United States Patent

Knodo et al.

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[54] **METHOD OF AIR-CONDITIONING UNDRAWN YARN PACKAGE IN DRAWING MACHINE**

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[51] **Int. Cl.**.....**B29c 17/02,** B29c 25/00, F26b 13/10

[58] **Field of Search**.....264/290 R, 290 N, 234, 237, 264/348, 210 R, DIG. 73; 62/89, 91; 34/13, 20, 23, 148; 18/1 FT

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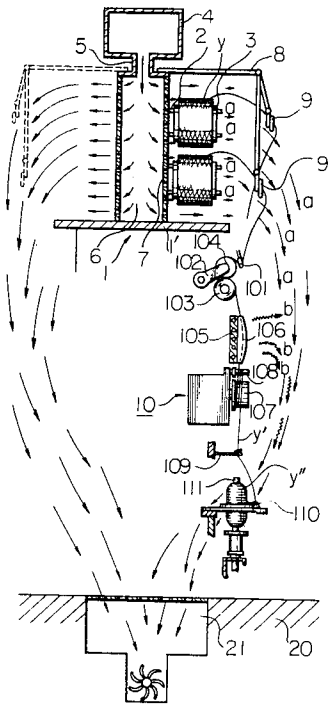
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[57] **ABSTRACT**

In a yarn drawing process of unwinding undrawn yarn from undrawn yarn packages placed on a creel stand located above a drawing machine, comprising introducing the undrawn yarn unwound to a hot drawing zone below for the hot drawing of the yarn and winding up the drawn yarn, the improvement comprising blowing the air conditioned to a predetermined temperature and humidity against the undrawn yarn packages from behind or above the packages and thereby preventing the hot air generated in the hot drawing zone from approaching the undrawn yarn packages placed on the creel stand and air conditioning the undrawn yarn packages.

