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Maddren

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[54] **HOT WATER SUPPLY SYSTEM AND METHOD**

[76] Inventor: **Herbert J. Maddren,** 29 Springlane Drive, Blackwood, N.J. 08012

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[51] **Int. Cl.** **F16k 49/00**

[58] **Field of Search** 137/337, 564, 334, 339, 137/335, 341

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Primary Examiner—Henry T. Klinksiek

Attorney, Agent, or Firm—Paul Maleson; Morton J. Rosenberg

[57] **ABSTRACT**

A hot water supply system and method adapted for use in residental and/or commercial edifices. The hot water supply system provides for water at a predetermined temperature to be passed through a faucet for use. Where the water temperature is less than the required predetermined temperature, the water is recirculated to a hot water heater. The system includes a pumping mechanism for forcing recirculated water into the hot water heater. Further, the system provides a mechanism for directing water in a predetermined flow path responsive to the water temperature. The flow path of the water is either through the faucet or directed back to the hot water heater dependent on the aforementioned water temperature.

14 Claims, 5 Drawing Figures

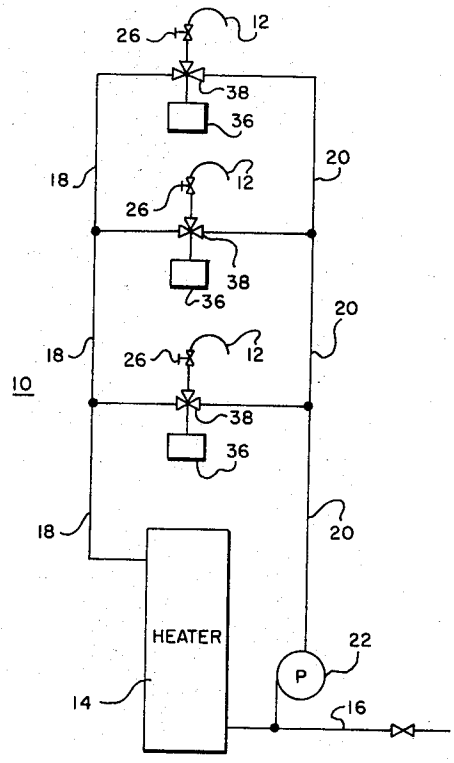
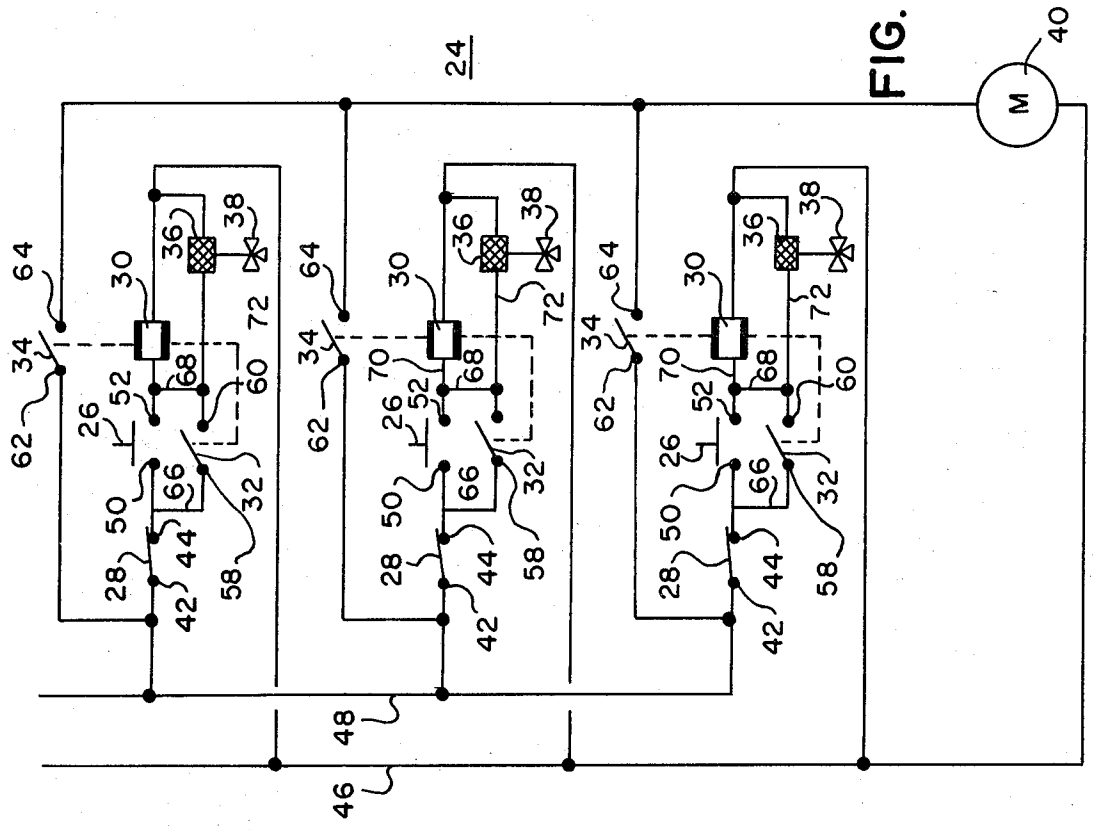


