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METHOD OF AND APPARATUS FOR TREATING TEXTILE STRANDS

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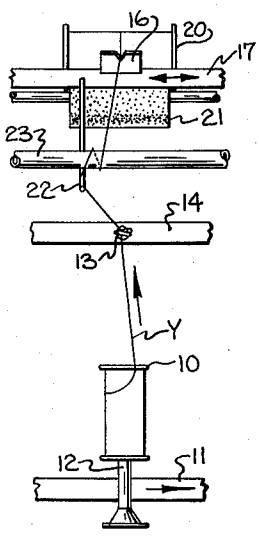


Fig-1

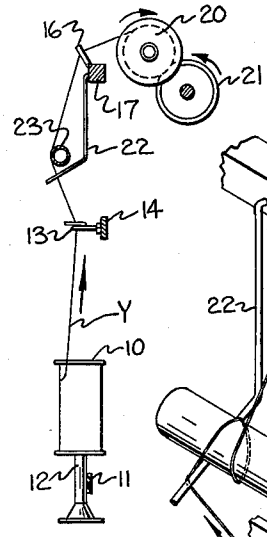


Fig-2

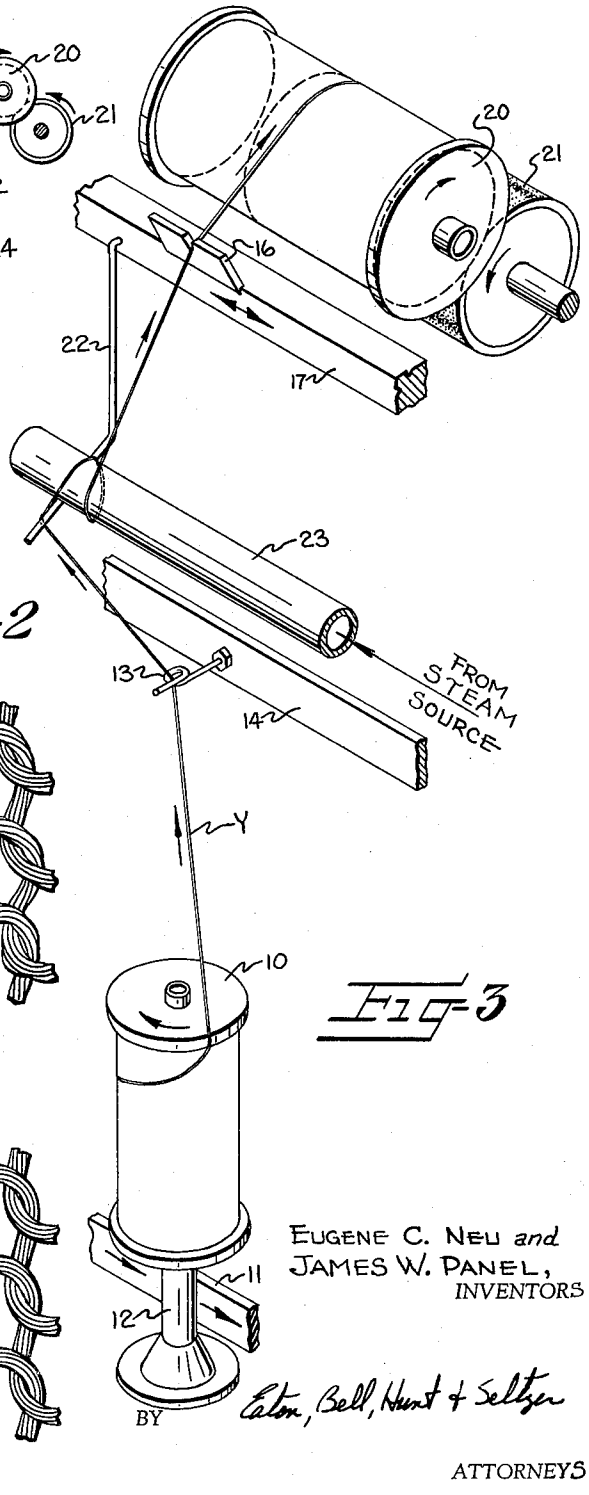


Fig-3

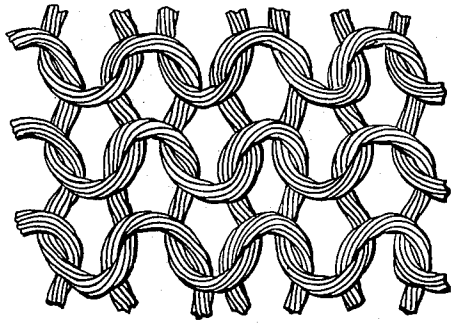


Fig-4

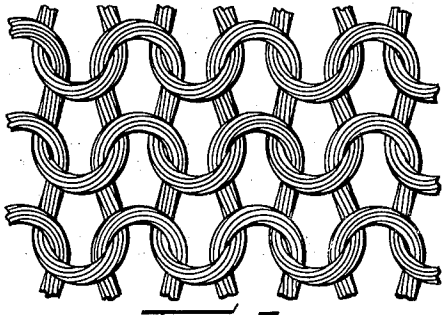


Fig-5

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METHOD OF AND APPARATUS FOR TREATING TEXTILE STRANDS

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This invention relates to the treatment of a textile strand or yarn and more particularly to a treatment whereby the exterior surface of the strand is smoothed to remove any irregularities on the surface thereof.

As is well known, the application of twist to a composite yarn strand produces a rough surface on the strand which is caused by the individual filaments of the yarn following a spiraled path along the surface of the strand. A yarn strand which has a rough exterior is difficult to control during later processing operations such as winding, knitting or weaving. Any time that a rough surfaced yarn passes through a yarn guide, it tends to more rapidly wear the yarn guide than would a smooth yarn passing therethrough. It is more difficult to maintain uniform tension on a yarn which has a rough surface as it passes through a yarn guide, over a guide rod and in the formation of loops during knitting. It is difficult to maintain a uniform twist in a twisted strand of yarn having a rough exterior because the roughened surface will engage yarn guides and the like in a non-uniform manner and back up the twist until the twist overcomes the resistance of the guide and then it will release itself so that the yarn strand no longer has uniform twist throughout its length.

