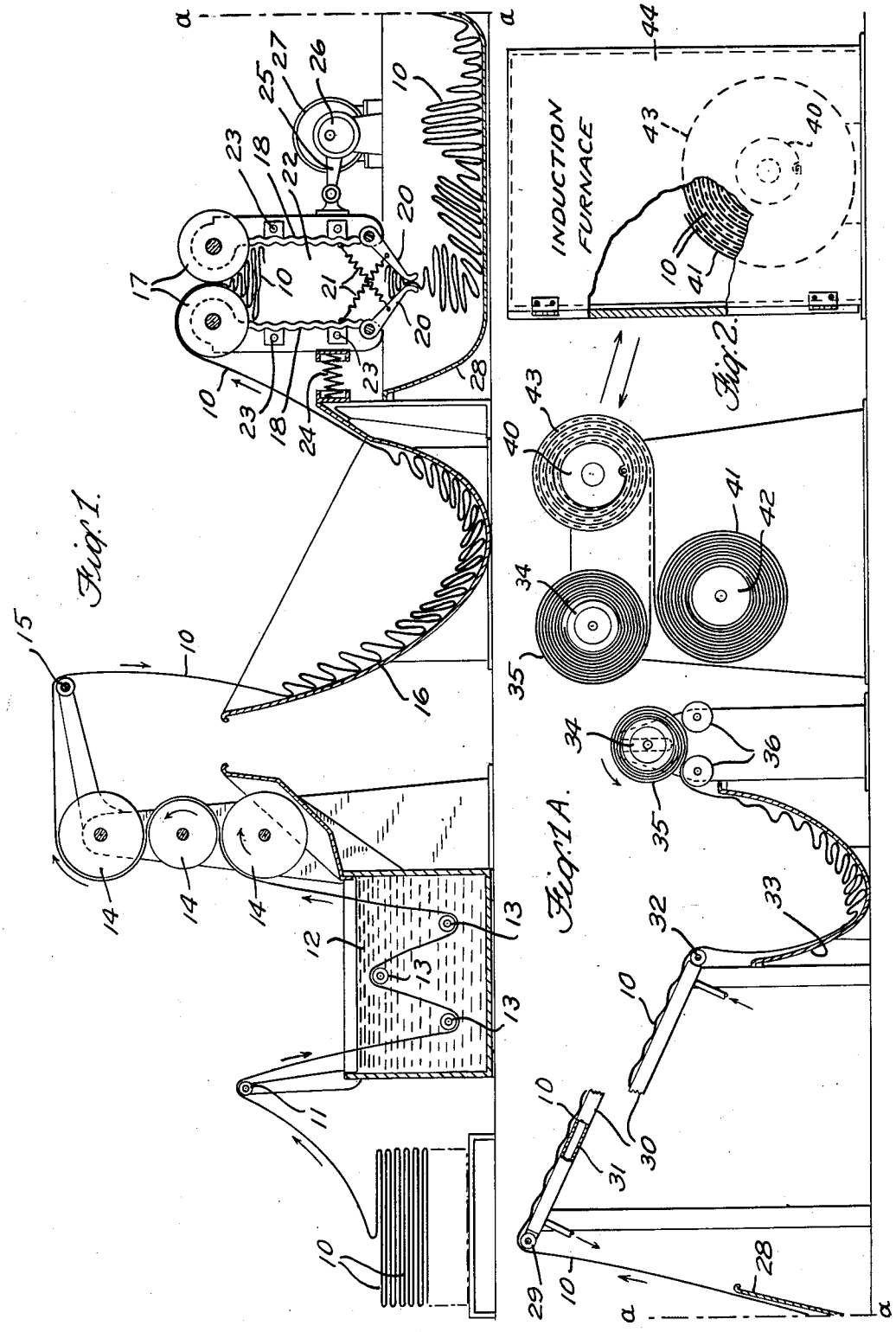
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METHOD AND APPARATUS FOR IMPARTING STRETCH TO WOOL FABRIC

