

(No Model.)

3 Sheets—Sheet 1.

W. H. MAYO.

CIRCULAR KNITTING MACHINE.

No. 363,528.

Patented May 24, 1887.

Fig: 1.

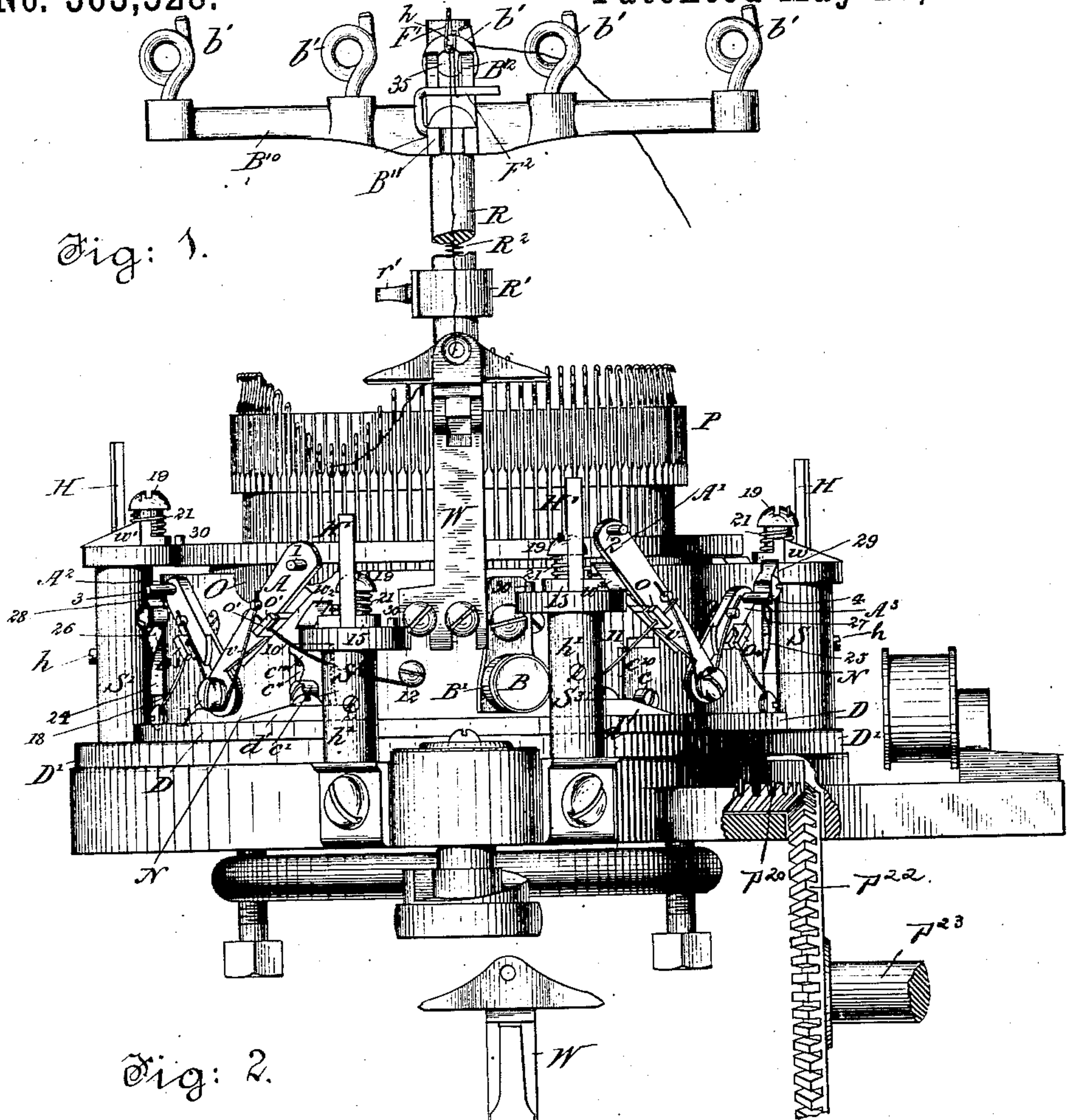


Fig: 2.

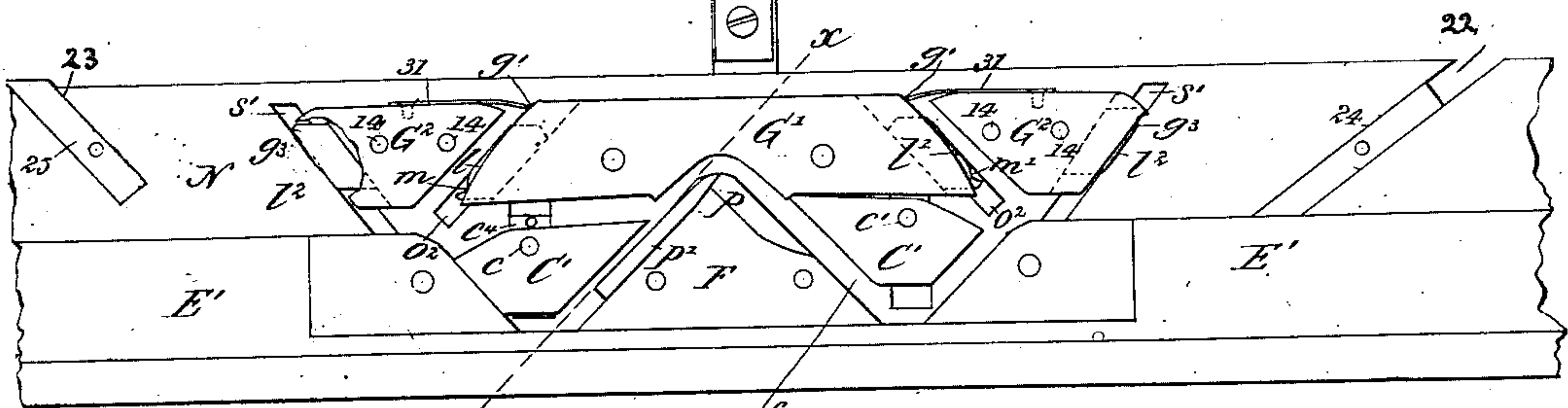


Fig: 2a.

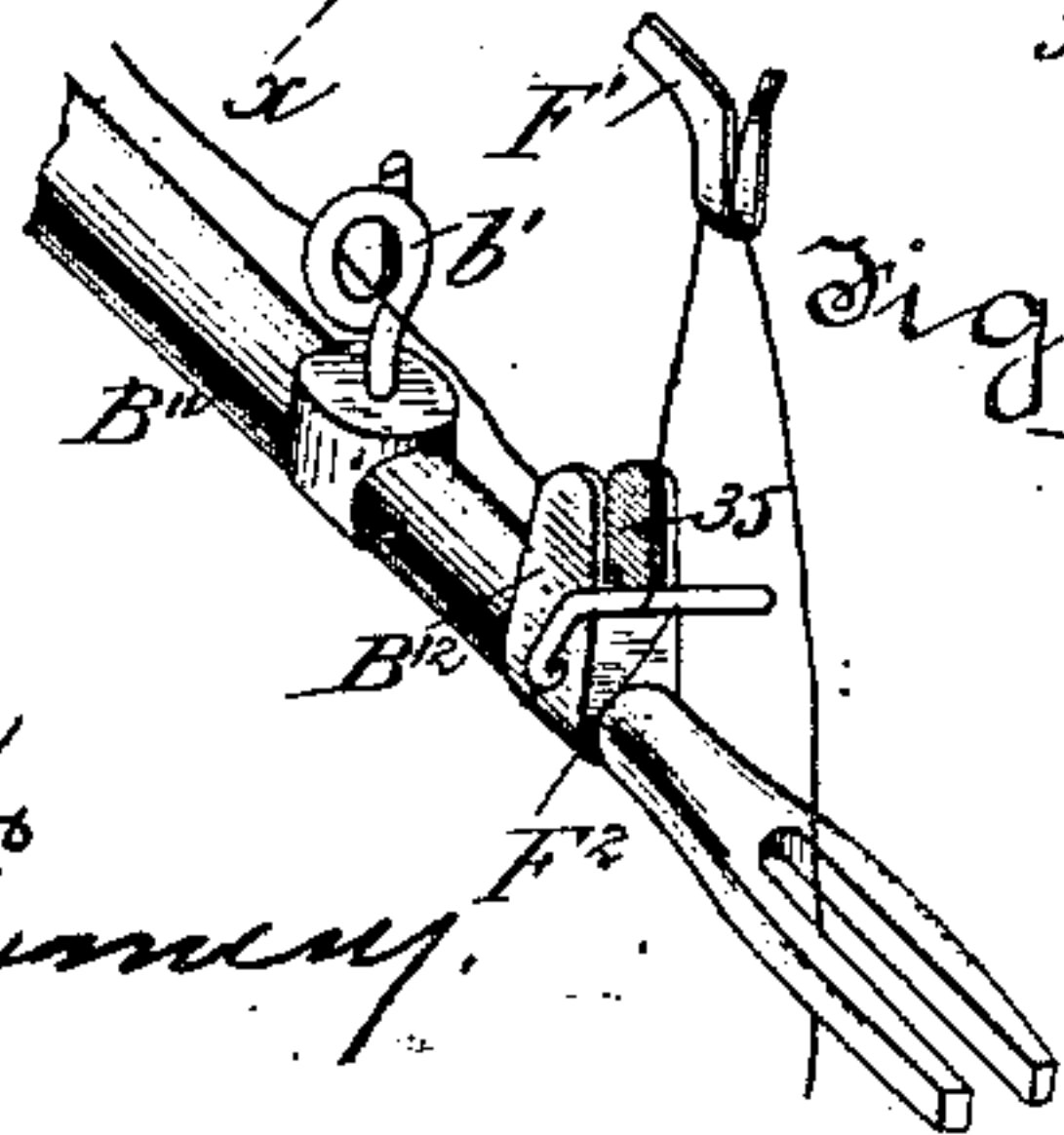
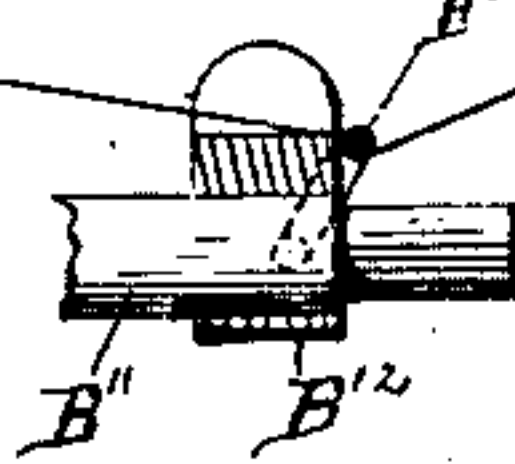


