

[54] **COMMINGLING JET FOR
MULTIFILAMENT YARN**

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[58] Field of Search..... **28/1.4, 72.12**

[56] **References Cited**

UNITED STATES PATENTS

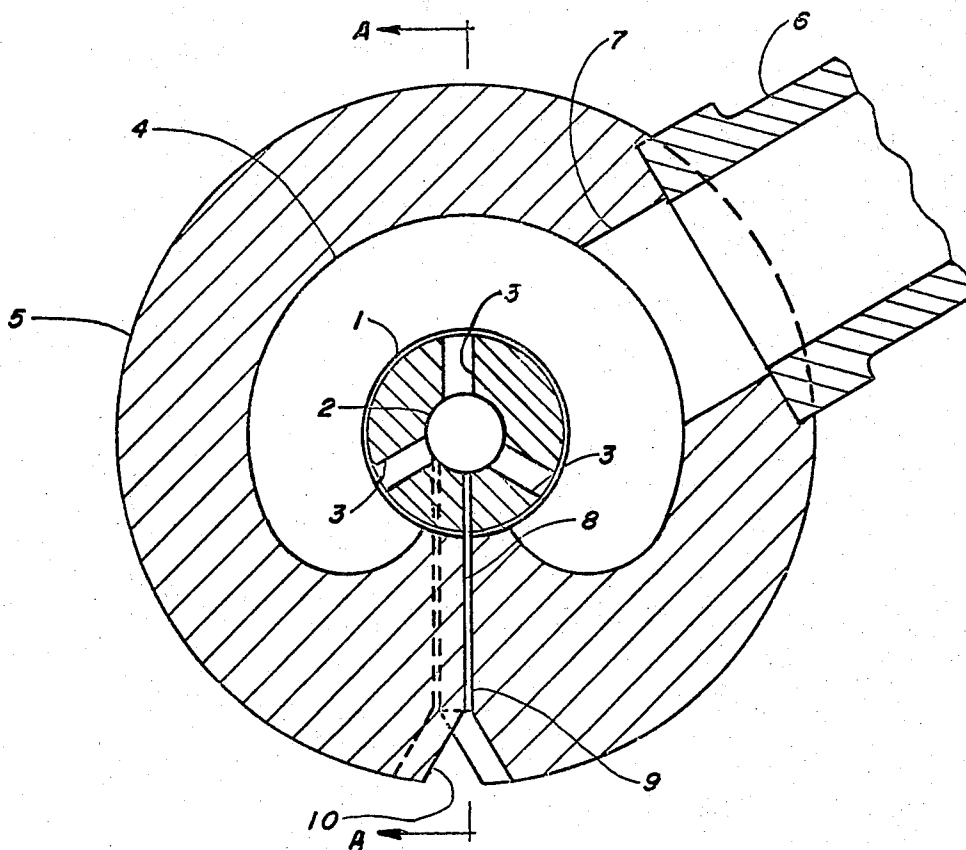
3,751,775 8/1973 Psaras..... **28/1.4**

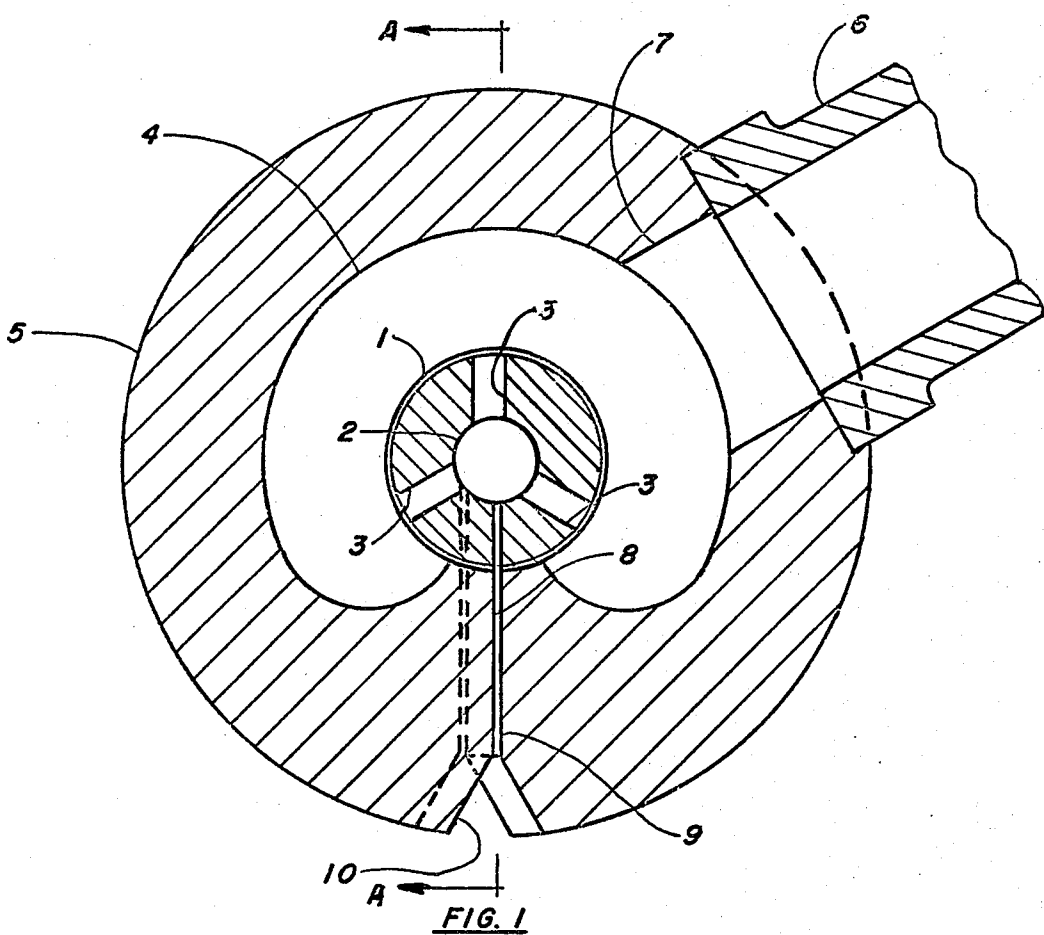
Primary Examiner—Louis K. Rimrodt
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[57] **ABSTRACT**

An improved apparatus and method for commingling multifilament yarn has been found. The apparatus comprises an elongated body having a straight yarn passageway with at least three orifices substantially equally spaced about the periphery of the body at substantially the same level. The orifice centerlines are offset so that they do not intersect with the center of the effective diameter of the yarn passageway. These orifices are drilled with a particular eccentricity, and communicate with a source of high pressure fluid which flows through the orifices into the yarn passageway causing yarn passing linearly through the passageway to have filaments commingled with one another. This improved process of entangling multifilament yarn can operate at from about 500 to about 8,000 feet per minute.

