Feb. 10, 1970 J. GROSS 3,494,149

WARP KNITTING PROCESS

Original Filed Sept. 3, 1963 2 Sheets-Sheet 1

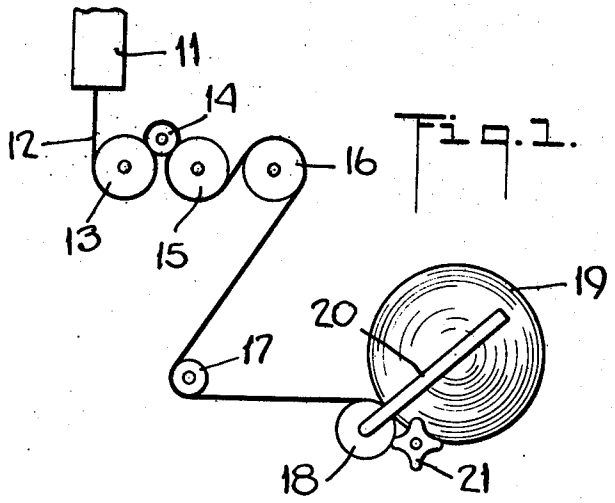

Fig. 1.

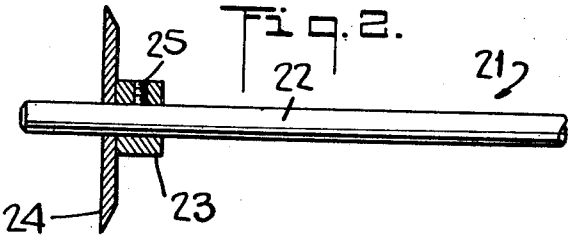

Fig. 2.

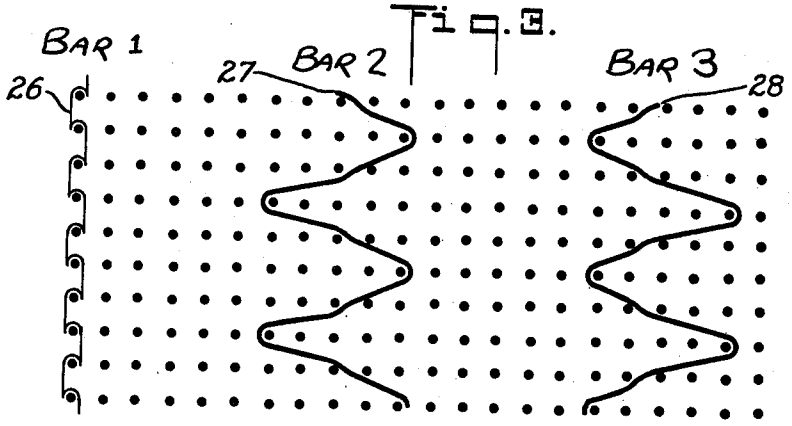

Fig. 3.

