

March 31, 1970

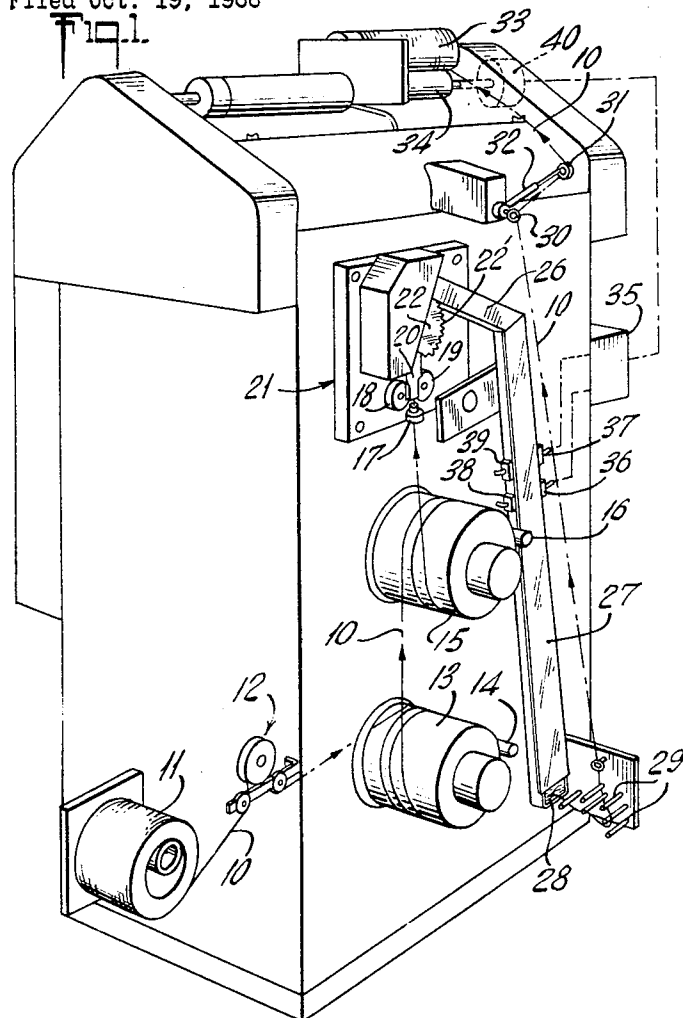
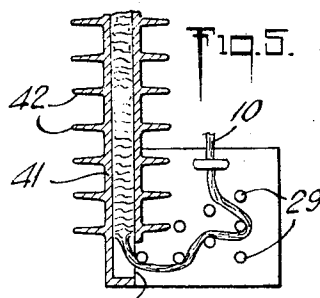
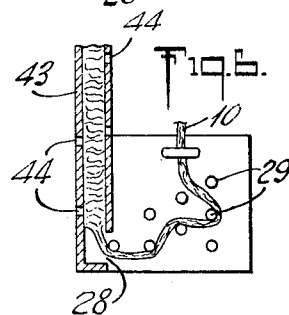
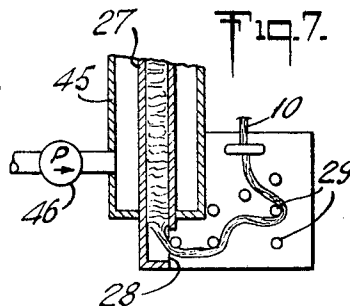
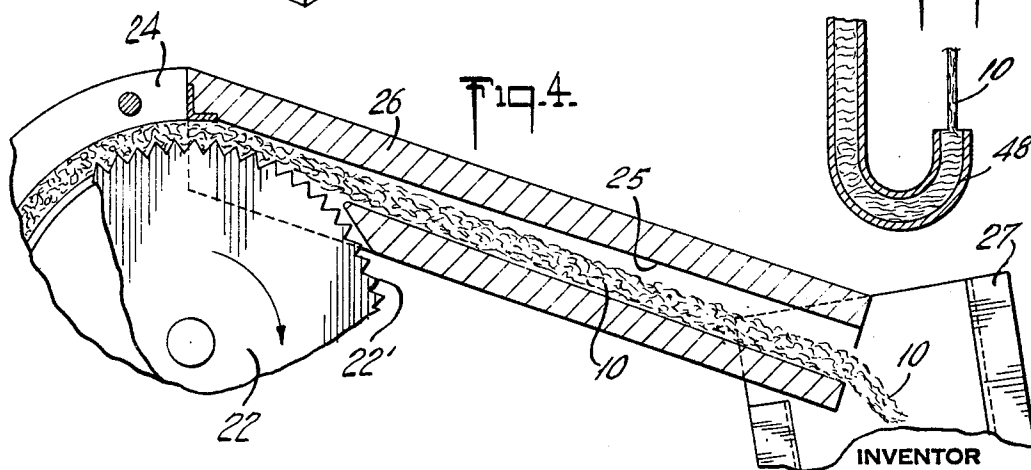
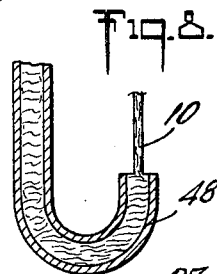
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3,503,104

