United States Patent

Yngve

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[54] YARN-TREATING JET

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[52] **U.S. Cl.** **28/1.4**

[51] **Int. Cl.** **D02g 1/16**

[58] **Field of Search** ..... 28/1.4, 72.12; 57/34 B, 157 F

[56] **References Cited**

UNITED STATES PATENTS

2,938,256	5/1960	Bauer et al.	28/1.4
2,995,801	8/1961	Cormier et al.	28/1.4

Primary Examiner—Louis K. Rimrodt

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[57] **ABSTRACT**

A yarn-treating jet comprising a body and a flat cover clamped together and having two air conduits of equal rectangular cross section for directing heated fluid on a yarn advancing through a passage in the surface of the jet body contiguous with the cover. The passage includes an expansion zone located downstream from the air conduits which has an entrance larger than its exit for the purpose of providing an extended static pressure zone in the jet to improve heat transfer between the heated fluid and the yarn. The cover plate has a guiding surface adjacent the exit of the jet for diverting fluid and entrained yarn outwardly away from the jet exit.

8 Claims, 5 Drawing Figures

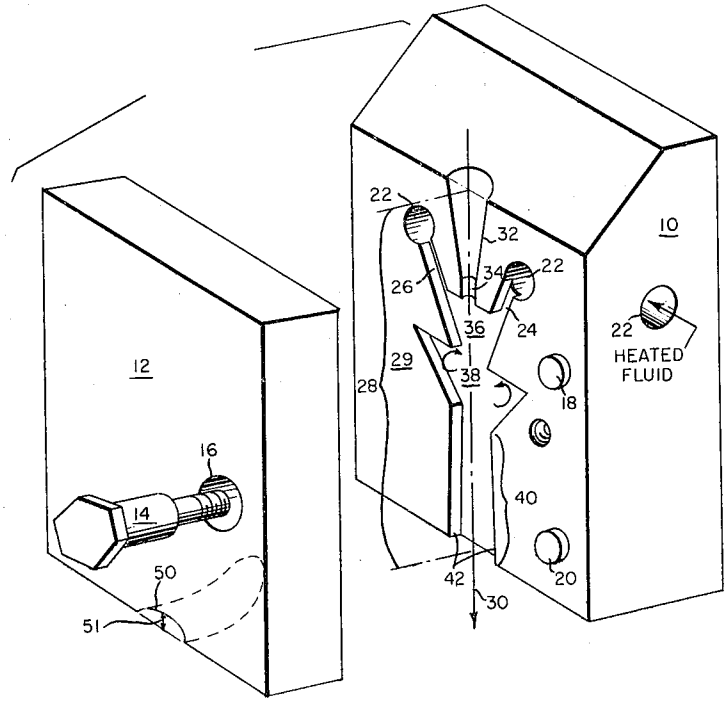


FIG. 1

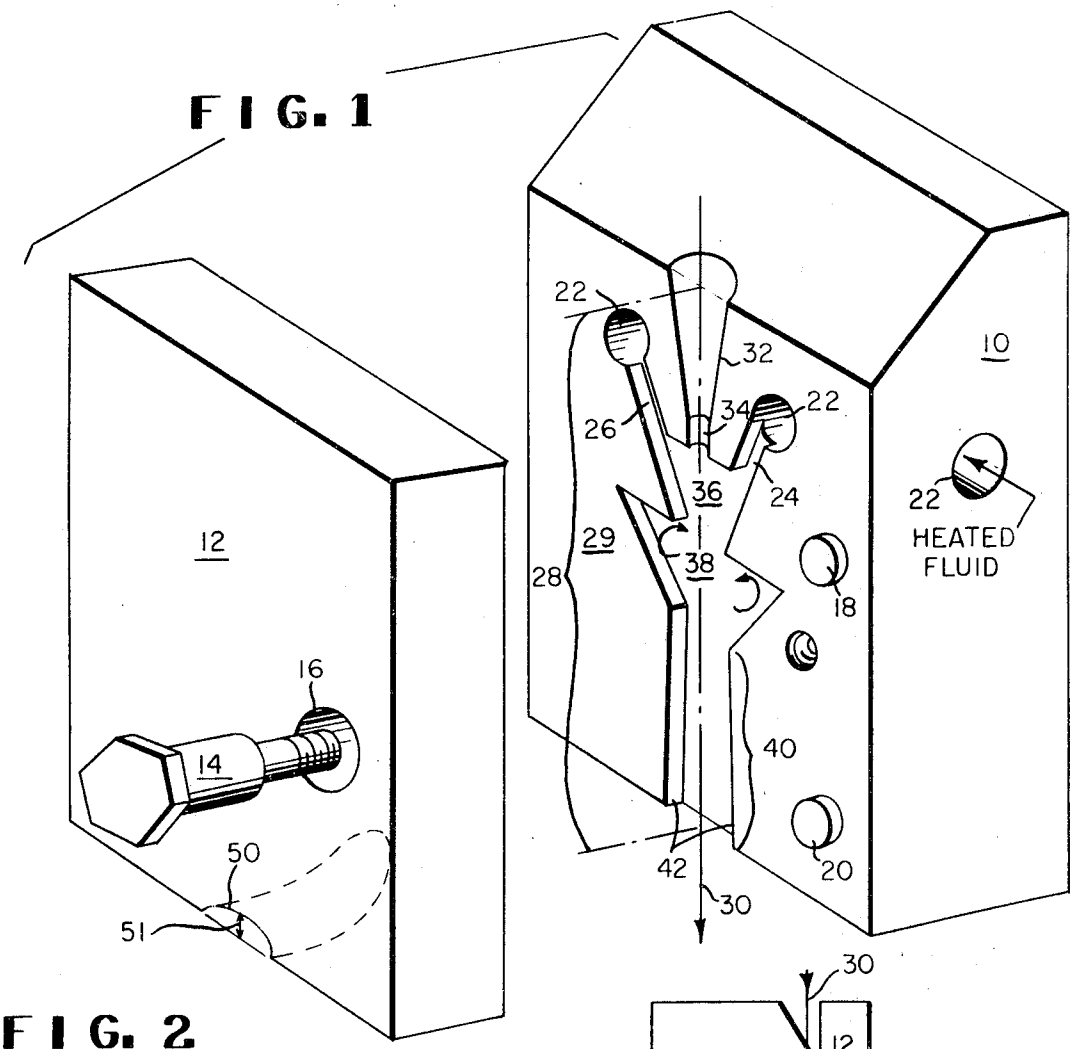
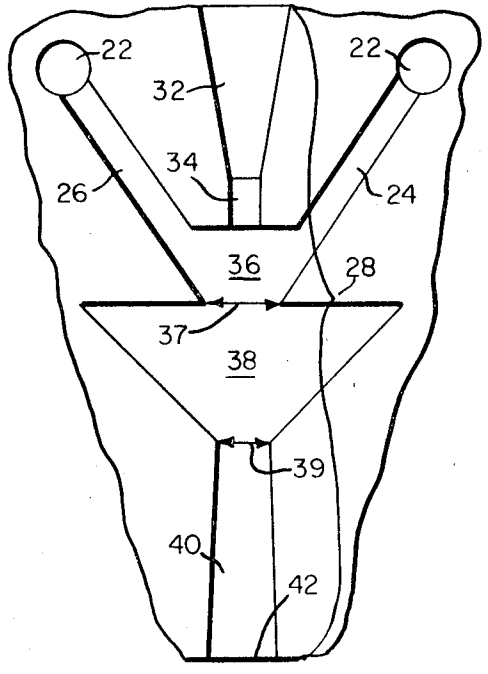


