

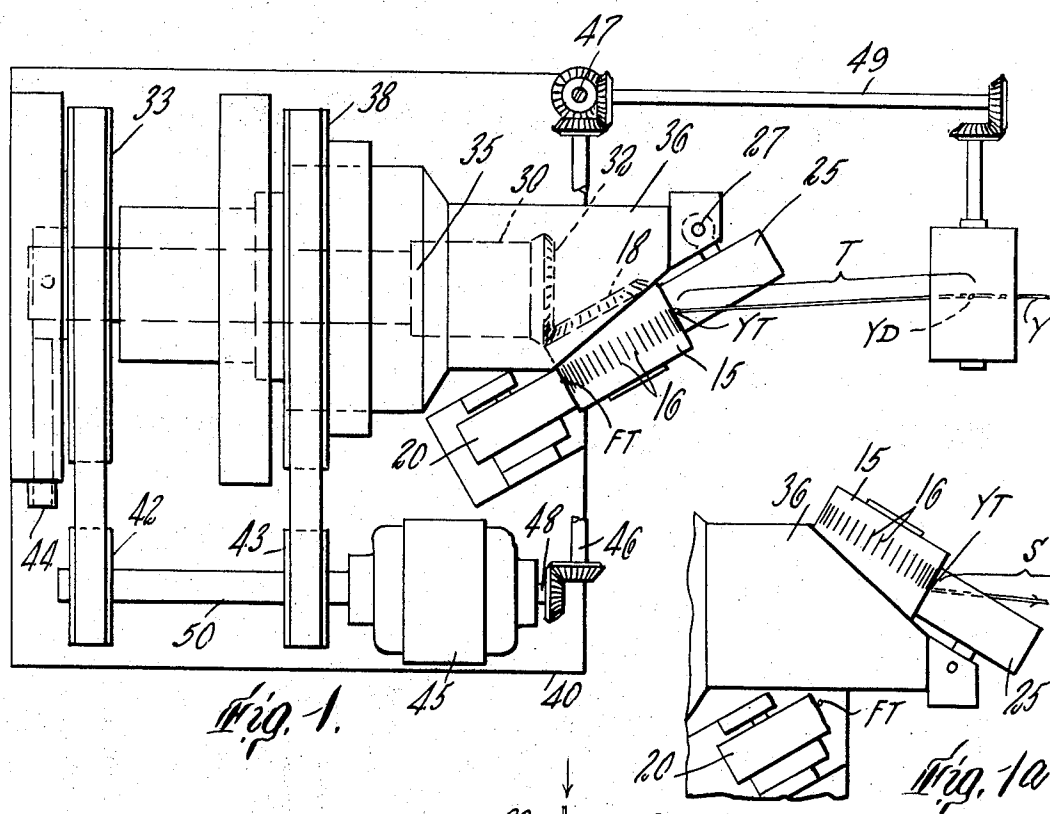
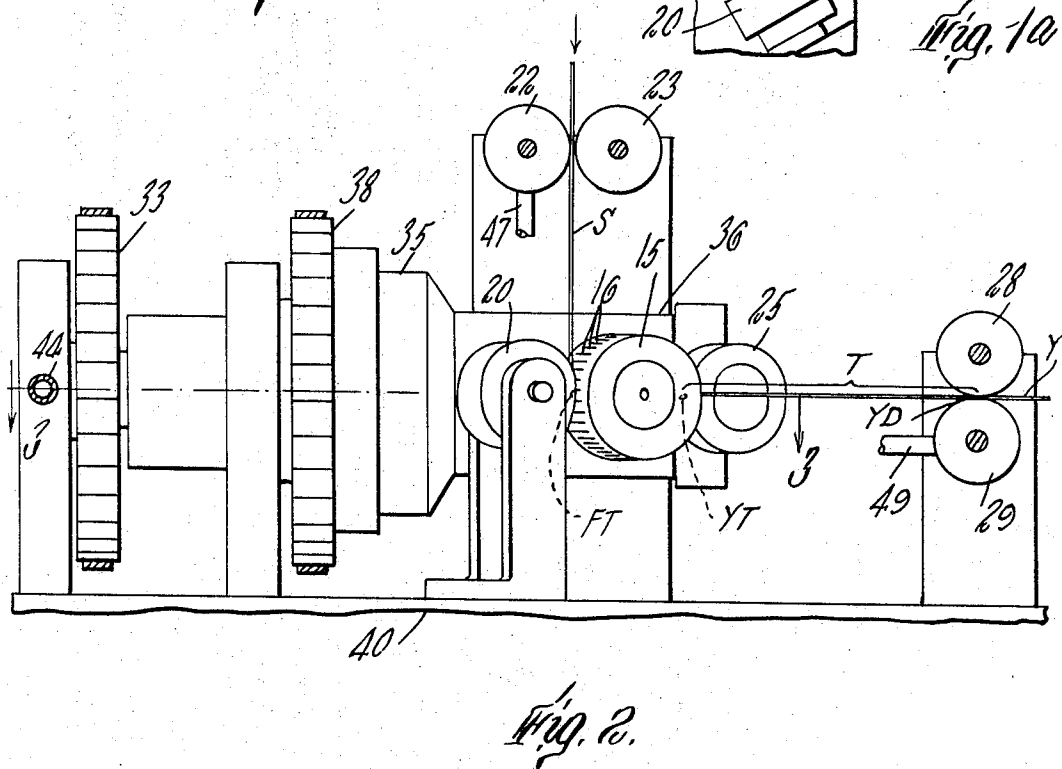
Sept. 26, 1967

H. M. BROWN
OPEN END SPINNING

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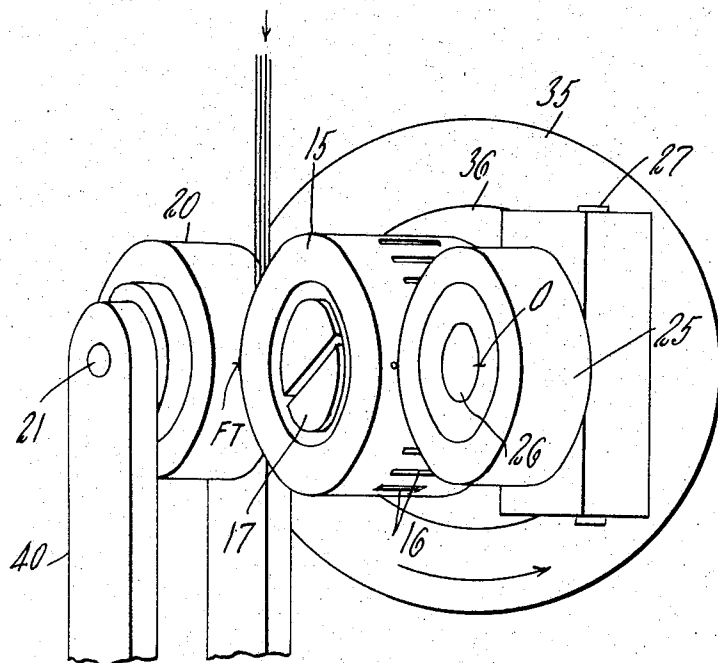


Fig. 5.

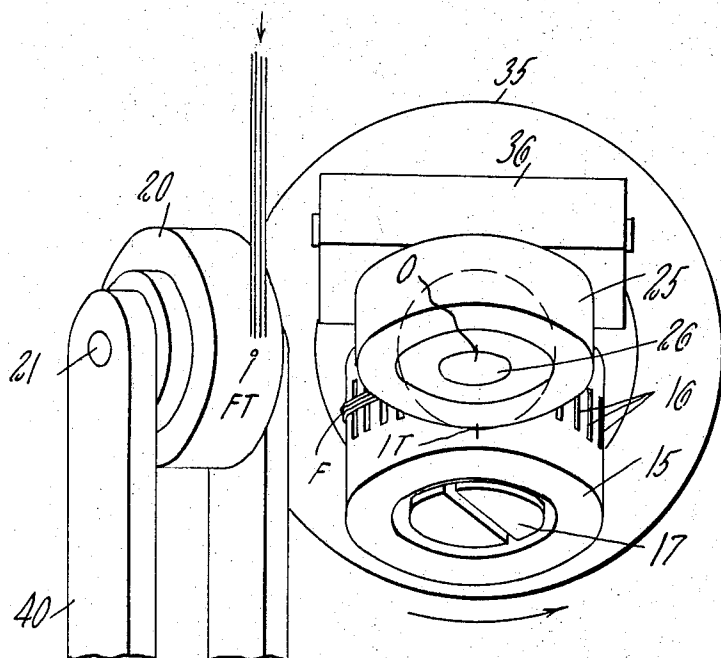


Fig. 6.

