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Potucek et al.(10) **Pub. No.: US 2007/0233420 A1**(43) **Pub. Date: Oct. 4, 2007**(54) **PROGRAMMABLE AERATOR COOLING
SYSTEM****Publication Classification**(76) Inventors: **Kevin L. Potucek**, Far Hills, NJ (US);
Carl L. Brunetti, Manville, RI (US);
Gilbert Conover JR., Providence, RI
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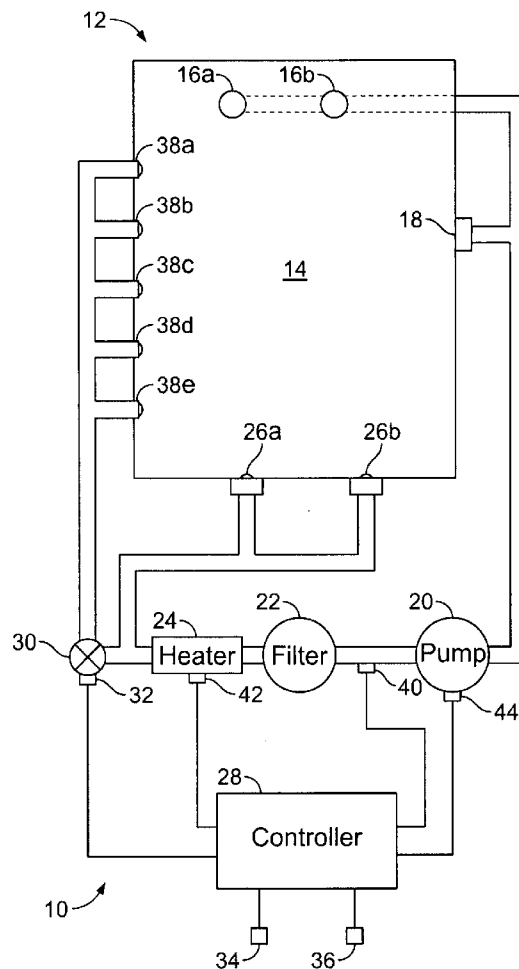
ABSTRACT

A programmable aerator cooling system for pools or spas is provided. The system selectively operates one or more aerator jets in a pool or spa to cool water in the pool or spa to a desired temperature. The system includes a microprocessor-based controller connected to a valve actuator for selectively actuating the one or more aerator jets, and one or more sensors. The sensors could include a water temperature sensor, and optionally, an ambient air temperature sensor and an ambient humidity sensor. The controller includes a user interface for allowing a user to interact with one or more stored control programs for controlling the water temperature of a pool or spa. Based on pool water and ambient conditions, the controller can activate the one or more aerators during optimal ambient conditions to cool the pool water.

Correspondence Address:

MCCARTER & ENGLISH, LLP
FOUR GATEWAY CENTER
100 MULBERRY STREET
NEWARK, NJ 07102 (US)(21) Appl. No.: **11/704,717**(22) Filed: **Feb. 9, 2007****Related U.S. Application Data**

(60) Provisional application No. 60/771,762, filed on Feb. 9, 2006. Provisional application No. 60/771,656, filed on Feb. 9, 2006.



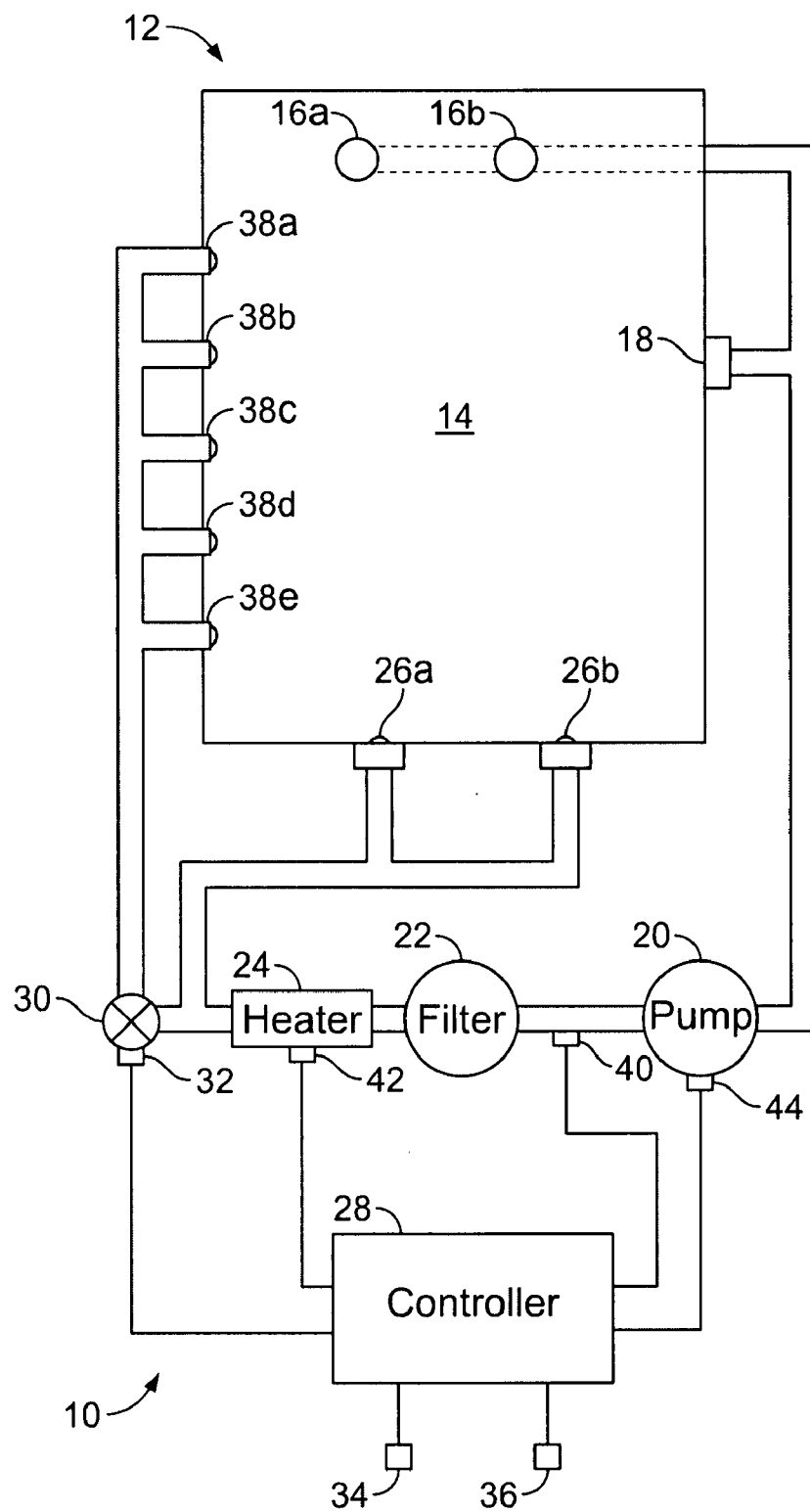
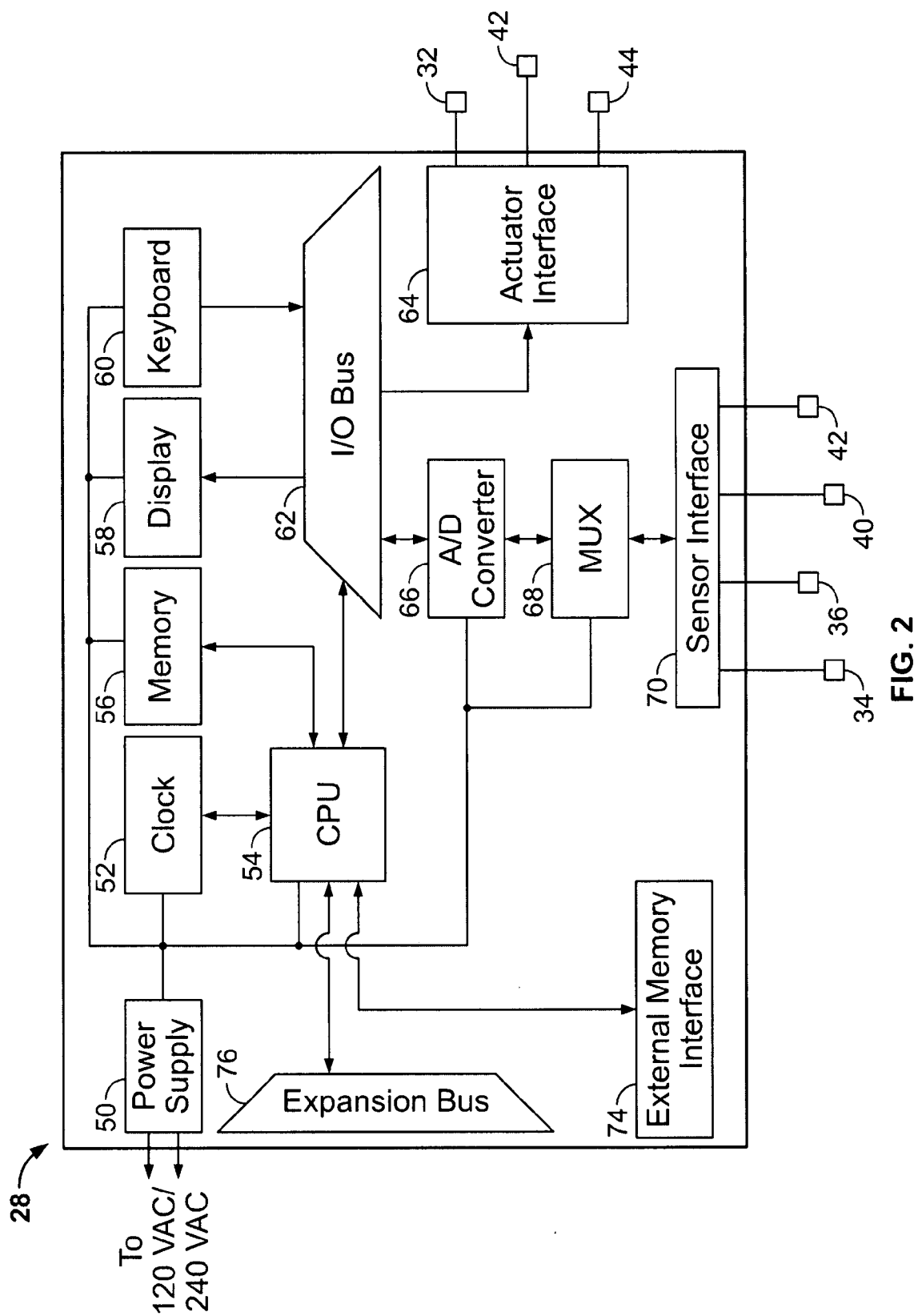


