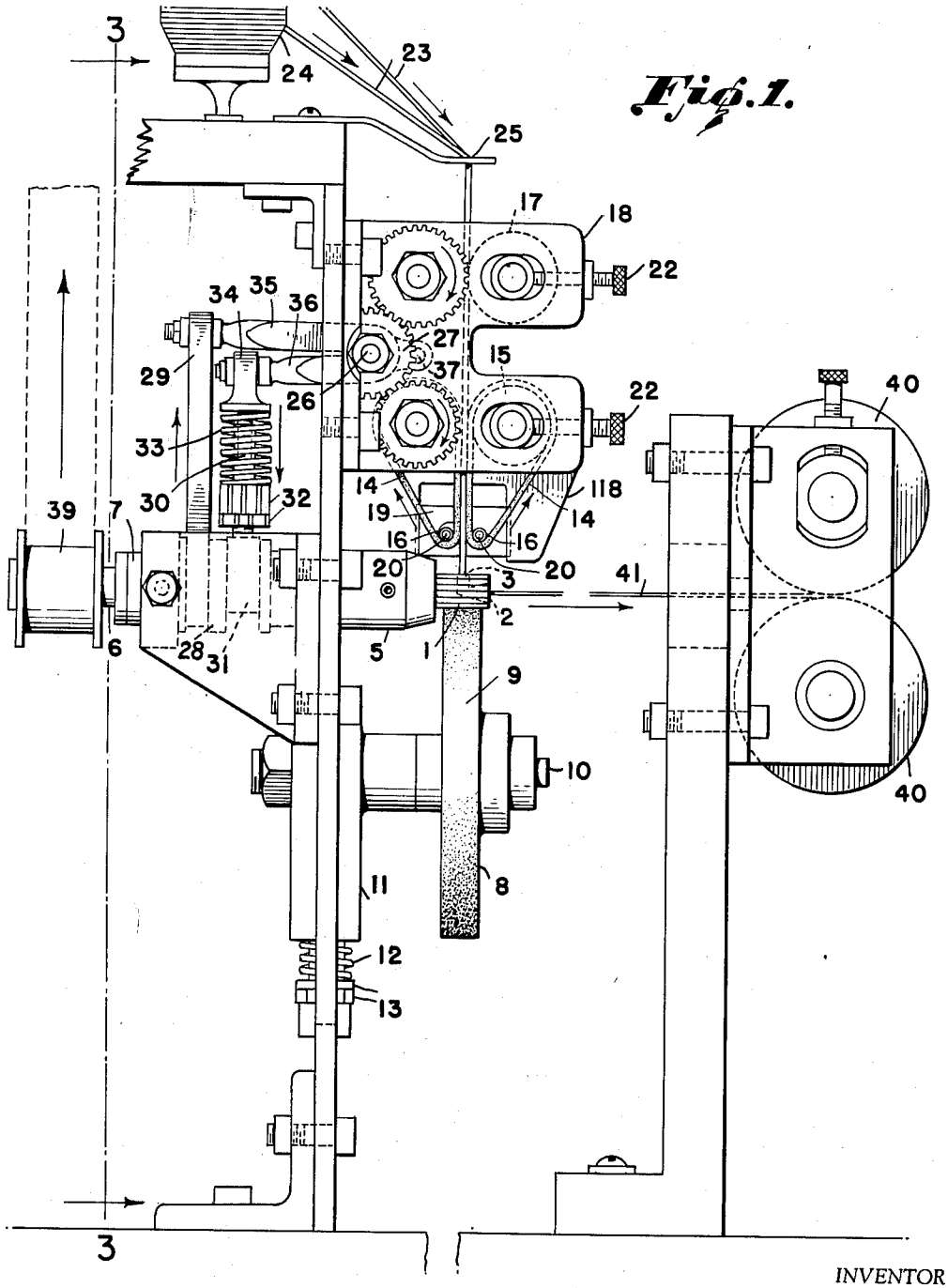
Jan. 31, 1956 G. J. KYAME 2,732,682

METHOD FOR SPINNING YARN FROM STAPLE FIBER

Filed June 24, 1952 5 Sheets-Sheet 1

Fig. 1.



