] Fluid distribution systems are very common in a variety of environments, such as residential homes, offices, and commercial and industrial buildings. Fluid distribution systems rely on a pressurization of a fluid to deliver the fluid to a point of use. Conventionally, manually operated valves operated at the point of use are used to control delivery of the fluid. However, a fluid distribution system including electrically operated valves which are triggered by a user or an automated system may also be used to control delivery of the fluid. U.S. Pat. No. 2,991,481, "FLUID DISTRIBUTION CONTROL SYSTEM" to Book, filed on Mar. 17, 1958, which is hereby incorporated by reference in its entirety, describes such a fluid distribution system. Such fluid distribution systems have been commonly referred to as "push button plumbing."

[0004] Fluid distribution systems including electrically operated valves offer many benefits over conventional fluid distribution systems including manually operated valves. Such systems require less work for installation and maintenance, may be easily automated, provide greater failsafe operation, and provide for conservation of energy and water.

[0005] Mixing of two water temperatures in conventional fluid distribution systems occurs at the point of use. As a result, each point of use must be fitted with two separate water lines. Each of these water lines is run from a water source to the point of use. Fluid distribution systems including electrically operated valves may require only a single water line for a significant portion of a distance between the water sources and the point of use, as the electrically operated valve may be positioned closer to each of the water sources.

[0006] Fluid distribution systems including electrically operated valves may be more easily automated than conventional fluid distribution systems. The addition of automation equipment to the conventional fluid distribution system typically requires the replacement of the manually operated valves with electrically operated valves and the installation of electronics for operating the valves. In contrast, fluid distribution systems including electrically operated valves require fewer additional components to enable automation. The electrically operated valves are typically operated with low voltage power systems, and are therefore compatible with many types of electronic automation equipment commercially available.

[0007] In environments which use the conventional fluid distribution system, failure of a valve or a pipe may result in significant damage to property, if a fluid within the distribution system is dispersed in the environment without control. Fluid distribution systems including electrically operated valves, however, may be configured so that all of the valves may be positioned in a single location. Such a location may be configured to collect or restrain fluid in the event of a failure of a valve or a pipe, reducing an amount of damage the failure may cause.

[0008] Fluid distribution systems including electrically operated valves may provide for conservation of energy and water. Such systems may be configured with valves configured to reduce a fluid flow therethrough. For tasks not requiring a full fluid flow, a user of the system may select a setting having the reduced flow rate, thus conserving water. Additionally, conventional fluid distribution systems may include an extensive amount of pipe for use with hot water. During period of non-operation of the conventional fluid distribution system, the hot water pipes cool to a temperature of an ambient environment. Further, once a request for hot water is received, the hot water pipes may initially absorb a significant amount of heat from the hot water. In conventional fluid distribution systems, this water and any energy associated with its heating, goes to waste. By reducing an amount of hot water pipe used in the fluid distribution system and by providing reduced flow rate settings, the fluid distribution systems including electrically operated valves provides for conservation of energy and water.

[0009] Despite the above mentioned benefits, fluid distribution systems including electrically operated valves are not without faults. Controllers employed at a point of use must be easy to operate while not restricting function. Such controllers to date have lacked the simple versatility of manually operated valves. Additionally, such controllers have not taken advantage of technological improvements now available. Such technological improvements may be used to enhance a user experience, such as by providing an enhanced interface, greater control over the electrically operated valves, and allow customization at the point of use by a user.

[0010] Previously, interfaces used with fluid distribution systems including electrically operated valves were minimal. In one version, the interface consisted of a plurality of labeled buttons, and operation of the system was performed by pressing one or more of the buttons. In this version, the selected button remained depressed until another selection was made or an "off" button was depressed. In another version, the interface consisted of a plurality of soft buttons and corresponding LED indicators. In this version, upon selection of a button, the corresponding LED indicator would be placed in a lighted state until another selection was made or an "off" button was depressed.

[0011] Such interfaces reflected the inherent limitations of the fluid distribution systems including electrically operated valves. At a single point of use, such interfaces were not configured to operate more than five of the electrically operated valves, and only operation of three of those valves could be used to affect fluid temperature. Accordingly, greater control over such a fluid distribution system was limited by such a minimal interface.

[0012] Previously, the fluid distribution systems including electrically operated valves allowed for calibration of any given valve of the system to affect the performance of the system. Such calibration could be used to adjust a mixture of hot and cold water to a preference of a user of the system. However, such calibration only applied to the single point of use corresponding to the calibrated set of valves. Further, such calibration required adjustment at the location of the

valve, not the location of use. As a result, individual temperature preferences by a plurality of users of the system were impossible to obtain without performing a calibration routine between users.

[0013] It would be advantageous to develop a controller for a fluid distribution system and a method of operation thereof that provides an enhanced interface, provides greater control over electrically operated valves of the fluid distribution system, provides for increased conservation of energy and water, and allows customization at the point of use by a user.

SUMMARY OF THE INVENTION

[0014] Presently provided by the invention, a controller for a fluid distribution system and a method of operation thereof that provides an enhanced interface, provides greater control over electrically operated valves of the fluid distribution system, provides for increased conservation of energy and water, and allows customization at the point of use by a user, has surprisingly been discovered.

[0015] In one embodiment, the present invention is directed to a controller for use with a fluid distribution system. The controller comprises a touch screen, a processing unit, and an output interface. The processing unit is in communication with the touch screen. The output interface is in communication with the processing unit and the fluid distribution system. In response to a touch input from a user, the processing unit accesses at least one valve profile and adjusts a state of operation of the fluid distribution system through the output interface.

