Jan. 20, 1970 S. F. PASTERNAK 3,490,524

HEAT EXCHANGERS

Filed Jan. 10, 1968

FIG. 1

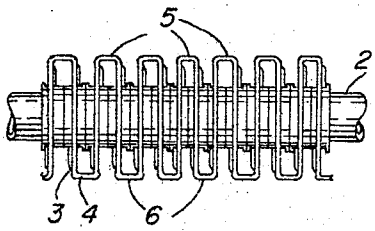


FIG. 4

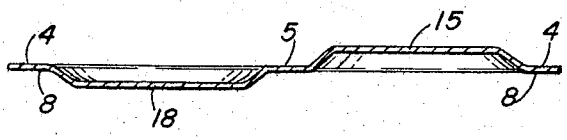


FIG. 2

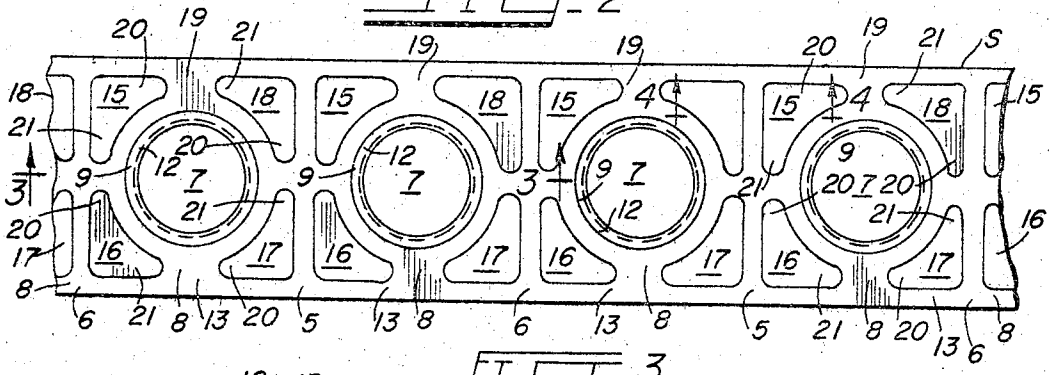


FIG. 3

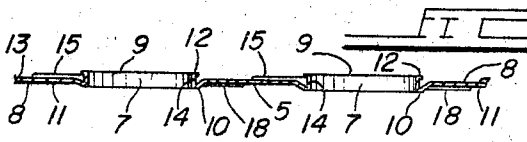
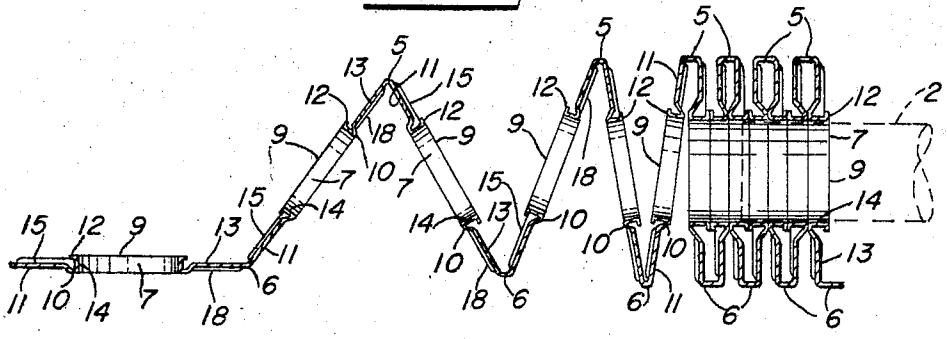


FIG. 5



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3,490,524

HEAT EXCHANGERS

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U.S. Cl. 165—182 6 Claims

ABSTRACT OF THE DISCLOSURE

A heat exchanger embodying cross fins having openings therethrough, with tubular members extending through the openings, the cross fins having flanges extending around the openings and projecting outwardly from both faces of the main body portion of the cross fins.

BACKGROUND OF THE INVENTION

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

Another object is to afford a novel fin construction for heat exchangers.

