Jan. 28, 1969 R. O. HOULE ET AL 3,424,359

YARN HANDLING APPARATUS

Filed July 17, 1967

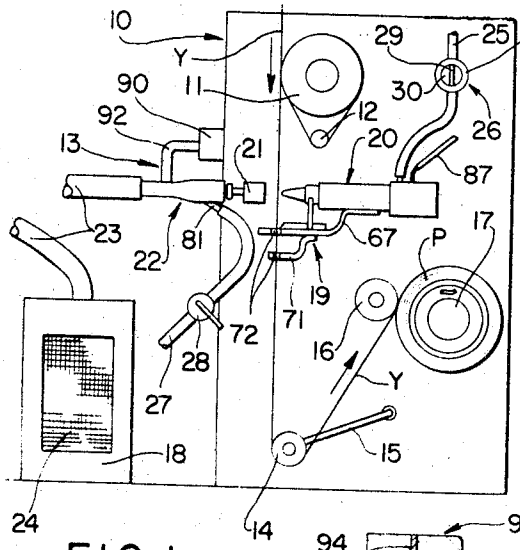


FIG. 1

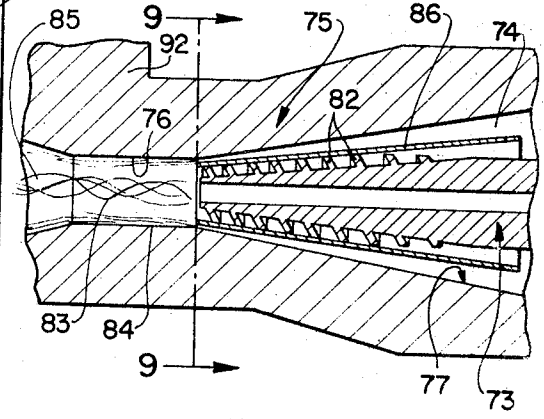


FIG. 3

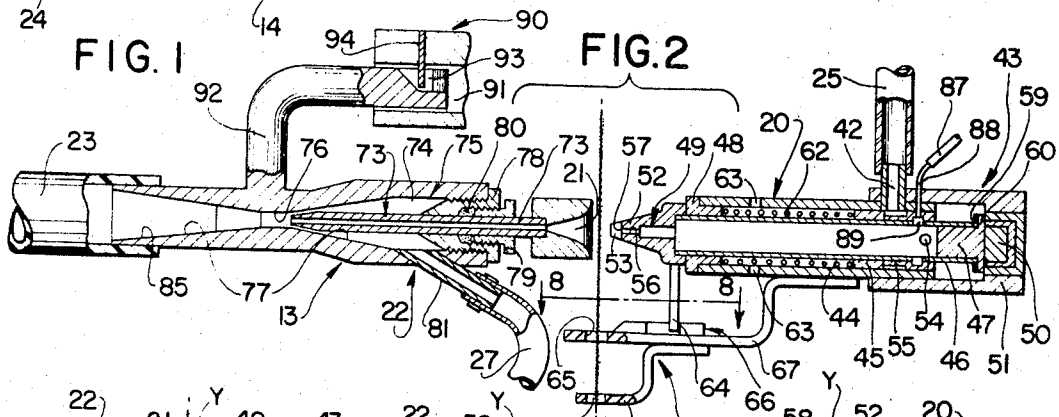


FIG. 2

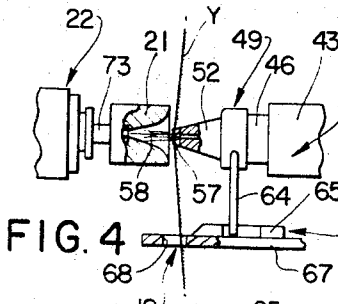


FIG. 4

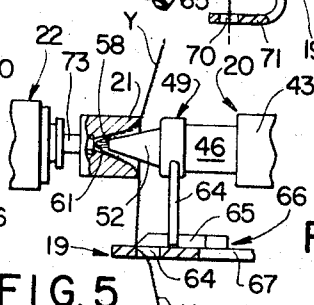


FIG. 5

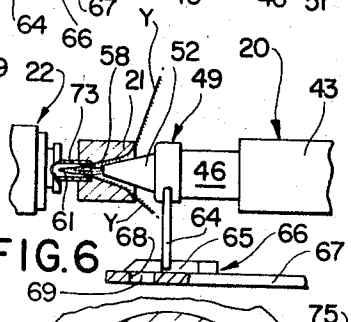


FIG. 6

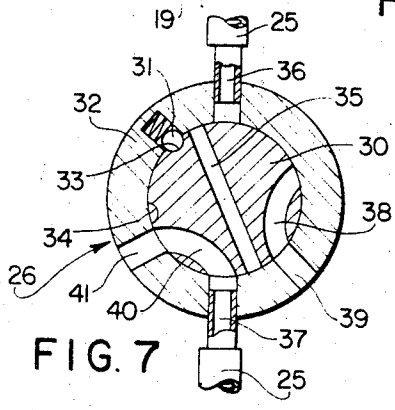


FIG. 7

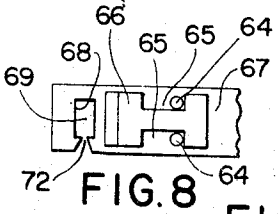


FIG. 8

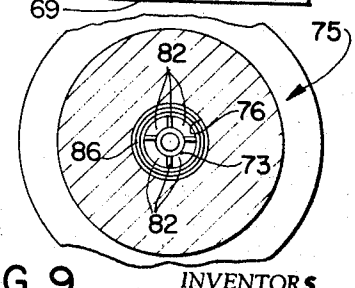


FIG. 9

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YARN HANDLING APPARATUS

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Int. Cl. B65h 17/28, 17/32

ABSTRACT OF THE DISCLOSURE

Apparatus for handling a strand of yarn continuously advancing at high speed through a winding machine. The strand is cut and an injector plunger and jet divert the strand into an aspirator which passes the strand to a disposal container. A vortex encircled by a high speed laminar stream substantially increases the capacity of the aspirator for keeping the cut strand moving after it has been diverted into the aspirator.

This invention relates to apparatus for handling an advancing strand of yarn and, more particularly, to an aspirator for handling the strand.

Throughout the following specification, the term "yarn" means all kinds of strand material, either textile or otherwise, and the term "package" means the product of a winding or twisting machine, whatever its form.

During winding of packages of yarn from a continuously advancing strand of yarn, it is common practice when a package is full, to cut the strand of yarn and pass the advancing strand through an aspirator and into a collection receptacle. The aspirator is then usually used to thread the strand of yarn onto a new core for winding another package. Commercially available aspirators have been found unsatisfactory for handling the yarn at higher speeds (3,000 to 5,000 y.p.m.) desired in more modern textile equipment. One problem is that available air pressure in many textile mills is relatively low, about 80 p.s.i. maximum.

To overcome these difficulties, the present invention is, in brief, directed to an aspirator of substantially increased capacity over that which has previously been commercially practical at normally available operating pressures. In order to handle the rapidly advancing strand at readily available operating pressures, the aspirator has a venturi through which a vortex is encased in a rapidly moving laminar stream, for moving the strand at high speed.

It is a primary object of this invention to provide new and improved apparatus for handling a continuously advancing strand of yarn.

Another object of this invention is to provide new and improved aspirator apparatus having substantially increased capacity.

A further object of this invention is to provide new and improved aspirator apparatus through which the strand is propelled by a stream including a vortex encased in a high velocity laminar stream.

