May 26, 1964 C. P. SMITH 3,134,216

WINDING APPARATUS AND METHOD FOR FORMING TUBULAR PRODUCTS

Filed Nov. 13, 1962 3 Sheets-Sheet 1

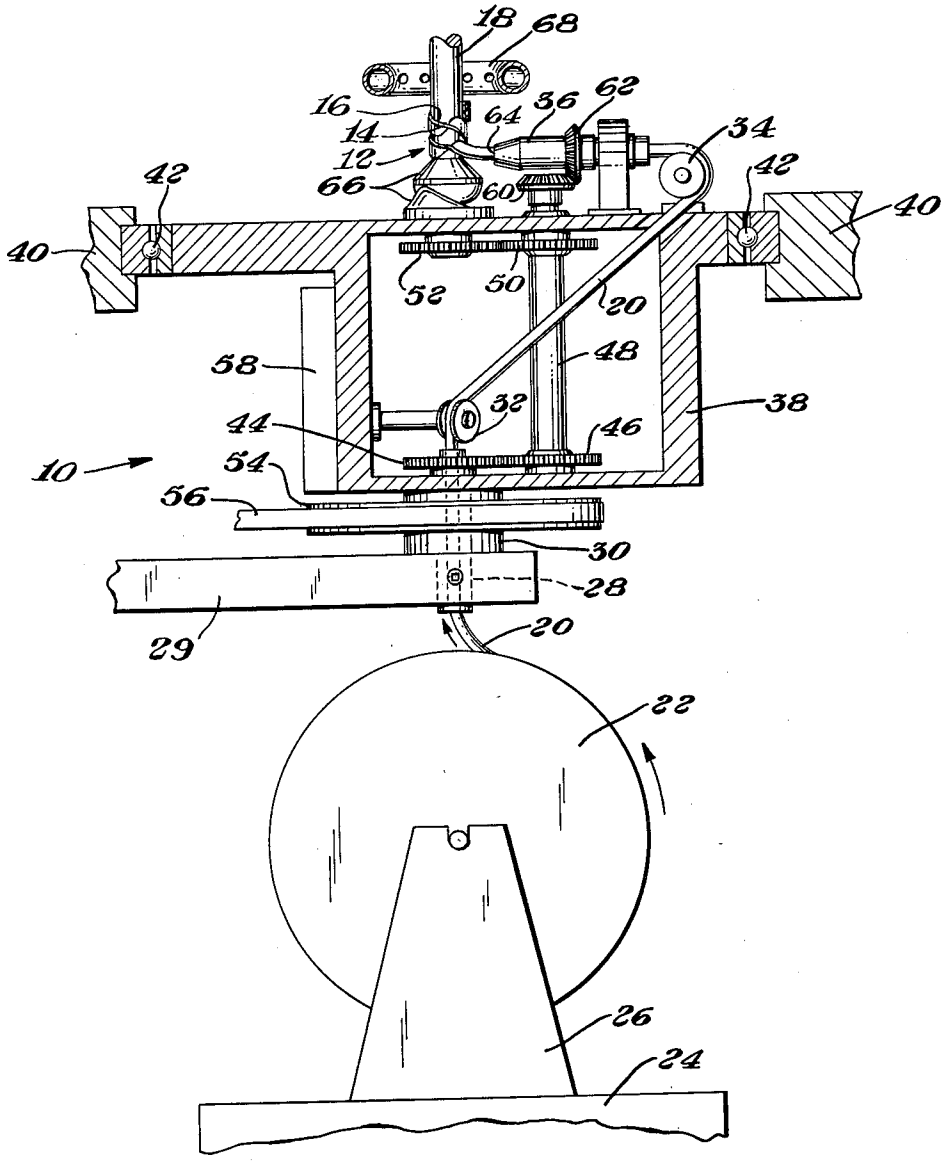


Fig. 1

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May 26, 1964 C. P. SMITH 3,134,216

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Filed Nov. 13, 1962 3 Sheets-Sheet 2

