Oct. 24, 1961 C. G. HATAY 3,005,250

MACHINE FOR FABRIC FINISHING TO REDUCE SHRINKAGE AND IMPROVE THE FEEL AND HAND OF CLOTH

Original Filed March 7, 1955 2 Sheets-Sheet 1

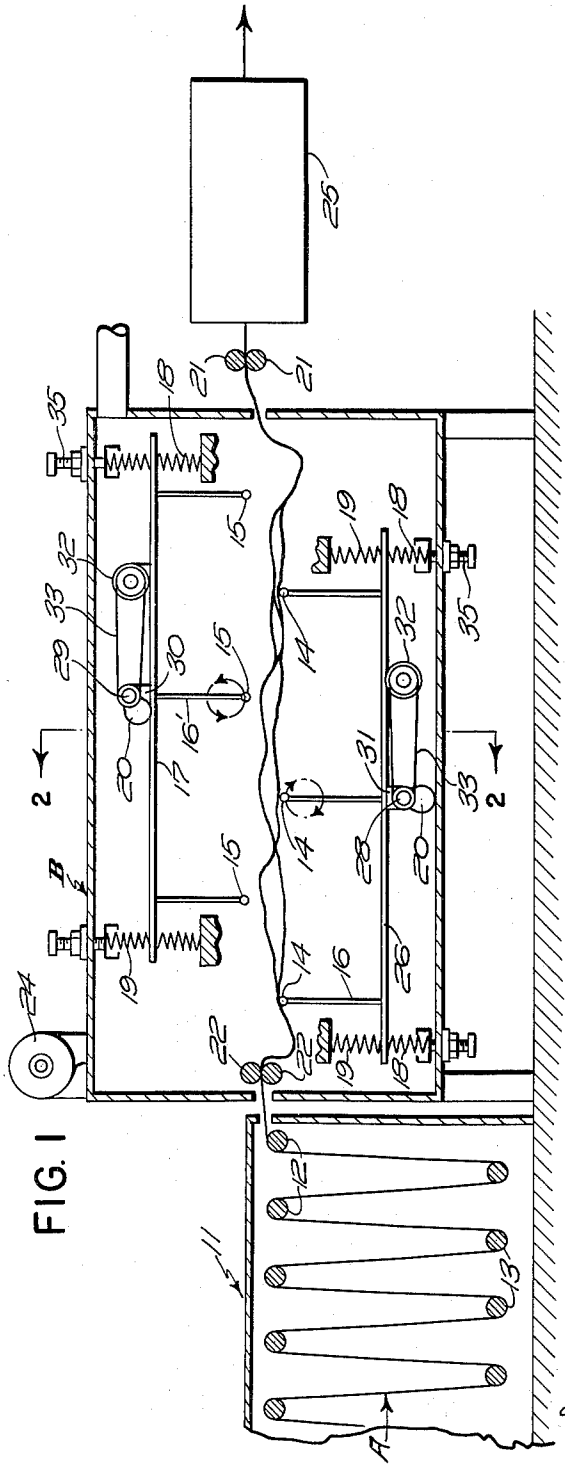


FIG. 1

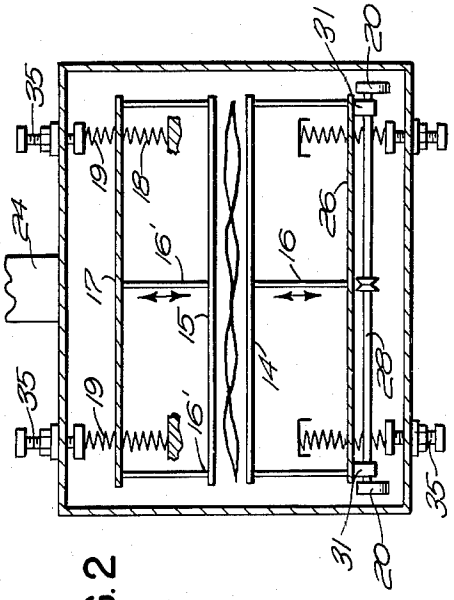


FIG. 2

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FIG. 3

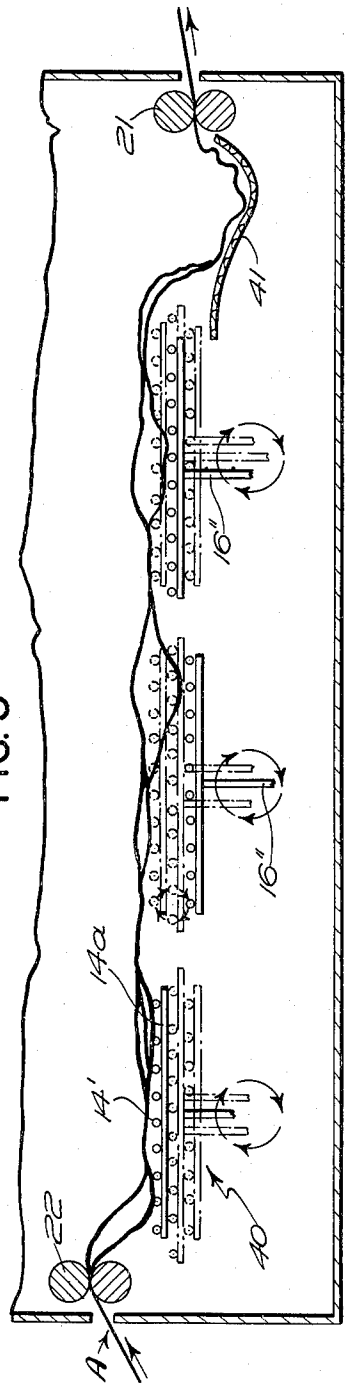


FIG. 5

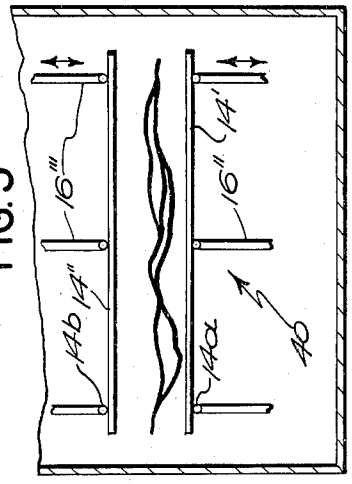
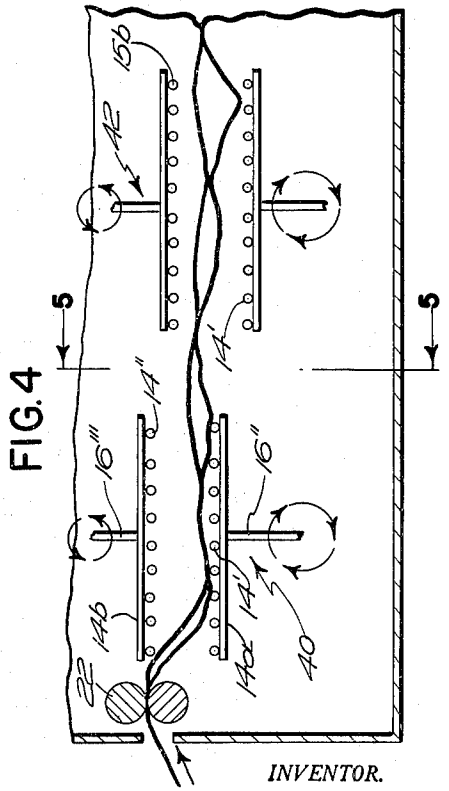


FIG. 4



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United States Patent Office 3,005,250 Patented Oct. 24, 1961

3,005,250

MACHINE FOR FABRIC FINISHING TO REDUCE SHRINKAGE AND IMPROVE THE FEEL AND HAND OF CLOTH

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Original application Mar. 7, 1955, Ser. No. 492,436, now Patent No. 2,733,498, dated Feb. 7, 1956. Divided and this application Feb. 3, 1956, Ser. No. 563,285
11 Claims. (Cl. 26—18.5)

The present application is a division of my prior application Ser. No. 492,436 filed March 7, 1955, now U.S. Patent No. 2,733,498, which was a continuation-in-part of application Ser. No. 205,760, filed Jan. 12, 1951, and now abandoned.

