Jan. 1, 1929. 1,697,491

W. BINNS ET AL

COMBING TEXTILE MATERIALS

Filed May 21, 1928 3 Sheets-Sheet 1

Fig. 1.

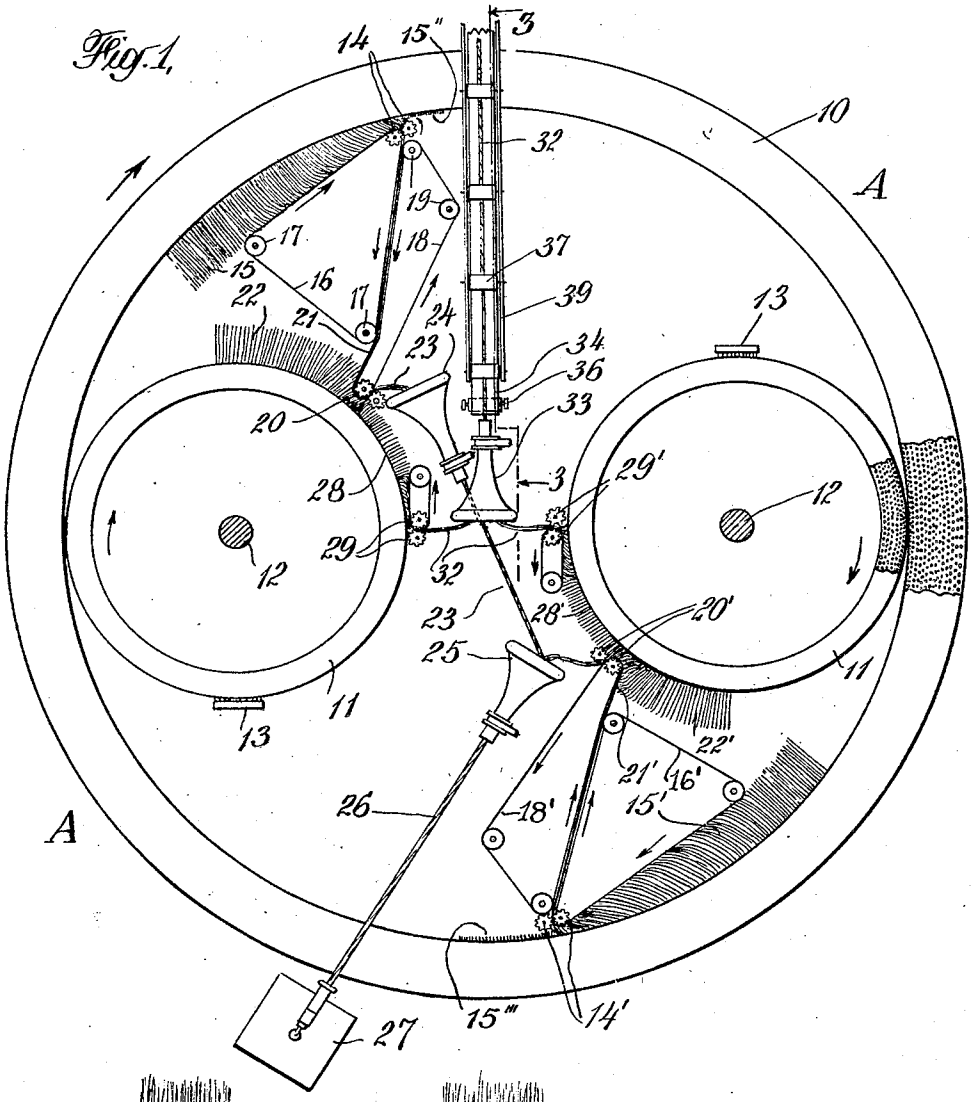


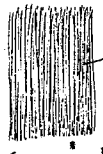
Fig. 4.



Fig. 5.



Fig. 6.



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Fig. 2.