These and other objects of the invention will be apparent from the following description and accompanying drawings in which:

FIG. 1 is a schematic elevational view of a winding machine including a preferred embodiment of the invention in the form of yarn handling apparatus;

FIG. 2 is an enlarged, fragmentary elevational view of the yarn handling apparatus as shown in FIG. 1, with parts broken away and in section for clearer illustration;

FIG. 3 is a further enlarged, fragmentary sectional elevational view of a portion of the structure shown in FIG. 2, and illustrating an additional feature of the invention;

FIGS. 4, 5, and 6 are fragmentary elevational views of a portion of the apparatus shown in FIG. 2, in progressive stages of operation, with parts broken away and in section of clearer illustration;

FIG. 7 is an enlarged, fragmentary elevational view of an actuating valve shown in FIG. 2, with parts broken away and in section for clearer illustration;

FIG. 8 is a sectional view taken generally along the line 8—8 in FIG. 2; and

FIG. 9 is a fragmentary sectional view taken generally along the line 9—9 in FIG. 3.

Referring to FIG. 1 in the drawings, a winding machine **10** receives a continuously advancing strand of yarn Y from a suitable source of supply such as a spinneret (not shown). The yarn makes multiple passes around a godet roll **11** and a filament separator **12** and then passes through yarn handling apparatus **13**. From this apparatus, the yarn passes around a roller **14** on a compensator arm **15** and then upwardly through a traversing mechanism **16** which guides the yarn as it is wound into a package P on a takeup sprindle **17**. When the package P is full, the yarn handling apparatus **13** is operated to cut the strand Y and direct the advancing strand from the spinneret into a container **18**. The strand of yarn may advance at speeds in excess of 5,000 yards per minute.

As shown in FIG. 1 and in greater detail in FIG. 2, the strand handling apparatus **13** includes a strand cutter **19** for cutting the advancing strand Y. The cut strand is diverted by an injector **20** into a strand inlet **21** of an aspirator **22** from which the advancing strand is discharged via a flexible tube **23** into the container **18** which is vented as through a screen **24**. The apparatus is operated by a pressurized fluid, usually compressed air at about 80 p.s.i., supplied through a conduit **25** and an actuating valve **26** to the injector **20** and through another conduit **27** and a shutoff valve **28** to the aspirator **22**.

When it is desired to terminate winding of the strand Y onto the package P, the shutoff valve **28** in the air conduit **27** to the aspirator **22** is opened and the actuating valve **26** in the air conduit **25** to the injector **20** is operated. With the actuating valve **26** in the position shown in FIGS. 1 and 7, and operating flange **29** (FIG. 1) on a valve member **30** is rapidly rotated clockwise from a position with a spring-pressed ball detent **31** in a body **31** of the valve seated in a first recess **33** in the valve member **30**, to a position with the ball detent **31** seated in a second recess **34** in the valve member. As the valve member **30** is rotated between these positions, a passage **35** through the valve member momentarily connects an inlet passage **36** in the valve body **32** with an outlet passage **37** in the body so that compressed air from the supply conduit **25** passes into the injector **20**. After the passage **35** in the valve member has passed the inlet and outlet passages, a vent passage **38** in the valve member connects the outlet passage **37** with a vent **39** in the valve body **32** to release the air from the injector **20**. The next time the apparatus is operated, the valve member **30** is turned counterclockwise so that the passage **35** again momentarily connects the inlet and outlet passages and then a second vent passage **40** in the valve member connects the outlet passage **37** with a second vent **41** in the valve body as the ball detent **31** again seats in the first recess **33** in the valve member **30**.

When the actuating valve **26** is operated, compressed air passes through the injector supply conduit **25** and an air inlet **42** (FIG. 2) in a rigid injector body **43** and into a hollow cylinder **44** of the body to move a piston **45** (about ½ sq. inch area) in the cylinder **44** to the left from a normal, retracted position as shown in FIG. 2. The piston **45** is concentrically, fixedly secured intermediate opposite ends of a tube **46**. The rear (right) end of the tube is sealed by a plug **47** securely fixed in the tube

end. The left end of the tube extends slidably through a cylinder end wall **48** and is fixedly secured to a plunger **49** which is moved along with the piston **45** from the retracted position (FIG. 2) to an extended position (about ¾ inch total stroke) as shown in FIG. 6.

