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METHOD OF MANUFACTURING TUBES FOR HEAT EXCHANGE DEVICES

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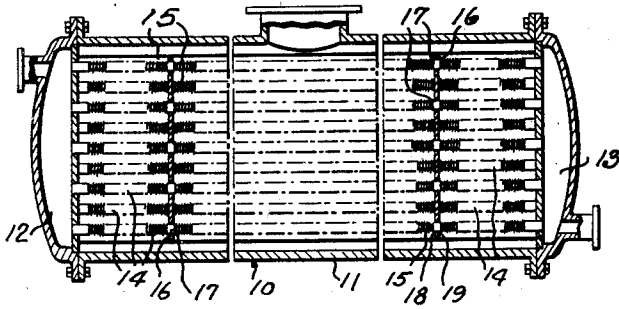


Fig. 1.

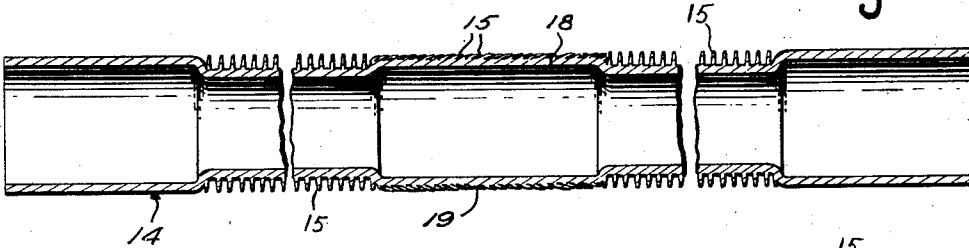


Fig. 2.

Fig. 3.

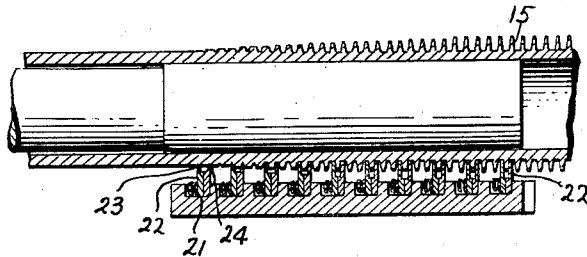


Fig. 4.

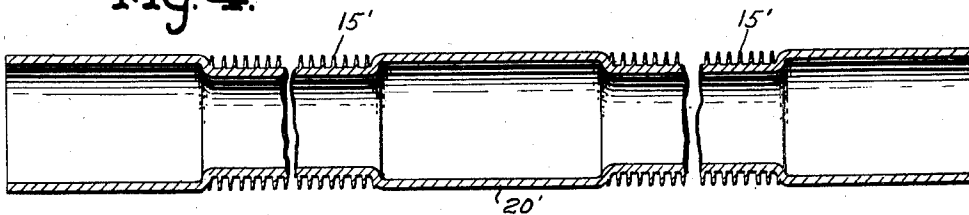
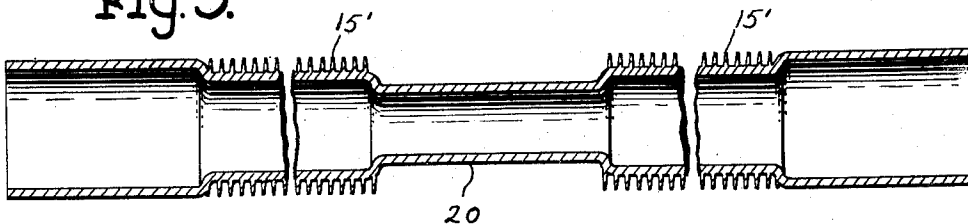


Fig. 5.



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METHOD OF MANUFACTURING TUBES FOR
HEAT EXCHANGE DEVICES

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1 Claim. (Cl. 29—157.3)

This invention relates to an improved method of manufacturing finned tubes for use in heat exchange devices and is a division of my co-pending application Serial Number 429,312 filed February 2, 1942.

More particularly this invention relates to a method of manufacturing finned tubes provided with integral bearing portions intermediate their ends whereby the tubes may be expeditiously assembled with and adequately supported in a heat exchange device.

In heat exchange devices requiring the use of relatively long finned tubes, it is customary to provide one or more apertured plates intermediate the ends of the device for supporting intermediate portions of the finned tubes. The openings or apertures in the supporting plates usually have a diameter at least equal to the outside diameter of the fins on the tubes in order to enable the tubes to be freely extended through these openings during assembly or replacement of the tubes. This requirement complicates the problem of adequately supporting the finned tubes intermediate their ends because the outer edges of the fins do not afford sufficient bearing area and because the fins are not sufficiently rigid to adequately withstand the stresses applied to the tube during shipment and operation of the heat exchanger.