4 Claims, 6 Drawing Figures





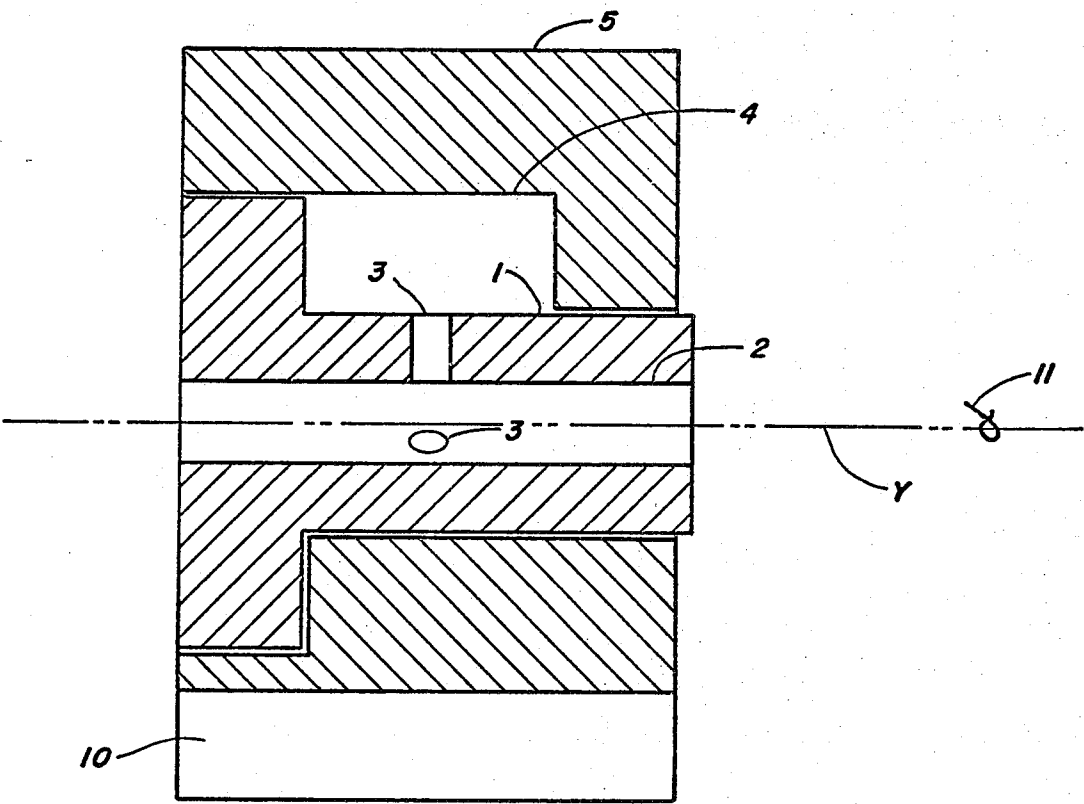


FIG. 2

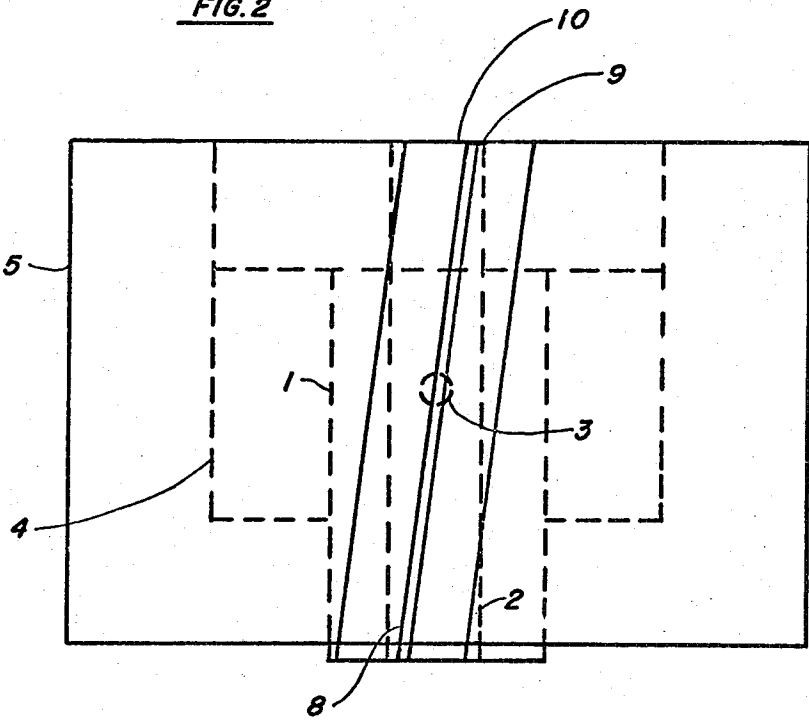


FIG. 3

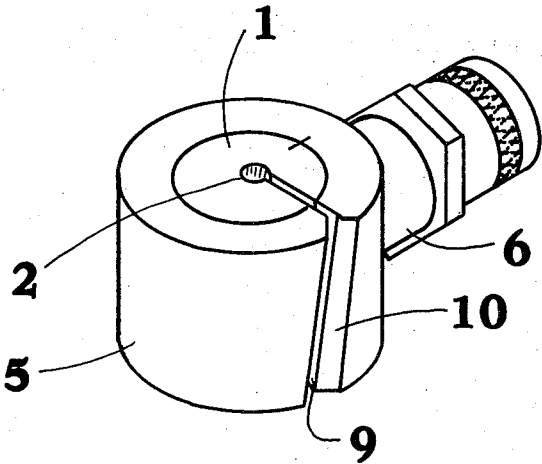


Fig. 4

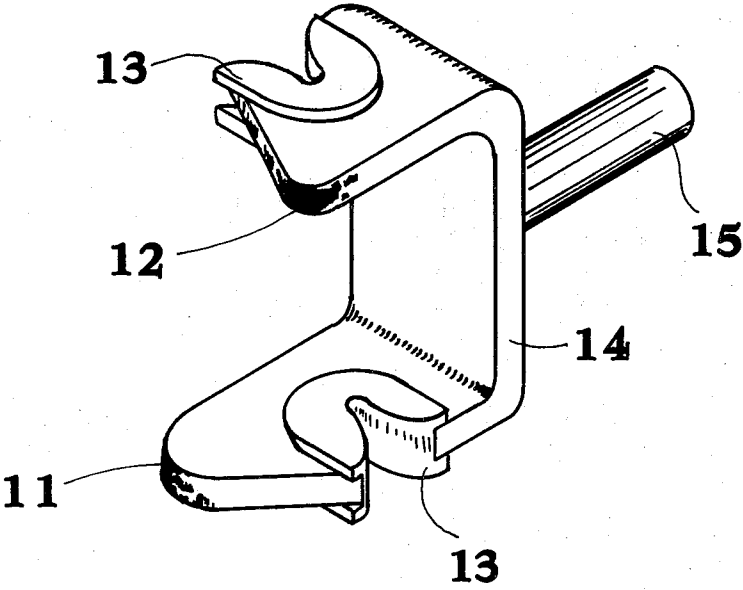


Fig. 5

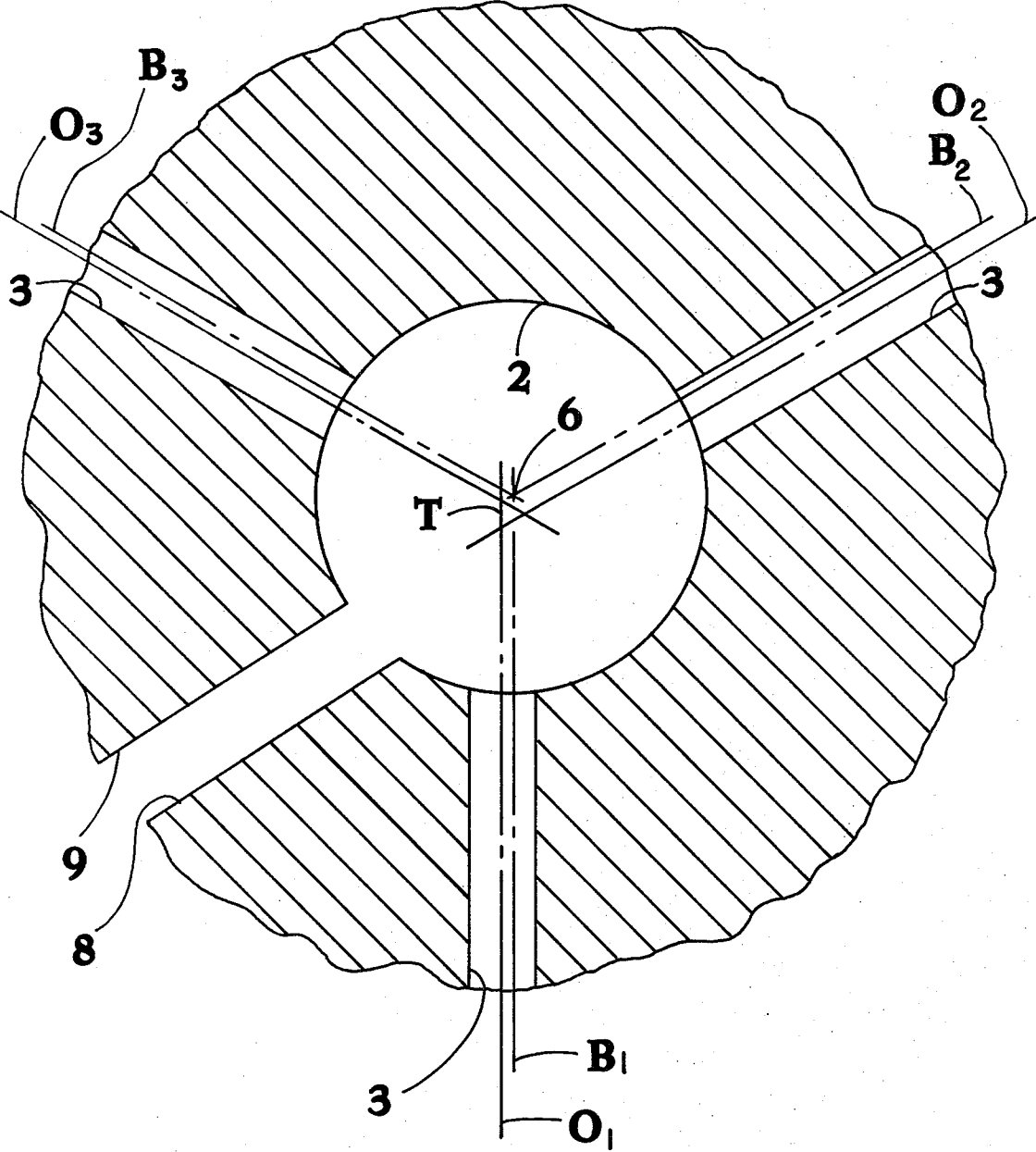


Fig. 6

COMMINGLING JET FOR MULTIFILAMENT YARN

BACKGROUND OF THE INVENTION

This invention relates to an improved method and apparatus for commingling or entangling multifilament textile yarn by passing a continuous strand of this yarn through a yarn passageway and directing high pressure fluid from orifices onto it.

Many prior art patents show various methods and apparatus for entangling a running continuous multifilament strand of yarn. However, the prior art is directed to intersecting and tangentially-directed fluid streams or combinations of them. For example, see U.S. Pat. No. 3,443,292 to Davis and U.S. Pat. No. 3,525,133 to Psaras.

This invention is similar to the invention in U.S. Ser. No. 260,676, filed June 6, 1972, now U.S. Pat. No. 3,751,775, granted 8/14/1973. However, that invention did not require that the orifices be offset in an opposed configuration such as right-left-right or left-right-left manner, now found to be essential to good entanglement.

