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3,363,294

SELF-CLOSING TANGLING JET APPARATUS

Filed Dec. 15, 1965

4 Sheets-Sheet 1

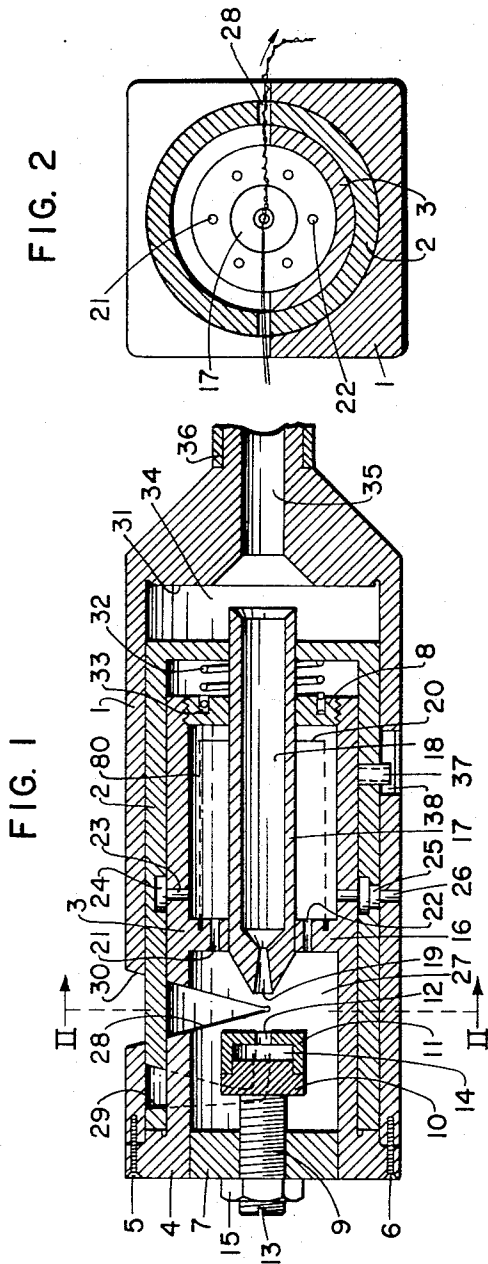


FIG. 2

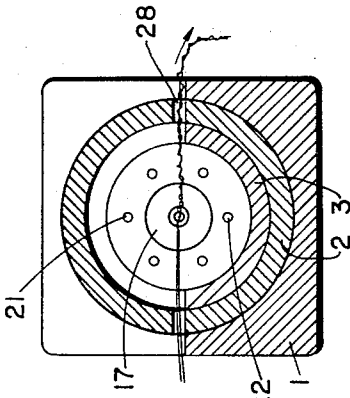
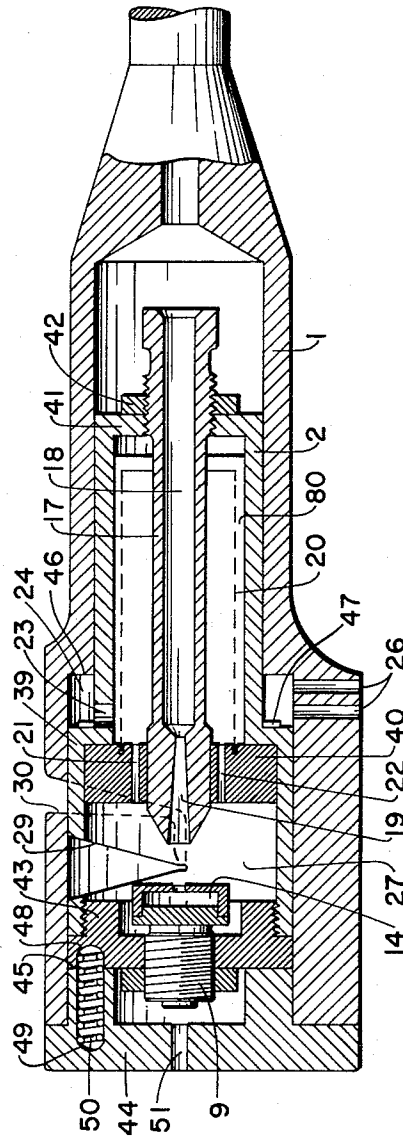


