Jan. 5, 1971 MOTOTADA FUKUHARA ET AL 3,552,114

POTENTIALLY CRIMPABLE COMPOSITE FILAMENT YARN MADE OF THERMOPLASTIC HIGH POLYMERS AND USABLE FOR A CREPE FABRIC

Filed Sept. 4, 1968 2 Sheets-Sheet 1

Fig. 1

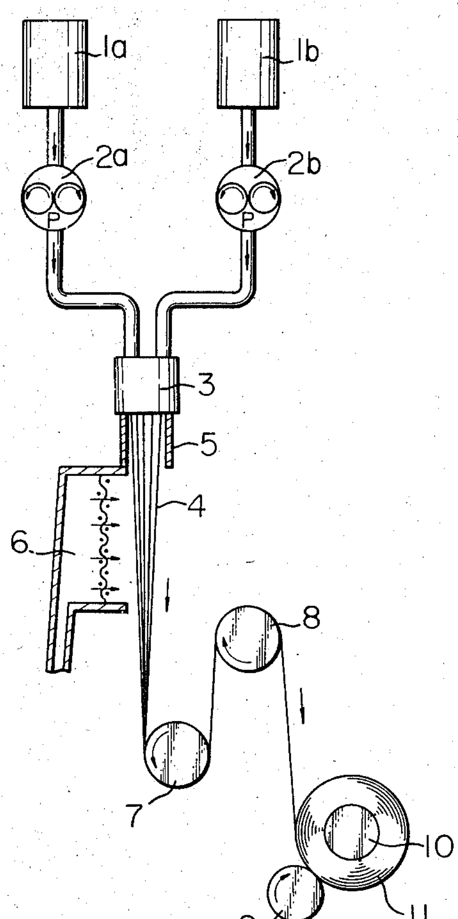
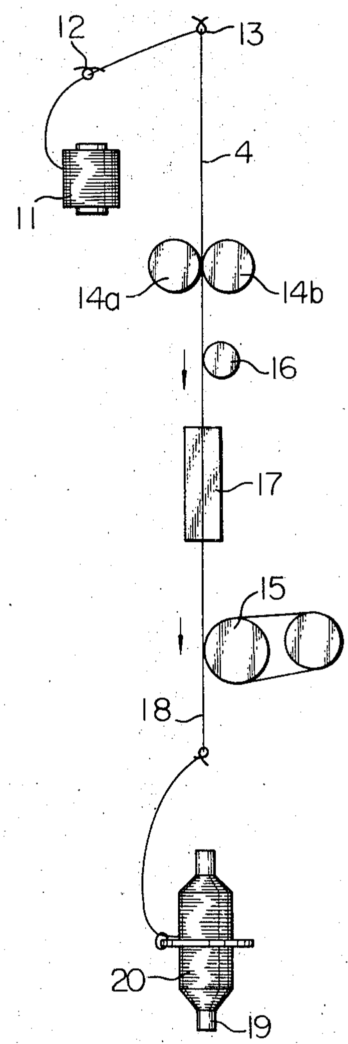