FIG. 2



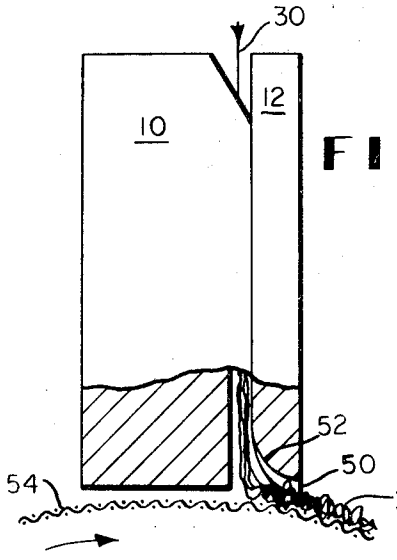


FIG. 3

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FIG. 4

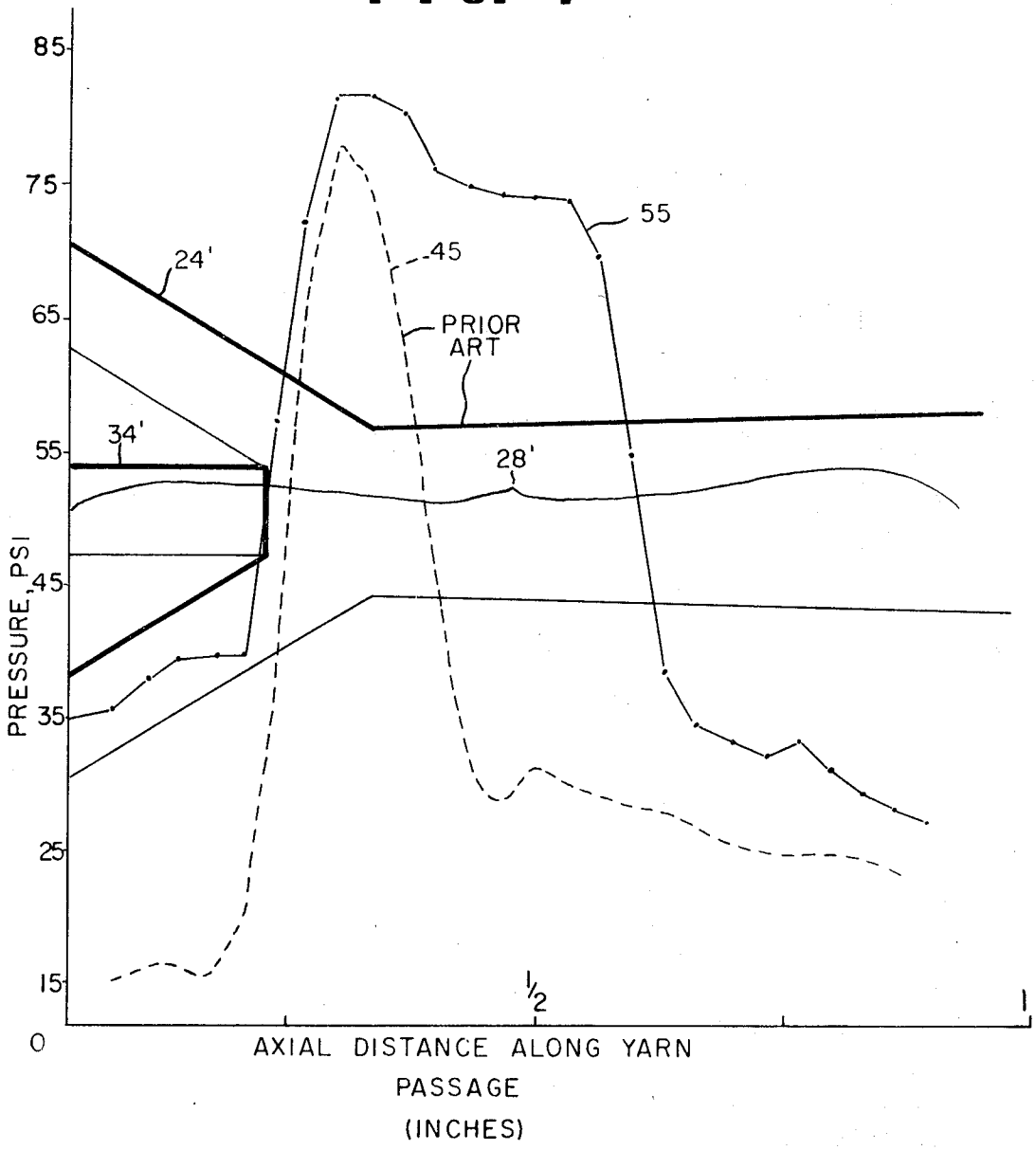

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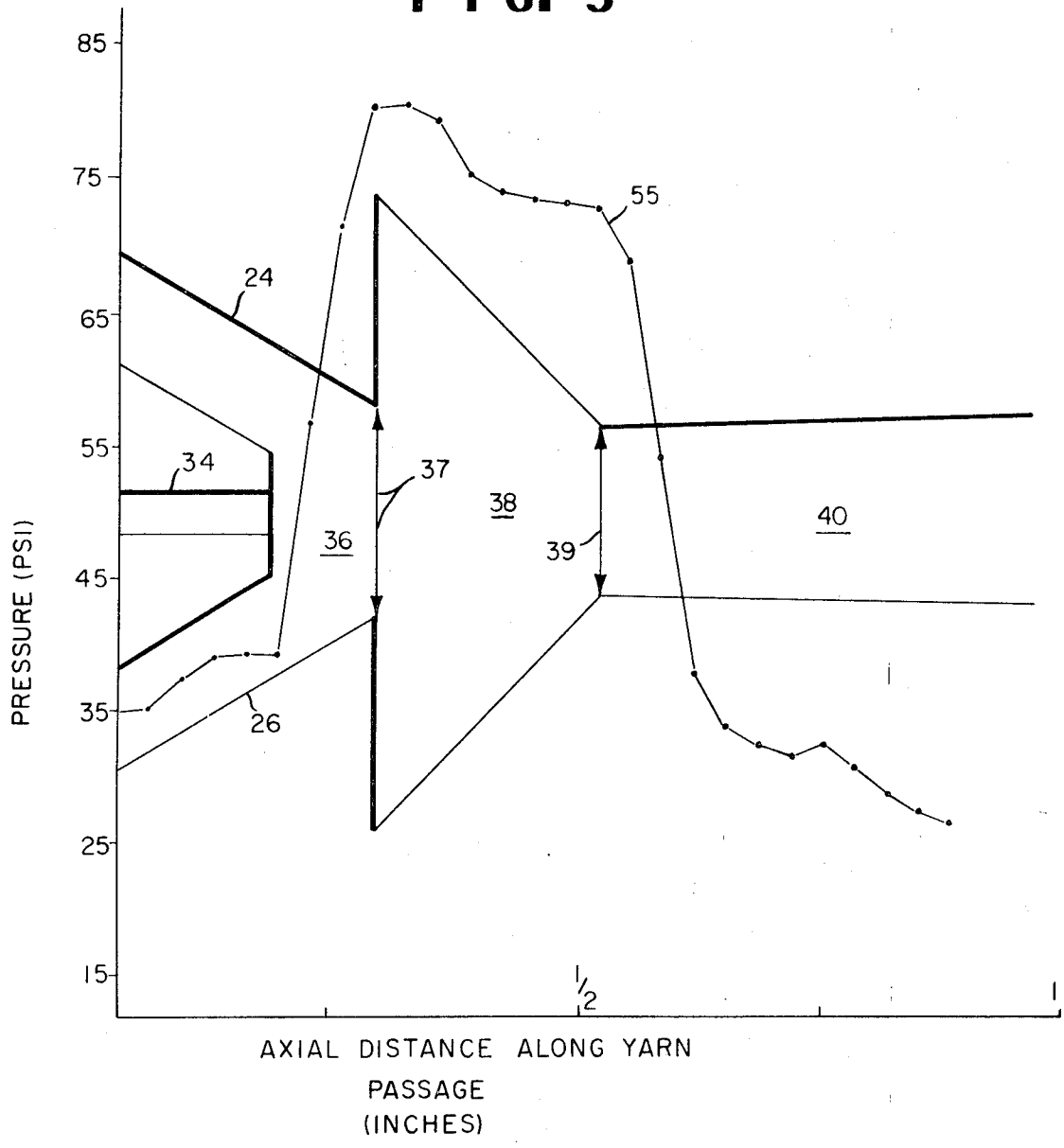
FIG. 5



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YARN-TREATING JET

BACKGROUND OF THE INVENTION

This invention relates to a jet device for treating yarn from synthetic filaments with a heated fluid to introduce random curvilinear crimp. In particular, the invention has to do with a two-piece bulking jet, one piece containing the critical fluid and yarn-treating passages which provide an extended zone for treating the yarn under increased fluid pressure to improve its dye uniformity and the other piece containing a guiding surface to divert fluid exiting from the jet to reduce tangling of the treated yarn.

