Aug. 2, 1960 R. G. RUSSELL 2,947,489

HIGH SPEED WINDING COLLET

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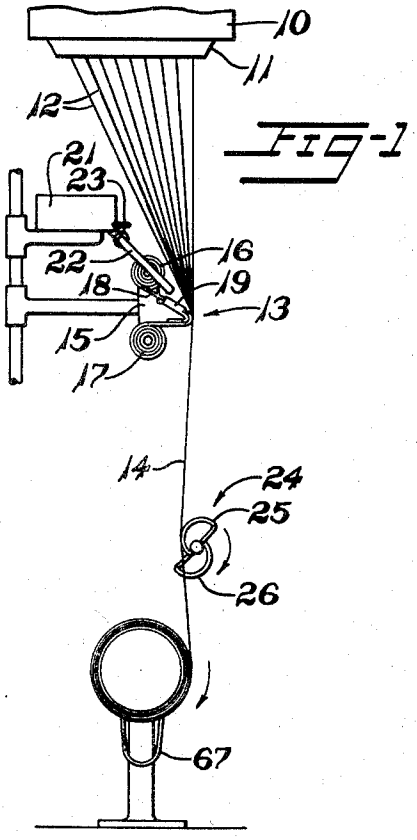


Fig-1

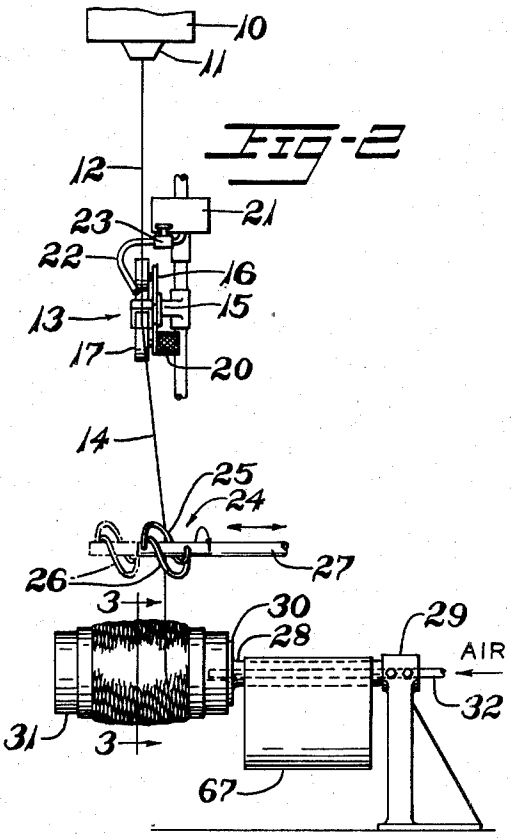


Fig-2

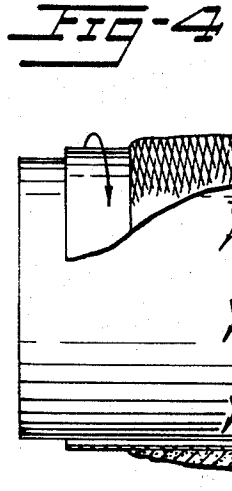


Fig-4

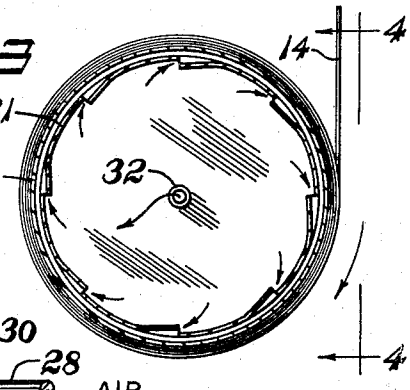


Fig-3

INVENTOR.
ROBERT G. RUSSELL
BY
Stalin & Overman
ATTYS.

