Jan 6, 1931. P. C. KALLOCH, JR 1,787,942

MANUFACTURE OF HEAT EXCHANGE APPARATUS

Filed Dec. 15, 1928

Fig. 1.

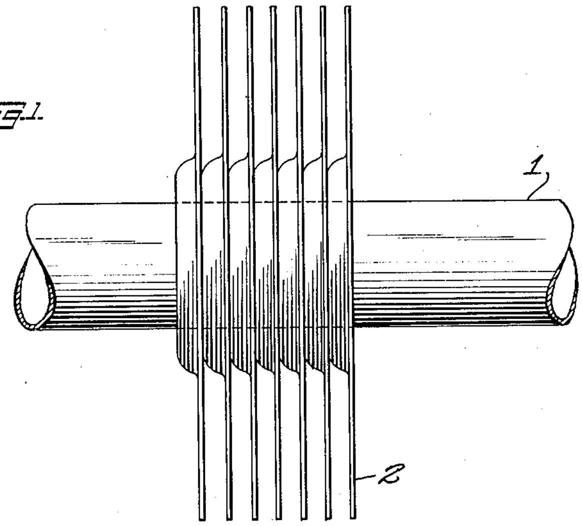


Fig. 2.

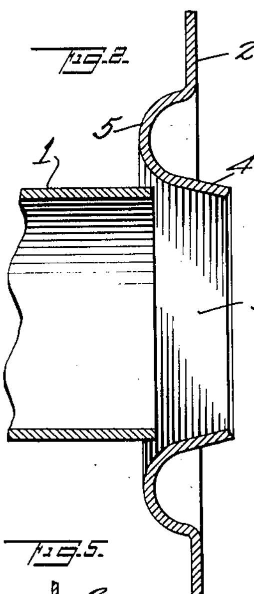


Fig. 3.

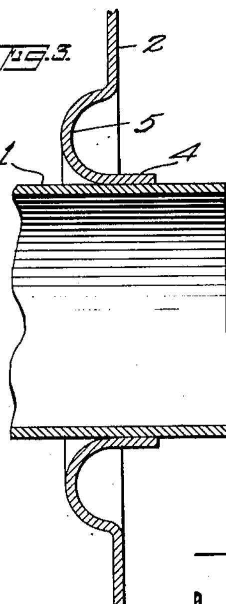


Fig. 4.

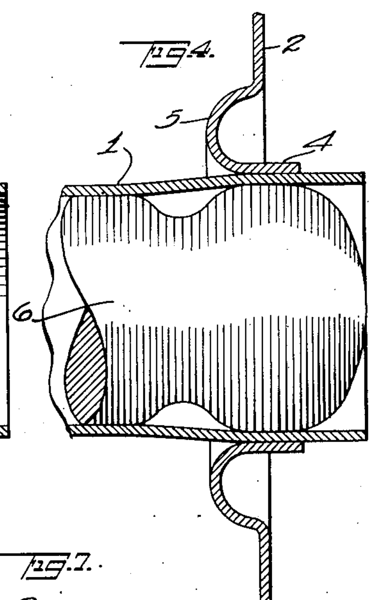


Fig. 5.

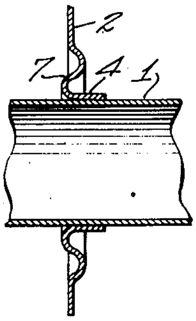


Fig. 6.

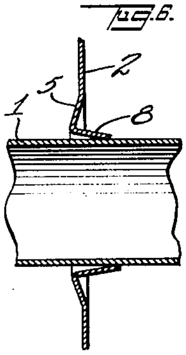
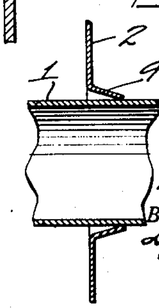


Fig. 7.



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UNITED STATES PATENT OFFICE

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MANUFACTURE OF HEAT-EXCHANGE APPARATUS

Application filed December 15, 1928. Serial No. 326,343.

My invention relates to manufacture of heat exchange apparatus for heating or cooling a medium surrounding the apparatus, or for heating or cooling a medium contained within or passed through the apparatus, as for example radiators for the heating of buildings, the cooling of automobile motors, etc.