FIG. 3



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FIG. 4

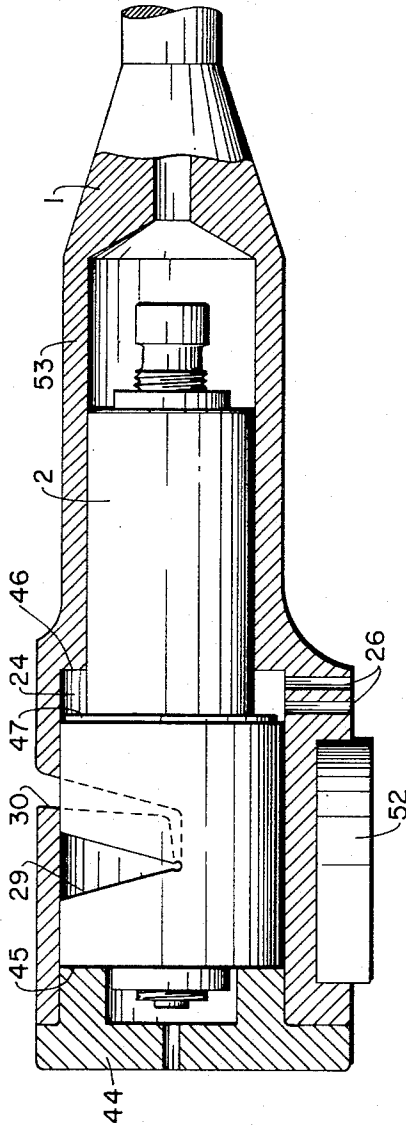
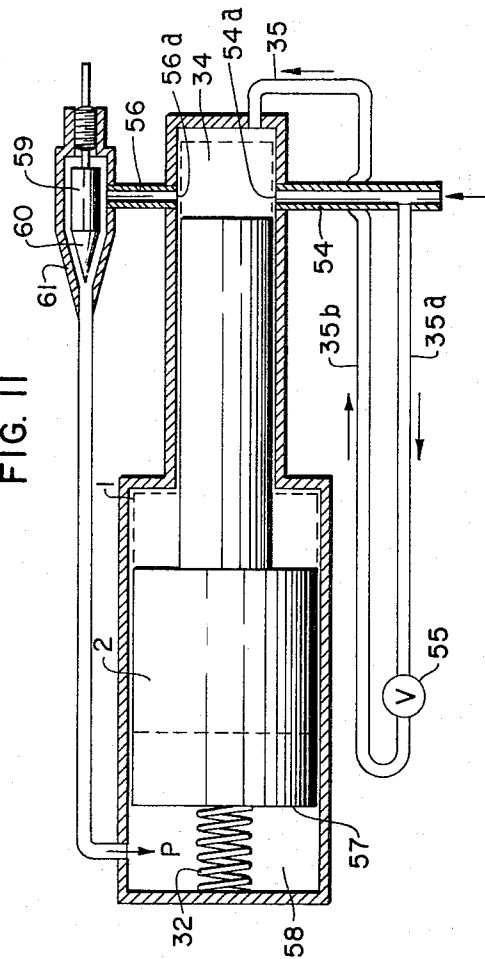


