April 20, 1948. F. R. REDMAN 2,440,209

METHOD AND APPARATUS FOR FINISHING AND SHRINKING TEXTILE FABRICS

Filed Jan. 8, 1945 3 Sheets-Sheet 1

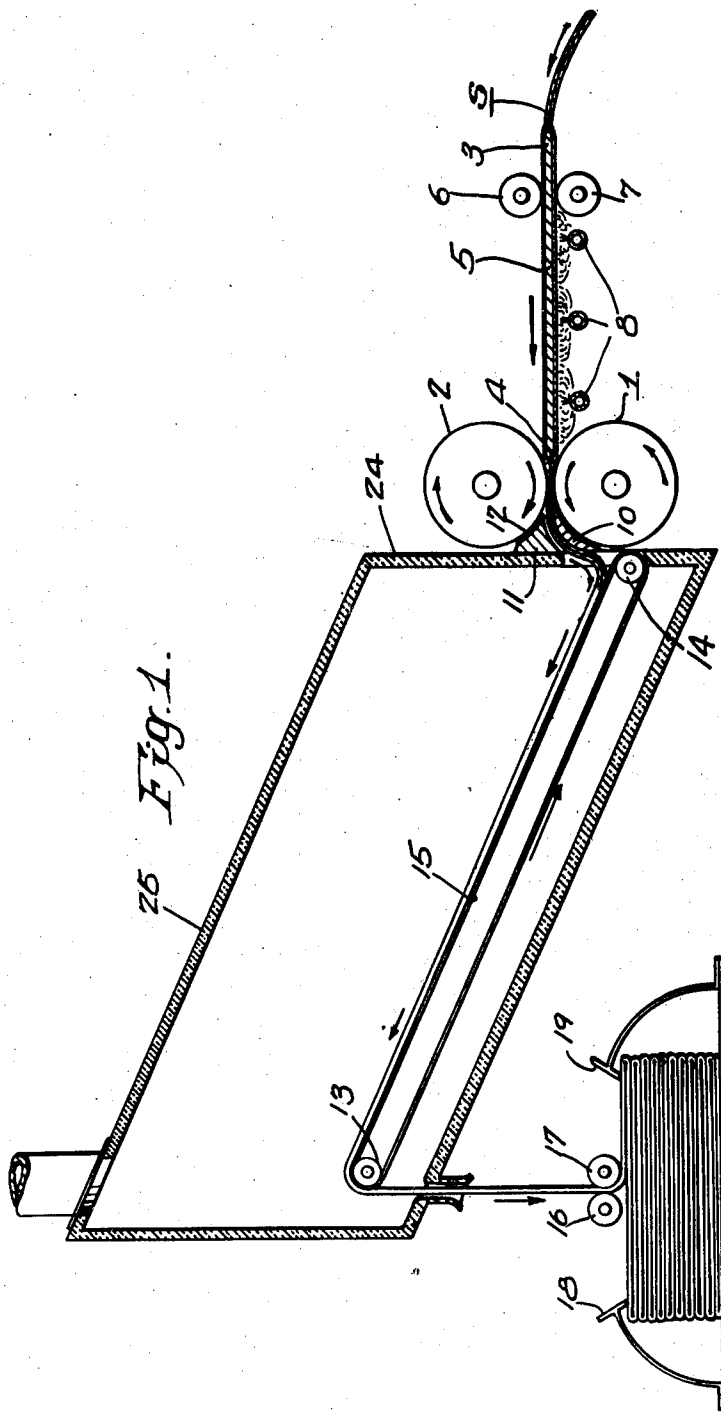


Fig. 1.

