Nov. 23, 1965 W. H. HENDRIX 3,218,675

APPARATUS FOR CRIMPING FIBERS

Filed June 27, 1963

FIG. 1

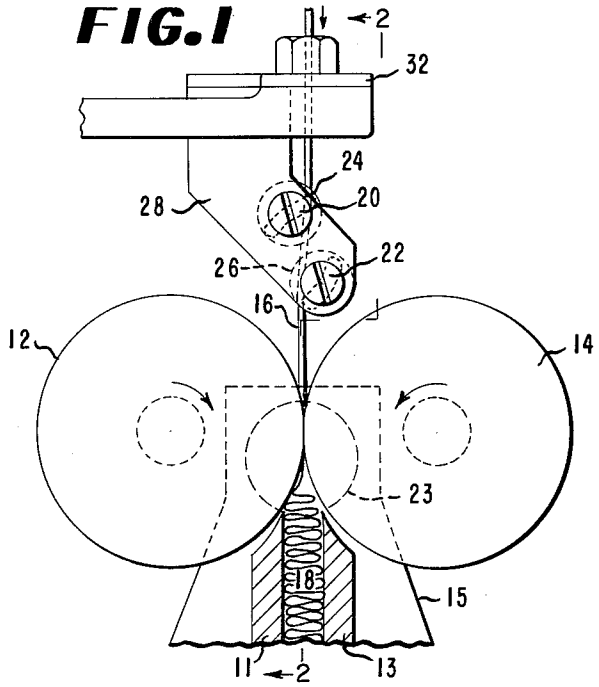


FIG. 2

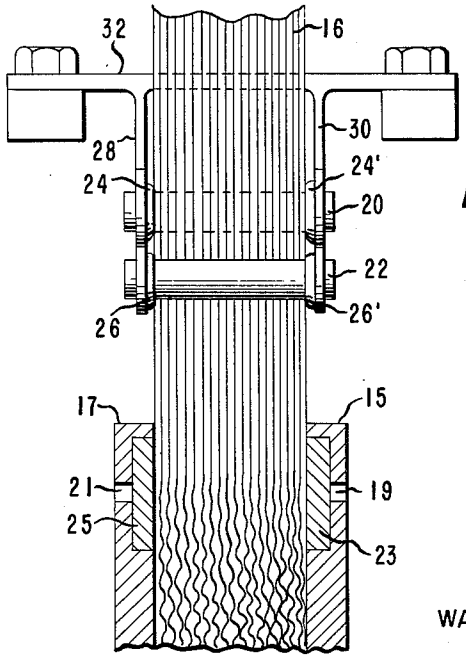


FIG. 3

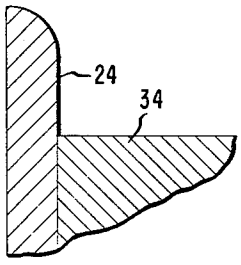
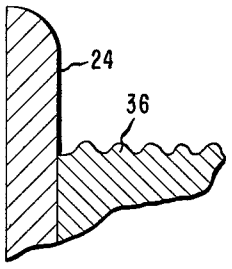


FIG. 4



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APPARATUS FOR CRIMPING FIBERS

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This invention relates to apparatus for mechanically crimping synthetic filamentary tow.

The need for crimp in commercial textile processing of fibers into staple yarns is well established. Since most synthetic filaments have little or no tendency to crimp as produced, it is necessary to impart crimp mechanically in the manufacturing process, using, for example, the "stuffing-box" crimper such as described in U.S. Patents 2,311,174 and 2,747,233, or some variant thereof.

It has long been recognized in the art that mechanical crimping leads to degradation of phyical properties of synthetic filaments. Properties such as fiber tenacity and elongation, both of which are important to textile processability and to broadest utility of fabrics made therefrom, are adversely affected by crimping. Furthermore, the tendency of most synthetic fibers to lose mechanically-induced crimp which is imparted without benefit of heat setting, imposes severe demands on initial crimp intensity to compensate for this loss. The development of crimp of initially high intensity in commercial rate processes, has required that the crimping process be operated in a critical performance area wherein minor process variations can lead to severe product property degradation. The criticality of this operation is further exaggerated by demand for increased speed of production.