WARP KNITTING PROCESS

Original Filed Sept. 3, 1963 2 Sheets-Sheet 2

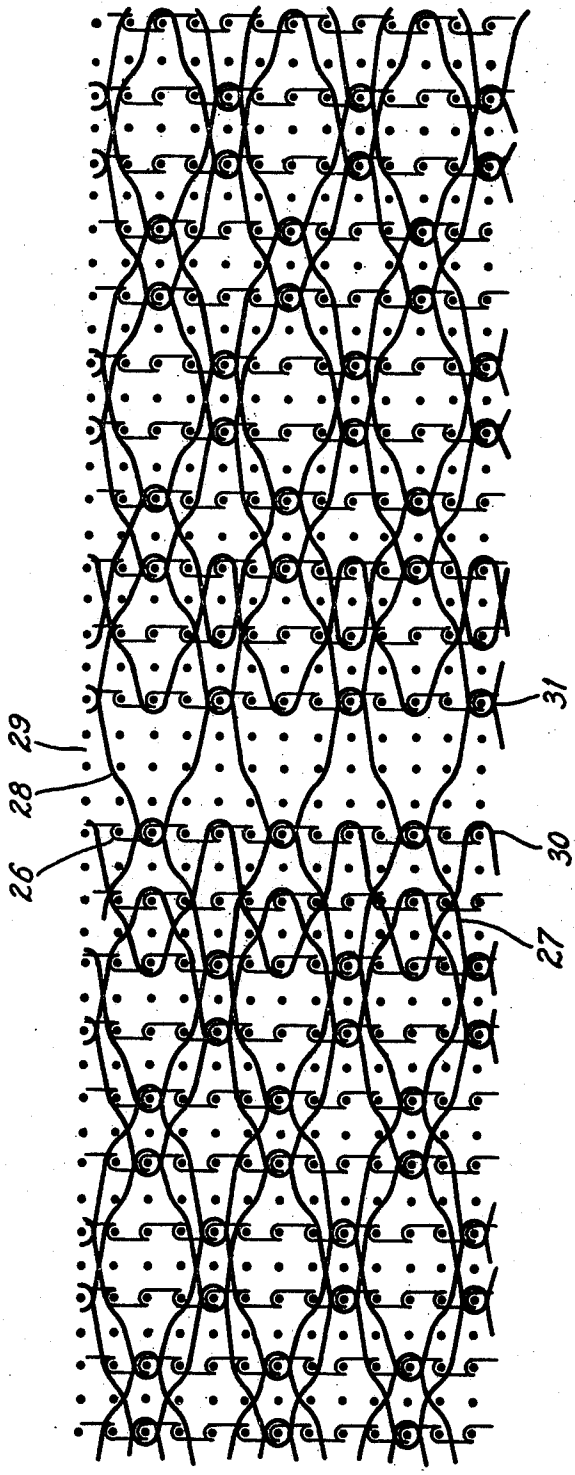

Fig. 4.

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WARP KNITTING PROCESS

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Original application Sept. 3, 1963, Ser. No. 306,244, now Patent No. 3,308,827, dated Mar. 14, 1967. Divided and this application Apr. 7, 1966, Ser. No. 562,009

Int. Cl. D04b 21/14

U.S. Cl. 66—85 2 Claims

ABSTRACT OF THE DISCLOSURE

A process for warp knitting at least two sets of yarns into a fabric, collecting the fabric as a roll and cutting the fabric into narrower bands when it is collected to insure that the roll bands have straight edges.

This application is a division of copending application Ser. No. 306,244, filed Sept. 3, 1963 now U.S. Patent No. 3,308,827, issued Mar. 14, 1967.

The present invention relates to novel fabrics and their use, especially as coverings for sanitary napkins.

Copending applications, Ser. Nos. 795,858 and 830,771 filed in the names of Stephen L. Porter, Calvin Auville and Allen R. Winch, now U.S. Patent Nos. 3,208,451, issued Sept. 28, 1965, and 3,340,134, issued Sept. 5, 1967, respectively, disclose novel fabrics warp knit of continuous filament yarns which are suited for sanitary napkin coverings because of their low weight, high strength and desirable physical properties such as hydrophobicity.

It is an object of the present invention to provide novel fabrics of even lighter weight which nonetheless possess the other desirable properties of the Porter et al fabrics.

A further object of the invention is to provide a fabric which can be produced rapidly on conventional equipment.

Another object of the invention is to provide a balanced fabric which will lie flat without any tendency to curl, thereby to facilitate its use as a wrapper for articles.

Still another object of the invention is to provide a novel process and apparatus for producing a multiplicity of fabrics simultaneously on a single machine.

Other objects and advantages of the invention will become apparent from the following detailed description and claims taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a schematic elevation of an apparatus for collecting and cutting fabric knit in accordance with the invention;

FIG. 2 is a sectional view through a cutting blade illustrating its mounting on its shaft, shown in full;

FIG. 3 is a schematic illustration of the stitches knit by the individual yarns of a three bar warp knitting machine; and

FIG. 4 is a schematic illustration of a preferred fabric construction.

In accordance with one aspect of the invention a flat undistorted fabric is produced by the warp knitting of three sets of warp yarns on a machine such as a Raschel machine. One set of warp yarns is formed into a set of chains extending longitudinally. Each of the other sets of warp yarns, supplied by a respective bar of the knitting machine, is formed into a set of yarns extending transversely of the chains and uniting adjacent chains into a fabric structure. Each transverse yarn may span only two adjacent chains or the stitch pattern may be such that it spans several chains.

Because each chain is united to any one neighboring chain by at least two transverse yarns, should one transverse yarn break the fabric will not separate or unzip even if the transverse yarns individually are not knotted to the chain yarns, i.e. even if each transverse yarn is in a zip stitch construction relative to a chain yarn rather than a lock stitch construction.

As a result, fabrics will be quite strong even at extremely low weight per unit area. This is especially useful when the fabrics are used as covers for sanitary napkins because of their longitudinal stability and ability to stretch laterally to conform to the pad. In such end use it is desirable to have a high yield, i.e. low weight per square yard, both for economy and in order for the fabric to be sufficiently open so as not to interfere with passage of fluid therethrough to the absorptive pad therebelow. At the same time the cover fabric must be sufficiently strong to withstand the forces imposed upon it in being clamped to or impaled by the buckles of a carrier belt. This is termed the "pinning strength," defined more fully hereinafter, and in the novel fabrics of the present invention it should exceed 2 pounds and preferably 2.5 pounds even with fabrics having a yield of more than 30 square yards per pound, i.e. weighing less than about 0.5 ounce per square yard.

