March 1, 1966 C. S. HAWKINS 3,237,269

YARN BULKING JET

Filed Sept. 26, 1963

FIG. 1

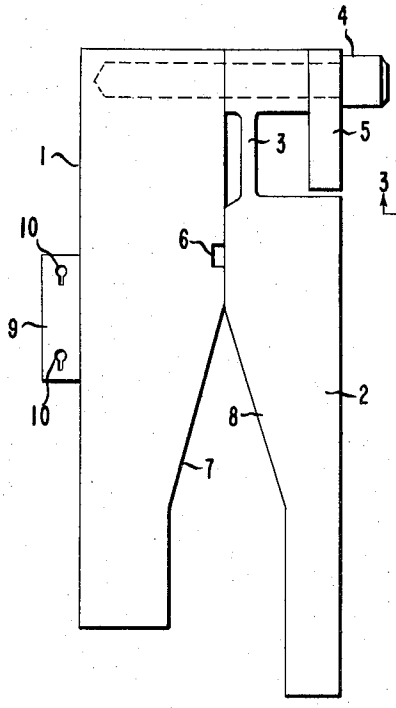


FIG. 2

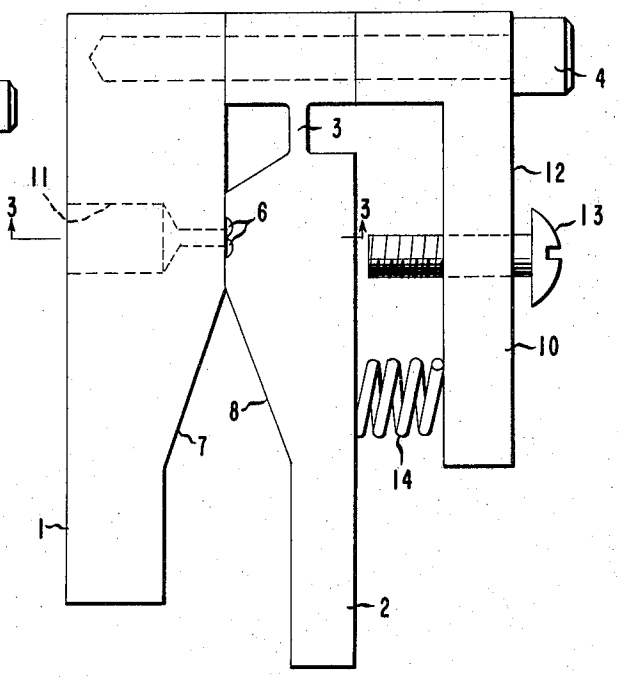


FIG. 3

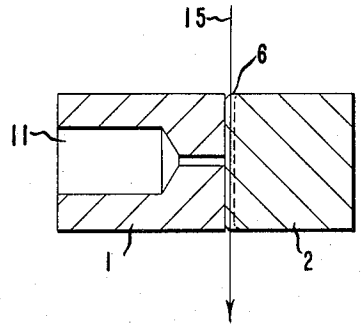
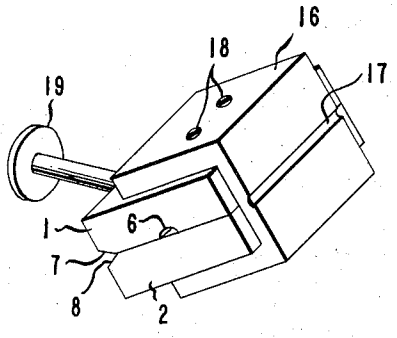


FIG. 4



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YARN BULKING JET

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This invention relates to the treatment of moving threadlines and especially apparatus for the continuous fluid treatment of filamentary yarn.

In the processing of synthetic fibers, most often produced as continuous filaments, various treatments have been devised to produce continuous yarns with different properties according to the desired effect or requirements of their use. Recent developments in the textile industry have provided useful routes to obtain these effects by treatment of running yarns with fluid streams. The fluid processes permit efficient treatment at high linear yarn speeds and, in turn, reduce processing costs. These processes require apparatus which bring the yarn into proper contact with a fluid stream to produce the desired result.

