Feb. 10, 1959 W. P. SPINING 2,872,999

DEAERATING FEEDWATER HEATER

Filed May 21, 1957 2 Sheets-Sheet 1

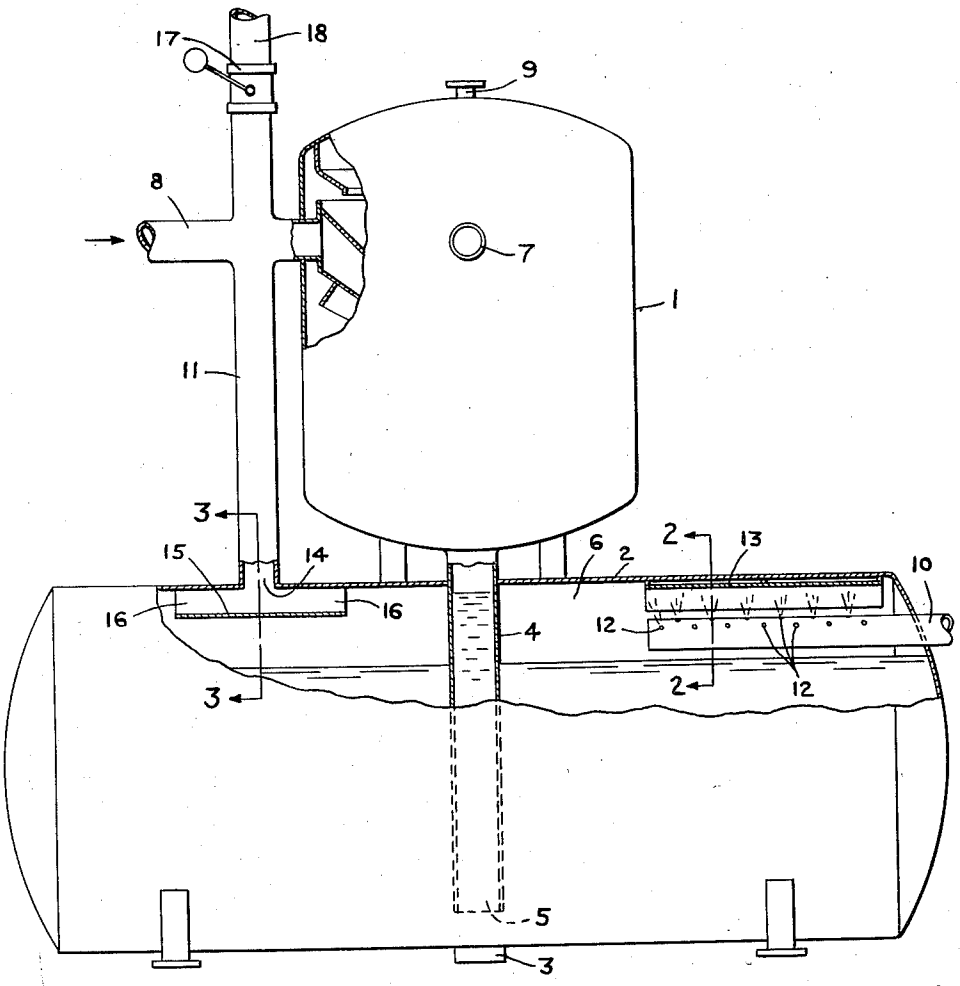


FIG. 1

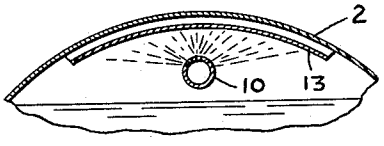


FIG. 2

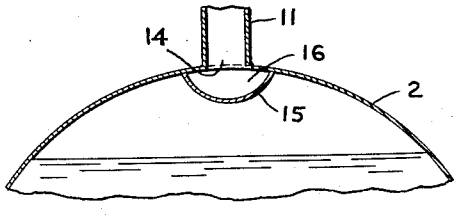


FIG. 3

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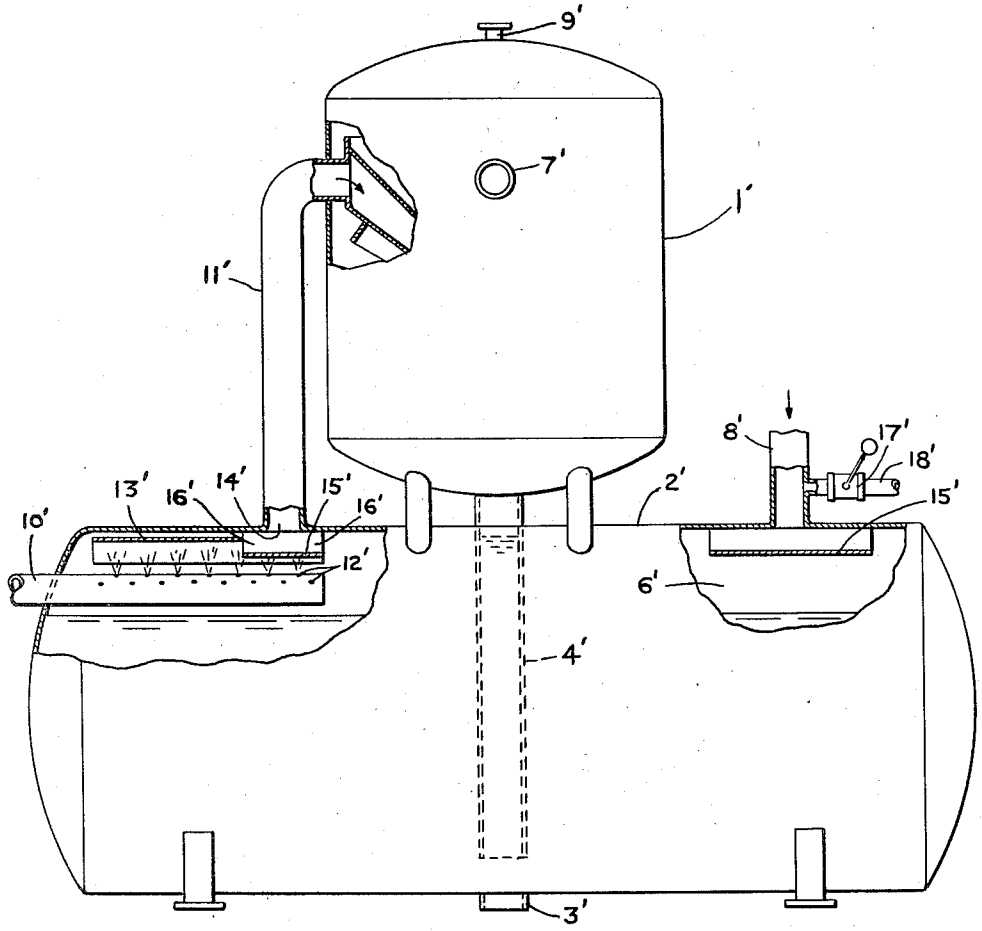


FIG. 4

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DEAERATING FEEDWATER HEATER

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2 Claims. (Cl. 183—2.5)

This invention relates to an apparatus for heating and degasifying liquids for boiler feed purposes and other services requiring practically oxygen-free water, and more particularly relates to improved means associated with said apparatus for accommodating the admission of relatively large quantities of high temperature condensate, and for utilizing the energy in this condensate for accomplishing a part or all of the heating and degasifying operation.

By high temperature condensate is meant any condensate which is at a temperature greater than that of saturated steam at a given pressure, which pressure in this case is the existing pressure within the heating and degasifying apparatus.

In U. S. Patent No. 2,457,605, issued on December 28, 1948, a steam-jet type degasifying feedwater heater is shown embodying two forms of structure for introducing high temperature condensate directly into the treatment chamber. While the apparatus therein shown is satisfactory for quantities of high temperature condensate most frequently encountered in power plant practice, it is not suitable for use in plants where the quantity of such condensate is very great in relation to the total output of the apparatus, and more particularly where such condensate flow is of an intermittent or widely variable nature, as is the case in plants employing so-called "once-through" boilers.

