Sept. 20, 1938. H. C. AUMENT 2,130,727

METHOD AND APPARATUS FOR FORMING TUBES

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Fig. 1

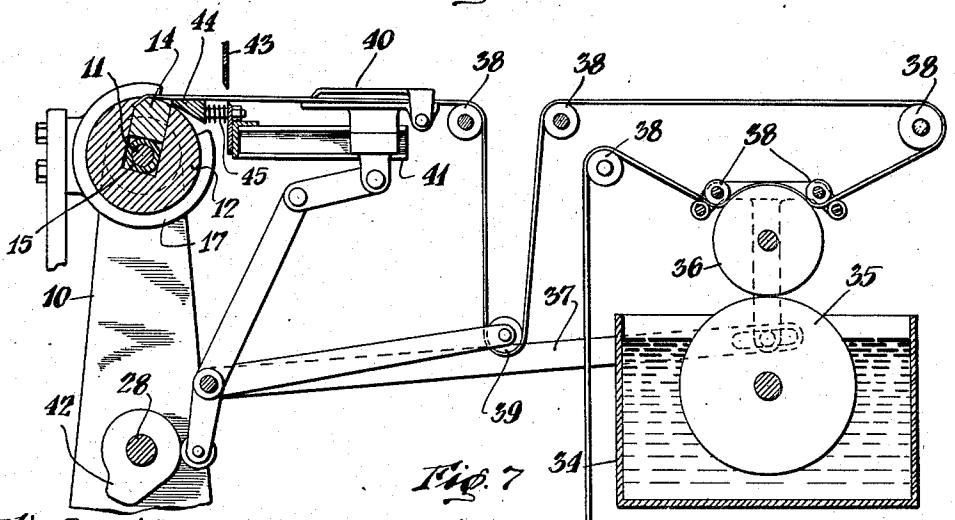
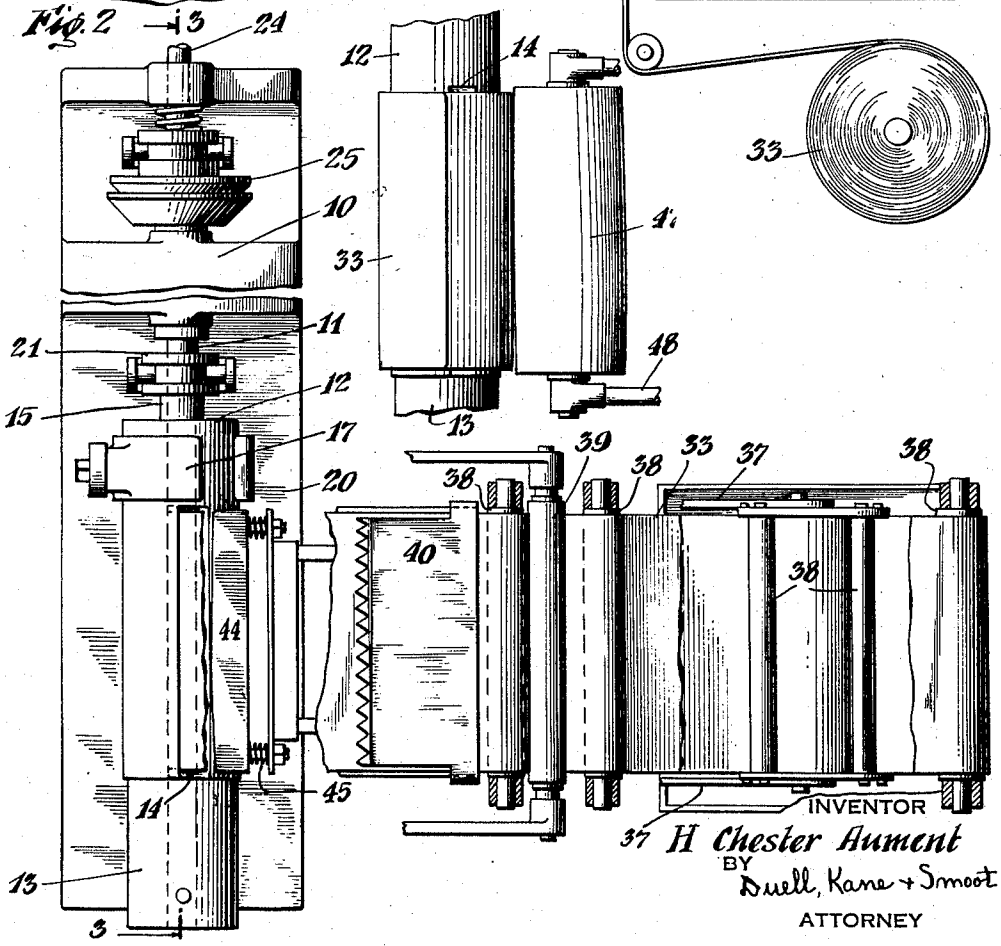


