Aug. 9, 1949. S. WILKINSON 2,478,799

CARDING METHOD AND MACHINE

Filed Nov. 22, 1944 2 Sheets-Sheet 1

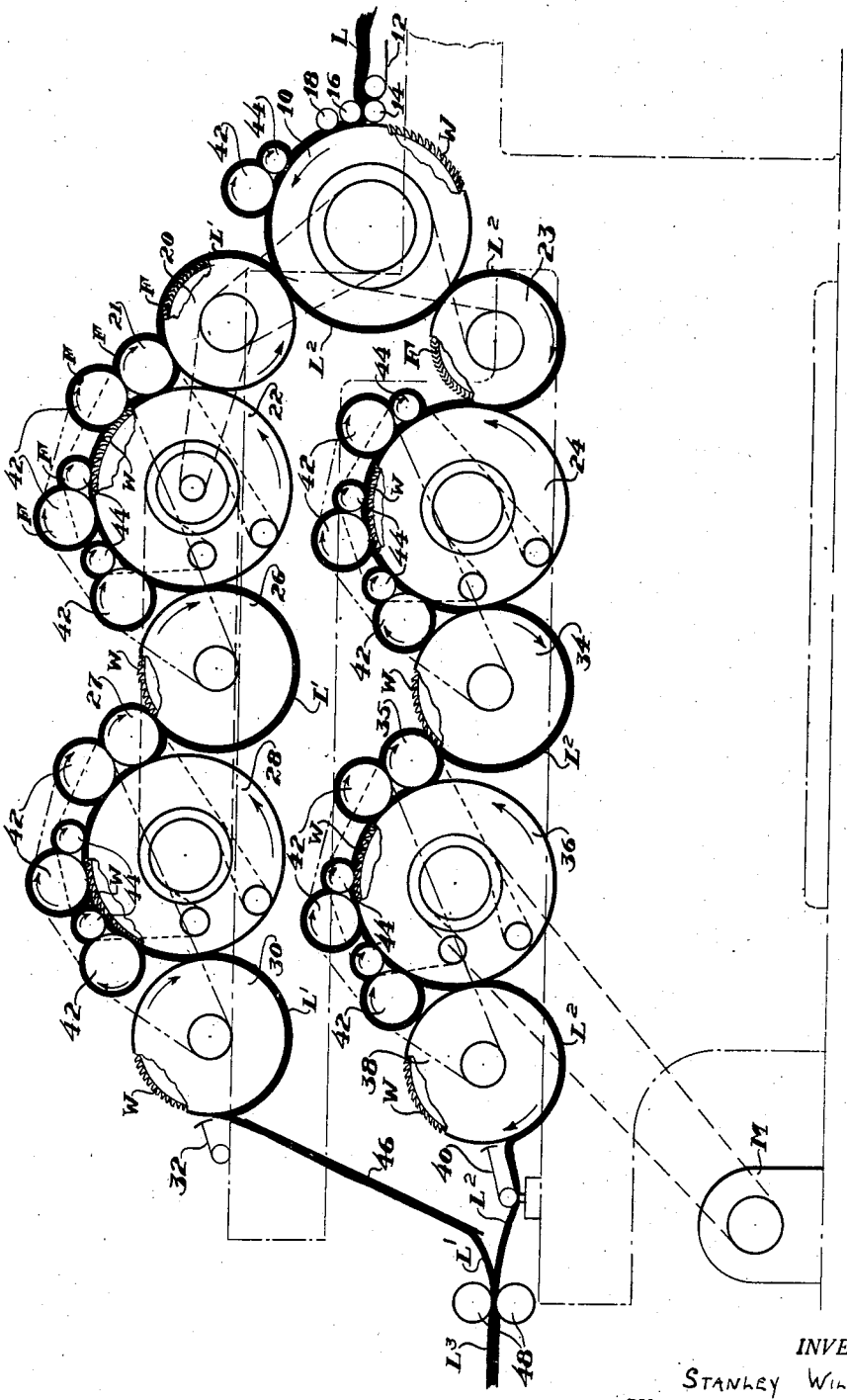


Fig. 1

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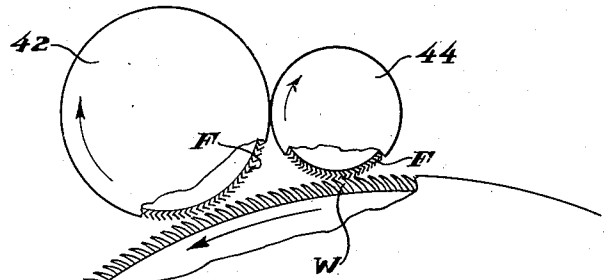


