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Parker

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[54] **METHOD OF PROCESSING YARN**

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[51] **Int. Cl.** **D02g 1/02**
[58] **Field of Search** .... 57/34 HS, 36, 51, 157 S, 57/140 R, 157 TS; 28/61, 62; 26/6

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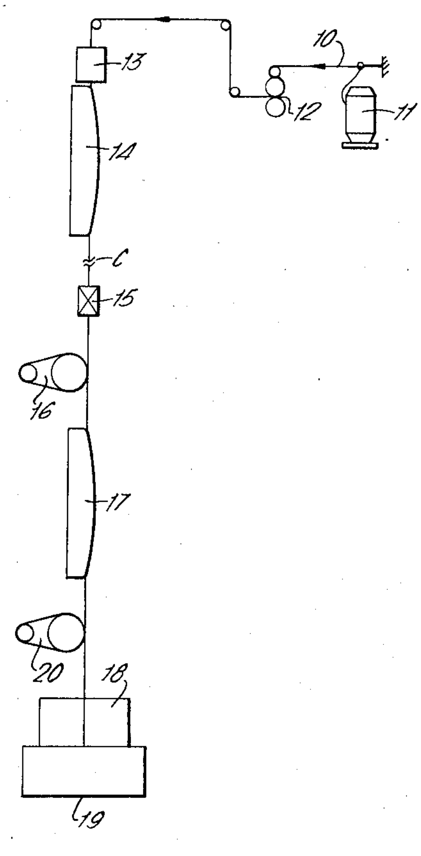
[57] **ABSTRACT**

Undrawn or partially drawn multifilament thermoplastic yarn is drawn in a first heating zone, and then passed through a second heating zone at heat setting temperature, through a cooling zone, through a false twist mechanism, and through a draw-roller system which effects drawing of the yarn in the first heating zone. From the draw-roller system the yarn can also be passed through a third heating zone at an overfeed rate of 10 percent to 40 percent.

