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MERCERIZATION

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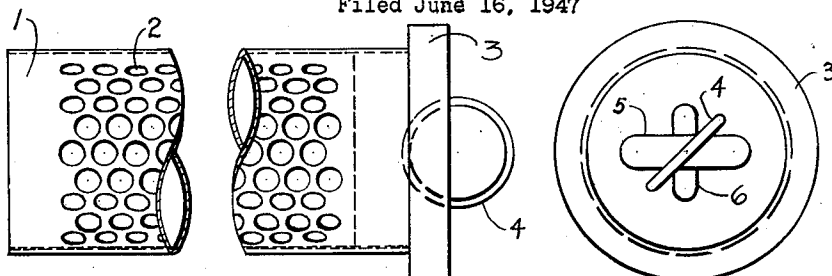
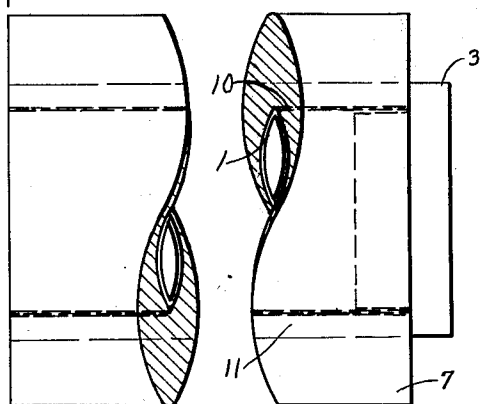


FIG. 1

FIG. 2



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FIG. 3

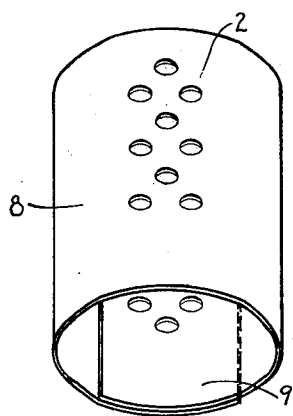


FIG. 4

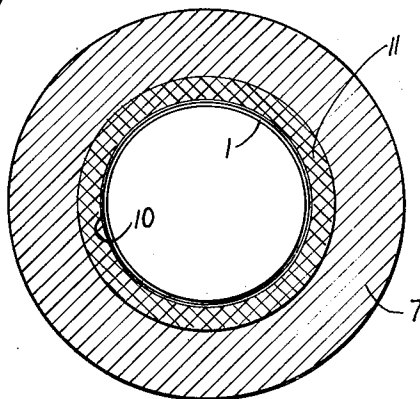


FIG. 5

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MERCERIZATION

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6 Claims. (Cl. 8—125)

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This invention relates to the mercerization of cotton yarns and more particularly to a process and apparatus for mercerizing single ply yarns.

Mercerization of cotton yarns is important to improve certain qualities such as luster, dye affinity, moisture absorption and tensile strength. As a common use of single ply yarns is for splicing purposes along with two-ply mercerized yarns in the heel, toe and sole portions of hosiery, the procurement of these desirable qualities makes mercerization a necessary treatment.

The mercerization of multi-ply yarns is now effectively accomplished by treatment in warp form. This is conveniently carried out by advancing the yarn warps in rope form by means of driven and squeeze rolls through vats containing the mercerizing and other treating liquors. It has not been found practical, however, to mercerize single ply yarns, especially those of higher counts, by this procedure because of their low strength. As the single ply yarns are quite frail, when an attempt is made to draw them through the mercerizing vats they either break or are irregularly attenuated at frequent intervals throughout their lengths.

As mercerization in the usual warp form is not practical for single ply yarns, they have more generally been mercerized in skein form. However, this practice has been far from satisfactory because of its high cost and the generally uneven dyeing properties of the yarn it produces. The high cost of the skein process, as compared to the warp process, is due primarily to greater labor and chemical costs. These in turn are due to the increased handling required by the nature of the batch processing operations. The large amount of handling also lowers the quality of the yarn and leads to waste. As is familiar to those acquainted with the mercerizing art, yarn of uneven dye affinity, giving what is called "tiger stripes" upon knitting and dyeing, is frequently met with in the skein mercerizing process.

