

[54] **HEAT EXCHANGER CORE AND METHOD OF FABRICATION THEREOF**

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[22] Filed: Mar. 29, 1973

[21] Appl. No.: 346,028

[52] U.S. Cl. 165/8, 29/157.3 D, 29/455 LM, 29/191.6, 29/193.5, 52/662, 161/68, 165/10

[51] Int. Cl. F28d 19/00

[58] Field of Search 165/10, 4, 8; 29/157.3 D, 29/455 LM, 191.6, 193.5; 52/618, 662; 161/68

[56] **References Cited**

UNITED STATES PATENTS

1,762,446	6/1930	Ljungstrom.....	165/10 X
1,776,162	9/1930	Martinka	165/10
3,635,784	1/1972	Snitber.....	161/68 X

FOREIGN PATENTS OR APPLICATIONS

155,596	8/1956	Sweden.....	165/10
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[57]

ABSTRACT

A heat exchanger core is constructed by assembling and joining by brazing a plurality of thin flat strips of stepped configuration into a stack with the steps thereof offset with respect to each other to provide a series of rectangular passages or cells through the stack. An opening is then cut through the center of the stack and the inwardly projecting, cut edges of the strips at the opening are bent over into contact with each other and attached to a hub by brazing. The outer periphery of the stack is cut to a circular configuration concentric with the central opening and the outwardly projecting cut edges of the strips at the outer periphery of the stack are also bent over in overlapping relationship to each other and an outer strip band secured thereto by brazing. This provides a core having a high aspect ratio without reduction in strength.