Fig. 7

Fig. 2



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Fig. 3

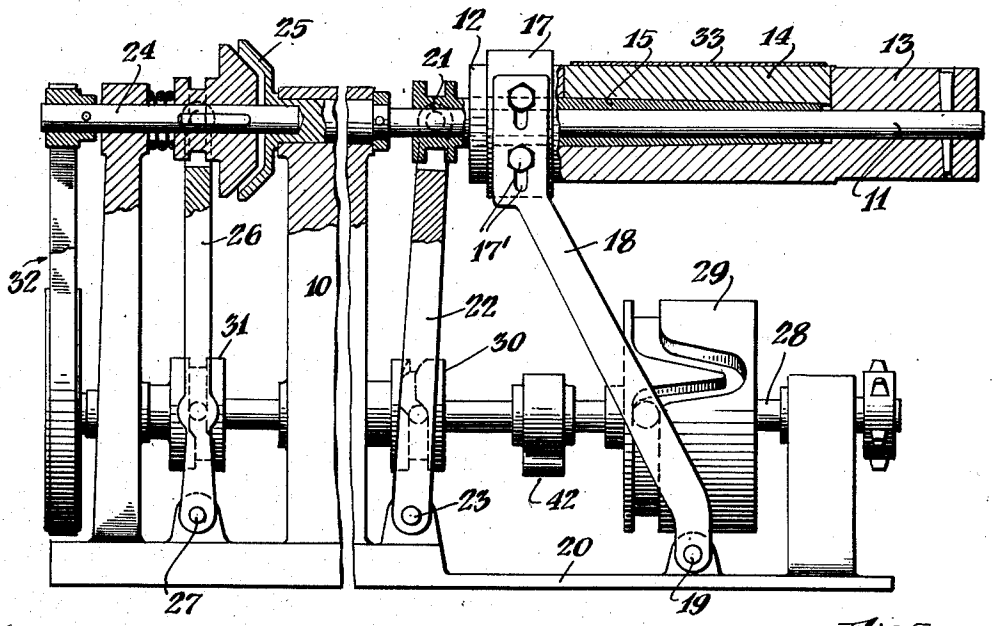


Fig. 4

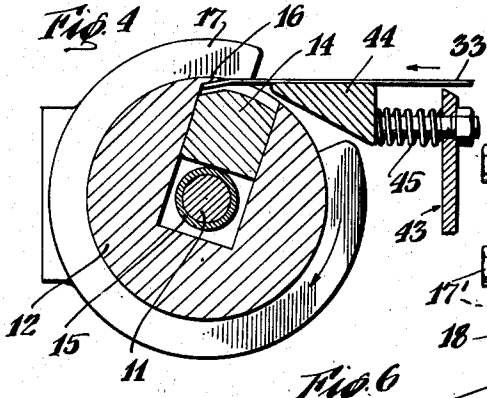


Fig. 5

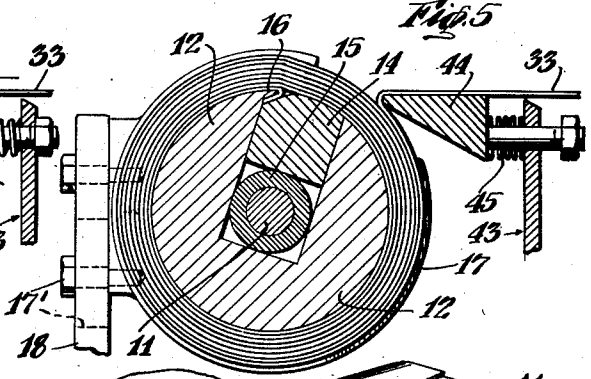
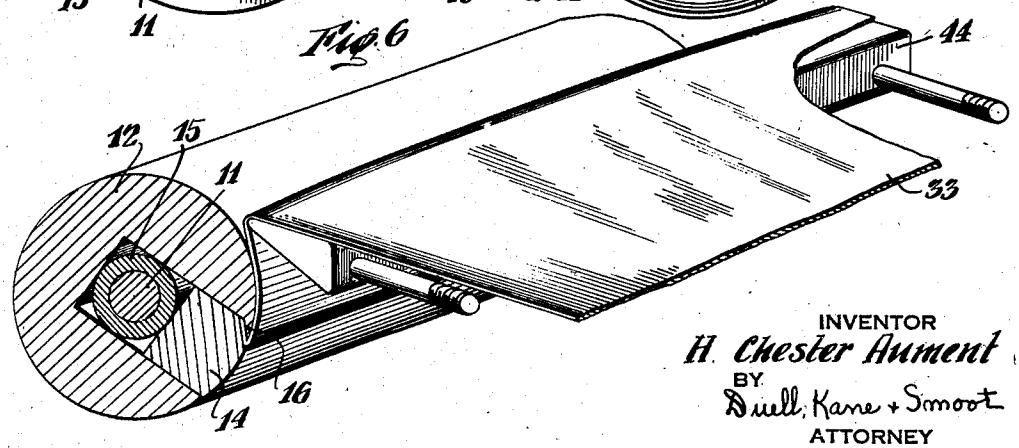