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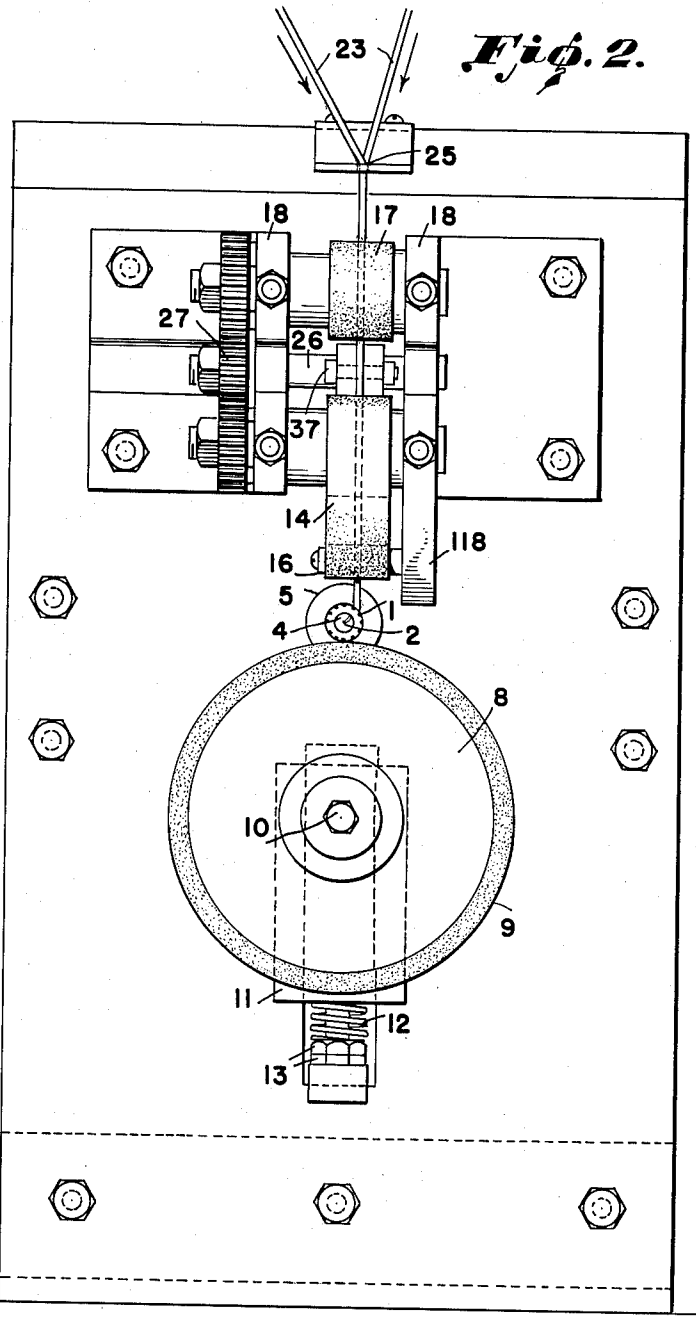
BY D. A. Seegrist
Williams Bier
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METHOD FOR SPINNING YARN FROM STAPLE FIBER

Filed June 24, 1952 5 Sheets-Sheet 2

Fig. 2.



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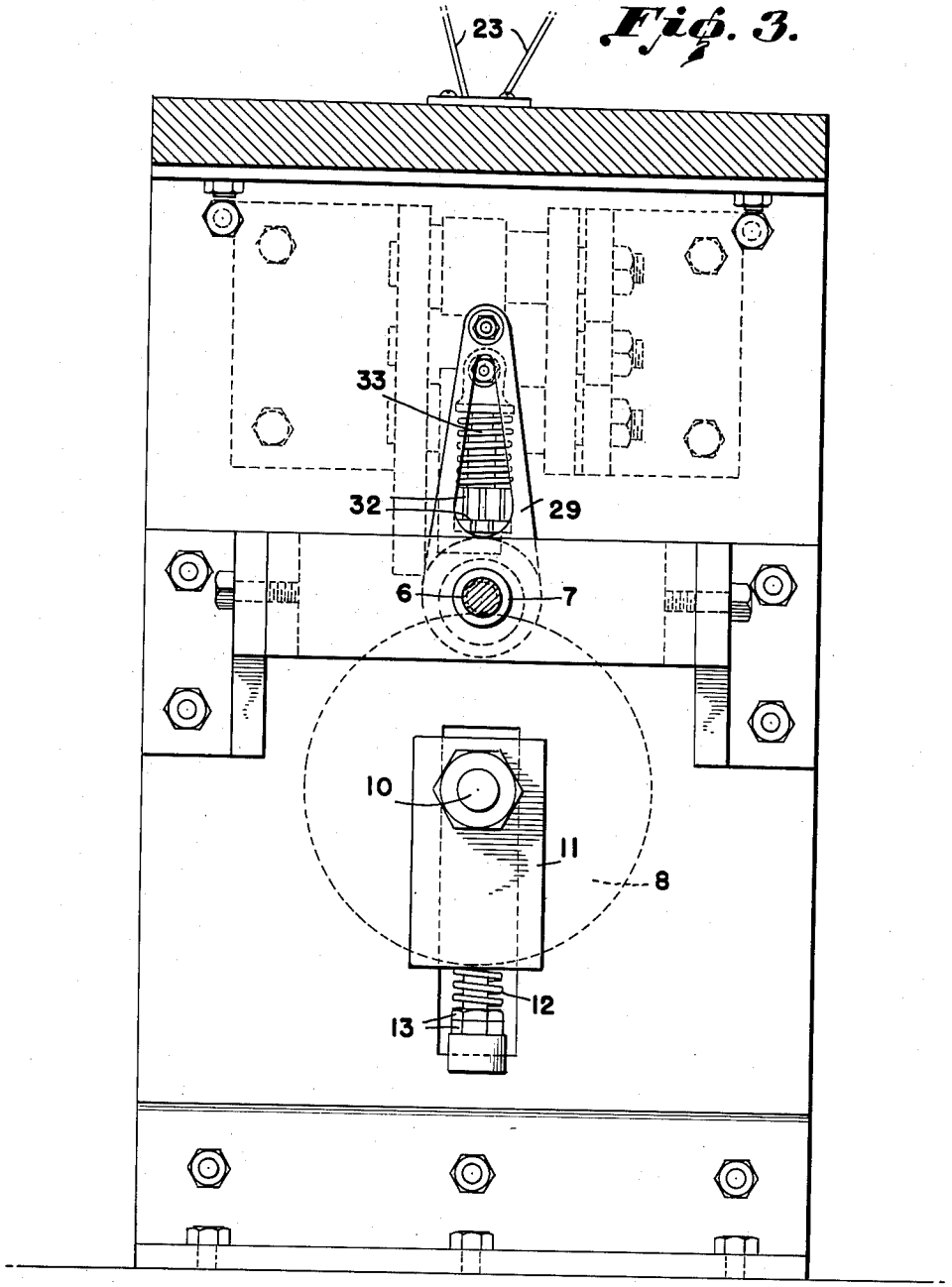
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METHOD FOR SPINNING YARN FROM STAPLE FIBER