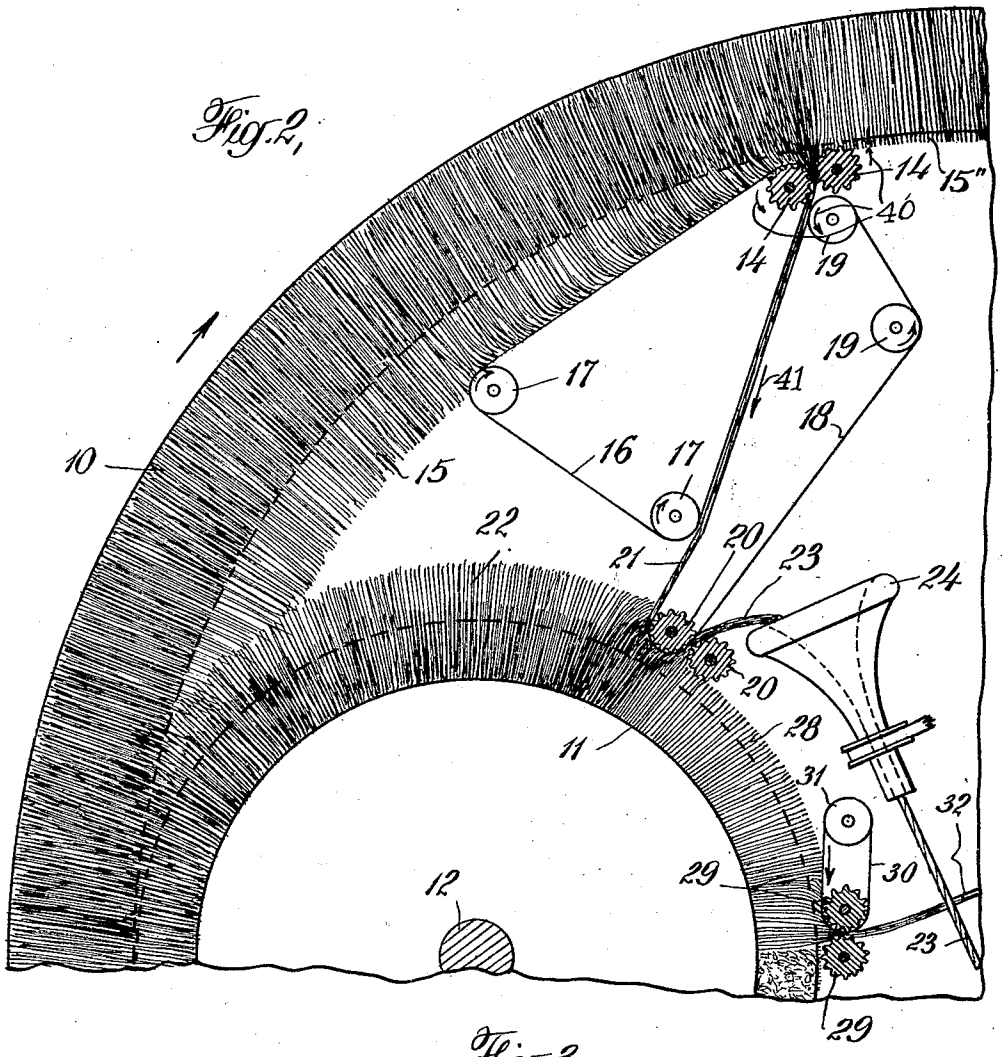
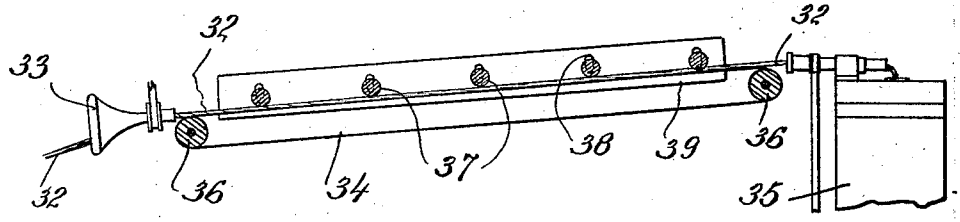


Fig. 3.



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Fig. 8.

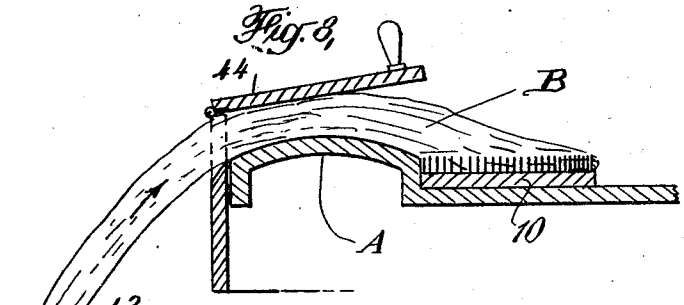


Fig. 9.

