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HEAT EXCHANGER CORE

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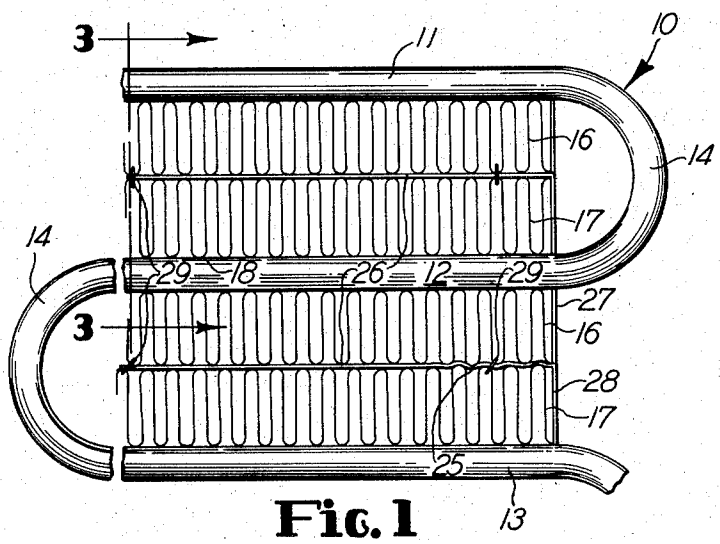


Fig. 1

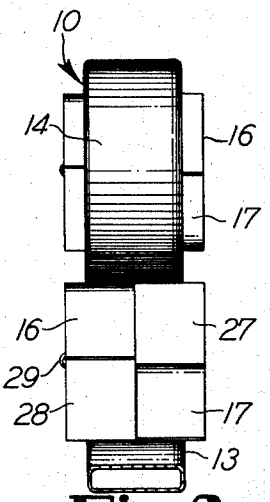


Fig. 2

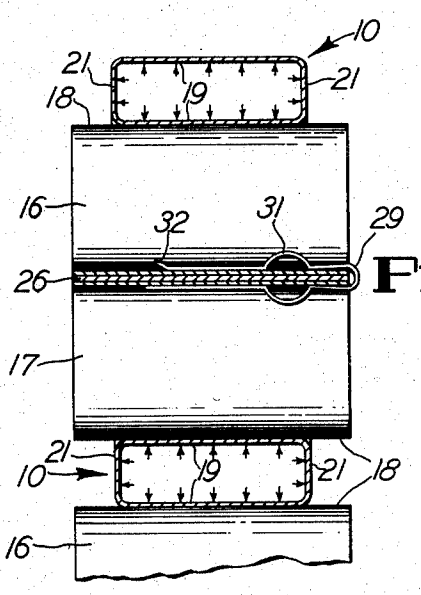


Fig. 3

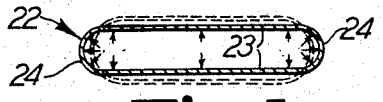


Fig. 4

INVENTORS:
ARNOLD E. JENSEN
STANLEY W. PETERSON
BY: Arthur J. Hanoman
ATTORNEY

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HEAT EXCHANGER CORE

Arnold E. Jensen and Stanley W. Peterson, Racine, Wis., assignors to Modine Manufacturing Company, Racine, Wis., a corporation of Wisconsin

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3 Claims. (Cl. 257—255)

This invention relates to heat exchanger cores.

With the advent of air-conditioning of automobiles, the provision of an efficient heat exchanger has become more important. While the heat exchanger of the present invention has been developed particularly for use in automobiles, and especially in automobile air-conditioning equipment, of course it has application in other fields where heat exchangers are required. In these uses of a heat exchanger, it is normal to have within the exchanger tubes fluid pressures which distort the tube, and, consequently, detrimentally change the over-all dimensions of the exchanger. This invention is concerned with tube distortion.

It is a general object of this invention to provide an improved heat exchanger core and accomplishing this object with a minimum of expense and time.

