May 21, 1968 CHOZO NAKAYAMA ETAL 3,384,694

METHOD OF PRODUCING ALIGNED ACRYLONITRILE POLYMER FILAMENT YARNS

Filed Nov. 12, 1964

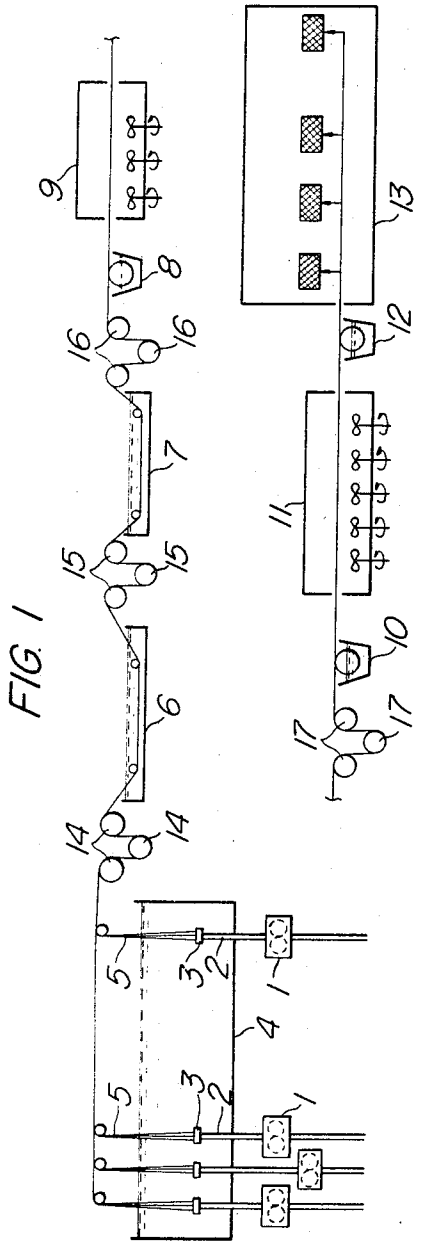


FIG. 1

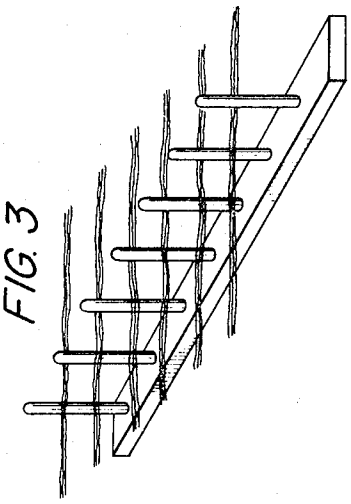


FIG. 3

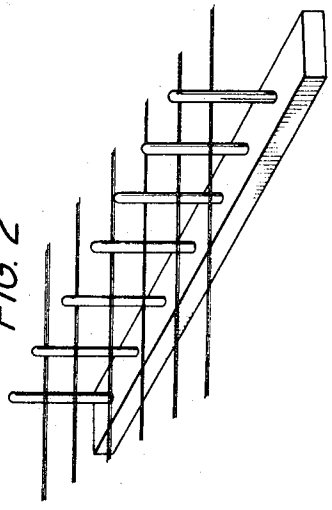


FIG. 2

United States Patent Office 3,384,694 Patented May 21, 1968

3,384,694

METHOD OF PRODUCING ALIGNED ACRYLONITRILE POLYMER FILAMENT YARNS

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Filed Nov. 12, 1964, Ser. No. 410,687
Claims priority, application Japan, Nov. 21, 1963, 38/62,275
10 Claims. (Cl. 264—290)

ABSTRACT OF THE DISCLOSURE

A method for producing well aligned acrylonitrile polymer filament yarns in which the filament yarns are prepared by wet spinning of acrylic polymer which comprises impregnating heated, stretched and swollen filament yarns with an oiling agent having a melting point below 100° C., or 2% or less of a sizing agent with respect to the weight of the filament yarns, or a mixture of said oiling agent and 2% or less of said sizing agent, drying the impregnated yarn in a dryer while subjecting same to 5–20% shrinkage in the direction of the filament length, impregnating the dried filament yarns with 10% or less of a sizing agent with respect to the weight of the filament yarns, and drying same while subjecting it to 0–10% stretching in the direction of the filament length.

This invention relates to methods of producing multiple-filament yarns.

