No. 689,556. Patented Dec. 24, 1901.

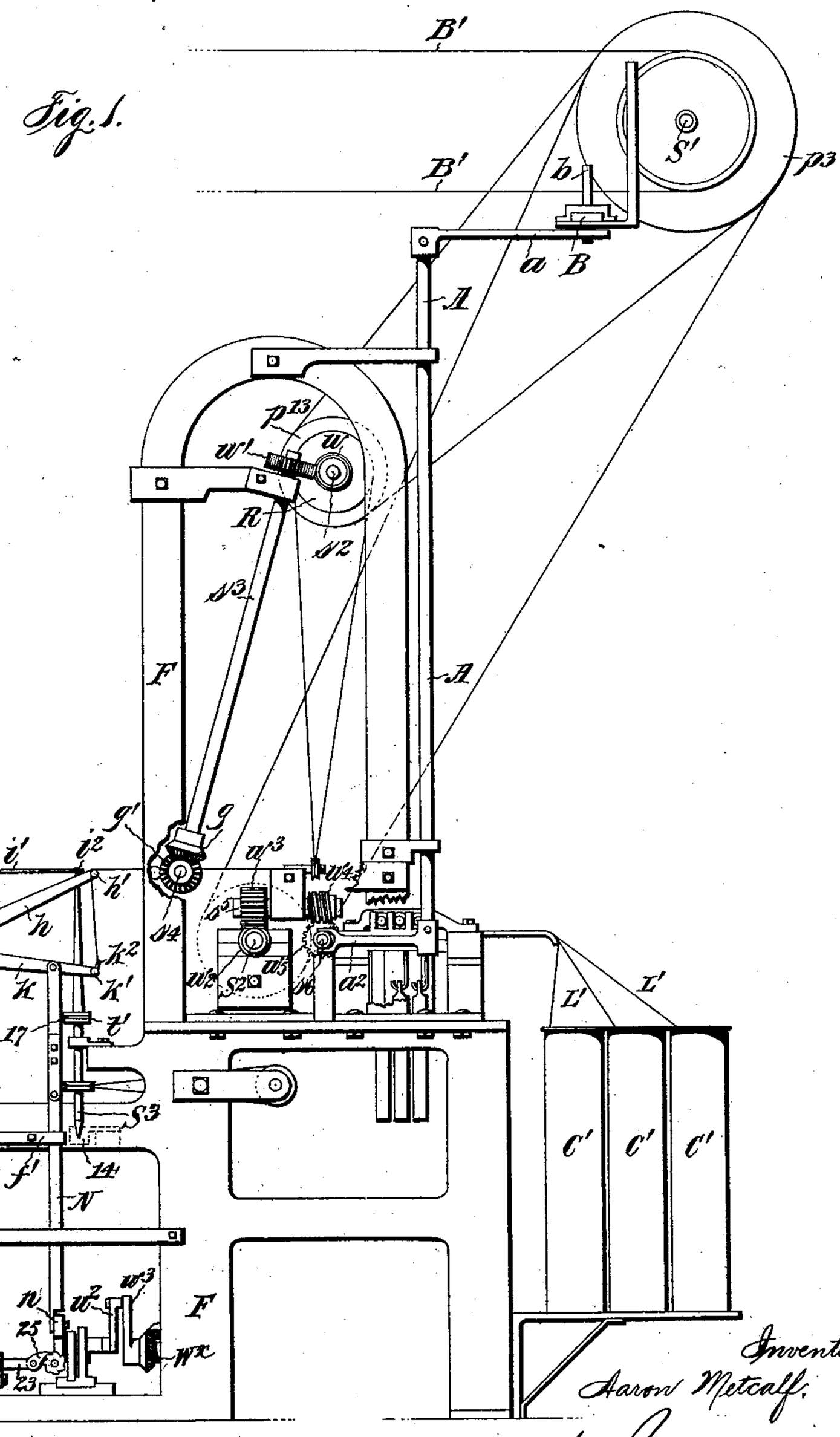
A. METCALF.

MACHINERY FOR SPINNING AND TWISTING FIBROUS MATERIALS.

(Application filed Mar. 27, 1901.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



Inventor.
Aaron Metcalf.
by Henry Orth
Atty.

Witnesses:
A. J. Ober.
B. H. Sommers.

No. 689,556. Patented Dec. 24, 1901.

A. METCALF.

MACHINERY FOR SPINNING AND TWISTING FIBROUS MATERIALS.

(Application filed Mar. 27, 1901.)

(No Model.) 5 Sheets—Sheet 2.

Fig. 2.