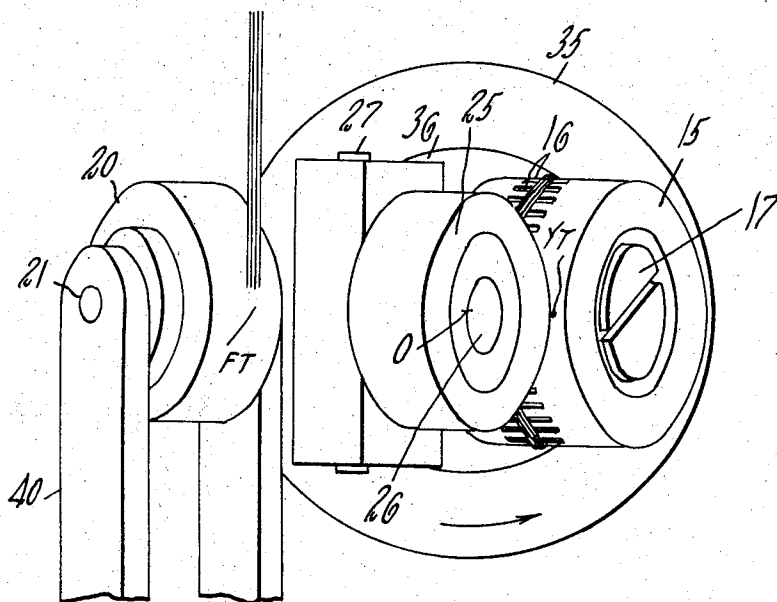
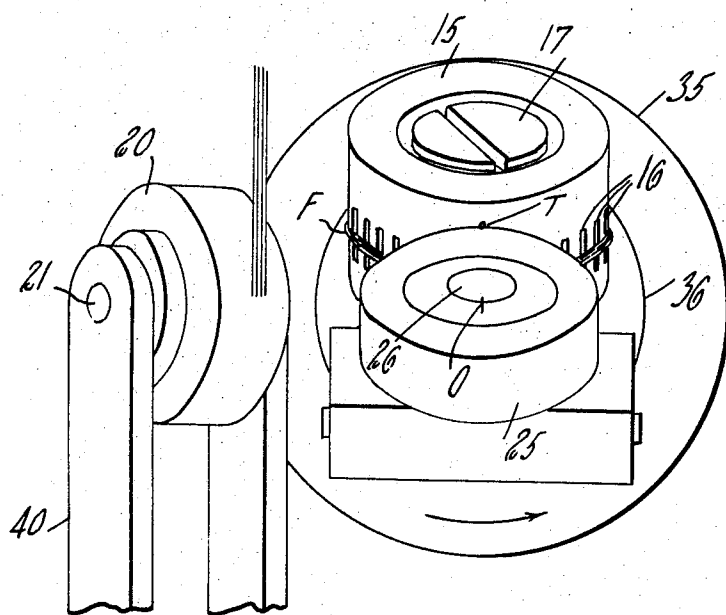
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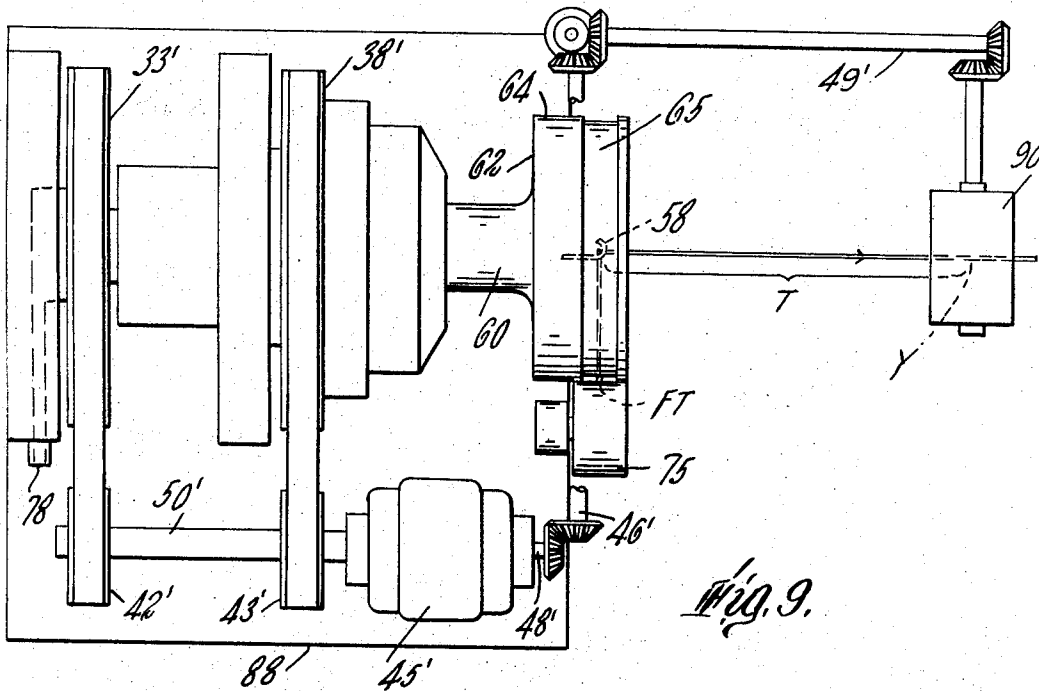
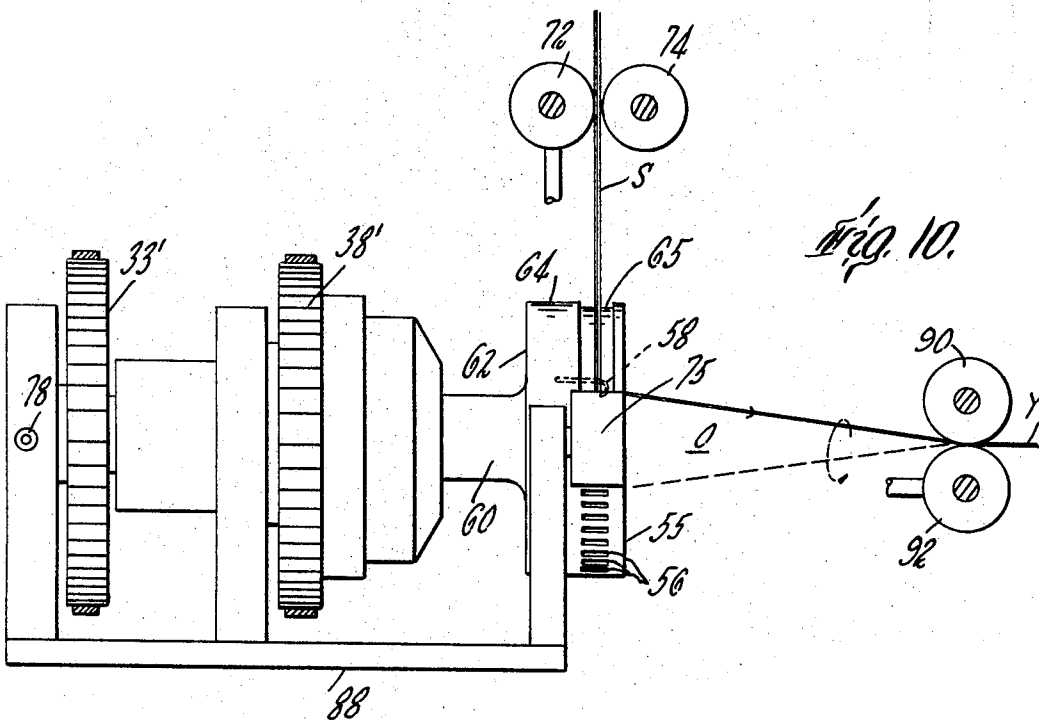
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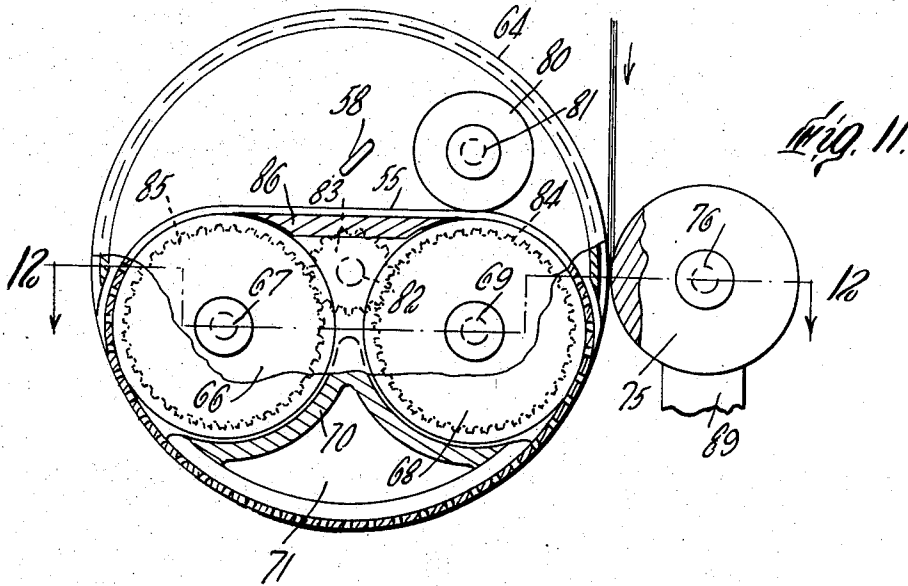
