

[54] **COMPACT MULTI-FILAMENT
TEXTILE TOW AND METHOD OF
MAKING THE SAME**

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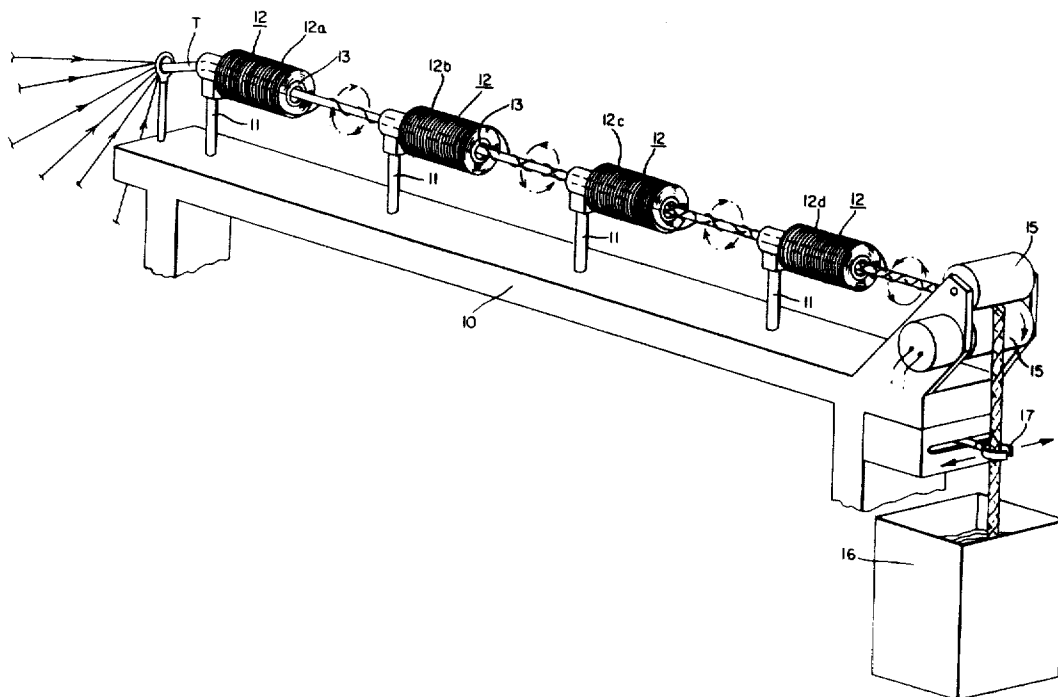
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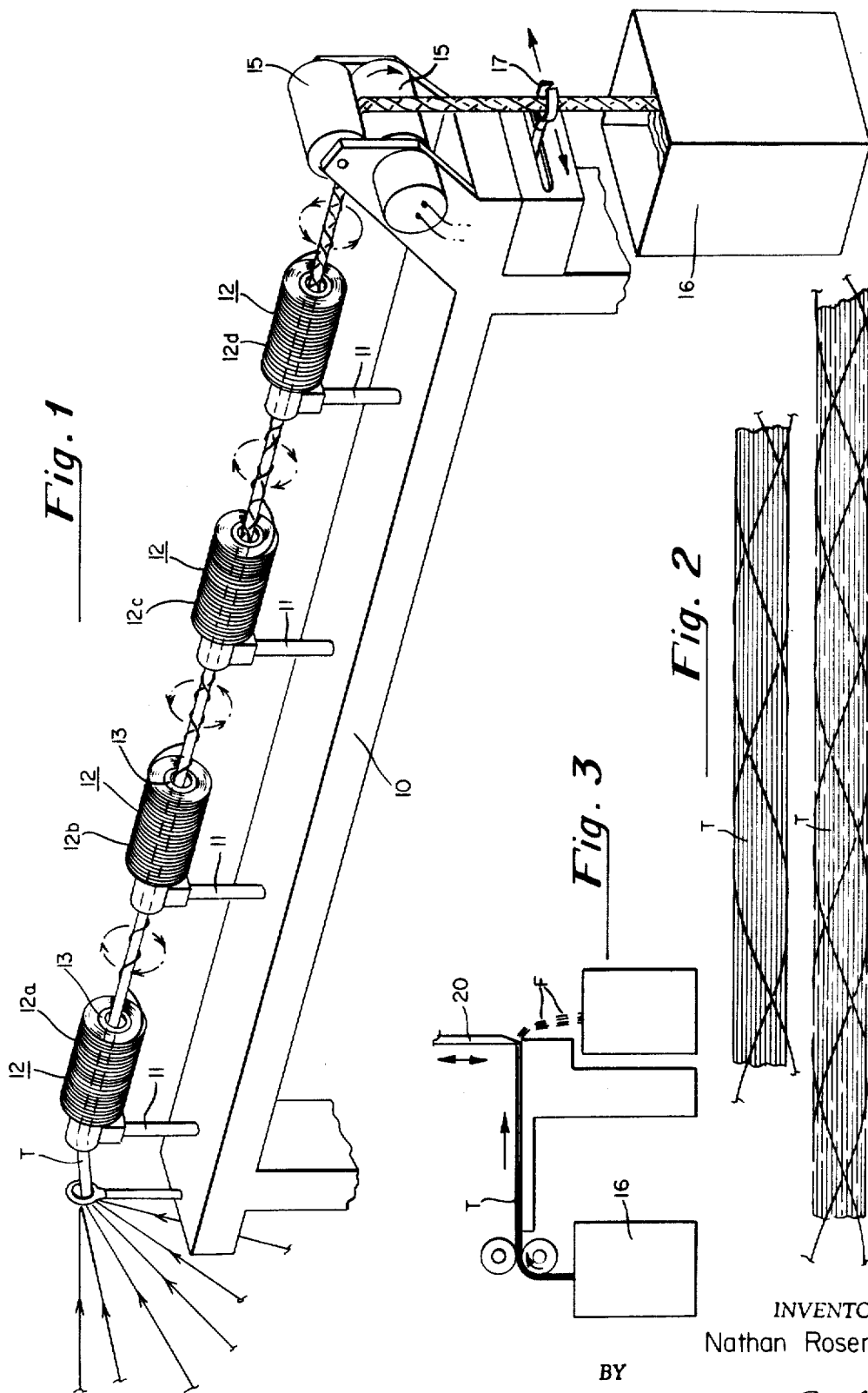
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ABSTRACT

