

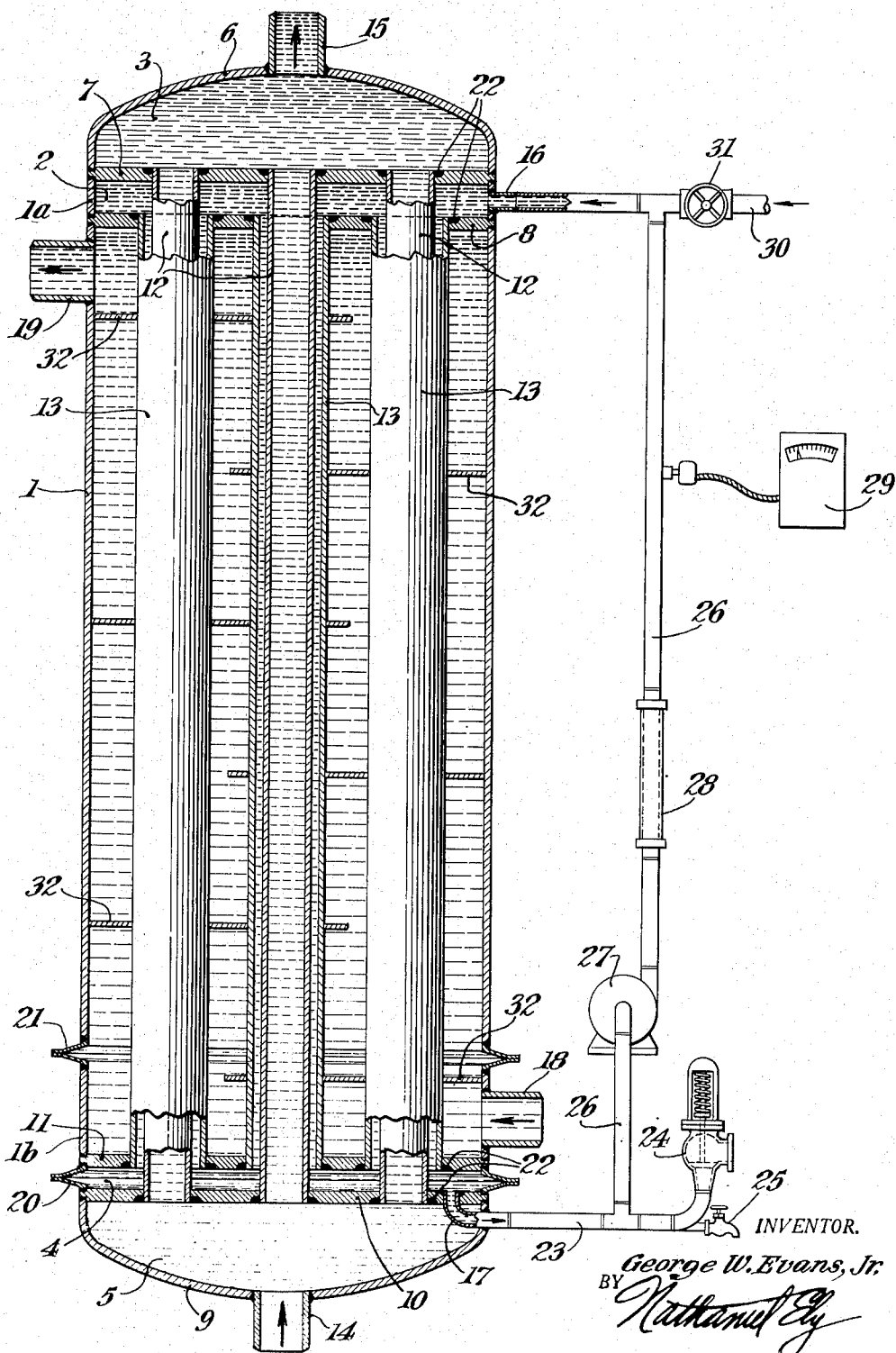
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METHOD OF DETECTING LEAKAGE BETWEEN HEAT TRANSFER FLUIDS

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## METHOD OF DETECTING LEAKAGE BETWEEN HEAT TRANSFER FLUIDS

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This invention relates to improvements in heat exchange as conducted by an indirect method wherein fluids at different temperatures are placed in heat exchange relation but out of contact with one another to prevent commingling of the fluids. In many heat exchange operations, due to the nature of the fluids employed, it is most important that the fluids be kept segregated in order to prevent pollution of one fluid by another and prevent chemical reaction and possible explosion.

