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⑤④ **Thermoplastic synthetic filaments and process for producing the same.**

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It is known that in order to produce thermoplastic synthetic filament having a desired gloss and frictional property, an inert inorganic substance, for example, titanium dioxide or china clay, in the form of fine solid particles is dispersed in a thermoplastic synthetic matrix polymer. That is, the inorganic particles are effective for modifying the optical and frictional properties of the filaments. The dispersed inorganic particles result in formation of numerous protuberances on the peripheral surface of the resultant individual filament. The number of the protuberances depends on the amount of the inorganic particles dispersed in the matrix polymer. These numerous protuberances create various problems on the filaments. For example, when a mixture of the thermoplastic matrix polymer with dispersed inorganic particles is subjected to a melt-spinning process, the dispersed inorganic particles cause the melt-spun filamentary streams of the melted mixture to be frequently broken. Also, when the resultant filaments are subjected to a weaving or knitting process, the protuberances on the peripheral surfaces of the filaments serve to accelerate the wear of the roads in the weaving machine or the needles in the knitting machine.

$$\alpha \leq 0.02T - 1.5D - 1.05 \quad (3')$$

$$0.80R_0 \leq D \leq R_0 \quad (4)$$

Moreover, the thermoplastic synthetic filaments of the present invention are capable of being
30 converted into filaments having an excellent water-absorbing property by treating them with an aqueous
alkali solution in order to remove said protuberances and to cause formation of numerous corresponding
concaves formed on the peripheral surface of each filament, each concave being composed of a
hemisphere, hemispheroid or hemiellipsoid-shaped center portion and a pair of hemicone or hemielliptic
cone-shaped wing portions thereof each extending from the center portion along the longitudinal axis of
35 the individual filament in opposite direction to the other.

Fig. 1 is a scanning electron microscopic photograph (magnification: 3000) showing a peripheral surface of a filament of the present invention having numerous hemispheroidal or hemiellipsoidal protuberances;

Fig. 3 is a scanning electron microscopic photograph (magnification: 3000) showing a peripheral surface of a filament modified from the filament of the present invention as shown in Fig. 1 and having numerous specific concaves, and;

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The individual thermoplastic filament of the present invention comprises 85 to 99% by weight, preferably, 91 to 97% by weight, of a thermoplastic fiber-forming matrix polymer and 1 to 15% by weight, preferably, 3 to 9% by weight, of a dispersed polymer which is different from and incompatible with the matrix polymer. The dispersed polymer is dispersed in the form of numerous fine spheres, spheroids or ellipsoids, extending along the longitudinal axis of the individual filament, in the matrix polymer. In this type of filament, it is characteristic that a portion of the dispersed polymer located in the peripheral surface of the filament, forms numerous fine protuberances with a number of at least 5 per 10 μm^2 , on the peripheral surface of the filament. The matrix polymer usable for the present invention is not limited to a special group of thermoplastic polymer, as long as the polymer is capable of being shaped into a filament or fiber and the resultant filament or fiber exhibits satisfactory mechanical properties, for example, elasticity, rigidity, and elongation. The matrix polymer may be selected from the group consisting of fiber-forming polyesters, polyamides, polyolefins and polystyrene. The important matrix polymer for the present invention is polyester. The matrix polyester may be a polycondensation product of at least one dicarboxylic compound, for example, terephthalic acid or its reactive derivative, with at least one alkylene

of fibers from corresponding starting materials and about dissolving one of the components by means of a suitable dissolving agent.

Proceeding on the basis of the various aspects of the prior art discussed above, it is the object of the present invention to provide thermoplastic synthetic filaments having a satisfactory tensile strength, ultimate elongation, breaking modulus and snap-back value without being subject to fibrillation.

This object according to the invention is accomplished by the thermoplastic synthetic filaments of the type indicated above and being characterized in that said dispersed polymer consists of at least one polysulfone polymer, and numerous fine protuberances consisting of said dispersed polysulfone polymer are formed in the number of at least 5 per $10\text{ }\mu\text{m}^2$ on the peripheral surface of each individual filament.

Furthermore, it is the object of the present invention to provide a process for producing such thermoplastic synthetic filaments. This object is accomplished by the process according to patent claim 11.

It is a specific advantage of the filaments according to this invention that they are capable of being converted into a false twisted filament yarn having a hand similar to that of conventional strongly twisted filament yarns and an excellent draping property.

According to this aspect of the invention the inventive thermoplastic synthetic filaments in which the matrix polymer is a polyester and which are in the form of a filament yarn and in a partially oriented state, can be converted into a drawn-false twisted filament yarn by draw-false twisting the filament yarn under the conditions satisfying the relationship (3):

$$\alpha \leq 0.02T - 1.5D - 1.05 \quad (3)$$

wherein α represents a twisting coefficient in the range of from 0.4 to 0.9, T represents a false-twisting temperature in a range of from 150 to 200°C and D represents a draw ratio satisfying the relationship (4):

$$0.80R_0 \leq D \leq R_0 \quad (4)$$

wherein R_0 represents a draw ratio which causes the resultant drawn filaments to exhibit an ultimate elongation of 30%, to produce a drawn-false-twisted filament yarn.

Moreover, the thermoplastic synthetic filaments of the present invention are capable of being converted into filaments having an excellent water-absorbing property by treating them with an aqueous alkali solution in order to remove said protuberances and to cause formation of numerous corresponding concaves formed on the peripheral surface of each filament, each concave being composed of a hemisphere, hemispheroid or hemiellipsoid-shaped center portion and a pair of hemicone or hemielliptic cone-shaped wing portions thereof each extending from the center portion along the longitudinal axis of the individual filament in opposite direction to the other.

Brief description of the drawings

Fig. 1 is a scanning electron microscopic photograph (magnification: 3000) showing a peripheral surface of a filament of the present invention having numerous hemispheroidal or hemiellipsoidal protuberances;

Fig. 2 is a scanning electron microscopic photograph (magnification: 3000) showing a peripheral surface of a conventional filament containing 1% by weight of titanium dioxide particles and having numerous projections;

Fig. 3 is a scanning electron microscopic photograph (magnification: 3000) showing a peripheral surface of a filament modified from the filament of the present invention as shown in Fig. 1 and having numerous specific concaves, and;

Fig. 4 is a scanning electron microscopic photograph (magnification: 3000) showing a peripheral surface of a comparative filament modified from the conventional filament as indicated in Fig. 2 and having irregularly shaped concaves.

Detailed description of the invention

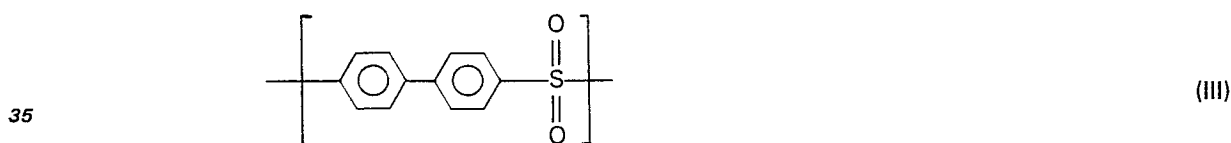
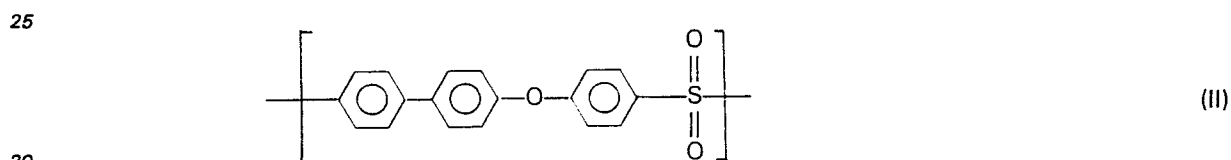
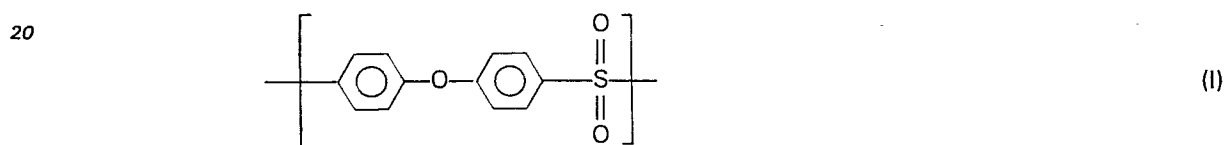
The individual thermoplastic filament of the present invention comprises 85 to 99% by weight, preferably, 91 to 97% by weight, of a thermoplastic fiber-forming matrix polymer and 1 to 15% by weight, preferably, 3 to 9% by weight, of a dispersed polymer which is different from and incompatible with the matrix polymer. The dispersed polymer is dispersed in the form of numerous fine spheres, spheroids or ellipsoids, extending along the longitudinal axis of the individual filament, in the matrix polymer. In this type of filament, it is characteristic that a portion of the dispersed polymer located in the peripheral surface of the filament, forms numerous fine protuberances with a number of at least 5 per $10\text{ }\mu\text{m}^2$, on the peripheral surface of the filament. The matrix polymer usable for the present invention is not limited to a special group of thermoplastic polymer, as long as the polymer is capable of being shaped into a filament or fiber and the resultant filament or fiber exhibits satisfactory mechanical properties, for example, elasticity, rigidity, and elongation. The matrix polymer may be selected from the group consisting of fiber-forming polyesters, polyamides, polyolefins and polystyrene. The important matrix polymer for the present invention is polyester. The matrix polyester may be a polycondensation product of at least one dicarboxylic compound, for example, terephthalic acid or its reactive derivative, with at least one alkylene

glycol component, for example, ethylene glycol, propylene glycol, butylene glycol. Preferably, the matrix polyester is polyethylene terephthalate, polybutylene terephthalate or a copolyester containing 75 molar% or more, more preferably, 85 molar% or more, of the recurring alkylene terephthalate units derived from the esterification reaction of an alkylene glycol with terephthalic acid or its functional derivative. Also, it is preferable that the matrix polyester has a limited (intrinsic) viscosity of 0.4 or more measured in o-chlorophenol at a temperature of 35°C.