9 Claims, 7 Drawing Figures

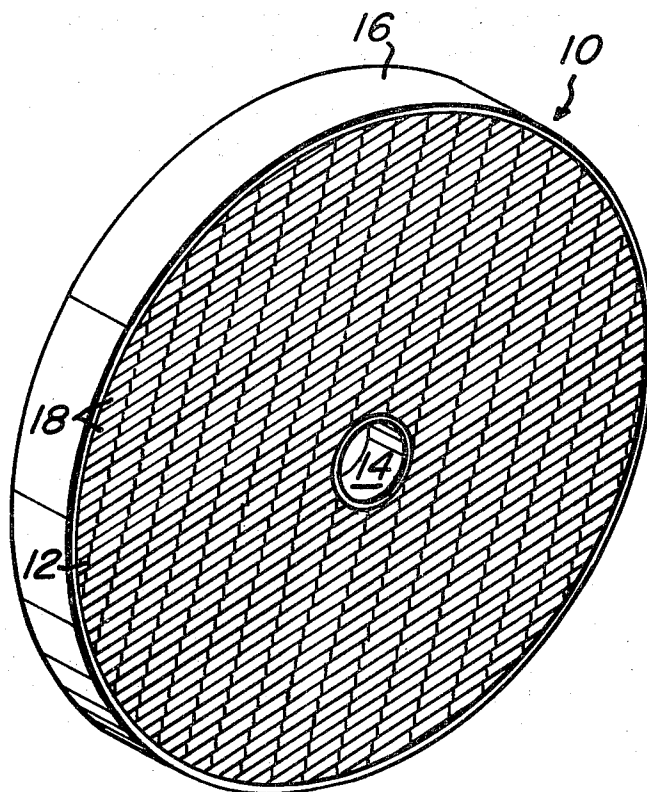


FIG-1

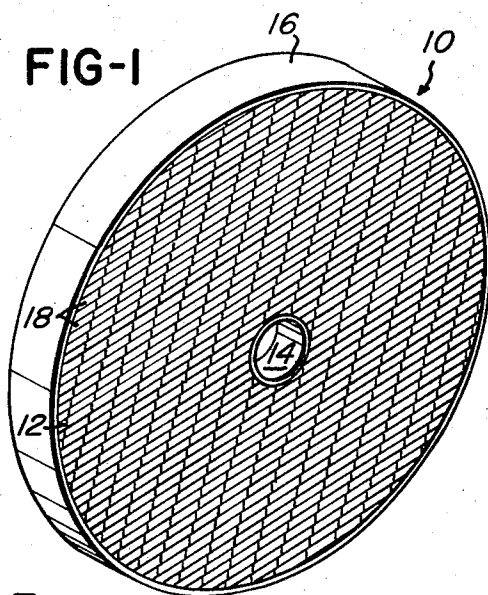


FIG-2

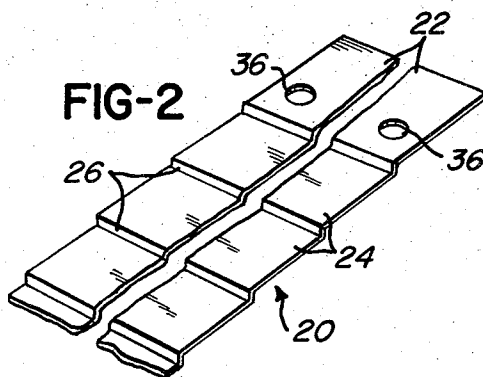


FIG-3

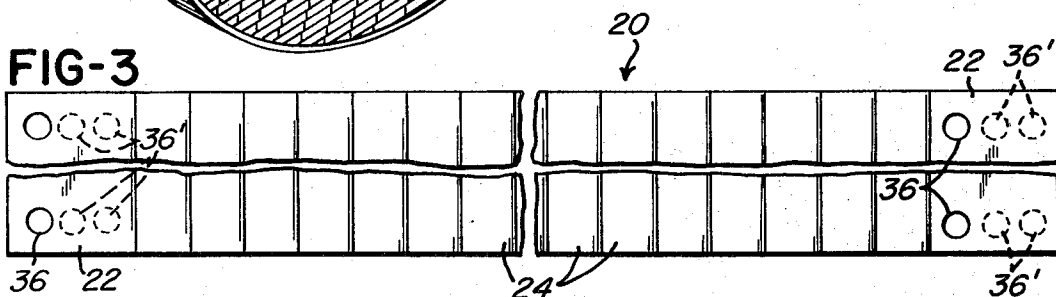


FIG-4

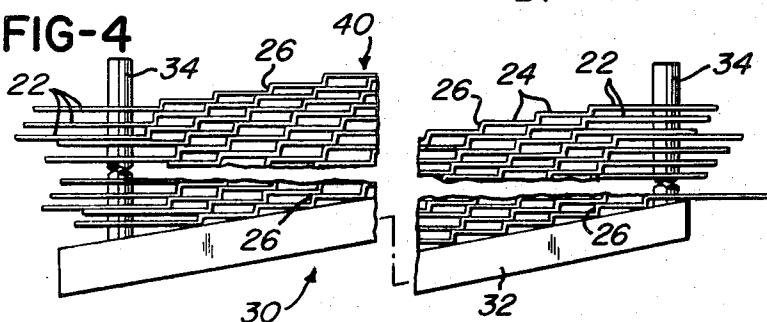


FIG-6

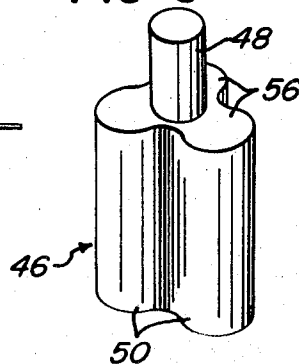


FIG-5

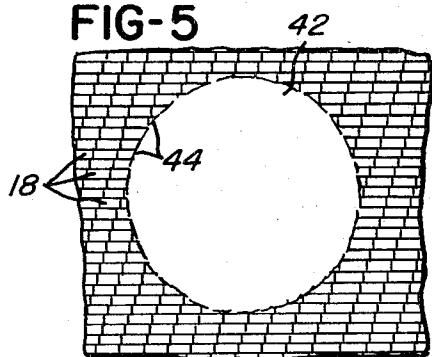
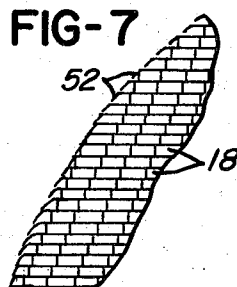


FIG-7



HEAT EXCHANGER CORE AND METHOD OF FABRICATION THEREOF

BACKGROUND OF THE INVENTION

In a conventional rotary heat exchanger, the core thereof will be positioned with respect to two ducts containing fluids at appreciably different temperatures such that portions of the core continuously rotate from one duct to the other. For example, if the core is rotating from a hot fluid to a cooler fluid, it will receive heat while it is in the hot fluid and later gives it up to the cooler fluid as it moves through the latter.

In heat exchangers of this type, it is desirable that the walls of the passages or cells through the core be as thin as possible so that they may heat up and cool quickly to provide a rapid heat transfer. In the past a common method of forming such cores has been by winding about a mandrel a thin corrugated sheet of material and a separator sheet, with both sheets under tension.

