

Feb. 5, 1963

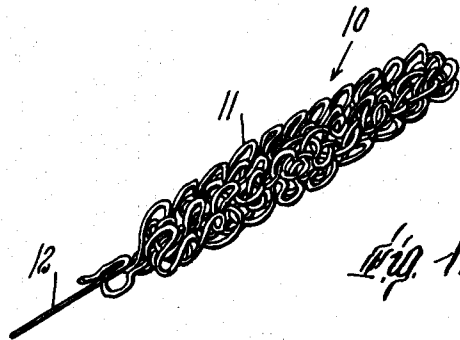
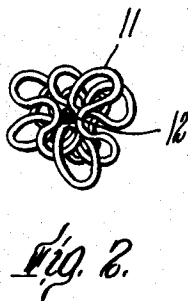
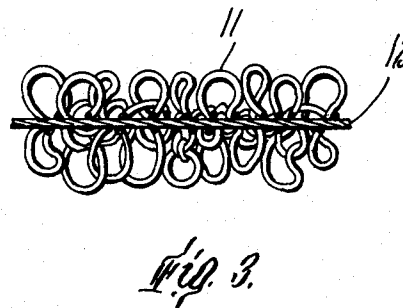
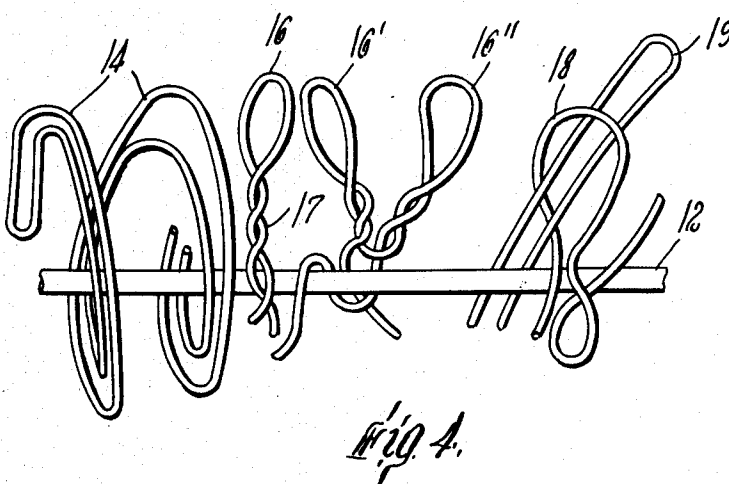
P. F. MARSHALL

3,076,307

NOVELTY CORE CONSTRUCTED YARN

Original Filed Dec. 10, 1959

4 Sheets-Sheet 1



Feb. 5, 1963

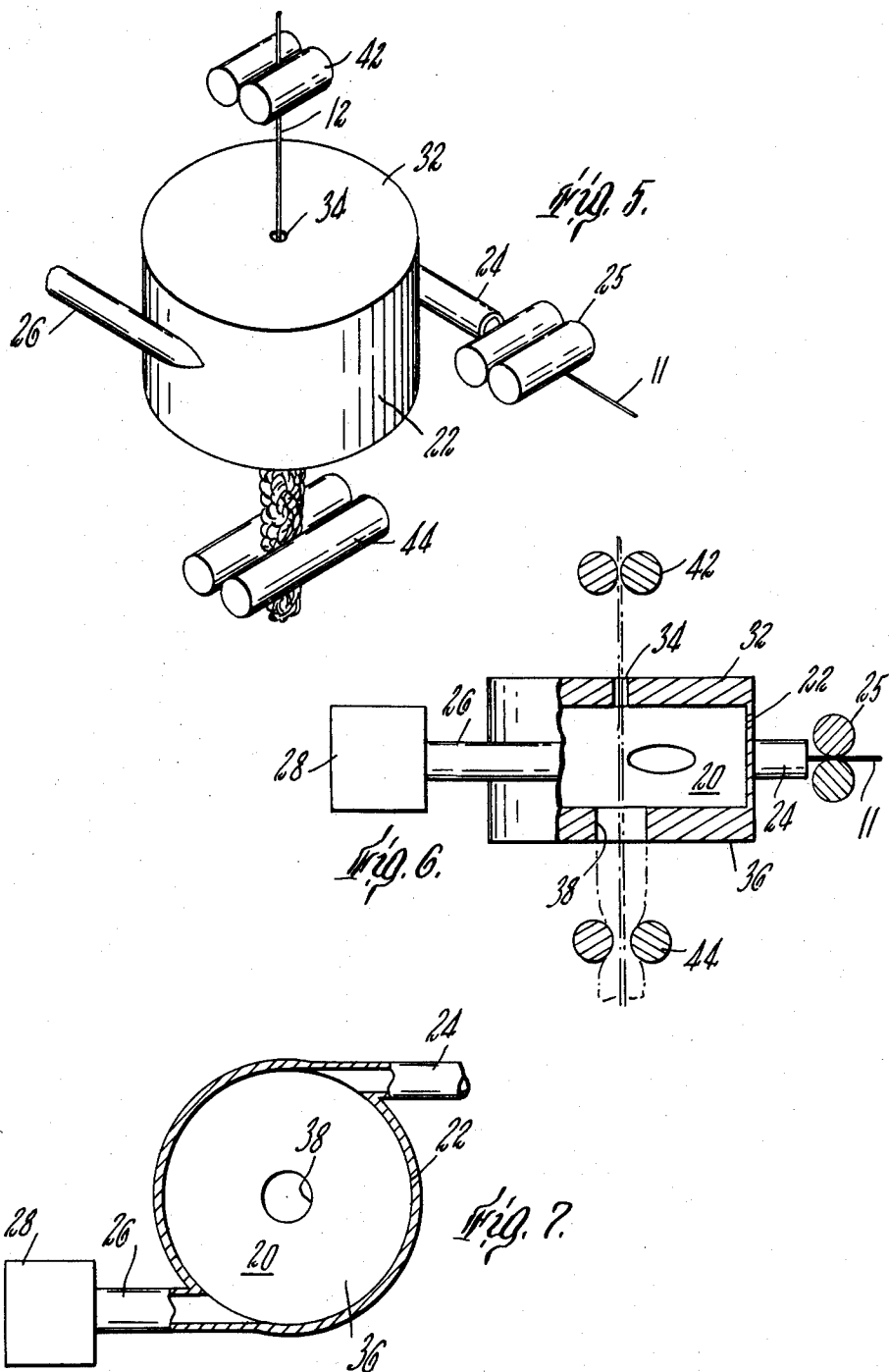
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NOVELTY CORE CONSTRUCTED YARN

