Dec. 4, 1956 P. M. PADGETT 2,772,646

MAKING AND COMPRESSING CORRUGATED FLEXIBLE HOSE IN ONE OPERATION

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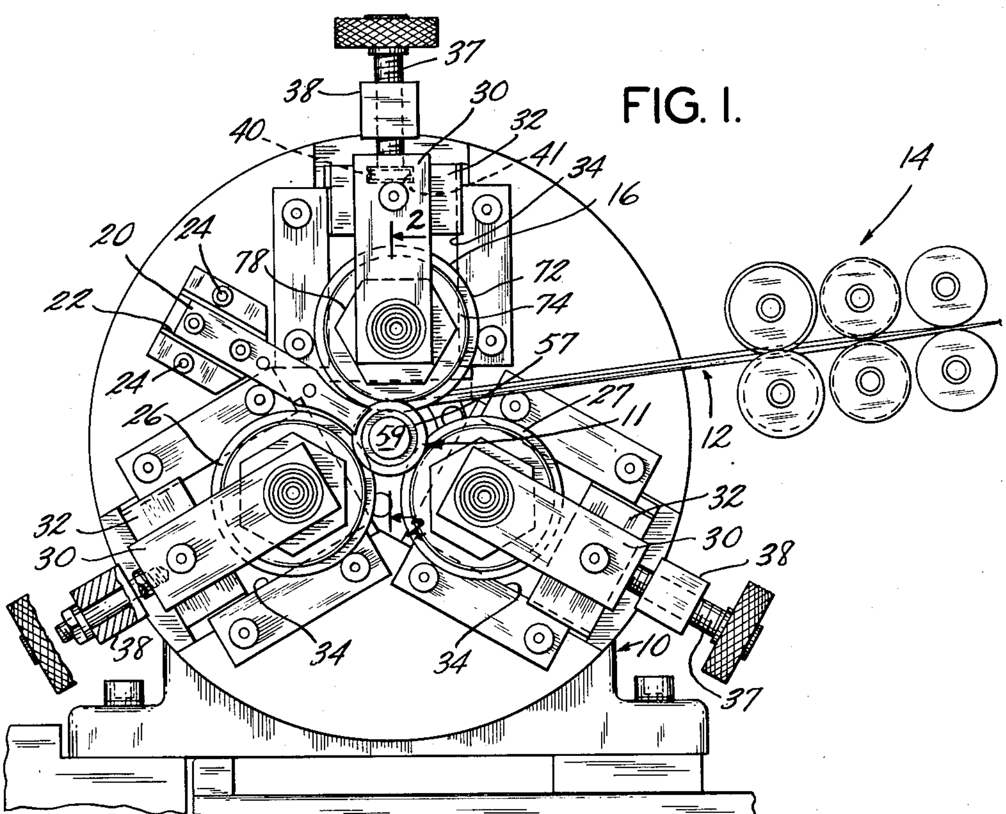
FIG. 1.



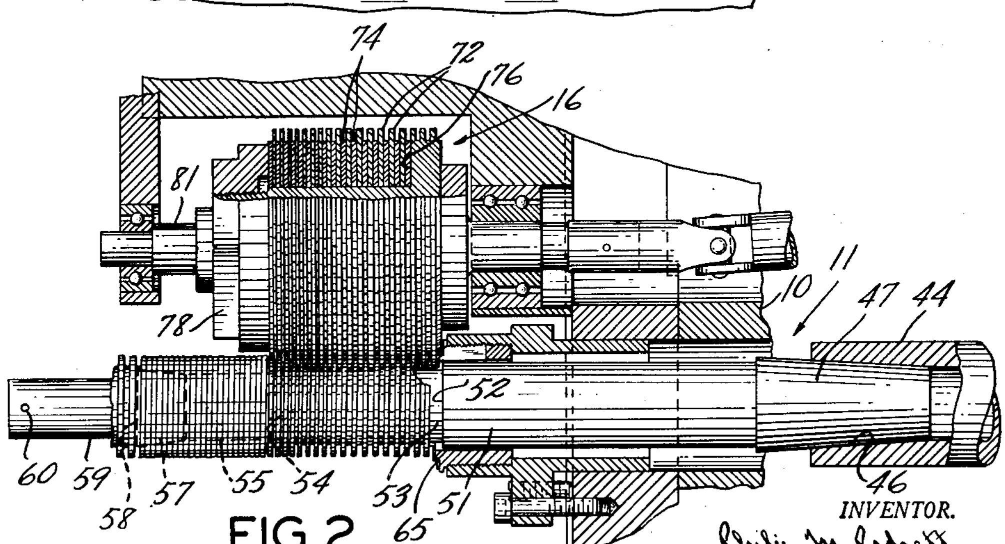


FIG. 2.

