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Open End Spinning

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OPEN END SPINNING

Filed Jan. 22, 1970 2 Sheets-Sheet 1

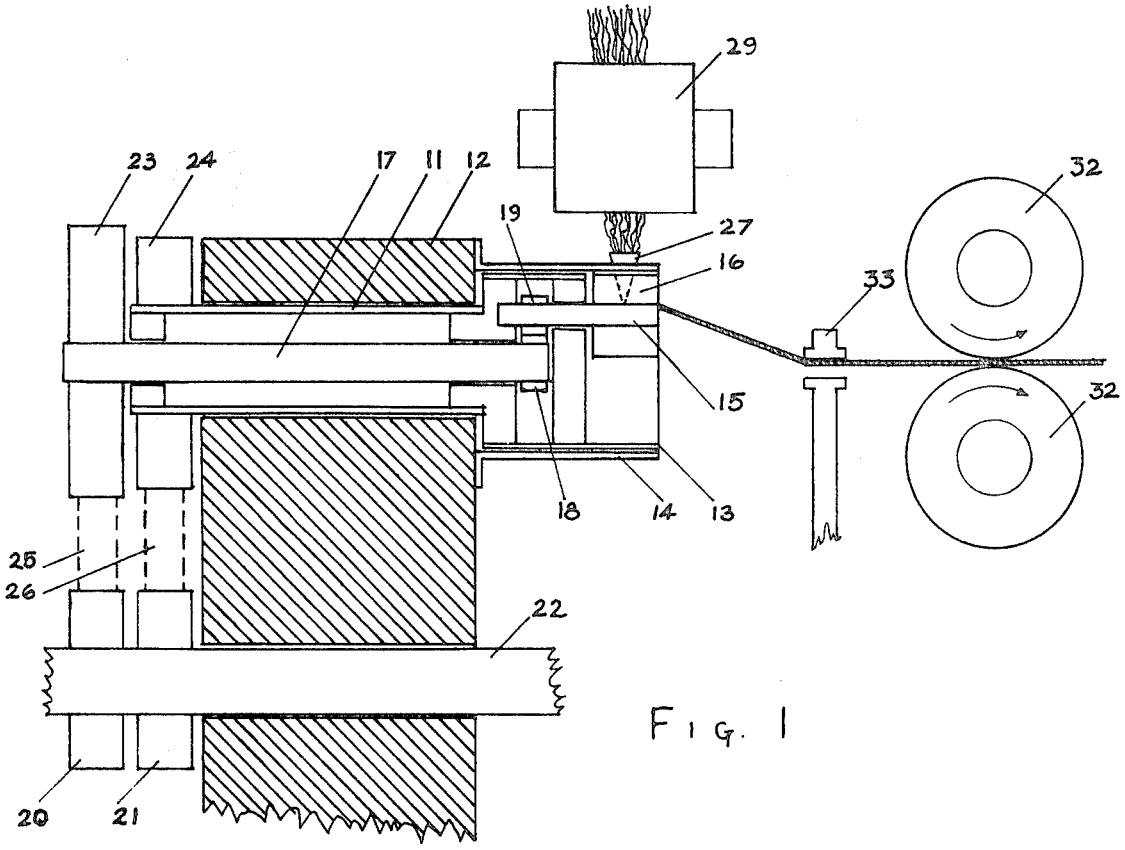

FIG. 1

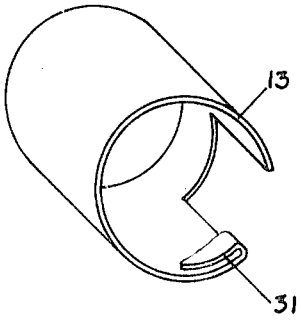

FIG. 3

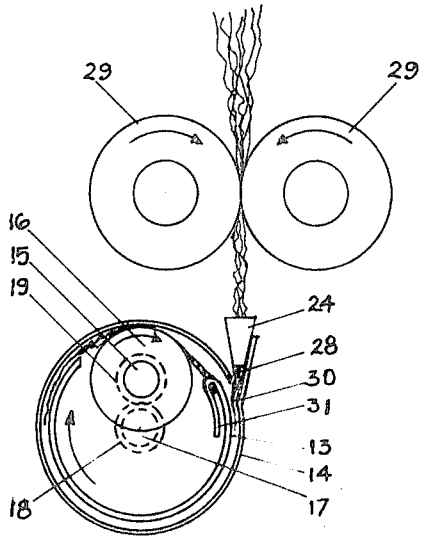

FIG. 2

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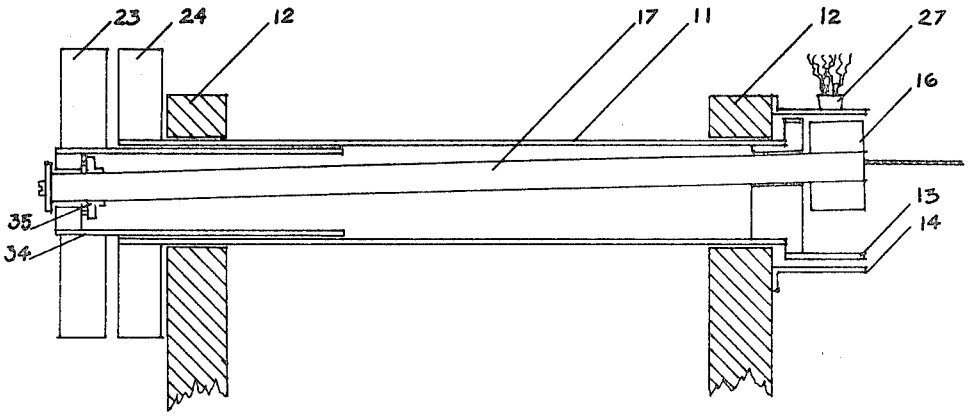

