

No. 616,600.

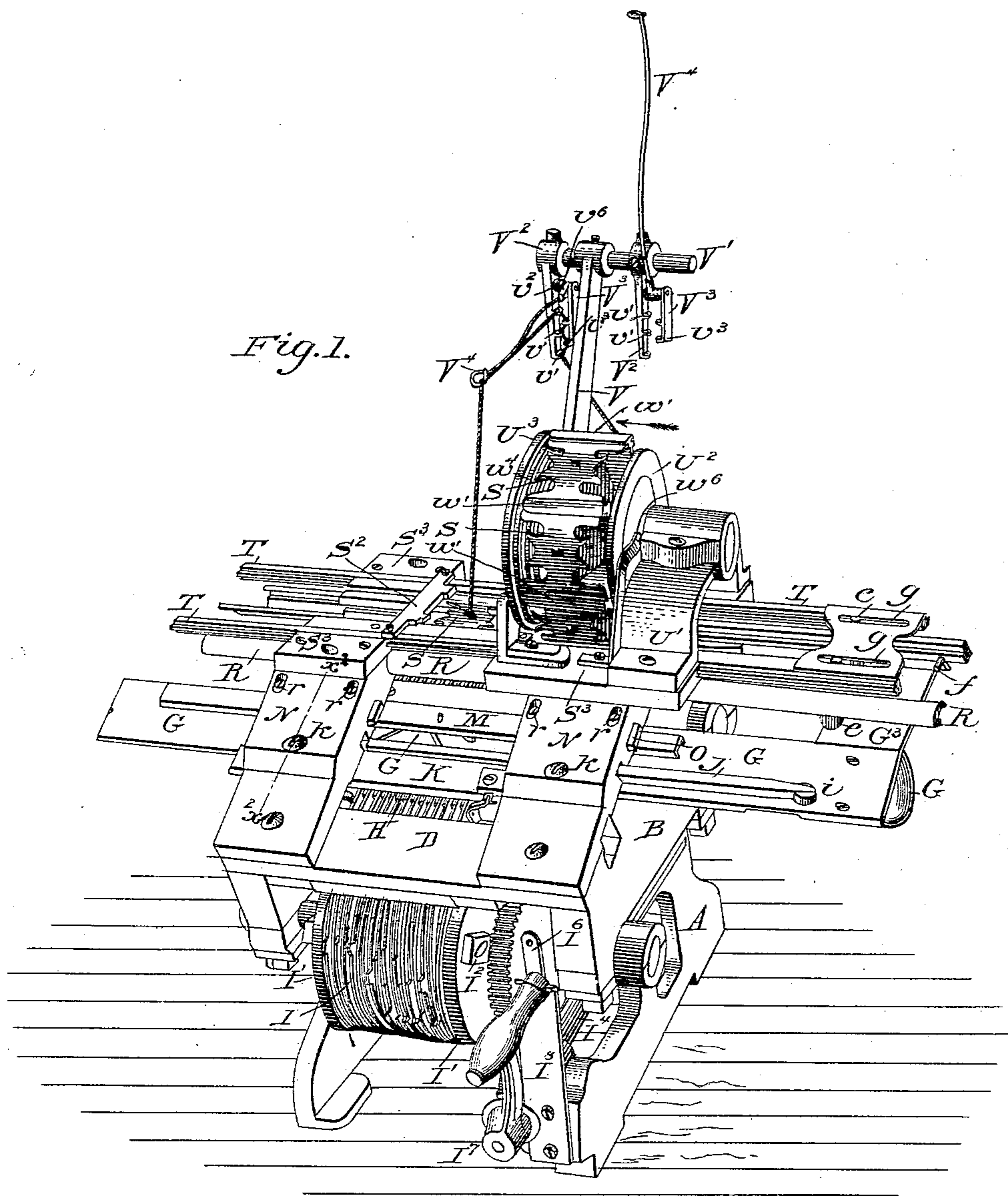
Patented Dec. 27, 1898.

W. W. BURSON.
KNITTING MACHINE.

(Application filed Mar. 13, 1886.)

(No Model.)

10 Sheets—Sheet 1.



Witnesses.

Inventor.

Samuel J. Wallace,

Fred A. Schmidt

William North Burson.

No. 616,600.

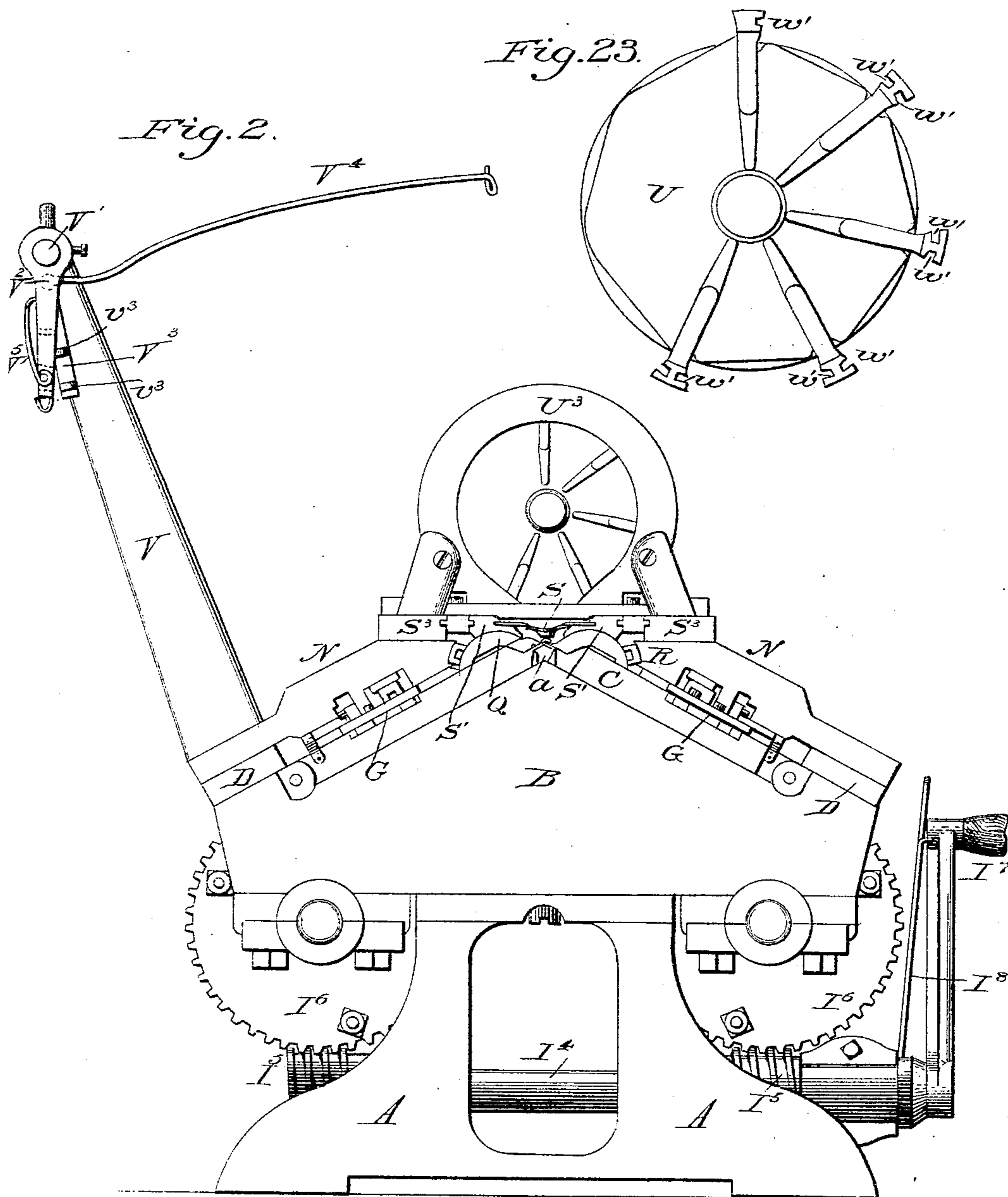
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10 Sheets—Sheet 2.



Witnesses.

Inventor

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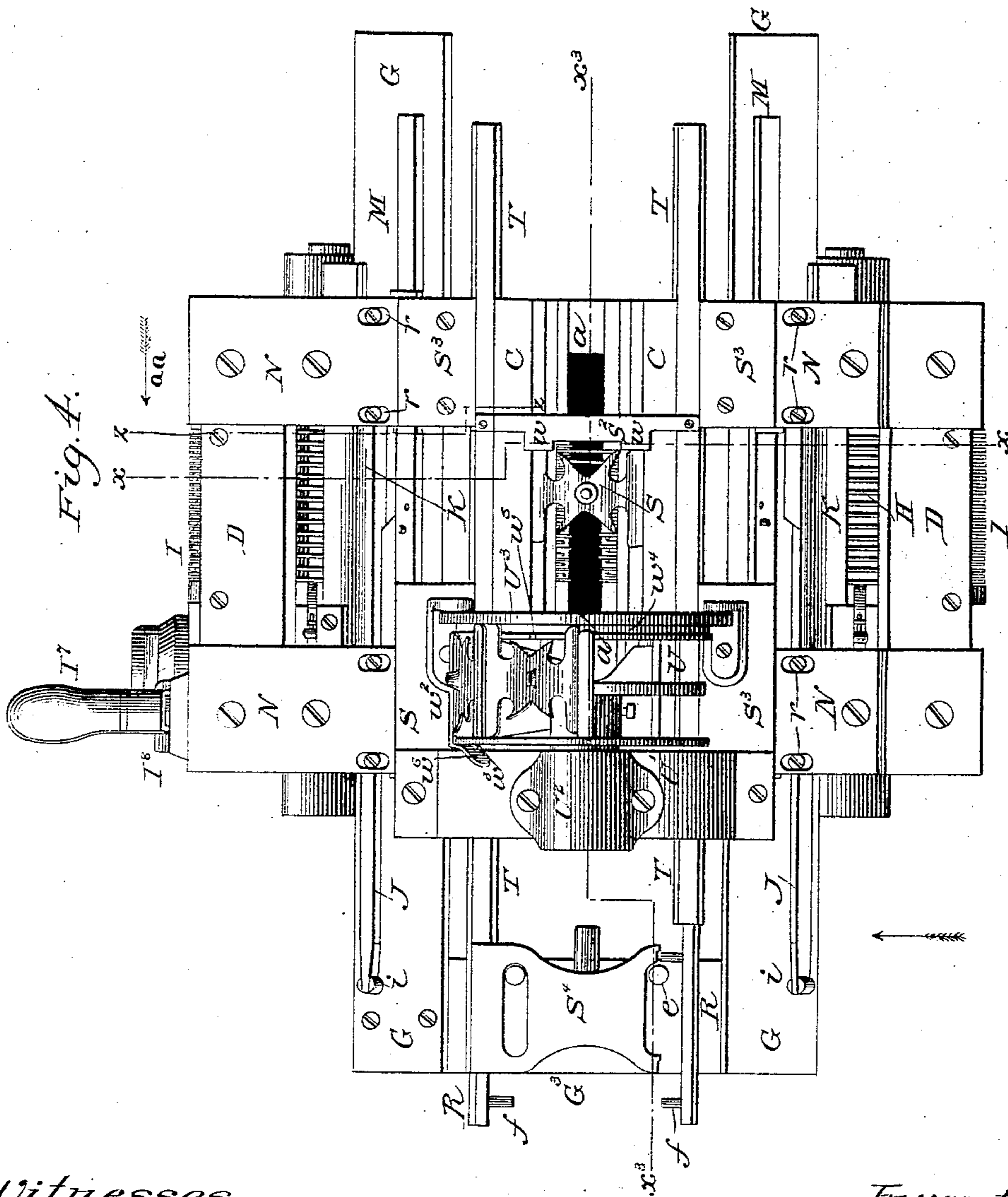
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Fig. 5.

