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METHOD OF SECURING FINS IN A HEAT EXCHANGER

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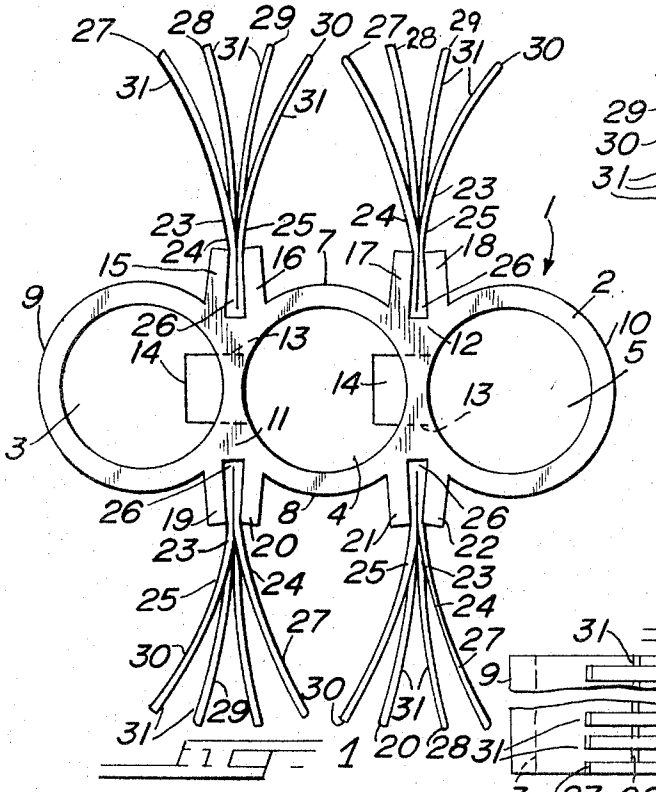