FIG. 4

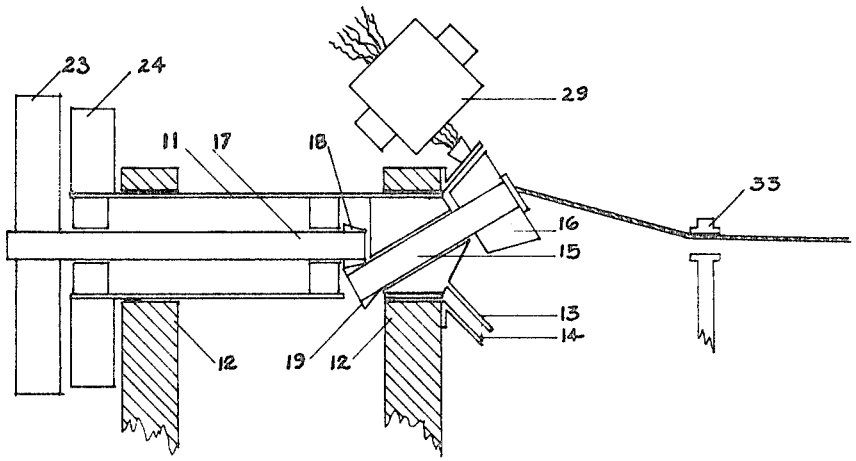

FIG. 5

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OPEN END SPINNING

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ABSTRACT OF THE DISCLOSURE

Textile apparatus capable of spinning, that is, drafting and twisting, yarn directly from staple fiber in conventional untwisted sliver form. Such apparatus includes a staple fiber assembly device having a relatively slowly moving endless fiber carrying surface such as a roll to be orbitally rotated about an axis at high speed for intermittently acquiring to its surface a relatively few fibers positively extracted from the end of a sliver at a fixed fiber transfer point on a more or less smooth surface for a permanent nipping contact with fiber carrying surface to intermittently remove a predetermined amount of fibers from the end of the sliver and transfer them directly and positively onto the fiber carrying surface in overlapping configuration to draft them. The transferred fibers are slowly advanced by the fiber carrying surface to a yarn transfer point on the carrying surface, maintaining a firm control grip between the fiber carrying surface and the smooth surface, while moving the acquired fiber assembly in a circular path on the smooth surface, creating a rapidly rotating continuous fiber holding point toward which drafted fibers in overlapping configuration are continuously advanced on the slowly moving fiber-carrying surface. The twisting phase in which the fibers are twisted into yarn takes place in a spinning zone extending from the yarn transfer point on the fiber carrying surface and a stationary yarn delivery means, such as a pair of cooperating delivery rolls, providing a yarn holding point spaced from the yarn transfer point. The fiber carrying roll thus serves simultaneously as fiber detaching means to remove fibers at the fiber transfer point from the end of the input sliver and as a positive nip at the yarn transfer point to provide a suitable tension in the twisting zone. The completed yarn passing from the yarn delivery rolls may be wound into a package of any desired size and configuration.

This invention relates in general to an improved method of spinning staple fiber into yarn or the like.

The manufacture of yarn from staple fiber has almost exclusively employed the ring and traveler to tension and twist the fiber strand while winding the yarn on a bobbin rotating inside the ring. It has long been realized that this method has several disadvantages.

Accordingly, it is a major object of this invention to provide an improved yarn spinning system which does not require the use of the ring and traveler that always limited the speed of twisting and required more or less frequent stoppage of the operation for doffing the bobbins and replacing travelers.

Another object of the present invention is to provide a method of spinning fibrous material into yarn while continuously winding it, knot free, on a final package of any desired form and size.