10 Claims, 6 Drawing Figures



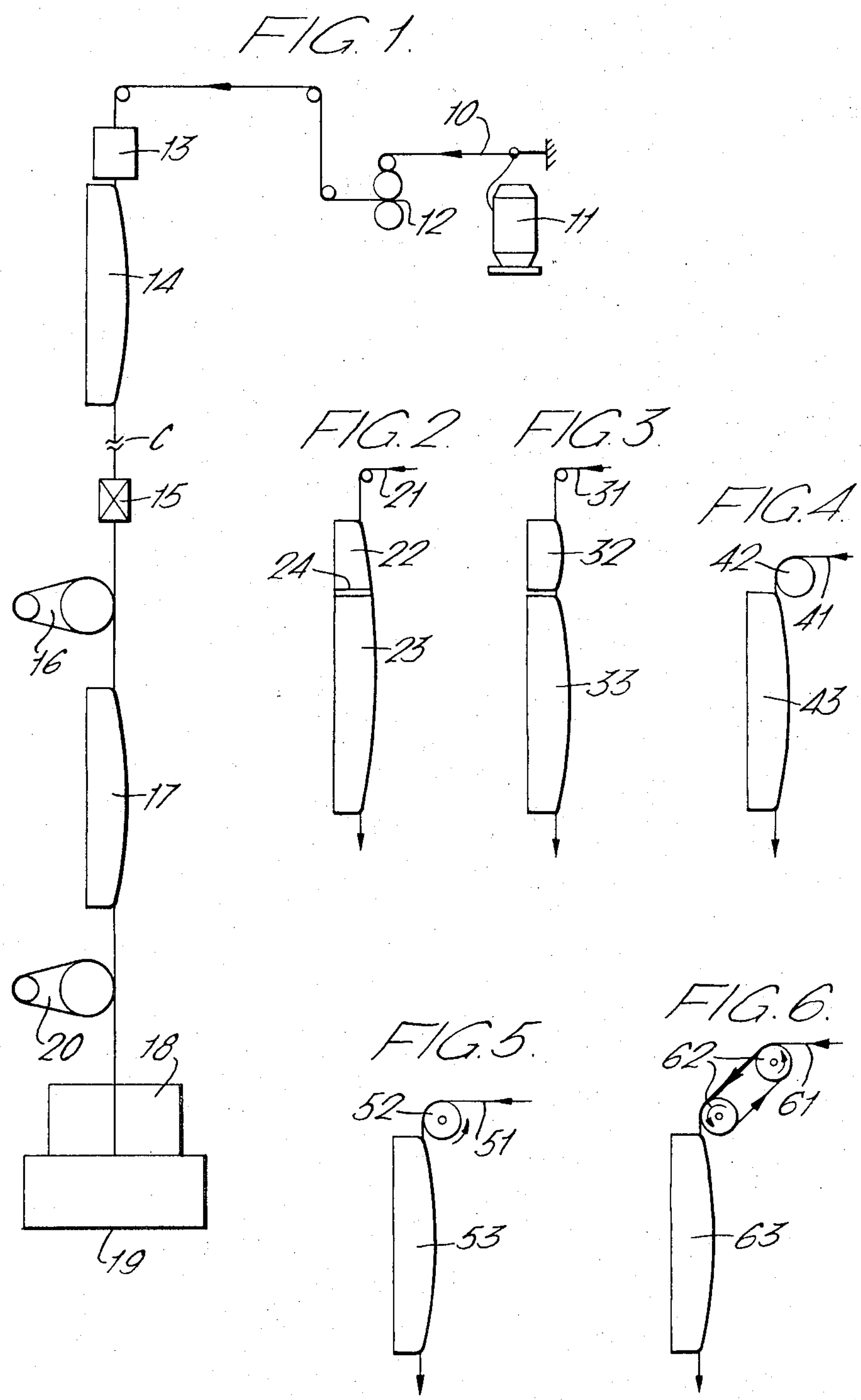


FIG. 1.
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FIG. 2.
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FIG. 3.
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FIG. 4.
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FIG. 5.
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FIG. 6.
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METHOD OF PROCESSING YARN

This invention relates to a method and apparatus for processing undrawn or partially drawn multi-filament thermoplastic yarn.

The invention comprises a method of processing undrawn or partially drawn multifilament thermoplastic yarn wherein yarn advanced by a feed roller system from a supply source is drawn in a first heating zone adapted to bring the yarn only up to a temperature at which it is in a drawable condition and is then passed, with little or no intervening cooling of the yarn, through a second heating zone, closely following the first heating zone, in which the yarn is brought up to a heat setting temperature, the yarn then being passed through a cooling zone and a false twisting zone before being passed through a draw-roller system which effects the drawing of the yarn in the first heating zone.

The yarn running from the draw-roller system may be passed through a third heating zone in which the yarn is brought up to a heat setting temperature at an overfeed rate of 10 percent to 40 percent, and thence passes to a winding zone.

Apparatus for processing yarn according to the invention comprises, in sequence, a feed roller system, first yarn heating means adapted to heat a running yarn only up to a temperature at which it is in a drawable condition, second heating means adapted to bring the yarn up to a heat setting temperature and located closely following the first heating means so that preferably there is no intervening cooling zone, false twisting means, and a draw-roller system adapted to effect drawing of the yarn at the first yarn heating means.

The apparatus may also comprise third heating means adapted to bring the yarn up to a heat-setting temperature, means for forwarding the yarn through said third heating means at a rate which provides for an overfeed of 10 percent to 40 percent, and a yarn take-up mechanism.

The first heating means may comprise a first section of a composite heater block or tube of which an adjacent second section comprises the second heating means.

The first heating means may comprise a heater block or tube closely adjacent a separate second heater block or tube which is the second heating means.

The first heating means may be a stationary heated cylindrical pin closely adjacent the end of a heater block or tube which is the second heating means.

