Nov. 19, 1957 E. J. DILLMAN 2,813,683

COMBINATION HOT WATER HEATING AND ROOM HEATING SYSTEM

Filed Dec. 8, 1955

3 Sheets-Sheet 1

Fig. 1

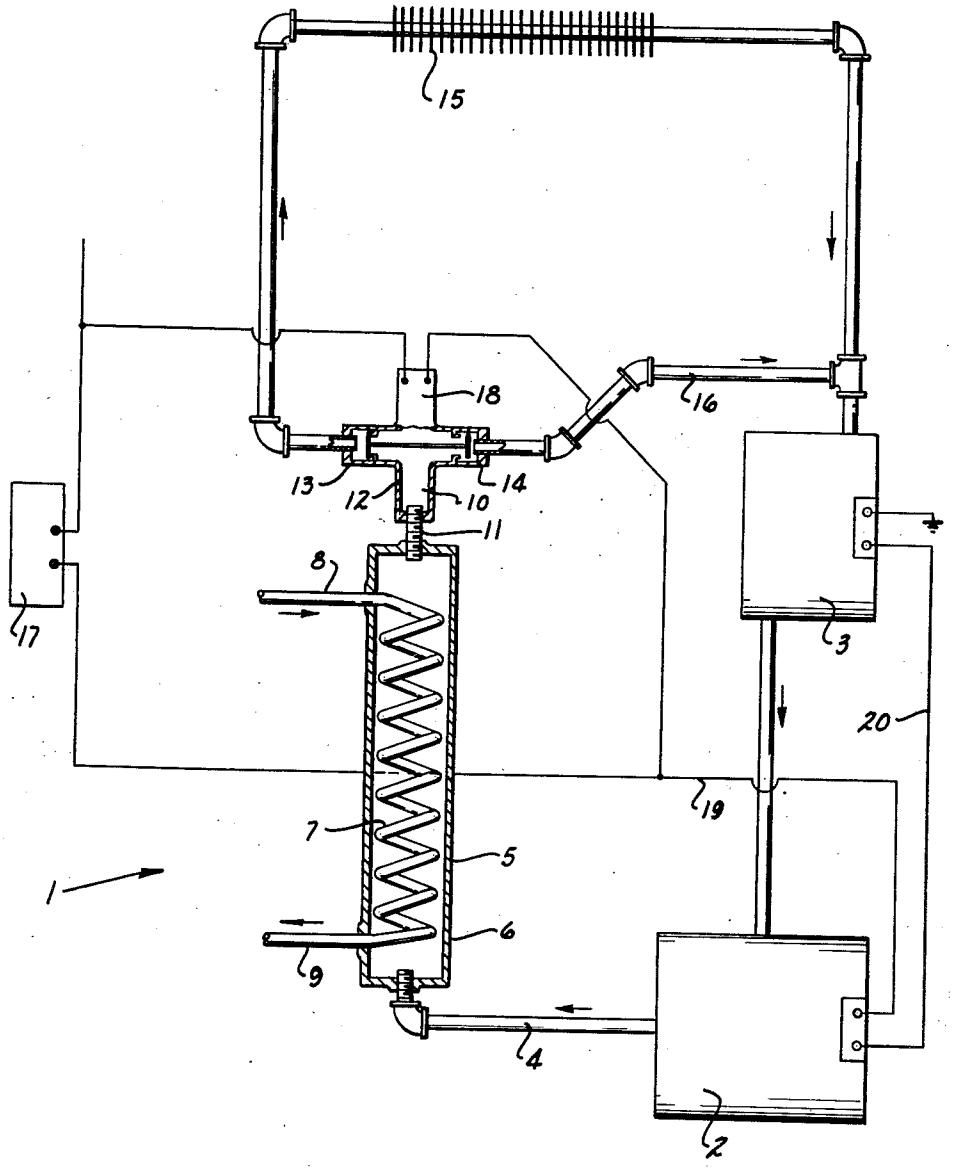

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FIG. 2