The present invention relates to a machine for practicing a method of finishing fabric, both woven and knitted, to reduce shrinkage during subsequent washing and to improve the feel and hand of the cloth. It is applicable to fabric made from the various textile fibers, for instance, cotton, wool, rayon and other natural and synthetic fibers or mixtures thereof, and it may be used as part of the ordinary procedure of finishing such fabrics. It is particularly applicable to knit goods as to which, as far as I am aware, no practical method has been discovered by which the shrinkage may be greatly reduced.

Heretofore, a commonly employed method of reducing shrinkage has been to compress the goods while in a wet condition against a flat surface, and while so compressed to dry them by the application of heat. As a practical matter this process is applicable only to cotton, linen and synthetic fibers of the same general nature, and while it reduces the subsequent shrinkage considerably, it is apt to give the cloth a polished, shiny surface and a less satisfactory hand and feel. This is probably due to the fact that the fibers composing the cloth are somewhat plastic in the presence of moisture and heat and are flattened and polished and are pressed into each other thereby reducing the thickness of the cloth.

My invention is based on the discovery that if fabric while in a substantially lax condition is subjected to successive sharp localized impacts, shocks or blows and if the area on the other side of the cloth opposite to the area where each of said impacts is imparted is free from contact with a rigid surface at the time of said impact, the fibers and strands composing the cloth are rearranged and repositioned, the cloth is thickened and some of the ends of the fibers are released from entanglement and brought to the surface and the hand and feel of the fabric is improved but the surface of the fibers is not polished nor rendered shiny.

I have further discovered that if, during at least a part of the time during which wet fabric is impacted, it is simultaneously dried and the water content thereof is reduced below that necessary to saturate the fibers and maintain a molecular film of water thereon (about 25% moisture content of the fabric) the tendency of the fabric to shrink on being subsequently washed and dried is reduced and may even be largely eliminated, the residual shrinkage depending on the moisture content left in the fabric after completion of treatment and the amount of impacting. Although the impacting may begin while the moisture in the cloth exceeds that necessary to saturate the fibers and maintain a molecular film of water thereon, this amount of water being ordinarily about twenty-five percent of the weight of the bone dry cloth, it is not until after the water content has fallen below this amount that there is any substantial improvement in the reduction of shrinkage during subsequent washing.

I have further discovered that by arranging the motion of the impactor in such a way that the resultant displacement of the fabric is in the direction of the desired advance, the fabric can be made to advance without pulling it or subjecting it to any substantial tension.

It is preferable that the area of each impact be as small as possible so that the amount of energy dissipated per unit of area shall be as large as possible, since, if applied over a large area, the result of the impact is chiefly to push the cloth out of the path of the impacting member without the desired effect on the fiber structure.

The amount of rearrangement and repositioning of the fibers depends primarily upon the momentum of each impact, total number of impacts given to each unit area of the fabric, and the weight and mass of the fabric. The momentum of each impact depends chiefly on the amplitude and rate of travel of the impactors while the total number of impacts given to each unit area depends also on the rate of travel of the fabric past the impactors. Different types of fabric require different amounts of energy to rearrange the fibers.

The following theoretical explanation which I believe to be correct may be helpful in understanding the invention but is not intended to limit it except as stated in the claims.

When moisture is applied to a fabric whose fibers are moisture absorbent, the fibers first absorb moisture and complete saturation is indicated by a molecular film of moisture on the surface of the fibers; thereafter as further water is applied the interstices fill up. The moisture in the interstices is conveniently called the entrapped moisture while that contained in the fibers themselves may be called the absorbed moisture. Thereafter when the fabric is dried the entrapped moisture is first removed, and afterward the absorbed moisture evaporates. If a wet fabric is impacted and simultaneously dried, and the impacting is stopped before the entrapped moisture is entirely removed, it is found that while the hand and feel is improved by the treatment, the shrinkage is reduced.