Fig. 6



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METHOD AND APPARATUS FOR FORMING TUBES

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Application March 17, 1937, Serial No. 131,354

13 Claims. (Cl. 93—81)

This invention relates to an improved method of forming tubes as well as a functionally and structurally improved apparatus whereby such method may be practiced.

It is an object to teach a method of forming tubes as well as to provide an apparatus for the practice of such method and by means of which units may be produced which will embody a multiply construction, but in which there will be no voids or excess material present which might impair the subsequent usefulness of the unit.

A further object of the invention—and viewed in its more specific aspects—is that of teaching a method and providing an apparatus as aforeidentified and by means of which tubes of cylindrical or other desired configuration may be efficiently produced, such tubes being ideally adapted to subsequently form the bodies of containers which will withstand severe abuse and strains while efficiently housing various types of materials and especially liquids.

A still further object of the invention is that of teaching a method and furnishing an apparatus for the practice thereof, which method may readily be followed by persons having a relatively small amount of skill and which persons additionally will not require any high degree of training to efficiently operate apparatus constructed in accordance with the teachings of the present invention.

An additional object is that of furnishing a method and apparatus, the former being susceptible to economical and high speed practice while the latter will embody relatively few parts, each individually simple and rugged in construction, these parts efficiently cooperating over long periods of time with freedom from all difficulties.

With these and other objects in mind, reference is had to the attached sheets of drawings, illustrating practical embodiments of the invention, and in which:

Fig. 1 is a somewhat diagrammatic sectional side view of an apparatus whereby the present method may be practiced.

Fig. 2 is a fragmentary plan view thereof;

Fig. 3 is an enlarged transverse sectional view taken along the lines 3—3 and in the direction of the arrows as indicated in Fig. 2;

Fig. 4 is a fragmentary sectional side view of one unit of the apparatus and showing the initial condition of the same;

Fig. 5 is a view similar to Fig. 4, but showing the final position which the parts of such unit assume;

Fig. 6 is a fragmentary perspective view of the apparatus as illustrated in Figs. 4 and 5; and

Fig. 7 shows an alternative form of unit.

As afore brought out, the present invention aims to provide a method and apparatus primarily intended for the production of tubes to form the bodies of containers. These tubes are preferably cylindrical in cross section and to this end the apparatus illustrated has a configuration so that the desired results are achieved.

Thus, referring to Figs. 1, 2 and 3, the numeral 10 indicates a support upon which there is rotatably mounted a shaft 11. In turn supported against movement with respect to this shaft is a mandrel 12 having a preferably reduced end portion 13 and a movable section 14. The latter extends throughout the operative or "receiving" zone of the mandrel and may be projected or retracted by means of a tapered sleeve 15 interposed between the shaft and the mandrel.

As illustrated especially in Figs. 4 and 5, the mandrel 12 presents a slot to receive section 14. Adjacent the forward edge of such movable section the edge of the mandrel may overlap the slot as has been indicated at 16. The major portion of the outer edge of section 14 is curved to merge with the outer surface of mandrel 12 when the section is projected. Adjacent its forward or leading edge this curvature is interrupted so as to conform to the overlapping form 16 of the mandrel. Thus, it will be understood that a layer of material may be introduced between the overlapping portion 16 and the adjacent surface of section 14 when the latter is retracted and this material will be firmly clamped in position upon the section being projected, as shown in Fig. 5.