The bulking jets of the present invention are useful for the types of yarn treatments disclosed by Clendening in U.S. Pat. No. 3,169,296 to produce bulked textile products as disclosed by Breen et al. in U.S. Pat. No. 3,186,155.

A large number of prior art jet types having conical or cylindrical bulking chambers and fluid exit sections are subject to spiral flow patterns which can twist the yarn erratically, inhibiting heat transfer and producing zones of low bulk and dyeability. This is a particular problem when such jets are operated at high fluid pressures in an attempt to obtain maximum crimp and entanglement at high productivity rates. Furthermore, at such pressures where the yarn laydown surface is a moving screen apparatus, uniform laydown of the yarn on the screen becomes difficult because the yarn has a tendency to creep upstream before depositing on the screen surface. As a result, this portion of the yarn remains momentarily longer than desirable in the hot fluid stream and is subjected to more heat treatment and turbulent entanglement than other portions of the yarn.

A two-piece bulking jet having critical passage relationships has been described by Coon in U.S. Pat. No. 3,525,134 as useful for yarn treatments disclosed by Clendening as noted above. In addition, Coon discloses that rectangular cross sections for fluid supply and yarn treatment channels minimize detrimental swirling of the treating fluid.

A principal object of the present invention is to provide an improved yarn-texturing jet capable of handling a relatively wide range of heavy-denier yarns at high productivity rates.

Another object of the present invention is to provide an improved yarn-texturing jet having more efficient utilization of the heated treatment fluid.

Another object is to provide a jet which can maintain high treatment pressure without detrimental twisting action.

Yet another object of the present invention is an improved texturing jet providing better control of the yarn as it is deposited on a foraminous surface.

SUMMARY OF THE INVENTION

A yarn-treating jet comprising: a body and a cover clamped together; a longitudinal passage recessed in the surface of the body contiguous with the cover through which yarn passes for treatment; a pair of angularly disposed conduits in communication with the passage for directing fluid against opposite sides of the yarn; fluid supply means connected to said conduits; said passage including successively, tapered and cylindrical lengths, an enlarged throat region, an expansion cavity and a continuously expanding rectangular treatment chamber terminating at an exit, said conduits intersecting said throat region in an opposed relationship and having equal rectangular cross-sectional areas, the cross-sectional area of said throat region in communication with said cavity being greater than the cross-sectional area of said cavity in communication with said expanding treatment chamber, said cover having a guiding surface adjacent said exit for deflecting fluid and entrained yarn outwardly from said exit.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of the subject jet with the cover removed to show the yarn treatment passage.

FIG. 2 is an enlarged plan view of a portion of the yarn treatment passage of FIG. 1.

FIG. 3 is an elevation of the subject jet positioned above a moving screen surface partially sectioned to show the curved guiding surface in the cover near the exit of the jet.

FIGS. 4 and 5 are respective illustrations of a prior art jet passage configuration and the jet passage configuration of this invention showing fluid pressure profiles of their respective yarn treatment zones. FIG. 4 also has the pressure profile of FIG. 5 superimposed upon it.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. 1–3, the jet of this invention is seen to include a body **10** and a flat detachable cover **12** which is secured to the body **10** by a conventional threaded fastener **14** that extends through hole **16** for that purpose. A pair of locating dowel pins **18**, **20** in body **10**, engage matching cavities (not shown) in cover **12** and serve to align the cover with the body. An internal supply manifold **22** within body **10** furnishes heated pressurized treatment fluid to a pair of angularly disposed conduits **24**, **26** of equal cross section which communicate with enlarged throat region **36** of longitudinal yarn passage **28** recessed in surface **29** of body **10** through which yarn **30** passes for treatment. Various types of treatment fluid, such as heated air and inert gas or superheated steam can be used and is supplied to manifold **22**.

