Oct. 7, 1969 G. ROBERTS 3,470,586

TEXTILE CARDING

Original Filed May 17, 1965 5 Sheets-Sheet 1

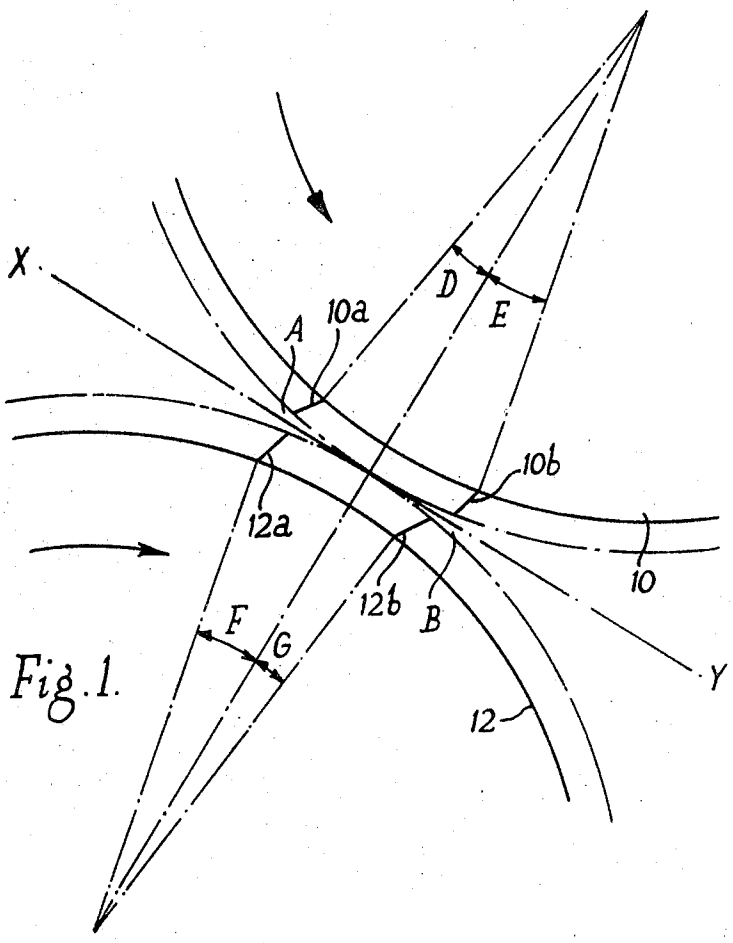


Fig. 1.

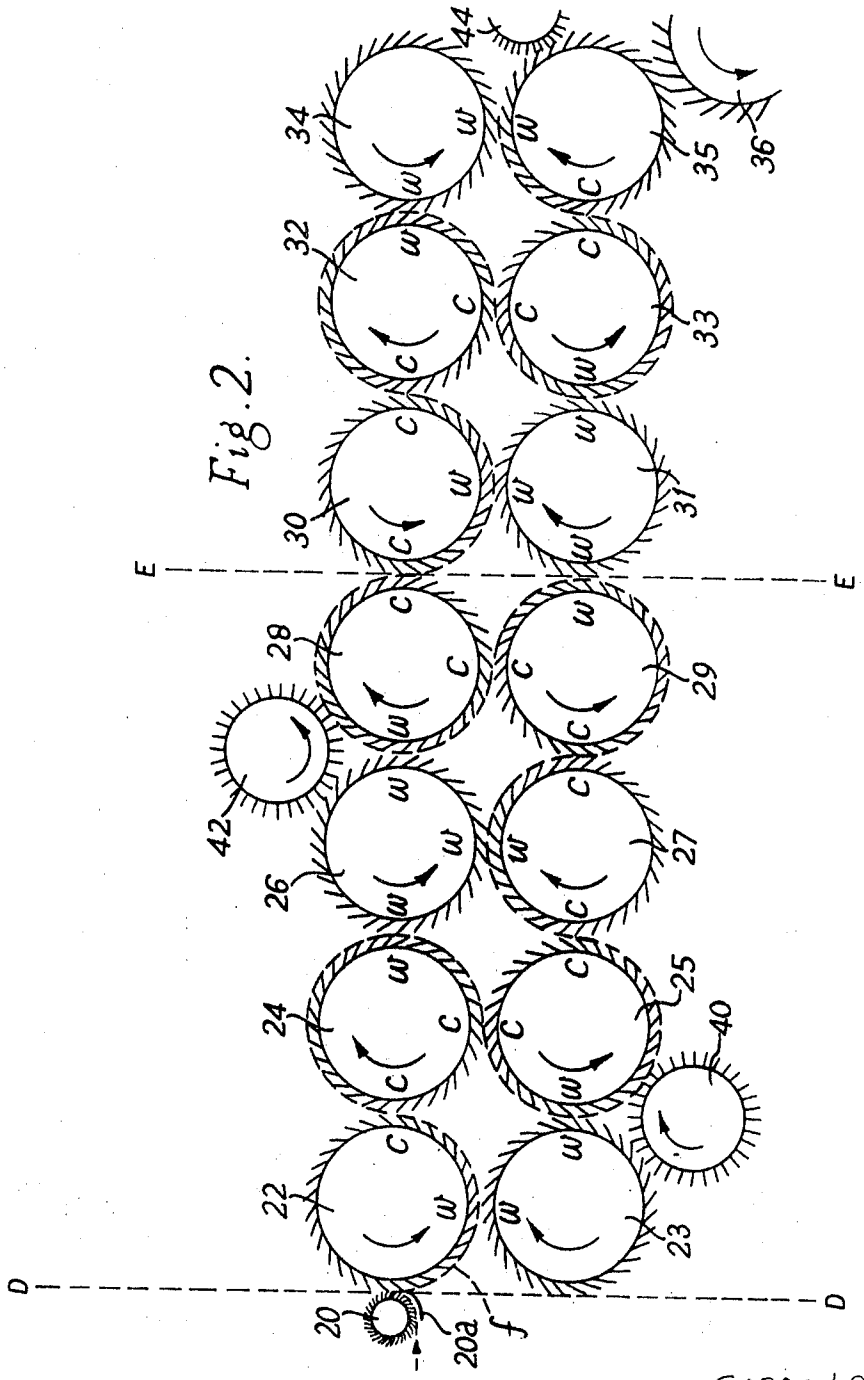
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Oct. 7, 1969 G. ROBERTS 3,470,586

