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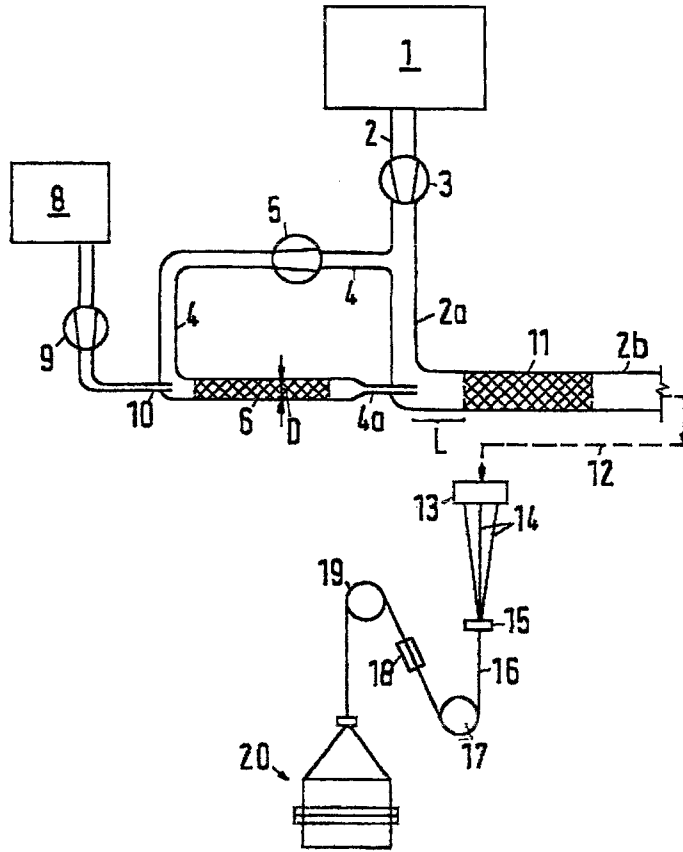
TITLE OF INVENTION	
54	METHOD FOR PRODUCING SYNTHETIC THREADS FROM A POLYMER BLEND BASED ON POLYESTER

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FOR ABSTRACT SEE THE NEXT SHEET



WO 01/90453 A1



(57) Abstract: A first stream of a polyester melt is subdivided into a second and a third polyester stream, whereby the throughput of the first stream lies between 100 and 2000 kg/h and the throughput of the second polyester stream lies between 5 and 300 kg/h. An additive polymer melt is introduced into the second polyester stream through a first mixing section (6), at a rate of between 0.2 and 100 kg/h. A first polymer blend with an additive polymer content of between 3 and 50 wt.-% is obtained. The first polymer blend is fed into the third polyester stream, said first blend and third polyester stream being guided through a second mixing section (11) to form a second polymer blend. The second polymer blend is spun into filaments (14), which are cooled and combined into threads (16). The threads are drawn at a speed of at least 1000 m/min. Said threads are subsequently processed either into continuous filament or staple fibres.

METHOD FOR PRODUCING SYNTHETIC THREADS  
FROM A POLYMER BLEND BASED ON POLYESTER

Description

This invention relates to a process of producing synthetic threads from a polyester-based polymer mixture. The threads can on the one hand be used as continuous threads or be processed to obtain staple fibres.

Spinning modified polymers is known and described e.g. in EP-A-0,860,524. A mixing means for mixing a polymer melt with a liquid or gaseous additive is known from EP-A-0,766,996. Processing polymer mixtures to obtain filaments is described in WO 99/07927.

Normally, the design of mixing systems is uncritical. However, polymer mixtures for the purpose of increasing the elongation when spinning threads at high speed require certain measures with respect to the mixing efficiency, in order to obtain a homogeneous and finely dispersed mixture and at the same time provide for a thermally stable processing.

When producing polymer mixtures in large extruder spinning plants or direct spinning plants, in which the matrix polymer melt is urged into at least one spinning line and is exposed to high dwell times, mixing faults, thread faults and processing faults must be largely excluded to ensure a high quality of the end product produced. In particular in the case of certain additives, the high thermal load in such plants leads to a breakdown of the polymer, which results in a disturbing content of low-molecular breakdown products and also visible discolorations in the end product. WO 99/57348 reports about polymer mixtures whose additives lead to an unacceptable yellowing of the textile thread. Even when adding a phosphorus stabilizer, perfect spools were at first obtained in the pilot

plant, but then in the production plant with a distinctly higher dwell time of the melt the yarn appears yellowish.

