Jan. 29, 1952

F. CHATFIELD

APPARATUS FOR SHRINKING AND CONDENSING TEXTILE FABRICS

2,583,630

Filed Jan. 15, 1949

8 Sheets-Sheet 1

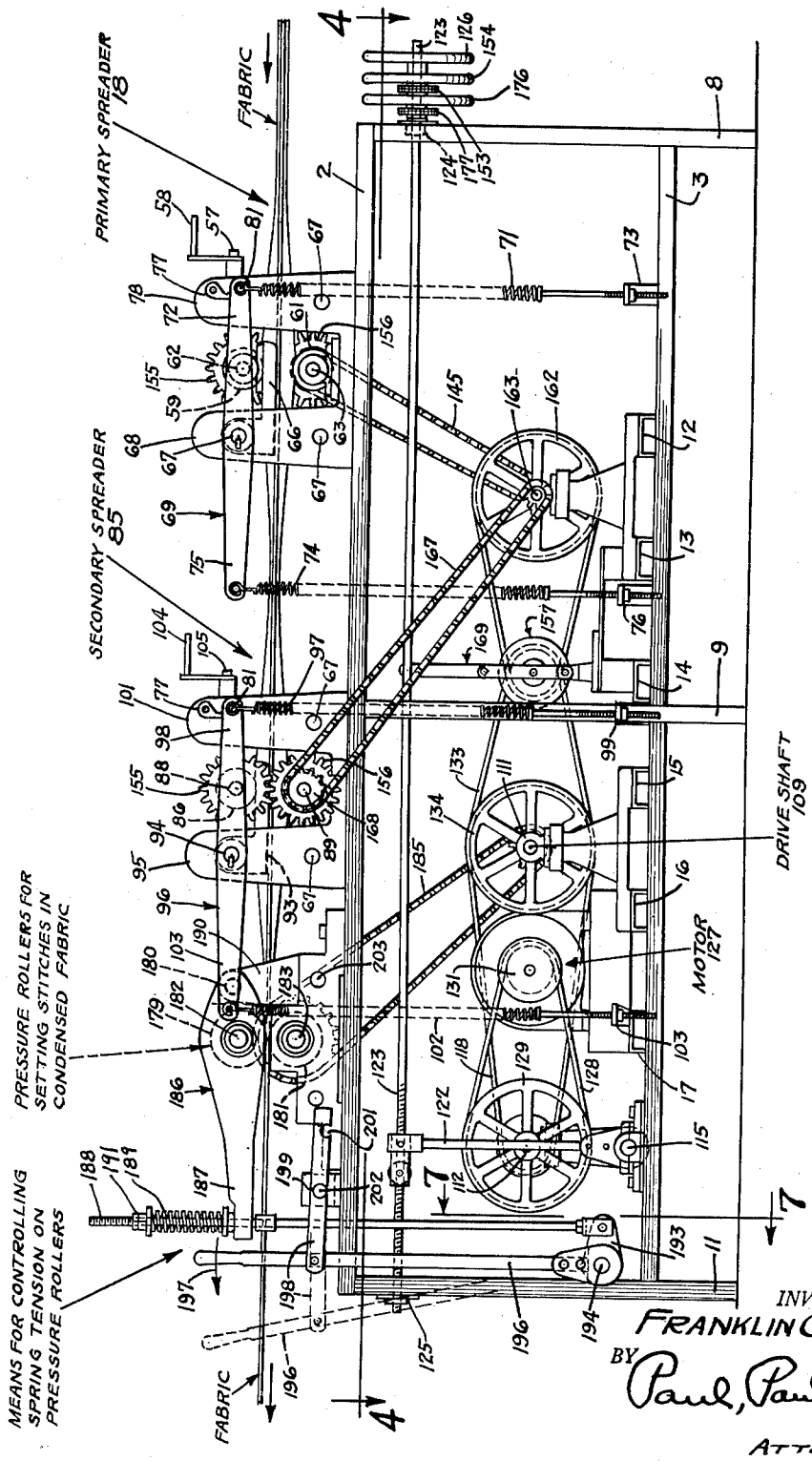


FIG. 1

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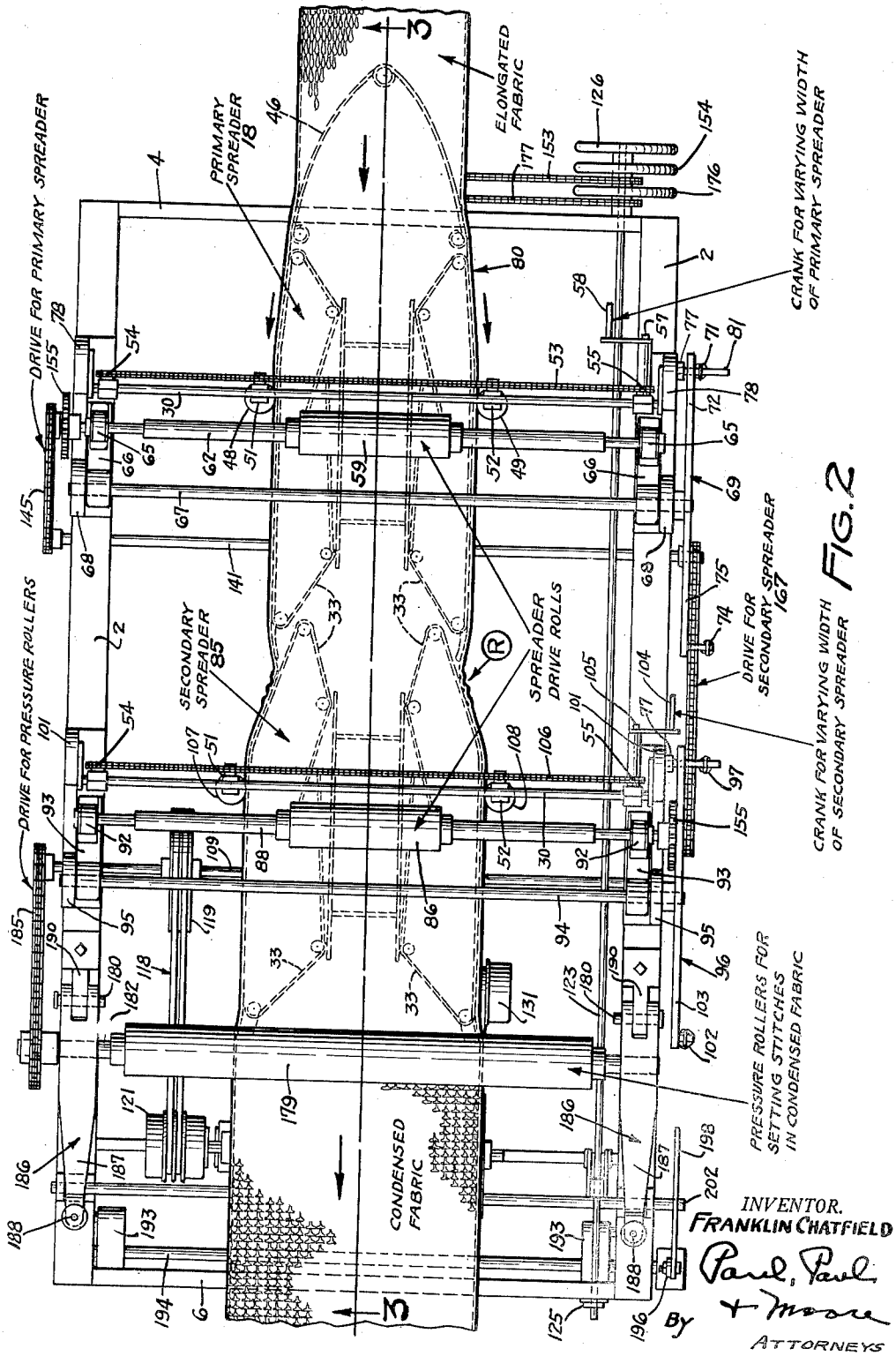


