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(54) Process of dyeing of synthetic polymeric thermoplastic yarns and product produced by the process.

(57) A process is provided in which partially oriented synthetic yarn such as partially oriented polyester yarn is fed continuously first to and through a bath 7 of a liquid conditioning agent such as a dye, then to a first heated roll 9 and then to a second heated draw roll 10 to draw the partially oriented yarn, then to a texturizer 12 and then to a takeup roll 14, all in one continuous operation, to produce a conditioned and texturized yarn product possessing about 12% to about 30% latent shrinkage. Also provided is a novel process for dyeing undrawn, partially drawn or fully drawn synthetic yarn.

Fig.1.

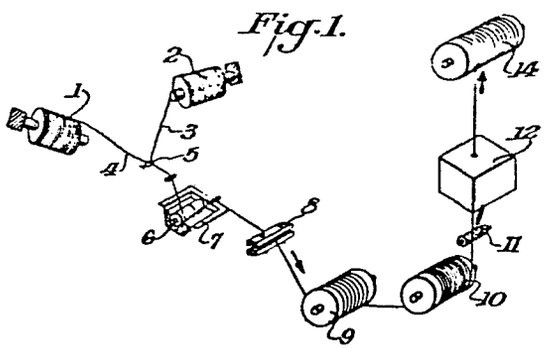
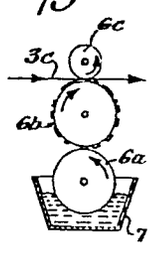


Fig.6.



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Process of dyeing of synthetic polymeric thermoplastic yarns and product produced by the process

The invention concerns the continuous conditioning and texturizing of synthetic yarns to produce a product possessing substantial latent shrinkage.

By "conditioning" the yarn, as used herein, means applying various liquid conditioners to the yarn such as dyes, fire retardants, optical brighteners, soil release agents, bonding agents, lubricants, antioxidants, delusterants, and antistatic agents.

U.S. Patent 3,434,189 (Buck et al.) discloses a method of continuously dyeing and stretching undrawn yarn. The patent discusses the well known process of making synthetic yarn from thermoplastic polymers by first extruding continuous filaments, drawing the extruded filaments to orient the molecules in the filament and to improve the tensile strength, and then dyeing and texturizing the yarn, the latter step accomplished, for example, by stuffer

box or false twist crimping. The patent discloses and claims a process for continuously applying dye to "undrawn yarn" followed by drawing and texturizing the dyed yarn.

As used in U.S. Patent 3,434,189,the term "undrawn yarn" refers to yarn produced by conventional thermoplastic filament extruders. The specification states that, in some instances, the "undrawn yarn" may in fact be slightly drawn after extrusion and before being applied to the drawing and texturizing apparatus. However, even though "slightly" drawn to provide a small degree of orientation of yarn filament molecules, this slightly drawn yarn is generally referred to in the art as "undrawn yarn". The patent states that before such yarns can be supplied to texturizing apparatus and later made up into finished garments, it is necessary to draw the yarn and extend its length by at least two times. Thus, the meaning of the term "undrawn yarn",by implication, includes yarn with a small degree of orientation of its molecules which yarn has been drawn to a degree considerably less than two times.

The specification and all claims of U.S. Patent 3,434,189 are limited by express language to "undrawn yarn". Nowhere in the reference is a product disclosed having substantial latent shrinkage.

U.S. Patent 3,751,778 (Grosjean et al.) discloses a process for the simultaneous texturizing and dyeing or finishing of synthetic thermoplastic yarns. The process comprises packing and compressing the yarns into a confined space through introduction of a flow of a compressed fluid heated to a temperature sufficient to set the yarns, allowing a portion of the compressed fluid to provide movement of the yarns axially in the confined space with the remainder of the fluid escaping laterally from the confined space into a further annular space under a pressure lower than the pressure of the first confined space but

higher than atmospheric pressure, and simultaneously introducing a dyeing solution or finishing agent into the confined space and over the compressed yarns. This process is characterized in that the compressed yarn is continuously passed through at least one expansion zone and then through at least one expansion zone and then through at least one zone in which an additional fluid is introduced under pressure. This process is said to provide simultaneous dyeing or finishing of thermoplastic yarns in a high speed texturizing process.

U.S. Patent 3,751,778 also describes in some detail the background art concerning the high speed texturizing and dyeing of synthetic, thermoplastic yarns. Specifically, it is noted therein that a high speeds the absorption of dyes by the thermoplastic yarns is often not sufficiently fast, and therefore the simultaneous texturizing and dyeing of such yarns has disadvantages. The reference further states that, until the development of patentees' process, no process for the successful simultaneous high speed texturizing and dyeing of thermoplastic yarns had been proposed. The reference discloses such simultaneous dyeing and texturizing by a process of injecting dye directly into a specially designed stuffer box crimper.