YARN AND METHOD AND APPARATUS FOR PRODUCING THE SAME

Filed Oct. 19, 1966

3 Sheets-Sheet 1



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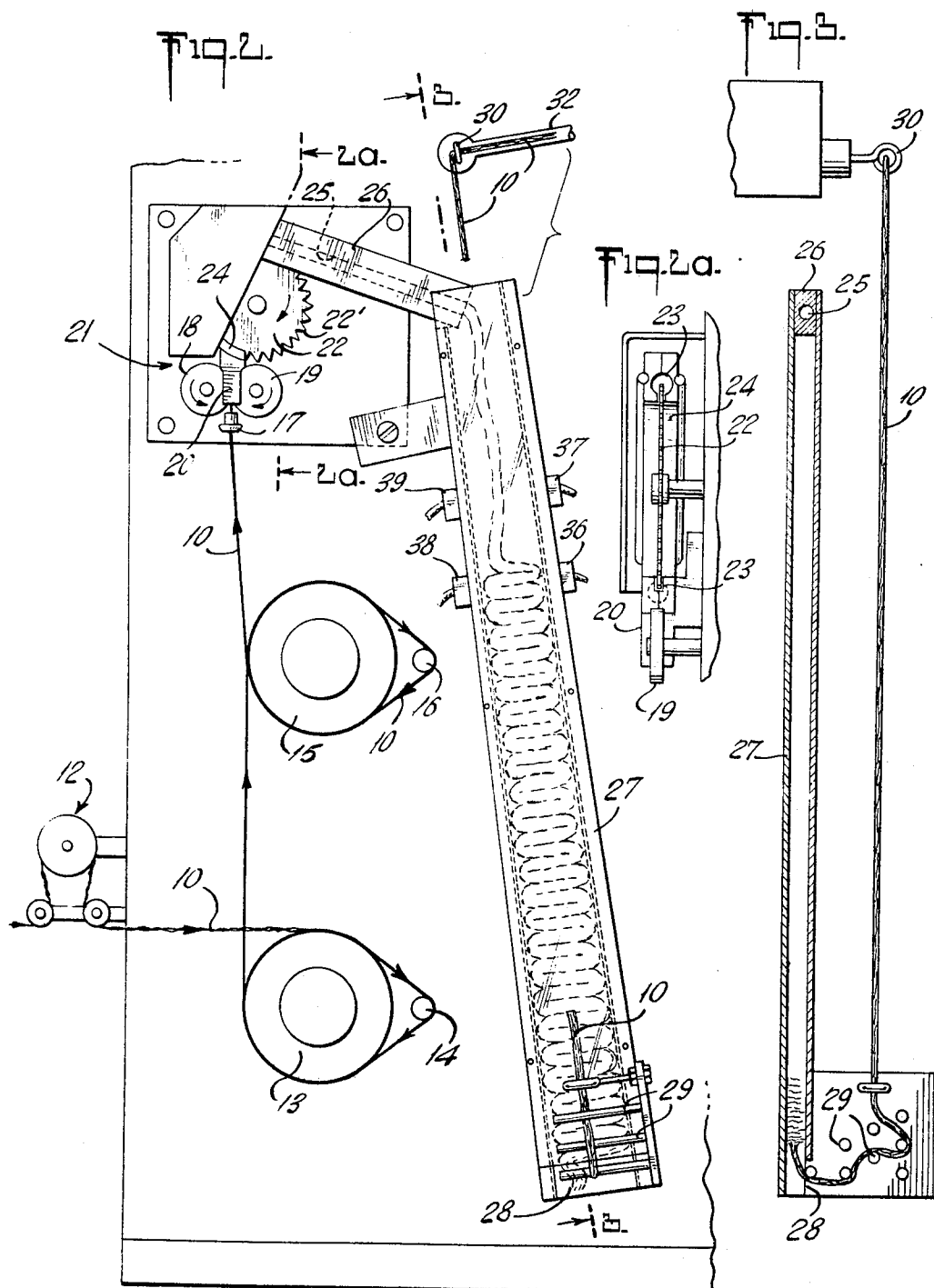
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YARN AND METHOD AND APPARATUS FOR PRODUCING THE SAME