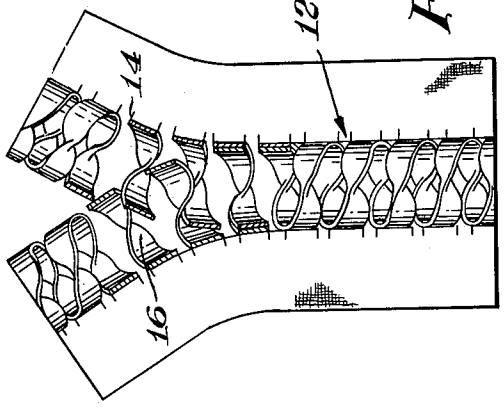


Fig. 2

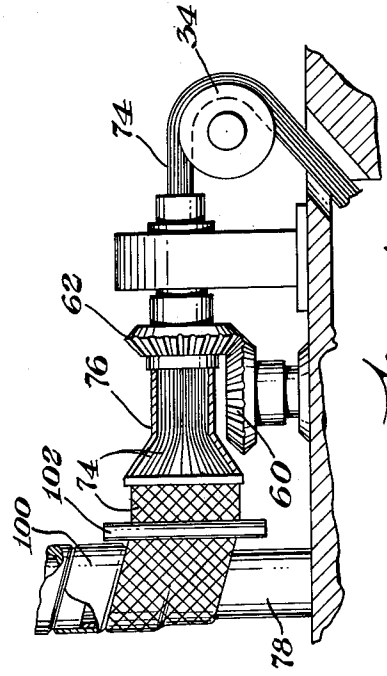


Fig. 4

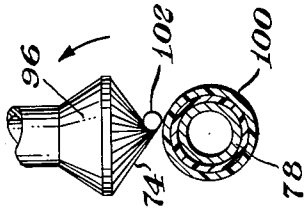


Fig. 6

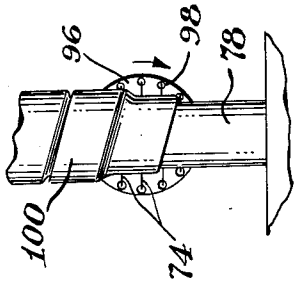


Fig. 5

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May 26, 1964 C. P. SMITH 3,134,216