U.S. Patent 3,602,966 discloses, like the first above-mentioned reference, a process for dyeing undrawn tow filaments, particularly polyester filaments, prior to drawing. The improvement therein is concisely set forth in claim 1 of that reference and is said to comprise providing drawing means in front of a washing unit, thereby removing at least part of the unfixed dyestuffs and auxiliary finishing agent in the drawing unit rather than in the washing unit.

U.S.Patent 3,919,749 discloses a method for producing space-dyed textured yarn. U.S. Patent 3,955,254 discloses

methods and apparatus for treating yarn with fluid materials, including dyes and conditioning agents. U.S. Patent 3,579,764 discloses a knit-deknit process for producing textured yarns, and a dyeing step is included in the process disclosed. U.S.Patent 3,137,056 discloses a method for dyeing and treating synthetic yarns, and U.S. Patent 3,892,020 discloses a method of dyeing a texturized yarn package. These latter references are deemed to be not as pertinent to the process disclosed and claimed herein as are the first three references described in detail herein-above.

According to the invention a process is provided for producing, in a continuous operation, conditioned and textured synthetic polymeric yarn. The process comprises continuously feeding at least one end of partially oriented synthetic thermoplastic feed yarn to and through a bath of a liquid conditioning agent, wiping any excess conditioning agent from the yarn, directing the yarn to and around a first heated predraw roller and thence to and around a second heated draw roller rotating at a faster peripheral speed than the first roller to impart draw to the yarn, then feeding the conditioned and drawn yarn to a texturizer and accumulating the conditioned and texturized yarn on a takeup roller, the product obtained thereby possessing latent shrinkage in the range of about 12% to about 30%. The conditioning agent may be a dye, a fire retardant, an optical brightener, a soil release agent, a bonding agent, a lubricant, an antioxidant, a delusterant, an antistatic agent, or other yarn conditioning agent.

When the conditioning agent is a dye, a sublimatable dye pigment is preferred.

The synthetic thermoplastic feed yarns may be polyester, polyamide, cellulose acetate, polyvinyl chloride, polypropylene or similar yarns.

Methods for producing heather-like qualities and space dyed effects to yarn bundles produced according to the above process are also provided.

A novel method of dyeing undrawn, partially drawn or fully drawn synthetic polymeric thermoplastic yarns using sublimatable dye pigments is also provided.

Other aspects, concepts, objects and advantages of the invention are apparent from the following description of embodiments of the invention in connection with the drawings.

Figs. 1 through 6 show the apparatus used in performing the process of this invention.

In Fig.1, feed yarn ends 3 and 4 are shown being withdrawn from feed yarn packages 1 and 2 and gathered at eyelet 5. The yarn ends then pass through trough 7 containing a conditioning agent such as a dye, the yarn ends being immersed in the dye by means of roller 6, and then wiped by yarn wiper 8. From wiper 8, the yarn ends are directed to and around heated predraw roll 9, thence to and around heated draw roll 10 which is rotating at a faster peripheral speed than the predraw roll. Optional treating roller 11 may be used to apply finishing agent or lubricant to the yarn bundle before it passes to crimp texturizer 12, and finally to product yarn takeup 14.

Fig.2 shows in detail a wiping device 8, including rubber pads 8a, support means 8b and wing-nut clamps 8c. Fig.3 is a side view of wiping device 8. Another preferred wiping device is shown in Fig.7. This is a standard gate tension device 18 and countercurrent air jet 19. Yarn 3d is passed through the annular ceramic guides 20 of gate tension device 18 and then to air jet 19 where excess dye is removed.

Fig.4 illustrates the dyeing process utilized when it is desired to produce a dyed product having a heather-like appearance. For such process, feed yarn 3a is white and is not dyed. Feed yarn 4a is fed to and through the dye bath 7., wiped, and both yarns are then processed as in Fig.1.

Fig.5 illustrates the dyeing process utilized when it is desired to produce a dyed product having a heather-like appearance in which feed yarn end 3b is dyed one color and feed yarn end 4b is dyed a different color by passage through the two dye baths 7b and 7a respectively, following which the yarns are processed as in Fig.1.

Fig.6 illustrates the configuration of dye bath 7 and the rollers employed when a space dyeing effect is desired. Dye roller 6a picks up dye from dye bath 7 and dye is transferred to the raised portions of gravure roll 6b, then to yarn 3c which is passed between gravure roller 6b and press roll 6c as shown. In this manner,dye is intermittently applied to the yarn at desired, predetermined intervals along the length of the yarn.