FIG. 1



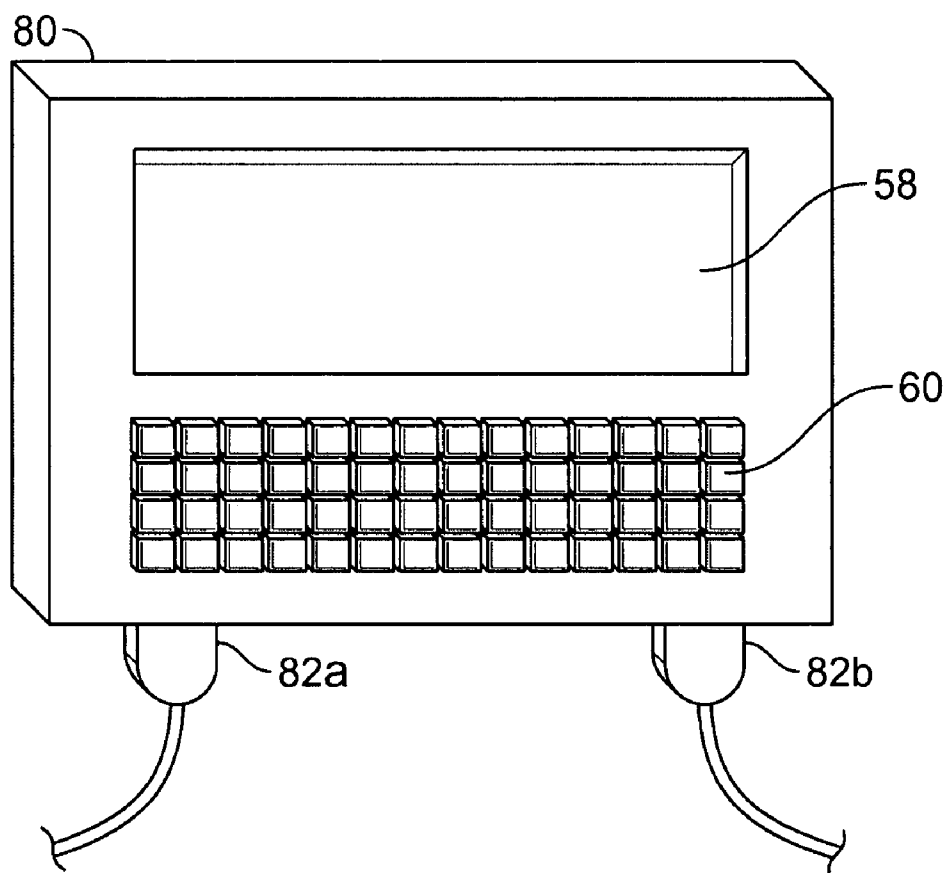


FIG. 3

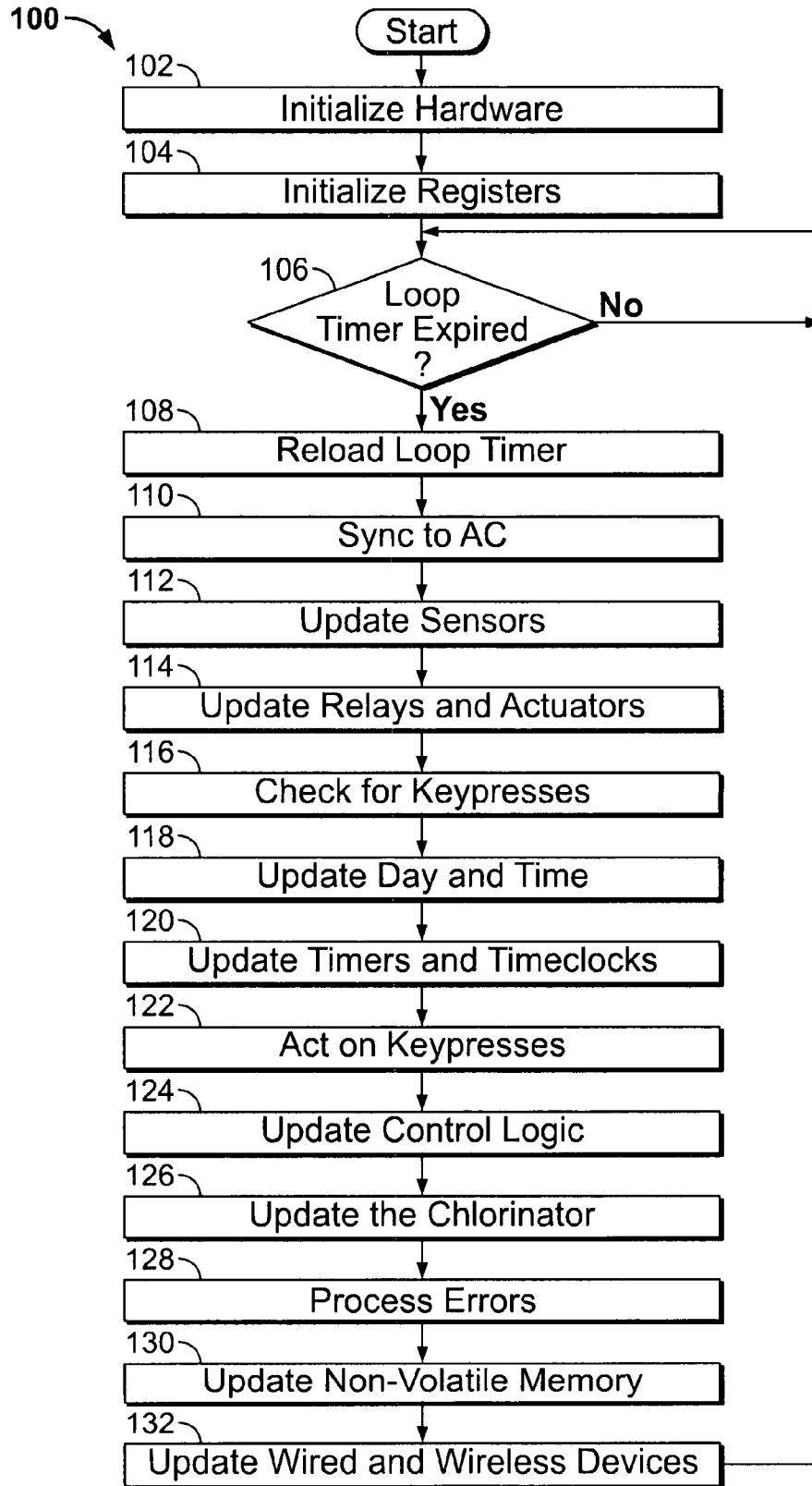