FIG. 2

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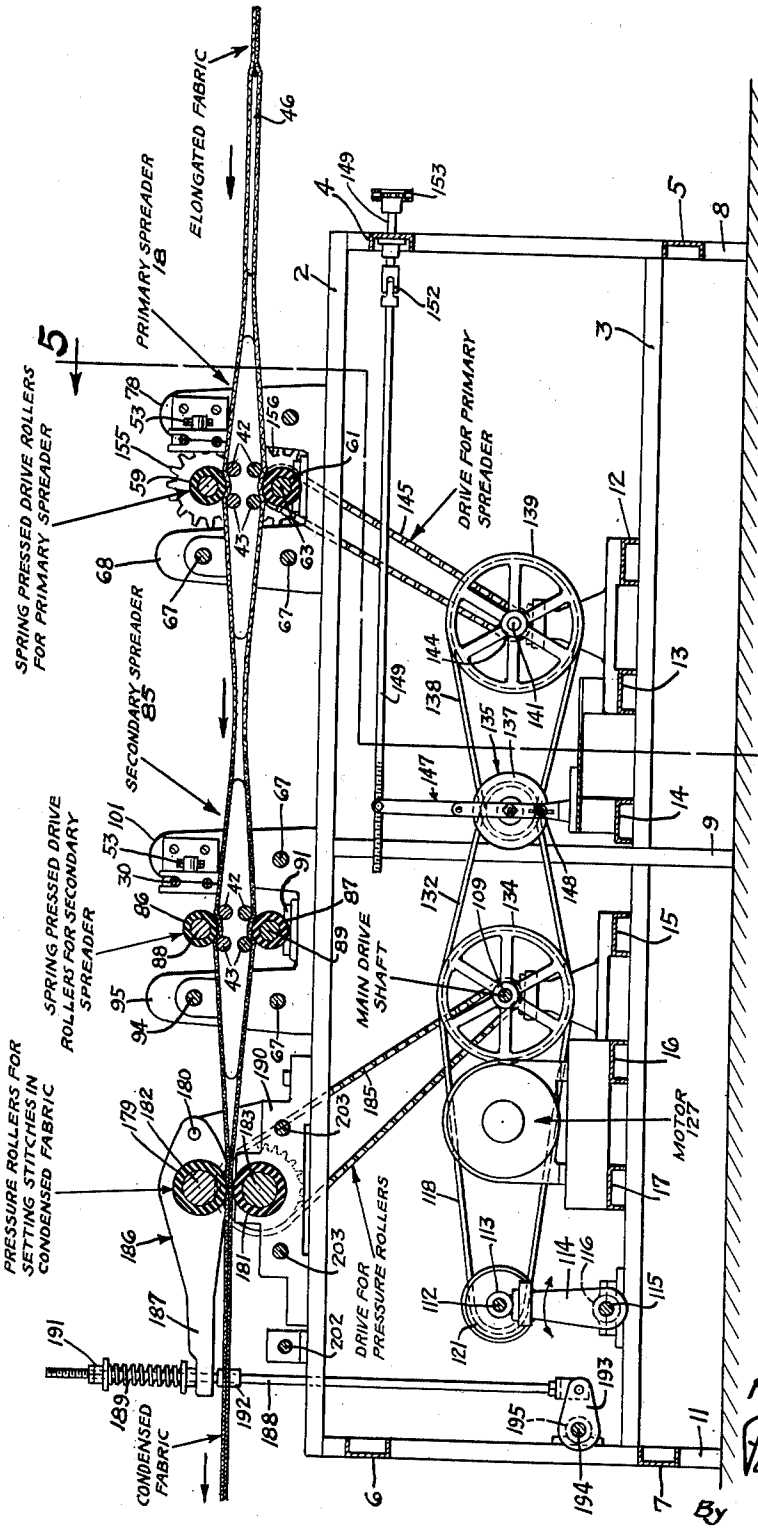


FIG. 3

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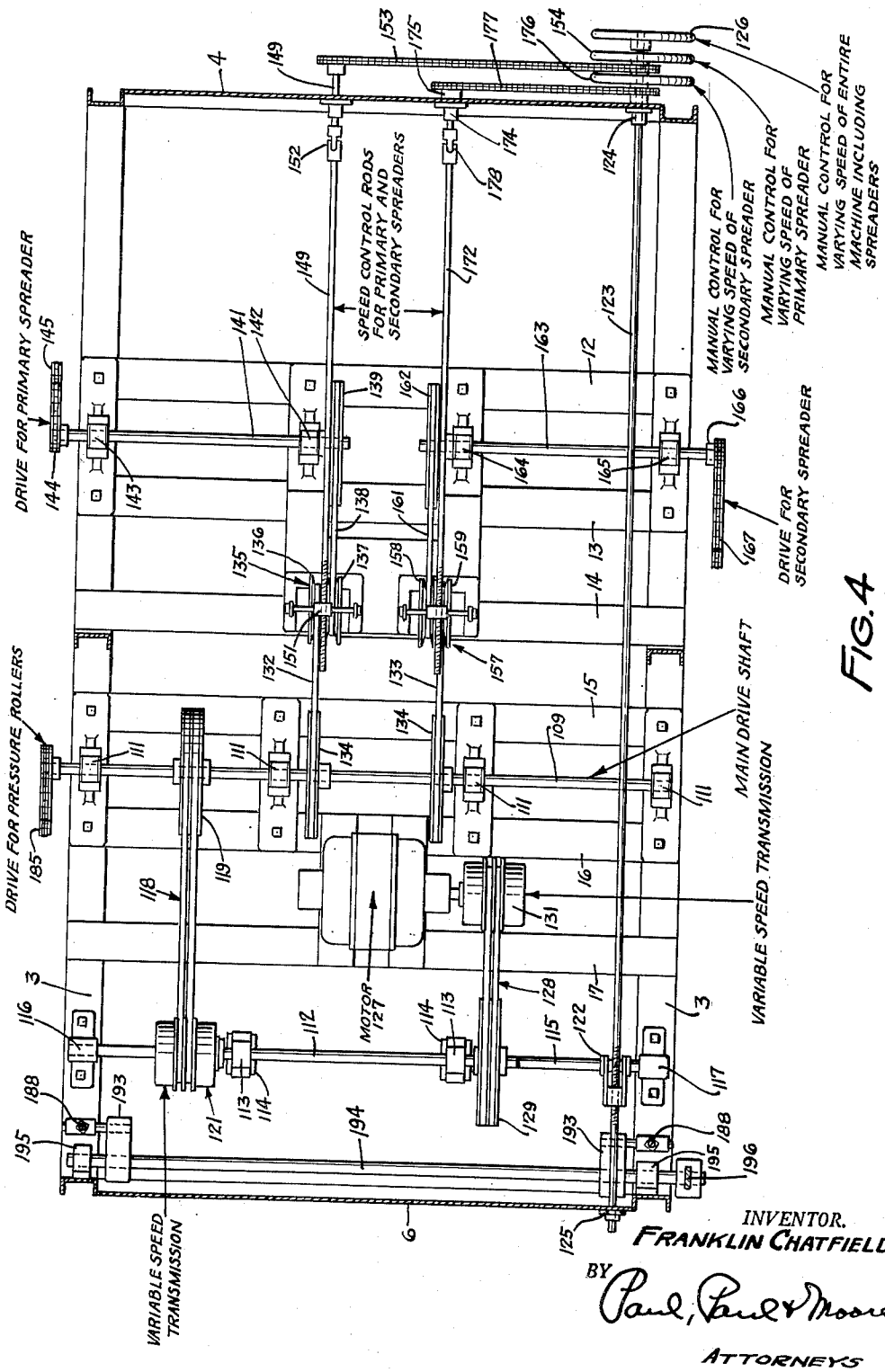


FIG. 4

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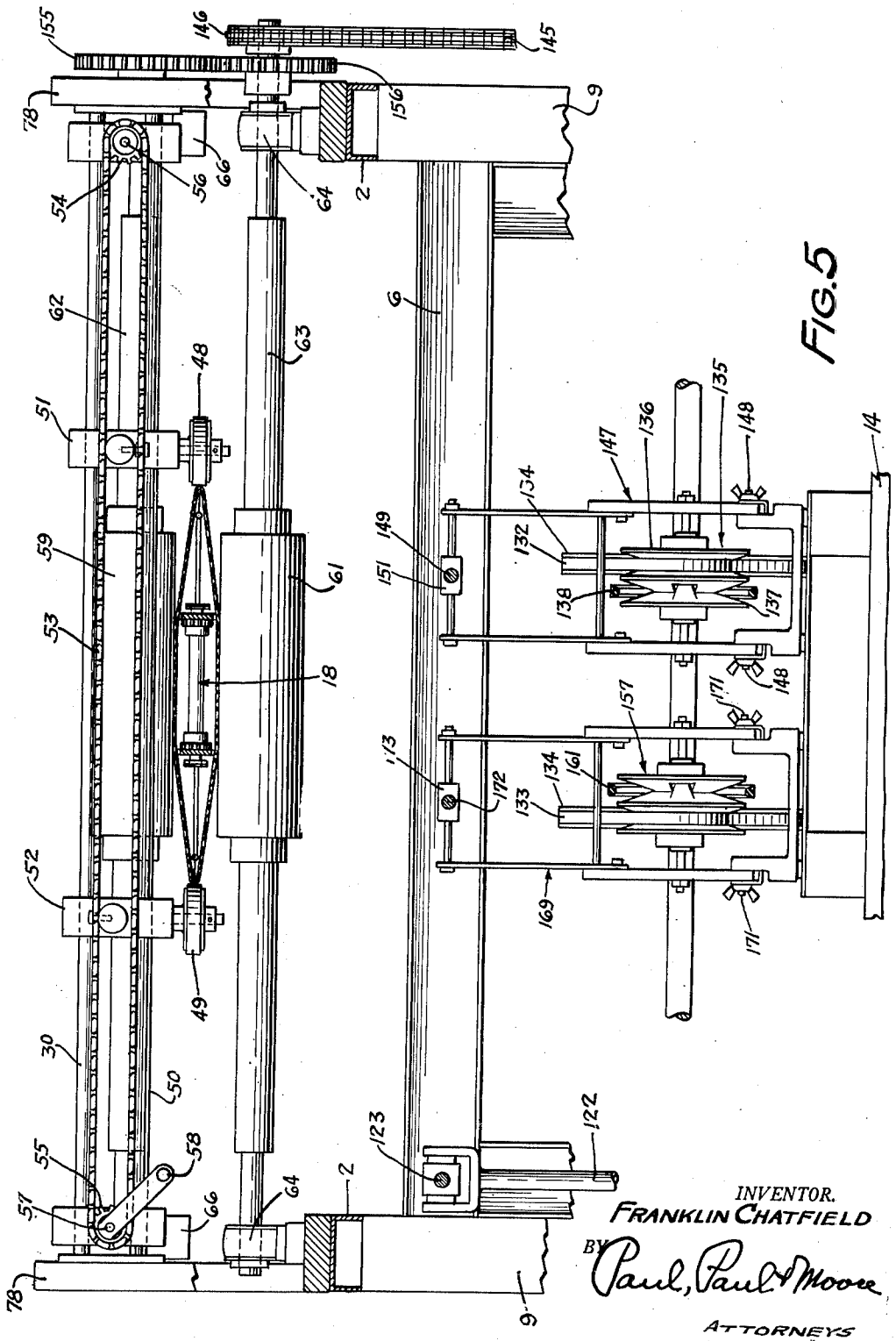