A magnet **50** (5 lbs.) in a rear closure member **51** of the rigid injector body **43** holds the tube **46** in place in the retracted position of the plunger **49** until a predetermined air pressure (10 p.s.i.) has built up in the cylinder **44**, whereupon the tube **46** breaks loose from the magnet **50** and the plunger **49** is accelerated more rapidly than it would without such restraint.

The plunger has a tip **52** with a generally frusto-conical configuration conforming generally to an inwardly converging configuration of the strand inlet **21** in the aspirator **22**. A notch **53** in the apex of the plunger tip **52** receives the strand Y as the plunger **49** moves toward its extended position (FIG. 4). In moving to the extended position, the plunger **49** engages the strand Y after about 1/16 inch plunger movement, and then moves the strand into the strand inlet **21** of the aspirator **22** as the cutter **19** cuts the strand (FIG. 5) after about 9/16 inch plunger movement.

Just before the strand Y is cut, a port **54** near the rear end of the injector tube **46** clears the front end of a seal member **55** (after about ½ inch plunger movement) fixedly secured at the rear of the injector cylinder **44**. Compressed air then passes into the tube **46** and through a passage **56** communicating with the front end of the tube and terminating in a port **57** (about 1/32 inch diameter) at the base of the injector notch **53**. The air leaves the port in the form of a jet **58** (FIGS. 4–6) which impinges the strand Y to drive it into the strand inlet **21**, as shown in FIG. 5, and to prevent the strand from moving rearwardly out of the aspirator **22**. Continued movement of the plunger **49** to its extended position causes a resilient washer **54** on the rear end of the injector tube **46**, and seated against a transverse flange **60** on the plug **47**, to strike the cylinder seal member **55**. As the washer **59** is compressed, the plunger **49** remains spaced sufficiently from the surface of the strand inlet **21** (FIG. 6) so that the strand Y may move freely through the inlet. A free end on the cut is sufficiently long that it forms a return portion **61** (FIGS. 5 and 6) as it passes through the aspirator strand inlet.

The injector plunger **49**, tube **46** and piston **45** are returned from the extended position (FIG. 6) to the retracted position (FIG. 2) by a compression spring **62** (2 to 3 lbs.) telescoped about the tube **46** and seated on the front end wall **48** of the injector cylinder **44** and against the piston **45**. Holes, as **63**, in the injector body **43** provide vents for the free passage of air into and out of the cylinder **44** between the piston **45** and the cylinder end wall **48** as the plunger **49** is moved to the retracted position and the extended position, respectively.

As mentioned previously, as the plunger **49** moves to its extended position, the cutter **19** is operated to cut the strand Y. More particularly and with reference to FIG. 2, a pair of pins **64** (FIG. 8) one fixedly secured to either side of the plunger **49**, are received in elongated notches **65** in opposite side edges of a cutter blade **66** slidably mounted atop a cutter body **67** fixedly secured to and depending from the injector body **43**. The pins **64** and notches **65** provide a lost motion connection between the plunger **49** and the cutter blade **66** such that the blade is delayed in cutting the strand Y until after the jet **58** has started and the plunger **49** has moved to the position shown in FIG. 5. As the cutter blade **66** engages the strand Y (FIG. 5) it, moves the strand against a cutting edge **68** of a strand guide **69** in the cutter body **67**. A similar strand guide **70** is in a bracket **71** (FIGS. 1 and 2) which depends from the cutter body **67**. These guides have reduced necks **72** (FIG. 8) opening through edges of the cutter body **67** and bracket **71** for the passage of the strand Y into the guides.

With reference to the aspirator **22**, (FIG. 2), as the strand Y enters the strand inlet **21** it passes through a conduit **73** in an inlet portion **74** of a hollow body **75** of the aspirator and into an elongated throat **76** (FIGS. 2 and 3) of a venturi passage **77** formed by the inner surface of the body **75**. The conduit **73** is fixedly secured in the venturi passage **77** by a clamping sleeve **78** threaded into the body **76** and a smaller clamping sleeve **79** threaded into the first sleeve **78** and against a suitable sealing packing **80** about the conduit **73**.

