

## Description

The present invention refers to a method of manufacturing a yarn characterized according to the general definition in claim 1, a yarn corresponding to this and a device for carrying out the method characterized by the general definition in claim 41.

Synthetic fibres, also known as chemical fibres, are not ready for further processing directly after the primary spinning. Synthetic fibres need to be drawn after the primary spinning in order to produce the essential textile properties, such as, for example, elasticity, elongation, low shrinkage behaviour etc.. The drawing process aligns the macromolecules, that are present in a tangled state after the primary spinning, along the length of the fibre, so that they assume a macrostructure that corresponds to the structure of natural fibres. The fibres that are drawn in this manner can be sold commercially as textile fibres.

As well that the aforementioned fully drawn fibres, fibres are also known that have only been partially drawn by the synthetic fibre manufacturer and which are known as partially drawn, pre-oriented or POY yarns, whereby these yarns or fibres will be uniformly referred to as pre-oriented fibres in the description that follows. These pre-oriented fibres supplied by the synthetic fibre manufacturer are then drawn once again by the customer in order to produce the aforementioned textile properties.

Furthermore, pre-oriented fibres are available that also have to be drawn before further processing. These pre-oriented multifilament yarns, intended for the production of high-tenacity yarns, are distinguished from the aforementioned pre-oriented yarns by a higher degree of polymeriza-

tion and a 10 - 20% higher solution viscosity measured according to SNV standards 195590 and 195591.

5 In order to make possible such a drawing before further processing of the fibres the aforementioned pre-oriented fibres are led over a first delivery work (feeder rolls), that is driven with a first speed, to a pin. In this manner the fibres are deflected round the pin through a certain angle, for example between 270 and 360 ° preferably 360 °, 10 and drawn by a second delivery work, that transports the fibres at a second speed. Whereby a pin is used that is heated to 140 °C to 200 °C and has a diameter of between ca. 40 mm to ca. 80 mm. The fibres are normally drawn to a degree of drawing of from about 1:1.5 to 1:1.7, whereby the 15 degree of drawing is defined as the ratio of the first speed (i.e. the speed of the first delivery work) to the second speed (i.e. the speed of the second delivery work).

20 As already described such a drawing causes the essential properties of the fibre materials to be defined. The strength of the fibres increases with the increasing degree of drawing. However, in the known method that involves the use of a heated pin there are limitations with respect to the degree of drawing, since, depending on the fibre used, 25 undesired breakage of individual filaments (capillary breaks) occurs at a degree of drawing of between about 1:1.7 and 1:1.9.

30 A method with the characteristics of the general description in claim 1 is known from US-A-36 94 872. Whereby the known method uses a nondrawn multifilament yarn as starting material, that is drawn with the aid of a suitable drawing pin, whose dimensions are left open in US-A-36 94 872. After being drawn the yarn is heated to a temperature of between 35 250 °C and 325 °C. However, the known drawing process is not

able to increase the strength of the yarn to any appreciable degree.

5 In supplement to the aforementioned state of the art reference is also made to US-A-40 44 089, that describes a method for the manufacture of yarn, whereby thick and thin places are deliberately introduced along the length of the yarn. This American patent does specify the diameter of the pin employed there to be 0.495 cm, but the starting material has  
10 not been drawn. Furthermore, this American patent does not provide any indication that the strength of the drawn yarn is increased by such drawing.

The previously applied for and later published WO-A-8 809  
15 403 describes another drawing process that dispenses completely with such a drawing pin. Here the multifilament yarn, that contains at least one multifilament adhesive yarn, is drawn between two galettes.

20 The purpose of the present invention is to make available a method of the type described by which yarns of a particularly high strength can be manufactured.

According to the invention this purpose is achieved by a  
25 method according to the characteristic attributes of claim 1.

The method according to the invention depends on the basic idea of using a nonheated pin in place of the aforementioned  
30 heated pin of the present state of the art. Whereby the aforementioned pre-oriented fibres (normal POY yarns, POY yarns with higher degrees of polymerization) employed, that generally take the form of multifilament yarns, are deflected round the unheated pin at an angle of ca. 270° to ca.  
35 360°, preferably ca. 360°. In the method according to the

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invention the unheated pin exhibits a diameter that is less than 10 mm. Immediately after being deflected round the pin the aforementioned fibres are heated to a temperature of between ca. 100° C and 250° C for 0.01 s to 10 s.

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The aforementioned method according to the invention exhibits a series of advantages. Thus, it has been found that, for the same degree of drawing, yarns that are treated by the method according to the invention exhibit up to 25% greater specific strength than do yarns treated by the  
10 aforementioned known methods. Whereby the specific strength is defined as the force per titre (cN/Tex). The yarns manufactured by the method according to the invention also have a thermal shrinkage that is up to 40% lower than that of  
15 yarns processed by conventional techniques. This again leads to the final products manufactured from the yarn according to the invention, for example sewing yarn, warp yarn, woof yarn or woven and knitted fabrics, exhibiting an excellent dimensional stability during thermal or hydrothermal treatment during further processing, for example dyeing, printing  
20 or steaming, or in the making up or in final use, for example during washing or ironing.

Furthermore, the method according to the invention exhibits  
25 a further fundamental advantage. For by application of the method according to the invention it is possible to apply a particularly high degree of drawing, that cannot be used in the case of the conventional method since it would lead to the occurrence of thread breakage (capillary breakage).

30 Thus, in the conventional method, for instance, this capillary breakage commences at a degree of drawing of about 1 : 1.8 to at most 1 : 2.0 depending on the starting material. In contrast, the same starting materials can be drawn to a degree of drawing of 1 : 2.3 to 1 : 2.7 by means of the  
35 method according to the invention before the first capillary

breakage occurs. This, in its turn, leads to the specific strength of the yarn processed by the method according to the invention being between ca. 35% and ca. 50% higher than that for conventionally manufactured yarns, as is demonstrated in the reproduced application examples that follow. In this manner it is possible to apply the method according to the invention to the manufacture of high-tenacity yarns from starting materials of normal strength, so that it becomes unnecessary to use corresponding high-tenacity starting materials, which are correspondingly expensive. Alongside the cost advantage the method according to the invention also opens up fully new technological fields, as will be illustrated later with sewing yarns as an example.

The aforementioned advantages, that are attainable by the application of the method according to the invention, are attributable to the fact that, in the method according to the invention, the drawing point lies between the unheated pin and the heated zone which leads to improved and greater orientation of the macromolecules comprising the fibres of the yarn. The higher specific strength and the lower shrinkage tendency of the fibres so manufactured are thereby explicable.