FIG. 2


24
40
M
64
34
62
30
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38
72
68
60
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26
70
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28
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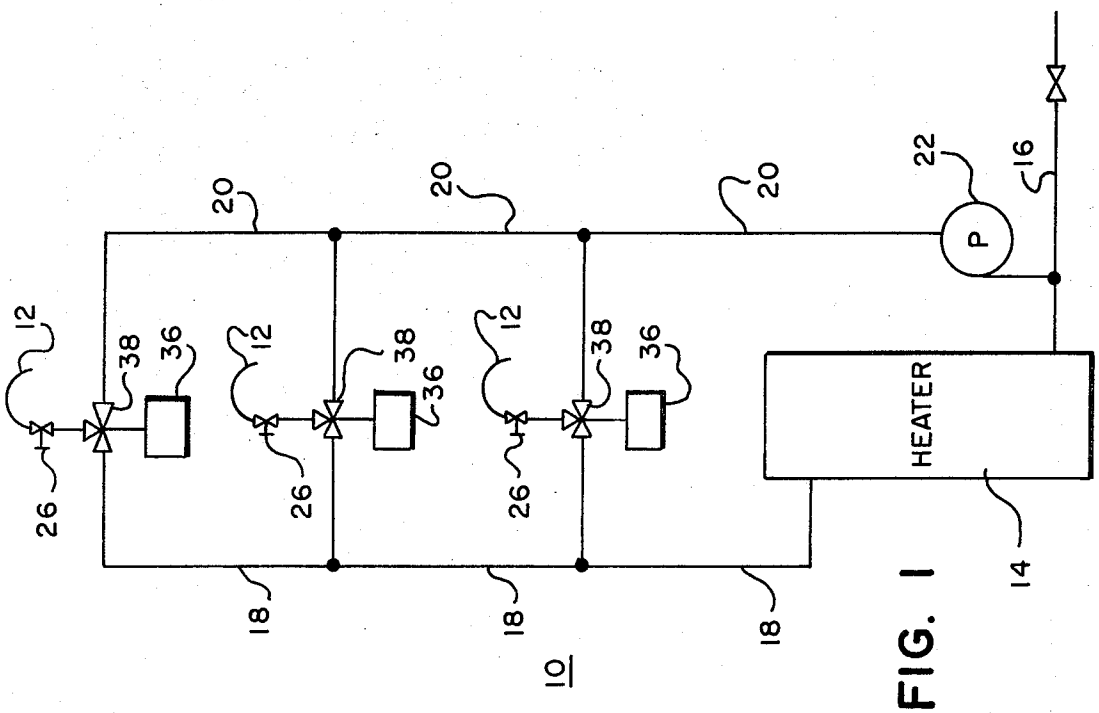

