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Clingan et al.

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[54] **SLIVER-KNIT PROCESS**

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Related U.S. Application Data

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[52] **U.S. Cl.** ..... **66/9 B**; 28/72 P

[51] **Int. Cl.** **D04b 9/14**

[58] **Field of Search** ..... 28/DIG. 1, 72 P; 66/9 B, 66/191, 194; 112/410, 411

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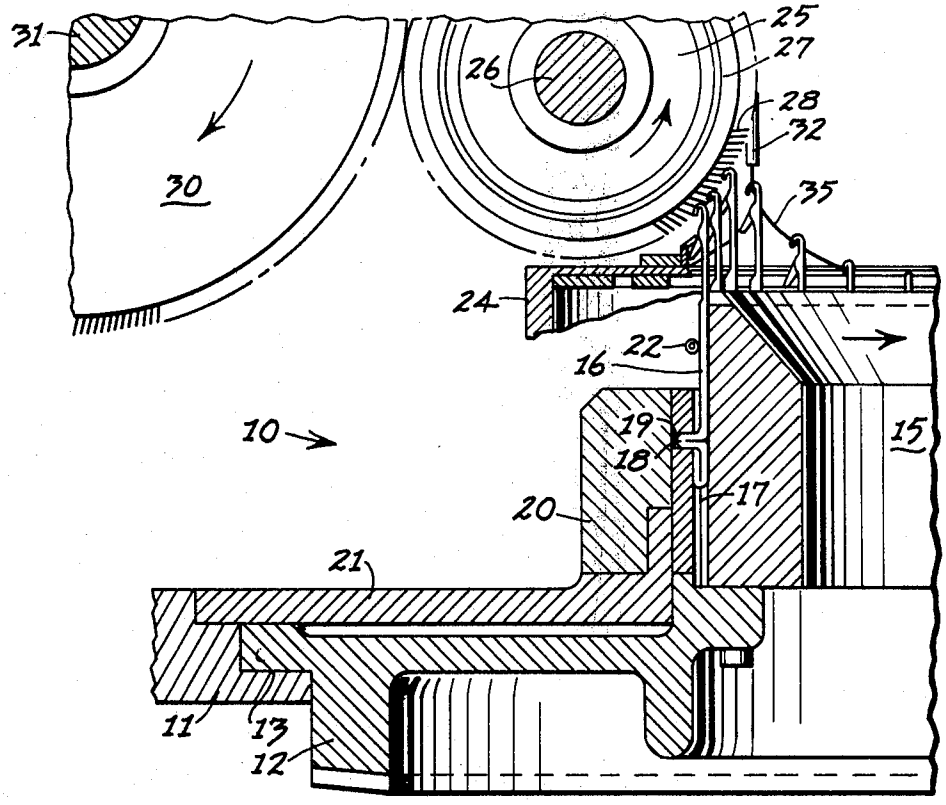
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[57] **ABSTRACT**

A method of making a sliver-knit pile fabric in which the base fabric is knitted from a fibrillated backing yarn and the pile is formed from sliver fibers which are also knitted within the base fabric to project from at least one face of the base fabric.