WINDING APPARATUS AND METHOD FOR FORMING TUBULAR PRODUCTS

Filed Nov. 13, 1962 3 Sheets-Sheet 3

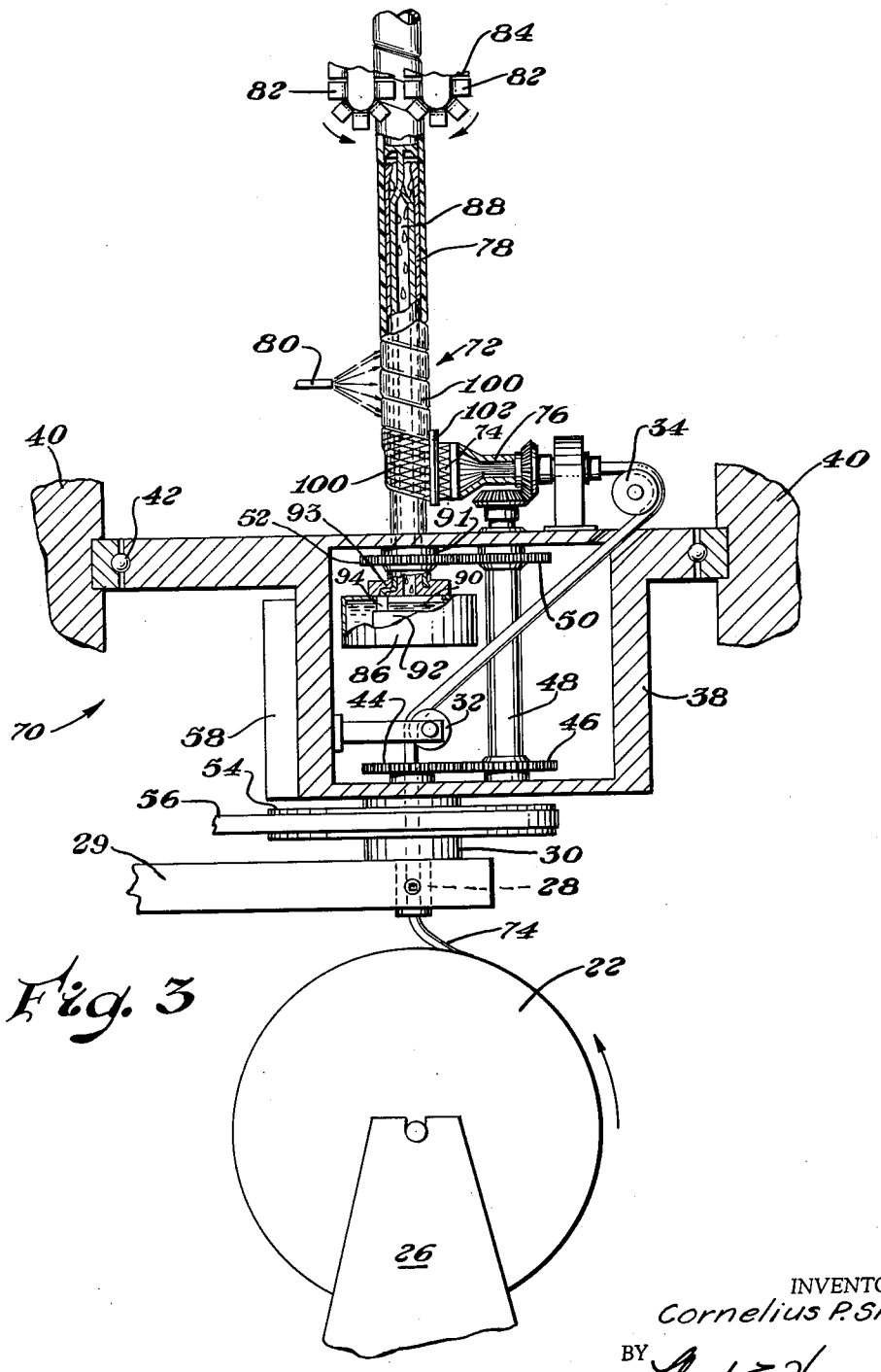


Fig. 3

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3,134,216

WINDING APPARATUS AND METHOD FOR FORMING TUBULAR PRODUCTS

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14 Claims. (Cl. 57—1)

This invention relates generally to strand winding apparatus and, more particularly, relates to a method and apparatus for winding continuous strands of material in a tubular fashion, without any back twist being exerted on the feeding source which provides the strands to be wound.

Prior apparatus for forming spirally wrapped fibrous materials, such as metal wire and plastic, for example, is that typically illustrated in U.S. Patent 2,738,641. It is usual in such apparatus to wrap the fibrous material or strands around a mandrel, the strand material being fed from a spool. Because of the twist action around the mandrel, and for other reasons which require a twist in the strand material itself, as will be apparent later, there usually results a back twist imparted on this strand material as it is being wound upon the mandrel. This twist is continuously imparted to the strands on the feeding spool and causes jamming and entanglements at the spool source as well as limiting the size of spool usable, the latter demanding frequent spool changes. Thus, prior to the present invention, no really satisfactory apparatus has been able to provide for wrapping fibrous strands in numerous forms, such as in a reinforced plastic pipe or in a zipper to which exemplary embodiments of the present invention are specifically directed.

Accordingly, it is an object of the present invention to provide novel methods and apparatus for the continuous wrapping of strands of material in a more efficient manner than that heretofore known.

A further object of the present invention is to provide a method and apparatus for the wrapping of strands of material in a continuously advancing system wherein back twist on the strand feeding source is substantially eliminated.

