MACHINE FOR PRODUCING STAPLE FIBERS FROM SLIVERS COMPOSED OF CONTINUOUS FIBERS

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1. This invention relates to an improved method of producing staple fibers from natural and artificial textile materials such as silk, rayon and other synthetics, and a novel and ingenious mechanism for practicing the method.

One object of the invention is to provide an improved method and mechanism for converting continuous textile fibers into staple fibers having characteristics suitable for producing a superior quality of yarn of uniform size and twist.

Another object of the invention is to provide a method of producing staple fibers from a sliver composed of continuous fibers substantially co-extensive therewith by mechanically severing the latter into relatively short lengths with their ends staggered lengthwise of the sliver to dispose them in overlapping parallel relationship.

Another object of the invention is to provide an improved method of producing yarn from a sliver composed of continuous fibers comprising mechanically severing the continuous fibers into relatively short overlapping lengths in condition to be gilled and drafted by a single operation to prepare the staple fibers for twisting into yarn without carding, combing and repeated dressings whereby to economize in the cost of manufacture of the finished product.

Another object of the invention is to provide a method of producing yarn from a sliver composed of continuous fibers substantially co-extensive therewith by mechanically severing the continuous fibers in relatively narrow zones spaced across the width of the sliver at points staggered along its length and thereafter drafting the sliver to convert it into roving and yarn while eliminating the usual processes of carding, multi-gilling, combing and repeated dressings.

Another object of the invention is to provide a method of producing staple fibers which not only eliminates several steps of the usual process, but also results in a more uniform, level and cleaner yarn without slubs, specks and other foreign matter liable to be picked up in the carding and not entirely removed by the combing process.

Another object of the invention is to provide a simple mechanism for mechanically severing the continuous fibers into shorter lengths in staggered overlapping relationship lengthwise of the sliver.

Another object of the invention is to provide a mechanism for cutting continuous fibers into staple fibers which may be applied to use in standard gill-boxes of the intersecting type without material alteration in the construction thereof.

2. Another object of the invention is to provide in a gill-box or gill-drawing frame, a series of traversing bars having relatively narrow knives arranged in staggered relationship across the width of the machine to adapt them to sever a sliver fed through the machine in narrow zones spaced across the width of the sliver and staggered along its length to continuously produce overlapping staple fibers throughout the feeding of the sliver.

Further objects of the invention are set forth in the following specification which describes the present improved method of producing staple fibers and a preferred form of mechanism for practicing the method, by way of example, as illustrated by the accompanying drawings. In the drawings:

Fig. 1 is an elevational view of the present improved mechanism for severing the fibers, shown partly in section to illustrate the arrangement of the toothed-bars or fallers and the knives carried by the upper set of bars;

Fig. 2 is a part-sectional transverse view of the mechanism, taken on line 2—2 of Fig. 1, showing a single faller-bar and one knife-bar in cooperative relationship with their ends engaged with the traversing screws;

Fig. 3 is a slightly enlarged fragmentary sectional view through a series of the fallers and knife-bars showing the cooperative relationship of several of the bars as they operate to sever the continuous sliver to produce staple fibers; and

Fig. 4 is a more or less schematic view showing the series of knife-bars in plan view and indicating the manner in which their knives sever the continuous fibers of the sliver to form shorter lengths or staple fibers.

It is now the general practice to manufacture yarn from staple fibers of both natural and artificial textile materials, such as silk, rayon and other synthetics, by cutting or breaking continuous fibers into shorter lengths which are carded, gilled, combed and drafted to produce a roving for subsequent spinning into yarn. When the continuous fibers are chopped into shorter lengths by cutting the sliver across its whole width, as is the usual practice, the resultant product must be carried through numerous subsequent processes such as those mentioned above before being converted into proper condition for twisting into yarn. Moreover, with this method the fibers have a tendency to mat together in an irregular mass requiring carding to straighten and loosen them which often breaks them into shorter lengths or not unsuitable for twisting.
3. Foreign matter is liable to be picked up in the carding process and cannot be entirely removed during combing so that it is difficult to produce a clean yarn from "tops" of this character.

It has also been proposed to produce staple fibers by fracturing relatively long fibers under tension, that is by exserting a strain or pull on the continuous fibers to break them into shorter lengths; but such a practice has not been found entirely satisfactory as the continuous fibers may have portions of greater or lesser strength so that the staple fibers broken therefrom are not of uniform length and the yarn manufactured therefrom is not always even or uniform in size.