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3 Sheets-Sheet 2



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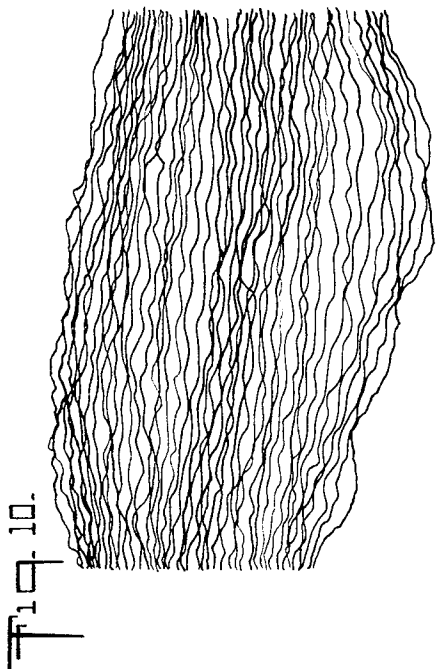
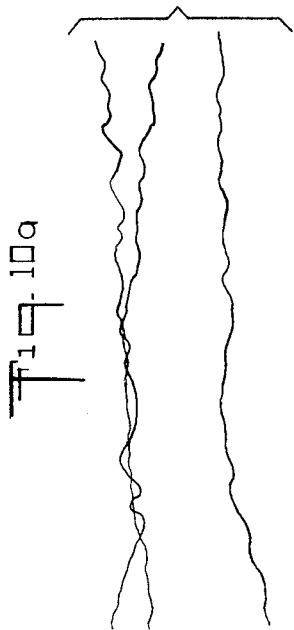
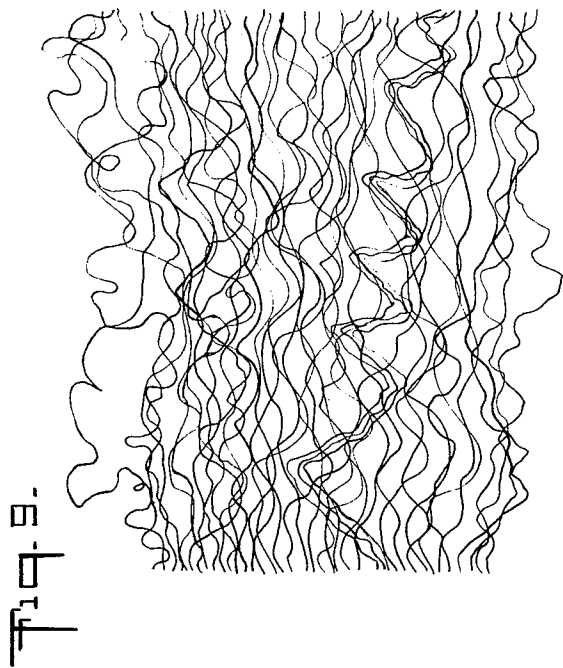
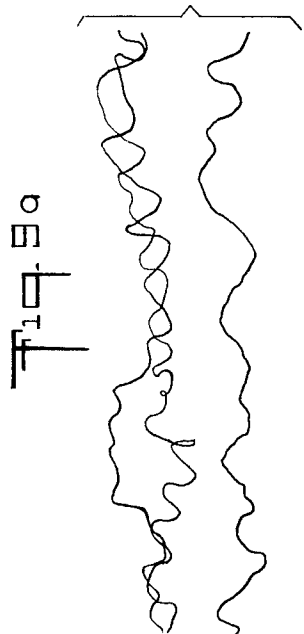
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YARN AND METHOD AND APPARATUS FOR PRODUCING THE SAME

