May 13, 1969 S. F. PASTERNAK 3,443,634

HEAT EXCHANGERS

Filed April 6, 1967

FIG. 1

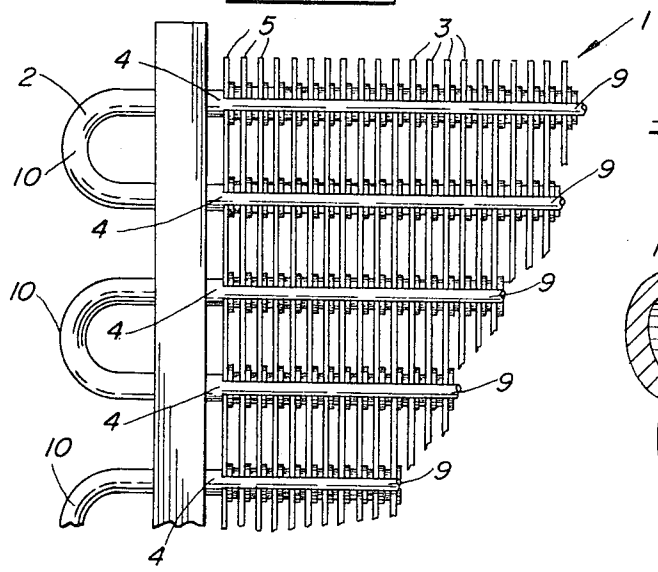


FIG. 2

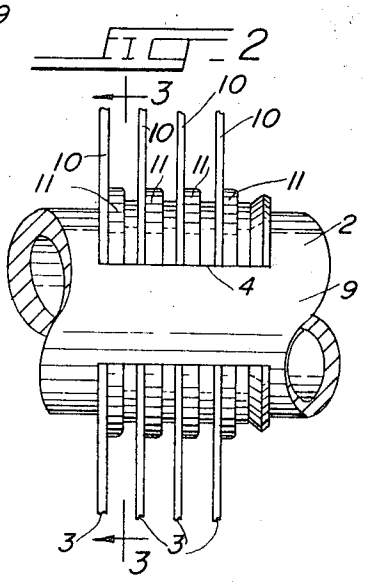


FIG. 3

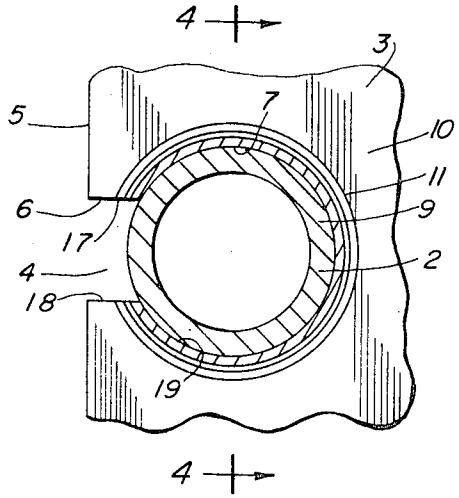
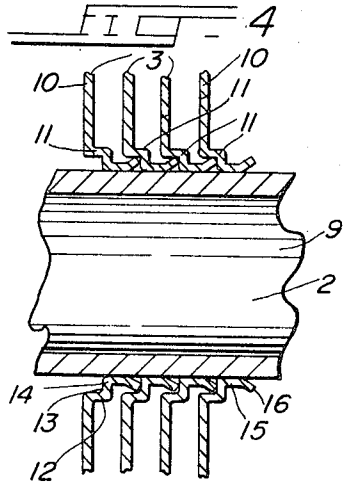


FIG. 4



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3,443,634

HEAT EXCHANGERS

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Continuation-in-part of application Ser. No. 576,599, Sept. 1, 1966. This application Apr. 6, 1967, Ser. No. 628,960

Int. Cl. F28f 1/32

U.S. Cl. 165—182 7 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 with the flanges interlocked to reinforce the marginal edges of the openings and space adjacent cross fins from each other.