By introducing the strand Y into the conduit **73** which the return portion **61** at its free end, as previously mentioned, the conduit **73** is more completely filled so that air flow through the conduit is more effective in moving the strand into the aspirator throat **76**. After the return portion **61** passes through the conduit **73** and into the throat **76**, only one thickness of the strand Y runs through the conduit so that friction is reduced.

Compressed air for operating the aspirator **22** is introduced through the aspirator supply conduit **27** and a nipple **81** opening into the inlet portion **74** of the aspirator body **75** and, more particularly, into the upstream end of the venturi. This nipple **81** is inclined at about 18° to the axis of the venturi **77** in a direction toward the venturi throat **76**.

The air passes between the outside of the conduit **73** and the venturi surface **77** to an end of the conduit at the upstream end of the elongated throat **76**. This end of the conduit is provided with a plurality of helical lands and grooves **82**, and as shown in FIG. 9, with four helical grooves. These lands and grooves may have a half inch lead for 840 to 1,300 denier yarn Y at a speed of about 3,500 y.p.m. with the grooves as wide and deep as is practical. The lands and grooves **82** are tapered at about 9° to the venturi axis at the end of the conduit, and are generally parallel to the venturi axis at the end of the conduit, and are generally parallel to the venturi axis at their rear ends. The lands and grooves **82** cause the compressed air to spiral and enter the throat **76** in the form of a vortex **83** (FIG. 3) which has low axial velocity and very high tangential velocity. The vortex **83** is encircled by a high velocity stream **84** of laminar air passing generally parallel to the venturi axis and generally along the surface of the venturi **77**.

Thus, as the strand Y emerges from the conduit **73**, the vortex **83** causes it to follow a generally spiral path transverse to the venturi axis through the venturi throat **76** and outlet portion **85** of the venturi **77**. This spiral path causes the strand Y to move into the laminar stream **84**, which propels the strand at high velocity through the aspirator, and at substantially the same speed that the strand advances through the winding machine **10** during winding. The laminar stream **84** retards movement of the spiriaing strand Y against the surface of the venturi **77** thus effectively preventing the whipping strand from cutting into the venturi throat **76** and damaging the aspirator.

The venturi throat **76** should be as long as possible without allowing the vortex **83** to dissipate the laminar stream **84** or the strand to cut into the venturi surface. With a throat diameter of about .20 inch. a throat length of about a half inch is preferable. As is understood in the art, the air velocity in the throat **76** is higher than downstream of the throat, and by maintaining this high speed as long as possible the strand Y is moved faster. The venturi inlet portion **74** converges at about 20° and the outlet portion **85** diverges at about 12°. Apparatus as shown in FIG. 2 is capable of handling a 1,300 denier strand of yarn advancing at a velocity up to at least 3,500 y.p.m. with an operating air pressure of 80 p.s.i.

At strand speeds above 3,500 y.p.m. and up to about 5,000 y.p.m., it has been found desirable to provide a frusto-conical sheath or sleeve **86** (FIGS. 3 and 9) (converging at about 18°) seated and adhesively secured on

the tapered helical lands **82** as shown in FIG. 3. It should be noted that the lands and grooves **82** are cut such that the sleeve **86** seats on the tapered lands at the end of the conduit but farther back where the lands are in line with the cylindrical sidewall of the conduit **73**, the sleeve is spaced from the lands. Thus, the compressed air is caused to enter the sleeve **86** and follow the spiral path defined by the lands and grooves **82** and to emerge into the venturi throat **76** in the form of the vortex **83**. Furthermore, the sleeve **86** is closely spaced from the venturi surface at the venturi throat **76** (about .010 inch) and diverges from the venturi surface to its opposite end so that the air passing between the sleeve and the venturi surface is compressed and its velocity increased as the laminar stream **84** is directed into the throat **76**. The laminar stream **84** enters the venturi throat **76** at higher velocity than without use of the sleeve and causes the yarn to be carried through the aspirator at a higher speed.

