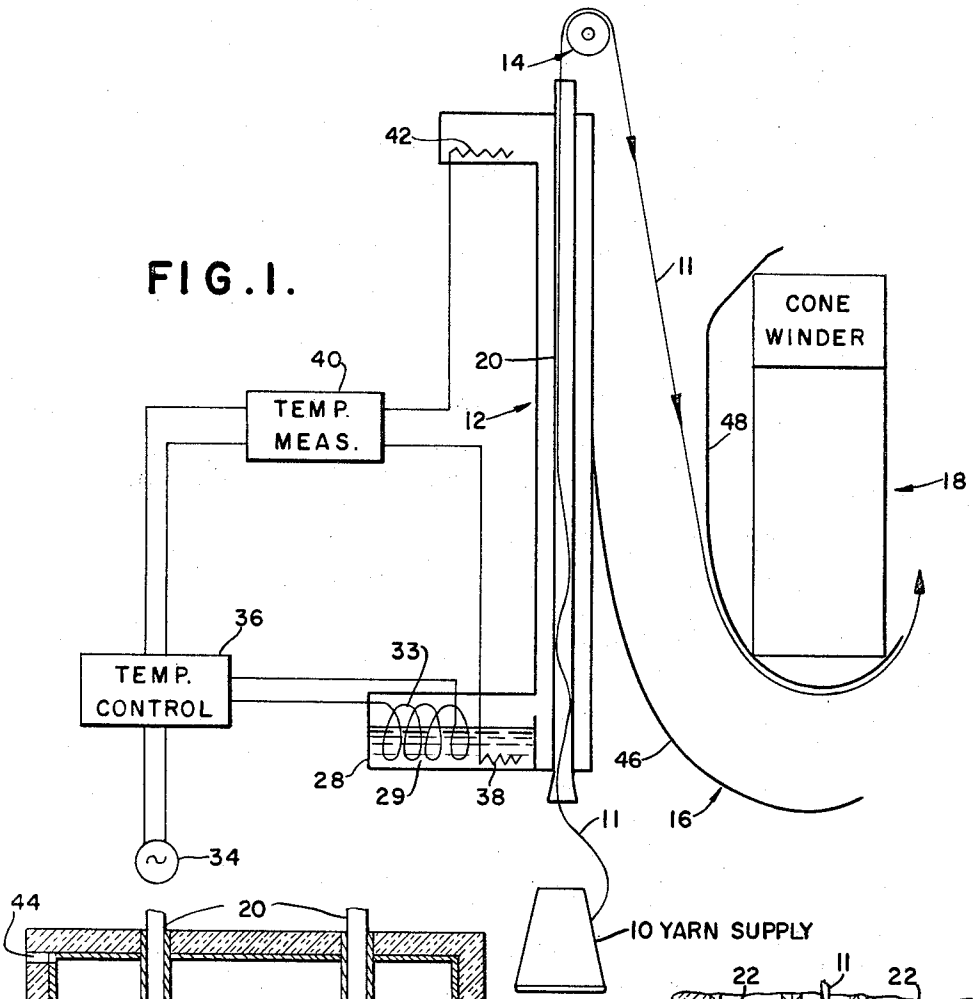
April 30, 1968 M. McKEW 3,380,132

APPARATUS FOR PRODUCTION OF BULKED YARN

Filed Jan. 12, 1966

FIG. 1.



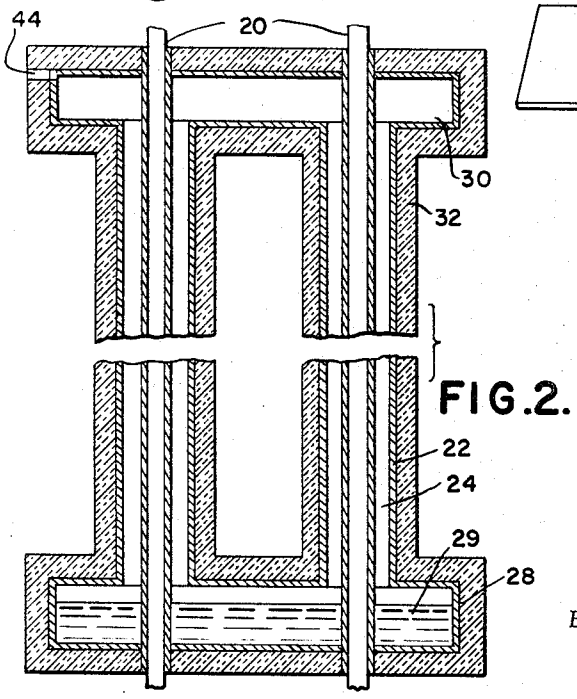


FIG. 2.