The foregoing figures are based on cellulose acetate multifilament yarns which have a tenacity of about 1.3 grams per denier and a density of about 1.3 grams per cubic centimeter. If other yarns are substituted and their densities and/or tenacities differ appreciably from the cellulose acetate reference there will be corresponding differences in the fabric yield required to give any particular pinning strength. Representative other yarns include cellulose triacetate, esters of cellulose other than the acetate, polyamides such as nylon, polyesters, polymers and/or copolymers of vinylidene compounds such as ethylene, propylene, acrylonitrile, vinylidene cyanide, vinyl chloride, vinylidene chloride, and the like. Not only synthetic yarns, but even natural yarns such as silk may be employed. The foregoing are preferred for sanitary napkin cover fabrics because of their hydrophobicity which keeps them from losing strength when wet but hydrophilic fibers such as rayon or cotton or the like may be used if desired, especially if they have been treated to render them more hydrophobic. The yarns may be spun from stable fibers but preferably comprise continuous multifilaments since this gives greater strength per unit weight and is more compact so as to leave larger openings in the fabric for passage of fluids. With cellulose acetate multifilament yarn, for example, it is possible to achieve the requisite strength at deniers of 75 or less, e.g. 55, which contributes to the high fabric yield with open structure.

In accordance with another aspect of the invention, desirably the stitch patterns of the transverse yarns engaging any one chain are approximately balanced in opposite directions. This is in contrast with certain constructions, e.g. in which the transverse yarn stitch patterns are such that each transverse yarn jogs only to one side of a chain or in which the sum of the torques to one side of any chain are greater than those in opposite direction. Balance can be achieved by equalizing the torques on any chain yarn. With two bars of transverse yarns this may be effected, for example, by having one transverse yarn of one bar jogging to the left of a particular chain while a transverse yarn of the other bar jogs to the right, with their stitch patterns offsetting one another. Advantageously their stitch patterns not only are counterbalanced but are exactly opposite, i.e. any loop

or stitch of a chain contacting a left-directed transverse yarn of one bar also contacts a right-directed transverse yarn of the other bar.

While a knitting machine may be capable of knitting fabrics as wide as 168 inches or more, for certain end uses much narrower fabrics are needed, e.g. about 7 inches for a sanitary napkin cover fabric. Rather than utilize only 7 inches of the available machine width, it has been proposed to knit several fabrics in side-by-side relation simultaneously on a single machine. This has been done by knitting in full width and then cutting the fabric as formed or by selecting a stitch pattern which permits the fabric to be unzipped at predetermined wales to give a multiplicity of narrower bands of fabric which are taken up simultaneously. Certain disadvantages attend either of these techniques and the present invention provides an improved process.

In accordance with this aspect of the invention a fabric is warp knit in substantially the full machine width. At locations spaced from one another by a predetermined lateral distance, e.g. 7 inches, the fabric construction is such that only a few and preferably only a single yarn end extends transversely between two adjacent chains or wales. As knit the fabric is taken up on a roll in full width and is continuously slit on the roll by blades positioned along the roll at locations spaced apart by distances equal to the spacing between such single end chain connectors, the blades being located at such single end positions and thereby cutting the rolled up fabric into 7 inch widths. Because the cutting of the fabric takes place just prior to the fabric storage roll the narrow rolls of fabric have flat faces which facilitates their use on wrapping equipment in subsequent operations. By contrast, if cutting is performed at a substantial distance from where the fabric is rolled up the faces of the narrow rolls may not always be flat, being distorted by corresponding distortions in the narrow bands which are not exhibited when rolling up is effected in full width. Similarly, if severance into narrower bands is effected by unzipping of stitches without cutting this would be done before wind up so that, again, the edges of the narrow bands might not be flat. In addition, severance by unzipping places somewhat of a strain upon the yarn (ends) near the split so as to weaken them and also to produce strains in them.

When the narrow bands are to be produced by cutting between two chains it has proven effective to employ a stitch pattern which results in selvages on both sides of the cut. This selvage, or zone or relatively dense stitch construction, strengthens the fabric against transverse tearing. As noted, the selvages are provided for a special purpose and have a dense construction and, moreover, appear on the outside or non-absorbing face of the sanitary napkin. Accordingly the fluid permeable stitch constructions described hereinabove refer to the body of the fabric rather than to such selvages.