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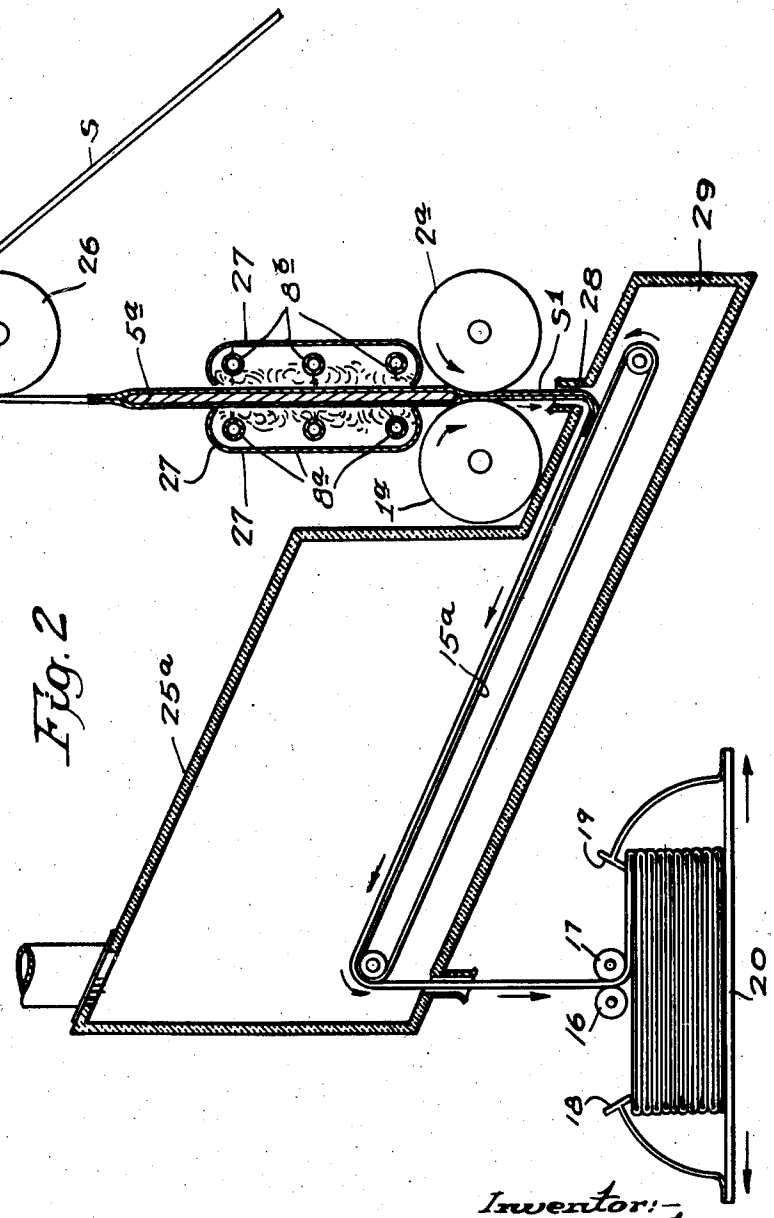