The expression "acrylonitrile polymer filament yarns" or the like as hereinafter used in this text means such products as are made of a polymer comprising acrylonitrile units alone or at least 85 percent by weight of acrylonitrile units and at most 15 percent by weight of units of at least one monomeric olefin which is copolymerizable with acrylonitrile.

The expression "acrylic filament yarns" when same hereinafter appears is to be construed as "acrylonitrile polymer filament yarns," which latter term appears in the claims and which is defined in the preceding paragraph.

It is well known that certain mechanical properties of acrylic fibers such as brittleness can be improved by relaxing the fibers such as by a shrinking treatment. However, in the wet spinning of acrylic filament yarns, attempts to effect shrinking treatments are accompanied by a great deal of trouble.

In the production of filaments of small total denier, it is advantageous to treat as many filament yarns as possible while moving them in parallel to one another with relatively small spacing therebetween and to take them up in an untwisted state. This brings about economic advantages such as an increase of production per unit floor space and a reduction of installation costs.

Accordingly, it has been found desirable to extrude a solution of acrylic polymer, through a plurality of spinnerets each of which has many small holes, into an aqueous coagulant to precipitate the polymer into fibrous form. A plurality of monofilaments are made into a unit of filament yarn at each spinneret, and a minimum distance between units is maintained. The technique further involves subjecting the fibers to washing, and then to heat stretching, and subjecting them simultaneously to drying and shrinking in a drier while maintaining the fibers in a substantially tension-free state.

However, when the shrinking treatment is effected fuzzing and breaking are induced. Further, as the moisture content decreases due to the drying, the individual filaments separate from each other due to mechanical vibration and an electrostatically repulsive force which results therefrom.

An object of the present invention is, accordingly, to provide an improved method of producing acrylic filament yarns wherein the filament yarns are maintained in good alignment and remain in an untwisted state and wherein many filament yarns can move in parallel to each other with a very small spacing therebetween and can be subjected to a shrinking treatment without inducing the above-mentioned disadvantages.

In accordance with the present invention, there is proposed a wet spinning of acrylic filament yarns wherein swollen fibers, which have been stretched by heating, are impregnated with an oiling agent which has a melting point lower than 100° C. and which is preferably a liquid at room temperature. Alternatively, the swollen fibers can be impregnated with less than 2 percent by weight and preferably less than 1 percent by weight of a sizing agent or a mixture of the above-mentioned oiling agent and the sizing agent. The swollen fibers are then heated at 100° C. to 200° C., and preferably at 100° C. to 180° C., in a drier in which drying and 5 to 20 percent shrinkage in the direction of the fiber axis are effected. Subsequently the fibers are treated with an aqueous solution of a sizing agent such that it adheres to the fibers in an amount less than 10 percent by weight of the fibers, the fibers being maintained under tension to obtain a stretching of from 0 to 10 percent in the direction of the fiber length which does not exceed the shrinkage afforded in the aforementioned shrinking treatment. The filaments are then heated at a temperature lower than that of the previous drying and shrinking treatment (e.g., from 80° C. to 120° C., and preferably from 90° C. to 110° C.) and are dried in a manner such that the filaments have a high resistance to stretching and can sustain a high tension load.

In general, when hot-stretched swollen fibers are subjected to drying and shrinking in a big tow, it is a common practice to dry them first at a relatively low temperature or at a high temperature under tension to render the fine structure of the fibers denier and then to shrink them at a high temperature under either dry or wet conditions. If an attempt is made to dry and shrink the fibers simultaneously by heating at a high temperature, the temperature inside the fiber bundle is elevated before the losing of water therefrom and devitrification of the fibers frequently results. However, in the case of small fiber bundles such as in the case of filament yarns, it has been discovered that devitrification surprisingly does not occur if the swollen fibers are immediately heated to a temperature higher than 100° C., hot air being employed as the heating medium and humidity being suppressed to about 0.1 kg. of water per kg. of dry air.

Due to this discovery, it has become possible to put the present invention readily into practice. The reason why the foregoing treatment meets the purpose of the present invention will be explained hereinafter.