The threads produced are on the one hand processed to obtain staple fibres, and on the other hand flat or bulky textile threads can be produced from the flat threads. When textile threads are desired, unwinding speeds between 2500 and 3600 m/min have so far been employed, in dependence on the titer to be produced. Such POY threads have elongations at break of 85 to 165 %, which turned out to be advantageous for the further processing in a stretching process or stretch texturizing process. With increasing unwinding speed the elongation at break of the thread is known to be reduced, and the minimum elongation at break necessary for processing is no longer ensured. Only by polymer modifications and in particular specific polymer mixtures can a desired elongation at break be adjusted also at high unwinding speeds. It was found out, however, that the amount of additive to be added must be increased considerably with increasing unwinding speed or under spinning conditions which lead to low elongations at break.

It is the object underlying the invention to create the increase of the elongation at break for polyester-based spun threads in high-capacity spinning plants in an economically optimized way. At the same time, the breaking elongation values required for further processing in a stretching process or stretch texturizing process should also be adjustable at high spinning speeds. Furthermore, an improved spooling behavior and a reduction of faults in the spooled thread should be obtained, so that e.g. a high uniformity is ensured when dyeing the textile thread upon further processing.

In accordance with the invention, this object is solved in that

- a) a first stream of a polyester melt is divided into a second and a third polyester stream, the amount of the first stream being 100 to 2000 kg/h and the amount of the second polyester stream being 5 to 300 kg/h,

- b) 0.2 to 100 kg/h of a molten additive polymer are metered to the second polyester stream, and the additive polymer together with the polyester is passed through a first mixing line consisting of a line with flow obstacles and a first polymer mixture is formed, whose content of additive polymer is 3 to 50 wt-%, preferably larger than 5 to 30 wt-%, and the ratio of the melt viscosity of the additive polymer and of the polyester of the first stream is 0.8:1 to 10:1,
- c) the first polymer mixture is passed through a line portion and is introduced into the third polyester stream, and that the first mixture together with the third polyester stream is passed through a second mixing line consisting of a line with flow obstacles and a second polymer mixture is formed, and
- d) the second polymer mixture is extruded to obtain filaments, the filaments are cooled and combined to form threads, and the threads are unwound with a speed of at least 1000 m/min.

Preferably, the additive polymer is amorphous and insoluble in the polyester matrix. It usually has a glass transition temperature of 90 to 200°C. The glass transition temperature is determined in a known manner by differential scanning calorimetry (cf. WO 99/07927). This amorphous polymer is suitable for thermoplastic processing. Expediently, the additive polymer is kept in the molten condition for a dwell time of 0.1 to 5 minutes, before it gets in contact with the second polyester stream upon leaving the extruder. During this dwell time, a metering pump is used for supplying the additive polymer from an extruder to the point of introduction into the second polymer stream. Furthermore, it is expediently ensured that upon leaving the extruder the additive polymer is kept in the molten condition for a dwell time of 0.2 to 7 minutes, before it gets in contact with the third polyester stream. Expediently, the dwell time of the second polymer mixture until entry in the package of spinning nozzles is less than 15 min. The dwell times are adjusted in a known manner by corresponding choice of the product line dimensions and the melt flow rate and determined as mean dwell time.

The additive polymer is chosen such that the ratio of the melt viscosities of the additive polymer and of the polyester of the first stream is 0.8:1 to 10:1 and preferably 1.5:1 to 8:1. The melt viscosity is measured in a known manner by means of an oscillation rheometer at an oscillation frequency of 2.4 Hz and a temperature which is equal to the melting temperature of the polyester plus 34°C. For polyethylene terephthalate, the temperature for measuring the melt viscosity is about 290°C. Details are found in WO 99/07927. The melt viscosity of the additive polymer preferably is higher than that of polyester, and it was found out that the choice of a specific viscosity range for the additive polymer and the choice of the viscosity ratio contributes to an optimization of the properties of the thread produced. With an optimized viscosity ratio the amount of the addition of additive polymer can be minimized, whereby the economy of the process is improved. The polymer mixture to be spun usually contains 0.05 to 5.0 wt-% additive polymer.

