Dec. 13, 1960 D. FINLAYSON ET AL 2,963,848
TREATMENT OF YARNS
Filed Aug. 2, 1957

FIG. 1

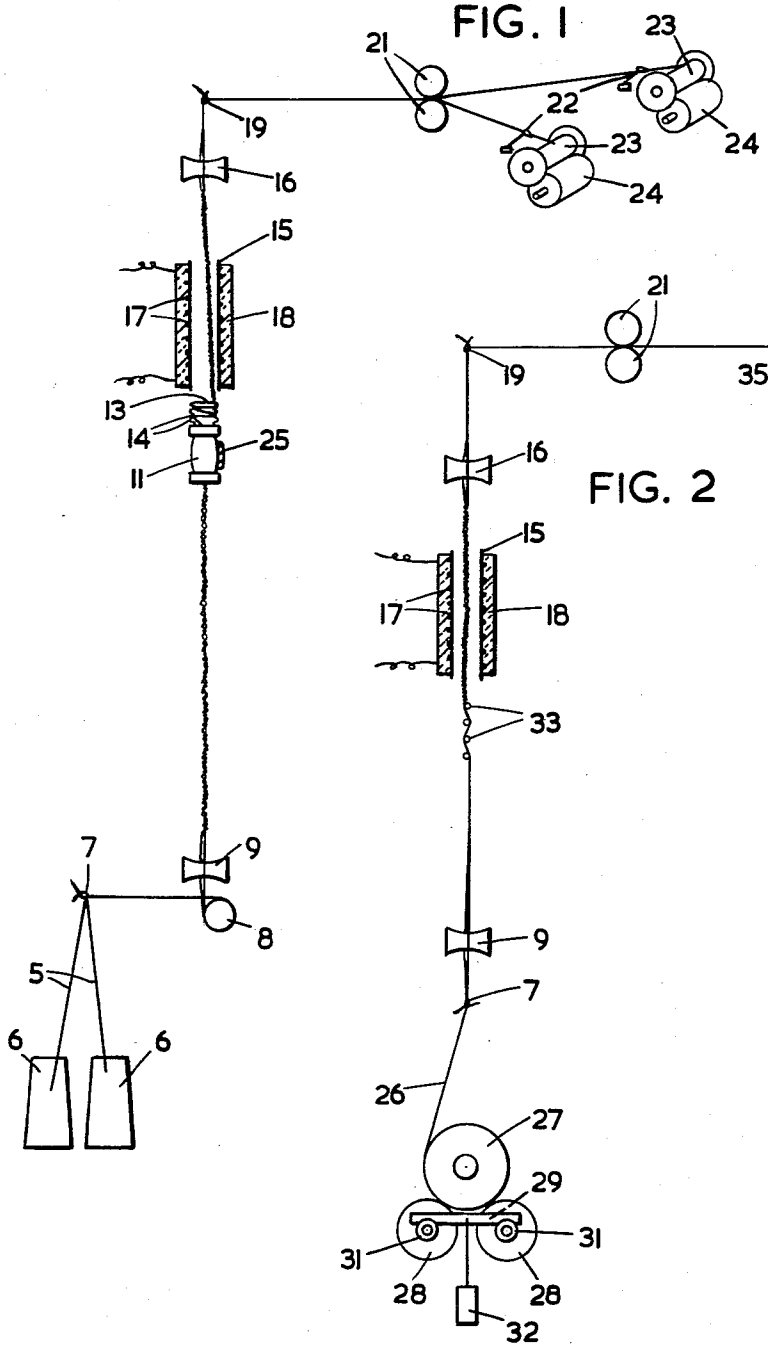


FIG. 2

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TREATMENT OF YARNS

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This invention relates to the treatment of yarns and particularly to a method and apparatus for the crimping of the fibres of yarns, especially continuous filament yarns, so as to produce yarns having a handle which is more woolly, springy and voluminous as a result of the treatment thereof.