A still further object of the present invention is the provision of a method and apparatus for the more efficient manufacture of zippers and the like.

Still another object of the present invention is to provide a method and apparatus for the more efficient manufacture of reinforced pipe and the like.

Another object of the present invention is to provide appartus for forming a tape as a flattened tube rather than as a flat strand-like element.

Briefly then, the present invention relates to a method and machine for winding together on a stationary mandrel, and from a stationary mounted reel rotating about its own axis, strands or filaments of proper cross section, wound and twisted simultaneously in the same direction into a double filament coil which can be disengaged giving two identical single coils.

The invention further comprehends a method and apparatus for preparing a plastic pipe, which comprises drawing a plurality of filaments from a stationary mounted reel, spiralling the filaments parallel-wise into a tube, flattening the tube, winding in an overlapping fashion on an advancing mandrel, with the embedding of the overlapped filaments in a plastic resin while the mandrel is melted for recycling.

The above described methods and apparatus both incorporate teachings and principles which provide for an opposite twist to the strand being wound upon a mandrel to neutralize the wrapping twist and thus preventing a back twist upon the strand source, the latter commonly being a wound spool. This lack of back twist on the spool source renders spools of any size desired available for source feeding.

Yet additional objects and advantages of the present invention, and its numerous cognate benefits and features are even more apparent and manifest in and by the ensuing description and specification taken in conjunction with the accompanying drawing in which, wheresoever possible, like characters of reference designate corresponding material and parts throughout the several views thereof, and in which:

FIGURE 1 is an elevational view, partially broken away, of zipper-making apparatus constructed according to the principles of the present invention;

FIGURE 2 is an isometric view of a zipper constructed by the apparatus of FIGURE 1;

FIGURE 3 is an elevational view, partially broken away, of a reinforced plastic pipe-making apparatus constructed according to the principles of the present invention;

FIGURE 4 is an enlarged fragmentary elevational view of a portion of the apparatus of FIGURE 3;

FIGURE 5 is an enlarged fragmentary elevational view looking at the left of FIGURE 4; and

FIGURE 6 is an enlarged fragmentary plan view of FIGURE 4.

Part of the present invention relates to apparatus for wrapping fibers, strands or other like materials around a mandrel. The zipper-making machine twists its wire-like strand 360° each revolution to provide a wrapping for a zipper coil without exerting a back twisting at the plastic strand source, while the plastic pipe machine wraps plastic strand material around a mandrel in a criss-cross pattern without exerting a back twisting at the plastic strand source. Both devices contain a gear train for transmitting motion, and the strands or fibers are obtained from a stock feeding member, such as a spool or the like. An output guide element is also rotationally mounted and geared to a pinion shaft. The strand feeder rotates in each instance. However, in the zipper-making machine the mandrel is not advancing nor rotating but in the pipe-making machine the mandrel, while it is non-rotating, is continuously advancing. There is relative rotation however, between the mandrel and its rotating housing, it being understood that either could be the rotating member just as long as relative rotation of the two elements is maintained. The strands are desirably fed in through a hollow shaft and twisted before they exit onto the mandrel.

Referring now more particularly to the zipper-making machine 10, as illustrated in FIGURE 1, there is shown apparatus for making, in a continuous manner, a coiled zipper or fastener 12; the latter being illustrated here in FIGURE 2 and more particularly described in U.S. Patent 2,296,880 (FIGURE 5) by the same inventor as that designated for the present invention.

The zipper 12 comprises two filaments 14 and 16 which must be twisted 360° while being wrapped upon the forming mandrel 18 to provide for the interlocking and disengaging relationship described in the aforesaid U.S. Patent 2,296,880. The two filamented feed stock 20 which later forms the zipper 12, is preferably fed off a rotating spool or spindle 22 mounted upon base and cradle 24 and 26, respectively. However, while the feed stock 20 is here indicated as being a two-ply filament feed stock, it is within the comprehension of this invention that a pair of spools could also be the supply source feeding single filaments which join prior to entry into the twisting portions of apparatus 10.