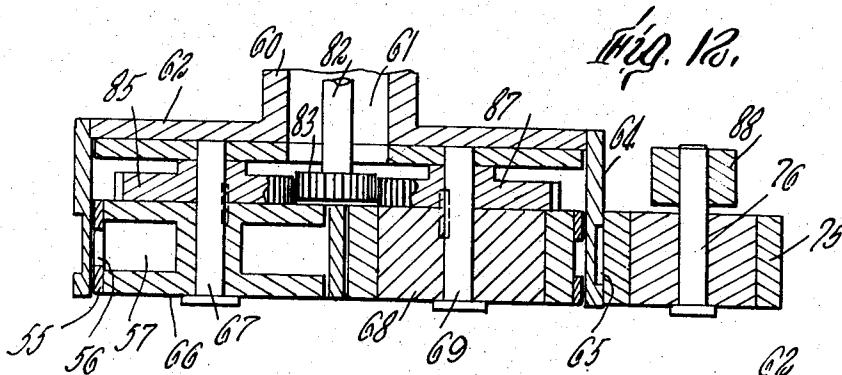
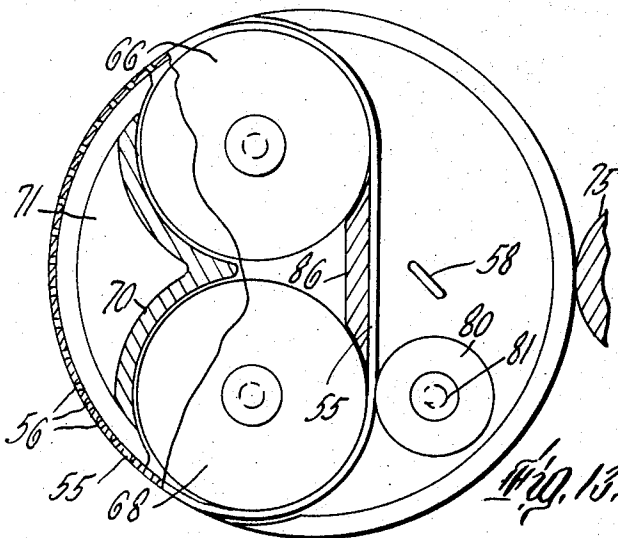
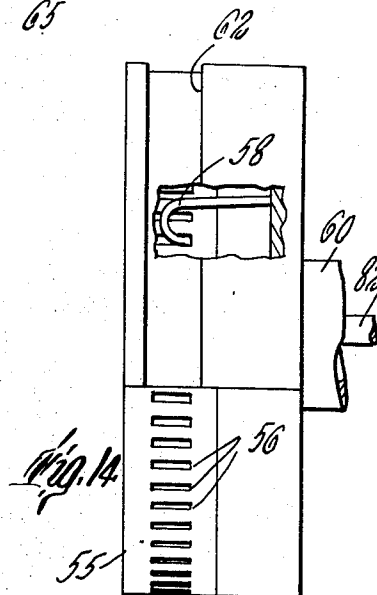
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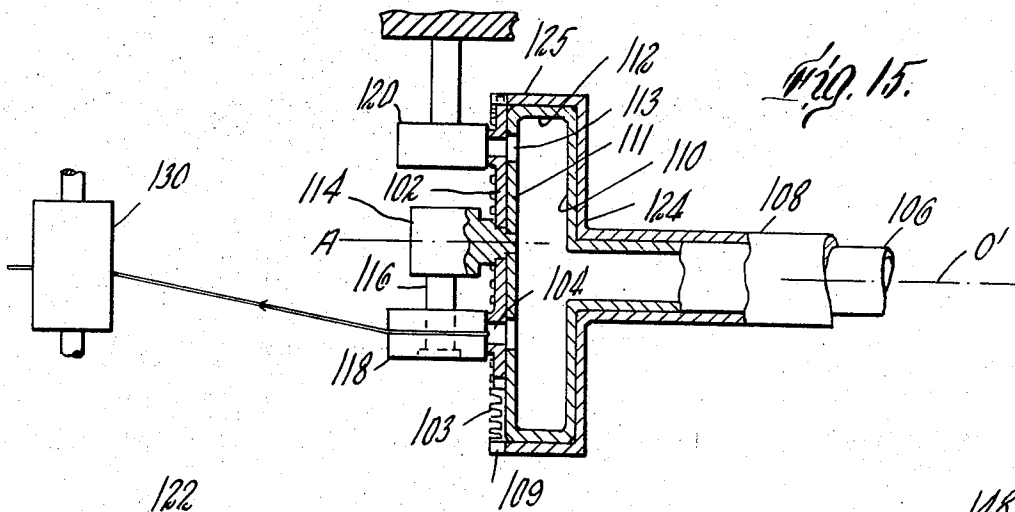
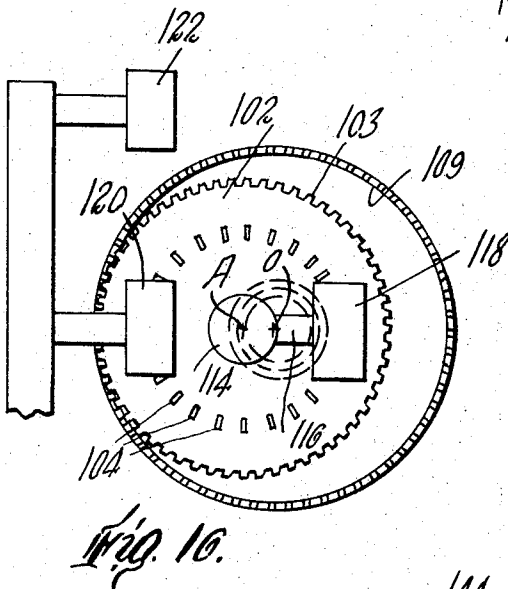