Heretofore, heat exchangers used in the refrigeration and air conditioning fields have often embodied cross fins of the plate-fin type. In the plate-fin type of heat exchangers, tubing forming the coil portion of the heat exchangers has been inserted longitudinally through openings formed in the cross fins of the heat exchanger in inwardly spaced relation to the marginal edges thereof. In this type of heat exchanger, the openings in which the tubing is mounted commonly have a continuous side wall and are complementary in size and shape to the outside of the tubular members, so that the tubing mounted therein may be connected to, or engaged with the fins along the entire outer periphery of the tubing.

In heat exchangers embodying cross fins, it commonly is desired to have the body portion of adjacent cross fins spaced from each other. In certain heat exchangers, such as, for example, in evaporators commonly used in the air conditioning field, the fins thereof are commonly relatively thin, often having a thickness in the nature of .006 inch, and are commonly spaced from each other at the rate of 10 to 16 fins per inch.

Heretofore, it has been common practice in the art to space such cross fins along tubular members by inserting spacing devices, such as combs, and the like, between adjacent fins during the manufacture of the heat exchangers, or by affording spacing members on the fins which abuttingly engage the faces of the body portions of adjacent cross fins. It is an important object of the present invention to enable such cross fins in a heat exchanger to be spaced from each other in a novel and expeditious manner.

Heretofore, in the manufacture of heat exchangers embodying cross fins having openings therethrough, the cross fins in certain instances, have had flanges extending around the openings to afford reinforcing members for the fins and to afford spacing members, such as, for example, the flanges shown in my copending application for United States Letters Patent, Ser. No. 628,960, filed Apr. 6, 1967. In such heat exchangers heretofore known in the art, flanges, acting as spacing members, have projected only from one face of the respective cross fins. It is an important object of the present invention to improve over the cross-fin construction of the aforementioned type heretofore known in the art.

Although the cross fin structures of the aforementioned type, embodying flanges projecting from one face of the respective fins, constituted improvements over what had been previously known in the art, and have had successful

commercial usage, they have had several inherent disadvantages, such as, for example, affording problems in the formation of the flanges; requiring relatively complicated and expensive dies; affording problems in the alignment of openings in adjacent cross fins; or creating problems in the assembling of cross fins on tubular members, and the like. It is an important object of the present invention to overcome such disadvantages.

In certain types of cross fin construction, known as ribbon-type fins in the art, the cross fins are made from a single unitary sheet of metal, bent back and forth upon itself to afford an integral interconnection between adjacent fins at alternately opposite side edges thereof. In such fins, wherein aligned flanges, projecting from one face of each fin, afford the spacing members between adjacent fins, the flanges in an assembled unit must project from their respective fins in the same direction as the flanges on the adjacent fins in order to afford equal spacing between the fins. Commonly, the flanges on such ribbon-type fins heretofore known in the art have been formed in stamping machines, with the flanges formed on a flat sheet of metal, and the flat sheet subsequently bent into a serpentine pattern between adjacent flanges to afford the ribbon-type construction. This, of course, as will be appreciated by those skilled in the art, requires that the stamping operations be performed in such a manner that adjacent flanges on the flat sheet project therefrom in opposite directions so that when the sheet is subsequently folded the flanges will project in the same direction. Such construction causes difficulties in the stamping operation, and causes complications in die construction, at is well known in the art. It is an object of the present invention to afford a novel cross fin construction which enables these difficulties to be overcome.

Another object of the present invention is to afford a novel cross fin construction embodying novel flanges disposed around tube-receiving openings therein for the purpose of affording reinforcing and spacing members.

Another object is to enable the aforementioned difficulties in stamping operations and die construction, heretofore known in the art, to be overcome in a novel and expeditious manner.

Another object is to afford a novel cross fin construction of the aforementioned type wherein the flanges on the cross fins are so constituted and arranged that, even in the formation of the flanges on flat sheets of metal, for subsequent deformation into the aforementioned serpentine pattern of the ribbon-type fins, the adjacent flanges on the flat sheet of metal may have the same identical construction.

Yet another object of the present invention is to insure that in the aforementioned ribbon-type fins, embodying flanges for spacing adjacent fins, the engagement of a flange on one fin with an adjacent fin is such as to afford the proper spacing between the two fins.

