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METHOD OF MANUFACTURING A YARN

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ABSTRACT OF THE DISCLOSURE

Method of making a yarn composed of a non-twisted sliver by winding thread around said sliver after a temporary twist is imparted to said sliver.

The present invention relates in general to yarn, and in particular to yarn formed of a sliver having little or no twist and thread wound around said sliver in convolutions spaced apart a considerable distance from one another still more particularly the invention relates to a method of manufacturing such yarn, the yarn having a sufficient strength for use in manufacturing woven or knitted fabrics.

It has hitherto been customary to manufacture yarn by imparting a twist to a sliver by a spinning process in order that yarn may have a sufficient strength. The yarn manufactured by the conventional spinning process is not without disadvantages. The spun yarn does not have the luster and resilience inherent in textile yarn because of the twist imparted to it, and fabrics manufactured by using the spun yarn are lacking in the good handling characteristics of textile fabrics.

In conventional processes of manufacturing yarn by spinning, fibers low in spinning property cannot be formed into yarn as they stand. Moreover, fibers have to be processed through additional operations such as twisting, or by means of flyers, caps, rings, or mules and a winding operation besides a carding operation. This means that conventional processes of manufacturing yarn rely on spinning involving a multitude of operational steps, a long interval of time, and a large number of skilled operators. An additional disadvantage is that since there are limits to the length of slivers to be formed and the length of spun yarn to be wound on bobbins in a single operation, it is not possible to perform a continuous yarn manufacturing operation over an extended interval of time.

The present invention obviates the aforementioned disadvantages of yarn manufacturing by conventional processes of spinning and of conventional methods of manufacturing yarn which rely on spinning. The invention provides a method of manufacturing yarn composed of a non-twisted sliver of a desired thickness prepared from raw material fibers by carding and other operating processes and thread wound spirally around said sliver after a temporary twist is imparted to said sliver in convolutions spaced apart a considerable distance from one another; the method comprises the steps of preparing slivers of a desired thickness from raw material fibers by carding and other processing operations, winding thread spirally around each of said slivers in convolutions spaced apart a considerable distance from one another while said each of said slivers is maintained in a temporarily twisted state, drawing each of said slivers with said thread wound spirally around the sliver in convolutions to obtain yarn of a predetermined thickness, and winding said yarn on a bobbin.

The present invention offers many advantages. One of them is that resilience inherent in fibers can be manifested substantially unspoiled in textile fabrics formed of the yarn manufactured according to this invention because no twist is remained to the component of the yarn. The yarn according to this invention can be formed into woven and knitted fabrics of sufficient firmness and improved quality because the yarn can be made uniformly resilient by making the number of fibers in each sliver identical with one another.

Another advantage of this invention is that since the yarn provided by this invention has no twist, restraining forces at work between the components of the sliver are small so that the yarn can be made markedly bulky after being subjected to dyeing and finishing operations. By using the method of this invention, it is possible to manufacture yarn of good quality from thick and rigid raw material fibers such as horse hair, human hair and the like.

Further advantage of this invention lies in the fact that no ballooning is caused to occur in slivers, so that no consideration has to be paid to resistance of air due to ballooning. This makes it possible to manufacture yarn freely because it is not necessary to pay attention to the relation between the number of fibers making up the yarn and the count of the yarn to be manufactured.

Further another advantage is that yarn of different varieties can be manufactured by means of the same apparatus, by the same operational processes, and without requiring any skill in operation. Slivers are conveyed by groups of rollers, and thread is wound around each of the slivers in coexisting relation when each of the slivers is formed into yarn so that there is almost no danger of the slivers or thread being broken during operation. It is thus possible to continue operation over an extended period of time, thereby markedly increasing the efficiency of production.

Coupled with a reduced area of factory sites required for installing equipment and reduced operation and personnel costs made possible by elimination of spinning and winding operations, the increase in production efficiency makes it possible to drastically reduce costs involved in manufacturing processes. A further object of the invention is to provide a method of manufacturing yarn, which permits to freely manufacture such yarn without regard to the varieties of fibers making up the yarn or the count of the yarn to be manufactured.

