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3,017,685

PROCESS FOR THE PRODUCTION OF FABRICS FROM SPECIALLY PREPARED YARNS

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No Drawing. Filed May 15, 1958, Ser. No. 735,392

Claims priority, application Austria May 25, 1957

5 Claims. (Cl. 28—72)

This invention relates to a process for the production of woven, knitted or warp-knitted fabrics from specially prepared yarns. It relates particularly to such fabrics containing synthetic resin textile fibers such as polyamide fibers and polyester fibers. Known crimped or stretch yarns of synthetic resin textile fibers are prepared by highly twisting such yarns, subjecting them to a heat-setting in the highly twisted state, and then detwisting them to a normal twist. The production of woven, knitted or warp-knitted fabrics from such crimped yarn presents a great difficulty, because the yarns have a very strong tendency to crimp and to contract during the course of the weaving or knitting operation, thus causing very often irregularities in the final fabric.

In order to overcome this strong tendency to crimp during processing, it has been suggested to size the crimped yarn either in the form of single or plied yarn while stretched sufficiently to remove all crimp, then to work the yarn in this state to form a fabric, and then to remove the size by a wet treatment from such fabric. Such removal restores the original crimp character of the yarn. Such sizing and removal thereof complicates and increases the cost of the process.

The principal object of the invention is to provide a process for the production of a warp-knit, knit or woven fabric containing crimp yarn, which shall be simpler, more efficient and less expensive than the above mentioned process.

I have found in accordance with my invention that I may produce such a fabric by knitting or weaving a synthetic resin polymer crimped yarn which after high-twisting, fixing and de-twisting is modified by heating under low tension. The modified yarn may be, for example, a polyamide yarn or a polyester yarn. The yarn may be single or plied. Such modified yarn, after high-twisting, fixing and de-twisting, is heated at a lower temperature than the temperature applied for the heat fixation in the high-twisted state; this heating is carried out under low tension. By this after-treatment the crimping tendency of the yarn is temporarily reduced. The temperatures used for fixing the high-twisted yarn may be the usual one employed, for instance, but without limitation, 180 to 225° C. The lower temperature used for after-treating the detwisted yarn may be in the range of 60 to 200° C., and the time of heating may range from 0.5 to 5 seconds in the case of application of dry heat. For the after-treatment also wet heat may be applied, e.g. saturated steam.

The yarn during such heating is kept under low constant tension which may range from 0.05 to 0.2 grams/denier. The yarn so produced has a reduced crimping tendency. I form a fabric therefrom by weaving, knitting or warp-knitting. Thereupon the fabric is subjected to a wet or steam treatment in a tensionless state to restore the crimp. When steam is applied, the fabric is exposed to it for 30 seconds to 5 minutes; in the case of a wet treatment the fabric is immersed for 15 to 30 minutes in a bath at a temperature between 30° C. and 80° C.

The temporary removal of the crimping tendency of the yarn can be carried out in two ways. (1) The detwisted crimped yarn can be wound under a low constant tension on non-collapsible or slightly collapsible bobbins,

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and in this state subjected, for example, to steam. The steam employed may be saturated steam or slightly superheated steam, depending on the character of the crimped yarn. (2) The second method consists of passing the detwisted yarn under constant tension continuously through a heating device. The yarn tension should be adjusted so that the yarn is stretched sufficiently to remove all crimp but without causing any substantial elongation of the filaments composing the yarn. As the heating device a metal tube may be used through which the yarn travels in an axial direction, which tube contains an electrical resistance heating wire to heat the air inside the tube. Instead of heating wire one can also use a tube which constitutes itself, a resistance in an electrical circuit. One can also use devices by which the heat-setting of the yarn under tension is carried out by contact with a hot surface, advantageously a metal surface, which is brought to the necessary temperature by electrical or other means. Further, the heat treatment can also be carried out with saturated steam or slightly superheated steam. Advantageously the continuous heating of the de-twisted yarn under low tension is combined with some other textile operation. The heating device may, for example, be situated after the twister head of a false-twist apparatus serving to crimp the yarn, so that the yarn, which is detwisted after leaving the twister head, passes through the heating device in the detwisted state under low tension.