Fig. 2



POTENTIALLY CRIMPABLE COMPOSITE FILAMENT YARN MADE OF THERMOPLASTIC HIGH POLYMERS AND USABLE FOR A CREPE FABRIC

Filed Sept. 4, 1968 2 Sheets-Sheet 2

Fig. 3

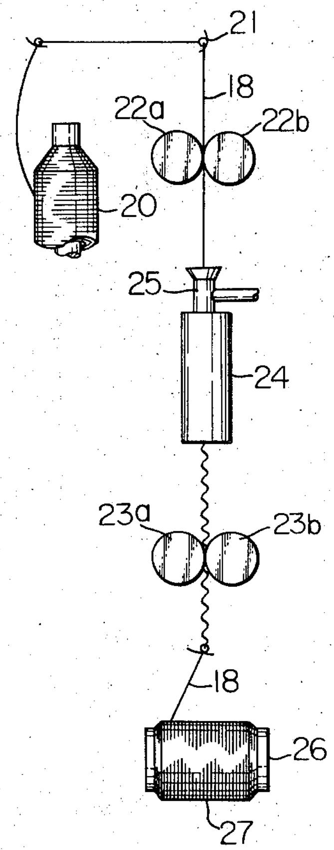
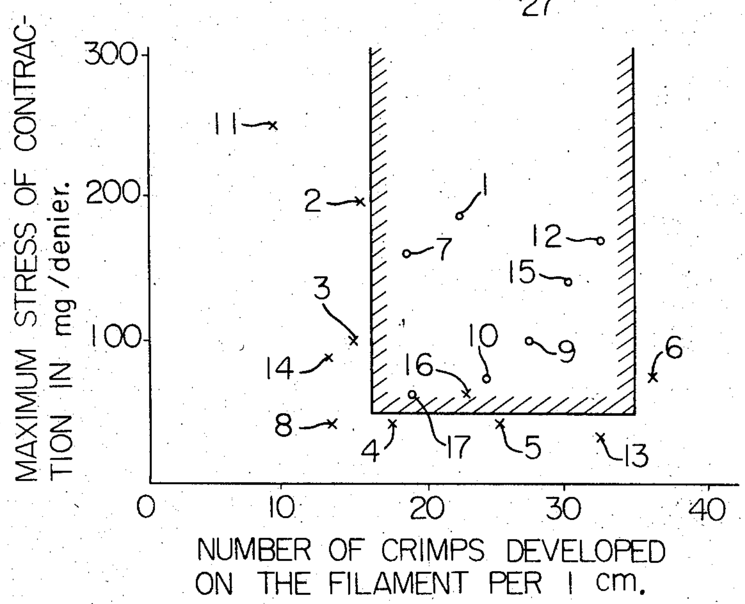


Fig. 4



United States Patent Office 3,552,114
Patented Jan. 5, 1971

3,552,114

POTENTIALLY CRIMPABLE COMPOSITE FILAMENT YARN MADE OF THERMOPLASTIC HIGH POLYMERS AND USABLE FOR A CREPE FABRIC

Mototada Fukuhara, Akira Ueno, Isao Nihei, and Chikara Sano, Mishima-shi, Japan, assignors to Toray Industries, Inc., Tokyo, Japan, a company of Japan

Filed Sept. 4, 1968, Ser. No. 757,363
Claims priority, application Japan, Sept. 6, 1967, 42/56,944
Int. Cl. D02g *3/02*
U.S. Cl. 57—140 5 Claims

ABSTRACT OF THE DISCLOSURE

A self-crimpable composite filament yarn comprising at least single filament composed of two kinds of thermoplastic high polymers having different viscosities and arranged in an eccentric disposition in the cross section of each filament. Material high polymers should be chosen from polyester groups and the difference in viscosities thereof should be larger than 0.05.

A crepe fabric containing the filaments can be provided with remarkably improved pebbles.

The present invention relates to a self crimpable composite filament yarn, more particularly relates to a self crimpable composite filament yarn suitable for developing pebbles on a woven or knitted fabric containing the filaments. In the specification, the term of filament yarn means a monofilament or multifilament yarn.

