MACHINE FOR FORMING FINNED HEAT TRANSFER TUBES

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This invention appertains to improvements in machines for forming finned heat transfer tubes and particularly relates to an improved machine for wrapping a strip of material spirally on a tube to form individual spiral fins on the exterior of the tube.

A primary object of this invention is to provide cooperating means for simultaneously moving a tube axially while rotating it about its axis; the rotation of the tube effecting the wrapping of the fin strip about the tube, and for deforming the strip, as it is coiled on edge about the tube, to ensure the creation of a smooth spiral fin which has its inner peripheral edge in proper heat transfer association with the exterior surface of the tube.

Another object of this invention is to provide means for rotating a tube while moving it longitudinally, as the strip is wrapped on edge concentrically about the exterior thereof, and to provide means driven in an exact synchronous speed with the tube for deforming the strip as it is being wound on the tube, the strip being deformed in an exact ratio of the finned tube external diameter to the external diameter of the tube itself.

A further object of this invention is to provide guide means over which the strip passes, as it leaves a holder, the guide means being formed and mounted to hold the strip taut and protect the strip against accidental deformation due to shock.

A still further object of this invention is to provide a drive means for rotating and longitudinally moving a tube, which drive means is adjustable to accommodate tubes of various diameters and to advance the tube longitudinally at ranging speeds, the latter function being important in providing control of the pitch of the fins wound on the tube from the strip.

A still further object of this invention is to form a smooth fin with a very low corrugated base or inner peripheral edge and, in this respect, to provide means for partially corrugating the strip while maintaining the rest of the strip free from strain and in a smooth condition, the corrugated portion forming the base or inner peripheral edges of the fins or tube side edge of the strip.

A further important object of this invention is to provide a novel means for rolling or extruding the smooth portion of the strip up to the corrugated portion, that is, the outer peripheral edges of the fins, as they are wound on the tube, such means embodying cooperating forming rolls between which such portion of the strip passes.

The forming rolls are rotatable about parallel axes perpendicular to the path of movement of the tube and receive the strip therebetween as it is starting to wind on the tube.

A still further important object of this invention is to provide means for relatively adjusting the rolls bodily towards and away from each other so as to adjust the pressure of the rolls on the strip and to provide means for relatively adjusting the rolls about an axis transverse to the axes of rotation of the rolls to change the angle of attack thereof on the strip.

Another important object of this invention is to provide fin guiding means through which the tube transversely passes in its axial motion so as to ensure that the fins being formed and correlated with the forming rolls such as to lead the strip, after it leaves the rolls, around the tube, while maintaining the fin in its formed position and under the stress imparted by the rolls.

A further important object of this invention resides in the provision of a rotatable support at the delivery or outlet end of the machine, which support guides and supports the finned portion of the tube to eliminate wear on the fins.

Generally considered, this invention contemplates the provision of an automatic machine for forming a tube to be finned is moved axially while being rotated about its axis and, after one end of the strip is fixed on edge to the exterior thereof, the strip is wound by the tube spirally on its outer surface. The strip is drawn from a rotatable holder over a resiliently mounted guide, which serves as a shock absorber and then through partial corrugating rollers to the fin forming unit or rolls which are driven at an exact synchronized speed to the speed of the tube and deform the fin strip in an exact ratio of the external diameter of the finned tube to the outside diameter of the plain tube. When the strip leaves the rolls, it immediately passes over the guiding means and around the tube with the corrugated portion in heat transfer contact with the exterior of the tube. The finned portion of the tube leaving the machine is conveyed from the machine in a rotating barrel which rotates at approximately the same speed as the tube and prevents the imposition of wear on the finned surface of the tube.