7 Claims, 7 Drawing Figures



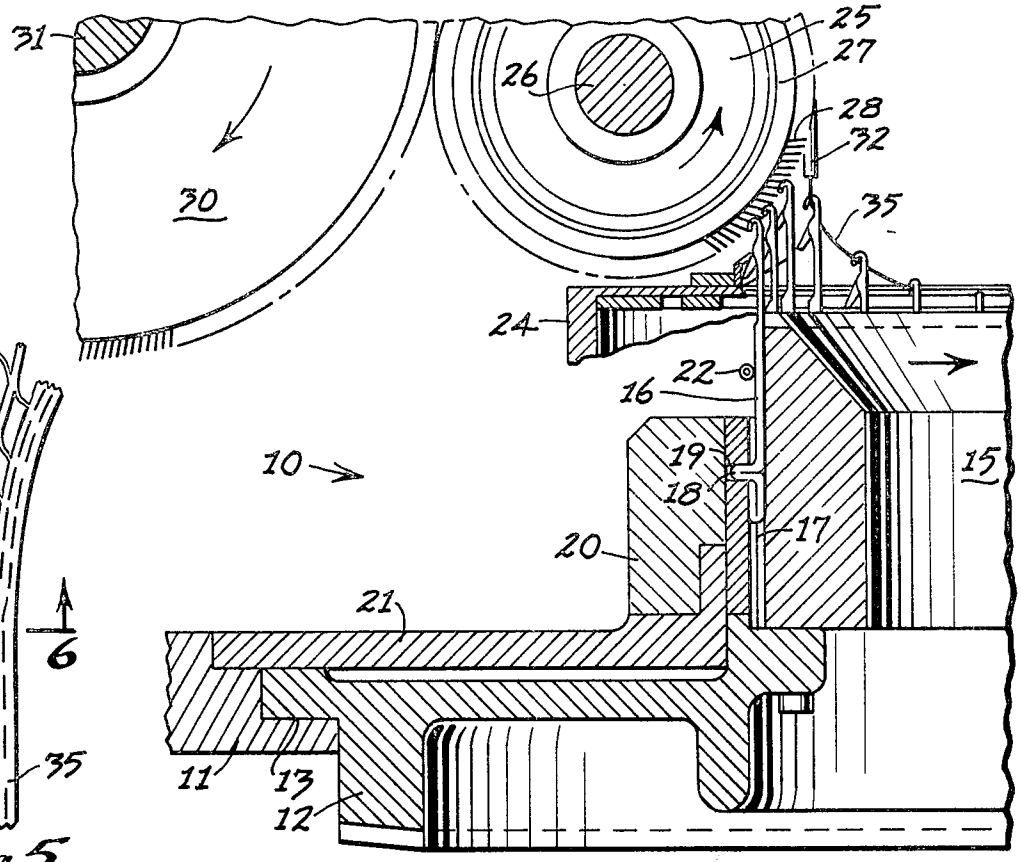


Fig. 5

Fig. 1

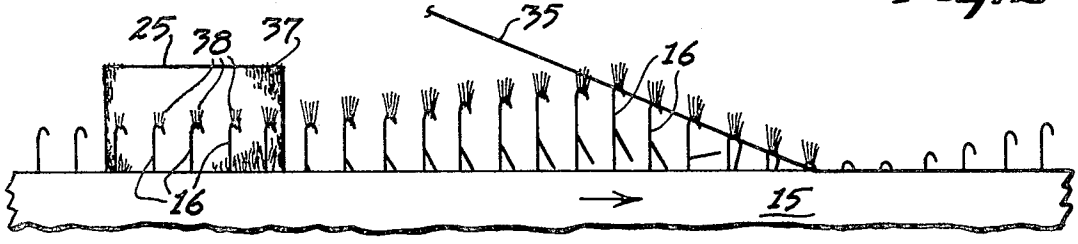


Fig. 2

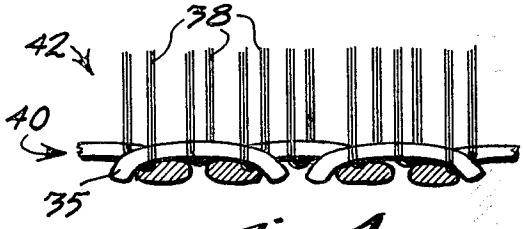


Fig. 4

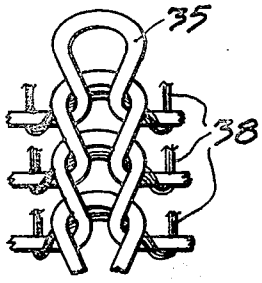


Fig. 3



PRIOR ART

Fig. 7



Fig. 6

SLIVER-KNIT PROCESS

This is a division of application Ser. No. 346,403, filed Mar. 30, 1973.

BACKGROUND OF THE INVENTION

This invention relates to a sliver-knit process, and more particularly to a method for making a sliver-knit pile fabric incorporating a fibrillated backing yarn in the base fabric.

The art of making sliver-knit pile fabrics is old as illustrated in the Tauber U.S. Pat. No. 1,114,414, issued Oct. 20, 1914, and the Schmidt et al. U.S. Pat. No. 2,737,702, issued Mar. 13, 1956.

The art of making fibrillated yarn by splitting or breaking up thermoplastic film or tape into a network of filaments or fibers is generally known, as illustrated in the Nozawa U.S. Pat. No. 3,427,912, issued Feb. 18, 1969. However, the commercial use and application of fibrillated yarns in textiles has so far been limited to fibrillated yarns of 1000 denier or greater. Attempts by others to produce commercially usable fibrillated yarns of less than 1000 denier in textile fabrics have resulted in failure.

Furthermore, it is believed that fibrillated yarns of any denier have never been incorporated in sliver-knit pile fabrics before applicants' invention.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a product and method of making a sliver-knit pile fabric in which a fibrillated yarn is employed as the backing yarn in the knitted base fabric.

