

[54] TUBE SUPPORTS

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[58] Field of Search.....248/68 R, 49; 165/162, 172; 138/112; 29/428

[56] References Cited

UNITED STATES PATENTS

3,420,297	1/1969	Romanos.....	165/162
3,600,792	8/1971	Valluy.....	165/172
1,818,591	8/1931	Tournier	248/49
1,882,474	10/1932	Black	165/162

2,198,529 4/1940 Fields 165/162 X

FOREIGN PATENTS OR APPLICATIONS

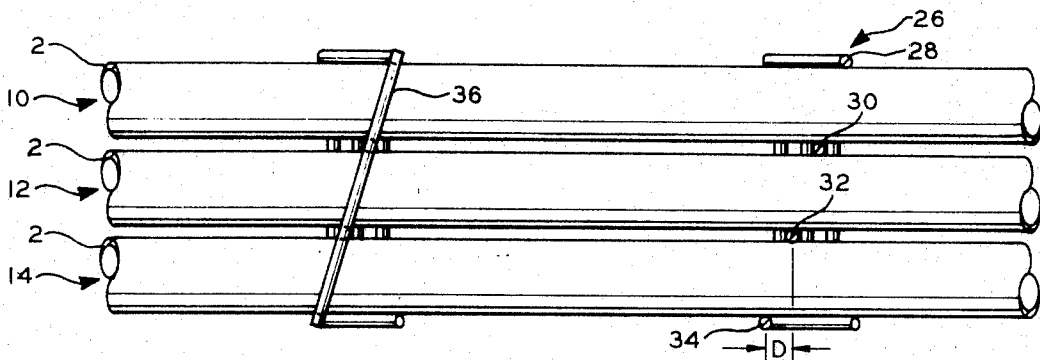
367,842 1/1972 Switzerland 165/162

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[57] ABSTRACT

A method and apparatus for supporting tubes of a tube bundle. First and second rod sets are inserted through the tube bundles with only one rod of the first rod set positioned between each row of tubes and only one rod of the second rod set positioned between each column of tubes. Each successive rod of each rod set is laterally spaced a common distance along the length of the tube relative to the succeeding rod of that rod set with a rod of each set being positioned on opposed sides of each tube of the bundle. A securing means is attached to the ends of each rod for urging each set of rods and the tubes together to form a unitary bundle.