Fig. 2

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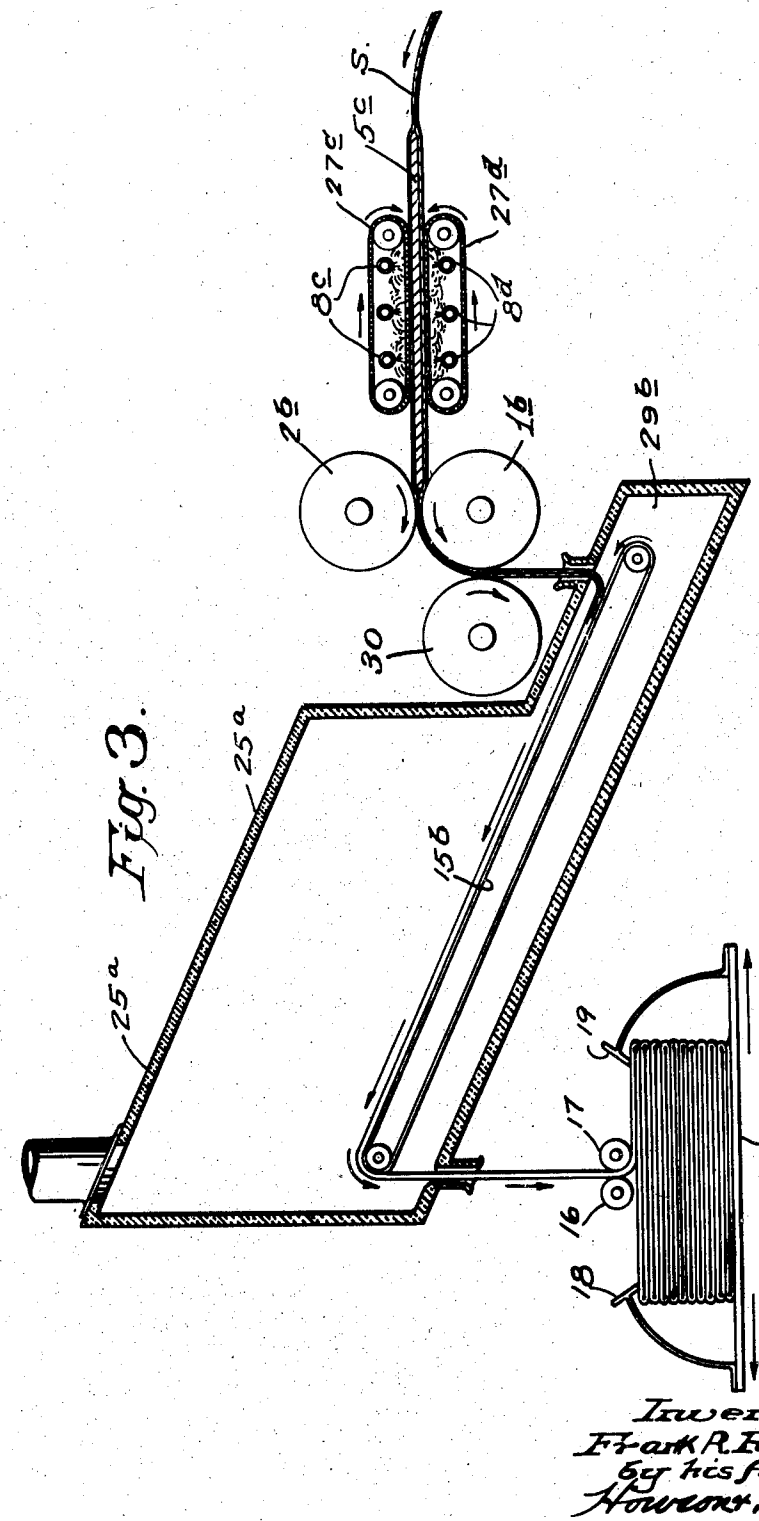


Fig. 3.

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UNITED STATES PATENT OFFICE

2,440,209

METHOD AND APPARATUS FOR FINISHING AND SHRINKING TEXTILE FABRICS

Frank R. Redman, Yardley, Pa.

Application January 8, 1945, Serial No. 571,841

6 Claims. (Cl. 26—18.5)

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This invention relates to the finishing of textile fabrics; and especially to the finishing of piece goods, in strip form, which have been shrunken in accordance with the process disclosed in my prior U. S. Letters Patent No. 2,325,544, using an apparatus of the same general character as, or the equivalent of, that shown and described in my companion prior U. S. Letters Patent No. 2,325,545, dated July 27, 1943.

The inventions as disclosed in the aforesaid prior patents have found particular aptitude in the shrinking of tubular knit goods, from which underwear and other washable articles of clothing, etc., are manufactured. Under these inventions it has been possible to reduce residual shrinkage in knitted tubular fabrics of the type employed for making undershirts, etc., to practically zero.

