Oct. 25, 1932. G. H. PICKHARD 1,884,203

METHOD OF AND MACHINE FOR MAKING SPIRAL FIN TUBING

Filed April 2, 1928 4 Sheets-Sheet 1

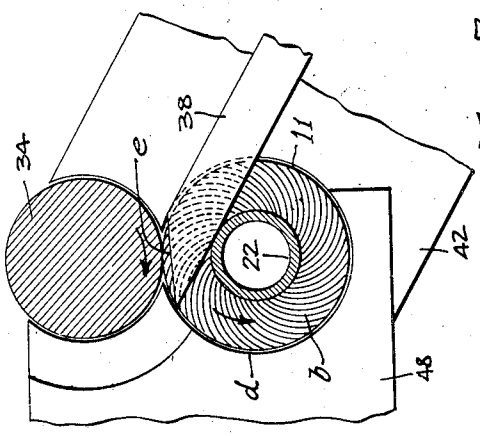


FIG. 3.

FIG. 1.

FIG. 2.

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METHOD OF AND MACHINE FOR MAKING SPIRAL FIN TUBING

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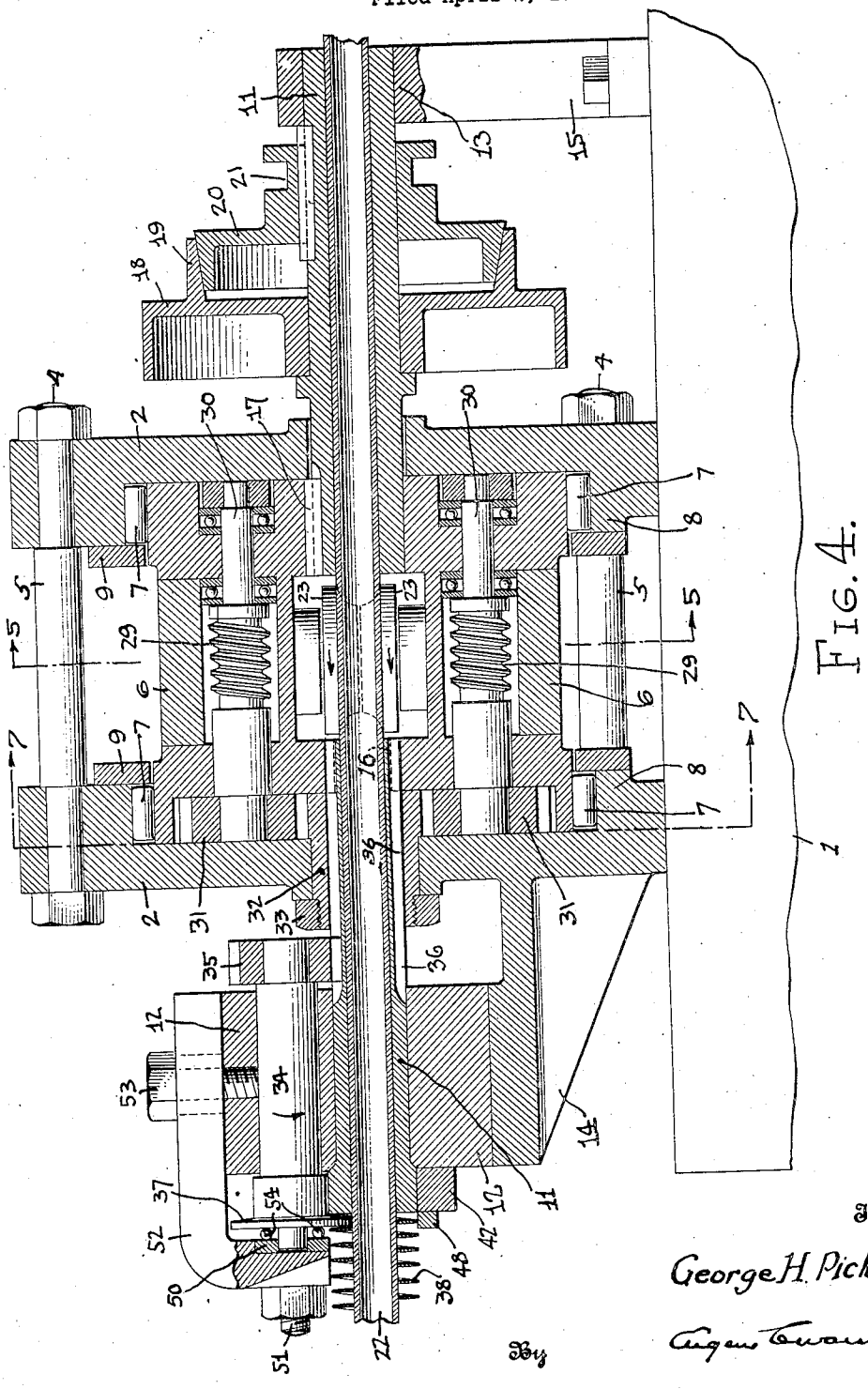


