

(19)



Europäisches Patentamt
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(11) Publication number:

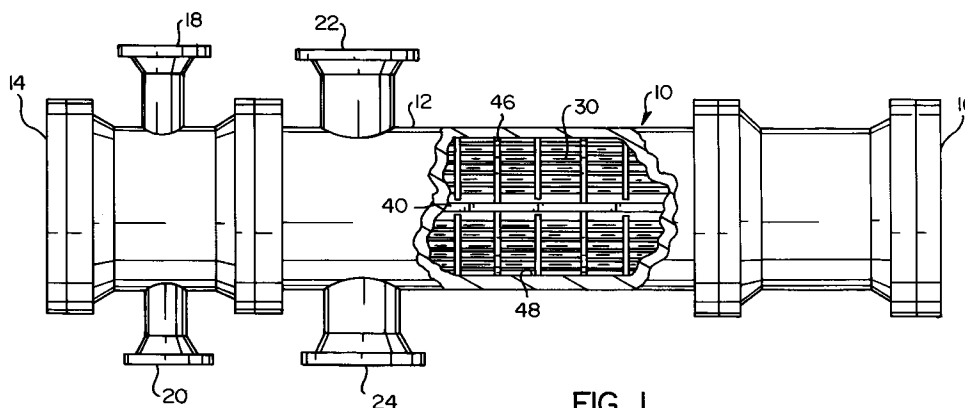
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EUROPEAN PATENT APPLICATION(21) Application number: **93103478.9**(51) Int. Cl.⁵: **F28F 9/00**(22) Date of filing: **04.03.93**(30) Priority: **05.03.92 US 846641**(43) Date of publication of application:
08.09.93 Bulletin 93/36(84) Designated Contracting States:
GB IT NL(71) Applicant: **PHILLIPS PETROLEUM COMPANY**
5th and Keeler
Bartlesville Oklahoma 74004(US)(72) Inventor: **Gentry, Cecil Calvin**
2604 Camelot Court
Bartlesville, OK 74006(US)(74) Representative: **Dost, Wolfgang,**
Dr.rer.nat.,Dipl.-Chem. et al
Patent- & Rechtsanwälte Bardehle .
Pagenberg . Dost . Altenburg . Frohwitter .
Geissler & Partner, Postfach 86 06 20
D-81633 München (DE)(54) **Two-pass shell and tube heat exchanger with rod baffle support.**

(57) A two-pass shell and tube heat exchanger (10) having a tube bundle (30) with a longitudinal baffle (40) which separates that tube bundle (30) into a first pass of tubes and a second pass of tubes is retrofitted with at least one rod baffle in order to provide additional support for the tubes of the tube bundle (40). The rod baffle (60) comprises a semi-circular baffle ring that can be fixedly secured to a baffle cross-ring so as to circumscribe either the first pass of tubes or the second pass of tubes with a plurality of rods (64) extending vertically from the

semi-circular baffle ring to the baffle cross-ring so as to provide support for either the first pass of tubes or the second pass of tubes. The baffle cross-ring is provided with a plurality of holes (86) passing through the inner face thereof so that one end of each of the plurality of rods (64) can be positioned within one of the plurality of holes (86) so that each rod (64) is fixedly secured to the baffle cross-ring without the necessity for welding at the interior of the tube bundle (30). Methods of constructing the described apparatus are also disclosed.

**FIG. 1****EP 0 559 191 A1**

Background of the Invention

This invention relates to shell and tube heat exchangers. More specifically, this invention relates to a two-pass shell and tube heat exchanger with rod baffle support.

Shell and tube heat exchangers have long been known as useful tools for heating fluids and using thermal energy. Such shell and tube heat exchangers have been developed to a significant degree of sophistication. These heat exchangers comprise of shell surrounding a tube bundle usually attached to a tube sheet. Fluid flowing through the shell is subjected to indirect heat exchange with another fluid flowing through the tubes. Because of their low shell side pressure loss characteristics, heat exchangers having two shell side fluid passes are increasingly being used in gas services and as feed water heaters. Two shell pass arrangements, containing a longitudinal plate along the shell axis, are also used to produce pure counterflow and to avoid temperature crosses, which may occur in conventional, single shell pass arrangements. The most common tube bundle configurations for a two shell pass geometry are the U-tube, split ring floating head, and pull through floating head designs. In a two shell pass arrangement, an axial plate is installed inside the shell of a shell and tube heat exchanger to form a longitudinal baffle. This longitudinal baffle produces two distinct shell side flow passages, i.e., an inlet and an exit passage. In such a configuration, fluid enters the shell through a single nozzle at the tube sheet end of the exchanger, flows axially through the shell side inlet passage, experiences a 180° flow reversal at the end of the longitudinal baffle, and flows axially back to the exit nozzle through the exit shell side fluid passage.

In order to reduce flow-induced vibration of the tube bundle while avoiding excessive flow obstructions and pressure losses, it is sometimes necessary to provide rod baffle support for the tube bundle of an existing shell and tube heat exchanger. In a two shell pass arrangement, this can be difficult because the longitudinal baffle prevents passage of a vertical rod from one side of the tube bundle to the opposite side.

An important object of the present invention is to provide a rod baffle that can be readily inserted into the tube bundle of a two pass shell and tube heat exchanger in order to reduce flow-induced vibration of the tube bundle.

Another object of this invention is to provide a two pass shell and tube heat exchanger having a plurality of rod baffles inserted in the tube bundle therein in order to reduce flow-induced vibration of the tube bundle.