FIG. 1

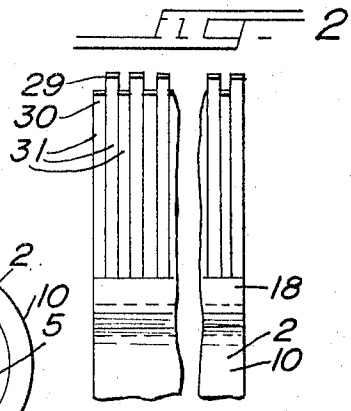


FIG. 2

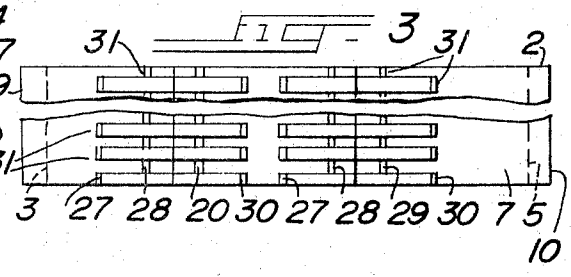


FIG. 3

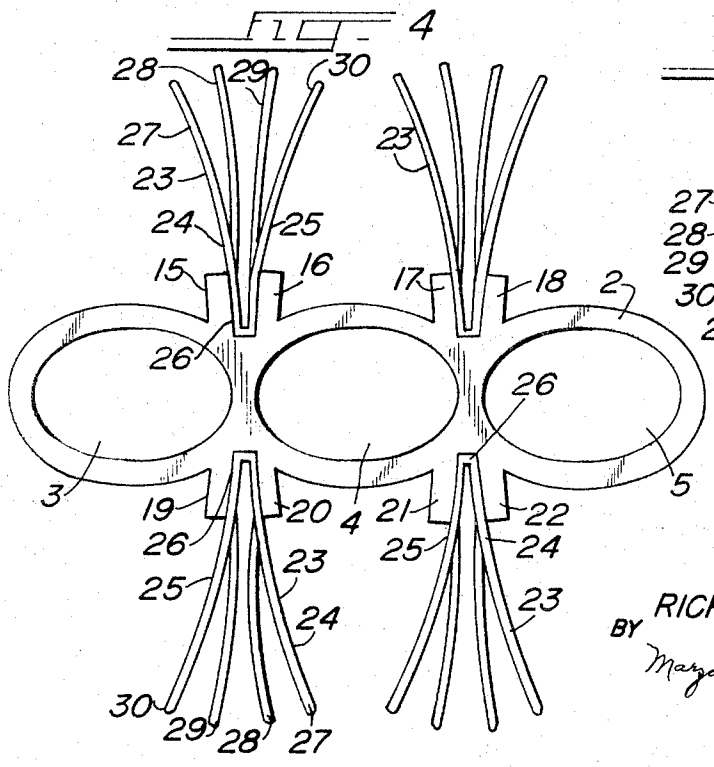


FIG. 4

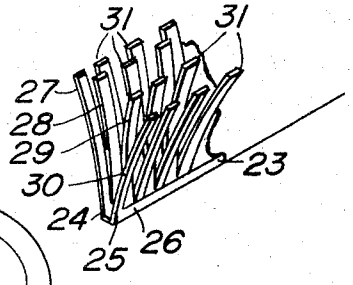


FIG. 5

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METHOD OF SECURING FINS IN A HEAT EXCHANGER

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ABSTRACT OF THE DISCLOSURE

A method of making a finned heat exchanger wherein the internal cross-section thereof is deformed to move exterior ribs into clamping relation to fins disposed therebetween.

This invention relates to heat exchangers and the method of making same.

It is a primary object of the present invention to afford a novel heat exchanger.

Another object of the present invention is to afford a novel method of manufacturing heat exchangers.

A further object of the present invention is to afford a novel heat exchanger, which embodies heat-transfer fins constituted and arranged in a novel and expeditious manner.

Another object is to enable a novel heat exchanger of the aforementioned type to be afforded wherein the fins thereof may be of a type which may be constructed separately from the main body portion of the heat exchanger and then attached thereto in a novel and expeditious manner.

Heat exchangers having separately formed heat transfer fins attached to the main body portion thereof have been heretofore known in the art. However, heat exchangers of this type which have been heretofore known have commonly had several inherent disadvantages such as, for example, not affording an efficient heat-transfer path between the fins and the main body portion of the heat exchanger; being difficult and expensive to manufacture; or not affording a secure attachment of the fins to the main body portion, and the like. It is an important object of the present invention to overcome such disadvantages.

In the manufacture of heat exchangers it is not uncommon that, for some reason, such as, for example, the conditions under which the heat exchanger is to be used, or the type of working fluid passing therethrough, or the like, the main body portion thereof, which embodies the passageway or passageways for the working fluid, must be made of a particular material, such as, for example, a special alloy, or the like, which is relatively expensive. If such a heat exchanger has heat transfer fins thereon, the construction of the fins from the same material as the body portion often represents a substantial item of cost in manufacture. It is an important object of the present invention to enable such cost of manufacture of heat exchangers of this type to be reduced.

Another object is to enable the body portion of such a heat exchanger to be made of one material, and the fins to be constructed of a less expensive material.

Yet another object of the present invention is to afford a novel heat exchanger of the aforementioned type which embodies novel fins.

A further object is to afford a novel heat exchanger of the aforementioned type which is practical and efficient in construction and operation, and which may readily and economically be produced commercially.

Other and further objects of the present invention will be apparent from the following description and claims and are illustrated in the accompanying drawings which,

by way of illustration, show a preferred embodiment of the present invention and the principles thereof and what I now consider to be the best mode in which I have contemplated applying these principles. Other embodiments of the invention embodying the same or equivalent principles may be used and structural changes may be made as desired by those skilled in the art without departing from the present invention and the purview of the appended claims.

In the drawings:

FIG. 1 is an end elevational view of a heat exchanger embodying the principles of the present invention;

FIG. 2 is a fragmentary, side elevational view of the heat exchanger shown in FIG. 1;

FIG. 3 is a fragmentary top plan view of the heat exchanger shown in FIG. 1;

FIG. 4 is an end elevational view similar to FIG. 1, but showing the heat exchanger in an intermediate step in the manufacture thereof; and

FIG. 5 is a fragmentary, perspective view of a fin-affording member of the type used in the manufacture of the heat exchanger shown in FIG. 1.

A heat exchanger **1**, embodying the principles of the present invention, is shown in the drawings to illustrate the presently preferred embodiment of the present invention.

The body portion **1** includes an elongated, tubular body portion **2** having three passageways **3**, **4** and **5** extending longitudinally therethrough in side-by-side relation to each other. The body portion **2** includes two oppositely disposed side walls **6** and **7** at the top and bottom thereof, respectively, FIG. 1, and two other oppositely disposed side walls **9** and **10** extending between the side walls **7** and **8**. Two partition walls **11** and **12** extend between the side walls **7** and **8** and divide the body portion **2** into the aforementioned passageways **3**, **4**, and **5**.

