

March 12, 1968

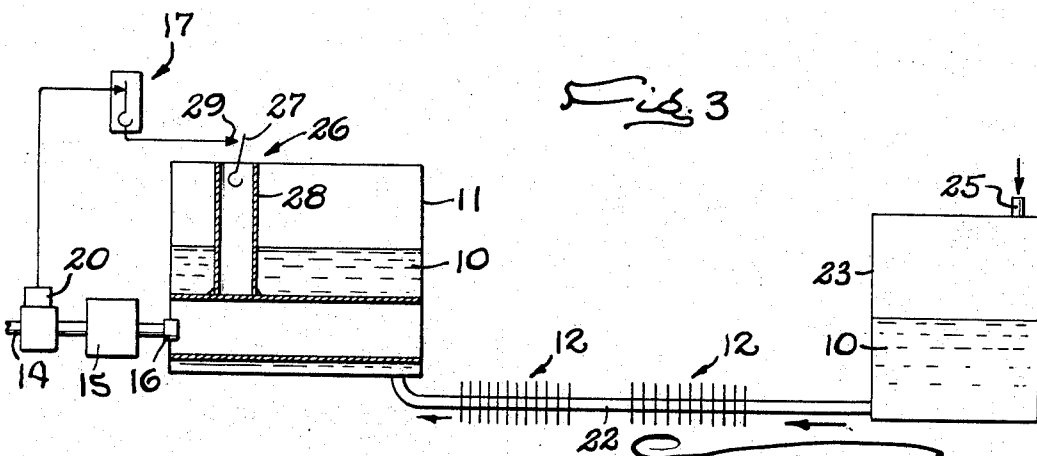
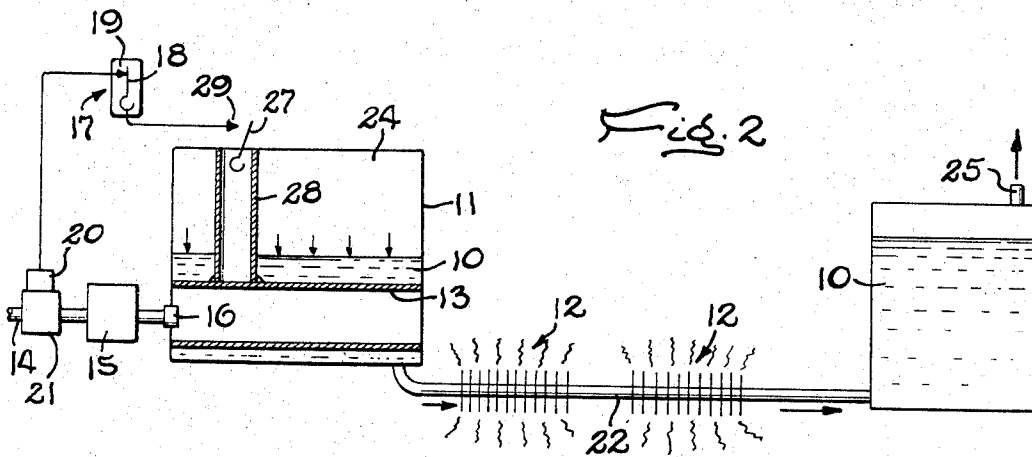
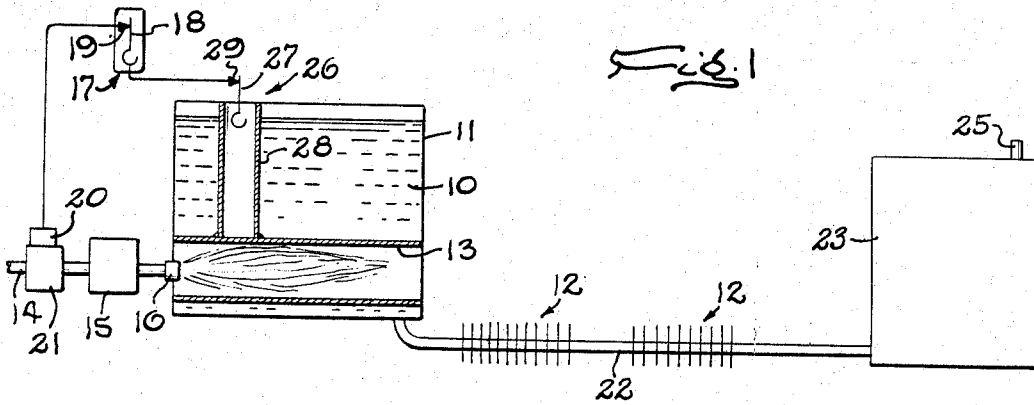
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3,372,871