Filed June 24, 1952 5 Sheets-Sheet 3

Fig. 3.



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METHOD FOR SPINNING YARN FROM STAPLE FIBER

Filed June 24, 1952 5 Sheets-Sheet 4

Fig. 4.

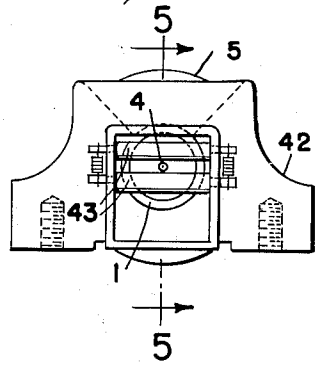


Fig. 5.

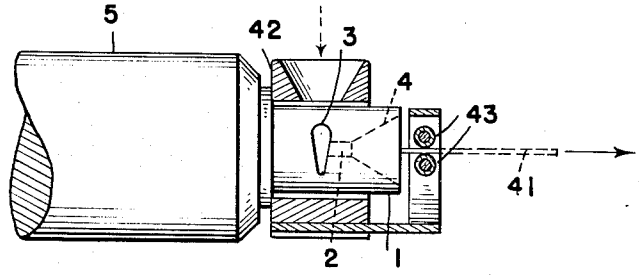
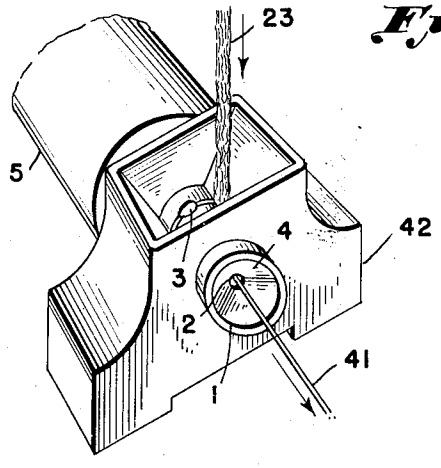


Fig. 6.



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METHOD FOR SPINNING YARN FROM STAPLE FIBER

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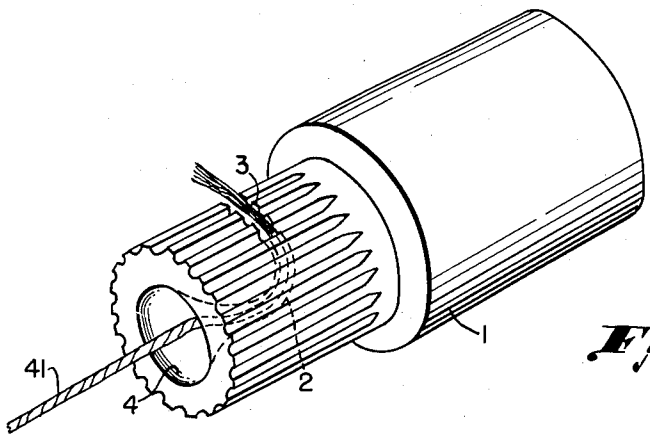


Fig. 7.