Referring now more particularly to the drawing, in FIG. 1 there is shown a knitting machine **11** such as a Raschel machine having three bars for knitting warps into a fabric **12**. The fabric is pulled from the machine by rolls **13**, **14**, **15**, **16** and **17** of which **13**, **15** and **16** are driven with a **14** and **17** serving as guide rolls. The fabric **12** next passes over a driven roll **18** which through a friction surface drives a storage roll **19** on which the fabric is collected. Guide **20** connects the axes of rolls **18** and **19** in conventional manner to permit the axis of roll **19** to move away from that of roll **18** as the fabric package increases in diameter. A cutter **21**, of non-circular contour for better cutting action, is positioned adjacent roll **19** to slit the fabric thereon into narrower bands.

As shown in FIG. 2 the cutter **21** comprises a rotating shaft **22** on which there are keyed one or more collars **23** connected to a blade **24**. The collar **23** is provided with a tapped hole **25** which can receive a set screw (not shown) so that the blade can be locked in predetermined position along the shaft **22** for cutting the fabric into bands of predetermined width.

In FIGS. 3 and 4 there is shown a preferred fabric construction knit on a Raschel machine from three warps supplied from three bars. As seen in FIG. 3 the first bar knits chains **26** of 0–2/2–0 stitch construction. The second bar knits transverse yarns **27** of 0–0/4–4/10–10/4–4 stitch construction and the third bar knits transverse yarns **28** of 10–10/6–6/0–0/6–6 stitch construction. To produce fabric bands 6.5 inches wide in relaxed condition, only half the guides are utilized. The first bar is threaded 68 in-1, out, the second bar is threaded (2 out-2 in)×17-1 out and the third bar is threaded 1 in-1 out-(2 in-2 out)×15-2 in-1 out-1 in-1 out-1 in-1 out. The warping ratio for the front and rear beam is 1:1. In this manner the fabric knit on a 100 inch machine can be slit into 13 bands of desired width.

The fabric has the appearance shown in FIG. 4 which, by suitable omission of chain **26** and transverse yarns **27**, includes a zone **29** which is traversed laterally by a single transverse yarn **28**. Slitting in this zone **29** produced the narrow bands which are bounded by selvages **30**, **31**.

By changing the threading of the first bar to 88 in-1 out, that of the second bar to (2 out-2 in)×22-1 out and that of the third bar to 1 in-1 out-(2 in-2 out)×20-2 in-1 out-1 in-1 out-1 in-1 out there can be produced 10 fabric bands each 8.5 inches wide.

At a setting of 18 courses per inch the resulting fabric knit of 55 denier cellulose acetate yarn of 22 filaments has a yield of 38.8 square yards per pound. Its pinning strength exceeds 2.5 pounds, determined as follows:

One end of a fabric sample is clamped between a pair of jaws mounted at a fixed location on a rod. Another pair of jaws is mounted on a carriage capable of sliding along the rod; the second pair of jaws has twoL-shaped pins projecting therefrom and spaced one-half inch laterally from one another. The pins extend toward the first pair of jaws and then stick up through the fabric. A weight is mounted on the second pair of jaws and the rod is tilted to vary the tension on the fabric, the fabric wales running parallel to the rod. The pinning strength is the vector of the weight acting along the rod when the pins tear the fabric. Any other tensile testing machine meeting ASTM D–76–53 requirements, suitably modified with pins, can be similarly employed.

What I claim is:

1. The process which comprises warp knitting at least two sets of warp yarns into a fabric, a first set of warp yarns being formed into longitudinally extending chains and at least one other set of warp yarns extending transversely of said chains, simultaneously knitting selvages into the fabric in pairs in the body of the fabric, each pair of selvages in the body of the fabric being joined by a single yarn extending transversely back and forth between said selvages, collecting said fabric in full width on the roll, and cutting said fabric on the roll into narrower bands continuously with its knitting by severing said single yarn between pairs of selvages, the cutting being effected immediately adjacent where said fabric is collected, thereby ensuring that said roll bands have straight edges.

2. The process which comprises warp knitting three sets of warp yarns into a fabric, a first set of warp yarns being formed into longitudinally extending chains and the second and third sets of warp yarns extending transversely of said chains in opposite directions and in balanced approximately opposite stitch patterns, simultaneously knitting selvages into fabric at both edges and in pairs in the body of the fabric, each pair of selvages in the body of the fabric being joined by a single yarn extending transversely back and forth between said selvages, collecting said fabric in full width on a roll, and cutting said fabric on the roll into narrow bands continuously with its knitting by severing said single yarns between pairs of selvages, the cutting being effected im-

mediately adjacent where said fabric is collected, thereby ensuring that said roll bands have straight edges.

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ROBERT R. MACKEY, Primary Examiner

U.S. Cl. X.R.

66—147; 242—56.3