FIG. II



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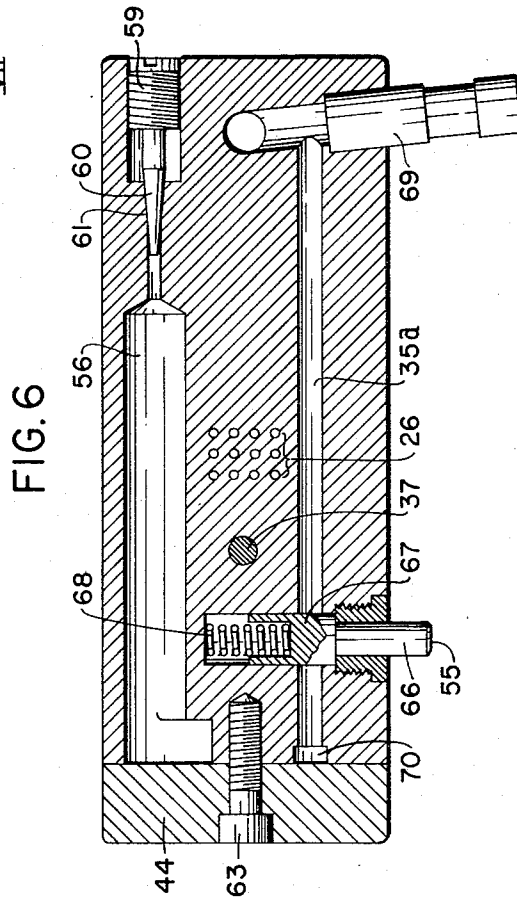
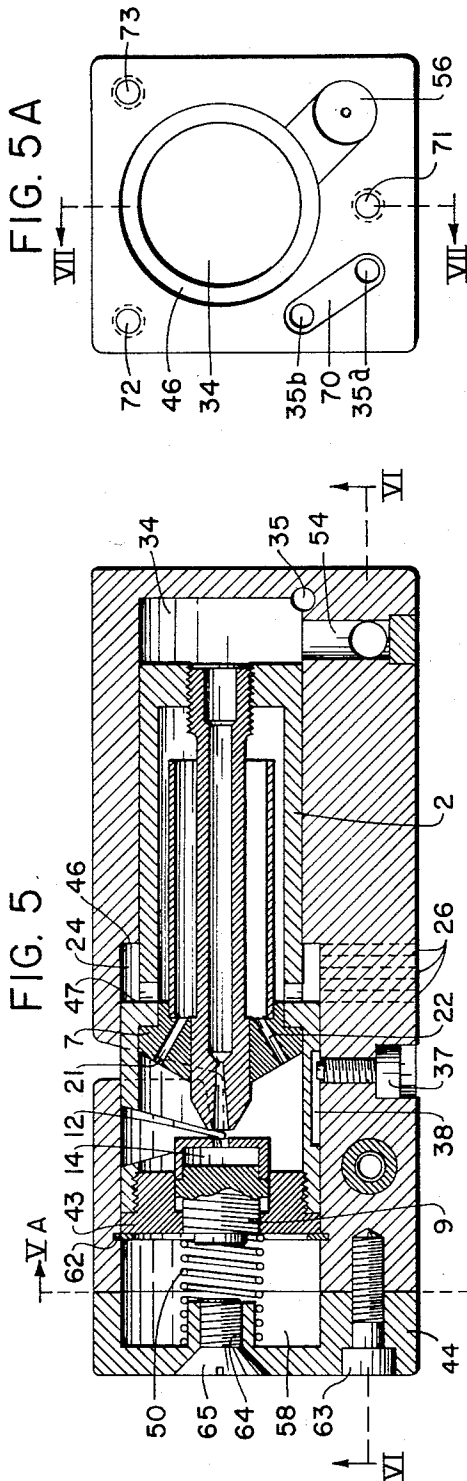
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FIG. 7

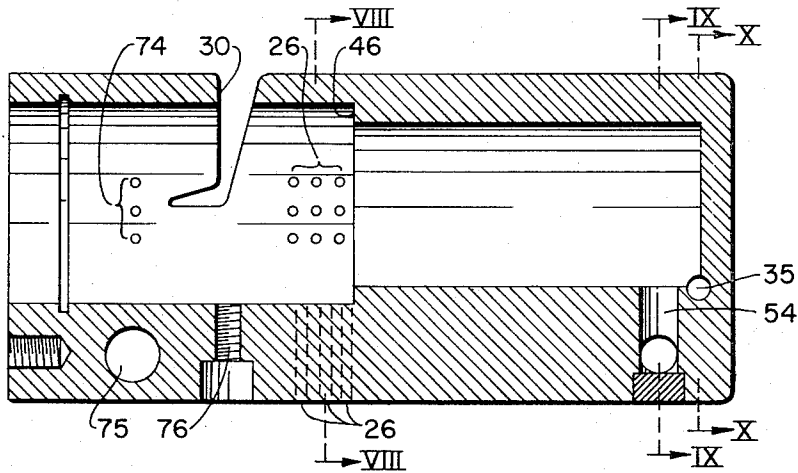


FIG. 8

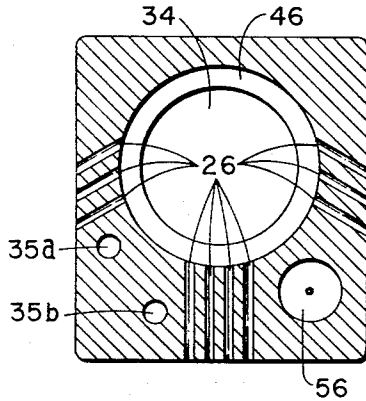


FIG. 9

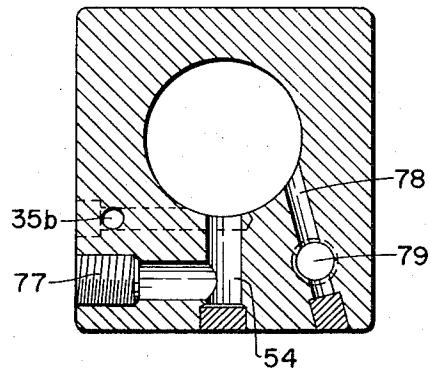
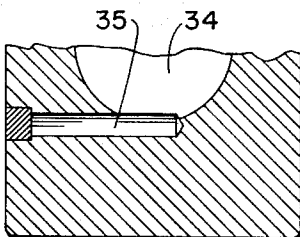