Attempts have been made to overcome the disadvantages of processing a rough surfaced twisted yarn strand by applying a size material to the strand in order to fill in the low portions and smooth the surface of the yarn. The size does provide a smooth surface on the strand but has several disadvantages. The most serious disadvantage is that the size may be scraped off the yarn and accumulates on any part against which the yarn passes and these accumulations of size have to be cleaned away frequently. Occasionally the accumulations of size will be carried along by the strand to cause variations in tension in the strand and when carried into the fabric the accumulation of size causes deformities therein. Another important disadvantage of applying size to the strand is that the size must be removed after the fabric is completed.

With the foregoing in mind, it is the primary object of this invention to provide an apparatus for and a method of smoothing the surface of a yarn strand so that the yarn may be more easily maintained under uniform tension during subsequent processing operations and provide a more uniform fabric produced therefrom.

It is another object of this invention to provide an apparatus for smoothing the surface of a running strand which may be easily and economically applied to existing strand processing machinery with very minor modification required.

It is a more specific object of this invention to provide a heated ironing apparatus for a strand twisting machine with means to lead the strand into engagement with the ironing element and means to move the strand while it is passing over the ironing element so that the complete surface of the strand will be contacted by the ironing element. While the heated ironing element is provided primarily to iron or smooth the surface of a twisted yarn strand, in many cases where the yarn is a synthetic thermoplastic type, the heat of the ironing element may be utilized to set twist, shrink the yarn or for other purposes.

