

(No Model.)

3 Sheets—Sheet 1.

J. BYFIELD.  
KNITTING MACHINE.

No. 354,502.

Patented Dec. 14, 1886.

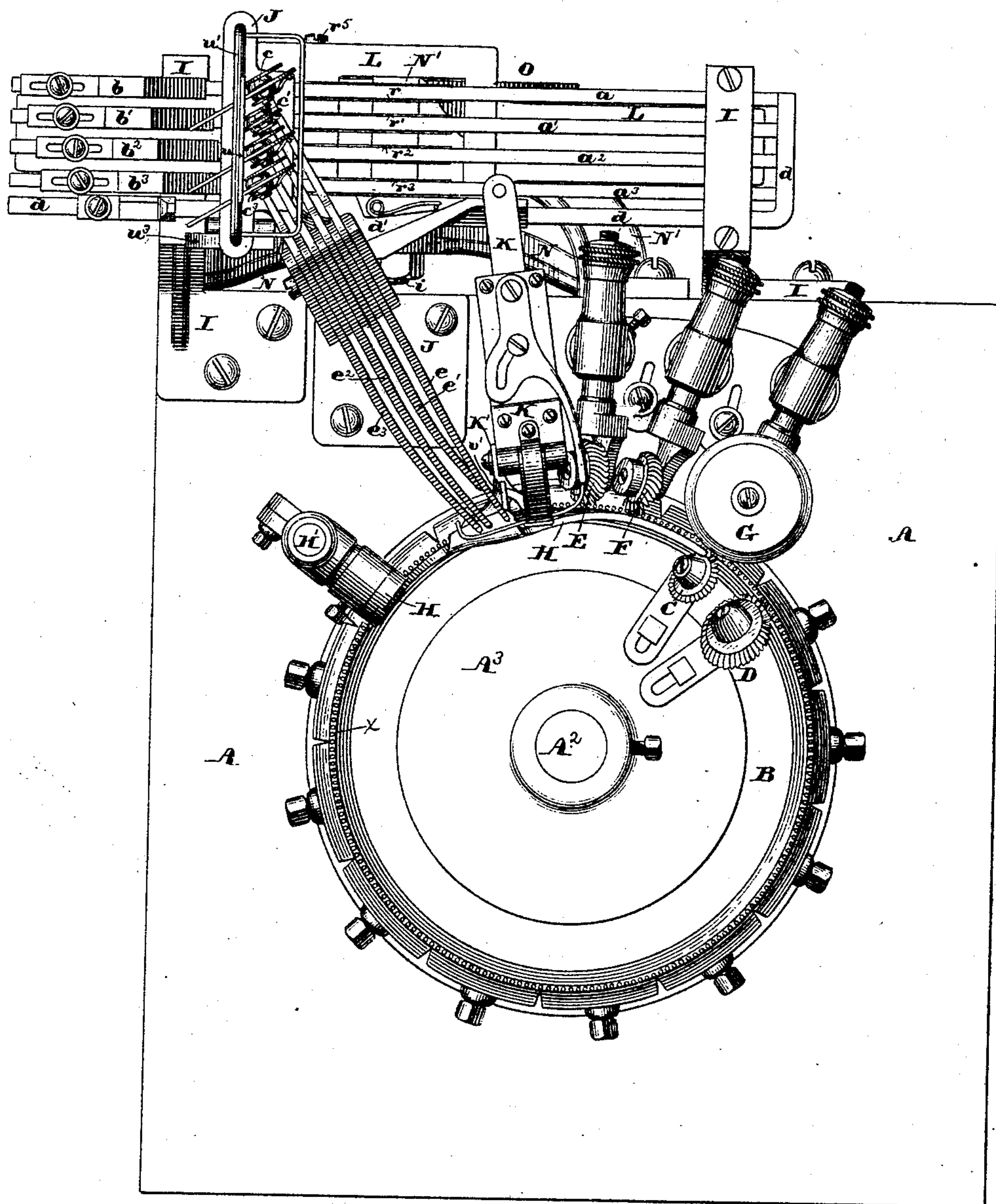


Fig. 1.

Witnesses:

Walter E. Lombard  
Orvil R. Chaplin

Inventor:

John Byfield,

by N. C. Lombard  
Attorney.



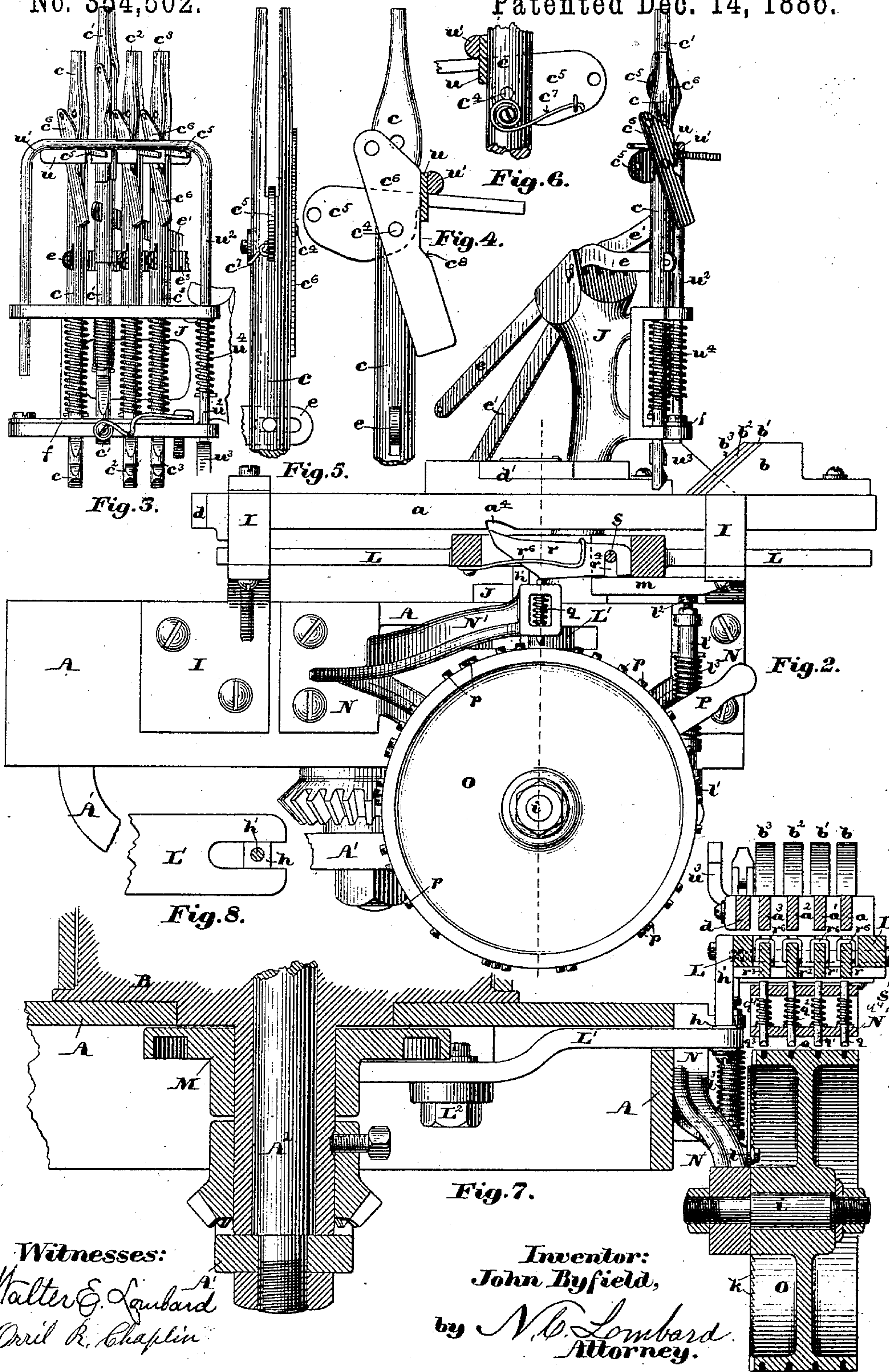
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3 Sheets—Sheet 3.

