June 21, 1932. J. ROBERTSON 1,864,373

FINISHING OF FABRIC

Filed Nov. 12, 1931

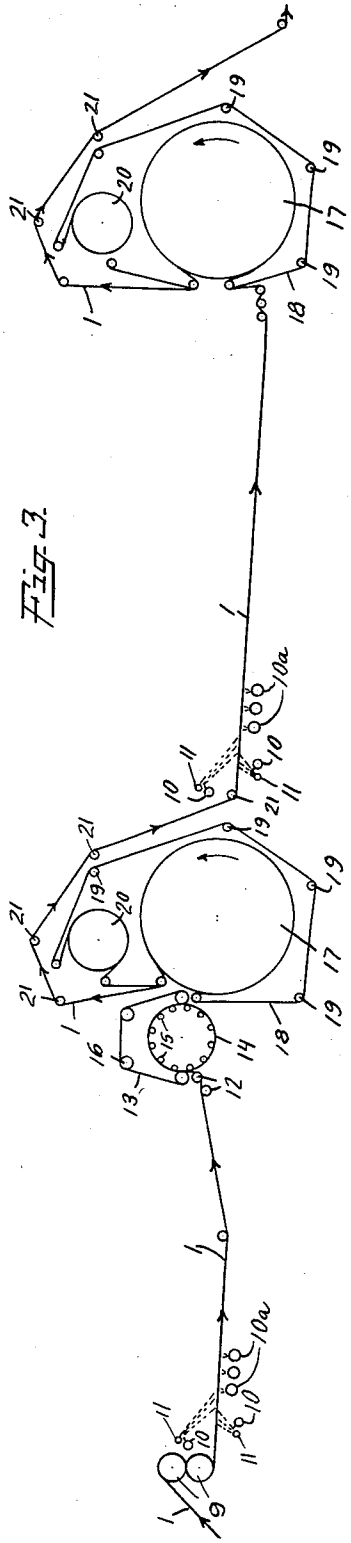


Fig. 3.

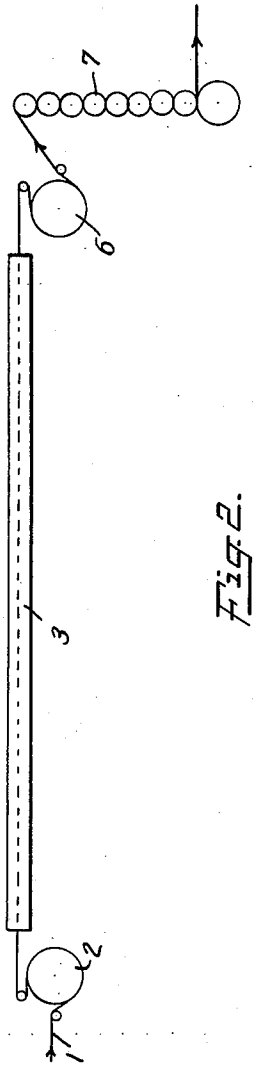


Fig. 1.

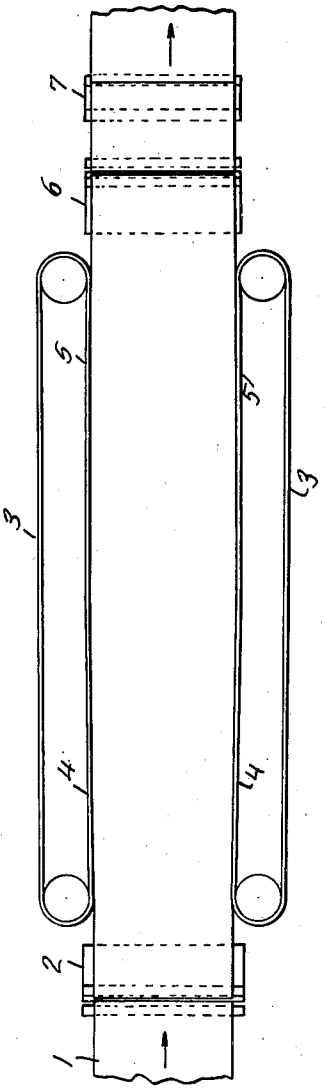


Fig. 2.