TEXTILE CARDING

Original Filed May 17, 1965 5 Sheets-Sheet 2

Fig. 2.



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Oct. 7, 1969 G. ROBERTS 3,470,586

TEXTILE CARDING

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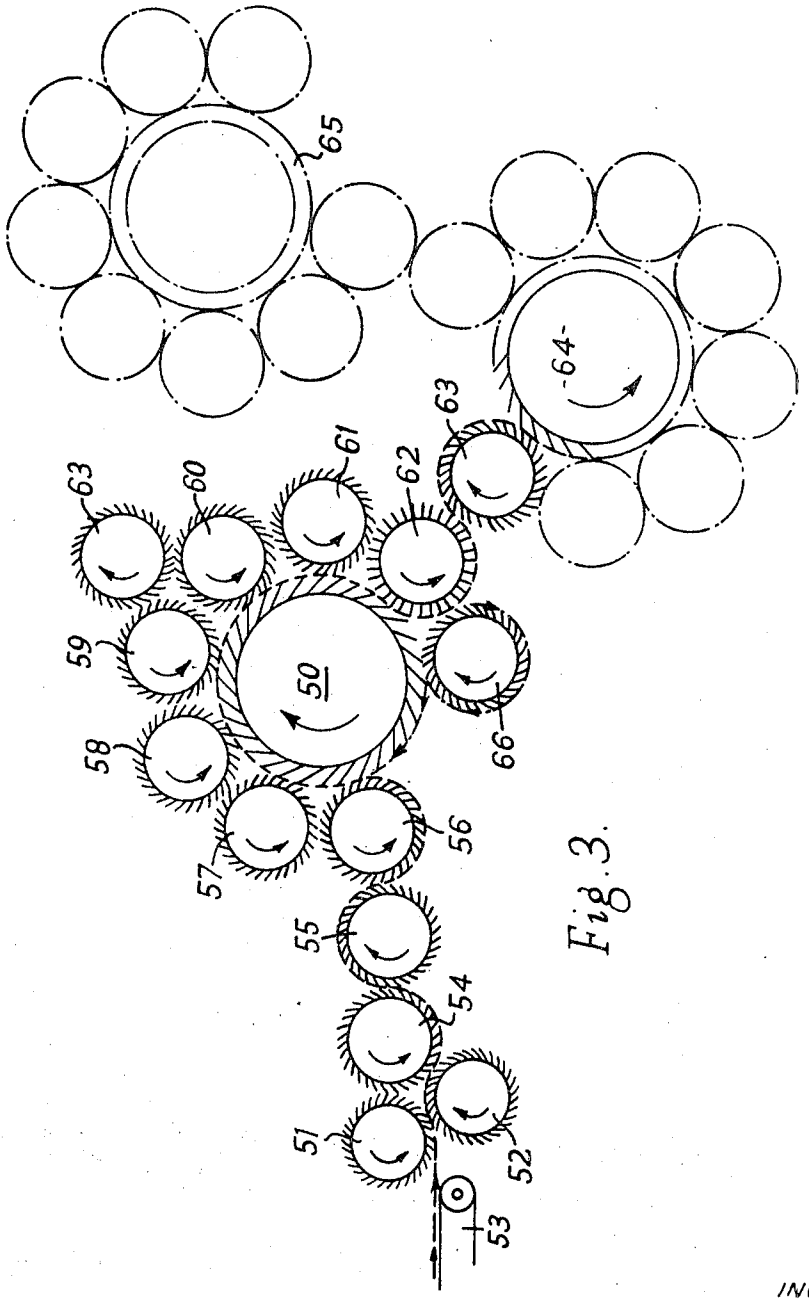


Fig. 3.

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Oct. 7, 1969 G. ROBERTS 3,470,586

