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YARN FLUID TREATING APPARATUS

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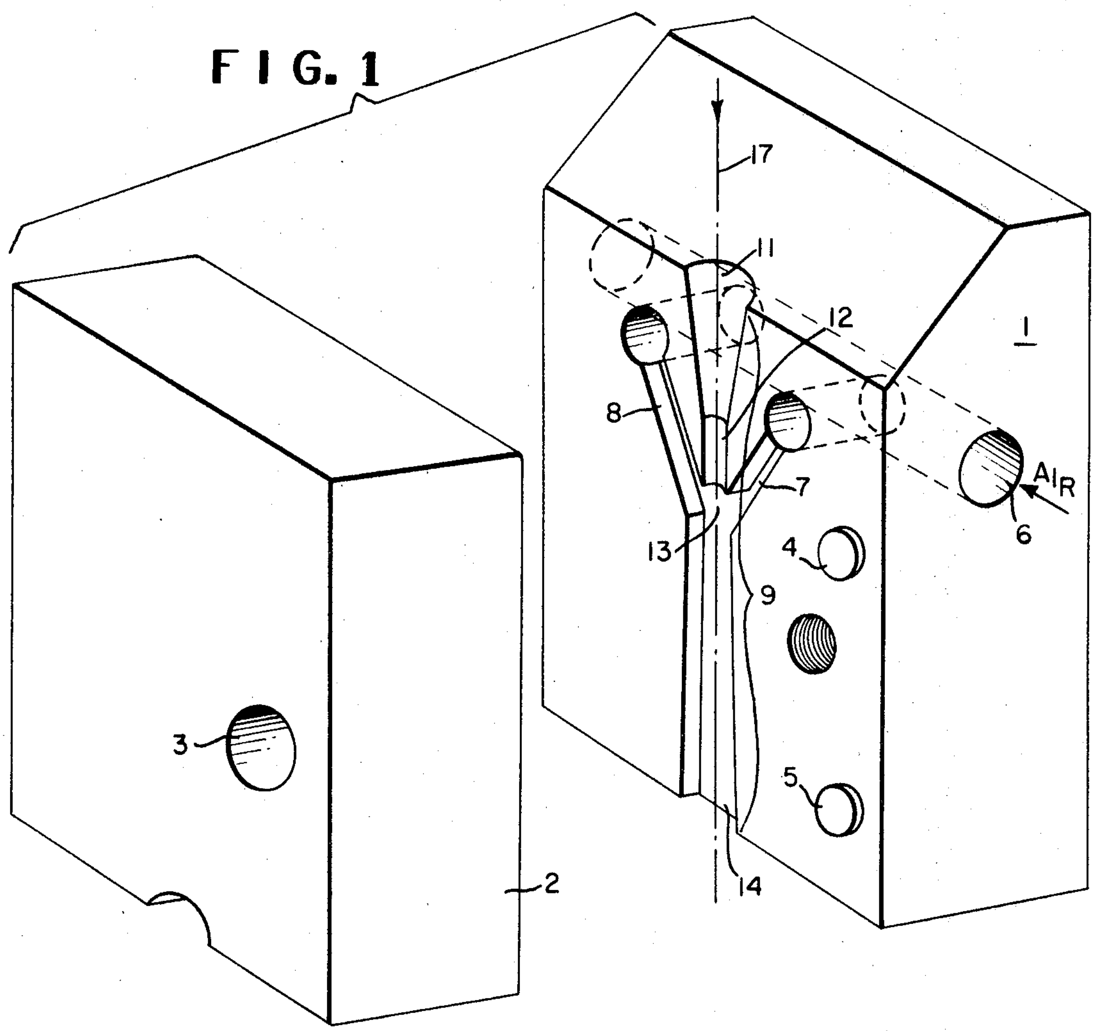
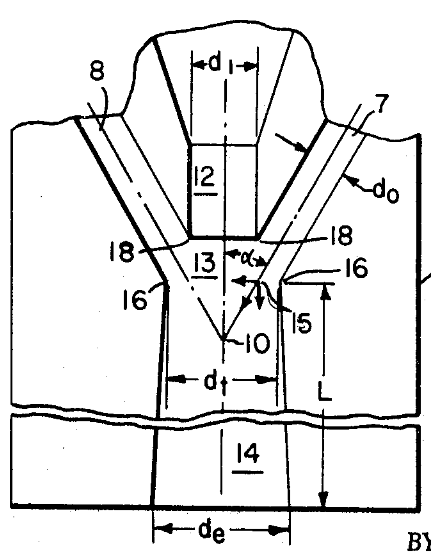
F I G. 1



F I G. 2



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YARN FLUID TREATING APPARATUS

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Int. Cl. D02g *1/16*
U.S. Cl. 28—1.4 4 Claims

ABSTRACT OF THE DISCLOSURE

In a yarn bulking jet through which yarn passes for treatment a particular arrangement of the yarn passage through the jet and the fluid conduits connected to the yarn passage for impinging fluid against the yarn functions to increase the fluid velocity just prior to its impingement on the yarn.

