

Dec. 22, 1931.

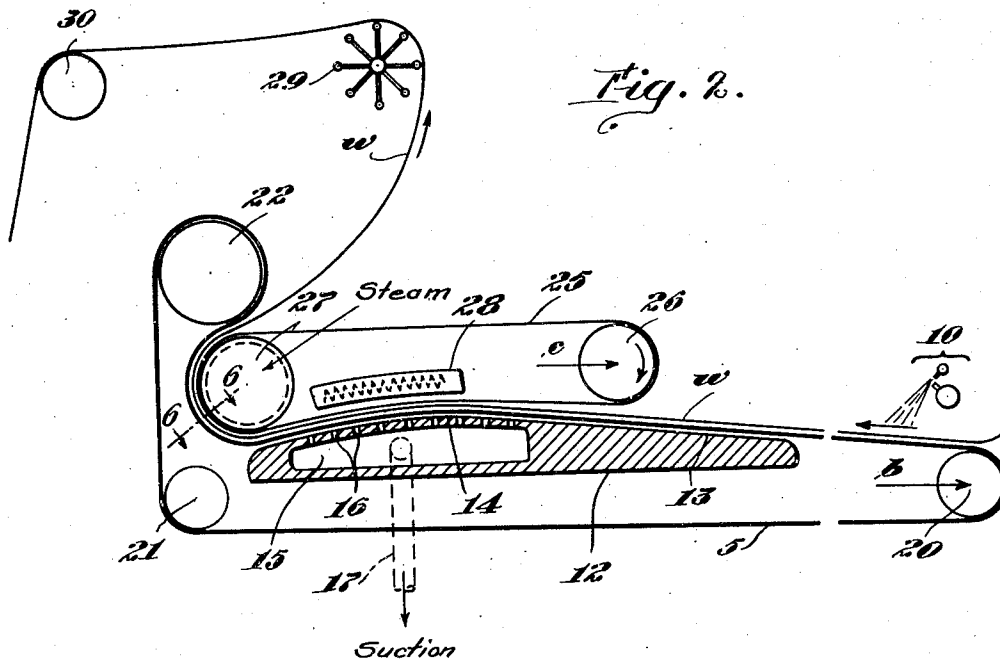
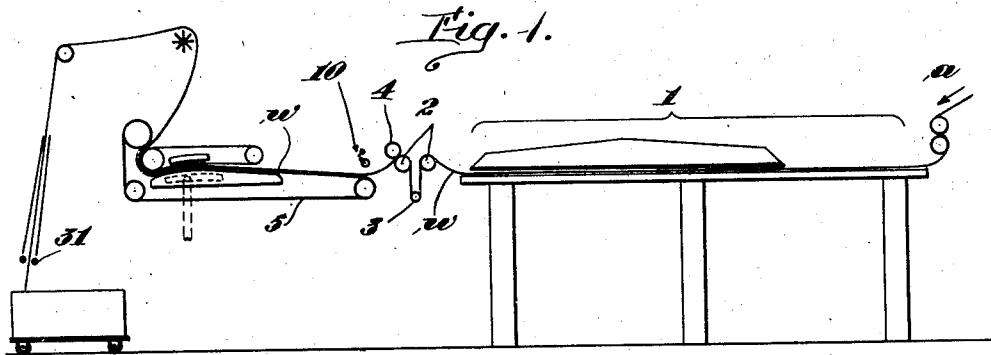
S. L. CLUETT

1,837,408

METHOD OF SHRINKING FABRICS

Filed April 18, 1930

2 Sheets-Sheet 1



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Fig. 3.

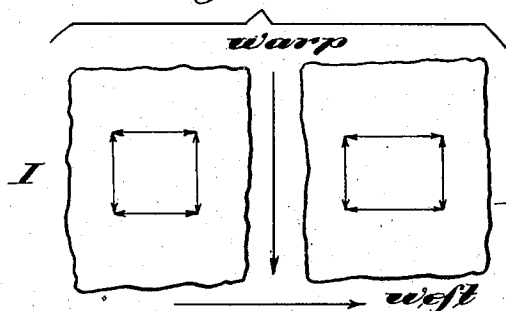


Fig. 4.

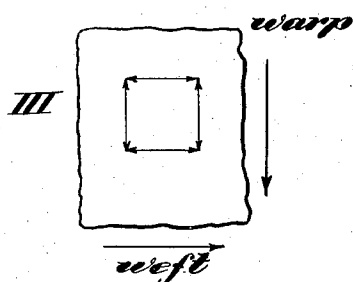


Fig. 5.

