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Wolowodiuk

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[54] **HEAT EXCHANGER**

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[52] **U.S. Cl.** **165/158;** 122/32; 165/160
[51] **Int. Cl.** **F28f 9/02**
[58] **Field of Search** 122/32, 34; 165/158–163

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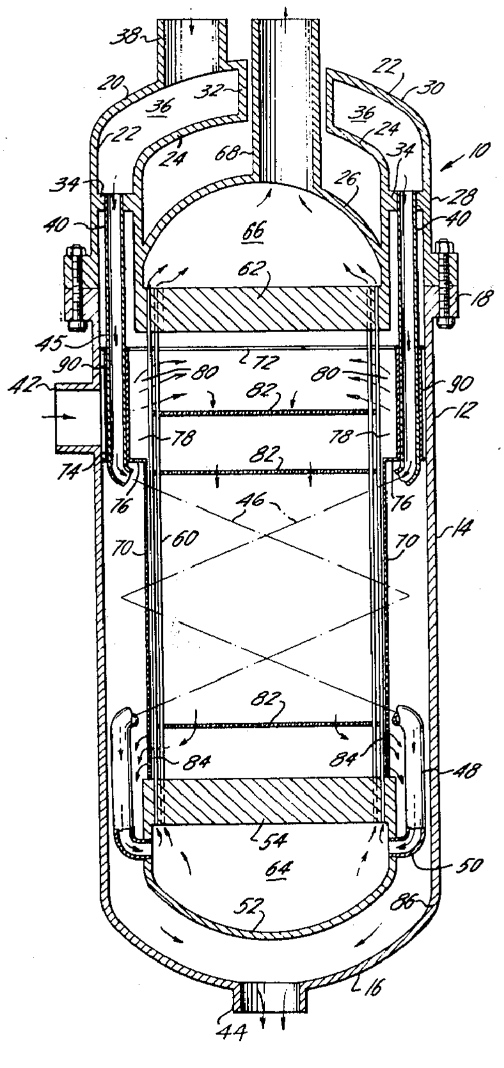
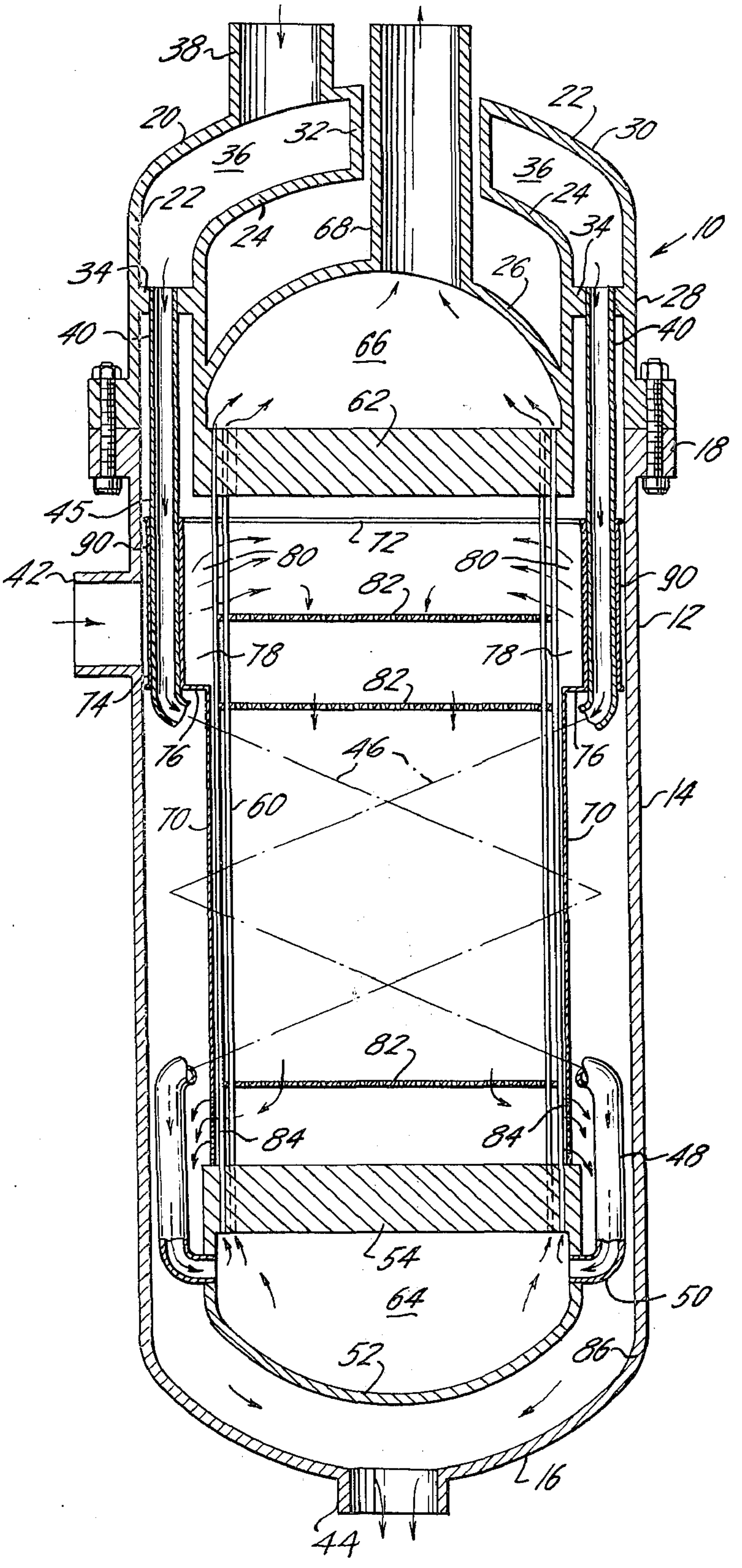
[57] **ABSTRACT**

