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J. G. HOPKINS ET AL
METHOD FOR TEXTURIZING YARNS

3,396,445

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2 Sheets-Sheet 1

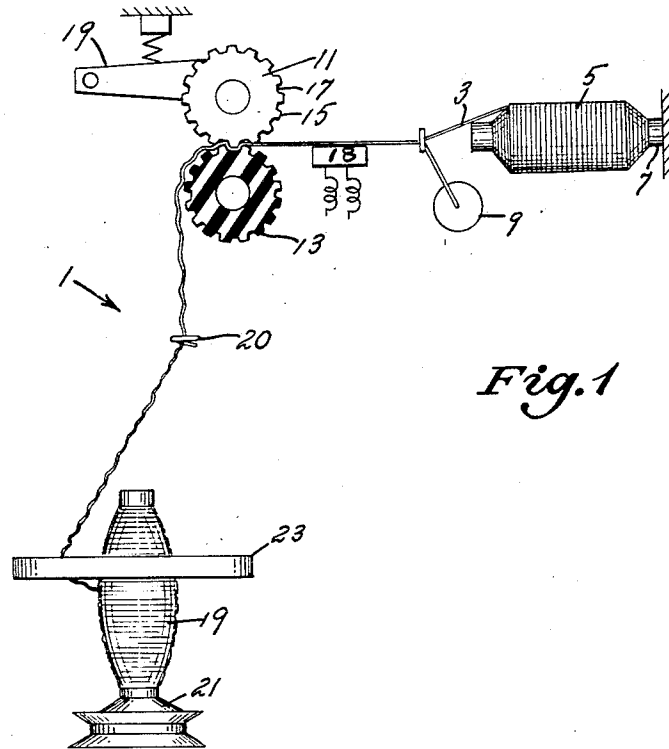


Fig. 1

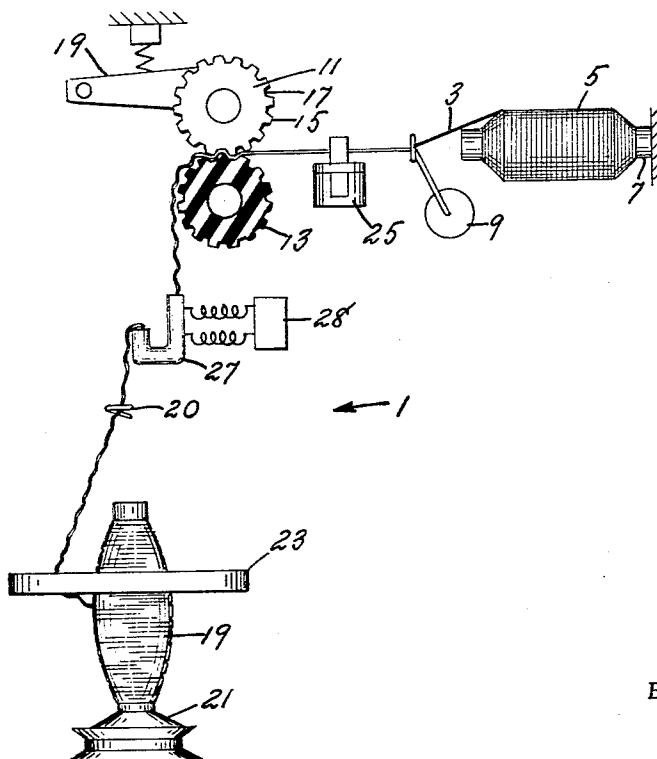


Fig. 2

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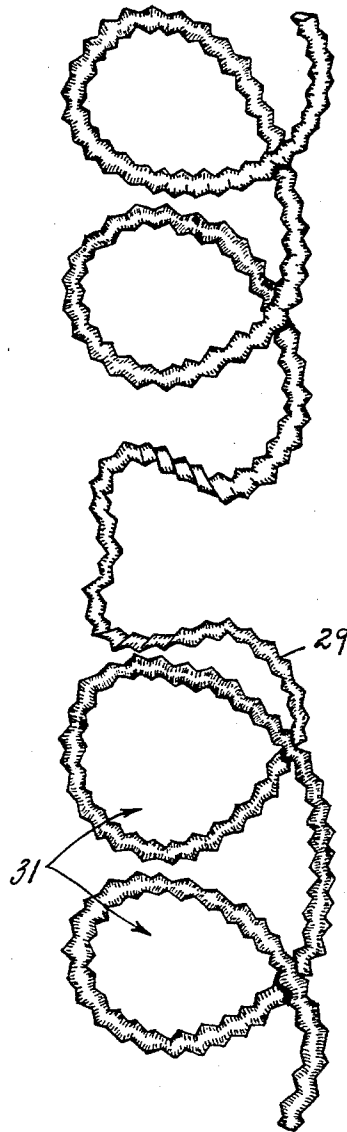


Fig. 3

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METHOD FOR TEXTURIZING YARNS

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ABSTRACT OF THE DISCLOSURE

This invention relates to a process for texturizing a material comprising the steps of introducing textile material under controlled tension between a set of opposed surfaces each having alternately depressed and raised areas while said surfaces are in contact under an applied pressure, at least one of said surfaces being resilient; deforming said textile material between said surfaces, removing said textile material from between said surfaces under controlled tension and correlatively controlling the tension and temperature of the material during the deforming step whereby a stabilized coil crimped textile product is produced.

This invention relates to a novel process and apparatus for the preparation of a stabilized coil-crimped texturized product.

It is an object of the invention to provide a texturized yarn which possesses a stabilized coil-crimped configuration;

Another object of this invention is to provide a bulked yarn which produces a surface effect when manufactured into a textile fabric;

A further object of this invention is to provide a yarn which produces a puckered or boucle effect in a knitted or woven fabric;

Yet another object of this invention is to provide a method for forming a yarn which is not only crimped but also coiled and in addition has residual shrinkage retained therein.

Other objects and many of the intended advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description which is considered in connection with the accompanying drawings wherein:

FIGURE 1 is a schematic view of one embodiment of an apparatus for carrying out the method of this invention;

FIGURE 2 is a schematic view of a second embodiment of an apparatus for carrying out the method of this invention; and

FIGURE 3 is a perspective view of a texturized yarn made according to the teaching of this invention.