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HIGH SPEED WINDING COLLET

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Fig-6

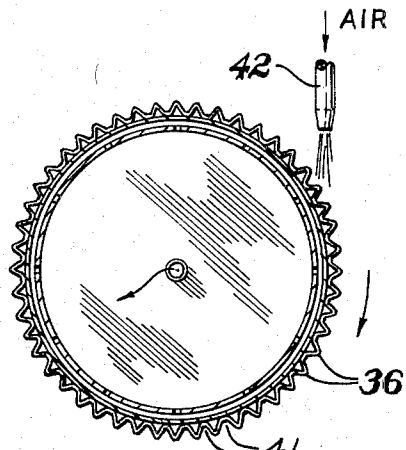
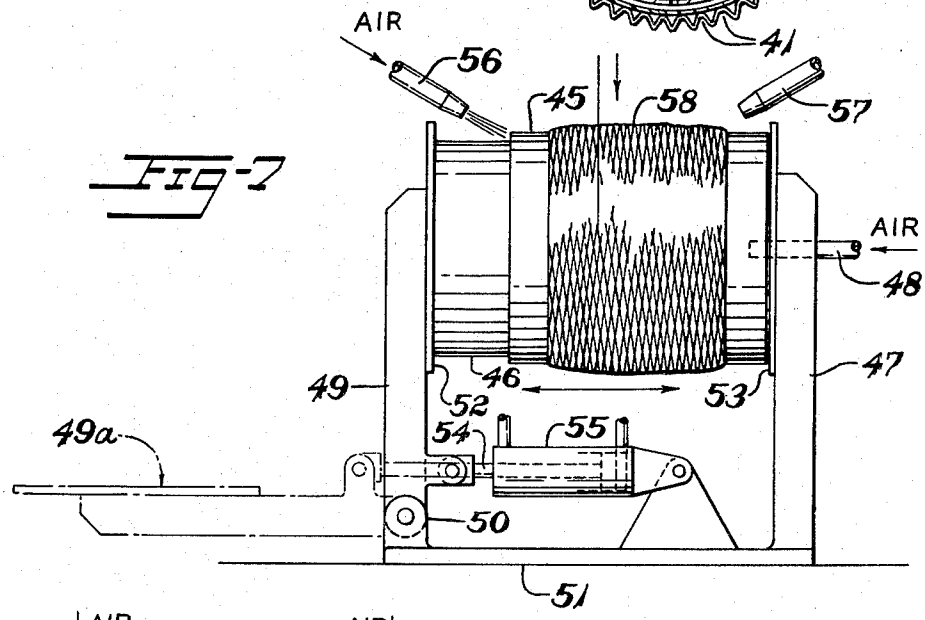


Fig-7



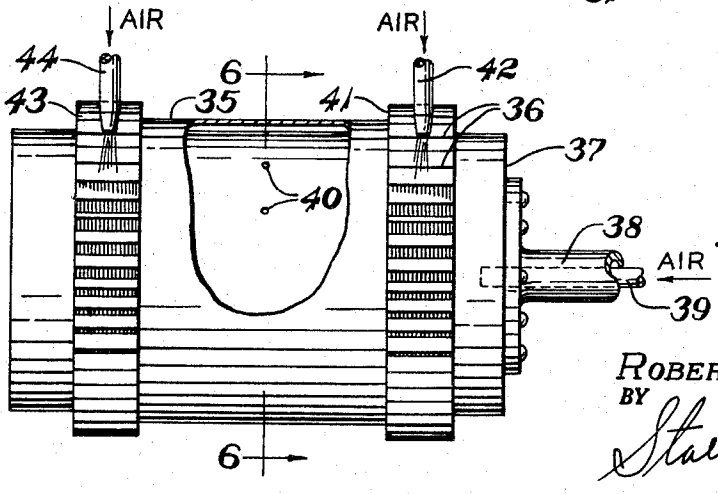


Fig-5

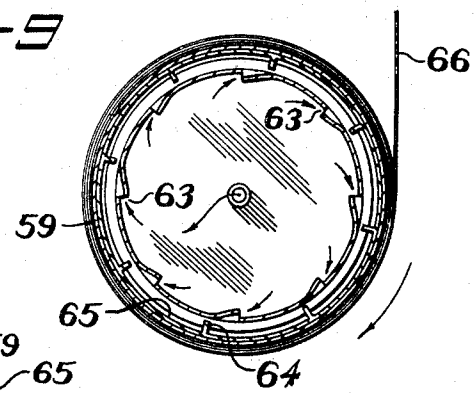
INVENTOR.
ROBERT G. RUSSELL
BY
Stallin & Overman
ATTYS.

