

Sept. 21, 1965

KATSUMI NAGAHARA ETAL

3,206,922

NOZZLE FOR PRODUCING CRIMPED YARN BY THE TWISTING METHOD

Filed June 19, 1961

4 Sheets-Sheet 1

Fig. 1

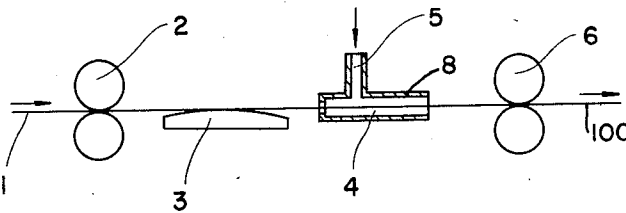


Fig. 2

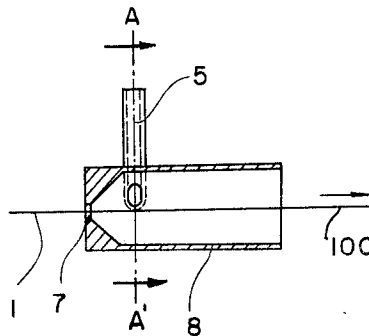


Fig. 3

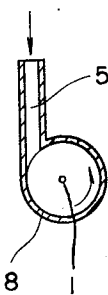
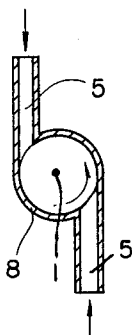


Fig. 4



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Fig. 5

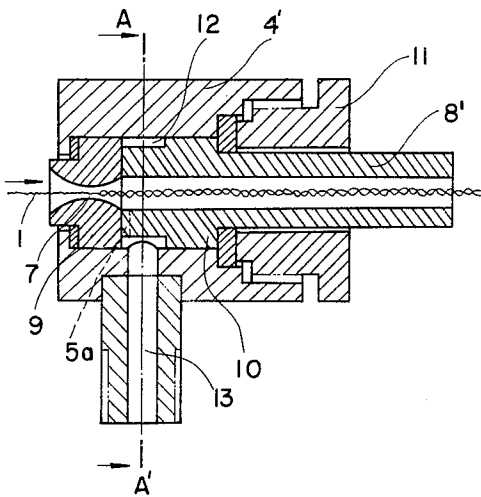


Fig. 6

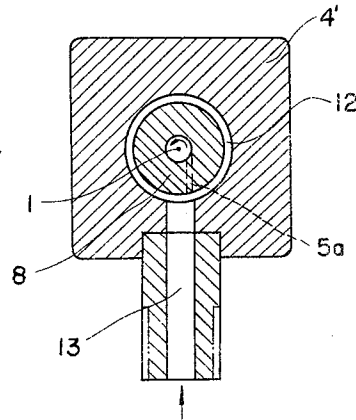


Fig. 7

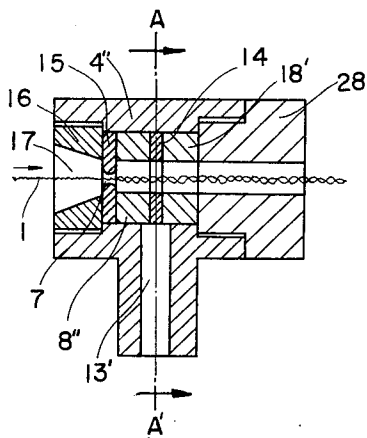
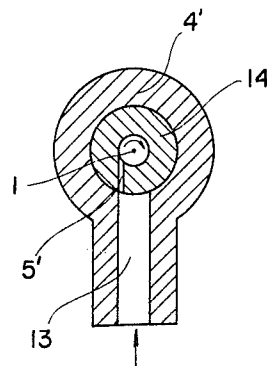