Breen U.S. 2,783,609, for example, has disclosed a product made by a new technique for improving the bulk of continuous filament yarns, rendering them light in weight and causing them to have the bulk and surface texture of yarns spun from staple fibers. This technique involves exposing a filamentary material to a rapidly moving turbulent fluid, thereby inducing a multitude of crunodal filament loops at random intervals along the individual filaments. The treating jets disclosed by Breen and others have required that the threadline be broken and a free end of yarn be laced through the yarn passage to commence the treating process. Breen and Sussman U.S. 3,009,309 reveals the use of fluid twister apparatus to impart a high speed twisting motion to a filament, yarn or strand by means of torque applied by a high velocity fluid stream. Bunting and Nelson U.S. 2,985,995 reveals a yarn which has a cohesive structure as a result of interweaving and interlacing of the individual filaments by means of fluid vortices. These patents disclose jets with openings to admit the yarn to be treated but no provision is made in such jets to confine the running threadline within the fluid stream. In the guiding of running threadlines, "pigtail" guides are commonly used for ease of string-up on-the-run. These devices require a slackness to accomplish the string-up. Smith et al. U.S. 2,588,053 contains an example of a thread-guide which is readily laced in which the threadline is temporarily aligned in a fixed eye and which automatically releases when the threadline is sufficiently tensioned.

This invention provides a closure means for yarn-treating jet devices. The structure is extremely simple and rugged, employing common materials of construction. It is readily opened to admit a running threadline without interruption and, when released, is self-closing. In the closed position, the running threadline is positively confined. Moving mechanical linkages are unnecessary in the assembly of the preferred embodiment. This invention may also be adapted for use as a guide for running threadline, a defect detector and the like.

In accordance with the present invention a readily loadable yarn guide device is provided comprising a body member having at least one essentially flat surface, a cover lying against the said surface and flexibly retained at one edge against said surface, an essentially straight line channel for yarn passage between the said surface and the said cover, at least one of the said cover and body member terminating on the side of the said channel opposite to that at which the said cover is retained in a lip tapering toward the junction between the said cover and the said body.

The invention will be more readily understood by reference to the drawings.

FIGURE 1 is a top view of a device of the present invention in one of its simplest forms.

FIGURE 2 is a top view of a device of the present invention adapted for use in fluid treatment of a running thread line to produce the compact interlaced yarn of Bunting and Nelson U.S. 2,985,995.

FIGURE 3 is a cross-sectional elevation on line 3—3 of FIGURE 2.

FIGURE 4 is a view in perspective of an alternative embodiment of the device of the present invention.

Referring particularly to FIGURE 1, the device comprises a body 1 having a cover 2 flexibly retained at one edge against the flat surface of the said body. In the simple embodiment shown, cover 2 is flexibly retained against body 1 by flexible web 3 and bolt 4, the width of opening possible upon flexing being controlled by the stop member 5. From the drawing it will be apparent that cover 2 may be flexed away from body 1, thereby providing an opening between them. An essentially straight line channel 6 for yarn passage is provided between the surface of body 1 and cover 2. A lip 7 on body 1 and lip 8 on cover 2 provide a string-up passage tapering toward the mating surfaces of 1 and 2. Mounting bracket 9 containing screw retaining holes 10 may conveniently be provided to permit mounting on machinery framework not shown.

A more sophisticated embodiment is shown in FIGURE 2. In this embodiment provision is made for fluid treatment of a running thread line to produce the compact interlaced yarn of Bunting and Nelson U.S. 2,985,995, the fluid being introduced to the yarn running through channel 6 by means of fluid passage 11. The device is shown as several parts viz. body member 1 (through which fluid passage 11 passes), cover 2 and a bracket 12, all rigidly retained in cantilevered tension by bolt 4. In this embodiment channel 6 is provided by a slot along cover 2. Thin web 3, a portion of cover 2, provides flexibility of the cover when a force is applied to separate body 1 and cover 2. Bracket 12 provides means for mounting a stop screw 13 which regulates the distance which cover 2 may be flexibly moved from body 1. (Bracket 12 also may provide tension means such as spring 14 to control the force required to separate cover 2 from body 1.)

FIGURE 3 is a cross-sectional elevation through lines 3—3 of FIGURE 2 and shows thread line 15 in channel 6 and the relative position of fluid passage 11.

In the embodiment illustrated in FIGURE 4, body 1, which is shaped to provide yarn channel 6 and lip 7, is held against cover 2 by flexible clamp 16 which flexes at groove 17. The clamp is secured to the body by set screws 18 and similarly to the cover by set screws not shown. Cover 2 is provided with handle 19 to assist opening during loading and unloading operations. Modification for fluid treatment of this embodiment can be made by providing a passage for fluid similar to fluid passage 11 of FIGURE 2.

In operation the continuous strand of yarn is placed against the string-up throat provided by lips 7 and 8. Cover 2 is then pressed back to permit the yarn to reach channel 6 in which it is intended to run. Cover 2 thereupon closes upon body 1 to retain the yarn in the channel. A mechanical device such as a cam or lever action may be employed to open and close cover 2.