Fig: 2b.



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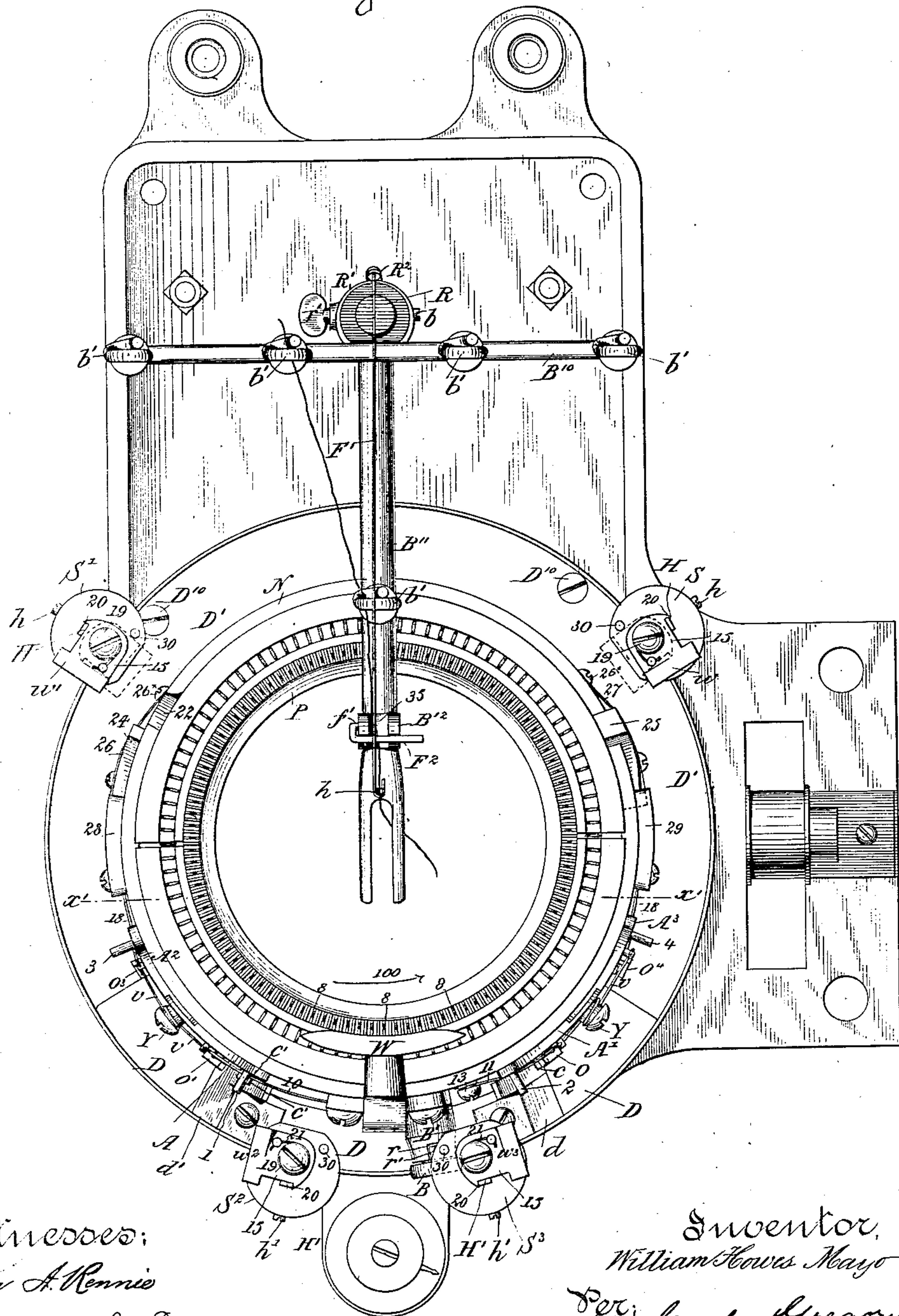
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Fig: 3.



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(No Model.)

3 Sheets—Sheet 3.

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CIRCULAR KNITTING MACHINE.

No. 363,528.

Patented May 24, 1887.