FIG. 5

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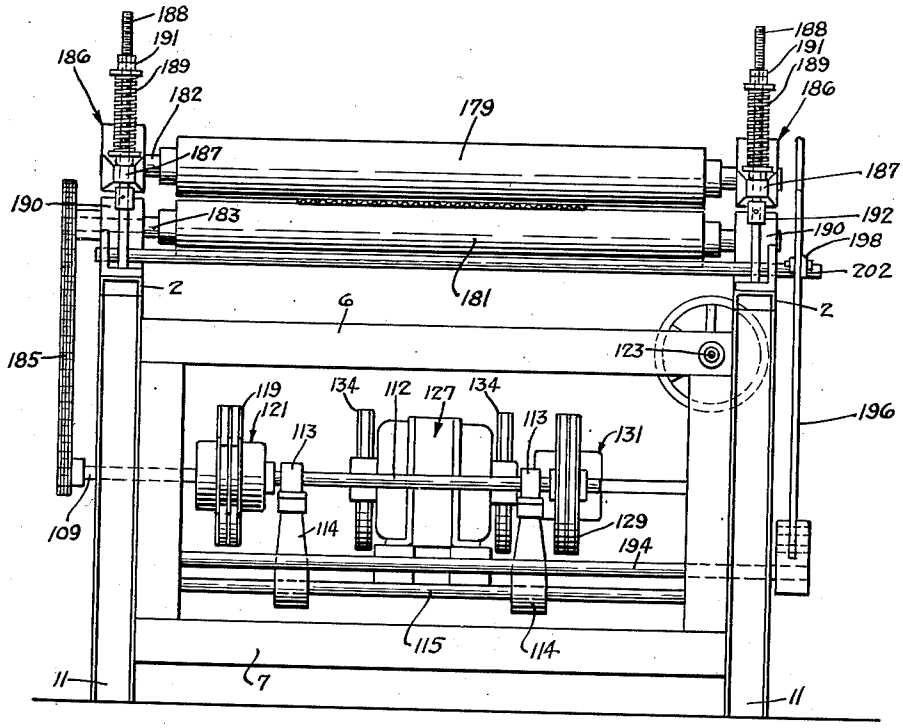


FIG. 6

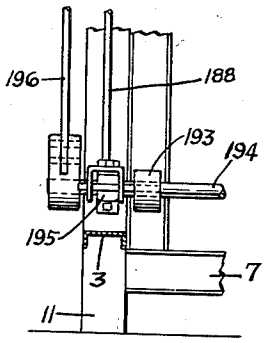


FIG. 7

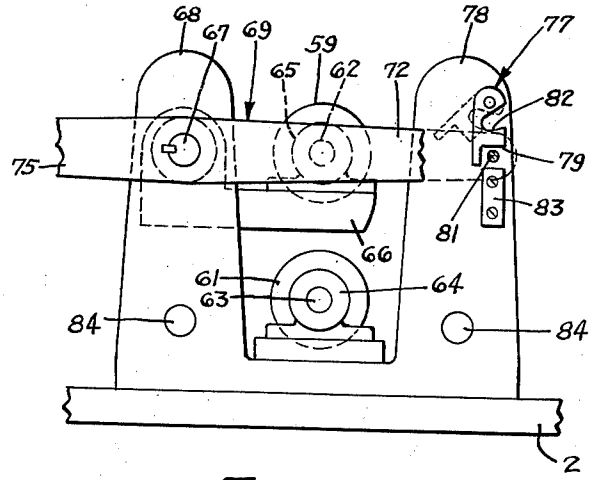


FIG. 8

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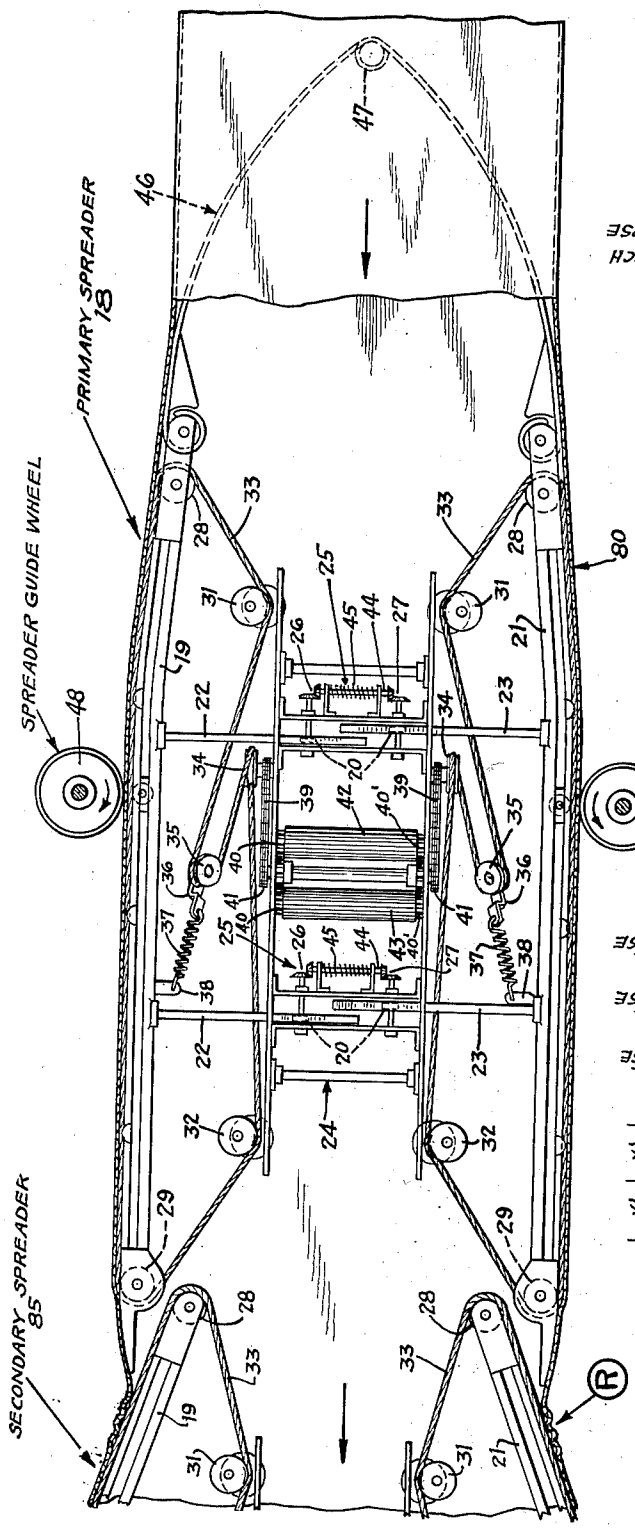