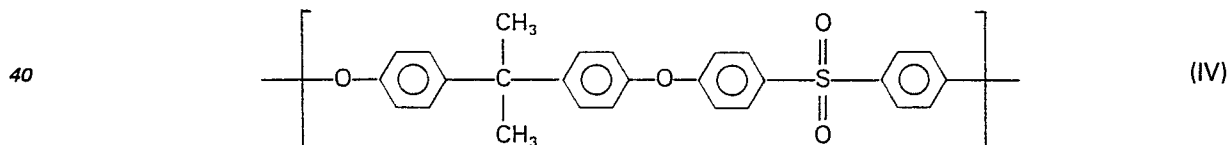
The matrix polymer may contain, as additives, a catalyst residue, ether-generation-preventing agent, stabilizer, flame retardant, anti-static agent, hydrophilicity-enhancing agent, coloring material, optical brightening agent, and/or delustering agent.

The dispersed polymer usable for the present invention consists of at least one polysulfone polymer which is different from, non-reactive to and incompatible with the matrix polymer. It is preferable that the dispersed polymer is non-crystalline and has a glass transition temperature of at least 150°C. The glass transition temperature of the dispersed polymer can be determined by the method described in U.S. Patent No. 2,556,295. The non-crystallinity of the dispersed polymer can be determined by the X-ray wide angle diffractometry. When no diffraction point or line is found in the diffraction X-ray photograph of the dispersed polymer, it is deemed that the dispersed polymer is non-crystalline.

The dispersed polymer may be selected from polysulfons having the recurring units of the formulae (I) through (IV):



and



The preferable polysulfone is one of the formula (IV) having a degree of polymerization of 60 to 120.

The dispersed polymer is used in an amount of from 1 to 15% by weight, preferably, from 3 to 9% by weight. When the amount of the dispersed polymer is less than 1% by weight, the number of the resultant protuberances is less than 5 per 10 μm^2 of the peripheral surface of the resultant filament, and, therefore, the surface appearance and the frictional property of the resultant filament are unsatisfactory. Also, more than 15% by weight of the dispersed polymer causes the resultant filament to exhibit a poor mechanical strength and, therefore, to be practically useless.

When a mixture of the matrix polymer and the dispersed polymer is melt-spun into filaments, at an elevated temperature higher than the melting point of the matrix polymer, the resultant filaments are provided with numerous fine protuberances formed on the peripheral surface of each individual filament. The density of the protuberances is at least 5 per 10 μm^2 of the peripheral surface of the individual filament. In this density, the protuberances are effective for delustering the surface of the resultant filament and for decreasing the dynamic friction of the filament peripheral surfaces with each other and with metal surfaces. Therefore, the filament exhibits a satisfactory delustered surface appearance and a satisfactory frictional property and hand. The decreased dynamic frictional property of the filament is effective in increasing the draping property of the fabric made from the filament. Preferably, the protuberances are each in the form of a hemispheroid or hemiellipsoid extending along the longitudinal axis of the individual filament. Also it is preferable that the area of the bottoms of the protuberances is 0.5 μm^2 or more.

The filaments of the present invention may have a circular cross-sectional profile or an irregular cross-sectional profile, for example, trilobal or another multilobal cross-sectional profile. The irregular cross-sectional profile is effective for imparting a silk-like gloss and hand to the filament.

The dispersed polymer particles dispersed in the matrix polymer in the filaments are effective for

enhancing the dyeing property of the filaments, because numerous small voids are formed in the interface between the matrix polymer phase and the dispersed polymer phase. Also, since there is a small difference in the thermal shrinkage between the matrix polymer phase and the dispersed polymer phase, the woven or knitted fabric made from the filaments of the present invention can have a preferable bulkiness and hand.

Fig. 1 shows an electron microscopic view of a peripheral surface of the filaments of the present invention in a magnification of 3000. Also, Fig. 2 shows an electron microscopic view of a peripheral surface of a conventional filament containing 1% by weight of titanium dioxide. The peripheral surface of the filament as indicated in Fig. 2 is provided with extremely small projections having irregular shapes. The extremely small projections do not cause the resultant filament to exhibit the properly delustered surface appearance and a proper frictional property like those of the present invention.

In the preparation of the thermoplastic synthetic filaments of the present invention, a mixture of 85 to 99% by weight of a thermoplastic matrix polymer with 1 to 15% by weight of a dispersed polymer which consists of at least one polysulfone polymer and which is incompatible with the matrix polymer, is prepared. This mixture may be prepared in such a manner that the dispersed polymer is admixed to a polymerization mixture containing monomers for producing the matrix polymer and, then, the admixed polymerization mixture is subjected to a polymerization of the monomers. The resultant polymerization mixture contains the resultant matrix polymer and the dispersed polymer which is non-reactive with the matrix polymer. Otherwise, the mixture may be prepared by mixing the matrix polymer with the dispersed polymer.

The mixture is subjected to a spinning process which may be a melt spinning process, dry spinning process or wet spinning process. When the matrix polymer is a polyester, the mixture containing the polyester is subjected to a melt-spinning process.

When the filaments of the present invention are subjected to a draft zone system spinning process or a fabric made from the filaments is subjected to a raising process, it is preferable that the filaments exhibit a snap back value of 4% or less. The term "snap back value" used herein is defined by the equation (1):

$$SB = (eb - esb) - eb \times rb / 100 \quad (1)$$

wherein SB represents a snap back value in % of the filaments, eb represents a breaking elongation in % of the filaments, rb represents a tensile recovery of % of the filaments at its break and esb represents an elongation of the filaments determined from the difference between the length of the filament at its break and the original length of the filament. When the snap back value is more than 4%, the filaments sometimes exhibit a poor stretch-breaking property in the draft zone system spinning process and the fabric made from the filaments sometimes exhibits an unsatisfactory raising property in the raising process. That is, sometimes, the resultant spun yarn is uneven and the resultant raised fabric exhibits as uneven surface appearance.

Also, it is preferable that the filaments of the present invention exhibit a breaking modulus of 3.64 g/dtex (4 g/den) or less. The term "breaking modulus" used herein is defined by the equation (2):

$$Nb = \frac{sb \times (100 + eb)}{D_0} \quad (2)$$

wherein Mb represents a breaking modulus in g/dtex (g/den) of a filament, sb represents a gradient in g/% of a tangential line drawn through a breaking point of the filament on the stress-strain curve of the filament, eb represents a breaking elongation in % of the filament and D_0 represents a titer in (dtex/den) of the filament.

The filaments having a breaking modulus of 3.64 g/dtex (4 g/den) or less can exhibit a proper stretch-breaking property and raising property.

The filaments of the present invention, in which the matrix polymer is preferably a polyester, may be treated with an alkali aqueous solution. The alkali treatment results in formation of numerous concaves on the peripheral surface of the individual filament. Each concave is composed of a center portion thereof, which is in the form of a hemisphere, hemispheroid or hemiellipsoid, and a pair of wing portions thereof, each of which is in the form of a hemicone or hemielliptic cone and extends from the center portion in opposite direction to the other along the longitudinal axis of the individual filament. The bottom of each wing portion is connected to the center portion. The center portion of the concave is derived from the removal of the protuberance by the alkali treatment. Also, the wing portion of the concave is derived from the removal of a portion of the matrix polymer located just adjacent to the protuberance.

The alkali may be selected from the group consisting of sodium hydroxide, potassium hydroxide, tetramethylammonium hydroxide, sodium carbonate and potassium carbonate. The most preferable alkali is sodium hydroxide or potassium hydroxide.

The concentration of the alkali in its aqueous solution is variable depending on the type of alkali and treating conditions. However, it is preferable that the concentration of the alkali is usually in the range of from 0.1 to 40% by weight, more preferably, from 0.1 to 30% by weight. The alkali treatment is preferably

carried out at a temperature of from room temperature to 100°C, for one minute to 4 hours. Also, it is preferable that the alkali treatment causes a reduction in the weight of the filaments to an extent of at least 10% of the original weight of the filaments. By this alkali treatment, the protuberances on the peripheral surface of the individual filament are removed so as to form the concaves in the form of hemispheroid or

5 hemiellipsoid.

In the alkali-treated individual filament, it is preferable that each concave has an opening area of at least 5 μm^2 . Also, it is preferable that the number of the concaves is at least one per 300 μm^2 of the peripheral surface of the individual filament.