Fig. 8



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Fig. 9

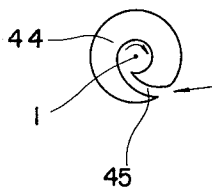


Fig. 10

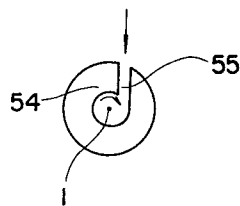


Fig. 11

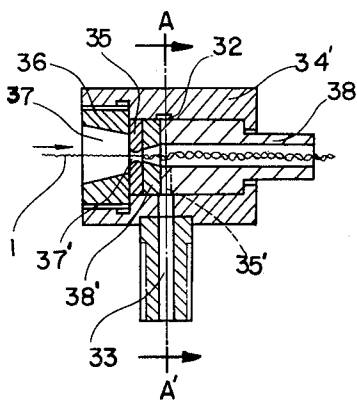
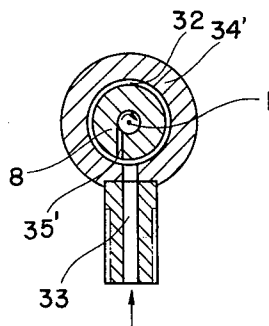


Fig. 12



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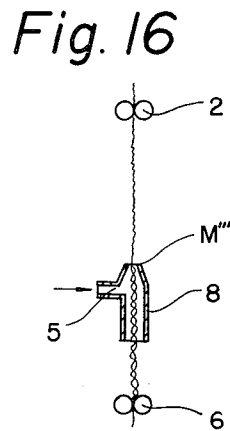
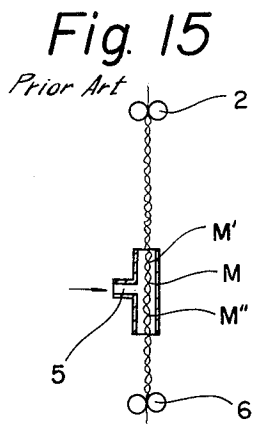
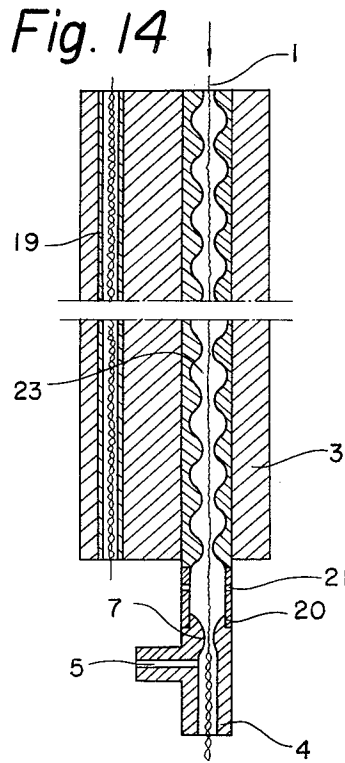
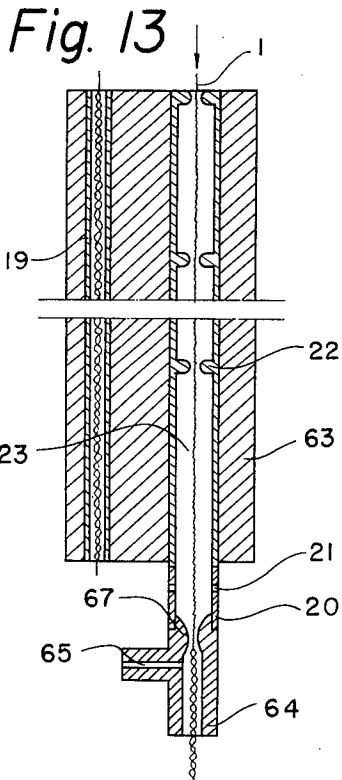
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NOZZLE FOR PRODUCING CRIMPED YARN BY THE TWISTING METHOD

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35/29,396; Dec. 26, 1960, 35/50,164; May 31,
1961, 36/18,909

8 Claims. (Cl. 57—77.3)

This invention relates to a nozzle for producing crimped yarn in which the yarn is twisted and untwisted by means of a gyrating fluid. More particularly the invention relates to a nozzle for crimping yarn which consists of a tubular passage for a filament, one end of which is constricted while the other end is left wide open.

While there have been various proposals made hitherto concerning the method of imparting crimping treatments to thermoplastic synthetic fibers, these have been, in short, those in which the fibers were heat set in their flexed state.