It is the purpose of the present invention to provide a method and means for mechanically severing the continuous fibers of a sliver into staple fibers of uniform length by cutting through a limited number of the fibers in relatively narrow zones spaced across the width of the sliver with the narrow cuts staggered along its length so that the staple fibers will all be of the same length and overlapped with exactness and uniformity for producing therefrom a level yarn of even twist and superior quality. It is also the purpose of the present invention to provide a mechanism for carrying out the process which may be applied to use with standard gill-boxes of the intersecting type by merely substituting knife-carrying bars for the usual upper set of intersecting fallers without modification of or addition to the mechanism of the gill-box. By gilling the sliver during the continuous severing of the fibers the staple fibers may be maintained in parallelism in proper condition for twisting after only a single further combined gilling and drafting operation, thereby eliminating various intermediate steps in the preparation thereof such as carding, combing, and repeated drafting. By the elimination of these steps the time required for processing the material from sliver to twisted yarn is greatly reduced while effecting a substantial saving in cost and also practical elimination of waste.

Referring to the accompanying drawings, the present improved method of producing staple fibers may be practiced in a gill-drawing frame or gill-box of standard construction comprising upper sets of intersecting toothed faller-bars. As shown in Fig. 1, the mechanism of the gill-box may be mounted in a framework embodying bearings for the shafts of the upper and lower sets of traversing screws for the fallers. As herein illustrated, the lower shaft 3 may be constructed as the drive-shaft for one side of the gill-box, being journaled in a suitable bearing in the framework and extended in the form of a bottom-screw 5 of the lower set constructed integral therewith. It will be understood that the arrangement of the screws and drive-shafts therefor shown in Fig. 1 of the drawings is duplicated at the opposite side of the gill-box, as well known to those versed in the art, and therefore it is considered sufficient to describe the shafts and screws at one side of the machine only. Extending above the bottom-screw 5 of the lower set of traversing screws is a top-screw 6 arranged parallel therewith with its axis in the same vertical plane as the axis thereof. The top-screw 6 is driven from its integral shaft 7 which carries a spur-gear 8 meshing with a similar gear 9 on the lower shaft 3.

The bottom-screw 5 is duplicated in the upper set by a similar screw 15 which cooperates with a screw 16 arranged therebelow with its axis parallel with and in the same vertical plane as the axis of the screw 15. The screws 15 and 16 are driven from the lower drive-shaft 3 by means of intermeshing gears 17 and 18, there being a gear 19 which meshes with the gear 5 on the shaft of the top-screw 6 of the lower set.

The two screws 5 and 16 are formed with square threads of relatively fine pitch which engage with and traverse the bars or fallers during their working stroke in a direction towards the right as viewed in Fig. 1. The bottom-screw 5 of the lower set and the screw 16 of the upper set have threads of much coarser pitch and are arranged to traverse the bars in their return stroke, at the end of which they are transferred respectively to the screws 5 and 13 to again be traversed for the working stroke.

Figs. 1 and 2 illustrate the lower set of bars or fallers 26 as of conventional form, that is, having teeth or pins 21 arranged in closely spaced relationship thereof and projecting therefrom to adapt them to be drawn through the fibers of the sliver 5, represented by dash-lines in Fig. 1, to process the material as it is fed through the machine. The sliver 5 is fed through the machine by means of rolls arranged in pairs at the front and back of the machine, the back rolls 22 and 23 acting to feed the sliver 5 into the machine and the front-rolls 24 and 25 operating to deliver it therefrom; the peripheries of the rolls usually being corrugated as represented in Fig. 1 of the drawings and in some instances carrying endless aprons.

Referring to Fig. 2, the bars 26 of the upper set are of different construction from that of the fallers 21, being without teeth but carrying relatively narrow knife-blades 30 projecting downwardly from their lower edges as shown more clearly in Figs. 2 and 3. Preferably, the knives 30 are constructed from strips of hardened steel with their upper ends set into recesses 31 formed in the side of the bars 26, for example, by machining the bars with an end-mill. The knives 30 may be held in place on the bars 26 by rivets 27 extending therethrough and headed over at the ends, see Fig. 3, and at their lower ends the knives are beveled to provide sharp edges for cutting through the fibers 5 of the sliver 5.