In order to dry the swollen hot-stretched fibers and provide them simultaneously with from 5 to 20 percent shrinkage in the direction of their length, the filament yarns must be maintained in a substantially tension-free state in the drier. A violent shaking of the filament yarns due to vigorous agitation by the hot air under these circumstances cannot be avoided. However, increasing the distance between the filament yarns to avoid the contacting of filaments is disadvantageous from an economical viewpoint. To solve this problem, the idea has been considered of placing combs across the direction of movement of the filament yarns to reduce the contact of the filament yarns as much as possible. However, this idea cannot be used with filament yarns which have not been impregnated with the aforesaid oiling agent, sizing agent or a mixture

thereof, for when the filament yarns are dried and subjected to shrinkage without the impregnating treatment, the filament yarns disassemble into their constituent monofilaments, due to mechanical vibration and electrostatically repulsive forces, and the monofilaments are broken by contact with the combs and fuzzing is induced.

If, however, the filament yarns are impregnated with 2 to 10 percent by weight or more of a sizing agent based upon the weight of fibers, the separation of the monofilaments due to drying can be prevented. But the filament yarns must not contact the combs before sufficiently drying, or else the sizing agent on the surface of the filaments will stick to the surfaces of the combs which are heated to a high temperature and there is then formed a rough surface which increases frictional resistance between the filaments and combs, thereby causing fuzzing and breaking of the filament yarns. Even if the treatment could be effected without causing fuzzing and breaking, dried sizing agent precipitates and solidifies on the surfaces of the combs, which gradually grow in size and ultimately become obstacles for filaments to pass through. As a consequence, the treatment cannot be continued for a long time.

When an oiling agent alone is impregnated into the fiber yarns, the separation of monofilaments due to drying can be prevented, the filaments remaining almost free from damage due to the lubricating effect of the oiling agent and being thus able to endue the simultaneous drying and shrinking treatments. However, in this instance, the only forces which maintain the alignment of the filament yarns are the viscosity and surface tension of the oil, and there are no other positive adhering and clinging properties available. As a result, when such filament yarns are supplied as untwisted yarns, monofilaments will be separated and damaged during weaving and knitting.

For the foregoing reasons, the method of the invention is best for subjecting filament yarns, which are swollen and oriented by heating and stretching in a wet spinning process, to a simultaneous drying under heat and shrinking from 5 to 20 percent in the direction of the fiber length in a substantially tension-free state while moving the filaments in parallel at a minimum spacing and for providing filament yarns which are untwisted and well aligned and adapted to be maintained in such state through preparatory operations for weaving and knitting.

The practice of the present invention will be more fully explained as follows:

The first step involves heating swollen fibers, which are oriented by hot stretching in a wet spinning process and which are moving in closely spaced relation and in substantially tension-free condition, to effect drying and simultaneously to shrink the same in the direction of length up to from 5 to 20 percent. In connection with this step and to maintain the filament yarns in good alignment, the filaments are impregnated with an oiling agent having a melting point lower than 100° C., and preferably an oiling agent which is in liquid state at room temperature. Alternatively, there can be employed less than 2 percent by weight of a sizing agent, and preferably less than 1 percent thereof, or a mixture of such sizing and oiling agents. The drying temperature used in this step is from 100° C. to 200° C. and preferably from 110° C. to 180° C. to obtain the desired shrinkage of from 5 to 20 percent. The oiling agent is used either by itself or in the form of an aqueous emulsion, but its melting point must be lower than 100° C. to prevent the oil from sticking to combs which are installed in the drier and from precipitating thereto as a solid. For facilitating impregnation, it is preferable to use an oiling agent which is liquid at room temperature.

Oiling agents useful for the impregnation treatment have no restriction except as to melting point. Various kinds of commercially available oiling agents which contain cationic, anionic, amphoteric, or non-ionic surfactants are useful. However, when the impregnation treatment is applied to undried wet fibers, as in the case of the present invention, oiling agents containing ionic surfactants are not suitable because they impart an unfavorable effect with respect to dyeability. For example, when the fibers are made with acrylic polymer produced by copolymerizing acrylonitrile with a monomeric olefin, which is copolymerizable with acrylonitrile and contains an acidic radical such as sulfonic acid or carboxylic acid for the purpose of rendering the fibers dyeable, a treatment with a cationic surfactant reduces the affinity of the product to basic dyes and a treatment with an anionic surfactant increases the affinity of the product to basic dyes. This will constitute no problem for those skilled in the art; however, the use of an oiling agent containing a non-ionic surfactant is generally preferable. Polyoxyethylene alkyl ethers such as "Actinol R–100," "Noygen ET–80" and the like, polyoxyethylene alkylphenols such as "Noygen K," "Elenon 20" and the like, polyoxyethylene alkyl esters such as "Emalox S," "Brian L 200" and the like, sorbitan alkyl esters such as "Nicols SL" and the like or other non-ionic surfactants such as "Pronon 104," "Tomenolin F" and so forth afford good results when they are used to adhere in an amount of from 0.5 to 2 percent by weight based upon the weight of the fiber. It is to be understood that the foregoing non-ionic surfactants and the applied amount are merely illustrative and do not limit the scope of the invention.