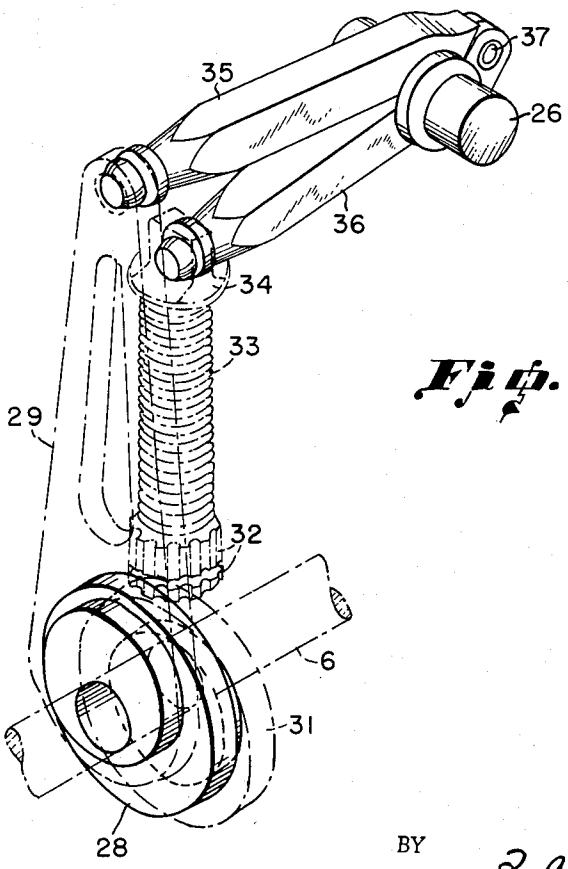


Fig. 8.

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United States Patent Office 2,732,682
Patented Jan. 31, 1956

2,732,682

METHOD FOR SPINNING YARN FROM STAPLE FIBER

George J. Kyame, New Orleans, La., assignor to the United States of America as represented by the Secretary of Agriculture

Application June 24, 1952, Serial No. 295,377

1 Claim. (Cl. 57—58.91)

(Granted under Title 35, U. S. Code (1952), sec. 266)

A non-exclusive, irrevocable, royalty-free license in the invention herein described, for all governmental purposes, throughout the world, with the power to grant sublicenses for such purposes, is hereby granted to the Government of the United States of America.

This invention relates to the production of yarns from staple fibers having spinning properties similar to cotton fibers.

More particularly, this invention provides a new spinning process by which yarns can be produced in continuous strands of unlimited length, new spinning machines, and a method and apparatus for converting continuous rotary motion to intermittent rotary motion.

The majority of the spinning machines presently in use twist fibers together to form yarn by rotaitng the bobbin or package which finally receives the fully formed product. Because of the high rotational speeds involved, such systems have the inherent disadvantage of having a limited package size thereby necessitating a rewinding operation before subsequent processing can proceed. In addition, the aforementioned systems require the use of rings, travelers, spinning pots, etc., each of which possesses one or more unwanted qualities all well known to those skilled in the art. For example, in the ring spinning system, the tension in the yarn as it is being spun changes continuously with the progressive increase in the effective diameter of the bobbin. This varying tension produces corresponding variations in the physical properties of the yarn, resulting in a product which is non-uniform and therefore is undesirable.

A principal object of this invention is to provide a method of and apparatus for spinning textile yarns whereby a continuous unbroken strand of yarn of any desired length can be made in a single operation.

Another object is to provide a simple and efficient spinning means whereby fibers are paralleled and twisted into yarn ready for direct delivery to a winder or spooler.

Another object is to provide means for spinning textile yarns from staple fibers without the use of rings, fliers, travelers, spinning pots, and the like, thereby avoiding their disadvantages.

Another object is to provide means for delivering drafted roving at a controlled intermittent rate to twist-inserting spindle, said means being driven by said spindle and being capable of functioning at the high rotational speeds normally encountered in the twist-inserting operation.

Another object is to provide an apparatus for converting continuous rotary motion into synchronized intermittent rotary motion of controllable increments in the same direction or into incremental oscillations.

Other objects of the present invention will be apparent from the specification and drawings.

According to this invention a method is provided for producing a continuous strand of yarn of unlimited length by a novel method which eliminates the rotating bobbin. According to the method a base body of yarn is provided,

one end of which is gripped so as to prevent substantial rotation or twisting and at the same time provide a substantial length of free, untwisted end fibers. The length of untwisted end fibers provides a foundation upon which is built incrementalwise a continuous strand of yarn. The end fibers of the base body are intermingled endwise with an incremental strand of untwisted fibers such as might be obtained by pulling from a roving strand. This incremental strand is then twisted, forming an additional increment of yarn integral with the base body. This forms a new base body, the end fibers of which are intermingled with a new increment of untwisted fibers, the increment twisted end thus integrated with the base body of yarn, and the cycles repeated indefinitely.

