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METHOD AND APPARATUS FOR STIFFENING FABRIC EDGES

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2 SHEETS—SHEET 1

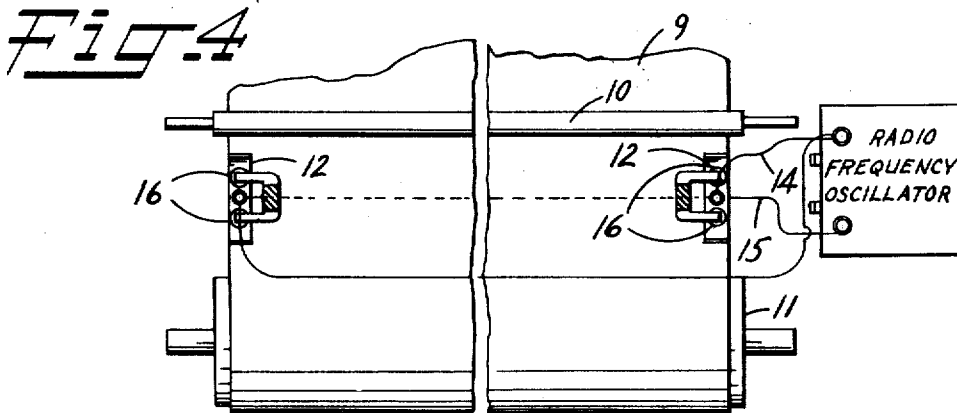
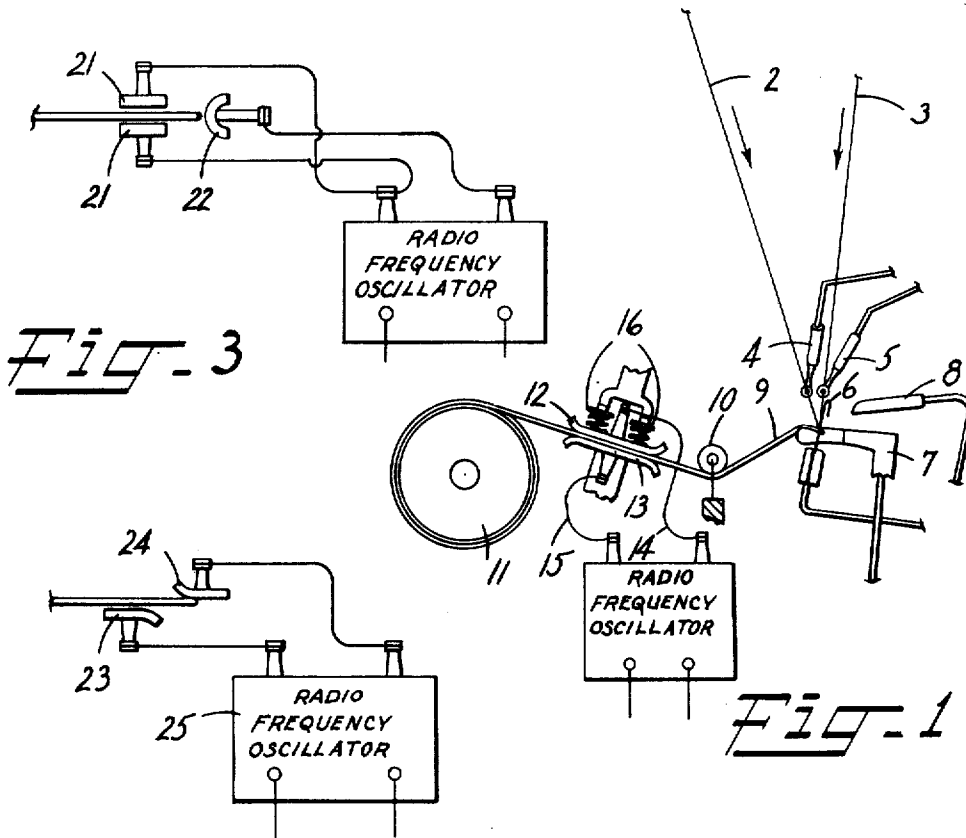