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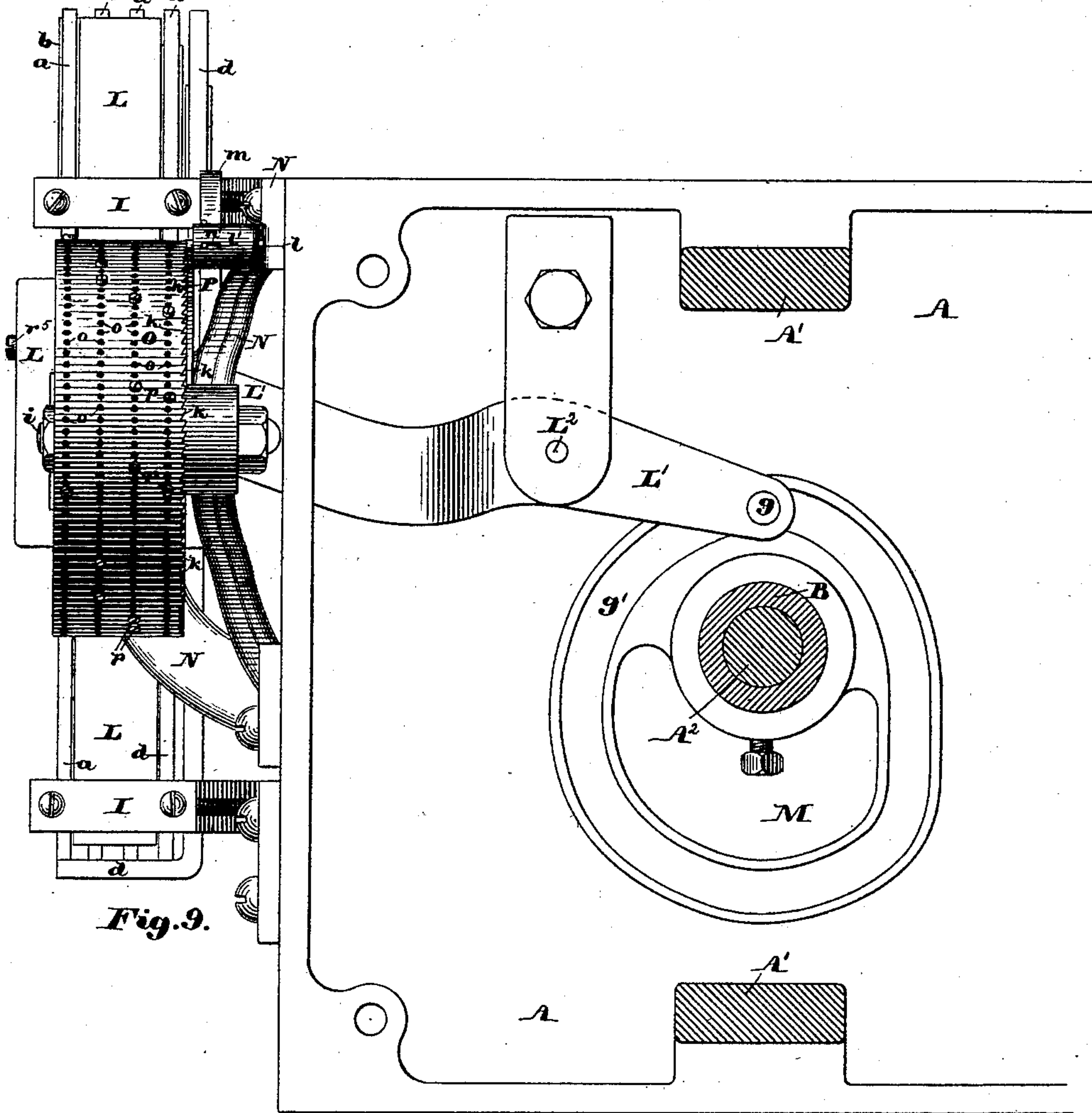


Fig. 9.