In the method according to the invention the temperature, the exposure time and the degree of drawing are adjusted to suit the particular starting material. As already described above the starting material can be any synthetic pre-oriented fibre (monofilament or multifilament), whereby it is preferably multifilament. Polyester or polyamide fibres are particularly suitable. Especially good results are obtained in the method according to the invention with respect to the specific strength and low thermal shrinkage if the exposure time is chosen to be between ca. 0.05 s and ca. 1 s at temperatures between ca. 180 °C and ca. 240 °C, whereby the

aforementioned exposure times and temperatures depend on the method of heating. The starting material in the method according to the invention is preferably heated by direct contact with a hot heating apparatus after being deflected round the pin. The heating apparatus can consist of a known contact heater, for example a heating drum or particularly a heating plate, that is known technically as a hot plate. It is also possible to heat the fibre or multifilament yarn to the aforementioned temperatures by indirect heating, for example by means of an appropriately designed heating tube. The fibre or multifilament yarn can also be heated by radiation, whereby IR radiators or preferably lasers, particularly gas lasers, such as for example CO<sub>2</sub> or CO lasers, can be employed.

If the fibre or multifilament yarn is heated by direct contact with the heating apparatus in the method according to the invention, then the temperature of the heating apparatus is preferably set to a value between ca. 180 °C and ca. 240 °C. Depending on the particular heating time, which preferably lies between ca. 0.05 s and ca. 1 s, the material being processed will then be heated to a temperature between 140 °C (for short contact times) and ca. 220 °C (for the aforementioned longer contact times). Such a relatively high material temperature is not uncommon, in spite of the aforementioned relatively short contact times, since measurements have shown that on being deflected round the pin the friction between the material and the pin causes the material to be heated to a temperature between ca. 35 °C and ca. 75 °C, usually about 50 °C. If such heating is undesired for some starting materials, then a further form of execution of the method according to the invention provides for the pin being cooled by means of a suitable fluid. It is thereby ensured in a particularly suitable manner that, even the longer application of the method according to the inven-

tion will not lead to an uncontrolled and continuous increase in the temperature of the material, which could, under certain circumstances, lead to undesired variations in the fibre structure and hence in the properties.

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In the simplest case the aforementioned cooling can be brought about by the pin and the material deflected round it being continually blown on by a stream of air. It is also possible to equip the interior of the pin with a cooling  
10 system and to pass a suitable cooling fluid, for example water or freon, continuously through it.

In order to ensure particularly low thermal shrinkage levels of the material processed by the method according to the  
15 invention, this material is preferably cooled during a given distance after being heated. Whereby, according to the particular material, the distance is made such that the material can shrink freely on cooling to a temperature of between ca. 40 °C and ca. 60 °C. It is naturally also possible to  
20 cause the cooling phase for the fibre or multifilament yarn to take place under a certain tension.

Depending on the further processing the fibre or multifilament yarn manufactured by the method according to the inven-  
25 tion can be wound under tension, tensionless, or with overfeed. If the material is to be dyed after winding it is preferable to wind it tensionless on the bobbins used for dyeing so that the material is able to shrink further on dyeing. The dyed fibres or multifilament yarns then exhibit  
30 a further reduced boiling or thermal shrinkage at 180 °C.

As already described above the degree of drawing (1st speed/2nd speed) in the method according to the invention can be just as high as in the known method, i.e. between 1 :  
35 1.3 and 1 : 1.9 depending on the material employed. Particu-

larly high strengths are obtained if a degree of drawing greater than 1 : 2.0 and in particular a degree of drawing between 1 : 2.1 and 1 : 2.7 is chosen for the method according to the invention, since a further increase in the specific strength (in force per titer; cN/tex) is detectable at these relatively high degrees of drawing. The aforementioned degrees of drawing refer to multifilament yarns of pre-oriented fibres (POY) having an elementary thread number of between ca. 20 and ca. 500, preferably between ca. 30 and ca. 150, as is usual in textile fibres. Furthermore, they exhibit a usual titre of between ca. 100 dtex and ca. 1000 dtex, preferably between ca. 100 dtex and ca. 600 dtex.

In general it may be said that for the method according to the invention the degree of drawing is usually between ca. 5% and ca. 50%, preferably between ca. 20% and ca. 40% greater than the degree of drawing recommended by the manufacturer of the particular material. The upper limit of the degree of drawing can be regarded as a value between ca. 5% and ca. 25% less than the degree of drawing that leads to breakage of the multifilament yarn or fibre. If the aforementioned general lower and upper limits for the degree of drawing of the yarn are taken into account, then the fibres and yarns having appreciably higher specific strength and considerably reduced free thermal shrinkage and boiling shrinkage can be manufactured by the method according to the invention. The specific strength, the thermal shrinkage and the boiling shrinkage can be adjusted to meet the particular requirements by varying the degree of drawing.

A pre-oriented fibre will preferably be used as starting material in the method according to the invention, whereby this fibre can be treated according to the aforementioned execution both as monofilament or as multifilament yarn.

Another form of execution of the method according to the invention envisages that the starting material is a pre-oriented multifilament yarn of a high degree of polymerization, whereby the process parameters of the aforementioned methods of execution also apply here. With a starting material of this type, the specific strength will be further improved and the thermal shrinkage at 180 °C and the boiling shrinkage further decreased compared with the results obtained when a material is treated in a conventional manner.

It is, in principle, possible to use all thermoplastic synthetic fibres in the method according to the invention. Particularly good results are obtained when polyester or polyamide fibres are used.

In a further arrangement of the method according to the invention the multifilament yarn, that has been treated according to the methods of execution described above, is twisted before being wound up, whereby this twist amounts to between ca. 5 twists/m and ca. 400 twists/m preferably between ca. 8 twists/m and ca. 30 twists/m.

The twisted multifilament yarn is then wound up immediately and can be further processed as desired, which can, for example, take place by texturing, throwing, dyeing, finishing and/or weaving.

A particularly preferred form of execution of the method according to the invention provides for the multifilament yarn being intermingled afterwards with a second yarn (effect yarn) in a fluid flow with the formation of an jacket-core yarn with slings and loops. Whereby the intermingling is carried out in such a manner that the multifilament yarn comprises the inner core and the second

yarn (effect yarn) forms the jacket surrounding the core. Such an intermingling can be brought about in known nozzle arrangements. The particular advantage of the yarn manufactured according to the aforementioned method, over that  
5 produced according to the state of the art, is that the jacket-core yarn manufactured by the method according to the invention not only possesses a higher strength and a lower thermal and boiling shrinkage but is also characterized by regular tone-in-tone dyeing. Here, in contrast to conven-  
10 tionally manufactured jacket-core yarns, the core yarn does not dye to a darker, lighter or different tone than the coating yarn (effect yarn), that is made from the same material as the core yarn. Rather both yarn components (core and effect components) exhibit the same colour tone and the  
15 same depth of colour. This also applies when the titre of the individual filaments of the core yarn is appreciably greater or less than that of the individual filaments of the effect yarn, for example by a factor between 1.5 and 4.

