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2,492,306

PRODUCTION OF YARN FROM STAPLE FIBERS

Filed April 7, 1947

5 Sheets-Sheet 1

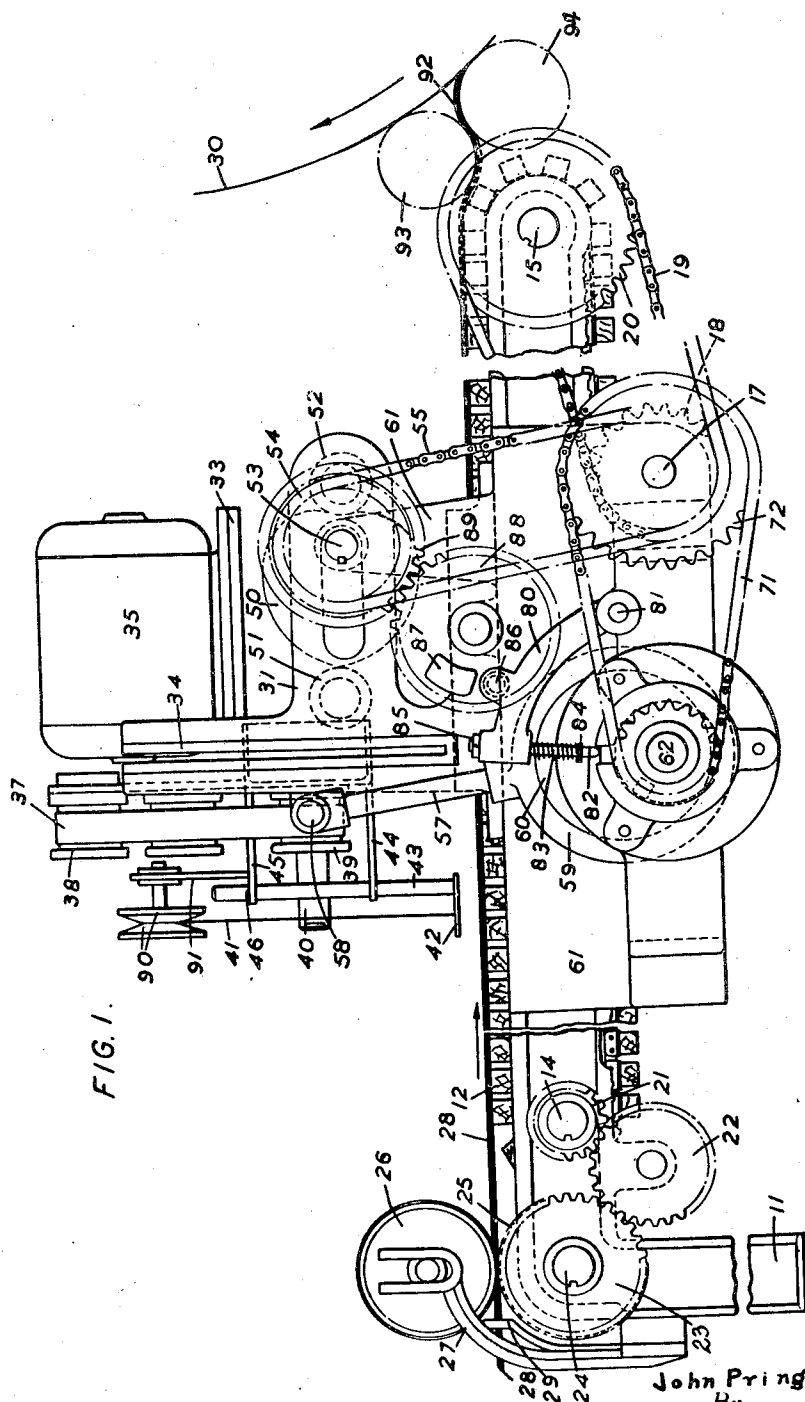


FIG. 1.