TEXTILE CARDING

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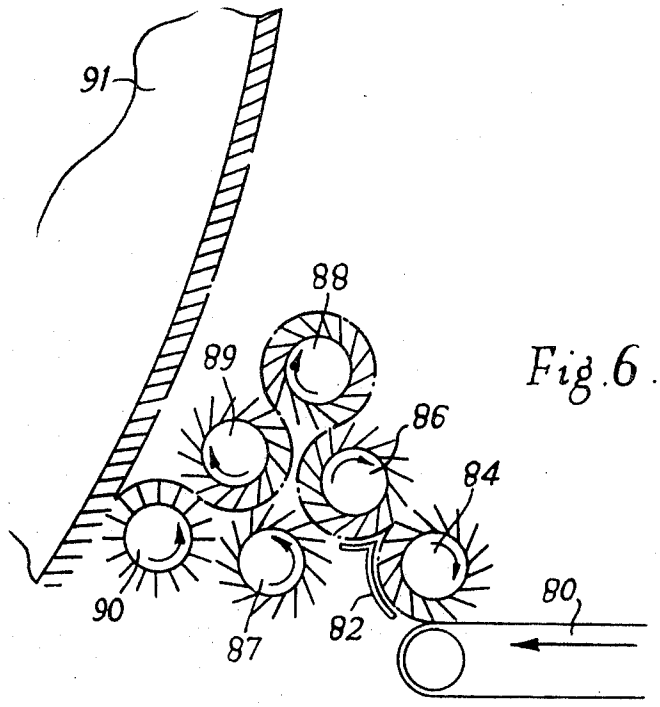
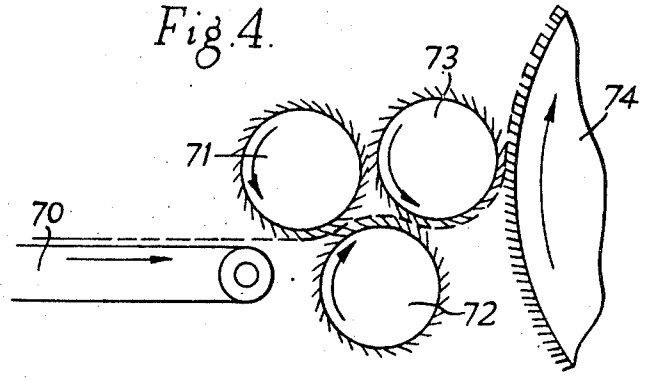


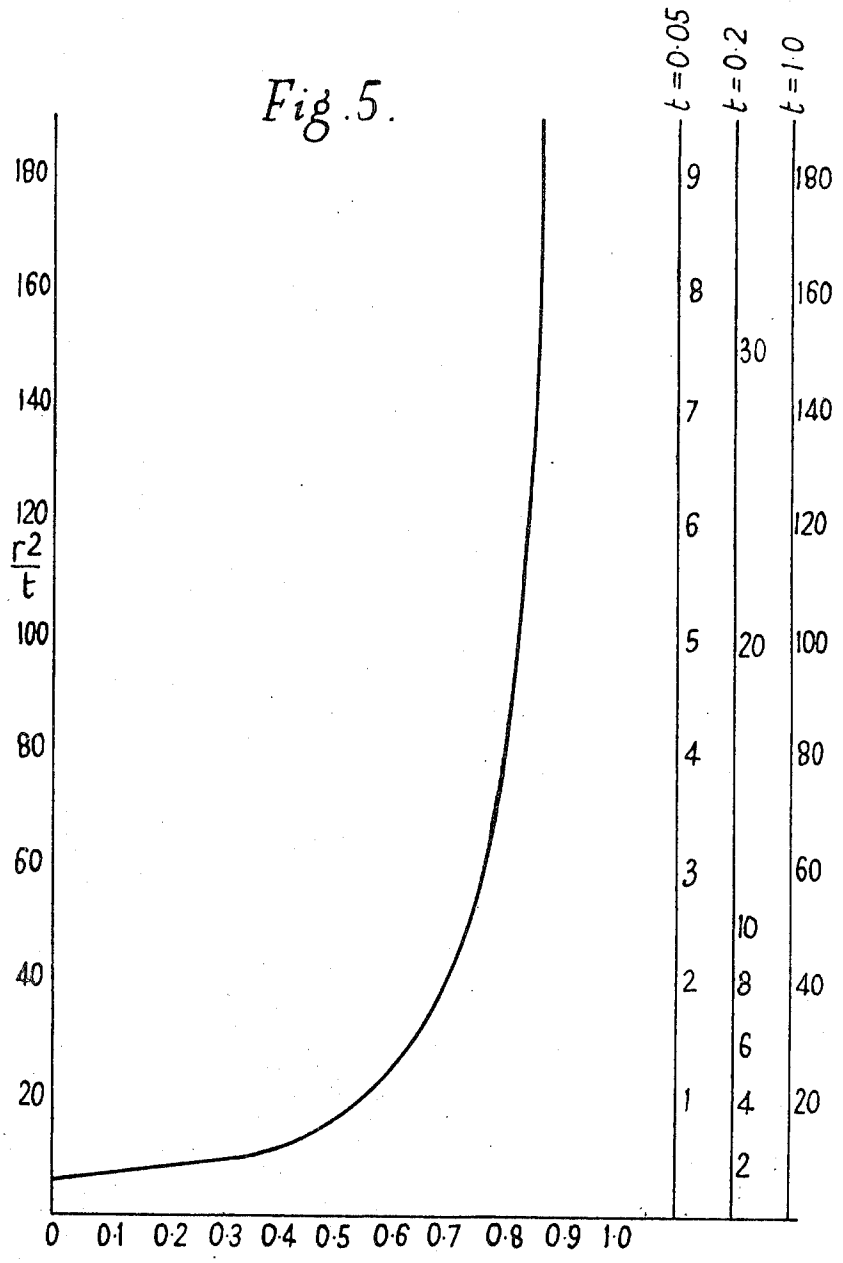
Fig. 6.

Fig. 4.



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Fig. 5.



