United States Patent

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[33] **Japan**
[31] **43/62557**

[54] **PROCESS AND APPARATUS FOR CONTINUOUSLY RELAXING TEXTILE FABRICS**
32 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **34/12, 34/60**
[51] **Int. Cl.** **F26b 7/00**
[50] **Field of Search** 34/9, 12, 13, 60, 61, 62, 155

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ABSTRACT: Textile fabric which has residual inner stresses can be uniformly continuously relaxed by a method in which the fabric is heated by steam or hot water and subjected to a mechanical impact such as vibration or jumping, and at the same time, carried along a treating surface owing to the effects of the heating fluid and the mechanical impact. An apparatus for carrying out the method comprises a carrying plate for fabric to be relaxed, a heating medium jetting means corresponding to the carrying plate, and an impact-exerting mechanism. By the method and the apparatus, the textile fabric can be uniformly and continuously relaxed without any fixed wrinkles, and results in suitable handling, bulkiness and dimensional stability.

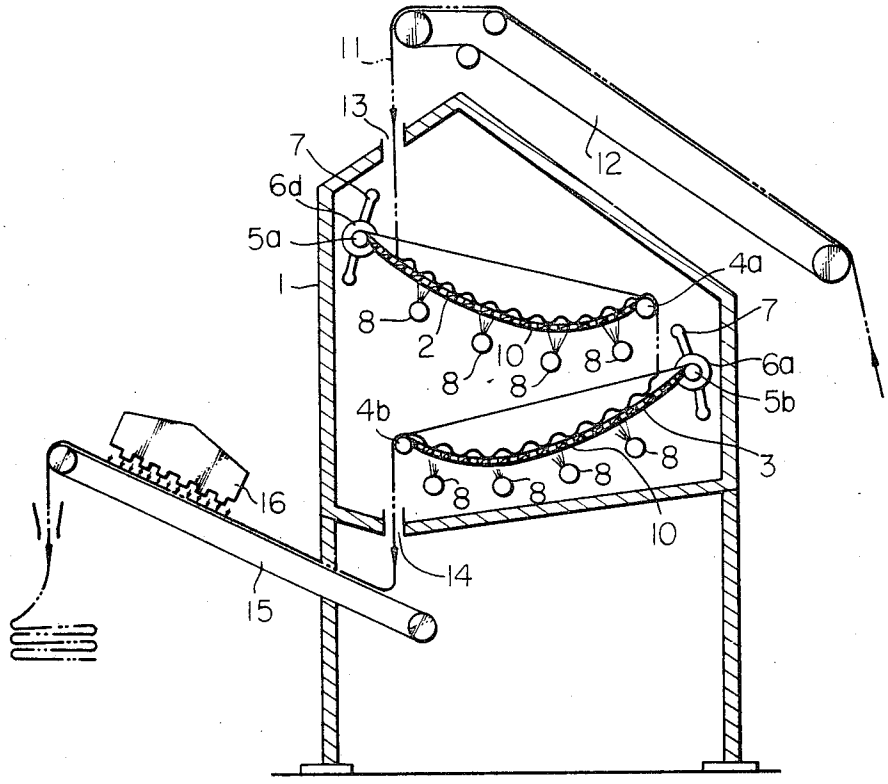

Fig. 1

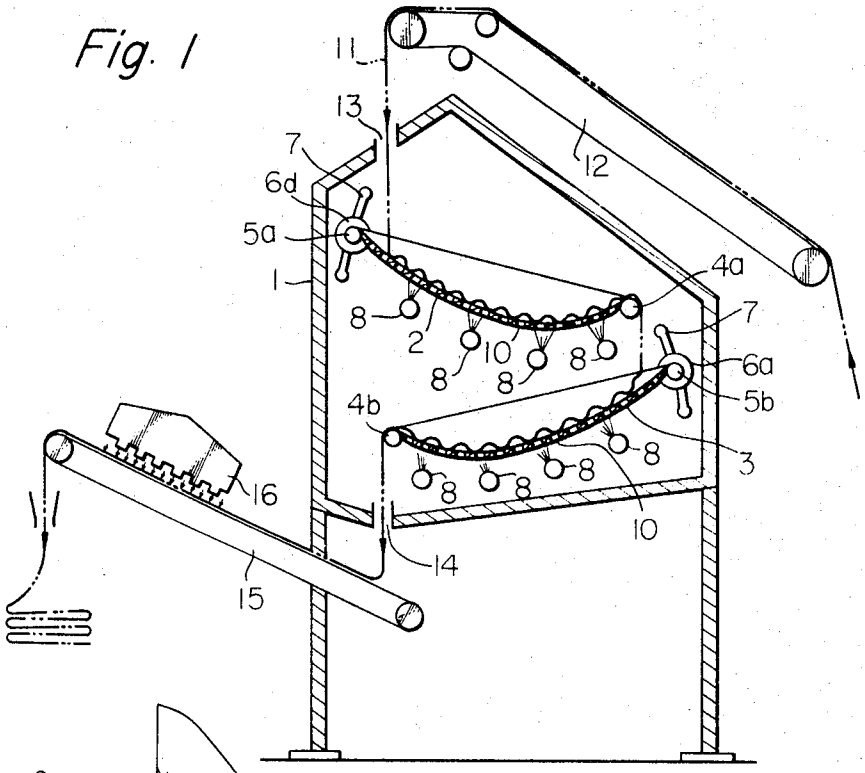
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Fig. 2