One of the problems which has been encountered in embodying reinforcing and spacing fins around openings in cross fins, and particularly in the plate-fin type of construction, has been that the thickness of the portion of each fin through which a tubular member is inserted longitudinally is increased by the formation of the flange thereon. As will be appreciated by those skilled in the art, any tilting of one cross fin relative to another in a stack of fins through which a tubular member is to be inserted creates a binding effect. The thicker the fin, the greater the binding effect. Also, the binding effect is even more pronounced if the thickness of the fin, around the opening, is caused by material projecting primarily from one side of the center line relative to which the fin has tilted. This is what occurs in the fins heretofore known in the art wherein combination reinforcing-and-spacing flanges have projected from one face only of adjacent fins. It is

an object of the present invention to enable such binding effect to be reduced in a novel and expeditious manner, while affording the same spacing between adjacent fins.

Another object is to afford a novel cross fin construction wherein the projecting of combination reinforcing-and-spacing flanges from the main body portion of the respective fins is divided between two opposite directions.

Yet another object of the present invention is to afford a novel cross fin construction wherein the spacing between adjacent fins in an assembled unit may be maintained at a predetermined distance by flanges which project from the respective fins only a fraction of the distance of spacing flanges on cross fins heretofore known in the art.

A further object is to afford a novel cross fin construction for heat exchangers, and the like, wherein flange-to-flange engagement is afforded between adjacent fins in a novel and expeditious manner.

Another object is to afford a novel cross fin embodying a novel combination reinforcing-and-spacing flange thereon, which is constituted and arranged in a novel and expeditious manner.

Another object is to enable a cross fin of the aforementioned type to be so manufactured that the flange portion thereof may be integrally formed with the remainder of the cross fin from the same sheet of material in a novel and expeditious manner.

In ribbon-type fins heretofore known in the art, difficulty commonly has been experienced in controlling the bending of the flat sheet of material into the necessary serpentine pattern so as to accurately align the corresponding openings in adjacent fins. It is an object of the present invention to overcome this difficulty.

Heretofore, in the formation of ribbon-type fins, it has been a common practice to weaken the sheet of material from which the fins were being made along the fold lines thereof by forming openings therethrough. Such weakening, of course, has several inherent disadvantages, including, when the weakening includes the formation of openings, the removal of material therefrom. It is an important object of the present invention to enable ribbon-type fins to be constructed in a novel and expeditious manner which does not require such weakening of the material and, particularly, does not require the formation of openings and the consequent removal of material.

Another object is to afford a novel cross-fin construction wherein the parts thereof are so constituted and arranged in a novel and expeditious manner that they tend to insure the proper folding of a ribbon-type fin during the folding operations thereof.

Yet another object of the present invention is to afford a novel heat exchanger which is practical and efficient in operation and which may be readily and economically 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.

DESCRIPTION OF THE DRAWINGS

In the drawings:

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

FIG. 2 is an enlarged, fragmentary, plan view of the cross fin embodied in the heat exchanger shown in FIG. 1, prior to bending thereof into serpentine form;

FIG. 3 is a fragmentary, detail sectional view taken substantially along the line 3—3 in FIG. 2;

FIG. 4 is a fragmentary, detail sectional view, taken substantially along the line 4—4 in FIG. 2; and

FIG. 5 is an enlarged, somewhat diagrammatic, longitudinal sectional view of a cross-fin constructed in accordance with the principles of the present invention, with the portions thereof shown in various positions relative to each other illustrating various stages of manufacture and assembly.

DESCRIPTION OF THE EMBODIMENT SHOWN HEREIN

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 heat exchanger **1** shown in the drawings embodies, in general, an elongated tubular member **2** and having a ribbon-type fin unit **3**, comprising a plurality of closely spaced cross fins **4**, mounted thereon, FIG. 1. As shown in FIG. 1, adjacent ones of the cross fins **4** are alternately connected at the tops and bottoms thereof along fold lines **5** and **6**, respectively. Each cross fin **4** embodies an opening **7** therethrough for receiving the tubular member **2** therein.

