May 19, 1953 D. G. C. HARE 2,638,634

STRETCH BREAKING APPARATUS AND METHOD

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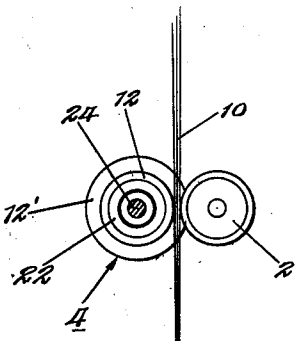


Fig. 1.

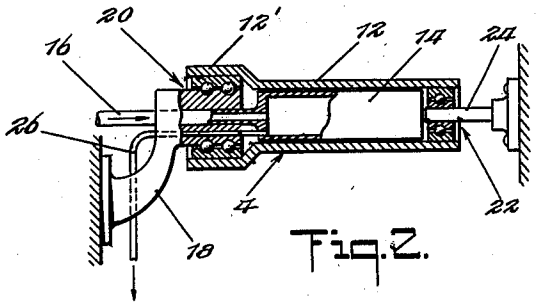


Fig. 2.

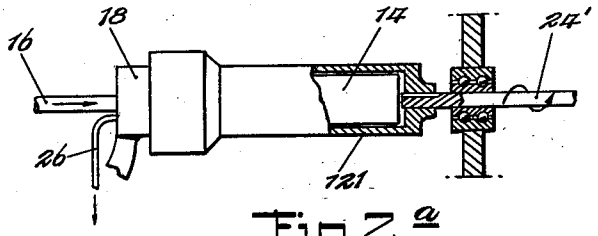
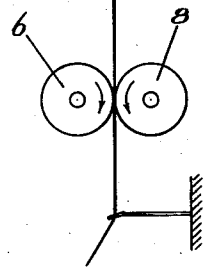


Fig. 2.a



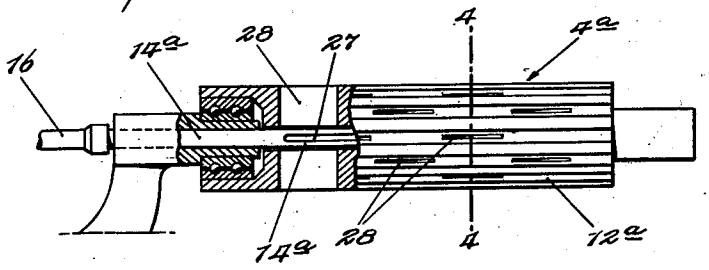


Fig. 3.

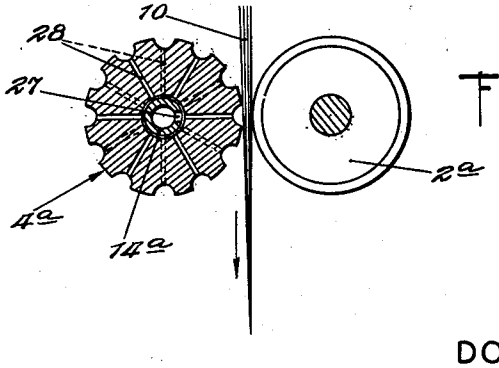


Fig. 4.

INVENTOR
DONALD G. C. HARE
BY
Norman P. Armitage
ATTORNEY

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STRETCH BREAKING APPARATUS AND METHOD

Donald G. C. Hare, Clemson, S. C., assignor to Deering Milliken Research Trust, New York, N. Y., a nonprofit trust of New York

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5 Claims. (Cl. 19—0.37)

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The present invention relates to the treatment of continuous textile filaments for production of sliver, roving or yarn therefrom and comprises an improved stretch breaking process, and means, for conversion of a tow of continuous filaments, such as rayon tow, into a staple fiber product of superior quality. The invention is particularly adapted for the treatment of rayon tow, whether of regenerated cellulose, such as viscose, or of an organic derivative of cellulose, such as cellulose acetate and will accordingly be described with reference to such application. The method of the invention is applicable, however, to any type of textile filamentary material that may be weakened by heat.

Conversion of rayon tow into staple fibers by stretch breaking, as heretofore practiced in the art, involves the gripping of the tow by at least two sets of rotating rolls, of which one set, the delivery set, rotates at a higher peripheral speed than that of the other, or feed set, with consequent breaking of the individual filaments of the tow during passage from the feed to the delivery rolls. Any one of the numerous drafting mechanisms ordinarily used in the textile industry for drafting staple fiber sliver and roving in the production of yarn or for reducing fiber length by stretch breaking can be used for stretch breaking tow. Such treatment of continuous filaments in a drafting mechanism is intended to cause the filaments to break randomly at different positions in the ratch with corresponding random length of staple fibers in the produced roving or yarn and consequent substantial uniformity of the product. Such intended action, however, does not materialize in practice as filament breakage, instead of being randomly distributed in the ratch, is disproportionately large near the draft or delivery rolls. This results in undesired short staple length of fibers in the roving or yarn. The concentration of filament breakage in the lower part of the ratch is believed due to interfilament friction which reduces the effective length of the ratch.