Another object of this invention is to provide a method for inserting a plurality of rod baffles into the tube bundle of a two pass shell and tube heat exchanger in order to reduce flow-induced vibration in the tube bundle while avoiding excessive flow obstructions and pressure losses.

Other and further objects, aims, purposes, features, advantages, embodiments, and the like will be apparent to those skilled in the art from the present specification, taken with the associated drawings, and the appended claims.

Summary of the Invention

More particularly, in one aspect, the present invention relates to a rod baffle for use in a two pass shell and tube heat exchanger having a tube bundle with a longitudinal baffle that separates the tube bundle into a first pass of tubes and a second pass of tubes. According to the present invention, a rod baffle is provided, having a semi-circular baffle ring that can be fixedly secured to a baffle cross-ring so as to circumscribe either the first pass of tubes in the top half of the shell or the second pass of tubes in the bottom half of the shell with a plurality of rods extending vertically from the semi-circular baffle ring to the baffle cross-ring so as to provide support for either the top half of the tubes of the tube bundle or the bottom half of the tubes of the tube bundle. The baffle cross-ring is provided with a plurality of holes passing through the inner face thereof so that one end of each of the plurality of rods can be positioned within one of the plurality of holes so that each rod is fixedly secured to the baffle cross-ring without the necessity for welding at the interior of the tube bundle. The second end of each rod is then fixedly secured to the semi-circular baffle ring in order to complete the insertion of the rod baffle within the tube bundle without the need for dismemberment of the tube bundle.

Materials utilized in the heat exchanger of this invention are standard materials and comprise carbon steel as an example for the shell and alloy steels for the tube sheet.

In the drawings, further preferred embodiments and details of this invention are shown. These drawings should, however, not be interpreted to unduly limit the scope of this invention.

Brief Description of the Drawings

FIG. 1 is a front elevation view of a shell and tube heat exchanger in accordance with this invention with portions thereof broken away in order to more clearly illustrate the present invention.

FIG. 2 is an enlarged front elevation view of the tube bundle of FIG. 1 after removal from the shell

of FIG. 1 in accordance with this invention.

FIG. 3 is a cross-section view taken along line 3-3 of FIG. 2.

FIG. 4 is a cross-section view taken along line 4-4 of FIG. 2.

FIG. 5 is an enlarged elevation view of the top vertical rod baffle illustrated in FIG. 3.

FIG. 6 is a top view of the vertical rod baffle of FIG. 5.

FIG. 7 is a left side view of the vertical rod baffle of FIG. 5.

FIG. 8 is a cross-section view taken along line 8-8 of FIG. 5.

FIG. 9 is an enlarged view of the baffle cross-ring shown in cross-section in FIG. 8.

Detailed Description of the Invention

Referring to the drawings, and to FIG. 1 in particular, there is seen an elevation view of one embodiment of a two pass shell and tube heat exchanger in accordance with the present invention which is herein designated in its entirety by the numeral 10. Heat exchanger 10 includes an elongated, substantially cylindrical housing or shell 12 with a first end 14 and a second end 16. A tube inlet 18 is positioned in the upper portion of the shell 12 near the first end 14 of the shell 12. A tube outlet 20 is positioned in the lower portion of the shell 12 near the first end 14 of the shell 12. A shell inlet 22 is positioned in the upper portion of the shell 12 between the tube inlet 18 and the second end 16 of the shell 12. A shell outlet 24 is positioned in the lower portion of the shell 12 between the tube outlet 20 and the second end 16 of the shell 12. Positioned within the shell 12 is a tube bundle, generally designated by the numeral 30.

FIG. 2 is an enlarged view of the tube bundle 30 having a first end 31 and second end 32. Tube bundle 30 includes a plurality of tubes with a first pass of substantially longitudinal tubes or tube portions 33 and a second pass of substantially longitudinal tubes or tube portions 34. First pass 33 and second pass 34 are parallel to the longitudinal axis of tube bundle 30. A plurality of U-bend tubes or tube portions 36 interconnect corresponding tubes or tube portions in the first pass 33 and the second pass 34. Each tube formed by first pass 33, second pass 34 and U-bend tube 36 may be integrally formed or fabricated from separate elements. Either U-tube construction is known in the art.

In addition to the U-tube configuration described, any other suitable configuration can be utilized to interconnect the corresponding tubes or tube portions in the first pass 33 and the second pass 34, such as, for example, split ring floating heads, pull through floating heads, etc.

A tube sheet or plate 38 is positioned at the first end 31 of the tube bundle 30 substantially normal to the longitudinal axis of tube bundle 30. The plurality of tubes of the first pass 33 extend through the tube sheet 38 so as to be in fluid flow communication with the tube inlet 18 (shown in FIG. 1). The plurality of tubes of the second pass 34 extend through the tube sheet 38 so as to be in fluid flow communication with the tube outlet 20 (shown in FIG. 1). Thereby, fluid flow communication is provided between the tube inlet 18 and the tube outlet 20 by way of the plurality of tubes comprising the first pass 33, second pass 34 and U-bend tubes 36.

A longitudinal baffle 40 is positioned between the first pass of tubes 33 and the second pass of tubes 34. The longitudinal baffle 40 has a first end 42 that is sealingly engaged with the tube bundle 30 and a second end 44 that is positioned near the second end 32 of the tube bundle 30. When the tube bundle 30 is positioned within the shell 12, as shown in FIG. 1, each side of the longitudinal baffle 40 is sealingly engaged with the inner surface of the shell 12 so as to divide the shell 12 into an upper chamber 46 and a lower chamber 48. An opening is provided between the second end 44 of the longitudinal baffle 40 and the second end 16 of the shell 12 in order to provide passage of the U-bend tubes 36 and additionally in order to provide direct fluid flow communication between the upper chamber 46 and the lower chamber 48.

