July 7, 1964 G. A. CARRUTHERS 3,139,664

TOW FIBER CRIMPING APPARATUS

Filed March 27, 1962

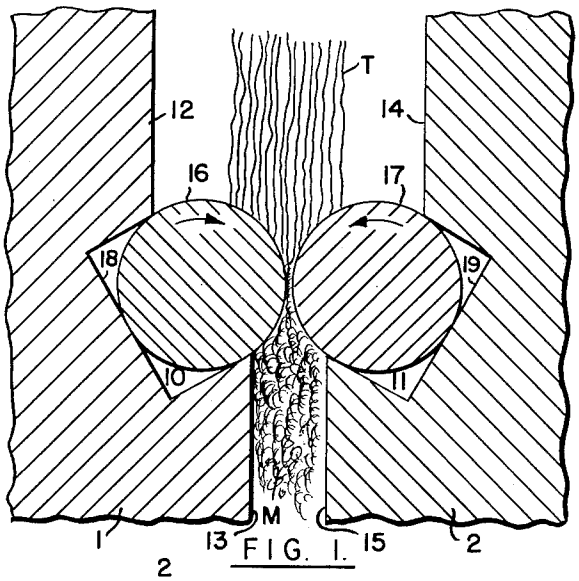

FIG. 1.

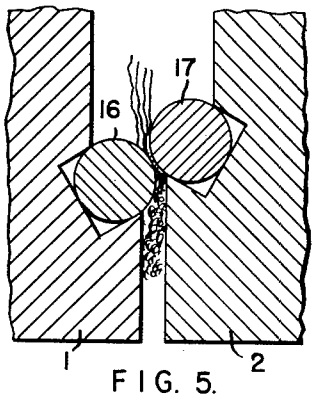

FIG. 5.

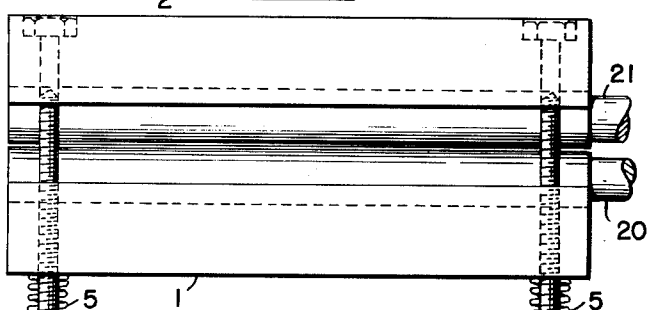

FIG. 2.

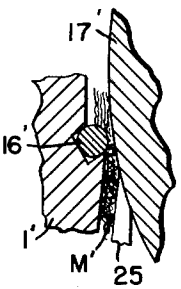

FIG. 6.

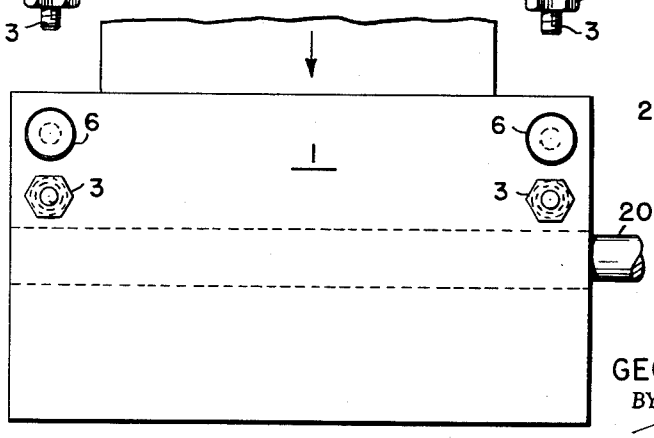

FIG. 3.

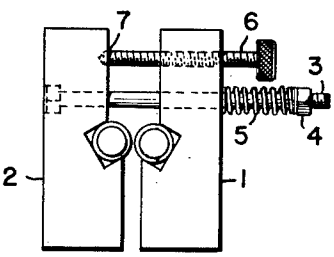

FIG. 4.