By choosing the favorable viscosity ratios in connection with the inventive division of the melt streams there is achieved a narrow distribution of the particle sizes of the additive polymer in the polyester matrix with the desired fibril structure of the additive polymer in the thread. The high glass transition temperature of the additive polymer as compared to polyester ensures a rapid stabilization of this fibril structure in the filament. The maximum particle sizes of the additive polymer directly upon leaving the spinning nozzle are about 1000 nm, whereas the mean particle size is 400 nm or less. Upon drafting the thread, the favorable fibril structure is achieved, where the threads contain at least 60 wt-% of the additive polymer in the form of fibrils with lengths in the range from 0.5 to 20  $\mu\text{m}$  and diameters in the range from 0.01 to 0.5  $\mu\text{m}$ . When using a draft of 50 to 200 or preferably 70 to 160, spooling becomes particularly favorable.

The additive polymer may for instance be chosen from one of the below-mentioned groups of substances:

1st group of substances:

A copolymer which contains the following monomer units:

A = acrylic acid, methacrylic acid or  $\text{CH}_2=\text{CR}-\text{COOR}'$ , where R is an H atom or a  $\text{CH}_3$  group and R' is a  $\text{C}_{1-15}$  alkyl radical or a  $\text{C}_{5-12}$  cycloalkyl radical or a  $\text{C}_{6-14}$  aryl radical,

B = styrene or  $\text{C}_{1-3}$ -alkyl-substituted styrenes,

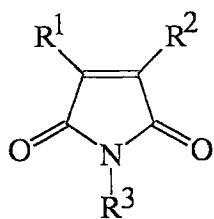
where the copolymer consists of 60 to 98 wt-% A and 2 to 40 wt-% B, preferably of 83 to 98 wt-% A and 2 to 17 wt-% B, and particularly preferably of 90 to 98 wt-% A and 2 to 10 wt-% B (sum = 100 wt-%).

2nd group of substances:

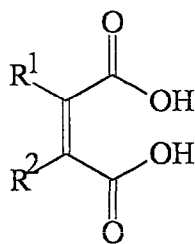
A copolymer which contains the following monomer units:

C = styrene or  $\text{C}_{1-3}$ -alkyl-substituted styrenes

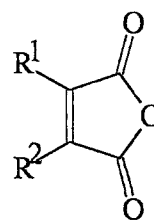
D = one or more monomers of formula I, II or III



(I)



(II)



(III)

where  $\text{R}_1$ ,  $\text{R}_2$  and  $\text{R}_3$  each are an H atom or a  $\text{C}_{1-15}$  alkyl radical or a  $\text{C}_{6-14}$  aryl radical or a  $\text{C}_{5-12}$  cycloalkyl radical,

where the copolymer consists of 15 to 95 wt-% C and 2 to 80 wt-% D, preferably of 50 to 90 wt-% C and 10 to 50 wt-% D, and particularly preferably of 70 to 85 wt-% C and 15 to 30 wt-% D, the sum of C and D together making 100 wt-%.

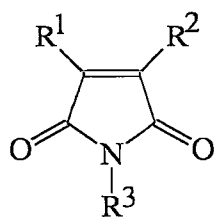
3rd group of substances:

A copolymer which contains the following monomer units:

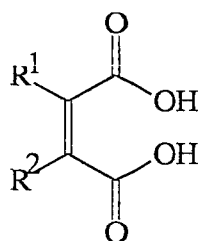
E = acrylic acid, methacrylic acid or  $\text{CH}_2=\text{CR}-\text{COOR}'$ , where R is an H atom or a  $\text{CH}_3$  group, and R' is a  $\text{C}_{1-15}$  alkyl radical or a  $\text{C}_{5-12}$  cycloalkyl radical or a  $\text{C}_{6-14}$  aryl radical,

F = styrene or  $\text{C}_{1-3}$ -alkyl-substituted styrenes,

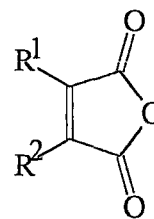
G = one or more monomers of formula I, II or III