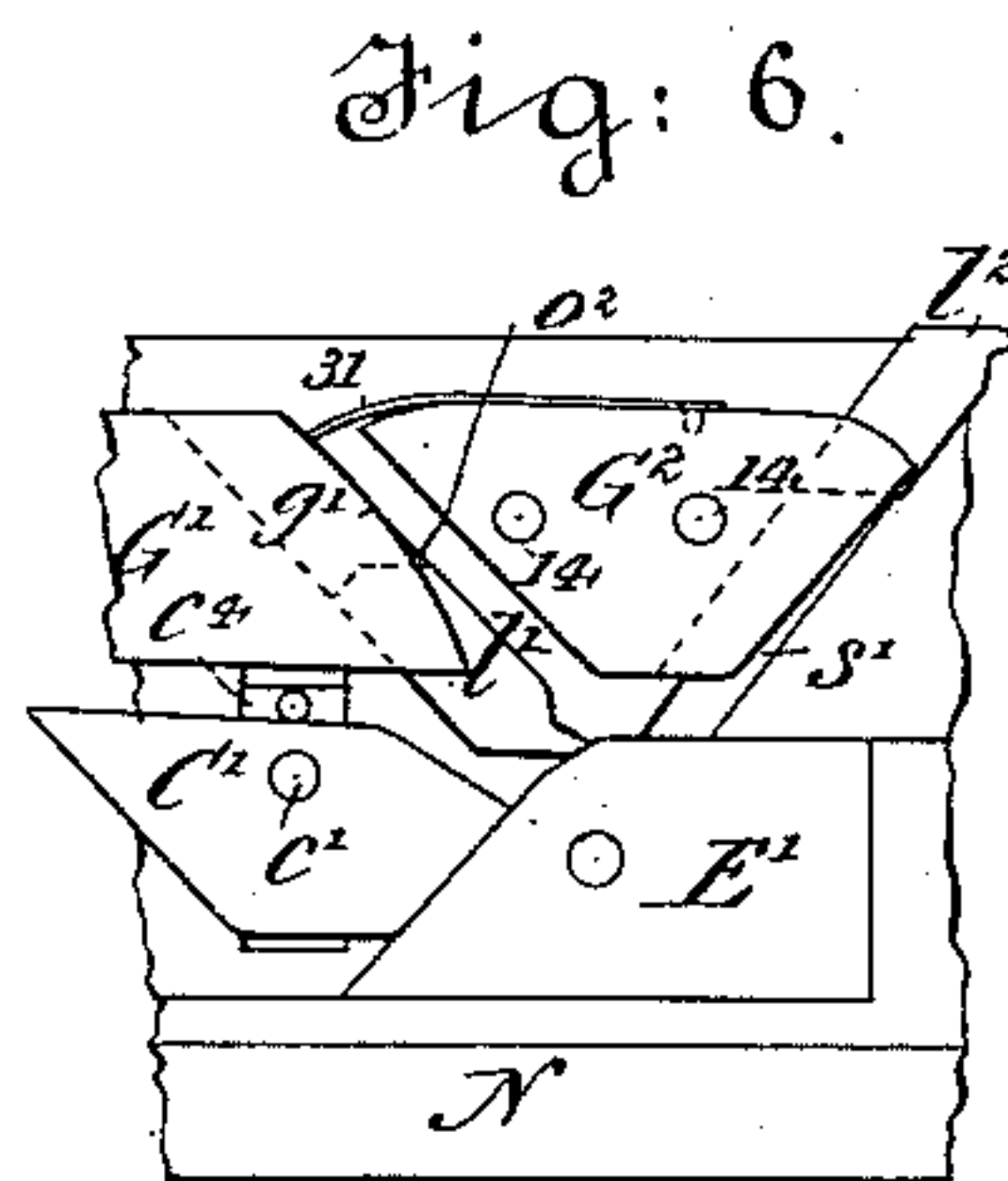
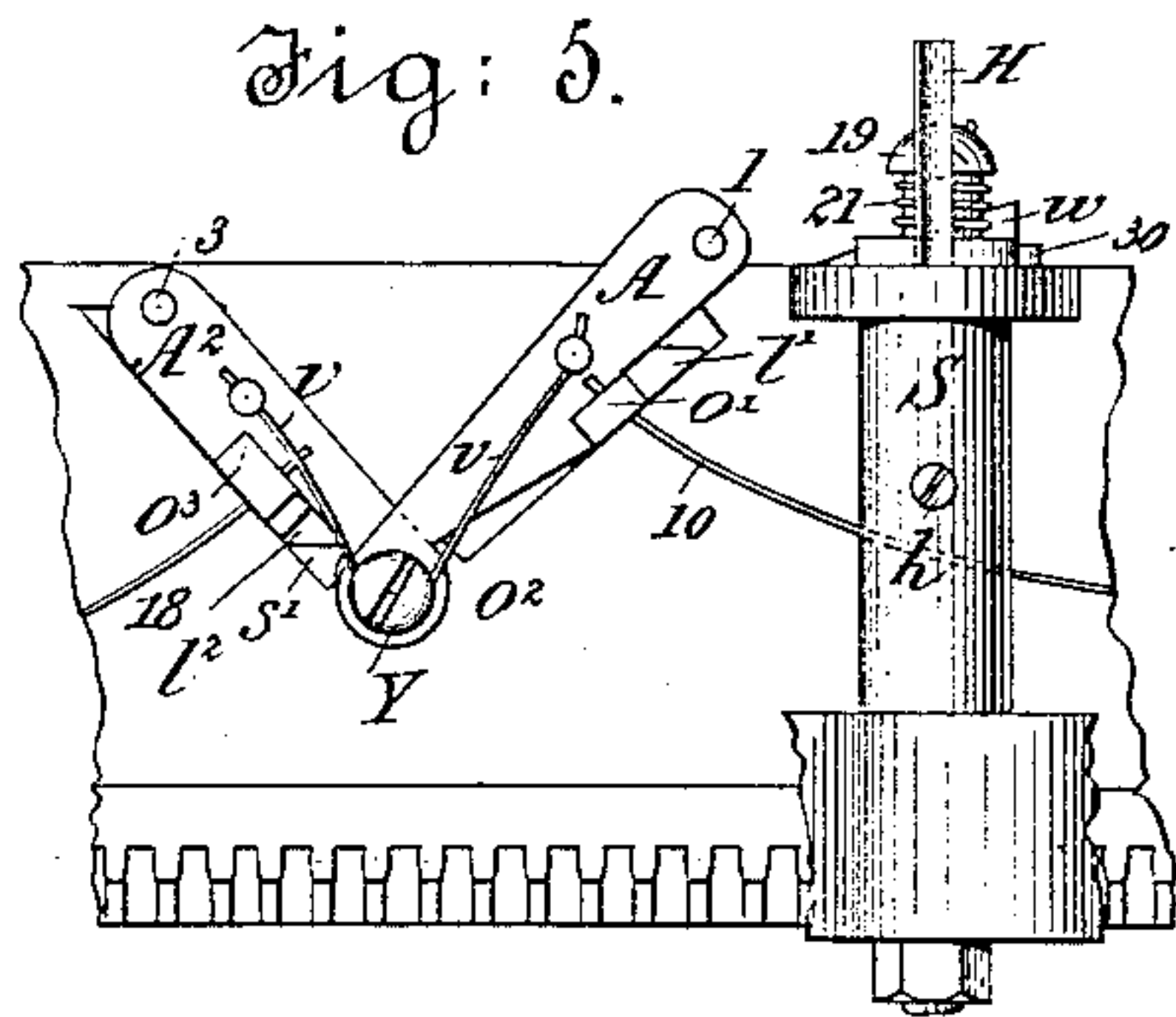
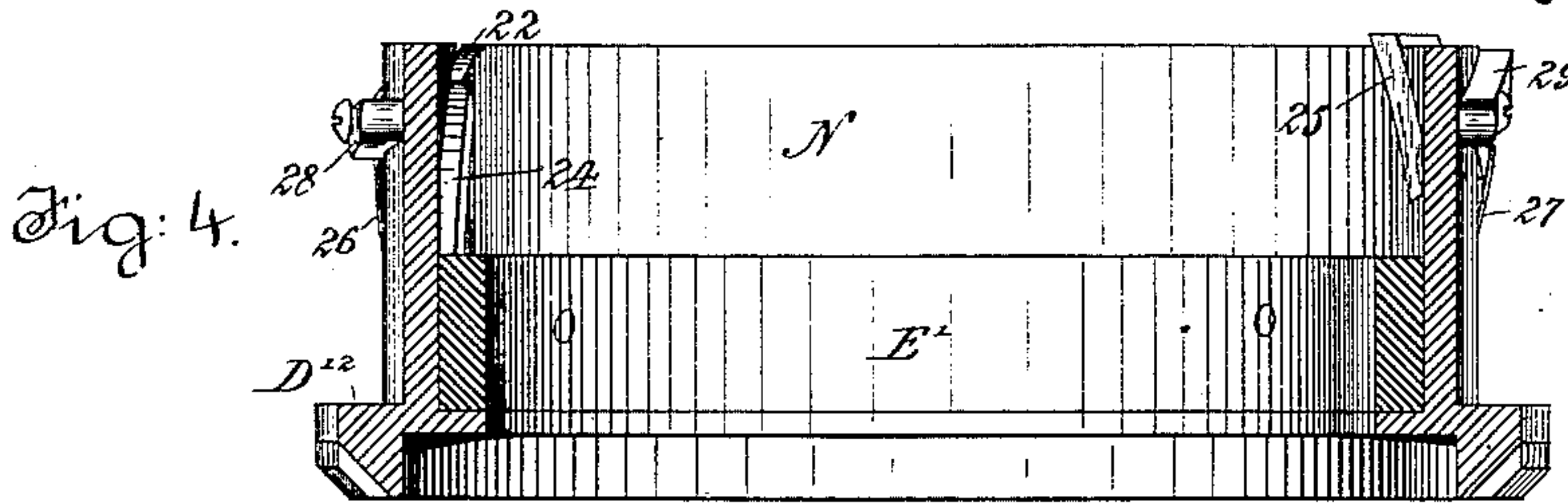
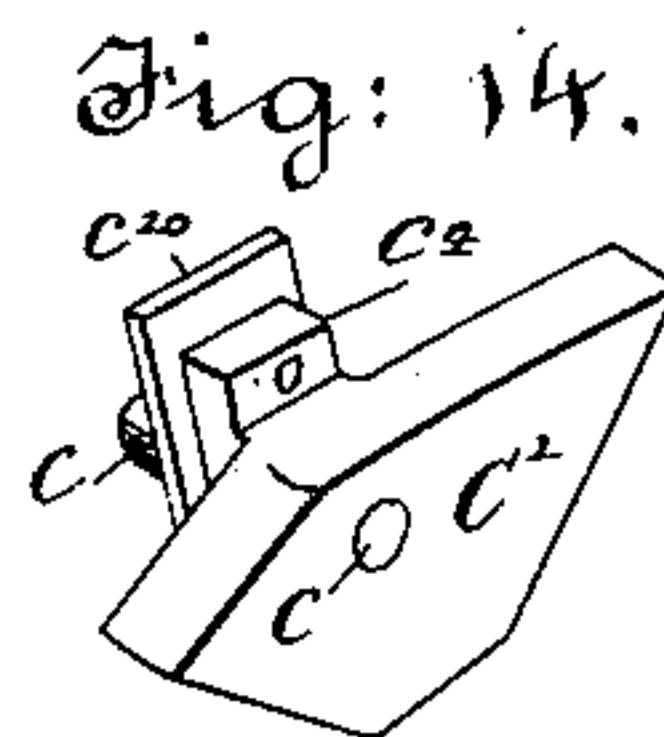
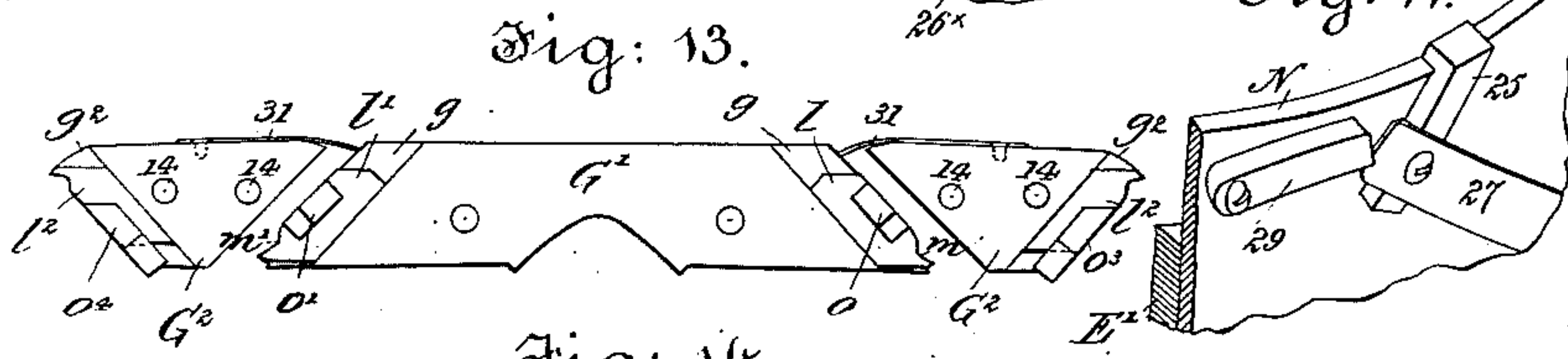
