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3,237,684 3/1966 Morgan 165/39
3,349,755 10/1967 Miller 165/108 X
3,383,040 5/1968 Darm 165/39 X

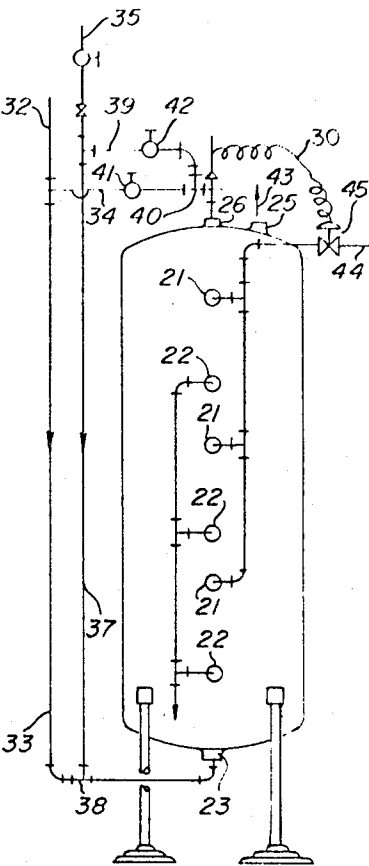
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[54] **HEAT EXCHANGER**
6 Claims, 2 Drawing Figs.

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122/32, 165/36, 165/39, 165/108
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B60h 1/00, F28f 13/06
[50] Field of Search **165/36, 39,**
108, 1; 122/32

[56] **References Cited**
UNITED STATES PATENTS
2,713,994 7/1955 Angelery **165/36**

ABSTRACT: A heat exchanger which is used to reheat a recirculated heating fluid in which most of the recycled fluid and most of the makeup fluid is mixed outside of the heat exchanger and fed to the heat exchanger via a bottom inlet. A small proportion of the recycled fluid and a small proportion of the makeup fluid is mixed outside of the heat exchanger and fed to an inlet at the top of the heat exchanger. This second flow of fluid passes through a control chamber mounted inside the heat exchanger to permit the temperature of this flow to be sensed by a temperature controller, which regulates the heat input to the heat exchanger.



