

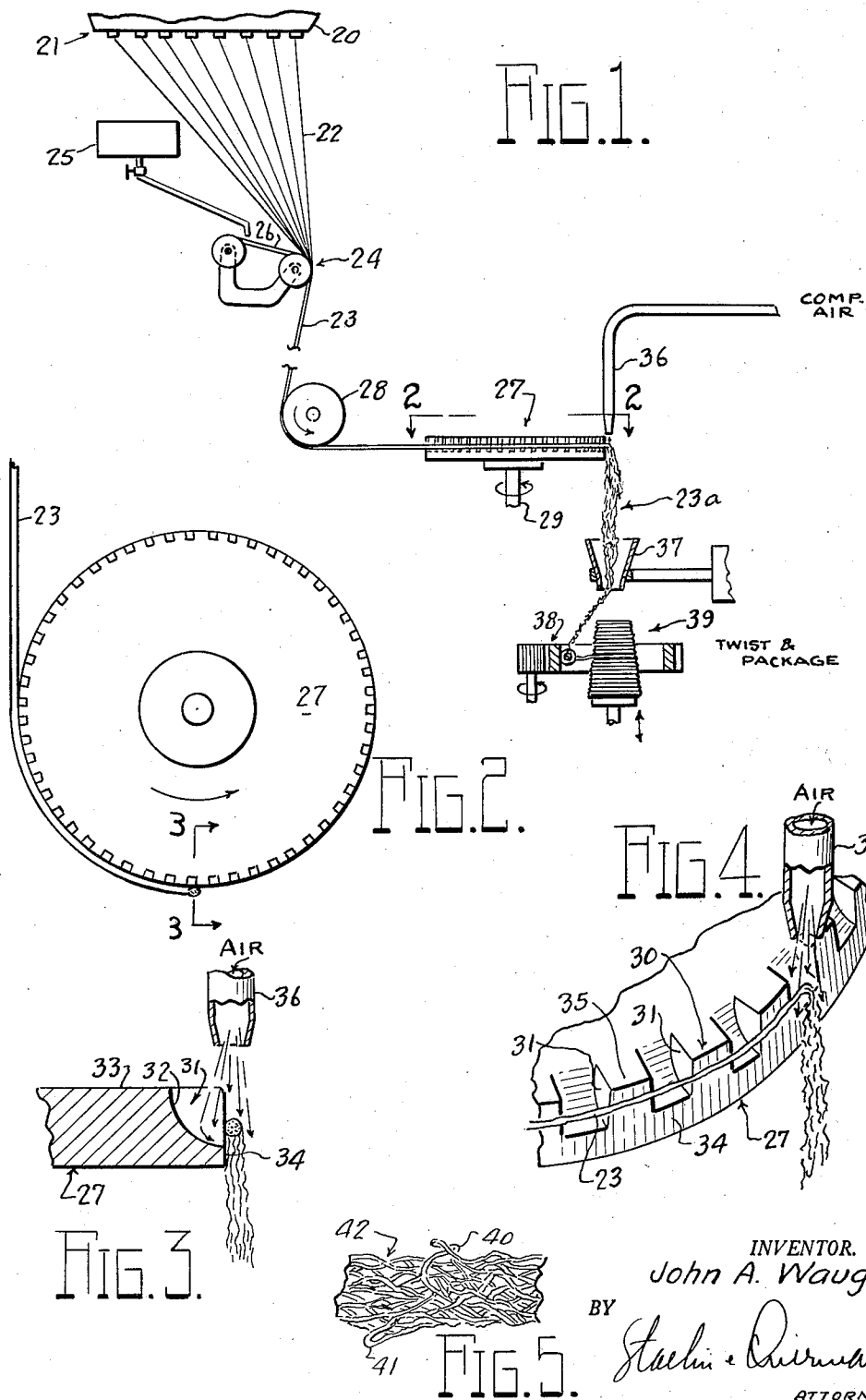
Oct. 27, 1959

J. A. WAUGH
METHOD AND APPARATUS FOR HANDLING
CONTINUOUS MULTIFILAMENT STRANDS

2,909,827

Filed Oct. 24, 1956

4 Sheets-Sheet 1



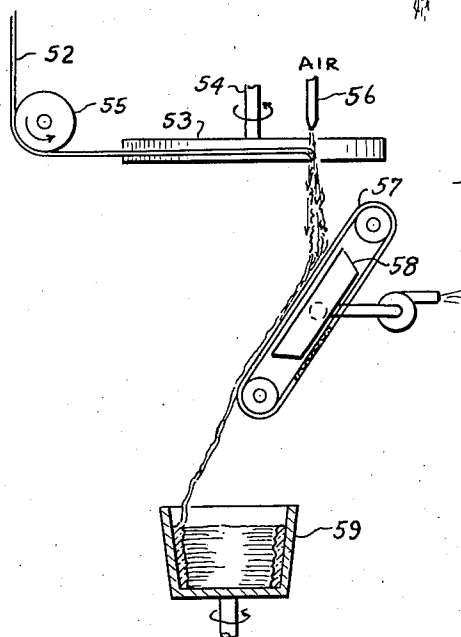
