Feb. 16, 1954 E. BRUEGGER 2,669,012

METHOD FOR MAKING FINNED TUBES

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Fig. 1.

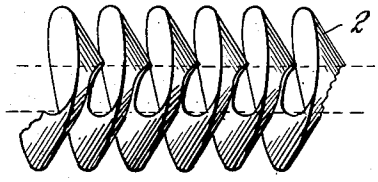


Fig. 2.

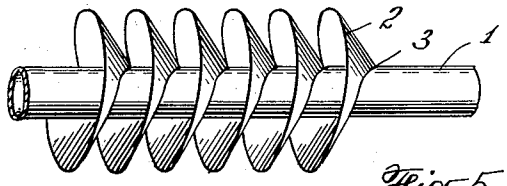


Fig. 3.

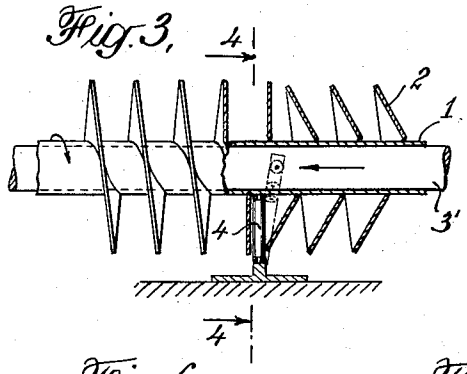


Fig. 4.

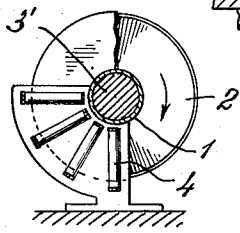


Fig. 5.

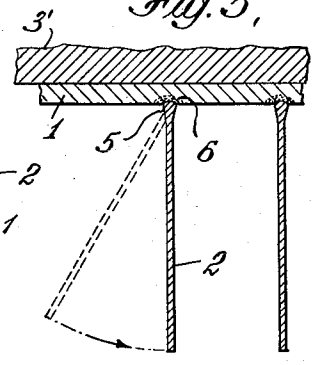


Fig. 6.

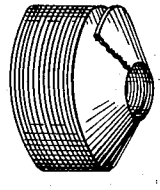


Fig. 7.

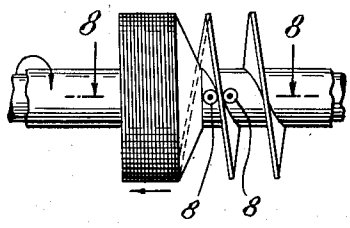


Fig. 8.

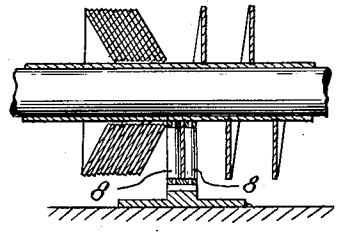


Fig. 9.

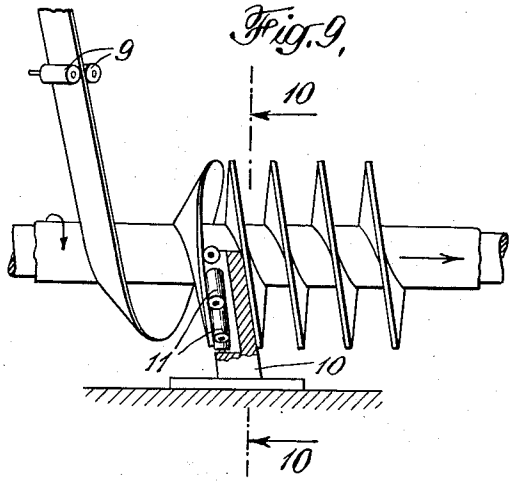
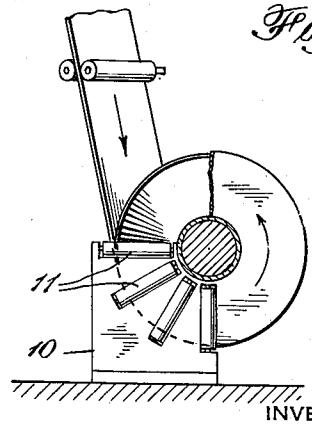


Fig. 10.



