Nov. 30, 1971 S. R. NECHVATAL ET AL 3,623,195

PROCESS AND APPARATUS FOR INTERTWINING YARN

Filed Dec. 30, 1969 2 Sheets-Sheet 1

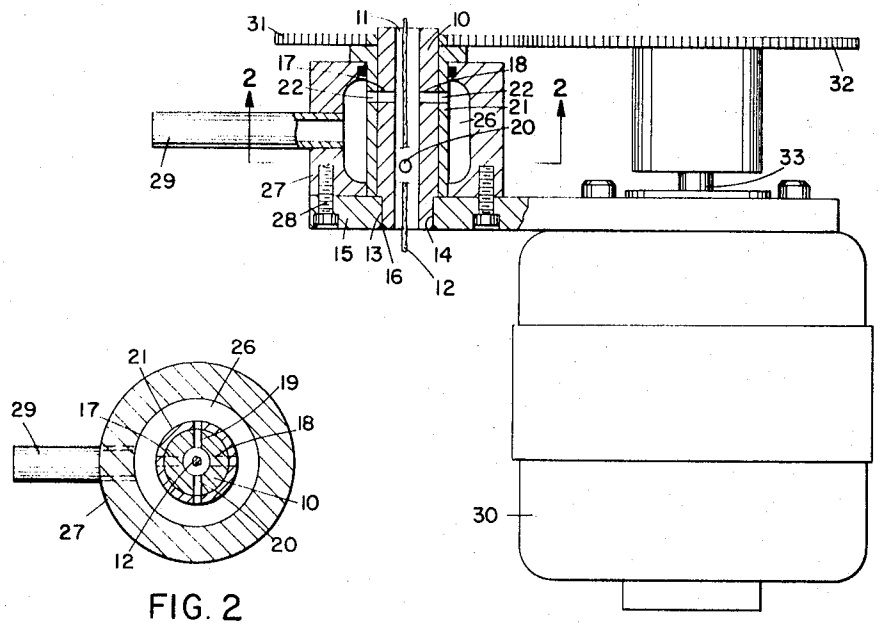


FIG. 1

FIG. 2

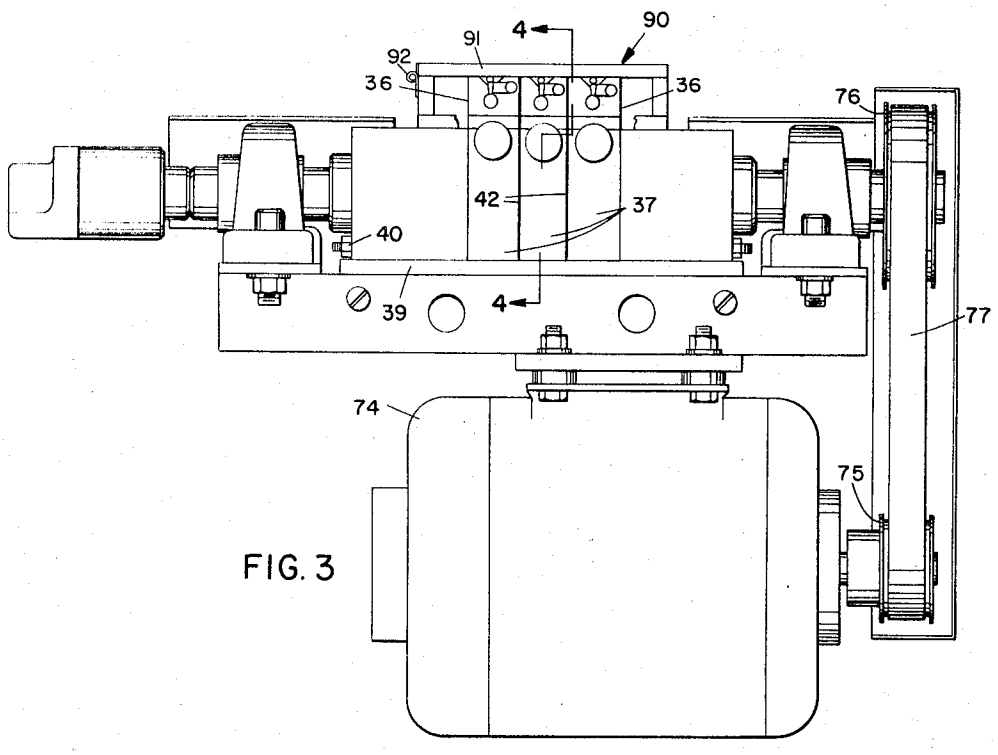


FIG. 3

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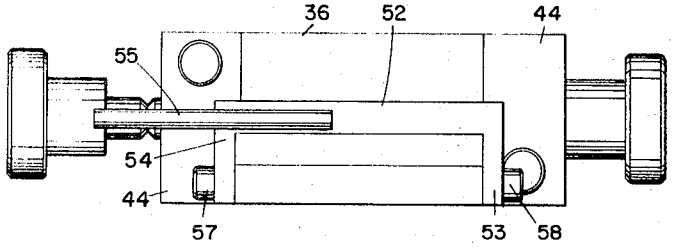


FIG. 6

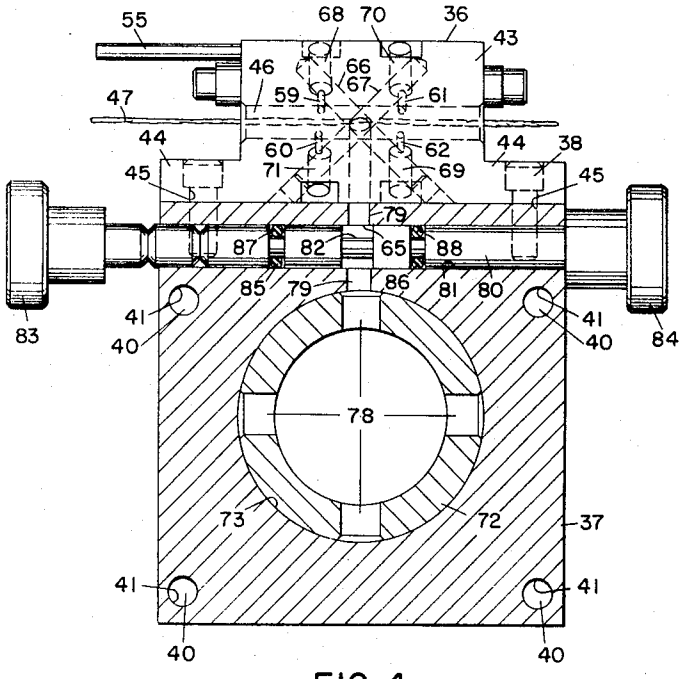


FIG. 4

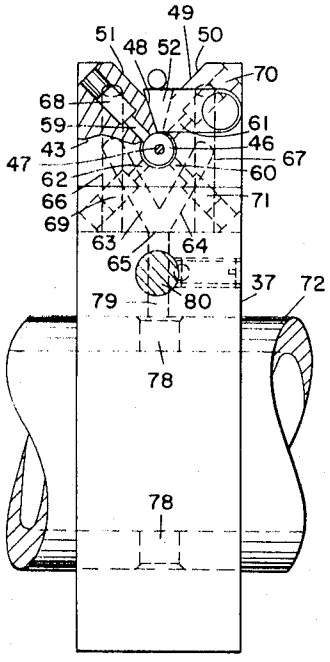


FIG. 5

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PROCESS AND APPARATUS FOR INTERTWINING YARN

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Int. Cl. D02g 1/16
U.S. Cl. 28—1.4 3 Claims

ABSTRACT OF THE DISCLOSURE

Jet apparatus and process for intertwining, entangling or interlacing synthetic yarn to improve its coherency is disclosed. Yarn is intermittently subjected to the action of a fluid, e.g., air, under pressure as it is pulled through a passageway. The intermittent introduction of air through jet conduits into the yarn passageway creates a kind of turbulence which causes the filaments of the yarn to be intertwined in a relatively uniform pattern at substantially uniform spaced sites therealong.

This invention relates to an improved process and apparatus for intertwining, interlacing or entangling yarn to improve its coherency.