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4 Sheets-Sheet 2



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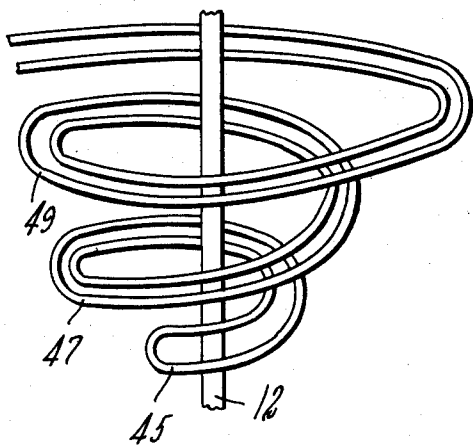
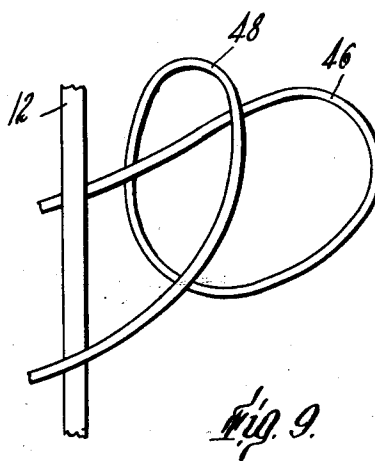
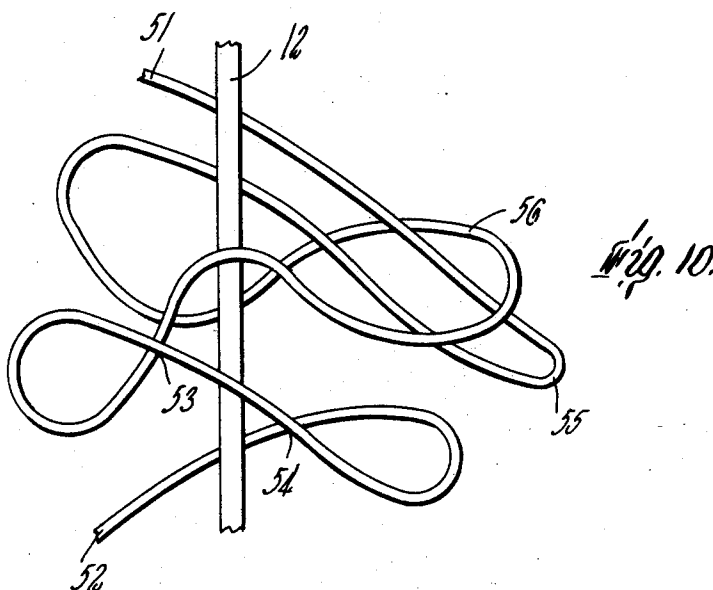
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NOVELTY CORE CONSTRUCTED YARN

Original Filed Dec. 10, 1959

4 Sheets-Sheet 3



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3,076,307

NOVELTY CORE CONSTRUCTED YARN

Original Filed Dec. 10, 1959

4 Sheets-Sheet 4

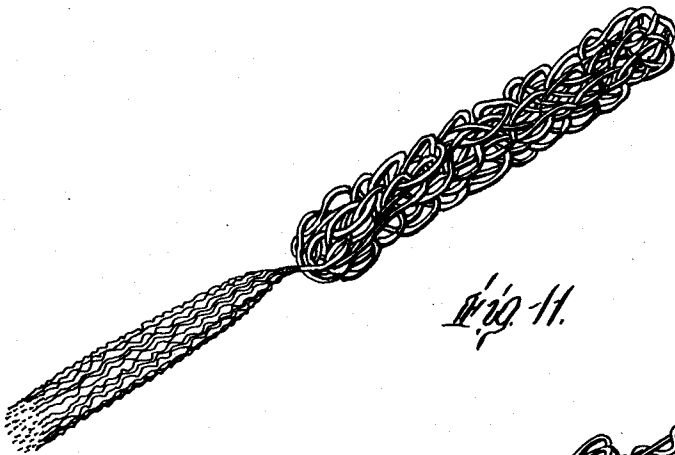


Fig. 11.