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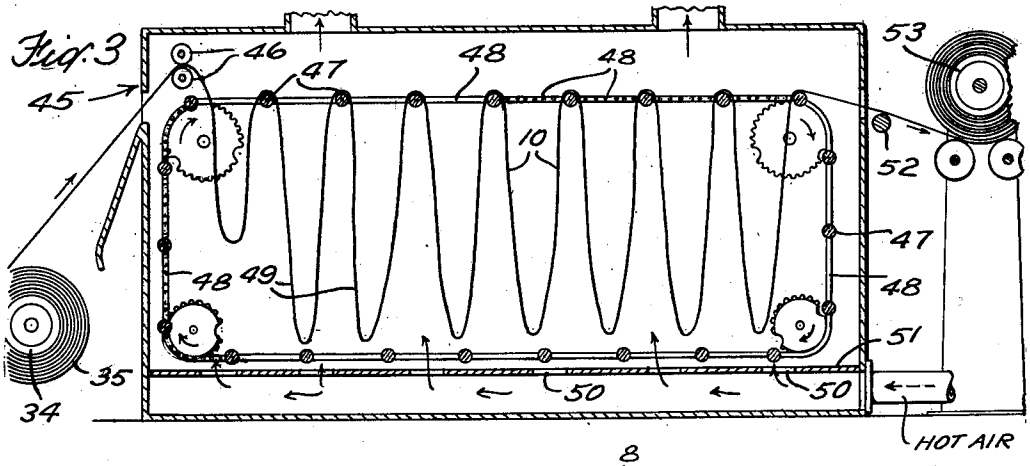


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METHOD AND APPARATUS FOR IMPARTING STRETCH TO WOOL FABRIC

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Fig. 3



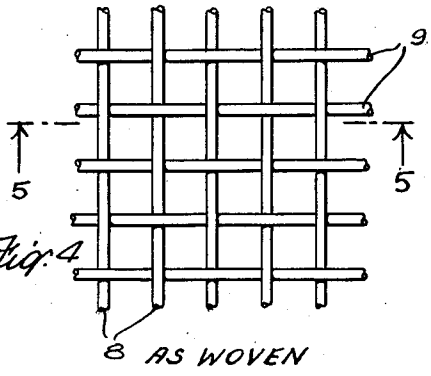




Fig. 4

AS WOVEN

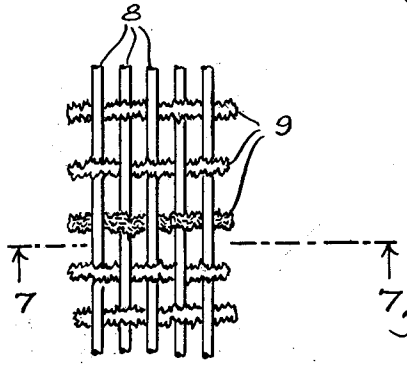



Fig. 6

AS STABILIZED

Fig. 8.

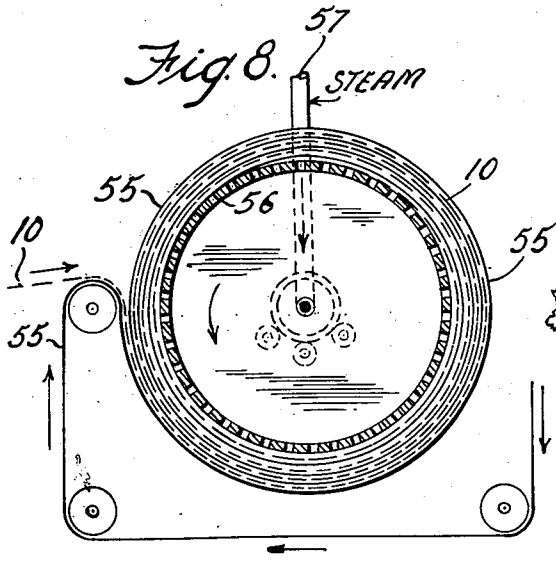



Fig. 5.

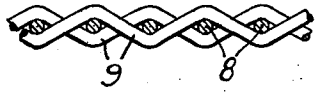
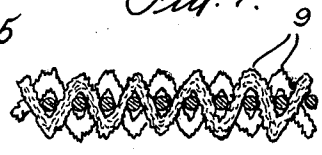



Fig. 7.