According to the present invention a plurality of textile strands are drawn from a source of supply at which they are not twisted together and, in the course of their travel from said source of supply, are associated together with twist and then separated from one another so that said twist is positively prevented from passing the point of separation, are passed before reaching said point in frictional engagement with a member whereby twist between them can pass said member in their direction of travel but is hindered from passing said member against their direction of travel so that twist accumulates in the zone between said member and said point, and are subjected in said zone to a setting treatment to fix in the fibres of said strands the distortion imposed thereon by the accumulated twist. It has been found, and the present invention is based on this discovery, that where a plurality of strands are run through a zone of twist terminating at a separating point so that twist between the strands is prevented from passing said point, the twist between the strands can more easily and more effectively be concentrated in a later part of said zone than in an earlier part. Advantage is taken of this fact by effecting the setting in the later part of the zone, where the strands run unimpeded from the member, whose frictional contact effects the concentration of the twist, to the separating point. An apparatus according to the present invention, suitable for carrying out the process described above, comprises means for drawing a plurality of associated textile strands from a source of supply, a member past which said strands are drawn by said drawing means and by which they are frictionally engaged while associated together, means following said member for setting in the strands temporary twist as between the strands, and guide means following said setting means for separating said strands from one another.

The member with which the strands run in frictional contact is preferably of the nature of a false-twist device, being rotated rapidly about an axis parallel to the general direction of travel of the strands. In such a case the degree of twist on the up-stream side of the member (with reference to the direction in which the strands are running) appears to be limited, when steady running is achieved, to a value equal to the rate of revolution of the false-twist spindle divided by the rate of travel of the strands. The degree of twist on the down-stream side of the member, however, is not so limited. Since no turns of twist enter the zone of twist from the source of supply and since none can leave it past the separating point, the algebraic sum of the turns of twist in the different parts of the zone is fixed throughout the operation, so that any turns of twist added by the false-twist device on the up-stream side thereof is accompanied by an equal number of turns of the opposite hand added to the down-stream side. By making the length of the up-stream part of the zone greater than that of the down-stream part, the turns per inch thus added on the down-stream side can be increased indefinitely.

The fixed value of the algebraic sum referred to above need not be zero but may be a positive value, predetermined by the manner in which the strands are initially threaded up at the beginning of the operation along the path they are to follow, the turns being preferably in the same sense as the turns of twist added on the down-stream side by the rotation of the false-twist spindle. With such a positive value for the algebraic sum it is even possible to use a non-rotating member instead of a rotating false-twist spindle, having the effect of concentrating all the turns of twist on its down-stream side (where the setting zone is situated) and leaving none or substantially none on the up-stream side. The invention may be regarded as running the textile strands through a zone in which temporary twist is trapped, positively at the down-stream end of said zone but frictionally at the up-stream end thereof, and setting in the fibres of the strands the twist so trapped. The invention is thus distinguished from every type of fibre-crimping operation in which temporary twist is set in a travelling yarn by a setting treatment preceding a false-twisting device by which the temporary twist is imparted, and from any arrangement in which a yarn travels through a zone in which twist is trapped, and the trapped twist is free to run back to the up-stream end of said zone.

The strands employed for the purposes of the present invention are preferably each of the nature of a yarn which may have some degree of twist as between its own filaments or fibres. The invention, while particularly applicable to continuous filament yarns is also applicable to staple fibre yarns, in which case some degree of twist is necessary in order to hold the staple fibres together. Where continuous filaments are employed, a single twistless bundle of such filaments may be used as the starting material, the filaments themselves being regarded as the strands and being divided into two or more fractions at the separating point, after which they may, if desired, be reunited and collected with or without added twist as a single yarn. The process can be applied to any type of yarn of a material in which it is possible to set the distortions imposed by the temporary twist in the setting zone. Thus it may be applied to continuous filament yarns of cellulose acetate or other organic derivative of cellulose, to yarns of reconstituted cellulose such as viscose, and to yarns of wholly synthetic fibres such as linear polyamides, e.g. polyhexamethylene adipamide, polyamino acids, e.g. polyaminocaproic acid, and polyesters, e.g. ethylene terephthalate. The invention may, moreover, be applied to one or more continuous filament bundles which are subsequently to be cut up or otherwise converted into staple fibres for making staple fibre yarns.

Setting of the distortion imposed by the stationary twist employed in the present invention can be effected by any setting agency appropriate for use in connection with rotating false twisting devices. The preferred setting agency is dry heat, supplied by passing the yarn through an electrically heated tube or channel siutated in the setting zone, or by running the yarns over and in contact with a heated surface, e.g. a curved plate or curved open channel, either of which may be provided with a heat-insulating or heat-reflecting cover, or along a curved heated tube. The temperature of the heating elements is adjusted to be as high as is safely possible having regard to the nature and speed of passage of the yarns, and the length of passage is made sufficient to bring about, at that temperature, a setting of the filaments in the shape imposed on them.