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3 Sheets-Sheet 3



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3,503,104

YARN AND METHOD AND APPARATUS FOR PRODUCING THE SAME

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23 Claims

ABSTRACT OF THE DISCLOSURE

Yarn is crimped by longitudinally compressing it in a stuffer box to form a plug of crimped yarn and, while still in the form of a plug, is advanced from the stuffer box through setting means and relaxation means whereby the crimp is set in the yarn and the yarn is then permitted to relax before being subjected to tension to withdraw it from the relaxation means.

The present invention relates to an improved method of and apparatus for drawing, crimping and processing yarn, especially thermoplastic yarn or yarn having a thermoplastic component. More specifically, the invention relates to an improved method of and apparatus for processing texturized multi-filament thermoplastic yarn, including continuous multi-filament yarn and yarn fibrillated from film, in order to make the yarn more suitable for further processing, as, for instance, weaving, knitting and tufting.

Still more specifically, the present invention is concerned with a method of and apparatus for processing multi-filament thermoplastic yarn after it has been drawn, crimped in a stuffer box, allowed to cure or set, and removed from the setting zone in the form of a plug.

With this last-mentioned method of drawing, crimping and processing yarns of the above-mentioned type, especially polypropylene, certain difficulties have been encountered. The finished yarn frequently will not have a uniform texture. Thus along the yarn, for instance, certain portions will retain more crimp than others, the appearance of the yarn will not be uniform, or certain portions of the yarn will absorb dye more readily than others.

Furthermore, the yarn will frequently not have the desired bulk and if, for instance, used in the manufacture of carpets that are dyed after tufting, may contract and leave certain areas of the carpet backing exposed.

It is, therefore, an object of the present invention, to provide an improved method of drawing, crimping and processing yarn, especially thermoplastic yarn as, for instance, yarn made of nylon, polyester and polypropylene, which will overcome the above-outlined drawbacks.

It is another object of the invention to provide a method of processing a yarn of the above-mentioned type, following the drawing and crimping operation, in such a way that the finished yarn will have a uniform texture and a uniform appearance.

Still another object of the invention consists in the provision of a method of processing a yarn as set forth in the preceding paragraph, which will result in a finished yarn with increased bulk, a yarn with less tendency to contract upon tufting and/or dyeing and a yarn with less crimp decay.

It is also an object of this invention to devise an apparatus for carrying out the method set forth above.

A still further object consists in the provision of a new yarn processed in conformity with the method according to the present invention.

Broadly, these objects have been realized by permitting

the texturized yarn to structurally and physically relax following removal of the yarn in the form of a plug from the texturizing and setting zone and prior to winding the yarn onto a bobbin.

According to one embodiment of the invention, the yarn is, in the form of a plug, removed from the setting zone and is dropped into or transported to a relaxation chamber, which may be designed as a straight box or as a J-box, whereup it is wound onto a bobbin.