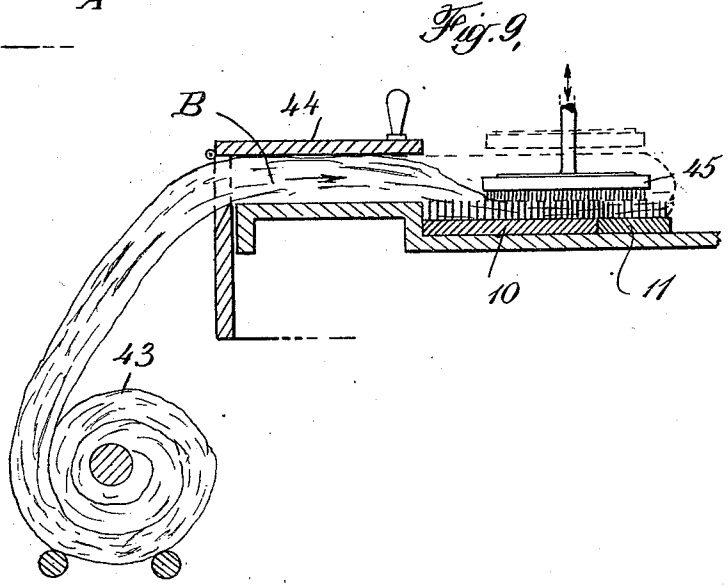
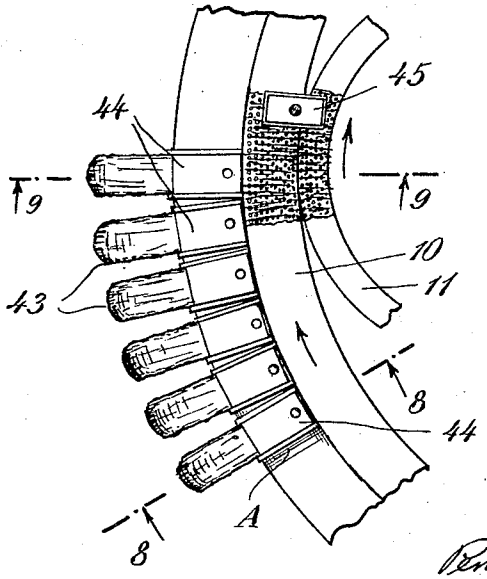


Fig. 7.



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UNITED STATES PATENT OFFICE.

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COMBING TEXTILE MATERIAL.

Application filed May 21, 1928. Serial No. 279,349.

This invention relates to the combing of textile materials and has particular reference to combing out and separating fibrous materials of different lengths from stock comprising fibres of varying lengths.

The sorting of wool, for example, according to length and grade is now done manually by "sorters" who separate the raw wool in grades and lengths before it is washed, carded, prepared and combed. This manual separation is tedious and expensive, and while the experienced wool sorter is skilled and adept, nevertheless, this manual method is too expensive to warrant the separation of the raw wool into more than a few distinct grades according to length, each of which, however, also comprises fibres of different lengths. This is due to the fact that the growth of wool is not uniform either in length or fineness, there being a large percentage of relatively short and fine fibres which grow nearest the hide of the sheep. Furthermore, the sorter cannot distinguish between perfect wools and certain inferior wools which are apparently long of fibre but contain some invisible defect which causes the fibres to break during the carding, preparing or combing processes. One of these invisible defects appears in the form of a constriction in the wool fibre which is caused by sickness of the sheep or lack of sufficient water at some time during the wool-growing season. Accordingly, these fibres break when strained so that the finished sliver, instead of consisting of carefully selected long fibres, includes short or broken fibres which cause an inferior sliver. The manual separation method, therefore, is incomplete and inadequate at best.

The raw wool, either as graded by the sorters or ungraded, is scoured, carded, prepared and combed into a strand of clean, straight, fibres known as the top sliver, and which contains fibres of all different lengths whether sorted or unsorted, although the variation in length is found to a lesser degree in the sorted stock. This top sliver containing a fair percentage of short fibres is universally employed for ordinary spinning, but it does not make as smooth a yarn as fibres which are substantially the same length. If long fibre sliver were obtainable it could be spun to a much higher count than the ordinary top sliver containing long and short fibres, or the spinning machinery could be run at much greater speed with correspondingly increased production, because the long fibres provide a much stronger yarn or thread.

Furthermore, due to manufacturing changes in the textile industry, there is an increasing demand for short top, i. e., fibres whose maximum length does not exceed, say, two and one-half inches, for example. This short top is used in some forms of French made spinning machinery, and could be used in a similar way for blending with silk, artificial silk or other fibres. These long and short fibres have been obtained heretofore only by performing two combing operations, the first in which the long fibres are abstracted and the second in which the remaining short fibres are recombed and the vegetable matter and very short fibres removed therefrom in the form of noil.

It has been attempted without success to perform these two operations at one time, but, while the long fibres are removable, the shorter remaining fibres, which are called "robbings," are not a merchantable product since they contain so much vegetable and felted matter in the form of lumps and particles, known as nips, as to make an inferior product which is unsuited for fine spinning unless recarded and recombed or merely recombed to obtain sliver stock in the manner described.