Another object of the invention is to provide a method of forming yarn of the type described in which the steps of preparing slivers by carding and other operations is followed directly by the steps of forming each of the slivers into yarn and winding the yarn thus forced on a bobbin without winding the slivers on bobbins to thereby eliminate the steps of winding slivers and rewinding the yarn, whereby the number of processing operations and the interval of working time involved in manufacturing yarn can substantially be reduced and the operation can be continuously performed over a long period of time.

Another further object of the invention is to provide a method of manufacturing yarn of the type described in which the bundle of fibers or components of the sliver be maintained in a firm and compact state while the thread can be wound around the sliver in convolutions, and said bundle of filaments and the yarn wound thereon can be tensioned by imparting a predetermined tension there-
to whereby the yarn manufactured can have a sufficient strength and thickness.

An additional object of the invention is to provide a method of manufacturing yarn in which each of the slivers can be formed into yarn which can be wound on a bobbin without requiring any yarn relaying steps except for the step of feeding the slivers from the carding operation to the opening of a rotational internal false twister.

Other objects and features of the present invention will become apparent from consideration of the following description when taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a view in explanation of the arrangement of an apparatus forming an operation line for carrying the method according to this invention into practice by applying same to the woolen card; FIG. 2 is a side view showing slivers as they are led from the condenser card to the winding section in the apparatus illustrated in FIG. 1; FIG. 3 is a plan view of FIG. 2; FIG. 4 is a sectional view showing essential portions of one embodiment of the apparatus adapted for carrying the method according to this invention into practice; FIG. 5 is a front view of yarn composed of a sliver in a non-twisted state and fine thread wound spirally around said sliver; FIG. 6 is a front view, with a portion thereof being shown on an enlarged scale, of yarn as a finished product according to this invention obtained by drawing yarn shown in FIG. 5; FIG. 7 is a front view, with a portion thereof being shown on an enlarged scale, of yarn as a finished product according to this invention obtained by repeating twice the method of this invention; FIG. 8 shows essential portions of another embodiment of the apparatus provided with a pneumatic sliver feeding tube adapted for carrying the method according to this invention into practice; FIG. 9 is a transverse sectional view of the pneumatic sliver feeding pipe shown in FIG. 8; and FIG. 10 is a longitudinal sectional view taken along the line X-X of FIG. 9.

In the system shown in FIG. 1, raw material fibers supplied to a fiber feeder 1 are fed through carding machines 2 and 3 to a condenser card 4, and then subjected to a rubbing motion by being passed between two moving leather belts at 5 to be formed into groups of slivers $S_1$, $S_2$, $S_3$, and $S_4$ arranged in four layers one above another. Each of the carding machines and the condenser card have their gauges adjusted in such a manner that each of the slivers can have a thickness corresponding to the count of the yarn to be manufactured.

Each of the slivers is separated from the others so as not to cross each other, discharged, and transferred in an orderly manner by means of guide rollers 6 and 7, reeds 8 and 9 disposed immediately before said guide rollers 6 and 7 respectively, and another guide roller R. A conveyor belt may be mounted along this path of travel of the slivers. In the embodiment shown, four groups of yarn forming and winding apparatus $G_1$, $G_2$, $G_3$, and $G_4$ are arranged in the direction of movement of the slivers, each group of apparatus being adapted to handle each one group of slivers. Each sliver of the sliver group $S_1$ is fed to each apparatus of the apparatus group $G_1$, each sliver of the sliver group $S_2$ to each apparatus of the apparatus group $G_2$, each sliver of the sliver group $S_3$ to each apparatus of the apparatus group $G_3$, and each sliver of the sliver group $S_4$ to each apparatus of the apparatus group $G_4$.

Shown in FIGS. 2 and 3 are only the slivers of sliver group $S_1$ and the apparatus of yarn forming and winding apparatus group $G_1$ for handling said slivers of sliver group $S_1$. The slivers of other sliver groups and the apparatus of other apparatus groups are arranged in the same manner.

