5 Sheets—Sheet 1.

W. WEILD.

YARN WINDING MACHINE.

No. 51,907. Patented Jan. 2, 1866.

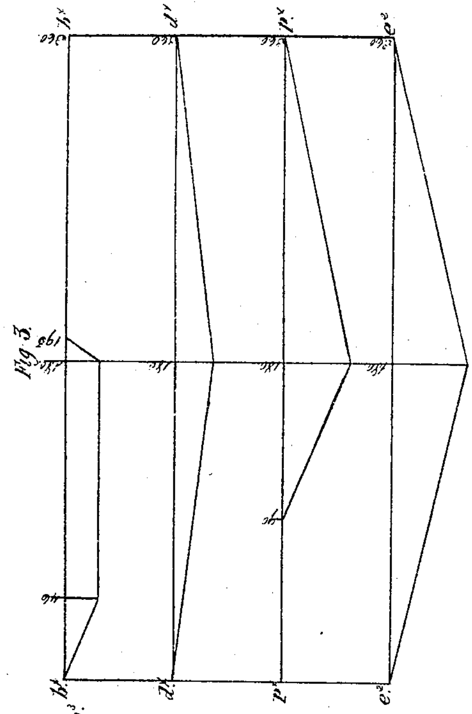

Fig. 3.

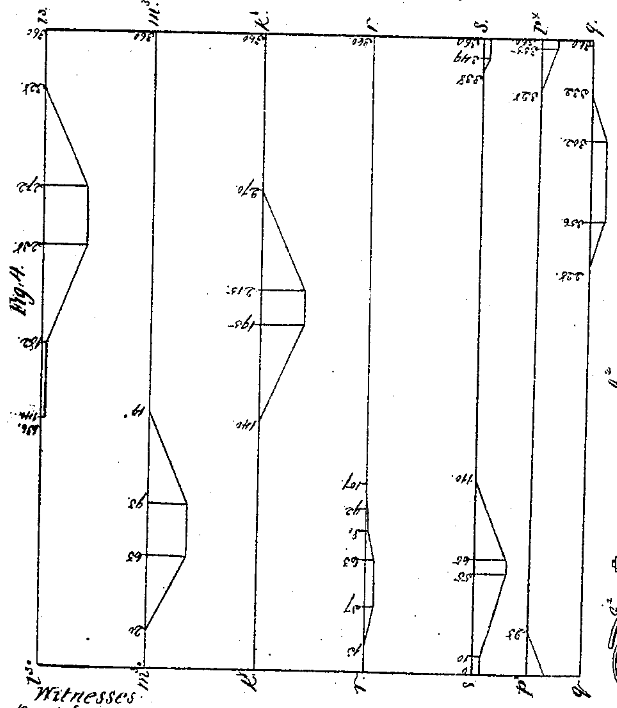

Fig. 4.

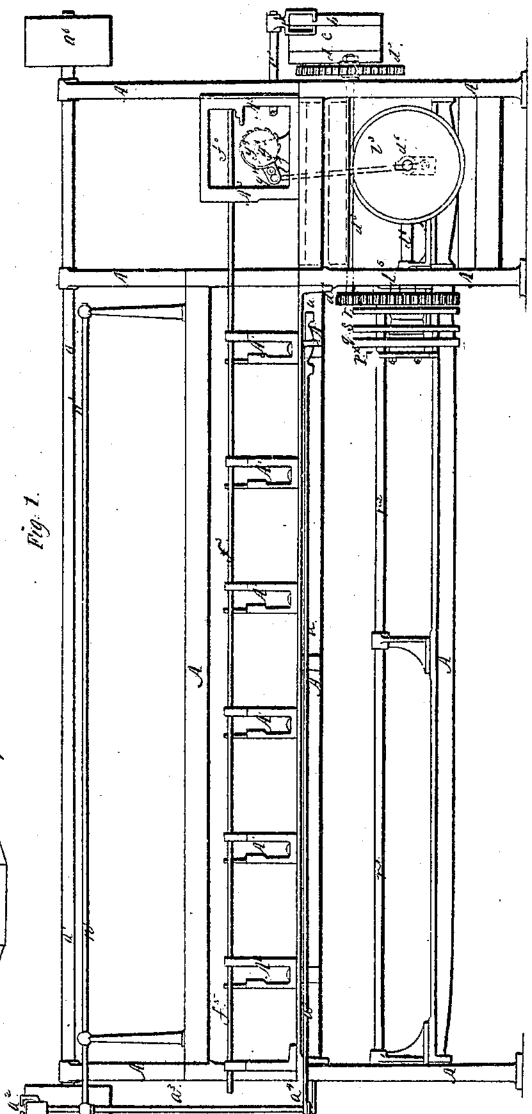

Fig. 1.

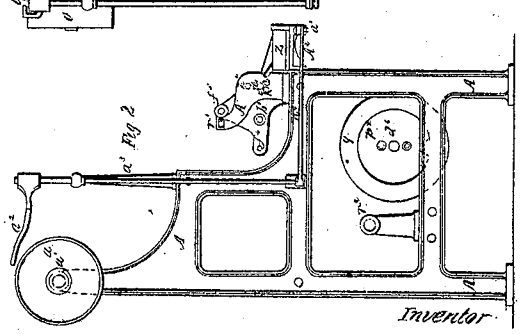

Fig. 2

Witnesses
Peter J. Livesey
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Inventor
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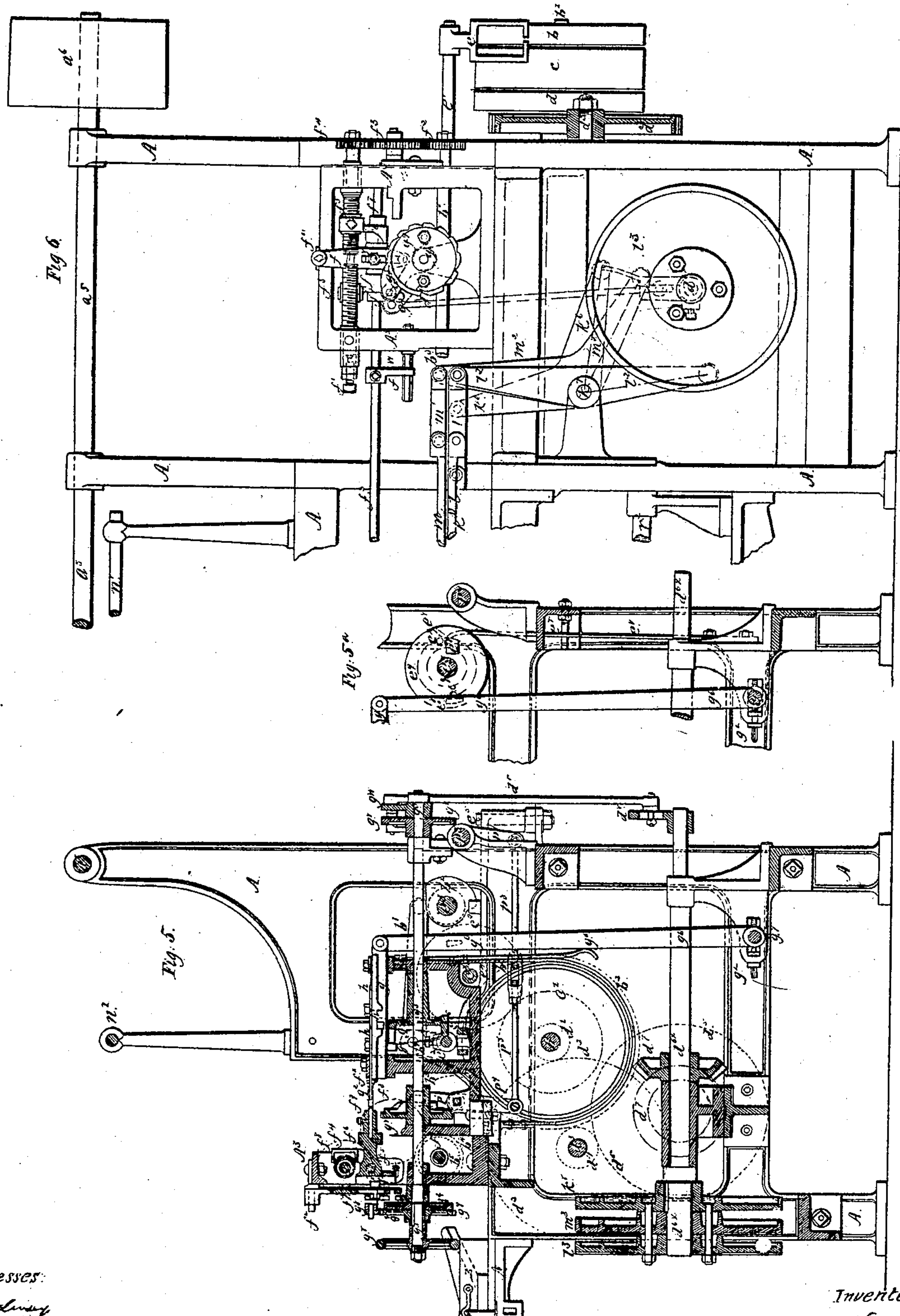