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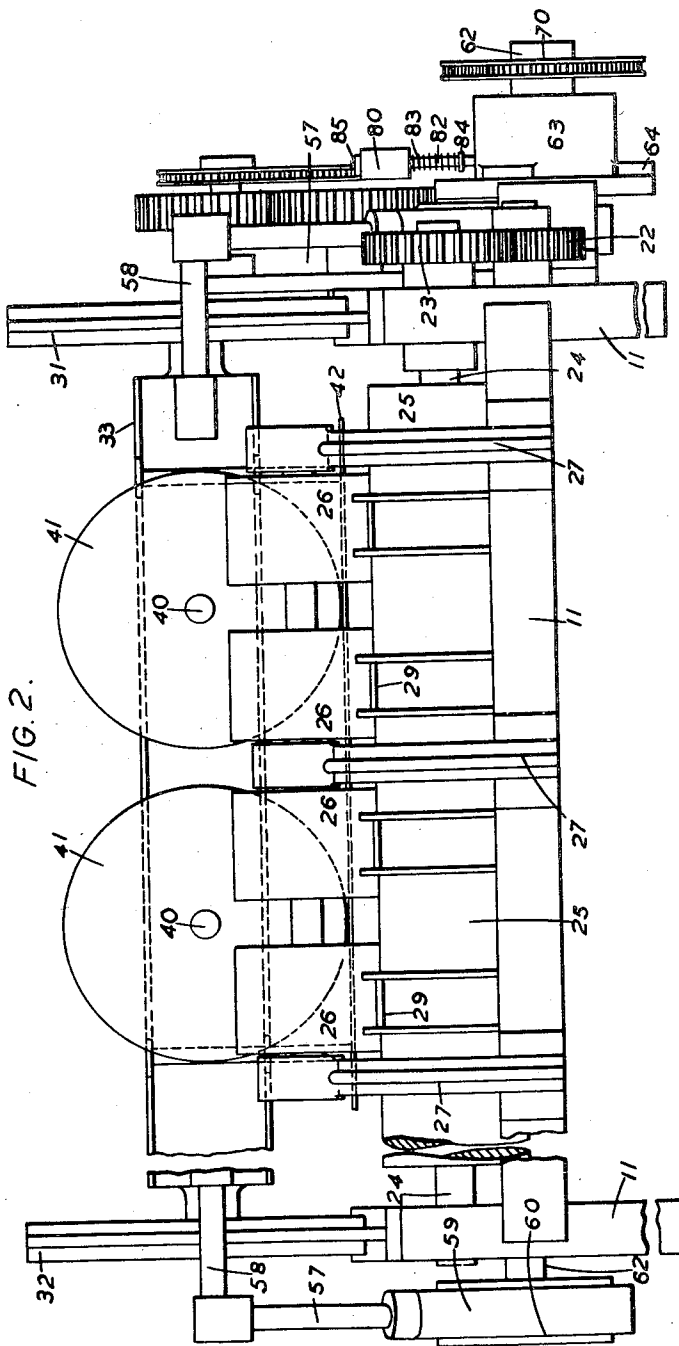
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PRODUCTION OF YARN FROM STAPLE FIBERS

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5 Sheets-Sheet 2



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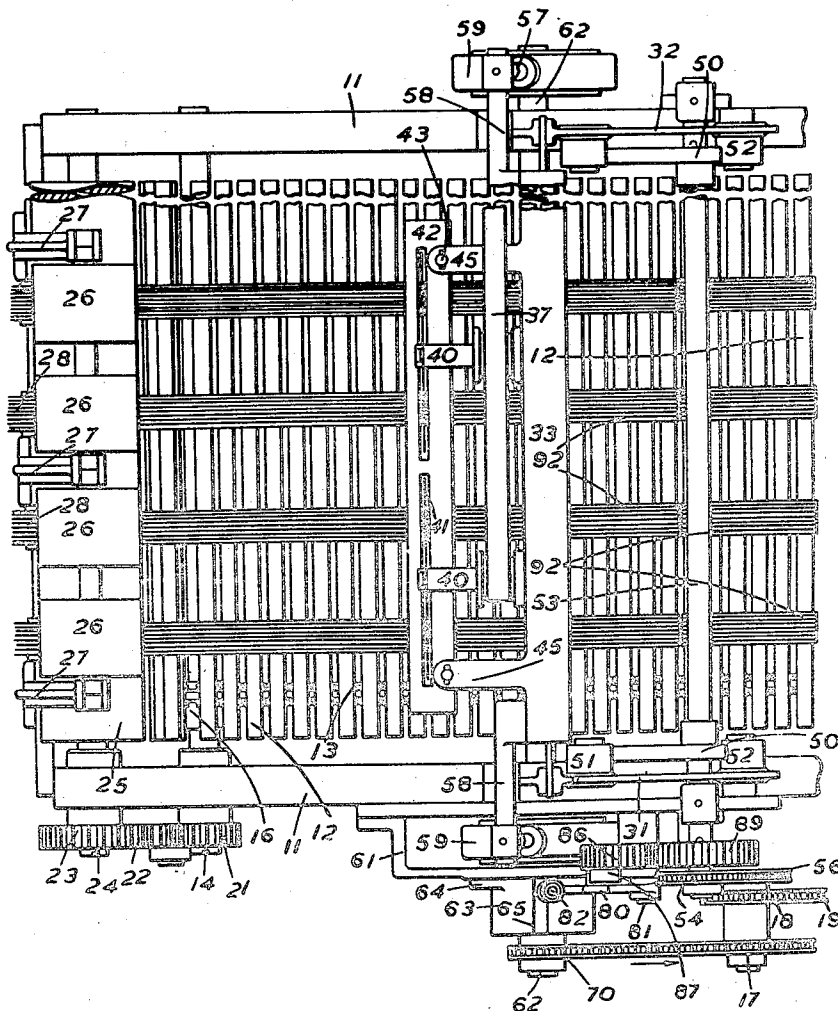
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PRODUCTION OF YARN FROM STAPLE FIBERS

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5 Sheets-Sheet 3

FIG. 3.