FIG. 10



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13 Claims. (Cl. 28-1)

ABSTRACT OF THE DISCLOSURE

Apparatus for intertwining, interlacing, knotting, convoluting or otherwise agitating artificial filaments, yarns or threads by a pressurized fluid flow when utilizing a jet assembly comprising a housing, closure means slidably positioned within the housing and adapted for reciprocating movement when subjected to the action of a pressurized fluid, said closure means further defining an open and closed yarn insertion and yarn treating position for the apparatus wherein the insertion position is defined by an absence of a pressurized fluid passing through the jet assembly and a treating position is defined when the closure means is subjected to fluid under pressure and where said fluid passes through the jet assembly.

The present invention relates to an apparatus for the treatment of yarn, and more particularly to an apparatus for subjecting substantially untwisted artificial or man made multifilament yarn such as rayon and/or thermoplastic synthetic high polymer yarn to the action of a fluid passing through the yarn in the form of a jet stream.

It is known that multifilament artificial yarns having little or substantially no twist are difficult to handle in textile operations. When filaments of the yarn are parallel, they lack cohesion because of their loose association with each other and therefore create problems in weaving and knitting operations. In order to overcome these problems, various methods and apparatuses have been developed for modifying multifilament yarn to improve bundle cohesion. One recent development consists of passing yarn to an apparatus having a turbulent zone to which a fluid, such as air, is introduced through a jet assembly under pressure. Individual filaments of the yarn in the zone are disoriented and by controlling yarn speed and pressure of the fluid in the zone, the yarn can be bulked or compacted and the filaments thereof thus become randomly tangled and interlaced.

Such apparatus and methods are also used for joining the ends of filament bundles. This is carried out by arranging two ends parallel to each other in an overlapping manner by either holding or clamping the overlapped portion within the apparatus. A jet of gas such as air is then directed across the overlapped portion, between the clamped points, while the yarn is maintained under slight tension. The jet or "blast" of gas through the bundle results in tangling, the filaments thereby causing the thread ends to be, in effect, "gas spliced." This serves to retain the ends in permanent engagement. The friction between the engaged filaments results in a joint having substantially the tensile strength of unbroken yarn or filaments per se. This type of an engagement results in a product which will not adversely affect the continuity of subsequent processes such as dyeing, weaving, knitting, etc.

Although these procedures and apparatuses used for bulking, tangling or entwining of yarns which are composed of artificial filaments have definite advantages over other methods such as twisting and knotting, special pro-

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cedures must be used for lowering, or if possible preventing, extremely high noise levels. Fluid used in these operations issues from a jet orifice at relatively high speeds and pressures and causes an extremely high level of noise. This noise is an extreme nuisance and, in some cases, is harmful to people working around or operating the device, particularly if a number of devices are operating at one time and in the same location. To lower such high accompanying noise, it has been proposed to enclose at least part of the apparatus in a hinged cover or housing. The housing is lined with a sound absorbing material and is provided with openings to allow passage of the yarn to and from the jet assembly. Such a proposal, however, has the disadvantage that when threading the device, two separate operations are required. The gas supply must be stopped and the cover of the housing must be opened. This is a very time consuming and cumbersome operation, particularly when the apparatus is used for splicing yarn ends. In this type operation, the operator must use both hands to hold the yarn ends and must somehow manage to close the cover of the housing before starting the air supply to the nozzle. As a result, many operators merely leave the cover open, further compounding noise of normal operation.

It is therefore an object of the present invention to provide an artificial yarn fluid jet tangling assembly having a minimum of attendant noise.

It is a further object of this invention to provide a simple yarn tangling assembly having a turbulent treating zone which is automatically closed when the fluid stream is blown through the filaments to be treated.

It is still a further object of this invention to provide a muffling chamber completely housed within a fluid jet tangling assembly for absorbing sound, thus avoiding the necessity of having a chamber which must be opened when rethreading or operating the apparatus.