Alternatively, the yarn may be passed through a chamber to which a gaseous or liquid setting medium is supplied, e.g. steam at or above atmospheric pressure, hot air, solvent vapours, or hot water or other softening liquid. After leaving the setting zone, the yarns are given a short run to allow them to harden, before being separated.

The component yarns leaving the separating point are collected by suitable take-up means, preferably working at constant linear speed, and may be collected separately, or re-associated and collected together as one yarn. The resulting yarns may be used directly in the form in which they are produced or may be doubled with other yarns of similar or different character. Thus, two ends of yarn twisted in separate crimping operations in accordance with the invention and with temporary twists of opposite hand may be associated together in the manner described in U.S. application S.N. 579,344, filed April 19, 1956, now abandoned. Or again, one or more yarns produced in accordance with the invention may be doubled with a yarn of continuous uncrimped filaments, with or without a further binder yarn of similar character as described in U.S. Patent No. 2,145,346.

By way of example, two forms of apparatus according to the invention, and the manner of using them for carrying out the process of the invention will now be described in greater detail with reference to the accompanying drawing, in which:

Figure 1 is a diagrammatic side elevation of one form of apparatus, and

Figure 2 is a similar view of a second form of apparatus showing several features alternative to those of Figure 1.

In the apparatus shown in Figure 1, two ends of yarn **5** are drawn upwards over-end from two supply packages **6** from which they are led round a common guide **7** and thence horizontally to and round a braked roller **8** serving as a tension device. From the braked roller **8** the yarns **5** are led upwards, one on each side of a waisted guide roller **9** which prevents doubling twist between the yarn above the guide roller **9** (as later to be described) from running back to the supply packages **6**. From the waisted guide roller **9** the yarns are passed upwards through a false-twist device **11** in the form of a hollow rapidly rotating spindle, provided with guide means **13** symmetrically disposed on the spindle and adapted for guiding and deflecting the yarns **5** through several sharp changes in direction. The guide means **13** is of wire, bent generally in the form of an inverted U, of which each limb has an equal number of deep waves or open loops **14** for the guiding of the associated yarns **5**. The distance from the guide roller **9** to the false-twist spindle **11** is 3 ft. From the false-twist spindle **11** the yarns continue upwards through an electrically heated setting tube **15**, 12 in. in length, and are then passed one on each side of a further waisted guide roller **16**, situated about 18 in. above the false-twist spindle **11**. The tube **15** is provided with heating elements **17** and is lagged at **18**. The yarns **5**, though passing together from the one waisted guide roller to the other may or may not be twisted with one another at the start of the operation as described hereafter. From the second waisted roller **16** the yarns are threaded together through a further yarn guide **19** above and in line with the spindle **11**, and are led from this guide horizontally through a pair of nip rollers **21** by means of which the yarns are drawn from the supply packages **6**. From the nip rollers **21** the yarns proceed by way of traverse guides **22** to separate take-up packages **23** driven at a constant and uniform linear surface speed by surface contact with driving rollers **24**, so that the yarns **5** are separately wound on the take-up packages **23**.

After the yarns **5** have been so threaded up, the apparatus is set in motion, the false-twist spindle **11** being driven at a high speed, say 15,000 revolutions per minute, by means of its driving belt **25** and the nip rollers **21** at a suitable peripheral speed for drawing the yarns through the apparatus. The take-up devices **22—24**, are driven to collect the yarn at a linear speed slightly less than that of the rollers **21** so that the yarn is collected under low tension. The effect of the rotation of the false-twist device **11** is to impart to the yarns **5** approaching it a temporary doubling twist of a total number of turns about equal to the rate of revolution of the spindle **11** multiplied by its distance from the roller **9** and divided by the linear speed of the nip rollers **21**. If the yarns **5** are initially not twisted together between the waisted guide rollers **9**, **16**, a like number of turns of twist will appear, in the reverse direction, on the down-stream side of the false-twist device, the average number of turns per inch on this side being, therefore, of the order of twice that of the upstream side. The distortions of the individual filaments imposed by this degree of doubling twist are set in the yarn by the heat applied in the setting tube **15**, after which the individual twist is removed by the separation of the yarns as they pass one on each side of the second waisted roller **16**.