10
20
22
16
P
12
38
36
26
18
HEATER
14

FIG. 1

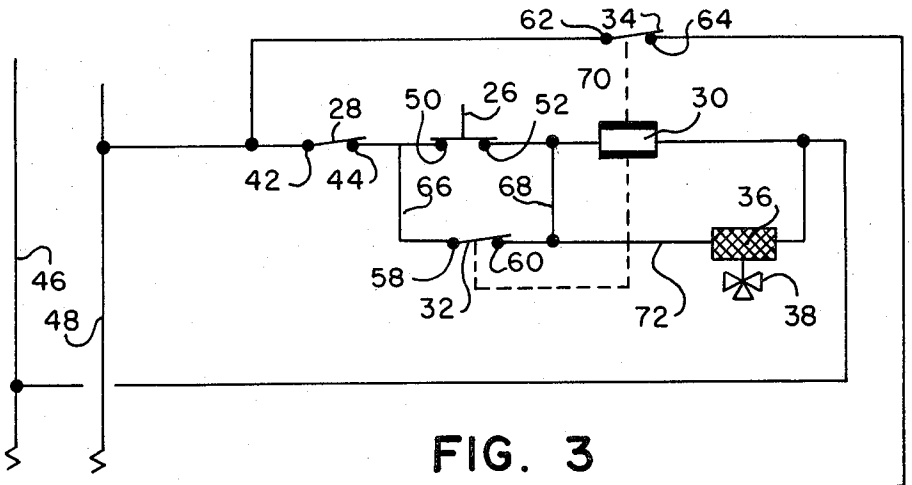


FIG. 3

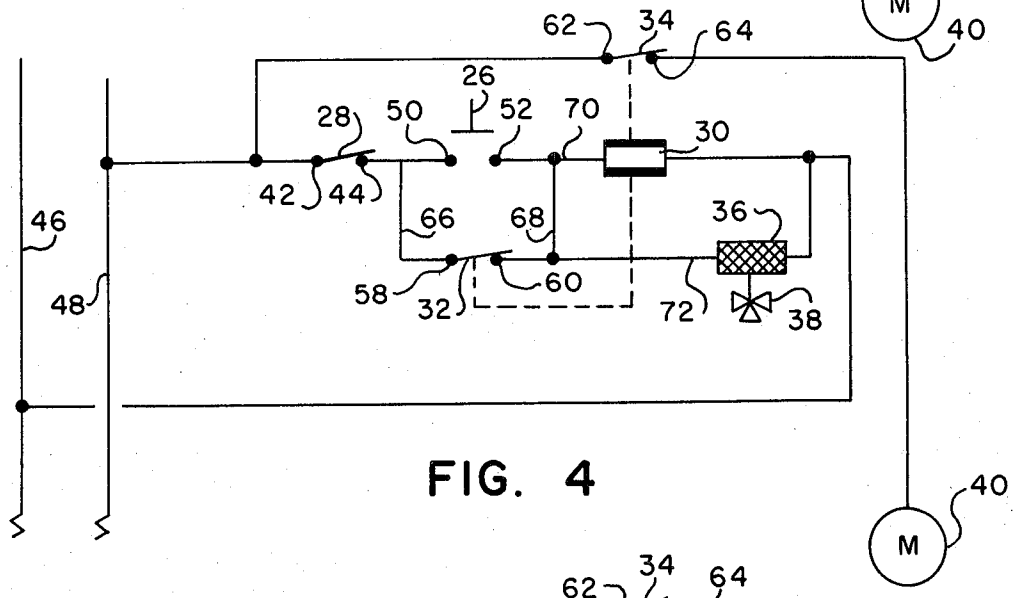


FIG. 4

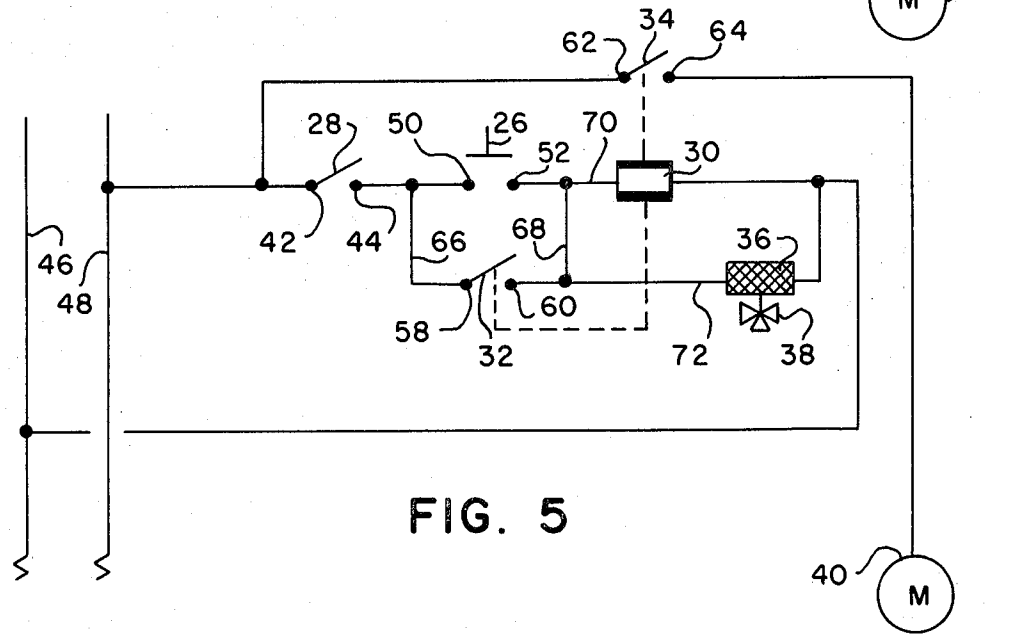


FIG. 5

HOT WATER SUPPLY SYSTEM AND METHOD

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention pertains to the field of hot water supply systems. In particular this invention relates to the field of providing water at a predetermined elevated temperature at a faucet. More in particular, this invention pertains to the field of recirculating water within a water supply system when the water has not reached a predetermined temperature.

2. Prior Art

Hot water supply systems are known in the art. In some prior systems hot water is provided at the faucet or tap through the addition of heat exchangers. However, such systems do not provide for an electrical bypass to recirculate the cold water back to the water heater. Such prior systems provide for constant recirculation which increases the operating complexity and lowers the reliability of the water supply system.

Other prior systems provide recirculation systems where the water of two different temperature values are mixed. However, such prior systems although providing some heated water, do not only permit water at a predetermined temperature to be tapped from the faucet.

Other systems for providing hot water include mechanisms where an electric heater is provided below the faucet. Although heated water is tapped, no recirculation is provided and cold water is still initially tapped from the faucet leading to loss of this processed water from the water supply system.

In other prior systems thermostats in combination with bypass values are used. However, in such cases, the water which is not used is passed into the sewerage system and no attempt is made to recirculate the water. In such cases this once again leads to the wasting of processed water.

SUMMARY OF THE INVENTION

An object of the instant invention is to provide a hot water supply system where only water reaching a predetermined elevated temperature is tapped from a faucet.

Another object of the present invention is to provide a hot water supply system where processed water which has not reached a predetermined elevated temperature is recirculated through the water supply system.

A still further object of the subject invention is to provide a hot water supply system which conserves the use of processed water.