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TEXTILE CARDING

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Continuation of application Ser. No. 456,414, May 17, 1965. This application Apr. 22, 1968, Ser. No. 723,328
Int. Cl. D01g 15/02
U.S. Cl. 19—99 2 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for carding fibrous material comprises essentially two card clothed rollers mounted on parallel axes, and rotating in opposite directions with one of the rollers having a faster surface speed than the other, said rollers being so relatively located that their teeth move in closely adjacent noncontacting relation through an arcuate zone of cooperation wherein the circles containing the outer ends of said teeth have a substantially common tangent, the teeth of said faster roller being inclined forwardly with respect to the direction of movement of said faster roller and the teeth of said slower roller being inclined rearwardly with respect to the direction of rotation of said slower roller and the teeth of said slower roller being the more acutely inclined to said common tangent at the entering side of said zone of cooperation and the teeth of said faster roller being more acutely inclined to said common tangent at the exit side of said zone of cooperation. Preferably the slower roller has a diameter of not more than 14 inches and not less than 2 inches, and the faster roller is of larger diameter. The speed of the slower roller is not less than about 30% that of the faster roller. The rollers may be arranged in various combinations involving a plurality of rollers that each have a working (opening and drafting) action at one zone of cooperation and a clearing action at another zone of cooperation.

This application is a continuation of Ser. No. 456,414, May 17, 1965, and now abandoned.

The present invention includes both a new kind of carding action, and a new arrangement of card clothed rollers which may incorporate the new carding action.

In a typical conventional carding machine there is a swift which is 50 inches diameter rotated at from 70 to 150 r.p.m., and a series of worker rollers, each about 8 inches diameter rotated at 5 to 10 r.p.m. This gives a surface speed ratio between swift and worker in the order of 90:1. The "working" action of the conventional machine is therefore, that the fibers are held by the worker roller, and subjected to a very fierce combing action by the teeth on the swift. This fierce action often has the effect of breaking the fibres and rolling them into neps.

The primary object of the invention is to provide a more gradual and gentle drawing apart action on the lumps of tangled fibres, which is at least as effective in opening the fibre lumps as the conventional method, and which results in less fibre breakage, and less formation of neps.

According to this invention a method of carding fibrous material between two card clothed rollers comprises, rotating the rollers in opposite directions and at different surface speeds, the diameters of the rollers and the angle of inclination of their teeth being such that fibrous material carried by the first roller is pressed into the teeth of the second roller at the entering side of the zone of cooperation between the two rollers, and then drawn out of the teeth of the second roller back on to the teeth of the first rollers at the leaving side of the zone of cooperation, substantially all the material being carried forward

by the first roller, without passing around the second roller.

Before discussing the invention in more detail, reference will now be made to the essential function differences between the method according to the invention and the conventional swift-and-worker operation. In the conventional arrangement, most of the material presented by the swift to the worker is taken off the swift on to the worker, and is then subjected to the severe combing or opening action by the teeth of the swift, whilst it is retained on the worker. Where a lock of wool or group of matted fibres are present the lock or group of fibres is torn into two parts—one part remaining embedded in the teeth of the worker and the other part being embedded in the teeth of the swift and carried forward until raised by the fancy so that it can be acted upon by the doffer which either collects it complete or again breaks it up into two parts one being carried forward by the doffer and the other part being embedded in the teeth of the swift. Eventually, the fibres are removed from the worker by the stripper, and transferred back to the swift. Thus the arrangement is characterized by a buildup of material on the worker roller. In the method according to the invention, there is no buildup of fibres on the "worker" roller, and indeed theoretically the teeth of the worker should remain clean except in the zone of cooperation with the "swift." (It will be understood, by those skilled in the art, that small quantities of fibres may remain on the "worker" and travel around that part of the "worker" which is not in the zone of cooperation with the "swift"—but this is purely incidental, and in operating the method of the invention, one should attempt to maintain this part of the "worker" roller clean.)

Reference has been made above to a "swift" and "worker roller." These terms have been used to explain the clearly visible difference between conventional carding and that of the invention. But since the action is completely different from the conventional "worker-swift" action, the two rollers will hereinafter be referred to simply as the first and second rollers (the first roller being that which carries the material forwardly—and therefore has been likened to a "swift" and the second roller being that which cooperates with the first roller to produce the carding action—and therefore has been likened to a "worker").

More detailed analysis of the differences shows that the action performed by the teeth of the two rollers upon the material is quite different, and altogether less severe than that of the conventional process. According to the method of the invention, the roller diameters, angles of inclination of the teeth and relative speeds of the rollers are all so related as to give the gentle action essential to the invention, whereby at the entering side of the zone of cooperation the fibres are pushed into the teeth of the second roller, and at the leaving side they are drawn out again. During this passage through the zone of cooperation any lock or group of fibres is opened and elongated in contrast to the breaking action in the conventional carding machine. Furthermore, due to the special action of the two rollers the material is not deeply embedded in the teeth of the swift, but is left with approximately half its mass standing proud on the surface of the swift so that the next worker can act on the material and continue the opening process.

Several factors which influence the attainment of this new carding method will now be discussed in more detail.

It should be understood that throughout the specification diameters are intended to refer to the diameter measured over the tops of the teeth of the card clothing, and that similarly surface speeds are intended to refer to the

speed of the tips of the teeth. Angles of inclination of the teeth are measured between the tangent to the circle described by the points of the teeth, and the effective portions of the teeth.

Diameter of "swift" or first roller.—Experiments and theory show that this has comparatively little bearing on the new type of carding action. The method has been successfully tried on a machine with a conventional swift of 50 inches diameter. Most of the experiments have been made with much smaller "swifts" or first rollers; down to rollers only 8 inches diameter. The opening effect improves with reduction in diameter of the swift (down to practical constructional limits) so that it is preferred to use a swift of relatively small diameter. It will be appreciated that a subsidiary advantage of the invention is that the desirability of using a small diameter swift means that it is possible to construct a carding machine much smaller than conventional machines.