The following are given as examples of the way in which the apparatus described above can be used:

Example I

Two ends of yarn, each of 30 denier and consisting of continuous filaments of hexamethylene adipamide, are drawn from the packages **6** of Figure 1 and threaded through the apparatus. The nip rollers **21** are driven at a peripheral speed of 13 yards per minute and the take-up rollers **24** at a linear speed of 12.5 yards per minute. By driving the spindle **11** at 15,000 revolutions per minute a temporary doubling twist of about 32 turns per inch is imparted to the yarns approaching the spindle **11** giving a total number of turns of twist of the order of 1150, while a like number of turns of twist in the reverse direction appear on the downstream side of the false-twist device, the average number of turns per inch of twist being of the order of 65.

Example II

Two continuous filament yarns each of 60 denier are treated as in Example I except that the nip rollers are driven at a speed of 16.6 yards per minute and the take-up rollers **24** at 15 yards per minute. The resulting temporary twist, whose distortions are set in the filaments in the setting tube **15**, is of the order of 50 turns per inch, the greater diameter of the aggregate doubled yarn increasing the degree of distortion brought about by each turn of twist.

Example III

In a further method of carrying out the invention the two 30 denier yarns as in Example I are threaded through the false-twist device **11** whereupon, before the ends are passed through the setting tube **15**, the false-twist spindle is driven in a reverse direction for a few seconds, so as to impart a number of turns of twist, say about 500, above and below the spindle **11**. The yarns are then separated just above the spindle **11**, and the length already drawn through is broken off and discarded. The new ends are passed through the setting tube **15** and led one on each side of the second waisted roller **16**, after which they are threaded forward to the take-up device **22—24**, as before. The distance between the false-twist spindle **11** and the second waisted roller **16** is increased to 25 in. By this means the turns per inch of twist in the zone between the false-twist spindle and the separating guide remains about the same, but a greater distance is allowed for the setting of the twist.

Example IV

Two 30 denier yarns are treated as in Example I except that the spindle speed is increased to 30,000 revolutions per minute, the speed of the nip rollers **21** to 25 yards per minutes, and the take-up speed to 23 yards per minute. The temporary twist in the zone between

the spindle 11 and the waisted roller 16 is of the order of 67 turns per inch.

In the arrangement shown in Figure 2, a single bundle 26 of continuous filaments is employed as the starting material, the bundle being wound without twist in the form of a cheese 27. The cheese is mounted for rotation between two supporting rollers 28 each of which is lightly braked by means of a yoke 29 resting on a reduced portion 31 of each of the rollers and loaded by means of a weight 32. This arrangement serves in place of the braked roller 8 of Figure 1. The untwisted bundle 26, is drawn from the cheese 27 directly past the guide 7 and waisted roller 9, half of the filaments being passed on one side of the roller and the other half on the other side. This is made possible by the twistless nature of the bundle 26. Proceeding upwards from the waisted roller 9 the bundle is passed in contact with a friction element 33 in the form of a series of horizontal bars in and out of which the bundle is threaded. From the element 33 the bundle passes through the setting tube 15, on emerging from which it is again separated into two parts which are passed one on each side of the second waisted roller 16. The distance between the friction element 33 and the waisted roller 16 is 18 in., as in Figure 1. The distance between the waisted roller 9 and the element 33 is 36 in., but this distance is of less importance than in Figure 1, and a smaller distance may be used.

In threading-up the device, at some stage after the ends of the bundle 26 have been threaded past the waisted roller 9 and before they are threaded past the waisted roller 16, the bundle is twisted to a total number of turns appropriate to the distance between the friction element 33 and the waisted roller 16 so that assuming (as will be the case) that all the twist is ultimately concentrated in this distance, it gives a number of turns per inch which, having regard to the diameter of the bundle, will result in a suitable degree of crimp in the individual filaments. It is convenient, though not essential, that the devision of the bundle as it passes on both sides of the waisted roller 16, should be the same as its division as it passes the first waisted roller 9. From the waisted roller 16, the bundle is passed through a further yarn guide 19 and between the nip rollers 21 from which it proceeds to collection.