The sizing agent used to impregnate the filament yarns before the drying and shrinking treatment is not necessarily a special one. The same sizing agents as used after the drying and shrinking treatment will generally serve the purpose. However, the amount of sizing agent to be impregnated is important, for it has been determined that when the amount is less than 2 percent and preferably lower than 1 percent by weight, the above-mentioned troubles due to stickiness are not encountered.

When a mixture of oiling and sizing agents is used for impregnating the filament yarns before the drying and shrinking treatment, there is no restriction as to their combination. The kinds of sizing agents useful in this instance will be illustrated hereinafter.

In performing the simultaneous drying and shrinking treatment, it is difficult to set a definite restriction as to the temperature of the drier. Even at a temperature as low as 100° C., it is possible to produce the shrinkage required. However, the attainable upper limit of shrinkage is restrictive and the length of drying at 100° C. is twice that when heating is performed at 130° C. Heating at a temperature higher than 200° C. is liable to cause heat-discoloration of the fiber.

If the residence time in the drier is minimized for affording the desired shrinkage while avoiding heat-discoloration at a temperature higher than 200° C., the unevenness of temperature distribution in the drier and of air flow is liable to injure the homogeneity of the filament yarns. Thus, such a treatment should be put into practice in the case of filament yarns for which excellent homogeneity in quality is required. In this regard, the drying and shrinking treatment must be performed at a temperature between 100° C. and 200° C. and preferably between 110° C. and 180° C. The residence time must be chosen so as to make the moisture content of the fiber less than 5 percent by weight.

The filament yarns provided with desired shrinkage while being maintained in good alignment and subjected to drying are, in the second step, treated so that there adheres thereto less than 10 percent by weight of sizing agent based upon the weight of fibers, the yarns being stretched by from 0 to 10 percent at a temperature lower than that of the previous drying and shrinking treatment and then further dried under tension.

The sizing agent used in the present invention is selected from those commercially available as warp sizing agents. These sizing agents include those of the polyvinyl alcohol type such as "Gosenol GH–17," "Gosenol GL–05,"

"Gosecizer S–100" and the like, those of the polyacrylic acid derivative type such as "Marbosol pp–20," "Marbosol A–840" and the like, and those of the vinyl acetate maleic acid copolymer type such as "Tamanori S–400" and the like, which are all useful for the purpose of the present invention.

These sizing agents are also merely illustrative and do not limit the scope of the invention. They can be used alone or in mixture. If required, it is possible to use them by mixing them with at least one kind of oiling agent which serves as the dispersing agent or impregnating agent. It is one of the essential conditions of the present invention that the filament yarns be dried with less than 10 percent by weight of the sizing agent under tension at a temperature lower than that of the previous drying and shrinking treatment so as to stretch the fiber by from 0 to 10 percent and to dry the same simultaneously. A problem to be considered in the drying of the sized filament yarns which are moving in a closely spaced relationship is that the filament yarns must not contact anything else except air while drying and particularly while the surface of filament yarns are sticky. If contact between filament yarns occurs, it is difficult to separate the filaments from each other without the damage due to strong cohesion. Unless combs be used to avoid contact of the filament yarns, the above-described difficulties cannot be avoided. The present invention solves this by effecting the drying of filament yarns under tension. The vibration of filament yarns due to the disturbance by air is minimized by applying more tension to the filament yarns and by greatly increasing the distance between combs which are installed transverse to the moving direction of the filament yarns to prevent them from contacting each other. Providing tension for the filament yarns can be accomplished by stretching the filament yarns. In connection with thermoplastic fibers, the force required to afford a definite proportion of stretching is smaller as the temperature is higher. Hence, the filament yarns are stretched at a low temperature if the stretching of the filament yarns is to be minimized under as great a tension as possible.