It is well known in the art that fluid jets can be used to intertwine the individual filaments of a synthetic yarn to improve its coherency and facilitate its further processing and use. These jets are usually provided with one or more openings through which a fluid, e.g., a gas such as air, under pressure, is continuously introduced into the passageway through which the yarn passes. The stream or streams of gas produce zones of turbulence in the passageway causing the filaments of the yarn to become intertwined, interlaced or entangled at randomly spaced sites, the average distance between which varies with a number of factors such as yarn speed, gas pressure, size and shape of the yarn passageway, and so on. Prior jet intertwining devices, while satisfactory in many respects, are uneconomical to operate from the standpoint of gas consumption and difficult to control so as to produce a uniformly entangled yarn. In addition, they are very noisy and difficult to muffle.

A principal object of the present invention is the provision of improved process and apparatus for intertwining bulked or unbulked yarn to improve its coherency. Further objects of the invention are the provision of apparatus of this type which is economical to operate, that is, it has a low fluid consumption rate compared to prior known jet intertwining devices, which is capable of producing a uniformly intertwined yarn having a desired degree of intertwining, which is less noisy and easier to muffle, and which is easy to operate.

In accordance with the invention, the above and other objects are attained by the provision of jet intertwining apparatus comprising a body member having a passage therethrough through which a multifilament yarn is adapted to be passed, conduit means in said body member communicating with said passage and through which a fluid under pressure is adapted to be intermittently passed and discharged into said passage to create turbulence therein, and means for intermittently introducing fluid under pressure into said conduit means, whereby a yarn passing through said yarn passage is subjected to the turbulence created by said intermittent flow of fluid, thereby causing the filaments of said yarn to become intertwined in a relatively uniform pattern and at substantially uniformly spaced sites therealong.

Preferred embodiments of the invention are illustrated in the accompanying drawings in which:

FIG. 1 is a plan view, partly in section, showing one embodiment of the invention.

FIG. 2 is a cross-sectional view of a portion of the apparatus taken along the line 2—2 of FIG. 1.

FIG. 3 is an elevational view of a modified form of the invention.

FIG. 4 is a view, partly in section, taken on the line 4—4 of FIG. 3 with the muffling device removed.

FIG. 5 is an end view, partly in section, looking from the right in FIG. 4, and

FIG. 6 is a top view of one of the jet devices.

In the embodiment of the invention shown in FIGS. 1 and 2, the numeral **10** denotes a cylindrical shaped body having a passageway **11** therethrough through which yarn **12** to be treated is adapted to be passed. Body **10** has a reduced lower portion **13** mounted in an opening **14** in a base member **15** and secured therein as by a weld joint **16**. The body **10** is provided with two pairs of fluid conduits **17**, **18**, and **19**, **20** spaced apart along the axis of the passageway **11**, the conduits of each pair being oppositely disposed with their axes on a line passing through the axis of the passageway at right angles thereto, the axes of one pair being disposed at right angles to the axes of the other pair as clearly shown in FIG. 2. The fluid conduits **17**, **18**, **19** and **20**, as shown, are circular in cross-sectional shape and can vary in diameter from about 0.040 inch to about 0.100 inch depending on the type of yarn being treated, its speed through the passageway **11**, the diameter of the yarn passageway, the fluid pressure, and so on. The length of the fluid conduits can likewise be varied but will usually be from about 0.080 inch to about 0.200 inch. The longitudinal spacing of the fluid conduits **17**, **18** from the fluid conduits **19**, **20** can vary from about 1/16 inch to about 2 inches, but will preferably be from 1/4 inch to about 1 inch.

A valve sleeve **21** is rotatably mounted on the body **10** and is provided with two pairs of ports **22** and **23**, the ports of each pair being oppositely disposed with the axes of one pair being at right angles to the axes of the other pair, the arrangement being such that the ports **22** move into and out of registration with the conduits **17** and **18** while the ports **23** simultaneously move into and out of registration with the conduits **19** and **20** to intermittently place the fluid conduits **17**, **18**, **19** and **20** in communication with a fluid plenum chamber **26** as the sleeve is rotated. Fluid chamber **26** is formed in a housing **27** which surrounds the sleeve **21** and is secured to the base member **15** in any suitable manner as by screws **28**. Fluid under pressure is supplied to the chamber **26** through conduit **29** from a source (not shown).