Diameter of second roller.—It has been found desirable to use second rollers having diameters not greater than 14 inches. Below 2 inches diameter, there are constructional problems, whilst above 14 inches diameter there is a rapid deterioration in the opening effect. Since it has already been stated that the size of the first roller is not important, it will be appreciated that the ratio diameter of second roller/diameter of first roller is not critical. However, most of the experimental work has been done with a first roller twice the diameter of the second roller.

Relative surface speeds.—It is, of course, essential that there shall be some differences in the surface speeds of the two rollers, or there could not be any carding effect on the material. It has been found preferable to arrange the surface speed of the second roller to be not less than 30% of that of the first roller. This is another obvious difference between the method according to the invention and conventional carding, because in conventional carding the surface speed of the swift is 50–100 times that of the workers.

In the following discussion of relative surface speeds, V is the ratio: second roller (worker) surface speed/first roller (swift) surface speed. It has already been stated that V must be less than unity. Preferably V should be between the value V*t* given by the formula below and unity.

To calculate V*t*.—The numerical values of the following quantities are:

r^1=radius of first roller in inches,

r^2=radius of second roller in inches,

t=distance between the tips of the teeth on the two rollers, measured along a line parallel with the line joining the axes of the two rollers, at the position where the fibres begin to slide off the teeth of the second roller. This distance t will increase with fibre length (and perhaps with the condition of the fibres) and can be observed experimentally for any particular type of fibre. For normal textile fibres not exceeding 6 inches, t must lie between 0.05 inch and 1 inch.

$\theta°$=angle of inclination of teeth of second roller.

First one must calculate the subsidiary quantity c from the formula:

$$c=1-t\frac{(r^1+r^2-\frac{1}{2}t)}{r^1r^2}$$

From a table of cosines one then finds the angle $\phi°$ whose cosine is c; i.e., $\phi=\cos^{-1}c$. Then the limiting value V*t* can be calculated from the formula:

$$Vt=\frac{1}{c+\sqrt{1-c^2}\tan(\theta+\phi-20)}$$

Angle of inclination of teeth.—All that has been said above about the diameter of the second roller and the relative surface speeds assumes that the teeth of the card clothing are inclined to the tangent to the circle described by the points of the teeth and lie between 55° and 75°, which is the preferred angle range. More specifically an angle of 65° is desirable.

Coefficient of friction.—The coefficient of friction between the fibres and the teeth of the card clothing will also effect the choice of optimum working conditions. If the coefficient is above average the angle of inclination of the teeth on the second roller should be increased and vice versa.

Also according to this invention, a textile carding machine comprises a first card clothed roller which cooperates with a second card clothed roller with an opening action, and then with a third card clothed roller with a clearing action, so that the fibres are transferred to the third roller, and a fourth roller which cooperates with the third roller with a clearing action so that the fibres are transferred to the fourth roller, the fourth roller being also arranged to cooperate with the second roller with an opening action. Thus each of the four rollers takes part in either a clearing and an opening action or two clearing actions and there are four arcs of cooperation between various pairs of the four rollers.

Some examples of the invention will now be described with reference to the accompanying drawings in which:

FIGURE 1 is a diagram of the zone of co-operation between two card clothed rollers illustrating the new carding action,

FIGURE 2 is a diagrammatic layout of a carding machine,

FIGURE 3 is a diagrammatic layout of an alternative form of carding machine,

FIGURE 4 is a diagrammatic layout of a feeding arrangement for a conventional carding machine,

FIGURE 5 is a graph showing the value of the quantity V*t* (vis. the limiting value of the surface speed of the second roller expressed as a percentage of the surface speed of the first roller), plotted horizontally, as a function of the diameter of the second roller and thickness t (ratio of r^2/t plotted vertically), and

FIGURE 6 is a diagrammatic view of a feed roller arrangement for a carding machine.

Referring to FIGURE 1 of the drawings, there is illustrated parts of two cooperating card clothed rollers **10** and **12**. These rollers are of the same diameter in this particular example, and, as indicated by the arrows, they are so driven that they rotate in opposite directions. Thus, at the arc of cooperation (i.e., between the points A and B) the card clothed surfaces of the two rollers are moving in the same general direction. The gearing to the two rollers is such that when the roller **10** is rotating at 60 r.p.m., the roller **12** is rotating at 100 r.p.m. Therefore, the roller **12** always has the faster surface speed.

The teeth on the roller **10** are inclined rearwardly relatively to their direction of rotation, and the angle which these teeth make with the tangent to the circle defined by the tips of the teeth at the plane which contains the two roller axes (i.e., the line X—Y) in 65°. The teeth on the roller **12** are inclined forwardly relatively to their direction of rotation, and the angle which these teeth make with the line X—Y is 60°.

Consideration will now be given to the two teeth **10***a* and **12***a* which have their points at the entering position A. The tangent X—Y passes through the positions A·B. Now at the position A, the tooth **10***a* is inclined to the common tangent XY by the angle (65°—*D*) which in this particular instance is approximately 56°, but tooth **12***a* is inclined to the common tangent XY by the angle (65°+F) which in this instance is approximately 71°. Thus, if fibres are carried to the posiiton A on roller **12**, they will be held back by the teeth on roller **10**, because the teeth on roller **10** are inclined at a more acute angle to the common tangent XY at this point. This is because fibres impaled on the more acutely angled teeth will find it more difficult to slide up and off those teeth than those on the less acutely angled teeth. Consequently, the groups

of fibres held by the teeth on roller **10** will be opened or extended by the action of the teeth on the faster moving roller **12**, and individual fibres will be straightened. Throughout this specification it is to be understood that references to "opening" are intended to include straightening individual fibres.