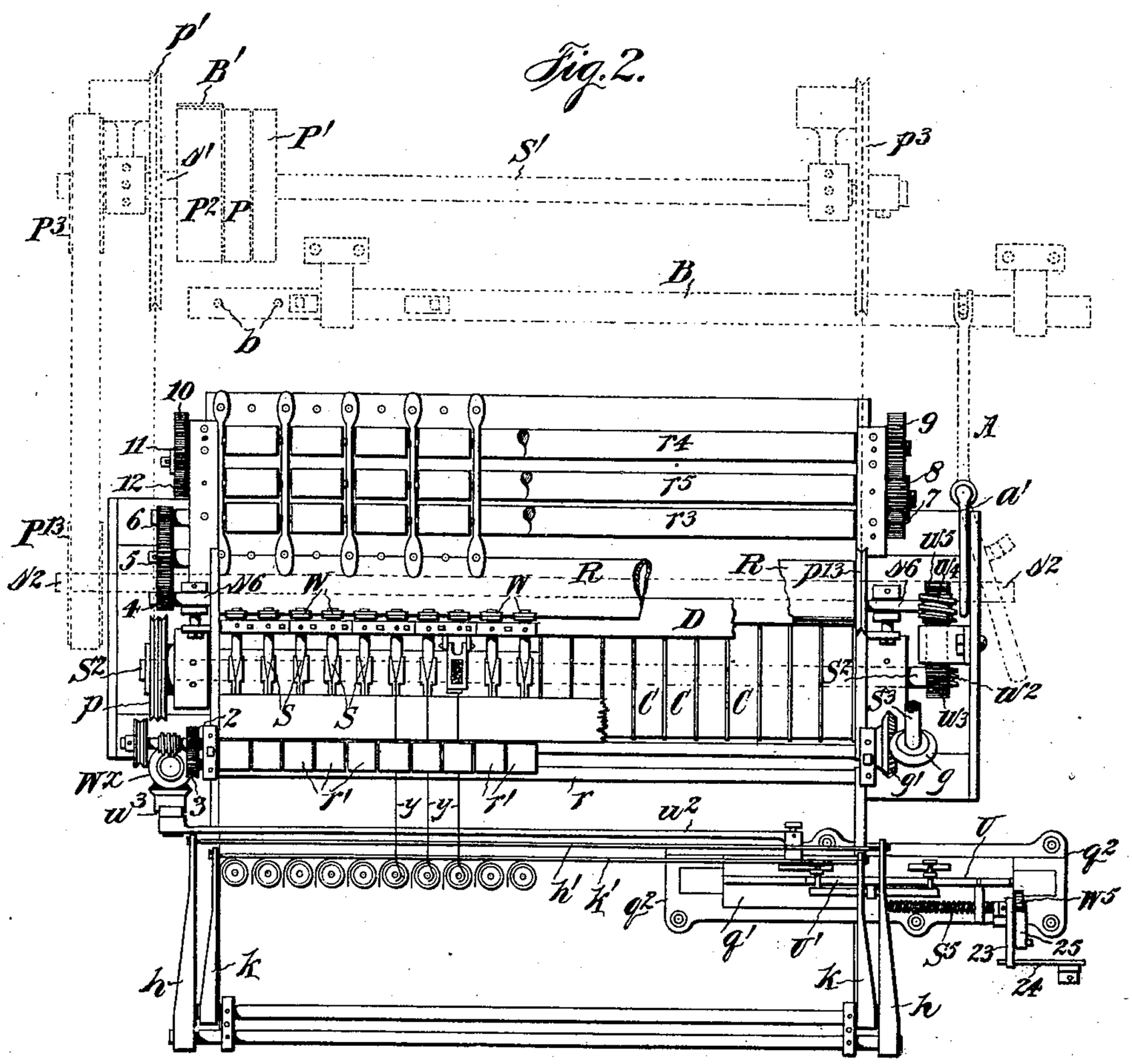
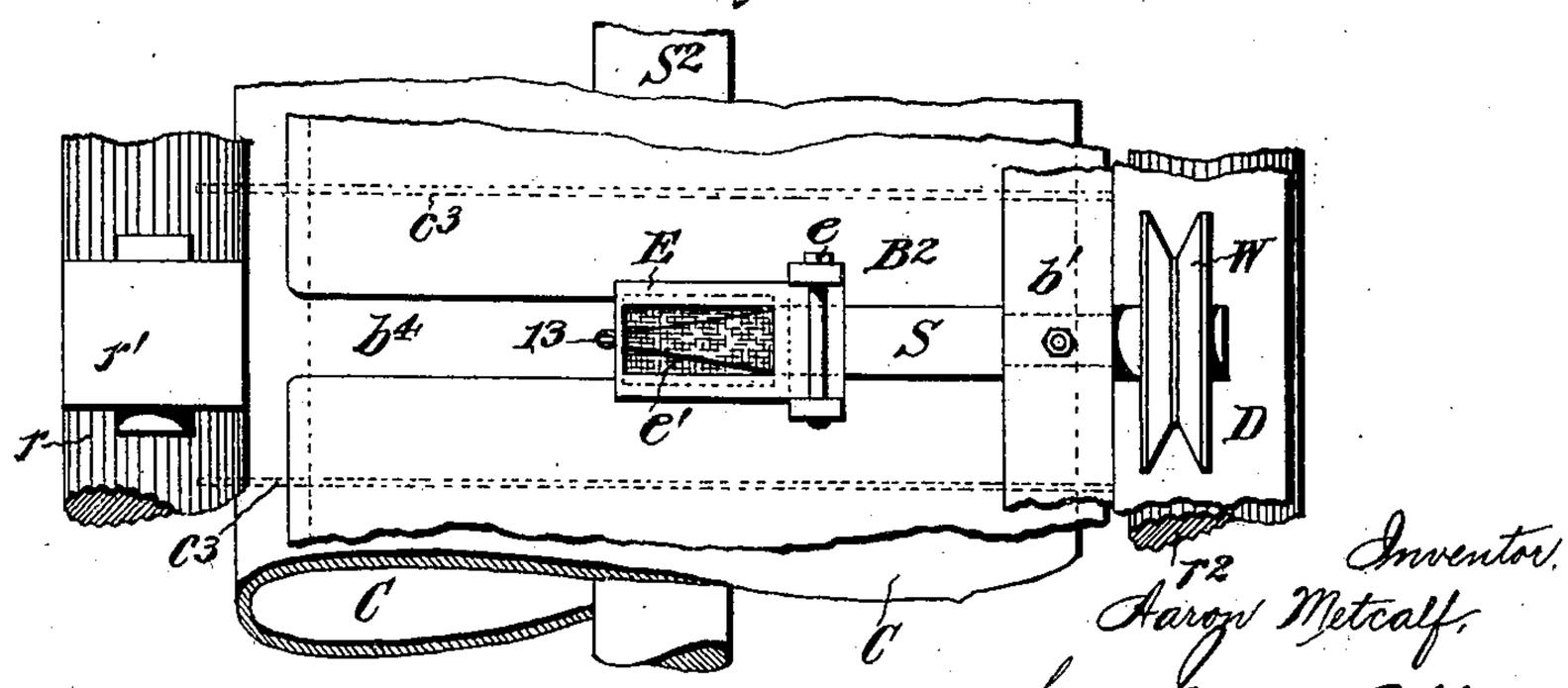


Fig. 1.



Witnesses:
B. J. Ober.
B. L. Sommers

Inventor.
Aaron Metcalf.
by Henry Orth
Atty.

No. 689,556. Patented Dec. 24, 1901.

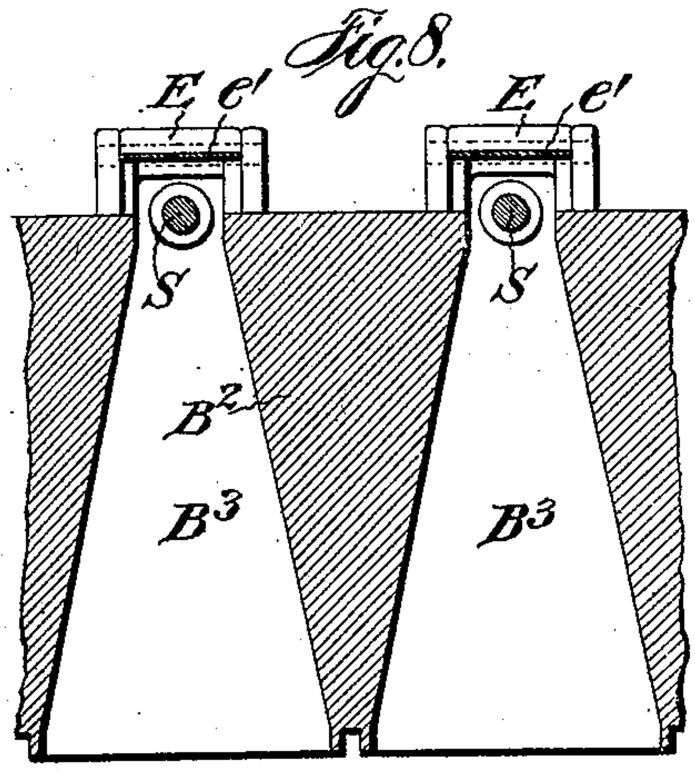
A. METCALF.

MACHINERY FOR SPINNING AND TWISTING FIBROUS MATERIALS.

(Application filed Mar. 27, 1901.)

(No Model.) 5 Sheets—Sheet 3.

Fig. 8.



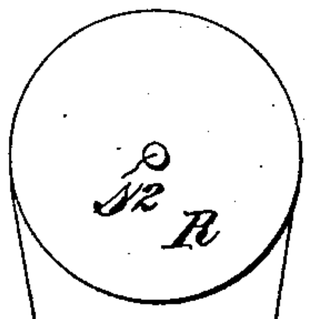


Fig. 3.