These and ancillary objects, including the provision of a compact, automatic and easily operated and controlled machine, are attained by this invention, the preferred embodiment of which is illustrated in the accompanying drawings, wherein:

Figure 1 is a perspective view of one of the machines, with the tube shown moving from left to right as it is finned; Figure 1A is a cross-sectional view taken on line 1—1A and illustrating the means for supplying additional tubes to the machine, the tubes being axially aligned and secured in end to end relationship to form a large tubing; Figure 2 is a perspective view of the drive means for axially feeding the tubes through the machine, while rotating the tubes; Figure 3 is a diagrammatic illustration of the action of the feed wheels which comprise the drive means for the tubes; Figure 4 is an enlarged perspective view of the forming head unit and guide means from the inlet end thereof; Figure 5 is an end elevational view of the forming head unit from the inlet end thereof; Figure 6 is an enlarged perspective view of the corrugating means which corrugates one longitudinal edge of the strip as it passes to the forming head unit, a guide element of which is shown in Figure 5; Figure 7 is a diagrammatic illustration of the corrugating means.
ing wheels, showing that the corrugations are formed accurately
from the plane of the strip while the other portion of the strip is maintained planar;

Figure 8 is an enlarged perspective view of the forming head rolls and guide means showing such guide means in operation as the fin is wrapped on the tube immediately after passage from the finning head rolls;

Figure 9 is an enlarged perspective view of the fin guide showing the spiral lead of the guide face thereof;

Figure 10 is an enlarged perspective view of the fin following guide;

Figure 11 is an enlarged fragmentary top plan view of the forming head unit and guide means;

Figure 12 is an enlarged vertical sectional view taken on line 12-12 of Figure 11;

Figure 13 is an enlarged top plan view of the forming head rolls; and

Figure 14 is an enlarged longitudinal vertical sectional view taken on line 14-14 of Figure 13.

Referring now more particularly to the accompanying drawings and initially to Figure 1, the machine 10 includes a feeding section 12, a working section 14 and a delivery or outlet conveying section 16.

The feeding section 12 includes a stationary supporting base 18 which is horizontally supported by legs 20 and is disposed axially at one end of the working section 14. Alongside the trough and inclined upwardly therefrom, a table 22 is provided and is mounted on the legs. The table supports a supply of tubes in side-by-side fashion and means is provided for ejecting the tubes in single fashion from the table and carrying the selected tube onto the trough. As shown in Figures 1 and 1A, a rod 24 is rotatably journaled in the upper ends of the legs and has a laterally offset handle 26, which, when manually pulled, rotates the rod. Substantially triangular plates 28 are fixed at their apices on the rod and have rounded bases which are provided to cam over the tubes and hold them back, as the first tube is picked up thereby for deposit in the trough. To effect the pick-up of the tubes, the sides 30 of the plates are notched, as at 32, adjacent the bases and the wall of the notch is configured in the form of a hook that will accommodate a tube. Thus, when the plates are in the position, shown in full lines in Figure 1A, the first tube will gravitate down and rest in the hooks.

When the rod is rotated clockwise, the plates will swing counterclockwise and pass through the slots 34 in the adjacent side wall of the trough to permit the tube to roll off the sides 30 onto the base of the trough and against the opposite side wall of the trough. In such position in the trough, the tube will be in axial alignment with the preceding tube 36, whose rear end has cleared the last slot 34 in the wall (Figure 1) and which is being processed through the working section of the machine.

The working section 14 includes a horizontal table top 38 which is supported by legs 40 and beneath which a horizontal frame 42 is provided. A plate 44 upstands from the position shown and carries a belt 46. The plate 44 has a large opening 48 to receive the tube 36, the opening being large enough in diameter for the passage through the plate of tubes of varying diameters. A drive means for moving the tube 36, for example, axially over the top 38, while rotating it about its axis, is provided and is shown more particularly in Figures 2 and 3. As shown in such figures, the drive means includes three knurled drive wheels 50, 52 and 54, which are grouped in a circular arrangement, 120° apart around the opening 48. Each wheel is keyed on a shaft 56, which is rotatably journaled in the legs 58 of a U-shaped carrier 60 for the wheels. An internally threaded sleeve 62 projects axially from the web 64 of each carrier and the threaded shank of a bolt 66 is threaded in the sleeve. The bolts extend through apertures in the lateral legs 68 which are formed on the inner face of the plate 44. Lock nuts 70 are provided for each bolt and hold the bolts in axially adjusted positions in the legs. By this mounting construction of the carriers 60, the wheels are adjustable radially of the opening 48 to drive tubes of varying diameters.

