A dual-chamber stuffer box crimper for synthetic fiber tows is provided where a second crimping chamber below the primary crimping chamber supports the crimped tow under pressure for an additional time, while at the same time, the second chamber positively controls and adjusts the orientation of the crimped tow band to provide greater uniformity in a subsequent stacking operation.

More particularly, there is provided a stuffer box crimper having feed rolls, a first crimping chamber fitted with entrance and exit ports for steam and with a pressure gate, a second pressure chamber fitted with a second pressure gate, with the second pressure chamber being characterized by having a rectangular cross section and a helical twist for the purpose of transporting and changing the orientation of the crimped tow band as it passes from the exit of the first crimper chamber to the exit of the second crimper chamber. In a preferred embodiment, the crimped tow band, leaving the gated exit of the second chamber, falls to an oscillating funnel which deposits the tow in folds in a J-box type feed hopper from which it slides onto a conveyor belt in an "on-edge" position.

1 Claim, 1 Drawing Figure
TOW PROCESSING APPARATUS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for crimping and relaxing a bundle of textile filaments, such as a tow of continuous filaments of synthetic polymer. More particularly, the invention is concerned with apparatus for improving crimping effectiveness and providing positive control of the crimped tow band leaving a stuffer box crimmer.

In the manufacture of staple or tow from synthetic polymers, such as polyethylene terephthalate, it is convenient to draw the tow bundle in steam or hot water, pass the wet tow through a stuffing box crimmer to impart a zig-zag crimp, drop the tow from the crimmer to a relaxing zone and 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 suitable for such a combination of steps is described in U.S. Pat. No. 3,235,442. An improvement in the method of controlling the orientation of the tow band as it falls from the crimmer to the conveyor belt is described in U.S. Pat. No. 3,466,716. The improvement involves the use of an open-ended, twisted chute below the crimmer to rotate the tow band so that it is properly oriented for uniform stacking on the conveyor belt.

It has also been proposed to use steam in the crimping chamber of a stuffer box crimer to facilitate the crimping of fibers and U.S. Pat. No. 2,865,080 describes a dual-chamber crimmer in which the tow band is first passed into a pressure zone for crimping and then the crimped fibers are passed into a second zone to increase the time of exposure to the steam treatment in the crimmer. Both zones of the crimmer have forced-pressures gates which control the pressure developed inside the crimping chambers.

SUMMARY OF THE INVENTION

In a continuous tow processing apparatus including cooperating crimmer rolls, a stuffer box associated with said rolls to crimp the tow and a four-sided helically twisted closed chute positioned below said stuffer box for changing the orientation of said tow, the improvement comprising: an interface connector connecting said stuffer box and one end of said chute; and a biased gate incorporated into the other end of said chute, whereby the crimped tow is supported under pressure while the orientation of said tow is being changed.

The apparatus of the invention not only eliminates erratic movement of the running tow leaving the stuffer box crimer and provides the desired orientation of the tow band as it is fed to the "J-box" feed hopper, but it also produces a more uniform crimped product with a higher crimp takeup, which is important for subsequent processability of the staple fiber produced. Furthermore, the invention combines the effects of a secondary holding chamber and an orientation controlling chute in a single apparatus which occupies only about half the space required if the holding and orienting operations were to be carried out separately.

BRIEF DESCRIPTION OF THE DRAWING

The drawing is a schematic elevation of apparatus suitable for carrying out the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawing, uncrimped synthetic fiber multifilament tow 1, usually supplied from a draw machine, is passed through a pair of crimmer feed rolls 2 which force the tow under high pressure into the first chamber 3 of the stuffing box crimmer. The pressure in the stuffing box is adjusted by the amount of weight 5 suspended on a projecting bar from crimmer gate 4. From the primary crimmer chamber 3, the crimped tow passes through interface collar 7 into the second crimmer chamber 6, which is characterized by having a rectangular cross section and a helical twist, as shown.

The tow band passing through the second chamber is rotated 90° with respect to its orientation in the primary crimming chamber and then forced out of the bottom of the second chamber into laydown spout 10. The pressure in secondary chamber 6 is regulated by the amount of force on crimmer gate 8 imposed by air cylinder 9. Laydown spout 10 is supported on pivots 12 and driven by drive rod 11. 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 13. 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 13 has a smoothly curved lower section which rotates the folds from their original horizontal orientation to a vertical orientation as the tow slides out of the hopper to conveyor belt 14, thus, depositing the tow on the belt in a series of folds standing on edge.

