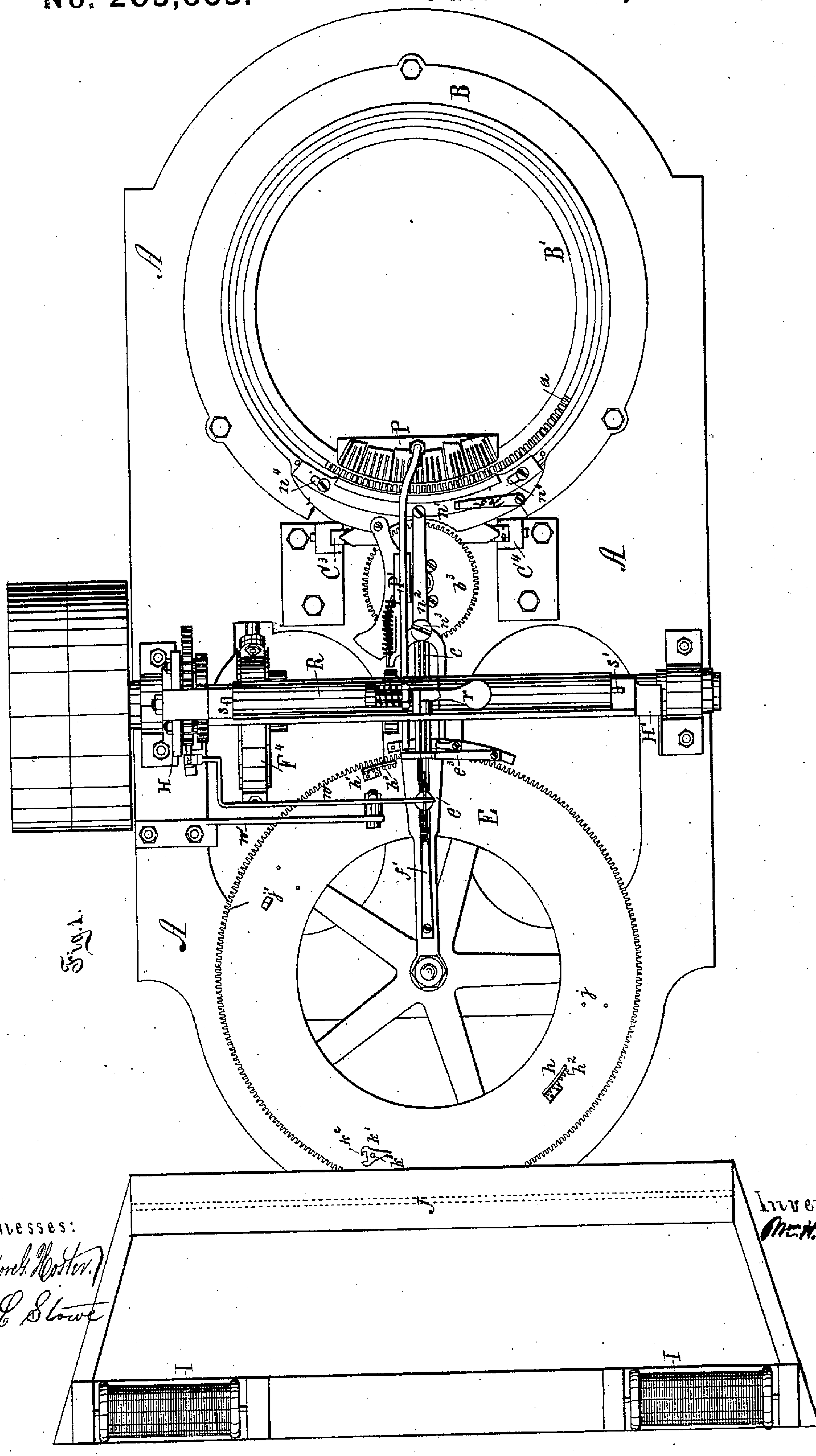
5 Sheets—Sheet 1.

W. H. McNARY.
Knitting-Machine.

No. 205,663. Patented July 2, 1878.

Fig. 1.



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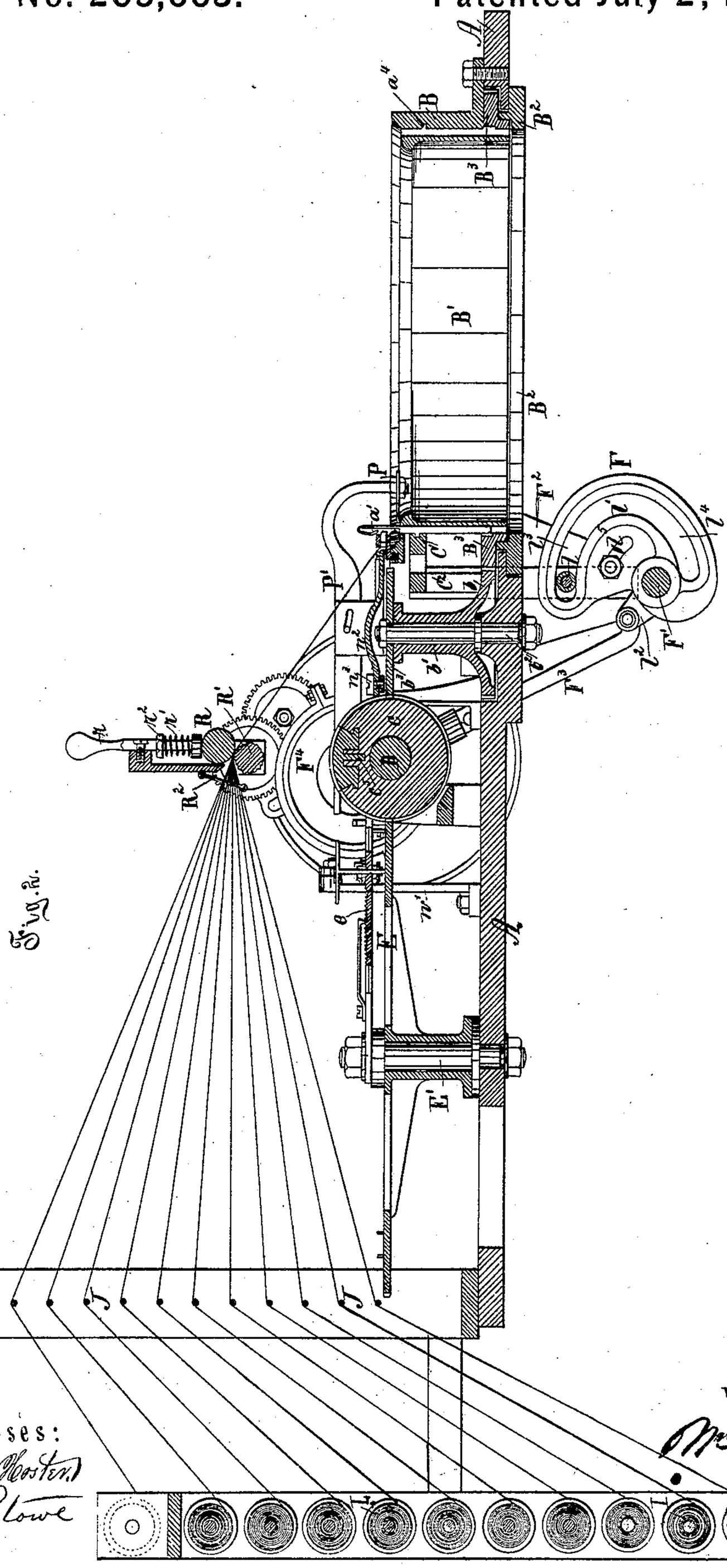

