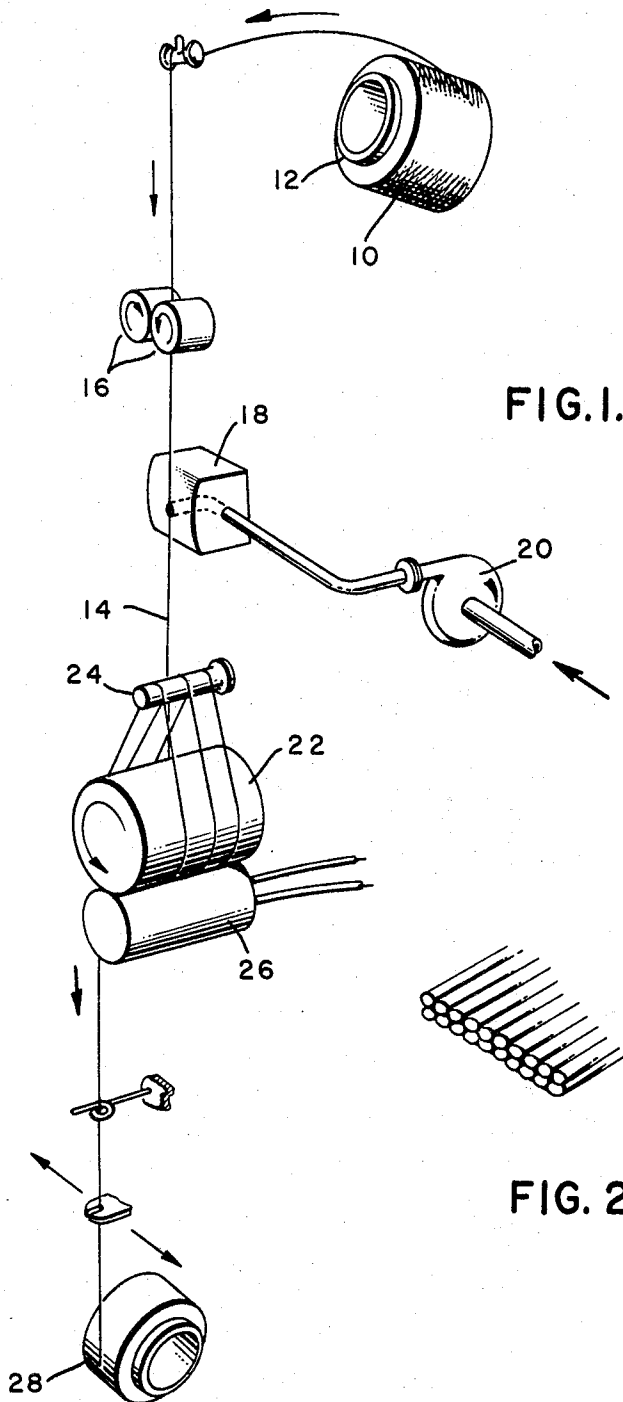


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OF PARALLEL BONDED FILAMENTS
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APPARATUS FOR FORMING A FLAT NARROW STRIP OF PARALLEL BONDED FILAMENTS

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1 Claim. (Cl. 156-441)

This invention relates to the production of a straw-like article from nylon continuous filaments. More particularly, the present invention relates to a straw-like article made from parallel arranged multi-continuous filament nylon yarn bonded together by means of a treatment with a bond-inducing agent of a particular class and to a method of producing such article.

It is known to make artificial straw of viscose rayon by extruding a viscose spinning solution through an L-shaped orifice in a spinneret. Such product consists of a continuous heavy filament folded during spinning and resembles a silk-like straw. In some cases there have been disclosed multi-filament versions of this. Also, it is known to melt spin a narrow ribbon-like structure from nylon by using a slot of proper size and shape or by coalescing a plurality of melt spun filaments before they are solidified. In either of these known melt spinning procedures, a satisfactory narrow, flat structure is expensive and difficult to produce. Extremely costly melt spinning spinnerets are required. Moreover, it is difficult to arrange enough slots in a conventional spinneret blank to render the melt spinning economically feasible.