The present invention is illustrated by way of example in the accompanying drawing, in which:

FIG. 1 is a perspective view of an apparatus for drawing and crimping yarn, embodying the present invention;

FIG. 2 is a front view of a portion of the apparatus according to FIG. 1, showing the relaxation chamber on a larger scale than FIG. 1;

FIG. 2a is a section taken along the line 2a—2a of FIG. 2;

FIG. 3 represents a section taken along the line 3—3 of FIG. 2;

FIG. 4 shows, on a larger scale than FIG. 2, the upper portion of FIG. 2, in cross section;

FIG. 5 shows a section similar to that of the lower portion of FIG. 3, of a modified relaxation chamber with fins for improving the heat dissipation of the chamber;

FIG. 6 is a section similar to that of FIG. 5 through a relaxation chamber with air vents;

FIG. 7 is a section similar to that of FIG. 5 through a relaxation chamber with a jacket and a fluid medium pump;

FIG. 8 is a section through the lower portion of a relaxation chamber designed as J-box;

FIGS. 9 and 9a respectively show a multi-filament textured yarn and individual filaments of this yarn, processed in a relaxation chamber in conformity with the present invention;

FIGS. 10 and 10a respectively show a multi-filament textured yarn and individual filaments of this yarn, processed without the use of a relaxation chamber, in conformity with heretofore known methods.

In FIGS. 1 and 2, a multi-filament yarn 10 having a thermoplastic component, such as nylon, polyester or polypropylene is fed from a supply bobbin 11 over a tensioning device 12 around a first heated drawing roller or godet 13 and an idler roller 14, and from there around a second drawing roller 15, which may also be heated, and an idler roller 16. Drawing roller 15 is rotated at a higher speed than roller 13 so as to orient and draw the yarn therebetween to approximately two to four times its original length.

The now heated and drawn yarn 10 is then passed through a guide 17 and fed by a pair of driven rollers 18, 19 into a crimping chamber 20 of a texturizing apparatus generally designated 21. This apparatus is disclosed in greater detail in U.S. Patent No. 3,212,157. In this crimping chamber 20 the yarn is compressed longitudinally so as to form a plug. The plug is engaged by the teeth 22' of a wheel 22 driven by a motor (not shown) and is transported by the wheel through a passage 23 of an arcuate member 24. Passage 23 forms a setting chamber or zone for the crimped yarn. Arcuate member 24 may be heated to maintain the yarn at a heat level at which the crimp in the yarn can set. Wheel 22 transports the plug of yarn through passage 23 without slip and without changing the crimp characteristics imparted to the yarn in crimping chamber 20. From passage 23 in member 24, the plug of crimped yarn is conveyed to a channel 25 of a transfer tube 26 for instance by a stream of air (see FIG. 4) from where it passes due to gravity into the top end of a box 27 where the yarn, still in the form of a plug, piles up. As clearly shown in FIG. 2, box 27 flares towards the bottom in order to pre-

vent any jamming of the yarn on the way down. Box 27 is provided with an opening 28 through which the yarn is withdrawn. The yarn is passed around tensioning rods 29 which help unravel the plug of yarn, and through eye-lets 30, 31 of an oscillatable arm 32 from where it is finally wound onto a package 33 driven by a roller 34 engaging package 33 which is driven by a motor 40.

The size of the relaxation chamber should be such that the residence time of the yarn therein is about two to five times greater than the residence time of the yarn in the setting zone behind the crimping chamber. As a general guide line, the residence time may be in the order of from 20 to 40 seconds although it is to be understood that this range may vary from 10 to 60 seconds or more depending on the material and on the specific purpose for which the yarn is to be used.

Moreover, the residence time of the yarn in the relaxation chamber, i.e. the length of the chamber should be such that the temperature of the yarn when it leaves the chamber is about 50% lower than the temperature at which it enters the relaxation zone, or lower.

Motor 40 is controlled via a well known electrical control device 35 by photocells 36, 37 mounted in box 27 opposite to light sources 38, 39 respectively. The photocells control motor 40 in such a way that when both light sources 38, 39 are obscured by the pile of yarn in box 27, the motor will increase its speed so that more yarn per time unit is withdrawn from the box and the height of the pile decreases. If the height decreases to such an extent that both photocells 36, 37 receive light from their respective light source 38, 39 motor 40 is induced to reduce its speed so that the level of yarn in box 27 increases again.