Although there have been some developments in open end spinning, in general, the proposed systems produce a yarn in which the fibers near the center are overtwisted with respect to fibers on the surface.

It is, therefore, another object of this invention to provide a spinning system that forms a full size yarn strand of parallel fibers before twisting the total group into high quality yarn.

In previous methods of spinning yarn it is found that

the tension of the fiber strand in the spinning zone varies and cannot be optimized because the tension is dependent on other spinning parameters such as spindle speed, traveler wear, bobbin size, balloon height, etc.

It is, accordingly, an object of this invention to provide a spinning apparatus in which the yarn tension may be always optimum, regardless of other process variables.

The roll drafting used in conventional spinning produces the well known drafting wave which causes variation in size of the drafted stock.

Therefore, it is an object of the present invention to provide a different means of drafting not having the so-called drafting wave. In this method the required draft is obtained by removing small increments of fiber from the tip end of the input sliver by completely detaching each increment before the succeeding one is gripped by the detaching means.

The basic novel principle of this invention is to firmly nip a group of parallel fibers against a smooth surface while employing friction to move the fiber group over the surface in a circular path passing over a transfer area where in each revolution an increment of fibers is added to the fiber group, which group is slowly advanced relative to the nip zone into a yarn that is continuously drawn away, generally along the axis of rotation of the fiber group, thus twisting the parallel fibers into the yarn near the continuous nip zone.

It is clear that since neither the input sliver nor the outgoing yarn is axially rotated, there can be no variation of twist due to the form or size of package for the input sliver or that upon which the yarn is wound.

The above and other objects and advantages of this invention will be more fully clarified by the following specifications in connection with the several drawings in which:

FIG. 1 shows a side view of the first embodiment of the novel apparatus of this invention. It illustrates the flow of staple fibers through the machine from the input sliver to the finished outgoing yarn. It also shows a suggested drive means for the novel part of the invention.

FIG. 2 shows an end view from the right side of the spinning head to more clearly illustrate the spinning principle of the invention.

FIG. 3 is a three-dimensional view of the spinning head sleeve 13 separate from the shroud 14 and the roll 16 to more clearly show its detail and that of the yarn guide hook 26.

FIG. 4 is a front view of a variant of the first embodiment in which the roll 16 is driven without the use of gears. An end view for this form would be essentially identical to that of the first embodiment as it is shown in FIG. 2.