(I)



(II)



(III)

where  $\text{R}_1$ ,  $\text{R}_2$  and  $\text{R}_3$  each are an H atom or a  $\text{C}_{1-15}$  alkyl radical or a  $\text{C}_{5-12}$  cycloalkyl radical or a  $\text{C}_{6-14}$  aryl radical,

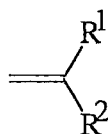
H = one or more ethylenically unsaturated monomers copolymerizable with E and/or with F and/or G, from the group including  $\alpha$ -methylstyrene, vinyl acetate, acrylic esters, methacrylic esters, which are different from E, vinyl chloride, vinylidene chloride, halogen-substituted styrenes, vinyl ethers, isopropenyl ethers and dienes,



where the copolymer consists of 30 to 99 wt-% E, 0 to 50 wt-% F, >0 to 50 wt-% G and 0 to 50 wt-% H, preferably of 45 to 97 wt-% E, 0 to 30 wt-% F, 3 to 40 wt-% G and 0 to 30 wt-% H, and particularly preferably of 60 to 94 wt-% E, 0 to 20 wt-% F, 6 to 30 wt-% G and 0 to 20 wt-% H, the sum of E, F, G and H together making 100 wt-%.

4th group of substances:

A polymer from the following monomer unit:



where  $R_1$  and  $R_2$  are substituents consisting of the optional atoms C, H, O, S, P and halogen atoms, and the sum of the molecular weight of  $R_1$  and  $R_2$  is at least 40 (e.g. polystyrene or polymethyl methacrylate).

Details of the production of these substances are described in WO 99/07927.

Embodiments of the process are explained with reference to the drawing.

Fig. 1 shows a flow diagram of the process,

and

Fig. 2 shows an example of a pump unit for joining the second polyester stream with the additive polymer in a schematic representation.

As shown in Fig. 1, polyester melt as base polymer comes from a reservoir (1), which may be an extruder or a polycondensation reactor. The polyester stream, here referred to as "first stream", at temperatures of 230-330°C, which are distinctly above its melting point, first of all flows through line (2) under the pressure of the extruder or under the influence of the first pump (3) to a branching point from which line (4) branches off. When the melt optionally flows through filters, booster pumps or heat exchangers, the branching point preferably is behind the heat exchanger, which cools the polymer stream by about 2 to 15°C. Under the

influence of the second pump (5), the part of the polyester which here is referred to as "second polyester stream" flows to a first mixing line (6), which is used as static mixer.

Melt of the additive polymer comes from an extruder (8) and at its outlet has a temperature which is 5 to 70°C and preferably at least 10°C lower than the temperature of the first polyester stream. Expediently, it is ensured that the monomer content in the additive polymer leaving the extruder is not more than about 0.6 wt-%. This may be achieved e.g. by a correspondingly selected raw product or also by degassing in the extruder. Under the influence of the third metering pump (9), the additive polymer is supplied to a metering point (10), where it enters the second polymer stream.

Mixing in the first mixing line (6) is effected by means of flow obstacles (e.g. mixing elements SMX, firm Sulzer). The tube in the middle of the mixing line (6) has the inside diameter (D), measured with empty line. A first polymer mixture leaves the mixing line (6) and flows through a mixer-free line portion (4a) into the third polyester stream, which moves through line (2a). The first polymer mixture moves along a flow line of the length (L) in contact with the third polyester stream until it reaches the flow obstacles of the second mixing line (11). It is expediently ensured that  $L \geq 2D$  and/or the diameter within the length L has a tapered cross-section to increase the polymer flow speed. The first mixture from the line portion (4a) together with the third polyester stream is then passed through the second mixing line (11), which likewise constitutes a static mixer. At the end of the second mixing line (11) a second polymer mixture has formed, which leaves the mixing region through the line portion (2b) and in a manner known per se is divided over various spinning points. Preferably, the length of the first mixing line (6) and of the second mixing line (11) is 6 to 15 times as large as the inside diameter of the line portion in which the mixing line is provided.