As shown in FIGS. 2 and 3, the yarn forming winding apparatus group comprises apparatus which are equal to the slivers in number and arranged in a zigzag fashion. Each apparatus comprises a sliver guide 10, a pair of upper and lower feed rollers 11, yarn forming means 12 adapted to be operated by a belt V, a pair of draft rollers 13 and a take-up device 4. In the drawings, C designates a clearer roller.

Embodiments of the construction of yarn forming and winding apparatus are shown in FIGS. 4 and 8. In FIG. 4, an internal false twister 16 is arranged vertically to extend through a supporter frame 15 provided with a pulley 17 and adapted to be rotated by a belt 18. The pulley 17 is rotatably journaled by a bearing M mounted on the supporter frame 15. Mounted at the upper end of the internal false twister 16 is a friction ring 20 formed of natural rubber, synthetic rubber or the like and provided with an opening therethrough which is concentric with the bore of said internal false twister. A bobbin 21 is mounted in intimate contact with the outer circumferential surface of the internal false twister 16 between the pulley 17 and the friction ring 20. Wound on the bobbin 21 as subsequently to be described is thread 22 which is generally a mono-filament or multifilament yarn of the order of 15 to 70 deniers. The friction ring 20 may be formed of metal depending on the varieties of fibers forming the slivers.

A pair of upper and lower feed rollers 24 for feeding a sliver 23 are arranged on the upper lateral side of the internal false twister 16, and a pair of draft rollers 25 and 26 are disposed below the internal false twister 16. Disposed below the draft rollers 25 and 26 is a yarn take-up device comprising a traverse motion 27, drive roller 28, bobbin 30 and means for supporting the bobbin 30.

In operation, the sliver 23 is led from the feed rollers 24 into the bore of internal false twister 16 through the opening 19 of the friction ring 20, then drawn by the draft rollers 25 and 26, and passed through the traverse motion 27 and drive roller 28 to be wound on the bobbin 30 and formed into a cheese 31.

The feed rollers 24 and draft rollers 25 and 26 are rotated at different rates of rotation set in such a manner that the surface speed of draft rollers is slightly higher than the surface speed of feed rollers whereby the yarn is slightly drawn between the two sets of rollers. The internal false twister 16 is driven by means of the belt 18 to rotate at a high speed over several thousand revolutions per minute.

Now the method of forming yarn by means of the apparatus described above will be explained. Raw material fibers are fed to the fiber feeder 1 which are passed through the carding machines 2 and 3 and the condenser card 4 to be discharged through the leather rubbing portion 5 as slivers of a predetermined thickness. At the same time, the belt 18 and the drive roller 28 are operated to rotate the internal false twister 16 through the pulley 17 and also to unwind thread 22 from the bobbin 21 and pass the end of said thread 22 through the opening 19 of the friction ring 20 to extend through the bore of the internal false twister 16 to be wound on the bobbin 30. This causes the thread 22 to rotate in conjunction with the internal false twister 16, so that the thread can be continuously unwound and passed downwardly through the opening 19 while developing ballooning.

The sliver 23 delivered from the rubbing leather section 5 is led to the feed rollers 24 which pass the sliver 23 toward the opening 19 of the friction ring 20. As soon as the end of the sliver 23 is introduced into the opening 19, the thread 22 being unwound from the bobbin 21 while rotating coils itself around the end portion of the sliver 23. As the thread 22 moves downwardly while rotating, the sliver 23 is pulled into the internal false twister 16 and led by the thread 22 to automatically pass through
the draft rollers 25 and 26 and traversing motion 27 to be wound on the bobbin 30. Since the feed rollers 24 are disposed on the upper lateral side of the internal false twister 16, the sliver 23 is brought into contact with the inner end edge of the friction ring 19 defining the opening 20 as the sliver is introduced into the opening 19. The friction ring 20 being rotated in conjunction with the internal false twister 16, a twist is imparted to the sliver by said internal end edge of the ring 20. However, the twist imparted to the sliver by this portion is a false or temporary twist from the feed rollers 24 extending from the feed rollers 24 to this portion and the length of sliver extending from this portion to the draft rollers 25 and 26 are twisted in the opposite directions, so that the twists offset each other and the sliver passing through this portion has little or no twist at all. The fibers making up the sliver 23 are formed into a bundle by the false twist imparted thereto, and the thread 22 is wound around said bundle of fibers. Thus the yarn composed of the sliver 23 having substantially no twist and the thread 22 wound spirally around the sliver as shown in FIG. 5 is continuously formed.

