April 29, 1969 ZENZI MURAKAMI ET AL 3,440,689

APPARATUS FOR SEPARATING FILAMENTS OF TOW (FILAMENT BUNDLE)

Filed Dec. 9, 1966 Sheet 1 of 2

Fig 1.

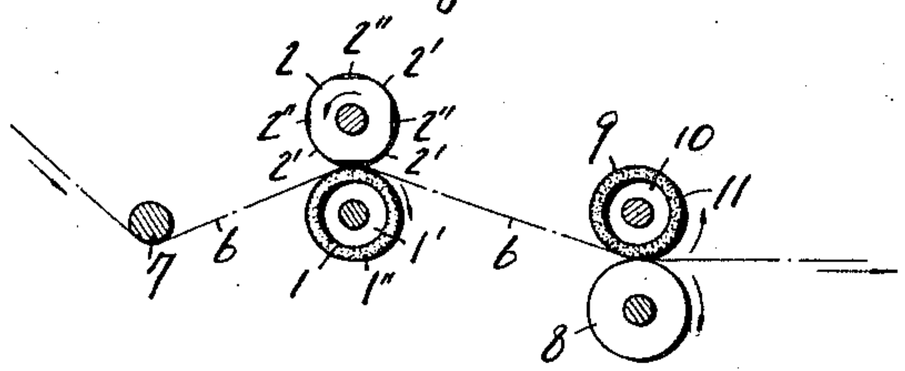

Fig 2.

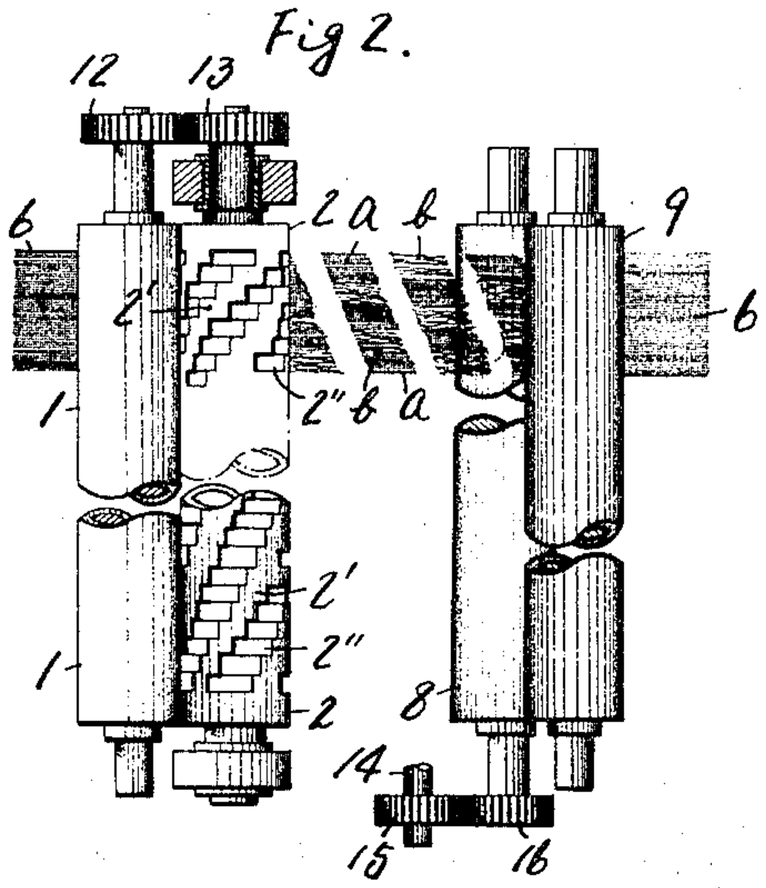

Fig 3.