It has now been found that non-uniformity in distribution of filaments as the tow enters the bite of the crimper stuffing rolls is a major cause for mechanical degradation of filaments when crimping under critical conditions of high speed and high crimp intensity. In extreme cases, near-fushion of filaments into agglomerations which are not readily opened by normal textile processing, as well as gross filament rupture, may occur. Such damaged tow is unsuitable for commercial textile use.

It is the primary object of this invention to provide apparatus for uniformly crimping filamentary tow. It is a more specific object of this invention to provide improved apparatus which can be operated at high speeds to crimp tow with a minimum of mechanical damage to the filaments. Other objects ill become apparent from the detailed description which follows.

The objects of this invention are achieved by providing in tow crimping apparatus which includes cooperating rolls which form a nip for advancing a tow and a crimping chamber below the rolls for receiving and restricting the advance of the tow, a pair of stationary flanged spool guides adjacent to and in advance of the rolls. The guides have their major axes parallel to the nip formed by the rolls and are aligned in staggered relationship along the axial path of advance of the tow to contact opposite surfaces of the tow and deflect it from its normal axial path as it passes between the guides to the rolls. Surprisingly, by deflecting the tow from about 5° to 22° from its normal course of travel as it passes between the spool guides, the filaments in the tow become oriented in a uniform pattern as they enter the bite of the feed rolls with the crimped filaments issuing from the stuffing-box showing little, if any, damage.

For a detailed description of the invention in its preferred form, reference is made to the accompanying drawings wherein:

FIGURE 1 is a diagrammatic sketch of the apparatus;

FIGURE 2 is a diagrammatic vertical sectional view

of the apparatus taken along line 2—2 of FIGURE 1, and FIGURES 3 and 4 are fragmentary sectional views of the flange and adjoining barrel portions of embodiments of the spool guides shown in FIGURE 1.

With reference to FIGURE 1, two feed rolls **12** and **14** having smooth cylindrical peripheral surfaces are mounted in opposed relationship to engage and forcibly feed a filamentary tow **16** into crimping chamber **18**. Mounted immediately above rolls **12** and **14** are flanged spool guides **20** and **22** with the inner surfaces of their respective flanges **24**, **24'** and **26**, **26'** substantially aligned with the vertical sides of rolls **12** and **14**. Spool guides **20** and **22** are fixedly positioned in a staggered relationship with respect to the normal course of travel of tow **16** and are mounted on arms **28** and **30** of frame **32**.

In operation tow **16** is passed from a source not shown between the flanges **24**, **24'** and **26**, **26'** and in contact with the peripheral surfaces of spool guides **20** and **22** when the lateral edges of the tow are aligned and the path of travel is slightly changed. As the tow comes into contact with the surfaces of the spool guides **20** and **22**, the deflection and contact with the surfaces causes the individual filament to become aligned in a uniform pattern. The tow is then engaged by feed rolls **12** and **14** and forced into crimping chamber **18**. As illustrated in FIGURES 1 and 2 of the drawing, the tow is confined in the crimping chamber by shoe plates **11** and **13** and by front and back plates **15** and **17**. The front and back plates **15** and **17** have their inner surfaces in adjacent parallel relationship with the peripheral surfaces of rolls **12** and **14** for restricting the lateral passage of the tow between the rolls. Pressure may be applied through openings **19** and **21** to inserts **23** and **25** to prevent lateral emergence of filaments from the nip of the rolls. Crimping of the filaments is accomplished by the action of a clapper plate positioned near the base of the crimping chamber, not shown, which restricts the rate at which the filaments are permitted to pass through chamber **18**.

The configuration of the flanged spool guides may be varied to achieve various effects. While a smooth barrel **34**, shown in FIGURE 3, provides greater freedom for filament distribution between flanges **24**, **24'** and **26**, **26'**, a grooved barrel **36**, as shown in FIGURE 4, may be used to force cross-flow of filaments from heavy areas in the tow to the thinner areas. In a preferred embodiment, the barrel portion has a corrugated configuration with the grooves being spaced from about 0.1 to 0.12 inch apart and being from about 0.025 to 0.035 inch deep. The tapered entrance to the surface of the barrel which is provided by the flanges accomplishes a foldover of the thin edges which are always present in a running tow. The tow is preferably adjusted to a total width slightly greater than the distance between the flanges by use of conventional spreading or contracting parabolic guides at a point upstream from the flanged spool guides.