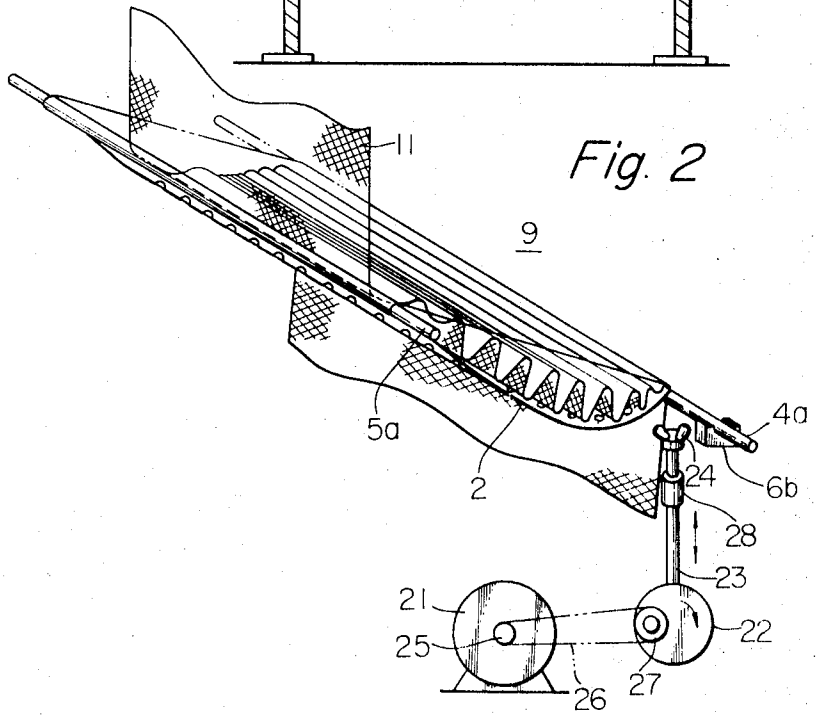
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Fig. 3

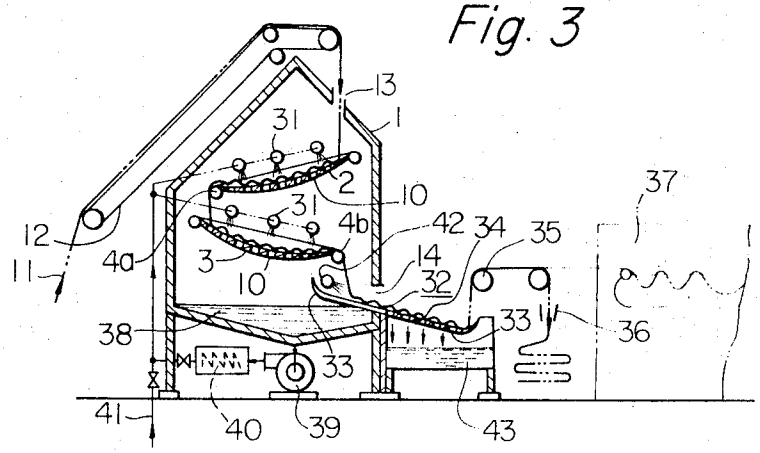
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Fig. 4

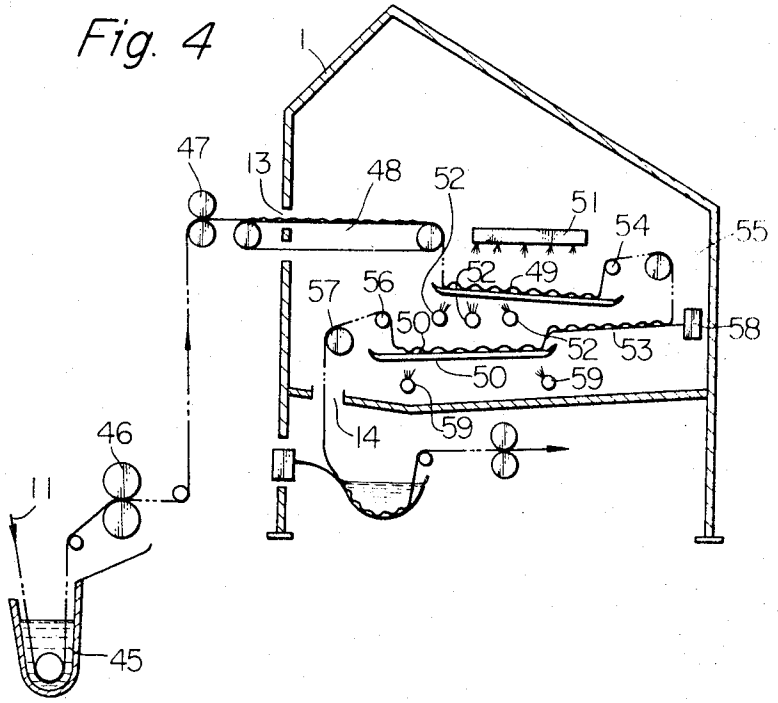
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Fig. 5

