Aug. 24, 1954 W. F. LUTHER 2,686,955

MERCERIZED COTTON THREAD

Filed Oct. 31, 1951

3 Sheets-Sheet 1

Fig. 1.

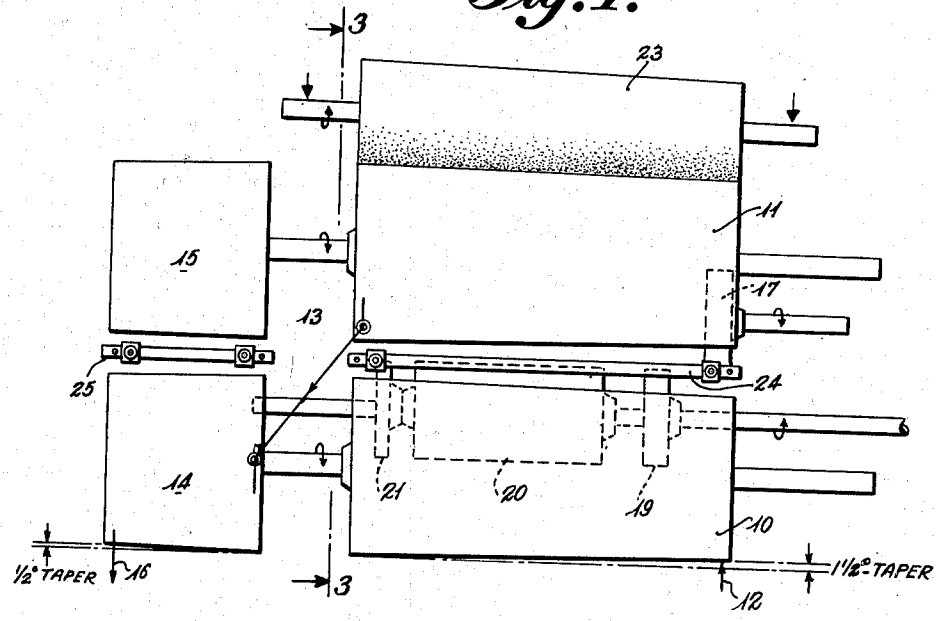


Fig. 2.

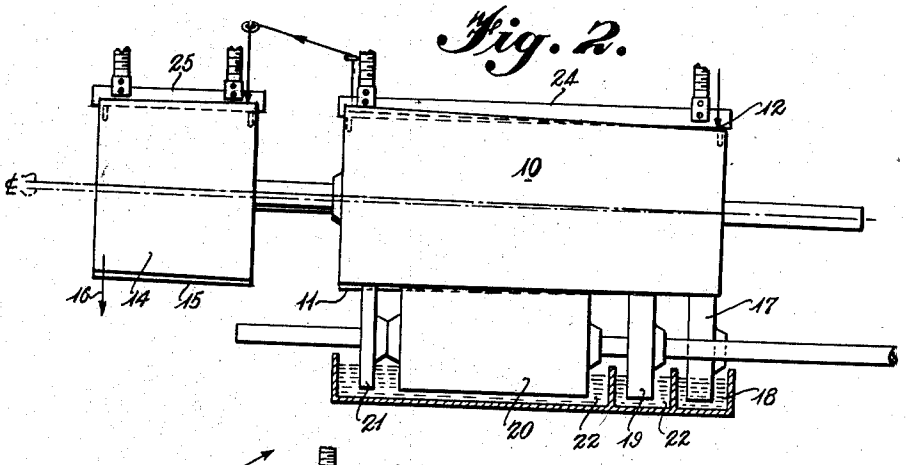
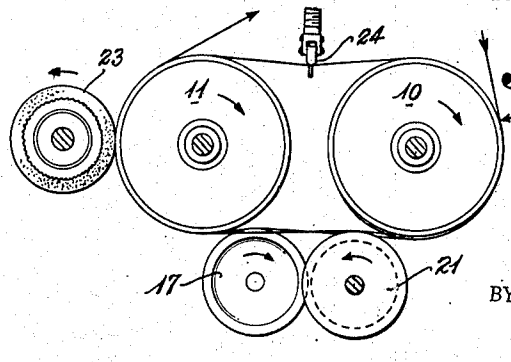


Fig. 3.



