

Dec. 20, 1966

J. WELTER ETAL

3,292,691

TUBE SPACING MEANS

Filed Jan. 5, 1965

FIG. 1

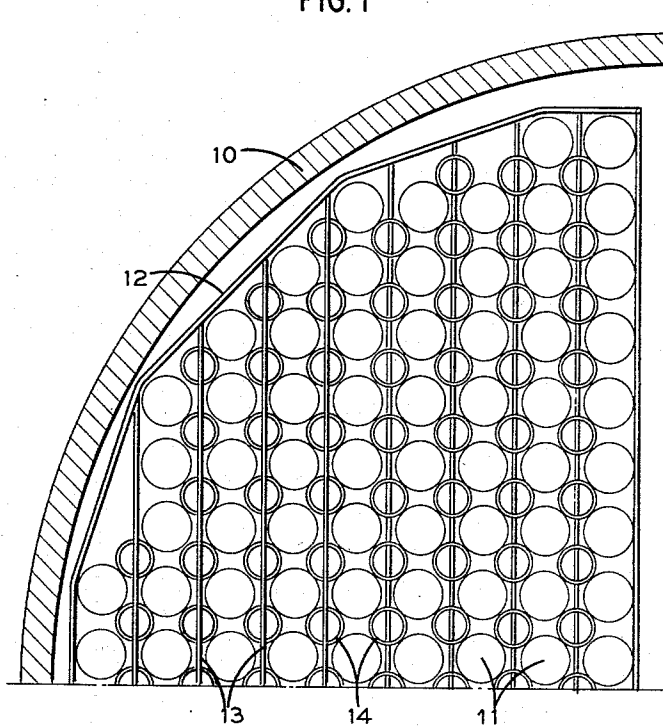
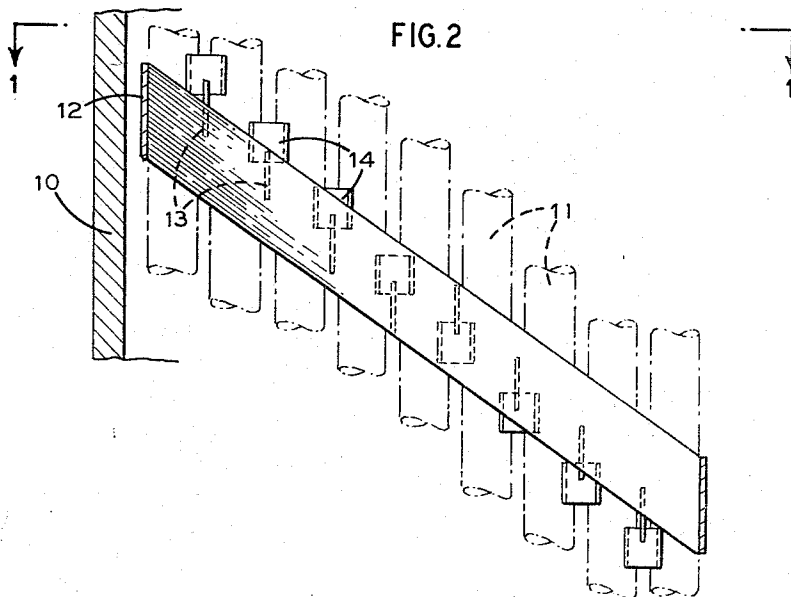


FIG. 2



BY

INVENTORS
Josef Welter
Josef Metger

J. P. Moran
ATTORNEY

1

3,292,691

TUBE SPACING MEANS

Josef Welter and Josef Metger, Oberhausen, Rhineland, Germany, assignors to Babcock & Wilcox, Limited, London, England, a corporation of Great Britain

Filed Jan. 5, 1965, Ser. No. 423,425

Claims priority, application Germany, Jan. 24, 1964,

D 43,432

8 Claims. (Cl. 165—162)

The present invention relates to a tube spacing means for heat exchangers wherein a plurality of tubes are arranged as a tube bundle which must be supported and spaced during operation. Furthermore, the present invention is directed to a tube spacing means which positively supports and spaces the tubes in the tube bundle while at the same time providing for a very low pressure drop thereacross.