Valve sleeve **21** is adapted to be rotated by an electric motor **30** through gears **31** and **32** mounted respectively on the sleeve **21** and the shaft **33** of the motor **30** and secured thereto in any suitable manner. The motor **30** is of the variable speed type so that the sleeve **21** can be rotated at any desired speed.

In operation, a strand of yarn **12** is passed through the passageway **11** by means (not shown) and at a speed of from about 30 feet per minute to about 900 feet per minute, suitable guide means (not shown) being provided to position the yarn along the center line or axis of the yarn passageway as it passes therethrough. The yarn is maintained under a slight tension, e.g., from about 0.004 to about 0.060 gram per denier (g.p.d.). A fluid, e.g., air, from the plenum chamber **26** under a pressure of from about 30 pounds per square inch to about 150 pounds per square inch is intermittently and simultaneously introduced into the fluid conduits **17**, **18**, **19** and **20** as the sets of ports **22** and **23** in the rotating valve sleeve **21** successively move into and out of registeration therewith. Thus, when two oppositely disposed ports **22**

are in registration with the conduits 17 and 18, and simultaneously therewith two oppositely disposed ports 23 are in registration with the conduits 19 and 20, air from the plenum chamber 26 passes through these ports and the associated fluid conduits 17, 18, 19 and 20 and is discharged therefrom through or across the yarn creating zones of turbulence in the yarn passage which cause the filaments of the yarn to become entangled or intertwined. As the sleeve continues to rotate, the ports 22 and 23 move out of registration with the conduits 17, 18, 19 and 20 so that the flow of air to these conduits is cut off and remains cut off for one-half revolution of the sleeve 21 at which point the pairs of ports 22 and 23 again move into registration with the conduits 17, 18, 19 and 20 to again place the conduits in communication with the plenum chamber 26. Thus, air under pressure is simultaneously discharged through the conduits 17, 18, 19 and 20 twice for each revolution of the sleeve 21.

While the shape of the ports 22 and 23 is not critical, i.e., they can be circular, as shown, elongated in the direction of rotation, e.g., oval shaped, rectangular, etc., it is important, in order to obtain a desired degree of intertwining with minimum air consumption, that the ports be so shaped, sized and arranged that the ratio of off-time to on-time does not exceed about 12 to 1, and preferably does not exceed about 6 to 1. Excellent results have been obtained utilizing ratios from about 6 to 2 to above 6 to 4, and hence these are preferred. It will be appreciated, of course, that there may be occasions where lower ratios, e.g., 1 to 1 or even lower, may be desirable and these are contemplated. As used herein the term "off-time" means the period of time air is not flowing through the fluid conduits and being discharged into the yarn passageway and the term "on-time" means the period of time air is flowing through the fluid conduits and being discharged into the yarn passageway.

As will be apparent from the above description, yarn passing through the passageway 11 is intermittently and simultaneously subjected to the flow of air from the opposed conduits 17, 18 and 19, 20, the flow of air from the conduits 17 and 18 being directed at the yarn at right angles to the flow of air from the conduits 19 and 20. This intermittent flow of air, delivered in the indicated manner, causes the filaments of the yarn to become intertwined in a relatively uniform pattern and at substantially uniformly spaced intertwinement or entanglement sites, the spacing of which depends on various factors including the speed of rotation of the sleeve 21 and the speed at which the yarn passes through the yarn passageway 11. Moreover, yarn intertwined in this manner has a considerably higher coherency factor than yarn similarly intertwined with the continuous flow jets of the prior art.

In the modified form of the invention shown in FIGS. 3, 4, 5 and 6, a plurality of intertwining jet units 36 are mounted on and secured to support members 37 by screws 38. The support members 37, in turn, are mounted on a base member 39 and are held together in side-by-side relationship by bolts 40 which pass through openings 41 in the support members. Gaskets 42 are provided between adjacent units to prevent leakage of fluid.