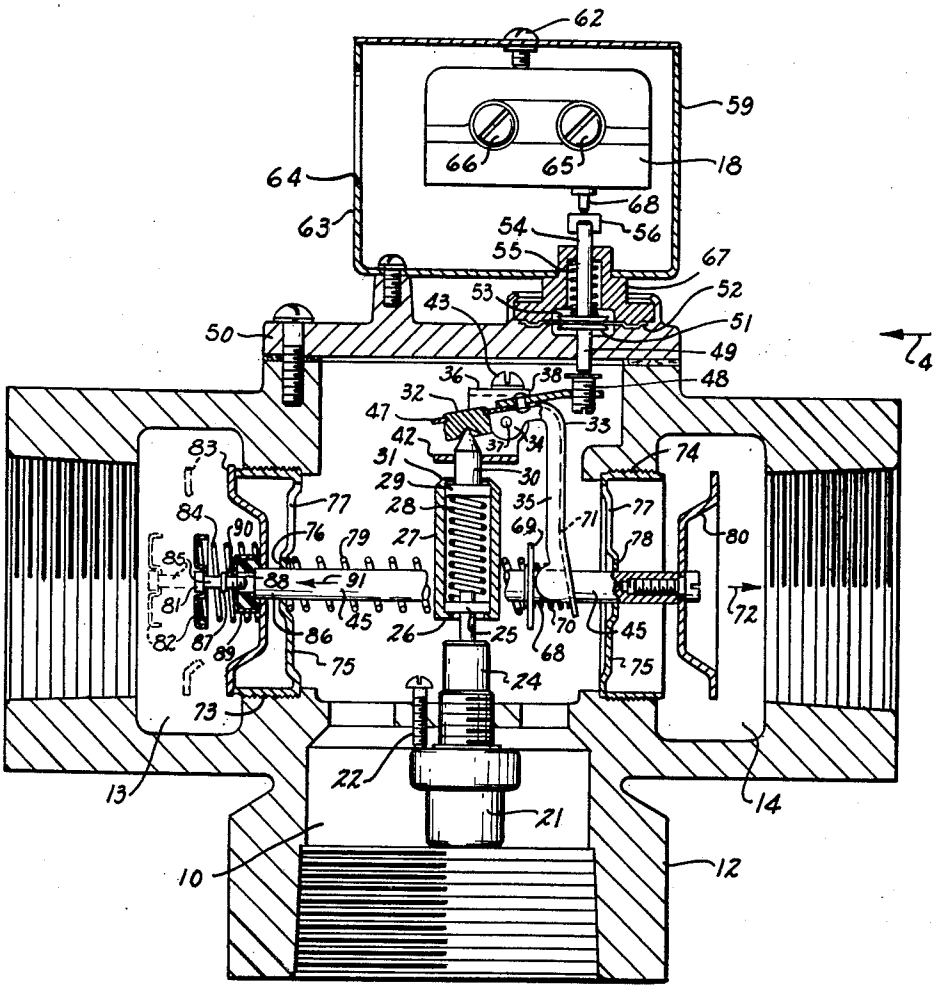

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FIG. 3

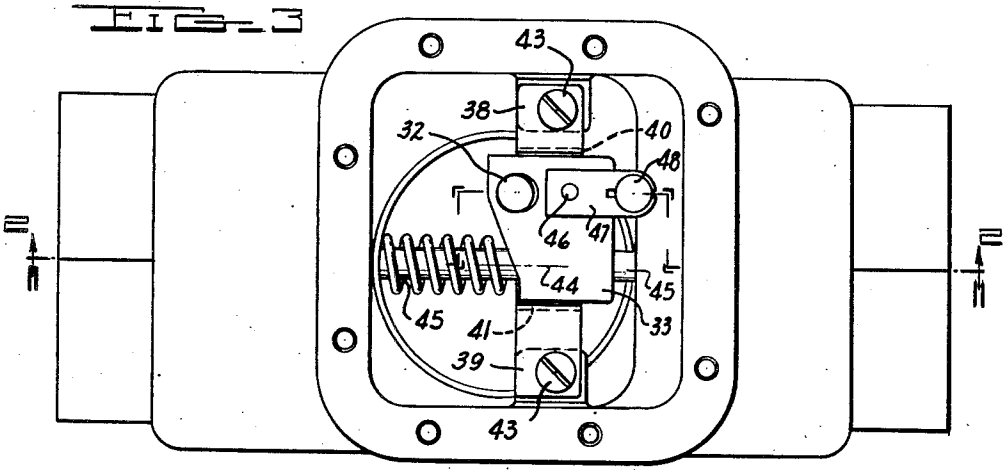
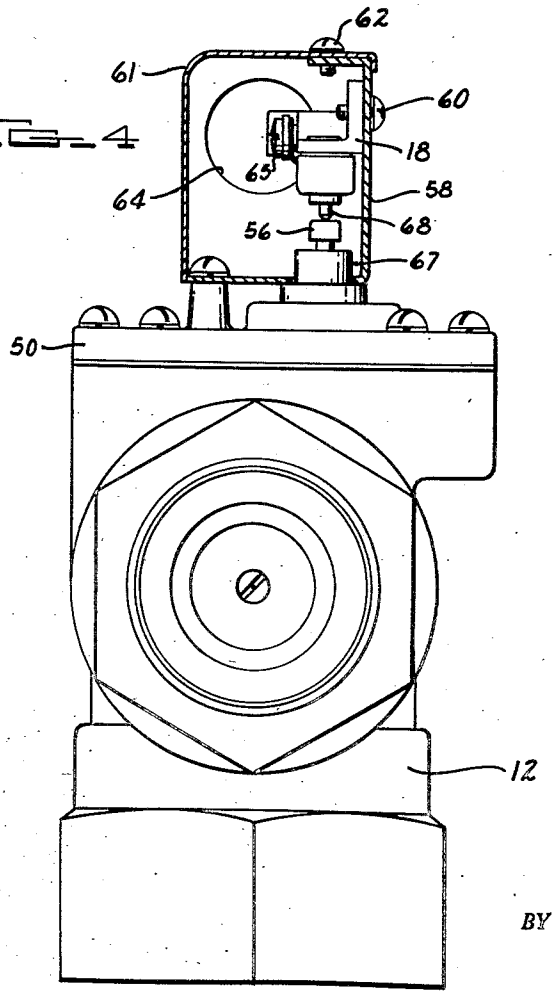