7 Claims, 3 Drawing Figures



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3 Sheets-Sheet 1

Fig. 1

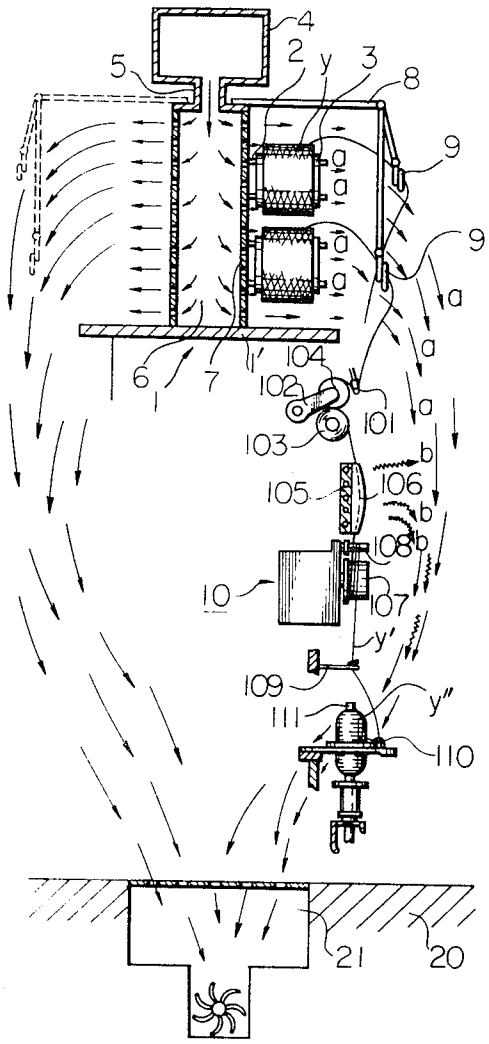


Fig. 2

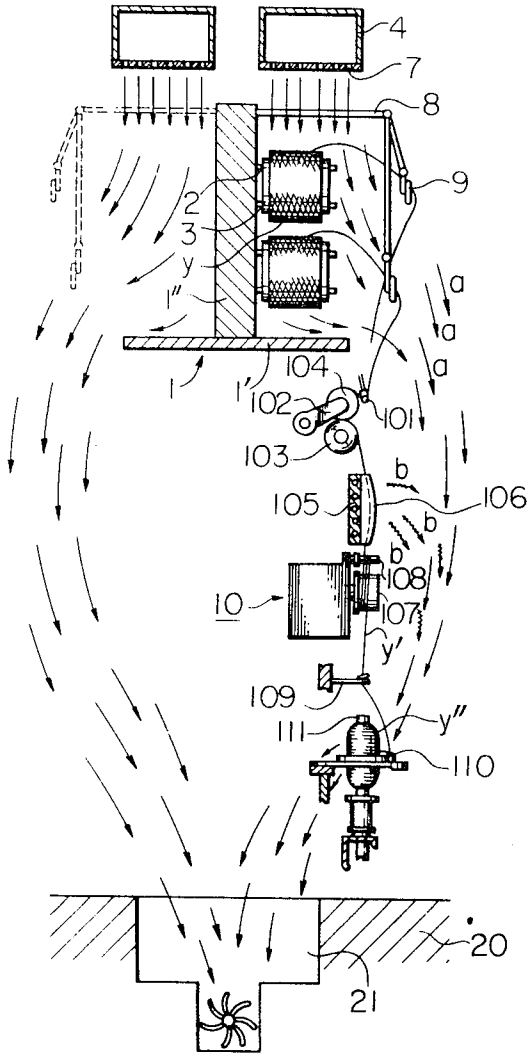
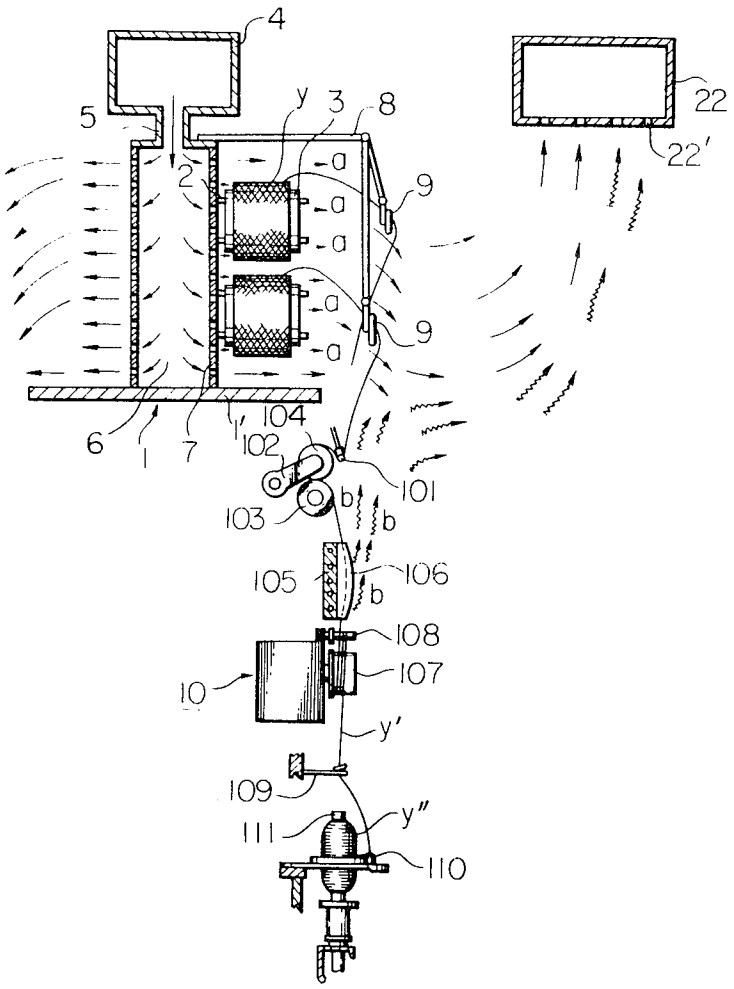