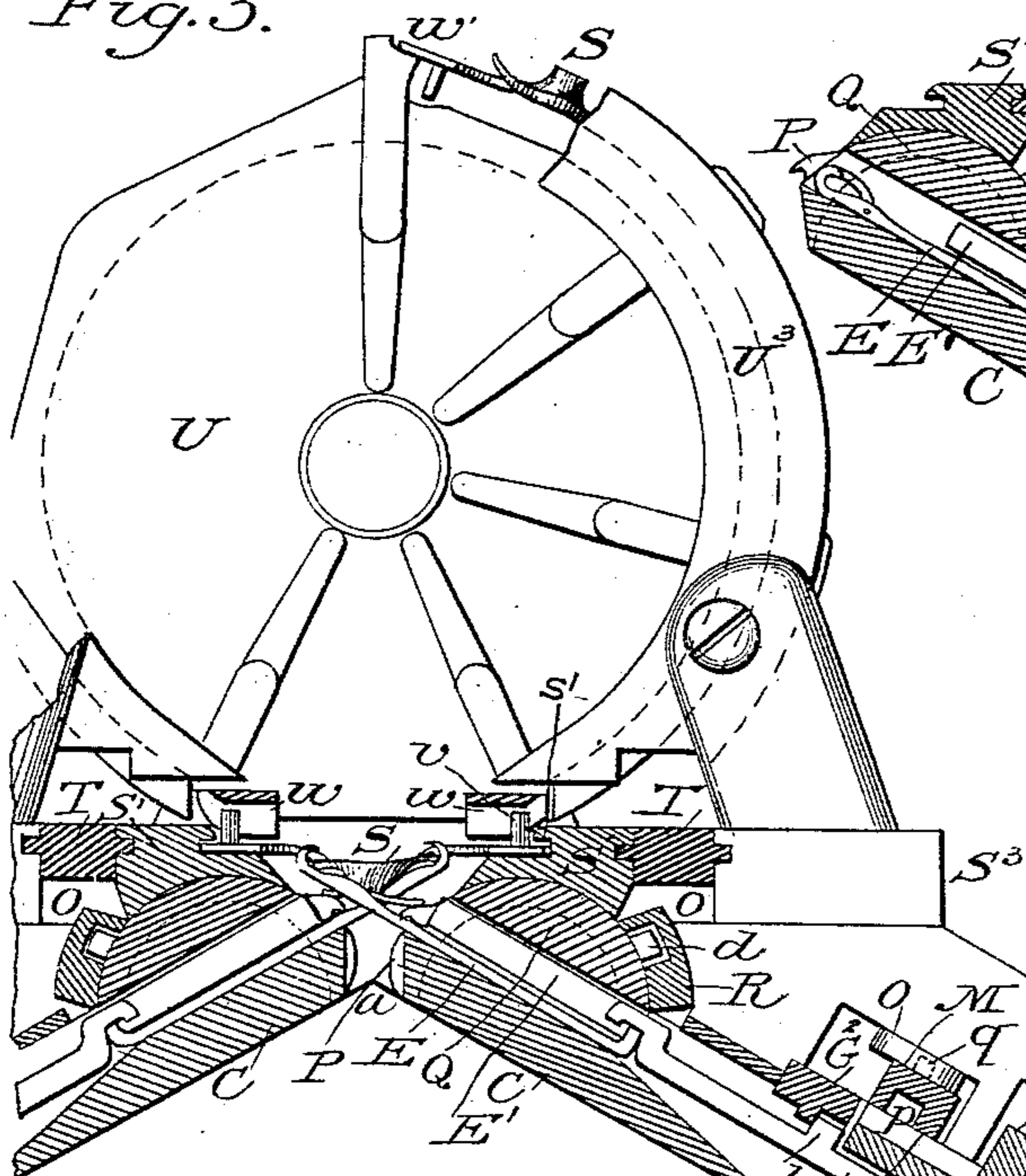


Fig. 6.

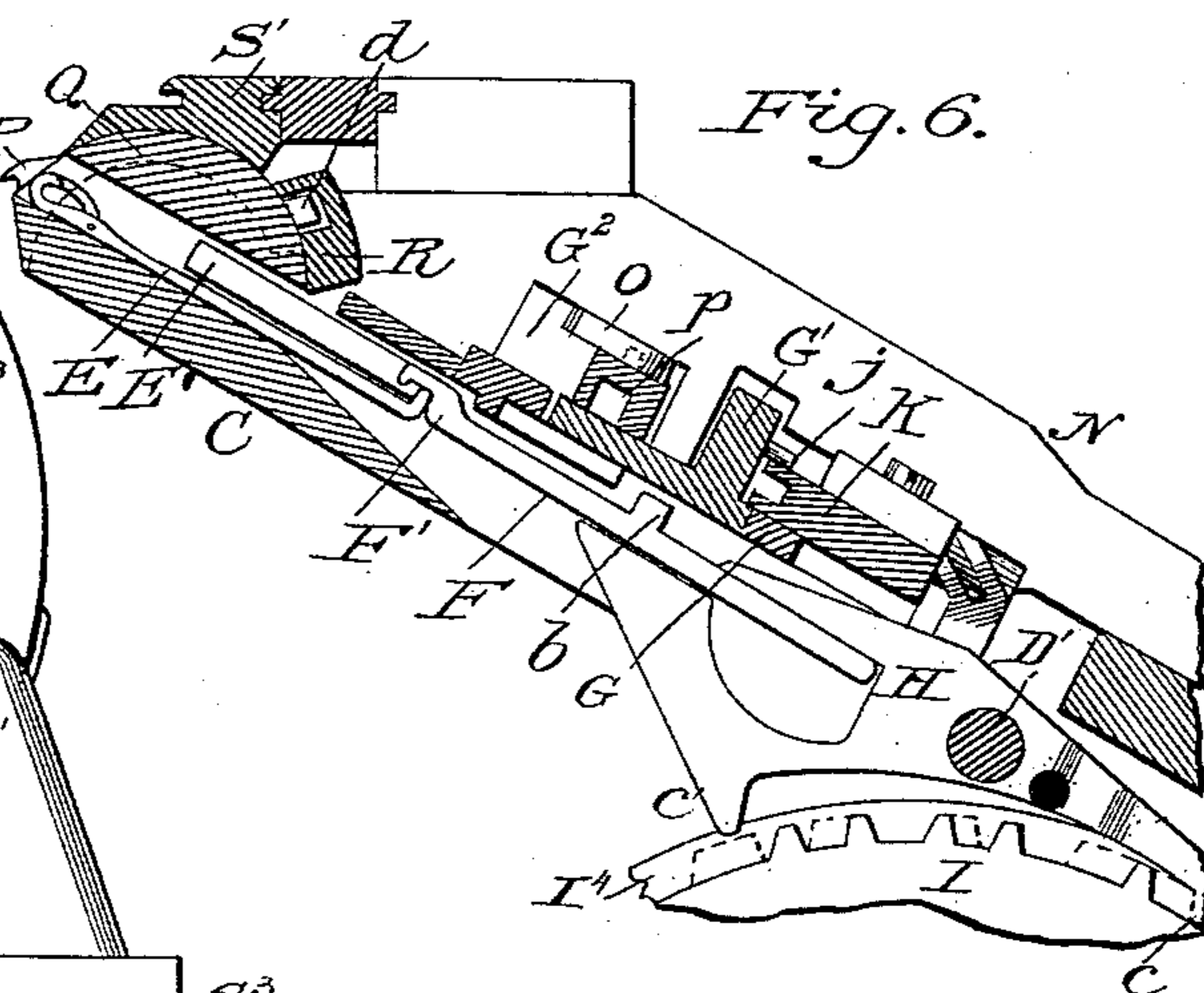
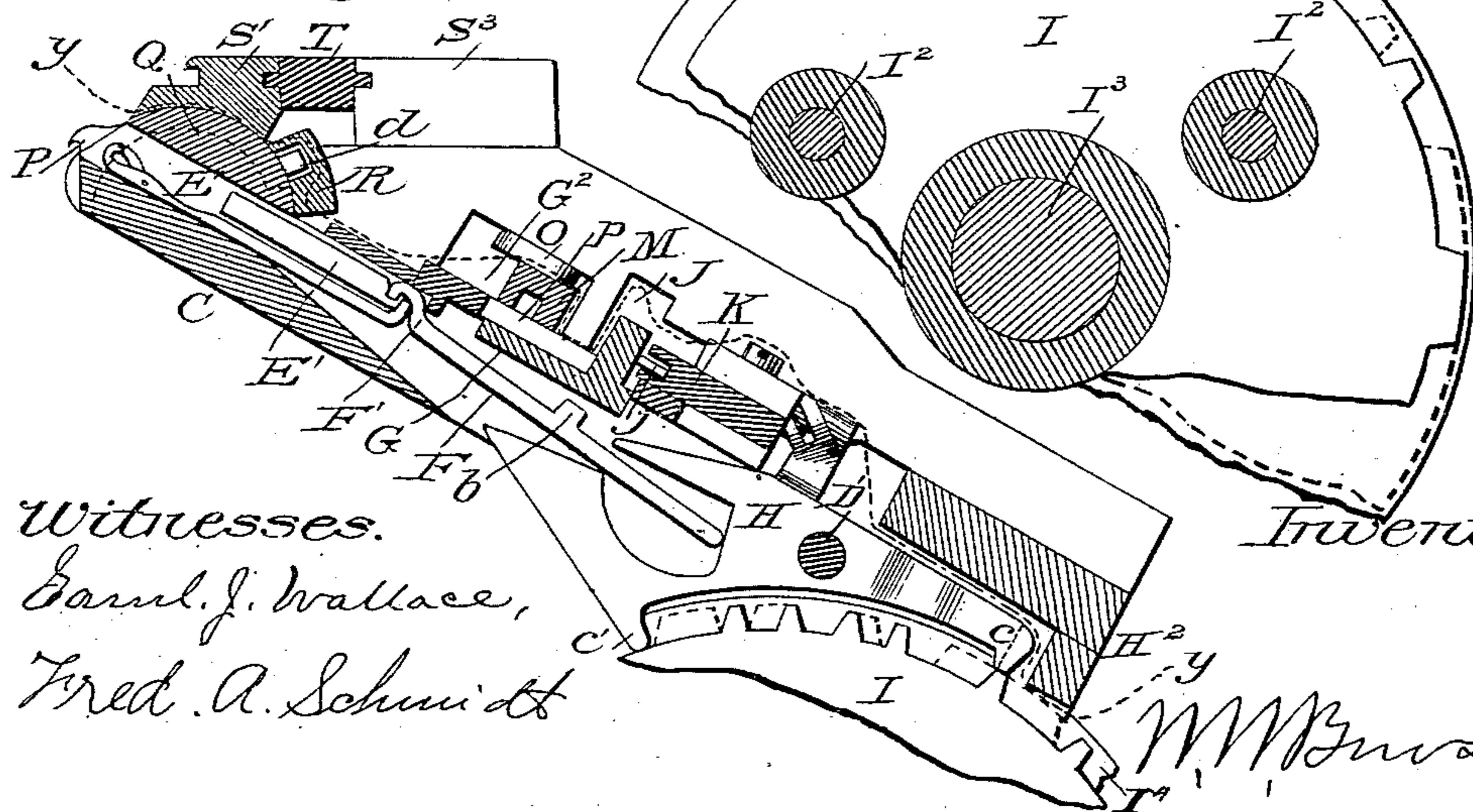


Fig. 7.