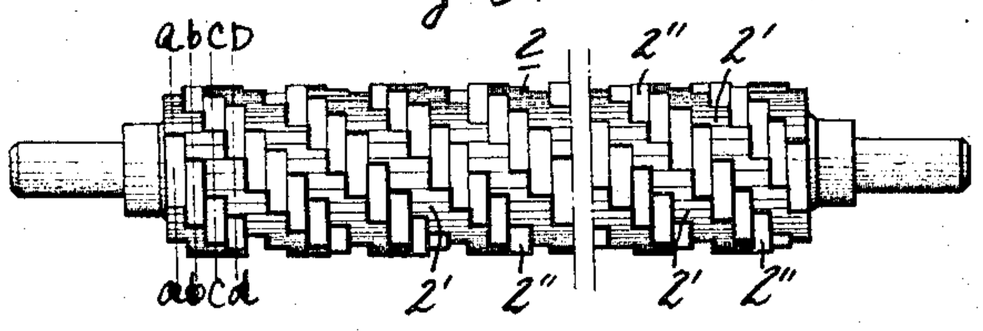

Fig. 4A

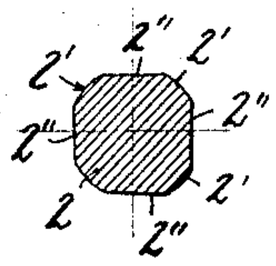

Fig. 4B

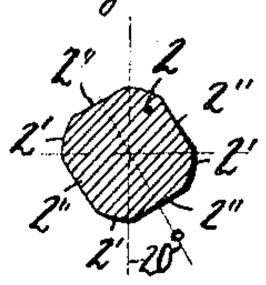

Fig. 4C

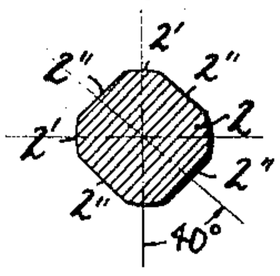

Fig. 4D

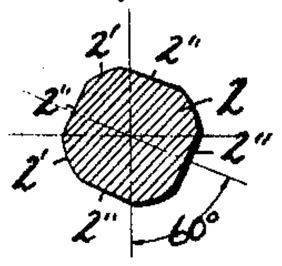

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Fig 5.

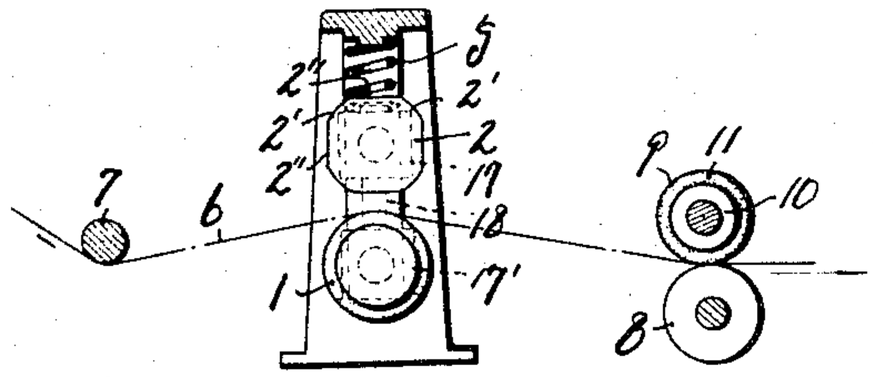


Fig 6.

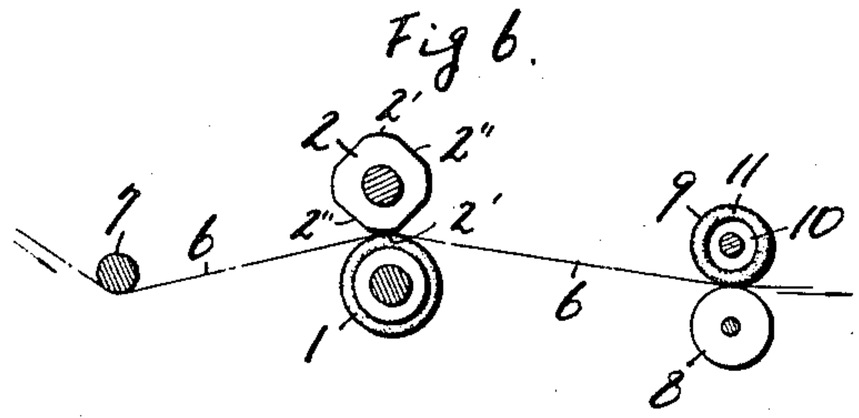


Fig 7.