It is the principal object of this invention to provide for the automatic and substantially simultaneous separation during a single combing operation of the long, short and intermediate length fibres from ordinary carded wool comprising fibres of all different lengths. It is a further object of this invention to provide a machine for accomplishing this function mechanically and automatically, whereby several top slivers are produced, each comprising fibres of substantially the same length, but each sliver containing fibres of different length than the other slivers, the slivers composed of the shorter fibres being of finer texture than those composed of the longer fibres. This graduation in fineness according to length holds as a general rule except where the aforementioned inferior long fibres are broken into shorter lengths because of defects therein, when the slivers composed of the shorter and finer fibres contain a few coarser fibres.

In accordance with these objects the invention consists in a combing machine which is preferably of the so-called "Noble" type in which the straightened carded fibre of various lengths, such as wool card sliver, is fed into the outer periphery of a large rotary comb circle having a number of rows of closely-spaced, needle-like vertical teeth, the teeth of the inner rows, being more closely spaced than those of the outer rows. The wool is advanced continuously between these teeth, being combed meanwhile, and the fringe projecting from the inner row of teeth is fed into one or more smaller comb circles rotating tangent to the inner periphery of the large comb circle on stationary shafts, and which also have several rows of vertical teeth, the teeth of the outer rows being more closely spaced than those of the inner rows. The inner and outer comb circles rotate in the same direction, and as they separate while rotating, a fringe of combed wool projects beyond the adjacent rows of teeth of each comb circle, these teeth being most closely spaced.

These fringes of wool are composed of straight fibres of all different lengths, which are withdrawn by nip rolls placed substantially tangent to the inner periphery of the large comb circle and the outer periphery of the small comb circle or circles, and the wool abstracted by each set of nip rolls is combined into a single top sliver comprising fibres of all lengths. The small bits of vegetable or other foreign matter and the very short fibres remain between the teeth of the small comb circles and are subsequently brushed out in the form of noil. Thus the product of the combing machine is a sliver composed of long, short and intermediate length fibres, of which the shorts average approximately twenty percent of the usual wool card sliver, this percentage being no criterion, however, but merely illustrative.

When the wool passes through the carding and combing machines, the longer fibres pass through first with the shorter fibres following. Thus, in the fringe projecting beyond the edges of both the large and small comb circles, the longest fibres extend furthest and shortest fibres least, while the fibres of intermediate lengths extend according to their lengths.

In the machine of this invention, which includes the mechanism described, a number of sets of nip rolls are so placed with respect to the wool fringes extending from the inner periphery of the large comb circle and the outer peripheries of the small comb circles that each set of nip rolls abstracts only fibres of a predetermined length from the fringes of these comb circles, the length of the fibres abstracted by each set of nip rolls being different than that abstracted by the other sets of nip rolls. For example, if a long and short top sliver are desired, a set of nip rolls is placed tangent to the inner periphery of the large comb circle from which substantially only the longest fibres project, and a similar set of nip rolls is placed adjacent the outer periphery of each of the small comb circles, but spaced a definite distance therefrom so that only the longer fibres, say from two to two and one-half and more inches in length, are engaged and abstracted thereby. These long fibres drawn from both the large and small comb circles are combined, temporarily slightly twisted together and conveyed as a self-supporting strand or sliver to the coiler which removes the twist and coils the sliver within a suitable container, or the like, as the finished long top sliver ready for spinning after a finishing process.

The short fibres appear only in the fringe of the small comb circles in abstractable form, because the continuous feeding of the card wool around the outer periphery of the large comb circle advances substantially only the long fibres beyond the inner periphery as the fringe, while in the small comb circles the fibres are not advanced after being placed therein so that the fringe includes both the long and the short fibres. A second set of nip rolls is placed tangent to the outer peripheries of each of the small comb circles and behind the first set of nip rolls which left the short fringe. The second sets of nip rolls therefore abstract the short fibres from the small comb circles. These short fibres withdrawn by these second sets of nip rolls of the small comb circles are combined and preferably given a slight twist, but these fibres are usually too short to form a continuously homogeneous sliver so that the sliver is not self-supporting but frequently breaks at thin points. The short top sliver is therefore supported as it is conveyed from the combing machine upon a novel device which includes a moving band between which and a number of floating rollers the short sliver is supported in passing to the coiler. The coiler removes the twist and coils the sliver within a suitable container, or the like, as the finished short top sliver ready for spinning after a finishing operation. Obviously, other sets of nip rolls may be placed between the first and second sets of nip rolls adjacent the small comb circles, these other sets being placed closer to the outer peripheries of the circles than the first set of nip rolls in order to abstract fibres of an intermediate length in a similar way.

