ABSTRACT OF THE DISCLOSURE

A hot water storage and supply system including a heater and a control for the heater. The system includes a constant recirculating mechanism which is connected to a cold water supply and a sampling or bypass conduit connects this recirculating mechanism to the temperature sensing control so that the control is sensitive both to the internal temperature of the container and anticipates the heat demand occasioned by hot water withdrawal.

This invention relates to storage water heaters, and more particularly to an improved steam-heated appliance of the general type referred to for example in U.S. Patents Nos. 2,879,749 and 3,133,590.

One object of the present invention is to provide in a device as aforesaid improved means whereby the heating fluid is utilized more efficiently, and whereby hot water of prescribed temperature is readily available at all times, while erratic demands for hot water are automatically and instantaneously met with improved facility.

Another object of this invention is to provide a heating system as aforesaid which will constantly furnish hot water at the prescribed temperature.

Another object is to provide a system as aforesaid which will furnish the required hot water at a reduced overall operational cost.

Another object of the invention is to provide an improved temperature change sensing arrangement in devices of the above referred type, and further, a means of automatically delivering water at the prescribed temperature, and function simultaneously as vertical supports for the tubes 22 and as liquid passageway guide devices so as to cause the water circulating through the casing 16 to pursue a zig-zag path around the heat exchange tubes as indicated by the directional arrows in the drawing at Fig. 1. The baffles 24 also control the velocity of the circulating water.

A manifold cover or bonnet as indicated at 26 is fixed to the outer face of the tube sheet 29 and is provided with an internal partition or rib 28, thereby dividing the fluid chamber portion thereof into two sections, as shown in the drawing. Thus, it will be appreciated that the tubes 22 may be initially assembled upon the tube sheet 29, and that this subassembly may then be slip-fitted into the shroud 16, and the tube sheet and bonnet assembly may then be fixed in place to complete the mounting of the heat exchange unit in the tank.

Steam inlet and outlet connections are made to the bonnet 26 as shown at 29, 30, respectively, the steam inlet being controlled by a valve as indicated at 32, and a steam trap being employed as shown at 34. Thus, it will be appreciated that upon withdrawal of heated water through outlet 14 from the interior of the tank 16, it will be replaced by cold water flowing through the conduit connections 11 or 12.

Adjacent its forward end the shroud 16 is provided with a water inlet 36 which connects into a water circulating system comprising a conduit 38, pump 40, and a conduit 42 leading to a connection 44 into the bottom level of the tank 16 adjacent its front end. The pump operates to maintain a circulation of water from the bottom level of the tank and upwardly into the front end of the shroud, thence through the heat-exchange tube bundle and out at the open inner end of the shroud, into the body of the tank again. This uniformly maintains the storage water in the tank at any prescribed temperature level, as regulated by adjustment of the steam flow control valve 32.

A by-pass conduit as indicated at 46 interconnects the water circulating conduit 38 with the interior of a housing 50 which encloses a temperature sensing "bulb" as indicated at 55 (FIG. 3). The housing and sensor device is disposed to extend into the man body portion of the water supply within the tank 16, the housing being mounted on the tank for this purpose by means of a flange 56. Apertures as shown at 58 are drilled through the main wall of the housing 50 to assist in the sensing operation.
as will be explained more fully hereinafter. A manually adjustable flow regulator device as indicated generally at 66, which is apertured to provide a seat for a poppet type valve 74 carried by a stem 76 which presses at its free end against a flexible water-tight diaphragm 78 which is positionally responsive to fluctuations of pressure in the conduit leading from the regulator to sensor housing 50. The valve head 74 is backed up by a compression spring 80, and the diaphragm 78 is reverse-biased by means of a spring 82, the effective force of which is manually adjustable by means of a hand screw 64 carried by the valve bonnet 86. Hence, the valve 74 is "pre-loaded" in both directions thereby establishing a "threshold" resistance to opening, which will be overcome only by "excessive rate" water withdrawals.