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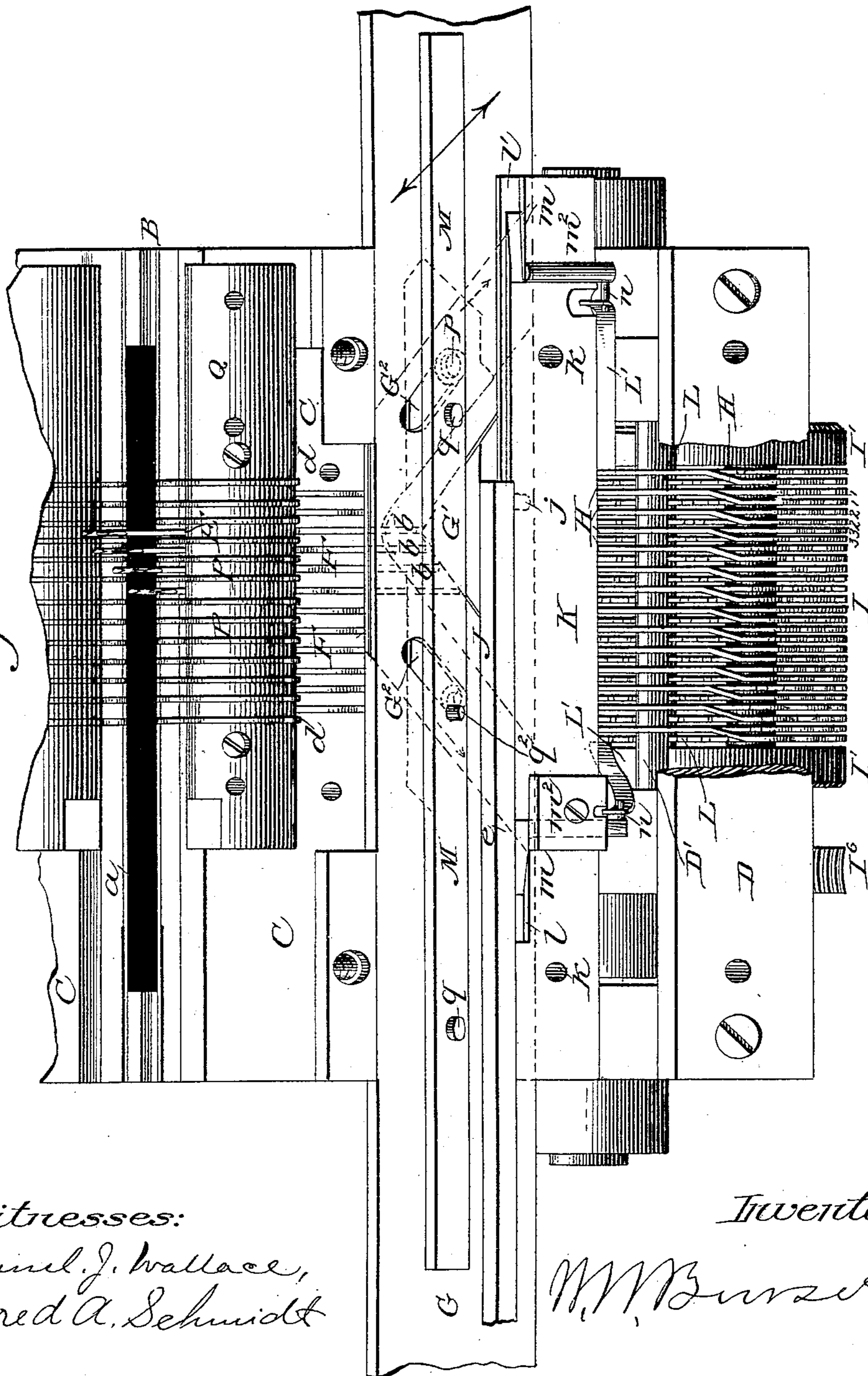
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Fig. 8.



Witnesses:

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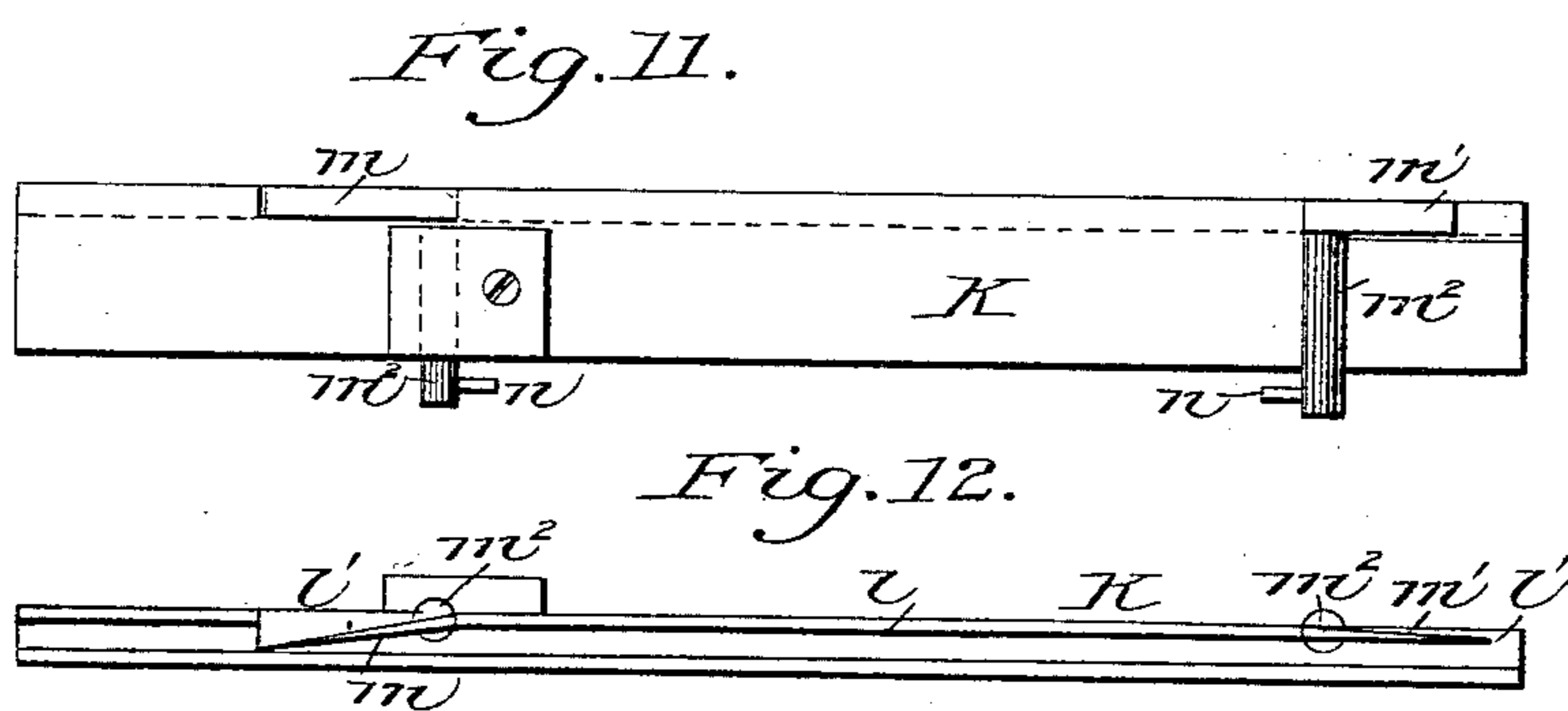
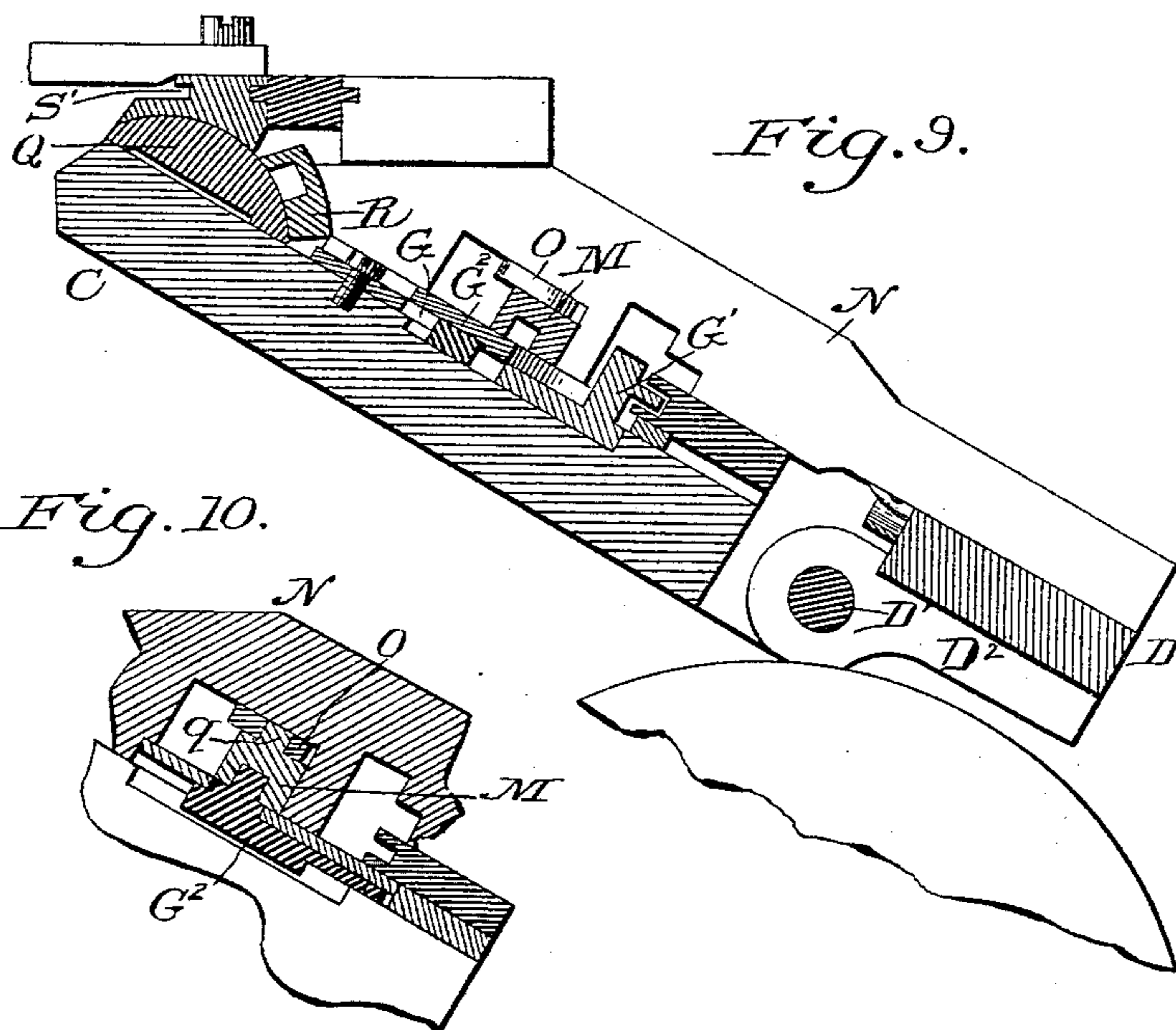


