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N. E. KLEIN

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FIBER HANDLING DRAFTING ROLL APPARATUS AND METHOD OF USE

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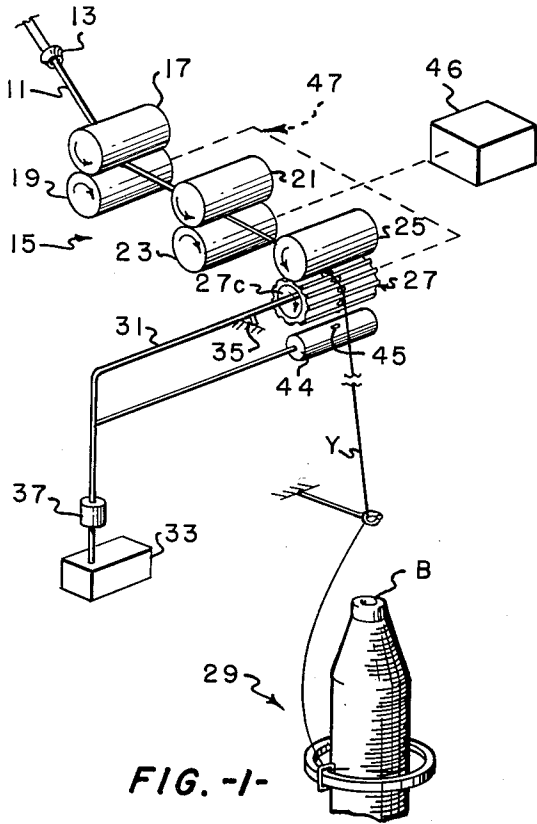


FIG. -1-

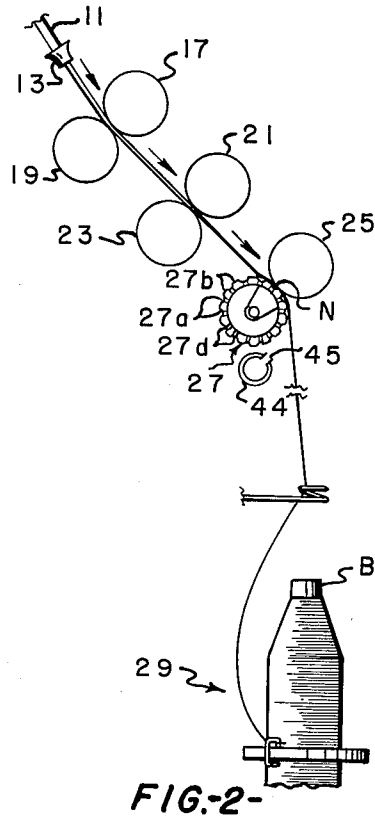


FIG. -2-

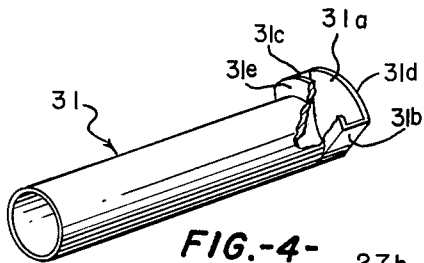


FIG. -4-

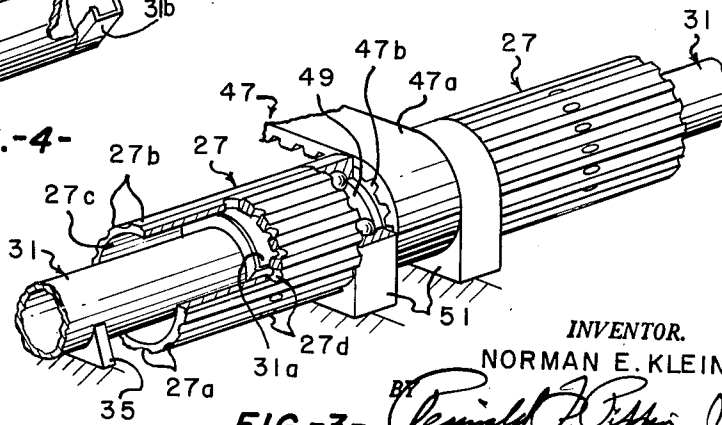


FIG. -3-

INVENTOR.
NORMAN E. KLEIN

BY *Ronald J. Ripper, Jr.*
ATTORNEY

1

2

3,131,438

FIBER HANDLING DRAFTING ROLL APPARATUS
AND METHOD OF USENorman E. Klein, Spartanburg, S.C., assignor to Deering
Milliken Research Corporation, Spartanburg, S.C., a
corporation of Delaware

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This invention relates to textile fiber handling apparatus, and more particularly to an improved staple fiber handling roll and roll arrangement which is particularly adapted for and useful in the drafting of staple fibers preparatory to forming into a yarn.