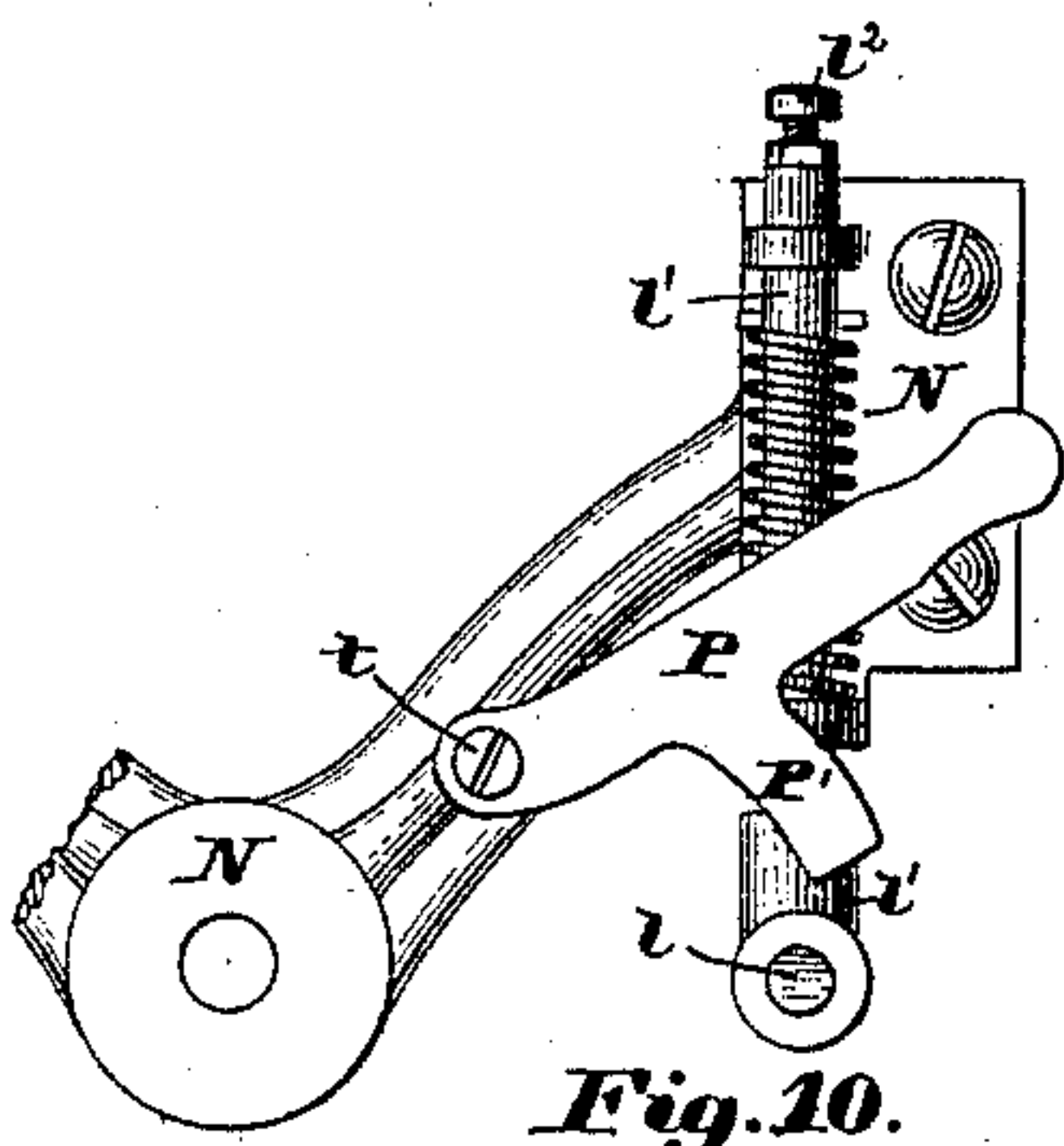


Fig. 10.

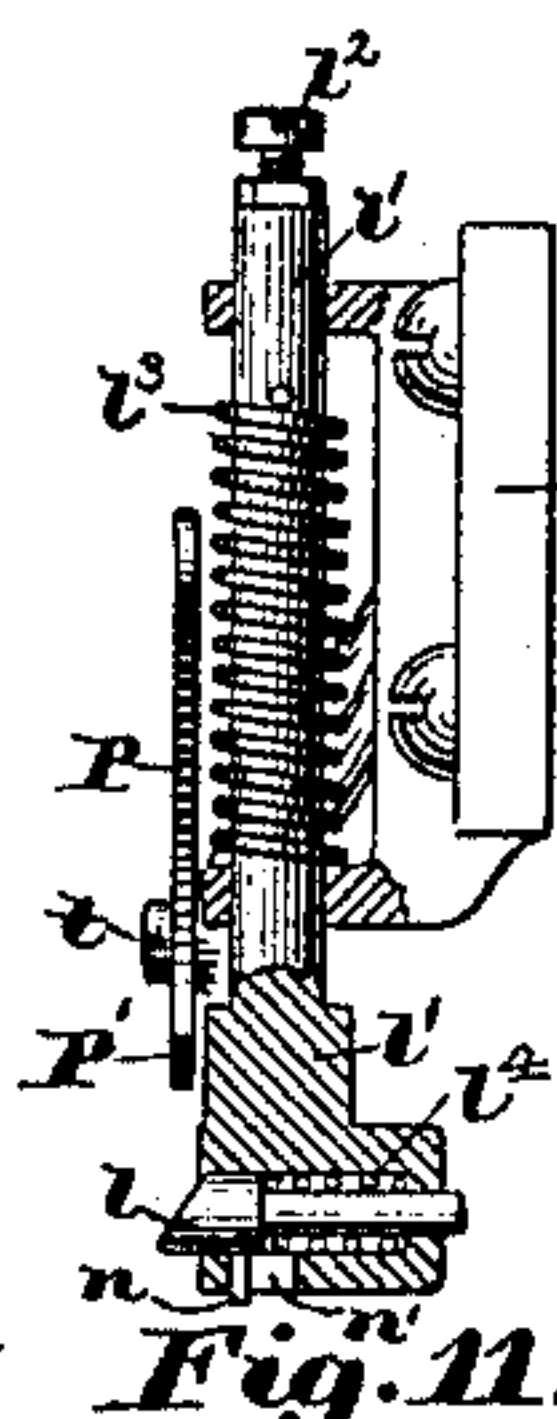


Fig. 11.

