METHOD FOR CARDING FIBERS


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ABSTRACT OF THE DISCLOSURE

An improved process for carding textile fibers on a flat top card, wherein, the teeth of the flats have been embedded between the wires fly and waste material, whereby the amount of waste material produced in the carding operation is greatly reduced.

This invention relates to revolving flat cards and more particularly to methods of carding with revolving flats so as to retain the utilizable portion of the staple fiber in the worked material and in the resultant carded fibrous web.

In the usual process of carding with revolving flat cards, waste material is taken off continuously by the flats and the flats continuously stripped by a stripper roll and comb mechanism located above the doffing cylinder and operating just after the flats have broken contact with the main card cylinder. The lead flats after being stripped are returned to the back of the main card cylinder for subsequent carding. It is a well-known fact that the discarded flat strips continuously taken from the flats contain a certain amount of good stock and generally it is the case that in standard carding procedures, there is no known method for separating this good stock from the actual waste, which is in reality all that the carding process should remove from the cotton for the greatest efficiency.

It is the purpose of the present invention to improve the carding action of revolving flat cards, as well as improve the leveling action of the card, i.e., improve the uniform distribution of short and long fibers in a carded fibrous web. Furthermore, it is the purpose of the present invention to greatly reduce the waste material occurring from the carding of fibers.

In accordance with the present invention, the carding of staple textile fibers is improved by feeding the fibers to be carded to a rotatable carding surface having metallic clothing and moving at an increased linear speed over that normally used in carding operations. This peripheral linear speed should be from about 2350 feet per minute to about 4050 feet per minute. While the fibers are on this rotatable carding surface, carding action is imparted to the fibers by revolving flats. The flats are preferably covered with fillet cloth with the wires of the clothing bent to impart carding action to the fibers. The revolving flats have embedded between these wires fly and minute waste particles so that carding action is substantially only imparted to the fibers by the points of the wires. The revolving flats move in the same direction as the rotatable carding surface but at a much slower speed. The carded fibers are then removed from the rotatable carding surface in the form of a uniform loose fibrous web by standard doffing techniques, such as doffing cylinder and doffing comb mechanisms.

If desired, the thus carded web may be further treated by passing it through a pressure-applying means in order to facilitate the removal of any trash or waste particles which have inadvertently been caught in the web. Generally, such pressure-applying means simply comprise a pair of rolls which crushes hard trash particles in the web as the web is passed between these pressure rolls.

The method of the present invention is especially adaptable to tandem or double carding of fibrous materials wherein fibers to be carded are fed to a first or breaker card and then to a second or finisher card and if desired, to further cards and the fibers given a multiple carding action. All of the advantages and improvements of the present invention with respect to a single carding operation are equally true with a tandem carding operation.

In the tandem carding operation the main carding cylinders of the breaker and finisher cards travel at a peripheral linear speed of from about 2350 feet per minute to about 4050 feet per minute. The revolving card flats cooperating with at least one of these surfaces has fillet-clothed flats, the wire of the clothing being bent to impart carding action to the fibers. Embedded between the wires of the flats at least up to the mid-portions of the wires and preferably further are fly and minute waste particles. The flats move in the same direction as the rotatable carding surface (main cylinder) but at a much slower speed to impart carding action to the fibers. Such revolving flats may be used on both the breaker and finisher cards or on just the breaker card or just the finisher card as desired. When used on both the breaker and finisher cards, the amount of waste is greatly reduced, and in most instances it is not necessary to pass the carded fibrous web produced by the double carding operation through a pressure-applying means to crush any loose trash or other waste particles which may inadvertently have been retained by the fibrous web. It appears that the tandem carding technique greatly reduces the possibility of any trash inadvertently getting into the final carded fibrous web.

The method of carding of the present invention whether used with a single or tandem carding operation improves the leveling action of the carding operation. It also gives improved carding due to the pressuring effect of the material which is embedded in the flats causing the fibers being carded to be worked nearer the points of the flat wire allowing the cylinder to do a better job of carding right down to the individual fibers. The method of carding of the present invention also improves the efficiency of carding in that it reduces the amount of waste in the carding operations and provides a method whereby substantially all of the good cotton stock is removed from the actual trash or waste material and very few good textile fibers are discarded.

Although the invention is of particular importance with regard to the carding of cotton fibers and said cotton fibers will be referred to more particularly in the following description of the inventive concept, it is to be appreciated that such is merely illustrative and that substantially any other type of staple fiber may be used. Representative examples of such other types of fibers are rayon, nylon, etc.