It is further found that the effect of impacting in reducing shrinkage increases as the drying reduces the moisture content, and is particularly noticeable as the point of complete dryness is approached.

The method practiced by the machine of the present invention may be incorporated as one step in the ordinary procedure of finishing fabrics.

The invention will be fully understood from the following description taken in connection with the accompanying drawings.

FIG. 1 is a vertical section of the machine through which cloth which is being treated passes horizontally after it leaves the dryer and before it enters a machine for some subsequent treatment, as for instance, a tenter, and spreader.

FIG. 2 is a section on line 2—2 of FIG. 1.

FIG. 3 is a vertical section of a machine like that of FIG. 1 except that the upper impacting members are omitted and the impacting wires are arranged in units, each unit being moved independently by a separate and independent driving means. These driving means are not shown but each of them is like the driving means of FIGS. 1 and 2.

FIG. 4 is a vertical section of a machine like that of FIG. 3 except that it has upper impacting units in addition to lower impacting units. Each of these upper units move and are moved in the same way and by the same means as, but independently of, the units of FIG. 3.

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

Referring now to FIGS. 1 and 2, a web, i.e., a continuous length, of fabric is indicated at A. At 11 is indicated a dryer with the support rolls 12—12 and weight rolls 13—13 supported by festoons of the fabric A. In this dryer a portion of the water is removed from the

web. The web is pulled through the dryer 11 by the rolls 22 and then passes into and through a novel machine, which is conveniently referred to as an impacting machine and which is designated B, in such a manner that while it is in the impacting machine, it is at all times slack and lax. This machine includes a series of taut wires 14 and 15 constituting impacting members which are stretched between vertical arms 16 and 16'. The wires in effect constitute means providing a face for impacting the fabric. The arms 16 for the wires 14 are located on and extend upwardly from a floating plate or support 26, and the arms 16' for the wires 15 are supported on and extend downwardly from another floating plate or support 17. The plates 26 and 17 are supported between upper and lower springs 18 and 19 so that the plates 26 and 17, and consequently the arms 16 and 16' and the wires or impacting members 14 and 15 are free to move bodily as a unit in a generally circular path or orbit under impulses given to the plate by some convenient device. The springs in effect constitute means for constraining the wire frame for translatory motion of the face. Rotating shafts 28 and 29 are carried in brackets 31 and 30 on the plates 26 and 17. Each shaft is rotated by a belt 33 and an electric motor 32 mounted on the respective plate, and each shaft carries on its ends eccentric weights 20. The eccentric weights in effect constitute means for constraining the face defined by the wires for motion through an orbit. The electric motor in effect constitutes means for driving the face through its orbit. It is apparent that upon clockwise rotation of the lower shaft and its eccentrics and counterclockwise rotation of the upper shaft and its eccentrics, the eccentrics attached to shaft 28 cause shaft 28, plate 26, arms 16 and wires 14 to move bodily and in a clockwise direction along a generally circular path or orbit, as shown by the arrows, and the eccentrics attached to shaft 29 cause shaft 29, plate 17, arms 16' and wires 15 to move bodily and in a counterclockwise direction along a generally circular path or orbit as shown by the arrows. This causes the wires to strike the fabric a succession of sharp localized impacts or blows and to move it longitudinally through the machine to the right. The period and implitude of movement of impacting members 14 and 15 may be regulated by regulating the speed of the motor and tension on the springs 18 and 19 by screws 35. At 21—21 is shown a pair of rolls which carry the slack web away from the impacting machine at a sufficiently slower rate than rolls 22 feed it into the machine to account for the shrinkage of the cloth while it is in the machine. Rolls 21—21 do not pull the cloth through the machine so as to cause the fabric in the machine to be under tension; on the contrary they serve only to take up slack in the fabric and while conveniently employed may be omitted without material effect on the operation of the machine.