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5 Sheets—Sheet 3.

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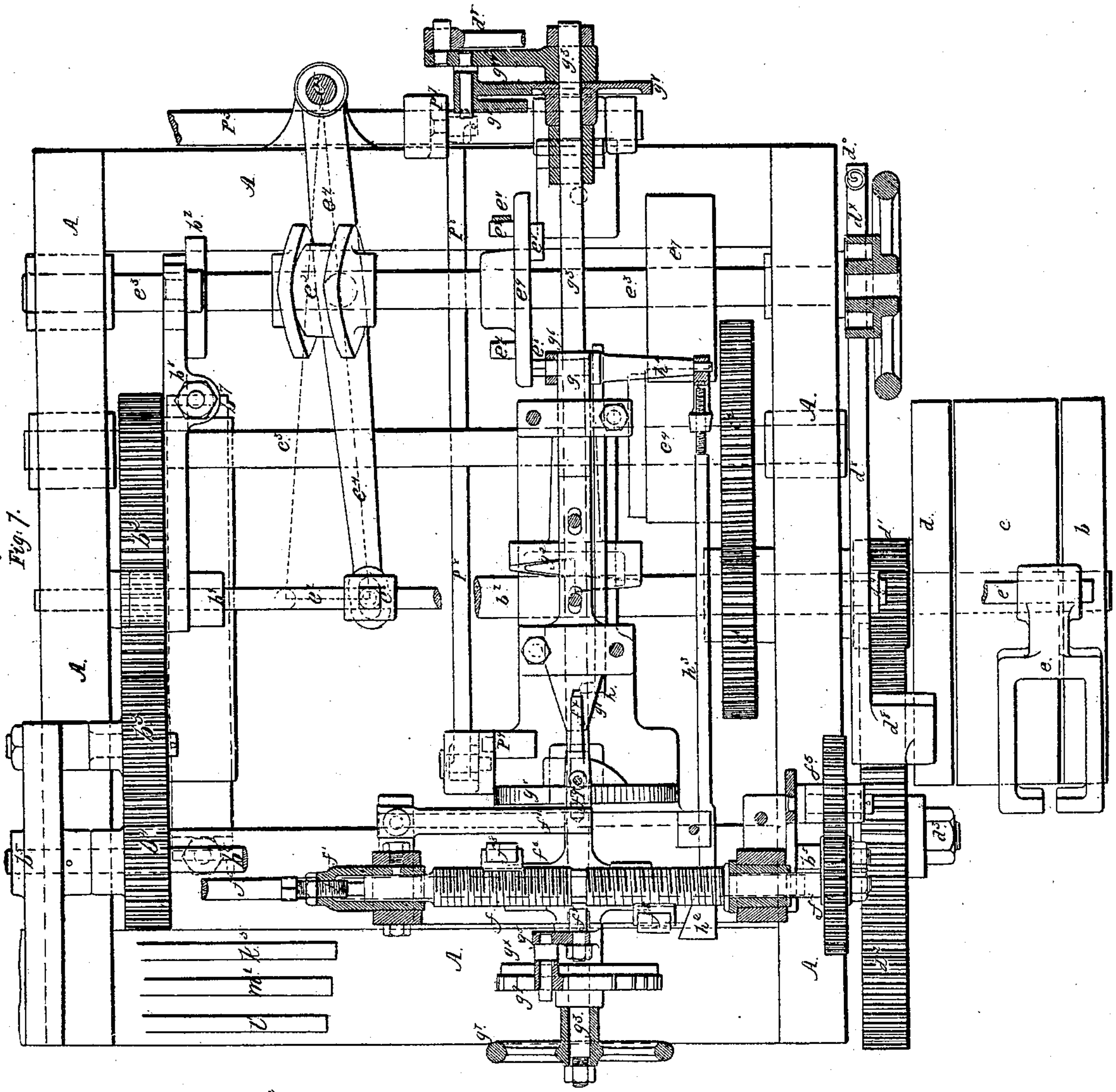

Fig. 7.

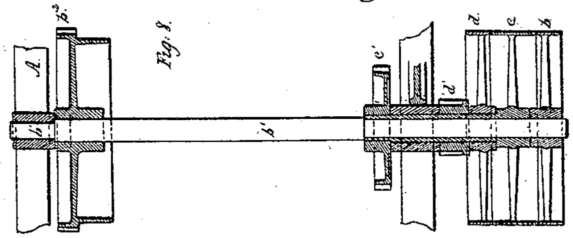

Fig. 8.

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5 Sheets—Sheet 4.

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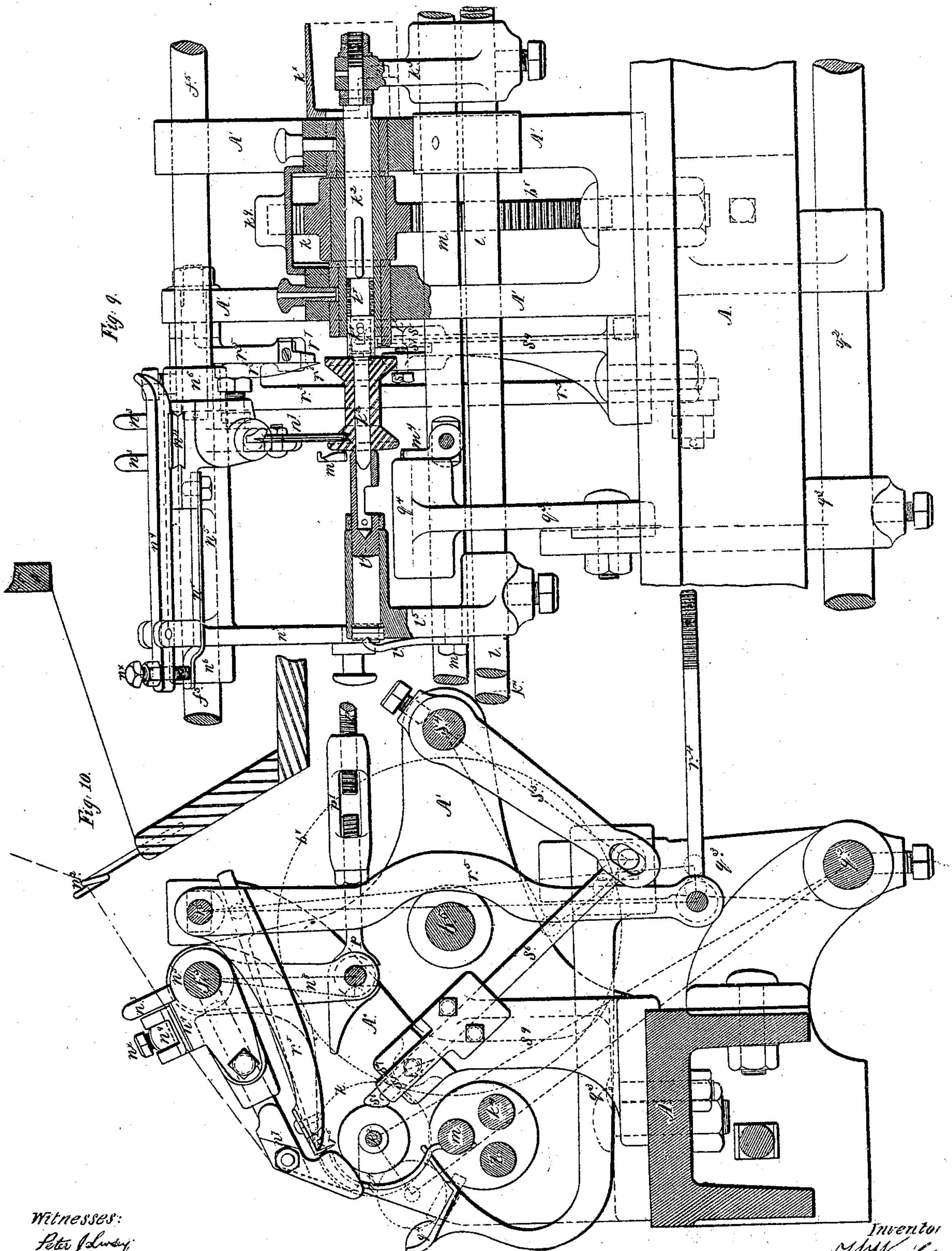