FIG. 4.

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METHOD OF AND MACHINE FOR MAKING SPIRAL FIN TUBING

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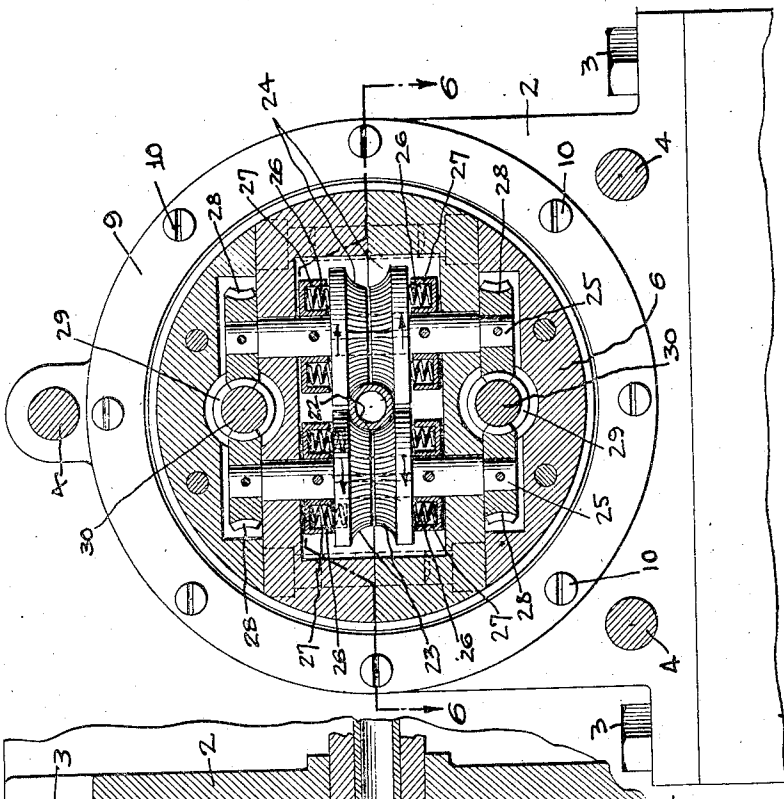


FIG. 5.

