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TWISTED CHUTE FOR IMPROVED TOW STACKING

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FIG. 1



FIG. 2



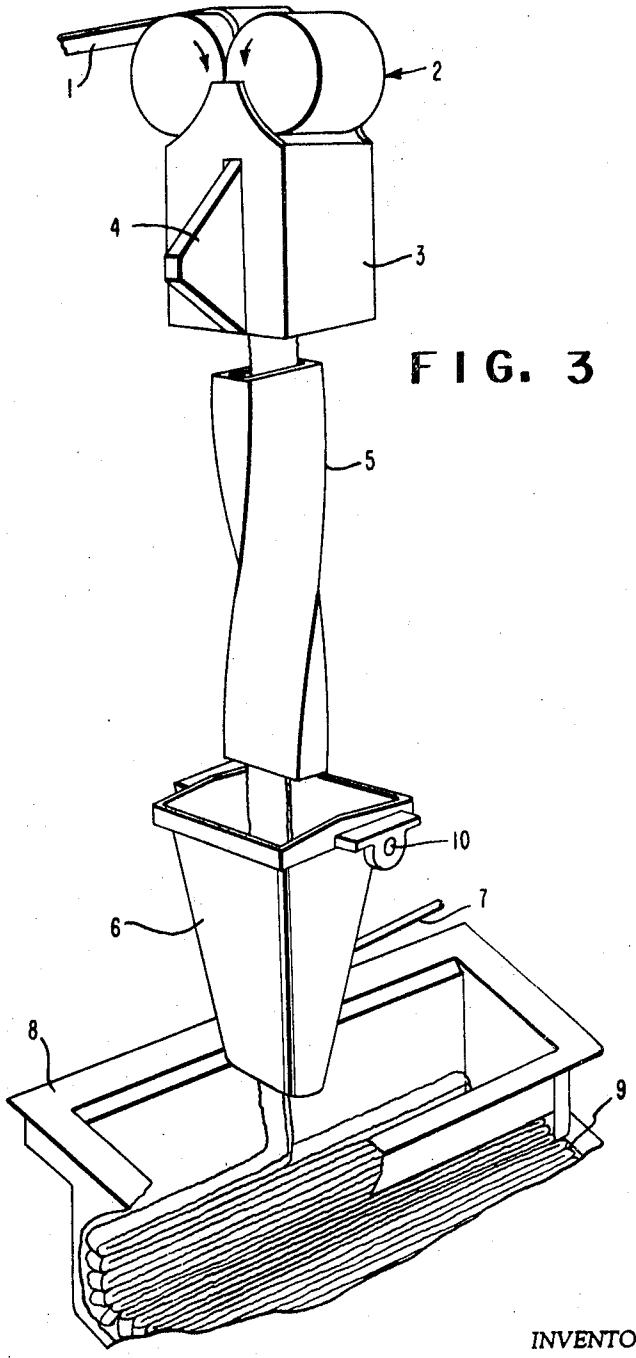


FIG. 3

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TWISTED CHUTE FOR IMPROVED TOW STACKING

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ABSTRACT OF THE DISCLOSURE

The improvement in a tow delivery apparatus of an elongated chute vertically mounted above a tow discharge spout, the chute being twisted to form a smooth tow carrying surface to stabilize movement of the running tow and rotate the tow width through an arc to align the tow with subsequent tow processing apparatus.

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to tow delivery apparatus for forwarding tow and depositing on a surface in a sinuous pattern a running length of yarn or tow composed of a plurality of filaments. More particularly, the invention is concerned with a novel device for controlling the orientation of a falling tow band to provide for greater uniformity of pattern as the band is laid down in superimposed and juxtaposed folds.

Description of the prior art

In the manufacture of staple or tow from synthetic polymers, such as polyethylene terephthalate, it is convenient to draw the tow bundle while wet, pass the wet tow through a stuffing-box crimper to impart a zig-zag crimp, and then lay the tow in a sinuous fashion on a conveyor belt which carries the tow through an oven for drying and heat-treating the tow to impart desired combinations of properties. Apparatus for such a combination of steps is described by Stump in U.S. Patent 3,235,442 dated July 30, 1962.