Each impact of the wires or impacting members bats the lax fabric into space where, while it is still in a floating condition as a result of such impact, it is again subjected to succeeding impacts, much as a tennis ball is kept in the air by repeatedly batting it upwardly with a tennis racquet. In other words the fabric is impacted while it is floating in space due to the next succeeding impact. In the case of the lower impacting members, the fabric is batted upwardly and forwardly and caused to progress toward the outlet of the machine. Where both upper and lower impactors are employed, the fabric is repeatedly batted back and forth by and between the impactors and also progresses through the machine. Warm, dry air is blown through the machine by a suitable blower 24 and reduces the water content of the web as the treatment takes place. As can be seen from the drawings the fabric A is extremely billowy along its width and length and is in the air a large part of the time as it progresses through the machine.

At 25 is indicated a device for treating the web further, for instance, a tenter to stretch it laterally or for such other treatment that may be required. Such treatment does not form a part of my invention.

The embodiment of FIG. 3 is similar to that of FIGS. 1 and 2 except that (1) it has no top impactors, (2) the bottom impacting wires are arranged in three units 40, each unit having a plurality of impacting members or wires 14' attached to three cross bars 14*a* which are in turn attached to arms 16'', and (3) each unit is driven independently and bodily along a generally circular path or orbit as shown by the arrows by independent driving means (not shown), each of which is like the driving means of FIGS. 1 and 2. That is, the arms 16'' of each unit are attached to a separate, independent plate like plate 26 of FIG. 1, which is moved independently and bodily along a generally circular path or orbit by a seperate shaft having eccentrics attached to the ends thereof, a separate set of springs and a separate motor which is arranged in the same manner as shaft 28, eccentrics 20, springs 18, 19 and motor 32 of FIGS. 1 and 2. The units 40, as shown, are not synchronized and move independently of each other. In the machine shown in FIG. 3 the left-hand unit, shown in full lines, is in its uppermost position while the middle unit, shown in full lines, is in its lowermost position and the right-hand unit, shown in full lines, is in an intermediate vertical position. The lowermost position and intermediate position of the left-hand unit, the uppermost and intermediate position of the middle unit and the uppermost and lowermost position of the right-hand unit are shown in broken lines. The lax cloth batted upwardly and to the right by the right-hand unit falls onto a trogh 41 from which it is taken up by rolls 21. As many units as desired can be used in series depending upon the amount of impacting desired.

The embodiment of FIGS. 4 and 5 is like that of FIG. 3 except that top impacting units 42, each of which has a plurality of wires 14'', cross bars 14*b* and arms 16''' are provided opposite each bottom unit. Each of the top units has independent driving means to move it independently in a generally circular path or orbit as shown by the arrows. Each of these driving means are the same as those used to drive the lower units. In the drawing the left-hand upper and lower units are at their uppermost positions while the right-hand upper and lower units are in their lowermost positions. However, the upper units need not be synchronized in any manner with the lower units and can move completely independent therefrom. It is apparent that opposing units never come together and are at all times spaced from each other so that the fabric is batted back and forth between them while being advanced to the right. In other words, the area on the other side of the fabric opposite from the area where each of the impacts is given is free from contact with a rigid surface at the time of such impact so that the fabric is freely displaced. In effect the fabric is floating or in a floating condition.

The impacting machines and drying means shown in FIGS. 1 to 5 are merely for the purpose of illustration, since any device which will give the fabric violent localized impacts may be employed.

I have found that cloth treated by my improved method will have a shrinkage after subsequent washing and drying less than one percent and that this shrinkage may be even as low as 0.2 percent. Cotton knit goods for underwear which have been subjected to the hereindescribed treatment were found to have a shrinkage after washing and drying of less than 5% or lower depending on the method of testing employed.

To determine the effect of my novel method for reducing shrinkage, four pieces of cotton knit goods suitable for underwear were treated as hereindescribed and then tested by the following procedure.