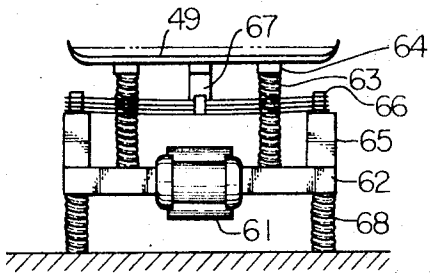


Fig. 6

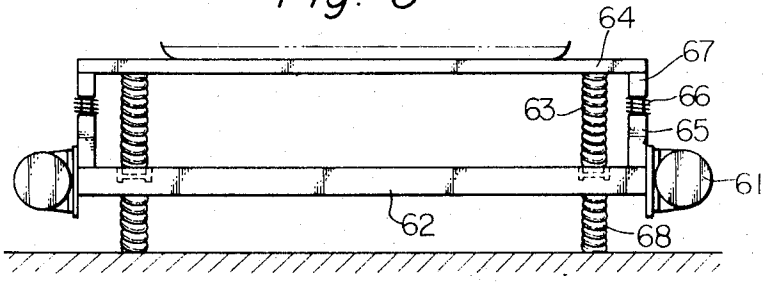
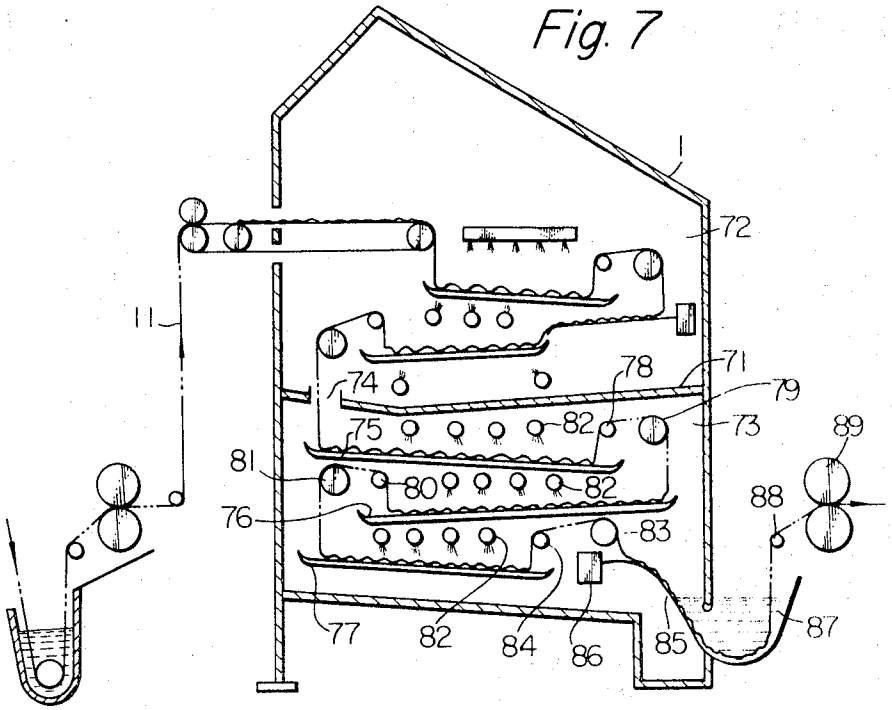


Fig. 7



PROCESS AND APPARATUS FOR CONTINUOUSLY RELAXING TEXTILE FABRICS

The present invention relates to a process and apparatus for continuously relaxing textile fabrics, more particularly relates to a process and apparatus for completely eliminating residual inner stresses from the textile fabrics by exerting a mechanical impact to the textile fabrics under a nontensioned condition and by simultaneously heating the textile fabric with steam or hot water.

Generally, textile products are prepared by passing them through some conventional process such as weaving, knitting, scouring, dyeing and finishing. The conventional process contains some stretching operations for continuously processing the textile fabric. This causes the remaining of stresses due to the stretching in the textile fabric. The remaining stress is a so-called residual inner stress.

Particularly, woven or knitted fabrics prepared from textured yarns which are easily extensible, have a tendency to produce an obvious residual inner stress.

The residual inner stresses accompany the textile fabric along with the following disadvantages:

1. easy dimensional change or deformation of the textile fabric during wearing or washing,
2. nonuniform bulkiness and extensibility, and
3. undesirable hand feel

In order to eliminate the above-mentioned disadvantages, a great many improvements have been proposed. For example, compressive shrinking processes, such as the Sanforized Shrinking Process and L and L Shrinkage Control Process are well known. It is true that the compressive shrinking process is effective for dimensionally stabilizing the textile fabric, however, bulkiness of the textile fabric resulting from the compressive shrinking process is poor, thus, the process is unsuitable for finishing the textured yarn fabrics which are required to have a high bulkiness and high expandability. On the other hand, a batch system for relaxing the textile fabrics within an organic solvent bath, as a perchloroethylene bath, is well known as a relaxing process. This system is unsatisfactory due to its noncontinuity and high cost.

It has been found by the inventors that the residual inner stresses in the textile fabric can be completely eliminated by continuously exerting a wet mechanical impact to the woven or knitted fabric, particularly textured yarn fabric, and at the same time, by jetting a heating medium, such as steam or hot water onto the fabric.

An object of the present invention is to provide a process and apparatus for continuously relaxing textile fabrics in which residual inner stresses, due to stretching operations in the textile processing, undesirably remain and to obtain a textile product having a high dimensional and formal stability.

Another object of the present invention is to provide a process and apparatus for continuously relaxing textile fabrics by exerting a mechanical impact and heat onto the textile fabric, in order to obtain a textile product having a desired bulkiness, softness, extensibility and hand feeling.

The method of the present invention is characterized by comprising the following continuous steps:

a. accumulating a textile fabric on a carrying surface under a nontensioned condition,
b. jetting a heating fluid of a wet desired temperature onto the accumulated textile fabric,
c. simultaneously exerting a mechanical impact on the accumulated textile fabric by an up-and-down reciprocatory motion of the supporting surface,
d. carrying the accumulated textile fabric along the carrying surface by effects of steps (b) and (c), by which the textile material is completely relaxed, and then
e. cooling the carried textile material with a cooling medium of a desired temperature under a nontension condition, by which the textile fabric is stabilized in a relaxed form and dimension.

