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CONVERSION OF CONTINUOUS FILAMENTS INTO STAPLE FIBERS

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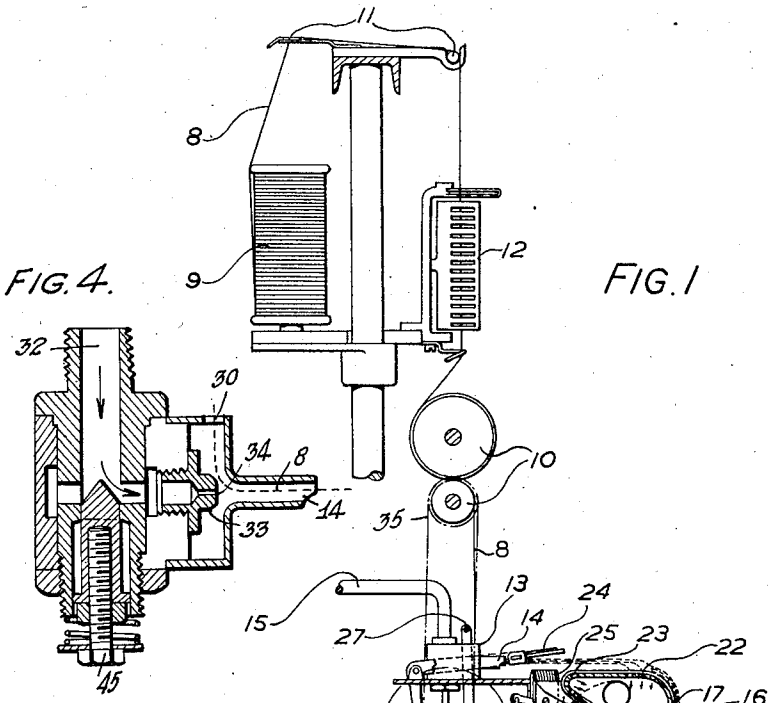


FIG. 1

FIG. 4.

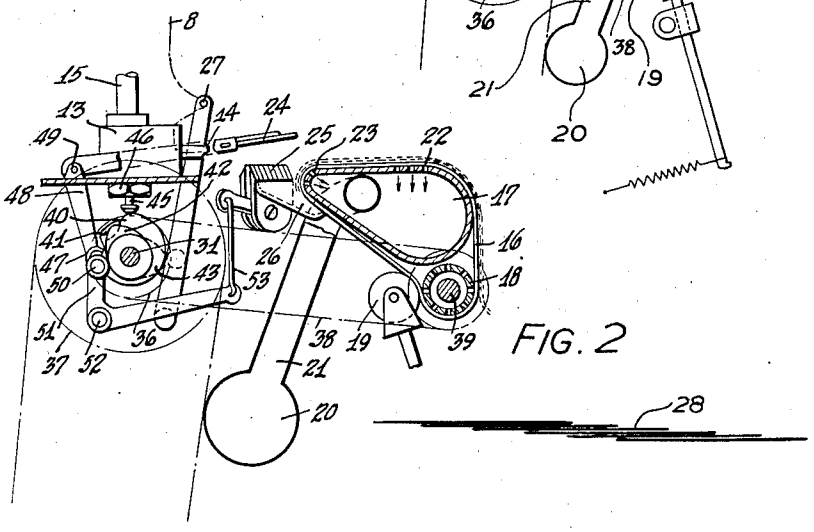


FIG. 3.

FIG. 2

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CONVERSION OF CONTINUOUS FILAMENTS INTO STAPLE FIBERS

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11 Claims. (Cl. 164—34)

The invention relates to the conversion of continuous filaments into staple fibers and more particularly to the cutting of continuous filaments into staple fibers of predetermined length.