This invention provides means for achieving the method of buildup of a continuous yarn by increments. The length of the increments which are built upon the base body may vary somewhat in length. The ultimate length is limited by the cohesive characteristics of the untwisted fibers. The minimum length is, of course, limited by the staple length of the fibers involved in carrying out the method of this invention.

In general, according to the invention, there is provided a spinning machine having means for withdrawing a staple fiber yarn in a linear, substantially non-twisting manner, having means for advancing a roving, and having a rotatable member containing a helical passageway entering the rotatable member at a side, following a continuous curve of decreasing radius which approaches zero at the axis of rotation of the member, and emerging at an end of the member. In operating the spinning machine, the roving is advanced into the helical passageway, and the rotatable member, within one revolution, separates an incremental strand of the roving having a length not exceeding the circumference of the rotatable member. This incremental strand advances in the passageway where the forward end fibers thereof are intermingled with the receding end fibers of the withdrawing yarn while the twist imparted to the incremental strand by the rotating member causes the incremental strand to attach to the receding yarn at the point of the intermingling.

In the new method of spinning provided by this invention, fibers preferably in the form of roving or sliver are longitudinally advanced to a means for withdrawing an increment stream of substantially parallel or untwisted fibers moving faster than the fibers in the roving or sliver. The fibers of one end of the withdrawn increment are mingled endwise with the end fibers of a base body of yarn, which are substantially parallel to the withdrawn fibers.

Substantially concurrently with the intermingling, the end fibers of the yarn body are given a twisting motion which integrates the increment fibers with the yarn body. Twist in the same direction with respect to the yarn is then imparted, in a substantially progressive manner, to the increment fibers themselves, thus incorporating the increment fibers into a yarn increment. This is accomplished by rotating the end fibers of the yarn body about an axis substantially parallel with and coincident with the longitudinal axes of the increment fibers. Viewed from the point of intermingling, the yarn body is caused to recede in a continuous helical path tangent to the increment fiber axes but with rapidly decreasing radius so that in one volution or less the helical path degenerates into a straight line forming the axial position of the receding yarn body, roughly at right angles to the axes of the increment fibers.

The receding yarn is led mechanically through this helical path, and twist is imparted to the end fibers by rotating the path itself. As the intermingled increment

fibers are integrated they become an increment of the yarn and follow the receding yarn, receiving the twist of the rotating path. Mechanically, the path consists of a curved passageway through a member of general cylindrical configuration. The passageway begins tangentially at the side of the cylinder and proceeds helical-wise but with a decreasing path radius so that in one revolution or less of the path within the cylinder, it coincides with the axis of the cylindrical member. Twist is imparted by rotating the cylindrical member about its own axis.

This mechanical embodiment affords orderly intermittent addition of increment fibers, continuous twist impartation to the growing yarn body, and orderly provision of the increment fibers by the feed of a roving or sliver into the region of intermingling. The length of the increment of fibers should be less than the circumference of the cylindrical member so that the point of ingress to the helical path, as it describes its circle of revolution may be substantially cleared of increment fibers from the preceding cycle before it again reaches the point of intermingling with fibers of the succeeding increment. The rate of withdrawal or recession of the formed yarn must be at least such that the yarn travels through the path sufficiently rapidly to clear the passageway of increments as fast as they are formed upon the yarn body.

In this manner neither the sliver or roving nor the finished yarn is rotated. Thus the package containing either the fibers or the formed yarn can be of any desired size. In addition, no variation in twist of the yarn is imparted by variations in the effective diameter either of the package from which the fibers are withdrawn, or of the package upon which the yarn is wound. By varying the rate at which the yarn is withdrawn relative to the rate at which the cylinder containing the helical path rotates, the amount of twist in the yarn can be varied.

As will be discussed in greater detail, a preferred machine for spinning a yarn by the above method is one which embodies a twisting apparatus comprising a roll having a friction imparting surface and containing a passageway which runs from its axis at one end to its surface and holds the integrated rotating increment fibers and formed yarn in the helical path described above, working in conjunction with an idler roll; particularly where the machine is equipped with a drafting means which intermittently feed drafter rovings to the cooperating roll pair as fibers from the roving are added to the forming yarn.

However, the method of spinning can be suitably practiced by the use of other apparatus. For example, it can be practiced by using a machine utilizing suction to draw fibers from the roving or sliver into a confined space in which they lie in substantially parallel lines and are mingled with fibers rotating about an axis substantially parallel to said lines, or by using a machine utilizing small high speed rollers to draw the fibers from the sliver or roving and to feed them into a cylindrical chamber the axis of which is a cylinder equipped with a passageway holding the rotating fibers in the above described continuous curve, or by using a device utilizing any apparatus for so twisting the fibers and forming the yarn.

