Dec. 5, 1961 C. S. SIMPELAAR 3,011,466

METHOD OF MAKING A FIN COLLAR

Filed May 4, 1955

Fig. 2

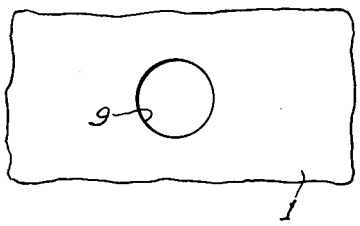


Fig. 1

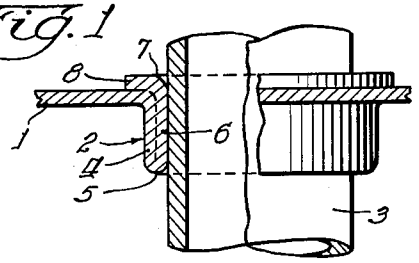


Fig. 3

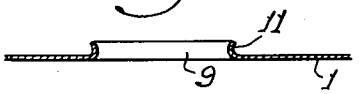


Fig. 6

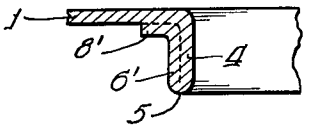


Fig. 4

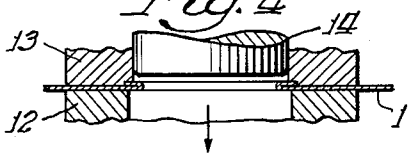


Fig. 7

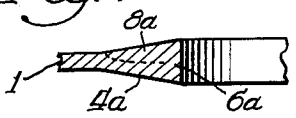
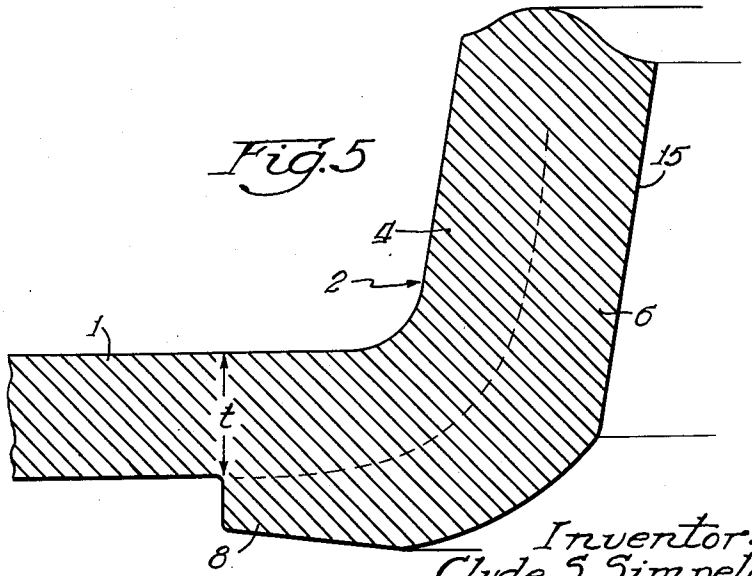


Fig. 5



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3,011,466

METHOD OF MAKING A FIN COLLAR

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1 Claim. (Cl. 113—118)

The invention relates to heat exchange structures and more particularly to a novel method of making a fin collar structure.

It has been common practice to attach sheet-like fin members to a plurality of fluid conducting tubes of a heat exchanger to increase the heat transfer efficiency of the exchange structure. The fin elements are normally attached to the fluid conducting tubes by either of two commonly employed methods, one of which is to form the fin elements with flange portions adapted to engage the tube or tubes, the two being secured in heat conducting relation by suitably bonding the contacting elements. Another method commonly employed is to form a similar flange about the periphery of the opening in the fin material through which the tube is to extend, the opening being of substantially the same size and shape as the external dimensions of the tube, whereby the latter may be inserted through the opening, and following the assembly of the desired number of fin members, the tube may be expanded to frictionally engage the flange of the fin element and provide a frictional interlock therebetween. As sheet metal stock utilized for fins of this type is relatively thin material and the attaching flange is usually stamped or drawn from the sheet, a stretching of the metal occurs, resulting in a decrease in the thickness of the metal forming the flange and at the same time decreasing the strength thereof.