These objects may be accomplished in accordance with this invention by providing means within a cylinder-like housing and operated by fluid under pressure to automatically close the cylinder during a yarn entwining operation. The means, inter alia, comprises a movable plunger housed in the cylinder and activated by gas under pressure. The plunger carries a yarn receiving and positioning slot which, in turn, cooperates with a yarn receiving slot cut in or on the cylinder. The plunger, when under the influence of gas under pressure, moves with respect to the cylinder to define an enclosed zone where the yarn entwining takes place. The plunger also carries an internal muffling space having vents communicating directly with the thus confined zone to effectively subdue attendant noise during a tangling operation.

The foregoing, as well as other objects and advantages of the present invention will become more apparent to those skilled in this art upon study of the following description taken in conjunction with the accompanying drawings, wherein

FIGURE 1 represents the apparatus according to this invention in longitudinal section;

FIGURE 2 is a cross-sectional view along the line II-II in FIGURE 1;

FIGURES 3 and 4 represent a different embodiment of the apparatus in longitudinal cutaway sections;

FIGURES 5 and 6 are detailed views of an additional embodiment;

FIGURES 7-10 are additional views of the apparatus as shown in FIGURES 5 and 6; and

FIGURE 11 schematically shows the embodiment shown in FIGURES 5 and 6.

In FIGURE 1, numeral 1 refers to the housing cylinder within which reciprocating plunger 2 is slidably supported. Plunger 2 is prevented from rotating by a pin 37

which fits in a guide slot 38. The internal surface of the plunger slides along the outer surface of fixed tubular bushing 3. Bushing 3 is attached to cylinder 1 by means of screws 5 and 6 at collar 4. Both ends of bushing 3 are internally threaded to receive support rings 7 and 8. Ring 7 is internally threaded to receive externally threaded stud bolt 9. Stud 9 carries a gas reversing member, which may consist of a flat circular disc or wall, and which preferably carries head 10, with a resonance chamber 14 defined by a small cylinder 11 having an entry port 12. Slot 13 is provided in the stud bolt 9 for axially adjusting head 10. Nut 15 serves to lock stud bolt 9 in position.

Bushing 3 is provided with a channeled partition 16 which, together with circular partition 8, supports jet assembly 17. Jet assembly 17 is provided with a fluid flow channel 18, ending as diverging gas exit orifice 19. Partition 16 is provided with fluid exit ports 21 and 22 which communicate with the muffler area 80. When the plunger 2 is in the FIGURE 1 position, ports 23 communicate with recess 24. The recess is externally vented through openings 26 by way of channels 25 in plunger 2, although for the sake of clarity, only one of each is shown.

Stationary bushing 3, with the partition 16, ring 7, and plunger 2 (when in an "operating" or yarn treating position) defines the yarn tangling and blowing zone at chamber 27 and includes jet orifice 19 and resonance chamber 14. The cylinder wall, at the chamber wall, and bushing 3 are provided with yarn receiving and aligning slots 28, 29, and 30.

Ring-shaped stop face 31 of cylinder 1 arrests plunger movement when air pressure is released and when under the influence of spring 32. Spring 32 is secured in recess 33. The expansion chamber or area of movement of the plunger is shown at 34. Fluid is supplied from a source (not shown) through feed tube 36 to conduit 35. The fluid used can be any gaseous substances, such as saturated and unsaturated steam or relatively cheap compressed air. The gas introduced operates the plunger and passes through the opened end jet assembly to tangle the yarn.

FIGURE 2 shows a cross-sectional view of FIGURE 1 facing the jet orifice 19; and also shows the gas escape vents 21 and 22 leading into the muffling chamber. Eyelets 28 serve to pass the yarn to and position same in a treating relationship with the orifice.

FIGURES 3 and 4 show a somewhat different embodiment of the invention, particularly in the mounting of the jet assembly, design of the plunger element with its associated recoil mechanism, and in the plunger housing. Yarn treating chamber 27 and orifice 19, along with resonance chamber 14, are in actuality considered part of and are maintained by plunger 2. Reference numeral 39 refers to an enlarged portion of the plunger provided with thread-receiving slot 29, which cooperates with a second thread-receiving slot 30 in cylinder 1.