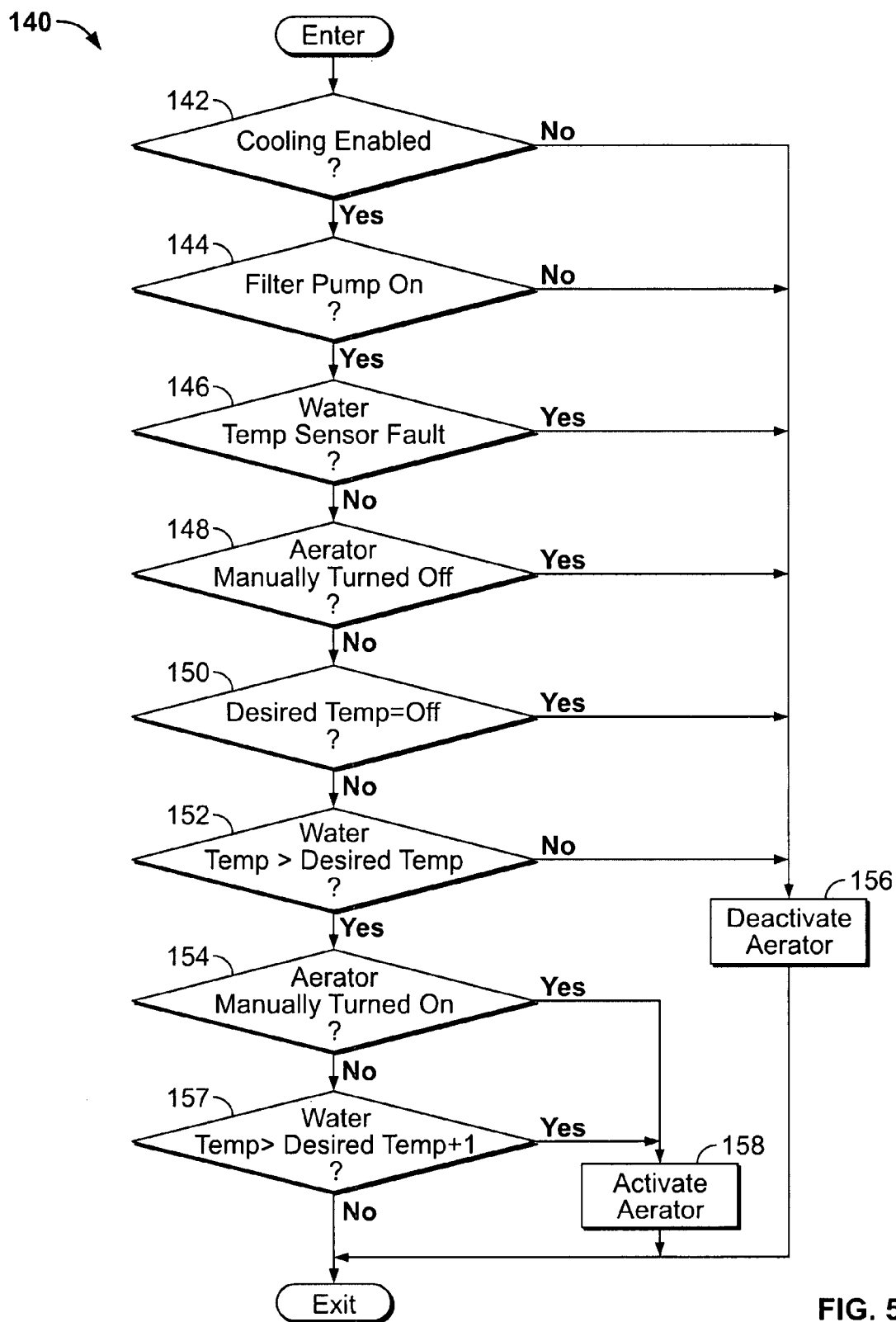
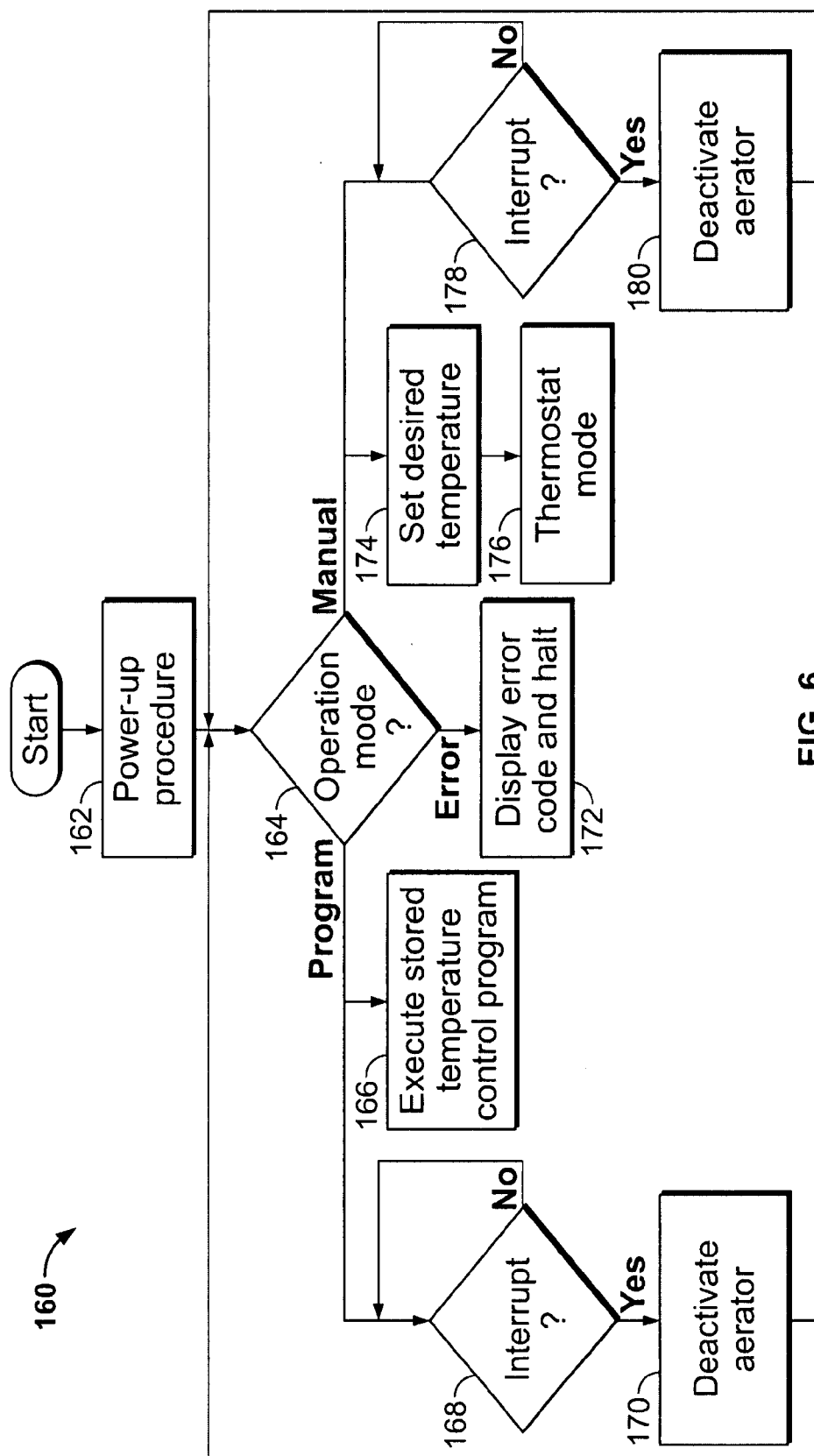