20 The aforementioned improvement of the dyeing behaviour of the yarn manufactured by the method according to the invention is attributed to the fact that the use of an unheated pin with the aforementioned diameter means that the thermal treatment that follows immediately can be varied in tempera-  
25 ture and exposure time in the aforementioned ranges, and to the fact that the aforementioned conditions during cooling allow the tension to be changed, so that it is possible to adapt the dyeing behaviour of the core material to the dyeing behaviour of the effect material.

30 In the method according to the invention the multifilament yarn making up the core and the effect yarn making up the jacket are intermingled with an advance. Preferably advances lying between ca. 1% and ca. 7% are chosen for the multi-  
35 filament yarn. The advances for the effect yarn lie between

ca. 15% and ca. 45%

A further form of execution of the method according to the invention is intended to produce a particularly high intermingling, i.e. a large number of intercrossing loops and slings in which the core material is wetted with water or an aqueous dispersion before the intermingling. Hereby the water or aqueous dispersion causes the friction between the individual fibres to be reduced. The addition of water also intensifies the intermingling, which is particularly to be observed when aqueous dispersions are used. Aqueous dispersions containing grain-like particles whose specific gravity is greater than 1 g/cm<sup>3</sup> can be used in aqueous dispersions. The concentration of the grain-like particles in such a dispersion lies between ca. 5 g/l and ca. 150 g/l, preferably between ca. 30 g/l and ca. 60 g/l. The diameter of the grain-like particles varies between ca. 4 µm and ca. 400 µm, particularly between ca. 20 µm and ca. 100 µm. The hardness of the grain particles on Moh's scale lies between 1 and 6½, preferably between 3 and 5. For example talcum, kieselguhr, aluminium oxide, titanium dioxide and/or barium sulphate can be used as the grain-like particles, whereby instead of a dispersion it is possible to use a suspension of the aforementioned concentration and composition.

In the method according to the invention a multifilament yarn that contains about half the elementary threads of the core yarn is used as the effect yarn. Thus, a typical core material contains between ca. 40 and ca. 500 elementary threads, preferably between ca. 50 and ca. 150.

The titre of the effect yarn is usually ca. 15% to ca. 40% of that of the core yarn. Normally core yarns are used having a titre of between ca. 100 dtex and ca. 1000 dtex, preferably between ca. 100 dtex and ca. 600 dtex.

A particularly regular dyeing behaviour with respect to the colour tone and depth of colour can be obtained in a further execution form of the method according to the invention by also deflecting the effect yarn, before intermingling, round  
5 an unheated pin, with a diameter of less than 10 mm, though an angle between  $270^\circ$  and  $360^\circ$ , preferably  $360^\circ$  and then heating the effect yarn immediately after it has been deflected to a temperature between  $100^\circ\text{C}$  and  $250^\circ\text{C}$ , particularly to a temperature between  $180^\circ\text{C}$  and  $240^\circ\text{C}$  for 0.01 s  
10 to 10 s, particularly for 0.05 s to 1 s. In this manner the treatment of the effect yarn is adapted to the treatment of the core yarn before the intermingling process is carried out. This is particularly the case when both yarns are drawn to the same degree of drawing, that lies within the range  
15 that was named at the start for the method according to the invention. It has been found to be particularly advantageous for the dyeing behaviour of the effect yarn if the cooling conditions with respect to the tension during cooling and the rate of cooling are adapted to the cooling conditions  
20 used for the core yarn.

The forms of execution sofar disclosed are directed at a method by which the effect yarn is intermingled with a core yarn. Naturally it is also possible in the method according  
25 to the invention to intermingle several core yarns with one effect yarn or several effect yarns with one core yarn, whereby preferably one to four core yarns are intermingled with one to four effect yarns.

30 Instead of intermingling the core and effect yarns with each other it is also possible to twist them together according to a conventional method.

In order to improve the composite of individual elements in  
35 the intermingled yarns that are thereby produced another

form of execution of the method according to the invention provides that after intermingling the yarns are drawn off with between about 150 twists/m and about 300 twists/m. If, on the other hand, a very voluminous yarn is desired then fewer twists, for example a protective twist of between ca. 2 twists/m and ca. 20 twists/m, can be applied to the yarn manufactured by the method according to the invention.

If the yarn manufactured by the method according to the invention is preferably wound up tensionless or with advance, then it can shrink in a subsequent thermal treatment, e.g. during dyeing. As a result the self-crossing loops and slings are reduced in their diameter by ca. 20% to ca. 95%. The degree of reduction in size thereby depends basically on whether, when heating the effect material previously, tensions were frozen into it by the following cooling process, that bring about shrinkage in the thermal treatment that follows. If a relatively nonbulky yarn is to be manufactured by the method according to the invention, such as is desired when such a yarn is to be used as sewing yarn, then it is necessary to carry out the heating of the effect yarn and its subsequent cooling under tension. In this case a particularly large shrinking effect occurs that leads to the diameters of the mutually intercrossing loops and slings being correspondingly reduced in size during the thermal treatment, for example by between 60% and 95% with respect to the original diameters. A complete contraction of the loops and slings with the formation of corresponding knots is, on the other hand, undesired for a yarn of this type that is to be used as a sewing yarn, since this would cause the processing properties of the yarn to deteriorate. Thus, it could be established that the loops and slings in their reduced diameters effect a very good yarn cohesion, which is particularly desired on account of the high stresses that the sewing yarn is subjected to during

processing. Furthermore, such a sewing yarn possesses a certain bulk, so that air is enclosed within the yarn and is pressed out of the yarn during the sewing process, particularly when the yarn is bent around the thread guides or the  
5 needle. This in its turn brings about a cooling of the thread guide or needle so that the frequency of thread breakages is considerably lower than for a yarn in which the loops have contracted to knots.

10 Another form of execution of the method according to the invention provides that the intermingled yarns are subjected to a tension treatment before winding up. Hereby the self-crossing loops or slings are made smaller, whereby the diameter of the slings or loops is reduced by ca. 20% to ca.  
15 95% depending on the tension applied. This reduction in the diameter of the loops and slings has an influence on the cohesion of the yarn composite and on the bulk and properties of a yarn that is so manufactured. As already described the bulk of the yarn continues to decrease as the diameters  
20 of the loops and slings are diminished. At the same time the yarn composite is improved so that such a yarn can be used without difficulty and also without additional twisting or doubling, for example as the warp yarn in weaving, in machine knitting and in particular as a sewing yarn. In the  
25 same manner as the yarn described above that has been subjected to a hydrothermal treatment, a yarn whose loops and slings have been reduced in size by the application of tension also exhibits excellent properties for use as sewing yarn. Thus it has been demonstrated that a sewing yarn whose  
30 loop and sling diameter has been reduced by ca. 80% - 95% by the tension treatment previously described exhibits fewer thread breakages during sewing in comparison to a sewing yarn manufactured from the same materials whose loops and slings have been pulled down to knots. This is attributable,  
35 on the one hand, to the fact that a yarn whose loops and

slings have not been pulled together into knots encloses an appreciably greater volume of air than a yarn whose loops and slings have been pulled together into knots. Furthermore, on account of its special treatment, the yarn produced by the method according to the invention exhibits an appreciably higher strength than a conventionally treated yarn, so that the reduction in the frequency of thread breakage when sewing with a yarn manufactured by the method according to the invention is explicable. It was also possible in comparative dyeing experiments to demonstrate that in the case of a sewing yarn manufactured from the same starting materials using conventional methods the core yarn and the effect yarn were dyed to differing degrees with respect to depth of colour and colour tone, whereas this was not the case for the sewing yarn manufactured by the method according to the invention.