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Fig. 4

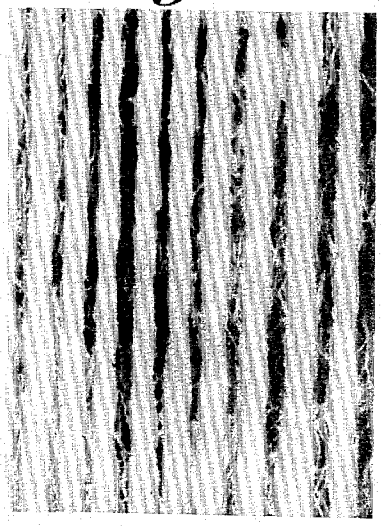


Fig. 5.

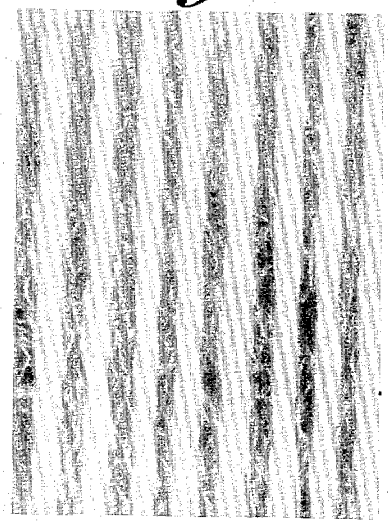
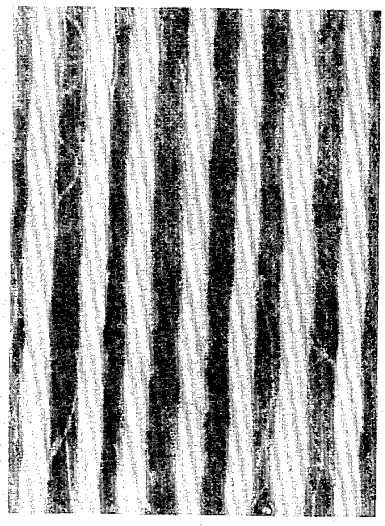


Fig. 6.



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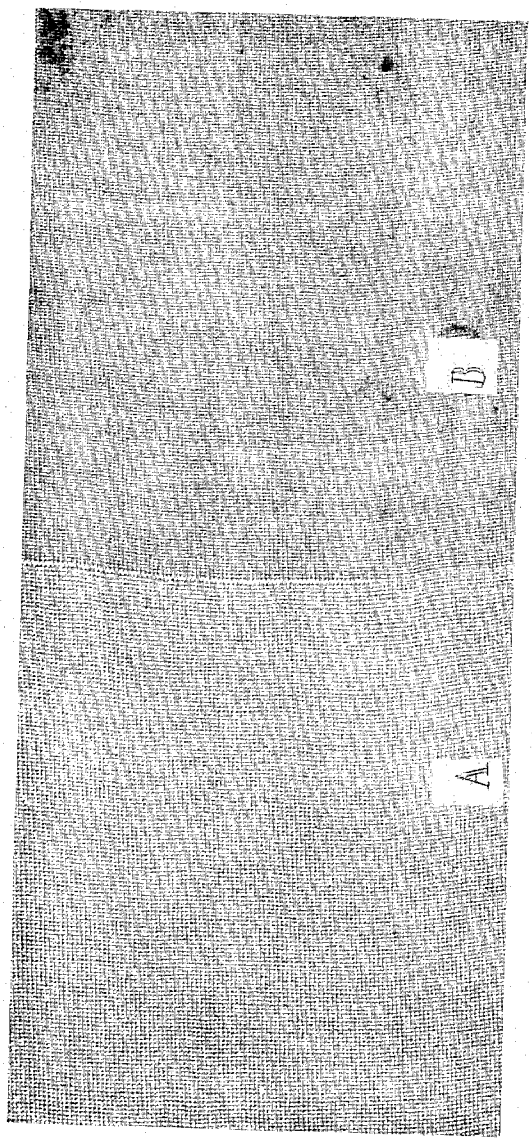


Fig. 7.