The general construction features of stuffer box crimmers have been previously described by Hitt in U.S. Pat. No. 2,311,174 with more recently developed variations being shown for example by Dennis in U.S. Pat. No. 3,237,270 by Price in U.S. Pat. No. 3,633,255 and by Hentschel in U.S. Pat. No. 2,865,080. The present invention utilizes a dual-chamber stuffer box crimmer in which the first chamber 3 is capable of handling much higher pressures than the second chamber 6. The crimmer has a pair of cooperating feed rolls of known type which force the tow band into a first crimmer chamber, also of a known type, usually made of heavy steel plates. The crimmer chamber exit is fitted with a gate 4 which applies pressure to the tow in the chamber. The gate pressure may be controlled by the use of a lever arm with weights, or by an air cylinder or some other arrangement for maintaining constant pressure. The chamber may also be fitted with entry and exhaust ports for supplying steam for heat treatment of the tow in the chamber. When steam is used, best results are usually obtained if the steam entry ports are near the feed rolls and exit ports are placed in the side walls of the chamber and in the chamber gate.

The second crimmer chamber 6, which may be made of lighter weight material than the first chamber because less pressure is developed within it, has a rectangular cross section at its upper end approximately the same size as the lower cross section of the first crimmer chamber. As indicated in the drawing, the chamber 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 of the chamber. The larger sides of the rectangular cross section of the second chamber are divergent in the direction of the
chamber exit, i.e., the distance between the larger sides increases in the direction of the exit. Preferably, the sides are uniformly divergent with a divergence angle of 2°-7° being preferred.

For commercial high-speed operations using heavy denier tow, it is preferred that the section of the second crimper chamber having the twist be at least 15 inches (38 cm.) long and preferably 24-36 inches (61-91 cm.) in length.

For convenience of construction, the first and second crimper chambers may be fabricated separately and then joined in some convenient fashion. As indicated in the drawing, the joint between the two chambers may be made by means of an interface collar 7 of suitable size.

In one embodiment of the invention, the second chamber is supported and held tightly against the bottom of the first chamber by an air cylinder arrangement attached by suitable brackets to the second chamber and to a support means.

As with all stuff box crimpers, it will be apparent that a smooth inner surface, free of snags, is required for satisfactory operation.

In operation, the exit of the second crimping chamber is preferably positioned directly above a laydown spout 10 which is pivoted and driven in such a manner that its delivery end moves back and forth in a direction perpendicular to the flat side of the tow band. Laydown spout 10 has a noncircular cross section to provide positive control of the orientation of the tow band delivered by the second crimper chamber.

In specific operative examples of the invention, wherein heavy-denier polyester tows of 500,000-2,500,000 denier are drawn at a speed of 350-500 yards per minute (320-457 meters per minute) and passed immediately to the stuffing box crimmer, a satisfactory crimmer has a first crimping chamber with a rectangular cross section with an inside long dimension of seven inches (17.8 cm.) and a short dimension of 0.75 inch (1.9 cm.). The second crimmer chamber has a cross section with dimensions similar to the first chamber at its top end, but the two wider sides diverge in the direction of the lower end with a constant divergence angle of 5°. The second crimmer chamber is 33 inches (84 cm.) in overall length, with the twisted portion occupying about 22 inches of the middle section of the chamber. Operated with a pressure of about 80 psig on both gates and with steam introduced into the first chamber at a pressure of 90-110 psig, the described apparatus gives a uniform crimped tow with a crimp takeup value 20 to 30 percent higher than that obtained with a standard, single-chamber crimper.

"Crimp takeup" (CTU) is a measure of the crimped fibers ability to retract after a load is applied and removed. Values of CTU, in %, are obtained by measuring the difference between a fiber's extended length and its relaxed length, dividing this difference by the extended length and converting to % by multiplying by 100. High CTU values contribute importantly to the operability of the staple carding process and are directly related to both lap strength and card sliver tenacity.

What is claimed is:

1. In a continuous tow processing apparatus including cooperating crimper rolls, a stuff box associated with said rolls to crimp the tow and a four-sided helically twisted closed chute positioned below said stuff box for changing the orientation of said tow, a further improvement comprising: a biased first crimper gate positioned in said stuff box for maintaining pressure on said tow in said stuff box; an interface collar connecting said stuff box and one end of said chute; and a biased second crimper gate incorporated into the other end of said chute the bias load on said second gate being the same as the first gate, whereby the crimped tow is supported under pressure while the orientation of said tow is being changed in said chute.