By improving the techniques and control in the process of making fibrillated yarn as described in the Nozawa U.S. Pat. No. 3,427,912, applicants have developed fibrillated yarns of less than 1000 denier, and more particularly, even less than 500 denier. Moreover, applicants have specifically developed 480 and 360 denier fibrillated yarns of polypropylene and incorporated them as the backing yarn in the knitted base fabric of a sliver-knit pile fabric.

A sliver-knit pile fabric employing a fibrillated backing yarn has decided advantages over sliver-knit pile fabrics incorporating conventional backing yarns, such as natural staple yarns of cotton, for example, or synthetic staple yarns of polyester, for example. Such advantages include greater strength and stability of the base fabric, and a backing yarn more expansible to provide greater coverage per yarn and per unit weight than conventional backing yarns. The fibrillated backing yarn is also knotless and slub-free. Moreover, the fibrillated yarn has a built-in texture as a result of its fur-like interior (hairiness).

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary sectional elevation of a circular sliver-knitting machine for carrying out the method of this invention;

FIG. 2 is a developed diagrammatic fragmentary elevation of the interior of the knitting cylinder;

FIG. 3 is an enlarged fragmentary plan view of the fabric, made in accordance with this invention, loosely knit to illustrate the pile fibers and the backing yarn;

FIG. 4 is an enlarged sectional elevation of a fragment of the sliver-knit pile fabric made in accordance with this invention;

FIG. 5 is an enlarged plan view of the fibrillated backing yarn, a portion of which has been expanded to illustrate its network structure;

FIG. 6 is a section taken along the line 6-6 of FIG. 5; and

FIG. 7 is a cross-section taken through a conventional backing yarn.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings in more detail, FIGS. 1 and 2 disclose a knitting machine 10 of the so-called Wildman Jacquard type having a head ring 11 forming part of the stationary frame of the circular knitting machine. A gear ring 12 is rotatably supported upon the bearing 13 formed on the head ring 11. The gear ring 12 is driven by pinions mounted on radially disposed shafts which are omitted from the drawings. The needle cylinder 15 is fixed to the gear ring 12 for rotation, and carries latch needles 16 in circumferentially spaced vertical grooves 17. In FIG. 1, all of the latch needles 16 are not illustrated, for clarity. The lower portion of each needle 16 is provided with an outwardly projecting abutment 18 riding in a cam groove or track 19 within a cam 20 supported upon cam ring 21. The latch needles are also held against the needle cylinder 15 by means of the circumferential coil spring 22.

A conventional sinker cam ring 24 is also provided to function with the latch needles 16 in a known manner.

Mounted above and adjacent one side of the needle cylinder 15 is a doffer roll 25 rotatably driven in the direction of the arrow by shaft 26, by power means not shown. The doffer roll is provided with card clothing 27 including a plurality of outwardly projecting resilient wire teeth 28. The doffer roll 25 receives a constant charge of sliver fibers from the carding drum 30 of conventional construction and driven by shaft 31 to turn in the direction of the arrow.

Yarn guide tube 32, schematically illustrated in FIG. 1, is mounted in the appropriate position above the needle cylinder 15 and behind doffer roll 25 to feed the backing yarn 35 to the latch needles 16.

The sliver 37 (FIG. 2) fed to the carding drum 30 may be formed from any desired natural or synthetic fibers, and may be initially prepared in the same manner in which it is prepared for conventional sliver-knit pile fabric manufacturing.

The sliver is preferably made from synthetic fibers, such as polyesters, acrylics or modacrylics in lengths ranging from 1⅛ to 6 inches.

The fibers are stock-dyed in dye kettles controlled for the cycle required by the particular fiber being processed and for the particular color. After dyeing, the fibers are removed for partial drying in an extractor, and subsequently introduced into an oven for drying on a continuous apron. The drying process is closely controlled for the exact degree of moisture content, lustre and softness of the fibers.

The fibers are next fed through a conventional picker for blending and conditioning of the fibers. Depending upon the required intimacy of the blend, the fibers may pass through the picker three or four times.

The blended fiber stock is then introduced into conventional carding machines to manufacture the sliver 37.

The silver 37 is fed as needed to the carding drum 30, which in turn transfers it in uniform amounts to the doffer roll 25.

As illustrated in FIGS. 1 and 2, the latch needles 16 are elevated by the cam 20 as they pass the carding drum 30 so that the hooks of the latch needles 16 are in the rotary path of the wire teeth 28. As the wire teeth 28 rotate upward, the hooked ends of the corresponding latch needles 16 pass between the teeth 28 at a uniform depth. Each needle 16 picks up a bunch of fibers 38 (FIG. 2) which is folded around the hook of the needle, with the aid of an air blast, if desired, from an adjacent air tube, not shown.