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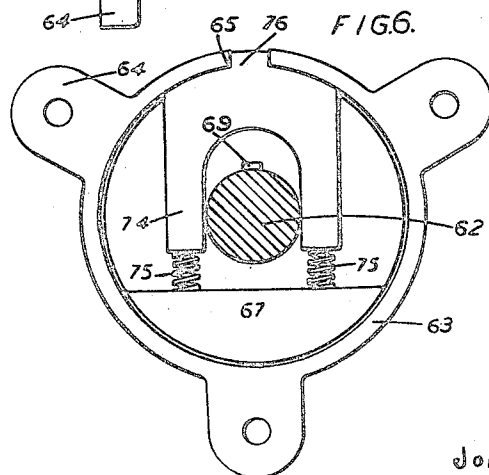
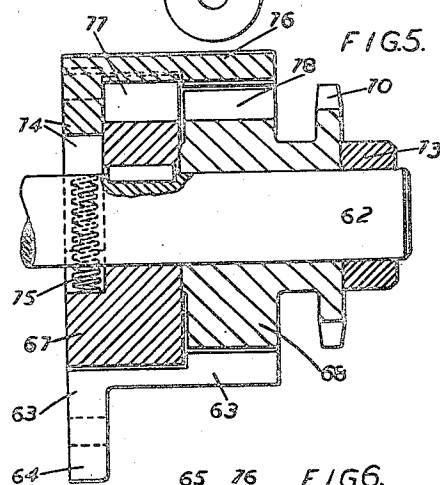
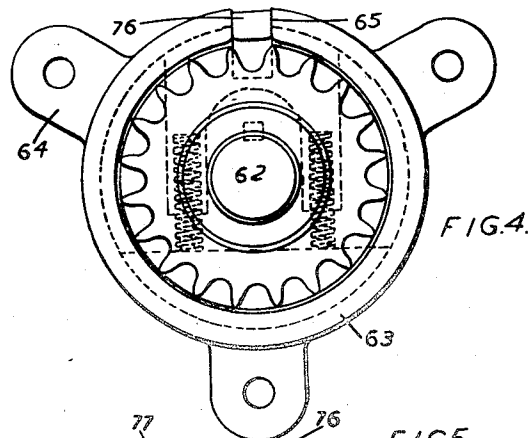
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PRODUCTION OF YARN FROM STAPLE FIBERS

