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COMPLETE SPECIFICATION

Compressive Shrinking and Finishing Machines for Fabric Webs and Improvements Thereto

We, CLUETT, PEABODY & CO., INC., a Corporation organised under the laws of the State of New York, United States of America, of 433 River Street, Troy, New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed to be particularly described in and by the following statement:—

This invention relates to compressive shrinking and finishing machines for fabric webs. The principal object of the invention is to provide an improved compressive shrinking machine for treating woven fabric webs to reduce the extent to which the web will elongate or shrink in subsequent laundering operations, with which the operator can, at all times, be aware of the amount of shrinkage which is being imparted to the web and which will be relatively simple, practical, easily controlled and accurate.

According to the invention a machine for treating a woven fabric web to reduce the extent to which the web will elongate or shrink in subsequent laundering operations comprises means for feeding forward the web at a predetermined rate, means for progressively and continuously compressively shrinking the web, a dryer for the web, means for delivering the web, and means whereby the ratio between the speeds of feeding and delivering the web is indicated to show the amount of lengthwise shrinkage.

Preferably the means for indicating the ratio between the speeds of feeding and delivering the web comprises a direct-current generator of constant field strength adapted to be driven at a speed proportional to the feeding speed, a second direct-current generator of constant field strength adapted to be driven at a speed proportional to the delivering speed and a galvanometer having two opposed coils, each coil being connected to the output of one of the generators.

In one preferred construction, the web is fed into a moisture conditioner and over a heated drum to a tentering machine from whence it passes to a comprehensive shrinking machine of the kind wherein the web is entrained between an endless rubber band or belt and the periphery of a heated drum. After shrinking the web is forwarded to a felt belt type or can type of dryer.

The shrinking machine and the dryer are conveniently driven from a common motor, a variable gear being connected between the dryer and the motor shaft.

One embodiment of the invention will now be more particularly described by way of example with reference to the accompanying drawings, wherein:—

Fig. 1 is a side elevation of one end portion of a machine constructed in accordance with this invention;

Fig. 2 is a similar elevation of the intermediate part of such machine;

Fig. 3 is a similar elevation of the other end of such machine, it being understood that Figs. 1 2 and 3 should be arranged in succession end to end, with Fig. 1 at the right and Fig. 3 at the left, to illustrate a single machine;

Fig. 4 is a side elevation of a modification in which the end part shown in Fig. 3 is eliminated and the mechanism used in place thereof is superimposed on the shrinking mechanism shown in Fig. 2;

Fig. 5 is a schematic view illustrating the relationship to the various parts of the machine of the controls which indicate the amount of shrinkage being imparted to the fabric web at any time; and

Fig. 6 is a face elevation of the visual indicator that indicates the amount of shrinkage or strain being imparted to the fabric at any time.

In the embodiment of the invention illustrated in Figs. 1 to 3, the fabric to be shrunk is supplied in folded relation in a truck 1 (see Fig. 1) from which the fabric web 2 to be shrunk is withdrawn and fed in succession over guide 3 and under guide roller or bar 4, and then passes alternately over and

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under the bars 5, then over and under adjustable tension bars 6 and 7, then over a guide 8, and then around a guide roll or bar 9. Just as the web approaches the roller bar 9 each of its margins passes between a pair of air guide rolls 10, one pair at each side. These guide rolls 10 control mechanism not shown that centres the fabric with respect to the roll or part 9. These air guides are well known for this purpose and are no part of the invention. From the roll or bar 9, the web 2 passes upwardly over and partially around a positive drive roll 11, which is driven through a suitable reduction gear 12 by a motor M at a selected speed. The web passes more than half way around this roll 11 so that it will be positively advanced thereby lengthwise. The web then passes around an idler or measuring roll 13, then over a bar 14, and thence to a conditioning device 15.

The roll 13 is freely rotatable so that as the fabric passes over and in contact with it, this roll 13 will be driven at the same speed as the moving fabric web. Therefore the peripheral speed of the roll 13 will always be the same as that of the moving web. Since the roll 11 is used to advance the web lengthwise, in doing so it must pull it from the truck 1 over the various bars and guides where there is considerable resistance to travel, and there might at times be slight slippage between the fabric and the roll 11, but by making the roll 13 an idler roll in contact with the fabric after it leaves this advancing roll 11, the speed of the periphery of the roll 13 will always correspond accurately to the speed of travel of the fabric web.

On one end of the idler roll 13 is fixed a sprocket 16 and it, through a chain 17, drives a sprocket wheel 18 which is coupled to a tachometer generator 19. This tachometer generator is one that is available on the open market, and is a direct current generator with a continuously and uniformly energised field, permanent magnets being used to provide such a field. Such generators when rotated, produce a current with a voltage which is directly proportional to their speed of rotation. Therefore, this generator 19 will generate a direct current having a voltage which is directly proportional to the speed at which the idler roll 13 is rotating at any time. The current developed by this generator will be utilized in a manner which will be explained later herein.