Fig. 3 shows an electron microscopic view of a peripheral surface of an alkali-treated individual filament which has been prepared from the individual filament of the present invention as indicated in Fig. 1. Referring to Fig. 3, each concave formed on the peripheral surface of the filament is composed of a hemisphere, hemispheroid or hemiellipsoid-shaped, caved center portion and a pair of hemicone or hemielliptic cone-shaped, caved wing portions, extending from the center portion in opposite directions to each other along the longitudinal axis of the filament. This configuration of the concave is very specific and

15 was obtained only by alkali treating the filament of the present invention.

Also, it is important that the alkali treatment applied to the filaments of the present invention does not cause the resistance of the resultant filament to fibrillation to be reduced. That is, the alkali treated filaments exhibit a satisfactory resistance to abrasion.

When the conventional filament as shown in Fig. 2 is treated with the alkali aqueous solution, the treated filament is provided with numerous concaves as shown in Fig. 4. The concaves as shown in Fig. 4 are significantly smaller than and different in configuration from the specific concaves as shown in Fig. 3. That is, the configuration of the concaves shown in Fig. 4 is irregular.

The filaments of the present invention can be converted into a false-twisted filament yarn having an appearance and touch similar to those of conventional hard twist filament yarn. That is, the filaments, which are polyester filaments in a partially oriented state and in the form of a filament yarn, are draw-false twisted under the conditions satisfying the relationship (3):

$$\alpha \leq 0.02T - 1.5D - 1.05 \quad (3)$$

30 wherein α represents a twist multiplier to be applied to the filament yarn in the range of from 0.4 to 0.9, T represents a false twisting temperature to be applied to the filament yarn in the range of from 150 to 200°C and D represents a draw ratio to be applied to the filament yarn satisfying the relationship (4):

$$0.80R_0 \leq D \leq R_0$$

35 wherein R_0 represents a draw ratio which causes the resultant drawn filament yarn to exhibit an ultimate elongation of 30%.

The twist multiplier (α) of the filament yarn can be calculated in accordance with the equation (5):

$$40 \quad TN = \left(\alpha \frac{32500}{\sqrt{De}} \right) = \alpha \frac{30982}{\sqrt{De}} \quad (5)$$

wherein TN represents the number of twists applied to the filament yarn and De and De' represent a titer in dtex(den) of the resultant drawn, false-twisted filament yarn.

The filament yarn to be subjected to the above mentioned draw-false twisting procedure is a partially oriented filament yarn preferably having an ultimate elongation of from 70 to 200%. The partially oriented filament yarn can be produced by a conventional high speed spinning process. The spinning speed adequate to produce the partially oriented filament yarn is variable depending on the intrinsic viscosity of the matrix polymer, the type and concentration of the dispersed polymer and the titer of the resultant individual filament. Usually, the spinning process is performed at a high speed of 2000 to 5500 m/sec.

In the above-mentioned draw-false twisting procedure, the filament yarn may consist of the filaments of the present invention alone or a blend of the filaments of the present invention with another type of filament.

55 The draw-false twisting procedure is distinctive in the relatively low draw-false twisting temperature of from 150 to 200°C, from the conventional draw-false twisting procedure for conventional polyester filament yarn. In order to produce a drawn, false twisted polyester filament yarn having a hard twist yarn-like touch, it is necessary that the draw-false twisting temperature to be applied to the polyester filament yarn is 215°C or more. However, such high temperature causes the individual filaments in the yarn to be fuse-bonded to each other and the dyeing affinity of the filament yarn to be significantly changed. However, in the above-mentioned draw-false twisting procedure, the draw-false twisting temperature is relatively low. Therefore, the change in the dyeing affinity of the filament yarn is very small and the filament yarn exhibits a satisfactory draping property. However, the individual filaments in the filament yarn are fuse-bonded to each other to a satisfactory extent.

65 The drawn, false-twisted filament yarn exhibits a satisfactory weaving and knitting property. In order to

Comparative Example 3, it is preferable to relax the filament yarn at an elevated temperature, for

The same procedures as those described in Example 1 were carried out, except that no dispersed polymer was used and the matrix polymer contained 1.0% by weight of titanium dioxide.

The resultant drawn filament had a satisfactorily delustered appearance thereof close to that in
5 Example 4 but not hemisphere, hemispheroid or hemiellipsoid protuberance.

Example 6

The drawn filaments obtained in Example 3 were converted into a tricot fabric. This fabric exhibited a satisfactory high bulkiness and dyeability and a desirable dry touch.

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Examples 7 through 11 and Comparative Examples 4 and 5

In each of the Examples 7 through 11 and Comparative Examples 4 and 5, the same procedures as those described in Example 1 were carried out with the following exception.

The used dispersed polymer consisted of a polysulfone compound which was produced and sold in the
15 trademark of "Udel" by Union Carbide Co., U.S.A. and which was non-crystalline and incompatible with the polyethylene terephthalate used and had a glass transition temperature of 175°C.

The mixture of the matrix polymer and the dispersed polymer in the amount as indicated in Table 2 was dried at a temperature of 160°C for 4 hours before the melt-extruding procedure.

The spinneret used had 36 spinning orifices each having a diameter of 0.4 mm, and the extruded
20 filamentary streams of the melted mixture was cooled by blowing cooling air at a flow linear speed of 0.3 m/sec across a spinning chimney to solidify them.

The solidified filament was oiled and, then, wound up at a winding speed of 1200 m/min.

The resultant undrawn filaments were preheated at a temperature of 90°C for 0.3 seconds, and drawn at a draw ratio of 3.3.

25 The properties of the resultant filaments are indicated in Table 2.

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Comparative Example 3

The same procedures as those described in Example 1 were carried out, except that no dispersed polymer was used and the matrix polymer contained 1.0% by weight of titanium dioxide.

The resultant drawn filament had a satisfactorily delustered appearance thereof close to that in
5 Example 4 but not hemisphere, hemispheroid or hemiellipsoid protuberance.

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15 trademark of "Udel" by Union Carbide Co., U.S.A. and which was non-crystalline and incompatible with the polyethylene terephthalate used and had a glass transition temperature of 175°C.

The mixture of the matrix polymer and the dispersed polymer in the amount as indicated in Table 2 was dried at a temperature of 160°C for 4 hours before the melt-extruding procedure.

The spinneret used had 36 spinning orifices each having a diameter of 0.4 mm, and the extruded
20 filamentary streams of the melted mixture was cooled by blowing cooling air at a flow linear speed of 0.3 m/sec across a spinning chimney to solidify them.

The solidified filament was oiled and, then, wound up at a winding speed of 1200 m/min.

The resultant undrawn filaments were preheated at a temperature of 90°C for 0.3 seconds, and drawn at a draw ratio of 3.3.

25 The properties of the resultant filaments are indicated in Table 2.

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Comparative Example 3

The same procedures as those described in Example 1 were carried out, except that no dispersed polymer was used and the matrix polymer contained 1.0% by weight of titanium dioxide.

The resultant drawn filament had a satisfactorily delustered appearance thereof close to that in
5 Example 4 but not hemisphere, hemispheroid or hemiellipsoid protuberance.

Example 6

The drawn filaments obtained in Example 3 were converted into a tricot fabric. This fabric exhibited a satisfactory high bulkiness and dyeability and a desirable dry touch.

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Examples 7 through 11 and Comparative Examples 4 and 5

In each of the Examples 7 through 11 and Comparative Examples 4 and 5, the same procedures as those described in Example 1 were carried out with the following exception.

The used dispersed polymer consisted of a polysulfone compound which was produced and sold in the
15 trademark of "Udel" by Union Carbide Co., U.S.A. and which was non-crystalline and incompatible with the polyethylene terephthalate used and had a glass transition temperature of 175°C.

The mixture of the matrix polymer and the dispersed polymer in the amount as indicated in Table 2 was dried at a temperature of 160°C for 4 hours before the melt-extruding procedure.

The spinneret used had 36 spinning orifices each having a diameter of 0.4 mm, and the extruded
20 filamentary streams of the melted mixture was cooled by blowing cooling air at a flow linear speed of 0.3 m/sec across a spinning chimney to solidify them.

The solidified filament was oiled and, then, wound up at a winding speed of 1200 m/min.

The resultant undrawn filaments were preheated at a temperature of 90°C for 0.3 seconds, and drawn at a draw ratio of 3.3.

25 The properties of the resultant filaments are indicated in Table 2.

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TABLE 2

Example	Item	Amount of dispersed polymer (wt%)	Protuberance		Coefficient of fiber-fiber dynamic friction at a speed of 3600 cm/min	Titer(dtex)/the number of filaments	Tensile strength (g/dtex)	Ultimate elongation (%)
			Configuration	The number per 10 μm^2				
Comparative Example 4		0.5	Substantially no hemisphere or hemiellipsoid protuberance		0.398	57.2/36	4.2	28.0
"	7	1.5	Hemiellipsoid	—	0.323	56.1/36	3.4	25.0
"	8	3.0	Hemisphere and Hemiellipsoid	—	0.300	55/36	3.3	23.5
Example	9	6.0	"	—	0.286	56.1/36	3.0	18.2
"	10	9.0	"	—	0.264	56.1/36	2.7	14.6
"	11	12.0	Hemisphere	—	0.225	55/36	2.5	12.9
Comparative Example 5		16.0	"	—	0.203	57.2/36	1.4	6.0

In Comparative Example 4, the resultant drawn individual filament had very small irregular protuberances which were derived from the fine particles of titanium dioxide, but had substantially no hemisphere or hemiellipsoid protuberance. Also, the resultant individual filament in Comparative Example 5 exhibited extremely poor tensile strength and ultimate elongation and therefore, was useless for practical use.

