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CONDENSER CONTAMINATION REMOVAL ARRANGEMENT

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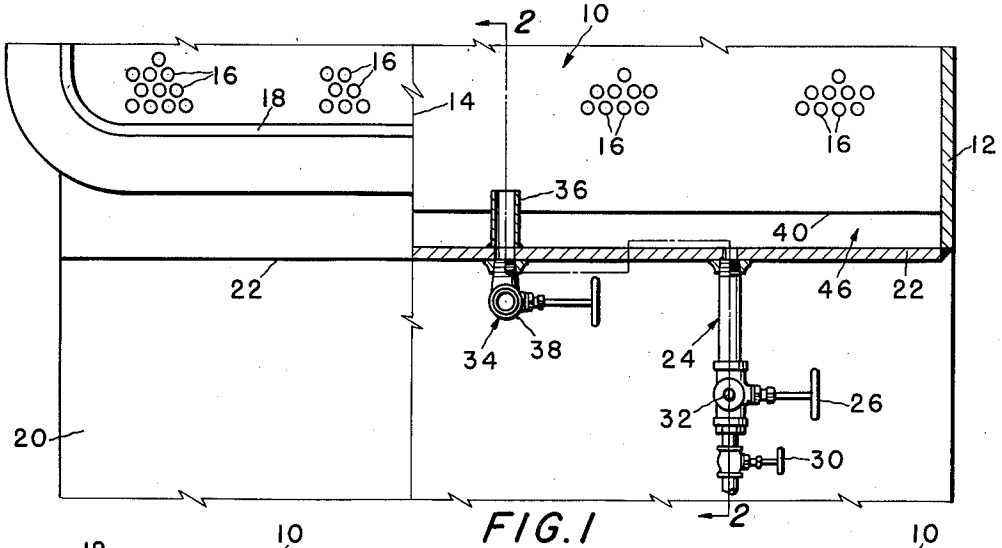


FIG. 1

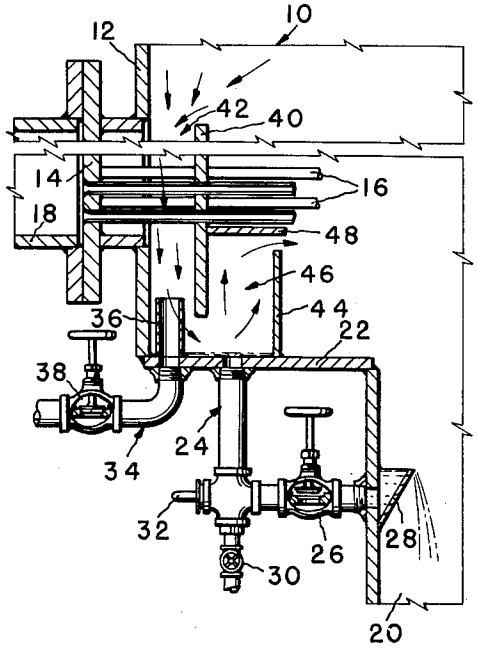


FIG. 2

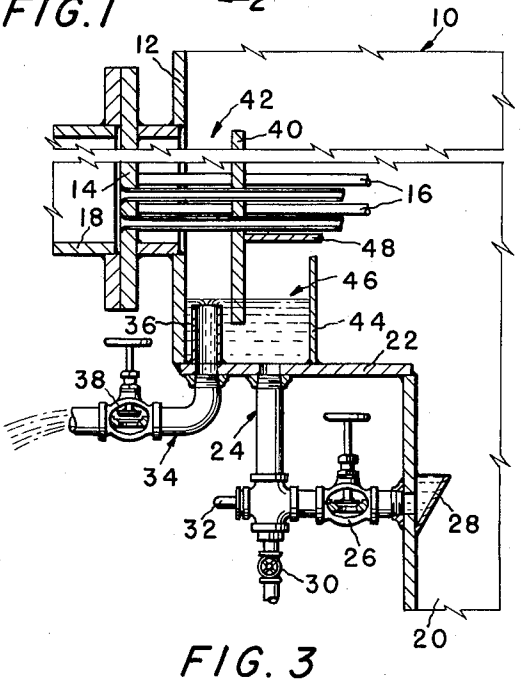


FIG. 3

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CONDENSER CONTAMINATION REMOVAL ARRANGEMENT

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This invention relates to surface condensers, and more specifically a means for entrapping and removing contaminated condensate therefrom.