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation of my copending application Ser. No. 667,924, filed Sept. 15, 1967, and now abandoned.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to apparatus for use in treating synthetic filaments with hot gas or steam to introduce a random curvilinear crimp, improve dyeability, or modify other properties, and is more particularly concerned with jet-treatment devices which produce a degree of crimp equal to jets of the prior art and at the same time give a greater degree of filament entanglement to improve yarn bundle cohesion. Since these devices are especially useful for providing bulk in multi-filament yarns or tows, they will be referred to hereinafter as bulking jets. However, they are also useful for treating filamentary strands with fluids for other purposes in various processes known to those skilled in the art. The bulking jets of the present invention are most useful for the types of yarn treatments disclosed in greater detail in Clendening U.S. Pat. No. 3,169,296, dated Feb. 16, 1965 to produce bulked textile products as described in Breen et al. U.S. Pat. No. 3,186,155, dated June 1, 1965.

Description of the prior art

Even though most bulking jet types introduce some degree of entanglement during bulking certain designs are particularly effective in producing entanglement during bulking. For example, the jet body shown in FIG. 6 of Clendening U.S. Pat. No. 3,169,296 when using two fluid orifices, 29′ and 29″, and employing the core of FIG. 2 of that patent, gives a more cohesive yarn than the same device using a single fluid entrance. The bulking device shown in Claussen et al. U.S. Pat. No. 3,055,080 also produces crimp and entanglement on a large tow which is spread out into a thin ribbon for bulking. However, the Claussen device, even when miniaturized to operate on smaller yarns, during bulking, does not produue both crimp and entanglement in the degree desired for current fabric-making processes. A large number of prior art jet types having conical yarn entrance sections and conical or cylindrical bulking chambers and fluid exit sections are subject to spiral fluid flow patterns which can twist the yarn erratically and produce zones of low bulk. This is a particular problem when such jets are operated at high fluid pressures in an attempt to obtain maximum crimp and entanglement. Such twisting effects are intensified by the difficulties of manufacturing jets to sufficiently close tolerances to avoid some degree of fluid

velocity tangential to the yarn line. Finish, which may be applied to the yarn prior to the bulking operation, is partially removed from the yarn by the hot fluid and is deposited on portions of the jet wall where yarn touches only occasionally. These deposits snag and break filaments and disrupt fluid-flow patterns, causing a deterioration in product quality and requiring expensive maintenance.

SUMMARY OF THE INVENTION

The bulking jet of the invention comprises a flat body and cover clamped together by a fastener means, a longitudinal yarn passage recessed in the surface of the body contiguous with the cover, the yarn passage having tapered and cylindrical lengths, a throat region and a continuously expanding treatment chamber, dual fluid conduits of equal cross-sectional area disposed on either side of the passage in the same plane as the passage and intersecting the throat region at a shallow angle, a supply manifold operatively connected to the fluid conduits and communicating with a source of pressurized fluid, the throat region having an exit width about 1.5 times greater than its entrance width and about twice the width of either fluid conduit. The present invention provides an improved type of bulking jet which produces fluid turbulence patterns suitable for bulking the yarn and at the same time entangling it to a higher degree than was afforded by jets of the prior art. The cited critical dimensions permit the fluid streams to go supersonic just prior to impinging on the yarn, thereby increasing the fluid forces perpendicular to the yarn line which function to entangle the filaments. The rectangular cross-section of the fluid channels and the yarn treatment channel minimize detrimental swirling of the fluid. Zones where finish deposits can collect are minimized, and the design is particularly suitable for accurate mass production of identical jet units.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of the subject jet with the cover member removed to show the yarn treatment passageway and dual fluid inlets.

FIG. 2 shows a close-up plan view of the yarn treatment passageway and dual fluid inlets.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in the drawing, the device is composed of a body **1** and a detachable cover **2** which is secured to the body **1** by a conventional threaded fastener (not shown) which protrudes through aperture **3** provided for that purpose. A pair of locator dowel pins **4** and **5** in the body **1** engage matching cavities in the cover **2** and serve to align the cover and body. An internal supply manifold **6** within the body **1** furnishes pressurized treatment fluid to a pair of conduits **7** and **8** of equal cross-section which communicate with a longitudinal yarn passage **9**. Fluid conduits **7** and **8** and treatment chamber **14** are rectangular cross-section cavities which are arranged so that their centerlines intersect at a common point **10** (FIG. 2) on the axis of passage **9**. It is noted that any type treatment fluid such as condensing vapor or inert gas can be used with good effect and is supplied to manifold **6**. In the present case, heated pressurized air is preferred.

