ABSTRACT OF THE DISCLOSURE

Apparatus for producing crimped yarn from undrawn or partially drawn thermoplastic yarn by false twisting or longitudinal compression in a stuffing box includes a rotating roller on the surface of which the yarn travels and heating means, conveniently integral with the roller, for heating the yarn in contact with the roller, the yarn then being crimped while still hot from the roller. The roller may be one of two or more rollers arranged to draw the yarn while hot immediately before crimping the yarn.

This invention relates generally to improvements in a method and apparatus for drawing and crimping thermoplastic yarn, such as, for instance, yarn made of polypropylene, polyester and the nylons, and in particular to an improved method and apparatus for drawing, crimping and treating yarn.

In the known methods of preparing thermoplastic materials for use as yarn, the yarn is first extruded and formed into a supply package. This package of yarn is then drawn to establish the desired denier of the yarn, by passing the yarn over a heater between a pair of drawing rollers onto a take-up package. To crimp this drawn yarn, it is then further processed by feeding it over a heating element from whence it is cramped in crimping apparatus, such as that described in U.S. Patent No. 3,212,157. (Such crimping apparatus in combination with the heating and drawing technique and apparatus to be described, results in high-speed operations for even the very heavy denier yarns.)

One of the problems in these various prior art steps is that it is difficult when thermoplastic yarn is heated, to accurately control the temperature of the heated yarn both internally and externally. In known crimping apparatus, the interior of the thermoplastic yarn is often not heated uniformly at the proper temperature just prior to crimping. Resultingly, non-uniform crimping occurs.

Another disadvantage in presently known crimping apparatus, where a drawing step is incorporated in the over-all process, is that it is difficult to keep the yarn drawing rate uniform. Furthermore, the range of available drawing rates is limited.

Yet another disadvantage in conventional drawing and crimping apparatus arises from yarn-heater contact where friction between the yarn and heater damages the yarn at least to the extent that non-uniform crimp may result.

It is, therefore, an object of the present invention to provide improved yarn processing apparatus which is simpler, less expensive, and more reliable, and by means of which an improved quality of yarn may be obtained.

It is a further object of the present invention to provide a novel combination of drawing and crimping apparatus for processing thermoplastic yarn and in which is provided improved temperature control of the yarn, a means for proper feeding and drawing of the yarn prior to the crimping thereof, and with a minimum of yarn-surface friction.

It is a further object of the present invention to provide such apparatus in which the rate of drawing can, if desired, be varied over a wide range for processing a wide range of yarn denier, and which may also be varied during the drawing process for special dying and crimping results.

It is yet another object of this invention, in one embodiment thereof, to provide drawing and crimping apparatus which obviates the need for separate predrawing processes after the initial extrusion of the yarn and before crimping thereof.

According to an embodiment of the invention, extruded but otherwise unprocessed yarn is passed over the surface of two driven rollers one or both of which being internally heated, by electrical means for example. The rollers are caused to rotate at different rates to draw the yarn and establish the desired denier of the yarn. The drawn yarn is then fed into the crimping chamber of a high-speed crimping apparatus from whence it is formed onto a take-up package. One immediate advantage here is that separate positive drive means for passing yarn frictionally over static apparatus which is used is eliminated as is yarn-heater surface frictional engagement.

The rates of rotation of the two rollers may be set to produce a desired denier of the yarn, or the rate may be continually or intermittently varied during the drawing process to obtain variable deniers along the yarn if so desired. To assure uniform internal as well as external heating at uniform speed of drawing, the number of turns of yarn around the heated roller or rollers can be calculated and varied for different yarn applications.

In another embodiment of this invention, the yarn is guided directly from the extruder onto the heated drawing rollers and then to the crimping apparatus in one continuous operation.

In yet another embodiment of this invention, the yarn after first being extruded and then drawn in a conventional manner may be then passed over a single heated roll which heats the yarn in an improved, uniform manner prior to the yarn entering the crimping chamber.

One aspect of the invention also lends itself to utilization in false twisting apparatus, in which the improved means of drawing and heating the twisted yarn is provided and in which the heated rollers preheat and postheat the yarn while simultaneously feeding the yarn through the false twisting apparatus. This method also eliminates the need for separate positive feed rollers in the heating areas of such apparatus.