Suitable fibers for use with the present invention are cardable textile fibers of a length which may vary from about 3/8 inch up to about 2 1/2 inches or more depending upon the particular properties and characteristics required or desired in the ultimate fibrous product.

The invention will be more fully understood from the description which follows taken in conjunction with the accompanying drawings in which there are illustrated preferred designs of machines and modes of operation embodying the invention. It is to be understood, however, that the invention is not to be considered limited to the constructions or modes of operation disclosed except as determined by the scope of the appended claims.

In the drawings:

FIGURE 1 is a simplified fragmented schematic view in side elevation showing the general principles of the apparatus in operation of one embodiment of the present invention with some minor conventional elements omitted for purposes of clarity;
FIG. 2 is a simplified fragmentary schematic view in side elevation showing a modification of the apparatus illustrated in FIG. 1.

FIG. 3 is a simplified fragmentary schematic view in side elevation showing the general principles of apparatus in operation of an embodiment of the present invention in use with a tandem carding operation, though two cards are shown in this drawing, it is to be appreciated that virtually any number of cards may be placed in tandem.

FIG. 4 is an enlarged plan view of a portion of the flats of the carding machine of FIG. 1; and FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 4.

Like numbers are used to represent like parts in FIGS. 1 and 2.

In the embodiment of the invention illustrated in FIG. 1 of the drawings, a single textile carding machine is used. It comprises a firm, rigid frame 11 upon which are mounted the operating elements of the card. As shown, the fibrous material to be fed to the card machine is a picker lap 12, which is a continuous, considerably compressed sheet of fibrous tufts rolled under pressure into a substantially cylindrical package. Other sources of fibrous materials may be used instead of the picker lap. For example, the fibers may be fed down a chute from a hopper by air means or other devices.

A rotatable lap roll 13 supports the picker lap and slowly unwinds it to feed the fibrous sheet separated from the lap over a flat, smoothly polished feed plate 14 and under a rotatable fluted steel feed roll 15. At the front end of the feed roll the fibers are presented to a cylindrical licker-in 16 mounted on a shaft rotating in bearings mounted in the card frame. The peripheral surface linear speed of the licker-in may be adjusted as desired; however, it is preferred that the licker-in rotate at a somewhat faster speed than normally used in conventional carding operations. For example, the diameter of the licker-in cylinder is generally about 9 inches, and speeds from about 500 r.p.m. to 900 r.p.m. or higher have been found suitable with such licker-ins. Preferably using a 9 inch diameter licker-in, speeds of between 650 r.p.m. and 750 r.p.m. are preferred. The licker-in consists of a hollow roller ring with spiral grooves. Into these grooves a wire with sharp teeth somewhat like a fine jigsaw is inserted. These teeth catch the fibers from the picker lap, carry them around the peripheral surface of the licker-in, and feed them to the main card cylinder 17 mounted on a shaft rotating in bearings provided in the card frame.

Other standard operating portions and elements of the feed works of a card machine such as the mote knives, the licker-in cover, and the licker-in screen are conventional and have been omitted for purposes of clarity. However, fiber retrievers or other special attachments or screens may be used if desired. In a similar way, several conventional elements which cooperate with the main card cylinder, such as the main cylinder screen, etc., have been omitted from the drawings.

The main cylinder itself is covered by metallic card clothing 18. The exact number of points on the main card cylinder differ with the various types of clothing and the width of the cylinders may also differ. It is preferred that fine metallic clothing, i.e., about 500 or more teeth per square inch be used. Generally, the main cylinder has a width of from about 40 to 45 inches and a diameter of about 50 inches. The card clothing on the cylinder takes the fibers off the licker-in and individualizes the fibers due to the great differences in the surface speed between the card cylinder and the licker-in. When using a 50-inch diameter card, we have found that peripheral surface linear speeds of from about 2350 feet per minute to 4050 feet per minute are suitable for the main cylinder. The preferred peripheral linear speeds are from about 2000 feet per minute to 3400 feet per minute with the most advantageous speeds being between about 3070 feet per minute to 3270 feet per minute.