FIG. 4





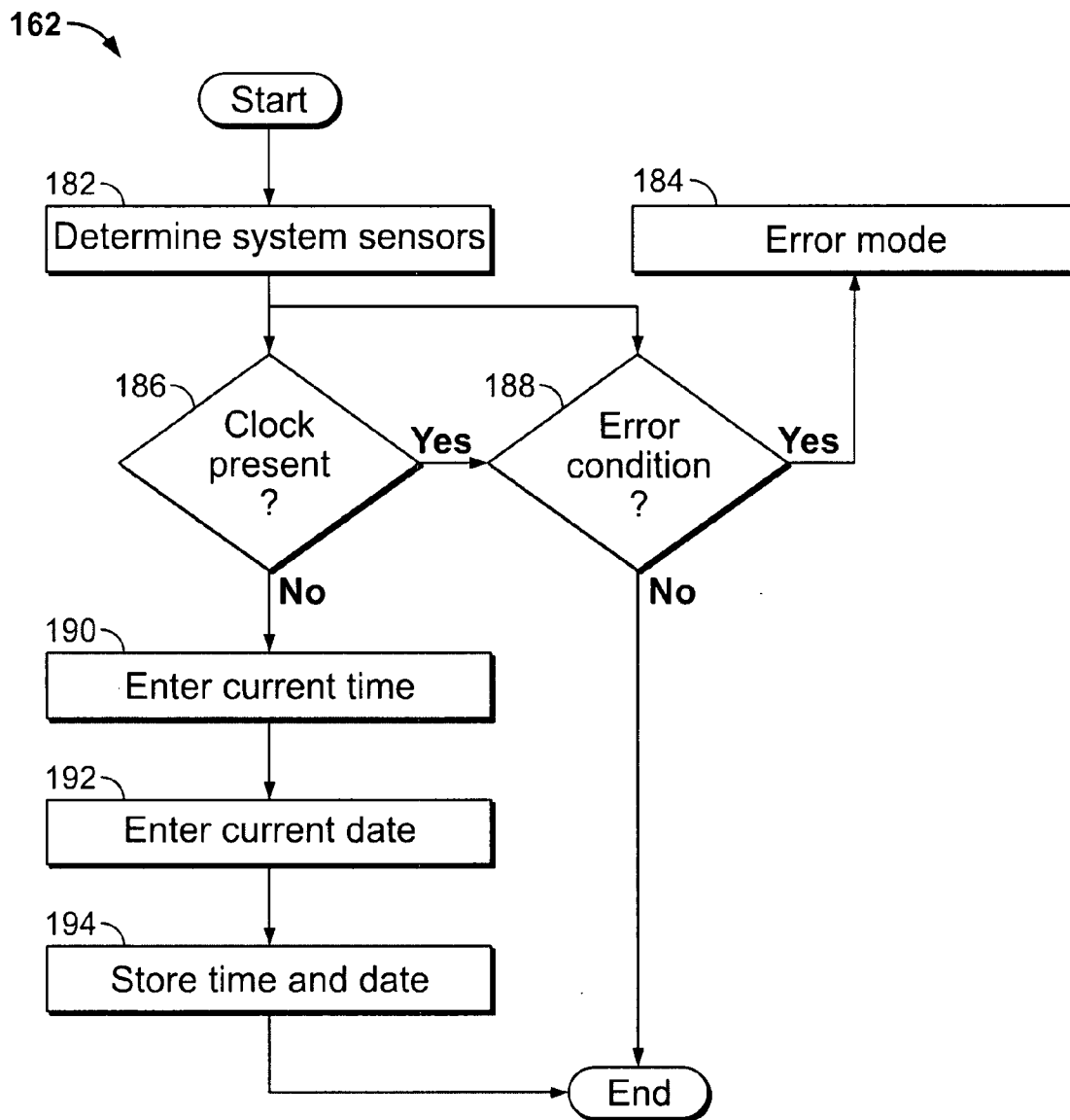


FIG. 7

176

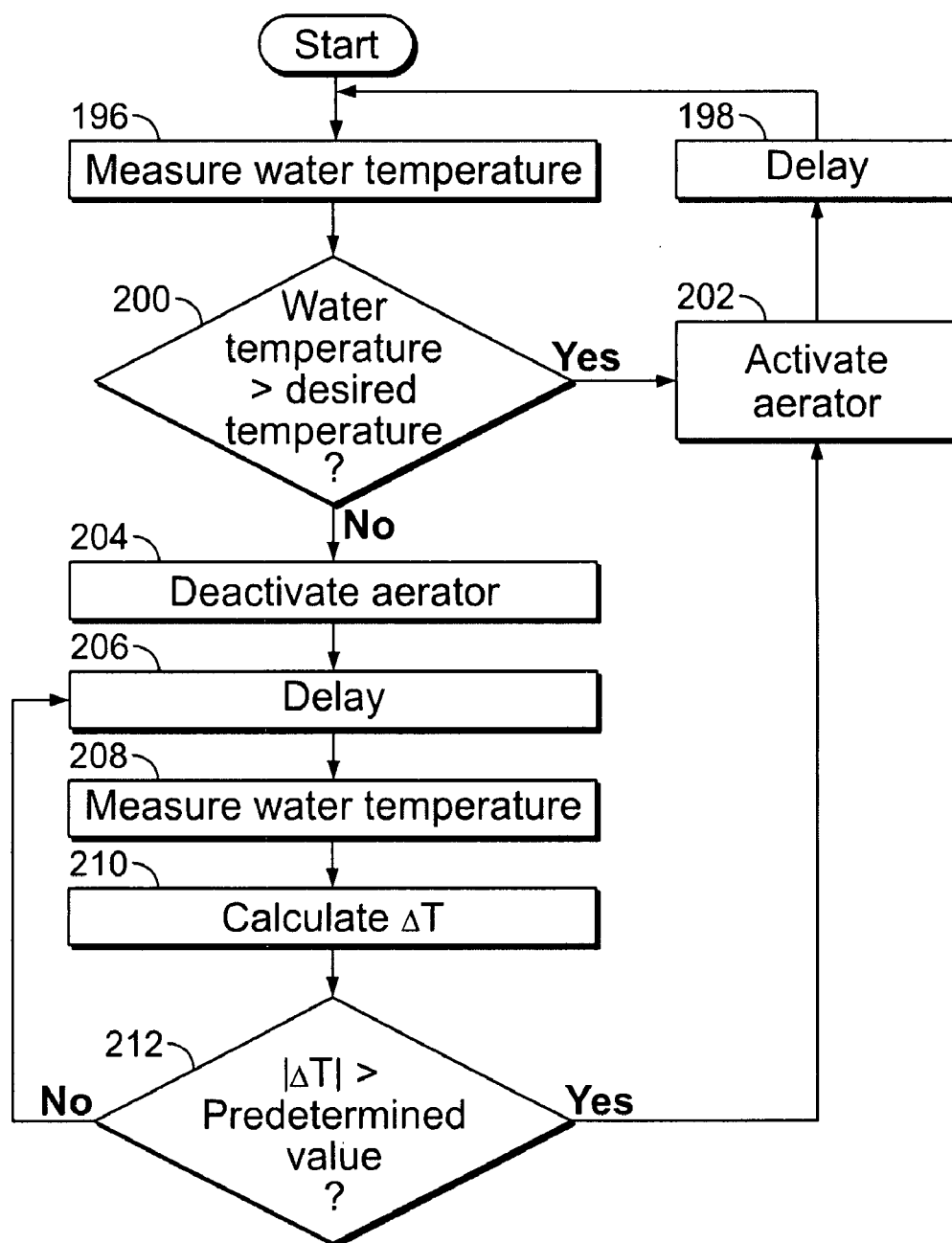


FIG. 8

166 ↗

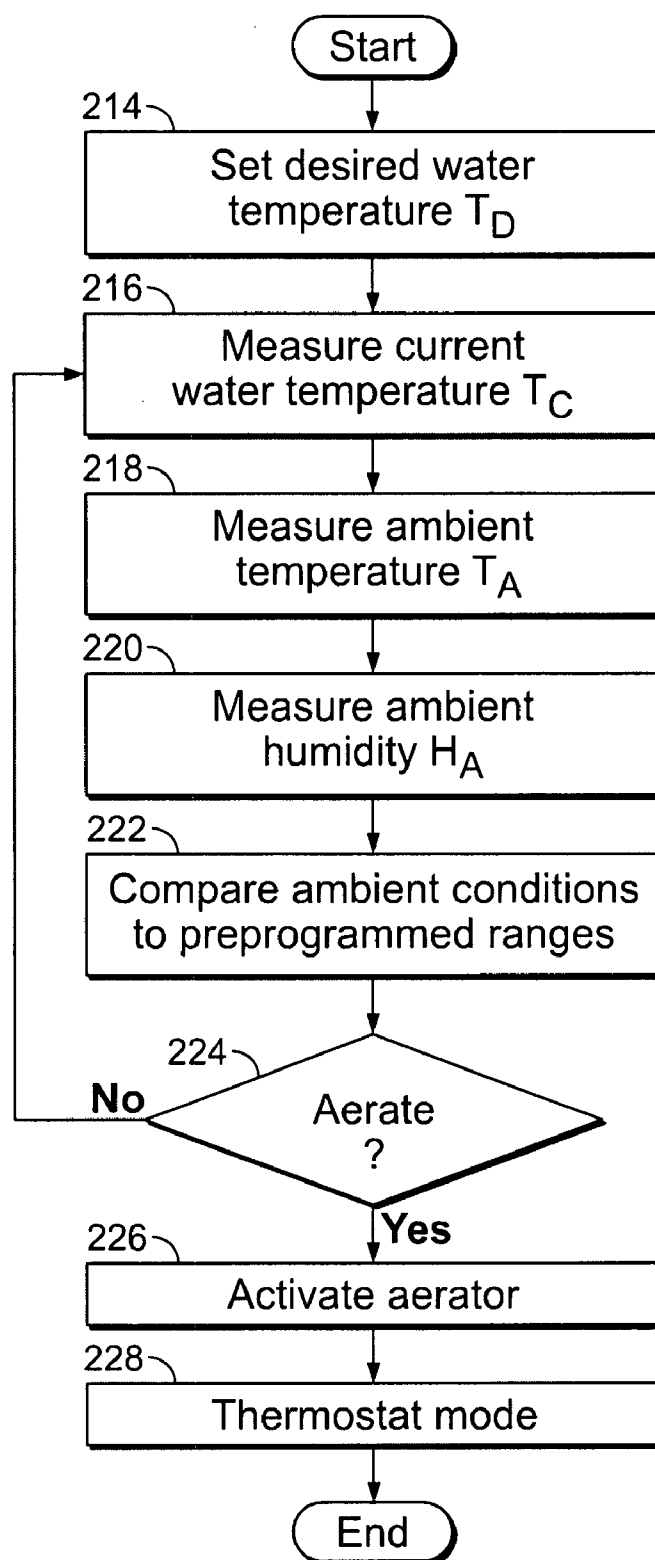


FIG. 9

PROGRAMMABLE AERATOR COOLING SYSTEM

RELATED APPLICATIONS

[0001] The present application claims the benefit of U.S. Provisional Application Ser. No. 60/771,762 filed Feb. 9, 2006 and U.S. Provisional Application Ser. No. 60/771,656 filed Feb. 9, 2006, the entire disclosures of which are expressly incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to the field of liquid cooling systems, and, more particularly, to a programmable aerator cooling system for cooling large bodies of water, such as pools and spas.

BACKGROUND OF THE INVENTION

[0003] In the past, aerators of various designs have been used to cool bodies of liquid (e.g., pools, ponds, and the like) and to provide a pleasing visual effect. As is well-known in the art, aerators cool liquids by exposing the liquid to ambient air, which increases heat transfer and thereby cools the liquid.

[0004] One example of an aerator design can be found in U.S. Pat. No. 3,735,926 to Ravitts (the "Ravitts '926 Patent"), which discloses a liquid spray device with fixed and rotatable diffusers. The aerator disclosed in the Ravitts '926 Patent includes an axial flow impeller that is rotated by an electric motor to pump a column of water from a pond upwardly through a throat formed in the aerator and against a fixed diffuser which divides the column of water in a central core. Thereafter, the water passes through a neck portion and against a baffle, such that the water is deflected in a flat trajectory so as to strike the surface of the pond with considerable force. A rotatable diffuser directs water outwardly relative to the throat in a path above and converging downwardly into the water deflected by the baffle.

[0005] Another example of an aerator can be found in U.S. Pat. No. 3,320,160 to Welles, Jr., et al. (the "Welles, Jr., et al. '160 Patent"), which discloses a method and apparatus for aerating a body of liquid. The aerator disclosed in the Welles, Jr., et al. '160 Patent can be driven across the surface of very large bodies of liquid, such as basins, lagoons, etc. Supporting cables suspended across the body of water guide the power-driven aerators.