Multi-filament textile tow is rendered compact by continuously disposing wrapper yarns in generally helical paths around the tow, one such yarn being disposed in a clockwise manner and the other counter-clockwise.

12 Claims, 4 Drawing Figures





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COMPACT MULTI-FILAMENT TEXTILE TOW AND METHOD OF MAKING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a tow which is maintained in cohesive form without depending upon crimping, and which has the advantage that it can be subjected to various handling and storage operations that are not normal for tow, and in which individual filaments of the tow tend to tangle, snag and break, and, particularly by the activity of static electricity, to balloon, tangle, snag and break.

For example, according to this invention tow can be folded down into a box in a generally serpentine form, so that it has many successive lengths that are laid across and against each other, and transported from place to place and stored indefinitely. Notwithstanding storage for a considerable period of time in this condition, the tow can be withdrawn in untangled and substantially parallel form easily and subjected to further processing, without ballooning, snagging or tangling of filaments from adjacent lengths of tow. In dyeing or application of wetting-out agents, the ability to unwind or withdraw the tow is considerably facilitated.

The invention also relates to a method of making a compact tow continuously and economically with high production rate.

2. Description of the Prior Art

It is known to wrap a yarn helically around a tow or other bundle of filaments, such as cotton yarn, for example. Cotton yarn which has been used for manufacture of dungarees, for example, has been subjected to a helical wrap of binder yarn in one direction only and then passed through a dye bath, following which the cotton yarns have been fed to a warp winder known in the trade as a long chain quiller for further processing of the cotton yarn. However, in such a process it was found necessary to develop a special machine to unwind the helically wound binder yarn, in order to free cotton yarns for the quiller operation.

With respect to metallic monofilaments, it has also been known to form helical wraps around copper wire, for example, to provide an intervening layer between the copper wire and its insulation. In such cases, however, the copper wire has been a thick, heavy monofilament and there has been no problem with respect to any compactness of multiple filaments.

It has already been proposed to make novelty yarns by interlacing or plying yarns together. The U. S. Pat. to Berry No. 2,821,835, for example, discloses a cabled yarn composed of a plurality of multi-ply yarns, all of about the same denier, twisted together in a manner to produce a braided appearance. It has also been proposed to twist more than two yarns around each other, some clockwise and some counter-clockwise to produce a composite yarn having a braided appearance. Again, all of the yarns are of the same denier and the purpose of such twisting is not to provide coherence in a core yarn or tow but to produce from a plurality of yarns, all of which are twisted about each other, a novelty yarn having substantially zero twist. Such yarns are, of course, to be distinguished sharply from tow.

Present uncrimped filament tows are known to use sizing agents for maintaining compactness and a certain amount of cohesion. Subsequently, such sizing agents must, at considerable effort and cost, be washed out to enable application of electrostatic agents required in the flocking industry. In this case, since the tow holds together without sizing agents, the electrostatic agents needed in flocking can be applied without prior "washing out".

