

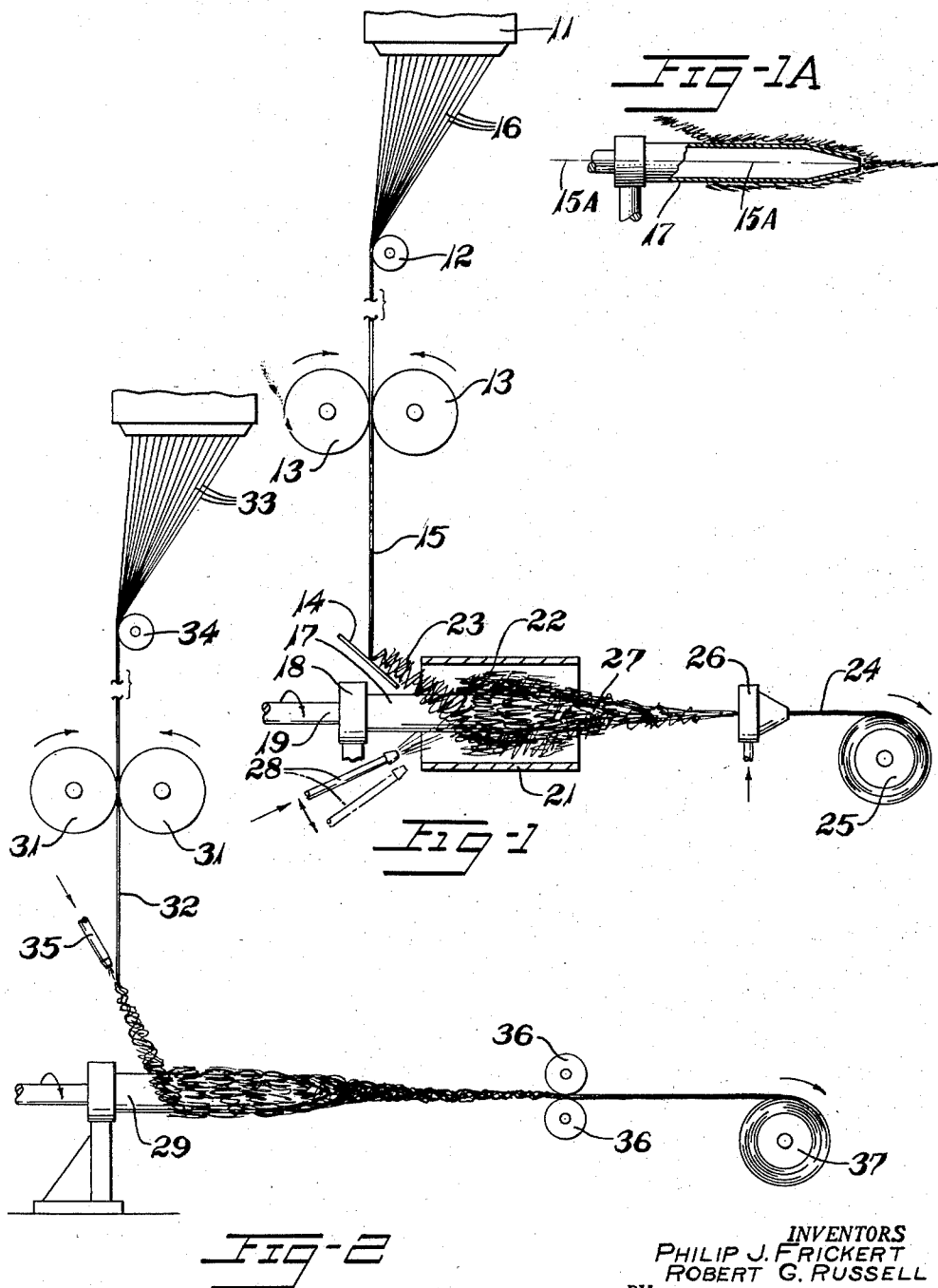
May 19, 1959

P. J. FRICKERT ET AL
METHOD AND APPARATUS FOR PRODUCING STAPLE
LIKE YARN FROM CONTINUOUS STRAND

2,886,877

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4 Sheets-Sheet 1