Feed stock 20 enters apparatus 10 through stationary shaft 28, held stationary by clamp means 29, and thence

through a fiber guide in the form of an input hollow trunnion 30, around a pair of direction spindles 32 and 34, thence through a fiber guide in the form of an output hollow trunnion 36, and onto mandrel 18.

Trunnion 30 rotates by virtue of its being integrally connected with housing 38, the latter being rotatably mounted between structural walls 40 or the like by any convenient mechanism such as ball bearings 42. Rotatably mounted with respect to housing 38 and connected with trunnion 30, is spur gear 44 which engages a mating spur gear 46 for transmission of the rotating movement through shaft 48 to an opposed spur gear 50. Spur gear 50 is in turn engaged with a mating spur gear 52 which is integrally attached to an end of the mandrel 18.

A drive wheel or pulley 54, secured to trunnion 30, is energized through belt 56 by a driving means, such as an electric motor or the like (not shown). Driving wheel 54 provides the energy for the rotation of the housing 38, and thus for subsequent rotation of the spur gears above mentioned.

A counter weight 58 can be employed on housing 38 to provide proper balance when such is considered necessary.

Shaft 48 also carries a bevel gear 60 which drives a mating bevel gear 62 for rotation of trunnion 36, the latter serving to rotate the feed stock 360° per each coil of aligning zipper 12 as it is fed onto mandrel 18 by way of pinch mouth 64 formed on the exit end of trunnion 36. A cam jumper arrangement 66 provides for pushing the formed zipper up along the vertical direction or height of mandrel 18 as the zipper is being formed. A coil heater 68 can be located around the periphery of mandrel 18, this heater being generally necessary if a plastic strand 20 is provided with a resin coating for reinforcement. Heater 68 is also used to set the strands in their new form so that they do not spring back to their original shape.

It can be seen by analyzing the apparatus of FIGURE 1 that the fiber guide trunnion 36 rotates in a direction opposite to that of the rotating housing 38 thereby neutralizing the back twist for twisting the filaments 20 in forming the zipper 12. That is, in looking at the rotating housing from the spool end, the housing rotates in a clockwise direction, and the fiber rotates in a counter-clockwise direction.

It can thus be seen that two identical filaments or strands 14 and 16 drawn from a stationary mounted rotating reel and fed through a hollow shaft to a rotating housing and coiling mechanism, neutralizes the twist produced by winding the filaments on a mandrel. It is obvious that a mere reversal of the directions of rotation and displacement of the filaments or strands can provide for a right hand coil with a left hand twist, rather than a left hand coil with a right hand twist as shown.

FIGURE 3 is particularly directed to a reinforced plastic pipe-making machine 70 and the method of its operation. The pipe-making machine is similar in many respects to the zipper-making machine 10 and corresponding operating parts thereof which are substantially similar are indicated by common reference numerals, reference being had to the discussion of those components hereinbefore. The machine 70 is somewhat different from machine 10 in the type of filament or strands it is intended to wind, and the type of mandrel employed in cooperation therewith. The similarity thus lies only in certain components thereof, the primary concern of which is to eliminate the back twist which would otherwise be imparted to the source of material if prior apparatus were instead used.

The filament components for forming tube or pipe 72 comprise a plurality of singular strands or fibers 74 which preferably come from a single spool 22 and are fed to a discharging member 76 where they are spiralled, parallelwise, into a tube which is flattened and wound onto a

non-rotating advancing mandrel 78 with the embedding of the filaments in a plastic resin, such as an epoxy, emitted from a spray nozzle 80 or the like as the pipe 72 advances upwardly with the mandrel. The twisting criss-cross fiber arrangement will be described in more detail hereinafter, with reference to FIGURES 4–6.

