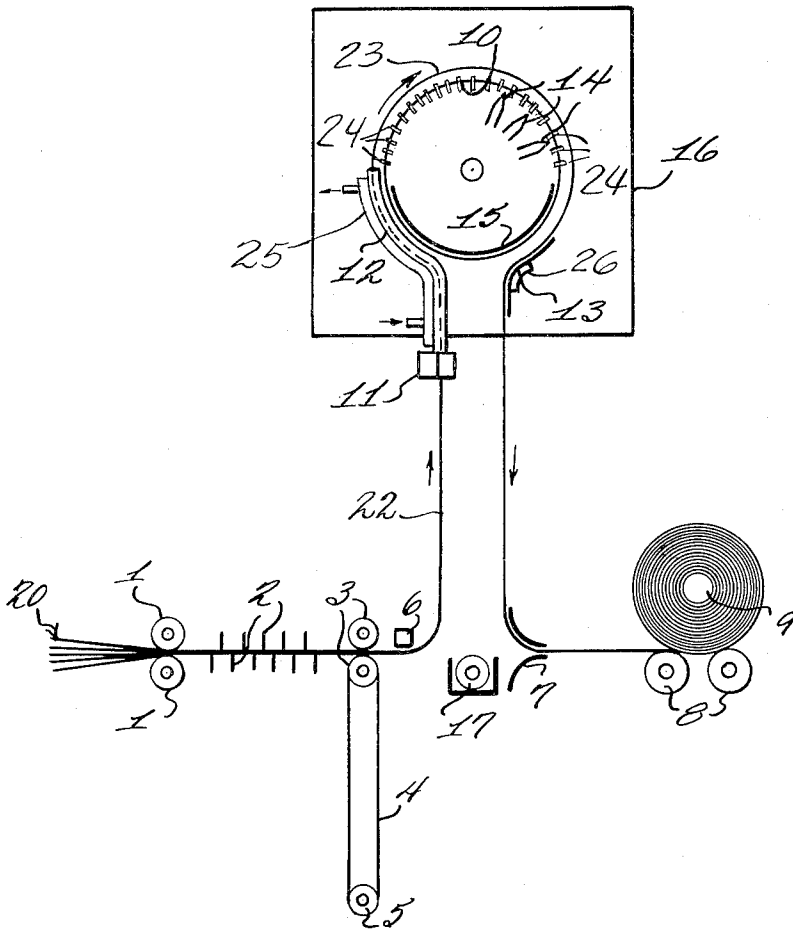


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METHOD AND APPARATUS FOR TREATING SLIVERS
OF WOOL OR OTHER FIBERS
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METHOD AND APPARATUS FOR TREATING SLIVERS OF WOOL OR OTHER FIBERS

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The present invention relates to a continuous method of and apparatus for treating one or more slivers of textile fibers, e.g., wool top, with steam, air and/or other gases to obtain rapid stress relaxation or strain recovery of the fibers. In this connection, the term "sliver" is used herein with its normal meaning in the art, referring to a strand of approximately parallel fibers.

In one important aspect, the invention is concerned with a method and apparatus for continuously aging wool top or like textile slivers in an accelerated fashion so as to obtain an aged product having optimum working characteristics. The invention is of especial importance when applied to wool tops but other textile materials may also be advantageously treated in the manner described herein.

It will be understood from the present disclosure that the term "aging" as used herein relates to operations which are intended primarily to effect relaxation of crimp-recovery stresses in the fibers being processed. This is to be differentiated from "conditioning" which, as understood in the art, is principally concerned with restoring or changing the moisture content of material being processed.

Much effort has been expended in the past towards effectively aging wool and other textiles, so as to improve drawing and spinning characteristics or other properties. However, there is still considerable room for improvement in this area. This is especially true in the case of wool aging where conventional practices are time consuming, discontinuous and costly. Thus, an important object of the invention is to provide certain improvements in the aging or stress relaxation of wool slivers or other like fiber assemblies whereby prior difficulties are obviated. A more specific object of the invention is to provide an accelerated aging process whereby wool slivers may be continuously, efficiently and economically aged. Still another object is the provision of a novel aging process and apparatus which gives an aged product having optimum characteristics, e.g. improved spinning performance when compared with conventionally aged products. Still another object of the invention is to provide a new and unique way of effecting controlled strain recovery in slivers of textile fibers using heat and moisture. Other objects will also be hereinafter apparent.