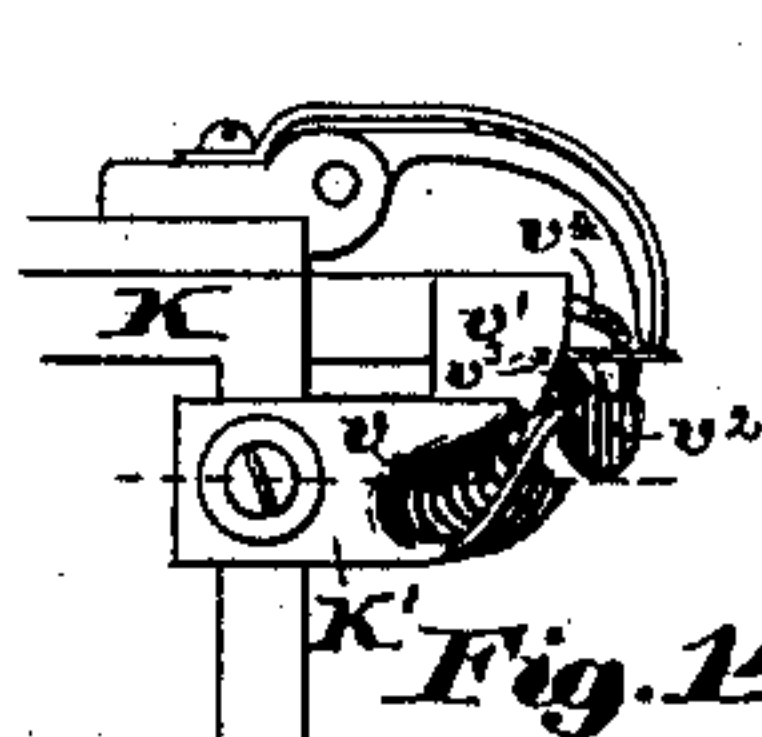


Fig. 12.



Fig. 13.



Fig. 14.

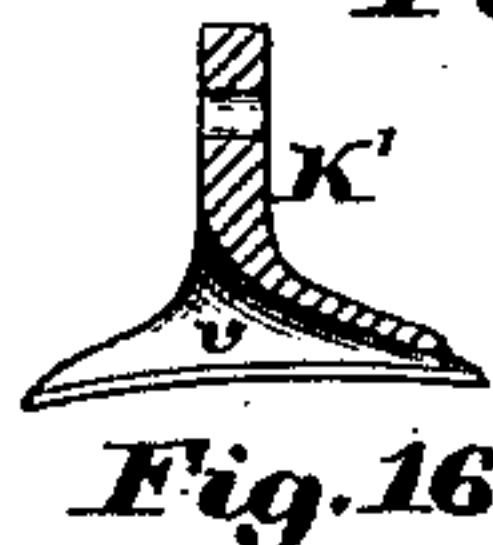


Fig. 15.

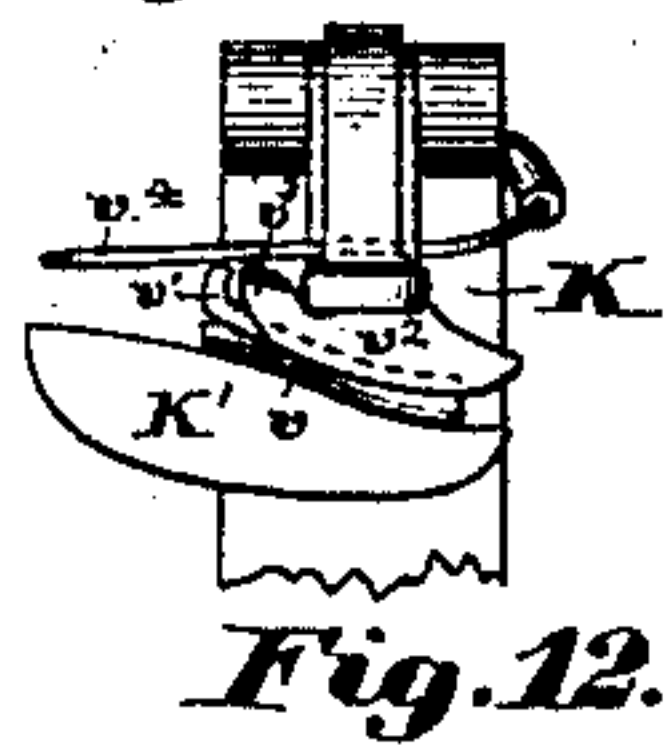


Fig. 16.

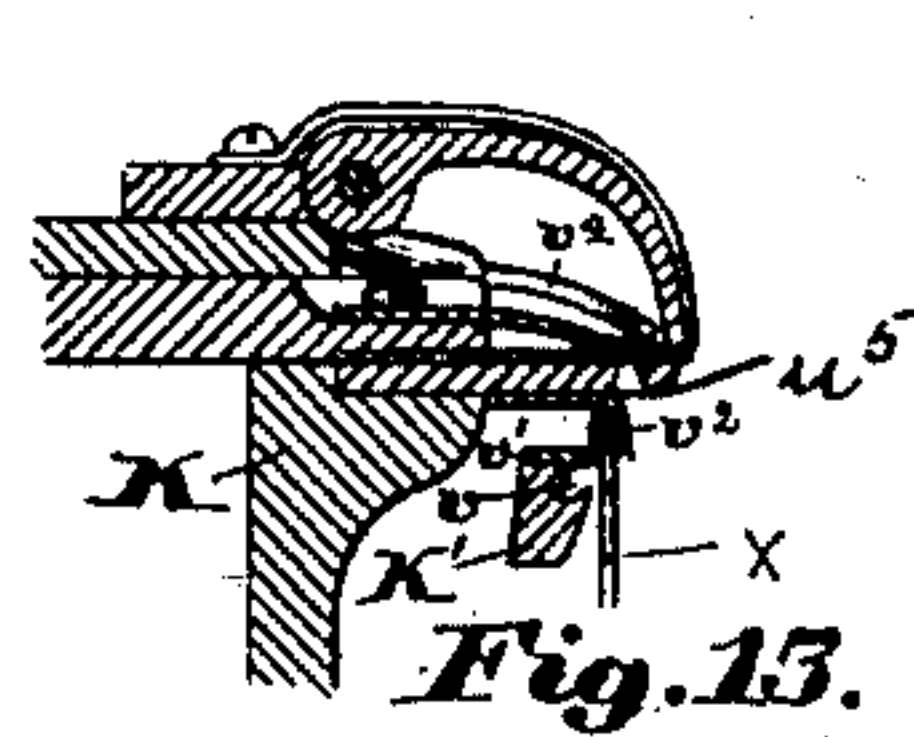


Fig. 17.