The conditioning unit 15 includes a casing in which are disposed for free rotation, a plurality of rolls 20 at the top, and a plurality of rolls 21 at the bottom. The rolls at top and bottom are arranged in rows, and the web 2 passes back and forth in succession between these rolls 20 and 21 so that it will be carried in vertical stretches progressively through the housing of the unit 15 and then leaves by passing over a guide roll 22. During its travel in the unit 15, the web 2 is conditioned with moisture so as to render the fibres of its yarns somewhat plastic or pliable. For this purpose of the first vertical stretch of web in the unit 15 is subjected to fine sprays of water from a plurality of nozzles 23, arranged in a row across the full width of the web, so that all of the web will be sprayed in its first downward travel in the conditioning unit 15. The travel of the moistened web through the unit 15 provides an opportunity for the moisture to penetrate the yarns and fibres and render them plastic or pliable since the unit 15 being an approximately closed structure, will confine the moisture therein and provide an extremely humid atmosphere as the web travels through it.

From the roll 22, the web 2 passes through a bias straightening device 24, which is adjustable so the the fabric, if on a bias, will not be pulled further on the bias. The fabric then passes over and partly around a heated drum or cylinder 25, which is rotatably mounted in bearings 26, so that this cylinder 25 can freely rotate while being heated by steam admitted through the shaft of the drum. The web passes nearly around the periphery of this drum and the heat of the drum is imparted to the moisture in the web so as to spread it uniformly across the entire width of the web, and also expedite the conditioning of the web as to the pliability or plasticity of its fibres and yarns. The web is guided to the drum 25 over a bar 27, and in leaving the drum, passes around a guide bar 28.

The web 2 passes from the mechanism shown in Figure 1 to the mechanism shown in Figure 2 and first passes around a scrimp bar 29 and guide bars 30 to a clip expander mechanism 31. In this device, indicated generally at 31, the fabric is picked up by clamps on two opposed adjustable travelling stretches of an endless chain and is pulled to the desired and selected width. The fabric is then delivered to the rubber belt shrinking machine indicated generally at 32. Clip expander devices of this type are well known in the market, and have been used in prior shrinking machines.

From the clip expander 31, the web 2 passes between two, spaced apart scrimp bars 33 and then into the rubber belt compressive shrinking machine 32. Compressive shrinking machines using rubber belts are old in the art, and therefore will only be generally described. These machines employ a heated drum 34 which is mounted to rotate on its longitudinal axis, and a rather thick rubber belt 35 passes approximately half way around the periphery of the drum 34 over an idler roll 36 which is mounted to rotate freely on an axis which is parallel to the axis of the drum 34, and which roll 36 may be shifted

bodily and generally toward and away from the drum 34 to a limited extent to tighten or loosen the belt. The belt 35, after leaving the roll 36, passes over an idler roll 37 which is beneath the drum 34 and spaced from it. It then passes upwardly and around a feed-in roll 38. This roll 38 is mounted at its ends in arms 39, there being one of such arms 39 at each end of the roll 38, and each of these arms 39 is movable individually about a pivot 40.

The ends of shaft 41 of the roll 38 are pivoted in the arms 39, and each arm extends upwardly and is pivotally or articulately connected by a link 42 to a nut 43 which is threaded on a shaft 44. The shaft 44 is rotatably mounted in a bracket 45 of the frame of the shrinker 32. A shaft 46*a* carrying a hand wheel 46 is geared to drive the screws 44 at both sides of the machine, so that operation of wheel 46 will rotate both screws and cause the nuts 43 to travel back and forth along them. Each nut 43 has a flat face which slides along a face 47 of the related bracket 45, so that while the nut 43 can slide along the bracket, it is held from rotating thereby, and therefore rotation of the hand wheel 46 and screws 44 will cause endwise movement of the nuts 43. Thus by adjusting the hand wheel 46 one may shift the ends of the roll 38 toward and from the drum 34. The belt 35 passes over the roller 38 and between the roller and the drum 34, at least about half way around the pheriphery of the drum 34, and then to the tensioning roll 36. The feed-in roll 38 is pushed toward the drum 34 so as to compress or squeeze the portion of the belt which is between the drum 34 and the feed-in roller at any time and thus indent or locally distort the belt at the nip between the roll 38 and the drum 34.

The fabric web 2, after leaving the clip expander and passing between the scrimp bars 33, passes over and in contact with the convex surface of the rubber belt which is in contact with the drum 38, then the web passes with the belt through the nip between the surface of the drum 34 and the surface of the belt 35. The previously convex surface of the belt when it was on the roll 38 now becomes concave and the web and belt move together with the drum for approximately one half the periphery of the drum 34, then the fabric 2 leaves the drum and belt, and passes over a guide bar or roll 48 whence it passes to the dryer designated generally at 49 in Figure 3.