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United States Patent Office 3,139,664 Patented July 7, 1964

3,139,664

TOW FIBER CRIMPING APPARATUS

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Filed Mar. 27, 1962, Ser. No. 182,764
10 Claims. (Cl. 28—1)

This invention relates to the deformation of tow in the the manufacture of synthetic staple fiber and is especially directed to a method of and apparatus for progressively crimping the individual fibers of synthetic tow to cause them to assume non-rectilinear form in which they are then permanently set by heat treatment preferably before being cut to staple lengths for the production of yarn therefrom.

My copending application for United States Letters Patent Serial No. 164,270, filed January 4, 1962, relates to the employment of certain mechanical principles in the curling of synthetic low twist and monofilament yarns to produce light and fluffy continuous filament yarns useful especially for knitting and in accordance with the present invention generally similar principles are adapted to the treatment of synthetic tow in the manufacture of crimped staple fibers for conversion to spun staple yarns which may be woven into light, soft, somewhat elastic fabrics of improved characteristics, the manufacture of fabric from the staple yarns produced in accordance with the invention forming no part of the latter.

Consistently with said principles this invention contemplates continuous projection of a web of synthetic fibers axially into impingement with a yielding obstruction to cause them to assume a crimped non-rectilinear contour, followed by heat treatment to set permanently the individual fibers so they tend to retain such contour and to return thereto when deformed therefrom by subsequent operations, whereby when reduced to staple, if desired blended with other staple, and then made first into yarn and then into fabric they impart a high degree of softness and improved yielding and elastic characteristics thereto.

It is therefore a principal object of the invention to provide apparatus for continuously projecting into impingement with a yielding obstruction a web of tow comprising a multiplicity of continuous synthetic filaments each usually about 0.001" in diameter and numbering one to two hundred thousand whereby to progressively and simultaneously cause them to assume a permanently crimped conformation.

A further object is the provision of an apparatus for this purpose including a pair of feed rolls at least one of which is of such small diameter as to enable a pair of substantially parallel restrictor guides disposed adjacent the roll nip to confine a moving mass of the crimped fibers between them for yieldingly obstructing axial movement of the following portions of the fibers as they issue from the rolls whereby they assume a non-rectilinear form in which they may be permanently set by heat treatment usually before being severed into relatively short lengths for production of staple.

Other objects, purposes and advantages of the invention will hereinafter more fully appear or will be understood from the following description of its practice with reference to the accompanying drawing in which:

FIG. 1 is a diagrammatic much enlarged fragmentary end view of the rolls and associated mechanism comprised in said apparatus;

FIG. 2 on a smaller scale is a top plan view from above in FIG. 1; and

FIG. 3 on the same scale as FIG. 2 is a side elevation thereof.

FIG. 4 is an end view on reduced scale showing the manner in which the roll supporting plates are held in adjusted relation;

FIG. 5 is a view like FIG. 1 on a smaller scale showing a modified arrangement, and

FIG. 6 is a fragmentary view also on a smaller scale illustrating another embodiment of the invention.

Referring now more particularly to the drawing there is diagrammatically illustrated therein a pair of plates 1, 2 yieldingly held together by bolts 3, nuts 4 and springs 5 adjacent their side edges with adjusting screws 6 threaded in one of the plates and having their ends seated in depressions 7 in the other for a purpose which will hereafter appear. The plates are provided in their opposed faces with longitudinal rectangular grooves 10, 11 disposed angularly to adjacent plane surfaces 12, 13 on plate 1 and 14, 15 on plate 2. Cylindrical rolls 16, 17 are disposed respectively in grooves 10, 11 and bear against the bottom surfaces 18, 19 of the grooves, the outer edges of the latter being tangent to the roll surfaces and, as will be evident from FIG. 1, when the plates are parallel surfaces 12, 14 are more widely spaced than surfaces 13, 15.