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5 Sheets-Sheet 4



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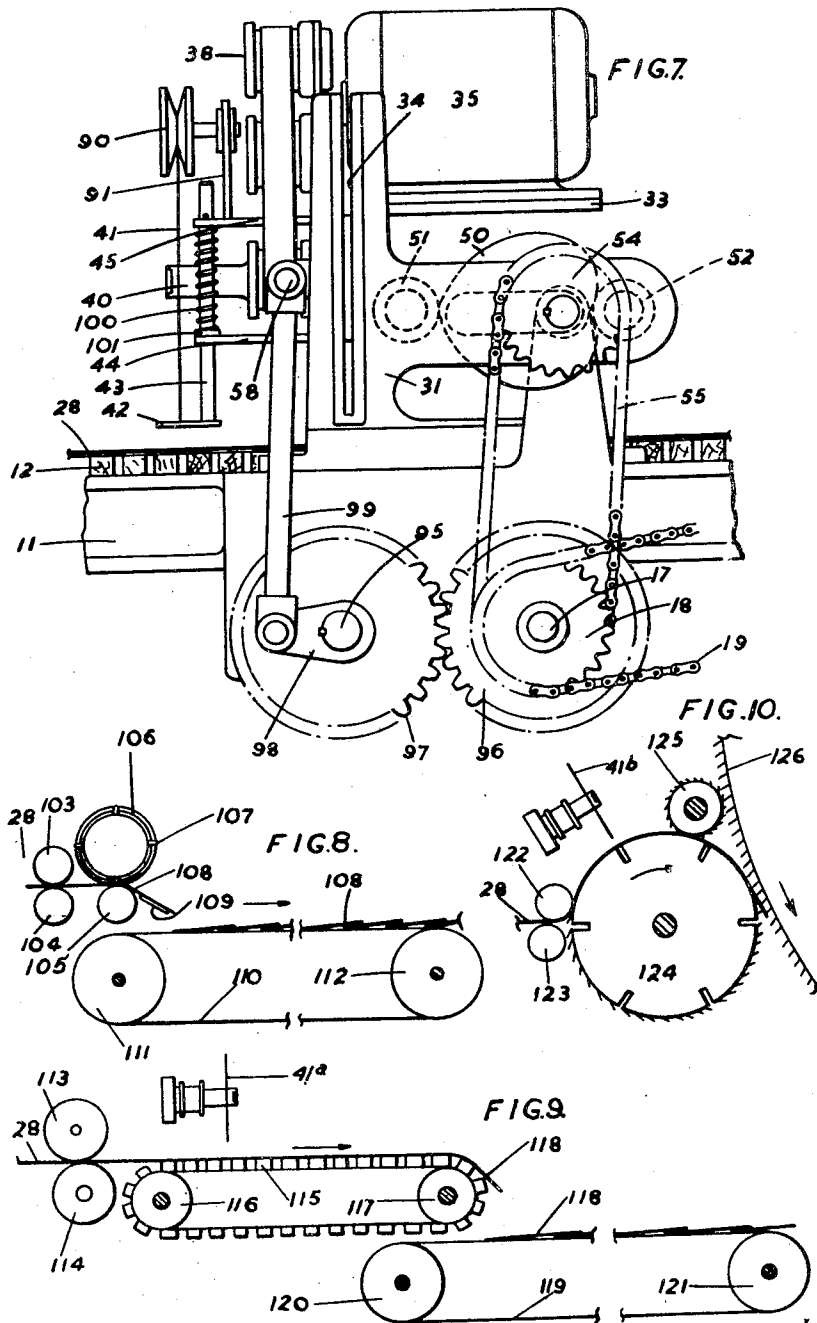
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PRODUCTION OF YARN FROM STAPLE FIBERS

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5 Sheets-Sheet 5



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UNITED STATES PATENT OFFICE

2,492,306

PRODUCTION OF YARN FROM
STAPLE FIBERS

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12 Claims. (Cl. 19—65)

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This invention relates to the production of yarn from staple fibres made by cutting continuously spun fibres into staple lengths. Various attempts have been made to break or cut the continuous tow of artificial silk into staple lengths and to draw out the product, form it into a roving and spin it without the interposition of a carding operation. It has not been found possible hitherto to make an entirely satisfactory and uniform yarn in this way, and the method most largely used up to the present has involved a carding operation. For this purpose a continuous tow was formed containing a large number of filaments of artificial silk, and this tow was passed through a machine which cut it into lengths or staple fibre, the cutting generally taking place while the filaments were wet, the staple product being then dried and delivered to textile mills as a package of material with the fibres lying in all directions therein. In the mills this material was carded and spun by methods similar to those used for natural fibres. The bunches of cut filaments were often found to be condensed or compacted, and the individual filaments were liable to be twisted and crimped, so that a good deal of breakage of the fibres occurred in carding and preparing the product for spinning. Neps or bunches of short fibre were also formed in the sliver which resulted in imperfections in the finished yarn. The staple fibre might either be fed automatically to the card or spread out more or less evenly by hand on the feed apron, but whichever method of feeding was adopted, considerable variation occurred in the weight of the sliver delivered by the card.

It is the principal object of the present invention to overcome these difficulties by a new method of feeding the material to a carding machine. We have found that if the fibres are fed in an endwise direction into the card, much less breaking of the fibres occurs in carding, and the resulting sliver is cleaner and substantially free from neps, while the yarn spun from it is smoother and more uniform. It is not possible, however, as a commercial operation, to feed individual filaments or sets of cut staple by hand all directed longitudinally into the card, and some method must be adopted to ensure a continuous feed and uniform distribution of the staple fibre. This is effected according to the present invention by delivering the artificial silk filaments in the form of continuous tow, cutting them into staple lengths, and causing these

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lengths to be fed end-on in a properly distributed arrangement to the card.

In its broad aspect the invention comprises a method of preparing tows of continuous filaments for spinning into staple fibre yarn, wherein such continuous tows are delivered to a severing device which severs them into successive bunches of staple fibre, these bunches being then presented automatically and in suitably distributed arrangement end-on to a carding machine which forms them into a continuous sliver suitable for drawing and spinning into yarn.

One method of attaining this result is by causing the continuous tows to be delivered to the moving feed member of a carding machine and severing them into adjacent successive lengths of fibre thereon by cutting means operating in association with the moving feed member in such manner as to dispose the staple fibres in bunches upon the feed member with the fibres presented end-on to the card.