Examples 12 through 16 and Comparative Examples 6, 7 and 8

In each of the Examples 12 through 16 and Comparative Examples 6, 7 and 8, the amount as indicated in Table 3 of the same dispersed polymer as that described in Example 6 was mixed with the balance consisting of the same polyethylene terephthalate as that described in Example 1. The mixture was dried at 160°C for 4 hours and melt-extruded in the same manner as that described in Example 1, and the solidified filaments were oiled and, then, wound at a speed of 1500 m/min.

The resultant undrawn filament yarn was preheated at 90°C for 0.3 seconds on a heating roll and drawn at a draw ratio of 2.8. The drawn filament yarn was bent-treated at 210°C by using a slit heater and wound at a speed of 800 m/min. The results are shown in Table 3.

TABLE 3

Example No.	Item	Amount of dispersed polymer (wt%)	Drawn filament yarn				
			Titer (dtex/24fil)	Tensile strength (g/dtex)	Ultimate elongation (%)	Breaking modulus (g/dtex)	Snap back value (%)
Comparative Example	6	0	82.5	4.7	29.5	6.0	7.0
"	7	0.5	83.6	4.2	28.0	4.9	5.8
"	12	1.5	82.5	3.5	25.0	3.7	3.9
"	13	3.0	83.6	3.3	23.5	3.5	3.6
"	14	6.0	85.8	3	18.2	3.1	3.1
"	15	9.0	84.7	2.7	14.6	2.9	2.7
"	16	12.0	81.4	2.5	12.9	2.8	2.2
Comparative Example	18	16.0	82.5	1.5	6.0	2.7	2.0

In each of Comparative Examples 6 and 7, the resultant filament yarn exhibited a large snap back value and breaking modulus and, therefore, is not suitable for the draft zone system spinning process and raising process. Also, the resultant filament yarn in Comparative Example 8 exhibited an extremely poor tensile strength and ultimate elongation and, therefore, is useless for practical use.

5 The filament yarns obtained in Examples 12 through 16 exhibited a satisfactory tensile strength, ultimate elongation, breaking modulus and snap back value. Therefore, these filament yarns are useful for the draft zone system spinning process and for producing a raised fabric.

Examples 17 through 21 and Comparative Examples 9 through 11

10 In each of the Examples 17 through 21 and Comparative Examples 9 through 11, the same procedures as those described in Example 12 were carried out, except that the amount of the dispersed polymer was as indicated in Table 4, the spinning orifices each had a diameter of 0.27 mm, the extrusion of the melted mixture was carried out at a temperature of 295°C, the oiled undrawn filaments were wound at a speed of 1200 m/min and the heat treatment for the drawn filament yarn was carried out at a temperature of 220°C.

15 The properties of the resultant filament yarn are indicated in Table 4.

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In each of Comparative Examples 6 and 7, the resultant filament yarn exhibited a large snap back value and breaking modulus and, therefore, is not suitable for the draft zone system spinning process and raising process. Also, the resultant filament yarn in Comparative Example 8 exhibited an extremely poor tensile strength and ultimate elongation and, therefore, is useless for practical use.

5 The filament yarns obtained in Examples 12 through 16 exhibited a satisfactory tensile strength, ultimate elongation, breaking modulus and snap back value. Therefore, these filament yarns are useful for the draft zone system spinning process and for producing a raised fabric.

Examples 17 through 21 and Comparative Examples 9 through 11

10 In each of the Examples 17 through 21 and Comparative Examples 9 through 11, the same procedures as those described in Example 12 were carried out, except that the amount of the dispersed polymer was as indicated in Table 4, the spinning orifices each had a diameter of 0.27 mm, the extrusion of the melted mixture was carried out at a temperature of 295°C, the oiled undrawn filaments were wound at a speed of 1200 m/min and the heat treatment for the drawn filament yarn was carried out at a temperature of 220°C.

15 The properties of the resultant filament yarn are indicated in Table 4.

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Each filament yarn was converted into a knitted fabric. The fabric was scoured and dried in an ordinary manner. The dried fabric was treated with an aqueous solution of sodium hydroxide in concentration as shown in Table 5 at a boiling temperature of the solution for the time period as indicated in Table 5. The decrease in the weight of the filament yarn is indicated in Table 5. Also, the configuration, opening area and
5 the numbers of concaves formed on the peripheral surface of the alkali-treated individual filament and the water-absorption and fibril-forming property of the alkali-treated filament yarn are shown in Table 5.

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TABLE 5

Item	Alkali treatment			Alkali-treated filament				
	Concentration of NaOH	Time (min)	Decrease in weight of filament yarn (wt%)	Configuration of concave	Opening area of concave (μm ²)	The number of concaves per 300 μm ²	Water-absorption (%)	Formation of fibril
Comparative Example 9	—	—	15	Linear	—	0	22.3	no
10	—	—	15	"	—	0	31.1	"
Example 17	—	—	15	(*)	5.2~6.3	1	42.2	"
Example 18	—	—	5	Linear	—	0	38.5	"
"	—	—	15	(*)	5.9~7.8	2	45.6	"
"	—	—	25	"	6.5~9.2	3	53.2	"
Example 19	—	—	15	"	6.4~9.4	4	46.2	"
"	—	—	25	"	7.0~11.2	5	58.3	"
Example 20	—	—	15	"	6.8~10.2	5	61.5	"
Example 21	—	—	15	"	6.9~9.8	5	65.8	"
Comparative Example 11	—	—	15	"	7.2~10.8	6	64.2	yes

Note: (*)—The concave was composed of a hemisphere, hemispheroid or hemiellipsoid-shaped center portion thereof and a pair of hemicone or hemielliptic cone-shaped wing portions thereof.

The water absorption was determined as follows. A test specimen was completely dried and the weight (W_0) of the dried specimen was measured. The specimen was immersed in water at room temperature for 30 minutes and, then, centrifugalized for 5 minutes by using a home centrifuge. The weight (W_1) of the centrifugalized specimen was measured. The water absorption (WA) of the specimen was calculated from the following equation.

$$WA(\%) = \frac{W_1 - W_0}{W_0} \times 100$$

The fibril-forming property was observed in the following manner. A test specimen (fabric) was rubbed 500 times with a crepe suzette fabric made of polyethylene terephthalate multifilament yarns having a yarn count of 82.5 dtex/36 filaments, and having a weight of 90 g/m² under a load of 5 N by using a rubbing tester. After the rubbing procedure, the surface of the specimen was observed by the naked eye.

The opening area of the concaves were measured in the following manner. That is, after the alkali treatment, the peripheral surface of the individual filament was photographed for an electron microscopic observation at a magnification of 3000. From the photograph, the opening area of the concave was measured.

Examples 22 through 26 and Comparative Examples 12 through 14

In each of the Examples 22 through 26 and Comparative Examples 12 through 14, the same procedures as those in Example 12 were carried out, except that the amount of the dispersed polymer was as indicated in Table 6, the number of the spinning orifices was 48, the linear flow speed of the cooling air was 0.3 m/sec, the winding speed for the solidified filaments was 1200 m/min, the draw ratio was 3.3 and the heat-treatment temperature for the drawn filament yarn was 230°C.

The properties of the resultant filament yarn are indicated in Table 6.

TABLE 6

Item		Drawn filament yarn				
		Amount of dispersed polymer (wt%)	Configuration of protuberance	Titer dtex/ per 48 filaments	Tensile strength (g/dtex)	Ultimate elongation (%)
Example No.						
Comparative Example 12	0	None	166.1/48	4.5	29.6	
“	13	0.5	Irregular	165/48	4.4	28.0
“	22	1.5	Hemiellipsoid	163.9/48	3.8	25.0
“	23	3.0	Hemisphere and Hemiellipsoid	167.2/48	3.3	24.2
Example	24	6.0	“	166.1/48	3	18.1
“	25	9.0	“	165/48	2.7	15.2
“	26	12.0	Hemisphere	165/48	2.5	13.1
Comparative Example 14	16.0	“	166.1/48	1.5	5.8	

The same alkali treatment as mentioned in Example 17 was applied to each filament yarn which was converted into a knitted fabric, except that the concentration of sodium hydroxide in the aqueous solution was 3.0%. The results are indicated in Table 7.

TABLE 7

5	Item		Alkali treatment		Alkali-treated filament yarn	
	Type of filament yarn		Time (min)	Decrease in weight (%)	Water-absorption (%)	The number and configuration of concaves Formation of fibrils
10	Comparative Example 12		—	15	24.1	a few, linear no
	"	13	—	15	33.4	many, linear no
	Example	22	—	15	40.9	a few, (*) no
15	Example	23	—	5	39.8	a few, linear no
	"		—	15	44.6	many, (*) no
20	"		—	25	51.2	many, (*) no
	Example	24	—	15	47.9	many, (*) no
	"		—	25	57.7	many, (*) no
25	Example	25	—	15	60.6	very many, (*) no
	Example	26	—	15	61.8	very many, (*) no
30	Comparative Example 14		—	15	58.9	very many, (*) no

Note (*)—The same as that described under Table 5.