Specifically the invention provides for a method of attachment of members having extended surfaces, such as fins or flanges, to the tube or body of the heat exchange apparatus, for increasing the efficiency of the unit.

Various methods have been employed to provide such a tube with extended surfaces. One such method consists in casting extensions, ribs or fins integral with the tube. This method is very expensive, and furthermore can be used only with certain alloys having the properties which enable them to be readily cast.

Another method consists in forming sheet metal fins with perforations slightly greater than the external diameter of the tube, spacing such fins along the tube and securing them thereto by soldering, welding, brazing or dipping. This method is objectionable in that the joint is likely to wear or work loose by reason of unequal expansion and contraction of fin and tube. Frequently gaps are left between the fin and tube so that a poor contact is obtained which results in poor transmission of heat.

According to a third method fins perforated as above mentioned are formed of comparatively thick sheet metal and after being spaced upon the tube the latter is expanded by a mandrel so as to cause the fins to become embedded within the material of the tube. Since copper has a high coefficient of heat conductivity, it is a desirable material to use, but on the other hand there is a tendency for the fin to buckle or warp and in order that such tendency may be successfully resisted the copper sheet must be of at least .026″ thickness. The use of thinner sheets is objectionable not only on account of buckling, but also because it cuts down the efficiency of the heat transmission.

In accordance with the present invention the fins are formed of thin resilient sheet metal, for example copper, in which an opening is punched and the material surrounding such opening drawn to form a flange. The opening is substantially smaller in diameter than the external diameter of the tube, and the tube is forced into such opening, thereby flexing the flange or the part by which it is united to the body of the fin. The shape of the flange is such that when the flange or its uniting part is flexed the flange extends longitudinally along the surface of the tube for a substantial distance. Furthermore, by reason of the resilient character of the material the flange presses tightly against the tube. The result is that although the connection or union between the fin and tube is frictional, it is so strong that there will be no shifting of the fins upon the tube under conditions of actual use, and furthermore such union provides for very efficient heat transmission.

The binding action of the fin upon the tube may be increased by passing a mandrel through the tube and thereby causing it to expand.

In order that the invention may be more fully understood reference is hereby made to the accompanying drawing of which Fig. 1 is a side view of a tube upon which a number of fins are mounted in accordance with my invention.

Fig. 2 is a vertical section showing a tube and fin before the latter is mounted on the former.

Fig. 3 is a similar view showing the fin mounted upon the tube without expansion of the latter.

Fig. 4 is a view similar to Fig. 3 after the tube has been expanded by a mandrel.

Figs. 5, 6 and 7 are vertical sections of modified forms of fins mounted upon a tube.

The tube 1 may be of any suitable material, for example copper or iron. The fin 2 may be stamped or drawn from a sheet of resilient metal or alloy into the form shown in Fig. 2. It will be noted that the diameter of the aperture 3 formed therein is substantially smaller than the exterior diameter of the tube 1. The material surrounding the aperture 3 forms a flange 4, preferably united to the body 2 by a curved or bowed spring portion 5.

In order to mount the fins upon the tube, the former may be placed in a jig having grooves for receiving each of the fins and holding same in spaced relation while the tube 1 is moved in a longitudinal direction and successively enters the apertures 3 of said fins, or the tube may be held while the fins are moved to force them upon the tube. By reason of the flexure of the bow portion 5, the flange 4 assumes the position shown in Fig. 3 in which it is parallel to the surface of the tube and extends along the same in close contact therewith for a substantial distance. Such contact provides for very efficient heat transmission, and furthermore by reason of the resilience of the fin material, the pressure between the flange 4 and tube 1 is considerable and the fin is very firmly held by friction against displacement. Such union may if desired be further strengthened by causing the expansion of the tube by passing a mandrel 6 therethrough, as shown in Fig. 4.

It is obvious that the material in proximity to the aperture 3 may take a great variety of forms some of which are illustrated. For example, Fig. 5 shows a flange 4 united to the body of fin 2 by a reversely curved portion 7.

In Fig. 6 a flange 8 is united to body 2 by portion 5 and in Fig. 7 a flange 9 is directly united to the body 2.