4
7
8
9
2
3
y
1''
a
a
a
1
1'
104
102
101
103
b
105
106
b
b
108
10
107
y'
109
111
y''
110
20
21

Fig. 3


4
5
y
3
8
22
22'
2
a
9
6
1
7
1'
104
102
101
103
b
105
106
108
107
10
y'
109
y"
111
110

METHOD OF AIR-CONDITIONING UNDRAWN YARN PACKAGE IN DRAWING MACHINE

The present invention relates to of a method of air-conditioning undrawn yarn packages in the drawing machine for synthetic yarn, and more particularly to a method of the preventiin of undrawn yarn packages placed above a hot drawing zone of the drawing machine from being subjected to hot air generated in the zone to positively maintain the pockages of undrawn yarn at a given humidity and temperature.

In general, in the manufacture of thermoplastic synthetic yarn such as polyesters and polyamides, the polymer thereof is formed into yarn by melt spinning, the resultant yarn is cooled, solidified, and wound onto a bobbin. Then the undrawn yarn thus wound is hot drawn several times after it is unwound from the undrawn yarn packages and thus wound as drawn yarn onto a bobbin. In this case in a drawing machine such as a known draw-winder or draw-twister, undrawn yarn packages are accommodated on a creel stand disposed above the drawing machine, unwound, and the unwounded yarn is led to a hot drawing zone located below the creel stand where said yarn is hot drawn.

The yarn thus hot drawn is wound on a bobbin with a suitable winding mechanism of a knowntype below the drawing zone. The hot drawing mechanism comprises, for instance, a feed roll, a draw roll, and a hot pin or plate arranged between the feed roll and the draw roll. The undrawn yarn is heated in contact with the hot pin or plate and drawn at the ratio of peripheral speed between the draw roll and the feed roll. In drawing, the pin or the plate is heated to, for instance, 50° to 250° C., and therefore the surrounding air is always being heated with the pin or the plate. This hot air will ascend as an ascending current and the undrawn packages located above the hot drawing zone are incessantly exposed to the hot air.

In drawing synthetic yarn like polyesters and polyamides it is well known that the stretchability of undrawn yarn or the properties of drawn yarn are affected by the temperature hysteresis or double refraction of undrawn yarn. Thus it disturbs the manufacture of consistent drawn yarn that air temperature to which undrawn yarn packages are exposed fluctuates always in drawing synthetic yarn. The comparatively long exposure of undrawn yarn package to hot air before it is drawn, causes decrease in stretchability of the undrawn yarn and uneven dyeing of the drawn yarn owing to changes in the molecular structure of the undrawn yarn.

To overcome such defects, air-conditioning of the drawing chamber itself has been carried out. In this case it is difficult to maintain the air around the drawing machine to constant temperature and humidity because of heat generated from the hot pin or plate. It is also difficult to prevent thoroughly the undrawn yarn package from being exposed to hot, ascending air generated in the hot drawing zone. Moreover, a huge air conditioner is required for air conditioning the whole drawing section and the costs of equipment and operations become high resulting in boosting the cost of production.

It is the object of the present invention to provide a method of preventing effectively the undrawn yarn packages located above the hot drawing zone from being affected by hot air generated in the hot drawing zone and of positively maintaining the undrawn packages at a given temperature and humidity with comparatively small amount of blown air.

According to the method of the present invention, the air conditioned at at a given temperature and humidity is blown against the undrawn yarn packages from behined or above them, and the hot air generated in the hot drawing zone is kept from approaching the packages so as to maintain them at a given temperature and humidity in a process wherely undrawn yarn is unwound from the packages placed on a creel stand located above the machine and the undrawn yarn thus unwound is led to the hot drawing zone below the creel stand for hot drawing.

Preferred embodiments will be described below referring to the accompanying drawings.