Aug. 2, 1960 R. G. RUSSELL 2,947,489

HIGH SPEED WINDING COLLET

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Fig-9



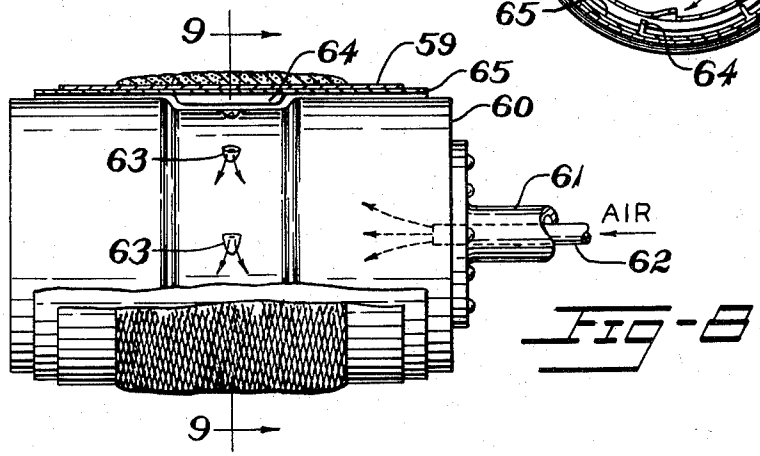


Fig-8

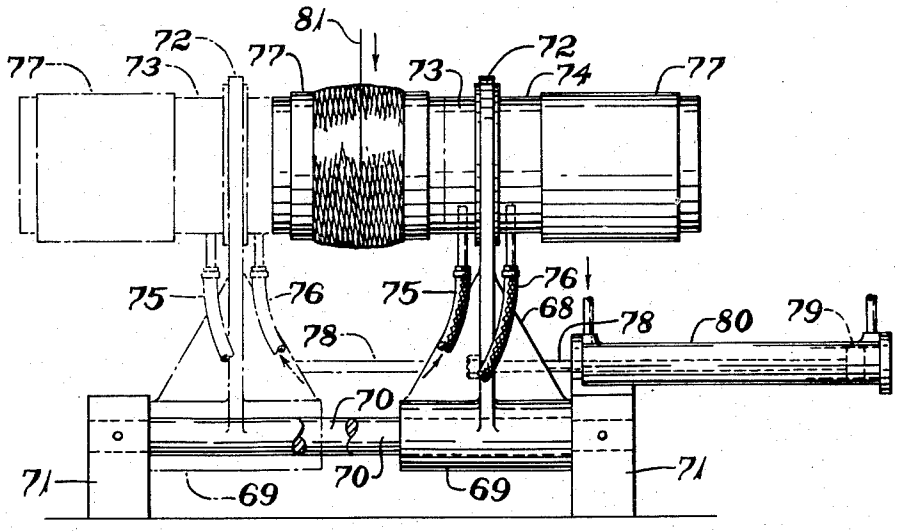


Fig-10

INVENTOR.
ROBERT G. RUSSELL
BY
Stachin & Overman
ATTYS.

Aug. 2, 1960 R. G. RUSSELL 2,947,489

HIGH SPEED WINDING COLLET

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Fig-11

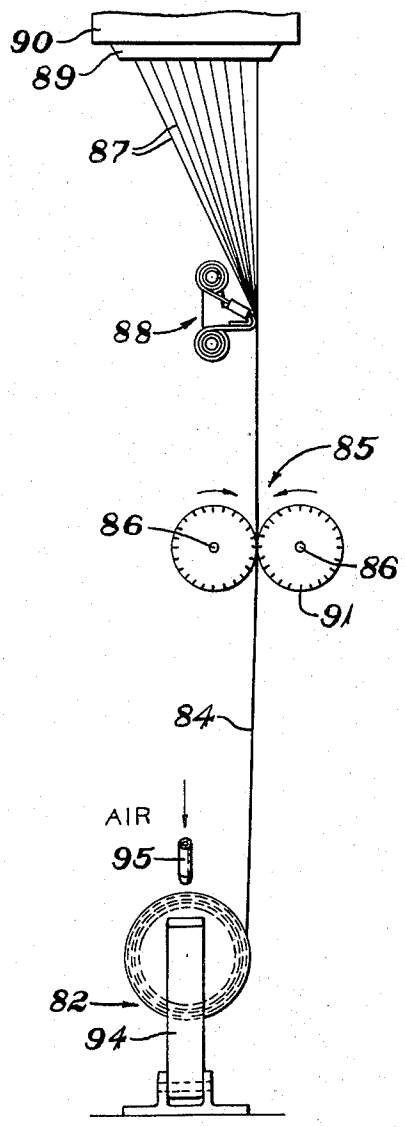
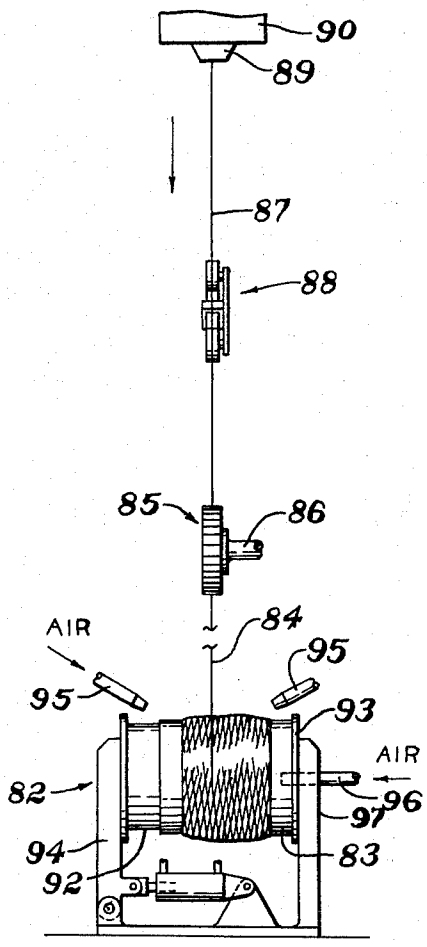


Fig-12



INVENTOR.
ROBERT G. RUSSELL
BY
Stallin & Ackerman
ATTYS.