It is, of course, to be understood that various other means may be employed for controlling the speed with which the yarn is wound onto the package. Thus, for instance, weighing pans or levers may be placed in the relaxation chamber or box 27 to control the rate of speed of a speed-variable D.C. motor in conformity with the weight resting on the pans or levers.

There exist various possibilities for increasing the cooling effect on the yarn passing through the relaxation chamber. Thus, for instance, the relaxation chamber may be made from a good heat conductive material, such as aluminum; in addition, as illustrated in FIG. 5, the relaxation chamber 41 may be provided with exterior heat dissipating fins 42, or if desired the relaxation chamber 43 (FIG. 6) may have provided therein apertures 44 to permit the passage of air through the chamber due to convection. Similarly, the relaxation chamber may be surrounded by a jacket 45 filled with a cooling medium which is circulated by a pump 46 (FIG. 7), or may be surrounded by a jacket which is flown through by a stream of air conveyed thereto by a blower. In order to facilitate the removal of the relaxed yarn from the relaxation chamber, it is advantageous to design the latter in the form of a J-box 48 (FIG. 8) instead of using a straight box (FIGS 1 to 7) in conjunction with deviating pins 29, so that withdrawal of the yarn from the plug will not be resisted by the weight of the plug.

One of the advantages of the method proposed herein consists in that the yarn, which is at a relatively high temperature when leaving the setting zone, will contract in the relaxation chamber and/or will develop crimp due to crimp memory before it is wound onto a bobbin. In this way, the yarn will have no tendency at all or only a small tendency to contract during the tufting, dyeing, or other subsequent processing steps. In other words, the yarn has been pre-shrunk prior to tufting or dyeing. Also, the bulk properties developed in the yarn during texturizing will be preserved. This is in contrast to where the yarn is taken up immediately after being heat set in chamber 23, for instance.

The relaxation zone makes it possible to produce yarns with varying degrees of crimp since the relaxation period

can easily be controlled by moving the yarn slower or faster through this zone.

Tests have shown that the present method of drawing, crimping and processing yarn is of extreme importance in the processing of yarn made from polypropylene because of its low crimp memory, its relatively low softening point, and its high heat retaining capacity. Moreover, it is estimated to be the best now known process which will produce a usable polypropylene yarn at the high speeds of 400 m./min. or more at which yarn producing machines have to operate to be economical for polypropylene.

With the method according to the present invention, it is possible to give the yarn more crimp or texture while using considerably less heat and mechanical energy than with processes employing no relaxation chamber, since almost no crimp is lost in the process of transferring the yarn from the setting zone to the tensioning device or the bobbin and since the yarn is wound onto the bobbin in cool condition and not while being hot, in which instance, a large portion of the crimp would be lost.

I view of the fact that the yarn is, in the present method, subjected to tension only after it has relaxed, it is believed that the yarn not only retains the crimp development imparted to it in the crimping steps, but also that the yarn actually will develop more crimp memory and bulk.

According to another feature of the invention the relaxation zone may be employed in part as a setting or curing zone, for instance by applying heat in a portion of the relaxation zone instead of applying it solely in the setting zone following the stuffer box.

Similarly, the relaxation zone may, in addition to serving as a relaxation chamber for the yarn, be employed as a processing chamber in which the yarn may be treated by application of moisture of a finishing agent.

Furthermore, the crimps of folds which are in the setting zone in alignment with each other, will, during residence of the yarn in the relaxation chamber, become misaligned and arranged at different circumferential positions with regard to the center line of the yarn. This factor also contributes to the production of a bulkier yarn, and will impart a limited amount of fiber entanglement to the yarn.

The difference between a multi-filament polypropylene yarn processed in conformity with the present invention, i.e. textured and passed through a relaxation chamber and a multi-filament polypropylene yarn textured in the same manner but not passed through a relaxation chamber is evident from a comparison between the enlarged photographs of FIGS. 9, 9a and FIGS. 10, 10a. The polypropylene yarn (FIGS. 9, 9a) passed through the relaxation chamber is bulkier and the individual filaments have a much wavier appearance. It is readily apparent that this yarn is much better suited for the manufacture of a carpet than a polypropylene yarn not passed through a relaxation chamber (shown in FIGS. 10, 10a).