An alternative method for achieving space dyeing is shown in Fig.8 wherein yarn 3e is guided through stainless steel trough 27 as shown and different color dyes are caused to drip intermittently upon yarn 3e from dye reservoirs 25. Air jet 26 effectively removes any excess dye.

According to the process of this invention, continuous thermoplastic synthetic polymer yarn filaments which have been partially oriented are continuously dyed and textured. The synthetic yarns suitable for use in this process include the yarns obtained by spinning or extrusion of polymers, copolymers, graft copolymers and mixtures thereof, including polyesters, polyamides, cellulose acetate, polyvinyl chloride, polypropylene and similar

thermoplastic polymers. The process is especially suited for continous dyeing and texturizing polyester yarns.

In usual operation according to this invention, multiple ends of partially oriented feed yarns are fed from multiple feed roll packages to and through a gathering eyelet and then to and through a bath containing a liquid conditioning agent such as a dye, then to a first heated predraw roller (called a "Godet" in the art), then to a second heated draw roller ("Godet") to draw the yarn, then to a texturizer and then to a takeup roll, all in one continuous operation, to produce a conditioned and texturized product yarn possessing substantial latent shrinkage.

The term "partially oriented" as used herein means yarn which has been drawn from its as-spun undrawn condition to an extent of at least two (2) times its undrawn length. Such yarns are commercially available and sold, for example, by E.I. duPont de Nemours and Co., Inc., under the product designation DACRON(R) polyester yarn.* This yarn is partially oriented by the manufacturer by drawing about 3X, i.e. from about 750 denier as-spun to about 250 denier as obtained commercially.

The term "latent shrinkage" as used herein means that the product yarn obtained by the process of this invention, when placed into water at about 82°C , shrinks to a length shorter than its length as produces. The amount of this shrinkage for all the products made according to the process herein ranges between about 12% and about 30%.

The bath containing liquid finishing agents is typically a small trough containing a small roller around which the feed yarn is guided to submerse it into the conditioning or finishing agent. The conditioning or finishing

* "DACRON" is a registered trademark of DuPont

agent may include any of those discussed hereinabove. The process is especially suited for continuously dyeing and texturizing yarn and further discussion herein will be limited to dyes being used as the conditioning agent.

The dyeing process described herein has been successfully demonstrated using so-called direct dyes obtained from a number of manufactureres including DuPont, Eastman Chemical Co. and Imperial Chemicals Industries. The best results, insofar as ease of preparation, evenness of application, sunlight fading resistance, and washfastness have been obtained when using printing inks containing sublimatable pigments.

These inks are made primarily for printing applications. Insofar as is known, they consist of direct dyes ground to a very fine particle size, and suspended in a water solution with the aid of suitable dispersing agents. They are intended for use where the ink is first applied to a printing paper and then transferred to a fabric being dyed by means of sublimation of the pigment and transferral to the fabric in the vapor phase. To satisfy various applications, these inks are available commercially in three general energy levels. Energy level indicates the degree of heat required to vaporize the dyestuff so that it will transfer to the medium being printed. The lower the energy level, the easier it is to transfer the ink. However, the lower energy inks may produce printings which are deficient in light and wash fastness. The high energy inks are more difficult to transfer but generally give printed fabrics having outstanding levels of light and wash fastness.

Preferred dyes include dyes manufactured by Ault and Wiborg, Ltd., London, England, including:

Aultran*	Red FO2
Aultran	Red FO4
Aultran	Blue F56
Aultran	Blue F57
Aultran	Yellow F23
Aultran	Yellow F24
Aultran	Violet F62
Aultran	Black F81

It is believed that these dye pigments are sublimatable anthroquinone, azo and methine dyestuffs.

Upon leaving the dye bath according to the process of this invention, the yarn ends are sent to and through a wiping device to remove excess dye and carrier liquid. A suitable wiping device is shown in Figs. 2 and 3, and comprises two rubber wiping members held by brackets and adjusted for pressure by wing-nuts as shown.

From the wiping device, the yarn ends are guided to the first heated Godet. Heat to this first roll is supplied by conventional means such as by internal resistance heaters. The yarn ends are wrapped around this first roller a multiplicity of times to provide the required time at temperature to heat the yarn. For 250 denier polyester yarn, this first roll typically may be 139,7 mm in diameter, heated to a temperature of about 93°C , rotating at 375-750 rpm, and has seven wraps of yarn.

From the first Godet, the yarn is sent to the second Godet which is also heated by conventional means. The yarn ends are wrapped around this roller a multiplicity of times also to fully heat the yarn, and this roll revolves faster than the first roller in order to draw the yarn. For 250 denier polyester yarn, this second roller typically may be 139,7 mm in diameter, heated to a temperature of about 218°C, rotating at 600-1200 rpm, and has fourteen wraps of yarn. Such conditions would result in a draw ratio of 1.6, i.e. 250 denier yarn would be

* "Aultran" is a trademark of Ault and Wiborg

drawn down to 150 denier yarn.

