

(No Model.)

5 Sheets—Sheet 1.

J. BYFIELD.  
KNITTING MACHINE.

No. 311,173.

Patented Jan. 27, 1885.

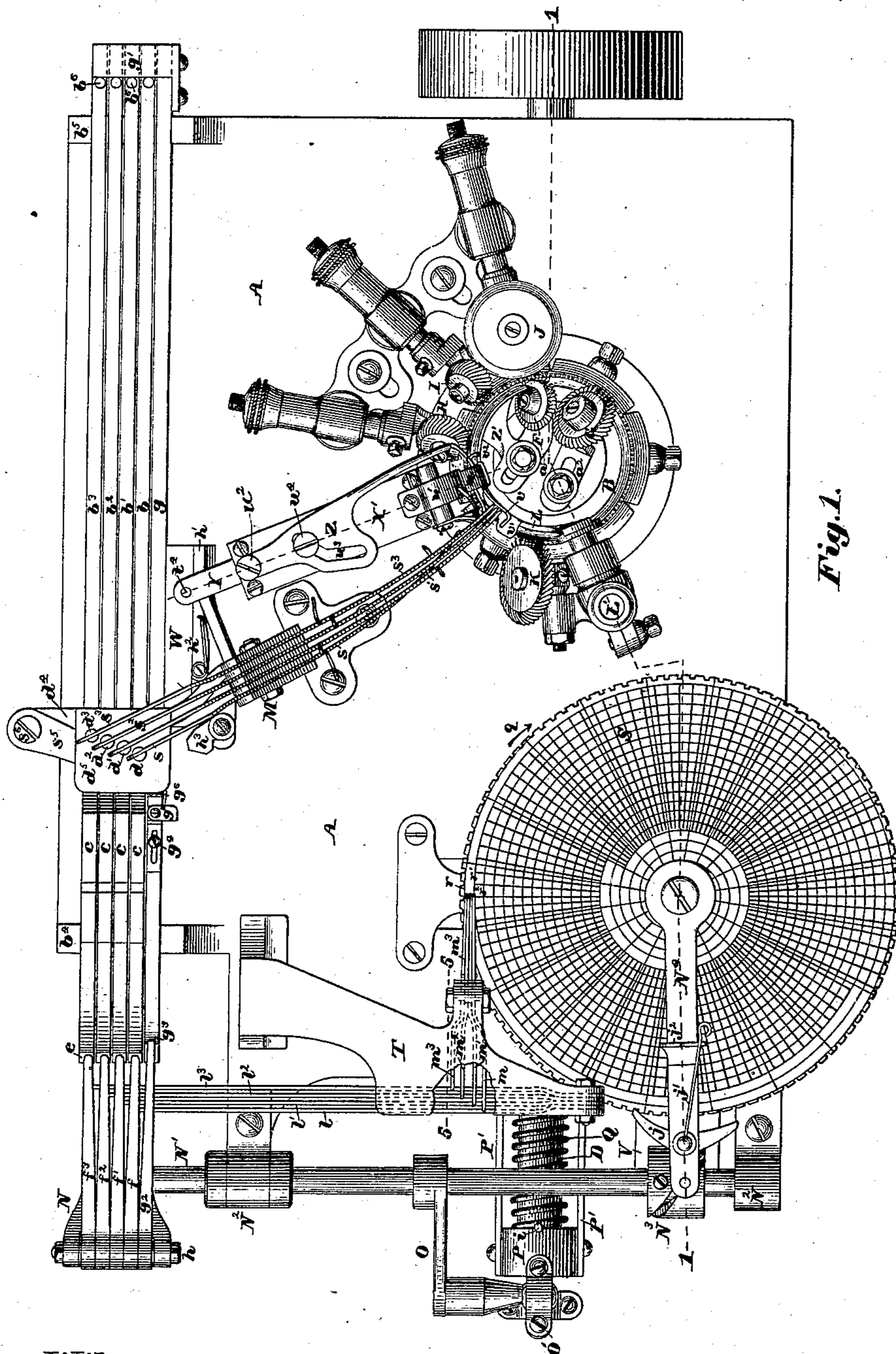


Fig. 1.

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E. A. Hemmenway.

Inventor:  
John Byfield,  
by N. P. Lombard  
Attorney.

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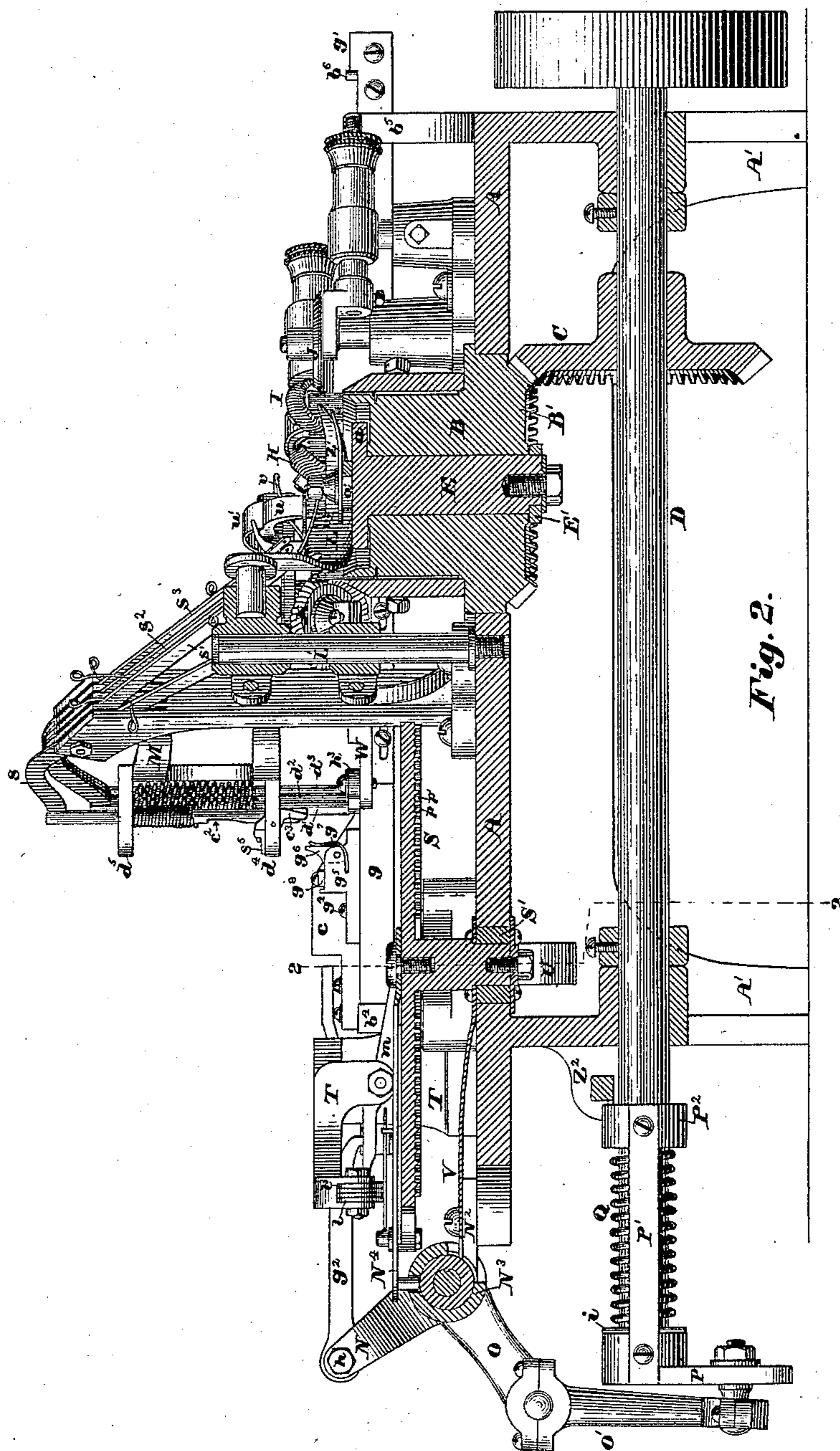


Fig. 2.

