United States Patent

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[54] FIN AND TUBE HEAT EXCHANGER

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[52] **U.S. Cl.**.....**165/172**, 165/69, 165/182, 165/184

[51] **Int. Cl.**.....**F28f 1/36**

[58] **Field of Search**.....165/69, 162, 172, 182, 184, 165/67

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[57] **ABSTRACT**

A metal fin and tube heat exchanger comprising laterally adjacent tubes and a helical fin around each tube in which each fin tip is closely adjacent the tip of the next fin so that shifting of the tube and its fin under thermal expansion and contraction tends to cause internesting and interlocking of these adjacent tips, and a helical metal strip around and engaging each fin adjacent its tip. Each strip has a pitch differing from that of its fin to provide barriers that block internesting and interlocking of the adjacent fins on relative movement between the adjacent fins.

8 Claims, 6 Drawing Figures

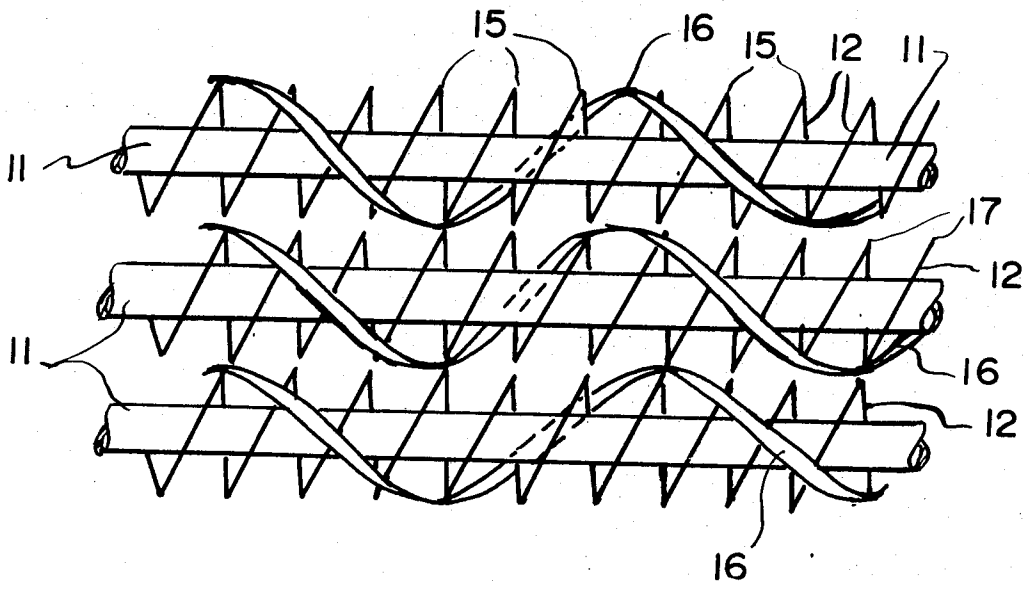


FIG. 1

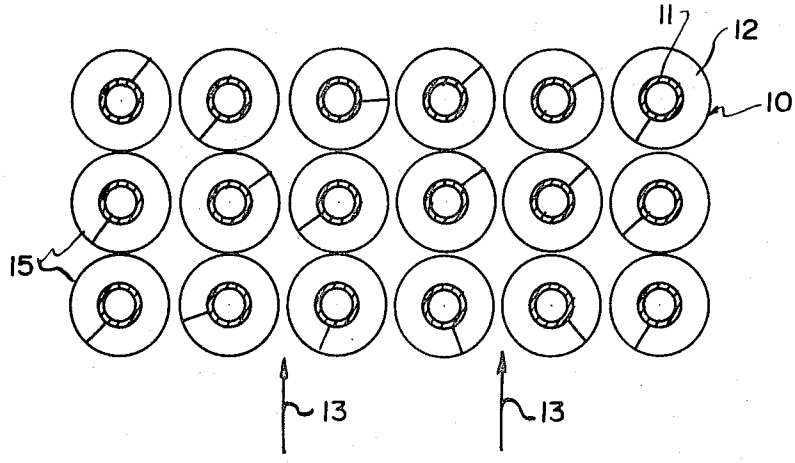
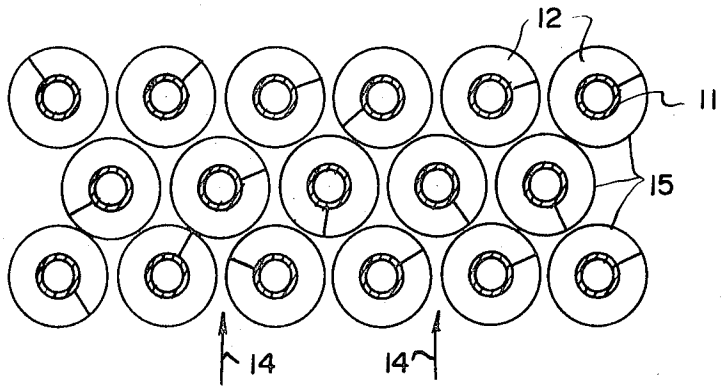