[0016] In another embodiment, the present invention is directed to a fluid distribution system. The fluid distribution system comprises a primary plumbing arrangement, a valving arrangement, a secondary plumbing arrangement, a system controller in communication with the valving arrangement, and a controller in communication with the system controller. The primary plumbing arrangement is in fluid communication with a fluid source. The valving arrangement is in fluid communication with the primary plumbing arrangement. The secondary plumbing arrangement is in fluid communication with the valving arrangement. The system controller is in communication with the valving arrangement. The controller is in communication with the system controller. The controller comprises a touch screen, a processing unit in communication with the touch screen, and an output interface in communication with the processing unit and the fluid distribution system. In response to a touch input from a user, the processing unit accesses at least one valve profile and adjusts the valving arrangement of the fluid distribution system through the output interface and the system controller.

[0017] In yet another embodiment, the present invention is directed to a method of operating a fluid distribution system. The method comprises the steps of providing the fluid distribution system in fluid communication with a fluid source, providing a controller in communication with the fluid distribution system, providing a touch input from a user of the fluid distribution system to the processing unit via the touch screen, accessing at least one valve profile using the processing unit in response to the touch input from a user, and adjusting the valving arrangement of the fluid distribution system using the processing unit through the output interface. The fluid distribution system includes a valving arrangement. The controller comprises a touch screen, a processing unit in communication with the touch screen, and an output interface in communication with the processing unit and the fluid distribution system.

[0018] Various aspects of this invention will become apparent to those skilled in the art from the following detailed description of the preferred embodiment, when read in light of the accompanying drawings.

BRIEF DESCRIPTION OF THE FIGURES

[0019] The above, as well as other advantages of the present invention will become readily apparent to those skilled in the art from the following detailed description when considered in the light of the accompanying drawings in which:

[0020] FIG. **1** is an exploded, schematic style illustration of a controller in communication with a fluid distribution system;

[0021] FIG. **2** is a schematic illustration of the fluid distribution system and controller illustrated in FIG. **1**;

[0022] FIG. **3** is a perspective view of a valving arrangement forming a portion of the fluid distribution system illustrated in FIG. **2**;

[0023] FIG. **4** is a schematic illustration of a portion of the fluid distribution system illustrated in FIG. **2** in communication with a plurality of the controllers illustrated in FIG. **1**;

[0024] FIG. **5** is a schematic illustration of a portion of the fluid distribution system illustrated in FIG. **2** in communication with the controller illustrated in FIG. **1**, the fluid distribution system and the controller configured for use with a shower;

[0025] FIG. **6** is a schematic illustration of a portion of the fluid distribution system illustrated in FIG. **2** in communication with the controller illustrated in FIG. **1**, the fluid distribution system and the controller configured for use with a lavatory sink;

[0026] FIG. **7** is a schematic illustration of a portion of the fluid distribution system illustrated in FIG. **2** in communication with the controller illustrated in FIG. **1**, the fluid distribution system and the controller configured for use with a kitchen sink; and

[0027] FIG. **8** is a schematic illustration of a portion of the fluid distribution system illustrated in FIG. **2** in communication with the controller illustrated in FIG. **1**, the fluid distribution system and the controller configured for use with a recirculation system.

DETAILED DESCRIPTION OF THE INVENTION

[0028] It is to be understood that the invention may assume various alternative orientations and step sequences, except where expressly specified to the contrary. It is also to be understood that the specific devices and processes illustrated in the attached drawings, and described in the following specification are simply exemplary embodiments of the inventive concepts defined in the appended claims. Hence, specific dimensions, directions or other physical characteristics relating to the embodiments disclosed are not to be considered as limiting, unless the claims expressly state otherwise.

[0029] FIG. **1** illustrates a controller **10** for a fluid distribution system **12** (more clearly illustrated in FIG. **2**) according to an embodiment of the invention. The controller **10** comprises a touch screen **14**, a processing unit **16**, and an output interface **18**. The touch screen **14**, the processing unit **16**, and the output interface **18** are disposed within a controller hous-

ing **20**. The controller housing **20** including the controller **10** are typically disposed in a wall **22** (shown in FIG. **2**) adjacent a plumbing outlet **24** (also shown in FIG. **2**); however, it is understood that the controller **10** may be disposed in a standalone housing adjacent the plumbing outlet **24**, may be mounted in a countertop or a vanity top, or may be mounted in another manner adjacent the plumbing outlet **24**. The controller **10** is in electrical communication with the fluid distribution system **12** to supply a fluid to the plumbing outlet **24** using the fluid distribution system **12**.

[0030] The touch screen **14** is a display device capable of providing output data based on a touch input by a user of the controller **10**. The touch screen **14** comprises a display **26**, a touch detection unit **28**, an input **30**, and an output **32**. The touchscreen **14** is in electrical and data communication with the processing unit **16** via the input **30** and the output **32**.

[0031] The display **26** in an LCD unit capable of displaying graphical content stored and/or generated by the processing unit **16**; however, it is understood that other display technologies, such as LED or OLED, among others, may be used. The display **26** is in data communication with the processing unit **16** via the input **30**. The display **26** is powered via an electrical connection (not shown) with the processing unit **16**; however, it is understood that the display **26** may be powered separate from the processing unit **16** or that the electrical connection may form a portion of the input **30**.

[0032] The touch detection unit **28** is a device capable of generating an output signal in response to a touch input by the user of the controller **10**. The touch detection unit **28** may be a resistive or capacitive panel; however, it is understood that other touch detection technologies may be used. The touch detection unit **28** is in data communication with the processing unit **16** via the output **32**. It is understood that the touch detection unit **28** and the display **26** of the touch screen **14** may form an integrated unit or that the touch detection unit **28** and the display **26** may be separate components. The touch detection unit **28** is powered via an electrical connection (not shown) with the processing unit **16**; however, it is understood that the touch detection unit **28** may be powered separate from the processing unit **16** or that the electrical connection may form a portion of the input **30** or the output **32**.

[0033] The input **30** is a portion of the touch screen **14** which receives a video signal from the processing unit **16**. The input **30** may include specialized circuitry which facilitates conversion of the video signal into a format compatible with the display **26**.

