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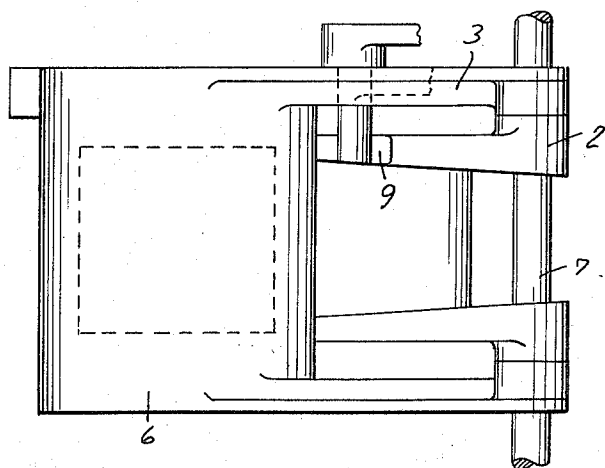
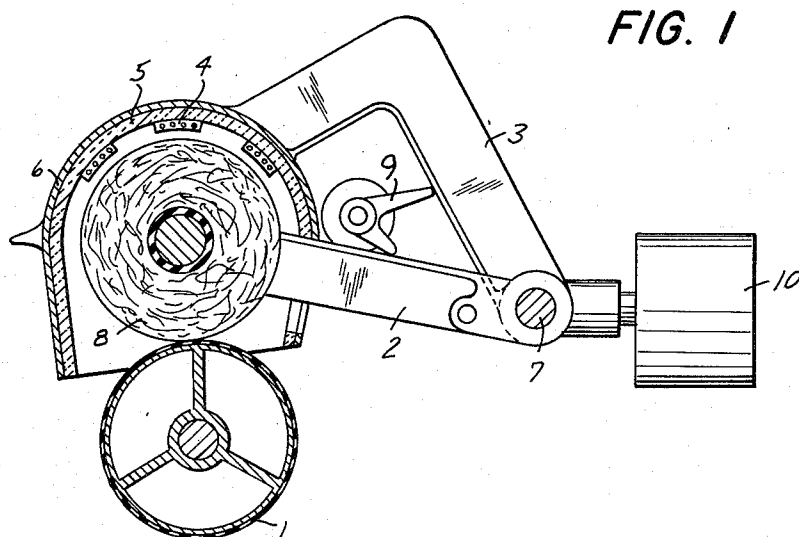
F. SCRAGG

3,131,528

METHOD AND APPARATUS FOR HEAT SETTING FALSE TWISTED YARN

Filed Aug. 10, 1959

2 Sheets-Sheet 1



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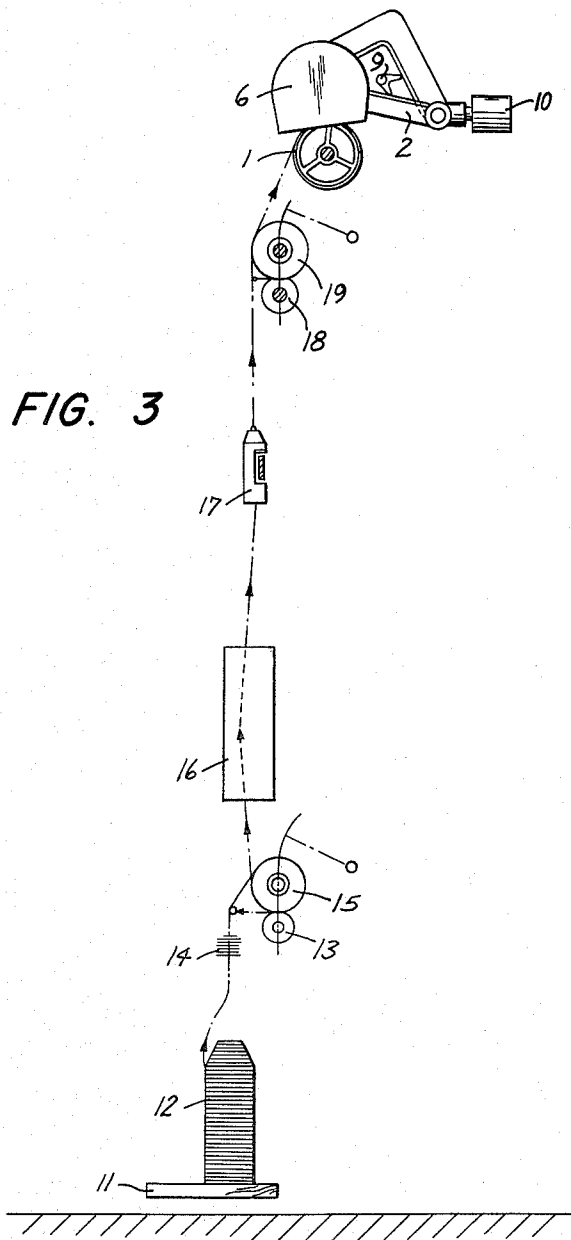
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METHOD AND APPARATUS FOR HEAT SETTING FALSE TWISTED YARN