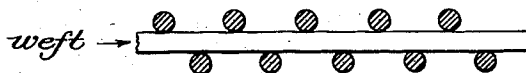


Fig. 6.

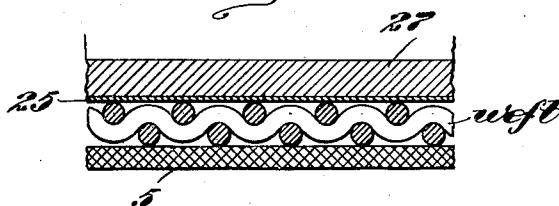
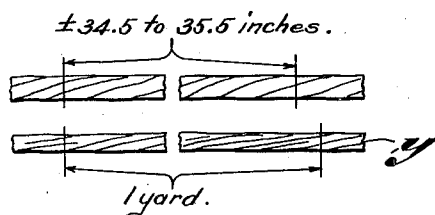


Fig. 7.



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UNITED STATES PATENT OFFICE

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METHOD OF SHRINKING FABRICS

Application filed April 18, 1930. Serial No. 445,299.

This invention relates to a method of shrinking fabrics.

In my Letters Patent of the United States No. 1,734,869 dated November 5, 1929, I have disclosed a woven textile fabric substantially incapable of shrinking by laundry treatments in one direction of its component yarns, and having its original trade finish substantially unimpaired, a characteristic condition of the fabric relating to the crinkled set or lay of one set of its component yarns, and a substantially straight condition of the other set of its component yarns; my said patent describes and claims a mode of securing this condition in the fabric comprising, in brief, stretching a fabric brought to proper condition to respond to the treatment in the direction of that system of its yarns which, when the treatment is complete, is to lie straight in the web.

One object of the present invention is to provide for operating upon the cloth, which may already be finished in the sense of having been bleached, mercerized, printed, dyed, calendered, starched, ironed or polished, or any of these, either in the yarn or on a finished web, or both, in such a way as to secure and set in the cloth a desired contraction in one dimension of the web, for which purpose resort may be had to the art or method of my said Patent 1,734,896, and also to secure a pre-shrunk condition in the other dimension of the web. An object of this invention is to supplement a state of one-dimensional shrinkage, whether or not secured by my said process or art, by causing the cloth to shrink in another dimension, so that the cloth will be reliably preshrunk in both dimensions. A subordinate object of my invention is to provide for subjecting cloth which has been shrunk in one direction, for example by my said process, to treatment causing it to shrink in the other dimension, and then to submit the cloth to treatment causing the fixation of the shrinkage in that dimension, and to do this without detriment to the effect gained by the original one-dimension shrinkage.

In a preferred series of steps, which can be carried out by mechanism, the invention may

be exemplified by allowing material which has undergone the process of my said Patent No. 1,734,896 to relax in that system of its component yarns which were stretched according to my said process; to then subject the relaxed system of yarns (and incidentally all of the fabric) to a humidifying or moistening treatment tending to swell the stretched yarns and causing them further to take-up in their length beyond their natural response to relaxation of stress upon them; and then by drying preferably by the application of pressure and heat upon the cloth to fix in the cloth the effect of the aforesaid operations. Fixation of the last-produced dimensional shrinkage by application of heat and pressure ensures the conservation of the trade finish on the goods, the removal of wrinkles, and smoothing to a dressed or plane condition; whereupon the cloth may be piled or wound for commerce or manufacturing operations upon it.

The invention also comprises a preferred form of apparatus which may be used in practicing the steps hereinabove suggested.

I will now explain the invention in connection with the accompanying drawings showing preferred steps and preferred apparatus only by way of illustration, and in which

Fig. 1 is a diagram in elevation of apparatus upon which the process is recommended to be carried out;

Fig. 2 is an enlarged diagram in section illustrating the steps of the process and operation of the apparatus in the part of the device to the left in Fig. 1;

Fig. 3 is a set of comparative diagrams illustrating the effect on the cloth at different stages of the treatment;

Fig. 4 is a section of the cloth in the direction of the warp, for example, at the completion of the first stage of the process;

Fig. 5 is a section in the direction of the weft at the stage corresponding to Fig. 4;

Fig. 6 is a diagram section, greatly enlarged, on the line 6-6 of Fig. 2, illustrating the condition in the cloth when the fixation of its final condition is being attained; and

Fig. 7 is a comparative diagram relating to the behavior of stretched yarns at one stage of the process.

The process is exemplified by operations conducted with the aid of apparatus shown in Figs. 1 and 2, which will now be referred to by way of explanation of the process in connection with steps carried out with the aid of the apparatus.