The top-screw 6 of the lower set is rotated in a direction to traverse the toothed fallers 26 toward the right as viewed in Fig. 1, or in the same direction as that in which the sliver 5 feeds. The fallers 26 slide on a saddle 32, so-called, consisting of a horizontal metal strip bolted to the frame of the gill-box. As the fallers 26 reach the end of their working stroke they are carried downwardly by means of suitable cams 28 rotatable with the screw 6 and caused to engage in the threads of the bottom-screw 5, by which they are traversed back in the opposite direction; it being noted that the screw 5 is driven in the opposite direction from that of the screw 6 through the means of the intermeshing gears 17 and 19. As the fallers 20 are traversed by the screw 5 during their return stroke they slide on a lower saddle 33 and at the end of each stroke in this direction they are traversed upwardly by suitable cams 29 to again engage in the threads of the top-screw 6 to be traversed once more through their working stroke.

The traversing motion of the knife-bars 26 is substantially the same as that of the toothed-bars or fallers 26. As shown in Fig. 1, I provide fifteen knife-bars 26 for operating on the con-
Continuous fibers of the silver S to sever them into shorter lengths in the form of staple fibers, but a greater or lesser number of knife-bars may be used if desired. Fig. 1 also shows the toothed fallers 20 as of greater number than the knife-bars 26, but it is to be understood that the relative number of the bars of the two sets may be varied as desired, the fallers being usually more numerous than the knife-bars. The knife-bars 26 have their ends in engagement with the relatively fine threads of the screw 16 for traversing them in the same direction as that of the fallers 20 as they slide on a horizontal saddle 36. As the knife-bars 26 reach the end of their travel in a direction towards the right, as viewed in Fig. 1, they are transferred by cams 38 at the end of the screw 16 to lift them into engagement with the threads of the return screw 15. The knife-bars 26 are then caused to slide rearwardly along an upper saddle 46. At the end of the return stroke of the knife-bars 25 in the threads of the screw 15 they are transferred downwardly by cams 41 on the screw to again engage them in the threads of the screw 16 to be traversed forwardly once more. It will be understood that the traversing motion of both the different knife-bars 20 and 25 is continuous throughout the operation of the gill-box, the bars being engaged at both ends by the opposite pairs of traversing screws as indicated in Fig. 2 of the drawings.

Referring to Figs. 3 and 6, it is to be observed that the fallers 20 are of somewhat different construction from that of the usual type of toothed-bars employed in gill-boxes. Instead of having a level upper edge, each bar 20 is formed with an upstanding flange or ledge 45 and a recess forward of the pins or teeth 21 to provide clearance for the cutting edges of the knife 39. The pins 21 have their shanks held in the central portion of the bar 20 with the flange or ledge rising therefrom at the rear of the pins as shown most clearly in Fig. 3. The top of the ledge 45 provides a rest for the silver S as it draws through the machine so that as the knives are carried downwardly to cut through the fibers s their pressure is resisted whereof to insure a clean cut through the silver.

The mechanism of the converted gill-box having been described in detail its method of operation is explained as follows: Referring to Fig. 1, the silver S, composed of continuous fibers s, is supplied from a suitable source and fed through the machine by the pairs of nip-rolls 22, 23 and 24, 25. The nip-rolls 24 and 25 may be rotated at the same speed as that of the rolls 22 and 23, but preferably they are driven at a slightly greater speed, for example, by providing a proper ratio between their driving gears. The object is to maintain the silver S under slight tension, but without any drafting effect thereupon. In this way the silver S is held taut resting against the top of the flanges of ledges 45 surmounting the fallers 20 as the latter are traversed through their working stroke. During the feeding of the silver S the pins or teeth 21 project through the silver S to straighten the fibers and maintain them in parallelism.

Concurrently with the traversing of the fallers 20 the knife-bars 26 are traversed forwardly by the screw 16 at the same rate of speed as that of the bars 20. At the ends of the working stroke of the fallers 20 the bars are transferred individually from the top-screw 6 to the bottom-screw 5 by means of the cams 28, previously referred to, and are then returned to be again transferred by the cams 28 into the top-screw 6 to carry them forward once more in their working stroke. Likewise, the knife-bars 26 are transferred into the return screw 15 and traverse rearwardly thereby to be transferred into the screw 16 for another working stroke. As each knife-bar 26 is carried down into engagement with the screw 16 the sharpened edge of its knife 30 will be forced through the silver S to sever or cut through a restricted width thereof as indicated at 30 in Fig. 4. The diagrammatic plan view of Fig. 4 shows all of the knife-bars 26 as in alignment for the purpose of illustrating the staggered arrangement of their knives 30; it being understood that they never assume this position in the machine but are caused to operate in sequence to cut the fibers at intervals in accordance with the pattern delineated in this view.