The apparatus of the present invention for carrying out the method of the present invention is characterized by containing the following;

a. carrying means containing at least a carrying plate along the upper surface of which textile material is carried,
b. at least a jetting means for jetting a heating medium onto said carrying plate, which is disposed corresponding to the carrying plate,
c. at least one means for exerting a mechanical impact to the carrying plate, which is connected to the carrying plate, and
d. a cooling means for cooling the textile fabric, which is disposed downstream of the carrying plate. These means may be contained in a housing.

Further advantages and features of the present invention will be seen from the following description, referring to embodiments shown in the drawings.

In the drawings:

FIG. **1** shows a cross-sectional schematic side view of an embodiment of the relaxing apparatus according to the present invention,

FIG. **2** shows a perspective view of a shocking means of the relaxing apparatus according to the present invention,

FIG. **3** shows a cross-sectional schematic side view of another embodiment of the relaxing apparatus according to the present invention,

FIG. **4** shows a cross-sectional schematic side view of still another embodiment of the relaxing apparatus according to the present invention,

FIG. **5** shows a side view of a vibrating means of the apparatus according to the present invention,

FIG. **6** shows a front view of a vibrating means illustrated in FIG. **5**, and

FIG. **7** shows a cross-sectional schematic side view of a composite apparatus composing the relaxing apparatus illustrated in FIG. **4** and a successive scouring apparatus.

An apparatus shown in FIG. **1** comprises (**1**) a housing **1** for forming a treating chamber therein, (**2**) a first carrying plate **2** disposed in a downwardly inclined form for carrying a textile fabric under a nontensioned condition, (**3**) a second carrying plate **3** disposed below the first carrying plate **2** in a downwardly inclined form in a cross direction with respect to the direction of the first carrying plate **2**, (**4**) lower-end-supporting shafts **4***a* and **4***b* fixed to the lower ends of the carrying plates **2** and **3**, respectively, (**5**) upper-end-supporting shafts **5***a* and **5***b* fixed to the upper ends of the carrying plates **2** and **3**, respectively, (**6**) movable bearings **6***a* for rotatably supporting the right and left ends of the upper-end-supporting shafts **5***a* and **5***b*, (**7**) U-shaped bearings **6***b* fixed on the sidewall of the housing **1** for supporting the right and left ends of the lower-end-supporting shafts **4***a* and **4***b*, (**8**) sliding means **7** disposed on the sidewalls of the housing **1** for sliding the bearings **6** in order to guide the position of the upper-end-supporting shafts **5***a* and **5***b* therealong, and (**9**) a plurality of steam pipes **8** disposed below the carrying plates **2** and **3**, respectively. The apparatus also comprises two jumping means connected with the lower-end-supporting shafts **4***a* and **4***b*, respectively, as shown in FIG. **2**.

Carrying plates **2** and **3** are smooth concave plates having a plurality of apertures, respectively. The carrying plates **2** and **3** are effective for downwardly carrying the fabric supplied from the upper portion of the housing **1**, continuously. The inclining angles of the carrying plates **2** and **3** can be adjusted by sliding the position of the bearings **6** connected with the upper-end-supporting shafts **5***a* and **5***b*, respectively, along the sliding means **7**. The upper-end-supporting shafts **5***a* and **5***b* can be adjusted in a desired position by fixing the bearing **6** onto the sliding means **7**. The steampipe **8** is provided with a plurality of steam-jetting apertures at peripheral upper portions thereof, and thus, can jet steam toward the lower surface of the corresponding carrying plates **2** and **3** through the steam-jetting apertures.

FIG. 2 illustrates a jumping means 9 connected to the carrying plate for exerting a mechanical impact to the fabric. The jumping means 9 comprises (1) a variable-speed motor 21, (2) eccentric cam 22, (3) reciprocating shaft 23, and (4) U-shaped bearing 24. The rotation of the motor 21 is transmitted from the motor pulley 25 to the pulley 27 eccentrically fixed to the eccentric cam 22 by way of the belt 26, by which the cam 22 is eccentrically rotated followed by a reciprocal motion of the reciprocating shaft 23 in an up-and-down direction. When the reciprocating shaft 23 moves upwardly, the U-shaped bearing 24 pushes the lower-end-supporting shaft 4*a* up so as to upwardly pivot the carrying plate 2 around the upper-end-supporting shaft 5*a*. When the reciprocating shaft 23 moves downwardly, the lower-end-supporting shaft 4*a*, which downwardly moves together with the U-shaped bearing 24, is caught in a shock manner by the fixed bearing 6*b* at the fixing position thereof. The carrying plate 2 jumps, owing to the impact. This motion is repeated by the rotation of the motor 21. Therefore, the textile fabric 11 accumulated on the carrying plate 2, also jumps, owing to the motion of the carrying plate 2 and can be downwardly carried along the carrying plate 2.

The screw thread joint 28 is valuable for adjusting the length of the reciprocating shaft 23.

Number of jumps of the jumping means per unit of time can be adjusted to any desired value by adjusting the speed of rotation of the motor 21.

The textile fabric 11 is relaxed with the apparatus shown in FIGS. 1 and 2 as follows.

