Nov. 10, 1936. S. COHN 2,060,664

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Filed Feb. 3, 1933 2 Sheets-Sheet 1

Fig. 1.

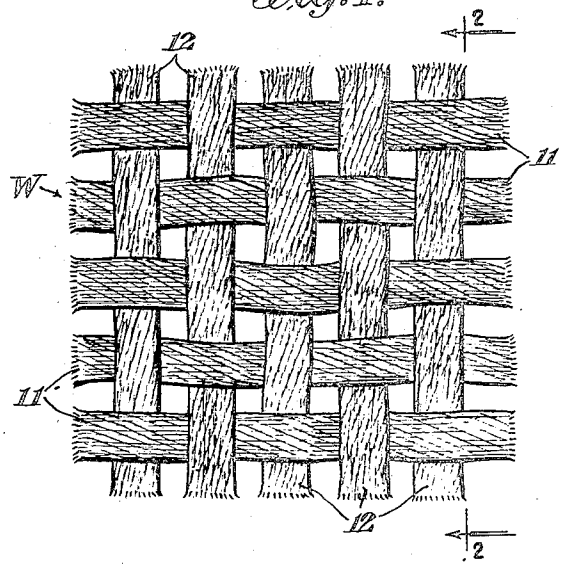


Fig. 2.

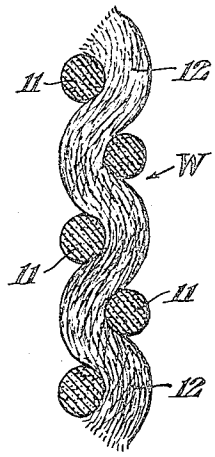


Fig. 3.

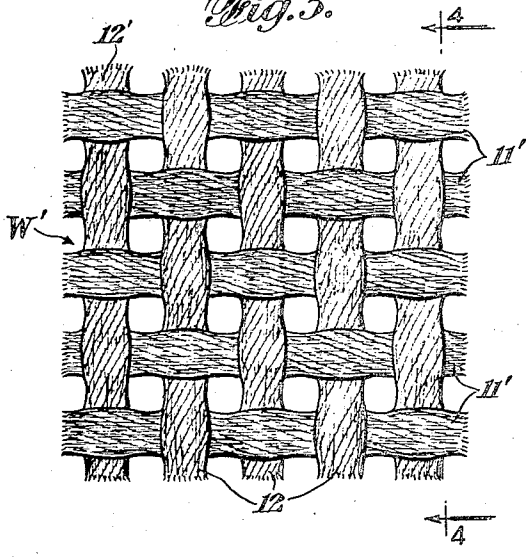
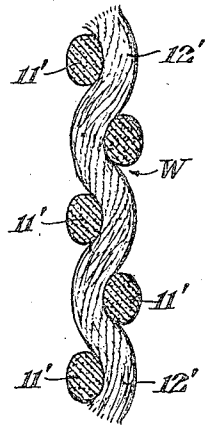


Fig. 4.



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Fig. 5

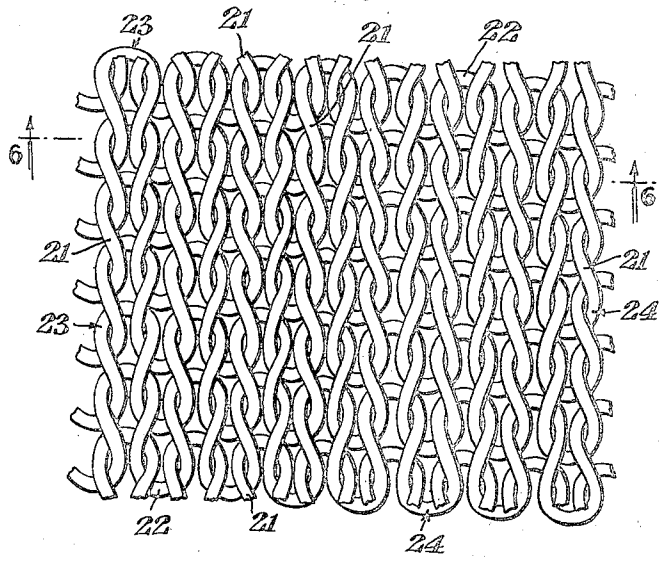


Fig. 6.

