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HEAT EXCHANGE APPARATUS

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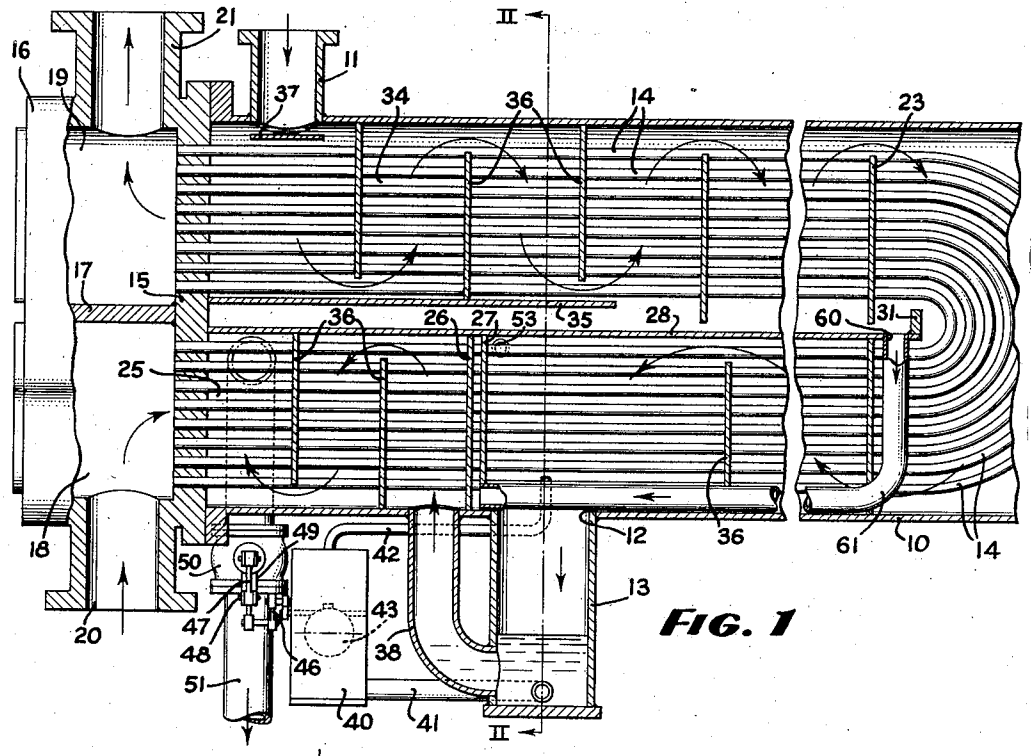


FIG. 1

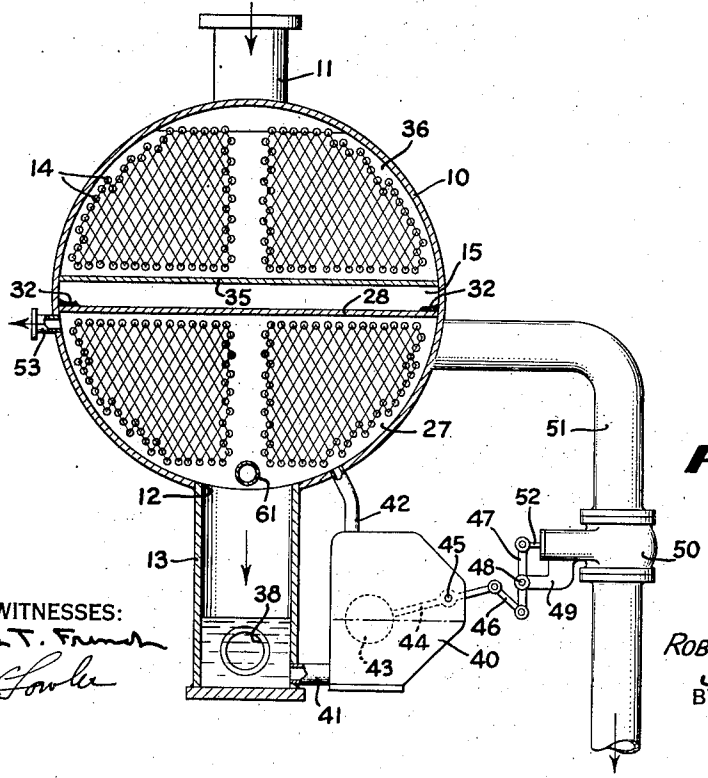


FIG. 2

WITNESSES:

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HEAT EXCHANGE APPARATUS

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2 Claims. (Cl. 257—32)

This invention relates to heat exchangers, more particularly to heat exchangers wherein provision is made for subcooling the condensate, and it has for an object the provision of improved apparatus of this character.