INVENTOR
LESLIE A. RUNTON

BY N. S. Leek

ATTORNEY

United States Patent Office 3,077,655 Patented Feb. 19, 1963



3,077,655

# METHOD AND APPARATUS FOR IMPARTING STRETCH TO WOOL FABRIC

Leslie A. Runton, Middle Haddam, Conn., assignor, by direct and mesne assignments, to J. P. Stevens & Co., Inc., New York, N.Y., a corporation of Delaware

Filed May 9, 1961, Ser. No. 118,217
18 Claims. (Cl. 26—18.5)

This invention relates to fabrics and has for an object to provide a fabric having novel and improved characteristics.

Another object of the invention is provide a fabric of the above type which is stretchable to an extent to provide comfort and which has sufficient elasticity or pull-back to retain its original shape and crease.

Another object is to rovide a fabric of the above type having a high degree of recovery and wrinkle resistance which is permanent to laundering and dry cleaning.

More specifically, the invention provides a fabric which is suitable for outer garments for men's and women's wear and imparts to such garments improved characteristics in both appearance and comfort. This is accomplished by processing wool fabrics composed of wool yarn made primarily on the worsted system to impart a substantial shrinkage in either the warpwise direction or the weftwise direction or in both directions as desired and to stabilize the fabric in the shrunken condition.

The high shrinkage results in increasing the number of yarns per inch and thereby produces a denser fabric and increases the crimp of the yarns as they pass over and under successive yarns of the transverse direction. The crimp is increased in frequency due to the increased number of yarns per inch and in amplitude as the yarns are pulled up and bent more sharply in their traverse. This increased density up-grades the fabric and improves its appearance and value by an amount greatly in excess of the processing cost. Fabrics can thus be given a number of picks equivalent to those in fabrics of much greater cost or in many cases a greater number of picks than it would be feasible to weave in fabrics having the same yarn size.

The process also provides for stabilizing the fabric in this highly compacted and crimped state. This stabilization imparts a memory to the yarn so that when it is thereafter deformed it tends to return to its original state. The fabric is highly stretchable due to the fact that when it is tensioned, the crimp is pulled out of the yarns although the yarns do not themselves increase in actual length. When the stretching force is removed, the yarn memory causes the yarns to pull back and the crimp to be restored. The pull-back effect is equivalent to that normally produced by rubber yarns but in this case is produced by the memory effect of the wool yarn.

This elastic effect has many advantages in garment fabrics. For example, the garments made from such material are more comfortable and may be made more form fitting as they accommodate themselves to bodily movements. This is an important advantage in sports wear such as ski suits or the like where it is essential that the garment be form fitting and yet have considerable elasticity. This new fabric has very high tailorability. The garments made from it have a high value because of their well tailored appearance. Garments made from this fabric remain smooth in appearance. They are also wrinkle resistant as any wrinkles are removed by the elastic pull-back of the fabric. Trousers retain their crease for long periods for he same reason. Furthermore, the garments do not tend to wrinkle or pucker at the seams in moist weather as in the case of the usual woolen fabrics which absorb moisture and shrink when wet.



The present methods being used to shrink or compact wool fabrics embody the felting characteristics of wool. This felting causes fiber migration and will deform the face appearance of the cloth. The proposed method of shrinking wool cloth eliminates fiber migration as no felting takes place.

These and other improved characteristics are imparted to the fabric by the processing steps hereinafter described.

The invention embodies the use of woven wool fabric composed essentially of wool yarns made on the worsted swstem wherein the yarns are given a high singles twist and a low ply twist. In some instances singles yarns may be used in which case they are given a high twist. In the case of yarns having two or more plies, the two ends may be twisted in opposite directions so that the ply twist will result in imparting a high singles twist to one of the ends and will result in a low twist in the other end to impart fullness or bulk to the yarn.

The weave is sufficiently open to provide space between adjacent yarns to accommodate the desired shrinkage, but not so open that the final fabric will be sleazy.