Inasmuch as the speed of the heated roller or rollers of the invention can be controlled and varied, it is still a further object of this invention to utilize this principle to provide an improved method for varying the denier of the yarn for special dyeing effects. Also, because of the use, in the inventive combination, of the high-speed crimping apparatus and because of the desirable speed and uniform heating and drawing achieved in the invention, various functional portions of the crimping apparatus may be used in varying the dyeing and crimping characteristics of the crimped yarn while taking advantage of the improved performance of the heated rollers of the invention.

In another aspect of the invention, the yarn is being drawn and crimped for tufting in carpet manufacturing, the apparatus of the invention is used for imparting a slight twist to the yarn just prior to the drawing operation from whence it is cramped, the slight twist being retained in the taken-up crimped yarn for facilitating tufting.

Yet another aspect of the invention contemplates the drawing and crimping of various untreated yarns in this respect, means for coating the yarn with oil and
the like are provided in the apparatus of the invention. In accordance with another aspect of the invention the rollers and other yarn contacting surfaces of the apparatus including the crimping chamber are coated with Teflon so that snagging of the yarn being processed at high speeds is reduced; sticking of decomposed polymers is substantially eliminated; and the fumes from and direct contact with the yarn will not coat the yarn contacting surfaces to adversely affect a next package of yarn to be processed.

The use of heated rollers in the drawing of yarn also lends itself to drawing combined yarns of different polymers and/or yarns with different heat histories, orientations, molecular weights, crystallizations, etc., to produce multi-filament yarn composed of yarns having various levels of crimp.

Further features and objects of the present invention will be derived from an examination of the specification below and in conjunction with the drawings in which:

FIG. 1 is a schematic diagram showing a conventional method for drawing and crimping yarn as known in the prior art;

FIG. 2 is a schematic diagram showing a method and apparatus for drawing and crimping yarn according to the invention;

FIG. 3 is a schematic diagram of another embodiment of the improvement to a yarn drawing and crimping apparatus;

FIG. 4 is a schematic diagram of yet another embodiment of an improvement in a yarn crimping apparatus according to the present invention;

FIG. 5 is a front elevational view of a preferred embodiment of a yarn drawing and crimping apparatus employing a heated roller according to the present invention;

FIG. 6 is a plan view of the apparatus of FIG. 5;

FIG. 7 is a side elevation of the apparatus of FIG. 5 when viewing in the direction of the arrows 7—7; and

FIG. 8 is a schematic diagram showing the use of the invention in false twist apparatus.

To better understand the improvements derived by use of the present invention, it will be useful to give a brief discussion of a presently known yarn drawing and crimping apparatus having reference to FIG. 1.

The thermoplastic yarn 10 is first extruded from an extruder 11 and after setting during its vertical travel is passed through guide rollers 12 and 13 from which the yarn is taken up on a supply package 14. The yarn 10 from the supply package 14 is subsequently subjected to a drawing process in which the yarn is stressed under heat to cause a re-orientation of the molecular structure of the thermoplastic yarn in order to increase the tenacity of the yarn. The extent of the drawing process, which may be varied, causes the final length of the yarn to be several times that of the original length and may be varied according to the desired characteristics and denier of the drawn yarn.

In the known process, the yarn 10 is drawn between two driven cold rollers 15 and 16 around which the yarn is made to travel through a few turns. The rate of rotation of roller 16 is caused to be greater than that of roller 15. This difference in rotational speed of the two drawing rollers 15, 16, effectuates the drawing process.

To facilitate the drawing of the yarn, the yarn is softened by drawing the yarn over a heating plate 17 being a guide roller 18 from which the yarn is taken up on package 18. The yarn on package 18 is then ready to be crimped. For this purpose, the yarn from package 18 is passed over a positive drive roller 19, over the heating surfaces of an elongated heating element 20 where the yarn is once again heated prior to being guided to a crimping apparatus 21 where the yarn is crimped. The crimped yarn is then formed onto a take-up package 22. Intermediate the crimping chamber 21 and takeup package 22, an oiler 23 may be provided, to provide the cramped yarn with a coating of oil for subsequent processing unless the oil coating step was performed prior to crimping.

Having explained the conventional apparatus and method for processing thermoplastic yarn, the improvements derived by the present invention can now be more readily understood. For the sake of clarity, corresponding components in the various embodiments will be identified by corresponding reference numerals.