8 Claims, 3 Drawing Figures



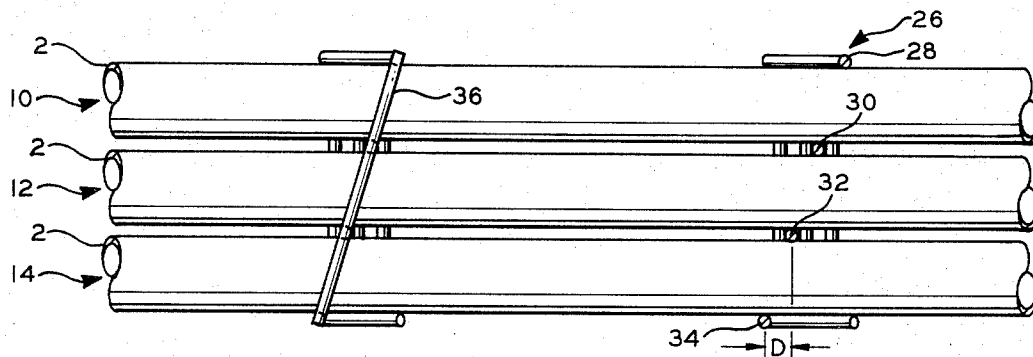


FIG. 1

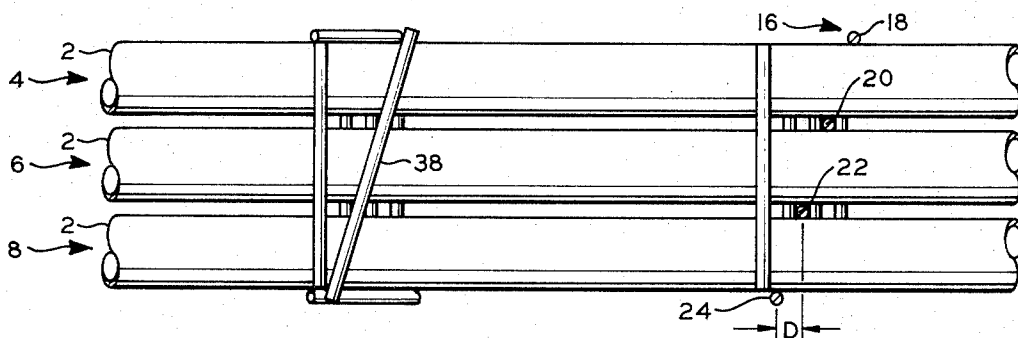


FIG. 2

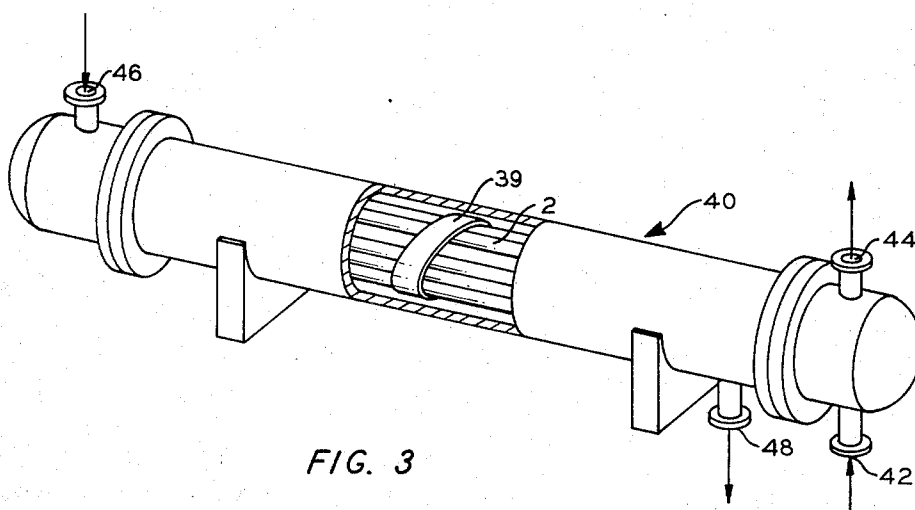


FIG. 3

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TUBE SUPPORTS

It is desirable to provide supporting means for tubes of a tube bundle, such as, for example, the tubes of a tube-in-shell heat exchanger. The supporting apparatus and method of this invention are provided for forming a unitary tube bundle, suppressing vibration of the tubes, preventing movement of the tubes relative one to the other and providing reduced flow restriction about the tubes. Heretofore utilized tube supports did not sufficiently maintain the tubes in a unitary form to prevent damage of the tubes and often seriously restricted the flow of fluid about the tubes.

In this invention, the tubes of the tube bundles are arranged in rows and columns. First and second rod sets are inserted within the bundle with the rods of each rod set being successively angularly disposed along the length of the tubes. A securing means connects the ends of the rods of each rod set and urges the rods and tubes together to form a unitary bundle.

Other aspects, objects, and advantages of the present invention will become apparent from a study of the disclosure, the appended claims, and the drawing.

The drawings are diagrammatic views of the tube rows and columns of the tube bundle and the supporting rods and securing means.

FIG. 1 is a plan view of the tube bundle showing the tubing columns, a pair of first and second rod sets and a supporting means attached to one of the second sets of supporting rods.

FIG. 2 is a frontal view of the tube bundle showing the tube rows, a pair of first and second rod sets and a supporting means attached to one of the first sets of supporting rods.