A plurality of plate baffles 50 are positioned within the tube bundle in order to provide a supporting means for first tube pass 33 and second tube pass 34. While the purpose of the present invention is to provide additional tube support to the tube bundle through the use of rod baffles, the pre-existing plate baffles 50 will remain in place within the tube bundle 30 after the addition of the rod baffles of the present invention. A plurality of tie rods 52 are evenly spaced along the periphery of the tube bundle 30 parallel to the longitudinal axis of the tube bundle 30. Each tie rod 52 has a first end 54 and a second end 56. The first end 54 of each tie rod 52 is fixedly secured to the tube sheet 38 and the second end 56 of each tie rod 52 is fixedly secured to the plate baffle 50 that is in closest proximity to the second end 32 of the tube bundle 30. The purpose of the tie rods 52 is to hold the plate baffles 50 securely in place while maintaining proper spacing between each plate baffle 50.

In accordance with the present invention, a plurality of vertical rod baffles 60 and a plurality of horizontal rod baffles 62 are positioned between the existing plate baffles 50 in order to provide additional support to the tubes of the tube bundle 30.

FIG. 3 illustrates a vertical rod baffle 60 providing support for the first pass of tubes 33 and a separate vertical rod baffle 60 providing support for the second pass of tubes 34. The vertical rod baffle 60 which supports the first pass of tubes 33 comprises a semi-circular structure that circumscribes the first pass of tubes 33 and provides support to a plurality of vertical rods 64. The vertical rod baffle 60 that provides support to the second pass of tubes 34 comprises a semi-circular structure that circumscribes the second pass of tubes 34 and provides support to a plurality of vertical rods 64. Each vertical rod baffle 60 is fixedly secured to at least one tie rod 52 in order to support the vertical rod baffle 60.

FIG. 4 illustrates a horizontal rod baffle 62 providing support for the first pass of tubes 33 and a separate horizontal rod baffle 62 providing support for the second pass of tubes 34. The horizontal rod baffle 62 which supports the first pass of tubes 33 comprises a semi-circular structure that circumscribes the first pass of tubes 33 and provides support to a plurality of horizontal rods 65. The horizontal rod baffle 62 that provides support to the second pass of tubes 34 comprises a semi-circular structure that circumscribes the second pass of tubes 34 and provides support to a plurality of horizontal rods 66. Each horizontal rod baffle 62 is fixedly secured to at least one tie rod 52 in order to support the horizontal rod baffle 62.

While the vertical rod baffles 60 shown in FIG. 3 and the horizontal rod baffle 62 shown in FIG. 4 are shown with vertical rod 64 and horizontal rod 66 adjacent to every other row of tubes, it is emphasized that a supporting apparatus in accordance with the present invention only requires that the rods in each baffle assembly inserted in the spaces between adjacent tube rows in one plurality of parallel tube rows are inserted into less than the total number of such spaces. It is immaterial whether the rods are inserted in adjacent spaces, alternate spaces, two adjacent spaces followed by skipping two spaces or any variation desired. The minimum number of rods in a baffle assembly is the number sufficient for the baffle set to provide radial support for each tube forming the tube bundle. It is preferred that this functional limitation also be used to determine the maximum number of rods in a baffle assembly because the pressure drop across the shell side of a shell and tube heat exchanger is the lowest when the least number of rods are used to form in the baffle assemblies; however, it is essential to use enough rods in each baffle assembly for the baffle set to provide radial support for each tube.

The vertical rod baffle 60 of the present invention is more clearly illustrated in FIG. 5 - FIG. 7. The vertical rod baffle 60 comprises a baffle ring

70 comprising a semi-circular member having a first end 72 and a second end 74. Interconnecting first end 72 and second end 74 of baffle ring 70 is a baffle cross-ring 76 having a first end 78, a second end 80, an inner first face 82 and an outer second face 84. First end 72 of the baffle ring 70 is fixedly secured to the baffle cross-ring 76 in close proximity to the first end 78 of the baffle cross-ring 76. Second end 74 of the baffle ring 70 is fixedly secured to the baffle cross-ring 76 in close proximity to the second end 80 of the baffle cross-ring 76. Preferably, first end 72 of the baffle ring 70 is fixedly secured to the first face 82 of the baffle cross-ring 76 in close proximity to the first end 78 of the baffle cross-ring 76. Preferably, second end 74 of the baffle ring 70 is fixedly secured to the first face 82 of the baffle cross-ring 76 in close proximity to the second end 80 of the baffle cross-ring 76. A plurality of holes 86, as shown in FIG. 6, pass through the baffle cross-ring 76 from the first face 82 to the second face 84. While it is preferred that the holes 86 pass from the first face 82 to the second face 84 of the baffle cross-ring 76, the holes 86 may comprise blind holes that pass from the first face 82 to a point between the first face 82 and the second face 84 rather than through the entire thickness of the baffle cross-ring 76. Preferably, the holes 86 are evenly spaced between the first end 78 and the second 80 of the baffle cross-ring 76 and the location of the hole 76 coincides with the desired locations of the vertical rods 64.