In order to carry out the tension treatment described above prior to the intermingling, the yarn is fed into the tension treatment at a speed that is between 0.1% and 5%, particularly between 0.1% and 2.5% lower than the speed at which the yarn leaves the tension treatment. Whereby the aforementioned speed differences depend, on the one hand, on the desired reduction in diameter and, on the other hand, on the particular starting material and on the conditions of drawing (degree of drawing, temperature, exposure time and tension during cooling).

Another form of execution of the method according to the invention provides that a thermal treatment at between ca. 100 °C and ca. 250 °C, particularly between ca. 180 °C and ca. 230 °C, is carried out in addition to the tension treatment or instead of the tension treatment before the intermingled yarns are wound up. The thermal treatment like the tension treatment brings about a reduction in the diameters

of the self-crossing loops and slings, which has the advantages already discussed. Furthermore, tensions frozen into the yarn are released so that a yarn that has been so treated exhibits degrees of thermal shrinkage and boiling shrinkage amounting to between ca. 2% and ca. 4% with respect to the starting length. The thermal treatment also has the effect of further equalizing the dyeing behaviour of the core material and the dyeing behaviour of the effect material particularly when the exposure time is between ca. 0.01 s and ca. 10 s particularly between 0.05 s and 1 s. This has the effect that even when dyeing such yarns with high molecular weight dyes that are markers for structural differences the dyeing behaviour of the core and effect yarns does not exhibit any difference.

The intermingled yarn is preferably passed into the thermal treatment with a speed that is the same or higher than the speed with which the yarn is removed from the thermal treatment. Whereby in particular feed velocities are employed that are 0.1% to 10%, preferably 2% to 4% higher than the removal velocities. This has the effect of making it possible for the intermingled yarn to shrink freely during thermal treatment so that there are no frozen-in tensions remaining that could later precipitate undesired shrinking.

If a sewing yarn is to be manufactured by the method previously described, then a pre-oriented multifilament yarn (POY yarn) is a suitable starting material for the core yarn. Whereby the core yarn is deflected round an unheated pin through an angle of between 270° and 360°, preferably through 360°. The pin has a diameter of less than 10 mm. Then the core yarn is heated to a temperature of between ca. 180 °C and ca. 250 °C, preferably by contact heating at a heating plate (hot plate). The drawing of the core yarn takes place between the first delivery work (feeder rolls)

that unwinds the core yarn from a spool and a second delivery work that is situated after the hot plate. Depending on the starting material being used at the time the degree of drawing preferably lies between 1:1.7 and 1:2.7, and particularly between 1:2.0 and 1:2.4, i.e. as a lower limit between ca. 5% and ca. 50% above the degree of drawing recommended by the manufacturer and as an upper limit between ca. 5% and ca. 25% below a value at which the yarn breaks. Thereafter, the core yarn is cooled, with freedom to shrink, to a temperature of ca. 50 °C and is then intermingled with an advance of between 1% and 7% with a second yarn that comprises the effect yarn.

Before intermingling the effect yarn is conventionally pre-drawn over a heated pin or preferably treated as described for the core yarn, with the only difference that the effect yarn is led into the intermingling with an advance of between 15% and 45%.

After intermingling the core-jacket yarn that exhibits self-crossing loops and slings is subjected to tension treatment. Depending on the desired diminution in diameter of the loops and slings the intermingled yarn is fed into the tension treatment at a speed that is between ca. 2% and ca. 5% less than the speed with which it is removed from the tension treatment. This is followed by a thermal treatment at a temperature between 180 °C and 240 °C lasting for ca. 0.05 s to ca. 2 s. The feeding velocity into the thermal treatment is ca. 2% to ca. 5% greater than the velocity of removal from the thermal treatment. Thereafter the yarn is cooled at constant length to a temperature of between ca. 60 °C and ca. 40 °C. Then the yarn is wound on without tension and if necessary subjected to a twist of between 100 twists/m and 600 twists/m before and/or after winding.

The sewing yarn that is so manufactured is dyed by conventional methods and then finished. Depending on the tension during the tension treatment after the intermingling, the temperature and the tension of the thermal treatment and the tension on cooling, the hydrothermal treatment during dyeing can lead to a further reduction in the diameter of the loops and slings. Whereby the sewing yarn must be prevented from shrinking so much that the loops and slings pull together like knots.

In the above forms of execution it is arranged that the diameters of the self-crossing loops and slings are reduced from their original diameter by ca. 20% to 95% by means of the tension treatment, the thermal treatment, the cooling after the thermal treatment and possibly the hydrothermal treatment. Naturally it cannot be excluded that some of the loops and slings may pull together like knots, but the proportion of the loops and slings that have pulled together like knots should be kept as low as possible, i.e. less than 15%, preferably less than 5% of the total number of loops and slings.

The invention also refers to a device for carrying out the method.

Whereby a first form of execution of the device according to the invention for carrying out the method possesses a first delivery work for winding up the fibre or multifilament yarn, preferably from a spool, a pin round which the yarn is deflected through an angle of ca.  $270^{\circ}$  to  $360^{\circ}$ , preferably  $360^{\circ}$ , a second delivery work to wind up the yarn from the pin and an arrangement for winding up the yarn. Whereby the pin takes the form of an unheated pin and has a diameter of less than 10 mm. A heating apparatus is positioned between the pin and the second delivery work.

The heating apparatus in the aforementioned device preferably takes the form of a contact heater, for example a heated drum or hot plate. It is also possible to employ an IR heater or a laser, particularly a gas laser, preferably a CO<sub>2</sub> or CO laser as the heating apparatus, whereby the latter effects a particularly rapid heating of the yarn or fibre. The heating apparatus can also take the form of a convection heater, for example a heating tube with a length of ca. 0.5 m to ca. 4 m.