It is an object of the present invention to provide as an article of manufacture a new and useful straw-like article from nylon continuous filaments.

It is another object of the present invention to provide a new and useful method of making an article simulating to some extent a straw and made from parallel arranged multi-continuous nylon filaments.

Other objects of the invention may become apparent from the following description.

In general, these objects are accomplished in the provision of a straw-like article or fillet composed of multi-continuous filament nylon yarn bonded together in a certain way. The yarn has a plurality of substantially straight individual continuous filaments disposed in a substantially parallel relation with respect to each other and preferably in a substantially parallel relation with respect to the long axis of the article. The article is elongated, narrow and flat, being laterally at least two times as wide as it is thick and is composed of at least two filaments. The longitudinal dimension of the narrow, flat article can be any suitable length. While there is no definite upper limit for the denier of the article with bands having deniers in excess of a million being contemplated, the denier of the article for practical reasons should be at least 15. It is preferred that the yarn from which the article is made have little or no twist, although the yarn can exhibit some twist without adverse effect. The individual filaments are fused together by means of a treatment with a suitable bonding agent, such as chloral hydrate or a multi-hydroxybenzene compound. First, a suitable nylon yarn is formed. The bonding agent, preferably in solution, is applied to the yarn. For convenience, the application of the bonding agent is made while the yarn is traveling longitudinally. Pressure of about 0.5 to 100 pounds per square inch and heat at about 50 to 250° C. are applied to the yarn shortly after the application of the bonding agent to unite the filamentary material at points along the length thereof and to induce evaporation and removal of the solvent of the bonding agent. The resultant straw-like structure possesses a coherency among the strands that is difficult to overcome without

the performance of considerable work. Any residual bond-inducing agent on the structure is not obnoxious and does not appreciably interfere with the dyeability of the fabric. While the resultant straw-like structure can be used without further processing in the construction of fabric by braiding, plaiting, knitting, or weaving, additional but optional treatments may be employed, such as washing, bleaching, dyeing, applying a softening agent, or the like. Fabric made from the straw-like structure can be used in making hats, bags, shoe uppers, curtains, artificial grass, carpets, upholstery, etc.

The present invention will be further illustrated by reference to the drawings wherein:

FIGURE 1 is a schematic perspective view of apparatus suitable for use in carrying out the method of the present invention;

FIGURE 2 is a perspective view of a straw-like structure of the invention.

Referring now to FIGURE 1, a package of yarn 10 wrapped about bobbin 12 is provided as a convenient source of a strand or bundle 14 of nylon filaments. The bundle of filaments can be unrolled from the bobbin or withdrawn overend. Alternatively, the bundle 14 can be advanced directly from a filament-forming machine involving spinning and drawing operations without any intermediate package being formed. The longitudinal movement of the bundle can be controlled by the use of a yarn forwarding device. As shown, a pair of driven nip-forming rolls 16 are operated at a predetermined peripheral speed to deliver the bundle of filaments at a controlled rate and tension from the source of supply thereof. The bundle of filaments is then passed over the surface of an applicator block 18, through which sufficient bonding agent is supplied from metering pump 20 to wet the bundle. A simple wick arrangement may replace pump 20, but generally the pump gives much better control at high speed operation.

Wetted bundle 14 is next passed a plurality of times around forwarding rolls 22 and 24, the axes of which are at a slight angle to provide proper advancement of the bundle 14, as is well known in the handling of textile strands. A pinch roll 26 squeezes the bundle against roll 22, ensuring the flattening of normally rounded bundle of filaments into a tape-like configuration as shown in FIGURE 2. At least one of rolls 22, 24 and 26 is heated, to produce bonds between the parallel filaments and evaporate the bonding agent solvent, if any. It has been discovered that a superior and more straw-like article is produced if the bundle is positively squeezed while heat is being applied; thus preferably one or both of rolls 22 and 26 is heated in any conventional manner, as by incorporating an electrical heater within the rolls.

The finished flattened and bonded bundle is now taken up in an orderly fashion, as on the schematically illustrated bobbin 28.