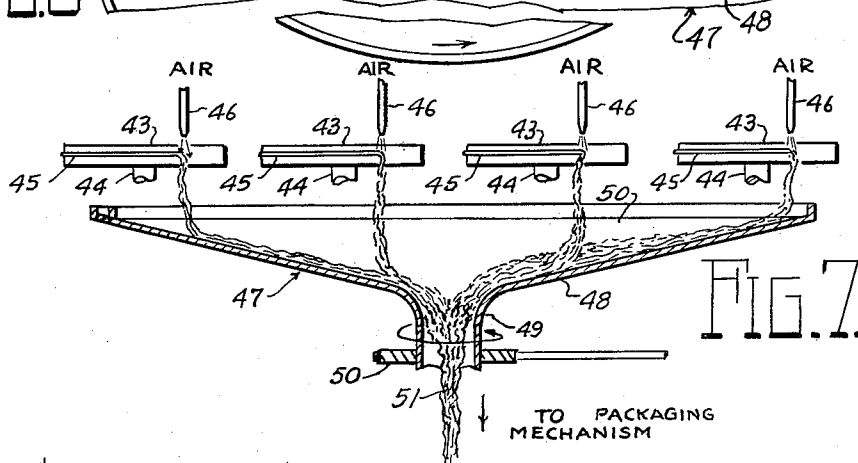
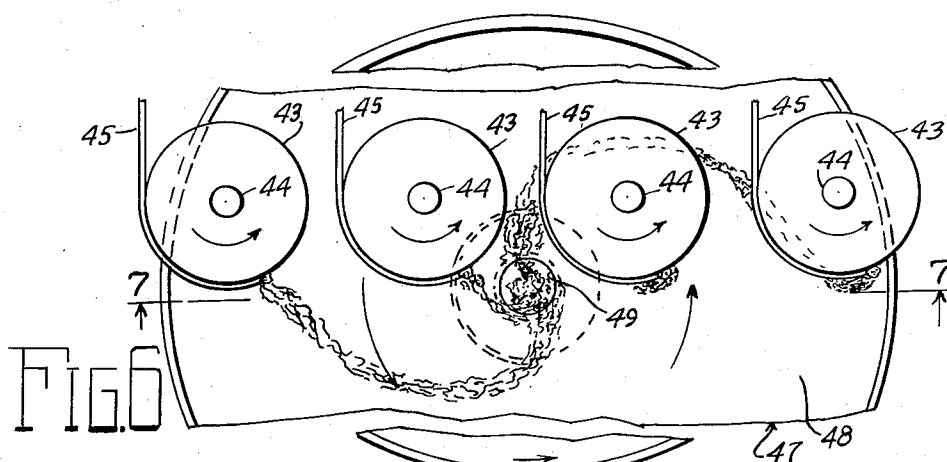
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INVENTOR.
John A. Waugh
BY *Arthur J. Sherman*
ATTORNEYS

