

Description

This invention relates to flow control systems and/or methods of controlling flows and/or equipment including such flow control systems and has been devised particularly though not solely for use in controlling the supply of attemperated water to laundry machines.

According to the present invention there is provided a method of controlling the temperature of a mixture of two liquids supplied to a mixing chamber, each liquid having a different temperature and a first one of said liquids having the higher temperature being caused to flow through a first valve to said mixing chamber and the second one of said liquids being caused to flow through a second valve to said mixing chamber, wherein are of said valves is initially held open and the flow through the other controlled in order to cause the temperature of the mixture in the mixing chamber to tend towards a desired temperature, characterised in that each of said valves has a valve seat, a spring loaded valve member biased to a closed position against said valve seat and an electromagnet effective on energization to actuate said spring loaded valve member towards a fully open position and actuable by causing a current to flow through said electromagnet to cause said electromagnet to progressively open said valve member, the said second valve is opened to a desired degree, current flowing in said electromagnet of said first valve is controlled in a manner such that the greater the current flowing the greater the flow of liquid through the first valve, the temperature in said mixing chamber is sensed and the current flowing in said electromagnet of said first valve is controlled according to said temperature of the liquid in said mixing chamber in a manner such that said valve member of said first valve progressively opens or closes so that the temperature of said mixture of said two liquids flowing through said first and second valves is maintained equal to or approaching the desired temperature in said mixing chamber, and when said first valve is opened to the fully open position and the desired raised temperature in said mixing chamber has not been reached, progressively closing said second valve to further/increase the temperature liquid in said mixing chamber up to the temperature of said first liquid when said desired temperature is equal to or higher than the temperature of said first liquid.

According to the present invention, there is further provided a flow control system to control the temperature of a mixture of a first and second liquid, each liquid having a different temperature and the first liquid having the higher temperature, wherein a mixing chamber has connected there to a first valve through which said first liquid flows, and a second valve through which said second liquid flows, one of said valves is initially held open and the flow through the other controlled in order to cause the temperature of the mixture to tend towards a desired temperature ; characteristic in that each said valve is a proportional control valve having a valve seat, a spring loaded valve member biased to a closed position against said valve seat and an electromagnet effective on energisation to actuate said valve member towards a fully open position, temperature sensing means are positioned in said mixing chamber for sensing the temperature of the mixture, first and second valve control means are responsive to said sensing means such that in operation with said second valve opened to a desired degree, current flowing through said electromagnet of said first valve is controlled by said first valve control means to desired levels responsive to signals from said sensing means in a manner such that said first valve is progressively opened or closed substantially according to current flowing in said electromagnet thereof so that the temperature of the mixture in said mixing chamber is maintained equal to or approaching a desired temperature and when said desired temperature level is not reached with said first valve fully open and said second valve open, said second valve is progressively closed to increase the temperature of liquid in said mixing chamber up to the temperature of said first liquid when the desired temperature level in said mixing chamber is equal to or higher than said first liquid temperature level.

According to the present invention there is also provided a laundry machine having a cabinet in which an agitator is mounted on a vertical shaft so as to rotate therewith and is oscillated back and forth within a coaxially mounted perforated spin tub, the spin tub and the agitator rotating continuously in one direction to give a spin action and the perforated spin tub and agitator in turn being mounted within a stationary water tight container, the cabinet containing an electric motor having a rotor and a stator and driving means to oscillate said agitator back and forth or rotate said spin tub continuously in one direction, said laundry machine including a flow control system according to the above described flow control system, said mixing chamber having an outlet conduit the inlet to which is disposed in said mixing chamber so as to maintain a quantity of liquid in said mixing chamber, and the exit from said conduit leading to said water tight container.

To those skilled in the art to which the invention relates, many changes in construction and widely differing embodiments and applications of the invention will suggest themselves without departing from the scope of the invention as defined in the appended claims. The disclosures and the descriptions herein are purely illustrative and are not intended to be in any sense limiting.

One preferred form of the invention will now be described with reference to the accompanying drawings in which Figure 1 is a cross section of a clothes washing machine incorporating the invention,

Figure 2 is a diagrammatic drawing showing the arrangements of circuitry and valves forming part of the invention,

Figure 3 is a cross-sectional view of a non-proportional valve that may form part of the present invention,

Figure 4 is a cross-sectional view of a proportional valve of a preferred form of the present invention,

5 Figure 5 is a detailed circuit diagram of valve drive electronic equipment forming part of the invention and Figure 6 is a circuit diagram of temperature sensing electronic circuitry forming part of the invention.

Water temperature is an important factor in the wash performance of laundry and other washing machines. In laundry machines water which is too cold results in reduced soil removal while if the water is too hot fabric damage may occur. An accepted optimum "warm" temperature is 40°C. However there is also a requirement
10 to allow for selection of a hot wash temperature in certain situations. Such a hot wash temperature must be controlled so that plastics in the machine and delicate clothes are not damaged and also so that the risk of burns to users is reduced. An acceptable "hot" wash temperature is 60°C.

Hot and cold water supply temperatures are unpredictable and as a result desired warm and hot wash temperatures can be difficult to achieve automatically in practice. Various control strategies have been developed
15 to ensure appropriate wash temperatures are achieved under varying hot and cold water supply temperatures.