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2,947,489

HIGH SPEED WINDING COLLET

Robert G. Russell, Granville, Ohio, assignor to Owens-Corning Fiberglas Corporation, a corporation of Delaware

Filed Dec. 29, 1953, Ser. No. 400,967

9 Claims. (Cl. 242—18)

This invention relates to high speed collets for winding continuous textile strands and similar materials and more particularly to a high speed collet which is driven by air jets.

In the fabrication of many artificial textile strands of which glass fiber strands are an excellent example, the strands are formed by pulling the material through fiber forming orifices at extremely high lineal speeds. In the case of glass fiber strands the strands are formed by associating together a plurality of individual fibers, say, 200 or more, each of which is pulled from an individual stream of molten glass.

Economical commercial operation in fiber forming operations of this type is performed at extremely high lineal speed, frequently in the order of 10,000 lineal feet per minute, and the elongation and attenuation of the streams produces the fine fibers which are associated into a strand. In order to attenuate the fibers, lineal tension must be applied and the strand produced at this high rate must be packaged so that it can subsequently be handled for the fabrication of various end products.

High speed rotary collets have been employed for the purpose of mounting and rotating sleeve-like tubes or "packages" which are slid over the collets. In this operation the end of the strand is wrapped around the tube or package which is then rotated by the collet at an appropriate speed to produce the lineal movement of the strand.

Heretofore such high speed collets have incorporated a considerable number of parts both to provide sufficient mechanical strength to withstand the forces created by high speed rotation and to provide supporting media for the relatively light and flexible sleeves or packages on which the strand is wound. All of these parts create weight and the collet has considerable mass so that mechanical problems are immediately created by the necessity for rotating the substantial mass at such high speed.

It is the principal object of this invention is provide apparatus on which a thin flexible sleeve can be rotated at a high rate of speed sufficient to produce a surface speed in the order of 10,000 feet per minute but without requiring the mechanical driving means, mounting means and supporting means customarily employed to mount and rotate the collets of the art.

It is a further object of this invention to provide apparatus for winding a continuously available strand on a compact lightweight form, in the utilization of which, the form alone is rotated, there being no rotary mechanical apparatus employed.

Yet another object of this invention is to provide means for rotating a lightweight sleeve at high speed so that a continuously available strand or similar material can be wound upon its exterior in a controlled pattern to produce a light weight though dense package of strand which can be unwound for subsequent use.

These and more specific objects and advantages will be better understood from the specification which follows and from the drawings in which:

Fig. 1 is a simplified side view in elevation of a glass fiber strand forming operation in which the strand is wound upon a package driven by mechanism embodying the invention.

Fig. 2 is a front view in elevation of the apparatus shown in Fig. 1.

Fig. 3 is a vertical sectional view on an enlarged scale taken on the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary view partly in section and partly broken away of the package rotating means shown in Fig. 3 and taken in part from the position indicated by the line 4—4 of Fig. 3.

Fig. 5 is a view generally similar to Fig. 4 but of a modified form of package rotating means embodying the invention.

Fig. 6 is a vertical sectional view taken on the line 6—6 of Fig. 5.

Fig. 7 is a view in elevation of a still further embodiment of the invention employing cooperating pneumatic means for traversing the package being wound.

Fig. 8 is a view, also generally similar to Figs. 4 and 5, but illustrating still another embodiment of the instant invention.

Fig. 9 is a vertical sectional view taken on the line 9—9 of Fig. 8.

Fig. 10 is a view in elevation of package tube mounting and rotating means embodying the invention and providing for alternate positioning of the tube carriers for the winding of successive packages.

Fig. 11 is a view similar to Fig. 1 but showing a high speed collet embodying the invention employed with strand pulling means in the attenuation and packaging of a continuous glass fiber strand.

Fig. 12 is a side view in elevation of apparatus shown in Fig. 11.

In the specification and claims which follow, the operation of mechanism embodying the invention will be explained and illustrated as it is employed in the forming and packaging of continuous glass fiber strand. Glass fiber strands are shown as illustrative and other continuous strand-like material also can be wound and/or formed simultaneously through the use of apparatus embodying the instant invention.