In the drawing, a spinning point is indicated schematically, to which part of the second polymer mixture is supplied through line (12) represented in broken lines. The polymer mixture is extruded through the spinning package (13), there are

formed numerous filaments (14), which are cooled, combined and provided with spinning oil (15). When it is desired to produce textile threads, the thread (16) formed runs over a first galette (17), then through an interlacing means (18) to a second galette (19). The unwinding speed for the thread, defined as peripheral speed of the galette (17), in this case is at least 3500 m/min and preferably lies in the range from 4000 to 9000 m/min. The thread runs to a spooling means (20) known per se, where it is spooled. The draft ratio, i.e. the ratio of the unwinding speed to the extrusion speed at the nozzle outlet, advantageously is 50 to 200, with which e.g. for POY threads a good spooling behavior is achieved.

The further processing of the thread to obtain the textile thread is known per se and not represented in the drawing. The thread is subjected to a stretching or stretch texturizing process, in which the elongation at break is reduced from at first 85 to 180 % to about 15 to 45 %. For the case of the production of staple fibres the threads are unwound at speeds of at least 1000 m/min over galettes and first of all coiled in cans. The further processing is effected in a known manner in a fibre line.

As shown in Fig. 2, a pump unit (25) is employed, to which the additive polymer is supplied through line (9a) and the second polyester stream is supplied through the branch lines (4a, 4b, 4c). In the present schematic representation, the unit includes the individual metering pumps (9) as well as (5a), (5b) and (5c). The metering pumps may be designed as jointly driven chambers of a planet wheel pump which is described in DE 19841376 A1. The unit feeds the mixture produced therein into the first mixing line (6).

### Example 1

As shown in Fig. 1, the procedure is as follows:

A melt of polyethylene terephthalate is discharged from a reactor with an intrinsic viscosity of 0.64 dl/g, corresponding to a melt viscosity at 290°C of 250 Pa·s, and a temperature of 282°C and is moved through the melt line by means of a booster

pump with a pressure of 205 bar. The melt flows through a filter with a fineness of 20  $\mu\text{m}$  and through a heat exchanger which cools the temperature of the melt from 292°C to 288°C. This first stream with a flow rate of 423.0 kg/h is divided and branched into the second stream with a flow rate of 21.18 kg/h, corresponding to 5.0 wt-% of the first stream, and into the third stream with a flow rate of 401.82 kg/h.

There is used a copolymeric additive of the 1st group of substances, containing 91 wt-% methyl methacrylate and 9 wt-% styrene with a melt viscosity, measured at 290°C, of 1100 Pa·s. The additive predried to a residual moisture of < 0.1 wt-% is molten in an extruder with degassing, supplied to a metering pump (9) at a melt temperature of 255°C and added to the second stream in line (4) with a flow rate of 2.115 kg/h. The subsequent mixing (mixing line 6) is effected in a first mixer of the type SMX of the firm Sulzer/CH, with an inside diameter of 26.5 mm and a length of 160 mm. The dwell time of the additive melt from the outlet of the extruder until contact with the second partial stream is 2.9 min. The first mixture has a content of additive polymer of 9 wt-%.

The first mixture is introduced into the third polyester stream and after a flow length  $L = 910$  mm supplied to a second mixer (11) with an inside diameter of 65 mm and a length of 910 mm, homogenized therein and dispersed.

The dwell time of the additive polymer from the outlet of the extruder until contact with the third polyester stream is 3.5 min.

By means of product lines, the second polymer mixture is distributed over 20 spinning positions, each position including 6 packages of spinning nozzles. The dwell time of the second polymer mixture until entry in the spinning package is 5 min. Each spinning package contains a round nozzle with 34 holes of the diameter 0.25 mm and the length of 2 times the diameter. Furthermore, the spinning package contains a spinning filter package above the nozzle plate, comprising a steel sand package having a height of 30 mm and a grain size of 0.35 to 0.50 mm as well as a microfine gauze having a pore diameter of 40  $\mu\text{m}$  and a steel web filter having a pore diameter of 20  $\mu\text{m}$ . The cross-sectional area of the spinning

filter package is 40 cm<sup>2</sup>. The dwell time of the melt in the filter package is about 1.8 min. During passage of the melt mixture a nozzle pressure of 145 bar is obtained, which is slightly lower than in the case of a PET melt without additive. The heating of the spinning package was adjusted to 288°C.