The first heating means may be a driven heated roller or rollers closely adjacent the input end of the second heating means which may be a heater block or tube. The heated roller or rollers may be driven at a peripheral speed which is equal to or smaller than the speed at which the yarn leaves the roller or rollers, and which is greater than but preferably equal to or smaller than the speed at which the yarn approaches the roller or rollers.

The driven heated roller, or that located nearest to the second heater when more than one heated roller is employed, may be spaced from the second heater the least possible distance.

Embodiments of the invention will now be described with reference to the accompanying diagrammatic drawings, in which:

FIG. **1** is a schemetic layout diagram of a false twist crimping machine provided with second-stage heating.

FIGS. **2** to **5** are fragmentary diagrams illustrating alternative forms of yarn heaters usable in the machine shown in FIG. **1.**

Referring to FIG. **1** of the drawings, drawable yarn **10,** in the sense that it is completely undrawn or is only partially drawn and capable of substantial further drawing, is taken from a supply bobbin **11** as by a feed-roller system **12,** and to a first yarn heating means **13** indicated wholly diagrammatically since it can be of many suitable forms, some of which are described below. The first heating means **13** provides a first heating zone in which the temperature-controlled heater **13** brings the yarn up to a temperature at which it is in a drawable condition, a suitable temperature for polyester yarns being 90°–115°C, preferably approximately 105°C.

The yarn then passes to a second heating means **14** closely following the first heating means **13** so that there is no intervening cooling zone between the two heating means, the second heating means being a heater block as indicated in the drawing, or a heater, of other suitable form, which provides a second heating zone in which the temperature-controlled heating means **14** brings the yarn up to a heat setting temperature, a suitable temperature for polyester yarns being 150°C to 200°C, preferably approximately 175°C.

From the second heating means **14** the yarn passes through a cooling zone C at least as long as the heater **14** and then through a false twisting means **15,** such as a friction twister or a false twist spindle or a fluid-jet twister, from which, as is well-known in the art, twist runs back over the heater **14** and is heat set in the yarn. From the false twisting zone provided by the false twisting means **15,** the yarn passes through a draw roller system **16** which causes the drawing of the yarn in the first heating zone provided by the first heating means **13,** the degree of stretching of the yarn in the first heating zone preferably being in the ratio of 1:1.5 to 1:5.5. With this process the twist inserted in the yarn by the false twisting means **15** runs back in the yarn to the point where the yarn is being drawn in the first heating zone of the first heating means **13,** i.e., to the so-called "draw point" of the yarn being thus processed. In addition to the linear drawing of the yarn due to the draw roller system **16,** a component of draw is also present at the draw point region due to the action of the false twisting means **15.**

Yarn leaving the draw roller system **16** could be wound up without further processing, but as shown in FIG. **1,** yarn from the draw roller system passes to a third heating means **17** which provides a third heating zone in which the temperature-controlled heating means **17** brings the yarn up to a heat setting temperature, the heat conditions to which the yarn is subjected in the third heating zone of the heating means **17** preferably being more severe than, or at least as severe as, those to which it is subjected in the second heating zone. By this is meant either that the temperature of the third heating zone is higher than than of the second zone, or that the yarn is in the third zone for an equal or longer time than it is in the second zone. The yarn then passes to a further feed-roller system **20,** which together with the system **16** provides underfeed or overfeed conditions in the third heating zone, for example an overfeed rate of 10 percent to 40 percent, the yarn then being wound-up into a package by a wind-up mechanism **19**.

FIG. **2** is a diagram illustrating that the yarn **21** runs through first and second heating zones provided respectively by first and second adjacent sections **22** and **23** of a composite heater block, which could also be a tubular heater, the two sections preferably having heat-insulation material **24** between them.

FIG. **3**, is a diagram illustrating that the yarn **31** runs through a first heating zone provided by a first heater block **32**, or a tubular heater, and then through a second heating zone provided by a separate second heater block **33**, or a tubular heater, which is closely adjacent the first heater block.