According to my Letters Patent of the United States No. 1,734,897, dated November 5, 1929, for apparatus preferred in the practice of the process of my said Patent No. 1,734,896, cloth to be treated may enter from the right in the direction of the arrow *a* in Fig. 1 into a treating machine according to my said Patent 1,734,897, which treating machine is illustrated in diagram at 1. In the said machine, the web is entered on the pins of a pin-chain tenter in such a way as to provide a ratio of slack fabric between points of engagement with the pins or other holding means of the tenter chains sufficient to accommodate a lengthwise shrinkage; the cloth is then stretched sidewise by diverging paths of the chains holding the margins of the web; and during this stretching, the cloth is subjected to a moist atmosphere for the purpose of rendering adhesions between the warp and weft systems of the fabric soft and pliable; these steps result in stretching to straight positions weft elements of the web, and causing the warp elements of the web to take up or crinkle to an extent determined by the degree of stretch and the slack with which the fabric is held at its margins, but in any case precalculated to lessen the length of the cloth to a degree corresponding to shrinkage in use and to laundry treatments, or to a degree exceeding or less than laundry shrinkage. Cloth undergoing treatment is now, according to my said patents, subjected to drying with the aid of heat while in a transversely tense state, and then doffed from the pins or other gripping devices upon which it has been carried during the stretching and drying operations. These steps taken upon the cloth deliver it from the apparatus 1 in a longitudinally shrunken condition, the wefts being relatively straight and the fabric having an increased widthwise extent.

As indicated in Fig. 1 the web of cloth *w* may be received from the apparatus after the treatment at 1 by driven rolls 2, which advance it without substantial stress lengthwise of the cloth. A very light tension may be placed upon the cloth by the weight roller 3; the operation of the rolls 2 may be aided by the top roll 4; the effect of the operations upon the cloth by the rolls 2, 3 and 4 being to deliver it at a predetermined rate, which, when the operation is continuous, may be the rate of delivery of the machine 1, on to a belt 5 upon which the web *w* lies in a re-

laxed state, free, especially in regard to its weft or widthwise extending element, to make any internal movement imposed upon it.

Immediately upon reaching the carrier 5, the web is so treated as to secure alteration of the previously straightened condition of its crosswise or weft elements as by moistening with steam or water. Referring now to Fig. 7, a component yarn of the fabric lying across the web, and woven as a weft and shown at *y* may, when it is delivered upon the carrier 5, have a length between two arbitrary points of one yard, a relatively small diameter, and the component fibers may predominantly lie in the direction of the axis of the yarn in helices nearly parallel to its extent.

A preferred treatment of the cloth as indicated at 10, Figs. 1 and 2, comprises the direct application to its upper face of a fine spray or mist of water or other suitable saturant capable of entering the capillary spaces of the straight weft or crosswise systems of yarns. A preferred form of moistening device indicated in the drawings, but not herein claimed, is a form of air blast atomizer using water, and adapted to apply a predetermined quantity according to the speed of passage of the cloth in order to accomplish the desired moistening or capillary filling of the crosswise yarns, without producing any detrimental permanent effect on the attained finish of the goods. I have determined by experience that these quantities can be ascertained for any particular cloth, having regard to its contained moisture when delivered to the apparatus, the temperatures of subsequent treatment, and especially the distance separating the moistening station at 10 from the place where according to this invention the cloth is dried, for example, by application of heat, to secure the degree of fixed shrinkage effect desired.

The effect desired is to shrink the system of yarns *y* in the cloth to a degree conforming to the previous mechanical shrinkage of the warp system shown in Fig. 4, by operations carried out in the apparatus 1 for example. As illustrated in Fig. 7, the conditions of treatment are satisfied when the straight-lying yarn *y* has been swollen by the applied moisture beyond its original stretched diameter; when the lie of its component fibers has increased in angle to the axis of the yarn, and when the points lying for example one yard apart in a stretched condition, have approached each other until they are materially less than one yard apart. In fabric suitable for shirts and collars, for example, I prefer to swell and moisten the yarns *y* until points one yard apart before treatment are, after the moistening and subsequent treatment mentioned below, 34.5 inches to 35.5 inches, more or less, apart. It will readily be under-

stood that the crinkled arrangement of the warp or longitudinally extending system of yarns shown in Fig. 4 will not be disturbed when the weft increases in diameter and loses in length, except that the warps may be crowded toward each other in a lateral sense; since moisture is also applied to these warps, they may swell in diameter, but by the conditions of the treatment at the stage of the process represented by the apparatus 1, they are incapable of occupying any less space longitudinally of the fabric, and are free to increase in length without altering the length of the goods. At the moist stage, the web is slightly thicker; from 10% to 20% of moisture on the weight of the goods is usually sufficient.