Fig. 2

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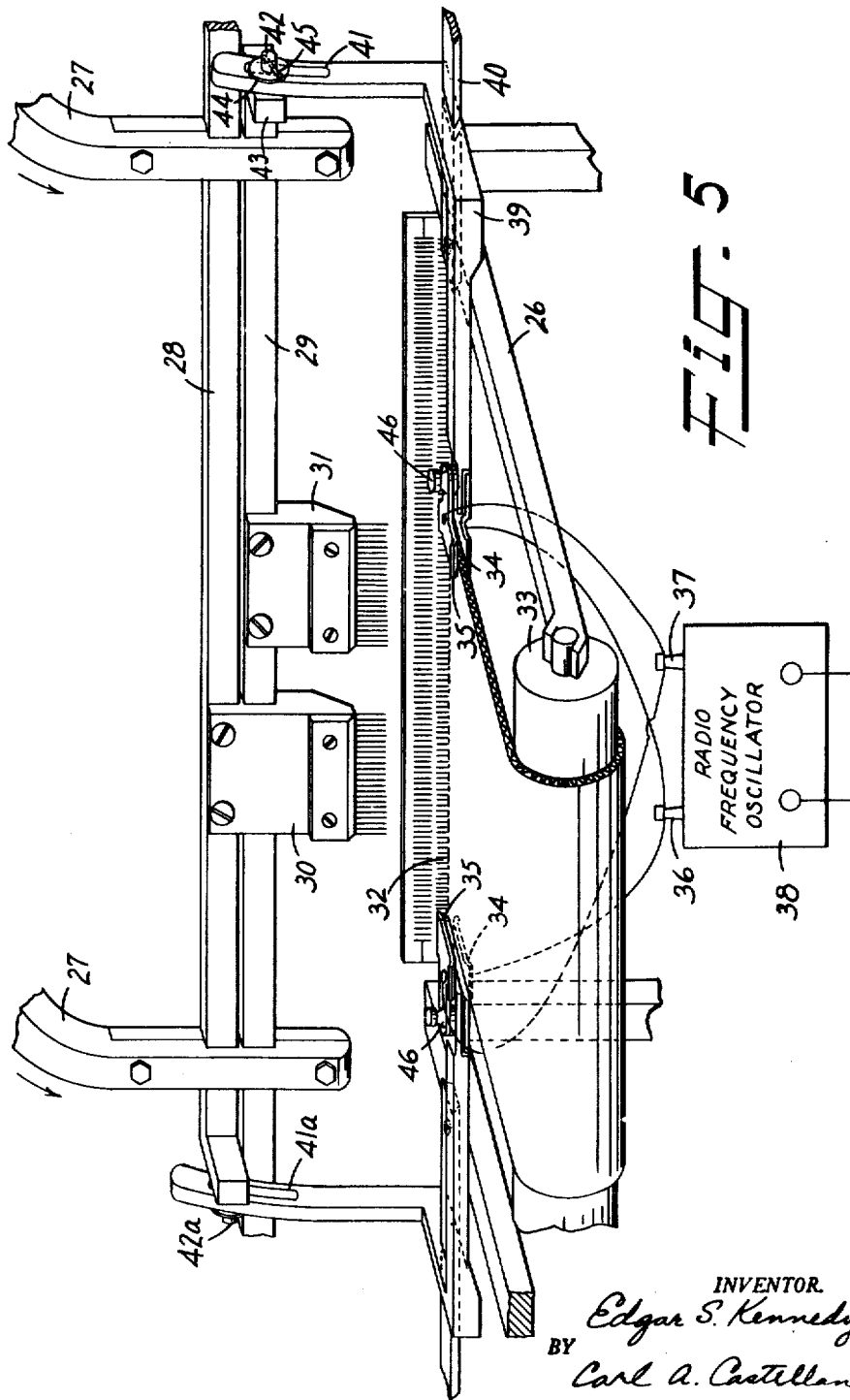
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2 SHEETS—SHEET 2



UNITED STATES PATENT OFFICE

2,578,889

METHOD AND APPARATUS FOR STIFFENING
FABRIC EDGES

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Original application June 28, 1944, Serial No. 542,459. Divided and this application December 9, 1947, Serial No. 790,592

11 Claims. (Cl. 66—147)

1

This invention relates to knitted fabrics comprising thermoplastic fibers, and to methods and apparatus for the production thereof, and it is the primary object of this invention to produce knitted fabrics whose selvages are substantially free of curl and have little or no tendency to develop a curled condition during the ordinary process of finishing. This application is a division of my copending application Serial No. 542,459, filed June 28, 1944, now Patent No. 2,448,032.