Referring next to Figure 3, the dryer illustrated is commonly known in the trade as a felt belt type of dryer. This dryer includes a large heated drum 50 which is rotatably mounted by axial trunnions in bearings 52 provided on the frame of the dryer, and an endless felt belt 53 passes in contact with the periphery of the drum 50 for nearly the entire periphery of the drum. This belt 53 passes over guide roll 54, thence in contact with the drum 50 for nearly its entire periphery and then passes around a roll 55 which is similar to roll 54, but spaced somewhat above it as shown in Figure 3. The belt then passes over guides 56 arranged in succession, toward the rear of the drum 50. It there passes around a tensioning roll 57 and then around most of the periphery of a heated drying drum 58 having its axial trunnions or shafts 59 rotatably mounted in bearings 60 on the frame of the dryer. Heat is supplied to the rotating drum 58 in any suitable manner, usually through passages in its end shafts or trunnions 59. The belt 53 then passes over an idler roll 61, and over a centering roll or device 62 and then over idler rolls 63 in succession back to the roller 54.

The fabric web 2 is fed from the shrinking machine 32 to the dryer so as to pass between the belt 53 and the drum 50. After passing around the drum, it passes to overhead reels 64 and thence to a position beyond the dryer. It is then fed through a folder or plaiter 65 to a receiving truck 66. The folder or plaiter 65 is a tubular guide which is carried on arms 67 which are pivoted on bearings 68 so that the folder or plaiter will swing as a pendulum back and forth and thus deposit the moving web 2 in superimposed layers or folds in the truck 66. The arms 67 are positively moved back and forth for definite distances by a link or connecting rod 69 connected to an extension of one of the ams 67. The link is also connected to a crank arm 70 which is fixed on a rotating shaft 71. The crank pin 72 by which link 69 is connected to the crank arm may be adjusted radially by the shaft 71 in a radial slot in the crank arm 70 and secured in adjusted position so as to determine the throw or limits of travel of the folder or plaiter 65. A pulley 73 is fixed on the shaft 71 and is driven by a belt 74 from a pulley 75, which in turn is driven by a motor 76 at a selected speed.

The motor M, in Figure 1, is preferably a direct current motor whose speed can be varied as desired in its operation of the feed roll 11. A large motor 77, Figure 1 serves to drive, through a plurality of parallel belts, 78, a pulley, 79 which operates through a speed reduction device 80 to drive a shaft enclosed in the housing 81, and which runs to the left in Figure 1 from the gear reduction box 80. The shaft in housing 81 extends past the clip expander 31, in Figure 2, to the shrinking machine 32, (Figure 2) and there carries a spur gear 82 which meshes with a spur gear 83. A bevel gear 84 is coupled to the spur gear to rotate therewith. The bevel gear 84 meshes with another bevel gear 85 which is fixed on a rotatable shaft that also carries a sprocket wheel 86, fixed therein. The latter through a sprocket chain

87 drives a sprocket wheel 88 which is rotatably mounted adjacent to the drum 34. Coupled to the sprocket wheel 88 is a spur gear 89 which meshes with the teeth of a gear 90 that is attached to one end of the drum 34, so that the drum 34 is positively driven by the shaft in the housing 81. The drum 34 therefore serves as the driving force which moves the rubber belt 35 lengthwise in an endless path. This rubber belt is rather thick and is usually used about two inches in thickness although it may of course vary in thickness to a considerable extent.

A water spray device 91 (Figure 2) arranged adjacent the roll 36 serves to deliver a cooling spray of water or other coolant in finely divided form upon the surface of the belt 35 which is then outermost, very shortly after the belt leaves contact with the drum 34. This cools the belt so that the heat from the drum 34 will not damage it. Any coolant or water delivered by the spray device 91 which adheres to the belt as it approaches the feed-in roller 38, is removed in any suitable manner, such as by passing the belt between two opposed wringer rollers, not shown. The shaft on which the bevel gear 84 is fixed is extended beyond the bevel gear 85 to the exterior of the housing in which the gears 84 and 85 are enclosed and there carries a sprocket wheel 92.

A positive, variable, speed drive device 93 is provided with a driving shaft 94 which extends to the exterior of the housing of device 93 and carries a sprocket wheel 95. A chain 96 connects the sprocket wheels 92 and 95 so as to form a drive between them. The driven shaft 97 of the variable speed drive is provided with a spur gear 98 fixed thereon, which meshes with and drives a spur gear 99 that is fixed on a shaft 100. The shaft 100 operates through a gear box 101 to drive a shaft in a housing 102 which in turn operates the dryer. The shaft 103 which is within the housing 102 (Figure 3) on its end carries a sprocket wheel 104, and operating over the wheel 104 is a sprocket chain 105 which also operates over a sprocket wheel 106 in a clutch box 107. A typical or suitable clutch within the box 107 serves to couple the sprocket wheel 106 to an operating shaft 108 and this clutch is operated by a handle 109 which is pivoted at 110 on the box 107. The clutch includes a sleeve keyed to the shafts 108 and having end teeth that engage with teeth on the end faces of the sprocket wheel. The handle 109 has a forked end that engages in an annular groove in the sleeve periphery so that operation of the handle shifts the sleeve endwise to couple or uncouple it to the sprocket wheel. Adjoining the box 107 is a reversing mechanism enclosed in a housing 111. Reversing boxes of this type are well known in the art and available in the open market, and therfore it has been illustrated only generally since the details of such a box form no part of the present invention.