A heat exchanger of the straight tube type in which different rates of thermal expansion between the straight tubes and the supply pipes furnishing fluid to those tubes do not result in tube failures. The supply pipes each contain a section which is of helical configuration.

6 Claims, 1 Drawing Figure





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HEAT EXCHANGER

SOURCE OF THE INVENTION

This invention was made or conceived in the course of or under a contract, sub-contract or arrangement entered into with or for the benefit of the Atomic Energy Commission.

BACKGROUND OF THE INVENTION

Of the several types apparatus used in industry to indirectly exchange between fluids there are many situations where the straight tube type is the most desirable. In the straight tube type of heat exchanger one fluid passes through a straight tube of heat conductive metal having a wall thickness thin enough to permit the efficient exchange of heat between the fluid within the tube and the fluid flowing over it.

A straight tube heat exchanger can be cleaned and inspected more easily than one in which the heat exchange tubes are of configuration where the tubes are not straight. An eddy current device, for example, can be passed down a straight tube to allow for examination. Cleaning devices which could never be passed through a bent tube can quite easily be passed through a straight tube when it is desired to clean out the tubes during a major maintenance procedure. Moreover, in case a tube should fail, a straight tube can be plugged, by internal welding devices or explosive plugs.

Often the heat exchange fluid which is flowed through the heat exchange tubes is passed longitudinally to the lower portion of the heat exchanger through a centrally located supply conduit within the heat exchanger and then allowed to reverse direction and come back through the heat exchange tubes. For example, in heat exchangers where the fluid which supplies heat to the heat exchanger, that is the primary fluid is liquid sodium, the sodium preferably passes downward over the tubes and it is often required that the secondary fluid passes longitudinally of the tubes in the direction of the primary sodium through a centrally located supply pipe into a chamber below a tube sheet where the secondary fluid reverses its direction to flow back through the heat exchange tubes. Sudden changes in temperature of either the secondary or primary fluids can cause the supply pipe and tubes to contract or expand at different rates thus overstressing the tubes. The rate of expansion or contraction due to a sudden change in the temperature of the fluids passing through the supply pipe and heat exchange tubes will cause the heat exchange tubes to change in length faster than the supply pipe because of the thin walls of the heat exchange tubes. This causes the supply pipe to exert a force on the tubes which could lead to tube failures.