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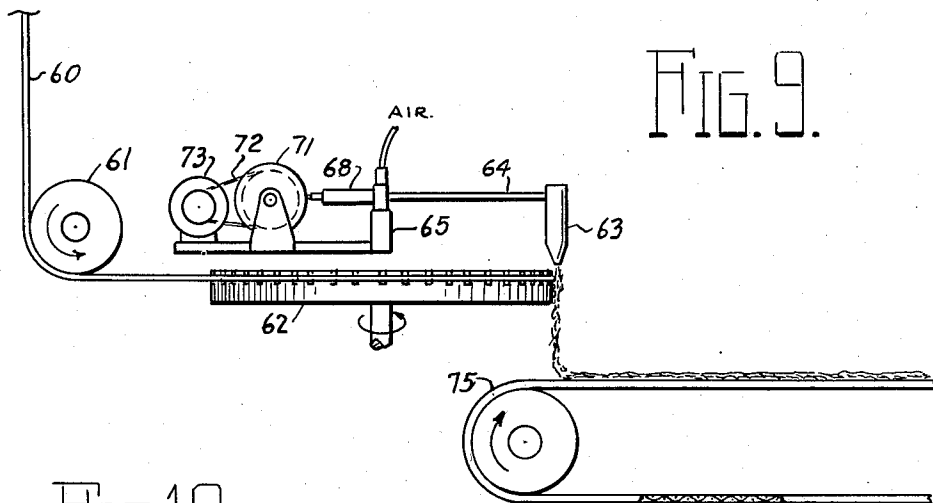


FIG. 9.

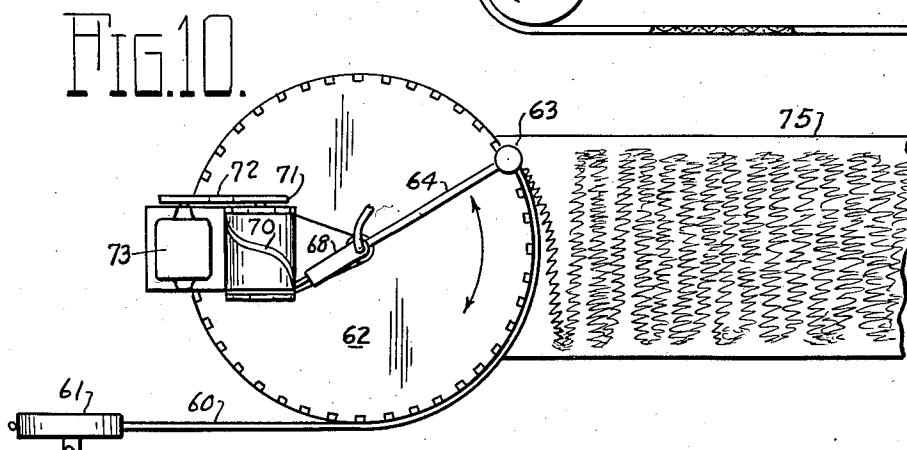


FIG. 10.

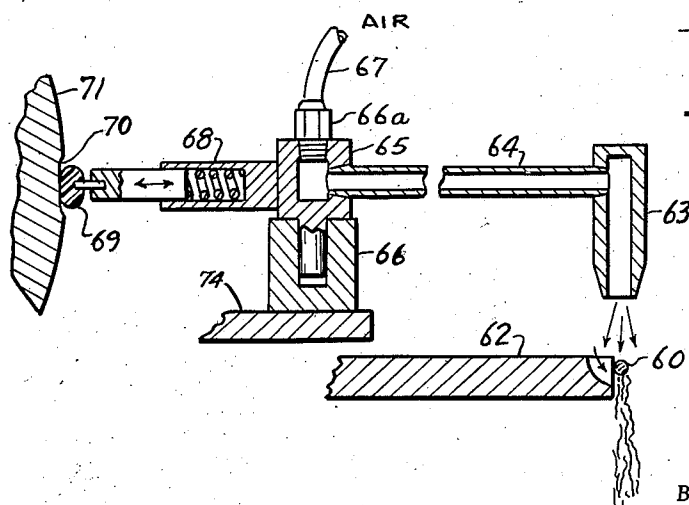


FIG. 11.

INVENTOR.
John A. Waugh

BY *Stachin & Sherman*
ATTORNEYS

Oct. 27, 1959

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J. A. WAUGH
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FIG. 12.

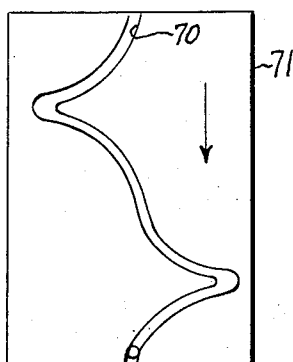


FIG. 13.