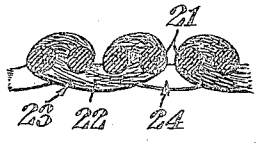


Fig. 7.

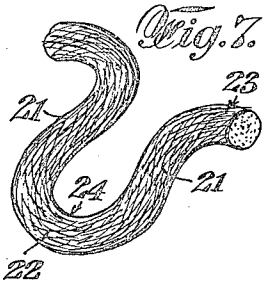


Fig. 8.

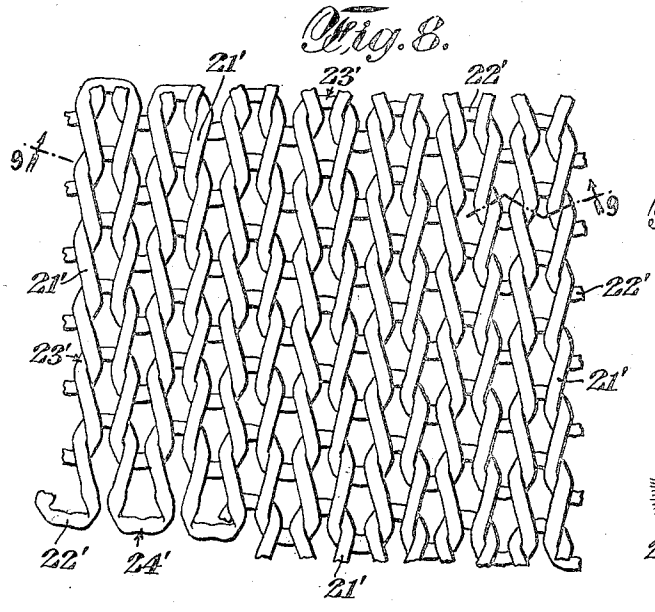


Fig. 9.

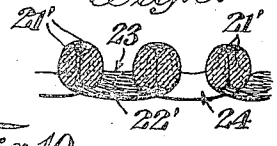
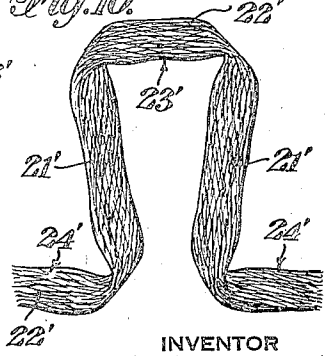


Fig. 10.



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UNITED STATES PATENT OFFICE

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FABRIC

Samuel Cohn, New York, N. Y., assignor to Samcoe Holding Corporation, New York, N. Y., a corporation of New York

Application February 3, 1933, Serial No. 655,046

4 Claims. (Cl. 28—1)

This invention relates to textile fabrics and particularly to fabrics preshrunk or otherwise treated to protect them against subsequent shrinking or to impart the desired appearance to the goods.

An object of the invention is to provide a fabric accurately preshrunk so as to maintain its size and shape in normal use and laundering.

A further object of the invention is to provide a fabric with its threads so flexed and set in special interwoven, interlocking relation as to give an even flat texture and appearance.

A further object of the invention is to provide a fabric readily produced in predetermined structure from textile material woven or knitted in usual manner and then treated to give the desired characteristic form and set to the threads.

Further objects of the invention, particularly in details of the treating processes involved will appear from the following specification taken in connection with the accompanying drawings in which

Fig. 1 is a plan view of the textile material on greatly enlarged scale showing it in its original or normal condition.

Fig. 2 is a sectional view of line 2—2 of Fig. 1,

Fig. 3 is a plan view corresponding to Fig. 1, but showing the textile material in its final form in accordance with this invention,

Fig. 4 is a sectional view taken on the line 4—4 of Fig. 3,

Fig. 5 is a plan view corresponding to Fig. 1, but showing another form of textile material in its original or normal condition,

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5,

Fig. 7 is a perspective view of the normal loop,

Fig. 8 is a plan view corresponding to Fig. 5 showing the material in its final form in accordance with this invention,

Fig. 9 is a sectional view taken on line 9—9 of Fig. 8, and

Fig. 10 is a plan view of the loop of the knitted fabric.