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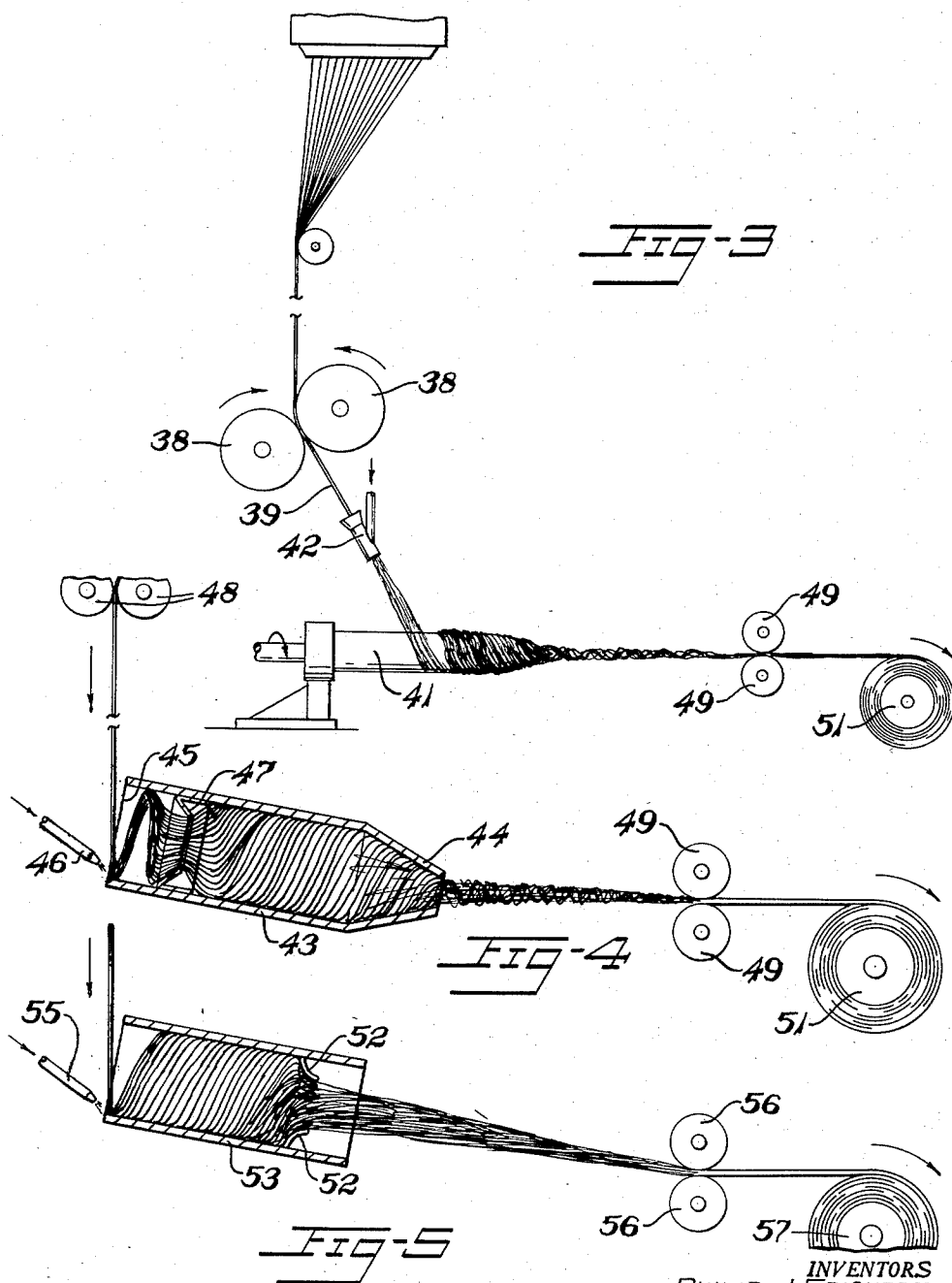
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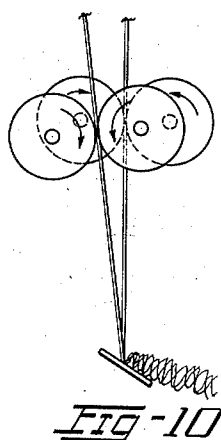
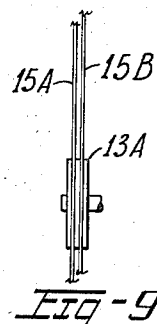
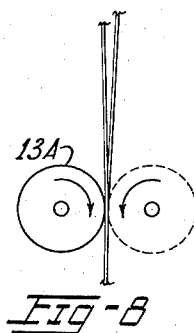
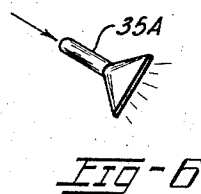