Means is provided to adjust the pitch of the wheels in relation to the tube, which adjustment controls the speed of the longitudinal or axial movement of the tube and, therefore, the pitch of the fins as the strip is wrapped around the tube. Such adjustment means includes a saddle block 73 in which each sleeve is slidable and which is mounted on the face of the plate 44. A clamping plate 74 is releasably bolted over the sleeves to the blocks 72 and holds the sleeves 62 against axial rotation. To adjust just the pitch of the wheels the clamping plates 74 are loosened and the sleeves 62 are rotated until the wheels are in the desired angular relationship to the tube (for example, as shown in Figure 3) and then the plates 74 are tightened to hold the sleeves in place.

Each of the shafts 56 is connected by a universal joint 76, provided to accommodate the adjustment of the wheels, to one of the three drive shafts 78, 80 and 82. The drive shafts are connected by universal joints 84 to the shafts 56, which are rotatably journaled in the support 88 which is horizontally supported by legs 90 and is disposed axially at one end of the feeding section 14. The support 88 is bolted onto the top 38 and has a center opening 92 for the passage of the tube. The sprockets 90 are driven by a chain 94 which is powered by a motor 96. As shown in Figure 1, the motor 96 is mounted on the frame 42 and drives a double belt 98 which goes to a do double sheave 100. The shaft 102, which carries the sheave 100, has a sprocket fastened thereon which over the chain 94 is passed. A chain tightener sprocket 104 is engaged with the chain and is carried by a shaft 106, which projects from the frame 42. The shaft 106 powers a drive belt 108 which is connected by a pulley 110 to a jack shaft 112. The jack shaft is mounted by bearing blocks 114 on the frame and extends axially of the frame. A pulley 116 is fixed on the jack shaft and drives a belt 118 which through a larger pulley 120 drives the forming rolls, as will be described. A pulley 122 is also fixed on the jack shaft 112 and has a belt 124 engaged therewith. The belt 124 powers the outlet conveying section 16.

In the latter respect, the outlet conveying section 16 includes a rotating cylindrical conveyor or barrel 126, which is rotatably mounted in bearing collars 128. The bearing collars are vertically disposed and rotatably mounted on a frame 130 (a portion of which is shown in Figure 1 along with one of the collars) and the barrel 126 is rotatable within the collars in axial alignment with the tubes moving axially through the working section. A pulley 132 is secured to the inner end of the barrel and is driven by the belt 124. The barrel rotates in the same direction as the tubes and receives the finned portions of the tubes, as the tubes leave the machine, for the purpose of supporting the tubes. Because the barrel rotates with the tube, there is little wear imposed on the finned surface of the tube. In this regard, the barrel is rotatably supported through the jack shaft and belt 124 at approximately the same speed as the tube is rotated by the motor through the drive wheels 50, 52, 54, shaftings and chain drive. Thus, the barrel has the same R. P. M. as the tube.

A holder for a supply of fin stock is provided and, as shown in Figure 1, includes a member 134 which is rotatably supported by a supporting block 136 so that the drum is free to rotate as the stock fin in strip form is unwound from the drum.

The frame 144 upstands from the top 38 and carries the slide member 142 between its sides, that is, being fixed to the top of the frame and a transverse bar between the sides thereof. The holder 140 is urged upwardly by springs 146 which are connected to the top of the frame 144 and to the holder 140. The holder 140, which carries the guide pulley 138 for the strip 150 is thus mounted on the slide member 142 to tension the strip.
By means of the resiliently mounted holder the pulley floats on the slide member and absorbs any shock coincident with the holder and strip 150 thus avoiding accidental deformation or damage to the strip. As shown generally in Figure 1 and more specifically in Figure 6 the strip 150 is passed through a funnel type guide 152 which is mounted vertically on the frame 144. The guide 152 is rectangular in cross section and is of a width to freely receive the strip which moves in flattened form there-through. The lower end of the guide 152 is turned inwardly to turn the strip from a vertical to a horizontal plane. As the strip exits from the guide 152, it is passed through a means for corrugating one longitudinal edge thereof.