The fabric 11 which is put on the conveyor 12 disposed above the housing 1, is supplied onto the upper end portion of the first carrying plate 2 through the entrance 13 formed on an upper position of the housing 1. The supplied fabric 11 is accumulated on the downward inclined carrying plate 2 in a wavy bent form which is formed owing to its weight and rigidity, as shown in FIGS. 1 and 2. The accumulated fabric 11 is downwardly carried continuously along the carrying plate 2 owing to its weight force and jumping motion accompanied by the jumping motion of the carrying plate 2 by way of the jumping means 9. At this time, steam ejected from the steampipe 8 is blown to the accumulated fabric 11 through the apertures 10 formed on the carrying plate 2 so as to exert an impact and heat to the fabric 11. The fabric 11, which arrives at the lower end portion of the carrying plate 2, is delivered onto the upper end portion of the carrying plate 3 over the lower end 4*a* and is thereby turned over. The supplied fabric 11 is carried from the upper end to the lower end of the lower carrying plate while the fabric is treated in the manner as described above. The fabric, which has arrived at the lower end 4*b*, is delivered onto the conveyor 15 through the exit 14 formed at a lower portion of the housing. The fabric is cooled by the cooling air ejected from the cooling means 16 under a non tensioned condition for fixing the relaxed fabric into desired dimensions and form, and the transported to the desired successive steps.

As described above, the textile fabric 11 supplied onto the carrying plates 2 and 3 is subjected to heating and mechanical shock by the effect of the ejected steam and at the same time, to jumping by the motion of the jumping means 9, by which the residual inner stresses in the fabric can be completely eliminated. Further, when the fabric 11 is delivered from the carrying plate 2 to carrying plate 3, the face of the fabric is turned over so that the upper face of the fabric on the carrying plate 2 is turned over to the lower face of the fabric on the carrying plate 3, in order to uniformly treat both faces of the fabric 11. The fabric, therefore, can be relaxed uniformly during its being carried on the carrying plates 2 and 3.

It is possible to effect the elimination of the residual inner stress of the fabric by using hot water instead of steam. FIG. 3 shows an embodiment of a relaxing apparatus in which hot water is used as a heating medium. In FIG. 3, the hot water supply pipe 31 is disposed above the carrying plates 2 and 3. The hot water supply pipe 31 is for downwardly jetting hot water onto the fabric 11 accumulated on the carrying plates 2 and 3 in order to heat and, at the same time, exert a mechanical impact to the fabric. The fabric arrives at the lower end of the carrying plate 3, then is delivered onto the inclined plate 32. The inclined plate 32 is composed of an inside portion 33 which is inserted within the housing 1 through the exit 14, and an outside portion 34 which is disposed outside the housing 1. The outside portion 34 is provided with a plurality of apertures. A water supply pipe 42 is disposed above the top portion of the inside portion 33. The water supply pipe 42 is effective for downwardly carrying the fabric along the inclined plate 32 and for cooling the fabric by the water stream ejected from the pipe 42. The water flows down into the tank 43 through the apertures of the outside portion 34, and, if desired, the water in the tank 43 is recycled to the pipe 42. The fabric 11 is withdrawn from the outside portion 34 by way of the draw up roll 35, and accumulated at a desired position by the delivery device 36 or dried by the dryer 37. The hot water jetted from the hot water supply pipe 31 flows down into the bottom portion 38 of the housing 1 and, if desired, may be recycled to the pipe 31 through the recycling pump 39 and heater 40 together with fresh water fed from a water source 41.

The carrying plates 2 and 3 in FIG. 3 can be jumped by the same jumping means as shown in FIG. 2. The fabric 11 being carried on the carrying plates 2 and 3 is subjected to heating by the jetted hot water and to mechanical shocking by the motions of the jetted hot water and the jumping means in order to uniformly eliminate the residual inner stress of the fabric.

Instead of the above-mentioned jumping means, a vibrating means can be utilized resulting in the complete elimination of the residual inner stress of the fabric. An embodiment of the relaxing apparatus having a vibrating means is shown in FIGS. 4, 5 and 6. In FIG. 4, the provisional wetting bath 45, a pair of squeezing rolls 46 and a pair of draw up rolls 47 are disposed outside the housing 1. The fabric 11 is provisionally wetted in the bath 45, dewatered by the squeezing rolls 46 to a desired water content, and then supplied onto the conveyor 48 through the draw up rolls 47. The supplied fabric 11 is introduced into the housing 1 under a nontensioned condition.

The housing 1 contains (1) two carrying plates 49 and 50 horizontally disposed or slightly inclined, (2) hot water jetting pipes 51 and 52 disposed above the carrying plates 49 and 50, respectively, (3) guide rolls 54 and 56, (4) draw up rolls 55 and 57, (5) an inclined plate 53 disposed between the carrying plates 49 and 50 for opening the fabric, (6) hot water tank 58, and (7) steam-ejecting pipe 59.

The two vibrating means 60, one of which is shown in FIGS. 5 and 6, are connected with the carrying plates 49 and 50, respectively. The vibration mechanism of the vibrating means 60 will be explained in detail hereinafter.

The fabric 11 supplied by way of the conveyor 48 is carried on the first carrying plate 49 in a wavy bent form, as shown in the drawing, under a nontensioned condition. The hot water supply pipe 51 is effective for jetting hot water downwardly onto the fabric accumulated on the first carrying plate 49 for uniformly wetting and heating the fabric 11. The fabric 11 is supplied from the first carrying plate 49 onto the inclined plate 53 through the guide roll 54 and draw up roll 55. The fabric 11 supplied onto the inclined plate 53 is opened by action of the hot water fed from the tank 58 onto the plate 53 and then, the opened fabric 11 is supplied onto the second carrying plate 50. The hot water supply pipe 52 can jet hot water toward the lower surface of the first carrying plate 49. The jetted hot water is deflected by the lower surface so as to uniformly run the hot water toward the fabric 11 accumulated on the second carrying plate 50.

The fabric 11, which arrives at the lower end portion of the second carrying plate 50, is drawn up by the draw up rolls 57 through the guide roll 56 and guided to the outside of the housing 1 through the exit 17. The guided fabric 11 is cooled by being passed through the cooling bath 44.

The steam-feeding pipe 59 disposed below the second carrying plate 50, is valuable for maintaining the temperature in the housing 1 as desired.