A shaft 112 extends rearwardly in Figure 3 from the box and carries a sprocket wheel 113 for a purpose which will appear presently. Within the box are bevel gears 114 and 115 which are loose on the shaft 108, and these two bevel gears mesh with a third bevel gear 116 which is fixed on the shaft 112. Between these bevel gears 114 and 115 and keyed to and sliding on the shaft is a sleeve which slides endwise and has teeth in both of its ends which engage alternately with recesses in the adjacent end gears 114 and 115. Thus by shifting the sleeve, one can reverse the direction of rotation of the shaft 112. Since this is a well known form of reversing clutch, it has been illustrated only generally. A spur gear 112*a* fixed on the shaft 112 meshes with and drives a gear 50*a* on an end of the drum 50, which causes the drum to rotate on its axis. The sprocket wheel 113, which is fixed on the shaft 112, operates a chain 117 that in turn operates a small sprocket wheel 118 on the shaft of another trachometer generator which is identical in kind with the tachometer generator 19 of Figure 1. Here it serves a similar purpose, which will be explained later herein. This generator 118 will deliver a voltage which is proportional to the speed at which it is driven and which is proportional to the speed of the drum 50. Therefore the voltage delivered by the generator 118 will also be directly proportional to the speed at which the fabric web 2 travels while in contact with the drum 50.

To reverse the direction of rotation of the drum 50, one merely releases the clutch by operation of handle 109, and then by another handle, not shown, shifts a sleeve on the shaft 108 to couple that sleeve to one or the other of the bevel gears 114 and 115. When the direction of movement of the drum 50 changes, so will that of the felt belt 53. This reversal requires a difference in the manner of feeding of the fabric web to the drying machine. When the drum 50 is rotating in a clockwise direction, in Figure 3, the fabric web 2 from the shrinker is delivered over a scrimp bar 119, then over an idler roll 120, and then downwardly between the periphery of the drum 50 and the portion of the belt 53 which has just left the roll 54. The fabric web after passing around the drum is taken off by a roll 121. It then passes upwardly over one or more reels 64 to the folder or plaiter 65. When the drum 50 is to be operated in a counter-clockwise direction, in Figure 3, then the web 2 from the shrinker is passed over a scrimp bar 122 and under the roller 121. It then passes upwardly between the drum periphery and the belt 53 which is moving from the roll 55 towards the drum surface. This fabric web then,

after passing around the drum, while the drum is rotating counter-clockwise in Figure 3, passes over the roll 120, then downwardly and around a roll 123 thence over successively arranged rolls 124 and 125 to the left of the drying mechanism as shown in Figure 3, and upwardly and over one of the reels 64 and then to the left to the folder or plaiter 65 through which it is deposited in the receiving truck 66.

The three reels 64 are driven at the same speed and in corresponding directions by an endless chain 126 which passes around the sprocket wheels on the two end reels 64, and in contact with the periphery of another sprocket wheel on the intermediate reel 64. One end reel 64 also carries a sprocket wheel 127 which is driven by a chain 128 from another sprocket wheel 129 (Figure 2) that is carried on a shaft 130 in the gear box 101. The shaft 130 has a bevel gear which is between and connects two bevel gears, one on the shaft 103 in the housing 102, and the other on shaft 100.

In Figure 4 the felt belt dryer is replaced by a can type dryer. In this case the can dryer is mounted on top of the rubber belt shrinking machine 32 that is shown in Figure 2. Upon the frame of this shrinking machine upright columns 131 are mounted and they carry, on the top thereof, a platform frame 132. A plurality of heated drums 133, 134, 135 and 136 are rotatably supported at their ends in bearing bosses 137, and arranged in a somewhat staggered relation vertically between the columns 131. These drums are heated in any suitable manner such as by steam admitted to the ends of the drums. Each drum has fixed to one end thereof a sprocket 138. Idler sprockets 140, 141 and 142 are rotatably mounted in suitable bearings that are carried by the column 131. An endless, driving chain 143 passes around the sprocket wheels 138 of the drums and also around the idler sprocket wheels 140, 141 and 142, so as to drive all of the drums in the proper direction and at the same rate of rotation.

