

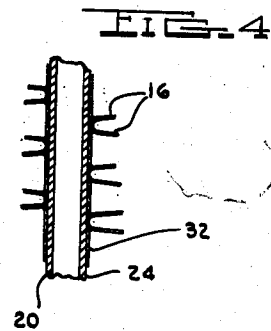
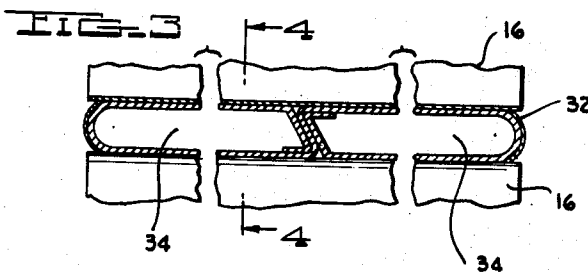
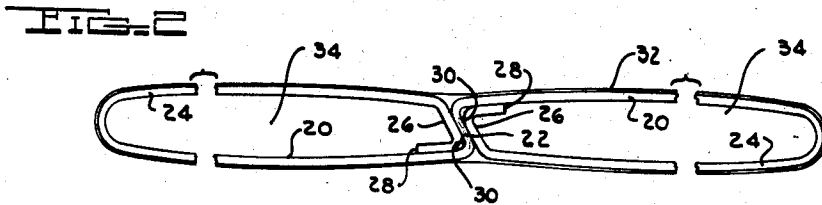
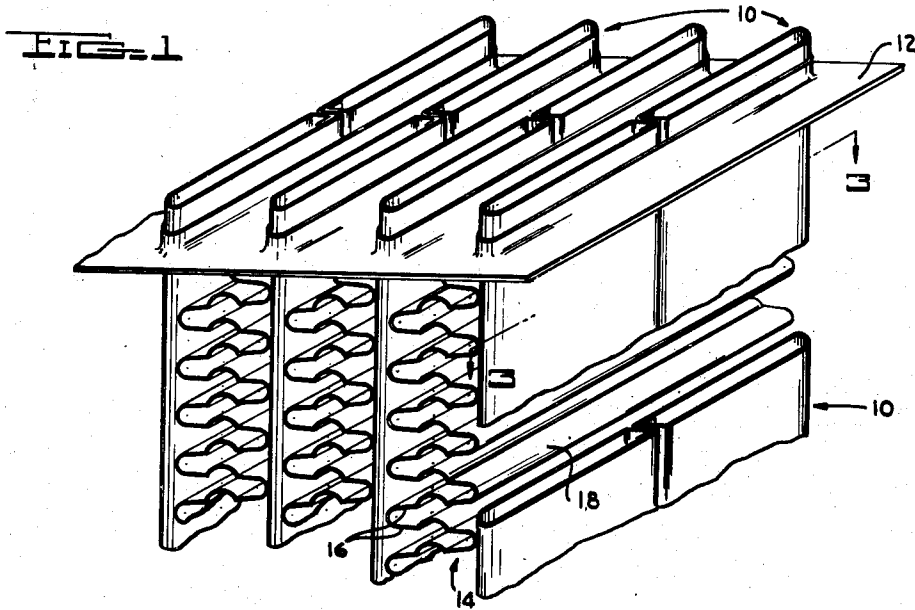
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J. H. COOPER

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TUBE CONSTRUCTION

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INVENTOR.

JAMES H. COOPER

BY

E. J. Balluff
ATTORNEY

UNITED STATES PATENT OFFICE

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TUBE CONSTRUCTION

James H. Cooper, Grosse Pointe Park, Mich., assignor to McCord Corporation, Detroit, Mich., a corporation of Maine

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4 Claims. (Cl. 138—87)

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This invention relates to the heat exchange art and has particular reference to heat exchange devices of the fin and tube type.

More specifically, the invention relates to heat exchange devices of the kind shown in Seemiller Patent No. 2,252,211, issued August 12, 1941, for "Heat Exchange Core," and contemplates a novel construction for the tube of such a device and a novel construction for such a heat exchange device employing a single row of such tubes arranged as part of a core with pleated fins between the tubes and in which the pleats of the fin extend crosswise of the tube, and in which the length of the pleats of the fin and the width of the tubes are substantially co-extensive.