HOT WATER HEATING SYSTEM

Filed April 1, 1966

2 Sheets-Sheet 1



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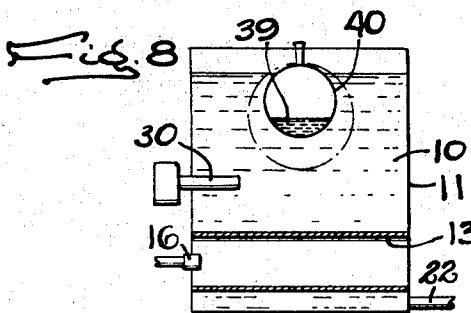
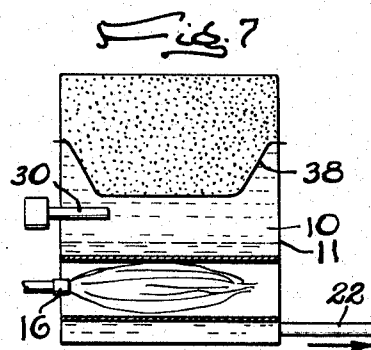
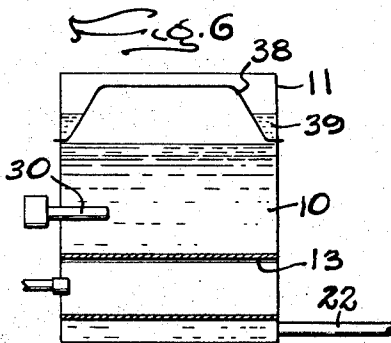
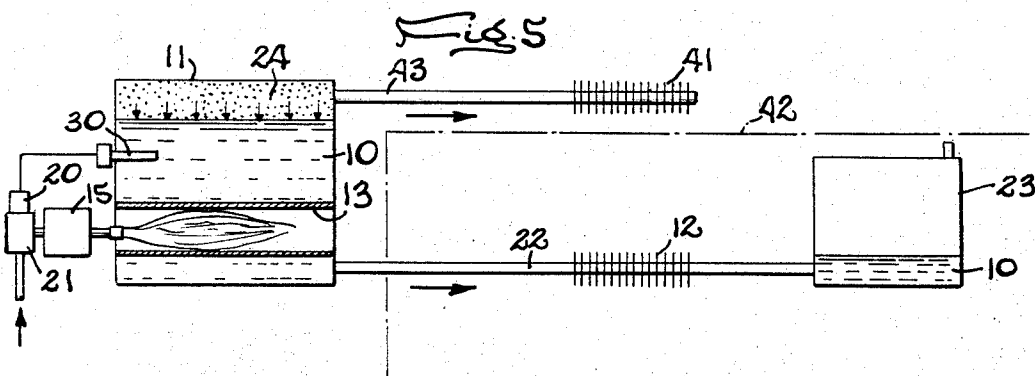
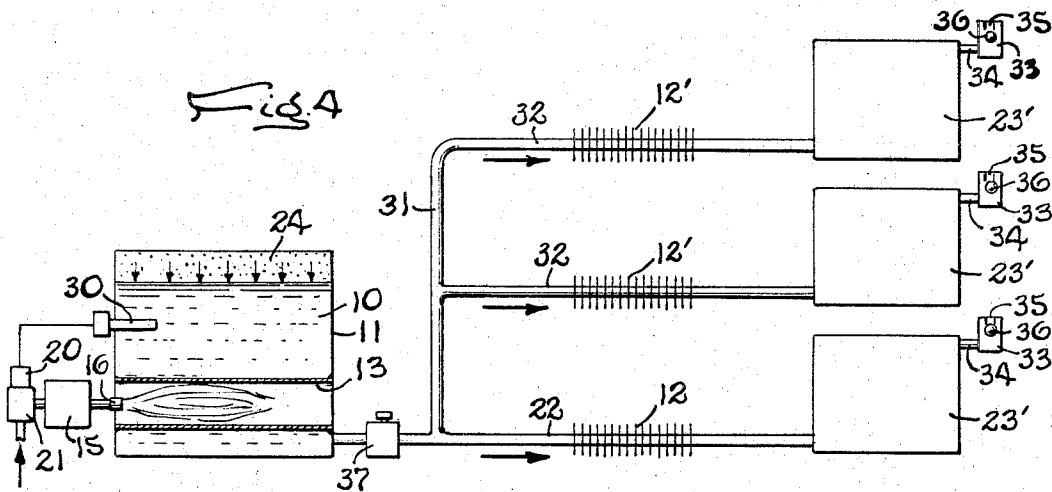
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2 Sheets-Sheet 2