The sprocket wheel 129, which rotates with the intermediate bevel gear in the gear box 101 drives the chain 128. The latter passes around a sprocket wheel 144 which is fixed on the same shaft 145 to which the sprocket wheel 141 is fixed. Thus the chain 143 will be driven from the gear box 101 at a definite rate of speed which is proportional at all times to the rate of operation of the main drum 34 of the rubber belt shrinking machine. In this embodiment of the invention the tachometer generator 118 is driven by means of a chain which passes around the sprocket wheel 146*a*, affixed to the shaft 145, and the sprocket wheel 142*a* which is coupled to the tachometer generator 118. The sprockets 138 are all of the same diameter and, therefore, they will all rotate at the same rate of speed. Also fixed on the shaft 145 is another sprocket wheel 146 which drives a chain 147. This chain 147 operates over a sprocket wheel 148 which is fixed on a shaft 149. The latter is rotatably supported in a bracket 150 which depends from the top platform 132.

A reel 151 is fixed on the shaft 149 so as to rotate therewith and feed the fabric to the folder or plaiter 152. The plaiter 152 is carried by depending arms 153 which are hinged at 154 to the bracket 150. A link 155 connects one of the arms 153 to a crank arm 156 which is fixed on a shaft 157. The shaft 157 is also rotatably supported in the depending brackets 150. The link 155 is connected to the crank arm 156 by a crank pin 158 which can be adjusted along a slot 159 arranged radially in the crank arm, so that the arc length or amplitude of oscillation of the plaiter or folder 152 may be selectively varied. The pin 158 is clamped in its different adjusted positions along the slot 159. Also fixed on the shaft 157 is a sprocket wheel 160. This sprocket wheel 160 is driven by a chain 161 which in turn is driven by small sprocket wheel 162. The sprocket wheel 162 is driven by motor 163 through a speed reduction device 164. The motor 163 and reduction device 164 are both secured to the underface of the platform 132.

The web 2 leaving the shrinking machine passes upwardly over roll 165 which is mounted in the frame of the shrinker, then over a guide bar 166 also mounted on the frame of the shrinker, then around the lowermost can or drum 136, then in succession around the drums 135, 134 and 133, after which it passes around an idler roll 167 which is rotatably mounted in suitable bearings 168 on the upright columns 131. From the roll 167 the fabric web passes over the reel 151 and then through the plaiter or folder to the receiving truck 66. Thus the web after being shrunk in the shrinker passes in succession around drums 136, 135, 134 and 133 where the web is dried in contact with the drums alternately on each face of the web, thus giving a glossy or lustrous finish on both faces.

In Figure 5 a circuit arrangement is shown in which the tachometer generator, 19 is connected by circuit wires 170 to a visual indicating instrument 171 where it passes through a coil 172. Similarly the generator 118 is connected by wires 173 to a coil 174, also in the instrument 171. The two coils influence a pointer or indicator hand 175 (Figure 6) which sweeps over a dial 176 in the instrument 171. The dial is graduated from a zero position in both directions and the scale is arranged in two arcuate rows, the upper scale of which indicates the gain or

shrinkage in inches per yard while the lower scale indicates the per cent of gain or shrinkage. The tachometer generators 19 and 118 deliver voltages which are proportional to their speed of operation, and the indicator hand 175 assumes a position which corresponds to the ratio between the voltages generated in the two generators.

Since the yarns of the fabric web will usually be pushed together by an amount that the fabric would normally shrink when laundered, it follows that the generator 19 will normally run faster than the generator 118 because the fabric passing through the dryer will be operating at a lower linear rate of travel than that which passes over the roll 13. If the speed of both generators was equal, then the opposing forces would be equal and the indicator hand 175 would be at the zero position in Figure 6 indicating that no shrinkage was being imparted to the web. When the generator 19 runs faster than the generator 118 the indicator 175 will move to the right in Figure 6 by an amount which is proportional to the ratio between the speeds of operation of the two generators, the degree of movement of the indicator arm 175 being proportional to the ratio between the voltages which are generated by the two generators. Thus one is able to observe at any time, by looking at the indicator 171, the exact amount of shrinkage which is being imparted to the fabric that is passing through the apparatus.

In the operation of this device, and referring particularly to Figures 1, 2 and 3, the fabric to be shrunk is delivered in the truck 1 in a folded condition, and it is drawn therefrom and conducted over the idler bars and rolls 3, 4, 5, 6, 7 and 8. It then passes downwardly with its marginal edges between the pairs of air guides 10 where it is properly centered. The fabric then passes over the roll 11 which is driven at a definite rate of speed by the motor M. The fabric then passes around the idler or measuring roll 13, which is rotated by reason of its frictional engagement with the moving fabric web, then it passes to the conditioning unit 15. Since the roll 13 exerts no driving action on the web, but is merely rotated by the web, it will give an accurate indication at all times of the actual linear speed of travel of the web as it is fed to the treating apparatus. The roll 13 also drives the generator 19 so that the latter will deliver a current which is proportional to the speed at which roll 13 is moving, which speed is proportional to the linear speed of the web as it passes around the measuring roll 13.