FIG. 2



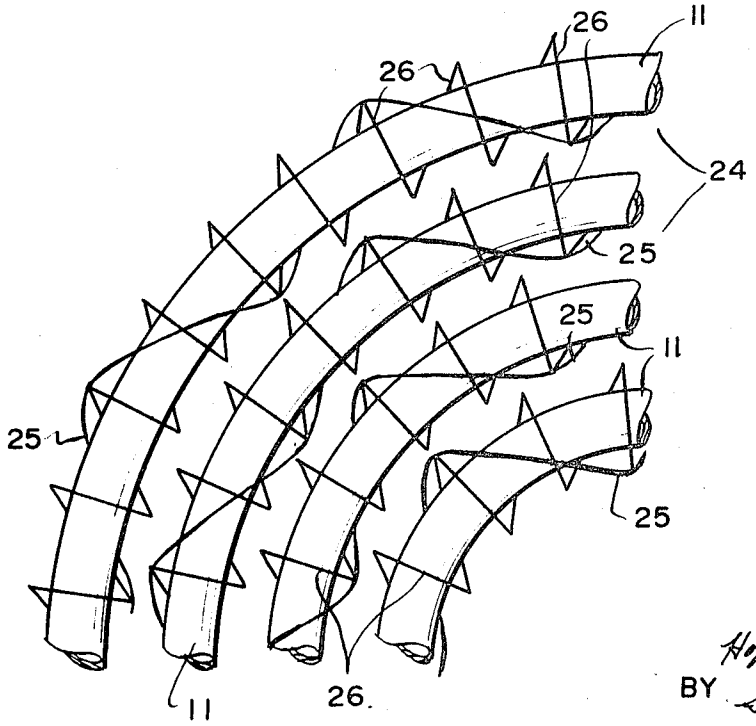
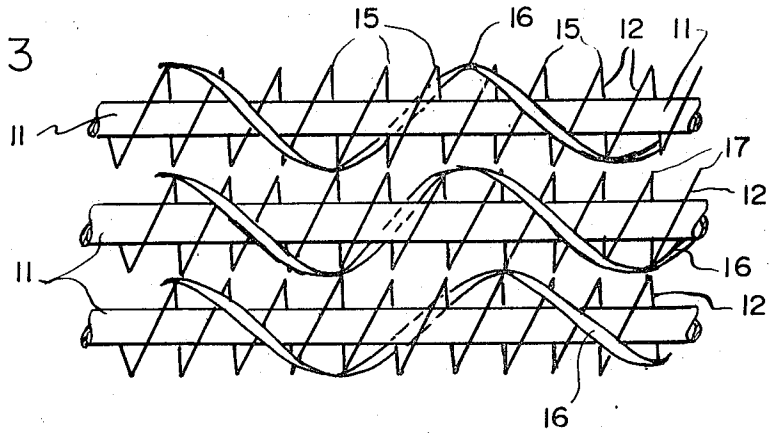