The molten filaments extruded from the nozzle holes are cooled by means of blow air flowing in horizontally with respect to the course of the thread with a speed of 0.5 m/sec and a temperature of 19°C and are bundled in an oiling stone (15) at a distance of 1400 mm from the nozzle plate and coated with spinning oil.

A pair of galettes enlaced in an S-shaped manner unwinds the thread with a speed of 4320 m/min, where a draft ratio of 149 is adjusted. Between the galettes an interlacing nozzle (18) is installed, which is closed in the case of a normal course of the thread and with an air pressure of 4.0 bar impresses a number of interlacing knots of 12 knots/m on the thread. The thread tension at the inlet of the interlacing nozzle is adjusted to 0.15 g/den.

Six threads each of one spinning position are spooled to form spool packages in a spooler, where the speed of 4290 m/min was chosen such that the thread tension before spooling is 0.10 g/den.

There were obtained preoriented (POY) threads, characterized by a titer of 128 den, a tear strength of 2.5 g/den and an elongation at break of 117 %. The POY spools were stretch-texturized in a Barmag texturizing machine, type FK6, with a speed of 900 m/min. There is chosen a draft ratio of 1.70. The first heater has a temperature of 210°C, the second heater a temperature of 170°C.

The texturized yarn has a titer of 76 den, a tear strength of 4.6 g/den and an elongation at break of 22 % and is characterized by a good uniformity of dyeing. The process in accordance with the invention is also characterized in particular by a small number of broken threads both during spinning and during texturizing.

### Example 2

Now, the pump unit explained in Fig. 2 is employed. Polyethylene terephthalate chips with a water content of less than 35 ppm and with an intrinsic viscosity of 0.64 dl/g are molten in an extruder and discharged at a temperature of 290°C with a pressure of 180 bar, conveyed as melt stream of 302.4 kg/h through the melt line and subjected to a filtration with a filtering candle of 20 µm.

This filtered first polyester stream with a flow rate of 302.4 kg/h is divided and branched into the second polyester stream with a flow rate of 13.98 kg/h, corresponding to 4.62 wt-% of the first stream, and the third stream with a flow rate of 288.42 kg/h.

For metering and transporting the second partial stream and the additive stream, a left-handed six-fold planet wheel pump of the firm Mahr GmbH, Göttingen, Germany is used. This is a spinning pump with 6 metering pumps (cf. Fig. 1), which by reversing the direction of rotation and thus the flow direction combines the identical volume flows of 6 inlet passages in one outlet passage.

The second polyester stream is supplied in equal parts to 5 of 6 inlets of the planet wheel pump.

A copolymeric additive of the third group of substances, containing 9 wt-% styrene, 89 wt-% methyl methacrylate and 2 wt-% N-cyclohexyl maleinimide, was chosen with a melt viscosity (at 290°C) of 1440 Pa·s.

The additive dried to a residual moisture of < 0.1 wt-% is molten in an extruder and supplied to the remaining inlet passage of the planet wheel pump at a melt temperature of 265°C with a flow rate of 2.33 kg/h, corresponding to 0.77 wt-% of the first polyester stream. In the outlet passage of the planet wheel pump, this additive stream is combined and premixed with the polyester stream from one of the five inlet passages fed with polyester, before the polyester streams of the four remaining inlet passages are supplied to this premix in the outlet of the planet

wheel pump. The dwell time of the additive melt from the extruder outlet to the outlet of the planet wheel pump is about 70 sec. The subsequent processing is effected in a first static mixer (6) of the type SMXS DN 17 of Sulzer AG, Zurich, Switzerland, with an inside diameter of 17.8 mm and a length of 9 times the inside diameter; the mixture has an additive content of 16.7 wt-%.

This first mixture is introduced into the third polyester stream and after a flow length  $L = 72$  mm supplied to a second mixer (11) of the type SMX of Sulzer AG with an inside diameter of 52.5 mm and a length of 525 mm, where it is homogenized and dispersed. The dwell time of the additive melt from the extruder outlet until contact with the third polyester stream is 100 sec.