For a better understanding of the invention reference is made to the accompanying drawings, in which—

Figure 1 is a plan view, partially diagrammatic, of the so-called Noble comb modified in accordance with this invention;

Fig. 2 is an enlarged portion of Fig. 1 showing the combing and separating action more clearly;

Fig. 3 is a fragmentary side view of the

short top sliver conveying device as seen along the line 3—3 of Fig. 1, with the sliver cording machine added;

Fig. 4 illustrates a tuft of fibres of which the ordinary wool top sliver is composed;

Figs. 5 and 6 illustrate tufts of wool slivers produced by the machine of this invention;

Fig. 7 is an enlarged portion of Fig. 1 showing the fibre advancing and laying mechanism; and

Figs. 8 and 9 are sectional views taken along lines 8—8 and 9—9, respectively, of Fig. 7, showing the operation of the fibre advancing and laying mechanism.

In these drawings, numeral 10 designates the large comb circle of the conventional Noble comb familiar to those skilled in the art, and which is adapted to rotate in a horizontal plane. As this invention is not concerned with all the details of the Noble comb, only such parts thereof as are necessary to the understanding of the present invention will be referred to. Within the compass of the large circle 10 are usually mounted two small comb circles 11 and 11′ which rotate in the same direction as the large comb circle 10 and tangent to the inner periphery thereof about relatively fixed axes 12. Into the outer periphery of the large comb circle 10, carded wool sliver is fed as the sliver and the large comb circle rotate, this feeding being performed by so-called stationary humps placed at A, as seen in Figs. 1, 7 and 8, which draw out the card sliver as it passes over these humps so that when the hump is passed, pivoted plates 42 bear on the foreshortened sliver causing it to be pushed so as to extend over the teeth of the large and small comb circles. This is illustrated particularly in Fig. 8 in which the end of card sliver B is shown secured in the teeth of large comb circle 10, so that when the hump A is reached, the card sliver B unrolls from its ball 43 as indicated by the arrow. The relatively heavy plate 44, which moves with the large comb circle 10 and the card sliver B, is also lifted by the hump A, so that when the hump A is passed approximately at the point of tangency of circles 10 and 11, the weight of plate 44 pushes the card sliver B over the tops of the teeth of both large circle 10 and small circle 11, as indicated in phantom in Fig. 9, the direction of movement of the card sliver B being indicated by the arrow. While in this position over the teeth of both comb circles, the card sliver B is then pushed down between the teeth of both comb circles by a dabbing brush 45 shown in Fig. 9, the conventional operating mechanism of which is not shown. As the large and small comb circles rotate away from each other at the point of tangency the fibres which have been placed in the small comb circle are withdrawn from the large comb circle and extend beyond the outer periphery of the small circle in the form of a fringe.

In the Noble comb as now used the fringes appearing on the inner periphery of the large comb circle and on the outer periphery of the small comb circle are abstracted by nip rolls and combined into a single top sliver which is coiled by suitable mechanism into containers ready for the finishing operation preparatory to spinning. A tuft from such a top sliver is illustrated in Fig. 4 and contains both long and short fibres, the long fibres usually being upwards of two to two and one-half inches in length, and the short fibres being from three-quarters to two to two and one-half inches in length. Thus, a single principal product consisting of a top sliver composed of both long and short fibres is produced by all known types of wool combs in universal use. A secondary product, however, which is called the "noil", is removed from the small comb circles 11 and 11′ by means of noil knives, not shown, and brushes 13 after the top sliver has been abstracted therefrom, this noil comprising small particles of very short fibres, vegetable or other foreign matter and the like, and is used for textile manufacture on the woolen systems.

In the preferred embodiment of the invention illustrated in the drawings, the large and small comb circles 10 and 11—11′, respectively, are driven in the same direction in the manner described. The large comb circle 10 has a number of rows of needle-like teeth, the teeth of the inner rows being more closely spaced than the teeth of the outer rows, while the small comb circles 11 and 11′ are provided with a fewer number of rows of teeth than the large comb circle, the teeth of the outer rows being more closely spaced than the teeth of the inner rows. As described, the card sliver is placed upon the teeth of the large comb circle around its entire outer periphery, and as the large comb circle and the card sliver rotate, the card wool is advanced so as to project through the finer teeth on the inner periphery of the large comb circle, this projecting wool including both the long and the short fibres which are abstracted by the small comb circle 11, leaving a fringe of substantially only long fibres on the inner periphery of the large comb circle 10 as it and the small circle 11 rotate away from each other. When the small comb circle abstracts the long and short fibres from the fringe of the large comb circle, a fringe of substantially only longer fibres remains on the inner periphery of the large comb circle as the two comb circles rotate away from each other, this probably being due to the fact that some of these fibres are long enough to be still held by the teeth of the large comb circle, so that only the long fibres which had projected furthest and those short fibres which accompanied them, were abstracted by the small comb circle. Accordingly, the fringe remaining upon the inner periphery

of the large comb circle after the small comb circle moves therefrom consists of substantially only the longest fibres, while the fringe projecting from the outer periphery of the small comb circle comprises long and short fibres, the long fibres projecting beyond the short fibres.