On this main cylinder over a local portion of its periphery is a chain of flats 19. The flats are a little longer on both sides than the cylinder is wide. The parts of the flats that face the cylinder are covered with fillet card clothing 20 or other suitable clothing in which trash and waste can become embedded. The clothing of the flats is generally finer than the clothing on the cylinder, and its teeth are more tightly set. The flats move in the direction shown. The flats generally move at a rate of about 0.1 inch per minute to about 3½ inches per minute and preferably from about 1½ inches per minute to 3 inches per minute. The points of the clothing on the flats almost touch the main cylinder; exact distance varies but it is usually about 0.010 inch. There are usually over a hundred flats on a card, but less than half of them are working with the cylinder at one time, as shown by the drawing.

The flats while carding tend to load up with waste and fly and are generally continuously stripped so that clean flats are always doing the carding operation. Hence the flats move very slowly in the direction shown and usually are continually stripped by a comb and brush operation. However, in accordance with the present invention, when the main cylinder speed is increased, the comb and brush operation is removed and the flats are allowed to load up with waste and fly material so that the wires are embedded in this waste material.

This is more clearly shown in the enlarged views, FIG. 4 and FIG. 5 wherein the flats 20 are shown in plan view and cross-sectional view respectively. Flats fillet-clothed 23 comprises numerous bent wires 24 embedded in a cloth foundation 26. Approximately midway between the point 25 of the wire and the foundation 26 the wire is bent, forming a knee 27. To impart carding action to fibers the wire is bent in the direction shown as shown in FIG. 1, FIG. 2, and FIG. 3 as compared to the direction of the metallic wire on the main cylinder. The wires on the flats are embedded in fly and waste 28 preferably to about the bend in the wire or knee portion or more. It appears that embedding the wires with fly and minute waste particles causes the fibers being carded to be worked nearer to the points of the flats, allowing the cylinder to do a better job of carding right down to the individual fibers. It may also be that some additional carding points are provided by the waste fiber embedded in the flats. By allowing this waste material to build up in the flats, all of the utilizable fibers are carried along by the main cylinder and form part of the final fibrous web generally being formed between the card in limiting this waste to what is really waste material rather than good fiber.

Directly in front of the main cylinder is the doffing cylinder 30. Construction of the doffing cylinder resembles the main cylinder of the card. The doffing cylinder, however, is much smaller, the diameter generally being about 27 inches. The doffing cylinder like the main cylinder is covered with metallic card clothing 31. The teeth in the doffing cylinder clothing are coarser and fewer teeth per square inch as compared to that of the main cylinder. Generally doffing cylinders having about 375 teeth per square inch have been found suitable for use in accordance with the present invention. The speed of the doffing cylinder may vary from about 5 r.p.m. to 100 r.p.m., and preferably from about 10 r.p.m. to about 40 r.p.m. The fibers leave the main cylinder and settle on the doffing cylinder clothing and form a fibrous web on the doffing cylinder. The fibrous web is removed from the doffing cylinder by a doffer comb 32 which resembles a fine saw.

The comb has a slight oscillating or chopping motion; it vibrates very fast at about 2000 strokes per minute on a very short motion. This movement removes the fibrous web from the doffing cylinder and also knocks or shakes out some non-fibrous material. A doffer comb is shown...
in the drawings; however, roller type doffing mechanisms or other doffing mechanisms may also be used. 

The card web removed by the comb is rolled away by a pair of calender rolls 35. Prior to passing through these rolls, the web W passes through a trumpet 34 and is condensed. From the calender rolls the sliver passes up and into the caller bonnet 36 and finally into the sliver or roving can 37.

Generally, the calender rolls exert a low degree of draft on the sliver of about 1% to 5% to insure better control of the sliver. 

As shown in FIG. 2, if desired after the fibrous web W has been formed as described with regard to FIG. 1, if trash particles and waste particles remain in the web, the web may be passed through the trash crushing device 40. Generally, such a device comprises a pair of rolls 41 which exert considerable pressure on the web and crush the trash and waste particles in the web causing them to drop from the web into a collecting means 42 or be extracted in some subsequent operation. If desired, these pressure rolls may be disposed at slight angles to one another so that even greater pressures may be applied to the web to improve the crushing or trash removing action. 

In a tandem carding operation as shown in FIG. 3, the picker lap 50 is fed in the form of a fibrous sheet over a polished feed plate 51 and under a fluted feed roll 52 on to a picker-in 53 as previously described. The main cylinder 54 of the first or breaker card 55 takes the fibers from the picker-in and cards them as described in conjunction with FIG. 1 and FIG. 2. The fibrous web is removed by a doffing cylinder 56 and the fibrous web taken from the doffing cylinder by a doffing comb 57 or other suitable mechanism. The fibrous web thus produced is fed to a second or finisher card 60 by passing the fibrous web over a feed plate 61 to a fluted feed roll 62 onto a second picker-in 63 and then to a second carding operation as previously described in conjunction with FIG. 1 and FIG. 2. If desired, the web may be passed through a third or more carding operations. The fibrous web is removed from the doffing cylinder 64 by a doffing comb 65 or other suitable means and triangularly converging to form a sliver which is slightly drafted, i.e., tension draft, by a pair of calender rolls 66 and placed in the sliver can 67.