A principal object of the invention is to provide a novel heat exchange device.

A further object of the invention is to provide a novel tube structure which is particularly useful in heat exchange devices of the type referred to.

Another object of the invention is to provide a novel construction for heat exchange cores.

Other and further objects of the invention will be apparent from the following description and claims and may be understood by reference to the accompanying drawing, of which there is one sheet, which by way of illustration shows a preferred embodiment of the invention and what I now consider to be the best mode in which I have contemplated applying the principles of my invention. Other embodiments of the invention may be used without departing from the scope of the present invention as set forth in the appended claims.

In the drawings:

Fig. 1 is a fragmentary perspective view, with parts broken away, of a heat exchange core embodying the invention;

Fig. 2 is an enlarged and elevational view of a tube embodying the invention;

Fig. 3 is an enlarged fragmentary sectional view taken along the line 3—3 of Fig. 1; and

Fig. 4 is a fragmentary sectional view taken along the line 4—4 of Fig. 3.

In Fig. 1 there is shown a fragmentary portion of a heat exchange core embodying the invention, such core being particularly useful as a radiator core for the cooling system of an internal combustion engine of a motor vehicle. Such a core may consist of a series of tubes 10 disposed with the wide sides thereof parallel to each other and secured at their upper and lower ends in plates, such as the plate 12 which forms a part of a header with which the tubes 10 communicate. A strip 14 of pleated fins is arranged between each pair or set of adjacent tubes 10.

The fin strips 14 may be of the construction shown in Seemiller Patent No. 2,252,211, and in general are made out of thin metal stock, such as copper, of the order of .003 inch thickness. The strip 14 comprises a pleated metal strip having all of its folds 16 substantially parallel with

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one another, and may have a frequency of the order of ten per inch. The turned over edges 18 of each fold preferably are rounded and of substantial width, and each edge 18 seats against a side of the tube as shown in Figs. 1 and 4, it being noted that the width of the tube 10 is substantially co-extensive with the length of the edge 18. As used herein, the width of the tube has reference to its dimension across the wide sides thereof and between the two faces of the core, the narrow sides of the tubes being disposed in the faces of the core.

The tubes embodying the invention may be made of copper or brass or any other suitable metal stock of the order of .005 inch and the tubes may be spaced from each other approximately one-half inch. Each of the tubes 10 is made from an elongated piece of such thin flexible metal which is formed lengthwise thereof to provide two offset portions 20 connected by a central portion 22 which is disposed transversely of the offset portions 20. Each of the offset portions has the outer part 24 thereof turned back upon itself generally in alignment with that part of the other offset portion 20 adjacent the central portion 22. The ends 26 of the turned back parts are bent back upon themselves as indicated at 28 and nested in the shoulders 30 formed between the central portion 22 and the offset portions 20.

The tube may be formed in a tube mill which progressively bends the metal stock to the form shown in Fig. 2. The formed stock is subjected to a fluxing bath and given a coat of solder in order to coat the outside of the tubes with a solder coating indicated at 32, such solder coating flowing into the joints between the bent back parts 26 and the central portion 22 so as to unite such parts and form water-tight joints capable of withstanding the pressures encountered in heat exchange cores of the type in question.

It will be observed that the tube is generally flat in cross section and that the central portion 22 divides the tube into two passages 34. During the formation of the tube the parts 20 and 24, which define the opposite sides of the passages 34, are outwardly bulged as shown in Fig. 2 for a purpose that will hereinafter be pointed out.

The central portion 22 and the portions 26 in contact therewith form a stiffening means for the tube so as to resist collapsing of the sides thereof. In addition such portions 22 and 26 also serve as a path for the flow of heat between the liquid in the center of passages 34 and the outer side surfaces of the tube.

In assembling the radiator core the tubes 10 and the fins 14 are stacked with the tubes and fins alternately arranged until a core of the desired dimension is obtained. The assembly is then compressed by pressing the tubes toward each other so as to obtain a good metallic contact

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between the edges 18 of the fins and the outside walls of the tubes 10. The outwardly bulged sides of the tubes 10 make it possible to obtain uniformly good contact between the edges 18 of each of the fins and the side walls of the tubes, and after the stack of tubes and fins is compressed the outwardly bulged sides of the tubes are compressed inwardly so that the contact between each edge 18 of a fin and the side wall of the tube is in a substantially straight line, as shown in Fig. 3.