In FIG. 2 is shown one embodiment of the present invention. Undrawn yarn 10 from a supply package 14 is drawn between two rollers 25 and 26, either the front one 25 of which must be, or both of which may be heated and around both of which the yarn travels through several turns. Again, the rollers are rotated at different rates of rotation in order to draw the yarn 10 to the desired denier.

It is apparent that the provision of a heated roller does away with the requirement of both heating plates 17 and 20 in the prior art embodiment shown in FIG. 1.

Also provided by the use of the heated roller because of constant yarn-heater contact, is a greater uniformity of heating throughout the entire length of the thermoplastic yarn, and this with a reduction in expense, and complexity of equipment. Other significant advantages derived by the use of the heated roller to replace the known heating plate, are that sharp bends in the heated yarn path are eliminated, frictional shearing forces are eliminated, and the heater is completely eliminated, and uniform heating of the interior as well as the exterior of the yarn is assured by the simple expedient of calculating the turns of yarn relative to the speed of the roller.

Due to the above-mentioned advantages, of the apparatus more fully described below, a very high drawing speed, such as up to 500 meters per minute off the second roller 26 may be obtained. At such speeds, the yarn may be passed directly from the extruder 11 to the drawing rollers 25—26, as shown in FIG. 3, thus eliminating the step of taking up extruded yarn onto a take-up package 14 as shown in FIG. 1.

From the drawing roller 26, the heated, drawn yarn is passed to a crimping chamber 21 where it is crimped and is then formed onto a take-up package 22.

Frequently, in the pre-processing of drawing yarn as in the prior art, the yarn is coated with oil and/or other compositions to finish or, for instance, predispose the yarn for later processes, such as dyeing or texturing. The present invention, in eliminating such pre-processing steps, may provide, for instance, after the cramped yarn leaves the crimping chamber 21, on the way to the take-up package 22, an oiler 23 in which a coating of oil is applied to the yarn 10, to make it more amenable to a subsequent dyeing process. Without the need for uniform heating of the yarn by the heated rollers, the oil is more uniformly distributed over the surface of the yarn and consequently the dyeing process is also more uniform.

It is also within the scope of the invention to vary the rate of rotation of the drawing rollers either continually or intermittently to create an uneven denier in the yarn so that when the yarn is dyed, the yarn will receive various levels of dye forming various shades of coloring thereon, to provide an aesthetically pleasing effect in the finished product. The lesser drawn areas will dye darker than those portions of the yarn which are drawn to a greater extent.

FIG. 4 shows another application of the inventive concept in which the yarn 10 is first drawn, such as by the prior art method shown in FIG. 1, the drawn yarn being formed onto package 18. The yarn 10 is taken from package 18 and passed around a single driven heated roller 42 which provides a uniform heating of the yarn, without drawing, before the yarn is led to the crimping chamber 21. After the crimping operation, the yarn is guided through roller 25 and then is formed onto take-up package 22 as in the previously described embodiments.

FIGS. 5, 6 and 7 illustrate yarn processing apparatus.
The yarn 50 is unwound from a supply roll 51 through guide disc 52 around rotatably mounted guide and tension constraining wheels 53, and wheels being mounted on an upper roller shelf 46 extending from housing 45, onto driven rollers 55 and 57 and their associated separating rollers 56 and 58.

The yarn 50 is first passed over the first driven roller 55, which is heated, and separating roller 56 through the desired number of turns, the separating roller 56, extending at an angle relative to the plane of the axis of roller 55 (see FIG. 6), assisting in distributing the yarn in a spiral path across the face of the roller 55. The yarn is then passed from roller 55 to the second driven roller 57, which may or may not be heated, as desired, and separating roller 58, through the desired number of turns, again, separating roller 58 serving to assist in distributing the yarn in a spiral path across the face of the roller 57.

The draw rollers 55 and 57 grip the yarn and are so driven, by conventional driving means (not shown) contained within the housing 45, that the roller 57 is caused to rotate at a speed greater than that of roller 55. As a result of the differential in the rates of rotation of the two rollers, the yarn is stretched or drawn.

Standard heated godet rolls, 12 inches in circumference with 2 to 5 inch wide faces, rated at 500 to 1000 watts at 120 to 240 volts for temperatures to 225° C. have been used as heated rollers 55 and 57 with exceptionally good results. Surface temperature in such rolls is maintained and varied by integral heaters and thermostats. Rheostat controls such as rotating controllers put out by Barber-Colman Company, specifically made for use as a surface heat controller for standard godet rollers, will act as further assurance close and constant temperature control.