A specific object of this invention is to provide a heat exchanger core which is most efficient and yet does not distort when subjected to normal operating pressures of the fluid within the exchanger tubes. This object is accomplished by means of a tube having a rectangular cross-section and by means of having the fins adjacent the tube support the latter.

Other objects and advantages will become apparent upon reading the following description in conjunction with the accompanying drawings, wherein:

Fig. 1 is a side view of a preferred embodiment of this invention, showing a fragment of a heat exchanger core.

Fig. 2 is an end view of a fragment of Fig. 1.

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 1, with the arrows indicating the internal fluid pressure within the tube.

Fig. 4 is a view similar to a part of Fig. 3 but showing the effect of the internal fluid pressure on a tube which does not have a rectangular cross-section, with the dotted lines showing the final shape of the tube after it has been subjected to the internal fluid pressure.

The same reference numerals refer to similar parts throughout the several views.

The drawings show a fragment of a heat exchanger core for use in the applications mentioned, and, it will be understood by those skilled in the art of making heat exchangers that the unshown parts of the heat exchanger will be like the fragment shown and the remainder of the exchanger, including the headers, can be of any conventional design. A tube **10** is formed in the usual serpentine shape to be disposed in lengths **11**, **12**, and **13** and curved ends **14**. Of course fluid, such as Freon used in air conditioners, is introduced into one end of the tube **10** to flow through the lengths such as **11**, **12**, **13**, and the ends **14**, and out the other tube end, all in a very well-known manner. Interposed between every two of the tube lengths, such as the lengths **11** and **12**, are two rows or layers of serpentine fins **16** and **17** which perform the usual function of allowing air or other fluid to pass therethrough in a direction transverse to the tube lengths **11**, **12**, and **13** and change the temperature of the fins **16** and **17**. The provision of a core with double layers of fins is not new in

and by itself. It is known in the art that certain types of cores preferably consist of double layers of fins which are provided for well-known reasons of core design. The present invention is concerned with an improvement on that known design which will be described later.

Fig. 3 particularly shows that the tube **10** is of a rectangular cross-sectional shape and this is an important feature of this invention. It should also be seen that the crests **18** of the adjacent fins **16** and **17** are in contact with the full width of the tube **10** since the latter is rectangular and therefore presents straight and parallel sides **19**. Also, the shorter opposite sides **21** are transverse to the sides **19** and the crests **18** of the fins. The arrows, of course, indicate the internal fluid pressure in the tube **10** in normal conditions of use, and it will be understood that the total force exerted by the fluid on the tube sides **19** will be greater than the total force exerted by the fluid on the sides **21**. Thus, the tube has a tendency to expand by increasing its height as viewed in Fig. 2. Because the tube is rectangular, and because the fins **16** and **17** provide support in the vertical directions, the tube will not expand or distort under normal operating pressures. Before the tube **10** will be distorted permanently, the sides **21** must be stressed beyond their yield point since the full tensile strength of the sides **21** is available to resist the vertical forces tending to expand the tube. As shown, the sides **19** are substantially three times as long as the sides **21**, and, of course, the dimensions provide the required cross-sectional flow area. Since the sides are so proportioned, the sides **21** are not too long for strain elongation which is, therefore, held to a minimum.

To further illustrate this feature of the invention, Fig. 4 shows in solid lines a tube **22** having straight parallel sides **23** and opposite curved sides **24**. The tube can be considered as possessing a cross-sectional flow area equal to that of the tube **10**. Here also, the internal fluid pressure creates total forces on the sides **23** in excess of the total forces on the sides **24**. There would be the usual fins, such as the fins **16** and **17**, in flat contact with the sides **23**, just as in the other figures, and the beam strength of the fins would prevent distortion of the sides **23**. However, the fluid pressures are normally great enough to distort the tube which thus changes to the shape shown by the dotted lines in Fig. 4. In this design of rounded or arcuate sides **24**, the total forces on the sides **24** are not great enough to keep the sides arcuately shaped, so they are deformed under the influence of the greater forces on the sides **23**. Since numerous tiers of the tube **22** would exist in a complete heat exchanger core, the summation of these vertical distortions would result in an overall dimensional increase which is prohibitive.