From the second draw roll, the yarn may optionally be treated with lubricant or other finishing agent as shown in Fig.1, following which it is directed to the texturizer, and finally to a takeup roll. Preferably the texturizer is of the stuffer box type, although any texturization process involving yarn deformation (crimping) under application of heat could be utilized. False twist texturizing for example, is also contemplated.

By the process of this invention, the yarn produced possesses substantial latent shrinkage, being generally in the range of about 12% to about 30%.

In additon to once-through dyeing using a single dye bath, it will be clear to one skilled in the art that multiple color effects may be obtained using multiple dye baths containing different color dyes as shown in Figs.4 and 5. Also, space dyeing is possible using conventional methods as shown in Fig.6.

The above discussion has been confined to the continuous process of dyeing and texturizing partially drawn yarn. Also contemplated and deemed to fall within the scope of this invention is the new dyeing process for dyeing undrawn, partially drawn and fully dranw filaments of synthetic yarn using the above-described sublimatable dye pigments. In addition, these dyestuffs may be used to dye, in addition to continuous filaments, synthetic staple and tow, for example, falling within the above-described class of synthetic polymers.

While the invention has been described above and in the examples which follow in connection with certain specific details and embodiments, it will be clear to one skilled in the art that changes of modifications deviating from

these specific embodiments may be made without deviating from the gist of this invention, and such changes and modifications are deemed to fall within the scope of the claims below.

The examples which follow are intended to be illustrative of the process of this invention, but not to limit the scope of the invention in any way. The best mode presently contemplated for carrying out the process of this invention is illustrated below in Example 7.

Example 1

Three ends of partially oriented polyester yarn (DuPont 235/34, "DACRON" polyester, type T56T) were fed at 342,5 m/min. from separate packages and gathered by an eyelet and fed through a dye bath comprising 30% Resolin Red dye (Sandoz Co.) and 70% Lurol 75 solvent (G.A. Goulston Co.) by passing the yarn bundle under a guide immersed in the dye liquor, and then the yarn was passed over a sponge to remove excess dye. From the sponge, the yarn passed over and around a first predraw roller (76,2 mm in diameter, rotating at 1430 rpm, 4 wraps, and heated to 177°C) and then to a second draw roller (88,9 mm in diameter, rotating at 1965 rpm, 3 wraps, and heated to 177°C , draw ratio 1.57X) and then to an FCJ crimper (manufactured by Techniservice Corp.) and thence to a takeup. Temperature in the crimper was maintained at 149°C.

By this process, the yarn was continuously dyed and crimped. Some spattering of the dye occured requiring improved wiping means. Approximately one pound of yarn was processed continuously with no breaks. No variation in depth of shade of the dye from inside to outside of the takeup package was observed.

The dyed yarn was knitted into fabric which was uniform

in shade with no defects noted other than those due to poor texturing of the base yarn.

When scoured in 71°C water for 30 minutes, however, the knitted fabric lost approximately one-third of its color strength indicating relatively ppor penetration of dye into the yarn bundle.

Example 2

In this example and those which follow, an M-600 stuffer box crimper (manufactured by Techniservice Corp.) was employed. This apparatus was equipped with internally heated predraw and draw rolls having variable speed drives.

Three ends of partially oriented polyester feed yarn (duPont "DACRON" polyester, 255/34, Type 242) were drawn from three sparate feed packages and directed through an eyelet to the first predraw Godet roll (139,7 mm in diameter, rotating at 120-240 rpm, 7 wraps) and then to a dye bath located between first and second Godet rolls. The yarns passed over a sponge upon exit from the dye to remove excess dye.

Various runs were made using different dye baths. Dyes used included Aultran DP Red, Aultran DP Blue and Aultran DP Yellow (supplied by Ault and Wiborg, Ltd., London, England).

From the dye bath, the yarn passed to the second heated Godet roller (139,7 mm in diameter, rotating at 220-440 rpm, 14 wraps, draw ratio 1.83), then to the stuffer box crimper and finally to the takeup.

The various experimental conditions are listed in Table 1.

Table 1

Trial	Dye Bath* Composition	Feed Yarn Speed, m./Min.	Temperature, °C Predraw Godet	Draw Godet	Stuffer Box	Latent Shrinkage %
A	40% Aultran Blue 40% Aultran Red 20% Aultran Yellow	201	116	149	116	12,1
B	100% Aultran Blue	192	116	177	116	19.6
C	25% Aultran Blue 75% Water	123,5	116	177	116	22.2
D	25% Aultran Blue 75% Water	101	116	177	177	29.8
E	25% Aultran Red 75% Water	101	116	177	177	30.1

The latent shrinkages shown represent the percent shrinkage of a skein of yarn when loaded with a weight of 0.005 grams per denier and immersed in a water bath maintained at 82-88°C.