Among these, one continuous method of treatment, the so-called twisting method, has been practiced in which a false twister such as a spindle is used. According to this method during the interim in which the yarn passes through the heating means it is given a strong twist by means of a false twister and in this state heat set; and in the meantime while being untwisted is wound up. Hence, the flexed state of the individual filament which has been heat set in its strongly twisted state remains in a complex spiral state even after untwisting.

As another method of producing crimped yarn there is a method in which two or more yarn bundles are first given a twist for a given distance, the yarn bundles then being moved while the twisted portion is heated.

The former, on account of the use of a false twister, has the advantage that the treatment can be performed continuously so as to make possible the attainment of higher efficiency as compared with the method in which an up-twister, ring twister or the like is used and in which the steps of twisting and heat setting are performed intermittently. In the former, because of the special construction of the spindle used as the false twister, high speed operation is possible. This method has the disadvantage, however, of excessive equipment and maintenance costs. High speed spindles of this type that are in common use are those of 20,000–50,000 r.p.m. This being the case, the production also inevitably depends on the speed of spindle rotation. That is to say, while the number of twists to obtain the desired crimped yarn will vary depending upon the size of the yarn, in general, in case of a 100 denier yarn it is said to be about 2,000–3,500 twists per meter, thus being a yarn speed of about 25 m./min.

On the other hand, since in case of the latter method a spindle is not used, it is possible, to a certain extent, to increase the processing speed. However, because of the necessity of forcibly dividing that part of the yarn that was twisted in advance, if the speed of operation is raised too much, there is the defect that troubles such as yarn breaks, shagging, etc. occur.

In this respect, the method of the French Patent No.

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1,178,980 whose processing speed is several times that of the conventional methods since it does not employ a spindle nor require yarn dividing is believed to be the most ideal method.

In this method the structure of the nozzle exerts an important bearing on the twisting speed (hence the processing speed), the quantity of fluid used, the uniformity of bulk, and the bulk properties. However the nozzles illustrated in the specification of the aforementioned patent, such as that in which both ends are opened wide, that which has various bends in the yarn passage, or that in which the yarn passage is tapered in venturi fashion are not necessarily fully satisfactory with respect to the foregoing points.

In consideration of these points a primary object of the present invention is to provide a nozzle for producing crimped yarn in which the processing speed is high, the fluid consumption low, and in which yarn of excellent bulkiness with the bulk uniformly distributed is obtained.

Another object of the invention is to provide an easily made nozzle for producing crimped yarn.

The nozzle of the present invention comprises a tubular yarn passage into which has been provided a fluid jetting outlet discharging into the passage which is essentially perpendicular and tangential with respect to the axis of said passage. One end of said tubular yarn passage is constricted to hold to a minimum the tendency of the filament to balloon, and the other end is left wide open.

The present invention will be described hereinafter with reference to the accompanying drawings in which:

FIG. 1 is a schematic view to illustrate the method of producing crimped yarn using the device of the present invention;

FIG. 2 is a front elevation in longitudinal section showing an embodiment of a nozzle for producing crimped yarn according to the invention;

FIG. 3 is a cross-sectional view taken along line A–A' of FIG. 2.

FIG. 4 illustrates a modification in which the fluid inlet tubes have been provided in two places.

FIG. 5 being a front elevation thereof in longitudinal of the present invention in which not only its precision has been enhanced from a constructional standpoint but also the construction of which has been simplified; FIG. 5 being a front elevation thereof in longitudinal section and FIG. 6, a cross-sectional view thereof taken along line A–A' of FIG. 5.

In FIGS. 7 and 8, another embodiment of the nozzle of the invention is shown; FIG. 7 being a front elevation thereof in longitudinal section, and FIG. 8 being a cross-sectional view thereof taken along line A–A' of FIG. 7.

FIGS. 9 and 10 illustrate other embodiments of the annular member as used in the nozzles of FIGS. 7 and 8.

FIGS. 11 and 12 show still another modification; FIG. 11 being a front elevation thereof in longitudinal section; and FIG. 12, a cross-sectional view taken along line A–A' of FIG. 11.

FIG. 13 is a longitudinal sectional view of the nozzle to which has been combined integrally a heating means for effectively performing the heat setting.

FIG. 14 is a view showing the heating means of FIG. 13 in which the walls of the yarn passage have been made corrugated in form.

