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APPARATUS FOR WINDING TUBES

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2 Sheets-Sheet 1

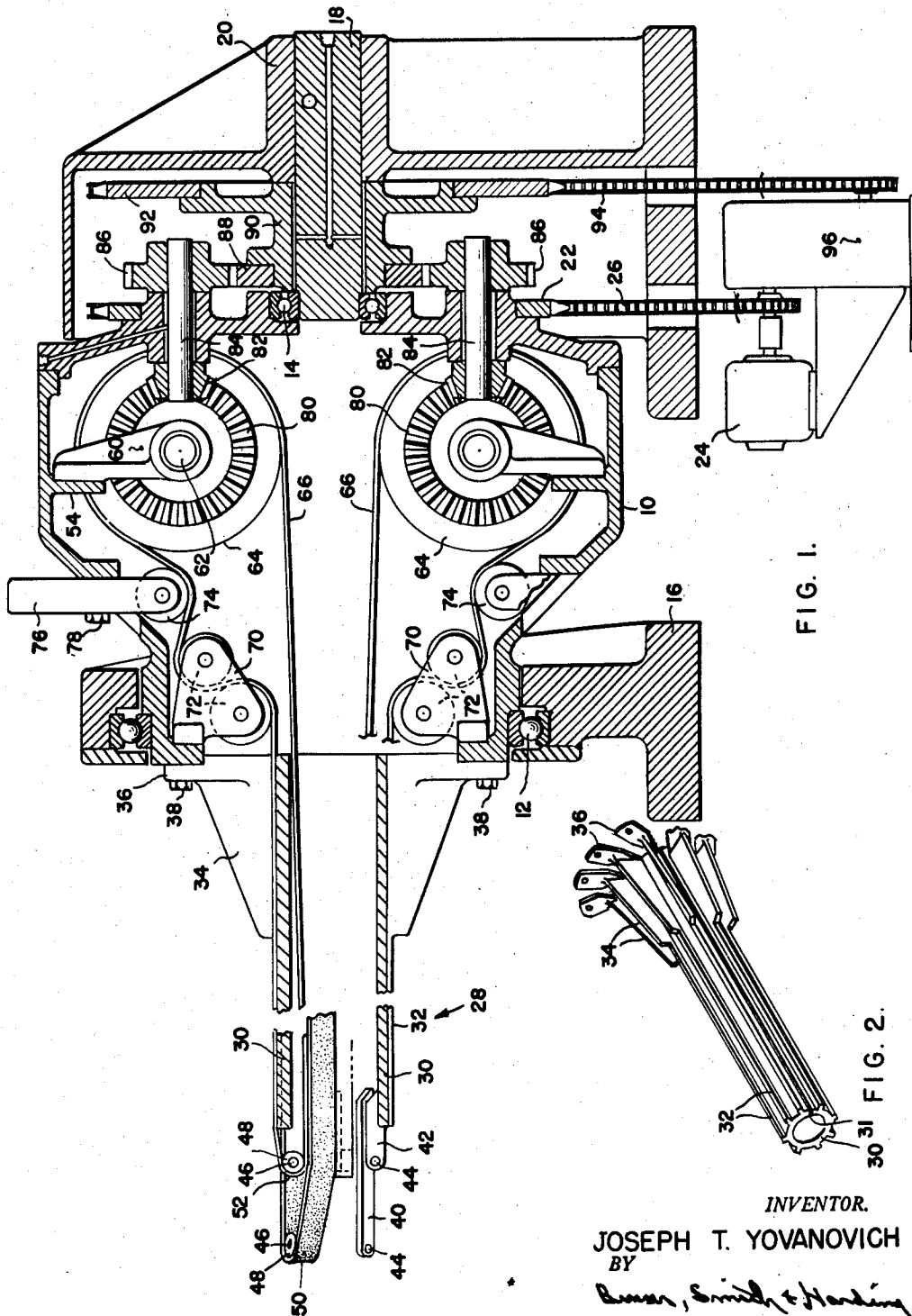


FIG. 1.

FIG. 2.