The trend in high pressure heater practice is to use a subcooling section in order to increase the heat recovery from the bled steam and thus reduce the quantity of steam required. The subcooler should be confined to the first tube pass, but the amount of surface required is normally very much less than the surface in this pass. While a longitudinal baffle may be provided to segregate as much of the first pass surface as is required for subcooling duty, this is not satisfactory as only part of the feed water is thus utilized for subcooling and the rise in temperature of the feed water in the subcooler is thus increased, with a resultant penalty on the mean temperature difference between the cooling water and the condensate in this section. This, of course, increases the amount of surface required in both the subcooling and condensing sections.

In our prior Patent No. 2,299,455, granted October 20, 1942, to Westinghouse Electric & Manufacturing Company, we stated that the most economical arrangement is to separate off by a longitudinal partition all of the first tube pass and utilize the required part of this pass nearest to the inlet tube plate as the subcooler. It is, of course, necessary to flood this subcooler, and since the rest of the first pass tubes which are in the condensing section must not be flooded, means had to be provided for accomplishing this double purpose.

We proposed draining the condensate from the condensing section into a small hotwell provided with a suitable float control which actuated a valve in the condensate discharge line from the subcooling section. This resulted in the outlet pressure from the subcooling section being reduced a sufficient amount to account for the static head between the condensate level in the hotwell and the condensate water level in the subcooling section. Normally, this pressure differential would cause steam leakage from the condensing section into the subcooling section through the transverse separating partition, which would obviously defeat the purpose of the subcooler.

To overcome this last-mentioned difficulty, we proposed collecting condensate on the longitudinal partition separating the first pass tubes from the remaining tubes of the heat exchanger and draining it through a port in the partition to the space between two transverse partitions positioned relatively close together. These transversely - extending partitions constitute means for segregating the inlet portion of the first pass from the remainder of the pass, the segregated portion constituting the subcooler section.

The draining of condensate from the longitudinal baffle to the space between the pair of transversely-extending partitions results in distribution of this condensate around all of the tubes in the first pass, thus water-sealing the clearance holes for the tubes in the transverse partitions, as well as any clearance space between these partitions and the shell.

We have found in certain extreme situations, for example, where the tube bundle is unusually long or the space between the longitudinal partition and the tubes thereabove is so small as to undesirably limit the height of the dam for retaining condensate on the partition, that the condensate so retained on the partition is unable to flow back to the space between the two transverse partitions which segregate the subcooler, due to the pressure drop occurring between the transverse partitions and the dam.

To take care of these extreme situations we now propose providing a conduit in the lower part of the shell for flow of condensate from the upper surface of the horizontal partition adjacent the dam to the space between the pair of transverse partitions, at the same time closing the top of the space between these transverse partitions to prevent entry of steam thereto from above the horizontal partition.

Therefore, an object of the present invention is to provide improved means for sealing the subcooling section of a horizontal heat exchanger.

These and other objects are effected by the invention as will be apparent from the following description and claims taken in connection with the accompanying drawing, forming a part of this application, in which:

Fig. 1 is a longitudinal sectional view through a heat exchanger embodying the principles of the invention; and,

Fig. 2 is a transverse sectional view taken along the line II—II of Fig. 1, looking in the direction of the arrows.

In the drawing there is shown heat exchange apparatus comprised by a shell 10 having a steam inlet 11 and a condensate outlet 12, the latter communicating with a hotwell 13. A plurality of U-tubes 14 extend longitudinally of the shell and have their terminal portions supported at one end thereof by a stationary tube plate 15,

the latter comprising a portion of the waterbox structure 16. The waterbox 16 is provided with a transverse partition 17 dividing the interior thereof into an inlet compartment 18 and an outlet compartment 19 provided with an inlet connection 20 and an outlet connection 21, respectively. Suitable means, such as intermediate tube supports 23, may be provided for further supporting the tubes 14 at suitable intervals throughout their length.

A section 25 comprised by the inlet or cold portion of the first tube pass is segregated from the remaining portion of that pass by a pair of slightly-spaced, transversely-extending, vertical partitions 26 and 27. A horizontal partition 28 extends longitudinally of the shell and separates the first pass tubes from the tubes of the remaining passes. The horizontal partition is provided at its innermost free end with a transversely-extending dam member 31 and is sealed at its longitudinal edges by suitable means, such as the Lamiflex seal 32 (Fig. 2).

Where the apparatus includes a desuperheating section, such as shown at 34, there may be provided an additional horizontal baffle 35 in vertically-spaced relation with respect to the baffle 28 in order to prevent fine particles of condensate lying on the baffle 28 being picked up and deposited on the tubes of the desuperheating section by the steam flowing through the latter.

Preferably, suitable baffles 36 extending transversely of the tubes 14, are provided throughout the apparatus to obtain maximum contact of the steam with the condensing and cooling surface. Similarly, a baffle 37 may be provided in the path of steam entering at the inlet 11 to prevent erosion of tubes by impingement of high velocity steam.