Disposed adjacent mandrel 12 is a stripping unit which may take the form of a yoke 17 and this unit is conveniently mounted for movement through bolt and slot connections 17' by an arm 18 pivotally supported as at 19 upon the base 20 of the machine. At this time it is also to be observed that the tapered sleeve 15 may be projected and retracted by a yoke 21 forming a part of or coupled to a lever 22 pivotally supported as at 23 by the base. Shaft 11 is rotated by means of a drive shaft 24 through the intermediary of a clutch 25, it being observed that the latter may be actuated by a yoke and lever 26 pivotally coupled as at 27 to the base.

With a view to providing for an automatic actuation of the assembly and also to drive shaft 24, a further shaft 28 may be rotatably supported by the base and mount cams 29, 30 and 31 respectively, coupled to operate levers 18, 22 and 26.

A drive connection 32 is provided between shafts 28 and 24 and in view of the fact that it is desired that each unit form include in the present exemplification seven layers or plies of material, the drive 32 should provide for a seven to one reduction. In other words, for each revolution of shaft 28, shaft 24 should revolve seven times. At the beginning of such revolutions section 14 will, of course, be projected by sleeve 15 and the parts of clutch 25 will be engaged. Thereafter mandrel 12 will rotate the desired number of revolutions and finally the parts of clutch 25 will be disengaged, sleeve 15 will be retracted to permit of a similar movement on the part of section 14, and the stripping yoke 17 will slide over the mandrel, thereby ejecting over the reduced end 13 thereof the tube which has been built up. Yoke 17 will now return to its initial position and the parts will be ready for a further operation. It is, of course obvious that the movements of the yoke are permited on account of the bolt and slot connection 17' or equivalent structures utilized, so that while arm 18 swings the movement of yoke 17 will be in effect a reciprocatory one. It is apparent that any desired method of driving shaft 28 may be resorted to.

Now returning to a consideration of Figs. 1 and 2, it is to be observed that a roll 33 of paper or other suitable material is conveniently supported adjacent the machine and moves adjacent a bath 34. This bath may be filled with glue or any other suitable material consistent with achieving the desired results. Immersed within the bath is a transfer roller 35 which carries the substance to a coating roller 36. By means of suitable tensioning and guiding elements 38 the web of paper or its equivalent moves in contact with the face of roller 36 and becomes uniformly and properly coated with glue or any other substance with which tank 34 is filled. Thereafter the web passes over the rollers to a tensioning and "slack take up" unit 39. At this time it is to be observed that the web coating mechanism including in the present exemplification rollers 35—36, has associated with it an arm 37 by means of which the coating operation may be periodically interrupted for a purpose hereinafter brought out. As illustrated, arm 37 is actuated by a cam (not shown) conveniently associated with shaft 28. It is, of course, to be understood that any form of mechanism whereby an interruption to the coating operation results, as well as any mechanism for actuating the same, may be employed. Thence the web passes to a feeding unit 40 which may be slidably mounted upon tracks as at 41 and be reciprocated by a cam and roller 42, the former of which is mounted upon shaft 28. At a point beyond the feeding and gripping unit 40, a severing mechanism 43 may be positioned to be actuated as desired for severing the web 33. Finally, it is to be observed, as in Figs. 4, 5 and 6, that a wrapping bar 44 is positioned adjacent mandrel 12 and is acted upon by relatively weak springs 45 to constantly tend to move toward the same.

In operation it is obvious that the parts are set up in the manner shown in Figs. 1 and 2, and the forward edge of the web is brought to lie between section 14 and the overlapping portion 16 of mandrel 12 in the manner illustrated in Fig. 4. If now section 14 is projected, this leading edge of the web is clamped and a rotation of mandrel 12 will result in the web being coiled around this unit in the manner shown in Fig. 5. During such coiling, a uniform arrangement of layers will result, which will be free from all voids, wrinkles, or other objectionable factors. This will be true because the bar 44 will be lightly bearing against the outer surface of the web, thereby not alone functioning to assure a completely even distribution of the coating upon its inner face, but acting to wrap the web around the mandrel and successively around its inner convolutions after the mandrel completes one rotation. Of course, during this action of the parts the wrapping function exerted by bar 44 will remain substantially constant. This is extremely desirable because as the body of the tube is built up a yielding aggregation of layers is presented and if the tensioning and wrapping effect were not present there would be danger of the succeeding layers presenting wrinkles and/or voids.