The fabric of this invention is secondary or derived in that it is produced by first weaving or knitting the thread or yarn material into fabric form and then transforming this into the desired final product. The changed fabric in its final form is preshrunk, and has its thread units increased in strength and set in predetermined shape, giving a pleasing appearance of regularity and flatness in texture.

To attain these results the threads of the normal fabric structure are subjected to high pressure, while sufficiently wetted to be saturated or malleable, and these wet threads are simultaneously subjected to a predetermined tension, causing an elongation and involving a change in the shapes of the cooperating parts of the threads. Then as the pressure is applied to the saturated material the threads in their tensioned condition become permanently set in their new form, imparting the new characteristics to the fabric. For instance, a flat cotton fabric W woven as illustrated in Figs. 1 and 2 is wetted or taken in wet condition from some prior operation. If dry it may be either wetted progressively before the pressing operation or the whole piece may be specially saturated prior to treatment.

I have found that with the threads interlaced in fabric form sufficient tension may be applied lengthwise and crosswise to elongate the longitudinal and transverse threads. Then the setting under saturation and pressure permanently fixes a part of this elongation in the thread, and at the same time sets the shape of the thread to correspond to the condition of the fabric under pressure. The tension may be applied simultaneously lengthwise and crosswise, or the crosswise and lengthwise tensions may be applied in sequence with a separate pressing of the material corresponding to each direction of the tension. Assuming that the material is first treated longitudinally and then transversely, the longitudinal tension may be applied to a short section of the fabric piece being drawn through a set of primary rolls by faster rotating secondary high pressure rolls. The primary rolls grip the fabric relatively lightly but with sufficient hold to avoid slippage so that the elongation between the primary and secondary rolls is accurately predeterminable. The secondary rolls with higher peripheral speed at the nip and with the higher pressures on the fabric will cause an elongation proportional to the relative speeds of the primary and secondary rolls and develop and maintain this elongation in each successive increment of the length of the fabric piece as it passes.

The fabric may be initially wet or wetted before the primary rolls, and preferably it will be soaked to saturation between the primary and secondary rolls so as to be thoroughly plastic and malleable as it is drawn into the secondary rolls under tension. These secondary rolls are hard-surfaced, for instance, hard rubber testing about ten by the Pusey & Jones plastometer and with a corresponding narrow bite or grip of great intensity, subjecting the tensioned threads to high pressures sufficient to thoroughly wring out the

moisture while setting the threads in their tensioned condition. Assuming a moisture content of three or more times the weight of the material at the entrance to the rolls, this will be reduced on the delivery side of the secondary rolls, but with low degrees of wetting little or no water may be removed. The setting pressure will vary with the fabric, increasing with the thickness of the goods and the coarseness of the thread and the degree of set required. Preferably the pressure will be fifty pounds or more per inch of width for the lighter goods and correspondingly higher for heavier goods of coarser stock. These high pressure rolls are preferably of small diameter, about six inches, with the sharp nip drawing in the fabric to quickly grip, press and fix it in its tensioned form.

Referring to Figs. 1 and 2 the original flat woven fabric W is shown in its normal condition at rest and free of stress, the longitudinal and transverse threads interlacing by reversals or curvature as indicated. Assuming a lateral, left to right or horizontal tension on the goods, this will be taken substantially exclusively along the lines of threads 11 which will tend to straighten themselves and accentuate the curvature of the longitudinal vertical threads 12 so that the fabric piece will tend to become shorter in length. Where the lengthwise setting is separate from the transverse, the tensioned saturated goods in this condition will be subjected to high pressure progressively so that each increment of the lateral threads 11 will be strongly acted upon to readjust and fix the fibers in their tensioned condition under the plasticizing action of the saturating liquid. The longitudinal fibers 12 under only light tension are relatively relaxed and correspondingly slightly acted upon by the pressure.