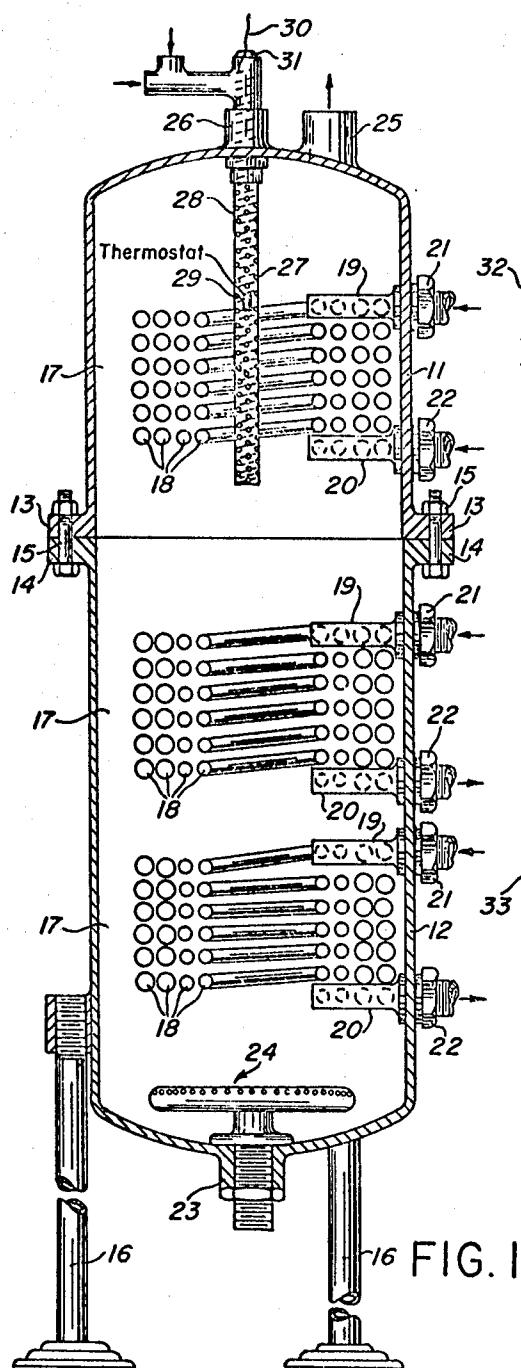


FIG. 1

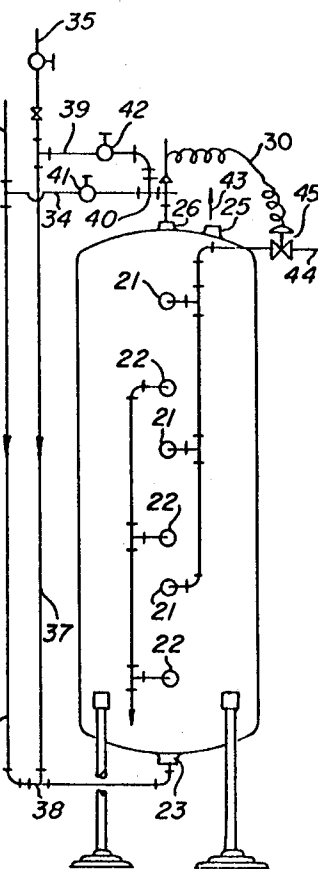


FIG. 2

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HEAT EXCHANGER

The present invention relates to heat exchangers and in particular to heat exchangers having improved temperature-sensing properties.

Domestic hot water distribution systems which are used in large commercial and industrial buildings are usually of the recycling type. In other words the hot water is taken from a storage tank and recycled throughout the building and returned to the tank. This is done so that the water in the hot water pipe throughout the building is at all times hot, thus, whenever some person opens a faucet the time lag before hot water actually reaches the faucet is kept to a minimum.

This hot water is normally heated in an out of contact heat exchanger in which the water is contained in the shell for distribution throughout the building and the heating medium such as steam is contained in coils or tubes within the shell or receiver. The demand for hot water of course varies greatly throughout the day and as the demand varies it is desirable to vary the amount of heat being given off by the heating coils, and, since the heating coils are normally heated by steam it is thus necessary that the amount of steam being fed to the coils be varied to suit the demand of hot water.

In many systems the receiver or heat exchanger actually acts as a reservoir to help reduce fluctuations in the demand and also to increase the time in which the water is actually in contact with the heating coils. In such a system there is however a serious fault. When the demand for hot water is suddenly increased there is a lag in the steam flow to the heating coils to give an increase in the heat given off by the heating coils. To overcome this problem the heating coils in many cases are greatly increased in size so that they can produce a lot of heat in a short period of time. This however produces another fault in that at very low flows, the amount of heat being given off by the heating coils can greatly exceed that which is required and can result in overheating of the water which of course is a very dangerous proposition.

One attempt to overcome this problem is discussed in Canadian Pat. No. 525,474 ANGELERY which issued on May 29, 1956. In this patent there is shown a hot water receiver in which the inlet tube is a vertical pipe extending some distance into the receiver. This inlet tube contains a restriction which produces a zone of reduced pressure when there is flow in the tube. A second vertical conduit is provided which is spaced from the inlet tube. This conduit is open at the top to permit an inflow of water from the receiver. The conduit is connected at its lower end to the inlet tube at a point downstream of the restriction. A bypass is also provided to permit the flow of water from the inlet tube upstream of the restriction to the conduit. A thermostat or other temperature sensing device is located in this conduit to detect the temperature of the water flowing through the conduit.

In operation it will be seen that the flow of cold water through the inlet tube causes a zone of reduced pressure downstream of the restriction which induces a flow of water through the conduit. This water flowing through the conduit is a mixture of hot water from the receiver entering the conduit at its upper end and cold water reaching the conduit by the bypass. The thermostat located in the conduit detects the temperature of the flows and operates valves to control the flow of steam to the heating coils.

It has been found in practice that heat exchangers of the above discussed type have certain inherent disadvantages. Firstly, the flow of mixed hot and cold water and the proportions of each which flow past the thermostat are determined by the design of the unit. This involves the size and shape of restriction in the inlet tube, the design of the bypass, the form of the conduit etc. and it is extremely difficult to determine these dimensions for a range of flows. In addition, in operation the restriction and certain of the pipes may become fouled or partially plugged and this can not readily be detected. Another disadvantage is that in order to rectify such a problem the whole exchanger must be dismantled.

It has now been found that these disadvantages can be overcome by providing a heat exchanger in which the hot and cold fluid flowing to the thermostat are mixed exteriorly of the heat exchanger and the proportions of the two flows can easily be varied to suit the requirements of the heat exchanger. In addition the critical parts of the heat exchanger, being the thermostat and the housing about the thermostat, are adapted to be easily removed from the heat exchanger without further dismantling of the heat exchanger so that maintenance can be done as simply and quickly as possible.