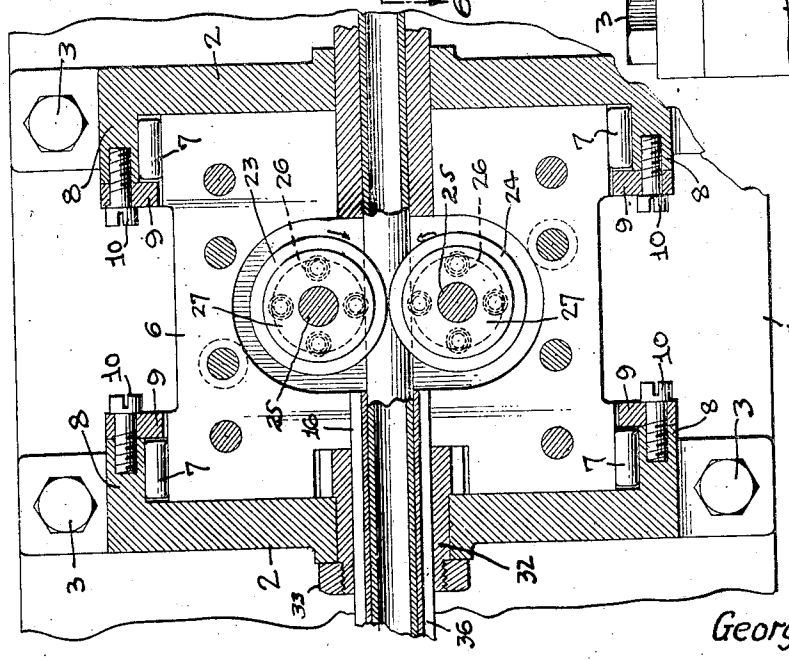


FIG. 6.

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METHOD OF AND MACHINE FOR MAKING SPIRAL FIN TUBING

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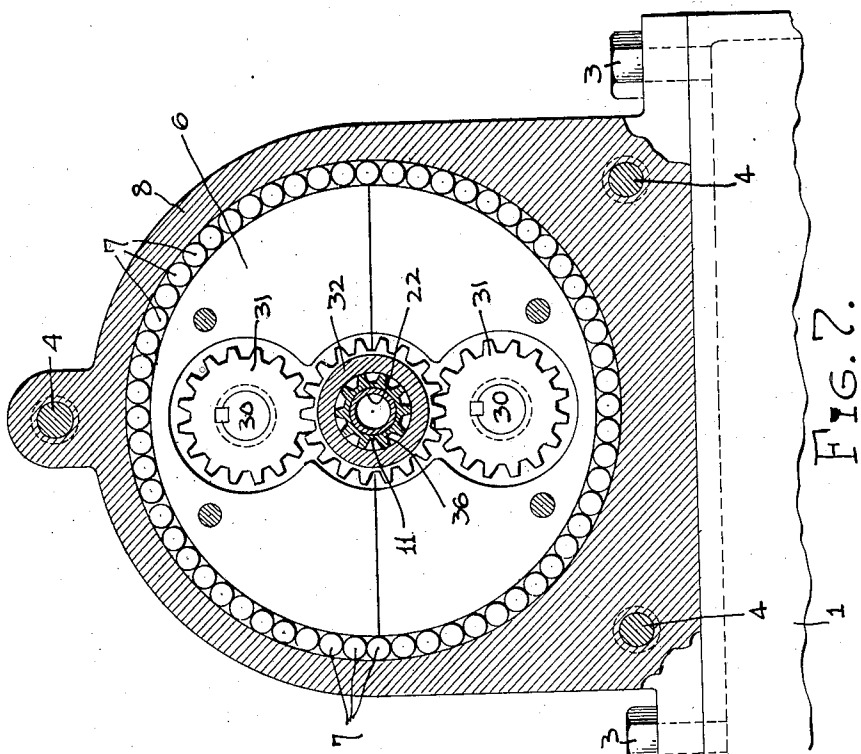


FIG. 7.

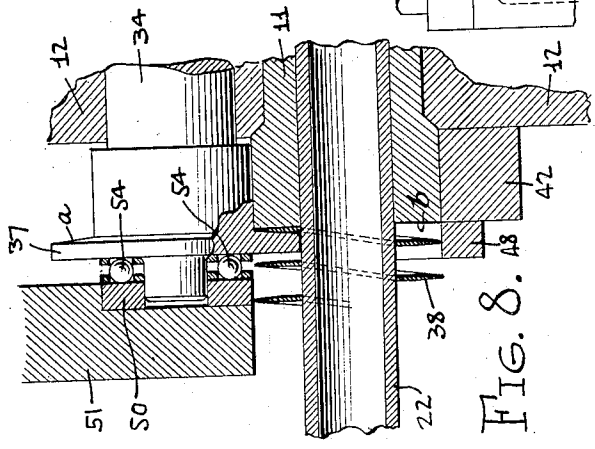


FIG. 8.