Each jet unit 36 comprises a body portion 43 having outwardly projecting flanges 44 at opposite bottom ends thereof provided with openings 45 for receiving the securing screws 38. A passageway 46 extends longitudinally through the body portion 43 through which yarn 47 to be treated is passed. At its upper part the body portion 43 is provided with a longitudinally extending slot 48, the lower portion of which intersects the yarn passageway 46 and the upper portion of which intersects a V-shaped groove 49 formed in the top of the body portion 43 and having upwardly and outwardly flared walls 50 and 51. The V-shaped groove 49 and connecting slot 48 provide an elongated opening through the top of the body through which a yarn can be introduced into the yarn passageway 46, thereby allowing the apparatus to be strung-up on-the-run without interrupting the movement of the thread line. The walls of the slot 48 are preferably inclined inwardly toward each other from top to bottom which together with the V-shaped groove 49 facilitate introduction of the yarn and its movement therethrough into the yarn passageway during the stringing-up operation.

The slot 48 is adapted to be closed by an elongated wedge shaped member 52, the side walls of which, in the closed position, snugly engage the side walls of the slot and the bottom wall of which is concavely curved to provide a continuation of the curved wall forming the yarn passageway 46. The closure member 52 is pivotally mounted for movement into and out of the slot 48 by means of laterally extending arms 53 and 54 at opposite ends thereof provided with openings to receive pins 57 and 58 secured to the top of the body portion 43. The closure member 52 is provided with a handle 55 which can be manually grasped to swing the closure member 52 into and out of the slot 48. It will be appreciated that when the closure member 52 is in closed position it prevents the yarn from being blown out of the passageway 46 through the slot 48.

The body portion 43 is provided with fluid conduits 59, 60, 61 and 62 which communicate at their inner ends with the yarn passageway 46 and through which a fluid, e.g., air, under pressure is intermittently introduced into the yarn passageway. The fluid conduits 59, 60, 61 and 62 are arranged in pairs (59, 60 and 61, 62) spaced apart along the axis of the yarn passageway 46, the conduits of each pair being oppositely disposed with their axes on a line passing through the axis of the passage 46 at right angles thereto, the axes of one pair being disposed at right angles to the axes of the other pair as clearly shown in FIG. 5. While this particular arrangement of the fluid conduits is preferred, it will be appreciated that variations therefrom, e.g., in spacing, angular disposition of the conduits with respect to each other and the yarn passage, and so on, may be made without departing from the scope of the invention.

The conduits 59, 60, 61 and 62 are supplied with air or other fluid under pressure through an arrangement of internal interconnected passages in the body portion 43 which are constructed and arranged so that the distances from the point of introduction of air to the jet body to all four air conduits are the same and so that the passages leading to the air conduits are symmetrically disposed. By virtue of this arrangement air is supplied to and flows through each of the fluid conduits under essentially the same conditions.

Referring particularly to FIGS. 4 and 5, the body portion 43 is provided with downwardly converging passages 63 and 64 which join at their lower ends to provide an opening 65 in the lower face of the body portion. At their upper ends the passages 63 and 64 join and communicate respectively with internal passages 66 and 67 which extend diagonally in opposite directions as viewed in FIG. 4 and vertically as viewed in FIG. 5. The internal passage 66, in turn, joins with internal passages 68 and 69, and the internal passage 67 joins with internal passages 70 and 71, the internal passages 68, 69, 70 and 71 constituting, in effect, enlarged extensions of the fluid conduits 59, 62, 61 and 60, respectively. Thus, air introduced through opening 65 flows through passages 63 and 64, the air from passage 63 then passing through passages 66, 68 and 69 to the fluid conduits 59 and 62, and the air from the passage 64 then passing through conduits 67, 70 and 71 to conduits 60 and 61.

Air is intermittently supplied to the openings 65 of each jet unit through a sleeve 72 rotatably mounted at the ends thereof in suitable bearing members and extending through openings 73 in support members 37. The sleeve 72 can be rotated in any suitable manner as by a motor 74 and a belt and pulley drive consisting of a pulley 75 mounted on the shaft of motor 74, a

pulley 76 mounted on the sleeve 72 and an endless belt 77 trained over the pulleys 75 and 76. Air under pressure is introduced into the sleeve 72 in any suitable manner (not shown).