In order to cool the yarn or fibre at a preset tension, a further form of execution of the device according to the invention involves placing, after the second delivery work, a third delivery work that can be chosen at will, by means of a suitable drive, to operate at the same speed as the second delivery work or faster or slower than this.

Another form of execution of the device according to the invention, that is particularly suitable for the manufacture of core-jacket yarn, provides a fourth delivery work that winds up the second yarn (effect yarn) preferably from a spool. After this in the direction of travel of the yarn there is a second pin, around which the second yarn is deflected through an angle of ca. 270° to 360°. This is followed by a fifth delivery work to wind up the second yarn from the pin, whereby the fourth delivery work and the fifth delivery work are driven by a motor from a drive. Whereby the drive is equipped with a matched pair of exchangeable gear wheels, which allow the speeds of the two drives to be adjusted relative to each other. In this manner it is arranged that the degree of drawing carried out at the start can be varied. The drive of the aforementioned first and second delivery works corresponds to the drive of the fourth and fifth delivery works. This is followed by a nozzle such as is supplied, for example, by the DuPont company under the

type designation XV.

5 The multifilament yarn of the core is intermingled through the nozzle with the second yarn. After the intermingling the yarn is wound up on a conventional reeling device.

10 In another form of execution of the device according to the invention an arrangement for wetting the core yarn with water or with an aqueous dispersion or suspension is placed before the nozzle. This can, for example, take the form of a trough, through which the core material is passed over a  
15 suitable deflection apparatus. It is also possible to employ a device on the principle of the slop pad technique, that is known and is, for example, supplied by the Heberlein company under the system designation Hema-Wet-Düse.

20 The aforementioned second pin can either consist of a conventionally designed hot pin with a diameter of between ca. 40 mm and ca. 80 mm. It is also possible to use a pin that is not heated and has a diameter of less than 10 mm. In this case a further form of execution of the device according to the invention provides for a second heating apparatus, before the 5th delivery work, that is of the same construction as one of the previously described heating systems.

25 Additionally this form of execution of the device can have a 6th delivery work situated before the nozzle that allows the effect yarn to be cooled under a particular tension. This 6th delivery work is preferably connected to the 5th delivery work by a suitable drive.  
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A further form of execution of the device according to the invention, that is particularly employed for the manufacture of sewing yarn, provides a tensioning arrangement, comprising  
35 a 7th and 8th delivery work, after the nozzle and before

the wind-up arrangement. If necessary a third heating apparatus and/or a cooling system, equipped in each case with an appropriate number of delivery works to allow tensioning of the intermingled yarn to a prechosen degree, is provided before the wind-up arrangement. Whereby the third heating apparatus preferably takes the form of a convection heater, for example a heating tube with a length between ca. 0.5 m and ca. 6 m or a radiation heater, for example an IR radiator or laser, in particular a gas laser, preferably a CO<sub>2</sub> or CO laser.

The aforementioned delivery works consist of galettes in order to ensure faultless transport of the yarn. These galettes are equipped with the necessary number of supporting rollers and "pigstails" to ensure precise transport of the yarn.

With respect to the material of which the first and second pins are constructed it has been found that these should preferably be equipped with a ceramic coating when the pins have a diameter of less than 10 mm. This ensures that the surface has a high degree of smoothness while at the same time ensuring that the pin can remain in operation without damage over a long period. If pins with internal cooling arrangements are used the ceramic coating ensures that there is good thermal conduction to the cooling system. Naturally the whole pin can also be constructed of ceramic.

Further advantageous developments of the method according to the invention and of the device according to the invention are included in the subsidiary claims.

The device according to the invention is further elucidated below by means of the illustration and the method according to the invention by means of the examples.

Whereby the only illustration is a drawing illustrating the principle of the yarn run.

5 A core yarn 1, for example a pre-oriented multifilament yarn (POY yarn) with a monofilament titre of 10.23 dtex, and a second yarn (effect yarn), also a pre-oriented multifilament yarn (POY yarn) with a monofilament titre of 3.46 dtex are transferred separately from a supply in a spool rack to a nozzle 3.

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The core yarn first runs through a drawing zone with a delivery work 3, an unheated drawing pin 5, round which the core yarn 1 is deflected through an angle of 360°, a hot plate 6 and a galette 7, and passes via an arrangement for wetting with water to nozzle 3 where it is intermingled with effect yarn 2.

20 The effect yarn has previously passed through a delivery work 9, a drawing arrangement 10 and a further delivery work 11. In the execution form shown the drawing arrangement consists of a conventionally constructed heated drawing pin (hot pin) with a diameter of 60 mm while drawing pin 5 has a diameter of 8 mm. As described above the effect yarn 2 is deflected round drawing pin 10.

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After the intermingling, which both yarns 1 and 2 undergo in nozzle 3, the yarn 12 that is produced in the nozzle and that is characterized by self-crossing loops and slings, passes through a tension treatment and a thermal treatment zone between the delivery works 17 and 18. Whereby the thermal treatment zone is equipped with a delivery work 13, a heating apparatus 14 and a delivery work 15. The heating apparatus 14 illustrated in the drawing takes the form of a heating tube and is equipped with the usual regulating and control system, so that the desired temperature can be

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- adjusted within the range between ca. 100 °C and ca. 250 °C. The tension treatment and the heating apparatus 14 cause the diameters of the loops and slings to be reduced by ca. 20 to ca. 95%, whereby the reduction in diameter depends, on the one hand, on the materials used and, on the other hand, on the speeds of delivery works 13 and 15 relative to each other, as has been described earlier. The finished yarn is then led to a wind-up device 16 in the normal manner.
- 10 On the aforementioned device the core yarn 1, which the manufacturer advised should be drawn to a degree of drawing of 1:1.86 was drawn to a degree of drawing of 1:2.3. Whereby the temperature of the hot plate was maintained at a temperature of 250 °C.
- 15 The effect yarn was drawn, in accordance with the manufacturer's recommendations, to a degree of drawing of 1:1.73 with the temperature of the drawing pin at 140 °C.
- 20 The core yarn was presented to the nozzle with an advance of 4% and the effect yarn with an advance of 20%. The temperature of the heating apparatus 14 was set to 230 °C. The speeds of the individual delivery works were set so that the speed of winding up was 16 500 m/min.
- 25 The specific strength of core yarn 1 was measured before the nozzle. It was 60 cN/tex. For the purpose of comparison the aforementioned device was modified and drawing pin 5 was replaced with a conventional heated pin that was heated to a temperature of 140 °C, while the hot plate 6 was also removed. The same core yarn and the same effect yarn were processed, in the manner described at the start, on the device after it had been rebuilt in this manner. Whereby the core yarn was drawn to a degree of drawing of 1:1.86 according to the manufacturer's recommendations.
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Core yarn was removed before nozzle 3 and the strength of the core yarn was measured. The 1:1.86 drawn yarn possessed a specific strength of 40 cN/tex.