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HOT WATER HEATING SYSTEM

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10 Claims. (Cl. 237-8)

This invention relates to a heating system and, more particularly, to a heating system in which liquid is heated in a boiler, circulated through at least one radiator disposed within an area or space to be heated, and then returned to the boiler for reheating.

The general object of the present invention is to provide a heating system of the above character in which the circulation of the liquid between the boiler and the radiator is dependent neither upon electrical pumps nor gravitational flow and is achieved through the medium of a single conduit leading from the boiler to the radiator.

A related object is to provide a heating system of the foregoing type in which liquid is forced from the boiler to the radiator through the conduit as heat is supplied to the boiler, and then is drawn from the radiator back into the boiler through the same conduit upon termination of the supply of heat to the boiler.

Another object is to provide a novel control for initiating and terminating the supply of heat to the boiler in response to the flow of liquid without being in actual contact with the liquid.

A more detailed object is to utilize a liquid having a boiling point lower than that of the circulating liquid for causing the circulating liquid to flow from the boiler at temperatures below its boiling point.

Still another object is to utilize the atmosphere outside of the area to be heated for assisting the return of the liquid to the boiler.

Other objects and advantages of the invention will become apparent from the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a schematic elevational view showing the heating system embodying the novel features of the present invention as the liquid is being heated in the boiler.

FIG. 2 is a view similar to FIG. 1 showing the system as the liquid is being forced into the radiator.

FIG. 3 is a view similar to FIG. 1 showing the system as the liquid is being returned to the boiler.

FIG. 4 is a view similar to FIG. 1 showing the system equipped with a plurality of radiators.

FIG. 5 is a view similar to FIG. 1 showing the system adapted to utilize the outside atmosphere for returning the liquid to the boiler.

FIG. 6 is a schematic view of a boiler equipped with means for causing the liquid to flow from the boiler at temperatures below its boiling point.

FIG. 7 is a view similar to FIG. 6 showing parts in moved positions.

FIG. 8 is a view similar to FIG. 6 but illustrates a modified form of the invention.

As shown in the drawings for purposes of illustration, the invention is embodied in a space heating system which is particularly suitable for use in warming small enclosed areas such as travel trailers and the like. In such a system, water or other liquid 10 is heated in a boiler 11 and circulated through one or more radiators 12 within the enclosed area thereby losing a portion of its heat to the air surrounding the radiators. The cooled water then is returned to the boiler for reheating, and the cycle is repeated until the area has been warmed to the desired temperature.

Herein, the boiler 11 includes a walled combustion chamber formed by a tube 13 disposed within the boiler

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chamber and surrounded by the water 10 to be heated. The boiler is fired by gas or liquid fuel which flows from an inlet 14 into an injector 15, and then into the combustion tube through a nozzle 16. When the area has been heated in accordance with the setting of a room thermostat 17, a bi-metallic element 18 housed within the thermostat opens a switch contact 19 to de-energize a solenoid 20. De-energization of the solenoid causes a valve 21 in the inlet 14 to close thereby shutting off the flow of fuel to the injector. When the thermostat again calls for heat, the bi-metallic element makes contact 19 to energize the solenoid and to open the valve thus permitting fuel to flow to the injector.