The sleeve 72 is provided with sets of ports 78 in the wall thereof which are brought successively into registration with passages 79 in the support members 37 which passages 79, in turn, communicate with the openings 65 in the lower faces of the jet units 36. It will be appreciated that a set of ports 78 and a cooperating passage 79 are provided for each jet unit. In a preferred arangement there are four ports 78 in each set equally spaced apart circumferentially, i.e., 90° apart, the ports of each successive set longitudinally of the sleeve 72 being circumferentially displaced with respect to the ports in the adjacent preceding set an amount such that air will be discharged from the sleeve at a substantially uniform rate, thereby maintaining a substantially constant air pressure in the sleeve. In the embodiment shown, since there are four ports 78 in each set and three jet units, the circumferential displacement of each successive set of ports with respect to the preceding set of ports would be one-third of ninety degrees or thirty degrees.

In order to permit the supply of air to an individual jet unit to be shut off without interrupting the supply of air to other jet units, valve means are provided for shutting off the flow of air through each passage 79. Such valve means for each unit comprises a piston 80 slidably mounted in an opening 81 extending through support member 37 and provided intermediate the ends thereof with a portion 82 of reduced diameter adapted to be moved into and out of alignment with the upper and lower portions of passage 79. It will be apparent that in the position of the piston 80 shown in FIG. 4 air can flow from the lower portion of passage 79 around the portion 82 of reduced diameter into the upper portion of passage 79. It will also be apparent that when the piston 80 is moved to the right in FIG. 4 sufficiently to move the portion 82 of reduced diameter out of alignment with the upper and lower portions of passage 79 the flow of air through the passage 79 will be cut off. Knurled knobs 83 and 84 are mounted on the ends of piston 80 for slidably moving same. The knobs 83 and 84 also serve as stops to limit sliding movement of the piston between open and closed positions. Thus, to move the reduced portion 82 out of alignment with the passage 79 to shut off the flow of air therethrough, the piston 80 is moved to the right (FIG. 4) until the end of the knob 83 contacts the front wall of the support member. Conversely, to move the reduced portion 82 into alignment with the passage 79 so that air can flow therethough, the piston is moved to the left until the end of the knob 84 engages the back wall of the support member. To prevent leakage of air around the piston 80 O-rings 85 and 86 are mounted in grooves 87 and 88 of the piston on opposite sides of the reduced portion 82.

In the operation of the embodiment of the invention shown in FIGS. 3, 4, 5 and 6, a strand of yarn 47 is drawn through the yarn passage 46 by means (not shown) and at a speed of from about 30 feet per minute to about 900 feet per minute. Suitable guide means (not shown) are provided to position the yarn along the center line or ozis of the yarn passage as it is drawn therethrough. The yarn is maintained under a slight tension, e.g., from about 0.004 to about 0.040 gram per denier.

As the yarn moves through the passage 46 of each jet unit, a fluid, e.g., air, under pressure from the sleeve 72 is intermittently and simultaneously introduced into each of the conduits 59, 60, 61 and 62 as the ports 78 in the rotating sleeve 72 move into and out of registration with the passage 79 in the support member 37. Thus, when a port 78 moves into registration with the passage 79 air from the sleeve 72 flows through the passage 79 and opening 65 into and through the internal passages of the body portion 43 to the conduits 59, 60, 61 and 62 and is discharged therefrom through or across the yarn 47 creating zones of turbulence which cause the filaments thereof to become entangled or intertwined. As the sleeve 72 continues to rotate, the port 78 moves out of registration with the passage 79 so that the flow of air to the conduits 59, 60, 61 and 62 is cut off and remains cut off for one-quarter revolution of the sleeve at which point the next succeeding port 78 moves into registration with the passage 79. Since there are four ports 78 for each jet unit, air intermittently flows through the conduits 59, 60, 61 and 62 four times for each revolution of the sleeve 72. The frequency of air discharge through the conduits depends, of course, on the speed of rotation of the sleeve. This can vary from about 100 to about 1000 revolutions per minute and preferably from about 400 to about 700 revolutions per minute. In this embodiment, as in the previous embodiment, it will be apparent that air will be discharged from conduits 59 and 60 at right angles to air discharged from conduits 61 and 62. This arrangement has been found to give the best resutls from the standpoints of degree and uniformity of entanglement.