According to the invention a bundle of substantially twistless continuous filaments is converted into staple fibers by apparatus which comprises means for feeding forward the bundle, means for separating the filaments of the bundle from each other at the end of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, and means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

The multi-toothed form of the cutting members provides a large number of cutting points distributed across the width of the separated filaments and so enables the filaments to be converted into a corresponding number or group of fibers while maintaining the fibers in the separated condition. The cutting device is capable of operating at high frequency and, moreover, requires only a slight cutting pressure to be applied to the filaments, which is of advantage in reducing the tendency of the cut ends of the fibers to stick together, as is found when cellulose acetate filaments, for example, are subjected to heavy cutting pressures.

As the filaments are fed into cutting position they are brought by any suitable means between the teeth of the cutting members. Conveniently the multi-toothed cutting device is disposed out of the line of feed of the filaments and the filaments are deflected into the teeth after the requisite length has been fed forward. The cutting device, however, may itself be arranged to move towards the filaments.

The cutting device may be disposed so as to cut the separated filaments obliquely across the width of the filaments so that the ends of the fibers of a group are progressively staggered lengthwise of the group. Such cutting assists in preserving the separated condition of the fibers and enables the groups to be opened easily and quickly in a subsequent carding, blending or like operation. Where, with such an obliquely disposed cutter, the filaments are deflected into the teeth of the cutter the deflecting means are arranged at an appropriate angle, the deflecting means conveniently being in the form of two rods disposed so as to move one to each side of the cutter to ensure that the filaments are carried between the teeth of the cutter.

The bundle of associated continuous filaments to be converted into staple fibers may take the form of a band or thread of untwisted filaments or of a thread having a very low degree of twist, but in the latter case, the degree of twist should be sufficiently low to enable the component filaments to be separated one from the other. The expression "substantially twistless" used in connection with the bundle means that the bundle contains no twist or that if any twist is present in the bundle, it should be insufficient to hinder free separation one from the other of the component filaments at the end of the bundle.

The separation of the filaments over the requisite length (i. e. a length longer than the length of staple desired) may be effected as the filaments are about to be cut into the staple fibers. Thus, the end of the bundle may be subjected to the action of a gaseous blast that serves to separate the component filaments of the bundle from each other and, at the same time, feed them to the cutting device. For example, the filaments may be led through an ejector nozzle pointing towards the cutting device and supplied with compressed air, the filaments being ejected from the nozzle and forwarded to the cutting device in separated condition. The action of the gaseous blast serves to remove any small amount of twist which may be in the bundle. The nozzle may with advantage be formed with a flat flared ejecting orifice so that the filaments are separated into a substantially flat band, such separation facilitating the cutting and assisting in maintaining freedom of the fibers in the cut fiber groups, as will appear hereinafter.

In order to control the separated filaments during cutting, means may be provided to seize and hold the free ends of the filaments as, for example, an endless permeable support, in the form of a permeable band, or a drum or wheel having a permeable surface, through which suction is applied. With such an arrangement the free ends of the filaments are drawn to and held on the permeable surface by the suction and while so held are cut by the cutting means. After cutting has been effected the support may be moved to convey the cut fibers from the position at which suction is applied, in readiness for the collecting of the fibers from the support. The staple fibers may be collected in separated condition for subsequent conversion into yarn with or without blending or mixing with other fibers, the sepa-

rated condition of the fibers enabling the fibers to be carded uniformly and formed into a substantially regular product.

When cutting staple fibers from continuous filaments of material such as cellulose acetate or other organic derivative of cellulose having a high di-electric strength and consequently liable to retain charges of static electricity, it is found that by rubbing the filaments prior to opening them a charge of static electricity is induced in the filaments, the charge causing the component filaments to repel each other with the result that the filaments are given a desirable preliminary spreading prior to being separated. Such preliminary spreading may be enhanced by limiting the opportunity for the static charge to leave the filaments prior to being separated, as by covering with rubber or like electrical insulating material machine parts with which the electrified filaments are likely to contact.