Circular partition 40 partially supports jet assembly 17, and is screwed into the plunger at head 41. This arrangement provides not only an assembly feature, but an adjustable feature as well and, when assembled and properly positioned, it may be locked by means of nut 42. Partition 40 is similar to an embodiment shown in FIGURE 1 and is provided with channels 21, 22 connecting the yarn treating or blowing chamber with muffler space 80. Muffler space 80 is essentially enclosed by the inner sidewalls of plunger 2. Gas passing to and contained in muffler 80 is eventually vented to the atmosphere through ports 26. Resonance chamber 14 is mounted for traveling with the plunger 43. Edge 45 of cylinder end cap or closure 44 serves as a stop face for the plunger and limits its lateral movement. Movement in the opposite direction is limited by stop rim 46 and cooperating plunger collar 47. Recesses 48 and 49 serve to house recoil spring 50. Cylinder end cap or closure 44 further has a gas escape channel 51 for release of gases trapped in front

of the piston which would act to hold back the plunger during its forward operating stroke.

FIGURE 4 shows a longitudinal cutaway portion of the cylinder housing of FIGURE 3. Cylinder 1 is provided with permanent magnet 52, which serves to mount the apparatus during operation. The reduced cross section 53 of the cylinder facilitates handling of the device.

FIGURE 5 shows an additional embodiment of apparatus according to the invention which is particularly suitable for joining yarn ends. Cylinder 1 has a spring locking ring 62, which serves as a stop for plunger 2 when in position for yarn entanglement. The plunger is subject to pressure of a spring 50, which bears against plunger face 43 at one end and against closure 44 at the other end. Closure 44 is attached to cylinder 1 by means of bolt 63 and screw 65 through opening 12 by stud bolt 9. The plunger reversing space is referred to by numeral 58. Travel of plunger 2 is adjusted by means of bolt 37 in guide slot 38. Conduit 54 is the entry way for the pressurized gas.

FIGURE 5A shows a view of the cylinder 1 along the line Va in FIGURE 5. The figure more clearly shows gas return channel 70 with connecting channels 35a and 35b. Pressure-equalizing channel 56 is shown along with the cylindrical space comprising the plunger stop rim 46. Threaded bores 71, 72 and 73 receive the bolts 63 securing closure 44.

FIGURE 6 shows a view along the line VI—VI in FIGURE 5. Channel 35a shows a manually operated valve 55 which will be more fully discussed below in relation to the schematic drawing in FIGURE 11. Channel 35a is connected to a gas return channel 70. Gas return channel 70 is shown as a recess formed in the cylinder 1 partially enclosed by closure 44. Valve 55 can be operated by means of pushbutton 66, which depresses element 67 against spring 68. The figure also shows gas vents 26 communicating to the atmosphere. Channel 56 is a pressure-equalizing channel and has a relatively large diameter to enable it to contain a higher gas volume compared with the gas volume contained in space 34 behind plunger 2 (when in a forward position). As a result, plunger reversing space 58 (FIGURE 11) and the pressure-equalizing channel 56 together form a relatively large dead space so that, during forward movement, any counter-pressure tending to be exerted on the plunger (as a result of compression) will be prevented. Gas is supplied to the cylinder through tube connection 69.

The paths through which gas passes through the cylinder are best shown in FIGURES 7—11, which show an elevation and a number of sectional views of the cylinder.

FIGURE 7 shows a longitudinal section of the cylinder along the line VII—VII of FIGURE 5A. The figure shows the shape of the thread-receiving slot 30, as well as air-escape ports 26 and vents 74 to connect the reversing space with the atmosphere when opened by the plunger during the back stroke. Further, the figure more clearly shows channel 35 and conduit 54, and also openings 75 and 76, which accommodate valve 67 and guide bolt 37, respectively.

FIGURE 8 shows the apparatus in cross-section along the line VIII—VIII in FIGURE 7, and FIGURE 9 shows a cross-section along the line IX—IX. FIGURE 10 more clearly shows conduit 54, leading to plunger expansion chamber 34, and opening 77 for tube connection 69 (FIGURE 6 only). Channel 78 of the pressure-equalizing channel 56 also connects to expansion chamber 34 and to opening 79 through which a conical gas adjustment pin 59 (not shown) is positioned. FIGURE 9 more clearly shows gas vents 26.

FIGURE 10 shows the cylinder in cross-section along the line X—X in FIGURE 7 wherein channel 35 is more clearly shown connecting to plunger expansion chamber 34.

In the above-described drawings, valve 55 is mounted within cylinder 1 although it is also possible to locate it

outside the apparatus as shown in FIGURE 11 (discussed below). This could permit external manipulation by an operator, e.g., by a foot pedal. The positioning indicated in FIGURES 5-11 does have an advantage, however, in that the apparatus can more readily be relocated.