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MERCERIZED COTTON THREAD

William F. Luther, Chattanooga, Tenn.

Application October 31, 1951, Serial No. 254,119

1 Claim. (Cl. 28—81)

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This invention relates to mercerized cotton yarns or threads and more particularly to such yarns and threads characterized by the greatest luster that has ever been achieved and by other desirable qualities such as outstanding knitability, good strength, lower content of two-ply knots, freedom from fuzz and cotton trash and excellent uniformity of dye affinity.

In my copending applications Serial Nos. 341, filed January 2, 1948, now Patent No. 2,647,037, and 189,177, filed October 9, 1950, there are disclosed processes and apparatus for the single strand mercerizing of cotton yarns. These processes and apparatus are of marked utility in reducing the handling requisite to the mercerization of cotton yarns and in greatly increasing the speed and convenience with which the mercerizing operation can be accomplished. These processes and apparatus therefore would be of very considerable utility even if the yarn produced therefrom were no better than the prior art product. It has been found, however, that by the exercise of certain controls in the processes described in said applications, it is possible to produce mercerized cotton yarn superior in all respects to any mercerized cotton yarn heretofore known.

The most common of the prior art processes for mercerizing cotton yarn is the warp process in which several hundred ends are brought together in a bundle or rope and this bundle is advanced through the mercerizing bath. Yarns so treated, while showing certain improved properties as compared with unmercerized cotton, lack uniformity to a considerable degree, are quite fuzzy and are not possessed of the great strength, the even dye affinity and high luster which characterize the product of the present invention.

In the applications mentioned above, of which this application is a continuation-in-part, suitable apparatus and a suitable method are shown for the production of the mercerized cotton yarn of the present invention. Accordingly, this invention is described with respect to schematic drawings of the apparatus sufficient to teach those skilled in the art the particular details of the process by which the superior article is produced. Reference is made therefore to the following drawings wherein:

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Figure 1 is a schematic view in top plan of a mercerizing machine suitable for the manufacture of mercerized cotton yarn according to the present invention;

Figure 2 is a view in side eelvation of the machine of Figure 1;

Figure 3 is an end view of the machine of Figure 1 taken from the plane of line 3—3;

Figure 4 is a photomicrograph of average samples of an unmercerized cotton yarn;

Figure 5 is a photomicrograph of average samples of the yarn of Figure 4 that has been mercerized according to prior art practices;

Figure 6 is a photomicrograph of average samples of the yarn of the present invention, the yarn of the present invention also having been produced from the yarn of Figure 4 as a starting material; and

Figure 7 is a photograph of dyed knitted samples of mercerized yarn, sample A being made up of yarn of the present invention and sample B being made up of prior art yarn.

In the drawings the numerals 10 and 11 represent cylindrical rollers which together constitute a thread storage thread advancing device, the axes of these rollers being disposed in askew relation to advance the thread from the point of delivery indicated at 12 to the point of discharge indicated at 13. The thread is passed from the point of discharge 13 through thread guides and across drying rollers 14 and 15 to a point of ultimate discharge indicated at 16. The details of the mechanical handling of the thread involving the formation of a generally helical body on the rollers 10, 11, 14 and 15 are fully shown in the prior applications mentioned above and need not be described herein. The thread in its lower run between the rollers 10 and 11 is contacted by a padding roller 17 which operates partially immersed in a mercerizing solution indicated at 18 and is thereafter contacted with washing rollers indicated at 19, 20 and 21, said washing rollers dipping in baths of wash water indicated at 22. After each lower run of the thread and before the succeeding upper run thereof between the

rollers 10 and 11, the thread is squeezed by the action of a squeeze roller 23 which bears tangentially against the side of the roller 11, and in the upper run of thread between the rollers 10 and 11 it is acted upon by a pressure bar 24 which is so tilted as to close up the coils of thread to contiguity and to lay down the thread fuzz in a manner which is permanently imparted as a characteristic to the thread.