In order to remove the long fibre fringe projecting from the inner periphery of the large comb circle, we provide adjacent the inner periphery thereof a pair of nip rolls 14, which are preferably fluted axially and are driven in any well-known manner to rotate toward each other and away from the large comb circle as indicated by the arrows 40 in Fig. 2, and are set so that they will grip and withdraw only the fringe 15 of long fibres from the large comb circle. These nip rolls 14 are not placed directly tangent to the inner periphery of the large comb circle as in the Noble comb in universal use, but are spaced a sufficient distance therefrom so as to leave the very narrow fringe 15″ of shorter fibres projecting from the inner periphery of this circle, as shown in Fig. 2. These shorter fibres are subsequently raised with other fibres by the hump at A and pushed over the teeth of the large comb circle and next small comb circle and then placed in these comb circles by the dabbing brush in the manner described.

In order to convey these abstracted long fibres, from nip rolls 14, an endless belt 16 is passed around one of the nip rolls 14 so as to be driven thereby and around several spools 17 suitably journalled on the frame of the machine. Engaging the surface of endless belt 16 is another endless belt 18 passing around spools 19 and one of the nip rolls 20, mounted near the outer periphery of the small comb circle 11. It will be seen that the fibres 21 abstracted by nip rolls 14 are carried between belts 16 and 18 in the direction indicated by the arrow 41 in Fig. 2. The nip rolls 20 are spaced at a distance from the outer periphery of the small comb circle 11 so as to engage and withdraw only the long fibres of the fringe 22 on the small comb circle 11, these long fibres projecting beyond the short fibres in the manner described and illustrated in Fig. 2.

The long fibres thus abstracted by nip rolls 20 are joined to the other long fibres 21, which were abstracted by nip rolls 14, so as to form a sliver 23 of long fibres which is conveyed into funnel 24 rotated by a belt or the like so as to impart a slight twist to the sliver in order that the fibres thereof may be more closely held so that the sliver is strong enough to be a self-supporting strand. This long top sliver comprises only the longest fibres, say upwards of two to two and one-half inches in length, a tuft of which resembles the illustration of Fig. 5. This tuft may be compared with that illustrated by Fig. 4 which is composed of a mixture of both long and short fibres and is the product of the ordinary wool combing machine in universal use.

The same process takes place at the opposite side of the machine, where nip rolls 14′ remove long fibres 21′ projecting as fringe 15′ beyond the inner periphery of the large circle 10, these fibres then being carried between belts 16′ and 18′ to nip rolls 20′ and there combined with the long fibres abstracted by nip rolls 20′ from the fringe 22′ projecting from the outer periphery of small circle 11′. This leaves a very narrow fringe 15‴ of short fibres on the inner periphery of large circle 10, described above. These combined long fibres are then joined with sliver 23 in a second rotating funnel 25 which adds a slight temporary twist to the sliver 26 thus formed so that it becomes a self-supporting strand passing to the conventional coiler 27 which removes the temporary twist as well as coils the sliver. This top sliver 26 is composed of the longer fibres and may be used for finer count spinning than the ordinary top sliver containing both long and short fibres, or the spinning machinery may be speeded up to greater production, because the long fibres make a much stronger and smoother yarn and thread.

After the long fibres have been abstracted by nip rolls 20 from the original fringe of small comb circle 11, only the short fibres remain in the small comb circle and project as a fringe 28 a short distance beyond the outer periphery thereof, in the manner illustrated by Figs. 1 and 2. In order to abstract these short fibres, another set of nip rolls 29 is placed tangent to the outer periphery of the small comb circle 11. An endless belt 30 passes around one of the nip rolls 29 and around a spool 31 suitably journalled on the machine. These nip rolls 29 abstract the short fibres 32 which are conveyed to a rotating funnel 33, which imparts a slight temporary twist to the sliver 32 thus formed. These short fibres, however, do not form a homogeneous sliver, but one containing several thin points so that the sliver is not self-supporting and frequently breaks if not supported. Accordingly, the slightly twisted sliver 32 as it emerges from funnel 33 is conveyed upon an endless belt 34 to the coiler 35 which removes the temporary twist as well as coils the sliver.