When filaments break near the lower rolls, the ends of those lengths of filaments held only by the upper rolls tend to snap up and out of the sliver and drag with them ends of other filaments which may have been broken higher in the ratch and are being advanced by the rotation of the feed rolls. There is thus presented to the nips of the draft rolls a relatively thin portion of sliver corresponding to the portion from which the broken ends have snapped back. This is followed by a thicker portion in which there is a plurality

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of frayed or broken ends turned back upon the sliver or projecting from the side thereof. The result is improper drafting and the production of slubby roving or yarn. The succession of relatively thin and thick portions of sliver in the ratch caused by the concentration of fiber breakage near the lower rolls, occurs cyclically, giving a "breathing" action to the drafting and resulting in a yarn or roving of periodically varying diameter.

A further disadvantage in the conversion of rayon tow to roving or to yarn by stretch breaking as heretofore practiced is that the physical characteristics of the cellulosic materials may be impaired by the necessary stretching of the filaments beyond their elastic limit.

Objects of the invention are, therefore, to provide a method of stretch breaking tow that will insure uniform long staple fibers, that will avoid concentration of breakage low in the ratch and that will result in a staple fiber product of superior quality.

In accordance with the invention, these objects are achieved by concentrating filament breakage at the nips of the feed rolls and such concentration of breakage is effected by heating one or both feed rolls so as to impart heat to the tow and thereby locally reduce its tensile strength. The optimum temperature of the feed rolls will depend upon the type of tow to be stretch broken and should be such that sufficient heat is imparted to the tow to cause such of the filaments as are under tension to break where heated. The temperature of the rolls should not be so high that filaments not under tension, that is filaments not gripped by both draft and feed rolls, break apart or attenuate substantially. With rayon tow, either acetate or viscose, temperatures obtained by heating the feed rolls with steam or superheated steam have been found satisfactory.

In the accompanying drawings:

Fig. 1 is a diagrammatic view of a tow stretch breaking mechanism showing the idler feed roll heated in accordance with the invention;

Fig. 2 is a longitudinal sectional view, partly in elevation of the heated idler feed roll of Fig. 1.

Fig. 2a is a view corresponding to Fig. 2 but showing a heated driven feed roll.

Fig. 3 is a side view of a heated feed roll representing a modification wherein steam is injected into the tow, and

Fig. 4 is a transverse sectional view taken on the line 4—4 of Fig. 3.

In Fig. 1, a tow stretch breaking mechanism is diagrammatically illustrated as comprising a

pair of feed rolls 2 and 4 and a pair of draft or tensioning rolls 6 and 8. As in the usual drafting mechanism one roll of each pair is driven, and the other roll of each pair is an idler roll; rolls 6 and 8 rotate at a substantialy higher rate than rolls 2 and 4 to exert tension on filaments held by both pairs of rolls. Rotation of the feed rolls 2 and 4 draws tow 10 from any suitable supply source (not shown) and feeds it into the ratch defined by the two pairs of rolls. When the forward ends of the filaments of the tow are seized by the rapidly rotating draft rolls, sufficient tension is applied to cause breakage of the filaments into staple lengths. In accordance with the invention, one or both of the feed rolls is heated to cause filament breakage at or near the nips of the feed rolls.

In the particular embodiment of the invention illustrated in Figs. 1 and 2, idler roll 4 is heated internally by steam. For this purpose the roll 4 comprises a rotatably mounted shell 12 enclosing a stationary hollow core 14 to which steam is supplied from a pipe 16. The pipe 16 is rigidly connected to member 14 and serves as a support therefor. A fixed bracket 18 supports the pipe 16 adjacent its connection with member 14 and carries the inner race of a ball bearing 20, the outer race of which is carried by the sleeve 12; sleeve 12 being suitably flared at 12', as shown, to enclose the bearing 20. The other end of a sleeve 12 is rotatably mounted, as by ball bearing 22, on a fixed shaft 24. A small condensate return pipe is indicated at 26. With the above described arrangement, the shell 12 will transfer heat from the steam heated core 14 to the tow 10 as it enters the nips of the feed rolls, and such filaments of the tow as are gripped by both sets of rolls will break at or near the nips of the feed rolls.

Once the stretch breaking is initiated, there is no danger of complete severance of the strand at the nips of the feed rolls as there will be in the ratch numerous ends of filaments previously broken, and such filaments will not be gripped by both sets of rolls and hence will not break at the nips of the feed rolls until their forward ends reach the nips of the draft rolls. In initiating the stretch breaking, if the advancing end of the tow is not sufficiently tapered, it may be cut on a bias so that all of the filament ends are not in alignment, or heating of the feed roll may be delayed until after some random breakage in the ratch has occurred.