The conventional method for manufacturing yarns used for crepe fabrics such as crepe wefts or textured yarns generally utilizes the so-called Italian twisting machine method or the false-twisting method. In both cases, the material yarn is processed by a multiple stage operation. For example, in the former case, the yarn is subjected to a process composed of winding up in the form of a pirn, rewinding, twisting, heat-setting of the twists, untwisting, sizing and winding up in the form of a filling cop, while in the latter case, the yarn is subjected to a process composed of winding up in the form of a pirn, false-twisting, sizing and winding up in the form of a filling cop. As is well-known by persons skilled in the art, the above-described complicated manufacturing process and the relatively low processing speed during the twisting operation, wherein usually a high degree of twisting is required, becomes a great barrier to increase in productivity. It is also required, in case of the above-described prior arts, to arrange yarns of different twisting directions alternately in the weaving structure of the fabric in order to develop a preferable pebbling effect on the fabric obtained. Generally, in the structure of a crepe fabric, yarns of S-twists and yarns of Z-twists are picked by ones, twos, threes, etc., and such special arrangement of the filling yarns can be obtained by using a loom provided with two shuttles. Therefore, an excellent pebbling effect on a crepe fabric can hardly be obtained by the ordinary loom provided with a single shuttle. Moreover, the mechanism of developing pebbles on the fabric includes partial elimination of strains temporarily imparted to the yarn configuration by twisting. It is therefore necessary to subject the yarn after twisting to a sizing operation in order to maintain the strained configuration of the yarn during the subsequent weaving operation before development of pebbles in the finishing operation. That is, sizing is an indispensable operation in the conventional manufacturing method of crepe fabrics.

In order to eliminate the drawbacks possessed by the prior arts, the inventors of the present invention have investigated the possibility of manufacturing crepe fabrics provided with excellent pebbling effect by utilizing crimped composite filament yarns. It is widely known by persons skilled in the art that a composite filament composed of two different eccentrically arranged material polymers can be provided wtih crimps when the filament is subjected successively after spinning to a drawing operation at a given drawing ratio and a subsequent relaxation thermal treatment. Thus, it can be concluded that, by utilizing such self crimpable composite filament yarn, manufacture of a crepe fabric having excellent pebbling effect can be carried out on a loom provided with a single shuttle and without employing the sizing operation. However, it was further confirmed by the inventors of the present invention that some special characteristic features are required for such self crimpable composite filament yarn in order to obtain a crepe fabric having excellent pebbling effect.

In case of the present invention, the so-called bimetal-like arrangement of two component polymers in the cross section of the filament is included in the term "eccentric arrangement."

A principal object of the present invention is to provide a self crimpable composite filament yarn which can develop excellent pebbles on a woven or knitted fabric containing the filaments.

Another object of the present invention is to provide a self crimpable composite filament yarn which can be utilized for manufacture of a woven or knitted fabric having excellent pebbling effect by a relatively simple method without employing a sizing operation which is indispensable in the conventional method.

A further object of the present invention is to provide a self crimpable composite filament yarn which can be utilized for manufacture of a woven or knitted fabric having excellent pebbling effect without employing a twisting operation which usually results in low productivity in the conventional manufacturing method.

A still further object of the present invention is to provide a self crimpable composite filament yarn which can be utilized for manufacture of knitted fabric having excellent pebbling effect on an ordinary loom provided with a single shuttle.

As a result of repeated research work by the inventors of the present invention, it was confirmed that, in order to attain the above-described objects of the invention, the self crimpable composite filament yarn of the present invention should be provided with characteristic features such as the composite filament is composed of at least two kinds of thermoplastic high polymers, the filament is provided with from 16 to 35 crimps/cm. after treatment with boiling water, the maximum stress of contraction of the filament is larger than 50 mg./denier, the temperature corresponding to the maximum stress of contraction of the filament is lower than 190° C. and the percent of pebbling contraction of the fabric is larger than 40%.

Further features and advantages of the present invention will be apparent from the ensuing description with reference to the accompanying drawings to which the scope of the invention is in no way limited.

FIG. 1 is a schematic side view of a composite spinning process employed in the manufacture of the composite filament yarn of the present invention,

FIG. 2 is a schematic side view of a drawing process employed in the manufacture of the composite filament yarn of the present invention,

FIG. 3 is a schematic side view of a relaxation thermal treatment process employed in the manufacture of the composite filament yarn of the present invention,

FIG. 4 is a graphical representtion of the result obtained with the illustrated example according to the present invention.