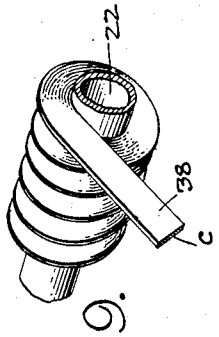


FIG. 9.

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UNITED STATES PATENT OFFICE

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METHOD OF AND MACHINE FOR MAKING SPIRAL FIN TUBING

Application filed April 2, 1928. Serial No. 266,488.

This invention relates to a method of and machine for making spiral fin tubing.

One object of my invention is to provide a machine for spirally winding a continuous flat sheet metal fin strip on a tube without displacing the sides of the strip out of the spiral path of the strip about the tube thereby permitting more convolutions of fin strip material to be wound on a given length of tube to obtain greater radiating surface than possible with a corrugated fin strip, as heretofore.

Another object of my invention to provide means for so changing the cross-sectional shape of the fin strip as it is presented to the tube that the strip may be spirally wound on the tube without stretching of the strip and thus keep the strip rigid and stiff to resist strains and stress which would otherwise bend and break down.

A further object of my invention is to provide a machine which is simple in construction and operation and which will produce a regular and uniform product rapidly, continuously, smoothly, and economically.

The invention consists further in the product produced by my improved method and machine and also in the matters hereinafter described and claimed.

In the accompanying drawings—

Fig. 1 is a front view of the machine of my invention;

Fig. 2 is a sectional view of a detail of construction taken on line 2—2 of Fig. 1;

Fig. 3 shows how the winding operation is initially begun;

Fig. 4 is an enlarged vertically longitudinal sectional view taken through the machine on line 4—4 of Fig. 1;

Fig. 5 is a transverse vertical sectional view taken on line 5—5 of Fig. 4;

Fig. 6 is a horizontal sectional view taken on line 6—6 of Fig. 5;

Fig. 7 is a vertical sectional view taken on line 7—7 of Fig. 4;

Fig. 8 is a vertical longitudinal sectional view taken through the machine at the winding station; and

Fig. 9 is a perspective view of a tube with a strip wound thereon.

The machine of my invention has a horizontal bed or base 1 similar to that as employed for metal-turning lathes. Mounted on the top of the bed are the tube feeding and strip winding assemblies of the machine.

The tube feeding assembly comprises a pair of upright end plates 2, 2 arranged crosswise of the bed and secured to the same, one in advance of the other, by cap screws 3, 3, as shown in Figs. 1 and 5. The plates 2 are tied together by bolts 4, 4 provided with spacers 5, 5 for keeping the plates apart, as shown in Fig. 4. A drum 6 is revolutionally mounted between the plates 2 on anti-friction bearing rollers 7, 7 confined in annular race-ways formed between the ends of the drum and inwardly extending portions 8, 8 on the plates. The outer ends of the race-ways are closed by the plates 2 while their inner ends are closed by rings 9, 9 which are secured by screws 10, 10 to the annular portions 8 of the respective plates 2, as shown in Figs. 4 and 5.

A horizontal shaft 11 extends through and beyond the plates 2, 2 on opposite sides thereof and is journaled at its ends in suitable bearings 12, 13, the former being at the forward end of the shaft and supported by a bracket 14 cast integral with and extending forward from the front plate 2, as shown in Fig. 4. The rear bearing 13 is at the upper end of a standard 15, which is secured to and extends upward from the base 1 to the rear of the rear plate 2. Shaft 11 also extends through the center of the drum 6 and the latter is fixed thereto, as at 16 and 17, respectively, so that the drum will turn with the shaft when the latter is rotated. To accomplish this, a belt pulley 18 is loose on the shaft 11 in the space between the rear plate 2 and the standard 15. The pulley 18 is provided on its rear side with an annular clutch flange 19 with which cooperates a friction cone member 20 splined on the shaft 11 and movable into and out of engagement with said flange through a hand operated shift-yoke (not shown) which engages in a groove 21 in the hub of said member.