The cross threads 11 are wetted, tensioned and pressed, for instance, by providing diverging tenter frames on each side of the fabric piece. Gripping jaws of said frames will grip the edges of the fabric and gradually stretch the fabric transversely (four percent for instance) due to the divergence of the frames. Just as the fabric enters the pressure rolls the jaws may be released without release of the tension on the material caught within the bite of the rolls. Each transverse thread 11 is thus tensioned and elongated from end to end and in its wet plastic condition subjected to the high pressure of the hard primary rolls so as to give a permanent set to each thread as it passes and thus complete the elongation, reshaping and setting of the threads. The tension on the tensioned transverse threads is released as soon as the pressure is released and the transverse threads recover partially from their maximum elongation, so that the permanent width of the fabric is less than the extreme width reached under the spreading action of the tenter frames.

Following closely on the primary rolls there are secondary rolls having higher peripheral speed to give an elongation of the longitudinal strands depending upon the relative speeds of the rolls, and which are set according to the results desired. Assuming an elongation of four percent between the sets of rolls, the resiliency of the fibers will restore the major part of this elongation but a certain portion of the elongation is permanently set by the combined tension, wetting and high pressure.

I have discovered that fibers so elongated and set are permanently fixed and preshrunk so that the changes resulting from the foregoing treatment are permanently impressed upon the fabric. The tensioned threads are reduced in diameter and in twist per unit length and with an increase in tensile strength. The shape of the threads is also set in relatively flattened form at the points of crossing with the transverse fibers, and the general texture of the fabric is made more regular and flat as illustrated for instance by the fibers 12' in Figs. 3 and 4.

In the resulting product the thread for a given number of twists per inch is of less width and of greater length and is permanent. Ordinarily it is impossible to produce a thread of the same length with a given number of twists per inch by the usual methods. Consequently, the new product is of greater yardage and greater tensile strength and of different more regular texture. All methods for manufacturing threads of fibers or filaments are based upon the principle of binding the fibers or filaments into intimate contact by twisting them together, the twist acting as a lock. The lock is made as strong as possible, for upon the strength of the lock depends the intimacy of contact, and it is from this that the thread derives its tensile strength.

All manufacturers of thread put as many twists per inch as possible, in order to accomplish the foregoing, and thus make as strong a thread as possible, for a given purpose. However, the manufacturer is limited to a certain number of twists per inch, by the running conditions of the thread upon a knitting machine or loom. Thus if he produces a thread of more twists per inch, the thread will begin to curl and kink on the fabricating machines, and consequently, he is held to certain strict limits. Thus the thread manufacturer is definitely restricted in the number of twists per inch, which he can make for any specific purpose. He would like to make the twists not only greater in number per inch but also tighter so that the fibers or filaments are in closer contact, but is blocked from doing so by the after operation of fabrication.

Merely as an example to illustrate what the yarn manufacturer would like to accomplish but cannot do, and also to illustrate (1) the increase and decrease of the locking action of the twists (2) the resultant change in the physical dimensions of the thread and (3) the resultant physical reactions which occur upon increasing and decreasing the twist, the following analysis is made:

Comparing three lengths cut from a piece of cotton cord of a certain number of twists per inch. Leaving one of the pieces A untreated for comparison, a second piece B is twisted a little tighter and pulled strongly after the twisting has stopped, while the third specimen piece C is twisted much tighter and pulled harder. Releasing pieces B and C to relax and untwist as much as they desire so that they are allowed to reach new points of stoppage, it will be found that B and C are both thinner in diameter and longer, C being thinner and longer than B. If then, the thread is twisted in a dry state, the natural elasticity of the fiber or filament is disturbed and tends to return to its former position or state, but this tendency is retarded and overcome by the twist. The severity of the twist regulates the amount of the return, and the twist of a thread acts as a lock to overcome the natural tendency of the fiber or filament to contract as developed by the tension exerted upon them by the twist itself. The tighter the twist and the harder the pull on the dry thread, the stronger the twist lock will become. If now the three threads, A, B and C

are immersed in water so as to become saturated and then laid out naturally and allowed to dry thoroughly, all three will shrink or contract, A the least, B intermediate and C the most. Consequently, the greater the stress or tension to which the thread is subjected in its dry state the more it will contract or shrink from a wet to a dry state.