The mercerization of single ply yarns in package form, which is a feature of the present invention, avoids the high labor costs and quality shortcomings of the skein process. The labor and chemical costs are of the same order of magnitude as the warp process, and the yarn dyes essentially level and devoid of "tiger stripes."

In arriving at the present invention, it was found that one major difficulty encountered in conducting mercerization in package form is to obtain uniform penetration of an economical size package without excessive fluid pressures when using caustic of conventional mercerizing con-

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centration. A further major difficulty, which is met with in package mercerization, and which the present invention solves, is to overcome the extreme differences of the dye affinity of the yarn from the top to the bottom of the package. It is undoubtedly due to these two major reasons that there is no previous successful practice of package mercerization.

In accordance with the present invention, one way of attaining uniform mercerization of single ply yarns is by winding a limited amount of yarn upon a rigid perforated tubular support, as an ordinary rigid dyetex tube, while gradually increasing the yarn tension and then subjecting the package to a caustic soda solution having a concentration within the range 26–35° Twaddell. An alternate method is to wind the yarn upon a contractible support such as that provided by a yieldable surface or a longitudinally split perforated tube, using a tension increasing somewhat less rapidly than in case of the rigid dyetex tube, but similar caustic concentration. By observing these conditions, the yarn is uniformly mercerized throughout its length, as is indicated by the uniformity of the dyed fabric knit therefrom. The properties of increased dye affinity, tensile strength and moisture absorption are obtained to the degree ordinarily reached in skein mercerization.

Suitable apparatus for carrying out the invention is illustrated in the accompanying drawings, in which:

Figure 1 is a side elevational view of a support for the thread, to which a winding disc has been applied,

Figure 2 is a view of the right hand end of Figure 1,

Figure 3 is a side elevational view of the wound thread package and support,

Figure 4 is a perspective view of a modified support, having overlapping longitudinal ends,

Figure 5 is an end elevational view of a modified form of thread package and support.

The selection of a caustic concentration within the range 26–35° Twaddell is important. If a materially lower concentration is used, the treatment is not sufficiently effective to impart the previously mentioned qualities to the yarn. If the concentration is materially greater, excessive swelling of the yarn occurs and this hinders passage of the treatment bath through the package. As a result of too high a concentration the caustic solution will not evenly penetrate the package and non-uniformity of mercerization will result.

Best results are obtained if a caustic solution low in waxes, pectins and soda ash is used.

It has been found important, according to the present invention, to increase the tension of the thread as it is being wound upon the tubular support. This may be done conveniently by dropping additional weights onto the tension bar of the winding machine at regularly timed intervals. Any other suitable means for increasing the tension may be practiced as by reversing the mechanism generally present in conventional winding machines for gradually reducing the tension upon the thread as it is being wound, so that a gradual increase in the thread tension occurs. This gradual increase in the tension of the yarn as it is being wound on the tubular support, serves to even out the differences which would otherwise occur in the extent of shrinkage of the yarn from the inner to the outer portion of the package during the mercerization operation.

The gradual increase in yarn tension as it is wound on the package, which is an important feature of the invention, is essential because shrinkage in package form is opposed by the winding tension of the yarn, the tube support and the friction of one yarn layer upon another. If package mercerization were to be carried out upon yarn wound in the usual way on conventional winding machines, it would be found that the yarn which is close to the rigid tubular support cannot shrink freely due to its proximity to the form and, therefore, it becomes placed under tension during the mercerization treatment. However, the yarn at the outer portion of the package is not so restrained in its shrinkage by the tubular support, nor does the underlying yarn offer sufficient resistance to the contractive forces set up in the yarn to result in placing the outer turns under the necessary tension. The outer portion of the yarn, in shrinking due to mercerization treatment, exerts a compressive action upon the inner turns which these inner turns do not sufficiently resist. If the thread has been wound with substantially uniform tension throughout, therefore, the outer turns of thread can contract to such an extent that they are not placed under the necessary tension to be effectively mercerized.