Various alternative methods may also be used in which for example the cutting into staple lengths is effected before the bunches of fibres are delivered to the moving feed member, provided that their end-on disposition is preserved as they are fed to the card. The lateral separation of the sets or bunches of fibres is also of importance in ensuring even distribution and avoiding overloading of the card.

The invention also includes apparatus designed to operate according to the methods above indicated.

The invention is illustrated by way of example in the accompanying drawings, in which:

Figure 1 is a side elevation, partly broken away, of the feed apron of a carding machine with means for cutting the fibres into lengths thereon;

Figure 2 is an end view of the mechanism shown in Figure 1, as seen from the front;

Figure 3 is a plan view, drawn to a smaller scale, of the same mechanism;

Figure 4 is a face view, drawn to a larger scale, of a clutch used in the construction of Figures 1 to 3;

Figure 5 is a longitudinal vertical section through the clutch;

Figure 6 is a detail view of the key member inside the clutch;

Figure 7 is a side elevation corresponding to Figure 1 illustrating a modified arrangement, in which no clutch is required;

Figures 8, 9 and 10 are separate diagrams illus-

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trating alternative methods of cutting the tows into staple lengths and delivering the staple fibres end-on to the card.

Referring first to Figures 1 to 3, a portion of a card drum is indicated diagrammatically at 30, while 11 is a frame supporting a feed apron 12. This apron is in the form of wooden slats with gaps between them carried by supporting bands 13 at the ends, which run over sprocket rollers 16 on shafts 14 and 15. A shaft 17 is driven from any convenient source of power (not shown) and carries a sprocket wheel 18 transmitting the drive to shaft 15 by a chain 19 and sprocket wheel 20 on shaft 15. The feed apron is therefore driven continuously so that its upper surface travels toward the card drum 30 as indicated by the arrow in Figure 1. The shaft 14 at the other end of the feed apron carries a gear wheel 21 transmitting a drive through idler wheel 22 to a gear wheel 23 on shaft 24. This shaft carries a roller 25 on which bear heavy rollers 26 supported at intervals in brackets 27 extending upward from frame 11. The tows 28 of continuous filaments are fed over guides 29 to the nip between rollers 25 and 26 and so to the surfaces of the feed apron 12 at the same speed as this apron is moving. The tows are thus laid in parallel strips on the apron as seen in Figure 3. This figure shows four such tows 28 spaced apart over the portion of the feed apron 12 there shown.

The mechanism for cutting the tows into staple lengths as they travel forwards over the feed apron 12 is as follows:

Brackets 31 and 32 suitably connected together across the machine are mounted to slide on the side members of the frame 11, and a transverse beam 33 extends between these brackets, the ends of the beam working in slotted guides 34 on the brackets 31 and 32. The beam carries an electric motor 35 (shown only in Figure 1) which drives a belt 37 carried over pulleys 38 and 39. The pulleys 39 are on spindles 40 supported by the beam 33 and these spindles carry disc cutters 41 which are clamped on their ends. The disc cutters 41 are adapted to pass through slots in a presser plate 42 carried by arms 43 which slide through slots in brackets 44 and 45 projecting from the beam 33. Stud 46 on the arms 43 cause the presser plate to rise with the beam 33 but permit it to stop when the beam descends so that the presser plate may rest by its weight upon and clamp the tows 28 while the disc cutters 41 descend through the slots in the presser plate and through gaps between the slats of the feed apron 12 for cutting the fibres of the tows 28 into staple lengths.

The brackets 31 and 32 are moved to and fro along the frame 11 parallel with the path of the feed apron 12 by heart-shaped cams 50 working between rollers 51 and 52 on the brackets, the cams 50 being carried by a shaft 53 which has a sprocket 54 upon it driven by a chain 55 from a sprocket 56 on shaft 17. The shaft 53 is carried in bearings in side extensions 61 of the frame 11, and passes through slots in the brackets 31 and 32 as shown. Heart-shaped cams such as 50 impart substantially uniform reciprocating movements through rollers 51, 52 to the brackets 31, 32 with the beam 33 and disc cutters 41 carried thereby, the speed of movement being such that the disc cutters move forwardly at the same speed as the apron 12, while they are so located that the cutters are over a gap between the slats of the apron when the cutters descend.