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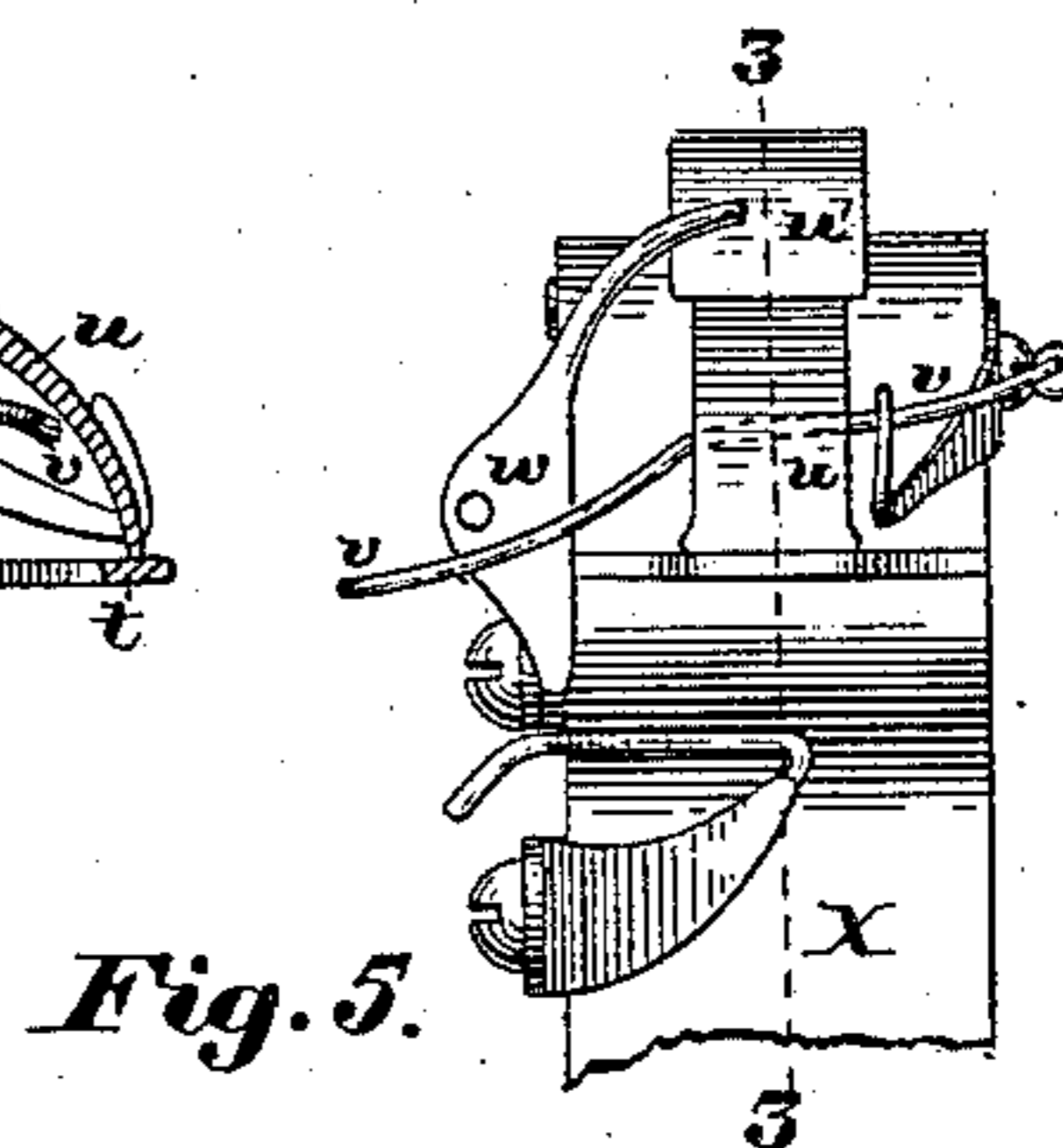
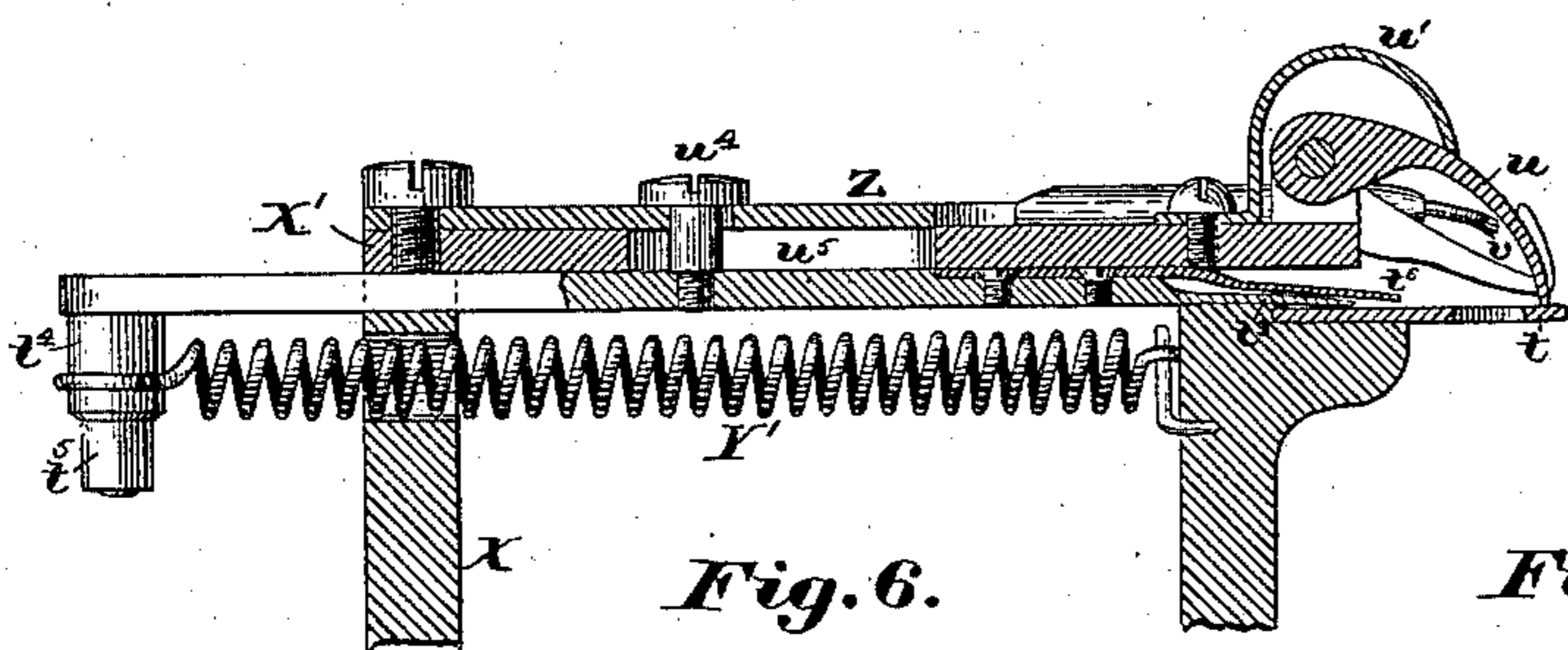
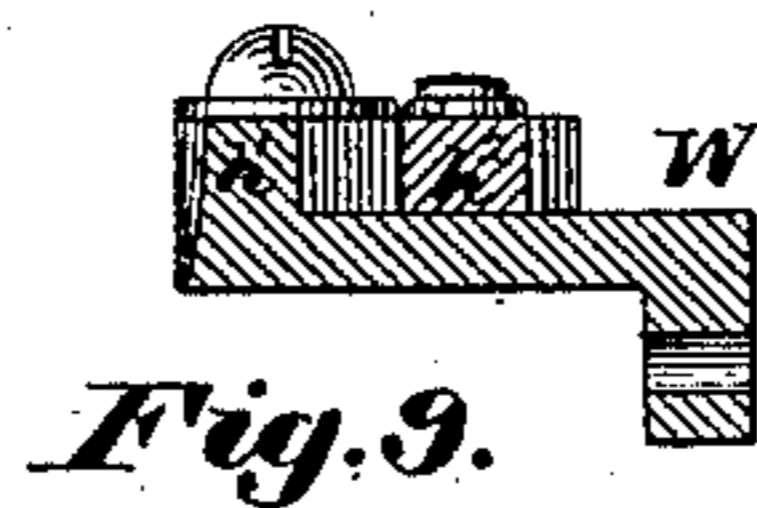
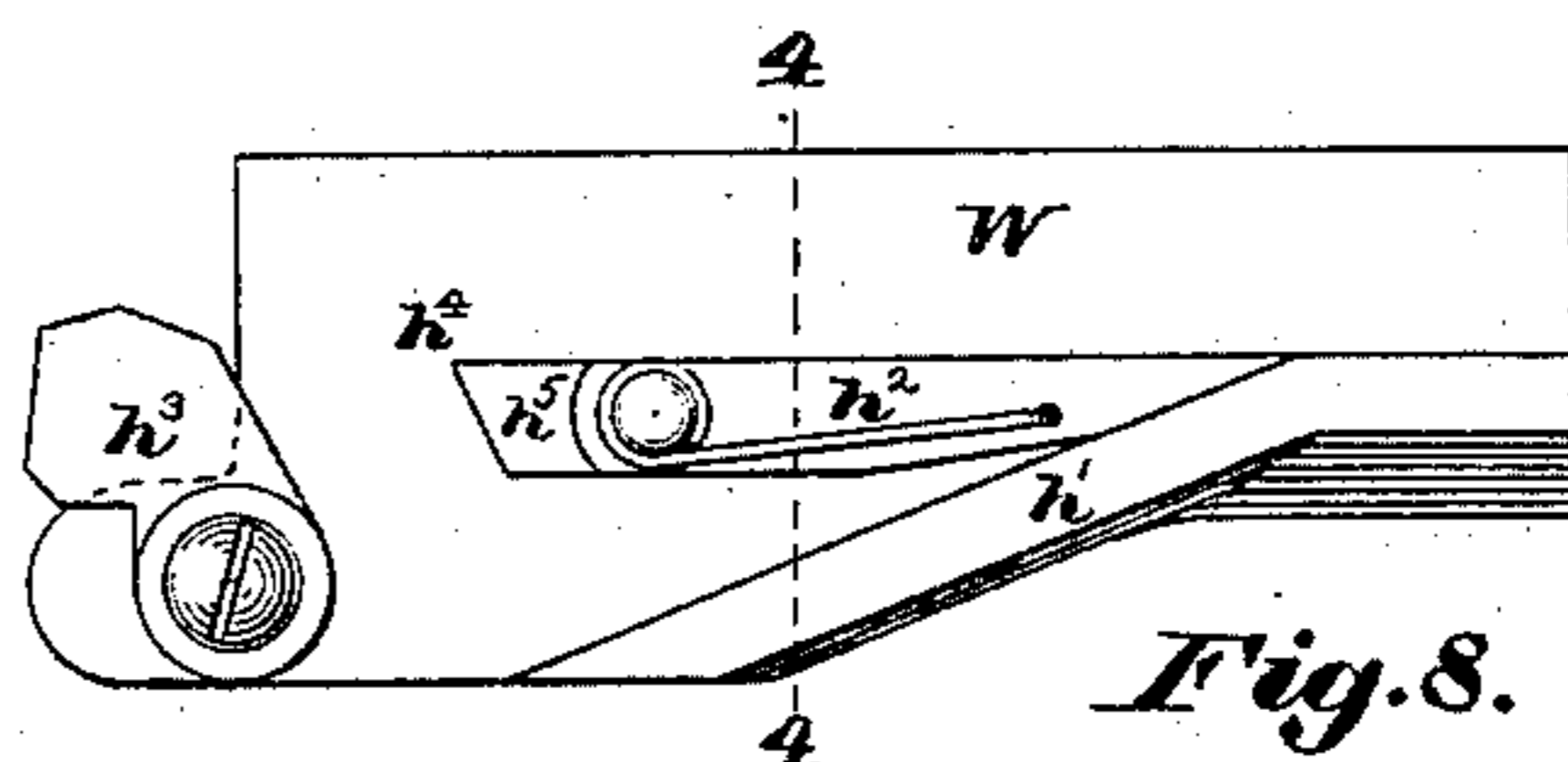