It has been proposed to solve the above problem by filling the space between adjacent fins intermediate the ends of the tube with a suitable bearing metal to provide a bearing having a diameter at least as great as the outside diameter of the fins on the tube and having a length sufficient to provide an extended bearing contact with the surface of the support surrounding the opening. Another method which has been proposed in cases where the tube has a helical fin is to thread a nut-like bearing element on the fin having a cylindrical exterior surface of the proper diameter to engage the surface of the support surrounding the opening.

Both of the above proposals are objectionable not only because of the cost of the additional metal necessary but also because of the time required to process the bearing and to install the same.

It is one of the principal objects of this invention to overcome the above objections by providing a finned tube having an integral cylindrical bearing portion intermediate its ends of a diameter approximating the diameter of the opening through the tube supporting plate or member. In accordance with this invention a portion intermediate the ends of a length of finned tubing is

enlarged or expanded to form a bearing with a cylindrical exterior surface having a diameter at least equal to the outside diameter of the fins on the tube and adapted to have a bearing engagement with the surface of the supporting member surrounding the opening through the latter.

One method of accomplishing the above results is to expand or enlarge a selected intermediate portion of a finned tube and thereafter roll or otherwise flatten the fins on this portion to form the latter with a cylindrical exterior bearing surface of the proper diameter.

Another method which is applicable in cases where a helical fin is developed from the outer surface of the tube is to initially reduce the portion of the tube on which it is desired to form the bearing so that the fin forming means escapes this portion of the tube or, in other words, leaves the same perfectly cylindrical. After the fin has been formed on the desired portions of the tube, the reduced portion is expanded or enlarged to a diameter at least equal to the outside diameter of the fin.

A further object of this invention is to expand the intermediate bearing portions after the finned tubes are positioned relative to their respective supporting members so that the cylindrical surfaces of the bearing portions are intimately engaged with the adjacent surfaces of the supporting members.

The foregoing, as well as other objects, will be made more apparent as this description proceeds, especially when considered in connection with the accompanying drawing, wherein:

Figure 1 is a fragmentary longitudinal sectional view through a heat exchange device embodying finned tubes constructed in accordance with this invention;

Figure 2 is an enlarged fragmentary longitudinal sectional view through one of the finned tubes employed in the heat exchange device shown in Figure 1;

Figure 3 is a fragmentary longitudinal sectional view of one type of equipment that may be employed to form the fins on the tubes;

Figure 4 is a longitudinal sectional view showing a slightly modified form of finned tube; and

Figure 5 is a longitudinal sectional view showing the tube in Figure 4 prior to forming the intermediate bearing portion on the tube.

In Figure 1 of the drawing I have shown a typical heat exchange device 10 having a shell 11 and having headers 12 and 13 at opposite ends of the shell. The header at one end of the shell communicates with the header at the other end

by a plurality of tubes 14 having the opposite ends respectively supported in openings formed in the inner walls of the headers.

The tubes 14 are provided with fins 15 on the exterior surface thereof in order to facilitate the transfer of heat between the fluid in the shell and the fluid flowing from one header to the other through the tubes 14. The tubes illustrated herein have integral fins because such a construction has many advantages over constructions wherein the fin is formed separately and soldered or otherwise bonded to the outer surface of the tube. One advantage is that the loss through the joint existing in an attached fin construction is eliminated and greater thermal conductivity is obtained with a given amount of radiating area. Another advantage is that the need for solder or other bonding agents is eliminated and, as a result, the cost of manufacture is reduced.

The openings in the inner wall of at least one of the headers are of sufficient diameter to enable extending the finned tubes endwise through the openings during assembly or replacement of the tubes. In the present instance the openings through both the inner header walls are of a diameter at least equal to the outside diameter of the fins on the tubes so as to enable the latter to be assembled from either end of the device.

The opposite ends of the tubes are devoid of fins and are expanded or enlarged to have a bearing engagement with the surfaces of the header walls surrounding the openings. If desired, the end portions of the tubes may be expanded into intimate contact with the surfaces of the inner header walls surrounding the openings so as to prevent any possibility of movement of the tube ends relative to these walls.

In many installations the length of the tubes is such as to require supporting the tubes intermediate the ends and suitable plates 16 are provided for this purpose. The plates 16 are anchored in any suitable manner in the shell and are provided with openings 17 of the same diameter as the openings through the header plates 12 and 13.