The tube 22 to be operated on is fed endwise through the machine through the shaft 11 which is made hollow to receive and guide

the tube, as shown in Fig. 4. To feed the tube, two pairs of rolls 23, 24 are located in the drums 6 and engage the tube on opposite sides thereof, as shown in Fig. 5. The peripheral surfaces of the rolls are concaved to conform to and engage the outside of the tube and these surfaces are roughened by milling so as not to slip on the tube and thus feed it through the machine when the rolls are revolved in the direction indicated by the arrows in Fig. 6. The rolls are splined on shafts 25, 25 journaled in the drum 6 and are arranged one for each pair of rolls. The rolls 23, 24 are yieldably held against the tube 22 by coiled springs 26, 26 arranged on the outer sides of the rolls and retained in place by channel shape retainer rings 27, 27 which are pinned on the respective shafts 25, 25, as shown. The spring 26 allows the rolls 23, 24 to yield laterally as the tube 22 passes between them and thus compensate for any irregularities that might be on the surface or in the shape of the tube. Thus, the tube 22 may be fed through the machine without putting any lateral strain on the feed rolls.

The rotation of the feed rolls 23, 24 is effected through the turning of the drum 6 by the shaft 11. This is accomplished by fixing worm pinions 28, 28 on the opposite ends of the shafts 25, 25 and having said pinions mesh with worms 29, 29 on worm shafts 30, 30. These are journaled in the drum 6 and have at their forward ends planet gears 31, 31 which mesh with and travel around a fixed or stationary sun gear 32 fixed in the front plate 2 by a nut 33, as shown in Fig. 4. With concave peripheries, the rolls 23, 24 engage about practically the entire circumference of the tube 22 and thus rotate it on its axis as the rolls are carried bodily around with the drum 6.

The strip winding mechanism comprises a horizontal shaft 34 journaled in the bearing 12 above the shaft 11 and arranged substantially parallel therewith. A spur gear 35 is fixed to the rear end of the shaft 34 and meshes with gear teeth 36 cut in the portion of the shaft 11 at said gear so as to rotate the same in the turning of said shaft. The teeth 36 extend back through and beyond the sun gear 32 and provide the spline connection at 16 with the drum 6.

At the front end of the shaft 34 is a radial flange 37 which extends inward toward the tube 22 over the front end of the shaft 11. The rear face *a* of the flange 37 is beveled or inclined outward while the opposed end surface *b* of the shaft 11 is straight and at right angles to the tube 22, as shown in Figs. 4 and 8. This provides a triangular-like throat with the apex of the triangle at the outer end of the throat.

The fin material to be spirally wound on the tube 22 is in the form of a continuous sheet metal strip 38 which is drawn endwise into the throat from a supply roll 39 turnably mounted on a bracket arm 40 secured to one side of the bed or base 1 of the machine, as shown in Fig. 1. The width of the strip 38 as furnished to the machine is substantially the same as the height or distance that the strip when wound on the tube extends outward therefrom so that the strip need not be trimmed down for winding on the tube. The normal cross-sectional shape of the strip 38 as it is furnished to the machine is rectangular with parallel flat sides and of substantially a uniform thickness throughout the width of the strip, as shown at *c* in Fig. 9. This thickness is substantially the same as the width of the base of the triangular throat into which the strip is drawn in the winding operation.