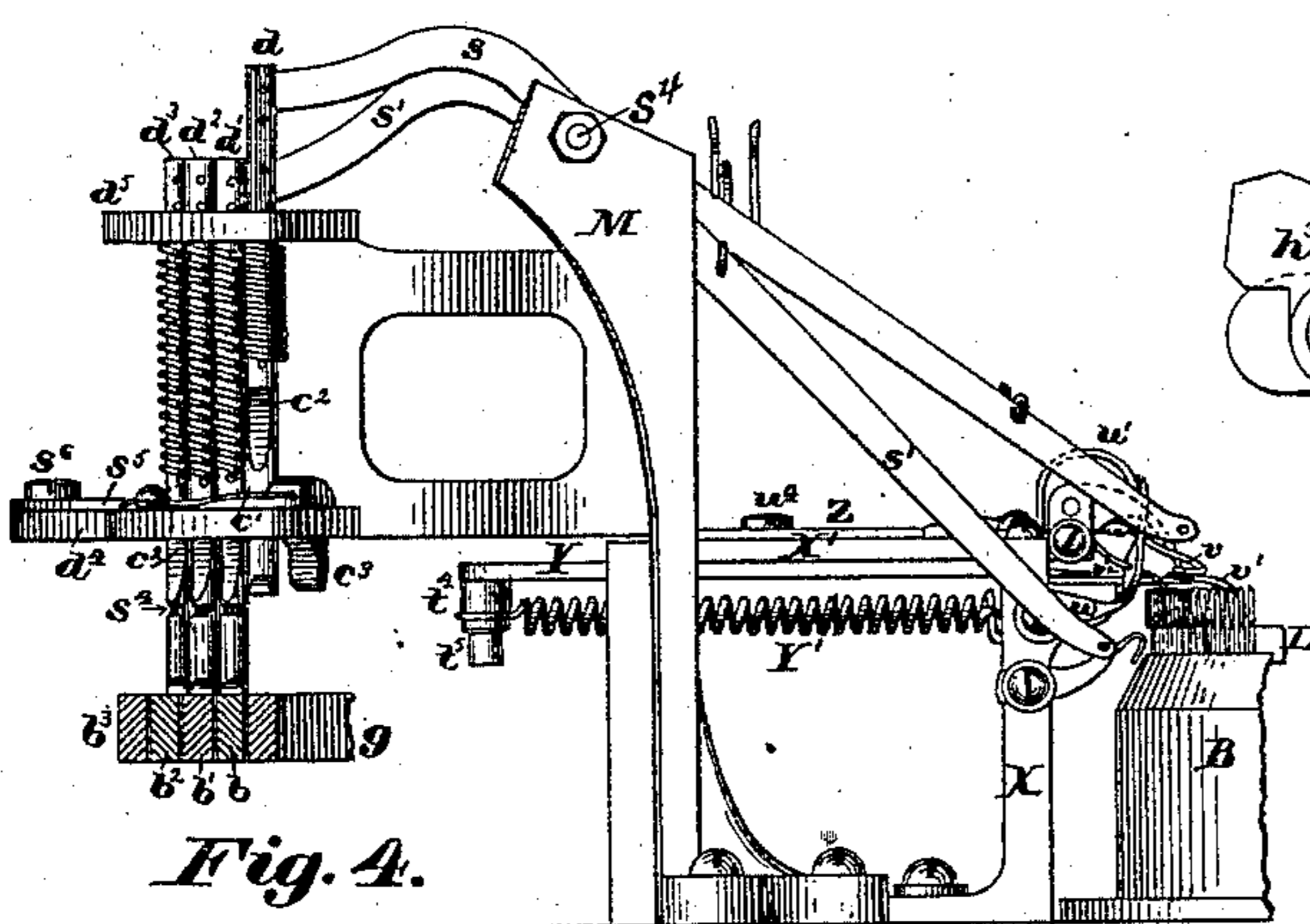
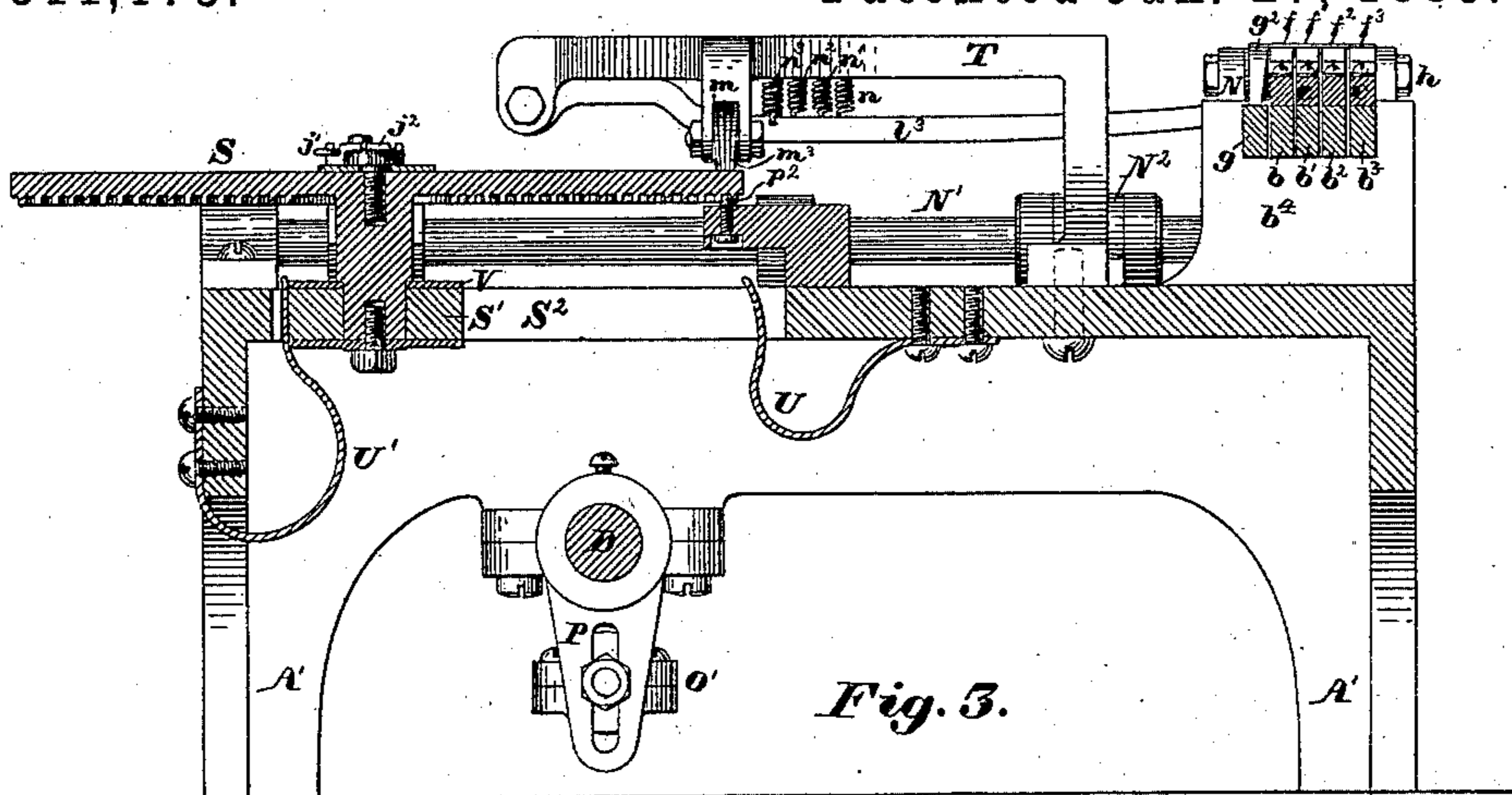
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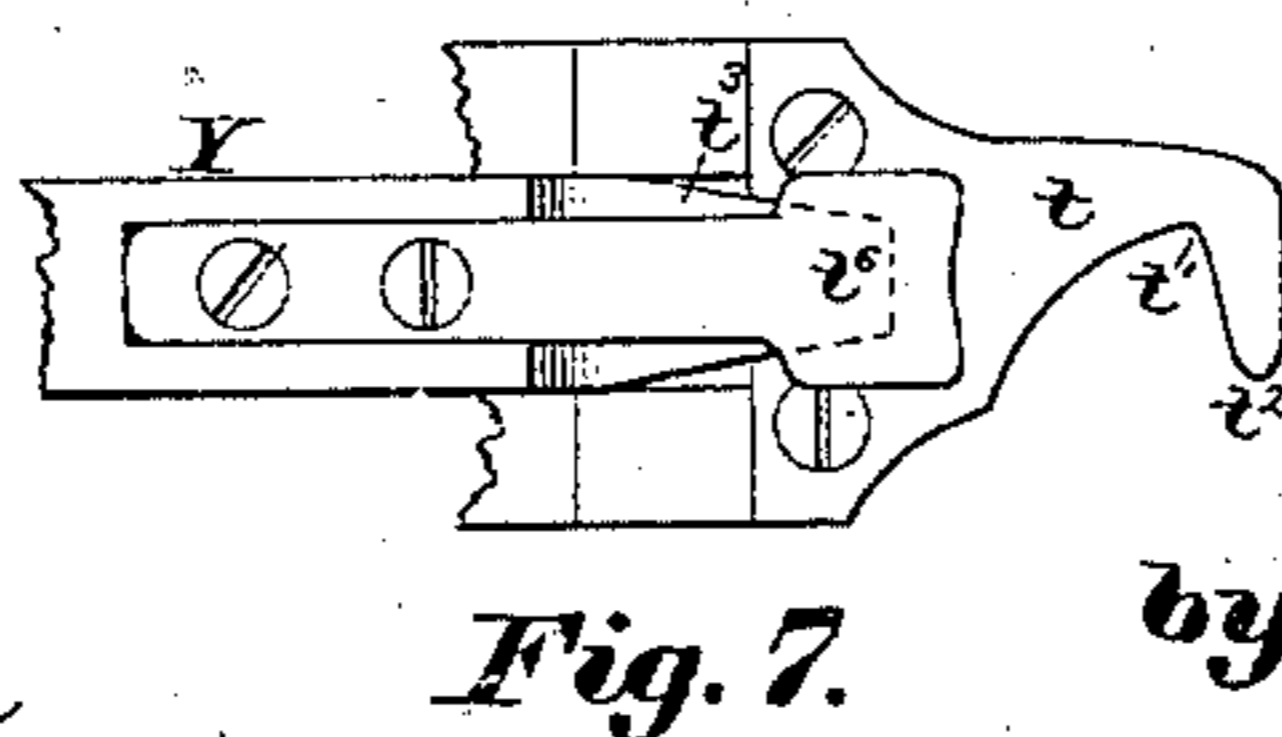
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