The aforesaid shrinking process was predicted upon the premise that complete shrinkage of knitted fabrics could be obtained, walewise and coursewise, by working and maintaining the fabrics in a completely relaxed state, in the presence of heat and moisture; by which the yarns forming the knitted stitches of the fabric are placed and maintained under longitudinal compression, whereby the individual fibres are relieved of all tension resulting from carding, condensing, spinning, twisting, etc., of the yarns, and the subsequent knitting and processing of the fabric, and whereby the fibres are permitted to return substantially to their original natural kinky condition.

The fabric is then dried while it is still in its thoroughly relaxed state, and garments made from fabrics processed in this manner will not shrink thereafter, regardless of how many times the garments may be subsequently laundered.

Ordinarily, the tubular knit goods from which washable garments, such as undershirts, drawers, slips, etc., are usually made, are normally run through a finishing process, after being scoured and/or bleached, to remove wrinkles from the fibres, to straighten the stitch wales in the fabric, and to give the fabric a smooth sleek finished appearance, preparatory to the fabric being cut to size and shape for seaming to complete the garment.

The ordinary finishing process usually consists in steaming and moistening the fabric and then running it through a pair of driven heated calendering rolls, with a loose spreader floating inside the tube immediately in advance of the nip of the calendering rolls.

From the calendering rolls the fabric is passed

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over and around two or more spaced driven take-off reels by which the fabric is placed under tension and is pulled away from the calendering rolls, to prevent sticking of the fabric to the rolls.

From the take-off reels the fabric usually passes vertically downward, between another pair of driven rolls which delivers the fabric onto a horizontally reciprocating table, by which the fabric is laid back and forth in successive layers until a pile of desired thickness is obtained, or the fabric is wound in a roll upon a core or mandrel.

The temperature of the calendering rolls, at the speed at which the fabric passes between the calendering rolls, is not sufficient, in either case, to dry the fabric thoroughly before it is piled on the reciprocating table or wound in the roll.

When the pile of moist fabric reaches the desired thickness, the layers are bound together to form a bundle, which is then removed from the piling table for storing or for shipping to the underwear manufacturer.

The fabric dries out in such rolls and bundles, and due to the fact that the fabric was moist and under tension when packaged, the fabric usually contains as high as 15% shrinkage and seldom if ever, does this shrinkage run as low as 10% when cut and seamed in the ultimate garment.

It has been found that fabric which has been shrunken and dried in accordance with my aforesaid process, if finished in the ordinary manner as noted above, gains in length to some extent, but less than usual, during finishing and thereby takes on an undesirable degree of shrinkage, approximately 7% to 8%, due to the remoistening of the fabric and the tension under which the fabric is placed by the take-off reels which draw the fabric away from the calendering rolls, and additionally, by the driven rolls which feed the fabric onto the reciprocating piling table.

One object of the present invention is to provide a process and apparatus for finishing preshrunken fabrics and particularly those which have been preshrunken in accordance with the process disclosed in my aforesaid prior patents, whereby the final residual shrinkage of the finished fabric will be maintained at substantially zero in the ultimate garments produced therefrom.

Another object of the present invention is to provide novel means for stripping the moist fabric from the calendering rolls without placing the fabric under any tension in addition to that to which the fabric is necessarily subjected in be-

ing drawn over the floating spreader, by the calendering rolls.

Another object of the invention is to provide means for reshrinking the fabric to remove any gain that may have been acquired by the fabric as a result of the tube being drawn over the spreader in advance of the calendering rolls.

Another object of the invention is to provide means by which the fibres of the yarns in the fabric may be maintained in a relaxed condition; and to provide means for thoroughly drying the fabric while the fibres are maintained in such a relaxed condition, prior to the fabric being fed to the piling table or being wound in a roll on a core.

Other objects and advantages of the present invention will become apparent from the following description taken with the disclosures of the accompanying drawings of which:

Fig. 1 is a vertical sectional elevation diagrammatically illustrating apparatus for finishing the fabric in accordance with the present invention; and

Figs. 2 and 3 are views similar to Fig. 1 showing modified arrangements of the apparatus.