In the drafting of sliver, roving, and other ropes or masses of staple fibers, it is desirable to compact the fiber mass from all sides. While various systems, such as tongue-and-groove rolls and hyperboloidal rolls, have been attempted for achieving better compacting and control, none of these has been to my knowledge either entirely satisfactory or commercially successful. A feature of this invention is the provision of a novel fiber handling roll and also a novel drafting arrangement incorporating such a roll which affords a novel and advantageous compacting of a progressing fiber mass, particularly a sliver or roving.

A further feature lies in the employment of air pressure in a novel manner for exerting a lateral compacting force on a progressing mass of fibers.

Other advantages which accrue from the invention include less fly and higher velocities of fiber flow in drafting.

Still other features and attendant advantages will be apparent to those skilled in the art from a reading of the following description of one physical embodiment constructed according to the invention, taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a schematic view in perspective of an embodiment constructed according to the invention.

FIGURE 2 is a schematic line drawing showing the general path of the fibers through the drafting arrangement, as viewed from one end of the drafting rolls.

FIGURE 3 is an enlarged and more detailed partially cutaway view of the apertured roll of FIGURE 1.

FIGURE 4 is a partial cutaway view of the stationary suction conduit which extends into the cavity formed in the aperture roll.

Referring now to the illustrative example shown in the figures of the drawing, roving 11 of staple fibers is fed from a supply source (not shown) through a guide trumpet 13 to a drafting arrangement 15 incorporating two stages of drafting. The drafting arrangement is schematically illustrated for purposes of simplicity of explanation, and it will be understood that conventional refinements such as aprons might be added thereto if desired.

In the basic drafting arrangement 15 as illustrated, there are three sets of drafting rolls, the breaker rolls 17, 19, middle rolls 21, 23 and front rolls 25, 27. At least one of each of these sets of rolls is driven, and each succeeding set of rolls is as usual driven at a faster peripheral rate than the preceding rolls in order to give the desired degree of drafting of the fibers in the zones between the respective pairs of rolls. The fiber mass is twisted as it leaves the nip N of the final pair of rolls 25, 27 by the twisting action of a twisting and takeup device in the form of a conventional ring-and-traveler twister takeup 29 onto which the drafted and twisted fiber mass is then taken up as yarn Y.

According to the invention at least one, and preferably the lower final one 27, of the drafting rolls is formed in a novel manner and serves to aid materially in the handling

and compacting of the fiber mass. This novel roll 27 is formed with alternate grooves 27a and ridges 27b on its circumferential periphery and running transversely to the path of the fiber mass of sliver/or roving and yarn thereover. In the illustrated example the grooves 27a and ridges 27b are formed by evenly spaced parallel flutes cut or formed in the roll periphery and running parallel to the roll axis of rotation. The roll 27 has a cavity 27c formed therein and a plurality, preferably all, of the grooves 27a are connected in fluid flow relation with this cavity 27c by apertures 27d each extending between the bottom of the respective groove 27a and the cavity 27c. The apertures 27d are disposed within a narrow discrete zone perpendicular to the roll axis, and are preferably in substantially single file alignment, with their respective centers lying in a common plane perpendicular to the roll axis and cutting through the longitudinal center of the roll 27 along the desired path of travel of the fiber mass over and past the roll.

A negative pressure (relative to the surrounding atmospheric pressure) is applied to the cavity 27c in a zone preceding, including, and subsequent to the nip N of the rolls 25, 27. This negative pressure may be applied as by a stationary conduit 31 connected to a vacuum source such as the suction side of a blower 33. The conduit 31 has an open convex mouth 31a which conforms to the internal radius of curvature of the cavity 27c and extends through a restricted arc of less than 360°. Open convex mouth 31a is defined by side baffle members 31b and 31c and arcuate shaped front and back baffle members 31d and 31e, respectively. The open convex mouth 31a is disposed in registry with the line of apertures 27d and is removably held in this position as by a fixed support 35 on the spinning or other processing frame. Preferably the restricted arc is less than 180° and encompasses the apertures in the drafting roll 27 within the arc area. A filter 37 may be disposed in the conduit 31 if desired.

While such is not a necessity for the basic operation of the invention it may be desirable to employ an external surface vacuum scavenging system adjacent the external circumferential periphery of the roll 27 in order to scavenge from the roll surface any fibers which may inadvertently remain on the roll 27 after the twisted fiber strand Y leaves the roll. For this purpose a hollow tube 44 having a small width slot 45 formed therein may be employed in conjunction with the vacuum source 33, the slot 45 being disposed beneath the lower peripheral surface of the roll 27.