Radial stresses are introduced into the core during the winding process which will collapse the cells or passages through the core unless they have a low aspect ratio; that is, a low ratio of peripheral width to radial depth. However, it is well known in the art that larger aspect ratios tend to give more efficient heat transfer so that, in the past, it was generally necessary to either sacrifice strength for the sake of greater efficiency or, more likely, to sacrifice efficiency to obtain the necessary strength.

SUMMARY OF THE INVENTION

The present invention provides a heat exchanger core and a method of manufacturing it which provides cells through the core having a relatively high aspect ratio but without appreciable loss of strength.

The core is formed from a plurality of thin flat strips of material, such as metal strips, which are bent uniformly into a stepped configuration. A jig may be provided for assembling the strips, the jig having upwardly extending guide posts received in openings formed in the ends of the strips. The distance from the ends of the strips at which the openings are formed is varied progressively so that when the strips are assembled on the jig with the guide posts thereof received in the openings the steps of the strips are offset to provide areas of contact between the strips. A brazing alloy is then applied to the resulting stack of strips by either spraying or pouring over the stack a thin measured amount of alloy mixture. The alloyed stack may then be furnace brazed to join the strips to each other at their points of contact.

An opening is cut through the center of the stack, with the opening having a slightly smaller diameter than the outside diameter of the hub to which the core is to be attached. Using the center opening as a guide the outer periphery of the stack is cut to a circular configuration having an outside diameter slightly larger than the desired diameter of the finished core.

The center opening is then worked with a special tool having a plurality of radially projecting ribs extending along its length. This causes the cut edges of the strips projecting inwardly into the opening to be bent over into overlapping relationship with each other. The outer periphery of the stack is treated in a somewhat similar manner. That is, the cut, outwardly projecting edges of the stack at the outer periphery thereof are

bent over into overlapping relationship with each other.

A hub is then brazed to the bent over edges of the strip at the opening through the stack and an outer strip band is brazed to the bent over edges of the strips at the outer periphery of the stack. As a result a strong heat exchanger core having a relatively high aspect ratio is produced.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a core formed in accordance with the present invention;

FIG. 2 is a perspective view of a portion of a single strip;

FIG. 3 is a plan view of a single strip;

FIG. 4 is an elevational view showing the strips received in stacked configuration on a jig;

FIG. 5 is an enlarged view of a portion of the core at the center thereof;

FIG. 6 is a perspective view of a tool used in constructing the core; and

FIG. 7 is an enlarged view of a portion of the outer periphery of the main body of the core.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning first to FIG. 1 of the drawings, it will be seen that a heat exchanger core 10 in accordance with the present invention will include a main body section 12, a hub 14 and an outer strip band 16. The main body portion 12 of the hub is divided up into a plurality of cells or passages 18 extending completely through the core 10.

The core is formed from a plurality of thin flat strips 20 which, as best seen in FIGS. 2 through 4, are formed with end portions 22 and are of stepped configuration, including a plurality of relatively broad flat portions 24 extending parallel to the end sections 22 and joined by means of relatively narrow sections 26 extending substantially at right angles to the portions 22 and 24.

The strips 20 are relatively thin, on the order of approximately 0.002 inch thick, and are preferably formed of metal. In a typical installation, the strips 20 may be approximately 3 inches wide and of a length sufficient to provide a finished core of approximately 25 inches in diameter. The sections 26 of the strips in such an installation may be approximately 0.016 inch deep and the portions 24 of sufficient width that when the strips are assembled as described below, cells or passages 0.016 inch deep by 0.128 inch wide are formed.

A jig 30 may be utilized in assembling the strips for the core 10. The jig includes a base 32 and a plurality of upright guide posts 34, preferably two at each end, although only one can be seen at each end in FIG. 4 of the drawings. Each of the strips 20 is provided with a pair of openings 36 adjacent each of its ends to receive the guide posts 34 to provide the non nesting, stacked configuration shown in FIG. 4 of the drawings. The distance from the ends of the strips 20 at which the openings 36 are formed is varied progressively, as shown in phantom lines at 36', so that when the strips 20 are assembled on the jig 30, the steps of the strips are offset to provide areas of contact between adjacent surfaces of the portions 24.

Stated somewhat differently, adjacent, relatively narrow sections 26 of adjacent strips are spaced from each

other a distance less than the width of the relatively broad portions 24 to provide the areas of contact between portions 24. Preferably, however, this spacing is greater than the depth of sections 26, on the order of approximately eight times as great, to give a substantially rectangular configuration to the resulting cells and a relatively high aspect ratio.