It has been found advisable to work with temperatures within the 85° C. to 185° C. for the first roller 55 for processing the various currently used thermoplastic yarns for carpeting.

The actual temperature to which the roller surface is raised is determined by the type of yarn being treated, upon the desired degree of crimping, and other considerations which arise in the subsequent processing of the yarn. The roller surface temperature will also depend upon the polymer of the thermoplastic yarn.

In a typical operation, which will produce yarn having a denier of between 1000 and 4000, the rotational rate of roller 57 will vary around approximately 500 meters per minute, while the peripheral speed of roller 55 will be approximately two and one-half to five times slower than that of roller 57.

As noted previously, it is not essential that the surface of roller 57 be heated, but in some applications, to increase the over-all heating of the yarn, it is conceivable that roller 57 will be heated.

It is also within the scope of this invention to supply heating means to separator roll 56 and/or 58 if required by any particular operating or processing considerations.

A greater or lesser amount of heat may be applied to a yarn to be drawn, to effect a desired degree of crimping. The peripheral speed of the rollers 60, 61 is rotated at the same peripheral speed as the second roller 57. The rollers 60, 61, pass the heated and drawn yarn into the crimping area or chamber 62 of a stuffer box crimpler 63, the details of which are fully set forth in U.S. Patent No. 3,212,157.

The yarn is bunched and crimped in the stuffer box area 63 and in such condition is engaged by the toothed periphery (FIG. 5) of wheel 64 which is rotated, clockwise as in FIG. 5. In timed relation with the nip rollers 60, 61, and then immediately with the peripheral speed of the rollers 60, 61 at a ratio of between one to one hundred and twenty and one to four hundred and twenty and one to four hundred and sixty according to the nature of the yarn and the form required, where the hole (not shown) into the crimping area is about 9/16 of an inch.

The toothed periphery of the wheel gathers up the bunched yarn moving it along the groove (not shown) in the arcuate element 65 which encloses the bunched yarn and may be heated if required to bring the yarn to a final required state.

After leaving the wheel 64, the yarn passes under tensioning device 66 through guide 67 to winding apparatus 68 which is driven at a constant speed with respect to the rate at which bunching of the yarn takes place.

The crimped yarn is formed onto take-up bobbin 71, which is driven by a roller 72 which contacts the periphery of the bobbin 71. The yarn is laid on the bobbin, in a well-known manner, by reciprocating guide means 73 adjacent the nip of the bobbin and the drive roller. In this manner a package of crimped yarn is uniformly formed over the entire surface of take-up bobbin 71.

To remove the completed package 71, an arm 74, from which bobbin holder 76 extends, is pivoted via shaft 75 (FIG. 7), which is pivotally mounted on a housing 77.

Inasmuch as the crimping apparatus, just described is capable of accepting yarn at the high rate of speed from rollers 55 and 57, such apparatus in combination with rollers 55 and 57 results in the provision of a continuous operation including, if desired, extruding, as well as drawing, heating and crimping with all intermediate yarn take-up and supply steps eliminated.

As noted, the drive means for the various parts described may be conventional, including a source of supply connecting a motor means M, heaters H in the rollers 55 and 57 as well as heater H2 in the arcuate element 65 and H2 for heating the teeth of wheel 64, if desired, through appropriate circuitry E.

The motor means M drives drive means D1, D2, D3 and D4 for operating gear boxes or other transmission means G1, G2, G3 and G4 properly set or variable for rotating the winding mechanism 68, toothed wheel 64, nip rollers 60, 61 and rollers 55 and 57 at desired speeds.

It is also within the scope of the invention to vary the rate of rotation of the drawing rollers to create an uneven denier in the yarn, by providing variable transmission characteristics to G1 and G3, so that when the yarn is dyed, the yarn will receive various levels of dye reception, forming various shades of coloring thereon. The lesser drawn areas will dye darker than those portions of the yarn which are drawn to a greater extent.

It is also within the scope of this invention to place movable electrically heated elements, such as wires, along the path of the yarn, for instance, between the crimping and take-up apparatus, the wires being driven and disposed relative to the yarn so as to periodically contact the yarn at predetermined intervals. That portion of the yarn which is contacted by the heated wires accepts less dye than those portions not contacted, so that a yarn is produced having various levels of dye acceptance. This optional feature is illustrated, as an example, in FIG. 3, where electrically heated wires 80 and 80' are arranged to be intermittently moved to contact with the yarn.