Some of the objects of the invention having been stated, other objects will appear as the description proceeds when taken in connection with the accompanying drawings, in which—

Figure 1 is a fragmentary front elevation showing one section of one type of strand processing machine with which the present strand smoothing apparatus may be associated;

Figure 2 is a vertical sectional view through one section of the strand processing apparatus, looking at the right-hand side of Figure 1;

Figure 3 is an enlarged isometric view of the apparatus shown in Figures 1 and 2, to further illustrate the path of travel of the strand;

Figure 4 is a greatly enlarged fragmentary view of a section of knit fabric formed with a twisted yarn strand which has not been smoothed in accordance with this invention;

Figure 5 is a view similar to Figure 4 except showing the appearance of the stitch loops when the fabric is formed with a twisted yarn strand which has been smoothed in accordance with this invention.

Referring to the drawings and particularly to Figures 1 through 3, the present invention is shown in association with a conventional up-twister having a supply bobbin **10** rotated at a predetermined speed by a belt **11** engaging a spindle **12** on which the bobbin **10** is mounted. A strand Y of yarn is fed from the bobbin **10** and travels upwardly therefrom through a pigtail yarn guide **13** suitably secured on a fixed support **14**. The strand Y is then processed in accordance with this invention, in a manner to be later described, then passes over a traversing yarn guide **16** fixed on a traversing rod or bar mechanism **17** adapted to guide the strand Y as it is wound onto a take-up bobbin **20** which is rotated by engagement with a driving roll **21**. The parts of the up-twister heretofore described are conventional parts and it is with these parts that the present apparatus is shown in association.

The apparatus for smoothing or ironing the strand Y includes a yarn guide wire **22**, the upper end of which is fixed in the traversing bar **17** and the lower end of which extends downwardly and is bent at an angle outwardly to pass in spaced relation below a heated pipe **23** adapted to confine a source of heat, such as steam, passing therethrough. The yarn guide wire **22** and heated pipe **23** are disposed between the pigtail yarn guide **13** and the traversing guide **16** and it is preferred that the strand engages the left-hand side (Figures 1 and 3) of the lower outermost end of the guide wire **22** and completely encircles the heated pipe **23** before it engages the traversing yarn guide **16**.

As the strand Y is drawn from the bobbin **10** to the take-up bobbin **20** it is pulled over the heated, non-rotating pipe **23** and as it is pulled over the same the traversing movement of the bar **17** will impart like movement to the yarn guide wire **22**. Thus, the strand Y surrounding the pipe **23** will be moved transversely along the heated pipe **23** as the strand Y is pulled over the pipe **23**.

While it is not known exactly what influence the heated pipe has on the physiochemical properties of strands of every type yarn, synthetic and natural, it is believed that the heated pipe would act as an iron to smooth the surface of any type strand passed therearound or in engagement therewith. The traversing yarn guide wire **22** causes the strand Y to be rolled as it passes in engage-

ment with the heated pipe 23 to insure that the complete periphery of the strand is smoothed or ironed to remove any irregularities or roughness thereon. The degree of smoothness achieved by this invention would depend upon the type of yarn being processed and the amount of heat transferred by the ironing element.

It is known that a smooth surfaced yarn strand produces a much more even and uniform fabric when knitted or woven than a yarn which has a rough surface. Any uneveness of the stitch loops produced in knitting sheer fabric, such as ladies' fine gauge sheer hosiery, is easily detected.

Since the leg and foot portions of most ladies' hosiery are presently being knit of monofilament yarn, which is relatively smooth, there is little stitch distortion or unevenness caused by roughness of the yarn in these portions. However, the yarn used in knitting the welt is usually a heavier denier multifilament yarn which is twisted and steamed to set the twist and shrink the same before knitting. The type of multifilament welt yarn has been found to be very rough on its surface and will result in uneven stitch loops when knitted, as illustrated in Figure 4. It has been found that when the principles of the present invention are used to process a twisted multifilament welt yarn, the resulting knitted welt fabric has an excellent appearance because of the uniformity of the stitch loops, as shown in Figure 5, and the welt fabric will have better stretching qualities since the yarn forming the stitch loops can slide easily. The fabric will also return to its original position after stretching by wear or laundering because the smooth yarn forming the stitch loops provide better recovery properties in the fabric.