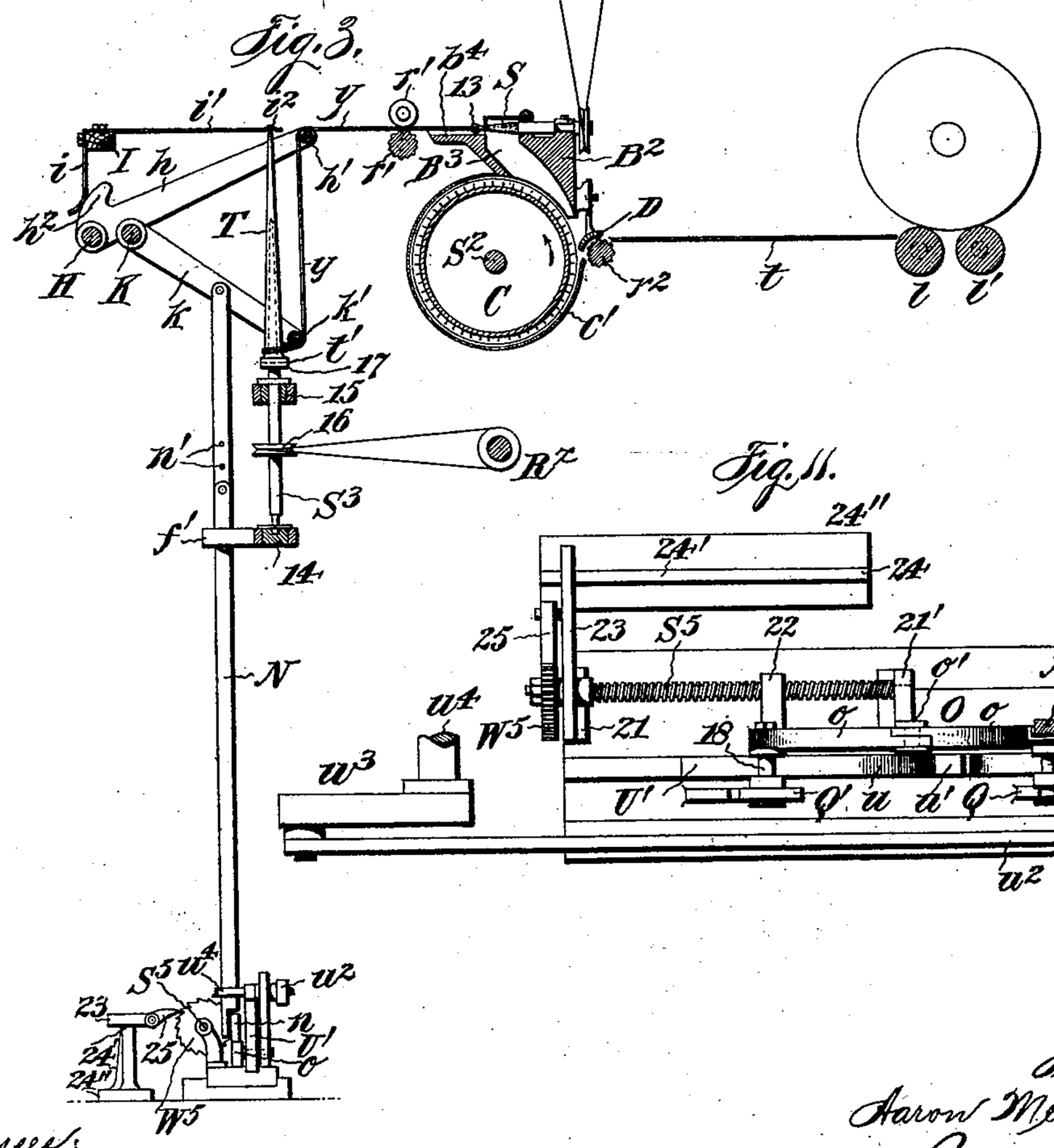


Fig. 11.

Witnesses:
B. Ober.
B. L. Sommers

Inventor,
Aaron Metcalf,
by Henry Orth
Atty.

No. 689,556. Patented Dec. 24, 1901.

A. METCALF.

MACHINERY FOR SPINNING AND TWISTING FIBROUS MATERIALS.

(Application filed Mar. 27, 1901.)

(No Model.) 5 Sheets—Sheet 4.

Fig. 4.

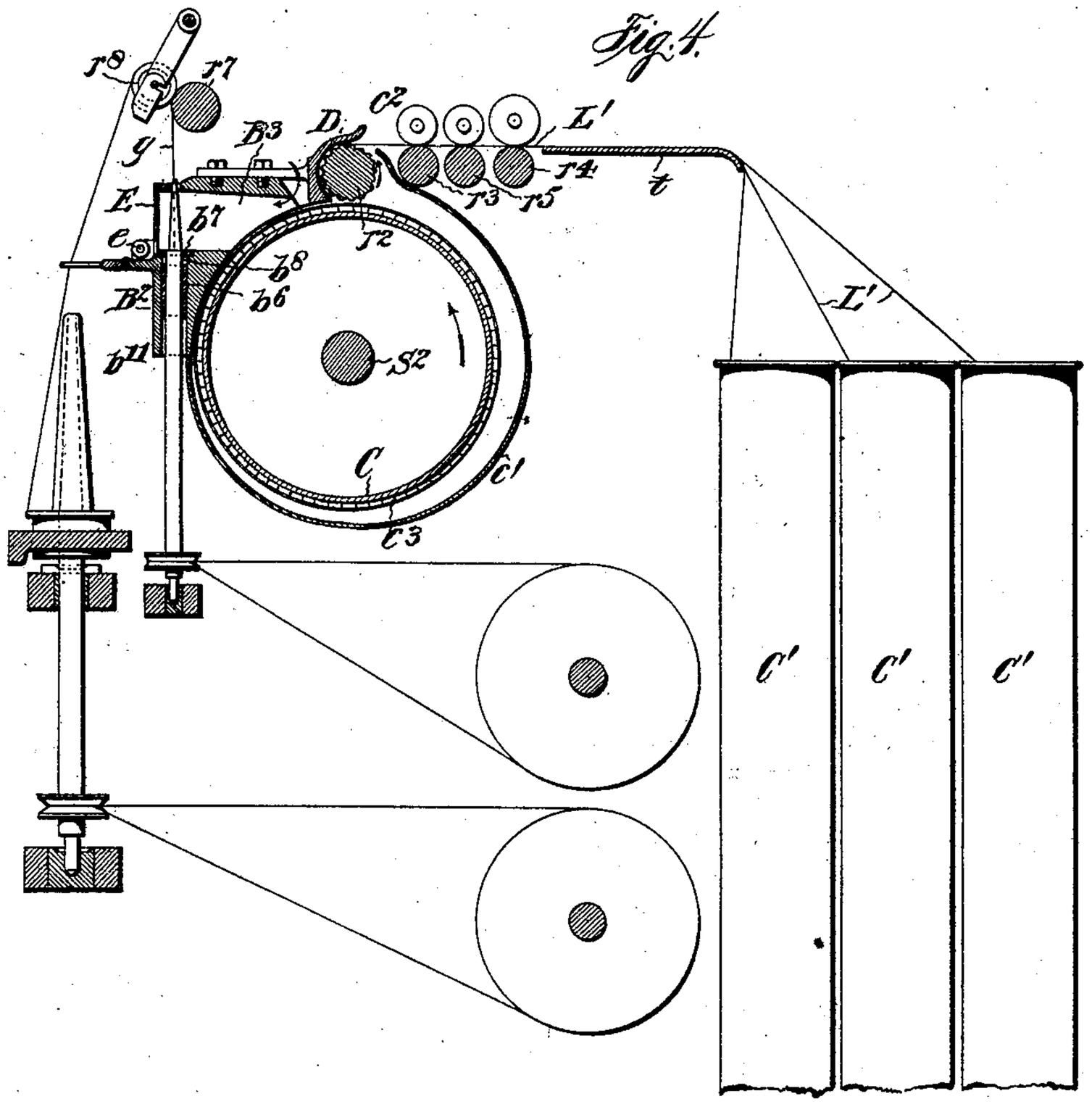
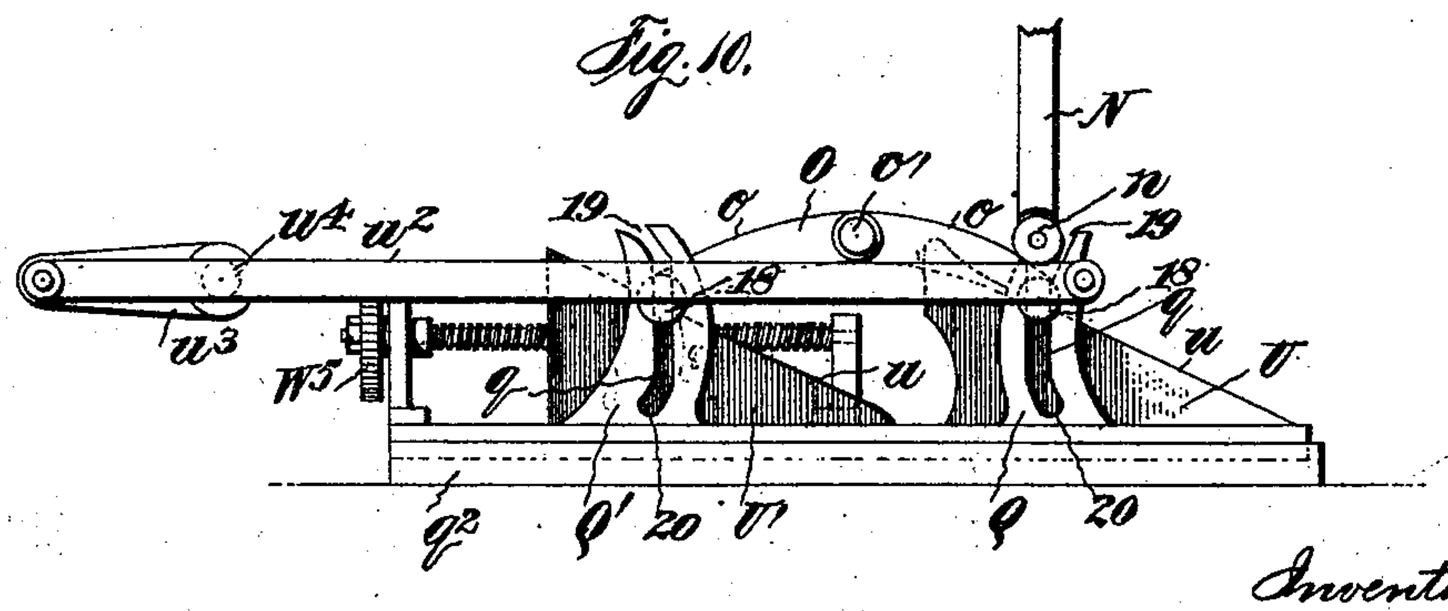