It is also within the scope of this invention to pad a resist dye onto the yarn during the texturing process, so that the yarn will be produced with various levels of dye.

Color variations in the dyeing process can also be achieved by heating the tips of the heated wires, by advantageous means such as a contact heater externally of the arcuate element 65 or by direct heat, via electric heating elements, for instance, to selected teeth within the arcuate element.

Because of the speeds at which the yarn is being drawn and then immediately with the peripheral speed of the rollers 60, 61 and then immediately with the peripheral speed of the rollers 60, 61, it may also be advantageous to coat the heated rollers 55 and 57 and the crimping chamber elements such as the toothed wheel 64 and the crimping area 63 with a coating of Teflon.
which because of its resistance to high temperatures and smooth surface characteristics, reduces snag areas in the apparatus; the decomposed polymer from the yarn will not stick to the Teflon surfaces; and the fumes from the oiling process will not form a coating on the Teflon surfaces in the apparatus.

In the process of manufacturing rugs and similar items from crimped yarn, it is necessary to tuft the yarn. To prepare the yarn for tufting, it has been found desirable to form a twist in the yarn prior to the tufting operation.

In the crimping apparatus as shown, twist is imparted to the yarn in a simple manner, by continuously rotating the supply package 51 while the yarn is being passed from the supply package 51 to the drawing and heating rolls 55 and 57. The supply package 51 is rotated about a vertical axis in FIG. 5 by providing a rotatable support 49 for the package 51 on base 49, and by imparting rotational movement by any conventional means including drive means D 9 from motor means M. The yarn retains the twist through the subsequent processing to the bobbin package 71.

As can be appreciated, the apparatus of the invention lends itself to combining yarns of various characteristics, such as yarns of different polymer and/or yarns of different heat histories, differing molecular weights, differing orientations and yarns of different crystallizations. Any one of these combinations of yarn may be processed by the apparatus shown in FIGS. 5-7 by providing a second, third, etc. supply package and passing the yarn therefrom simultaneously over the rollers 56, 58 through the crimper 65 and onto the windup or take-up apparatus 68.

The guides 53, 59, 67, as well as the rollers and crimper may readily, accept the yarns either physically combined or, be modified to accept the yarns in parallel relation.

When the yarn leaves the drawing rollers, loose fibers often are found which hang from the surface of the yarn, thereby creating problems in some subsequent processing. The application of a "weld" or oil on the yarn from oiler, such as shown at 23 in FIG. 2, causes the fibers to cling to the surface of the yarn forming a smooth surface.

Yet another embodiment of this invention is shown in FIG. 8 in which a heated roller is used in a false twist apparatus.

In the known false twist apparatus the yarn is passed from a supply package onto a positive feed roller and then onto a heating plate on which the yarn is softened. After leaving the heating plate, the yarn is passed through a false twist system from which it is then passed to another positive feed roller and then to a take-up package.

In the improved embodiment shown in FIG. 8, the two positive feed rollers and the heating plate are replaced by roller 81 and 82, one or both of which may be heated by electrical heating means disposed within each roller. The rollers thereby serve to heat the yarn and also operate as a positive feed means, so that the yarn 80 is passed from supply package 83 onto the first heated roller 81, and is then passed through a false twist head 85.

The yarn is softened by being passed several turns over heated roller 81 to achieve a uniform heating so as to better prepare the yarn for the twisting operation. After passing through false twist head 85, the yarn 80 is passed over driven roller 82, which may or may not be heated by internal heating means, onto a take-up package 84.

The invention is not limited by the embodiments shown, but rather by the scope of the claims which are appended below.

What I claim is:

1. A method of treating thermoplastic yarn including the steps of taking yarn from a supply, guiding the yarn directly to and winding the yarn around an internally heated roller, rotating the roller in the direction of the winding of the yarn therearound, heating the yarn by means of the roller as it travels in contact with the roller and directly crimping the thus heated yarn.