The following example is illustrative of a specific application of this invention to a particular type of multifilament yarn adapted for use as a welt yarn in knitting the upper portion of sheer knit ladies' stockings but should not be construed as limiting this invention to this particular use.

Example

A 50-denier nylon strand having 17 filaments twisted together approximately ¼ to ½ turn per inch is first transferred or unwound from the pirn, on which it was supplied by the manufacturer, and wound onto a twister supply bobbin on conventional winding machinery without adding any further twist. The twister supply bobbin **10** is then placed on the spindle **12** of an up-twister (Figures 1, 2 and 3) and fed to the take-up bobbin **20** after the surface is ironed smooth by engagement with the heated pipe **23**, in the manner previously described. In this instance, the spindle **12** is rotated at a speed of 10,000 r.p.m. and the yarn or strand Y is taken up on the bobbin **20** at the rate of 49 yards per minute to thus apply seven turns per inch twist to the strand Y. In this case, the outside diameter of the heated pipe **23** is approximately 1⅛ inches with the outer periphery of the pipe being polished relatively smooth and its surface temperature being maintained at approximately 275° F.

In this case, since the yarn is thermoplastic and the heat is sufficiently high, the twist in the yarn will be set and the yarn shrunk approximately two percent. Thus, the heated pipe **23** serves three purposes in this instance, sets the twist placed in the strand, shrinks the strand and smoothes the surface of the strand. The take-up bobbin **20** is then placed on a winding machine and the strand Y is unwound from the take-up bobbin **20** and wound onto suitable cones in preparation for knitting. In this winding operation, no additional twist is placed in the yarn nor is any size material placed on the strand.

The cones of smoothed, set and shrunk welt yarn are then used to knit the welt of a conventional lady's stocking on a circular seamless knitting machine while the remainder of the stocking is knit with a light denier monofilament yarn in a conventional manner. After the stocking is completed and in what is known as the greige, it is tested to determine the stretchability of the welt in a coursewise direction. In order to compare the stretchability of this welt with a welt which is knit of identical yarn which is set and shrunk but not smoothed, the welts of both stockings were stretched on a machine constructed for this purpose and it was found that the welt knit of the smoothed yarn would extend to 13 inches and the welt knit of the unsmoothed yarn would extend to 12¾ inches on the same stretch testing machine.

These two stockings were then dyed and finished in the conventional manner and again tested for stretchability. In this test, the stocking knit with the smooth yarn in the welt would stretch 13 inches while the stocking knit with the unsmoothed yarn in the welt would only stretch 12 inches. It is believed that the welt having the smooth yarn would stretch further after finishing because the yarns in each stitch loop could slide easily relative to each other and thus let the fabric extend to its fully extended position uniformly (Figure 5). On the other hand, the stretchability of the welt having the rough surfaced yarn (Figure 4) would be restricted since the roughness of the yarn would cause resistance to movement of the yarns relative to each other and stretchability of some portions of the welt would be greater than others so that the fabric would not be stretched uniformly.

The yarn made in accordance with this invention has also been tested to determine the elongation and strength thereof and the results compared with an identical yarn which has not been smoothed but which has been steam-set and shrunk in a steam cabinet. These tests were made on a conventional yarn testing machine which includes a means for measuring the pull required to break the yarn and means to measure the amount stretched before the yarn breaks. In the case of the conventionally processed unsmoothed yarn, 212 grams of pull were required to break the yarn and it stretched 1½ inches before breaking. In the case of the smoothed yarn processed in accordance with this invention, 227 grams of pull were required to break the yarn and it stretched 2¼ inches before breaking. Thus, this test indicates that the smoothed yarn is stronger and has better stretchability than the conventional processed unsmooth yarn.

The appearance of the welt of the stocking knit with the smoothed yarn is much more pleasing than the appearance of the stocking formed of the non-smoothed or conventional welt yarn and this may be compared by referring to Figures 5 and 4 respectively. It will be noted that the smoother surfaced yarn, shown in Figure 5, forms more even stitch loops and they are positioned in straight vertical wales and straight horizontal courses to aline with each other more perfectly than the stitch loops knit of the unsmoothed yarn shown in Figure 4.

