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(54) HIGH BULK YARN AND METHOD OF MANUFACTURING THEREOF

(57) A method of manufacturing high bulk continuous multi-filament yarn comprises a number of distinct steps. In a first step, a plurality of filaments of polymer are melt spun to form a partially oriented yarn (POY) wherein a weight of the filaments is greater than 7 denier per filament (dpf). In a second step, the POYs are drawn and textured to form a draw textured yarn, wherein texturing is carried out in a friction texturing process. Subsequently at least two plies of the draw textured yarn are twisted and/or cabled together and heat set to obtain the high bulk continuous multifilament yarn.

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Description

Field of the invention

[0001] The present invention relates to the textile industry and more specifically, to a method of manufacturing high bulk yarns, as well as, the high bulk yarns and floor covering materials made from the aforementioned high bulk yarns.

Background art

[0002] Bulk Continuous Filament (BCF) yarns have many applications in a day-to-day life. One such application is carpet manufacturing. However, in order to satisfy requests of the carpet industry, the BCF yarns have to be strong and resilient but at the same time to offer an acceptable feel, look and coverage of a final product. To meet these demands, the manufacturers are forced to produce dense carpets with high grams per square meter (GSM) coverage, which results in high consumption of material and high costs of the final product.

[0003] Reducing the GSM is not an option as it directly affects the quality of the final product. Another option is to increase the bulk of the BCF yarn by texturing. The BCF yarns are traditionally textured using a stuffer box texturing method wherein, the yarn after an extrusion and drawing process is placed into a stuffer box machine where it is crimped in a special atmosphere. This is a single step process, i.e. it takes place in-line with the extrusion process at effectively the same speed. However, the resulting textured yarn does not meet requirements of the carpet industry as the obtained bulk is not high enough and random in nature. Consequently, the coverage of the carpet obtained with such yarn remains poor. To make up for poor coverage, stitch rate, gauge, pile height and yarn denier may be increased but all of these adaptations are sub-optimal.

[0004] Therefore, it would be advantageous to provide yarns that offer more efficient use of the material in order to improve the coverage while maintaining the feel, look, and overall quality of the final product.

Summary of the invention

[0005] According to a first aspect of the present invention, there is provided a method of manufacturing a high bulk continuous multifilament yarn as defined in claim 1. The method comprises:

1. in a first step, melt spinning a plurality of filaments of polymer to form a partially oriented yarn (POY) wherein a weight of the filaments is greater than 7 denier per filament (dpf);
2. in a second step, drawing and texturing one or more partially oriented yarns to form a draw textured yarn, wherein texturing is carried out in a friction texturing process; and
3. in a third step, twisting and/or cabling at least two plies of the draw textured yarn together and heat setting the twisted plies to obtain the high bulk continuous multifilament yarn.

The resulting continuous multifilament yarn has a much improved bulk compared to BCF yarns. This ensures that when integrated into a carpet or floor covering, for the same denier, better coverage can be achieved.

[0006] Throughout the present disclosure, the term *"step"* refers to a stage of a multi-staged process in which different stages are performed on different machines in an ordered manner such that a subsequent step (such as a second step) is performed after completion of a previous step (such as a first step). The step may include a plurality of (sub-)processes but an end of each step is marked by winding the yarn to a bobbin or a hank or similar and/or by moving the yarn from one machine to another. Thus for a multistep process, each step is independent from the other in terms of speed, whether measured in linear terms or mass terms. Furthermore, a failure, stoppage or error in one step need not cause another step to be interrupted.

[0007] As stated above, the first step comprises melt spinning the plurality of filaments by extruding the melted polymer using a spinneret to form the partially oriented yarn (POY). The POY is a yarn that comprises filaments that are only partially drawn and crystalized. The polymer may include at least one of a polyethylene terephthalate (PET) and a polybutylene terephthalate (PBT). The weight of each of the filaments is greater than 7 denier per filament (dpf) and may also be greater than 12 dpf, or greater than 15 dpf, or even greater than 20 dpf. A value of 10 dpf has been found optimal. An upper value has not been identified but will generally be less than 50 dpf. Such a high weight of the filaments is not conventional in the POY, where filaments are more generally used in the range of 0.5 dpf to 3 dpf. However, the presently proposed higher weight is believed to be crucial for carrying out the present invention, as will be discussed further below.

[0008] After extrusion, the filaments are cooled in a quench chamber. Due to the relatively larger thickness of the extruded filaments compared to the conventional POY, a length of the quench has to be increased from a conventional short quench of around 1 m to allow for a significantly longer quench length. The effective quench length may be more than 1.2 m, preferably more than 1.5 m or more than 1.8 m. An air flow speed in the quench chamber may be increased to at least 0.9 m/s to further improve efficiency of the cooling process of the filaments.

[0009] For the purpose of the present specification, reference to the effective quench length is taken to be the distance between the spinneret and a spin-finish applicator. The increased effective quench length is necessary to allow for a completion of the cooling process due to the large weight and relatively smaller surface area of the high dpf filaments. The cooled POY may be wound to a bobbin after which the first step ends. It should be added, that the POY process may include additional treatments, including an air-nip to lightly entangle the filaments and maintain the coherency of the yarn for winding and unwinding.

[0010] The POY obtained in the first step may have a weight of from 100 denier to 1000 denier, preferably between 200 denier and 400 denier and optionally around 240 denier. Given the relatively heavy weight of the filaments, it may comprise from 10 to 50 filaments, optionally around 25 filaments.

[0011] The second step comprises simultaneously drawing and texturing at least one POY obtained in the first step to create the draw textured yarn.