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Fig. 11,

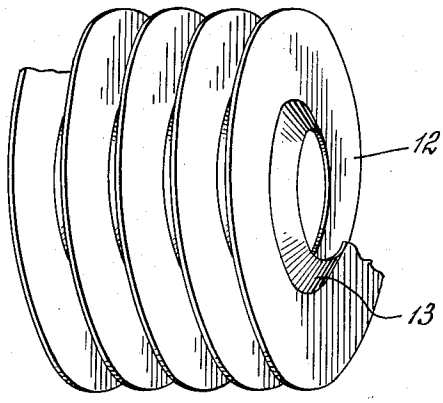




Fig. 12,

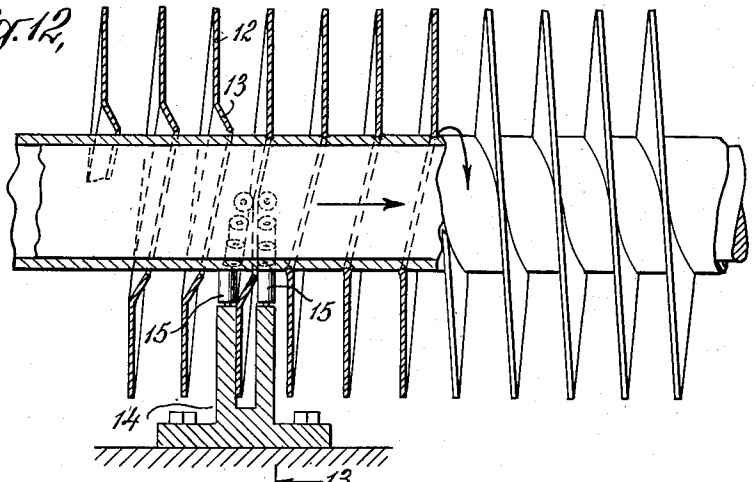
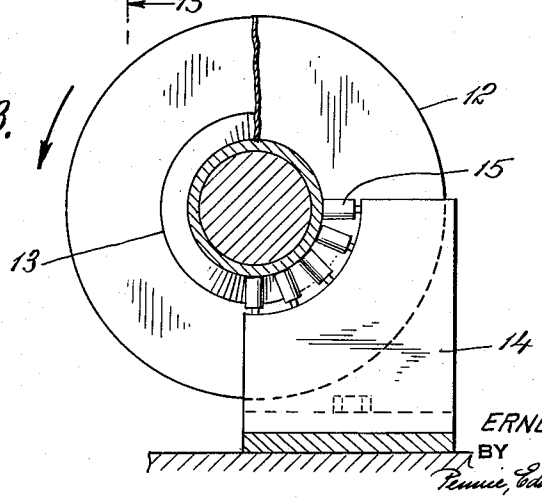


Fig. 13.



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METHOD FOR MAKING FINNED TUBES

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Application December 23, 1948, Serial No. 67,005

4 Claims. (Cl. 29—157.3)

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This invention relates to methods for making heat-transfer tubes having an extended surface in the form of a spirally wound fin.

The principal object of the invention is to provide a method for making a heat-transfer element of this character wherein the fin is fitted to the tube by the pressure of the fin against the tube surface, which pressure, due to the method of manufacture, is sufficient to produce a heat-transfer union equal to that obtainable by embedding the edge of the fin in the metal of the tube wall in the manner shown, for example, in U. S. Patent No. 1,668,534, dated May 1, 1928, to Berg. The method of this application is particularly advantageous where the fin is of soft metal such as aluminum which is difficult to wind sufficiently tight by the usual winding methods to produce a satisfactory heat-conducting joint.

A further object of the invention is to provide a finned heat-transfer tube wherein the tube wall is not weakened by grooving, scoring, or any deformation, making it more liable to rupture from internal or external pressure or mechanical stress.

A further object of the invention is to provide a method of making heat-transfer elements of the kind described, which method is characterized by low cost, high rate of production and a uniform product.