While all of the foregoing has been described in the applications of which this application is a continuation-in-part, it has been found that by controlling the speed of the padding rollers 17, 19, 20 and 21 relative to the speed of the thread, by using a squeeze roller of a certain resiliency urged against the roller 10 under a certain pressure and by exerting a certain pressure on the pressure bar 24, it is possible to produce a truly new mercerized yarn of very superior quality.

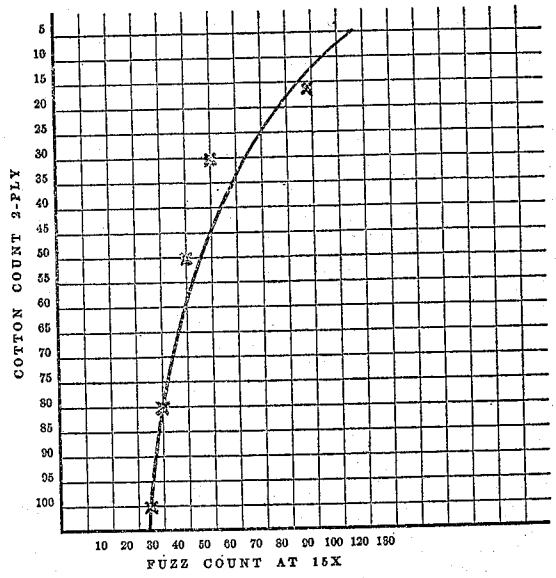
Aside from closing up the coils of thread to contiguity and thus permitting the use of short cylinders, the pressure bar performs two functions which affect the physical properties of the thread. In the first place, it actually removes a substantial portion of the loosely bound short fibers and cotton trash which project from the body of the yarn, and in the second place, it lays down the longer, more tightly bound fibers in such manner as to leave them more or less contiguous to the main body of the yarn. By the action of the pressure bar 24, a product is obtained that is characterized by a minimum of fuzz, giving the yarn an appearance approaching that of a true filament yarn. In order to illustrate this novel aspect of the present invention, comparative reference is made to the photomicrographs appearing as Figures 4, 5 and 6 of the drawings hereof.

Figures 4, 5 and 6 are all photomicrographs taken at 15× magnification of average cotton threads stretched across a black card. The threads of Figure 4 are unmercerized cotton having a count of 29/2. The threads of Figure 5 are cotton threads originally having a count of 29/2 which is altered to 30/2 by the mercerization. A comparison of Figures 4 and 5 reveals small difference in quantity of fuzz. Figure 6, on the other hand, represents cotton threads originally having a count of 29/2 (altered to 30/2 by mercerization) which are notably free of fuzz. By comparison of Figures 4, 5 and 6, it can be seen that the fuzz reduction apparent in the threads of Figure 6 represents far greater improvement over Figure 5 (prior art mercerized) than does Figure 5 over Figure 4 (unmercerized).

The reduction in fuzz brought about by this special single strand process over the conventional warp process is best expressed in a fuzz count made on yarn photographed at 15× on a blackboard. The fuzz count is defined as the number of apparent fibers projecting from the body of the yarn to the inch. For example, in Figures 4 and 5, there are over 40 fibers noticeably projecting from each length of yarn on the average. Taking into consideration the magnification, this would mean over 150 projecting fibers to each inch of 30/2 yarn. In the case of Figure 6, there are only about 15 fibers noticeably projecting or about 60 to each inch of yarn. With finer yarn counts the fuzz count drops until in the case of 80/2 it becomes about 40 as against over 100 for warp mercerized yarn.

