July 16, 1963 O. B. ALSTON 3,097,399

PROCESS AND APPARATUS FOR CARDING COTTON FIBERS

Filed Jan. 2, 1962 4 Sheets-Sheet 1

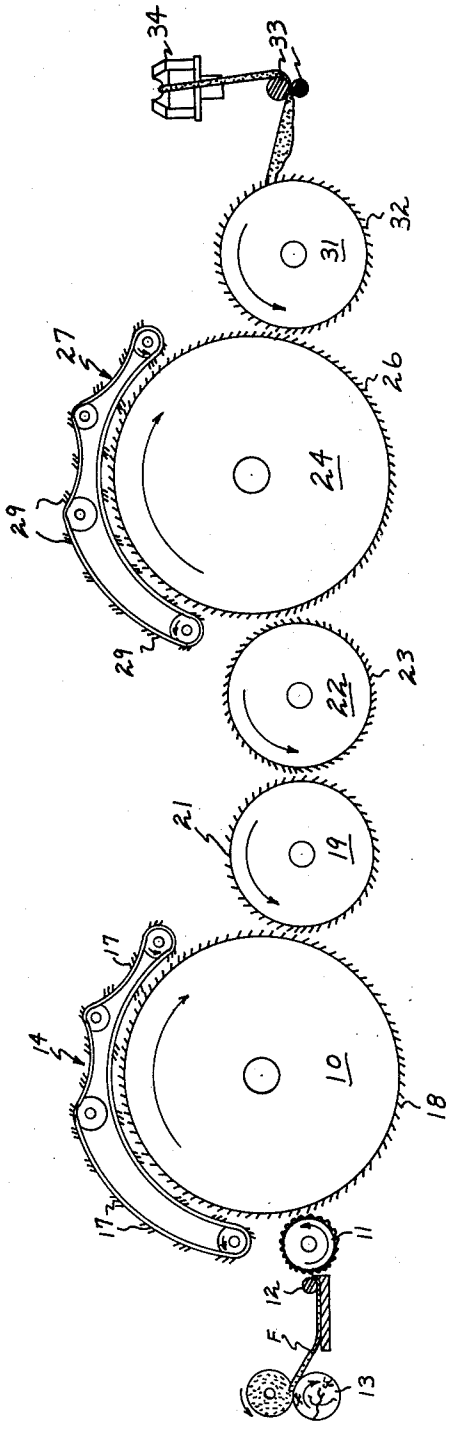


FIG. 1

INVENTOR.
Otis B. Alston
BY
Jennings, Carter & Thompson
Attorneys

July 16, 1963 O. B. ALSTON 3,097,399

PROCESS AND APPARATUS FOR CARDING COTTON FIBERS

Filed Jan. 2, 1962 4 Sheets-Sheet 2

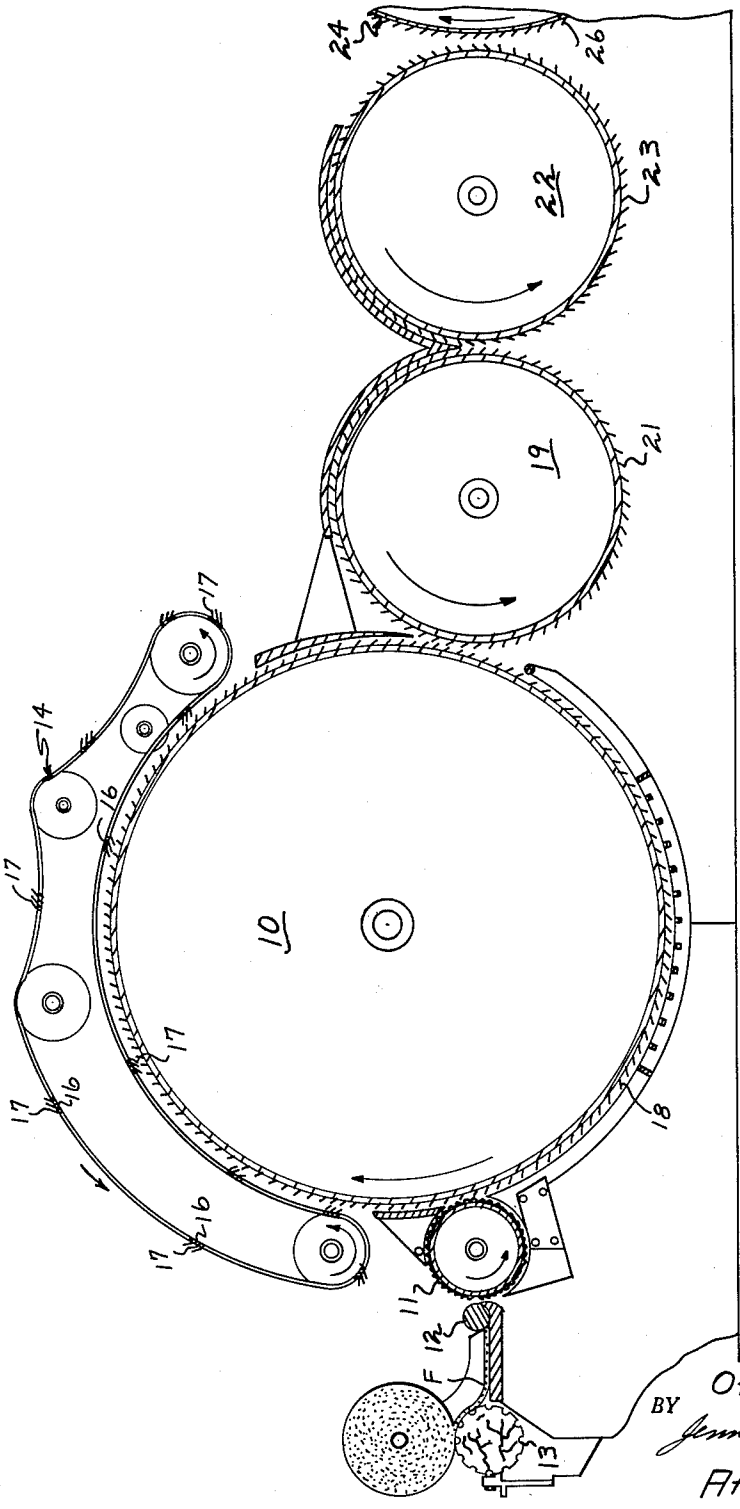


FIG. 2

INVENTOR.
Otis B. Alston
BY Jennings, Carter & Thompson
Attorneys

July 16, 1963 O. B. ALSTON 3,097,399

PROCESS AND APPARATUS FOR CARDING COTTON FIBERS

Filed Jan. 2, 1962 4 Sheets-Sheet 3

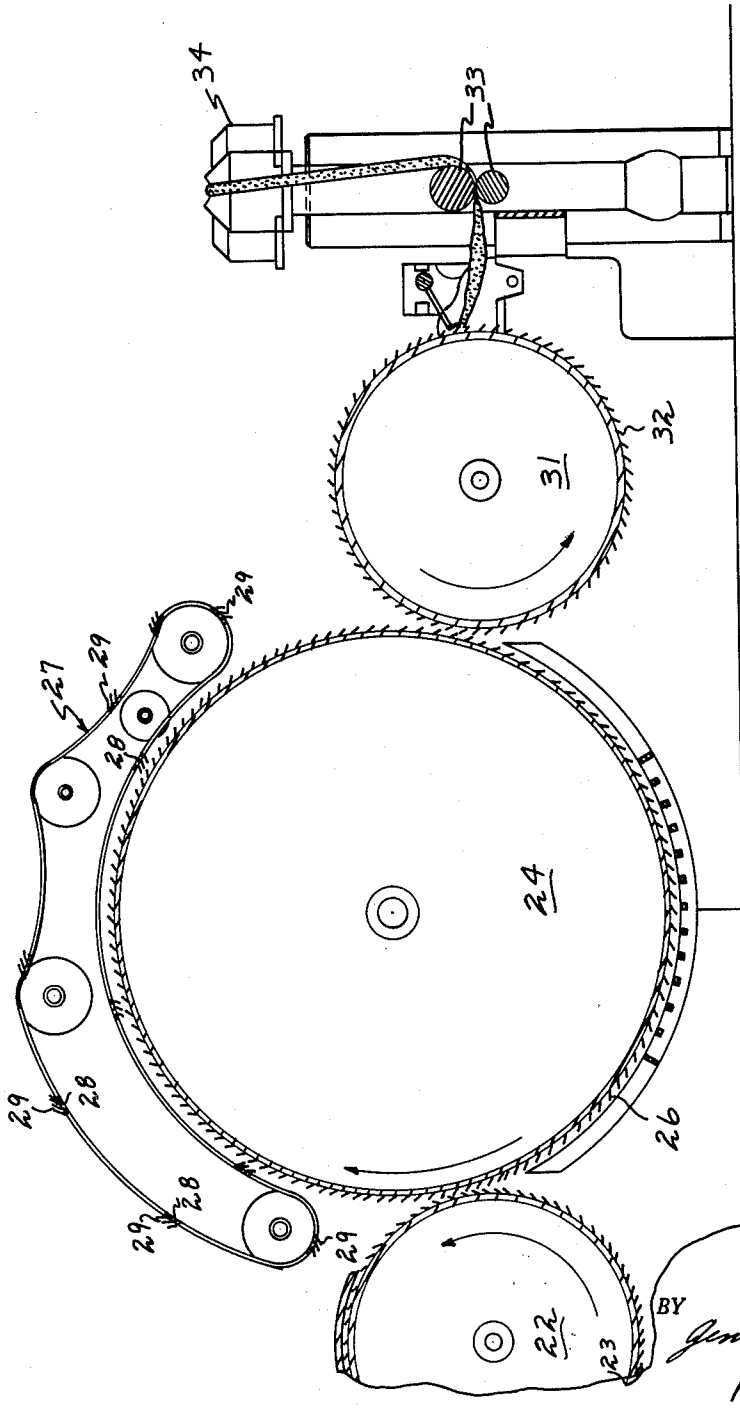


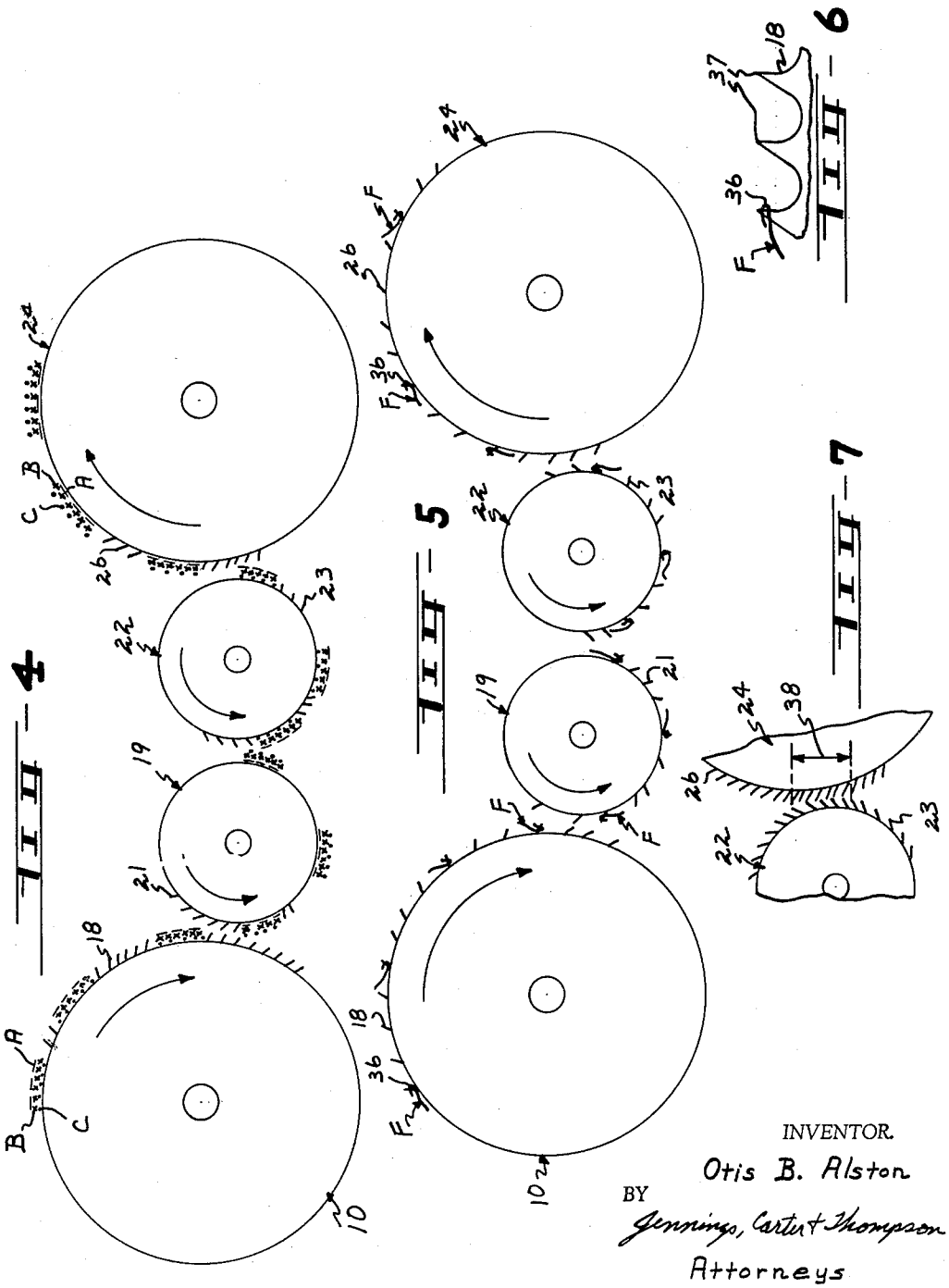
FIG. 3

INVENTOR.
Otis B. Alston
BY Jennings, Carter & Thompson
Attorneys

July 16, 1963 O. B. ALSTON 3,097,399

PROCESS AND APPARATUS FOR CARDING COTTON FIBERS

Filed Jan. 2, 1962 4 Sheets-Sheet 4



United States Patent Office 3,097,399 Patented July 16, 1963

3,097,399

PROCESS AND APPARATUS FOR CARDING COTTON FIBERS

Otis B. Alston, Columbus, Ga., assignor to Swift Spinning Mills, Inc., a corporation of Georgia

Filed Jan. 2, 1962, Ser. No. 165,713
12 Claims. (Cl. 19—98)