As shown in Figures 6 and 7, the edge 150c of the strip is transversely corrugated, while the remaining portion and opposite edge 150a is left smooth. The corrugated edge 150c of the strip constitutes the tube edge thereof or the inner peripheral edges or bases of the fins formed by the spiral winding of the strip on the tube 36. Only the edge 150c is corrugated by means of a pair of cooperating corrugating rollers 154 and 156. The rollers are rotatably journaled on shafts which project laterally from the support 149 that is carried by the frame 144 and which also carries the guide 152. The corrugating rollers are disposed in vertical alignment with the teeth 154a and 156a in meshing engagement. The roller 156 is provided with a smooth cylindrical extension 158 which is aligned alongside the teeth 156a and projects beyond the end of the roller 154. The extension 158 is provided to support the edge 150c of the strip, and thus, the uncorrugated portion of the strip.

As shown in the diagrammatic illustration in Figure 7, the teeth of the corrugated rollers form the corrugations in the edge 150c by accurately displacing the material from the plane of the strip proper. From the corrugating rollers, the strip passes through a channel guide 160, the channel passage of which is vertically disposed and thus, turns the strip 90° from a horizontal plane to a vertical plane. The channel 160 positions the corrugated edge 150a adjacent the exterior of the tube so as to form the tube side edge of the strip or inner peripheral edges of the fins.

As shown in Figures 8 and 11, the strip 150 is guided by the channel 160 toward the underside of the rotating tube 36, and positioned beneath the tube 36 to act on the strip 150 as it advances under the tube 36 in the forming head unit. Such unit includes a pan roll 62 in the tube 36 and a small cooperating roller 164, with a backup roll 166 being provided for the small roller 164. The pressure between the pan roll 162 and the roller 164 causes the strip 150 to be unreeled from the drum 134.

The backup roll 166 is horizontally disposed above the surface 38 and is provided with an integral depending shaft 168 as shown in Figure 14. The shaft is rotatably supported by bearings 170 in a block 172 which upstands from the surface 38. A pulley 174 is fixed on the shaft above the lower end thereof which is rotatably journaled in a collar 176 on the frame 42. The pulley 174 is connected by a belt 178 to a pulley 180 which is horizontally carried by a shafting 182 below the top or surface 38. The shafting 182 projects from a gear reduction unit 184 from which an input shaft 186 laterally projects and is provided with the pulley 120. The shaft 168 and the shafting 182 are driven by the motor 96 through the jack shaft 112 and attendant bolt transmission systems in an exact synchronized speed with the speed of the rotating tube 36 so that the forming roll unit rotates in the linear movement therebetween of the strip in a synchronized speed with the rotational speed of the tube 36 as the strip is wrapped or wound thereon. The shaft 190 is supported by a constant speed universal joint 192 to the shafting 182 and projects upwardly therefrom. The shaft 190 carries the pan roll 162 which is integral therewith.