The four fabrics were cut to uniform length and

treated twice by running in home type portable washing machines at 120° F. with .5% soap and given three rinses in water of 100° F. (each washing for a thirty minute period). Each piece was measured in a straight but not stretched condition before laundering and between each laundering after being dried. The average measurement of the two results were taken in each case to the nearest 1/16 in. The fabric was dried once by laying flat on a table top and the second time by hanging to dry, equal weight being distributed on either side.

It was observed that the fabric did not shrink by treating under above conditions except for a non-significant shrinkage in width of the fabric. It will be observed that in general the treated fabrics show a tendency to elongate during laundering rather than to shrink.

Sample	Stitch	Average Percent Shrinkage		Average Percent Elongation	
		Length	Width	Length	Width
a	Rib			3.75	1.9
b	Flat		0.7	3.75	
c	Rib			1.875	1.3
d	Flat			3.75	nil

It is to be understood that the momentum, i.e., a function of the mass, speed and amplitude of movement of impacts should be great enough to produce the desired results but should not injure the structure of the fiber. In the practice of the invention, I have used impacting members having amplitudes of movement varying from 1/8 to 2.3 inches and rates of movement from 5000 strokes a minute to 520 strokes a minute and have obtained satisfactory results. The amplitudes of movement, and the rates of impact will of necessity vary with the character of the fabric to be treated. In practice the fabric can enter the machine in a thoroughly wet condition, be dried as it passes the impactors and emerge from the machine in dry condition with a much improved hand and feel and a marked reduction in shrinkage, the amount of the reduction depending largely on the extent of the drying and impacting.

I claim:

1. In a machine for treating a web of fabric, the combination of a plate, supporting springs on opposite sides of said plate, an impactor carried by the plate, means for moving said plate and thereby the impactor to give the web sharp, localized impacts while the successive impacted areas of the fabric are movable freely away from the impactor at the time of impact, and means for guiding the fabric in substantially lax condition past the impactor.

2. In a machine for treating a web of fabric, the combination of two plates, one on each side of the web of fabric to be treated, supporting springs engaging opposite sides of each plate, an impactor carried by each plate, means acting on the said plates to cause them to vibrate and thereby give the web sharp, localized impacts while the successive impacted areas of the fabric are movable freely away from the impacting members at the time of impact, and means for guiding the fabric in substantially lax condition past the impacting members.

3. In a machine for treating a web of fabric, the combination comprising first means providing a support, second means mounted on said support providing a plurality of distinct impacting surfaces disposed in a plane, third means for constraining said support for motion in an orbit, fourth means for constraining said support for motion of said plane in parallelism with itself, and fifth means for driving said support through said orbit.

4. In a machine for treating a web of fabric, the combination comprising a plurality of impacting members defining a path, each of said impacting members comprising first means providing a support, second means mounted on said support providing a plurality of distinct impacting surfaces disposed in a plane, third means for constraining said support for motion in an orbit, fourth means for constraining said support for motion of said plane in parallelism with itself, and fifth means for driving said support through said orbit.

5. In the machine of claim 4, the plurality of planes of said impacting surfaces being in parallelism.

6. In the machine of claim 4, the plurality of third means of said plurality of impacting members being independent of one another.

7. In the machine of claim 4, said path being defined by opposed planes of certain of said impacting members.

8. In the machine of claim 4, roller means for feeding said web of fabric through said path, said roller means being aligned with said path.

9. In the machine of claim 4, means for subjecting said fabric to hot air.

10. In a machine for treating a layerwise material, the combination comprising first means providing a face, second means for constraining said first means for motion in an orbit, third means for constraining said first means for translatory motion of said face, fourth means for driving said first means through said orbit, fifth means for advancing said layerwise material to said face, and sixth means for advancing said layerwise material from said face.

11. In a machine for treating a layerwise material, the combination comprising first means providing a face, second means for constraining said first means for motion in an orbit, third means for constraining said first means for translatory motion of said face, fourth means for driving said first means through said orbit, and sixth means for directing-hot gas into the region of said orbit.

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