Means (not shown) connected with roll shafts 20, 21 are provided for driving them in opposite directions while other suitable means (likewise not shown) feed tow T continuously between the plates to the nip of the rolls, preferably under slight tension to minimize entangling the generally parallel fibers of the tow; measured parallel to the rolls the width of the web is relatively great in proportion to its thickness, for example, tow webs 4"–10" wide are usually in the range of 1/16"–1/8" thick, and nuts 4, on bolts 3, together with adjusting screws 6 provide means for controlling the pressure exerted by the rolls on the tow as it passes between them.

In operation plates 1, 2 are mounted on any suitable support and nuts 4 and screws 6 adjusted in relation to the thickness of the web of tow T to cause the rolls to exert considerable pressure on the latter. The rolls, at least one of which is preferably of the order of about 1/8"–1/2" in diameter, or even smaller if relatively thin webs of tow are to be treated, are driven at appropriate speed to project the tow fibers axially from the roll nip into impingement with an adjacent obstruction disposed substantially normal to the fiber axes to thereby crimp the fibers. Such obstruction normally should recede from the roll nip at a rate corresponding to the accumulation of crimped fibers and when it comprises a mass M of the crimped fibers frictionally held adjacent the nip of the rolls by the adjacent faces of the plates preceding crimped fibers are forced from between the plates at a substantially uniform rate corresponding to the rate at which newly crimped ones accumulate adjacent the roll nip. The plate faces when disposed substantially parallel to each other and to the plane of tangency of the rolls and as shown in FIG. 1 provide a passage for the crimped fiber tow which is symmetrical with respect to the plane of the roll nip but if asymmetry of the passage is desired it can be attained by slightly offsetting the plates as in FIG. 5 so the common plane of the roll axes is at an angle other than normal to the guide surfaces of the plates while they may be disposed in non-parallel relation by appropriate adjustment of nuts 4 and adjusting screws 6.

Ordinarily tow fed between the rolls when the latter are properly adjusted and driven at adequate speed accumulates automatically between the guide surfaces due to its initial tendency to adhere to one or the other of the rolls after passing between them until peeled therefrom by the tangent edge of the corresponding plate groove engaging the periphery of the roll in question. If it does not, however, it is a simple matter at start-up to insert an appropriate instrument such as a rod be-

tween the guides until a mass of the crimped fibers has accumulated beyond the rolls sufficient to frictionally engage the guides. Thereupon the rod may be removed, following which the guide surfaces **13**, **15** frictionally retain mass M of the crimped fibers in close proximity to the roll nip and as the mass accumulates by progressive passage of crimped fibers into it the friction of the guides is overcome sufficiently to allow a progressive discharge of the crimped fiber tow from between the guides into a suitable receptacle (not shown) or onto a conveyor for passing it through a heating chamber if the crimping is to be succeeded immediately by the heat treatment requisite for permanently setting the fibers in their non-rectilinear crimped conformation. If preferred, however, the crimped tow can be first reduced to staple lengths and then subjected to heat treatment by either a batch or continuous operation the details of which constitute no part of the invention.

It will be recognized the crimping of the individual fibers in the tow in accordance with the invention occurs as a result of their axial projection into engagement with an obstruction athwart the path of their movement and in view of the great flexibility and negligible compression strength of the individual fibers it is essential the obstruction be located closely adjacent the point of origin of the projection, i.e., the nip of the rolls. Hence small diameter rolls or at least one roll of small diameter must be employed as otherwise it is impractical without the use of side plates to maintain an effective obstructing body of crimped fibers close enough to the roll nip to cause the succeeding portions of the fibers to assume crimped conformation.

While I have shown in FIGS. 1–5 and usually prefer to employ rolls of substantially equal diameter and support both in the grooves in which they rotate, nevertheless as illustrated in FIG. 6 one roll **16'** of small diameter, say ⅛"–½" may be associated with a considerably larger one **17'** 3"–4" in diameter of sufficient rigidity not to require intermediate support between its end bearings. In that case a suitable blade **25** engaging roll **17'** adjacent the roll nip should be disposed to prevent the fibers of the tow from adhering to the roll and provide with plate **1'** supporting roll **16'** one of the two frictional surfaces required for retention of the crimped tow mass M' in position for obstructing free passage of fibers from the rolls.