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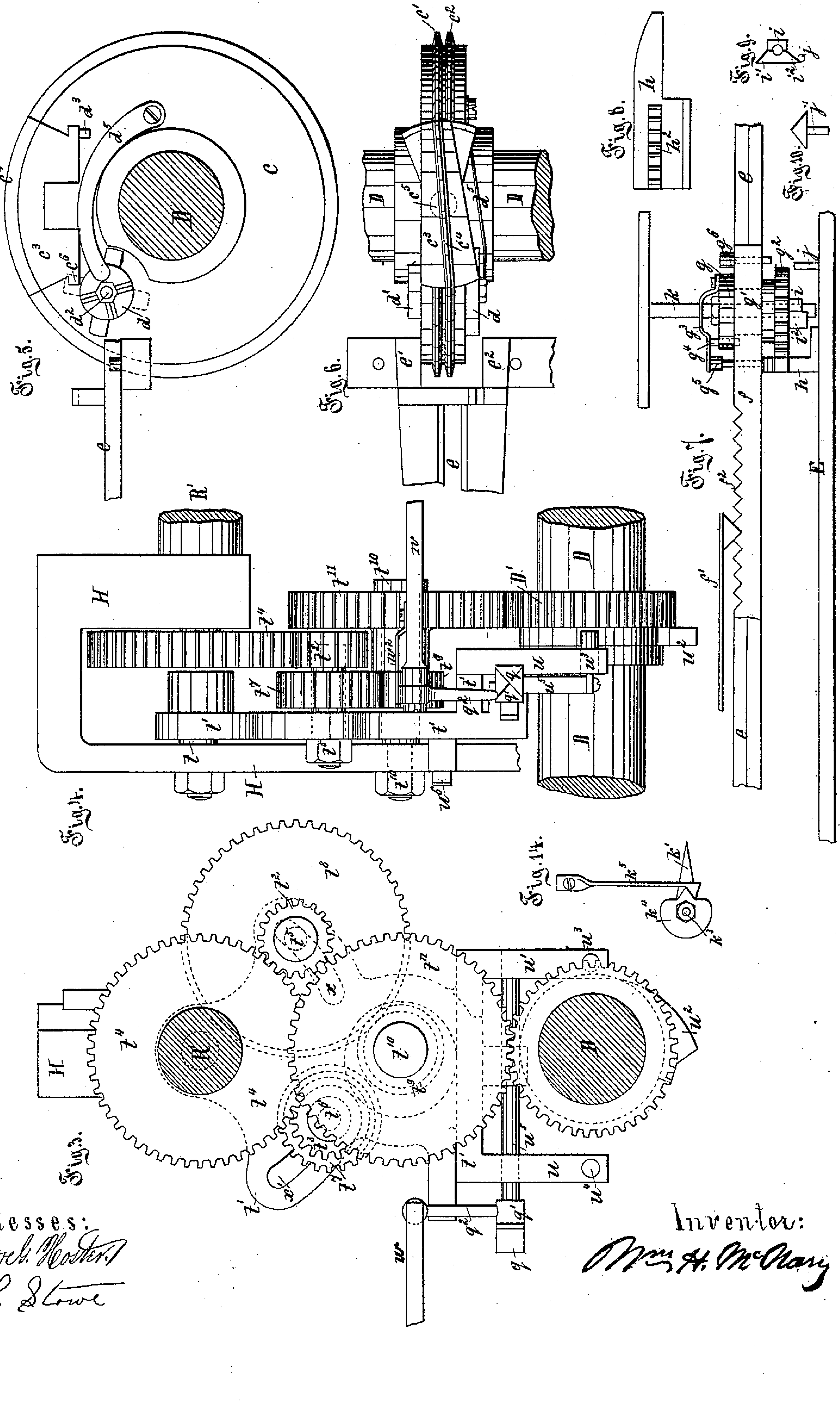
Knitting-Machine.

No. 205,663. **Patented July 2, 1878.**



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5 Sheets—Sheet 4.

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Knitting-Machine.

No. 205,663. Patented July 2, 1878.

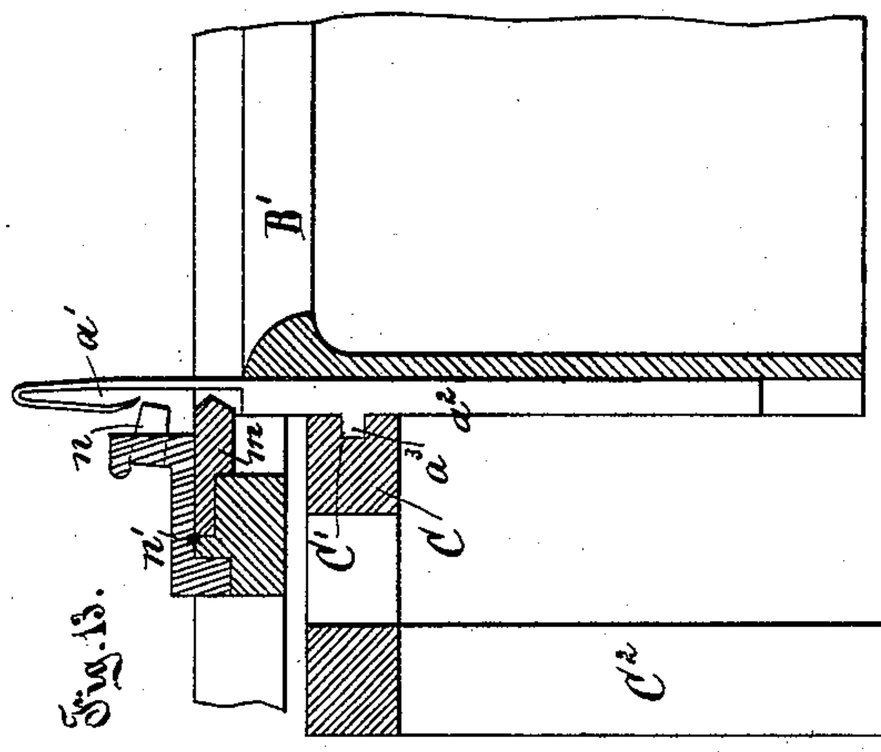

Fig. 13.