[0034] The output **32** is a portion of the touch screen **14** which transmits a data signal from the touch detection unit **28** to the processing unit **16**. The output **32** may include specialized circuitry which facilitates conversion of the data signal into a format compatible with the processing unit **16**.

[0035] The processing unit **16** is a computing device forming a portion of the controller **10**. At least one microprocessor **34** of the processing unit **16** executes a series of instructions in response to the data signal from the output **32** of the touch screen **14**. The at least one microprocessor **34** may also execute a series of instructions in response to a data signal from a sensor **36** via the output interface **18**. In response to the signal from the touch screen **14**, the processing unit **16** may access information on a storage device **38** forming a portion of the processing unit **16**, change information on the storage device **38**, adjust a signal supplied to the output interface **18**, and adjust a signal supplied to the input **30**. It is understood that the series of instructions executed by the at least one microprocessor **34** may be stored on the storage device **38** or an additional storage device (not shown). The processing unit **16** comprises a printed circuit board onto which the at least one microprocessor **34**, the storage device **38**, a communication module **39**, and other components are mounted to. The processing unit **16** may comprise at least one microcontroller which includes the microprocessor **34**, the storage device **38**, and the communication module **39**. However, it is understood that the communication module **39** may be separate from and in communication with the microcontroller. The at least one microcontroller includes data storage capability in the form of random access memory (RAM). The random access memory is used to facilitate operation of the processing unit **16** through the temporary storage of data, such as operating instructions that allow the processing unit **16** to access information on a storage device **38** forming a portion of the processing unit **16**, change information on the storage device **38**, facilitate communication using the communication module **39**, adjust a signal supplied to the output interface **18**, and adjust a signal supplied to the input **30**. The processing unit **16** includes a plurality of inputs and outputs **40**, and at least a portion of the plurality of inputs and outputs **40** are in communication with the input **30** and the output **32** of the touch screen **14**. As a non-limiting example, the processing unit **16** may be in communication with the touch screen **14** through a serial interface using the RS-232 standard. Another portion of the plurality of inputs and outputs **40** are in communication with the output interface **18**. As a non-limiting example, the processing unit **16** may be in communication with the output interface **18** through a plurality of digital outputs. As another non-limiting example, the communication module **39** may be a Wi-Fi™ compliant module.

[0036] The storage device **38** is in communication with the at least one microprocessor **34**. The storage device **38** may be an EEPROM chip, a flash memory chip, or another form of non-volatile computer memory. As mentioned hereinabove, the microprocessor **34** may access information on the storage device **38** or change information on the storage device **38**. Information stored on the storage device **38** may include at least one temperature profile, a series of instructions to be executed by the processing unit **16**, or a series of instructions used to operate the at least a portion of the touch screen **14**.

[0037] The output interface **18** facilitates communication between the processing unit **16** and the fluid distribution system **12**. Further, as mentioned hereinabove, the output interface **18** may also facilitate communication between the sensor **36** and the processing unit **16**. The output interface **18** includes specialized circuitry which facilitates conversion of a microcontroller level output signal from a portion of the plurality of inputs and outputs **40** to an output level compatible with the fluid distribution system **12**.

[0038] The fluid distribution system **12** comprises a primary plumbing arrangement **42**, a secondary plumbing arrangement **44**, a valving arrangement **46**, a system controller **48**, and a power supply **50**. The fluid distribution system **12** is illustrated in FIG. **2**. A portion of the fluid distribution system is illustrated in FIGS. **3** and **4**. FIG. **4** schematically illustrates a portion of the fluid distribution system **12** in communication with a plurality of the controllers **10**. At least a portion of the secondary plumbing arrangement **44**, the valving arrangement **46**, the system controller **48**, and the power supply **50** are disposed in an enclosure **52**; however, it is understood that a portion of the valving arrangement **46**, the system controller **48**, and the power supply **50** may be dis-

posed in a plurality of enclosures **52**. The system controller **48** of the fluid distribution system **12** is in electrical communication with the output interface **18** of the controller **10** via a communication line **54**.

[0039] The primary plumbing arrangement **42** comprises a pair of conduits **56** and a pair of inlet manifolds **58**. Each of the pair of conduits **56** comprises conventional plumbing components (such as pipes and elbows) and is in fluid communication with a fluid source. The fluid source may be a water main, a pump, or a reservoir, for example. One of the conduits **56** is in fluid communication with a water heater to supply a heated fluid to one of the inlet manifolds **58**. It is understood that the fluid distribution system **12** may also be supplied with filtered water or softened water via the pair of conduits **56** in any conventional manner. Each of the inlet manifolds **58** is a conduit having a plurality of branch conduits **62** extending therefrom, each of the plurality of branch conduits **62** in fluid communication with a portion of the valving arrangement **46**. It is understood that the branch conduits **62** may be configured to supply a mixture of water from each of the conduits **56** to a portion of the valving arrangement **46**, such as through a tee fitting.

[0040] The secondary plumbing arrangement **44** comprises a plurality of conduits **64**. Each of the plurality of conduits **64** comprises conventional plumbing components (such as pipes and elbows) and is in fluid communication with a portion of the valving arrangement **46**, as will be described hereinbelow. Each of the plurality of conduits **64** facilitates fluid communication between a portion of the valving arrangement **46** and one of a plurality of fluid use locations. As non-limiting examples, the fluid use locations may be a kitchen sink, a lavatory sink, or a shower. It is understood that the plurality of fluid use locations may comprise any other location which may be supplied with hot water, cold water, or a mixture of hot and cold water.

