Aug. 25, 1953 R. M. INGHAM, JR 2,649,623

METHOD AND APPARATUS FOR STRETCH-BREAKING TEXTILE FILAMENTS

Filed June 7, 1947 2 Sheets-Sheet 1

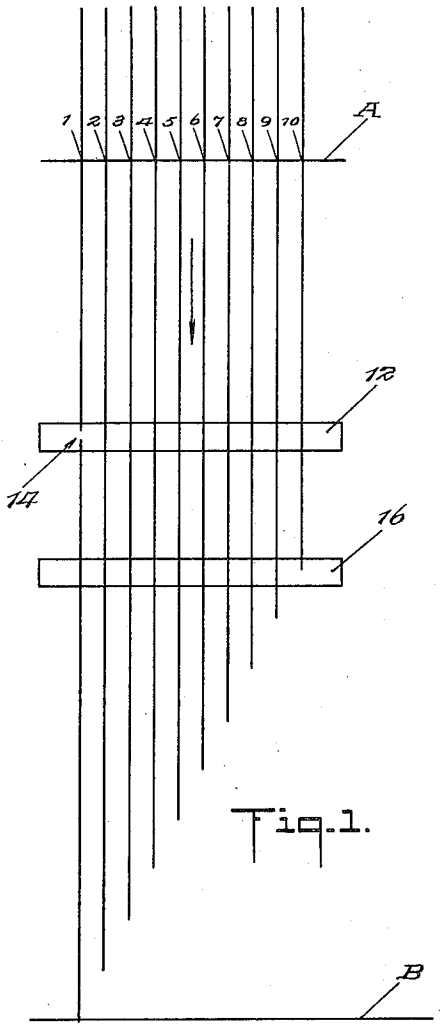


Fig. 1.

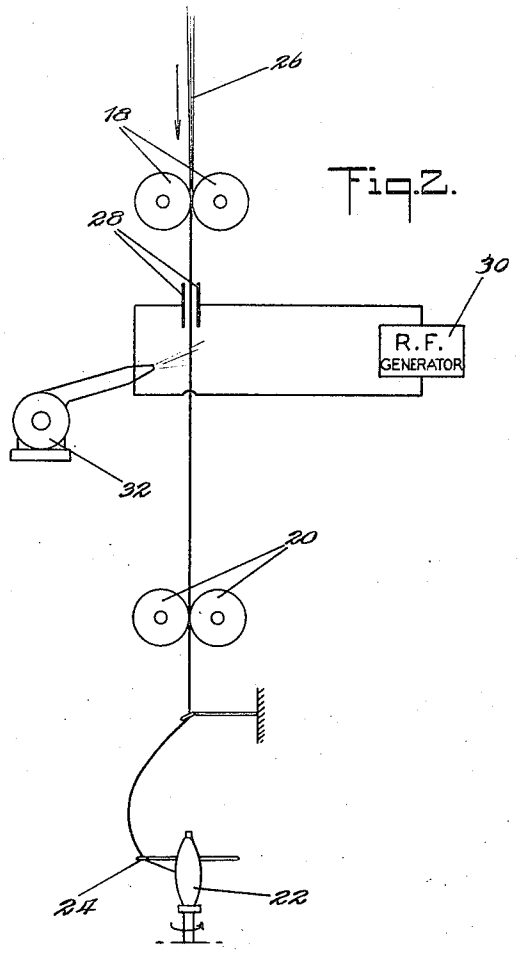


Fig. 2.

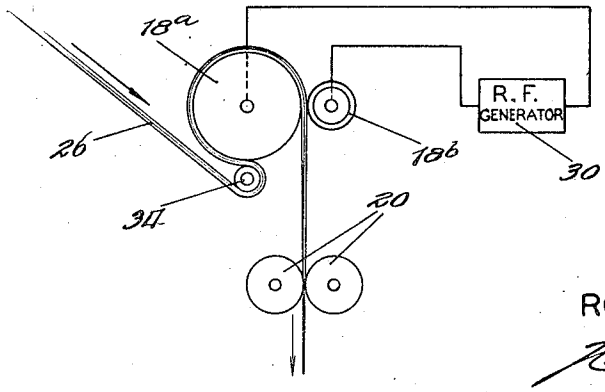


Fig. 3.

