

Dec. 9, 1947.

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2,432,355

MANUFACTURE OF STAPLE FIBER-YARNS AND TOWS

Filed June 7, 1945

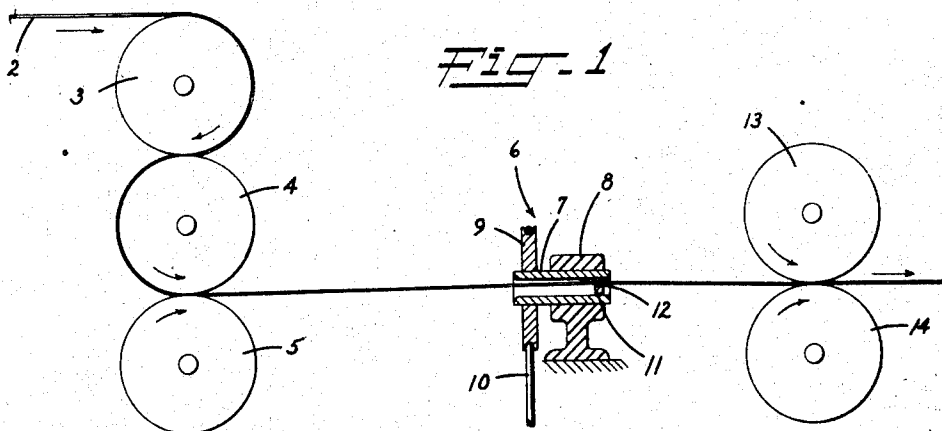


Fig. 1

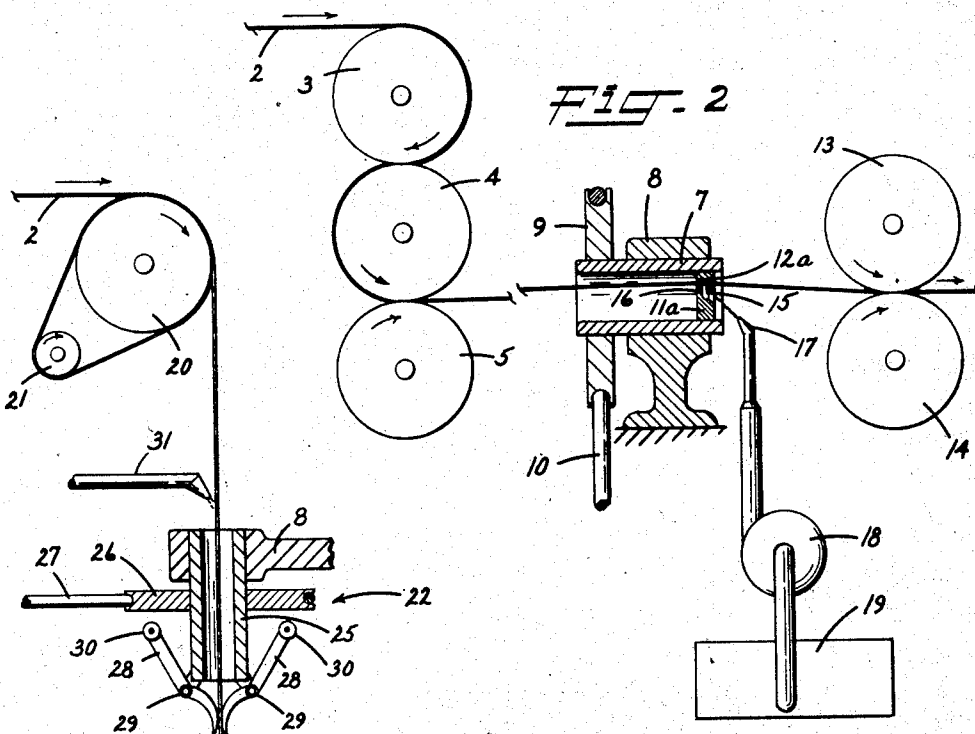


Fig. 2

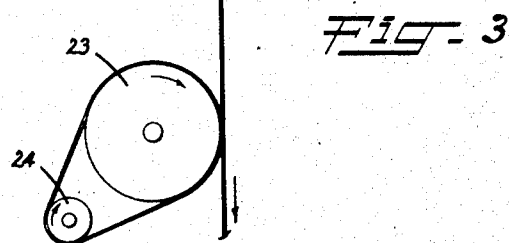


Fig. 3

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2,432,355

MANUFACTURE OF STAPLE FIBER YARNS
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Application June 7, 1945, Serial No. 598,005

14 Claims. (Cl. 57-2)

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This invention relates to a procedure and apparatus for converting continuous filament bundles, such as yarns or tows, into staple fiber bundles without the loss of continuity of the bundle.