This type of construction also presents an additional disadvantage in connection with the heat transfer characteristics of the structure. Flanges of this type are generally formed of tubular shape, the axis of which extends transversely to the plane of the fin material, usually perpendicular thereto, the material forming the flange being provided with a right angle bend at the juncture of the collar with the body of the fin. As a result of the reduction in material thickness resulting from the drawing or stamping of the flange and the right angle bend formed therein, the connecting material at such bend normally is of considerably less thickness than either the body of the material or the remainder of the flange or collar. This result normally occurs at any time a right angle bend is made in a sheet of material, the material stretching at the exterior surface of the bend and thus reduced in thickness. As the efficiency of the fin is dependent, among other things, on the thickness of the material along the heat conducting path, any point of minimum thickness may be considered as one of the determining factors with respect to the heat conductivity and dissipation of the remaining fin structure. In the present instance as the collar is in heat transfer engagement with the fluid conducting tube, the heat must flow from the collar around the bend at the juncture of the latter and the fin body and along the latter. If the material connecting the fin collar with the fin body is of insufficient thickness, a loss in heat transfer efficiency of the fin will result. It has therefore normally been necessary in the past to utilize fin material of sufficient thickness to insure adequate material at the juncture of the completed fin collar and the fin body, necessitating the use of heavier material than that actually necessary to provide the desired heat transfer characteristics of the fin body.

The present invention has among its objects the production of a fin collar structure which eliminates the disadvantages above referred to and wherein the thickness of

the material of the formed fin collar is greater adjacent the juncture of the collar and the fin body than the thickness of the material comprising the latter, eliminating the heat transfer bottleneck heretofore referred to and enabling the use of thinner fin material, at the same time retaining equivalent or better efficiency than prior structures.

Another object of the invention is the production of such a fin collar which provides improved heat transfer contact between the fin collar and the fluid conducting tube as well as a collar having greater strength and improved tensile characteristics.

A further object of the invention is the utilization of a novel method of forming such a fin collar whereby perfect sizing may be obtained in the finished collar, the physical as well as operational characteristics of the structure are improved and uniformly improved results are provided with fin stock having commercial tolerances.

A further object of the invention is the production of such a fin collar and novel method of forming the same wherein the elements of the fin collar are substantially bonded or welded together during the forming operations whereby the fin collar, which is formed from two thicknesses of material, provides the heat conductivity of solid or homogeneous material.

A further object of the invention is the production of such a novel fin collar which provides a fin which is of greater thicknesses adjacent its connection with the fluid conducting tube than it is at a point spaced from the tube, whereby the advantages of a tapered fin are achieved.

Many other objects and advantages of the construction herein shown and described will be obvious to those skilled in the art from the disclosure herein given.

To this end my invention consists in the novel construction, arrangement and combination of parts herein shown and described, and more particularly pointed out in the claim.

In the drawings, wherein like reference characters indicate like or corresponding parts:

FIG. 1 is a sectional view through a fin collar constructed in accordance with the present invention;

FIG. 2 is a top plan view of a portion of a fin element illustrating the first step in the formation of a fin collar;

FIG. 3 is a sectional view through a portion of a fin element at an intermediate stage in the formation of a fin element at an intermediate stage in the formation of a collar;

FIG. 4 is a sectional view similar to FIG. 3 illustrating a subsequent stage of operation;

FIG. 5 is an enlarged sectional view similar to FIG. 1 showing the details of construction;

FIG. 6 is a sectional view similar to FIG. 1 illustrating a modified form of construction; and

FIG. 7 is a sectional view similar to FIG. 1 illustrating another modification.