Following these trials, fabric tubes were knitted using each of the yarns produced. One-half of each tube was scoured in water at 71°C with detergent for 30 minutes and then tumble dried. The dried tube sections were visually compared with the unscoured sections, and estimates of color loss are shwon in Table 2.

* Total dyestuff concentration was 5% in water

Table 2

Trial	General Appearance	Color Loss-Scoured
A	Very splotchy, uneven	50%
B	Fairly even, texture variations	25%
C	Medium blue, even	10%
D	Medium blue, even	5%
E	Splotchy, uneven	15%

From these trials, it was evident that the dye solution was not being evenly applied and that the slower yarn speeds improved dye penetration and color fastness. Higher temperatures also appeared to improve dye fixation.

Example 3

Unless otherwise indicated, this example and those that follow were performed as in Example 2 except that the dye bath was located prior to the first Godet, i.e. between gathering eyelet and predraw Godet.

Three ends of partially oriented polyester yarn (DuPont "DACRON" polyester 235/34, Type 242) were fed to the apparaturs as described above. The experimental conditions are shown in Table 3. The draw ratio in all trials was 1.83.

Table 3

Trial	Dye Bath Composition	Feed Yarn Speed, m/Min	Temperature, °C Predraw Godet	Draw Godet	Stuffer Box
A	25% Aultran DP Red 75% Water	110	116	224	204
B	10% Aultran Black 90% Water	192	116	224	204
C*	10% Aultran DP Blue 10% Aultran DP Yellow 80% Water	283	116	224	204
D	10% Aultran DP Blue 10% Aultran DP Yellow 80% Water	283	116	224	204

Tubes were knitted using each of the yarns so produced and scoured as in Example 2. Results of these tests are shown in Table 4.

Table 4

Trial	General Appearance	Color Loss-Scoured
A	Deep, even application, Any unevenness due to texturing defects.	15 %
B	Medium gray color, very even	5 %
C	Splotchy, heavy texturing defects	10 %
D	Very even, heavy blue	5 %

* During this run, Lurol 75 lubricant was applied to the yarn bundle in the draw zone.

Example 4

Unless otherwise indicated, this example and those that follow were performed as in Example 3 except that the dye wiper shown in Figs. 2 and 3 was located between the dye bath and the predraw Godet in order to wipe excess dy from the yarn bundle.

The conditions under which these trials were run are shown in Table 5.

Table 5

Trial	Dye Bath Composition	Feed Yarn Speed, m/Min	Temperature, °C Predraw Godet	Draw Godet	Stuffer Box
A	5% Resolin Yellow 4GL 2.5% Resolin Blue FBL 92.5% Water	192	160	221	177
B	5% Resolin Yellow 4GL 2.5% Resolin Blue FBL 92.5% Lurol 75	192	160	221	177

Tubes were knitted using these yarns as before and scoured. Results are shown in Table 6.

Table 6

Trial	General Appearance	Color Loss-Scoured
A	Even, medium Kelly green color	10 - 15%
B	Slightly uneven, color lighter than in "A"	10 - 15%

It was apparent from these trials that the use of Lurol 75 mineral oil inhibited the pickup of dye by the yarn.

It was concluded that a major portion of the color loss upon scouring was due simply to excessive dye pickup. For the remaining trials, additional wiping of the yarn prior to reaching the predraw Godet was employed.

Example 5

These trials were conducted under the experimental conditions of Example 4. Results after scouring the knitted tubes made from the yarns produced are shown in Table 7. The feed yarn used in these trials was partially oriented DuPont "DACRON" polyester, 255/34, Type 242.

Table 7

Trial	Dye Bath Composition	Appearance	Color Loss-Scoured
A	10% Aultran Black 90% Water	Deep, even gray	1-3%
B	5% Aultran Black 95% Water	Medium, even gray	0-2%

These knitted sample cloths were of commercial quality insofar as color penetration, evenness and wetfastness properties are concerned.

Example 6

Two different types of partially oriented polyester yarns were compared in these trials. In both trials, the dye bath composition was 2.5% Aultran Black in 97.5% Water.

In each trial, three ends of feed yarn were processed as in the preceding examples. Experimental conditions are shown in Table 8. In all cases, a draw ratio of 1.83 was employed.

Table 8

Trial	Feed Yarn	Feed Yarn Speed, m /Min	Temperature, °C Predraw Godet	Draw Godet	Stuffer Box
A	DuPont 255/ 34 "DACRON" Type 242	457	160	221	177
B	DuPont 255/ 34 "DACRON" Type 56	457	160	221	177

Tubes knit from these product yarns were scoured as before and the results of these tests are shown in Table 9.