The novel apparatus provided by the invention will appear more clearly from the following detailed description when taken in conjunction with the accompanying drawings showing, by way of example, a preferred embodiment of the inventive adea.

In the drawings:

Figure 1 shows a side view of one embodiment of the novel apparatus of this invention. It illustrates roving **23** being advanced from bobbin **24** through the advancing mechanism that actuates feed roll pair **17** and transport apron pair **14**. The roving is fed to twisting head **1**, where it is built up in increments and passes from the twisting head, through its trumpet shaped opening, in the form of the twisted yarn **41**.

Figure 2 is a front view of the apparatus showing the advancing roving **23** as it passes through the feed mechanism to the twisting head **1**. It is fed tangentially to the side of the cylindrical twisting head as will be described in detail below, exiting as twisted yarn from the opening of the head.

Figure 3 is a section along the line **3—3** of Figure 1 showing the end of spindle **6** and the details of the drive actuating mechanism.

Figure 4 shows a variant of the spinning mechanism, wherein means are provided for guiding the increment fibers into contact with the twisting head and means are provided for gripping the twisted yarn exiting from the twisting head.

Figure 5 is a section along the line **5—5** of Figure 4.

Figure 6 is a three dimensional view of the variant shown in Figures 4 and 5.

Figure 7 is a three dimensional view of the twister head **1** of Figure 1 showing the helically curved path in detail; and

Figure 8 is a three dimensional view of the intermittent feed mechanism shown in Figure 1 and illustrating the double eccentric **28** in detail.

Referring to the drawings in greater detail, the invention is shown applied to the spinning of a roving of cotton supplied from a conventional bobbin **24** utilizing a conventional power supply to turn the tape driven whorl **39** attached to spindle **6**.

Roving **23** from bobbin **24** is threaded through guide **25** into the nip of roving feed roll pair **17** which then feeds said roving to the nip of transport apron pair **14**, said apron pair being held in intimate contact due to the action of pressure adjusting screws **22** and knurled roll pair **15**. At the lower edge of the apron contact area, tensioning guide rolls **16** bring the apron surfaces together with sufficient pressure to exert a firm grip on the roving being fed through. Although transport aprons are preferred for conveying the roving to the twisting head, they are not essential to the invention; for example, a pair of feed rolls similar to roll pair **17** may be used in their stead. The components of gear train **27** are chosen such that the linear surface speed of apron pair **14** is greater than the linear surface speed of roll pair **17** so that roving **23** is drafted prior to being fed into the nip of the twist-head **1**-idler roll **8** combination thus facilitating the removal of fibers from said roving during the yarn spinning operation.

The inner roll of roll pair **17** is fluted and the outer roll has a resilient cover.

The transport aprons **14**, situated directly above twisting head **1**, are flexible, endless, coacting elements similar to those found in the drafting system of the conventional spinning frame. Said aprons are stretched between the knurled driving roll pair **15** and the tensioning guide roll pair **16** in such manner and position that the outer faces of each apron are in contact with each other for a distance equal to the vertical separation of said roll pairs. They are in a vertical plane transverse the axis of twisting head **1** and passing through the point **3** in the fluted side of said head.

Roll pairs **15** and **17** are rotatably supported in parallel alignment by brackets **18** as shown. One of said brackets extends downward and is cut out to form a rectangular opening. This extended portion is shown at **118**. The vertical edges of said rectangular opening are grooved to receive a sliding plate **19** from which studs **20** project inwardly to rotatably support tensioning guide rolls **16**. One of said studs is fixed to plate **19** and the other is pivoted eccentrically and is adjustable to regulate the pressure between the two apron faces passing therebetween. A capstan arrangement, not shown, may press downward on the top edge of plate **19** thereby to put aprons **14** in tension. The outer members of roll pairs **15** and **17** are slidably as well as rotatably mounted in brackets **18**. Pressure adjusting screws **22** regulate the

squeezing or gripping action of the coacting members of said roll pairs thereby providing the traction necessary to pull roving **23** from the customary skewer supported bobbin **24** through guide trumpet **25** and advance it on to twisting head **1**.