FIG. 3 shows a tube-in-shell heater with the tubes positioned therein and another embodiment of the supporting means attached to the rod sets.

Referring to FIGS. 1 and 2, a plurality of tubes 2 such as, for example, tubes of a tube-in-shell heat exchanger, are uniformly arranged in rows 4,6,8 and columns 10,12,14. Each tube 2 of the bundle is preferably spaced a common preselected distance from each adjacent tube.

Referring to FIG. 2, at least one first set of supporting rods 16 extends across the rows 4,6,8 of the tubes 2 of the tube bundle. Only one rod of the first rod set 16 is positioned between each tube row 4,6,8, separate rods 18,20,22 or 24 are positioned on opposed sides of each tube row 4,6,8 and each successive rod 18,20,22,24 is laterally spaced a common distance "D" along the length of the tubes 2 relative to the succeeding rod of said first rod set 16.

Referring to FIG. 1, at least one second set of supporting rods 26 extends across the tube columns 10,12,14 of the tube bundle. Only one rod of the second set of rods 26 is positioned between each tube column 10,12,14, separate rods 28,30,32 or 34 are positioned on opposed sides of each tube column 10,12,14 and each successive rod 28,30,32,34 is laterally spaced a common distance D along the length of the tubes 2 relative to the succeeding rod of said second rod set 26.

Securing means 36,38, such as metal bands, for example, are attached to the ends of each rod of each rod set 16,26 for maintaining and urging each rod of rod set 16,26 and tubes 2 of the tube bundle together to form a unitary bundle.

The securing means 36,38 are preferably metal bands that contact each of the ends of their respective rods 18,20,22,24 or 28,30,32,34 and are secured to their respective rods by, for example, welding the band to the rod ends. The securing means of this construction, when applied to the rods during a period when the rods and tubes are maintained in forcible engagement one with the other, secure the tubes against relative movement one to the other and dampen and/or eliminate vibrational forces on the tubes and rods that is caused by fluid passing therethrough and thereover. This dampening and/or elimination of vibration and the prevention of relative motion dramatically decreases flexure and abrasion failures of the tubes.

In order to more completely secure the tube bundle into a unitary structure, it is preferred that the distance D described above be substantially equal to twice the diameter of the rods. It is also preferred that the rods, bands and tubes be of the same metal in order to preclude possible damage through electrolysis. By the placement of the rods of this invention relative to the tubes, a plane passed perpendicularly through the longitudinal axis of the tubes preferably will not pass through more than two of the supporting rods. This construction thereby maintains the pressure drop of fluid passing over and around the tubes and rods at a low level. Where long length tube bundles are used, it is also preferred that a plurality of first and second rod sets be utilized to secure the tube bundle. The supporting rod set's location can also be designed through calculations by one skilled in the art to provide a minimum of rod sets yet suppress harmonic vibrations over the length of the tube bundle. It is also preferred that a first rod set be interspersed as described above with a second rod set.

Here, the rows are shown in horizontal planes and the columns are shown in vertical planes, but the orientation can be different so long as a plane of a row intersects a plane of a column at preferably substantially a 90° angle. The number of rows can also be different than the number of columns for forming a resultant bundle of different cross-sectional configuration, such as generally circular or triangular for example.

Referring to FIG. 3, the tubes 2 are arranged in a generally circular configuration and maintained by the rod sets (not shown) which are attached to a securing means 39. The securing means 39, shown in FIG. 3, is another embodiment which is a band of relatively larger width than the securing means 36 or 38. The width of securing means 39 is sufficient for attachment of both rod sets thereto. Here the example hairpin tube bundle secured together by the apparatus of this invention is positioned in a vessel 40 for the passage of a first fluid into port 42 through the tubes 2 and from the tubes 2 and vessel 40 through port 44 and a second fluid into port 46, about and along the tubes 2 within the vessel 40 and from said vessel 40 through port 48.