The present invention therefore provides in a fluid heating system in which the heated fluid is piped away from the heat exchanger and is returned to the heat exchanger to be reheated and any heated fluid which is not returned is compensated for by a cold fluid makeup, the improvement which comprises combining most of the recycled fluid and the makeup fluid in a first conduit exteriorly of the heat exchanger and feeding them to the heat exchanger through a bottom inlet, combining some small proportion of said recycled fluid and some small proportion of said makeup fluid in a second conduit exteriorly of the heat exchanger and feeding them to an inlet at the top of the heat exchanger. Said second flow comprising the small proportion of recycled fluid and makeup fluid is then caused to flow through a control chamber within the heat exchanger such that the temperature of the second flow is sensed by temperature responsive means which is adapted to regulate the heat to the heat exchanger.

In addition the present invention also provides a heat exchanger comprising:

- a shell;
- a plurality of heating coils within said shell;
- an inlet at the bottom of the shell adapted to permit passage of most of the fluid entering the shell;
- an outlet at the top of the shell;
- a second inlet at the top of the shell adapted to permit passage of a small proportion of the fluid entering the shell, said second inlet being provided with a perforated control chamber located within said shell;
- a temperature responsive means located within said control chamber such that fluid entering the shell through said second inlet is discharged through said control chamber and around said temperature responsive means;
- said temperature responsive means being adapted to regulate the heating effect of said heating coil.

The following is a description by way of example of a certain embodiment of the present invention, reference being had to the accompanying drawings in which:

FIG. 1 is a sectional side elevation of a preferred embodiment of the heat exchanger;

FIG. 2 is a schematic view showing a typical piping arrangement.

Referring to FIG. 1, the heat exchanger illustrated comprises a shell which is formed of an upper section 11 and a lower section 12 which are joined by flanges 13 and 14 and bolts 15. The shell is supported in a vertical position by legs 16.

Three bands of heating coils 17 are shown in FIG. 1. Each bank is composed of four spiral tubular coil members 18 which are connected at the top to an inlet header 19 and after making six turns downwardly are connected to an outlet header 20. The inlet header 19 and the outlet header 20 protrude through the shell and terminate in pipe connections 21 and 22. The connections joining the spiral coils and the headers can be of a permanent nature and the only screw type dismantlable connections are on the exterior of the shell. Thus the possibility of having a leaking connection in the heating coils and the possibility of contaminating the fluid to be heated by the heating medium is kept to a minimum.

The number of bands of heating coils, the number of coils, and the design of the individual coils can of course be varied to suit the individual requirements.

The liquid to be heated enters by inlet 23 in the bottom of the shell. The inlet may be equipped with diffuser 24 to assist in distributing the cold liquid about the interior of the heat

exchanger. The heated liquid leaves by outlet 25 at the top of the heat exchanger.

A second inlet coupling 26 is provided at the top of the heat exchanger and a small proportion of the liquid to be heated is admitted to the exchanger through this inlet whereas the greater proportion is admitted through inlet 23 at the bottom of the exchanger. A control chamber 27 passes through the second inlet coupling 26 and extends into the shell of the heat exchanger. That part of the control chamber which is inside the shell is perforated with a plurality of holes 28. A temperature responsive device 29 is located inside the control chamber 27 with the connecting wires 30 extending upwardly through the inside of the control chamber and passing from the top of the chamber through connection 31.

FIG. 2 illustrates the piping arrangement when the heat exchanger of the present invention is used with a domestic hot water heating system which operates on a recirculating principle. In most large buildings a recirculating system is used in conjunction with the domestic hot water piping layout. In such a system the hot water is taken from the heat exchanger pumped throughout the building and returned to the heat exchanger for reheating. The hot water leaves the heat exchanger by a pipe 43 and returns to the heat exchanger in return pipe 32. This return flow is divided into two streams, pipe 33 being used to direct most of the return flow to inlet coupling 23 at the bottom of the heat exchanger and a minor portion of the return flow is directed along pipe 34 to inlet coupling 26.

All of the circulated hot water which is used up must be replaced by fresh, cold water. This fresh water makeup is added by pipe 35 which in turn is divided to provide a main flow along pipe 37 to join up with return pipe 33 at Tee 38 to enter the heat exchanger by coupling 23. A small proportion of the fresh water makeup is directed along pipe 39 to join return pipe 34 at Tee 40 and enter the heat exchanger by top coupling 26. The proportions of return water and cold makeup water entering the heat exchanger via top coupling 26 may be varied by valves 41 and 42. The water entering the heat exchanger by coupling 26 flows down through the control chamber 27 and contacts the temperature responsive device 29 which in turn controls valve 45 in the steam line 44 feeding the heating coils 17. The temperature-responsive device is thus contacted by a flow of fluid entering the heat exchanger which is a sampling of the main flow entering the bottom of the exchanger through coupling 23 and diffuser 24. The temperature-responsive device can thus sense a future change in temperature of the fluid in the body of the heat exchanger and immediately regulate the steam flow accordingly. When there is no flow of fluid into or out of the heat exchanger the holes 28 in the control chamber 27 permit the fluid in the heat exchanger to circulate about the temperature responsive device 29 so that any small changes in temperature may be detected and corrected.