[0041] The valving arrangement **46** comprises a plurality of valving manifolds **68**, each having at least two solenoid valves **70** disposed therein. The valving manifolds **68** illustrated in FIG. **3** include two or three solenoid valves **70** disposed adjacent corresponding inlets **72** of the valving manifold **68**. Each of the inlets **72** is in fluid communication with at least one of the conduits **56** through the branch conduits **62**. It is understood that the valving manifolds **68** may be configured with any number of inlets **72** and solenoid valves **70**, such as illustrated in FIG. **2**, where the valving manifolds **68** respectively include two, three, and eight solenoid valves **70**. Each of the valving manifolds **68** also includes at least one hammer arrestor **74**. As shown in FIGS. **2** and **3**, one of the valving manifolds **68** may include a restricting solenoid valve **76** disposed adjacent an outlet **80** of the valving manifold **68**; however, it is understood that any number of the valving manifolds **68** may include the restricting solenoid valve **76**. While not illustrated in FIG. **2** or **3**, it is understood that a plurality of the outlets **80** of the valving manifolds **68** may be in fluid communication to act as a valving manifold having a greater number of inlets **72** and solenoid valves **70**.

[0042] Each of the solenoid valves **70** may be placed in an open position and a closed position. In the closed position, the solenoid valve **70** does not permit fluid to flow from the corresponding inlet **72** to the associated outlet **80** through the valving manifold **68**. In the open position, the solenoid valve **70** permits fluid to flow from the corresponding inlet **72** to the associated outlet **80** through the valving manifold **68**. Each of the solenoid valves **70** may be adjusted to change a flow rate therethrough when placed in the open position.

[0043] Each of the restricting solenoid valves **76** may be placed in an open position and a restricted position. In the open position, the restricting solenoid valve **76** permits fluid to flow from the valving manifold **68** to the associated outlet **80** in a generally unrestricted manner. In the restricted position, the restricting solenoid valve **76** permits fluid to flow from the valving manifold **68** to the associated outlet **80** at flow rate less than a flow rate when the restricting solenoid valve **76** is placed in the open position. Each of the restricting solenoid valves **76** may be adjusted to change a flow rate therethrough when placed in the restricted position.

[0044] The system controller **48** actuates the solenoid valves **70** and the restricting solenoid valves **76** in response to signals received from the controller **10**. The system controller **48** includes a plurality of relay circuits **82**. Each of the relay circuits **82** corresponds to one of the solenoid valves **70** and the restricting solenoid valves **76**. In response to signals the system controller **48** receives from the output interface **18**, which are generated by the output interface **18** of the controller **10**.

[0045] The system controller **48** communicates with and supplies power to the controller **10** via the communication line **54**. The communication line **54** is a multi-conductor cable having registered jack connectors attached thereto; however, it is understood that the communication line **54** may comprise any type of conductor. It is understood that the output interface **18** and the system controller **48** each include an interface corresponding to the communication line **54**.

[0046] The power supply **50** supplies a low voltage current to the system controller **48** for operation of the solenoid valves **70**, the restricting solenoid valves **76**, and the controller **10**. The power supply **50** converts alternating current to direct current and also transforms alternating current from one voltage to another. The power supply **50** supplies about 12 volts of direct current electric potential and about 12 volts of alternating electric current potential; however, it is understood that the controller **10** and the fluid distribution system **12** may be configured for other voltages. As a non-limiting example, the controller **10** may be powered using direct current potential and the plurality of solenoid valves **70** may be powered using alternating current potential.

[0047] In use, the controller **10** and the fluid distribution system **12** may be configured in a plurality of arrangements based on the fluid use locations **66**. As non-limiting examples, the controller **10** and the fluid distribution system **12** may be configured for supplying water to a kitchen sink, a lavatory sink, or a shower; however, it is understood that the controller **10** and the fluid distribution system **12** may be configured for other fluid use locations such as a utility sink or a bath tub, for example. The controller **10** and the fluid distribution system **12** may also be configured to be controlled using a wireless communication device **83** (shown in FIGS. **5-8**) over a local area wireless network, which may be a Wi-Fi™ wireless network.

[0048] The communication device **83** may be used as a user interface for at least one controller **10** using at least one specialized application installed on the communication device **83**. The communication device **83** may be a mobile phone, a personal media player, a tablet computer, a notebook computer, a personal digital assistant, a handheld gaming device, and an e-book reading device. Further, it is understood that other devices may be used. The communication device **83**

may be a Wi-Fi™ compliant device. The communication device **83** is configured to send and receive information from the user to the processing unit **16** over a local area wireless network.

[0049] The communication device **83** and the controller **10** may also facilitate the generation of a usage report regarding the operation of the fluid distribution system **12**. To generate the usage report using the communication device **83**, the user interacts with a specialized application installed on the communication device **83** configured to operate the controller **10** in a remote manner. In response to a wireless command submitted by the user via the computing device **83**, one of the processing unit **16** and the computing device **83** may be used to generate the usage report detailing information about at least one of water consumption and energy consumption.

[0050] FIG. **5** schematically illustrates the controller **10** and the fluid distribution system **12** configured for a shower **84**. The valving manifold **68***a* shown in FIG. **5** is configured with eight of the solenoid valves **70**. One of the inlets **72** is in fluid communication with the conduit **64** supplying cold water. One of the inlets **72** is in fluid communication with the conduit **64** supplying hot water. Six of the inlets **72** are in fluid communication with both of the conduits **64** to supplying a mixture of hot and cold water.

[0051] To operate the shower **84**, the user touches a portion of the touch screen **14** designated as a "soft button" for controlling a flow of water to the shower **84** via the secondary plumbing arrangement **44**. The soft button is an area of the display **26** which the user may recognize as performing a specific function. As a non-limiting example, the soft button for controlling the flow of water to the shower **84** may be designated by a power symbol. It is understood that the controller **10** may enter a "sleep mode" after a pre-designated amount of time after being placed in an off position by the user. In the sleep mode, the display **26** may be turned off. The user may "awake" the controller **10** by touching any portion of the touch screen **14**, so that the soft buttons which are normally displayed become visible.