In this modification of the invention yarn can be placed into the yarn passage without cutting it. This is accomplished by grasping the handle 55 and swinging the closure member 52 out of the slot 48, introducing the yarn into the passage 46 through the now open slot 48, and then swinging the closure member 52 back into the slot 48 to close same. Moreover, this can be done without turning off the air and without stopping rotation of the sleeve 72. However, if, for any reason, it is desired to cut off the air supply to a particular jet unit, this is readily accomplished by moving the piston 80 to the right in FIG. 4 until the reduced portion 82 is out of alignment with the upper and lower portions of the passage 79.

While the intermittent air flow jet entangling devices of the present invention are less noisey than the continuous air flow jet entangling devices of the prior art, a still further reduction of noise level can readily be obtained by the provision of a suitable muffling device indicated generally by the numeral 90 in FIG. 3. This may consist of a metallic, plastic, or the like, enclosure means including an upwardly swingable top portion 91, hinged at one end as at 92, and lined with a suitable sound-deadening or absorbing material such as polyurethane foam. Suitable openings are provided in the front and rear portions of the container to permit passage of the yarn.

The effectiveness of the apparatus of this invention is illustrated by the following examples. In these examples, the coherency factor (C_f) of the yarns was determined as follows. A 120 cm. length of yarn was mounted vertically next to a meter stick. A tension weight of 0.20 g.p.d., but not greater than 100 grams, was attached to the bottom of the yarn. The point of a weighted hook (weight=10 grams) was passed through the yarn and allowed to drop until the intertwining of the yarn stopped the fall. The measurement was repeated for a total of 50 trials per sample. The average stop distance, in centimeters, is divided into 100 to obtain the coherency factor (C_f).

EXAMPLE 1

A 2600/100 denier crimped polypropylene yarn having a coherency factor of 29.6 was processed in-line through an intermittent flow jet of the type shown in FIGS. 1 and 2. The air pressure in the plenum chamber 26 was 70 pounds per square inch and the speed of rotation of the sleeve 21 was 1,000 revolutions per minute. The yarn was pulled through the yarn passage at a speed of 390 feet per minute under a tension of 0.02 gram per denier. The treated yarn had a coherency fac-

tor (C_f) of 120. The jet consumed 3.4 cubic feet per minute of air as measured at standard atmospheric conditions (s.c.f.m.) of 0° C. and 30 inches of mercury when the jet was set for continuous air flow, e.g. speed of rotation of the sleeve **21**, 0 revolution per minute, and sleeve **21** aligned to permit continuous air flow through passages **17**, **18**, **19** and **20**, the treated yarn had a coherency factor of 90. The jet set at these conditions consumed 11.5 s.c.f.m. of air.

EXAMPLE 2

A 2600/100 denier crimped polypropylene yarn having a coherency factor of 29.6 was processed in line through an intermittent flow jet of the type shown in FIGS. 3, 4, 5 and 6. The air pressure in the sleeve **72** was 70 pounds per square inch and the speed of rotation of the sleeve was 550 revolutions per minute. The yarn was pulled through the yarn passage at a speed of 390 feet per minute under a tension of 0.015 gram per denier. The treated yarn had a coherency factor (C_f) of 114.7. The jet consumed 2.4 s.c.f.m. of air. The same yarn, when processed through the same type of jet under conditions of continuous flow, e.g., with air continuously flowing through the conduits **59**, **60**, **61** and **62**, had a coherency factor of 86.7. The consumption of air was 11.5 s.c.f.m.

EXAMPLE 3

A 2600/100 denier crimped polypropylene yarn having a coherency factor of 29.6 was backwormed through an intermittent flow jet of the type shown in FIGS. 1 and 2. The air pressure in the plenum chamber **26** was 80 pounds per square inch and the speed of rotation of the sleeve was 1500 revolutions per minute. The yarn was pulled through the yarn passageway at a speed of 200 feet per minute under a tension of 0.015 gram per denier. The treated yarn had a coherency factor of 193.6. The jet consumed 3.5 s.c.f.m. of air. The same yarn when processed through a continuous flow jet had a coherency factor of 60. The jet consumed 11.5 s.c.f.m. of air.