Two important factors can be considered as affecting the pebbling effect on the fabric containing filaments of the present invention. One of the factors is the stress of contraction of the filament and the other is the number of crimps developed on the filament by the thermal treatment. The larger the stress of contraction, the better is the pebbling effect on the fabric obtained, and the stress of contraction should preferably be larger than 50 mg./denier. The larger the number of crimps developed on the filament, the finer are the pebbles of the fabric obtained. Generally, it is necessary for the number of the crimps to be larger than 16 crimps/cm. in order to obtain sufficient pebbling effect on the fabric obtained. However, as the number of crimps increases, the crimps developed on the filament become finer and too fine crimps results in a rather flat appearance of the fabric surface. Therefore, there is an upper limit to the number of crimps developed on the filament in order to obtain a preferable pebbling effect on the fabric. It is therefore clear from the above discussion that the number of crimps should range from 16 to 35 crimps/cm. in order to assure a preferable pebbling effect on the fabric obtained.

In case of a textured yarn used for manufacturing a crepe fabric and made by the conventional false-twisting method, the yarn is passed while contacting a heated plate maintained at a temperature higher than 200° C. for the purpose of heat-setting of the twists previously imparted into the yarn and this often results in a relatively poor effect of the thermal treatment applied to the fabric for the purpose of developing pebbles. However, in case of the self crimpable composite filament yarn of the present invention which does not require a heat-setting treatment, a thermal treatment at a temperature lower than 200° C. is sufficient to develop preferable pebbles on the fabric obtained. Moreover, in case the temperature corresponding to the maximum stress of contraction is chosen lower than 190° C., development of preferable pebbles on the fabric together with sufficient heat-setting of the pebbles developed on the fabric can be completed simultaneously. This is one of the outstanding advantages of the present invention.

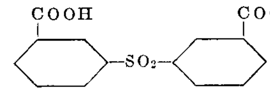
Moreover, elimination of the thermal treatment of the filaments under a relatively severe processing condition, which is generally the case in the conventional false-twisting method, assures uniform dyeing effect of the fabric containing the filaments. Again, crimps developed on the individual filaments due to the intrinsic difference in the shrinkability of the polymers composing the filament but not to strains mechanically imparted to the filament results in uniform development of pebbles on the fabric containing the filaments. This is another outstanding advantage of the present invention.

With respect to material polymers composing the self crimpable composite filament yarn of the present invention, any knid of thermoplastic high polymers can be utilized although it is preferably composed of polymers substantially chosen from polyester groups for obtaining better pebbling effect on the fabric containing the filaments.

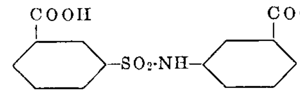
The above-described polyester polymers should preferably be chosen in combination from a group composed of terephthalic acid, lower alkyl derivatives of terephthalic acid, ethylene glycol, bis-2-hydroxyl-ethylterephthalate or its low polymers and polyesters containing at least 70% by weight of polyethylene terephthalate.

The combination of polymers chosen from the above-described polyester group should be determined in such a manner that the difference in the intrinsic viscosities of polymers should be as hereinafter described. For example, a combination of terephthalic acid with ethylene glycol is preferably employed.

The above-described polymers can also contain copolymer components chosen from a group composed of aliphatic di-carboxylic acids such as oxalic acid, adipic acid and azelaic acid; aromatic di-carboxylic acids such as isophthalic acid, phthalic acid, 2,6-naphthalene di-carboxylic acid and diphenic acid; di-carboxylic acid having alicycles such as 1,2-cyclobutane di-carboxylic acid; di-carboxylic acid containing elements other than carbon, hydrogen and oxygen such as compounds having structures shown by the following general formulas,