The graph below expresses the general relation between fuzz and cotton count. On the graph the ordinate is calibrated in cotton count

and the abscissa in average fuzz per inch at 15× magnification. It can be seen that the fuzz count increases with lower cotton count which is an expected phenomenon in view of the fact that the count is expressed by the linear inch and coarser threads have more surface per linear inch due to their increased size.



The above graph was prepared from the following tables, except that the table likewise includes typical average fuzz counts of prior art mercerized cotton of comparable count:

Count	Warp Mercerized	New Mercerized
16/2	200	100
30/2	150	60
50/2	130	50
80/2	100	40
100/2	80	35

In addition to the lowering of the fuzz count, the single strand process also changes the alignment of the remaining fuzz fibers. Referring again to Figures 4, 5 and 6, it will be noticed that in Figures 4 and 5 the fuzz fibers project from the body of the unmercerized yarns and the warp mercerized yarn at all angles from 0 to 180° whereas in Figure 6 the fuzz fibers of single strand mercerized yarn project at less than 90° from the body of the yarn. This is a very important difference that explains the better knitting qualities of this special yarn such as lower running tension, less lint in knitting, and a sheerer, clearer fabric.

Reference is made to a specific example involving the features of the process which have been found to be critical in the production of the new yarn of Figure 6.

The mercerizing solution was a caustic soda solution of about 55° Tw. or 24.5% NaOH by weight. The mercerizing solution contained ½ to 1% of a caustic compatible penetrant such as Tergitol 08 (sodium 2 ethyl hexyl sulfate) and .2 to .5% of a defoaming agent such as octyl alcohol (2-ethyl hexanol). While in the specific example the penetrant and the defoaming agent were both present, it has been found that so long as the mercerizing solution is of the proper con-

centration, the superior thread of the present invention will be produced.

The padding roller **17** is of stainless steel and was ¾" wide and had a diameter of 3½". During the treatment of the thread it was rotated in the same direction as the roller **10** so that it turned against the lower run of the yarn between the rollers **10** and **11** as can be very clearly seen in Figure 3.

The rollers **10** and **11** were 6.497" in diameter at the right end as viewed in Figure 1 and were 6.627" in diameter at the left end as viewed in the same figure. This is a taper of 2% which imparted 2% stretch to the yarn in the course of its run from the point **12** to the point **13**. The rollers **10** and **11** were 15" long and were operated at about 1300 R. P. M. to produce a peripheral speed of about 730 yards per minute and the padding roller **17** was operated at 120 R. P. M. The wash rollers **19**, **20** and **21** were 1, 7 and ½" long, respectively, and all had a diameter of 3½". These rollers are operated at 300 R. P. M., turning counter-clockwise as viewed in Figure 3.

The squeeze roller **23** was 15" long and is a steel core covered with a rubber sleeve vulcanized to the core, the rubber sleeve being ⅜" to ½" thick and having a Shore hardness of 58. The squeeze roller was urged against the roller **11** at a total pressure of 450 pounds or at 30 pounds per running inch. It has been found that the pressure of the squeeze roller **23** against the roller **11** can vary from about 300 to about 500 pounds without materially affecting the quality of the yarn. Above 500 pounds excessive breakage occurs and below 300 pounds the squeezing effect is inadequate.

The pressure bar **24** displaced the yarns from a straight line course between the rollers **10** and **11** by a distance of ⅜" at the left end of the apparatus as shown in Figure 1, decreasing to a bare touch at the right end of the cylinders in the same figure. A yarn loop at a point one inch from the take off end of the rollers **10** and **11** was found to have a running tension of approximately 55 grams, partly as a result of the pressure bar **24** and partly as a result of the taper of the rollers **10** and **11**. In addition to the pressure bar **24** acting between the rollers **10** and **11**, there is an additional pressure bar **25** acting between the drying rollers **14** and **15** and it has been found that this bar somewhat assists in completing the job done by the bar **24**, although insofar as thread properties are concerned, the bar **25** may be regarded as optional.