In the operation of the heat exchanger **1**, working fluid, such as, for example, a refrigerant, a heated liquid, or the like, may be fed through the passageways **3–5** from one end of the body portion **2** to the other. If desired, openings **13** may be formed in the partition walls **11** and **12**, for feeding working fluid between the passageways **3–5**, and ears **14** may be embodied on the partition walls **11** and **12** in position to deflect and guide working fluid from the passageway **3** into the passageway **4** and from the passageway **4** into the passageway **5**, for balancing the flow of working fluid through the heat exchanger **1**, as discussed in greater detail in my copending application for United States Letters Patent, Ser. No. 345,914, filed Feb. 19, 1964, now Patent No. 3,229,722.

Two pairs of elongated ribs **15** and **16**, and **17** and **18**, respectively, project laterally outwardly from the side wall **7** of the body portion **2**, FIG. 1. The ribs **15–18** extend longitudinally of the body portion **2** throughout the length of the latter, with the pair of ribs **15** and **16** disposed directly above the partition wall **11**, between the passageways **3** and **4**, and with the ribs **17** and **18** disposed directly above the partition wall **12**, between the passageways **4** and **5**.

Two other pairs of elongated ribs **19** and **20**, and **21** and **22**, respectively, project laterally outwardly from the side wall **8**. Like the ribs **15–18**, the ribs **19–22** extend longitudinally of the body portion **2** throughout the full length thereof, with the ribs **19** and **20** projecting downwardly from the side wall **8** immediately below the partition wall **11**, between the passageways **3** and **4**, and with the ribs **21** and **22** projecting downwardly from the side wall **8** immediately below the partition wall **12**, between the passageways **4** and **5**.

Four elongated, fin-affording members **23** are disposed between each of the pairs of ribs **15–16**, **17–18**, **19–20**,

and 21–22, respectively, FIG. 1. Each of the members 23 is bifurcated in transverse cross section, having two side wall portions 24 and 25 projecting outwardly from a common longitudinal edge portion 26 thereof.

In the heat exchanger 1 shown in the drawings, each of the side wall portions 24 affords two fins 27 and 28, extending the length of the body portion 2, and each of the side wall members 25 affords two fins 29 and 30, extending the length of the body portion 2. Each of the fins 27–30 is made up of a plurality of elongated spines 31 extending outwardly from the base portion 26 of the respective member 23, the spines 31 in each of the respective fins 27–30 being spaced from each other, and laterally aligned with each other longitudinally of the respective member 23, FIGS. 1 and 3.

In the heat exchanger 1, the spines 31 in the fins 27 are disposed between the spines 31 in the fins 28 in the respective side wall portions 24 of the members 23, and the spines 31 of the fins 29 are disposed between adjacent ones of the spines 31 of the fins 30 on the respective side wall portions 25 of the members 23, FIGS. 3 and 5. The fins 27 and 28 and the fins 29 and 30, respectively, curve outwardly away from the base portion 26 of the respective members 23 in opposite directions, with the fins 28 and 29 curving outwardly a lesser amount than the fins 27 and 30, so that they are disposed between the fins 27 and 30, FIGS. 1 and 3. With this construction, substantially straight passageways are afforded longitudinally of the heat exchanger 1 between the adjacent fins 27, 28, 29 and 30 of the respective members 23, and tortious passageways are afforded transversely thereof between and around adjacent spines 31 of the adjacent fins 27–30.

In the assembled heat exchanger 1 shown in FIGS. 1–3 of the drawings, the base portions 26 of the fin-affording members 23 are firmly clamped between the respective pairs of ribs 15–16, 17–18, 19–20 and 21–22, in such a manner that they are firmly clamped therebetween, and a good heat transfer path is afforded between the body portion 2 and each of the members 23.

In the construction of the heat exchanger 1 the body portion 2 is preferably formed as an extrusion. As originally formed, the body portion 2 is somewhat compressed vertically and somewhat extended horizontally, as viewed in FIG. 4, so that the passageways 3–5 are somewhat oval-shaped, being elongated in a horizontal direction. With the body portion 2 thus constructed, the ribs in each of the pairs 15–16, 17–18, 19–20 and 21–22 are spaced from each other a greater distance than they are in the completed form of the heat exchanger 1 shown in FIG. 1.