Fig. 24.

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(No Model.)

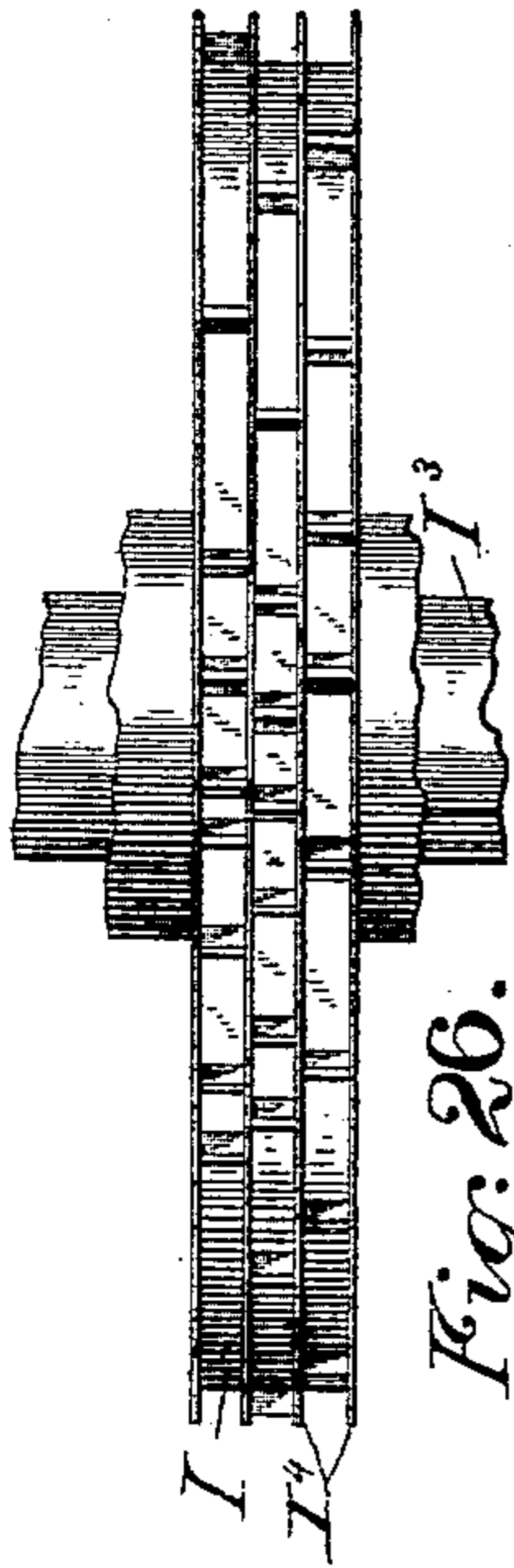


Fig. 26.

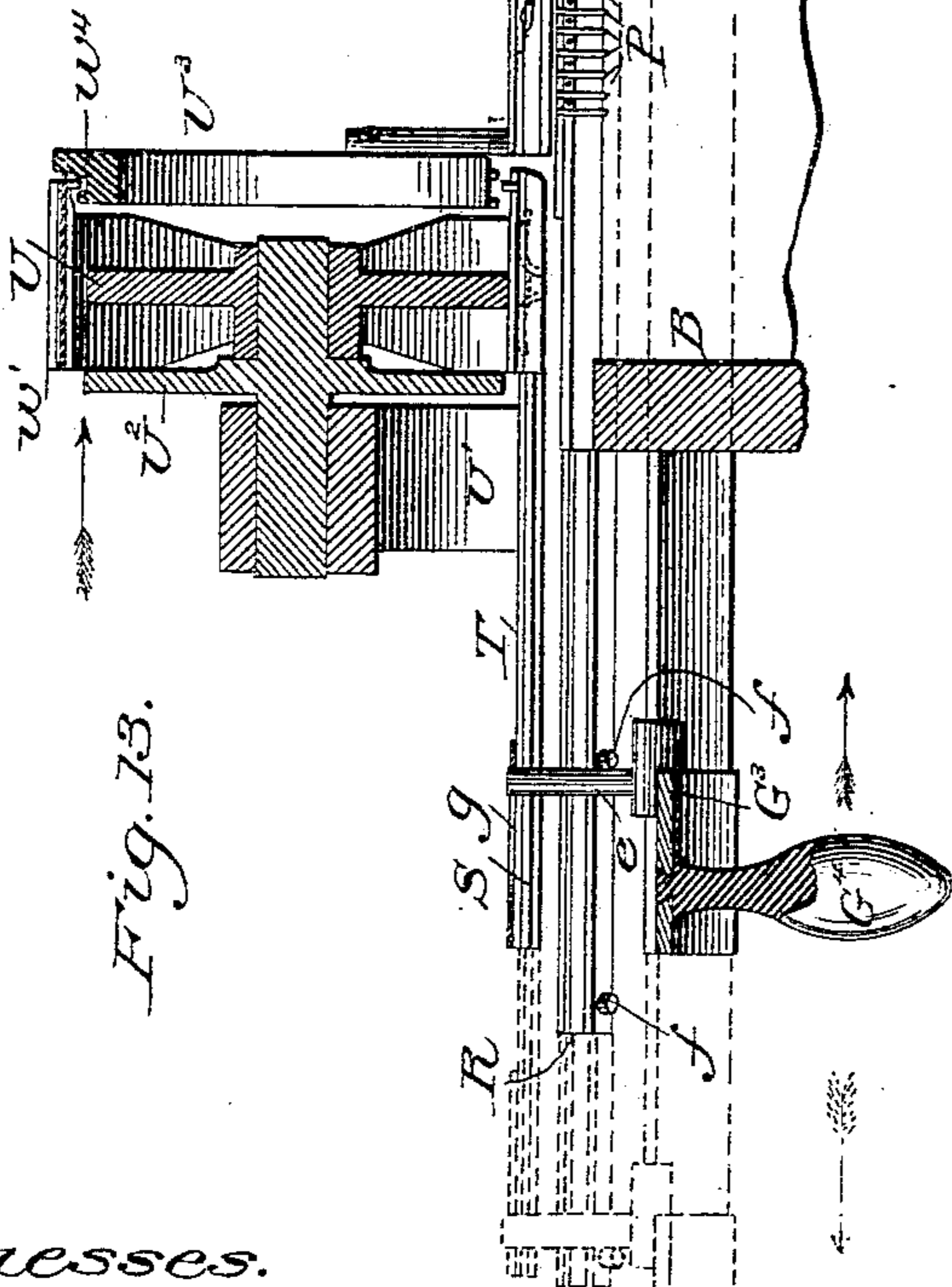


Fig. 13.

