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2,301,703

KNITTING METHOD

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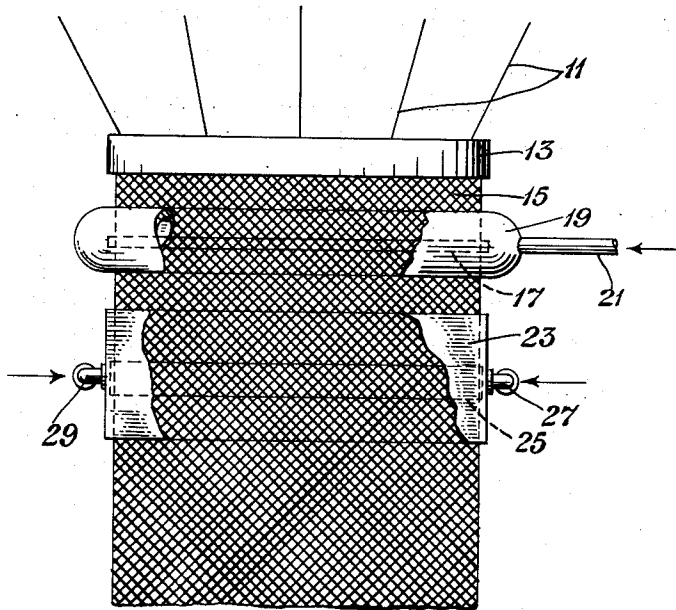


Fig. 1

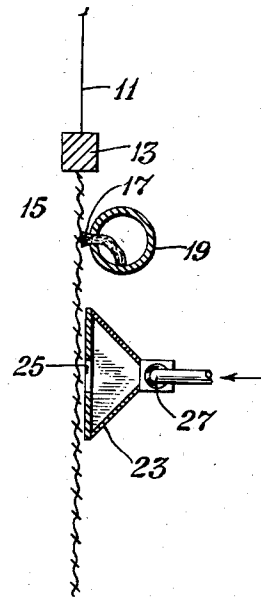


Fig. 2

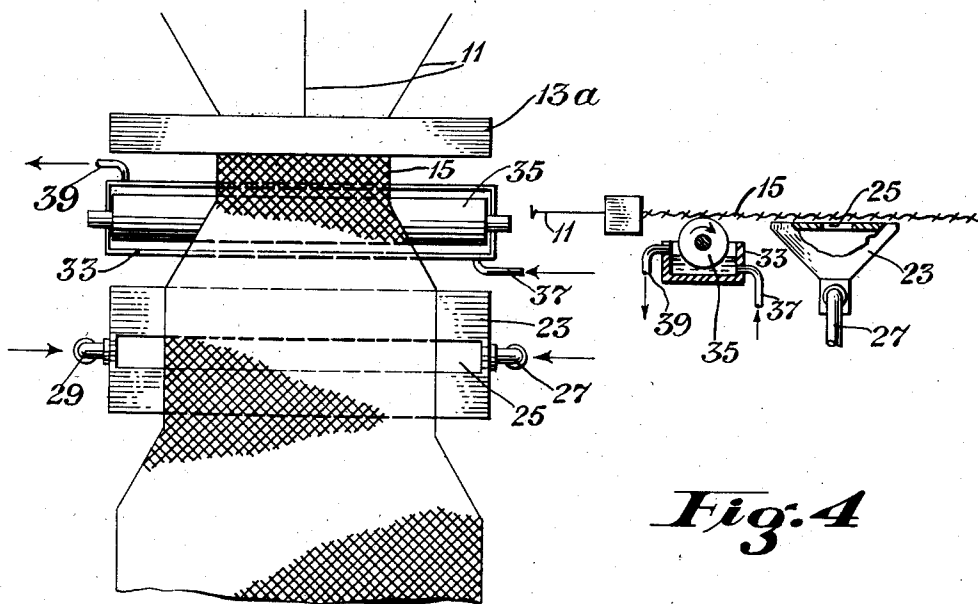


Fig. 3

Fig. 4

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KNITTING METHOD

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4 Claims. (CL 66—147)

This invention relates to a method and apparatus for the knitting of yarns, threads and filaments. The invention is particularly applicable to the knitting of nylon yarn on flat knitting apparatus for the production of full-fashioned hosiery fabric. The invention will, therefore, be described with particular reference to the knitting of full-fashioned hosiery fabric from nylon yarn.

The term, "nylon," is used herein to designate the synthetic linear polyamides of the general types disclosed in Carothers U. S. Patents Nos. 2,130,948 and 2,071,253.

In the flat knitting of nylon yarns into full-fashioned hosiery fabric, it is customary to use a light yarn, such as one of 30 denier, and one having a high degree of twist, such as 30 turns per inch. In the early experiments, it was found that nylon yarn could not satisfactorily be made into stockings since the flat fabric had an extremely pronounced tendency to edge-rolling, with the result that the step of seaming became so complicated that the operating labor became unbearably expensive. Moreover, it was found that the knitted fabric, as it was handled in the several operations, was likely to be damaged by snagging.