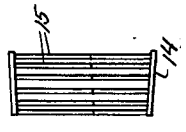


Fig. 4.

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FINISHING OF FABRIC

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This invention relates to the finishing of fabric, and more particularly to the finishing of fabric for the production of pre-shrunk fabric, which is pre-shrunk in both directions, that is, both lengthwise and crosswise.

Woven cotton fabric, as it comes from the loom, is not directly marketable except as gray goods. The usual processes to which the gray goods are subjected to convert them into marketable fabric includes such operations as singeing, bleaching, mercerizing, dyeing, tentering, calendering, etc. Some of these operations can be omitted, for example, the dyeing operation, where the fabric is to be marketed as a white fabric, or the mercerizing operation, where an unmercerized fabric is desired.

The process of the present invention can be applied to bleached and unmercerized, or bleached and undyed fabric, or to mercerized and undyed fabric, or to both mercerized and dyed fabric, etc., to give fabric which can be unmercerized and undyed but pre-shrunk, or fabric which is not only pre-shrunk but also mercerized or dyed or both. An important application of the invention has to do with the production of pre-shrunk broadcloth, which is a mercerized cotton fabric, and which may be either in an undyed or dyed condition.

The gray goods from the loom, as they come to the finishing plant, are usually singed and then subjected to a bleaching treatment. Where mercerized fabric is to be produced, the mercerizing operation usually follows the bleaching operation. During these operations, the fabric is kept wet, being subjected to the various liquors, such as the bleaching liquor, washing liquors, the mercerizing liquor, etc. Also, in handling long lengths of fabric, the fabric is pulled through the plant in long continuous lengths, and through the various vats or tanks or places of treatment until it comes to a point where it can be rolled up on to rolls.

During these preliminary treatments of the fabric in a wet state, it is subjected to tension lengthwise and is stretched lengthwise. This tension and stretching results from the pulling of the fabric through the various treating equipment and from one part of the plant to another and, in some cases, it is held tight during its passage through part of the equipment. No attempt is ordinarily made to stretch the fabric crosswise, or to keep it in a stretched condition, although this may be done during part of the mercerizing operation. As a result, when these various preliminary wet operations are completed, the fabric is usually stretched somewhat lengthwise so that it is longer than it was originally as it came from the mill in the form of gray goods. The fabric may be stretched for example around 4%, that is, so that it is about 4% longer than it was in the form of the gray goods. Ordinarily this lengthening of the fabric by stretching is accompanied by a shrinkage or contraction of the fabric transversely so that the bleached and mercerized fabric, as it comes from these operations in a wet state, is somewhat longer, and quite a little narrower, than the original fabric in the form of the gray goods.

In the further treatment of such fabric, it has been customary to stretch the fabric transversely, on a tentering machine, while holding it under tension lengthwise, and to dry the fabric and then calender it to form the finished fabric which is then sold over the counter or to garment manufacturers.

Fabric so finished will shrink appreciably in both directions, and allowance has to be made for this shrinkage in using the fabric in making garments, etc.

According to the present invention, the fabric is finished in such a way that it is shrunk during the finishing process, both lengthwise and crosswise, giving a fabric which is substantially fully pre-shrunk before it leaves the finishing plant.

According to the present invention, I subject the wet fabric after it has been pulled through the various preliminary treatments, such as bleaching, washing, mercerizing in the case of mercerized fabric, etc., to a series of finishing operations, as follows: 1. A tentering treatment with stretching of the fabric transversely in the tentering machine while holding it under tension lengthwise; 2. A calendering treatment of the fabric after

such stretching treatment; 3. A shrinking treatment which shrinks the fabric both lengthwise and crosswise; 4. A stretching of the fabric transversely while holding it under tension lengthwise, which stretching can advantageously be done on a belt stretcher; 5. A drying and ironing or finishing treatment in a suitable ironing machine; 6. A second shrinking treatment by which the fabric is again shrunk both lengthwise and crosswise; and 7. A final ironing or finishing treatment.