Fig. 1a

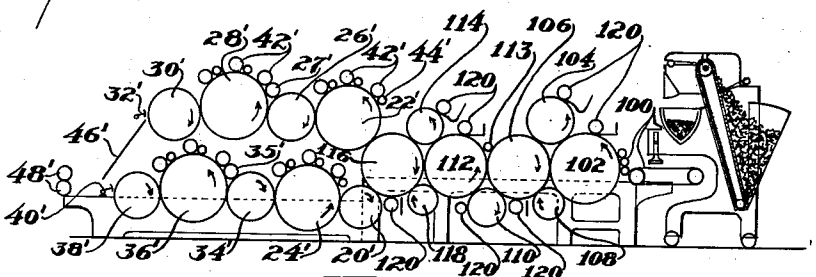


Fig. 2

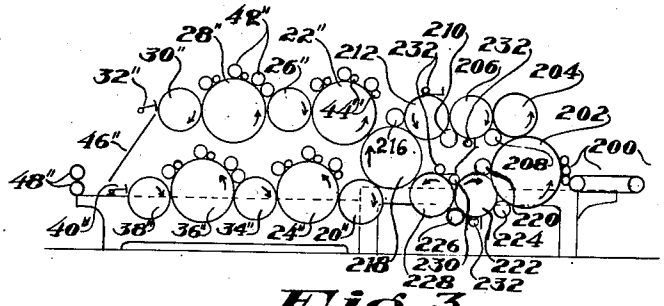


Fig. 3

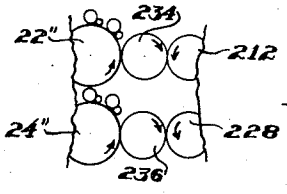


Fig. 3-a

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2,478,799

UNITED STATES PATENT OFFICE

2,478,799

CARDING METHOD AND MACHINE

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Application November 22, 1944, Serial No. 564,595

12 Claims. (Cl. 19—100)

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This invention relates to machines and methods for carding textile fibres, particularly wool.

Heretofore, the most efficient method of carding textile fibres that has been developed, and which has been the standard method in use for many years, is by a machine having a set of successively arranged rotary "carding cylinders" of large diameter surfaced with fine teeth, over which cylinders the stream or layer of wool or other fibre successively passes and upon which the heterogeneously arranged fibres of the uncarded layer are combed or "worked" into a generally parallel condition lengthwise of the layer. The usual carding machine of this character has two such carding cylinders, four to five feet in diameter, together with feed rolls, worker rolls, doffers, etc.

Satisfactory carding can be obtained with these machines only so long as the cylinder speed and depth of the fibre layer processed are kept below certain definite maximum limits, and the quality of the carding action tends to decrease as these limits are closely approached. These limits in turn determine the maximum possible production output per machine, as output is a function of the cylinder speed and thickness of the fibre layer. These limiting factors, determining maximum productive capacity of these prior machines, vary somewhat according to the type and condition of fibre being carded, the quality of carding needed, and the make of carding machine employed, but taking wool as an example, about the maximum carding speed of the best available two cylinder machine on the more easily carded fine wools is, for minimum acceptable carding, within the vicinity of 45 pounds per hour carded fibre output, and this varies down to the vicinity of 30 pounds per hour for high grade carding and wools that are more difficult to card.

The limited productive capacity obtainable with these prior carding machines is exceedingly low when their large size and high cost are considered. Upwards of ten such carding machines are required to handle the output of the average wool combing plant of seven Noble combs. They not only take up a vast amount of floor space, but they aleo require much labor, as it is ordinarily necessary to have one operator for each two carding machines. In addition, their productive capacity is likely to be considerably lower than that of machines which feed them, such as wool burring machines to which worsted cards are frequently attached, which therefore have

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to be run at a lower production rate than would otherwise be warranted.