[0052] Upon recognition by the processing unit **16** that the user has touched the soft button for controlling the flow of water, the processing unit **16**, through the output interface **18** and the system controller **48** opens at least one of the solenoid valves **70** of the valving manifold **68***a*. The processing unit **16** may select the at least one of the solenoid valves **70** based on a most recently used temperature setting or the processing unit **16** may select a default arrangement of the at least one of the solenoid valves **70**. Upon the opening of the at least one of the solenoid valves **70**, water flows to the shower **84** through the secondary plumbing arrangement **44**.

[0053] The sensor **36** is typically disposed on a portion of the secondary plumbing arrangement **44** near the shower **84**. In response to the processing unit **16** placing at least one of the solenoid valves **70** in the open position, the processing unit **16** also receives a signal from the sensor **36**. In response to a change in the temperature of water flowing through the secondary plumbing arrangement **44**, the signal sent by the sensor **36** is modified to reflect the change in temperature. Upon receipt of the signal by the processing unit **16** via the output interface **18**, the processing unit **16** converts the signal into a temperature value, which is output to the display **26**, for observation by the user. FIG. **5** illustrates the display **26** of the controller **10** displaying an exemplary temperature value. It is understood that the processing unit **16** may be configured to respond in a particular manner to the signal sent by the sensor **36**, such as by closing the at least one solenoid valve **70** in response to the temperature value being above a predetermined value, for example.

[0054] After the user has touched the soft button for controlling the flow of water, the user may adjust a temperature of the flow of water to the shower **84**. The user may adjust the temperature in one of two manners.

[0055] First, the user may adjust the temperature of the flow of water to the shower **84** incrementally by pressing one of a pair of soft buttons to raise or lower the temperature of the flow of water. As a non-limiting example, the soft buttons for adjusting the temperature of the flow of water may be designated by a plus symbol and a minus symbol. In response to a selection of a desired temperature, the processing unit **16** outputs the desired temperature to the display **26**, for observation by the user.

[0056] The processing unit **16** then selects a solenoid valve profile based the selection of the desired temperature. The storage device **38** includes a plurality of solenoid valve profiles stored thereon, each of the solenoid valve profiles corresponding to a temperature that may be selected by the user. It is understood that the processing unit **16** may also employ an algorithm to determine which solenoid valves **70** to open instead of selecting a solenoid valve profile. The solenoid valves **70** are opened in response to a signal received from the system controller **48**, in response to signals received from the processing unit **16** sent via the output interface **18**.

[0057] Secondly, the user may adjust the temperature of the flow of water to the shower **84** by pressing a soft button corresponding to a temperature profile stored on the storage device **38**. As a non-limiting example, the soft buttons corresponding to a temperature profile may be designated by text reading "User **1**", "User **2**", and "User **3**". FIG. **5** illustrates the display **26** of the controller **10** displaying three soft buttons corresponding to temperature profiles; however, it is understood that the controller **10** may be configured to display any number of soft buttons corresponding to temperature profiles. In response to a selection of one of the temperature profiles, the processing unit **16** outputs a temperature associated with the temperature profile to the display **26**, for observation by the user.

[0058] The processing unit **16** then selects a solenoid valve profile based on one of the temperature profiles. The storage device **38** includes a plurality of solenoid valve profiles stored thereon, each of the solenoid valve profiles corresponding to a temperature that may be selected by the user by selecting one of the temperature profiles. It is understood that the processing unit **16** may also employ an algorithm to determine which solenoid valves **70** to open instead of selecting a solenoid valve profile. The solenoid valves **70** are opened in response to a signal received from the system controller **48**, in response to signals received from the processing unit **16** sent via the output interface **18**.

[0059] When the user desires to adjust the temperature of the flow of water to the shower **84** after initially selecting a temperature, the user may adjust the temperature of the flow of water to the shower **84** in either of the above described options.

[0060] When the user desires to stop operation of the shower **84**, the user touches the soft button for controlling a flow of water to the shower **84** via the secondary plumbing arrangement **44**. Upon recognition by the processing unit **16** that the user has touched the soft button for controlling the flow of water, the processing unit **16**, through the output

interface **18** and the system controller **48** closes one or all of the solenoid valves **70** that are in the open position.

[0061] As mentioned hereinabove, the controller **10** and the fluid distribution system **12** may also be configured to be controlled using the wireless communication device **83** over a local area wireless network. To operate the shower **84** using the communication device **83**, the user interacts with the specialized application installed on the communication device **83** configured to operate the controller **10** in a remote manner. Upon recognition by the processing unit **16** that the user has instructed the controller **10** to operate in a remote manner using the communication device **83**, the processing unit **16**, through the output interface **18** and the system controller **48**, opens at least one of the solenoid valves **70** of the valving manifold **68***a* to operate the shower **84** in any of the manners described hereinabove.

[0062] FIG. **6** schematically illustrates the controller **10** and the fluid distribution system **12** configured for a lavatory sink **86**. The valving manifold **68***b* shown in FIG. **6** is configured with two of the solenoid valves **70**. One of the inlets **72** is in fluid communication with the conduit **64** supplying cold water. The remaining inlet **72** is in fluid communication with the conduit **64** supplying hot water.

[0063] To operate the lavatory sink **86**, the user touches a portion of the touch screen **14** designated as a soft button for controlling a flow of water to the lavatory sink **86** via the secondary plumbing arrangement **44**. As a non-limiting example, the soft button for controlling the flow of water to the lavatory sink **86** may be designated by a power symbol.