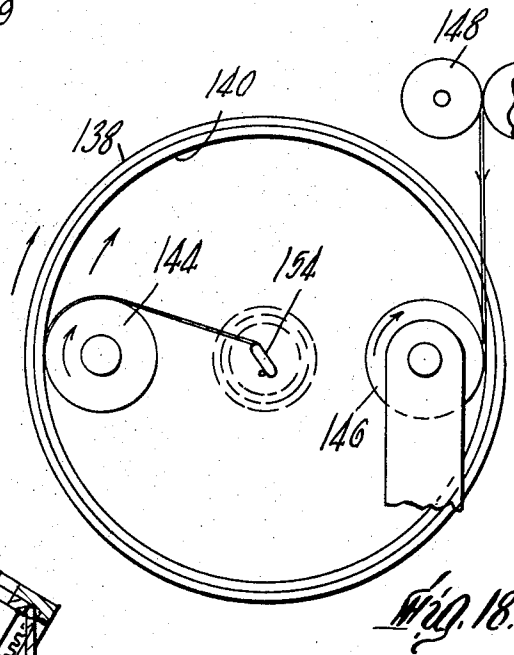
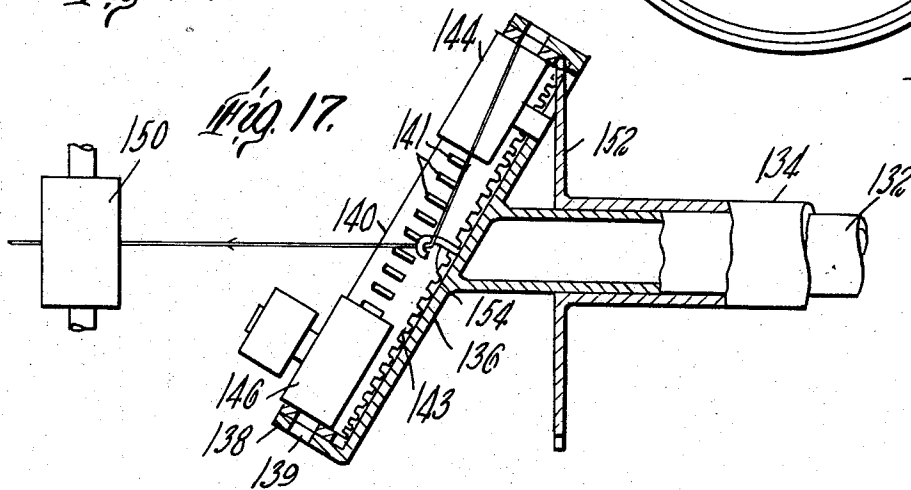
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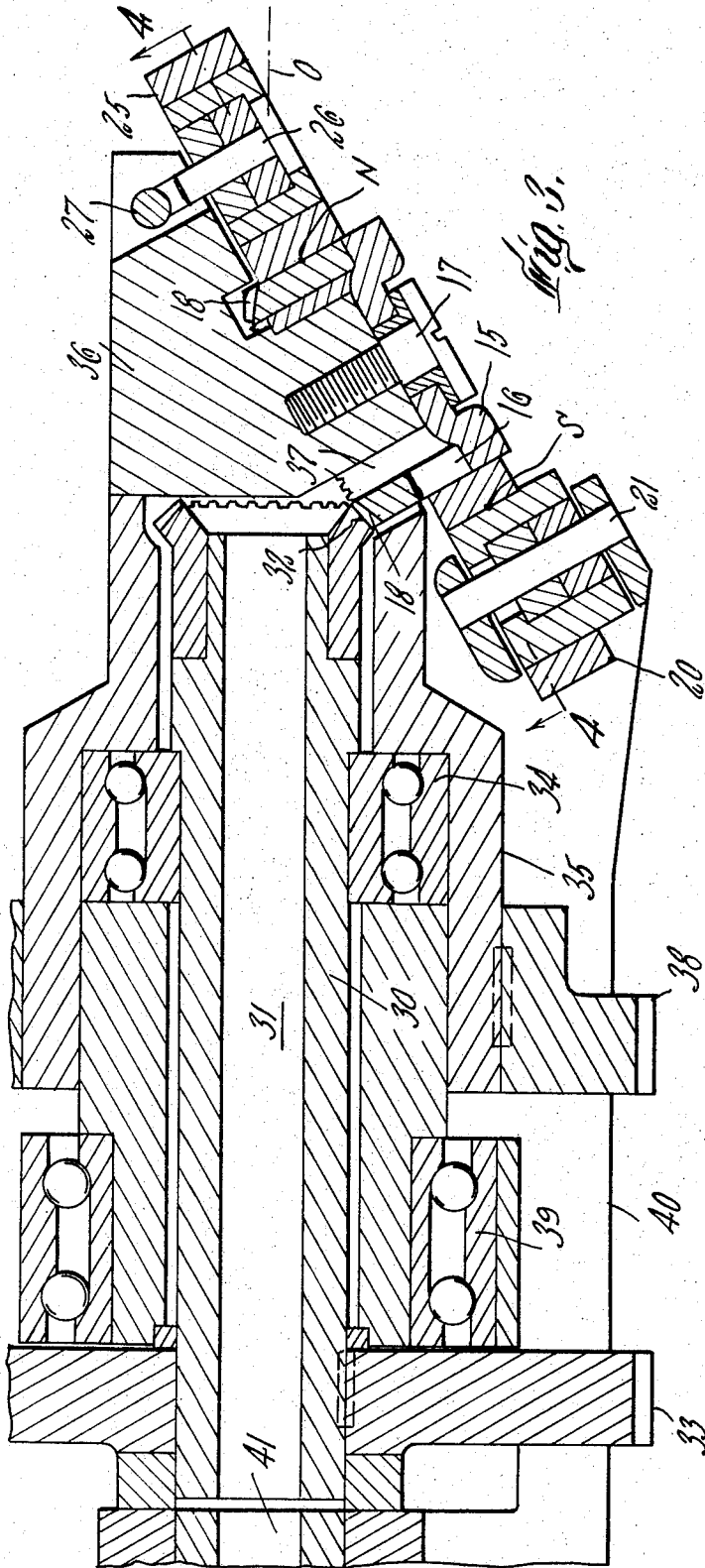
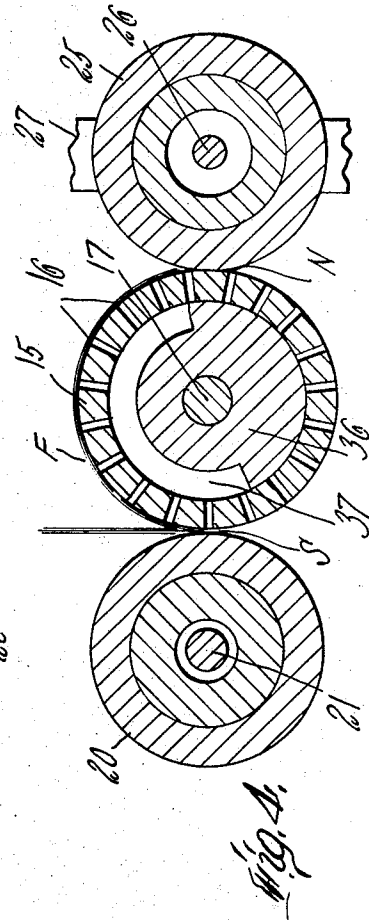
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23 Claims. (Cl. 57—58.91)