As shown in Fig. 3, this endless belt 34 passes over pulleys 36, one of which is driven by any suitable means, not shown. In order to hold the short sliver 32 upon the belt 34 so that the belt may advance the same, a series of spaced rollers 37 engage the sliver 32 as it passes toward the coiler 35 upon belt 34. In order to prevent rollers 37 from injuring the sliver or causing it to break because of friction, these rollers are made floating by jour-

nalling them in large openings or slots 38 formed in side frames 39 as is illustrated in Fig. 3. The same operation takes place at the opposite side of the machine, i. e., at small circle 11′ where nip rolls 29′ abstract the short fibres therefrom so that they pass into rotating funnel 33 which twists them with the fibres abstracted from opposite small circle 11 into the sliver 32 which is conveyed to coiler 35 in the manner described. After these short fibres have been abstracted from small comb circles 11 and 11′, the noil, comprising very short fibres, vegetable and other foreign matter and the like, is removed from the teeth by noil knives, not shown, and noil brushes 13 in the usual way. Thus, small comb circles 11 and 11′ are clean and ready for the reception of the long and short fibres in large comb circle 10 and additional fibres advanced thereto by the hump A and placed therein by the dabbing brushes in the manner described.

It will be seen that by this invention the combing machine provides at least two distinct, different and very valuable products where only one product was produced before, and from the same card sliver stock. This is done by a novel method of separating the long from the short fibres after they have been combed, but during a single combing operation. By distinguishing between the long and short fibres the machine of this invention also compensates for and properly classifies the inferior fibres or fibres which may be broken when strained during the carding or preparing processes. Furthermore, because of the nature of wool, the short top sliver produced by the new machine is of finer texture as a whole than the long top sliver produced thereby, thus producing an exceptionally soft and smooth short sliver and an exceptionally strong and smooth long sliver, each of which has a distinct advantage in the textile arts over the ordinary top sliver composed of both long and short fibres.

While the invention and description thereof have been particularly directed to the Noble comb which is in widest use in this country, it is conceivable that the invention might be applied to different types of combs in a similar way, and therefore it is to be understood that the invention is susceptible of such broad applications as the scope thereof warrants.

We claim:

1. In a machine for combing and separating fibrous material according to length, the combination of a pair of adjacent combs, means for placing fibrous material jointly in said combs, mechanism for moving said combs relatively to each other to divide the material between them, this movement producing a fringe of long fibres projecting beyond the short fibres, means for abstracting only the long fibres, and means for abstracting only the short fibres.

2. In a machine for combing and separating fibrous material according to length, the combination of a pair of adjacent combs, means for placing fibrous material jointly in said combs, mechanism for moving said combs relatively to each other to divide the material between them, this movement producing a fringe of substantially only long fibres on one comb, and a fringe of long fibres projecting beyond short fibres on the second comb, means for abstracting the long fibres from both combs, and means for abstracting the short fibres remaining on said second comb.

3. In a machine for combing and separating fibrous material according to length, the combination of a pair of adjacent combs, means for placing fibrous material jointly in said combs, mechanism for moving said combs relatively to each other to divide the material between them, this movement producing a fringe of long fibres projecting beyond the short fibres on one of the combs, means spaced beyond the short fibres for abstracting only the long fibres of said fringe, and means placed behind said first means for abstracting the short fibres forming the remainder of the fringe.

4. In a machine for combing and separating fibrous material according to length, the combination of a comb, means for feeding material thereto, a second comb placed adjacent said first comb so as to receive a portion of the material fed thereto, mechanism for moving said combs relatively to each other whereby the material is divided between the two combs so that the long fibres project further than the short fibres from at least one of said combs, means spaced from said one comb for abstracting only the long fibres therefrom, and means adjacent said one comb for abstracting only the short fibres therefrom.

5. In a machine for combing and separating fibrous material according to length, the combination of a comb, means for feeding material thereto, a second comb moving relatively to said first comb for abstracting a portion of the material therefrom, said second comb having long and short fibres projecting therefrom and leaving substantially only long fibres projecting from said first comb, means adjacent the first and second combs for abstracting only long fibres therefrom, and a second means for abstracting only short fibres from the second comb.

6. In a machine for combing and separating fibrous material according to length, the combination of a comb, mechanism for combing said material into said comb whereby the long fibres projecting beyond the short fibres, means spaced from said comb for ab-

stracting only the long fibres therefrom, and means placed adjacent said comb for abstracting only the short fibres therefrom, and devices for forming said long and short fibres into separate strands of finished sliver.