[0064] Upon recognition by the processing unit **16** that the user has touched the soft button for controlling the flow of water, the processing unit **16**, through the output interface **18** and the system controller **48** opens at least one of the solenoid valves **70** of the valving manifold **68***b*. The processing unit **16** may select one or both of a pair of the solenoid valves **70** based on a most recently used temperature setting or the processing unit **16** may select a default arrangement of the solenoid valves **70**. Upon the opening of one or both of the solenoid valves **70**, water flows to the lavatory sink **86** through the secondary plumbing arrangement **44**.

[0065] In response to the processing unit **16** placing one or both of the solenoid valves **70** in the open position, the processing unit **16** also displays a temperature indication. In response to a selection by the processing unit **16**, the processing unit selects the temperature indication corresponding to the solenoid valves **70** placed in the open position. The temperature indication is output to the display **26**, for observation by the user. FIG. **6** illustrates the display **26** of the controller **10** displaying an exemplary temperature indication. As non-limiting examples, the temperature indication may be "HOT", "COLD", or "WARM".

[0066] After the user has touched the soft button for controlling the flow of water, the user may select a temperature of the flow of water to the shower **84**. The user may select the temperature from three options, which appear as soft buttons on the display **26** of the controller **10**.

[0067] First, the user may select the temperature of the flow of water to the lavatory sink **86** by pressing a "HOT" soft button. In response to the selection of the "HOT" soft button, the processing unit **16** selects the solenoid valve **70** of the valving manifold **68***b* in fluid communication with the conduit **64** supplying hot water, and is opened in response to a signal received from the system controller **48**, in response to signals received from the processing unit **16** sent via the output interface **18**.

[0068] Secondly, the user may select the temperature of the flow of water to the lavatory sink **86** by pressing a "COLD" soft button. In response to the selection of the "COLD" soft button, the processing unit **16** selects the solenoid valve **70** of the valving manifold **68***b* in fluid communication with the conduit **64** supplying cold water, and is opened in response to a signal received from the system controller **48**, in response to signals received from the processing unit **16** sent via the output interface **18**.

[0069] Lastly, the user may select the temperature of the flow of water to the lavatory sink **86** by pressing a "WARM" soft button. In response to the selection of the "WARM" soft button, the processing unit **16** selects the solenoid valves **70** of the valving manifold **68***b* in fluid communication with both the conduits **64** supplying cold water and the conduit supplying hot water. The solenoid valves **70** are opened in response to a signal received from the system controller **48**, in response to signals received from the processing unit **16** sent via the output interface **18**.

[0070] When the user desires to change the selected temperature of the flow of water to the lavatory sink **86** after initially selecting a temperature, the user may adjust the temperature of the flow of water to the lavatory sink **86** by selecting another soft button.

[0071] When the user desires to stop operation of the lavatory sink **86**, the user touches the soft button for controlling a flow of water to the lavatory sink **86** via the secondary plumbing arrangement **44**. Upon recognition by the processing unit **16** that the user has touched the soft button for controlling the flow of water, the processing unit **16**, through the output interface **18** and the system controller **48** closes one or both of the solenoid valves **70** that are in the open position.

[0072] As mentioned hereinabove, the controller **10** and the fluid distribution system **12** may also be configured to be controlled using the wireless communication device **83** over a local area wireless network. To operate the lavatory sink **86** using the communication device **83**, the user interacts with a specialized application installed on the communication device **83** configured to operate the controller **10** in a remote manner. Upon recognition by the processing unit **16** that the user has instructed the controller **10** to operate in a remote manner using the communication device **83**, the processing unit **16**, through the output interface **18** and the system controller **48**, opens at least one of the solenoid valves **70** of the valving manifold **68***a* to operate the lavatory sink **86** in any of the manners described hereinabove.

[0073] FIG. **7** schematically illustrates the controller **10** and the fluid distribution system **12** configured for a kitchen sink **88**. The valving manifold **68***c* shown in FIG. **7** is configured with three of the solenoid valves **70** and one restricting solenoid valve **76**. One of the inlets **72** is in fluid communication with the conduit **64** supplying cold water. One of the inlets **72** is in fluid communication with the conduit **64** supplying hot water. The last of the inlets **72** is in fluid communication with both of the conduits **64** to supplying a mixture of hot and cold water.

[0074] To operate the kitchen sink **88**, the user touches a portion of the touch screen **14** designated as a soft button for controlling a flow of water to the kitchen sink **88** via the secondary plumbing arrangement **44**. As a non-limiting

example, the soft button for controlling the flow of water to the kitchen sink **88** may be designated by a power symbol.

[0075] Upon recognition by the processing unit **16** that the user has touched the soft button for controlling the flow of water, the processing unit **16**, through the output interface **18** and the system controller **48** opens at least one of the solenoid valves **70** of the valving manifold **68***c*. The processing unit **16** may select one of the solenoid valves **70** and the restricting solenoid valve **76** based on a most recently used temperature and flow setting or the processing unit **16** may select a default arrangement of the solenoid valves **70** and the restricting solenoid valve **76**. Upon the opening of one the solenoid valves **70** or one the solenoid valves **70** and the restricting solenoid valve **76**, water flows to the kitchen sink **88** through the secondary plumbing arrangement **44**.

[0076] In response to the processing unit **16** placing one of the solenoid valves **70** in the open position, the processing unit **16** also displays a temperature indication. In response to a selection by the processing unit **16**, the processing unit selects the temperature indication corresponding to the solenoid valves **70** placed in the open position. The temperature indication is output to the display **26**, for observation by the user. FIG. **7** illustrates the display **26** of the controller **10** displaying an exemplary temperature indication. As non-limiting examples, the temperature indication may be "HOT", "COLD", or "WARM".

[0077] After the user has touched the soft button for controlling the flow of water, the user may select a temperature of the flow of water to the kitchen sink **88**. The user may select the temperature from three options.

[0078] First, the user may select the temperature of the flow of water to the kitchen sink **88** by pressing the "HOT" soft button. In response to the selection of the "HOT" soft button, the processing unit **16** selects the solenoid valve **70** of the valving manifold **68***c* in fluid communication with the conduit **64** supplying hot water, and is opened in response to a signal received from the system controller **48**, in response to signals received from the processing unit **16** sent via the output interface **18**.