35 From Tables 5 and 6, it is clear that when the filament yarn of the present invention (Examples 17 through 26) was alkali treated to an extent that the decrease in weight was 10% or more, the resultant concaves had a specific shape and exhibited an excellent water absorption of 40% or more and a satisfactory resistance to the formation of fibrils.

Examples 27 through 44 and Comparative Examples 15 through 18

40 In each of the Examples 27 through 44 and Comparative Examples 15 through 18, the same procedures as those described in Example 22 were carried out, except that the amount of dispersed polymer was as indicated in Table 8, the number of the spinning orifices was 36, the oiled filaments were wound at a high speed as indicated in Table 8, and the undrawn filament yarn had an ultimate elongation of about 120% and a titer of 165 dtex/36 filaments. That is, the resultant filaments were partially oriented filaments.

45 Each resultant filament yarn was draw-false twisted under the conditions as indicated in Table 8 by using a Draw-False twister (Type FW-III, made by Teijin Seiki K.K. Japan; the length of heater=1.0 m), and the drawn, false twisted filament yarn was relaxed at a temperature of 200°C while overfeeding the yarn at an overfeed of 5% by using a non-contact type heater, and wound at a speed of 100 m/min. The results are indicated in Table 8.

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TABLE 8

Item	Draw-false twisting process					Drawn, false-twisted filament yarn		
	Amount of dispersed polymer (wt%)	Winding speed (m/min)	Twist multiplier (α)	Draw ratio (D) ^{*)1}	Temperature (T) (°C)	Hard twist yarn-like touch	Degree of fuse-bonding (class ^{*)3})	Torque (t/m)
Comparative Example	15	0	3300	0.65	1.3	235 ^{*)2}	ordinary	43
"	16	"	"	0.40	1.2	200 ^{*)2}	poor	30
"	17	0.5	"	"	"	^{*)2}	"	35
Example	27	1.5	3000	0.45	1.3	195	ordinary	20
"	28	3.0	2800	0.50	1.4	190	"	35
"	29	4.5	2600	0.75	1.5	200	poor	45
"	30	"	"	0.75	1.4	195	ordinary	40
"	31	"	"	0.75	1.3	190	"	35
"	32	"	"	0.60	1.3	190	excellent	30
"	33	"	"	0.50	1.3	190	"	20
"	34	"	"	0.50	1.3	180	ordinary	25
"	35	"	"	0.50	1.3	170	poor	30

TABLE 8 (contd.)

Item	Draw-false twisting process					Drawn, false-twisted filament yarn		
	Amount of dispersed polymer (wt%)	Winding speed (m/min)	Twist multiplier (α)	Draw ratio (D) ^{*1)}	Temperature (T) (°C)	Hard twist yarn-like touch	Degree of fuse-bonding (class ^{*3)})	Torque (t/m)
Example	36	"	0.50	1.2	170	ordinary	ordinary	25
"	37	"	0.40	1.2	170	"	excellent	18
"	38	2500	0.80	1.4	195	poor	poor	42
"	39	"	0.75	1.4	195	ordinary	excellent	38
"	40	"	0.6	1.4	190	"	"	33
"	41	"	0.5	1.3	180	excellent	"	26
"	42	"	0.4	1.2	170	"	"	19
"	43	2300	0.6	1.4	180	"	"	37
"	44	2100	"	"	"	"	"	35
Comparative Example	18	2000	"	"	"	Extremely poor strength		

Note: ^{*1)}— $R_0 = 1.5$ ^{*2)}—Relaxing temperature = 25°C^{*3)}—Degree of fuse-bonding was determined by observing the cross-sectional profile of the drawn, false twisted filament yarn by using a microscope.

In Comparative Examples 16 and 17 in which the dispersed polymer was used in an amount less than 1%, the draw-false twisting procedure applied to the resultant filament yarns having substantially no protuberances failed to obtain hard twist filament yarn-like false twisted yarns, even when a high draw-false twisting temperature of 200°C was applied to the filament yarns. In the Comparative Example 15 in which no dispersed polymer was used and the resultant filaments had no protuberances, an excessively high draw-false twisting temperature of 235°C was applied to the filament yarn in order to cause the resultant yarn to exhibit a hard twist filament yarn-like configuration and touch.

In Comparative Example 18, the resultant filament yarn containing 16.0% of the dispersed polymer exhibited an extremely poor mechanical strength.

In Examples 27, 28, 30 through 34, 36, 37 and 39 through 44 wherein the draw-false twisting procedures were carried out under the conditions satisfying the relationship (3), the resultant filament yarns all exhibited satisfactory hard twist filament yarn-like configuration and touch. However, in Examples 29, 35 and 38 wherein the draw-false twisting procedures were carried out under conditions not satisfying the relationship (3), the resultant filament yarns exhibited unsatisfactory touch and degree of fuse bonding of the individual filaments.

Table 8 shows that as long as the relationship (3) is satisfied, the larger the amount of the dispersed polymer and the lower the twist multiplier and the draw ratio and the higher the draw-false twisting temperature, the better the hard twisted filament yarn-like configuration and touch.

Examples 45 through 62 and Comparative Examples 19 through 22

In each of the Examples 45 through 62 and Comparative Examples 19 through 22, the same procedures as those described in Example 27 were carried out, except that the dispersed polymer was used in the amount as indicated in Table 9, the winding speed for the solidified filaments were as indicated in Table 9, and the draw-false twisting procedure was carried out under the conditions as indicated in Table 9. The results are indicated in Table 9.

TABLE 9

Item		Draw-false twisting process				Drawn, false twisted filament yarn		
		Amount of dispersed polymer (wt%)	Winding speed (m/min)	Twist multiplier (a)	Draw ratio (D) ^{(*)1}	Temperature (T) (°C)	Hard twist yarn-like touch	Draping property
Example No.								Torque (t/m)
Comparative Example	19	0	3300	0.65	1.30	235 ^{(*)2}	remarkable	poor
"	20	"	"	0.40	1.20	160 ^{(*)2}	poor	excellent
"	21	0.5	"	"	"	" ^{(*)2}	"	"
Example	45	1.5	3000	0.45	1.30	170	ordinary	remarkable
"	46	3.0	2800	0.50	1.40	180	"	"
"	47	"	"	0.75	1.50	200	"	ordinary
"	48	"	"	0.75	1.40	190	"	"
"	49	"	"	0.75	1.30	180	"	"
"	50	"	"	0.60	1.30	185	excellent	very poor
"	51	"	"	0.50	1.30	175	ordinary	ordinary
"	52	"	"	0.50	1.30	165	"	"
"	53	"	"	0.50	1.30	160	"	"

TABLE 9 (contd.)

Item	Draw-false twisting process					Drawn, false twisted filament yarn			
	Example No.	Amount of dispersed polymer (wt%)	Winding speed (m/min)	Twist multiplier (α)	Draw ratio (D)*1)	Temperature (T) (°C)	Hard twist yarn-like touch	Draping property	Torque (t/m)
Example	54	"	"	0.50	1.20	170	ordinary	very poor	43
"	55	"	"	0.40	1.20	160	"	ordinary	38
"	56	6.0	2500	0.80	1.40	195	"	"	42
"	57	"	"	0.75	1.40	180	"	"	43
"	58	"	"	0.60	1.40	180	"	"	38
"	59	"	"	0.50	1.30	180	excellent	very poor	26
"	60	"	"	0.40	1.20	160	ordinary	ordinary	30
"	61	9.0	2300	0.60	1.40	170	"	"	43
"	62	12.0	2100	0.60	1.40	170	"	"	41
Comparative Example	22	16.0	2000	0.60	1.40	170	extremely poor strength		

Note: $*1) - R_0 = 1.5$ $*2) -$ Relaxing temperature= 235°C

In Comparative Example 19 wherein the filaments contained no dispersed polymer, the draw-false twisting procedure was carried out at an excessively high temperature of 235°C. The resultant filament yarn exhibited poor draping property.

In Comparative Example 20 and 21 wherein the filaments contained zero or 0.5% by weight of the dispersed polymer, the draw-false twisting procedures were carried out at a relatively low twist multiplier of 0.40, draw ratio of 1.2 and temperature of 160°C. The resultant filament yarns exhibited an unsatisfactory hard twist filament yarn like configuration and touch.

In Comparative Example 22 wherein the dispersed polymer was used in a large amount, 16% by weight, the resultant filament yarn could not be draw-false twisted because of its extremely poor mechanical strength.

In Examples 45 through 49, 51 through 53, 55 through 58 and 60 through 62, wherein the draw-false twisting conditions satisfied the relationship (3), the resultant filament yarns exhibited satisfactory hard twist filament yarn-like configuration and touch and draping property. However, in Examples 50, 54, and 59, wherein the draw-false twisting conditions did not satisfy the relationship (3), the resultant filament yarns exhibited a poor draping property.