Fig. 10.



Witnesses:
D. Ober.
B. H. Sommers.

Inventor.
Aaron Metcalf.
by Jenney & Mills
Attys.

No. 689,556. Patented Dec. 24, 1901.

A. METCALF.

MACHINERY FOR SPINNING AND TWISTING FIBROUS MATERIALS.

(Application filed Mar. 27, 1901.)

(No Model.) 5 Sheets—Sheet 5.

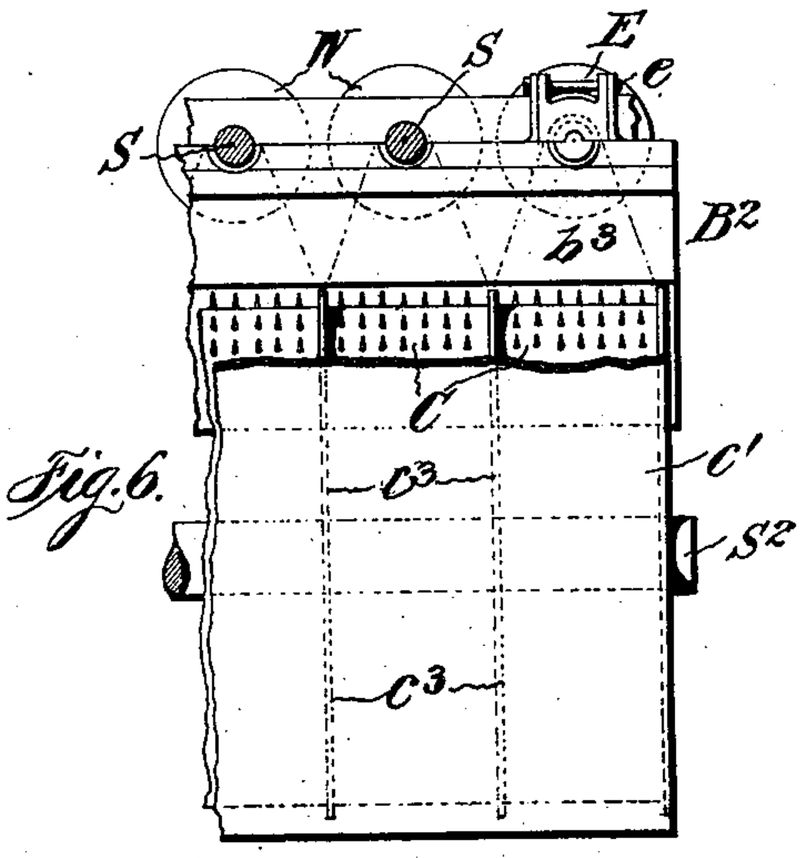


Fig. 6.

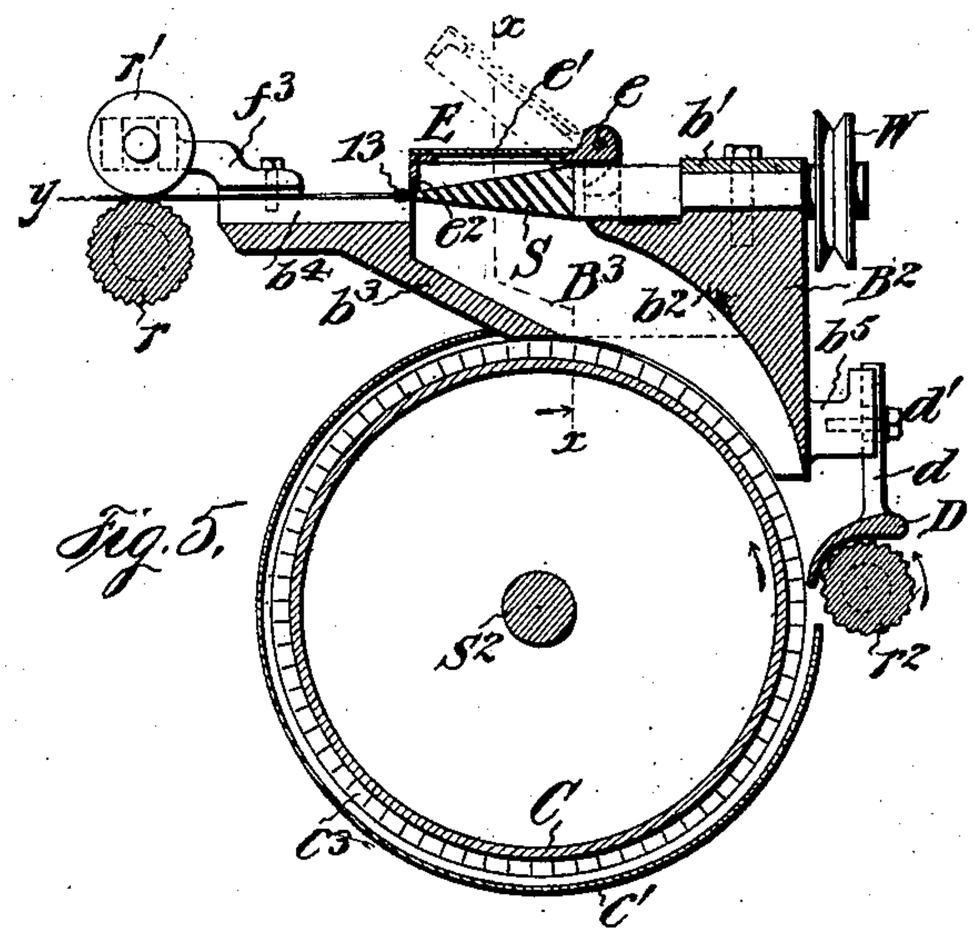


Fig. 5.