SUMMARY OF THE INVENTION

The method and apparatus of this invention has shown a much more efficient entangling operation using up to 75 percent less air and costing as little as one-tenth of the cost of the prior art devices, with a much quieter operation. The method and apparatus can be used at speeds from 500 to 8,000 feet per minute. Specifically, the improved apparatus for commingling continuous multifilament yarn of this invention comprises an elongated body having a straight yarn passageway passing through the elongated body and at least three orifices substantially equally spaced about the periphery of the elongated body at substantially the same level. The orifices must have their extended centerline offset to one side from a radius of a circle of the effective diameter of a cross section of the yarn passageway at the orifice level. In other words, if a radius was drawn from the center point of the effective diameter these orifices would not have an extended centerline which would fall on that radius but instead would be offset. At least two of the orifices should be offset both to the same side, that is, if you were looking into the orifice from the outside toward the center of the effective diameter, they would be both offset to the left or both offset to the right. At least one of the orifice centerlines must also be offset in a direction counter to the other offset orifice centerlines. That is, if two are offset to the right, the third must be to the left. Also, none of the extended centerlines may intersect the center of the effective diameter. Another proviso is that the intersection of the extended centerlines form a polygon, such as a triangle, which must have a side nearer to the center of the effective diameter than an apex. These polygon sides must measure greater than 0.1 percent, but less than 7.5 percent of the effective diameter and the side must be at a distance greater than 0.1 percent, but less than 5 percent of the effective diameter from the center of the effective diameter.

The orifices communicate with a source of high pressure fluid. The high pressure fluid flows through the orifice into the yarn passageway causing swirling fluids so that any yarn passing linearly through the yarn passage-

way would have filaments commingled with one another.