While the invention is applicable generally to flat knitted fabrics whose edges have a tendency to curl because of liveliness of twist, that is, any plain knit fabric, it is of special advantage as applied to warp knit fabrics, and its application will be described with reference to the manufacture of a tricot or warp knit fabric. Such curling of the edges causes great difficulty in stitching the edges together to form a tube preparatory to dyeing and finishing processes. If dyeing and finishing is to be performed by passing the fabric through a tenter frame, either clip or pin, there is difficulty in properly feeding the fabric to the tenter or the curled edge portions thereof must be wasted. In either system, it has been customary to cut the curled selvage from the fabric as waste at the stage of garment cutting. As this curled edge frequently amounts to a width of as much as an inch or two and sometimes more, it can be seen that such waste has been substantial.

Generally, my invention involves the application of a substantially dry internal heat by means of a high frequency electric field to the fabric edges as it proceeds from the knitting needles to a take-up roller or mandrel. At this time, the fabric is under tension and by applying heat close to the needles there is little opportunity for it to manifest its tendency to curl and it is traveling slowly so that precise control of the heating effect upon the fabric edges can be readily exercised. By applying dry internal heat, there is substantially no tendency for the disposition of the fibers in the individual yarns of the fabric to become altered by surface tension, or adhesive effects exerted by the presence of moisture alone or in conjunction with sizing material carried by or within the yarns. In addition, the thermoplastic fibers exposed on the surface of the yarns do not suffer any serious deformation and loss of fiber identity while those within are brought to sufficient temperature to relieve internal fiber stresses and to become adhesive to bind fibers in the yarns. In this manner, a uniform activation of the thermoplastic fibers is obtained through-

2

out the fabric, and the setting of the fabric edges to control curling is obtained without undue loss of pliability, softness, porosity, handle and the like.

5 The knit fabrics may consist entirely of heat-activatable fibers or may comprise them in any desired substantial proportion together with non-activatable fibers. By "heat-activatable" is meant those fibers which are capable of being rendered adhesive upon the application of heat. By non-activatable or non-adhesive fibers is meant any which are not rendered adhesive by the treatment used in activating the heat-activatable fibers.

10 The potentially adhesive fibers may be composed of a wide variety of materials, and may comprise any material capable of being formed into fibers which have an inherent tackiness upon heating to temperatures below that at which the non-activatable fibers are damaged or rendered tacky and which are non-tacky at room temperature. Examples of the heat-activatable fibers include such thermoplastic fibers or filaments as those of cellulose acetate or other cellulose esters and ethers or mixed esters, such as cellulose acetate propionate or cellulose acetate butyrate, preferably in plasticized condition; also, resins, either permanently thermoplastic or thermosetting but in the thermoplastic state, formed by the polymerization or condensation of various organic compounds such as coumarone, indene or related hydrocarbons, vinyl compounds, styrene, sterols, phenol-aldehyde resins either unmodified or modified with oils, urea-aldehyde resins, sulfonamide-aldehyde resins, polyhydric alcohol polybasic acid resins, drying oil modified alkyd resins, resins formed from acrylic acid, its homologues and their derivatives, sulfur-olefine resins, resins formed from dicarboxylic acids and diamines (nylon type); synthetic rubbers and rubber substitutes, herein called "resins," such for example as polymerized butadiene, olefine polysulfides, isobutylene polymers, chloroprene polymers; and fibers formed from a resin comprising the product of copolymerizing two or more resins, such as copolymers of vinyl halide and vinyl acetate, copolymers of vinyl halide and an acrylic acid derivative; and also a mixture of resins, such as a mixture of vinyl resins and acrylic acid resins or methacrylic acid resins, a mixture of polyolefine resins and phenol-aldehyde resins, or a mixture of two or more resins from the different classes just named. There may be employed also fibers made from rubber latex, crepe rubber, gutta percha, balata, and the like.

Further, the potentially adhesive fibers may be

mixtures of the cellulose derivatives with resins or rubber, such as, a mixture of cellulose nitrate and an acrylic acid resin, or a mixture of benzyl cellulose and a vinyl resin, or a mixture of ethyl cellulose and shellac.

A preferred class of vinyl resins from which the fibers may be formed are the copolymers of vinyl chloride with vinyl acetate or vinyl cyanide and after-chlorinated copolymers of vinyl chloride and vinyl acetate.