It will be apparent in the apparatus shown in the drawing each of plates **1**, **2** or one plate **1'** with which blade **25** cooperates performs a plurality of functions, including backing up the roll with which it is associated throughout the length thereof engaged in the plate groove making end bearings unnecessary without risk of bending the roll, providing in effect a scraper edge which prevents adherence of the tow fibers to the roll beyond such edge, and also presenting a frictional retaining face lending support to a progressive mass of crimped fibers adjacent the roll nip to assure crimping of the fibers as they issue therefrom. While the rolls may be of polished steel and the plates bronze with full finished surfaces where they engage the rolls to minimize friction the specific materials of which the parts are made are not critical and may be varied as desired.

More over while I have herein described with particularity certain embodiments of the apparatus contemplated by the invention and suggested certain obvious modifications which may be made therein I do not desire or intend to be thereby limited or confined in any way as other changes and modifications in the form, construction, arrangement and relationship of the parts of the apparatus will readily occur to those skilled in the art and may be utilized if desired without departing from the spirit and scope of the invention as defined in the appended claims.

Having thus described my invention, I claim and desire to protect by Letters Patent of the United States:

1. Apparatus for crimping the individual fibers of synthetic tow comprising a pair of substantially tangent rolls, means engaging the rolls adjacent their nip defining an open sided passage for tow delivered from the rolls and presenting opposed parallel surfaces extending in the direction of the roll axes a distance substantially greater than the width of the tow, said surfaces being relatively movable with the rolls in the plane of the common axis of the latter and spaced apart to frictionally engage the crimped tow at spaced points, yielding means biasing the rolls and said roll engaging means toward each other, and means for driving the rolls in opposite directions in engagement with the tow to project it into said passage to form an obstruction therein operative to decelerate the tow as it passes thereinto from the rolls.

2. Apparatus as defined in claim 1 which includes a plate having a groove receiving one of said rolls, said passage-defining means including a surface of said plate adjacent said groove.

3. Apparatus as defined in claim 1 which includes a plate having a substantially rectangular groove receiving one of said rolls, the bottom and an edge of said groove being substantially tangent to said roll.

4. Apparatus as defined in claim 1 which includes a plate having a substantially rectangular groove the bottom of which is tangent to one of said rolls and is disposed angularly to the common plane of the roll axes.

5. Apparatus for crimping the individual fibers of synthetic tow which comprises a pair of elongated parallel substantially tangent rolls, means for driving the rolls concurrently in opposite directions, a pair of plates disposed adjacent the rolls, means for maintaining the plates in parallelism, having substantially parallel faces in opposed relation and at least one of the plates having in its face proximate the other plate a substantially rectangular groove receiving one of the rolls, and yielding means biasing the plates together.

6. Apparatus as defined in claim 5 in which said plate groove has a bottom surface oblique to the adjacent face of the plate.

7. Apparatus as defined in claim 5 in which an edge of said plate groove is tangent to the surface of the adjacent roll.

8. Apparatus as defined in claim 5 in which said plate groove has a bottom surface engaging the roll received therein and an outer edge tangent to said roll.

9. Apparatus as defined in claim 5 in which the bottom surface of said plate groove lies in a plane oblique to the adjacent outer face of the plate and is tangentially engaged by the roll received in said groove and at least one outer edge of the groove is tangent to said roll.

10. Apparatus as defined in claim 5 in which the means biasing the plates together comprise a plurality of bolts extending through both plates, nuts on the bolts, a spring surrounding each bolt between its head and the corresponding nut and engaging one of the plates and an adjusting screw adjacent each bolt threaded into one of the plates and engaging the other plate cooperative with the springs to maintain the plates in relatively fixed spaced relation.

References Cited in the file of this patent

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,139,664 July 7, 1964

George A. Carruthers

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, lines 37 and 38, strike out " , means for maintaining the plates in parallelism,"; line 41, after "rolls," insert -- means for maintaining the plates in parallelism, --.

Signed and sealed this 3rd day of November 1964.

(SEAL)
Attest:

ERNEST W. SWIDER
Testing Officer

EDWARD J. BRENNER
Commissioner of Patents