For the purpose of description and acting as our own lexicographers, we indicate the yarn texturized according to our invention as having a stabilized coil-crimped configuration. Such a configuration results in a yarn which, when either knitted or woven, imparts a surface effect to the resulting fabric. This is due to the fact that the yarn enters the knitter or loom in an uncoiled but crimped state, and if a stitch is opened the yarn due to its coiled memory tries to reassume a coiled configuration thereby resulting in a random stitch effect which produces a puckered or boucle effect in the fabric. A stabilized coil configuration in the yarn indicates that, if the opposite ends of the yarn are pulled apart, it will be straight rather than having twists therein.

Briefly, this invention comprises the steps of introducing textile material under controlled tension between a set of opposed surfaces each having alternately depressed and

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applied pressure, at least one of said surfaces being resilient; deforming said textile material between said surfaces; removing said textile material from between said surfaces under controlled tension and correlatively controlling the tension and the temperature of the textile material during the deforming step whereby a stabilized coil-crimped textile product is produced.

The term "fiber" as employed throughout the specification and claims is to be understood to include drafted fibers, continuous monofilaments, continuous multifilaments, composite yarns of staples and monofilaments and other filamentary materials.

The fibers can be manufactured from a wide variety of materials which include proteinaceous material, cellulosic material, synthetic thermoplastic polymeric material, thermosetting polymeric material, and the like. Illustrative of such materials are the cellulose, cellulosic acetates, polyamides, polyesters, acrylics, polyolefins, and the like.

The crimp frequency for a given length of fiber can vary widely. The number of crimps per given length is not critical although limited somewhat by the physical limitations of the apparatus and the size and nature of the fibrous material being processed therein. In general, as the denier of the fibrous material is increased, the number of crimps per given length of textile material being treated decreases. In terms of apparatus, as the number of the raised and depressed areas on the opposed surfaces per given area thereof are decreased, the depth of the depressions increase.

With reference to FIGURES 1 and 2, there is shown an apparatus, generally designated as 1, which is suitable for treatment of textile materials, in this case illustrated as fibers, in accordance with the invention.