[0079] Secondly, the user may select the temperature of the flow of water to the kitchen sink **88** by pressing the "COLD" soft button. In response to the selection of the "COLD" soft button, the processing unit **16** selects the solenoid valve **70** of the valving manifold **68***c* in fluid communication with the conduit **64** supplying cold water, and is opened in response to a signal received from the system controller **48**, in response to signals received from the processing unit **16** sent via the output interface **18**.

[0080] Lastly, the user may select the temperature of the flow of water to the kitchen sink **88** by pressing the "WARM" soft button. In response to the selection of the "WARM" soft button, the processing unit **16** selects the solenoid valve **70** of the valving manifold **68***c* in fluid communication with both the conduits **64** supplying cold water and the conduit supplying hot water. The solenoid valve **70** is opened in response to a signal received from the system controller **48**, in response to a signal received from the processing unit **16** sent via the output interface **18**.

[0081] When the user desires to change the selected temperature of the flow of water to the kitchen sink **88** after initially selecting a temperature, the user may adjust the temperature of the flow of water to the kitchen sink **88** by selecting another soft button.

[0082] As mentioned hereinabove, the controller **10** and the fluid distribution system **12** may also be configured to be controlled using the wireless communication device **83** over a local area wireless network. To operate the kitchen sink **88** using the communication device **83**, the user interacts with a specialized application installed on the communication device **83** configured to operate the controller **10** in a remote manner. Upon recognition by the processing unit **16** that the user has instructed the controller **10** to operate in a remote manner using the communication device **83**, the processing unit **16**, through the output interface **18** and the system controller **48**, opens at least one of the solenoid valves **70** of the valving manifold **68***a* to operate the kitchen sink **88** in any of the manners described hereinabove.

[0083] FIG. **8** schematically illustrates the controller **10** and the fluid distribution system **12** configured for the shower **84**, as shown in FIG. **5**. However, the fluid distribution system **12** shown in FIG. **8** further comprises a recirculation system **90**. The recirculation system **90** includes a recirculation valve **92** and a recirculation line **94**. The recirculation valve **92** is disposed on a conduit **64***a* in fluid communication with the shower **84**. The recirculation valve **92** may be actuated to divert water from the conduit **64***a* through the recirculation line **94** to a conduit **64***b*, which supplies cold water to the fluid distribution system **12** or to a water heater **96** associated with the fluid distribution system **12**. The recirculation line **94** is fitted with a check valve **98** which prevents water from flowing from the conduit **64***b* to the recirculation line **94**. The recirculation valve **92** is in communication with the processing unit **16**. The recirculation system **90** allows the fluid distribution system **12** to supply water to the shower **84** at a temperature selected by the user without the need to waste water and any energy therein as the conduit **64***a* may initially absorb a significant amount of heat from the water supplied thereto. The recirculation system **90** allows the fluid distribution system **12** to be operated in a recirculation mode to provide for increased conservation of energy and water.

[0084] To operate the fluid distribution system **12** in the recirculation mode, the user touches a portion of the touch screen **14** designated as a "soft button" designated for the recirculation mode. As a non-limiting example, a soft button associated placing the fluid distribution system **12** in the recirculation mode may be labeled as "ECO-START".

[0085] Upon recognition by the processing unit **16** that the user has touched the soft button for placing the fluid distribution system **12** in the recirculation mode, the processing unit **16**, through the output interface **18** and the system controller **48** opens at least one of the solenoid valves **70** of the valving manifold **68***a* and actuates the recirculation valve **92** to divert water from the conduit **64***a* through the recirculation line **94** to a conduit **64***b*. The processing unit **16** may select the at least one of the solenoid valves **70** based on a most recently used temperature setting, the processing unit **16** may select a default arrangement of the at least one of the solenoid valves **70**, or the processing unit **16** may select the at least one of the solenoid valves **70** based on a temperature preference selected by the user.

[0086] As mentioned hereinabove, the sensor **36** is typically disposed on a portion of the secondary plumbing arrangement **44** near the shower **84**. In response to the processing unit **16** placing the fluid distribution system **12** in the recirculation mode, the processing unit **16** also receives a signal from the sensor **36**. In response to a change in the temperature of water flowing through the conduit **64***a* and the

recirculation line **94**, the signal sent by the sensor **36** is modified to reflect the change in temperature. Upon receipt of the signal by the processing unit **16** via the output interface **18**, the processing unit **16** converts the signal into a temperature value, which is output to the display **26**, for observation by the user. FIG. **8** illustrates the display **26** of the controller **10** displaying an exemplary temperature value. Once the processing unit **16** recognizes that the signal sent by the sensor **36** is equivalent to one of a most recently used temperature setting, at temperature associated with a default arrangement of the at least one of the solenoid valves **70**, or a temperature preference selected by the user, the processing unit **16** closes any open solenoid valves **70** and closes the recirculation valve **92**. Upon closure of any open solenoid valves **70** and the recirculation valve **92**, the processing unit **16** may output an indication to the display **26**, for observation by the user. As a non-limiting example, the indication output by the processing unit **16** may be "SHOWER READY".

[0087] As mentioned hereinabove, the controller **10** and the fluid distribution system **12** may also be configured to be controlled using the wireless communication device **83** over a local area wireless network. To operate the shower **84** in the recirculation mode using the communication device **83**, the user interacts with a specialized application installed on the communication device **83** configured to operate the controller **10** in a remote manner. Upon recognition by the processing unit **16** that the user has instructed the controller **10** to operate in a remote manner using the communication device **83**, the processing unit **16**, through the output interface **18** and the system controller **48**, opens at least one of the solenoid valves **70** of the valving manifold **68***a* to operate the shower **84** in the recirculation mode.