ABSTRACT OF THE DISCLOSURE

Textile apparatus capable of spinning, that is, both 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 pneumatic suction roll or apron, orbitally rotating about an axis at high speed for intermittently applying to its surface a relatively few fibers positively extracted from the end of a sliver at a staple fiber sliver supply, such as a detaching roll, positioned at a fixed fiber transfer point for intermittent fiber nipping contact with the fiber carrying surface to 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. At the yarn transfer point, there is provided a control device, such as a control roll, in contact with the fiber-carrying surface and rapidly orbitally rotating therewith, creating a rapidly rotating continuous fiber holding point toward which drafted fibers in overlapped configuration are continuously advanced on the slowly moving fiber-carrying surface. The twisting step, in which the fibers are twisted into yarn, takes place in a spinning zone extending from the yarn transfer point between the rapidly rotating fiber holding point at the yarn transfer point 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 completed spun yarn may be wound into a package of any desired configuration.

This invention relates to textile machinery and more particularly to novel apparatus for spinning yarn from staple fibers which may be in the form of conventional untwisted sliver or the like.

Over a period of many years there have been numerous attempts to spin yarn from staple fibers without the use of twisting devices such as flyers or spinning rings and travelers, by reason of the known speed and yarn package limitations inherent in such devices. The major difficulty has not been in providing apparatus which will function to produce a twisted fiber strand recognizable as a yarn, but rather in providing apparatus which will produce yarn of uniformly acceptable commercial quality, generally the equal of that produced on conventional twisting devices, and at a speed such that the operation of such apparatus will be economically comparable to the commercial devices presently in use.

Accordingly, it is a major object of the present invention to provide novel textile apparatus capable of spinning, that is, both drafting and twisting, commercially acceptable yarn directly from staple fiber, such as cotton, which may be in conventional untwisted sliver form, such as is delivered by a card, a draw frame, or other textile staple fiber sliver preparatory machine.

It is another object of the invention to provide such apparatus capable of winding the yarn therefrom directly onto a package of any desired configuration, without any limitation as to package diameter, for example, such as is imposed by conventional twisting devices.

It is another object of the invention to provide such

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apparatus capable of producing yarn at speeds in excess of those at which conventional twisting devices are capable of producing yarn.

It is still another object of the invention to provide such apparatus capable of providing a high draft of sliver delivered thereto, so that relatively bulky sliver may be utilized directly for the production even of fine yarn.

These and other objects are provided by novel apparatus according to the present invention. Such apparatus includes staple fiber assembly means having a relatively slowly moving endless fiber-carrying surface, such as a pneumatic suction roll or apron, orbitally rotating about an axis at high speed for intermittently applying to its surface a relatively few fibers positively extracted from the end of a sliver at a staple fiber sliver supply means, including a staple fiber supporting surface such as a detaching roll, positioned at a fixed fiber transfer point or zone for intermittent fiber nipping contact with the fiber carrying surface to 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 at the completion of the drafting step are slowly advanced by the fiber carrying surface from the intermittently functioning staple fiber transfer point or zone to a yarn transfer point or zone remote therefrom for the twisting operation.

At the yarn transfer point or zone, the invention provides control means, such as a control roll, in contact with the fiber-carrying surface and rapidly orbitally rotating therewith, creating a rapidly rotating continuous fiber holding point toward which drafted fibers in overlapped configuration are continuously advanced on the slowly moving fiber-carrying surface.

The twisting step, in which the fibers are twisted into yarn, takes place in a spinning zone extending in a direction generally along the axis from the yarn transfer point between the rapidly rotating fiber holding point at the yarn transfer point 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 completed spun yarn may be wound into a package of any desired configuration.

Thus, by rotating the slowly moving fiber assembly means together with its cooperating control means at high speed, the apparatus of the invention uniquely achieves intermittent positive fiber transferring cooperation with the fiber supply means at the fixed fiber transfer point or zone for effective uniform drafting of the fibers by arranging them in overlapping configuration a few fibers at a time on the assembly means, as an entirely separate step from the subsequent continuous twisting operation, all carried out simultaneously in the same apparatus.

For the purpose of more fully explaining the above and other objects and features of the present invention, reference is now made to the following detailed description of preferred embodiments thereof, together with the accompanying drawings, wherein;

FIGS. 1 and 2 are top and side views of a first embodiment of apparatus according to the invention, with FIG. 1a being a partial top view with the rotating elements in a position displaced from that of FIG. 1;

FIG. 3 is a sectional detail top view of the apparatus of FIGS. 1 and 2;

FIG. 4 is a side sectional detail view of a portion of the apparatus of FIGS. 1 and 2;

FIGS. 5 through 8 are end views of a portion of the apparatus of FIGS. 1 and 2 showing the rotating elements thereof in successive orbital positions, spaced 90 degrees from one another, in and out of fiber transferring position relatively to the cooperating fiber supply roll;

FIGS. 9 and 10 are top and side views of a second embodiment of apparatus according to the present invention;

FIGS. 11 and 12 are front and side sectional views of the apparatus of FIGS. 9 and 10;

FIG. 13 is a front view, partly in section, of the apparatus of FIGS. 9 and 10 with its orbitally moved fiber carrying surface in fiber transferring position relatively to its cooperating fiber supply roll;

FIG. 14 is a detail side view of a portion of the apparatus of FIGS. 9 and 10;

FIGS. 15 and 16 are side sectional and end views of a third embodiment of apparatus according to the present invention, and

FIGS. 17 and 18 are side sectional and end views of a fourth embodiment of apparatus according to the present invention.

Referring to FIGURES 1 through 8, a preferred apparatus for spinning yarn from staple length fiber according to the present invention in general comprises an orbitally rotated staple fiber assembly means including a rotatable hollow roll 15 providing an endless movable fiber carrying surface with axially extending air slots 16 about its outer periphery; staple fiber supply means including a detaching roll 20 rotatable about a fixed axis for intermittent contact with assembly roll 15 for detaching fibers F from the end of a sliver S and delivering them onto the surface of assembly roll 15 at a fiber transfer point FT, and staple fiber output means including a control roll 25 in continuous contact with assembly roll 15 providing a continuous positive fiber nip therewith at a yarn transfer point YT. The axes of assembly roll 15 and pressure roll 25 are parallel and together movable in an orbit about an orbit axis O at an angle to the axes of said rolls toward and away from that of detaching roll 20 for intermittent contact therewith, the axis of the latter roll being parallel when in contact with assembly roll 15 at fiber transfer point FT, as hereinafter explained in detail. The staple fiber supply means further includes staple fiber supply means consisting of a pair of input rolls 22, 23 for supplying at a predetermined rate staple fibers in sliver form to detaching roll 20. The staple fiber output means further includes yarn delivery means including a pair of delivery rolls 28, 29 providing a yarn nip point YD spaced in a direction generally along the orbit axis O from the yarn transfer point YT providing a spinning or twisting zone T therebetween.

For rotating the staple fiber assembly roll 15 together with pressure roll 25 about orbital axis O to move it toward and away from detaching roll 20, and for rotating it about its own axis, a pair of hollow concentric shafts, inner shaft 30 and outer shaft 35, are provided, the shafts having suitable bearing 34 interposed therebetween, and being mounted by bearings 39 in fixed support 40. Pulleys 33 and 38, respectively, are provided on shafts 30 and 35 respectively for rotating them through suitable timing belts trained around drive pulleys 42, 43 respectively, of slightly different diameter, on the shaft 50 of motor 45.

For such rotation of the operating rolls, the shaft 17 of hollow fiber assembly roll 15 is mounted on end member 36 of outer concentric shaft 35 with its axis at an angle to orbit axis O of about 150 degrees and supports hollow roll 15 for rotation thereabout, said roll being provided with a bevel gear 18 at its inner end cooperating with a bevel gear 32 forming the end of inner concentric shaft 30. The end member 36 of outer concentric shaft 35 lies within hollow roll 15 to provide a chamber 37 communicating both with its slots 16 for approximately a 180 degree sector of its inner periphery and with the hollow interior 31 of inner concentric shaft 30. The opposite end of said hollow interior 31 communicates with a rotatably fixed air chamber 41, forming a part of fixed support 40, a suitable seal being provided between said support and the end of inner shaft 30. A connection 44 communicating with air chamber 41 is provided for connect-

ing said chamber and hence, the interior of hollow assembly roll 15 to a suitable source of suction (not shown), for drawing air inwardly through its slots 16.

The shaft 26 of pressure roll 25 is also mounted on end member 36 parallel to the shaft 17, roll 25 being rotatably mounted therein with its outer periphery in contact with that of roll 15, a pivotal mounting of shaft 26 on end member 36 being preferably provided by pivot shaft 27 so that roll 25 may be swung away from contact with roll 15 for access to their contacting surfaces at yarn transfer point YT as desired. It is desirable that orbit axis O pass as closely as possible through the effective center of the line of contact of rolls 15 and 25, in order that the yarn balloon may be kept as small as possible.

Detaching roll 20 is mounted for rotation about its fixed shaft 21 which is in turn mounted on fixed support 40 at the same angle to orbit axis O as are shafts 17 and 26, so that when the shafts axes and the orbital axis are in the same plane at one point in the orbital position of rolls 15 and 25, all three rolls are momentarily in the same plane.