The fabric when passing through the conditioner has its fibres and yarns made somewhat plastic or pliable by the moisture and humid condition in the conditioner, then it passes around the heated cylinder 25 which eliminates some of the excess moisture from the web and also spreads the remaining moisture across the width of the web. The fabric then passes through the clip expander 31 where the edges of the web are engaged by clamps on endless chains. These clamps travel in a diverging path, which is adjustable, to pull the web to the desired width. This width is that which has been predetermined by test to be the width which the fabric when laundered would normally assume. The objective is, of course, approximately zero shrinkage in width. The fabric then passes through the rubber belt shrinking machine 32 where it is overshrunk by some amount which need not be known. These rubber belt shrinking machines are well known in the art.

It has been extremely difficult heretofore to control the amount and extent of shrinkage imparted to a fabric when shrunk on this type of rubber belt machine along when it is operated at reasonably rapid rates. With the present arrangement the shrinker is set to overshrink the fabric substantially by an amount which is immaterial and need not be known. While the fabric is in contact with the heated drum 34, the moisture in the fabric web in contact therewith is heated well above the vapourisation point of water, which would be well above 212°F. When the fabric leaves its position between the rubber belt 35 and the heated drum 34 and both faces are exposed to the atmosphere, much of the water in the web is flashed off or vapourised quickly while the web is travelling to the felt belt dryer shown in Figure 3 or to the can dryer shown in Figure 4.

Referring to Figure 3, and as explained earlier herein, the web passes in either of two possible directions through the felt belt dryer depending upon the direction of rotation of the large drying drum 50. When the drum 50 rotates clockwise in Figure 3 the web passes over the scrimp bar 119 and the roller 120, and downwardly between the drum 50 and the belt 53, just after the belt has passed over the roll 54. During its travel in contact with the felt belt 53 and the drum 50 the fabric is dried. It then passes over one or more of the reels 64 to the plaiter or folder where it is folded and deposited in the receiving truck 66. With this arrangement the face of the fabric web which was in contact with the surface of the hot drum 34 in the shrinker will also pass in contact with the hot drum 50 of the dryer, and the opposite face of the web which was in contact with the rubber belt 35 of the shrinker will then pass in contact with the felt belt 53 of the dryer. This gives to the one face which was in contact with both drums a slightly more lustrous finish than the other face which was in contact

with the rubber and felt belts.

If the dryer is set to operate counter clockwise in Figure 3, then the web leaves the dryer by passing over the roll 120. The web is then conveyed under the machine to another one of the reels 64, such as the intermediate reel 64, and then to the plaiter or folder 65. With the drum of the dryer running counter clockwise in Figure 3, the face of the fabric 2 which was in contact with the heated drum surface of the shrinking machine 32 (Figure 2) will then pass in contact with the felt belt 53, Figure 3 in the dryer, and the opposite face of the fabric which was in contact with the rubber belt in the shrinker 32, Figure 2 will pass in contact with the hot drum 50, Figure 3 of the dryer. The fabric thus will have both faces in contact with a hot drum which gives a more lustrous finish on both faces of the web. When the drum of the dryer rotates clockwise in Figure 3, one face of the web may have a somewhat more lustrous finish than the other face.

The generator 118, Figure 3 will always rotate at a speed proportional to the speed of the rotation of the dryer and thus the voltage delivered by the generator 118 will be directly proportional to the linear speed of the felt belt 53 and web 2 which are passing around the drum 50 of the dryer. Thus, the voltage delivered by the generator 118 will urge the indicator pointer or hand 175 in a direction which is opposed to the moving force imparted to the hand 175 by the current delivered by the generator 19.

The motor M, (Figure 1) the motor 77 (Figure 1) and the motor 76 (Figure 3) are operated from a common source of direct current, so that if the voltage in the line varies, the speed of all three motors will vary uniformly. Suitable rheostats may be employed to control the speed of operation of the motor M, and thus determine the speed at which the fabric web is directed to the conditioner 15. The belt 35 of the shrinker is driven from the drum 34 at a rate which moves the fabric through it at a much lower rate than that at which it is fed by the motor M to the conditioner 15, due to the slippage of the belt on the drum. The motor 77 also drives the dryer at a rate slower than that of the shrinking machine. This difference in rate is determined by the adjustment of the speed varying device 93 (Figure 2). A suitable manual control is provided with these speed varying devices 93 by means of which the speed ratio is selectively varied by practically infinitesimal steps. By adjusting the speed ratio of this device 93, the rates at which the dryer drum 50 and the belt 35, Figure 2 are operated may be selectively varied. The speed of the dryer belt 50, Figure 3 will be slightly faster than the speed of the shrinker belt 35, Figure 2. This drum 50 and belt 53 (Figure 3) by pulling the fabric at a somewhat higher rate than that at which it leaves the shrinking machine 32, Figure 2, places the web 2 under tension and serves to stretch the fabric and to remove some of the overshrinkage.