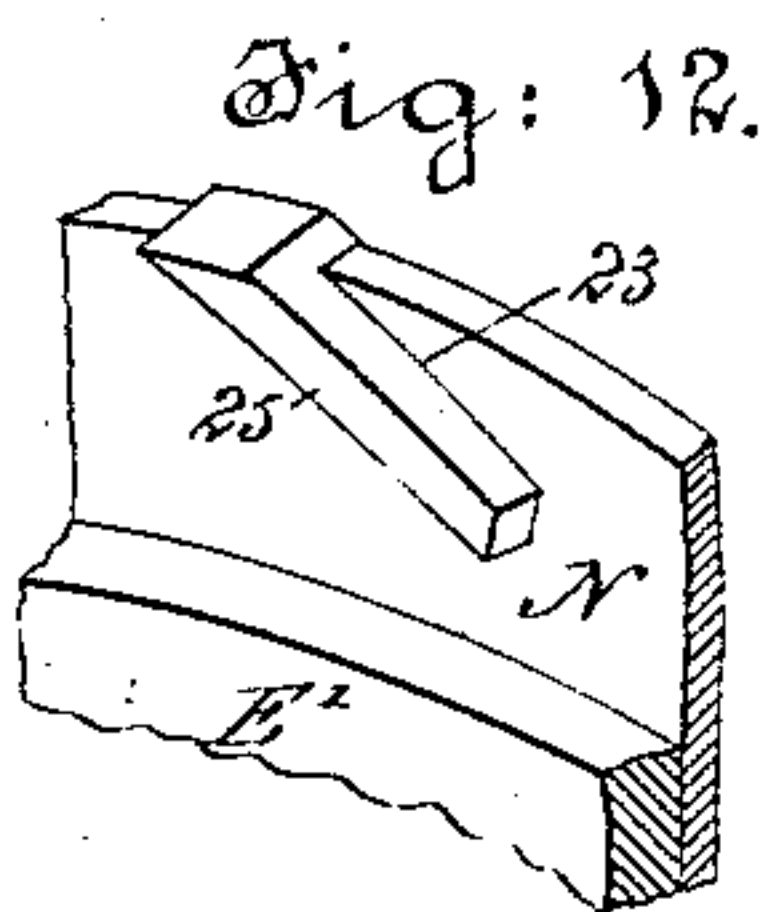
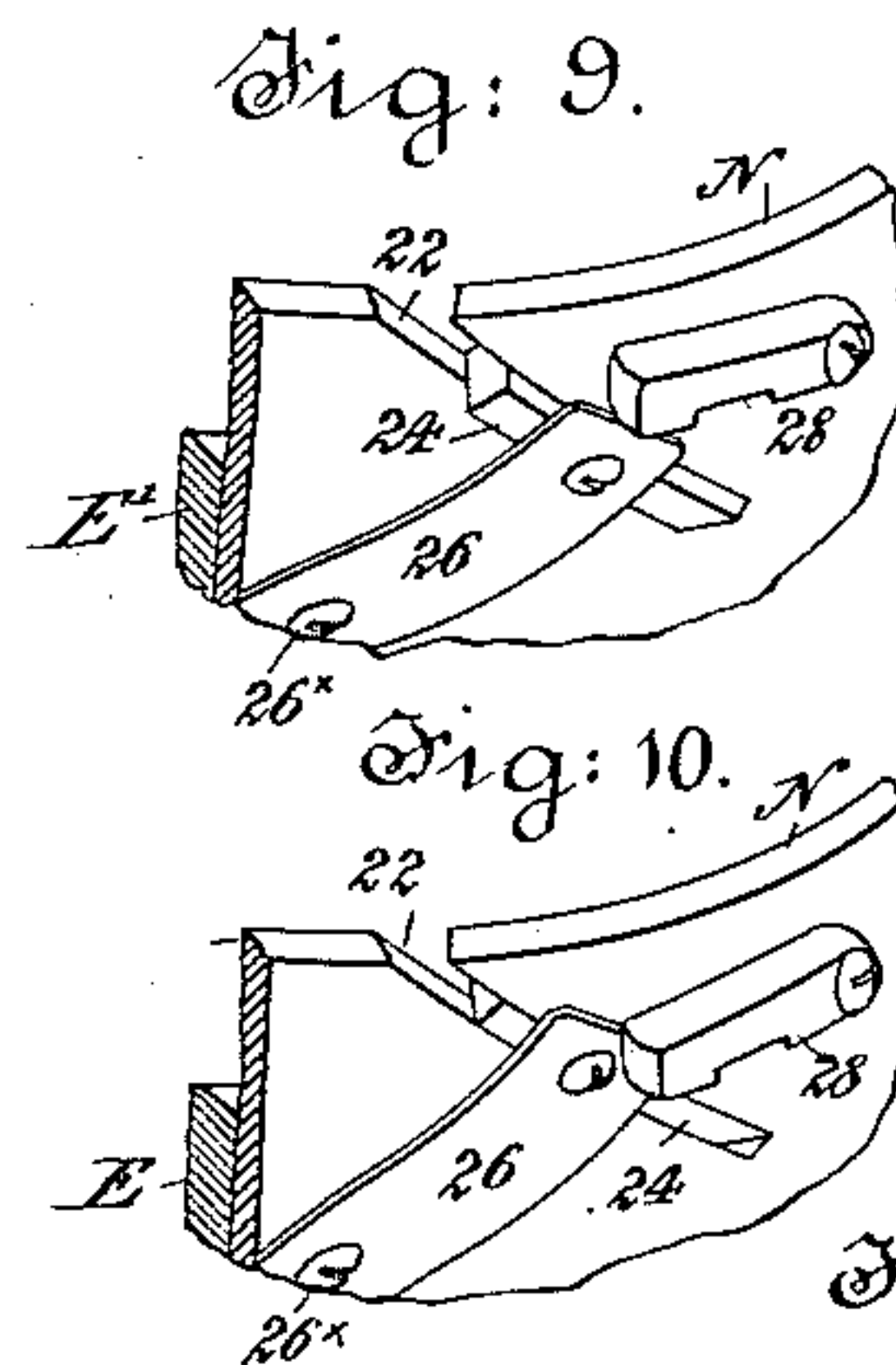
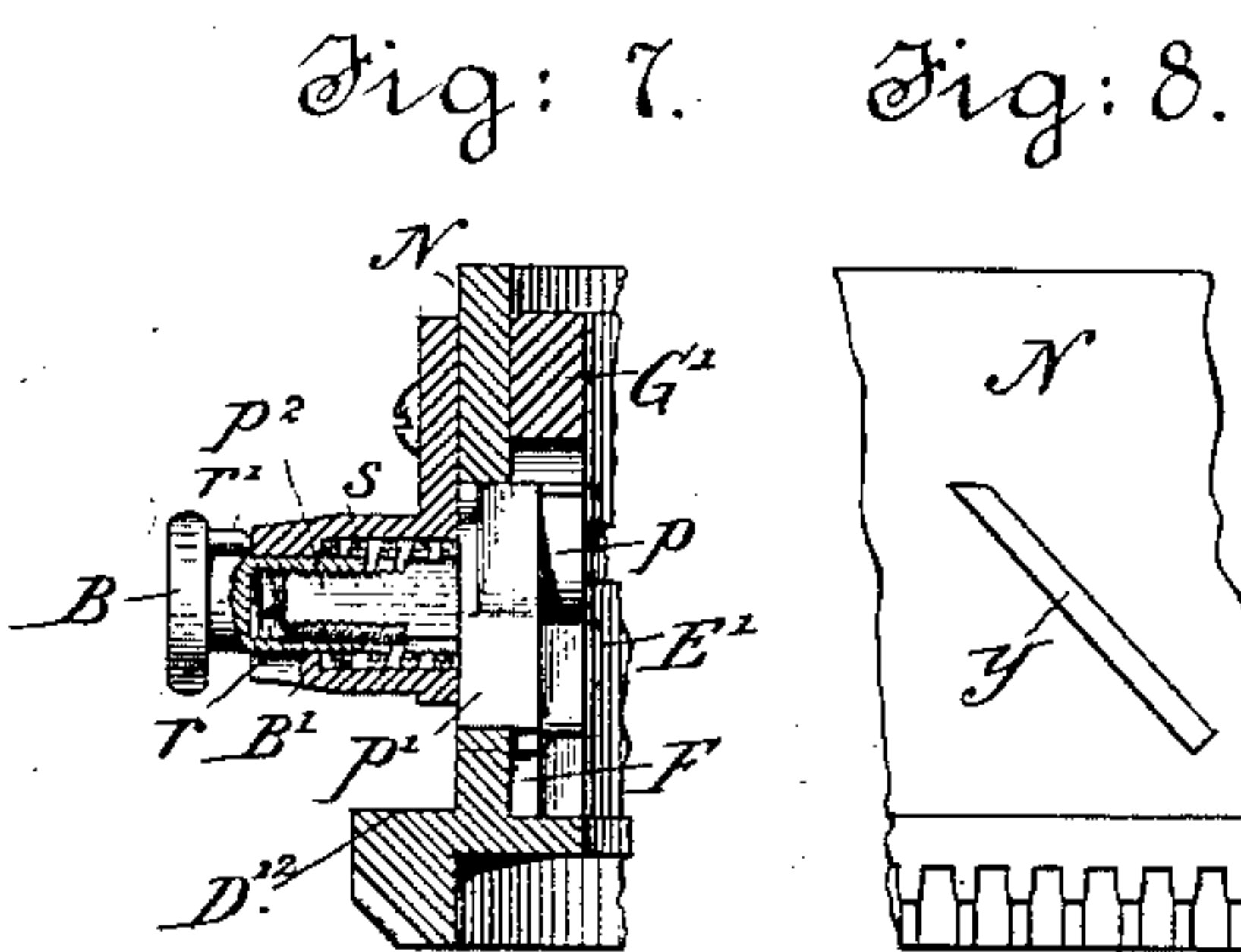
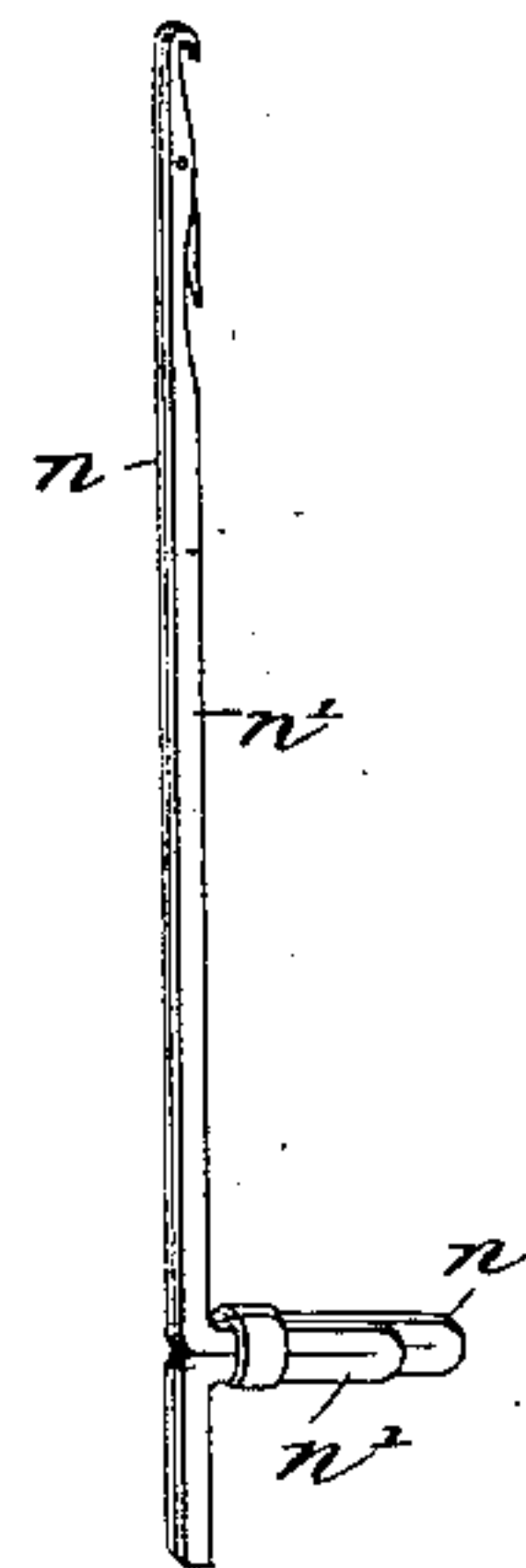