An important object of the present invention is to provide an effectual safeguard against commingling of the fluids due to leakage.

A further object of the invention is to minimize the effect of any leakage which may occur.

A still further object is to render leakage of one fluid to another readily detectable so that the heat exchange operation may be halted before appreciable damage occurs.

Another object is to provide heat exchanger apparatus of improved construction for practicing the invention.

Other objects and advantages of the invention will appear from the following description and the accompanying drawing.

In the drawing, the figure is a view, partly, in vertical section and partly in elevation, of the heat exchanger apparatus for performing the improved method.

According to the invention, different fluids are passed respectively along separate confined and spaced courses within a heat exchange zone and the said courses are separated by a third fluid. This third fluid is maintained in indirect heat exchange relation to said courses for heat exchange between the three fluids. In addition to its heat exchange function the third fluid also has two important safety functions. First, it dilutes any leakage which may occur from either of said courses. Second, at least a portion thereof is conducted outside of the heat exchange zone and there inspected to detect such leakage so that proper precautions may be taken.

The apparatus shown in the drawing for performing the improved method includes a vertical heat exchange unit of a shell-and-tube type. This unit comprises a cylindrical shell 1 which is upright in the present instance but may be otherwise disposed. At the upper end thereof the shell has inner and outer channels 2 and 3, respectively. At the lower end of the shell there are inner and outer channels 4 and 5, respectively. Channel 3 is formed by a dome-shaped member 6 and a tube sheet 7 welded be-

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tween the base of said member and an annular shell section 1a. Channel 2 is formed by the tube sheet 7, the shell section 1a and a tube sheet 8 welded between said shell section and the body of the shell. At the lower end of the shell, the channel 5 is formed by a dome-shaped member 9 and tube sheet 10 welded between said member and an annular shell section 1b. Channel 4 is formed by the tube sheet 10, the shell section 1b and a tube sheet 11 welded between said section and the body of the shell.

Within the shell there is a nest of tubing of the double-pipe type. The nest includes inner tubes 12 connecting the outer tube sheets 7 and 10, and outer tubes 13 surrounding said inner tubes individually and connecting the inner tube sheets 8 and 11. The outer tubes are substantially larger than the inner tubes therein and provide substantial space surrounding the latter. The lower end member 9 has a central inlet nozzle 14 and the upper end member 6 has a central outlet nozzle 15. The shell section 1a has a nozzle 16 opening into the channel 2. An elbow drainage conduit section 17 extends downwardly from the upper face of the tube sheet 10 and laterally outwardly through the shell section 9 and is welded to both.

The body of the shell has an inlet nozzle 18 located just above the tube sheet 11 and an outlet nozzle 19 located just below the tube sheet 8. The shell section 1b has an expansion joint 20 permitting expansion and contraction of the inner tubes 12, and the body of the shell has an expansion joint 21 permitting expansion and contraction of the outer tubes 13.

All of the tubes have their end portions rolled into holes in their respective tube sheets. As shown, the upper ends of both the inner tubes and the outer tubes are flush with the upper faces of their respective tube sheets and said faces of the sheets are formed with grooves surrounding the tube ends and charged with welding material 22 which joins the tubes to their respective sheets and is also flush with the upper faces of the tube sheets. The lower tube sheets 10 and 11 have similar grooves in their lower faces charged with welding material which joins the tubes to these sheets. The upper end of the elbow drainage conduit section 17 is flush with the upper face of tube sheet 10 and similarly welded thereto. Complete drainage is obtainable from the channel 3 through the tubes 12 and the channel 5 and from the channel 2 through the tubes 13, the channel 4 and the elbow 17.

A lateral conduit section 23 is welded to the outer end of the elbow 17 and has an upturned end provided with a springloaded pressure relief valve 24. Said section also has a valved tap 25 for drawing off fluid when desired. A conduit section or pipe 26, in welded connection to the section 23, extends upwardly from the latter and has its upper end in welded connection to the nozzle 16 which opens into the channel 2. Connected into the pipe 26 there are a pump 27 and a sight glass section 28, preferably equipped with flow-indicating means. An electrical conductivity meter 29 is also connected to the pipe 26 to indicate changes in conductivity in the fluid within the pipe. Through a pipe 30 connected to the pipe 26 and having a valve 31 make-up fluid is supplied when required.