For example, in US 4,330,081 a laundry machine water temperature control system is disclosed where hot and cold water bi-state valves are initially open and on a cyclical basis the cumulative average temperature of the mixed water in a mixing chamber is determined and one or other valve closed (or opened if already closed) to bring the average temperature to the desired wash water temperature. US 4,406,401 discloses a
20 laundry machine water temperature control system where one of the hot or cold water bi-state valves is held open and the other cycled on and off to cause the wash water temperature as calculated from temperature measurements of the hot and cold supply to equal the desired wash water temperature. Neither of the control systems described above are particularly effective where the hot and cold water supply pressures are grossly different.

25 It is an object of the present invention to provide a system for controlling the temperature of a mixture of two liquids of differing temperatures which goes at least some way towards overcoming the abovementioned disadvantage or which at least provides the public with a useful choice.

The present invention, in a preferred form, provides a new flow control method and system that can provide reasonably accurate warm and hot fill temperatures substantially without regard to the operating environment.

30 Referring now to the drawings, there is shown in Figure 1 a laundry machine 1 having a container 2 in which a spin tub 3 and an agitator 4 are driven by an electric motor 5 through a belt (not shown) and a pulley 6. Such a construction is known. Mounted on the cabinet of the washing machine is a console control panel 7 which contains user control, includes a microprocessor 8.

Referring now to Figure 2, two electromagnetic solenoid operated valves are provided, a hot water valve
35 10 and a cold water valve 11 having inlets from a hot water supply and a cold water supply respectively and the outlets 12 and 13 from the valves lead to a mixing or mixed liquid e.g. water chamber 14. An outlet 15 having a weir type inlet 16 at an upper level of the mixing chamber 14 leads to the container 2 of the laundry machine. Mounted on the upper surface 17 of the chamber 14 is an assembly of electronic devices which heat up in use and such devices may comprise power switches such as I.G.T.'s, a high voltage IC rectifier and other
40 control devices which in normal use are associated with an air cooled heat sink to dissipate heat which the devices generate in use. The chamber 14 is mounted in a container 18, the devices being embedded in a heat transfer material e.g. an epoxy resin and the container 18 is fixed to the surface 17 e.g. by and epoxy adhesive or by mechanical fixing including a heat transfer coating such as a heat transferring gel. The surface 19 of the container 18 is arranged to be below the level of the weir inlet 16 and is preferably corrugated as shown to
45 give and enlarged surface area exposed to water in the mixing chamber 14. The surface 19 is also preferably exposed to cold water flow from valve 11 before material mixing occurs.

One of the valves 10 and 11, e.g. the hot water valve 10 may be of the known form shown in Figure 3, the valve comprising a body 20 having an inlet 21 and outlet 22 there being a filter 23 in the inlet 21. An electro-magnet 24 has a solenoid coil 25 with a connection tab 26 and an armature or valve member 27 having a flexible
50 seal 28 and running in an armature guide 29 being moved to a closed disposition by a spring 30. The rate of spring 30 is about 10N/m. The valve has a diaphragm 31 with a bleed hole 32 therein normally closed by the armature seal 28 but on energising the coil 25 the seal is raised and the valve then admits water over the valve member seal 35 and the valve seat 36.

The other valve, i.e. the cold water valve 10 and preferably both valves, may be modified to provide proportional opening in accordance with Figure 4 where in place of the spring 30 of Figure 3 which as stated above normally has a rate of about 10N/m, a spring 40 is provided having a rate of about 1000N/m. Additionally an abutment 41 for the spring 40 may be provided as a screw adjustable abutment having a screw thread 42 engageable with a corresponding part 43 of the armature guide 29.

Some details of diaphragm 32 and the seat may be changed to provide progressive operation of the valve.

As referred to above preferably both valves 10 and 11 provide proportional opening and for example ELBI 12volt DC proportional valve type NZ-068-LB88 may be used. These valves are generally of the construction shown in Figure 4.

The control system for controlling the valves 10 and 11 comprises broadly a microprocessor (Figure 2), being part of the microprocessor 8 of Figure 1 proportional valve driver circuits 51, and a specified physical characteristic sensing circuit comprising in the preferred form, a temperature sensing circuit 52. The temperature sensing circuit is supplied with temperature signals from a thermistor 53 (Figure 2) provided in a recess 54 which is below the level of the weir entry 16 to the outlet 15.

Referring now to Figure 5, the valve driver circuits 51 are shown in reached outline boxes referenced 63 and 73 shown associated with the console microprocessor 8. Each valve driver circuit 63 and 73 is self oscillating and operates as follows. Only the valve driver circuit 63 will be described in detail, the circuit 73 being of similar construction and operation. A transistor 50 is turned on by an electronic device 59, which acts as a comparator, through resistance 64 causing at least 30 mA to flow in resistor 69, most of which is base current in transistor 71. Transistor 71 saturates, causing increased current to flow from the +18V supply through the coil 56 of say the hot water valve 10 causing operation of that valve as will be described further later. When the device 59 and the transistors 50 and 71 are turned off as a result of the self oscillation of the circuit, inductive current continues to flow in the coil 56 through the diode 57. At all times the current in the coil can be sensed at shunt resistor 58.

As stated above device 59 acts as a comparator sensing the coil current from the shunt resistor 58 through resistor 60. Hysteresis is provided by resistors 61 and 62. The circuit oscillates with a period relating to the coil inductance and the hysteresis values. The average coil current is maintained at a sufficient level that the average voltages at the comparator inputs are the same. When the demand voltage through resistor 63 is altered, the average current level alters to suit. This is achieved by varying the duty cycle of the oscillator.