Claims

1. Thermoplastic synthetic filaments comprising 85 to 99% by weight of a thermoplastic matrix polymer and 1 to 15% by weight of a dispersed polymer which is incompatible with said matrix polymer and dispersed in the form of fine particles in said matrix polymer, which filaments are characterized in that said dispersed polymer consists of at least one polysulfone polymer, and numerous fine protuberances consisting of said dispersed polysulfone polymer are formed in the number of at least 5 per 10 μm^2 on the peripheral surface of each individual filament.

2. The filaments as claimed in claim 1, wherein said protuberances are each in the form of a hemisphere, hemispheroid or hemiellipsoid extending along the longitudinal axis of the individual filament.

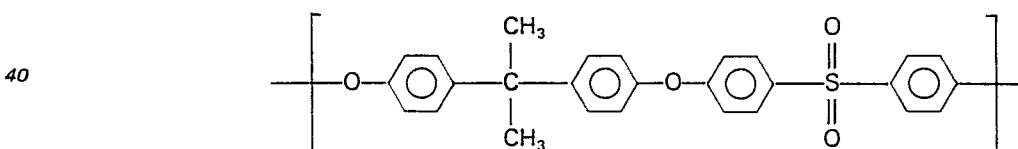
3. The filaments as claimed in claim 1, wherein the area of bottoms of said protuberances is 0.5 μm^2 or more.

4. The filaments as claimed in claim 1, wherein said matrix polymer is thermoplastic polyester.

5. The filaments as claimed in claim 4, wherein said polyester consists essentially of recurring ethylene terephthalate units.

6. The filaments as claimed in claim 1, wherein said dispersed polymer is non-crystalline and has a glass transition temperature of at least 150°C.

7. The filaments as claimed in claim 1, wherein said polysulfone comprises the recurring unit of the formula:



8. The filaments as claimed in claim 1, wherein the amount of said dispersed polymer is in the range of from 3 to 9% by weight.

9. The filaments as claimed in claim 1, wherein the individual filaments exhibit a snap back value of 4% or less, said snap back value being defined by the equation (1):

$$\text{SB} = (\text{eb} - \text{esb}) - \text{eb} \times \text{rb} / 100 \quad (1)$$

wherein SB represents a snap back value in % of the filaments, eb represents a breaking elongation in % of the filaments, rb represents a tensile recovery in % of the filaments at its break and esb represents an elongation in % of the filament determined from the difference between the length of the filament at its break and the original length of the filament.

10. The filaments as claimed in claim 1, wherein each individual filament exhibits a breaking modulus of 3.64 g/dtex or less, said breaking modulus being defined by the equation (2):

$$\text{Mb} = \frac{\text{sb} \times (100 + \text{eb})}{D_0} \quad (2)$$

wherein Mb represents a breaking modulus in g/dtex of the filament, sb represents a gradient in g/% of a tangential line drawn through a breaking point of the filament on the stress-strain curve of the filament, eb represents a breaking elongation in % of the filament and D_0 represents a titer in dtex of the filament.

11. A process for producing thermoplastic synthetic filaments as claimed in claim 1 comprising the steps of:

preparing a mixture of 85 to 99% by weight of a thermoplastic matrix polymer with 1 to 15% by weight of a dispersed polymer which consists of at least one polysulfone polymer and which is incompatible with said matrix polymer and;

spinning said mixture to produce filaments in each of which said dispersed polymer is dispersed in said matrix polymer, and numerous fine protuberances consisting of said dispersed polymer are formed in the number of at least 5 per $10 \mu\text{m}^2$ on the peripheral surface of each individual filament.

12. The process as claimed in claim 11, wherein said mixture is prepared in such a manner that said dispersed polymer is admixed to a polymerisation mixture containing monomers for producing said matrix polymer and, then;

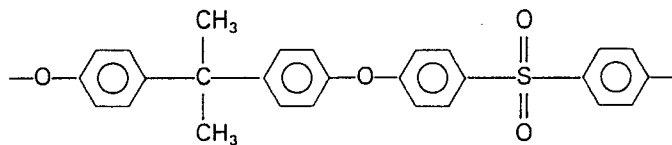
said admixed polymerization mixture is subjected to a polymerization of said monomers.

13. The process as claimed in claim 11, wherein said matrix polymer is a thermoplastic polyester.

14. The process as claimed in claim 13, wherein said polyester consists essentially of recurring ethylene terephthalate units.

15. The process as claimed in claim 11, wherein said dispersed polymer is non-crystalline and has a glass transition temperature of at least 150°C .

16. The process as claimed in claim 11, wherein said polysulfone comprises the recurring unit of the formula:



17. The process as claimed in claim 11, wherein the amount of said dispersed polymer is in the range of from 3 to 9% by weight.

18. The process as claimed in claim 11, wherein said filaments, which are polyester filaments in a partially oriented state, and in the form of a filament yarn, are draw-false twisted under the conditions satisfying the relationship (3):

$$\alpha \leq 0.02T - 1.5D - 1.05 \quad (3)$$

wherein α represents a twist multiplier to be applied to the filament yarn in the range of from 0.4 to 0.9, T represents a false-twisting temperature to be applied to the filament yarn in the range of from 150 to 200°C and D represents a draw ratio to be applied to the filament yarn satisfying the relationship (4): $0.80 R_0 \leq D \leq R_0$, wherein R_0 represents a draw ratio which causes the resultant drawn filament yarn to exhibit an ultimate elongation of 30%, to produce a drawn-false-twisted filament yarn.

19. The process as claimed in claim 18, wherein said partially oriented filament yarn has an ultimate elongation of from 70 to 200%.

20. The process as claimed in claim 11, wherein said matrix polymer is preferably a polyester and is modified in that the resultant filaments are additionally treated with an aqueous alkali solution to cause the treated individual filament to have numerous concaves each of which is composed of a center portion thereof in the form of a hemisphere, hemispheroid or hemiellipsoid and a pair of wing portions thereof each in the form of a hemicone or hemielliptic cone and each extending from the center portion in the opposite direction to the other along the longitudinal axis of the individual filament.

21. The process as claimed in claim 20, wherein said aqueous alkali solution contains 0.01 to 40% by weight of the alkali.

22. The process as claimed in claim 20, wherein said alkali treatment is carried out at a temperature of from room temperature to 100°C .

23. The process as claimed in claim 20, wherein said alkali treatment causes the weight of said filaments to be reduced to an extent of at least 10% of the original weight thereof.

24. A porous filament obtainable according to the process of claim 20.

25. The filament as claimed in claim 24, wherein said concaves each have an opening area of at least $5 \mu\text{m}^2$.

26. The filament as claimed in claim 24, wherein the number of said concaves is at least one per $300 \mu\text{m}^2$ of the peripheral surface of the individual filament.

60 Patentansprüche

1. Thermoplastische synthetische Fasern, welche 85 bis 99 Gew.-% eines thermoplastischen Matrixpolymers und 1 bis 15 Gew.-% eines mit dem Matrixpolymer nicht kompatiblen, dispergierten Polymers enthalten, welches in Form feiner Partikel in dem Matrixpolymer dispergiert ist, wobei die Fasern dadurch gekennzeichnet sind, daß das dispergierte Polymer aus mindestens einem Polysulfonpolymer

besteht und daß zahlreiche feine Vorsprünge, die aus dem dispergierten Polysulfonpolymer bestehen, in einer Anzahl von mindestens 5 pro $10 \mu\text{m}^2$ an der Mantelfläche jeder einzelnen Faser ausgebildet sind.

2. Fasern gemäß Anspruch 1, bei denen jeder der Vorsprünge die Form einer Halbkugel, eines Halbsphäroids oder eines Halbellipsoids hat, welches sich längs der Längsachse der einzelnen Faser erstreckt.

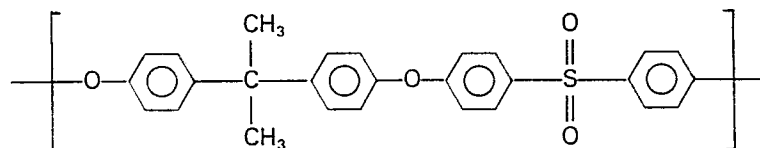
3. Fasern gemäß Anspruch 1, bei denen die Bodenfläche der Vorsprünge $0,5 \mu\text{m}^2$ oder mehr beträgt.

4. Fasern gemäß Anspruch 1, bei denen das Matrixpolymer ein thermoplastischer Polyester ist.

5. Fasern gemäß Anspruch 4, bei denen der Polyester im wesentlichen aus wiederkehrenden Ethylenterephthalat-Einheiten besteht.

6. Fasern gemäß Anspruch 1, bei denen das dispergierte Polymer nicht-kristallin ist und eine Glas-Übergangstemperatur von mindestens 150°C besitzt.