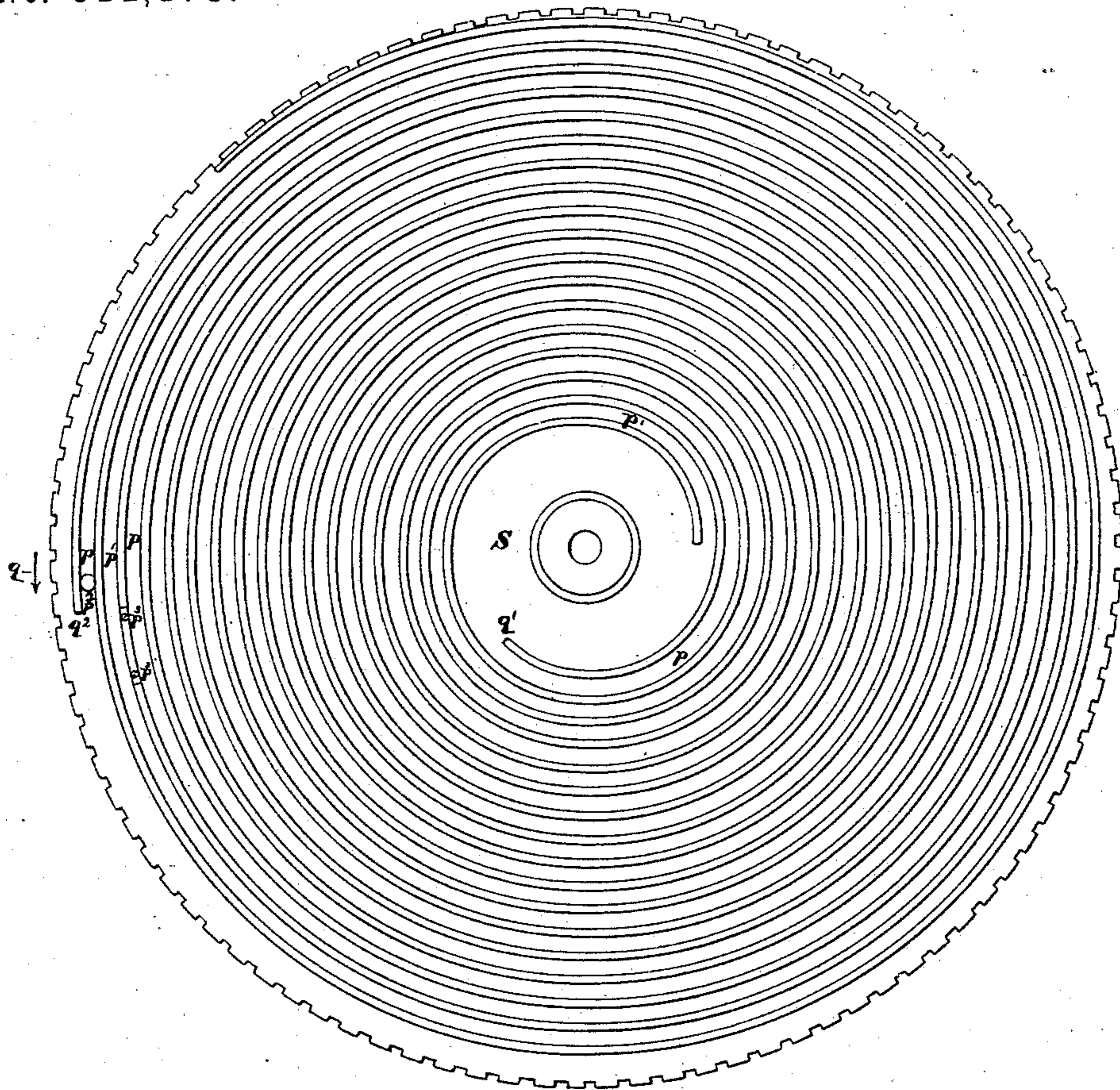
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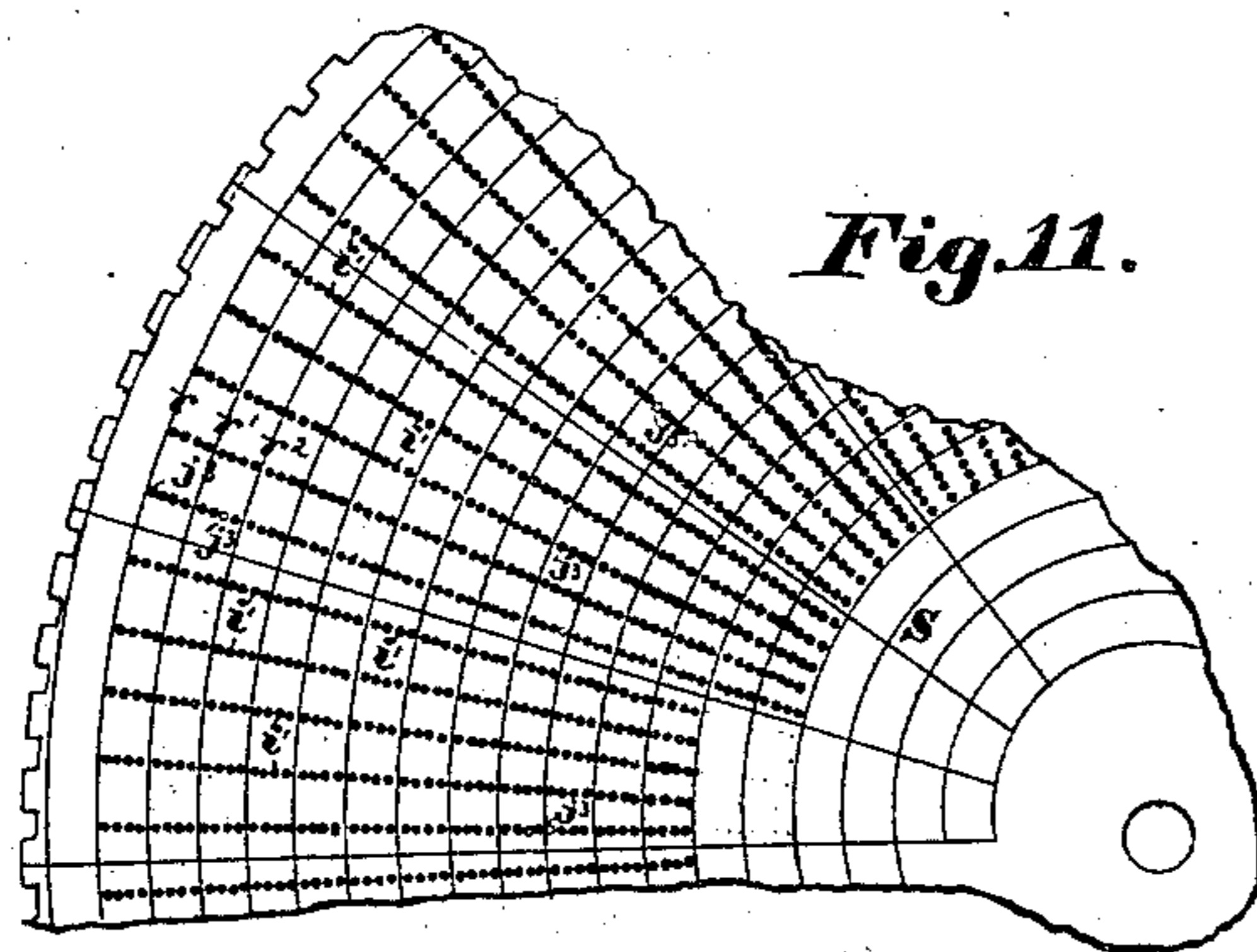
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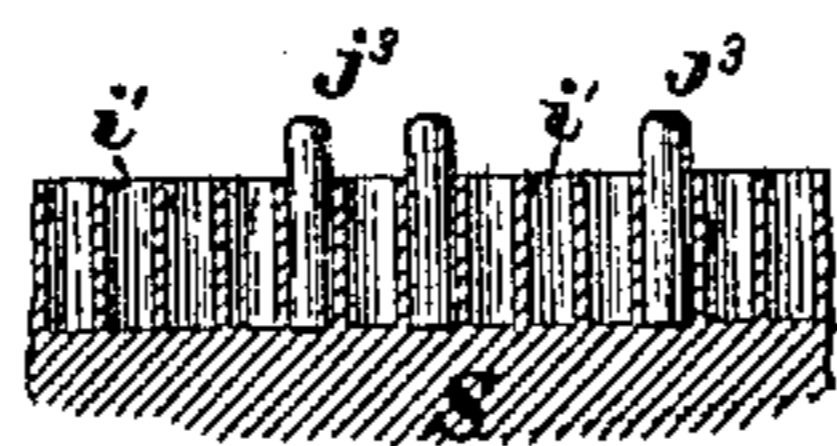