The motion of the needle cylinder 15 carries the needles in their elevated position with the fiber bunches 38 retained in the hooked ends of the needles 16 until they move to the knitting position in which the hooks also engage the backing yarn 35 fed from the tube 32. Tube 32 is fed with fibrillated backing yarn 35 from overhead creels. After the hooked end of each needle 16 has engaged the backing yarn 35, the needles are depressed by the operation of cam 20 to carry both the fiber bunch 38 and the hooked portion of the fibrillated backing yarn 35 down through the previously knitted loop carried upon the needle. Subsequently, the needle 16 sheds the previously formed loop along with its fiber bunch 38 in order to form the next stitch.

The loosely stitched sliver-knit pile fabric is fragmentarily shown in FIG. 3.

Of course, during the circular knitting process the stitches, as they are progressively formed, not only lock together the interlocking loops or stitches of the fibrillated backing yarn 35, but also lock in the bunch of sliver fibers 38, which project from one face of the pile fabric 42, as disclosed in FIG. 4.

The fibrillated backing yarn 35 may be made by splitting a thermoplastic tape or film as taught in the Nozawa U.S. Pat. No. 3,427,912. However, in order to make a fibrillated backing yarn 35 of a small enough denier in order to be commercially desirable for a sliver-knit pile fabric, the Nozawa process must be carried out under certain definite controlled conditions relating the speed of the film or tape, the rotary speed of the fibrillating head, the arc of tangency of the fibrillating head against the film, and the structure of the tape material to each other. Under proper controls, a fibrillated backing yarn 35 of continuously constant cross-sectional area, dimensions and weight may be produced in deniers of less than 1000, and even less than 500. As a matter of fact, sliver-knit pile fabrics have been produced in which the fibrillated backing yarn is 480 denier, and also in which the fibrillated backing yarn 35 is 360 denier.

Moreover, controlled fibrillated backing yarns 35 have been produced and knitted into the base fabric of a sliver-knit fabric, not only in which the backing yarn 35 is less than 500 denier, but also in which the filaments forming the network of the fibrillated yarn are of constant denier. For example, in one sliver-knit fabric incorporating a 480 denier constant fibrillated backing yarn 35, the filaments had a uniform count of approxi-8 by 28 denier each.

It has been found that by employing a fibrillated backing yarn 35 in the base fabric 40 that a sliver-knit pile fabric 42 of superior quality results. The base fabric 40 provides better coverage and hiding capacity because it has flat characteristics and is expansible several times its original width, as illustrated in FIG. 5. Its endless uniformity in cross-section, and particularly its propensity to be slub-free and knotless, provides a superior backing yarn 35 not only for continuously knitting the fabric, but also to present a better uniform appearance in the finished fabric.

The openings in the network of the fibrillated yarn 35, as best illustrated in FIG. 5, not only permit the expansion of the yarn 35 for coverage and hiding capacity, but also reduces the cross-sectional weight, without substantially reducing its strength. The fibrillated yarn 35, being quite stable, provides a stable base fabric 40 which renders it easier to cut.

The shrinkage from dry cleaning or laundering of the fabric 42 is approximately one-half of a similarly produced sliver-knit pile fabric in which the backing yarn is made from cotton.

Because of its coverage and hiding capacity, less fibrillated backing yarn 35 is required in the base fabric 40 than conventional backing yarns, whether natural staple yarns or synthetic yarns.

Although sliver-knit fabrics 42 have been made from fibrillated backing yarns 35 of polypropylene, nevertheless other types of polymers, such as polyester or nylon could be employed.

After the sliver-knit fabrics 42 have been knitted, they may be further processed substantially in the same manner as conventional sliver-knit pile fabrics are processed.

The fabric 40 may be back-coated, depending upon its end use. A rug fabric would receive a heavy coat, while an apparel fabric would receive a light coat for proper draping by the stylist. Further stability may be obtained by tentering and curing of the back coating.

It has been found that when a low-melt thermoplastic material, such as polypropylene, is incorporated in the backing yarn 35, that it will take a set in its stitched formation in the backing fabric 40, when cured, without any back coating. Accordingly, the step of back-coating may be dispensed with in sliver-knit pile fabrics in which the fibrillated backing yarn is formed from a low-melt thermoplastic material.

Finally, the fiber pile 38 may be sheared and electrified by "fur ironing machines" in a conventional manner.