By "effective diameter" is meant a diameter of the largest circle which fits within and yet is tangent to the opposite sides of the narrowest dimension across the yarn passageway. Thus, a circular yarn passageway has the same effective diameter as the actual passageway diameter. However, a polygonal passageway such as a rectangle would have an effective diameter equal to the narrowest dimension of the polygon. For example, a rectangular yarn passageway would have an effective diameter equal to the narrowest dimension of the rectangle.

A yarn entry slot may be present in the device to ease string up, but is not necessary.

The fluid can be any fluid which can be jetted through an orifice such as nitrogen, steam or possibly even liquids. However, the preferred fluid is air. When air is used, the fluid pressure of between 30 and 90 psig is preferred. This results in a maximum air consumption of about 10 standard cubic feet per minute for each commingling device. Compare this to about 60 SCFM consumption with the device of U.S. Pat. No. 3,473,315. Tension on the yarn passing through the commingling device can be any tension which gives the desired amount of commingling. The preferred range is from about 0.03 to about 0.2 gram per denier. The commingling device and method can be used on yarns of any denier but has been preferably used on textured 1,300 denier yarn or two ends of 1,300 denier yarn resulting in 2,600 denier yarn. The advantages of this specific commingling jet over all the prior art commingling jets are as follows: (1) This commingling jet provides strong tie points in the entangled yarn, that is, the points of entanglement in the yarn are much harder to pull apart than the prior art entanglements. (2) This commingling jet provides a very good uniformity of entanglements. That is, the entanglement tie points occur at regular lengths along the length of the yarn and the strength of each individual tie point is substantially the same. (3) Because this commingling jet has low skip area, that is, the length between tie points is not very long, it may be used at yarn speeds of 5,000 or even up to 8,000 feet per minute. It may be used for entangling all types of synthetic yarns, particularly textured carpet yarn. It reduces the splaying of yarn during subsequent handling operations. An additional improvement has been found in a double V-shaped guide to constrain the yarn as it enters and as it exits from the commingling jet of this invention. The bore size of the commingling jet where the yarn passes through varies, depending on yarn denier. For example, for 1,300 denier yarn, a 0.156 inch bore is preferred and for 2,600 denier yarn, a 0.180 inch bore is preferred.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross section of the plan view of the commingling device at the orifice level.

FIG. 2 is a cross section in elevation of the commingling device.

FIG. 3 is an elevation view of the commingling device showing the string-up slot.

FIG. 4 is an isometric view of the commingling jet of this invention.

FIG. 5 is an isometric view of the alignment guide through which the yarn feeds to the commingling jet of this invention.

FIG. 6 is a partial cross section of the commingling device showing the circumference of the effective yarn passageway with extended orifice centerlines.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The device of this invention has been successfully used to commingle a single and two ends of 1,300 denier 70 filament textured carpet yarns. The operating pressure range was between 60 to 90 psig and the air consumption was approximately 8 to 11 standard cubic feet per minute at this range of pressure. The operating yarn tensions were between 0.03 to 0.20 grams per denier. Yarn entanglement levels can be as high as 50 or more entanglements per meter for 2600/140 denier yarns (two ends of 1300 denier 70 filament) at 3,000 and 5,000 feet per minute.

Carpets were tufted from yarn commingled by the device of this invention on scroll and slat machines with good performance and overall appearance, hand, apparent weight, etc. In addition, shag carpets were made of individually commingled ends of light and dark dyed 1300 denier 70 filament yarn which were equivalent to carpets of non-commingled ends on all counts.

The typical dimensions of the commingling device used above were as follows. The circular yarn passageway length was 1 inch. The yarn passageway diameter was 0.180 inch. Three orifices were used at 1/2 inch from top. Each orifice diameter was 0.055 inch.

The special entanglement test is based on the hook-drop test in U.S. Pat. No. 2,985,995, May 30, 1961. This test has been modified to the special entanglement per meter test as follows. An entanglement among the filaments in the yarn bundle is so identified when it has the cohesion to "trigger" a needle which is allowed to slowly move through the yarn. The entanglement tester counts the number of times a needle with a 70 gram "trigger pull" in a horizontally moving yarn is "stopped." The instrument counts the "stop," raises the needle, moves a fresh portion of yarn under the needle, inserts the needle and starts the yarn moving. The instrument stops the test when the needle has moved through 2 meters of yarn. Approximately 1 meter of yarn by-passes the needle between needle insertions.