A plurality of vertical rods 64 having a first end 88 and a second end 90 and having a constant diameter are fixedly secured between the baffle ring 70 and the baffle cross-ring 76 in parallel equally spaced relation. The first end 88 of each vertical rod 64 is fixedly secured to the baffle ring 70 by any suitable means, such as tack welding. The second end 90 of each vertical rod 64 is positioned within one of the holes 86 passing through the first face 82 of the baffle cross-ring 76 so that a tight fit is maintained between the second end 90 of the vertical rod 64 and the hole 86, thereby fixedly securing the vertical rod 64 to the baffle cross-ring 76.

As illustrated in FIG. 8 and FIG. 9, the holes 86 are preferably tapered so that the diameter of each hole 86 decreases as each hole 86 passes from the first face 82 to the second face 84 of the baffle cross-ring 76. The diameter of each hole 86 at the first face 82 of the baffle cross-ring 76 is greater than the diameter of the vertical rods 64 and the diameter of each hole 86 at the second face 84 of the baffle cross-ring 76 is less than the diameter of the vertical rods 64. As a result of this tapered design of the holes 86, when the second end 90 of a vertical rod 64 is positioned within a hole 86, a downward pressure upon the vertical rod 64 will

cause the second end 90 of the vertical rod 64 to become wedged within the hole 86, thereby fixedly securing the second end 90 of the vertical rod 64 to the baffle cross-ring 76. This configuration allows each vertical rod 64 to be fixedly secured to the baffle cross-ring 76 without the need to access the point at which the vertical rod 64 is fixedly secured to the baffle cross-ring 76, which would be quite impractical because such a point would lie well within the interior of the tube bundle 30.

It is presently preferred to assemble the rod baffle of the present invention within the tube bundle illustrated in FIG. 2 in the following manner. Initially, the tube bundle 30 is removed from the shell 12. In order to support the tubes of the first pass of tubes 33, a baffle ring 70 is positioned around the periphery of the first pass of tubes 33 and tie rods 52 so that the baffle ring 70 is normal to the first pass of tubes 33 at the point at which support is desired for the first pass of tubes 33. The baffle ring 70 is positioned so that it is in contact with at least one tie rod 52.

A baffle cross-ring 76 is positioned normal to the first pass of tubes 33 between the first pass of tubes 33 and the longitudinal baffle 40 so that the first end 72 of the baffle ring 70 is in contact with the baffle cross-ring 76 at a point near the first end 78 of the baffle cross-ring 76 and the second end 74 of the baffle ring 70 is in contact with the baffle cross-ring 76 at a point near the second end 80 of the baffle cross-ring 76. The first end 72 of the baffle ring 70 is then fixedly secured to the baffle cross-ring 76 near the first end 78 of the baffle cross-ring 76 and the second end 74 of the baffle ring 70 is fixedly secured to the baffle cross-ring 76 near the second end 80 of the baffle cross-ring 76 by any suitable means, such as welding. Welding is defined for the purposes of this application to mean the localized coalescing of metal wherein coalescing is produced by heating to suitable temperatures, with or without the application of pressure, and with or without the use of filler metal.

The combination of the baffle ring 70 and the baffle cross-ring 76 forms a one-piece structure which completely circumscribes the first pass of tubes 33 at the point at which support is to be provided for the first pass of tubes 33. This structure is secured in place by fixedly securing the baffle ring 70 to the tie rods 52 which circumscribe the first pass of tubes 33, by any suitable means, such as welding.

The vertical rods 64 are then inserted in the desired spaces between adjacent rows of the first pass of tubes 33 so as to provide support for the first pass of tubes 33. The vertical rods 64 are positioned generally vertically in horizontally spaced mutually parallel relation. The second end 90 of each vertical rod 64 is positioned within one

of the holes 86 passing through the first face 82 of the baffle cross-ring 76. Downward pressure is then applied to each vertical rod 64 so that the second end 90 of each vertical rod 64 is firmly wedged within the hole 86. The first end 88 of each vertical rod 64 is then fixedly secured to the baffle ring 70 by any suitable means, such as welding, so that each vertical rod 64 is fixedly secured extending generally vertically between the baffle ring 70 and the baffle cross-ring 76.

At least one vertical rod baffle 60 is positioned amongst the second pass of tubes 34 in the same manner as described above with relation to the first pass of tubes 33 in order to provide support for the second pass of tubes 34.

Horizontal rod baffles are also positioned amongst the first pass of tubes 33 and the second pass of tubes 34 in order to provide support to the tubes. The baffle ring 70 and the baffle cross-ring 76 of each horizontal rod baffle 62 is positioned in the same manner as described above for the vertical rod baffle 60. The horizontal rods 66 are then inserted in the desired spaces between adjacent rows of tubes so as to provide support for the tubes. The horizontal baffles 66 are positioned generally horizontally in vertically spaced mutual parallel relation. Each end of each horizontal rod 66 can be fixedly secured to the baffle ring 70 by any suitable means, such as welding.

Reasonable variations and modifications can be made in the construction and arrangement of parts or elements in the embodiment disclosed herein without departing from the spirit and scope of the invention as defined in the following claims.

Claims

1. A rod baffle for use in a two pass shell and tube heat exchanger comprising:

a baffle ring comprising a semi-circular member having a first end and a second end;

a baffle cross-ring comprising a member having a first end and a second end and an inner face and an outer face wherein said first end of said baffle ring is fixedly secured to said baffle cross-ring at said first end of said baffle cross-ring and wherein said second end of said baffle ring is fixedly secured to said baffle cross-ring at said second end of said baffle cross-ring and wherein said inner face of said baffle cross-ring has a plurality of holes passing therethrough;

a plurality of rods having a first end and a second end wherein each first end of said rods is fixedly secured to said baffle ring and each second end of said rods is positioned within one of said holes so that said rods are fixedly secured between said baffle ring and said baf-

file cross-ring in parallel spaced relation.