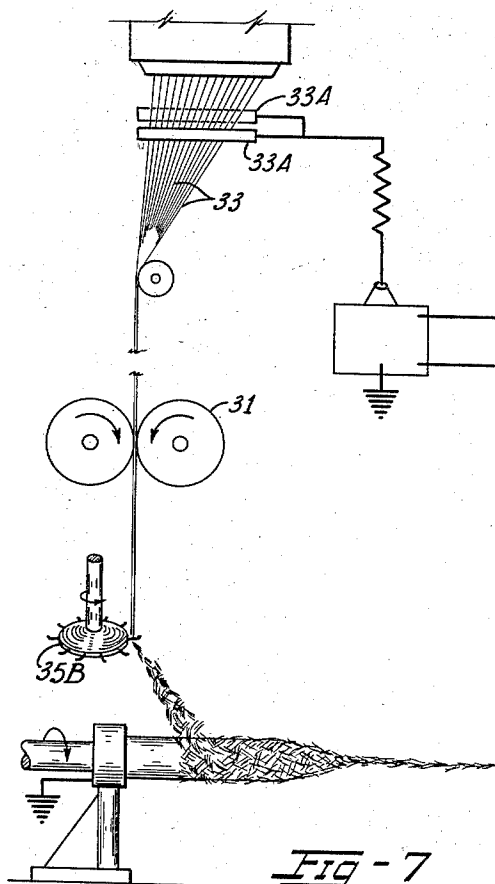
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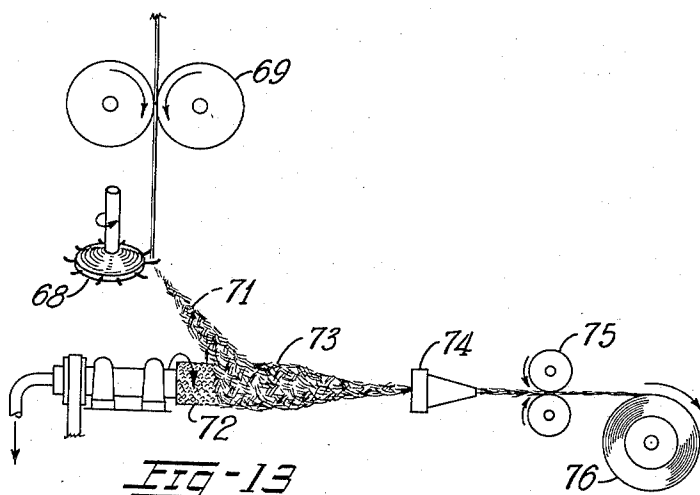
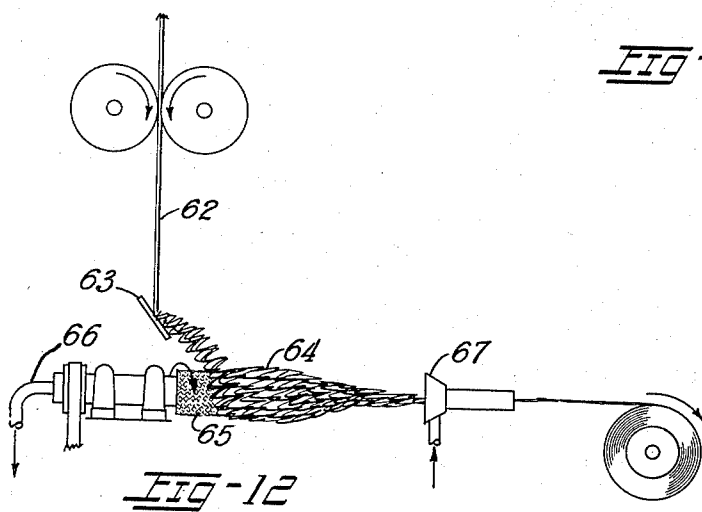
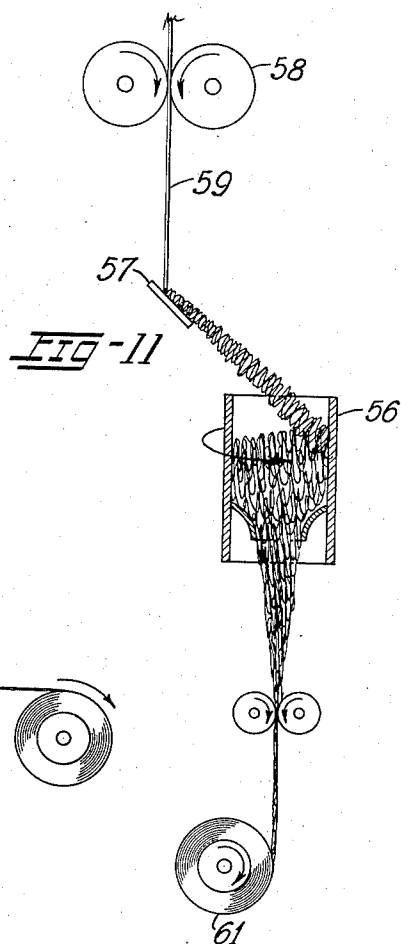
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2,886,877