FIG. 5 shows another variant of the invention wherein instead of a cylindrical shroud, a conical shroud is used.

Referring to the drawings in greater detail the invention is shown applied to spinning staple fiber from a conventional package into knot free yarn in any desired quantity.

As shown in FIGS. 1 and 2 the hollow shaft 11 rotating in bearing 12 rotates a spinning head 13 concentrically in a cylindrical shroud 14, which has a smooth inside surface. Mounted off-center in the head 13 is a short shaft 15 for driving a somewhat resilient friction roll 16 always in suitably firm contact with the inner surface of said shroud. A shaft 17 mounted in bearings within hollow shaft 11 employs gears 18 and 19 to drive shaft 15 and roll 16. Pulleys 20 and 21 on the main drive shaft 22 drive both pulleys 23 and 24 clockwise by means of belts 25 and 26 but turning shaft 17 slightly slower than shaft 11 so that relative to shaft 11 the shaft 17 will be driven slowly counterclockwise which causes roll 16 to be driven clockwise in the spinning head 13.

The shroud **14** is provided with a partially funnel-shaped piece **27** and a more or less tangential opening **28** to direct fibers from sliver feed rolls **29** to a fiber transfer area **30** on the inside surface of the shroud immediately ahead of said tangential opening **28**.

During each revolution of the spinning head **13** an increment of staple fibers are nipped at the said transfer area by the friction roll **16** and by friction of said roll are moved around the inside surface of the shroud **14** being continuously and firmly held between the roll **16** and the shroud **14**. By this action during each revolution of the head **13** an increment of fibers is completely detached from the sliver being fed through the tangential opening **28** and one turn of twist is inserted in the outgoing yarn.

A pilot yarn being inserted through the tangential opening **28** between roll **16** and shroud **14** and through guide hook **31** thence to take off rolls **32** is drawn away as fast as it is advanced by the slow rotation of roll **16** in the spinning head **13**. The rotation of the spinning head twists the yarn close into the "bite" between roll **16** and the inside surface of shroud **14**. This twisting action also involves new fibers being brought around roll **16** so that as the pilot yarn leaves the roll, new yarn is drawn off indefinitely and wound on a package of any desired form and size.

The roll **16** has a higher coefficient of friction on staple fiber than that between the shroud and the fiber which enables the group of parallel fibers nipped between the roll and the shroud to be held sufficiently firmly that the outgoing yarn may be given optimum tension in the twisting zone and twist be prevented from passing past the "bite" of roll **16** on the shroud. This insures that a strand of parallel fibers in brought to the twisting zone where the whole strand is twisted as is done in conventional yarn spinning.

Thus the roll **16** serves simultaneously as a fiber detaching roll for incoming fibers and a tension roll for the outgoing yarn.

The function of the yarn guide hook shown in FIG. 3 is to enable pulling the yarn almost tangentially from the "bite" point of roll **16**. It is found that the operation is improved by pulling the yarn at an angle having a small axial component toward the take off rolls.

The cylindrical sleeve **13** of the spinning head (shown in detail in FIG. 3) serves as staple fiber guide means providing a surface parallel and near the surface of shroud **14** to lightly control the trailing ends of the fibers held in bite between roll **16** and shroud **14**. This element **13** tends to keep the fibers collected on roll **16** in a loosely compacted parallel relation to each other as they are being advanced through the fiber nip zone.

The element **33** is a false twisting means which may be of any well known driven type or it may be simply a small stationary circular aperture having an inner surface with a fairly high coefficient of friction relative to the staple fiber. The use of false twisting creates a higher degree of yarn twist in the region between the roll **16** and the false twisting device enabling yarn to be made with lower final twist than if false twisting is not used.

It should be noted, however, that the false twisting device is not essential to practical operation of the invention.

In a variant form of the invention shown in FIG. 4 the roll **16** is driven without the use of gears since it is mounted directly on shaft **17**.