Thus, a final result is reached somewhat in the manner shown in Fig. 5 in which it is observed that each of the inner faces of the convolutions has been coated with glue which has been forced to actually penetrate the fibres of the layer to which it is applied, thus providing (in the case of a seven-ply or layer tube) a composite article which, in effect, embraces 13 layers of material intimately merged and interlocked to furnish a unitary structure of extreme rigidity and which will be substantially impervious to moisture and atmospheric conditions. This will be especially true if there is incorporated in the glue or its equivalent, moisture resisting or water-proofing characteristics. The reason for there being one less layer of glue or its equivalent than the number of web layers provided is to be found in the fact that the innermost convolution is uncoated.

Upon the unit having been substantially built up, knife 43 will function to sever the web and the rear edge of this severed portion will conclude the last convolution of the article. Thereupon, section 14 will be retracted, the driving of shaft 11 will cease, and yoke 17 will function to strip the unit from the mandrel. The gripping and feeding device 40 will now act to feed the forward edge of the web to the mandrel to again establish the initiation of the cycle as viewed in Fig. 4. It is of course to be understood that adjacent the leading edge of the web the undersurface of the same is uncoated for a distance corresponding to one convolution of the tube to be formed. This result is achieved in that the parts are so timed as to cause an actuation of arm 37 after a web area equal to six convolutions has passed in contact with roller 36 or its equivalent, to assure that an area equal to one convolution will remain uncoated. In this manner the inner face of the inner convolution will not present objectionable characteristics and will not tend to adhere to the mandrel.

In certain instances it may be desired not to employ the wrapping bar 44. An alternative structure is suggested, for example, in Fig. 7, in which a roller 47 is mounted as at 48 to cooperate with mandrel 12. This roller is, of course, yieldingly pressed toward the mandrel in any desired and obvious manner, so that a proper cooperation between the mandrel and the wrapping member occurs. I have, however, found that under most circumstances a wrapping bar having the functional characteristics of that illustrated in Figs. 4, 5 and 6, is preferable and in any event it is to be understood that as illustrated in Figs. 4 to 7 the wrapping element (be it bar or roller) should preferably be bevelled or reduced in the direction of its end or ends. Such bevelling or reduction has been somewhat exag-

gerated in Figs. 6 and 7 for the purpose of emphasizing the construction which is desired. It is found, as a consequence of such structure, that a uniform wall thickness on the part of the unit results, and additionally there exists a tendency on the part of the glue or its equivalent to be squeezed between the adjacent layers of material in such a manner that any probability of voids or bulges occurring is overcome. It is, of course, additionally to be appreciated that the mandrel may be of any desired length so that the tube, after being discharged therefrom, can be subdivided into sections of any desired number to provide a corresponding number of container bodies.

It is to be understood that the coated web, as it is received by the mandrel, is of a relatively fragile nature and could not ordinarily be tensioned to an extent such that a proper unit would result without there being great danger of the web tearing. However, by applying the wrapping or tensioning structure after the web is once supported on the mandrel, it has been discovered that any danger of tearing is substantially eliminated, despite the fact that the effective tension is such, that no voids occur and the layers are intimately and properly joined. This, of course, according to certain aspects, follows from the practice of the present method and use of the disclosed machine, in that a slight excess of coating material may be employed and, incident to the pressures set up, this coating material is not alone evenly distributed, but is caused to fill out all voids inherent to the web structure and to penetrate the material of such structure so that substantially complete impregnation follows. According to the substance employed, the resultant container may be rendered impervious to the action of moisture, air, oil, and/or practically any other agent or liquid which surrounds or is contained within the same.

Obviously, numerous changes in the steps of the method and in the sequence of such steps might be resorted to and the construction of the apparatus employed for the practice of such method may also be varied in numerous particulars without departing from the spirit of the invention as defined by the claims.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A tube forming machine including a mandrel to receive coated web convolutions, a roller disposed adjacent said mandrel to co-act with the convolutions of web material as they are received thereon and to wrap successive layers of such material in intimate contact with said mandrel and preceding convolutions, and the zone of said roller adjacent at least one of its edges being disposed in non-parallel relationship to the surface of said mandrel.

2. A method of forming a multi-ply container from a fibrous web which includes applying to at least one face of such web a substance which will cause adherence thereof of successive layers of web material and in such application utilizing substance in excess of that necessary merely to coat such face, thereafter coiling such web so as to provide a multi-layer structure and, during such coiling, exerting pressure upon the web to cause the excess of said substance to fill all voids in the surface thereof and to penetrate the web fibres, whereby one layer of the substance is caused to merge through the web body with an adjacent layer of such substance.