FIG. 1 is a side view showing the arrangement of each mechanism of one appropriate apparatus for practicing the method of the present invention.

FIG. 2 is a side view showing another desired apparatus for working the same method.

FIG. 3 is a side view showing a further apparatus for practicing the method of the invention.

In FIG. 1 creel stand 1 is located above drawing machine 10 to serve as a support for the supply bobbins. The creel stand is provided with air chamber 6 comprising base 1', porous ventilating plate 7 and side plates (not shown). Porous plate 7 may be of any ventilating material such as a punching plate, a wire gauze, and a sintered metal plate. On porous plate 7 are mounted forwardly projecting bobbin holders 2 on which supply bobbin 3 of undrawn yarn *y* wound as a package are placed. Air duct 4 is disposed above air chamber 6 and connected with it with connecting member 5. Guide brackets 8 are mounted on the frame of creel stand 1 and guides 9 are mounted substantially coaxially with, and ahead of, supply bobbins 3 on brackets distant from the tips of supply bobbins 3 placed on bobbin holders 2.

Below guides 9 are disposed drawing, twisting and winding devices of a well-known type. Undrawn yarn *y* is unwound from supply bobbin 3 on the creel stand, and pulled downwards via creel guide 9. The undrawn yarn *y* is fed into feed roll 103 via fixed guide 101 and top cot roll 104 that is adapted to be rotatable and to be engaged with feed roll 103 by means of arm 102. Hot plate 106 heated with electric heater 105 to a temperature of drawing synthetic yarn is disposed below feed roll 103, and draw roll 107 and separator roll 108 are placed below hot plate 106. Feed roll 103 and draw roll 107 are driven, and yarn *y* runs from feed roll 103 to hot plate 106, draw roll 107 and separator roll 108 and is drawn to be drawn yarn *y'* by the difference between the peripheral speed of feed roll 103 and that of draw roll 107. Yarn *y'* thus drawn is introduced to a ring and traveler assembly of a wellknown type 110, via balloon guide 109 located below draw roll 107, and twisted and wound on windup bobbin 111 as package.

According to the present invention the air conditioned to a predetermined humidity and temperature is blown against undrawn yarn packages from behind or above them and thereby the hot air generated in the hot drawing zone is prevented from coming near to the packages, which are to be air conditioned.

For this purpose, in FIG. 1, the conditioned air blown from air duct 4 is fed into air chamber 6 via connecting member 5 and is jetted through porous ventilating plate 7 as shown with solid line arrows *a* to cover undrawn yarn packages by a conditioned air atmosphere to drive down the air heated with heater 105 as shown with wave-line arrows *b*.

Thus the present invention makes it possible to effectively obviate the exposure of the undrawn yarn to high temperatures which are caused by the hot air generated in the hot drawing zone turning into an ascending current and making touch with the undrawn yarn packages and to thereby air condition the undrawn yarn packages with a relatively small amount of air. Hence the occurrence of yarn breakage, fuzzing at the time of drawing and the occurrence of uneven dyeing in textiles made from the yarn are prevented and variations in stretchability, dyeability and other yarn properties attributable to yarn's exposure to high temperatures can completely be stopped.

The humidity and temperature of the air supplied through the air duct depend upon the type of synthetic yarn to be drawn, but it is generally preferred that the temperature be 30° C. or below, preferably, 28° C. or below and the relative humidity be 60 percent or above, preferably, 70 percent or above. And the velocity of conditioned air blown from the air duct varies with the drawing temperature of the yarn to be drawn and any velocity sufficient for preventing the hot air from approaching the undrawn yarn packages may be employed. In general, an air velocity of 0.1 to 0.8 m/sec around the packages will be used to advantage. The effect on undrawn polyethylene terephthalate of air velocity in accordance with

this invention is conspicuous. In a most appropriate embodiment of the present invention, the conditioned air supplied to the undrawn yarn packages is introduced to the hot drawing zone by the air suction of the suction duct disposed at the base of the wind-up zone and is drawn together with the hot air generated in the hot drawing zone and sucked with the suction duct after its passage through the wind-up zone.