Another object of the current invention is to recirculate processed water which is not acceptable for use, thereby reducing the water charges to be paid by a user.

A hot water supply system which comprises at least one faucet for passing water at a predetermined temperature external to the hot water supply system. A hot water heater is connected to the faucet by at least one water conduit. A mechanism for pumping the water into the hot water heater is included in the water supply system as well as a mechanism for directing the water in a predetermined flow path as a function of the water temperature. The water directing mechanism is oppositely connected to the hot water heater and the water pumping mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a piping flow diagram of the hot water supply system showing a plurality of faucets;

FIG. 2 is an electrical circuit diagram of the hot water supply system recirculation mechanism for a plurality of faucets and defining an activity state I prior to the tapping of water from a faucet;

FIG. 3 is an electrical circuit diagram for one faucet of the water supply system, defining an activity state II at the time the faucet is opened or turned on;

FIG. 4 is an electrical circuit diagram for one faucet of the water supply system defining an activity state III between the time the faucet has been opened and the time the water has reached a predetermined elevated temperature; and,

FIG. 5 is an electrical circuit diagram for one faucet of the water supply system defining an activity state IV after the water has reached the predetermined elevated temperature.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1 there is shown a schematic flow diagram of hot water system **10** for use in residential and commercial buildings. Water system **10** provides for water to be emitted from faucet **12** only after the water has reached a predetermined temperature. When faucet **12** is turned to an open position, water is pumped from hot water heater **14** through system **10.** However, in most cases, the water is not heated sufficiently for use since the water in the pipes has had a chance to cool considerably from the last opening of faucet **12.** Therefore, an electric circuit, shown in FIG. **2.**, is actuated which recirculates the colder than acceptable water back to hot water heater **14** while maintaining faucet **12** in a closed position. When the water has reached a predetermined elevated temperature, the circuit opens faucet **12** for the release of hot water. In this manner, a considerable amount of processed water can be saved by the consumer resulting in savings in water bills. Additionally, system **10** would greatly reduce the amount of processed water being sent into sewerage systems.

As shown in FIG. **1,** water is brought into the building or other edifice through external water conduit or pipe **16.** The water being brought into the edifice through pipe **16** is relatively cold and comes from standard water pipelines carrying processed water for use by the consumer. External water conduit **16** is attached to hot water heater **14** for maintaining a constant supply of water to be heated. Heater **14** may be a standard water heating unit well known in the art.

The water flow passes from heater **14** through water inlet piping **18** to a plurality of faucets **12** where water can be drawn off for use when it has reached a predetermined temperature. When the water being drawn through piping **18** is not hot enough, faucet **12** is maintained in an off position. The water bypasses faucet **12** and flows through recirculation pipes **20.** The water then enters pump mechanism **22** where it is redirected to water heater **14** through water conduit **16.** Pump **22** may be a standard water pump of any well known variety.

Water recirculation mechanism **24** is clearly shown in FIGS. **2, 3** and **4.** FIG. **2** shows a plurality of systems **10** operating while FIGS. **3** and **4** show only one system

for different states of actuation. Each mechanism **24** includes an actuation switch **26** for energizing recirculation mechanism **25.** Switch **26** may be of the push button variety or formed integral with faucet **12** to automatically actuate mechanism **24** when faucet **12** is turned on. Recirculation mechanism or circuit system **24** also includes thermal switch **28** for sensing the temperature of the water passing through pipes **18** and maintaining or breaking the electrical path as a function of water temperature. Relay **30** having operating relay switches **32, 34** provide an electrical path to solenoid valve **36** which either closes "T" valve **38** to permit recirculation of water through recirculation pipes **20** or opens valve **38** to provide water passage from faucet **12.**

Electrical operation of water system **10** may be broken into four states defining the different operating modes of the hot water system **10.** As herein described, the states will be defined in a chronological sequence in normal operating procedure and will be labeled with the designations I, II, III, IV.