Demand voltages for the oscillator are derived for example from a PWM output from the microprocessor 8, at a frequency of for example between 1 kHz - 5 kHz, the frequency not being critical. The output is integrated to a DC voltage by resistance 65 and capacitor 66. This circuit acts as a digital to analog convertor with 8 bit resolution. The 2 valve PWM outputs (2 valves and beeper) are interrupt driven from a timer, and are standard totem pole outputs. Only one PWM circuit at a time is operated in pulse width modulation mode. The outputs from the driver circuits 63 and 73 to the solenoids of the valves 10 and 11 are arranged so that static off (0V) provides off mode and, static on (5V) provides full on mode. The circuit gain is such that +5V gives 66% duty cycle equivalent to 12 volt DC operation. This relieves the microcomputer 8 from having to control both valves at once and also assists in preventing valve damage. Referring now to Figure 6 the temperature sensing circuit and apparatus is therein shown. Thus the temperature sensitive device (silicon sensor or thermistor) 53 which is mounted in the mixing chamber as shown in Figure 2, operates in association with resistors 80, 81, 82 and a 6 bit R-2R network 83. These resistors and network have a current summing point at their common junction. Resistances 81 and 82 serve to set the average DC output at the junction and the effective gain of the digital to analog convertor formed by resistance 83 (the R-2R network) and the microprocessor 8. The gain provided is such that the range of the 6 bit D-A convertor just exceeds the operating temperature range. It provides one degree C resolution over the range 10 to 73 degrees in the example being described.

The microprocessor operates the A to D operation by the successive approximation method where it attempts one bit at a time (high order first) to match the D to A output voltage to the voltage at the junction 84 of R101 and R103. The six microprocessor outputs to the R-2R network 83 control the network as described above. The device 85 which acts as a comparator is used to sense whether the A to D output exceeds the thermistor voltage or not. Its inputs are to the junction 84 and the junction between resistances 81, 82 and the R-2R network 83.

The output of comparator 85 goes to a microprocessor input 86 and requires a pullup resistor 87 since the comparator output is open collector.

At the end of the successive approximation temperature sensing cycles the microprocessor stores the 6 bit value it has arrived at as the current temperature, referred to below as the CURRENT TEMPERATURE word.

The operation of the apparatus above described is as follows. The microprocessor 8 provides a variable DC voltage by software pulse width modulation techniques. The DC voltage is filtered and applied to the valve driver circuits of Figure 5. When the microprocessor output is low (0V) the oscillator still runs but with the duty cycle so low that the valve controlled by the particular valve drive circuit 63 or 73 does not operate. When the output is high the oscillator duty cycle is about 66% so that the particular valve 10 or 11 is fully on. At 66% duty cycle the coil current is about the same as DC operation on 12 volts (the valve solenoids are fitted with 12 volt DC coils in the particular example being described). It is to be noted that the valve solenoids are driven with DC current to enable the inductance to be sensed. The driver circuits self oscillate as above described

and the period of oscillation depends on the hysteresis threshold of the comparator and on the inductance of the coil at any particular instant. It is of course recognised that the inductance of the coils of the valves 10 and 11 will vary according to the position of the armature of the valves which will vary according to the current supplied to the coils. Thus the period of oscillation varies from 0.3 to 4.4 milliseconds for particular parameters and this period is sensed by the microprocessor 8. The duty cycle of oscillation depends on the output voltage provided by the microprocessor.

The two valve circuits as stated are identical and the physical arrangement of the water system is such that correct operation is possible with the hot water supplied to either one of the two valves. The software can test which valve is which so flexible foolproof operation is possible. At any time during filling, one valve is preferably left fully on which maximises the fill rate while the other valve is proportionally controlled. This means that the microprocessor only needs to pulse width modulate one output at a time.

It should be mentioned that the console microprocessor 8 handles a number of tasks in relation to the washing process but the filling operation and temperature control are treated in isolation since they operate independently due to the nature of an interrupt control provided in the console microprocessor.

In setting the temperature, the valve control task is given a number which equates to the demanded fill temperature (the DEMAND word). This temperature can be anywhere within the six bit range, 10° to 73° C. Presuming that the microprocessor knows by now which valves supplies hot water (as stated above either valve can be selected and identified by the apparatus collating the change in temperature indicated by the thermistor 53 as compared with the demand fill temperature). The first operation of the apparatus is to turn the cold water valve fully on. The duty cycle of the hot valve is slowly increased as will be described further later until a point is reached when the CURRENT TEMPERATURE word equals the DEMAND word. In this regard temperature sensing is effected by successive approximations to arrive at an output 6 bit word to the D-A convertor, (R-2R network) which approximation is the closest to the current temperature dependant voltage at the thermistor 53. This word is stored for later use by the valve control algorithm and is the CURRENT TEMPERATURE word above referred to. When the CURRENT TEMPERATURE word equals the DEMAND word then that is an equilibrium point but if the CURRENT TEMPERATURE word does not equal the DEMAND word when the hot water valve is fully on, the hot water is left fully on and the cold water valve duty cycle is slowly reduced in the preferred form of the invention when both valves are proportional valves until the CURRENT TEMPERATURE word and the DEMAND word are equal, in other words the current temperature corresponds to the demanded fill temperature. At this point the fill continues with corrections taking place at regular intervals due to fluctuation in the water temperatures or pressures or flow rates. By maintaining one valve fully on maximum fill rate is achieved.