The roller 164 is rotatably mounted in a suitable manner in a transverse cutout 194 formed vertically in a guide plate 196 which is interposed between the shafting 182 and the pan roll 162 in a manner and for a purpose to be described. As shown in Figure 9, the channel guide 160 is integral with the plate 196 and one side 198 of the channel guide extends beyond the opposite side 200 in a manner to confront in spaced relation the face 202 of the plate 196. The side 198 of the channel guide is attached to the face 202 which is spaced therefrom so that the strip moves between the side 198 and the lower portion of the face 202. The side 198 terminates at the roller 164 so that the strip is lead directly by the channel guide, particularly the side 198 in cooperation with the portion of the face 202, over the protruding peripheral portion of the roller 164. In this respect as shown in Figure 14, the diameter of the roller 164 is slightly greater than the width of the plate 196 so that the roller protrudes or extends beyond the opposite faces of the plate 196 and is in contact with the periphery of the back roll 166 and the pan roll 162. The strip passes between the contacting peripheries of the pan roll 162 and the roller 164 and the outer peripheral edges of the fins or uncorrugated outer edge of the strip is rolled or extruded by the pressing contact of the pan roll and the roller 164. At the time that the strip is subjected to the rolling or extruding action of the pan roll and the roller 164, the corrugated edge 150c is in contact with the underside of the rotating tube 36 and the strip is in the commencement of the fin forming process. Thus, the strip is rolled or extruded so as to force the inner corrugated edge 150a into contact with the tube and to relieve the outer periphery of the fin proper of any strain and thereby create a smooth spiral fin as the strip is being wound on the tube 36.

The pan roll 162 is mounted for bodily adjustment relative to the roller 164 so that the amount of pressure exerted by the pan roll and roller 164 on the strip can be adjusted. In other words the pan roll and the roller are relatively adjustable both towards and away from each unit. The pan roll is also mounted for adjustment about an axis transversely to the axes of rotation of the rolls and roller so as to adjust the angle of deformation of the strip.

Such adjustable mounting structure is shown in Figures 13 and 14 wherein it will be noted that an opening 204 is formed in the surface 38 and receives the depending hub portion 206 of a pivot rod 210 which is securedly mounted at one end on a pivot rod 210 which is supported by lugs 212 that upstand from the surface 38. The plate is locked in a tilted position of adjustment about the pivot rod by a bolt 214 which is threaded vertically through the opposite end thereof and extends through a threaded opening 216 in the surface 38. A bolt 218 is threaded vertically through the plate adjacent the bolt 214 and is held in adjusted positions by a locknut 220. The bolt 218 rests on the surface 38. Thus, to adjust the angle of tilt of the plate 208 and thereby the angular relationship between the pan roll 162 and the roller 164, that is the angle of deformation of the strip, the bolt 214 is unscrewed from the surface 38 and the bolt 218 is axially adjusted to set the plate 208 in the desired angle. The bolt 214 is then threaded into the opening 216 to lock the plate in such set position.

The shaft 190 of the pan roll 162 is rotatably mounted by ball bearing assemblies in an eccentric hub 222, which is mounted within the hub 206 of the plate 208 by an arm 224, which radially projects therefrom and extends beyond the periphery of the roll 162. The outer end of the arm 224 is disposed between a pair of axially aligned set screws 226 and 228. The set screws are carried by ears 230, which upstand from the plate and receive the set screws. It can be seen from a consideration of Figure 13 that the relative axial movement of the set screws controls the rotation of the eccentric hub which will ad...
vance the periphery of the pan roll towards and away from the periphery of the roller 164. It is particularly noted that the upsetting annular periphery 232 of the pan roll is slightly inclined outwardly from the bottom of the roll so as to engage the roller 164 at a slight angle and thereby roll and extrude the interposed strip, without flattening the corrugated edge. In this respect, the upper edge 234 of the peripheral portion of the pan roll is V-shaped or at least the outer portion of the upper end is provided with a relief angle and, similarly, the upper edge portion of the small roller 164 is convergent at an angle. Therefore, the upper outer edge of the peripheral portion of the pan roll and when the nut 260 is loosened the fin for a back an angle so as to permit the corrugated edge 150a to pass therebetween without being subjected to the rolling or extruding action.

As shown in Figures 4 and 5, a plate 236 is vertically mounted on the block 172 on the table top surface 38 and is provided with a suitable cutout portion 238 to accommodate a portion of the periphery of the backup roll 166 which bears against the small steel roller 164 and provides the necessary pressure to withstand the pressure impressed on the roller by the pan roll. The plate 236 is also formed with a circular opening 240 through which the tube passes. Guide rollers 242 and 244 are mounted on the front face of the plate 236 and project inwardly of the opening 240 to engage the rotating tube and stabilize the tube as it passes over the top 38, and particularly over the forming roll unit as the strip is being wound.