The mixing of the return water and the makeup water is accomplished exteriorly of the heat exchanger and the ratio of return to makeup may be varied to give optimum results by simply changing the setting of valves 41 and 42. This is a great improvement over prior art devices which usually cannot be varied by the operator and may actually change due to scaling or fouling.

The proportion of water which is fed through the top inlet 26 as compared to the flow of water through the bottom inlet 23 does not appear to be critical. Substantially less than 10 percent flow through the top inlet 26 and thus through the control chamber has given excellent results.

Another feature of the present invention is that the whole control chamber and temperature responsive device may be adapted to be removed completely from the heat exchanger thus greatly reducing maintenance problems.

What I claim is:

1. In a method of operating a fluid-heating system in which the heated fluid is piped away from a heat exchanger and is returned to the heat exchanger to be reheated and any heated

fluid which is not returned is compensated for by a cold fluid makeup, the improvement which comprises combining most of the recycled fluid and the makeup fluid in a first conduit exteriorly of the heat exchanger and feeding them to the heat exchanger through a bottom inlet, combining some small proportion of said recycled fluid and some small proportion of said makeup fluid in a second conduit exteriorly of the heat exchanger and feeding them to an inlet at the top of the heat exchanger, the relative proportions of recycled fluid and makeup fluid introduced into said second conduit being adjustable to alter the temperature characteristics of the second conduit flow relative to those of the first conduit flow, causing said second flow comprising the small proportions of recycled fluid and makeup fluid to flow through a control chamber within said heat exchanger such that the temperature of said second flow is sensed by a temperature responsive means which is adapted to regulate the heat to the heat exchanger.

2. The method of operating a heating system as claimed in claim 1 in which when there is no flow of recycled fluid and makeup fluid through the inlet at the top of the heat exchanger, the fluid in the body of the heat exchanger circulates through said control chamber and about said temperature responsive means.

3. The method of operating a heating system as claimed in claim 1 in which the volume of flow through said inlet at the top of the heat exchanger is less than 10 percent of the volume of flow through the inlet at the bottom of the heat exchanger.

4. The method of operating a heating system as claimed in claim 3 in which the proportion of flow through said inlet at the top of the heat exchanger and said inlet at the bottom of the heat exchanger is variable.

5. A heat exchanger comprising:

a shell;

a plurality of heating coils within the shell;

a first inlet at the bottom of the shell;

a second inlet at the top of the shell;

an outlet at the top of the shell;

a control chamber inside said shell adjacent said second inlet and adapted to receive fluid admitted into said shell therethrough;

temperature control means located within said control chamber responsive to the temperature of fluid admitted therein from said second inlet to regulate the heating effecting of said heating coils;

first conduit means for discharging heated liquid from said outlet at the top of said shell;

second conduit means for introducing recycled heated liquid into said first inlet at the bottom of said shell;

third conduit means for introducing cold makeup fluid into said second conduit means upstream of said first inlet whereby a mixture of recycled fluid and makeup fluid may be introduced into said shell through said first inlet;

fourth conduit means for conveying a portion of recycled fluid from said second conduit means to said second inlet at the top of said shell whereby a portion of the recycled heated liquid is introduced into said shell through said second inlet;

fifth conduit means for conveying a portion of said cold makeup fluid from said third conduit means to said fourth conduit means upstream of said second inlet whereby a mixture of recycled fluid and makeup fluid may be introduced into said shell through said second inlet;

first valve means in said fourth conduit for regulating the flow of recycled fluid therein relative to the flow thereof in said second conduit; and

second valve means in said fifth conduit for regulating the flow of makeup fluid therein relative to the flow thereof in said third conduit;

said first and second valve means together regulating the amount of fluid entering the shell through the second inlet relative to that entering the bottom inlet and regulating the ratio of makeup fluid relative to recycled fluid entering the shell through said second inlet independently to said ratio entering the shell through said first inlet.

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6. The heat exchanger as claimed in claim 5 in which the walls of said control chamber are perforated to permit the fluid in the shell of the heat exchanger to circulate about the

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temperature responsive means, when there is no flow of recycled fluid and makeup fluid through said inlet at the top of the heat exchanger.

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