Fig: 15.



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UNITED STATES PATENT OFFICE.

WILLIAM HOWES MAYO, OF LYNN, MASSACHUSETTS, ASSIGNOR OF ONE-HALF TO GEORGE D. MAYO, OF SAME PLACE, AND NATHANIEL F. MAYO, OF REVERE, MASSACHUSETTS.

CIRCULAR-KNITTING MACHINE.

SPECIFICATION forming part of Letters Patent No. 363,528, dated May 24, 1887.

Application filed January 8, 1886. Serial No. 187,955. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM HOWES MAYO, of Lynn, county of Essex, and State of Massachusetts, have invented an Improvement in Circular-Knitting Machines, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

My invention relates to that class of circular-knitting machines which are adapted to produce tubular fabric, as in the formation of the leg of a sock or stocking, and straight fabric, as in the formation of a heel or toe; and it relates more particularly to improvements upon those machines invented by me and patented under the respective numbers 226,091, 274,208, and 319,000, to which reference may be had.

In this machine, as in machines of a similar class, a rotary motion is given to the cylinder, and the full set or complement of needles may be employed in the formation of the leg of a sock, stocking, or other tubular fabric; but in the formation of the heel or toe a reciprocatory motion is given, and only a portion of the needles—preferably about one-half—are at such time employed, the needles not then being moved to knit being raised out of the way of the knitting cam.

In the formation of the heel or toe it is necessary to raise one needle at a time from the series employed, which is done at each reciprocation of the cam-cylinder until only sufficient needles are left in operation to produce the narrowest course, after which the needles so raised are again lowered, one at a time, into line with the knitting-cams to resume knitting and widen the fabric, and the pouch for a heel or toe having been made, all the needles elevated preparatory to commencing the heel or toe are lowered together into line with the knitting-cams and circular knitting is again resumed.

In the machines described in the patents above referred to, the needles have had to be raised and lowered by hand, which is not only a tedious operation, requiring the constant watchfulness of the operator, but is also a great source of injury to the hooks of the needles.