Referring now to Fig. 2 it is provided that the carrier 5 shall take the moistened web after the wefts have drawn up under the application of moisture at 10 into a suitable press adapted to apply heat and pressure normal to the web surface, but not to disturb the lie of the web on the carrier 5, except as hereinafter mentioned. Within limits, it is of no consequence in what manner these operations are performed upon the web, but in order to insure that it shall be dried in the condition attained by the regulated absorption of moisture from the device 10, I prefer to employ apparatus operating substantially according to the behavior of the apparatus illustrated in Figs. 2 and 6. This preferred apparatus comprises a bed or support 12 for the carrier 5, which bed 12 is preferably metal, has a plane upper surface at 13, rising to a maximum height at a point 14, preferably in a gradual curve; the bed 12 may be hollow as at 15, perforated as at 12, and the space within it may be exhausted by any suitable suction apparatus working through a duct indicated at 17.

In the preferred form shown the carrier 5 runs about cylindrical rolls 20, 21, and 22, one of which is suitably driven at the described speed of delivery of the goods in the direction of the arrow *a*. One of the rolls, such as 20, may be subjected to spring or gravity stress in the direction of the arrow *b* to keep the carrier belt 5 taut.

As is illustrated in Fig. 6, the carrier belt 5 is a relatively thin and relatively inextensible structure permeable to water vapor. A preferred material is a multiple-ply interwoven strong cloth having a high tensile strength and little thickness, for example not more than a few times thicker than the cloth under treatment. But in the direction of its length, it is preferred that the belt 5 shall be exceedingly strong; and it is preferred that the belt 5 if any part of its thickness is more extensible than another, shall have that part arranged within, i. e. so as to be that surface which contacts with the rolls 20, 21 and 22. Above the table or bed 12 there is arranged

a strong and thin endless band 25, which may be made of a heat-conducting metal polish if the face of the goods is to be polished, or of a strong textile fabric. The band 25 is carried over a cylindrical roller 26 which may be stressed in the direction of the arrow *c* to maintain the band 25 taut about a hollow roll 27 which may be suitably heated, as by steam at a predetermined pressure introduced through its hollow axes, not shown. If desired, the band 25 may be further heated by a radiating heater 28 which, as indicated, may be an electric resistance heater, or might be a steam box.

The carrier belt 5, the band 25 and the web under treatment pass over the convex face of bed 13 and around the hot roller 27, after passing which the band 25 separates from the carrier belt 5. The web may be delivered from the nip between the belt 5 and the band 25 after passing the roll 6 to a rotated cage roll 29 and carrier roll 30, which if desired may be associated with a cloth piler 31, Fig. 1.

In operation, the moistened web *w* as it shrinks laterally or weftwise gradually approaches the nip opposite the summit 14 of the table 12 at and from which point it is under normally applied pressure, by the operation of the band 25. To this end the band 25 and the belt 5 may travel at the same or nearly the same speed. The moistened, swelled and shrunken condition of the yards *y* will, it will be observed, be conserved and maintained in the region between the band 25 and the belt 5, except that the result of pressure as indicated in Fig. 6 tends to cause the warps which have been displaced by the previous weft stressing operation as indicated in Fig. 5, to resume their original position in respect to each other, which they can do by the yielding to bending of the weft, now in a moist, pliant and swollen state, to assume the crinkle shown in Fig. 6. This is of course the result of transverse pressure between the carrier belt 5 and the band 25, occurring prior to and after the point 14 of the bed 13, from and after passing which point the application of heat either through the heater 28 or the hollow roll 27 is effective, by which the attained state of the web will be fixed and preserved during passage around the roll 27. Having regard to the speed of travel of the web, this passage is through a sufficient distance to set the fibers by drying off the moisture. The dispositions of the apparatus are such that the entering pressure opposite the summit 14 is light, but upon passage around the roll 27, the full tension of the carrier belt 5 is available transversely to press the web under the ironing heat developed.

It will be observed that the remaining steps of the process, after moistening at 10, comprise the swelling and shrinkage of the wefts, the fixation of the web *w* by compression applied transversely of the web, under

conditions imposing no alteration whatever in respect to stress upon either system of yarns in the woven fabric being treated and maintaining and increasing this pressure during the application of ironing heat, releasing the web from pressure and allowing it to cool without substantial tension exerted upon it.