2. A rod baffle in accordance with claim 1, wherein each of said plurality of holes passing through said inner face of said baffle cross-ring has an essentially circular cross-section. 5
3. A rod baffle in accordance with claim 2, wherein each of said plurality of holes passing through said inner face of said baffle cross-ring is tapered so that the diameter of each of said plurality of holes decreases as each of said holes extends from said inner face towards said outer face and wherein the diameter of each of said plurality of holes at said inner face is greater than the diameter of each of said plurality of rods and the diameter of each of said plurality of holes at some point between said inner face and said outer face is less than the diameter of each of said plurality of rods. 10 15 20
4. An apparatus comprising:
 - a plurality of parallel tubes arranged to form a plurality of parallel rows of tubes; 25
 - at least one first baffle comprising a first baffle ring comprising a semi-circular member having a first end and a second end;
 - a first baffle cross-ring comprising a member having a first end and a second end and an inner face and an outer face wherein said first end of said first baffle ring is fixedly secured to said inner face of said first baffle cross-ring at said first end of said baffle cross-ring and wherein said second end of said first baffle ring is fixedly secured to said inner face of said first baffle cross-ring at said second end of said first baffle cross-ring and wherein said inner face of said first baffle cross-ring has a plurality of holes passing therethrough; 30 35 40
 - a first plurality of rods having a first end and a second end wherein each first end of each said first plurality of rods is fixedly secured to said first baffle ring and each second end of each said first plurality of rods is positioned within one of said holes so that said first plurality of rods are fixedly secured between said first baffle ring and said first baffle cross-ring in parallel equally spaced relation; 45
 - at least one second baffle comprising a second baffle ring comprising a semi-circular member having a first end and a second end; 50
 - a second baffle cross-ring comprising a member having a first end and a second end and an inner face and an outer face wherein said first end of said second baffle ring is fixedly secured to said inner face of said second baffle cross-ring at said first end of said 55

baffle cross-ring and wherein said second end of said second baffle ring is fixedly secured to said inner face of said second baffle cross-ring at said second end of said second baffle cross-ring and wherein said inner face of said second baffle cross-ring;

a second plurality of rods having a first end and a second end wherein each first end of each second plurality of rods is fixedly secured to said second baffle ring and each second end of each said second plurality of rods is fixedly secured to said second baffle rings so that said second plurality of rods are fixedly secured between said first baffle ring in parallel equally spaced relation;

wherein the combination of said first baffle ring and said first baffle cross-ring of each said first baffle surrounds at least a portion of said plurality of tubes in a plane about normal to said plurality of tubes in each rod of said first plurality of rods of each first baffle extends between two adjacent rows of said tubes so as to be in support of contact with each said tube of the two adjacent rows; and

wherein the combination of said second baffle ring and said second baffle cross-ring of each said second baffle surrounds at least a portion of said plurality of tubes in a plane about normal to said plurality of tubes and each rod of said second plurality of rods of each second baffle extends between two adjacent rows of said tubes so as to be in support of contact with each said tube of two adjacent rows.

5. A rod baffle in accordance with claim 4, wherein each of said plurality of holes passing through said inner face of said baffle cross-ring has an essentially circular cross-section.
6. A rod baffle in accordance with claim 5, wherein each of said plurality of holes passing through said inner face of said first baffle cross-ring is tapered so that the diameter of each of said plurality of holes decreases as each of said holes extends from said inner face towards said outer face and wherein the diameter of each of said plurality of holes at said inner face is greater than the diameter of each of said first plurality of rods and the diameter of each of said plurality of holes at some point between said inner face and said outer face is less than the diameter of each of said first plurality of rods.
7. A method of assembly of a rod baffle within the tube bundle of a two-pass shell and tube heat exchanger having a plurality of parallel

tubes arranged to form a plurality of parallel rows of tubes and having a longitudinal baffle separating said plurality of tubes into a first pass of tubes and a second pass of tubes and having a plurality of tie rods spaced along the periphery of said tube bundle parallel to the longitudinal axis of said tube bundle comprising the steps of:

positioning at least one first baffle ring normal to said plurality of tubes around the periphery of said pass of tubes wherein said first baffle ring comprises a semi-circular member having a first end and a second end and wherein said first baffle ring is in contact with at least one of said tie rods;

positioning at least one first baffle cross-ring normal to said plurality of tubes between said first pass of tubes and said longitudinal baffle wherein said first baffle cross-ring comprises a member having a first end and a second end and an inner face and an outer face and wherein said inner face has a plurality of holes passing therethrough and wherein said first end of said first baffle is in contact with said first baffle cross-ring at said first end of said first baffle cross-ring and said second end of said first baffle is in contact with said first baffle cross-ring at said second end of said first baffle cross-ring;

fixedly securing said first end of said first baffle ring to said first baffle cross-ring at said first end of said first baffle cross-ring and fixedly securing said second end of said first baffle ring to said first baffle cross-ring at said second end of said first baffle cross-ring so that said first baffle ring and said first baffle cross-ring are combined to form a continuous loop which circumscribes all of said first pass of tubes;

fixedly securing said first baffle ring to at least one of said tie rods;

inserting a first plurality of rods in positions extending generally vertically between adjacent rows of tubes of said first pass of tubes in horizontally spaced mutual parallel relation wherein said first plurality of rods have a first end and a second end and wherein said first end of each rod of said first plurality of rods is positioned in one of said holes passing through said inner face of said first baffle cross-ring;

fixedly securing each of said first plurality of rods to said first baffle cross-ring by applying pressure to each of said rods so that said first end of each of said first plurality of rods is secured within one of said holes passing through said inner face of said first baffle cross-ring;

fixedly securing said second end of each said first plurality of rods to said first baffle ring so that each of said first plurality of rods is fixedly secured generally vertically between said first baffle ring and said first baffle cross-ring in horizontally spaced mutual parallel relation with a common axis of alignment.