In Fig. 1 there is shown a fragment of a glass melter or molten glass tank **10**. The tank **10** is provided with a bushing **11** in the bottom of which there are formed a plurality of minute orifices. Molten glass in the tank **10** flows through the minute orifices in the bushing **11** under force of gravity or pressure or a combination thereof, and the streams of molten glass upon entering the cooler atmosphere are congealed to form fibers **12** which are led over a guide generally indicated at **13** and are associated together to form a strand **14** which is fed and packaged by apparatus embodying the invention. The longitudinal movement of the strand **14** attenuates each of the streams of molten glass into the fine fibers **12**.

The guide **13** comprises a frame **15** having two vertically spaced spools **16** and **17** carrying a web or strip **18** of felt or similar material. The upper spool **16** carries a supply of the felt strip **18** which is led downwardly over a formed metal bracket **19** and onto the spool **17**. The fibers **12** slidingly engage that portion of the strip **18** which lies over the nose end of the bracket **19** and the abrasion resulting from their lineal movement over the strip **18** gradually cuts it away. After a period of operation during which the strip **18** is severely cut, the operator may turn a knurled knob **20** (Fig. 2) rotating the spool **17** and moving the strip **18** downwardly to provide a fresh fiber engaging surface. A tank **21** is mounted just above the guide **13** and contains a suitable lubricant, adhesive or other coating material which it is desired to transfer to the fibers **12** or strand **14** by their engage-

ment with the strip 18. The tank 21 is provided with a nozzle 22 having a valve 23 by which the rate of flow of material from the tank 21 and through the nozzle 22 is controlled.

As the strand passes downwardly from the guide 13 it may be engaged with the wires of a traverser generally indicated at 24 and shown as illustrative of mechanical traverser mechanisms known in the art, for traversing the strand 14 back and forth across a package on which it is wound. A traverser of the type illustrated in Figs. 1 and 2 comprises two shaped wires 25 and 26 mounted upon a rotary and axially reciprocable shaft 27. Rotation of the shaft 27 rotates the shaped wires 25 and 26 and, by engagement between the wires 25 and 26 and the strand 14 carries the strand 14 back and forth axially of the shaft 27. This motion, in combination with the axial motion of the shaft 27 itself, produces a complex traversing movement to lay up the strand on a rotary package in a generally "barrel-shaped" mass.

At a point beneath the traverser 24 there is located a horizontally extending stationary shaft 28 (see also Fig. 4) which is rigidly mounted in a bracket 29. The shaft 28 has a circular flange 30 on its end and the flange 30 in turn is riveted to and supports a hollow cylindrical drum 31. The shaft 28 also is hollow and an air line 32 extends through the shaft 28 into the interior of the drum 31. The cylindrical wall of the drum 31 has at least one circumferentially extending series of lanced openings 33 out of which jet of air exude in a direction generally tangential to the exterior surface of the drum 31. The openings 33 are so lanced through the wall of the drum 31 that the jets of air emanating therefrom extend in a direction appropriate to produce rotary components of force which rotate a sleeve 34 loosely fitting over the drum 31. The sleeve 34 is relatively light in weight and of such size and length as to provide sufficient surface for the accumulation of a substantial length of the strand 14 thereon.

Because of their generally tangential direction the jets of air emanating from the lanced openings 33 impinge upon the inner surface of the sleeve 34 and provide rotative force. Since the only escape of the air from beneath the sleeve 34 is axially outward from its ends, the air jetting from the openings 33 produces not only rotative movement of the sleeve 34 but also provides a thin cushion of air between the sleeve 34 and the surface of the drum 31 preventing frictional engagement therebetween and "floating," as it were, the sleeve 34 completely out of contact with the drum 31 as the sleeve 34 rotates.

The speed of rotation of the sleeve 34 may be determined and controlled by measuring and varying the pressure of the air introduced through the air line 32 into the interior of the drum 31, the size and number of lanced jet openings 33 and the weight of the mass to be rotated and the resistance to rotation provided by the attenuating force required to draw the molten streams of glass to form the fibers 12 and pass the fibers 12 over the guide 13 and traverser 24; or, in the case of merely winding a strand previously formed, the force necessary to pull the strand off of or out of its previous container.

The embodiment of the invention disclosed in Figs. 5 and 6 comprises a modification in which a package sleeve 35 is provided with exterior vanes 36 at at least one of its ends. In common with the earlier modification, the sleeve 35 is supported for rotation upon a drum 37 mounted upon a stationary hollow shaft 38 through the center of which an air line 39 extends into the interior of the drum 37. In this modification of the inventionn the drum 37 has one or more circumferentially extending series of openings 40 through which the air in the drum escapes.

The vanes 36 may be lightly and inexpensively fabricated by gluing or otherwise securing a corrugated strip 41 of light material such as paper, on the end of the sleeve 35. An air jet 42 is mounted with its axis extending substantially tangentially to the sleeve 35 so that the jet of air directed against the vanes 36 produces rotation of the strip 41 and the sleeve 35 on which it is mounted in the desired direction to wind up and accumulate the strand thereon. In this embodiment of the invention the openings 40 in the drum 37 need not be lanced since the air emitted through the openings 40 is relied upon solely to provide the sleeve supporting cushion surrounding the drum 37. In this embodiment of the invention rotative force is provided by the air from the air jet 42 impinging against the vanes 36.