After the plates 12 which form part of the headers are assembled on both ends of the tubes 10, as shown in Fig. 1, the assembly may be run through a baking furnace so that the solder coating 32 on the outside of the tubes will melt and form a good heat transfer joint between the fins 14 and the tubes 10 which integrally unites the tubes and the fins. During this baking operation the solder also flows into the joint between the bent back parts 26 and the central portion 22 so as to form a good pressure tight joint therebetween.

In use, air flows over the tubes 10 and between the folds or pleats 16 of the fins 14, the fins forming secondary surfaces for the liquid contained in the tubes 10. The thickness of the solder coating 32 is somewhat exaggerated for illustrative purposes.

By using a single tube of the construction shown, it is possible to obtain contact between the entire length of each fin edge 18 and a tube 10. This makes it possible to reduce the thickness of the core.

The stiffening means incorporated in the tube and formed by the central portion 22 and the bent back portions 26 also function as fin spacers in that they accurately space each fin 14 from the next fin and prevent the collapse of the tube under the pressure to which the fins and tubes are subjected in the assembly operation.

The heat exchange core embodying the invention thus comprises a series of thin, flat tubes of metallic material disposed with the wide sides thereof parallel to each other and with a flexible corrugated fin 14 arranged between and spacing the wide sides of each set of adjacent tubes 10. The folds 16 of each of said corrugated fins extend crosswise of the tubes and between the front and rear faces of the core. The narrow sides of each of the tubes are arranged in the core faces.

Due to the pressure under which the fins and tubes are pressed together during the assembly operation, each fin has the edges of its folds in continuous, resilient contact with the wide sides of an adjacent set of tubes throughout substantially the entire extent of the length of such edges 18 and the width of the tubes 10, and each of the tubes has integral stiffening means intermediate the narrow sides thereof and extending lengthwise of the tubes, such stiffening means resisting collapse of the wide sides of the tubes and forming a means for spacing adjacent fins from each other. Such stiffening means also forms a metallic path for the flow of heat directly from the center of the tubes to the outside thereof and to the fins 14. Some of the resiliency or flexibility of the stock will be lost during the baking operation.

The acute angle corner formed between the central portion 22 and each of the offset portions 20 and the nesting of the bent back ends 26 in such corners provides a mechanical interlocking of the parts of the tube joints which help to

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locate the parts of the joint for the soldering operation and also provide a stronger joint.

For some applications the fins may project slightly beyond the tubes in order to protect the latter. The term solder as used herein includes a coating on the tube 10 suitable for brazing operations so that the tube joints may be brazed, as well as the tubing brazed to the fin edges.

The heat exchanger illustrated has particular reference to radiator core construction. For other types of heat exchangers, other metals such as steel may be employed, and the metal gauge may be lighter or heavier than that specified, depending on the particular requirements of each application.

While I have illustrated and described a preferred embodiment of my invention, it is understood that this is capable of 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. A tube useful for heat exchange purposes comprising an elongated piece of thin flexible metal formed lengthwise thereof to provide two substantially flat offset side portions connected by a central transversely extending portion with a shoulder between said central portion and each of said offset portions, each of said offset side portions having the outer part thereof turned back upon itself generally in alignment with that part of the other offset portion adjacent said central portion to form other side portions, the ends of said turned back parts being bent inwardly back upon themselves to form portions parallel to and seated against said central portion and extending into said corners, and means integrally uniting said parallel portions of said bent back ends to said central portion so as to form a pressure tight tube, said central portion and bent back portions integrally united therewith extending transversely of said tube lengthwise thereof from one side to the other thereor or forming a multi-ply stiffening element which extends between and supports the sides of said tube intermediate the ends thereof.

2. A tube according to claim 1 wherein said ends of said turned back parts are bent to form corner portions in addition to said parallel portions and wherein said corner portions are nested in said corners.

3. A tube according to claim 1 wherein said central portion divides said tube into two passages and wherein the portions of said piece forming the opposite sides of said passages are outwardly bulged.

4. A tube according to claim 1 wherein said central portion forms an acute angle corner with each of said offset portions.

JAMES H. COOPER.

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