FIG. 4



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COMBINATION HOT WATER HEATING AND ROOM HEATING SYSTEM

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Application December 8, 1955, Serial No. 551,832

6 Claims. (Cl. 237—8)

This invention relates to a combination domestic hot water heating and room heating system, and to valve mechanism for use therein.

The system of the present invention includes (1) a boiler for producing a supply of hot heat exchange fluid (2) a domestic hot water heater including a hot water coil extended through a heat exchange tube (3) one or more room radiation tubes downstream from the heat exchange tube (4) by pass conduit means for the room radiation tubes (5) pump means for circulating heat exchange fluid through the system and (6) a valve for directing heat exchange fluid from the hot water heater to the room radiation tubes or by pass conduit means according as the room thermostat is or is not calling for heat, and according as the hot water heater is not or is satisfied.

One object of the invention is to provide a combination hot water heating and room heating system, wherein there may be utilized as the heat source a boiler having a smaller heat output than that required to simultaneously product maximum domestic hot water and room radiation.

Another object is to provide a system of the above-identified character wherein water heating requirements are satisfied prior to room heating requirements so as to always make available a supply of domestic hot water.

Another object is to provide a system of the above-identified character wherein changeover from water heating to room heating is effected as quickly as possible, thereby minimizing the time lag between the room thermostat's call for room heating and the beginning of the room heating operation.

Another object is to provide a valve and switch mechanism for use in the above-identified system, which mechanism eliminates the need for the temperature-operated burner controls commonly employed in present day boilers.

Another object is to provide a valve mechanism for use in the above-identified system, which valve mechanism eliminates the need for the check valves commonly employed in present day hot water type room heating systems.

Other objects of this invention will appear in the following description and appended claims, reference being had to the accompanying drawings forming a part of this specification wherein like reference characters designate corresponding parts in the several views.

In the drawings:

Fig. 1 is a schematic view of a combination domestic hot water heating and room heating system according to the present invention.

Fig. 2 is a sectional view along 2—2 in Fig. 3.

Fig. 3 is a top plan view of the Fig. 2 valve mechanism with cover plate 50 and switch mechanism 18 removed for illustration purposes.

Fig. 4 is an elevational view along arrow 4 in Fig. 2 with a switch casing member 59 broken away for illustration purposes.

Before explaining the present invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and arrangement of parts illustrated in the accompanying drawings, since the invention is capable of other embodiments and of being practiced or carried out in various ways. Also, it is to be understood that the phraseology or terminology employed herein is for the purpose of description and not of limitation.