[0006] Despite efforts to date, improved aeration systems are needed that offer users greater control and/or flexibility in achieving desired cooling effects. These and other needs are addressed in the systems and methods disclosed herein.

SUMMARY OF THE INVENTION

[0007] The present invention overcomes the disadvantages and shortcomings of the prior art by providing a programmable aerator cooling system for pools or spas. The system selectively operates one or more aerator jets in a pool or spa to cool water in the pool or spa to a desired temperature. The system includes a microprocessor-based controller connected to a valve actuator and one or more sensors. The sensors include a water temperature sensor, and optionally, an ambient air temperature sensor and an ambient humidity sensor. Optionally, the controller could be connected to a heater actuator for controlling a pool heater, as

well as a pump controller for controlling a pool pump. The controller includes a user interface (e.g., a keypad or keyboard, and an associated display) for allowing a user to interact with one or more stored control programs for controlling the water temperature of a pool or spa. In one embodiment, the stored control program selectively activates the aerator jets to maintain the water temperature at a desired temperature specified by a user.

[0008] In another embodiment of the present invention, the stored control program allows the controller to operate in a manual mode or a program mode. In manual mode, the user can specify a desired water temperature, and the system activates one or more aerators (e.g., by activating one or more valves and/or pumps associated with the aerators) for cooling the water to the desired temperature. Then, the system operates in a thermostat mode, wherein the water temperature is monitored and the aerator is controlled to maintain the water temperature at the desired temperature. In program mode, the user can activate one or more stored temperature control programs. The stored temperature control program allows the user to specify a desired water temperature; and, based on pool water and ambient conditions, it will cause the activation of one or more aerators during optimal and/or predetermined ambient conditions to cool the pool water. Any desired types of stored temperature control programs could be provided in the controller.