FIG. 6

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FIG. 3



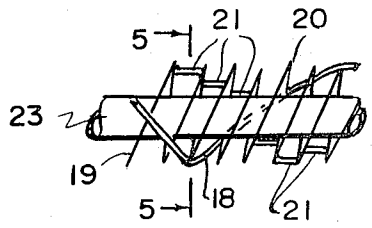


FIG. 4

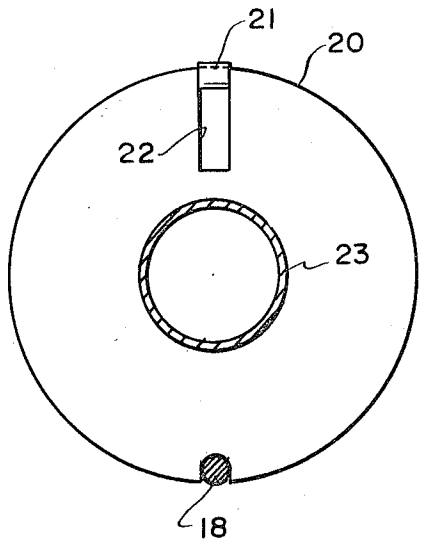


FIG. 5

FIN AND TUBE HEAT EXCHANGER

SUMMARY OF THE INVENTION

One of the features of this invention is to provide a metal fin and tube heat exchanger in which the tubes are laterally adjacent each other for flow over and around the tubes of the first fluid for heat exchange with the second fluid within the tubes, each tube being provided with a helical fin to aid the heat transfer and with at least some of the fins each having a helical metal strip engaging the fin adjacent its tip and of a pitch differing from that of its fin tip to provide barriers that prevent internesting and interlocking of the tips on relative movement between adjacent tube and fin assemblies.

Other features and advantages of the invention will be apparent from the following description of certain embodiments thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-sectional view of one embodiment of the invention.

FIG. 2 is a view similar to FIG. 1 but illustrating a second embodiment.

FIG. 3 is a fragmentary side elevational view of one of the embodiments illustrating the invention.

FIG. 4 is a view similar to FIG. 3 but illustrating a further embodiment.

FIG. 5 is an enlarged sectional view taken substantially along line 5—5 of FIG. 4.

FIG. 6 is a semidiagrammatic fragmentary end elevational view of a further embodiment of the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the embodiment of FIG. 1 the tube and fin assemblies **10** each comprising a metal tube **11** and a helical fin **12** therearound and attached thereto are positioned so that the assemblies are in parallel rows that are parallel to the direction of airflow as indicated by the arrows **13**. Thus the air comprises one fluid that is in heat transfer contact by way of the tubes **11** and fins **12** with a second fluid such as water flowing within the tubes **11**.

In FIG. 2 the tube and fin assemblies **10** are the same as those of FIG. 1 but here they are arranged in tandem in relation to the airflow **14**.

As is illustrated in the embodiment of FIG. 3 the tips or edges **15** of the fins are closely adjacent to each other. Any shifting of the assemblies relative to their neighbors and particularly shifting due to thermal expansion and contraction would ordinarily tend to cause the fin tips to internest and interlock and thereby interfere with each other as well as tend to cause damage to the fins. This problem occurs in very large tube and fin structures where the tubes are either horizontal or inclined as they tend to sag thereby bringing the fin edges or tips into contact with each other. The damaging interengagement of fin tips is also particularly acute when one tube of an adjacent assembly is subjected to temperatures that are considerably different from the temperatures of adjacent tubes. In an attempt to solve this problem tube supports have been tried and even cylindrical sleeves around the fin tips have been proposed. All of these, however, have been found to be unsatisfactory, as either not preventing the problem or interferring with the proper heat transfer and with the necessary fluid flow over and between the fins and tubes.

FIG. 3 illustrates one embodiment of a solution to this problem. As is illustrated there, the helical fins **12** around each tube **11** are each provided with a helical metal strip **16** attached to the fins **12** adjacent their tips **15**. Each helical strip **16** is of a pitch differing from that of the fin tip **15** with the result that the strip provides an effective barrier as illustrated in FIG. 3 to prevent the tips **17** of one fin **12** from being shifted into the space between the tips **15** of the next set with possible damage and malfunctioning of the heat exchanger.

In the preferred construction as illustrated in FIG. 3 the helix of the metal barrier strip extends counter to the direction of the helix of the fin **12**. Thus when viewed from the left of FIG. 3 the helix of the fin **12** is counterclockwise to the tube **11**. The helix of the barrier strip **16**, on the other hand, is clockwise to the tube **11** as viewed from the left side of FIG. 3.