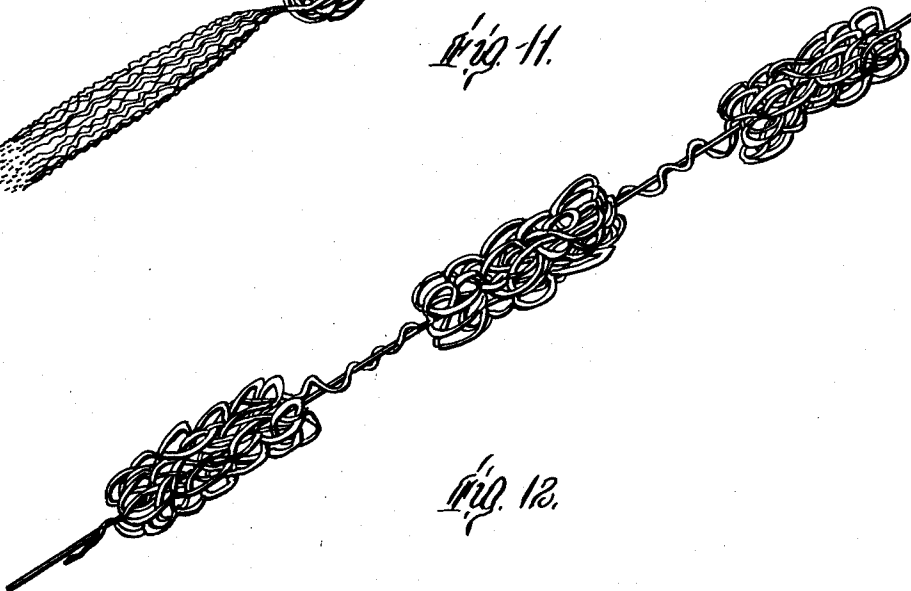


Fig. 12.

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3,076,307

NOVELTY CORE CONSTRUCTED YARN

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8 Claims. (Cl. 57—144)

This invention relates to a novelty yarn, particularly, it relates to a novelty core-constructed yarn prepared from a filamentary material wrapped in a series of looped configurations about the axis of said yarn. It is a division of my application Serial No. 858,694, filed December 10, 1959.

Novelty yarns, useful in the production of textured or "visual effect" fabrics or used in strand form alone for decorative ties, etc., are typified by products such as boucle yarns, slub yarns, loop yarns, and the like. In general they are prepared by feeding at different rates two yarns into a twisting device which wraps one yarn, which is overfed, around another yarn which is held under tension, or by overfeeding one yarn to form loops which are held between a pair of tensioned binder yarns twisted together. Core yarns are similarly prepared by wrapping a covering strand more or less completely around a core by means of a rotating hollow spindle.

All such yarns are prepared in a rotating or spinning device that wraps one type of filamentary material around another with a true wrap or twist. The process suffers from known limitations and deficiencies inherent in rotating mechanical devices, wherein problems of friction and lubrication become critical at high speeds, and constant maintenance and supervision are necessary. The yarns so prepared have taken many forms but in general have either had too low a bulk factor for many uses, have been too expensive to manufacture, were not attractive, or were subject to a combination of these and other factors.

Accordingly, it is a primary object of the invention to produce a novel and attractive yarn of the core-constructed type having unusually high bulk factor and low density if such be desired, yet economical to manufacture and of striking and attractive appearance. Following the principles of the invention, such yarns may be constructed from textile strand material, either of single or multiple strands of filaments, spun or unspun.

In general, the yarns of the invention are high-volume, low-density products, and preferably (though not necessarily) include a continuous core strand with one or more covering or wrapping strands wound, doubled, or looped thereabout. The wrapping yarn is generally deposited in a multi-layered, haphazard manner, which is commonly more closely packed adjacent to the yarn axis or core than it is around the periphery of the assembly. However, the presence of an actual core strand may be dispensed with in some instances. The covering or wrapping strand about the central axis of the yarn of the invention has a multiplicity of closely adjacent portions haphazardly doubled and twisted, and wound to a large extent as closed loops in doubled configuration, generally in the form of a closely spaced multi-layered and partially overlapping helix for a plurality of turns. A multiplicity of the loops of the wrapping yarn are twisted to form stems or pedicles and are frequently intertwined with adjacent loop formations. Additionally, loop forms are often interlaced with other loops by passing there-through. These loops extend generally perpendicular to and radially of the central axis of the yarn and project outwardly therebeyond.

The novelty yarn of this invention, therefore, includes

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a wrapping of serially connected loops, said loops being disposed at various angles to each other but essentially with the loops lying in planes generally perpendicular to the main axis of the core yarn. Although the wrapped covering has been "false wrapped" around the core, so that it is essentially free from residual wrap, nevertheless the individual strand portions thereof are so entangled, snarled, and frictionally engaged with adjacent and contacting loop portions as to resist unwrapping thereof and provide a normally stable structure particularly where a central core strand is present. Although the preferred yarn according to the invention is generally uniformly wrapped throughout its length, it may also be intermittently wrapped with generally longitudinally extending strand portions alternating with wrapped portions.