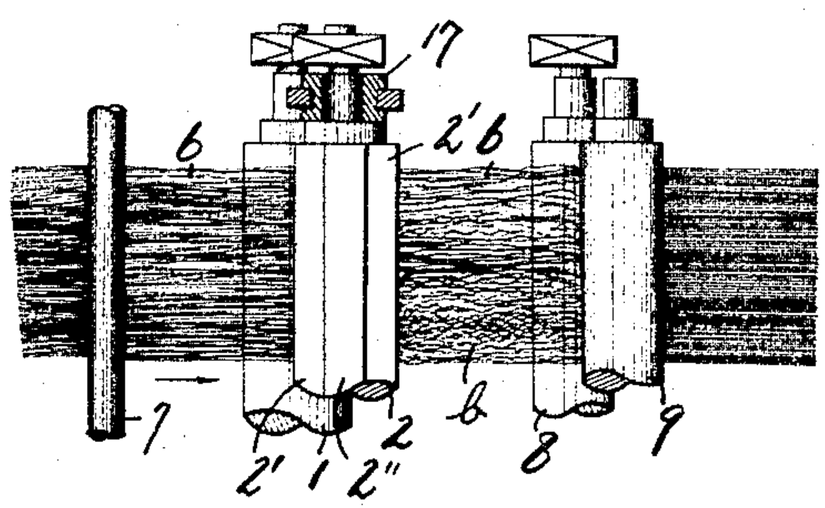


Fig 8.

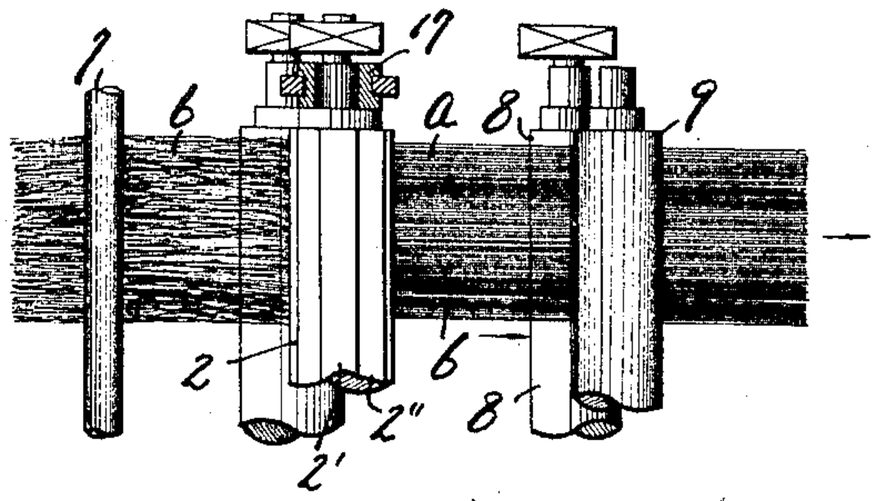
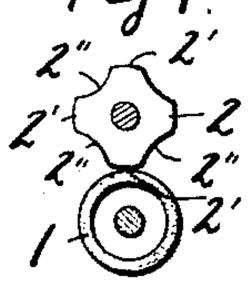


Fig 9.



