

July 1, 1969

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3,452,910

YARN HANDLING APPARATUS

Filed July 17, 1967

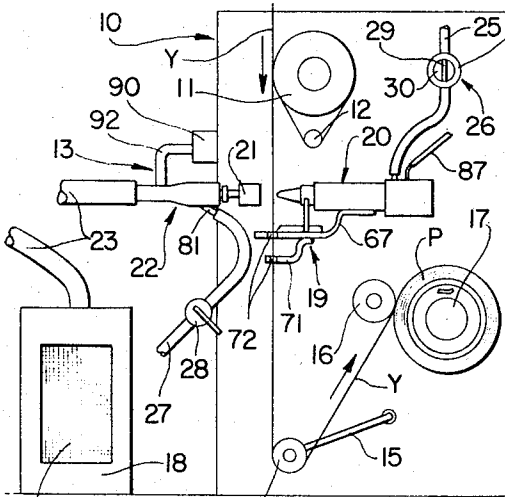


FIG. 1

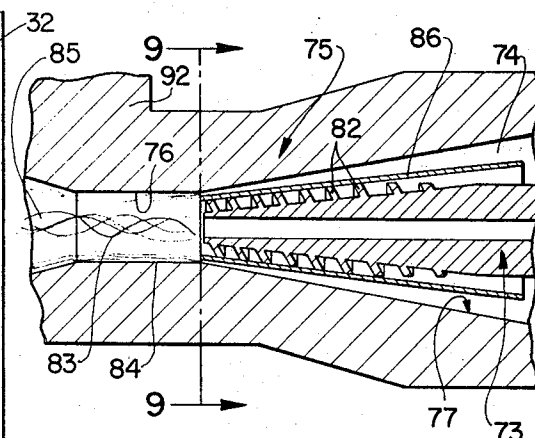


FIG. 3

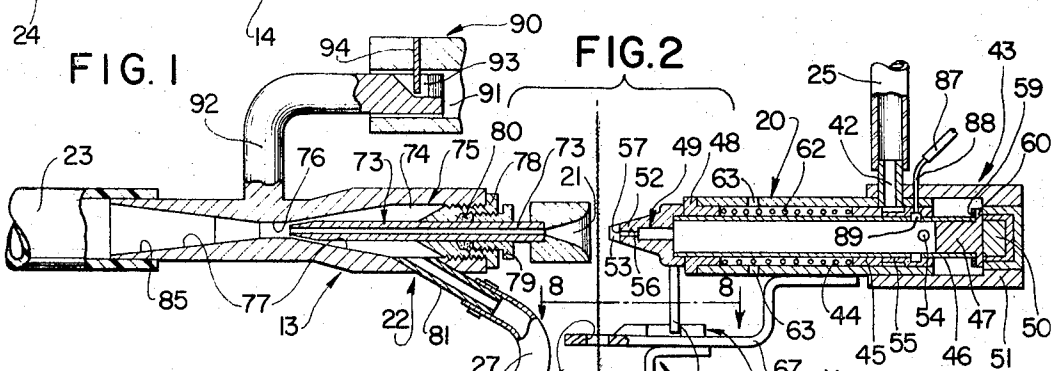


FIG. 2

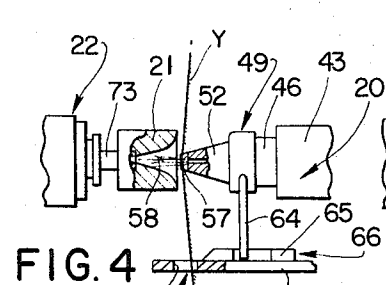


FIG. 4

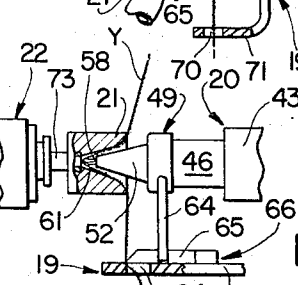


FIG. 5

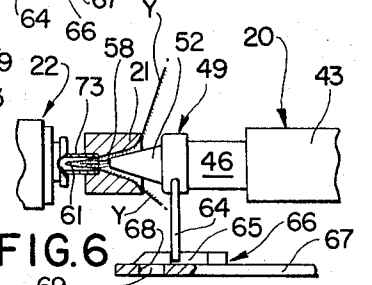


FIG. 6

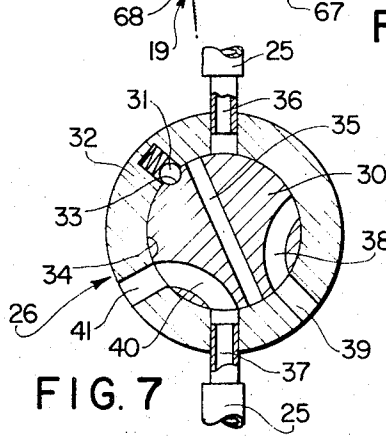


FIG. 7

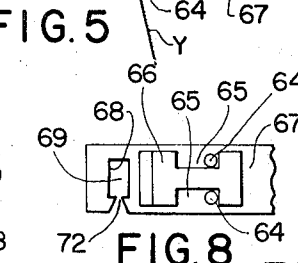


FIG. 8

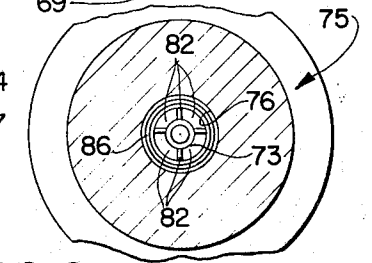


FIG. 9

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3,452,910

YARN HANDLING APPARATUS

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Filed July 17, 1967, Ser. No. 653,767

Int. Cl. G03b 1/56; B65h 17/32

U.S. Cl. 226-91

31 Claims

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 apparatus for cutting the strand and handling the cut 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 yards per minute) 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. Additionally, prior yarn cutting techniques have been found to be inadequate at the higher yarn speeds, at least in part because the momentum of the advancing strand causes it to be somewhat unmanageable.

To overcome these difficulties, the present invention is, in brief, directed to apparatus for cutting a rapidly advancing strand and passing it through 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. A strand injector cooperates with a cutter in aiding entry of the strand into the aspirator.

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 apparatus including an aspirator having substantially increased capacity.

Another object of this invention is to provide a new and useful injector.

A further object of this invention is to provide new and improved apparatus for handling a continuously advancing strand of yarn and including a cutter operable for cutting the advancing strand, an injector for diverting the cut strand into an aspirator 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 ap-

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parent 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;

FIG. 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 for clearer illustration;

FIG. 7 is an enlarged, fragmentary elevational view of an actuating valve shown in FIG. 1, 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 take-up spindle 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 at least 5,000 y.p.m.

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 shut-off valve 28 to the aspirator 22.

When it is desired to terminate winding of the strand Y onto the package P, the shut-off 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, an 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 32 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 con-

nects 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 an actuating valve 26 is operated, compressed air passes through the injector supply circuit 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 $\frac{1}{2}$ 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 $\frac{3}{4}$ 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 pre-determined 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 accelerates 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 $\frac{1}{16}$ 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 $\frac{9}{16}$ 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 $\frac{1}{2}$ 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 $\frac{1}{32}$ 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 upon 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 59 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 sufficiently spaced from the surface of the strand inlet 21 (FIG. 6) that the strand Y may move freely through the inlet.