Many heat exchangers have tube bundles in which a plurality of tubes are arranged with very close spacing therebetween. For example, heat exchangers used for reheat steam attemperators have many small tubes spaced on very close centers because of the high flow velocities incurred in both the primary fluid within the tubes and the secondary fluid outside of the tubes. Such tube bundles often have a length of 30 to 50 feet and the tubes must be supported and spaced along the length thereof. It is well known in the prior art to space tubes of such heat exchangers by various means such as thin plates inserted between adjacent rows of the tubes in the tube bundle. However, such tube spacing means of the prior art have incurred high pressure losses in the fluid flowing outside of the tubes due to the fact that they extend across the tube bundle in a single, common plane perpendicular to the axis of the tube bundle. As a result of this arrangement all of the fluid flowing thereover had to pass through areas in the tube bundle where the flow area was reduced a substantial amount causing high pressure losses. The reduction in flow area with tube spacers of the prior art have ranged from 30 to 40% of the total flow area. Inasmuch as such heat exchangers as reheat steam attemperators require a minimum of pressure drop to assure the lowest possible pressure drop in the secondary fluid system, commonly being a maximum of 5 p.s.i., the tube spacing means of the prior art accounted for nearly half of this pressure loss, severely restricting the arrangement of the remainder of the system.

Accordingly, the present invention is directed to an improved tube spacing arrangement wherein the tube spacers are inclined to the axis of the tube bundle so that, at any given cross-section in the tube bundle, the tube spacers do not unduly restrict the flow area on the shell side of the heat exchanger. As a result of the arrangement of the present invention the pressure drop incurred by tube spacing arrangements of the prior art is substantially reduced, simplifying both the construction of the heat exchanger and the arrangement of the remainder of the system, and reducing the operating costs of the system as a result of the reduced pressure drop.

Accordingly, the present invention provides a tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, the tubes being arranged in a plurality of rows parallel to the axis of the tube bundle, the spacer arrangement comprising an outer member embracing at least a portion of the outer periphery of the tube bundle and inclined to the axis of the tube

2

bundle, and a plurality of spacing means extending between opposite portions of the embracing member through the tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in the tube bundle, adjacent spacing means between adjacent rows of tubes being displaced from each other at an angle to the axis of the tube bundle at least as great as the angle of inclination of the embracing member.

The various features which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawing and descriptive matter in which there is illustrated and described a preferred embodiment of the invention.

In the drawing:

FIG. 1 illustrates a vertical section of a portion of a heat exchanger tube bundle; and

FIG. 2 is a view of the tube spacer arrangement perpendicular to the view illustrated in FIG. 1.

In FIG. 1 is illustrated one quarter of a cross-section of a heat exchanger having an outer cylindrical pressure vessel 10 and a plurality of tubes 11 arranged therein as a tube bundle. An outer metal ring 12 embraces the outer periphery of the tube bundle, or as illustrated in FIG. 1 one half of the tube bundle, and is inclined to the longitudinal axis of the tube bundle as illustrated in FIG. 2. The angle of inclination of the outer embracing member, or ring 12 to the axis of the tube bundle depends upon the specific construction of the heat exchanger and the fluid flow conditions therethrough, but will range between 35 and 45°. A plurality of relatively thin spacing members or sheets 13 extend between opposite portions of the outer member 12 between adjacent rows of tubes and are connected at each end to the outer member. A plurality of tubular spacers 14 are connected to one edge of the spacer sheets 13 and are arranged to contact the four adjacent tubes providing the spacing and support necessary. Inasmuch as the outer member 12 is inclined to the axis of the tube bundle it will be appreciated that the arrangement of the tubular spacers 14 will also be inclined to the axis of the tube bundle so that the reduction in flow area at any given cross-section of the tube bundle is much less than would be the case if the tube spacer elements 13 and 14 were all arranged in a common plane perpendicular to the axis of the tube bundle.

However, as clearly illustrated in FIG. 2, the spacer elements 13 and 14 may be displaced at an even greater angle than that of the outer embracing member 12 by selectively connecting the spacer sheets 13 across the width of the embracing ring 12. Thus each adjacent spacer sheet 13 will be displaced a different amount from the edge of the embracing ring 12 than is the next adjacent spacer sheet.