OBJECTS OF THE INVENTION

Accordingly, it is an object of this invention to provide a multi-filament tow product and a method of making the same, having particular advantage in the textile industry.

As another example, problems have existed in the precision flocking industry, wherein a cutter knife is provided for

cutting a tow repeatedly to furnish short lengths such as 0.03 of an inch, for example, precision is required in producing a substantially uniform flock length, i.e., each individual fiber has essentially the same length as all of the other individual fibers.

It has been found that, when tow is chopped by means of a knife in a flocking machine, substantially all of the filaments of the tow must be compactly presented with substantially parallel fibers. Otherwise, when the filaments are presented at random angles, because of ballooning the knife tends to chop individual flock filaments non-uniformly with respect to filament lengths. It is a particular object of this invention to provide a novel, compact tow which is ideally suited for cutting into flock.

It has been found that, when a tow is snaked down into a box and then withdrawn, static electricity is developed which tends to cause ballooning, and which in turn tends to cause intermingling and snagging of filaments from different lengths of the tow. An object of this invention is to overcome that difficulty.

It is also desired to process tow by snaking it down into a box, storing it and later withdrawing it in untangled parallel form and then subjecting it to treatment in aqueous bath, such as a dye bath for example. In such a circumstance, it is important and advantageous to provide a means for maintaining the tow in a compact form, such that tangling does not occur upon storage or upon retrieval after storage, but nevertheless maintaining tow in such a condition that it is sufficiently open that it can be dried with relative ease after it has been processed in an aqueous bath. Ballooning is a particularly troublesome problem after or during the drying operation. It is accordingly another object of this invention to provide a compact tow which has a substantial degree of openness for the purpose just discussed.

SUMMARY OF THE INVENTION

It has been discovered that, when a multi-filament tow, even when free of crimp, is subjected to wrapping in a generally helical manner with at least a pair of individual yarns or filaments, one arranged helically in a clockwise manner and the other arranged helically in a counter-clockwise manner, such yarns or filaments being applied to the tow under substantially zero tension, a tow is created which is sufficiently compact that it can readily be snaked into a container, stored and later withdrawn without causing tangling or intermingling of individual filaments, which tow is sufficiently open that it can be subjected to an aqueous bath and advantageously and economically dried thereafter.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention is directed to a tow which consists of multiple filaments, indeed to tows which may contain thousands of filaments or more. One typical tow to which this invention has been very advantageously applied has been a polyester tow of about 500,000 denier, 6 denier per filament. Other tows for which the invention is ideally suited include nylon tows, of only 3,000 denier, 15 denier per filament, nylon tows of more than 1,000,000 denier, 3 denier per filament, and various tows of all known synthetic and cellulosic materials including nylon, polyester, polyethylene, polypropylene, cuprammonium fibers, rayon, acetate and various other synthetic continuous filamentary materials, regardless of denier per filament and regardless of total denier of the tow. The invention can also be applied to tows composed of discontinuous fibers and of natural fibers including cotton, wool and the like.

Indeed, this invention is applicable to tows that have been made up from waste fibers, after subjecting the waste fibers to (a) chopping or cutting, (b) carding or garnetting and (c) pin-drafting to make the component discontinuous filaments parallel. For many uses it is important to create such a tow and process it without crimping the discontinuous filaments. If the component filaments were crimped there might be adequate

cohesion for such a tow to hold together in processing, but the crimped filaments would not be of a suitable linear configuration for subsequent conversion into flock, for example. However, without any crimp and in the absence of some sort of adhesive sizing, the tow would completely fall apart in processing. Thus, it is important to provide a tow composed of discontinuous filaments in linear or non-crimped form, which nevertheless holds together in processing.

It is important in accordance with this invention that multiple ends of yarn are arranged in a generally helical manner and of opposite hand about the tow.

In applying the yarns to the tow, a controlled amount of tension may be applied, but it has been discovered that a tight wrap for certain uses is usually unsatisfactory because of difficulty in drying the tow after it has been immersed in an aqueous solution. For that reason, especially when aqueous solutions are used, substantially zero tension is preferably applied to both ends of yarn, or to all of them if more than two ends are used, when the ends of yarn are being helically wrapped around the tow.

DRAWINGS

FIG. 1 of the drawings shows an apparatus and method which advantageously causes the formation of a continuous, compact tow embodying features of this invention.

FIG. 2 shows a length of continuous filament tow, shown broken off at the ends, constructed and arranged in accordance with features of this invention, with the ends of some of the wrapping yarns shown broken off at random in order to illustrate the nature of the wrap more clearly.