The beam 33 with the disc cutters upon it is

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moved up and down in the slots 34 of the brackets by connecting rods 57 pivoted on arms 58 projecting from the beam 33, the rods 57 being secured to the straps 59 of eccentrics 60 on a transverse shaft 62. This shaft is driven so as to turn the eccentrics and to lower and raise the beam 33 during the forward travel of the brackets 31, 32, but it remains at rest with the beam 33 raised during the return travel. With this object in view the shaft 62 is driven by a clutch which makes one revolution and then remains stationary for a revolution. The clutch is shown in detail in Figures 4 to 6. A housing 63 which surrounds the shaft 62 has lugs 64 which are fixed by means of screws to the extension 61 of the frame of the machine. The housing has a slot at the top as at 65, and accommodates two hub members 67 and 68, of which hub 67 is fixed by key 69 on the shaft 62, while hub 68 turns freely on the shaft and carries a chain sprocket 70 driven by a chain 71 from sprocket 72 on the power shaft 17. The hub 68 is held in place by a bush 73 fixed on the end of shaft 62. The shaft is embraced by a saddle-shaped key member 74 whose arms are bored to accommodate the springs 75 which project and bear against a shoulder on the hub member 67. The key member 74 has a projecting nib 76 which, when the key is raised as in Figures 4 to 6, engages in the slot at 65 in the housing 63, while said nib 76 always engages in a slot at 77 in the hub member 67, thus keying this hub member and its shaft 62 to the housing so long as the key is in its outward position as shown. The fixed housing and the key then hold shaft 62 stationary.

The other hub member 68 is smaller in diameter than hub member 67 and rotates inside a smaller bore of the housing 63. The hub member 68 is also slotted at 78 for engagement by the nib 76 when this is pressed inwards away from the slot 65 in the housing 63. Under these conditions the nib 76 keys the hub 67 to the hub 68 causing the shaft 62 to be driven by the sprocket wheel 70 on hub 68, while the nib 76 of the key member is held inwards by the smaller bore of the housing and thus prevented from springing outwards until it has completed one turn and is again opposite the slot 65.

For depressing the nib 76 of the key member 74 an arm 80 is provided pivoted at 81 on the extension 61 of the frame, and carrying at its end a sliding plunger 82 pressed downwardly by a strong spring 83 which bears against a collar 84 on the plunger. The top end of the plunger bears a collar 85 which limits its downward movement. The arm 80 has a lug carrying a cam bowl or stud 86 adapted to be struck and pressed down by a cam projection 87 on a gear wheel 88, this wheel being constantly driven by engagement with a gear wheel 89 on shaft 53. Once in each rotation of the shaft 53 therefore, at or about the moment when the heart-shaped cam 50 begins to move the brackets 31 and 32 forwards with the feed apron 12, the cam projection 87 depresses the arm 80 for a short time. This causes the plunger 82 to press on the nib 76 of key 74 until the pressure exerted by spring 83 is strong enough to overcome the pressure of springs 75. The nib 76 and key 74 are then forced inwardly releasing engagement with the slot 65 in the housing and keying the hub members 67 and 68 together for one revolution. The pressure of the plunger 82 on the nib 76 of the key member 74 will generally be exerted just before the slot 78 in hub member 68 is in its top position, so that the spring 83 may be exerting a strong pressure on the nib 76

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member directed end-on toward said carding machine.

2. Apparatus for forming slivers of staple fibre from tows of continuous filaments comprising a carding machine, a wide feed member therefor, an intermittently operating severing device, means for delivering a plurality of continuous filament tows in parallel relation and spaced apart laterally by several times their width to said severing device, and means for depositing severed lengths of filaments in bunches upon said feed member directed end-on toward said carding machine and spaced apart laterally by several times their width.

3. Apparatus for forming slivers of staple fibre from tows of continuous filaments comprising a carding machine, a travelling feed member therefor, a severing device and means for supporting it movably over said feed member, means for imparting longitudinal to and fro movements to said severing device parallel to the direction of movement of said feed member, and for imparting intermittent rising and falling movements to said severing device relatively to said feed member, means for delivering a plurality of continuous filament tows in parallel relation and spaced apart laterally on the surface of said feed member, the rising and falling movements of said severing device being timed in relation to its to and fro movements so that said severing device severs the filaments of said continuous tows during the movements of said severing device in the same direction of travel as that of said feed member, whereby a plurality of laterally spaced bunches of staple fibre are located on said feed member and delivered end-on to said carding machine.

4. Apparatus for forming slivers of staple fibre from tows of continuous filaments comprising a carding machine, a feed member and means for imparting a travelling movement to the upper surface of said feed member toward said carding machine, a transverse beam and means supporting it over said feed member such that it can make reciprocating movements parallel with the direction of travel of said feed member, a severing device and means supporting it on said beam such that it can make up and down movements relative to said feed member, mechanism for imparting reciprocating movements to said beam and for imparting up and down movements to said severing device, means for delivering continuous filament tows to said feed member in positions such that they are severed into staple lengths by said severing device on the descending movements thereof, whereby said staple lengths are presented end-on to said carding machine as bunches of fibres disposed in parallel relation on said feed member.