As starting materials for the present process, crimped yarns from polyamides, such as for example, polyhexamethylene adipamide or polymers of E-caprolactam; further, yarns from polyesters for example polyethylene glycol terephthalate, may be used. Along with the modified crimped yarn, other yarns as plain yarns, crepe yarns or yarns of any type made of natural, or regenerated cellulose, cellulose derivatives, silk, or other synthetic organic material, may be applied for producing fabrics by weaving or knitting.

The following are examples of the process as I now prefer to carry it out. These examples are illustrative, and it is to be understood that the invention is not to be considered as restricted thereto, except as indicated in the appended claims.

Example 1

A crimped plied yarn of polyhexamethylene adipamide, 100 denier, 34 filament, produced by temporarily high-twisting each ply to 2400 t./m. in S and Z directions respectively, and setting in the high-twisted state for 0.8 second with hot air at a temperature of 220° to 225° C. is put through a heating chamber in which it is subjected for two seconds to hot air at a temperature of 160° C. in the stretched state under a constant yarn tension of 0.1 gram/denier. The crimping tendency of this yarn is temporarily substantially reduced. A woven fabric is then produced whose warp is of crepe yarns of cuprammonium rayon 80 denier, and whose filler consists of the above described crimped yarns whereby alternately crimped yarns, which were temporarily high-twisted in S and Z directions, are woven.

The so obtained fabric is then pre-goffered with a slightly warmed crepe roller, treated with 2% aqueous sodium hydroxide solution, subsequently scoured for 20 minutes at 30–70° C., bleached by the use of sodium chlorite, washed and dried, in a loop dryer. The crimped yarns attain their bulky character in this wet treatment, that is, the original crimp of the yarn is in large part restored. The fabric is then heated while under light tension in a tenter frame for a short time at 190° C., and thereby set to the desired dimensions. One so obtains a crepe-like slightly elastic fabric.

Example 2

A crimped yarn of polyhexamethylene adipamide 70

denier produced by temporarily high-twisting to 3000 t./m. in S direction by means of a false-twisting device and setting in the high-twisted state for 1 second with hot air at a temperature of 220 to 225° C. is plied with a similarly crimped yarn temporarily high-twisted in Z direction. This ply-yarn is subjected in the stretched state for 30 seconds to a saturated steam temperature of 100° C. A fabric is then produced whose warp is made of plain polyamide yarns of the polymer of E-caprolactam, 30 denier with a twist of 1000 t./m., and whose filler consists of the above described plied crimped yarn.

The so-obtained fabric is then pre-goffered with a slightly heated crepe roller and subjected to a scouring bath at 30 to 60° C., in its full width, therein treated for some time, thoroughly rinsed and bleached by the use of sodium chlorite, washed, lightly blued and dried in a loop dryer. By the wet treatment the crimped yarns attain their bulky character, that is, the temporary diminution in the crimping tendency is substantially removed. The fabric is then steamed on a tenter frame and dried under light tension. One thus obtains an elastic fabric.

Example 3

Two yarns consisting of E-caprolactam polymer 90 denier (30 filament) are crimped on a false-twisting device by temporarily high-twisting to 2600 t./m. in S and Z directions respectively and setting in the high-twisted state for 0.85 second with hot air at a temperature of 185 to 190° C. Then the yarns are plied together and the ply-yarn is put through a heating chamber in which it is subjected for 2 seconds to hot air at a temperature of 160° C. in stretched condition under a constant yarn tension of 0.1 gram/denier. This ply-yarn is then knit on a full-fashioned machine to produce a sweater. The sweater is then scoured at 40–60° C. in the usual manner to fully develop the crimp, dried in a loose state, pre-boarded, dyed, dried and lightly steamed at 100° C. One so obtains a sweater with good elongation characteristics.