Heretofore, it has been the common practice to subject continuous filament bundles without twist or having an extremely low twist, to a drafting action by which the filaments are stretched beyond the limit of their extensibilities to effect breakage thereof, such as between two or more spaced pairs of drafting rolls or equivalent stretching devices. This procedure has the disadvantage of requiring a large filament bundle, such as 10,000 to 200,000 denier, in order to assure that the entire bundle is not interrupted at intervals and to avoid the tendency of broken ends to fly out of the general bundle.

In accordance with the present invention, the position of breaking of the fibres is controlled in an improved fashion, so that the loss of ends by complete interruption of the bundle is prevented and the tendency of the broken terminal portions of the filaments to fly is reduced to a negligible quantity. In general, the objects of the invention are accomplished by first twisting the bundle a substantial amount, such as 3 to 25 turns per inch, and then introducing the twisted bundle into the drafting system while subjecting the bundle as it proceeds between the pairs of drafting rolls to a false twisting action in a direction opposite to the twist in the bundle as it enters the system. The false twisting requires the engagement of the bundle at a definite position of its path between the pairs of drafting rolls and reduces the twist adjacent the point of engagement to either a low twist or to no twist at all. The low twist may be either in the same or the opposite direction to that originally in the bundle as it enters the system. Because of the rotation of the point of engagement of the bundle with the false twisting system, and because of the continuous longitudinal travel of the bundle through the twisting system, a point of weakness is established in the filaments which engage the twisting system, because of the low or complete lack of twist and the rubbing action against the system. The relative rotation of the twist system simultaneously with the longitudinal travel of the bundle with respect thereto and the relative non-uniformity of tensile strength at points spaced along the individual filaments assure that the points of breakage on the various filaments making up the bundle are staggered throughout the length thereof, especially when some twist is present in the bundle at the position of engagement with the twister system. Another important effect of the procedure is to immediately re-twist the broken fiber bundle as it proceeds from the false twisting system, thereby assuring that

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the bundle remains in integral assemblage. The twist of the bundle as it leaves the drafting system is less than the twist of the bundle as it is fed thereto, depending inversely upon the drafting ratio, but the initial twist of the continuous filament bundle may be of sufficient magnitude so that it is unnecessary to provide additional twisting to the staple fiber bundle issuing from the drafting system, or to take special precautions to assure unity of the staple fiber bundle as it proceeds to a twisting device following the drafting system. In some cases, it may be desirable to add additional twist, but for many purposes, the final twist desired in the staple fiber bundle may be obtained merely by predetermining the twist in the continuous filament bundle as it is provided for delivery to the drafting system.

Thus, the false twisting system assures staggered breaks at fairly definitely controlled distances apart, prevention of lost ends flying from the staple fiber bundle between the drafting rolls, and elimination of the necessity to impart twist or to provide special means to prevent interruption of the staple fiber bundle as it is discharged from the system.

The invention is applicable to the treatment of bundles of filaments of any character, such as artificial filaments of regenerated cellulose produced from viscose, nitro-cellulose, cuprammonium cellulose; cellulose esters, such as cellulose acetate, cellulose propionate, cellulose acetate butyrate; cellulose ethers, such as ethyl cellulose and benzyl cellulose; nylons, such as the polyamides; proteinous fibers such as those from casein; resin fibers such as the vinyl polymers, e. g. polyvinyl chloride, polyvinylidene chloride, copolymers of vinyl chloride and vinyl acetate, copolymers of vinyl chloride and acrylonitrile, polyethylene; resins from polyacrylic derivatives, such as polyacrylonitrile; and the like. The invention is also applicable to continuous filaments such as silk or those of extremely long length which may desirably be reduced in length, such as hemp, jute and the like.