Input rolls 22, 23 and delivery rolls 28, 29 are driven by geared shaft 48 of motor 45 in timed relationship to the other driven machine elements through cross shaft 46, which shaft drives input roll shaft 47 and delivery roll shaft 49 by suitable bevel gears.

The operation of the apparatus of FIGS. 1 through 8 is best shown by reference to FIGS. 1, 1a, and 2 together with the sequence of FIGS. 5 through 8. Thus, with a suitable source of suction applied at connection 44, and with motor shafts 48 and 50 rotating to rotate input rolls 22, 23, delivery rolls 28, 29 and shafts 30 and 35, the latter being rotated at speeds of the order of 10 to 20 thousand r.p.m. with a differential speed of a few r.p.m., the assembly roll 15 and control roll 25 will be rotated at high speed about orbit axis O, with the assembly roll being rotated about its own axis at a slow speed of a few r.p.m. and intermittently contacting detaching roll 20 to detach a few fibers from the end of a sliver fed downwardly at a predetermined rate by control rolls 22, 23, the fibers being positively transferred in predetermined amount to the surface of the assembly roll 15 for uniform drafting into overlapping configuration and being retained thereon by air passing inward through its slots 16 as the fiber carrying surfaces advance the fibers from fiber transfer point FT to yarn transfer point YT.

More specifically, as the assembly roll 15 is moved around the orbital axis O, its fiber-carrying surface contacts the surface of detaching roll 20 at fiber transfer point FT only momentarily once each revolution as shown in FIGS. 1, 2, 3, 4 and 5, at which time the loose fibers at the lower end of the downwardly feeding sliver will be positively nipped and so positively pressed onto the surface of assembly roll 15 and positively pulled downwardly with respect to the sliver end extending downward from the input rolls 22, 23. The fibers so removed will be held on the surface of assembly roll 15 by suction even after the roll has been moved out of contact with detaching roll 20, as shown in FIGS 1a and 6 through 8. Thus, each revolution of the shafts 30, 35 causes the assembly roll 15 to extract a few of the fibers as they are fed in sliver form downwardly from the supply rolls 22, 23 and to transfer them onto the surface of assembly roll 15, the latter being moved at a sufficiently low speed to ensure their transfer in overlapping configuration.

This can be achieved by driving the shaft 30, 35 at a desired predetermined small differential speed, so that the assembly roll 15 is advanced but a fraction of a revolution at each revolution of said shaft about the orbit axis O so that a uniform layer of overlapping parallel fibers is built up on its surface.

When assembly roll 15 has advanced to a sufficient degree, it will carry the parallel fibers on its surface under

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the control roll 25 positively to nip them at yarn transfer point YT from this point they are twisted throughout the twisting zone T which extends generally along the orbit axis O to the yarn delivery point YD provided at the nip of the delivery rolls 28, 29. Thence the completed spun yarn Y may be led to any desired type of winder (not shown).

The apparatus of the present invention is especially unique in that the fibers are not simultaneously drafted and gathered at the twisting point but rather are first drafted by being laid down parallel to each other on a slowly moving smooth sliver-carrying assembly surface cooperating with a smooth fiber supporting surface on the detaching roll to maintain fiber parallelization during transfer and accurately determine the number of fibers to be transferred onto the assembly surface which slowly advances to feed the parallel fibers to a twisting zone separate from the drafting and assembly zone. The high speed motion of the assembly surface past the detaching roll is highly effective in properly detaching a predetermined number of fibers from the tip of the sliver extending downwardly from the input rolls. The number of fibers detached each revolution is very small. For yarn having n turns of twist per inch, only $1/n$ of the fibers per cross-section are placed on the assembly roll during each revolution. This enables the air suction to have good control of the fibers to maintain them parallel so that they will be parallel in the strand to be twisted.

A unique advantage of the apparatus of the invention lies in the positive and controlled transfer of a predetermined number of parallelized fibers from the end of the infed sliver directly onto the smooth surface of the fiber assembly means, by reason of the cooperating smooth fiber nipping surface of the detaching roll, whereby fiber misalignment and non-uniform transfer, both of which are essential for proper drafting, are avoided.

Another unique advantage of the apparatus of the invention lies in the fact that the fibers are twisted in a twisting zone T entirely separated from the fiber drafting operation, such twisting zone extending from the yarn transfer point YT of the control roll to the yarn delivery point YD between the delivery rolls just as in conventional spinning so that a proper twisting tension may be maintained between spaced yarn holding points.

Piecing up is carried out in a manner similar to the way it is carried out in heretofore known spinning apparatus and is accomplished by simply placing the yarn end extending from the delivery rolls under the control roll 25, with the shafts stopped.

It is not necessary to place the assembly roll 15 at an angle as shown in FIGS. 1 through 8, although such is desirable in providing a straight run of yarn throughout the twisting zone. It may, indeed, be used with its axis at any angle from parallel to the orbit axis O to perpendicular thereto, a parallel arrangement being shown in FIGS. 9 through 14.

In FIGS. 9 through 14 is shown a second preferred embodiment of the invention which differs from the embodiment of FIGS. 1 through 8 mainly in that its orbit axis O is parallel to the axes of the operating rolls, and a suction apron 55 having slots 56 about its periphery is utilized as the fiber assembly means.

With this arrangement, an outer concentric shaft 60, mounted on machine frame 88 and driven by suitable means similar to the means shown in regard to FIGS. 1 through 8 and having like reference numerals, has on its end a disk 62. Disk 62 has a semi-cylindrical element 64 extending therebeyond for about half of its periphery, with a shallow central peripheral groove 65 in its outer surface. Also on disk 62 are mounted on shafts 67, 69 a pair of spaced apron supporting rolls 66, 68 and an apron cradle 70 having trained thereabout apron 55, the configuration of the apron being controlled by rolls 66, 68 and cradle 70 to provide a semi-cylindrical

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surface generally continuous with that of semi-cylindrical element 64. Roll 66 has a central groove 57, and cradle 70 has a similar central opening 71 communicating with the hollow interior 61 of concentric shaft 60. Rolls 66, 68 are driven by inner shaft 82 by its gear 83 driving their gears 85, 87. A suitable suction connection 78 communicates with the inner surface of slotted apron 55 through the hollow interior 61 of shaft 60. Air can thus enter the slots 56 along the length of cradle 70 from its leaving contact with roll 68 around roll 66 until it again reaches the closed rear surface 86.

Also mounted on disk 62 by its shaft 81 is a control roll 80 which is in continuous contact with roll 68 through apron 55 providing the continuous yarn transfer point characteristic of the invention, although it is desirable in the embodiment of FIGS. 9 to 14 to utilize a yarn guide in the form of hook 58 to lead yarn from nip point YT to the delivery rolls 90, 92 axially spaced therefrom generally along the orbit axis O of shafts 60 and 82.

For cooperating with the surface of apron 55 to feed fibers thereto, as with the embodiment of FIGS. 1 through 8 there is provided a detaching roll 75 mounted by its shaft 76 on frame 88, such being in contact either with semi-cylindrical element 64 or apron 55 throughout the rotation of disk 62. Input rolls 72, 74 similar to those shown in FIGS. 1 through 8 are utilized for supplying sliver to detaching roll 75.

The operation of apparatus of FIGS. 9 through 14 is generally similar to that above described, in that the fibers at the end of the sliver S extending downwardly from the input rolls 72, 74 are fed into the bite between detaching roll 75 and apron 55 on cradle 70, so that the fibers are rolled onto the portion of the perforated apron over the cradle. The air suction then holds the fibers on the apron. By rotating the shafts 60 and 82 at the correct speeds, a small number of fibers will be collected at each orbital revolution of the unit and the fibers collected on the apron 55 will slowly advance with it. Upon passing between apron supporting roll 68 and control roll 80, the fibers are twisted in the twisting zone T extending between yarn transfer point YT and the yarn delivery point YD at delivery rolls 90, 92. Hook 58 is employed to take care of the change in yarn direction necessary in this embodiment of the invention. For each revolution of the yarn transfer point YT, one turn of twist is given the yarn Y being removed. Proper twist is given by advancing apron 55 by $1/n$ inches each revolution of shaft 60 to give n turns of twist per inch, which is accomplished by driving shaft 82 at a slightly slower speed than shaft 60.