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YARN WINDING MACHINE.

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Fig. 11.

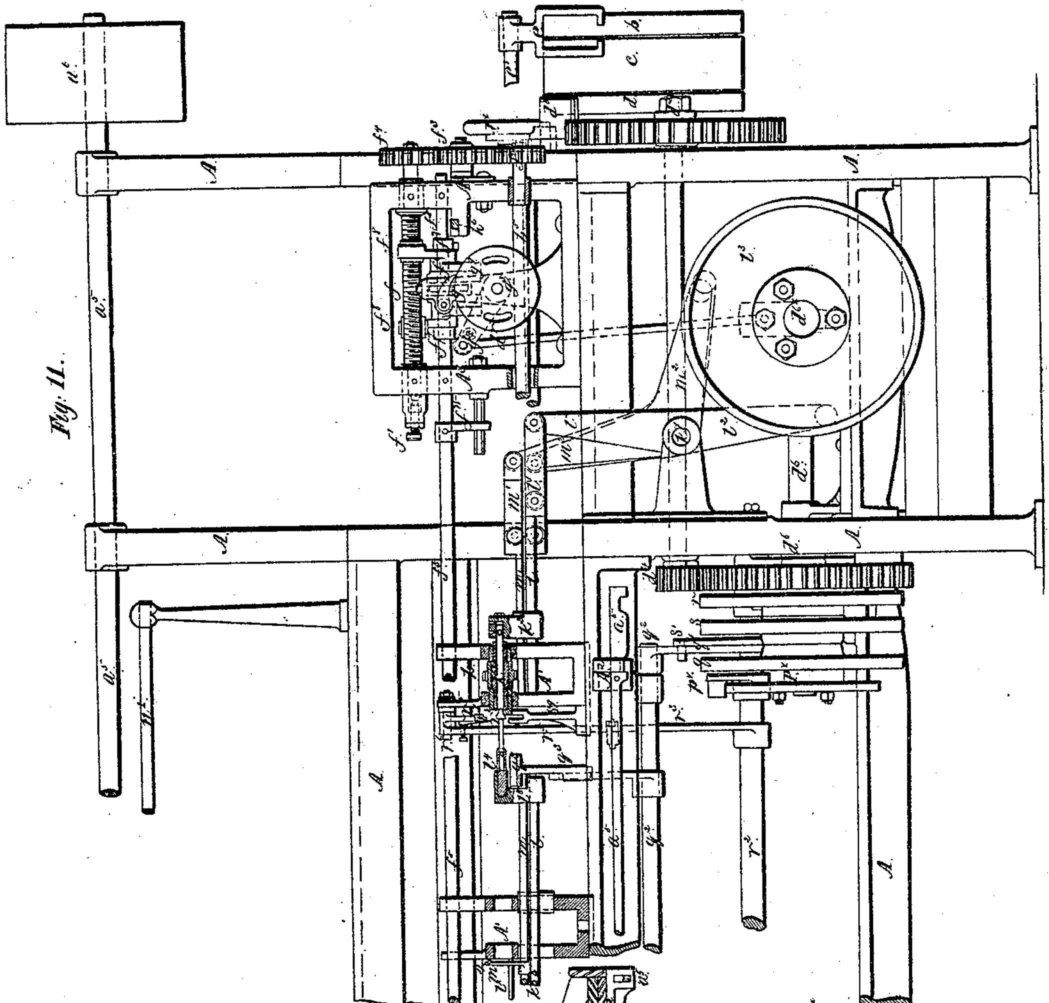
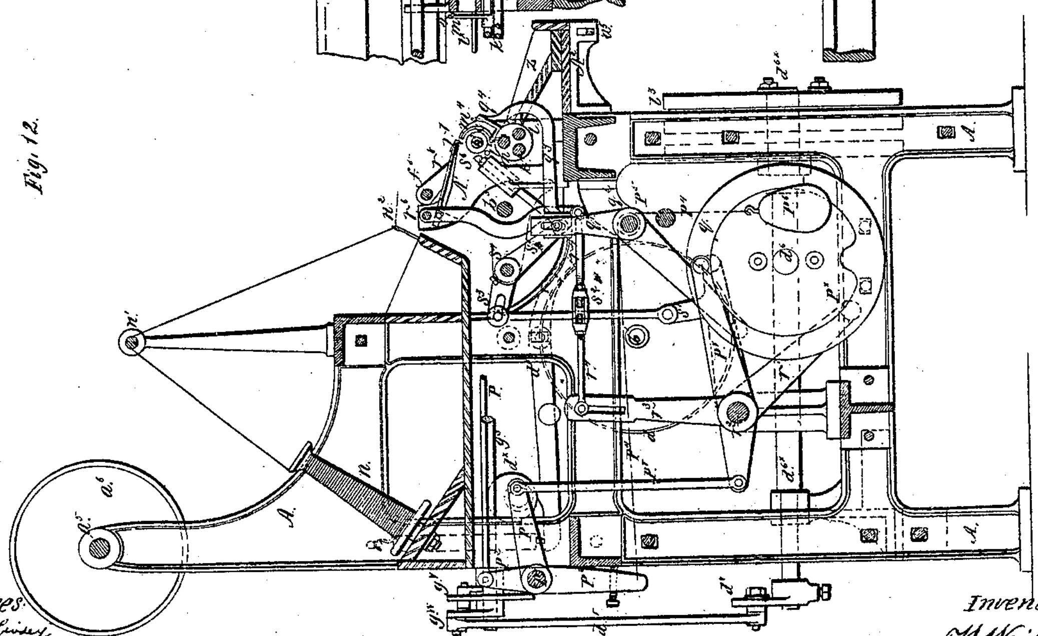


Fig. 12.



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UNITED STATES PATENT OFFICE.

WILLIAM WEILD, OF MANCHESTER, GREAT BRITAIN.

IMPROVEMENT IN MACHINES FOR WINDING SEWING-THREAD UPON SPOOLS.

Specification forming part of Letters Patent No. **51,907**, dated January 2, 1866; antedated March 28, 1865. Patented in England January 22, 1859.