FIG. 9

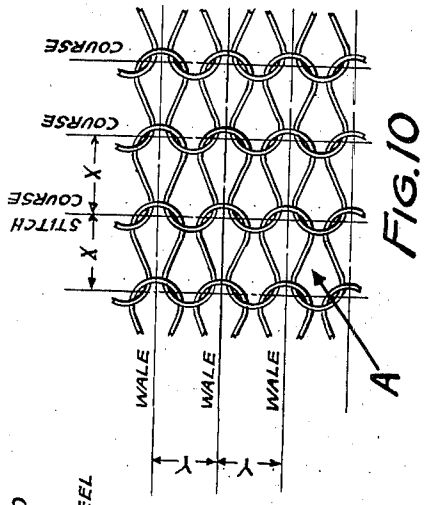


FIG. 10

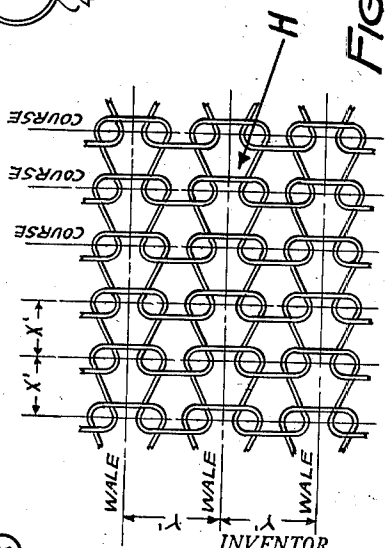


FIG. 11

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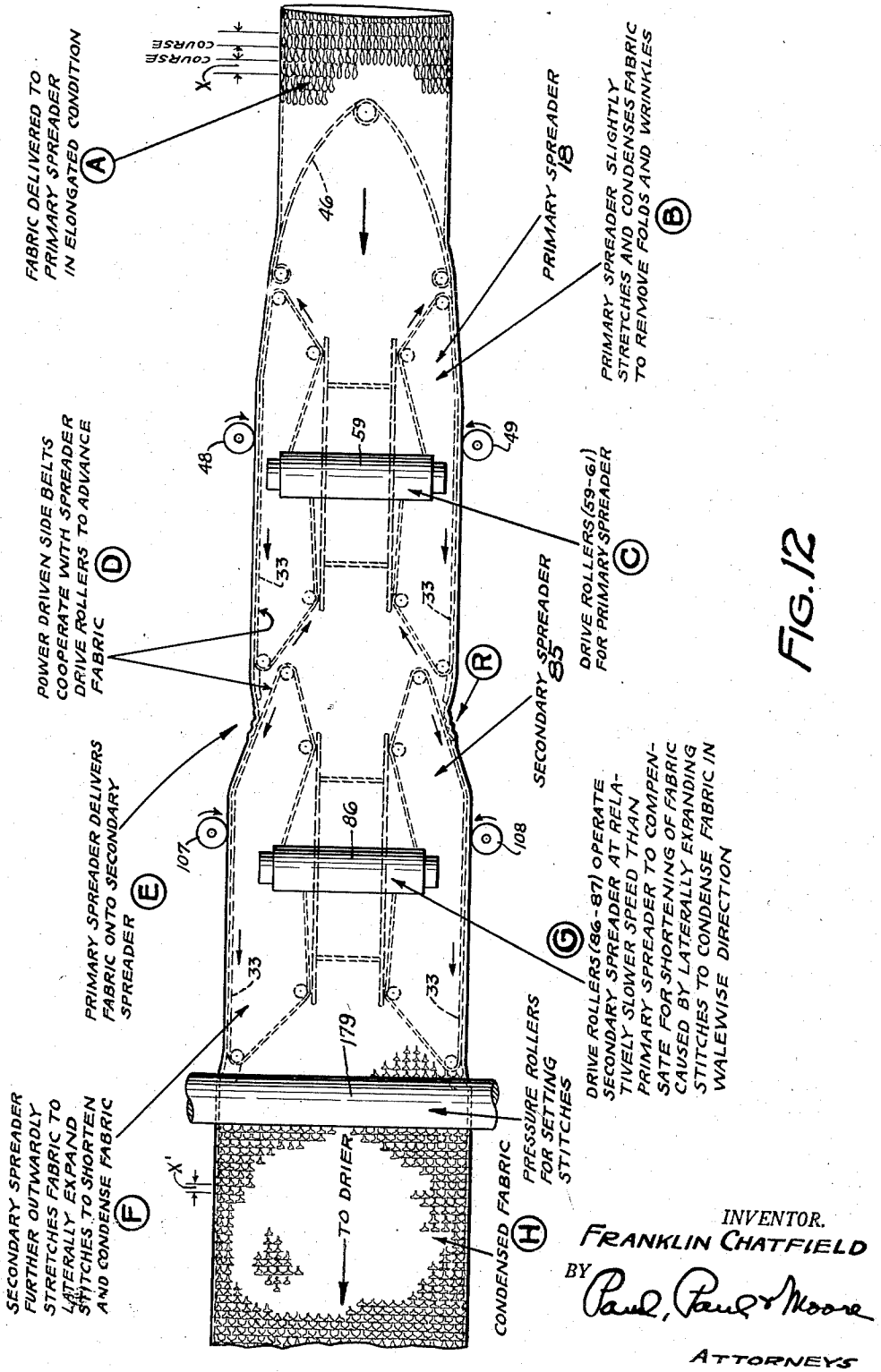


FIG. 12

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UNITED STATES PATENT OFFICE

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APPARATUS FOR SHRINKING AND CONDENSING TEXTILE FABRICS

Franklin Chatfield, Minneapolis, Minn., assignor, by mesne assignments, to Frank R. Redman, Yardley, Pa.

Application January 15, 1949, Serial No. 71,176

14 Claims. (Cl. 26—18.5)

1

This invention relates to new and useful improvements in apparatus for shrinking and condensing fabrics to minimize the likelihood of the fabric shrinking beyond a predetermined degree, when subsequently sewn into garments and subjected to frequent washings.

It is well known that garments made from knitted fabrics may have a tendency to shrink more or less, when subsequently subjected to frequent washings by the purchaser. This is particularly true if the fabric was not fully preshrunk or condensed following the usual processing of the fabric, such as washing, dyeing, etc., to return the stitches of the fabric to their normal laterally expanded condition, so far as possible, prior to sewing the fabric into garments. Tubular knit fabric is usually knitted into long tubular blanks, and to facilitate handling in the usual processing of the fabric, these long knitted blanks are secured together in end-to-end relation, whereby the strip of fabric may be passed from one processing tank or apparatus to another in a lengthwise direction, without interruption. During the process of washing, dyeing, and otherwise treating the fabric, the wet fabric is constantly subjected to a pulling action lengthwise of the fabric, whereby the fabric is elongated or stretched in the direction of its wales and narrowed in width, as will readily be understood.

The fibers and strands of most yarns and threads, particularly woolen fibers, when in their original state prior to being spun into yarns or threads, are usually more or less irregular, and may take the form of small curves, bends, and twists, which may be somewhat removed when preparing the fibers and strands for spinning into yarns or threads and during the spinning operation.

The strands of most yarns and threads have a tendency to return to their normal kinky or wavy state, if given an opportunity, and to accomplish this, various forms and types of equipment have heretofore been produced for shrinking and condensing knitted fabrics, prior to the fabric being rolled or folded for storage purposes, after which the fabric is subsequently cut into predetermined shapes and sizes, as may be required for the particular form of garment or article to be made therefrom.

The present invention is particularly designed for shrinking and condensing and relaxing knitted fabrics, thereby to restore the threads of the fabric, so far as possible, to their initial contracted state, whereby the finished fabric may

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be sewn into garments with the assurance that the garments or articles made therefrom will not be likely to noticeably shrink after having been sewn into garments and the garments are subsequently washed or laundered.

An important object of the invention, therefore, is to provide an improved method of shrinking, relaxing, and condensing tubular knitted fabrics prior to being sewn into garments to reduce to a minimum, the possibility of the garments made therefrom shrinking to the extent that the garments may eventually become too small for the wearer.

A further and more specific object of the invention resides in the provision of an improved method for shrinking and condensing knitted fabrics which consists in feeding the fabric along a known path to a given point at a predetermined speed, decreasing the speed of the fabric from said point onward, and simultaneously laterally stretching and widening the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, whereby the fabric is shortened and condensed in a walewise direction, after which the fabric may be slightly wetted or moistened and pressure applied thereto to set the stitches.

A further object of the invention is to provide an improved apparatus for shrinking and condensing knitted tubular fabrics, which comprises a pair of spreaders arranged in tandem and over which the fabric is fed, and means being provided for independently controlling the operations of the spreaders thereby to effect the desired shrinking and condensing of the fabric as it passes over the spreaders.

Other objects of the invention reside in the novel arrangement of the driving means for the tandem spreaders, whereby their operations may be quickly varied to produce the desired results, when changing from one fabric to another, even though the fabrics may vary considerably in texture and other characteristics; in the unique arrangement of the multiple controls of the apparatus whereby an operator may conveniently manipulate such controls, when necessary, and without interrupting the operation of the machine; in the arrangement of the variable speed drives provided for independently controlling the operations of the spreaders, and also whereby the traveling speed of the fabric may be varied in accordance with other equipment or apparatus to which the fabric may be fed from the shrinking and condensing machine; in the simple means provided for moving the spreader drive

rollers into or out of driving engagement with their complemental spreaders, and also whereby the pressure of the spreader drive rollers upon the spreaders may be varied to obtain the desired driving contact between the spreader supporting rollers and the spreaders; and in the provision of such an apparatus which is extremely simple and efficient in operation and wherein all parts are readily accessible to facilitate inspection and making repairs, when necessary.

These and other objects of the invention and the means for their attainment will be more apparent from the following description taken in connection with the accompanying drawings.

In the accompanying drawings there has been disclosed a structure designed to carry out the various objects of the invention, but it is to be understood that the invention is not confined to the exact features shown, as various changes may be made within the scope of the claims which follow.

In the drawings:

Figure 1 is a side view of the improved fabric condensing and shrinking machine showing the driving means for operating the various mechanisms thereof;

Figure 2 is a plan view of Figure 1; showing the tandem arrangement of the primary and secondary spreaders;

Figure 3 is a longitudinal sectional view on the line 3—3 of Figure 2, showing the drive rollers for the spreaders, and also the pressure rollers;

Figure 4 is a sectional plan view on the line 4—4 of Figure 1, showing the variable speed transmissions utilized for driving the spreaders and pressure rollers;

Figure 5 is an enlarged cross sectional view substantially on the line 5—5 of Figure 3, showing the means for varying the width of the spreaders;

Figure 6 is a view showing the discharge end of the machine with some of the parts omitted;

Figure 7 is a fragmentary detail sectional view on the line 7—7 of Figure 1, showing the means for raising or lowering the upper pressure roller;

Figure 8 is an enlarged detail sectional view showing the means provided for moving the spreader drive rollers into or out of driving engagement with the fabric passing over the spreaders;

Figure 9 is an enlarged detail sectional plan view of the primary spreader showing the belts provided thereon for advancing the side edge portions of the flattened fabric over the spreader to minimize friction and prevent lagging of the outer side portions of the fabric in its traveling movement;

Figure 10 is a view on a greatly enlarged scale showing a portion of the elongated fabric and stitch formation before being condensed;

Figure 11 is a similar view showing the same fabric after having been condensed; and

Figure 12 is a schematic view illustrating the entire operation of condensing the fabric in accordance with the method and apparatus herein disclosed.

Supporting structure

The novel machine herein disclosed is shown comprising a suitable frame embodying upper and lower horizontal side members 2 and 3, respectively, preferably in the form of inverted channels. The side members 2 and 3 are secured together at the receiving end of the machine by horizontal cross members 4 and 5, and similar horizontal cross members 6 and 7 are provided at the discharge end of the machine. All of the

above frame members are shown supported upon and secured to upright posts 8, 9 and 11 by such means as welding, or, if desired, bolts may be used.

A plurality of horizontally disposed frame members 12, 13, 14, 15, 16, and 17 are shown supported upon and secured to the lower horizontal side rails 3, intermediate the ends of the machine frame, and cooperate to provide means for supporting the various operating mechanisms of the apparatus, subsequently to be described.

