May 5, 1959 W. I. HEAD 2,884,756

APPARATUS AND METHOD FOR PRODUCING BULK YARN

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Fig. 1

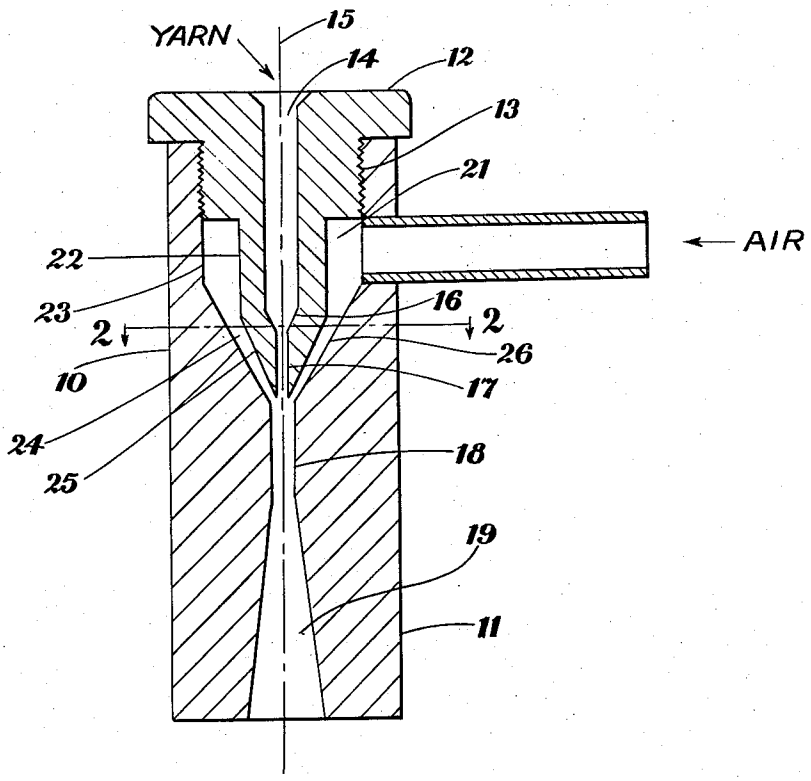


Fig. 2

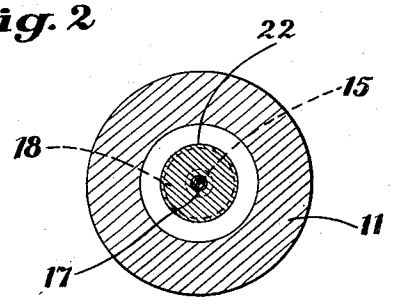


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Fig. 3

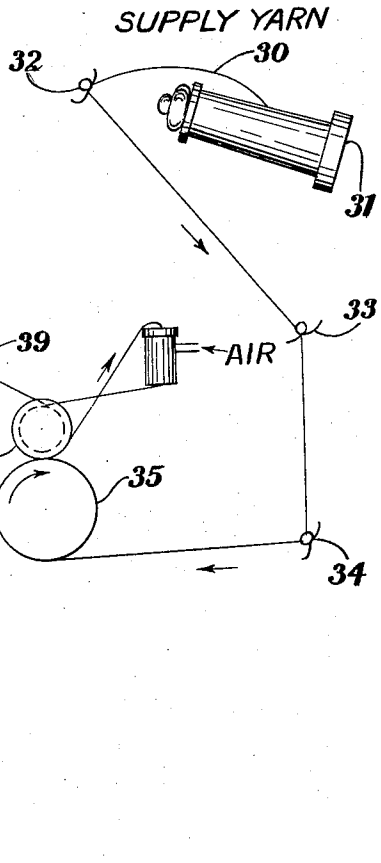



Fig. 4

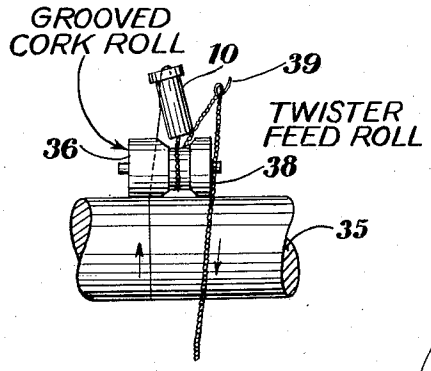
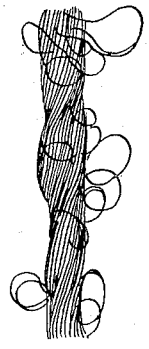



Fig. 5

Fig. 6



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2,884,756

# APPARATUS AND METHOD FOR PRODUCING BULK YARN

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Application January 12, 1953, Serial No. 330,778

13 Claims. (Cl. 57—34)

This invention relates to treatment of continuous filament yarn, and more particularly to a process adapted to impart to continuous filament yarn a bulkiness or loftiness such as is possessed by spun yarns made from cut staple fibers.