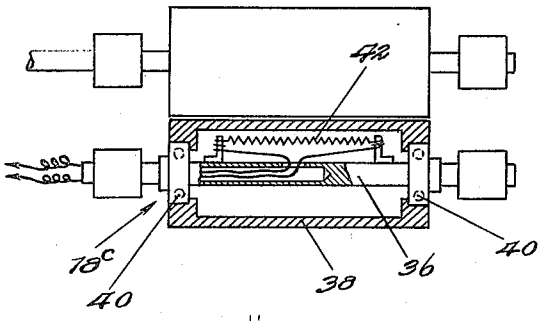
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Fig. 4.



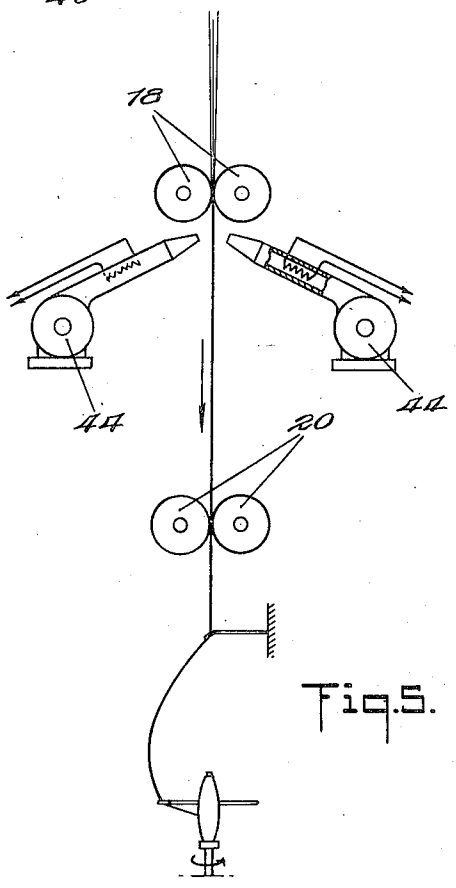


Fig. 5.

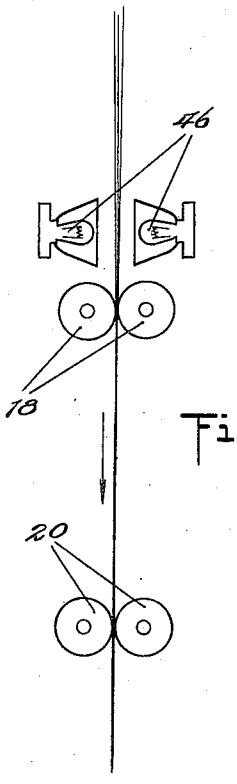


Fig. 6.

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2,649,623

METHOD AND APPARATUS FOR STRETCH-BREAKING TEXTILE FILAMENTS

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Application June 7, 1947, Serial No. 753,197

13 Claims. (Cl. 19—.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 for conversion of a tow of continuous filaments, such as rayon tow, into a staple fiber product of superior quality. As the improved process is particularly applicable to rayon tow, whether produced by the acetate, cuprammonium or viscose process, the invention will be described with reference thereto. It should be understood, however, that the invention is applicable to any type of textile filamentary material that may be weakened by heat, as, for example, glass nylon, vinyl or vinylidene chloride polymers or copolymers or derivatives of protenoid materials.

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

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followed by a thicker portion in which there is a plurality 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 material may be impaired by the necessary stretching of the filaments beyond their elastic limit.

Another object of the invention is thus to provide a method of, and means for, stretch breaking of tow into fibers of uniform and substantial staple length.

Another object of the invention is to provide a method of, and means for, converting tow into a staple fiber product without substantial impairment of its physical characteristics.

In accordance with the invention, both of these general objects are attained by the application of heat to the tow in the neighborhood of the feed rolls. Such application of heat concentrates filament breakage high in the ratch and thus insures fibers of longer staple length and substantially eliminates the "breathing" action hereinbefore described. When filaments are subjected to localized heating, the elastic limit of the heated part of each filament is lowered and hence breakage will occur without stretching the entire length of filament in the ratch beyond its elastic limit. Thus, the localized application of heat high in the ratch not only insures fibers of longer staple length and more uniform roving or yarn, but also a product of improved physical characteristics as compared to roving or yarn produced by stretch breaking tow without the application of heat.

For a better understanding of the invention, reference may be had to the accompanying drawings of which:

Fig. 1 is a diagram explanatory of the improved process of the invention;

Fig. 2 illustrates diagrammatically apparatus embodying the invention and adapted for dielectric heating of the filaments high up in the ratch;

Figs. 3 and 4 illustrate the invention as embodied in apparatus for heating the filaments at the nips of the feed rolls, and

Figs. 5 and 6 illustrate the invention as embodied in apparatus for heating the filaments by convection and radiation, respectively; the apparatus of Fig. 5 heating the filaments high in the ratch and that of Fig. 6 just prior to entering the ratch.