[0088] The controller **10** may also be configured to operate the fluid distribution system **12** in a manner that conserves water. By actuating the restricting solenoid valve **76**, the restricting solenoid valve **76** permits fluid to flow from the valving manifold **68***c* to the secondary plumbing arrangement **44** at flow rate less than a flow rate when the restricting solenoid valve **76** is placed in the open position. To operate the kitchen sink **88** in the manner that conserves water, the user touches a portion of the touch screen **14** designated as a soft button for controlling a position of the restricting solenoid valve **76**. As a non-limiting example, a soft button associated with a position of the restricting solenoid valve **76** may be labeled as "ECO-FLOW".

[0089] Upon recognition by the processing unit **16** that the user has touched the soft button for operating the fluid distribution system **12** in a manner that conserves water, the processing unit **16**, through the output interface **18** and the system controller **48** places the restricting solenoid valve **76** in the restricted position. Upon placing the restricting solenoid valve **76** in the restricted position, water flows to the kitchen sink **88** through the secondary plumbing arrangement **44** in a manner that conserves water.

[0090] When the user desires to stop operation of the kitchen sink **88**, the user touches the soft button for controlling a flow of water to the kitchen sink **88** via the secondary plumbing arrangement **44**. Upon recognition by the processing unit **16** that the user has touched the soft button for controlling the flow of water, the processing unit **16**, through the output interface **18** and the system controller **48** closes the solenoid valve **70** that is in the open position.

[0091] In accordance with the provisions of the patent statutes, the present invention has been described in what is considered to represent its preferred embodiments. However, it should be noted that the invention can be practiced otherwise than as specifically illustrated and described without departing from its spirit or scope.

What is claimed is:

1. A controller for use with a fluid distribution system, the controller comprising:

a touch screen;

a processing unit in communication with the touch screen; and

an output interface in communication with the processing unit and the fluid distribution system, wherein in response to a touch input from a user, the processing unit accesses at least one valve profile and adjusts a state of operation of the fluid distribution system through the output interface.

2. The controller according to claim **1**, wherein the controller is in communication with a sensor to provide the processing unit with information regarding a state of operation of the fluid distribution system.

3. The controller according to claim **2**, wherein the temperature sensor is disposed on a portion of the fluid distribution system.

4. The controller according to claim **3**, wherein in response to information received from the sensor, the processing unit displays a temperature value on the touch screen.

5. The controller according to claim **1**, wherein the output interface includes specialized circuitry which facilitates conversion of a microcontroller level output signal from the processing unit to an output level compatible with the fluid distribution system.

6. The controller according to claim **1**, wherein the processing unit executes a series of instructions in response to a data signal from a sensor via the output interface.

7. The controller according to claim **1**, wherein the processing unit accesses information on a portion of the processing unit, changes information on the portion of the processing unit, adjusts a signal supplied to the output interface, and adjusts a signal supplied to the touch screen in response to a touch input from the user via the touch screen.

8. The controller according to claim **7**, wherein the touch input from the user is a selection of a desired temperature and the processing unit selects a valve profile based on the selection of a desired temperature.

9. The controller according to claim **1**, wherein the processing unit comprises at least one microcontroller including a storage device for information.

10. The controller according to claim **9**, wherein the information includes at least one of a temperature profile, a series of instructions to be executed by the processing unit, or a series of instructions used to operate the at least a portion of the touch screen.

11. The controller according to claim **1**, wherein the processing unit further comprises a communication module.

12. The controller according to claim **11**, wherein the communication module allows the user to adjust a state of operation of the fluid distribution system using a computing device in a wireless manner.

13. The controller according to claim **12**, wherein in response to a wireless command from the user via the computing device, one of the processing unit and the computing device generates a usage report regarding the operation of the fluid distribution system.

14. The controller according to claim **1**, wherein the fluid distribution system further comprises a recirculation valve and a recirculation line.

15. The controller according to claim **14**, wherein in response to a wireless command from the user via the computing device, the processing unit adjusts a state of operation of the fluid distribution system to place a portion of the fluid distribution system in a recirculation mode.

16. A fluid distribution system comprising:

a primary plumbing arrangement in fluid communication with a fluid source,

a valving arrangement in fluid communication with the primary plumbing arrangement;

a secondary plumbing arrangement in fluid communication with the valving arrangement;

a system controller in communication with the valving arrangement; and

a controller in communication with the system controller, the controller comprising a touch screen, a processing unit in communication with the touch screen, and an output interface in communication with the processing unit and the fluid distribution system, wherein in response to a touch input from a user, the processing unit accesses at least one valve profile and adjusts the valving arrangement of the fluid distribution system through the output interface and the system controller.

17. A method of operating a fluid distribution system comprising the steps of:

providing the fluid distribution system in fluid communication with a fluid source, the fluid distribution system including a valving arrangement;

providing a controller in communication with the fluid distribution system, the controller comprising a touch screen, a processing unit in communication with the touch screen, and an output interface in communication with the processing unit and the fluid distribution system;

providing a touch input from a user of the fluid distribution system to the processing unit via the touch screen;

accessing at least one valve profile using the processing unit in response to the touch input from a user; and

adjusting the valving arrangement of the fluid distribution system using the processing unit through the output interface.

18. The method according to claim **17**, wherein the step of adjusting a state of operation of the fluid distribution system is performed by the processing unit, the processing unit employing an algorithm to determine how to adjust a state of operation of the fluid distribution system.

19. The method according to claim **17**, further comprising the step of displaying an exemplary temperature indication on the touch screen in response to the processing unit adjusting a state of operation of the fluid distribution system.

20. The method according to claim **17**, wherein the step of adjusting the valving arrangement of the fluid distribution system is performed to restrict a flow rate through the fluid distribution system in response to a touch input from the user.

* * * * *