FIG. 1 shows a cross-sectional plan view at the orifice level of a commingling device of this invention. Inner body 1 has yarn passageway 2 passing longitudinally through it. Inner body 1 also has offset orifices 3 spaced substantially equally about the diameter of yarn passageway 2. These orifices are offset so that the centerline of each orifice, if extended, would not pass through the centerline of the yarn passageway 2. Orifices 3 communicate with manifold 4 which in turn communicates with large orifice 7 in register with tube fitting 6 which is secured to outer body 5. Outer body 5 also contains a string-up slot defined by the surfaces labeled 8 and 9. The string-up slot has a flared opening 10.

FIG. 2 is an elevation view cross section at A-A on FIG. 1 of the commingling device of this invention. Like numbers indicate the same apparatus as in FIG. 1. In addition, Yarn Y is shown passing through guide 11 above yarn passageway 2. Guide 11 and another guide identical below the commingling device keep the yarn Y centered through yarn passageway 2 to effect more efficient commingling.

FIG. 3 is an elevation view of the commingling device of this invention. Here again, like numbers indicate the same parts of the apparatus as in FIG. 1.

FIG. 4 is an external isometric view of the commingling jet. Like numbers indicate the same parts of the apparatus as in FIG. 1.

FIG. 5 is an isometric view of the double V-shaped guide of this invention, used to align the yarn on both sides of the commingling jet. Opposing V-shaped ceramic guides 13 are mounted in lugs 11 and 12 projecting at top and bottom from body 14 of the guide. The guide is mounted to a stationary fixture with rod 15. It can be used to replace guide 11 in FIG. 2. In addition, another double V-shaped guide could be used at the exit of the device of FIGS. 1 to 4.

FIG. 6 is a partial cross section at the orifice level of the commingling device of this invention, showing the offset orifice centerlines and centerlines extended. Inner body 1 has yarn passageway 2 or bore extending through it in a longitudinal direction and orifices 3 in a transverse direction, as shown. Slot surfaces 8 and 9 define the string-up slot in body 1. Bore centerline or radius lines B all intersect the center or midpoint of the effective diameter C. Orifice centerlines O are all offset from bore centerlines as shown. Note that the orifice centerlines O₁ and O₂ are offset to the left of respective bore centerlines B₁ and B₂ when visualized as looking into the bore through the orifice from the outside of the body 1. On the contrary, orifice centerlines O₃ is offset counter to O₁ and O₂, that is, O₃ is offset to the right of bore centerline B₃ visualized as above. These orifice centerlines O intersect near the center, to form triangle T, which does not include the center of the effective diameter C and measures at least 0.1 but less than 7.5 percent of the effective diameter across each side, and is located at a distance of greater than 0.1 percent but less than 5.0 percent of the effective diameter away from C with a side of T closer to C than an apex of T.

EXAMPLES

EXAMPLE 1

An extended run using the device of this invention to produce over 2.5 million pounds of yarn was made with 1300 denier 70 filament textured yarn at 3,000 feet/min. yarn speed using a device of 0.156 inch diameter bore and 0.055 inch diameter orifice holes. Results are shown in Table I below. The offset column refers to the orifices O₁, O₂ and O₃ shown in FIG. 6. "EPM" stands for entanglements per meter, tested as described above. The offset numbers are in thousandths of an inch away from the corresponding line labeled B. By "right" and "left" is meant the orifices are offset to the right or left of the bore radius lines B visualized as looking in toward the bore.