By subjecting the fabric to these treatments, the fabric is stretched crosswise to compensate for the greater part of the crosswise shrinkage produced from the preceding treatment, and is given a two-stage shrinking treatment so that the resulting finished fabric has a length approximating the length of the original fabric at the gray goods stage, and a width which is somewhat less than the width of the gray goods. The fabric nevertheless, owing to the stretching in both directions, and the double shrinking to which it is subjected, is a pre-shrunk fabric, and a fabric moreover, which has an acceptable trade finish imparted to it by the series of operations, including the two ironing operations which follow the two shrinking treatments.

Where the fabric has been finished at another plant to a stage which includes the first two steps above mentioned, that is, through the tentering and calendering stage, the present process can begin at the third step of the process above mentioned, and the fabric then subjected to the successive shrinking and ironing treatments, with the transverse stretching of the fabric after the first shrinkage treatment and prior to the second shrinkage treatment.

I find it advantageous however to operate the first step of the process by giving the fabric a somewhat increased transverse stretch as compared with the ordinary transverse stretch given to a fabric in the ordinary tentering machine. That is, I find it advantageous to stretch the fabric crosswise, while maintaining it under tension lengthwise, until the fabric is stretched to a width which approximates the original width of the fabric at the gray goods stage. In the case of a fabric which is 37½ inches wide in the gray goods, I find it advantageous to stretch the fabric in the tentering machine to around 36½ inches, where a final fully shrunk fabric is desired about 35½ inches wide.

Before the tentering treatment, the wet fabric, owing to the preceding treatment above mentioned has been stretched, for example, about 4% in length, and has shrunk crosswise to a considerably greater extent, for example, to a width of around 30 inches in the case of a mercerized fabric. The mercerizing treatment tends to set the fabric and its threads or yarns in a stretched condition in which they occur during such treatment. In order to compensate for this transverse shrinkage of the fabric, I stretch the fabric in the tentering machine to a width which approximates the original width, while holding the fabric under tension lengthwise, so that it is stretched both lengthwise and crosswise. Accordingly, as the fabric leaves the tentering machine, it will ordinarily have a width which is somewhat less than the original width of the gray goods, and a length which is somewhat greater than the original length of the gray goods, but which approximates the gray goods both in length and width.

The fabric dried in a stretched condition on the tentering machine is then calendered. The calendered fabric has approximately the same length and width as the fabric leaving the tenter and going to the calender, although there may be a slight increase in length and decrease in width during the calendering operation. After the calendering operation the fabric can be rolled up into rolls where it is not to be directly subjected to the subsequent steps of the process, or where the arrangement of apparatus does not permit the continuous handling of the fabric through the tenter, calender, and subsequent shrinking and ironing operations.

The subsequent steps of the process can advantageously be carried out in a continuous manner, with the fabric passing continuously through the series of steps so that the finished and pre-shrunk fabric can then be rolled up on rolls.

The third step of the process, following the calendering treatment, is a shrinking treatment, in which the fabric is wet while it is free from tension in either direction, except for such lengthwise tension as is caused by the weight of the cloth and the pulling of the cloth through the apparatus. This shrinking can be carried out continuously by spraying water and steam in sufficient amount on to the fabric as it is passing continuously through a chamber. As a result of this treatment, the fabric shrinks both lengthwise and crosswise.

After this shrinking treatment the fabric is again subjected to a transverse stretching treatment, while maintaining it under such tension lengthwise as is incident to pulling the fabric through the apparatus, and before the first ironing treatment. The fabric, during the first shrinking treatment, tends to shrink considerably more in a transverse direction than in a lengthwise direction, and this transverse stretching of the fabric, while holding it under lengthwise tension, brings the threads or yarns of the fabric back to a condition more nearly approximating that of the original gray goods, but not to a

width as great as that of the fabric when it left the tenter and calender. For example, in the case of a fabric which, prior to tentering and calendering, had increased in length about 4%, and which had shrunk transversely from the original width of the gray goods of 37½ inches to around 30 inches, the fabric might be stretched to a width of around 36½ inches in the tenter, it might shrink to around 34 inches during the first shrinking treatment and at the same time contract about 3% in length, it might be then stretched transversely to around 36 inches in width by the stretching treatment, while retaining its length approximately the same, and might undergo a further shrinking to about 35½ inches during the second shrinking treatment, while contracting or shrinking in length say 1% during the final shrinking treatment.