5 In a further experiment on the rebuilt apparatus with a conventionally constructed drawing pin with a diameter of 60 mm and heated to a temperature of 140 °C, an attempt was made to draw out core yarn 1 to a degree of drawing of 1:2. Whereby it was established that core yarn 1 exhibited a  
10 multiplicity of capillary breakages before reaching the nozzle, so that this experiment had to be abandoned.

A further experiment was carried out at a degree of drawing of 1:1.925. Whereby it was found that the use of the conven-  
15 tional drawing pin yielded a slight improvement of the specific strength so that this became 41 cN/tex.

The core yarns, that had been drawn to differing degrees, were then intermingled as described above with the same  
20 effect yarn 2, then subjected to thermal treatment and then wound up. Whereby that yarn whose core yarn exhibited a specific strength of 60 cN/tex was designated sewing yarn No. 1. The yarn whose core yarn exhibited a specific strength of 40 cN/tex was designated sewing yarn No. 2 and  
25 the yarn whose core yarn exhibited a specific strength of 41 cN/tex was designated sewing yarn No. 3.

A sewing yarn No. 4 whose core yarn exhibited a specific strength of 40 cN/tex and that was manufactured from the  
30 same starting materials and with the same titre as sewing yarns No. 1 to No. 3 was used as reference yarn in the industrial sewing experiments that followed. Whereby sewing yarn No. 4 differed from sewing yarns No. 1 to No. 3 in having loops and slings contracted to knotlike structures  
35 instead of loops and slings that had been reduced in size.

The results of the industrial sewing experiment revealed that for forward, backward and multidirectional sewing at stitching rates of 4000 to 6000 stitches per minute sewing yarn No. 1 exhibited the lowest thread breakage rate. Sewing yarn No. 3 was found to have a thread breakage rate that was ca. 30% higher, while within the limits of error sewing yarn No. 2 possessed the same thread breakage rate as sewing yarn No. 3. Sewing yarn No. 4 was appreciably worse with a thread breakage rate 45% higher than that of sewing thread No. 1.

Sewing threads No. 1 - 4 were then wound onto the dye bobbins and dyed in a bath with several colour combinations. Since all four sewing yarns were made from polyester, the dyeing was carried out at 130 °C. The following temperature scheme was chosen for dyeing.

Start temperature: 70 °C

Heating rate of 2 °C/min to 130 °C

Exposure time at 130 °C: 45 minutes

Cooling at 2 °C/min to 80 °C

After dyeing the material was cold rinsed twice and hot rinsed twice and then dried conventionally. The dye mixtures were adjusted on each occasion to pH 4.5 by the addition of acetic acid and sodium acetate. Furthermore, all dyeing mixtures contained 0.5 g/l of a dispersing and levelling agent (Lewegal HTN, Bayer). The following dye combinations were tested.

#### Dye combination I

0.5% Resolingelbbraun 3 GL, 200% (C.I. Disperse orange 29)

0.25% Resolinrot FB, 200% (C.I. Disperse red 60)

1% Resolinmarineblau 2 GLS, 200% (C.I. Disperse blue 79)

Dye combination II

- 3% Resolinmarineblau 2 GLS, 200% (C.I. Disperse blue 79)  
0.15% Resolingelb 5 GL, 200%  
5 0.8% Resolinrot BBL, 200%

Dye combination III

- 0.5% Resolinblau BBLS, 200% (C.I. Disperse blue 165)  
10 1.5% Resolingelbbraun 3 GL, 200% (C.I. Disperse orange 29)  
0.5% Resolinrot FB, 200% (C.I. Disperse red 60)

- 15 The visual and colorimetric evaluation of the four sewing yarns revealed that only the spool of sewing yarn 1 yielded a uniform dyeing impression with respect to both colour tone and depth of colour. The dyeing of sewing yarns 2 to 4 was uneven and skittery. The colour tone and depth of colour of the differently dyed core material was clearly visible.

- 20 Other materials were also treated for comparison. For this purpose a polyester multifilament yarn with an initial titre of 285 dtex and an elementary thread number of 32 was used first. This material designated starting material 2 was drawn at various degrees of drawing by deflecting at an  
25 angle of 360° round a pin heated to 140 °C. The results for specific strength and free thermal shrinkage at 180 °C as a function of the degree of drawing chosen are listed in the following table.

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Table 1

|   | Degree of drawing | Sp. strength<br>(cN/tex) | Thermal shrinkage<br>(180 °C) |
|---|-------------------|--------------------------|-------------------------------|
| 5 | 1 : 1.700         | 37.24                    | 10.1                          |
|   | 1 : 1.800         | 39.08                    | 10.9                          |
|   | 1 : 1.900         | 43.05                    | 11.88                         |
|   | 1 : 2.000         | 48                       | 12.3                          |

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The same starting material 2 was also deflected at an angle of 360° round an unheated pin with a diameter of 8 mm and then passed over a hot plate heated to 240° and was, thus, drawn with differing degrees of drawing. The results of the experiment are given in the following table.

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Table 2

|    | Degree of drawing | Sp. strength<br>(cN/tex) | Thermal shrinkage<br>(180 °C) |
|----|-------------------|--------------------------|-------------------------------|
| 5  | 1 : 1.750         | 41.06                    | 6.29                          |
|    | 1 : 1.800         | 42.61                    | 6.29                          |
|    | 1 : 1.850         | 45.26                    | 6.09                          |
|    | 1 : 1.900         | 49.22                    | 5.88                          |
| 10 | 1 : 1.950         | 50.06                    | 6.06                          |
|    | 1 : 2.000         | 52.28                    | 6.09                          |
|    | 1 : 2.050         | 55.93                    | 6.29                          |
|    | 1 : 2.100         | 57.69                    | 6.29                          |
|    | 1 : 2.125         | 59.99                    | 6.29                          |
| 15 | 1 : 2.150         | 61.03                    | 6.09                          |
|    | 1 : 2.175         | 62.85                    | 6.09                          |
|    | 1 : 2.200         | 63.20                    | 6.29                          |
|    | 1 : 2.225         | 64.90                    | 6.29                          |
|    | 1 : 2.250         | 63.97                    | 6.10                          |
| 20 | 1 : 2.275         | 67.00                    | 6.10                          |
|    | 1 : 2.300         | 67.12                    | 6.10                          |

As can be seen by comparison of the two aforementioned tables, the material that was drawn over the unheated drawing pin and then heated by a hot plate, has an appreciably lower thermal shrinkage and a considerably higher specific strength. In particular the specific strengths obtained at degrees of drawing greater than 1:2, could not be achieved using material that was only drawn using the heated pin, since capillary breakage began at degrees of drawing of between 1:1.9 and 1:1.95. For this reason the strength of 48 cN/tex obtained with the first material with a degree of drawing of 1 : 2 is not suitable for production. Hence, the maximum specific strength that could be obtained

by a method involving drawing starting material 2 over a heated pin was 43.05 cN/tex.