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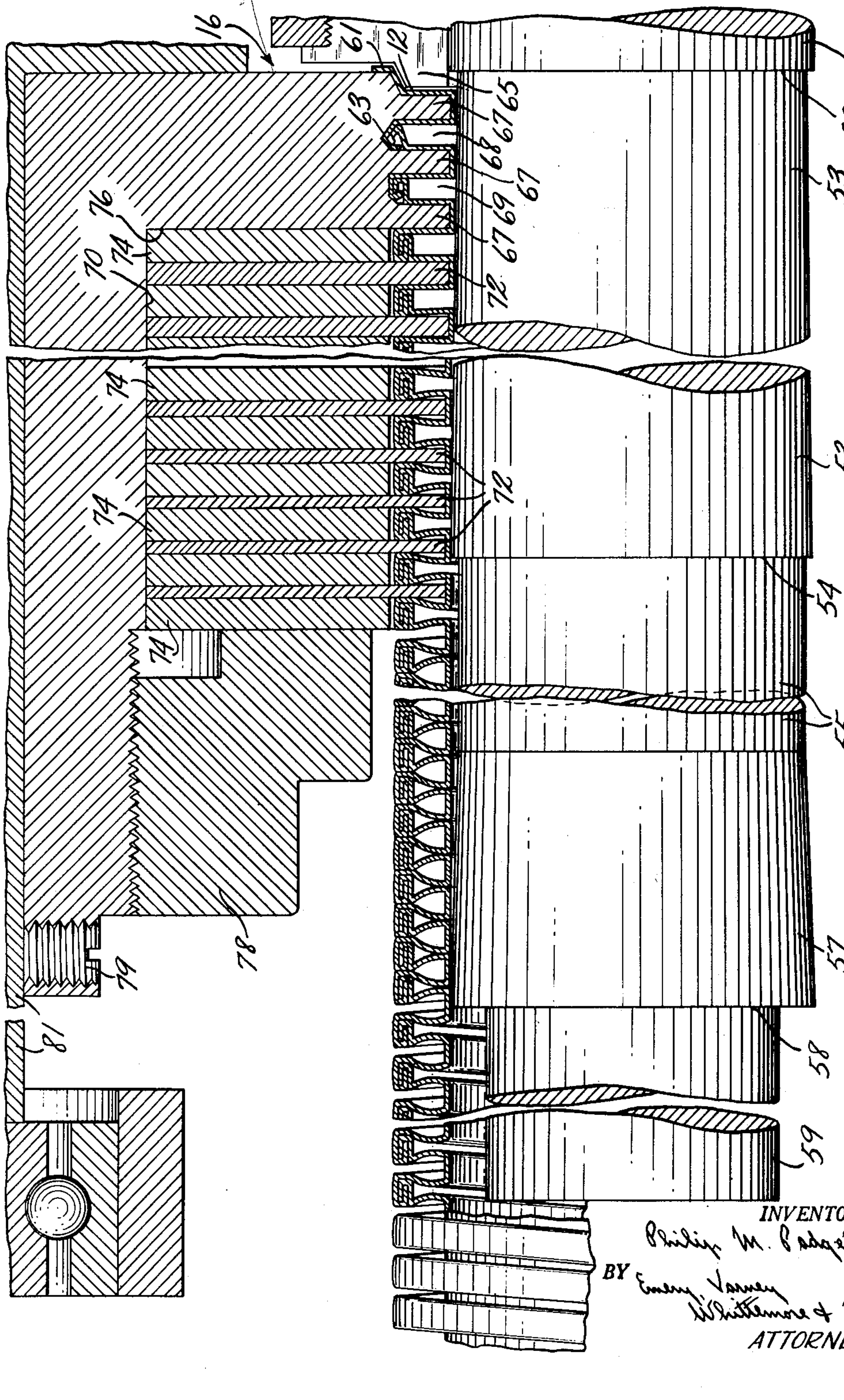

FIG. 3.

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MAKING AND COMPRESSING CORRUGATED FLEXIBLE HOSE IN ONE OPERATION

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4 Claims. (Cl. 113—35)

This invention relates to apparatus for making helically wound, corrugated metal tubing. Such tubing is commonly made by supplying a longitudinally corrugated metal strip to a mandrel in a direction to wrap in a helix around the mandrel with the edges of adjacent convolutions forming a seam. An interlocked seam is obtained by having a turned-up edge along one side of the strip and a folded-over edge along the other side of the strip; the strip being guided so as to engage the flange in the folded-over edge. The engaged edges are then bent over to form an interlocked seam.