In FIGURE 2 it is seen that the bundle of filaments after the thermo-chemical treatment is in the form of a thin, flat narrow strip but that the individual filaments have not lost their identity. The product possesses substantial longitudinal strength, as well as lateral strength.

Dihydroxybenzene bond-inducing agents which can be employed include resorcinol, hydroquinone, and pyrocatechol. The trihydroxybenzenes include pyrogallol, for example. Chloral hydrate has been found to give excellent results. The agents are not limited to the specifically enumerated compounds since derivatives of the foregoing specific compounds also can be used to develop a strong coherency between the individual nylon filaments. Ordinarily, the bonding agents are solid at room temperature; and for best results they are rendered fluent before being applied to the filaments in order that the filaments can be more uniformly coated therewith. The compounds can

be melted before application. However, the preferred procedure is to dissolve the compounds in a suitable volatile solvent. Dihydroxybenzenes, trihydroxybenzenes, and chloral hydrate generally are readily soluble in water, common alcohols (methanol, ethanol, etc.) and ethers (dimethyl ether and the like). These compounds dissolved in such solvents or other solvents can be conveniently applied to the bundle of filaments in a variety of ways. The compounds can be sprayed, brushed, rolled, padded or applied to the bundle of filaments in other similar ways. The addition of the compound can be uniform along the length of the bundle of filaments, or for economic reasons can be made only at certain spaced points along the length of the bundle.

It has been found that preferably a predetermined amount of the bonding agent is dissolved in methanol. A solution containing about 5 to 80 percent bonding agent on a weight basis gives excellent results. The preferred concentration of the bonding agent in the solution is about 20 to 60 weight percent. The concentration of the compound selected, as can be perceived, will depend on many factors such as the method of application, the proportion of the liquid picked up by the bundle of filaments, the bundle, etc. The temperature of the compound when applied to the bundle of filaments is not too important. It has been found that room temperature is quite satisfactory as long as the compound is fluent when applied, although higher and lower temperatures can be employed.

It is necessary that the bundle of filaments picks up an amount of the bonding agent sufficient to effect a strong coherency of the bundle of filaments. The amount of bonding agent applied to the bundle of filaments prior to heating can be varied within relatively broad limits, depending upon the thickness and weight of the structure, the nature and characteristics of the particular nylon filaments employed, the individual properties of the bond-inducing agent employed, the physical properties desired in the final straw-like structure, and so forth. Within the broader aspects of the invention from about 5 to 80 weight percent bonding agent can be added on a dry basis.

As above indicated, it is necessary to heat the bundle of filaments carrying the bond-inducing agents in order to effect a strong cohesion of the filaments. Heating of the filaments at an elevated temperature is feasible by means of radiation, convection, or conduction. Preferably, the heat is supplied to the bundle of filaments by contact with a heated surface supplied by a heated rotating yarn forwarding roll or rolls. In this heating step the temperature of the strands is raised to about 50 to 250° C., preferably 50-150° C., this being below the melting point of the nylon filaments. While heated, the bundle of filaments is positively laterally pressed in order to effect a better cohesion of the bundle of filaments and to shape the bundle into a straw-like structure. This can be accomplished by pressing the bundle between two flat or rounded heated surfaces such as provided by nip-forming rolls. Pressures of about 0.5 to 100 pounds per square inch are satisfactory, although pressures lesser or greater can be employed. The strength of the resultant structure generally rises up to a point where a higher pressure is used. Generally, excessive temperatures and pressures ought to be avoided since they can induce an inferior product to be formed. However, prudent selection of optimum conditions to obtain the desired product is not difficult.

Finally, the resultant straw-like structure is cooled prior to any further operation that undesirably would disturb the individual filaments of which the structure is composed. The cooling can be quickly accomplished by directly applying a coolant thereto. However, merely allowing the strands to reach equilibrium with room temperature is quite satisfactory. After cooling, the resulting structure can be used in the construction of textile articles normally made of straw or artificial straw.