It is another object of the invention to provide novel apparatus and methods for manufacturing the novel core-constructed yarn of the invention simply and at high speed by utilizing fluid, preferably gaseous, operating forces thereon. In this novel method, core-constructed yarns meeting the above objectives are generally produced preferably by simultaneously separately feeding a core strand and a wrapping strand into a fluid vortex in which a rapidly rotating air mass is localized. The core strand is preferably kept under tension but its rate of speed through the vortex may be varied periodically or irregularly. The wrapping strand is preferably fed in under little or no restraint, and usually its rate of feed is largely determined by the rate at which the air mass rotates in the vortex. If an especially uniform degree of wrapping is desired, the rate of feed of the wrapping yarn may be regulated to any predetermined rate.

More specifically, this may be accomplished by providing a generally cylindrical vortex chamber with a tangential fluid inlet thereto for pressurizing the chamber and creating a whirling body of fluid therein, the covering or wrapping strand preferably being introduced into said chamber through a tangential inlet thereto and passing from said chamber as the novel wrapped yarn of the invention through an axial outlet therefrom. The wrapping strand is drawn into the vortex chamber along the wall of the chamber. The core strand is preferably introduced through an axial inlet in the end of the chamber opposite to the outlet end. The covering or wrapping strand is continuously overfed into the chamber at a lineal rate greatly in excess of its bulked lineal withdrawal rate so that a portion thereof is continuously maintained in slack condition within the vortex chamber, wherein the whirling mass of fluid acts upon it to form randomly and haphazardly doubled-back loops and twisted pedicles. Simultaneously, the whirling fluid mass winds the loops into the form of a closely spaced and multi-layered and partially overlapping helix for a plurality of turns, and entangles, snarls, and interlaces the loops with one another. A central core strand or an equivalent thereof aids in this process.

The tendency of the wrapping yarn is to form a non-uniform series of variously sized loops, which spiral around the core strand generally radially to the yarn axis. As the core strand is advanced through the vortex, these loops form a series of collapsed bights, serially engaged with the core strand in the form of a constantly descending helix. Since there is no continuous unidirectional wrapping of the end of the wrapping strand around the core strand, the net unidirectional wrapping in the final product is mathematically zero. The looped and wound assembly is continuously removed from the vortex chamber opening, aided by the flow of fluid therethrough, preferably at a rate of the order of 1 percent to 20 percent of the rate of feed of the covering or wrapping strand into the chamber. The outfeeding assembly is at the

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same time more restricted against movement in a lateral direction than the rotating wrapping strand in the vortex chamber, the amount of such restriction varying somewhat in accordance with a variety of factors such as strand size and weight, chamber size, degree of air pressurization, air flow speed, etc.

Various other objects and features of the invention will become apparent from the following description of preferred embodiments of the invention, taken with the accompanying drawings, wherein:

FIG. 1 is a diagrammatic prospective view, partially broken away, of a yarn of the present invention;

FIG. 2 is an enlarged cross section of the yarn of FIG. 1,

FIG. 3 is an enlarged longitudinal section of the yarn of FIG. 1,

FIG. 4 is a diagrammatic showing of certain aspects of the yarn of FIGS. 1-3,

FIG. 5 is a prospective view of the preferred apparatus of the invention,

FIG. 6 is a side elevation, partially in section, of apparatus according to the invention,

FIG. 7 is a sectional plan of the apparatus of FIG. 4, FIGS. 8-10 are diagrammatic views illustrating the formation of the yarn of FIGS. 1-3,

FIG. 11 is a diagrammatic prospective view of a modification of the yarn of FIGS. 1-3, and

FIG. 12 is a diagrammatic prospective view of another modification of the yarn of FIGS. 1-3.

Referring first to FIGS. 1 through 3, the core-constructed yarn 10 of the invention there shown includes a generally straight central core strand 12 having a wrapping strand 11 thereabout.

The strands themselves may be strands of a wide variety of textile fibers, or other strands, either staple or continuous, as is hereinafter more fully explained. For example, cotton, or wool yarns may be used in sizes from 10's to 200's cotton system, as may the synthetic fibers such as rayon, nylon, etc., either spun or continuous filament. Continuous strands of rayon, comprising a low twist bundle of filaments of size 1.5 to 20 denier per filament are especially useful in the invention because of the high bulking characteristic of such strands. Mixed fiber yarns may be used as well, and the physical and chemical characteristics of the central core strand 12 and the wrapping strand 11 may be quite different. It will be appreciated also that the invention is not confined to a cored yarn in the ordinary textile sense, but that the core may be of wire or other filamentary material, such as twisted paper, plastic monofilament, metallic ribbon, and the like. In this manner, a bulky novelty yarn may be produced which has exceptionally high tensile strength due to the nature of the core filament employed.

It is also within the scope of the invention to use two or more strands as a core. Exceptionally bulky products are obtained when the core consists of one or more strands of inexpensive material such as cotton roving, combined with a strand of glass or nylon serving to give high tensile strength.