The resins above mentioned may be classified as:

(a) Heat non-convertible resins such for example as glycol polybasic acid resins, vinyl resins (particularly those of the preferred class above) and the acid type phenolaldehyde resins and the like.

(b) Heat-convertible or thermosetting resins such for example as glycerol-polybasic acid resins, polyolefine resins, phenol-aldehyde resins and the like.

(c) An element-convertible resin (which becomes infusible through the action of certain elements, such as oxygen and sulfur) such for example as glycerol-polybasic acid-drying oils resins and olefine-sulfur resins.

Among the non-adhesive fibers which may be used are wood-pulp fibers, cotton, flax, jute, kapok, silk, and the like, or synthetic fibers or filaments of cellulosic composition, such as a cellulose or regenerated cellulose, cellulose derivatives, such as cellulose esters, mixed cellulose esters, cellulose ethers, mixed cellulose ester-ethers, mixed cellulose ethers, cellulose hydroxy-ethers, cellulose carboxy-ethers, cellulose ether-xanthates, cellulose xanthofatty acids, cellulose thiourethanes; natural and synthetic rubber and derivatives thereof when the potentially adhesive fibers become tacky at a sufficiently lower temperature than the rubber or derivative thereof; alginic acid, gelatine, casein; mineral fibers or filaments such as spun glass, asbestos, mineral wool and the like; fibers or filaments made of natural and synthetic resins which should be of such type that they are not rendered tacky when the potentially adhesive fibers are rendered tacky by heating; and the fibers made by slitting, cutting or shredding non-fibrous films, such as waste cellophane.

Prior to the knitting or even as they are fed to the needles of the knitting machine, the yarns may be treated with sizings or they may be moistened. They may carry a sizing or a lubricant, or some other conditioning agent applied at some earlier stage of fabrication, and the sized yarns may be moistened as they proceed to the knitting needles. Again the selvages of the fabric may be moistened very shortly after leaving its line of formation at the knitting needles but prior to entering the heating device. Such moistening may be effected by water alone, or when the yarns are of extremely low conductivity because of an unsized condition, those from which the fabric edges are formed may be moistened by a dilute electrolyte, such as a dilute salt solution to increase the conductivity of the edge portions. This may advantageously be applied in the case of hydrophobic vinyl resin yarns. However, many materials, such as cellulose acetate, from which the yarns may be formed are sufficiently hygroscopic so that their moisture content when in equilibrium with the normal conditions of temperature and humidity renders them sufficiently conductive without additional moistening for treatment in accordance with the present

invention. Accordingly, cellulose acetate yarns carrying merely a lubricant, such as ethylene oxide condensation product of sorbitan oleates, may be knit in the dry condition, and have their selvages treated to prevent curling. In addition, the activatable fibers themselves may be so produced artificially in the first instance as to be constituted of or contain a heat-conductive material. Thus a material such as graphite or metallic powders may be distributed in this manner more or less homogeneously throughout the fiber or filament mass, or it may be localized in the core of the fiber or filament or upon the surface thereof.

Any suitable high frequency oscillator may be employed for the purpose of the invention and the voltage at which it is operated may be varied widely within the limits determined by the development of a corona discharge between the electrodes. A frequency of from ten to thirty megacycles per second is entirely satisfactory, the particular frequency employed in any particular case pending upon the allowable voltage and the amount of power desired.

Pressure may be applied to the fabric edge while it is being subjected to the high frequency electric field and such pressure may advantageously be applied through the medium of the electrodes themselves, such electrodes being insulated in such case. While the application of pressure is by no means necessary, it generally serves to more reliably and effectively control the extent of adherence between the adhesive and non-adhesive filaments in the product.

The operating characteristics of the oscillator system including power, voltage, relationship of fabric speed to electrode area, conductivity of yarns and pressure of electrodes are so correlated as to produce the desired heating effect which depends upon the particular thermoplastic material in the fabric. Thus, a temperature of 250° F. is effective upon a cellulose acetate fabric in equilibrium with the atmosphere while a temperature of 140° F. is effective for Vinyon.

An illustrative arrangement is shown in the drawing in which Figure 1 is a diagrammatic side elevation of one embodiment of the invention in association with a warp knitting machine;

Figure 2 is a top view of this embodiment at right angles to Figure 1;

Figure 3 is a modification looking in the longitudinal direction of the fabric;

Figure 4 is a view of another modification looking in the direction of the fabric; and

Figure 5 is a view illustrating the application of the invention to a full-fashioned hosiery machine.