This invention relates to a process and apparatus for carding cotton fibers and blends thereof and more particularly to such a process and apparatus which shall impart a double carding action to the fibers in an improved manner, and is a continuation-in-part of my co-pending application Serial No. 95,310 filed March 13, 1961, and entitled Process and Apparatus for Carding Fibrous Material, now abandoned.

An object of my invention is to provide a process and apparatus for carding cotton fibers and blends thereof of the character designated in which the surface speed of one movable element relative to another movable element is maintained at a very low rate to thereby minimize harsh action to the fibers.

Another object of my invention is to provide a process and apparatus for carding cotton fibers and blends thereof in which the quality of the yarn produced is greatly enhanced due to the increased brightness and luster of the yarn and the decrease of the neps, trash and other foreign materials in the yarn.

Another object of my invention is to provide a process and apparatus for carding cotton fibers and blends thereof in which the rate of production is greatly increased due to the fact that two card cylinders operating in accordance with my invention will process substantially more of the fibers than conventional type apparatus employing two separate card cylinders.

Another object of my invention is to provide a process and apparatus for carding cotton fibers and blends thereof in which the amount of apparatus required is reduced to a minimum and at the same time the overall apparatus is compact and requires a minimum of floor space since one aisle is eliminated.

A further object of my invention is to provide a continuous process for carding cotton fibers and blends thereof in which there is a minimum handling of the fibers under pressure, thereby reducing damage of the fibers to a minimum.

A further object of my invention is to provide a process and apparatus for carding cotton fibers and blends thereof of the character designated in which the fibers are transferred to and from substantially straight teeth of the card clothing with a gentle action rather than a harsh action.

A still further object of my invention is to provide apparatus of the character designated which shall be simple of construction, economical of manufacture and which shall be adapted for use with conventional type cotton carding apparatus.