The vibrating means **60**, connected with each carrying plate, is indicated in FIGS. **5** and **6**. In FIGS. **5** and **6**, the vibrating means **60** is shown as comprising (**1**) vibration motor **61**, (**2**) vibration transmission frame **62**, which is vibrated by the motor **61**, (**3**) four amplifier springs **63**, an end of which is connected with the vibration transmission frame **62** and another end of which is connected with a supporting member **64** being fixed on the lower surface of the carrying plate **49**, the amplifier springs **63** are valuable for amplifying the vibration of the frame **62** and transmitting the amplified vibration to the carrying plate **49**, and (**4**) four vibration absorber springs **68** by which the vibration transmission frame **62** is supported on the base frame **69**, the springs **68** are effective for absorption of vibration of the vibration transmission frame **62** in order to insulate the base frame **69** from vibration. Further, the vibrating means may contain means for preventing horizontal vibration of the carrying plate **49**. The means, shown in FIGS. **5** and **6**, further comprises (**5**) four supporting members **65** disposed on the frame **62**, (**6**) two laminated springs **66** both ends of which are fixed with the supporting members **65**, respectively, so as to bridge over the frame **62** at angles with respect to the longitudinal direction of the carrying plate **49**, and (**7**) two connecting members **67**, an upper end of which is fixed on the lower surface of the carrying plate **49** and a lower end of which is connected with an intermediate portion of the laminated springs **66**, respectively. The laminated springs **66** are effective for preventing the carrying plate **49** from vibration in a horizontal direction caused by the vibration of the amplifier springs **63**.

When the textile fabric **11** is introduced into the housing **1**, the fabric **11** is relaxed into an inner stress-free condition by vibration of the vibrating means **60** and by heat impact of the jetted hot water while the fabric **11** passes over the carrying plates **49** and **50**.

The relaxing apparatus, according to the present invention, may be directly connected to a wet process such as rinsing, scouring and desizing. In FIG. **7**, the inside space in the housing **1** is partitioned by the partition **71** into two compartments. The upper compartment **72** contains the relaxing apparatus as shown in FIG. **4**, and the lower compartment **73** contains a rinsing, scouring or desizing apparatus. The fabric, which is carried through the relaxing apparatus, is introduced into the lower compartment **73** through the intermediate opening **74**. The introduced fabric **11** is successively carried on the inclined plates **75**, **76** **77** through the guide rolls **78** and **80** and draw up rolls **79** and **81**. A plurality of hot water showers **82** are disposed above the inclined plates **75**, **76** and **77**, respectively, the shower **82** can jet hot water onto the fabric **11** supplied on the inclined plates **75**, **76** or **77**. The supplied fabric **11** is rinsed, scoured or desized with hot water and at the same time the fabric **11** is opened and carried on the inclined plates by action of the jetted hot water. The fabric **11**, which arrives at the lower end of the inclined plate **77**, is drawn up by way of the draw up roll **83** through the guide roll **84**, and is supplied onto the inclined fabric opening plate **85**. The water tank **86** is usable to feed water onto the inclined fabric opening plate **85**. The fabric **11**, together with the fed water, is introduced into the cooling bath **87** through the exit **14** along the inclined fabric opening plate **85**. The water fed from the tank **86** and cooling bath **87** are effective for cooling and setting the fabric **11** in a relaxed dimension and form.

The cooled fabric **11** is withdrawn from the cooling bath **87**, passed through the guide roll **88**, dewatered by way of a pair of squeezing rolls **89** to a desired water content, and then supplied to a successive step.

Temperature and flow rate of steam or hot water to be jetted onto the fabric may be controlled according to the kind and design of fabric to be treated and purpose of the process.

In the process in accordance with the present invention, the textile fabric can be uniformly relaxed into an inner stress-free condition by mechanical impact caused by the jetting action of the heating medium such as steam and hot water and mechanical jumping or vibrating motion, and by heat of the jetted heating medium. Further, the fabric can be carried through the relaxing apparatus by action of the mechanical impact, under a nontensioned condition.

As further illustration of how the present invention can be carried out effectively, references will now be made to the following examples.

EXAMPLE 1

A union satin fabric was prepared from a warp of nylon-6 textured yarn (70 denier × 2) and a filling of rayon yarn (20^s/2). The satin fabric was subjected to a relaxing treatment under the following conditions:

1. relaxing apparatus:	as shown in FIG. 1.
2. heating medium:	steam of 105° C.
3. staying time with the relaxing apparatus:	2.5 minutes
4. number of jumps:	1,000/min.
5. amplitude of jumps:	20 mm.

The resultant fabric was uniformly relaxed without any fixed wrinkle.

The textile properties of the original fabric and the relaxed fabric is shown in Table **1**.

TABLE 1

	Measurement			
	Relaxation shrinkage in warp direction (percent)	Laundering shrinkage [1] in warp direction (percent)	Extensibility [2] in warp direction (percent)	Thickness (mm.)
Fabric:				
Original		5.2	48	0.99
Relaxed	40	1.1	54	1.08

[1] Laundering shrinkage is measured based upon JIS 1042 F-1.
[2] Extensibility was measured based upon JIS L-1080 Test B.

As is clear in Table **1**, the relaxation, according to the method of the present invention, resulted in an improved dimensional stability and bulkiness in the treated satin fabric.

EXAMPLE 2

A tubular knitted jersey was prepared from a nylon-6 textured yarn (70 denier × 2).

The nylon-6 jersey was subjected to a relaxation under the same conditions as stated in Example **1**. The nylon-6 jersey was uniformly relaxed without any fixed wrinkle. The textile properties of the original and relaxed jersey are indicated in Table **2**.