The control components of the system are so provided and adjusted that when the rate of withdrawal of heated water from the outlet 14 is "normal" or relatively slow, the pressure differential between the interior of the tank and the interior of the tube shroud 16 (and therefore at opposite sides of the valve 60) is insufficient to cause the regulator valve device to open. Thus, under normal or slow draw conditions, the valve remains closed, and cold water simply replaces the drawn-off heated water by flowing through the shroud 16 and then into the body of the tank. Here it gradually mixes with and lowers the temperature of the water within the tank in the area of the bulb 55. The bulb 55, through the connection 62 then operates the control valve 32 so as to adjust the steam flow rate accordingly, thereby substantially maintaining the temperature of the main body of water within the tank uniformly within the prescribed range of temperature therefore.

However, whenever large quantities of hot water are rapidly withdrawn from the tank outlet 14, the baffling devices within the shroud 16 operate to retard the rate of responsive replacement flow of water through the shroud from the cold water inlet. Hence, a substantial hydrostatic pressure differential is immediately established between the interior of the tank 10 and the inlet end portion of the shroud 16 which is reflected by a similar differential at opposite sides of the regulator 60. This function to unseat the valve member 74, whereupon cold replacement water immediately starts to flow from the cold water pump line directly through the conduit 46, and thence into the housing enclosing the sensor bulb 55. The advent of cold supply water directly into the casing surrounding the sensing bulb 55 immediately causes the latter to call upon the steam control valve 32 for a correspondingly increased flow of heating fluid. However, as soon as the heavy withdrawal ceases and the temperature of the water generally throughout the tank 10 recovers to the prescribed level and permeates the interior of the bulb housing, the bulb 55 will react to set back the steam control valve 32 accordingly. The apertures 58 through the bulb housing assist in this respect.

Hence, the system of the present invention does not wait upon a general mixing of cold inlet water into the relatively large volume of water occupying the main body of the tank, and upon a consequent gradual lowering of the temperature thereof in the neighborhood of the sensing bulb, as in the case of conventional heating arrangements. Instead, in the case of the present invention any heavy withdrawal is immediately signaled to the regulator 60 which thereupon admits a supply of cold water directly to the sensing bulb. This in turn responds instantly to call upon the heating supply for a commensurate increased flow of heating fluid. Hence, in the same system, slow or "normal" withdrawals are matched by slow and correspondingly economical heat additions; while heavy withdrawals are matched by rapid and commensurate heat additions.

Note, that as best shown in FIG. 3 of the drawing herewith, the sensor shroud device 59 includes a tubular shell 58 which terminates short of the inner end of the bulb 55 (thereby permitting that portion of the bulb to gain free heat-exchange access to the main body of water in the container) while being dimensioned so as to closely hug the main portion of the sensor bulb. The cold water entering the shroud from the by-pass conduit 46 is thereby closely confined in heat-exchange relation with the sensor bulb and thus it will be appreciated that the control system of the invention provides improved results because of the close enclosure of the bulb 55 by the shell of the housing 59 which operates to render the bulb particularly sensitive to inlet of cold water discharging through the conduit 46. Also, the pre-loaded regulator valve device 60 in the cold water by-pass line 46 operates to provide an improved automatic control technique, because it avoids oversensitive responses to slow draws-off and/or other erratic functioning such as would result in sporadic overheating and generally inefficient operations.

Note particularly that the operative response of the control valve 60 is readily regulatable by simple manual adjustments of the spring force control screw 84. Hence, the system is easily and quickly adjustable to temperature range requirements and/or load demands. Note also that the control valve 60 is located in the lowestest level of the by-pass conduit system, thereby avoiding the possibility of any undesirable convection responsive "hot spot" formations in the line, such as would result in erratic and/or incorrect heat source control effects.

Whereas only one form of the invention has been illustrated and described in detail hereinabove, it will be understood that various changes may be made therein without departing from the spirit of the invention or the scope of the following claim.

We claim:

1. A water heating and storage system comprising, in combination, a container having a cold water inlet and a hot water outlet at spaced positions relative to each other; temperature sensor means within said container disposed generally between said cold water inlet and said hot water outlet, a water heater including an elongate housing extending into said container and having heating means and baffle means therein, means for constantly recirculating water within said container through said elongate housing and including a pump having an inlet connected both to the interior of said container and to cold water supply means, said pump also having an outlet, a bypass conduit connected to said outlet of the pump and discharging to said temperature sensor means, and a valve in said bypass conduit for passing water therethrough only in response to withdrawal of hot water from said hot water outlet.

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