5. Apparatus for forming slivers of staple fibre from tows of continuous filaments comprising a carding machine, a feed member therefor having transverse gaps therein at spaced intervals, means for imparting a continuous movement of said feed member towards said carding machine, a severing device and means for traversing it back and forth longitudinally of said feed member and up and down in relation to said feed member, said traversing means being such that said severing device descends through the transverse gaps in said feed member and returns clear of said gaps during its forward movements, and remains elevated clear of said feed member during its backward movements, means for delivering a plurality of continuous filament tows to said feed member

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in position such as to pass thereon under said severing device, holding means adapted to clamp said tows on said feed member while being acted upon by said severing device and in position such that the severed lengths remain as separate bunches of staple fibre on said feed member directed end-on to said carding machine.

6. Apparatus according to claim 5 for forming slivers of staple fibre from tows of continuous filaments wherein said feed member with gaps therein at spaced intervals comprises a feed apron with a series of slats thereon spaced apart longitudinally, and said severing device comprises a plurality of disc cutters each adapted to pass between said slats when severing the filaments of said continuous filament tows.

7. Apparatus according to claim 5 for forming slivers of staple fibre from continuous filament tows, wherein the means for imparting up and down movements to said severing device comprises a one-revolution clutch, and power actuated means for driving the same, mechanism operated by said clutch and connected to said severing device adapted to lower and raise again said severing device during one revolution of said clutch, and means for engaging said clutch in alternate revolutions to said power actuated driving means.

8. Apparatus according to claim 5 for forming slivers of staple fibre from continuous filament tows, wherein said severing device comprises a plurality of disc cutters with means for rotating the same, and said holding means comprises a presser plate and supporting means therefor adapted to permit said presser plate to rise and fall with said disc cutters, but to stop when resting on said continuous filament tows while said disc cutters continue to descend and to rise again, during the severing of such tows into staple lengths on said feed member.

9. Apparatus according to claim 5 for forming slivers of staple fibre from continuous filament tows, wherein the means for traversing said severing device longitudinally in relation to said feed member comprises a transverse shaft and means for rotating the same, a plurality of heart-shaped cams on said shaft and members associated with said severing device engaging said cams and adapted to impart to and fro traversing movements to said severing device while leaving it free to rise and fall in relation to said feed member.

10. Apparatus for forming slivers of staple fibre from tows of continuous filaments comprising a carding machine, a gapped feed member therefor and means for imparting continuous forward motion to said feed member, a severing device and means for imparting up and down movements thereto over and into gaps in said feed member, means for delivering a plurality of continuous filament tows spaced laterally of said carding machine upon said feed member, holding means adapted to clamp such tows on said feed member while being severed by said severing device, said feed member, severing device and holding means being so disposed as to deliver severed lengths of staple fibre in laterally spaced bunches all directed on said feed member end-on to said carding machine.

11. A method of forming slivers of staple fibre from tows of continuous filaments, comprising delivering a plurality of such continuous filament tows in spaced parallel relation to a severing device, cutting them at spaced intervals lengthwise thereof into successive bunches of staple fibre, and

ready to cause the nib to drop at once into the slot 78 the moment this is in position to receive the nib. In this way the transfer of the nib from engagement with slot 65 in the housing to its engagement with slot 78 in hub member 68 is effected substantially instantaneously. The arm 80 is freed and the plunger 82 rises again directly after it has served its purpose, but the key is kept in its inward position by the inner circumference of the housing 63 as hub member 68 turns until it can spring outwardly again and engage with the slot 65 at the completion of the revolution. It will be noted that the sprocket 72 is twice the size of sprocket 70, so that sprocket 70 and hub member 68 are driven at twice the speed of shaft 17, while the sprockets 56 and 54 are equal in size, as also are the gears 88 and 89 so that hub member 68 makes two revolutions for each complete turn of the heart-shaped cam 50, and for each operation of the plunger 82. Hence, the device described operates as a one-revolution clutch, remaining stationary while the brackets 31, 32, and beam 33 with the disc cutters 41, are moving back clear of the apron, but making one revolution while the beam 33 advances with the apron 12, causing the cutters 41 to move down and return to their raised position again during this advancing movement. As the cutters are set to register with a gap between the slats of the apron 12 while they advance, they effect the cutting by descending into the gap and rising again from it without fouling the apron. As the cutters descend the presser plate 42 clamps the fibres of the tows 28 against the slats of the apron, so preventing them from being displaced by the rotation of the disc cutters.