Table 9

Trial	General Appearance	Color Loss-Scoured
A	Mediumgray, very even	1 - 2 %
B	Light gray, very even	0 %

The Type 56 yarn dyed perceptibly lighter than the Type 242. The Type 56 yarn was stronger than the Type 242.

Example 7

These trials were conducted under the experimental conditions of Example 4 except that feed yarn speed was increased to 366 m /min, and six (6) ends of DuPont "DACRON" polyester yarn, 255/34, Type 242T were fed to the apparatus. The dyes used were all sublimatable pigment inks obtained from Ault and Wiborg. Dye bath compositions, resultant color of finished yarn and latent shrinkage of finished yarn are shown in Table 10. The dye bath compositions shown in the table indicate percentages by weight of dyes only. For each trial, the dyes were diluted to three separate baths containing 2, 4 and 8% dye in 98,

94 and 92% water respectively.

Table 10

Trial	Dye Bath Composition	Color of Finished Yarn	Latent Shrinkage of Finished Yarn, % (8% dye concentration)
A	100% Aultran Blue F57	Navy blue	16.0
B	100% Aultran Blue F56	Medium/Deep Blue	21.0
C	100% Aultran Red FO2	Fuchsia	25.0
D	100% Aultran Yellow F23	Deep Yellow	23.5
E	50% Aultran Red FO2 50% Aultran Yellow F23	Red/Orange	28
F	25% Aultran Red FO2 75% Aultran Yellow F23	Orange	26.0
G	50% Aultran Blue F56 50% Aultran Yellow F23	Blue/Green	26.0
H	25% Aultran Blue F56 75% Aultran Yellow F23	Kelly Green	28.0
I	50% Aultran Blue F56 50% Aultran Red FO2	Royal Purple	28.0
J	33.3% Aultran Blue F56 33.3% Aultran Red FO2 33.3% Aultran Yellow F23	Brown/Olive	28.0

Tubes were knitted as before using certain of the yarns produced in these trials. These tubes were tested for light fastness, wash fastness and dry cleaning fastness, and the results are shown in Tables 11-13. In these tables, the number entries shown are ratings of the cloth following the indicated test, based upon a scale of 1 to 5, 5 being perfect. A rating of 4 is good, and a rating of 3 indicates a commercially acceptable product.

Table 11

Trial	Dye Liquor Composition	Light Fastness Xenon 60 WR - 120 Hrs. Std. Fading Units
B	4.0% Aultran Blue F56	3
C	4.0% Aultran Red FO2	4-3
D	4.0% Aultran Yellow F23	4
F	0.5% Aultran Red FO2 1.5% Aultran Yellow F23	4
H	0.5% Aultran Blue F56 1.5% Aultran Yellow F23	4-3

Table 12

	Wash Fastness*			
	1#2 Cycle		5#2 Cycles	
Trial	Shade Change	Staining	Shade Change	Staining
B	4	4	4-3	4-3
C	4-3	4	3	4-3
D	4	4-3	4-3	3
F	4	4-3	4-3	3
H	4	4	4-3	4-3

* AATCC Wash Test II-A. The samples were not prewashed before any of the trials.

Table 13

Trial	Dry Cleaning Fastness 1 Cycle Shade Change	Dry Cleaning Fastness 5 Cycles Shade Change
B	4	4-3
C	4-3	3
D	4-3	3
F	4	4-3
H	4	4-3

Claims

1. The process of dyeing of synthetic polymeric thermoplastic yarns characterized in that the dye used in said process is a sublimatable ink.

2. The process of claim 1 for producing, in a continuous operation, conditioned and textured synthetic polymeric yarn, comprising:

a) continuously feeding at least one end of synthetic thermoplastic feed yarn to and through a bath of a liquid conditioning agent,

b) wiping excess conditioning agent from said yarn,

c) drawing said yarn,

d) feeding said conditioned and drawn yarn to a texturizer, and

e) accumulating said conditioned and texturized yarn on a take-up device, characterized in that said synthetic thermoplastic feed yarn is partially oriented yarn, said liquid conditioning agent is a sublimatable ink, and, after the wiping step, said yarn is directed to and around a first rotating, heated predraw roller (9) and thence to and around a second rotating, heated draw roller (10) rotating at a faster peripheral speed than said first roller to impart draw to said yarn, the product obtained thereby possessing latent shrinkage in the range of about 12% to about 30%.

3. The process of claim 2 in which a multiplicity of feed yarn ends (3, 4) are processed.

4. The process of claim 2 in which the said partially oriented synthetic thermoplastic feed yarn is selected from the class consisting of polyesters, polyamides,

cellulose acetates, polyvinyl chlorides and polypropylenes.