As may be best seen in FIGS. 2 and 3, the wrapping strand 11 is wound double and deposited about the core strand 12 in a many-layered and haphazard manner. It is characterized by a multiplicity of closely adjacent portions haphazardly doubled back and wrapped in doubled configuration either with themselves, or with other such portions, generally in the form of a closely spaced, multi-layered, and partially overlapping helix. As may be seen at 14 in FIG. 4, a multiplicity of the doubled-back ends form loops 16 with twisted pedicles 17 which are frequently intertwined with adjacent pedicled loops as at 16' and 16''. The loops 16, 16' and 16'' etc., extend generally perpendicular to and radially of the central core strand 12 from the central axis of the yarn, and outwardly therebeyond. In the so-wound and twisted wrapping strand 11, the individually looped strand portions are en-

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tangled, snarled, and interlocked with adjacent looped portions as shown at 18 and 19 in FIG. 4, so as to resist unwinding.

Apparatus suitable for manufacturing the yarn of FIGS. 1-4 is shown in FIGS. 5-7. Such apparatus may comprise a chamber 20 having a cylindrical wall 22 with a pair of tangential openings 24, 26 thereinto and end walls 32, 36, having openings 34, 38. As a means for creating a longitudinally-extended whirling body of fluid in said chamber, tangential opening 26 is connected to a source of fluid pressure such as air pump 28, while the wrapping strand 11 may be fed into the chamber 20 through tangential opening 24 by means of rolls 25. The core strand 12 is fed into chamber 20 from tension device 42 through opening 34 in the upper end wall thereof, while the core-constructed wrapped yarn 10 is removed from the axially-extended opening 38 in the opposite end wall by means of a pair of rolls 44.

In operation, to carry out the method of the invention, the core strand 12 is supplied from any suitable package, not shown, and is passed through guides or feed rolls 42 which, together with the take-up mechanism, insure that the core strand passes through the vortex chamber at a controlled velocity and under constant tension, so that it is essentially undistorted by the circulating air mass in the chamber. The core strand 12, of whatever composition desired, is fed through the inlet 34, passes through the vortex chamber, and is threaded through the outlet 38 to a pair of nip rolls 44.

When the core strand is suitably tensioned between rolls 42 and 44, compressed air is fed from pump 28 into the chamber through the tangentially-directed inlet 26 while the wrapping strand 11 is fed to the oppositely-disposed wrapping strand inlet 24. The metering rolls 25, feeding the wrapping strand 11, are frequently omitted in the process, but may be used if a closely controlled but varying rate of input is desired, as for the production of sculptured yarns.

Air is fed into inlet 26 at from about 10 to 100 or more pounds pressure. The preferred tangential direction of the air stream, coupled with the generally cylindrical shape of the chamber, creates a miniature tornado in the vortex chamber, with a rapidly revolving stream of air circling around the walls. The end of wrapping strand 11, drawn into the chamber through the inlet 24 by the rotating air mass, apparently either impinges on the core strand or else slows down due to wall friction within a fraction of a second after the process of feeding the wrapping strand is started. More wrapping strand is being drawn in, however, with the net result that the continually advancing wrapping strand passes the leading end, and a loop or bight is formed.

Under hypothetical ideal conditions, as shown in FIG. 8, the advancing end 45 of a loop thus formed would wrap spirally in the form of doubled loops 47 and 49 around the core strand 12. One feature of the product of this invention, therefore, is the presence in the wrapping layer of incrementally doubled looped windings, generally perpendicular to the core strand axis.

Due probably to the presence of some turbulence and pulsing in the air flow, however, and to slight irregularities in the core strand and wrapping strand, the idealized type of wrapping shown in FIG. 8 is apparently not often realized. A loop of wrapping strand in the vortex chamber is subjected to air forces which tend to twist it on itself, as well as to rotate it around the chamber.

Such a twisting action means that numerous loops or loop segments will be given a half turn or more of twist around their own bifilar axes, as shown in FIGS. 9 and 4. Such a secondary action interrupts the smooth advancement of the strand, with the result that the infedding end of the strand 45 will be propelled beyond the twisted portion 48, to form another loop of different configuration. In this way, the continuous propagation of doubled loops is constantly being interrupted by inertial forces, by twist-

ing of a part of the loop, or by engagement with a previously twisted loop segment.

Still a fourth cause of entanglement is the fact that a loop may be thrust through another loop, as illustrated in FIGS. 10 and 4. In FIG. 10, the strand ends 51 and 52 are the end portions of the compound loop which lies between them. This compound loop contains two places, 53 and 54, where a half-twist bight has been formed, and another region where a newly formed loop 55 has passed through the eye of a previously formed loop 56.

Such compounded entanglement and frictional engagement of the wrapping strand doublings gives considerable structural strength and coherence to the product of this invention.

Nevertheless, inspection of FIG. 10 will show that if the ends 51 and 52 are pulled to the left, the whole compound loop is freed from the core yarn 12, and no wrapping is left. Thus, there is no true winding of the wrapping end around the core yarn as in prior art cored yarns. Hence, the type of wrapping effected herein is referred to as "false wrapping," as mentioned above. The doubled and compounded loops are wrapped around the core, with frequent reversals of direction, in a random and haphazard manner, depending on the instantaneous state of strand aggregation just ahead of the wrapping loop as it whirls around in the vortex chamber.