FIG. 6 illustrates a typical cross-section of the fibrillated yarn 35 of constant denier employed in this invention, while FIG. 7 illustrates a typical cross-section of the conventional staple yarn 45 commonly used in the knitted base fabric of a sliver-knit pile fabric. Although the thickness or height of the yarns 35 and 45 are substantially the same, nevertheless the vast difference in width, and thereby coverage and hiding capacity is marked.

The following table illustrates the advanatages of the sliver-knit pile fabric 42 made from a 360 denier fibrillated polypropylene backing yarn 35 as opposed to sliver-knit pile fabrics made with other known backing yarns:

ASTM TESTS UPON SLIVER-KNIT PILE FABRICS

Test Method	BACKING YARNS		
	360 Denier Fibrillated Polypropylene	14's Single Polyester	14's Single Acrylic
(1) Mullen Burst Test (to rupture)	190 lbs.	108¾ lbs.	87 lbs.
(2) Tear Test (notched tear)	13.5 lbs.	6 lbs.	5 lbs.
(3) Grab Test	157 lbs.	54 lbs.	43 lbs.
(4) Seam/strength	91 lbs.	71¼ lbs.	57 lbs.

The above comparable competitive tests show that 360 denier fibrillated polypropylene backing yarn has a distinct advantage over present spun yarns employed as the backing yarn in the base fabric of a sliver-knit pile fabric.

Since the specific gravity of polypropylene is 0.91 the pile fabric yield is almost twice as great when the base fabric is knitted from fibrillated polypropylene, than it is when knitted from other conventional types of backing yarns.

The covering and hiding power of the expansible fibrillated backing yarn **35** also provides a material advantage in tending to cover any holes which might occur because of loose knitting, and also to be self-mending when holes are formed in the fabric during use.

Sliver-knit pile fabrics **42** made in accordance with this invention may be used as stuffed animal coverings, interior pile lining and exterior pile surfaces for wearing apparel, as well as pile-knitted area rugs and accessories. The sliver-knit pile fabrics **42** may be used in the same manner as any other conventional sliver-knit pile fabrics, but can be used more advantageously and to up-grade the quality of the fabric. Moreover, because of its superior qualities, the sliver-knit pile fabric **42** made in accordance with this invention will probably find additional uses because of its superior characteristics.

What is claimed is:

1. In said process of making a sliver-knit pile fabric wherein sliver fibers are fed to a knitting station, the improvement comprising:

a. feeding an elongated, stable, fibrillated backing yarn, having a widthwise dimension, of synthetic material and of substantially longitudinally continuously constant denier less than **1000,** and less the denier of a conventional backing yarn for a corresponding sliver-knit pile fabric, to said knitting station;

1. said backing yarn being substantially flat widthwise and having a substantially rectangular cross-section, the width of said backing yarn being substantially greater than its thickness when flattened,

2. said backing yarn comprising a network of filaments permitting said backing yarn to be substantially expansible widthwise,

3. said backing yarn having longitudinal edge portions substantially uninterrupted continuously longitudinally of said backing yarn, said filaments being substantially confined between said longitudinal edge portions,

b. knitting said fibrillated backing yarn at said knitting station to form a base fabric, in which said backing yarn is expansible in the plane of said base fabric, toward and away from other portions of said backing yarn in said base fabric, and

c. substantially simultaneously with said knitting step, locking said sliver fibers between the stitches of said knitted fibrillated yarn, so that said sliver fibers project from one face of said base fabric to form pile.

2. The invention according to claim **1** in which said feeding step comprises feeding a fibrillated backing yarn having filaments of substantially equal and constant denier.

3. The invention according to claim **1** in which said feeding step comprises feeding a fibrillated backing yarn having a substantially longitudinally continuously constant denier less than 500.

4. The invention according to claim **3** in which said feeding step comprises feeding a fibrillated backing yarn having a substantially longitudinally continuously constant denier less than 400.

5. The invention according to claim **3** in which said feeding step comprises feeding a fibrillated backing yarn having a substantially longitudinally continuously constant denier of a range of approximately 360–480.

6. The invention according to claim **1** in which said feeding step comprises feeding a fibrillated backing yarn of polypropylene.

7. The invention according to claim **1** in which the process of making a sliver-knit pile fabric includes operating a circular knitting machine rotatably carrying a plurality of vertically reciprocable needles, said knitting step comprising rotatably moving and reciprocating said needles to form the stitches of said base fabric from said fibrillated backing yarn, and said locking step comprising engaging said needles upon said sliver fibers and pulling the needles carrying the sliver fibers between the stitches of said knitted fibrillated yarn.

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