However, if the thread is wound with increasing tension as contemplated by the invention, the greater tension which exists in the outer turns serves to compensate for the uneven shrinkage which the yarn would otherwise undergo during the mercerization. As a consequence of the gradual increase in the tension of the yarn as it is wound upon the tubular support, therefore, the outer turns of the thread will be under substantially the same ultimate tension that the inner turns will be under after shrinkage due to mercerization has taken place. The result of this is that the final yarn possesses uniform properties throughout its length.

It is essential to obtain the full advantages of the invention, when winding onto rigid perforated tubes, to wind the first few turns with lower tension than is ordinarily obtainable on the conventional package winding machine. For example, in the package mercerization of single ply yarn of sixty count, the first few layers should be wound with a tension of approximately 5 grams which is considerably below the tension obtainable on the ordinary winding machine. I have found that tension of this order of magnitude or less is obtainable for the first few layers of yarn by employing a special winding tube holder of larger

diameter than the dyetex tube, as is illustrated in Figures 1 and 2.

In these figures the ordinary dyetex tube 1 is shown as having a plurality of perforations 2 therethrough. To one end of this tube 1 is applied a plug or disc 3 having a reduced portion to fit within the tube and be centered thereby. The disc 3 also has an enlarged cylindrical portion of greater diameter than the tube to provide a driving surface. The disc may be held in place against the end of the tube by any appropriate means, and as here shown this includes a lock key or retaining ring 4. This ring is drawn inwardly of the tube by a spring, for example, attached inwardly of the tube. After the disc 3 is in place, the ring 4 is drawn through a slot 5 through the disc and is then turned to seat within the cross-notch 6.

The dyetex tube is thus initially driven by frictional contact of the special tube holder 3 with the driven drum instead of by the yarn surface upon the drum and the first several turns on the tube are consequently under low tension. After the package has built up to the diameter of the special tube holder 3, the higher or normal winding tension takes over. The inner turns of reduced tension are indicated at 11 and the outer turns of gradually increasing tension are indicated at 7.

Still another method is to fit a thin sleeve over the tube prior to winding and then remove the same after the package has been wound or prior to mercerization. A still further arrangement whereby the first several thread turns may be permitted to shrink inwardly, is shown in Figure 4. The tube 8 of this figure is longitudinally split and the ends are overlapped as shown at 9. As the dyetex tube is of flexible material, this construction will permit the inner turns to contract under the shrinkage action of the mercerizing fluid.

Another manner of practicing the present invention is illustrated in Figure 5. In this arrangement an ordinary rigid tubular support as the dyetex tube 1 is employed and several thicknesses of heavy knit fabric 10 is placed thereon. This fabric 10 may, for convenience, be ordinary tubular knit material of stocking-like character. It has been found that if three layers of such tubular fabric are drawn over the tube prior to the winding of the thread thereon, a satisfactory yieldable under surface is presented.

It is therefore apparent that to practice the invention, the first several turns of thread should be contractible and that this may take place because the thread is wound on a yieldable surface or is placed on a rigid surface under a negative tension. Irrespective of the manner in which the shrinkage of the inner turns is provided for, the outer turns should be wound on under gradually increasing tension as has been explained, so that the final tension on the yarn is on the order of from 20 to 35 grams.

The mercerization may be carried out at ordinary prevailing room temperature. Some advantages are obtained if the temperature is regulated within the range of 70-90° F.

The time of treatment is not critical. The period of time to obtain the desired mercerization may be easily judged by the usual standards and a shorter or longer period will not materially affect the results, except that a prolonged period may injure the material. A treatment time within the range of 3-5 minutes will ordinarily be effective.