Difficulty has been encountered in the past in providing an intermediate support for the finned tubes which is not only economical to produce but which also avoids any possibility of the tubes moving relative to the supporting plates either during shipment or during operation of the equipment in connection with which the tubes are used. This problem is greatly aggravated by the fins on the tubes and by the necessity of being able to freely pass the tubes endwise through the openings in the supports either during assembly or replacement. The edges of the fins do not afford sufficient bearing area to adequately support the tubes on their respective supports and it is, of course, not possible to strip portions of the fins from the tube to provide extended intermediate bearing areas because such practice would result in a construction wherein the diameter of the intermediate bearing supporting surface would necessarily have to be less than the diameter of the fins. This would preclude passing the tubes through the supporting plates in the manner previously described.

In Figure 2 of the drawing I have shown one form of tube which solves the above problem simply and economically. In detail, the tube shown in Figure 2 has an intermediate portion 18 which is enlarged or expanded and the fins 15 on this portion are flattened to provide a smooth

bearing surface 19 of a diameter at least as great as the outside diameter of the fins 15. The fins 15 on the portion 18 may be rolled down or drawn through a suitable die after the portion 18 is enlarged or expanded. In either case the tubes are provided with intermediate bearing portions of the same diameter as the enlarged ends of the tubes. This construction enables the tubes to be freely passed through the openings in the supporting plates and, at the same time, renders it possible to provide an extended bearing contact with the surfaces of the supporting plates surrounding the openings therethrough. The intermediate bearing portions on the finned tubes may be expanded into intimate contact with the adjacent surfaces of their respective supports in the same manner as the ends of the tubes, if desired.

In Figure 4 of the drawing I have shown another type of tube which may be successfully employed to solve the tube supporting problem outlined above. As shown in Figure 5, the tube is reduced intermediate the ends, as at 20, prior to developing the fins 15' from the outer surface of the tube so that the tube forming mechanism will escape the reduced portion and leave the same smooth.

In connection with the above attention is directed to Figure 3 wherein one type apparatus is shown for forming a helical integral fin on the tube. The apparatus selected for the purpose of illustration is similar to the one shown in the A. A. Locke Patent 1,761,733, dated June 3, 1930. Briefly described, the apparatus comprises a series of dies 21 spaced from each other in the direction of length of the tube. Each of the dies comprises a pair of members 22 having spaced pressure surfaces extending transversely of the axis of the tube at an angle corresponding to the pitch of the helix. The members 22 of the first die are formed with knife edges which serve to cut the initial grooves 23 and 24 in the wall of the tube. The surfaces of the cutting members 22 are non-parallel and are slightly converging in the forward direction of rotation of the tube so as to impart a wedging action on the metal between the grooves 23 and 24 to decrease the width of this metal. The succeeding dies continue the squeezing action for reducing the metal between convolutions of the grooves and these dies are arranged in such a manner that they come successively into action during the advance of the tube. Thus, the metal between convolutions is gradually forced radially outward until it finally produces the finished helical fin which is wider at the point of integral connection with the outer surface of the tube and tapers to a substantial knife edge.

The dies, of course, escape the reduced intermediate portion of the tube and, as a result, leave this portion perfectly smooth. Upon completion of the fin forming operation, the intermediate portion 20 is expanded or enlarged as shown at 20' in Figure 4 to a diameter at least as great as the outside diameter of the fin on the tube. If desired, the reduced portions may be expanded after the tubes are positioned in the openings in the supporting plates so as to firmly engage the plates and prevent any possibility of shifting movement of the tubes relative to the plates either during operation or shipment of the assembly.

Tubes constructed in accordance with the above may be readily passed through the openings in the supporting plates during assembly and are capable of being rigidly supported by the plates

because the enlarged portions form extended bearing surfaces of sufficient dimension to firmly contact the surfaces of the plates surrounding the openings therethrough. Moreover, the cost of forming the tubes is minimized because it enables the tubes to be rigidly supported intermediate the ends thereof without the necessity of forming separate metal bearing elements and attaching the same to the tubes.

What I claim as my invention is:

The method of forming a finned tube to enable the same to be supported intermediate the ends in an opening having a diameter at least as great

as the outside diameter of the fins, comprising the steps of providing a length of tubing having outwardly projecting fins extending from a point adjacent one end of the tubing to a point adjacent the opposite end, forming a cylindrical bearing surface on the finned tubing intermediate the ends to a diameter approximating the diameter of the opening by expanding a portion of the tubing intermediate the ends and by bending the fins to overlap each other and form a substantially flattened surface on the expanded portion.

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