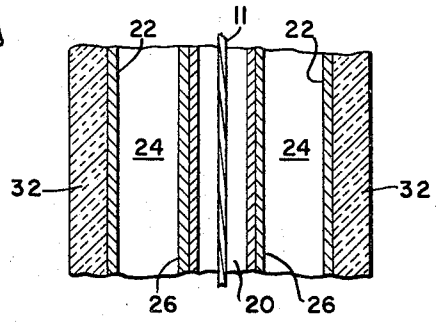


FIG. 3.

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APPARATUS FOR PRODUCTION OF BULKED YARN

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ABSTRACT OF THE DISCLOSURE

A heating tube assembly which is arranged above a yarn supply. The yarn is passed through the heating tube assembly from which it is dropped into a scray for cooling. The cooled yarn is then withdrawn from the scray and passed onto a winding machine or the like from which the bulked yarn may be taken, the heating and cooling taking place while the yarn is in a substantially tensionless condition.

The present invention relates generally to the bulking of yarns, and, more particularly, to the continuous bulking of staple fiber yarns.

It has been found that in order to provide a yarn with a softer appearance and fluffiness, a bulking of such yarn is required. Previously, for staple fiber yarns, bulking was carried out in batches in the conventional batch-skein method. In the batch method the batches are processed in a kier. However, in the batch method, the bulking of the yarns is not uniform in that different batches produce yarns bulked to varying degrees. The prior processes for producing bulked staple fiber yarns suffer from other disadvantages in that the bulked yarn is not evenly relaxed, nor is there a standardization of size. Also, after the bulking of such yarn the yarn contains 1% to 8% of residual shrinkage which generally appears when the yarn is processed in subsequent operations, such as dyeing.

It should be noted that in the batch-skein method which was used previously the skeins were hung from pins and these pins interfered with shrinkage since it was observed that the shrinking which occurred on the portion of the skeins which contacted the pins was different from that of the remainder of the skeins. Furthermore, since the skeins were hanging, moisture would collect at the bottom of the skeins and interfere with proper shrinkage. When the skeins are arranged to lie flat in order to overcome this disadvantage, the surface on which the skeins rest interferes with the uniform heat penetration so that again uniform shrinkage is not obtained.

It is to be noted that there is a difference between bulking and crimping. In a bulking process there is more thickness or bulk to the yarn, that is, it is of a larger diameter. More air space is provided in the bulking process whereas in crimping the fibers are merely bent in order to provide that they interlock better because of increased interfiber friction. Crimping can not have as controlled an effect as bulking and the shrinkage of a crimped yarn is not as uniform. Thus, bulking provides a soft textured yarn.

In the prior art, methods and apparatus for the continuous bulking of continuous filament yarns have been commercially successful. Generally, these prior art arrangements include a feed means having a limited pay out for feeding the yarn to a heating zone with the shrinkage of the yarn being determined by the pay out. However, with a staple fiber yarn, other factors must be taken into consideration and a continuous bulking of such yarns has heretofore been unobtainable on a commercial scale.

With this in mind, it is an object of the present invention to provide a method and apparatus for the continuous bulking of staple fiber yarns.

Another object of the present invention is to provide a bulked yarn which has been uniformly shrunk to provide for a standardization of size in garments made of such yarn.

It is a further object of the present invention to provide for the production of a bulked yarn having a relatively small amount of residual shrinkage.

These objects and others ancillary thereto are accomplished in accordance with preferred embodiments of the present invention, wherein the method includes the continuous shrinking of yarn while in a tensionless condition, so that the yarn returns to its normal state and produces a bulked effect.

The apparatus according to the present invention includes a heating tube assembly which is arranged above a yarn supply. The yarn is passed through the heating tube assembly from which it is dropped into a scray for cooling. The cooled yarn is then withdrawn from the scray and passed onto a winding machine or the like from which the bulked yarn may be taken.

Additional objects and advantages of the present invention will become apparent upon consideration of the following description when taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a schematic view of the arrangement comprising the present invention.