TABLE 2

	Relaxation shrinkage (percent)		Laundering shirnkage (percent)		
	Warp	Filling	Warp	Filling	Weight (g./m.^{2})
Fabric:					
Original			9.3	1.5	251
Relaxed	5.2	1.2	3.0	0.5	268

Table **2** clearly shows that the relaxed jersey has a desirable dimensional stability and bulkiness.

EXAMPLE 3

A plain weave fabric was prepared from a polyester textured yarn (75^d×2). The polyester fabric was subjected to a relaxation under the following conditions:

1. relaxing apparatus:	as shown in FIG. 3
2. heating medium:	hot water of 90° C.
3. staying time within the apparatus:	3 minutes
4. number of jumps:	1,200/min.
5. amplitude of jumps:	15 min.

The polyester fabric was relaxed as shown in Table 3 without any fixed wrinkle.

TABLE 3

	Relaxation shrinkage	
	After dewatering by a mangle (percent)	After drying by a short loop dryer (percent)
Direction:		
Warp	22	23
Filling	19	20

The relaxed polyester fabric has a desirable hand feeling and a very small laundering shrinkage.

EXAMPLE 4

A union cloth was prepared from a warp of nylon-6 textured yarn (70^d×2) and a filling of rayon yarn (20^s/2). The union cloth was subjected to a relaxing treatment under the following condition:

1. relaxing apparatus:	as shown in FIG. 3
2. heating medium:	hot water of 70° C.
3. staying time within the apparatus:	4. 5 minutes
4. number of jumps:	1,000/min.
5. amplitude of jumps:	15 mm.

The union cloth was relaxed as shown in Table 4 without any wrinkle.

TABLE 4

	Relaxation shrinkage	
	After dewatering by a mangle (percent)	After drying by a short loop dryer (percent)
Direction:		
Warp	21	26
Filling	9	11

The resultant union cloth has an improved bulkiness, desirable hand feeling and a very small laundering shrinkage,

EXAMPLE 5

A plain fabric was woven from a polyester textured yarn (75 denier × 2) and a triple-interlock jersey was knitted from a polyester textured yarn (150 denier × 1). The two fabrics were subjected to relaxation under the following conditions:

1. relaxing apparatus:	as shown in FIG. 4
2. heating medium:	boiling water
3. staying time within the apparatus:	3.5 minutes
4. number of vibrations:	900 cycles/min.
5. amplitude of vibrations:	20 mm.

Temperature in the relaxing apparatus was maintained by injecting steam of 4 kg/cm^2 pressure.

A vibrating motor (made by YASUKAWA DENKI, Japan, type KEB-2.5-6, 200V, 0.2 KW) having a vibration power of 250 kg and a maximum rotation speed of 1,200 r.p.m. was used for the relaxing apparatus. Each carrying plate of the relaxing apparatus has a length of 1.5 m., a width of 1.9 m. and depth of 0.5 cm. The fabrics were supplied into the relaxing apparatus at a velocity of approximately 10 m./min.

The relaxed fabrics were dewatered by a mangle into a water content of 100 percent based upon the weight of the fabric, respectively, and dried by passing the fabrics through a short loop-type dryer at 100° C. for 5 minutes.

The resultant fabrics had no undesirable fixed wrinkles.

The textile properties of the original fabrics and resultant fabrics were as shown in Table 5.

TABLE 5

	Measurement				
Fabric	Relaxation shrinkage [1] in area (percent)	Thickness [2] (mm.)	Specific [3] volume (cm.^{3}/g.)	Extensibility [4] Warp	Filling
Woven fabric:					
Original		2. 90	0. 21	2. 5	1. 5
Relaxed	30. 5	0. 485	0. 35	14. 2	11. 5
Jersey:					
Original		0. 90	3. 76		
Relaxed	31. 7	1. 40	3. 98		

[1] Relaxation shrinkage in area is established as follows:
(1) Fabric marking; a standard square mark of 1 m. in warp and filling directions is marked on the original fabric.
(2) Measurement; after relaxation, the warp length and filling length of the mark are measured.
(3) Calculation of the shrinkage in area; shrinkage in area is calculated from the measured lengths.
[2] Thickness is measured based upon JIS L-1079.
[3] Specific volume is measured based upon JIS L-1079.
[4] Extensibility is measured based upon JIS L-1080, Test B.

Both relaxed fabrics were provided with a very good hand feeling and a suitable bulkiness, and the laundering shrinkages were very small, respectively.

EXAMPLE 6

A union cloth fabric was woven from a warp of nylon-6 textured yarn (70^d×2) and a filling of rayon yarn (20^s/2), and a triple-interlock jersey was knitted from a nylon-6 textured yarn (70^d×2)

The two opened fabrics were subjected to a relaxation under the following conditions:

1. relaxing apparatus:	as shown in FIG. 4
2. heating medium:	hot water of 70° C.
3. staying time within the apparatus:	4 minutes
4. number of vibrations:	800 cycles/min.
5. amplitude of vibration:	25 min.

Temperature in the relaxing apparatus was maintained at 70° C. injecting steam. The relaxed fabrics were dewatered by a mangle into a water content of 100 percent based upon the weight of the fabric, and dried at 100° C. for 5 minutes in a short loop-type dryer, respectively. The resultant fabrics did not have undesirable fixed wrinkles, but had the textile properties as shown in Table 6.