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APPARATUS FOR SEPARATING FILAMENTS OF TOW (FILAMENT BUNDLE)

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Int. Cl. D01g *11/00*
U.S. Cl. 19—65 4 Claims

ABSTRACT OF THE DISCLOSURE

Filaments of a tow moving longitudinally are separated from each other by an apparatus which stretches portions of the tow while releasing other portions of the tow. The stretching and releasing is effected by a special roller longitudinally divided into a considerable number of narrow regions, each region comprising arcuate and relieving sections, and those of adjacent regions being peripherally displaced progressively along the roller. The arcuate surfaces nip the filaments being stretched by the more rapidly moving surfaces of the delivery rollers, and the relieving surfaces free the stretched groups of filaments to contract relative to those still being stretched. Snubbing action is also employed to accentuate the separation of the filaments as they are released.

Generally, in processes in which spinning is effected by using tow (filament bundle), tow is treated in accordance with various purposes.

In order to supply tow to the machine, it is essential that the filaments of tow be fully separated from each other in advance. While there are two or three examples heretofore known of this filament separation method or apparatus, the apparatus of the present invention is entirely different in concept from these conventional techniques the principle of the invention consisting in the fact that crimped tow, while in its course of travel, is firmly gripped between a first region in which a pair of rollers one of which is a partially flat-surfaced round roller having alternate arc and flat-cut areas are located and a second region in which a pair of stretching and delivering rollers are located, said tow being tightly stretched within the elastic limit thereof, and as the partially flat-surfaced round roller is rotated, gripping and releasing actions are divisionally and stepwise imparted repeatedly at the same place whereby the tow filaments are separated throughout the width of the tow.

The invention will now be described in more detail with reference to some embodiments thereof shown in the accomyanying drawings, in which:

FIG. 1 is a side elevational view of an embodiment;

FIG. 2 is an expansion plan view;

FIG. 3 is a plan view of a partially flat-surfaced round roller;

FIGS. 4–A, 4–B, 4–C and 4–D are longitudinal sections taken along lines *a—a, b—b, c—c* and *d—d* of FIG. 3, respectively;

FIGS. 5 and 6 are side elevational views of another embodiment;

FIGS. 7 and 8 are plan views of said second embodiment, the former showing relaxed condition and the latter showing stretched condition; and

FIG. 9 is a sectional view showing the shape of another partially flat-surfaced round roller.

In FIG. 1, the numeral **1** designates a bottom roller comprising an iron core **1'** on which is fitted a cylindrical body **1''** made of an elastic covering material such as rubber or entirely of steel or synthetic resin. The numeral **2** designates a partially flat-surfaced round roller made of steel or other material. As shown in FIGS. 3 and 4A–4D, the partially flat-surfaced round roller **2** is provided alternately with arc areas **2'** and flat-cut areas **2''**. These arc areas **2'** and flat-cut areas **2''** are provided in their respective peripheral surface regions of unit width defined by equally dividing the overall length of the roller so that each region may be equal in width to the others (the unit width being about 10 cm. in the case of the illustrated example). Each of the arc areas **2'** and flat, chordal, relieving areas **2''** is twisted or offset with respect to adjacent ones so as to have a suitable divisional angle (which is 20 degrees in the case of the illustrated example). In the drawings is shown an instance in which the overall length of the roller is divided into several tens of regions and 4 arc areas **2'** and 4 flat-cut areas **2''** are alternately provided in each peripheral surface region of unit width.

The aforesaid numerical values for the various factors such as the angle of 20 degrees, width of 4 cm., and 4 flat-cut areas **2''** and 4 arc areas **2'**, which may suitably be selected depending upon the conditions of tow to be processed, are variable. Further, it is desirable to apply hard chrome plating or the like plating to the surface of the partially flat-surfaced round roller **2**. The roller **2** of such special structure is placed on the bottom roller **1**, and bearings **17** in which the roller **2** is journaled and which are vertically movable are urged by means of springs **5** or the like.