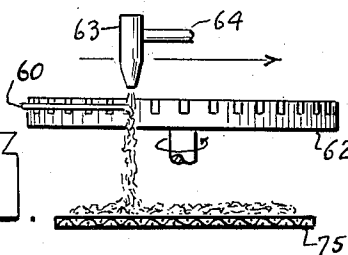


FIG. 14.

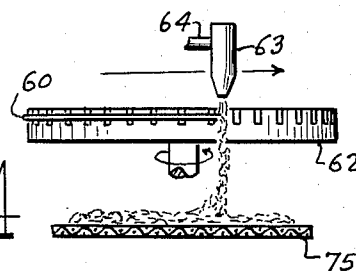


FIG. 15.

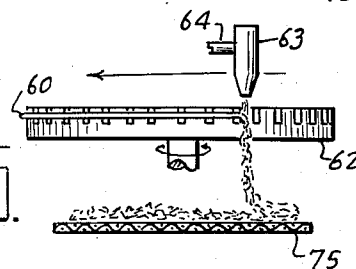
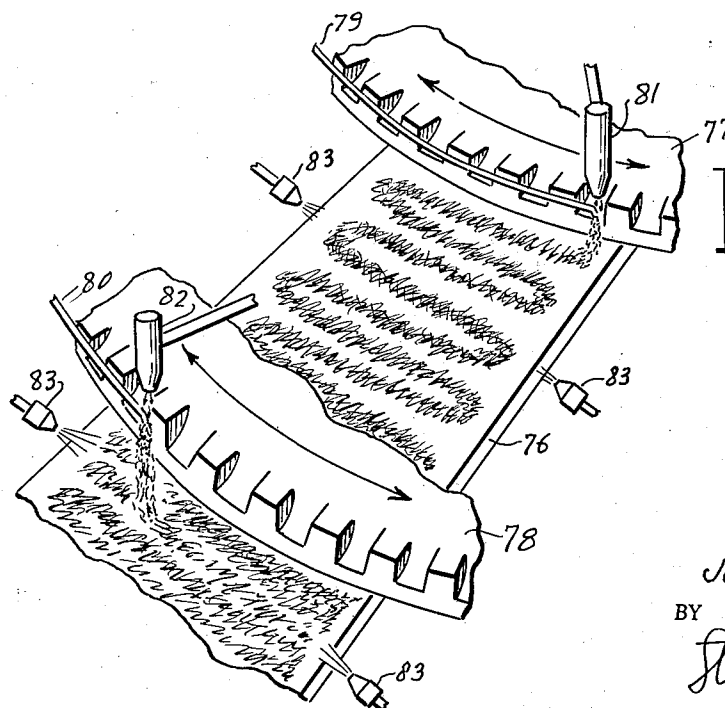


FIG. 16.



INVENTOR.
John A. Waugh
BY
Stachio Curran
ATTORNEYS

1

2,909,827

METHOD AND APPARATUS FOR HANDLING CONTINUOUS MULTIFILAMENT STRANDS

John A. Waugh, Cumberland, R.I., assignor to Owens-Corning Fiberglas Corporation, a corporation of Delaware

Application October 24, 1956, Serial No. 618,049

5 Claims. (Cl. 28—1)

This invention relates to a method and apparatus for handling continuous multifilament strands such as glass fiber strands, which may be composed of 200 or more individual continuous filaments laterally compacted in a generally parallel group to form a unitary strand.

It is the object of the instant invention to provide an apparatus and a method whereby a continuous multifilament strand either may be fed from a supply such as a creel, or may be attenuated by drawing the fibers from a supply of molten glass, at high lineal speed and directly processed to modify the characteristics of the continuous strand and to deposit or accumulate it directly in a usable form either for subsequent disaccumulation as in the textile industry, or in the form of a finished product, as in the making of blanket-like mats, reinforced sheet material and the like.