For these reasons, strenuous efforts have been made to provide a speedier method and machine for carding, but, heretofore, without success. Many attempts have also been made to increase the productive capacity of the standard method and machine by increasing the number of successive carding cylinders, with corresponding worker rolls, over and between which the fibre layer passes, and thus multiplying the number of successive carding actions on the layer. But while a slight increase in productive capacity has been obtained in this way, it is so small that in most cases it does not justify the added machine expense and increased floor space required over the usual two carding cylinder machine.

I have discovered that by splitting the fibre layer into two, preferably approximately equal, parts, each of lesser thickness than the initial layer, and completely carding each of the two layer parts separately by successive working carding steps like those heretofore applied to the layer in its entirety, a much better grade of carding is obtained at the same productive rate than by the prior method, and therefore that the same quality of carding can be obtained at a much greater rate of production. In fact, by thus splitting a layer of wool fibre to be carded into close to equal parts and subjecting each part separately to separate carding steps, substantially like those performed on the layer as a whole in the prior method previously described, I have been able to card wool to the same or superior extent or grade at from one and a half to twice and even more times the production rate possible in the prior method.

I have further found that this method makes possible, and indeed, preferable, substantial reduction in diameter of the carding cylinders, a diameter of twenty to thirty inches being suitable, which is about half the diameter of carding cylinders usually employed heretofore. In the carding machine of the invention, such small diameter carding cylinders are preferably employed, arranged in upper and lower sets on a frame, there being usually the same number of carding cylinders in each set, normally two, as would be employed for carding the fibre in a single layer in the prior practice and machine. By reason of such reduced size of cylinders and other parts, I am enabled by the invention to provide a carding machine of substantially double the capacity of the prior standard machine, which takes less floor space than the prior machine, and which

can be produced and operated at little, if any, additional cost and with no more tending labor needed. The large increase in productive capacity possible with the new method and machine of the invention therefore results in substantially correspondingly large savings in floor space, labor, and power cost, which are in turn reflected in reduced cost of the carding operation.

Working of the two parts of the split layer of fibre during the carding operation is accomplished by combing a portion of the fibre from the carding cylinder, as by means of a "worker" roll and returning it to the cylinder and to the fibre stream thereon in advance of the take-off point by means of a stripper roll. Such working action takes place at least at two points and preferably at three or more points on each carding cylinder.

The foregoing and other features and advantages of the process of the invention will be more fully understood from the ensuing description of the appended drawings, wherein:

Fig. 1 is a diagrammatic side elevation of a preferred embodiment of the carding machine of the invention, with framework indicated in dot and dash lines and suitable drive connections for the various cylinders and rollers indicated in dotted lines, the toothed surfacing of the carding and other cylinders being partially indicated, on an exaggerated scale;

Fig. 1*a* is a diagrammatic illustration on a larger scale of a set of worker and stripper rolls and a portion of a carding cylinder of Fig. 1, indicating the arrangement of surfacing teeth on an exaggerated scale;

Fig. 2 is a diagrammatic side elevation of carding apparatus of the invention combined with wool burring and opening mechanism;

Fig. 3 is a diagrammatic side elevation of carding apparatus of the invention combined with a different type of burring and opening mechanism; and

Fig. 3*a* is a diagrammatic side elevation of a modified portion of the apparatus of Fig. 3.

Referring to Figs. 1 and 1*a* of the drawing, the wool or other fibre is fed as a layer L onto a feeding in cylinder **10**, called a "taker-in" or "lickerin," by suitable feed mechanism which includes the conveyer belt **12**, feed rolls **14**, **16**, and tightener roll **18**. Layer L is carried by cylinder **10** to a rotary splitter **20** which removes the upper half of the layer L on cylinder **10**, indicated by L^1, and transfers it, by means of angle stripper **21**, to a first upper carding cylinder **22**. The other half of the layer L remaining on the cylinder **10**, indicated by L^2, is carried by that cylinder to a transfer roll **23** by which it is stripped from cylinder **10** and transferred to a first lower carding cylinder **24**.