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2 Sheets-Sheet 2



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1

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METHOD AND APPARATUS FOR HEAT SETTING FALSE TWISTED YARN

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The invention is concerned with the provision of a new process for imparting certain desirable characteristics to textile yarns, and has for its object the provision of means and apparatus for making a textile yarn from monofilaments and having mechanical and thermal properties resembling those possessed by yarns made from natural fibres.

Such natural fibre yarns are known to have a high degree of randomness in the form of the individual fibres comprising the yarn. This arises in the process of natural growth which always tends to produce similar structures with slight differences rather than structures exactly resembling one another. Yarn made from natural fibre therefore consists of a series of approximately parallel twisted fibres, the twisting imparting strength to the yarn whilst the random kinks present on each yarn cause the yarn to bulk uniformly along its length providing that the drafting processes preceding the spinning have been efficiently performed. This quality of uniformity combined with bulking, has hitherto been found difficult to copy by yarns made from artificial fibres, since from their manner of production, such fibres are normally of substantially uniform cross-section, straight and smooth, and have uniform physical properties throughout their length. Again, manufacturing processes lend themselves more readily to the production of continuous monofilaments than to staple fibres of random length. As a result, yarns made directly from a bundle of monofilaments to which a relatively low rate of twist has been imparted, tend to be inelastic, non-bulking, smooth and cold to the touch.

Various attempts have been made to overcome these disadvantages and to produce monofilament yarns, more particularly a yarn constructed from thermoplastic monofilaments, which tends to bulk or fluff, and a considerable measure of success in this direction has been achieved. Certain disadvantages however are still remanent in such bulk yarns. For example, if a yarn is made by imparting a high degree of twist to it, setting the twist in the yarn and then untwisting it, the resulting yarn tends to be too bulky, and has too high a degree of natural contraction. In addition, a certain amount of residual torque may remain in the yarn, which if no measures are taken to prevent it, causes garments made from this yarn to distort in a spiral manner. Again, in another type of bulk yarn, the process tends to cause uneven dyeing although there is no remanent torque.

The invention provides a partially bulked yarn in which the previously recited disadvantages are wholly or mainly overcome by the treatment to which the yarn is subjected. The process is applicable to thermoplastic yarns, i.e., those composed of filaments of which the material softens progressively as its temperature is raised, any distortion or form applied to the filaments whilst so heated being retained when the filaments are cooled. The object of the invention may therefore be restated as being the production of a moderately bulked yarn constructed from a plurality of thermoplastic monofilaments, the said yarn exhibiting little or no residual torque and having a small or zero contraction in length when freely suspended in air.

To produce this yarn, I may adapt a machine similar to that of the normal uptwister employed in connection

2

with monofilament yarns. I provide a yarn package and support preferably at the base of the machine, and a pair of feed rollers above it, the yarn passing through the nip of the rollers and being drawn off at a predetermined rate. The yarn may receive a relatively low degree of twist—say two to four turns per inch—before being wound onto the package, or alternatively it may be ring-twisted as it is being drawn from the package. From the feed rollers the yarn passes over a suitable heater which may be in the form of a convexly curved plate, the temperature of which is set to and controlled at a temperature found by experience to be suitable for treating the yarn concerned. Thereafter the yarn passes through a cooling zone which may be merely a predetermined distance of passage through air at ambient temperature and then through a false twist sprindlle which imparts a high degree of twist to the yarn. This twist runs backwards to the heated face of the plate where it is set in the yarn, causing the filaments of the latter each to assume a substantially spiral formation, this twist being fixed during its passage through the air space.