Example 4

Two yarns of polyhexamethylene adipamide 100 denier (34 filaments) produced by temporarily high-twisting to 2550 t./m. in S and Z directions respectively by means of a false-twisting device for 0.8 second with hot air at a temperature of 220 to 225° C., are first evenly moistened with water and then put through a heating chamber in which they are subjected for 2 seconds to hot air at a temperature of 200° C. in the stretched state under a constant yarn tension of 0.15 gram/denier. The tendency to crimp of each yarn is temporarily substantially reduced. A woven fabric is then produced whose warp consists of crepe yarns of viscose rayon 100 denier and whose filler consists alternately of the above described crimped yarns which were temporarily high-twisted in S and Z directions. The so-obtained fabric is then treated as in Example 1. One so obtains a crepe like slightly elastic fabric.

Example 5

Two yarns of polyethylene glycol terephthalate 100 denier are crimped by temporarily high-twisting to 2400 t./m. in S and Z directions respectively by means of a false-twisting device and setting in the high-twisted state for 0.8 second with hot air at a temperature of 225 to 228° C. A yarn temporarily high-twisted in S direction and a yarn temporarily high-twisted in Z direction are plied together and this ply-yarn is put through a heating

chamber in which it is subjected for 2 seconds to hot air at a temperature of 80° C. in the stretched state under a constant yarn tension of 0.1 gram/denier. The tendency to crimp of this yarn is temporarily substantially reduced. The ply-yarn is then knit on a full-fashioned machine to produce a knitted sweater which is finally treated as in Example 3. One thus obtains a sweater with good elastic properties.

I claim:

1. A process which comprises heating a twisted, heat-set and detwisted stretch yarn of synthetic resin polymer under low tension at a lower temperature than that employed for heat-setting the twisted yarn to reduce temporarily the tendency to crimp of the yarn and cause it to lie flat for fabrication, forming a fabric therefrom, and subjecting the fabric to a moist heat treatment to restore a substantial part of its original crimp character.

2. A process which comprises heating a stretch yarn of synthetic resin polymer which has been temporarily high-twisted and heat-set in the high-twisted state, under low tension at a lower temperature than that employed for heat-setting of the high-twisted yarn said lower temperature being in the range of about 60 to 200° C. dry heat, forming a fabric therefrom, and subjecting the fabric to a treatment with saturated steam at a temperature of about 100° C. for 0.5 to 5 minutes.

3. A process which comprises high-twisting a stretch yarn of synthetic resin polymer, heat-setting the yarn in the high-twisted state and detwisting it, then winding the detwisted yarn under low tension on a bobbin and heating the yarn on said bobbin at a lower temperature than that employed for heat-setting the high-twisted yarn to reduce temporarily the tendency to crimp of the yarn and cause it to lie flat for fabrication, forming a fabric therefrom, and subsequently subjecting the fabric to a moist heat treatment.

4. A process which comprises heating in steam a stretch yarn of synthetic resin polymer which has been temporarily high-twisted and heat-set in the high-twisted state, under low tension at a lower temperature than that employed for heat setting the high-twisted yarn to reduce temporarily the tendency to crimp of the yarn and cause it to lie flat for fabrication, forming a fabric therefrom, and subjecting the fabric to a treatment with saturated steam of about 100° C. for 0.5 to 5 minutes.

5. A process which comprises continuously heating in a hot gaseous medium a stretch yarn of synthetic resin polymer which has been temporarily high-twisted and heat-set in the high-twisted state under low tension, at a lower temperature than that employed for heat setting to reduce temporarily the tendency to crimp of the yarn and cause it to lie flat for fabrication, forming a fabric therefrom, and subjecting the fabric to a moist heat treatment to restore the crimp of the yarn.

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