Through the practice of the invention and using apparatus embodying the invention it has been found possible to attenuate a multifilament glass fiber strand through the medium of a single rotary pulling wheel with the periphery of which the strand is engaged and from the periphery of which the strand is removed by the use of a fluid jet. By properly controlling and operating the fluid jet it is possible to remove the strand from the rotary pulling wheel in either of two ways: (1) with its filaments virtually undisturbed relative to each other, and (2) with its filaments laterally separated for short distances in random dispersal patterns so that when the strand is twisted, either alone or in combination with other strands, short loops and swirls of strand may extend from the sides of the twisted mass, giving to the twisted thread or yarn an appearance not unlike that of a staple thread or yarn.

Heretofore the fabrication of staple threads and yarns from fibrous glass usually has been performed by steam or air blowing of discontinuous fibers which are then accumulated upon gathering means and drafted into staple textile products in much the same manner as discontinuous natural fibers are handled. By the practice of the instant invention, however, continuous filaments may be so distributed relative to each other that the strand gains the appearance and many of the characteristics of a staple product.

The mode of achieving the foregoing objects and apparatus constituting the invention will be better understood from the following specification and from the drawings in which:

Fig. 1 is a fragmentary view in elevation, somewhat diagrammatic in nature, showing apparatus for the practice of the instant invention for the production of a continuous, staple-like textile element such as a single ply twisted thread or yarn.

Fig. 2 is a fragmentary, horizontal view taken along the line 2—2 of Fig. 1 and shown on an enlarged scale.

Fig. 3 is a fragmentary, vertical, sectional view taken along the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary view in perspective and partly

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in section, showing a portion of the strand pulling and/or attenuating element employed in Fig. 1 and particularly illustrating how a fluid jet is employed to remove the strand from the pulling element in the form of an opened, fiberized, or laterally separated strand.

Fig. 5 is a fragmentary view in elevation of a short length of finished twisted strand made according to the invention as illustrated in the embodiments of Figs. 1—4 and showing how individual filaments are disturbed from their generally parallel, compact relationship to produce a textile element having many of the characteristics of a staple and yet being a continuous fiber structure.

Fig. 6 is a fragmentary, plan view showing how a plurality of devices may be operated simultaneously according to the invention to produce a finished textile item of greater size, bulk, or strength.

Fig. 7 is a vertical, sectional view of the apparatus shown in Fig. 6 taken generally from the position indicated by the line 7—7 of Fig. 6.

Fig. 8 is a view similar to Fig. 1 and illustrating a further modification of apparatus operated according to the invention for the production of a continuous textile element such as a twisted thread or yarn.

Fig. 9 is a fragmentary view in elevation showing apparatus for the practice of the instant invention for the production of a sheet-like mass of staple-like fibers from a continuous strand.

Fig. 10 is a fragmentary plan view of the apparatus shown in Fig. 9.

Fig. 11 is a fragmentary, vertical sectional view, on an enlarged scale, of apparatus for the control of the distribution of a continuous strand according to the invention.

Fig. 12 is a developed plan view of a cylindrical cam which may be employed in the apparatus of Fig. 11.

Figs. 13, 14 and 15 are fragmentary, schematic views in elevation showing three steps in the control of the strand distribution as exercised by the apparatus of Fig. 12.

Fig. 16 is a fragmentary view in perspective illustrating the use of two or more apparatuses of Figs. 9 and 10 for the accumulation of continuous strands in a fluffy controlled mass upon a moving conveyor or sheet of material with which the strands are to be combined.

The embodiment of the invention which is illustrated in Figs. 1—4 is shown as being used for the fabrication and packaging of a staple type yarn from a continuous multifilament glass fiber strand. In the apparatus illustrated in Fig. 1 the strand is shown as being actually manufactured concomitantly with its handling and packaging. A source of molten glass such as a bushing 20 has a plurality of individual orifices generally indicated at 21 through which minute streams of molten glass are flowed and from the individual streams of glass a plurality of individual continuous filaments 22 are attenuated. The filaments 22 are gathered together in the form of a laterally compacted multifilament strand 23 by being led over a gathering and coating shoe generally indicated at 24. A coating, binder, lubricant, or other liquid material is applied to the filaments 22 at the time of their association into the strand 23, the liquid being metered from a supply in a container 25 onto a strip 26, for example, made of felt or other absorbent material, which extends around a suitable roller at the front of the forming shoe 24.