By way of example the invention will now be described in greater detail with reference to the accompanying diagrammatic drawings of which

Fig. 1 is a part cross-sectional end elevation of a filament-converting machine generally similar to part of that shown in U. S. application S. No. 155,226 filed July 23, 1937;

Fig. 2 shows diagrammatically a succession of fibers produced by the apparatus shown in Fig. 1;

Fig. 3 is a detail of Fig. 1 on a larger scale; and

Fig. 4 is a cross-sectional elevation of a detail of Figs. 1 and 2 on a large scale.

In the following description reference is made only to the salient features of the apparatus, a more detailed description of which may be had from U. S. application S. No. 155,226 above mentioned.

Referring to Figs. 1 and 3 a bundle band or thread of substantially twistless continuous filaments 8 is withdrawn from a supply bobbin 9 by a pair of nip rollers 10, the filaments passing from the supply bobbin to the rollers by way of guides 11 and through a "gate" tension device 12. The nip rollers 10 feed the filaments to an ejector nozzle 13 formed with a filament entrance hole 30 (Fig. 4) and a flat flared ejecting orifice 14, the nozzle being fed with compressed air from a supply pipe 15.

As indicated by arrows in Fig. 4 the air passes downwardly along a conduit 32 and through a jet 33 to the orifice 14, the jet being formed with three adjacent passages 34 in order to spread the blast of air as it passes through and out of the orifice 14 the flat flared shape of which assists in flattening and spreading out the current fanwise.

The air blast issuing from the ejecting orifice 14 ejects the filaments 8 from the orifice and separates the filaments one from the other in the form of a substantially flat band during the ejection. The bandwise spreading of the filaments facilitates their subsequent manipulation as will appear hereinafter. The bundle of filaments should not contain a finish that prevents the air current from separating the filaments, and for this reason it is desirable to employ unlubricated filaments.

On being ejected from the orifice 14 the separated filaments 8 extend across an endless permeable band 16 which is driven over the surface of a suction conduit 17 by a roller 18 engaging the inside of the band. The roller 18 is hollow and is supplied with compressed air which discharges from the roller through perforations formed in its periphery, the air passing outwardly through the band 16 in a manner and for a purpose to be described later. The band is kept taut by an idler roller 19 which is spring-urged into contact with the band. The suction conduit 17 is connected to a suction vessel 20 by a pipe 21.

As shown clearly in Figs. 1 and 3 the conduit 17 is of flattened cross-section and is perforated at two points 22, 23, two separate streams of air thus flowing into the conduit through the permeable band 16 as indicated by the arrows. On the ejection of the filaments 8 from the orifice 14 the ends of the separated filaments are attracted to and held on the band 16 by the suction due to the perforations 22.

Substantially simultaneously with the sucking to the band 16 of the filament ends a cam 40, of a series of cams 40, 41, 42 and 43, fixed to a driving shaft 31 (see Fig. 3) is caused by the rotation of the shaft to press the stem 45 of a valve 46 controlling the supply of air to the nozzle 13. The pressing of the stem interrupts the supply of air to the nozzle, and the separated filaments are left extending from the orifice 14 to the band 16.

The succeeding cam 41 (partly hidden from view by the cam 40) now bears against the end 47 of a deflecting lever 48, and causes the lever to rock about its pivot 49. The lever 48 is formed with a forked portion 24 which is caused by the rocking of the lever to bear downwardly upon the separated filaments 8 extending from the orifice 14 to the band 16 and deflect the filaments into the teeth of a multi-toothed cutting device 25 which is disposed obliquely with respect to the width of the separated filaments. On deflection, one limb of the forked portion 24 lies to each side of the cutting device 25 to ensure proper engagement of the filaments with the teeth.

On engagement of the filaments 8 by the teeth of the cutting device 25, the next cam, 42, bears against the end 50 of a lever 51 and causes the lever to rock about its pivot 52. The lever is connected by an upright arm 53 to the cutting device 25, the rocking of the lever thus operating the device to cut the filaments. Two or more cutting devices 25 may be arranged for operation by common actuating means, and two or more deflecting levers 48 may likewise be arranged for common actuation.