Cross-reference to related application

The present application is a continuation-in-part of my copending application for United States Letters Patent, Ser. No. 576,599, filed Sept. 1, 1966

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, the cross-fin type of heat exchangers commonly used in the refrigeration and air conditioning fields have been of two types, namely, the plate-fin type and the side entry type. In the plate-fin type of heat exchangers, the 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. The tubing in such heat exchangers is normally disposed in a serpentine pattern with substantially straight parallel passes of the tubing interconnected at their ends by return bends. Commonly the return bends of such heat exchangers are soldered to the ends of the respective passes interconnected thereby. In this type of heat exchanger, the openings in which the tubing is mounted may have a continuous side wall, so that the tubing mounted therein may be connected to, or engaged with the fin along the entire outer periphery of the tubing.

In the aforementioned side-entry type of heat exchangers, the cross fins therefore have slots formed in the marginal edge portions thereof and the tubing is inserted transversely into the slots. With such construction, of course, tubing inserted into the slots cannot have contact with the cross fins throughout the entire outer periphery of the tubing, the peripheral contact being reduced at least by the width of the slot through which the tubing is inserted into the fins. Heretofore, it has been common practice in the manufacture of side-entry type heat exchangers to form the aforementioned slots with an entry portion leading into a body portion, and with the entry portion smaller in width than the body portion, so that the tubing may be inserted transversely through the entry portion into the body portion, and then expanded. Such expansion of the tubing serves two purposes, namely, to interlock the cross fins and tubing against removal from each other, and to engage the tubing with the side walls of the body portions.

In the plate-fin type of heat exchangers heretofore known in the art, it has been common practice to expand the tubing thereof into engagement with the side walls in

the openings of the cross fins by the application of internal pressure to the interior of the tubing.

Heretofore, in the manufacture of side-entry type heat exchangers, it has been a common practice to use tubing having such a normal outside diameter that it could be inserted transversely through the entry portion of the slots in the marginal edge portions of the cross fins into the body portions thereof and then to expand the tubing, transversely to the longitudinal center line of the entry portion, into the enlarged body portions of the slots, by the application of external pressure, as disclosed in United States Letters Patents Nos. 2,540,339 and 2,567,716 issued to R. W. Kritzer; or to first flatten the passes of the tubing, having a normal outside diameter greater than the width of the entry portion of the slots, so that the tubing may be inserted transversely through the entry portions into the body portions of the slots and, then, by the application of external pressure expand the tubing into the body portions of the slots as disclosed in United States Letters Patent No. 2,913,806, issued to R. W. Kritzer.

Also, it will be observed that in the novel method of making novel heat exchangers, as disclosed in my aforementioned co-pending application, Ser. No. 576,599, tubular members are expanded by the combined simultaneous application of external and internal pressure thereto.

The forces exerted on cross fins of either the plate-fin type or the side-entry type by the expansion of tubular members therein tend to distort the portions thereof defining the marginal edge portions of the openings therethrough. In heat exchangers, such as refrigeration coils, and the like, wherein the spacing of adjacent fins may be sufficiently great to enable fins of sufficient size to be used that the structural strength thereof is clearly sufficient to withstand such deforming forces, such forces do not create a substantial problem. However, 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", and are commonly spaced from each other at the rate of 10 to 16 fins per inch. In this latter type of construction the protection of the cross fins from being deformed around the marginal edges of the openings therethrough by the forces inherent in the aforementioned methods of expanding tubular members into snug fitting engagement with such marginal edge portions is of particular importance. It is an important object of the present invention to enable the portions of cross fins for heat exchangers defining the marginal edge portions of tube-receiving openings therethrough to be reinforced in a novel and expeditious manner against being deformed by the forces inherent in the expanding of tubular members therein.

In heat exchangers embodying cross fins, it commonly is desired to have the body portions of adjacent cross fins spaced from each other. 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 to be spaced from each other in a novel and expeditious manner.

Another object of the present invention is to afford a novel heat exchanger embodying a novel fin construction whereby adjacent fins are interlocked in a novel and expeditious manner.