The invention may be performed upon the dry continuous filament bundle or the bundle may first be wetted. Similarly, the process may be performed at room temperatures or at higher temperatures, the latter being particularly adapted to thermoplastic filaments which can be weakened by the heat. Alternatively, the wetting or heating, either expedient being used to weaken the fibers, may be applied locally, such as at the point of engagement of the false twisting system with the continuously traveling bundle. By this expedient, those fibers which make the immediate contact with the wet or heated engaging surface are momentarily and separately weakened; whereas the others are relatively unaf-

fect, being out of engagement with the wet or heated surface.

The invention is applicable to bundles of a wide range of sizes, from 100 denier up to 200,000 denier and has the advantage over the breaking systems using low twist or none at all that such low denier sizes as 100 to 1,000 or even 10,000 denier can satisfactorily be reduced directly to a staple fiber yarn without the necessity of additional drafting, such as would be required when using a high denier tow. In addition, the present invention is adaptable to a wide range of draft ratios. Whereas the systems mentioned hereinabove require drafts of 2:1 to 7:1, lower drafts but slightly exceeding the break-extensibility of the fibers being used are satisfactory with the present invention though higher drafts, such as up to 40:1, may be used if desired.

Preferred embodiments of the invention are illustrated in the accompanying drawing, in which—

Figure 1 is an elevation, partially in cross-section, of a preferred embodiment;

Figure 2 is a modification; and

Figure 3 is a further modification.

Referring to Figure 1, a twisted continuous filament bundle 2 proceeds about a roll 3 and then around a roll 4 constituting the upper of the first pair of driven drafting rolls 4 and 5 between which the bundle is nipped. From the pair of rolls 4 and 5 the bundle proceeds through a false twisting device 6 comprising a rotatable tube 7 within a bearing 8 driven by a pulley 9 and a belt 10. The tube 7 may contain any form of trapping or filament-engaging device, such as the disc 11 having an eccentric bore 12 securely fastened in the tube adjacent its discharge end. From the twister 6 the bundle proceeds through a pair of drafting rolls 13 and 14 driven at a higher speed than rolls 4 and 5, from which it is discharged in a twisted condition and as stated before, it may proceed to a twister to insert additional twist or merely to a collecting device in which it may be wound without further twist being imparted.

The surface of the bore 12 in the disc 11 which engages the filaments in the bundle 2 controls the position of breaking action and the length of staple fiber obtained in the final product can be generally predetermined by suitably selecting the draft ratio and distance between the engaging surface of bore 12 and the nip of the rolls 13 and 14.

The portion of the surface of bore 12 that engages the bundle may be somewhat roughened or sharpened to an edge extending transversely to the bundle, so that an abrasive or cutting effect may be exerted upon the filaments as they are engaged.

In Figure 2 a modification is provided in which the disc 11a corresponding to the disk 11 of Figure 1 has a central axial channel 15 which communicates with a radial channel 16 opening into the bundle-engaging surface of the bore 12a and a nozzle 17 which may be supplied with a fluid, such as a liquid by a pump 18 projects into the passage 15, so that a liquid may be forced therein. By centrifugal force, the liquid will flow outwardly through the radial passage and make contact with the filaments of the bundle bearing on the adjoining surface of the bore 12. The reservoir 19 may contain any desired liquid such as cold or heated water, acetone, or other softening, solvent, or weakening liquids. Water is particularly useful in connection with regen-

erated cellulose filaments, whereas acetone or an acetone solution in water is adaptable particularly to cellulose esters and vinyl resins for which they have a softening or solvent effect. Heated air may also be thus applied to weaken the filaments, especially of the thermoplastic materials.

Figure 3 shows a modification in which the bundle 2 proceeds about a driven draw wheel or godet 20 and an associated wrap-displacing guide 21, through a false twister 22 and then about a second draw wheel or godet 23 and its associated wrap-displacing guide 24, the draw wheel 23 being driven at a higher speed than godet 20 in order to effect stretching beyond the extensibility at break. The false twister 22 in this instance comprises a tube 25 adapted to be driven by the pulley 26 and belt 27 or equivalent means such as herein. Two yarn-engaging levers 28 are pivotally mounted at 29 upon the lower end of the tube 25 in the position shown. The yarn-engaging portion of the levers is curved as illustrated, and if desired may be roughened, but is preferably smooth. The levers may be weighted at 30 so that during rotation of the twister tube the pressure of the levers upon the yarn increases because of the tendency of the weights 30 to fly outwardly. If desired, a fluid, such as heated air or a liquid as in the embodiments mentioned hereinabove, may be applied by means of the nozzle 31 to the bundle adjacent the twister, such as just above it, as shown.