METHOD AND APPARATUS FOR PRODUCING STAPLE LIKE YARN FROM CONTINUOUS STRAND

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11 Claims. (Cl. 28—1)

This invention relates to methods of handling continuous strand and particularly to the production of a yarn having staple yarn characteristics.

It is an object of this invention to provide a light staple type yarn from continuous strand.

It is also an object to provide a cord of considerable bulk from continuous strand.

It is a further object to provide a method for producing yarn from strand at conventional forming speeds.

The objects of this invention have been attained by manipulating a strand into loops, which loops are then elongated and oriented into a compact form similar to a staple yarn. Loops are defined for the purposes of this description as being folds in the form of helixes, waves or the like or the result of doubling a strand, cord or roving upon itself or upon other loops, windings or other similar patterns.

In producing a staple yarn it is necessary to collect staple fibers in the form of a web which is then drafted into a yarn. Natural occurring fibers are generally in short lengths which provide a true staple. Fibrous glass is produced both in a continuous form and in a staple form. Staple fibers are produced in short lengths, generally less than 17 inches, as distinguished from continuous fibers which are generally much longer and are regarded as true continuous lengths. In the staple fiber process, molten glass is attenuated by a blowing process into fibers of small diameter and of relatively short lengths. There has been a great need in the past for methods which will provide a staple type yarn from continuous strand. Continuous fibers and continuous strand of fibrous glass are readily manufactured; however, for certain purposes the staple products give desirable properties which are not achieved by the use of continuous strand.

As will be understood by reference to the drawings and to the following description, the present invention provides methods and apparatus for producing staple type products from continuous strand at normal forming speeds generally used in producing continuous strand.

In the drawings Figure 1 is an elevational view of one form of the invention, the apparatus shown including a rotatable mandrel in a housing and an adjustable air jet means;

Figure 1A is a view of another form of mandrel through which a reinforcing yarn or strand can be introduced into the staple product;

Figure 2 is a view in elevation of another embodiment of the invention;

Figure 3 is a view in elevation of another embodiment utilizing a rotatable mandrel;

Figure 4 is a view in elevation of a forming operation showing apparatus comprising a generally cylindrical, hollow mandrel;

Figure 5 is a view in elevation of a modification of the apparatus shown in Figure 4.

Figure 6 is a view of another form of air nozzle having a flat air slot;

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Figure 7 is an elevational view of another embodiment of the apparatus similar to that shown in Figure 2;

Figures 8 and 9 are views of a pair of pulling wheels which pull two strands at one time;

Figure 10 is a view showing two sets of pulling wheels delivering two strands onto the same deflector;

Figure 11 is an elevational view of another embodiment of the invention;

Figure 12 is a view in elevation of an apparatus which includes a drum having a screened periphery and suction device; and

Figure 13 is another form of equipment similar to that shown in Figure 12.