In accordance with the invention, a sliver (or slivers) of wool or other fibers is treated in a continuous manner at the entry to, or delivery from, a machine, which may be a conventional textile processing machine such as a card, gillbox or combing machine, the sliver being passed through apparatus in which steam, air or other gas is forced through the sliver so as to change the temperature and/or moisture content of the fibers, and being thereafter passed to an appropriate sliver storage unit, which may be a normal type of ball package or a sliver can or a continuous-type storage unit, and there stored in a hot and/or moist condition for a period which may be several hours during which period stress relaxation or strain recovery takes place depending on the tension applied to the sliver when entering the storage unit and retained during storage. During storage, or at the completion of the storage period, heat and/or moisture is lost to the surrounding atmosphere gradually, or it is rapidly re-

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moved, so that when the sliver passes from the storage unit to the next process the fibers remain in a configuration and at a strain level approaching that which they had during storage.

As applied to the aging of a previously combed sliver of wool top or the like, the present process involves the application of heat and moisture, e.g. steam and/or hot moist air, to the sliver under low tension, after which the fibers therein are held at a low crimp level whereby rapid stress relaxation is achieved in a low crimp state. One way of accomplishing this, as discussed in more detail below, is to pass steam and/or hot moist air through the combed sliver and then wind the thus treated sliver into a ball under sufficient tension to remove a considerable proportion, e.g. two thirds of the crimp in the fibers. The resulting hot moist balls may then be allowed to cool at ambient temperature for a few hours, e.g. 2-4 hours. The resulting sliver has many of the characteristics of a normally aged sliver, and may have even superior spinning and other properties, depending on the adjustment of variables in the process.

In order that the nature of the invention may be more fully understood an embodiment of the invention suitable for aging wool top sliver or the like is hereinafter described in detail by way of example. In this particular example, rapid stress relaxation of fibers held at a low crimp level in a wool top sliver is obtained by means of an attachment to a top finishing gillbox as shown in the accompanying diagrammatic drawing.

Referring more specifically to the drawing, the numerals 1 to 9 represent elements of one type of conventional gillbox. Thus, the sliver 20, e.g. oiled and combed wool top sliver, is fed by a pair of back rollers 1 into faller bars 2, the latter conveying the fibers to the front drafting rollers 3 as known in the art. The bottom front drafting roller 3 is advantageously covered by a leather apron 4 tensioned by the roller 5.

In operating the gillbox conventionally, the drafted fibers normally pass from the front rollers 3 under a guide and stop-motion bar 6 and then through a reversing funnel 7 to the ball winding rollers 8 which rotate and reciprocate axially to wind the sliver into a cross-wound cylindrical package or ball. The ball is formed on a cylindrical wooden or metal core or arbor 9 which is normally removed from the top ball when the ball is doffed.

Parts 10 to 16 represent elements added to the conventional gillbox as described in order to carry out the accelerated aging or stress relaxation process of the present invention. Thus, part 10 is a cylindrical element, such as a drum or wheel, which conveys the sliver through the system in the direction shown by the arrows. The cylindrical surface of element 10, referred to hereinafter as a drum for convenience, comprises perforated metal so that air and/or steam can be passed radially inwards or outwards through the surface and also through the sliver positioned thereon. The drum 10 is appropriately driven as discussed later on so that its surface speed is approximately equal to that of the front rollers 3. However, the exact speed of the drum is adjusted so that the sliver between the front rollers 3 and the drum 10 is maintained under a constant low tension.

Part 11 is a sliver guide which forms the broad sliver 22 emerging from the front rollers 3 into a narrower sliver 23. This narrowing of the sliver reduces the area of contact with the drum and makes the sliver more coherent to thereby facilitate subsequent removal of the sliver from the drum. The narrowed sliver 23, usually about 1-1½ inches wide compared to 6 inches before narrowing, passes from the guide 11 to the curved guide 12 which leads the sliver onto the surface of the drum 10 while the guide 13 leads the sliver off the drum. Both the guides 12 and

13 are heated by steam pipes or steam jackets 25 and 26 respectively, attached to their under-surfaces to prevent condensation of moisture on their surfaces and thus avoid the adherence of fibers thereto and roughening of the sliver in the guides. The heating of guide 12 also serves to preheat the sliver before it reaches the drum thus reducing the cooling effect of the sliver on the drum itself. Advantageously, the guides 12 and 13 are U-shaped in cross-section, so as to prevent the narrow sliver from spreading out sideways.