The strips 20 are assembled on the jig 30 until the resulting stack 40 of such strips is of approximately rectangular configuration. Thereafter, a brazing alloy is applied to the stack by either spraying or pouring over the stack a thin, measured amount of alloy mixture. The alloyed assembly is then furnace brazed, joining the strips to each other at their points of contact along the portions 24 thereof.

The stack may then be removed from the jig 30 and an opening 42 formed through the stack transversely thereof adjacent the center of the stack. As a result of forming the opening 42, cut edges 44 of the strips 20 will project inwardly of the opening 42 about the inner periphery thereof. These strips are bent over into overlapping relationship with each other, as shown in FIG. 5 of the drawings, by means of the special tool 46, shown in FIG. 6 of the drawings.

It will be noted that the tool 46 includes a shaft 48 and a plurality of axially extending ribs 50. The tool is rotated into the opening 42 causing the ribs 50 to wipe the cut ends of the strip projecting into the opening and bend them over into overlapping relationship with each other. This provides a significantly large area of contact for the hub 14 and, therefore, a strong joint between the hub and the main body portion 12.

Using the center opening 42 as a guide, the outer periphery of the stack is then cut to a circular configuration slightly larger in diameter than the desired diameter of the finished main body portion 12 and concentric with the opening 42. The cut edges 52 of the strips 20 projecting outwardly at the periphery of the main body portion 12 are then bent over, as seen in FIG. 7, to provide an overlapping relationship similar to that at the center opening 42.

The hub 14 is then secured in the opening 42, the outer strip band 16 secured around the periphery of the body 12, the joints alloyed, and the entire assembly re-brazed to provide the configuration shown in FIG. 1 of the drawings.

From the above it will be apparent that the present invention provides a heat exchanger core of novel construction and a method of fabrication thereof which provides a relatively high aspect ratio without reduction in strength of the core.

While the method and product herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to this precise method and product, and that changes may be made therein without departing from the scope of the invention.

What is claimed is:

1. A rotary heat exchanger core comprising:

- a. a plurality of elongated, relatively thin strips,
- b. each of said strips being bent to a stepped configuration including a plurality of relatively broad flat portions extending substantially parallel to each other and a plurality of relatively narrow sections extending substantially parallel to each other and joining said relatively broad portions of said strip,

c. each of said narrow sections of each of said strips extending angularly between adjacent of said broad portions of said strip,

d. each said narrow section displacing adjacent of said broad portions away from each other along the direction of said narrow section,

e. said strips being stacked in offset relationship to each other with said relatively broad portions of each strip extending substantially parallel and in contact with said relatively broad portions of other strips and said relatively narrow sections of each strip extending in spaced, substantially parallel relationship to said relatively narrow sections of the other strips,

f. means interconnecting said strips at the areas of contact therebetween, and g. the periphery of the core being substantially circular.

2. The core of claim 1 wherein:

a. said spacing between said adjacent relatively narrow sections is greater than the depth of said relatively narrow sections.

3. The heat exchanger core of claim 1 further comprising:

a. means defining an opening through said joined strips extending transversely thereof.

4. The heat exchanger core of claim 3 wherein:

a. said joined strips have an outer periphery substantially concentric with said opening therethrough.

5. The heat exchanger core of claim 3 wherein:

a. portions of said strips at said opening are bent over about the periphery of said opening into overlapping relationship with each other.

6. The core of claim 5 further comprising:

a. a hub attached to said bent over portions of said strips about the periphery of said opening through said stack.

7. The heat exchanger core of claim 4 wherein:

a. portions of said strips at said outer periphery are bent over into overlapping relationship with each other about said outer periphery.

8. The core of claim 7 further comprising:

a. an outer strip band attached to said bent over portions of said strips about said outer periphery of said stack.

9. A rotary heat exchanger core comprising:

a. a plurality of elongated, relatively thin strips, b. each of said strips being bent to a stepped configuration including a plurality of relatively broad flat portions extending substantially parallel to each other and a plurality of relatively narrow sections extending substantially parallel to each other and joining said relatively broad portions,

c. said strips being stacked in offset, non nesting relationship to each other with said relatively broad portions of each said strip extending substantially parallel to said relatively broad portions of the other strips and said relatively narrow sections of each strip extending in spaced, substantially parallel relationship to said relatively narrow sections of the other strips,

d. the spacing between adjacent relatively narrow sections of adjacent strips being less than the width of said relatively broad portions of said strips to provide areas of contact therebetween,

e. means interconnecting said strips at said areas of contact, and

f. the periphery of the core being substantially circular.

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