In the accompanying drawings I have illustrated the successive steps followed in the manufacture of said tube in accordance with the best methods now known to me. I have also illustrated the essential elements of the apparatus required to carry the process into effect.

In said drawings,

Fig. 1 shows the precoiled fin as it is used in one method herein described;

Fig. 2 shows the second step in the process employing the precoiled fin illustrated in Fig. 1;

Fig. 3 shows the third step in the process;

Fig. 4 is a transverse section on line 4—4 of Fig. 3;

Fig. 5 is an enlarged section of a tube made by the method illustrated in Figs. 1 to 4 showing particularly the heat-transfer union between the tube and fin;

Figs. 6 and 7 show the successive steps of a process similar to that shown in Figs. 1 to 4, but wherein two of the steps are combined into a single operation;

Fig. 8 is a section on line 8—8 of Fig. 7;

Figs. 9 and 10 show the successive steps of a further modification;

Fig. 11 is an enlarged perspective view of a modified form of fin which may be advantageously employed particularly for wide fins;

Fig. 12 is a longitudinal sectional view showing the application of the fin of Fig. 11 to the tube; and

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Fig. 13 is a section on line 13—13 of Fig. 12.

Referring to the drawings, particularly to Fig. 1, my improved heat transfer element comprises a continuous tube 1 for the circulation of the liquid to be cooled or heated, as the case may be, and an extended helical fin 2 which is wrapped around said tube to form an extended heat-transfer surface which depends for its efficiency on the rate of heat-transfer from the metal of the tube 1 through the joint 3 at the base of the fin 2.

In carrying out the process as disclosed in Figs. 1 to 4, inclusive, the ribbon forming the fin is first precoiled as shown in Fig. 1 in the form of a continuous helix which has its radial plane at an angle to the axis of the helix so that when the coiled fin is extended along the tube, as shown in Fig. 2, the plane of the surface of the helix will be at an angle to the axis of the tube.

In the manufacture of my improved heat-transfer element the tube may be supplied in continuous lengths or in previously cut sections. Likewise the helically coiled fin material may be supplied continuously or in sections of a length to correspond with the lengths of tube to be supplied. After forming the helix and extending it along the tube as shown in Fig. 2, the metal forming the helix is turned upward into position where the plane of the ribbon is normal to the axis of the tube as shown in Figs. 3 and 4. This operation may readily be accomplished by a succession of rollers 4 such as here shown wherein the axes of the rollers are successively at different angles to the axis of the tube with the final pair of rollers normal thereto.

The effect of this operation is to further reduce the diameter of the internal bore of the helix so that the metal of the fin is pressed into the metal of the tube to such an extent as to deform the softer metal and put the two contacting surfaces under permanent compression to thereby provide a heat-transfer contact of high heat-transfer efficiency.

In Fig. 5 I have diagrammatically illustrated the action that takes place as the metal at the base of the fin is compressed against the metal of the tube. The base of the fin as illustrated at 5 is mushroomed out as shown and pressed into the metal of the tube which is thereby compressed as indicated by the stippled areas 6, the relative deformation of the tube and fin depending on the relative hardness of the metal of which they are made.

The heat-transfer element produced by the above described process is quite as efficient as heat-transfer elements of the same dimensions manufactured in accordance with the Berg Patent No. 1,668,534. In addition, the heat-transfer element of the present application has the advantage that the tube material is not weakened by grooving and the cost of operation of

pre-coiling and applying the fin is considerably less than that required for producing a similar quantity of the Berg tube. Both the Berg machine and the machine used for carrying out the present process are wholly automatic in their operations but a machine capable of successfully carrying out the improved process may be operated at a much higher rate of speed than the Berg machine wherein the metal of the tube must be grooved in order to receive the edge of the fin material.

As shown in Figs. 3 and 4, the tube is supported on a mandrel 3' which is continuously rotated and may also be shifted longitudinally at a rate corresponding to the pitch of the helix of the fin of the finished tube, the rollers 4 being supported on a stationary base adjacent the mandrel. If desired the mandrel may be rotated but not shifted longitudinally and the rollers 4 mounted on a longitudinally moving carriage alongside the mandrel; both types of machines are old in the art and either type may be satisfactorily employed for carrying out the present process.