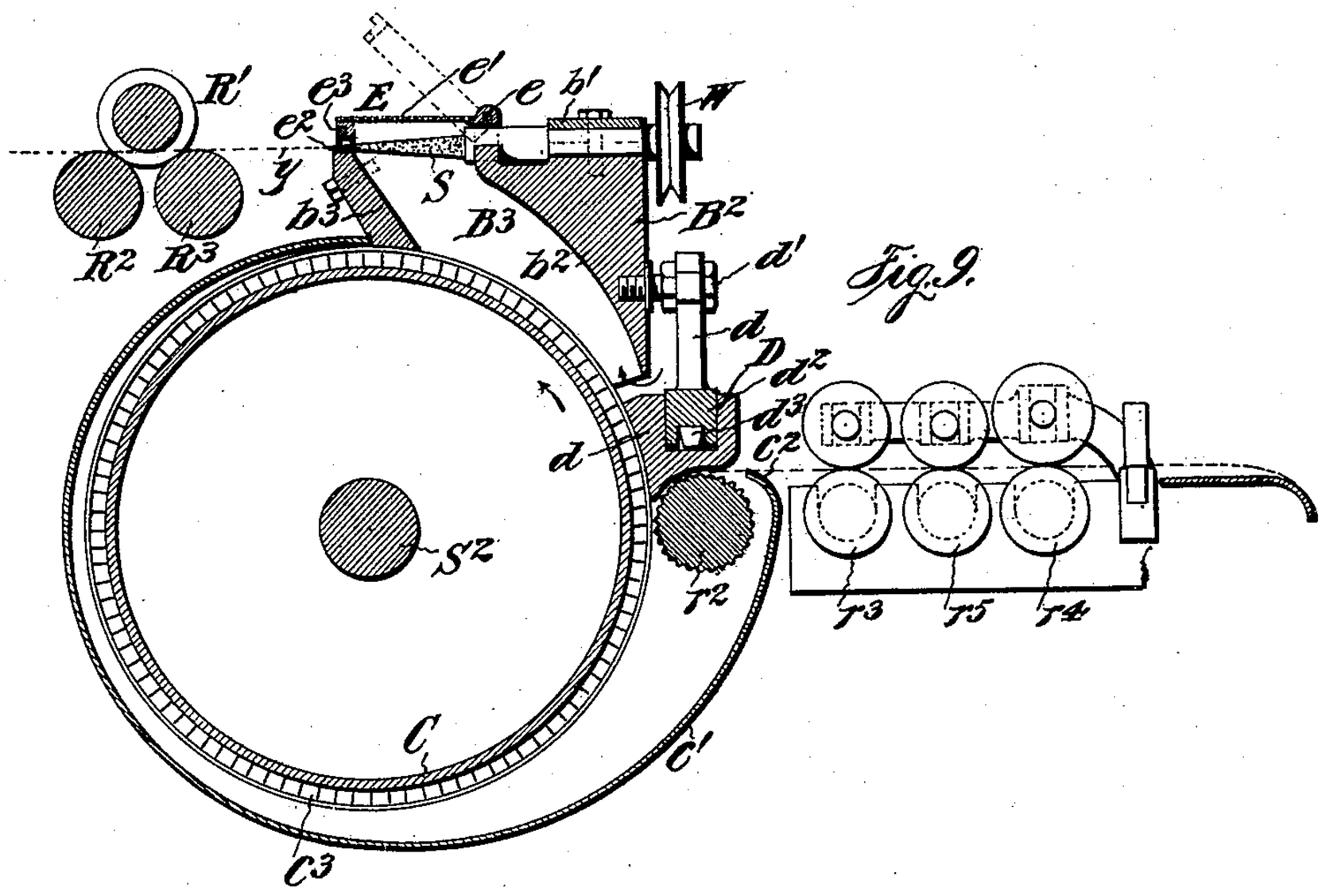


Fig. 9.

Witnesses:
C. F. Ober.
H. Sommers.

Inventor:
Aaron Metcalf.
by Emery O'Neill
Atty.

UNITED STATES PATENT OFFICE.

AARON METCALF, OF PRESTON, ENGLAND.

MACHINERY FOR SPINNING AND TWISTING FIBROUS MATERIALS.

SPECIFICATION forming part of Letters Patent No. 689,556, dated December 24, 1901.

Application filed March 27, 1901. Serial No. 53,068. (No model.)

To all whom it may concern:

Be it known that I, AARON METCALF, a subject of the King of Great Britain, residing at Preston, in the county of Lancaster, England, have invented certain new and useful Improvements in the Art of Spinning and Twisting Fibrous Materials and in Machinery Therefor; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters and figures of reference marked thereon, which form a part of this specification.

This invention has relation to the art of spinning fibrous materials; and it has for its object the provision of means whereby the cost of spinning such materials is greatly reduced and whereby yarn or thread for weaving can be obtained, as well as yarn or thread especially adapted as a weft for so-called "napped" fabrics and for other purposes.

This invention resides, essentially, in the mechanism for carrying out a novel and improved method of spinning fibrous materials.

The improved method of spinning consists, essentially, in separating the fibers from a lap, sliver, or fleece and feeding the separated fibers onto a revolving conical or tapering surface, to which they are caused to adhere and to adhere to one another, and whereby a conical or tapering fibrous sheath is formed on said surface, the smaller or pointed end of which when drawn off will be twisted into yarn or thread, which may then be copped or further twisted and then copped or wound on bobbins, as required.

I do not intend to claim herein the method of spinning just described, as this forms the subject-matter of a separate application for patent, filed September 5, 1901, Serial No. 74,397.

That my invention may be fully understood I will describe the same in detail, reference being had to the accompanying drawings, in which—

Figure 1 is an end elevation of a spinning-machine organized in accordance with my invention. Fig. 2 is a top plan view thereof, parts of the mechanism being removed and showing in dotted lines the mechanism located above the machine in Fig. 1. Fig. 3 is a fragmentary sectional elevation of the machine, showing means for feeding a lap of fibrous material of sufficient width to supply fiber to a number of spinning-spindles. Fig. 4 is a fragmentary sectional elevation showing the spinning-spindles arranged vertically. Fig. 5 is a fragmentary longitudinal sectional view through the spinning-spindle rail. Fig. 6 is a fragmentary left-hand sectional elevation of Fig. 5. Fig. 7 is a fragmentary top plan view of Fig. 6, and Fig. 8 is a fragmentary vertical section on line $x\,x$ of said Fig. 5. Fig. 9 is a view similar to Fig. 5, the toothed cylinder and its casing being removed, showing a spinning-spindle devoid of the twisting-prongs and a modified arrangement for appressing the shell or presser-bar to the feed-roller, Figs. 6 to 9 being drawn to an enlarged scale. Fig. 10 is a side elevation, and Fig. 11 a top plan view, of the copping-motion.

Similar symbols of reference indicate like parts wherever such may occur in the figures of the drawings above described.

Referring more particularly to Figs. 1 and 2, the operating mechanism is supported from a suitable frame F, and S′ indicates the overhead main driving-shaft driven from any suitable prime motor by belt B′. Said shaft S′ carries a sleeve s', loose thereon and carrying a fast and loose belt-pulley P and P^2, respectively, and a grooved pulley p'. Adjacent to fast belt-pulley P is a second belt-pulley P′, fast on shaft S′, both pulleys adapted to be driven at one and the same time or independently of each other by one and the same prime-motor belt B′, and to this end the width of the belt-rims of said two pulleys P and P′ is about the same as that of the loose pulley P^2 and the same as the width of the driving-belt B′.

On the left-hand end of shaft S′, Fig. 2, is secured a belt-pulley P^3 and on the right-hand end a grooved pulley p^3. The grooved pulley p' on shaft S′ is connected by cord or rope with a pulley p on the shaft S^2 of the toothed cylinder C. The grooved pulley p^3 is connected by cord or rope with a like pulley p^{13} on tin roller R, which drives the spinning-spindles S by means of cords connected with the whirls W on said spindles. The tin roller

R is loosely mounted on its shaft s^2, which latter carries at one end a belt-pulley p^{13}, belted to pulley P^3 on main driving-shaft S, and said shaft s^2 carries at its opposite end a worm w in gear with a worm-wheel w' on an inclined shaft s^3, carrying at its lower end a bevel-gear g, geared to a similar gear g' on shaft s^4, that drives the lower drawing-off roller r, said shaft carrying a pinion 2 in gear with a pinion 3 on the shaft or journal of the upper coöperating drawing-roller r', or a series of such rollers r', one for each spindle, may be used, as shown in Figs. 2 and 7, in which case the upper rollers may act by their own weight or be weighted or acted on by pressure-springs in a well-known manner.