The stretching of the fabric, after the first shrinking treatment, is advantageously accomplished with a belt stretcher which clamps the fabric at its edges between diverging belts and rolls.

After stretching the fabric is ironed to dry it and to improve its finish and it is then subjected to the second shrinking treatment where it is wet with water and steam in a continuous manner and permitted to stretch both lengthwise and crosswise, being kept free from tension in either direction, except the lengthwise tension incident to the fabric pulling itself through the process. The fabric is thus permitted to shrink to a condition such that, on further drying and ironing in the final finishing step of the process, the fabric will be pre-shrunk and ready for marketing.

During the two shrinking treatments the fabric is thoroughly wet with water and steam, but the two subsequent ironing and finishing treatments by which the fabric is dried and ironed, give to the finished fabric an acceptable finish so that the fabric is ready for marketing without further treatment.

An arrangement of apparatus suitable for the practice of the process of the invention, is illustrated in a somewhat conventional and diagrammatic manner, in the accompanying drawing, in which:

Figs. 1 and 2 show respectively an elevation and plan of a tenter and calender, the showing being conventional and diagrammatic;

Fig. 3 is a similar diagrammatic outline showing the apparatus for shrinking and ironing the fabric; and

Fig. 4 is a plan of the roll or rotating part of the belt stretcher of Fig. 3.

In the arrangement of Figs. 1 and 2 the fabric 1 passes over the roll 2, and accompanying guide-rolls, to the tenter having the chain 3 suitably supported and provided with means (not shown) for clamping the edge of the fabric and holding it clamped as the fabric passes through the tenter and for then releasing the fabric. A portion 4 of the tenter belt is arranged so that these belts diverge while the portion 5 of the tenter chains is parallel. From the tenter the fabric may pass to a roll and later to the calender or it may pass directly to the roll 6 and then to the calender shown conventionally at 7, from which the calendered fabric is wound on rolls or passed to the portion of the apparatus where it is to be subsequently shrunk, etc.

The apparatus illustrated in Fig. 3 includes feed rolls 9 over which the fabric 1 passes, water pipes 10, and air pipes 11 arranged above and below the fabric, and steam pipes 10*a* arranged below the fabric for supplying water and atomizing the water and supplying steam so that the fabric is thoroughly moistened and permitted to shrink; a belt stretcher comprising a roll or rotating member 14 and belt 13 supported on rolls 16; an ironing machine comprising the roll 17; additional water and air supply pipes 10 and 11 for further wetting the fabric to further shrink it; and a final ironing machine comprising the roll 17 and associated elements.

The water and air pipes 10 and 11 will, in practice, be surrounded with a casing (not shown) by means of which the spray will be confined.

The belt stretcher has end discs or wheels 14 with rods or rolls 15 between them and slidable therein, and two belts 13, one at each end of the belt stretcher, supported on the roll 16 and held tightly against the wheels or discs 14 so that the fabric 1 will be clamped between the belts and the discs or wheels. The discs or wheels 14, as shown in Fig. 4, diverge, and the belts similarly diverge as they travel over the upper portions of these discs so that the edge of the fabric, held between the belts and the discs, will be pulled apart and the fabric stretched at the same time that the fabric is held under tension lengthwise.

The wet and shrunk fabric, after stretching transversely in the belt stretcher, passes around the heated ironing roll 17 and is held against this roll by the belt or blanket 18, passing over rolls 19, drum 20, and the heated roll 17. The fabric after passing around the roll 17 beneath the belt or blanket 18, passes over the rolls 21 to the second set of water and air pipes for again spraying and wetting the fabric with water to effect further shrinking. The fabric then passes to another ironing machine similar to that already described, where the fabric passes around another heated roll 17 similar to that above described and is given another ironing treatment between the roll and the blanket 18. The ironed fabric then passes over the rolls 21 and is rolled up on a roll (not shown).