Heretofore in the art to which my invention relates, various means have been devised for double-carding fibrous materials. However, so far as I am aware, such apparatus has been unsatisfactory for carding cotton fibers due to the fact that the fibers are subjected to very harsh treatment as the material is transferred from one moving element of the apparatus to another moving element thereof. As is well known in the art to which my invention relates, excessive handling of cotton fibers under pressure damages the fibers due to the fact that the orientation of the fibers is disturbed. That is to say, any time the fibers are pulled relative to each other while pressure is applied or drawn over each other while pressure is applied, the fibers are damaged.

To overcome the above and other difficulties, I provide a continuous process for carding cotton fibers in which a

uniform, loose web of fibers is transferred by gentle action from a first card cylinder to a second card cylinder without harsh action being imparted to the fibers since I main tain very low relative surface speeds of the moving elements relative to each other and at the same time the fibers are presented to the second carding cylinder with the hooks of the fibers predominantly leading. I also eliminate the necessity of passing the cotton fibers through a lap winder, a second series of feed rolls and a second licker-in which would damage the fibers greatly due to the compression of the fibers by the feed rolls and the pulling of the fibers out of a dense bat by the licker-in. Also, my improved process and apparatus eliminates one doffer comb operation and one coiling operation as used in conventional double carding. Furthermore, in accordance with my invention, the fibers forming the outer stratum of the web on the first cylinder have a tendency to form the inner stratum of the web on the second cylinder, thereby providing uniform blending and cleaning of the fibers since the fibers at both sides of the web are subjected to the positive carding action of the flats associated with either the first or second cylinder.

Apparatus embodying features of my invention and which may be employed to carry out my improved process is illustrated in the accompanying drawings, forming a part of this application, in which:

FIG. 1 is a diagrammatic view showing my improved apparatus with the first and second doffing or transfer cylinder mounted between the first and second card cylinders;

FIG. 2 is a vertical sectional view showing the feed mechanism, the licker-in, the first card cylinder together with its carding flats and the first and second doffing or transfer cylinders;

FIG. 3 is a vertical sectional view showing a fragment of the second doffing or transfer cylinder, the second carding cylinder together with its carding flats, the third doffing cylinder and a coiler;

FIG. 4 is a diagrammatic view showing the movement of the individual fibers as they pass through my apparatus whereby the fibers forming the outer stratum of the web on the first cylinder have a tendency to form the inner stratum of the web on the second cylinder;

FIG. 5 is a diagrammatic view showing the movement of the individual fibers and the relative position of the hooks formed in the fibers;

FIG. 6 is an enlarged fragmental view showing the hook of a fiber carried by card clothing having substantially straight teeth; and,

FIG. 7 is a fragmental view showing the effective contact area between the second transfer cylinder and the second card cylinder.

Referring now to the drawings for a better understanding of my invention, I show a card cylinder **10** which receives the cotton fibers "F" from a conventional type licker-in **11**. The cotton fibers are fed to the licker-in **11** by a feed roll **12** which in turn receives the fibers from a lap roll **13**.

Partially surrounding the upper portion of the card cylinder **10** is an endless set of carding flats indicated generally at **14**. Each flat **16** of the set of carding flats is covered with clothing **17** which moves adjacent the clothing **18** of the card cylinder **10** in a manner well understood in the art. As clearly shown in FIGS. 1, 2 and 6, the teeth of the clothing on the card cylinder **10** are generally straight and extend outwardly at an angle in the direction of movement of the clothing or in the direction of rotation of the card cylinder **10**. The teeth of the clothing **17** on the flats **16** extend outwardly at an angle in a direction opposite the direction of movement of the card cylinder clothing.

Mounted adjacent the delivery side of the card cylin-

der 10 is a first doffing or transfer cylinder 19 which is driven, by suitable means, in a direction opposite the direction of rotation of the card cylinder 10 and at a surface speed substantially less than the surface speed of the card cylinder 10. The doffing cylinder 19 is covered with clothing 21 and the teeth of the clothing are generally straight and extend outwardly at an angle in a direction opposite the direction of movement thereof, whereby the cotton fibers are deposited on the doffing cylinder 19. That is, since the surface speed of the card cylinder 10 is substantially greater than the surface speed of the doffing cylinder 19, the cotton fibers are continuously deposited on the clothing 21 of the doffing cylinder 19.

Mounted for rotation adjacent the doffing or transfer cylinder 19 at the side thereof opposite the card cylinder 10 is a second doffing or transfer cylinder 22 which is driven in the same direction as the doffing cylinder 19, as shown in FIGS. 1, 2, 4 and 5. Also, the relative surface speeds of the doffing or transfer cylinders 19 and 22 are such that a gentle treatment of the fibers is obtained as the fibers are transferred from transfer cylinder 19 to transfer cylinder 22. Card clothing 23 is provided on the doffing cylinder 22 and the individual teeth of the card clothing 23 are generally straight and extend outwardly at an angle in the direction of movement thereof whereby the teeth of the card clothing 23 are in position to remove the cotton fibers from the card clothing 21 as the transfer cylinders 19 and 22 rotate relative to each other. In view of the fact that the teeth of the card clothing 23 extend forwardly in the direction of movement of the teeth, they are adapted to remove the cotton fibers from the teeth of the card clothing 21 with a gentle action whereby the fibers are removed in a direction toward the free ends of the teeth forming the card clothing 21.