5. The process of claim 4 in which said partially oriented synthetic thermoplastic feed yarn is a polyester yarn and said conditioning agent is a sublimatable dye.

6. The process of claim 2 wherein at least one feed yarn end (3a) is white and is not dyed during passage through said process and wherein at least one other yarn end (4a) is dyed to a desired color, to produce a product yarn bundle having a white/color heather effect.

7. The process of claim 2 wherein at least one feed yarn end (3b) is dyed one color during passage through said process and at least one other yarn end (4b) is dyed another color during passage through said process to produce a product yarn bundle having a color/color heather effect.

8. The process of claim 2 in which said conditioning agent is a dye and is applied intermittently along the length of said yarn to produce a space dyed effect.

9. The product produced by the process of claim 1.

10. The product produced by the process of claim 2.

Fig.1.

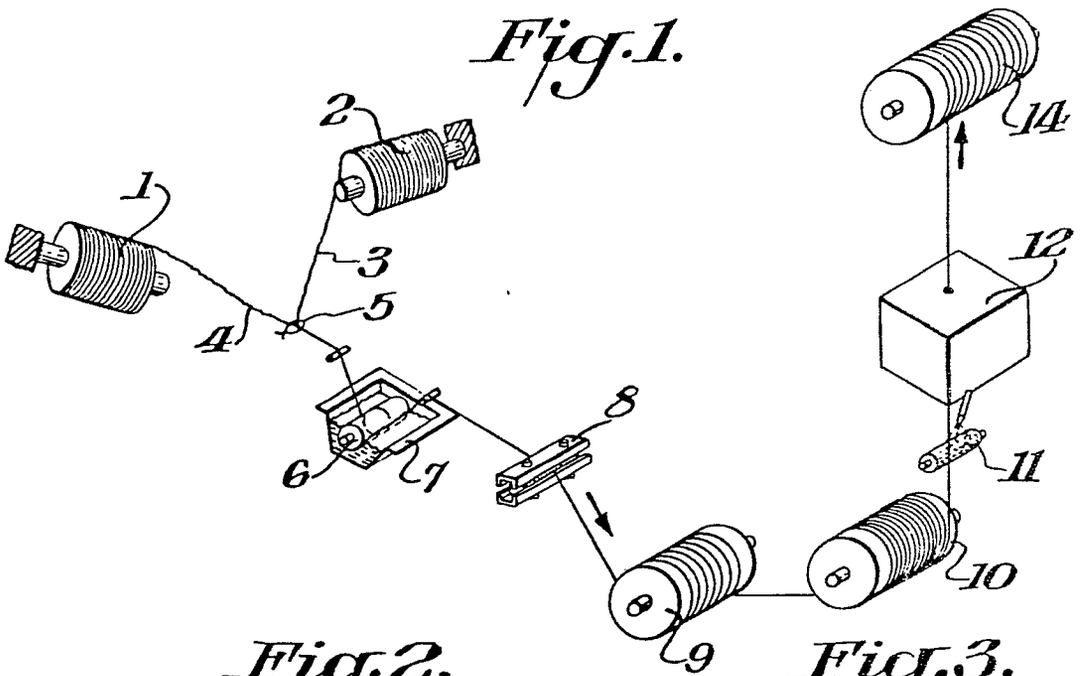


Fig.2.

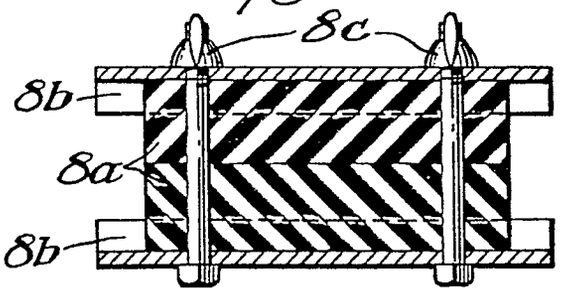


Fig.3.

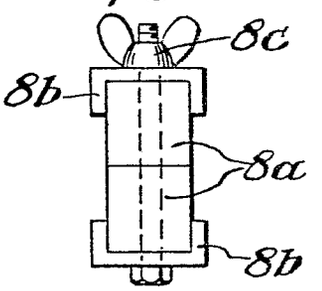


Fig.4.

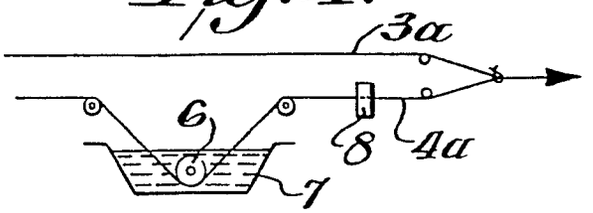


Fig.6.