Thus by operating the belt 50, Figure 3 at a rate faster than that of the belt 35, Figure 2, and slower than that of the measuring roll 13, Figure 1 by a known and selected amount, the residual shrinkage which is left in the web can be accurately determined. It may be selectively varied by adjusting the speed varying device 93, Figure 2. The control for this speed varying device 93 is preferably made convenient to the indicator 171, so that the operator can while observing the position of the indicator hand 175, conveniently operate the control for the speed varying device 93 which will increase or decrease the speed of the dryer. By predetermining the potential shrinkage of a sample of fabric before it is run through the machine, one will know how much shrinkage to impart to the web in its passage through this range, in order that the residual shrinkage in the treated or shrunk web will be substantialy zero, or whatever residual shrinkage one desires to leave in the web, the speed varying device being adjusted to give the desired indication on the indicator 171. One may even leave so much imparted shrinkage in the web that when it is laundered it will gain in length. To do this, the dryer is operated at such a low rate of speed that all of the overshrinkage is not removed from the web that leaves the shrinker unit 32, Figure 2.

The reels 64, Figure 3 are driven from the gear box 101, Figure 2 at a speed proportional to that of the dryer drum Figure 3, so that if one varies the rate of operation of the dryer drum, the speed of the reels 64, Figure 3, will be proportionally varied and thus there will not be any substantial amount of tension applied to the fabric being carried by such reels.

In the can dryer, the operation is similar to that explained above except that the fabric leaving the shrinker is passed around the drying cans in succession instead of through the felt belt dryer. By varying the rate at which the cans are operated, one can exert enough tension on the fabric delivered by the shrinker, to remove therefrom any undesired overshrinkage and leave in the fabric any desired amount of the shrinkage.

It will be understood that the conditioner 15, the cylinder 25, the clip expander 31, the basic parts of the rubber belt shrinker 32, the basic parts of the felt belt dryer and of the can dryer, and the reels and folder are generally old and have been illustrated and

described only to the extent necessary to explain the use of them in this combination, and the adaptation of the improvements thereto. Parts or small asemblies which are available in the open market, such as tachometer, indicator, gear boxes and reversible gear device 93 for example, have not been shown in full detail, because the present invention relates to the utilisation of those assemblies which are available in the open market in the present combinations, and not to their details.

Referring particularly to Figure 2, it will be noted that the operating shaft for the dryer is coupled to this drive shaft 81 by the variable speed drive 93, which enables one to change the speed at which the dryer is operated, relatively to the shrinker 32, while this machine is operating. The variable speed drive 93 may be replaced by a separate electric motor of the variable speed type, such as a direct current motor, which drives the shaft 97, in which case the driving connection to the shaft in housing 81 from the motor 77 is broken. Such a variable speed motor to replace the drive 93 will be controlled by a rheostat or similar speed control, so that the speed of operation of the dryer can be changed while the machine is operating. This is now practical with the use of the tachometer generators 19 and 118 and the visual indicator 171 to constantly indicate the amount of imparted shrinkage being left in the fabric web.

What we claim is:

1. A machine for treating a woven fabric web to reduce the extent to which the web will elongate or shrink in subsequent laundering operations comprising means for feeding forward the web at a predetermined rate, means for progressively and continuously compressively shrinking the web, a dryer for the web, means for delivering the web, and means whereby the ratio between the speeds of feeding and delivering the web is indicated to show the amount of lengthwise shrinkage.

2. A machine according to claim 1 wherein the means for indicating the ratio between the speeds of feeding and delivering the web comprises a direct-current generator of constant field strength adapted to be driven at a speed proportional to the feeding speed, a second direct-current generator of constant field strength adapted to be driven at a speed proportional to the delivering speed and a galvanometer having two opposed coils, each coil being connected to the output of one of the generators.

3. A machine according to claim 2 wherein the first-mentioned generator is driven by a rotatable roller over which the web passes and which is frictionally driven by contact with the web.

4. A machine according to claim 2 or 3 wherein the second-mentioned generator is driven from the drive for carrying the web through the dryer.

5. A machine according to any of the preceding claims wherein the feeding means for the web comprises freely rotatable guide rolls including air guide rolls for centering the fabric with respect to the rolls and a drive roll for the fabric driven by a motor.

6. A machine according to any of the preceding claims wherein the means for shrinking the fabric web comprises a moisture conditioning unit, a clip expander device, and a compressive shrinking machine.

7. A machine according to claim 6 wherein the conditioning unit comprises spaced apart guide rolls within a housing whereby the web is guided into a sinuous path and a moisture spray directed onto the web.