The theory of the invention can best be understood by reference to Fig. 1 wherein the line A represents the location of the nips of a pair of feed rolls, the line B, that of the nips of a pair of draft rolls and the lines identified by reference numerals 1 to 10 inclusive, ten continuous filaments in the ratch. If the filaments, as they move down through the ratch, for example, as they pass the area 12, are subjected to heat, sufficient to weaken them but insufficient to cause them to fall apart when not under tension, then at any moment only those filaments that are nipped by the draft rolls will be broken, and such breaking will occur at the location of the application of heat. In Fig. 1 therefore, filament 1, the forward end of which is assumed to be in the nips of the draft rolls, is broken, as indicated at 14, into a fiber of a staple length equal to the distance from the draft rolls to the location at which heat is applied. During successive intervals of time during each of which all the filaments are advanced uniformly in the ratch, filaments 2, 3, 4, etc., are successively nipped by the draft rolls. When filament 2 is nipped, the part thereof which was subjected to heat when filament 1 broke, is cooler than the part newly exposed to heat and breakage of the filament thus occurs at the heated location with the result that the staple length of the fiber formed from filament 2 is the same as that formed from filament 1. The same is true of each filament in the ratch so long as the applied heat is insufficient to cause separation of the filament when the filament is not held by the nips of both sets of rolls. If desired, to insure sufficiently rapid cooling of the filaments after leaving the heating zone to prevent breaking lower in the ratch, a cooling station, at, for example, the location indicated diagrammatically at 16 may be provided.

Fig. 1 has purposely been made entirely diagrammatic in order to make it clear why application of localized heating to the filaments during stretch breaking results in the production of fiber of a length substantially equal to the distance between the draft rolls and the location at which the heat is applied. It will be understood, of course, that in practice, at any one time there will be a plurality of filaments in the ratch corresponding to each of the filaments 1 to 10 of Fig. 1 and that such filaments are in a bundle and not isolated, as diagrammatically indicated.

In accordance with the invention, any one of a variety of means may be provided for applying heat to the filaments, and such means may be located so as to heat the filaments high in the ratch, or at the nips of the feed rolls, or just prior to entering the ratch. Figs. 2 through 6 indicate diagrammatically such various alternative heating arrangements.

In Fig. 2 a direct tow to yarn spinner is indicated diagrammatically as including a pair of feed rolls 18, a pair of draft rolls 20 and a spindle carried bobbin 22 with its associated spinning ring 24. The feed rolls draw tow 26 from any suitable supply reel (not shown) and feed it into the ratch where it is converted into fiber of staple length and drafted by the rapid rotation of draft rolls 20. In accordance with the invention, the filaments, as they leave the feed rolls 18 pass

between a pair of plates 28. Plates 28 are connected to a radio frequency generator 30. The filaments thus form the dielectric of a condenser and will be heated by the high frequency electrostatic field set up between the plates 28 by the generator 30. The temperature of the filaments may thus be raised sufficiently to cause breakage of those filaments nipped by both sets of rolls, as explained in connection with Fig. 1. The filaments, upon emergence from between the plates 28 may be cooled, if desired, as by a cool air stream supplied by a blower 32.

Instead of providing separate condenser plates, as in Fig. 2, the feed rolls themselves could be constructed as electrodes and connected to a high frequency generator as shown in Fig. 3. In Fig. 3, the driven feed roll 18*a* has a conducting surface, as of copper and the tow 26 is wrapped well around the surface of this roll, as by passage around a small idler 34 positioned near the lower surface of roll 18*a*. A relatively small idler feed roll 18*b* has a conducting core of copper and an insulating resilient coating of polyethylene or the like. The rolls 18*a* and 18*b* are connected as by brushes (not shown) to the generator 30. By wrapping the tow well around the roll 18*a*, the pressure between the rolls 18*a* and 18*b* can be kept low enough to prevent damage to the insulating surface of roll 18*b*. With this arrangement, the heat is concentrated at the nips of the feed rolls and in the filaments, rather than in the rolls and cots. If desired, cooling means, as in Fig. 2 could be provided.

In Fig. 4, an alternative arrangement for heating the tow at the nips of the feed rolls is illustrated. In this embodiment of the invention, the idler roller 18*c* of the feed rolls has a stationary hollow shaft 36 and an outer shell 38 rotatably supported thereon as by ball bearings 40. A heating coil 42 is mounted on the shaft 36 so as to transfer heat to the shell 38. This arrangement has the advantage that electrical connections to moving parts are not needed.