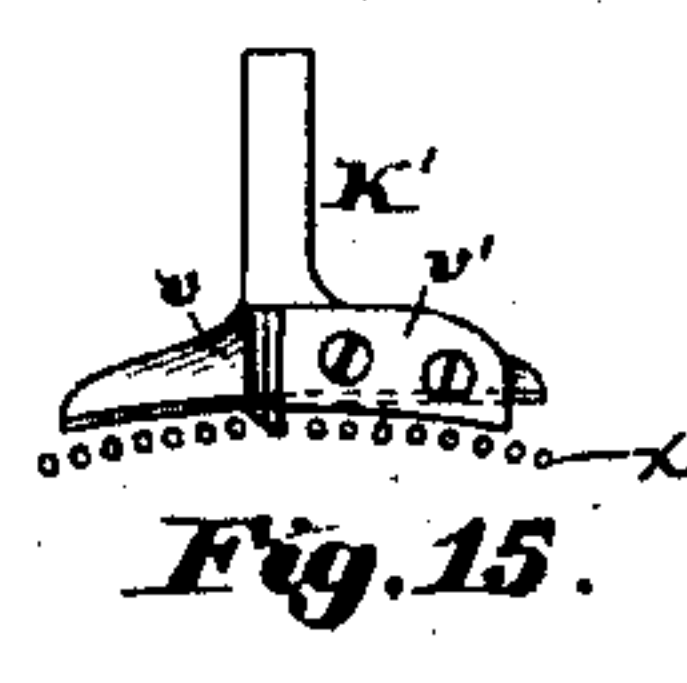


Fig. 18.

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# UNITED STATES PATENT OFFICE.

JOHN BYFIELD, OF LOWELL, MASSACHUSETTS, ASSIGNOR TO THE BYFIELD MANUFACTURING COMPANY, OF SAME PLACE.

## KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 354,502, dated December 14, 1886.

Application filed December 31, 1885. Serial No. 187,231. (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  
5 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 circular-knitting machines in which barbed or  
10 spring needles are used, and in which two or more yarns of different colors are or may be used for knitting striped goods; and it is an improvement upon the inventions described  
15 in the Letters Patent Nos. 311,172 and 311,173, granted to me January 27, 1885; and it consists in certain novel constructions, arrangements, and combinations of parts, which will be readily understood by reference to the description of the drawings, and to the claims, to be hereinafter given.

Of the drawings, Figure 1 represents a plan of a machine embodying my invention. Fig. 2 represents a rear elevation of the same with  
25 the needle-head, the star-boxes, and the cutting-off mechanism removed. Fig. 3 represents an elevation of the rods for operating the yarn-guides and a portion of the stand in which they are mounted, looking toward the right-hand end of Fig. 1. Fig. 4 represents a side  
30 elevation of a portion of one of the yarn-guide-operating rods and the tension device with which the upper end of each of these rods is provided, viewed from a direction oblique to Fig. 3, and showing the bar *u* and rod *u'* in section. Fig. 5 represents an elevation of the same, looking at right angles to Fig. 4. Fig. 6 represents an elevation of a portion of the same, looking at the side opposite to that  
40 shown in Fig. 4, and showing the bar *u* and rod *u'* in section. Fig. 7 represents a sectional elevation through a portion of the needle-head and the pattern-cylinder and its attendant mechanism, looking toward the left-hand end of Fig. 1. Fig. 8 represents a plan of the outer end of the lever for operating the pawl-carrying bar. Fig. 9 represents an inverted plan of the machine with the cross-bar which supports the lower end of the spindle  
50 about which the needle-head revolves, and the spindle itself cut in section. Figs. 10 and 11

represent, respectively, an elevation and a partial sectional elevation of the device for imparting to the pattern-cylinder a step-by-step movement about its axis, and showing the lever by which said step-by-step movement is interrupted. Figs. 12, 13, and 14 represent, respectively, a front elevation, a central longitudinal section, and a side elevation of the front portion of the thread severing and holding mechanism and its stand, and show the guides for insuring the proper placing of the yarn. Figs. 15, 16, 17, and 18 represent details of the guides for insuring the proper placing of the yarn, which will be hereinafter  
55 referred to.

In the drawings, A is the bed of the machine, provided on its under side with the cross-bar A', in which is firmly secured, in a fixed position, the stud A<sup>2</sup>, about which the  
60 needle-head B revolves, and to the upper end of this stud is secured the disk A<sup>3</sup>, upon which are mounted the "landing-wheel" C and the "knocking-over wheel" D, all in a well-known manner.

The "stitch-wheel" E, the "dividing-wheel" F, and the "presser-wheel" G are all arranged around the outside of the circular series of needles *x*, and are adapted to co-operate therewith in the usual manner, while the "push-back" H is of ordinary construction and adjustably mounted upon the post H' in any  
75 suitable manner.

To the rear of the machine are secured the stands I I in suitable bearings, in which the  
80 bars *a*, *a'*, *a*<sup>2</sup>, and *a*<sup>3</sup> are adapted to be reciprocated, each of said bars *a* *a'* *a*<sup>2</sup> *a*<sup>3</sup> being provided with a cam, *b*, *b'*, *b*<sup>2</sup>, or *b*<sup>3</sup>, which, when either of the bars *a*, *a'*, *a*<sup>2</sup>, or *a*<sup>3</sup> is moved toward the right-hand end of the machine, which  
90 is represented by the right-hand side of Fig. 1, will raise one of the vertical rods *c* *c'* *c*<sup>2</sup> *c*<sup>3</sup>, mounted in bearings in the shelves of the stand J. Another bar, *d*, is mounted in the same manner, and has its right-hand end bent backward and at right angles to itself in such a manner that it will be moved toward the right-hand end of Fig. 1, whenever one of the bars  
95 *a* *a'* *a*<sup>2</sup> *a*<sup>3</sup> is moved in that direction, by the end of said bar *a*, *a'*, *a*<sup>2</sup>, or *a*<sup>3</sup> coming in contact with and acting upon said right-angle portion of said bar *d*, and that either of the bars *a* *a'* *a*<sup>2</sup> *a*<sup>3</sup>,  
100



which has been moved to the right, shall be moved to the left again by the movement of the bar *d* in that direction by the right-angle portion of said bar *d* coming in contact with the end of said bar *a*, *a'*, *a''*, or *a'''*.