Accordingly, the primary objective of the present invention is to provide a heating and degasifying apparatus which is an improved model of the said prior art apparatus.

More particularly, it is an object to provide a heating and degasifying apparatus in which a greater flow range of high temperature condensate can be accommodated without interfering in any way with the heating and degasifying process.

Another object is to insure a continuous supply of steam for heating and degasifying purposes in the treatment chamber irrespective of the quantity of steam derived from the high temperature condensate.

Still another object of the invention is to provide means for preventing excessive pressure build-up in the apparatus in the event that the amount of steam derived from the high temperature condensate exceeds the amount required in the treatment chamber.

In the present invention the above objects are accomplished by providing first, a suitably equipped storage tank for treated water into which the high temperature condensate is initially introduced for separation into its liquid and steam components; second, a steam passage or pipe for conducting the steam component to the treatment chamber together with normally supplied steam; and third, an outlet or downtake pipe from the treatment chamber to the storage tank for carrying treated water to the storage tank, which downtake pipe is effectively sealed against the possibility of steam in the storage tank flowing in reverse direction through the downtake pipe into the treatment chamber. Further, a suitable pressure relief valve is provided in the apparatus to prevent any excessive pressure build-up therein.

The invention will be better understood when considered in connection with the accompanying specification and drawings forming a part thereof in which:

Figure 1 is a vertical sectional view of a feedwater heater in accordance with the invention.

Figure 2 is a detailed view taken on line 2—2 of Figure 1.

Figure 3 is another detailed view taken on line 3—3 of Figure 1, and

Figure 4 is a vertical sectional view of a modified form of feedwater heater also in accordance with the invention.

Referring to Figure 1, the apparatus includes a treatment chamber or shell 1 containing a heating and degasifying element of the standard steam-jet type, and a storage tank 2 for receiving and storing the water that has been heated and degasified in the shell 1. An outlet 3 is provided in the bottom of the storage tank 2 through which the treated water can be removed to service as desired.

The treated water enters the storage tank 2 after being processed in the shell 1 through a downtake pipe 4 which is connected at its upper end to the bottom of shell 1 and extends downwardly into the storage tank 2 terminating at a point near the bottom of the tank. The discharge opening 5 of the downtake pipe 4 is purposely located substantially below the normally maintained water level of the storage tank 2 so that steam received in the vapor space 6 above the water level in the storage tank 2 cannot enter the said downtake pipe discharge opening 5 and thereby pass into the interior of the shell 1.

The water to be treated in the shell 1 is caused to flow from a suitable source (not shown) into the shell 1 through an inlet 7 therein. This water is brought into contact with steam normally supplied through an inlet pipe 8 to the shell 1, and the steam and water are mixed according to the well known principle of operation of a standard steam-jet type heating and degasifying apparatus to produce treated water. As previously indicated, the treated water then passes to the storage tank 2 through the downtake pipe 4. The non-condensible gases from the untreated water together with a small quantity of steam is vented to atmosphere through a vent port 9 provided in the top of the shell 1.

In the form of the apparatus shown in Figure 1, the means for supplying the high temperature condensate to be used in the treatment of water in the shell 1, consists of an inlet pipe 10 extending into the storage tank 2, and a pipe 11 connecting the top portion of the storage tank 2 to the steam inlet pipe 8. The upper half of the inlet pipe 10 is provided with a plurality of perforations 12 through which the high temperature condensate is sprayed when delivered into the storage tank 2. This spray of condensate is directed against an arcuate baffle plate 13 which is connected by any suitable means to the inner wall of the storage tank 2 and which is positioned immediately above the inlet pipe 10. In the other end of the top portion of the storage tank 2, the opening 14 of the connecting pipe 11 is covered over with a semi-circular baffle plate 15 so that essentially only dry steam vapor can pass through the end openings 16 of the baffle plate 15 for escape from the storage tank 2 through the connecting pipe 11.

In the upper end of the connecting pipe 11 above the juncture of this pipe with the steam inlet pipe 8, a relief valve 17 is provided to vent excess steam before there is an excessive build-up of pressure in the steam inlet

pipe. The excess steam can be vented to atmosphere, or else discharged to other apparatus operating at lower pressures through a suitable conduit **18**.