*Fig. 10.*



*Fig. 11.*

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*Fig. 12.*

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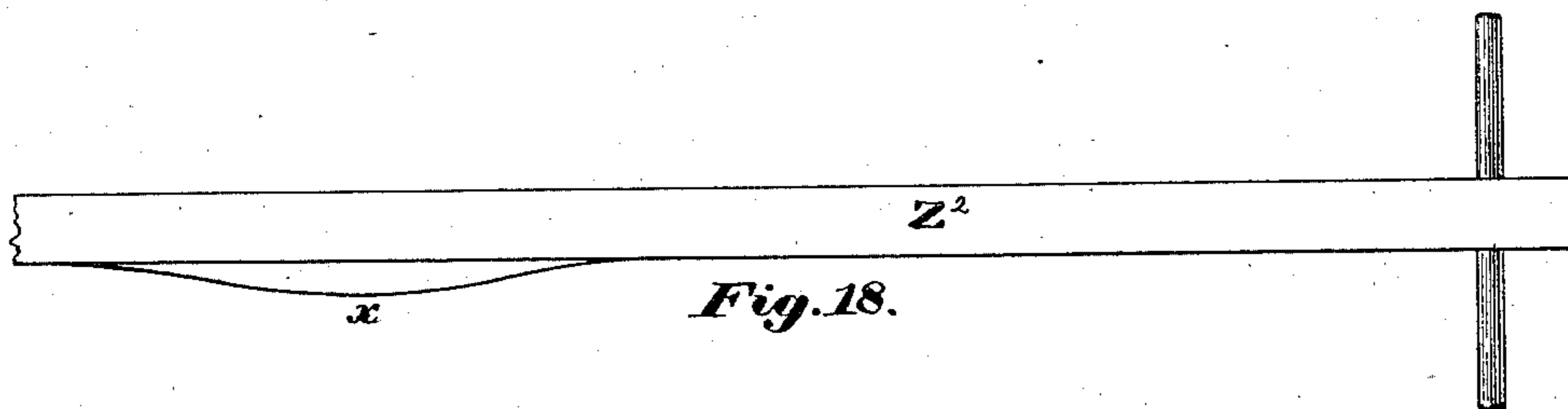
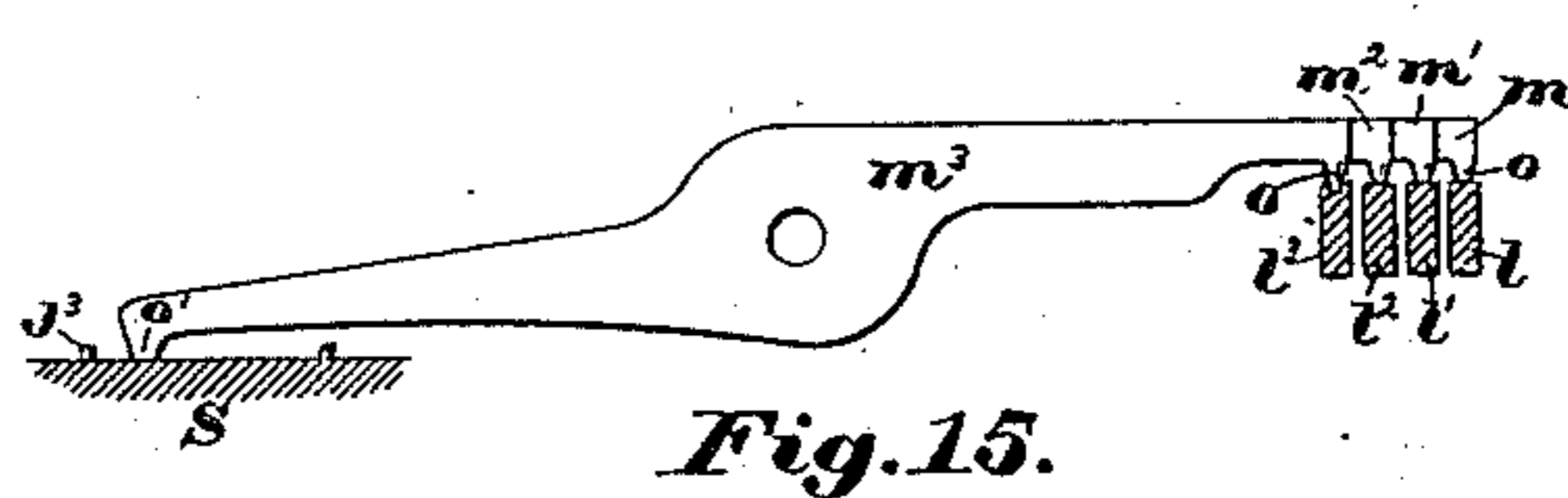
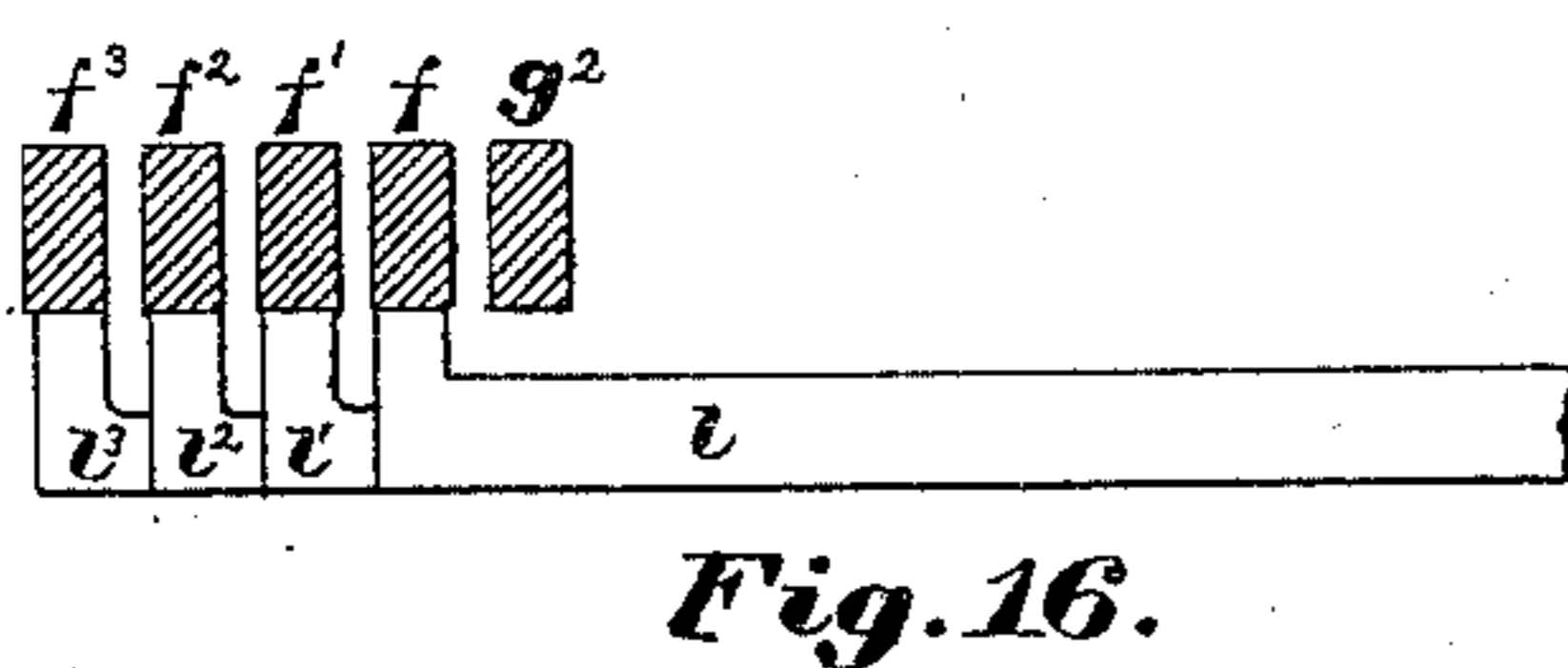
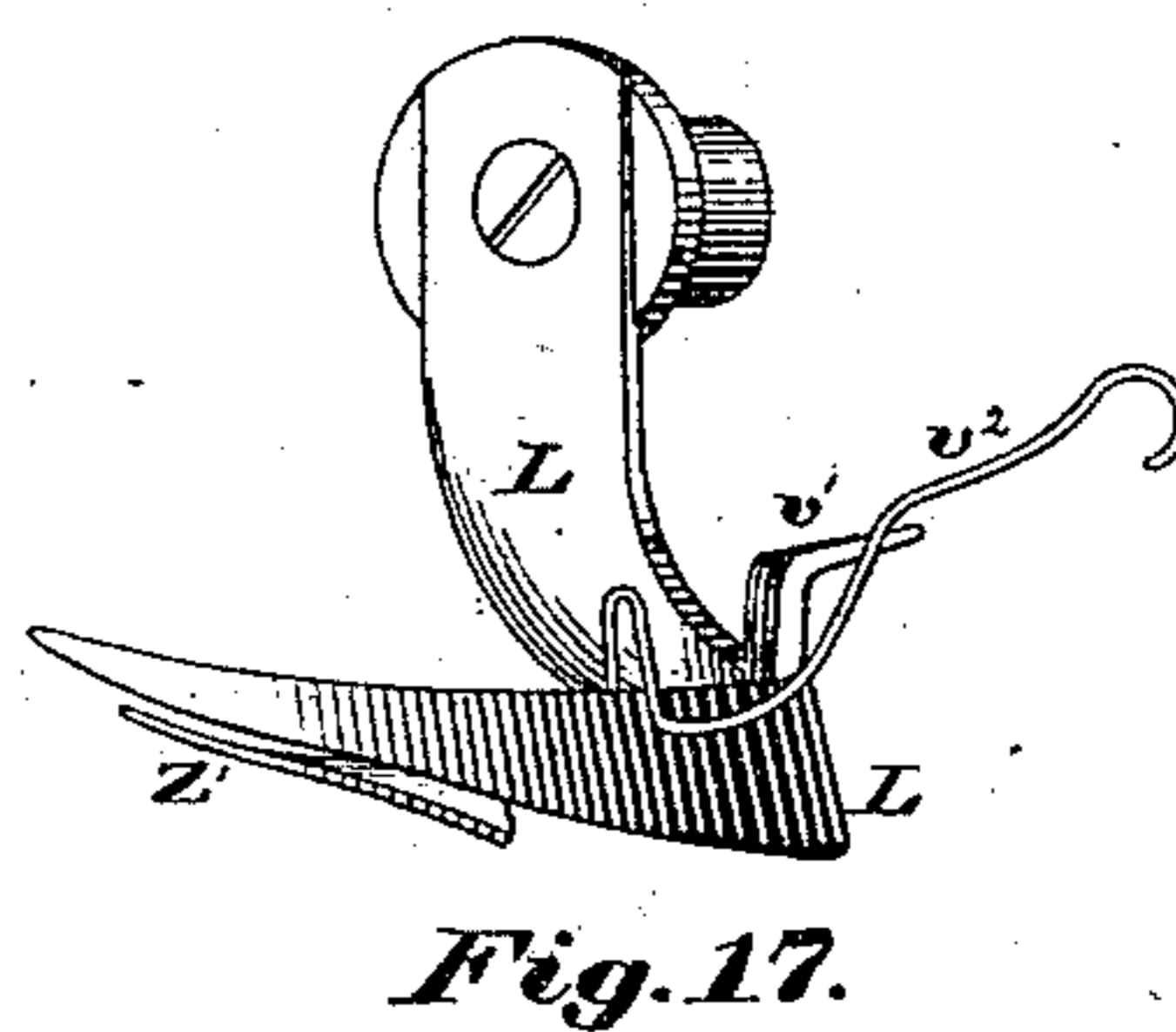
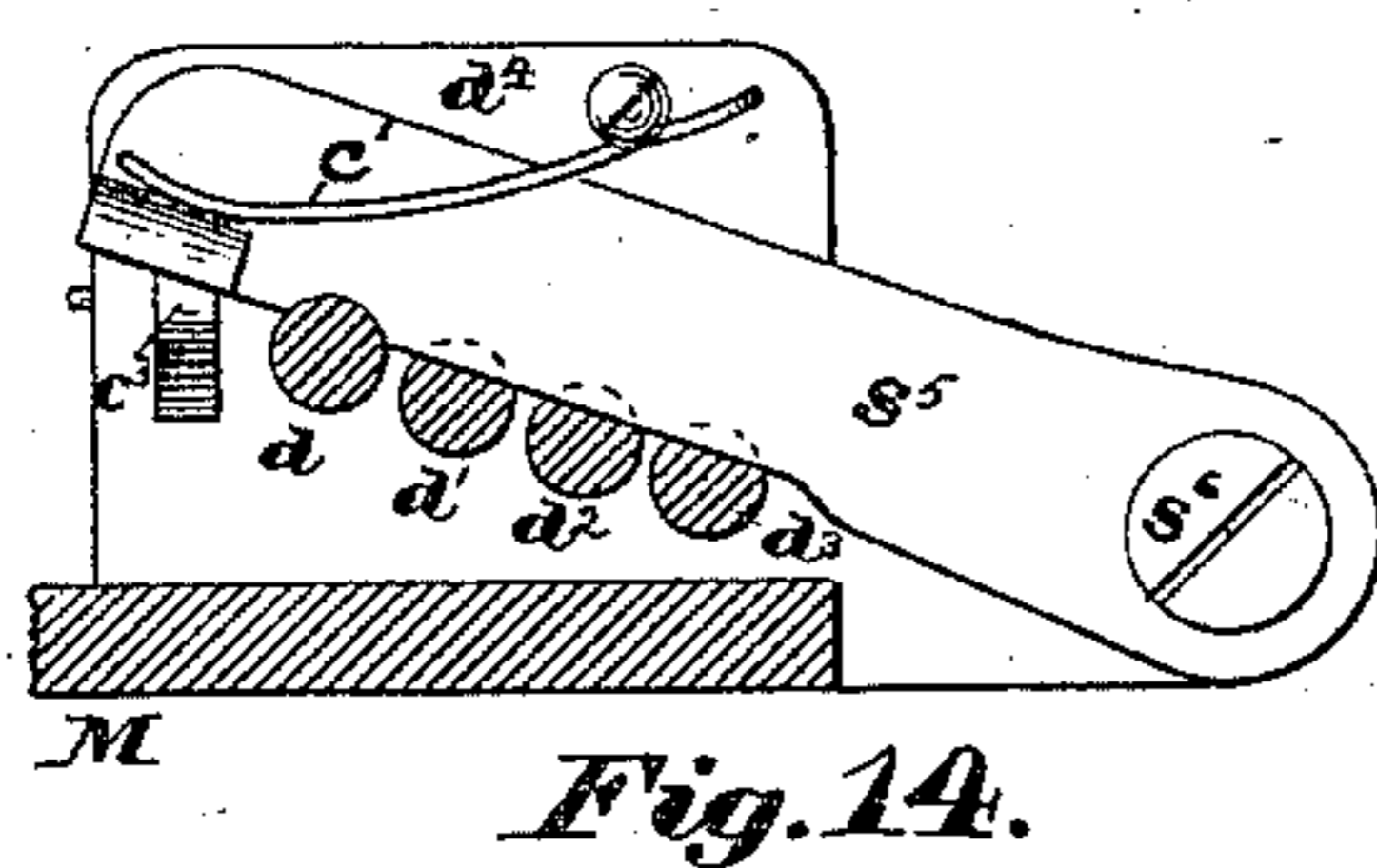
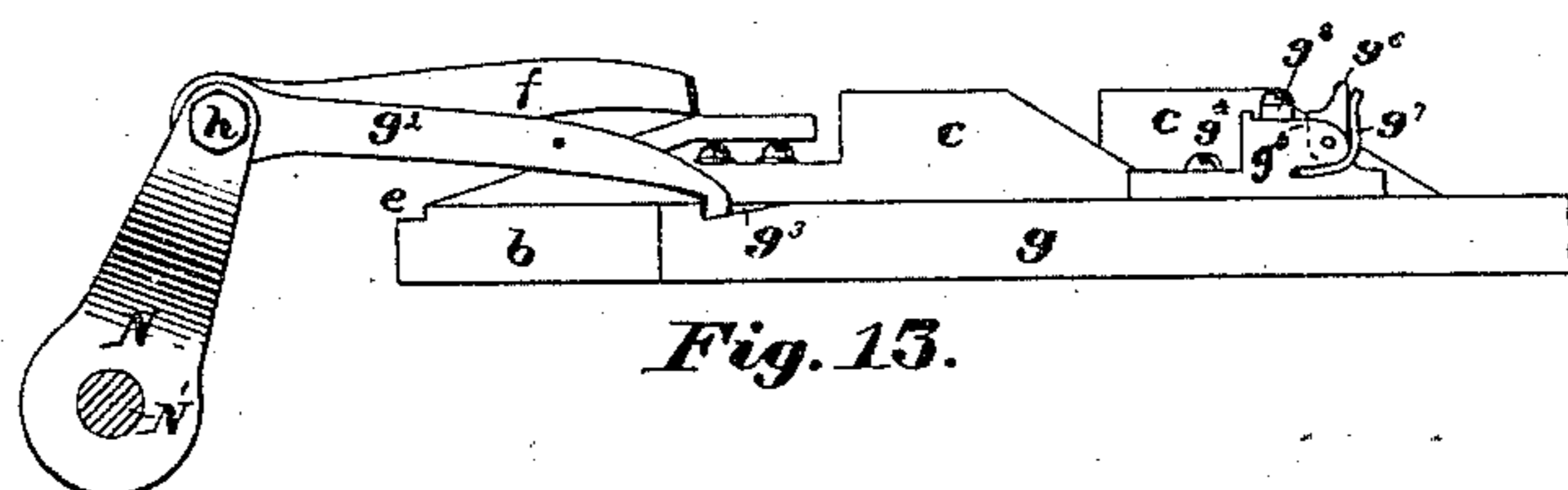
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***Witnesses:***

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C. A. Hemmenway

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# UNITED STATES PATENT OFFICE.

JOHN BYFIELD, OF LOWELL, MASSACHUSETTS.

## KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 311,173, dated January 27, 1885.

Application filed May 2, 1883. Renewed September 26, 1884. (No model.)

*To all whom it may concern:*

Be it known that I, JOHN BYFIELD, of Lowell, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Knitting-Machines, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to that class of knitting-machines in which a series of barbed or spring needles are arranged and adapted to be revolved in a circle, and in which mechanism for intermittently throwing into and out of action yarns of different colors is employed, and is an improvement upon the inventions described in Letters Patent No. 252,864, granted to me January 31, 1882, and in another application of mine filed January 16, 1882; and it consists in certain novel constructions, arrangements, and combinations of devices, which will be readily understood by reference to the description and drawings, and to the claims hereinafter given.