[0009] Further features and advantages of the present invention will appear more clearly upon a reading of the following detailed description of exemplary embodiment(s) of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] For a more complete understanding of the present invention, reference is made to the following detailed description of exemplary embodiment(s) considered in conjunction with the accompanying drawings, in which:

[0011] FIG. 1 is a block diagram of a programmable aerator cooling system for a pool and/or spa constructed in accordance with an exemplary embodiment of the present invention;

[0012] FIG. 2 is a block diagram showing the controller of FIG. 1 in greater detail;

[0013] FIG. 3 is a perspective view of a control panel having a display and keyboard for allowing a user to interact with the controller of FIG. 2;

[0014] FIG. 4 is a flow chart showing processing steps of the main control program executed by the controller of FIG. 2;

[0015] FIG. 5 is a flow chart showing processing steps according to one embodiment of the stored control program of the present invention for selectively actuating aerator jets to control water temperature;

[0016] FIG. 6 is a flow chart showing processing steps according to another embodiment of the stored control program of the present invention for selectively actuating aerator jets to control water temperature;

[0017] FIG. 7 is a flow chart showing, in greater detail, the power-up procedure 162 of the stored control program shown in FIG. 6;

[0018] FIG. 8 is a flow chart showing, in greater detail, the thermostat mode 176 of the stored control program shown in FIG. 6; and

[0019] FIG. 9 is a flow chart showing, in greater detail, the stored temperature control sub-program 166 of the stored control program shown in FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

[0020] FIG. 1 is a block diagram showing a programmable aerator cooling system 10, which is adapted for operation with any pool or spa. As shown in FIG. 1, the cooling system 10 is operable to control the temperature of water 14 in a pool 12, which can be constructed in accordance with any desired design, and could have any desired shape. Thus, for example, the pool 12 could include dual main drains 16a, 16b, a skimmer 18, a pump 20, a filter 22, a heater 24, and return jets 26a-26b. The cooling system 10 includes a controller 28, a valve 30, a valve actuator 32 for selectively controlling the valve 30, an optional ambient air temperature sensor 34, an optional ambient humidity sensor 36, a plurality of aerators 38a-38e connected to the valve 30, and a water temperature sensor 40. Optionally, the controller 28 could be interconnected with the heater 24 via actuator 42 and/or with the pump 20 via actuator 44 so as to control these devices. Of course, any desired number and type of sensors could be provided without departing from the spirit or scope of the present invention. The controller 28 selectively actuates the valve 30 using the valve actuator 32 based upon pool water temperature and, optionally, ambient conditions such as air temperature and humidity, so as to cool the water 14 of the pool 12. The valve actuator 32 could be any commercially-available actuator known in the art, such as a solenoid- or motor-driven valve actuator. Additionally, the valve 30 and the valve actuator 32 could be provided in a single, integral device.

[0021] The aforementioned pool water and ambient conditions are monitored by the controller 28 using temperature sensor 40, and optionally, the ambient air temperature sensor 34 and ambient humidity sensor 36. The water temperature sensor 40 measures the temperature of the water 14 of the pool 12. Optionally, a temperature sensor within the pool 12 could also be provided. The ambient air temperature sensor 34 measures the temperature of the air outside of the pool 12. The ambient humidity sensor 36 measures the humidity of the air outside of the pool 12. The heater actuator 42, if provided, could include circuitry for actuating the heater 24, as well as a temperature sensor (not shown) for measuring the temperature of water flowing into the heater 42.

[0022] In operation, the water 14 is pumped by the pump 20 from the pool 12 via the main drains 16a, 16b and the skimmer 18. From the pump 20, the water 14 passes through the filter 22, which could be any suitable commercial or residential pool filter known in the art, and then to the heater 24, which is an optional element of the system 10. The controller 28 operates the valve 30 via the valve actuator 32, causing the water 14 to flow through the aerators 38a-38e and thus cooling the water 14 before it is returned to the pool 12. The return jets 26a-26b could be bypassed when the aerators 38a-38e are activated. In most instances, the return jets 26a-26b are operated in conjunction with the aerators 38a-38e. Any desired number of aerators 38a-38e could be

provided (e.g., one through ten); and, they could be of any suitable design available in the art. If cooling is not desired, the valve 30 is closed by the valve actuator 32 under direction of the controller 28, causing the water 14 to return to the pool 12 using the conventional return jets 26a-26b. Additionally, it should be noted that the valve 30 and the valve actuator 32 could also be positioned upstream of the heater 24, i.e., between the heater 24 and the filter 22.

[0023] FIG. 2 is a block diagram showing the components of the controller 28 of FIG. 1 in greater detail. The components of the controller 28 include a power supply 50, a clock 52, a processor (including a microprocessor or microcontroller) or central processing unit (CPU) 54, memory 56, a display 58, a keyboard 60, input/output (I/O) bus circuitry 62, an actuator interface 64, an analog-to-digital (A/D) converter 66, a multiplexer (MUX) 68, a sensor interface 70, an optional external memory interface 74, and an expansion bus 76. The power supply 50 can include one or more AC-to-DC converters for supplying various voltage levels to the components of the controller 28. The power supply 50 can also include a ground fault circuit interrupter (GFCI) to protect against ground faults. The clock 52 can be a battery-backed, real time clock or a zero-crossing detector which derives clock pulses from the AC power line. Processor 54 can reside within an embedded system having an external standard bus system. The bus system, such as STD, VME, or any other bus type, can accept several types of expansion cards via the expansion bus 76. The processor 54 could be the PIC 18F2620 microprocessor manufactured by Microchip, Inc. The processor 54 could be programmed in any suitable high or low level language (e.g., assembler language), and it could also run any suitable operating system. The memory 56 can be random access memory, read-only memory, hard disk, FLASH memory, or other suitable memory. Non-volatile memory for the system could also be provided in the memory 56, and could be expanded as desired using the external memory interface 74, if provided. The memory 56 (or external memory plugged into the external memory interface 74, if provided) stores the control logic executed by the present invention, as well as data gathered from the sensors 34, 36, and 40 and control signals for the actuator 32. Optionally, temperature information could be provided from the heater actuator 42. Control information could be passed to the heater actuator 42 for controlling the heater 24, as well as to the pump actuator 44 for controlling the pump 20. The control logic of the present invention could be written in any suitable high or low level programming language, and stored as executable object code in the memory 56. Further, each of the components shown in FIG. 2 could be provided in a single, commercially-available integrated circuit.

[0024] Referring now to FIGS. 2 and 3, the display 58 and the keyboard 60 can be provided in a housing 80. The keyboard 60 can include push buttons or a flat panel membrane for allowing a user to interact with the controller 28 of the present invention. The keyboard 60 acts as an array of on/off switches, which the processor 54 receives as interrupts. Keyed information can be displayed on the display 58, which can be a vacuum-fluorescent tube, an electroluminescent display, LCD display, etc. Optionally, the keyboard 60 and display 58 could be replaced with a single, touch-sensitive display. Electrical wiring interfaces 82a, 82b connect the keyboard 60 and the display 58 to the controller 28.

The keyboard **60** and the display **58** can reside in the vicinity of the pool **12**, or at a remote location, such as within a dwelling.

[0025] Referring again to FIG. 2, the processor **54** includes a number of general purpose, digital I/O control lines which can drive outputs or receive inputs from other devices via the I/O bus circuitry **62**. The I/O bus circuitry **62** could also provide a path to the processor **54** for receiving (i) optional data and interrupts from a GFCI within the power supply **50** when a ground fault is detected; (ii) data from the clock **52**; and (iii) data entered at the keyboard **60**. The processor **54** utilizes the I/O bus circuitry **62** to drive the display **58**. The processor **54** can receive measurements from the sensors **34**, **36**, and **40**, as well as temperature information from the heater actuator **42**, via the sensor interface **70**, the analog-to-digital (A/D) converter **66**, and the multiplexer **68**. Additionally, the processor **54** can control the valve actuator **32** (e.g., to operate the valve **30** of FIG. 1), the pump actuator **44** (e.g., to control the pump **20** of FIG. 1), and the heater actuator **42** (e.g., to control the heater **24** of FIG. 1) using the actuator interface **64** and the I/O bus circuitry **62**. The controller **28** can be electrically isolated from valve **30** and the rest of the pool **12** via isolation circuitry within the actuator interface **64**, which may be implemented, for example, using opto-isolators, solenoids, transformers, etc.

[0026] FIG. 4 is a flow chart showing processing steps of the main control program of the present invention, indicated generally at **100**. The control program **100** is executed by the controller **28** of FIG. 1 upon application of power to the controller. Specifically, when power is applied to the controller **28**, the processor **54** (see FIG. 2) loads the main control program from memory **56** (see FIG. 2) and begins executing the control program. The main control program **100** begins in step **102**, wherein all hardware connected to the controller **28** of FIG. 1 is initialized for operation, as well as hardware within the controller **28**. Then, in step **104**, the registers of the controller are initialized for use. This could be accomplished by setting all of the registers of the controller to pre-defined values. At this time, a loop timer is also initialized for controlling overall program flow. In step **106**, a determination is made as to whether the loop timer has expired. If a negative decision is made, step **106** is re-invoked. If a positive determination is made (i.e., the loop timer has expired), step **108** is invoked, wherein the loop timer is re-loaded. In step **110**, the circuitry of the controller is synchronized to the frequency of the alternating current (AC) power supply connected to the controller. Among other functions, this allows the controller **28** to synchronously read the sensors and update the relays, actuators, and other devices connected to the controller **28**.