FIGURE 2 is a detailed sectional view of the heating tube assembly.

FIGURE 3 is an enlarged fragmentary sectional view taken vertically through the heating tube.

Referring now to the drawings, there is shown in FIGURE 1 a creeling arrangement **10** positioned below a heating tube assembly **12** through which a pre-stretched yarn **11** from the yarn supply at the creel **10** passes. A frictionless or free-running roller assembly **14** is positioned above the outlet of the heating assembly and guides the yarn as it passes upwardly from the heating assembly. A scray **16** is positioned below the roller assembly **14** and is laterally spaced from the heating tube. The scray receives the heated yarn as it passes from the roller and provides a cooling zone for the yarn. A machine **18** which may, for example, be a cone winder, is positioned behind the scray and withdraws the cooled bulked yarn from the scray and packages the yarn for further processing or the like. According to the present invention, the yarn is processed in a substantially tensionless condition from its movement off creel **10** until it is finally wound by the subsequent cone winder **18**. It should be noted that the yarn may be fed from the creel at any desired rate of speed, for example, the subsequent assembly, pulls the yarn off the package as needed and thus the feeding speed of the yarn is always proper.

As shown, the heating tube assembly **12** comprises a vertically oriented tube **20** which may, for example, be 6 feet in height and through which the yarn **11**, for example, a pre-stretched acrylic yarn such as orlon, passes upwardly. The guide tube **20** is preferably constructed of a material which is a good heat conductor and the tube is surrounded by a heating jacket **22** so that a chamber **24** is formed between the tube **20** and the outer wall of the jacket **22**, as shown in FIGURES 2 and 3. As further shown in FIGURE 3, the heating jacket includes an inner wall **26** which is in intimate surface-to-surface contact with the tube **20**.

The heating assembly **12** is also provided with a boiler **28** disposed at the lower end of the chamber **24** and in communication therewith. The boiler contains water **29** which is heated to form steam that rises into the chamber **24** to thereby heat the inner wall **26** and tube **20** through which the yarn passes. As shown, an accumulation chamber **30** is provided at the upper end of the chamber **24** into which the steam passes and sometimes condenses into water. The accumulation chamber is provided

with a bleed valve **44** which may be manually opened to permit the removal of the water accumulated therein. The water formed in the chamber **30** causes a cooling and a reduction in the desired temperature of the heating arrangement and may be removed from the accumulator by simply opening the valve and allowing the pressure of the steam to force it from the accumulator. The heating assembly further comprises an asbestos lining **32** which surrounds and insulates the entire heating assembly so as to prevent the escape of heat therefrom. As shown in FIGURE 2, a plurality of heating tubes may be provided for simultaneously processing a plurality of yarns, with a common boiler and accumulation chamber communicating with each of the tubes.

The boiler **28** also contains electric heating coils **33** for heating the water to form steam for the heating tube. The coils are connected to a source of electrical energy **34** via a temperature controlling means **36** which selectively connects the heating coils to the energy source. A temperature sensing transducer **38** is provided within the boiler and is connected with a temperature measuring arrangement **40**. If desired, a further temperature sensiing transducer **42** may be provided in the accumulation chamber **30** in order to assure that the temperature at the upper end of the tube is identical or not significantly below that at the boiler. The transducers **38** and **42** are connected to the temperature measuring arrangement **40** to thereby give an indication of the temperature provided throughout the heating assembly **12**. The temperature controlling means **36** may also be interconnected with the temperature measuring device **40**, so that when the temperature measuring device senses that the temperature in the heating arrangement is higher than is desired, the heating coils are de-energized by the control means **34** whereas when the temperature measuring device senses that the temperature is too low, the heating coils are energized so as to provide more steam. Accordingly, as the yarn **11** passes upwardly from the heating tube **20**, it contacts the free-running guide pulley or roller **14** which is positioned directly above and closely adjacent to the upper end of tube **20** and forms a vertical tangent with this roller. The yarn **11** is then passed over the roller and allowed to drop down into a scray **16** where it cools. The scray includes a J-shaped back plate **46** and an upper plate **48** which serves as a protective shield for the subsequent winding machine **18**. The yarn passes between the two plates and is allowed to cool and set while in the scray. The lower portion of the scray and that of the J-shaped plate is positioned at a distance from the roller **14** corresponding to at least the height of the heating arrangement **12** and is preferably positioned at a somewhat greater distance. After the yarn **11** has cooled and set while in the scray it is withdrawn therefrom by the machine **18** wherein the yarn can be tensioned and processed in the conventional manner.