As shown in Fig. 1 of the drawings a strip S, of tubular knib fabric, is fed, in a flattened condition, between a pair of power driven heated calendering rolls 1 and 2, with a flat boot-shaped spreader frame 5, of ordinary open grid-like foraminous, or other suitable construction, floating freely within the tube at the intake side of said rolls, with the straight rear end edge 4 of the frame 5 closely adjacent the nip of the calendering rolls 1 and 2, and with the portion of the frame just astern of the rounded head end 3 of the frame lying between a pair of power driven rolls 6 and 7, by which the opposite separated face plies of the tubular fabric, spread apart by the thickness of the frame 5, are drawn onto and pushed along the frame 5 into the nip of the calendering rolls 1 and 2.

The frame 5, as usual, spreads the tube laterally into a smooth flat condition and holds it to a predetermined width as it enters the nip of the calendering rolls, and at the same time causes the stitch wales to straighten out and lie parallel to the longitudinal center line and side edges of the frame. This is common practice in the art and needs no further explanation.

As the flattened fabric is advanced along the frame 5 by the pull of the calendering rolls 1 and 2 and the push of the advancing rolls 6 and 7, the fabric is moistened and heated by sprays of steam or hot water 8, 8 playing on the fabric from beneath, above, or both preparatory to the flattened fabric entering the nip of the calendering rolls 1 and 2.

At the delivery side of the calendering rolls 1 and 2 the double plies of the flattened tube are lifted off or prevented from adhering to the peripheral surfaces of the rolls 1 and 2 by stripper blades 10 and 11 respectively, which may be of any desired cross sectional contour.

Preferably, the stripper 10 is of a thin crescent shaped cross section, with the concave side of slightly greater radius than the peripheral surface of the roll 1 and positioned with very slight clearance therebetween. The convex face of the stripper 10 is of smaller radius than the concave face and the two intersect in relatively thin feather edges extending substantially parallel to each other and to the axis of the roll 1.

The stripper 11 is preferably of a substantially triangular cross section with the face adjacent the peripheral surface of the calendering roll 2 convex and slightly clearing said roll surface.

A second face of the triangular stripper 11 lying adjacent and spaced apart from the convex face of the stripper 10 is also preferably of a concave nature, while the third face of the triangular stripper 11 may be flat, convex, concave or any other shape that may be desired.

As the calendering rolls 1 and 2 revolve they deliver the flattened double-ply fabric strip S through an arcuate slot 12 formed by and between the adjacent convex and concave faces respectively of the stripper bars of blades 10 and 11, which directs the fabric downwardly onto the lower end of an inclined traveling belt or apron 15 which is trained around a roll 14 adjacent the peripheral surface of the lower calendering roll 1, below the lower edge of the stripper bar 10, and a second roll 13 remotely disposed at a higher elevation whereby the upper run of the apron 15 is disposed at a substantial angle to the horizontal.

Either or both of the rolls 13 and 14 may be driven to drive the apron 15 at a linear speed less than the peripheral speeds of the calendering rolls 1 and 2, preferably from 1% to 2% less, so that the fabric is completely relaxed on apron 15 after its passage through the calendering rolls.

The apron 15 delivers the fabric S over the high roll 13 from which it hangs vertically and passes between a pair of power driven delivery rolls 16 and 17, traveling at a peripheral speed substantially equal to the linear speed of the apron 15.

The rolls 16, 17 deliver the fabric to either an ordinary roll forming device for rolling the fabric on a core or mandrel or preferably onto a horizontally reciprocable flat piling table 20 of usual well known construction which is reciprocated longitudinally at a linear speed consistent with the peripheral speed of the delivery rolls 16, 17.

The mechanism by which the table 20 is reciprocated is well known in the art and per se forms no part of the present invention, further disclosure therefore is believed to be unnecessary.

Furthermore, these reciprocable piling tables are usually provided with automatic clamps 18, 19 which bear on the top most of the layers of fabric successively piled on the table 20 to hold the one end of a layer being formed during the travel of the table 20 relative to the fixed rolls 16, 17 by which each successive layer is formed.