The pulley **23** is mounted on a hollow shaft **34** running in a bearing inside hollow shaft **11**. The shaft **17** is mounted at a small angle to shaft **11** thereby requiring roll **16** to be slightly conical and also requiring a suitable flexible connection **35** to shaft **34**. To avoid having the shaft **17** at too great an angle to shaft **11** the unit is made longer than the first embodiment. It is obvious that a suitable flexible shaft may be used instead of the rigid shaft **17** to drive the roll **16**.

FIG. 5 illustrates another variant of this invention in which the shroud is conical instead of cylindrical. The roll **16** is mounted on a short shaft **15** which is driven from shaft **17** by gears as in the first embodiment shown in FIG. 1. It is clear that within the invention the apparatus could be made with the conical angle having any value between 0 and 90 degrees. For the limiting angle of 0 degrees the shroud cone would be the cylinder as in the first embodiment of the invention, and for the limiting angle of 90 degrees the shroud cone would be a disc.

It is apparent that the above descriptions are given to illustrate certain embodiments of the invention although the various structures are subject to wide variations without departing from the scope of the appended claims.

I claim:

1. Apparatus for spinning yarn from staple fiber comprising

staple fiber control means having about an axis a stationary smooth surface with a fiber transfer area thereon

staple fiber supply means arranged to deliver staple fibers in sliver form to said fiber transfer area staple fiber transfer means structured to have movable surface rotatable about an axis to employ friction of said surface on staple fiber to collect in parallel overlapping relation on said surface staple fibers delivered by said fiber supply means to said fiber transfer area

arrangement to use friction of said rotatable surface on staple fiber to move collected fibers about an axis on smooth surface of said staple fiber control means in a path concurring with said staple fiber transfer area

staple fiber progression means for advancing staple fibers collected on surface of said staple fiber transfer means to a yarn transfer point thereon

staple fiber output means including

means for removing, externally, in yarn form staple fibers from said yarn transfer point tangentially to surface of said transfer means in a direction generally parallel to said axis

yarn delivery means with a yarn nip at a yarn delivery point at some distance from said yarn transfer point

power means for

driving said staple fiber supply means and

moving surface of said fiber transfer means to collect fibers on said surface from said fiber transfer area and

moving fibers collected on surface of staple fiber transfer means in a closed path on surface of said fiber control means about said axis and

advancing said collected fibers on surface of said transfer means to said yarn transfer point and

rotating said transfer means to rotate fibers at said yarn transfer point to spin them into yarn in a twisting zone which extends from said yarn transfer point to said yarn delivery point and

driving said yarn delivery means.

2. Apparatus as claimed in claim **1** further including false twisting means acting on yarn strand in said twisting zone for increasing degree of twist in region between said false twist means and said yarn transfer point including power means for operating said false twist means.

3. Apparatus for spinning yarn from staple fiber comprising

staple fiber control means providing about an axis a smooth stationary surface having somewhat low friction on said staple fiber arranged with a fiber transfer area thereon

staple fiber supply means arranged to deliver staple fiber in sliver form to said fiber transfer area

staple fiber transfer means arranged to have

movable surface with somewhat high friction on staple fibers rotatable about an axis to collect

in parallel overlapping relation on said surface the staple fibers delivered by said staple fiber supply means to said fiber transfer area

arrangement for using friction of said surface on staple fibers and friction between fibers to move the collected fibers on surface of said staple fiber control means about an axis in a closed path which passes through said fiber transfer area

staple fiber progression means for advancing staple fibers collected on surface of said staple fiber transfer means to a yarn transfer point thereon

staple fiber output means including

means for removing externally, in yarn form staple fibers from said yarn transfer point tangentially to surface of said transfer means in a direction generally parallel to said axis yarn delivery means with a yarn nip at a yarn delivery point at some distance from said yarn transfer point

power means for

driving said staple fiber supply means and

moving surface of said fiber transfer means to collect fibers on said surface from said fiber transfer area and

moving fibers collected on surface of staple fiber transfer means in a closed path on surface of said fiber control means about said axis and

advancing said collected fibers on surface of said transfer means to said yarn transfer point and

rotating said transfer means to rotate fibers at said yarn transfer point to spin them into yarn in a twisting zone which extends from said yarn transfer point to said yarn delivery point and

driving said yarn delivery means.