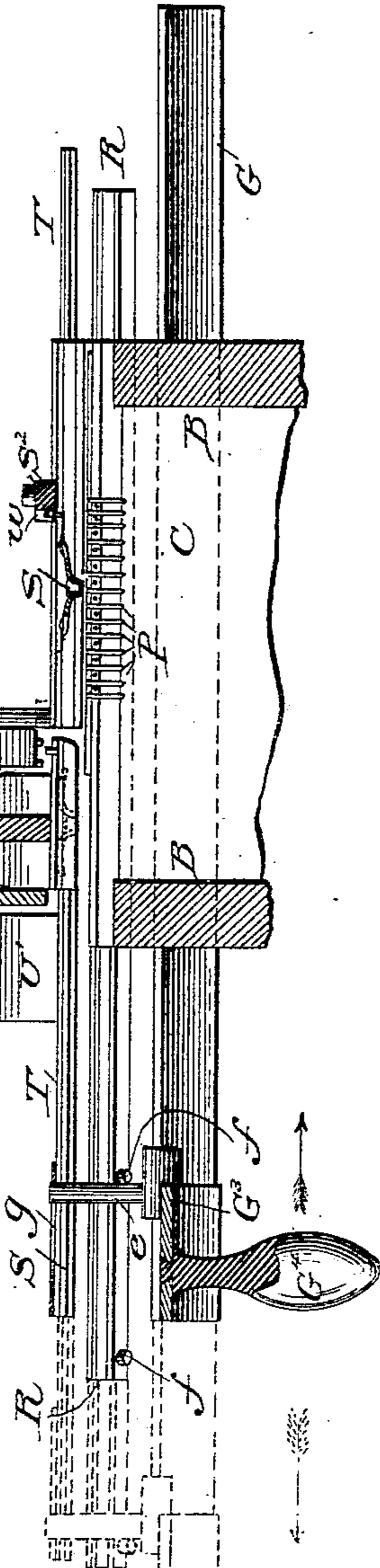
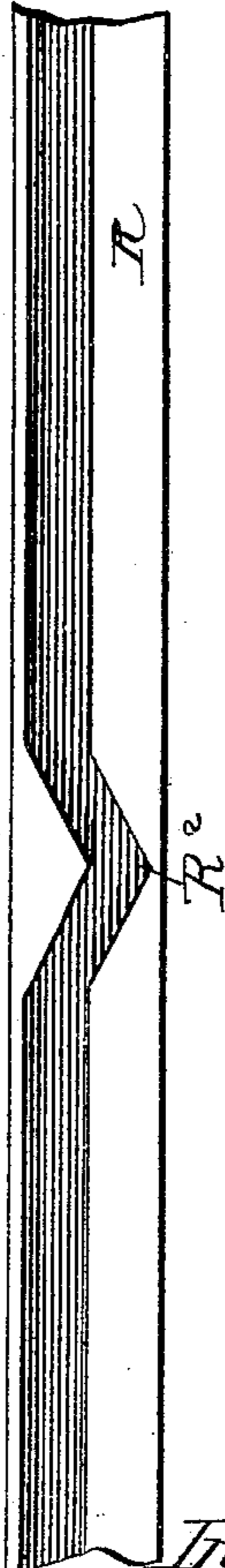
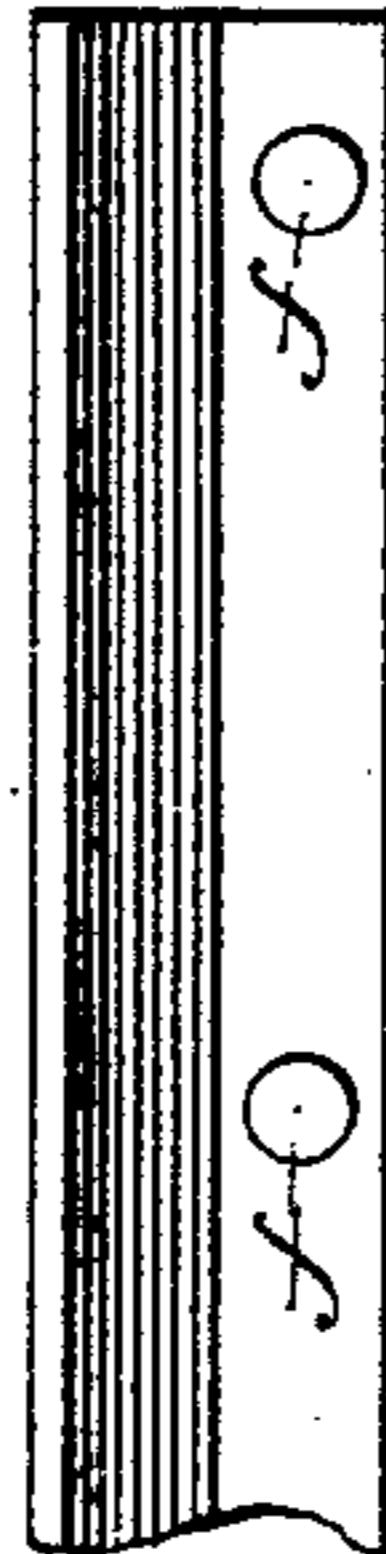


Fig. 14.



Witnesses.

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Fig. 15.

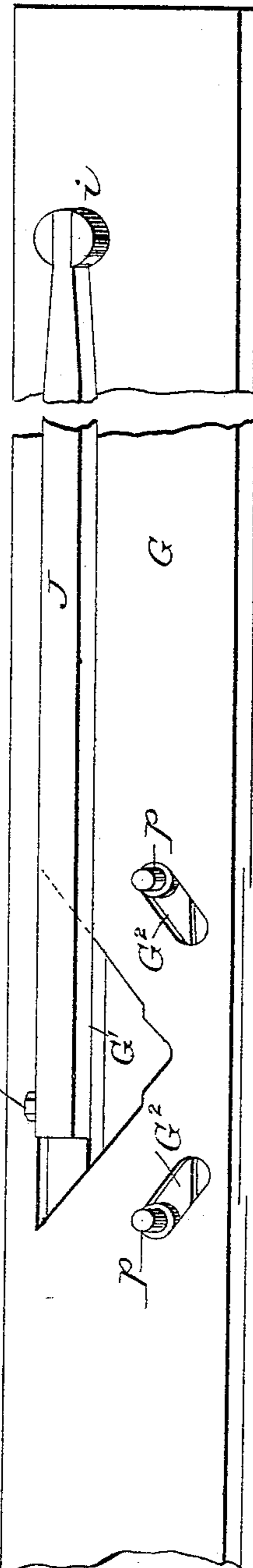


Fig. 16.

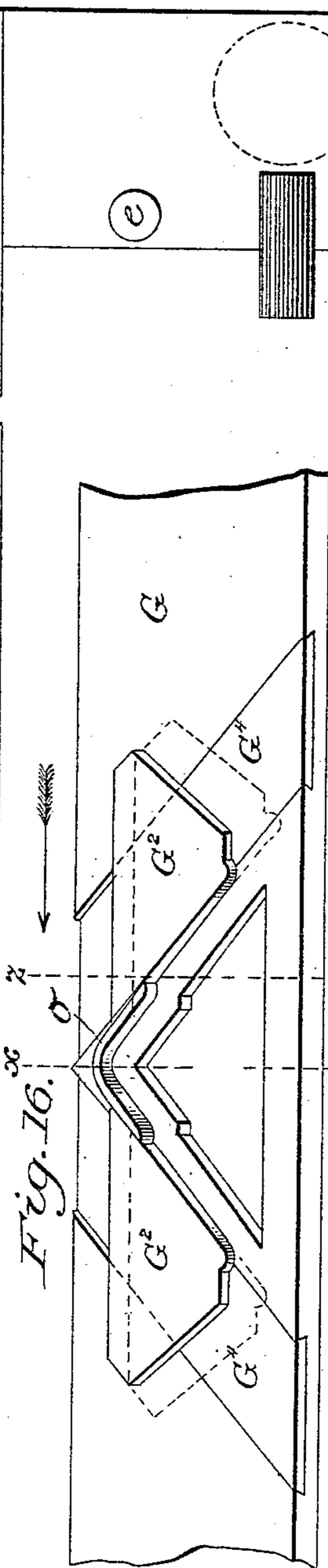
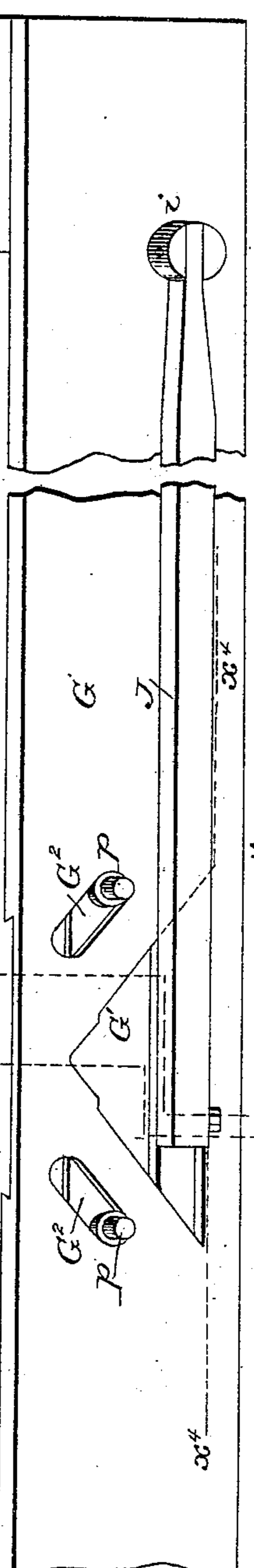
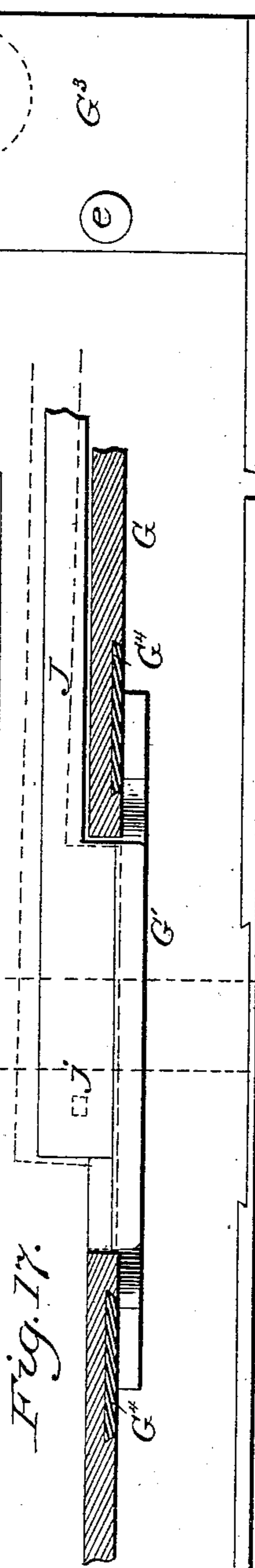


Fig. 17.



Witnesses.

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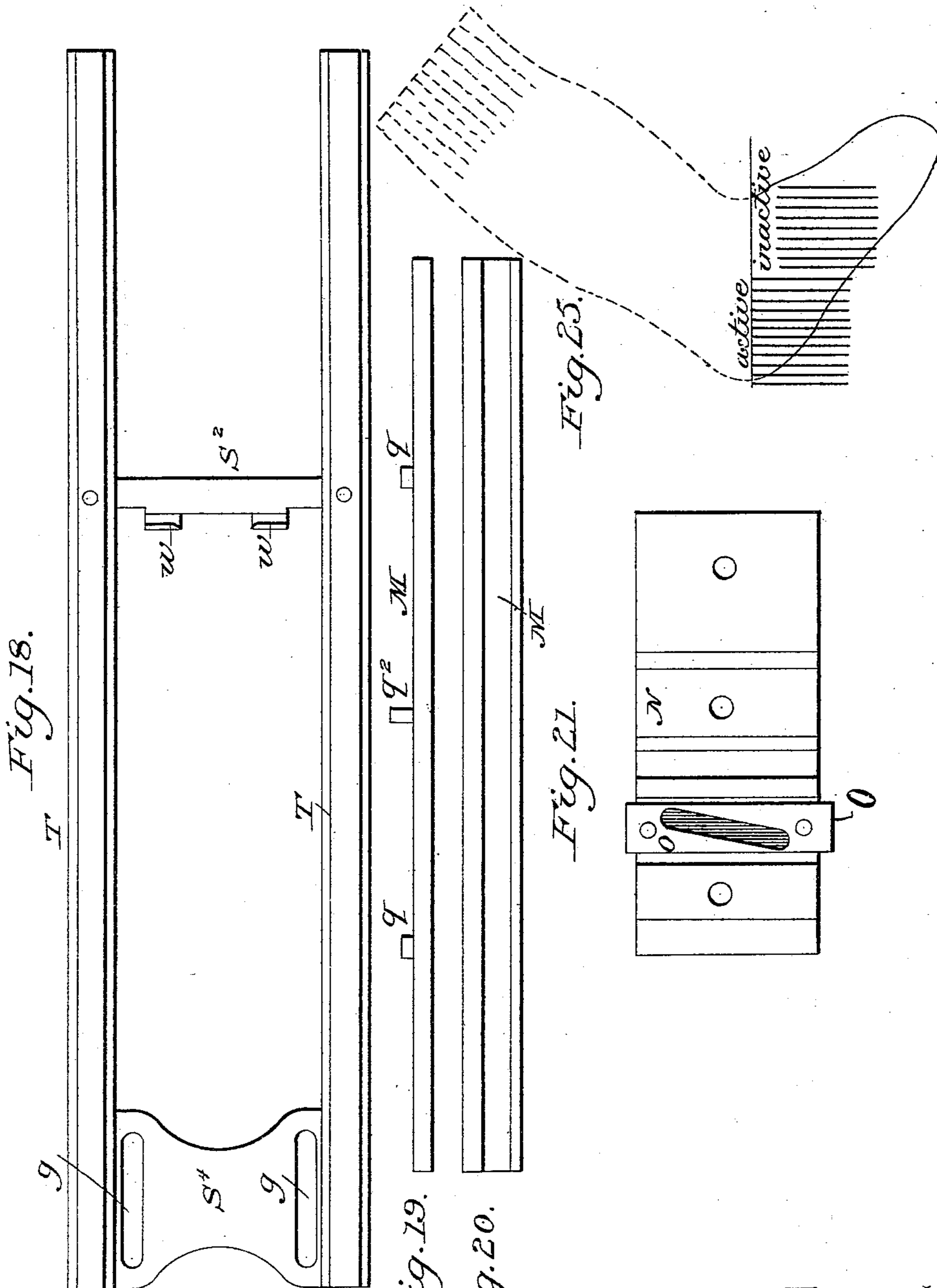
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10 Sheets—Sheet 10.