[0012] Drawing and texturing processes are generally conventional for providing bulk to POY. According to the invention, this is carried out in a friction texturing process also known as a false twist texturing or friction disk texturing. In the friction texturing process, the yarn passes between a number of partially overlapping disks that rotate about an axis generally parallel to the yarn axis. These insert a twist into the yarn. Depending on a configuration of the disks, the texture may be S- or Z-twist yarn. The yarn then may pass through a heater unit which heats the yarn to a temperature where it can be thermo-set. In the friction texturing process a diameter-to-yarn-speed ratio, i.e. a D/Y ratio, is an important parameter that determines a degree of twist applied to the textured yarn. This represents the ratio between the transverse speed at the outer circumference of the friction disk that engages with the yarn and the yarn speed. It should be noted that the actual speed at which the friction texturing is performed is significantly lower than the speed at which the step of melt spinning the filaments is run. Consequently, friction texturing and melt spinning are difficult to perform in a single step. For this reason, the created POY is wound to a bobbin and then friction textured in a following step. This is substantially different from a common BCF yarn manufacturing process where stuffer box texturing is performed in the same step as the melt spinning and drawing as these processes run at same speeds. Further, it may be noted that friction textured yarns result in a helical three-dimensional crimp which is desirable for floor covering applications as it can provide more uniform bulk over the whole area of the material. Yarns textured using a stuffer box texturing lead to crimping that is highly non-uniform in nature. The friction texturing step may be carried out at between 500 m/min and 1000 m/min, preferably at below 700 m/min. It will be understood that by reducing the linear speed, the D/Y ratio can be increased.

[0013] The second step may be performed at appropriate conditions such as for a temperature and the D/Y ratio. The temperature for the drawing and texturing may be in a range between 130°C and 200°C, preferably between 170°C and 200°C, and more preferably between 180°C and 200°C. The D/Y ratio may be in a range between 1.5 and 2.5, preferably between 1.7 and 2.3, more preferably between 1.85 and 2. Conventional POY comprising low dpf filaments are believed to be unable to withstand such high transverse speeds of the friction disks and the resulting high false-twist in the texturing process. This would lead to unacceptable levels of breakage. In should be noted that in the second step, a final weight of the yarn is reduced to about 60% of the weight of the POY. Thus initial POY filaments of 10 dpf would be reduced to around 6 dpf. According to the present invention, it has been found that the heavier weight POY obtained in the first step is able to accept a much higher degree of texturing. At the end of the second step, the draw textured yarn may be wound again to the bobbin or the hank.

[0014] Only one POY may be textured and wound to the bobbin or the hank to create a single-density draw textured yarn. However, two, three or more POY may be simultaneously drawn and textured to create a double-density, triple-density or multi-density draw textured yarn. Double-density texturing with two POY twisted in opposite directions (S- and Z-twist) is preferred because it results in a draw textured yarn without residual torque. Further, the multi-density draw textured yarns have more bulk compared to the single-density draw textured yarn. A weight of the draw textured yarn may be in a range between 200 and 600 denier, preferably around 300 denier.

[0015] As an optional step following the second step, at least two draw textured yarns may be intermingled together to form a single ply. Preferably, four draw textured yarns are intermingled together. The yarns may be nipped or lightly twisted for improved overall stability of the ply but this is optional. The purpose of intermingling is to achieve a sufficiently high weight in the plies intended for the subsequent step. A weight of the intermingled draw textured ply may be in a range of 400 to 2400 denier, preferably greater than 500 denier, e.g. between 1000 and 1500 denier. Intermingling can also take without a separate step e.g. by combining multiple yarns exiting from the draw texturing process, without first winding to a bobbin. Nevertheless, a separate step is preferred, running independently of the draw texturing process, e.g. from bobbin to bobbin.

[0016] After the second step and the optional intermingling step, follows the third step wherein, at least two plies of the draw textured yarn are twisted and/or cabled together. Each of the plies may be greater than 500 denier. The twisting and/or cabling may be performed in a range between 30 and 400 twists per meter (TPM), preferably between 110 and

250 TPM, more preferably between 110 and 210 TPM. During the twisting, the yarn may be imparted with permanent and distinctive texture in the form of twists. It will be appreciated that twisting together a number of plies may be advantageous in terms of creating an additional bulk in the yarn.

[0017] The twisted draw textured yarn is subsequently heat set. The heat setting may be carried out in the same step of the method as the twisting and/or cabling e.g. by passage through a heated medium such as air, steam or a liquid. In the process, a heat is transferred from the medium to the twisted yarn as the yarn passes through a heat setting device. A temperature of the medium may be chosen such that the yarn does not melt. Alternatively, if the temperature of the medium is above the melting point of the yarn, then an exposure time, or a dwell time, is shortened to prevent the yarn from melting. The heat setting may be performed at a temperature in a range between 85°C and 200°C, preferably between 110°C and 190°C, more preferably between 160°C and 180°C. The dwell time may be in a range between 50 s and 80 s. It will be appreciated that heat setting stabilizes the twist in the yarn and eliminates undesirable torquing. Moreover, heat setting does not result in loss of resilience and overall appearance of the yarn. Discontinuous heat setting processes may also be applicable such as autoclaving.

[0018] After twisting and/or cabling, the yarn may also be subjected to a frieze process in order to provide additional bulk. The frieze process may be applied in a frieze box in a continuous process that includes both the twisting/cabling and the heat setting.

[0019] The high bulk continuous multifilament yarn obtained following the method described above has a bulk of at least 12 cm^3/gm, preferably at least 14 cm^3/gm and more preferably as least 16 cm^3/gm. This is significantly higher than for the conventional textured BCF yarns. The overall weight of the yarn will be greater than 1000 denier and generally will be greater than 1500 denier or even greater than 2000 denier. The present invention is advantageous as it provides yarn with high bulk resulting in lower consumption of raw material for manufacturing of an end product and consequently, reducing the manufacturing costs. The high bulk yarns of the present invention may result in 20-50% lower material consumption compared to conventionally bulked continuous filament yarns without affecting the properties of an end product such as the look, the feel and the coverage. Moreover, the high bulk yarns according to the present invention have been shown to have superior resilience compared to the conventional bulked continuous filament yarns. Bulk is measured using a standard bulkometer such as available from Wira Instrumentation Ltd. Measurement takes place with a 500g load applied over an area of 100 mm x 60 mm.