If instead of following the operations of twisting and tensioning the thread in the dry state as practiced in the spinning of the thread, the lengths B and C are saturated and subjected to tension and pressure, an entirely different and new result is reached, tension and pressure on C being made considerably greater than the tension and pressure on B. It will be found that B as compared to A is longer and thinner, and C is still longer and thinner than B. Now wetting threads A, B and C and allowing them to dry will show that A as compared to B has shrunk a greater percentage, and that C has shrunk such an infinitesimal amount that it may be said that the shrinkage has been eliminated. A thread thus saturated or made malleable by a liquid when subjected to pressure and tension simultaneously will become stabilized in its length and width dimensions, or stated differently, it will become preshrunk permanently.

Since the twist will act as a lock upon a dry thread within certain limits, and taking advantage of this, any threads such as C or threads 11 of Figs. 1 and 2 may be reduced to a malleable condition by wetting and then tensioned to first tighten the twist and then subjected to severe pressure. As a result of the tension and pressure, a locking action is created upon the twist so that it cannot release and therefore it remains permanently preshrunk. Comparing threads A and C under the last treatment, A will become permanently preshrunk after a number of wetting outs. The two forms are preshrunk differently, thread A has been allowed to drift to its stoppage point and the other thread C has been forcefully set to a definite stoppage point with the development of new characteristics, the thread C being longer and thinner and its lock or twist tighter. The result in the thread A is arrived at by contraction in the length or yardage, loosening of the twist and without increase in tensile strength. The result in the case of thread C is arrived at by increasing the yardage, tightening the twist and increasing the tensile strength.

Similarly throughout the entire lengths of the threads 11 the fabric W of Figs. 1 and 2 is subjected to progressive treatment by wetting, tension and pressure from end to end. Each thread 12 has the portion of its length between the primary and secondary rolls elongated and subjected to setting pressure so that longitudinally the fabric is increased in length to the length of the threads 12', and these longitudinal threads are increased in tensile strength with slight reduction in diameter and with a tightening of the twist or lock of the threads. Such setting is substantially permanent and after the fabric has dried, subsequent wetting and drying will produce only negligible shrinkage.

The combined longitudinal and transverse setting of the fabric substantially similarly treats both the lengthwise and crosswise threads to transform the fabric into a form indicated in Figs. 3 and 4. The longitudinal and transverse threads 12', 11' have been reshaped into successive portions of different shape, alternating, widening and narrowing slightly in plan view (Fig. 3) and relatively flattened at the areas of intersection (Figs. 3 and 4). The threads 11', 12' are reduced in cross sectional area and tightened in twist and increased in tensile strength. The relatively smoother curves of the threads in winding back and forth between the interlacing threads (Fig. 2) are flattened out into curves of larger radius along the areas of intersection (Fig. 4) but with less change in the intermediate portions of the threads between the areas of intersection.

Such a fabric as illustrated in enlarged view in Figs. 3 and 4 is of noticeably even texture in comparison with the normal fabric (Fig. 1) where the threads tend to assume irregular shapes due to lack of tension and setting. The tensioning during the transformation is limited in amount to that avoiding any weakening of the threads. Such tensioning is sufficient to cause temporary elongation, four percent for instance, and from this there is a substantial contraction when the setting pressure is released.

As a result the fabric is somewhat extended in the direction of the tension and since the setting is substantially permanent the fabric is preshrunk by these expanding processes.

Similar results are accomplished with fabric of knitted texture as shown in Figs. 5, 6, and 7. In this simple form of knitting, the fabric is made from a single thread folded into rows or loops, each loop (or row of loops) interlacing with that which proceeds it and the new loops being drawn through the old. The parent thread thus constitutes both the longitudinal element 21 in the cloth and the transverse element 22, these elements forming between them complementary loops 23 and 24. Thus loop hanging on loop, and one row upon another, establish a delicate principle of equilibrium by which a loop when disturbed at once seeks to right itself. The loops formed by the knitting machine tend to be symmetrical but yield under the action of the neighboring loops while still retaining their flexibility. If the knitting machine produces too loose a fabric there will be less tendency of the loops to re-establish their natural position if disturbed and if knit too tight their return to equilibrium will be retarded. Consequently, the knitting is done within certain limits such that in the normal use of the material the loops will be allowed to change from and return to their natural position of balance, as originally established. The knitting, therefore, must be done within certain distinct limits in shaping loops and these limitations vary with the elasticity of the yarn or threads. The prime requirement of elasticity requires loops to be left in a free state so that the parent thread can flow back and forth as the goods is distorted. The main factor which actually controls the shape of the loop is the bending of the thread, and this factor must be left in a free state. Because of this freeness the loops will arrange themselves in the fabric more or less irregularly in the normal fabric due to inevitable inequalities and variations as illustrated, for instance in the plan view of the normal fabric in Fig. 5.