To all whom it may concern:

Be it known that I, WILLIAM WEILD, of the city of Manchester, in the county of Lancaster, in the United Kingdom of Great Britain and Ireland, have invented new and useful Improvements in Machinery for Winding Yarn or Thread onto Bobbins, Spools, or Similar Surfaces; and I do hereby declare the following to be a full, clear, and exact description of the same, reference being had to the accompanying five sheets of drawings, which form a part of this specification, and to the letters of reference marked thereon.

My invention relates to the machinery for winding sewing-thread principally upon bobbins or spools for the market; and the object of my improvements is to perform this operation wholly or partly by self-acting machinery which shall take the empty spools or bobbins, wind the thread upon them, stop when the required quantity is wound upon the spool, cut an incision in the edge of each spool, fix the end of the thread therein, sever the thread and discharge the filled spools, take fresh empty spools, and start the machine to wind the thread upon them, these operations going on continuously as long as motion is given to the machine, provided it is supplied with thread and empty bobbins or spools.

The machine forming the subject of this specification is the result of a combination, in a modified and improved form, of two machines described in the specification of a patent granted to me for Great Britain and Ireland, numbered 122, and dated the 22d of January, in the year of our Lord 1858; and in its combined, modified, and improved form it is described in the specification of a patent granted to me for Great Britain and Ireland, numbered 699, and dated the 16th day of March, in the year of our Lord 1860. Some further improvements in detail made since the date of the last-named patent will be described, but no claim made herein for such improvements.

In order to enable others skilled in the art to make and use my invention, I will now proceed to describe the construction and operation of my improved machine.

Sheet 1: Figure 1 is a front elevation of the framing of one of my machines having six heads or sets of operating parts, each head acting to wind the thread upon one bobbin or spool, all the heads being actuated simultaneously by the mechanism of one head-stock. Fig. 2 is an end elevation of the framing. The working parts are omitted from these views, which are only intended to give a general idea of the complete machine and the mode of imparting motion to it. Fig. 3 is a diagram to explain the form of each cam and their times of action in relation to each other, these cams being placed upon a shaft in the head-stock having sudden intermittent movements, principally for changing the operations of the machine. Fig. 4 is a similar diagram, referring to the cams which come into operation when the machine is changing the spools or bobbins.

Sheet 2: Fig. 5 is a cross-sectional elevation of the head-stock, looking at the end of the machine. Fig. 5[a] is a detached view, illustrating the mode of holding, releasing, and starting the belt cam-shaft; and Fig. 6 is a front elevation of part of the head-stock end of the machine.

Sheet 3: Fig. 7 is a plan view of the mechanism at the upper part of the head-stock, half-size. Fig. 8 is a detached view, showing the arrangement of the pulleys upon which the driving-belt works.

Sheet 4: Fig. 9 is a front sectional elevation of one set or head of the parts for operating upon the thread and spool or bobbin, and Fig. 10 is an end view of the same, both views full size.

Sheet 5: Fig. 11 is a front elevation of one end of the machine, showing part of one head or set of operating parts; and Fig. 12 is a cross-sectional elevation, showing the manner in which movements are conveyed to some of the parts operating upon the thread and bobbins or spools.

The same letters and figures of reference will be used for the same and for corresponding parts throughout the drawings.

Figs. 1 and 2 show the framing A of the machine with the brackets or stands A′, carrying the spindle by which rotating motion is given to the bobbin or spool acted upon by each head. The machine is driven by a belt working upon the pulley a upon the end of a shaft, a', passing from end to end of the machine. The machine is stopped and started by a belt-guide, a^2, upon the end of the vertical shaft a^3, carried in bearings attached to the framing, and at the lower end of this shaft an arm, a^4, is secured, which is jointed with a rod, a^5, passing in front of the machine, the end of this rod passing through a slot in one of the brackets A^2 carrying the box or trough Z, which receives the spools filled with thread, and the end of the rod a^5 is made of the form shown, so as not to move too easily by the working of the driving-belt against the belt-guide a^2. By means of this rod a^5 the machine can be conveniently stopped or started from any position in front of it. Motion is conveyed from the first-motion shaft a', by a belt working upon the pulley a^6, to a series of three pulleys, b c d, upon the shaft b', having bearings in the head-stock part of the machine. This belt working upon the three pulleys is in one position when the machine is winding and in another position when the machine is changing the spools, and the guide e for traversing the belt is fixed upon the end of a rod, e', sliding endwise in bearings in the head-stock. The position of this rod e' is shown by Figs. 1, 5, 6, and 7. It receives end movements from a cam, e^2, on the belt-changing cam-shaft e^3, this cam e^2 acting upon a pin fixed in or formed upon a lever, e^4, having its fulcrum on a stud, e^5, in a bracket or projection from the framing, and the end of the lever e^4 has a slot in it lengthwise of the lever, in which slot a pin fits formed upon a collar, e^6, adjustable upon the sliding rod e'.

Fig. 8 shows the arrangement of the three pulleys on the shaft b'. The outside pulley, b, is fast upon the shaft. The middle pulley, c, is loose upon the shaft and has a long boss. The inside pulley, d, is loose upon the long boss of the middle pulley, c. Upon the end of the boss of the middle pulley, c, a spur-wheel, c', is secured, which gears with one, c^2, upon the friction-pulley shaft c^3. These spur-wheels are shown in Fig. 7, and also by red pitch-lines in Fig. 5.

To the boss or side of the wheel c^2 a pulley, c^4, is fixed or formed, covered with leather, and this pulley works in close contact with a pulley, e^7, on the belt-changing cam-shaft e^3, so that when permitted the leather-covered friction-pulley gives rapid movement to the pulley e^7, and consequently to the belt-changing cam-shaft e^3, which makes two semi-rotations for each set of spools filled with thread, and becomes stationary after each semi-rotation, those parts of the periphery of the pulley e^7 opposite the pulley c^4 at the end of each movement being cut away to enable the friction-pulley to rotate freely without contact. The manner in which the pulley e^7 is brought into contact with the friction-pulley will be explained hereinafter.

The boss of the inside pulley, d, has a spur-pinion, d', secured upon it, which gears with a wheel, d^2, secured upon one end of a shaft, d^3, upon the other end of which a pinion, d^4, is secured, that gears with a spur-wheel, d^5, on the cam-shaft d^6, for effecting the changes of the spools. These wheels are shown in Fig. 1 and in other figures of the drawings, and their red pitch-lines are shown in Fig. 5. The cam-shaft d^6, parallel to the front of the machine, is geared by bevel-wheels d^7, of equal diameter with a cam-shaft, $d^{6\times}$, having bearings in the head-stock at a right angle to the first-named cam-shaft. It is upon these shafts that the cams are placed which actuate the parts requiring motion when the change of the spools is taking place.

When the machine is winding the thread onto the spools the driving-belt is working upon the outside pulley, b, and partly upon the middle pulley, c, and when the winding is completed the belt is traversed to the inside pulley, d, still remaining partly upon the middle pulley, and by this movement the winding is stopped and the cam-shafts for changing are brought into operation. The driving-belt is always upon the middle pulley, c, so that there is always one part of the machine in motion, by which the other parts of the machine are brought into gear and out of gear. The rotary motion for winding the thread onto the spools is transmitted from a spur-wheel, b^2, fixed upon the shaft b', and this wheel gears, by means of a carrier or intermediate wheel, b^3, on a stud in the framing, with a wheel, b^4, fixed on a shaft, b^5, passing from end to end of the machine, which shaft gives motion to each separate head. The red pitch-lines of these wheels are shown in Fig. 5. When the spool is filled to the required extent with thread the winding motion has to be stopped as suddenly as possible, and this is accomplished by a brake-belt, b^7, one end of which is attached to a projection from the framing. It then passes round a pulley-surface formed upon the side of the wheel b^2, (see Fig. 8,) and its other end is secured by screws for adjusting the tightness to a lever, b^8, centered upon a stud, b^9, fixed in the framing. The free end of this lever b^9 is acted upon by a cam, $b^\times$, on the belt-changing cam-shaft e^3, and thus the sudden semi-rotation of this shaft to traverse the belt from the winding to the spool-changing pulley simultaneously puts the brake on and stops the winding, this brake being again released when the belt-changing cam-shaft makes its next semi-rotation.