In view of the foregoing, in the drying of a plurality of sized filament yarns, it is important to stretch the filament yarns so as to afford a stretching which is smaller than the shrinkage given to the filament yarns in the previous shrinking treatment, and to select a drying temperature lower than that of the previous drying and shrinking treatment or particularly 80° C. to 120° C. and preferably from 90° C. to 110° C. In this step there may be no combs installed in the drier. However, there may be combs installed if sufficient inter-teeth spacing is maintained so that the filament yarns do not contact until their surfaces lose their stickiness due to drying.

By the above method, it has now become possible to manufacture acrylic filament yarns which are untwisted but are maintained in good alignment with a sizing agent and which possess excellent mechanical properties. Said method can be affected as a continuous run consisting of subjecting closely spaced fiber filaments in good alignment to a simultaneous drying and shrinking treatment during the movement thereof to take up in a wet spinning process, and then effecting sizing and drying again.

The nature of the present invention can be more fully understood by referring to the accompanying drawings. FIG. 1 is a flow sheet of the present process. FIGS. 2 and 3 are partially enlarged views of a mass of filament yarns being separated individually by teeth of a comb fixed in a drying apparatus, FIG. 2 showing the case where the filament yarns are treated with an oiling agent, a sizing agent or a mixture of the two, and FIG. 3 showing the case where the filaments are not treated at all.

In FIGURE 1, an acrylic polymer is dissolved in a nitric acid solvent having 70 percent by weight concentration so as to form a 15 percent by weight spinning solution. After de-aeration, this spinning solution is sent to a spinning apparatus having 100 spinnerets per unit. More particularly, the spinning solution is delivered from the dissolver to a pipe **2** at desired speed by a gear pump **1**. At the end of the pipe **2** there is provided a multi-holed spinneret **3**. The spinning solution is extruded from these fine holes into an aqueous coagulating bath **4** which contains 30 percent by weight of nitric acid and is cooled to a temperature of —3° C. Filaments **5** precipitated in fiber form are taken from the bath by a group of rollers **14** running at a peripheral speed of from 5 to 10 meters/minute and the fibers are spaced by a distance ranging from 4 to 10 millimeters. These filaments are led to a washing bath **6** where the solvent is completely removed, passed through a group of rollers **15** which are running at the same speed as the rollers **14** and delivered to a stretching bath **7** in which a liquid or steam is used as a heating medium. By causing a group of rollers **16** to run at a peripheral speed at least 4 times as fast as that of the roller group **15**, the filaments **5** are stretched in the stretching bath **7** in their direction of length by an amount at least 4 times their original length.

The wet, swollen filaments stretched by heating are impregnated with an oiling agent by contacting the filaments lightly with the upper peripheral surface of a roller which is running in the same or reverse direction as the direction of filament movement and the lower side of which is immersed in an oiling bath **8**. When the oiling agent is an oil having a melting point of lower than 100° C. and is preferably a liquid at room temperature, it is further desirous, as aforementioned, that the oil be a non-ionic surfactant. The oiling agent may be used by itself or in the form of an aqueous emulsion, but in general the use by itself is preferable. It is not harmful to heat the bath **8** to a temperature lower than 100° C. If necessary, the amount of oiling agent adhering to the fibers can be made more than 2 percent by weight, but, for the purpose of the present invention, from 0.5 to 2 percent by weight is generally sufficient. The adhesion of an excessive amount of oiling agent weakens the adhesive force of the sizing agent which is supplied in the next operation. As a practical matter, it is possible to determine the amount of oiling agent simply by experiment with the relationship between the contact length of the filaments with the related roller and the relative speed of filaments with respect to the roller surface.

When a sizing agent is used as the treating liquid, it can be in the form of an aqueous solution of a single substance or a mixture of substances. The adhered amount is suitable when it is less than 2 percent by weight and preferably less than 1 percent by weight relative to the fibers. In general such an amount is especially practical for the shrinking treatment, where the shrinkage is as low as from 5 to 15 percent. Further, in the following sizing operation, the sizing enables reducing the concentration of sizing agent, and to perform the drying after the sizing under relatively low tension conditions by which the extent for reducing the effect of the shrinking treatment during the drying operation can be minimized.

When a mixture of sizing agent and oiling agent is used as the treating liquid, it is preferable to use an oiling agent dispersed in an aqueous solution of sizing agent. The amount to be adhered to the fibers is the same as when an oiling agent or sizing agent is used alone.