It is an object of this invention to provide a machine for making helically corrugated metal tubing and compressing the corrugations together, to increase the flexibility of the tubing, in the same operation with the forming and stripping of the tubing. In tube-making apparatus of the prior art, the helically corrugated tubing has been subjected to a subsequent manufacturing step in which the corrugations are crowded close together, and then allowed to spring apart, so as to obtain a much more flexible product than the tubing that comes direct from the forming machine. This compressing of the corrugations to increase the flexibility is particularly important for tubing that is to be covered by rubber sleeves and/or braiding which necessarily reduces the flexibility considerably.

By compressing the tubing as a continuous operation with the forming and stripping, this invention makes unnecessary the subsequent handling of the tube for the usual compressing. One feature of the invention relates to a roller construction which crowds the corrugations closer together as they advance through the machine, and another feature relates to a mandrel construction which causes a crowding together of the corrugations beyond the stripping rollers. In the preferred embodiment of the invention both of these features are combined in a single machine.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views,

Fig. 1 is an end elevation, partly diagrammatic, of a tube-making machine embodying this invention;

Fig. 2 is an enlarged, fragmentary view, mostly in section, of a portion of the apparatus shown in Fig. 1; and

Fig. 3 is a greatly enlarged view of the mandrel and a portion of one of the rollers with the corrugations of the tubing shown at the various stages through which they pass in the forming and compressing operations of the invention.

The machine shown in Figure 1 comprises a rigid, main frame 10 and a mandrel 11 supported by the main frame and rotatable about its longitudinal axis by power means. A strip of metal 12 is supplied to the mandrel and is wrapped around the mandrel in a helix. The strip

12 passes through forming apparatus 14, which is illustrated diagrammatically. The forming apparatus illustrated is merely representative of apparatus for bending the strip to a transverse contour suitable for making the flexible corrugated tubing with which this invention is concerned.

The metal strip 12, after passing through the forming apparatus 14, preferably has a longitudinally extending corrugation along the center portion of the strip, a turned-up flange at one side, and a folded-over edge along the other side of the strip. As the strip is wound on the mandrel the up-turned flange is guided into engagement with the folded-over edge to form a seam. The engaging edges are then bent over at right angles to form an interlocked seam, in a manner which will be described more fully hereinafter.

The edges of adjacent convolutions of the strip 12 are guided into engagement with one another by a guide roller 16 located adjacent to the mandrel 11 at the region where the strip 12 initially comes into contact with the mandrel 11. Further guidance and uniform bending of the metal strip is obtained by means of a shoe 18 supported from the main frame 10.

This shoe 18 is located immediately beyond the guide roller 16 and substantially in line with the direction in which the strip 12 is fed to the mandrel. The shoe 18 is connected to a slide 20 which is adjustable in a dove-tail guideway 22 to move the shoe 18 toward and from the axis of rotation of the mandrel. This provides an adjustment of the clearance of the shoe 18 from the mandrel to accommodate the thickness of the particular gauge of strip being used. The slide 20 can be locked in any position by screws 24 of the dove-tail guideway 22.

There are other rollers 26 and 27 which are angularly spaced around the axis of the mandrel. The rollers 16, 26 and 27 are shown at 120° spacing. This obtains a uniformly distributed control of the strip and the tubing as the lattter is formed on the mandrel and is stripped from the mandrel by advancing the tubing along the mandrel toward the discharge end of the mandrel. In the preferred construction, each of the rollers 16, 26 and 27 has fins and grooves for engaging the corrugations of the tubing; and the successive rollers are canted and located progressively further ahead along the axis of the mandrel to compensate for the pitch of the seam and helical corrugation of the tubing.

Each of the rollers 16, 26 and 27 is carried by a yoke 30 connected to a slide block 32 which is adjustable, toward and from the axis of the mandrel, along an undercut guideway 34. The guiding elements of each guideway 34 can be clamped against the slide block 32 to lock the slide block and yoke 30 in any adjusted position. The slide blocks 32 are advanced and retracted by means of screws 37 that thread through lugs 38 attached to the main frame of the machine. Secured to the radial inner end of each screw 37, there is a collar 40 contained in an undercut socket 41 which serves as a thrust bearing for raising and lowering the slide block 32 and its associated roller when the clamping screws 37 are released.