The upper half of the fibre layer, L^1, is carried upon the surface of the carding cylinder **22** about a half-revolution to a doffer **26** which strips it from the cylinder. The fibre is stripped from doffer **26** by an angle stripper roll **27** which transfers it to the second carding cylinder **28** of the upper set on which the fibre is carried to a second doffer **30**, from which it is removed by doffer combs **32**. In like manner, the lower half of the fibre layer, L^2, is advanced by carding cylinder **24**, doffer **34**, angle stripper **35** and carding cylinder **36** to doffer **38** from which it is removed by doffing combs **40**.

Each of the carding cylinders **22**, **24**, **28** and **36** has associated therewith a set of worker rolls, designated **42**, there being three such rolls for each carding cylinder in the apparatus as illustrated. These worker rolls are arranged at spaced intervals about the cylinder axis to engage and pick up part of the fibre from the cylinder surface and each is preceded by a stripper roll which strips the fibre from its worker roll and returns it to the surface of the cylinder in advance of the worker roll, thus effectively working and combing the fibre in its passage over the carding cylinders. The strippers for the first worker roll of each upper carding cylinder and of the second lower carding cylinder are the angle strippers **21**, **27** and **35**, respectively. The strippers for the remaining worker rolls, of somewhat smaller diameter than the angle strippers, are designated **44**. A worker roller **42** and stripper **44** are also associated with the lickerin cylinder **10**.

The carded fibre stream L^1, removed from the doffer **30** by combs **32**, is guided downwardly in an inclined chute **46** where it is recombined with the carded fibre stream L^2, combed from doffer **38** by combs **40**, into a single layer L^3 of now completely carded fibre, which passes between draw-off rollers **48**.

A frame in which the parts are mounted is indicated in dot-dash lines in Fig. 1. To facilitate cleaning, the frame may be divided into two successive separable sections, suitably between the first doffers and second carding cylinders of the two sets of carding mechanisms.

The direction of rotation of the cylinders and rolls is shown by arrows in Figs. 1 and 1*a*. Suitable toothed surfacing or "clothing" for the cylinders and rollers is indicated thereon in Figs. 1 and 1*a*, in partial exaggerated section. The carding and lickerin cylinders, and the doffers, have, as shown, what is called "metallic wire" clothing, designated W, formed of saw-toothed flat wire wound edgewise in closely spaced spiral turns about the surface of the cylinders. The teeth are inclined, in the case of the carding cylinders and lickerin cylinder in the direction of rotation and, in the case of the doffers, in the direction opposite to the direction of rotation. The splitter, transfer roll, worker rolls and strippers are shown as clothed with what is known as "fillet," designated by the letter F in Figs. 1 and 1*a*, consisting of fine, closely spaced bent wires anchored in a fibrous base and projecting therefrom as finely spaced teeth forming a wire comb. The inclined outer ends of the fillet teeth of the splitter, transfer roll and stripper rolls point in the direction of their rotation (the direction of the fillet teeth of the angle strippers is the same as that of the strippers **44** as indicated in Fig. 1*a*), whereas the fillet teeth of the worker rolls point opposite to the direction of rotation.

Both the metallic wire and fillet types of clothing are well known and commercially available. Either type can be used throughout if desired, although I prefer the use of both types as shown.

Suitable drive connections from a motor M to the various cylinders and rolls are indicated by dash lines in Fig. 1, except for the drive to the doffers which may be by reduction gearing connection to the carding cylinders. The arrangement is such that the carding cylinders are all driven at a uniform surface speed and the other cylinders and rolls at correlated lower surface speeds. Th worker rolls are driven at the lowest surface speed which may, for example, be about 1% of the surface speed of the carding cylinders and one-third to one-half that of the doffers and transfer roll. The strippers and angle strippers

are usually operated at one-quarter to one-third, the lickerin at about 4 to 10%, of the surface speed of the carding cylinders.

For best results, the splitter should be operated to divide the layer into equal, or close to equal, parts. The splitter roll performs its function by means of the point to point relation of its teeth to those of the lickerin cylinder and a lower surface speed of rotation than that of the lickerin. The proper surface speed ratio of splitter to lickerin to obtain an even split of the fibre being carded. For carding fine wool that is fully opened, I have found that the splitter should be operated at from one-fifth to one-quarter of the surface speed of the lickerin.

The carding cylinders are preferably from 20 to 30 inches in diameter, and the ratio of the diameters of the other cylinders and rolls thereto may be of the order of that indicated in Fig. 1.