Cylindrical twisting head **1** is one apparatus suitable for holding fibers in a continuous helically curved path tangent to the circumference of the head cylinder perpendicular to its axis and curves inwardly to become parallel to and substantially coincident with the axis of the cylinder. Twisting head **1** is fixedly held in chuck **5**, said chuck being an integral part of spindle **6** which is rotatably supported by bearings **7**. In contact with the lower side of head **1** is an idler roll **8** covered with a smooth-surfaced, resilient covering **9**. Said idler roll is rotatably mounted on stud **10** outwardly extending from sliding mount **11**. A spring **12** exerts an upward force against the lower edge of mount **11** to bring idler roll covering **9** into firm contact with the fluted side of twist-inserting head **1**. Nuts **13** permit regulation and holding of the force exerted by said spring. While twisting head **1** is fluted, twisting heads suitable for spinning yarn in accordance with this invention can have a smooth surface but preferably have a friction imparting surface such as a knurled or fluted surface. While the passageway **2** in twisting head **1** starts from opening **3** and runs diagonally to the trumpet-shaped opening **4** in the end face of head **1**, the particularly preferred shape for said passageway is a continuous curve of the character described above with the openings rounded enough to prevent undue friction on the yarn, said passageway having a diameter sufficient to allow the formation of a yarn of the desired diameter. However, as illustrated by the successful employment of twisting head **1**, the exact shape of the passageway is not critical, the essential features being that it mechanically holds the yarn-forming fibers substantially in the curve described.

Driving means for feed roll pair **17** and apron drive roll pair **15** consists of jackshaft **26**, rotatably mounted on bracket **18** between said roll pairs, and gear train **27**. Jackshaft **26** receives its motive power from spindle **6** through the combined action of double eccentric **28**, connecting rod **29**, collapsible connecting rod **30**, nut-cracker arrangement comprising arms **35** and **36** and fulcrum **37**.

A continuous feed of roving **23** can be used in spinning yarn in accordance with this invention, but an intermittent feed which can be synchronized with the rotation of twisting head **1** is preferred. A novel arrangement for doing this is shown in the drawings. In this arrangement arms **35** and **36** pivoting about fulcrum pin **37** are made to grip and release jackshaft **26** once during each revolution of spindle **6** and hence with each revolution of twisting head **1**. Said arms are actuated by double eccentric **28** through connecting rod **29** and the collapsible connecting rod **30** which is made up of eccentric strap **31**, nuts **32**, spring **33**, and plunger **34**. Integral with eccentric strap **31** is a portion which extends outward and upward from its periphery to form a hollow cylinder. The lower end of said cylinder is threaded externally to receive nuts **32**, while the remainder is smooth and of such diameter as to slide freely inside of compression spring **33**. Plunger **34** operates within the hollow of the aforesaid cylindrical portion of strap **31** and is flanged to engage the upper end of spring **33**. A self-aligning bearing in plunger **34** just above the flanged portion engages the end of arm **36**. A similar bearing in the upper end of connecting rod **29** engages the end of arm **35**.

Eccentric **28** has two eccentric surfaces suitably spaced to receive their respective connecting rods, said eccentric surfaces being preferably 90 degrees out of phase with each other so that as the eccentric rotates, the aforementioned connecting rods make one upward and one downward movement each with each revolution of the eccentric, the movement of one rod being a quarter of a cycle ahead that of the other. Thus with connecting rod **29** in its uppermost position and leading connecting rod **30**, rotation of spindle **6** will, through rotation of eccentric **28** cause arm **35** to move downward simultaneously with a corresponding upward movement of arm **36**. As a result, the gripping jaws of arms **35** and **36** close on jackshaft **26** and cause said jackshaft to rotate in the direction of movement of arm **35**, while spring **33** is being compressed by the consequent downward motion of plunger **34** and the upward movement of nut **32** which bears against the lower end of said spring. As connecting rod **30** reaches its topmost position, connecting rod **29** is halfway down and during the next quarter cycle, both rods move downward and spring **33** is being relaxed. By the time rod **29** has reached its lowermost position, rod **30** is halfway down, spring **33** is completely relaxed, and arms **35** and **36** no longer grip jackshaft **26**. Connecting rod **30** then continues downward as rod **29** moves upward and jackshaft **26** remains stationary. When connecting rod **30** passes through its lowermost position rod **29** is halfway up; both then move upward together for the remaining quarter cycle to complete the sequence of operations.

The amount of rotation of jackshaft **26** per revolution of spindle **6** is dependent on the amount of compression produced in spring **33** during the above described cycle of operations, said compression being adjustable by means of nuts **32**, the lower nut serving to lock the upper nut in the desired position on the threaded portion of eccentric strap **31**. For example, by positioning nut **32** such that the maximum compression of spring **33** obtained is either zero or does not produce sufficient gripping action on jackshaft **26**, said jackshaft will not turn. However, as nut **32** is raised, sufficient action results to rotate jackshaft **26** any desired amount up to one half revolution, viz., the half revolution during which arm **35** moves downward. Continued raising of nut **32** will cause jackshaft **26** to oscillate because the gripping period will be extended thereby to include part or all of the half cycle of upward movement of arm **35**, thus causing reversed rotation of said jackshaft.