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The size of the tubular support is not material except that with larger diameter supports it is not necessary to increase the tension to such an extent. One suitable support is the so-called "dyetex" tube which is approximately $6\frac{1}{2}$ " long, $1\frac{1}{8}$ " in diameter and has its surface approximately 60% perforated with $\frac{3}{8}$ " holes. Preferably, they are of stainless steel construction.

It is desirable that only a limited amount of yarn be wound upon the tubular support. Thus, best results are obtained if the layer of yarn is not materially in excess of three-fourths inch thick. Thus, if a tube of $1\frac{1}{8}$ " diameter is used, from 8 to 10 ounces of yarn may be in the package.

In subjecting the yarn to the treatment bath, the conventional package dyeing practice with minor changes is conveniently used. The fluid may be caused to flow from the inside out, or from the outside in. After the mercerization treatment, the usual washing and drying steps are carried out.

As an example of one possible procedure for carrying out the invention, a single ply yarn of 60 count was wound upon a longitudinally split spool $1\frac{1}{8}$ " in diameter and $6\frac{1}{2}$ " long until 8 ounces of yarn were in the package. The tension was gradually increased from a pull of 10 grams at the beginning to a pull of 30 grams at the finish. The package was immersed for five minutes in a caustic soda bath of 30° Tw. at 85° F. After the usual washing and drying operations, it was found that the resulting yarn was uniformly mercerized throughout its length. The yarn showed good luster and regular dye affinity along its entire length; it also had excellent moisture absorption qualities and was of high tensile strength.

As another example for carrying out the teachings of the invention, a single ply yarn of 60 count was wound upon a rigid dyetex tube $1\frac{1}{8}$ " in diameter and $6\frac{1}{2}$ " long which was held upon the mandrel of a winding machine by a special winding tube holder 2" in diameter. The tension of the yarn, until the package built up to the diameter of the winding tube holder, was approximately 5 grams. After the package started winding from its own facial frictional contact, the yarn tension was gradually increased to 20 grams. The package was then mercerized as explained in the previous example. Equivalent results were obtained for the yarn.

What I claim is:

1. The process of mercerizing single ply cotton yarns that comprises initially forming a yarn package by winding on a perforate tubular support succeeding lengths of a yarn in superimposed courses while progressively increasing the winding tension during the winding period and thereafter subjecting the supported package to a caustic soda solution of concentration about 26-35° Tw.

2. The process of mercerizing single ply cotton yarns that comprises initially forming a yarn package by winding on a rigid, perforated, tube succeeding lengths of a yarn in superimposed

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courses while progressively increasing the winding tension during the winding on period and thereafter flowing a caustic soda solution of about 26-35° Tw. through the package.

3. The process of mercerizing single ply cotton yarns that comprises initially forming a yieldable tubular body over the outside circumferential surface of a rigid, perforated tube, then forming a yarn package over said body by winding succeeding lengths of a yarn in superimposed courses while progressively increasing the winding tension during the winding on period and thereafter flowing a caustic soda solution of about 26-35° Tw. through the package.

4. The process of mercerizing single ply cotton yarns which comprises winding a package of yarn on a rigid, perforated, tubular support while initially rotating said support through driving contact upon a surface of greater diameter than the tubular support whereby the innermost layer of thread will be wound under a negligible tension, thereafter winding the yarn under gradually increasing tension until the outer layer of thread is completed, and then subjecting the resulting package to a caustic soda solution having a concentration of 26-35° Tw.

5. The process of mercerizing single ply cotton yarns that comprises initially forming a yarn package by winding on a yieldable perforate tubular support succeeding lengths of a yarn in superimposed courses while progressively increasing the winding tension during the winding period and thereafter subjecting the supported package to a caustic soda solution of concentration about 26-35° Tw.

6. The process of mercerizing a high count single ply cotton yarn of about 60 count that comprises initially forming a yarn package by winding on a rigid perforated tube succeeding lengths of yarn in superimposed courses while progressively increasing the winding tension from an initial value of about 5 grams to a final value of about 20 grams and thereafter subjecting the supported package to a caustic soda solution about 26-35° Tw.

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