An object of this invention is to provide a process for imparting to continuous filament yarn a bulkiness or loftiness commonly possessed by spun yarns made from cut staple fibers. Another object of the invention is continuous filament yarn having a fluffed, bulky or lofty structure.

A particular object of this invention is to provide a new method of imparting bulkiness, of the type aforementioned, to cellulose organic ester yarn such as cellulose acetate and cellulose acetate propionate or cellulose acetate butyrate yarn. Still another object is to provide a new product, cellulose acetate bulk yarn. Other objects will appear hereinafter.

In accordance with the invention, these and other objects are attained by drawing under low tension a preformed continuous filament yarn continuously through a passage in an air jet device. The passage through the air jet device is of varying diameter and in one portion forms in effect a venturi tube through which air under pressure comes initially into contact with the filaments. At this point, the high velocity of the air along with the opening effect caused by the slope of the venturi causes the individual filaments of the strand to form small randomly spaced loops. This looping effect is accompanied by yarn contraction usually about 15% which is facilitated by withdrawing the yarn from the bottom of the jet at a lower linear speed than that at which it entered at the top of the jet.

For best results it is desirable that this contraction remain fixed for the production of any given run of yarn since the degree of loopiness and final yarn denier both are directly dependent upon this factor.

This invention is further illustrated in the following detailed description and drawings in which:

Fig. 1 is a sectional, elevational view of the jet device for treating continuous filament yarn;

Fig. 2 is a sectional view taken on the lines 2—2 of Fig. 1;

Fig. 3 is a schematic view of the jet device and auxiliary equipment which is employed to conduct the yarn from a supply through the jet and thence to a windup;

Fig. 4 is an end elevational view taken on the lines 3—3 of Fig. 3 showing the twister feed roll and grooved roll and the path of the yarn about these rolls.

Fig. 5 is a magnified view of the continuous filament yarn before it has been processed in accordance with my invention.

Fig. 6 is a diagrammatic illustration of my new bulk cellulose acetate yarn, such as it would appear when viewed through a low powered magnifying or reading glass.

Referring to Fig. 1 there is shown in section the jet device 10 comprising members 11 and 12 which are



threadedly engaged with each other as shown at 13. A passage 14 extends vertically through the jet device 10 and the yarn 15 is shown traveling downward through the passage 14. The passage 14 in member 12 is of substantially uniform diameter for the greater portion of its length but tapers inwardly at 16 to form a cylindrical passage 17 of constricted diameter. The yarn 15 then continues through a portion of the passage shown at 18 in member 11 which is of uniform diameter and into the outwardly flaring portion of the passage shown at 19 and thence out of the device. An annular air chamber 21 into which air under pressure is admitted through pipe 22 is located in jet device 10 between the outer cylindrical surface 22 of member 12 and the adjacent internal cylindrical surface 23 of member 11. This bottom of annular air chamber 21 opens into a throat 24 formed between the conical portion 25 of member 12, and the adjacent flared out surface of member 11. Air from chamber 12 is thus continuously directed downwardly into the venturi-like passage 18 adjacent the end of the portion of passage 17.

As apparent from the description of the jet set forth in the preceding paragraph concerning Fig. 1 and as will be further apparent from the examples and other description which follows there can be considered that there is a bulking zone present within the jet. The longitudinal axis of the zone extends generally and approximately along a line, from 14 to 19, the numerals shown in Fig. 1.

As shown in Fig. 3 continuous filament yarn 30 is continuously drawn from supply bobbin 31 and conducted through guides 32, 33 and 34 partly around roll 35 and between co-acting rollers 35 and 36, as shown more clearly in Fig. 4, which act as a snubbing device to assure an even flow of yarn at a relatively constant tension, to jet device 10 where the action of the air pressure causes the yarn to become bulky in accordance with the invention. The yarn is conducted from the bottom of the jet device 10 and once or more around the grooved portion 38 of roll 36 to prevent the yarn from slipping, thereby assuring the low yarn tension which is necessary to the formation of the small randomly spaced loops on the individual filaments. The difference in diameter between roll 36 and its grooved portion 38 permits the yarn to enter the jet at a greater linear speed than the subsequent take-up of the yarn after processing in the jet. This differential in speed between the yarn entering the jet and the yarn leaving the jet provides the amount of compensation for the reduction in length of the yarn during the formation of the randomly spaced loops in the individual filaments. The processed yarn then passes through guides 39 and 40 to bobbin 41 on which it is suitably wound by conventional means not shown. It will be understood that the various rolls and bobbins may be rotated by conventional apparatus well known in the art.