If the hot water temperature available does not meet the demanded fill temperature, the cold water valve remains closed and if desired a circuit is provided to indicate a cold washing condition.

The ramping up and down of valve duty cycle demand (call it VALVE DEMAND) is done using an integrating technique. The CURRENT TEMPERATURE is subtracted from the DEMAND word at fixed intervals about once per second. The result is positive if the CURRENT TEMPERATURE is low and negative if the CURRENT TEMPERATURE is high. Each time this calculation is made, a correction is made to the demand output of the control valve as follows:

Subtraction result	Hot valve controlled	Cold valve controlled
positive	VALVE DEMAND increased	VALVE DEMAND decreased
negative	VALVE DEMAND decreased	VALVE DEMAND increased

When a steady state is reached the demand is incremented and decremented slightly e.g. by one step on alternate control cycles thus retaining the required average demand. By restricting the sensing cycle rate, good stability of the control loop is achieved (the thermistor response time is of the order of seconds).

Since the temperature control loop response time is long, the loop cannot correct for short term variations in temperatures caused particularly by changes in water supply pressures. For this reason a second fast control loop may be added which operates as follows. An external input from the proportionally controlled valve driver 63 or 73 to the microprocessor 8 causes a regular interrupt which the microprocessor uses to measure the oscillation period of the driver. This period is dependent on the displacement of the armature in the electro-

magnet At intervals between e.g. 0.3 and 4.4ms the microprocessor will know of any displacement error in the valve armature as a change in period reading. If the period is reduced it means that the armature has moved out of the solenoid in the direction that reduces the flow.

At the start of each temperature control cycle (about once per second) the current driver period is stored call it "PERIOD REFERENCE". At every interrupt from the valve driver the measured period (CURRENT PERIOD) is compared with the PERIOD REFERENCE by subtraction. The difference is multiplied by a scaling factor and added to or subtracted from the current VALVE DEMAND. This loop is much faster (250 to 3,000 times per second) and easily stabilises small armature movements. Note that the result (call it VALVE OUTPUT) is sent to the PWM D-A converter routine in the microprocessor but is not used for subsequent corrections. At all times the inductive current control loop works with VALVE DEMAND. Inductive control is preferably only used below about 30% duty cycle where the effective pressure changes are most marked ie. at low flow rates. As it happens, this is also where the change of inductance with armature displacement is most sensitive. Because inductive control only occurs at lower demand duty cycles, there is never any need to inductively control two valves at once. The decision as to which period sense input to use depends only on which valves is not at 100% PWM.

To provide the microprocessor with an analogue output, an 8 bit up counting timer is used to produce pulse width modulated output, which is integrated on an external capacitor to a DC voltage. The timer is used to provide an internal interrupt when it overflows to zero. At every alternate interrupt, the timer is loaded with VALVE OUTPUT, and alternately with the complement of VALVE OUTPUT. When VALVE OUTPUT is loaded into the timer, the PWM output pin is set low; when the complement is loaded, the PWM output pin is also complemented. Thus the timer produces a square wave output on the pin with a period equal to 256 times the timer clock and a duty cycle related to VALVE OUTPUT.

Although a digital to analogue converter and comparator temperature sensing circuit has been described a multiple slope ramp circuit or other technique may be used. The invention in the preferred form provides reasonably accurate control of the temperature of water used to fill the water container of a laundry machine thus overcoming at least some of the disadvantages of current filling methods and systems.

The invention is applicable to apparatus in which a mixture of two or more fluids having different physical characteristics is required. Such apparatus for example comprises refrigerators, freezers, dish washers and air conditioners and the different physical characteristics may comprise for example colours, optical density and specific gravity.

Claims

1. A method of controlling temperature of a mixture of two liquids supplied to a mixing chamber (14), each liquid having a different temperature and a first one of said liquids having the higher temperature being caused to flow through a first valve (10) to said mixing chamber and the second one of said liquids being caused to flow through a second valve (11) to said mixing chamber (14), wherein one of said valves is initially held open and the flow through the other controlled in order to cause the temperature of the mixture in the mixing chamber to tend towards a desired temperature, *characterised in that* each of said valves (10, 11) has a valve seat (36), a spring (40) loaded valve member (27) biased to a closed position against said valve seat (36) and an electromagnet (24) effective on energization to actuate said spring loaded valve member (27) towards a fully open position and actuable by causing a current to flow through said electromagnet to cause said electromagnet (24) to progressively open said valve member (27), the said second valve (11) is opened to a desired degree, current flowing in said electromagnet (24) of said first valve (10) is controlled in a manner such that the greater the current flowing the greater the flow of liquid through the first valve (10), the temperature in said mixing chamber (14) is sensed and the current flowing in said electromagnet (24) of said first valve is controlled according to said temperature of the liquid in said mixing chamber in a manner such that said valve member (27) of said first valve (10) progressively opens or closes so that the temperature of said mixture of said two liquids flowing through said first and second valves (10, 11) is maintained equal to or approaching the desired temperature in said mixing chamber (14), and when said first valve (10) is opened to the fully open position and the desired raised temperature in said mixing chamber has not been reached, progressively closing said second valve (11) to further increase the temperature of liquid in said mixing chamber (14) up to the temperature of said first liquid when said desired temperature is equal to or higher than the temperature of said first liquid.
2. A flow control system to control the temperature of a mixture of a first and second liquid, each liquid having a different temperature and the first liquid having the higher temperature wherein a mixing chamber (14)

magnet At intervals between e.g. 0.3 and 4.4ms the microprocessor will know of any displacement error in the valve armature as a change in period reading. If the period is reduced it means that the armature has moved out of the solenoid in the direction that reduces the flow.