or



for instance 5 sodiumsulfophthalic acid and 5-methylsulfophthalic acid; multifunctional compounds such as trimellitic acid and piromellitic acid; lower alkyl esters and glycol esters of such multifunctional compounds; polyoxy compounds such as di-ethylene-glycol, propylene glycol, polyethylene glycol, butendiol, tioglycol, p-xylylene glycol, 1,4-cyclohexan-di-methanol, 2,2-bis(p-2-oxyphenyl) propane, 2,2-bis(p-oxyethoxyphenyl) propane, glycerol and pentaerythritol; and p-oxyethoxy benzoic acid, p-oxymethyl benzoic acid and glycollic acid. It is also possible for the polymers to contain such pigments as carbon black, phthalocyamine, titanium pigments and silicic anhydride, and phospho-compounds such as phosphoric acid, phosphorous acid, tri-phenyl-phosphate, tri-methyl-phosphate and tri-phenyl-phosphate. Furthermore, in case the viscosity of the molten polyester solution is remarkably low, it is also recommended that additives such as boric compounds or aluminate compounds be mixed. With respect to the difference in the intrinsic viscosities of the material polyester polymers composing the filament of the present invention, better results can be obtained when the difference in the intrinsic viscosities is larger than 0.05. Moreover, it is preferably required that the intrinsic viscosity of the component polyester polymer of higher viscosity is in a range from 0.60 to 0.85 while that of the component polyester polymer of lower viscosity is in a range from 0.45 to 0.55.

The characteristic features of the crimped composite filament yarn of the present invention were measured in the following manner.

(1) Intrinsic viscosity of the material polymer.—Limiting viscosity of the material polymer with respect to o-chlorophenol solution was measured at 25° C.

(2) Number of crimps developed on the filament.—A crimped filament having an effective length of 20 cm. was loaded 1 mg./denier. In this condition, the number of the crimps in 10 cm. length of the sample was counted and converted into the number per 1 cm. length of the sample.

(3) Stress of shrinkage of the filament.—A crimped filament having an effective length of 25 cm. was loaded 1/30 g./denier and, in this loaded condition, the sample was immersed in a silicone oil bath maintained at 50° C. Stress produced in the filament was measured with a strain meter while increasing the temperature of the bath up to 230° C. at a rate of 5 deg./min.

(4) Percent thermal shrinkage of the undrawn filament.—A bundle composed of 20 undrawn filaments were loaded 200 mg./denier and the length (L_1) of the bundle in this loaded condition was recorded. Next the bundle were immersed in a boiling water bath for 15 minutes under a load of 1.2 mg./denier. After thermal treatment, the length (L_2) of the bundle was again recorded. Then the percent thermal shrinkage of the undrawn filament was obtained by the following,

$$\left(1-\frac{L_2}{L_1}\right)\times 100$$

(5) Percent pebbling contraction of the fabric.—Filament yarns composed of a plurality of conventional filaments of 2 denier and twisted at a twisting rate of 100

turns/meter, were used as the warps and filament yarns of the present invention were used as the fillings. Both component yarns were provided with substantially similar total fineness. A plain woven fabric having a warp density of 100 ends/inch and a filling density of 80 picks/inch was manufactured with the yarns. First, the width in grey (D_1) of the fabric was measured. Next, the fabric was immersed in a boiling water bath in a free condition for 20 minutes for the purpose of developing pebbles. After pebbles have developed sufficiently, the fabric was dried in a free condition and the width after finishing (D_2) of the fabric was measured. Then, the percent pebbling contraction of the fabric was obtained by the following,

$$\frac{D_1-D_2}{D_1}\times 100$$

The method for manufacturing a self crimpable filament yarn of the invention will now be described.