At high speeds the spool-changing cam-shaft d^6 and connected parts are carried forward by their momentum after their motion should stop. To prevent this a brake is used which is a lever, d^8, having its fulcrum upon a stud, d^9, in the framing. One end of the lever has a surface which is brought into contact with the pulley d by a spring, d^o, secured to the other end of the lever and to a stud in the framing. This lever is actuated by a cam, $d^\times$, upon the end of the belt-changing cam-shaft e^3, which is formed upon the side of a wheel for conveniently turning the shaft by hand. (See Figs. 7 and 11.) When the spools are being changed some of the parts may get wrong or get in the way by accident. To prevent damage should this occur at any time, the wheel d^2 is secured against a washer that comes against a shoulder on the shaft d^3 by a screw-nut, which becomes unscrewed by the rotation of the wheel d^2 should any obstruction occur. (See Fig. 6.) The wheel is screwed sufficiently tight to drive the cam-shafts d^6 and $d^{6\times}$ when there is no more than the usual strain required for effecting the changes of the spools, as is the case when every part works correctly.

The thread is distributed in even layers upon the spools by means of a rotating shaft, f, having a right-and-left-handed screw-thread formed upon it. This screw-shaft has bearings upon a frame or stand, A^3, secured to the head-stock frame. It is arranged, as shown best in Fig. 7, with a set-screw, f', and lock-nut at one end to prevent end-play. This screw-shaft receives a rotary movement from the shaft b^5 by means of three wheels, f^2 f^3 f^4, the red pitch-lines of which are shown in Fig. 5. Below the screw-shaft f a rod, f^5, is placed, which passes from end to end of the machine, and is supported in bearings formed in the brackets A' for each head, and is capable of sliding endwise freely, and it is by the movements of this traversing rod f^5 that the thread is distributed upon the spools. Upon the traverse-rod, and just under the screw-shaft, a boss, f^6, is placed, which is free to oscillate, being secured upon the traverse-rod by means of adjustable collars f^7, so that it is without end-play upon the rod. From the boss f^6 two arms extend, one arm on one side, the other on the other side, of the screw-shaft, and upon each of these arms is secured a segment of a screw-nut, f^8, corresponding to the screw-thread of the shaft, and by oscillating the boss part f^6 these nuts are brought one into gear and the other out of gear with its corresponding screw-thread upon the shaft, and thus a to-and-fro movement is given to the traverse-rod f^5. A projection is made from the boss part f^6 in a horizontal direction, and inclines are formed upon the upper and lower sides of it, upon each of which the end of a flat spring, f^{10}, acts, which springs are firmly secured to the head-stock, as shown in Fig. 7, where one spring, f^{10}, is supposed to be removed. The ends of both springs touch their respective inclines when the traverse-rod is in its central position; but should it move to one side, then the spring upon that side will be forcibly acted upon, but the spring upon the opposite side will cease to act. Consequently while the traverse-rod is moving from the central position in one direction the spring on that side is being bent and pressed to one side by its incline, and is thus charged with force, which will cause the oscillating part to bring one segment of the screw-nut out of gear and the others into gear, and then, again, the force of the spring is permitted to act.

The mechanism for regulating the times of oscillation of the part f^6 consists of a bar, g, fitted in a part of the head-stock framing so as to slide free in the direction of its length, but free from lateral play, and upon this side bar a thin plate of metal is secured, to project beyond the end of the bar. This plate g' is termed the "shaper," as its edges are tapered, as shown in Fig. 7, so that a line drawn across it will be equal in length to the shortest traverse or layer to be put upon the spool at the barrel, while another line drawn across at another part of the shaper will be equal in length to the longest traverse or layer to be put upon the spool, and other lines drawn across the shaper, between the two, will represent the lengths of the traverse or layers intermediate between the spool when empty, and when filled these gradually increasing in length.

The projection f^9 from the boss is formed into a socket to receive a tail part, $f^\times$, which is adjustable inward and outward. This tail part is of the shape shown in Figs. 5 and 7, and it comes opposite the shape-plate g'. When this tail part rests upon the upper side of the shaper one of the screw-nuts f^8 is in gear with the screw-shaft f, and when against the under side of the shaper the other nut is in gear with the screw-shaft. Assuming that one of the screw-nuts f^8 is in gear, the tail part $f^\times$ will traverse till it arrives at the edge of the shaper, when that spring, f^{10}, which has been charged by the movement will cause the part f^6 to oscillate. The tail part $f^\times$ will then be upon the opposite side of the shaper, and will traverse back in the opposite direction till it arrives at the other edge of the shaper, when it is again reversed by the other spring, and so on, each spring alternately reversing the tail part. As long as the shaper or plate g' remains stationary the traverse will be uniform in length. Therefore, to vary the length of the traverse it is only necessary to vary the position of the shaper to a greater or less distance from the tail part, as by this means the tail part $f^\times$ will have greater or lesser widths of the shaper to cross before it is reversed. The movements are given to the shaper by a cam, g^2, fixed on a shaft, g^3, in suitable bearings in the head-stock. This cam acts upon a pin, g^4, in the slide-bar, and the pin is pressed against the cam by a spring, g^5, secured to the head-stock frame, which spring acts upon a lever, g^6, mounted upon a fulcrum at g^7, which lever is jointed with the end of the slide-bar g. The shaft g^3, upon which the shaper-cam is fixed, has intermittent rotatory motion imparted to it, so as to make one revolution for each set of spools filled with thread. This is accomplished by the traverse movement by means of a stud, f^v, fixed in the boss part f^6, which fits into a slot formed in a lever, $f^\times$, centered at f^L, and this lever has a stud fixed in it, which fits in a slot in an arm, g^8, which is centered on the shaper cam-shaft g^3. This arm g^8 has a pawl jointed upon it, which acts upon a ratchet-wheel, g^9, secured by screws to a disk, $g^\times$, fixed upon the shaper cam-shaft g^3. Concentric slots are formed in the disk part for the screw-bolts, so that the ratchet g^9 can be adjusted in relation to the shaper-cam in the direction of rotation. The ratchet-teeth vary in length to suit the varying lengths of traverse, and the shaper-cam g^2 is formed to bring the shaper into the position suited to the required length of the layer and to the movement produced by the action of the pawl upon the ratchet. In some cases the stud f^v may be connected directly with the arm g^8, as shown in Fig. 11. A fine pitched tooth racket-wheel, g^v, is fixed to the shaper cam-shaft, and a pawl (not shown) is jointed so as to enter its teeth to prevent any accidental backward movement in the cam-shaft. A wheel, g^r, is fixed upon the front end of the shaper cam-shaft, so that it may be turned when required by hand.

In winding the thread upon the spools the machine always begins the first layer and ends the last layer of thread upon the same side of the spool, and at that instant when the last coil of the last layer of thread has been wound upon the spools the belt-changing cam-shaft e^3 is brought into gear to stop the winding part of the machine and bring into operation the spool-changing part of the machine. How this is accomplished will be explained by Fig. 5a—a detached view.

The lever g^6 is jointed with and partakes of the movements of the shaper slide-bar g, and upon its side a steel projection is formed, which will come in contact with two similar projections, e^8, from the side of a disk, e^9, fixed upon the belt-changing cam-shaft. These projections upon the disk are so arranged that the disk-plate cannot rotate without the projections coming in contact with that upon the side of the lever g^6. By moving the lever first in one direction and then in the other the projections e^8 will pass, and the disk-plate e^9 will make half a revolution at each oscillation. It will thus be seen that the lever g^6 and disk e^9 form an escapement.