It will thus be seen that the present invention provides a process and apparatus for intertwining yarn which has a number of advantages over prior art processes and apparatus used for this purpose. Thus, under similar conditions of operation, the process and apparatus of the invention will intertwine yarn to a much higher level of coherency than can be obtained with the known types of continuous flow jets. Moreover, fluid consumption for a given level of intertwining is much lower than that for a continuous flow jet, thus resulting in economy of operation. Furthermore, the degree of intertwining is not dependent upon fluid consumption in the pressure range from 50–100 pounds per square inch fluid pressure. In addition, the degree of intertwining can easily be varied by changing the frequency of the off-on cycle. And finally, the turbulence created by the intermittent flow of fluid in the manner described causes the filaments of the yarn to become intertwined in a relatively uniform pattern and at substantially uniformly spaced sites therealong.

The process and apparatus of the invention are particularly useful for intertwining the filaments of any of the well-known types of synthetic yarns such as those formed from polyolefins, polyesters, polyamides, polyacrylics, and so on. In addition, they can be used to tack together, by intertwining, two or more single yarns to obtain unusual ply combinations.

While preferred embodiments of the invention have been illustrated and described, it will be appreciated that variations therefrom may be made without departing from the scope of the invention.

What we claim and desire to protect by Letters Patent is:

1. Apparatus for intertwining multifilament yarn comprising a body member having a passage therethrough through which a multifilament yarn is adapted to be passed, conduit means in said body member communicating with said passage and through which a fluid under pressure is adapted to be intermittently passed and discharged into said passage to create turbulence therein, said conduit means comprising two pairs of conduits spaced apart along the axis of the yarn passage, the conduits of each pair being oppositely disposed with their axes on a line passing through the axis of the yarn passage at right angles thereto with the axes of one pair of conduits being disposed at right angles to the axes of the other pair, and means for intermittently introducing fluid under pressure into said conduit means, said means for intermittently introducing fluid under pressure comprising a valve sleeve rotatably mounted on said body member and provided with two pairs of ports spaced apart along the axis of the yarn passage the same distance as the pairs of fluid conduits, the ports of each pair of ports being oppositely disposed with their axes at right angles to each other, the arrangement being such that the pairs of ports simultaneously move into and out of registration with the pairs of conduits to intermittently and simultaneously place the fluid conduits in communication with a source of fluid under pressure whereby a yarn passing through said yarn passage is subjected to the turbulence created by said intermittent flow of fluid thereby causing the filaments of said yarn to become intertwined in a relatively uniform pattern and at substantially uniformly spaced sites therealong.

2. Apparatus for intertwining multifilament yarn comprising a body member having a passage therethrough through which a multifilament yarn is adapted to be passed, conduit means in said body member communicating with said passage and through which a fluid under pressure is adapted to be intermittently passed and discharged into said passage to create turbulence therein, said conduit means comprising two pairs of conduits spaced apart along the axis of the yarn passage, the conduits of each pair being oppositely disposed with their axes on a line passing through the axis of the yarn passage at right angles thereto with the axes of one pair of conduits being disposed at right angles to the axes of the other pair, and means for intermittently introducing fluid under pressure into said conduit means, said means for intermittently introducing fluid under pressure comprising an arrangement of internal passages in said body member communicating each of said conduits with an opening in one face thereof, and a rotatable valve sleeve having ports therein and adapted when rotated to intermittently place said opening in communication with a source of fluid under pressure whereby a yarn passing through said yarn passage is subjected to the turbulence created by said intermittent flow of fluid thereby causing the filaments of said yarn to become intertwined in a relatively uniform pattern and at substantially uniformly spaced sites therealong.

3. Apparatus according to claim **2** wherein the rotatable valve sleeve is mounted in an opening in a support member, said support member having a passage therein joined at one end with the opening in the face of said body member and at its other end with the opening in said support member, said ports being disposed so as to move into and out of registration with the passage in said support member as said valve sleeve is rotated whereby fluid under pressure is intermittently supplied to said fluid conduits.

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LOUIS K. RIMRODT, Primary Examiner

U.S. Cl. X.R.

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