Another object is to afford a novel heat exchanger embodying cross fins of the aforementioned type wherein the interlocking thereof is effective to hold the adjacent cross fins against movement toward and away from each other

longitudinally of the tubular members on which they are mounted.

Yet another object of the present invention is to afford a novel heat exchanger embodying cross fins having openings therethrough in which tubular members are mounted, and wherein the marginal edge portions of the openings are reinforced in a novel and expeditious manner.

A further object of the present invention is to afford a novel heat exchanger embodying a novel cross fin construction which includes novel flanges around tube-receiving openings.

An object ancillary to the foregoing is to afford such a novel heat exchanger wherein the aforementioned flanges of adjacent fins are interlocked with each other in a novel and expeditious manner, effective both to afford reinforcement for the marginal edge portions of the tube-receiving openings, and to afford a novel retaining and spacing mechanism for holding the adjacent fins in properly spaced relation to each other.

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, side elevational view of a portion of the heat exchanger shown in FIG. 1;

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

FIG. 4 is a detail sectional view taken substantially along the line 4—4 in FIG. 3.

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** preferably is of the tape shown in my aforementioned copending application for United States Letters Patent, Ser. No. 576,599, wherein the construction and method of making the heat exchanger is discussed in substantially greater detail than is necessary for the proper disclosure of the present invention.

The heat exchanger **1** embodies, in general, a one-piece tubular coil **2** having a plurality of closely spaced cross fins **3** mounted thereon, FIGS. 1, 2 and 4. The cross fins **3** shown in the drawings are of the side-entry tape, as illustrated in FIG. 3. Each fin **3** is rectangular in shape and embodies a plurality of identical side-entry slots **4** disposed in spaced relation to each other in the longitudinal marginal edge portions **5** thereof. Each of the slots **4** has a relatively narrow entry portion **6** which extends inwardly from the longitudinal marginal edge **5** of the respective fins **3**, and an enlarged body portion **7** in communication with the inner end of the side-entry portion **6** and extending inwardly therefrom. The slots **4** are preferably so disposed in each of the fins **3** that the entry portions **6** in the respective longitudinal edge portions **5** are disposed in parallel relation to each other.

The coil **2** may be formed of any suitable material, such as, for example, aluminum, and preferably consists of a single, unitary tubular member. As discussed in greater detail in my aforementioned co-pending application, Ser. No. 576,599, it is formed into a serpentine pattern having parallel passes **9**, with adjacent passes interconnected at their ends by return bends **10**. With this construction, working fluid, such as, for example, refrigerant may be fed from a suitable source of supply, such as a compressor, not shown, into one end of the coil **2** from which it may flow through the passes **9** horizontally back and forth through the fins **3** as viewed in FIG. 1, and be discharged from the othe rend of the coil **2**.

Each of the fins **3** embodies a body portion **10** which, in the form shown herein, is substantially flat. Flanges in the form of collars **11** are formed on each of the fins **3** around the body portion **7** of each of the slots **4**, FIGS. 2–4. The flanges **11** project transversely outwardly from the planes of the body portions **10** of each of the respective fins **3** to afford combination spacers and reinforcing members, as will be discussed in greater detail presently.

Preferably, each of the flanges **11** embodies an inner edge portion **12** which is attached directly to the respective body portion **10** and projects substantially perpendicular thereto; an intermediate portion **13**, which projects substantially perpendicular to the inner edge portion **12**, radially of the slot body portion **7** around which it is disposed; and an outer free edge portion **14**, which projects laterally outwardly from the intermediate portion **13**, FIG. 4. The edge portion **15** of each of the outer free edge portions **14**, which is directly attached to the intermediate portion **13** of each of the respective flanges **11**, preferably projects outwardly from the respective intermediate portion **13** in substantially perpendicular relation to the attached body portion **10**, with the outer free edge portion terminating at its free edge in an outwardly flared lip **16**, FIG. 4, for a purpose which will be discussed in greater detail presently.

In the preferred form of the invention shown in the drawings, the shape of the body portions **7** of the slots **4** is that of an arc of a circle, and the entry portions **6**, extending outwardly therefrom are substantially straight, having paralled side walls **17** and **18** extending outwardly from the side walls **19** of the respective body portions **7**.