Mounted for rotation adjacent the doffing or transfer cylinder 22, at the side thereof opposite the doffing cylinder 19, is a second card cylinder 24 which rotates in the same direction as the card cylinder 10 and in an opposite direction from the direction of rotation of the transfer cylinders 19 and 22. The card cylinder 24 is driven at a surface speed substantially greater than the surface speed of the transfer cylinder 22 and is provided with card clothing 26. The individual teeth of the card clothing 26 are generally straight and extend outwardly at an angle in the direction of movement of the teeth or in the direction of rotation of the card cylinder 24 whereby the cotton fibers carried by the transfer cylinder 22 are continuously deposited on the card cylinder 24. Since the teeth of the card clothing 23 extend at an angle in the direction of movement thereof and the teeth of the card clothing 26 extend in the direction of movement thereof, the teeth of the card clothing 26 continuously remove the cotton fibers in a gentle manner from the teeth of the card clothing 23. That is to say, as the cotton fibers are removed from the card clothing 23, they move in a direction toward the free ends of the teeth of the card clothing 23.

Surrounding a portion of the card cylinder 24 is an endless set of carding flats 27 having individual flats 28. Each individual flat 28 is covered with clothing 29 which extends outwardly at an angle and in a direction opposite the direction of movement of the card cylinder clothing, as shown, whereby carding action is imparted to the cotton fibers carried by the card cylinder 24.

Mounted for rotation adjacent the delivery side of the card cylinder 24 is a doffing cylinder 31 which is rotated in a direction opposite the direction of rotation of the card cylinder 24. Also, the doffing cylinder 31 is driven at a greatly reduced surface speed relative to the surface speed of the card cylinder 24. As shown in FIGS. 1 and 3, the doffing cylinder 31 is provided with card clothing 32 having individual teeth which are generally straight and extend outwardly at an angle and in a direction opposite the direction of movement thereof, whereby the cotton fibers are continuously deposited on the doffing cylinder 31 by the card cylinder 24. The cotton fibers pass from the doffing cylinder 31 through the usual calender rolls 33 to a coiler 34, in the usual manner.

Referring now to FIG. 4 of the drawings, I show the movement of the individual fibers as they pass through my apparatus to obtain maximum blending and cleaning. The web of fibers passing over the first carding cylinder 10 comprises an outer stratum of individual fibers "A," an intermediate stratum of individual fibers "B," and an inner stratum of individual fibers "C." In order to better understand the movement of the fibers through my apparatus, I show the individual fibers forming the stratum "A" by dash lines. The individual fibers forming the stratum of fibers "B" is indicated by a series of cross marks while the individual fibers forming the stratum "C" is indicated by dotted lines.

The individual fibers forming the stratum "A" are furthest from the axis of the first cylinder 10 and near the clothing 21 of transfer cylinder 19 and are thus the most likely ones to be first transferred from the card cylinder 10 to the first transfer cylinder 19. Since the teeth of the clothing 21 of the first transfer cylinder 19 are free of fibers prior to receiving the same from the card cylinder 10, the individual fibers forming the stratum "A" would tend to move to a position on the bottoms of the pockets between the individual teeth of the clothing 21. That is, the individual fibers forming the stratum "A" would tend to form a stratum nearest the axis of the transfer cylinder 19. In like manner, the individual fibers forming the stratum "B" would tend to be the next fibers to be transferred to the clothing of the first transfer cylinder 19 whereby these fibers would be slightly further from the axis of the first transfer cylinder 19 than the fibers forming the stratum "A." The individual fibers forming the stratum "C" would tend to be transferred last on top of the fibers forming the stratum "B" and still further from the axis of the first transfer cylinder 19.

As the teeth of the clothing of the first transfer cylinder 19 move to a point tangent to the teeth of the clothing 23 of the second transfer cylinder 22, the fibers forming the stratum "C" would be nearest the transfer cylinder 22 and would accordingly be expected to be deposited first on the periphery of the second transfer cylinder 22. That is, the fibers forming the stratum "C" would tend to move toward the bottoms of the individual teeth of the clothing 23 of the second transfer cylinder 22 and would thus lie nearest the axis of the transfer cylinder 22. The individual fibers forming the stratum "B" would then tend to be deposited on top of the individual fibers forming the stratum "C" and the individual fibers forming the stratum "A" would tend to be the next deposited on top of the fibers forming the stratum "B." Accordingly, the individual fibers forming the stratum "A" would assume an outermost position relative to the axis of the second transfer cylinder 22 whereas on the first transfer cylinder 19, the individual fibers forming the stratum "A" were positioned nearest the axis of the first transfer cylinder 19. Accordingly, there is a substantial amount of mixing and blending as the fibers are transferred from transfer cylinder 19 to transfer cylinder 22.

Since the individual fibers forming the stratum "A" are positioned furthest from the axis of the transfer cylinder 22, they would tend to be the first fibers to be engaged by the clothing 26 of the second card cylinder 24. In like manner, the fibers forming the stratum "B" would tend to be the next to be deposited on card cylinder 24 while the last fibers which would tend to be deposited on card cylinder 24 would be the individual fibers forming the stratum "C."

From the foregoing description, it will be seen that as the web of fibers passes over the first carding cylin-

der 10, the individual fibers forming the stratum "A" are positioned on the outer surface of the web adjacent the carding flats 14 whereby they are subjected to positive carding as the fibers are drawn under the flats 14. On the other hand, as the web of fibers passes over the second carding cylinder 24, the individual fibers forming the stratum "C" are positioned on the outer surface of the web adjacent the carding flats 27 whereby they are subjected to positive carding as the fibers are drawn under the flats 27. Accordingly, both sides of the web are subjected to the positive carding action of the carding flats either as the web passes over the first carding cylinder 10 or as it passes over the second carding cylinder 24.