In the drawings there is disclosed a combination hot water heating and room heating system 1 including a source of hot heat exchange fluid in the form of a boiler 2. Hot heat exchange fluid (preferably hot water) is pumped from boiler 2 by a pump 3 into a line 4, and thence into a heat exchange tube 5 which constitutes part of a water heater 6. Heater 6 includes a coil 7 which receives cold water through an inlet 8 and discharges hot water through an outlet 9. Heat is extracted from the fluid in tube 5 to effect the heating of the water in coil 7. Outlet 9 may lead to a hot water storage tank, although the illustrated outlet 9 leads directly to the domestic hot water taps.

Tube 5 is provided with a nipple 11 which threads into the inlet opening 10 of a valve housing 12. Housing 12 includes two outlet ports 13 and 14. Port 13 discharges into one or more room radiation tubes diagrammatically illustrated at 15. Port 14 discharges into a room radiation by pass conduit 16. Tube 15 and conduit 16 both communicate with pump 3.

The electrical system for controlling the operation of a pump 4 and the boiler burner includes a room thermostat 17 and a switch 18 positioned on valve housing 12. Thermostat 17 and switch 18 are wired in parallel to a line 19 which leads to the boiler burner. A line 20 leads from the burner to pump 3. When the contacts of thermostat 17 or the contacts of switch 18 are closed the boiler burner and pump are put into operation.

Within housing 12 there is fixedly but adjustably secured a temperature responsive power mechanism 21 which may be similar to that disclosed in United States Patent No. 2,636,776, issued on April 28, 1953. A screw 22 holds mechanism 21 in any of several adjusted positions.

Mechanism 21 includes a plunger 23 which moves in and out of a sleeve 24 according as the temperature in housing 12 decreases or increases, respectively. Plunger 23 is provided with a head 25 which is urged against the end flange 26 of a sleeve 27 by a relatively stiff spring 28. The upper end of spring 28 pressuringly engages against a head portion 29 of a shaft 30. Shaft 30 is held in sleeve 27 by a flange 31. The only reason for utilizing the spring 28-sleeve 27 construction is to provide an overload mechanism which would prevent damage to the valve parts in the event that the temperature in housing 12 became so high as to cause excessive upward movement of plunger 23. During normal valve operation plunger 23 and shaft 30 operate as a unit with head portions 25 and 29 against their respective flanges 26 and 31.

Shaft 30 is provided with a conical end portion which seats in a conically shaped recess in a plug 32. Plug 32 is fixedly secured in a lever 33 having side flanges 34 and 35. Lever 33 is pivotally mounted on a bracket 36 by means of a pin 37. Bracket 36 includes mounting flanges 38 and 39, vertically extending wall portions 40 and 41, and a web-portion 42. Screws 43 secure bracket 36 in housing 12, and pin 37 extends through flanges 34 and 35 into wall portions 40 and 41 in order to effect the pivotal mounting of lever 33. Web-portion 42 is provided with an opening which serves to guide member 30 during its movement. It will be noted from Fig. 3 that plug 32 is offset from centerline 44. Plug 32 is positioned directly

above mechanism 21 so as to offset said mechanism from centerline 44 and provide clearance for a shaft 45 (to be described later).

Secured on lever 33 by a rivet 46 is an arm 47 which mounts a screw 48. Screw 48 abuts against a plunger 49 which extends through a cover plate 50 for housing 12. Plunger 49 is provided with an enlarged head 51 which engages against one face of a sealing disc 52 (of polytetrafluoroethylene or other flexible material). A housing member 67 holds disc 51 on cover plate 50. The upper face of disc 51 engages the head 53 of a plunger 54. A compression spring 55 urges plunger 54 downward. The strength of spring 55 is such as to prevent fluid pressure in housing 12 from causing upward movement of plunger 49. Plunger 54 is provided with a head 56 which engages the actuator element 68 of the aforementioned switch 18. Switch 18 is mounted on wall 58 of a casing member 59 by screws 60. A cover element 61 is secured over member 59 by a screw 62. Wall 63 of member 59 is provided with an opening 64 for the admission of electrical conductors into securement with switch terminals 65 and 66. Switch 18 is of such construction that upward movement of plunger 54 (in response to volumetric contraction of the temperature responsive material in mechanism 21) causes the contacts in switch 18 to be closed. As was stated earlier closing of switch 18 serves to operate pump 3 and the burner for boiler 2.