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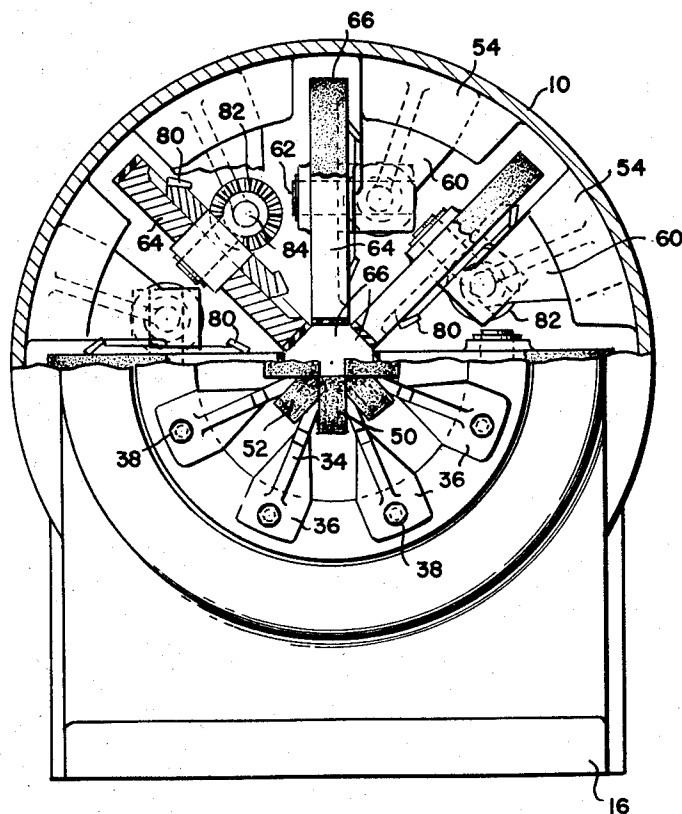


FIG. 3.

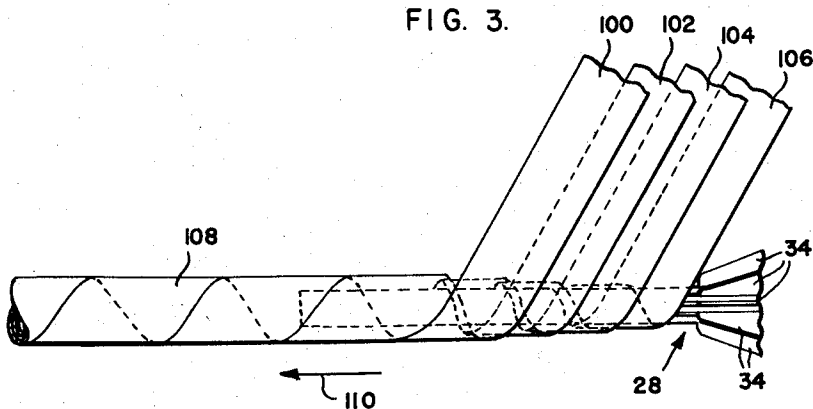


FIG. 4.

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APPARATUS FOR WINDING TUBES

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3 Claims. (Cl. 93—80)

This invention relates to tub winding apparatus and, more particularly, to an improved mandrel around which a plurality of strips of material may be wound in overlapping helical convolutions to form a tube.

Heretofore, in the production of spiral wound tubes an endless belt has been positioned with one turn around the tube being formed and with the belt passing around drive rollers positioned on each side of the tube being formed. This arrangement has not been entirely satisfactory for the reason that there occurs slippage of the belt on the drive rollers and/or slippage of the belt on the tube being formed resulting in uneven rates of advance of the tube being formed and uneven and irregular winding of the strips of material into the tube frequently involving interruption of the winding process as the result of buckling, tearing or other malformation occurring among the strips being wound. Furthermore, slippage of the belt over the surface of the tube being formed frequently results in the formation of gathers or ripples in the adhesive softened strips of material out of which the tube is being formed and, under some conditions, slipping of the belt gives rise to scoring, scorching and other surface deformation of the tube being formed.

It is the primary object of this invention to provide a mandrel around which a plurality of strips of material are wound in overlapping helical convolutions to form a tube in which the mandrel is provided with longitudinally moving outer surface forming means and rotated around its longitudinal axis as strips are helically wound thereon. It will be evident that with this mandrel there is involved substantially no relative motion between the surface of the mandrel and the convolutions of the inner strip of material being helically wound thereon.

It is a further object of the invention to provide a rotating mandrel having a longitudinally moving surface in which the relative rates of the longitudinal surface motion and the rotation may be adjusted in order that the helix angle of the convolutions may be adjusted to permit the formation of strips of various widths into a tube of a given diameter.

These and other objects of the invention relating particularly to the construction thereof will become evident from the following description when read in conjunction with the accompanying drawings in which:

Figure 1 is a partially cut-away vertical section taken along the longitudinal axis of the apparatus;

Figure 2 is a perspective view of a fragmentary portion of the apparatus shown in Figure 1 in a disassembled condition;

Figure 3 is a partially cut-away end view of the apparatus shown in Figure 1 taken from the left-hand end thereof; and

Figure 4 is a showing of strips of material being helically wound in superimposed relation on the mandrel portion of the apparatus shown in Figure 1.