In its primary aspect, the present invention contemplates a new and improved heating system which not only avoids the need for electrically operated pumps or gravitational force for circulating the water 10 through the radiators 12, but which also both feeds the water to the radiators and returns the water to the boiler 11 through a single conduit 22. For this purpose, the conduit or pipe (FIGS. 1 to 3) leads from the lower portion of the boiler to the radiators and then leads to a reservoir or storage tank 23. As heat is supplied to the combustion tube 13, the water is heated, and vapor 24 (FIG. 2) is generated in the upper portion of the boiler chamber, the volume and pressure of the vapor increasing as additional heat is supplied. This increase in vapor pressure forces the hot water downwardly through the conduit 22, into the radiators 12, and then into the storage tank 23. In order to admit the water, the storage tank is vented at its upper end to the atmosphere by an open pipe 25. After a predetermined quantity of water has flowed from the boiler into the storage tank, the fuel supply to the injector 15 is shut off thereby terminating combustion within the tube 13. Accordingly, the vapor in the boiler cools and condenses to form a vacuum within the boiler chamber. The vacuum acts to draw the water in a reverse direction (FIG. 3) through the conduit 22 from the storage tank, through the radiators, and back into the boiler. When a quantity of water has been returned to the boiler, fuel flow to the injector again is initiated, and the cycle thereafter is repeated until the room thermostat 17 is satisfied. If desired, the reservoir or storage tank 23 itself may be a radiator which is closed at one end and vented to the atmosphere.

In accordance with another aspect of the invention, a new and improved control 26 (FIGS. 1 to 3) is provided for shutting off the fuel flow to the injector 15 after a predetermined quantity of water 10 has been forced from the boiler 11 and for initiating the fuel flow to begin a new cycle after the water has been returned to the boiler. Although the control is responsive to the flow of water, it is not in contact with either the water or the vapor 24 and thus problems of corrosion do not arise.

In this instance, the control 26 comprises a sensing element 27 such as a bi-metallic strip which changes its position in accordance with variances in temperature. The sensing element is electrically connected in series with the room thermostat 17 and the solenoid 20, and is disposed within a tubular member 28 in the boiler 11. The tubular member, preferably formed of heat-conductive metal, is bonded metallurgically to the combustion tube 13 and projects upwardly therefrom into the area of the boiler occupied by the water and the vapor.

Initially, the boiler 11 is filled with water 10, and the sensing element 27 is in a closed position with respect to a contact 29. Upon signal from the room thermostat 17, heat is supplied to the combustion tube 13 and is conducted from the combustion tube to the tubular member 28. Because the tubular member is surrounded by water and because of the excellent heat conductivity between liquid and metal, the heat is conducted rapidly away from

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the tubular member by the water, and the temperature within the tubular member remains relatively low. Accordingly, the sensing element continues to make contact 29, and heat continues to be supplied to the combustion tube. Then, as the water level drops as the hot water is forced from the boiler, the major portion of the tubular member is exposed to vapor. Since there is poor conductivity between metal and vapor, very little heat is conducted away from the tubular member and the temperature within the latter increases sharply. As a consequence, the sensing element 27 moves away from the contact 29 to de-energize the solenoid 20, close the valve 21, and terminate the supply of heat to the boiler. When the water subsequently returns to a certain level within the boiler under the influence of the vacuum therein, the tubular member is cooled and the sensing element again makes contact 29 to start the flow of fuel into the combustion tube. The operation thereafter is continuous with water flowing to and from the boiler until the room thermostat is satisfied. With arrangement, the sensing element 27, being surrounded by the tubular member, is not subject to corrosion and does not have to be finely adjusted since the temperature within the tubular member changes rather suddenly in response to the flow of the water into and out of the boiler.