TABLE I

Position No.	Offset (X.001) Inches			EPM
	O ₁ Right	O ₂ Right	O ₃ Left	
1	3	5	3.5	23
2	3.5	5.5	3	26
3	3	4	3	24
4	4	5	3	29
5	3.5	4.5	2.5	25
6	3.5	4.5	3	22

TABLE I-Continued

Position No.	Offset (X.001) Inches			EPM
	O ₁ Right	O ₂ Right	O ₃ Left	
7	3	5	3	29
8	2.5	4	4	26
9	4	4.5	3	38
10	4	5	3.5	22
11	3.5	5	3	28
12	3.5	5	2.5	23
13	4	6	3.5	27
14	4	5	3.5	32
15	3	5	3	36
16	3.5	4.5	3	24
17	3.5	5	3	36
18	2.5	5	3	29
19	3	5	3	27
20	2.5	4.5	4	24
21	2.5	5	2	27
22	4	4.5	3	33
23	Unknown	Unknown	Unknown	43
24	2.5	4.5	3	31
25	3	5	3	25
26	3	5	3.5	28
27	3	5	3.5	35
28	3	4.5	4	20
29	2.5	6	2.5	24
30	3.5	5	2.5	23
31	3	4.5	3	25
32	3	4.5	3	36
33	3.5	4.5	4	27
34	3	5.5	3.5	36
35	4.5	5	2.5	33
36	3	5	3	41

EXAMPLE 2

Various experimental or pilot plant runs were made with the jets shown in following Table II.

TABLE II

Run	Bore Diameter Inches	Orifice Diameter Inches	O ₁ *	Offset (X0.001) Inches			Yarn Denier Filament	Yarn Speed fpm	Air Pressure psig	EPM*
				O ₂ *	O ₃ *					
1	0.180	0.55	R*7.5	L*7.5	R8		2600/140	5,000	70 & 85	above 35
2	0.180	0.55	L 4.5	L 3.5	L3		1300/70	3,000	70	less than 5
3	0.180	0.55	L 1.5	R 1	R.5		1300/70	3,000	70	less than 5
4	0.180	0.55	L 7	L 6.5	R3		1300/70	3,000	70 & 85	less than 5
5	0.146	0.55	L 2.5	L 3.5	R3		1300/70	3,000	70	25
6	0.180	0.55	L 3.5	L 6.5	R2		1300/70	5,000	70	28

* R means offset right as defined in Example 1.

L means offset left as defined in Example 1.

The O₁, O₂, and O₃ refer to the orifices position shown in FIG. 6. EPM means entanglements per meter measured as defined above.

DISCUSSION

All the devices of Example 1 and Runs 1, 5 and 6 fall within the limitations given in the Summary (above) and claims. The pattern of the extended orifice centerlines of Runs 2 to 4 fall outside the critical parameters. Run 2 device orifice centerlines extended form a triangle in the center of the bore which overlaps the center, therefore, does not have a side at a distance greater

than 0.1 percent of the effective diameter from the center of the effective diameter. The same is true for Run 4. Run 3 forms a triangle which is nearly a point, thus does not have a side of sufficient length, namely, at least 0.1 percent of the effective diameter.

We claim:

1. An improved apparatus for commingling multifilament yarn comprising an elongated body having a straight yarn passageway passing through said elongated body,

at least three orifices substantially equally spaced about the periphery of said body at substantially the same level,

at least two of said orifices having an extended centerline offset to one side from the radius of a circle of the effective diameter of a cross section of said yarn passageway at the orifice level and at least one of said orifices centerlines offset in a direction counter to the said other offset orifices, and so that none of said extended centerlines intersect the center of said effective diameter also provided that the intersection of the extended centerlines forms a polygon which must have a side nearer to the center of said effective diameter than an apex, also provided that the polygon side must measure greater than 0.1 percent but less than 7.5 percent of the effective diameter, and said side must be at a distance greater than 0.1 percent but less than 5.0 percent of the effective diameter from the center of said effective diameter

said orifices communicating with a source of high pressure fluid so that any yarn passing linearly through said passageway would have continuous filaments commingled with one another.

2. The apparatus of claim 1 wherein said fluid is air.

3. The apparatus of claim 1 wherein said apparatus also includes a double V-shaped guide, mounted so that said yarn is constrained and aligned to enter said yarn passageway.

4. The apparatus of claim 3 wherein said apparatus also includes another double V-shaped guide mounted so that said yarn is constrained and aligned to receive said yarn as it exits said yarn passageway.

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