In Fig. 5, a pair of blowers 44 direct streams of hot gas, such as air, onto the tow high in the ratch and in Fig. 6, the tow, just before entering the nips of the feed rolls, passes by a battery of infrared lamps 46. It will be understood that the streams of hot gas from blowers 44 of Fig. 5 are concentrated so as to apply heat over a relatively restricted area and that the lamps 46 of Fig. 6 are powerful enough and close enough to the feed rolls so that the heat retained by the tow when it enters the nips of the feed rolls will be sufficient to insure breakage of filaments held by both feed and draft rolls.

The invention has now been described with reference to various embodiments thereof. Obviously, localized heating of filaments in accordance with the invention to insure breakage at reduced tension and into fibers of substantially constant length could be effected by means other than those specifically described herein. In practicing the invention, it is only necessary that the heat applied to the filaments be localized, be relatively rapidly dissipated and be sufficient to cause breakage when the filaments are subjected to tension. The heat should not be great enough to cause permanent alteration of the physical characteristics of the material.

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. While in the particular embodiments of the invention illustrated and described, the heating station has been indicated as stationary and as in continuous operation, obviously, if desired, the location of application of heat could be varied at will or heat could be applied intermittently, with corresponding change in length of the produced fibers.

The application of heat and moisture to tow during a stretchbreaking operation is disclosed and claimed in the co-pending application of Donald G. C. Hare, filed June 20, 1947, Serial Number 756,069, and assigned to the assignee of this application.

The following is claimed:

1. Apparatus for stretch breaking textile filaments comprising in combination, a stretch breaking mechanism including feed and draft rolls defining a ratch therebetween, means in the neighborhood of the feed rolls for heating the filaments whereby breakage of the filaments occurs high in the ratch and means for dissipating the heat applied to the filaments by said heating means.

2. The apparatus of claim 1 wherein said heating means comprises a means for dielectric heating of the filaments during passage between the feed rolls, said means including a generator of high frequency oscillations connected to the feed rolls for setting up a high frequency electrostatic field for passage of the filaments therethrough.

3. In a direct tow-to-yarn spinner of the type having spaced feed and draft rolls defining a ratch therebetween, the improvement comprising heating means for the tow located in the neighborhood of the feed rolls and adapted to apply heat to the tow sufficient to cause breaking of the filaments of the tow when tensioned and gripped by both draft and feed rolls but insufficient to cause severance of filaments not so tensioned and means for cooling the tow subsequent to the heating thereof by said heating means, to insure filament breakage at a predetermined distance from the draft rolls.

4. The method of stretch breaking a continuity of substantially parallel textile filaments during passage through a zone which comprises feeding the filaments into the zone at one rate while withdrawing the filaments from the zone at a greater rate to tension the filaments, maintaining the filaments substantially parallel during passage through the zone and applying to the filaments in the nighborhood of the entrance into the zone heat sufficient to cause breakage of tensioned filaments but insufficient to cause severance of untensioned filaments.

5. The method according to claim 4 wherein heat is applied to filaments after entrance thereof into the zone.

6. The method according to claim 4 wherein heat is applied to the filaments during entrance into the zone.

7. The method according to claim 4 wherein heat is applied to the filaments prior to entrance thereof into the zone.

8. The apparatus as in claim 1, wherein said heating means comprises located means for generating infra-red rays.

9. The method according to claim 4 including cooling the filaments in the zone at a location in their path beyond that at which heat is applied.

10. The apparatus as in claim 1 wherein said heating means comprises an electric heating coil carried by one of said feed rolls.

11. The apparatus for stretch breaking textile filaments comprising in combination, a stretch breaking mechanism including feed and draft rolls defining a ratch therebetween, aligned spaced conducting plates positioned on either side of the ratch adjacent the feed rolls, a high frequency generator connected to said plates for setting up a high frequency electrostatic field between said plates whereby heat is applied to the filaments and means for directing a current of air against said filaments after passage through said field in order to cool the same.

12. The apparatus as in claim 1 wherein the said heating means comprises means for directing a stream of a hot fluid medium against said filaments.

13. The method of treating textile filaments which comprises stretchbreaking the filaments in a drafting mechanism while locally heating the filaments in the neighborhood of their entrance into the ratch and subjecting the filaments to forced cooling immediately following said heating to cause the filaments gripped by both sets of rolls of the mechanism to break near the feed rolls.

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