In Fig. 2 of the drawings, carding apparatus of the invention is shown combined with opening and burring mechanism of what is known as the "four lickerin" type. In this figure, parts of the carding apparatus corresponding to those of Fig. 1 are represented by primes of the same reference numerals. The unit shown comprises feeder mechanism indicated at **100** by which the wool is fed to a first lickerin roll **102**. Part of the wool on the first lickerin is removed by a divider **104** which transfers it to a second lickerin **106**. The remainder of the fibre on the first lickerin is stripped by the second lickerin and the fibre is carried, past a tightener roll **108** to a divider **110** which removes part of the fibre and transfers it to a third lickerin, which is a so-called "Morel" cylinder **112**. The rest of the fibre on lickerin **106** is stripped by the Morel cylinder and the fibre is carried past a brush **113** to a divider **114** which removes part of the fibre and transfers it to a lickerin **116**. The rest of the fibre on the Morel cylinder is stripped by lickerin **116** and the fibre is tightened thereon by a tightener roll **118**. In passing over the cylinders and dividers, the wool is engaged by rotary beaters or "burr knockers" **120** which remove the burrs and other foreign matter. The direction of rotation of the cylinders and rolls is shown by arrows.

The last lickerin **116** of the burr removal mechanism takes the place of lickerin **10** of the carding apparatus as arranged in Fig. 1. Since lickerin **116** is rotating oppositely to lickerin **10** of Fig. 1, the splitter, **20'**, is here located between the lickerin and the first lower carding cylinder **24'** and transfers the upper half of the fibre layer, shown at L' in Fig. 1, to the carding cylinder **24'**. Also, in this case, the remaining half of the fibre layer on the lickerin **116** may, as shown, be stripped directly therefrom by the first upper carding cylinder **22'**. Thus, no transfer roll corresponding to the roll **23** of Fig. 1 is needed. In this case, the splitter transfers directly to the carding cylinder **24'** and, therefore, the angle stripper shown at **21** in Fig. 1 is omitted, being replaced by an ordinary stripper **44'**. With the exceptions noted, the form and operation of the carding apparatus of Fig. 2 is the same as that of Fig. 1 and will, therefore be understood without repeated description.

Fig. 3 shows the carding apparatus combined with another type of opening and burring mechanism for worsted burring and carding. In this figure, the parts of the carding apparatus corresponding to those of Fig. 1 are designated by double primes of the same reference numerals. In this unit, the wool fibre is fed by a feeder device **200** to a lickerin **202**. A divider **204** removes part of the fibre from the lickerin and the fibre is in turn stripped from the divider by a first upper Morel roll **206**. The fibre on roll **206** is carried past a tightener **208** to a divider **210** which transfers part of it to a second upper Morel roll **212** which strips the remainder of the fibre directly from roll **206**. Roll **212** transfers the fibre to lickerin **218**, partly by means of divider **216** and the rest directly.

The part of the fibre layer on lickerin **202** passing divider **204** is transferred, by a brush roll **220**, to a first lower Morel roll **222** which carries it past a tightener **224** to a divider **226** by which a part is transferred to the second lower Morel roll **228**. The rest of the fibre on roll **222** is stripped directly onto roll **228** which carries the fibre past a brush **230** to lickerin **218** which strips the fibre onto the fibre it has previously received from the second upper Morel roll **212**.

In passing over the Morel rolls, the fibre is substantially freed of burrs, shives, etc., by burr knockers **232**.

Lickerin **218** corresponds to lickerin **116** of Fig. 2, taking the place of the lickerin **10** of the carding apparatus of Fig. 1. The carding apparatus is the same as in Fig. 2, the upper half of the fibre layer being transferred to the first lower carding cylinder **24''** by splitter **20''** and the other half being stripped from the lickerin by the first upper carding cylinder. The operation is the same as in the embodiments of Figs. 1 and 2.