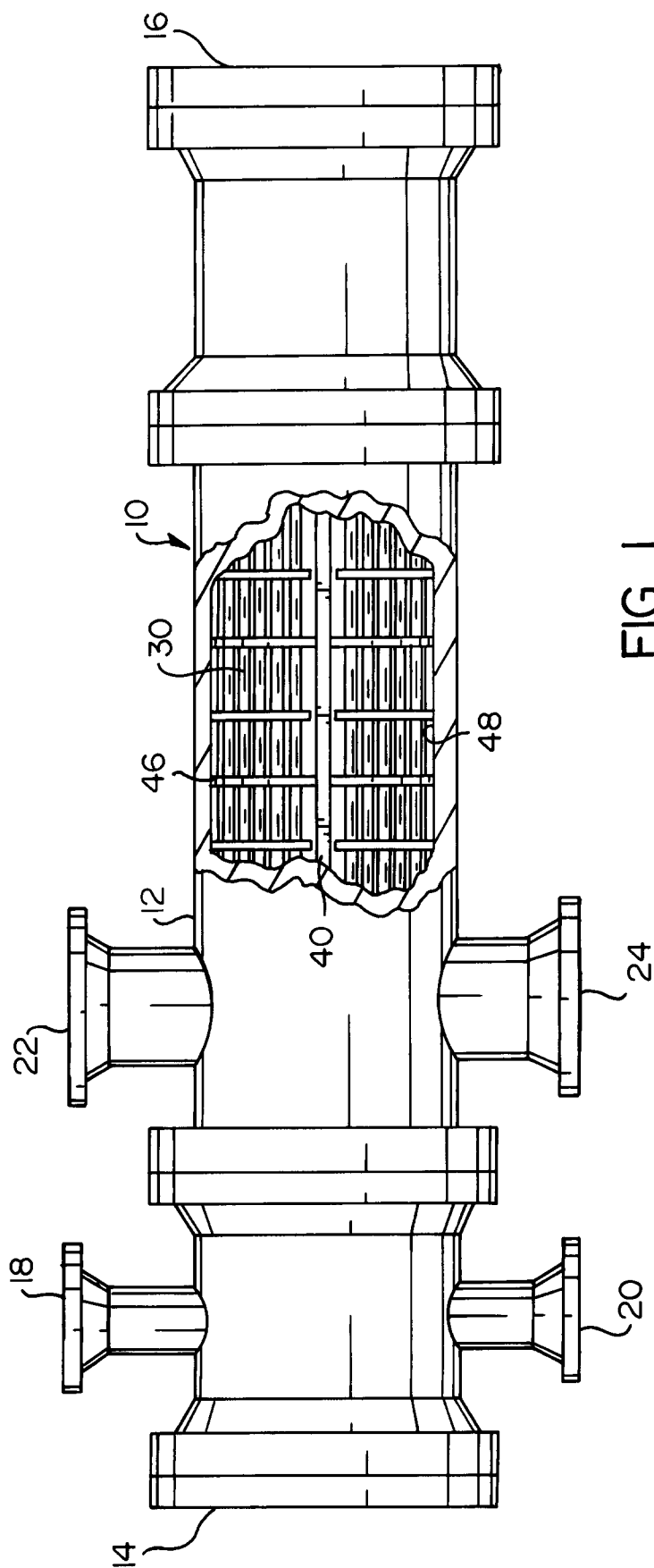


FIG. 1

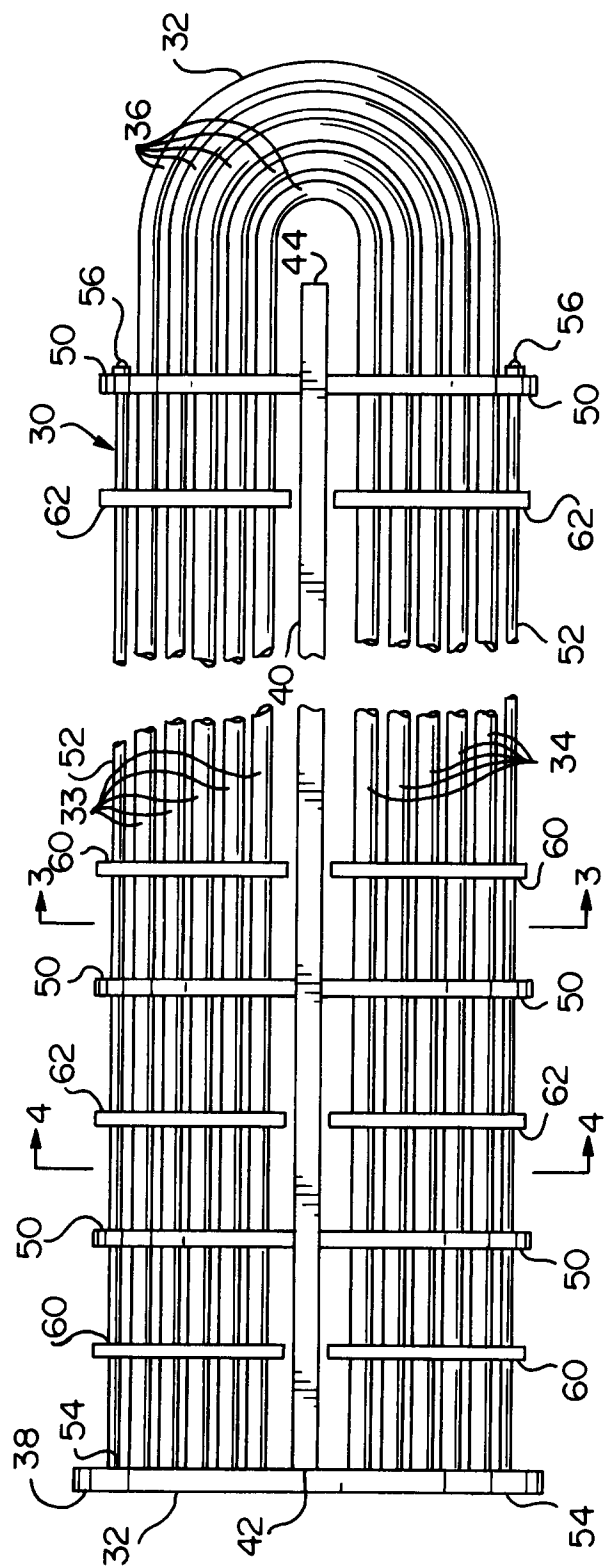


FIG. 2

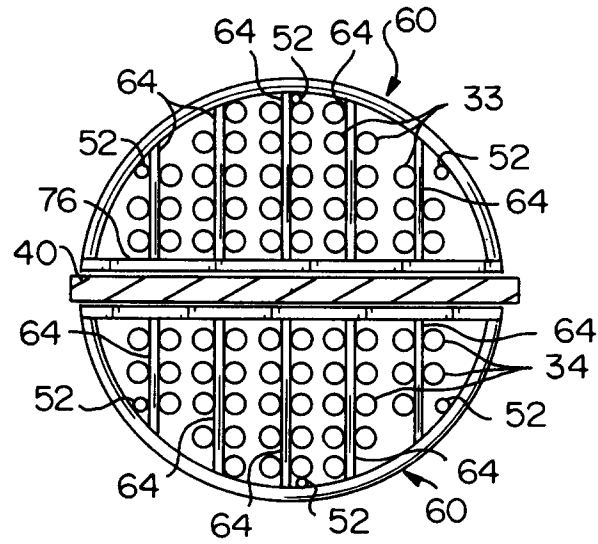


FIG. 3

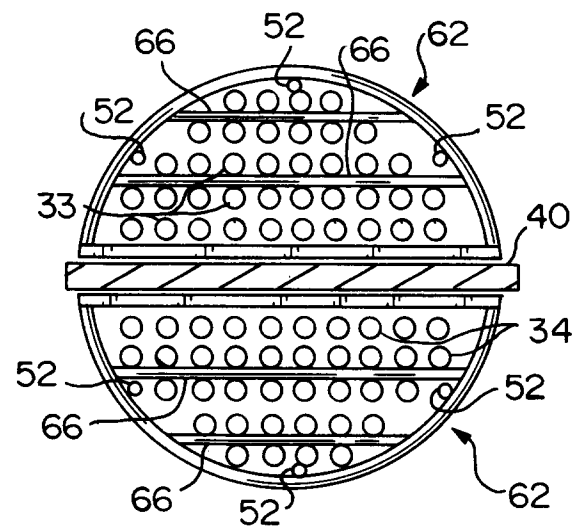


FIG. 4

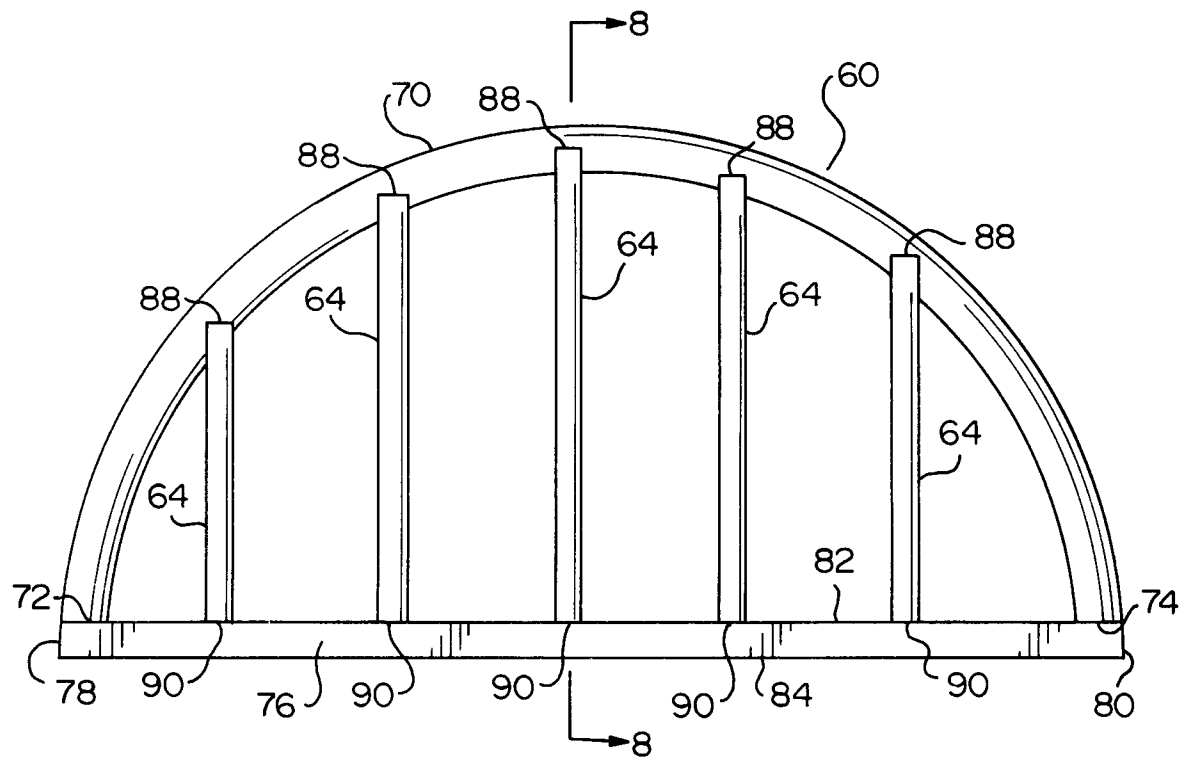


FIG. 5

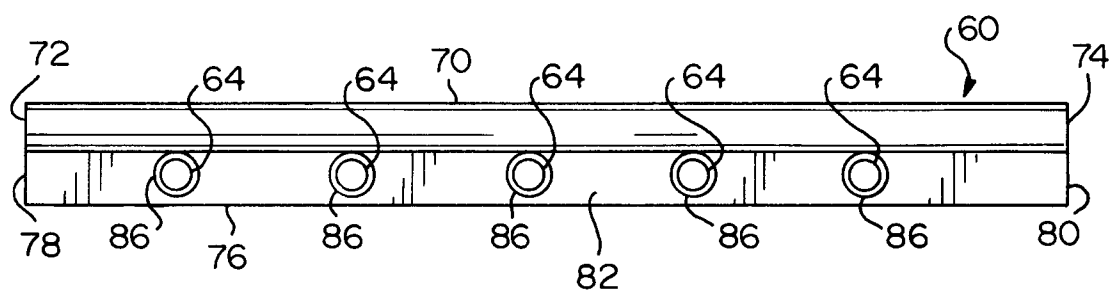