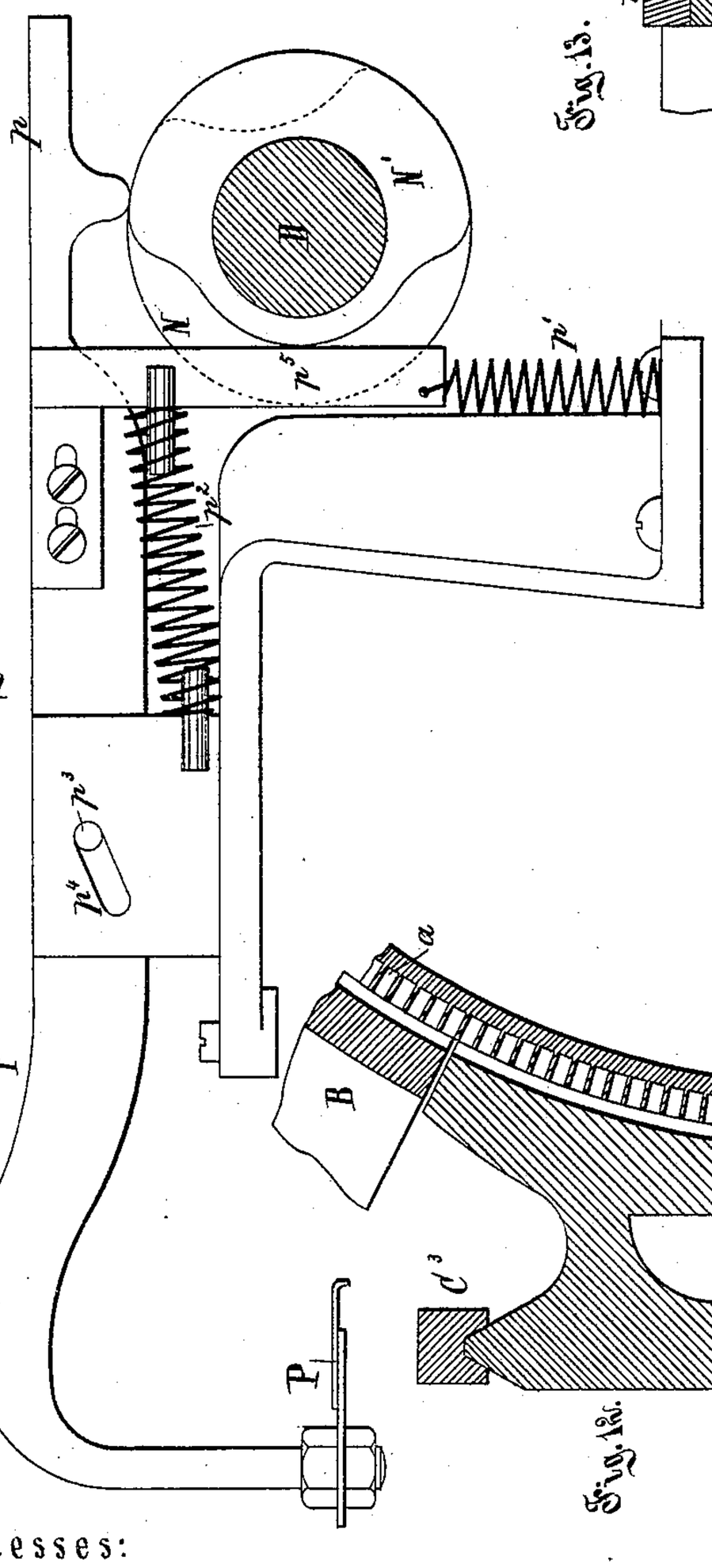

Fig. 11.

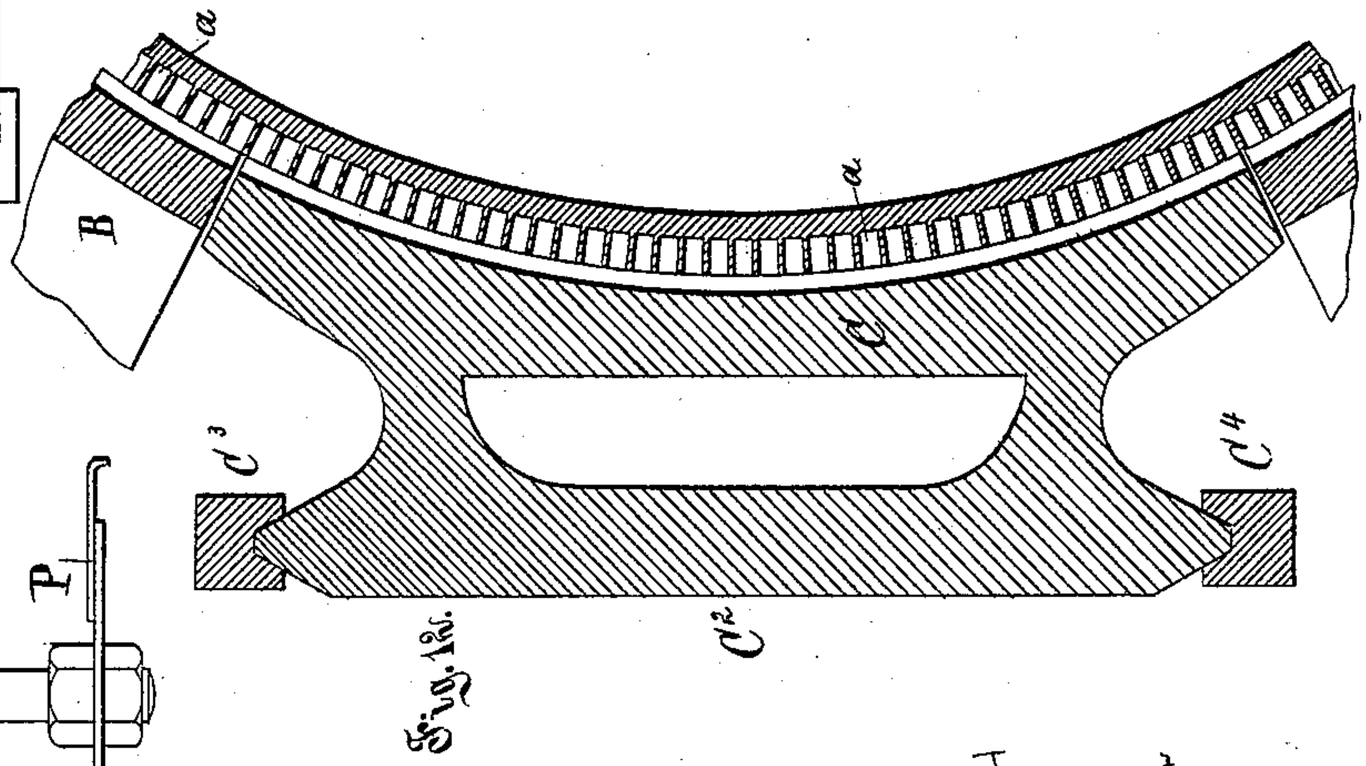

Fig. 12.