Each of the cross fins **4** embodies a body portion **8** which, throughout the major portion of its area, is substantially flat. Flanges in the form of collars **9** are formed on each of the fins **4** around each of the openings **7**, FIGS. 3 and 5. Each of the flanges embodies an edge portion **10** integrally connected to the respective body portion **8**, the edge portion **10** projecting outwardly from one face **11** of the body portion **8** at an acute angle thereto in a direction toward the longitudinal center line of the opening **7** around which the respective flange **9** extends, FIG. 3. Each of the flanges **9** also includes a free edge portion **12** preferably disposed in outwardly spaced relation to the face **13** of the respective body portion **8** remote from the face **11** thereof, with the free edge portion **12** connected to the edge portion **10** by an intermediate portion **14**. The intermediate portion **14** is connected at one edge to the edge portion **10** of the respective flange **9** and at its other edge to one edge of the free edge portion **12** thereof. The intermediate portion **14** of each of the flanges **9** is preferably disposed in substantially perpendicular relation to the flat portion of the respective body portion **8** and extends from one side thereof to the other in position to define the outer peripheral edge of the opening **7** around which it is disposed. Preferably, the outermost portion of the edge portion **10**, and the outer face of the free edge portion **12** of the respective flanges **9** are disposed equal distances outwardly from the faces **11** and **13**, respectively, on the body portion **8** on which they are formed, FIGS. 3 and 5.

Each of the body portions **8** also have formed therein in equally outwardly spaced relation to each of the openings **7** therein four bosses **15**, **16**, **17** and **18**, FIG. 2. The bosses **15–18** are somewhat L-shaped, each embodying two legs **20** and **21** disposed perpendicular to each other. The two bosses **15** and **16** project outwardly from the face **13** of the respective body portions **8** of the fins **4** and are convex inwardly in the other face **11** thereof. The other two bosses **17** and **18** project outwardly from the face **11** of the respective body portions **8** and are concave inwardly in the other face **13** thereof.

As may be seen in FIG. 1 and in the righthand portion of FIG. 5, when the cross fins **4** are disposed in assembled relation to each other, the flanges **9** on adjacent ones of the cross fins **4** are disposed in abutting engagement with each other, with the free edge portions **12** on alternate adjacent pairs of cross fins **4** engaging each other, and edge portions **10** on the other adjacent pairs of cross fins **4** engaging each other.

With this construction, the ribbon-type fin **3** may be formed from a single sheet of material, such as, for example, a suitable metal, such as aluminum, or the like, with the flanges **9** all being formed in the same manner, and facing in the same direction, in the sheet of material while the latter is in substantially flat position, as shown in FIGS. 2 and 3. Thereafter, when the sheet of material is folded back and forth upon itself along the fold lines **5** and **6**, during the assembling of the heat exchanger **1**, from a substantially flat position to a substantially parallel, stacked relation, as illustrated from left to right in FIG. 5, the adjacent cross fins **4** are disposed thereby in oppositely facing relation to each other to thereby afford the alternate oppositely facing relation of the flanges **9** in the adjacent cross fins **4** of the assembled fin unit **3**.

The bosses **15–18** preferably are so disposed around the respective openings **7** that the angle defined by the respective legs **20** and **21** thereof open toward the axial center of the opening **7**. The outer longitudinal edges of each of the legs **20** and **21** are substantially straight, and the bosses **15–18** are so disposed around each of the respective openings **7** that the legs **20** of the bosses **15–18** are disposed in alignment with the legs **21** on the bosses **18, 15, 16** and **17**, respectively; and the legs **21** on the bosses **15–18** are disposed in alignment with the legs **20** on the bosses **16, 17, 18** and **15**, respectively, FIG. 2. With this construction, the bosses **15–18** define the boundaries of a substantially square area **19** around each of the openings **7**, with the legs **21** and **20** on the bosses **15** and **16**, respectively, and the legs **21** and **20** on the bosses **17** and **18**, respectively, being disposed inwardly toward the opening **7** from the fold lines **6** and **5**, respectively, in substantially parallel relation thereto, on respective opposite sides of each of the areas **19**, FIG. 2. The bosses **15** and **16** and the bosses **17** and **18** in each of the aforementioned square areas are preferably disposed substantially equal distances from the center lines of the respective adjacent fold lines **5** or **6**.