Witnesses.

Samuel J. Wallace,
Fred A. Schmidt

Fig. 19.

Fig. 20.

Fig. 21.

Fig. 23.

Inventor.

William Worth Burson,

UNITED STATES PATENT OFFICE.

WILLIAM WORTH BURSON, OF CHICAGO, ILLINOIS.

KNITTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 616,600, dated December 27, 1898.

Application filed March 13, 1886. Serial No. 195,111. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM WORTH BURSON, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Knitting-Machines, of which the following is a specification.

This invention relates to knitting-machines of the class having needles set in straight parallel rows.

It consists in a peculiar general construction and arrangement and in many details therein, substantially as set forth and claimed hereinafter and as illustrated in the drawings, in which—

Figure 1, Sheet 1, shows the machine in perspective. Fig. 2, Sheet 2, is an end elevation of the same. Fig. 3, Sheet 3, is an end elevation of the entire machine from the end opposite to that shown in Fig. 2 with a portion of the frame broken away to show the worm-gear for operating the two pattern-cylinders. Fig. 4, Sheet 4, is a plan view of the whole machine with the arm V and its attachments removed. Fig. 5, Sheet 5, is an enlarged sectional view through the line xx of Figs. 4, Sheet 4, and Figs. 15, 16, and 17, Sheet 9, looking in the direction of the arrows $a a$ and showing the relation of the pattern-cylinder, shifting levers, needle-jacks, and actuating-cam, the latter being down in position to operate against the needle-jack lugs and the needles being projected to their utmost throw in position to be operated upon by the latch-opener on the yarn-carrier. Fig. 6, Sheet 5, is a similar section of a number of the same parts, taken in the same plane and showing the needle-actuating cam raised out of range of contact with the needle-jack lugs. Fig. 7, Sheet 5, is a similar view in the same plane, but showing the needle-jacks depressed by the shifting levers and pattern-cylinders, so that the needles are thrown out of work for both reciprocations of the cam-slides. Fig. 8, Sheet 6, is a plan view of one-half of the machine, taken on line $y y$ of Fig. 7, the parts above said line being removed. Fig. 9, Sheet 7, is a vertical section through the line $z z$ of Fig. 4, Sheet 4, and Figs. 15, 16, and 17, Sheet 9, looking in the direction of the arrows $a a$. Fig. 10, Sheet 7, is a vertical section through line $x^2 n^2$ of Fig. 1, showing the relation of the tension-

bar to its operating cam-groove. Figs. 11 and 12, Sheet 7, are details of the track-plate. Fig. 13, Sheet 8, is a vertical longitudinal section of the upper portion of the machine, taken through the line $x^3 x^3$ of Fig. 4, Sheet 4. Fig. 14, Sheet 8, is a detail of the hook-actuating cam-bar, looking into its cam-groove. Fig. 15, Sheet 9, is a top view of the needle-actuating slides and their constructions, showing the symmetrical or corresponding construction for the opposite sides of the machine. Fig. 16, Sheet 9, shows the needle-moving cams as seen from below or turned over, the full lines of cams $G^2 G^2$ showing their position for doing tight or close work and the dotted lines their positions for loose stitches, and cam G' being raised to avoid knitting. Fig. 17, Sheet 9, is a longitudinal section taken through the line $x^4 x^4$, Fig. 15, and looking in the direction of the double arrows. Fig. 18, Sheet 10, is an underneath view of the yarn-carrier slides and warp-bar. Figs. 19 and 20, Sheet 10, are respectively a side view and an underneath view of the tension-bar. Fig. 21, Sheet 10, is an underneath view of block N. Fig. 23, Sheet 2, is a side view of yarn-carrier wheel U. Fig. 22, Sheet 3, is the yarn-carrier. Fig. 24, Sheet 7, shows hook P. Fig. 25, Sheet 10, is a diagrammatic view looking at right angles to the rows of needles and showing which portion of each row of needles is active and which inactive in rounding the heel of a sock. Fig. 26, Sheet 8, is a detail of the pattern-wheel.

Similar letters refer to the same part throughout the several views.

The machine has end frames B, with legs A and top parts N, which are connected with cross parts C, Q, G' , K, D, and H^2 in duplicate. It has two parallel rows of needles working in needle beds or holders C, set at an angle of about thirty degrees, so their points will cross when advanced in knitting and with a space a between the proximate edges of said needle beds or holders for the descent of the fabric. It also has two sets of pattern-cylinders I and slides G, R, T, and M, one set for each row of needles parallel thereto and connected together in pairs, and various other operating parts and details.

The needles E are of the kind known as "latch-needles," and have shanks turned up

at their outer ends. They reciprocate in grooves in needle plates or beds C, which have covers Q, supporting certain parts above. These needle-grooves are of greater depth than the height of the shanks of the needles, and the needles are operated by jacks F, which connect with the shanks of the needles by hooks F'. Filler-pieces E', which also are engaged by said hooks, fill up the spaces above the needles to the covers of the grooves, so as to enable the needles to be held firmly and truly, while leaving them free to reciprocate and also to be taken out with their jacks without removing the groove-covers. The jacks F have pins or lugs b, on which cams act to move the needles back and forth in knitting. The jacks F are acted upon by levers H at their outer ends, so as to enable the said jacks to be raised to bring the lugs or pins b into contact with the cams for operating them or to be lowered to hold any particular needle out of action without dropping its loop. The levers H are pivoted on a rod D', which latter is held at its ends in blocks D², Fig. 9, which are attached to cross-bar D, and each lever H has two points c c' on opposite sides of the pivot of the lever to engage with projections on the corresponding pattern-cylinder. These two points are put so as to fit onto separate disks in the cylinders, one to throw the needle into action and the other out of action—that is to say, one point is offset laterally slightly with respect to the other point. These levers H have a peculiar formation to engage with jacks F—that is to say, each of such levers has an open space H' to receive the end of the corresponding jack when the latter is drawn down and a projecting point H¹⁴ to hold the said jack up when knitting. These levers play in vertical slots or grooves in the parts H², whereby they are retained from lateral displacement and are held over the pattern-cylinders I, so as to engage properly with the disks therein and with the needle-jacks.

The machine has two slides G G, arranged to move in seats in frames B B and connected by a cross-bar G³, bearing a handle or pin G⁴, by which they are pushed back and forth to operate the machine by any suitable motor, either hand or power. These slides are flat plates, and near their centers triangular spaces are cut through them for the reception of advancer-cams G' G', (see Figs. 15, 16, and 17, Sheet 9,) having their lower sides parallel with those of the slides. These cams are held on the free ends of bars J J, the latter being located on top of the slides and extending from cams G' G' toward the handle or pin G⁴, the ends thereof which are adjacent to said handle being hinged to the slides at i i, so that the cams may be moved up and down in said spaces. This construction permits the said cams to be moved in said spaces or slots in the slides either down into engagement with the lugs b of the jacks, so as to advance the needles, or up, so as to ride over

said lugs and allow the needles to remain at rest. The position of each cam is regulated by a laterally-projecting pin j, attached to each bar J near the corresponding triangular cam, which pin travels in a grooved track l in plate K, Fig. 5, Sheet 5, Fig. 8, Sheet 6, and Figs. 11 and 12, Sheet 7. This groove is provided with a switch m or m' at each end, which switches are each mounted on a rock-shaft m², held in bearings in the track-plate. The said rock-shafts each have upon the side of the track-plate opposite the switches an arm n, Figs. 8, 11, and 12, adapted to be operated upon to change the position of the switches. When both switches m m' of a given plate K are elevated or parallel with the track-grooves l, the pin j of the corresponding bar J, carrying a triangular cam G', simply moves back and forth in the groove l in the position shown in Fig. 5, and in this position the triangular cam is low enough to strike the lugs b of the needle-jacks and operate the needles at both the forward and the backward movement of the cam-slides, one face of the triangular cam advancing the needles at one stroke and the other face of said cam advancing the needles at the return stroke, the needles being drawn back in the interval by the retracting-cam, as hereinafter described. If one switch m of a given plate K be down, as shown at the left-hand side of Fig. 12, then at one stroke of the slide G the pin j will travel in the groove l and the needle-advancing cam G' will be made to operate the needle-jacks, while the return stroke will be made with pin j upon the upper side of the track-plate, as in Fig. 6, and cam G' will be above the needle-jack lugs, and hence the needles will remain at rest. If both switches m m' of the plate K are thrown down into an inclined position, the pin j will always ride on the top of the track-plate and the advancing needle-cam G' of that side will always be held out of range with the needle-jacks for both strokes. It will thus be seen that in addition to the individual adjustment of the needle-jacks by the movement of levers H all of the needles may be operated collectively twice for every complete reciprocation or once for every complete reciprocation, or they may be entirely thrown out of action. The effect of these several adjustments of the four switches and of levers H is as follows: When the switches are all up, the pins j j reciprocate back and forth in the grooves l l, and all the needles on both sides are operated at every forward and backward movement, a flat ribbed fabric being the result of such knitting. When one switch is down on each side and on opposite ends of the machine, on the advance movement the needles on one side knit and on the return are quiescent, while on the opposite side on the advance they are quiescent and on the return they knit, thus knitting forward on one side and back on the other. This produces plain tubular fabric,

such as the plain portions of a sock. For turning the heel of a sock the needles of each row which would knit the instep portion are thrown out of range of the operating-cam by their individual adjusting-levers H, so as to be inactive, as indicated in Fig. 25, Sheet 10, and fullness is given to the ball portion of the heel by knitting forward on one side with the active portion of the needles and back on the same side, then forward on the opposite side through the active section of needles and back upon the same side. In knitting the heel as herein described the pattern-cylinder should be turned one step for each round, so that a change of one or more needles can be made on each side for each stroke of the cam G'. These changes, except the last mentioned, are controlled by the four switches, and the changes are effected automatically by the pattern-cylinders, as follows: For each of the four switches there is a rocking lever L, Fig. 8, Sheet 6, similar to levers H, which levers L are arranged at the ends of the series. Each lever L has toes that are acted upon by the pattern-cylinder, each such lever having also a slotted spring-arm L', that extends from the said lever to and embraces the arm *n*, which controls the position of the adjacent switch. The sections of the pattern-cylinder operating these levers L are properly laid off as to the timing of the changes in the switches, and when the proper point is reached the levers are moved by the pattern-cylinder, the rock-shafts *m*² *m*² are turned through the spring-arms L' L', and the switches *m* and *m*' are moved to divert the paths of the pins *j j* and give the necessary change in the action of the advancing-cams G' G' upon the lugs of the needle-jacks. The arms L' are made in the form of springs to allow the switches to be yielding, so that the pins *j j* can readily pass under the same when down.