The central groove 65 in element 64 prevents fibers being pulled from the supply rolls by the element 64 as there is no bite on fibers by the detaching roll 75 except when the perforated apron 55 is pressed against it by the cradle 70.

Advantages of this embodiment are that the detaching roll is driven all the time instead of intermittently and the fibers are rolled onto apron 55 for their whole length, giving more positive fiber control.

Also, if desired, the radius of the element 64 may be slightly smaller than that of the apron 55 around cradle 70 whereby the detaching roll 75 will be in driving contact only with apron 55, thereby eliminating the necessity of the central groove 65 in the element 64. When operating at high speeds, e.g. 10-20,000 r.p.m. the inertia of roll 75 will keep the same running essentially at a constant r.p.m. even though not in physical contact with the semi-cylindrical element 64.

In FIGS. 15 and 16 is shown a third preferred embodiment of the invention in which the orbit axis O is perpendicular to the axes of the operating rolls and in which a fiber assembly disk 102 having a series of circularly disposed slots 104 in its face rather than its periphery is utilized as the fiber assembly means.

With this arrangement, outer and inner hollow concentric shafts 106, 108 are mounted and driven by suit-

able means such as is shown in FIGS. 1 through 8. Inner shaft 106 has mounted on its end a cylindrical chamber member including an inner circular wall 110 and an outer circular wall 111 spaced therefrom by cylindrical connecting wall 112. Outer wall 111 has mounted thereon a fixed shaft 114 carrying, for rotation about its eccentric axis A, said disk 102, a circular series of openings 113 being provided in wall 111 inside of slots 104 of disk 102 for air communication from said slots to the hollow interior of inner shaft 106. Fixed shaft 114 has mounted thereon adjacent its outer end, a control roll shaft 116 carrying a control roll 118 for rotation about an axis perpendicular to and intersecting said eccentric axis A, said control roll having its periphery continuously in contact with disk 102 at its circular arrangement of slots 104. A pair of yarn delivery rolls 130 are provided for removing the yarn from control roll 118.

A detaching roll 120 mounted on the machine frame for rotation about a fixed axis is provided for intermittently contacting disk 102 at its series of slots 104, a pair of input rolls 122 being utilized for supplying sliver to detaching roll 120.

For rotating the fiber assembly disk 102, its outer periphery is provided with gear teeth 103 which are driven by outer concentric shaft 108 through an internal gear 109 of larger diameter than the gear teeth 103 of disk 102 and in driving engagement at one point thereof which moves about the periphery of said gears during operation. Shaft 108 is connected to its gear 109 by a disk 124 and cylinder 125 surrounding the inner shaft chamber elements.

In operation, with air suction being applied to the interior of hollow inner shaft 106 and shafts 106 and 108 being rotated at high speeds with a small differential speed for rotating fiber assembly disk 102 at a slow speed, fibers of the sliver fed by input rolls 122 are intermittently detached and deposited in overlapping configuration on the slots 104 of disk 102, where they are held by the air passing through said slots as they are slowly advanced toward the nip of control roll 118. Beyond said nip, which is being continuously rotated at high speed, the fibers in the form of a yarn are twisted in the spinning zone which extends to the nip of delivery rolls 130, which are rotated to advance the spun yarn therefrom.

In FIGS. 17 and 18 is shown a fourth preferred embodiment of the invention which differs from the above described embodiments mainly in that the fiber is deposited on a fiber assembly surface on the inside of a surrounding member, this having an advantage in that centrifugal force can be utilized to retain the fibers on the surface of the assembly means, either in conjunction with air flow through slots or the like, or acting by itself.

The inside surface fiber assembly means can, like the outside surface arrangements described above, take various forms, that of FIGS. 17 and 18 being a concentric form canted with respect to the axis of its inner and outer concentric shafts 132, 134, respectively. As shown, inner shaft 132 has a canted disk 136 mounted on its end supporting an outer cylindrical bearing member 138 having peripheral through slots 139 therein. Concentrically mounted within bearing member 138 is a fiber assembly cylinder 140 having slots 141 thereabout. A control roll 144 is rotatably mounted on disk 136 adjacent the rearwardmost extension of said disk with its periphery continuously in contact with the inner surface of fiber assembly cylinder 140. A fixed detaching roll 146 is mounted for intermittent contact with said cylinder adjacent its forwardmost extension. Suitable input rolls 148 and delivery rolls 150 are provided to cooperate with said detaching and control rolls, respectively, and a lead hook 154 is provided for guiding the yarn from control roll 144 to the delivery rolls 150.

For rotating fiber assembly cylinder 140, its inner periphery is provided with gear teeth 143 which are driven by a gear 152 mounted on the end of outer shaft 134, a

portion of the periphery of said gear extending through an opening in disk 136 adjacent the rearwardmost extension thereof into driving engagement with gear teeth 143 of the fiber assembly cylinder 140.

In operation, with shafts 132 and 134 rotating at a differential speed, air will pass outwardly through slots 139 and 141 by reason of the centrifugal force created by the high speed rotation of the apparatus, such air flow creating suction to aid in holding the fibers onto the fiber assembly surface. It is contemplated, though, that such slots may be omitted in some instances, the centrifugal force on the fibers then keeping them on the fiber assembly surface in the absence of any air suction. Except in this respect, this embodiment of the invention operates as do the others, with the input rolls 148 and detaching roll 146 depositing fibers on the inner surface of assembly cylinder 140, on which they are slowly advanced toward the nip of control roll 144. Beyond said nip, which is continuously maintained and rotated at high speed, the fibers are twisted, to the greatest degree in the zone between said nip and lead 154, although to some extent therebeyond.

As will be understood from the above description of several embodiments of the invention, structures utilizing the principle of the invention may differ substantially in their construction and arrangement. Thus, each of the three general types, the external type of FIGS. 1 through 14, the internal type of FIGS. 17 and 18, and the disk type of FIGS. 15 and 16, may be arranged with the axes of their operating rolls either parallel or non-parallel to the axis of rotation of the device. If parallel axes be used, however, it is necessary that an eccentric arrangement be used in order to provide clearance between the rapidly revolving control roll and the fixed detaching roll, such an arrangement being shown in FIGS. 11 through 16. If non-parallel axes be used, as in the remaining figures, either a concentric arrangement, as in FIGS. 17 and 18, or an eccentric arrangement as in FIGS. 1 through 10, may be used, since the required clearance between the control and detaching roll can be provided by displacing them along the axis of rotation.

Still further modifications of the invention, not herein described, but within the spirit thereof and the scope of the appended claims, will be apparent to those skilled in the art.

I claim:

1. Apparatus for spinning yarn from staple fiber comprising

staple fiber assembly means having a movable fiber-carrying surface rotatable about an axis

staple fiber supply means including a fiber supporting surface constructed and arranged for intermittent fiber nipping contact with said fiber supporting surface for intermittently delivering staple fibers in sliver form and overlapping relationship onto the surface of said fiber assembly means at a fiber transfer point

yarn output means for removing staple fibers in yarn form from said fiber assembly means at a yarn transfer point remote from said fiber transfer point including

control means in contact with said surface of said staple fiber assembly means providing a continuous positive fiber nip therewith at said yarn transfer point and

yarn delivery means providing a yarn nip point at a yarn delivery point spaced from said yarn transfer point in a direction generally along said axis,

power means for moving said movable surface relatively to said staple fiber supply means fiber supporting surface intermittently positively to apply fibers in overlapping relationship to said fiber assembly surface at said fiber transfer point

for moving said movable surface with said fibers on said movable surface from said fiber transfer point to said yarn transfer point and

for rotating about an axis said staple fiber assembly means together with said control means to rotate fibers at said yarn transfer point to spin said fibers into a yarn in a twisting zone between said yarn transfer point and said yarn delivery point. 5

2. Apparatus as claimed in claim 1 further including means for operating said fiber supporting surface and said yarn delivery means to deliver yarn at a predetermined rate

relatively to the rotation of said staple fiber assembly means and said control means about said axis producing a predetermined twist of said delivered yarn. 10