In the preferred form of the present invention, the legs **21** and **20** on the bosses **15** and **16**, and the legs **21** and **20** on the bosses **17** and **18** on adjacent cross fins **4** are so disposed relative to each other that they define oppositely disposed longitudinal edge portions of the adjacent fold lines **5** or **6** disposed therebetween. Thus it will be seen that the bosses **15–18** assist in controlling the location of the fold lines **5** and **6**. Also, they afford reinforcing members for the body portions **8** and assist in preventing deformation thereof outside the fold line during a folding operation.

The fold lines **5** and **6** are disposed midway between the pairs of bosses **15** and **16** and the pairs of bosses **17** and **18** defining adjacent marginal edges of adjacent areas **19** on adjacent cross fins, FIG. 2. Thus, when it is desired to bend the sheet of metal having the properly positioned openings **7**, flanges **9** and bosses **15–18** thereon into a ribbon-type fin, adjacent cross-fins **4** may be bent upwardly around the lower fold lines **6** and downwardly around the upper fold lines **5** from the flat position shown in FIG. 2 and at the left end of FIG. 5 through the folding positions shown in the immediate portion of FIG. 5 to the final assembled position shown at the right end of FIG. 5, in which latter position, it will be remembered, the flanges **9** on adjacent cross fins **4** are disposed in abutting engagement with each other. During these folding operations, the bosses **15–18** on opposite sides of the respective fold lines **5** and **6** afford guides for the folding operation and permit the same to be performed quickly and easily.

In the manufacture of the heat exchanger **1** shown in the drawings, a substantially flat sheet of material S, such as, for example, sheet aluminum having a suitable thickness such as six thousandths of an inch may be formed in a stamping machine, or the like, to afford the openings **7**, the flanges **9**, and the bosses **15–18**. In this forming operation the bosses **15** and **16** are formed to project outwardly from the face **13** of the sheet S and the bosses **16** and **17** are formed to project outwardly from the face **11**. Although in FIG. 2 each of the cross fins **4** are shown only as embodying one opening **7**, this is merely by way of illustration and not by way of limitation, and it will be appreciated by those skilled in the art that each cross fin may be of any desired, practical height and width with a greater or lesser number of areas **19**, each having an opening **7**, formed therein in respective rows extending perpendicular and parallel the fold lines **5** and **6** without departing from the purview of the present invention.

After the aforementioned forming of the openings **7**, the flanges **9** and the bosses **15–18** on the sheet S, the latter may be folded in any suitable manner, such as, for example, in a suitable gathering machine or folder along the upper fold lines **5** and lower fold lines **6** into the position shown in FIG. 1 and as shown in the right side of FIG. 5. The folding of the sheet S along the fold lines **5** and **6** is guided by the bosses **15–18**, the latter affording accurate indexing of the folds so as to insure axial alignment of the corresponding openings **7** in the adjacent cross fins **4**. Also, the accurate location of the fold lines **5** and **6** insure proper alignment of the adjacent corresponding flanges **9**, so as to insure the face-to-face engagement of the adjacent flanges **9** in the assembled ribbon-type fin **3**.

The flanges **9** preferably project equal distances outwardly in opposite directions from the respective body portion **8** on which they are formed, and the engagement of the adjacent flanges **9** in the assembled ribbon-type fin **3** affords accurate spacing between the adjacent cross fins **4** thereof. With the bosses **15–18** being formed in the manner shown herein, the bosses **15–18** disposed adjacent to the upper fold line **5** all face in one direction, such as to the right as shown in FIG. 5, and the bosses **15–18** disposed adjacent to the lower fold lines **6** all face the same direction, but in the opposite direction to that in which the upper bosses **15–18** face, such as to the left as shown in FIG. 5. The bosses **15–18** are all of the same size and configuration and are preferably so disposed on the sheet S that when the ribbon-type fin **3** is in assembled position, as shown in FIG. 1, all of the bosses **15** and **18** at the tops of the cross fins **4** are disposed in alignment with each other, as are all of the bosses **16** and **17** at the tops of the fins **4**; and all of the bosses **15** and **18** at the bottom of the fins **4** are disposed in alignment with each other as are all the bosses **16** and **17** at the bottoms of the fins **4**. With this construction, the convex and concave sides of the bosses **15–18** in the assembled ribbon-type fin **3** are disposed in facing relation to the concave and convex side, respectively, of the adjacent ones of the aligned bosses **15–18**.