It is desirable to introduce the cut strand of yarn Y into the strand inlet with as great a velocity as possible. To this end, the path of the strand Y from the point where it is engaged by the plunger 49 is such that the momentum of the rapidly advancing strand aids in moving the strand into the strand inlet. Furthermore, the cutter 19 is spaced a sufficient distance (about $1\frac{1}{2}$ to 2 inches) from the axis of the aspirator strand inlet 21 and the injector plunger 49 to provide a free end on the cut strand sufficiently long that the strand may form a return portion 61 (FIGS. 5 and 6) which more completely fills the aspirator strand inlet as is desirable for reasons which will become apparent later.

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 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 with 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 dn. 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 on the conduit, and are generally parallel to the venturi axis at their rear ends. The land 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 an 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 spiraling 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 0.20 inch, a throat length of about 0.50 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) which telescopically receives 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 aspirator means including a body having a passage with an inlet end and an outlet and a connecting passage surface, said aspirator means being operable for passing the strand through said passage and including, fluid handling means for passing a low axial velocity and relatively high tangential velocity vortex generally axially through said passage and for passing adjacent the passage surface an axially directed relatively high velocity laminar stream substantially encircling said vortex, and injector means adjacent said inlet end for receiving the advancing strand between said injector means and said inlet end, said injector means being operable for diverting the strand into said inlet end.

2. Apparatus as set forth in claim 1 in which said vortex is effective for passing the strand axially through said passage in a path extending transversely across said passage and into said laminar stream, and said laminar stream is effective for rapidly moving the strand through said 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 aspirator means includes a conduit extending into said passage from said 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. Apparatus 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.

11. Apparatus as set forth in claim 1 in which said injector means is operable for emitting a jet to divert said strand into said inlet end of said aspirator means.

12. Apparatus as set forth in claim 1 in which said injector means is operable for emitting a jet comprising liquid to divert the strand into said inlet end.

13. Apparatus as set forth in claim 1 in which said injector means is operable for diverting the strand into said inlet end in a path in which the momentum of the advancing strand aids in carrying the strand into said passage.