Figure 1 is a plan of a machine embodying my invention as applied to a single needle-head, that side of the machine nearest which the pattern-wheel is mounted being the front side of the machine and the end where the driving-pulley is the right-hand end of the machine for the purposes of the description hereinafter contained. Fig. 2 is a vertical section on line 1 1 on Fig. 1. Fig. 3 is a transverse vertical section on line 2 2 on Fig. 2, looking toward the left. Fig. 4 is an elevation of the yarn guiding and controlling devices, the yarn holding and severing devices, and a portion of the needles and needle cylinder or head. Fig. 5 is a front end elevation of the yarn holding, directing, and severing devices. Fig. 6 is a vertical section of the same on line 3 3 on Figs. 1 and 5. Fig. 7 is a plan of the front portion of the severing devices and the push-blade for carrying the loop of yarn between the holding devices. Fig. 8 is a plan of the latch-cam for operating the movable yarn-severing knife, drawn to an enlarged scale. Fig. 9 is a transverse section of said cam on line 4 4 on Fig. 8. Fig. 10 is an inverted plan of the pattern-wheel, drawn to an enlarged scale. Fig. 11 is a plan of a small section of the same, and Fig. 12 is a vertical section through a portion of said

wheel on a line cutting through the center of one of the radial rows of pin-holes. Fig. 13 is an elevation of a portion of the left-hand ends of the series of cam-bars and the pawls for moving them, with two of the bars moved forward. Fig. 14 is a plan of the latch-lever for holding the yarn guide-lifter-rods in raised positions. Fig. 15 is an elevation of the levers for depressing the pawl-lifting levers, said levers and a portion of the pattern-plate being shown in section. Fig. 16 is a vertical transverse section through the cam-bar-operating pawls, and showing the relation of the lifter-levers thereto. Fig. 17 is an elevation of the push-back and the work-lifting plate; and Fig. 18 is a plan of the cam-bar for operating the reversible crank.

A is the table or bed of the machine, supported upon the legs A' A', and having mounted in a suitable bearing therein the needle-head B, provided with the bevel gear-wheel B' at its lower end, which engages with and is operated by a corresponding bevel gear-wheel, C, on the driving-shaft D, mounted in bearings beneath the table A, in a well-known manner. The needle-head B has secured thereon a series of barbed or spring needles, arranged in a circle about said head in a well-known manner. The needle-head B is arranged to be revolved about the vertical shaft or stud E, set in a fixed position in the stand E', and provided at its upper end with a collar or flange, a, to which are secured the stands a' and a'', which carry the journals, upon which are mounted the "landing-wheel" F and the "knocking-over wheel" G in a well-known manner.

H is the "stitch-wheel," I the "dividing-wheel," J the "presser-wheel," and K the clearing-wheel, all arranged around the outside of the circular series of needles and adapted to co-operate therewith in a well-known manner.

L is the "push-back," of ordinary construction, adjustably mounted upon the post L' in a well-known manner.

Two, three, four, or more bars, b b' b<sup>2</sup> b<sup>3</sup>, according to the number of colors of yarn to be used, are arranged in suitable bearings, b<sup>4</sup> b<sup>5</sup>, at the rear of the bed A, each of said bars having secured thereto or formed thereon a cam or wedge, c, which, when said bar is moved

toward the right-hand end of the machine, acts upon and raises one of the vertical rods  $d$ ,  $d'$ ,  $d''$ , and  $d'''$ , mounted in bearings formed in the shelves  $d^4$  and  $d^5$  on the stand M. The bars  $b$ ,  $b'$ ,  $b''$ ,  $b'''$  are also each provided with a shoulder,  $e$ , at or near its front end, with which one of the pawls  $f$ ,  $f'$ ,  $f''$ ,  $f'''$  is arranged to engage to move said bar forward or toward the right-hand end of the machine at certain predetermined intervals, which are controlled or regulated by the pattern-wheel, as will be hereinafter described. Another bar,  $g$ , is mounted in the same manner by the side of the bars  $b$ ,  $b'$ ,  $b''$ ,  $b'''$ , and has secured to its right-hand end the arm or plate  $g'$ , which projects transversely therefrom and over the ends of the bars  $b$ ,  $b'$ ,  $b''$ ,  $b'''$  in a position to be acted upon by either of the pins  $b^6$ , set in the upper sides of the barbs  $b$ ,  $b'$ ,  $b''$ ,  $b'''$ , in such a manner that the bar  $g$  shall be moved toward the right-hand end of the machine whenever either of the bars  $b$ ,  $b'$ ,  $b''$ , or  $b'''$  is moved in that direction, and that either of the bars  $b$ ,  $b'$ ,  $b''$ ,  $b'''$  that has been moved to the right shall be moved to the left again by the movement of said bar  $g$  to the left, caused by the engagement of the hook-pawl  $g^2$  with the notch or shoulder  $g^3$ , formed in the upper edge of the bar  $g$ , at or near its left-hand end, as shown in Fig. 13. The pawls  $f$ ,  $f'$ ,  $f''$ ,  $f'''$ , and  $g^2$  are mounted side by side upon a common pivot,  $h$ , set in the forked movable end of the lever N, mounted upon the rear end of the rocker-shaft N', which in turn is mounted in the bearings N<sup>2</sup> N<sup>2</sup>, and to which an oscillating or rocking motion is imparted by the driving-shaft D, through the medium of the lever O, firmly secured to the shaft N', the crank P, mounted on the shaft D, and the link or connecting-rod O', connected to said crank and lever by ball-and-socket or universal joints, as shown. The crank P is mounted loosely upon the shaft D, and connected by the straps or stays P' P' to the collar P<sup>2</sup>, also mounted loosely on said shaft. The hub of the crank P has formed therein a radial groove or notch, which engages with the side of the pin  $i$ , set in the shaft D, to compel the shaft D and crank P to move in unison with each other, said crank being held in engagement with the pin  $i$  by means of the spiral spring Q, surrounding the shaft D between the collar P<sup>2</sup> and the pin  $i$ , the object of which will be hereinafter described. The rock-shaft N' has loosely mounted thereon, so as to revolve therewith and be moved endwise thereon, the cam N<sup>3</sup>, in the form of a segment of a cylinder, the path of which acts upon a pin set in the outer or movable end of the lever N<sup>4</sup>, pivoted to the axis of the pattern-wheel S, to vibrate said lever about the axis of the wheel S and impart an intermittent step-by-step revolving movement to the wheel S about its axis in either direction through the medium of the double-armed pawl  $j$ , which is pivoted to the lever N<sup>4</sup>, and engages with the teeth cut in the periphery of said wheel S, as shown in Fig. 1. The position of the pawl  $j$ , and

consequently the direction in which the wheel S will be revolved, is determined by the spring-arm  $j'$ , according as to whether said arm is placed in one or the other of the two outer detent-notches in the rib  $j^2$ , extending transversely across the upper side of the lever N<sup>4</sup>, and if it is desired to stop the motion of the wheel S the arm  $j'$  is placed in the central detent-notch in said rib, when both ends of the pawl  $j$  will be disengaged from the teeth in the periphery of the wheel S. This arrangement and mode of controlling the position of the pawl  $j$  is the same as described in my prior application now pending before the Patent Office. In my said prior and pending application is shown and described a pattern-wheel provided upon its under side with a single scroll-cam path or groove, which by engagement with a fixed guide caused the axis of said wheel to be moved transversely of the machine as said wheel was revolved about its axis, and upon its upper side with a series of holes arranged in the form of a scroll corresponding to the scroll-path in its under side, in certain of which holes were placed rounded pins, which projected above the surface of the wheel and acted as cams to lift a lever, thereby causing a movement of the yarn-guide-operating cam-wheel about its axis to throw out of action one yarn and into action another yarn. In said prior application the pins in the scroll-wheel simply determined the number of courses of a color that was to be knit, or the time of changing colors, while the cam-wheels, acting directly upon the yarn-guides, determined the order in which the colors should be knit.

By making the cam-wheel which acted upon the yarn-guides of sufficient diameter to contain the requisite number of cams to make the necessary changes required in a pair of stockings, most any pattern or arrangement of stripes could be knit; or with a smaller cam-wheel, adapted to contain the necessary cams for the changes of a single stocking, any design or arrangement of stripes that was symmetrical, or, in other words, which commenced and ended with the same color and width of stripe, and in which the corresponding stripes, counting from the top and the bottom, were alike in color and width, could be knit. Either of these arrangements, however, involved considerable expense in the large number of movable or changeable cams required in designs containing a large number of stripes, and to overcome this objection I conceived the idea of having the scroll-wheel not only determine the time of changing the colors, but also determine which color should be thrown into action; and to accomplish this I form in the under side of the wheel S two scroll-paths,  $p$  and  $p'$ , parallel with each other, and upon the upper surface of said wheel I mark two corresponding scrolls, and drill within the lines of each of said scrolls two, three, four, or more series of holes, according to the number of colors the machine is designed to use, there be-

ing as many holes in each of said series as there are teeth in the periphery of said wheel.

In the machine shown in the drawings the pattern-wheel S is provided with two sets of four-scroll series of holes,  $i'$ , four bars,  $b$   $b'$   $b^2$   $b^3$ , and four yarn guiding and changing levers,  $s$ ,  $s'$ ,  $s^2$ , and  $s^3$ . If four colors of yarn are to be used, pins  $j^3 j^3$  are placed in certain of the holes  $i'$  in each of the eight series, according to the arrangement of colors desired, said pins being removed and arranged in a different order when it is desired to change the design. The pawls  $f f' f^2 f^3$  are held in elevated positions, with their free ends above the shoulders  $e$  on the bars  $b$ ,  $b'$ ,  $b^2$ , and  $b^3$ , by the levers  $l$ ,  $l'$ ,  $l^2$ , and  $l^3$ , respectively, until said levers  $l$ ,  $l'$ ,  $l^2$ , and  $l^3$  are depressed by the levers  $m$ ,  $m'$ ,  $m^2$ , and  $m^3$ , respectively. The levers  $l$ ,  $l'$ ,  $l^2$ , and  $l^3$  are pivoted to the stand T at one end by a common pivot, and are made of different length, and are provided at their free ends with upwardly-projecting portions, upon which the pawls  $f f' f^2 f^3$ , respectively, rest, said upwardly-projecting portions being of sufficient height to permit a single pawl to drop so as to engage with the shoulders  $e$  without coming in contact with either of the levers  $l$ ,  $l'$ ,  $l^2$ , or  $l^3$ , that are not depressed. The levers  $l$ ,  $l'$ ,  $l^2$ , and  $l^3$  are held up by the springs  $n$ ,  $n'$ ,  $n^2$ , and  $n^3$ , respectively, until they are depressed by the levers  $m$ ,  $m'$ ,  $m^2$ , and  $m^3$ , respectively, operated by the pins  $j^3$ . The levers  $m$ ,  $m'$ ,  $m^2$ , and  $m^3$  are mounted upon a common axis near the middle of their lengths in positions at right angles to the levers  $l$ ,  $l'$ ,  $l^2$ , and  $l^3$ , and are each provided at one end with a downwardly-projecting teat or point,  $o$ , which fits into a recess formed in the upper edge of one of the levers  $l$ ,  $l'$ ,  $l^2$ , or  $l^3$ , as shown in Fig. 15. These levers  $m$ ,  $m'$ ,  $m^2$ , and  $m^3$  are also provided at their opposite ends with downwardly-projecting toes  $o'$ , the two opposite sides of which are inclined in such a manner that the round-ended pins  $j^3 j^3$ , set in the scroll-wheel, may pass easily under the same and vibrate said lever, whether said wheel is being rotated in one direction or the other. The axis of the scroll-wheel S is mounted in a bearing in the block or carriage S', which is fitted to slide in the transverse slot S<sup>2</sup> formed in the bed A as it is impelled thereto by the traveling of the scroll-paths  $p$  or  $p'$  past the stationary pin  $p^2$ , as shown in Fig. 3. Two springs, U and U', are secured to the bed A by one end, while the other end projects into the slot S<sup>2</sup>—one near each end thereof—in positions to be struck by the carriage S' as it approaches the ends of the slot S<sup>2</sup>, as shown in Fig. 3. The scroll-paths  $p$  and  $p'$  are formed by downwardly-projecting ribs formed upon the under side of the wheel S, said ribs commencing at one end some little distance from the center of the wheel, and terminating at the other end near the periphery of said wheel, as shown in Fig. 10. If the wheel S is set, as shown in the drawings, with the pin  $p^2$  in the position indicated in Fig. 10, and the spring-arm  $j'$  is in