5 The results depicted in the second table look quite different. Hereby the material drawn over the unheated pin in conjunction with the hot plate exhibits a maximum specific strength of 67 cN/tex since it was only at degrees of drawing of 1:2.325 that capillary breakage became apparent. An investigation was made under production conditions whereby a  
10 batch of several tonnes yarn was manufactured with a degree of drawing of 1:2.3. It was not hereby possible to detect any capillary breakage. It may be added in supplement that the manufacturer of starting material 2 specified a degree of drawing of 1:1.8 to 1:85. Starting material 2 was a  
15 commercially available POY polyester yarn

A further starting material 3 was drawn by different techniques as described for starting material 2. Whereby starting material 3, which was also a polyester multifila-  
20 ment yarn, exhibited a starting titre of 410 dtex and an elementary thread number of 40. In contrast to the investigation carried out on starting material 2, starting material 3 was only drawn over the heated pin, whose diameter was 60 mm, at a temperature of 140 °C, with a degree of drawing of  
25 1:1.85. The degree of drawing of 1:1.85 corresponded to the manufacturer's recommendation for this material. The yarn that was so treated possessed the following specific strength and the following thermal shrinkage.

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Table 3

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| Degree of drawing | Sp. strength<br>(cN/tex) | Thermal shrinkage<br>(180 °C) |
|-------------------|--------------------------|-------------------------------|
| 1 : 1.850         | 34.8                     | 10                            |

An attempt was made in addition to increase the degree of drawing of the aforementioned material. Whereby it was found that the first capillary breakage took place when the degree of drawing was increased to 1:1.95, while at a degree of drawing of 1:2.075 the capillary breakage was so frequent that yarn drawn in this manner was no longer usable.

For comparison starting material 3 was also drawn at various degrees of drawing round an unheated pin with a diameter of 8 mm and then heated by a hot plate at a temperature of 240 °C. The following specific strengths and thermal shrinkages were hereby obtained.

Table 4

|    | Degree of drawing | Sp. strength<br>(cN/tex) | Thermal shrinkage<br>(180 °C) |
|----|-------------------|--------------------------|-------------------------------|
|    | 1 : 1.850         | 38.23                    | 6.68                          |
| 20 | 1 : 1.950         | 42.19                    | 6.88                          |
|    | 1 : 2.050         | 51.15                    | 6.68                          |
|    | 1 : 2.150         | 56.81                    | 6.90                          |
|    | 1 : 2.200         | 58.87                    | 6.88                          |
|    | 1 : 2.250         | 61.47                    | 7.09                          |
| 25 | 1 : 2.300         | 64.02                    | 6.88                          |
|    | 1 : 2.350         | 66.40                    | 6.88                          |
|    | 1 : 2.375         | 67.12                    | 6.90                          |
|    | 1 : 2.400         | 68.44                    | 6.88                          |
|    | 1 : 2.425         | 69.23                    | 6.88                          |
| 30 | 1 : 2.450         | 68.81                    | 6.68                          |
|    | 1 : 2.500         | 71.74                    | 6.68                          |
|    | 1 : 2.500         | 70.92                    | 6.69                          |

The first capillary breakage did not occur until a degree of drawing greater than 1:2.475. A large batch has already been

manufactured under production conditions using starting material 3 and a degree of drawing of 1:2.300, without any capillary breakage occurring.

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## Patent Claims

1. A method of producing a yarn according to which a synthetic multifilament yarn is fed to a pin with a first speed, the multifilament yarn is deflected around the pin between about 270° and 360°, preferably around 360°, the multifilament yarn is heated immediately after the deflection and is drawn off with a second speed which is higher than the first speed, and the drawn-off multifilament yarn is wound up, characterized by using a pre-oriented multifilament yarn (POY yarn) as multifilament yarn, by using a non-heated pin having a diameter smaller than 10 mm as pin, and by heating the multifilament yarn after the deflection to a temperature of between 100° C and 250° C for 0.01 s to 10 s.
2. The method according to claim 1, characterized by heating the multifilament yarn to a temperature of between 180° C and 240° C for 0.05 s to 1 s.
3. The method according to claim 1 or 2, characterized by heating the multifilament yarn by contact with a heating means, especially a heating plate or a heating drum.
4. The method according to claim 3, characterized by heating the heating means to a temperature of between 180° C and 240° C.



5. The method according to one of the preceding claims, characterized by cooling the multifilament yarn after the heating below a predetermined length of a length, which has such a value that the material can freely shrink.
6. The method according to one of the preceding claims, characterized by drawing off the multifilament yarn with a second speed which is higher than the first speed by the factor 1.3 to 2.7, especially the factor 1.7 to 2.4.
7. The method according to one of the preceding claims, characterized by using a pre-drawn multifilament yarn (POY yarn) whose solution viscosity is 10 - 20 % higher than with a normal POY yarn.
8. The method according to one of the preceding claims, characterized by using a multifilament yarn of polyester or polyamide.
9. The method according to one of the preceding claims, characterized by providing the multifilament yarn with a twist of between 5 and 400 twists/m, preferably of between 8 and 30 twists/m, prior to winding up.
10. The method according to one of the preceding claims, characterized by using a multifilament yarn having a number of elementary threads of between about 20 and about 500, preferably of between about 30 and about 150.
11. The method according to one of the preceding claims, characterized by using a multifilament yarn with a titre of between about 100 dtex and about 1000 dtex, preferably of between about 100 dtex and about 600 dtex.



12. The method according to one of the preceding claims, characterized by intermingling the multifilament yarn in a fluid stream with a second yarn (effect yarn) without winding up the same before, so that a core-jacket-yarn provided with loops and slings is formed, wherein the intermingling is carried out such that the multifilament yarn forms the inner core and the second yarn forms the jacket enclosing the core, and by subsequently winding up the core-jacket-yarn.

13. The method according to claim 12, characterized by feeding the multifilament yarn with an advance of between 1 % and 7 % and the second yarn with an advance of between 15 % and 45 % to the intermingling.

14. The method according to claim 12 or 13, characterized by wetting the multifilament yarn with water or an aqueous dispersion prior to intermingling.

15. The method according to one of the claims 12 to 14, characterized by using a pre-drawn multifilament yarn (POY yarn) as second yarn.

16. The method according to claim 15, characterized by using as second yarn a multifilament yarn the titre of which is about 15 % to about 40 % and the number of elementary threads of which is about 50 %, related to the titre or the number of elementary threads of the core yarn, respectively.