Another control suitable for the purposes of the present system is shown in FIG. 4. This control comprises a thermostat sensing rod 30 similar to those used in domestic hot water heaters. The rod extends through one wall of the boiler 11 and is positioned above the combustion tube 13. As long as the rod is surrounded by water 10, the solenoid 20 remains energized to allow fuel to flow to the injector 15. When the water level drops, the temperature of the rod 30 increases due to the exposure of the latter to the vapor. As a result, the rod produces a signal to de-energize the solenoid and shut off the flow of fuel.

The system described above is not limited to use with single branch of radiators 12 connected in series, but instead, can be employed with a number of branches as shown in FIG. 4. In this instance, a header 31 is connected to the conduit 22 at a point on the latter between the boiler 11 and the radiators 12. Extending from the header are a number of conduits 32 which lead first to additional radiators 12' and then to additional storage tanks 23'. In the multiple branch system, the tanks also are vented to the atmosphere, but the open pipe 25 is replaced with a valve housing 33 having one port 34 communicating with the tank and having a second port 35 open to the atmosphere. Disposed within the housing is a floating ball-type valve 36 which is operable to close the port 35 when water 10 enters the valve housing. At the beginning of each cycle, hot water flows through all of the radiators and into the storage tanks, the valves 36 being open with respect to the ports 35 to vent the tanks. In the event one of the tanks should become filled with water before the other two tanks, the valve in the filled tank will rise into sealing relation with the port 35 to prevent overflow, and the remaining water from the boiler will be diverted to the unfilled tanks.

In some instances, the heating system may tend to push the water 10 from the boiler 11 to the radiators 12 at a relatively fast rate and to draw it back into the boiler at a somewhat slower rate. To equalize the rate of flow in both directions and thereby obtain the maximum amount of heat from the water, a flow control valve 37 (FIG. 4) may be inserted in the conduit 22 between the boiler and the radiators. The water is allowed to flow freely through the valve from the radiators to the boiler, and the valve may be adjusted to throttle the rate of flow in the opposite direction to a rate equal to the free flow.

The present invention also contemplates novel means for causing the water 10 to flow from the boiler 11, through the radiators 12, and into the storage tank 23 at temperatures lower than its boiling point should it be desirable to circulate the water at lower temperatures

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and should it be desirable to obtain a faster cycle time for the system. Herein, these means comprise a flexible diaphragm 38 (FIGS. 6 and 7) which is fastened to the interior walls of the boiler and divides the latter into the upper and lower compartments. The water or other liquid to be circulated is contained within the lower compartment below the diaphragm, and a liquid 39 having a boiling point lower than that of the circulating liquid is placed in the upper compartment above the diaphragm. Accordingly, when heat is supplied to the boiler, the liquid 39 vaporizes in a relatively short time thereby increasing the pressure in the upper compartment and forcing the diaphragm downwardly into the lower compartment (FIG. 7). The diaphragm thus acts as a piston and forces the water from the boiler and into the conduit 22 before the water reaches its boiling point.

A second adaptation of this principle is illustrated in FIG. 8. In this instance, a small amount of the liquid 39 having a relatively low boiling point is placed within an enclosed bag 40 in the form of a flexible bladder or balloon. The bag is suspended from the top of the boiler 11 and is substantially surrounded by the circulating water 10 prior to the beginning of each cycle. As the water is heated, the liquid 39 within the bag vaporizes and, as a consequence, the bag expands to occupy greater space within the boiler and to force the water into the radiating system through the conduit 22.

Means also are provided for effecting a more rapid return of the water 10 from the storage tank 23 back into the boiler 11. Herein, these means comprise a small radiator 41 (FIG. 5) which is placed outside of the area to be heated (indicated by the broken line 42 in FIG. 5) and is exposed to the colder outside atmosphere. A conduit 43 connects the upper, vapor portion of the boiler 11 with the outside radiator, the conduit being closed at its end remote from the boiler. As heat is supplied to the boiler, the heated vapor 24 enters into the conduit 43 and the radiator 41 and is condensed rapidly by the cold outside atmosphere. As a result, the vacuum within the boiler is formed more rapidly, and the time required for drawing the water back into the boiler is decreased. With this arrangement, the rapidity of condensation increases as the outside temperatures fall thus resulting in faster cycle times during periods of colder weather.