The toothed cylinder-shaft S^2 carries a worm w^2 in gear with a worm-wheel w^3 on a counter-shaft s^5, on the other end of which is secured a worm w^4 in gear with a worm-wheel w^5 on the shaft or journal s^6 of the feed-roller r^2. On the other end of the said shaft s^6 is secured a pinion 4 in gear with an idler 5, which latter is in gear with a pinion 6 on the shaft of the foremost drawing-roller r^3 of a pair of such on the feed side of the machine, said roller-shaft carrying at its opposite end a pinion 7, gearing with an idler 8, meshing with a pinion 9 on the lower drawing-roller r^4 of the rearmost pair of such, the shaft of the latter roller carrying at its opposite end a pinion 10 in gear with an idler 11, meshing with a pinion 12 on the shaft of the lower feed-roll r^5 of the intermediate pair of such, the upper coöperating draft-rolls r^6 being weighted in a well-known manner.

Below the driving-shaft S' is arranged a belt-shifting bar B, having endwise motion in suitable brackets and carrying the belt-fork b, said bar having a pin on its under side engaged by the forked end of a radial arm a on the upper end of a vertical shifting-rod A, provided with a hand-lever a', so that by turning said rod the driving-belt can be shifted from the loose pulley P^3 onto the pulley P or onto both pulleys P and P'. The shifting-rod A also carries a forked shifting-lever a^2, engaging the hub of worm-wheel w^5, feathered on the shaft s^6 of the feed-roller r^3, whereby said wheel can be shifted into and out of gear with its worm w^4.

The object of the above-described driving mechanism is to provide means whereby the operative parts of the machine can be put successively in operation or thrown out of operation in the order in which they should be started and stopped.

By shifting the driving-belt first onto the pulley P the toothed cylinder C will be set in motion through sleeve s' and pulleys p and p', and through the gearing w^2 w^3 w^4 w^5 the feed-roll r^2 will be set in motion, and therethrough and through the described gearing 4 to 12 the three sets of draft-rollers will be started to feed the lap or laps or slivers to said feed-roller r^2. The driving-belt is then shifted to drive both pulleys P and P', whereby and through the belt-pulleys P^3 and p^{13} the tin roller R, that drives the spinning-spindles S, and the tin-roller shaft s^2 are set in motion, and through the latter and the gearing w, w', g, and g' the drawing-off rolls r and r' are set in motion.

It is obvious that by reversing the order of shifting of the driven belt B' first from pulley P' onto pulley P and then onto loose pulley P^2 the order in which the operative mechanisms will be stopped relatively to the order in which said mechanisms were started will be reversed, the rotation of the toothed cylinder C being stopped last.

The spinning-spindles S are cone or taper spindles at the ends and may have at their pointed end two twisting-prongs 13, Figs. 3, 5, and 7, though this is not absolutely necessary, as said spindles may simply terminate in a point, as shown in Figs. 4 and 9.

The taper portion of the spindles may be roughened, Figs. 3 and 9, or may have a spiral-groove formed therein, Fig. 5, to cause the fiber to more readily adhere to the spindle; but practice has shown that this is not absolutely necessary, and the spindle may have a perfectly smooth taper portion, Fig. 4, whereon the fiber is collected and spun or twisted into yarn or thread.

From Fig. 2 it will be understood that any desired number of spindles S within proper limits may be used in one and the same machine, and these spindles are mounted to revolve in bearings in a rail B^2, which I call and which will hereinafter be referred to as the "spindle-rail," said bearings having a removable cap-plate b' and each spindle carrying a whirl W, corded to the tin roller R.

Each spindle S is mounted to extend across the top of a chamber B^3, formed in the spindle-rail B^2, which chamber in cross-section—*i. e.*, at right angles to the spindle—tapers thereto, as shown in dotted lines in Fig. 6 and in full lines in Fig. 8. The rear wall b^2 of said chamber curves forwardly to the base of the cone or taper portion of the spindle S, while the front wall b^3 is inclined forwardly and then rises vertically to the point of said spindle, the spindle-rail having a forwardly-projecting ledge, in which is formed a channel b^4 for the passage of the yarn or thread.

To the rear face of the spindle-rail B^2 are secured vertically-grooved brackets b^5 for the arms d of which is commonly termed the "shell" D, that appresses the lap or sliver or slivers onto the fluted feed-roll r^2, said arms d being slotted vertically and secured to their brackets by means of a screw-bolt and nut d', whereby the shell D can be adjusted relatively to the feed-roller, as may be necessary to the proper feed of the fibrous material.

Instead of the described arrangement I prefer to use the arrangement shown in Fig. 9, wherein the arms d of shell D are shown as adjustable on bolts d', provided with bar d^2, fitting a cavity in shell D and having a leaf or other spring d^3 interposed between said head

or bar and the shell, whereby the latter is held yieldingly to the feed-roll r^2. Below each chamber B^3 in the spindle-rail B^2 is secured a casing c', inclosing the toothed cylinder C, said casing being preferably, though not necessarily, eccentric relatively to said spindle, Figs. 4 and 9, its rear wall extending upwardly and curving toward the feed-roller r^2 into the line of feed of the lap, as shown at c^2, Figs. 4 and 9, such lap then forming a closure for the rear open end of said casing when the machine is in operation.

The cylinder may have straight teeth or spikes c, or said teeth may have a slight inclination in the direction of rotation of the cylinder, which is divided by means of rings or circular flanges c^3 into a number of toothed sections corresponding with the number of spindle-chambers B^3 in spindle-rail B^2, said flanges c^3 forming the lateral walls of the lower open end of chambers B^3 and also dividing the casing c' into corresponding chambers, said casing, with a view to simplifying the construction, extending the full length of the spindle-rail B^2, thus avoiding the necessity of a separate casing for each spindle-chamber.

The spindle-chambers B^3 and the rear wall b^2 of which is eccentric to the axis of rotation of the toothed cylinder C, as shown, are in fact mere fiber-ducts, and will hereinafter be so referred to, said ducts leading from the casing c' of the toothed cylinder C in the direction of rotation of the latter and are open at top along the taper end of the cone as well as at their lower rear end, so that when the toothed cylinder is rotated a partial vacuum will be formed in said ducts and an air-current induced therethrough; but to prevent fibers from being carried out of the ducts I provide a cover E, hinged to spindle-rail B^2 at e and having an opening in its top covered with a foraminous material e', as wire-gauze, the front wall of said cover having an opening or recess e^2, through which the taper end of the spindle S projects.

To the forward projection of the spindle-rail B^2 are bolted arms f^3, that carry the bearings for the upper drawing-off rollers r' of a pair of such, the lower feed-roller r being geared or not, as hereinbefore described, with the worm w on tin-roller shaft s^2.

The operation of spinning will be readily understood. The fibrous material may first be formed into a lap of such width as to be fed to each toothed-cylinder section C, Fig. 3, such lap being divided by the circular flange c^3 into slivers, and when such a lap L is used it is wound as usual into a roll and acted upon by unwinding-rollers $l\,l'$, Fig. 3, in the usual manner and passes thence over a feed-table t to the feed-roller r^2, which feeds it to the toothed cylinder C, whereby it is torn and the fibers separated and thrown by centrifugal action toward or to the taper portion of the spinning-spindles S, the feed of the fibers to said spindles being assisted by the current of air induced through the fiber-duct B^3, as above set forth. The fibers adhere to the spindle and to each other and a shell of fiber is speedily formed, which when drawn off, by hand first and then by the drawing-off rollers r and r', is twisted into yarn or thread either by the mere rotation of the spindle or by the combined rotation and the twisting-prongs 13, such twist being in a sense put in from the inside of the tapering fiber shell, so that a yarn or thread is produced having one end of the fibers loose or untwisted and projecting from such yarn or thread, such yarn or thread being eminently suitable as a weft for those fabrics which have a nap and are known as "flannelette" and other purposes.

If the yarn or thread to be spun is to be smooth, then I apply to the front wall of the cover E for fiber-duct B^3 a pressure-plate e^3, Fig. 9, bearing lightly on the point or delivery end of the spindle S, whereby the loose or projecting fiber ends are smoothed down and twisted in.