Should speeds in excess of 5,000 yards per minute be encountered, the apparatus is capable of handling the yarn by addition of at least a drop of liquid, such as water, into the jet **58**. This drop of water may be supplied in any suitable manner, for example by water introduced into the injector tube **46** through a water supply conduit **87** (FIGS. 1 and 2). This conduit is connected with a nipple **88** extending through the injector body **43** and seal **55** and communicating with an annular passage **89** in the injector seal **55** facing the tube **46**. The annular passage **89** is slightly ahead of the tube inlet port **54** when the plunger **49** is in its retracted position (FIG. 2). As the plunger **49** is moved to its extended position the inlet port **54** passes across the annular passage **89** to admit water to the interior of the tube **46**, and as the resilient washer **59** at the end of the tube strikes the seal **55**, the water in the tube is caused to move toward the leading end of the tube and is ejected through the port **57** along with the jet **58**. The effect of the water is to more completely seal the conduit **73** in the aspirator **22** and to accelerate the yarn because of the mass of the water, so that the jet **58** is more effective in moving the yarn Y through the conduit **73**.

When the filled package P has been removed from the takeup spindle **17** and a new core inserted thereon, the aspirator **22** may be removed from a mounting bracket **90** on the winding machine **10** and used for guiding the advancing strand Y through the cutter guides **69** and **70** and around the roll **14** on the compensator arm **15**, through the traverse mechanism **16** and onto the new core for winding another package P. The aspirator **22** may be releasably mounted in any suitable manner and, as illustrated, the mounting bracket **90** is fixedly mounted on the winding machine **10** and has a socket **91** (FIG. 2) telescopically receiving a finger **92** of the aspirator body **75**. A groove **93** in the leading end of the finger **92** receives a guide pin **94** extending into the socket **91** so that the aspirator is stationary when on the winding machine.

What is claimed is:

1. Apparatus for handling an advancing strand, comprising a body having a passage with an inlet end and an outlet and a connecting passage surface, and strand handling means for passing the strand through the passage and including, fluid handling means for passing a low axial velocity and relatively high tangential velocity vortex generally axially through the passage and for passing adjacent the passage surface an axially directed relatively high velocity laminar stream substantially encircling said vortex.

2. Apparatus as set forth in claim **1** in which said vortex is effective for passing the strand axially through the passage in a path extending transversely across the passage and into said laminar stream, and said laminar stream is effective for rapidly moving the strand through the passage and substantially retarding the strand from engaging the passage surface.

3. Apparatus as set forth in claim **1** in which said passage is substantially a venturi having an elongated generally cylindrical throat, and in which said fluid handling means passes said vortex and said laminar stream through said throat.

4. Apparatus as set forth in claim **1** in which said strand handling means further includes a conduit extending into said passage from the inlet end for the passage of the strand through said conduit and flow about said conduit of fluid forming said vortex and said laminar stream.

5. Apparatus as set forth in claim **4** in which said inlet end includes a strand inlet communicating with one end of said conduit and said conduit has an opposite outlet end, and said fluid handling means includes vortex forming means at said outlet end of said conduit for forming said vortex, and said vortex forming means is spaced from the surface of said passage for the flow of said laminar stream between said surface and said vortex forming means.

6. Apparatus as set forth in claim **5** in which said vortex forming means comprises groove means along the outer surface of said conduit.

7. Apparatus as set forth in claim **5** in which said fluid handling means includes a sleeve about said conduit and said vortex forming means for flow within said sleeve of fluid forming said vortex, and said sleeve being spaced from the passage surface for flow between said sleeve and said passage surface of fluid forming said laminar stream.

8. Appartus as set forth in claim **7** in which said passage is substantially a venturi converging from said inlet end to a throat, the outlet end of said conduit is at said throat, and said sleeve converges toward said throat.

9. Apparatus as set forth in claim **8** in which said venturi throat is an elongated generally cylindrical portion.

10. Apparatus as set forth in claim **9** including means for the passage of fluid into said venturi in a direction toward said throat to provide said vortex and said laminar stream.

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U.S. Cl. X.R.

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