By means of the product line, this second polymer mixture is distributed over 12 spinning positions, each position including 6 spinning packages, where the dwell time of the second polymer mixture from leaving the second mixture (11) until entering the spinning package is 5 min. Each spinning package contains a round nozzle with 34 holes having a diameter of 0.25 mm and a length of 2 times the diameter. Above the nozzle plate, the spinning package includes a spinning filter package, comprising a steel sand package with a height of 30 mm and a grain size of 0.5 to 0.85 mm as well as a gauze with a pore diameter of 40  $\mu\text{m}$  and a steel web filter with a pore diameter of 20  $\mu\text{m}$ . The diameter of the spinning filter package is 85 mm. The dwell time of the melt in the filter package is about 1.5 min. The heating of the spinning package is adjusted to 290°C. The surface of the spinning nozzle is 30 mm above the boundary of the heating box. During passage of the melt mixture a nozzle pressure of 150 bar is obtained.

The molten filaments extruded from the nozzle holes are cooled by means of blow air flowing in horizontally with respect to the course of the thread with a speed of 0.55 m/sec and a temperature of 18°C and are bundled to form the thread in an oiling stone (15) at a distance of 1250 mm from the nozzle plate and are coated with spinning oil.

A pair of galettes enlaced in an S-shaped manner unwinds the thread with a speed of 5000 m/min, where a draft ratio of 141 is adjusted.

Between the gallettes, an interlacing nozzle (18) is installed, which is closed in the case of a normal course of the thread and with an air pressure of 4 bar impresses a number of interlacing knots of 12 knots/m on the thread. The inlet tension in the inlet of the interlacing nozzle is adjusted to be 0.15 g/den.

Six threads each of one spinning position are spooled in a spooler to form spool packages, the spooling speed of 4985 m/min having been chosen such that the thread tension before spooling is 0.1 g/den. There are obtained preoriented (POY) threads, characterized by a titer of 126 den, an elongation at break of 116 % and a tear strength of 2.4 g/den. The POY spools are stretch-texturized with a Barmag texturizing machine, type FK6, with a speed of 900 m/min. The draft ratio is chosen to be 1.77, and the heater temperatures 1 and 2 are chosen to be 210°C and 170°C, respectively. The texturized yarn has a titer of 74 den, a tear strength of 4.5 g/den and an elongation at break of 18.3 % and is characterized by a good uniformity of dyeing.



Claims

1. A process of producing synthetic threads from a polyester-based polymer mixture, characterized in that
  - a) a first stream of a polyester melt is divided into a second and a third polyester stream, the amount of the first stream being 100 to 2000 kg/h and the amount of the second polyester stream being 5 to 300 kg/h,
  - b) 0.2 to 100 kg/h of a molten additive polymer are metered to the second polyester stream, and the additive polymer together with the second polyester stream is passed through a first mixing line consisting of a line with flow obstacles and a first polymer mixture is formed, whose content of additive polymer is 3 to 50 wt-%, and the ratio of the melt viscosity of the additive polymer and of the polyester of the first stream is 0.8:1 to 10:1,
  - c) the first polymer mixture is passed through a line portion and introduced into the third polyester stream, and that the first mixture together with the third polyester stream is passed through a second mixing line consisting of a line with flow obstacles and a second polymer mixture is formed, and
  - d) the second polymer mixture is extruded to obtain filaments, the filaments are cooled and combined to threads, and the threads are unwound with speeds of at least 1000 m/min.
2. The process as claimed in claim 1, characterized in that the unmixed additive polymer is molten in an extruder and at the outlet of the extruder has a temperature which is 5 to 70°C lower than the temperature of the first polyester stream.

3. The process as claimed in claim 1 or 2, characterized in that the additive polymer is amorphous and insoluble in the polyester melt.
4. The process as claimed in any of claims 1 to 3, characterized in that the additive polymer is kept in the molten condition for a dwell time of 0.1 to 5 minutes, before it gets in contact with the second polyester stream.
5. The process as claimed in claim 4, characterized in that the additive polymer is kept in the molten condition for a dwell time of 0.2 to 7 minutes, before it gets in contact with the third polyester stream upon leaving the extruder.
6. The process as claimed in claim 1 or any of the preceding claims, characterized in that the flow length  $L$  of the flow of the first polymer mixture in contact with the third polyester stream until reaching the flow obstacles is equal or greater than  $2D$ , where  $D$  is the inside diameter of the empty line of the first mixing line.
7. The process as claimed in claim 1 or any of the preceding claims, characterized in that the ratio of the melt viscosities of the additive polymer and of the polyester of the first stream is 1.5:1 to 8:1.