In accordance with the present invention, the apron 15 is housed in a drying chamber 25 which is preferably of an insulated walled construction to retain the interior thereof at a sufficiently high temperature, for example from 250° F. to 300° F., to dry the fabric thoroughly while it reposes in a relaxed condition on the apron 15, from the time it is deposited on said apron adjacent the calendering roll 1 until it is delivered by the apron 15 over the upper roll 13 which supports the apron.

Any suitable means common to the drying art may be employed for maintaining the interior of the chamber 25 at the desired drying temperature, without departing from the spirit of the present invention, such as steam coils, electric heating coils, etc., with or without circulating fans or blowers by which heated air may be circulated within or through the chamber 25 to dry the fabric S as it reposes on the apron 15.

During the drying of the fabric as it reposes in a relaxed state on the apron 15, any gain the fabric may have acquired as a result of the tube

being moved into and along the spreader 5 is taken out of the fabric because of the speed of the apron 15 being less than the peripheral speed of the calendering rolls 1 and 2, by which the fabric is at no time placed under tension and is permitted to rest and to contract freely on the apron 15 until it is thoroughly dried.

Preferably the linear speed of the apron 15 and the peripheral speed of the delivery rolls 16, 17 are regulated relative to the peripheral speed of the calendering rolls 1, 2 by use of any of the well known variable speed power transmitting devices, such as the "Reeves" drive, etc., to insure complete drying and complete contraction of the fabric between the instant it is deposited on the lower end of the inclined apron 15 until it is delivered thereby over the upper supporting roll 13 of said apron.

The drying chamber may be made to include the delivery side of the calendering rolls 1 and 2 and the stripper bars 10 and 11 if desired or with one end wall 24 of the drying chamber adjacent the rear of the rolls 1 and 2 and stripper bars 10 and 11 as shown in Fig. 1.

If desired the calendering rolls 1 and 2, instead of being arranged with their axes in a common vertical plane, as shown in Fig. 1, may be installed with their axes in a common horizontal plane, as shown at 1*a*, 2*a* in Fig. 2.

Under such circumstances, the spreader frame 5*a* would be arranged in a vertical plane and a feed reel 26 would be mounted above the upper end of the spreader frame to feed the tubular fabric vertically downward to said frame.

In such instances a pair of moistening devices 8*a*, 8*b* would be installed adjacent the opposite faces respectively of the spreader 5*a* with enclosures 27 housing the spray pipes 8*a*, 8*b* and open on their sides adjacent the two plies of fabric respectively passing over the opposite flat faces of the frame 5*a*.

The inclined apron, in such structures as shown in Fig. 2 would extend downwardly on an angle beneath the calendering rolls 1*a*, 2*a* and the fabric S' would then fall directly from the nip of the rolls 1*a*, 2*a* onto the top run of the conveyer apron 15*a*, through a suitable opening 28 formed in the upper wall of an angular prolongation 29 of the drying chamber 25*a*.

With the arrangement dislosed in Fig. 2, the stripper bars 10 and 11 may be eliminated as the fall of the fabric from the nip of the calendering rolls 1*a*, 2*a* onto the dryer apron 15*a* would obviate the use of the stripper bars 10 and 11 for stripping the fabric from the peripheral faces of the rolls 1*a* and 2*a*.

As shown in Fig. 3, three calendering rolls 1*b*, 2*b*, and 30 may be arranged with the axes of the rolls 1*b*, 2*b* in a common vertical plane and with the axes of the rolls 1*b*, 30 in a common horizontal plane.

In this case the apron 15*b* and dryer prolongation 29*b* would extend below the rolls 1*b* and 30 as noted with respect to the rolls 1*a*, 2*a* in Fig. 2. The spray pipes 8*c*, 8*d* would then set horizontally above and below the spreading frame 5*c* within foraminous endless belts 27*c* and 27*d* which would travel at the same surface speed as the calendering rolls 1*b*, 2*b*, and move the fabric along the spreader 5*a* into the bite of the calendering rolls without any frictional back drag on the frame 5*c*.