State I, as shown in FIG. **2,** defines the electrical state of recirculation mechanism **24** prior to faucet or water release mechanism **12** being turned on by a user. In this electrical state, pump motor **40** is deenergized or turned off, therefore, no water is being pumped through lines **18** from hot water heater **14.** At this state, solenoid valve **36** is also deenergized. Solenoid valve **36** acts on "T" — value **38** in a normally open type position. In other words, when valve **36** is in a deenergized state, water would be directed from pipes **18** through faucet **12** for use. When solenoid **36** is energized, it moves to a closed position, blocking water passing into faucet **12,** and redirects the water to recirculation pipes **20** as shown in FIG. **1.** However, in state I even though solenoid **36** is in a deenergized mode, no water is flowing from faucet **12** because faucet **12** is in an "off" position. Further in this state, thermal switch is closed forming a continuous electrical path between thermal switch node points **42, 44.** Therefore, in this state, an electrical path does exist between voltage lines **46, 48** and node point **44.** At this time, actuation switch **26** is in an open position and is not contacting actuation switch nodal points **50, 52.** Relay **30,** which magnetically operates relay switches **34, 32,** is in an open position. Therefore, since the circuit is broken or discontinuous at nodal points **50, 52** and at switch **32** nodal points **58, 60,** it is seen that no electrical path is completed to valve **36** or relay **30.** Further, in this state, it is seen that relay switch **34** is also open, thereby breaking the electrical path between node points **62, 64** and consequently keeping pump motor **40** in a deenergized state.

In summary of state I, it is therefore understood that pump **22** is deenergized, solenoid valve **36** is deenergized, actuation switch **26** is open, thermal switch **28** is closed, and relay switches **34, 32** are open. This results in no flow in pipes **18** and **20** during this activity state.

Activity state II, as shown in FIG. **3,** defines the electrical state of recirculation mechanism **24** at the time faucet **12** is turned on and actuation switch **26** is closed. As is apparant, actuation switch **26** may be actuated by the turning on of faucet **12** or through a separate push button type of arrangement, not important to the inventive concept of the invention as herein detailed.

At this activity state, it is seen that thermal switch **28** remains in a closed position, since the water in pipes **18** is generally not hot enough to cause opening. Actuation switch **26** has been manually closed, thereby forming a continuous circuit through nodes **50** and **52.** This in turn, energizes relay **30** and closes relay switches **32, 34.** Once relay switch **32** is closed, solenoid valve **36** is also energized and closes the water path through faucet **12.** At the same time, since relay **30** has been energized, switch **34** is closed, completing a continuous electrical path from voltage lines **46, 48** to pump motor **40.** Therefore, activity state II represents the initial time at which faucet **12** is turned on and recirculation mechanism **24** is actuated through the closing of actuation switch **26.**

Activity state III, as shown in FIG. **4,** defines the electrical state of recirculation mechanism **24** from the time switch **26** was closed in activity state II until the water in pipes **18** has reached a predetermined elevated temperature. In this activity state thermal switch **28** remains closed since the water has not reached the elevated temperature necessary for the opening of switch **28.**

Actuation switch **26,** is shown in the open condition breaking the circuit between nodes **50** and **52.** However, relay **30** remains actuated through line **66,** closed switch **32,** and lines **68, 70.** It must be remembered that this electrical flow path was insured in activity state II when switch **26** was closed, thereby closing relay switch **32.**

Since switch **32** is closed, solenoid **36** is energized during this activity state by the continuous electrical path from line **66,** through closed switch **32** and line **72.** Therefore, although faucet **12** is turned on, water is directed to recirculation pipes **20.** Additionally, it is seen that since relay **30** is energized, relay switch **34** is closed and pump motor **40** is kept running during activity state III.

Therefore, in state III, water passes from heater **14,** through conduits **18,** into pipes **20;** pump **22** and back to hot water heater **14.** During this time period, the water is not emitted from faucet **12** since it has not reachced the proper elevated temperature.