Tractive force for attenuating all of the filaments 22 and for feeding the strand 23 is provided by engaging the strand 23 with at least a considerable portion of the periphery of a rotary pulling element 27. In the apparatus shown in Fig. 1 the strand 23 is led around an idler 28 which changes its direction or plane of movement and

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guides the strand 23 into engagement with the periphery of the pulling element 27. The element 27 rotates on a vertical shaft 29 at high lineal speed, say, in the order of 8,000-15,000 feet per minute.

In this embodiment of the invention the rotary pulling element 27 is illustrated as having a slotted periphery. As can best be seen by reference to Figs. 3 and 4, the upper edge 30 of the element 27 has a series of circumferentially spaced notches 31 milled therein. The notches 31 have arcuate bottoms 32 opening onto an upper face 33 of the element 27 and through the peripheral surface 34 thereof. It will be observed, particularly in Fig. 4, that the strand 23 is fed onto the periphery of the pulling wheel 27 at such height that it engages the vertical peripheral faces of lugs 35 between the notches 31. Because the strand 23 is moistened by the liquid material applied thereto at the time of its gathering or by means of suitable spraying or coating devices, the strand 23 clings to the smooth peripheral surfaces of the lugs 35 of the wheel 27 with sufficient tenacity as to transmit abundant tractive force back up the length of the strand 23 to the filaments 22 for their attenuation. In other embodiments or uses of apparatus embodying the invention, the strand 23 may be pulled, for example, from a creel or package and as in the case of its initial attenuation, a pulling wheel designed as shown in Figs. 1-4 provides more than ample tractive force to feed the strand from its supply.

Having become engaged with the periphery of the pulling wheel 27, the strand tends to cling to the peripheral surfaces of the lugs 35 and, according to the invention, is removed therefrom by a jet of fluid, for example air, directed downwardly partially into the notches 31 and across the faces of the lugs 35 from an air supply pipe 36. As can best be seen in Fig. 3 some of the air emitted from the pipe 36 enters the notches 31 where it impinges upon their curved bottoms 32 and is directed radially outward of the wheel 27 and some of the air from the jet sweeps across the peripheral faces of the lugs 35 and the periphery 34 of the wheel 27 so that the action of the jet peels the strand away from the surface of the lugs 35 and directs it axially of the wheel 27, in this case downwardly.

It has been discovered that the degree of opening or filamentizing of the strand is directly proportional to the force of the air jet where it impinges upon the strand. Variations in the degree of "filamentization" or separation of the filaments are achieved by changing the effective force of the jet of air from the pipe 36 as by adjusting either its spacing from the wheel 27 or its pressure.

In Fig. 1 the filamentized strand indicated at 23a is blown downwardly by the jet of air from the pipe 36 and into the open upper end of a gathering funnel 37 whence it is pulled by a conventional textile spinner 38 and twisted and packaged, for example, upon a textile tube generally indicated at 39. This operation produces a continuous textile element properly described as a single ply yarn having a twist determined by the operation of the flyer and the textile tube and with some of the opened filaments caught and twisted beneath other filaments and with other portions of the filaments protruding from the mass as loops or swirls. Such a structure is illustrated in Fig. 5 where loops of filament 40 and 41 are shown as protruding laterally from the general mass of filaments comprising the twisted yarn indicated at 42. The specific relationships of the individual filaments 40 and 41 and others as shown in Fig. 5 are illustrative only.

Figs. 6 and 7 illustrate how a plurality of pulling wheels are utilized to produce a heavier textile unit. In these figures four pulling wheels 43 are mounted upon parallel, vertical shafts 44. The wheels 43 may be designed according to the embodiment of the invention shown in Figs. 1-4 or they may have unbroken peripheries, as illustrated. Each of the pulling wheels 43 serves to feed, pull or attenuate a continuous multifilament strand 45 and each of the strands 45 is discharged from the pe-

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riphery of its respective pulling wheel 43 by a downwardly directed jet of air from a supply pipe 46. When smooth periphery pulling wheels 43 are employed the positions of the supply pipes 46 will vary slightly in a radial direction from the position they occupy when serrated periphery wheels, as shown in Figs. 1-4 are used.

A gathering turntable 47 extends transversely across beneath the portions of the peripheries of the pulling wheels 43 from which the strands 45 are discharged for the purpose of guiding the discharged strands together. The turntable 47 has an inclined bottom 48 leading toward a center, downwardly directed, funnel-like neck 49. The neck 49 is rotatably journaled and the table is rotated by a belt engaged in a pulley 50. All of the strands 45 are gathered and twisted together in the neck 49 to form a heavy yarn generally indicated at 51, and then led to conventional packaging mechanism (not shown).