From the foregoing it will be clear that any gain the dry fabric passing onto the outer end 3 of the spreader 5 may acquire when it is moistened as it is being passed along the frame 5 will be lost again when the fabric is permitted to rest in a relaxed state on the apron 5 moving at slower speed than the surface speed of the calendering rolls 1 and 2 so that by the time the fabric is thoroughly dried on the apron 15*b* it has returned to its zero state of shrinkage before being piled on the table 20 or wound onto a roll.

After the fabric is dry and smooth it is ready to be cut into garments which will withstand any number of launderings without shrinkage, thus the garment will retain its original size at all times.

While the foregoing description has been directed to the finishing of fabrics which have been preshrunken in accordance with the inventions disclosed in my two prior patents aforesaid, it will be understood that the present invention is applicable in cases where the fabric has been processed by other methods and apparatuses which are in general use and by which preshrinking to the same extent as I have been able to attain is impossible. Under such circumstances the present invention is applicable, and the drying of the fabric in a quiescent thoroughly relaxed state on the belts 15, 15*a* or 15*b* traveling at a reduced speed with respect to the peripheral speed of the calendering rolls will result in the non-shrunken fabric shrunken to some extent during the finishing operation.

I claim:

1. Apparatus for finishing fabric comprising a set of calendering rolls, means for moistening the fabric in advance of said rolls, means adjacent and spaced from the peripheral surfaces of said rolls for stripping the moist calendered fabric from said rolls said stripping means having an intermediate slot through which the stripped fabric passes from said rolls, means for relaxing the fabric following said rolls, and means for drying the fabric while in a relaxed condition under control of said relaxing means.

2. Apparatus for finishing fabric comprising a pair of calendering rolls, means for moistening the fabric in advance of said rolls, a pair of stripper bars disposed adjacent the peripheries of said rolls respectively and providing a delivery slot for said fabric therebetween, means for relaxing the fabric following stripping thereof from said rolls by said bars, and means for drying the fabric while relaxed.

3. Apparatus for finishing fabric comprising a pair of calendering rolls, means for moistening the fabric in advance of said rolls, a pair of stripping bars having concave faces respectively disposed adjacent the peripheral surfaces of said rolls and complementary surfaces providing a delivery slot for said fabric, means for relaxing the fabric following its removal from said rolls by said bars, and means for drying the fabric while relaxed.

4. A method of finishing and shrinking textile fabric, which comprises moistening the fabric, passing the moist fabric between power-driven calendering rolls, depositing the fabric on a movable surface directly from said rolls substantially free from tensional stress, moving said surface at a speed less than the peripheral speed of said rolls, whereby the fabric is completely relaxed on said surface after its passage through said rolls, and applying heat to the fabric to dry it while it is in a relaxed condition on said surface.

5. Apparatus for finishing and shrinking textile fabric, comprising a set of power-driven calendering rolls, means for moistening the fabric in advance of said rolls, a conveyor arranged to re-

ceive the fabric directly from said rolls substantially free from tensional stress, means actuating said conveyor at a surface speed less than the peripheral speed of said rolls, whereby the fabric is completely relaxed on said conveyor after its passage through said rolls, and means for applying heat to the fabric to dry it while it is in a relaxed condition on said conveyor.

6. Apparatus for finishing and shrinking textile fabric, comprising a set of power-driven calendering rolls, means for moistening the fabric in advance of said rolls, a pair of stripper bars disposed adjacent said rolls to strip the moist fabric therefrom and providing a delivery slot for said fabric, a conveyor arranged to receive the fabric directly from said rolls substantially free from tensional stress, means actuating said conveyor at a surface speed less than the peripheral speed of said rolls, whereby the fabric is completely relaxed on said conveyor after its

passage through said rolls, and means for applying heat to the fabric to dry it while it is in a relaxed condition on said conveyor.

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