7. Fasern gemäß Anspruch 1, bei denen das Polysulfon wiederkehrende Einheiten gemäß (folgender) Formel umfasst:



8. Fasern gemäß Anspruch 1, bei denen die Menge des dispergierten Polymers in dem Bereich von 3 bis 9 Gew.-% liegt.

9. Fasern gemäß Anspruch 1, bei denen die einzelnen Fasern einen Rücksprungwert von 4% oder weniger besitzen, wobei der Rücksprungwert durch die (folgende) Gleichung (1) definiert ist:

$$SB = (eb - esb) - eb \times rb / 100 \quad (1)$$

wobei SB für einen Rücksprungwert der Fasern in % steht, wobei eb für eine Bruchdehnung der Fasern in % steht, wobei rb für eine Dehnungsrückbildung der Fasern bei ihrem Brechen in % steht und wobei esb für eine Dehnung der Fasern in % steht, die aus der Differenz zwischen der Länge der Faser bei ihrem Brechen und der ursprünglichen Länge der Faser bestimmt wird.

10. Fasern gemäß Anspruch 1, bei denen jede einzelne Faser einen Bruch-Modul von $3,64 \text{ g/dtex}$ oder weniger besitzt, wobei der Bruch-Modul durch die (folgende) Gleichung (2) definiert ist:

$$Mb = \frac{sb \times (100 + eb)}{D_0} \quad (2)$$

wobei Mb für einen Bruch-Modul des Filaments in g/dtex steht, wobei sb für einen Gradienten in $\text{g/\%}$ einer Tangente steht, die durch einen Bruch-Punkt des Filaments auf der Spannungs-Dehnungs-Kurve des Filaments gezogen ist, wobei eb für eine Bruchdehnung des Filaments in % steht und wobei D_0 für eine Titer des Filaments in dtex steht.

11. Verfahren zum Herstellen thermoplastischer, synthetischer Fasern gemäß Anspruch 1, welches die (folgenden) Schritte umfasst:

Es wird eine Mischung von 85 bis 99 Gew.-% eines thermoplastischen Matrixpolymers mit 1 bis 15 Gew.-% eines dispergierten Polymers hergestellt, welches aus mindestens einem Polysulfonpolymer besteht und welches mit dem Matrixpolymer nicht kompatibel ist, und

diese Mischung wird versponnen, um Fasern zu erzeugen, in jeder von denen das dispergierte Polymer in dem Matrixpolymer dispergiert ist, wobei an der Mantelfläche jeder einzelnen Faser zahlreiche feine Vorsprünge erzeugt werden, die aus dem dispergierten Polymer bestehen, und zwar in einer Anzahl von mindestens 5 pro $10 \mu\text{m}^2$.

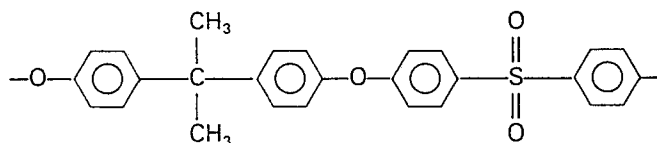
12. Verfahren gemäß Anspruch 11, bei dem die Mischung in einer solchen Weise zubereitet wird, daß das dispergierte Polymer einem Polymerisationsgemisch beigemischt wird, welches Monomere zur Erzeugung des Matrixpolymers enthält, und daß dann das Polymerisationsgemisch mit dem beigemischten Anteil einer Polymerisation der Monomere unterworfen wird.

13. Verfahren gemäß Anspruch 11, bei dem das Matrixpolymer ein thermoplastischer Polyester ist.

14. Verfahren nach Anspruch 13, bei dem der Polyester im wesentlichen aus wiederkehrenden Ethylenterephthalat-Einheiten besteht.

15. Verfahren nach Anspruch 11, bei dem das dispergierte Polymer nicht-kristallin ist und eine Glasübergangstemperatur von mindestens 150°C besitzt.

16. Verfahren nach Anspruch 11, bei dem das Polysulfon die wiederkehrende Einheit gemäß (folgender) Formel umfasst:



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17. Verfahren gemäß Anspruch 11, bei dem die Menge des dispergierten Polymers in dem Bereich von 3 bis 9 Gew.-% liegt.

18. Verfahren nach Anspruch 11, bei dem die Fasern, welche Polyesterfasern in einem teilweise orientierten Zustand sind und in Form eines Filamentgarns vorliegen, einer Streck-Falschdrahttexturierung unter Bedingungen unterworfen werden, welche die (folgende) Beziehung (3) erfüllen:

$$\alpha \leq 0,02T - 1,5D - 1,05 \quad (3)$$

15 wobei α für einen Drehungsmultiplikator steht, dem das Filamentgarn zu unterwerfen ist und der im Bereich von 0,4 bis 0,9 liegt, wobei T für eine Falschdrahterzeugungstemperatur steht, die in dem Filamentgarn zu erzeugen ist und die in dem Bereich von 150 bis 200°C liegt, und wobei D für ein Verstreckungsverhältnis steht, welchem das Filamentgarn zu unterwerfen ist und welches die (folgende) Beziehung (4) erfüllt:

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$$0,80R_0 \leq D \leq R_0 \quad (4)$$

25 wobei R_0 für ein Verstreckungsverhältnis steht, welches bewirkt, daß das resultierende gestreckte Filamentgarn eine Bruchdehnung von 30% zeigt, um (auf diese Weise) ein gestrecktes, falschdrahttexturiertes Filamentgarn zu erhalten.

19. Verfahren nach Anspruch 18, bei dem das teilweise orientierte Filamentgarn eine Bruchdehnung von 70 bis 200% besitzt.

20. Verfahren nach Anspruch 11, bei dem das Matrixpolymer vorzugsweise ein Polyester ist und derart modifiziert wird, daß die resultierenden Fasern zusätzlich mit einer wässrigen alkalischen Lösung behandelt werden, um zu bewirken, daß die einzelnen behandelten Fasern zahlreiche Hohlräume haben, von denen jeder aus einem mittleren Teil in Form einer Halbkugel, eines Halbsphäroids oder eines Halbellipsoids und einem Paar von Flügelteilen zusammengesetzt ist, von denen jeder die Form eines Halbkugels oder eines elliptischen Halbkugels hat, und die sich, ausgehend von dem mittleren Teil, in entgegengesetzte Richtungen erstrecken, und zwar längs der Längsachse der einzelnen Faser.

21. Verfahren gemäß Anspruch 20, bei dem die wässrige alkalische Lösung 0,01 bis 40 Gew.-% des alkalischen Stoffes enthält.

22. Verfahren nach Anspruch 20, bei dem die Alkalibehandlung bei einer Temperatur durchgeführt wird, die von der Raumtemperatur bis zu 100°C reicht.

23. Verfahren gemäß Anspruch 20, bei dem die Alkalibehandlung eine Gewichtsreduzierung der Filamente in einem Umfang von mindestens 10% des ursprünglichen Gewichts derselben bewirkt.

24. Poröse Faser, welche nach dem Verfahren gemäß Anspruch 20 erhältlich ist.

25. Faser nach Anspruch 24, bei dem die Hohlräume jeweils eine Öffnungsfläche von mindestens 5 μm^2 besitzen.

26. Faser nach Anspruch 24, bei dem die Anzahl der Hohlräume mindestens 1 pro 300 μm^2 der Mantelfläche der einzelnen Faser beträgt.

Revendications

50 1. Filaments synthétiques thermoplastiques comprenant de 85 à 99% en poids d'un polymère thermoplastique constituant une matrice et de 1 à 15% en poids d'un polymère dispersé qui est incompatible avec le polymère formant la matrice et qui est dispersé sous la forme de fines particules dans le polymère formant la matrice, caractérisés en ce que le polymère dispersé est constitué par au moins un polymère polysulfoné et en ce que de nombreuses protubérances fines, constituées en polymère dispersé polysulfoné, sont formées à raison d'au moins 5 per zone de 10 μm^2 sur la surface périphérique de chaque filament individuel.

2. Filaments suivant la revendication 1 caractérisés en ce que les protubérances ont chacune la forme d'un hémisphère, d'un hémispéroïde ou d'un hémiiellipsoïde s'étendant le long de l'axe longitudinal du filament individuel.

60 3. Filaments suivant la revendication 1 caractérisés en ce que l'aire des pieds des protubérances est égale à au moins 0,5 μmm^2 .

4. Filaments suivant la revendication 1 caractérisés en ce que le polymère formant la matrice est un polyester thermoplastique.

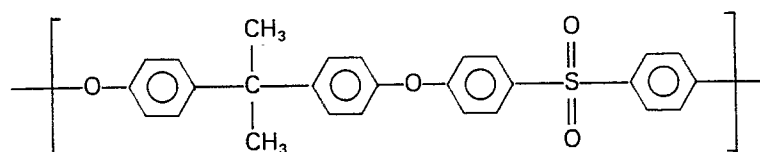
65 5. Filaments suivant la revendication 4 caractérisés en ce que le polyester consiste essentiellement en motifs récurrents de téréphtalate d'éthylène.

6. Filaments suivant la revendication 1 caractérisés en ce que le polymère dispersé est non cristallin et il a une température de transition vitreuse d'au moins 150°C.

7. Filaments suivant la revendication 1 caractérisés en ce que le polysulfone comprend le motif récurrent de formule

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8. Filaments suivant la revendication 1 caractérisés en ce que la quantité de polymère dispersé est de 3 à 9% en poids.