A fiber 3 passes from supply bobbin 5, supported on a suitable spindle 7, through a tension compensator 9 which places the fiber under a tension ranging from 0.0033 to 0.2 gram per denier preferably from 0.0066 to 0.08 gram per denier. Grams per denier tension is that stress exerted along the longitudinal length of the fibers expressed in units that relate to the fiber weight per unit length. For example, 0.2 gram/denier tension on a 100 denier yarn would be 100×0.2 or 20 grams. (Denier is the weight in grams of the material per 9000 meters of length.)

The tensioned fiber passes between roll 11, which contains ribs 15 and depressions 17, and roll 13. While located between the rolls the fiber is maintained at a temperature at least sufficient to permit it to undergo deformation. The upper temperature limit should not exceed that which will cause destruction or decomposition of the textile material being treated.

It is also within the scope of this invention that the number of opposed surfaces may be greater than two. Roll 13 is made of a resilient and relatively soft material such as polyurethane. The other roll 11 is fabricated from a relatively hard material such as steel. In any case, rolls 11 and 13 have surface configurations which are designed to impart a crimp to the fiber 1 when the surfaces of rolls 11 and 13 are in pressure contact. This state or condition of pressure is attained and maintained by means 19, which by any suitable arrangement (not shown) generally forces the upper roll 11 against the lower roll 13. Drive roll 11 is rotated by means not shown and soft roll 13 is driven as a result of the frictional force resulting from the pressure contact with roll 11.

By correlatively controlling both the tension on the fiber and its temperature as it is being deformed between rolls 11 and 13, we have surprisingly discovered that in addition to imparting a crimp into the fiber, we are also able to place a stabilized coil therein whereby the fiber pos-

sesses residual shrinkage. For our purposes the temperature of the fiber is maintained within a range of from 200 to 400° F. and preferably from 250 to 350° F. The particular temperature employed in the treatment of a particular textile material, as enumerated hereinbefore, depends upon the characteristics of the material itself. Nylon, for example, is processed at a temperature of at least about 200° F.

Roll 11 can be heated, for example, by passing heated fluid through the center thereof. It is also within the scope of our invention to heat the fiber sufficiently in advance of its being deformed between rolls 11 and 13. A pre-heater 18 through which the fiber is passed prior to its being deformed can achieve this result.

After passing from between the rolls 11 and 13, the deformed fiber passes through guide means 20 and is collected onto take-up bobbin 19 mounted on a spindle 21, the latter being driven by a belt 23. The fiber passes between the rolls 11 and 13 at a speed sufficient to minimize residence time therein. For our purposes, speeds ranging from 50 to 1000 ft./min. and preferably from 100 to 400 ft./min. are suitable. The deformed yarn is also wound upon the packaging or take-up bobbin 19 in a substantially tensionless condition. The let-off tensions for rolls 11 and 13 are maintained under .0033 gram/denier in order to maintain the crimp and coil therein, i.e., less than ½ gram on 150 denier yarn.

FIGURE 2 illustrates another embodiment of our invention wherein the fiber passes through a water-wick 25 in order to moisten the fiber prior to its being deformed. It has been determined that a stabilized coil cannot be placed into the fiber without first wetting it if the temperature during the deforming step exceeds 330° F. It has been determined that coil can be produced at 200° F. crimping temperature with or without a prior water application. It is believed that the wetting of the fiber is necessary in order to both hold the fibrous filaments together and also to provide for a more uniform distribution of temperature. Thus, when yarn exits from the intermesh

the surfaces as well as to the raised areas thereof. At the same time material should not have so much pressure applied thereto that it is physically damaged by contact between the surfaces. Applied pressures depend, to a great extent, on the amplitude, frequency and configuration of rolls 11 and 13, as well as the characteristics of the fiber being crimped.

Generally speaking, an applied pressure in a range of from about 3 to 400 pounds per linear inch of the roll is sufficient in most cases to achieve a desired result. The relatively soft roll 13, a suitable compacted composition, has a Durometer hardness (Shore D scale) in a range of from about 72 to 100 and preferably in a range of from about 80 to 86 (see ASTM designation D1484-59). For example, the resilient roll 13 can be suitably fabricated from a blend of about 65% cotton and 35% wool which is resin-impregnated and pressed to have a Durometer hardness in the ranges expressed hereinabove.