The rollers 242 and 244 are rotatably journaled on suitable shafts 246 and 248 which extend through the plate 236 and are attached to the guide plate 196. The guide plate 196 is formed with a circular opening 250 to accommodate the axial passage of the tube 36 therethrough. The face 202 of the plate 196 is formed with a spiral cam 252 which is concentric to the opening 250 in the plate. The cam surface 252 starts at the roller 164 as shown in Figure 9, and spirals around the opening back to its terminating low point at the channel passage. The purpose of the spiral cam surface is to guide the fins, as shown in Figure 11, around the tube, after the strip has been rolled or extruded by the forming roll unit.

Cooperating with the guide plate 196 is a fin forming guide member 254, which is hinged by a pin 256 to the projecting end 258 of the plate 196. The pin 256 is threaded and the following guide member 254 is locked in place by a nut 260, which is threaded on the threaded shank of the pin 256. The fin forming guide member 254 has a handle 262 which extends above the plate 196 so that it can be raised to allow the fins to fall. The fin forming guide member can be swung about the pin 256. The fin forming guide member has a concave recess 264 formed in its lower edge to provide clearance for the tube 36. The edge 266 of the recess is beveled.

As shown in Figure 9, the inner end of the side 198 is concaved, as at 199, to provide clearance for the periphery of the pan roll and enable the periphery of such roll to contact the roller 164, with the bite of the roll and roller immediately disposed at the exit end of the channel guide passage. The purpose of the beveled edge 266, as shown in Figure 12, is to avoid mashing the corrugated inner edges or bases 150a of the fins. The outer portions of the fins, as shown in Figure 12, pass over the spiral cam surface 252 and also over the inner face of the fin forming guide member 254. Therefore both the bevel concave recess 264 and the beveled inner peripheral edge 266 of the cam 252 are necessary to permit the outer peripheral portions of the fins to slide over the cam and the face of the fin forming guide member, without the corrugated inner peripheral bases of the fins becoming deformed.

The plate 196 has a laterally projecting pin 270 and the fin forming guide member has a notch 272 which seats on the pin to locate the fin forming guide member in the proper horizontal position. To assist in the guiding of the strip in its fin forming windings around the tube, the inner face of the fin following guide member is provided with an integral hook 274, the portion 276 of which has a flattened inner surface which parallels the face of the member. A pin 278 projects laterally from the inner face across the concave recess from the hook 274 and is received in a slot 282. The inner hook 274 has a portion 282 which is rotatably positioned on the pin and held in adjusted positions by a radial set screw 24. Thus, the hook 274 is adjustable to various positions on the face. The purpose of the hook and finger which cooperate together is best shown in Figure 11 when it will be noted that such members cooperate to hold the outer peripheral portions of the fins in guided contact with the flat inner face of the fin following guide member.

While the operation of the machine is believed clear from the drawings, a brief description of the operation will be given. Thus, considering Figure 1, it will be understood that the tube 36 is fed from trough 18 through the working section, where it is fined, to the rotating outlet conveying barrel 126. Before the tube is passed to the drive means for movement through the working section the exterior surface of the tube is coated with a suitable substance, such as solder or the like, by means of the applicator 158, for the purpose of causing an adherence between the corrugated inner peripheral edges or bases of the fins with the extruded surface of the tube but in more for the purpose of ensuring an intimate heat exchange contact between the fins and the tube, avoiding air gaps. The tube is, of course, milled axially while being rotated about its axis by the adjustable drive means and the pan roll and backup roll are rotated, thus rotating the interposed small steel roller, at exact synchronized speed with the speed of rotation of the tube. The end of the strip 190 is manually fixed or attached to the exterior surface of the tube preparatory to the automatic operation of the machine.