14. Apparatus as set forth in claim 1 in which said

injector means comprises a plunger, and means mounting said plunger for movement from a retracted position distant from the inlet end of said aspirator means to an extended position relatively proximate said inlet end for engaging and moving the strand into said passage.

15. Apparatus as set forth in claim 14 in which said injector means is further operable for emitting a jet to divert the strand into said inlet end of said aspirator means.

16. Apparatus as set forth in claim 14 in which said means mounting said plunger includes an injector body having a hollow cylinder, a piston telescopically received in said cylinder, means connecting said piston and said plunger for movement of said plunger between said retracted position and said extended position responsive to movement of said piston.

17. Apparatus as set forth in claim 16 in which said injector means includes means releasably holding said plunger against movement from said retracted position to said extended position until a pre-determined fluid pressure is applied to said piston, for increasing acceleration of said plunger toward said inlet end of said aspirator means.

18. Apparatus as set forth in claim 17 in which said releasable holding means comprises a magnet.

19. Apparatus as set forth in claim 17 in which said injector means is operable as said plunger is moving between said retracted and extended positions for emitting a jet including at least a drop of liquid to assist in diverting the strand into said inlet portion.

20. Apparatus as set forth in claim 1 in which the inlet end of said aspirator means includes an inwardly converging strand inlet, said injector means comprises a plunger having an outwardly converging end generally complementary to said strand inlet and a notch in the apex of the plunger for receiving said strand and diverting the strand into said strand inlet, means mounting said plunger for movement between a retracted position distant from said strand inlet and an extended position with the plunger end within said strand inlet and slightly spaced therefrom so that the strand may move freely into said strand inlet, said mounting means including an injector body having a hollow cylinder, a piston telescopically received in said cylinder, a tube communicating with said port and connecting said plunger and said piston for movement of said plunger between said retracted position and said extended position responsive to movement of said piston, means including a port opening through said notch in said plunger for emitting a jet to divert said strand into said strand inlet, the last said means being operable for deferring emission of said jet until said plunger is moving toward its extended position, and means for passing fluid into said cylinder for moving said piston and therewith said plunger between said retracted and extended positions.

21. Apparatus as set forth in claim 20 in which said means for deferring emission of said jet includes an inlet in said tube, means closing the tube inlet when said plunger is in its retracted position and opening said tube inlet for communication with said cylinder as said plunger moves toward its extended position for passage of the fluid in said cylinder through said tube and said port to form said jet.

22. Apparatus as set forth in claim 20 in which said passage in said aspirator means is substantially a venturi converging from said inlet end to a throat, said aspirator means includes a conduit having an end communicating with said strand inlet and an opposite outlet end adjacent said throat for the passage of the strand through the conduit and flow about the conduit of fluid forming said vortex and said laminar stream, 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.

23. Apparatus as set forth in claim 22 in which said venturi throat is an elongated generally cylindrical portion, and in which said fluid handling means passes said vortex and said laminar stream through said throat.

24. Apparatus as set forth in claim 23 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.

25. Injector apparatus for handling an advancing strand, comprising a plunger for engaging the strand, jet means including a port opening through said plunger for emitting a jet, means mounting said plunger for movement between a retracted position and an extended position and including a body having a hollow cylinder, a piston telescopically received in said cylinder, a tube communicating with said port and connecting said plunger and said piston for movement of said plunger between said retracted position and said extended position responsive to movement of said piston, and means for passing fluid into said cylinder for moving said piston and therewith said plunger between said retracted and extended positions.

26. Apparatus as set forth in claim 25 in which said jet means is operable for deferring emission of said jet until said plunger is moving toward its extended position.

27. Apparatus as set forth in claim 26 in which the plunger mounting means includes means releasably holding said plunger against movement between said retracted and extended position after the fluid enters the cylinder and until a predetermined fluid pressure is applied to said piston, for increasing acceleration of said plunger toward said extended position.

28. Apparatus as set forth in claim 26 in which said jet means includes an inlet in said tube, means closing said tube inlet when said plunger is in its retracted position for deferring emission of said jet, and means opening said tube inlet for communication with said cylinder as said plunger moves toward its extended position for passage of the fluid in said cylinder through said tube and said port to form said jet.

29. Apparatus as set forth in claim 28 in which said jet means is operable for emitting at least a drop of liquid in said jet.

30. Apparatus as set forth in claim 29 in which the plunger mounting means includes means releasably holding said plunger against movement between said retracted and extended positions after the fluid enters the cylinder and until a predetermined fluid pressure is applied to said piston, for increasing acceleration of said plunger toward said inlet end of said aspirator means.

31. Apparatus as set forth in claim 30 in which the releasable holding means comprises a magnet.

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U.S. Cl. X.R.

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