SUMMARY OF THE INVENTION

It is an object of the present invention to overcome drawbacks found in the prior art such as those discussed above. Accordingly, a straight tube heat exchanger is provided with supply pipes of a configuration which allows them to expand or contract without exerting an appreciable force on the heat exchange tubes.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a front view, partly in section, showing a heat exchanger made in accordance with the present invention. The drawing shows a heat exchanger indicated generally as **10** having an outer shell **12** which comprises a longitudinal cylindrical section **14** and a bottom **16** closed except for an exhaust opening **44** and which has at its top an upper flange **18**. The flange **18** is annular and projects outward from the top of the cylindrical section **14**. The top of the heat exchanger **10** has a head section **20** which has three walls, **22**, **24** and **26** which extend generally upward and inward. The wall **22** is outward of the walls **24** and **26** and includes a lower cylindrical section **28** which at its top merges with a curved inwardly flared upper section **30**. The wall **24** is inside of and generally concentric with the wall **22**. At their inner edges the walls **22** and **24** are joined to an annular spoolpiece **32** which has substantially restricted walls. An annular plate **34** bridges the walls **22** and **24** at a location in the middle of the lower cylindrical section **28**. The walls **22** and **24** along with the spoolpiece **32** and annular plate **34** define an annular inlet chamber **36**. An inlet **38** through the wall **22** can be connected to a conduit not shown for admitting a heat exchange fluid into the inlet. In the preferred embodiment the fluid coming through the inlet **38** is a secondary fluid such as liquid sodium. The secondary fluid in the inlet chamber **36** flows downward through supply pipes **40** which extend down through the annular plate **34**. An intake **42** permits primary fluid such as liquid sodium to come into the heat exchanger. The primary fluid eventually exits through the exhaust **44** to be recycled to the heat source which is not shown.

The supply pipes **40** each have portions **45** which are generally straight and portions **46** which are helical in configuration. The helical portions **46** extend downward adjacent to the cylindrical section **14** of the shell **12** to a level adjacent to the bottom of the cylindrical section **14**. Here they merge with straight portions **48**, which at their bottoms, curve inward at **50**. The curved bottoms **50** project through a dish shaped plate **52** which at its top merges with a lower tube sheet **54**.

Extending upward from the lower tube sheet **54** is a plurality of straight heat exchange tubes **60** which extend up to an upper tube sheet **62** which is above the intake **42**. The secondary fluid flowing down through the supply pipes **40** including the helical portions **46** and the straight portions **48** flow into a lower chamber **64** which is defined by the plate **52** and the lower tube sheet **54**. Thereafter, the secondary fluid flows upward through the straight heat exchange tubes **60** and through the upper tube sheet **62** and into an upper chamber **66** which is defined by the lower tube sheet **62** and the wall **26**. The secondary fluid then leaves the heat exchanger **10** through an outlet **68** which passes through the wall **26** and through the spoolpiece **32** to apparatus not shown which makes use of the secondary sodium.

A shroud **70** which is generally cylindrical and extends from the lower tube sheet **54** to a top circular plate **72** just below the upper tube sheet **62** separates the straight heat exchange tubes **60** from the supply pipes **40**. The top plate **72** and lower support plate **76** are of a greater diameter than is the shroud **70** and extend laterally beyound the secondary supply pipes **40**. These define along with the upper portion of the outer shroud **70** and the cylindrical section **14** of the shell **12** a distribution chamber **78**. Distribution openings **80** are provided in the shroud **70** between the plates **72** and **76** to allow the primary fluid to enter into the shroud **70** below the plate **72**.