It is, of course, to be understood that the present invention is, by no means, limited to the particular constructions shown in the drawing and the methods set forth in the specification.

What is claimed is:

1. A method of processing yarn having a thermoplastic component, comprising longitudinally compressing the yarn in a crimping zone to form a plug of crimped yarn, setting plug of crimped yarn in a setting zone and then relaxing the yarn in a relaxation zone while maintaining the yarn in the form of a plug, and withdrawing the yarn from the relaxation zone.

2. A yarn produced by the method of claim 1.

3. A method according to claim 1, wherein the yarn is heated prior to texturing.

4. A method of processing yarn according to claim 1, which includes drawing said yarn prior to longitudinally compressing the same.

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5. A method according to claim 1, which includes heating said yarn in said setting zone.

6. A method according to claim 1, wherein said yarn in said setting zone is maintained at a temperature approximately equalling that of the yarn in the crimping zone.

7. A method according to claim 1, wherein the residence time of the crimped yarn in said relaxation zone is approximately two to five times longer than the residence time of the yarn in said setting zone.

8. A method according to claim 1, in which the temperature of the yarn when leaving the relaxation zone is considerably lower than the temperature of the yarn when entering the relaxation zone.

9. A method according to claim 1, which includes the step of varying the speed of withdrawal of the yarn from said relaxation zone to thereby vary the residence time of the yarn in said relaxation zone.

10. A method according to claim 1, which includes the step of applying heat to said yarn in said relaxation zone.

11. A method according to claim 1, which includes the step of applying moisture to the yarn in said relaxation zone.

12. A method according to claim 1, which includes the step of applying a finishing agent to said yarn in said relaxation zone.

13. A method according to claim 1, which includes the step of cooling said yarn in said relaxation zone by a stream of air.

14. A method according to claim 1, in which said yarn is relaxed in said relaxation zone by permitting the yarn to fall under gravity and build up into a pile.

15. A method of processing yarn of polypropylene according to claim 1, in which the polypropylene is heat set in said setting zone.

16. A polypropylene yarn produced by the method of claim 15.

17. An apparatus for processing yarn having a thermoplastic component, comprising: crimping means having an inlet and an outlet, means for feeding the yarn into the inlet of said crimping means to form the yarn into a plug in said crimping means, setting means extending from the outlet of said crimping means, means for positively engaging the plug of crimped yarn at said outlet and for transporting it through said setting means, relaxation means arranged to receive and contain the plug of yarn issuing from said setting means, the setting means and the relaxation means forming a substantially continuous passage way for the plug of crimped yarn, and means for withdrawing relaxed yarn from said relaxation means.

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18. An apparatus according to claim 17, in which said relaxation means includes an elongated substantially vertically extending container with an inlet for crimped yarn at the upper end portion thereof and with an outlet for relaxed yarn near the lower end portion thereof.

19. An apparatus according to claim 18, in which said container tapers from the lower end portion to the upper end portion thereof.

20. An apparatus according to claim 17, in which said relaxation means includes a substantially vertically extending substantially J-shaped container having an inlet for crimped yarn at the upper end portion of the longer leg of said J-shaped container and having an outlet for relaxed yarn at the upper end portion of the shorter leg of said J-shaped container.

21. An apparatus according to claim 17, which includes means for controlling the speed of withdrawal of relaxed yarn from said relaxation means.

22. An apparatus according to claim 21, in which said control means comprises sensing means mounted in said relaxation means and adapted to vary the speed of said withdrawing means in conformity with the quantity of yarn in said relaxation means.

23. An apparatus according to claim 21, in which said control means comprises two photocells mounted at two different levels in said relaxation means and also comprises two light sources mounted respectively in said relaxation means oppositely to said photocells, and means interposed between said withdrawing means and said two photocells and operable to increase the speed of said withdrawing means when said two photocells are separated from their respective light source by a pile of yarn in said relaxation means and to decrease the speed of said withdrawing means when the space between said light sources and said photocells is free from a pile of yarn.

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U.S. Cl. X.R.

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