In such a normal knitted fabric examination of a series of the loops will show there are variations in the centers of the loops as to the sizes of the openings. Also the relation of the threads as to their contact with each other will show differences in the degrees of contact, some engaging gently with very slight bending of the loops, others missing engagement in the then condi-

tion of the fabric and others engaging so as to change the degree of curvature from the normal shape of the loop. These contacting points vary as to the tightness of the fabric, but the tighter the fabric the less the elasticity so that there is a limit to the permissible tightness. Consequently, the knitting machine must produce fabrics within certain limits, and these limits must allow the free movement of the thread from loop to loop and the free flexing of the loops to change their relative shapes as the goods is stretched or pulled. All of these factors in varying degrees illustrated in the knitted fabric of Fig. 5 represent the material in a condition of repose or relaxation, and with the threads simply accommodating themselves to the irregularities inherent in the original material. As illustrated in Fig. 6 the loops are relatively free with light unstrained contacts, and with consequently only a medium flattening of the threads where they cross, and substantially no flattening along a median line, such as 6—6 substantially equi-distant from the opposite ends of the interlocking loops. Fig. 7 shows one of these loops in perspective freely flexed and assuming its natural shape under its own elasticity.

In developing the preshrunk material of this invention from this normal knitted fabric, it will be assumed that there are forty stitches to the inch made upon a twenty inch cylinder knitting machine. One hundred yards of gray goods are first scoured and dyed in the regular way and after being taken from the dye kettle are subjected to simultaneous wetting, tension and pressure by pressure rolls. To accomplish this the tubular knit goods is run over a propeller unit such for instance as illustrated in my Patents Nos. 1,790,655 and 1,893,197, holding the goods between primary rolls running at a predetermined rate and delivering the goods to secondary pressure rolls running at a higher peripheral speed so as to stretch the goods between the primary and secondary rolls while at the same time developing a transverse tension. These longitudinal and transverse tensions may be predetermined to any desired point, depending upon the strength and elasticity of the material. For instance, the elongation between the primary and secondary rolls may be in the neighborhood of fifteen percent. Setting the pressure of the secondary rolls at something over fifty pounds per inch of width of the rolls, the fabric may be carried through and delivered twenty inches in width, and with an increase in length of about five percent, representing approximately one third of the percentage of elongation between the primary and secondary rolls.

The fabric is thus transformed into a new product as illustrated in Fig. 8. The longitudinal and transverse tensions have drawn the loops together, causing an increase in the flattened portions and also changing the shapes of the open spaces within the loops. Each loop has its thread decreased in diameter and increased in tensile strength and tightened in twist, and the pressure sets the loops in this extended shape and with the changed and flattened curvatures at the areas of contact with the interlacing loops. As shown in Fig. 8, there is less overlap of the loops and the threads are flattened where the loops are drawn together along the transverse section, such as line 9—9 of Fig. 8, and as illustrated in the sectional view of Fig. 9. Both the longitudinal portions 21' and the transverse portions 22' of the threads are similarly affected. Each loop 23', 24' is transformed from this relatively freely flexed curvature (Fig. 7) to flattened curvatures warped to interfit with similar flat warped portions of the neighboring loops as illustrated in Fig. 10 and indicated at the lower left hand portion of Fig. 8.

With the product of this invention the shrinkage is reduced to a negligible amount, less than one half of one percent for woven goods and from two percent for close knitting of sixty eight threads per inch to five percent for loose knitting of twenty threads per inch.

Care should be taken in subsequent operations to avoid any straining of the threads to so disturb their condition as to superpose any new strains, the reaction to which will involve a shrinkage. It has been previously explained how any stretching of the threads without setting pressure and without sufficient plasticizing action will leave the threads with a tendency to recover or relax by shrinkage.