Although the description of this invention will be directed toward the manufacture and handling of fibrous glass, the invention is not to be limited thereto since the methods and apparatus disclosed herein are especially adapted for handling all synthetic or man-made fibers including the flexible fibers referred to as Dacron, Orlon, rayon, nylon and the like.

The apparatus shown in Figure 1 comprises a feeder 11, a gathering wheel 12 and a pair of pulling wheels 13, 13. An adjustable deflecting plate 14 is arranged to direct the strand 15 which comprises a plurality of fibers 16, 16 toward mandrel 17. Rotatable mandrel 17 is journaled in frame 18 and is provided with a drive shaft 19 which is turned by an electric motor, not shown.

About rotatable mandrel 17 is disposed a housing 21 adapted for confining loops 22, 22 of strand which are formed by introducing the strand in the form of a wavy pattern 23 upon mandrel 17. The staple-like yarn product 24 is removed from mandrel 17 by the action of wind-up roll 25. As the yarn is pulled from mandrel 17, it passes through turbine 26 which provides a false twist in the yarn and folds any loose ends which are on the surface of the product into the yarn.

An air jet nozzle 28 is disposed at the entrance end of housing 21 and is so mounted that it may be adjusted as shown by the dotted lines in Figure 1. This jet of air serves a dual purpose in that it urges the loops of strand toward the exit end of the housing 21 and at the same time disperses the fibers within the strand to form a fuzzy strand. When strand 15 hits deflecting plate 14, the fibers within the strand become somewhat dispersed and the strand forms a wavy pattern as indicated in Figure 1. The jet of air tends to disperse the fibers still more and facilitates the movement of the loops toward the discharge end of the housing.

When starting this apparatus the operator gathers the fibers 16, 16 and pulls them downward while placing the gathered fibers into gathering wheel 12, 12. The bundle of fibers so gathered is then introduced into the bite of the pulling wheels 13, 13 and the rotation of the pulling wheels is commenced. Strand 15 passes downwardly until it hits deflecting plate 14 which causes the strand to change direction and to follow a substantially wavy pattern as indicated by numeral 23. The strand is deflected toward mandrel 17 which is rotated on its own axis, the power being transmitted through drive shaft 19.

The filament dispersed strand collects within housing 21 and is gradually gathered closely about rotating mandrel 17 as the strand moves toward the tapered end of mandrel 17. Helixes of the strand are formed by winding of the strand upon the mandrel itself. In addition to this action, the strand is looped upon itself within housing 21 and about mandrel 17. A jet of air from nozzle 28 is directed into the entrance end of the housing 21 in order to help compact and form the loops which are gathered within housing 21. During the compaction of the loops, they are elongated and drawn out into substantial alignment. The angle of the air jet nozzle 28 with respect to the axis of the rotating mandrel is adjusted as

desired in order to get the best effect in the loop forming working zone.

When the product starts coming out the exit end of housing 21, the operator pulls the loopy product from the housing 21 and directs it into an air turbine 26 which imparts a false twist to the product and folds in all loose ends of the strand and any stray ends of fibers which may be protruding at the surface of the product. If the loops of strand do not come out the exit end of the housing, the operator uses a wire pick to pull the loops from the housing. Air driven turbine 26 imparts integrity to the product which is then wrapped up on a tube placed on wind-up roll 25. The turbine is more fully described in United States Patent 2,239,722, issued to Lannan et al. on April 29, 1941.

The strand 15 is advanced at about 5000 feet per minute by the action of pulling wheels 13, 13. Attenuation of the fibers takes place very near to the feeder 11 and before the fibers are gathered into a strand by the action of gathering wheel 12. Mandrel 17 is generally rotated at from 30 to 60 thousand revolutions per minute; however, the speed of rotation of the mandrel is not deemed critical since the apparatus operates successfully with the mandrel speed varying over a very wide range of speeds. The speed of rotation of the mandrel is a factor, however, in determining the amount of false twist imparted to the loops and the staple-like product formed within the housing 21. The rotation of mandrel 17 facilitates the removal of the product from the tapered end 27 of mandrel 17. By varying the angle of the air jet from air jet nozzle 28, it is possible to control the amount of compacting of the dispersed strand which takes place within housing 21.