As the material polymers composing the filament, two kinds of polyester polymers having different intrinsic viscosities are used. One of the polyester polymers is provided with an intrinsic viscosity ranging from 0.45 to 0.55 while the other polyester polymer is provided with an intrinsic viscosity ranging from 0.60 to 0.85. Both polymers are fed to a composite spinning process held at a spinning temperature between 295 and 305° C. In this spinning, it is not desirable to subject the spun filaments to a sudden coagulation which is generally employed in the conventional spinning process of synthetic filaments. About 120 to 150 mm. downstream of a spinneret, there should be formed a calm windless zone, and the temperature measured at a position 30 mm. under the spinneret and 10 mm. horizontally away from the periphery of the spun filaments stream should be maintained at about 180° C. After passing through the calm windless zone, the filaments are coagulated with a coagulating air flow maintained between 15 and 20° C. and taken up onto a package without the drawing operation at taking-up speed of about 900 meters/min. By the above-described spinning-windless zone passing - coagulation - taking - up process, the undrawn composite filament obtained is provided with a percent thermal shrinkage in a range between 16 and 24%. Next, the undrawn filaments are subjected to a drawing operation at a drawing ratio from 3.6 to 4.0 while passing through a drawing zone comprising a heated pin maintained at about 100° C. and a heated plate maintained from 130 to 180° C. After this drawing operation, the drawn filaments are next subjected to a relaxation thermal treatment while passing through a heated cylinder maintained between 80 and 160° C. and while being held at a relaxation ratio from 5 to 25%. The self crimpable composite filament yarn of the present invention can be obtained not by a random combination of the conditions but only a certain preferably designed combination of the conditions among the above-described processing conditions as will be made apparent in the examples hereinafter described.

Referring to FIG. 1, an embodiment of the composite spinning process employed in the manufacture of the composite filament yarn of the present invention is schematically shown. In the process shown in the drawing, chips of the material polymers are melted in the respective melter **1***a* and **1***b*. After being melted independently, the molten polymers are fed to a composite spinneret **3** by way of the respective gear pumps **2***a* and **2***b* and are extruded through the spinneret **3** in the form of a plurality of composite filaments **4** composed of the two different kinds of material polymers arranged in an eccentric disposition in the cross section of the individual filament **4**. The outlet side of the spinneret **3** is provided with a cylindrical shelter **5** having a length from 120 to 150 mm. to form the above-described calm, windless zone. The strand of filaments **4** coming out of the cylindrical shelter **5** is exposed to a coagulating air ejected from a cooling chimney **6** disposed directly downstream of the cylindrical shelter **5**. After coagulation, the filaments **4** are taken up onto a bobbin **10** driven by a take-up roller **9** in the form of a package **11** while the processing tension is being adjusted by a pair of godet rollers **7** and **8** disposed in the passage of the filaments **4**.

Next, the filaments **4** in the form of the package **11** is supplied to the drawing process shown in FIG. 2, wherein, the undrawn filament yarn **4** is drawn out from the package **11** by a pair of feed rollers **14***a* and **14***b* by way of yarn guides **12** and **13**. A drawing roller **15** is positioned downstream of the feed rollers **14***a*, **14***b* and the undrawn filament yarn **4** is drawn within a zone between the feed rollers **14***a*, **14***b* and the drawing rollers **15** by the difference in surface speeds of both rollers. During this drawing operation, the filament yarn **4** passes through the zone while contacting a heated pin **16** and a heated plate **17**, both of which are positioned within the zone. After this drawing operation, the drawn filament yarn **18** is taken up onto a bobbin **19** in the form of a cop **20** by any of the known method.

Referring to FIG. 3, an embodiment of the thermal relaxation treatment process preferably employed in the manufacture of the composite filament yarn of the present invention is schematically shown. In the drawing, the drawn filament yarn **18** is drawn out from the cop **20** by a pair of feed rollers **22***a* and **22***b* by way of a yarn guide **21**. A pair of relaxing rollers **23***a* and **23***b* are also positioned downstream of the feed rollers **22***a*, **22***b* and a heated cylinder **24** is disposed within a zone between the pair of rollers. After passing through the feed rollers **22***a*, **22***b*, the drawn filament yarn **18** is sucked into the heated cylinder **24** by an air ejector **25** disposed to the inlet end of the heated cylinder **24** and is subjected to a thermal relaxation treatment while passing therethrough. After the treatment, the filament yarn **18** provided with numerous curled crimps is taken up onto a bobbin **26** in the form of a package **27** in any of the known manners.