It is believed that the more uniform stitch loops, shown in Figure 5, are the result of several factors. The smoothed yarn will be fed to the knitting instrumentalities under uniform tension at all times and a smooth surfaced yarn will slide in the hooks of the needles and over the sinkers to form uniform stitch loops each time the needles are drawn down to stitch loop forming level. A smooth surfaced yarn will pass through the various yarn guides and tension devices on the knitting machine in an even flowing manner whereas a yarn which has a roughened surface would tend to drag or hang on the roughened surfaces and at times be slowed down by the roughness thereof. As heretofore pointed out, the twist (seven turns per inch) is set by the heated pipe **23** as the yarn passes therearound and this twist is more even than it would be if the twist were set at a later time since in this case it does not have a chance to untwist or become uneven before it is set.

The example given above illustrates one specific application of the principles of the present invention and, of course, the invention is not limited to this specific example. Although nylon yarn is used in the example other types of twisted synthetic yarn may be smoothed

or ironed and it is not essential that the heat applied to the yarn be high enough to set and shrink the same as long as it is high enough to smooth the surface of the yarn. There may also be cases where it is beneficial to apply the principles of this invention and smooth the surface of strands of natural yarns, such as cotton, to facilitate handling the strand during weaving, knitting, etc.

While the invention is described for use with a multifilament twisted yarn strand, there may be instances where it would be beneficial to smooth the surface of a monofilament yarn. The strand Y may engage only a portion of the periphery of the heated pipe 23, the complete periphery when wrapped around the pipe one time as shown or more than the complete periphery by wrapping the strand Y around the pipe more than one time. Thus, the length of time the strand engages the heated pipe may be varied as desired.

It is thus seen that an apparatus for and a method of treating textile strands have been provided wherein the strand is passed in engagement with a heated element while being moved transversely of its path of travel to roll the same, insuring that the yarn is engaged on all surfaces thereof to smooth the outer surface of the yarn in an ironing operation. The heat applied may be varied with certain yarn so that additional operations may be simultaneously carried out along with the ironing operation, such as heat-setting a synthetic thermoplastic yarn and shrinking the same to the desired degree.

In the drawings and specification there has been set forth a preferred embodiment of the invention and, although specific terms are employed, they are used in a generic and descriptive sense only and not for purposes of limitation, the scope of the invention being defined in the claims.

We claim:

1. A method of smoothing the surface of a thermoplastic yarn strand in a continuous process which comprises the steps of running the yarn from a supply to a take-up at a predetermined speed, passing the running yarn completely around and in engagement with a heated element positioned between the supply and take-up, and moving the running yarn transversely of its direction of movement while in engagement with the heated element.

2. A method of heat-setting, shrinking and smoothing the surface of a twisted multifilament thermoplastic yarn strand in a continuous process which comprises the steps of running the yarn from a supply to a take-up at a predetermined speed, passing the running yarn completely around and in engagement with a heated element positioned between the supply and take-up, and moving the running yarn transversely of its direction of movement while in engagement with the heated element.

3. A method of processing a multifilament thermoplastic yarn strand in a continuous process which comprises the steps of running the yarn from a supply to a take-up at a predetermined speed, applying twist to the yarn as it is removed from the supply, passing the twisted running yarn completely around and in engagement with a heated element positioned between the supply and take-up to heat-set the twist in the yarn and to shrink the same, and moving the running yarn transversely of its running direction while in engagement with the heated element.

4. Apparatus for smoothing the surface of thermoplastic yarn in a continuous process which comprises a yarn supply source, driven yarn take-up means onto which said yarn is wound from said supply source, an elongated heating element positioned between said supply source and said take-up means, said heating element being positioned with its longitudinal axis perpendicular to the path of travel of said yarn and in engagement with the yarn, and movable yarn guiding means engaging said yarn adjacent said heating element to traverse said yarn in a direction parallel with the longitudinal axis of said heating element while the yarn is in engagement with said heating element.