The drying rollers **14** and **15** were tapered reversely from the rollers **10** and **11** in order to permit the yarn to shrink under relaxed tension while drying. These rollers at their right ends, see Figure 1, are of a diameter of 6.627" tapering downwardly to 6.594" at the respective left ends, a taper of ½%, the length of the rollers **14** and **15** being 5½". These rollers were heated to a temperature of about 180° F.

While the foregoing example is concerned with a two-ply cotton yarn having a cotton count of 30/2, see Figure 6, it is noted that the process with some variations will produce high quality two-ply yarns ranging in cotton count from 10/2 to 120/2. To produce equally satisfactory results with yarns of increasing or decreasing weight, it is only necessary to adjust the speed of the padding roller **17** and padding rollers **19**, **20** and **21** relative to the running speed of the thread. For example, at a thread speed of 700 yards per minute, padder speeds have been used in accordance with

the following tabulation for the yarns counts as indicated:

Yarn Count	Padder Roller 17	Padder Rollers 19, 20 and 21
	R. P. M.	*R. P. M.*
20/2 to 30/2	180	450
30/2 to 40/2	120	300
40/2 to 60/2	90	225
60/2 to 90/2	60	150
90/2 to 120/2	40	100

Yarns produced in accordance with the specific example set forth above were tested by the U. S. Testing Company and by the inventor and found to have an average luster of 6.5 units on a photovolt glossmeter according to ASTM specification D–523–41T, where a theoretical perfect mirror rates 1000 units. Commercial yarns of the prior art on similar tests averaged about 5.5 units.

The change in physical properties of the yarn mercerized according to the foregoing example from the corresponding unmercerized yarn is set forth in the table below:

Count	Single Strand Break (Ounces)	Single Strand Elongation (Percent)	Twist (Turns Per Inch)
19.10 before mercerization	31.0	5.92	9.7
20.24 after mercerization	34.8	4.04	9.8
39.22 before mercerization	18.4	5.67	12.7
40.98 after mercerization	20.6	3.37	12.9
47.62 before mercerization	14.9	4.95	14.8
49.75 after mercerization	17.5	3.49	15.0
78.12 before mercerization	9.9	4.83	18.9
80.65 after mercerization	11.1	3.63	19.0

Yarns of the present invention are smaller in cross section than prior art yarns of equal weight. Fabrics made from them are more sheer and open than any heretofore producible from mercerized cotton. Moreover, the yarn of the present invention possesses a definitely higher degree of knitability in terms of freedom from dropped stitches and in terms of the production of a better fabric possessed of more uniform and level stitches.

Also, the yarn of the present invention is characterized by a greater freedom from two-ply knots than yarn heretofore employed as required by the limitations upon the length of yarn that could be processed by the conventional warp process, which is essentially a batch one. The length of yarn that can be processed by the conventional warp process is dependent upon the amount of yarn that can be placed upon a standard size quiller bobbin. A standard bobbin holds approximately 8 ounces of yarn, although recently there have been some machines developed to accommodate bobbins with 12 to 15 ounces. Thus, to wind a standard size knitting cone of approximately 2½ pounds from 3 to 5 quiller bobbins are required, thereby introducing 2 to 4 knots per cone. In addition, the operations of warping, mercerizing, splitting and quilling introduce some knots due to entanglement and breakages. This will usually add another knot per cone on the average.

The process herein described does not add any knots incident to mercerization since one bobbin of mercerized yarn taken from the machine of the present invention fills one full size knitting cone. Therefore, the only knots will be those introduced by the twisting and winding operations before the yarn is subjected to mercerization. The number of two-ply knots introduced by these operations ranges from 3 to 5. It is

therefore apparent that the new mercerized yarn of the present invention is possessed of only approximately one-half the number of two-ply knots as standard commercial yarn.

It has already been mentioned that the yarn of the present invention is free of projecting short fibers and has the long fibers laid down with the long axis of the yarn. It has also been found that the factors which produce this effect result is a clean yarn free of small black specks and motes known by the trade as "pepper trash." This is an important consideration for knitters since tests have shown that knitting machines running on the yarn of the present invention remain much cleaner and require far less cleaning attention than present commercial mercerized yarns either gassed or ungassed.