For maximum residence time in an oven of given size it is desirable to stack the tow band on edge in closely laid rows on the conveyor belt with the rows being transverse to the direction of belt movement. Uniformity of the product produced, as well as efficiency of operation, requires that the tow be laid on the belt in a highly uniform fashion, with no fold-overs, twists, or loops. Apparatus purporting to accomplish this purpose has been described, for example, in Knopp et al., U.S. Patent 2,598,000 dated May 27, 1952; Spruill, U.S. Patent 3,302,839 dated Feb. 7, 1967; and British patent specification 1,035,966 published July 13, 1966. None of these devices have been completely satisfactory for heavy denier tows in relatively high-speed operation, e.g. 300–500 yds./min. (274–456 meters/min.). In particular, the prior art failed to recognize the importance, or if it were recognized, failed to provide the solution of maintaining full control of the orientation of the tow band as it falls from the crimper to the conveyor belt. If the processing equipment is laid out in a straight line fashion, as it usually is in a large commercial plant, normal orientation of the tow band is such that the reciprocating laydown spout moves in a direction parallel to the width of the tow band. In such a situation the spout pushes against the narrow edge of the band and causes it to twist, but does not control the direction of twist. The result is nonuniform stacking, with some folds being twisted and others untwisted,

thereby leading to nonuniformity of product and process inefficiency.

SUMMARY OF THE INVENTION

The present invention provides an improved method of laying tow on a traveling belt which results in fewer fold-overs, twists, loops, snags, and jams, and provides more uniform dried tow. This result is accomplished by providing a means for positively controlling the orientation of the tow band as it falls from a stuffing-box crimper to means for laying the tow on the conveyor belt. Also, the erratic movement of the tow discharging from the crimper is dampened out and stabilized such that the running tow discharges smoothly in a well defined, substantially constant path.

In accordance with the present invention, there is provided a chute having a rectilinear cross-section and a helical twist for the purpose of transporting and controlling the orientation of a falling tow band as it passes under the force of gravity from a stuffing-box crimper to an oscillating funnel which deposits the tow in folds in a J-box type feed hopper for transfer to a conveyor belt in an edge-wise position.

Another important feature of the invention is that the otherwise erratic movement of the running tow is stabilized in addition to the rotation of the running width of the tow through an arc sufficient to align the tow width with subsequent processing equipment. Tow being discharged from a stuffing box type crimper generally moves in an erratic, jerky type manner rather than smoothly in a well defined path. The erratic movement leads to poor, nonuniform laydown in the subsequent process stages and hence the aforementioned problems arise. The apparatus of this invention dampens out this erratic movement and in effect stabilizes the erratic movement of the tow such that the running tow is discharged smoothly in a well-defined path.

Brief description of the drawing

In the drawings, which illustrate an embodiment of the invention:

FIGURE 1 is an isometric view of a helical chute useful in carrying out this invention. The longitudinal axis is within the chute.

FIGURE 2 is another form of the helical chute useful in carrying out this invention. In this embodiment the longitudinal axis of the chute is outside the chute.

FIGURE 3 is a schematic view of apparatus suitable for carrying out the invention and showing the location of the helical chute.

Referring now to FIGURE 3, uncrimped synthetic fiber multifilament tow **1**, usually supplied from a draw machine, is passed through a pair of crimper rolls **2** which force the tow under high pressure into the crimper stuffing-box **3**. The pressure in the stuffing-box is adjusted by the tension on the crimper gate **4**. From the stuffing-box the crimped tow falls in a coherent band through helical chute **5** which rotates the tow band 90° and passes it to laydown spout **6** which is supported on pivots **10** and driven by drive rods **7**. The spout moves back and forth in a direction transverse to the direction of movement of the conveyor belt and lays the tow band in neat, substantially uniform folds in the J-box hopper **8**. The hopper receives and stacks the folds of tow one on top of the other with the flat sides of the folds generally horizontal. Hopper **8** has a smoothly curved lower section which rotates the folds from their original horizontal orientation to a vertical orientation as tow slides out of the hopper to the conveyor belt, thus depositing the tow on the belt in a series of folds standing on edge.