[0027] In step **112**, the controller updates all sensors connected to the controller **28**. Optionally, in this step, the controller **28** can poll each sensor to determine the types of sensors connected to the sensor interface **70**, as well as the operational status of each sensor (e.g., operational, failure mode, etc.). In step **114**, the controller **28** updates all relays and actuators connected thereto. In step **116**, the controller **28** checks for user input (such as user input or "keypresses" using the keyboard **60** of FIG. 2). In step **118**, the controller's memory is updated with the current day and time information stored in the controller's clock (e.g., a real-time

clock). In step **120**, all timers and clocks ("timeclocks") utilized by the controller are then updated.

[0028] In step **122**, the controller **28** acts on commands or information entered by a user. For example, in this step, the user can enter or change date and time information. In step **124**, the controller executes a specialized control program loaded into the memory of the controller, such as the stored control programs of the present invention which will be discussed hereinbelow. Optionally, in step **126**, if an automated pool chlorinator is connected to the controller, it is updated for operation and control by the controller. In step **128**, any errors detected by the controller are processed, including, but not limited to, malfunctioning sensors or actuators connected to the controller. In response to such errors, the controller can disable a malfunctioning sensor or actuator, display an error code, or undertake any other preprogrammed action. In step **130**, non-volatile memory of the controller is updated, if applicable. Finally, in step **132**, any wired or wireless devices in communication with the controller, including but not limited to, handheld controllers, remote control panels connected to the controller (such as inside of a dwelling), or other devices, are updated for use and control. Processing then returns to step **106**.

[0029] FIG. 5 is a flow chart showing processing steps according to one embodiment of the stored control program of the present invention, indicated generally at **140**. The stored control program **140** could be executed at step **124** of the main control program **100** of FIG. 4. The stored control program **140** selectively actuates one or more aerator jets to maintain pool water temperature at a user-specified temperature. In step **142**, a determination is made as to whether aerator cooling is enabled, i.e., whether the pool includes aerators that can be used to cool pool water. If a negative determination is made, step **156** is invoked, wherein no aeration occurs and processing subsequently ends. If a positive determination is made, step **144** occurs, wherein a determination is made as to whether the filter pump, such as the pump **20** of FIG. 1, is on. If a negative determination is made, step **156** is invoked, wherein aeration is deactivated and processing subsequently ends. If a positive determination is made, step **146** is invoked, wherein a determination is made as to whether a water temperature sensor, such as the sensor **40** of FIG. 1, has experienced a fault. If a positive determination is made, step **156** occurs, wherein aeration is deactivated and processing subsequently ends.

[0030] If a negative determination is made, step **148** is invoked, wherein a determination is made as to whether the aerator has been manually turned off. If a positive determination is made, step **156** occurs, wherein aeration is deactivated and processing subsequently ends. If a negative determination is made, step **150** is invoked, wherein a determination is made as to whether the desired temperature has been set to "off" by the user. If a positive determination is made, step **156** occurs, wherein aeration is deactivated and processing subsequently ends. If a negative determination is made, step **152** is invoked, wherein the controller measures the current water temperature (e.g., using the temperature sensor **40** of FIG. 1) and determines whether the current water temperature is greater than a desired water temperature specified by the user. If a negative determination is made, step **156** occurs, wherein aeration is deactivated and processing subsequently ends. If a positive determination is made, step **154** occurs, a decision is made as to whether the

user desires to manually activate the aerator. If a positive determination is made, step 158 occurs, wherein the aerator is activated by the controller (e.g., by activating the valve 30 of FIG. 1 using the valve actuator 32) and processing subsequently ends. If a negative determination is made, step 157 is invoked, wherein a determination is made as to whether the current water temperature is greater than the desired temperature specified by the user plus one degree of temperature. If a positive determination is made, step 158 occurs, wherein the controller activates the aerator (e.g., by activating the valve 30 of FIG. 1 using the valve actuator 32), and processing ends. The stored control program 140 can be re-invoked as necessary by the controller for additional processing.

[0031] With general reference to FIGS. 1, 2, and 6, and with particular reference to FIG. 6, a flow chart is provided showing processing steps of another embodiment of the stored control program of the present invention, indicated generally at 160. The stored control program 160 could be executed at step 124 of the main control program 100 of FIG. 4. The stored control program 160 allows for both manual and program control of one or more aerator jets to maintain pool water temperature at a user-specified temperature. Upon the application of power to the controller 28 (see FIG. 1), the processor 54 loads the stored control program 160 from the memory 56 and begins executing a power-up procedure at step 162. During the power-up procedure 162, which will be discussed in more detail hereinbelow with reference to FIG. 7, input parameters are entered by the user and sensor types and conditions are determined. After the power-up procedure 162 is completed, step 164 is invoked, wherein the processor 54 retrieves a flag from the memory 56 which indicates whether the controller 28 is to operate in manual mode or program mode, and whether an error condition is present. This flag could be set (i) during the power-up procedure in step 162; (ii) by the user pressing one of the keys on the keyboard 60 to select an operating mode, thereby generating an interrupt; or (iii) by the presence of an error condition (i.e., a faulty sensor). If, at step 164, the processor 54 determines that the controller 28 is to run in program mode, then, at step 166, the processor 54 executes a stored temperature control sub-program which resides in the memory 56. This stored temperature control sub-program will be described hereinbelow with reference to FIG. 9. Operating in parallel is a process or task, illustrated in steps 168-170, which listens for interrupts (for example, from the keyboard 60). If the processor 54 receives an interrupt at step 168, then the processor 54 deactivates the aerators 38a-38e of FIG. 1 in step 170 by sending a signal to the valve actuator 32 to close the valve 30. Control of the main control program 160 then returns to step 164.

[0032] If, at step 164, the processor 54 determines that an error condition has occurred, then, at step 172, an error code is displayed to the user on the display 58 and the program 160 halts. If, at step 164, the processor 54 determines that the controller 28 is to run in manual mode, then, at step 174, the processor 54 prompts the user via the display 58 to enter a desired temperature to which to cool the pool water. After the user enters the desired temperature at the keyboard 60, the desired temperature is stored by the processor 54 in the memory 56. Then, at step 176, the processor 54 goes into a thermostat mode, which will be described hereinbelow with reference to FIG. 8. Operating in parallel is a process or task, illustrated in steps 178-180, which listens for interrupts (for

example, from the keyboard 60). If the processor receives an interrupt at step 178, then the processor 54 deactivates the aerators 38a-38e of FIG. 1 in step 180 by sending a signal to the valve actuator 32 to close the valve 30. Control of the main control program 160 then returns to step 164.

[0033] With reference to FIG. 7, which is a flow chart showing the power-up procedure 162 of FIG. 6 in greater detail, as well as to FIGS. 1-2, at step 182, the processor 54 polls the sensor interface 70 via the multiplexer 68 and the I/O bus circuitry 62 to determine the numbers and the types of sensors present, and stores this information in the memory 56. At step 186, the processor 54 polls for the presence of a battery-backed clock (i.e., clock 52). If such a clock is determined to be present at step 186, then, at step 188, the processor 54 determines whether the clock 52 is running properly. If not, then step 184 is invoked, wherein an error condition is flagged and the processor 54 then goes into error mode, in which it notifies the user of the error condition via the display 58 and halts the program 160. The processor 54 could also spawn a process or task to monitor proper functioning of the clock 52, which process or task could run in the background. If the clock is running properly, then the current time and date are retrieved by the processor 54 from the clock, and this data is stored in the memory 56. If the processor 54 determines that a battery-backed clock is not present, then step 190 is invoked, wherein the processor 54 prompts the user at the display 58 to enter the current time. After the user has entered the current time at the keyboard 60, the processor 54, at step 192, prompts the user at the display 58 to enter the current date. After the user has entered the current date at the keyboard 60, then, at step 194, the processor 54 stores the current time and date in the memory 56. It should be noted that the power-up procedure 160 could be substituted with one or more of the initialization procedures disclosed in connection with the main control program 100 of FIG. 4 without departing from the spirit or scope of the present invention.