2. A method according to claim 1, in which said crimping comprises subjecting the yarn to longitudinal compression.

3. Apparatus for treating thermoplastic yarn comprising means for drawing the yarn, means for crimping the drawn yarn by longitudinal compression and means for winding the crimped yarn, said drawing means comprising a driven roller said driven roller including a peripheral surface around which the yarn is wound with which the yarn travels, means for holding the yarn as it travels with said peripheral surface, and means for advancing the heated yarn from said roller at a faster rate than the rate at which the yarn is advanced by said roller, said crimping means including a chamber defining a yarn bunching zone for forming a plug of crimped yarn, and means for driving the drawn yarn into the said chamber while the yarn is still in a heated condition from said drawing means, said winding means winding the drawn and crimped yarn from the head of the plug thereof formed by the said chamber.

4. Apparatus for treating thermoplastic yarn comprising means for heating and drawing the yarn while advancing the yarn, means for crimping the yarn by longitudinal compression directly after drawing while the yarn is still in a heated condition from the heating and drawing means, and means for winding up the drawn and crimped yarn, said heating and drawing means comprising a pair of rollers, each of said rollers having a peripheral surface around which the yarn is wound, said one roller being rotatable and heatable and rotatable to heat and advance yarn from the supply to the other of said rollers, said other roller being rotatable to advance the yarn at a rate greater than the rate at which the yarn is advanced by the said one roller to thereby draw the yarn while in a heated condition from the said one roller, said crimping means comprising a chamber defining a yarn bunching zone for forming a plug of crimped yarn and means for driving the drawn yarn into the chamber while the yarn is still in a heated condition from the heating and drawing means, the winding up means being arranged to wind the crimped and drawn yarn from the head of said plug.

5. Apparatus for treating thermoplastic yarn comprising a first feed roller around which the yarn is wound for heating and linearly advancing the yarn, a second feed roller for advancing and drawing the yarn as it leaves the first feed roller, and means for imparting a false twist to yarn interposed between said first and second rollers, said first roller being internally heated and constituting the sole means for heating the yarn prior to the false twisting means.

6. Apparatus for treating thermoplastic yarn comprising a driven roller for linearly advancing yarn from a supply, said roller including a peripheral surface around which the yarn is wound and with which the yarn travels, means for heating the yarn as it travels with said peripheral surface, means for crimping the yarn by longitudinal compression while still in a heated condition from said peripheral surface and for forming a plug of the crimped yarn, said crimping means including a chamber defining a yarn bunching area and means for driving the heated yarn from said peripheral surface into the chamber, said apparatus comprising means for winding the crimped yarn from the head of said plug and means for driving in timed relation said roller and said driving means.

7. Apparatus for treating thermoplastic yarn comprising means for drawing the yarn, means for crimping the drawn yarn by longitudinal compression and means for winding the crimped yarn, said drawing means comprising a roller arrangement and means for heating the yarn and means for advancing the heated yarn away from said roller arrangement, said heating means being arranged to heat the yarn as it travels around said roller arrangement and said means for advancing the yarn being adapted to advance the heated yarn away from said roller arrangement at a faster rate than the rate at which the yarn travels around said roller arrangement, said crimp-
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The apparatus of claim 8 wherein said roller arrangement includes a driven roller and a spacing roller for spacing axially along the driven roller turns of yarn wound around both said driven roller and the spacing roller.

10. The apparatus of claim 8 wherein said driven roller includes integral means for heating said peripheral surface thereof.

11. The apparatus of claim 8 including means for extruding yarn, said roller arrangement being adapted to take up and advance the yarn at the rate at which the yarn is extruded.

12. The apparatus of claim 8 wherein said means for advancing the heated yarn away from said roller arrangement comprises a second roller arrangement, said second roller arrangement including a second driven roller having a peripheral surface in contact with which the yarn travels.

13. The apparatus of claim 12 wherein said second driven roller includes integral means for heating said peripheral surface thereof.

14. The apparatus of claim 12 wherein said second roller arrangement includes a second spacing roller for spacing turns of yarn wound around both said second driven roller and said second spacing roller.

15. The apparatus of claim 12 wherein means are provided for varying the relative rate of speed of said driven roller and said means for advancing the heated yarn.

16. The apparatus of claim 15, wherein said driven roller is driven at a peripheral speed of two and one-half times to five times slower than the peripheral speed of said second roller and said second roller passes the yarn at a speed within a range including 500 meters per minute.

17. The apparatus of claim 8, wherein means are provided along the course of travel of the yarn for intermittently heating portions of the yarn.