4. Apparatus as claimed in claim 3 having surface of said staple fiber control means on a suitable cylinder about said axis.

5. Apparatus as claimed in claim 3 having surface of said staple fiber control means on a suitable cone about said axis.

6. Apparatus as claimed in claim 3 having a surface of said staple fiber control means on a suitable plane perpendicular to said axis.

7. Apparatus for spinning yarn from staple fiber comprising

staple fiber control means having about an axis a stationary smooth surface with a fiber transfer area thereon

staple fiber supply means arranged to deliver staple fibers in sliver form to said fiber transfer area staple fiber transfer means arranged to have

movable surface having somewhat high friction on staple fiber rotatably supported on said fiber transfer means to intermittently collect in parallel overlapping relation on said surface staple fibers delivered by said fiber supply means to said fiber transfer area

arrangement to use friction of said surface on staple fibers and friction between fibers to move the collected fibers about said axis on said smooth surface of said staple fiber control means in a closed path that passes over said fiber transfer area

staple fiber guide means providing a surface near and parallel to surface of said fiber control means for maintaining collected fibers in somewhat loose parallel order between said surfaces

staple fiber progression means for advancing staple fibers collected on surface of said staple fiber transfer means to a yarn transfer point thereon

staple fiber output means including

means for removing externally, in yarn form staple fibers from said yarn transfer point tangentially to surface of said transfer means in a direction generally parallel to said axis

yarn delivery means with a yarn nip at a yarn delivery point at some distance from said yarn transfer point

power means for

driving said staple fiber supply means and

moving surface of said fiber transfer means to collect fibers on said surface from said fiber transfer area and

moving fibers collected on surface of staple fiber transfer means in a closed path on surface of said fiber control means about said axis and

advancing said collected fibers on surface of said transfer means to said yarn transfer point and

rotating said transfer means to rotate fibers at said yarn transfer point to spin them into yarn in a twisting zone which extends from said yarn transfer point to said yarn delivery point and

driving said yarn delivery means.

8. Apparatus as claimed in claim 7 further having false twist means structured in form of a stationary sleeve with frictional inner surface to loosely surround the yarn strand in said twisting zone for increasing degree of yarn twist in region between said false twist means and said yarn transfer point.

9. Apparatus for spinning yarn from staple fiber comprising

staple fiber control means arranged and structured to have

about an axis a smooth stationary surface with somewhat low coefficient of friction relative to staple fiber

staple fiber transfer area on part of said smooth stationary surface

aperture through surface of said staple fiber control means from one side of the surface to the other

funnel shaped staple fiber guide adjacent to said aperture in said staple fiber control means

staple fiber supply means on one side of surface of said fiber control means for delivering staple fibers in sliver form through said fiber guide and said aperture to said fiber transfer area on other side of said surface

staple fiber transfer means arranged to have

movable surface rotatable about an axis and having a somewhat high coefficient of friction relative to said staple fiber for collecting in parallel overlapping relation on said surface the fibers delivered by said fiber supply means to said fiber transfer area where the said fibers are intermittently, positively nipped between the said highly frictional surface of the fiber transfer means and the less frictional surface of the said staple fiber control means

arrangement to use friction of said surface on the collected fibers to move same about an axis by slipping said fibers on surface of said fiber control means in a circuitous path concurring with said fiber transfer area maintaining throughout the said path a continuous fiber nip between surface of said fiber transfer means and surface of said fiber control means

staple fiber guide means providing a surface near and parallel to surface of fiber control means for maintaining collected fibers in somewhat loose parallel order between said surfaces