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9. Filaments suivant la revendication 1 caractérisés en ce que les filaments individuels présentent une valeur de relâchement d'au plus 4%, cette valeur de relâchement étant définie par l'équation (1):

$$SB = (eb - esb) - eb \times rb / 100$$

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dans laquelle SB représente la valeur de relâchement des filaments en %, eb représente un allongement à la rupture des filaments en %, rb représente un rétablissement de la traction des filaments en % lors de la rupture et esb représente un allongement en % du filament déterminé à partir de la différence entre la longueur du filament au moment de sa rupture et la longueur originale du filament.

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10. Filaments suivant la revendication 1 caractérisés en ce que chaque filament individuel présente un module de rupture au plus égal à 3,64 g/dtex, ce module de rupture étant défini par l'équation (2):

$$Mb = \frac{sb \times (100 + eb)}{D_0}$$

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dans laquelle Mb représente un module de rupture du filament, en g/dtex, sb représente un gradient en g/% d'un étirage en ligne tangentielle à travers un point de rupture du filament sur une courbe tension-dilatation du filament, eb représente un allongement à la rupture en % du filament et D_0 représente un titre du filament en dtex.

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11. Procédé de fabrication de filaments synthétiques thermoplastiques suivant la revendication 1 caractérisé en ce qu'on prépare un mélange de 85 à 99% en poids d'un polymère thermoplastique formant une matrice avec 1 à 15% en poids d'un polymère dispersé qui consiste en au moins un polymère polysulfoné et qui est incompatible avec le polymère formant la matrice, et un fils ce mélange de manière à produire des filaments dans chacun desquels le polymère dispersé est réparti dans le polymère formant la matrice et de nombreuses protubérances fines, constituées en polymère dispersé polysulfoné, sont formées à raison d'au moins 5 par zone de 10 μmm^2 sur la surface périphérique de chaque filament individuel.

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12. Procédé suivant la revendication 11 caractérisé en ce qu'on prépare le mélange de telle façon que le polymère dispersé soit ajouté à un mélange de polymérisation contenant des monomères pour produire le polymère formant la matrice et on soumet ensuite ce mélange de polymérisation ainsi complété à une polymérisation des monomères.

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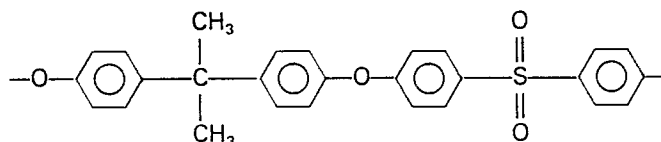
13. Procédé suivant la revendication 11 caractérisé en ce que le polymère formant la matrice est un polyester thermoplastique.

14. Procédé suivant la revendication 13 caractérisé en ce que le polyester consiste essentiellement en motifs récurrents de téréphtalate d'éthylène.

15. Procédé suivant la revendication 11 caractérisé en ce que le polymère dispersé est non cristallin et il a une température de transition vitreuse d'au moins 150°C.

16. Procédé suivant la revendication 11 caractérisé en ce que le polysulfone comprend le motif récurrent de formule:

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17. Procédé suivant la revendication 11 caractérisé en ce que la quantité de polymère dispersé est de 3 à 9% en poids.

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18. Procédé suivant la revendication 11 caractérisé en ce que les filaments, qui sont des filaments de polyester dans un état partiellement orienté et sous la forme d'un fil de filament, soumis à un étirage et à une fausse torsion dans les conditions satisfaisant à la relation (3):

5 dans laquelle α représente un multiplicateur de torsion devant être appliqué au fil de filament compris dans la gamme allant de 0,4 à 0,9, T représente une température de fausse torsion devant être appliquée au fil de filament comprise dans la gamme allant de 150 à 200°C et D représente un rapport d'étirage devant être appliqué au fil de filament satisfaisant à la relation (4): $0,80R_0 \leq D \leq R_0$, dans laquelle R_0 représente un rapport d'étirage qui amène le fil de filament étiré résultant à présenter un allongement maximal de 30%, afin de produire un fil de filament ayant subi un étirage et une fausse torsion.

10 19. Procédé suivant la revendication 18 caractérisé en ce que le fil de filament orienté partiellement a un allongement maximal allant de 70 à 200%.

15 20. Procédé suivant la revendication 11 caractérisé en ce que le polymère formant la matrice est de préférence un polyester et il est modifié du fait que les filaments résultants sont traités additionnellement avec une solution alcaline aqueuse afin d'amener les filaments individuels traités à présenter chacun de nombreuses cavités, chacune de ces cavités étant composée d'une portion centrale ayant la forme d'un hémisphère, d'un hémisphéroïde ou d'un héliellipsoïde, et d'une paire de portions latérales ou ailes ayant chacune la forme d'un demi-cône ou d'un cône semi-elliptique et qui s'étendent depuis la partie centrale dans des directions opposées l'une à l'autre le long de l'axe longitudinal du filament individuel.

21. Procédé suivant la revendication 20 caractérisé en ce que la solution alcaline aqueuse contient de 0,01 à 40% en poids d'alcali.

20 22. Procédé suivant la revendication 20 caractérisé en ce que le traitement à la solution alcaline est réalisé à une température allant de la température ambiante à 100°C.

23. Procédé suivant la revendication 20 caractérisé en ce que le traitement à la solution alcaline amène le poids des filaments à être réduit à au moins 10% du poids original des filaments.

24. Filament poreux pouvant être obtenu par la mise en oeuvre du procédé suivant la revendication 20.

25 25. Filament suivant la revendication 24 caractérisé en ce que chacune des cavités a une aire d'ouverture d'au moins 5 μmm^2 .

26. Filament suivant la revendication 24 caractérisé en ce que le nombre des cavités est d'au moins une par 300 μmm^2 de la surface périphérique du filament individuel.

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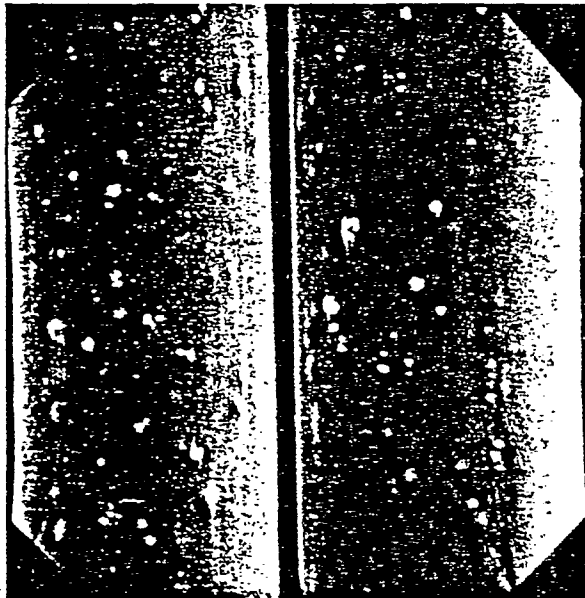
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Fig. 1



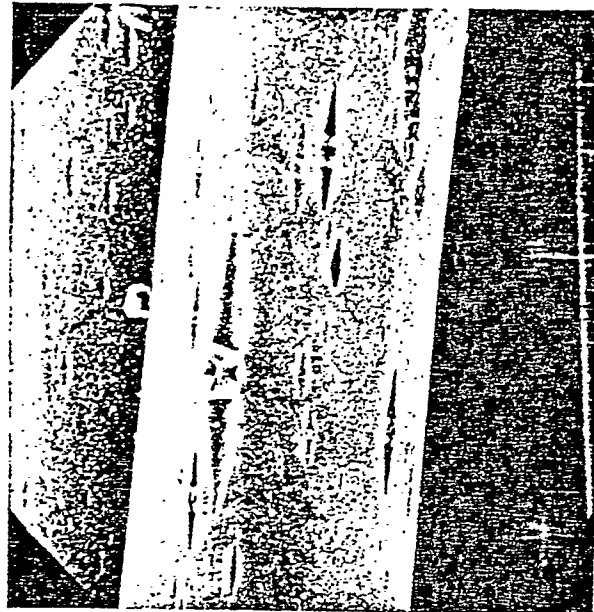
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Fig. 2



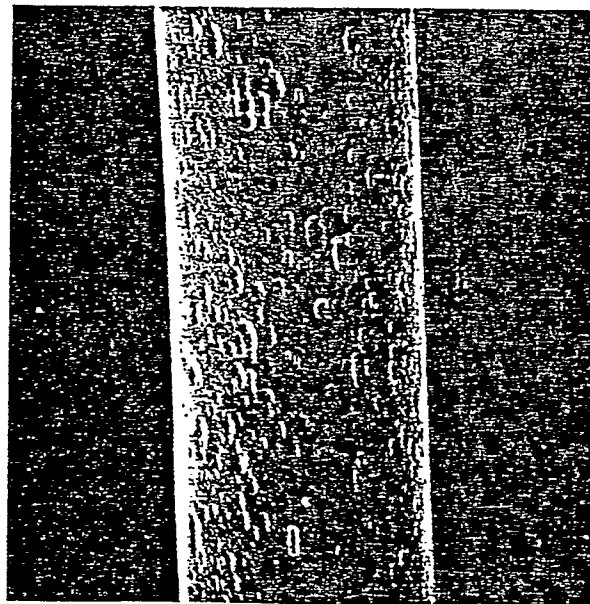
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Fig. 3



x 3000

Fig. 4



x 3000