When a tandem carding operation is used, it is preferred that the picker-in cylinders rotate at a speed of from about 500 to 900 r.p.m. when using a 9 inch cylinder and preferably from about 650 to 750 r.p.m. with such a cylinder.

It is also preferred in the tandem carding operation that the main cylinders have increased peripheral linear speeds of from about 2350 feet per minute to about 4050 feet per minute and preferably from about 2600 feet per minute to about 3400 feet per minute with the most advantageous speeds being about 3070 feet per minute and 3270 feet per minute. The revolving flats 70 have fillet card clothing 71 and card the fibers of the main cylinder by having fly and waste material embedded in these flats up to the knees of the wires and preferably further as described in conjunction with FIG. 4 and FIG. 5. However, if desired, the flats on one or more card cylinders may be operated conventionally, i.e., by stripping the fibers from these flats continually by using a comb and brush mechanism as is known in the art. However, one of the carding operations must be accomplished with fly and waste particles embedded in the wires in order to obtain the advantages of the present invention. 

If desired the trash crushing roll may also be incorporated in a tandem carding operation either after the first doff and comb operation or any subsequent doff and comb operation or any combination of places depending upon the fibers being processed and the type of yarn desired to be produced from the operation. 

The invention will be further illustrated in greater detail by the following examples. It should be understood, however, that although these examples may describe in particular detail some of the more specific features of the inventive concept, they are given primarily for purposes of illustration, and the invention in its broader aspects is not to be construed as limited thereto.

**Example I**

The apparatus used in this example is illustrated in FIG. 1. The picker lap weighs about 16 ounces per linear yard and is delivered by the feed roll to the licker-in at a speed of about 6 inches per minute. The licker-in is 9 inches in diameter and is rotating at about 690 r.p.m. The main cylinder is 50 inches in diameter and is rotating at 240 r.p.m. The revolving flats are fillet clothed and move in the direction shown at a speed of about 2.6 inches per minute imparting the carding action to the fibers on the main cylinder. No comb or brush mechanism is used and fibers and waste material are removed in the wires of the flats. The carded fibers are transferred to the doffing cylinder which is 27 inches in diameter and is rotating at about 8 r.p.m. The fibrous web is removed from the doffing cylinder by a standard doffing comb and the weight of this fibrous web is about 47 grains per square yard. The web is drawn together in a typical triangularly converging form through a conventional condensing trumpet to a pair of calender rolls to form a substantially cylindrical sliver. The calender rolls have a peripheral surface linear speed of about 62 feet per minute and the sliver produced therefore has a weight of about 52 grains per linear yard. This is equivalent to a weight production of about 10 pounds per hour. The sliver is then drawn upwardly through the top cover of the conventional caller and is deposited in the usual coiling fashion in a caller can.

The spinning of this sliver to produce a 20s yarn produces a yarn of substantially equal quality and uniformity to standard 20s yarns. Ends down in spinning are substantially the same as normally encountered with such yarns using silver produced by standard carding operations. Irregularities in the yarn and in the cloth made from the yarn are no more noticeable with standard yarns. There are no flat strips produced from this card, and the amount of waste produced from this card operation is approximately 50% less than is normally produced in carding operations. The productivity of the card is increased approximately 2%.