[0020] In another aspect of the present invention, a high bulk continuous multifilament yarn is provided wherein the high bulk continuous multifilament yarn is obtained using the method according to the first aspect of the present invention.

[0021] In a further aspect of the present invention, a high bulk continuous multifilament yarn is provided. The high bulk continuous multifilament yarn comprises a plurality of plies wherein, each ply further comprises at least one draw textured yarn. The draw textured yarn may be obtained using the method steps and processes described above and hereinafter. The draw textured yarn may refer to a yarn having a helical three-dimensional crimp. Alternatively or additionally, the draw textured yarn may comprise false twists wherein the false twists are obtained in a friction texturing process. The draw textured yarn may further comprise one or more partially oriented yarns (POY) wherein, each of the partially oriented yarns comprises a plurality of continuous filaments of polymer. A weight of the filaments of the POY may be greater than 7 dpf, or greater than 10 dpf, or greater than 12 dpf or even greater than 15 dpf prior to draw texturing. Upon draw-texturing the POY, draw textured filaments may have a final weight greater than 4 dpf, or greater than 6 dpf, or greater than 7.5 dpf or even greater than 9 dpf. A bulk of the high bulk continuous multifilament yarn may be at least 12 cm^3/gm, preferably at least 14 cm^3/gm, more preferably at least 16 cm^3/gm.

[0022] In preferred embodiments, the two or more plies of the high bulk continuous multifilament yarn are twisted and or cabled together and heat set. Optionally, they may be provided with an additional frieze treatment. The resulting high bulk continuous multifilament yarn may have an overall weight of greater than 1000 denier, preferably more than 1500 denier and more preferably greater than 2000 denier.

[0023] In an embodiment, the high bulk yarn according to the present invention comprises single-component filaments. In other words, the filaments forming the high bulk yarn are made of a single component or material. The high bulk single-component yarn according to an embodiment of the present disclosure would also be advantageous in terms of providing an easier end product to recycle. Preferred materials include polyesters including but not limited to a polyethylene terephthalate (PET) and a polybutylene terephthalate (PBT)

[0024] Alternatively, the high bulk yarn may be multi-component yarn. In this case, the filaments may be side by side or core-sheath filaments of two or more different materials. The filaments may comprise e.g. a combination of PET and PBT or any other suitable and beneficial combination of materials.

[0025] In a further aspect of the present invention, a floor covering material is provided comprising a base backing and a pile comprising the high bulk continuous multifilament yarn according to present invention. The floor covering material may include, but is not limited to, carpets, rugs, mats and so forth.

[0026] The high bulk yarn may be tufted into the base backing to form the floor covering material. Alternatively, the high bulk yarn may be knitted, knotted, or woven into the base backing to form the floor covering material.

[0027] In an embodiment, the high bulk yarn is cut to form a cut pile floor covering material. Alternatively, the high bulk yarn may be used in the form of a loop pile.

[0028] The floor covering materials according to present invention are advantageous with respect to similar, prior art materials as they offer soft feel, luxurious look, and higher resilience while lowering the weight and raw materials consumption of the end product.

Brief description of the drawings

[0029] The features and advantages of the present disclosure will be appreciated upon reference to the following drawings of an of exemplary embodiment, in which:

Figures 1A to 1E show in schematic view, steps of a method according to the invention;
Figure 2 shows a cross-section through a high bulk yarn produced according to the method of Figure 1; and
Figure 3 shows a cut-pile tufted carpet incorporating the yarn produced according to the method of Figure 1.

Description of embodiments

[0030] The following detailed description illustrates an embodiment of the present disclosure and ways in which they can be implemented. Although some modes of carrying out the present disclosure have been disclosed, those skilled in the art would recognise that other embodiments for carrying out or practising the present disclosure are also possible.

[0031] Figure 1 shows steps of a method for manufacturing a high bulk yarn according to an exemplary embodiment of the invention. It will be understood that the numbers and values given are of one specific example and many alternative process parameters may be applied.

[0032] In a first step, according to Figure 1A, a plurality of continuous filaments 1 of polyester are extruded from an extruder 10. The filaments 1 are quenched in a quench chamber 24 and drawn over rollers 20 for making a partially oriented yarn (POY) 2. The quench chamber 24 has an effective quench length E of 1.8 m and a quenching air speed in the chamber is set to 0.9 m/s for completing a process of cooling and solidifying the filaments 1. The effective quench length E is defined between the extruder 10 and spin finish applicators 18. The filaments 1 are spin-drawn to have a weight of 10 denier per filament (dpf). In total, 24 filaments 1 are wound together as the POY 2 to a first bobbin 3 with an overall denier of 240.

[0033] In a second step shown in Figure 1B, two first bobbins 3, each wound with the POY 2 of continuous polyester filaments 1, are combined together and draw-textured in a double-density friction texturing machine 40. The POYs 2 are guided by a number of rollers starting with input rollers 41 to friction disks 47. The friction disks 47 twist the POYs 2 in a section between the input rollers 41 and the friction disks 47. In the same section, the POY 2 passes through a first heater 43 that heats the twisted POYs 2 to a temperature of 180°C in order to set the twist. A D/Y ratio of 1.9 is used in the texturing process. Central rollers 45 are placed after the first heater 43 to draw the twisted POYs at a draw ratio of 1.7 and to form a draw textured yarn 4. Due to the draw texturing process, a weight of individual filaments of the draw textured yarn reduces to around 60% of the weight of the POY filaments 1 to a value of around 6 dpf. The draw textured yarn 4 is then guided to a second heater 49 and overfeed rollers 51 which cause the draw textured yarn 4 to overfeed in order for crimps to develop and set. The resulting draw textured yarn 4 with a weight of around 300 denier is wound to a third bobbin 6.

[0034] In Figure 1C are shown four third bobbins 6 carrying the draw textured yarn 4 which are intermingled in an intermingling jet 50 to form a single ply 5. The ply 5 has a weight of 1200 denier and is wound to a fourth bobbin 8. In this example, intermingling is performed as a separate step from bobbin to bobbin. This allows it to take place independently at an optimal speed. It will be understood that it can also be implemented at the back end of the draw-texturing step, with a number of draw textured yarns 4 being intermingled prior to winding to the third bobbin 6.