As best shown in FIG. 2, yarn passage **28** includes successively, tapered and cylindrical lengths **32**, **34**, an enlarged throat region **36**, a triangle-shaped expansion cavity **38** and a continuously expanding treatment chamber **40** terminating in an exit **42**. The conduits **24**, **26** and passage **28** are of constant depth in body **10**. The conduits **24**, **26** have uniform equal rectangular cross-sectional areas while passage **28** is seen to have varying cross-sectional areas due to changes in its width along its length.

The relationship of particular cross-sectional areas along the passage **28** are specifically established to provide specific fluid flow conditions within the jet. For example, it has been found that a highly uniform quality bulked yarn is obtained when, in addition to that disclosed above, the following relationships also exist: cylindrical length **34** has a minimum cross-sectional area equal to or less than one-half the area of one fluid conduit (e.g., conduit **24**) and at the opening **37** leading into expansion cavity **38**, the cross-sectional area is greater than that at opening **39** leading from the expansion cavity to the treatment chamber **40**. More particularly, the cross-sectional area at opening **37** is more than twice that of one fluid conduit (e.g., conduit **24**) while the cross-sectional area at opening **39** is approximately equal to twice that of one fluid conduit. The opening **37** is sized to permit the yarn **30** to open freely without restraint as it passes into cavity **38**. The treatment chamber **40** preferably continuously increases in width from opening **39** to exit **42**, the included angle being 6° or less. The included angle between conduits **24**, **26** is preferably held to about 60°.

The entire length of passage **28** is enclosed by cover plate **12**, secured to body **10** except for a tunnellike opening **50** in cover **12**, substantially perpendicular to yarn line **30** and to the closure plane of the cover near exit **42**. A contoured surface **52** having a radius between one and three times the dimension **51** of the opening **50** is provided to deflect a portion of the treatment fluid toward opening **50** for assisting the entrained yarn **30** in that direction for deposit on rotating foraminous surface **54** (FIG. 3).

FIG. 4 schematically illustrates a portion of the yarn passage **28'** and conduits **24'**, **26'** of a prior art jet similar to that disclosed by Coon in U.S. Pat. No. 3,525,134. Also shown is a tracing **45** of the static pressure profile along the yarn passage **28'** when operated at 100 p.s.i. manifold pressure and normal operating temperatures.

By comparison, FIG. 5 schematically illustrates substantially the same portion of the yarn passage **28** of the jet of the present invention with a tracing **55** of its static pressure profile

under the same pressure and temperature conditions as above. Profile **55** is superimposed on FIG. **4** for a ready comparison which shows that under substantially the same operating conditions the jet of this invention extends the zone of increased static pressure for a greater distance along the axis of the yarn passage than the prior art jet of FIG. **4**. Comparative test runs have shown advantages for the jet of this invention over the one depicted in FIG. **4** such as improved dye uniformity as well as higher productivity on 1,300-denier yarn and permitting 2,600-denier yarn to be processed in the same jet under the same conditions whereas the jet depicted in FIG. **4** cannot practically process both 1,300- and 2,600-denier yarn under the same process conditions.

In the preferred embodiment, the fluid conduits, the throat region, the expansion zone and the expanding treatment chamber are of equal constant depth. The cross-sectional area of the entrance to the expansion cavity is more than twice, while the cross-sectional area of the exit from the cavity is substantially twice, that of one of the fluid conduits supplying heated air to the yarn passage.

The provision of an expansion cavity in the shape of a triangle in a two-piece jet with the particular relationship of fluid supply and yarn treatment passages not only provides an extended static pressure zone in the jet to improve heat transfer to the yarn but also provides a type and degree of fluid oscillation in the cavity quite different from that of conical jet configurations. It has been found that a portion of the treatment fluid at an edge of the fluid stream surrounding the yarn line in the expansion chamber recirculates back toward the base of the triangle, turns inward toward the thread line and impinges on the main fluid stream. Its velocity deflects the main stream toward the opposite side of the chamber, whereupon a portion of the fluid on the opposite side of the stream beings to recirculate within the opposite portion of the chamber, turns inward and impinges on the main fluid stream, deflecting it toward the opposite side. This oscillation of the main stream aids in opening the filament bundle and improving the degree and uniformity of heat transfer to the individual filaments.