The invention will be further illustrated in the following example.

*Example 1*

A 300 denier, 75 filament cellulose acetate yarn 30 with a twist of 0.5 turns is threaded through the device from bobbin 31 as shown in Figs. 3 and 4 and continuously drawn through the apparatus and wound onto bobbin 41. Roll 35 has a surface speed of 25.00 yards per minute, while the grooved portion 38 of roll 36 has a surface speed of 21.25 yards per minute, thus permitting a contraction of 15% in the length of the yarn after it enters air jet device 10. During this run, air was supplied to air jet device 10 at 8 pounds per square inch. It is desirable as shown in Fig. 3 that the yarn leave the bottom of air jet device 10 at almost a 90° angle. This will prevent prolonged exposure of the yarn to the air

stream which causes unnecessary tension which prevents proper looping inside the air jet device.

Superior results have been obtained with five or six turns of twist for 300 denier yarn. Low twist allows the loops to be pulled out, thus contributing to irregular and low breaking strength, while too-high twist causes unnecessary shearing which also contributes to low breaking strength. For lower deniers or higher numbers of filaments, the optimum twist increases slightly. The process works well with 300 denier, 75 filament yarn, but lower deniers may be bulked satisfactorily if the denier per filament is kept low enough to insure a sufficient number of filaments for looping and binding. Also higher numbers of filaments may be used with the 300 denier yarn. Generally, the greater the number of filaments with any given denier yarn, the softer and bulkier will be the finished product. This is accompanied by some loss in strength and stretch. Good results have been obtained under operating conditions as recited in Example 1 with 300 denier—104 filament, 300 denier—75 filament, 200 denier—68 filament and 100 denier—34 filament yarns.

The bulked yarn is preferably twisted to 5.5 twists per inch as it is collected on bobbin 41 by a conventional twisting apparatus, not shown in the drawing. Typical test results on a 300 denier, 75 filament cellulose acetate yarn with initial spun twist of 0.5 turn which has been processed in accordance with the procedure described in Example 1 are shown in the following table in comparison with the supply yarn and regular spun staple yarn.

| | Twist | Denier | Dry Suter, S.S. | |
|---|---|---|---|---|
| | | | g./d. | Percent stretch |
| Supply yarn | 0.5 | 300 | 1.30 | 28.0 |
| Bulked yarn | 5.5 | 345 | .90 | 22.0 |
| Spun staple | 14.0 | 333 | .82 | 20.0 |

In operating the air jet device, I have found that from 7 to 12 pounds per square inch is sufficient when employing a venturi throat of ⅛ inch diameter or less. As this dimension is decreased, the air pressure required is also decreased. Filtered air should be used for best results, since any condensation or trash in the air tends to interfere with the bulking action.

As already indicated above and as shown in Figs. 3 and 4 of the drawing, I prefer to remove the bulked yarn from the bottom of the jet at a rather abrupt angle such as at approximately a 90° angle. Also as shown in the drawing, I prefer to feed the yarn into the jet at a similar abrupt angle. It will be further noted that the jet is positioned in relatively close proximity to the feed and take-up roller having the common drive and that the air is fed to the jet on the side thereof.

The resulting product comprises continuous lengths of multiple filament yarn which has the appearance of a wool-like, bulky yarn with substantially no broken filaments. This product is depicted in Fig. 6 of the drawing in which the loopiness and bulky characteristics of the yarn structure is emphasized.

I claim:

1. In apparatus for making bulky continuous filament yarn which comprises a jet adapted to create a zone wherein the yarn is bulked, means for supplying a gas to said jet, means for feeding yarn continuously through said zone, means for withdrawing the bulk yarn from said zone, the apparatus being characterized in that the means for feeding and the means for taking up the yarn are comprised of two coacting rollers in rotative contact, and one of said rollers having a reduced periphery portion and positioned so that the yarn leaving the jet passes in contact with said reduced periphery portion the apparatus being further characterized in that the rollers aforesaid are located in close proximity to the jet.

2. The apparatus in accordance with claim 1 wherein the roller having a reduced periphery portion is a grooved roller.

3. The apparatus in accordance with claim 1 wherein with respect to said coacting rollers in rotative contact, the jet is positioned so that the yarn emerging from the jet to said rollers is at approximately a right angle to said jet.