Since the surface speeds of the feed rollers 24 and the draft rollers 25 and 26 are set in such a manner that the yarn is slightly drawn between said two pairs of rollers, the sliver 23 and the thread wound spirally around the sliver are drawn as a unit. This causes the fibers making up the sliver 23 to be laid tightly by the thread 22, with the result that the sliver 23 and the thread 22 are formed into yarn as indicated by Y in FIG. 6 by virtue of the force of resistance of the fibers to bending and compression, the force of friction developing between the fibers from this force of resistance and the force applied by the thread 22 to the sliver 23 all working in combination. The yarn Y is passed around guide rollers 32 and 33 and through the traverse motion 27 to be wound on the bobbin 30 in the form of a cheese 31.

If the sliver 23 led through the internal false twister 16 as aforementioned is passed through another internal false twister of the same construction rotated in the direction opposite to the direction of rotation of the first internal false twister so that thread may be wound around the sliver again, the yarn obtained will have two pieces of thread 22a and 22b wound around the sliver 23 substantially crosswise as shown in FIG. 7.

According to the method of this invention, the sliver can be passed through the internal false twister to be formed into yarn and wound on the bobbin by merely inserting the end of the sliver into the upper opening of the internal false twister as aforementioned. It is thus more advantageous to use a pneumatic sliver feed pipe 101, as shown in FIGS. 8 to 10 to ensure that the end of the sliver is inserted more quickly and positively into the opening 19. The pneumatic sliver feed pipe 101 is frustoconical in shape and has an opening 102 at the minor diameter end which is disposed above the opening 105 of the friction ring 104 fitted over the internal false twister 103. An opening 106 at the major diameter end of the pneumatic sliver feed pipe 101 is disposed near the nip of the feed rollers 107, and air nozzles 108 and 109 are mounted on the pipe 101 in such a manner as to open into the pipe near the opening 106 of the pipe, the openings of said nozzles being directed toward the portions of the inner wall of the pipe near the opening 102 and staggered in position.

When air under pressure is blown into the pneumatic sliver feed pipe 101 through the openings of nozzles 108 and 109, and air current rotating and moving in the direction of the opening 102 is developed which aids in positively delivering the sliver supplied from the feed rollers 107 to the opening 105 of the friction ring 104. The air current also serves the purpose of preventing the fibers of the sliver from bulging out of the bundle.

In FIG. 8, 110 designates a fixed internal sub-tube disposed inside the internal false twister 103. The sliver is led through this fixed internal tube to the draft rollers 111 and 112. The yarn Y formed in this embodiment is wound by a yarn winding device identical in construction to the yarn winding device of the first embodiment and consisting of the traverse motion 113, drive roller 114, bobbin 115 and bobbin supporter 116.

It should be noted that in the present invention the thickness of the sliver, the kind of fibers making up the sliver, and the kind and count of thread to be wound spirally around the sliver can be selected as desired, so that the yarn manufactured according to this invention can be composed of a sliver and thread of any combination of materials.

The examples of carrying the method of this invention into practice will be explained below.

**EXAMPLE 1**

1. **Count of the yarn to be manufactured**, 1/20's.
2. **Raw materials used**—
   - Kind of fibers: polyester.
   - Percentage of mixing fibers:
     - Polyester fiber 34%, fiber length 76 mm. 70%.
     - Polyester fiber 44%, fiber length 89 mm., 30%.
3. **Thread used for winding**—
   - Kind of fibers: polyester.
   - Denier: 1/20's.
4. **The number of turns of thread**, 430 T/m.
5. **The number of rotation of internal false twister**, 5,300 r.p.m.
6. **Surface speed of feed rollers**, 12.3 m./m.
7. **Surface speed of draft rollers**, 13.9 m./m.
8. **Break strength of the yarn manufactured**, 494 g.
9. **Elongation of the yarn manufactured**, 14.0%.