In Figs. 6, 7 and 8 I have illustrated a modification of the above described process. As here shown a closely coiled length of fin, Fig. 6, is placed on the tube without extending the helix in the manner shown in Fig. 2. The mandrel is rotated and shifted longitudinally with respect to a pair of rollers 8 supported alongside the mandrel with their axes radial to the axis of the mandrel and with their adjacent surfaces spaced apart a distance equal to the thickness of the fin. The leading end of the ribbon is soldered to the tube wall and the ribbon threaded between the rollers. As the tube is rotated and shifted axially past the rollers the fin is straightened up to radial position and the coils spaced to the desired distance apart. As the fin is straightened up to radial position the edge of the fin is pressed into the metal of the tube in the manner illustrated in Fig. 5.

In Figs. 9 and 10 I have illustrated a further modification of my invention. As here shown the ribbon is coiled simultaneously with its application to the tube. To this end the flat ribbon is fed into the machine through a pair of guide rollers 9 and thence coiled around the tube with its surface, in a direction across the width of the ribbon at an angle to the tube wall as in the previously described procedures. Supported adjacent the mandrel which rotates and shifts axially as previously described, is a frame 10 carrying a series of rollers 11 extending around a quarter turn of the tube and with their axes radial to the axis of the tube. As the tube is moved longitudinally past the frame 10 the turn of the fin which has just been coiled around the tube will be straightened into radial position, forming a good heat-conducting union with the tube as shown in Fig. 5.

In Figs. 11, 12 and 13 I have illustrated a further modification of my process, particularly suitable for wide fins. As here shown the fin is not formed of a flat ribbon as in the previously described processes, but instead the pre-coiled fin 12 is throughout the major outer portion of its width radial to the axis about which it is coiled but at its inner edge is bent away from the radial plane to an angle of about 30 degrees thereto as shown at 13. To apply the above described fin to the tube I provide a base 14 which is moved longitudinally with respect to the tube as above described, the base having two sets of arcuately disposed rollers 15 adapted to receive the edge 13 of the fin between and straightening

the fin so that through the entire width it is radial to the axis of the tube. To this end the rollers of the two sets converge in the direction of rotation of the tube as more fully shown in Fig. 12.

It will be understood that whereas I have disclosed several embodiments of my invention and the best methods and apparatus now known to me for carrying the invention into effect, the invention is not limited to the specific examples herein described but covers all such modifications thereof as fall within the scope of the appended claims.

I claim:

1. The method of making finned tubing which consists in forming a coil of a ribbon of metal about a tube in the form of a helix with the plane of a portion of the width of the ribbon inclined at a substantially uniform angle to the axis of the tube and with the inner edge of the helix unsecured to the tube wall and then bending such portion of the ribbon progressively to a plane substantially normal to the axis of the tube to thereby press the inner edge of the helix against and secure it to the wall of the tube to form a good heat-conducting joint therewith.

2. The method of making finned tubing which consists in forming a coil of a ribbon of metal about a tube in the form of a helix with the plane of the ribbon inclined at a substantially uniform angle to the axis of the tube and with the inner edge of the helix unsecured to the tube wall and then bending the ribbon to a plane substantially normal to the axis of the tube to thereby press the edge of the helix against and secure it to the wall of the tube to form a good heat-conducting joint therewith.

3. The method of making finned tubing which consists in coiling a ribbon of metal in the form of a helix with the plane of the ribbon uniformly inclined to the axis of the helix throughout the helix, assembling the helix on the tube with the inner edge of the helix unsecured to the tube wall and then progressively bending the ribbon to a plane substantially normal to the axis of the tube to thereby press the edge of the helix against and secure it to the wall of the tube to form a good heat-conducting joint therewith.

4. The method of making finned tubing which consists in advancing a ribbon of metal toward the tube with its surface at an angle to the axis of the tube, rotating the tube to coil the ribbon about the tube in the form of a helix with the plane of the ribbon uniformly inclined to the axis of the tube without securing the inner edge of the helix to the tube and bending the ribbon to a plane substantially normal to the axis of the tube to thereby press the inner edge of the helix against the wall of the tube to secure it to the tube and to form a good heat-conducting joint therewith.

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