The benefit of the flanged spool guides to crimping uniformity and thereby to product quality is substantial. Uniformity of crimp and of tow quality heretofore unobtainable is regularly obtained with the apparatus of this invention. As shown previously, a major factor in satisfactory processability of a multi-filament tow is intimate interlacing of adjacent filaments so as to permit handling of the entire bundle as a consolidated ribbon. Without interlacing at all points along its length, the tow may "split" which prevents the filament interaction necessary to broadening, narrowing, and uniformizing filament distribution in the tow structure by means of, for example, convex or concave parabolic guides.

A test procedure for evaluating splitting which has been devised takes into consideration not only the frequency

of "splits" but also their length. A split which is from barely apparent to 5 yards in length is graded as a 2 point split. One which has a length of 6 to 11 yards is assigned a value of 4 points. Those which are 12 yards or longer are assigned a value of 6 points. With this rating in mind, the comparisons of the test described below can more readily be understood. All ratings are based on 100 lbs. of tow.

A test wherein this invention was compared with a previous process which employed "finger" guides to control only the lateral position of the tow at each edge thereof demonstrated striking improvement in a critical tow quality characteristic. In this test, several hundred pounds of 3 denier per filament tow, having a total denier of 470,000, made by each process were run on a Turbo Stapler which is commonly used in the textile trade to break tow to staple. The quality of the entering tow and the emerging sliver were monitored visually throughout the test. Tow made using the apparatus of this invention had 5.6 degradation points for splits while the tow made by use of the finger guides showed 102 points. A split occurs due to failure of the crimping process to interlace the filaments properly. It is not possible to maintain a uniform distribution of feed to the Turbo Stapler in the area of a split, and a sliver defect known as a slub may develop. A slub results from exactly parallel breaks in a group of filaments and generally occurs in a thick area of the tow cross section. Since each filament in a slub is presented simultaneously to drafting rolls in succeeding steps of textile processing, they will not be drafted properly and will lead to a defect in the final yarn. In this test, less than half as many slubs were observed in the product made using the apparatus of this invention as were observed in the product made using the finger guides.

In another test, the influence of the flanged spool guide on maximum speed of crimper operation without tow defects was determined. With the finger guides for control of the edges of the tow as it enters the bite of the stuffing rolls, a maximum of 300 yards per minute processing without easily observable degradation in the crimped tow was found. With the apparatus and process of this invention, extended runs at 360 yards per minute were made without tow degradation, and short tests have shown speeds as high as 400 yards per minute to be feasible.

Since various embodiments of this invention will become apparent to those skilled in the art, the invention is not to be limited by the specific embodiment disclosed herein except as set forth in the appended claims.

I claim:

1. In tow crimping apparatus which includes cooperating rolls which form a nip for advancing a tow, a crimping chamber below said rolls for receiving and restricting the advance of said tow, and a pair of opposed plate members having the inner surfaces in adjacent parallel relationship with the peripheral surfaces of said rolls for restricting the lateral passage of said tow between said rolls: a pair of stationary flanged spool guides adjacent to and in advance of said rolls, said spool guides having their major axes parallel to the nip formed by said rolls, the flanges of said guides having inwardly tapering surfaces with the bases of said flanges being in a plane essentially parallel to and in alignment with the lateral surfaces of said rolls, said guides being arranged in staggered relationship with the axial path of advance of said tow to contact opposite surfaces of said tow and deflect it from its normal axial path as it passes between said guides to said rolls.

2. The apparatus of claim **1** wherein said flanges have inwardly tapering surfaces at their extremities and essentially straight portions adjacent the base of said flange.

3. The apparatus of claim **2** wherein the surface between the flanges of said guides has a corrugated configuration consisting of annular grooves and ridges.

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