For this purpose in FIG. **1** suction duct **21** is disposed at floor **20** below wind-up mechanism **110** at the back of the machine. Air *a* passed around undrawn yarn packages *y* and discharged, woves downwards along the periphery of drawing machine **10** by suction of suction duct **21**, joins in hot air *b* from hot plate **106**, passes around wind-up mechanism **110**, and enters suction duct **21**. In this case since the hot air at hot plate **106** is positively driven downwards together with the air passed around the undrawn yarn packages and discharged, there is less tendency for the undrawn yarn packages to be exposed to the hot air.

In twisting and wind-up mechanism comprising a ring and traveler assembly, the film of an oiling agent coating the surface of yarn weakens its covering power by variations in temperature and humidity around said assembly, particularly, by humidity rise and is broken by friction with the traveler. Frictional coefficient between the traveler and the yarn increases and the abrasion of the traveler is intensified so that yarn itself is subjected to injuries. However when the conditioned air passed around the undrawn yarn packages and discharged is positively moved downwards with a suction duct, it is heated by the heat from the drawing zone, stripped partially of humidity, and reaches the twisting and wind-up mechanisms to maintain lower the atmospheric humidity around the wind-up mechanism and to lessen the abrasion of the traveler and the injuries of the yarn.

According to the present invention, air can be blown against undrawn yarn packages from above them in lieu of from behind them. In FIG. **2** like reference numerals refer to like components in the drawings in the other figures. Back plate or frame **1''** is mounted perpendicular on base **1'** of creel stand **1**, and supply bobbin **3** on which undrawn yarn *y* is packaged are placed on bobbin holders **2** forwardly projecting from the back plate or the frame. Air duct **4** having openings **7** at its base is disposed close to, and above, the location where the undrawn yarn packages are placed. The air conditioned as desired is jetted downwards from air duct **4**, is passed around undrawn yarn bobbins **3** so as to enclose the packages, and drives downwards hot air *b* heated with the hot plate **106**. In this case the temperature, humidity, and velocity of the conditioned air to be blown against the undrawn yarn packages may be within the above-mentioned range.

And in lieu of passing positively the conditioned air to be discharged through the surroundings of the packages via the hot drawing zone, the ascending hot air generated at the drawing zone may be turned to the outside of the packages to prevent them from being subjected to hot air. In FIG. **3** like reference numerals refer to like components in the drawings in the other figures, and the mechanism of creel stand **1** is identical with that as shown in FIG. I. The conditioned air is discharged in the direction of arrows *a* after it has passed around the undrawn yarn packages. On the other hand, ambient air is heated at hot plate **106**, and permitted to ascend in the direction of arrows *b* as an ascending current. This hot air is turned outwards near the creel stand by the conditioned air to be exhausted after its passage around the undrawn yarn packages. Suction duct **22** distant from creel stand **1** is disposed outward the creel stand. The discharged, conditioned air and the hot air are sucked into suction duct **22** through openings **22'** of the duct.

The present invention makes it possible to effectively obviate the exposure of undrawn yarn to the hot air generated in a hot drawing zone and to maintain positively the undrawn yarn packages at a predetermined temperature and humidity. The invention has an advantage that such effect can be obtained by comparatively small amount of conditioned air.

The present invention will be described with the use of examples, in which the following methods of measurement are employed.

A. Methods of testing uneven dyeing

A knit sample is dyed at the boil for 90 min. in a solution containing 3 percent of a dyestuff (Dispersed Scarlet B) based on the weight of the sample. Uneven dyeing is judged with the naked eye. The test results are then converted to N. B. S. unit as follows:

Judgment with naked eye	N. B. S. unit
Trace	0.0–0.5
Slight	0.1–1.5
Noticeable	1.5–3.0
Appreciable	3.0–6.0
Much	6.0–12.0
Very much	Above 12.0

B. Methods of determining fuzz on drawn yarn

The number of fuzzes per 1 million meter length of drawn yarn is counted.