I have hereinbefore stated that a single lap of sufficient width to supply all of the spindles with fiber may be employed. This of course can only be done with a limited number of spindles, and to avoid this I prefer to first convert the fibrous material or the lap into slivers and feed the same from the usual cans C', Figs. 1 and 4, to the sections of the toothed cylinder C, one or more of such slivers L' being fed to each cylinder-section C, in which case I use the feeding devices described, and shown in Figs. 1, 2, 4, and 9.

If the speed of the drawing-off rollers r and r' is fixed, the thickness or counts of the yarn or thread will be determined by the speed of the feeding device, and, if desired, when not too hard twisted the yarn or thread may be carried to well-known drawing-out or reducing rollers and reduced to the extent desired before receiving the final twist.

From the drawing-off rollers r and r' the thread or yarn y passes to the copping mechanism, which I will now describe, reference being had to Figs. 1 and 3. A shaft H carries radial arms h, connected by a wire h', which I may call the "counter-faller," one or both of said arms having a cam projection h^2 at the hub on which bears a spring i on a bar I, that is polygonal in cross-section and is free to turn on journals j^2, having their bearings in standards f on or secured to the main frame F, as shown in Fig. 1, in which standards the faller-shafts also have their bearings, and K is the faller-shaft, carrying radial arms k, connected by faller wire or rod k'. The yarn or thread may be passed over the counter-faller wire h' and under the faller-wire k'; but this requires the use of both hands, to avoid which I provide the faller-wire with a hook or curl k^2, Fig. 1. To the upper face of bar I is secured a leaf-spring i', one for each copping-

spindle, the free end of which spring has bearing on the tip of the shell T upon the said copping-spindle.

The copping-spindles S^3 are in a well-known manner stepped in a spindle-rail 14 and guided in a guide-rail 15, said spindles S^3, carrying a whirl 16, driven by cord from a tin roller or $R^\times$, which may be driven by belt and pulleys from the drawing-off-roller shaft R^2.

The tapering shell or tube T, on which the yarn or thread is wound, is by preference a sheet-metal tube and has at its base or larger end a flange t', fitting a friction-disk 17 on the copping-spindle S^3, whereby said tube T is caused to revolve with said spindle.

From the arrangement of the faller and counter-faller wires k' and h' and the construction of the counter-faller, together with the bar I and its springs, it will readily be seen that when the drag or tension of the yarn or thread pulls the counter-faller h downward the pressure of the cam h^2 on spring i is reduced, and hence also the pressure of the springs i' on the copping-spindles S^3, thus giving less drag upon the threads or yarns, and to prevent the displacement of the tips of said spindles I form on the under face of the free end of springs i' a recess i^2.

The thread or yarn is distributed on the cop-tubes T by means of a novel copping-motion, which I will now describe, referring more particularly to Figs. 10 and 11, part of said motion being also shown in Figs. 1 and 3.

One of the faller-arms k has pivoted thereto an actuating-bar N, made in two parts adjustably secured together by providing one or the other part with a series of bolt-holes n', a well-known mode of adjusting a flat bar as to length, said bar being guided in a suitable guide-bracket f' on the main frame F. At its lower end the actuating-bar N carries a roller n, that has bearing upon the upper edge of an arched bar O, composed of two segmental links o o, articulated together at o', and each link has at its free end a pin 18, that projects into a slot q, formed in two standards Q Q', rising from a plate q', that has sliding motion in a bed-plate q^2 on the floor. These slots q have an upper and a lower portion 19 and 20 at an angle to an intermediate vertical portion, the angular or inclined terminals 19 and 20 of the slot q in standard Q' diverging from the like terminals in the standard Q, and the aforesaid pins 18 bear on the upper faces of two plates U and U', which I call the "shaping-plates" and which are rigidly connected together or formed integral with a basal portion u', that slides freely into a groove in the slide-plate q', said shaping-plates U U' being, above their base, of substantially triangular form, the inclines u being from left to right, Fig. 11, or crosswise of the machine from front to rear, Figs. 1 and 3. These shaping-plates may have their inclined edges u so shaped as to allow of a different upward movement to each pin 18 on the ends of the links o of the curved or arched bar O, as shown in Fig. 10.

To the rear slotted standard Q is pivoted one end of a connecting-rod u^2, whose opposite end is pivoted to the pin of a crank u^3 on a shaft u^4, which may also be driven from the drawing-off-roller shaft.

From the slide-plate q' rise two standards 21 and 21', in which revolves a screw-spindle S^5, that works in the correspondingly-threaded bore of a sleeve 22 on an arm projecting laterally from the shaping-plate U', whereby the position of the shaping-plates relatively to the slide-plate q' is changed. The screw-spindle S^5 carries a ratchet-wheel W^5 at its forward or outer end. Between the ratchet-wheel W^5 and standard 21 the screw-spindle S^5 carries a radial arm 23, loose on said spindle and bearing on the upper edge 24' of a plate 24, which upper edge is inclined crosswise of the machine, or from the front end to the rear end of said plate, Figs. 1 and 3, and may have a separate foot portion 24'' or may rise from a projection or extension of the base-plate q^2 of the copping motion, and to the aforesaid arm 23 is pivoted a pawl twenty-five times in engagement with the ratchet-wheel W^5, so that when the shaping-plates U and U' are reciprocated with slide-plate q' through the crank u^3 the arm 23 rides to and fro and up and down on the inclined edge of plate 24, and thus imparts a step-by-step rotation to the ratchet-wheel W^5, whereby the shaping-plates are gradually displaced relatively to slide q'.

The operation of the copping motion is as follows: In starting, the pins 18 on linked bar O lie at the bottom of the slots q in standards Q and Q' and the thread or yarn is wound to form the bottom of the cop, and when said pins pass into the vertical part of said slots the bottom of the cop has been formed and the middle or cylindrical portion of said cop is being formed. At the beginning of the copping the link-bar is drawn out to its greatest extent—that is to say, the curve is flattened—and as said links approach each other as they pass from the lower diverging portions 19 into the intermediate parallel vertical portions of the slots q the curvature of the link-bar O is gradually increased, thereby increasing the lift of the actuating-bar N, connected with the faller-arm k. As the pins 18 pass from the parallel portion of slots q into the upper diverging portions 19 of said slots the middle portion of the cop will be completed and the upper cone portion thereof will be formed, and as the links of the bar O are gradually drawn out again the lift of the connecting-bar N will again be reduced. During these operations the appliances mounted on slide-plate q' will be reciprocated by the crank u^3 and connecting-rod u^2, pivoted to standard Q, whereby a vertical reciprocating motion is imparted to the aforesaid connecting-rod N and the thread or yarn

traversed on the cop-tube T; but during the building up of the cop the shaping-plates U and U′ are displaced, as above stated, in a direction from left to right, Fig. 11, or from the front to the rear side of the machine, Figs. 1 and 3, so that the reciprocations of the slide q' and the link-bar O, acting upon the faller k', impart to the latter the required vertical reciprocations, such faller traveling more slowly up and down during the building up of the small part of the cop, the travel increasing gradually from the large to the small end of the cone of the cop, and vice versa. This displacement of the plates U and U′ is effected by the step-by-step rotation of screw-spindle S^5, causing the pins 18 on linked arm O to gradually rise, said pins lying at the bottom of the inclined faces u of their respective shaping-plates U and U′ at the beginning of the copping operation, and the crank motion favors the motion required by the faller as it acts slowly at the beginning and end of the stroke and more quickly at the middle.