FIG. 15 is a schematic view showing the state of a

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filament as produced by the twisting action in case both ends of the nozzle are left wide open, while FIG. 16 shows the state of a filament produced according to the present invention.

Referring more particularly to the drawings, in FIG. 1, the starting yarn 1, consisting of one or more fibers, is fed by the feed rolls 2. This starting yarn is imparted high speed rotation by means of a fluid introduced from a fluid inlet tube 5 of a nozzle 4 for producing crimped yarn 100.

The numeral 3 is the heating means for setting the twist of the starting yarn 1, while 6 is the take-up rolls. The speed at which the starting yarn 1 is fed by the feed rolls 2 to the nozzle 4 for producing crimped yarn is so adjusted as to be greater than the speed of the take-up rolls 6. Hence with the vicinity of the fluid inlet tube as a dividing point, the starting yarn 1 on the feed side is imparted a twist while on the take-up side it is untwisted. Thus by being heat set at the twisted portion by means of the heating means 3 followed by untwisting, the yarn 1 is continuously crimped, withdrawn by the take-up rolls 6, and wound up.

Next, the nozzle for producing crimped yarn of the present invention will be described, reference being made to FIGS. 2 and 3. A cylindrical tubular body 8 has at its one end a yarn entrance 7 which has been constricted in order to reduce to a minimum the ballooning of the yarn, while its other end is left wide open. In addition, this tubular body 8 is provided with a fluid inlet tube 5 for imparting high speed rotation to yarn 1. Now while referring to FIG. 2, the function of the nozzle for producing crimped yarn will be described. The air which has been introduced into the interior of the tubular body 8 from the fluid inlet tube 5 suddenly expands and gyrates in the direction indicated by the arrow at an amazingly high velocity whereby the yarn 1 passing through said tubular body 8 has imparted to it a high speed rotation in the range of several hundred thousand revolutions per minute. For this purpose it is preferable that the fluid inlet tube 5 be installed in such a manner as to cause the fluid to be introduced in a direction perpendicular to the axis of the tubular body and tangential to said tubular body. The reason is that, as shown in FIG. 3 by an arrow, the force that gyrates the yarn is the component which acts on the yarn perpendicular to it. Consequently, by causing the flow of the fluid to be perpendicular to the axis of the tubular body it is possible to attain a maximum force. Additionally, by introducing the fluid at this instance in a direction tangential to the tubular body, a rotational force is created with a maximum of smoothness. Thus, it becomes possible to impart twisting effects that are most effective as well as uniform.

Now, the reasons why in the present nozzle the yarn passage consists of a tubular body with its one end being constricted while its other end is left wide open will be explained below:

As shown in FIG. 15, in a method such as this a spiral-like ballooning occurs in the yarn; and if both ends of the tubular body are left wide open as in FIG. 15, the ballooning of the yarn occurs back to the point of the rolls 2, resulting in an increase in the contact resistance of the yarn with air and the tubular body, by which a braking effect is imparted on the rotational force, thus causing a fall in the twisting efficiency. Again, in nozzles in which both ends are wide open, since the dividing point of the twist (with this as the turning point the direction of ballooning becomes opposite) frequently shifts from point M to either points M' or M'', twisting irregularities occur in spots. In nozzles that are constricted at one end, on account of the fluid's direction of escape being at all times towards the open end and thus stabilized, the dividing point of the ballooning, i.e., the dividing point of the twist (as shown in FIG. 16), is fixed at point M''', and remarkably stable twisting effects can be imparted.

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In the nozzle of the present invention, the entrance being constricted and the exit opening having the same diameter as the yarn passageway, the fluid supplied to the tubular body forms a gyrating air stream and pushes solely in the direction of the exit port. The center of the gyrating stream turns vacuous and the entrance serves as a suction port. Therefore, when the fluid is ejected at the beginning of operations, the yarn is automatically sucked into the tubular body and the stringing up operation is simplified. On the other hand, in the nozzle that is wide open at both ends, the fluid tends to push out the yarn and the stringing up operation becomes very difficult.