Accordingly, the tube spacing arrangement of the present invention provides for the positive spacing and support of a plurality of tubes in a tube bundle while at the same time minimizing pressure drop thereacross resulting in more economic operation of the heat exchanger system. Furthermore, with the present arrangement the inclination of the spacer means to the axis of the tube bundle is easily adaptable to various conditions requiring differing minimum pressure drops.

3

While in accordance with the provisions of the statutes there is illustrated and described herein a specific embodiment of the invention, those skilled in the art will understand that changes may be made in the form of the invention covered by the claims, and that certain features of the invention may sometimes be used to advantage without a corresponding use of the other features.

What is claimed is:

1. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, adjacent spacing means between adjacent rows of said tubes being displaced from each other at an angle to the axis of said tube bundle at least as great as the angle of inclination of said outer member.

2. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, each of said spacing means including a relatively thin member connected at each end to opposite portions of said outer member, adjacent spacing means between adjacent rows of said tubes being displaced from each other at an angle to the axis of said tube bundle at least as great as the angle of inclination of said outer member.

3. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said outer member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, each of said spacing means including a relatively thin member connected at each end to opposite portions of said outer member, said thin member having means cooperating therewith to space adjacent tubes in each row, adjacent spacing means between adjacent rows of said tubes being displaced from each other at an angle to the axis of said tube bundle at least as great as the angle of inclination of said outer member.

4. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said outer member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, each of said spacing means including a relatively thin member connected at each end to opposite portions of said outer member, said thin member having a spacer connected thereto and arranged to space adjacent tubes in each row, adjacent spacing means between adjacent rows of said tubes being displaced from each other at an angle to the axis of said tube bundle at least as great as the angle of inclination of said outer member.

4

5. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said outer member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, each of said spacing means including a relatively thin member connected at each end to opposite portions of said outer member, said thin member having a tubular spacer connected thereto and arranged to space adjacent tubes in each row, said spacing means between adjacent rows of said tubes being displaced from each other at an angle to the axis of said tube bundle at least as great as the angle of inclination of said outer member.

6. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said outer member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, each of said spacing means including a relatively thin member connected at each end to opposite portions of said outer member, said thin member having a plurality of tubular spacers connected thereto and arranged to space adjacent tubes in each row, said spacing means between adjacent rows of said tubes being displaced from each other at an angle to the axis of said tube bundle at least as great as the angle of inclination of said outer member.

7. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said outer member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, each of said spacing means including a relatively thin member connected at each end to opposite portions of said outer member, a plurality of tubular spacers connected to one edge of each of said thin members to space adjacent tubes in each row, said spacing means between adjacent rows of said tubes being displaced from each other at an angle to the axis of said tube bundle at least as great as the angle of inclination of said outer member.

8. A tube spacer arrangement for positively spacing a plurality of tubes arranged as a tube bundle, said tubes being arranged in a plurality of rows parallel to the axis of said tube bundle, said spacer comprising an outer member embracing at least a portion of the outer periphery of said tube bundle and inclined to the axis of said tube bundle, and a plurality of spacing means extending between opposite portions of said outer member through said tube bundle between adjacent rows of tubes therein and arranged to position and space adjacent tubes in said tube bundle, each of said spacing means including a relatively thin member connected at each end to opposite portions of said outer member, a plurality of tubular spacers connected to one edge of each of said thin members to space adjacent tubes in each row, said thin members being connected to said outer member at a distance from the edge of said outer member different from the next adjacent thin member so that adjacent

spacing means between adjacent rows of said tubes are displaced from each other at an angle to the axis of said tube bundle greater than the angle of inclination of said outer member.

References Cited by the Examiner**UNITED STATES PATENTS**

1,882,474	10/1932	Black	-----	165—162
2,505,695	4/1950	Villiger et al.	-----	165—162

3,007,679	11/1961	Byerley et al.	-----	165—162 X
3,104,218	9/1963	Speidel et al.	-----	165—162 X
3,176,762	4/1965	Greenwood et al.	-----	165—162

FOREIGN PATENTS

5	553,485	5/1943	Great Britain.
---	---------	--------	----------------

ROBERT O'LEARY, *Primary Examiner.*

A. DAVIS, *Assistant Examiner.*