Instead of leading all of the strands 45 together to form one heavy continuous textile element 51, they may be individually led from their respective pulling wheels 43, as through individual guide eyes, for example. If this is done a multi-ply structure is formed with each strand twisted and the strands all twisted together.

Fig. 8 illustrates a modification of the invention in which a strand 52 is fed or pulled by a rotary pulling wheel 53 mounted on a vertical shaft 54. In this case the strand 52 is led around an idler wheel 55 onto the periphery of the wheel 53 and is delivered off of the periphery of the wheel 53 by a single downwardly directed air jet delivered from an air pipe 56. A foraminous conveyor 57 moves downwardly at an incline beneath the point of delivery of the strand 52. A suction box 58 is located beneath the upper span of the conveyor 57 to carry away the air from the pipe 56 and to compact the opened strand on its surface. For example, if the force of the draft in the suction box 58 is high, the opened strand 52 is laid on the conveyor 57 as a thin dispersed ribbon. If less force is employed, the strand 52 retains its circular form.

The opened strand 52, whether in the form of a ribbon or a filamentized strand, is led off the conveyor 57 and into a conventional spinning bucket 59 which, through the application of centrifugal force in a known manner, lays the strand around its wall and creates in the strand a number of turns of twist per unit of length determined by the relative speeds of rotation of the bucket 59 and lineal feeding of the strand 52.

Fig. 9 shows an apparatus operated according to the invention for the accumulation of a fluffy, blanket-like mass of fibers from a continuous multifilament strand 60 guided by an idler wheel 61 into engagement with the periphery of a pulling wheel 62. The strand 60 is discharged from the pulling wheel 62 by a jet of air from an oscillatory pipe 63 that is mounted upon the end of an oscillating arm 64. The arm 64 (see also Figs. 10 and 11) serves as an air pipe and is mounted by a hub 65 on a pedestal 66. The hub 65 is bored to receive a coupling 66a from an air supply line 67. A telescoping arm 68 aligned with the pipe arm 64 has a cam follower 69 on its rear end. The follower 69 is engaged in a cam track 70 (see also Fig. 12) cut in the periphery of a drum cam 71 rotated through a belt 72 by a motor 73.

The pedestal 66, cam 71 and motor 73 are all supported on a platform 74 above the pulling wheel 62 with the axis of the hub 65 and the axis of the pulling wheel 62 aligned. Rotation of the cam 71 oscillates the arm 64 and the pipe 63 back and forth through the path indicated by the arcuate arrow in Fig. 10 so that the jet from the pipe 63 discharges the strand 60 from the pulling wheel 62 in a reciprocatory path.

A conveyor 75 passes beneath the pulling wheel 62 and receives the strand 60 as it is discharged. The conveyor 75 may be foraminous as indicated in Fig. 9 or it may be a sheet of material, for example asphalt coated

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paper, adhesive coated metal foil, or similar material, to which it is desired to adhere the strand 60.

As can be seen by comparing Figs. 13, 14 and 15, oscillation of the pipe 63 causes the discharge of the strand 60 from the pulling wheel 62 at a point beneath the particular location of the pipe 63 at any time. In Fig. 13 the pipe 63 is moving along the arcuate path indicated by the arrow from left to right. The strand 60 feeds around the pulling wheel 62 until the jet from the pipe 63 discharges it. As the pipe 63 moves to the right (toward the position indicated in Fig. 14) the strand 60 clings to and is carried along with the wheel 62 so that it progressively travels farther on the pulling wheel 62 before it is stripped therefrom by the jet. When the pipe 63 begins its back stroke (Fig. 15) its movement is contra to the direction of rotation of the pulling wheel 62 so it gradually strips the strand 60 off the pulling wheel 62 more quickly and progressively.

This results in depositing the strand 60 in fluffy open form upon the moving conveyor or sheet of material 75 in a generally wave form configuration. By appropriately timing the speed of the conveyor 75 and oscillation of the pipe 63 the strand may be laid on the conveyor 75 with its waves relatively closely packed.