Moreover, in a tubular body having a yarn passageway that increases in diameter from the entrance port of the fluid conduit towards the exit port of the yarn passageway, the fluid supplied at right angles to the axis of the passageway and tangentially to the periphery of the passageway tends to turn parallel with the axis of the passageway earlier than in the tubular body of the present invention. Therefore, the velocity component of the fluid in the direction perpendicular to the axis of the passageway is smaller when compared with the present invention (this fluid is useful for a twisting effect). Further, the velocity component of fluid in the direction of the axis of the passageway inevitably increases in velocity and the tension of the yarn therein grows higher than in the present invention. This is unfavorable for a twisting effect. However, in the nozzles of the present invention with one end being constricted, the unnecessary ballooning is avoided, as shown in FIG. 16, thus minimizing frictional losses. Moreover, with one end being left open wide the twisting effect is remarkably good.

It is to be understood that the nozzle of the present invention is not limited to the use of one fluid inlet tube disposed in one location. It is possible, of course, to dispose two or more fluid inlet tubes in two or more locations, as shown in FIG. 4.

FIGS. 5 and 6 illustrate a modification of the nozzle of the present invention in which the tubular yarn passage has been separated into a constricted portion and a tubular body with a fluid jetting gap being provided at the surfaces where the two parts come together. In a hollow main nozzle body 4' there are precisely fitted an annular piece 9 whose both ends are flared and having a constricted yarn entrance 7, and a hollow tubular body 8. These members are assembled into a unit by means of a screw member 11 being screwed into the main nozzle body 4' so as to press against a ridge 10 of the tubular body 8'. The reason why the yarn entrance is flared is not only for facilitating the stringing up of the yarn but also for the reason that when an angular recess is present at the entrance scum adheres therein which, upon gradually accumulating, comes in contact with the yarn and results in a braking action being applied to the yarn. Therefore the flare is provided for eliminating such an undesirable recess. The numeral 12 is the annular fluid chamber which has been formed by an annular cutaway part at the end of the tubular body 8', the interior wall of the main nozzle body 4', and the end surface of the annular piece 9. The purpose of this fluid chamber is to equalize the jetting pressures of the fluid inlet tubes of each of the spindles, thereby providing a uniform amount of fluid being jetted in each of the spindles so as to eliminate unevenness in the twisting effects.

In the tip of the tubular body 8' a fluid inlet groove 5a is provided to introduce a fluid in a direction tangential to said tubular body, and when the tubular body 8' is pressed against the back surface of the annular piece 9 by means of the aforementioned screw member a tubular fluid passage is formed. While in the drawing only a single fluid inlet groove 5a is shown, a plurality thereof may also be provided as shown in the aforementioned FIG. 4. If a plurality of inlet grooves is employed, the fluid chamber 12 becomes an indispensable requisite, be-

cause in such a case the fluid chamber 12 becomes the passage for the fluid. However, even when only one fluid inlet groove is employed, it is desirable to have such a fluid chamber as described hereinabove. This is because the presence of a fluid chamber 12 would obviate the necessity of disposing the fluid inlet groove 5a so that it comes opposite the fluid feed pipe 13, thus greatly simplifying the assembly operations.

The functioning of the nozzle shown in FIG. 5 is as follows: The fluid introduced from the fluid feed pipe 13 is introduced via the fluid chamber 12 and the fluid inlet groove 5a (a tubular fluid passage being formed by union with the annular piece 9 as described hereinabove) into the tubular body 8' where it suddenly expands and gyrates at high velocity in the direction indicated by the arrow whereby the yarn 1 that passes through said tubular body 8' has imparted thereto high speed rotation.

It is very difficult to drill the fluid inlet tubes in a direction tangential to the tubular member, and it is particularly difficult when they are numerous, to drill all of them uniformly. In the case of the nozzle illustrated in the aforementioned FIGS. 5 and 6, if a groove is machined at one end of the tubular body 8', and a tubular passage is formed by union with the part 9, the machining work involved is greatly simplified while at the same time accuracy is attained. Moreover, the assembly of the nozzle is simplified.

FIGS. 7 and 8 illustrate another embodiment of the invention in which the yarn passage is divided into a constricted part, an annular plate and a tubular body. In the drawings is shown a most preferred form thereof in which a further division has been made resulting in the separation of two annular pieces, one each from the constricted part and the tubular body; thus constituting five members, namely a constricted part, an annular piece, annular plate, an annular piece, and a tubular body.