In the finishing process of this invention all such stresses are avoided and the material is steamed and rolled under the usual finishing pressures in such relaxed condition as to prevent the stressing of the thread fibers in any objectionable manner. Here again I use primary and secondary rolls, but without any substantial difference in peripheral speeds, or preferably with the primary rolls rotating faster than the secondary rolls. The effect is, therefore, reversed in the finishing step and instead of elongating the threads the material is compacted as it enters the finishing rolls. The finishing pressure is relatively light, only about a tenth of the setting pressure, and the material is thoroughly steamed so as to be heated, moistened and relaxed. Under these conditions a tendency to contract is developed and this contraction is supplied or overrun by the higher speed of the primary rolls feeding the material and pushing it into the secondary rolls.

With woven material a simultaneous lateral contraction may be provided by tenter frames carrying jaws gripping the edges of the material and converging toward the finishing roll while the material is being steamed. There will then be both a longitudinal and lateral decrease so that the fabric is compacted in all directions as it enters between the finishing rolls. With knitted fabric both the lateral and longitudinal contraction are effected by the propeller action, the propeller rolls being rotated at higher peripheral speed than the finishing rolls, and the guide frame between them being contracted to permit of lateral contraction.

This contraction in each direction may be varied as desired and is finished permanently so that the material may be overshrunk as much as five percent or ten percent with a consequent tendency to later expand. Goods so treated instead of shrinking will actually tend to spread. Consequently, a fabric elongated by the setting treatment of this invention may be maintained elongated or returned to its original dimensions or even contracted in either or both directions. The final fabric may, therefore, be dimensioned as desired while at the same time maintaining it against any appreciable tendency to shrink.

This finishing action with its control of dimensions may be applied to any fabric whether or not it is previously treated according to the setting process of this invention. I have found that a thorough steaming action in combination with a compacting of the threads permits a natural

contraction which is not disturbed by the pressure of the finishing rolls. The heat and steam cause the thread fibers to position themselves naturally and in this natural state the finishing rolls remove the wrinkles by an ironing action and deliver the goods. With knitted fabrics not previously set against shrinkage this finishing action reduces the residual shrinkage to less than half or approximately five percent for close knitting of sixty eight threads per inch or ten percent for loose knitting of twenty threads per inch.

By applying a non-substantive chemical to a fabric by the use of an open box reel, the fabric will pick up the chemical in a non-uniform manner and the chemical will subsequently remain non-uniformly distributed throughout the fabric. This uneven distribution will particularly become visible to the eye when delustering materials such as metallic or clay pigments are used. They show up in the final result as streaky and uneven formations on the face of the cloth.

In contrast to the foregoing method, if the process of this invention is used with apparatus, for instance such as described in my Patent No. 1,893,197, the result will show up as a fabric within and upon which the chemical has been perfectly placed. Instead of allowing the fabric to pick up the chemical in a haphazard manner, the process first saturates the fabric thoroughly and then immediately removes the surplus to a predetermined residual amount left in the fabric. In other words, the spraying saturates the fabric immediately prior to its entrance into the nip of a pair of squeeze rolls, the pressure of which has been set, so as to leave a predetermined amount of chemical material with the fabric.

The distinction exists in that the dye-reel allows the fabric to pick the material up as it may, resulting in an uneven pick-up and distribution of the chemicals in the fabric as against the described apparatus which predeterminedly impregnates the fabric with a known amount of chemical and distributes it perfectly.

Such chemical application in the open kettle or box reel produces a non-uniform fabric, of no commercial value, especially where the result desired would require the use of such amounts of chemical to approach the saturation point in the liquor. The wringer uses liquors which have concentrations of chemicals far beyond that which the dye-reel is limited to, and places the chemicals uniformly throughout the fabric and thus produces a commercial result impossible to produce heretofore with the dye-reel.

The chemical is applied best, however, as the fabric is tensioned and treated as hereinbefore described, and its application is advantageous in connection therewith. Thus the setting of the fabric is produced simultaneously with the foregoing result, for, the factors of tension, saturation and pressure are all brought into play as the fabric receives its chemical application.