Goods treated by my present process differ from the effect characteristic of the article of my Patent No. 1,734,896 in that tests by repeated laundry operations show no shrinkage in either warp or weft direction in the fabric; the original slightly lustrous trade finish of the goods prior to treatment at 1 is maintained or improved, the effect of stationary ironing pressure from 14 and around the roll 27 of the apparatus being altogether superior in developing lustre and a smooth face on the web.

So far as shrinkage of the web is concerned, referring now to Fig. 3, a square marked off on the web as originally produced and to be treated, as shown at I, will upon treatment according to my said patents and at 1, Fig. 1. of this application, be represented by a laterally elongated and longitudinally shrunken quadrangle, as shown at II; whereas after treatment by the further stages of my present art or process, the marked-off area will again be square, each side being of the small dimension of the quadrangle shown at II.

While I prefer to rely upon tension of the belt 5 for compression of the cloth about the hot roller, it will be obvious that the function of the belt 5 may be carriage of the cloth web only, and in that case pressure on the carried web of cloth may be attained by suitable concave surfaces, or a succession of rollers, opposing the hot roll 27 and suitably pressed against the belt 5 where it turns about said roll.

I claim:

1. Art of treating textile webs comprising stretching one yarn component of the web, in one dimension, thereby causing take-up of the other yarn component and shrinkage of the web in the other dimension, fixing this condition of one-dimensional shrinkage; then moistening the web, causing take-up of the previously stretched yarn component while maintaining the web as a whole in relaxed condition, and fixing the web-shrinkage caused by said take-up.

2. Art of treating textile webs comprising stretching one yarn component of the web, in one dimension, thereby causing take-up of the other yarn component and shrinkage of the web in the other dimension, fixing this condition of one-dimensional shrinkage; then moistening the web, causing take-up of the previously stretched yarn component while maintaining the web as a whole in relaxed condition, applying heat and pressure to the web, and fixing the web-shrinkage caused by said take-up.

3. Art of treating textile webs comprising stretching one yarn component of the web, in one dimension, thereby causing take-up of the other yarn component and shrinkage of the web in the other dimension, fixing this condition of one-dimensional shrinkage by drying the web; then moistening the web, causing take-up of the previously stretched yarn component while maintaining the web as a whole in relaxed condition, and fixing the web-shrinkage caused by said take-up.

4. Art of treating textile webs comprising stretching one yarn component of the web, in one dimension, thereby causing take-up of the other yarn component and shrinkage of the web in the other dimension, fixing this condition of one-dimensional shrinkage by drying the web; then moistening the web, causing take-up of the previously stretched yarn component while maintaining the web as a whole in relaxed condition, applying heat and pressure to the web, and fixing the web-shrinkage caused by said take-up.

5. Art of treating textile webs comprising stretching one yarn component of the web, in one dimension, thereby causing take-up of the other yarn component and shrinkage of the web in the other dimension, fixing this condition of one-dimensional shrinkage, then moistening the web, causing take-up of the previously stretched yarn component while maintaining the web as a whole in relaxed condition, pressing the web between surfaces of which one is hard and polished, the other permeable to water vapor, drying the web while thus pressed and fixing the web shrinkage.

6. Art of preshrinking woven cloth comprising progressive conveyance of a web of cloth lengthwise and, as successive steps during progress:—moistening the cloth while subjecting it to weft tension while relaxing warp tension, fixing the resultant condition of warpwise shrinkage by drying while maintaining the weft tension, moistening the cloth without tension, thereby producing weft-shrinkage, and fixing the resultant condition by drying.

7. Art of preshrinking woven cloth comprising progressive conveyance of a web of cloth lengthwise and, as successive steps during progress:—moistening the cloth while subjecting it to weft tension while relaxing warp tension, fixing the resultant condition of warpwise shrinkage by drying while maintaining the weft tension, moistening the cloth without tension, thereby producing weft-shrinkage, subjecting the cloth to pressure exerted transversely only, and fixing the resultant condition by drying while under said pressure.

8. Art of preshrinking woven fabric comprising progressive conveyance of a web of cloth lengthwise while moist, and as successive steps during progress:—subjecting the

cloth to weft tension while relaxing warp tension, thereby enhancing the crinkle of the warps, then releasing the weft tension and, in the absence of such warp tension as would destroy the previously enhanced warp crinkle, causing weft shrinkage of the cloth by the influence of moisture thereon, and fixing the cloth by drying in its state of two-dimensional shrinkage.

Signed by me at Troy, N. Y., this twenty-ninth day of March, 1930.

SANFORD L. CLUETT.

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