When leaving the false twist device, the formation of each filament is changed from that of a spiral to a substantially straight or slightly curved or undulating form, though in so doing it should be noted that the false twist device, although removing the spiral formation, inserts torque in each filament as a result of the unwinding of the spiral imparted to the filaments. The yarn is drawn away from the false twister by a second pair of feed rollers, the peripheral speed of which is preferably in the region of the peripheral speed of the input feed rollers located below the heating zone. If found desirable, the second feed rollers may draw the yarn at a slightly less rate than that of the input feed rollers to allow for yarn contraction in the heating zone. The yarn is now wound on a package or cheese, the peripheral speed of which is maintained constant at a value considerably lower than that of the second pair of feed rollers. Thus if the rate of delivery of the yarn from the second feed rollers is 100 feet a minute, then the peripheral speed at which the yarn is wound onto the cheese may be between 60 and 70 feet a minute. The peripheral speed of the wind-up cheese may be maintained constant by allowing the cheese to rest rotatably on the surface of a driven roller, or by the use of a suitable infinitely variable gear acting on the spindle of the cheese.

Considering the physical characteristics of the yarn wound on the cheese, it will be found that each filament now has a series of random or partially random kinks or small loops formed on it by the effect of the false twist device in unwrapping the spiral shape given to the filaments and set by the heating zone. There is also a tendency on the part of each filament to contract lengthwise, and in addition each filament exerts a torque which is the result of the untwisting provided by the false twist device after twist has been set in the heater. Only the first of these three characteristics is desirable, since this is the one which provides moderate bulk to the yarn. The tendency to contract would cause the yarn to shorten excessively, or alternatively if the yarn were made into a garment, the garment would be smaller in an unworn than in a worn condition. Finally, the inherent torque of each filament would cause the yarn composed from the filaments to tend to twist, and to impart twist to garments made from it. It is therefore now required to remove residual shrinkage and torque from the filaments.

To this end, I heat the yarn either on or before it reaches the cheese a second time to a temperature at which intermolecular strains are reduced, i.e., the material is annealed. Since each filament has a slightly wavy or undulating shape, and since only a low tension is applied to the filaments whilst they are wound, there is lit-

tle or no tendency for this undulating form to be removed. There is however both a compulsion on the yarn which prevents its additional contraction, and a compulsion which prevents the yarn from twisting, with the result that if heat of sufficient amount is applied for an appropriate time to the yarn, both longitudinal and twist stresses in the yarn are greatly reduced or removed. As a result, the finished yarn possesses an appreciable bulk, little extension under load, and very low or zero tendency to twist. Since real twist was initially imparted to the yarn and still remains therein, the bulking effect is limited, and adjacent yarns do not appreciably coalesce. Again, since the undulations of each monofilament are restricted in amplitude, the material has a handle similar to that of yarns made from natural fibres.

To effect the heating of the material on the cheese I provide an oven in the form of a cover which encloses as much as possible of the cheese itself. The oven has an inner radius of curvature which is somewhat greater than that of the maximum radius achieved by the material during winding on the cheese, and the inner surface of the oven is provided with one or more heater strips preferably with reflectors so as to direct the heat produced at the yarn, and reduce the amount of heat loss outwards through the body of the oven, which is either of heat insulating material, or which contains heat insulating material as a filling. The cover is supported in such a way as to keep its inner surface as nearly as possible concentric with the surface of the cheese as it is being wound. Again, the oven is so supported that it can be readily moved away from the cheese so that the latter can be removed after winding.

Although the former method of heating the yarn after the false twisting stage enables the yarn to be kept hot during part or all of the winding time, the method may present certain disadvantages and I therefore have devised an alternative method of heating the yarn which consists in winding the yarn after it has left the top pair of feed rollers, on to the surfaces of a pair of rollers having a plurality of grooves, the grooves being so arranged that yarn travels from one end of the rollers to the other during its passage round them. One or both of the rollers is or are heated to a temperature sufficient to cause the relaxation or removal of molecular strains in the yarn as it passes over the rollers. The peripheral speed of the said rollers is appreciably less than that of the peripheral speed of the feed rollers, so that the yarn is in a partially bulked condition as described above during application of the heat treatment to it. After leaving the heated rollers the yarn is wound on a cheese the peripheral speed of which is substantially the same as that of the rollers. The yarn may or may not be further heated whilst wound on the cheese, but it is thought that such further heat treatment may be unnecessary.