In a surface condenser, any leakage of contaminated circulating water into the steam space and thus into condensate going to the boiler or reactor must be prevented. This leakage can occur either due to improper tube to tube sheet attachment, a failure of the attachment or its components. Most of said tube failures normally occur at or near the water inlet end usually due to erosion-corrosion.

The common method now employed in making the attachment of the tubes to the tube sheet is to roll or expand the tubes into close tolerance reamed holes containing serrations or threads. This method has not been found effective in all cases, particularly over an extended period of time due to various severe operating conditions. Currently, two attempts to minimize contamination are being employed in surface condensers, both having severe limitations.

The first is the use of a conventional single tube sheet construction with the tubes normally expanded and then welded to the tube sheet. The welding is initially an effective secondary seal; however, failures in the tubes could occur either due to erosion, vibration, or stress. Further, the entrance roughness of welded joints add to the problem of tube failures.

The second utilizes double tube sheets spaced from one another having the tubes expanded into the openings of both sheets to provide seals. This method prevents direct contamination from the coolant as the space between the double tube sheets contains either condensate or atmosphere depending on the specific design. However, a greater overall size is required to obtain a condenser of a predetermined capacity as the space between the tube sheets is not utilized as condensing surface. The outer tube sheet is subject to coolant temperatures while the inner sheet is subject to elevated steam temperatures. The dimensional variations of these sheets, due to thermal expansion and contraction, will stress the tubes and tube connections thus intensifying the possibility of failure particularly after normal expected cycling. Problems of determining the location of failure and method of repair are also present requiring a shut-down of the unit.

It is an object of this invention to provide a condenser in which the full enclosed area is utilized having a two walled construction for prevention of condensate contamination.

Another object of this invention is to provide a condenser in which contaminated condensate may be entrapped and removed without shut-down of the system.

Still another object of this invention is to provide a condenser adapted to be actively used in a system while there is contaminated leakage for a prolonged period of time without contaminating the major portion of the condensate.

These and other objects will become apparent by reference to the following specification and the attached drawings, in which

FIGURE 1 is a partial, vertical section showing a portion of a condenser incorporating the invention,

FIG. 2 is a vertical section taken on line 2—2 of FIG. 1 under normal operating conditions, and

FIG. 3 is a view similar to FIG. 2 when contaminated leakage is entering the condenser at the tube end joints.

By referring to the drawings there is shown a portion of a condenser 10 having walls 12. The opposed walls 12 have openings for the reception of tube sheets 14 with multiple perforations therein for the reception of the ends of the tubes 16. Outwardly of the tube sheets 14 is a collector area 18 to supply the coolant fluid to the entrance of the tubes 16. At the far end of the tube bank or cooling means (not shown) is a similar collector or manifold receiving the coolant discharge. Since the condenser and associated construction at both ends of the tubes 16 or tube bank is the same, only one end has been shown. At the bottom portion of the condenser 10 is a hotwell 20 receiving the condensate and having an outlet (not shown) to supply fluid to a boiler. Spaced from the bottom tubes 16 is a short step-base 22 adjacent the walls 12 having the tube plates 14. A normal condensate drain line 24 or first fluid means extends from the step-base 22 to the side wall of the hotwell 20 and includes a delivery valve 26, a spillway 28, a drain-off valve 30 and a contamination detecting device 32. A contamination overflow line 34 or second fluid flow means also extends from the step-base 22 has a valve 38 and a standpipe 36 surrounding the opening in the base.

An isolation support means or plate 40 spaced inwardly from the side wall 12 extends from a point above the uppermost tube 16 of the cooling means, formed by the plurality of tubes 16, and below the top of the standpipe 36. The support plate 40 is perforated similarly to the tube plate 14, the tubes 16 passing through the various openings. Although the tubes may be expanded in the openings to form a positive joint, it has been found that a close fit between the tubes and openings is preferable and is sufficient to prevent leakage and permit normal tube movements due to thermal expansion. The area between the side wall 12 and the plate 40 is a contamination isolation passage. A second wall means 44 extends upwardly from the step-base 22 to a point below the lowermost tubes 16 of the tube bank and is spaced inwardly of the plate 40. A cover plate 48 is attached to and extends inwardly from the plate 40 to a point beyond the second wall means or plate 44 and covers the contamination catch basin therebetween. The cover plate 48 prevents the condensate, inwardly of the plate 40, from entering the catch baain 46.