The pipe 72 is aided in its advancement upwardly with mandrel 78 by endless belts 82 located on each side of the mandrel and engaging the pipe as it advances. Each belt 82 is diametrically arranged relatively to the melting mandrel 78, and includes a plurality of guide reels 84 pivotally interlocked by boards or the like (not shown). The guide reels 84 are each found to provide a similar groove which projects outwardly so as to engage the pipe 72 forcing the latter into a snug engagement with the mandrel. A plurality of heating coils (not shown) preferably of the induction heater type, are positioned within each endless belt 82 to aid in melting the mandrel at its upward extent.

The mandrel 78 is preferably of the non-rotating melting variety as explained, for example, in U.S. Patent 2,993,526 only there shown in a horizontal position. Melting pot 86 serves to receive the returning melted mandrel material 90, which, upon melting, returns via the central void 88 in mandrel 78. The melted material or metal 90, resting in the melting pot 86, is acted upon by a pump 92 which continuously pushes the newly forming mandrel upwardly through nozzle 94 to form a hollow core identified as the mandrel 78. As the mandrel 78 melts near its upper extent, the only portion then remaining above that point and emitted from the apparatus 70 is the finished plastic pipe 72. The heaters used for melting the mandrel also serve to seal overlapping plastic pipe portions together. Collar 91 is formed so as to rotate with respect to housing 38 and is integrally secured to mandrel forming extruder port member 93 so that the housing rotates with respect to the forming mandrel 78.

The arrangement for forming the tubular tape, which is later formed into the plastic pipe 72, is seen in somewhat more detail in FIGURES 4–6 and comprises the spindle head 76 having as many orifices 98 as are necessary to accommodate the plurality of strands 74 which are emitted therefrom. Preferably the spindle head 76 is circular in form and makes one complete revolution for each revolution of the housing 38 about mandrel 78, the latter being non-rotating as previously described. The 360° twist given fibers 74 as they are emitted from the spindle head 76 results in a tube-like criss-cross patterned tape 100 being wound around mandrel 78. The degree of advancement of the mandrel 78 is such that there is an overlapping of a substantial quantity of tape 100 upon itself as it progresses over the mandrel. A controlling factor in the evenness of tape 100 is that contributed by roll bar 102 which engages the spirally wound strands 74 as they are emitted out of the spindle 76 just before they engage mandrel 78. Roller bar 102 holds the strands 74 against the mandrel to prevent disalignment. Roller bar 102 also helps prevent disalignment by shortening the distance the strands have to travel before making contact with the mandrel.

Thus it can readily be seen that in both the zipper-making machine and plastic pipe machine, and in other related machines where it is desirable to eliminate a back twist upon the source supplying the material for wrapping on a mandrel, that the arrangement of the present invention is advantageous. While certain representative embodiments and details have been shown for the purpose of illustrating the invention, it will be apparent to those skilled in the art that various changes and modifications can be made therein without departing from the spirit and scope of the invention.

Accordingly what is claimed is:

1. An apparatus for wrapping fibers or the like, said apparatus comprising a stock feeding member, a housing,

a mandrel protruding from said housing, means connected with said housing for transmitting said fibers from said stock feeding member to said mandrel, a fiber guide means located adjacent the mandrel end of said transmitting means for twisting the fibers as they are wound upon and fed to said mandrel, and another fiber guide means located at a position in said transmitting means more remote from the mandrel end thereof than said first mentioned fiber guide means, said other fiber guide means being adapted to twist said fibers in a direction generally opposite from that of said first mentioned guide means to prevent back twisting of the fibers on said stock feeding member.

2. An apparatus for wrapping fibers or the like from a stock feeding member, said apparatus comprising a housing, a gear train located within said housing, a mandrel protruding from said housing, a rotating fiber guide at the mandrel end of said gear train for twisting the fibers as they are wound upon and fed to said mandrel, and said gear train including parts for providing an opposite twist to the fibers than that given by said fiber guide to prevent back twisting of the fibers on said stock feeding member.