The apparatus is operated as follows to perform the method: The outer tube system including the channel 2, the spaces between the tubes 12 and 13, the channel 4 and the conduit piping 17, 23, and 26 are charged with a suitable fluid. Another fluid is passed through the nozzle 14, the channel 5, the inner tubes 12, the channel 3 and the nozzle 15. Still another fluid is passed through the nozzle 18, the body of the shell and the nozzle 19. For assisting heat exchange between the shell-side fluid and the fluid between the inner and outer tubes the shell is provided with staggered transverse baffles 32 spaced therealong.

Assume that transfer of heat between a hot shell-side fluid, surrounding the outer tubes 13, and the fluid within the inner tubes 12 is required. Then, the fluid between the tubes 12 and 13, which may be referred to as the "third" or "intermediate" fluid, will serve as a heat exchange medium for transfer of heat from the shell-side fluid to the fluid within the inner tubes 12. In addition to that, the said third fluid has the two safety functions previously mentioned herein. Said fluid assists in isolating the shell-side fluid from the fluid in the tubes 12 and serves as a diluent for any fluid which may leak into the tubes 13 from either the shell or the inner tubes and thereby prevents or minimizes damage from the leakage. The said third fluid is also made to serve as an indicator of the leakage. It is led outside of the heat exchange zone by the piping 23 and 26 for convenient inspection. Dependent upon the fluids employed, the presence of leakage fluid within the intermediate fluid may be indicated in various ways as by change in color of the latter fluid, change in pressure, change in viscosity, change in odor, change in electrical conductivity or by other changes either physical or chemical. By observation of the sight glass 28 a change in appearance of the fluid can be readily noticed, and increase in pressure will be indicated by blow-off at the relief valve 24. Change in electrical conductivity of the fluid will be indicated by the meter 29. Samples of the fluid may also be drawn off through the tap 25 for examination and analysis. Having detected the leakage by any of said tests, the operation may be halted and the heat exchanger apparatus drained of fluids, for repairs.

The said intermediate fluid may be allowed to remain static within the spaces between the tubes 12 and 13 by leaving the pump 27 idle or it may be circulated by operation of the pump. Instead of the closed circulating system shown, fresh fluid may be constantly supplied by the pump or the fluid may be temperature condi-

tioned in the closed system by any suitable well known means. While the third fluid is described as employed as an intermediate heat exchange medium for transfer of heat from one of the primary fluids to the other it may be temperature conditioned to either heat or cool the two other fluids. Any one or all of the fluids may be either liquid or gaseous.

It will be seen that my invention provides for effectual safeguard against leakage and damage therefrom and that the desired results are accomplished in a simple manner and by simple means.

The term "leakage," except where qualified, in the specification and claims is intended to comprehend not merely leakage of liquid, gas or vapor but also the passage of rays or electronic flux from the course of one of the fluids and into the detecting fluid and whose presence or effect there can be detected.

While I have disclosed a very satisfactory method and apparatus for accomplishing the desired purposes both the method and apparatus are susceptible of modification without departing from the invention. The disclosure is merely illustrative and in nowise limiting and the invention comprehends such modifications as fall within the scope of the appended claims.

I claim:

1. The method of indirectly transferring heat from a first fluid to a second fluid and detecting leakage of either of said fluids, which comprises introducing a liquid having suitable heat transfer qualities into a closed independent path completely within one of the fluids and completely surrounding the other of said fluids, whereby the desired heat transfer from the first fluid to the second fluid is through the liquid, and employing said liquid to indicate leakage thereto of one of said fluids.

2. The method of indirectly transferring heat from a first fluid to a second fluid and detecting leakage of either of said fluids, which comprises introducing a liquid having suitable heat transfer qualities into a closed independent path completely within one of the fluids and completely surrounding the other of said fluids, whereby the desired heat transfer from the first fluid to the second fluid is through the liquid, circulating a part of the intermediate liquid through an outside closed circuit and therein measuring a significant change in a predetermined characteristic of the liquid indicating the presence therein of one of said fluids due to leakage.

3. The method of claim 2 in which the predetermined characteristic of the liquid is electrical conductivity.

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