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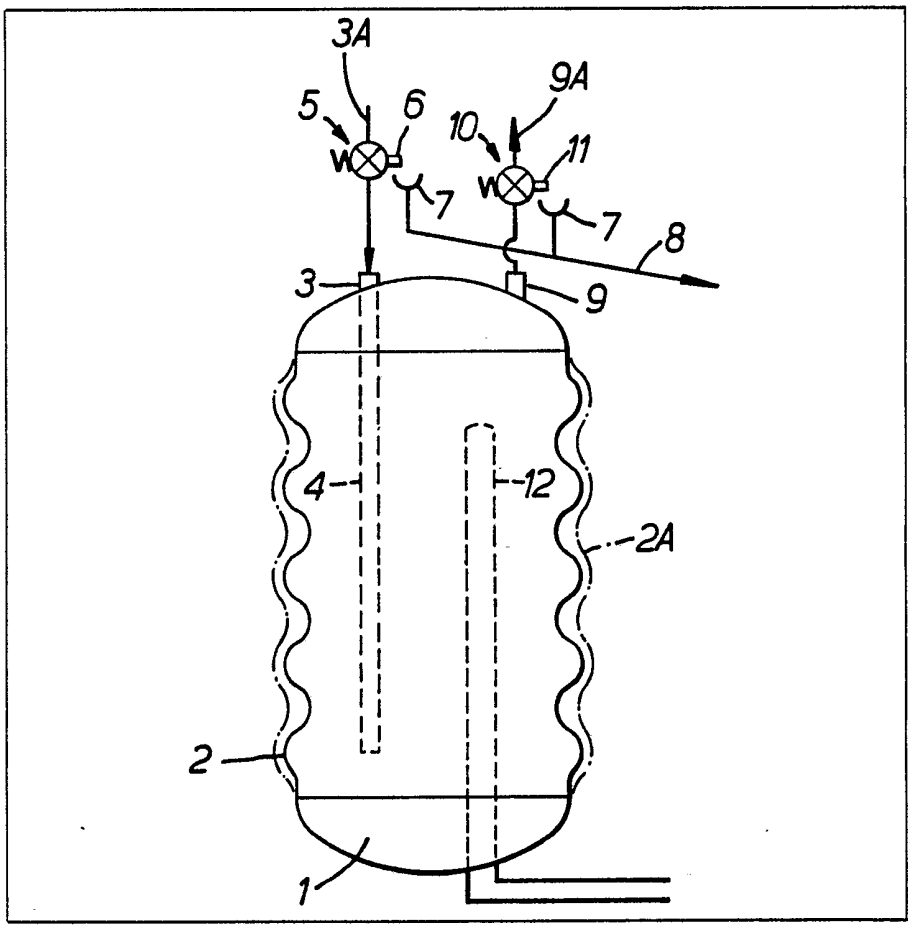
(54) **Means to accommodate liquid expansion in a closed liquid storage vessel**

(57) A closed liquid storage vessel has a liquid storage chamber (1) a liquid inlet (3) a liquid outlet (9) and means (12) to heat the liquid in the chamber.

In order to prevent wastage of liquid as occurs in an unvented system or in a traditional vented system upon expansion of the liquid in the vessel, the sides (2) of the chamber are profiled so that they can move to accommodate the expansion of the liquid in the chamber without excess liquid being expelled.

In an alternative form, the vessel is divided into two separate chambers by a flexible membrane, one of the two chambers containing the liquid to be heated and the other chamber containing a gas charged to a pressure which is approximately the same as the pressure at the liquid inlet.