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Claims

1. A method of controlling temperature of a mixture of two liquids supplied to a mixing chamber (14), each liquid having a different temperature and a first one of said liquids having the higher temperature being caused to flow through a first valve (10) to said mixing chamber and the second one of said liquids being caused to flow through a second valve (11) to said mixing chamber (14), wherein one of said valves is initially held open and the flow through the other controlled in order to cause the temperature of the mixture in the mixing chamber to tend towards a desired temperature, *characterised in that* each of said valves (10, 11) has a valve seat (36), a spring (40) loaded valve member (27) biased to a closed position against said valve seat (36) and an electromagnet (24) effective on energization to actuate said spring loaded valve member (27) towards a fully open position and actuable by causing a current to flow through said electromagnet to cause said electromagnet (24) to progressively open said valve member (27), the said second valve (11) is opened to a desired degree, current flowing in said electromagnet (24) of said first valve (10) is controlled in a manner such that the greater the current flowing the greater the flow of liquid through the first valve (10), the temperature in said mixing chamber (14) is sensed and the current flowing in said electromagnet (24) of said first valve is controlled according to said temperature of the liquid in said mixing chamber in a manner such that said valve member (27) of said first valve (10) progressively opens or closes so that the temperature of said mixture of said two liquids flowing through said first and second valves (10, 11) is maintained equal to or approaching the desired temperature in said mixing chamber (14), and when said first valve (10) is opened to the fully open position and the desired raised temperature in said mixing chamber has not been reached, progressively closing said second valve (11) to further increase the temperature of liquid in said mixing chamber (14) up to the temperature of said first liquid when said desired temperature is equal to or higher than the temperature of said first liquid.

2. A flow control system to control the temperature of a mixture of a first and second liquid, each liquid having a different temperature and the first liquid having the higher temperature wherein a mixing chamber (14)



- has connected thereto a first valve (10) through which said first liquid flows and a second valve (11) through which said second liquid flows, are of said valves is initially held open and the flow through the other controlled in order to cause the temperature of the mixture to tend towards a desired temperature *characterised in that*: each said valve is a proportional control valve having a valve seat (36), a spring (40) loaded valve member (27) biased to a closed position against said valve seat (36), and an electromagnet (24) effective on energisation to actuate said valve member (27) towards a fully open position, temperature sensing means (53) are positioned in said mixing chamber (14) for sensing the temperature of the mixture, first (63) and second (73) valve control means are responsive to said sensing means (53) such that in operation with said second valve (11) open to a desired degree, current flowing through said electromagnet (24) of said first valve is controlled by said first valve control means (63) to desired levels responsive to signals from said sensing means (53) in a manner such that said first valve (10) is progressively opened or closed substantially according to current flowing in said electromagnet (24) thereof so that the temperature of the mixture in said mixing chamber (14) is maintained equal to or approaching a desired temperature, and when said desired temperature level is not reached with said first valve (10) fully open and said second valve (11) open, said second valve (11) is progressively closed to increase the temperature of liquid in said mixing chamber (14) up to the temperature of said first liquid when the desired temperature level in said mixing chamber (14) is equal to or higher than said first liquid temperature level.
3. A flow control system as claimed in Claim 2 wherein said temperature sensing means comprises a thermistor (53) mounted in said mixing chamber (14).
 4. A flow control system as claimed in either of Claims 2 or 3 wherein a microprocessor (8) is provided operatively connected to said temperature sensing means (53) for acting in response to signals therefrom, the electromagnet (24) of each valve (10, 11) comprises a solenoid coil (2-5), and a valve driving circuit (63, 73) controls the current through each said solenoid, each valve driving circuit (63, 73) being connected to said microprocessor for receiving commands from said microprocessor (8) for proportionally controlling the degree of opening of the valve (10, 11) controlled by the respective valve driving circuit (63, 73).
 5. Apparatus comprising a flow control system according to any one of Claims 2 to 4 and a container (3), said container (3) receiving mixed liquids from the mixing chamber (14) of said flow control system.
 6. A laundry machine (1) having a cabinet in which an agitator (4) is mounted on a vertical shaft so as to rotate therewith and is oscillated back and forth within a coaxially mounted perforated spin tub (3), the spin tub (3) and the agitator (4) rotating continuously in one direction to give a spin action and the perforated spin tub and agitator in turn being mounted within a stationary water tight container (2), the cabinet containing an electric motor (5) having a rotor and a stator and driving means to oscillate said agitator back and forth or rotate said spin tub continuously in one direction, said laundry machine (1) including a flow control system according to any one of Claims 2 to 4, said mixing chamber (14) having an outlet conduit (15) the inlet to which is disposed in said mixing chamber (14) so as to maintain a quantity of liquid in said mixing chamber (14), and the exit from said conduit leading to said water tight container (2).
 7. A laundry machine as claimed in Claim 6 wherein said rotor and stator driving means include electronic devices which produce heat in use, at least some of said electronic devices being grouped and mounted in a container (18) having at least one surface (19) thereof exposed to the flow of the cooler of said two liquids to be mixed.
 8. A laundry machine according to Claim 6 wherein said at least one surface (19) of said container (18) is disposed in said mixing chamber (14) below the level of said entry to said outlet conduit (15) and adjacent the outlet of the valve (10,11) through which the cooler of said two liquids flows.