Inside the drum 10 are one or more stationary steam nozzles 14 from which low pressure steam (e.g. saturated steam at 1-3 p.s.i.g.) emerges to pass through the perforated surface of the drum and through the sliver on the drum surface. The system may also be provided with an appropriate fan (not shown) arranged to circulate air either radially inwards or outwards through the perforated drum surface and the sliver on the drum surface. It will be recognized that the flow of air, if used, and steam should be sufficiently low that the sliver is not lifted off the surface of the drum. A baffle plate 15 may also be positioned inside drum 10 to prevent or minimize air from the fan passing through the portion of the perforated drum surface not covered by the sliver.

The drum 10 is enclosed in a box or compartment 16 which retains the hot humid air in the fan circulating system. The box 16 may be made of any suitable material, e.g. sheet aluminum on a supporting frame. Advantageously, the box is provided with hinged doors (not shown) at the front and back to give access to the drum. Means (not shown) may also be provided in the floor of the box to drain off condensate. Advantageously, the box is bolted or otherwise fixed to a part of the gillbox frame.

Typically, drum 10 may be 18 inches in diameter with a perforated cylindrical surface of the order of 4 inches in width. The drum may be driven by suitable chain and sprocket means (not shown) operatively associated with the standard conditioning roller 17 of the gillbox.

To obtain the desired crimp-reducing or crimp-removing tension of the sliver between the reversing funnel or trumpet 7 and the balling rollers 8, suitable adjustable means (not shown) may be associated with the funnel 7 to restrict the passage of the sliver through the funnel. These means may comprise an appropriately shaped compression block positioned within the funnel passage and appropriately adjustable to vary the size of the passage by tension spring means, on the top outside surface of the funnel. As noted, the purpose of such an attachment to funnel 7 is to allow the necessary tension to be developed in the sliver between the funnel and the balling rollers 8 so as to reduce the crimp level to that desired in the ball without imparting excessive tension to the portion of the sliver between the guide 13 and the funnel 7.

It will be recognized that the degree of stress relaxation or degree of fiber crimp retained in the fiber after treatment depends on a variety of operating conditions which may be appropriately selected to accomplish the desired result. These conditions include such factors as (1) the time of treatment in the hot and moist atmosphere; (2) the thickness and shape of the sliver; (3) the degree of heat and moisture applied; (4) the heat and moisture retained by the sliver when it is wound onto the ball; (5) the sliver tension as it is wound onto the ball; and (6) the conditions of storage of the ball before use in the next process, particularly time, temperature and humidity. Obviously, these conditions can be widely varied but, as a typical illustration, the temperature within the box 16 may be in the range of 70°-90° C. using sufficient steam from a desirably low pressure (e.g. 1-3 p.s.i.g.) to keep the air circulating within the box sufficiently saturated at all times. With a temperature of about 80° C. in the box or on the drum surface, the sliver temperature leaving the box may be in the range of 55-65° C. A time of treatment on the drum in the order of one to two seconds is usually suffi-

cient and the moisture regain of the emerging sliver, if it is wool, may be about 12 to 18%. A sliver of 64s Noble combed wool top (3 oz./5 yds.) processed under such conditions gives top balls which have sufficient heat, moisture and tension to give fiber stress relaxation at a very low crimp level when stored for a few hours before further processing. After storing these sliver-steamed balls for several hours, e.g. 2-4 hours, in a box or bin open to the atmosphere or covered to reduce the rate of moisture and heat loss, it is found that the crimp level of fibers removed from the ball is considerably lower than that of unaged sliver. Furthermore, the sliver-steamed top produced by means of the invention has been demonstrated to give superior drawing and spinning properties when compared with unaged or normally aged top. For example, top processed according to the invention by sliver-steaming has been spun into yarn of 1/60 s. worsted count, with fewer end breakages and greater evenness than similar yarn made from unaged or normally aged material.

It will be appreciated from the foregoing that the invention herein may be applied at the delivery of the first-finisher gillbox after combing, the hot balls being put into a storage bin for several hours, or overnight. After this storage period, the material can be processed on the final gillbox, giving tops with the characteristics of aged tops, ready for immediate use by spinners.

Alternatively, the process may be applied at the so-called second-finisher gillbox, the necessary storage period of a few hours taking place during subsequent storage before delivery, or during transit if immediate delivery is necessary. In a spinning mill using unaged or partly-aged tops, the process may be applied at the first gillbox operation of drawing, and in a mill spinning tops of its own manufacture, the sliver-steaming may be done at any of the stages mentioned. This sliver-steaming process may also be arranged as a separate process, not attached to an existing process, if desired.