My invention has for its object to automatically elevate those needles which are not to be employed in knitting a heel or toe; and to thereafter elevate, one at a time, the needles which are to be used to knit in the formation of the heel or toe, and then, at the proper time, to automatically depress not only the needles used for heel and toe work, but also those needles which were elevated and thrown out of action when the heel or toe was commenced.

To this end my invention consists, essentially, in a cam-cylinder, its needle-elevating and stitch cams, combined with a guide-plate placed above the stitch cam, and with needle-elevating latches adapted to slide in ways made at the ends of the said guide-plate; in the combination, with the cam-cylinder, of needle-lifting and needle depressing latches, locking devices to keep the said latches, when desired, in such position as not to act upon the heels of the needles, and mechanism, to be described, to release the said locking devices and allow the needle-lifting and needle-depressing latches to come into position to effectually elevate and depress the needles at the proper times; also, in the combination, with the cam-cylinder, of a needle-lifting guide by which those needles not moved to knit during the operation of the machine to form the heel or toe are successively raised just before the commencement of the heel or toe, and a needle-lowering guide to lower the needles after the completion thereof.

My invention also embraces a peculiar construction of knitting-cam to be described, by which I am enabled to indiscriminately actuate the long and short heeled needles which I use in my present invention, as in the Patents Nos. 274,208 and 319,000, above referred to, in the formation of plain and fancy stitches.

Other improvements will be described, and pointed out in the claims at the end of this specification.

Figure 1, in front elevation, represents the needle-cylinder, its needles, the cam-cylinder, bed-plate, and yarn-guides of a knitting-machine embodying my invention, the bed-plate being partially broken out to show the lower beveled toothed edge of the cam-cylinder and a portion of the bevel-gear which imparts mo-

tion thereto, the same being mounted upon and receiving its motion from the usual driving-shaft, a portion of which is shown, the skeleton ring to keep the skeleton cylinder in place being omitted. Fig. 2 is a developed view of the inside of the cam-cylinder, showing the knitting-cams, needle-lifting and needle-depressing latches, and the needle-elevating and needle-lowering guides in position, as for circular knitting. Fig. 2^a is a detail of part of the yarn-guide and some of its parts, including the clamp, to be described. Fig. 2^b is a sectional detail of Fig. 2^a through the shoulder B¹² and the finger F². Fig. 3 is a plan view of Fig. 1. Fig. 4 is a transverse section of the cam-cylinder, showing the needle-elevating cam in position to engage the heels of and elevate those needles not used during the formation of the heel or toe. Fig. 5 is a detail view to be referred to, showing the parts instrumental in operating one of the needle-lifting and needle-depressing latches. Fig. 6 is a detail inner side view of a portion of the cam-cylinder, showing one of the needle-lifting latches in its depressed position ready to act upon and raise the needles and one of the needle-depressing latches in its elevated position ready to act upon and draw the needles previously elevated down again during the formation of the heel or toe of a sock or stocking. Fig. 7 is a section of Fig. 2 on the diagonal line *x x*, looking toward the right, showing the knitting-cams, to be described, as in position to actuate only the long-heeled needles. Fig. 8 is a detail to be referred to. Figs. 9, 10, 11, and 12 are detail views of portions of the cam-cylinder, showing the needle-elevating and needle-depressing guides and the means to operate the same. Fig. 13 is a detail view of the needle-lifting and needle-depressing latches and their guide-plates detached from the cam-cylinder. Fig. 14 is a detail view of one of the stitch-cams removed from the cam-cylinder. Fig. 15 is a detail view of the long and short heeled needles, to be referred to.

The needle-cylinder P, the means for adjusting it vertically, the needles, the cam-cylinder N, provided with vertically-movable wedge-shaped stitch-cams C' C', annular ledge E', extending nearly around the whole inner face of the cam-cylinder, the skeleton cylinder O, having the fingers to guide the heels of the needles, and the guide-plate G' are the same as and are represented by like letters in my Patent No. 319,000, above referred to. The lower end of the cam-cylinder N is provided with teeth at P²⁰, which are engaged by the bevel-toothed gear P²² on the shaft P²³, the rotation of which in one or the other direction turns the cam-cylinder, all as usual.

The wedge-shaped stitch-cams C' C' are attached by the screws *c c'* to blocks *c'*, adapted to slide vertically in suitable slots, one of which slots and block therein is shown at the left of Fig. 1 by partially breaking away the carriage *c*¹⁰, to which the said cam is attached,

the said screws *c c'* projecting beyond the said carriage *c*¹⁰ at the outer side of the cam-cylinder sufficiently to be acted upon by the cams *d d'*, attached to a segmental plate, D, adapted to move within an annular groove formed in a ring, D', which encircles the outside of the cam-cylinder and is attached to the bed-plate by suitable screws, D¹⁰, the said ring D' serving to bear on the ledge D¹² (see Fig. 4) of the cam cylinder to keep it in place.

Within the space left by the division of the annular ledge E', and riveted to the cam-cylinder, is a Λ -shaped plate, F, which constitutes the needle elevating cam, it being made of such size as to leave a channel, *f*, between it and the movable stitch-cams C' C' for the passage of the heels of the needles. This plate is made about one-half the thickness of the annular ledge E' and of the stitch-cams C' C', the difference being, approximately, the difference between the length of the heels of the long-heeled needles *n* and the heels of the short-heeled needles *n'*. (Shown in Fig. 15.)

The plate F is provided at one edge (see the right of Fig. 2) with a rib or flange, *p*, which projects outward as far as the face of the annular ledge E', and at the opposite inclined edge of the plate F the cam-cylinder is provided with a slot, *y*, for the reception of a slide-piece, *p'*, somewhat similar in shape to the flange *p*, the upper edge of the said slide-piece *p'* interlocking with the upper edge of the flange *p*. This slide-piece *p'* has a shoulder provided with an elongated threaded shank, *p*², (see Fig. 7,) which is extended through the diagonal slot *y* in the cam-cylinder N, the said threaded shank receiving upon it, at the outside of the cam-cylinder, a nut, B, and being surrounded by a spiral spring, *s*, inclosed within a hub, B', fastened to the cam-cylinder. The spiral spring *s* bears against the back of the slide-piece *p'* and the flange at the inner end of the hub B' and forces the said slide-piece *p'* forward, so as to normally remain in line with the face of the rib or flange *p*, so that the long and short heeled needles *n n'*, when so desired, may be actuated to take yarn from the yarn-guide W. (Shown in Figs. 1 and 3.)

In Figs. 3 and 7 of the drawings I have shown the hub B' as provided with a recess, *r*, and the nut B with a short pin, *r'*, adapted to fit the said recess. The pin serves to prevent the rotation of the nut, and also to keep the slide-piece *p'* drawn back in line with the face of the Λ -shaped plate F when it is desired that only the long-heeled needles should take yarn and knit, the nut B in such event being drawn out to remove the pin *r'* from its recess *r* in the hub, when it may be turned to the right or left, causing the pin *r'* to rest upon the end of the sleeve, as shown clearly in Fig. 7. When the slide-piece *p'* is thus withdrawn, only those needles with the long heels are actuated to knit. As they come in contact with the cam F, the short-heeled needles, being too short to be actuated by it, being brought into contact with the under side of the rib or flange

p, and being forced beneath it, cause the hooks of such needles to pass below and without taking yarn from the yarn-guide.

The ends of the guide-plate *G'* are shown in Figs. 2 and 13 as provided with recesses *g* to receive within them the needle-lifting latches *l l'*, formed with notched ends at *m m'*, and having pins *o o'*, which latter project through slots *o² o²* (see Figs. 1, 2, and 5) in the cam-cylinder *N*. The pins *o o'* are provided with recesses at their outer ends to receive the loose ends of springs 10 11, the other ends of the said springs being fastened to the cam-cylinder by the screws 12 13.

Guide-plates *G² G²*, one at each end of the guide-plate *G'*, are fastened to the cam-cylinder by the screws 14 14, a sufficient space being left between them and the inclined ends of the guide-plate *G'* to form channels for the passage upward of the heels of the needles when caught by the notched end of a needle-lifting latch when narrowing the fabric in the formation of a heel or toe. These guide-plates *G² G²* have their outer ends recessed at *g² g²*, (see Fig. 13,) to receive the needle-depressing latches *l² l²*, which are in shape similar to the needle-lifting latches *l l'*, except that their upper ends are notched to engage with the heels of and lower those needles previously raised to narrow the fabric. The latches *l² l²*, being also provided with pins or projections *o³ o⁴*, which project through diagonal slots *s' s'* in the cam-cylinder *N*, and being recessed to receive springs 18, fastened to the cam-cylinder, the free ends of the said springs entering the said recesses, serve to force the needle-depressing latches up to their highest required point when released by the locking devices, to be described, where they will remain in position to engage with the heels of the needles elevated by the needle-lifting latches when narrowing the fabric, the said latches *l² l²* acting to lower the needles into line with the knitting-cams when the elevated needles are to be lowered to widen the fabric or to do circular knitting.