Patentansprüche

1. Verfahren zum Regeln der Temperatur einer Mischung zweier Flüssigkeiten, die in eine Mischkammer (14) gegeben werden, wobei jede Flüssigkeit eine unterschiedliche Temperatur hat und bewirkt wird, daß eine erste der Flüssigkeiten mit der höheren Temperatur durch ein erstes Ventil (10) in die Mischkammer strömt, und bewirkt wird, daß die zweite der Flüssigkeit durch ein zweites Ventil (11) in die Mischkammer



(14) strömt, wobei eines der Ventile anfänglich offen gehalten wird und der Durchfluß durch das andere geregelt wird, um zu bewirken, daß die Temperatur der Mischung in der Mischkammer sich auf eine gewünschte Temperatur bewegen wird, dadurch gekennzeichnet, daß jedes der Ventile (10, 11) einen Ventilsitz (36), ein mit Feder (40) belastetes Ventilelement (27), das gegen den Ventilsitz (36) in eine geschlossene Position vorgespannt ist, und einen Elektromagneten (24) hat, der bei Anregung wirksam wird, um das mit Feder belastete Ventilelement (27) in eine voll offene Position zu treiben, und betätigbar ist, indem ein Strom durch den Elektromagneten fließen gelassen wird, um zu bewirken, daß der Elektromagnet (24) fortschreitend das Ventilelement (27) öffnet, hat, wobei das zweite Ventil (11) zu einem gewünschten Grad geöffnet wird, wobei der Strom, der in dem Elektromagneten (24) des ersten Ventils (10) fließt, derart geregelt wird, daß, je größer der fließende Strom ist, desto größer der Durchfluß an Flüssigkeit durch das erste Ventil (10) ist, wobei die Temperatur in der Mischkammer (14) abgefühlt wird und der in dem Elektromagneten (24) des ersten Ventils fließende Strom entsprechend der Temperatur der Flüssigkeit in der Mischkammer geregelt wird, in einer solchen Weise, daß sich das Ventilelement (27) des ersten Ventils (10) fortschreitend öffnet oder schließt, so daß die Temperatur der Mischung der zwei Flüssigkeiten, die durch das erste und zweite Ventil (10, 11) fließen, gleich oder annähernd auf der gewünschten Temperatur in der Mischkammer (14) gehalten wird, und wenn das erste Ventil (10) in die voll offene Position geöffnet ist und die gewünschte angehobene Temperatur in der Mischkammer nicht erreicht worden ist, das zweite Ventil (11) fortschreitend geschlossen wird, um weiter die Temperatur der Flüssigkeit in der Mischkammer (14) auf die Temperatur der ersten Flüssigkeit anzuheben, wenn die gewünschte Temperatur gleich oder höher ist als die Temperatur der ersten Flüssigkeit.

2. Durchflußregelsystem, um die Temperatur einer Mischung einer ersten und zweiten Flüssigkeit zu regeln, wobei jede Flüssigkeit eine unterschiedliche Temperatur hat und die erste Flüssigkeit die höhere Temperatur hat, wobei an eine Mischkammer (14) ein erstes Ventil (10), durch das die erste Flüssigkeit fließt, und ein zweites Ventil (11), durch das die zweite Flüssigkeit fließt, angeschlossen ist, wobei eines der Ventile anfänglich offen gehalten wird und der Fluß durch das andere gesteuert wird, um zu bewirken, daß die Temperatur der Mischung sich in Richtung auf eine gewünschte Temperatur bewegen wird, dadurch gekennzeichnet, daß: jedes Ventil ein Proportionalregelventil ist, mit einem Ventilsitz (36), einem mit Feder (40) belasteten Ventilelement (27), das in eine geschlossene Position gegen den Ventilsitz (36) vorgespannt ist, und einem Elektromagneten (24), der auf Anregung wirksam wird, um das Ventilelement (27) in eine voll offene Position zu treiben, wobei Temperaturfühleinrichtungen (53) in der Mischkammer (14) angeordnet sind, um die Temperatur der Mischung zu fühlen, wobei erste (63) und zweite (73) Ventilsteuereinrichtungen auf die Fühleinrichtung (53) derart ansprechen, so daß im Betrieb, wobei das zweite Ventil (11) zu einem gewünschten Grad offen ist, Strom, der durch den Elektromagneten (24) des ersten Ventils fließt, durch die erste Ventilsteuereinrichtung (73) auf gewünschte Werte gesteuert wird, ansprechend auf Signale von der Fühleinrichtung (53) derart, daß das erste Ventil (10) fortschreitend geöffnet oder geschlossen wird, im wesentlichen entsprechend zu dem Strom, der in dem Elektromagneten (24) desselben fließt, so daß die Temperatur der Mischung in der Mischkammer (14) gleich oder sich an eine gewünschte Temperatur angenähert gehalten wird, und wenn der gewünschte Temperaturwert nicht erreicht wird, wenn das erste Ventil (10) voll offen und das zweite Ventil (11) offen ist, das zweite Ventil (11) fortschreitend geschlossen wird, um die Temperatur der Flüssigkeit in der Mischkammer (14) bis auf die Temperatur der ersten Flüssigkeit zu erhöhen, wenn der gewünschte Temperaturwert in der Mischkammer (14) gleich oder höher ist als der erste Flüssigkeitstemperaturwert.