If a fuzzy product is not undesirable, turbine 26 need not be used. Instead the product is pulled off of the tapered end of the mandrel 17 and is immediately wound on wind-up roll 25.

The product may be removed from the mandrel at various speeds depending upon the weight of yarn desired. When the strand is advancing at a speed of 5000 feet per minute from pulling wheels 13, 13, and the mandrel 17 is rotating at from 45,000 to 50,000 revolutions per minute, the yarn 24 removed at a rate of about 5000 feet per minute is a light-weight staple yarn which has heretofore been unobtainable even when using conventional staple forming methods.

If the strand speed onto the mandrel is greater than the speed of the product taken from the mandrel, the product is a heavier and more bulky yarn. By properly setting the strand speed, the yarn withdrawal speed, and the speed of rotation of the mandrel, the desired weight can be obtained in the yarn. The strand speed may be increased to 10,000 feet per minute or even to 20,000 or 30,000 feet per minute using pulling wheel equipment.

Other forms of apparatus may be used in carrying out the invention as is shown in Figures 2, 3, 4 and 5. In Figure 2 is shown a rotating mandrel 29 disposed below pulling wheels 31, 31 in such a manner that strand 32 is wound up on mandrel 29. Strand 32 is formed by gathering together a plurality of fibers 33, 33 by the action of gathering wheel 34. The jet of air from nozzle 35 is directed toward strand 32 in order to disperse the fibers within the strand before the strand is wound upon mandrel 29 and to deflect the strand toward the target which is the rotating mandrel. Nozzle 35A is provided with a flat air slot when a wide blast of air is desired instead of a jet of air, see Figure 6.

The loops of dispersed strand formed upon rotating mandrel 29 are advanced toward the end of the mandrel by the action of pulling rolls 36, 36 between which the loopy product passes as it leaves rotating mandrel 29. The product is then wound up on the take-up roll 37.

If desirable, electrodes 33A are placed on either side of the fan of fibers 33, 33 in order to impart an electrical charge to the fibers and the mandrel is grounded so that

the charged fibers will be attracted by mandrel 29. A true staple product is formed when a rotary cutting device 35B having a plurality of blades secured to its periphery is mounted below pulling wheels 31, 31; this cutting device is substituted for nozzle 35 as a dispersing means and at the same time cuts the strand into short lengths which are collected upon mandrel 29, see Figure 7. Reference may also be made to U.S. Patent 2,491,889.

If desired, the pulling wheels may be disposed at an angle as shown in Figure 3 wherein pulling wheels 38, 38 deliver a strand 39 at an angle toward rotatable mandrel 41. The strand is dispersed by passing through an air gun 42 which has a body member that is generally cylindrical with a funnel-shaped entrance and projecting from the body member a side tube through which air is introduced into the body member. The air gun is tilted preferably so that the center line of its body member is at an angle with respect to the line of travel of the strand 39 in order to achieve optimum dispersion of the fibers within the strand. The strand is wound upon rotating mandrel 41 and is pulled off the mandrel by the action of pull rolls 49, 49 and then rolled into a package as was done formerly in the equipment shown in Figure 2. Other strand dispersing means may be used instead of the air gun 42 such as air jet nozzle 35 shown in Figure 2, a deflecting plate as shown in Figure 1, or other similar means. To dispose the pulling wheels 38, 38 as shown in Figure 3 is advantageous in that the strand approaches the rotating mandrel at an angle which facilitates wrapping of the dispersed strand upon mandrel 41.

When using a tapered mandrel such as those shown in Figures 1, 2 and 3, it is advantageous to direct the strand in such a manner that it contacts and wraps upon the mandrel at its tapered end. If desired, the mandrel is tapered throughout its length to facilitate removal of the loops from the mandrel. Air jets similar to that shown in Figure 1 are positioned adjacent to mandrels 29 and 41 of Figures 2 and 3 respectively if it becomes necessary to help along the forward motion of the loops on the mandrel.

A continuous strand 15A is introduced into the staple product when additional tensile strength is desired by passing the continuous strand through mandrel 17 so that it emits from a drilled passage at the point of the tapered end of the mandrel. The central core of continuous strand helps provide bulk in addition to providing additional strength and integrity to the product, see Figure 1A.