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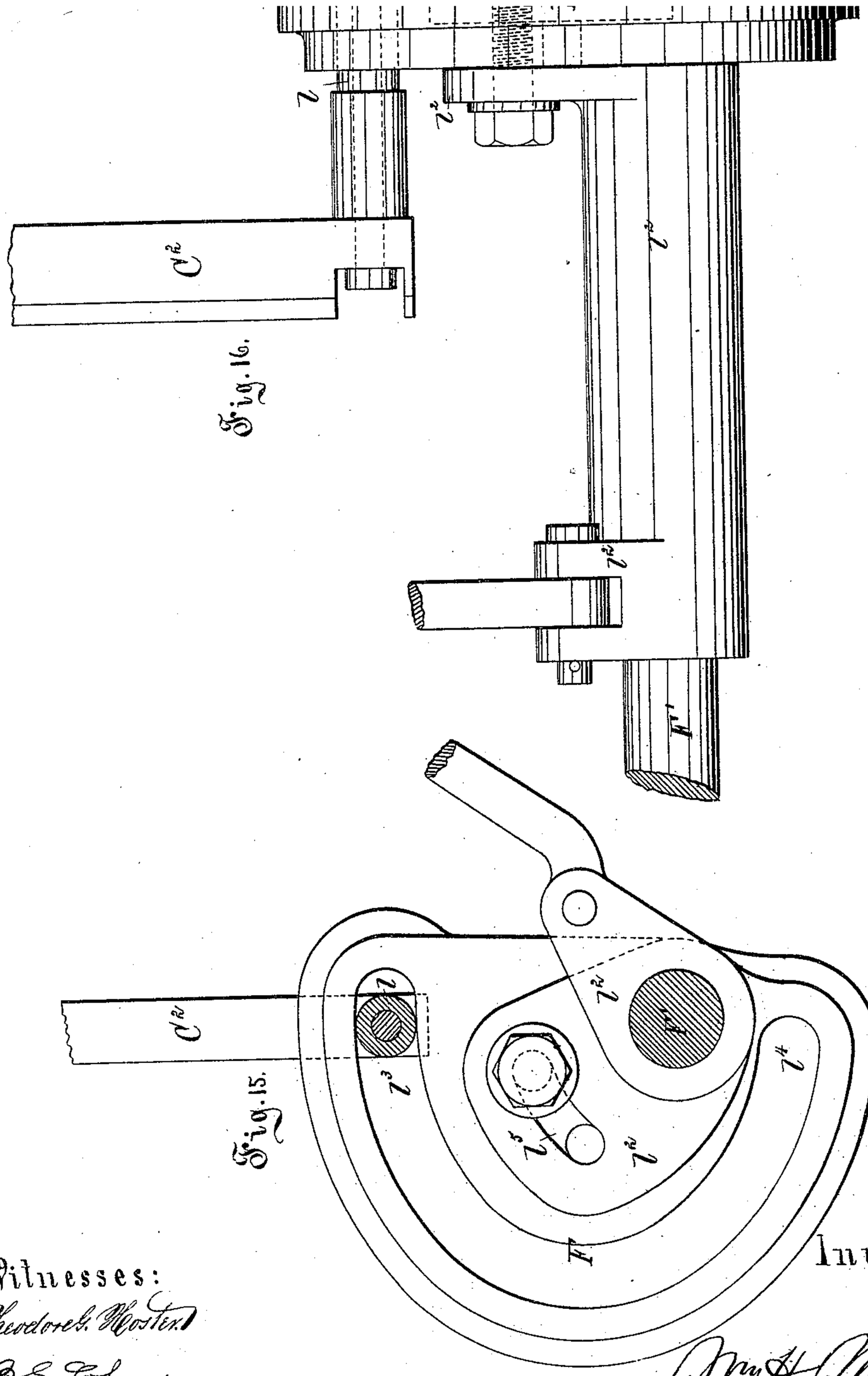

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UNITED STATES PATENT OFFICE.

WILLIAM H. McNARY, OF BROOKLYN, ASSIGNOR TO JOHN V. D. REED, OF NEW YORK, N. Y.

IMPROVEMENT IN KNITTING-MACHINES.

Specification forming part of Letters Patent No. **205,663**, dated July 2, 1878; application filed January 24, 1878.

To all whom it may concern:

Be it known that I, WILLIAM H. McNARY, of the city of Brooklyn, county of Kings, State of New York, am the inventor of Improvements in Knitting-Machines, for knitting articles of various regular or irregular forms, including spherical or partly spherical as well as straight work, or a combination of the two, and of which the following is a specification, reference being had to the accompanying drawings, forming part of the same.

My invention is more specially applicable to that class of rotary and flat machines in which a desired form is given to the article knitted by controlling the rotary or lateral motions of the needles during the process of knitting, and for improvements for which Letters Patent have been heretofore granted to me.

Figure 1 is a plan of a knitting-machine containing my improvements. Fig. 2 is a central vertical section of the same. Fig. 3 is a front elevation of the change-gearing and other mechanism for regulating the speed of the feed-rollers. Fig. 4 is a side view of the same. Fig. 5 is a side view of what is denominated the "switch-wheel" and a portion of the forked switch-lever. Fig. 6 is a top view of the same. Fig. 7 is a side view of a portion of the switch-lever and its attachments at the point where the pinion upon it is in contact with segmental gear upon the index. Fig. 8 is a side view of an incline and segmental gear used by me. Fig. 9 is a top view of the lower attachments of the revolving button, consisting of squares and angles, and also showing the position of one of the pins in the index-ring at the point where it first comes in contact with one of the angles. Fig. 10 is one of the small inclines sometimes placed upon the index. Fig. 11 is a side view of a wiper, wiper-lever, and its attachments, and the cams for operating it. Fig. 12 is a top view of the gate, its guides, and a section of the needle-ring. Fig. 13 is a side sectional view of the gate, the needle-ring, the yarn-guide, the fixed presser, and a side view of a needle and the blank attached to it. Fig. 14 is a bottom view of the small switch on the index-ring and its attachments. Fig. 15 is an end view of the cam, and Fig. 16 is a side view of the same.