In assembling the heat exchanger **1**, the fins **3** may first be disposed in parallel spaced relation to each other shown in FIG. 1, with the corresponding flanges **11** thereon disposed in nested relation to each other, FIG. 4. In the assembled position of the fins **3** the lip **16** on each of the nested flanges **11** to the left of the flange **11** disposed the farthest to the right as viewed in FIGS. 2–3, is disposed in abutting engagement with the inner face of the inner edge portion **12**, and with the adjacent face of the intermediate portion **13** of the flange **11** disposed immediately to the right thereof, FIG. 4. This engagement of the adjacent lips **16** and intermediate portions **13** is effective to hold, in a positive manner, the adjacent fins **3** from movement toward each other. In addition, the engagement of the adjacent lips **16** and inner edge portions **12** is preferably with a sufficiently snug fit that it is effective to hold the fins **3** against separation from each other by the normal forces to which they are subjected during assembly of the heat exchanger **1**.

With the fins **3** so disposed relative to each other, the passes **9** of the tube **2** may be inserted through the entry portions **6** into the body portions **7** of the respective slots **4**, and then expanded outwardly into snug fitting engagement with the portions of the body portions **10** of the respective fins **3** which define the outer marginal edges of the body portions **7** of the slots **4**. Preferably, the insertion of the passes **9** into the body portions **7** of the respective slots **4**, and the expansion of the passes in those body portions is accomplished in the manner disclosed in greater detail in my aforementioned co-pending application Ser. No. 576,599. Briefly, this method of assembling the fins **3** on the tubular member **2** includes flattening the passes **9** to

such a thickness that they may be inserted transversely through the entry portions **6** of the slots **4** into the body portions **7** thereof, and then expanding the passes **9** to a substantially round shape, such as shown in FIG. 3, by simultaneously subjecting the tubular member **2** to internal pressure and external pressure sufficient to expand the passes **9** from the aforementioned flattened shape to the desired substantially round shape.

It has been found that by using this novel method of making heat exchangers, the passes **9** may be so firmly engaged with the side walls **19** of the body portions **7** of the slots **4** that the fins **3** are securely held by this engagement, alone, in position on the coil **2**, and it is unnecessary to afford any additional securing of the cross fins **3** to the coil **2**, such as, for example, by soldering.

The expansion of the passes **9** within the body portions **7** of the slots **4** presses outwardly on the side walls **19**. This outward pressure on the side walls **19** urge the outer free edge portions **14** of the flanges **11** on each of the fins **3** outwardly to thereby increase the normal frictional engagement between the lips **16** and the inner faces of the inner edge portions **12** of the adjacent nested flanges **11** and thus increase the frictional force tending to hold the fins **3** against separation from each other.

Also, it will be observed that with the flanges **11** disposed in the aforementioned nested relation to each other in the assembled heat exchanger **1**, the interlocking of the adjacent flanges **11** affords a reinforcement to each of the side walls **19** against the spreading and deforming forces applied thereto by the expansion of the passes **9** in the body portions **7** of the respective slots **4**. This reinforcement by the nested flanges **11** is afforded not only by the double thickness of metal afforded thereby around the slots **4** in each of the fins **3** disposed to the right of the furthermost left fin, as viewed in FIGS. 1 and 4, but is aided by the construction of the flanges **11**, themselves, and in the manner in which they interlockingly engage. Thus, it will be seen that the substantially radially extending intermediate portions **13** and the outwardly flaring lips **16** on each of the flanges **11** afford radially outwardly extending structure which affords reinforcing strength against outward deforming of the side walls **19** of the slots **4** in the nested fins **3**. In addition, the engagement of the lips **16** with the inner edge portions **12** of the flanges **11** disposed immediately to the right thereof, as viewed in FIG. 4, adjacent to the edge portions of the body portions **10** of the fins **3**, which define a portion of the slots **4** affords additional strength by reason of the confining relationship of the body portions **10** to the respective flanges **11** nested therewithin.