staple fiber progression means for advancing the fibers collected on the surface of said staple fiber transfer means to a yarn transfer point thereon

staple fiber output means including

means for removing externally, in yarn form staple fibers from said yarn transfer point tangentially to surface of said transfer means in a direction generally parallel to said axis

yarn delivery means with a yarn nip at a yarn delivery point at some distance from said transfer point

power means for

driving said staple fiber supply means and

moving surface of said fiber transfer means to collect fibers on said surface from said fiber transfer area and

moving fibers collected on surface of staple fiber transfer means in a closed path on surface of said fiber control means about said axis and

advancing said collected fibers on surface of said transfer means to said yarn transfer point and

rotating said transfer means to rotate fibers at said yarn transfer point to spin them into yarn in a twisting zone which extends from said yarn transfer point to said yarn delivery point and

driving said yarn delivery means.

10. Apparatus same as claimed in claim **9** having effective surface of said staple fiber control means cylindrical.

11. Apparatus as claimed in claim **9** having effective surface of said staple fiber control means conical.

12. Apparatus as claimed in claim **9** having effective surface of said staple fiber control means flat.

13. Apparatus for spinning yarn from staple fiber comprising

staple fiber control means arranged and structured to have

about an axis a smooth stationary surface with somewhat low coefficient of friction relative to staple fiber

staple fiber transfer area on part of said smooth stationary surface

aperture through surface of said staple fiber control means from one side of the surface to the other

funnel shaped staple fiber guide adjacent to said aperture in said staple fiber control means

staple fiber supply means on one side of surface of said fiber control means for delivering staple fibers in sliver form through said fiber guide and said aperture to said fiber transfer area on other side of said surface

staple fiber transfer means structured and arranged to have

movable surface rotatable about an axis to maintain a moving permanent positive fiber nip on surface of said staple fiber control means for sliding collected fibers about said axis on surface of said fiber control means in a circuitous part of which is said fiber transfer area

friction of said movable surface on fiber higher than the friction of said fibers on surface of said fiber control means

arrangement for intermittently collecting increments of fibers in parallel overlapping relation on said movable surface by said fiber nip passing over said fiber transfer area in successive cycles said increments of fibers clinging to surface of said fiber transfer means and slipping on surface of said fiber control means

staple fiber guide means providing a surface near and parallel to surface of said fiber control means for maintaining collected fibers in somewhat loose parallel order between said surfaces

yarn guide hook means mounted on said staple fiber guide means tangentially forward of said movable surface

staple fiber progression means for advancing fibers collected on surface of said staple fiber transfer means to a yarn transfer point thereon

staple fiber output means including

means for removing externally, in yarn form staple fibers from said yarn transfer point tangentially from surface of said fiber transfer means in a direction generally perpendicular to said axis to said yarn guide hook thence generally parallel to said axis

yarn delivery means with the yarn nip at a yarn delivery point at some distance generally along said axis

false twist means in form of a stationary sleeve with frictional inner surface loosely surrounding yarn strand in said twisting zone for increasing degree of yarn twist in region between said false twist means and said yarn transfer point

first drive shaft means arranged for rotating said staple fiber transfer means in a path about an axis maintaining a continuous contact between surface of said transfer means and surface of said fiber control means effecting intermittent, positive fiber nipping between said surfaces the fibers delivered to said transfer area by said fiber supply means

second drive shaft means mounted in first drive shaft means for rotating said fiber collecting surface relative to said staple fiber transfer means

power means having provisions for

driving said staple fiber supply means delivering staple fibers in sliver form to said fiber transfer area and

moving surface of said staple fiber transfer means to intermittently collect fibers from said staple fiber transfer area and

moving fibers collected on surface of said fiber transfer means in a closed path on surface of said staple fiber control means about said axis and

advancing said collected fibers on surface of said fiber transfer means to said yarn transfer point and

rotating said staple fiber transfer means to rotate fibers at said yarn transfer point to spin said fibers into yarn in a twisting zone which extends from said yarn transfer point to yarn delivery point in said yarn delivery means and

driving said yarn delivery means and

driving first and second drive shafts at differential speeds.