The yarn of the present invention is characterized by a high degree of uniformity of dye affinity. The difference in this property between standard commercial yarns and the yarn of the present invention is best illustrated by knitting a continuous fabric using any commercial grade mercerized yarn for one-half of the fabric and yarn of the present invention, but of the same count, for the other half, and then dyeing the two sectional fabric at the same time in the same bath with a quick direct type dyeing cotton dyestuff such as Fastusol Gray LVGLA. Reference is made to Figure 7 which illustrates a fabric knit as described above and dyed with 1% of Fastusol Gray LVGLA on the weight of the goods. The greater dye uniformity is readily observable in section A of this fabric which was knit from 30/2 cotton yarn of the present invention. The greater dye uniformity in section A over section B is expressed by the smaller variation in total reflectance values as determined by a Model 610 Photovolt Photoelectric Reflection Meter. The measurements were made with the standard green filter in the reflectance search unit. Readings were taken with the search unit placed in 10 different locations on each section of the dyed fabric. The readings ranged from 15 to 17% total reflectance for section B (standard warp mercerized) as against only 17 to 18% for section A (the yarn of the present invention). The percentages given are in comparison to 100% for a fresh magnesium oxide surface.

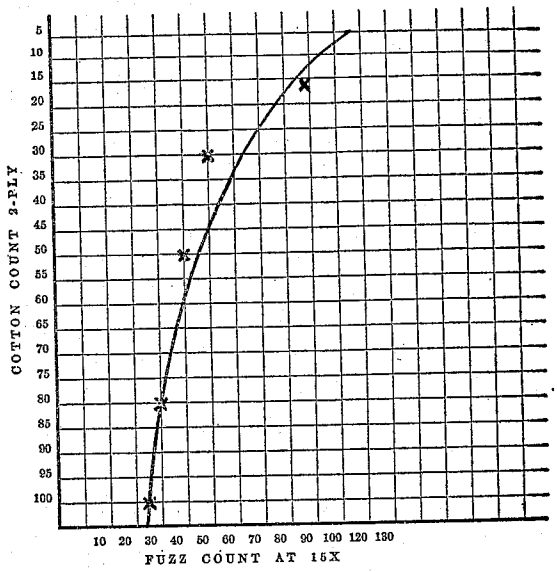
The uniformity of dye affinity was checked with other cotton dyes in the same way. Another fabric was knit: one section (A) knit from yarn of the present invention and another section (B) knit from standard warp mercerized yarn. The two-sectional fabric was dyed all at the same time in a dyebath containing 0.2% of Chlorantine Fast Green BLL and 0.15% of Direct Brilliant Sky Blue 6B. Reflectance measurements were made on each section with the photovolt reflectance meter with the green filter in the search unit. Again the greater uniformity of dye affinity of the yarn in section A was demonstrated. The group of 10 readings on section B varied from 22.0 to 24.2 against only 22.5 to 23.0 for section A.

The difference in uniformity of the dye affinity of the two types of yarn is clearly evident in the photograph which is Figure 7, which was taken on panchromatic film through a Wratten deep red filter from a polarized light source. The greater uniformity in dye affinity is only one of many other properties in which the new yarn excels the yarn of the prior art.

While in the foregoing specification references and examples largely refer to two-ply yarns, it is quite apparent that yarns of the present invention other than two-ply are possessed of the same desirable qualities.

What is claimed is:

A mercerized cotton yarn of high dye uniformity having a luster not less than 6.5 units as measured on a photovolt glossmeter according to ASTM Standard D–523–41T; substantial freedom from pepper trash; no knots introduced during or after the mercerization process; a single strand elongation between 1 and 2% lower than the elongation of the unmercerized cotton thread from which it was made; a variation in total reflectance, as measured by a photoelectric reflection meter, below 2% when dyed in the form of knit goods and the number of projecting fibers per inch with relation to the weight of the yarn expressed in cotton count, in substantial conformity with the following curve:



No references cited.