Reference should now be made to the accompanying drawings in which FIG. 1 is a side view of the wind-up mechanism and heating oven which we propose to employ in connection with the final processing to be applied to our yarn, FIG. 2 is a plan view of FIG. 1, and FIG. 3 is a side view of a diagrammatic representation of one half of a machine for carrying out my process.

Referring to FIG. 3, it will be seen that a yarn package 12 is provided in the base of the machine, located on a support 11. Yarn is drawn from the package through a yarn stabiliser 14 by means of nip rollers 13 and 15. Yarn is then pulled over the surface of a heater 16, the temperature of which may be automatically stabilised, and through a false twist tube 17 by means of further nip rollers 19 and 18. The peripheral speeds of the two roller assemblies are adjusted so that a small amount of shrinkage takes place in the yarn whilst it passes over the heater and whilst it is subject to false twist. The yarn may receive a relatively low degree of twist—say two to four turns per inch—before being wound onto the package, or alternatively it may be ring twisted as it is being drawn from the package.

The yarn emerging from the top nip rollers 18 and 19 (FIG. 3) is collected to form the package 8 shown in FIG. 1. The package 8 rests on the driven roller 1 which has a constant speed of rotation less than the rate of delivery of the yarn from the rollers 18, 19. Thus, if the rate of delivery from the latter rollers is 100 feet a minute, then the peripheral speed of the package 8 provided by the driven roller 1 may be between 6 and 70 feet a minute.

As is evident from FIG. 1 the package 8 is supported on an arm 2 which is itself pivotally supported by a shaft 7 carried by a support 10.

To effect the heating of the package 8 an oven is provided, this oven 6 (FIGS. 1 and 2) forming a cover in which the package 8 is located. The inner radius of curvature of the oven 6 is somewhat greater than the maximum radius achieved by the yarn during winding onto the package 8, and the inner surface of the oven is provided with a plurality of electrical heating strips 4 as well as with reflectors which direct the heat to the yarn so as to reduce the amount of heat loss outwards through the body of the oven. The material of the oven 6 may be heat insulating, or as shown in FIG. 1 a layer of heat insulation 5 lines the inner surface of the oven, and the heater strips 4 are located at the inner surface of the insulation layer 5.

The partially cylindrical cover 6 is supported in such a way as to keep its inner surface as nearly as possible concentric with the surface of the package 8 as the latter is wound and for this purpose the oven 6 is fixedly carried by an arm 3 also pivotally carried by the shaft 7, the arm 3 engaging the upper arm of a bell crank 9, as viewed in FIG. 1, the lower arm of this bell crank engaging the arm 2. The bell crank 9 is supported for turning movement around a stationary axis parallel to that of the shaft 7, and thus as the diameter of the package 8 increases the arm 2 will turn in a clockwise direction around the shaft 7, as viewed in FIG. 1, thus causing the bell crank 9 to turn in a counterclockwise direction, as viewed in FIG. 1, and in this way the upper arm of the bell crank by engagement with the arm 3 will turn the latter in a clockwise direction around the shaft 7, as viewed in FIG. 1, so that in this way the inner surface of the oven is maintained a substantially constant distance from the exterior surface of the package 8 during winding thereof. As is apparent from FIG. 2 the oven 6 can be manually turned at any time, independently of the arm 2, around the shaft 7 in a clockwise direction, as viewed in FIG. 1, so as to remove the oven from its position enclosing the package 8 to enable the latter to be removed from the arm 2. The yarn as it is taken from package 8 is only contractile to a small degree, but remains fully bulked.

The arrangement of levers 2, 3 and 9 is so dimensioned that as the package grows in size, the spacing between the heaters 4 and the surface of the package remains substantially constant. When the package 8 is fully wound, the heating oven is lifted away from it, pivoting about the shaft 7. The package is removed from its arm 2 and is replaced by an empty support, and the process of crimping is renewed by lowering the oven.

Although the former method of heating the yarn after the false twisting stage enabled the yarn to be kept hot during part or all of the winding time, the method may present certain disadvantages and in an alternative embodiment of the invention the yarn after it has left the top pair of nip rollers 18, 19 is fed onto the surfaces of a pair of spacer rollers having a plurality of grooves, the grooves being so arranged in known manner that yarn travels from one end of the rollers to the other during its passage round them. One or both of the rollers is heated to a temperature sufficient to cause the relaxation or removal of molecular strains in the yarn as it passes over the rollers. The peripheral speed of the said rollers is considerably less than that of the peripheral speed of

the feed rollers 18, 19 so that the yarn is in a partially bulked condition as described above during application of the heat treatment to it. After leaving the heated rollers the yarn is wound on a cheese the peripheral speed of which is substantially the same as that of the rollers. The yarn may or may not be further heated whilst wound on the cheese, but it is thought that such further heat treatment may be unnecessary.