When the carding operation is preceded by an operation, such as the opening and burring operation of the apparatus of Fig. 3, in which the fibre layer is divided into two parts which are separately treated, it is not essential to recombine the parts of the fibre layer preliminary to carding, as is done in the apparatus of Fig. 3. For example, in the apparatus of Fig. 3, lickerin **218** and splitter **20''** may be omitted and the two halves of the fibre layer may then be passed by transfer rolls to the first upper and lower carding cylinders, respectively, from the second upper and lower Morel rolls, as in Fig. 3*a*, in which lickerin **218** and splitter **20''** of Fig. 3 have been replaced by upper and lower transfer rolls **234** and **236**, respectively, which transfer the two fibre streams directly from the second upper and lower Morel rolls **212** and **228** to the first upper and lower carding cylinders **22''** and **24''**. I prefer, however, the arrangement of Fig. 3, since it is more difficult to make a uniform split of unopened wool and, furthermore, the initial split may become unbalanced due to removal of more burrs and other foreign matter from one half of the fibre layer than from the other.

The great improvement in carding which the method and apparatus of the invention produce is illustrated by the following comparative results in wool carding of various common types of wool with the split layer method practiced with carding apparatus as shown in Fig. 3 (four carding cylinders, two upper and two lower) combined with opening and burring mechanism, as also shown in Fig. 3, and with the prior, single layer method practiced with two carding cylinder carding machines of standard make, combined with the same opening and burring mechanism. The wool in both cases was made into tops and tested for quality of carding by the standard nib-count test. (Nibs are snarls of short, uncombed fibre and the quality of the carding varies inversely with the number of nibs. The nib count is the number of nibs per four drams, one-fourth

ounce, of tops.) Results are set forth in the following table:

Type of Wool Carded	Split Layer Method		Single Layer Method		Maximum Nib Count for Good Quality Fine Wool Tops
	Production per hour	Average nib count	Production per hour	Average nib count	
	Pounds		*Pounds*		
#64s Domestic	50	42	45	130	About 120
Do	75	82			About 120
#62s Australian	90	54	45	95	About 75–80
#64s Australian	70	62	45	125	About 80–100
#70s Australian	75	75	40	145	About 120

In the carding apparatus according to the invention used for practicing the split layer method with the results reported in the foregoing table, the fibre treating cylinders and rollers were of regular length and of the following diameters: carding cylinders, 26''; doffers, 20''; workers, 5.5''; strippers, 4''; splitter, 16''; angle strippers, 5.5''. They were operated at the relative surface speeds previously mentioned as illustrative of suitable speed ratios for wool carding. The apparatus required about one-fourth less floor space than the comparative two cylinder, single layer machines. Also, the surface speed of the splitter relative to that of the lickerin was such that the wool layer on the lickerin was divided by the splitter into two streams of close to equal weight and thickness, and the two sets of carding mechanisms were of like construction and operation so as to produce the same carding action on equal fibre streams. This is preferable, since the carding efficiency of the method and apparatus is normally less if the two fibre streams formed by the splitter are of materially different weight and thickness, or if the two sets of carding mechanisms operate to produce distinctly different grades of carding on the two streams.

While it is ordinarily desirable to recombine the two carded halves of the fibre layer at the completion of the carding operations thereon, this is not essential. Each set of carding mechanism normally and preferably has two carding cylinders with corresponding workers, strippers, etc., as in the embodiments illustrated, but only one, or more than two, such cylinders may be employed in each set.

Having described preferred forms of the apparatus and method of the invention, what I desire to claim and secure by Letters Patent is:

1. Carding apparatus comprising feed means for feeding a unitary layer of fibres to be carded, two sets of carding mechanisms disposed one above the other, each set including a rotary carding cylinder adapted to carry upon its surface, above and partially about its axis, a stream of fibres to be carded, and a plurality of fibre working means associated with said cylinder and located above the same, each including a worker roll operative to comb a portion of the fibre stream from the cylinder and means for stripping the fibre from the worker roll and for returning it to the cylinder at the side of the worker roll toward which the cylinder rotates, splitter means located between said feeding means and said cylinders for separating said unitary layer of fibres into two fibre streams each of substantially uniform lesser thickness than said layer and for transferring one of said fibre streams onto one of said cylinders and the other of said fibre streams onto the other one of said cylinders, and means for simultaneously operating said two sets of carding mechanisms to separately card said two fibre streams.

2. Carding apparatus as claimed in claim 1 which includes means for doffing said fibre streams from said carding cylinders and for recombining said doffed fibre streams.