the position shown in Fig. 1, and the machine be set in motion, the wheel S will be rotated in the direction indicated by the arrow  $q$ , and by the action of the pin  $p^2$  upon the path  $p$  the wheel S will be moved bodily toward the rear of the machine till the point  $q'$  reaches the pin  $p^2$ , when the reaction of the spring U, which has been compressed or sprung by the rearward movement of the carriage S', moves said wheel S bodily toward the front of the machine a distance sufficient to transfer the pin  $p^2$  to the path  $p'$ . During the rotation of the wheel S in the direction indicated by the arrow  $q$  all of the pins  $j^3$  set in the four-scroll series of holes formed between the lines  $r$   $r'$  on the upper face of the wheel S will have passed under the inner ends of the levers  $m$ ,  $m'$ ,  $m^2$ , and  $m^3$ , thereby operating the mechanism for throwing into and out of action the different-colored yarns and making the necessary changes to complete a design for a single stocking. It will be evident upon careful examination that if the motion of the scroll-wheel were reversed without transferring the pin  $p^2$  from the scroll-path  $p$  to the path  $p'$ , the same pins  $j^3$  that have just passed under the levers  $m$ ,  $m'$ ,  $m^2$ , and  $m^3$  will again pass beneath said levers, but in the reverse order; and it will also be obvious that the passage of any given pin beneath said levers will cause the necessary movements of parts to throw into action the same colored yarns without regard to the direction in which the wheel S is moving. If now, the last pin which passed beneath and operated one of the levers  $m$ ,  $m'$ ,  $m^2$ , or  $m^3$  caused the throwing into action of a red yarn, and out of action a blue yarn, and the motion of the wheel S were reversed by moving the spring-arm  $j'$  so as to cause the opposite end of the pawl  $j$  to engage with said wheel while said red yarn was being knitted into the work, the red yarn would continue to be knitted into the work until the pin  $j^3$  which last passed under a lever  $m$ ,  $m'$ ,  $m^2$ , or  $m^3$  again passed beneath the same lever and caused the same movements of the yarn-guide-operating mechanism which threw into action the red yarn and out of action the blue yarn; but as the red yarn is already in action, no change of yarns would be produced until the second pin  $j^3$  passes beneath its lever, when the blue yarn would be thrown into action. If, however, the stripe which preceded the blue in knitting the first stocking was a greater or less width than the blue stripe, the blue stripe in the second stocking would be of the same width as said other stripe, so that the two stockings would be of essentially different designs; hence the necessity for the use of the double scroll-path and the double sets of pins  $j^3$ . When the wheel S has been moved by the spring U so as to transfer the pin  $p^2$  from the path  $p$  to the path  $p'$ , the operator moves the spring-arm  $j'$  to the detent-notch in the opposite end of the rib  $j^2$ , thereby disengaging from the wheel S the end of the pawl  $j$  that has been acting thereon, and causing its opposite end to

engage with the teeth of said wheel and rotate it in the opposite direction.

In the four-scroll series of holes formed in the upper surface of the wheel S between the scroll-lines  $r'$  and  $r''$  are arranged a series of pins  $j^3$  corresponding in number to the series set between the lines  $r$  and  $r'$ , but so arranged that the pin between the lines  $r'$  and  $r''$  and in the same radial row of holes with the pin between the lines  $r$  and  $r'$  which when it passed under its lever caused the red color to be thrown into action and the blue color out of action shall cause the red yarn to be thrown out of action and the blue yarn into action, and so through the entire design. When the wheel S has been moved toward the front of the machine and compressed the spring U' till the pin  $p^2$  reaches the point  $q^2$ , Fig. 11, the tension of the spring U' will move the carriage S' and the wheel S toward the rear of the machine a distance equal to the distance between the centers of the two parallel paths  $p$  and  $p'$ , thus transferring the pin  $p^2$  from the path  $p'$  to the path  $p$  again, when the operation may be repeated at will.

In order to adapt the machine to knit stockings of various lengths, or to vary the length of tube to each cluster or design of stripes, I make one or more short sections of one or both of the scroll-ribs which form the sides of the paths  $p$  and  $p'$  removable, as indicated at  $p^3 p^3$ , Fig. 10, so that by detaching said sections the transfers of the pin  $p^2$  from one path to the other will take place at those points instead of at the points  $q'$  and  $q^2$ , said sections  $p^3$  being secured in position, when desired, by screws, as shown, or in any other convenient manner.

V is a thin metal arm, secured at one end to the carriage S' so as to travel therewith, and having its outer end forked and arranged to receive between the arms of the fork the cam N<sup>3</sup> in such a manner that the movements of the carriage S' transversely of the bed A will be transmitted to the cam N<sup>3</sup> substantially as described in my prior pending application. Four yarn-guiding levers,  $s$ ,  $s'$ ,  $s^2$ , and  $s^3$ , are pivoted at  $s^4$  to the upper end of the stand M, and at their rear ends to the pendent rods  $d$ ,  $d'$ ,  $d^2$ , and  $d^3$ , and are each provided at their inner ends with an eye, through which the yarn is passed in its passage from the bobbin (not shown) to the needles. Each of the rods  $d$ ,  $d'$ ,  $d^2$ , and  $d^3$  has fitted thereon a spiral spring, so arranged as to tend to force said rods downward, and thus raise the inner ends of the yarn-guiding levers  $s$ ,  $s'$ ,  $s^2$ , and  $s^3$  above the needles to throw the yarns out of action with the needles. The rods  $d$ ,  $d'$ ,  $d^2$ , and  $d^3$  each has formed therein a detent-notch,  $s^4$ , with which the latch  $s^5$ , pivoted at  $s^6$  to the shelf  $d^4$  of the stand M, engages when said rod is raised by the cam  $c$ , said latch being pressed into said notch by the spring  $c'$ , said rods  $d$ ,  $d'$ ,  $d^2$ , and  $d^3$  being flattened or cut away above said notch, as shown at  $c^2$ , Fig. 4, so that those rods which are not raised shall not prevent the engagement of the latch  $s^5$  with the notch

$s^4$  of the rod that is raised so as to lock it and hold it in said raised position until it is desired to throw the yarn carried by its yarn-guide out of action. A short lever,  $c^3$ , is pivoted at or near the middle of its length to the shelf  $d^4$  in a vertical position, with its upper end in contact with the inner edge of the latch  $s^5$ , and its lower end projecting below the shelf  $d^4$ , as shown in Figs. 2 and 4. The bar  $g$  has adjustably secured to its upper edge by the screw  $g^4$  the stand  $g^5$ , in a slot in the right-hand end of which, Fig. 13, is pivoted the toe  $g^6$ , held in an upright position by the spring  $g^7$ , pressing said toe against the left-hand end of said slot, in which position the end of said toe will, when the bar  $g$  is moved to the right, strike the lower end of the lever  $c^3$ , pivoted in a slot in the shelf  $d^4$ , and move it about its fulcrum a sufficient distance to disengage the latch  $s^5$  from the notch  $s^4$ , in which every rod  $d$ ,  $d'$ ,  $d^2$ , or  $d^3$  may have been previously raised, and thus permit said rod to be forced downward by its spring. The toe  $g^6$  may be moved into an inclined position by turning the button  $g^8$  into a position parallel to the rod  $g$  when it is desired for any reason to prevent the lever  $c^3$  from being operated thereby. The bar  $g$  also has adjustably secured to its front side the cam-plate W, provided with fixed rib  $h'$ , arranged obliquely to the side of said bar, and with the pivoted gates  $h^2$  and  $h^3$ , all constructed and arranged as shown in detail in Figs. 8 and 9.

X is a stand upon which are mounted the yarn severing and holding devices, as follows: To the inner end of said stand X is secured in a fixed position the hook-shaped steel plate  $t$ , having a cutting-edge from  $t'$  to  $t^2$  to co-operate with the end of the cutter-blade  $t^3$ , secured to or forming a part of the bar Y, which is fitted to slide endwise in bearings in the stand X, and provided at its rear end with the stud  $t^4$ , which carries the anti-friction roll  $t^5$ , with which the vertical face of the rib  $h'$  acts to move said bar toward the rear of the machine, and extend the spring Y', the reaction of which causes said bar Y and the cutting-blade  $t^3$  to be suddenly moved inward when the bar  $g$  has been moved to the right till the corner  $h^4$  of the fixed block  $h^5$  has passed the roll  $t^5$ . A clamping-jaw,  $u$ , is pivoted between ears on the inner end of the cap X' of the stand X, the movable end of which rests upon and is pressed by the spring  $u'$  to the upper surface of the stationary cutting-blade  $t$  as a means of holding the end of the severed yarn preparatory to its being again thrown into action. The cutter-bar Y has secured to its inner end the push-blade  $t^6$ , which is bent downward so as to rest upon or be in close proximity to the upper surface of the cutter-blade  $t^3$ , said push-blade extending some distance beyond the cutting end of said cutter-blade  $t^3$ , as clearly shown in Fig. 6. The forward end of the push-blade  $t^6$  is made thin, but rounded so as not to cut the yarn when it comes in contact therewith, but instead push

the yarn doubled over its edge between the upper surface of the fixed cutter  $t$  and the end of the spring-pressed clamp  $u$ .

$Z$  is a lever pivoted at  $w^2$  to the upper surface of the cap  $X'$  of the stand  $X$ , and having formed therein the cam-shaped slot  $w^3$ , in which works the pin  $w^4$ , set in the bar  $Y$ , for the purpose of imparting thereto a vibratory motion about its pivot, the cap  $X'$  having formed therein a longitudinal slot,  $w^5$ , for the passage and travel of the pin  $w^4$ , as shown in Fig. 6. The inner end of the lever  $Z$  has formed thereon or secured thereto the wire  $v$ , bent at right angles, or nearly so, to the length of said lever, and having a portion of its end bent backward toward the fulcrum end of said lever, as shown in Fig. 1, the object of said wire hook being to insure the proper placing of the yarn thrown out of action in the proper position to be carried by the push-blade  $t^6$  between the holding-surfaces, and to be severed by the advance of the movable cutter-blade  $t^3$ . The push-back  $L$  has secured thereon the plate  $v'$ , which rises above and projects outward over the needles for the purpose of preventing the wire hook  $v$  from getting caught in the needles. The push-back also has secured thereto the wire guard  $v^2$ , which rises above and extends outward over the needles and through an eye in the guard-plate  $w$ , and has its other end secured to the cap  $X'$  of the stand  $X$ , the object of said wire guard  $v^2$  being to insure the proper engagement of the yarns with the needles when the yarn-guides are thrown downward to throw the yarns into action.

$Z'$  is a curved shoe or work-directing plate secured in position within the circle of needles, with its outer edge in close proximity thereto, by the same bolt that secures the stand that carries the landing-wheel, the upper surface of said shoe being curved upward and parallel with and a short distance below the under surface of the push-back, as shown in Fig. 17, for the purpose of starting the work upward on the needles before it reaches the landing-wheel, said plate being placed so close to the needles that the work cannot pass between its edge and the needles, and hence it must rise on the needles to the extent that said plate is curved upward.