In view of the fact that cotton fibers are not uniform in shape or length, all fibers would not necessarily take the exact positioned described hereinabove. However, the fibers would have a tendency to assume the positions set forth. Accordingly, there would be some migration of the individual fibers from stratum "A" to stratum "C" and vice versa. In like manner, there would be some transfer of fibers from stratum "B" to both stratums "A" and "C" and vice versa. This tendency of the fibers to migrate from one stratum to the other brings about an inner working of the fibers whereby improved mixing or blending of the fibers is obtained. Also, this inner working of the fibers brings about a better cleaning action and presents substantially all of the fibers to the positive carding action of the carding flats. Furthermore, substantially all of the neps are exposed at one time or another for easy removal.

Referring now to FIG. 5 of the drawings, I show the relative positions of the hooks formed on the fibers during the carding operation. The individual fibers of cotton transferred from the licker-in 11 to the clothing 18 of the first carding cylinder 10 are carried forward in a clockwise direction, as viewed in FIG. 5, and are drawn through the projecting points of the clothing on the first set of carding flats 14. The flats retain the short fibers which become embedded in the clothing of the flats and these short fibers are removed from the apparatus as waste. The fibers remaining on the clothing of the first carding cylinder 10 are carried forward since the teeth of the clothing 18 on the first carding cylinder 10 take hold of the forward part of the fibers "F" and create hooks 36 at the leading ends of the fibers. As the fibers on the first carding cylinder 10 are transferred to the clothing 21 of the first transfer cylinder 19, it is believed that most of the hook deformations 36 remain in the fibers.

The fibers "F" are carried counterclockwise on the first transfer cylinder 19 to the point of tangency with the second transfer cylinder 22. At this point, the fibers are thoroughly mixed and blended as pointed out hereinabove. Also, at this point, it is believed that the points of the teeth of the clothing 23 on the second transfer cylinder 22 contact the hooks 36 previously formed in the fibers and carry these fibers forward counterclockwise, as viewed in FIG. 5, whereby they are presented to the second carding cylinder 24 with the hooks 36 predominantly leading. By presenting the individual fibers "F" to the second carding cylinder 24 whereby the hooks 36 thereof are predominantly leading, I bring about a gentle action of transfer rather than a harsh action due to the fact that the hooks 36 are already formed in the fibers and do not have to be created by the points of the teeth of the clothing 26 on the second carding cylinder 24. Also, by reducing the number of hooks formed in the fibers to a minimum, breakage and damage to the fibers is materially reduced.

The clothing 18, 21, 23, 26 and 32 is provided with straight teeth 37, as shown in FIG. 6, whereby there are no knees in the clothing. By providing generally straight teeth 37, substantially no stripping is required. In actual practice, I find that conventional type metallic clothing, such as that shown in FIG. 6, is satisfactory in every respect.

While I show the doffer or transfer cylinders 19 and 22 as being substantially the same size in diameter, the cylinders may be of different diameters. For example, the transfer cylinder 19 may be the same size as a conventional type doffer whereas the transfer cylinder 22 may be the same size as a conventional type licker-in. Where conventional type doffers and licker-ins are employed as the transfer cylinders 19 and 22, one transfer cylinder would be approximately 27 inches in diameter whereas the other transfer cylinder would be approximately 9 inches in diameter. While the transfer cylinders may be smaller that 9 inches in diameter, for example 6 inches, I preferably employ a relatively large diameter transfer cylinder 22 so as to provide a wide area of effective contact, as indicated by the arrow 38 in FIG. 7. By providing the relatively wide effective area of contact, the fibers are placed in better orientation prior to being subjected to carding action on the second card cylinder whereby more effective cleaning is obtained. Accordingly, less neps are in my finished product since the neps are exposed for cleaning. Furthermore, with a relatively large effective area of contact between the clothing of the transfer cylinder 22 and the carding cylinder 24, the fibers are aligned in the direction of movement as they are deposited on the carding cylinder 24 with the hooks 36 thereof predominantly leading, as shown in FIG. 5.

From the foregoing description, the operation of my improved carding apparatus will be readily understood. The cotton fibers "F" are continuously deposited on the card cylinder 10 by the licker-in whereby carding action is imparted to the fibers as they pass relative to the first set of carding flats 14. The fibers carried by the card cylinder 10 are then deposited on the card clothing 21 of the doffing or transfer cylinder 19 due to the fact that the surface speed of the card cylinder 10 is greater than the surface speed of the transfer cylinder 19. Since the doffing or transfer cylinders 19 and 22 are rotating in the same direction and the teeth of the card clothing 23 extend forwardly in the direction of movement thereof, the fibers are continuously removed from the transfer cylinder 19 and deposited on the transfer cylinder 22. Since the transfer cylinder 22 rotates in a direction opposite the direction of rotation of the card cylinder 24 and the teeth of the card clothing 26 extend forwardly in the direction of movement thereof, the fibers are continuously removed from the transfer cylinder 22 and deposited on the card cylinder 24 whereby carding action is then imparted by the second set of carding flats 27. The cotton fibers carried by the card cylinder 24 are deposited on the card clothing 32 of the doffing cylinder 31 whereby the fibrous material is then transferred to the coiler 34 in a manner well understood in the art.

As an example, I have employed card cylinders approximately 50 inches in diameter and doffing or transfer cylinders approximately 27 inches in diameter. By rotating such card cylinders at approximately 165 to 175 r.p.m. to obtain a surface speed ranging from approximately 2,100 to 2,300 feet per minute and driving the doffing or transfer cylinders 19 and 22 at a speed ranging from approximately 16 to 90 r.p.m., to obtain a surface speed ranging from approximately 100 to 635 feet per minute, or any combination thereof, my improved apparatus operates satisfactorily in every respect. However, it will be obvious to one skilled in the art that the sizes of the card cylinders and doffing or transfer cylinders and the speeds of rotation thereof may be varied without departing from the spirit of my invention.