7. In a machine for combing and separating fibrous material according to length, the combination of two circular combs tangent to each other, means for feeding fibrous material to both combs at the point of tangency, mechanism for rotating said combs in the same direction whereby the material is divided between them, this division producing a fringe of long fibres projecting beyond the short fibres on said other comb, relatively stationary means spaced beyond the short fibres for abstracting the long fibres as said other comb rotates, and relatively stationary means for abstracting the short fibres remaining on said other comb as it rotates.

8. In a machine for combing and separating fibrous material according to length, the combination of two circular combs tangent to each other, means for feeding fibrous material to both combs at the point of tangency, mechanism for rotating said combs in the same direction whereby the material is divided between them, this division producing a fringe of long fibres on said one comb and a fringe of long fibres projecting beyond short fibres on said other comb, relatively stationary means for abstracting said long fibres from said one comb, relatively stationary means spaced beyond the short fibres for abstracting the long fibres from said other comb as it rotates, and relatively stationary means for abstracting the short fibres remaining on said other comb as it rotates.

9. In a machine for combing and separating fibrous material according to length, the combination of a pair of adjacent combs, means for placing fibrous material jointly in said combs, mechanism for moving said combs relatively to each other to divide the material between them, this movement producing a fringe of long fibres projecting beyond the short fibres on one of the combs, means spaced beyond the short fibres for abstracting only the long fibres of said fringe, means placed behind said first means for abstracting the short fibres forming the remainder of the fringe, mechanism for forming the long fibres into a self-supporting strand, and a device for conveying the short fibres, said device including a belt for supporting the fibres.

10. In a machine for combing and separating fibrous material according to length, the combination of a pair of adjacent combs, means for placing fibrous material jointly in said combs, mechanism for moving said combs relatively to each other to divide the material between them, this movement producing a fringe of substantially only long fibres on one comb, and a fringe of long fibres projecting beyond short fibres on the second comb, means for abstracting the long fibres from both combs, means for abstracting the short fibres remainins on said second comb, mechanism for combining the long fibres abstracted by said first means into a self-supporting strand, and a device for conveying the short fibres abstracted by said second means, said device including a belt for supporting the fibres.

11. In a machine for combing and separating fibrous material according to length, the combination of a large circular comb, a small circular comb adjacent the inner periphery of said large comb, means for rotating said combs in the same direction, means for feeding the material to both combs substantially at the point of tangency, said material being divided between the combs as they rotate from said point of tangency whereby a fringe of long fibres projecting beyond short fibres is formed on the small comb, means spaced different distances in said fringe for abstracting fibres of different lengths, and devices for forming the different length fibres abstracted into separate slivers.

12. In a machine for combing and separating fibrous material according to length, the combination of a large circular comb, a small circular comb adjacent the inner periphery of said large comb, means for rotating said combs in the same direction, means for feeding the material to both combs substantially at the point of tangency, said material being divided between the combs as they rotate from said point of tangency whereby a fringe of long fibres projecting beyond short fibres is formed on the small comb, and a fringe of long fibres formed on the large comb, means spaced beyond the short fibres of the small comb fringe for abstracting only long fibres therefrom, means behind said first means for abstracting the short fibres from the small comb, means adjacent the large comb for abstracting the said long fibres therefrom, a device for combining the long fibres abstracted from both combs into one separate sliver, and a device for forming the short fibres abstracted from the small comb into a separate sliver.

13. In a machine for combing fibrous material, the combination of a comb, means for abstracting the fibres therefrom, means for forming said fibres into a continuous sliver, and a conveyor for said sliver, said conveyor including a belt, means for driving said belt, and a series of rollers spaced along said belt, said sliver being adapted to be supported between the belt and rollers.

14. The method of combing and separating fibrous material according to length, which consists in combing said material in one operation into a fringe of long fibres projecting beyond the short fibres, abstracting only

long fibres from the fringe beyond the ends of the short fibres, and then abstracting the remaining short fibres.

15. The method of combing and separating fibrous material according to length, which consists in placing the material between two combs, moving the combs away from each other to divide the material into a fringe of long fibres projecting beyond the short fibres on one of the combs, abstracting only the long fibres from the outer edge of the fringe, and abstracting the short fibres remaining in the fringe.

16. The method of combing and separating fibrous material according to length, which consists in feeding the material through two adjacent combs, moving one of the combs from the other to divide the material into fringes on each comb, the long fibres of the fringe on the moving comb extending beyond the short fibres, the fringe of the other comb comprising substantially only long fibres, abstracting the long fibres from said other comb and from the outer edge of the fringe of the moving comb, combining the long fibres from both combs, and separately abstracting the short fibres remaining on the moving comb.

In testimony whereof we affix our signatures.

WILLIAM BINNS.
FRANK D. NEILL.