In the disk-plate e^9 are two round pins, $e^\times$, upon which, as they come round, a spring, e^v, acts, of the form shown in Fig. 5a. This spring is secured at its lower end to the framing, and it passes through a hook in a stud, e^r, adjustable in the framing, the slot or hook in this stud limiting the range of its action. When the ecapement-disk is arrested by the escapement-lever the angle of the end of the spring e^v has just passed one of the pins $e^\times$ in the escapement-disk, and in this position the force of the spring acts to push forward the escapement-disk in its direction of rotation, and thus, when the escapement-disk is released, the spring acts to force the changing cam-shaft e^3 round till the pulley e^7 bites upon the friction-pulley c^4, and this suddenly rotates the belt-changing cam-shaft, and the other pin, $e^\times$, as it comes around, forces the spring e^v back again, and thus recharges it for the next starting movement.

During the time the last layer of thread is being wound upon the spools the shaper cam-shaft g^3 is receiving motion and is moving the shaper-bar g, and consequently the end of the escapement-lever g^6, so that the projection upon its side becomes free from that upon the disk-plate when the last coil is being wound upon the spools. This allows the escapement-disk e^9 to make a semi-rotation, which stops the winding and brings the spool-changing cams into operation. The edges of the projections upon the escapement-lever and plate require very accurate adjustment, so that the stoppage of the winding shall take place at the exact time, and this is effected by mounting the fulcrum of the escapement-lever g^6 so as to slide to and fro in a slot, and by arranging an adjusting-screw, g^L, to act upon it, as shown in Fig. 5. By this means a fine adjustment is obtained, as a small movement of the fulcrum of the escapement-lever is still further divided or reduced, owing to the leverage or ratio between the entire length of the lever and the length from the jointed end to the projection on the side of the lever. The same exactness in starting is not so necessary as in stopping the winding, but this is accomplished suddenly.

Upon the end of the cam-shaft $d^{6\times}$ (see Fig. 5) an arm, d^y, is fixed, having a slot in it in which a stud is fixed, and upon this stud a rod, d^r, is jointed, which connects it with another stud in an arm, g^w, which can oscillate freely upon the end of the shaper cam-shaft. On the arm g^w a pawl is jointed, which works upon the edge of a disk, g^y, fixed upon the shaper cam-shaft. In this disk there is one ratchet-notch. It will now be seen that when the cam-shaft $d^{6\times}$ for changing the spools begins to rotate the crank-pin d^r will cause the arm g^w to move and make one oscillation for one revolution of the cam-shaft. The single ratchet-notch in the disk g^y is in such position when the cam-shaft $d^{6\times}$ begins to move that the pawl will pass over the notch in the direction it first begins to move, but in its back movement it will enter the notch and give movement to the shaper cam-shaft. This will cause the edge of the shaper-cam g^2 to escape from the edge of the square pin g^4 in the shaper slide-bar, at which moment the spring g^5 will force the escapement-lever g^6 back, and this will again release the escapement-disk, when the belt-changing cam-shaft will stop the motion of the spool-changing cam-shaft and start the winding part of the machine into operation again.

When the machine has filled a set of spools with thread the traverse-rod is left at one extreme of its greatest traverse, and before the winding of the thread upon a fresh set of spools can commence the traverse-rod requires to be adjusted so that the thread-guides will come opposite one end of that part of each spool close to its barrel. To accomplish this object a slide-bar, h, is fitted alongside of the shaper-slide g, so that it can slide endwise when sufficient force is applied; but it is pressed upon by a spring so as not to move by accident; and this slide-bar h is acted upon by a pin, h', in the side of the shaper-slide-bar, which pin plays in a gap in the slide-bar h, this gap being of such length that the pin h' will come in contact with the slide-bar h and carry it along with it for, say, the last sixteenth of an inch of its movement in both directions. Being thus arranged, the slide-bar h is moved forward with the shaper when it is making its last movement at the last layer of the thread, so that when the tail-piece $f^{\times}$ arrives at the edge of the shaper and is forced down by one of the springs f^{10}; but the end of the slide-bar h prevents its descent below the central position, as shown in Fig. 5, in which position neither of the screw-nuts f^8 is in contact with the screw-shaft f. Consequently the traverse-rod f^5 can be moved endwise. The traverse-rod is adjusted by means of an incline, h^2, corresponding to one side of the shaper, and this incline rests upon a projection from the stand A^3, carrying the screw-shaft f, and the incline acts upon a pin or collar on the traverse-rod f^5. This incline h^2 is at the end of a rod, h^3, adjustable in length by a screw-coupling, and is attached to a stud, h^4, fixed in the shaper slide-bar, as shown in Fig. 7. It will now be seen that when the shaper slide-bar makes its quick back movement the traverse-rod will be simultaneously adjusted, as the tail-piece $f^{\times}$ will be held in the central position to the last moment, when the pin h' in the shaper slide-bar will come in contact with the slide-bar h and move it back, so that its end releases the tail-piece $f^{\times}$ and allows one of the springs f^{10} to force one of the nuts f^8 into gear with the screw-thread of the screw-shaft f.

The slide-bar h would be necessary if the back movement took place slowly; but it has now been discovered that it may be dispensed with, as the movements are so rapid that the tail-piece $f^{\times}$ has not time to fall before the adjustment is effected; but to dispense with the slide-bar h the machine must be arranged so that the tail-piece $f^{\times}$ will remain, say, just at the edge, and at the upper side of the shaper when the winding is completed. Then by adjusting the incline h^2 with a slight play or space the tail-piece will pass freely from the edge of the shaper by the time the adjustment of the traverse-rod has been effected.

The traverse-bar f^5 is round, and is kept from oscillating by an arm, f^{w}, fixed upon it, which has a hole in it to slide upon a stud fixed in the stand carrying the screw-shaft.

It has already been explained that the shaft b^5 gives the rotary motion for winding the thread upon the spools, there being a toothed wheel, b^{v}, upon this shaft for each head of the machine, which wheel gears with a wheel, k, having a hollow axis, k', arranged in bearings in a bracket, A', as shown in Fig. 9. Within this hollow shaft a spindle, k^2, is fitted, which is arranged with a key and keyway, so that it will rotate with the hollow axis k' and move endwise. This spindle is connected with an arm, k^3, as shown in Fig. 9, in which the spindle can rotate, and this arm is secured upon one, k^4, of three similar rods, k^4, l, and m, passing from end to end of the machine, each rod being capable of sliding to and fro endwise. Each of these rods is connected by a link, k^5, l', and m', to one arm of a lever, and the three levers k^6, l^2, and m^2 for the three rods are centered upon the same axis k^7, and each lever is acted upon by a separate cam, k^8, l^3, and m^3, one of which is fixed upon the cam-shaft $d^{6\times}$, and the other two are secured by bolts to the first, concentric slots being formed in the other two cams for the bolts to pass through, so as to allow the cams to be adjusted to their proper relative position to each other upon the cam-shaft.

The parts k^9 and $k^{\times}$ shown in Fig. 9 are merely shields or covers.

Upon the front end of the spindle k^2 a collar or hoop, k^{v}, is shown in Fig. 9, which will slide freely in the lengthway of the spindle; but it is carried round with the spindle by means of a pin which fits into a slot in the collar or hoop. Upon the spindle k^2 a spring, k^{T}, is placed, which acts against a shoulder upon the spindle and against the hoop k^{v}, tending to force it against the spool, that edge of the hook coming against the spool being serrated to take hold of it. When the spindle k^2 is withdrawn by the action of the cam k^8 the end of the spool comes against a projection, k^{L}, from the bush or bearing of the hollow spindle. (See Fig. 9.)

The spool is forced upon the spindle and kept in its correct position by a hollow spindle, l^4, which is arranged, as shown in Fig. 9, free to slight end movements in an arm, l^5, secured upon one, l, of the three sliding rods. A spring, l^6, is secured to the arm l^5, which presses against the end of the hollow spindle l^4, so that when the cam l^3 has forced the spool tightly against the shoulder upon the spindle a slight back motion may be given, leaving the springs to press the spindle against the end of the spools. By this means provision is made for slight variations in the length of the spools, and they are thus held by a uniform pressure, instead of one being tight and another slack, as is the case where there is no similar elastic provision.