Referring to Fig. 3, it will be noted that the knives 30 are carried downwardly in the space between the teeth 21 of adjacent fallers 20, the recesses in the bars at the front of the pins assuring sufficient clearance so that the knives may cut clear through the whole mass of fibers in the silver S without danger of striking the bars. Since the knife-bars 26 are traversed at the same speed as the fallers 20 the cooperative relationship of the knives 30 and pins 21 remains constant throughout the cutting operation and thereafter as both sets of bars move through a working stroke.

Fig. 4 shows, as an example, a suitable pattern for the arrangement of the knives 30 on fifteen bars adapted for use with the present embodiment of the invention, but the pattern may be varied at will providing that the knives are arranged in series so that the cuts are staggered and grouped to insure a proper overlapping of the staple fibers as they are severed from the silver. With the pattern shown in Fig. 4, the knife on the first bar is disposed to cut through a group of fibers at one edge of the silver, the knife on the second bar to cut through a group at some distance from the first group, the knife on the third bar to sever a group located still further across the width of the silver, while the fourth bar has its knife positioned to cut through a group of fibers nearer the first group, and so on with an irregular stagger of the cuts as indicated. The arrangement of the knives 30 as herein shown is designed to sever the continuous fibers into staple fibers of approximately five and one-half inches in length, but by using a different number of knife-bars and a different arrangement of the pattern of their knives, staple fibers of any desired length may be produced.

As the silver S is fed continuously throughout the operation of the machine the knives 30 on the bars 26 come into action in sequence to sever the continuous fibers in staple fibers at intervals along the silver with the cuts spaced across its width and staggered lengthwise thereof. As the machine operates in this manner the continuous fibers in the silver are severed into short lengths or staple fibers with the latter maintained in parallelism by the teeth of the fallers and disposed in overlapping arrangement more or less in the manner in which staple fibers are drafted as in a drawing frame. However, since no drafting of the fibers is effected as the silver passes through the machine it is desirable to subsequently process the material in a standard gill-box with the drawing rolls operating to draft the staple fibers to the extent required.
After the material has been processed by this latter combined gilling and drafting operation it may be twisted into a roving for final spinning into yarn without further conditioning. It will therefore be observed that the present method of producing staple fibers eliminates the several intermediate processes of carding, multi-gilling, combing and repeated drafting with the inherent disadvantages thereof as set forth hereinabove. Moreover, the present method of processing the sliver materially reduces the cost of manufacture of the final yarn by a saving in time and labor while eliminating the use of considerable extra machinery and conserving floor space, besides producing a more even and level yarn of superior quality.

It is also to be noted that the present improved method of producing staple fibers may be practiced in a gill-drawing frame or gill-box with only slight modification in the construction thereof, that is by merely displacing the usual upper set of fallers with knife-bars of simple construction. In other words, the present method does not entail use of special machines of complicated structure but may be accomplished with very slight investment of capital for constructing the required number of gill-boxes to carry out the process.

While I have illustrated and described a preferred manner of practicing the present improved method of producing staple fibers from continuous fibers and a preferred form of mechanism for transferring the fallers from one set of staple fibers to another set in the gill-box, it is to be understood that various changes may be made in the steps of the method and modifications adopted in the construction of the mechanism without departing from the spirit or scope of the invention. Therefore, without limiting myself in this respect, I claim:

1. A mechanism for producing staple fibers from a sliver composed of continuous fibers comprising means for continuously feeding the sliver, a plurality of toothed fallers for gilling the fibers, a plurality of relatively narrow rectangular knife-blades projecting vertically in overlying relation to the sliver and means for depressing said knife-blades in sequence at points between adjacent fallers to cause them to cut through relatively small groups of the fibers at intervals staggered therealong.

2. Means for producing staple fibers from a sliver composed of continuous fibers comprising a gill-box having means for continuously feeding the sliver, a series of toothed fallers in said gill-box, means for operating the fallers to gill the fibers, a series of bars extending transversely above the sliver across its full width and carrying narrow single vertically-projecting knife-blades thereon arranged in staggered relation to each other, and means for operating the bars in sequence to cause them to cut through relatively small groups of the sliver at points between adjacent fallers and spaced at intervals along the fibers.

3. In a machine for producing staple fibers from continuous textile fibers, means for feeding the continuous fibers into the machine, a series of toothed fallers for gilling the fibers, means for operating the fallers, a plurality of cutter elements carrying relatively narrow individual knives arranged in staggered relationship across the width of the machine in opposed relation to the fallers, and means for continuously operating the cutter elements to cause their knives to cut through the continuous fibers in groups between adjacent fallers at intervals spaced thereacross in staggered relationship therealong to divide the continuous fibers into shorter staple lengths disposed in overlapping relationship.