Fabrics constructed in accordance with the present invention and in general suitable for use in clothing, should have stretch characteristics of from four to twenty percent.

The nature of the invention will be better understood from the following description taken in connection with the accompanying drawings in which a specific embodiment is being set forth for purposes of illustration.

In the drawings:

FIGS. 1 and 1A when joined on the lines 2—2 constitute a diagrammatic view illustrating an elevation of one type of apparatus which may be used for carrying out the present process.

FIG. 2 is a sectional view illustrating the packaging and heating steps.

FIG. 3 is a sectional view illustrating the final drying stage.

FIG. 4 is a plan view showing the fabric as woven and prior to the shrinking operation.

FIG. 5 is a section taken on the line 5—5 of FIG. 4.

FIG. 6 is a plan view similar to FIG. 4 showing the fabric in finished contracted form;

FIG. 7 is a section taken on the line 7—7 of FIG. 6; and

FIG. 8 is a detail view of a heating apparatus illustrating a further embodiment of the invention.

Referring to the drawings more in detail, a fabric **10** of the type above described is passed over a roll **11** into a bath **12**, containing a stabilizing agent, thence around rolls **13** to immerse the fabric in said bath in a substantially tensionless state so that the fabric absorbs a substantial quantity of said agent, said quantity being at least in excess of one hundred percent of the weight of the fabric. The stabilizing agent consists of a reducing agent of the type used in the Harris process which results in breaking down disulphide linkages and rearranging the hydrogen bonds. The bath may comprise for example a twenty to one water solution of monoethanolamine sulphite and a sequestering agent. The yarn thus contracts and the crimp is accentuated due to the increased sharpness of the bend as the yarns pass over and under the more closely spaced transverse yarns in the weave.

The wet fabric is then removed from the bath between squeeze rolls **14** which are adapted to remove excess liquid and to reduce the liquid content of the fabric to from sixty percent to one hundred percent of its dry weight. From the squeeze rolls **14** the fabric passes over a roll **15** into a J-box **16** where it rests in tensionless folds.

From the J-box **16** the fabric **10** passes between feed rolls **17** into a compactor which may take the form of a full width fulling machine of the Kicker type or of

the type using fluted plates. In the form shown the compactor comprises a pair of horizontally corrugated plates 18 which are pivotally mounted about the axis of the feed rolls 17 and are provided with hinged doors 20 which are biased by springs 21 to resist the delivery of the fabric from the compactor. The zone 22 between plates 18 constitutes a compacting zone wherein the fabric is placed under a back pressure due to the action of the discharge doors 20. The incoming fabric as it is discharged from the bite of the feed rolls 17 is caused to flex back and forth so that the individual fibers are worked in a relaxed state which permits the desired take-up and shrinkage of the fibers to take place. The plates 18 may be heated by heating rods 23. One of said plates is spring biased toward the zone 22 by a spring 24. The other of said plates is vibrated by means of a link 25 and eccentric 26 which is driven by a motor 27. The vibrating plate causes the fibers in the fabric to be worked individually as a fabric moves down between the plates and by alternately compacting and releasing the fabric causes the treating liquid to be uniformly dispersed therein.

The fabric after being discharged from the doors 20 drops into a container 28 from which it passes over a feed roll 29 and over an inclined plate 30 which is heated by suitable means shown, as a steam jacket 31 to a temperature of the order of 210° F. and 215° F. In this way the fabric is heated for a few seconds while still in a tensionless state. This heating step should not exceed a time of about thirty seconds and should be sufficient to enable the fabric to reach the wet bulb temperature of the water and cloth. This heating of the fabric promotes the chemical action above mentioned and causes the fabric to undergo a substantial degree of shrinkage. The fabric 10 passes from the plate 30 over a roll 32 into a second J-box 33 from which it is wound on to a core 34 in the form of package 35 which rests upon and is driven by rolls 36.