My improved knitting-machine is attached to a suitable frame consisting of a flat horizontal plate, A, which may be mounted upon any suitable legs or table. To this frame is attached at the front a short upright cylinder, B, containing the needle-ring B′, and which are both substantially similar to those employed in the machines already in use. The needle-ring B′ receives its step-by-step and oscillatory motion from the switch-wheel *c* upon the main driving-shaft in a similar manner to that described in Patent No. 64,241; but the mechanism for shifting the position of the switch-lever *e*, by which the changing of the direction of the obliquity of the switch c^4 is effected, is what I desire to protect by this application for Letters Patent.

The large flat horizontal wheel or index E, revolving in either direction about the vertical stud E′ securely fixed in the rear of the frame A, is geared directly into the switch-wheel *c* in a manner similar to the wheel b^3 upon the opposite side of switch-wheel *c*. Over the index-wheel E is placed the switch-lever *e*, one end of which is pivoted upon the stud E′ at the center of the index E, and the other end, which is similar in form to the corresponding end of the one already used, reaches out toward and its forked ends embrace the outer edge of the switch-wheel *c* in the usual manner.

Secured in a longitudinal slot in lever *e*, in such a manner as to have a motion parallel with the lever *e* only, is a slide, *f*, held in a position longitudinally, except when being acted upon by mechanism to be hereinafter described, by the V-shaped end of a spring, f^1, resting upon a ratchet, f^2, upon the slide *f*. Near one end of this slide *f* is a revolving button, *g*, connected by the stud g^1 to the small pinion or toothed wheel g^2 on the under side of the slide *f*. Upon the top of this button *g* is a small flat spring, g^3, fastened at one end to the button *g* near its outer periphery, and extending across to and a little beyond the opposite edge of the button, and having near its end a small pin, g^4, which, extending downward through a small hole in the button, and entering a little way into one of two similar holes in the slide, prevents the button *g* from revolving, except when the end of the spring g^3 is slightly raised.

Passing through the slide *f*, upon opposite

sides of the button g, and sufficiently near to the button so that the extended end of the spring g^3 will reach over one or the other of them, are two vertical pins, g^5 g^6. These pins, which have shoulders to prevent their dropping entirely through the holes in the slide f, through which they pass, extend down a little below the lever e. They are pushed up one at a time at certain intervals by inclines or angle-pieces h h^1, of which there are two, set at different points upon the horizontal surface of the index E running under them. The pin g^5 or g^6 so pushed up raises the extended end of the flat spring g^3 over it, and this, drawing the lower end of the pin g^4 out of the hole in the slide in which it was, unlocks the button g and leaves it free to turn half-way about. This turning is effected by one or the other of two segments of gears, h^2 h^3, one fastened to the inner side of one of the inclines h, the other to the outer side of the incline h^1. These segments, acting upon opposite sides of the pinion g^2, give the button g a half-turn in the opposite direction, according to which one of the segments comes in contact with the pinion, and it is thus locked again by the pin g^4 in its position.

Below the pinion g^2, and attached to it, is a peculiarly-shaped piece, i, Fig. 9, being a square with angle-pieces i^1 i^2 projecting outward upon two opposite sides. One of the pins j, of which there may be any number upon the index, according to the form which it is desired to give the article to be knitted, coming in contact with one of these angles i^1 i^2, causes the slide f to move longitudinally a distance equal to the width of one tooth of the ratchet. This movement causes a square portion of the piece i to come immediately in front of the pin j, and at the next movement of the index E exerts sufficient lateral pressure upon the square to overcome the resistance of the V-shaped spring in the notch and force the end of the lever laterally far enough to bring a different fork, e^1 e^2, of the lever e into contact with the button upon the opposite side of the switch from the one last operated upon, and cause the shifting of the switch, which, by changing the direction of the thread's (c^4) obliquity, causes the direction of the rotation of the index-wheel E, as well as that of the needle-ring B, to be reversed. This reversed rotation will continue until another one of the pins j upon the index E comes into contact with the angle i^1 and i^2 upon the other side of the piece i, when a similar operation will be performed, though reverse in its results, as the lever will be pushed back and the switch c^5 again changed back to where it was before the first change.

The longitudinal movement of the slide f, produced by the contact of the pins j with the angles i^1 i^2, will cause a different pin, j, to be brought into contact at each oscillation of the index E. These pins j are set at any desired points, one each upon imaginary meridian-lines drawn at regular intervals, equal to the width of one tooth of the ratchet f^2 from the center of the index.

The slide will be caused to move in one direction until such time as one of the inclines h h^1 upon the index E shall push up one of the pins g^5 or g^6, and, by raising the spring, cause the button g to be unlocked, and leave it free to be turned half-way round by the segment of gears h^2 h^3 attached to the inclines h h^1 acting upon pinions g^2. This will change the position of the button g, so that the angles i^1 i^2 presented to the pins j will be reversed, and the slide moved in an opposite direction by their pressure until it is moved far enough to bring the other of the two pins g^5 g^6 in line with the other incline h h^1 and the pinion g^2 in contact with the other segment h^2 h^3, and again reverse the direction of its movement.

For making the requisite oscillations for the knitting of some shapes a pin, k, is placed in the center of the button g, and projects below the square i, and upon which a small switch, k^1, (shown in detail in Fig. 14,) placed upon the index E, acts, whereby the slide f is moved one notch while the wheel is going in one direction, and back again at the next oscillation of the index E in the same direction, the switch k^1 not acting upon the slide f when the index is moving in a reverse direction. The object of this switch is, by having the lever acted upon by four pins, j, only (set two each upon an adjacent two of the meridian-lines of the index,) to cause alternate double oscillations of the needle-ring B to be of a uniform duration. This switch k^1 is in the form of an acute-angled triangle, slightly widened upon each of its two longer sides from about their middle to their base, and forked at its base to admit a stop-pin, k^2, which limits the amount of its rotation upon a pivot, k^3, near its center, this pivot consisting of a stud which passes through to the under surface of the index E, where a piece, k^4, with a V-shaped projection attached to it, and acted upon by a similarly-shaped lug upon the end of a spring, k^5, serves to hold the switch k^1 in whichever of its two positions it may have been placed by contact with pin k.