In normal operation the steam vapor enters the condenser case from above at a specified flow rate and passes downwardly over the cooling tubes 16, the condensate dropping into the hotwell 20. In all condensers of this type having steam pass over cooling tubes, a predetermined flow rate must be maintained to prevent the tubes from becoming air-bound or the steam from stagnating. This also aids in removing condensate from the tubes surfaces. That portion of the condensate formed in the isolated passage between the plate 40 and the wall 12 or the tube sheet 14 falls into the catch basin means 46, enters the normal drain line or first fluid flow means 24, passes through the open valve 26 and enters the hotwell 20 over the spillway 28. It has been found that condensate has an amount of entrapped oxygen. By using a spillway 28, the condensate is broken into droplets which, as they pass through the steam enriched atmosphere found in the upper portions of the hotwell 20, are subjected to high temperatures and the entrapped oxygen is released. When there are no leaks the drain valve 30 and the contamination overflow line 34 are both closed. That portion of the steam which has not been fully condensed passes through the basin 46 and enters the main tube bank area through the opening between the plate 44 and the cover plate 48 for further contact with the tubes 16.

In the course of normal flow through the drain line or

first fluid flow means 24, should there be any leakage of contaminated coolant from the tube end connections, the contaminated condensate would pass through the line 24 and a signal would be given by the detecting device 32. The detecting or sensing device is normally a resistance element of the nature capable of initiating a sensory signal such as a visual or audible alarm. When the alarm is initiated, the delivery valve 26 is closed to prevent the contaminated condensate from further entering the hotwell 20 through the first fluid flow means 24. The condensate formed in the area 42 now collects in the catch basin 46 and together with the leakage causes the liquid level to rise until it reaches a point as shown in FIG. 3, above the bottom of the wall 40 forming a hydraulic seal. With the lack of flow of steam across the tubes 16, the steam presently between the tube sheet 14 and the plate 40 will become stagnated and air-vapor bound thus substantially no condensate will form in the area 42. The valve 38 is then opened and contaminated condensate and leakage above the standpipe 36 is permitted to drain off through the second fluid flow means 34 to prevent overflow of the catch basin 46. The standpipe 36 extending above the bottom of the wall 40 determines the overflow level and insures a positive closure of the path of flow of rejection steam at all times that the drain path 24 is closed. As may be seen, since the contaminated condensate is entrapped in the catch basin 46 and the area 42 is isolated, the condenser may still be used until repairs may be made although its effective area and capacity is reduced.

When the system is turned off for repairs, by opening the valve 30, the contaminated condensate present in the catch basin 46 may be drained off.

Under normal operating conditions the full extent of the condenser is used. Thus, a condenser, incorporating the subject invention has approximately the same capacity as the same size condenser having a single tube sheet construction. Under leakage conditions, the effective tube length is reduced an amount not exceeding the lost area in a condenser of double tube sheet construction. Although there is a temporary loss of capacity, the problem of induced stresses caused by the differential in expansion and contraction encountered in the double tube sheet construction is alleviated.

While we have shown and described a specific form of the invention, it is to be understood that various changes and modifications may be made without departing from the spirit of the invention as set forth in the appended claims.

We claim:

1. In a surface condenser having a top and a bottom, side wall means, tube sheet means connected to said side wall means, support means suspended between said top and bottom of said condenser and displaced from said side wall means and defining with said side wall means an isolated passage means, cooling means extending longitudinally across said isolated passage means for carrying a cooling fluid, catch basin means defined by said side wall means and wall means disposed below said isolated passage means for confining contaminated fluids, cover means disposed above said catch basin means for limiting flow of the condensate into said catch basin means by way of said isolated passage means, hotwell means disposed adjacent said catch basin means, first fluid flow means connecting said catch basin means with said hotwell means, and a second fluid flow means communicating with said catch basin means for overflow control.

2. The surface condenser of claim 1 having first valve means disposed in said first fluid flow means for shutting off the latter to permit the formation of a hydraulic seal therefor, said catch basin means being provided with an inlet and a standpipe surrounding said inlet and projecting into said catch basin means for hydraulically sealing off said first fluid flow means.

3. The surface condenser of claim 1 having first valve means in said first fluid flow means for shutting off said first fluid flow means, second valve means in said second fluid flow means for opening said second fluid flow means, said catch basin means being provided with an inlet, a standpipe surrounding said inlet and projecting into said catch basin means for hydraulically sealing off said first fluid flow means, contamination detecting means disposed in said first fluid flow means for detecting the presence of contamination in said first fluid flow means, and indicating means connected to said contamination detecting means and actuated by the latter when a contaminated fluid is detected by said contamination detecting means to provide a sensory signal for an operator so that said first valve means in said first fluid flow means may be closed and said second valve in said second fluid flow means may be opened.

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