18. The apparatus of claim 8, wherein means are provided for yarn travel therethrough for coating the yarn with yarn-conditioning material.

19. The apparatus of claim 18, wherein said coating means comprises means for intermittently coating the yarn.

20. The apparatus of claim 8, wherein selected surfaces comprising means contacting said yarn through its course of travel therethrough are composed of high temperature resistant plastic.

21. The apparatus of claim 8 including means for continuously advancing the plug of yarn away from said chamber.

22. The apparatus of claim 21, wherein said means for advancing said plug is a wheel having a toothed periphery for engaging the plug and at least some of the teeth of said wheel are heated.

23. A method for treating thermoplastic yarn including the steps of taking yarn from a supply, guiding the yarn directly to and winding the yarn around an internally heated roller, rotating the roller in the direction of the winding of the yarn therearound, heating the yarn by means of the roller as it travels in contact with the roller, drawing the yarn off the roller at a greater speed than the peripheral speed of the roller, and directly crimping the drawn yarn while said yarn is still in a heated condition from said heating step.

24. The method of claim 23, wherein the yarn is taken from an extruder and is guided directly to and wound around the roller.

25. The method of claim 23, further comprising feeding the yarn from the roller onto and around a second roller, rotating the second roller at a peripheral speed greater than that of the first named roller and guiding the yarn from the second roller into crimping apparatus.

26. The method of claim 25, including the step of heating the yarn as it travels in contact with the second roller.

27. A method according to claim 23, in which said crimping comprises subjecting the yarn to longitudinal compression.

28. A method for treating thermoplastic yarn including taking yarn from a supply internally, heating a roller, guiding the yarn around the heated roller to heat the yarn, rotating the roller to advance the heated yarn, passing the heated yarn around a second roller, rotating the second roller at a peripheral speed greater than that of the heated roller to draw the yarn, and imparting a false twist to the yarn intermediate the said rollers while the yarn is still in a heated condition from the heated roller.

29. A method of treatment a thermoplastic yarn including the steps of taking the yarn from a supply, guiding the yarn directly to and winding the yarn around a roller, driving the roller in the direction of the winding of the yarn therearound to advance the yarn, heating the yarn as it travels in contact with the roller and directly crimping the thus heated yarn.

30. A method according to claim 29, further comprising drawing the yarn off the roller at a speed greater than the peripheral speed of the roller and wherein said yarn in said crimping step is still in a heated condition from said heating step.

31. A method of treating a thermoplastic yarn according to claim 30, in which said crimping comprises bunching the yarn in the form of a plug and further comprising winding the yarn from the head of the plug.

32. A method for treating thermoplastic yarn comprising the steps of taking the yarn from a supply, advancing the yarn around a roller arrangement, heating the yarn as it travels around said roller arrangement, advancing the heated yarn away from the roller arrangement at a faster rate than the rate at which the yarn travels around said roller arrangement and thereby drawing the heated yarn, driving the drawn yarn into a stuffer box crimping chamber while said drawn yarn is still in a heated condition and thereby crimping the yarn and forming a plug of cramped yarn, and removing the cramped yarn from the head of the plug.

33. Apparatus for treating a thermoplastic yarn, comprising a roller adapted for winding of a thermoplastic yarn therearound and for rotation in the direction of winding of the yarn, means for heating the yarn while it is wound around the roller, means for crimping the yarn and means for feeding the yarn from the roller to the crimping means, the crimping means being so positioned.
relative to the roller that the yarn is still in a heated condition at the crimping means.

<table>
<thead>
<tr>
<th>UNITED STATES PATENTS</th>
<th>FOREIGN PATENTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,686,339 8/1954 Holt.</td>
<td>LOUIS K. RIMRODT, Primary Examiner</td>
</tr>
<tr>
<td>2,758,358 8/1956 Shattuck.</td>
<td>U.S. Cl. X.R.</td>
</tr>
<tr>
<td>3,069,745 12/1962 Schippers 28—71.3</td>
<td></td>
</tr>
<tr>
<td>3,099,064 7/1963 Haynes.</td>
<td></td>
</tr>
<tr>
<td>3,125,846 3/1964 Noordenbos 28—71.3 X</td>
<td></td>
</tr>
</tbody>
</table>

3,454,998 11

3,212,157 10/1965 Mattingly.