When after threading-up in the manner described above the operation is started, the turns of twist inserted between the waisted rollers 9, 16, however they may initially be distributed between the rollers, will soon be concentrated between the friction element 33 and the roller 16. The twist of the bundle can readily pass the friction element 33 in the direction of travel of the bundle 26 but cannot be readily transmitted back past the element 33 to the part of the bundle between the waisted roller 9 and this element. On leaving the nip rollers 21, the bundle may be collected, as shown in Figure 2, on a single take-up package 34 to which it is guided by a traverse guide 35, and which is driven by means of a surface-contact roller 36. The completed package 34 can then be used to supply a cutting machine by which the crimped filaments are cut into staple fibres. Alternatively, the nip rollers 21 may deliver the bundle directly to such a cutting device. Or again, the two parts of the bundle 26 may be separately collected as bulked yarn, in the manner described in Figure 1. Again, the twisting device 11, of Figure 1 may be substituted for the friction element 33 or the friction element 33 may be used in place of the false-twist device 11 in the apparatus of Figure 1.

The following is given as an example of the way in which the apparatus of Figure 2 can be used:

Example V

A heavy continuous filament yarn of fully acetylated cellulose acetate (acetyl value 61.1% calculated as acetic acid) and consisting of 250 continuous filaments each of 4 denier associated together without twist, are drawn from the cheese 27, threaded through the guide 7 and separated into bundles of 125 filaments each, for passage round opposite sides of the waisted roller 9. After passing the waisted roller 9 the two parts are brought together and the bundle 26 is given 360 turns of twist by hand. The bundle is then threaded onwards to take-up package 34 and the operation is started, the nip rollers 21 being driven at 30 yards per minute and the driving roller 36 at 28 yards per minute. The resulting crimped yarn can be cut into staple fibres, preferably in association with other crimped yarns of the same kind, or can be used directly as a yarn, e.g. as the pile yarn in rugs and carpets or as a hand-knitting yarn.

Having described our invention, what we desired to secure by Letters Patent is:

1. Process for the crimping of textile fibres, said process comprising drawing a plurality of strands of textile fibres from a source of supply past a first point at which point said strands are associated together without twist and then past a second point spaced from said first point, twisting the strands together between said first point and said second point, separating said strands at said second point so that twist between the strands is positively prevented from passing said second point, passing said strands between said first and second points in frictional engagement with a member whereby twist between said strands can pass said member in the direction of their travel but is hindered from passing said member against their direction of travel so that twist accumulates in the zone between said member and said second point, and subjecting said strands in said zone to a setting treatment to fix in the fibres of said strands the distortion imposed on said fibres by the accumulated twist.

2. Process according to claim 1, in which the algebraic sum of the turns of twist with which the strands are associated between their source of supply and their point of separation has a non-zero value.

3. Process according to clam 2, wherein the member with which the associated strands pass in frictional contact is a non-rotating member.

4. Process according to claim 1, wherein the member with which the associated strands pass in frictional contact is a rapidly rotating false-twist spindle.

5. Process according to claim 1, wherein each of the strands is a textile yarn, said process comprising separately collecting the several yarns as they leave the point of separation.

6. Process according to claim 5, wherein each strand consists, initially and finally, of a plurality of continuous filaments twisted together.

7. Process according to claim 5, wherein each of the strands is a staple fibre yarn.

8. Process according to claim 1, wherein the strands initially constitute a single bundle of continuous filaments associated without twist.

9. Process according to claim 8, comprising separately collecting the several strands as they leave the point of separation.

10. Process according to claim 8, comprising reassociating the several strands after they leave the point of separation, to form a single bundle.

11. Process according to claim 10, comprising subjecting the bundle of crimped filaments to a cutting operation whereby the filaments are converted to staple fibres.

12. Process according to claim 1, comprising setting the temporary twist in the associated strands by the application of dry heat.

13. Apparatus for the crimping of textile fibres, said apparatus comprising in succession first guide means adapted to receive a plurality of textile strands and guide them onwards in association, a friction member spaced from said first guide means and adapted to frictionally engage the associated strands, means for setting in the strands temporary twist as between the strands, second

guide means for separating said strands from one another, said second guide means being spaced from the friction member, and means for drawing a plurality of strands in succession past said first guide means, said friction member, said setting means and said second guide means, in that order.

14. Apparatus according to claim 13 wherein the friction means is a false twist device for frictional engagement with and rotation of the associated strands.

15. Apparatus according to claim 13 wherein the friction device is a stationary friction device.

16. Apparatus according to claim 13 comprising separate winding means for the several strands leaving the separating guide.

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