Supposing that one of the pins j in the inner meridian has acted upon the square i, and consequently changed the direction in which the index is rotating, and that the pin k in the center of the button has just come in contact with the outer side of the switch k^1 near its point; now, as the point of the lever is considerably nearer to the center of the index than the middle of the outer side of the switch k^1 when the latter is in its present position, the pin k, and consequently the slide f, will be crowded out, as the pin k moves from the point toward the base of the switch a distance equal to one tooth of its ratchet f^2, which allows the pin k to pass the center of the switch where it is pivoted; and then, instead of the switch changing the slide f, the pin k will cause the switch itself to turn, and the pin k will pass, leaving the switch turned so that

the point of the switch is outside of the arc through which the pin *k* is traveling. A pin, *j*, in the outer meridian will now act upon the lever *e* and reverse the rotation of the index. As the index returns the pin *k* clears the broader end of the switch, and passing outside of it moves the point slightly in; but the V-spring k^5, upon the under side of the index, pushes it out again as soon as the pin *k* is passed, and leaves it out far enough so that after the pin *j*, in the outer meridian, at the other end of the oscillation, has caused the direction to be again reversed, and the pin *k* returns, traveling upon the same arc, it will strike inside of the point, and the slide *f* will consequently be moved in one tooth of its ratchet f^2, and the switch k^1 again reversed and put back to its position by the action of the pin *k* upon its broader end. As the index returns the pin *k* will pass upon the inside of the switch without changing its position, and the operation described above will be repeated.

It will be observed that the angles i^1 i^2 upon the button never come in contact with the pins *j* in the index when this switch is employed, so that the position of the slide *f* is changed only by the action of the switch k^1 itself, and neither do the inclines *h h* or segments h^2 h^3 come into operation in this case.

Another form of oscillation may be produced by using two pins, *j*, only, placed upon the same meridian of the index, and none of the mechanism for changing the positions of the slide is employed, the pins acting directly upon the square *i*.

When it is necessary to make a complete revolution, or several complete revolutions, of the needle-ring, in combination with a reciprocatory movement of the same, the angles i^1 i^2 extend below the square *i*, and short pins, otherwise similar to pins *j*, are placed in the index, which, while being long enough to reach these angles and change the position of the slide *f*, will not come into contact with the squares, and consequently the position of the lever will not be changed, and the rotation of the index and the needle-ring will not be reversed until the slide is moved out or in sufficiently to bring longer pins *j* against the square, and bring the mechanism intended to produce the oscillating movement of the needle-ring into operation.

My invention also consists in an improvement in the method of giving the longitudinal movement to the needles necessary to form the stitches.

The gate C and upper portion of the upright guides C^3 C^4 are similar to those described in specification of patent granted to Reed and Mulligan; but a better result in their operation is obtained by substituting for the adjustable pitman employed and described in that invention an adjustable cam and other devices, of which the following is a description: Reaching downward from the slide C^3 C^4 are two parallel arms, which embrace at their lower ends a portion of an open cam, F, attached to a rocking shaft, F^1, supported by castings F^2 attached to the lower side of the frame A, and a short horizontal shaft, *l*, having upon it a friction-roller, which reaches from one to the other, passing through a groove in the cam. This cam receives a reciprocatory rotary movement by means of a crank, l^2, or lever on the rock-shaft F^1 and connecting-rod F^3 from an eccentric, F^4, on the main driving-shaft. The groove in the cam is cut at one end for a certain distance upon a circle concentric with the center of the shaft, so that while the shaft-roller is in this position of the groove no motion will be communicated to the gate C and needles a^2 by the rotary movement of the cam F. The remainder of the groove gradually approaches the center of the cam's rotation as it approaches the other end l^4. The cam is set in such a position upon the rock-shaft relative to the position of the roller on the shaft *l* as to raise the gate to its highest point when the roller is in the end of the groove at l^3 farthest from the center of the cam, and to carry it to its lowest point when the roller is in the end of the groove at l^4 nearest the center of the cam; but the amount of this movement may be regulated, for the purpose of taking longer or shorter stitches, by means of a slot, l^5, in the cam and the bolt by which the cam is fastened to the crank l^2, the amount of throw, of course, being greater or less according as the roller is caused to remain less or greater time in the circular portions of the groove l^3, where no motion is communicated to the gate C.

It will be observed that whatever variation is made in the length of throw of the gate always occurs when it is at its lowest point, never varying in its height when it is in its upper position, in which respect I claim an advantage over the adjustable pitman employed in machines other than mine now in use.

My invention also consists in the substitution of tapered oblong tubes *n* in the place of round tubes heretofore used in the yarn-guides, by means of which I am enabled to use a coarser yarn, with less liability of breakage at knots, without narrowing the space between the tubes, through which the beards of the needles pass. The longer diameter of the oblong tube is parallel with the needle.

Another improvement consists in the employment of a spring-toothed wiper, P, for wiping or drawing the work away from the needles, in place of the plain or solid one previously employed. This wiper P is provided with an independent spring-tooth for each needle-thread or stitch, whereby the work is held or drawn equally, notwithstanding any irregularity or unevenness that may be occasioned by knots or otherwise in the material used.

My invention also consists in the employ-

ment of one or more pairs of feed-rollers and mechanism for operating them, for the purpose of regulating the amount of yarn supplied to the needles during the process of knitting, to conform to whatever length or tightness of stitch it may be desirable to produce, and also to supply to each and every needle a perfectly uniform quantity.

The feed-rollers R R^1, consisting of two parallel rolls set one above another, the under one, R^1, fluted, and the upper one, R, covered with some yielding substance, in order to give a gripe or hold upon the yarn, are supported by the frame H H′ in a position over and parallel with the main driving-shaft D. The upper one of these rollers can be removed at pleasure, the ends of the shaft passing through it, entering vertical guideways *s s′* in the frame H H′, open at the top, so that the rollers may be lifted out. When at its lowest position this roller rests upon the lower one, and the required downward pressure is given to it when in operation, or the pressure is relieved, when it is required to remove the roller, by means of the lever *r* and its attachments. This lever *r*, pivoted near its center, has below this point a thread cut upon it, and in this thread works an adjusting-nut, r^2. Around the lever, between this nut and a movable piece upon the lower end of the lever, is wound a spiral spring, r^1, arranged to exert whatever degree of pressure upon the movable piece that the adjusting-nut r^2 shall be set to give. When this lever is in a vertical position the piece will press against the upper side of the roller near its center, the yielding substance with which it (the upper roller) has been heretofore described as being covered being removed at this part of the roller; but when the lever is turned upon its pivoting-pin to a nearly horizontal position the lever will be sufficiently out of the way to permit the lifting of the roller out of the guideways *s s′*, for the purpose of removing it.