The bosses **15–18** preferably project from the respective body portions **8** only a fraction of the distance which the flanges **9** project therefrom. For example, in a heat exchanger wherein the fin **3** is made from sheet metal having a thickness of six thousandths of an inch, with the flanges **9** having an over-all thickness of sixty-six thousandths of an inch and projecting equal distances from both sides of the repective body portions **8**, the bosses may project from the respective body portions **8** a distance in the natural of twenty-four thousandths of an inch. With this construction, the main portions of the body portions **8** of adjacent cross fins **4** are spaced from each other by the flanges **9** a distance of sixty thousandths of an inch, with the bosses **15–18** projecting toward the adjacent cross fins **4** less than half of this distance, so that effective spacings between the cross fins **4**, radially outwardly of the flanges **9** are afforded throughout the length and breadth of the fins **4**.

After the ribbon-type fin **3** has been gathered together into its assembled form, as previously mentioned, the tubular member **2** may be inserted longitudinally into the aligned openings **9**. Preferably, the tubular member **2** is of such outside diameter that it fits in the openings **9**

with a snug, but relatively freely slidable fit. After the tubular member **2** has been inserted into proper position in the openings **9** it may be secured to the cross fins **4** by suitable means such as, for example, by expanding the tubular member **2**, or by soldering the cross fins **4** to the tubular member **2**, both of which procedures are well known in the art.

It will be remembered that in the preferred form of the present invention the flanges **9** project equal distances from opposite sides of the respective body portions on which they are formed. This construction has several advantages over flange constructions heretofore known in the art. One such advantage is that the balanced formation of the flanges **9** on both sides of the body portions **8** enables the sheet S to be handled more easily in folding mechanisms than was true in unbalanced constructions heretofore known in the art, such as, for example, in fins wherein the flanges project from only one side thereof.

Another advantage of the present invention is with respect to the improved characteristics relative to the tendency of the tubular members **2** to bind in the openings **7** during insertion thereof into the gathered ribbon fins. If in the gathering of the ribbon fins embodying reinforcing and spacing flanges which project from only one side, any of the cross fins are tilted out of the desired plane therefor, the tilting causes the fin ends of the flanges to be tilted into the desired pathways for insertion of tubular members such as the tubular member **2**, substantially twice the distance that it would be so projected if the flange projected from the body portion of the respective fin only half that distance. With the flanges **9** projecting equal distances from both sides of the body portions of the respective fins, as shown in the drawings, they do project only half the distance it would be necessary for flanges to project if the latter projected from only one side thereof and still afforded the same spacing between adjacent cross fins. Thus, it will be seen that the present construction not only affords a structure wherein improper positioning of cross fins relative to each other is effectively guarded against, but it also affords a construction wherein, if such improper positioning is effected by undesired tilting, or the like, the detrimental effects of such tilting are minimized, while still affording the same flange thickness and the same spacing between fins.

From the foregoing it will be seen that the present invention affords a novel heat exchanger.

In addition, it will be seen that the present invention affords a novel ribbon-type fin construction.

Also, it will be seen that the present invention affords a novel combination reinforcing and spacing flange construction for ribbon-type fins.

In addition, it will be seen that the present invention affords a novel construction for ribbon-type fins, which is effective in a novel and expeditious manner to assist in insuring the proper positioning of fold lines in an assembled ribbon-type fin and thereby correspondingly insures the proper disposition of the cross fins thereof relative to each other.