It is apparent that the novel arrangement for converting the continuous rotary motion of spindle **6** to intermittent rotary motion transmitted to jackshaft **26** can be used wherever a conversion of rotary motion to synchronized intermittent rotary motion is required. Contrary to conventional apparatus for so converting continuous rotary motion this arrangement is adapted to operate at speeds of 9000 r. p. m. and above, although it can, of course, be operated at any lower speed desired. Whereas the eccentric surfaces **28** are positioned 90° out of phase with each other they can be positioned up to 180° out of phase to provide maximum versatility in the controllable amount of intermittent rotation produced by each continuous revolution. When the eccentric surfaces are positioned between 90° and 180° out of phase the intermittent rotation contains increments of reverse motion and becomes oscillatory when the eccentric surfaces are 180° out of phase. The eccentric surfaces can be positioned at any degree above 1° out of phase to provide lesser increments of intermittent motion. While plunger **34** is compressibly connected to strap **31** by means of a spring and self-aligning plunger arrangement the connection can be made through any compressible arrangement. While the gripping jaws of arms **35** and **36** and the surface of jackshaft **26** are smooth surfaces, thereby inducing rapidly accelerating motion of jackshaft **26** as the gripping jaws close, any or all of said surfaces can be friction imparting surfaces which tend to induce substantially instantaneously corresponding rotational rates in jackshaft **26** as the gripping jaws close.

Roving **23** after being drafted and advanced by roll pair **17** and apron pair **14**, feeds into the nip of the twisting head **1**-idler roll **8** combination in line with opening **3** of said head to meet the end fibers of yarn **41** pro-

truding therefrom. Said yarn, threaded through diagonal hole 2 of head 1, emerges from trumpet-shaped opening 4 and passes into the nip of delivery roll pair 40 which pulls said yarn away from twisting head 1 and advances it to the winding mechanism not shown. Rotation of twisting head 1 causes twist to be inserted into said yarn, part of said twist running back to the free end protruding from opening 3. The twisting end fibers of yarn 41 tangle or intermingle with the fibers of the advancing roving 23 and pulls therefrom as an increment those fibers which are free of the grip of apron pair 14, which increment fibers are thereby incorporated into the yarn strand thus being formed. Said operation is repeated with every revolution of head 1, the yarn so formed being withdrawn by the action of delivery roll pair 40.

The count or size of the yarn produced is determined by the size of roving used, the amount of predrafting of said roving, the rate with which said drafted roving is fed to twisting head 1, and the rate of withdrawal of yarn from said head by delivery roll pair 40. The overall draft is given by the ratio of rate of yarn delivery to rate of roving input. Any amount of draft desired may be obtained by varying the constants of the component parts which govern said rates of yarn delivery and roving input.

A novel feature of this invention is its adaptability to multiple spindle construction similar to the conventional ring spinning frame.

As shown in Figures 4, 5, and 6, idler roll 8 can be replaced by a guide which brings fibers into contact with twisting head 1. The point of contact is preferably adjacent to the opening 3. Guide 42 is constructed of plastic, but any construction material adapted to present smooth surfaces can be used. Guide 42 forces roving 23 into contact with twisting head 1 and forces it to remain in such contact substantially all of the way around twisting head 1. The distance around the outside of the head over which roving 23 is forced to remain in contact with the spinner can suitably be varied widely. The positioning of the fibers by a guide such as guide 42 can suitably be aided by the application of suction or by the application of air under pressure.

Gripping members 43 have been found to aid in preventing a kinking of the yarn which would cause interruptions in the spinning operation. Such gripping members can suitably consist of a pair of rollers, of spring loaded co-acting bars, or the like gripping members.

It is apparent that the above description is given by way of illustrating one embodiment and the various structures are subject to wide variations without departing from its scope. For example, it is not essential that the intermittent roving feed device be driven by spindle 6. An alternative means would consist in ganging the driven members of the roll pairs 15 and 17 as in the conventional spinning frame and driving them from a single intermittent driving means actuated by the delivery roll driving means. In this case, it will be necessary to provide additional means for synchronizing said roving feed with the rotation of twisting head 1 so as to provide optimum conditions for fiber pickup by the twisting free end of yarn strand 41. Other variations are readily apparent to those skilled in the art.

I claim:

A spinning machine comprising means for withdrawing a staple fiber yarn in a linear, substantially non-twisting manner, means for advancing a roving, and a rotatable member containing a helical passageway entering said rotatable member at a side, following a continuous curve of decreasing radius which approaches zero at the axis of rotation of said member, and emerging at an end of said member, whereupon as said roving is advanced into said helical passageway, the said rotatable member, within one revolution, separates an incremental strand of the roving having a length not exceeding the circumference of the said member, this incremental strand advancing in the passageway where the forward end fibers thereof are intermingled with the receding end fibers of the withdrawing yarn while the twist imparted to the said increment by the rotating member causes the said incremental strand to attach to the receding yarn at the point of intermingling.

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