14. Apparatus for spinning yarn from staple fiber comprising

staple fiber control means structured to have

about an axis a stationary cylinder means having smooth inside surface with a somewhat low coefficient of friction relative to staple fiber

staple fiber transfer area on part of said smooth surface

aperture from outside to inside through wall of said cylinder means to said transfer area

funnel shaped fiber guide on outside of said cylinder means immediately adjacent to said tangential aperture

staple fiber supply means outside of surface of said cylinder means for delivering staple fiber in sliver form through said fiber guide and tangential aperture to said fiber transfer area

staple fiber transfer means arranged and structured to have

movable surface rotatable about an axis and having somewhat high coefficient of friction relative to staple fiber maintaining a permanent fiber nipping contact with said cylindrical surface of said staple fiber control means for intermittently nipping at said staple fiber transfer area the fibers delivered thereon by said staple fiber supply means and collecting said fibers in parallel overlapping relation on said movable surface

means for rotation of said movable surface about said axis to provide the said intermittent nipping and to slide the said collected fibers on inside

wall of said cylinder means holding said collected fibers in a permanent, positive fiber nip between said movable surface and stationary surface of said cylinder means

staple fiber guide means providing a surface near and concentric with surface of said cylinder means for maintaining said collected fibers in somewhat loose parallel order between said surfaces

yarn guide hook means mounted on said staple fiber guide means somewhat forward of said movable surface

staple fiber progression means for advancing fibers collected on surface of said staple fiber transfer means to a yarn transfer point thereon

staple fiber output means including

means for removing externally, in yarn form staple fibers from said yarn transfer point tangentially from surface of said fiber transfer means in a direction generally perpendicular to said axis to said yarn guide hook thence generally parallel to said axis

yarn delivery means with the yarn nip at a yarn delivery point at some distance generally along said axis

false twist means in form of a stationary sleeve with frictional inner surface loosely surrounding yarn strand in said twisting zone for increasing degree of yarn twist in region between said false twist means and said yarn transfer point

first drive shaft means arranged for rotating said staple fiber transfer means in a path about an axis maintaining a continuous contact between surface of said transfer means and surface of said fiber control means effecting intermittent, positive fiber nipping between said surfaces the fibers delivered to said transfer area by said fiber supply means

second drive shaft means mounted in first drive shaft means for rotating said fiber collecting surface relative to said staple fiber transfer means

power means having provision for

driving said staple fiber supply means delivering staple fibers in sliver form to said transfer area and

moving surface of said staple fiber transfer means

to intermittently collect fibers from said staple fiber transfer area and

moving fibers collected on surface of said fiber transfer means in a closed path on surface of said staple fiber control means about said axis and

advancing said collected fibers on surface of said transfer means to said yarn transfer point and

rotating said staple fiber transfer means to rotate fibers at said yarn transfer point to spin said fibers into yarn in a twisting zone which extends from said yarn transfer point to yarn delivery point in said yarn delivery means and

driving said yarn delivery means and

driving first and second drive shaft means at differential speeds

driving said staple fiber supply means at a predetermined rate relative to rates of said fiber transfer means and said fiber progression means to draft the input sliver in a desired ratio

driving said yarn delivery means at a predetermined rate with respect to rates of said fiber transfer means and said fiber progression means for producing yarn having a desired degree of twist.

15. Apparatus as claimed in claim **14** having

staple fiber control means having about an axis a stationary cone with a smooth inside surface with a somewhat low coefficient of friction relative to staple fiber.

16. Apparatus as claimed in claim **14** having

staple fiber control means having about an axis a stationary disc one side with a smooth surface having a somewhat low coefficient of friction relative to staple fiber.

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JOHN PETRAKES, Primary Examiner

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