In the example of construction illustrated, each disc cutter 41 severs two of the tows 28 at each operation, but this is not an essential feature. The slats of the apron 12 are conveniently spaced at intervals of one inch and the cuts are made at intervals of six inches in the lengths of the tows, as indicated in the plan view, Figure 3. This is only one example of the application of the invention as it will be obvious that the spacing may be varied by suitable choice of the gear wheels and sprockets, and the size of the heart-shaped cams 50.

The disc cutters 41 are constantly driven at a high speed by motor 35 and belts 37. For keeping the edges of the discs sharp it is convenient to provide pairs of sharpener members 90 carried by a cross beam 91 extending across the machine between the brackets 31 and 32. Each time that the disc cutters rise again after a cutting operation they then engage the sharpeners 90 for a short interval before they move down for the next cutting operation. The sharpeners may be otherwise arranged so as to act on the disc cutters only at longer intervals of time and this device is only illustrated by way of example.

The cutting operation leaves the cut fibres in bunches as at 92, Figure 3, on the apron 12, and as the apron advances these bunches pass between rollers 93 and 94 which will usually be pinned or roughened, and which present the bunches of staple fibre end-on to the surface of the card 30. The card carries them away and forms them into a lap or sliver in the usual manner.

The necessity for the use of the one-revolution clutch can be avoided by arranging the mechanism as shown in Figure 7. The parts identical with those shown in Figure 1 are numbered to correspond with Figure 1, the principal change

being in the mechanism which raises and lowers the beam 33.

In this case the shaft 17 drives a shaft 95 through gears 96 and 97 at the same speed as shaft 17, and cranks 98, one at each end of the shaft 95, are connected by rods 99 to the arms 58 projecting from the ends of the transverse beam 33. As the cranks 98 turn they raise the beam 33 so that the cutter 41 and presser foot 42 are clear of the apron 12 over more than half the rotation of the cranks 98 corresponding to the backward movement of the brackets 31, only lowering the cutters and presser foot into the operative position during the forward movement of the apron 12. In this example, a spring 100 is shown bearing on a collar 101 on the rod 43 of the presser foot for augmenting its weight in exerting pressure on the tows 28 when these are clamped on the apron.

The invention is not limited to cutting the tows of continuous filaments on the feed apron itself, and some alternative arrangements are indicated diagrammatically in Figures 8, 9 and 10.

In Figure 8 the continuous tows 28 are fed between rollers 103, 104 to the nip between rollers 105, 106, the latter of which has cutting blades 107 spaced around its periphery at the circumferential distance apart corresponding with the staple length of the fibres to be cut. Bunches of cut fibres 108 slide down over a smooth inclined plate 109, and come to rest on the surface of a feed apron 110 which travels over pulleys 111 and 112. In the example illustrated the circumferential speeds of the rollers 103 to 106 inclusive are such that the bunches of fibres are fed a little faster than the surface speed of the apron 110, so that the bunches are laid in slightly overlapping positions on the apron. The apron delivers them to the card in this condition, but the distribution is quite satisfactory for feeding purposes.

In Figure 9 the continuous tows 28 are delivered between rollers 113 and 114 to the surface of a travelling apron 115, moving over rollers 116 and 117 at each end. The apron has slats in it, as is the case with the feed apron 12 of Figures 1 to 3, and the continuous tows are cut on the apron 115 by cutter discs 41a which may be operated by a mechanism such as that shown in Figures 1 to 3. The severed bunches 118 are delivered to the surface of an ordinary feed apron 119 moving over rollers 120 and 121, and this apron delivers the bunches to the card in the usual manner.

In Figure 10 the continuous tows are delivered between a pair of rollers 122 and 123 to the surface of a pinned drum 124 rotating in the direction of the arrow so as to carry the tows over the top of the drum as it turns. The drum is slotted at intervals corresponding with the distance apart at which cuts are to be made in the tows, and cutter discs 41b, raised and lowered by mechanism such as that shown in Figures 1 to 3, sever the tows into lengths of staple fibre, while the drum 124 rotates. The tows are delivered under another pinned roller 125 to the surface of the licker in or card 126, which carries the fibres away and forms them into a lap or sliver in the usual manner.

I claim:

1. Apparatus for forming slivers of staple fibre from tows of continuous filaments comprising a carding machine, a feed member therefor, an intermittently operating severing device, means for delivering continuous filament tows to said severing device and means for depositing the several lengths of cut filaments in bunches upon said feed

presenting a plurality of such bunches end-on simultaneously to a carding machine in continuous succession.

12. A method of forming slivers of staple fibre from tows of continuous filaments as set forth in claim 11, comprising delivering such continuous filament tows in widely spaced relation to a severing device, laying the successive bunches widely spaced apart laterally and overlapping lengthwise on the feed member of a carding machine, and delivering such spaced overlapping bunches end-on to the surface of the drum of said carding machine.

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