Although I have hereinbefore described my invention as carried out in a machine in which the spinning-spindles S revolve in horizontal planes, this is not absolutely necessary, as said spindle may be arranged to revolve in vertical planes, as shown in Fig. 4, in which case the construction of the spindle-rail B^2 and fiber-duct B^3 is modified to suit the arrangement of the spindles, S indicating the spindles, stepped to revolve in any well-known manner and guided in bearings b^{11} on the spindle-rail B^2, the spindles revolving in bushes b^6, arranged in said bearings to form an annular lubricant-space b^8, closed by a plate b^7. In the spindle-rail b^2 are formed the fiber-ducts B^3, open in front and rear and closed in front by a cover E, hinged to turn downwardly, as shown. D indicates the shell that coöperates with the feed-roller r^2. c' indicates the cylinder-casing, C the toothed cylinder, and r^3 r^4 r^5 the lower drawing-rolls of three pairs of such; t, the feed-table; C′, the sliver-cans, and R′, R^2, and R^3 indicate a set of rollers for drawing off the thread. I have hereinbefore also stated that the yarn or thread may receive but a partial twist by the spinning-spindles and may receive its final twist from ordinary winding and twisting mechanism—as, for instance, the ordinary throstle or ring-frame—or mechanism such as used in roving or slubbing, which latter will be preferable if the yarn or thread after passing from the spinning-spindle is passed through drawing or reducing rollers to reduce it so that it can be further twisted or spun in machines similar to the ordinary throstle or ring-frames or spinning-machines, and in Fig. 4 I have shown the yarn or thread as passing from drawing or reducing rolls to an ordinary ring and traveler spinning, twisting, and winding mechanism.

Of course when the yarn or thread is but partially twisted by the spinning-spindle S if both spindles are driven at their greatest speed each need only put in half the total twist required, and the speed of production will be greatly increased.

As hereinbefore stated, a single lap wide enough to supply a number of cylinders C with fiber may be used, or narrow laps, one for each cylinder, may be used. I prefer, however, as stated, to use slivers, one or more of which may be fed to a section of the toothed cylinder C, these laps or slivers being produced by any well-known machine. The lap of fibrous material may be from any ordinary scutcher or lap-machine, or a lap of carded fiber may be used, so as to deliver the fleece to the toothed cylinders; but, as stated, I prefer to use separate slivers.

It will be evident to those skilled in the art of spinning that the cost of spinning fibrous materials in accordance with my invention is materially reduced, as the number of processes is greatly diminished and the speed of production greatly increased.

Having thus described my invention, what I claim as new therein, and desire to secure by Letters Patent, is—

1. In a spinning-machine, the combination with a revoluble conical or tapering spinning-spindle, of means for feeding loose fibers thereto, whereby a shell of fibrous material is formed thereon, and means for applying tractive force to said shell at its smaller end, for the purpose set forth.

2. In a spinning-machine, the combination with a revoluble conical or tapering spinning-spindle, of means for feeding loose fibers thereto, whereby a shell of fibrous material is formed thereon, and means for applying pressure and tractive force to said shell at its smaller end, for the purpose set forth.

3. In a spinning-machine, the combination with a revoluble conical or tapering spinning-spindle, having twisting prongs at its smaller end, of means for feeding loose fibers to said spindle, whereby a fibrous shell is formed thereon, and means for applying tractive force to said shell at its smaller end, for the purpose set forth.

4. In a spinning-machine, the combination with a revoluble spindle, having an uneven conical or tapering spinning portion; of means for feeding loose fibers to said spinning portion, whereby a shell of fibrous material is formed thereon, and means for applying tractive force to said shell at its smaller end, for the purpose set forth.

5. In a spinning-machine, the combination with a revoluble conical or tapering spinning-spindle, of a revoluble toothed cylinder, feeding appliances for feeding a lap or sliver or slivers of fibrous material to said cylinder to be disintegrated thereby, the cylinder arranged relatively to the spindle to direct the loose fibers thrown off by centrifugal action to said spindle, whereby a fibrous shell is

formed thereon, and means for applying tractive force to said fibrous shell at the smaller end thereof, for the purpose set forth.

6. In a spinning-machine, the combination with a revoluble conical or tapering spinning-spindle, a toothed cylinder, a chamber in which said cylinder is revoluble, and a fiber-duct in which the spindle rotates, said duct leading from the cylinder-chamber in the direction of rotation of the cylinder of feed mechanism for feeding a lap or sliver to the toothed cylinder, and means for applying tractive force to the smaller end of the fibrous shell formed on the spindle, for the purpose set forth.

7. In a spinning-machine, the combination with a revoluble conical or tapering spinning-spindle, a toothed cylinder, a chamber in which said cylinder rotates, a fiber-duct in which the spindle rotates, said duct leading from said chamber in the direction of rotation of the cylinder and being open to the atmosphere at its opposite ends, and means for preventing loose fibers from being ejected from said duct; of feed mechanism for feeding a lap or sliver to the cylinder, and means for applying tractive force to the smaller end of the fibrous shell formed on the spindle, for the purpose set forth.

8. In a spinning-machine, the combination with a revoluble conical or tapering spindle and means for feeding loose fibers thereto whereby a shell of fibrous material is formed thereon; of winding mechanism for winding the spun yarn or thread on bobbins or the like, and drawing-off rolls interposed between said mechanism and the spindle for drawing off the fibrous shell and feeding it to the winding mechanism, for the purpose set forth.

9. In a spinning-machine, the combination with a revoluble conical or tapering spindle, and means for feeding loose fibers thereto whereby a shell of fibrous material is formed thereon; of copping appliances for winding the spun yarn or thread into cops, and drawing-off rolls for drawing the fibrous shell off the spindle and feeding it to the copping mechanism, for the purpose set forth.

10. In a spinning-machine, the combination with a toothed cylinder, a feed-roll and coöperating feed-shell, an eccentric casing in which said cylinder rotates, said casing extending around the feed-roll to the line of feed, of a fiber-duct leading from said casing in the direction of rotation of the cylinder, a spinning-spindle revoluble in said duct, and means for applying tractive force to the small end of the fibrous shell formed on said spindle, for the purpose set forth.

11. The combination with a toothed cylinder, a feed-roll and coöperating feed-shell, an eccentric casing in which said cylinder rotates, said casing extending around the feed-roll to the line of feed; of a fiber-duct leading from the casing in the direction of rotation of the cylinder, said duct open to the atmosphere at opposite ends, a spinning-spindle revoluble in the duct, and means preventing loose fibers thrown off the cylinder from being ejected from said duct, for the purpose set forth.

12. In a spinning-machine, the combination with a fiber-feed duct open to the atmosphere at opposite ends, a conical or tapering spinning-spindle revoluble in said duct, and means for feeding loose fibers thereto; of a cover closing the outlet of said duct and having an opening, and a foraminous sheet covering said opening, for the purpose set forth.

13. In a spinning-machine, the combination with the spindle-rail having fiber-ducts B^3 formed therein, and a spinning spindle S revoluble in each of said ducts; of a revoluble toothed cylinder C below said ducts, an inclosing casing for said cylinder, the latter having peripheral flanges c' dividing the casing into chambers corresponding with the fiber-feed ducts, the cover E having an opening covered with wire-gauze and an opening through which the small end of the spindle projects, substantially as and for the purpose set forth.

14. In a spinning-machine, the combination with the spindle-rail having fiber-ducts B^3 formed therein, and a spinning-spindle S revoluble in each of said ducts; of a revoluble toothed cylinder C below said ducts, an inclosing casing for said cylinder, the latter having peripheral flanges c' dividing the casing into chambers corresponding with the fiber-feed ducts the cover E having an opening covered with wire-gauze and an opening through which the small end of the spindle projects, and a pressure-plate e^3 in said opening bearing lightly on said small end of the spindle, substantially as and for the purpose set forth.

15. In a spinning-machine, the combination with a plurality of revoluble spindles, a revoluble toothed disintegrating-cylinder, feed mechanism for feeding a lap or sliver of fibrous material to said cylinder or cylinders, means for conducting the loose fibers thrown off the cylinder to the spindles, and drawing-off rolls for drawing off the fibrous shell formed on said spindles; of driving mechanism organized so that the disintegrating-cylinder can be started first, then the feed mechanism, spinning-spindles, and drawing-off rolls, and the parts stopped in the reverse order, substantially as and for the purpose set forth.

In testimony that I claim the foregoing as my invention I have signed my name in presence of two subscribing witnesses.

AARON METCALF.

Witnesses:

PETER J. LIVSEY,

WILLIAM FAULKNER.