The thread to be wound upon the spools is drawn in each head from off the end of a large bobbin, n, fixed as shown in Fig. 12. It then passes over a rod, n', then through a wire eye, n^2, then between two pins or guides, n^3, then between pinching-surfaces n^4 along the thread-guide onto the spool.

The thread-guide holder (see Figs. 9 and 10) is formed of a hollow boss, n^5, having two projecting arms. The hollow boss fits upon the traverse-rod f^5, upon which it is free to oscillate; but it is prevented from moving endwise by two collars, n^6, secured to the traverse-rod, as shown. One of the projecting arms forms a socket to receive the thread-guide n^7, which is formed, as shown, in two parts, the part pressing upon the spool being made of steel, and is secured to the other part by a screw-bolt, as shown, so that the steel part may be readily renewed or changed to suit the thickness of the thread, as that edge pressing upon the spool is grooved to correspond with the pitch of the threads when wound upon the spool, so as to give to the thread the smoothing and polishing effect required in the trade. The other arm, n^8, projecting from the boss n^5, has a pin or stud in it, upon which fits the notched end of a rod, p, so that by lifting the rod it may be readily detached from the arm. This rod p is adjustable in length by a screw-coupling link, p', and its other end is jointed with an arm, p^2, (one for each head,) upon a shaft, p^3, passing along the back of the machine from end to end. (See Fig. 12.) To other arms from this shaft p^3 chains p^4 are attached, which pass over anti-friction pulleys p^5 on a shaft, q^2, a weight, p^6, being suspended at the end of each chain. (See Fig. 12.) It is by means of the shaft p^3, arm p^2, and rod p that force is transmitted to press the thread-guide n^7 against the spool when winding.

It is the custom of the trade to give extra pressure upon the thread-guide in winding by hand during the last layer to produce a polishing effect. This may be accomplished by connecting an arm, p^7, on the shaft p^3 with one end of a rod, p^8, the other end being jointed with one end of a lever, p^9, having its fulcrum upon a stud in the framing. The other end of this lever has a square pin in it, which comes opposite the edge of a projection upon the side of the ratchet-wheel g^{v} upon the shaper cam-shaft g^3. (See Figs. 5 and 7.) The increase of pressure for polishing is effected by causing the pin in the lever p^9 to come in contact with the projection at, say, the last layer but two, by which means the use of the thread-guides by each layer is resisted, and consequently there is an increase of pressure. The thread-guide and other parts have sufficient elasticity to give way to a slight extent. In this case the edge of the square pin in the lever p^9 is just free from the edge of the projection when the winding is completed, so as to leave the thread-guides at liberty to be lifted and held up while the spools are being changed.

The thread-guides may be lifted by a cam upon the belt-changing cam-shaft e^3; but it is now preferred to lift them by one, $p^{\times}$, of the set of cams upon the cam-shaft d^6, which acts upon a lever, p^{v}, centered at r^2, and the motion of this lever is transmitted by a rod, p^{T}, to an arm, p^{L}, upon the back shaft p^3.

I prefer, also, to put the extra polishing pressure upon the spools by fixing a piece to the cam $p^{\times}$, to come in contact with an adjusting-screw in the lever p^{v}, and to resist its motion during the last two layers. This piece upon the cam will pass clear of the adjusting-screw in the lever when the cam-shaft d^6 begins to turn. The tension of the thread as it is wound upon the spool is regulated by passing between pinching-surfaces, before referred to. These are formed by two hard-steel faces, n^4, one fixed (so as to be easily replaced) to the boss part n^5 of the thread-guide, the other to the end of an arm, n^9, jointed to projections from the boss, as shown in Figs. 9 and 10. The end of the arm n^9 carries an adjusting-screw, $n^{\times}$, the point of which acts against the end of a spring, n^{v}, fixed to the boss n^5, as shown. (See Fig. 9.) By means of this screw and the spring n^{v} the pinching action, and thus the tension upon the thread, is regulated.

The cam q for feeding the empty spool is fixed on the shaft d^6. It acts upon an arm, q', fixed upon the shaft q^2, which passes from end to end of the operating part of the machine. Upon this shaft an arm, q^3, is secured for each head in a vertical position, to which another arm is bolted, the end of which is formed into a V-trough, q^4. The attendant places the empty spools one in each of these troughs while the machine is winding, and when the empty spool is to be passed onto the spindle the V-trough is moved by the cam q till the axis of the spool comes opposite the spindle k^2, when the hollow part l^4 pushes the spool from the trough q^4 onto the spindle k^2, and then the V-trough assumes the first position by the action of the cam q.

When the spools are filled with thread and the winding stops the first operation of the changing cams is to lift the thread-guides from the spools, and when this movement begins a finger, m^4, secured to one, m, of the three sliding rods, traverses across and catches the thread between the thread-guide and the spool, so as to take it to one side; but before this is accomplished an arm, r^5, carrying a knife and spring-point, is caused by a cam, r, to descend upon the edge of the spool. The knife cuts an incision into the edge of the spool and then lifts, the same movement of the cam causing the spring-point to press against the spool, and this point fixes a limit to the unwinding of the thread at a point in a line with the incision cut by the knife. About this time the thread, which has been brought to one side by the finger m^4, is caught by a hook, s^6, which pulls it firmly into the incision, and by the time this is accomplished the hook has brought that part of the thread between itself and the spool against a knife-edge on one side of the hook, which severs the thread on that side, and the thread on the other side of the hook has become pinched between it and a spring. The spindle k^2 is then withdrawn, and the full spool falls against a pin, t, fixed in the side of the bracket A′, which tilts it over the rod m, so that it rolls down the spout into the trough z, in front of the machine, and while an empty spool is being put upon the spindle the thread (by the tension upon it) takes such a line between the thread-guide and the pinching apparatus that it is caught between the hoop or shoulder of the spindle k^2 and the end of the spool. This holds the end of the thread secure. The hook s^6 then ascends and releases the end of the thread, and the thread-guides are lowered upon the spools, when the change is completed. Then the traverse-rod f^5 is adjusted and the winding begins.

The cam r for actuating the incision knife and point is fixed on the shaft d^6. It acts upon an arm, r', fixed on a shaft, r^2, passing from end to end of the operating part of the machine. Upon this shaft there is a vertical arm, r^3, for each head, to which a rod, r^4, is jointed, having a screw-coupling for adjusting its length. This rod r^4 is also jointed to one arm of a bell-cranked lever, r^5, having its fulcrum upon a stand, r^6, from the bracket A′. To one arm of this lever the incision-knife r^7 is attached, as shown in Figs. 9 and 10, and also a spring, r^8, bent at the end and sharpened to a point. This spring-point r^8 descends below the edge of the knife r^7 and comes first in contact with the spool. It is made elastic, so that it can remain in contact after the knife has been lifted to allow the thread to enter the incision.

The cam s, for working the hook, is fixed upon the shaft d^4. It acts upon a lever, s', free to oscillate upon the shaft r^2, and this lever is connected by a rod, s^2, with an arm, s^3, upon a shaft, s^4, passing in bearings on the brackets A′ from end to end of the operating parts of the machine. Upon this shaft s^4 an arm, s^5, is fixed for each head, which has a slot on its end that fits a pin fixed in the end of the hook s^6. This hook is made to slide freely in a groove formed in a bracket, s^9, and close to one side of the hook a knife-edge, s^7, is fixed by a set-screw, $s^\times$, (see Figs. 9 and 10,) and upon the other side a spring, s^8, is arranged to press against the side of the hook, keeping it against the knife-edge upon its other side. It will now be seen that when the hook catches the thread and pulls it downward one side will come between the spring and hook and the other side against the knife-edge, and that the thread will assume such a line between the thread-guide n^7 and hook as to pass close against the spindle, so as to be caught between the shoulder of a collar upon the spindle and the end of the spool, where it is held secure.