[0034] Referring to FIG. 8, which is a flow chart showing the thermostat mode 176 of FIG. 6 in greater detail, as well as to FIGS. 1-2, in step 196, the processor 54 takes a measurement of the temperature of the water 14 of the pool 12. A decision is then made in step 200 as to whether the temperature of the water 14 is greater than the desired temperature. If a positive decision is made, then step 202 is invoked, wherein the processor 54 activates the aerators 38a-38e by sending a command to the valve actuator 32 to open the valve 30. Then, at step 198, the processor 54 delays a predetermined amount of time before taking another water temperature measurement at step 196. The delay could be pre-set by the manufacturer, or specified by the user. Preferably, the delay is pre-set at 100 milliseconds, but other times are possible.

[0035] If, at step 200, the processor 54 determines that the water temperature of the pool is equal to or less than the desired temperature, then at step 204, the processor 54 deactivates the aerators 38a-38e by sending a command to the valve actuator 32 to close the valve 30. At step 206, the processor 54 delays a predetermined amount of time (e.g., 100 milliseconds) before taking a water temperature measurement at step 208. At step 210, the processor 54 then calculates the difference (ΔT) between the desired temperature and the present pool water temperature. At step 212, a determination is made as to whether the absolute value of ΔT

is greater than a predetermined value (i.e., a maximum permissible temperature deviation, which can be pre-set or specified by the user). If a positive determination is made, then the processor 54, at step 202, reactivates the aerators 38a-38e by sending a command to the valve controller 32 to open the valve 30. Otherwise, control returns to step 206.

[0036] Referring again to FIG. 2, the processor 54 monitors pool temperature by selecting one or more of the output lines associated with the I/O bus circuitry 62 which, in turn, selects an address on address lines (not shown) of the multiplexer 68. The address corresponds to selecting the analog output voltage of the temperature sensor 40 or, optionally, a thermostat in the heater interface 42, both of which measure the water temperature of the pool. The analog output voltage of the sensor 40 or 42 is impressed upon the inputs of the A/D converter 66 via the multiplexer 68 and the sensor interface 70. The A/D converter 66 converts the voltage to a digital bit stream which travels through the I/O bus circuitry 62 to the processor 54. The processor 54 compares this temperature to the desired temperature stored in the memory 56.

[0037] Referring to FIG. 9, which is a flow chart showing step 166 of FIG. 6 in greater detail, as well as to FIGS. 1 and 2, at step 214, the desired water temperature T_D of the pool 12 is determined. If the user has previously entered the desired water temperature T_D , and no change in temperature is desired, then the processor 54 retrieves the desired temperature from the memory 56. If the user wishes to change the desired water temperature T_D , or the desired temperature has not been previously entered, then the processor 54 prompts the user at the display 58 to enter the desired water temperature T_D . After receiving the desired water temperature T_D from the user via the keyboard 60, the processor 54 stores the desired water temperature T_D in the memory 56. In steps 216-220, the current water temperature T_C , the ambient air temperature T_A , and the ambient air humidity H_A are measured using the sensors 40 (or thermostat in the heater interface 42, if provided), 34, and 36, respectively. Then, in step 222, the ambient conditions T_C , T_A , and H_A are compared to preprogrammed ranges stored in the controller 28. Such ranges could specify ambient temperature and humidity ranges for which aeration is optimal, and could be varied as desired by the user. It should be noted that any desired number of ambient conditions could be sensed and compared to any desired, preprogrammed ranges. In step 224, a determination is made as to whether the measured ambient conditions fall within the preprogrammed ranges. If a positive determination is made, step 226 is invoked, wherein the aerators are activated. Then, in step 228, the system enters the thermostat mode described above with respect to FIG. 8 to selectively control the aerators 38a-38e to achieve the desired temperature. If a negative determination is made in step 224, step 216 is re-invoked, so that ambient conditions are monitored. Optionally, the system could be programmed so that aeration is provided during optimal times of the day, e.g., from 6 PM to 9 PM during the evening.

[0038] Importantly, the stored temperature control program shown in FIG. 9 allows aerator cooling system 10 of the present invention to operate at optimal ambient conditions to achieve maximum cooling of the water 14 of the pool 12. By selectively channeling the water 14 of the pool

12 through the aerators 38a-38e, the water 14 is exposed to the ambient air to increase heat transfer thereto, thus cooling the water 14.

[0039] It will be understood that the embodiments described herein are merely exemplary and that a person skilled in the art may make many variations and modifications without departing from the spirit and scope of the invention. All such variations and modifications are intended to be included within the scope of the invention.

What is claimed is:

1. An aerator control system, comprising:

a user interface for allowing a user to specify a desired temperature for a body of water; and

a processor in communication with the user interface, the processor selectively actuating an aerator operatively associated with the body of water to cool the body of water to the desired temperature.

2. The system of claim 1, further comprising a water temperature sensor in communication with the processor, the processor monitoring a current temperature of the body of water using the water temperature sensor.

3. The system of claim 2, wherein the processor activates the aerator if the current temperature is greater than the desired temperature.

4. The system of claim 3, wherein the processor deactivates the aerator if the current temperature is equal to or less than the desired temperature.

5. The system of claim 1, further comprising an ambient air temperature sensor in communication with the processor, the processor monitoring ambient air temperature using the ambient air temperature sensor.

6. The system of claim 5, wherein the processor controls the aerator in response to changes in the ambient air temperature.

7. The system of claim 1, further comprising an ambient humidity sensor in communication with the processor, the processor monitoring ambient humidity levels using the ambient humidity sensor.

8. The system of claim 1, wherein the processor controls the aerator in response to changes in the ambient humidity level.

9. The system of claim 1, wherein the processor selectively actuates a heater associated with the body of water.

10. The system of claim 9, wherein the processor selectively actuates a pump associated with the body of water.

11. The system of claim 1, further comprising a memory in communication with the processor, the memory including a stored control program for selectively activating the aerator.

12. The system of claim 11, wherein the stored control program causes the processor to activate the aerator during a pre-defined time period.

13. An aerator control system, comprising:

an aerator associated with a body of water;

an actuator for selectively actuating the aerator; and

a processor in communication with the actuator, the processor selectively actuating the aerator to cool the body of water to a desired temperature.

14. The system of claim 13, further comprising a water temperature sensor in communication with the processor, the

processor monitoring a current temperature of the body of water using the water temperature sensor.

15. The system of claim 14, wherein the processor activates the aerator if the current temperature is greater than the desired temperature.

16. The system of claim 15, wherein the processor deactivates the aerator if the current temperature is equal to or less than the desired temperature.

17. The system of claim 13, further comprising an ambient air temperature sensor in communication with the processor, the processor monitoring ambient air temperature using the ambient air temperature sensor.

18. The system of claim 17, wherein the processor controls the aerator in response to changes in the ambient air temperature.

19. The system of claim 13, further comprising an ambient humidity sensor in communication with the processor, the processor monitoring ambient humidity levels using the ambient humidity sensor.

20. The system of claim 13, wherein the processor controls the aerator in response to changes in the ambient humidity level.

21. The system of claim 13, further comprising a second actuator in communication with the processor for selectively actuating a heater associated with the body of water.

22. The system of claim 21, further comprising a third actuator in communication with the processor for selectively actuating a pump associated with the body of water.

23. The system of claim 13, further comprising a memory in communication with the processor, the memory including a stored control program for selectively activating the aerator.

24. The system of claim 23, wherein the stored control program causes the processor to activate the aerator during a pre-defined time period.

25. A method for controlling temperature of a body of water, comprising:

allowing a user to specify a desired temperature for a body of water;

measuring a current temperature of the body of water;

determining whether the current temperature is greater than the desired temperature; and

if the current temperature is greater than the desired temperature, activating an aerator to cool the body of water to the desired temperature.

26. The method of claim 25, further comprising deactivating the aerator when the desired temperature is equal to or less than the desired temperature.

27. The method of claim 25, further comprising measuring an ambient air temperature.

28. The method of claim 27, further comprising controlling the aerator in response to a change in the ambient air temperature.

29. The method of claim 25, further comprising measuring an ambient humidity level.

30. The method of claim 29, further comprising controlling the aerator in response to a change in the ambient humidity level.

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