The following examples are illustrative of the present invention but are not to be construed as limiting the same.

EXAMPLE 1

Two kinds of poylethyleneterephthalate chips having intrinsic viscosities measured in orthochlorophenol of 0.80 and 0.45 were used as material polymers. The material polymer chips were fed to the process shown in FIG. 1, wherein molten polymers were composite spun at a spinning temperature of 300° C. in the form of composite filaments having a bimetal-like cross sectional profile. After coagulation, the filaments were taken up onto a package in the form of a multifilament yarn of 50 denier containing 24 filaments. In the above-described spinning process, the length of the cylindrical shelter was 130 mm., the temperature at a position 30 mm. Under the spinneret and 10 mm. horizontally away from the periphery of the filaments strand was maintained at 180° C., the temperature of the coagulating air ejected from the cooling chimney was maintained at 18° C. and the thermal shrinkage of the undrawn filament thus obtained was 16.2%.

Next, the undrawn filament yarn thus obtained was fed to the process shown in FIG. 2 and was drawn at a drawing ratio of 3.8. In the process, the heated pin was maintained at 100° C. and the heated plate was maintained at 160° C. After the drawing operation, the drawn filament yarn was fed to the process shown in FIG. 3 and subjected to a relaxation thermal treatment at a relaxation ratio of 15% and a processing temperature of 140° C. The characteristic features of the composite filament yarn thus obtained are shown by sample No. 1 in Table 2; tenacity of the yarn was 3.7 g./denier, breaking elongation was 18.3%, number of crimps developed on the filament was 22.0 crimps/cm. after treatment in boiling water, the maximum stress of shrinkage was 190 mg./denier and the temperature corresponding to this stress was 148° C.

Further, a crepe fabric was manufactured using the composite filament yarn thus obtained. The crepe fabric thus obtained was provided with a pebbling contraction of 50% and had sufficiently developed pebbles of the preferable appearance.

EXAMPLE 2

In a manner similar to that employed in Example 1, various types of composite filament yarn and crepe fabrics were manufactured. Processing conditions were substantially similar to those employed in Example 1 with the exception of those illustrated in Table 1.

TABLE 1.—PROCESSING CONDITIONS

Intrinsic viscosities of the material polymers:	
High	0.60–0.85.
Low	0.45–0.66.
Fineness of individual filaments in denier	2–4.
Total fineness of the multifilament yarn obtained in denier	50.
Thermal shrinkage of the undrawn filaments in percent	0–30.
Drawing ration in percent	3.3–4.3.
Temperature of the heated pin in ° C	100.
Temperature of the heated plate in ° C	0 below 190° or without heat.
Processing temperature during relaxation thermal treatment in ° C.	Room temperature, 230.
Relaxation ratio in percent	5–40.

By various combinations of the processing conditions listed in Table 1, 16 sample yarns were prepared and the properties of the resulting sample yarns are illustrated by samples Nos. 2 to 17 in Table 2. Further, crepe fabrics are manufactured using the respective sample yarns. The functional properties of the sample fabrics are also illustrated in Table 2.

TABLE 2

Sample No.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Properties of the yarn:																	
Tenacity in g./denier	3.7	3.8	3.8	3.5	3.5	3.7	3.7	3.4	3.7	3.6	4.2	3.8	3.5	3.2	3.4	3.2	3.3
Breaking elongation in percent	18.3	21.8	24.0	26.5	22.0	17.6	20.6	27.5	17.7	21.5	21.5	17.8	24.0	4.5	23.5	24.0	22.7
Number of crimps per/cm	22.0	15.5	14.7	17.2	25.3	36.0	18.7	13.2	27.2	24.3	9.0	32.3	3.2	13.0	30.0	22.8	19.0
Stress of contraction in mg./denier	190	200	100	42	48	70	160	40	100	70	250	170	30	90	120	62	58
Temp. corresponding to the stress in ° C	148	148	147	120	200	150	152	215	150	180	150	142	190	175	158	200	188
Properties of the fabric:																	
Pebbling contraction in percent	50	68	35	15	18	30	55	16	4.5	42	40	60	10	20	48	38	42
Development of pebbles	O	O	△	X	X	△	O	X	△	△	X	O	X	X	O	△	△
Appearance of pebbles	O	X	X	----	----	O	△	----	O	O	----	O	X	----	O	----	O
Height of pebbles	O	O	△	X	X	△	O	X	△	△	O	O	X	X	O	X	△
Handling	O	△	△	X	△	X	O	X	O	O	X	O	X	X	O	X	O
Total appreciation	O	X	X	X	X	X	O	X	O	O	X	O	X	X	O	X	O