The filaments are composed of nylon. As is well known, nylon is a long-chain synthetic polymeric amide which has recurring amide groups as an integral part of the main

molecular chain, and which is capable of being formed into a filament in the direction of the axis. Specific types of nylon from which the filaments can be manufactured include nylon-66 (polyhexamethylene adipamide), nylon-6 (polymeric E-aminocaproic acid), nylon-610 (polyhexamethylene sebacamide), nylon-4, nylon-7, nylon-11, etc., and various fiber-forming copolymers thereof.

The number of nylon filaments which can be bonded together by the practice of the present invention to obtain the straw-like structure can range from two to any suitable number of filaments including tow. The cross section of the filaments may be round, but the cross section can be multi-lobal, multi-faceted or the like. A bundle of filaments wherein the filaments have a hexalobal cross section can be shaped into a very dense straw-like structure since the lobes of the filaments will nest into the concavities of adjacent filaments.

The following examples illustrate specific embodiments of the present invention. It is understood that the invention is not limited thereto. All parts and percentages in the examples are by weight unless otherwise indicated.

Example I

A drawn continuous filament nylon-66 yarn composed of 140 filaments and having a total denier of 840 was unwound from a bobbin through a tensioning device at a rate of 180 feet per minute. The yarn was moved across an applicator issuing an aqueous solution containing 66 weight percent chloral hydrate. The yarn then was passed 6 times around a 4" diameter internally heated feed roll maintained at 180° C., having a peripheral speed of 180 feet per minute. A pinch roll squeezed the yarn sufficient to flatten it to the configuration shown in FIGURE 2. The yarn leaving the feed roll was wound up on a bobbin in a conventional way. The resultant structure had a straw-like appearance and texture. The longitudinal strength of the structure was 8 grams per denier. The lateral strength was also excellent.

Example II

Instead of employing nylon-66 yarn, nylon-6 yarn was used. The same procedure as set forth in Example I was followed. Similarly excellent nylon artificial straw was obtained.

Example III

Instead of employing chloral hydrate, a 35 percent aqueous solution of pyrocatechol was employed as the bond-inducing agent. Otherwise, the same procedure as in Example I was followed. Similarly excellent nylon artificial straw was obtained.

Example IV

Instead of employing chloral hydrate, a 35 percent aqueous solution of hydroquinone was employed as the bond-inducing agent. Otherwise, the same procedure as in Example I was followed. Similarly excellent nylon artificial straw was obtained.

Example V

Instead of employing chloral hydrate, a 35 percent aqueous solution of pyrogallol was employed as the bond-inducing agent. Otherwise, the same procedure as in Example I was followed. Similarly excellent nylon artificial straw was obtained.

Example VI

Instead of employing chloral hydrate, a 35 percent aqueous solution of resorcinol was employed as the bond-inducing agent. Otherwise, the same procedure as in Example I was followed. Similarly excellent nylon artificial straw was obtained.

In the place of water for rendering the bonding agent fluent, methanol, ethanol and diethyl ether can be used. Moreover, the use of a solvent may be omitted entirely.

There are a number of advantages afforded by the

practice of the invention. A non-woven, thin, flat, narrow band or straw-like structure of nylon is provided. The procedure is simple and inexpensive. The straw-like structure can be braided, plaited or woven into articles of manufacture such as bags, hats, etc. Other advantages may be noted.

It is not intended that the invention be limited solely to the details of the embodiments set forth above. It will be recognized that numerous modifications conforming to the spirit of the invention may be made. Therefore, it is intended that the invention be limited only by the scope of the following claim.

We claim:

1. Apparatus comprising in combination:
 - (a) first and second forwarding rolls having their axes at a slight angle to one another,
 - (b) a supply mechanism for feeding to said forwarding rolls a bundle comprising a plurality of parallel drawn filaments, said bundle passing a plurality of times around said first and said second forwarding rolls,
 - (c) a pinch roll mounted adjacent and in contact with said first forwarding roll for squeezing said bundle against said first forwarding roll,

(d) means heating at least one of said first forwarding rolls and said pinch roll to a temperature between 50° and 200° C.,

(e) and a metering mechanism for applying a bonding agent to said bundle, said metering mechanism being mounted between said supply mechanism and said forwarding rolls.

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