The retracting-cams G² G², Fig. 8, Sheet 6, and Fig. 16, Sheet 9, for the needles act immediately after the advancing-cams and are made adjustable to prolong or diminish the downward stroke of the said needles to secure a greater or less length of loop, these cams G² G², respectively, having inclined faces parallel with the adjacent edges of the advancing-cams G' G' and just far enough from the same to allow the lugs of the needle-jacks to pass between. The continuation of the retreating wall of each pair of retracting-cams G² G² is made at the apex of the corresponding triangular advancing-cam G' by an angular lip *o*. The sides of each cam G' are cut away at the apex, so as to give room for the passage of the lugs *b* between the apex of cam G' and the corresponding lip *o*, which lip, in consequence of fitting nicely the faces of the corresponding pair of retracting-cams G² G², permits the latter to be drawn down without breaking the continuity of the cam-groove, which is thereby enabled to be made of uniform size throughout. For varying the length of the groove between each of the advancing-cams G' and its

adjacent pair of retracting-cams G² G² the latter cams, respectively, are made adjustable in a line parallel with the respective face of cam G'. This will vary the distance the needle is drawn backward, and when proper means of adjustment is provided the whole constitutes a means of knitting loose or tight. In making the retracting-cams G² G² adjustable they are attached to slides G⁴ G⁴, which slides are retained in undercut grooves in the bottom side of the corresponding cam-slide G, which grooves are made parallel with the faces of the advancing-cam. To the upper sides of these retracting-cams G² G² are attached studs *p p*, Fig. 5, Sheet 5, Fig. 8, Sheet 6, and Fig. 15, Sheet 9, which pass through oblique and converging slots in the slide G and enter also a straight groove in the channeled adjuster-bar M, resting above the slides G. The two bars M M, Figs. 19 and 20, Sheet 10, have in turn studs *q q*, Figs. 5, 8, 10, and 19, upon their upper sides, which enter oblique grooves in the cam-plates O O, Figs. 10 and 21, fixed adjustably to the under sides of the guide-blocks N N. When the needles have advanced and are nearing the end of their downward stroke, if a longitudinal movement has been given to the channel-bar M its studs *q q* in traversing the oblique grooves in the corresponding pair of fixed plates O O will cause the said channel-bar to have a parallel lateral movement in a downward direction, as indicated by the double-pointed arrows, Fig. 8, and this movement, acting upon the studs *p p* of the retracting-cams G², throws said cams farther down, as shown in dotted lines, Fig. 16, and by prolonging the downward movement of the needles makes the loops longer, and hence the knitting looser. For varying the length of loops the grooved plates O O are adjustably secured to the guide-blocks N N by slots and screws *r*, Figs. 1 and 4, so that said plates may be adjusted higher or lower along the inclined bed.

The presser-hooks P P, Fig. 24, Sheet 7, are made of curved sections, which are arranged in transverse parallel slots in the cylindrical segmental bar Q, Figs. 5 and 8, and alternate with the needles. The hooked ends of these presser-hooks project slightly into the slot or space *a*, while their lugs *d*, projecting from their rear ends above the curved surface of the segmental bar, enter cam-grooves in the hook-actuating cam-slides R R, one of which last reciprocates in guideways *o o* in the guide-blocks N N on each side of the machine and each of which is provided with tappets *f f*, Fig. 4, Sheet 4, and Fig. 13, Sheet 8, which are struck by the pins *e e* on the cam-slide hereinbefore described. I prefer this construction of the presser-hook to that shown in the patent to Burson and Nelson, dated November 30, 1875, as being more cheaply made, more durable, and especially inasmuch as there is no rod to interfere with the removal of the needles from the needle-plate. These hooks have no pivoted bearings and

are adapted to be guided in their motions by their curved seats.

The yarn-carrier S, Fig. 22, is made from a single piece of sheet metal and is formed with parallel and elongated side wings *s s*, four horns or latch-openers *t t*, and a central reinforce-eye *u*, through which the yarn is threaded. This yarn-carrier rests in ways formed in guide-bars *s' s'*, Fig. 5, secured to the top of the cylindrical segmental hook-bars Q Q, and is reciprocated along such guides parallel with and above the two rows of needles, which last when projected have their latches opened by the horns *t t*. For moving the yarn-carrier it has upon the extremity of its two wings upwardly-projecting studs *v v*, which enter the recessed lugs *w w* of a cross-bar *S²*, connecting the two yarn-carrier slides T T, Fig. 5, Sheet 5, Fig. 13, Sheet 8, and Fig. 18, Sheet 10. These slides have ribs or tongues upon both edges of the same, the outer ones of which enter grooved guide-plates *S³ S³*, secured upon the tops of the guide-blocks N N, and the inner ones of which enter grooves in the inner edges of the yarn-carrier guides *S' S'*. The yarn-carrier slides T T receive their reciprocating motion by the pins *e e* of the cam-slides protruding through slots *g g* in the cross-plate *S⁴*, which gives them a drag motion. The yarn-carrier frame is formed of two slide-bars T T, connected by the cross parts *S²* and *S⁴*.

To provide for the use of several different yarns and to enable me to change them readily, the polygonal wheel U, Fig. 13, Sheet 8, and Fig. 23, Sheet 2, is journaled in an arched support *U'*, Figs. 1, 3, 4, and 13, at one end of the machine. This polygonal wheel has several pairs of guideways *w' w'*, parallel with its axis, which are the same distance apart as the yarn-carrier guides *s' s'*, Fig. 5, Sheet 5, so as to receive the wings *s s* of the yarn-carriers. This enables a plurality of yarn-carriers to be mounted on the said wheel U. To this wheel is attached a disk *U²*, having stop-perforations *w² w²*, Fig. 3, into which enters a locking-stud *w³*, Figs. 3 and 4, to lock the polygonal wheel in a position in which a given pair of the guideways *w' w'* in the shifter are in direct line with the guideways *S' S'*, in which the yarn-carrier reciprocates. This locking-stud is mounted upon an upright bar *w⁶*, the top of which is bent to form a thumb-piece for disengaging the stud. Just in front of the polygonal wheel is a guard-ring *U³*, Figs. 1, 2, 5, and 13, which is secured adjustably to the upper portion of the machine and is provided with a groove *w⁴*, Figs. 1, 4, and 13, into which enter the studs *v v* of all the yarn-carriers contained in the wheel. This guard-ring prevents the yarn-carriers from slipping or jolting out of the wheel and serves also to keep the studs of the yarn-carrier in said wheel in the proper position to enter laterally the recessed lugs *w w* of the cross-bar *S²*, Figs. 5 and 13, whenever said cross-bar is drawn back sufficiently to cause the recesses

in the lugs *w w* to register with the groove *w⁴* in said guard-ring. (See dotted lines, Fig. 13.) In constructing the polygonal wheel the series of guideways are made to extend around only a part of its periphery to permit the fabric to be dropped from the needles, as will be hereinafter explained. The guard-ring *U³* has two openings *w⁵ w⁵*, leading into the groove *w⁴*, which openings are located the same distance apart as the studs on the yarn-carrier, which is easily placed in the wheel when turned so as to agree with these openings and retained therein by the next turn of the wheel. To transfer a yarn-carrier from the wheel-shifter to the recessed lugs of the reciprocating cross-plate *S²*, the latter is pulled back until the recesses in its lugs coincide with the groove *w⁴* of the guard-ring, as in dotted lines of Fig. 13. Wheel U is then turned until the desired yarn-carrier registers with the ways in bars T T, its pins *v v* being in recesses *w w* of the cross-bar *S²*, Figs. 5 and 18, in which position it will be moved by said bars until shifted out of said lugs. To change the yarn-carrier from the cross-bar *S²* back to its receiver, the latter being in the position for working—that is, in range with the ways of bars T T—when the yarn-carrier has entered the wheel U it is turned with said wheel out of engagement with the reciprocating bar and another takes its place, if there be one in that part of the wheel in range with the yarn-carrier ways in bars T T. To throw off the fabric, it is only necessary to turn into range with bars T T that section of wheel U which has no yarn-carrier or no yarn in the carrier, when one reciprocation of the bars operating the needles without yarn drops the fabric from them.

The pattern-cylinders are two in number when two rows of needles are used, arranged one on each side of the machine, the journals of said cylinders being hung in bearings on the lower edge of plate B. These cylinders are made of a series of rings or disks, Fig. 5, Sheet 5, Fig. 8, Sheet 6, and Fig. 26, Sheet 8, having the desired pattern cut upon their peripheries and are fastened together upon a central shaft *I³* between two heads *I' I'* by bolts *I² I²*, Figs. 1, 5, and 8. These rings or disks are made in pairs, as at 1 1, or 2 2, or 3 3, &c, Fig. 8; and each pair of rings constitutes a pattern for one rocking lever H and its corresponding needle. One of said rings by operating against one toe of the lever raises it, the corresponding part of the other disk being cut away for the other toe of the lever to be depressed in and the lever being bent or offset laterally to enable the engaging parts or toes thereof to cooperate with the two rings or disks of the pair. The pattern-plates I may be set together alone to form the pattern-cylinder; but I prefer to place between them alternately disks *I⁴*, with their edges projecting beyond the plates, so as to form grooves between the disks for the guide-toes *c c'* of the rocking lever H to run in, either with or

without the grooved block H². This plan of construction makes a more positive guide for the operating-toes upon the pattern-plates than block H² and works with less friction.