From the foregoing it will be seen that the flanges **11** on the fins **3** of the assembled heat exchanger **1** afford an effective reinforcement against distortion of the fins **3** around the slots **4**, and also afford effective spacer members and position-retaining members for holding the body portions **10** of the adjacent fins **3** in properly spaced relation to each other.

While a heat exchanger **1** having cross fins of the side-entry type have been shown herein for disclosing the preferred embodiment of the present invention, this is merely by way of illustration, and not by way of limitation of the broader aspects of the present invention. As will be appreciated by those skilled in the art, other types of fin construction, and other shapes of tube-receiving openings, such as, for example, the aforementioned plate-fin type, wherein the passes **11** are inserted longitudinally into circular openings in the respective fins may be afforded without departing from the purview of the present invention.

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

In addition, the present invention affords a novel fin construction for heat exchangers.

Also, 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 cross fins, with each of said cross fins including a body portion having an opening therethrough, and a tubular member extending through said opening in each of said fins,

(a) a plurality of flanges

(b) each of said flanges

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

(2) projecting laterally from said body portion in which said respective opening is disposed,

(c) said flanges on adjacent ones of said fins being disposed in nested relation to each other,

(d) each of said flanges having

(1) an inner edge portion directly attached to said body portion from which said flange projects, and

(2) an outer free edge portion projecting laterally outwardly of said inner edge portion and terminating in a radially outwardly projecting free edge, and

(e) said outer free edge portions of said flanges on certain of said fins being disposed radially inwardly of, and in abutting engagement with said inner edge portions on respective adjacent ones of the other of said fins to thereby reinforce said certain fins around said openings therein.

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

(a) said body portions of said adjacent fins are disposed in spaced relation to each other.

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

(a) each of said outer edge portions on each of said flanges is disposed radially inwardly of said inner edge portion on said flange,

(b) each of said flanges includes an intermediate portion interconnecting said inner and outer edge portions thereof, and

(c) said free edges of said outer edge portions of said certain fins are disposed in abutting engagement with said intermediate portions of said respective other fins to thereby hold said body portions of said adjacent fins in said spaced relation to each other.

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

(a) said intermediate portions are disposed transversely to said inner and outer edge portions connected thereby and substantially radially of said respective openings around which they are disposed.

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

(a) said flanges define at least a portion of the marginal edges of the respective openings around which they are disposed.

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

(a) said openings are slots having

(1) entry portions opening outwardly through marginal edge portions of the respective body portions in which they are disposed, and

(2) body portions disposed inwardly of said entry portions, and

(b) said flanges define marginal edge portions of said body portions of said respective openings around which they are disposed.

7. In a heat exchanger including a plurality of cross fins, with each of said cross fins including a body portion having an opening therethrough, and a tubular member

extending through said opening in each of said fins,

(a) a plurality of flanges

(b) each of said flanges

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

(2) projecting laterally from said body portion in which said respective opening is disposed,

(c) said flanges on adjacent ones of said fins being disposed in nested relation to each other,

(d) each of said flanges having

(1) an inner edge portion directly attached to said body portion from which said flange projects, and

(2) an outer free edge portion projecting outwardly of said inner edge portion, and

(e) said outer free edge portions of said flanges on certain of said fins being disposed radially inwardly of, and in abutting engagement with said inner edge portions of respective adjacent ones of the other of said fins to thereby reinforce said certain fins around said openings therein,

(f) said body portions of said adjacent fins being disposed in spaced relation to each other,

(g) said openings are slots having

(1) entry portions opening outwardly through marginal edge portions of the respective body portions in which they are disposed, and

(2) body portions disposed inwardly of said entry portions, and

(h) said flanges define marginal edge portions of said body portions of said respective openings around which they are disposed.

References Cited

UNITED STATES PATENTS

1,960,955	5/1934	Recker	165—182
2,038,912	4/1936	Summers	29—157.3
2,427,336	9/1947	Askin	29—157.3
2,434,676	1/1948	Spender	165—182
2,899,178	8/1959	Dubin et al.	165—182
2,913,806	11/1959	Kritzer	29—157.3 X

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