In the operation of the apparatus, the wet fabric after the preliminary wet treatments of bleaching, mercerizing, washing, etc., comes to the tenter in a wet condition and is stretched between the diverging portions 4 of the tenter belt and is thereby stretched, and then passes between the parallel portions 5 of the tenter belt where the fabric is dried, after which it passes to the calender 7 to be there calendered.

The calendered fabric, which has been stretched before calendering to compensate in part for the shrinkage which it has undergone during the preliminary wet treatment will approximate in length and width the original fabric leaving the loom in the form of gray goods, but ordinarily the calendered fabric will be somewhat longer than the gray goods, and also somewhat narrower, as hereinbefore pointed out.

The calendered fabric is then wet to shrink it in both directions, is then stretched transversely in the belt stretcher while being held under tension lengthwise, and is then ironed and finished in the first ironing machine. It is then again wet and shrunk in both directions by the second set of spray pipes and is thereby given its final shrinking, after which it is ironed in the second ironing machine to give the finished shrunk fabric.

The word "continuous" is used in the appended claims in its broad sense to describe a web fabric which is of a substantial length but not necessarily a fabric which is endless. Also, the term "drafting tension" is used in some of the claims to refer to tension which is positively and externally applied to fabric.

I claim:

1. The method of finishing continuous web fabric which has been stretched lengthwise and shrunk crosswise during the preliminary wet treatments of bleaching, etc. to which the fabric has been subjected, which comprises stretching the fabric transversely while holding it under lengthwise tension and drying the fabric in such stretched condition, calendering the fabric, subjecting the calendered fabric to a shrinking treatment to permit shrinkage in both directions by wetting the fabric, stretching the fabric transversely while holding it under lengthwise tension, drying and ironing the fabric, subjecting it to a further shrinking treatment by wetting the fabric to permit further shrinking in both directions, and finally drying and ironing the fabric.

2. The process of finishing continuous web cotton fabric which has been maintained under tension lengthwise and permitted to shrink crosswise during the preliminary treatments of bleaching, mercerizing, etc., which comprises stretching the fabric transversely while holding it under tension lengthwise on a tentering machine and drying the fabric in its stretched condition, calendering the fabric, subjecting the fabric to a shrinking treatment to permit shrinking in both directions, subjecting the shrunk fabric to a second stretching treatment to stretch the fabric transversely while holding it under lengthwise tension, ironing the fabric, subjecting it to a further shrinking treatment to permit further shrinkage in both directions, and subjecting the resulting shrunk fabric to a final ironing treatment.

3. The method of finishing continuous web fabric which has been subjected to preliminary treatment including bleaching, mercerizing and calendering, which comprises subjecting the calendered fabric to a shrinking treatment by wetting the fabric while it is substantially free from either lengthwise drafting tension or transverse tension to permit shrinkage of the fabric in both directions, subjecting the fabric while still wet from the shrinking treatment to transverse stretching by transverse pull applied at the edges of the fabric to effect substantial increase in width while holding the fabric under lengthwise tension but without any substantial increase in lengthwise stretch of the fabric, drying and ironing the fabric, subjecting it to a further shrinking treatment by wetting the fabric while it is substantially free from drafting tension in both directions to permit shrinking of the fabric in both directions, and drying and ironing the shrunk fabric.

4. The method of finishing continuous web fabric which comprises subjecting the fabric to a shrinking treatment by wetting the fabric while it is substantially free from either lengthwise drafting tension or transverse tension to permit shrinkage of the fabric in both directions, subjecting the fabric while still wet from the shrinking treatment to transverse stretching by transverse pull applied at the edges of the fabric to effect substantial increase in width while holding the fabric under lengthwise tension but without any substantial increase in lengthwise stretch of the fabric, drying and ironing the fabric, subjecting it to a further shrinking treatment while it is substantially free from drafting tension in both directions to permit free shrinking in both directions by wetting the fabric, and drying and ironing the shrunk fabric.

In testimony whereof I affix my signature.

JULIAN ROBERTSON.