17. The method according to one of the claims 12 to 16, characterized by deflecting the second yarn, prior to intermingling, around a non-heated pin with a diameter smaller than 10 mm by an angle of between about 270° and 360°, preferably 360°, and by heating the second yarn, immediately after the deflection, to a temperature of between 100° C and 250° C,



especially to a temperature of between 180° C and 240° C, for 0.01 s to 10 s, especially for 0.05 s to 1 s.

18. The method according to claim 17, characterized by drawing off the second yarn from the pin with a speed which is higher than the speed with which the second yarn is fed to the pin by the factor 1.3 to 2.7, especially the factor 1.7 to 2.4.

19. The method according to one of the claims 12 to 18, characterized by intermingling one to four first multifilament yarns with one to four second yarns.

20. The method according to one of the claims 12 to 19, characterized by providing the yarns with a twist of between 100 twists/m and 500 twists/m after intermingling.

21. The method according to one of the preceding claims, characterized by dyeing and/or lubricating the yarn or the yarns prior to winding up the same.

22. The method according to one of the claims 10 to 21, characterized by subjecting the intermingled yarns to a tension treatment prior to winding up the same so that the self-crossing slings or loops formed during intermingling are decreased in such a manner that they are reduced in their diameter for about 20 % to about 95 %, related to their original diameter.

23. The method according to claim 22, characterized by feeding the intermingled yarns to the tension treatment with a speed which is between 0.1 % and 5 %, especially between 0.1 and 2.5 %, lower than the



speed with which the yarns are drawn off the tension treatment.

24. The method according to one of the preceding claims, characterized by subjecting the intermingled yarns prior to winding up to a thermal treatment at a temperature of between about 100° C and 250° C, especially of between about 180° C and about 240° C.

25. The method according to claim 24, characterized by carrying out the thermal treatment in a hot stream of air.

26. The method according to one of the claims 24 or 25, characterized by carrying out the thermal treatment for between 0.01 s and 10 s, especially for between 0.05 s and 1 s.

27. The method according to one of the claims 24 to 26, characterized by feeding the intermingled yarns to the thermal treatment with a speed which is equal to or higher than the speed with which the yarns are drawn off the thermal treatment.

28. The method according to claim 27, characterized by using a feed speed which is higher than the draw-off speed for about 0.1 % to 10 %, preferably 2 % to 4 %.

29. The method according to one of the claims 24 to 28, characterized by providing the intermingled yarns with a twist of between about 10 twists/m and about 800 twists/m, preferably of between about 100 twists and about 600 twists.

30. The method according to one of the claims 12 to 29, characterized by winding up the intermingled yarns with an advance of between 0 % and 10



%, and subsequently dyeing and/or lubricating the same.

31. Yarn, especially sewing yarn, produced according to one of the preceding claims, characterized in that the yarn has a core-jacket-structure with at least one inner multifile core material and at least one multifile effect yarn intermingled therewith, and in that at least 85 %, preferably 95 %, of the self-crossing slings or loops formed during intermingling are not drawn together in a knot-like manner.

32. The yarn according to claim 31, characterized in that it consists of up to four multifile core materials and up to four multifile effect yarns.

33. The yarn according to claim 31 or 32, characterized in that it is threaded and has between 100 twists/m and 600 twists/m.

34. The yarn according to one of the claims 31 to 33, characterized in that the core material has a number of elementary threads of between 20 and 500, preferably of between 30 and 150.

35. The yarn according to one of the claims 31 to 34, characterized in that the effect yarn has a number of elementary threads which corresponds to about half of the number of elementary threads of the core material.

36. The yarn according to one of the claims 31 to 35, characterized in that the core material has a titre of between 100 dtex and 1000 dtex, preferably of between 100 dtex and 600 dtex.

37. The yarn according to one of the claims 31 to 36, characterized in



that the titre of the effect yarn corresponds to about 15 % up to about 40 % of the titre of the core yarn.

38. The yarn according to one of the claims 31 to 37, characterized in that the yarn has a thermal shrinkage at 180° C and a boiling shrinkage in water of between 2 % and 4 %.

39. The yarn according to one of the claims 31 to 38, characterized in that the core material, prior to the drawing, has an original titre of 285 dtex and a number of elementary threads of 32, that it has a titre of between 162.8 dtex and 123.9 dtex after the drawing, and that the specific strength of the core material varies between 41.06 cN/tex and 67.12 cN/tex.

40. The yarn according to one of the preceding claims 31 to 39, characterized in that the core material as starting material has a titre of 410 dtex and a number of elementary threads of 40, that the core material after the drawing has a titre of between 221.6 dtex and 165.6 dtex and a specific strength of between 38.23 cN/tex and 68.81 cN/tex.

41. A device for carrying out the method according to one of the preceding claims comprising a first delivery works for drawing off the multifilament yarn, preferably from a spool, a pin wrapped by the yarn with an angle of between 270° and 360°, preferably 360°, a second delivery works for drawing off the yarn from the pin and means for winding up the yarn, characterized in that the pin (5) is formed as non-heated pin with a diameter smaller than 10 mm, and in that a heating device (6) is located between the pin (5) and the second delivery works (7).



\* C L M S \*

42. The device according to claim 41, characterized in that the heating device (6) is formed as contact heater.

43. The device according to claim 42, characterized in that the heating device (6) is a heating plate (hot plate).

44. The device according to one of the claims 41 to 43, characterized in that a third delivery works is provided behind the second delivery works (7).

45. The device according to one of the claims 41 to 44, characterized in that it includes a fourth delivery works (9) for drawing off the second yarn (2), preferably from a spool, a second pin (10) wrapped by the second yarn with an angle of between  $270^\circ$  and  $360^\circ$ , preferably  $360^\circ$ , a fifth delivery works (11) for drawing off the second yarn from the pin and a nozzle (3) for intermingling the multifilament yarn (1) with the second yarn (2) as well as a device (16) for winding up.

46. The device according to claim 45, characterized in that a device (8) for wetting the multifilament yarn (1) with water or with an aqueous dispersion or suspension is disposed ahead of the nozzle (3).

47. The device according to claim 45 or 46, characterized in that a second heating device is provided ahead of the fifth delivery works (11), and in that the second pin (10) has a diameter which is smaller than 10 mm.

48. The device according to claim 47, characterized in that a sixth delivery works is provided between the fifth delivery works (11) and the nozzle (3).



49. The device according to one of the claims 41 to 48, characterized in that a tensioning device comprising a seventh and an eighth delivery works, a third heating device (14) and/or a cooling device having an eighth and ninth delivery works are provided behind the nozzle (3) and ahead of the means (16) for winding up.

50. The device according to one of the claims 41 to 49, characterized in that the delivery works (4, 7, 9, 11) are formed as galettes.

51. The device according to one of the claims 41 to 50, characterized in that the non-heated pins (5, 10) are made of ceramic or have a surface of ceramic.