Filament yarns impregnated as above-described are afforded a desirable extent of shrinkage ranging from 5 to 20 percent in a drier **9** at a temperature of from 100° C. to 200° C. and preferably from 110° C. to 180° C. within a controlled range of ±5° C. Inside the drier **9** there are provided 10 combs spaced 40 centimeters apart across the direction of filament movement. These combs prevent mutual contacting of the filament yarns. Desired shrinkage is imparted by groups of rollers **16** and rollers **17**, of which the latter run at a slower peripheral speed.

The filament yarns thus subjected simultaneously to drying and shrinking treatment, while maintaining a good alignment, are subsequently treated in a sizing bath **10**

which has the same construction as the bath 8 and is provided with an aqueous solution of the above-mentioned sizing agent alone or a mixture of two or more such sizing agents in an amount to render the adhesion less than 10 percent by weight relative to the fibers. Then the filament yarns are given in a drier 11 a stretching which is in the range from 0 to 10 percent in the direction of length and less than the extent of shrinkage produced in the above-mentioned shrinking treatment and are dried under tension at a temperature of from 80° C. to 120° C., and preferably from 90° C. to 110° C. Inside the drier 11 no combs are provided within 2 meters of the inlet for the filament yarns. By heating under tension as above-mentioned, the shaking of filament yarns is prevented as much as possible, and the drying is continued until the surfaces of the filament yarns lose their stickiness. Thereafter, the drying is completed while preventing the mutual contacting of the filament yarns by the use of combs.

If necessary, sized and dried filament yarns are impregnated with finishing oil in a bath 12 and wound up on take-ups 13.

The gist of the present invention will be further understood by comparing FIGS. 2 and 3. That is to say, when the filament yarns are treated with an oiling agent, a sizing agent or a mixture of the two according to the present process, and simultaneously dried and shrunk in the first drier, the filament yarns remain well bundled as shown in FIG. 2. However, the filament yarns subjected to no treatment as in the present invention are remarkably separated into single filaments as shown in FIG. 3, and hence if the filament yarn arranged at narrow intervals as in the present invention are treated, they will be readily contacted with adjacent filament yarns to cause fuzzing or breaking.

EXAMPLE 1

An acrylic polymer comprising 91.5% by weight of acrylonitrile, 8% by weight of methylacrylate and 0.5% by weight of sodium methallyl sulfonate, was dissolved in a nitric acid solvent having a concentration of 70% by weight so as to form a 15% by weight spinning solution. After deaeration, this spinning solution was sent to a spinning apparatus having 100 spinnerets per unit, at a speed such as to form 75 denier filament yarns when the yarns were wound up at a speed of 60 m./min. The spinning solution was extruded from a nozzle of 26 holes having a diameter of 0.08 mm. into an aqueous coagulating bath which contains 30% by weight of nitric acid and was cooled to a temperature of −3° C. Filaments coagulated in a fibrous form are taken from the bath so as to form a yarn with each spinneret and the yarns were spaced 5 mm. apart. These filaments were led to a washing bath where the solvent was completely removed, and delivered to a stretching bath in which steam saturated at atmospheric pressure was used as a heating medium. The filaments were stretched in the stretching bath to 7 times their original length.

The stretched, swollen filaments were impregnated with a treating liquid containing the following components.

Sizing agent: Percent
- Polyvinyl alcohol type "Gosenol GL–50" (trademark of Nihon Gosei Kagaku Kogyo K.K.) — 1
- Polyacrylic acid derivative type "Marposol PP–20" (trademark of Matsumoto Yushi Kogyo K.K.) — 0.5

Oiling agent:
- Non-ionic surfactant of polyoxyethylene alkyl ethers "Actinol R–100" (trademark of Matsumoto Yushi Kogyo K.K.) — 0.5

and the total amount of sizes adhered was 1.5% by weight relative to the filaments. Thusly treated filament yarns were led to the first drier and subjected to drying and shrinking simultaneously at a temperature of 170° C.

Inside the drier there are provided 10 combs spaced 40 cm. apart along the direction of filament movement and crosswise to it. The combs have 100 teeth spaced 5 mm. apart. The filament yarns were separated from one another by the teeth of the combs and were prevented from mutal contact.

The filament yarns thus subjected simultaneously to drying and shrinking treatments, while maintaining a good alignment, were subsequently treated in a sizing bath having the following components.