Although the invention has been described in connection with the use of nip rollers 13 and 15 for removing yarn from the supply package, it should be understood that the said rollers may be omitted, the yarn being drawn through the machine by the top nip rollers 18 and 19. A yarn tensioner or stabiliser located between the supply package and the heater then replaces the rollers 13 and 15.

What I claim is:

1. A method of producing a bulked yarn of thermoplastic textile monofilaments in a continuous process consisting in continuously withdrawing the yarn from a suitable package, passing the yarn through a heating zone, passing the yarn through a false twist device so as to impart twist to the yarn, drawing the yarn through the said twist device at a predetermined speed, winding the yarn onto a further package at a speed lower than that of the said predetermined speed, and subjecting the yarn to a further heat treatment after it is wound on said further package, the time and temperature of the second heat treatment being adjusted so as to remove at least some of the internal stresses of the yarn at said further package.

2. Yarn-treating apparatus comprising drawing means for drawing the yarn from a package and through the apparatus at a constant rate, a heater along which the yarn passes, means for applying false twist to the yarn so that part of the twist runs backwards into the heater and is set therein in the yarn, a yarn package for collecting the yarn, means for driving the said package so that its peripheral speed is less than said constant rate of the drawing means, and package-heating means for heating the yarn while it is wound on the package.

3. Apparatus according to claim 2 in which the package heating means consists of an oven which is arranged to cover the yarn package and to heat the yarn thereon during winding of the package.

4. Apparatus according to claim 2 in which the yarn drawing means comprise two pairs of nip rollers.

5. Apparatus according to claim 2 in which the yarn drawing means is a pair of nip rollers located between the false twist means and the yarn receiving package, the yarn passing through a stabiliser or tensioning device located between the yarn delivery package and the heater.

6. For use in an apparatus of the character described, a device for heating yarn while it is wound onto a package, comprising in combination, an elongated arm; support means supporting said arm adjacent one end thereof for turning movement about a given axis; package supporting means carried by said arm adjacent an opposite end thereof for supporting a package during the winding thereof; driven roller means located beneath said opposite end of said arm for engaging a package and rotating the same; a heating oven enclosing the space in which the package is located; and means cooperating with said oven and said arm for maintaining an inner surface of the oven at a substantially constant distance from the package during the winding thereof.

7. For use in an apparatus of the character described, a device for heating yarn while it is wound onto a package, comprising, in combination, an elongated first arm; support means supporting said first arm adjacent one end thereof for turning movement about a given axis; package supporting means carried by said first arm adjacent an opposite end thereof for supporting a package during the winding thereof; driven roller means located beneath said opposite end of said first arm for engaging a package and rotating the same; a heating oven enclosing the space in which the package is located; a second arm fixed to and carrying said oven and supported by said support means for turning movement about said given axis; and bell crank lever means turnable about an axis parallel to said given axis, and having a pair of arms respectively engaging and located between said first and second arms, said bell crank lever means transmitting turning of said first arm to said second arm for maintaining said oven at a substantially constant distance from the package during the winding thereof.

8. The combination of claim 6 and wherein a yarn treating means treats the yarn as it approaches said driven roller means so that any stresses in the yarn resulting from treatment thereof by said yarn treating means will be at least partly eliminated during heating of the yarn in said oven.

9. The combination of claim 7 and wherein a yarn treating means treats the yarn as it approaches said driven roller means so that any stresses in the yarn resulting from treatment thereof by said yarn treating means will be at least partly eliminated during heating of the yarn in said oven.

10. Yarn-treating apparatus comprising drawing means for drawing the yarn from a package and through the apparatus at a constant rate, a heater along which the yarn passes, means for applying false twist to the yarn so that part of the twist runs backwards into the heater and is set therein in the yarn, a yarn package for collecting the yarn, means for driving said package so that its peripheral speed is less than said constant rate of the drawing means, and package-heating means for heating the yarn while it is wound on the package, the package-heating means consisting of an oven which is arranged to cover the yarn package and to heat the yarn thereon during winding of the package and in which a means cooperates with the oven for maintaining an inner surface thereof at a substantially constant distance from the package during the winding thereof.

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