Referring again to the provision of the fins **16** and **17**, it will be seen in the drawings that a partition or center spacer **26** is disposed between the tiers of fins **16** and **17**. The partition **26** is of a light gage metal (eight thousandths of an inch has been found to be satisfactory), and it serves several important features in this invention. One feature is that the fins **16** and **17** assume and retain their proper positions in abutment with their adjacent tube lengths, and the fins will not nest into each other's folds. However, since the spacer **26** is of a light gage, the fins can actually indent the spacer to properly align in abutting contact with the tube lengths, as shown at **25**. Another feature of the spacer is the fact that the ends thereof can be split into two sections **27** and **28** to each abut the end of a respective fin **16** and **17**, at each end of the fins, and thereby determine and maintain the overall length of the fins **16** and **17**. Of course, since the fins are accordion pleated, they tend to be extremely variable in both their lengths and their position along the length in the direction transverse to the plane of the paper in

Fig. 1 which direction is in the plane of the spacer **26** and motion of the fins in this direction would be in the nature of accordion action. The spacers thus determine the fin length and can have the split ends **27** and **28** which may be nested in the end fold of the fins.

To control the fins transverse to their lengths, the spacer is again utilized by being fastened to the fins by means such as the clips **29** shown in Figs. 1 and 3, indicated to be spaced in several positions along the length of the fins. The clips preferably are of hair-pin shape and preferably have an enlarged portion **31**, to facilitate handling and directing the clip to its position, and the clip preferably has an outwardly turned end **32** to facilitate directing the legs of the clip to opposite sides of the spacer and fins. With the spacer fastened to the fins, the greatest strength of the spacer, namely its strength in its own plane, is available to support the fins against deflection in the plane of the spacer. The sub-assembly of the two fins **16** and **17** and the spacer **26** thus becomes a relatively rigid body which can be handled for positioning between the lengths **11** and **12** of the tube **10**, and thus the flexibility of the fins is removed so that the assembly can be accomplished through mass production standards.

Of course, the final assembly of the core, as shown in Fig. 1, is then bonded together so that the contacts between fin and the tube, and the fin and the spacer are all permanent. Thus, one rigid core is made by means of a conventional final bonding process. Because the clips **29** are small, they can be left in place after the bonding process.

While a specific embodiment of this invention has been shown and described, it should be obvious that certain changes could be made and, therefore, the scope of this invention should be limited only by the appended claims.

What is claimed is:

1. A heat exchanger core comprising a serpentine shaped tube presenting several spaced apart and parallel lengths of tube and having a rectangular cross-sectional shape including two shorter sides disposed in planes which are parallel to the plane in which said lengths of said tube lie, and serpentine shaped fins disposed in the space between and forming a mechanical support between every

adjacent two of said lengths of tube, and said fins being disposed in said plane of said tube but having the serpentine shape oriented transverse to that of said tube and including crests having straight surfaces of a length longer than the length of the two longer sides of said rectangle and with said straight surfaces being adhesively bonded to and overlapping said longer sides of said rectangle.

2. A heat exchanger core comprising serpentine shaped fiins of a given length and width and having a plurality of crests closely spaced apart and shaped to present a straight surface on the extremity of each of said crests and across said width of said fins, a tube of a rectangularly shaped cross-section including two long sides and two short sides with said long sides being shorter than said width of said fins and being in bonded contact with said straight surfaces and spaced within both lateral extremities of said width of said fins and said tube including parallel sections spaced apart a distance fully spanned by said fins for the latter to mechanically support said sections one by the other, said two short sides of the rectangle of said tube each being entirely of one continuous and straight and homogeneous wall devoid of any joint or seam.

3. A heat exchanger core comprising a tube having a rectangular cross-sectional shape and formed to present parallel sections disposed apart a selected distance, and serpentine shaped fins completely extending for said distance to be snugly disposed between said sections for forming a support of one of said sections on the adjacent one of said sections and in adhesively bonded contact with and overlapping the sides of said rectangle.

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