The rotation of the tube will, of course, wind the strip in fin formations on the exterior surface of the tube after the strip has been partially corrugated and passed through the forming head rolls. The forming head rolls deform the fin strip in an exact ratio of the fin tube outside diameter to the tube outside diameter. Thus, the fins will have a very low corrugated base and the outer peripheral portions of the fins will be extremely smooth. The relationship between the speed of the axial movement of the tube and the cam surface 252 will control the pitch of the fins on the tube, each fin being identically pitched and evenly spaced from its companion fins. The portion of the tube that has been fined and passed beyond the forming roll unit enters the rotating barrel 126 which supports the tube and ensures against the imposition of wear on the fined surface.

While this machine has been designed to form a smooth fin with a very low corrugated base or inner peripheral edge, the same machine can form a perfectly and entirely smooth fin by removing the relief angle of the angle of the edge of the peripheral portion of the pan roll and the top edge of the small roller and omitting the companion corrugating rollers.

Thus, while the preferred form of the invention has been described herein and illustrated in the accompanying drawings, other forms may be realized as come within the scope of the appended claims.

I claim:
1. A device for wrapping a strip on edge spirally around the exterior of a longitudinally moving and rotating tube to provide spiral, spaced heat exchange fins exteriorly on the tube comprising drive means for longitudinally feeding and rotating a tube having one end of a strip affecting said motion, means for rolling the strip as it initiates the formation of fins on the tube, guide means around the tube and through which the tube passes receiving the strip from said rolling means
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and guiding it around the tube, while maintaining it in its roller condition, a rotatable guide cylinder axially aligned with the tube following the fin formation and guidingly receiving and supporting the finned tube, motor means, and a drive transmission means connected between the motor means, the drive means for the tube, the strip rolling means and the guide cylinder, said drive transmission means commonly actuating the drive means and the rolling means so that the rolling means rotates in the linear movement therefrom of the strip in synchronized speed with the rotational speed of the tube as the strip is being wound on the tube and the drive transmission means guiding the cylinder in the same direction and at approximately the same speed as the tube is rotated to prevent wear being imposed on the fins of the tube.

2. A device for wrapping a strip on edge spirally around a tube to provide heat exchange fins exteriorly on the tube comprising, a drive means for axially rotating and longitudinally feeding a tube having an end of a strip affixed on edge to the exterior thereof and adapted to wind the strip spirally on edge around its exterior surface as it rotates, resiliently tensioned guide means for the strip, means for transversely corrugating one longitudinal edge of the strip as it passes from the guide means to the tube with such corrugated edge forming the inner peripheral edges of the fins, means disposed adjacent the tube for rolling the uncorrugated portion of the strip as it initiates the fin windings on the tube, guide means through which the tube passes disposed adjacent said last means and receiving the strip therefrom to guide the strip around the tube in forming the fins while maintaining the strip in its stressed condition, a rotatable guide cylinder axially aligned with the tube and receiving the tube following the formation of fins thereon, motor means and a drive transmission means connected between the motor means, the tube drive means and the cylinder for rotating the tube and the cylinder at approximately the same rate of speed and in the same direction.

3. In a device for forming spiral heat exchange fins on a longitudinally moving and axially rotating tube; means for guiding and forming a strip as it is wound around the tube responsive to the rotational movement of the tube, said means comprising a small roller rotatably positioned vertically below the tube, a pan roll positioned adjacent said roller and having a peripheral flange disposed below the roller and cooperating therewith to roll the outer edge of the strip and forcing the flange edge into contact with the tube as the strip is being wound on the tube, a backup roller engaging the small roller and positioned on the opposite side from the pan roll, said roller and backup roller being rotatable about parallel axes perpendicular to the tube, and means mounting the pan roll for bodily curvilinear adjustment toward and away from the small roller about an axis at right angles to the axis of rotation of the small roller and for rotation about an axis, substantially parallel with the axis of the small roller and adjustable relative to and away from the small roller whereby the amount of pressure exerted by the pan roll and the roller on the strip can be adjusted and whereby the angle of deformation of the strip can be selectively adjusted.