The invention contemplates the utilization of material which is displaced during manufacture from the fin element to provide an opening through which the fluid conducting tube may be inserted, to form a fin collar of greater thickness than that of the original stock, such increased thickness extending to a point along the fin element where the thickness of the latter is substantially that of the original thickness of the material comprising the same. Preferably such material is extended to a point whereby a tapered fin effect is produced. In one form of the invention, the collar may be provided with a cross sectional shape which may actually taper outwardly from the engagement thereof with the fluid conducting tube.

Referring to FIGS. 1, 2 and 3 and 4, FIG. 1 illustrates a sectional view of a fin collar constructed in accordance with the present invention wherein the reference numeral 1 indicates generally a fin body of relatively thin sheet

material having desired heat conductivity characteristics, as for example, aluminum, copper, or the like. The embodiment illustrated in FIG. 1 is provided with a cylindrical collar 2 adapted to encircle a fluid conducting tube 3. The material forming the fin body 1 usually will be relatively thin compared with the thickness of the tube 3 and may, for example, run from .012" to .014" in thickness, while the tube may be of any suitable thickness. As illustrated in section in FIG. 1, the collar 2 is formed from two thicknesses of the stock of the fin body 1 with the material extending downwardly from the fin body as indicated at 4, thence folded back upon itself, forming the end 5 of the collar, with the inner portion 6 extending generally parallel to the portion 4 and the free end being bent or flared outwardly as indicated at 7 to form an annular flange portion 8 positioned adjacent the opposite face of the body 1.

The collar illustrated in FIG. 1 may be formed in the manner illustrated in FIGS. 2, 3 and 4, FIG. 2 illustrating the first operation on the body 1, comprising the forming of an opening or hole 9 in the fin body. The second operation may be the flanging or flaring of the material adjacent the periphery of the opening 9 to form an outwardly extending flange portion 11, which by suitable die structure 12, 13 and 14 may be formed down upon the body of the sheet as illustrated in FIG. 4, following which the doubled portion of the fin may be bent at right angles to the plane of the body by a suitable die member 14. As a practical matter the dies 12, 13 and 14 may be so designed that the forming operations illustrated in FIG. 4 may take place as a single operation rather than several individual operations. In forming the collar opening 9, preferably little or no material is removed from the fin body, all of the material being utilized in the formation of the collar. However, as a practical matter it may be costly as well as difficult to fabricate a die capable of such operation, and it will be apparent to those skilled in the art that dies may be readily constructed utilizing the severing or punching out of a relatively small portion of the fin body which, if suitably designed, may be of progressive type.

In forming the collar 2, illustrated in FIG. 1 by the method illustrated in FIGS. 2, 3 and 4, the working of the material tends to harden the collar structure, making a stronger collar and tending to provide the same with an increased degree of resilience. Fig. 5 illustrates an enlarged or magnified section of an actual fin collar constructed in accordance with the invention and it will be noted that the combined thickness of the portions 4 and 6 is greater than the fin gauge but is less than twice the metal thickness of the material forming the fin body 1. The final forming operation illustrated in FIG. 4 also readily adapts itself to an accurate sizing operation as well as a forming operation, whereby the internal diameter of the collar may be accurately controlled. At the same time this method of fabrication results in the production of a polished or burnished contact surface 15 along the inner face of the portion 6, of a length approximately three times the fin thickness, resulting in exceptionally high heat conduction efficiency between the tube 3 and the collar 2 and fin 1. It will be apparent from reference to FIG. 5 that the flange 8 provides a substantial increase in the effective thickness of the fin adjacent the collar 2. Obviously, in this construction the critical thickness of the fin is that adjacent the edge of the portion 8 indicated by the letter *t* in FIG. 5, representing the normal thickness of the fin stock and the location thereof is removed approximately three times the thickness of the fin body 1 from the tube 3, whereas in previous structures the critical thickness has been located at the bend or juncture of the collar with the tube body and thus substantially adjacent the exterior of the tube.