Activity state IV, as shown in FIG. **5,** defines the electrical state of recirculation mechanism **24** after the water in pipes **18** has reached the predetermined elevated temperature. Once the water has reached the prescribed temperature, thermal switch **28** opens, thereby breaking the electrical circuit between thermal switch node points **42** and **44.** This has the effect of deenergizing relay **30** and opening associated switches **32, 34.** Further, the electrical flow path to solenoid **36** is cut off and solenoid **36** is deenergized. This permits water to flow from faucet **12** and blocks the water path to recirculation conduits **20.** Additionally, once relay **30** is deenergized, switch **34** is opened also and pump motor **40** is turned off, thereby deenergizing the pump **22.**

In this manner, in activity state IV, the water has reached a predetermined temperature and opened thermal switch, **28.** This cuts off power to pump **22,** relay **30** and solenoid **30.** Heated water is then emitted from faucet **12** and no water is recirculated through pipes **20.**

In summary, operation of each of the major components is shown in the following table for each of the activity states:

ACTIVITY TABLE

	Open	Closed	Emergized	Deenergized
ACTIVITY STATE I				
Actuation Switch (26)	X			
Thermal Switch (28)		X		
Solenoid Valve (36)	X			X
Pump (22)				X
Relay (30)				X
Relay Switch (32)	X			
Relay Switch (34)	X			
ACTIVITY STATE II				
Actuation Switch (26)		X		
Thermal Switch (28)		X		
Solenoid Valve (36)			X	
Pump (22)			X	
Relay (30)			X	
Relay Switch (32)		X		
Relay Switch (34)		X		
ACTIVITY STATE III				
Actuation Switch (26)	X			
Thermal Switch (28)		X		
Solenoid Valve (36)			X	
Pump (22)			X	
Relay (30)			X	
Relay Switch (32)		X		
Relay Switch (34)		X		
ACTIVITY STATE IV				
Actuation Switch (26)	X			
Thermal Switch (28)	X			
Solenoid Valve (36)				X
Pump (22)				X
Relay (30)				X
Relay Switch (32)	X			
Relay Switch (34)	X			

In general, what has been herein described is hot water supply system **10** for forcing water through faucet **12** when the water is at a predetermined temperature and for recirculating the water to hot water heater **14** when the water temperature is determined to be less than the predetermined temperature. Water supply system **10** includes faucet **12** which only passes water at the predetermined temperature to an external environment. As seen in FIG. **1**, hot water heater **14** is connected to faucet **12** through water conduits **18.** Water pump **22** pumps or directs water being recirculated through conduits **20** back into hot water heater **14.** The mechanism for directing water **24** in a prescribed flow path is connected opposingly to hot water heater **14** through conduits **18** and pump **22** through conduits **20.**

As will be understood, relay **30** inserted into the circuit as shown becomes a latched relay. This is provided by the fact that once actuation switch **26** contacts nodes **50** and **52,** relay **30** is energized. This has the effect of closing relay switches **32** and **34** between nodes **58, 60** and **62, 64** respectively. Once relay **30** is energized, switch **26** may be released from node points **50, 52** and relay **30** will remain energized since closed relay switch **32** and line **68** provide a continuous electrical path to relay **30.**

Although switch **26** is shown as being releasable it is understood that during activity states II, III and IV represented by FIGS. **3, 4** and **5** actuation switch **26** may continually contact nodes **50, 52** and the relay energization will not be impaired. Therefore, actuation switch may be activated by faucet **12** being turned on or be included as a separate pushbutton type of mechanism.

A number of modifications and variations of the present invention as hereinbefore set forth may be made without departing from the spirit and skill thereof, and therefore only such conditions should be imposed as are indicated by the appended claims.