From the foregoing, it will be apparent that the new and improved heating system of the present invention obtains all of the advantages of hot water heat without requiring pumps or gravity for circulating the water. This, coupled with the simplicity of the valving and connecting conduits, makes the system especially suitable for use in installations where cost and space requirements are important considerations. Moreover, the system is additionally advantageous since the heat of the water is transferred to the surrounding atmosphere as the water is being returned through the radiators to the boiler as well as when the water is being forced through the radiators from the boiler.

I claim as my invention:

1. In a heating system, the combination of, a boiler having a chamber within which to heat liquid, a radiating device for transferring heat from the liquid to the surrounding atmosphere and thereby cooling the liquid, a reservoir open to the atmosphere for storing the cooled liquid, a conduit leading from said chamber to said radiating device, and then to said reservoir, heating mechanism associated with said boiler for heating the liquid in said chamber and for increasing the pressure of the vapor therein whereby the pressure exerted on the liquid by the vapor forces the liquid in one direction through said conduit from said chamber to said radiating device, and then to said reservoir, and control means operable in response to the flow of liquid from said chamber to deactivate said heating mechanism whereby the vapor within said chamber cools and condenses to form a vacuum therein for drawing the liquid in the opposite direction through said conduit from said reservoir to said chamber.

2. A heating system as defined in claim 1 in which said control means comprises a sensing element disposed in said chamber, said sensing element operable to activate said heating mechanism when the liquid in said chamber is above a predetermined level and operable to de-activate said heating mechanism when the liquid falls below the predetermined level.

3. A heating system as defined in claim 2 further including a walled combustion chamber disposed within said boiler chamber, a tubular member of heat-conductive material secured to said combustion chamber, said member having a portion surrounded by the liquid when the latter is above said predetermined level and projecting above the level of the liquid when the latter is below said predetermined level whereby the temperature within said member varies in accordance with the level of the liquid, said sensing element being housed within said tubular member and responsive to the variance of the temperature therein to activate and de-activate said heating mechanism.

4. A heating system as defined in claim 1 further including a second radiating device and a second reservoir, and a second conduit connecting said chamber with said second radiating device and said second reservoir.

5. A heating system as defined in claim 4 in which said second conduit is connected to said first conduit at a point along the latter between said chamber and said first radiating device.

6. A heating system as defined in claim 1 further including a second liquid in said chamber having a boiling point lower than that of the first liquid, and flexible means disposed in said chamber for separating the second liquid from the first liquid.

7. A heating system as defined in claim 6 in which said flexible means is a deformable diaphragm extending between the walls of said chamber and dividing the latter into upper and lower compartments, the first liquid being in said lower compartment and the second liquid being in said upper compartment.

8. A heating system as defined in claim 6 in which said

flexible means is an enclosed, deformable bag, the second liquid being contained within said bag.

9. In a heating system for heating an enclosed area, the combination of, a boiler having a chamber within which to heat liquid, said chamber having an upper portion for containing vapor and a lower portion for containing liquid, a radiating device disposed within the enclosed area for transferring heat from the liquid to the atmosphere within the area, a reservoir for storing the liquid after the latter passes through said radiating device, a conduit extending from the lower portion of said chamber to said radiating device and then to said reservoir, heating mechanism associated with said boiler for heating liquid in the lower portion of said chamber and increasing the pressure of the vapor in the upper portion of said chamber whereby the pressure exerted by the vapor on the liquid forces the latter from the lower portion of the chamber and through said conduit, first to said radiating device and then to said reservoir, and control means operable in response to a change in the condition of the liquid to de-activate said heating mechanism whereby the vapor in the chamber cools and condenses to create a negative pressure therein for drawing the liquid through said conduit from said reservoir to the lower portion of said chamber.

10. A heating system as defined in claim 9, further including an additional radiating device disposed outside of the enclosed area and exposed to atmosphere having a temperature less than that within the enclosed area, and a second conduit connecting the upper portion of said chamber to said additional radiating device whereby vapor flows from the chamber to the additional radiating device and is cooled and condensed by the low-temperature atmosphere.

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