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The drawing originally filed was informal and the print here reproduced is taken from a later filed formal copy.
The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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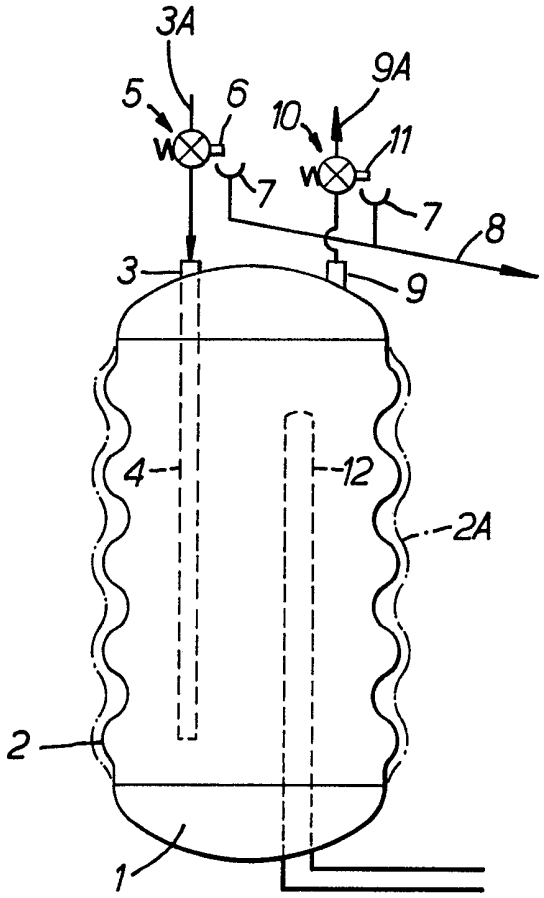

SPECIFICATION

Means to accommodate liquid expansion in a closed liquid storage vessel

This invention relates to means to accommodate liquid expansion in a closed liquid storage vessel.

More particularly, the invention relates to a storage vessel in which water is heated, particularly but not exclusively for domestic uses.

The traditional British system for this purpose, hereinafter called a "vented system", comprises a cold water storage system which communicates with a vessel within which water is heated. When this water is heated, expansion takes place and the water which has expanded communicates back *via* an open pipe to discharge into the cold water feed cistern. This system thus prevents any rise in pressure in the cistern above that obtained by the static head of water of the feed cistern above the heater vessel.

In other countries, the heater vessel is normally connected directly to the mains water supply under a controlled pressure and this is referred to hereinafter as an "unvented system". In this situation, when the water is heated in the vessel, the rise in pressure due to the increase in volume and/or a rise in temperature causes either a pressure relief valve or a thermal relief valve to open. The valves will discharge the excess volume of water to waste.

This discharge each time water is heated is obviously wasteful and the British Water Authorities insist that an expansion vessel be fitted to accommodate the expansion volume as water is heated under normal conditions. Other countries are considering similar containment. The pressure and/or relief valves are also fitted but now will only discharge water to waste under emergency conditions when there has been a failure of the normal control devices such as a thermostat or high limit cut out. The fitting of the separate expansion vessel which has to be sized in accordance with the volume of water under heat, although reducing waste water, adds new manufacturing and fitting costs to the appliance.

It is therefore an object of the present invention to provide an unvented vessel in which water is heated with integral provision to accommodate the expansion volume of the heated water.

According to the present invention, there is provided a closed liquid storage vessel comprising a liquid storage chamber, a liquid inlet for the chamber, a liquid outlet for the chamber and means to heat the liquid in the chamber, the liquid storage chamber being constructed to increase its volume as pressure of liquid in the chamber increases to accommodate expansion of the liquid within the chamber upon heating of the liquid.

For a better understanding of the invention and to show how the same may be carried into effect, reference will now be made, by way of example, to the accompanying drawing, in which the single figure is a diagrammatic side view of one form of a domestic hot water storage vessel according to the invention.

The drawing shows a substantially cylindrical water storage vessel comprising a chamber 1 having profiled side walls 2. The chamber 1 has a cold water inlet 3 leading from a supply conduit 3A. The inlet 3 can be connected inside the chamber 1 to a distributing conduit 4 which can be provided to ensure that the cold water enters the main body of the chamber 1 remote from a hot water outlet 9 of the chamber 1.

A heater 12 is provided in the chamber; this heater can be electric and be in the form of immersed heating elements, or can be an indirect heating coil supplying heat from a gas or oil boiler, for example. The heater 12 is in all cases controlled by a thermostat and a high limit stat or energy cut-out (not shown).