As shown in the figures the parts of this apparatus are conveniently of simple rectangular shapes with flat mating surfaces which can be machined easily by conventional

methods. Other forms and shapes may be produced by forging or casting without departing from the spirit of the invention. The mating surfaces which form the enclosure for the yarn channel may be curved as well as planar. The yarn channel may be more complex than the simple grooved passage shown to produce the desired yarn treatment. Thus yarn channel **6** and the mating faces may be inclined as well as perpendicular to the external body faces. While the fluid passage **11** is shown to intercept yarn channel **6** perpendicularly in the figures, in actual practice, any desired angle may be used. In Hallden U.S. 3,084,413, for example, the fluid conduit is skewed with respect to the yarn passage. In other words, the apparatus may take many geometric forms but only the simplest and, therefore, generally preferred embodiment of the invention is depicted in the drawings.

The apparatus of this invention may be fabricated from readily available materials of construction, such as metals or plastics. The principal requirement of the cover is that it be sufficiently elastic or flexible to be deflected without being deformed. The conditions of use will generally dictate the other property requirements. Yarn treatment at elevated temperatures will usually require a dimensionally stable metal. Corrosion-resistant materials may be needed when steam or chemically reactive gases or liquids are used in the treatment. A combination of materials may be employed. To withstand abrasion by the running threadline, for example, a wear-resistant ceramic, corundum or metal alloy insert may be fitted in the yarn passage in a cover plate of spring steel.

For satisfactory lacing, a surprisingly narrow gap will accommodate a continuous multifilament yarn. For example, a strand of 840-denier 140-filament nylon yarn will pass through a slot approximately .002 to .003 inch wide. The yarn bundle appears to spread into a ribbon of filaments momentarily as they slip through the passage and regroup in the treating channel.

The space required to admit the yarn bundle determines the amount of deflection required of the cover. Knowing this, the cross-sectional dimensions of the flexing portion of the cover can be calculated from standard stress formulae for cantilever beams.

Using these formulae, a cover plate as shown in FIG. 2 of a steel with maximum allowable bending stress of 80,000 p.s.i. and a modulus of elasticity 30,000,000 p.s.i. having a flexing section of thickness .062 inch, width .281 inch and force arm 2.37 inches. The maximum allowable deflection of the cover plate is .164 inch requiring a force of 13.5 lbs. The stop plate is then positioned so that the deflection of the cover will not exceed the allowable maximum. Other dimensions may be selected to provide the desired string-up passage and force required to open the string-up passage.

The apparatus of this invention may be used for various fluid processes under different conditions. The treating fluid may be gaseous or liquid. A gas such as air may be used to bulk, interlace or otherwise modify a multifilament yarn. The gas may be heated to plasticize the yarn. A fluid such as water, size solution, solvent or other liquid may be applied to a running yarn to achieve a desired result.

The device may be further modified to treat a plurality of running threadlines simultaneously by providing a series of parallel yarn channels. In this case, separate fluid passages are provided to accommodate each threadline with appropriate fluid. The shape of channel **6** is not critical. It may be round, half-round, or rectangular in cross section. It may be formed by a groove in body member **1**, a groove in cover **2** or mating grooves in each of these members.

This invention also comprehends use of this device for purposes other than fluid treatment. Without fluid conduits, the apparatus may be used as a thread guide for single or multiple threadlines. The device may also be used to clean fluffballs or slubs from a running threadline by selection of the proper dimensions for the yarn passage.

Many equivalent modifications will be apparent to those skilled in the art from a reading of the above without a departure from the inventive concept.

What is claimed is:

1. Apparatus for fluid treatment of continuous filamentary material from a yarn of continuous substantially straight filaments including a body member having an essentially flat surface and a cover lying against the said surface together cooperating to form an enclosed channel having a yarn inlet and exit opening, retaining means for positively retaining said body member and said cover in contact with each other at one side of the enclosed channel, said cover and said retaining means together defining a pair of elements, at least one of said pair of elements being of a relatively flexible construction in a region situated on one side of said enclosed channel, said flexible construction thereby permitting separation of said body member and said cover for lacing of said yarn within and through said channel when a separating force is applied, lip means on the said body member and the said cover at their edges on the side of the channel away from said region, and means operatively connected with the said enclosed channel between said inlet and exit openings for introducing fluid along the length of the filaments.

2. The apparatus of claim **1** wherein said cover is of said relatively flexible construction in said region.

3. The apparatus of claim **1** wherein said retaining means is of said relatively flexible construction in said region.

4. The apparatus of claim **1** wherein said cover is of said relatively flexible construction, the flexibility thereof being due to a webbed construction of the cover in the region situated on said one side of said channel.

5. The apparatus of claim **1** wherein said retaining means is a clamp substantially enclosing said cover and said body member except on the side of said lip means, said retaining means being of said relatively flexible construction, the flexibility thereof being due to a groove in said retaining means running parallel to the axis of said enclosed channel.

6. The apparatus of claim **1** in combination with stop means for regulating the distance which said cover may be flexibly moved from said body member.

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