The tow (filament bundle) **6**, while in its course of supply via a guide roller **7**, is gripped by the bottom roller **1** and partially flat-surfaced round roller **2** and is then delivered through the stretching and delivering rollers **8** and **9**. The lower stretching and delivering roller **8** has a smooth or fluted surface and is made of steel or the like or synthetic resin. The upper stretching and delivering roller **9** comprises an iron core sleeve **10** on which is fitted a cylindrical body **11** made of an elastic material such as rubber. Alternatively, the upper roller **9** may be made entirely of synthetic resin. The peripheral speed of the stretching and delivering rollers **8** and **9** is faster than that of the rollers **1** and **2**. As a result, during the time when some filaments of the tow **6** are gripped by an arc area **2'** of the partially flat-surfaced round roller **2** and the bottom roller **1**, said filaments are subjected to a stretching action as indicated at *a* as the stretching and delivering rollers **8** and **9** are rotated. Further, when a flat-cut area **2''** of the partially flat-surfaced round roller **2** is brought just above the top of the bottom roller **1** as the rollers **1** and **2** continue their rotation, a clearance is established between the rollers **1** and **2**, with the result that the filaments are subjected to instantaneous relaxing action as indicated at *b*. These actions, namely stretching due to the gripping by means of the arc areas **2'** and instantaneous

relaxing due to the releasing by means of the flat-cut areas 2'' are repeatedly applied to the tow, since the overall length of the partially flat-surfaced round roller 2 is divided into regions of unit width and the flat-cut area 2'' are stepwise distributed while being progressively twisted at a suitable divisional angle with respect to the angle of circumference. Further, in the course of travel of the tow and in the region between the first pair of rollers 1, 2 and the second pair of rollers 8, 9, instantaneous relaxing and stretching are repeatedly effected several times at the same place.

In FIG. 2, the partially flat-surfaced round roller 2 and the upper stretching and delivering roller 9 are shown as laterally displaced with respect to the bottom roller 1 and the lower stretching and delivering roller 8, respectively, for the purpose of a clear representation of the actions. Further, in order to demonstrate that the tow is subjected to stretching *a* and instantaneous relaxing *b* several times in the course of travel in the region between the first pair of rollers 1, 2, and the second pair of rollers 8, 9, such stretched portions *a* and relaxed portions *b* are alternately shown in those filaments of the tow which are included in unit width.

The arc areas 2' of the partially flat-surfaced round roller 2 may be smooth, or the roller 2 may be tooth-shaped as shown in FIG. 9. Alternately it may be of a separable ring fit lamination clamp roller type.

The partially flat-surfaced round roller 2 and bottom roller 1 have their respective shafts operatively connected with each other through coupling gears 12 and 13 so that their peripheral speeds at the press contact point between the two rollers 2 and 1 may be equal to each other.

The lower stretching and delivering roller 8 is driven from a driving shaft 14 through gears 15 and 16.

As to the pressing of the partially flat-surfaced round roller 2 and the upper stretching and delivering roller 9, springs, air pressure or oil pressure may be utilized.

In addition, while the guide roller 7, bottom roller 1, partially flat-surfaced round roller 2 and stretching and delivering rollers 8 and 9 may be so positioned as to allow the tow 6 to run in a straight line, practical tests have proved it preferable to arrange the bottom roller 1 and partially flat-surfaced round roller 2 on a level above the stretching and delivering rollers 8 and 9 so as to give the tow 6 a suitable angle of contact at which the tow is contacted with the bottom roller 1, thereby increasing the frictional resistance to prevent the lateral displacement of the tow. By this arrangement, gripping and releasing are stepwise repeated several times at the same place with respect to the tow proceeding between the first pair of rollers 1, 2 and the second pair of rollers 8, 9, whereby complete separation of the filaments can be assured.

FIGS. 5 through 8 illustrate another case in which a modified form of partially flat-surfaced round roller is used. This partially flat-surfaced round roller 2 is provided with arc areas 2' and flat-cut areas 2'' which are alternately arranged on the peripheral surface thereof, so that all the filaments of the tow 6 throughout the width will in unison be subjected alternately to stretching *a* (FIG. 8) and instantaneous relaxing *b* (FIG. 7). In this case, when any one of the flat-cut areas 2'' of the partially flat-surfaced round roller 2 faces on the top of the bottom roller 1, the partially flat-surfaced round roller 2 itself will fall down onto the bottom roller 1. In order to prevent this, a distance regulating member 18 is provided on the lower part of the bearing 17 of the roller 2, as shown in FIG. 5. Thus, the arc areas 2' of the roller can be pressed against the bottom roller 1 to grip the tow 6 therebetween, while the flat-cut areas 2'' can be prevented from gripping the tow 6, as shown in FIG. 5.