The continuous downward movement of the core strand 12 has the effect of continuously transporting these radially-disposed, compounded, and entangled loops out of the vortex chamber and to the winding mechanism as an integrated wrap. The term "radially-disposed" means that if a cut is made through the cored yarn of my invention, I may get three or four very short pieces of wrapping strand, a fraction of an inch in length, due to cutting through the tips of loops which are not perfectly perpendicular to the core yarn axis. In general, however, cutting through the cored yarn of this invention gives two pieces of wrapping strand, indicating that the compound loops radiate out from the core and are not substantially laterally disposed to it.

The descending spiral of interacting incremental doublings has been described above as it is collapsed onto a constantly progressing core strand. By proper selection of yarn size and air pressure, however, the wrapping strand may be made to entangle upon itself and serve as its own core to produce a "self-cored" core-constructed strand according to the invention, as described more specifically in Examples 5, 6, 8, 9 and 10 below.

In such cases, the explanation is probably as follows:

The spiraling doubled strands are constantly moving down through the vortex chamber, due to gravity and to the tendency of the air to be exhausted through the exit tube. At a point near the bottom of the chamber, the entangled wrapping strand becomes so bulky and so dense that a following loop wraps around this nucleus, much as if it were a core strand. If this wrapped nucleus is then withdrawn from the vortex chamber and wound up at an appropriate rate, it is found that the doubling and wrapping will continue to propagate a bulky voluminous product without the need for providing a core for the wrapping strand to wrap around. It is important, of course, that this voluminous coreless yarn be removed from the vortex chamber as fast as it is formed, or else it will quickly plug the chamber and the process will stop.

Motion pictures taken at 8,000 frames per second indicate that in producing a coreless novelty yarn of this type, the real yarn formation takes place at or near the bottom of the vortex chamber 20, that is, near the lower tip of the descending, narrowing spiral. The initiation may be due to any momentary irregularity in mass density, but once begun, the self-wrapping continues so long as the input and windup are adjusted so as to maintain a steady equilibrium state.

In this process, it is obviously not necessary to have separate inlets for core and wrapping strands. A cham-

ber such as shown in FIGS. 5-7 may be used to advantage, but with the opening 34 omitted or with the wrapping strand fed through opening 34 and air introduced through both side openings 24 and 26. As is true of this invention in general, more than one strand at a time can be fed into the chamber. Two ends of yarn of different color may be combined, for example, to give a bulky decorative structure useful as a Christmas tree trim, or decorator's material.

To some extent the size of the loop formation will depend on the density of the material of which the yarn is composed. Even more important is the modulus of rigidity of the yarn composition, nylon differing from viscose, which in turn differs from acetate. In addition, the resistance to bending, which governs the size and shape of the loops formed, can be varied widely in any one type of yarn by varying the denier or weight per unit length of the filaments chosen. For example, in a 260 denier-17 filament nylon yarn, the individual filaments are about 15 denier. Such a yarn tends to form springy, resilient bows which radiate clearly from the center of the assembly and have quick recovery from deformation. In a 70 denier-34 filament nylon yarn, however, a softer and more compliant product is obtained.

By proper choice of the above variables, a wide variety of structures may be produced in which various components are stratified in the surface or at the center of the assembly, as desired.

Another useful modification of the invention, resembling a slubbed yarn, is shown in FIG. 11. Such a yarn is produced when the withdrawal of the core strand is slightly in excess of the speed of wrapping that takes place in the vortex chamber. This can be brought about either by speeding up the windup, or by decreasing the air pressure so that less rotational energy is imparted to the wrapping yarn. Specific illustrations are given in Examples 5 and 9, below.

As above set forth, if the rate of wrapping in the lower part of the chamber is balanced against the rate of withdrawal, a continuous even wrapping is obtained, with no plugging of the exit tube and no backward propagation which would plug the chamber.

However, if the yarn is withdrawn at a rate too fast to allow uniform wrapping, the wrapping does not become thinner and uniformly attenuated, as might be expected, but instead, it is suddenly converted to a series of slubs, separated by unwrapped areas, as shown in FIG. 11. The exact reason for this is not understood, but apparently the excess take-up speed of the winder, coupled with the air stream issuing from the exit tube, creates a pulsing action in the process which leads to the intermittent wrappings appearing like beads on a string. The periodicity is quite regular, and by manipulation may be varied over a substantial range. Such slubbed products can be made either with or without a core strand, as desired.

Among the major advantages of this invention are the simplicity, speed, and economy with which a wide variety of useful and novel yarnlike arrays may be produced. A thick and quite inexpensive paper core yarn may be smoothly wrapped with a thin layer of fine viscose rayon, to simulate a textile yarn, at speed which cannot be matched by conventional wrapping or braiding techniques. A cotton core yarn wrapped with coarse nylon combines strength with bulky resilience, for use as a rug yarn. If a tensioned rubber core is wrapped with rayon or nylon, an inexpensive elastic yarn is produced. Wires may be quickly wrapped with any desired electrically insulating strands. Although the invention has been described chiefly in terms of textile yarns or wire, it is equally applicable to any filamentary material that can be fed continuously into the vortex chamber, such as silt Mylar film, plain or metalized, and similar materials.