The freshly cut end of the fiber-group thus formed is sucked away from the cutting device 25 and on to the band 16 by the air current flowing into the conduit through the perforations 23, the air current being in part concentrated on the teeth of the cutting device by a shield 26 arranged between the cutting device and the perforations 23. A staple length or group of filaments is thus cut and laid on the surface of the moving band 16.

On operation of the cutting device 25 a pivoted guiding member 27 normally disposed behind the continuous filaments as they proceed in a straight line from the nip rollers 10 to the nozzle 13 is rotated about its pivot (viz. to the right as shown in Figs. 1 and 3 by the cam 43) and in so moving deflects the filaments from the straight line and draws their cut ends backwardly towards the orifice 14 clear of the teeth of the cutting device 25 to free the filaments for further forward movement.

With the filaments drawn clear of the cutting device, the guide 27 is retracted to its normal inoperative position and the air blast is restarted to separate and eject the filaments over the band 16 again from the orifice 14, by the continued ro-

tation of cams 43 and 40. The ends of the separated filaments are again sucked to the band 16 in the manner shown in Fig. 1 and the sequence of operations described above is repeated.

As shown in Figs. 1 and 3 the lower nip roller 10 is driven by a chain 35 from a chain sprocket 36 attached to the driving shaft 31 which is driven by chain and sprocket gearing 37 from any suitable source of power, while the upper roller is driven by frictional contact with the lower nip roller 10.

The shaft 31 also drives through chain and sprocket gearing 38 a shaft 39 upon which is mounted the roller 18 which drives the band 16.

While the nip rollers 10 feed the continuous filaments 8 to the nozzle 13 continuously, and the filaments are ejected from the nozzle to the band 16 intermittently, the ejecting and cutting operations are effected in such rapid succession than any small amount of slack formed in the filaments between the rollers and the nozzle due to the continued feed of the filaments during the periods in which the compressed air supply is stopped is insignificant and is quickly taken up by the air blast when the air supply is restarted. The nip rollers 10 may, however, be driven intermittently in accordance with the timing of the air blasts.

The rate of progress of the filaments 8 from the orifice 14 is dependent on the rate of rotation of the nip rollers 10 and by adjusting such rotation the staple length of the fibers laid on the band 16 can be regulated. With the continuous filaments delivered at a constant rate to a cutting device working with a constant frequency the fibers are substantially uniform in length.

Each successive group of fibers cut from the end of the filament bundle remains held to the band 16, the groups being carried away from the cutting device by the movement of the band. Depending on the relative rates of feeding the filaments and of moving the band, the groups may be separate from each other on the band, or may overlap each other, as shown in Fig. 2.

As the band 16 travels along its course the fiber groups drop away from the band into a suitable container (not shown) disposed beneath the band. The removal of the groups of fibers from the band is assisted by the currents of air escaping through the perforations formed in the hollow roller 18 and passing outwardly through the band.

As shown in Figs. 1 and 3 the cutting device 25 is disposed obliquely with respect to the width of the filaments so that the cut ends of the filaments are progressively staggered lengthwise of the bunch. Such arrangement is of advantage in that the separated condition of the staple fibers is preserved and the groups are capable of being opened easily and quickly in a subsequent carding, blending or like operation.

While apparatus for the treatment of one bundle of continuous filaments 8 only has been referred to in the foregoing description, it will be understood that any number of such forms of apparatus could be disposed in side-by-side relation in order simultaneously to treat any desired number of bundles.