The yarn is processed in a substantially tensionless condition with the feeding of the yarn being provided by pulling the yarn at the machine **18**. This pull is transmitted to the free-running guide roller **14** which, as it turns, draws the yarn upwarly through the tube **20** causing the yarn to unwind from the yarn supply. As the pre-stretched yarn passes upwardly, it is heated by dry heat and since it is in a tensionless condition, the yarn shrinks toward its normal state and in an extremely uniform manner. It should be noted that when the yarn passes through the heating tube assembly **12**, the yarn does not intentionally come into contact with any of the physical elements therein. Naturally some contact will occur, but this will not disturb the proper operation. The yarn which passes outwardly from the tube **20** is still hot and since the roller **14** is free running, there will be little tension or friction between the yarn and the guide which the roller forms. The yarn then drops down into the scray **16** where it is allowed to cool and set in its bulked state. By the time the yarn reaches the subsequent machinery, it has already cooled and set so that it can be processed in the usual manner.

It should be noted that a yarn to be processed in accordance withe the present invention could be first crimped if this is desired. The distinction between crimping and bulking as mentioned above should be noted and the purpose also is frequently different, the crimping being used to provide interfiber friction whereas the bulking is used for giving bulkiness and softness to the yarn. In order to bulk the yarn it must first be stretched and this may be accomplished on a Turbo machine which stretches the yarn and heat-sets it in the stretched condition and for example a temperature of 240° F. may be used. Then, this tow is converted into staple form, for example, on a Pacific Converter. Next, the yarn is processed in the normal, conventional manner by being placed onto spinning frames or the like. Then, the yarn, preferably, in packaged form would be processed by the apparatus of the present invention so that the bulking process could be carried out.

In the example mentioned above where the Turbo machine used a temperature of 240° F., a temperature of 500° F. would be provided in the heating device of the present invention, for example with a two-ply orlon yarn passing through the device at a speed of about 125 yards per minute. A two-ply 33 count yarn for example could be fed from the yarn supply (worsted count) and a two-ply 28 count yarn would be delivered, the coarser yarn being provided because of the bulking process.

The present invention can also be used to only partially shrink the yarn and the remainder of stretch can be removed during a subsequent dyeing operation. This procedure, however, could only be used if there is uniform shrinking. Since the shrinking will be uniform if the prestretching has been performed uniformly when this procedure is used, it is necessary that the stretching be performed in a uniform manner. For example a size 12 garment can be knit which would be allowed to shrink to a size 11 during dyeing. It should be noted that the relationship between speed or time and heat for proper shrinkage is an empirical one. If a lesser amount of heat is used and the speed is made less, then this would be the equivalent of having a greater heat and a faster speed. Thus, it is the speed and heat relationship taken together which determines how much shrinkage will occur.

In order to test the amount of shrinkage which has occurred, in one of the standard tests, such as the test described in Dupont Technical Information Bulletin OR–85, the yarn will be completely shrunk, that is, shrunk as much as possible so that there is no pre-stretch remaining. In the standard test it has been found that the measured results of shrinkage which has not been removed in the yarn when the batch or kier methods were used has been 1% to 8%. That is, when tested the yarns shrunk from 1% to 8% whereas in the method in accordance with the present invention the largest measured amount was 1%.

This to a large extent is accounted for by the fact that in the present invention the shrinkage occurs in a completely tensionless condition. For example, in the apparatus specifically disclosed above the subsequent machine for example the cone winder pulls the yarn and is the only yarn moving means used so as to provide as little tension as possible. Actually the winder tugs the yarn and this pulls the yarn against the bottom of the shield **48**. The yarn rolls over pulley **14** which continues turning and this turning pulls the yarn up from the supply **10**. As roller **14** appears to be slowing down it is pulled again and this takes place continuously. The slight tugs which pull the yarn off the package do not provide sufficient tension so as to be disturbing or create nonuniformities.

The bulking of yarn in accordance with the present invention is performed on a pre-stretched yarn which, in many cases has been pre-stretched in a nonuniform manner. However, this nonuniformity will not affect the shrink-

age or uniformity of the bulking in that the pre-stretched yarn can be freely shrunk to its original state. The bulked yarn produced according to the present invention may, if desired, be shrunk to the maximum extent in which condition it will have a residual shrinkage which is generally less than 1%.