I have also found that the product of this invention is useful as a starting material for the production of "bulked yarns" or "textured yarns," such as are known to the

textile trade as Taslan, Ban-Lon, or Agilon. Such yarns, made from continuous filaments, are characterized by having the individual filaments in the bundle crimped or looped or otherwise dispersed so that they tend to stand apart from each other in the filamentary bundle, thus providing a feeling of bulk, softness, and warmth that is lacking in regular untextured continuous filament yarn.

By the incremental doubling and looping process of this invention, continuous filament yarn may be compacted into a tight, false-wrapped yarn. This wrapping may be around a true core strand, or it may be around its own bulk as described above, where a "self-cored" yarn is described. I have found that if a yarn of this latter type is subsequently drawn out, so that the wrapping is attenuated to approximately its original length, the redrawn yarn is markedly different from the yarn originally fed to the vortex tube, as shown in FIG. 12. This represents a multifilament strand compacted on itself according to the invention, and subsequently drawn out to about 95% of its original length, by conventional drawing means.

Such a process is to be contrasted with certain conventional "bulk-yarn" processes which have the disadvantage of needing to combine a dispersing or crimping process with a heat-setting process. That is, unless the filaments are heat-set, the bulkiness and loft that have been applied to the yarn are of a temporary nature, and will not resist subsequent processing into fabrics. Hence, it is common practice to apply heat to the yarn at or just prior to the point at which the individual filaments are to be separated and dispersed.

In the product of my invention, however, the individual filaments in the wrapping yarn are not dispersed or blown apart in the vortex tube, but the relatively intact filament is wrapped into a series of doubled loops radiating out from the central axis, as described above. This creates a stable product which may be wound up in a conventional package and stored indefinitely. Any subsequent desired treatment, such as dry heating, steaming, impregnating, or treatment with resin solutions, may be carried out on the individual packages at any time and in any equipment, that is suitable. Since the compacted yarn has no true wrapping, as explained above, it can be drawn out by conventional methods. I have found that due apparently to the tight doubling that the yarn has undergone, the individual filaments in the yarn tend to spring apart in a series of irregular waves, as shown in FIG. 12. Such a drafted product has many of the properties of "textured yarns," but is much more economical to produce.

The product of the invention will now be illustrated by the following examples.

Example 1

A vortex chamber similar to that shown in FIGS. 5 to 7 was used to wrap a 70 denier-34 filament nylon strand around a 260 denier-17 filament core. The brass chamber was $\frac{1}{4}$ inch in diameter, $\frac{1}{8}$ inch high, with a core strand inlet of $\frac{1}{16}$ inch diameter and an outlet of $\frac{1}{8}$ inch diameter. The air inlet and wrapping strand inlet were each 0.040 inch in diameter.

An air pressure of 60 lbs. per square inch and a windup speed of 20 yards per minute was used. The final denier of this nylon wrap or nylon core was 4,200. Subtracting the uncontracted core yarn denier of 260 shows that the wrapping yarn is now 3,940 denier. This indicates that approximately 56 yards of the 70 denier wrapping strand are wrapped around each yard of product.

Example 2

The same chamber was used as in Example 1. The wrapping strand was again 70 denier-34 filament nylon, and the air pressure 60 lbs. Three parallel core strands were used, one of 260 denier-17 filament nylon and two strands of 900 denier-230 filament Estelon, to provide a high-tensile strand. The takeup speed was 80 feet or 26.7 yards per minute.

The total denier of the product was 5,550. Subtracting the 2060 core denier indicates that the wrapping was 3,490 denier, showing that about 50 yards of wrapping strand were wrapped around each yard of product.

Example 3

The same chamber, wrapping strand, and air pressure were used as in Examples 1 and 2. The core was of two strands, 260 denier-17 filament nylon and 4,400 denier-3,000 filament viscose. Takeup was 53 feet or 17.7 yards per minute.

The product weighed 10,600 denier, of which 4,660 was core and 5,940 was wrapping. This indicates that about 85 yards of 70 denier nylon are wrapped around each yard of final product.

Example 4

Using the same chamber, wrapping strand, air pressure, and take-up speed as in Example 3, the 70 denier nylon was wrapped around a compound core made of one strand of soft steel wire, 9,600 denier, and one strand of 4,400 denier-3,000 filament viscose cord.

The product of Example 4 weighed 22,800 denier, of which 8,800 denier was wrapping. This indicates that about 126 yards of 70 denier nylon is wrapped around each yard of product.

Example 5

Using the same chamber as in previous examples, a 70 denier-34 filament nylon strand was fed into the side opening 24, with no yarn being fed in as a core strand. An air pressure of 40 pounds per square inch and a take-up speed of 134 feet or 44.7 yards per minute was used.

The product consists of a series of slubs, about $\frac{3}{16}$ inch in diameter, spaced about 1 inch apart on the 70 denier nylon strand. The denier of the product is 1,000, indicating that about 14 yards of 70 denier nylon has been intermittently wrapped upon itself to form 1 yard of product. This product can be made equally well with chamber opening 34 open or closed.