At least one of each of the pairs of drafting rolls is suitably driven from a drive source 46 through a suitable mechanical drive connection 47, such as a gear train or cog belt drive of desired speed ratio proportions. As seen in FIGURE 3, the drive to the apertured front drafting roll 27 may be through a cog belt 47a and a gear 47b centrally disposed on a common shaft 49 between two adjacent spinning positions, the shaft 49 having formed on its opposite ends the respective two apertured fluted and apertured rolls 27 for the two side-by-side spinning positions. The shaft 49 may be rotatably mounted in suitable mountings 51 and the suction conduits 31 may extend into the respective fluted and apertured rolls 27 through their opposite open ends.

In operation, the rope of textile fibers 11 is passed through the forming trumpet 13 and drafting assembly 15 to the ring and traveler twister takeup 29. The apertured and fluted front roll 27 of the drafting assembly 15 exerts a sucking action on the fibers in the zone immediately preceding, including and subsequent to the nip N. This sucking action is effective to exert both radial forces and opposing compacting forces transverse to the direction of travel of the fiber mass, thereby tend-

ing to compact the fiber mass 11 against the roll surface, both in a direction normal to the surface of the roll and in opposite directions toward the center of the fiber mass and normal to the passage of the mass of fibers over the roll 27. This dual compacting is particularly aided by the presence of a single line of apertures formed in the recesses or grooves of the fluted roll. It has been found, and it is an important aspect of the present invention, that the provision of ridges 27b between the apertures and extending transversely of the direction of movement of the fiber mass substantially enhances the lateral compacting movement of the fibers toward the longitudinal center of the fiber mass. The ridges 27b tend to form in effect smooth supporting rails on which the fibers may move under the influence of the lateral sucking action exerted in opposite lateral directions on the fibers lying on both lateral sides of the line of apertures, thereby greatly facilitating the compacting action.

Not only are the fibers of the fiber mass brought into a more compact longitudinally extending mass by the sucking action and the consequent sliding of the fibers on the ridges 27b of the roll 27, but also the sucking action on the fibers in the zone immediately preceding the nip N tends to draw the succeeding fibers from the fiber mass moving theretoward into a more straight configuration. This is particularly brought about by the pneumatic suction and inter-fiber pulling action on the fibers in the angular zone preceding the nip N. This pneumatic pulling action exerted on the fibers as they approach the suction zone preceding the nip N in cooperation with the angular or rotational movement of the roll surface 27a, 27b in frictional contact with the fibers effects a gentle plucking action as distinguished from the more positive nip plucking action afforded by conventional front nip rolls. This plucking action is also facilitated by the ridges 27b which are formed on the surface of the roll 27 between the recessed suction apertures 27d. The fibers which have been plucked and lie in part on the ridges 27b of the ridged or fluted and apertured roll 27 serve by the frictional cohesion with the subsequent fibers to gently drag such subsequent fibers onto the roll as these preceding fibers are pneumatically plucked onto, held, and compacted on the rotating roll surface 27a, 27b. This inter-fiber plucking plus the pulling action caused by the movement of the surface of rotating roll 27 preceding the nip zone N effects a general straightening of the fibers prior to their passage through the delivery roll nip N. This straightening action also tends to straighten out the "leading hooks" which normally occur in various masses of staple fibers, including carded sliver, roving, etc. The straightened fibers are then nipped in sequence in respect to their ordered lay in the fiber group as such fibers successively approach and reach the nip N.

The laterally compacted mass of fibers leaving the nip N is twisted by the twisting action of the ring and traveler takeup 29, and proceeds thereafter in the form of yarn Y or other desired strandular product to the takeup bobbin B. While a twister takeup is disclosed for illustrative purposes, it will be apparent that a non-twist imparting takeup might be employed if desired for the formation and handling of a particular other fiber mass product or intermediate product.

As added advantages of the present invention, the suction action in the vicinity of the nip N tends to reduce the amount of lint fly formed as a result of the normally substantial drafting action which takes place between the middle and final pairs of rolls. Also, as a result of the partial vacuum that exists in the approach area to the nip N of the rolls the fibers approaching the nip N do not tend to spread out as they approach the nip as in conventional drafting arrangements at high speeds due to the normal positive pressure air pocket and consequent laterally outward air movement in the nip approach region. On the contrary, the partial vacuum in the

approach area to the nip N enables the fibers to maintain and come into closer contact toward the longitudinal center of the mass under the compacting action exerted thereon by the air stream entering the line of suction apertures 27d in the recesses or grooves 27a between the ridges 27b of the fluted or ridged roll 27.

A further advantage lies in the scavenging action which the apertured roll 27 exerts on the adjacent top roll 25 of the final roll pair, thus tending further to reduce any necessity for clearing or cleaning of this top roll 25.