In the schematic showing in FIGURE 11, numerals 1 and 2 again refer to the cylinder and the plunger, respectively. Gas conduits 35 and 54 connect to expansion chamber 34. Conduit 35 serves as a by-pass conduit branching from conduit 54 and is provided with externally located valve 55. Valve 55 divides conduit 35 into two parts 35a and 35b. The opening of conduit 54 into area 34 is permitted by the movement of plunger 2. The pressure-equalizing channel 56 (discussed above) connects expansion chamber 34 to plunger reversing space 58 at point "P." Channel 56 is provided with an adjustable flow characteristic by pin 59 having conical end 60 cooperating with conical seat 61.

With reference first to the embodiment shown in FIGURE 1, operation of the apparatus is as follows:

Air may be supplied to chamber 34 of the apparatus from any suitable source, not shown. In the absence of pressurized air, the plunger will be under the action of spring 32 and will be pressed against stop face 31 and yarn-receiving slots 28 and 30 and yarn-receiving slot 29 will then be properly aligned in a "receiving" relation. The yarn to be entangled can then be inserted into blowing chamber 27. This alignment of the yarn-receiving slots 28, 29 and 30 will hereinafter be referred to as the "open" position; and for the purposes of this invention the terms "yarn" and "thread" are to be used for the same material.

When compressed gas is supplied to expansion chamber 34, plunger 2 is moved to the left until in contact with the collar 4 of the bushing 3. This position hereinafter is referred to as the "operating" or the "forward" position. Yarn-receiving slots 28 and 29 will then overlap in a manner to form two eyelets or small openings which surround the multifilament yarn. The openings serve as guides and define a path for the yarn intersecting the center line of jet orifice 19. This is perhaps best shown in FIGURE 2.

Compressed gas being supplied through the conduit 35 enters the blowing chamber 27 by way of the jet assembly 17. The pressure of the gas being used is dependent on two factors: (1) the denier of the yarn being entangled, and (2) the diameter of the jet assembly's exit orifice. For example, when the orifice measures 1.2 mm., and the yarn being treated is 100 denier, the preferred gas pressure is around 4 atmospheres (absolute). A pressure range normally preferred for the embodiments of the present invention range from approximately 4 to 6 atmospheres (absolute).

The gas flows past the filaments and enters resonance chamber 14 through the opening 12, which is in alignment with orifice 19. As a result, the gas becomes highly turbulent, and completely interlaces or tangles the filaments positioned in the chamber. Tension of the filaments during this tangling process should be low enough to permit deviation of the filaments from their feed path. Since thread-receiving slot 28 is in effect closed during tangling, the gas can only be discharged from blowing chamber 27 by way of channels 21 and 22 in partition 16. Thus, gas is discharged in muffler space 80. The gas leaves the muffler space by way of ports 23 and is eventually vented to the atmosphere through ports 26. Muffler space 80 may be lined with sound-absorbing material or provided with pipe 20, to extend the gas residence time in the muffler (indicated by the broken line 20 in FIGURES 1 and 2). Either expedient will provide effective sound reducing means. The diameter of the muffling discharge channels leading from blowing chamber 27 and from muffler space 80 must be considerably larger than that of jet assembly 19 in order to keep the speed of the gas to be discharged as low as possible.

When the gas supply to chamber 34 is cut off, spring

32 presses plunger 2 against stop face 31. Thus, thread-receiving slots 28, 29 and 30 again resume an open position relative to each other. The operating cycle is repeated by the operator by again merely inserting the yarn to be tangled and controlling the gas supply.

In operation of the embodiment shown in FIGURES 5-11, the yarn ends to be joined are inserted in the same manner as set out in relation to the operation above when the plunger is in the position indicated by the broken lines in FIGURE 11. This position is permitted by a constant pressure of gas, such as air, which prevails in conduit 54 when valve 55 is closed. Valve 55 is spring loaded in a closed position and when opened, air enters chamber 34 and drives plunger 2 to an "operating" position where the same air under an increased pressure, because of the reduced diameter of the jet orifice, serves to tangle the filaments. Conduit 54 will then be completely open and, after spring valve 55 is released, the amount of air introduced to the chamber 34 will be constant. Towards the end of the forward travel of the plunger, gas exit 56a of pressure-equalizing channel 56 will be opened and gas flows through the channel to reversing space 58. This (aided by recoil spring 32) acts to form a counter-pressure against the plunger thus returning the plunger to its original yarn loading or inserting position.