Under some conditions it may be desirable to mount a second corrugated strip 43 at the end of the sleeve 35 opposite the strip 41 and to employ a second air jet 44 in connection therewith. Whether one or two of the corrugated strips 41 or 43 are employed depends upon the resistance to rotation afforded by the particular operation, upon the weight of the mass of strand to be accumulated and similar considerations. It also is to be observed, of course, that the use of two corrugated strips and air jets may be advantageous from the standpoint of balancing the forces acting upon the sleeve 35.

It may be desirable in some instances to provide the drum 37 or its corresponding drum 31 of Figs. 1–4, with more than one series of circumferentially extending openings, for example in Fig. 4 two such series of lanced openings might be employed, one near each end of the sleeve 34. In the embodiment of Fig. 5 it might, in some instances, be desirable to employ both the external vaned strips 41 and/or 43 and also to provide for lanced openings in place of the perforated openings 40. Combinations of these means for producing both the rotation and relatively frictionless support of the strand accumulating sleeve may be employed.

In the embodiment of the invention disclosed in Fig. 7 a sleeve 45 is shown as positioned by a drum 46, similar in nature to the drums 37 and 31 of the previous embodiments, and provided, like the drum 31, with one or more series of lanced openings (not shown) to produce rotation of the sleeve 45 on the drum 46. The drum 46 is mounted by a rigid arm 47 and air to produce rotation of the sleeve 45 is fed into the drum 46 from an air line 48.

A second arm 49 may be pivotally mounted between ears 50 on a base 51 which also supports the arm 47. The arm 49 carries a circular flange 52 similar to a large circular flange 53 formed on the end of the drum 46 adjacent the arm 47. The arm 49 is connected to a cylinder rod 54 extending into a hydraulic or pneumatic cylinder generally shown at 55 which swings the arm 49 between its upper position shown in solid lines in Fig. 7 and its lower position shown in dotted lines (indicated by the reference number 49*a*) to permit a filled package to be slid off the end of the drum 46.

It will be observed in Fig. 7 that the drum 46 is of considerably greater axial length than the sleeve 45. The apparatus of Fig. 7 is designed to be used without a mechanical traverser such as the traverser 24 of Fig. 2 and traversing motion of the sleeve 45 on the drum 46 is produced by alternately feeding air through a pair of inwardly inclined jets 56 and 57. The jets 56 and 57 are mounted above the drum 46 so that when air is fed through the jet 57, for example it impinges against the edge of the accumulating mass of strand generally indicated at 58 and produces a slow axial movement of the mass of strand 58 and sleeve 45 across the drum 46 until the edge of the sleeve 45 strikes one of the flanges 52 or 53. Since the air escaping from beneath the sleeve 45 cushions the sleeve 45 on the drum 46, friction between the two is virtually eliminated and but little force is necessary to produce the axial movement of the sleeve 45. By controlling the force of the air blast delivered from the two jets 56 and 57 the speed of traversing of the sleeve 45 across the drum 46 can be controlled.

Alternate feeding of air to the two jets 56 and 57 produces reciprocatory movement of the sleeve 45.

A further modification of structure embodying the invention is illustrated in Figs. 8 and 9. In this form of the invention a combination of internal air jets with a vaned member is employed to produce both the rotation of a strand carrying sleeve 59 and its "floating" with respect to a drum 60. In common with the earlier modification of the invention the drum 60 is provided with a support shaft 61 having an internal air line 62 and has a circumferentially extending series of lanced openings 63.

In this case the drum 60 has a central depressed area in which the lanced openings 63 are located and which provides for an annular recess extending around the drum 60 to accommodate a plurality of inwardly extending vanes 64 located on the inner surface of a sleeve carrying rotor 65. The rotor 65 has an inner diameter slightly larger than that of the drum 60 and an outer diameter suitable to slidingly and frictionally engage the inner surface of the strand carrying sleeve 59. In this embodiment of the invention air emitted from the lanced openings 63 produces both rotative movement of the roller 65 and "floats" the rotor 65 out of engagement with the drum 60. A strand 66 (Fig. 9) is engaged with and wound upon the sleeve 59 by its rotation as is the case in the earlier embodiments of the invention.