In the claims, the work "extensibility" is intended to refer to the elongation at break.

While specific embodiments of the invention have been shown and described, it is to be understood that these are merely illustrative, and that changes may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. The process of converting a twisted continuous filament bundle into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation.

2. The process of converting a twisted continuous filament bundle into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation and weakening at least part of the filaments adjacent the position of minimum twist.

3. The process of converting a twisted continuous filament bundle into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation and applying a weakening fluid to parts of the filaments adjacent the position of the minimum twist.

4. The process of converting a twisted con-

tinuous filament bundle into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation and applying a softening liquid to parts of the filaments adjacent the position of the minimum twist.

5. The process of converting a twisted continuous filament bundle into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation and applying a heated gas to parts of the filaments adjacent the position of the minimum twist.

6. The process of converting a twisted bundle of continuous filaments of regenerated cellulose into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation and applying water to parts of the filaments adjacent the position of minimum twist.

7. The process of converting a twisted bundle of continuous filaments of an organic derivative of cellulose into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation and applying acetone to parts of the filaments adjacent the position of minimum twist.

8. The process of converting a twisted bundle of continuous filaments of a vinyl resin into a staple fiber yarn comprising continuously forwarding the twisted bundle longitudinally while subjecting it to a stretch in excess of the extensibility of the individual filaments therein, and simultaneously reducing the twist of the bundle along an intermediate portion thereof under the stretching tension by subjecting it to a false twisting operation and applying acetone to parts of the filaments adjacent the position of minimum twist.

9. Apparatus for converting a twisted continuous filament bundle to a staple fiber bundle comprising two spaced driven stretching rolls, means for driving the second roll at sufficient speed in excess of that of the first to stretch the twisted bundle as it passes about the rolls in succession beyond the extensibility of the filaments therein, a rotatable tube through which the bundle passes between the rolls, means rotatable with the tube for engaging the bundle as it passes therethrough, means for rotating the tube in a direction to reduce the twist in the bundle as it passes over the engaging means thereon, and means for applying a fluid to the bundle-engaging means.

10. Apparatus for converting a twisted contin-

uous filament bundle to a staple fiber bundle comprising two spaced pairs of driven drafting rolls, means for driving the second pair at sufficient speed in excess of that of the first to stretch the twisted bundle as it passes through the rolls in succession beyond the extensibility of the filaments therein, a rotatable tube through which the bundle passes between the pairs of rolls, means rotatable with the tube for engaging the bundle as it passes therethrough, means for rotating the tube in a direction to reduce the twist in the bundle as it passes over the engaging means thereon, and means for applying a fluid to the bundle-engaging means.

11. Apparatus for converting a twisted continuous filament bundle to a staple fiber bundle comprising two spaced pairs of driven drafting rolls, means for driving the second pair at sufficient speed in excess of that of the first to stretch the twisted bundle as it passes through the rolls in succession beyond the extensibility of the filaments therein, a rotatable tube through which the bundle passes between the pairs of rolls, means rotatable with the tube for engaging the bundle as it passes therethrough, means for rotating the tube in a direction to reduce the twist in the bundle as it passes over the engaging means thereon, and means for applying a fluid to the bundle-engaging means.

12. Apparatus for converting a twisted continuous filament bundle to a staple fiber bundle comprising two spaced pairs of driven drafting rolls, means for driving the second pair at sufficient speed in excess of that of the first to stretch the twisted bundle as it passes through the rolls in succession beyond the extensibility of the filaments therein, a rotatable tube through which the bundle passes between the pairs of rolls, an eccentric bore in the tube having a surface engaging the bundle, means for rotating the tube in a direction to reduce the twist in the bundle as it passes over the engaging surface, and means for wetting the engaging surface.

13. Apparatus comprising two spaced pairs of driven drafting rolls, means for driving the second pair at a higher speed than that of the first pair, a false twister between the pairs of rolls, and means for supplying the false twister with a fluid.

14. Apparatus comprising two spaced pairs of driven drafting rolls, means for driving the second pair at a higher speed than that of the first pair, a false twister between the pairs of rolls, and a nozzle for applying a jet of liquid to the false twister.

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