The winding 35 is unwound from the core 34 on to a second core 40 as shown in FIG. 2 where it is interleaved between convolutions of a thin metal sheet 41 which is composed of stainless steel which is inert to the chemicals contained in the fabric. The metal sheet 41 is withdrawn from a roll 42 as it is wound with the wool fabric 10 on to the core 40 to form a package 43 composed of interleaved convolutions of the wool fabric and metal. This package 43 is then placed in an induction furnace 44 wherein heat is induced in the metal sheet 41 electrically so that the entire package is heated to a temperature at or near the boiling point of the treating liquid within the wool fabric. Alternatively the wool fabric 10 could also be wrapped between layers of a fabric 55 such as Dacron as shown in FIG. 8 which fibre is unaffected by the treating liquid although this cloth web does absorb moisture and become wet. The Dacron fabric 55 could be wrapped around a perforated metal drum 56 with the wool fabric and heated by the passage of steam through the drum from a pipe 57 or could be placed in an autoclave and heated under pressure after previous evacuation. In any of these cases a heating period of about five minutes would be required.

In this stage the wet wool fabric is heated to a setting temperature so that the yarn is set permanently in the state in which it is held in the package 43. Since the wool fabric in this package is in a highly shrunken state and is maintained in a smooth condition by the interleaved convolutions of the metal sheet the wool fabric is permanently set in this compacted and smooth state. However the liquid is not driven off of the wool fabric by the heat of the induction furnace so that the wool fabric retains its wet state during this heating step.

After being heated for the desired length of time in the induction furnace 44, the package 43 is removed therefrom and unwound, the wool fabric being rewound on to the core 34 and the metal sheet being rewound into the form of a roll 42 for reuse.

The wool fabric from the core 34 is then fed through a loop dryer 45 as shown in FIG. 3. The wool fabric is fed between driven rolls 46 over a plurality of spaced bars 47 which are continuously advanced by chains 48 so as to form a plurality of fabric loops 49 which hang from the bars 47 in tensionless state. Hot air is supplied to the dryer 45 through passages 50 in a floor plate 51 so that the dryer is maintained at a temperature suited to remove the remaining liquid from the wool fabric. In this dryer some additional shrinkage of the fabric takes place although the wool fabric remains in smooth condition. In this dryer the fabric is subjected to a temperature of about 250° F. until the moisture content is reduced to about twenty percent of its dry weight after which the temperature may be reduced to about 180° F. The temperature may be measured by an infra-red sensing device and the temperature controlled by means used in ordinary cloth dryers of this type. From the dryer 45 the fabric is delivered over a roll 52 to a winder wherein it is wound on a core 53.

Since the setting of the wool is due to the rearrangement of the hydrogen bonds following the scission of the disulphide links which normally proceeds relatively slowly a certain further shrinkage and an improved permanent set can some times be obtained by repeating the process a second time or by allowing an additional time to elapse in the final heating stage in the induction furnace. In some instances, improved results can be obtained by repeating the process a third time although it is not ordinarily desirable.

Varying degrees of stretch can be obtained in either direction by two methods. One method is to change the relationship of the yarn size. If the warp yarn is fine and the filling yarn is coarse, a fabric with warp stretch will be developed. If the warp yarns are coarse and the filling yarns fine, a greater degree of filling stretch can be developed. If the yarns are of equal size, stretch both ways will result. The second method is to hold the fabric while being dried in the direction that no stretch is desired. This will restrict shrinkage, and, therefore, eliminate stretch. Pins or clips can be used to hold the cloth width wise, and tension on the rolling and unrolling of the cloth can reduce the stretch length wise.

The fabric now has the ability to stretch from four percent to twenty percent in either the warp wise direction or the weft wise direction or in both directions according to the previous treatment, and will return to its original form after the stretching force is released.

While a specific agent has been specified by way of example, it is to be understood that other well known reducing agents which are used for setting wool may be employed, for example thioglycolate acid and its salts such as calcium or sodium thioglycolic formaldehyde, a sulfoxylate formaldehyde such as zinc or sodium or the like. It has been found however that the monoethanolamine sulphite produces superior results and requires a comparatively short time to effect the necessary setting action.

The process is particularly applicable to fabrics composed of wool made on the worsted system. In some instances however the worsted yarns may be blended with wool yarns or may be blended up to fifteen percent of a synthetic fabric and still retaining their stretch characteristics.