What is claimed is:

1. A hot water supply system, comprising;

a. at least one valved faucet for passing water from said hot water supply system only when said water is at least at a predetermined temperature;

b. a hot water heater connected to said faucet by a water inlet pipe and a water recirculation pipe;

c. means for piping water through said inlet pipe and said recirculation pipe to said hot water heater, said pumping means being operable only when said valved faucet is open; and,

d. temperature actuated means for directing water in a predetermined flow path when said valved faucet is open, said flow path being a function of said water temperature as follows;

1. water temperature below said predetermined temperature, flow path being from inlet pipe to recirculation pipe only, for recirculation of said heater;

2. water temperature at least at predetermined temperature, flow path from inlet pipe to valved faucet only.

2. The not water supply system as recited in claim **1** wherein said means for directing said water includes electrical circuit means for actuating said faucet responsive to said water temperature, said electrical circuit means passing water into said faucet when said water is at said predetermined temperature and recirculating said water to said hot water heater when said water temperature is less than said predetermined temperature.

3. The hot water supply system as recited in claim **2** wherein said electrical circuit means includes solenoid valve means connected to said faucet for (**1**) passing water into said faucet when said water is at said predetermined temperature and (**2**) recirculating said water to said hot water heater when said water is at a temperature less than said predetermined temperature.

4. The hot water supply system as recited in claim **3** wherein said electrical circuit means includes:

a. means for determining said temperature of said water passing into said faucet; and,

b. relay means connected to said temperature determining means and said solenoid value means for maintaining a continuous electrical path from said determining means to said solenoid valve means when said temperature of said water is less than said predetermined temperature.

5. The hot water supply system as recited in claim **4** wherein said determining means includes a thermal switch, said thermal switch for (**1**) maintaining a continuous electrical path to said solenoid valve means when said water temperature is less than said predetermined temperature, and (**2**) breaking said electrical path to said solenoid value means when said water temperature is at said predetermined temperature thereby directing water flow through said faucet.

6. The hot water supply system as recited in claim **5** wherein said relay means includes a first relay switch and a second relay switch, said first relay switch for maintaining a continuous electrical path from said thermal switch to said solenoid valve means when said relay means is electrically activated from a voltage supply line.

7. The hot water supply system as recited in claim 6 wherein said second relay switch maintains a continuous electrical path from said voltage supply line to said pump when said relay means is electrically activated from said voltage supply line.

8. The hot water supply system as recited in claim 7 including means for initially actuating said relay means, said actuation means for electrically connecting said relay means to said voltage supply line when said water temperature is less than said predetermined temperature.

9. The hot water supply system as recited in claim 8 including circuit means for maintaining an electrical path from said voltage supply line to said relay means when said initial actuation means is removed from providing an electrical connection from said voltage supply line to said relay means.

10. A method of providing water at a predetermined temperature to flow from a valved faucet, including the steps of;

a. determining the temperature of said water available near said faucet from a hot water heater;

b. opening said valved faucet;

c. preventing said water from flowing through said open valved faucet and only recirculating said water to said hot water heater when said water temperature is less than said predetermined temperature, said recirculation being forced only when said valved faucet is open and said water is at less than said predetermined temperature; and,

d. preventing said water from recirculating and directing said water solely through said faucet when said water is at least at said predetermined temperature.

11. The method as recited in claim 10 wherein the step of recirculating said water includes the step of energizing a solenoid value connected to said faucet for blocking a water path through said faucet.

12. The method as recited in claim 11 wherein the step of recirculating said water includes the step of energizing a pump for forcing said recirculated water into said hot water heater.

13. The method as recited in claim 12 wherein the step of directing said water through said faucet includes the step of deenergizing said solenoid value means for blocking a water path to said hot water heater.

14. The method as recited in claim 13 wherein the step of determining said temperature of said water includes the step of maintaining a continuous electrical connection from a voltage supply line to said solenoid value when said water temperature is less than said predetermined temperature.

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