FIGURE 3 shows the yarn which results from being textured according to the process described hereinabove. It will be noted that it contains crimps 29 which are arranged in coils 31.

Example

In order to demonstrate the effectiveness of the present process in texturizing a yarn to form a stabilized coil-crimp therein, a 150/34 polyester fiber was treated in accordance with the process of the present invention.

Using the apparatus described in the second embodiment, the yarn was moistened in water-wick 25, and passed between rolls 11 and 13 which contained 20 crimps per inch, wherein the roll pressure was maintained at about 3 to 5 pounds per linear inch. The deformed fiber was taken up on a bobbin 19 under a tension of 0.003 gram per denier at a rate sufficient to move the fiber through the deforming zone at a speed of 350 ft./min.

The tension on the fiber entering between rolls 11 and 13 was varied as was its temperature.

The results are indicated in the following table.

Yarn incoming tension, grams/denier	Less than 0.003		0.003-0.007		0.04-0.06		0.11-0.13		0.14-0.18		Greater than 0.18	
Roll temperature, ° F.....	350	400	350	400	350	400	350	400	350	400	350	400
Coil definition (visual).....	(1)	(1)	(2)	Poor	(2)	Poor	Good	(1)	Good	(1)	(1)	(1)
Approximate coils/inch ²	0-1	0-1	5-7	0-1	6-8	0-1	4-6	0	4-5	0	0-1	0-1

¹ Very poor. ² Very good. ³ Relaxed yarn.

between rolls 11 and 13, the fiber retains some cohesiveness thereby preventing the fibrous filaments closest to the heat source from shrinking individually. This enables these filaments to pull on the lesser heated filaments thereby forming the entire bundle of filaments into a coil. If the water is not applied at higher temperatures, the filaments tend to shrink differentially and individually which results in a crimped but uncoiled yarn.

It is also within the scope of this invention to pass the fiber through a post-heater 27 preferably a J box, after the fiber passes from between rolls 11 and 13 in order to permanently heat-set the coiled crimp into the fiber. The temperature in the J box is controlled by heater means 28 and varies over a range from about 250 to 400° F. It is to be understood that it is difficult to determine the precise temperatures and tensions which are obtained in the practice of this invention with the apparatus of the drawing. The precise tension and temperature employed in the deforming of a particular textile fibrous material depends to a great deal upon the characteristics of the material itself. However, it is well within the capability of the operator to determine what tension and temperature values he desires. In carrying out the process of this invention the textile material is being deformed between surfaces 11 and 13 over a wide variation of applied pressure. The particular amount of pressure should be at least enough to assure that the material passing between the opposed surfaces is made to conform to the shape impressed on

It can be readily observed that if the fiber incoming tension is maintained within the range set forth in the specification, and if the fiber is moistened prior to crimping at temperatures above 300° F., a coil can be imparted into the yarn as well as a crimp. Operating outside of these ranges will not produce the stabilized coil.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described herein.

What is claimed is:

1. A process for texturizing a material comprising the steps of introducing textile material under a controlled tension, ranging from about 0.0033 to 0.2 gram per denier, between a set of opposed surfaces each having alternatively depressed and raised areas while said surfaces are in contact under an applied pressure, at least one of said surfaces being resilient; deforming said textile material between said surfaces; removing said textile material from between said surfaces under a tension below 0.0033 gram per denier and correlatively controlling the tension and temperature of the material during the deforming step to produce a stabilized coil-crimped textile product.
2. A method according to claim 1 further including the step of preheating the textile material prior to the

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step of introducing said material between the opposed surfaces.

3. A method according to claim 1 further including the step of moistening the textile material prior to the step of introducing the said material between a set of opposed surfaces. 5

4. A process according to claim 1 further including the step of heat-setting the stabilized coil-crimped textile product after removing it from said surfaces.

5. A process according to claim 1 wherein the textile material is one selected from the group consisting of cellulosics, cellulosic acetates, polyamides, polyesters, acrylics, and polyolefins. 10

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