Another method of providing a bulky product without greatly increasing the strand speed from the pulling wheels comprises directing more than one strand toward a single mandrel. For instance, a single set of pulling wheels 13A, 13A is used to advance two strands 15A, 15B by running the strands in a side-by-side relationship between the wheels, see Figures 8 and 9. Multiple sets of wheels are used by positioning them adjacent the mandrel and then using the desired deflecting means to direct the strands onto the mandrel. Two sets of wheels are conveniently used by disposing the wheels adjacent one another as shown in Figure 10.

The apparatus shown in Figure 4 comprises a generally cylindrical member 43 which is rotatable upon its own axis. The cylindrical member 43 is provided with a converging discharge end 44. Cylindrical member 43 has a tapered ring 47 disposed within it, which tapered ring is secured to the inner periphery of the cylindrical member. Air nozzle 46 is disposed adjacent cylindrical member 43 at the entrance end thereof.

In starting the apparatus of Figure 4, the operator pulls the individual fibers downwardly, gathering them upon a gathering wheel, not shown, and the strand is then directed into pulling wheels 48, 48. Cylindrical member 43 is commenced to rotate and the strand from pulling wheels 48, 48 is directed into the entrance of cylindrical member 43. The jet of air from nozzle 46 disrupts the integrity of the strand and also deflects the strand into the

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cylindrical member. The strand impinges upon tapered ring 47 and becomes further dispersed with the individual filaments separating slightly one from another. The strand is formed into loops and helixes which move over tapered ring 47 toward the converging discharge end 44 of the cylindrical member 43. As the looped product emits from the converging discharge end 44 of the cylindrical member 43 it is pulled toward pulling rolls 49, 49 which advance the product as it is formed. The final product is wrapped upon take-up roll 51.

To facilitate the movement of the loops and helixes through cylindrical member 43, at the start of the process the operator may introduce a pick into the cylindrical member through the discharge end of the cylindrical member to pull the looped product from the cylindrical member. Also additional jets of air may be introduced at the entrance end of the cylindrical member to move the loops of strand toward the discharge end of the cylindrical member and to disperse the fibers within the strand.

In Figure 5 is shown a modified embodiment in which the cylindrical member is provided with curved pegs 52, 52 upon which the loops of strand impinge as they move through cylindrical member 53. The loops are compacted by passing through the curved peg area so that the product emitting from the cylindrical member comprises a staple type yarn of elongated generally parallel loops of strand. A jet of air from nozzle 55 is introduced into cylindrical member 53. This jet of air disperses the fibers within the loop of strand and also facilitates the movement of the loops toward the exit end of the cylindrical member and over the curved pegs 52, 52. Pulling rolls 56, 56 advance the product toward the take-up roll 57.

Other forms of apparatus may be used to accomplish the dispersing of a continuous strand, the formation of loops of this strand, and the compaction and gathering of these loops into a yarn which is similar to staple yarn. For instance in Figure 11, a cylindrical member 56 having a vertical axis of rotation is used with a deflecting plate 57 by placing the cylindrical member below a pair of pulling wheels 58 so that the driven strand 59 from the pulling wheels travels downwardly until it hits a deflecting plate and then it travels at about a 45° angle until it contacts the inner periphery of the cylindrical member. The deflecting plate disrupts the integrity of the strand and the effect of the wind-up device 61 and the forces of gravity advance the loops formed within the cylindrical member through the apparatus.

A continuous wheel-pulled strand 62 which is deflected off an inclined plate 63 or by a jet of air is collected in the form of a web 64 on a drum 65 which is provided with a screen periphery connected to a suction device 66 in another embodiment of the invention, see Figure 12. This web of looped, dispersed strands is then pulled from the drum and passed through a turbine 67 to produce a staple-like yarn. If desirable a rotary cutting device 68 is located below the pulling wheels 69 and the cut strand 71 is collected on the drum 72 in the form of a web 73 of dispersed strands. This web is then removed from the drum 72 and it passes through an air turbine 74 on its way to the pulling rolls 75 which advance the product to the roll-up device 76, see Figure 13.