FIG. 2a shows a length of tow similar to FIG. 2 but composed of discontinuous filaments.

FIG. 3 shows tow, removed from storage in a box, being fed to a flocking machine to produce precision length flock.

Referring to FIG. 1, it will be seen that a machine frame 10 supports a plurality of standards 11 on which are mounted a plurality of cylindrical yarn packages collectively designated by the number 12, each having a central, open core 13. The tow T which may be multi-filament tow of any type or denier as already referred to herein, continuous or discontinuous, is continuously passed through the cores 13 of the yarn packages 12. The tow T is continuously moved, preferably but not necessarily at a constant speed, by means of a pair of drive rollers 15, 15 and is delivered into a box 16. The tow is snaked into the bottom of the box by a distributing arm 17 which moves according to a predetermined path in order to distribute the tow substantially evenly along the bottom of the box, or upon the surface presented by tow that has already been snaked into the box. The distributing arm 17 is moved back and forth, and from side to side (to allow for overall distribution) by conventional mechanical means, not shown.

It will be observed that the yarn package 12a is mounted in such a direction that, when yarn is taken off over the end of the package, it is wrapped in a clockwise direction around the tow. It will be noted that the second yarn package 12b is arranged with the yarn wound on the package on the opposite hand with respect to the yarn on the package 12a; subsequently, when the yarn is drawn over the end of the package, it is wrapped around the tow in a counter-clockwise manner, as shown. Similarly, the yarn is arranged to wrap in a clockwise manner from yarn package 12c, and in a counter-clockwise manner from yarn package 12d. There is no practical limit to the number of yarn packages that may be utilized, but it is preferred to space the yarn packages longitudinally along the length of the tow, so that spaces exist between the various yarns in the positions they occupy after they are applied to the tow.

A preferred manner of starting up is to provide substantially equal lengths of yarn on each yarn package 12, and to hand-wrap the yarns around the tow until sufficient length of wrapped, compact tow is provided so that the take-up device 15, 15 takes up not only the tow but the spirally wrapped yarns

as well. Then, by simply operating the drive of the take-up device, both the tow and all of the wrapper yarns are automatically moved as a unit in a longitudinal direction.

It is important in accordance with this invention to apply the yarns to the tow at substantially zero tension. The operation of the take-up device 15, 15 gently unwinds the wrapper yarns from their packages at substantially zero tension.

For special purposes, requiring extreme degrees of compactness, and particularly where it is not intended to subject the wrapped tow to an aqueous bath, it is, of course, possible to apply conventional tension devices to the yarns as they pass from the packages to the tow, as is well known in the textile industry, to provide a controlled tension for each wrapper yarn. Also, for any specific purpose, it may be possible to apply more tension to one yarn than to the other yarn, and that each may be applied at an individual controlled tension.

In those instances where zero tension is highly preferred, it has been noted that when the diameter of the yarn on the package becomes too small, the yarn tension tends to increase because of friction between the yarn and the end of the package core 13. Accordingly, it is highly desired to control the diameter of the yarn package, so that the yarn does not come off the end of the package at such an angle that it would drag against the package core 13, by replacing yarn packages and rewinding them, so that the packages always contain enough yarn to avoid friction of the type referred to.

It will be appreciated that the compact tow manufactured in accordance with this invention can be fed into a flock cutter of the type shown in FIG. 3, and that the wrapper yarns maintain the filaments of the tow in substantial parallelism, thus providing for a uniform presentation to the cutter 20, resulting in the production of uniform flock lengths. Only the wrapper yarns themselves are presented at an angle to the longitudinal axis of the tow, and they are cut into lengths that are only infinitesimally longer than the filaments of the tow.

While flock cutting machines of various types are in existence, one particularly useful form of flock cutter, as shown in FIG. 3, consists of a base block 21 which may be made of metal, for example, on which the compact tow is continuously fed in a step-wise manner. In timed sequence with the step-wise advancement of the tow, the guillotine-type knife 20 reciprocates vertically up and down toward and away from the supporting block 21. In this manner, the knife 20 operates in a manner similar to a guillotine and chops off short lengths of filaments F each time it descends toward the block. Other types of flock cutters are also known in the art.

In flock cutting, since each wrapper yarn will also become cut and will become flock, it is preferable to provide a wrapper yarn of the same filament type and denier per filament as the tow. However, for other uses, it is not essential to meet this requirement, and the wrapper yarns may indeed be composed of other types of filament, and of deniers which differ from the deniers of the flock filament. For example, it is possible to use wrapper yarns which may later be dissolved for the purpose of separating them from the flock filaments. Also, while it is preferable to have both wrapper yarns applied clockwise and counter-clockwise as heretofore discussed herein, it is also possible to use a single yarn for this purpose, and to cut the composite tow and wrapper yarn into flock.