As shown in Fig. 1, the bearing 12 for the forward end of the shaft 11 is in the form of an upright block which is secured by cap screws 41, 41 to the bracket 14 with the front face of the block flush with the front end of the bracket. A flat guide plate 42 is secured to the front end of the bracket 14 by a screw 43 and extends inward over the front face of the block 12 toward the tube 22. The plate 42 is arranged on the side of the tube adjacent the supply roll 39 and the strip 38 is guided from said roll to the tube over the flat front face of said plate. A guide bar 44 is secured to front face of the plate 42 and has a channel 45 therein to receive the strip 38 and guide it to the tube. The channel 45 conforms to the normal shape of the strip 38 and is long enough to straighten the strip as it is drawn to the tube. One form of securing the guide bar 44 to the plate 42 is shown in Figs. 1 and 2. As there illustrated, fastening strips 46, 46 overlap the rabbetted upper and lower edges of the guide bar and are secured to the plate 42 by screws 47, 47.

A guide plate 48 is secured by screws 49 to the front side of the block 12 on the side of the tube 22 opposite the guide bar 44. Plate 48 has a curved edge *d* in a vertical plane extending part way around the circumference of the tube 22 and arranged concentric therewith. Edge *d* is spaced radially outward from the tube 22 slightly greater than the distance that the wound strip extends outward therefrom, as shown in Fig. 3. The upper end of edge *d* is opposite the entrance point of the strip 38 into the throat between flange 37 and shaft end *b* so as to be struck by the strip on being drawn into the throat and give the strip its initial curvature about the tube in the starting of the machine. The shaft end *b* is spirally milled, as shown in Fig. 3, so as to grip the flat side of the strip and assist curved edge *d* in curving the strip. After the strip 38 has taken several convolutions about the tube 22, the strip is then tight on the tube and the further drawing of the strip from the supply roll 39 is through the turning of the tube by the rotation of the drum 6.

At the start of a winding operation, the end

of the strip 38 is cut off at an angle, as at *e* in Fig. 3, before the strip end is inserted into the throat between flange 37 and shaft end *b*. In so cutting the strip, it is given a pointed end so that there is no metal in the way to interfere with the strip following around the curved edge *d*. On passing into this throat, the strip 38 is deformed by the squeezing action on the opposite flat sides of the strip and its cross-sectional shape is changed from rectangular to triangular, as shown in Figs. 4 and 8. This squeezing action is merely along the outer half of the strip and effects a reduction of thickness of such portion sufficient to compensate for the larger circumference around the outer edge of the strip as it winds on the tube. Thus, the strip 38 may be wound on the tube without undue strain or stretching which relieves the strip of the necessity of being corrugated, in order to compensate for the larger circumference, as heretofore. Being kept plain, the lateral dimension taken up by the strip at its contact with the tube is less than with a corrugated strip, thereby giving greater radiating surface by permitting more strip material to be wound on a given length of tube by winding the convolutions of the strip closer together. Moreover, with a plain strip, it will withstand to better advantage the edgewise and side strains when struck by exterior objects as the body of the strip has not been weakened by any bending or stretching strains as heretofore.

With the rolling action on the strip confined along its outer half, the inner half of the strip is not deformed with the result that cross-sectional shape of such portion remains substantially the same as the original cross-sectional shape of the strip. This provides an effective base for the strip at its contact with the tube and thus supports the strip against bending when struck on either side.

The forward end of the shaft 34 is reduced and is supported in a bearing plate 50 secured by bolts 51 to the rear side of a bracket arm 52 which is fastened by a cap screw 53 on the upper side of the bearing block 12. Anti-friction bearing balls 54, 54 are suitably retained between the plate 50 and the adjacent front face of the flange 37 so as to take care of the outward end thrusts on said flange as the strip 38 is squeezed thereby.

The machine is simple in construction and operation and is highly efficient. The fin strip material 38 is wound rapidly, smoothly, evenly and continuously on the tube, as the latter is rotated and fed past the winding assembly. The pitch of the wound strip on the tube is determined by the speed of the linear movement of the tube past the winding station and this is regulated by the speed of rotation of the feed rolls 23, 24. In carrying these around bodily with the drum 6, the feed rolls also serve to rotate the tube so as to draw the strip 38 thereon. Thus, the feed and rotation of the tube is effected through a single set of rolls instead of two sets as heretofore, thereby reducing the overall length and cost of construction of the drum head assembly by requiring fewer and less complicated parts.