At opposite ends of a main body 4'' to which has been installed a fluid feed pipe 5' there are screwed in a hollow tubular body 28 and a screw member 16 having a yarn entrance 17. An annular piece 18', an annular plate 14 having a fluid inlet crevice 5', an annular piece 8'', and an annular plate 15 having a constricted entrance 7 for the passage of a yarn 1 are provided between tubular body 28 and screw member 16. As the crevice 5' of the annular plate 14 is held in between the annular pieces 18' and 8'' it forms a fluid inlet passage continuing from the fluid feed pipe 13'.

The functioning of the present nozzle, when described with reference to FIG. 7, is as follows: The fluid fed from the fluid feed pipe 13' fitted to the main nozzle body 4'' is introduced via the crevice 5' of the annular plate 14 (which forms a tubular passage by union with the annular pieces 18' and 8'') into the interior of the nozzle where it suddenly expands, setting up a high velocity gyrating air stream in the direction indicated by the arrow whereby the yarn passing therethrough is imparted a high speed rotation. The fluid inlet crevice of the annular plate 14 may also be made such that the whole of the fluid inlet tube assumes a curve shape indicated by numeral 45 in a plate 44 shown in FIG. 9, or the foremost part of the crevice (the portion that continues on to the tubular member) may be made to assume a parabolic shape as shown in FIG. 10 by numerals 54, 55. Since by doing this the jetted fluid is given directional property in advance, it becomes possible to obtain a much more effective high velocity gyrating air stream.

In addition, as the annular plates of these embodiments consist of a thin sheet material, not only is the work of providing the curved crevices therein simplified but also the assembly of these annular plates in the nozzle is readily accomplished.

While the annular piece 8'' and the annular plate 15, as well as the annular piece 18' and the tubular body 28 may be of integral construction, by dividing them as in the drawing there is the convenience that the distance

between the constricted part and the fluid inlet crevice may be changed as desired since the annular piece 8'' can be changed to another of an optional thickness.

FIGS. 11 and 12 illustrate still another embodiment of the invention. In this embodiment the yarn passage is made up of the divided members consisting of a constricted part, an annular piece and a tubular body. Precisely, a hollow member 38 at one end of which is provided a fluid inlet groove 35' is fitted into a main nozzle body 4' having an annular fluid chamber 32 and to which is installed a fluid feed pipe 33. The numeral 35 is the annular plate which has a constricted entrance 37' for preventing the further continuance of the ballooning of a yarn 1 passing therethrough. The numeral 38' is the annular piece for maintaining a prescribed distance between the fluid inlet groove 35' and the entrance 37'. This spacing is provided since the twisting effects decrease when said fluid inlet groove 35' and entrance 37' are too close to each other. The taper in the entrance 37' is for performing the same function as the flare in the aforementioned FIG. 5. The numeral 36 is the screw member for securing the tubular body 38, annular piece 38' and the annular plate 35 in the main nozzle body, and has a yarn entry mouth 37.

The functioning of this embodiment, when described with reference to FIG. 12, is as follows: The fluid from the fluid feed pipe 33 attached to the main nozzle body 34' introduced via the fluid chamber and the fluid entry groove 35' (which by union with the other parts forms a tubular passage) imparts high velocity gyration to the yarn 1 in the direction indicated by the arrow. This also is readily fabricated, its machining and assembling being simple to perform.

In FIG. 13 is illustrated an embodiment in which to the entrance side of the nozzle 64 a heating means 63 having a tubular or a U-shaped grooved yarn passage has been installed. This heating means is heated by means of a heating element 19, thus heat setting the yarn 1 that passes through said yarn passage. The intertwined lines within the heating element 19 designate the heat sources, such as Nichrome wires and the like. The reference character 20 is the insulation for preventing the transmission of the heat from the heating means to the nozzle. The numeral 21 represents small holes provided in the insulation which have been provided for preventing the heated air from being sucked into the nozzle from the yarn passage 23 as a result of the suction that occurs at the entrance 67; i.e., as air enters from the small holes 21 when suction occurs at the entrance 67, the air of the yarn passage 23 is not sucked in.