The time required for the cycle varies and is dependent on the pressure of the gas introduced to the system and the width selected for the passage between conical pin 59 and seat 61. However, when sufficient pressure builds up in 58 (in excess of pressure at 34), the plunger is driven back. During the back stroke, the plunger opens air-escape vent 74 (FIGURE 7) for bleeding off any air remaining in the reversing space 58. Exits 56a and 54a will again be closed and the cycle can then be repeated.

The embodiment shown in FIGURE 5 is particularly suitable for making tangled splices in glass yarn since the duration of the tangling treatment can be kept within relatively narrow limits. Running lengths of glass filaments cannot be joined by conventional knotting and heretofore the lengths have been glued together which is highly undesirable in making textile fabrics. Glued spots scorch upon further treatment. With the present apparatus, however, it is possible to repair rapidly and effectively, without gluing, any yarn breakages which take place at any stage of operation.

The present apparatus has the additional advantage of compact construction, which facilitates handling and point to point movement with ease. This is an especial advantage in splicing yarn ends. For instance, the device may be fastened to the body by means of a belt or, if desired, the apparatus may be mounted on a light, readily displaceable stand.

Since other modifications or embodiments will become apparent, it is intended that the scope of this invention be limited only to the extent set forth in the following claims.

What is claimed is:

1. In apparatus for intertwining, interlacing or otherwise agitating artificial filaments by pressurized fluid flow utilizing a jet assembly, the improvements comprising, in combination;

- (a) a housing,
- (b) closure means within said housing adapted for movement when subjected to a pressurized fluid,
- (c) said means having an open and closed position wherein the yarn is inserted and treated, respectively, and
- (d) said means when in a closed position at least partially defining a yarn treatment chamber wherein the yarn is intertwined by a flow of fluid passing through a jet orifice in said chamber.

2. An apparatus for intertwining artificial multifilament yarn which comprises a housing, a plunger movably supported in said housing and adapted to be operated by a fluid under pressure, said plunger being adapted for

movement along a jet assembly between open and closed positions when subjected to said fluid under pressure, and said jet assembly having means for channeling at least a portion of the fluid under pressure to a yarn treatment chamber when in said closed position to thereby intertwine the yarn by the action of the fluid issuing from the assembly to the chamber.

3. Apparatus as defined in claim 2 wherein said treatment chamber is essentially completely closed by the plunger when in a forward position and under the influence of fluid under pressure.

4. Apparatus as defined in claim 2 wherein said treatment chamber comprises a jet orifice for supplying a fluid under pressure, a cylindrical resonance chamber having an opening disposed opposite the jet orifice, yarn guides to position yarn between said orifice and the opening in said resonance chamber, said treatment chamber being further provided with fluid exit vents connecting said chamber to a muffling chamber.

5. Apparatus as defined in claim 4 wherein the plunger is provided with channels cooperating with vents in the apparatus housing for removal of the operating fluid from the apparatus.

6. Apparatus as defined in claim 4 wherein said muffling chamber is provided with means to absorb sound.

7. Apparatus as defined in claim 1 wherein said plunger is adapted for movement along a fixed bushing within said housing.

8. An apparatus for joining artificial multifilament yarn ends which comprises a cylindrical housing having a movable plunger therein, said plunger adapted to be reciprocated by a fluid under pressure between an open and closed yarn insertion and yarn treating position, respectively, said plunger, when in a closed position, substantially enclosing a jet assembly within a yarn treat-

ment chamber, and said jet assembly having means for channeling at least a portion of the fluid under pressure to the chamber to thereby entangle said ends in said chamber.

9. Apparatus as defined in claim 8 wherein said treating chamber has a yarn treating zone having a jet orifice for supplying a fluid under pressure to yarn in said zone, a cylindrical resonance chamber having an opening disposed opposite and in alignment with said orifice, and yarn guides to position yarn between said orifice and the opening in said resonance chamber.

10. Apparatus as defined in claim 9 wherein said treating chamber is further provided with fluid exit vents connecting said chamber to the muffling chamber within said plunger.

11. Apparatus as defined in claim 8 having a plunger reversing space which accumulates sufficient pressurized fluid to return the plunger to a yarn inserting position.

12. Apparatus as defined in claim 11 having a pressure-equalizing channel connecting said plunger reversing space and a plunger expansion chamber.

13. Apparatus as defined in claim 8 having at least one valve mechanism controlling the amount of fluid being introduced to the system.

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