4. A device as claimed in claim 3, wherein said peripheral flange is slightly inclined outwardly toward the small roller so as to engage the roller at a slight angle and said flange has a V-shaped outer edge and said roller has an upper end cut back at an angle so that there is a space between the upper end of the roller and the outer edge of the flange for free passage of the inner edge of the strip between the pan roll and the roller.

5. A device as claimed in claim 3, wherein a support is provided transverse to the tube and through which the tube passes, said support carrying the small roller and having a face formed with a spiral guide surface for the strip as it is initially wound on the tube and channel guide means carried by the support and positioned so as to guide the strip right up to the bite of the pan roll and the small roller below the tube at the initial point of contact between the strip and the tube.

6. A device as claimed in claim 5, wherein an arm is mounted above and transversely of the tube and is moveable toward and away from the tube into a position confronting the face of the support, said arm having a guide surface on its side confronting said face which cooperates with the guide surface on the support and having an opposite side provided with a guide means for engaging and guiding the outer edge of the strip after it has been wound on the tube.

7. A device as claimed in claim 3, wherein a table top is provided below the tube and said last means includes a plate hingedly mounted at one end on the table top and moveable vertically about a horizontal axis, means carried by the other end of the plate for cooperation with the table top for setting the plate in selected positions, said plate having a vertical opening coinciding with a vertical opening in the table top, an eccentric hub rotatably mounted in the plate opening, a shaft for the pan roll mounted in the hub, an arm radially extending from the hub parallel with the top of the plate and beyond the plate and adjustment means on said plate in engagement with the arm to rotate the arm and hub and lock the arm and hub in selected positions.

8. In a device for forming spiral heat exchange fins on a longitudinally moving and axially rotating tube; means for guiding and forming a strip being wound on the tube responsive to the rotational movement of the tube, said means comprising a vertical support arranged transversely of the tube and having an opening through which the tube passes, said support having a face formed with a spiral cam concentric to the opening over which the strip passes as it is being wound on the tube, a channel guide means carried by the support tangentially to the cam and leading almost directly up to the starting low point of the cam so as to guide the strip immediately up to the cam, a guide arm cooperating with the cam and disposed in confronting relation at one side therewith, a guide arm having an opposite side provided with guide means for engaging the outer edge of the strip and guiding the fins after they have been formed on the tube, and means disposed below the opening at the end of the channel guide means for rolling the outer edge of the strip at the moment the inner edge of the strip is formed, and a pan roll, said pan roll being rotatable about parallel axes perpendicular to the tube, and means mounting the pan roll for bodily curvilinear adjustment toward and away from the small roller about an axis at right angles to the axis of rotation of the small roller and for rotation about an axis, substantially parallel with the axis of the small roller and adjustable relative to and away from the small roller whereby the amount of pressure exerted by the pan roll and the roller on the strip can be adjusted and whereby the angle of deformation of the strip can be selectively adjusted.

9. A device as claimed in claim 8, wherein said channel guide means includes a first vertically disposed arm extending laterally from the plate flush with the face thereof, a second vertically disposed arm spaced slightly from and arranged parallel with the first arm and extending inwardly beyond the first arm and arranged in confronting relation with said face of the support.

10. A device as claimed in claim 8, wherein said guide arm is moveable vertically above the tube toward and away from the tube and said guide means on the opposite side thereof includes a fixed finger and an adjustable finger disposed in spaced confronting relation with said side.

11. A device as claimed in claim 8, wherein said last-named means includes a small roller, said support having a cut-out formed below the opening and in which said roller is vertically positioned for rotation, said roller being disposed intermediate the end of the channel guide means and the starting point of the cam and being of a diameter slightly greater than the thickness of the support, a cooperating pan roll engaging the small roller on the cam side of the support and a backup roller engaging the small roller on the other side of the support, the bite between the small roller and the pan roll being disposed right at the end of the channel guide means.

(References on following page)
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