These problems were finally solved by sizing the yarn with specially prepared sizes. It was then found, however, that the step of knitting itself became extremely critical because the sizing composition, momentarily softened by the usual moistening devices preceding the knitting step proper, tended to soften and accumulate on the needles and sinkers and tended to clog the fine moving parts of the knitting machine with the result that the machine had to be stopped for cleaning or that knitted fabric of faulty construction was prepared. This new problem has been partially solved by careful adjustment of the action of the size composition in the knitting step at some cost of protection against edge-rolling and snagging.

It is an object of the present invention to provide an improved method for the knitting of yarns, particularly the flat knitting of nylon yarns, which process will avoid clogging and gumming of knitting machine elements, and will also substantially prevent snagging and/or edge-rolling.

Other objects of the invention will appear hereinafter.

The objects of the invention may be accomplished, in general, by knitting a dry yarn containing a water-soluble size, or a size which can

be definitely softened by water, and then, after the knit goods has passed from the actual knitting mechanism, that is, the mechanism comprising the needles and sinkers, but before the fabric has proceeded far from the knitting mechanism, applying water to the knit goods whereby to soften the size contained thereon and cause the yarn in the fabric to adjust itself to the knitted loops, and immediately thereafter drying the fabric to resolidify the size so as to protect the fabric against snagging and edge-rolling. When it is stated that the yarn is knitted in its dry state, it does not mean that the yarn need be bone-dry but at equilibrium with the moisture in the atmosphere. Generally, a yarn contains up to 10% moisture under ordinary room atmospheric conditions.

The invention will be more readily understood by reference to the following detailed description when taken in connection with the accompanying illustrations, in which;

Figure 1 is a diagrammatic side elevational view, with parts broken away, showing the details of the present invention applied to a circular knitting machine.

Figure 2 is a diagrammatic cross-sectional view of the device shown in Figure 1.

Figure 3 is a diagrammatic side elevational view of a flat knitting machine provided with the present invention.

Figure 4 is a cross-sectional view of the apparatus shown in Figure 3.

Referring to Figures 1 and 2 of the drawing, a plurality of yarns 11 is passed to the knitting mechanism 13 of a circular knitting apparatus. The knit fabric 15 immediately after it passes from the knitting mechanism is contacted with wick 17 whereby to apply water to the fabric. The wick 17 is positioned within a chamber 19 which may be supplied with water through conduit 21.

Immediately after passing the liquid applying wick, the fabric passes a drying apparatus 23 which comprises a narrow slot 25 through which dry air at an elevated temperature is blown through the fabric. The air is supplied to the drying apparatus through conduits 27 and 29.

In the operation of the apparatus shown in Figures 1 and 2, the liquid is fed to the wick 17 and as the fabric moves past the wick, the water is applied thereto. The wick must apply the water in sufficient amount to soften the size contained on the yarns of the knit fabric. The knit fabric then passes adjacent the drier 23 to dry the fabric and thereby resolidify the size on the

knit yarns. By softening the size on the yarns, the fibers in the knit loops adjust themselves, and by drying the size the knit loops are fixed by reason of the solidification of the sized adjacent yarns contacting each other.

The apparatus shown in Figures 3 and 4 comprises a flat knitting mechanism 13a. The knit yarn 15 immediately after passing from the knitting mechanism contacts roller 35 positioned within trough 33. The roller 35 is rotated in any desired manner to apply liquid to the fabric 15. If desired, the liquid may be circulated within the trough 33 by means of inlet conduit 37 and outlet conduit 39. Immediately after passing from the moistening roll 35 the fabric passes over a drying device 23 similar to that shown in Figures 1 and 2.

The device of Figures 3 and 4 operates in an identical manner with that shown in Figures 1 and 2.

The water may be applied to the knit goods by any desired liquid applicating means. It may, for example, be applied by sprinkling, spraying, immersion or the like. Likewise, the fabric may be dried in any known manner for drying fabric. It may be dried by heat convection, conduction or radiation with any known type of drying apparatus.

The following illustrative example clearly shows, in detail, one preferred method of practicing the invention, it being understood that the invention is not so limited.

Example

Several yarns of 30-denier, 20-filament, 30-turn polyhexamethylene adipamide yarn sized with 4% (based on the weight of the dried yarn) of a composition consisting of 10 parts of a partially saponified polyvinyl acetate [saponification number 140 ± 10 having a viscosity within the range of 400 to 500 seconds (Universal Saybolt) at 78° F. in a 14.5% solution in water] to 2.5 parts of glycerin are supplied to a conventional 3-carrier Wildman full-fashioned hosiery machine adjusted to produce a 51-gauge fabric of 48 courses per inch. The usual yarn-moistening devices are by-passed and the dry yarn fed directly to the needles by the usual tension devices.

The knitted fabric just leaving the knitting zone is passed in contact with a wick contacting the fabric one-half inch from the knitting needles and dipping in water whereby it is wetted. The fabric is then quickly passed through a drying zone to remove the water within a distance of three inches from the needles. The fabric is maintained under sufficient tension during the wetting and drying to produce stitches of the desired shape.