Figure 2 shows a power-driven axle 44 with a tapered socket 46 into which fits a complementary seat 47 of the mandrel 11. The taper of the socket 46 and seat 47 is gradual so that the mandrel fits tightly and is held with its longitudinal axis in line with the axis of the power-driven axle 44.

The mandrel 11 has a cylindrical portion 51 immediately beyond the tapered seat 47 and of a diameter less than the diameter of the large end of the seat 47. At the outer end of the cylindrical portion 51 there is a shoulder 52 extending inwardly to the small end of a tapered portion 53 of the mandrel. This tapered portion

53 increases in diameter toward the outer or discharge end of the mandrel and terminates in a shoulder **54** which extends inwardly to another cylindrical portion **55** of the mandrel.

At the outer end of the cylindrical portion **55** there is another tapered section **57**. This tapered section **57** increases in diameter toward a shoulder **58** at its outer end, and this shoulder extends inwardly to a reduced-diameter cylindrical portion **59** of the mandrel beyond the tapered section **57**. A hole **60**, near the outer end of the mandrel, is used for lacing the strip when initially starting the winding of the strip, this being a conventional practice. Although all of the shoulders **52**, **54** and **58** are shown substantially normal to the axis of rotation of the mandrel, they need not be so abrupt and may slope inward.

The increase in the diameter of the tapered section **53** is for the purpose of obtaining a tight fit of the tubing on the mandrel so that there is ample friction for driving the tubing and pulling additional strip to the mandrel. This increase in diameter may amount to approximately .003 inch, though this value is given merely by way of illustration and as an example for use with brass strips and mandrels of the order of one-half (½) inch in diameter.

The tapered section **57** of the mandrel is preferably greater in its angle because of the fact that it is shorter than the tapered section **53**, but the total increase in diameter is preferably the same as for the tapered section **53** and the maximum diameter is preferably the same also. These relations are not essential, however, and they can be varied to suit the particular characteristics of the metal which is being used to make the tubing. The length of this tapered section may be three-eights (⅜) inch on a material having a diameter of one-half (½) inch. This is given merely by way of illustration.

Figure 3 shows the way in which the tubing is formed on the mandrel, and compressed on the mandrel to bring the successive corrugations close together with resulting increase in the flexibility of the tubing. The formed strip **12** is initially applied to the mandrel near the inner end of the tapered section **53**. The upstanding flange along one side of the strip is indicated by the reference character **61** and the folded-over edge at the other side of the strip is indicated by the reference character **63**. Suitable guides are provided for maintaining the flange **61** upright and for insuring the proper direction of the strip so that it will wrap as a helix. This guidance is supplied by a cam element **65** extending angularly around a portion of the mandrel **11** with the desired pitch for the helix, and by the first fin and groove of the roller **16**. This cam element **65** is adjustable longitudinally by screws **66** and **66'** to secure accurate positioning with respect to the rollers **16**, **26** and **27**.

The guide roller **16** has three fins **67** with grooves **68** and **69** between them. The grooves **68** and **69** are of different shape and have their surfaces sloped so as to cause the flange and folded-over edge of the strip to engage and bend at right angles to form an interlocked seam. It will be understood that the other rollers which are angularly spaced around the mandrel, also have grooves of a contour to assist in the bending over and seaming of the edges of the strip.

The guide roller **16** may have other fins formed on its surface in the same manner as the fins **67**, but in the preferred construction the guide roller **16** has a cylindrical surface **70**, and other fins and grooves are formed by washers or fins **72** with alternate spacers **74** between them to provide the grooves for the roller. These washers or fins **72** and spacers **74** are clamped against a shoulder **76** of the roller by a nut **78** threaded on the outer end of the roller. A set screw **79**, beyond the nut **78**, engages an axle **81** of the roller so that the roller and axle rotate as a unit. In the preferred construction, power is supplied to the axle **81**.

The longitudinal width of the first few washers or fins **72** is the same as the fins **67** and is of a width to substantially fill the corrugations of the tubing. Beyond the first few fins **72**, the successive fins **72** are of progressively less longitudinal width, but the spacers **74** are preferably of the same longitudinal width throughout the entire length of the roller. As the tubing is formed and advances along the roller **16**, this progressive decrease in the width of the fins **72** locates the grooves closer together and causes the pitch of the corugation to become progressively less, with the result that the seams are crowded closer together.

The advantage of having a number of fins **72** of progressively less width is that the corrugations are crowded closer together with less pressure against the individual corrugations than would be the case if the entire amount of crowding were done against only one corrugation in a single step and with only one fin.