Flanges 34 and 35 form circular edge surfaces 68 at the lower limit of lever 33 which register with a ring element 69 fixedly secured on shaft 45. Element 69 forms an abutment means for a compression spring 70. Spring 70 is positioned between ring element 69 and web-portion 71 of lever 33 so as to urge the lever in a counterclockwise direction (as viewed in Fig. 2). An opening is provided in web-portion 33 to allow passage of shaft 45 therethrough. The purpose of spring 70 is to let lever 33 follow downward movement of shaft 30 (during temperature decrease) after shaft 45 has reached the limit of its movement in the direction of arrow 72. Fig. 2 shows shaft 45 at the limit of its arrow 72 movement with spring 70 just beginning to urge lever 33 away from ring element 69. The design of system 1 is such that switch 18 is not closed by plunger 54 until after lever 33 leaves ring element 69. Spring 70 is therefore necessary to actuate plunger 54 and switch 18.

Fixedly positioned in outlets 13 and 14 are two cylinders 73 and 74 having spoke-forming walls 75 leading to rings 76 and 78. The openings 77 formed by spokes 75 allow heat exchange fluid to pass through outlets 13 and 14. Rings 76 and 78 serve to mount shaft 45 in housing 12, and a compression spring 79 is positioned between ring 76 and ring element 69. Spring 79 urges shaft 45 to the limit of its arrow 72 movement except when lever 33 is moved in a clockwise direction by expansion movement of the temperature responsive material in mechanism 21. In this connection spring 79 is slightly stronger than spring 70.

The right end of shaft 45 has fixedly secured thereon a valve element disc 80 which is adapted to engage the rightmost limit of cylinder 74 so as to close port 14. The left end of shaft 45 is provided with a head 81 which serves to mount a disc 82. Slidably mounted on shaft 45 is a valve element disc 83, and positioned between discs 82 and 83 is a compression spring 84. Shaft 45 includes a short section 85 which threads into a longer section 86. Shoulders 87 and 88 are formed on the respective sections, and a cup member 89 is positioned between these shoulders. A body of polytetrafluoroethylene or other sealing material is contained in cup 89, and a spring washer 90 tends to hold cup 89 against shoulder 88. The sealing material seals the joint between disc 83 and shaft 45 when shaft 45 occupies its illustrated position relative to disc 83. When shaft 45 moves to the left relative to disc 83 the sealing material leaves the joint, but the seal must only be effective during periods when the room thermostat is not calling for heat, and during such periods shaft 45 is in its Fig. 2 position.

Operation of system 1 is such that heating of hot water in coil 7 is accomplished while the heat exchange fluid is in one range of temperatures, and room heating through radiation tubes 15 is accomplished while the heat exchange fluid is in a higher range of temperatures. Any of several different temperature ranges may be employed but as an example the hot water heating may take place when the heat exchange fluid is between 173° F. and 177° F., and the room heating may take place when the heat exchange fluid is between 180° F. and 195° F. Pump 3 and the boiler burner are under the control of switch 18 during the water heating operation, and pump 3 and the boiler burner are under the control of room thermostat 17 during the room heating operation.

Fig. 2 shows the valve 12 elements in the positions they occupy at 180° F. If the water in coil 7 should cool down by reason of hot water being taken from the domestic taps then the heat exchange fluid in tube 5 and housing 12 will cool down correspondingly so as to cause a contraction of the temperature responsive material in mechanism 21. There is a hysteresis lag in mechanism 21 so that plunger 23 does not move immediately in response to a drop in the heat exchange fluid temperature. Thus, although switch 18 is designed to put the boiler and pump on at 177° F. the hysteresis lag in mechanism 21 may cause plunger 54 to delay behind the heat exchange fluid temperature to such an extent that the boiler and pump are not turned on until the heat exchange fluid temperature drops to 173° F. The time delay between turning on of the domestic water taps and the production of hot water in coil 7 may be about twenty seconds but the ultimate time delay to the user will be considerably less than that due to the hot water storage capacity of the coil.

As long as hot water is being withdrawn from the domestic taps heat will be taken from the heat exchange fluid in tube 5 by the water in coil 7. The loss of heat from the heat exchange fluid will periodically cause the heat exchange fluid to drop below 177° F., and the pump and boiler will periodically cut on so as to circulate hot heat exchange fluid through the system. Valve outlet 13 will be closed and all the valve 12 fluid will flow through bypass conduit 16. Switch 18 opens above 177° F. to maintain the temperature of the heat exchange fluid below 180° F. A hysteresis lag in mechanism 21 causes switch 18 to delay somewhat behind the heat exchange fluid temperature but not enough to allow the heat exchange fluid to increase beyond 180° F.