Upstream of point **10**, yarn passage **9** consists of a frusto-conical tapered length **11**, to facilitate entrance of a moving yarn line **17**, leading into a cylindrical length **12** of constant cross-section. Immediately thereafter, passage **9** abruptly forms a throat region **13** into which conduits **7** and **8** supply pressurized fluid. The conduits intersect throat region **13** forming sharply defined upper and lower edges respectively designed as **18**, and **16** (FIG. 2). It is important for product uniformity that cylindrical length 12 terminate in the throat region 13 perpendicular to the longitudinal axis of passage 9. Fluid conduits 7 and 8 have the same depth as throat 13 and yarn treatment chamber 14 and lie in the same plane. At the downstream or lower edges 16 of fluid channels 7 and 8, passage 9 becomes an elongated continuously expanding yarn treatment chamber 14. Chamber 14 must expand to establish and sustain supersonic flow of the treatment fluid.

As best shown in FIG. 2, the geometric proportions of the jet cavities are precisely predetermined to establish a specific fluid flow condition within the throat region 13 and the treatment chamber 14. It is highly desirable to establish at the outset a highly turbulent condition in the throat region 13. Accordingly, conduits 7 and 8 are angularly disposed into passage 9 in opposition to each other at a relatively shallow angle. This angle designated in FIG. 2 as angle α is preferably held to about 30°. It is of equal importance that width d_l of cylindrical length 12 be less than the throat region width d_t.

In actual operation, optimum operability occurs when d_t is about $1.3d_l$. In addition, the width d_0 of conduits 7 and 8 respectively is equal to about ½ the throat region width d_t. Lastly, exit width d_e of chamber 14 is made slightly greater than d_t so that the chamber 14 continues to expand throughout its entire length. The length L of chamber 14 depends on the treatment time required by the product to be bulked.

Since entangling is performed chiefly by the components of fluid velocity which are directed perpendicularly to the yarn axis, it is important for maximum entangling that such perpendicular velocity components be as high as possible to exert maximum entangling force on the filaments. By the particular selection of dimensions of this invention, the fluid streams which have been traveling at sonic velocity through the conduits 7 and 8 become supersonic after they have passed the point of minimum throat area d_t. This occurs at or near point 15, as shown in FIG. 2. Shock waves are generated by the transition to supersonic flow and are propagated with less loss through the supersonic medium than through one of less velocity. For this transition to occur at or before the point where the fluid impinges on the yarn, it is critical that point 10, where the longitudinal axes of the conduits 7, 8 intersect the axis of the yarn passage 9, be downstream of the zone of minimum channel cross-section d_t i.e. within chamber 14. If point 10 is upstream of d_t, and falls within throat region 13 as in jets of the prior art, the fluid velocity in the region where the fluid streams meet the yarn is sonic or sub-sonic and therefore entangling forces are less. An additional criterion to maximize the fluid velocity vector transverse to the yarn line is that the intersection between the downstream wall of the fluid channel and the side wall of the treatment channel, edges 16, must not be rounded or chamfered enough to produce a "Coanda effect" but must be sharp enough to cause the flow to separate from the wall at this region.

Bulking jets of the present invention were tested against those of Clendening described above, each being sized for the particular yarn to be treated and each being operated at conditions which gave optimum bulk and entanglement. The bulk level of yarns ranging from 1300 to 3700 denier from the two types of jets was approximately the same for each yarn count whereas the degree of entanglement measured by the hook drop test in Bunting et al. U.S. Pat. No. 2,985,995, of the yarns made by the jets of the present invention was greater than those of the Clendening jets by factors of $1.3x$ to over $2x$.

What is claimed is:

1. A yarn bulking jet including a body having a passage extending along a straight axis therethrough and through which yarn passes for treatment, a pair of angularly disposed conduits into the passage for directing fluid against opposite sides of the yarn, fluid supply means connected to said conduits, wherein the improvement comprises: said passage including successively, tapered and cylindrical lengths, an enlarged throat region and a continuously expanding rectangular treatment chamber, said conduits intersecting said throat region in an opposed relationship forming, upper and lower edges and having equal rectangular cross-sectional areas, said treatment chamber extending downstream from said lower edge, said conduits having longitudinal axes which intersect the passage axis at a point within said treatment chamber.

2. The jet defined in claim 1 wherein the cross-sectional area of each of the fluid conduits is approximately equal to ½ the minimum cross-sectional area of the treatment chamber.

3. The jet defined in claim 1 wherein said conduits are disposed from the axis of the passage at an angle of approximately 30°.

4. The jet defined in claim 1 wherein the intersection of the conduits with the throat region form sharp lower edges.

References Cited

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U.S. Cl. X.R.

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