In this embodiment shown in FIG. 13, since the heating means continues from the nozzle, the heat setting is accomplished at that part where the number of twists is great. Consequently, besides obtaining excellent crimps the equipment also becomes compact.

Furthermore, because the passage for the yarn is made a tubular or of U-shaped groove-like form, the frictional resistance is not as great as compared with the conventional method of contacting the yarn with a heated plate. Thus the tension that is exerted on the yarn is less, and thus a stronger twist is imparted resulting in an increase of the amount of crimp. Particularly in case the yarn passage is made tubular, with the yarn passage and nozzle being directly connected and no portion being exposed to the outside atmosphere and furthermore with the yarn passage 23 being subject to some suction from the bottom part, the air inside the yarn passage 23 has difficulty in escaping and thus there is the advantage that heat losses can be prevented.

Further, as to the small holes 21, these are not necessarily required since by the effects of the jetting pressure of the fluid from the fluid inlet tube 65 and other effects, the amount of heated air from passage 63 which is sucked into entrance 67 can be substantially reduced to zero.

While 22 is also for enhancing the heating effectiveness by enlarging the surface for giving off the radiant heat, by making the walls of the yarn passage 23 in corrugation as in FIG. 14 identical effects can be achieved. These however are not indispensable to the invention.

Next, in the table below will be given a comparison of the number of crimps (crests/25 mm.) obtained when crimping was performed employing the different types of nozzles while using as the starting yarn a 120 denier polyvinyl chloride fiber.

	Tube diameters (mm.)			Pressure (kg./cm. ²)			
	Entry dia.	Tube dia.	Outlet dia.	1.5	2.0	2.5	3.0
A-----	0.7	2.5	2.5	23.4	26.5	30.2	36.5
B-----	0.7	2.5	0.7	12.0	17.3	16.3	22.0
C-----	2.5	2.5	2.5	17.3	20.3	23.2	24.5

A is the nozzle of the present invention.

B is a nozzle in which both ends of the tubular yarn passage are constricted.

C is a nozzle in which both ends of the tubular yarn passage are left wide open.

Processing conditions:

Crimp setting temperature -----° C-- 140

Crimping process speed -----m./min-- 80

Overfeed -----percent-- 6

Sectional area of yarn passage 8/sectional area of fluid inlet tube 5=9.8.

As apparent from the above table the number of crimps obtained, when the nozzle of the present invention was used, was on the whole excellent.

While in the so-called false twister that uses a rotating pin even if the number of rotations is low this can be taken care of by reducing the speed of the yarn, thus increasing the amount of crimping. On the other hand, since in the method of the present invention which uses a fluid the yarn is merely riding the gyrating air stream and as such not being held positively, there is no correlation between the amount of crimping and the speed of the yarn, it being a fixed value under fixed conditions. The amount of crimping cannot be increased by reducing the speed of the yarn; nor is the amount of crimping reduced by an increase in the speed of the yarn. Therefore, since according to the present invention it is possible to increase the processing speed several tens of times as compared with the instance when a rotating pin type false twister is used, in this respect the invention possesses great significance.

While not shown in the foregoing table, it is to be noted that even in case of those yarns whose number of crimps attain a certain level, crimping skips occur in proportion as the diameter of the entrance approaches that of the tubular body, thus rendering impossible the obtaining of excellent crimped yarn. This is believed to be due to the nonuniformity of the twisting effects caused by the occasionally occurring irregularities in the tension resulting from the ballooning of the yarn.

In the present invention what is meant when it is said that the yarn entrance is constricted is that the diameter of the yarn entrance is at least less than 10 times the diameter of the yarn, it preferably being 7-8 times with 5-6 times being particularly desirable.

Furthermore, in the nozzle of the present invention the fluid inlet tube is advantageously provided at a point 1-10 mm. from the yarn entrance 7, with the ratio of cross-sectional area of fluid inlet tube to that of the tubular yarn passage being 1:5-1:10.

By having made the distance between the entrance 7 and the fluid inlet tube 5 from 1 to 10 mm. the property of the crimp obtained was very excellent as shown in Table I. By having made the cross-sectional area ratio of the fluid inlet tube 5 to that of the tubular yarn passage 8 from 1:5 to 1:10, the consumption of the fluid

was reduced, and not only was it possible to obtain very uniform twisting effects but also the untwisting could be made uniform.