3. A tube forming machine including a mandrel, means for wrapping a web of material around said mandrel, said means including a body disposed adjacent said mandrel, means for mounting said body to prevent an intimate contact between the same and the outer convolution of the tube being formed on said mandrel, and said wrapping means functioning to tension said web and over which the latter passes at a pronounced angle and directly to said mandrel.

4. A tube forming machine including, in combination, a mandrel to receive a web of material over which a composite tube is to be formed, means for coating such web with a layer of adhesive, wrapping means disposed adjacent said mandrel and including a body extending towards said mandrel to a maximum extent adjacent its central portion, and means for mounting said body to prevent intimate contact between the same and the outer face of the outermost convolution of said web which is disposed upon said mandrel.

5. A tube forming machine including, in combination, a mandrel to receive a web of material from which a composite tube is to be formed, means for coating said web with a layer of adhesive material, a bar disposed adjacent said mandrel, and means for supporting said bar to prevent an intimate contact between the same and the outermost convolution of the web disposed upon said mandrel, said bar providing a web-supporting means over which said web moves at a substantial angle and directly to said mandrel.

6. A tube forming machine including, in combination, a mandrel to receive a web of material from which a composite tube is to be formed, means for coating said web with a layer of adhesive material, a bar disposed adjacent said mandrel, and means for supporting said bar to prevent an intimate contact between the same and the outermost convolution of the web disposed upon said mandrel, said bar providing a web-supporting means over which said web moves at a substantial angle and directly to said mandrel, the web traversing edge of said bar being disposed in non-parallel relationship with respect to the surface of said mandrel.

7. A tube forming machine including, in combination, a mandrel to receive a web of material from which a composite tube is to be formed, means for coating said web with a layer of adhesive material, a bar disposed adjacent said mandrel, and means for supporting said bar to prevent an intimate contact between the same and the outermost convolution of the web disposed upon said mandrel, said bar providing a web-supporting means over which said web moves at a substantial angle and directly to said mandrel, the web contacting edge of said bar being substantially centrally extended towards the surface of said mandrel.

8. A tube forming machine including, in combination, a mandrel to receive a web of material from which a composite tube is to be formed, means for coating said web with a layer of adhesive material, a roller disposed adjacent said mandrel, means for mounting said roller to preclude of an intimate contact between the surface of the same and the outermost web convolution upon said mandrel, and said roller providing a web-supporting surface over which said web moves through a substantial angle and directly towards said mandrel.

9. A tube forming machine including, in combination, a mandrel to receive a web of material

from which a composite tube is to be formed, means for coating said web with a layer of adhesive material, a roller disposed adjacent said mandrel, means for mounting said roller to preclude of an intimate contact between the surface of the same and the outermost web convolution upon said mandrel, and said roller providing a web-supporting surface over which said web moves through a substantial angle and directly towards said mandrel, the surface of said roller extending in non-parallel relationship with respect to the surface of said mandrel.

10. A tube forming machine including, in combination, a mandrel to receive a web of material from which a composite tube is to be formed, means for coating said web with a layer of adhesive material, a roller disposed adjacent said mandrel, means for mounting said roller to preclude of an intimate contact between the surface of the same and the outermost web convolution upon said mandrel, and said roller providing a web-supporting surface over which said web moves through a substantial angle and directly towards said mandrel, the central portion of said roller being bulged towards said mandrel.

11. A method of forming a tube which includes employing a web of material, coating such web with an adhesive material, coiling such web in the form of a tube and under tension, and meanwhile applying a relatively great strain to said web at a point spaced from the edges thereof whereby to cause such material to flow over the surface of the web and towards the edge of the same.

12. A method of forming a tube which includes employing a web of material, coating such web at a point spaced from its leading edge a distance equivalent to one convolution of such tube with an adhesive material, coiling such web in the form of a tube and under tension, and meanwhile applying a relatively great strain to said web at a point spaced from the edges thereof whereby to cause such material to flow over the surface of the web and towards the edge of the same.

13. A method of forming a tube which includes employing a web of material, coating such web with an adhesive material, coiling such web in the form of a tube and under tension, meanwhile applying a relatively great strain to said web at a point spaced from the edges thereof whereby to cause such material to flow over the surface of the web and towards the edge of the same, and applying the greatest tension to said web at a point substantially intermediate its side edges whereby to cause said material to tend to flow towards such edges.

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