NOTE: In the table, the symbol "O" indicates "excellent"; the symbol "△" indicates "not sufficient"; and the symbol "X" indicates "poor."

The results obtained are graphically shown in FIG. 4, wherein the stress of shrinkage is taken on the ordinate while the number of crimps is taken on the abscissa. In the drawing, the numerals attached to the plots corresponds to the numbers of samples listed in the table and the results obtained according to the present invention should fall within the area of the oblique shadings. In the results obtained, the filament yarn of sample No. 16 is regarded as satisfying the object of the invention as it is within the area. However, the filament yarn of sample No. 16 is actually not suitable for the purpose of the invention because the temperature corresponding to the maximum stress of shrinkage is higher than 200° C., which causes deterioration of the functional properties of the crepe fabric obtained. In case the characteristic features of the yarn falls outside the area shown in FIG. 4, it is impossible to manufacture crepe fabrics provided with excellent pebbling effect and excellent handling from such material yarns.

While the invention has been described in conjunction with certain embodiments thereof, it is to be understood that various modifications and changes may be made without departing from the spirit and scope of the invention.

What is claimed is:

1. A composite filament yarn comprising: at least one filament composed of two different high polymer thermoplastic materials eccentrically positioned with repect to each other in cross-section of said filament; said filament having from 16 to 35 crimps per centimeter of axial length and a maximum shrinkage stress greater than 50 mg./denier at temperatures less than 190° C.

2. A composite filament yarn according to claim **1**; wherein said two different high polymer thermoplastic materials comprise polyester materials.

3. A composite filament yarn according to claim **1**; wherein each of said high polymer thermoplastic materials has an intrinsic viscosity when in a molten state, and wherein the difference in intrinsic viscosities of said two different high polymer thermoplastic materials is greater than 0.05.

4. A composite filament yarn according to claim **2**; wherein one of said polyester materials has an intrinsic viscosity in the molten state within a range of from 0.60 to 0.85 and the other of said polyester materials has an intrinsic viscosity in the molten state within a range of from 0.45 to 0.55.

5. A self-crimpable composite filament yarn for use in manufacturing a crepe yarn comprising: at least one filament composed of two kinds of high polymer thermoplastic material eccentrically disposed with respect to each other in cross-section of said filament; said filament having a potentially crimpable property of developing 16 to 35 crimps per centimeter of axial length; and wherein said filament has a maximum shrinkage stress greater than 50 mg./denier at temperatures less than 190° C.

References Cited

UNITED STATES PATENTS

3,117,362	1/1964	Breen	57—140
3,137,989	6/1964	Fior et al.	57—140
3,181,224	5/1965	Tanner	57—140X
3,199,281	8/1965	Maerov et al.	57—140
3,350,871	11/1967	Pierce et al.	57—140
3,365,873	1/1968	Matsumoto et al.	57—157
3,404,710	10/1968	Pierce	57—140X
3,444,681	5/1969	Reese	57—140
3,446,005	5/1969	Kosaka et al.	57—140X

STANLEY N. GILREATH, Primary Examiner

W. H. SCHROEDER, Assistant Examiner

U.S. Cl. X.R.

57—157; 264—168