As a special example, a plain weave fabric composed of two ply 60s wool yarn made on the worsted system having twenty-two turns S singles twist and fourteen turns Z ply twist and woven with forty-nine warp yarns per inch and forty-two weft yarns per inch when treated by the above process, may be contracted to have sixty-one warp yarns per inch and fifty-one weft yarns per inch and set in this contracted state. The fabric may thereafter be

stretched to its original dimensions but will return to its contracted state when released.

Other examples of specific yarn sizes and weaves are given in the following table:

| Turns of S Twist Single | Z Ply | Yarn Size Worsted Counts | Number of Warp Ends | | Number of Weft Ends | |
|---|---|---|---|---|---|---|
| | | | Before | After | Before | After |
| 22 | 14 | 2/60s | 49 | 60 | 42 | 51 |
| 18 | 20 | 2/60s | 68 | 74 | 68 | 77 |
| 17 | 18 | 2/50s | 68 | 72 | 52 | 64 |
| 16½ | 17½ | 2/46s | 49 | 60 | 42 | 52 |
| 15 | 17 | 2/40s | 53.5 | 59 | 48 | 59 |
| 12 | 8 | 2/20s | 38 | 42 | 40 | 44 |

While the above examples have indicated two-ply yarns it will be evident that singles yarns of the equivalent sizes may be used for either warp or weft or both in place of the two-ply yarns specified in which case the twist of the singles yarns will be within the ranges set forth for the equivalent singles yarns in the examples.

The fabric according to this invention is shown in FIGS. 4 to 7 as composed of warp yarns **8** and weft yarns **9**. FIGS. 4 and 5 show a fabric as woven and prior to shrinkage. In this form the yarns are spaced a sufficient distance apart to provide clearance for the shrinkage to which the fabric is to be subjected. In the embodiment shown the fabric is woven with a plain weave wherein the warp yarns **8** are substantially straight and the weft yarns **9** are crimped as they pass under and over successive warp yarns.

The finished fabric after being shrunken and stabilized as illustrated in FIGS. 6 and 7 wherein it will be noted that the warp and weft yarns are more closely spaced than the fabric of FIGS. 4 and 5 and the weft yarns **9** are more highly crimped, that is, there are more crimps per inch due to the greater number of warp yarns per inch in the contracted state of the fabric and they are bent more sharply as they pass under and over the successive warp yarns.

It will be evident that when the fabric is stabilized in this form the weft yarns tend to be pulled out into a straighter or less highly crimped state as the fabric is stretched and due to the memory imparted by the stabilization process will tend to restore the fabric to the stabilized form when the stretching force is released.

This application is a continuation-in-part of my copending application Serial No. 75,394 filed December 12, 1960.

What is claimed is:

1. The method of imparting stretch characteristics to a woven fabric composed essentially of wool yarns made on the worsted system and having an open weave adapted to provide clearance between adjacent yarns to accommodate a shrinkage in fabric dimensions of from 4% to 20% with the resultant compacting of the weave, which comprises incorporating in said fabric from 60% to 100% of the dry weight of the fabric of a treating liquid adapted when heated to cause the yarns to pull up and to have an increased crimp amplitude as they pass under and over successive transverse yarns and to effect a breaking down of some of the disulphide linkages and a rearrangement of the hydrogen bonds such that the yarns are given a permanent set in their more highly crimped state, heating said fabric for a few seconds while said fabric is free to contract in size to a temperature adapted to cause the fabric to shrink and the weave to be compacted, then confining the fabric in smooth state and while confined heating the same to a temperature below the boiling point of the treating liquid for a time to give the yarn a permanent set without appreciably drying the fabric, then heating the fabric while unconfined to a temperature and for a time to remove said treating liquid and to produce a limited further shrinkage of the fabric whereby the fabric may subsequently be stretched by applying a force adapted to reduce the crimp amplitude of the yarns and will return to its contracted state when the stretching force is removed.



2. The method set forth in claim 1 wherein said yarns are 20s to 60s plied yarns having a singles twist of from 12 to 22 turns per inch and a ply twist of from 8 to 14 turns per inch, the twist varying inversely with the yarn size.