Among the advantages of my invention are the following:

(1) The fins may be held on the tube with sufficient firmness without expanding the latter, so that fins and tubes of any desired material and thickness may be employed.

(2) The area of contact between fin and tube may be increased, whereby flow of heat is facilitated and efficiency increased.

(3) In case the tube should be expanded no warping or buckling of fins will occur, and thinner metal may, therefore, be used in the making of the fin.

(4) The area of contact of fin and tube does not depend on the thickness of the fin material so that thinner fin material may be used without loss of efficiency.

(5) The extent to which the tube may be expanded without causing any buckling of the fin is increased by reason of the stretching of the flange and flexure of that portion of the fin between the flange and body portion.

(6) The fin is stiffened by the flange and curved or grooved portion between flange and body.

The openings or perforations 3 need not be circular, but may be oval or other desired shape. Each fin may be formed with a plurality of perforations and a tube passed through each. Such perforations may be situated in any desired position within the fin.

The fins may be of any desired size or shape, and the units formed by mounting same on tubes may be assembled side by side or in banks one above another. The cross section of the tubes may be circular, oval or other desired shape.

My invention is not limited to the use of fins having perforations 3 of smaller diameter than the external diameter of the tube 1. The fin may be of the form shown in Fig. 3 before being placed on the tube and the latter then expanded by use of a mandrel 6 sufficiently to cause the fin to be firmly united to the tube by frictional engagement therewith.

The degree of resiliency of the fin materials may vary widely and various materials may be used, as for example, but without limitation thereto, copper, aluminum, steel, nickel, and various alloys of such metals, for example monel metal. Any metal or alloy having sufficient ductility and resiliency for forming the flange 4 and curved portion 5 may be used.

Having now described my invention, what I claim is:

1. A heat exchange apparatus comprising a tubular support and a fin mounted thereon, said fin consisting of a perforated sheet of relatively elastic sheet metal having an integral flange surrounding the perforation, said flange being expanded upon said support to grip the same by its contraction and contacting with said tubular support for a substantial distance along the length thereof and being united to the body of the fin by a relatively yieldable bowed portion which is flexed within its elastic limit.

2. The method of making tubes having fins which consists in taking a relatively elastic sheet, forming therein a flanged aperture and a bowed portion intermediate the flange and the outer portion of the sheet adapted to yield to provide spring resistance, and inserting a tube through said flange and expanding the latter against the yieldable resistance of said bowed portion by the action of the tube to cause said flange to grip said tube over an extended surface without distorting the outer portion of the fin.

3. The method of making tubes having fins which consists in taking a metallic sheet, forming therein a flanged aperture and a bowed spring portion intermediate the flange and the outer portion of the sheet, and inserting a tube of greater diameter than that of said flange through said flange to expand the latter against the yieldable resistance of said spring portion and cause said flange to frictionally grip said tube by the combined effect of the contracting action of the flange and the spring portion, distortion of the portion of the fin beyond the spring portion being prevented by transmitting the stresses due to the flange expansion to said spring portion.

4. The method of making tubes having fins

which consists in taking a relatively elastic metallic sheet, forming therein a flanged aperture and a bowed portion intermediate the flange and the outer portion of the sheet of relatively greater yieldability than the flange and the outer portion of the fin, inserting a relatively rigid tube of greater diameter than that of said flange through said flange to expand the latter against the yieldable resistance of said bowed portion and cause said flange to frictionally grip said tube by the combined effect of the contracting action of the flange and the bowed portion, distortion of the portion of the fin beyond the bowed portion being prevented by transmitting the stresses due to the flange expansion to said bowed portion, and expanding the tube, by distortion thereof to increase the gripping action.

5. In apparatus of the character described, a fin of relatively elastic metal having a flanged aperture and a bowed portion of relatively greater yieldability formed therein at the juncture of the flange with the body of the fin, and a relatively rigid tube received within said flange and expanding the latter against the spring resistance of said bowed portion, said flange under the contracting action due to the inherent elasticity thereof and under the spring action of said bowed portion frictionally gripping said tube, and said bowed portion receiving the stresses due to the expansion of the flange for preventing the distortion of the body portion of the fin.

In testimony whereof, I have signed my name hereto.

PARKER C. KALLOCH, Jr.