3. Apparatus as claimed in claim 2 wherein said power means advances said fiber-carrying surface at a rate predetermined with respect to the delivery of a sliver of staple fibers by said input means to draft said fibers in a predetermined ratio. 15

4. Apparatus for spinning yarn from staple fiber comprising

staple fiber assembly means having a movable fiber-carrying surface rotatable about an axis 20

staple fiber supply means for intermittently delivering staple fibers in sliver form and overlapping relationship onto the surface of said fiber assembly means at a fixed fiber transfer point including detaching means mounted adjacent said fixed fiber transfer point and having a fiber supporting surface constructed and arranged for intermittent fiber nipping contact with said fiber carrying surface 25

yarn output means for removing staple fibers in yarn form from said fiber assembly means at a yarn transfer point remote from said fiber transfer point including 30

control means having an endless surface in contact with said surface of said staple fiber assembly means providing a continuous positive fiber nip therewith at said yarn transfer point and 35

yarn delivery means providing a yarn nip point at a yarn delivery point spaced from said yarn transfer point in a direction generally along said axis, 40

power means for moving said movable surface relatively to said staple fiber supply means fiber supporting surface intermittently positively to apply fibers in overlapping relationship to said fiber assembly surface at said fiber transfer point 45

for moving said movable surface with said fibers on said movable surface from said fiber transfer point to said yarn transfer point and

for rotating about an axis said staple fiber assembly means together with said control means to rotate fibers at said yarn transfer point to spin said fibers into a yarn in a twisting zone between said yarn transfer point and said yarn delivery point. 50

5. Apparatus as claimed in claim 4 wherein said staple fiber supply means fiber supporting surface includes 55

detaching roll means mounted for rotation about a fixed axis and

sliver input means for supplying at a predetermined rate staple fiber in sliver form to said detaching roll means. 60

6. Apparatus as claimed in claim 4 wherein said staple fiber assembly means includes pneumatic air flow means for retaining staple fibers on said surface. 65

7. Apparatus as claimed in claim 6 wherein said fibers are retained on an outer said surface.

8. Apparatus as claimed in claim 6 wherein said fibers are retained on an inner said surface.

9. Apparatus for spinning yarn from staple fiber comprising 70

staple fiber assembly means having a movable fiber carrying endless surface rotatable about an axis

staple fiber supply means including a fiber supporting surface constructed and arranged for intermittent 75

fiber nipping contact with said fiber carrying surface for intermittently delivering staple fibers in sliver form and overlapping relationship onto the surface of said fiber assembly means at a fixed fiber transfer point

yarn output means for removing staple fibers in yarn form from said fiber assembly means at a yarn transfer point remote from said fiber transfer point including

control means in contact with said surface of said staple fiber assembly means providing a continuous positive fiber nip therewith at said yarn transfer point and

yarn delivery means providing a yarn nip point at a fixed yarn delivery point spaced from said yarn transfer point in a direction generally along said axis

first drive shaft means mounting said staple fiber assembly means together with said control means for rotation in a path about an axis for intermittent co-operation with said staple fiber supply means at said fixed fiber transfer point in said path

said endless fiber-carrying surface being mounted on said first drive shaft means for movement relatively to said control means while remaining in continuous fiber nipping contact therewith throughout said path

second drive shaft means driving said endless fiber-carrying surface for movement relatively to said control means, and

power means driving said first and second drive shaft means at differential speeds

for rotating at high speed about said axis said staple fiber assembly means together with said control means to transfer fibers from said fiber supply means fiber supporting surface positively to apply said fibers in overlapping relationship to said fiber assembly surface at said fiber transfer point.

10. Apparatus as claimed in claim 9 wherein said staple fiber assembly means includes an endless surface having a smooth surface with slots therein and pneumatic suction means for retaining staple fibers on said surface by moving air through said slots.

11. Apparatus for spinning yarn from staple fiber comprising

staple fiber assembly means having a movable fiber-carrying endless surface rotatable about an axis

staple fiber supply means for intermittently delivering staple fibers in sliver form and overlapping relationship onto the surface of said fiber assembly means at a fixed fiber transfer point including

detaching roll means mounted for rotation about a fixed axis

sliver input means for supplying at a predetermined rate staple fiber in sliver form to said detaching roll means and

power means for driving said sliver input means at said predetermined rate

yarn output means for removing staple fibers in yarn form from said fiber assembly means at a yarn transfer point remote from said fiber transfer point including

control means in contact with said surface of said staple fiber assembly means providing a continuous positive fiber nip therewith at said yarn transfer point

yarn delivery means providing a yarn nip point at a fixed yarn delivery point spaced from said yarn transfer point in a direction generally along said axis and

power means driving said yarn delivery means at a predetermined rate

first drive shaft means mounting said staple fiber assembly means together with said control means for rotation in a path about an axis for intermittent con-

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tact with said detaching roll means at said fixed fiber transfer point in said path
 said endless fiber-carrying surface being mounted on said first drive shaft means for movement relatively to said control means while remaining in continuous fiber nipping contact therewith throughout said path
 second drive shaft means driving said endless fiber-carrying surface for movement relatively to said control means, and
 power means driving said first and second drive shaft means at differential speeds
 for rotating at high speed about said axis said staple fiber assembly means together with said control means to transfer fibers from said fiber supply means and to apply said fibers in overlapping relationship to said fiber assembly surface at said fiber transfer point
 to move said movable surface to advance said fibers on said movable surface from said fiber transfer point to said yarn transfer point and
 to spin fibers in a twisting zone between said yarn transfer point and said yarn delivery point,
 said movable surface being advanced at a low speed proportional to the differential speed of said first and second shaft means,
 said power means driving said fiber-carrying surface and said yarn delivery means at a rate predetermined relatively to the rate of rotation of said staple fiber assembly means and said control means about said axis producing a predetermined twist of the delivered yarn and
 said power means driving said sliver input means at a rate predetermined with respect to the rate of advance of said fiber carrying surface to draft sliver in a predetermined ratio.

12. Apparatus as claimed in claim 11 wherein the surfaces of said fiber assembly means, said detaching roll means and said control means are at an angle to said axis,
 said surfaces being parallel when said staple fiber supply means is in contact with said detaching roll means at said fixed fiber transfer point.

13. Apparatus as claimed in claim 12 wherein said angle is about 150 degrees.

14. Apparatus as claimed in claim 11 wherein said staple fiber assembly means is a roll.

15. Apparatus as claimed in claim 11 wherein said staple fiber assembly means is a pneumatic suction roll.

16. Apparatus as claimed in claim 11 wherein the surfaces of said fiber assembly means, said detaching roll means and said control means are parallel to one another and to said axis.

17. Apparatus as claimed in claim 11 wherein said staple fiber assembly means is an apron.

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18. Apparatus as claimed in claim 11 wherein said staple fiber assembly means is a pneumatic suction apron.

19. Apparatus as claimed in claim 18 wherein said pneumatic suction apron has a semi-cylindrical surface and
 means having a semi-cylindrical surface is provided as a continuation thereof,
 said detaching roll being in contact with one of said semi-cylindrical surfaces throughout said path.

20. Textile staple fiber spinning apparatus including staple fiber assembly means having an endless surface with a line of perforations on which staple fibers may be collected and held thereon by air flow through said perforations
 assembly support means rapidly rotatable about a fixed axis and carrying said staple fiber assembly means thereon for bodily movement in a closed orbital path about said axis with said assembly support means and for relative movement of said surface to said assembly support means and
 power means for rotating said assembly support means about said fixed axis, for slowly moving said staple fiber assembly means on said support means
 thereby causing air flow through said perforations in said staple fiber assembly means.

21. Apparatus according to claim 20 wherein the staple fiber is held on the outside of said staple fiber assembly means by air flow inward through said perforations.

22. Apparatus according to claim 20 wherein fiber is held on the inside of said staple fiber assembly means by air flow outward through said perforations which is caused by said rapid rotation of said support means carrying said fiber assembly means.

23. Apparatus according to claim 20 further including staple fiber supply means including a fiber supporting surface constructed and arranged for intermittent fiber nipping contact with said staple fiber assembly means for intermittently delivering staple fibers in sliver form and overlapping relationship onto the surface of said staple fiber assembly means at a fiber transfer point.

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