In the method of this invention, a plurality of tubes 2 are arranged in a plurality of rows 4,6,8, for example, and columns 10,12,14, for example, with each tube 2 of each row spaced a common distance D one from the other and each tube of each column spaced a common distance D from an adjacent column with the tubes of each row being positioned in a common plane and the tubes of each column being positioned in a common

plane that is preferably substantially perpendicular to the planes of the rows of tubes.

At least one first set of supporting rods 16 and one second set of supporting rods 26 are each inserted between the tubing rows 4,6,8 and the tubing columns 10,12,14 respectively. Separate rods of each rod set are positioned on opposed sides of the tubes with successive rods of each rod set 16,26 being laterally spaced one from the other a common distance and direction along the length of the tubes relative to the succeeding rod of that set.

The tubes 2 of the bundle and inserted rods are thereafter forcefully urged into contact one with the other and in that position the ends of each set are secured one to the other for forming a unitary bundle of tubes.

Other modifications and alterations of this invention will become apparent to those skilled in the art from the foregoing discussion and accompanying drawing, and it should be understood that this invention is not to be unduly limited thereto.

What is claimed is:

1. Supporting apparatus for a plurality of tubes arranged in substantially parallel columns and substantially parallel rows, comprising:

at least one first set of supporting rods extending between the rows of tubes with only one rod of each first set of rods being positioned between each tube row, a separate rod positioned on opposed sides of each row, and each successive rod being laterally spaced a common distance along the length of the tube relative to the succeeding rod of said first rod set;

at least one second set of supporting rods extending between the columns of tubes with only one rod of each second set of rods being positioned between each column of tubes, a separate rod positioned on opposed sides of each column, and with each successive rod of said second rod set being laterally spaced a common distance along the length of the tubes relative to the succeeding rod of said second rod set;

securing means attached to the ends of each rod set for maintaining and urging said set of rods and tubes together to form a unitary bundle.

2. An apparatus, as set forth in claim 1, wherein there are a plurality of first and second supporting rod sets with each first and second rod set spaced a distance along the length of the tubes from adjacent first and second rod sets.

3. An apparatus, as set forth in claim 1, wherein the

securing means of each rod set is a metal band contacting each of the ends of the rods of that set and being welded to the rod ends.

4. An apparatus, as set forth in claim 1, wherein the lateral distance along the length of the tubes between each successive rod of each set is a length sufficient for positioning not more than two rods within a plane passed perpendicularly through the longitudinal axis of the tubes.

5. An apparatus, as set forth in claim 1, wherein the lateral distance along the length of the tubes between each successive rod of each set is a length substantially equal to the diameter of the rods.

6. An apparatus, as set forth in claim 1, wherein the tubes and rods are formed of the same material.

7. A method for securing together in a unitary form a bundle of tubes, comprising:

arranging the tubes in a plurality of rows and a plurality of columns with each tube of each row spaced a distance from an adjacent row and each tube of each column spaced a distance from an adjacent column with the tubes of each row being positioned in a common plane and the tubes of each column being positioned in a common plane that is substantially perpendicular to the planes of the rows of tubes;

inserting at least one first set of securing rods through the bundle with only one rod of the first rod set being positioned between each tubing row, a separate rod positioned on opposed sides of each row and with each successive rod being laterally spaced one from the other a common distance along the length of the tubes relative to the succeeding rod of said first rod set;

inserting at least one second set of securing rods between the columns of tubes with said second rod set being positioned substantially perpendicularly relative to said first rod set with only one rod of the second rod set being positioned between each column, a separate rod positioned on opposed sides of each column and with each successive rod of said second rod set being laterally spaced one from the other a common distance along the length of the tubes relative to the succeeding rod of said second rod set;

urging the tubes and first and second rod sets into forcible contact one with the other; and securing the ends of each rod set one to the other for forming a unitary bundle of tubes.

8. A method, as set forth in claim 7, including inserting a plurality of first and second sets of securing rods.

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