At the position B, a tooth **10***b* on the roller **10** is inclined at an angle $(65°+E)$ which is approximately 76° to the tangent XY whereas a tooth **12***b* on the roller **12** is inclined at $(60°-G)$ which is approximately 53° to the tangent XY. Therefore, the teeth on the roller **12** will strip the fibres from the teeth on the roller **10** because those on the roller **12** are the more acutely angled with reference to the tangent XY, and are moving faster than those on the roller **10**. The distance between the tips of the teeth on the two rollers measured on a line parallel with the line joining the axes of the rollers at the point B, is the distance *t* previously referred to.

It will be appreciated that between the points A and B there is an opening and drafting action between the rollers **10** and **12**. This action is, however, novel insofar as any group of fibres is transferred from roller **10** to roller **12** and during this transfer the group of fibres are extended and opened up, but the group of fibres is not broken into two parts and embedded in the teeth of the two rollers, as happens in the conventional caring machine. Accordingly it is more effective and at the same time it is not as fierce as the conventional working action. The remainder of the surface of the roller **10** is comparatively clean, because of the clearing action at B. The novel opening arrangement is achieved because of the change which takes place between point A (where the teeth on roller **10** are the more acute), and point B (where the teeth on roller **12** are the more acute), and also because of the difference in the surface speeds of the two rollers is not so large as to tear into two parts any group of fibres.

It should be understood that the diameters of the rollers, the roller speeds and angles of inclination of the teeth mentioned in the foregoing specific description may be varied within quite wide limits so long as the following essentials are maintained, which are (a) that the roller **12** must rotate at a greater surface speed than roller **10**, and (b) that whereas the teeth on roller **10** are inclined more acutely to the common tangent at the entering side of the zone of cooperation the reverse is true at the leaving side, and (c) the fibrous material does not remain on the roller **10**, but is drawn off the teeth of that roller onto those of the roller **12**.

It has been found that in order to maintain the correct operation of the two rollers, it is necessary to have a certain relationship between the diameter of the slower moving roller **10** and the surface speed ratio of the roller **10** to that of the roller **12**. FIGURE 5 of the drawings is a graph on which experimentally obtained values of V*t* (limiting surface speed of roller **10** expressed as a percentage of the surface speed of the roller **12**), have been plotted against values r^1/t (as herein defined). The effect of changing values of *t* can be seen at the right hand side of the graph where three values of *t* (0.05, 0.2 and 1) have been plotted. For given r^2/t, the permissible values of V lie in the right of the line plotted, i.e., V must lie between V*t* and 1. A further limiting factor of V is that it must not be so small that the length of the relative movement between the two rollers within the zone of cooperation (i.e., where both rollers are acting simultaneously on the material) is so great as to tear in two any groups of fibres and in so doing embed the fibres into the two rollers. V therefore will depend both on the diameters of the cooperating rollers and also on the nature and length of the material being worked.

Referring now to the arrangement shown in FIGURE 2, there is shown a novel form of carding machine. In this machine **20** is the dish feed roller and **20***a* the dish (but any of the usual feed arrangements may be used). **22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34** and **35** are carding

rollers arranged in two rows one above the other with zones of cooperation between each roller and the adjacent rollers on each side and the adjacent roller below or above as the case may be. **40** and **42** are fancy rollers operating in the usual manner to lift the fibres to the tips of the teeth of the card clothed carding rollers **23** and **26** with which the fancies cooperate as these two rollers **23** and **26** are not at any point cleared by a faster roller. For some types of material the fancy rollers may not be required. In this particular arrangement, all the carding rollers **22–35** are 4 inches diameter (unclothed) and are run at the following speeds:

	R.p.m.
22	100
23	80
24	110
25	120
26	90
27	132
28	160
29	145
30	176
31	120
32	195
33	215
34	155
35	235

The direction of rotation of each roller is indicated by an arrow in the drawing. The section between the dotted lines D—D and E—E constitutes are "repeat" which could be duplicated as many times as required to give the desired degree of carding.

The wood fibres pass over the rollers in the path indicated by the dotted line *f*, and the action between the various pairs of rollers at their zones of cooperation is designated W for the new opening action and C for clearing. As indicated, the fibres passing around the lower half of the perimeter of the roller **22**, are subjected to an opening action between the rollers **22** and **23**, before being cleared by the roller **24**. In passing around approximately 270° of the perimeter of the roller **24**, the fibres are subjected to an opening action between rollers **24** and **26**, and are then cleared by roller **25**. In passing around 270° of the perimeter of roller **25**, the fibres are subjected to an opening action between rollers **25** and **23** (the roller **23** thus performing two opening actions), before being cleared by the roller **27**. In passing through approximately 180° around the perimeter of the roller **27**, the fibres are subjected to opening between rollers **27** and **26** before being cleared by the roller **29**. As the fibres pass around approximately 270° of the perimeter of the roller **29**, they are opened between rollers **29** and **31** and then cleared by the roller **28**. Then the fibres pass around approximately 270° of the perimeter of the roller **28**, and in so doing, they are subjected to opening between rollers **28** and **26**, and then cleared by roller **30**.