[0035] In a third step, shown in Figure 1D, two plies 5a,b from two fourth bobbins 8a,b are twisted/cabled together to form a high bulk yarn 7 having a weight of 2400 denier. A cover ply 5b is twisted around a core ply 5a by rotating a cover bobbin 8b around a core bobbin 8a as shown in the figure by rotation R. The core ply 5a remains untwisted in the process. The plies 5a,b are twisted/cabled at 110 twists per meter (TPM) and wound to a fifth bobbin 9.

[0036] In a next step, shown in Figure 1E, three fifth bobbins 9 with the high bulk yarn 7 are simultaneously guided to a frieze box 60 for achieving additional bulk and then to a heat setting tunnel 70 wherein the high bulk yarn 7 stabilizes at a temperature of around 170°C. Each of the three exiting heat-set high bulk yarns 7 is wound to a separate sixth bobbin 13.

[0037] Figure 2 shows a cross-section through the high bulk yarn 7 of Figure 1E, illustrating the two plies 5. Each of the plies 5 is formed of four draw textured yarns 4, wherein each of the draw textured yarns 4 is further composed of two POYs 2, each having 24 continuous filaments 1. It will be understood that the cross-section is purely illustrative and that in actual fact, the individual POYs will no longer be discernible.

[0038] Figure 3 shows a cut-pile tufted carpet 100. The carpet 100 has a woven backing 102, into which are tufted the high bulk yarns 7 as illustrated in Figures 1 and 2. The yarns 7 form upstanding threads 104.

Examples

[0039] The comparison between carpets made from yarns according to the present invention and the conventional yarns is shown in Table 1. In the table properties of the yarn such as a material, weight, weight of the filaments, and bulk are listed together with the properties of the carpet such as gauge, stitch rate and pile properties. The last columns show performances of each carpet in a Hexapod test as well as an overall rating of the carpet. The overall rating is assessed by a group of independent users who compared carpets based on their appearance and quality. All carpets are constructed to have approximately the same coverage of around 1050 grams per square meter (GSM) and consist of PET filaments. Further, the conventional carpets are compared with the carpets according to the present invention having a lower coverage. The assessment is performed using the conventional carpets as a standard and the independent users rated a feel and a look of the carpets according to the present invention with respect to the conventional carpets. The feel is linked to the coverage of the carpet as the lower coverage would result in users pressing onto a base backing of the carpet which is harsh and unpleasant to walk on. The look on the other hand is linked to the bulk of the carpet. High bulk of the yarn results in more luxurious look of the carpet.

[0040] The hexapod rating represents the rating achieved by the sample during the Hexapod drum test at 4000, 8000, and 12000 cycles. The Hexapod rating as referenced throughout the present specification is obtained using the D 5252 - 98a (2003) standard for the operation of the Hexapod tumble drum tester of 3.8 kg weight. The test was performed using a standard, upright type vacuum cleaner as supplied with the Hexapod drum tester. The Hexapod drum test include a rotating drum used as an instrument to test pile floor coverings. Carpet samples are placed in this rotating drum with a polyurethane studded metal ball to simulate the physical effects of traffic. This accelerated test provides a specific rating of the ability of the carpet to withstand crushing and matting.

[0041] The Hexapod test measures the resiliency of the carpets and, as shown in Table 1, the carpets according to the present invention are superior to the carpets with conventional PET yarns of similar denier-filament range. The 12000 Hexapod rating of the carpets comprising high bulk yarns is up to 2.5 while the conventional carpets show a rating of only 1. The results show that the fibres are less likely to collapse upon longer use due to a higher bulk that prevents fibre-crashing.

[0042] Yarn bulk is measured in units of cc/gm which is reversed to the unit of density. The bulk is measured using a Yarn Bulkometer by WIRA instrumentation having a chamber of size 100x60 mm. In the process, an aligned hank of yarn with known weight and length is placed inside the bulkometer. The chamber is closed and the hank is pressed with an evenly distributed weight of 0.5 kg. A volume of the measured portion of the hank is measured and the bulk is calculated as a ratio of the volume and the weight per unit of length.

[0043] As shown in the Table 1, the high bulk yarn according to the present invention clearly exhibits much higher bulk values compared to the conventional BCF yarns available in the similar denier range. Additionally, it is observed that the yarns according to the present invention offer comparable or slightly improved results even when the constructed carpets have much lower gsm than the conventional carpets. The rows 9-11 in Table 1 show carpets made with relatively low coverage of only 800 gsm compared to carpets with regular PET BCF yarns having the coverage of 1040 gsm. However, both, the user assessment and the Hexapod rating, show comparable or even better results of the carpets according to the present invention. Therefore, the high bulk yarns according to the present invention may be advantageous over the other products even with lower values of the coverage. It should be noted that the improved results are achieved for both the frieze and the straight yarns.

[0044] Thus, the invention has been described by reference to certain examples discussed above. It will be recognized that these embodiments are susceptible to various modifications and alternative forms well known to those of skill in the art. In particular, different initial filament weights may be employed according to the intended use. Many modifications in addition to those described above may be made to the structures and techniques described herein without departing from the spirit and scope of the invention. Accordingly, although specific embodiments have been described, these are examples only and are not limiting upon the scope of the invention.