It is now possible to produce a staple type yarn from a continuous strand at any forming speed desired. Using the methods of this invention, it is not necessary to go through separate forming, twisting and plying operations which are normally required when making yarn from continuous strand. In addition, the methods disclosed provide a yarn having the desirable properties of a staple yarn. This is accomplished without forming a true staple by the usual expensive staple forming methods.

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Yarns formed by the processes of this invention have many uses. The yarn is adapted for weaving into staple fabrics. It is also useful as a reinforcement for resinous molded and laminated articles. It can be used as roving, yarn or as a bulky cord.

Obvious variations and modifications may be made within the scope and spirit of the appended claims.

We claim:

1. A method of producing yarn comprising advancing a strand comprising a plurality of continuous filaments along a generally defined path under its own inertial forces, dispersing the filaments in the advancing strand, interrupting the advancement of said strand along said generally defined path while forming and collecting loops of strand, orienting the loops so collected in a generally parallel compacted relationship to form a yarn, and collecting the yarn so produced in the form of a package.
2. A method of producing yarn comprising advancing a continuous multi-filament strand toward a working zone under its own inertial forces, dispersing the filaments in the advancing strand as the strand enters said working zone, forming and collecting loops of advancing strand in said working zone to reduce the speed of said strand, orienting the loops so collected in a generally parallel compacted relation to form a yarn, and removing the yarn from said working zone.
3. A method of producing staple-yarn comprising driving a continuous, multi-fiber strand into a working zone, dispersing the fibers in the strand as the strand enters said working zone, forming and collecting loops of the strand in said working zone, twisting and compacting said loops upon themselves to form a yarn, and continuously removing the staple-type yarn from said working zone.
4. A method of handling continuous strand comprising advancing a strand under its own inertial forces toward a working zone, dispersing the fibers within said strand as the strand enters said working zone, in said working zone forming and collecting loops of the dispersed strand, drawing out the loops to bring them substantially into alignment with one another, compacting said loops upon themselves to form a yarn, and continuously removing the yarn from said working zone.
5. A method of handling continuous strand comprising advancing a strand of a plurality of fibers toward a working zone under its own inertial forces, dispersing the fibers within said strand as the strand enters said working zone, forming and collecting loops of the dispersed strand within said working zone, elongating and compacting said loops to bring them into substantial alignment with one another, removing the yarn so formed from said working zone, and imparting a false twist to the yarn removed from said working zone to remove loose ends and fuzziness.
6. Apparatus for producing a staple-type yarn comprising a rotatable, cylindrical member adapted for interrupting a driven strand and forming loops thereof, means for advancing a continuous strand under its own inertial forces toward said cylindrical member, means for dispersing the fibers within said advancing strand, and means for removing strand collected by said cylindrical member.
7. Apparatus for producing a staple-type yarn comprising a pair of pulling wheels for advancing a continuous multi-fiber strand under its own inertial forces, means for dispersing the fibers within said strand, a rotatable cylindrical member adapted for interrupting said advancing strand and forming successive loops therein, and means for removing said successive loops from said cylindrical member in compacted yarn form.
8. Apparatus for handling continuous strand comprising a rotatable mandrel, means for advancing a continuous strand comprising a plurality of individual fibers

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into contact with said mandrel, means for dispersing the individual fibers within said advancing strand, means for rotating said mandrel to form loops of said strand, and pulling means for advancing the loops along the length of said mandrel.

9. Apparatus for handling continuous strand comprising means for advancing a continuous strand along a generally defined path, under its own inertial forces, a cylindrical, rotating member adapted for interrupting said continuous strand to form loops thereof, means associated with said rotating member for folding and compacting said loops into a yarn, and means for removing said yarn from said rotating member.

10. In combination a feeder adapted for forming a plurality of streams of glass, a pair of pulling wheels adapted for attenuating the streams of glass into a continuous multi-filament strand and for imparting sufficient motion to the strand so that it advances under its own inertial forces, a rotating member adapted for interrupting said strand to form loops thereof, and pulling means for removing the loops from said rotating member.

11. Apparatus for handling continuous strand comprising means for advancing a continuous multi-filament

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strand under its own inertial forces; along a generally defined path, a rotatable tapered mandrel adapted for interrupting said strand to form loops thereof, means associated with said tapered mandrel for dispersing the filaments within said strand, and pulling roll means for removing said loops from said tapered mandrel.

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