In the preferred construction there are eight (8) fins of progressively decreasing width, but this number is given merely by way of illustration. The spacing between the successive corrugations is cut down to approximately one-half (½) of the original spacing by the reduced-width fins **72**.

Near the last of the fins **72**, and preferably just ahead of this last fin **72**, the tapered section **53** of the mandrel reaches its maximum diameter and the diameter of the mandrel decreases abruptly at the shoulder **54**. As the tubing is stripped, it is advanced across the reduced cylindrical portion **55** of the mandrel and encounters the resistance of the tapered section **57**. This resistance is sufficient to cause the stripping action of the rollers to crowd the successive corrugations into actual contact with one another at the tops an bottoms of the corrugations. If the strip material is stiff, it may be necessary to have the maximum diameter of the tapered section **57** slightly larger than the maximum diameter of the tapered section **53** in order to obtain enough resistance to crowd the corrugations of the tubing against one another.

As the tubing is pushed beyond the large end of the tapered section **57** of the mandrel, the corrugations spring apart to some extent, depending upon the resilience of the metal from which they are made and upon how tightly they were crowded when compressed. With brass strips and a maximum diameter on the tapered section **57** equal to the maximum diameter of the tapered section **53**, the crowded corrugations spring apart to the desired extent for the final tubing so that no subsequent compressing or stretching operations are necessary as was the case with the prior art.

With dead, soft material, the crowding may be done entirely by the progressively narrower fins **72** because there is little or no tendency for the corrugations to spring apart when stripped from the mandrel.

The preferred embodiment of the invention has been illustrated and described, but changes and modifications can be made and some features can be used without others within the scope of the claims.

What is claimed is:

1. Apparatus for forming corrugated, flexible tubing, including a multi-section mandrel and guide means that feed a longitudinally corrugated strip to the mandrel in a direction to wrap in a helix around the mandrel with the edges of adjacent convolutions engaging one another to form a seam, and a roller with its axis of rotation radially outward from the mandrel and adjacent to the mandrel and having fins which extend into the corrugations of the tubing to strip the tubing from a first section of the mandrel progressively as the tubing is formed on said first section, the fins on the roller being of progressively less width toward the discharge end of the mandrel for crowding at least the upper parts of the corrugations together as they are progressively stripped from the first section of the mandrel by said fins, the mandrel having a reduction in diameter intermediate the ends of the

roller near the discharge end of the stripping roller for relieving friction of the tubing on the surface of the first section of the mandrel, and a second section of the mandrel, the reduction in diameter of the mandrel being the beginning of said second section, and the second section beyond said reduction in diameter having a taper that increases the diameter of the second section of the mandrel to a size that frictionally resists the stripping of the tube from the mandrel, the increase taking place toward the discharge end of the second section of the mandrel and being sufficient to cause resistance to forward movement of the tubing whereby the corrugations of the tubing are further crowded together as the stripper roller forces the tubing over the second section of the mandrel beyond the stripping roller and beyond the location of said reduction in diameter.

2. The apparatus for forming corrugated, flexible tubing as described in claim 1 and in which there is mechanism that imparts continuous rotation to the mandrel, and there are a plurality of rollers at regularly spaced regions around the mandrel for forming and stripping the tubing, each of the rollers having its axis of rotation radially outward from the mandrel and having spaced fins that extend into the corrugations of the tubing.

3. The apparatus for forming corrugated, flexible tubing as described in claim 2 and in which there is forming apparatus in which the strip is shaped to a contour having a single longitudinally extending corrugation, an upturned flange along one side and a folded-over edge along the other side of the strip, and the guide means that feed the strip to the mandrel are shaped so that they engage the flange of one convolution in the folded over edge of the next adjacent convolution to form a helical seam at the top of the ridges formed between the successive convolutions of the inwardly extending undulations of the corrugations into which the fins of the rollers extend.

4. The apparatus for forming corrugated, flexible tubing as described in claim 1 and in which the second section of the mandrel increases in diameter progressively to a maximum diameter substantially equal to the large diameter end of the first section of the mandrel.

References Cited in the file of this patent

UNITED STATES PATENTS

794,433	Thibodeau	July 11, 1905
998,214	Wallis	July 18, 1911
2,023,417	Guarnaschelli	Dec. 10, 1935
2,033,717	Kopetz	Mar. 10, 1936
2,268,088	Scholtes	Dec. 30, 1941
2,350,070	Shellmer et al.	May 30, 1944
2,383,253	Ingalls	Aug. 21, 1945
2,481,490	Bennett et al.	Sept. 13, 1949
2,496,790	Guarnaschelli	Feb. 7, 1950
2,595,747	Anderson	May 6, 1952