FIG. 6

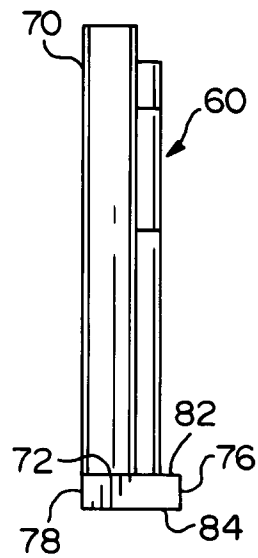


FIG. 7

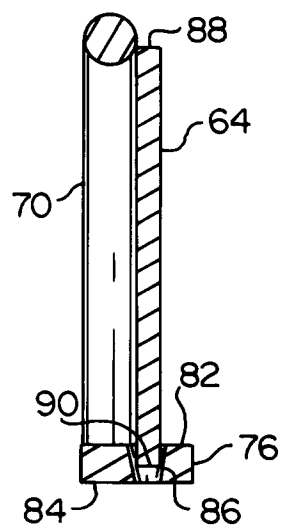


FIG. 8

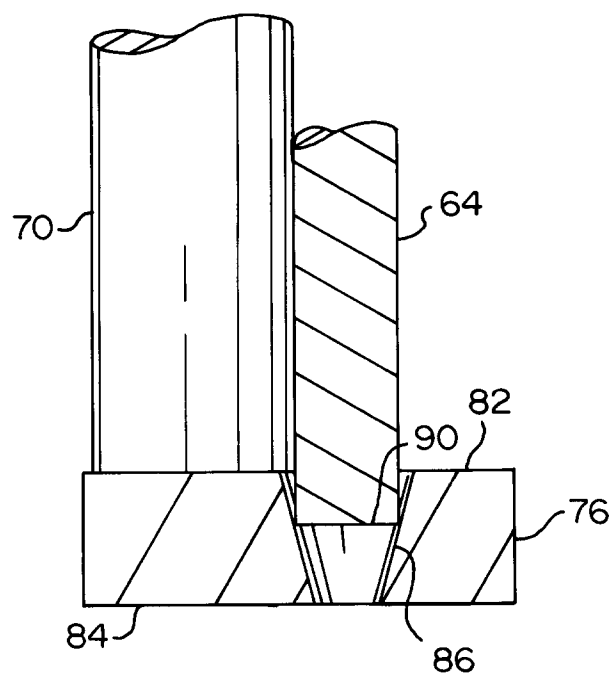


FIG. 9



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 10 3478

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
A	US-A-5 058 664 (GENTRY) * the whole document *	1	F28F9/00
A	US-A-4 429 739 (GENTRY ET AL.) * the whole document *	1	
			TECHNICAL FIELDS SEARCHED (Int. Cl.5)
			F28F F22B
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 02 JUNE 1993	Examiner SMETS E.D.C.
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			