The fin-affording members 23 may be initially formed separately from the body portion 2. The members 23 may be formed from elongated strips of suitable sheet material, such as, for example, sheet aluminum, or the like, the spines 31 preferably being formed, first, by slitting or cutting the flat elongated strip from the opposite longitudinal edge portions thereof toward the longitudinal center. Thereafter, the strip may then be folded along its longitudinal center line, between the oppositely disposed spines 31 to thereby afford the two side wall portions 24 and 25 disposed on opposite sides of the base portion 26. The side walls 23 and 25 may then be formed to afford the laterally off-set fins 27 and 28 and the laterally off-set fins 29 and 30, respectively. Thereafter, the members 23 may be disposed in operative position between the respective pairs of ribs 15–16, 17–18, 19–20, and 21–22. In such position of the members 23, they are loosely held by the ribs 15–22.

With the members 23 thus loosely held by the ribs 15–22, the body portion 2 may be deformed laterally to thereby expand it vertically and compress it horizontally as viewed in FIGS. 1 and 4. Such deformation of the body portion 2 may be effected by compressing it horizontally by pressure applied on the side walls 9 and 10, or by inserting mandrels in the passageways 3–5. Such deformation of the body portion 2 is effective to change the cross-sectional shape of the passageways 3–5 from the horizontally elongated, oval-shape shown in FIG. 4 to the circular shape shown in FIG. 1. The movement of the side walls 7 and 8 during this deformation of the body portion 2 is effective to move the outer longitudinal edges of the pairs or ribs 15–16 and 17–18, and the pairs of ribs 19–20 and 21–22, respectively, inwardly toward each other from the positions shown in FIG. 4 to the positions shown in FIG. 1, and thereby tightly clamp the bases 26 of the respective members 23 therebetween. The clamping of the members 23 by the ribs 15–18 is preferably tight enough to insure that they cannot be pulled therefrom, and to insure a good heat-transfer path between the body portion 2 and the members 23.

It will be appreciated by those skilled in the art that although the members 23 are disclosed herein as being formed from single sheets of material, folded along the longitudinal center line thereof, this is merely by way of illustration, and not by way of limitation and that they may be afforded in other suitable manners, such as, for example, by forming the side wall portions 24 and 25 from separate sheets of material, and then hemming or otherwise suitably securing together the longitudinal edges thereof opposite to the spines 31, to thereby afford the base portions 26.

With the heat exchanger 1 constructed in the manner disclosed herein, the body portion 2 thereof and the fin-affording members 23 may be readily constructed of different materials. Therefore, when it is necessary because of special requirements, or the like, that the body portion 2, which affords the passageways 3–5, be made of special materials which are relatively expensive, such as, for example, special steel alloys, and the like, the body portion 2 may be so constructed of such materials, and the fin-affording members 23 may be constructed of other, cheaper materials, such as, for example, aluminum, copper or the like. By constructing the heat exchanger 1 in the aforementioned manner, substantial savings in the cost of materials may oftentimes be made.

From the foregoing it will be seen that the present invention affords a novel heat exchanger, and a novel method of constructing heat exchangers.

In addition, it will be seen that the present invention affords a novel heat exchanger which is practical and efficient in operation, and which may be readily and economically produced commercially.

Thus, while I have illustrated and described the preferred embodiment of my invention, it is to be understood that this is capable of variation and modification, and I therefore do not wish to be limited to the precise details set forth, but desire to avail myself of such changes and alterations as fall within the purview of the following claims.

I claim:

1. The method of making a heat exchanger comprising

(a) making an elongated tubular body portion of a first internal cross-section and having
  (1) a side wall portion and
  (2) a pair of elongated ribs
    (a') projecting laterally from said side wall portion, and
    (b') extending longitudinally of said body portion in spaced relation to each other,
(b) making an elongated fin-affording member,
(c) placing said fin-affording member between said ribs in longitudinally extending relation to said body portion, and
(d) deforming said side wall portion laterally of the length of said body portion in a direction effective to move said ribs closer together into clamping en-

gagement with said fin-affording member and to produce a second internal cross-section.

2. The method of making a heat exchanger comprising

(a) making an elongated body portion having

(1) elongated passageways of substantially oval shaped internal cross-section extending longitudinally therethrough in side-by-side relation to each other, and

(2) two pairs of elongated ribs

(a') extending longitudinally of said body portion, and

(b') projecting laterally from opposite sides of said body portion between each pair of adjacent passageways, with

(c') said ribs in each of said pairs spaced from each other,

(b) disposing an elongated fin-affording member between said ribs in each respective one of said pairs in longitudinally extending relation thereto, and

(c) deforming said passageways transversely to the length thereof to form said passageways into substantially circular internal cross-section and thereby cause said ribs in each of said pairs to move closer to each other into clamping engagement with said fin-affording member disposed therebetween.

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