At the back of the rollers are guides R^2, through which the yarn passes before entering the rollers, arranged to keep the yarns separated while passing through the rolls. The shaft passing through the lower rollers is supported at each end by journals in the frame H H^1, and has at one end, outside of the journal, a gear, t^4, keyed to it. The frame H, at this end of the roller made of the form shown in Figs. 3 and 4, has pivoted to it, by a stud, *t*, directly opposite the end of the shaft of the lower roller, a swinging frame, t^1, to which is attached a train of change-gearing. This swinging frame t^1, which, with the exception of the resistance of a spring, w^6, acting upon a V-shaped lug upon it, is free to swing laterally upon the stud *t*, has two slots, *x x′*, one upon each side of the frame, cut so that the studs about which revolve the pinions t^2 t^3 will hold said pinions in gear with the gear t^4 upon the roller R^1 in whichever part of the slots *x x′* it may be necessary to receive the studs, in order to accommodate the different sizes of change-gearing that it may be desirable to use in the place of gears t^7 t^8 upon the stud. These change-gears are so set that but one of them will be in gear with a pinion, t^9, upon a stud, t^{10}, passing through an opening in the swinging frame and fixed in the stationary frame H at one time; but either one or the other of them, as required, (it will be observed that they are of different sizes,) may be brought into gear by swinging the swinging frame t^1 from one to the other of the two positions in which it is held by the spring w^6. The pinion t^8 has attached to it and revolving with it a gear, t^{11}, which is geared directly into another gear upon the main shaft D. The changing of the positions of the swinging frame, by which one or the other of the change-gears is brought into contact with the pinion for the purpose of changing the speed of the rollers, and thereby supplying a varying quantity of yarn to the needles, when it is desired to make tight and loose stitches in the same article, is effected automatically during the process of knitting by means of the following devices: The swinging frame t^1 is forked at the bottom, the two side *u* u^1 of the fork extending downward one upon each side of the driving-shaft D, and each of these forks has passing through it, in a line parallel with the driving-shaft, a small pinion, w^3 w^4, attached at the rear end to arms extending downward from a lever, w^5, pivoted midway between these arms, so as to turn in a horizontal direction only to the swinging frame t^1. This lever w^5 has two operative positions, and the pins w^3 w^4 are made of a proper length, so that while in one of its positions one of the pins reaches through the fork of the frame which it is in, and projects inward from the frame a little way, and the pin in the other fork extends only through the fork, and does not project beyond the inner surface of the frame. Their order is reversed whenever the position of the lever is changed from one of its operative positions to the other, the end of the pin that was projecting before being drawn in flush with the inner surface of the fork, and the other that was in before now projects. The pins are about upon a level with the center of the main shaft, and it is by means of a cam, w^2, upon this shaft, coming in contact with the projecting pin, one or the other, as the case may be, that the position of the swinging frame is changed from one to the other of its two positions, thereby causing one of the gears t^7 t^8 to be thrown out and the other into gear with the pinion t^9, to vary the speed of the rollers R R^1. One end of this swinging lever w^5 extends out beyond the frame t^1, and has near its outer end two angles or bevels, *q* q^1, one upon each side, the incline *q* nearest the end of the lever being made by removing that portion of the lever that is above a line drawn from the inner and upper corner to the outer and lower one, and the other, q^1, a little farther in upon the lever, is made by

removing so much of the lever as is above a line drawn from the outer and upper corner to the lower and inner one. Over the angles $q\,q^1$ extends one end of lever w, and projecting downward from the end of this lever, its lower end resting immediately over one or the other of the two inclines, is a pivoted piece, q^2, which has a slight lateral motion parallel with the lever w^5, but held in a central vertical position when free by stress of a V-shaped spring upon it. The lever w is pivoted near its center to an arm, w^1, attached to the main frame A, and the other end extends out to and over the center of the revolving button g upon the switch-lever e, through the center of which buttons passes a vertical pin, k, its lower end resting upon the surface of the index E, and the upper end being in contact with the under side of the lever w. Small angles j', Fig. 10, are placed at certain points upon the surface of the index E, arranged so that at definite times they will run under the pin k, in the center of the button g, and push it up. This will in turn force up the end of the lever w over it, and cause the other end of the lever to be depressed. We will now suppose that the swinging frame t^1 is in one of its two positions nearest to the front of the machine, and the pin w^3, attached to the front end of the lever, is projecting through the fork, and is in contact with the cam w^2, or rather was in contact with cam until the cam pushed it forward out of its circle of contact. The front end of this lever being in will cause the rear end to be in its outer position, and the swinging frame t^1, to which the lever w^5 is attached, being in its forward position, the incline q upon the lever nearest the end will be directly under the swinging piece q^2 in the end of the lever w. Now, as the end of the lever w is depressed, the swinging piece q^2 will come in contact with the rear incline q; and as this incline is beveled outward, the end of the swinging piece q^2, crowding downward upon it, will force inward the end of the lever w^5, and with it the pin w^4, in the rear fork of the frame, at the same time driving the other pin, w^3, at the front end of the lever outward. This will cause the front pin, w^3, to be drawn out of the circle of contact with the cam w^2, and at the same time the other pin, w^4, being forced in, will be operated upon by the cam w^2, and the swinging frame t^1 forced into its other position, where it will be held by the V-pointed spring w^6. This change of the position of the frame will have caused also the lever w^5 to have moved back, so that the incline q, upon which the swinging piece q^2 upon the end of the lever w has just operated, will no longer be directly under the end of the lever w, but will have been superseded in that position by the other incline q^1. As, however, the lower end of the swinging piece q^2 was resting upon the rear incline q when the position of the swinging frame t^1 was changed, it was carried back, as it was enabled to be, by the pivot at its top, and is held in a position a little inclined from a vertical one until the angle upon the index j, having passed the pin k in the center of the button g, this end of the lever w, with the swinging piece q^2, is allowed to rise, and as soon as the lower end of the piece q^2 is clear of the inclines the springs w^2 will cause it to assume a vertical position immediately over the front incline q^1. Another angle-piece, j', upon the index, coming in contact with the pin k, will cause this piece q^2 to act upon the front incline q^1, which it is now over, and the frame and lever will be brought back again to their original positions.