The heated water will discharge from the chamber 1, when fittings such as taps in the domestic circuit are opened, *via* the outlet 9 and through a discharge conduit 9A.

In use, the chamber 1 is filled with cold water from the conduit 3A and this water is subsequently heated by the heater 12. As the cold water is heated, its volume expands. The profiled walls 2 of the chamber 1 will then distort to accommodate the expansion volume of the hot water to assume a shape as diagrammatically shown at 2A. Accordingly, in this unvented system, expansion of the walls 2 (in particular) of the vessel 1 will be sufficient to accommodate the expansion of the water within the chamber as it is heated.

To allow for failure of the thermostat and the high limit stat, which will cause an excessive heating of the water, an expansion relief valve 5 is provided in the inlet conduit 3A and a thermal relief valve 10 is provided in the discharge conduit 9A. If the designed limit of expansion of the chamber 1 is therefore exceeded, either or both of the relief valves 5, 10 will open and will discharge water through orifices 6, 11, respectively into waste water drain funnels 7 connected to a common overflow conduit 8, thereby relieving the excess pressure and the hottest water. As water is discharged from the chamber 1, it is automatically supplied with fresh cold water from the supply conduit 3A. The discharge outlet 6 and 11 are caused to discharge into an open funnel 7 and the discharge conduit 8 is also open at its downstream end so that discharge of water can be observed indicating fault conditions, so that remedial action can be taken.

It will be appreciated that the valve 5 will

only open when a predetermined pressure is achieved in the chamber 1 and the valve 10 will only open when a predetermined temperature is reached in the chamber 1 so that, under normal circumstances, expansion of the water in the chamber 1 will be accommodated by the distortion of the walls 2 of the chamber 1.

In an alternative form, not shown, the vessel could be divided into two separate chambers by a flexible membrane, one of the two chambers containing the water to be heated and the other chamber containing a gas charged to a pressure which is approximately the same as the controlled pressure of the cold water supply at the water inlet to the vessel. In this case, when the water is heated in its own chamber, the increased volume of the water causes flexing of the membrane and so the expanded volume of the water is accommodated. The membrane returns towards its original position, aided by the gas pressure in the gas chamber, when the water temperature falls.

As in the first form of vessel, relief valves are provided which will open under the previously discussed emergency conditions.

In a further form, the vessel can have one wall which comprises a flexible membrane, movement of which being controlled by a mechanical pressure balancing method.

In both the last-described forms and in the form shown in the drawing, means can be provided to control the distortion/flexing movement to a desired maximum amount and, if necessary, in a desired shape relative to the initial shape of the vessel. In this manner, stresses to the walls of the vessel due to distortion and flexing and heat can be pre-determined and controlled.

CLAIMS

1. A closed liquid storage vessel comprising a liquid inlet, a liquid outlet and means to heat the liquid in the vessel, the vessel having substantially rigid profiled walls but which are able to distort to increase the volume in the vessel as pressure of liquid in the vessel increases, in order to accommodate expansion of the liquid within the vessel upon heating of the liquid.

2. A vessel as claimed in claim 1, wherein said means to heat the liquid in the vessel is in the form of an electric heater in the vessel.

3. A vessel as claimed in claim 1, wherein said means to heat the liquid in the vessel is an indirect heating coil supplying heat from an outside source.

4. A vessel as claimed in claim 1, 2 or 3 wherein an expansion relief valve is provided to prevent untoward excessive expansion of the liquid in the vessel.

5. A vessel as claimed in any one of the preceding claims, wherein a thermal relief valve is provided to prevent untoward excessive heating of the liquid in the vessel.

6. A vessel as claimed in any one of the preceding claims and being substantially cylindrical, said profiled side walls being of corrugated form.

7. A vessel as claimed in claim 6, wherein means are provided to control the distortion movement to a desired maximum amount upon expansion of the liquid in the chamber.

8. A closed liquid storage vessel, substantially as hreinbefore described with reference to the accompanying drawing.

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