From the foregoing 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. In a heat exchanger including a plurality of side-by-side cross fins interconnected at their edges along fold lines to afford a ribbon-type fin, with each of said cross fins including a body portion having an opening therethrough, and with said body portion having two oppositely disposed faces, and a tubular member extending through said opening in each of said fins,

(a) a plurality of flanges on said body portions,

(b) each of said flanges

(1) being disposed around a respective one of said openings, and

(2) projecting outwardly away from each of said faces of said body portion having said respective one opening therein,

(c) each of said flanges including

(1) one edge portion

(a') directly connected to said respective body portion and

(b') projecting outwardly at an acute angle from one face of the latter generally toward said opening around which said flange is disposed,

(2) an intermediate portion

(a') directly connected to said one edge portion and

(b') defining the outer edge of at least a portion of said last-mentioned opening, and

(3) a free edge portion

(a') directly connected to said intermediate portion outwardly of the other face of said respective body portion,

(d) said intermediate portion being disposed transversely to said faces, and

(e) said free edge portion being disposed in axial alignment with said one edge portion,

(f) said one edge portions engaging each other, and said free edge portions engaging each other on alternate pairs of adjacent cross fins.

2. The combination defined in claim **1**, and in which

(a) each of said body portions have bosses spaced from each of said openings, and

(b) said bosses extend along said fold lines.

3. In a heat exchanger including a plurality of side-by-side cross fins interconnected at their edges along fold lines to afford a ribbon-type fin, with each of said cross fins including a body portion having an opening therethrough, and with said body portion having two oppositely disposed faces, and a tubular member extending through said opening in each of said fins,

(a) a plurality of flanges on said body portions,

(b) each of said flanges

(1) being disposed around a respective one of said openings, and

(2) projecting outwardly away from each of said faces of said body portion having said respective one opening therein,

(c) each of said flanges including

(1) one edge portion

(a') directly connected to said respective body portion and

(b') projecting outwardly at an acute angle from one face of the latter generally toward said opening around which said flange is disposed,

(2) an intermediate portion

(a') directly connected to said one edge portion and

(b') defining the outer edge of at least a portion of said last-mentioned opening, and

(3) a free edge portion

(a') directly connected to said intermediate portion outwardly of the other face of said respective body portion,

(d) said intermediate portion being disposed transversely to said faces, and

(e) said free edge portion being disposed in axial alignment with said one edge portion,

(f) each of said body portions having four bosses spaced around each of said openings,

(g) each of said bosses embodying two elongated legs disposed substantially perpendicular to each other,

(h) two of said elongated legs on one pair of said bosses being disposed in alignment with each other and defining a marginal edge of one of said fold lines on one side of said opening around which said bosses are disposed, and

(i) two of said elongated legs on the other pair of said bosses being disposed in alignment with each other and defining a marginal edge of another of said fold lines on the side of said last-mentioned opening remote from said one fold line.

4. The combination defined in claim **3**, and in which

(a) said one pair of bosses

(1) project outwardly from one face of said body portion, and

(2) are convex inwardly in the other face of said body portion, and

(b) said other pair of bosses

(1) project outwardly from said other face of said body portion, and

(2) are convex inwardly in said one face of said body portion.

5. In a heat exchanger including a plurality of side-by-side cross fins interconnected at their edges along fold lines to afford a ribbon-type fin, with each of said cross fins including a body portion having an opening therethrough, and with said body portion having two oppositely disposed faces, and a tubular member extending through said opening in each of said fins,

(a) a plurality of flanges on said body portions,

(b) each of said flanges

(1) being disposed around a respective one of said openings,

(2) having one portion

(a') directly connected to said respective body portion and

(b') projecting outwardly from one face of the latter, and

(3) having another portion

(a') connected to said respective body portion through said one portion, and

(b') projecting outwardly from the other face of said respective body portion, and

(c) said one portions engaging each other, and said other portions engaging each other on alternate pairs of adjacent cross fins.

6. The combination defined in claim **5**, and in which

(a) each of said body portions have bosses spaced from each of said openings, and

(b) said bosses extend along and define outer limits of said fold lines.

References Cited

UNITED STATES PATENTS

2,046,968	7/1936	Raisely	165—181 X
2,053,239	9/1936	Forrer et al.	113—118 X
2,063,736	12/1936	Hardiman et al.	165—182
2,977,918	4/1961	Kritzer	165—150 X
3,011,466	12/1961	Simpelaar	165—182 X

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U.S. Cl. X.R.

165—181; 113—118; 29—157.3