TABLE 6

	Measurement			
Fabric	Relaxation shrinkage in area (percent)	Thickness (mm.)	Specific volume (cm.^{3}/g.)	Extensibility in warp direction (percent)
Woven fabric:				
Original		1. 07	2. 65	5. 3
Relaxed	23	1. 56	2. 98	29. 5
Knitted fabric:				
Original		1. 05	3. 76	
Relaxed	28. 4	1. 52	3. 94	

As is obviously indicated in Table 6, both resultant fabrics were provided with a satisfactory hand feeling, a suitable bulkiness and a very small laundering shrinkage, respectively.

We claim:

1. A process for continuously relaxing textile fabric comprising the steps of:

a. continuously accumulating a textile fabric onto a carrying surface under a nontensioned condition,

b. jetting a wet heating fluid having a desired temperature

onto said accumulated textile fabric,

c. simultaneously, exerting a repetitive mechanical impact on said accumulated textile fabric by an up-and-down reciprocatory motion of said carrying surface,

d. continuously carrying said accumulated textile fabric along said carrying surface by the action of said steps (b) and (c), and then,

e. cooling said carried textile fabric with a cooling medium, under a nontensioned condition.

2. A process as set forth in claim **1**, in which said heating medium is steam.

3. A process as set forth in claim **1**, in which said wet heating fluid is hot water.

4. A process as set forth in claim **1**, in which said jetting is downwardly carried out onto said accumulated textile fabric.

5. A process as set forth in claim **1**, in which said jetting is upwardly carried out onto said accumulated textile fabric through apertures in said carrying surface.

6. A process as set forth in claim **1**, in which said mechanical impact is imparted by a jumping motion of said surface.

7. A process as set forth in claim **1**, in which said mechanical impact is imparted by a vibrating motion of said surface.

8. A process as set forth in claim **1**, in which said carrying is carried out along a staircase carrying surface.

9. A process as set forth in claim **8**, in which said staircase carrying is carried out along a zigzag carrying surface.

10. A process as set forth in claim **1**, in which said cooling is carried out by passing said textile fabric through a cooling medium bath.

11. A process as set forth in claim **1**, in which said cooling is carried out by jetting said cooling medium onto said textile fabric.

12. A process as set forth in claim **1**, further comprising carrying said textile fabric on a downwardly inclined surface by action of a water stream which flows down along said inclined surface, by which said textile fabric is opened.

13. A process as set forth in claim **12**, in which said opening of said textile fabric is carried out at a downstream position of said carrying passage.

14. A process as set forth in claim **12**, in which said opening of said textile fabric is carried out at an intermediate position of said carrying surface.

15. An apparatus for continuously relaxing textile fabrics comprising;

a. carrying means which contains at least a carrying plate along an upper surface of which a textile fabric is carried,

b. at least one jetting means for jetting a heating medium toward said plate, which is disposed corresponding to said carrying plate,

c. at least one means for exerting a mechanical impact to said carrying plate, which is connected with said carrying plate, and

d. a cooling means disposed downstream of said carrying plate, for cooling said textile fabric.

16. An apparatus as set forth in claim **15**, in which said carrying plate is disposed in a horizontal condition.

17. An apparatus as set forth in claim **15**, in which said carrying plate is disposed in a downwardly inclined condition.

18. An apparatus as set forth in claim **15**, in which at least two carrying plates are arranged longitudinally side by side.

19. An apparatus as set forth in claim **18**, in which said carrying plates are arranged with a head mutually.

20. An apparatus as set forth in claim **15**, in which at least two carrying plates are arranged face to face with a head mutually.

21. An apparatus as set forth in claim **15**, in which said carrying plate is a concave plate.

22. An apparatus as set forth in claim **15**, in which said carrying plate is a plane plate.

23. An apparatus as set forth in claim **15**, in which said carrying plate has a plurality of apertures.

24. An apparatus as set forth in claim **15**, in which said carrying plate is provided with (a) a shaft for supporting an upper end of said carrying plate, (b) a shaft for supporting a lower end of said carrying plate, (c) means for adjusting a position of an upper end-supporting shaft-carrying plate, and (d) means for pivotally fixing said upper-end-supporting shaft.

25. An apparatus as set forth in claim **15**, in which said mechanical impact exerting means comprises:

a. a driving motor,

b. at least eccentric cams which are rotated by said driving motor,

c. at least reciprocating shafts connected with said eccentric cams,

d. at least U-shaped bearings connected to a top end of said reciprocating shafts, which can push up said lower end supporting shafts.

26. An apparatus as set forth in claim **11**, in which said mechanical impact exerting means is vibrating means which comprises;

a. two vibrating motors,

b. a vibration transmission frame connected to said two motors,

c. at least two vibration amplifier springs, upper ends of which are connected to said carrying plate, and lower ends of which are connected to said vibration transmission frame, respectively,

d. at least two springs for preventing a base frame for supporting said vibrating means from said vibration, an upper end of said preventing spring is connected to said vibration transmission frame, and a lower end of said preventing spring is connected to said base frame.

27. An apparatus as set forth in claim **26**, in which said vibrating means further comprising at least a spring for preventing said carrying plate from a horizontal vibration, which bridges over said vibration transmission frame in a right angle with respect to the longitudinal direction of said carrying plate.

28. An apparatus as set forth in claim **15**, in which said cooling means is a cooling bath containing a cooling medium.

29. An apparatus as set forth in claim **15**, in which said cooling means is a means for jetting a cooling medium.

30. An apparatus as set forth in claim **15**, further comprising a housing for containing at least said means of (a) and (b).

31. An apparatus as set forth in claim **15**, further comprising at least one means for opening said textile fabric which is disposed downstream of said at least one carrying plate and comprises at least an inclined plate and at least a water-feeding means for feeding water onto an upper end portion of said inclined plate.

32. An apparatus as set forth in claim **31**, in which said opening means is disposed between at least two carrying plates.