5 This pattern-cylinder is readily taken apart to enable the pattern to be changed in part or entirely. To operate these pattern-cylinders, worm-wheels I⁶ I⁶, Figs. 2 and 3, are attached to the same shafts therewith, and a lower shaft I⁴ is arranged at right angles to said cylinder-shafts in suitable bearings and is provided with two worms I⁵ I⁵, which mesh with the two worm-wheels I⁶ I⁶ and impart motion to the same. To the worm-shaft is attached a crank I⁷ for operating it by hand, which crank is provided with a spring stop-plate I⁸.

In this machine an effective take-up for the yarn is regarded as a necessity. In providing one for this purpose I erect upon one side of the machine an arm V, Figs. 1, 2, and 3, carrying at the top a short cross-shaft V', to which it is attached by a sleeve and set-screw, a pendent projecting arm V² having a series of lugs v' v', with perforations through the same. To this arm is attached or upon it is formed a right-angular stud v², upon which is swung a second threading-arm V³, having a set of lugs v³, perforated and slotted like the lugs v' v', but with the slots arranged upon the opposite side. This swinging arm V³ has its lugs arranged to alternate with the lugs of arm V², Fig. 1, and the yarn being threaded through the perforations in both sets of lugs the arm V³ and its set are thrown against the yarn and made to bend it zigzag as it passes through the lugs of the other arm by means of a spring v⁵. The tension is regulated by passing the yarn through more or less of the lugs. Upon the stud v² is also loosely pivoted a flexible wire arm v⁴, having at its end a loop, through which the yarn is threaded as it passes from the perforated lugs, and from which point it passes to the yarn-carrier. This flexible arm is held normally in an elevated position by a spiral spring v⁶, Fig. 1, wound about the stud v², and constitutes an elastic take-up for the slack of the yarn when the yarn-carrier changes the direction of its movement at the end of the stroke.

It will be seen from the foregoing description that I regulate the movement of each needle, and hence my machine is adapted to knit all kinds of plain and fancy and irregular fabrics. When the parts herein described are connected with suitable mechanism to render them automatic, it can be applied to a large range of uses.

I claim—

60 1. The combination of a needle having an upturned shank, a needle-bed having a needle-groove of greater depth than the height of the shank, a separate filler-piece adapted with the needle to fill said groove, and a cover inclosing said groove with the needle and filler-piece therein, as set forth.

2. The combination of a needle having an

upturned shank, with a needle-bed having a covered groove for the needle, a filler-piece E', and a jack F' engaging with the needle and filler-piece, substantially as set forth. 70

3. A loom having a needle-groove and a cover therefor, combined with a needle E, an operating-jack F, and a filler-piece E', all fitted and adapted to work in the groove and to be inserted and removed in use without removing the cover from the groove. 75

4. The combination in a knitting-loom with a grooved needle-bed, of a needle having an elevated shank and located in the groove of said bed, a separate filler-piece E', also located in said groove, moving in unison with said needle, and serving to hold the needle firm and true while leaving it free to reciprocate, and means to operate the said needle, substantially as set forth. 80

5. A grooved needle-bed, a cover for the grooves of said bed having its upper face the segment of a cylinder, provided with grooves concentric therewith and forming seats for presser-hooks P, the presser-hooks P curved to fit said seats and provided with lugs d, and a curved concentric cover for said segment adapted to hold the hooks in place, all combined substantially as set forth. 85

6. The combination of the segment Q provided with concentric grooves adapted to form seats for presser-hooks, presser-hooks P formed with lugs d, and bar R formed with a cam-groove therein adapted to operate said hooks in succession by means of said lugs, the said hooks being formed without pivotal bearings and adapted to be guided solely by their curved seats. 90

7. The hook-driving cam R having tappets f, f, a distance apart, and yarn-carrier slide T having slot g, combined with needle-slide G having driving-pin e projecting between said tappets and into said slot, to permit lost motion of the hook-driving cam and yarn-carrier relative to the needles. 100

8. A yarn-carrier having an upwardly-projecting stud or studs, combined with slide T and the connecting cross-bar S² having one or more recessed lugs w, w, opening at their ends to permit the yarn-carrier to be moved out of engagement with said lug or lugs, and the shifter-frame turning on an axis above and parallel to the needle-rows, and in a direction at right angles to the line of the said slide, substantially as set forth. 110

9. A series of yarn-carriers combined with a shifter-frame, and with a holder-ring U³ having a guide-groove w⁴ having an open space below to admit the passage of the yarn-carriers into and from the same. 115

10. The needle-cam slide G having two diagonal guide-channels, combined with two cams G², G² fitting into and adjustable along said channels and bearing studs p, p, slotted pieces O, an adjustment-bar M having the studs q, q, guided in the oblique slots o of piece O and connecting with said studs p, p, and an advancer-cam G' having faces paral- 120

11. The channel-bar M movable endwise and sidewise and bearing studs *q*, combined with stationary plates O having oblique slots into which said studs project, and with reciprocating slide G bearing adjustable cams G^2 , G^2 having studs *p*, *p*, projecting into the channel of bar M, arranged so an endwise movement of bar M will carry it sidewise and move said cams so as to increase or diminish the throw of the needles and length of the stitch-loops in knitting, substantially as set forth.

12. The series of needles E and their jacks combined with separate operating-levers H, and a cylinder I constituted of separate disks bearing guide-patterns for a series of actions of the needles, held together as shown, and capable of recombination to change the pattern of work, substantially as set forth.

13. The pattern-cylinder I formed of a series of disks, two for each needle, combined with a series of rocking levers H having each two working points to engage one with each disk to control the needles according to the patterns on the disks.

14. The pattern-cylinder I formed of a series of disks, having pattern projections to control the needles, and of spacing or guide disks between which the pattern-disks are interposed, substantially as set forth.

15. The pattern-cylinder I formed of a series of disks having pattern projections to control the needles, and of spacing or guide disks of larger diameter between which the pattern-disks are interposed.

16. In a knitting-machine, the combination of a grooved needle-bed, a pattern-cylinder formed of pairs of plates, one pair for each needle, each pair of plates having coacting patterns cut on the peripheries thereof and with each alternate pattern-plate held in line with a groove in the needle-bed, a rocking lever for each needle-bed groove having one foot in line with the needle-bed groove and resting on one pattern-plate and one foot offset to and resting on the companion plate, whereby to control the action of the needles in knitting, substantially as specified.

17. The combination of a grooved needle-bed, a pattern-cylinder formed of pairs of plates, each pair of plates having coacting patterns cut on the peripheries thereof and with each alternate pattern-plate held in line with a groove in the needle-bed, a guide-plate of greater diameter than the pattern-plates separating the pattern-plates, a rocking lever for each needle-bed groove having one foot in line with the needle-bed groove and resting on one pattern-plate and one foot offset to and resting on the companion plate, whereby to control the action of the needles in knitting, substantially as specified.

18. The combination of the needle-bed, the cam-bar provided with the channels, the retracting-cams held in said channels and provided with the studs extending upward through the cam-bar, the channel-bar held on the upper side of the cam-bar and grooved to receive the said studs, and the vertically-movable needle-advancing cam, all substantially as described, whereby the needles may be advanced and retracted by the cam-bar moving in either direction, or left at rest by lifting the advancing-cam above the plane of contact with the needle-jacks.

19. The combination of the needles, and the needle-actuating cam-bar G provided with a pin *e*, with the presser-hooks, and the hook-actuating cam-bar R provided with the tappets *f*, *f*, whereby cam-bar R is moved with a drag motion in both directions relative to cam-bar G, substantially as specified.

20. The combination of the yarn-carrier-actuating bar, the presser-hook-actuating cam-bar, and the needle cam-bar, all connected loosely to each other, whereby a drag motion is given the yarn-carrier bar and presser-hook cam-bar, and the relative position of said bars is changed at each reverse movement of the needle cam-bar, substantially as specified.

21. The combination with straight-row-knitting mechanism, of a yarn-carrier having an upwardly-projecting stud or studs, and a reciprocating cross-bar provided with a groove adapted to admit and release the yarn-carrier stud or studs by a movement at right angles to the line of reciprocation, and to move the carrier across the needles in both directions, substantially as set forth.

22. In a knitting-machine, a series of needles, one or more yarn-carriers, and a carrier-traversing device combined with a shifter-frame mounted to turn or rotate on an axis of motion parallel with the needles, and constructed to receive and carry the yarn carrier or carriers.

23. The combination of a series of needles, with two retracting-cams G^2 , G^2 , the adjustment-bar M whereby the position of said cams is controlled and to adjust said bar M laterally.

24. A reciprocating needle-driving cam G' having stud *j*, bar J, slide G, bar K having two tracks and switches, and a pattern device having means for controlling the position of the switches, substantially as set forth.

25. The hook-driving cam R having two tappets *f*, *f*, a distance apart, combined with the needle-cam slide G having a driving-pin *e* less in width than the distance between said tappets, said pin extending between the said tappets, substantially as set forth.

26. A series of needles, a series of yarn-carriers, a yarn-carrier track, and a carrier-traversing device, combined with the shifter-frame mounted to rotate or turn on an axis parallel to the needle-rows and constructed to receive a number of carriers.

27. The combination of the slide G having an opening for cam G', with the needle-advancer cam G', the projection or stud j connected therewith, bar K having tracks along which the said projection or stud travels, and switches and controlling devices therefor, whereby to determine the track along which the projection or stud shall move.

28. The reciprocating slide G bearing two adjustable retracting-cams G², G², combined with an adjustment-bar M operatively connected with said cams and means to adjust said bar M laterally, the bar M operating to shift both of the cams G², G² simultaneously in varying the stitch, substantially as set forth.

29. The needle-operating slide G bearing an adjustable retracting-cam, combined with an adjustment-bar M movable endwise and operatively connected with said cam and means whereby the endwise movement of said bar occasions a lateral shift thereof also, to thereby adjust the said retracting-cam, substantially as set forth.

30. The combination of two parallel rows of needles, with two sets of operating-cams therefor, two pattern-cylinders, one for each row of needles, devices intermediate each of said cylinders and the needles of the corresponding row, whereby the individual needles

of both rows respectively are controlled in their action, two sets of presser-hooks, one for each row, a yarn-carrier adapted to feed yarn to both rows, and means for their joint action consisting of mechanical connections whereby all of these elements will act in combination and the character of the work on the two rows may be separately controlled and tubular work may be done plain, fancy and irregular, and plain and fancy ribbed work may be produced by both rows.

31. The rocking lever for supporting a needle-jack having its slot wider at its extreme end than at its front, substantially as set forth, to enable the jack to hold its needle out of action while retracted.

32. In a knitting-machine, the combination with the slide carrying the knitting-cams, an arm pivoted thereto, and a needle-actuating cam supported by said arm, of a bar having two tracks adapted to receive a projection from the pivoted arm, a switch, and means comprising a vertically-movable arm for controlling the switch.

WILLIAM WORTH BURSON.

In presence of—

SAML. J. WALLACE,
M. H. BALLINGER.