3. An apparatus for wrapping fibers, strands or the like, said apparatus comprising a housing, portions of a gear train carried by said housing and adapted for relative rotation with respect to said housing, a mandrel protruding from said housing and relatively rotatable therewith, a fiber guide forming part of said gear train and which feeds and twists fibers onto said mandrel, said housing and said fiber guide rotating in relatively opposite directions so as to prevent back twisting on the feeding source of said fibers.

4. The apparatus of claim 3 wherein said mandrel includes a jumper to cause the twisted fibers to progress along the mandrel while being fed thereto.

5. The apparatus of claim 3 wherein said mandrel is continuously advancing in a direction outwardly from said housing so as to cause the fibers to progress away from said fiber guide.

6. The apparatus of claim 5 wherein said continuously advancing mandrel is of the self-melting, re-forming type.

7. The apparatus of claim 5 wherein a heating element is located closely adjacent said mandrel so as to cure a resin compound applied to the wrapped strands, and to melt the advancing mandrel.

8. An apparatus for forming a coil fastener in a continuous manner, said apparatus comprising a feeding spindle having a pair of filaments, a wrapping apparatus including a housing, a stationary shaft connected to said housing, a fiber guide in the form of an input trunnion supported by said housing, fiber direction spindles supported by said housing, and a fiber guide in the form of an output trunnion supported by said housing, a mandrel rotatably extending from said housing, means for causing the filaments as they are wrapped to advance along said mandrel, said housing rotating in a direction opposite from said output trunnion to neutralize a back twist in the filaments which would otherwise be exerted upon said spindle.

9. Apparatus for making plastic pipe, said apparatus comprising a rotatable housing, a discharging member rotatable with respect to said housing and in a direction opposite to that of the rotation of said housing, a continuously advancing mandrel located adjacent said discharging member and receiving a plurality of filaments

therefrom, said discharging member including a plurality of orifices located generally around the periphery for discharging said plurality of filaments in a parallel criss-cross pattern, said mandrel advancing so that there is an overlapping of said filaments upon one another as said mandrel progresses.

10. Apparatus for making plastic pipe, said apparatus comprising a rotatable housing, a discharging member rotatable with respect to said housing and in a direction opposite to that of the rotation of said housing, a continuously advancing mandrel located adjacent said discharging member and receiving a plurality of filaments therefrom, a roll bar located between said discharging member and said mandrel and adapted to engage said filaments, said discharging member including a plurality of orifices located generally around the periphery for discharging said plurality of filaments in a parallel criss-cross pattern, said mandrel advancing so that there is an overlapping of said filaments upon one another as said mandrel progresses.

11. The apparatus of claim 9 wherein a plastic resin is coated on said wrapped filaments.

12. A method for forming plastic pipe from fibers, said method comprising the steps of placing said fibers in a parallel relationship such that their cross-sections generally define a tubular configuration, twisting said parallel fibers in a helical fashion while still maintaining a tubular configuration, flattening the twisted tubular configuration of fibers as it is progressively spirally wrapped about a mandrel in a partially overlapping fashion, and treating said wrapped fibers such that the overlapping portions thereof adhere to one another as they leave said mandrel.

13. A method for forming plastic pipe from fibers, said method comprising the steps of placing said fibers in a parallel relationship such that their cross-sections define a generally tubular configuration having a circular periphery, twisting said parallel fibers in a helical fashion while still maintaining a tubular configuration, flattening the twisted tubular configuration of fibers as it is progressively spirally wrapped about a mandrel in a partially overlapping fashion, and heat treating said wrapped fibers such that the overlapping portions thereof adhere to one another as they leave said mandrel.

14. A method for forming plastic pipe from fibers, said method comprising the steps of placing said fibers in a parallel relationship such that their cross-sections generally define a tubular configuration, twisting said parallel fibers in a helical fashion while still maintaining a tubular configuration, providing an opposite and equal back-twisting on a rearward portion of said fibers, flattening the twisted tubular configuration of fibers as it is progressively spirally wrapped about a mandrel in a partially overlapping fashion, and treating said wrapped fibers such that the overlapping portions thereof adhere to one another as they leave said mandrel.

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