The metal barrier strip **16** may be either a flat narrow ribbon as in FIG. 3 or a wire **18** as in the embodiment of FIG. 5. Regardless of the form of the strip it is preferably metallurgically bonded to the metal of the fin **12** as by welding, soldering, brazing or the like in order to secure it fixedly in position and also to provide an additional heat transfer member having efficient heat transfer connections between the barrier strip and the fin tips.

In the embodiment of FIGS. **4** and **5** the fin adjacent its tip **20** is provided with a succession of metal tabs **21** struck from the fin **19** thereby leaving an opening **22** that extends generally radially from the tube **23**. These tabs **21** engage the next adjacent turn of the fin **20** and are preferably themselves arranged in a helix as shown in FIG. **4**. The ends of these tabs are metallurgically bonded to the next turn of the fin so as to provide a strong additional barrier and also to provide more efficient heat transfer between successive turns adjacent the fin tips **20**. As illustrated in FIGS. **4** and **5** there may also be provided an additional barrier strip **18** of the type described in connection with the barrier strip **16** that also aids in preventing internesting and interlocking engagement of the successive fins which as described and as disclosed in FIG. 3 are closely adjacent each other.

In the preferred construction the succession of tabs **21** is arranged in a helix that is substantially diametrically opposite the helical barrier strip **18**. As stated earlier, this barrier strip **18** may be in the form of a wire as illustrated in FIG. **5** or a flat ribbon.

With both the strip **18** and the helically arranged tabs **21** acting as barriers there can obviously be considerable shifting of the tube and fin assemblies relative to each other without substantial internesting or interlocking.

The barrier strips of this invention not only provide efficient interlocking and internesting barriers but such structures can be manufactured automatically with the proper equipment and also require less labor to install than the conventional tube and fin heat exchanger assemblies. In addition, because the fluid such as the air can pass easily between the turns of the helical barriers there is no substantial interference to fluid flow. As mentioned earlier, when the barrier strips are metallurgically bonded to adjacent fin turns they provide added heat transfer paths and surfaces as well as promoting additional turbulence, all of which increases the total heat transfer coefficient.

A very important advantage of the invention is that now assemblies of multiple row tube and fin structures **24** can be bent to a desired curvature as is illustrated in FIG. **6**. It is obvious that in bending such multiple rows the assemblies must be free to move relative to each other because all of the assemblies are bent to different radii. The provision of the helical barrier strips **25** of the type already described permits this bending of the tube and fin structures **24** in unison while preventing the internesting and interlocking of adjacent fins **26**. Thus with this invention it is now possible to bend many tube and fin cores simultaneously while before it was necessary to bend each core individually to the required radius. This is obviously a considerable saving in time and labor.

Having described my invention as related to the embodiment shown in the accompanying drawings, it is my intention that the invention be not limited by any of the details of description, unless otherwise specified, but rather be construed broadly within its spirit and scope as set out in the appended claims.

I claim:

1. A metal fin and tube heat exchanger, comprising: a plurality of laterally adjacent tube sections; a helical fin on each tube section attached thereto and extending therearound to

provide an assembly, the outer tip of each fin being closely adjacent the tip of the next fin; and a helical metal strip engaging each said fin adjacent its tip of a pitch differing from that of its said fin tip to prevent internesting and interlocking of said tips on relative movement between said adjacent assemblies.

2. The heat exchanger of claim 1 wherein the helix of said metal strip extends in a direction counter to the direction of the helix of the fin engaged by the metal strip and has a pitch greater than that of its fin tip.

3. The heat exchanger of claim 1 wherein said metal strip comprises a flat metal ribbon.

4. The heat exchanger of claim 1 wherein said metal strip comprises a wire.

5. The heat exchanger of claim 1 wherein each fin tip is provided with a tab struck from the fin and engaging the next successive turn of the fin adjacent the tip to provide a succession of tabs as further barriers to said internesting and interlocking, said succession of tabs being arranged in a helix.

6. The heat exchanger of claim 1 wherein said helical metal strip is metallurgically bonded to its said fin.

7. The heat exchanger of claim 6 wherein the helix of said metal strip extends in a direction counter to the direction of the helix of the fin engaged by the metal strip and has a pitch greater than that of its fin tip.

8. The heat exchanger of claim 7 wherein each fin tip is provided with a tab struck from the fin and engaging the next successive turn of the fin adjacent the tip to provide a succession of tabs as further barriers to said internesting and interlocking, said succession of tabs being arranged in a helix.

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