The straight heat exchange tubes **60** extend through openings in a series of horizontal tube support plates **82** which are supported from the upper tube sheet **62** by the rods (not shown). The openings in the support plates are provided to allow the primary fluid to flow down through the support plates **82**.

At the lower portion of the shroud **70** above the lower tube sheet **54** are a series of exit openings **84** which allow the primary fluid which has passed down over the heat exchange tubes **60** to pass outward over the lower tube sheet **54** and down through a space **86** between the plate **52** and the bottom **16** of the outer shell **12** to the exhaust **44**.

In operation primary fluid coming in at the intake **42** passes into the distribution chamber **78** through which pass a series of sleeves **90** which encircle the straight portions **45** of the supply pipes **40** between the plates **76** and **72** and thereby protect them from the hot primary fluid. Thereafter the fluid passes through the openings **80** and down through the tube support plates **82** and over the heat exchange tubes **60** to leave the space within the shroud **70** through the exit openings **84**. Thereafter the primary fluid flows downward through the space **86** and out through the exhaust **44**. Secondary fluid coming in through the inlet **38** and into the inlet chamber **36** passes down through the supply pipes **40**, and around the heat exchange tubes **60** through the helical sections **46** to the lower straight portions **48** and then inward through the curved portions **50** into the lower chambers **64** to reverse direction and flow up through the heat exchange tube **60** which extend between the lower tube sheet **54** and the upper tube sheet **62**. The secondary fluid is collected in the upper chamber **66** to leave the heat exchanger **10** through the outlet **68**.

The present heat exchanger **10** is especially advantageous in that a sudden change in temperature in either the primary or secondary fluid which would cause a different rate of thermal expansion or contraction in the supply pipes **40** and the heat exchange tubes **60** will not result in a large force causing a rupture of either the supply pipe or the heat exchange tubes. Since the supply pipes **40** have helical sections **46**, the change in length of either the supply pipe **40** or the heat exchange tubes **60** can be accommodated by flexure of the supply pipes **40** at the helical sections **46**.

The foregoing describes the one preferred embodiment of the present invention, other embodiments being possible without exceeding the scope as defined in the following claims:

What is claimed is:

1. A heat exchanger comprising: a shell;
an upper tube sheet within said shell;
a lower sheet within said shell;
plate means below said lower tube sheet, said plate means joining with said lower tube sheet to define a chamber below said lower tube sheet;
a plurality of straight heat exchange tubes extending between said first tube sheet and said second tube sheet;
a shroud within said shell and surrounding said heat exchange tubes;
an intake in said shell for flowing a first heat exchange fluid down through said shroud, between said tube sheets and over said heat exchange tubes;
an exhaust in said shell for allowing said first heat exchange fluid to leave said shell;
an inlet in said shell for admitting a second heat exchange fluid into said shell;
an outlet in said shell for permitting said second heat exchange fluid to leave said heat exchanger;
a supply pipe connected between said inlet and said chamber, said supply pipe extending generally longitudinally, and laterally of said heat exchange tubes, said supply pipe having a helical portion encircling said shroud;
whereby differences in thermal expansion between said supply pipe and said heat exchange tubes will not result in structural failure because said helical portion will flex to accommodate the difference in thermal expansion.

2. The heat exchanger defined in claim **1** wherein both of said tube sheets are horizontal and wherein said heat exchange tubes extend vertically.

3. The heat exchanger defined in claim **2** wherein said intake is above said exhaust.

4. The heat exchanger defined in claim **3** wherein said supply pipe is one of a plurality of supply pipes.

5. The heat exchanger defined in claim **4** wherein said helical portions define a series of helices with a common axis.

6. The heat exchanger defined in claim **5** wherein said helices have equal radii of curvature.

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