Primary spreader

An important feature of the present invention resides in the novel means provided for condensing the fabric. The fabric usually in the form of an elongated tubular blank, may be delivered to the machine in a wet or dry state, after the fabric has been subjected to the usual processing, such as washing, bleaching, dyeing, etc., necessary to condition the fabric for condensing or shrinking in preparation for being sewn into garments or other articles.

The novel means provided for condensing and shrinking the fabric comprises a pair of power driven spreaders, arranged in tandem, whereby the tubular fabric passes first over one spreader and then over the other, as illustrated in Figures 2, 3 and 12. To facilitate explanation, the first spreader will hereinafter be referred to as the primary spreader, and the second spreader as the secondary spreader.

The primary spreader, generally designated by the numeral 18, comprises laterally movable side members 19 and 21. The side member 19 is shown supported by rods 22, and the side member 21 by similar rods 23. The rods 22 and 23 have their inner end portions slidably supported in suitable guides provided in the spreader frame, generally designated by the numeral 24. The inner ends of each pair of supporting rods 22 and 23 are geared together for simultaneous axial movement in opposite directions by suitable gear mechanisms, generally designated by the numeral 25. Each such mechanism comprises opposed sets of bevel gears 26 and 27 having rack-and-pinion connections with their respective rods 22 and 23, respectively, as indicated at 20 in Figure 9.

The side members 19 and 21 of the spreader are provided at their forward ends with pulleys 28 and have similar pulleys 29 at their rear ends. Additional pulleys 31 and 32 are secured to the side members of the spreader frame 24. Endless belts 33 have running connections with the pulleys 28, 29, 31 and 32 at each side of the spreader. The outer runs of said belts are supported in suitable guides (not specifically shown) provided in the outer edges of the spreader side members 19 and 21, whereby the edge portions of the flattened fabric, as the fabric passes over the primary spreader 18, are advanced by said belts, thereby to prevent the outer edge portions of the flattened tubular fabric from lagging behind the central portion of the web. The belts 33 constitute an important part of the invention, in that they assure that the courses of stitches of the fabric are always maintained straight and at right angles to the wales of the fabric, and that the side portions do not drag and lag behind the central portion of the web. See Figure 12.

The belts 33 also have running connections with pulleys 34 and 35. The pulleys 35 are mounted in brackets 36 secured to the adjacent ends of suitable springs 37, the opposite ends of which are shown connected to brackets 38 secured to the side members 19 and 21 of the

spreader, as will be noted by reference to Figure 9. The pulleys 34 are driven by suitable chains 39 having running connections with drive pulleys 41 which, in turn, have driving connections with opposed pairs of fabric engaging rollers 42 and 43 of the spreader 18, as indicated at 40 in Figure 9. The rollers 42 and 43 are disposed crosswise of the spreader, and are driven by the fabric as the fabric frictionally engages the peripheries thereof, as will subsequently be more clearly described.

Each spreader comprises two rollers 42, arranged one over the other and geared together for simultaneous operation in opposite directions by suitable gears 40', indicated in Figure 9. Each spreader also has two rollers 43 similarly arranged and interconnected for simultaneous rotation in opposite directions by gears 40'.

The belts 33 are so threaded around their drive pulleys 34 that the outer runs of the belts will be driven in the direction of fabric travel, whereby the outer belt runs will convey the outer edge portions of the tubular fabric over the spreaders and prevent lagging of said edge portions with respect to the central portion of the fabric.

The driving connections between the spreader rollers 42 and 43 and the belts 33 are such that the lineal travel of the spreader belts 33 is synchronized with the peripheral speed of the spreader rollers 42 and 43, whereby the outer marginal edge portions of the flattened tubular fabric will advance at the same speed as the central portion of the fabric. Thus, the side portions of the traveling fabric cannot lag behind the traveling movement of the central portion of the fabric, as the fabric passes over the spreaders.

The gear mechanisms 25 connect together the spreader side members 19 and 21 for simultaneous movement in opposite directions, and are each shown comprising a shaft 44. Suitable torsion springs 45 are coiled about the shafts 44, and each has one end secured to its complemental shaft 44 and the opposite end of each of said springs being secured to one of the supporting brackets for the shaft. The springs 45 are placed under sufficient torsional tension to constantly urge the spreader side members 19 and 21 outwardly to hold the outer runs of the belts 33 in feeding engagement with the inner side portions of the fabric, as best illustrated in Figures 5, 9 and 12.

A guide member, generally designated by the numeral 46, is shown composed of two arch-shaped rod-like members pivotally connected together at their forward ends, as indicated at 47, and having their rear ends pivotally connected to the forward end portions of the side members 19 and 21 of the spreader, as illustrated in Figure 9. The guide member 46 serves to flatten the elongated tubular fabric and remove therefrom wrinkles and folds prior to guiding the fabric onto the primary spreader in a smooth unstretched condition with the wales of the fabric running substantially straight. A separate application will subsequently be filed specifically covering the spreader, and it is therefore deemed unnecessary herein to further describe the spreader in detail.

Means for varying width of primary spreader

As hereinbefore stated, the springs 45 constantly exert a force on the supporting rods 22 and 23 of the spreader side members 19 and 21 to press the outer runs of the belts 33 firmly against the interior surfaces of the opposed folded edge portions of the flattened fabric, thereby

to hold said side edges in engagement with a pair of guide wheels 48 and 49. The peripheries of the guide wheels 48 and 49 may be faced with a suitable resilient material such as rubber, to minimize the danger of damage to the fabric as the fabric contacts the peripheries thereof. Such partial widening or lateral stretching of the fabrics as it passes over the primary spreader 18 also removes from the fabric any wrinkles or folds present therein.

The guide wheels 48 and 49 are laterally adjustable with respect to one another, as best shown in Figure 5, and are mounted on similar supporting members 51 and 52 secured respectively to the upper and lower runs of a horizontally disposed endless chain 53. The chain has running connections with idler sprockets 54 and 55 rotatably mounted on suitable shafts 56 and 57, respectively. A crank 58 is shown secured to the pulley 55 whereby the chain 33 may readily be manipulated to move the guide wheels 48 and 49 towards or away from one another, thereby to vary the effective or working width of the primary spreader 18, as will readily be understood by reference to Figure 5. The supporting members 51 and 52 are slidable upon suitable guide rods 30 and 50, and are axially translated thereon by manipulation of the crank 58.

Supporting means for primary spreader

The primary spreader 18 is floatingly supported between a pair of rubber covered rollers 59 and 61 secured to shafts 62 and 63, respectively. The lower shaft 63 is supported in suitable bearings 64 mounted on the side frame members 2 of the main supporting frame, as best illustrated in Figure 5.

The upper shaft 62 is shown rotatably mounted in suitable bearings 65 secured to the outer ends of arms 66 fixed to a rock shaft 67 mounted in upright members 68 of the machine frame. An elongated arm, generally designated by the numeral 69, has its intermediate portion secured to one end of the shaft 67, as shown in Figure 1. A suitable tension spring 71 has one end connected to the end portion 72 of the arm 69. The lower end of spring 71 is shown adjustably secured to a fixed bracket 73 whereby the tension of the spring may be varied, for purposes subsequently to be described.

A similar spring 74 has its upper end connected to the opposite end portion 75 of the arm 69 and its lower end adjustably secured to a fixed bracket 76 in a manner similar to the spring 71. The spring 74 serves to counterbalance the weight of the roller 59 and its supporting shaft 62, and is so tensioned that when the arm is free, the roller 59 rests freely on the upper rollers 42 and 43 of the primary spreader 18, or on the fabric passing thereover. The spring 71 is adjusted to impose a predetermined pressure on the fabric to hold it in feeding engagement with the spreader rollers 42 and 43. The roller 59 may readily be moved out of contact with the fabric by manipulation of the arm 75 to permit an operator to readily slip the tubular fabric over the primary spreader positioned between the rollers 59 and 61, or to withdraw the fabric from the spreader.

To minimize twisting strains in the shaft 67, an arm, similar to the arm 69, may be secured to the opposite end of said shaft, and provided with similar springs 71 and 74.

Means is provided for positively holding the roller 59 in an elevated position to facilitate in-

serting a spreader between the rollers 59 and 61 or removing it therefrom. Such means is best shown in Figure 8, and comprises a latch member 77 pivotally supported on the upper end of an upright frame member 78. The latch is normally supported as shown in full lines in Figure 8 and has its lower end notched, as shown at 79, adapted to receive the inner end of a pin 81 secured to the end portion 72 of the arm 69. A second notch 82 is provided in the latch 77 adapted to receive the pin 81 when it is desired to lift the upper roller out of driving engagement with the fabric, as will be understood by reference to Fig. 8.

A suitable stop 83 is secured to the frame member 78 directly below the pin 81 adapted to be engaged by said pin to limit the downward movement of the end portion 72 of the arm 69, when the primary spreader is removed from between the drive rollers 59 and 61.

The spring 71 is so tensioned that it will hold the roller 59 in pressing engagement with the upper web or ply of the tubular blank, whereby the lower web of the blank is similarly held in driving engagement with the lower roller 61. The upper wall of the notch 79 of the latch 77 limits upward movement of the roller 59 in the event the fabric happens to be bunched or an abnormal pull is exerted thereon. In such an emergency, the pull upon the fabric may cause automatic interruption of the apparatus as a result of the usual automatic control means (not shown) usually embodied in apparatus of this general type, and well known in the art. The latch member 77 thus serves the dual purpose of limiting upward movement of the upper roller 59, or to hold the roller 59 out of driving engagement with the fabric.

Suitable tie rods 84 are shown interposed between the upright frame portions 68 at opposite sides of the machine and also between the upright frame portions 78. The pin or rod 81 secured in the end portion 72 of the arm 69 is preferably outwardly extended beyond the outer face of the arm, as shown in Figure 2, to provide, in effect, a handle which may be conveniently grasped by the operator, when manipulating the arm 69, as when slipping fabric over the primary spreader or removing it therefrom, or when it becomes necessary to remove the spreader from between the rollers 59 and 61.