The needle-lifting latches *l l'* are kept elevated and the needle-depressing latches *l² l²* depressed during the rotary motion of the cam-cylinder for the production of tubular fabric by locking devices herein shown as arms *A A'* and *A² A³*, pivoted to the outside of the cam-cylinder at *Y Y*, Figs. 1, 3, and 5, and provided at their lower edges with suitable shoulders, against which the pins or projections *o o'* and *o³ o⁴* of their respective latches will rest when in their elevated or depressed position. The arms *A A'* and *A² A³* are kept in proper relation with their co-operating pins by the aid of springs *v v*, held in place on the cam-cylinder by the said screws *Y Y*, the free ends of the said springs engaging with the upper ends of the arms or locking devices in convenient or desired manner, they being herein shown as entering holes in pins carried by the said arms. It is therefore evident that when the needle-lifting latches are in their elevated position and the needle-depressing

latches in their depressed position, their pins will be caught by the locking devices and locked until released, as will be described, when the springs 10, 11, and 18 will operate to bring the latches into position to act upon the heels of the needles to elevate or to depress them, as the case may be.

Each of the arms or locking devices is provided with an outwardly-projecting pin marked 1, 2, 3, 4, arranged one above the other, which, when desired, are acted upon by tripping or releasing devices, shown as arms or inclined ways *w w' w² w³*, formed upon the end of plates 15, held in place upon uprights or standards *S S' S² S³* by the screws 19, which pass through them and are secured in the said uprights or standards. The said plates are further provided with catches 20, adapted to engage with upright spring-engaging handles *H H' H² H³*, fastened in the said uprights or standards by the screws *h h' h² h³*, the said spring-engaging handles serving to keep the plates 15 held back in the position shown in the drawings, Figs. 1 and 3, so as to keep the cams or ways *w w' w² w³* out of the line of the pins of the locking devices, in which position the machine is rotated for circular knitting.

Fastened to the head or other convenient part of each of the screws 19 is a spiral spring, 21, which surrounds the same and is fastened to each of the plates 15. These springs act to bring the plates, when released by the spring-engaging handles *H H' H² H³*, into such position that their attached inclines or cams *w w' w² w³* may act to trip the locking devices and disengage the pins of the needle-lifting or needle-depressing latches, according as to whether the fabric is being narrowed or widened.

The cam-cylinder *N* is provided with two inclined slots, 22 23, (see Figs. 9, 10, 11, and 12,) at opposite sides thereof. The slot 22, which extends slightly below the upper edge of the annular ledge *E'*, receives within it a needle-elevating guide, 24, while the slot 23 at the opposite side, which is somewhat shorter than the slot 22, receives within it a needle-depressing guide, 25. These guides 24 and 25 are held back flush with the inner face of the cam-cylinder *N*, as in Figs. 1, 3, 9, and 11, when the machine is being rotated for the production of tubular fabric, and during the formation of a heel or toe, by the aid of the springs 26 27, each having one of its ends fastened to the guides themselves, the other end of each spring being fastened to the cam cylinder by the screws 26^x.

Assuming that the leg or foot of a sock or stocking is to be knitted, all the needles being then used, the cam-cylinder will be rotated in the direction of the arrow 100, Fig. 3; but the segmental plate *D*, by reason of its friction on the ring *D'* outside the cam-cylinder, will remain at rest until the stud *c'*, then at the lower end of the cam *d'*, has ascended to the highest point of the said cam, lifting with it its attached stitch-cam *C'*, and at the same time the opposite stud, *c*, which at the start

of the cam-cylinder in the direction of the said arrow had rested on the highest point of the cam *d*, will travel down the said cam, permitting the descent to its lowest position of the stitch-cam *C'*, connected to the said stud *c*, which will have the effect of placing the said stitch-cams *C' C'* in the position shown in Fig. 2.

In the formation of the heel or toe of a sock or stocking, or when it is desired to gradually narrow the fabric, the needle elevating guide 24 is pressed in by the finger 28, operated by hand, causing the inner face of the said guide to project within the cam-cylinder *N*, as shown in Figs. 4 and 10 of the drawings, so as, during the rotation of the cam cylinder, to engage with the needles having only the long heels *n*, preferably about one-half, and lift them successively into line with the upper edge of the guide-plates *G'* and *G²*, thus throwing them 20 out of operative position, where they are left, after which the elevating-guide is released by raising the said finger 28 by hand, the spring 26 then acting to withdraw the guide. The tension of the stitches upon the shanks of the needles 25 thus raised will be sufficient to keep them elevated until positively depressed by the needle-depressing guide 25 after the formation of the heel or toe. The spring-engaging handles *H* *H* are then pressed back by hand out of engagement with the catches 20 of the plates 15, 30 the springs 19 acting to bring the cam-shaped or inclined ends *w w'* into the position shown in dotted lines, Fig. 3, and in full lines, Fig. 5, the pins or studs 30 on the uprights or standards *SS'* serving to stop the travel of the plates 15, so as to bring their attached cam-shaped or inclined ends *w w'* always into line with and ready to act upon the pins 1 and 2 of the locking devices *A A'*. The cam-cylinder is then 40 turned for about one-half a revolution to bring it into position directly opposite that shown in the drawings, and the pin 1 of the locking device *A*, by this movement of the cam-cylinder, rides over the inclined way or cam *w*, releasing its contact with the pin *o'* of the needle-lifting latch *l'*, which latch is immediately pressed down by the spring 10, with its notched end *m'* in line with the annular ledge *E'*, as shown in Fig. 6. The cam cylinder is then rotated 50 in a direction opposite that of the arrow 100, bringing the notched end of the needle-lifting latch *l'* in contact with the heel of the first or outermost needle of those employed to knit in narrowing or forming a heel or toe, and the needle engaging the said latch causes the latter to rise in the recess *g* of the guide-plate *G'* until the heel of the needle comes in contact with the inclined end *g'* of the said plate, when the heel of the needle is 60 by the said inclined end *g'* thrown out of the notch of the said latch, and thereafter travels up the said inclined end to a position above the plate *G'*; or, in other words, the upward movement of the said latch effects the lodging of the heel of the needle upon the inclined end *g'* of the guide-plate *G'*, after which 65 the needle so acted upon by the said inclined

end *g'* will be lifted until the heel has passed the spring 31 and rests upon the top of the said guide-plate *G'*, the needle-lifting latch 70 being then prevented, by its locking device engaging the pin *o'*, from falling until the cam or incline *w*, in the motion of the cam-cylinder forward in the direction of the arrow, is again reached, which cam then acts to raise the 75 locking device and release the needle-lifting latch. In the described reverse movement of the cam-cylinder—*i. e.*, in the direction opposite to that indicated by the arrow—the pin 2 of the locking device *A'* rides over the cam 80 or incline *w'*, thereby releasing the pin *o* of the needle-lifting latch *l* and allowing it to drop into line with the annular ledge *E'*, so that its notched end may be brought into engagement with the heel of the first or outermost 85 needle of those employed at the opposite side, elevating it in a similar manner to that above described.

The springs 31 serve to close the channels formed between the guide-plates *G' G² G²* and 90 to prevent the heels of the needles from being caught therein during the reciprocation of the cam-cylinder. Thus one needle at a time is raised from each side of those employed in narrowing the fabric until those needles directly 95 in the center, and indicated by the numerals 8 in Fig. 3, have been reached, which form the shortest course in the heel or toe, when the plates 15, previously brought into position to have their cams or inclines *w w'* co- 100 operate with and trip the locking devices *A A'*, will be again brought back into the position shown in full lines in Figs. 1 and 3, where they are held by the spring-engaging handles *H H*, as described. The needles having thus 105 been elevated one at a time to narrow the fabric, the spring-engaging handles *H' H'* are operated to release the plates 15, which, by their springs 19, are caused to turn, bringing their attached cams or inclines *w² w³* into line to act 110 upon the pins 3 and 4 of the locking devices *A² A³*. The cam-cylinder being still reciprocated and moving in a direction opposite that of the arrow 100, Fig. 3, the pin 3 is brought in contact with the cam or incline *w³*, over 115 which it rides, raising its locking device or arm and releasing the pin or projection *o³*, whereupon the spring 18 will immediately cause the connected needle-depressing latch *l'* to rise in time to engage the heel of the inner- 120 most or last one of those needles previously raised to narrow the fabric, causing it to be lowered simultaneously with the said needle-depressing latch until it has forced the said needle-depressing latch completely into its recess, 125 the downward movement of the said latch lodging the heel of the needle so engaged by it upon the inclined end *g³* of the guide-plate *G²*, down which it travels until it is brought into line with the annular ledge *E'*, where it is in turn 130 acted upon and lifted by the cam *F* to receive yarn from the guide *W*. The pin 4 of the locking device or arm *A³*, in the next movement of the cam-cylinder in the direction of the said

arrow, rides over the cam or incline w^2 , which releases the pin o^1 and permits its attached latch l^2 , through the agency of the spring 18, to rise in time to engage with the heel of the inner-most or last one of those needles at the opposite side of those elevated in narrowing, bringing it into line with the annular ledge E' in a similar manner to that just described.