The rate of rotation of the doffing cylinder 31 is varied as the throughput of the cotton fibers is varied. That is, the doffing cylinder 31 is driven at a speed which is in direct proportion to the rate of production. The relative surface speeds of adjacent rotating elements is maintained at a very low ratio so as to reduce harsh action

to the fibers being processed. Also, a series of card cylinders comprising more than two card cylinders associated with doffing cylinders in the manner described hereinabove may be employed. Accordingly, throughout the specification and claims, the description of the apparatus as comprising a first card cylinder and a second card cylinder is intended to include a plurality of card cylinders operating in series with a pair of doffing or transfer cylinders mounted between adjacent card cylinders in the manner described hereinabove.

From the foregoing, it will be seen that I have devised an improved process and apparatus for carding cotton fibers. By reducing the harsh action imparted to the fibers as they are being processed, there is a minimum of damage to the fibers. Also, by subjecting the fibers to a double carding action in a single unit whereby the fibers pass from one card cylinder to a pair of doffing or transfer cylinders and then to another card cylinder with a minimum of abrupt or harsh treatment to the fibers, I increase production of the unit and at the same time greatly increase the quality of the fibers processed. Also, there is a material savings in waste where the cotton fibers are carded in accordance with my invention due to the fact that there is a substantial reduction in breakage and damage of fibers. Furthermore, by providing a compact carding unit comprising two card cylinders which will process substantially more cotton fibers than two separate carding units embodying one card cylinder each, I greatly reduce the space required for the apparatus due to the fact that one aisle is eliminated.

While I have described the fibers being carded as cotton fibers it will be understood that my improved process and apparatus is adapted for carding cotton fibers blended with other fibers. Accordingly, throughout the specification and claims it is intended that the expression "cotton fibers" includes cotton fibers and cotton fibers blended with other fibers.

While I have shown my invention in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof, and I desire, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What I claim is:

1. An improved process of carding cotton fibers to increase the rate of carding obtainable over a like single cylinder cotton card and to improve the quality of the carded product which comprises continuously carrying out the following steps in the sequence named:

(*a*) feeding the fibers to be carded at more than twice the rate of feed of said like single cylinder cotton card to a first revolving card cylinder having substantially straight tooth clothing thereon,

(*b*) imparting carding action to the fibers on said first card cylinder by carding flats,

(*c*) removing the thus carded fibers in a uniform, loose web from said first card cylinder by gentle action of a first transfer cylinder having substantially straight tooth clothing thereon,

(*d*) rotating said first transfer cylinder in a direction opposite the direction of rotation of said first card cylinder and at a surface speed less than the surface speed of said first card cylinder,

(*e*) transferring said fibers in a uniform, loose web from said first transfer cylinder to a second card cylinder having substantially straight tooth clothing thereon by gentle action of a second transfer cylinder having substantially straight tooth clothing thereon,

(*f*) rotating said second transfer cylinder in the same direction as said first transfer cylinder,

(*g*) rotating said second card cylinder in a direction opposite the direction of rotation of said second transfer cylinder and at a surface speed greater than the surface speed of said second transfer cylinder,

(*h*) imparting carding action to said fibers on said second card cylinder by carding flats, and

(*i*) doffing said fibers from said second card cylinder.

2. An improved process of carding cotton fibers to increase the rate of carding obtainable over a like single cylinder cotton card and to improve the quality of the carded product which comprises continuously carrying out the following steps in the sequence named:

(*a*) feeding the fibers to be carded at more than twice the rate of feed of said like single cylinder cotton card to a first revolving card cylinder having substantially straight tooth clothing thereon extending outwardly at an angle in the direction of movement thereof,

(*b*) imparting carding action to the fibers on said first card cylinder by carding flats,

(*c*) removing the thus carded fibers in a uniform, loose web from said first card cylinder by gentle action of a first transfer cylinder having substantially straight tooth clothing thereon extending outwardly at an angle opposite the direction of movement thereof,

(*d*) rotating said first transfer cylinder in a direction opposite the direction of rotation of said first card cylinder and at a surface speed of at least 100 feet per minute and less than the surface speed of said first card cylinder,

(*e*) transferring said fibers in a uniform, loose web from said first transfer cylinder to a second card cylinder having substantially straight tooth clothing thereon extending outwardly at an angle in the direction of movement thereof by gentle action of a second transfer cylinder having substantially straight tooth clothing thereon extending outwardly at an angle in the direction of movement thereof,

(*f*) rotating said second transfer cylinder in the same direction as said first transfer cylinder at a surface speed of at least 100 feet per minute,

(*g*) rotating said second card cylinder in a direction opposite the direction of rotation of said second transter cylinder and at a surface speed greater than the surface speed of said second transfer cylinder,

(*h*) imparting carding action to said fibers on said second card cylinder by carding flats, and

(*i*) doffing said fibers from said second card cylinder.