I have found that a fin collar of non-ferrous metal, made in accordance with the method herein described functions with the same efficiency insofar as the formed collar is concerned as if the collar were made of solid material rather than a double thickness of material, the forming action in FIG. 4, in effect, welding the portions 4 and 6 as an integral, substantially homogeneous structure. While cold pressure welding has been in use for some time, such type of welding normally involves at least a seventy percent reduction in the thickness of the portions of the material to which pressure is applied. I am of the belief that the present results which are achieved at room temperature with a reduction in the thickness of the material of approximately only ten to fifteen percent due to the fact that in the forming operation of FIG. 4, not only is pressure applied between the two portions to be welded, but a slight amount of planar travel between the portions 4 and 6 is produced during the forming operation which together with the applied pressure results in what I consider for all practical purposes, particularly in connection with the invention, as a cold pressure weld. It will be particularly noted that these results are obtained with pressures far below those required in previous methods. Consequently it ie believed that satisfactory uniting by the present method could be obtained with reductions from approximately ten to seventy percent.

The dotted lines in between the portions 4 and 6, in FIG. 1, and between corresponding portions in FIGS. 5, 6, and 7, are intended to show the approximate ultimate proportions of the portions 4 and 6 and not intended to indicate a division therebetween.

While FIG. 1 illustrates the portion 6 of the fin collar as being turned inwardly and thus defining the inner diameter of the collar, such portion may be turned outwardly to define the exterior diameter of the collar, such a construction being illustrated in FIG. 6, wherein the portion 6' is positioned at the exterior of the portion 4 and the flange 8' at the collar side of the fin body 1, and could generally be produced in a die structure similar to that illustrated in FIG. 4 with the fin stock reversed to position the flange 11 below the fin material instead of above it, as illustrated. In some instances it may be desirable to provide the fin collar with an outwardly tapering shape such as that illustrated in FIG. 7, wherein the material of the fin body is illustrated in FIG. 4, and by means of suitable dies the enlarged peripheral portion of the fin is shaped as illustrated in FIG. 7, wherein the portion 4*a* corresponds generally to the portion 4 illustrated in FIG. 1, the portion 6*a* to the portion 6 and the portion 8*a* to the portion 8. It will be noted that this construction also provides a contacting face having an axial length of approximately three times the fin thickness.

While the construction illustrated in FIG. 6 has been found to work very satisfactorily, I normally prefer to employ the construction illustrated in FIG. 1, as between these two formed, as the latter construction does not involve the degree of stretching of the portion 6 as that illustrated in FIG. 6.

Having thus described my invention, it is obvious that various immaterial modifications may be made in the same without departing from the spirit of my invention; hence, I do not wish to be understood as limiting myself to the exact form, construction, arrangement and method, and combination of parts herein shown and described or uses mentioned.

What I claim as new and desire to secure by Letters Patent is:

The method of forming a fin collar of a fin body for heat exchanger tubes, which comprises the following steps: forming an opening in a sheet of heat conductive material of the fin body, deforming the material defining the periphery of the opening out of the plane of the sheet of heat conductive material to provide a double thickness of material adjacent to and surrounding the opening and parallel to the plane of the surface of the sheet of heat conductive material and in intimate metallic contact and heat-transfer relationship therewith so that the double thickness of the heat conductive material provides the

heat conductivity of substantially homogeneous material, and bending the double thickness of material intermediate the radial edges thereof to form a tubular collar of greater thickness than said sheet of heat conductive material and a flange extending radially of said collar and in intimate metallic contact with said sheet surface, said collar having its axis extending normal to the plane of the sheet of heat conductive material whereby the heat conductive material of the formed flanged collar is greater adjacent the juncture of the collar and the fin body than the thickness of the sheet of heat conductive material providing the fin body.

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