3. Flußsteuersystem nach Anspruch 2, bei dem die Temperaturfühleinrichtung einen Thermistor (53) aufweist, der in der Mischkammer (14) angebracht ist.

4. Durchflußregelsystem nach einem der Ansprüche 2 oder 3, bei dem ein Mikroprozessor (8) vorgesehen ist, betriebsmäßig mit Temperaturfühleinrichtung (53) verbunden, um ansprechend auf Signale davon zu wirken, wobei der Elektromagnet (24) jedes Ventils (10, 11) eine Zylindermagnetspule (2-5) aufweist, und eine Ventiltreiberschaltung (63, 73) den Strom durch jede Magnetspule steuert, wobei jede Ventiltreiberschaltung (63, 73) mit dem Mikroprozessor verbunden ist, um Befehle von dem Mikroprozessor (8) zu erhalten, um proportional den Grad des Öffnens des Ventils (10, 11) zu steuern, gesteuert durch die jeweilige Ventiltreiberschaltung (63, 73).

5. Vorrichtung mit einem Durchflußregelsystem nach einem der Ansprüche 2 bis 4 und einem Behälter (3), wobei der Behälter (3) gemischte Flüssigkeiten aus der Mischkammer (14) des Flußsteuersystems erhält.



6. Waschmaschine (1) mit einem Gehäuse, in dem ein Rührwerk (4) auf einer vertikalen Welle angebracht ist, um sich mit dieser zu drehen, und hin- und her innerhalb einer coaxial angebrachten, gelochten Drehtrommel (3) bewegt wird, wobei die Drehtrommel (3) und das Rührwerk (4) sich kontinuierlich in eine Richtung drehen, um eine Drehwirkung zu ergeben, und die gelochte Drehtrommel und das Rührwerk wiederum in einem stationären wasserdichten Behälter (2) angebracht sind, wobei das Gehäuse einen elektrischen Motor (5) mit einem Rotor und einem Stator und Antriebseinrichtungen zum Drehen des Rührwerkes hin und her oder zum Drehen der Drehtrommel kontinuierlich in eine Richtung enthält, wobei die Waschmaschine (1) ein Durchflußregelsystem nach einem der Ansprüche 2 bis 4 enthält, wobei die Mischkammer (14) eine Auslaßleitung (15) hat, wobei der Einlaß in diese hinein in der Mischkammer (14) angeordnet ist, um so eine Menge an Flüssigkeit in der Mischkammer (14) zu halten, und der Auslaß aus der Leitung in den wasserdichten Behälter (2) führt.
7. Waschmaschine nach Anspruch 6, bei der die Antriebseinrichtung für den Rotor und Stator elektronische Vorrichtungen umfassen, die bei der Verwendung Wärme erzeugen, wobei wenigstens einige der elektronischen Vorrichtungen in einem Behälter (18) gruppiert und angebracht sind, der wenigstens eine Fläche (19) aufweist, die der Strömung der Kühlung der zwei zu mischenden Flüssigkeiten ausgesetzt ist.
8. Waschmaschine nach Anspruch 6, bei der die wenigstens eine Fläche (19) des Behälters (18) in der Mischkammer (14) unterhalb dem Pegel des Einlasses in die Auslaßleitung (15) und benachbart dem Auslaß des Ventils (10, 11), durch die Kühlung der beiden Flüssigkeiten strömt, angeordnet ist.

Revendications

1. Procédé de contrôle de la température d'un mélange de deux liquides fournis à une chambre de mélange (14), chaque liquide ayant une température différente et un premier desdits liquides, ayant la température la plus élevée, étant forcé à s'écouler dans une première soupape (10) vers ladite chambre de mélange et le deuxième desdits liquides étant forcé à s'écouler, en passant par une deuxième soupape (11), vers ladite chambre de mélange (14), dans lequel l'une desdites soupapes est initialement maintenue ouverte et l'écoulement par l'autre soupape est contrôlé en vue de forcer la température du mélange contenue dans la chambre de mélange à tendre vers une température souhaitée, caractérisé en ce que chacune desdites soupapes (10, 11) présente un organe de soupape (27) sollicité par un ressort (40), déplacé vers une position fermée contre ledit siège de soupape (36), et un électroaimant (24), agissant lors de l'activation pour actionner ledit organe de soupape (27) sollicité par un ressort vers une position complètement ouverte et pouvant être actionné pour provoquer le passage d'un courant dans ledit électroaimant, afin de forcer ledit électroaimant (24) à ouvrir progressivement ledit organe de soupape (27), ladite deuxième soupape (11) est ouverte à un degré souhaité, un courant passant dans ledit électroaimant (24) de ladite première soupape (10) est contrôlé de manière que, plus le courant passant est grand, plus le débit de liquide passant par la première soupape (10) est grand, la température dans ladite chambre de mélange (14) est mesurée et le courant passant dans ledit électroaimant (24) de ladite première soupape est contrôlée en fonction de ladite température de liquide dans ladite chambre de mélange, de manière que ledit organe de soupape (27) de ladite première soupape (10) s'ouvre ou se ferme progressivement, afin que la température dudit mélange desdits deux liquides passant par lesdites première et deuxième soupapes (10, 11) soit maintenue égale ou à peu près égale à la température souhaitée dans ladite chambre de mélange 14, et, lorsque ladite première soupape (10) est ouverte vers la position complètement ouverte et que ladite température plus élevée souhaitée dans ladite chambre de mélange n'a pas été atteinte, provoquant la fermeture progressive de ladite deuxième soupape (10) pour augmenter encore la température du liquide dans ladite chambre de mélange (14) jusqu'à la température dudit premier liquide, lorsque ladite température souhaitée est supérieure ou égale à la température dudit premier liquide.
2. Système de contrôle de débit pour contrôler la température d'un mélange d'un premier et d'un deuxième liquides, chaque liquide ayant une température différente et le premier liquide ayant la température la plus élevée, dans lequel une chambre de mélange (14) est connectée à une première soupape (10) par laquelle s'écoule ledit premier liquide et une deuxième soupape (10) par laquelle s'écoule ledit deuxième liquide, l'une desdites soupapes étant maintenue initialement ouverte et le débit passant par l'autre soupape étant contrôlé en vue de forcer la température du mélange à tendre vers une température souhaitée, caractérisé en ce que : chaque dite soupape est une soupape à commande proportionnelle ayant un siège de soupape (36), un organe de soupape (27) sollicité par un ressort (40), déplacé vers une position fermée contre