TABLE I

Number of crests per 25 mm.

Pressure (kg./cm. ²)	Distance (mm.)						
	2	4	6	8	10	12	14
1.5-----	20.6	24.5	23.9	19.6	18.5	16.4	16.1
2.0-----	27.3	37.5	33.6	25.4	19.4	17.5	17.1
2.5-----	29.6	35.2	39.6	34.7	29.3	24.8	21.1

15 Starting yarn used ----- 120 denier 40 filament polyvinyl chloride fiber.

Processing speed ----- 100 m./min.

Overfeed ----- 6%

Diameter of yarn passage

20 8 ----- 2.5 mm.

Length of above ----- 60 mm.

Ratio of cross-sectional area of above/cross-sectional area of fluid inlet tube=9.6

TABLE II

Number of crests per 25 mm.

Pressure (kg./cm. ²)	Ratio of cross-sectional area				
	1	5	10	15	20
1.5-----	22.1	36.2	16.8	(1)	(1)
2.0-----	25.5	39.5	19.9	(1)	(1)
2.5-----	26.1	41.4	38.2	12.8	(1)
3.0-----	(1)	(1)	39.3	22.1	13.1
3.5-----	(1)	(1)	(1)	29.9	18.0
4.0-----	(1)	(1)	(1)	(1)	19.2

¹ Not possible.

40 Starting yarn used ----- 100 denier 24 filament nylon.

Processing speed ----- 100 m./min.

Overfeed ----- 10%

Diameter of yarn passage ----- 25 mm.

Length of same ----- 60 mm.

45 Distance from entrance to fluid inlet tube ----- 5 mm.

Even though the number of crimps is less when the cross-sectional area ratio is 1:1-1:4 there are present faults such as that the crimps lack uniformity, that the untwisting is not uniformly effected or that the occurrence of snags becomes great. On the other hand, at a ratio above 1:10 the number of crimps decreases noticeably.

55 As to the distance from the yarn entrance to the exit this preferably should be more than 10 times the diameter of the tubular yarn passage. If this ratio is small, the high velocity rotating air stream is not able to fully seize the yarn and the gyrating force that acts on the yarn is weakened, and thus the number of crimps decreases. Moreover, irregularities in the untwisting occur as a result of even slight irregularities in the tension imparted to the yarn.

Having fully described the invention, what is claimed is:

65 1. A nozzle for producing crimped yarn by the twisting method comprising means defining a tubular yarn passage and a fluid inlet tube disposed in a direction substantially perpendicular and tangential to the axis of said tubular yarn passage, characterized in that the inlet end of said tubular yarn passage is constricted for the purpose of minimizing ballooning of the yarn, said yarn passage ahead in the running direction of the constricted portion being substantially cylindrical and the other end of said yarn passage being left wide open, said tubular

yarn passage being divided into a constricted portion and a tubular body, and a fluid inlet groove being provided in an adjoining surface of said constricted portion of said tubular body, forming part of said inlet fluid tube.

2. The nozzle is defined in claim 1 wherein said fluid inlet tube is disposed at a point from 1 to 10 mm. from the point of constriction of said constricted portion.

3. The nozzle as defined in claim 1 wherein the ratio of the cross-sectional area of said fluid inlet tube to that of the yarn passage of said tubular body is from 1:5 to 1:10.

4. The nozzle as defined in claim 1 wherein the length of the yarn passage of said tubular body is more than 10 times the diameter thereof.

5. The nozzle as defined in claim 2 wherein the ratio of the cross-sectional area of said fluid inlet tube to that of the yarn passage of said tubular body is from 1:5 to 1:10.

6. The nozzle as defined in claim 2 wherein the length of the yarn passage of said tubular body is more than 10 times the diameter thereof.

7. The nozzle as defined in claim 3 wherein the length of the yarn passage of said tubular body is 10 times the diameter thereof.

8. The nozzle as defined in claim 2 wherein the length

of the yarn passage of said tubular body is 10 times the diameter thereof, and the ratio of the cross-sectional area of said fluid inlet tube to that of the yarn passage of said tubular body is from 1:5 to 1:10.

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