5. Apparatus for heat-setting, shrinking and smoothing the surface of thermoplastic yarn in a continuous process which comprises a yarn supply source, driven yarn take-up means onto which said yarn is wound from said supply source, an elongated cylindrical heating element positioned between said supply source and said take-up means, said heating element being positioned with its longitudinal axis perpedicular to the path of travel of said yarn, said yarn passing around and in engagement with said heating element, and movable yarn guiding means engaging said yarn adjacent said heating element to traverse said yarn in a direction parallel with the longitudinal axis of said heating element while the yarn is in engagement with said heating element.

6. Apparatus for twisting, heat-setting, shrinking and smoothing the surface of multifilament thermoplastic yarn in a continuous process which comprises a yarn supply source, yarn take-up means onto which said yarn is wound from said supply source, means for driving said yarn supply source and said take-up means to impart twist in said yarn, an elongated heating element positioned between said supply source and said take-up means, said heating element being positioned with its longitudinal axis perpendicular to the path of travel of said yarn and in engagement with the yarn to set the twist in said yarn and shrink the same, and movable yarn guiding means engaging said yarn adjacent said heating element to traverse said yarn in a direction parallel with the longitudinal axis of said heating element while the yarn is in engagement with said heating element to roll the yarn against said heating element and smooth the surface of the yarn.

7. An apparatus for twisting, heat-setting, shrinking and smoothing the surface of mutifilament nylon yarn in a continuous process comprising a yarn supply bobbin, a yarn take-up bobbin, means for driving said yarn supply bobbin and said yarn take-up bobbin to run said yarn from said supply bobbin to said take-up bobbin while imparting twist to said yarn, a heated pipe positioned between said supply bobbin and said take-up bobbin, said pipe being positioned with its longitudinal axis perpendicular to the path of travel of said yarn, said yarn passing around and in engagement with said pipe, the temperature of said pipe being sufficient to set the twist in said yarn and shrink the same, a yarn guide positioned adjacent said pipe, and means to traverse said yarn guide in a direction perpendicular to the path of travel of said yarn to roll the yarn against said pipe and smooth the surface of the yarn as it passes around said pipe.

8. An apparatus for twisting, heat-setting, shrinking and smoothing the surface of a 50-denier 17 filament nylon yarn in a continuous process comprising a yarn supply bobbin, a yarn take-up bobbin, means for driving said yarn supply bobbin and said yarn take-up bobbin to run said yarn from said supply bobbin to said take-up bobbin while imparting about seven turns per inch of twist to said yarn, a heated pipe positioned between said supply bobbin and said take-up bobbin, said pipe being positioned with its longitudinal axis perpendicular to the path of travel of said yarn, said yarn passing around and in engagement with said pipe at the rate of about 49 yards per minute, the temperature of said pipe being about 275° F. to set the twist in said yarn and shrink the same, a yarn guide positioned adjacent said pipe, and means to traverse said yarn guide in a direction perpendicular to the path of travel of said yarn to roll the yarn against said pipe and smooth the surface of the yarn as it passes around said pipe.

9. A method of processing a yarn strand in a continuous process which comprises the steps of running the yarn from a supply to a take-up at a predetermined speed, passing the running yarn around and in frictional engage-

ment with a heated element positioned between the supply and take-up, and moving the running yarn transversely of its direction of travel as the yarn is engaged by the heated element while transmitting sufficient heat to the running yarn to smooth the surface of the same.

10. A method of processing a twisted multifilament thermoplastic yarn strand in a continuous process which comprises the steps of running the yarn from a supply to a take-up at a predetermined speed, passing the running yarn around and in frictional engagement with a heated element positioned between the supply and take-up, and moving the running yarn transversely of its direction of travel as the yarn is engaged by the heated element while transmitting sufficient heat to the running yarn to heat-set, shrink and smooth the surface of the same.

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