It will be appreciated that in some instances more or less force may be required to produce rotation of the strand accumulating sleeve and/or a rotor such as the rotor 65 of Figs. 8 and 9, depending upon the nature of the strand being accumulated on the sleeve. If its accumulation includes the delivery of sufficient longitudinal force, for example, to attenuate glass fibers or to unwind packages of fibers or strand to be associated together, it may be desirable to employ one or the other embodiments of the invention having means for producing more positive rotation or delivering greater torque to the sleeve. Selection of the particular type of torque producing means employed depends, therefore, upon the considerations outlined rather than upon mere arbitrary choice.

It is desirable in commercial packaging operations where there is available a continuous supply of strand as, for example in the formation and packaging of a glass fiber or similar synthetic strand, to be able to "doff" a finished package and replace it with an empty sleeve in a short time. In the embodiment of the invention illustrated in Figs. 1–4 the stationary shaft 28 is long enough between the bracket 29 and the flange 30 to support an empty sleeve 67 and one is shown in that position in Figs. 1 and 2.

In the embodiment of the invention illustrated in Fig. 7 the arm 49 is movable to an unobstructing position in order to allow a filled sleeve 45 to be "doffed" by sliding it off the thus freed end of the drum 46.

While both of these expedients do permit relatively rapid replacement of the filled sleeves with empty sleeves, the mechanism illustrated in Fig. 10 is designed for more rapid change from one package to the other and thus provides ample time during which an operator may "doff" a filled package. In Fig. 10 there is shown a carriage 68 having a pair of parallel sleeves 69 which are slidably mounted upon parallel rods 70 supported in pillars 71. The slidable carriage 68 has an upwardly extending arm 72 which coaxially supports a pair of identical drums 73 and 74. Each of the drums 73 and 74 has an air inlet line 75 or 76 respectively and each has a series of appropriately formed air jet openings through which air is emitted to produce rotation of a strand packaging sleeve 77, there being such a sleeve shown on each of the drums 73 and 74 in Fig. 10.

The sliding carriage 68 is linked by a rod 78 to a piston 79 in a pneumatic or hydraulic cylinder 80. By alternately applying pressure to one end or the other of the cylinder 80 the carriage 68 is moved between the two positions shown in solid lines and in broken lines in Fig. 10. In the right hand position of Fig. 10 the drum 73 is so positioned as to be beneath the line of movement of a strand 81 being packaged on the sleeve 77 carried by the drum 73. In this position the air line 75 is connected to the source of air pressure and, in the manner already described, the sleeve 77 on the drum 73 is rotated to accumulate the strand 81 thereon. When a sufficient quantity of strand has been accumulated upon the sleeve 77 mounted on the drum 73, the operator initiates the action to shift the carriage 68 to its left-hand position and to simultaneously connect the air line 76 to the source of air pressure. At the same time he may manually grasp the strand 81 and swing it across from the sleeve 77 on the drum 73 to the sleeve 77 on the drum 74. After only a few turns of the sleeve 77 have taken place the strand is sufficiently well engaged therewith so that further rotation of the sleeve 77 on the drum 74 starts to wind the strand 81 positively thereon and the winding proceeds as theretofore. In the meantime the operator has severed the strand 81 between the two sleeves 77 and, as the air line to the drum 73 is disconnected, its sleeve 77 comes to a halt and the operator can slide the finished package of strand off the end of the drum 73, replacing it with an empty sleeve 77 while the strand is being packaged on the sleeve 77 carried by the drum 74.

While the mechanism of Fig. 10 is illustrative of a manner in which its sleeve rotating drums may be rotated for alternate utilization it is not intended to limit the operation of apparatus of the instant invention to either a single drum set up or to a double drum set up. For example, by mounting three similar drums upon a frame which rotates on an axis perpendicular to the plane of the drum axes, three drums can be successively positioned in strand accumulating position.

The mechanism illustrated in Fig. 11 comprises a high speed winding collet of the type shown in Fig. 7, generally indicated by the reference number 82 in Figs. 11 and 12. The collet 82 is used to rotate and traverse a sleeve package 83 for the accumulation of a strand 84. The strand 84 is made available for packaging on the collet 82 by a pair of high speed rotary pulling wheels 85. Each of the pulling wheels 85 is mounted upon one of a pair of parallel horizontal shafts 86 and the two shafts 86 are so spaced from each other that the strand 84 is tightly grasped between the peripheries of the wheels 85. Rotation of the pulling wheels 85 in the direction of the arrows in Fig. 11 thus produces high speed longitudinal movement of the strand 84. The tractive force applied to the strand by the pulling wheels 85 is utilized to attenuate a plurality of fibers 87 making up the strand 84, pulling them over a guide 88 from streams of molten glass which flow through orifices in the bottom of a bushing 89 on a molten glass tank 90.