Call for heat by room thermostat 17 puts the pump and boiler into continuous operation irrespective of the condition of switch 18. Continuous operation of the pump and boiler will bring the heat exchange fluid temperature above 180° F. At about 185° F. plunger 23 will move upward from its Fig. 2 position (due to expansion of the temperature responsive material in mechanism 21). Shaft 45 will thereby be moved in the direction of arrow 91. Spring 84 is not strong enough to resist the pressure of pump 3 after valve element disc 80 has begun to close, and valve disc 83 will therefore move with shaft 45 so as to open port 13 and allow heat exchange fluid to circulate through room radiation tubes 15. As the temperature of the heat exchange fluid increases port 13 will be more fully opened and port 14 will be more fully closed. Increase in the heat exchange fluid temperature occurs because the pump and boiler are operating continuously, and the water in coil 7 is not extracting any appreciable amounts of heat from the heat exchange fluid (relative to the total heat content of said heat exchange fluid). When the temperature of the heat exchange fluid increases to about 195° F. port 13 is fully opened and port 14 is fully closed. During all but the coldest days the room thermostat will be satisfied before port 13 is fully opened.

Whenever room thermostat 17 is not calling for heat

(as throughout summer operation) spring **84** causes disc **83** to act as a check valve for preventing convection currents in tubes **15** from causing counterflow operation through the system in the direction of arrow **92** (see Fig. 1). Spring **84** therefore eliminates the need for a separate check valve for radiation tubes **15**.

Spring **84** is of sufficient strength to hold disc **83** tightly against cylinder **73** when pump **4** is not operating or when element **80** is open. As a result no heat exchange fluid can travel through radiation tubes **15** during summer operation (such as would heat up the rooms being serviced by tubes **15**).

Room thermostat **17** and switch **18** are so related to each other and the other mechanisms in system **1** that the temperature of the heat exchange fluid is always between 173° F. and 195° F. As a result the need for a separate boiler burner control is eliminated.

The boiler and pump operate in conjunction with valve **12** to produce and maintain a supply of hot water in coil **7** for use when needed. The temperature of the heat exchange fluid is closely controlled by switch **18** so that change-over from water heating to room heating is effected quickly with a minimum time lag between the room thermostat's call for room heating and the beginning of the room heating operation. In this connection the motion-transmitting system provided by lever **33** and shaft **45** produces a relatively great movement of valve discs **80** and **83** per given movement of plunger **23**. It is thereby possible to employ a relatively small expansive movement of the temperature responsive material in mechanism **21** to actuate the valve discs. A small material expansion will of course be effected in a comparatively short period of time and will accordingly cut down on the hysteresis lags which take place in mechanism **21** upon every change in the heat exchange fluid temperature. Reduction is the hysteresis lags contributes to greater responsiveness timewise of valve **12**.

Due to the fact that the boiler and pump automatically cut on to maintain a supply of domestic hot water the boiler can be of smaller heat exchange fluid producing capacity than that required to simultaneously produce maximum domestic hot water and room radiation. It is only on the coldest winter days that water heater **6** may interfere with quick maximum room radiation action.

I claim:

1. A combination hot water heating and room heating system comprising hot water heat exchange means; heater and pump means for supplying heat exchange fluid to said heat exchange means; room heat exchange means downstream from said hot water heat exchange means; bypass conduit means for said heat exchange means; valve means for feeding heat exchange fluid from the hot water heat exchange means to the bypass means in one fluid temperature range and to the room heat exchange means in a higher fluid temperature range; switch means operable in said one fluid temperature range to energize the heater and pump means; room thermostat means operable irrespective of the fluid temperature to energize the heater and pump means; and heat exchange fluid temperature responsive power means operable in said one temperature range to actuate the switch means and move the valve means into a position for admitting fluid to the bypass means, and operable in said higher fluid temperature range to move the valve means into a position for admitting fluid into the room heat exchange means.