It was found that when this procedure was used, the knitting step proceeded remarkably well and free from the difficulties which have usually accompanied it. It was found too that the knitted fabrics had excellent protection against snagging in the subsequent steps and that edge-rolling was reduced to a minimum.

The foregoing example is a specific embodiment of the invention. It will be understood that many variations are possible within the broad bounds of the invention. Thus, the specific sizing composition is not critical, it being agreed that a sizing composition known to be suitable for nylon yarns will be employed. It is to be noted that this method of sizing obviates the necessity for certain modifying agents, such as boric acid, with sizes that have been found to be suitable for

nylon, such as partially saponified polyvinyl resins, which produce poor stitch formation and other undesirable features when used in the conventional knitting procedure in the absence of such modifiers. By the present invention, it may be possible to satisfactorily use sizes which are not otherwise suitable for use in the sizing of nylon yarn. Other sizes generally useful in accordance with this invention are, by way of example, protein sizes, such as gelatin or casein sizes which have no hardening agent present in them, alginic acids, methyl cellulose, water-soluble glyptal resins, gum tragacanth and other sizes too numerous to mention. The above-mentioned modified sizes, specially developed for use in the conventional knitting methods are, of course, not precluded for use in this invention. It is, in general, desirable, although not necessary, that the sizes used be rather highly plasticized with non-aqueous plasticizing agents, for example, glycerin, glycols, polyethylene glycols, esters of polyethylene glycols (e. g., the sebacic acid ester of polyethylene glycol), etc. in order to facilitate good stitch formation.

The specific method of moistening the freshly knit fabric and of drying it are not critical. Any method adaptable to the particular knitting machine or suitable to the facilities and practices of the knitting plant may be employed. In general, the moistening of the knit fabric should be carried out before the yarn has passed to exceed about 5 inches from the knitting needles, and the drying should be carried out before the fabric has progressed to exceed about 5 inches from the moistening apparatus. In the flat knitting of hosiery fabric with nylon yarn, it is much to be preferred that the sizing composition be softened by moistening within one inch from the knitting needles since a prolonged delay gives a very lively yarn a chance to roll at the edges. Similarly, and for the same reason, it is greatly preferred that the moisture in the knitted fabric be reduced to below 10%, based on the weight of the dried fabric, within four inches from the needles.

The moistening liquid may contain wetting agents, tints or even resins or finishing agents.

If the fabric is knitted with nylon yarn, drying of the moist yarn can be carried out at a temperature sufficiently high to cause a setting or pre-boarding of the stocking fabric. For example, the moist knit fabric can be dried at a temperature in excess of 90° C. whereby the fabric will be pre-set in a manner similar to that disclosed in Miles U. S. Patent No. 2,157,119. The yarn should not, of course, be heated to such high temperatures that the yarn will be softened or degraded. By setting the yarn on the knitting machine in this manner, the knit loops will be substantially permanently set before they can be distorted.

The invention has been described in terms of nylon yarn and, more specifically in terms of polyhexamethylene adipamide yarn. It will be understood that it is equally useful for other synthetic linear condensation polymer yarns such as the polyesters, polyanhydrides and polyethers since these also exhibit a high degree of bending elasticity. The invention, although applicable, is not so important or necessary in the knitting of cotton, viscose rayon, acetate rayon or silk yarns. The invention is applicable to the knitting of monofilaments whenever it is found desirable to use a size with the monofilaments to effect a temporary cementing of the junction points.

Specific reference has been made to the manufacture of a stocking fabric in a full-fashion hosiery machine. It will be obvious that many of the principles of this invention are equally applicable to the knitting of tubing and to the knitting of seamless hosiery and to other related textile steps.

By virtue of this invention, a knitting procedure is now available which permits very rapid knitting with a small degree of interruption and with a production of extremely high quality goods with only ordinary supervision. Edge-rolling is minimized by reason of the fact that the dry sized yarn, when knitted into a fabric, does not give a fabric with such high edge-rolling tendency as does an unsized yarn or a wetted sized yarn; and the wetted sized fabric is dried so quickly that edge-rolling is not permitted to become serious.

Since it is obvious that many changes and modifications can be made in the above-described details without departing from the nature and spirit of the invention, it is to be understood that the invention is not to be limited to these details except as set forth in the appended claims.

I claim:

1. The method of knitting yarn which comprises knitting a dry yarn containing a water-soluble size, applying sufficient water to the fabric to soften the said size and drying the moist fabric after the knit fabric has passed the knitting needles but before the fabric is removed from the knitting machine.
2. The method of knitting yarn which comprises knitting a dry yarn containing a water-soluble size, moistening the fabric with water before it has passed to exceed 5 inches from the knitting needles, and drying the moistened fabric before it has passed to exceed 5 inches from said moistening point.
3. The method of flat knitting full-fashioned hosiery fabric which comprises knitting a dry yarn containing a water-soluble size, after the knit fabric has passed the knitting needles but before it has passed to exceed one inch from said needles, applying sufficient water to the fabric to soften the said size, and before the fabric has passed to exceed four inches from said needles, drying the moist fabric.
4. The method as defined in claim 3 in which the fabric is knit with nylon yarn.

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