DESCRIPTION OF PREFERRED EMBODIMENTS

The helical chute **5** may be constructed of any suitable sheet metal, e.g. stainless steel, or of fine-mesh wire cloth, or of plastic, e.g., a polyhaloethylene. As illustrated, the chute has a rectangular cross-section large enough to comfortably accommodate the crimped tow band issuing from the stuffer-box crimper, but not large enough to lose control of the tow. The chute has a helical twist, either left-hand or right-hand, which imparts the desired degree of rotation, usually 90°, between the top and bottom openings. For high-speed operation in commercial manufacturing plants, e.g., 300–500 yds./min. (274–456 meters/min.), the chute is usually at least 15 inches (38 cm.) long and preferably more than 25 inches (64 cm.) in length. Higher speeds require a lower degree of twist per unit length.

It will be apparent that a smooth inner surface, free of snags, is required for satisfactory operation.

For best control of the tow bundle the helical chute **5** is mounted in contact with the bottom of the stuffing-box crimper. Suitable stuffer crimpers have been described by Hitt in U.S. Patent 2,311,174 and by Dennis in U.S. Patent 3,237,270.

The helical chute used in this invention may have the axis of rotation within the chute, as illustrated in FIGURE 1, or the chute may be wrapped around the axis of rotation in the manner of a circular stairway as illustrated in FIGURE 2. In the latter arrangement, the "upper" side of the chute may be open, if desired, with the tow band sliding along the lower side as in a trough.

The bottom opening of the helical chute is positioned directly above a laydown spout which is pivoted and driven in such a manner that its delivery end moves back and fourth in a direction normal to the flat side of the tow band. Laydown spout **6** has a non-circular cross-section to provide positive control of the orientation of the tow band delivered by the helical chute. An elliptical cross-section, as shown in the drawing, is satisfactory. A rectangular cross-section may be used if desired.

In specific operative examples wherein heavy denier polyester tows of about 50,000–1,000,000 denier per inch width are drawn at a speed of 500 yds./min. (456 meters/min.) and passed through a stuffing-box crimper to give a crimped tow band having a width of 2 inches (5.1 cm.), a satisfactory helical chute has a rectangular cross-section with a short dimension of 1.5 in. (3.75 cm.) and a long dimension of 3.25 in. (6.9 cm.) and makes a 90° turn from top to bottom in an overall length of 30 inches (76 cm.).

The helical chute described above is also useful in controlling the orientation of the tow as it is removed from the conveyor belt at the exit end of the oven. When an in-line equipment arrangement requires a 90° twist, high speed operation causes the tow to whip to and fro erratically and intermittently to fold lengthwise or turn over completely unless positive control is maintained.

The improved apparatus of this invention is useful in handling running filamentary bands or tows of any material. It is particularly useful in the manufacture of staple from synthetic polymers.

What we claim is:

1. In a continuous tow processing apparatus including, in combination, a stuffing-box crimper having crimper rolls forming a nip to crimp the tow and adapted to discharge by gravity a crimped tow band of at least 2 inches in width in a jerky pulsating manner, a J-box operably arranged to receive the tow band from the crimper through an associated pidler spout adapted to oscillate in a direction parallel to the nip of the crimper rolls to lay the band in folds in the J-box with the straight segments of the tow between folds being parallel to the nip of the crimper rolls, and a conveyor belt arranged to pick up and carry folded tow sliding from the J-box edgewise in rows that are transverse to the direction of belt movement; the improvement in the apparatus for achieving greater uniformity of the folded tow in the J-box and on the conveyor belt which comprises an elongated four-sided closed chute vertically mounted above said spout and beneath the crimper, said chute being twisted to form a smooth tow carrying surface to stabilize movement of the jerky, pulsating tow and to rotate the tow width through a 90 degree arc to align said tow with the J-box, said tow carrying surface being further characterized as being generated and defined by a horizontal line spaced from the longitudinal axis of the elongated chute and rotating horizontally through an arc of about 90° at substantially a uniform rate while traversing the length of the chute.

2. The apparatus as in claim **1** wherein the chute is greater than about 15 inches in length and has a four-sided rectilinear cross section of about 2 to 8 inches in width and a dimension of about 1 to 3 inches in a direction normal to the width.

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