When forming staple fibers from continuous filaments of material such as cellulose acetate or other organic derivative of cellulose having a high di-electric strength and consequently liable to retain charges of static electricity, it is found that the "gate" tensioning device 12 in addition to subjecting the filaments to the desired tension electrifies the filaments and thus causes them to repel each other with the result that the filaments are given a desirable preliminary spreading prior to entering the ejector nozzle 13. Such preliminary spreading may be enhanced by limiting the opportunity for the static charge to leave the filaments prior to entering the nozzle, and for this reason at least the upper nip roller 10 may with advantage be covered with rubber or other electrical insulating material. In order to prevent excessive wear on any one portion of the nip rollers 10 the filaments 8 may be traversed to and fro along the length of the rollers.

Having described my invention, what I desire to secure by Letters Patent is:

1. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, means for separating the filaments of the bundle from each other at the end of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, and means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

2. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, means for separating the filaments of the bundle from each other at the end of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, said cutting device being disposed near the path of the separated filaments, means for bringing the separated filaments and the cutting device into engagement with each other at intervals, and means for operating the cutting device during such engagement so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

3. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, an ejector nozzle adapted to receive the end of the bundle and to apply thereto a gaseous blast so as both to separate the filaments at the end of the bundle from each other and to forward the filaments, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, and means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

4. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, an ejector nozzle formed with a flat, flared ejecting orifice, said nozzle being adapted to receive the end of the bundle and to apply thereto a gaseous blast so as both to separate the filaments at the end of the bundle into the form of a flat band and to forward the filaments, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, and means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

5. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, an ejector nozzle adapted to receive the end of the bundle and to apply thereto a gaseous blast so as both to separate the filaments at the end of the bundle from each other and to forward the filaments, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, said cutting device being disposed near the path of the blast produced by the nozzle, means for bringing the separated filaments into engagement with the cutting device at intervals, and means for operating the cutting device during such engagement so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

6. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, means for separating the filaments of the bundle from each other at the end of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, said cutting device being disposed near the path of the separated filaments, means for bringing the separated filaments into engagement with the cutting device at intervals, means for operating the cutting device during such engagement so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length, and means for drawing the ends of the separated filaments clear of the cutting device after each cutting operation.

7. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, an ejector nozzle formed with a flat, flared ejecting orifice, said nozzle being adapted to receive the end of the bundle and to apply thereto a gaseous blast so as both to separate the filaments at the end of the bundle into the form of a flat band and to forward the filaments, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, said cutting device being disposed near the path of the separated filaments, means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length, and means for drawing the ends of the separated filaments clear of the cutting device after each cutting operation.

8. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, means for separating the filaments of the bundle from each other at the end of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, said co-operating members being disposed obliquely across the width of the separated filaments, and means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length, the ends of each fiber of a group being staggered with respect to the ends of the other fibers of the group.

9. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, a nozzle disposed in the path of the bundle, said nozzle being formed with an orifice adapted to receive the end of the bundle and a further orifice adapted for the ejection of the bundle, means for supplying the ejecting orifice with compressed air so that the filaments at the end of the bundle received in the receiving orifice are ejected from the ejecting orifice and during such ejection are separated one from the other, means for interrupting the compressed air supply at intervals in order to bring about intermittent ejection and separation of the filaments of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, said cutting device being disposed near the path of the air blast produced by the nozzle, means for bringing the separated filaments into engagement with the cutting device between the ejecting intervals, and means for operating the cutting device during such engagement so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

10. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, means for separating the filaments of the bundle from each other at the end of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length, and a movable support disposed near the cutting device and adapted to carry the succession of groups of fibers away from the cutting device.

11. Apparatus for the manufacture of staple fibers from continuous filaments, comprising means for feeding forward a bundle of continuous filaments, a "gate" tension device disposed in the path of the filaments so as to impart tension to the filaments prior to their engagement with the feeding means, means for separating the filaments of the bundle from each other at the end of the bundle, a cutting device comprising a pair of multi-toothed co-operating members of a width sufficient to accommodate the separated filaments, and means for operating the cutting device at intervals so as to cut from the separated filaments a succession of groups of separated staple fibers of predetermined length.

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