With reference first to Figures 1 and 2, a plurality of the yarns 2 and 3 supplied by warp beams (not shown) are shown proceeding to guides 4 and 5, then to the needles 6 and sinkers 7 associated operatively with the presser bar 8 to perform the knitting cycle repeatedly to form the fabric 9 which then passes under tension beneath a roll 10 to the cloth take-up beam 11 driven in conventional fashion. Along each edge of the fabric, there are disposed upper and lower electrodes 12 and 13 respectively which are connected to opposite terminals of a high frequency oscillator by means of the leads 14 and 15.

The lower electrodes are stationary and while the upper electrodes may also be fixed, it is preferable that they be resiliently pressed against the fabric, such as by springs 16.

5

In Figure 3, a modified arrangement of electrodes is shown in which the fabric passes between opposed electrodes 21 which may or may not be pressed against the fabric, but are at least in close proximity thereto. A third electrode 22 (which may or may not be arcuate as shown) is arranged adjacent the edge of the fabric and is connected to a pole of the oscillator opposite to that to which both the other electrodes are connected. If desired, one or the other of the electrodes 21 may be omitted. Electrode 21 is spaced so that its center line runs approximately along the inner limit of the portion of the edge which ordinarily curls up.

In Figure 4 a lower electrode 23 is spaced inwardly from the edge of the fabric and an upper electrode 24 connected to an opposite pole of the oscillator 25. This arrangement in which the electrodes are offset from each other on opposite sides of the fabric, sets up eddy currents across the width of the fabric extending between the two electrodes and is a preferred arrangement.

In Figure 5, there is shown a flat knitting machine unit, such as in use for the production of full-fashioned hosiery comprising the supporting frame 26 and the narrowing frame arms 27 which is rocked in conventional fashion in response to a conventional narrowing cam and associated linkage and carries the bars 28 and 29 which in turn carry the fingers 30 and 31 and are moved longitudinally to narrow or widen the fabric by conventional controlling mechanism. As the fabric proceeds from the needles 32 to the take-up 33, its selvage regions pass between corresponding pairs of electrodes 34 and 35 connected to opposite poles 36 and 37 of a radio frequency oscillator 38. Each pair of electrodes is carried by an arm 39 which is slidably mounted on a guide 40 secured to the frame 26. As shown, the arm 39 and guide 40 have a dovetail shaped connection. Arm 39 has an upwardly extending branch provided with an arcuate slot 41 through which a pin 42 secured to a lateral projection 43 on the bar 29 extends. A washer 44 held in place on pin 42 by a cotter pin 45 provides a positive connection for imparting the longitudinal movement of the narrowing bar 29 to the arm 39 carrying the electrodes while the arcuate slot permits the rocking movement of the bar 43. A similar connection (41a and 42a) is provided between the pair of electrodes at the other side of the fabric and the narrowing bar 28. In this manner, a constant width strip of fabric adjacent each selvage is treated to prevent curling regardless of the position of the selvages during knitting when narrowing or widening occur. The upper electrodes 35 may be pivotally mounted as at 46 to permit them to be swung out of the way during the operation of turning the welt.

The description herein is intended to be illustrative only and it is to be understood that changes and variations may be made without departing from the spirit and scope of the invention as defined by the appended claims.

I claim:

1. A method comprising the steps of flat-knitting a fabric from yarns comprising thermoplastic fibers carrying a conditioning agent, moistening a narrow portion along each of the selvages with an aqueous medium, passing the fabric under tension from the line of its formation to a take-up position, and subjecting only the portions along the selvages during such passage under tension to a high frequency electric current to render thermoplastic fibers therein

6

tacky and thereby to bind fibers in the fabric and simultaneously to dry the selvage portions.

2. In combination, a machine for flat-knitting a fabric having a row of knitting needles and a fabric take-up roll, means for tensioning the fabric as it passes from the needles to the take-up roll and means adjacent the selvages comprising a pair of electrodes on opposite sides of the fabric for subjecting a narrow portion along each of the selvages to a high frequency electric current, the electrodes of each pair being offset laterally in the direction of the fabric width.