Fig.1

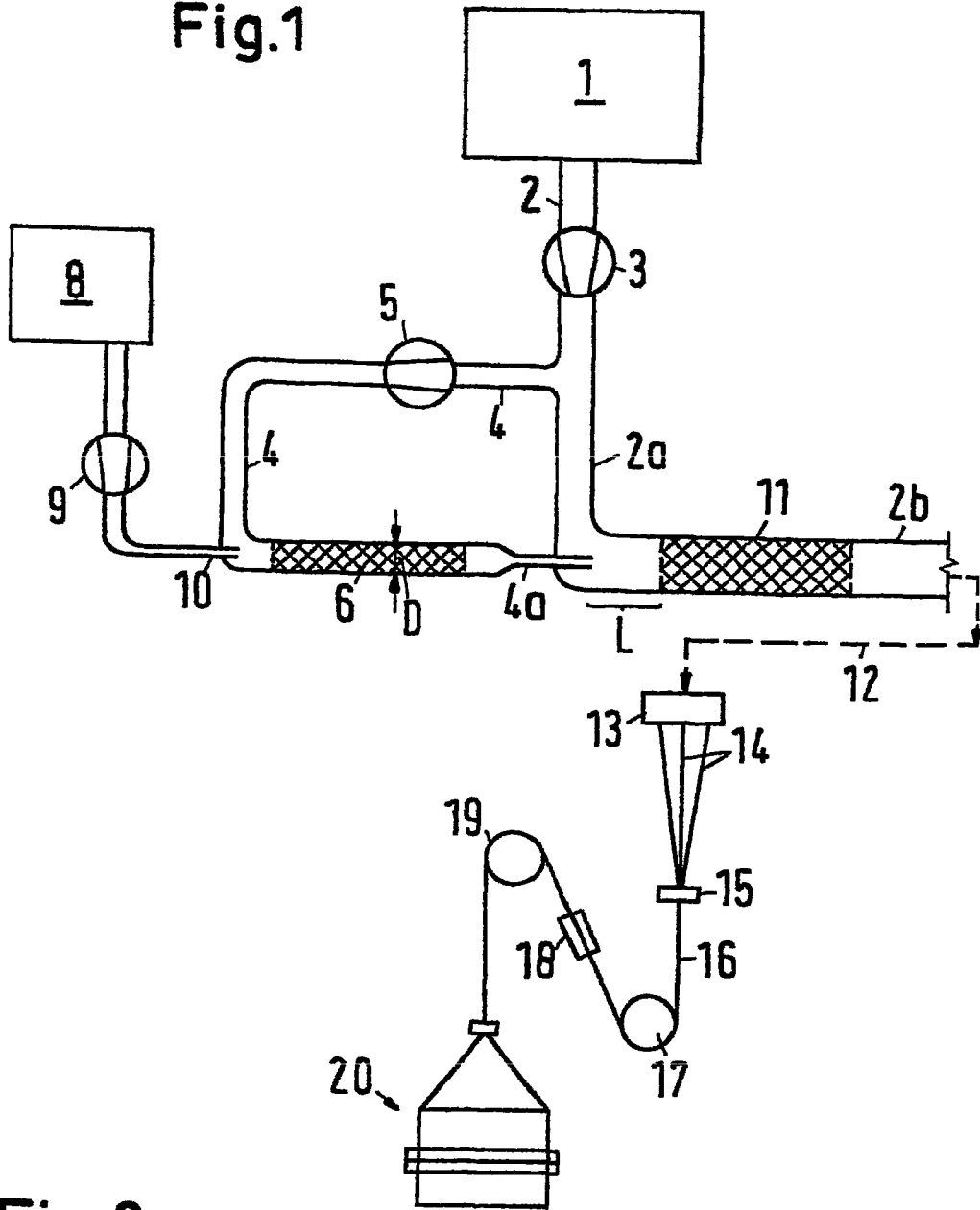


Fig.2