The hotwell 13 is located at the condensing side of the transverse partitions 26 and 27, but is in communication with the subcooler 25 through a conduit 38. In order that the subcooler 25 may be maintained completely flooded at all times, there is provided an automatic float valve control comprised by a float housing 40 in communication with the bottom of the hotwell through the conduit 41 and vented to the interior of the condensing portion of the apparatus through the conduit 42. A float 43, disposed within the housing 40, is carried at one end of the lever 44, the latter being pivoted at 45 to the housing 40 with its free end projecting outwardly of the latter. This free end is pivotally connected through the link 46 with a lever 47 pivotally mounted at 48 on the arm 49 of the valve housing 50, the latter constituting a section of the condensate discharge conduit 51. The lever 47 is operatively connected through the valve rod 52 with a control valve (not shown) mounted in the valve housing 50.

It will be apparent from consideration of Fig. 2 that upon increase in the amount of condensate in the hotwell 13, the float 43 in the housing 40 will be raised, thereby moving the valve rod 52 to the left to open the valve in the housing 50 and permit discharge of condensate from the subcooling section 25, with which the condensate discharge conduit 51 communicates. The condensate discharged through the conduit 51 will be replaced by condensate from the hotwell 13 until the level in the latter has fallen enough to cause the float 43 to drop sufficiently to close the valve in the housing 50, thereby shutting off the discharge flow of condensate from the subcooler.

The last section of the condensing portion of the apparatus, considered in the direction of steam flow, may be provided with the usual offtake for air and noncondensable gases, as at 53 (Fig. 2).

In the construction disclosed in our previous patent, mentioned above, the space between the pair of transverse partitions 26 and 27 was maintained flooded by provision of an opening in the horizontal partition 28 overlying the space to be flooded, for entry thereinto of condensate collecting on the partition 28. In certain extreme situations, for example, where the tube bundle is unusually long, or the space between the horizontal partition and the tubes thereabove is so small as to undesirably limit the height of the dam 31, the pressure drop occurring from the partitions 26 and 27 to the dam 31 is great enough to prevent flow of condensate from the vicinity of the dam 31 back along the partition 28 to the partitions 26 and 27.

Therefore, in the construction herein illustrated, we omit any opening in the horizontal partition overlying the space between the partitions 26 and 27, but provide an opening 60 in the horizontal partition adjacent the dam 31, together with a conduit 61 leading therefrom to the space between the partitions 26 and 27, with the result that the space is maintained flooded as long as there is any condensate on the partition 28. Of course, the excess condensate flows over the dam 31 to the lower part of the shell and thence to the hotwell.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. Heat exchange apparatus comprising a horizontal shell having a steam inlet and a condensate outlet; a plurality of tubes extending longitudinally of said shell; waterbox structure associated with said tubes and providing for circulation of water therethrough in a plurality of passes with the first pass tubes disposed in the lower part of the shell; a horizontal partition extending lengthwise of the shell and separating the first pass tubes from the remaining tubes, said partition terminating in spaced relation to the end of the shell adjacent the warm end of the first tube pass to provide a passage for flow of condensate and steam from the space above the partition to the space therebelow; means separating the space surrounding the coldest portion of the first tube pass from the remaining portion thereof with said separated portion constituting a subcooler, said means comprising a pair of spaced, parallel, vertical partitions extending transversely of the space surrounding the first tube pass; dam means at the terminal portion of the horizontal partition adjacent the steam and condensate passage for maintaining a body of condensate on the partition; and a conduit disposed below the horizontal partition for conducting condensate from the horizontal partition at a point adjacent the dam means to the space between the pair of partitions defining an end of the subcooler, said conduit constituting the sole means of communication between said space between the pair of transversely extending partitions and the space above the horizontal partition, whereby the pressure drop in the steam

flow path through the condenser aids the flow of condensate through said conduit.

2. Heat exchange apparatus comprising a horizontally-disposed shell having a steam inlet and a condensate outlet; a plurality of U-tubes extending longitudinally of the shell; a tube plate closing one end of the shell and supporting the terminal portions of the tubes; waterbox structure associated with the tube plate and providing for flow of water through the tubes in two passes with the tubes of the first water pass disposed in the lower part of the shell; a horizontal partition extending between the legs of the U-tubes from the tube plate to adjacent the bend of the U-tubes and separating the first and second pass tubes; dam structure on the horizontal partition adjacent the end thereof remote from the tube plate for retaining a body of condensate on the partition, said partition having an opening therethrough adjacent said dam; means segregating the space surrounding the coldest portion of the first pass tubes from the remaining portion thereof with the segregated portion constituting a subcooler, said segregating means comprising a pair of spaced parallel, vertical, transversely-extending partitions; and a conduit disposed beneath the horizontal partition and providing communication between the opening in the horizontal partition and the space between the spaced pair of transversely-extending partitions, whereby condensate collecting on the horizontal partition adjacent the dam may flow to said space and maintain the latter flooded to prevent leakage of steam therethrough to the subcooler, said conduit constituting the sole means of communication between said space between the pair of transversely extending partitions and the space above the horizontal partition, whereby the pressure drop in the steam flow path through the condenser aids the flow of condensate through said conduit.

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