It has been found that with all other conditions being equal yarns produced in accordance with the present invention when dyed have a clearer and less muddy color than other yarns not so produced. Also, when the yarns are to remain white, and they are scoured and bleached, the yarns come out whiter when tested by a Whiteness Tester such as the one made by Hunter Laboratory, McLean, Va. Furthermore, when such yarns are used to knit socks, for example, where there is plaiting using 30% nylon yarn on the inside and 70% bulked orlon on the outside, it has been found that the nylon does not grin through and this can be attributed to the more uniform bulking provided by the present invention.

It will be understood that the above description of the present invention is susceptible to various modifications, changes, and adaptations, and the same are intended to be comprehended within the meaning and range of equivalents of the appended claims.

What is claimed is:

1. Apparatus for the continuous bulking of yarns, comprising, in combination:

heating means having guide tube means through which the yarn may pass in a substantially tensionless condition so that the yarn passing therethrough is continuously shrunk;

scray means positioned below said heating means for receiving the yarn in a substantially tensionless condition as it passes therefrom for allowing the yarn to cool and set while within said scray means; and

means for feeding the yarn through said heating means and into said scray means in a substantailly tensionless condition.

2. Apparatus as defined in claim 1 wherein said heating means is arranged to subject the yarn to dry heat and completely surrounds the yarn during its entire passage therethrough.

3. Apparatus as defined in claim 1 wherein said feeding means are free of friction producing elements between the supply of yarn and the heating means.

4. Apparatus for the continuous bulking of staple fiber yarns comprising, in combination:

a heating arrangement having a vertically oriented guide tube means through which the yarn may pass upwardly in a substantially tensionless condition so that the yarn passing therethrough is continuously shrunk;

free-running roller means disposed above the outlet of said heating arrangement for receiving the heated yarn as it passes upwardly from the heating arrangement and over said roller means; and

scray means being positioned below said roller and spaced laterally from said heating arrangement for receiving the yarn in a substantially tensionless condition as it passes from said free-running roller means for allowing the yarn to cool and set while within said scray means.

5. Apparatus as defined in claim 4 comprising means disposed adjacent to the outlet of said scray means for withdrawing the formed bulk from the scray means.

6. Apparatus as defined in claim 5 comprising supply means disposed below said tube means for delivering a prestretched staple yarn thereto.

7. Apparatus as defined in claim 5 wherein said heating arrangement further comprises a heating jacket in the form of a double-walled tube which surrounds said guide tube means with the inner wall being disposed adjacent to and in contact with said guide tube means and the outer wall being spaced from said inner wall to form a chamber therebetween, boiler means disposed at the lower end of said heating tube arrangement and in communication with said chamber for passing steam through said chamber, an accumulation chamber disposed at the upper end of the heating tube arrangement and in communication with said steam chamber for accumulating any steam which has condensed to water, a valve connected to said accumulation chamber for withdrawing the water therefrom, and insulation means surrounding said heating tube arrangement for preventing the escape of heat therefrom.

8. Apparatus as defined in claim 7 wherein said boiler is provided with heating coils and further including a first temperature sensing means disposed within said boiler, a second temperature sensing means disposed within said accumulation chamber, said first and second temperature sensing means being connected to a temperature measuring means for indicating the temperature within the heating arrangement, and a temperature control means connected to said heating coils for connecting a source of electric energy thereto, said temperature control means being connected to said temperature measuring means for connecting said source of energy to said heating coils to activate said coils in response to said temperature measuring means when the temperature in the heating tube arrangement is below a predetermined temperature and to de-activate said heating coils by disconnecting the electric energy connected thereto in response to said temperature measuring means when the temperature in the heating tube arrangement is above a predetermined level.

9. Apparatus as defined in claim 8 wherein the lower portion of said scray means is spaced a vertical distance from said free-running roller means corresponding to at least the height of said heating tube arrangement, and said scray means comprises a lower J-shaped plate onto which said yarn is dropped and an upper plate which serves as a protective shield for said withdrawal means to keep said yarn from being drawn into said means at points other than the inlet therefor.

10. Apparatus as defined in claim 9 wherein said withdrawal means is a cone winder.

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