The final doffing of the carding roller train is achieved as in conventional carding by a doffer roller **36**, which cooperates with the roller **35** in the arrangement shown in FIGURE 2, or with the final carding roller in any other arangement. A conventional fancy roller **44** is provided to lift the fibre web to the top of the teeth of the roller **35** ready for the doffing action. The fancy roller **44** has a surface speed from 5% to 25% faster than that of the roller **35**, but the speed of the doffer is slower than that of the roller **35**, and is regulated according to the thickness of the web which has to be taken off. The doffer roller **36** is stripped by the usual fly comb or roller stripper arrangement.

It will be observed that each of the carding rollers **23–24** cooperates with at least two other rollers of the series, and in some of the zones of cooperation there is a clearing action, while in others there is an opening action, and that the rollers **24–29** each take part in three action zones. This arangement is made possible by uti-

lising the opening action described with reference to FIGURE 1, because the fibres are not carried around the slower moving roller after the opening zone is passed. It will be obvious that a considerable degree of opening can be carried out in a relatively small machine because of the two and three actions per roller.

It should be understood that rollers of different diameter may be substituted for carding rollers **22** to **35** to suit different kinds of material, being carded. This machine is particularly useful for short fibres such as short cotton fibres and they could be reduced to 2 inches or even less in diameter. It could also be used for opening knitted and woven rags with suitably clothed rollers. Furthermore, the speeds quoted above are for a specific example. These speeds may also be varied according to practical carding experience.

The alternative arrangement shown in FIGURE 3 of the drawings, provides an even more compact carding machine. A central roller or swift **50** is provided, with various worker rollers arranged around it. The swift is 8 inches in diameter. Rollers **51** and **52** are feed rollers which receive the uncarded material from a conveyor **53**. These feed rollers are card clothed and are each rotated at 10 r.p.m. From the feed rollers, the material passes under a card clothed roller **54** rotated at 15 r.p.m. and over a card clothed roller **55** rotated at 75 r.p.m. Between the rollers **51** and **54** there is the normal clearing action which keeps the roller **51** clean. Between the rollers **54** and **52** there is the opening action described with reference to FIGURE 1. The roller **55** is a brush or fancy roller which clears the roller **54** and transfers the material to a roller **56**, which is the first of a train of 4 inches diameter opening rollers **56**, **57**, **58**, **60** and **61**, each of which cooperates with the swift **50**, and with the adjacent opening roller or rollers.

At the zone of cooperation between the opening roller **56** and the swift **50**, the fibres are opened, and transferred to the teeth of the swift. At each of the zones of cooperation between the swift and the openers **57** and **58** there is an opening action similar to that described with reference to FIGURE 1. In addition, the rollers **56**, **57** and **58** have their teeth just contacting each other, and the back-of point action keeps the teeth on those rollers sharp and ensures that any fibres which are not carried away by the swift are brought back by the succeeding opening roller.

After passing the three opening rollers **56**, **57** and **58**, some of the fibres may have become embedded below the surface of the teeth on the swift, and for this reason a fancy roller **59** may be provided, to raise the fibres to the surface of the teeth on the swift, so that the web can be opened by opening rollers **60** and **61** which operate in similar fashion to the openers **57** and **58**. It is possible to set the fancy roller **59** so that it will keep the roller **58** clean, and it will be appreciated that the opener roller **60** will prevent "fly" being thrown up by the fancy roller **59**. A clearer roller **63** is provided for clearing material off the fancy roller **59** and transferring it to the opener roller **60**, but in some cases, this clearer roller may not be required.

In this particular example, all the opener rollers are 4 inches in diameter, and they are run at the following speeds:

	R.p.m.
55	25
56	60
57	62
58	64
59	120
60	60
61	62
62	110/150
66	150/130
63	50

The swift is rotated at 50 r.p.m.

It will be noted that there is a progressive increase in speed from the opener roller **56** to the opener roller **58**, and from the opener roller **60** to the opener roller **61** which enables each succeeding opener roller to clear the previous opener. By varying the speed and settings of the opener rollers, a greater or lesser degree of opening and drafting can be achieved to suit the material being carded.

As the material passes around the swift **50** and is opened by the successive action of the rollers **57**, **58**, **59**, **60** and **61**, the tufts become elongated. Consequently, the tufts are able to withstand greater drafting action without being broken into two parts (which breakage must be avoided, to prevent the fibres being carried around the "workers"). In order to provide greater drafting as the material travels around the swift, the "worker" rollers may be made of progressively increasing diameter (instead of being all the same diameter as shown in the drawings).

A further brush type roller **62**, with teeth more nearly radial than those of an ordinary fancy roller is provided, the purpose of this roller **62** being to brush out the material on the swift **50** and carry it way. In the arrangement shown in FIGURE 3, the roller **62** transfers the material on to a roller **63** which is the first of a train of rollers which cooperate with a second swift **64**, the arrangement of rollers around this second swift being a duplicate of these around the first swift. From the second swift **64**, the material travels around a third swift **65** with a similar set of opener rollers. It will be understood that any number of swifts (each with its own set of opener rollers) can be employed. The arrangement shown in FIGURE 3, where the material passes over the swift **50**, under the swift **64**, and over the swift **65** is particularly compact, but it will be understood that the swifts could all be arranged at one level (as in a conventional carding machine) with the material passing over all the swifts.

If only one swift **50** is required, the roller **62** could be arranged to transfer the material on to a roller similar to **63** (but not cooperating with a second swift) so that the roller **63** acts as a doffer, which can, of course, be cleared by a fly comb or roller stripper arrangement as is usual with a tape doffer, except that the material would come all over the top of the stripper and bright roller instead of below them.