FIG. **4** is a diagram illustrating that the yarn **41** runs through a first heating zone provided by a stationary heated pin **42**, which is closely adjacent the end of a heater block **43**, or a tubular heater, providing the second heating zone. For example the pin **42** is 4 inches in diameter and has a ceramic, satin-chrome or matt-chrome surface finish, and the yarn preferably makes an 180° wrap about the pin although FIG. **4** shows a 90° wrap. The pin can have a circumferential yarn guide groove or grooves.

FIG. **5** is a diagram illustrating that the yarn **51** runs through a first heating zone provided by a heated rotatably driven roller **52** closely adjacent the end of a heater block **53**, or a tubular heater, which provided the second heating zone. The roller **52** is driven to rotate in the yarn travel direction, but at a circumferential speed which is preferably less than, or equal to the speed of the yarn approaching it, so that besides the yarn it provides a degree of relief of yarn tensions in the system upstream the roller **52**, according to its speed of rotation. As previously mentioned, the speed of the roller **52** could also be equal to, or greater or smaller than the speed at which the yarn is leaving the roller.

FIG. **6** is a diagram illustrating a modification of FIG. **5**, with yarn **61** running through a first heating zone provided by two equal-diameter spaced-apart driven heated rollers **62** about which the yarn is wrapped, the rollers being driven at equal circumferential speeds and preferably at a lower speed which is less than or equal to the speed of travel of the yarn approaching them, or equal to or less than the speed at which the yarn is leaving them, or more than the latter.

One roller **62** is closely adjacent the end of a heater block, **63**, or a tubular heater, which provides the second heating zone, as is the roller **52** of FIG. **5**.

All the heaters above referred to are temperature-controlled and can be heated electrically or by internal circulation of hot fluid.

The process and apparatus according to this invention provide that the yarn is drawn at the most suitable temperature in the first heating zone, with the drawn point beneficially located with precision in the first heating zone, with the result that ther are less tension variations across the false twisting means and the processed yarn is of good quality and uniformity.

What I claim is:

1. Method of processing undrawn and partially drawn multifilament thermoplastic yarn, comprising the steps of advancing yarn from a source of supply sequentially through a first and a second heating zone; heating the yarn in said first heating zone to only such a temperature which is required to place the yarn in drawable condition; so drawing the yarn that the draw point is located in said first heating zone; heating the drawn yarn in said second heating zone to a higher heat-setting temperature; cooling the set yarn in a cooling zone downstream of said second heating zone; false-twisting the cooled yarn in a false-twisting zone; and winding up the thus processed yarn.

2. Method as defined in claim **1**, said yarn being supplied from said source at a first rate of speed; and wherein the step of drawing comprises advancing said yarn downstream of said first heating zone at a higher second rate of speed to thereby effect drawing of the yarn in said first heating zone.

3. Method as defined in claim **1**; further comprising the steps of advancing the yarn at an overfeed rate of substantially 10–40 percent prior to the step of winding up, and simultaneously re-heating the yarn to a heat-setting temperature in a third heating zone.

4. Method as defined in claim **3**, wherein the step of drawing comprises drawing said yarn at a draw ratio in the range of 1:1.5 and 1:5.

5. Method as defined in claim **3**, wherein the temperature and the length of time to which the yarn is heated in said third heating zone are at least equal to the temperature and time to which said yarn is heated in said second heating zone.

6. Method as defined in claim **1**, said yarn being a polyester yarn; and wherein the step of heating the yarn in said first heating zone comprises subjecting the yarn to a temperature of about 105°C.

7. Method as defined in claim **6**, wherein the step of further heating said yarn in said second heating zone comprises subjecting the yarn to a temperature of about 175°C.

8. Method as defined in claim **1**, said yarn being a polyester yarn; and wherein the step of heating the yarn in said first heating zone comprises controlling the temperature in said first heating zone within the range of substantially 90°C to 115°C.

9. Method as defined in claim **8**, wherein the step of further heating the yarn in said second heating zone comprises controlling the temperature in said second heating zone within the range of substantially 150°C to 200°C.

10. Method as defined in claim **1**, wherein the step of drawing comprises drawing said yarn at a draw ratio in the range of 1:1.5 and 1:5.

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