The peripheries of the pulling wheels 85 shown in Figs. 11 and 12 are slit or slotted axially with a plurality of thin slits 91 extending inwardly and across the wheels. When the pulling wheels 85 are rotated at a speed to produce an appropriate lineal speed of the strand 84, say 10,000 feet per minute, the strand 84 is projected out from between the pulling wheels downwardly through space toward the location of the air driven collet 82 constructed according to the invention. The cooperation of the high speed pulling wheels 85 with their positive tractive force and the high speed air driven collet 82 provides a neat, tightly wound package wherein all of the torque delivered to the package 83 is employed merely to keep slack out of the strand 84 and to snug its loops tightly around the package 83.

In Fig. 12, particularly, it can be seen that the package 83 is shorter longitudinally than a drum 92 on which it is rotatable and that the drum 92 is provided with a stationary rim 93 and a movable rim 94 to limit the traversing movement of the package 83 on the drum 92 as it is moved back and forth by the alternate connection

of a pair of jets **95** to a source of fluid under pressure. As is the case in the earlier embodiments of the invention, an air line **96** leads through a support **97** for the rim **93** and into the interior of the drum **92** to provide air force for rotating the package **83**.

While the jets in all of the cylindrical walls of the drums **31** of Figs. 1–4, **37** of Fig. 5, **46** of Fig. 7, **60** of Fig. 8, **73** and **74** of Fig. 10 and **92** of Fig. 12, have been described as air jets, as have the traversing jets **56** and **57** of Fig. 7 and **95** of Fig. 12, it is, of course, apparent that fluids other than air may be employed both to rotate the packages and to traverse the packages in those modifications employing a jet traverse arrangement. It may, in fact, be desirable in some instances to employ a liquid medium. For example, it might be advantageous to traverse the package, say in Fig. 12, by alternately feeding a mist of a coating material through the jets **95**. This would not only produce the traversing of the package **83** but also would apply a suitable coating substance to the strand **84** as it is wound upon the package **83**. Suitable coating media may be applied in this manner and liquid force producing media may also be employed to cause rotation of the packages by being fed into the interior of the drums through the pressure lines shown in the various forms of apparatuses embodying the invention.

I claim:

1. Apparatus for packaging a continuously available continuous strand comprising a hollow cylindrical sleeve having a thin wall and fully open ends, a chamber having a cylindrical outer surface of diameter smaller than the inside diameter of said sleeve and at least one circumferentially extending series of air jets opening outwardly from the interior of said chamber and impinging against the interior of said sleeve when mounted circumjacently to said chamber, said air jets being directed at an angle to a tangent to the surface of said sleeve at the point of impingement thereon less than normal, and means for introducing air under pressure into the interior of said chamber.

2. Apparatus according to claim 1 in which the chamber is formed by a closed, hollow cylinder and the air jets consist in openings through the cylindrical wall thereof.

3. Apparatus according to claim 2 in which the air jets are lanced openings whereby the jets emanate along lines directed generally tangentially against the interior of said sleeve.

4. Apparatus according to claim 2 in which the sleeve has a circumferentially extending series of vanes and there are air jets located and directed to impinge thereon along a line generally tangential to said sleeve.

5. Apparatus for packaging a plurality of glass fibers as a strand, said apparatus comprising, a stationary drum, means for introducing air under pressure into said drum, a sleeve adapted to loosely encircle said drum, means for feeding air from the interior of said drum into the space between said drum and said sleeve for supporting said sleeve circumjacently of said drum but out of contact therewith, and means for directing jets of air generally tangentially of said sleeve for producing revolution thereof around said drum.

6. Apparatus according to claim 5 in which the means for feeding air into said drum and sleeve space comprises jet openings in the wall of said drum and the means for directing the jets of air generally tangentially against the sleeve comprises guide sections of the wall of said drum inwardly inclined adjacent said jet openings and acting to deflect the air from said jets.

7. Apparatus for packaging a continuously available, continuous, flexible strand comprising, in combination, a chamber having an outer cylindrical surface, means for introducing a fluid under pressure into the interior of said chamber, a circumferentially extending series of air openings leading from the interior of said chamber and opening to atmosphere through said cylindrical surface, a hollow cylindrical sleeve having an inner diameter greater than the diameter of said cylindrical surface by a small margin such that when said sleeve is circumjacent said chamber air escaping through said openings and flowing axially between said sleeve and said cylindrical surface maintains said sleeve substantially out of contact with said cylindrical surface and air jet directing means for impinging jets of fluid against said sleeve at an angle to a tangent to said sleeve at the point of impingement less than normal for rotating said sleeve around said cylindrical surface.

8. Apparatus according to claim 7 in which the means for impinging jets of fluid consists of air nozzles located exteriorly of said chamber and directed angularly inwardly toward said sleeve.

9. Apparatus according to claim 7 in which the means for impinging jets of fluid consists of circumferentially extending guide sections in said cylindrical surface of said chamber for deflecting air from said openings into contact with the interior surface of said sleeve.

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