3. The method set forth in claim 2 wherein the fabric contains from 42 to 74 warp yarns per inch and from 44 to 77 weft yarns per inch when in the relaxed state.

4. The method set forth in claim 1 wherein the first heating step comprises passing the fabric in tensionless state over a hot surface.

5. The method set forth in claim 1 wherein the fabric is mechanically compacted while in a relaxed state after the initial heating step in order to permit the shrinkage and to disperse the treating liquid uniformly therein.

6. The method set forth in claim 5 wherein the compacting step is effected in a confined zone with the fabric passing between vibrating plates having transverse corrugations.

7. The method set forth in claim 1 wherein the second heating step is effected by rolling the fabric together with a thin metal sheet into a package wherein the fabric convolutions are interleaved between successive convolutions of said metal sheet and inducing heat into said metal sheet for thereby applying said heat uniformly to the various convolutions of said fabric.

8. The method set forth in claim 1 wherein the second heating step is effected by confining the fabric between a smooth surface and a flexible web while subjecting the fabric to heat.

9. The method set forth in claim 1 wherein the final drying stage is effected while the fabric is in tensionless looped state.

10. Apparatus for shrinking and setting a wool fabric comprising means immersing said fabric in a bath, containing a treating liquid, squeeze rolls disposed to remove excess treating liquid from said fabric, means feeding said fabric to a heating stage including an inclined hot plate, means passing said fabric from said squeeze rolls over said plate while in a tensionless state to effect shrinkage of said fabric, a second heating stage including a member having a smooth surface, means confining said fabric in contact with said smooth surface, means supplying heat to said fabric while so confined, a drying chamber, and means passing the fabric in tensionless state from said last heating stage to said drying chamber.

11. Apparatus as set forth in claim 10 in which said second heating stage comprises a thin metal sheet and means for wrapping said sheet with said fabric in interleaved convolutions around a core to form a package.

12. Apparatus as set forth in claim 11 including an induction furnace wherein said package is disposed in said induction furnace for inducing heat electrically in said metal sheet.

13. Apparatus according to claim 10 wherein said second heating stage comprises a cylindrical member having a smooth surface, a flexible web and means passing said fabric and said web over said surface with the fabric confined between said surface and said web during heating.

14. Apparatus as set forth in claim 10 in which said drying stage comprises a loop dryer wherein the fabric is held in tensionless loops and a heated gas is supplied to said dryer.

15. The method of making a woven stretch fabric composed essentially of wool from a woven fabric having weft yarns and warp yarns and said yarns being spaced to permit shrinkage of the fabric, comprising wetting the fabric with a stabilizing agent to increase the density of said yarns in at least one direction and increase the crimp frequency of other yarns by from 4% to 20%, subjecting the fabric to steam while in a smooth state, in the presence of the stabilizing agent for thereby imparting a permanent

set to the yarns and drying the fabric in its permanently set state to thereby produce a stabilized fabric which is stretchable in at least one direction by from 4% to 20% and is capable of returning to its stabilized state when the stretching force is released.

16. The method set forth in claim 15 wherein the weft yarns are 20s to 60s plied yarns having a singles twist of from 12 to 22 turns per inch and a ply twist of from 8 to 14 turns per inch, the twist varying inversely with the yarn size.

17. The method set forth in claim 15 wherein the fabric contains from 42 to 74 warp yarns per inch and from 44 to 77 weft yarns per inch when in the relaxed state.

18. The method of making a woven stretch fabric composed essentially of wool from a woven fabric having weft yarns and warp yarns and said yarns being spaced to permit shrinkage of the fabric, comprising wetting the fabric with a stabilizing agent to increase the density of said yarns in at least one direction and increase the crimp frequency of the other yarns by from 4% to 20%, subjecting the fabric while in a smooth state in the presence of the stabilizing agent to a temperature at about the boiling point of the stabilizing agent for thereby imparting a permanent set to the yarns and drying the fabric in its permanently set state to thereby produce a stabilized fabric which is stretchable in at least one direction by from 4 to 20% and is capable of returning to its stabilized state when the stretching force is released.



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