8. A machine according to claim 6 or 7 wherein the compressive shrinking machine comprises a heated rotatable drum, an endless tensioned flexible band having one face extending partway round the peripheral surface of the drum for entraining the web and compressing it between the surface of the belt and the surface of the drum, and a drive for the drum.

9. A machine according to claim 8 wherein the flexible band is of rubber or the like elastic material.

10. A machine according to any of the preceding claims wherein the dryer is a reversible felt belt dryer.

11. A machine according to any of claims 1-9 wherein the dryer is a can type dryer.

12. A machine according to any of the preceding claims wherein the drive for the dryer and the drive for the means for shrinking the web are powered by a common motor, the connection between the dryer drive and the motor including a variable speed gear.

13. A machine for treating a woven fabric web to reduce the extent to which the web will elongate or shrink in subsequent laundering operations constructed and arranged substantially as described herein and shown in Figures 1, 2, 3, 5 and 6 of the accompanying drawings.

14. A machine for treating a woven fabric web to reduce the extent to which the web will elongate or shrink in subsequent laundering operations constructed and arranged substantially as described and shown in Figures 1, 2, 4 and 6 of the accompanying drawings.

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described only to the extent necessary to explain the use of them in this combination, and the adaptation of the improvements thereto. Parts or small asemblies which are available in the open market, such as tachometer, indicator, gear boxes and reversible gear device 93 for example, have not been shown in full detail, because the present invention relates to the utilisation of those assemblies which are available in the open market in the present combinations, and not to their details.

Referring particularly to Figure 2, it will be noted that the operating shaft for the dryer is coupled to this drive shaft 81 by the variable speed drive 93, which enables one to change the speed at which the dryer is operated, relatively to the shrinker 32, while this machine is operating. The variable speed drive 93 may be replaced by a separate electric motor of the variable speed type, such as a direct current motor, which drives the shaft 97, in which case the driving connection to the shaft in housing 81 from the motor 77 is broken. Such a variable speed motor to replace the drive 93 will be controlled by a rheostat or similar speed control, so that the speed of operation of the dryer can be changed while the machine is operating. This is now practical with the use of the tachometer generators 19 and 118 and the visual indicator 171 to constantly indicate the amount of imparted shrinkage being left in the fabric web.

What we claim is:

1. A machine for treating a woven fabric web to reduce the extent to which the web will elongate or shrink in subsequent laundering operations comprising means for feeding forward the web at a predetermined rate, means for progressively and continuously compressively shrinking the web, a dryer for the web, means for delivering the web, and means whereby the ratio between the speeds of feeding and delivering the web is indicated to show the amount of lengthwise shrinkage.

2. A machine according to claim 1 wherein the means for indicating the ratio between the speeds of feeding and delivering the web comprises a direct-current generator of constant field strength adapted to be driven at a speed proportional to the feeding speed, a second direct-current generator of constant field strength adapted to be driven at a speed proportional to the delivering speed and a galvanometer having two opposed coils, each coil being connected to the output of one of the generators.

3. A machine according to claim 2 wherein the first-mentioned generator is driven by a rotatable roller over which the web passes and which is frictionally driven by contact with the web.

4. A machine according to claim 2 or 3 wherein the second-mentioned generator is driven from the drive for carrying the web through the dryer.

5. A machine according to any of the preceding claims wherein the feeding means for the web comprises freely rotatable guide rolls including air guide rolls for centering the fabric with respect to the rolls and a drive roll for the fabric driven by a motor.

6. A machine according to any of the preceding claims wherein the means for shrinking the fabric web comprises a moisture conditioning unit, a clip expander device, and a compressive shrinking machine.

7. A machine according to claim 6 wherein the conditioning unit comprises spaced apart guide rolls within a housing whereby the web is guided into a sinuous path and a moisture spray directed onto the web.

8. A machine according to claim 6 or 7 wherein the compressive shrinking machine comprises a heated rotatable drum, an endless tensioned flexible band having one face extending partway round the peripheral surface of the drum for entraining the web and compressing it between the surface of the belt and the surface of the drum, and a drive for the drum.

9. A machine according to claim 8 wherein the flexible band is of rubber or the like elastic material.

10. A machine according to any of the preceding claims wherein the dryer is a reversible felt belt dryer.

11. A machine according to any of claims 1-9 wherein the dryer is a can type dryer.

12. A machine according to any of the preceding claims wherein the drive for the dryer and the drive for the means for shrinking the web are powered by a common motor, the connection between the dryer drive and the motor including a variable speed gear.

13. A machine for treating a woven fabric web to reduce the extent to which the web will elongate or shrink in subsequent laundering operations constructed and arranged substantially as described herein and shown in Figures 1, 2, 3, 5 and 6 of the accompanying drawings.

14. A machine for treating a woven fabric web to reduce the extent to which the web will elongate or shrink in subsequent laundering operations constructed and arranged substantially as described and shown in Figures 1, 2, 4 and 6 of the accompanying drawings.

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