By the particular contour of the cam track 70 which is employed, the deposition of the strand upon the conveyor 75 may be evened out to a certain extent so that the density of the strand on the conveyor 75 remains almost constant across the conveyor. In Fig. 12 the cam track 70 is shown as having very sharp peaks. This causes the pipe 63 to speed up as it approaches the limits of its stroke and to return therefrom at a diminishing rate of speed. As a result the pipe 63 remains only briefly at the limits of its stroke and, consequently, a lesser weight of strand is discharged at the limits of the stroke than would be the case if the oscillatory movement were regular, for instance, with a crank arrangement.

If it is desired to further increase the density of the mass of open strand accumulated upon a conveyor, two or more apparatuses operating according to the invention may be employed in combination with a single conveyor. Such an arrangement is illustrated in Fig. 16 where a conveyor 76 is shown as being moved lineally beneath a pair of pulling wheels 77 and 78. Each of the pulling wheels 77 and 78 feeds a multifilament strand 79 or 80, respectively, the strands 79 and 80 being discharged from the wheels 77 and 78 by oscillating jet pipes 81 and 82, respectively. The strand 79 is deposited upon the conveyor 76 forming a layer of controlled density and configuration and the strand 80 is deposited on top of the layer of strand 79.

If desired, suitable spray pipes 83 may be employed to spray binder, size or other coating material onto the accumulating mass of strand for fixing the strand in its deposited form or for combination with the strand in a subsequent product. For example, a suitable synthetic resin may be sprayed as a liquid, suspension or solution and the resin subsequently set up to form a reinforced resinous product.

Although not shown in the drawings, similar spray heads may be employed in the apparatus of Fig. 9 or in the earlier apparatuses where it may be desired to apply coatings of one kind or another to the textile products or the mat products being manufactured.

I claim:

1. A method for handling a continuous, multi-filament strand comprising, feeding said strand into peripheral contact with a rotary circular element rotating said ele-

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ment at high speed, maintaining said strand in contact with said element for a sufficient angular distance thereon to impart traction to said strand, directing at least one jet of air against said strand along a path extending at least generally parallel to the axis of said element, intermittently directing a part of said jet of air in a direction generally radially outward of said element and collecting said strand after departure from said element on a generally planar receptacle moved past the point of departure at a linear speed less than the linear speed of said strand.

2. A method for fabricating a blanket-like mass of fibers in spaced non-linear relation from a continuous multi-filament untwisted strand, said method comprising, feeding said strand tangentially into peripheral surface contact with a rotary circular feeding element, maintaining said strand in surface contact with said element for a sufficient angular movement therewith to impart traction to said strand, directing a jet of air against said strand along a line parallel to the axis of said element and simultaneously in a direction radially outward of said element for separating the filaments of said strand from each other, moving a continuous surface along a plane extending beneath said element at a linear speed less than the linear speed of said strand and reciprocally translating said jet in an arcuate path lying in a plane normal to such axis and overlying the periphery of said element and said surface.

3. Apparatus for forming a blanket-like mass of fibers in spaced, non-linear inter-relation from a continuous, laterally compacted, multi-filament strand of untwisted fibers, said apparatus comprising, a rotary pulling wheel, means for guiding said strand longitudinally into peripheral surface contact with said wheel, said wheel having a plurality of circumferentially spaced slots cut angularly through the edge of one face thereof and the joining edge of the peripheral surface thereof in a radial direction, a collector surface, means for moving said collector surface linearly beneath and away from said wheel, an air jet nozzle, means for mounting said nozzle for directing said jet axially across said edge of said face and said peripheral surface of said wheel against said strand thereon and toward said collector surface whereby part of the air from said jet flows through such slots and emerges outwardly thereof for separating the fibers in said strand, and means for reciprocally translating said jet nozzle in an arcuate path lying above the periphery of said wheel and extending laterally across and above said surface.

4. Apparatus according to claim 3 in which the means for reciprocally translating the jet nozzle comprises an arm lying in a plane normal to the axis of the pulling wheel and pivotally mounted on such axis and cam means for oscillating said arm.

5. Apparatus according to claim 4 in which the cam means has a track having accelerated pitch into and away from the extremes of such track whereby the quantity of strand deposited on the collector surface is evened out over the sweep of the nozzle.

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