3. In combination, a machine for flat-knitting a fabric having a row of knitting needles, a fabric take-up roll, and narrowing and widening mechanism, means for tensioning the fabric as it passes from the needles to the take-up roll, means adjacent the selvages comprising electrodes along opposite edges of the fabric for subjecting a narrow portion along each of the selvages to a high frequency electric current, and means for moving the electrodes transversely of the fabric in response to the motion of the narrowing and widening mechanism.

4. In combination, a machine for flat-knitting a fabric having a row of knitting needles, a fabric take-up roll, and a narrowing and widening mechanism, means for tensioning the fabric as it passes from the needles to the take-up roll, means adjacent the selvages in front of the needles comprising a pair of electrodes on opposite sides of the fabric for subjecting a narrow portion along each of the selvages to a high frequency electric current, means for moving the electrodes in response to the movement of the narrowing and widening mechanism, the upper electrodes being pivotally mounted to permit swinging thereof laterally of the fabric.

5. In combination, a machine for flat-knitting a fabric having a row of knitting needles, a fabric take-up roll, and a narrowing and widening mechanism comprising narrowing bars, means for tensioning the fabric as it passes from the needles to the take-up roll, means adjacent the selvages in front of the needles comprising a pair of electrodes for subjecting a narrow portion along each of the selvages to a high frequency electric current, each part of electrodes being connected to the narrowing bar controlling the corresponding selvage of the fabric.

6. The method of preventing curling of the edges of a textile fabric comprising thermoplastic fibers and having a tendency to curl at the edges comprising internally heating a narrow portion only thereof along each of the selvages thereof by the application of a high frequency electric current to raise the temperature of the fibers inside the yarns to a temperature which relieves internal fiber stresses and renders the fibers adhesive to bind the fibers in the interior of the yarns without serious deformation or loss of fiber identity in the fibers exposed on the surface of the yarns.

7. The method of preventing curling of the edges of a flat knit fabric comprising thermoplastic fibers comprising internally heating a narrow portion only thereof along each of the selvages thereof by the application of a high frequency electric current to raise the temperature of the fibers inside the yarns to a temperature which relieves internal fiber stresses and renders the fibers adhesive to bind the fibers in the interior of the yarns without serious deformation or loss of fiber identity in the fibers exposed on the surface of the yarns.

7

8. A method comprising the steps of flat-knitting a fabric from yarns comprising thermoplastic fibers, passing the fabric under tension from the line of its formation to a take-up position, and internally heating a narrow portion only thereof along each of the selvages during such passage under tension by the application of a high frequency electric current to raise the temperature of the fibers inside the yarns to a temperature which relieves internal fiber stresses and renders the fibers adhesive to bind the fibers in the interior of the yarns without serious deformation or loss of fiber identity in the fibers exposed on the surface of the yarns.

9. A method comprising the steps of flat-knitting a fabric from yarns comprising cellulose acetate while in normally dry condition, passing the fabric under tension from the line of its formation to a take-up position, and internally heating a narrow portion only thereof along each of the selvages during such passage under tension by the application of a high frequency electric current to raise the temperature of the fibers inside the yarns to a temperature which relieves internal fiber stresses and renders the fibers adhesive to bind the fibers in the interior of the yarns without serious deformation or loss of fiber identity in the fibers exposed on the surface of the yarns.

10. A method comprising the steps of flat-knitting a fabric from yarns comprising thermoplastic fibers carrying a conditioning agent, passing the fabric under tension from the line of its formation to a take-up position, and internally heating a narrow portion only thereof along each of the selvages during such passage under tension by the application of a high frequency

8

quency electric current to raise the temperature of the fibers inside the yarns to a temperature which relieves internal fiber stresses and renders the fibers adhesive to bind the fibers in the interior of the yarns without serious deformation or loss of fiber identity in the fibers exposed on the surface of the yarns.

11. A method comprising the steps of flat-knitting a fabric from yarns comprising cellulose acetate fibers carrying a conditioning agent, said yarns being in normally dry condition, passing the fabric under tension from the line of its formation to a take-up position, and internally heating a narrow portion only thereof along each of the selvages during such passage under tension by the application of a high frequency electric current to raise the temperature of the fibers inside the yarns to a temperature which relieves internal fiber stresses and renders the fibers adhesive to bind the fibers in the interior of the yarns without serious deformation or loss of fiber identity in the fibers exposed on the surface of the yarns.

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