Sizing agent: Percent
- Polyvinyl alcohol type "Gosenol GL–05" — 3
- Polyacrylic acid derivative type "Marposol PP–20" — 1

Oiling agent:
- Non-ionic surfactant "Tomenolin F" (trademark of Matsumoto Yushi Kogyo K.K.) — 1

and the total amount of sizes adhered was less than 10% by weight relative to the filaments. Then the filament yarns were given in the second drier a longitudinal stretch to an extent less than that of shrinkage produced in the aforementioned shrinking treatment and dried at a temperature of 110° C.

Inside the drier, there are provided a comb placed 2 m. from the inlet of the filament yarns, and 6 combs including the first comb, are spaced, 1 m. apart along the direction of filament movement and crosswise to it. The combs have the same shape as in the first drier. The filament yarns were separated from one another by the teeth of the combs and were prevented from mutual contact. Subsequently, these filament yarns were impregnated with a finishing oil comprising a non-ionic surfactant containing liquid paraffin "TT–021," and wound up on take-ups at a speed of 60 m./min.

Properties of filament yarns variously shrunk and sized in accordance with the present invention are shown in Table 1.

TABLE 1

No	1	2	3	4	5	6
Percent shrinkage [1] in the first drier	0	5	10	15	19	19
Percent stretching [2] in the second drier	0	0	1	3	0	4
Dry tensile:						
Strength (g./d.)	3.9	3.8	3.6	3.6	3.1	3.4
Elongation (percent)	8.0	10.7	15.0	16.8	28.0	21.3
Knot:						
Strength (g./d.)	1.1	1.9	2.1	2.2	3.1	2.5
Elongation (percent)	1.8	6.0	7.0	10.0	22.4	15.0
Residual shrinkage in boiling water (percent)	14	12	11	10	4	6
Amount of sizing agent adhering to the fiber (percent)	3.2	5.2	2.9	7.0	4.1	6.2

[1] [2] Percent shrinkage in the first drier and percent stretching in the second drier are all based upon the swollen fibers which are stretched while being heated.

These filament yarns remained well bundled with no trouble when spun, and were subjected to Slasher sizing without and difficulty. Further, No. 4 as such can be used as a warp, and No. 5 was applied as such to warping and knitting tricot without any problem.

EXAMPLE 2

A spinning solution was fed under pressure by a gear pump at a speed such that 40 denier filaments were obtained when the winding speed was 60 m./min. into a spinneret having 14 orifices, from which the solution was extruded into an aqueous coagulating bath to form filaments. These filaments were spun and stretched under heat in the same way as in Example 1 to obtain swollen filament yarns, to which a sizing agent solution having the same composition as in Example 1 was then applied. The sized filament yarns were shrunk 20% in the first drier and then stretched 2% in the second drier. After all, the filament yarn had 3.5% of the sizing agent based on the weight of the filament yarn. Said filament yarns were used without any trouble in warping and knitting tricot.

EXAMPLE 3

Filaments obtained by coagulating and washing in the same way as in Example 1 so that filament yarns had 75 deniers (the number of filaments per unit is 15) when wound up at a speed of 70 m./min. were stretched 8 times in saturated steam. The thus obtained swollen filaments was contacted with a sizing agent solution containing the following components in a treating bath:

	Percent
Polyvinyl alcohol type size, "Gosenol GH–17" (trademark of Nihon Gosei Kagaku Kogyo K. K.)	1
Acrylic size. "Marposol pp-20"	1
Oiling agent, non-ionic surfactant, "Tomenolin F"	0.5

so that the total amount of the size adhering to the filament was 2% based on the weight of filament. The resulting filaments were shrunk 18% in the same first drier as in Example 1, and then further contacted with a 2% solution of a polyvinyl alcohol type size, "Gosenol GH–17" so that the total amount of the two sizes adhering to the filament was 4%, and then dried in the second drier while being stretched 1%. Well-bundled filament yarns having good properties were obtained.

EXAMPLE 4

A spinning solution extruded under pressure through a spinneret having 60 holes of a diameter of 0.12 mm. so that 300 denier yarns were obtained when one unit consists of 60 spinnerets and the winding speed was 40 m./min. was coagulated in the same way as in Example 1 to form a yarn every spinneret. The resulting filament yarns were washed while maintaining spaces between filament yarns at 10 mm., and then stretched 8 times in hot water.