4. In a machine for producing staple fibers from a sliver composed of a multiplicity of continuous fibers, means for feeding the sliver under tension history of toothed fallers, means for traversing the fallers in the machine, a plurality of bars extending in opposed relation to the fallers, means for traversing the bars lengthwise of the sliver, a relatively narrow knife carried by each bar with the several knives arranged in staggered relationship, and means for continuously operating the bars in sequence to cause their knives to cut through the sliver in restricted zones located between adjacent fallers and spaced across the sliver and staggered therealong.

5. In a gill-drawing frame, nip-rolls for feeding a sliver composed of substantially coextensive fibers under tension, a set of fallers having pins for intersecting the sliver to maintain the fibers in parallelism, a plurality of knife-bars arranged in opposed relation to the fallers, knives carried by said bars in staggered relationship thereacross, pairs of gill-screws for traversing the fallers and knife-bars in parallel courses in the direction of feed of the sliver, and a plurality of screws for returning the bars in the opposite direction, and means for transferring the fallers and bars respectively from one pair of screws to another pair to maintain their traverse continuous, said knife-bars being operated during transfer to cause their knives to cut through the sliver at intervals therealong with the points of severance staggered laterally and longitudinally thereof.

6. In combination with the two sets of traversing gill-screws at each side of an intersecting type gill-box, fallers for engaging the threads of the screws to be traversed thereby in opposite directions and having teeth adapted to intersect a sliver fed through the machine, cams for transferring the toothed fallers from one pair of screws to the other pair of one set to cause them to be traversed in the direction of feed of the sliver, and a plurality of knife-bars traversed by the pairs of screws of the other set, cams for transferring said bars from one pair of screws to the other pair of their respective set, and relatively narrow knife-blades carried by said bars in position to cause them to sever the sliver in narrow zones at intervals therealong and staggered lengthwise of the sliver as the bars are transferred from one pair of screws to another pair.

7. In a gill-drawing frame, means for feeding a sliver composed of continuous fibers, a plurality of fallers having teeth for intersecting the sliver, two sets of screws for continuously traversing the fallers in the direction of feed of the sliver and returning them in the opposite direction, means for transferring the fallers from each set of screws to the other set, a series of bars arranged in opposed relation to the fallers, individual knives carried by said bars, two sets of screws for traversing the bars in the direction of feed of the sliver and returning them in the opposite direction, and means for transferring the knife-bars from each set of screws to the other set, said transfer-means operating to actuate the bars to cause their knives to cut through the sliver in narrow zones staggered lengthwise of the sliver to divide the continuous fibers into shorter lengths disposed in overlapping relationship.

8. In a gill-drawing machine of the intersecting type comprising means for feeding a continuous sliver through the machine, a plurality
of pairs of traversing gill-screws, toothed fallers adapted to be traversed by one pair of screws in the direction of feed of the silver and transferred to another pair of screws for traversing the fallers in the opposite direction, and means for transferring the fallers between their respective pairs of screws at each end of their traverse, the combination therewith of a plurality of cutter bars carried relatively narrow knives projecting vertically therefrom, and means to traverse said cutter bars in opposed relation to the fallers whereby to cause their knives to cut through the sliver in narrow zones as said cutter bars are transferred between their respective pairs of traversing screws at the end of their return stroke.

9. In a gill-drawing machine of the intersecting type comprising means for feeding a sliver of continuous fibers, a plurality of superimposed pairs of traversing screws, toothed fallers disposed beneath the fibers with their teeth projecting upwardly therethrough, said fallers engaging the screws of certain pairs to traverse them in opposite directions, and means for transferring the fallers between their respective pairs of screws at each end of their traverse, the combination therewith of a plurality of cutter bars disposed above the fibers in parallel relation to the fallers, a single knife-blade projecting downwardly from each cutter bar and sharpened on its lower horizontal edge, said individual knife-blades on the several cutter bars spaced at different distances lengthwise thereof to dispose them in staggered relation throughout the whole series of bars, said cutter bars engaging the traversing screws to traverse them in opposite directions, and means for transferring the cutter bars between their respective pairs of screws at each end of their traverse, said cutter bars being operated during their transfer at the end of their return traverse to cause the sharpened edges of their knife-blades to sever the fibers in groups at points between adjacent fallers as the fibers are supported on the fallers therebeneath.

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