Both the needle-depressing latches l^1 l^2 are preventing from rising after being depressed or acted upon by the heels of the needles at each alternate reciprocation of the cam-cylinder by the said locking devices A^2 A^3 , which engage with the pins o^3 o^4 , where they are held until released by the cams or inclines w^2 w^3 , as above described. Thus one needle at a time is lowered from those needles elevated in narrowing the fabric until they have all been successively brought into line with the ledge E' , after which they are acted upon by the knitting-cams to widen the fabric to form the pouch for the heel or toe. The finger 29 is then operated by hand to force the needle-depressing guide 25 into its most inward position, as shown in Fig. 12, in which position the heels of the needles, raised previous to the commencement of the heel or toe, are brought by the rotation of the cam-cylinder into contact with the under edge of the said needle-depressing guide, which will have the effect to successively lower the needles into line with the knitting-cam. The finger 29 is then raised, and the spring 27 will withdraw the said needle-depressing guide, when circular knitting may be again resumed.

At each reverse motion of the cam-cylinder it is evident the segmental slide D and its attached cams d d' will act to reverse the position of the stitch-cams C' C'' through their attached studs c c' , so as to form a proper channel for the guidance of the heels of the needles, all as usual.

I have shown an intermediate yarn-guide composed of a cross-piece, B^{10} , fastened by the screw b to the upper end of a vertical rod, R , screwed into the bed-plate, the said cross-piece having an arm, B^{11} , projecting at right angles therefrom, and also provided with the usual guide-eyes, b' , through which the yarn is passed after leaving the bobbins. (Not shown.) The arm B^{11} is shown as provided with a forked end and with a shoulder, B^{12} , in which is made a recess, 35. In front of the shoulder B^{12} , I have provided a finger, F^2 , the free end of which is bent so as to cross the yarn in front of the shoulder B^{12} before the yarn enters the hook h of the take-up lever F' , from which it passes to the yarn-guide W .

The lever F' is fulcrumed to the vertical rod R , and is connected by a spiral spring, R^2 , to a collar, R' , made adjustable on the rod R by the thumb-screw r' , the upward or downward movement of the said collar giving a greater or less tension to the yarn, through the lever F' , in being fed to the needles.

In the reciprocation of the cam-cylinder, and just at the commencement of each reverse movement thereof, any slack in the yarn is taken

up by the take-up lever F' , which immediately rises and draws upon the yarn, at the same time raising the finger F^2 , which grips the yarn between it and the shoulder B^{12} , and, acting as a clamp, prevents any more yarn from being drawn from the bobbins until the surplus yarn, which may be occasioned by any slack, has been taken up by the needles, in which event the take-up lever F' will be drawn down by the yarn until the finger F^2 slightly falls, which will allow more yarn to be drawn from the bobbins.

Should any of the needles employed in narrowing and widening or those unemployed needles which were raised out of the way by any possible chance drop down partially from their elevated position and come in contact with the needle-elevating or needle-depressing latches l^1 l^2 and l^3 , it is obvious the said latches will form resilient contact-points for the heels of the needles, as well as guides to direct them into their proper course, the play of the pins o o' and o^3 o^4 in the slots o^2 o^2 and s' s' and their point of contact with the arms or locking devices A A' and A^2 A^3 being sufficient to permit the needle-elevating and needle-depressing latches to slide back when struck by the heels of the needles so dropping.

I claim—

1. The cam-cylinder, its needle-elevating cam F , and stitching-cams C' C'' , combined with a guide-plate, G' , placed above them, and the sliding needle-elevating latches l^1 l^2 at the opposite ends of the said guide-plate, and arranged to operate substantially as and for the purpose described.

2. The cam-cylinder, its attached annular ledge, and the needle-elevating and stitching-cams, combined with guide-plates G' G^2 and with the needle-depressing latches l^1 l^2 , arranged to slide in the said guide-plates, to operate substantially as and for the purposes described.

3. The cam-cylinder and its attached guide-plates G^1 and G^2 , the said guide-plates being provided with recesses, combined with the sliding needle elevating latches l^1 l^2 and the sliding needle-depressing latches l^3 l^4 , the said latches being provided with notched ends to engage the heels of and elevate or depress the needles when required, substantially in the manner and for the purposes described.

4. The needle cylinder and its needles, and the cam-cylinder provided with inclined slots and attached guide-plate, and the notched needle-lifting latches provided with outwardly-projecting pins entering the said inclined slots of the cam-cylinder, combined with locking devices to co-operate with and engage the pins of the needle-lifting latches, and means, as described, to move the cam-cylinder, substantially as set forth.

5. The needle-cylinder and its needles, and the cam-cylinder provided with inclined slots and attached guide-plates, and the notched needle-depressing latches provided with outwardly-projecting pins entering the said slots

of the cam-cylinder, combined with locking devices to co-operate with and engage the pins of the said needle-depressing latches, and means, substantially as described, to move the cam-cylinder, substantially as set forth.

6. The needle-cylinder and its needles, and the cam-cylinder provided with inclined slots and attached guide-plates, the needle-elevating and needle-depressing latches, each provided with pins or projections, as described, and the locking devices having attached pins, combined with releasing devices, substantially such as described, to co-operate with said locking devices to release them from engagement with the pins of the needle-lifting and needle-depressing latches and allow the said needle-lifting or needle-depressing latches to fall or rise, and means to move the cam-cylinder, substantially as and for the purposes described.

7. The needle-cylinder, its needles, the cam-cylinder, its attached ledge E' , guide-plates G' and $G^2 G^2$, and the needle-lifting latches $l' l'$ and needle-depressing latches $l^2 l^2$ and their co-operating devices, substantially as described, adapted to engage with the heels of and elevate or depress the needles when desired, and the stitch-cams $C' C'$ and needle-elevating cam F , provided at one inclined edge with a flange, p , combined with a slide-piece, p' , at its opposite inclined edge, the said slide-piece being movable within a correspondingly-shaped slot in the cam-cylinder, substantially as described.

8. The cam-cylinders slotted at y and provided with stitch-cams and a needle-elevating cam having at one of its inclined edges an outwardly-projecting rib or flange and at its other edge a slide-piece working within the said slot y and having an elongated threaded shank, and a nut, B , engaging the said shank and provided with a pin, combined with a spiral spring surrounding the shank of the said slide-piece and with

a hub or sleeve fastened to the cam-cylinder and inclosing the said spring, the said hub or sleeve having a recess to co-operate with the pin of the said nut, as described, and for the purposes set forth.

9. The cam-cylinder N , having pivoted thereto the arms $A A'$ and $A^2 A^2$, provided with locking shoulders and pins 1 2 and 3 4, combined with the springs $v v$, needle-lifting and needle-depressing latches $l' l'$ and $l^2 l^2$ and their attached recessed pins $o o'$ and $o^3 o^4$, and the springs 10, 11, and 18, substantially in the manner and for the purposes described.

10. The needle-cylinder and its needles and the cam-cylinder provided with inclined slots 22 and 23 and with fingers 28 and 29, combined with a needle-elevating guide, 24, adapted to enter the slot 22, and a needle-depressing guide, 25, adapted to enter the slot 23, and the springs 26 and 27, substantially as and for the purposes described.

11. The needle-cylinders, the needles therein, the cam-cylinder, needle elevating and depressing latches, the locking devices $A A'$, pivoted thereon and provided with projecting pins, and the plates 15, provided at one end with cams or inclines $w w' w^2 w^3$ and with catches 20, uprights or standards $S S' S^2 S^3$, and screws 19, by which to pivot the said plates to the said standards, and locking devices $A^2 A^3$, combined with the spiral springs 21 and the spring-engaging handles $H H$ and $H' H'$, substantially in the manner and for the purposes described.

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

WILLIAM HOWES MAYO.

Witnesses:

G. W. GREGORY,
F. CUTTER.