Table 1: Comparison of properties between regular products and high bulk yarn of the present disclosure

Yarn Details					Final Yarn Bulk (cc/gm)	Carpet Construction					Hexapod rating			Carpet Bulk and coverage after backcoating
Type	Denier	Filament	DPF	Twist & HS		Guage	Stitch	Pile Height (mm)	GSM	Cut/ Loop	4000	8000	12000	
PET BCF	1200	120	10	2 ply 188Z Friese Heat Set	10,5	1/8’	48	12	1040	Cut	3,5	1	1	Standard
PET BCF	1325	144	9	2 ply 185S Friese Heat Set	11,5	1/8’	48	12	1040	Cut	3,5	1	1	Standard
High Bulk	1200	190	6,3	2 ply 190Z Friese Heat set	16,6	1/8’	31	16	1050	Cut	4	3,5	2.5/2	Significantly higher bulk and more coverage
						1/8’	36	14		Cut	3,5	3	2/1.5	Significantly higher bulk and more coverage
						1/8’	42	12		Cut	4.0/3.5	2.5/2.0	2	Significantly higher bulk and more coverage
						1/8’	26	16	900	Cut	3	2,5	1	Higher bulk and coverage
						1/8’	30	14		Cut	3,5	3/2.5	2/1.5	Higher bulk and coverage
						1/8’	39	12		Cut	3	2,5	1,5	Higher bulk and coverage
						1/8’	23	16	800	Cut	3,5	2.5/2	1	Comparable
						1/8’	26	14		Cut	3,5	2,5	1,5	Comparable
						1/8’	34	12		Cut	3	1.5/1.0		Higher bulk and coverage
	1200	190	6,3	2 ply 190Z Straight Heat set	16,3	1/8’	31	16	1050	Cut	4	3,5	2.5/2	Significantly higher bulk and more coverage

Claims

1. A method of manufacturing a high bulk continuous multifilament yarn, comprising:

   in a first step, melt spinning a plurality of filaments of polymer to form a partially oriented yarn wherein a weight of the filaments is greater than 7 dpf;
   in a second step, drawing and texturing one or more partially oriented yarns in a friction texturing process to form a draw textured yarn; and
   in a third step, twisting and/or cabling at least two plies of the draw textured yarn together and heat setting the twisted plies to obtain the high bulk continuous multifilament yarn.

2. The method according to claim 1, wherein the method includes an intermediate step after the second step, wherein at least two and optionally four draw textured yarns are intermingled together to form a single ply of draw textured yarn.

3. The method according to claim 1 or 2 wherein, the drawing and texturing is performed at a temperature in a range between 130°C and 200°C.

4. The method according to any preceding claim wherein, the twisting and/or cabling is performed in a range between 30 and 400 twists per meter (TPM).

5. The method according to any preceding claim wherein, the heat setting is performed at a temperature in a range between 85°C and 200°C.

6. The method according to any preceding claim wherein, the first step includes quenching of the partially oriented yarn and wherein, an effective quench length is in more than 1.2 m, preferably more than 1.5 m or more than 1.8 m.

7. The method according to any preceding claim, wherein the plies of draw textured yarn each have a weight of more than 500 denier.

8. The method according to any preceding claim wherein, the high bulk yarn has a bulk of at least 12 cm^3/gm, preferably at least 14 cm^3/gm and more preferably at least 16 cm^3/gm.

9. The method according to any preceding claim further comprising applying a frieze to the high bulk continuous multifilament yarn, preferably in a frieze box.

10. The method according to any preceding claim wherein, the polymer includes at least one of a polyethylene terephthalate (PET) and a polybutylene terephthalate (PBT).

11. The method according to any preceding claim wherein, the filaments are single component filaments.

12. The method according to any preceding claim wherein, the friction texturing is carried out at a diameter to yarn speed (D/Y) ratio of greater than 1.5, preferably greater than 1.7 and more preferably greater than 1.9.

13. A high bulk continuous multifilament yarn obtainable using the method according to any one of the preceding claims.

14. A high bulk yarn comprising a plurality of plies wherein, each ply further comprises at least one draw textured yarn and wherein, the at least one draw textured yarn further comprises one or more partially oriented yarns, each comprising continuous filaments of polymer wherein,

    a weight of the filaments is greater than 4 dpf;
    the at least one draw textured yarn is friction textured to have a helical texture;
    the plurality of plies are twisted and/or cabled together and heat set, and
    the bulk of the high bulk yarn is at least 12 cm^3/gm.

15. The high bulk yarn according to claim 14, wherein the filaments are single-component filaments.

16. The high bulk yarn according to claim 14 or claim 15, having a weight of at least 1000 denier.

17. The high bulk yarn according to any one of claims 14-16, wherein the high bulk yarn has a bulk of at least 16 cm^3/gm.

18. The high bulk yarn according to any one of claims 14-17, wherein the polymer includes at least one of a polyethylene terephthalate (PET) and a polybutylene terephthalate (PBT).

19. A floor covering material comprising:

a base backing; and
a pile comprising the high bulk yarn according to any one of claims 13-18.

20. The floor covering material according to claim 19 wherein, the high bulk yarn is tufted, knitted, knotted and/or woven to the base backing.

21. The floor covering material according to claim 19 or 20 wherein, the high bulk yarn is cut to form a cut pile floor covering material.