These stretched swollen filament yarns were contacted with a 40% solution of a polyoxyethylene alkyl ether type non-ionic surfactant, "Actinol R–100" to cause 1% of the oiling agent based on the weight of the filament yarns to adhere to the filament yarns, and then dried in the first drier while shrinking them 5%. The resulting filament yarns were further contacted with a 2% solution of a vinyl acetate maleic acid copolymer, "Tamanori S–400" (trademark of Arakawa Rinsan Kagaku Kogyo K. K.) to cause 1.5% of the size based on the weight of the filament yarn to adhere to the filament yarn, and then dried under no tension.

The thus obtained filament yarns remained well bundled before the subsequent processing, while after being processed into textured yarns, they were made into yarns having a soft handle in which single filaments were separated from the yarns.

EXAMPLE 5

Swollen filaments obtained by effecting the spinning and stretching under heat in the same way as in Example 1 so that 150 denier filament yarns were obtained when wound up at a speed of 70 m./min. were contacted with a melt solution of a solid paraffin, "Sizecoat 50–A" (trademark of Ipposha) having a melting point of 70° C. and containing a non-ionic surfactant to cause 1% thereof based on the weight of the filament yarn to adhere to the filament yarns, and then dried in this state in the first drier while causing them to shrink 20%. The resulting filament yarns were further contacted with a 2% solution of a polyvinyl alcohol type sizing agent, "Gosesize S–100" (trademark of Nihon Gosei Kagaku Kogyo K. K.) to allow 1.5% of the size based on the weight of the filament yarn to adhere to the filament yarns, and thereafter dried while being stretched 2%. "Sizecoat 50–A" was applied to the filament yarns in an amount of 2% based on the weight of the filament yarn.

Yarns obtained by processing the filament yarns according to the False twist method were textured yarns having a kindly handle in which single filaments were separated from the yarns, though the yarns before the processing remained suitably bundled.

We claim:

1. A method of producing well aligned acrylonitrile polymer filament. Polymer yarns, comprising impregnating a hot, stretched and swollen acrylonitrile polymer filament yarn with an oiling agent having a melting point below 100° C., drying the yarn while effecting a 5 to 20 percent length-wise shrinkage thereof, impregnating the thusly shrunken yarn with less than 10 percent by weight of a sizing agent, and drying the yarn while stretching same by 0–10%.

2. A method according to claim 1, wherein the oiling agent contains a non-ionic surfactant.

3. A method according to claim 1, wherein the sizing agent is selected from the group consisting of polyvinyl alcohol, polyacrylic acid salts and a copolymer of vinyl acetate and maleic acid.

4. A method according to claim 2, wherein the non-ionic surfactant is selected from the group consisting of polyoxyethylene alkyl ethers, polyoxyethylene alkyl-phenols, polyoxyethylene alkyl esters and sorbitan alkyl esters.

5. A method of producing well aligned acrylonitrile polymer filament yarns comprising impregnating a hot, stretched and swollen acrylonitrile polymer filament yarn with less than 2 percent by weight of a first sizing agent, drying the yarn while effecting a 5 to 20 percent length-wise shrinkage thereof, impregnating the thusly shrunken filament yarn with less than 10 percent by weight of a second sizing agent and drying the yarn while stretching the same by 0–10 percent.

6. A method according to claim 5, wherein said sizing agents are selected from the group consisting of polyvinyl alcohol, polyacrylic acid salts and a copolymer of vinyl acetate and maleic acid.

7. A method of producing well aligned acrylonitrile polymer filament yarns comprising impregnating a hot, stretched and swollen acrylonitrile polymer filament yarn with a mixture of an oiling agent having a melting point below 100° C., and less than 2 percent by weight of a first sizing agent based on the weight of the filament yarn, drying the yarn while effecting a 5 to 20 percent length-wise shrinkage, impregnating the thusly shrunken filament with less than 10 percent of a second sizing agent based on the weight of the filament yarn and drying the yarn while stretching same by 0–10%.

8. A method according to claim 7, wherein the oiling agent contains a non-ionic surfactant.

9. A method according to claim 7, wherein the sizing agents are selected from the group consisting of polyvinyl alcohol, polyacrylic acid salts and a copolymer of vinyl acetate and maleic acid.

10. A method according to claim 8, wherein the non-ionic surfactant is selected from the group consisting of polyoxyethylene alkyl ethers, polyoxyethylene alkyl-phenols, polyoxyethylene alkyl esters and sorbitan alkyl esters.

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