The apparatus includes a housing 10 rotatably mounted in bearings 12 and 14. The bearing 12 is mounted in

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a support member 16 adapted to be affixed to a suitable base plate and the bearing 14 is mounted on a stub shaft 18 affixed to a support bracket 20 adapted to be mounted on the base plate. A sprocket 22 is affixed to the housing 10 and a motor 24 drives the sprocket 22 through a drive chain 26 and serves to rotate the housing 10 on the bearings 12 and 14.

Extending to the left of the housing 10 and affixed thereto is a mandrel indicated generally at 28 in Figure 1. The mandrel is a cylindrical member 30, as shown in Figure 2, which is provided with eight evenly spaced longitudinally extending radially positioned external ribs 32 terminating at the right-hand end of the mandrel in enlarged webs 34 mounting pads 36 adapted to be bolted to the housing 10 by means of an annular array of bolts 38. The longitudinal axis of the mandrel 30 is coincident with the axis of rotation of the housing 10.

The cylindrical member 30 is provided at its left-hand end, as viewed in Figure 1, with mounting arms 40 and 42 which are affixed to the inside surface of the cylinder 30 and extend outwardly from the left-hand end thereof. The arms 40 and 42 are positioned between the radial flanges 32 and four short arms 42 are provided and four long arms 40 are provided in alternative arrangement. The outermost end of each of the arms 40 and 42 is provided with a bore 44 through which there is passed a pin 46 on which there is mounted belt supporting rollers 48.

A plurality of endless belts pass around the rollers 48, belts 50 passing around rollers on the ends of arms 40 and belts 52 passing around rollers on the ends of arms 42. The inner reach of each of the belts extends inside the cylindrical member 30 and the outer reach of each of the belts extends exteriorly of the cylinder 30 between and outwardly of the ribs 32. The belts extend back into the interior of the housing 10.

The housing 10 is provided with inwardly extending pads 54 to which there are affixed mounting arms 60 supporting shafts 62 rotatably mounting drums 64. The drums 64 lie on longitudinally extending planes intersecting the longitudinal axis of the apparatus and the right-hand ends 66 of the endless belts 50 and 52 pass around the drums 64. Brackets 70 mount guide rollers 72 around which the outer reaches of the belts pass between the right-hand end of the cylindrical member 30 and the radially outer portions of the drums 64. Tension rollers 74 are provided in order to adjust the belt tensions and may be positioned by means of slotted bars 76 bolted in position against the housing 10 by means of bolts 78. As will be evident from Figure 3, eight drums 64 are provided in radial array to carry the endless belts in the housing 10.

Each of the drums 64 has affixed to its face a bevel gear 80 which is driven by a mating bevel gear 82 mounted on a shaft 84 rotatably mounted in the housing 10 and extending through the housing. Spur gears 86 are mounted on the right-hand most ends of shafts 84 and mesh with a ring gear 88 affixed to a sleeve 90 rotatably mounted on the stub shaft 18 for rotation independently of the housing 10. The sleeve 90 carries a sprocket gear 92 which is driven through a chain 94 by the output of a speed reducer 96 which is shown as being driven by the motor 24 but which may, if desired, be driven independently of the chain 26.

In operation, each of the eight belts, four belts 50 and four belts 52, are driven by their respective drums 64 in such a direction that the outer reach of each of the belts moves to the left, as viewed in Figure 1, and the inner reach of each of the belts moves to the right, as viewed in Figure 1. The linear velocity of the outer surface of each of the belts is equal and may be adjusted when desired by adjusting the speed of the output of

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the speed reducer 96. At the same time that the longitudinal motion of the belts is being provided, the entire assembly is rotated as the result of driving of motor 24. It will be noted that the arrangement of the belts is such that there is an overlapping of the belts 50; inside of the belts 52 and that the outer surfaces of the belts 50 and 52 extend radially outwardly of the surfaces of the ribs 32. The ribs 32 are, however, of such height as to retain the outer reaches of the belts in parallel longitudinally extending relation.