**Example II**

The apparatus used in this example is illustrated in FIG. 3 of the drawings. The picker-lap weighs about 16 ounces per linear yard and is fed at about 13.2 inches per minute to the fluted feed roll and to a 9 inch diameter licker-in rotary at about 675 r.p.m. The main cylinder of the first or breaker card is 50 inches in diameter and rotates at about 240 r.p.m. The main cylinder removes the fibers from the licker-in and as the cylinder passes the carding flats the fibers are carded. No comb or brush mechanism to strip fibers from the flats is used. The flats are fillet card clothing and have the minute waste particles embedded between the wires of the flats giving the carding action to the fibers on the main cylinder. The flats move in the direction shown at a speed of about 2.6 inches per minute. The fibers are transferred to the doffing cylinder and the doffing comb removes the fibers from the first doffing cylinder. The doffing cylinder is 27 inches in diameter and is rotating at about 13 r.p.m. The web removed is 40 inches wide and weighs about 60 grains per linear yard. The web is fed to a second feed roll and on to a second licker-in having a 9 inch diameter and rotating at about 675 r.p.m. The main cylinder of the second or finisher card is 50 inches in diameter and is rotating at 240 r.p.m. The revolving flats move at about 2.6 inches per minute and have fillet card clothing and fine minute waste particles embedded between the points.
of the clothing to improve carding action. No comb or brush mechanism is used to strip fibers from these flats. Fibers are transferred to the second doffing cylinder which is 27 inches in diameter and is rotating at 15 r.p.m. The fibers are removed from this second doffing cylinder in the form of a fibrous web weighing about 47 grams per square yard by means of a doffing comb. The fibrous web is then drawn together in typical triangular converging form through a conventional condensing trumpet and a pair of calibrator rolls to form a substantially cylindrical sliver. The calibrator rolls have a peripheral surface linear velocity of about 148 feet per minute, and the sliver processed therethrough has a weight of about 52.2 grams per linear yard. This is equivalent to a weight production rate of about 22 pounds per hour. The fibers are then drawn upwardly through the top cover of a conventional coiler and is deposited in the usual coiling fashion in a coiler can. The spinning of this fiber produces yarn of good quality and uniformity with excellent breaking strength. Ends down in spinning are substantially fewer than normally encountered with standard single carding, and about the same as encountered with tandem carding. Trash particles in the yarn are not significantly different than with standard carding particles. Furthermore, no flat strips are formed in this carding operation thus reducing the total waste from the carding operation 50% and improving production of the double carding operation 2 to 3%.

Although several specific examples of the inventive concept have been described, the same should not be construed as limited thereby nor to the specific features mentioned therein but to include various other equivalent features as set forth in the appended claims. It is understood that any suitable changes, modifications and variations may be made without departing from the spirit and the scope of the invention.

It is to be appreciated that the advantages obtained with the present invention will vary and will depend to a large extent on the grade of fiber being processed, production rate and the coarseness or size of the yarn to be produced. The single carding operation appears to have greater advantages when producing coarser yarns, i.e., 20's yarn and the tandem operation appears to have greater advantages in producing finer yarns, i.e., 50's yarn or finer.

Although no motors, pulleys, belts, gears or like mechanical means have been illustrated in the drawings or described in the specification for driving the various rotating cylinders and rollers in the desired or required speeds or with the rotation indicated by their direct arrows, it is to be appreciated that such elements have been omitted to keep the description short and to avoid the introduction of matter for which there are well-known expedients in the art. The mechanical driving means which are used are conventional and merely involve the application of well-known mechanical driving principles.

What is claimed is:

1. An improved process of carding textile fibers comprising: feeding the fibers to be carded to a rotatable metallic clothed carding surface moving at a linear speed of from about 2350 feet per minute to 4050 feet per minute, imparting carding action to the fibers on said rotatable metallic clothed carding surface by flats covered with felt card clothing whereby flat strips are produced in said flats, the wires of said clothing being bent to impart said carding action to the fibers while on said rotatable carding surface, said flats moving in the same direction as said rotatable carding surface and at a linear speed of from about 1.5 inches per minute to 3 inches per minute, embedding said flat strips between the wires of each flat, at least from the base up to the mid-portion thereof, said flat strips being so embedded throughout the entire process and removing the thus carded fibers in a uniform, loose web from said rotatable carding surface.

2. An improved process of carding textile fibers comprising: feeding the fibers to be carded to a rotatable metallic-clothed carding surface moving at a linear speed of from about 2350 feet per minute to 4050 feet per minute, imparting carding action to the fibers on said rotatable metallic clothed carding surface by flats covered with felt card clothing whereby flat strips are produced in said flats, the wires of said clothing being bent to impart said carding action to the fibers while on said rotatable carding surface, said flats moving in the same direction as said rotatable carding surface and at a linear speed of from about 1.5 inches per minute to 3 inches per minute, embedding said flat strips between the wires of each flat, at least from the base up to the mid-portion thereof, said flat strips being so embedded throughout the entire process, said flats moving in the same direction as said rotatable carding surface and at a linear speed of from about 1.5 inches per minute to 3 inches per minute, and doffing
said carded fibers from said second rotatable carding surface.

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DORSEY NEWTON, Primary Examiner.