3. Carding apparatus as claimed in claim 1 wherein said splitter means separates the fibre layer into two fibre streams each of aproximately half the thickness and fibre content of the initial layer.

4. Carding apparatus as claimed in claim 1 wherein said feed means includes a toothed surfaced rotary drum for advancing the fibre layer on its said surface and said splitter means comprises a toothed surfaced rotary roll associated with said drum and rotated about an axis parallel to the drum axis in the same direction of rotation as the drum, said roll and said drum both having the teeth of their toothed surfaces pointing in the direction of rotation thereof.

5. Carding apparatus as claimed in claim 1 wherein said carding cylinders have a diameter substantially less than four feet.

6. Carding apparatus comprising feed means for feeding a unitary layer of fibres to be carded, two sets of carding mechanisms disposed one above the other, each set including a first and a second rotary carding cylinder each adapted to carry upon its surface, above and partially about its axis, a stream of fibres to be carded, a plurality of fibre working means associated with each said carding cylinder and located above the same, each including a worker roll operative to comb a portion of the fibre stream from the cylinder and means for stripping the fibre from the worker roll and for returning it to the cylinder at the side of the worker roll toward which the cylinder rotates, and means for doffing the fibre stream from said first carding cylinder and transferring it to said second carding cylinder, splitter means located between said feeding means and said carding cylinders for splitting said unitary layer of fibres into two fibre streams each of substantially uniform lesser thickness than said layer and for transferring one of said fibre streams onto one of said first carding cylinders and the other of said fibre streams onto the other one of said first carding cylinders, and means for simultaneously operating said two sets of carding mechanisms to separately card said two fibre streams.

7. Carding apparatus as claimed in claim 6 which includes means for doffing said fibre streams from said second carding cylinders and for recombining said doffed fibre streams.

8. Carding apparatus as claimed in claim 6 wherein said splitter means separates the fibre layer into two fibre streams each of approximately half the thickness and fibre content of the initial layer.

9. Carding apparatus as claimed in claim 6

wherein said feed means includes a toothed surfaced rotary drum for advancing the fibre layer on its said surface and said splitter means comprises a toothed surfaced rotary roll associated with said drum and rotated about an axis parallel to the drum axis in the same direction of rotation as the drum, said roll and said drum both having the teeth of their toothed surfaces pointing in the direction of rotation thereof.

10. Carding apparatus as claimed in claim 6 wherein said carding cylinders have a diameter substantially less than four feet.

11. The combination with fibre opening mechanism which includes means for feeding a unitary layer of the fibres, means for splitting the layer into two fibre streams each of lesser thickness than said layer and means for advancing said streams in vertically superimposed paths while treating each stream separately to open the fibre thereof, of two sets of carding mechanisms disposed one above the other, each set including a rotary carding cylinder adapted to carry upon its surface, above and partially about its axis, a stream of fibres to be carded, and a plurality of fibre working means associated with said cylinder and located above the same, each including a worker roll operative to comb a portion of the fibre stream from the cylinder and means for stripping the fibre from the worker roll and for returning it to the cylinder at the side of the worker roll toward which the cylinder rotates, means for transferring one of said streams of opened fibres onto one of said cylinders and the other of said streams onto the other said cylinder, and means for simultaneously operating said two sets of carding mechanisms to separately card said two fibre streams.

12. The method of treating wool and other fibres which comprises feeding a layer of the fibres to be treated, splitting from the layer two fibre streams each of lesser thickness than the initial layer, advancing said streams along separate, vertically superimposed paths and while so advancing said streams separately simultaneously subjecting each stream to the action of fibre opening mechanism, then separately simultaneously carding each stream by carrying the stream on a carding surface past successive fibre working zones and in each of said zones combing off an outer upper portion of the fibre stream from said surface and recirculating said portion beyond and above said surface to the combing off point by depositing it on a preceding part of the stream.

STANLEY WILKINSON.

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Certificate of Correction

Patent No. 2,478,799 August 9, 1949

STANLEY WILKINSON

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 1, line 49, for "aleo" read *also*; column 4, line 71, for "Th" read *The*; column 5, line 11, after the word "fibre" insert *layer will vary somewhat with the type and condition of fibre*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 20th day of December, A. D. 1949.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.