The apparatus shown in Figure 4 is a slightly modified form of that shown in Figure 1, but is similar in construction and operation so that the same but primed reference characters are directed to corresponding parts in Figure 4. The major change consists in the steam inlet pipe **8'** being connected to the storage tank **2'** instead of to the shell **1'**. To effectuate this change, the connecting pipe **11'** is connected directly to the shell **1'**, and the high temperature condensate inlet pipe **10'** is transposed to the opposite side of the storage tank **2'** and is located directly beneath the opening **14'** of the connecting pipe **11'**. Further, the relief valve **17'** is disposed in the relocated steam inlet pipe **8'**.

Operation

In the operation of the apparatus of Figure 1, the end of the inlet pipe **10** is connected to a suitable source of high temperature condensate (not shown) and the said condensate is delivered through this inlet pipe into the storage tank **2**. The condensate is sprayed from the perforations **12** of inlet pipe **10** against the arcuate baffle plate **13**, and as characteristic of high temperature condensate, in the spraying process a portion thereof will flash into steam while the remaining portion will remain in the liquid state. The liquid portion of the condensate is deflected by the arcuate baffle plate **13** downwardly into the body of treated water being stored in the storage tank **2** where it remains until removed to service through the storage tank outlet **3**.

The steam portion of the condensate meanwhile, expands longitudinally through the vapor space **6** in the top of the storage tank **2** to the opening **14** of the connecting pipe **11**. The steam escapes through this opening and passes through the connecting pipe **11** joining with the steam being normally supplied to the shell **1** through the steam inlet pipe **8**. In the event that there is an excess of steam in the steam inlet pipe **8**, the relief valve **17** opens to relieve any excessive pressure build-up.

In the operation of the apparatus of Figure 4, the high temperature condensate enters the storage tank **2'** from the inlet pipe **10'** on the left, while the normally supplied steam enters through the inlet pipe **8'** on the right. The steam derived from the high temperature condensate and the normally supplied steam then enters the treatment chamber of the interior of the shell **1'** through the connecting pipe **11'**. Further, the relief valve **17'** in the steam inlet pipe **8'** vents any excess steam before there can be an excessive pressure build-up in the storage tank **2'**.

Thus, in both forms of the apparatus shown in Figures 1 and 4, since the high temperature condensate is first introduced into the storage tank, and the steam component of this high temperature condensate together with

normally supplied steam is then introduced into the shell, there will not be any interference with the heating and degasifying process resulting from changes in the quantity of high temperature condensate supplied.

It will be understood that the invention is not to be limited to the specific construction or arrangement of parts shown, but that they may be widely modified within the invention defined by the claims.

What is claimed is:

1. In combination, a steam-jet type heating and degasifying apparatus including a shell, a storage tank, means connected to said shell for flowing untreated water into said shell, means connected at one end to an independent source of steam and at its other end connected to said shell for flowing steam into said shell for direct heat exchange and degasifying relationship with said untreated water, first conduit means connected between said shell and storage tank for flowing treated water from said shell into said storage tank, means connected at one end to an independent source of high temperature condensate and at its other end connected to said storage tank and extending into the area of said storage tank above the level of treated water normally maintained therein for flowing high temperature condensate into said storage tank, and second conduit means connected between said storage tank and shell for flowing steam flashing from said high temperature condensate in said storage tank to said shell.

2. In combination, a steam-jet type heating and degasifying apparatus including a shell, means connected to said shell for flowing untreated water into said shell, a storage tank, first conduit means connected between said shell and storage tank for flowing treated water from said shell into said storage tank, a first means connected at one end to an independent source of steam and at its other end connected to said storage tank and extending into the area of said storage tank above the level of treated water normally maintained therein for flowing steam into said storage tank, a second means connected at one end to an independent source of high temperature condensate and at its other end connected to said storage tank above the level of treated water normally maintained therein for flowing high temperature condensate into said storage tank, and second conduit means connected between said storage tank and shell for flowing the steam in said storage tank flowing through said first means and flashing from the high temperature condensate flowing through said second means into said shell for direct heat exchange and degasifying relationship with untreated water.

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