When a tube is to be formed on the tube forming apparatus, a plurality of individual strips of material, such as paper or other suitable fibrous material, are fed to the mandrel in partial overlapping relation such as that of the strips 100, 102, 104 and 106 shown in Figure 4. These strips, which are gummed or otherwise provided with an adhesive coating on their engaging faces, are wound around the mandrel 28 in overlapping helical convolutions producing a tube 108 which is moving to the left as indicated by the arrow 110 in Figure 4. The mandrel 28 is being rotated to turn downwardly toward the viewer in Figure 4 and the belts on the mandrel are moving to the left as viewed in Figure 4. It will be evident that this arrangement provides for substantially no relative motion between the outer surfaces of the belts and the convolutions of the inner strip of material 106. Thus the strips may be wound with a degree of tightness depending upon the tension provided by the strips 100—106 and with no undesirable slipping, gathering, bunching, etc. taking place on the exterior surface of the tube such as would otherwise occur if an external drive belt were employed to form the convolutions and to rotate and drive the finished tube. Furthermore, this arrangement of internal winding mandrel avoids the necessity of employing a fixed internal mandrel which is generally employed in connection with external belt winding apparatus. When a fixed mandrel and exterior winding belt are used, the convolutions of the innermost strip must slide over and around the mandrel. In my apparatus, the mandrel is rotating and the surface of the mandrel is moving to the left, as shown in Figure 4, at a speed identical to the speed of the tube 108. Thus there is no relative motion between the surface of the mandrel 28 and the convolutions of the innermost strip 106. It follows, therefore, that the friction and other power losses normally encountered in tube winding are reduced to a minimum.

In Figure 2 the wall of the cylinder 30 is shown as having a slot 31. This slot is provided for the entry of molded endless belts. In place of molded endless belts, chain belts or other types of belts may be employed, and if belts are employed which may be joined after their installation, the provision of this slot is not necessary. It will be evident that various types of belts may be employed. Hereinafter, the words "endless belts" are intended to refer to any of these types of belts. The word "housing" as employed hereinafter is intended to mean any type of housing or frame assembly suitable for mounting the belt drive rollers and mandrel cylinder. It will be evident that various arrangements of motors and speed reducers may be employed to provide independent speed control for the speed of rotation of the mandrel and for the speed of linear movement of the belts. While the mandrel disclosed herein a generally octagonal by virtue of the eight belts employed thereon it will be evident that by the employment of various numbers of belts, square, rectangular or substantially cylindrical mandrels can be provided. Hereinafter, when

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reference is made to an elongated mandrel or to an elongated member extending from the housing it will be evident that the member may provide a mandrel of square, round, cylindrical or other desired form. It will be evident that these and various other mechanical modifications may be made in the embodiment of the invention disclosed herein without departing from the scope of the invention as set forth in the following claims.

What is claimed is:

1. Tube winding apparatus comprising means forming a mandrel, means providing longitudinally movable outer surfaces on said mandrel, means mounting said mandrel for rotation around its longitudinal axis, means driving said movable surface forming means, means rotatably mounting said mandrel, said mandrel rotating while overlapping strips of material are helically wound thereon and the helically wound strips forming a tube moving longitudinally over said mandrel on said longitudinally moving surfaces, and means for adjusting the relative speeds of said movable surface and rotating mandrel for adjusting the helix angle of the strips being wound into a tube.

2. Tube winding apparatus comprising an elongated mandrel, means mounting said mandrel for rotation around its longitudinal axis, a plurality of parallel longitudinally extending belts mounted externally and movable longitudinally of said mandrel providing longitudinally movable external surfaces, driving means including a gear rotatable coaxially with said mandrel for rotating said mandrel, driving means including a second gear rotatable coaxially with said mandrel for moving said belts, said mandrel and belts rotating while overlapping strips of material are helically wound thereon and the helically wound strips forming a tube moving longitudinally over said mandrel on said longitudinally moving surfaces, and means driving said gears and including means for adjusting the relative speed thereof to adjust the relative speeds of said movable belts and said rotating mandrel for adjusting the helix angle of the strips being wound into a tube.

3. Tube winding apparatus comprising a rotatably mounted housing, an elongated mandrel affixed to and extending from said housing with the longitudinal axis of the mandrel lying on the axis of rotation of the housing, a plurality of endless belts in parallel arrangement extending longitudinally of and around the wall of said mandrel and extending into said housing, means mounted in annular array within said housing and a gear rotatable coaxially with said mandrel for driving said belts for movement longitudinally of said mandrel, means including a second gear rotatable coaxially with said mandrel for rotating said rotatable housing and elongated mandrel and belts supported thereby, said elongated mandrel and belts rotating while overlapping strips of material are helically wound thereon and the helically wound strips forming a tube moving longitudinally of said mandrel on said longitudinally moving belts, and means for driving said gears and including means for adjusting the relative speeds thereof to adjust the relative speeds of said rotating housing and longitudinally moving belts for adjusting the helix angle of the strips being wound into a tube.

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