A roller **66** is provided beneath the swift **50**. This is a mixing roller, its purpose being to take part of the material which has been lifted out of the swift by the roller **62**, and return it once more to the swift. The amount of material returned to the swift for a second processing and mixing with material newly arrived on the roller **56** is determined by the speed and setting of the roller **66** with respect to the roller **62**. As the setting (i.e., distance apart) is reduced, and the speed of the roller **66** is reduced, the amount of material returned to the swift is increased. This mixing roller **66** will also act selectively in the way it takes material from the roller **62**, for reopening, i.e., it will let the web of opened material on **62** pass, but it will catch any lumps or tufts of imperfectly opened material standing proud on the surface of the roller **62**.

The roller **66** may also be covered with "Morrell" or other special wire which will hold onto fibrous material, but foreign matter such as slive, sand, etc., will fall out between rollers **66** and **62**. For further cleaning of the material being returned by roller **66** a burr beater of the conventional type may be added beneath it.

The arrangement shown in FIGURE 4 of the drawings can be used on a conventional carding machine, and provides an improved method of feeding material to the swift. It will be noted that this arrangement is similar to the feed arrangement shown in FIGURE 3.

There are two well known methods of feeding material to the swift, these being (a) the dish feed, which

tends to break the longer fibres, and (b) the "three roller feed" with a liker-in, in which there is inevitably a gap between the feed roller and the liker-in, which allows lumps of material to escape control, and so produces irregular feeding.

In the arrangement shown in FIGURE 4, uncarded material is supplied on a conveyor **70** to a pair of feed rollers **71** and **72**. These feed rollers are card clothed, and are each rotated at approximately 10 r.p.m. From the feed roller, the material passes under a card clothed roller **73** rotated at 15 r.p.m. from which roller it is cleared by the upward running portion of the conventional swift **74**. Between the rollers **71** and **73** there is the normal clearing action which keeps the roller **71** clean, and between the roller **73** and **72** there is the opening action described with reference to FIGURE 1.

Referring now to FIGURE 6 of the drawings, there is shown a further novel feed arrangement for a carding machine which makes use of the invention.

Material is fed on the travelling lattice conveyor **80** to a dish feed, which comprises a fixed dish plate **82**, and a cooperating roller **84**, which is covered with coarse garnett wire. Following the dish feed there is a series of rollers of small diameter (say 1½ inches before covering) **86**, **87**, **88**, **89** and **90**. The roller **86** is covered with medium garnett wire; the roller **87** with fine garnett wire, the roller **88** with stripper fillet clothing or medium garnett wire; the roller **89** with fine garnett wire, and the roller **90** with fancy wire.

The action of the feed rollers is as follows:

Between the roller **84** (part of the dish feed) and the roller **86** theer is an ordinary stripping action. The material is opened (by the process of the invention) between the rollers **86** and **87**. The material is carried around on the roller **86**, from which it is cleared by the roller **88**. This is in turn cleared by the roller **89** and is opened between the rollers **89** and **87** (which is covered with fine garnett wires). A brush roller **90** clears both the rollers **87** and **89** and is itself cleared by the swift **91**.

This feeding arrangement provides some preliminary opening of the fibres before the swift is reached.

It should be understood that garnett wire may be substituted for fillet wire on any of the rollers described in any of the above examples.

What is claimed is:

1. Apparatus for carding textile fibres comprising a first rotatable card clothed roller having inclined teeth on its periphery, a second rotatable card clothed roller rotating at a surface speed slower than said first roller and having inclined teeth at its periphery adapted for material working relation with the teeth on the periphery of said first roller, a third rotatable card clothed roller having a surface speed faster than said first roller and having inclined teeth at its periphery adapted for material clearing relation with the teeth on the periphery of said first roller, a fourth rotatable card clothed roller having a surface speed slower than said third roller and having inclined teeth adapted for material working relation with the teeth on the periphery of said third roller, and a fifth rotatable card clothed roller with its periphery disposed in clearing relation to said third roller and in working relation to said second roller, the teeth of said rollers disposed in working relation being oppositely inclined and moving in the same direction through zones of cooperation wherein the tips of said teeth are disposed in closely adjacent circles having a substantially common tangent, and the teeth of said rollers disposed in clearing relation being similarly inclined and moving in the same direction through zones of cooperation wherein the tips of said teeth are disposed in closely adjacent circles having a common tangent.

2. Apparatus for carding textile fibres comprising a first rotatable card clothed roller having inclined teeth on its periphery, a second rotatable card clothed roller rotating at a surface speed slower than said first roller and having inclined teeth at its periphery adapted for material working relation with the teeth on the periphery of said first roller, a third rotatable card clothed roller having a surface speed faster than said first roller and having inclined teeth at its periphery adapted for material clearing relation with the teeth on the periphery of said first roller, a fourth rotatable card clothed roller having a surface speed slower than said third roller and having inclined teeth adapted for material working relation with the teeth on the periphery of said third roller, a fifth rotatable card clothed roller having a surface speed higher than said third roller and having inclined teeth on its periphery adapted to be disposed in clearing relation to the teeth on said third roller and in working relation to the teeth on said second roller, a sixth rotatable card clothed roller having inclined teeth on its periphery disposed in clearing relation to the teeth on said fifth roller and in working relation to the teeth on said fourth roller, a seventh rotatable card clothed roller having inclined teeth on its periphery in clearing relation to the teeth on said sixth roller, and an eighth rotatable card clothed roller having inclined teeth on its periphery disposed in clearing relation to the teeth on said seventh roller and in working relation to the teeth on said fourth roller, said sixth, seventh and eighth rollers having surface speeds progressively higher than said fifth roller.

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