C. Methods of determining air velocity

A hot-wire anemometer, Model 14-2111 of Japan Science Industries Co., Ltd. is placed on the surface of an undrawn yarn package to determine air velocity.

EXAMPLES 1 AND 2 AND CONTROL 1

Polyethylene terephthalate having an intrinsic viscosity of 0.65 measured by O-chlorophenol solution at 35° C. was melted at 285° C and extruded through a spinneret with 36 orifices 0.25 mm in diameter and wound at a speed of 900 m/min. to obtain 260–de undrawn yarn package.

This package of undrawn yarn was placed on a creel stand as shown in FIG. I, unwound and drawn 3.65 times between a feed roll heated to 80° C. and a draw roll having a larger peripheral speed than the feed roll. Air having a temperature of 26° C. and and RH of 70 percent was fed around undrawn yarn package from porous ventilating plate **7** at various air velocities. The conditions of experiment are given in Table I.

TABLE 1

Experimental results in Examples 1 and 2.

	Air velocity from plate m/sec	Air velocity around undrawn yarn package m/sec	Ambient temperature around package (° C.)
Ex. 1	0.5	0.3–0.5	26–28
Ex. 2	0.2	0.1–0.2	26–30
Control 1	No air feed	0–0.1	28–35

	RH % around package	Uneven dyeing After 24 hr	After 72 hr	After 120 hr
Ex. 1	70±8	0.5	0.5	0.5
Ex. 2	70±10	0.5	1.0	1.5
Control 1	45–80	0.5	5.0	10.0

	Fuzz (number of fuzz per one million meter length of yarn) After 24 hr	After 72 hr	After 120 hr
Ex. 1	0.3	0.2	0.5
Ex. 2	0.2	0.6	1.2
Control 1	0.3	4.0	6.8

In examples 1 and 2, the drawing chamber was not particularly air conditioned but in control 1, it was supposed to be air conditioned to 26° C. and 70 % RH.

In examples 1 and 2, in which the conditioned air from behind undrawn yarn package was fed toward the package so that air velocity around the package is 0.1 m/sec or above, uneven dyeing and fuzzing did not increase so much even more than 120 hours after the undrawn yarn package had been allowed to stand, Particularly in example 1 in which the air velocity around the package was 0.2 m/sec or above, the occurrence of uneven dyeing and fuzzing little changed after a long interval of time.

However in control 1 in whichair velocity around undrawn yarn package was sometimes below 0.1 m/sec, as the time length when package was allowed to stand was lengthened, uneven dyeing and fuzzing was increased remarkably so as to lower the value of the final product. In control 1, there was no air feed from ventilating plate 7, but owing to convection current in the drawing chamber, an air velocity of 0.00 to 0.10 m/sec was seen around the package.

EXAMPLES 3 AND 4 AND CONTROL 2

Polyethylene terephthalate having an intrinsic viscosity of 0.65 measured by O-chlorophenol solution at 35° C. was melted at 283° C, extruded through a spinneret with 48 Y-shaped orifices and wound at 1,000 m/min to obtain 340-de undrawn yarn.

This underdrawn yarn package was placed on a creel stand as in FIG. 2, unwound, and drawn 3.42 times between the feed roll heated to 83° C. and the draw roll having a larger periphery speed.

Air having a temperature of 24° C. and a humidity of RH 70 percent was blown against the package from ventilating plate 7' at a velocity of 4 m/sec. Punching plates having various opening percent were inserted between ventilating plate 7' and package 3, to make various air velocities around the package. The experimental conditions and results are given in Table 2.