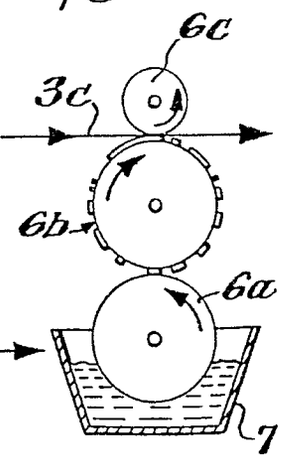


Fig.5.

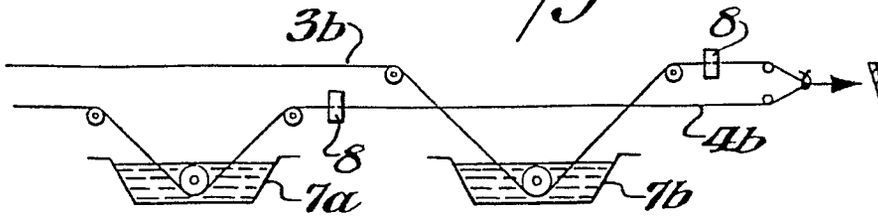


Fig. 8.

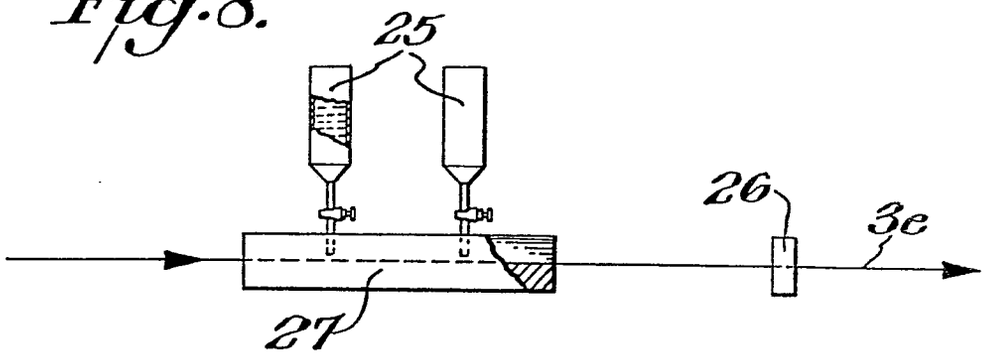
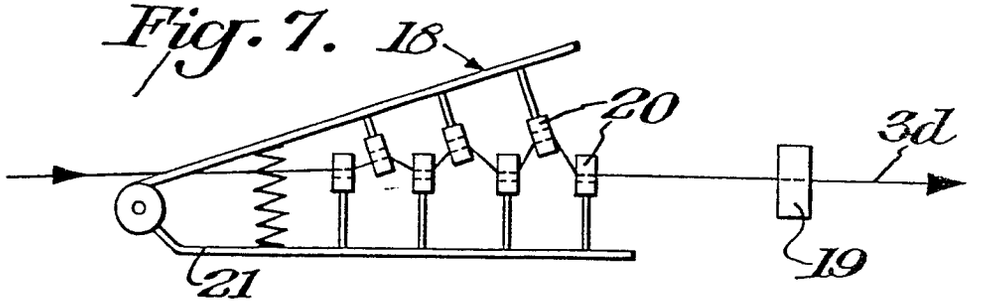


Fig. 7.



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EUROPEAN SEARCH REPORT

0009765

Application number EP 79 10 3656

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim
X	FR - A - 1 425 965 (HOECHST) * Abstract; example 4 * --	1-5
D	FR - A - 1 532 903 (KLINGER MANUFACTURING) * Whole document * & US - A - 3 434 189 --	2-4,8
	GB - A - 937 798 (MONSANTO) * Whole document * --	2-4
	DE - A - 2 026 646 (ELITEX ZAVODY) * Claims 1-6 * --	2-4
	NL - A - 72 12497 (MANUFACTURA FORTI ARGENTINA) * Whole document * & DE - A - 2 247 671 --	2-4
A	FR - A - 2 076 149 (SUBLISTATIC) * Example 1; claim 1 * ----	1

CLASSIFICATION OF THE APPLICATION (Int. Cl. ³)

D 06 B 21/00
D 02 J 1/22

TECHNICAL FIELDS SEARCHED (Int.Cl. ³)

D 06 B
D 06 P
D 02 J

CATEGORY OF CITED DOCUMENTS

X: particularly relevant
A: technological background
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P: intermediate document
T: theory or principle underlying the invention
E: conflicting application
D: document cited in the application
L: citation for other reasons

&: member of the same patent family, corresponding document

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	06-11-1979	PETIT

EPO Form 1503.1 06.78