The details of construction shown and described may be variously changed and modified without departing from the spirit and scope of my invention. The invention is not to be limited to tubes as rods could be substituted for tubes. This term as used in the claims is to be given a meaning comprehensive enough to include rods or any other cylindric elements on which the strips are to be wound.

I claim as my invention:

1. In a machine for making spiral fin tubing comprising in combination, means for supporting a tube, means for presenting a flat sheet metal fin strip edgewise to the tube, and rotary means for reducing the thickness of the strip along its outer edge portion as the strip is presented to the tube to compensate for the larger circumference around the outer edge of the strip as it is spirally wound on the tube, said last named means while shaping the strip also forcing it about the tube.

2. In a machine for making spiral fin tubing, comprising in combination, means for rotating a tube and feeding it through the machine, means for presenting a sheet metal fin strip edgewise to the tube, rotary members between which the strip is passed on being wound on the tube, one of said members having an inclined surface to reduce the outer edge portion only of the strip as it is presented to the tube to compensate for the larger circumference about the outer edge of the strip as it is wound on the tube, and means for rotating said members with the tube in a direction to cause the same to force the strip about the tube.

3. In a machine for making spiral fin tubing comprising in combination, means for presenting a flat sheet metal fin strip edgewise to a tube to wind the fin strip spirally thereon as the tube is rotated and fed endwise through the machine, and means for rotating the tube and feeding it through the machine comprising, a single set of rolls engaging the tube, and means for carrying the rolls bodily around the axis of the tube for rotating the same and at the same time rotating the rolls in a direction to feed the tube through the machine, said rolls having concave peripheries to engage the tube about substantially the entire circumference thereof.

4. In a machine for making spiral fin tubing comprising in combination, means for presenting a flat sheet metal fin strip edgewise to a tube to wind the fin strip spirally

thereon as the tube is rotated and fed endwise through the machine, and means for rotating the tube and feeding it through the machine comprising, a rotary drum to receive the tube, a single set of rolls carried by the drum and engaging the tube for rotating the same in the turning of the drum, and means for rotating the rolls in the turning of the drum to feed the tube through the drum, said rolls having concave peripheries to engage the tube about substantially the entire circumference thereof.

5. In a machine for making spiral fin tubing comprising in combination, means for presenting a flat sheet metal fin strip edgewise to a tube to wind the fin strip spirally thereon as the tube is rotated and fed endwise through the machine, and means for rotating the tube and feeding it through the machine comprising, a rotary drum to receive the tube, a single set of rolls carried by the drum and engaging the tube for rotating the same in the turning of the drum, and means including a planetary gearing for rotating the rolls in the turning of the drum to feed the tube through the drum, said rolls having concave peripheries to engage the tube about substantially the entire circumference thereof.

6. In a machine for making spiral fin tubing comprising in combination, a hollow rotary shaft to receive and guide a tube, means for rotating the tube and feeding it through said shaft, means for presenting a flat sheet metal fin strip edgewise to the tube across the end of the shaft where the tube leaves the same, a rotary member cooperating with the end of the shaft to press the strip against the same to reduce the thickness of the strip along its outer marginal portion to compensate for the larger circumference around the outer edge of the strip as it is spirally wound on the tube, and means for rotating the shaft and member with the tube in a direction to cause the shaft and the member while shaping the strip to force it about the tube.

7. In a machine for making spiral fin tubing comprising in combination, a hollow rotary shaft to receive and guide a tube, means for rotating the tube and feeding it through said shaft, means for presenting a flat sheet metal fin strip edgewise to the tube across the end of the shaft where the tube leaves the same, and a rotary member cooperating with the end of the shaft to press the strip against the same and having an inclined surface to reduce the thickness of the strip along its outer marginal portion to compensate for the larger circumference around the outer edge of the strip as it is spirally wound on the tube, said rotary member being rotated by the shaft in the rotation thereof with the tube to cause the shaft and the member while shaping the strip to force it about the tube.