The flat-cut areas 2'' of the partially flat-surfaced round roller 2 may alternatively be in the form of a recessed curved surface as shown in FIG. 9.

From the foregoing it is seen that the present invention comprises a partially flat-surfaced round roller 2 provided with arc areas 2' and flat-cut areas 2'' alternatively arranged on the peripheral surface thereof and stepwise and gradually offset with a constant width with respect to adjacent ones, said partially flat-surfaced round roller 2 being pressed against a bottom roller 1, so that tow 6 drawn out from between the two rollers 1 and 2 is held in stretched condition by stretching and delivering rollers 8 and 9, whereby stretching and instantaneous relaxing are stepwise applied to the tow 6 throughout the width thereof thereby eflecting the separation of the filaments of the tow. Consequently, the separation of filaments can be perfectly effected and the efficiency of operation is increased.

What is claimed is:

1. An apparatus for separating from each other the filaments of a tow moving in a longitudinal direction, said apparatus comprising:

(a) first and second sets of rollers through which the tow is passed in the longitudinal direction in sequence, said sets being spaced apart in said longitudinal direction,

(b) said second set of rollers being tow delivering rollers having continuous surfaces,

(c) said first set of rollers being tow filament gripping and releasing rollers comprising

(1) a cylindrical roller having a resilient surface,

(2) a cooperaitng roller having surface contact therewith and

(3) means for driving said cylindrical and cooperating rollers at the same surface speed,

(d) said cooperating roller

(1) having its length sub-divided into contiguous longitudinal regions relatively narrow in proportion to the diameter of the roller,

(2) having each of said longitudinally narrow regions formed with a plurality of arcuate surfaces conforming to and defining the cylindrical surface of the roller, with such arcuate surfaces symmetrically separated by relieving surfaces lying below said cylindrical surface, and

(3) having the arcuate and relieving surfaces of each region peripherally displaced about the axis of the roller relative to those of the adjacent regions,

(e) said second set of rollers being driven at a surface speed greater than the surface speed of said first set of rollers by an amount which applies tension to the tow and longitudinally stretches respective filaments of the tow within the elastic limit of said filaments while said respective filaments are nipped by said second set of rollers and by the arcuate and resilient surfaces of said first set of rollers,

(f) whereby as the tensioned tow is being longitudinally drawn continuously through said first set of rollers by said second set of rollers, spaced groups of tow filaments of said tensioned tow corresponding in width to said narrow regions as they are nipped between the arcuate and resilient surfaces of said first set of rollers are longitudinally elastically stretched between said sets and, as rotation of said first set of rollers moves the relieving surfaces of said regions into a position overlying the so stretched filaments and releases the nip thereon, the so released groups of filaments are drawn longitudinally forward relative to the next adjacent still stretched groups of filaments by the contraction of the stretched portions thereof extending to said second set of rollers.

2. An apparatus as claimed in claim 1, wherein

(g) said second set of rollers is located to draw the tensioned tow from said first set of rollers at an angle from the tangent plane therebetween on the side of said plane toward said resiliently surfaced roller, thereby to snub said tensioned tow over a corresponding arc of the resilient surface of said resilient roller.

3. An apparatus as claimed in claim 1, wherein said relieving surfaces are in the form of flat chordal surfaces separating the arcuate surfaces of said narrow regions.

4. An apparatus as claimed in claim 1, wherein each of said narrow regions comprises four arcuate sections separated by four relieving surfaces arranged in symmetrical relation peripherally, and wherein the surfaces of the adjacent narrow regions are displaced about the axis of said cooperating roller progressively by about 20° per region.

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