Supporting means for secondary spreader

The secondary spreader, generally designated by the numeral 85, is constructed in a manner similar to the primary spreader 18 with the exception that it does not require the front guide member 46 shown pivoted to the front end of the primary spreader.

The secondary spreader is supported between drive rollers 86 and 87 secured respectively to shafts 88 and 89. The shaft 89 of the lower roller 87 is shown rotatively supported in suitable bearings 91, partially shown in Figure 3. The shaft 88 of the upper drive roller 86 is rotatably supported in suitable bearings 92 provided at the outer ends of arms 93. The arms 93 are secured to a rock shaft 94 mounted for rocking movement in upright members 95 of the machine frame, as clearly illustrated in Figures 1 and 2.

An arm 96, similar to the arm 69 of the primary spreader 18, is secured to one end of the rock shaft 94 and has one end of a suitable spring 97 secured to the end portion 98 thereof. The lower end of said spring is adjustably secured to a fixed bracket 99, whereby the tension of the spring 97 may be varied in a manner similar to the spring 71, thereby to vary the driving engagement of the drive rollers 86 and 87 with the fabric.

A latch 77 similar to the corresponding latch of arm 69, is shown mounted at the upper end of the frame portion 101 and is adapted for operation to retain the arm 96 in its operative or inoperative position, in a manner similar to the supporting means for the primary spreader. If deemed necessary, an arm similar to arm 96 may be secured to the opposite end of shaft 94 to minimize torsional strains in said shaft.

A spring 102 has its upper end secured to the end portion 103 of the arm 96, and its lower end adjustably secured to a fixed part of the machine, such as a bracket 103, whereby the spring 102 may be tensioned to counter-balance the weight of the upper roller 86 and its supporting shaft 88.

Means for varying width of secondary spreader

The means for varying the width of the secondary spreader 85 is similar to the corresponding means of the primary spreader 18, shown in Figure 5, and comprises an operating crank 104 secured to a short shaft 105 having a sprocket 55 secured thereto for operating an endless chain 106. The chain 106 has running connections with the sprocket 55 and a sprocket 54 supported at the opposite side of the machine frame, as shown in Figure 5. Guide wheels 107 and 108 are secured respectively to the lower and upper runs of the endless chain 106 by mounting members 51 and 52, similar to the ones used in conjunction with the primary spreader 18. When the crank 104 is relatively rotated, the guide wheels 107 and 108 are moved towards or away from one another thereby to vary the operating width of the secondary spreader 85.

It will thus be seen that by the simple manipulation of the cranks 58 and 104, the primary and secondary spreaders may be conveniently adjusted in width to obtain the desired shrinkage or condensing of the fabric, as it passes from the primary to the secondary spreader, without interrupting operation of the apparatus.

Drive means for spreaders

Another important feature of the present invention resides in the manner of driving the primary and secondary spreaders to obtain the desired condensing and shortening of the fabric in a walewise direction, whereby shrinkage of the fabric when subsequently sewn into garments, or other articles, and subjected to frequent washings, is substantially eliminated. The means provided for thus driving the two spreaders, is best illustrated in Figures 1, 3, 4 and 5, and comprises a main drive shaft 109 rotatably mounted in suitable bearings or pillow blocks 111 shown secured to the cross members 15 and 16 of the lower portion of the machine frame. The drive shaft 109 is driven from a countershaft 112 shown mounted in suitable bearings 113 secured to the upper ends of arms 114. The arms 114 are fixed to a rock shaft 115 mounted in bearings 116 and 117 secured to the lower side frame members 3 of the main frame.

The driving connection between the main drive shaft 109 and the countershaft 112 is shown comprising dual V-belts 118 mounted on pulleys 119 secured to the drive shaft 109, and a variable speed pulley 121 of well known construction.

The pulley 121 is of the type whose effective diameter may be automatically varied to change the speed ratio between the shafts 109 and 112, when the variable speed pulley 121 is moved towards or away from the drive shaft 109.

To thus laterally shift the variable speed pulley 121 towards or away from the driven pulley 119, an upright arm or rod 122 is shown having its lower end secured to the rock shaft 115 and its upper end is operatively connected to the threaded ends of a shaft 123, mounted in suitable bearings 124 and 125 secured to the ends of the main supporting frame, as clearly illustrated in Figures 1 and 4. A suitable hand wheel 126 is secured to the opposite end of the adjusting shaft 123 for manipulating said shaft to rock the shaft 112, thereby to vary the effective diameter of the variable speed pulley 121.

The countershaft 112 is driven from a conventional motor 127 by dual V-belts 128 similar to the V-belts 118. The belts 128 have running connections with a dual pulley 129 secured to the countershaft 112 and with a variable speed pulley 131 secured to the motor 127.

The primary and secondary spreaders are driven from the main drive shaft 109 by suitable V-belts 132 and 133, respectively, whereby the operations of the spreaders may be varied independently of one another. The V-belt 132 has a running connection with a pulley 134 secured to the drive shaft 109, and with a variable speed pulley, generally designated by the numeral 135, of well known construction, and which therefore need not be described in detail. The variable speed pulley 135 comprises V-pulleys 136 and 137.

The pulley 136 is driven from the shaft 109 by the belt 132, and the pulley 137 has a belt 138 operatively connecting it to a pulley 139 secured to a shaft 141, as shown in Figure 4. The shaft 141 is mounted in bearings 142 and 143 and has a sprocket wheel 144 secured thereto, preferably exteriorly of the machine frame. A suitable chain 145 operatively connects the sprocket wheel 144 to a sprocket wheel 146 secured to one end of the shaft 63 of the lower drive roller 61 of the primary spreader, as best illustrated in Figure 5.

The pulley 135 is supported in a frame, generally designated by the numeral 147, shown pivoted at 148 and having one end of an adjusting rod 149 operatively connected therewith, as shown in Figure 3. To thus connect the rod 149 to the frame 147 a threaded block 151 is mounted in the upper portion of the frame 147, and has a threaded connection with the rod 149 whereby when the rod is relatively rotated, the frame 147 may be oscillated about its pivots 148 to thereby cause the variable speed pulley 135 to function and vary the speed of the shaft 141 with respect to the speed of the main drive shaft 109. The adjusting rod 149 may be provided with a universal joint 152, and is supported in the cross member 4 of the main frame, as shown in Figure 3. A suitable sprocket 153 is secured to the adjusting rod 149 and has a chain 153 operatively connecting it to a hand wheel 154, conveniently located adjacent to the adjusting wheel 126, as shown in Figures 1, 2 and 4.

The lower drive roller 61 is directly driven by the chain 145, whereas the upper drive roller 59 is driven from the lower roller 61 by intermeshing spur gears 155 and 156. The teeth of said gears are sufficiently long to permit limited movement of the roller 59 away from the lower roller 61 during operation of the machine and whereby slight variations in the fabric will not interfere with the driving engagement between said gears.

The secondary spreader 85 is also driven from the main drive shaft 109 by a variable speed transmission or mechanism 157, similar to the variable speed pulley 135 of the primary spreader 18. The variable speed mechanism 157 comprises pulleys 158 and 159, the pulley 159 being driven from the shaft 109 by the belt 133. The other variable pulley 158 has a belt 161 operatively connecting it to a pulley 162 secured to a shaft 163 mounted in bearings 164 and 165. A sprocket 166 is secured to the outer end of the shaft 163 and has a chain 167 operatively connecting it to a sprocket 168 secured to the shaft 89 of the lower drive roller 87 of the secondary spreader. The drive rollers 86 and 87 of the secondary spreader are operatively connected together by suitable gears 155 and 156 similar to the corresponding gears of the drive rollers 59 and 61 of the primary spreader.

In Figure 2 the upper drive roller 59 of the primary spreader 18 is shown driven from one end only of the shaft 63 supporting the lower drive roller 61, and, in like manner, the shafts 88 and 89 of the drive rollers 86 and 87 of the secondary spreader are geared together at one side of the machine. If deemed necessary, said shafts may be geared together at both sides of the machine to minimize torsional strains therein.

Variable speed pulley unit 157 is shown mounted in a frame 169, supported on pivots 171 for pivotal movement in a manner similar to the frame 147, thereby to vary the effective diameters of the variable speed pulley elements 158 and 159, as may be desired. An adjusting shaft or rod 172 has one end received in threaded engagement with a threaded block 173 secured to the upper end of the frame 169. The opposite end of shaft 172 is supported in a bearing 174, and has a sprocket 175 secured thereto which is operatively connected to a hand wheel 176 by a suitable chain drive 177. The adjusting rod or shaft 172 may be provided with a universal joint 178 similar to the universal joint 152 of the adjusting rod or shaft 149 of the primary spreader.

Stitch setting mechanism

Means is provided for setting the stitches of the fabric in their laterally expanded condition as the condensed fabric leaves the secondary spreader. To thus set the stitches in their contracted form, a pair of rubber faced pressure or squeeze rollers 179 and 181 are mounted upon suitable shafts 182 and 183, respectively, as shown in Figure 3. The lower shaft is driven from the main shaft 109 by a suitable chain drive 185, and the upper roller 182 is driven by peripherally engaging the lower roller 183, or the fabric fed between said rollers.