4. An apparatus for making bulky continuous filament yarn which comprises a jet adapted to create a zone wherein the yarn is bulked, means adapted to supply air to said jet, roll means for feeding yarn continuously through said zone and for withdrawing the bulked yarn from said zone, said roll means including a reduced periphery portion and an unreduced periphery portion, both of said roll portions being directly associated with a common drive so that the rate of rotation of the reduced periphery portion with respect to the other portion is always constant, the roll means being positioned in such proximity to the jet that the yarn to be bulked enters the jet with approximately a right angle bend and leaves the jet with approximately a right angle bend, the direction of yarn movement being turned approximately 180 degrees in a plane.

5. Apparatus in accordance with claim 4 wherein the yarn enters the jet from the unreduced roll portion and leaves the jet around the reduced roll portion.

6. The method of making a more uniform bulky continuous filament yarn which comprises feeding a continuous multi-filament yarn to be bulked into a bulking zone wherein the bulking takes place, said feed being at a predetermined rate and the yarn being introduced into the zone at about a right angle bend to the longitudinal axis of the zone, bulking the yarn thus fed into the bulking zone, withdrawing the bulked yarn from the zone at about a right angle bend to the longitudinal axis of the zone, the direction of the yarn withdrawal being turned about 180 degrees in a plane, the yarn withdrawal being at a lower rate than the predetermined rate of feed, the lower rate of withdrawal with respect to the predetermined rate of feed being maintained uniform and constant.

7. The method in accordance with claim 6 wherein the uniform and constant rate is obtained by driving the feed and withdrawal with the same drive.

8. An apparatus for making bulky yarn which comprises a jet adapted to receive the yarn into one end of the jet and to discharge yarn from the other end thereof, said jet being adapted to create a zone within the jet wherein the yarn is bulked, means associated with the jet for supplying air to the side thereof, roll means for feeding yarn through said zone and for withdrawing the bulk yarn from said zone, said roll means including a reduced periphery portion and an unreduced periphery portion, both of said roll portions being directly connected together in a fixed relationship and carried on a common shaft so that the rate of rotation of the reduced periphery portion with respect to the other portion is always constant, the roll means and jet being located in relatively close proximity and positioned so that the yarn to be bulked passes from the roll means into the end of the jet at a relatively abrupt angle and the bulked yarn leaves the jet at a relatively abrupt angle and passes to the roll means.

9. An apparatus in accordance with claim 8 wherein the difference in diameter between the reduced periphery portion and the unreduced periphery portion is sufficient to permit at least a 15% contraction in the yarn being bulked.

10. An improved method of making bulky yarn which comprises feeding a multifilament yarn to be bulked into a bulking zone wherein the bulking takes place, said feed being at a predetermined rate and the yarn being fed into the zone at a relatively abrupt angle to the longitudinal axis of the zone, supplying air to the side of the zone for bulking said yarn, withdrawing the bulked yarn from the zone at a relatively abrupt angle to the longitudinal axis of the zone, the yarn withdrawal being at a lower rate

than the predetermined rate of feed, the lower rate of withdrawal with respect to the predetermined rate of feed being maintained substantially uniform and constant.

11. The method in accordance with claim 10 wherein improved introduction into and withdrawal of the yarn from the bulking zone is accomplished by passing the yarn over the unreduced periphery of roll means and withdrawing the bulk yarn over a reduced periphery portion of the same roll means, said periphery portions being directly connected together and carried on a common shaft.

12. An apparatus for making bulky continuous filament yarn which comprises a jet adapted to create a zone wherein the yarn is bulked, means adapted to supply air to said jet, roll means for feeding yarn continuously through said zone and for withdrawing the bulked yarn from said zone, said roll means including a reduced periphery portion and an unreduced periphery portion, both of said roll portions being directly associated with a common drive so that the rate of rotation of the reduced periphery portion with respect to the other portion is always constant, the roll means and the jet being located in relatively close proximity and positioned so that the yarn to be bulked passes from the roll means into the jet at a relatively abrupt angle and the bulk yarn leaves the jet at a relatively abrupt angle and passes to the roll means.

13. The method of making a more uniform bulky continuous filament yarn which comprises feeding a continuous multifilament yarn to be bulked into a bulking zone wherein the bulking takes place, said feed being at a predetermined rate and the yarn being fed into the zone at a relatively abrupt angle to the longitudinal axis of the zone, bulking the yarn thus fed into the bulking zone, withdrawing the bulked yarn from the zone at a relatively abrupt angle to the longitudinal axis of the zone, the yarn withdrawal being at a lower rate than the predetermined rate of feed, the lower rate of withdrawal with respect to the predetermined rate of feed being maintained substantially uniform and constant.




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