Fig. 1A

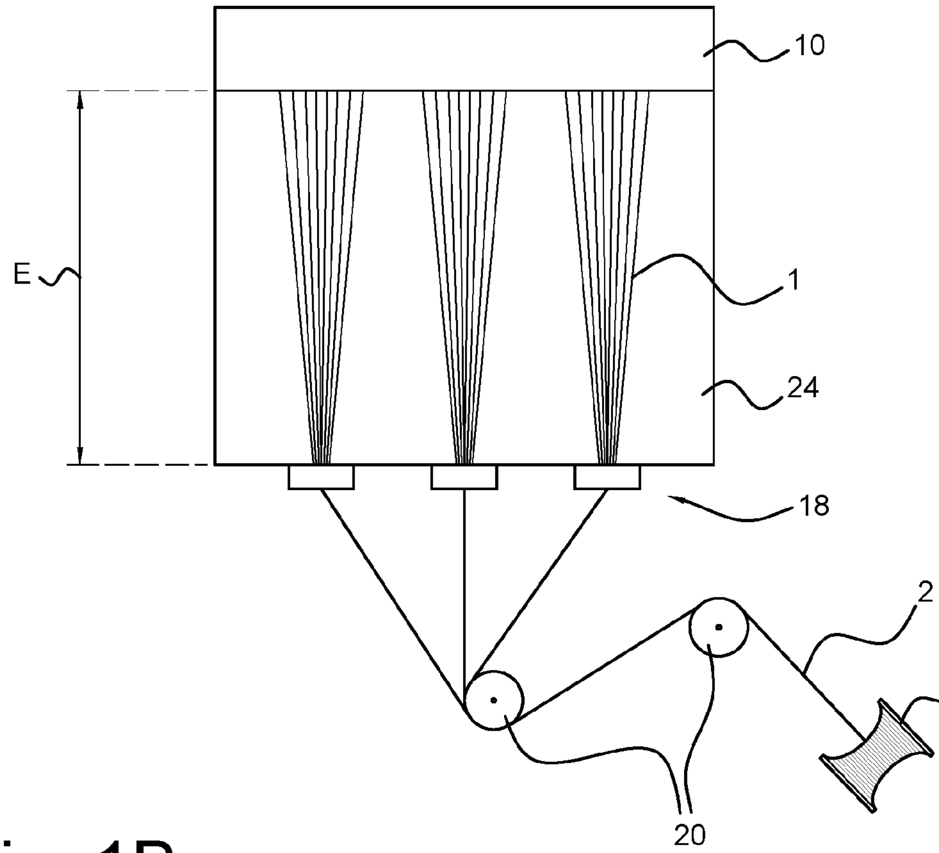


Fig. 1B

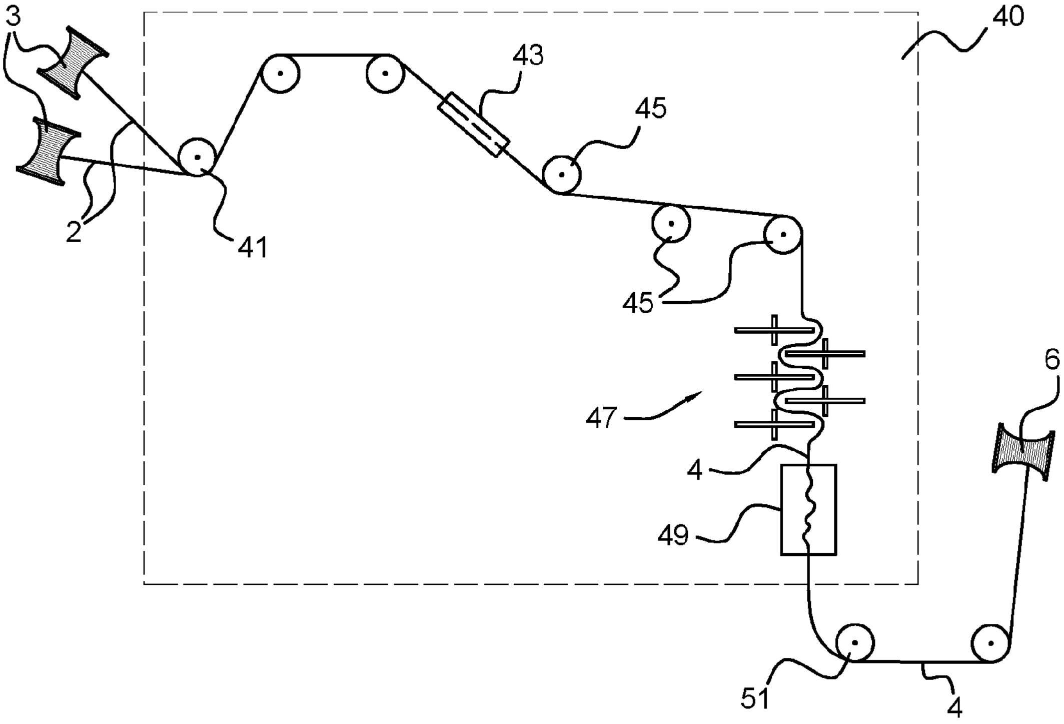


Fig. 1C

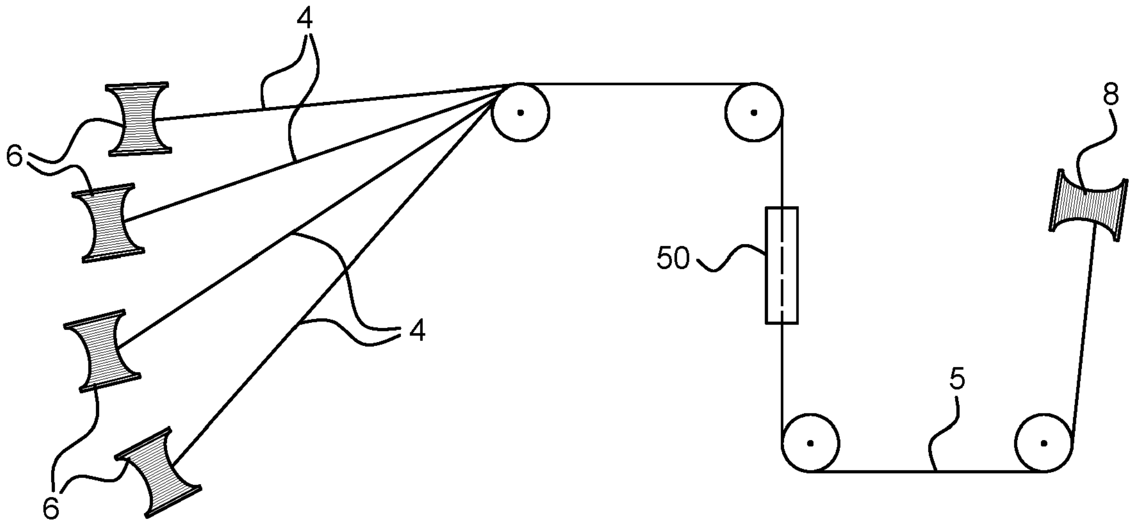


Fig. 1D