The upper squeeze roller 179 is laterally movable with respect to the lower squeeze roller 181, and the upper roller is therefore shown supported in suitable arms 186 pivoted at 180 to the bearing blocks 190 in which the lower shaft 183 is rotatably supported. The opposite end portions 187 of the arms 186 are apertured to receive the upper ends of bars or rods 188, each having a spring 189 coiled thereabout. The springs 189 exert a yielding pressure on the arms 186, when the rods 188 are thrust downwardly to move the upper squeeze roller 179 into squeezing engagement with the fabric passing between rollers 179 and 181.

Suitable adjusting nuts 191 are received in

threaded engagement with the upper ends of the rods 188 to vary the tension in the springs 189. Suitable stops 192 are secured to the rods 188 and have their upper ends positioned adjacent the lower faces of the arm portions 187 whereby when the arms 186 are swung upwardly, the upper roller 179 may be moved out of engagement with the fabric.

To thus upwardly move the roller 179, the lower ends of the rods 188 are pivotally connected to arms 193 secured to a rock shaft 194 mounted in suitable bearings 195 secured to the main supporting frame adjacent one end thereof.

A lever 196 has its lower end secured to the rock shaft 194 whereby when the lever 196 is oscillated in the direction of the arrow 197, in Figure 1, the rods 188 will be moved upwardly to thereby upwardly move the arms 187 to elevate the upper roller 179 out of engagement with the lower driven roller 181.

A latch member 198 is pivoted to the lever 196 and has suitable notches 199 and 201 in its lower edge adapted to selectively engage a pin or stud 202 fixed to the machine frame thereby to retain the squeeze rollers 179 and 181 in feeding engagement with the fabric, or in an elevated position, out of contact therewith.

In Figure 1, the full line position of the operating lever 196 indicates its position when the squeeze rollers are in engagement with the fabric, as shown in Figure 3. When thus positioned, the pin 202 is received in the notch 199 in the latch member 198, to thereby lock the upper squeeze roller 179 in operative position. When the operating lever 196 is swung outwardly to the dotted line position shown in Figure 1, the arms 193 will upwardly move the rods 188 and thereby swing the arms 187 upwardly to cause the upper squeeze roller 179 to move out of contact with the fabric.

Suitable tie rods 203 are preferably interposed between the upright frame members 95—95 and bearings 190—190, as shown in Figures 1 and 3, thereby to reinforce and strengthen the main supporting structure or frame.

Operation

An important feature of the present invention, as hereinbefore stated, resides in the unique arrangement and manipulation of the primary and second spreaders to effect the desired degree of condensing or shrinkage in the finished fabric. The processed fabric, in the form of an elongated tube which may be wet or dry, is delivered to the primary spreader from a suitable container such as an enlarged box, into which the processed fabric is delivered, usually by a well known form of fabric folder, which lays the moistened fabric into the receiving box in large folds thereby to facilitate the removal of the fabric from said box.

The fabric thus delivered into the receiving box may be composed of a plurality of strips of tubular knit fabric as they come from the knitting machine, sewn together in end-to-end relation, whereby the composite strip delivered into the receiving box in preparation for condensing and drying may be many feet in length. To thus secure the knitted strips together in endwise relation is well known in the art, and is usually done prior to subjecting the fabric to the usual processing operation in order that the operation of processing the fabric may be carried on continuously and without interruption.

The elongated fabric strip is guided onto the primary spreader by the guide member 46, as shown at A in Figure 12, and then engages the side belts 33 of the primary spreader which assists to manually advance the end of the tubular fabric into driving engagement with the guide wheels 48 and 49 and the drive rollers 59 and 61 of the primary spreader 18. The drive rollers 59 and 61 cooperate to advance the fabric to the secondary spreader 85. The fabric as it is guided onto the primary spreader 18, is slightly widened or laterally stretched, as shown at B, in Figure 12, thereby to remove any wrinkles or folds which may be present in the fabric prior to the fabric reaching the drive rollers shown at C in Figure 12.

The fabric advancing or feeding speed of the primary spreader is controlled by manipulation of the hand wheel 154, and is determined by the speed of the secondary spreader 85 which operates at a relatively slower speed than the primary spreader because of the condensing and shortening of the tubular fabric as a result of laterally expanding the stitches of the fabric, as the fabric travels from E to G, as indicated at H in Figure 12. The amount of spread imparted to the tubular fabric, as it passes over the primary spreader, is controlled by manipulation of the crank 58. The above controls are clearly illustrated in Figures 1, 4 and 5.

When the elongated strip of fabric is delivered to the primary spreader 18, the fabric is in a laterally contracted condition, whereby the stitches may be considerably elongated in a direction lengthwise of the fabric, as illustrated at A in Figures 10 and 12, wherein X represents the spacing between adjacent stitch courses of the fabric lengthwise thereof, and Y, the spacing between adjacent wales of the fabric transversely thereof. To minimize shrinkage of the fabric when completed, the fabric must be condensed or shortened in a lengthwise direction. According to the present invention, this is accomplished by laterally expanding the stitches, as indicated at H in Figures 11 and 12, wherein it will be noted that the spacing X' between adjacent stitch courses has been considerably reduced as compared to the spaces between adjacent courses in Figure 10. At the same time, the spacing Y' between adjacent wales has been considerably increased over the spacing between the wales shown in Figure 10.

As the fabric passes on from the feed rollers C of the primary spreader 18, the side belts 33 of the primary spreader cooperate to deliver the fabric onto the secondary spreader 85, as shown at D and E in Figure 12, whereupon the stitches of the fabric are expanded laterally with respect to the wales of the fabric, resulting in increasing the spacing Y' between adjacent wales, as indicated in Figures 10, 11 and 12. At the same time the spacing between adjacent stitch courses of the fabric correspondingly decrease as indicated at X', in Figures 11 and 12.

Condensing and shortening the fabric in a wale-wise direction, as above described, obviously reduces the traveling movement of the fabric from the secondary spreader 85 on, relative to the speed of the primary spreader, whereby the speed of the secondary spreader must be reduced to compensate for such shortening of the fabric in a lengthwise direction, due to the widthwise spread of the fabric. When the fabric passes from the primary spreader onto the receiving end of the secondary spreader, it is in a free and relaxed

condition, and may be slightly rippled as indicated at R in Figures 2, 6, 9 and 12.

The side belts 33 of the secondary spreader cooperate with its drive rollers 86 and 87 to positively advance the fabric over the secondary spreader substantially without slippage, and with the assurance that the stitch courses will be maintained substantially straight transversely of the fabric. The guide rollers 107 and 108 hold the edge portions of the tubular fabric in engagement with the outer runs of the belts 33 of the secondary spreader 85 to prevent any possible lagging of the outer edge portions of the fabric relative to the central portion thereof, as the fabric passes over the secondary spreader.

The speed of the secondary spreader is controlled by varying the speed of the drive rollers 86 and 87 by manipulation of the hand wheel 176, shown in Figures 1 and 4. See also G in Figure 12. The increased width of the secondary spreader relative to the width of the primary spreader, in combination with the reduced speed of the secondary spreader to compensate for the widening of the fabric as it passes over the secondary spreader, determines the amount of shrinkage or shortening imparted to the fabric in a lengthwise direction, and is readily variable by varying the width of the secondary spreader relative to the primary spreader by manipulation of the operating crank 104.

When the fabric leaves the secondary spreader 85, as shown at F in Figure 12, it passes between the pressure rollers 179 and 181 which apply pressure to the laterally expanded stitches of the condensed fabric and thereby set the stitches and the fabric in its condensed condition. From the pressure rollers 179 and 181, the fabric may be delivered into a suitable dryer, not shown, through which the fabric is fed in a loose free condition and without exerting any pulling on the fabric.

The condensing action imparted to the fabric by the tandem spreaders, as hereinbefore stated, is accomplished by increasing the effective width of the secondary spreader relative to the width of the primary spreader, whereupon the stitches of the fabric are expanded laterally as shown in Figure 11, and indicated at H in Figure 12. The amount of condensing or shortening of the fabric may readily be varied by manipulation of the hand wheels 154 and 176, shown in Figure 4. When the desired condensing of the fabric is obtained, the speed of the entire apparatus may be adjusted by manipulation of the operating wheel 126, to synchronize the delivery of the condensed fabric with the speed of the dryer, not shown, through which the fabric is usually passed as it is discharged from the condensing apparatus, thereby to complete the fabric for sewing into garments.

The apparatus herein disclosed has been found to operate efficiently on either dry or wet fabrics. In most cases, however, the fabric is delivered to the dryer in a moistened condition, as it has been found the expanded stitches set more firmly when the fabric is moist when pressure is applied thereto. If added moisture is required to produce the desired results, such added moisture, either in the form of a spray or live steam, may be introduced into the fabric just prior to passing the fabric between the pressure rollers 179 and 181.

It will be apparent to those skilled in the art that I have accomplished at least the principal objects of my invention, and it will also be apparent to those skilled in the art that the embodiments herein described may be variously changed and modified without departing from the spirit of the invention, and that the invention is capable of uses and has advantages not herein specifically described; hence it will be appreciated that the herein disclosed embodiments are illustrative only, and that my invention is not limited thereto.

I claim as my invention:

1. In an apparatus for shrinking and condensing tubular knit textile fabrics, a pair of power driven spreaders arranged in tandem and over which the tubular knit fabric is fed, one of said spreaders flattening the tubular fabric and delivering it onto the second spreader, said second spreader being relatively wider than the first spreader and laterally stretching and widening the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric.

2. In an apparatus for shrinking and condensing wet tubular knit textile fabrics, a pair of power driven spreaders arranged in tandem and over which the tubular knit fabric is fed, one of said spreaders guiding the tubular fabric onto the second spreader, the second spreader being relatively wider than the first spreader and laterally stretching and widening the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, and means for receiving the outstretched fabric from said second spreader and applying pressure thereto to set the stitches of the fabric whereby the fabric will retain its condensed condition when released from the pressure means.