The previously described yarn laydown problems are overcome by providing a downwardly facing contoured surface **52** in cover **12** which slopes gradually away from a substantially tangential relationship with the treatment chamber **40** and terminates at opening **50**. This generates a Coanda effect to divert a portion of the treatment fluid with the entrained yarn **30** in the same direction (i.e., out opening **50**) as the moving screen **54**. In the preferred embodiment, surface **52** has a 0.25-inch radius and diverts the fluid stream outwardly about 10° from perpendicular.

While the preferred embodiment shows a triangle-shaped cavity, it is to be understood that other configurations will operate satisfactorily. The main consideration in sizing and shaping cavity **38** is that a portion of the treatment fluid recirculates in the expansion cavity **38** and impinges on the main fluid stream with a substantial velocity component perpendicular to the main fluid stream.

Since many different embodiments of the invention may be made without departing from the spirit and scope thereof, it is to be understood that the invention is not limited by the specific illustrations except to the extent defined in the appended claims.

What is claimed is:

1. A yarn-treating jet comprising: a body and a cover clamped together; a longitudinal passage recessed in the surface of the body contiguous with the cover through which yarn passes for treatment; a pair of angularly disposed conduits in communication with the passage for directing fluid against opposite sides of the yarn; fluid supply means connected to said conduits; said passage including successively, tapered and cylindrical lengths, an enlarged throat region, an expansion cavity and a continuously expanding rectangular treatment chamber terminating at an exit, said conduits intersecting said throat region in an opposed relationship and having equal rectangular cross-sectional areas, the cross-sectional area of said throat region in communication with said expansion cavity being greater than the cross-sectional area of said expansion cavity in communication with said expanding treatment chamber.

2. The apparatus as defined in claim **1**, said throat region, said cavity, said chamber and said conduits being recessed at the same constant depth.

3. The apparatus as defined in claim **2**, said cavity having a width adjacent said throat region greater than the width of said throat region and greater than the width of the cavity adjacent said chamber.

4. The apparatus defined in claim **1**, the cross-sectional area of said throat region in communication with said expansion cavity being more than twice the cross-sectional area of one of said conduits.

5. The apparatus as defined in claim **2**, the cross-sectional area of said expansion cavity in communication with said expanding treatment chamber being about twice the cross-sectional area of one said conduits.

6. The apparatus defined in claim **1**, said cover having an opening there through adjacent said exit and a contoured surface sloping outwardly away from said treatment chamber toward said opening for diverting fluid and entrained yarn outwardly toward said opening.

7. A yarn-bulking jet comprising: a body and a flat cover clamped together; a longitudinal passage recessed in the surface of the body contiguous with the cover through which yarn passes for treatment; a pair of angularly disposed conduits in communication with the passage for directing fluid against opposite sides of the yarn; fluid supply means connected to said conduits; said passage including successively, tapered and cylindrical lengths, an enlarged throat region, a triangle-shaped expansion cavity and a continuously expanding rectangular treatment chamber terminating at an exit, aid conduits intersecting said throat region in an opposed relationship and having equal rectangular cross-sectional areas, said conduits, said throat region, said cavity and said chamber being recessed at the same constant depth in said surface, the cross-sectional area of said throat region in communication with said expansion cavity being greater than the cross-sectional area of said expansion cavity in communication with said expanding treatment chamber, said cover having an opening adjacent said exit and a downwardly facing contoured surface sloping gradually away from a substantially tangential relationship with said treatment chamber and terminating at said opening for diverting a portion of said fluid away from the treatment chamber outwardly toward said opening.

8. The apparatus defined in claim **4**, said contoured surface sloping gradually away from said treatment chamber in a radius of from about one to three times the height of said opening.

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