In the preparation of the material for the setting, wetting has been referred to as the plasticizing agent. Other liquids than water, for instance, certain acids, may be used with some materials such as wool, and chemical solutions where chemicals are to be applied simultaneously with the setting. Heat is also a plasticizing agent and may be used with varying amounts of liquid, less water for instance being required when heat is applied.

In the combined application of chemicals and setting pressures, less pressure may be required while the distribution of the chemical solution is better attained under the action of softer surfaced rolls. For instance, one of the pressure rolls may be of hardness corresponding to forty or fifty by a Pusey & Jones plastometer. Then the fabric fresh from the centrifuge and containing, for example, eighty percent of water when properly tensioned may be simultaneously impregnated and pressed to set form.

The setting desired will vary in degree with different fabrics. However, to aid the factors of tension and pressure, the factors of plasticizing liquids and heat may be used, or each may be varied either separately or in conjunction with one or more of the other factors. Then as the desired variation of setting requires, it may be accomplished by a change in one or more factors. As an example, if a certain setting is desired, wherein it is necessary to use a light pressure on the squeeze rolls, a softening agent, such as an oil, may be used to soften the fabric, and thus having its ductility increased more tension may be applied, and the lack of pressure on the squeeze rolls is thus offset by the increased plasticity of the fabric. As another example, heat may be used instead of the oil and the necessary plasticity produced, which may or may not require additional tension to replace the lack of pressure.

I claim:

1. A knitted fabric derived from a prior normal knitted fabric and comprising threads in interlocked loops with interengagement at successive points along the lengths of the thread, said threads having their twist tightened beyond the normal initial tightness of the thread and with fewer twists per inch than in said normal fabric, and reduced in shrinkage under subsequent wetting and drying from the shrinkage characteristic of the normal fabric so that said fabric is preshrunk in all directions, the threads of said loops being flattened and relatively sharply curved at the areas of contact with the interlocking loops and set in snug engagement tending to maintain the said contacting areas together so as to give a pleasing appearance of regularity and flatness in texture.

2. A knitted fabric derived from a prior normal knitted fabric and comprising threads in interlocked loops with interengagement at successive points along the lengths of the thread, said threads having their twist tightened beyond the normal initial tightness of the thread and with fewer twists per inch than in said normal fabric and increased in tensile strength beyond the normal initial strength and reduced in shrinkage under subsequent wetting and drying from the shrinkage characteristic of the normal fabric so that said fabric is preshrunk in all directions, the threads of said loops being flattened and relatively sharply curved at the areas of contact with the interlocking loops and set in snug engagement tending to maintain said contacting areas together, and said interlocking loops being set to be larger than those of the said normal fabric in relaxed unstrained condition of each fabric and having larger open spaces within said loops so that said derived fabric has fewer threads per inch and greater area than said normal initial fabric.

3. A knitted fabric derived from a prior normal knitted fabric and comprising threads in interlocked loops with interengagement at successive points along the lengths of the thread, said threads having their twist tightened beyond the normal initial tightness of the thread and with

fewer twists per inch than in said normal fabric and set against shrinkage in all directions to less than five percent for close knitting of sixty-eight threads per inch or ten percent for less knitting of twenty threads per inch under subsequent wetting and drying, the threads of said loops being flattened and relatively sharply curved at the areas of contact with the interlocking loops and set in snug engagement tending to maintain said contacting areas together, and said interlocking loops being set to be larger than those of the said normal fabric in relaxed unstrained condition of each fabric and having larger open spaces within said loops so that said derived fabric has fewer threads per inch and greater area than said normal initial fabric.

4. A textile fabric derived from a prior normal fabric and comprising a plurality of thread sections inter-engaging with other thread sections at successive points along their lengths, all of said thread sections in all directions having their twist tightened beyond the normal initial tightness of the thread and with fewer twists per inch than in said normal fabric and increased in tensile strength beyond the normal initial strength so that said fabric is reduced in shrinkage in all directions under subsequent wetting and drying from the shrinkage characteristics of the normal fabric, said thread sections having permanently set flattened portions at said points of interengagement to fit together and minimize the flexure of each thread at each point of intersection and relatively rounded portions between said points so that each of said thread sections has a number of alternating flattened and rounded portions giving a pleasing appearance of regularity and flatness in texture.

SAMUEL COHN.