To the stand *J* are pivoted the yarn-guiding levers *e e' e'' e'''*, operated by the rods *c c' c'' c'''*, respectively, and by which the yarns may be thrown into or out of action with the needles. The rods *c c' c'' c'''* are raised by the cams *b b' b'' b'''*, and held in an elevated position by the latch *f*, and said latch *f* is disengaged from the notches in said rods to allow them to regain their normal positions, all in exactly the same manner as has been fully described in the before-mentioned Letters Patent, and therefore need no further description here.

*K* is the mechanism for severing the yarns which are thrown out of action with the needles and holding the ends of the same until again required, said mechanism being operated by the cam *d'*, forming part of and reciprocating with the bar *d*.

Beneath the bars *a a' a'' a'''* is placed a flat bar, *L*, provided at or near the middle of its length with a rectangular opening through the same and mounted in bearings in the stands *I I*, in which said bar is adapted to be reciprocated by the lever *L'*, pivoted at *L''* to the under side of the bed of the machine, the inner end thereof being provided with a suitable pin, *g*, which projects into and is operated upon by the path *g'* of the cam *M*, secured to the hub of the head and adapted to be revolved therewith. The outer end of this lever *L'* is forked, so as to embrace the flat-sided sleeve *h*, mounted loosely upon the lower end of the downwardly-projecting arm *h'*, the upper end of which is firmly secured to the bar *L*, so that a reciprocating movement is given to said bar by the revolution of the cam *M* in an obvious manner.

Upon the rear side of the bed is secured by two feet the bracket *N*, to which is firmly secured the stud *i*, upon which is loosely mounted the cylinder or wheel *O*, the inner edge of which is provided with a series of ratchet-teeth, *k k*, with which the pin *l* engages to impart thereto a step-by-step movement, said pin *l* being mounted in bearings in the lower end of the vertical rod *l'*, the upper end of which is provided with an adjustable screw, *l''*, by which said rod *l'* may be shortened or lengthened to regulate the amount of movement to be given thereto. This rod *l'* is moved downwardly in its bearings in the stand *N* by the action of the cam-arm *m*, firmly secured to the bar *L*, so that with every reciprocation of the bar *L* the cylinder *O* is moved about its axis a distance equal to the length of one of its teeth, there being enough friction upon said cylinder to prevent its moving backward when the rod *l'* is moved upward by the tension of the spring *l'''*.

The pin *l* is made to engage with the teeth *k k*, and at the same time is capable of moving backward over said teeth by the action of

the spiral spring *l''*, which, acting upon a shoulder formed upon said pin, serves to force said pin outwardly and retain it in such outward position, except when, by the tension of the spring *l'''*, said pin is being raised over one of the teeth *k k* preparatory to giving another forward movement to the cylinder *O*.

The small pin *n*, secured to the pin *l'*, and working in the slot *n'*, prevents the latter pin from being forced out of its bearings by the tension of the spring *l''*, and also prevents said pin *l* being turned about its axis, all as shown in Fig. 11.

The face of the cylinder *O* is provided with as many circumferential rows of holes *o o* as there are cam-bars *a a' a'' a'''*, the holes in each row being the same distance apart as the teeth *k k*, and are threaded, so as to receive the screw pattern-pins *p p*, constructed and applied in the same manner as similar pins are applied to the pattern-chain described in the former of the before-mentioned patents.

The bracket *N* has formed thereon an additional arm, *N'*, which projects over the cylinder *O* and provides bearings for the pins *q q' q'' q'''*, pressed downwardly by suitable springs, *q''*, and which are raised against the tension of these springs by the pattern-pins *p p*, inserted in the cylinder *O*, as said cylinder rotates beneath them. Immediately above the pins *q q' q'' q'''* are the pawls *r r' r'' r'''*, pivoted to the bar *L* upon the fixed pin *s*, and adapted to be reciprocated with said bar beneath the cam-bars *a a' a'' a'''* without engaging with the notches *a''* in the under sides of said bars, unless one of the pins *q q' q'' q'''* has been raised by the action of the pattern-pins, and one of the pawls *r r' r'' r'''* has been raised so as to engage its point in the notch *a''* of the cam-bar above it, in which case, with the next movement of the bar *L* toward the right-hand end of the machine, (which is represented by the right-hand side of Fig. 1,) said cam-bar will be carried therewith and operate the yarn-guide, with which it is connected in substantially the same manner as described in my former Letters Patent, hereinbefore mentioned.

The pawls *r r' r'' r'''* are each provided at their rear ends with open slots *r''*, by which they are readily attached to or removed from the fixed pivot-pin *s*, and each one is prevented from dropping below a horizontal position by its rear end abutting against the front edge of the slot in which it is pivoted, while the point of each of said pawls is prevented from engaging with the notch *a''* of the cam-bars by means of the spring *r''* until said pawl is acted upon by the pin *q, q', q'', or q'''* to overcome the tension of said spring.

To the bracket *N* is pivoted at *t* the lever *P* in such a manner that enough friction is created at said fulcrum to hold said lever in any position it may be placed by the operator. This lever *P* is provided with a downwardly-projecting arm, *P'*, which, as said lever is moved downward about its fulcrum *t*, will be interposed between the pin *l* and the teeth *k k*



of the pattern-cylinder O, and prevent motion being imparted to said cylinder O as said pin *l* is moved up and down by the action of the cam-wedge *m* upon the vertical spindle *l'*. By this means of throwing the pattern-cylinder out of action I am enabled to knit a stocking, shirt, &c., with a pattern of considerable length with a pattern-cylinder the circumference of which is exceedingly small, for while with pattern-pins placed upon the cylinder in a position such that by a continuous knitting and a movement being given to said cylinder with every revolution of the needle-head but a single course of a certain color would be knitted. By throwing the pattern-cylinder out of action by this device during the knitting of that course a stripe of that color may be knit, the width of which may be determined by the operator, for it is obvious that the machine will continue to knit with that color until the operator again throws into action the pattern-cylinder when at the completion of the course and the second pattern-pin *p* comes into contact with one of the vertical pins *q*, *q'*, *q''*, or *q'''*, at which time that yarn will be thrown out of action and another of a different color thrown in, as described in the Letters Patent hereinbefore referred to.