**EXAMPLE 2**

1. **Count of the yarn to be manufactured**, 1/18's.
2. **Raw materials used**—
   - Kind of fibers: wool (raw materials 66 to 64%).
   - Percentage of mixing fibers: 100%
   - Average fiber length: 90 mm.
3. **Thread used for winding**—
   - Kind of fibers: nylon.
   - Denier: 1/20's.
4. **The number of turns of thread**, 430 T/m.
5. **The number of rotation of internal false twister**, 5,300 r.p.m.
6. **Surface speed of feed rollers**, 12.3 m./m.
7. **Surface speed of draft rollers**, 13.9 m./m.
8. **Break strength of the yarn manufactured**, 233 g.
9. **Elongation of the yarn manufactured**, 15.1%.

Yarn manufactured by the method of this invention as described above was compared with woolen yarn of the same thickness manufactured by conventional processes from identical raw materials in order to show the characteristics of the yarn manufactured according to this invention. The results obtained are as follows:

**Raw materials used**—100% wool, 64's and 60's and average fiber length of 96 mm.

**Count of the yarn manufactured**—40's monofil.

<table>
<thead>
<tr>
<th>Woolen Yarn</th>
<th>Yarn of this invention (A)</th>
<th>Yarn of this invention (B)</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of turns of twist (T/m.)</td>
<td>410</td>
<td>0</td>
</tr>
<tr>
<td>No. of turns of thread wound (T/m.)</td>
<td>0</td>
<td>500</td>
</tr>
<tr>
<td>Thread used for winding and its denier (nylon)</td>
<td>12/94</td>
<td>12/94</td>
</tr>
<tr>
<td>Break strength (g.)</td>
<td>109</td>
<td>109</td>
</tr>
<tr>
<td>Elongation (percent)</td>
<td>8.4</td>
<td>10.1</td>
</tr>
</tbody>
</table>

It will be appreciated from the results obtained that an added advantage of the yarn manufactured according to
this invention lies in the fact it has a markedly higher break strength than woolen yarn of same count.

The yarn manufactured according to this invention has the original characteristics of raw material fibers due to the fact that the fibers making up the sliver have considerable freedom of motion in the yarn whereby the thread wound around the sliver can be contracted and the characteristic of fibers can be manifested in the yarn after it is dyed and finished. When the raw materials used are crimpable fibers, the yarn manufactured according to this invention compares favorably with spun yarn in bulkiness, flexibility, and firmness. When the yarn manufactured is for hair cloths, it retains the firmness of the raw material fibers. By using fibers such as cashmere or mohair, the yarn manufactured has the luster and harshness characteristic of the raw material fibers.

In spite of the fact that the yarn manufactured according to this invention has little or no twist, the yarn has a higher strength than spun yarn. This makes it possible to use the yarn according to this invention as a single yarn instead of as a plurality of filaments doubled together.

The invention thus contributes greatly to the development of textile industry because the method of this invention is simple, high in production efficiency and low in production costs.

What I claim is:

1. A method of manufacturing yarn, comprising the steps of carding a mass of fibers and thereby converting it into a coherent fibrous sliver; continuously advancing said sliver in a predetermined path; false-twisting successive increments of said sliver during advancement thereof in said predetermined path and at a predetermined false-twisting location of the latter; continuously helically convoluting a thread about the false-twisted increments of said sliver while the increments undergo false-twisting to thereby form a wrapped yarn; and drawing said wrapped yarn to an extent requisite for imparting to it a predetermined reduced thickness.

2. A method as defined in claim 1, and further comprising the step of compacting the advancing sliver radially inwardly of itself preliminary to convoluting of said thread thereabout.

3. A method as defined in claim 1, wherein the step of convoluting a thread about said sliver, comprises advancing the thread in conjunction with said sliver along a portion of said path and to said predetermined location.

4. A method as defined in claim 1, the step of advancing said sliver comprising mechanically engaging the sliver at a position upstream of said location for advancing it in direction thereto, confining the advancing sliver intermediate said position and said location, and directing a stream of gaseous fluid through said enclosed space towards said location for guiding said sliver to the same.

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