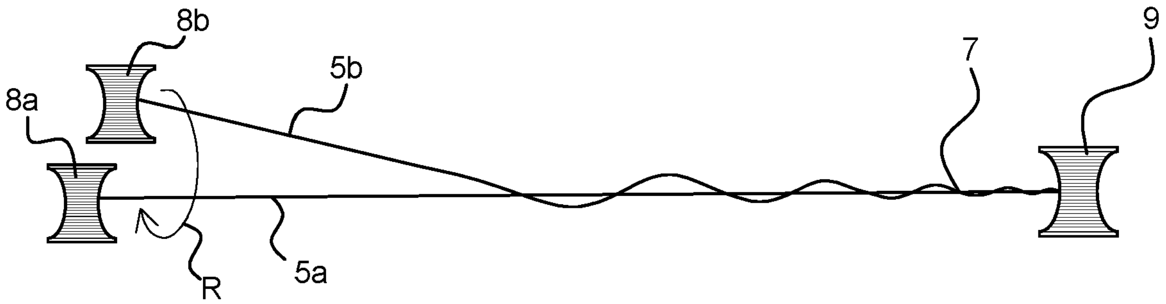


Fig. 1E

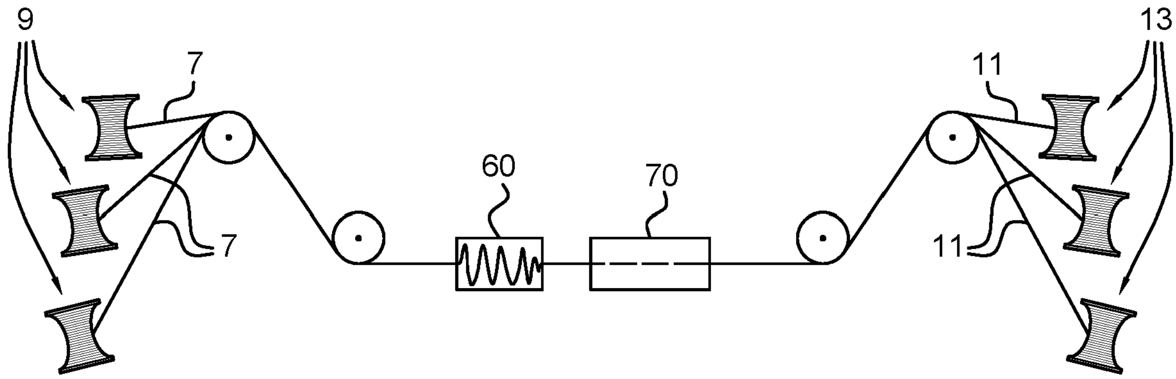


Fig. 2

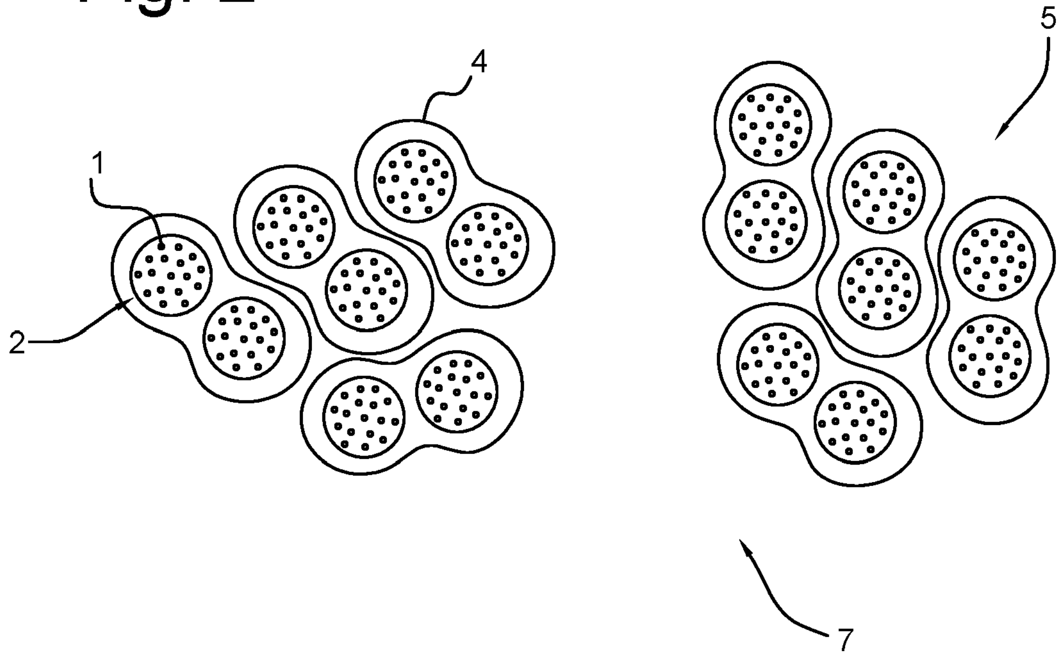
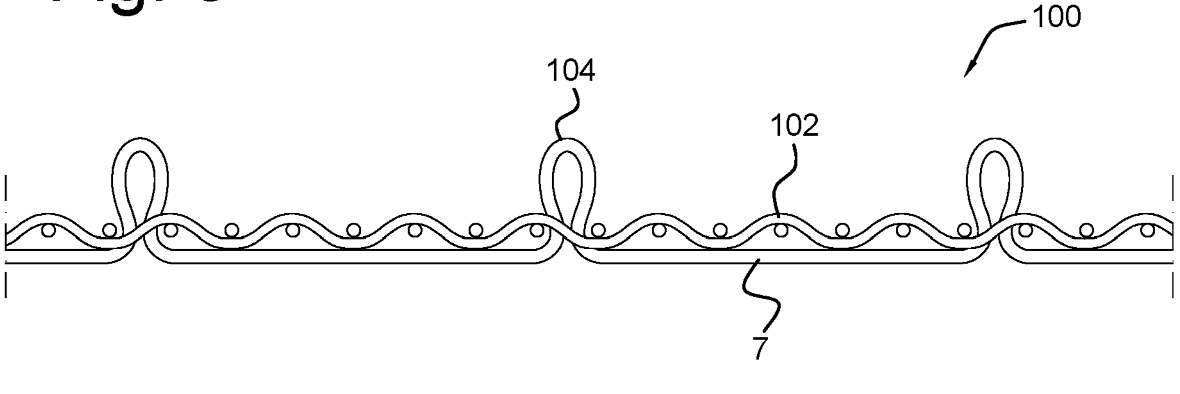