The upper ends of the vertical rods *c*, *c'*, *c''*, and *c'''* are each provided with two uprights parallel to each other, and between which is pivoted at *c'* a lever, *c<sup>5</sup>*, while another lever, *c<sup>6</sup>*, is pivoted at the same point *c'* upon the rear side of the rear upright. These uprights may be provided with suitable yarn-holes, similar to those with which the levers *c<sup>5</sup>* *c<sup>6</sup>* are provided, and at the same distance from the pivot *c'*, so that all these holes will be in a line when the levers *c<sup>5</sup>* *c<sup>6</sup>* are in a vertical position; or they may be used without these yarn-holes with the same result, as will be more fully described.

The yarn in passing from the bobbin to the yarn-guiding lever may pass through the hole in the lever *c<sup>6</sup>*, through the hole in the rear upright, through the hole in the lever *c<sup>5</sup>*, and then through the hole in the front upright to the yarn-guiding lever; or it may pass, if desired, through the hole in the lever *c<sup>6</sup>*, around the left-hand edge of the rear upright, through the hole in the lever *c<sup>5</sup>*, and then either through a hole in the front upright, or around the left-hand edge thereof, with substantially the same results, care being taken, however, in either case to insure that the yarn may pass freely in a straight line from the bobbin to the yarn-guiding lever when said tension-levers are in a vertical position.

The terms "front," "rear," and "left hand" in the preceding paragraph refer to the front, rear, and left-hand sides of Fig. 1.

The lever *c<sup>5</sup>* is made to normally keep a horizontal position by the action of the spring *c'*, so that the yarn passing from one upright to the other is drawn out of a straight line, thereby taking up any slack which there may be in the yarn between said uprights and the yarn sev-

ering and holding device. When it is desired that the slack in the yarn should be taken up by the lever *c<sup>5</sup>*, the lever *c<sup>6</sup>* is moved slightly out of a perpendicular position, so that the yarn which passes through a hole in its end will be nipped between it and the upright to which it is pivoted, whether the yarn passes through a hole in said upright or around its edge, and thus prevent any slack in the yarn between this point and the bobbin from interfering with the tension on the yarn between this point and the yarn-holding device. This lever *c<sup>6</sup>* is retained in its normal position—i. e., slightly out of perpendicular—by the horizontal bar *u*, which acts upon all of said levers simultaneously and prevents them from assuming a vertical position until one of the rods *c*, *c'*, *c''*, or *c'''* is raised by its cam *b*, *b'*, *b''*, or *b'''*, when the inclined portion *c<sup>8</sup>* of the lever *c<sup>6</sup>* will come into contact with the bar *u*, and the said lever will be forced into a vertical position, while at the same time the lever *c<sup>5</sup>* will come into contact with the horizontal portion of the inverted-U-shaped rod *u'*, and will also be forced into a vertical position, so that the yarn may pass freely to the yarn-guiding levers.

The vertical arms of the U-shaped rod *u'* are mounted in suitable bearings in the shelves of the stand J, and one arm, *u''*, thereof is forced into contact with a cam-wedge, *u<sup>3</sup>*, by the coiled spring *u<sup>4</sup>*, said cam-wedge *u<sup>3</sup>* being secured to and reciprocating with the bar *d*. This cam-wedge *u<sup>3</sup>* is some little distance ahead of the cam-wedges *b* *b'* *b''* *b'''*, and is inclined in the opposite direction thereto, the longest arm, *u''*, of the rod *u'* resting upon its upper surface when the rods *c* *c'* *c''* *c'''* are in their normal positions.

When either of the cam-bars *a* *a'* *a''* *a'''* is moved toward the right-hand end of the machine, it will move with it the bar *d* and its cam-wedge *u<sup>3</sup>*, and in so doing will allow the rod *u'* to slowly drop and the tension upon the yarn to be relieved before the cam upon the bar *a*, *a'*, *a''*, or *a'''* begins to lift the rod *c*, *c'*, *c''*, or *c'''* to change the yarns. Upon the return of the bar *d* and the wedge *u<sup>3</sup>* the U-shaped rod *u'* will be again lifted and the tension thrown onto those yarns not in action. By means of these devices and the cam-wedge *u<sup>3</sup>* the tension is thrown off of all of the yarns previous to the changing of the yarn, and is kept off a sufficiently long time to allow of the knitting into the fabric of enough of the yarn just thrown out of action to make with the new yarn a firm joining, which is always necessary in making striped goods, and after the joining has been completed, the yarn severed, and its end grasped by the yarn-holding device the tension is again thrown onto all the yarns not in action, all slack therein being thus taken up, so that the yarns are prevented from accidentally becoming engaged with the needles in an obvious manner.

To the inner end of the stand upon which is mounted the yarn severing mechanism K is secured the bracket K', the inner edge of which



is quite thin and curved to conform to the arc of the needles of the head of the machine, said bracket being provided with a long tapered or funnel-shaped passage,  $v$ , through which the yarn which is being knit is guided to the stitch-wheel E and the needles.

To the upper surface of the bracket K' is secured a thin guide-plate,  $v'$ , which has that end which is nearest the yarn-guiding levers bent upwardly, while the portion which is secured to the upper surface of the bracket K' gradually curves downwardly to a point below the beards of the needles, while its edge is arranged to press lightly against the needles. To the under side of the stationary cutter-blade  $w^5$  is secured another guide,  $v^2$ , having a portion thereof extending downwardly inside of and in close proximity to the circle of the needles, the end  $v^3$  of which is bent over the tops of the needles and above the guide-plate  $v'$ . The under edge of this downwardly-projecting portion is provided with a curve similar to the curve of the under surface of the plate  $v'$ , as shown in Fig. 12. This guide  $v^2$  is a substitute for and serves the same purpose as the wire-guide  $v^3$ , described in Letters Patent No. 311,173, hereinbefore mentioned.