Example 6

This was an exact duplicate of Example 5 except that the take-up speed was decreased to 32 feet or 10.7 yards per minute. The slubs are thereby run so closely together that the product has the appearance of a more or less continuous yarn. The denier of the product was 2,850, indicating that over 40 yards of 70 denier nylon has been used to form one yard of product.

Example 7

Using the same chamber as in the above examples, a 260 denier-17 filament nylon strand was wrapped around another 260 denier-17 filament nylon strand as core. Air pressure was 60 pounds, take-up speed 17.7 yards per minute.

The increased resilience of a large-denier nylon wrap is seen by comparing Example 7 with Example 1. The wrapping component was 7,840 denier, indicating that about 30 yards of wrapping strand are wrapped around each yard of core strand of the same composition.

Example 8

Using the same chamber as in the above examples, an air pressure of 30 pounds, and a take-up speed of 10 feet per minute, a 70 denier-34 filament nylon strand was fed into the core strand inlet 34 under no tension. No wrapping strand was used, and the wrapping strand inlet 24 was left open.

The denier of the product was 5,100, indicating that 130 yards of 70 denier of nylon had been wrapped on itself to form one yard of product.

Example 9

Using the same chamber and the same 70 denier nylon

strand as in Example 8, the air pressure was increased to 40 pounds and the take-up speed to 80 feet per minute. Under these conditions, a product was obtained in which each slub is about $\frac{1}{4}$ inch long, and they are spaced about 2 inches apart. The final product is 600 denier, indicating that about 9 yards of 70 denier yarn are consumed for each yard of product.

Example 10

A chamber similar to FIGS. 5-7 was used, with an inside diameter of $\frac{1}{2}$ inch, a height of $\frac{1}{4}$ inch, core strand inlet of $\frac{1}{16}$ inch, and an outlet of $\frac{1}{4}$ inch diameter. Air at 20 pounds pressure was blown through both side openings 24 and 26, which were 0.094 inch in diameter.

Two strands of Fiberglas yarn, type G150-1/9-1Z were fed in through the opening 34. The take-up rate was 45 feet or 15 yards per minute.

The product weighed 4 grams per yard. The two initial strands weighed 7,315 yards per pound, or 0.062 gram per yard. The contraction factor was therefore 64.5 yards of input material for each yard of product.

It will be clear to those skilled in the art that there may be a variety of modifications, not disclosed herein, of the products, processes, and apparatus of the invention within the spirit thereof and the scope of the appended claims.

I claim:

1. A core-constructed yarn comprising at least one continuous strand having a multiplicity of closely adjacent portions randomly doubled back and wound in doubled configuration in the form of a close spaced and partially overlapping helix for a plurality of turns, with the doubled-back ends forming loops in the nature of pedicled bights which extend generally perpendicular to and radially from the central axis of said yarn, and projecting outwardly therebeyond, said yarn being essentially free from residual wrap but with the individual strand portions so entangled, snarled and frictionally engaged with adjacent strand portions as to resist unwinding thereof.

2. A yarn as claimed in claim 1 wherein said portions are spaced from one another with generally straight strand portions therebetween.

3. A yarn as claimed in claim 1 wherein at least two said strands are provided.

4. A core-constructed yarn comprising at least one con-

tinuous generally straight central core strand extending generally axially of said yarn and at least one continuous wrapping strand having a multiplicity of closely adjacent portions randomly doubled back and wound in doubled configuration thereabout in the form of a close spaced and partially overlapping helix for a plurality of turns with the doubled-back ends forming pedicled loops which extend generally perpendicular to and radially from the central axis, and projecting outwardly therebeyond, said yarn being essentially free from residual wrap but with the individual wrapping strand portions so entangled, snarled and frictionally engaged with adjacent strand portions of said wrapping strand and said core strand as to resist unwinding thereof.

5. A yarn as claimed in claim 4 wherein the core strand is a metallic wire.

6. A yarn as claimed in claim 4 wherein the core strand comprises a high strength yarn and a roving in combination.

7. A yarn as claimed in claim 4 wherein said wrapping strand portions are spaced from one another with generally parallel and straight core and wrapping strand portions therebetween.

8. A core-constructed yarn comprising at least one continuous strand having a multiplicity of closely adjacent portions randomly doubled back and wound in doubled configuration in the form of a close spaced and partially overlapping helix for a plurality of turns, with the doubled-back ends forming loops in the nature of pedicled bights which extend generally perpendicular to and radially from the central axis of said yarn, and projecting outwardly therebeyond, said yarn being more closely packed adjacent said axis than around the periphery thereof and essentially free from residual wrap but with the individual strand portions so entangled, snarled and frictionally engaged with adjacent strand portions as to resist unwinding thereof.

References Cited in the file of this patent

UNITED STATES PATENTS

2,026,736	Gruber	Jan. 7, 1936
2,535,376	Thompson	Dec. 26, 1950

FOREIGN PATENTS

814,934	France	Mar. 30, 1937
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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,076,307

February 5, 1963

Preston F. Marshall

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 6, lines 30 and 47, for "FIG. 11", each occurrence, read -- FIG. 12 --; column 7, lines 17 and 46, for "FIG. 12", each occurrence, read -- FIG. 11 --.

Signed and sealed this 31st day of December 1963.

(SEAL)

Attest:

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Attesting Officer

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Acting Commissioner of Patents