8. In a machine for making spiral fin tubing comprising in combination means for rotating a tube and moving it endwise through the machine, means for presenting a flat sheet metal fin strip edgewise to the tube, and power driven rotary means operating on the strip as it is presented to the tube in a manner to reduce the thickness of the strip along its outer marginal portion to compensate for the larger circumference around the outer edge of the strip as it is spirally wound on the tube, said rotary means while shaping the strip also forcing it about the tube.

9. In a machine for making spiral fin tubing comprising means for rotating a tube and moving it endwise through the machine, means for presenting a flat sheet metal fin strip edgewise to the tube, and power driven rotary disclike members between which the strip is passed to the tube, said members acting to squeeze the strip laterally between them to reduce the thickness of the outer marginal portion of the strip to compensate for the larger circumference about the outer edge of the strip as it is spirally wound on the tube, said members while shaping the strip also acting to force the strip about the tube.

10. The method of making spiral fin tubing, which consists in rotating and longitudinally moving a tube past a strip winding station, presenting a flat sheet metal strip edgewise to the tube at said station, and while presenting the strip to the tube at said station reducing the thickness of the strip along its outer marginal portion by rotary forces which also serve to force the strip about the tube.

11. In a machine for making spiral fin tubing comprising in combination, means for supporting a tube and moving it endwise through the machine, means for presenting a flat sheet metal fin strip edgewise to the tube having a normal rectangular cross section, and power driven rotary means operating on the strip as it is presented to the tube in a manner to reduce the thickness of the strip along its outer marginal portion to compensate for the larger circumference around the outer edge of the strip as it is spirally wound around the tube, said rotary means while shaping the strip also forcing it about the tube.

12. In a machine for making spiral fin tubing comprising in combination means for presenting a flat sheet metal fin strip edgewise to a tube to wind the fin strip spirally thereon as the tube is rotated and fed endwise through the machine, and means for rotating a tube and feeding it through the machine comprising a rotary drum to receive the tube, a single set of rolls carried by the drum and engaging the tube for rotating the tube in the turning of the drum, a stationary sun gear at one end of the drum and having a bore for the passage of the tube therethrough, planet gears in mesh with said sun gear and carried about the same in the rotation of the drum, and means connecting the rolls with said planet gears for

turning the rolls to feed the tube through the drum in the rotation of the latter.

13. In a machine for making spiral fin tubing comprising in combination means for presenting a flat sheet metal fin strip edgewise to a tube to wind the fin strip spirally thereon as the tube is rotated and fed endwise through the machine, and means for rotating the tube and feeding it through the machine comprising a rotary drum to receive the tube, a single set of rolls in the drum and engaging the tube, a stationary sun gear associated with the drum and having an axial passage for the tube, planet gears in mesh with said sun gear, transversely arranged shafts journaled in the drum and connected with the rolls and planet gears, respectively, and worm gearing connecting the shafts of the rolls with those of the planets for rotating the rolls in the turning of the drum.

14. In a machine for making spiral fin tubing comprising in combination means for presenting a flat sheet metal fin strip edgewise to a tube to wind the fin strip spirally thereon as the tube is rotated and fed endwise through the machine, and means for rotating the tube and feeding it through the machine comprising a hollow rotary shaft to receive the tube, a drum fixed to the shaft for rotation thereby, and a single set of rolls mounted in the drum and engaging the tube for rotating and feeding the tube in the rotation of the drum.

15. In a machine for making spiral fin tubing comprising in combination means for presenting a flat sheet metal fin strip edgewise to a tube to wind the fin strip spirally thereon as the tube is rotated and fed endwise through the machine, and means for rotating the tube and feeding it through the machine comprising a rotary drum to receive the tube, shafts mounted in the drum on opposite sides of the tube, feed rolls splined on said shafts and engaging the tube, springs means for yieldably holding the rolls against the tube, and means for rotating the shafts to turn the rolls in the rotation of the drum.

In testimony whereof I affix my signature.

GEORGE H. PICKHARD.