TABLE 2

Experimental results in Examples 3 and 4

	Punching plate opening percent	Air velocity around package	Temperature around undrawn yarn package
Ex. 3	20	0.2–0.5	24–27
Ex. 4	40	0.4–0.9	24–27
Control 2	no feed of air	0.0–0.1	28–35

	RH % around underawn yarn package	Uneven dyeing after 24 hr	after 72 hr	after 120 hr
Ex. 3	70±8	0.5	0.5	0.5
Ex. 4	70±8	0.5	0.5	0.5
Control 2	45–80	0.5	4.0	9.5

	Fuzzing after 24 hr	after 72 hr	after 120 hr
Ex. 3	0.4	0.8	0.7
Ex. 4	0.3	0.6	1.0
Control 2	0.3	4.8	11.2

In examples 3 and 4, the drawing chamber was not specifically air conditioned, but in control 2, the chanber supposed to be controlled to 24° C., RH 70 percent and was not supplied with air from porous ventilating plate 7'. But air current of 0 to 0.1 m/sec was seen around undrawn yarn package on account of convection current in the chamber. In example 4, when air velocity exceeded 0.6 m/sec, the end of unwound yarn from bobbin 3 swung to get entangled with adjacent yarn or guides, and when it exceeded 0.8 m/sec, the entanglement was intensified.

CONTROL 3

In example 1, in lieu of conditioned air supply from porous ventilating plate 7, air of 26° C., RH 70 percent was blown from the base of the chamber against the undrawn yarn package placed on the creel stand above at a velocity of 3.5 m/sec. At this time, the temperature was 27 to 34° C., RH 50 to 80 percent, and the air velocity 0.2 to 0.6 m/min around the undrawn yarn package. When the residence time of the package exceeded 72 hours, uneven dyeing became worse to 3.0 and fuzzing 2.8, and when it exceeded 120 hours, the former became 7.0 and the latter 4.8.

What I claim is:

1. In a process for drawing thermoplastic synthetic polymeric yarn comprising unwinding the thermoplastic synthetic polymeric, melt spun, undrawn yarn from undrawn yarn packages placed on a creel stand located above a hot drawing machine; introducing said undrawn yarn unwound from said undrawn yarn packages to a hot drawing zone located below said creel stand and hot drawing said undrawn yarn; and winding up the drawn yarn; the improvement comprising blowing air conditioned to a predetermined temperature and humidity against and over said undrawn yarn packages from behind or above said undrawn yarn packages, and sucking a stream of hot air rising from said hot drawing zone and a stream of said conditioned air discharged from said creel stand into an air-exhausting duct located below said hot drawing zone, thereby preventing a stream of the hot air rising from said hot drawing zone from approaching said undrawn yarn packages while maintaining said undrawn yarn packages at the predetermined temperature and humidity.

2. The process of claim 1 wherein an air duct having openings in its base is disposed close to and above a zone occupied by said undrawn yarn packages, thereby causing said air, which has been conditioned to a predetermined temperature and humidity, to be blown against and over said undrawn yarn packages through said openings.

3. The process of claim 1 wherein said creel stand which is loaded with said undrawn yarn packages on its side is provided with a chamber, a wall of said chamber adjacent to said undrawn yarn packages being porous to air, said chamber being in communication with said air duct, said conditioned air being supplied to said undrawn yarn packages through said porous wall of said chamber.

4. The process of claim 1 wherein said air conditioned to a predetermined temperature and humidity has a temperature of 30° C. or below and a relative humidity of 60 percent or above and is blown at a velocity of 0.1 to 0.8 m/sec.

5. The process of claim 1 wherein said air conditioned to a predetermined temperature and humidity has a temperature of 28° C. or below and a relative humidity of 70 percent or above and is blown at a speed of 0.25 to 0.6 m/sec.

6. The process of claim 1 wherein said conditioned air blown against said undrawn yarn packages is passed through said hot drawing zone by suction with said air duct mounted at the base of a drawn yarn winding zone and, after passed through the drawn yarn winding zone together with the hot air generated in the hot drawing zone, sucked with said air duct.

7. The process as set forth in claim 1 wherein the undrawn yarn which is packaged is polyethylene terephthalate.

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