Having described the parts of this machine, I will now proceed to describe its operation. Having first provided the bobbins I at the rear of the machine with the yarn or material to be used, the ends, one strand for each needle in the gate, are brought forward over the guide-rods J in the frame and passed through the guides R^2, and then between the rollers R R^1, from which they are led directly to the yarn-guides n, and through them to the knitting-point. Now, suppose that the process of knitting has been temporarily suspended at a point where the needle has arrived at its highest point with a complete loop or stitch about it and has just been moved laterally one space by the mechanism for that purpose. The machine now being advanced the needle will descend, and in its descent the beard of the needle will seize the yarn running obliquely across its passage from a yarn-guide, n, immediately behind to the stitch formed upon the needle immediately in advance of it, and will carry a loop of the yarn down with it, and as the fixed presser m will, during the operation, crowd the beard of the needle close against the body of the needle, and the wiper P will hold the work, the loop previously formed upon the needle will slip up over the beard, and the new loop will be formed. The needle after descending the requisite distance regulated by the adjusting-screw and slot l^5 in the cam F, to give the desired length of stitch, will rise again, the wiper P will draw the work away from the needle the proper distance, regulated by adjustable arm p^5, and the row of stitches, one stitch for each needle in the gate, will have been completed. All of this has transpired while the parallel threads $c^1\,c^2$ upon the switch-wheel c have been passing through the teeth of the wheel b^3, and the needle-ring B′ has consequently been at rest; but now, the needles having been raised to their highest point, the oblique thread c^4 upon the switch c^3 will come in contact with the teeth of wheel b^3, and the needle-ring B′ will have been moved in one direction or the other, according to the direction of the obliquity of the thread c^4 upon the switch c^3, a space equal to the distance from the center of one needle to the center of another. The groove C^1 in the gate C being at the same level as the groove a^4 about the inside of the cylinder B during this lateral

movement of the needles, the lug a^3 upon one of the needles will have left the groove C^1 in the gate C, and will have gone into the groove a^4 in the cylinder, while upon the opposite side of the gate C the lug a^3 of a needle will have left the groove a^4 in the cylinder B and entered the one in the gate. The wiper P will rise and approach the needle in readiness to descend and repeat its functions of holding and withdrawing the work. The necessary amount of yarn for forming the stitches will have been drawn from the bobbins and supplied to the needles at a perfectly uniform tension for each strand by the feed-rollers R R^1 and their attachments.

The amount of yarn supplied by the rollers to the needles may be varied, as desired, to form tight or loose stitches by means of the change-gearing connecting these rollers to the main shaft, and changes of the speed of the rollers may be made automatically and without stopping the machine during the process of knitting, when it is desired to make tight and loose stitches in the same work, by the use of the cams, levers, and other devices operated upon by the angle-pieces j' upon the index described as being for that purpose. The switch c^3 in the switch-wheel c, acting alternately upon the needle-ring and index, will cause the index to be moved step by step in one direction until one of the pins j upon the index will come into contact with one of the angles i^1 i^2, move the slide f in or out, according to the position of the angles, and then striking the square i will push the lever e laterally sufficient to throw one of its forks e^1 e^2 away from the switch-wheel c, and bring the other fork into the circle of contact with one of the buttons d d'. The button d d', as it arrives at this point in its rotation, will receive a quarter-turn, thereby unlocking the switch, changing it, and relocking it in its new position.

The side of the switch c^3 will now protrude upon an opposite side of the switch-wheel, and will come in contact with one of the forks n^2 of the lever, and force it laterally sufficient to cause the yarn-guides n to be moved a distance equal to that from one needle to another, in order that the yarn may be supplied upon the proper side of the needle, now that the direction of the rotation of the needle-ring is reversed. The reversed position of the switch c^3 will cause the needle-ring B′ and index E to rotate in an opposite direction until another pin, one degree farther in or out from the center of the index than the last, according to the direction in which the slide was moved by the last pin, will come into contact with the opposite angle i^1 i^2, crowd the slide f one notch more in the same direction as before, and again reverse the position of the lever e and switch c^3 and the direction of the rotation of the needle-ring B′ and index E.

These operations will be continued until one of the inclines h or h^1 comes under one of the pins g^5 or g^6, crowds it up, unlocks the buttons, and one of the segment of gear h^2 h^3, coming into contact with the pinion g^2, gives the button g a half-turn, where it is locked by the pin g^4, reversing the direction of the angles i^1 i^2, and causing the slide f to move in an opposite direction whenever the pins come in contact with the angles until it brings the other inclines h h^1 under the other pin, and the other segmental gear h^2 or h^3 turns the button g and its angles i^1 i^2 back again. The use of this mechanism enables the machine to knit a succession of similar articles without stoppage of the machine. Whenever it is desired to make every alternate two oscillations of the needle-ring of the same duration, a pin, k, is inserted in the center of the button and switch k^1 is employed. If to make all the oscillations of a uniform duration, two pins, j, only, acting directly upon the squares i, are used, and when desirable to alternate oscillations with complete revolution of the needle-ring, the short pins j and lower angles i^1 i^2 are employed with the mechanism for producing the oscillations.

What I claim as my invention, and desire to protect by Letters Patent, is—

1. The combination, in a knitting-machine, of cam F, crank l^2, shaft l^1, passing through slot l^3 l^4 in the cam from one to the other of the two arms, of the vertical slide C^2 and friction-roller upon the shaft l^1, by means of which the distance the needles descend may be regulated to vary the length of stitch without changing the height of the needles when at their highest point, substantially as specified.

2. The combination, with mechanism in a knitting-machine, of the spring-teeth in the wiper P, operated by the wiper-lever P′, cam N N′ upon the driving-shaft, spring p^1 p^2, and fulcrum-pin p^3 with adjustable arm p^5, as shown and described.

3. The combination, in a knitting-machine, with the connecting and operating mechanism and with the needle-ring and needles, of the horizontal index-wheel E, provided with fixed pins j, inclines h h^1, segments of gear h^2 h^3, and small switch k, and the switch-lever e, provided with the slide f and button g, the latter provided with the gear g^2, angular and square portions i and i^1 i^2, spring g^3, pins g^4 g^5 g^6, and the pin k in the center of said button for controlling the oscillations of the needle-ring to give the desired form to the articles knitted, substantially as specified.

4. The combination of the feed-rollers R R^1 and guide R^2, for supplying a uniform quantity of material to each needle, and the pivoted lever r, adjusting-nut r^2, spring r^1, and the supports H H′, provided with the slots s' s', for removing the upper roller, for the purposes specified.

5. The combination, in a knitting-machine, for changing automatically the speed of the feed-rollers and the amount of yarn supplied.

to the needles, for the purpose of making tight and loose work in the same article when desired, of the frame H, swinging frame t^1, with their train of gearing, spring u^6, acting on the swinging frame t^1, pinions t^2, forks u u^1 of the swinging frame t^1, pins u^3 u^4, and lever u^5, with its angles or bevels q q^1, cam u^2, lever w, pivoted piece q^2, pin k, and angle j', substantially as specified.

Witness my hand this 20th day of November, A. D. 1877.

WM. H. MCNARY.

Witnesses:
ALVERT REED,
B. S. CLARK.