The operation of my invention is as follows: The several parts being in the position shown in the drawings, and the yarn carried by the yarn-guiding lever  $s$  being in action with the needles, if power be applied to the shaft  $D$  to revolve it the yarn in action will continue to be knit into the work till a pin in the scroll-wheel  $S$  passes beneath one of the levers  $m'$ ,  $m^2$ , or  $m^3$ —say  $m'$ —thereby raising its inner end and depressing the lever  $l'$ , and allowing the pawl  $f'$  to drop onto the bar  $b'$  in position to engage with the shoulder  $e$  on said bar as said pawl is moved toward the right, which causes the bar  $b'$  to be moved toward the right, carrying with it, by the action of the pin  $b^6$  in its right-hand end upon the plate  $g'$ , the bar

$g$ . The movement of the bar  $b'$  to the right carries the cam  $c$ , secured thereon, beneath the rod  $d'$  and moves it upward, thereby compressing the spring thereon and throwing the front end of the yarn-guide  $s'$  downward to throw the yarn carried thereby, which, for convenience, we will say is blue, into action with the needles, and at the same time by the forward movement of the bar  $g$  the toe  $g^6$  comes in contact with the lower end of the lever  $c^3$  and vibrates it sufficiently to move the latch  $s^5$  from engagement with the notch in the rod  $d'$ , when said rod  $d'$  will be suddenly thrown downward by the tension of the spiral spring surrounding it, causing the yarn-guide  $s$  to be thrown upward to throw its yarn, which we will say is red, out of action with the needles, and drawing it into a position between the wire hook  $v$  and the severing and holding devices. When the bar  $g$  has moved toward the right till the corner  $h^4$  of block  $h^5$  on the cam-plate  $W$  has passed the roll  $t^5$ , the reaction of the spring  $Y'$  causes the bar  $Y$  and the cutter-blade  $t^3$  and the push-blade  $t^6$  to be suddenly moved inward, the first result of which is a movement of the wire hook  $v$  to the right, carrying with it the red yarn just thrown out of action and placing it in a position between the cutting-edge of the cutter-blade  $t$  and the front ends of the push-blade  $t^6$  and the movable cutter-blade  $t^3$ , when the push-blade  $t^6$ , coming in contact with the yarn, doubles it around its edge and forces it between the upper surface of the stationary cutter-blade  $t$  and the end of the clamping-jaw  $u$ , and a continued advance of the bar  $Y$  causes the cutter-blades  $t$  and  $t^3$  to sever the yarn beneath the push-blade  $t^6$ . When the toe  $g^6$  has passed the lever  $c^3$ , the tension of the spring  $c'$  causes the latch  $s^5$  to engage with the notch  $s^4$  in the rod  $d'$ , to hold said rod in its elevated position until it becomes necessary to throw out of action the blue yarn carried thereby. When the lever  $N$  is vibrated toward the left, carrying with it the pawls  $f, f', f^2, f^3$ , and  $g^2$ , the pawl  $g^2$  engages with the notch or shoulder  $g^3$  in the bar  $g$ , and moves said bar toward the left, said bar carrying with it the bar  $b'$  by virtue of the plate  $g'$  acting upon the pin  $b^6$  set in said bar  $b'$ , thereby removing the cam  $c$  from beneath the rod  $d'$ , so that it may be thrown down, when the latch  $s^5$  is again tripped by the next forward movement of the bar  $g$ . The movement of the cam-plate  $W$  toward the left causes the movable cutter-blade and the push-blade to be moved toward the rear by the action of the vertical face of the oblique rib  $h'$  upon the roll  $t^5$ , preparatory to severing and clamping the next yarn thrown out of action. The pawls  $f, f', f^2, f^3$ , and  $g^2$  are vibrated to the right and left at each revolution of the driving-shaft  $D$ ; but no effect is produced thereby unless one of the levers  $l, l', l^2$ , or  $l^3$  is depressed, so as to permit one of the pawls  $f, f', f^2$ , or  $f^3$  to engage with its bar  $b, b', b^2$ , and  $b^3$ .

The operations above described are repeated

every time that a pin  $j^3$  passes beneath one of the levers  $m$ ,  $m'$ ,  $m^2$ , or  $m^3$ , the color of the yarn to be thrown into action being determined by the particular lever  $m$ ,  $m'$ ,  $m^2$ , or  $m^3$  beneath which the pin passes.

The operation of reversing the motion of the wheel S, and thereby reversing the order of the stripes, so as to knit a section of a tube from which two stockings may be made by dividing a portion of it longitudinally and transversely in such a manner that the feet of both stockings may be made from the same section of the tube in a well-known manner, has been hereinbefore described, and need not be repeated here.

The joining of the yarns when the colors are changed necessarily makes a slight break in the edge of each stripe, and it is desirable that said joints should all be at the back of the leg; but in order to accomplish this in the case of making the feet of two stockings from the same section of the tube divided longitudinally, it is necessary that the crank P should be turned upon the shaft D one-half a revolution during the time that each foot-section is being knit. This may be done without stopping the machine by the operator simply pulling the bar  $Z^2$  toward the front of the machine, to release the crank P from engagement with the pin  $i$ , said bar  $Z^2$  being provided with a curved or cam-shaped surface,  $x$ , which acts upon the collar  $P^2$  to move it and the crank P along the shaft D toward the left till the crank is disengaged from the pin  $i$ , when the shaft D will make a half-revolution without moving the crank P. The operator having moved the bar Z back to its former position, the radial groove in the hub of the crank P will engage with the pin  $i$  again when the shaft D and the needle-head have made a half-revolution each, thus transferring the joints to the opposite side of the tube being knit.

The machine shown and described contains but one needle-head; but two or more needle-heads may be arranged upon the same bed, and all be operated in unison, using only one scroll-pattern wheel and one set of bars  $f f'$ ,  $f^2, f^3$ , and  $g$ , by simply extending the said bars and the machine-bed to the desired length, mounting the needle-heads in proper positions in said bed, and properly gearing them to the main shaft, duplicating the stands M and X and the parts mounted thereon—the cam-plates W, the cams  $c$ , and the toe  $g^6$ —for each needle-head. If only one head is used, the button  $g^8$  may be dispensed with, said button only being necessary when two or more heads are mounted upon one bed and it is desired to have one of said heads remain inoperative while the others are in operation.

Instead of using the pivoted clamp  $u$  and the spring  $u'$  to press thereon, the spring  $u'$  may be made of sufficient length to reach and bear upon the cutter-blade  $t$  in place of the clamp  $u$ , which latter may then be dispensed with.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination, with two or more yarn-guiding levers adapted to carry yarns of different colors, of two or more reciprocating cam-bars, mechanism connecting said cam-bars with said yarn-guides, a pattern-wheel for controlling the movements of said cam-bars, and mechanism connecting said pattern-wheel with said cam-bars, substantially as and for the purposes described.

2. The combination, with two or more yarn-guiding levers and yarn severing and holding devices, of two or more reciprocating cam-bars, mechanism connecting said cam-bars with said yarn-guides, a single reciprocating cam-bar for operating the yarn severing and holding devices, and mechanism connecting said cam-bars with the pattern-wheel, substantially as and for the purposes described.

3. The combination of a plurality of cam-bars,  $b, b', b^2$ , or  $b^3$ , provided with the shoulders  $e$  and pins  $b^6, b^6$ , the cam-bar  $g$ , provided with the shoulder  $g^3$  and the arm or plate  $g'$ , a plurality of pawls,  $f, f', f^2$ , or  $f^3$ , the hook-pawl  $g^2$ , and mechanism for intermittently moving said pawls endwise, substantially as and for the purposes described.

4. The combination, with two or more yarn-guiding levers adapted to carry yarns of different colors, of a plurality of pendent rods,  $s, s', s^2$ , and  $s^3$ , connected thereto, and each provided with a detent-notch,  $s^4$ , the latch-lever  $s^5$ , arranged to engage with each of said detent-notches  $s^4$  when said rods are raised to hold said rods in said elevated positions, mechanism for raising said rods, and mechanism for tripping said latch to release the rods, substantially as described.

5. The combination of a plurality of yarn-guiding levers,  $d, d', d^2$ , or  $d^3$ , of a plurality of pendent rods,  $s, s', s^2$ , or  $s^3$ , the latch-lever  $s^5$ , the spring  $c'$ , the lever  $c^3$ , the bar  $g$ , having mounted thereon the toe  $g^6$ , a plurality of bars,  $b, b', b^2$ , or  $b^3$ , each carrying a cam or wedge,  $c$ , and mechanism for intermittently moving the bars  $b, b', b^2, b^3$ , and  $g$  endwise, substantially as described.

6. The pattern-wheel S, provided upon its under side with the double scroll-paths  $p$  and  $p'$ , and having formed in its upper side four or more scroll series of pin-holes arranged in two sets, each corresponding to one of the scroll-paths in its under side, substantially as and for the purpose described.

7. The wheel S, provided with the two parallel scroll-paths  $p$  and  $p'$  in its under side, and having one or more sections of the walls of said paths removable, substantially as and for the purpose described.

8. The pattern-wheel S, provided with the two parallel scroll-paths  $p$  and  $p'$ , and the two sets of two or more scroll series of pin-holes, the sliding carriage  $S'$ , and means for moving said wheel, in combination with the fixed pin  $p^2$ , and the springs U and  $U'$ , all arranged and

adapted to operate substantially as and for the purposes described.

9. The combination of two or more yarn-guiding levers, two or more reciprocating cam-bars, mechanism connecting said cam-bars with said yarn-guiding levers, two or more pawls arranged to engage with and move said bars, mechanism for reciprocating said pawls, two or more levers, and two or more springs engaging with said levers, and adapted to hold said pawls above the point of engagement with said cam-bars, two or more other levers arranged to bear one upon each of the first-named levers to depress them, a pattern-wheel provided with two sets of two or more scroll series of holes, two sets of pattern-determining pins set therein, and mechanism for intermittently rotating said wheel and moving its axis, substantially as and for the purposes described.

10. The combination, with two or more yarn-guiding levers and yarn severing and holding devices, of two or more reciprocating cam-bars, mechanism connecting said cam-bars with said yarn-guiding levers, a single cam-bar for operating the yarn severing and holding devices, three or more pawls arranged to engage with and move said cam-bars, mechanism for reciprocating said pawls, two or more levers arranged and adapted to hold the pawls for operating the yarn-guide-operating cam-bars above the points of engagement with said bars, two or more springs for raising said levers, two or more other levers arranged to bear one upon each of said first-named levers to depress them, a wheel provided with two sets of two or more scroll series of holes, two sets of pattern-determining pins set therein, mechanism for intermittently rotating said wheel in either direction, and mechanism for moving the axis around which said wheel revolves, substantially as and for the purposes described.

11. The combination of the shaft D, having set therein the fixed pin  $i$ , the crank P, having a radial groove formed in the inner face of its hub, and the collar  $P^2$ , secured thereto or formed in one piece therewith, the spring Q, and the reciprocating cam-bar  $Z^2$ , all arranged and adapted to operate substantially as and for the purpose described.

12. The combination of two or more yarn-

guiding levers, yarn-severing mechanism, yarn-holding devices, two or more reciprocating cam-bars, mechanism for connecting said cam-bars with the yarn-guides, and a single cam-bar for operating the yarn severing and holding devices, and an arm or shoulder formed upon or secured to said single bar, and arranged and adapted to engage with or be acted upon by each of the first-named cam-bars to move them in one direction or to move it in the opposite direction, substantially as and for the purposes described.

13. The combination of the reciprocating bar  $g$ , the cam-plate W, provided with the fixed oblique rib  $h'$ ; and spring-actuated pivoted gate  $h^2$ , the bar Y, provided with the cutter-blade  $t^3$ , and the roll  $t^5$ , and the fixed hook-shaped cutter-blade  $t$ , all arranged and adapted to operate substantially as described.

14. The reciprocating bar Y, having secured thereto the cutter-blade  $t^3$ , and the push-blade  $t^6$ , in combination with the fixed hook-shaped cutter-blade  $t$ , and the spring-pressed clamping-jaw  $u$ , all arranged and adapted to operate substantially as and for the purposes described.

15. The combination of the reciprocating bar Y, carrying the cutter-blade  $t^3$ , the stationary hook-shaped cutter  $t$ , the pivoted lever Z, provided with the cam-slot  $w^3$ , the pin  $u^4$ , and the wire hook  $v$ , attached to the movable end of said lever Z, and arranged and adapted to be moved at right angles, or nearly so, to the movement of the bar Y, substantially as described.

16. The combination of the bar X, carrying the cutter-blade  $t^3$ , means for reciprocating said bar, the pivoted lever Z, provided with the cam-slot  $w^3$ , the pin  $u^4$ , the wire hook  $v$ , attached to the movable end of said lever Z, the push-back L, and the plate  $v'$ , secured to said push-back and projecting over the needles, substantially as and for the purposes described.

In testimony whereof I have signed my names to this specification, in the presence of two subscribing witnesses, on this 28th day of April, A. D. 1883.

JOHN BYFIELD.

Witnesses:

N. C. LOMBARD,

W. E. LOMBARD.