Instead of heating the idler roll, as described in connection with Figs. 1 and 2, the driven roll 2 could be heated, or both rolls could be heated if desired. If a driven, rather than an idler roll is to be heated, the shell 12l of the roll could be splined, as indicated in Fig. 2*a*, to a drive shaft 24'.

The above described heating arrangement, which imparts dry heat to the tow, is particularly suitable for acetate tow which readily weakens when subjected to heat. For viscose tow which is susceptible to moisture as well as to heat, the modification of the invention illustrated in Figs. 3 and 4 is preferred.

In Figs. 3 and 4, a fluted roll 4*a*, which may be an ider feed roll, or a driven feed roll, is shown as comprising a shell 12*a* within which is a tubular member 14*a* connected to the steam supply pipe 16. The tubular member 14*a* is provided with an elongated slot 27, and the shell 12*a* is provided with a plurality of radial passages 28 of substantial axial length. The slot 27 is on the side of member 14*a* facing the other feed roll 2*a* and hence, during rotation of the rolls, steam from member 14*a* will be ejected into the tow 10 through the passages 28 in the shell 12*a*. By providing a relatively close fit between the inner surface at the shell 12*a* and the outer surface of member 14*a*, ejection of steam from the roll 4*a* can be substantially confined to the nips of the feed rolls. The heat and moisture thus delivered to the tow will concentrate filament breakage at or near the nips as heretofore described.

This arrangement, whereby steam is ejected directly into the tow, avoids the necessity for the provision of a condensate return pipe, increases the local weakening of tow that is susceptible to moisture, such as viscose tow, and provides a vehicle, if desired, for treating agents for the tow, as for example, lubricants, crimping agents, or the like.

The invention has now been described with reference to two embodiments thereof, one particularly suitable for use with cellulose acetate tow and one particularly suitable for use with viscose tow. Although in each embodiment of the invention illustrated in the drawings, the heating agent has been indicated as steam, obviously other heating means for one or both of the feed rolls could be provided without departing from the spirit of the invention. For example, hot gases, such as hot air, or products of combustion, could be introduced into, or played upon, one or both of the feed rolls or heat could be transferred conductively to the rolls, as by contact of their outer surfaces with stationary heating means, or the rolls could be heated electrically or subjected to radiant or dielectric heat as is disclosed and claimed in the co-pending application of Robert M. Ingham, filed June 7, 1947, Serial No. 753,197, and assigned to the assignee of this application. Preferably, as described herein, the feed rolls are continuously heated, but obviously, if desired, they could be heated intermittently, with corresponding change in length of the produced staple fibers.

While the invention has been described in connection with a direct tow-to-yarn spinner, the method and means of the invention are not concerned with the particular form of staple fiber product, that is, whether it is in the form of yarn or of roving, nor is the invention necessarily limited to the treatment of artificial, as distinguished from natural filaments or fibers as the invention may be advantageously employed for stretch breaking of any filamentary material which is thermoseverable and of a length greater than that of the ratch. The heated rolls of the invention could be utilized in any textile drafting or drawing operation if heat treatment of the material being drawn or drafted is desired.

The following is claimed:

1. The method of treating tow which comprises stretch breaking the tow in a drafting mechanism while applying heat and moisture to the tow at the nips of the feed rolls.

2. The method according to claim 1 wherein heat and moisture are applied to the tow at the feed rolls by localized injection of steam into the tow.

3. Apparatus for converting continuous filamentary material into fibers of staple length which comprises a first and second pair of driven rolls, at least one of said first pair of rolls having a plurality of perforations therein, means for introducing a heat containing fluid medium into the interior of said perforated roll, said medium passing through said perforations and im-

pinging upon individual filaments passing between said rolls in order to weaken the same, and means for driving the second pair of rolls at sufficient speed in excess of the first pair to stretch weakened filaments beyond their extensibility, whereby said stretched filaments weakened by the heated fluid break in the neighborhood of said first pair of rolls.

4. The apparatus of claim 3 wherein said perforated roll comprises a hollow tubular axle provided with an elongated slot facing the other roll of said pair adjacent the nip and an outer shell provided with a plurality of radial passages, said shell being rotatably mounted on said axle whereby heated fluid under pressure delivered to the interior of said axle passes out through the slot and passages substantially at the nip of the first pair of rolls.

5. The process of converting substantially parallel continuous filamentary material into fibers of staple length, which comprises forwarding the material between a pair of driven holding rolls, applying heat and moisture to individual filaments in a zone adjacent said rolls to weaken the filaments and, while maintaining the parallel relationship of the filaments, subjecting them to a stretch in excess of the extensibility of the weakened filaments, whereby the weakened stretched filaments break in the neighborhood of the rolls.

DONALD G. C. HARE.

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