3. In an apparatus for shrinking and condensing tubular knit textile fabrics, a pair of power driven spreaders arranged in tandem and over which the tubular knit fabric is fed, the first spreader flattening the tubular fabric and guiding it onto the second spreader, the second spreader being relatively wider than the first spreader and laterally stretching and widening the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, the first spreader operating at a relatively higher speed than the second spreader and delivering the fabric to the second spreader at a rate commensurate with the shortening of the fabric as a result of the spreading action imparted thereto by the second spreader.

4. In an apparatus for condensing and shrinking a moistened tubular knit textile fabric, a pair of power driven spreaders arranged in tandem and over which the tubular knit fabric is constantly fed, the second spreader being relatively wider than the first spreader and laterally stretching and widening the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, the first spreader operating at a relatively higher speed than the second spreader and delivering the fabric to the second spreader at a rate commensurate with the shortening of the fabric as a result of the spreading action imparted thereto by the second spreader, a pair of squeeze rollers between which the moistened outwardly stretched fabric is passed, thereby to cause the stitches of the condensed fabric to become set, and whereby the fabric will retain its condensed condition when subsequently released from the squeeze rollers.

5. In an apparatus for shrinking tubular knit fabrics, first and second spreaders disposed in tandem relation and over which the tubular fabric blank is fed, said second spreader being rela-

tively wider than the first spreader and laterally stretcing and widening the fabric to cause its stitches to expand laterally, and whereby the fabric is shortened and condensed in a walewise direction, pressure rollers positioned to receive the outwardly stretched fabric from the second spreader and applying pressure thereto to set the laterally expanded stitches, and separate means for supporting and driving said spreaders and whereby the speed of the first spreader may be increased relative to the speed of the second spreader to deliver the fabric to the second spreader at a rate commensurate with the shortening of the tubular knit fabric by the second spreader.

6. In an apparatus for shrinking tubular knit fabrics, first and second spreaders disposed in tandem relation and over which the tubular fabric blank is fed, said spreaders being laterally adjustable independently of one another to control the shrinking action imported to the fabric, said second spreader being relatively wider than the first spreader and laterally stretching and widening the fabric to cause its stitches to expand laterally, and whereby the fabric is shortened and condensed in a lengthwise direction, a pair of pressure rollers positioned to receive the outwardly stretched fabric from the second spreader and applying pressure thereto to set the laterally expanded stitches, pairs of independent coacting rollers for supporting and driving said spreaders, and independent drive means for said pairs of rollers whereby the fabric feeding actions of said spreaders may be independently varied to effect the desired shrinkage in the fabric.

7. In an apparatus for shrinking tubular knit fabrics, a plurality of spreaders longitudinally aligned with respect to one another and over which the tubular fabric is fed, said spreaders being adjustable laterally independently of one another whereby said spreaders may vary in width in the direction of fabric travel to gradually laterally stretch and widen the fabric to cause its stitches to expand laterally and thereby shorten and condense the fabric in a lengthwise direction, and independently drives for said spreaders whereby the fabric may be successively discharged from one spreader onto the next at a rate commensurate with the shortening of the fabric at each succeeding spreader.

8. In an apparatus for shrinking a wet tubular knit fabric, a plurality of spreaders longitudinally aligned with respect to one another and over which the tubular fabric is fed, said spreaders being adjustable laterally independently of one another whereby said spreaders may be varied in width in the direction of fabric travel to gradually laterally stretch and widen the fabric to cause its stitches to expand laterally and thereby shorten and condense the fabric in a lengthwise direction, independent drives for said spreaders whereby the fabric may be successively discharged from one spreader onto the next at a rate commensurate with the shortening of the fabric at each succeeding spreader, and means for applying pressure to the condensed fabric to set the stitches thereof.

9. In an apparatus for shrinking and condensing tubular knit fabrics, a supporting frame, pairs of coacting drive rollers mounted in said frame and spaced apart lengthwise thereof, a spreader mounted upon and driven by each pair of said coacting rollers whereby the spreaders are disposed in tandem to facilitate passing the tubular fabric over said spreaders, the second spreader being relatively wider than the first spreader and laterally stretching and widening the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, and whereby the fabric is shortened and condensed in a lengthwise direction, said first spreader operating at a relatively higher speed than the second spreader to deliver the fabric to the second spreader at a rate commensurate with the shortening of the tubular knit fabric by said second spreader.

10. In an apparatus for shrinking and condensing tubular knit fabric, a supporting frame, pairs of coacting drive rollers mounted in said frame and spaced apart lengthwise thereof, a spreader mounted upon and driven by each pair of said coacting rollers whereby the spreaders are disposed in tandem to facilitate passing the tubular fabric over said spreaders, the second spreader being relatively wider than the first spreader and laterally stretching and widening the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, and whereby the fabric is shortened and condensed in a lengthwise direction, said first spreader operating at a relatively higher speed than the second spreader and delivering the fabric to the second threader at a rate commensurate with the shortening of the tubular knit fabric by said second spreader, and means for independently controlling the operations of said spreaders in accordance to the shrinkage to be imparted to the fabric.

11. In an apparatus for shrinking and condensing tubular knit fabrics, a supporting frame, a pair of coacting drive rollers mounted in said frame, a fabric spreader supported between said rollers and adapted to be driven thereby, a second pair of coacting drive rollers mounted in said frame and spaced from said first drive rollers in the direction of fabric travel, a second fabric spreader mounted between and driven by said second pair of coacting rollers and having its receiving end positioned within the confines of the discharge end of the first spreader whereby the fabric may be discharged from the first spreader directly onto the second spreader in a somewhat rippled condition, said second spreader increasing in width from its receiving end to a relatively wider spread than the first spreader, thereby to laterally stretch and widen the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, and whereby the fabric is shortened and condensed in a lengthwise direction, and a variable drive for each pair of coacting spreader drive rollers whereby the operations of said spreaders may be independently controlled to gradually vary the fabric feeding actions thereof to effect the desired shrinkage of the fabric.

12. In an apparatus for shrinking and condensing tubular knit fabrics, a supporting frame, a pair of coacting drive rollers mounted in said frame, a fabric spreader supported between said rollers and adapted to be driven thereby, a second pair of coacting drive rollers mounted in said frame and spaced from said first drive rollers in the direction of fabric travel, a second fabric spreader mounted between and driven by said second pair of coacting rollers and having its receiving end disposed in overlapping relation to the tail end of the first spreader whereby the fabric may be discharged from the first spreader directly onto the second spreader in a slightly rippled state, said second spreader increasing in width from its receiving end to a relatively wider spread than the first spreader, thereby to laterally

stretch and widen the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, and whereby the fabric is shortened and condensed in a lengthwise direction, the sides of said second spreader being equipped with endless belts adapted to directly engage the fabric and operating at a speed corresponding to the peripheral speed of the drive rollers for said second spreader whereby the fabric, throughout its full width, is uniformly fed over the second spreader.

13. In an apparatus for shrinking and condensing tubular knit fabrics, a supporting frame, a pair of coacting drive rollers mounted in said frame, a fabric spreader supported between said rollers and adapted to be driven thereby, a second pair of coacting drive rollers mounted in said frame and spaced from said first drive rollers in the direction of fabric travel, a second fabric spreader mounted between and driven by said second pair of coacting rollers and having its receiving end disposed in overlapping relation to the tail end of the first spreader whereby the fabric is discharged from the first spreader directly onto the second spreader, said second spreader being relatively wider than the first spreader, thereby to laterally stretch and widen the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, and whereby the fabric is shortened and condensed in a lengthwise direction, each of said spreaders comprising longitudinally extending side frame members mounted for lateral adjustment to vary the effective width of the spreaders, pulleys mounted at the ends of said side frame members, and endless belts mounted on said pulleys and having driving connections with the coacting drive rollers of said spreaders whereby said endless spreader belts are driven at a speed corresponding to the peripheral speed of the coacting drive rollers of their respective spreaders, and whereby said spreader side belts will coact with their respective drive rollers to feed the fabric forwardly at a uniform speed the full width of the fabric, said spreader side belts also preventing lagging of the fabric at the sides of the spreader.

14. In an apparatus for shrinking and condensing tubular knit fabrics, a supporting frame, a pair of coacting drive rollers mounted in said frame, a fabric spreader supported between said rollers and adapted to be driven thereby, a second pair of coacting drive rollers mounted in said

frame and spaced from said first drive rollers in the direction of fabric travel, a second fabric spreader mounted between and driven by said second pair of coacting rollers and having its receiving end positioned in overlapping relation to the tail end of the first spreader whereby the fabric may be discharged from the first spreader directly onto the second spreader, said second spreader being relatively wider than the first spreader thereby to laterally stretch and widen the fabric to cause its stitches to expand in a direction crosswise of the wales of the fabric, and whereby the fabric is shortened and condensed in a lengthwise direction, each of said spreaders comprising longitudinally extending side frame members mounted for lateral adjustment to vary the effective width of the spreader, pulleys mounted at the ends of said side frame members, endless belts mounted on said pulleys and having driving connections with the coacting drive rollers of said spreaders whereby said endless belts are driven at a speed corresponding to the peripheral speed of the coacting drive rollers for each spreader, and whereby said spreader side belts will coact with the drive rollers to feed the fabric forwardly at a uniform speed the full width of the fabric, said spreader side belts also preventing lagging of the fabric where engaged with the sides of the spreader, and means for independently varying the speeds of the spreaders whereby the speed of the first spreader may be increased relatively to the speed of the second spreader, thereby to deliver the fabric to the second spreader in a slightly rippled condition at a rate of feed commensurate with the shortening of the fabric by the second spreader.

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