2. The combination comprising a fluid flow valve including a valve housing having an inlet port; a first outlet port, and a second outlet port; a first valve element for closing said first outlet port, and a second valve element for closing said second outlet port; a shaft interconnecting said valve elements; spring means between the housing and shaft for releasably closing said first valve element and opening said second valve element; lever means operatively connected with said shaft; fluid temperature responsive power means operable in a first fluid temperature

range to move the lever means and thereby open the first valve element against the action of the spring means; second spring means between the shaft and lever means for causing said lever means to follow the movement of said power means during fluid temperature drop in a second lower fluid temperature range; pump and heater means for supplying a heated fluid to said inlet port; and switch means operatively connected to said lever means for energizing the pump and heater means when the fluid is in said lower fluid temperature range.

3. The combination comprising a fluid flow valve including a valve housing having an inlet port, a first outlet port, and a second outlet port; a first valve element for closing said first outlet port, and a second valve element for closing said second outlet port; spring means urging the first valve element to a closed position; pump and heater means for supplying heated fluid to said inlet port; switch means operable in one fluid temperature range to energize the pump and heater means; thermostat means for energizing the pump and heater means irrespective of fluid temperature; fluid temperature responsive power means operable in said one temperature range to actuate said switch means and operable in a second higher fluid temperature range to open the first valve element and close the second valve element; and second spring means having sufficient strength to urge said first valve element into a tight fit with its port when the fluid is in the one temperature range, but having insufficient strength to resist fluid pressure when the fluid is in the second higher temperature range.

4. The combination comprising a fluid flow valve including a valve housing having an inlet port, a first outlet port, and a second outlet port; a first valve element for closing said first outlet port, and a second valve element for closing said second outlet port, a shaft interconnecting said valve elements; abutment means on an end portion of said shaft; spring means between the abutment means and first valve element for urging said first valve element to a closed position; second abutment means on said shaft; second spring means between said housing and second abutment means for urging said shaft to a position wherein the second valve element is open; pump and heater means for supplying heated fluid to said inlet port; switch means operable in one fluid temperature range to energize the pump and heater means; lever means between said switch means and said shaft; third spring means between said lever means and shaft; fluid temperature responsive power means operable in a second higher fluid temperature range to actuate the lever means and shaft to close the second valve element and open the first valve element, and operable in said one temperature range to (1) move the lever means during fluid temperature increase and (2) permit said third spring means to move the lever means during fluid temperature decrease; said first spring means having sufficient strength to urge said first valve element into a tight fit with its port when the fluid is in the one temperature range, but having insufficient strength to resist fluid pressure when the fluid is in the second higher temperature range.

5. The combination comprising a fluid flow valve including a valve housing having an inlet port, a first outlet port, and a second outlet port aligned with said first outlet port; a first valve element for closing said first outlet port, and a second valve element for closing said second outlet port; a shaft interconnecting said valve elements; abutment means on said shaft; spring means between said housing and abutment means for urging said shaft to a position wherein the second valve element is open; pump and heater means for supplying heated fluid to said inlet port; switch means operable in one fluid temperature range to energize the pump and heater means; lever means between said switch means and said shaft; second spring means between said lever means and shaft; fluid temperature responsive power means operable

in a second higher fluid temperature range to actuate the lever means and shaft to close the second valve element and open the first valve element, and operable in said one temperature range to (1) move the lever means during fluid temperature increase and (2) permit said second spring means to move the lever means during fluid temperature decrease.

6. The combination comprising a fluid flow valve housing having an inlet chamber, a first outlet port and a second outlet port aligned with said first outlet port; a first valve element for closing said first outlet port, a second valve element for closing said second outlet port, and a shaft interconnecting said valve elements; fluid temperature responsive power means positioned in said inlet chamber and having an element thereof movable at right angles to the axes of the outlet ports; a bell crank pivotally mounted in said housing on an axis at right angles to the direction of the movable element and aforementioned axes; said crank having a relatively short arm engaged with the movable element, and having a relatively long arm engaged with the shaft; pump and heater means for supplying heated fluid to the inlet chamber; switch means positioned on one wall of the housing and having an actuator mechanism in operative engagement with the bell crank; said switch means being operable in one fluid temperature range to energize the pump and heater means; said power means being operable in a higher fluid temperature range to de-energize the switch means and close the first outlet port via the movable element, bell crank and shaft; and spring means operable to open the second port when the power means is subjected to fluid temperatures in the one fluid temperature range.

References Cited in the file of this patent

UNITED STATES PATENTS

1,177,857	Gilbert	Apr. 4, 1916
2,073,677	Broderick	Mar. 16, 1937
2,322,872	Moore	June 29, 1943
2,463,699	Klug	Mar. 8, 1949