Fig. 3



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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 7061

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X Y	EP 0 646 665 A1 (DU PONT [US]) 5 April 1995 (1995-04-05) * abstract * * page 3, line 33 - line 52 * * page 3, line 56 - page 4, line 15 * * page 4, line 19 - line 20 * * page 5, line 7 - line 10 * * page 33, line 45 - line 50 * * example 1 * -----	1,3-8, 11-17, 19-21 2,9,10, 18	INV. D02G3/24 D01D10/02 D02G3/44 D01D5/22 D02G1/20
Y	US 2004/175534 A1 (BRIDGES JAMES C [US] ET AL) 9 September 2004 (2004-09-09) * abstract * * paragraph [0057] * * figure 5 * -----	2	
Y	EP 0 547 176 B1 (DU PONT [US]) 24 May 1995 (1995-05-24) * page 3, line 14 - line 27 * * page 5, line 18 - line 19 * * figure 3 * -----	2,9	TECHNICAL FIELDS SEARCHED (IPC)
Y	EP 0 767 846 B1 (DU PONT [US]) 16 August 2001 (2001-08-16) * abstract * * paragraph [0021] * -----	10,18	D02G D01F D01D D02J
Y	EP 0 848 095 A1 (BASF CORP [US]) 17 June 1998 (1998-06-17) * abstract * * column 1, line 1 - column 2, line 11 * * column 4, line 50 - column 6, line 12 * * figures 1-2 * -----	10,18	
A	US 4 343 146 A (NELSON THOMAS L) 10 August 1982 (1982-08-10) * abstract; figure 1 * ----- -/--	1	

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	19 December 2022	Humbert, Thomas

CATEGORY OF CITED DOCUMENTS

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 7061

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 01/71072 A1 (TORAY INDUSTRIES [JP]; MATSUOKA HIROSHI [JP] ET AL.) 27 September 2001 (2001-09-27) * abstract; figure 4 * -----	1	
A	EP 3 423 618 B1 (GUPTA RONAK RAJENDRA [IN]) 11 August 2021 (2021-08-11) * the whole document * -----	1-18	

TECHNICAL FIELDS SEARCHED (IPC)

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 December 2022	Humbert, Thomas

1

CATEGORY OF CITED DOCUMENTS

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 22 18 7061

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19-12-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0646665 A1	05-04-1995	AU 7297694 A	13-04-1995
		CA 2132082 A1	31-03-1995
		EP 0646665 A1	05-04-1995
		JP H07150428 A	13-06-1995
		US 5414987 A	16-05-1995
US 2004175534 A1	09-09-2004	AT 390273 T	15-04-2008
		AU 2003297919 A1	29-07-2004
		CA 2511113 A1	22-07-2004
		DK 1594686 T3	14-07-2008
		EP 1594686 A2	16-11-2005
		JP 2006512177 A	13-04-2006
		NZ 540930 A	25-11-2005
		TW 200422478 A	01-11-2004
		US 2004175534 A1	09-09-2004
		WO 2004061189 A2	22-07-2004
EP 0547176 B1	24-05-1995	AU 650067 B2	09-06-1994
		CA 2090621 A1	08-03-1992
		DE 69110048 T2	23-11-1995
		EP 0547176 A1	23-06-1993
		JP H06501063 A	27-01-1994
		US 5175038 A	29-12-1992
		WO 9204486 A1	19-03-1992
EP 0767846 B1	16-08-2001	AT 204345 T	15-09-2001
		CA 2189548 A1	11-01-1996
		DE 69522226 T2	02-05-2002
		DK 0767846 T3	22-10-2001
		EP 0767846 A1	16-04-1997
		ES 2161295 T3	01-12-2001
		GR 3036590 T3	31-12-2001
		JP 3853357 B2	06-12-2006
		JP 4347862 B2	21-10-2009
		JP H10502139 A	24-02-1998
		JP 2006283273 A	19-10-2006
		PT 767846 E	30-11-2001
		TW 288052 B	11-10-1996
		US 5645782 A	08-07-1997
		US 5662980 A	02-09-1997
		US 6242091 B1	05-06-2001
		US 2001021433 A1	13-09-2001
		US 2005060980 A1	24-03-2005
		WO 9600808 A1	11-01-1996
EP 0848095 A1	17-06-1998	AU 4836097 A	18-06-1998

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

EP 22 18 7061

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The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

19-12-2022

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
		CA 2215889 A1	13-06-1998
		EP 0848095 A1	17-06-1998
		US 5804115 A	08-09-1998
US 4343146 A	10-08-1982	CA 1159240 A	27-12-1983
		DE 3112247 A1	01-04-1982
		FR 2479284 A1	02-10-1981
		GB 2072728 A	07-10-1981
		IT 1136876 B	03-09-1986
		NL 8101519 A	16-10-1981
		US 4343146 A	10-08-1982
WO 0171072 A1	27-09-2001	CN 1380918 A	20-11-2002
		EP 1193336 A1	03-04-2002
		KR 20020010668 A	04-02-2002
		TW 480298 B	21-03-2002
		US 2003041586 A1	06-03-2003
		WO 0171072 A1	27-09-2001
EP 3423618 B1	11-08-2021	AU 2016404407 A1	22-11-2018
		CN 109072496 A	21-12-2018
		EP 3423618 A1	09-01-2019
		ES 2897996 T3	03-03-2022
		LT 3423618 T	10-12-2021
		PT 3423618 T	17-11-2021
		US 2019040552 A1	07-02-2019
		US 2020190709 A1	18-06-2020
		US 2021017677 A1	21-01-2021
		US 2021032783 A1	04-02-2021
		WO 2017187248 A1	02-11-2017

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82