A particular advantage of the arrangement as disclosed herein is that the equipment for treating the sliver with steam and moist air does not take up any floor space in view of the way in which it is associated with the gillbox.

Various modifications may be made in the invention described above. For example, provision may be made for leading the sliver around the drum several times by addition of further guide means. Additionally, it may be advantageous to preheat the drum before passing the sliver thereover in order to facilitate removal of the sliver therefrom at the start of operations.

In applications of the present process to the case where the object is to allow strain recovery or contraction of the fibers take place, the hot treated sliver may be delivered directly into a can without tension rather than being taken up into ball form. After the desired storage period in the can, e.g. 2-4 hours, the fibers in the sliver are in a considerably more relaxed condition than before treatment and can be further processed into yarns and fabrics where this fiber relaxation process can have desirable effects.

The sliver treatment apparatus described herein can also be used to produce yarns of greater bulk than normal. Two or more lots of slivers which have been treated differently so as to contain fibers with different degrees of potential shrinkage are blended together before spinning. Yarns made from such a blend will become very bulky due to differential contraction of the fibers when the yarn is subsequently given a relaxation treatment.

With respect to the sliver treatment unit of this process, it is within the scope of this invention to make such further variations and changes as may be desirable for the treatment of a particular type of fiber or sliver. Such variations will include weight per unit length of the sliver; the length of time of treatment; the speed of the

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sliver passing through the process; the pressure, temperature or moisture content of the steam or other gas passed through the sliver; the number and size and positions of the jet openings in the drum or tube types of apparatus; the construction and method of heating of the stationary sliver guides or guide rollers.

With respect to the sliver delivery and storage parts of the process, which may be designed to produce stress relaxation or strain recovery of the fibers, it is within the scope of this invention to make variations in the construction of the reversing funnel or its attachment which tensions the sliver as it is wound into ball form; the size and shape of the ball or sliver formed; and in the case of sliver delivered into a can or other storage unit, the size and shape of such can or storage unit.

In addition, the sliver delivery and storage unit may be of a continuous process type, in which sliver is fed in from the treatment unit at a steady speed, is stored for periods of up to several hours at the required conditions of temperature and moisture content, either under tension or without tension, then continuously delivered to the next process, without necessitating any break in the sliver.

While the invention has been described above in connection with the treatment of combed wool top or slivers, the sliver-steaming process and apparatus visualized herein may also be used for reducing the crimp level of fibers before combing in order to obtain less fiber breakage in combing and better overall production.

The scope of the invention is defined in the following claims wherein we claim:

1. The method of treating a sliver of textile fibers to obtain rapid stress relaxation or strain recovery of said fibers, said method comprising the steps of preheating the sliver with dry heat while said sliver is maintained under relatively low tension, passing the preheated sliver into a steaming zone and applying steam directly to the preheated sliver therein while maintaining essentially the preheat tension thereon, removing the steamed sliver from said steaming zone, heating the steamed sliver with dry heat and then changing the amount of tension thereon and collecting the sliver under said changed tension.

2. Apparatus for treating a sliver of textile fibers for stress relaxation or straining recovery, said apparatus including a supply for said sliver, a heating compartment having a sliver inlet and a sliver discharge, means for preheating said sliver, said preheating means communicating with said heating compartment for passing said sliver into said heating compartment through said inlet, steam-

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ing means within said compartment between said sliver inlet and discharge, said steaming means including means for maintaining the sliver under a relatively low, essentially constant tension in said preheating means and said heating compartment and through the sliver discharge from said heating compartment, said steaming means further including a plurality of steam discharging apertures therein positioned for close proximity to sliver within said compartment, means for supplying steam to sliver within said compartment through said apertures, and means for changing the tension on said sliver after discharge from said compartment, the last said means including means for collecting said discharged sliver under said changed tension.

3. Apparatus according to claim 2 including additional means for further heating said sliver after leaving said steaming means.

4. Apparatus according to claim 2 wherein said means for changing the tension of said sliver further includes a trumpet having a relatively wide inlet to receive sliver from said discharge and a relatively narrow outlet communicating with said collecting means.

5. Apparatus for treating a sliver of textile fibers according to claim 2 wherein said means for preheating said sliver comprise a heated guide shaped to receive said sliver, said steaming means comprise an apertured cylinder having an outer surface to receive the sliver passing through said compartment and jets within said cylinder to apply steam to said sliver, and said means for changing the tension on said sliver further includes a trumpet having a relatively wide inlet positioned to receive sliver discharged from said compartment and a relatively narrow outlet communicating with said collecting means.

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