While the yarn is in action it is guided to the stitch-wheel E by the before-mentioned funnel-shaped passage  $v$ ; but as soon as the yarn-guiding lever is raised, so as to throw the yarn out of action, said yarn is carried across the circle of the needles at the bent corner of the guide  $v'$ , and is drawn between two needles, and is carried by said needles down the incline of the two guides  $v'$   $v^2$  till it reaches the stitch-wheel, and forms a perfect stitch with the last one formed, and is severed by the cutting-off mechanism, and the severed end is seized by the holding device in the usual manner, while simultaneously with this operation the yarn which is now thrown into action will pass across and between the needles, and be carried thereby against the curved edge of the plate  $v^2$  and the curved under side of the plate  $v'$ , so that it will be forced in the same manner below the beards of the needles, and be carried to the stitch-wheel, by which it will be seized and knit into the fabric, the yarn being released from the yarn-holding device at the same time. Either of these guides  $v'$   $v^2$  could be used separately with advantage, but to make the work positive necessitates the use of both together, as has been described.

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

1. The combination, with a series of needles arranged in a circle, a stitch-forming mechanism co-operating therewith, a plurality of vibrating yarn-guiding levers, a plurality of vertically-reciprocating rods connected to said yarn-guiding levers, a plurality of cam-bars for operating said vertical rods, and a pattern mechanism for controlling the movements of said cam-bars, of a yarn-tension device attached to each of said vertically-reciprocating rods, consisting of two upright rods or bars, a

pivoted tension-lever provided with a yarn-receiving eye, and a spring for throwing said tension-lever from a perpendicular position to deflect the yarn from a direct line, and a horizontal bar for moving said tension-lever into a perpendicular position when the vertically-reciprocating rod carrying it is moved upward by a cam-bar, substantially as described.

2. The combination, with a series of needles arranged in a circle, a stitch-forming mechanism co-operating therewith, a plurality of vibrating yarn-guiding levers, a plurality of vertically-reciprocating rods connected to said yarn-guiding levers, a plurality of cam-bars for operating said vertical rods, and a pattern mechanism for controlling the movements of said cam-bars, of a yarn-tension device attached to the upper end of each of said vertically-reciprocating rods, consisting of two vertical rods or bars, two pivoted levers, each provided with a yarn-receiving eye, a spring for throwing one of said pivoted levers out of a perpendicular position to deflect the yarn from a direct line, the other of said levers being constructed and arranged to clamp the yarn between it and one of the uprights, and the bars  $u$  and  $u'$ , substantially as described.

3. In combination with the bed of the machine, the stand N, provided with the stud  $i$ , and the arm N', the pattern cylinder or drum O, mounted on said stud and provided with a plurality of circumferential rows of removable pins, mechanism, as set forth, for operating said drum, a plurality of vertically-movable pins mounted in the arm N' of the stand N, the reciprocating bar L, carrying the fixed fulcrum-pin  $s$ , and provided with the arm  $h'$ , a plurality of pawls,  $r$ ,  $r'$ ,  $r^2$ , or  $r^3$ , each provided with the open slot  $r^4$ , to engage the fulcrum-pin  $s$ , a plurality of springs,  $r^6$ , engaging with said pawls, the lever L', the cam M, and a plurality of cam-bars,  $a$ ,  $a'$ ,  $a^2$ , and  $a^3$ , all constructed and arranged to operate substantially as and for the purposes described.

4. The combination of the pattern cylinder or drum O, provided with radial teeth in the edge of its rim, with the spring-supported rod  $l'$ , the spring-pressed pawl or latch-bolt  $l$ , mounted in bearings in the lower end of said rod  $l'$ , the bar L, provided with the wedge  $m$  and the downwardly-projecting arm  $h'$ , the lever L', and the cam M, all constructed and arranged to operate substantially as described.

5. The combination of the pattern cylinder or drum O, provided with radial teeth in the edge of its rim, with the spring-supported rod  $l'$ , the spring-pressed pawl or latch-bolt  $l$ , mounted in bearings in the rod  $l'$ , the bar L, provided with the arm  $h'$ , the wedge  $m$ , the lever L', the cam M, and the lever P, constructed and arranged to be interposed between the pawl  $l$  and the teeth of the cylinder O to arrest the operation of said cylinder, substantially as described.

6. The combination of a series of barbed or spring needles arranged in a circle, the guide-plate  $v'$ , located outside of the circle of needles



and in close proximity thereto, and the plate  $v^2$ , located opposite thereto within the circle of needles, substantially as described.

7. The combination of a series of needles arranged in a circle, the bracket  $K'$ , provided with the funnel-shaped passage  $v$ , and having secured thereto the guide-plate  $v'$ , located outside of and in close proximity to the circle of needles, and the guide-plate  $v^2$ , located opposite thereto within the circle of needles, all substantially as described.

8. The combination, with a series of needles arranged in a circle, of a stitch-forming mechanism co-operating therewith, a plurality of vibrating yarn-guiding levers, a plurality of vertically-reciprocating rods connected to said yarn-guiding levers, a plurality of cam-bars for operating said vertical rods, a pattern mechanism for controlling the movements of said cam-bars, a yarn-tension device attached to each of said vertically-reciprocating rods, consisting of two upright rods or bars, and a pivoted tension-lever provided with a yarn-

receiving eye, and a spring for throwing said tension-lever from a perpendicular position to deflect the yarn from a direct line, a bent rod, the horizontal portion of which is adapted to operate said levers to bring them into a vertical position, a spring for forcing said bent rod downwardly, a cam-wedge for raising said bent rod, and mechanism for reciprocating said wedge, all substantially as and for the purposes described.

9. The combination, with a needle-head of a circular-knitting machine, of the guide-plate  $v'$ , located in a fixed position outside the circle of needles and in close proximity thereto, substantially as and for the purposes described.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 17th day of December, A. D. 1885.

JOHN BYFIELD.

Witnesses:

WALTER E. LOMBARD,  
N. C. LOMBARD.