3. An improved process of carding cotton fibers to increase the rate of carding and improve the quality of the carded product which comprises:

(*a*) mounting a first card cylinder having substantially straight tooth clothing thereon extending outwardly at an angle in the direction of movement thereof and having carding flats associated therewith in spaced relation to a second card cylinder having substantially straight tooth clothing thereon extending outwardly at an angle in the direction of movement thereof and having carding flats associated therewith,

(*b*) rotating said card cylinders in the same direction,

(*c*) feeding the fibers to be carded at more than twice the rate of feed of a like single cylinder cotton card to said first card cylinder to thus impart carding action to said fibers by the carding flats associated with said first card cylinder,

(*d*) transferring the thus carded fibers in a uniform, loose web from said first card cylinder to said second card cylinder by gentle action of a pair of adjacent transfer cylinders mounted in tandem between the card cylinders and extending parallel to each other and said card cylinders with the clothing of the transfer cylinder adjacent said first card cylinder being generally straight and extending outwardly at an angle opposite the direction of movement thereof and the clothing of the transfer cylinder adjacent said second card cylinder being generally straight and extending outwardly at an angle in the direction of rotation thereof,

(e) rotating said pair of transfer cylinders in the same direction at a surface speed of at least 100 feet per minute and in a direction opposite the direction of rotation of the card cylinders to impart an inner working and blending of the fibers as they are transferred from the first card cylinder to the second card cylinder to thereby present different fibers adjacent the carding flats associated with the second card cylinder from the fibers presented adjacent the carding flats associated with the first card cylinder, and

(f) doffing said fibers from said second card cylinder.

4. A process of carding cotton fibers as defined in claim 3 in which the fibers are presented to the second card cylinder with the hooks of said fibers predominantly leading.

5. A process of carding cotton fibers as defined in claim 3 in which the first and second card cylinders are driven at a surface speed of at least 2,100 feet per minute.

6. Apparatus for carding cotton fibers to increase the rate of carding and improve the quality of the carded product comprising:

(a) a first revolving card cylinder having substantially straight tooth clothing thereon,

(b) feed means operable to deliver cotton fiber to said first card cylinder at a rate in excess of twice the rate of feed to a like single cylinder cotton card,

(c) carding flats cooperating with said first card cylinder in position to impart carding action to said fibers on said first card cylinder,

(d) a first transfer cylinder adjacent said first card cylinder mounted for rotation in a direction opposite the direction of rotation of said first card cylinder at a surface speed less than the surface speed of said first card cylinder and having substantially straight tooth clothing thereon disposed to remove the fibers in a uniform, loose web from said first card cylinder,

(e) a second transfer cylinder adjacent said first transfer cylinder mounted for rotation in the same direction as said first transfer cylinder at a surface speed less than the surface speed of said first card cylinder and having substantially straight tooth clothing thereon disposed to remove the fibers in a uniform, loose web from said first transfer cylinder,

(f) a second card cylinder mounted for rotation adjacent said second transfer cylinder at a surface speed greater than the surface speed of said second transfer cylinder and having substantiaily straight tooth clothing thereon disposed to remove the fibers in a uniform, loose web from said second transfer cylinder,

(g) carding flats cooperating with said second card cylinder in position to impart carding action to the fibers on said second card cylinder, and

(h) doffing means to remove said fibers from said second card cylinder.

7. Apparatus for carding cotton fibers as defined in claim 6 in which the doffing means comprises a doffing cylinder mounted for rotation adjacent said second card cylinder in position to remove the fibers from said second card cylinder.

8. Apparatus for carding cotton fibers as defined in claim 6 in which the substantially straight teeth of the clothing on the first and second card cylinders and the clothing on the second transfer cylinder extend outward

at an angle in the direction of movement thereof, and the substantially straight teeth of the clothing on the first transfer cylinder extends outwardly in a direction opposite the direction of movement thereof.

9. Apparatus for carding cotton fibers as defined in claim 6 in which the clothing of the card and transfer cylinders is metallic card clothing.

10. Apparatus for carding cotton fibers as defined in claim 6 in which a relatively wide effective contact area is provided between said second transfer cylinder and said second card cylinder.

11. Apparatus for carding cotton fibers as defined in claim 6 in which the card cylinders are driven at a surface speed of at least 2,100 feet per minute and the transfer cylinders are driven at a surface speed of at least 100 feet per minute.

12. An improved process of carding cotton fibers to increase the rate of carding obtainable over a like single cylinder cotton card and to improve the quality of the carded product which comprises continuously carrying out the following steps in the sequence named:

(a) feeding the fibers to be carded at more than twice the rate of feed of said like single cylinder cotton card to a first revolving card cylinder having substantially straight tooth clothing thereon,

(b) imparting carding action to the fibers on said first card cylinder by carding flats,

(c) removing the thus carded fibers in a uniform, loose web from said first card cylinder by gentle action of a first transfer cylinder having substantially straight tooth clothing thereon,

(d) rotating said first transfer cylinder in a direction opposite the direction of rotation of said first card cylinder and at a surface speed less than the surface speed of said first card cylinder,

(e) transferring said fibers from said first transfer cylinder to a second card cylinder having substantially straight tooth clothing thereon by a second transfer cylinder having substantially straight tooth clothing thereon,

(f) rotating said second transfer cylinder in the same direction as said first transfer cylinder,

(g) rotating said second card cylinder in a direction opposite the direction of rotation of said second transfer cylinder and at a surface speed greater than the surface speed of said second transfer cylinder,

(h) imparting carding action to said fibers on said second card cylinder by carding flats, and

(i) doffing said fibers from said second card cylinder.

References Cited in the file of this patent

UNITED STATES PATENTS

631,992	Magid	Apr. 29, 1899
2,097,046	Sio	Oct. 26, 1937
2,603,840	Dunn	July 22, 1952

FOREIGN PATENTS

567,715	France	Dec. 11, 1923
599	Great Britain	of 1877

OTHER REFERENCES

Leigh, Evan: "The Science of Modern Cotton Spinning . . .," 2d ed., v. 1, London, England, Simpkin, Marshall & Co., 1873; vii, 160 p., pp. 94 and 95, Fig. 75.