The forms of the cams and their times of action in relation to each other will now be described by reference to the diagrams on Figs. 3 and 4. In these diagrams the form of each cam is represented upon a straight line, supposed to be divided into three hundred and sixty degrees, so that the point marked 0 and 360 represent the same point of the path of the cam when the two ends of the lines are joined together to form a circle. The diagrams show the times at which the cams act relatively to each other by being drawn with an assumed zero of each cam upon the same vertical line, so that the movements and times of action at any point of the revolution of the cam-shaft will be seen at a glance by drawing a vertical line through the given point upon the diagrams. Fig. 3 will explain those cams upon the belt-changing cam-shaft e^3, which makes one revolution for each set of spools filled with thread—that is, one sudden semi-rotation when the winding is completed and the other when the change of the spools is effected. The cams stand at the zero-point 0 in respect to the bowls acted upon when the machine is winding. $b^\times$ represents the brake-lever cam for stopping the winding. The brake is fully applied by the time the cam has passed through forty-six degrees of rotation, and it remains applied during the remainder of the one hundred and eighty degrees of the first semi-rotation, and at the one hundred and ninety-third degree the brake is fully withdrawn, and remains so for the remainder of the second semi-rotation. The cam $d^\times$ for the brake d^8, acting to stop the motion of the spool-changing cams d^6 and $d^{6\times}$, is withdrawn from the pulley d during the first semi-rotation and is applied during the second semi-rotation. The cam $p^\times$, for lifting the thread-guides when actuated by a cam upon the belt-changing cam-shaft e^3, lifts the guides between the ninetieth and one-hundred and eightieth degree of rotation and lowers them during the remaining three hundred and sixty degrees of rotation, or during the second semi-rotation.

The belt-changing cam e^2 acts to traverse the belt from the winding-pulley b to the spool-changing pulley d during the first semi-rotation and back again during the second semi-rotation.

Fig. 4 is the diagram of the cams upon the spool-changing cam-shafts d^6 and $d^{6\times}$. These cams are at the assumed zero (0) in relation to the bowls acted upon when the machine is winding, and they make one continuous rotation after the first and before the second semi-rotation of the belt-changing cam-shaft e^3.

When the thread-guides are operated upon by a cam, $p^\times$, on the shaft $d^{6\times}$, as is now preferred, they are lifted from the spools during the first twenty-five degrees of rotation, remain up till the three hundred and twenty-eighth degree, and from this point descend to the three hundred and fifty-fifth degree, then remain down during the remainder of the three hundred and sixty degrees of rotation. The incision and point cam r causes the knife to remain stationary during the first thirteen degrees, to cut the incision between the thirteenth and thirty-seventh degree, to remain in the incision between the thirty-seventh and sixty-third degree, to withdraw from the incision between the sixty-third and eightieth degree, and then remain stationary to the ninety-second degree, and finally assume the first position, withdrawing the point between the ninety-second and one hundred and seventh degree, remaining stationary during the remainder of the rotation of the cam.

The cam m^3 for actuating the fingers m^4, that take the thread to one side, produces no movement till the twentieth degree of rotation. It then begins to act, and has made the movement to push the thread to one side, so as to be caught by the hook s^6 at the sixty-third degree, and remains in this position till the ninety-third degree, when it begins to retire to its first position, which it attains at the one hundred and forty-fifth degree, then remaining stationary the remainder of the three hundred and sixty degrees of rotation. The cam s for working the hook s^6 produces no movement till the tenth degree of rotation, when the hook begins to ascend to catch the thread, this movement being finished at the fifty-fifth degree, from which point the hook remains stationary till the sixty-fifth degree, when it begins to descend to its lowest point, which it attains at the one hundred and tenth degree. The thread being now cut, one end being held by the spring s^8, the hook remains in this position to the three hundred and thirty-eighth degree, then makes the short ascending movement to release the end of the thread, and remains in this position during the remainder of the three hundred and sixty degrees of rotation.

The cam l^3 for actuating the hollow spindle l^4 produces no movement during the first one hundred and thirty-six degrees of rotation, when it begins to withdraw to give space for the full spool to be discharged. The short movement is completed at the one hundred and fortieth degree. The spindle then stands till the one hundred and eighty-second degree, at which point it begins to withdraw still farther, ending this movement at the two hundred and thirty-eighth degree, when it remains stationary to the two hundred and seventy-second degree to allow the empty spool to be brought opposite the spindle; then it begins its back movement, forcing the empty spool out of the feeding trough or cradle q^4 onto the spindle k^2, this movement being completed at the three hundred and twenty-eighth degree, the hollow spindle remaining in this position during the remainder of the three hundred and sixty degrees of rotation.

The cam k^8 for giving end motion to the spindle k^2 for rotating the spools produces no motion during the first one hundred and forty degrees of rotation, when the spindle begins to withdraw from the full spool, and finishes this movement at the one hundred and ninety-fifth degree, when it becomes stationary, and remains so till the two hundred and fifteenth degree, at which point it begins its back movement, ending it at the two hundred and seventieth degree, and remaining stationary during the remainder of the three hundred and sixty degrees of rotation.

The cam q for bringing the empty spool opposite the spindle k^2 is formed so that the trough or cradle q^4 is stationary during the first two hundred and twenty-eight degrees of rotation. It then begins to move the trough so as to bring the empty spool opposite the spindle, which it accomplishes at the three hundred and fifty-sixth degree of rotation, when the trough becomes stationary till the three hundred and second degree of rotation, at which point the trough begins to go back to its position when the machine is winding, at which point it arrives at the three hundred and thirty-second degree, being stationary during the remainder of the three hundred and sixty degrees of rotation.

I have now particularly described the nature of my invention and the manner of carrying the same into effect, and would remark that I am aware that machines have been proposed having several heads, all worked together at the same time, and in such machines the distribution of the thread was intended to be effected by self-acting means; but in such machines the stopping of the winding when the spools were full by a brake, the securing of the end of the thread to full spools, the removing and replacing of them by empty ones, the arranging of the threads to wind onto the empty spools, and the starting of the machine to wind were not performed by self-acting means, as by my invention hereinbefore described. I therefore wish it to be understood that I do not confine myself to the details herein given so long as the peculiar features of my improvement are retained; but

I claim as my invention—

1. The machine as a whole, composed of the elements combined, arranged, and operating substantially as set forth.

2. The brake b^7, in combination with the devices herein described, or the equivalent to the same, for causing the belt-changing shaft e^3 to stop the winding part of the machine when the bobbins or spools are sufficiently full.

3. The combination of the shaper g' with the oscillating parts f^6 and f^9, the whole operating substantially as and for the purpose set forth.

4. The combination of the shaper or its equivalent with the cam g^2.

5. The combination of the traverse-rod f^5 with the incline h^2 and the shaper or its equivalent.

6. The brake d^8 and the devices described, or the equivalent to the same, for stopping the motion of the cam-shaft.

7. The lever g^6, in combination with a screw, g^2, by which the adjustment of the lever's fulcrum is effected.

8. The point r^8, or its equivalent, so operated as to prevent the uncoiling of the thread from a given point and to assist in guiding the thread when pulled into the incision made in the edge of the spool or bobbin.

9. The combination of the spring-point r^8 and the incision-knife r^7 upon the same arm.

10. The hook s^6, or its equivalent, operated substantially as set forth, for drawing the thread into the incision and severing the same.

11. The mode herein described of securing the thread between the collar of the spindle k^2 and the end of the bobbin, so that it will wind thereon.

12. The combination of the point r^8, incision-knife r^7, hook s^6, spring s^8, and thread-knife s^7, as herein set forth, for the purpose specified.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

W. WEILD.

Witnesses:
PETER J. LIVSEY,
W. GIFFARD.