Various other modifications may be resorted to without departing from the spirit and scope of this invention. For example, equivalent elements may be substituted for those specifically disclosed herein, certain features of the invention may be used independently of other features, and various modifications may be made in the form of the method by which the wrapper yarns are applied to the tow, all within the spirit and scope of this invention as defined in the appended claims.

I claim:

1. A compact tow which may be stored with portions laid across or against each other and nevertheless withdrawn in essentially untangled form without significant snagging or breakage of filaments, said tow comprising a multiplicity of substantially parallel textile filaments packed into a container

in the form of a plurality of lengths laid closely adjacent to each other, said filaments of said lengths being encased in a plurality of generally spirally arranged continuous wrapper yarns, one wrapper yarn being spiraled under low tension in contact with said textile filaments and another wrapper yarn being spiraled under low tension in a direction of opposite hand and being wrapped around said filaments and repeatedly and successively over said one wrapper yarn.

2. The tow defined in claim 1, wherein the wrapper yarn has essentially the same composition as the filaments of the tow, and wherein the filaments of the yarn and the filaments of the tow have essentially the same denier per filament.

3. The tow defined in claim 1, wherein the filaments of the tow are continuous.

4. The tow defined in claim 1, wherein the filaments of the tow are discontinuous.

5. The tow defined in claim 1, wherein the wrapper yarns are under substantially zero tension.

6. The tow defined in claim 1, wherein more than two wrapper yarns are applied to the tow.

7. In a method of packaging a compact tow for transportation from one place to another, the steps which comprise continuously feeding a core comprising a multiplicity of substantially parallel filaments along a predetermined path, continuously applying a continuous wrapper yarn in a generally helical manner around the core and continuously applying another continuous wrapper yarn in a counter-directional generally helical manner around the core and repeatedly over the wrapper yarn first mentioned while maintaining said multiplicity of filaments in said core substantially parallel to each other, and packing the resulting tow into a package with a plurality of lengths of said tow laid alongside and in contact with each other.

8. The method defined in claim 7, wherein the wrapper yarns are substantially inelastic and are disposed as a package having a core opening, and wherein the core is substantially inelastic and is conducted through the core opening.

9. The method defined in claim 7, further characterized by continuously chopping the filaments of the tow into flock filaments of substantially equal length while continuously concurrently chopping the wrapper yarns.

10. In a method of producing short cut filaments of substantially equal length, the steps which comprise:

continuously feeding a tow having a multiplicity of filaments along a predetermined path, continuously applying a plurality of continuous wrapper yarns having substantially

the same composition as the tow filaments around said tow and substantially spirally with respect to said tow filaments while maintaining said tow filaments substantially parallel to one another,

applying one such wrapper yarn in a clockwise manner around said tow and applying another such wrapper yarn in a counterclockwise manner around said tow, continuously cutting the substantially parallel filaments of said tow into short cut filaments of substantially equal length while concurrently cutting the wrapper yarns, the angle of the spiral being limited so that the wrapper yarns are cut into lengths that are substantially similar to the lengths of the cut fibers produced from the tow filaments.

11. In a method of making uniform, short, cut filaments which are suitable for formation of flock or the like, the steps which comprise continuously feeding a tow comprising a multiplicity of substantially parallel filaments along a predetermined path, continuously applying a first continuous wrapper yarn in a spiral manner around the tow, and continuously applying another wrapper yarn spirally in a counter-directional manner around the tow while maintaining said filaments substantially parallel to each other, and continuously cutting the filaments of the tow into short filaments of substantially equal length while continuously concurrently cutting the wrapper yarns to form additional short filaments of substantially the same length.

12. In a method of making a package containing a tow which is readily removable in an essentially untangled form from the package, without significant snagging or breakage of filaments, the steps which comprise continuously feeding a core comprising a multiplicity of substantially parallel filaments along a predetermined path, continuously applying a continuous wrapper yarn spirally around the core, continuously applying another continuous wrapper yarn spirally in a counter-directional manner around the core and repeatedly over the wrapper yarn first mentioned, while maintaining said multiplicity of filaments in said core substantially parallel to each other, and snaking the resulting wrapped tow into a container such that repeated lengths of said tow lie next to and touching each other, said wrapper yarns being arranged at such angles with respect to the tow axis that they maintain the coherence of the fibers of the core such that there is substantially no significant amount of snagging between the filaments of adjacent lengths, when the tow is withdrawn from the package.

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