While the invention has been described with reference to only one preferred physical embodiment constructed in accordance therewith, it will be apparent that various modifications and improvements may be made without departing from the scope and spirit of the invention. For instance, the apertured and fluted or ridged roll 27 may in some instances be disposed in another position, such as by forming one of the second or middle pair of rolls, or two or more apertured rolls may be employed, e.g., one in each of the middle and final pair of drafting rolls. Also, while the fluted or ridged and grooved apertured roll 27 is particularly advantageous as employed in a drafting arrangement such as illustrated in the present application, this novel roll per se might also be employed to advantage either alone or in other combinations in order to effect the unique fiber mass compacting according to the present invention. Accordingly, it will be understood that the invention is not to be limited by this illustrative embodiment but only by the scope of the appended claims.

That which is claimed is:

1. Textile fiber handling apparatus comprising a roll having recesses and fiber-engaging ridges formed on its circumferential surface, said recesses and ridges extending in a direction axial of said roll, said roll having an internal cavity adapted to be connected to a negative pressure source, and a plurality of apertures formed in said roll about its circumference in a relatively narrow width circumferential band bounded on each side by a non-apertured band of relatively greater width than said narrow band and providing fluid communication paths between said recesses and ridges and said hollow internal cavity, and a second member movable about an axis spaced from said roll and having a peripheral surface in direct contact with said ridges on the circumferential surface of said roll.

2. Apparatus according to claim 1 wherein one of said apertures is formed in substantially each of said recesses.

3. Textile fiber handling apparatus comprising a roll having recesses and fiber-engaging ridges formed on its circumferential surface, each of said recesses and ridges extending in the axial direction of said roll, said roll having an internal cavity adapted to be connected to a negative pressure source, a plurality of apertures formed in said roll about its circumference and providing fluid communication paths between said recesses and ridges and said hollow internal cavity, a second member movable about an axis spaced from said roll and having a peripheral surface in direct contact with said ridges on the circumferential surface of said roll, and a conduit having an arcuate mouthed opening of less than approximately 180° in arc opening within said cavity and in registry with a portion of less than approximately 180° in arc of said apertures.

4. Textile drafting apparatus comprising a plurality of drafting rolls, one of said rolls having an internal cavity and a plurality of recesses and ridges formed on its circumferential periphery, each of said recesses and ridges extending in a direction axial of said roll, a plurality of apertures formed in said roll about its circumference and providing fluid communication paths between said recesses and ridges and said internal cavity, conduit means for connecting a selected zone of said apertures to a source of negative pressure at the cavity connection end, and a

5

vacuum source operably associated through said conduit means with said apertures in said selected zone.

5. The structure of claim 4 wherein one of said apertures is substantially in each of said recesses.

6. The structure of claim 4 wherein said apertures are in substantially the longitudinal center of said recesses.

7. The method of handling a mass of staple fibers comprising exerting opposed mechanical compacting forces on said mass of fibers by passage thereof between a first revolving surface and a second series of revolving transversely smooth surfaces opposing said first surface and separated from one another by intermediate revolving air-guiding grooves extending transversely of the direction of revolution of said second series of revolving surfaces, exerting pneumatic compacting forces on said mass of fibers by passage of air along said air-guiding grooves in opposing directions extending toward and into transversely compacting relation with said mass of fibers, and permitting the fibers in said mass to move freely on and in contact with said second series of surfaces under the influence of said pneumatic compacting forces in advance of passage of said mass of fibers between said first and second surfaces.

8. Apparatus according to claim 4 wherein said selected zone extends through an arc of less than approximately 180°.

9. Apparatus according to claim 4 wherein said apertures are formed and confined within a discrete band extending about the circumference of said roll and bounded on each lateral side by a circumferential zone free of said apertures.

10. Apparatus according to claim 9 wherein said selected zone extends through a width substantially coextensive with the width of said apertures.

11. Apparatus according to claim 4 wherein said recesses and ridges are formed by substantially parallel

6

grooves formed on the circumferential periphery of said roll.

12. Apparatus according to claim 11 wherein said recesses and ridges are substantially parallel to the axis of said roll.

13. Apparatus according to claim 4 wherein said conduit means includes baffles normally disposed in substantially stationary position within said roll and defining said selected zone.

14. The method according to claim 7 wherein said mass of fibers is a part of a rope of staple fibers which is passed in running relation between said first and second opposing surfaces.

15. The method according to claim 14 including applying a longitudinal drafting force to said mass of fibers during the application of said compacting force to said mass.

16. Apparatus according to claim 4 wherein said roll is in peripheral nip forming engagement with another of said rolls, said selected zone including the nip zone of said rolls.

17. Apparatus according to claim 4 wherein said roll is in peripheral nip zone forming engagement with another of said rolls, said selected zone including the zone immediately preceding the nip zone of said rolls.

18. Apparatus according to claim 17 wherein said selected zone includes the nip zone of said rolls and terminates adjacent the point of tangency of the yarn fibers leaving said roll.

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