ledit siège de soupape (36), et un électroaimant (24) agissant lors de l'activation pour actionner ledit organe de soupape (27) vers une position complètement ouverte, des moyens de mesure de température (53) sont disposées dans ladite chambre de mélange (14) pour mesurer la température du mélange, des premiers (63) et deuxième (73) moyens de commande de soupape sont sensibles audits moyens de mesure (53) de manière que, en fonctionnement avec ladite deuxième soupape (11) ouverte à un degré souhaité, le courant passant par ledit électroaimant (24) de ladite première soupape soit contrôlée par ledit premier moyen de commande de soupape (63) à des niveaux souhaités sensibles à des signaux provenant dudit moyen de mesure (53) de manière que ladite première soupape (10) soit progressivement ouverte ou fermée sensiblement selon un courant passant dans son dit électroaimant (24), de manière que la température du mélange contenue dans ladite chambre de mélange (14) soit maintenue égale ou à peu près égale à une température souhaitée, et, lorsque ledit niveau de température souhaitée n'est pas atteint avec ladite première soupape (10) complètement ouverte et ladite deuxième soupape (11) ouverte, ladite deuxième soupape (11) soit progressivement fermée pour augmenter la température du liquide contenu dans ladite chambre de mélange (14), jusqu'à la température dudit premier liquide, lorsque la niveau de température souhaitée dans ladite chambre de mélange (14) est supérieure ou égale audit premier niveau de température de liquide.

3. Système de contrôle de débit selon la revendication 2, dans lequel ledit moyen de mesure de température comprend une thermistance (53) montée dans ladite chambre de mélange (14).

4. Système de contrôle de débit selon l'une des revendications 2 ou 3, dans lequel un microprocesseur (8) est prévu, connecté fonctionnellement audit moyen de mesure de température (53), pour agir en réponse à des signaux provenant de ce dernier, l'électroaimant (24) de chaque soupape (10, 11) comprend une bobine de solénoïde (2 à 5), un dispositif de contrôle du courant passant dans chaque dit solénoïde, et un circuit de commande de soupape (63, 73), chaque circuit de commande de soupape (63, 73) étant connecté audit microprocesseur pour recevoir des commandes depuis ledit microprocesseur (8), afin de contrôler proportionnellement le degré d'ouverture de la soupape (10, 11) contrôlée par le circuit de commande de soupape (63, 73) respectif.

5. Dispositif comprenant un système de contrôle de débit selon l'une quelconque des revendications 2 à 4, et un récipient (3), ledit récipient (3) recevant des liquides mélangés depuis la chambre de mélange (14) dudit système de contrôle de débit.

6. Machine à laver (1) ayant une enceinte dans laquelle un agitateur (4) est monté sur un arbre vertical, de manière à tourner avec ce dernier et est mis en oscillation, dans un sens et dans l'autre, dans une cuve rotative (3) perforée, montée coaxialement, la cuve rotative (3) et l'agitateur (4) tournant en continu dans une direction pour exercer une action de rotation et la cuve rotative perforée et l'agitateur étant montés à leur tour dans un récipient étanche à l'eau (2) stationnaire, l'enceinte contenant un moteur électrique (5) ayant un rotor et un stator et un moyen d'entraînement pour mettre en oscillation dans un sens et dans l'autre ledit agitateur ou faire tourner ladite cuve rotative de manière continue dans une direction, ladite machine à laver (1) comprenant un système de contrôle de débit selon l'une quelconque des revendications 2 à 4, ladite chambre de mélange (14) ayant une conduite de sortie (15), dont l'entrée est disposée dans ladite chambre de mélange (14) de manière à maintenir une quantité de liquide donnée dans ladite chambre de mélange (14), et la sortie de ladite conduite menant audit récipient étanche à l'eau (2).

7. Machine à laver selon la revendication 6, dans laquelle lesdits moyens de commande de rotor et de stator comprennent des dispositifs électroniques qui produisent de la chaleur en utilisation, au moins certains desdits dispositifs électroniques étant groupés et montés dans un récipient (18) ayant sur lui au moins une surface (19) exposée au débit du plus froid desdites deux liquides à mélanger.

8. Machine à laver selon la revendication 6, dans laquelle ladite au moins une surface (19) dudit récipient (18) est disposée dans ladite chambre de mélange (14), au-dessous du niveau de ladite entrée à ladite conduite de sortie (15) et de manière adjacente à la sortie de la soupape (10, 11) par laquelle s'écoule le plus froid desdits deux liquides.

