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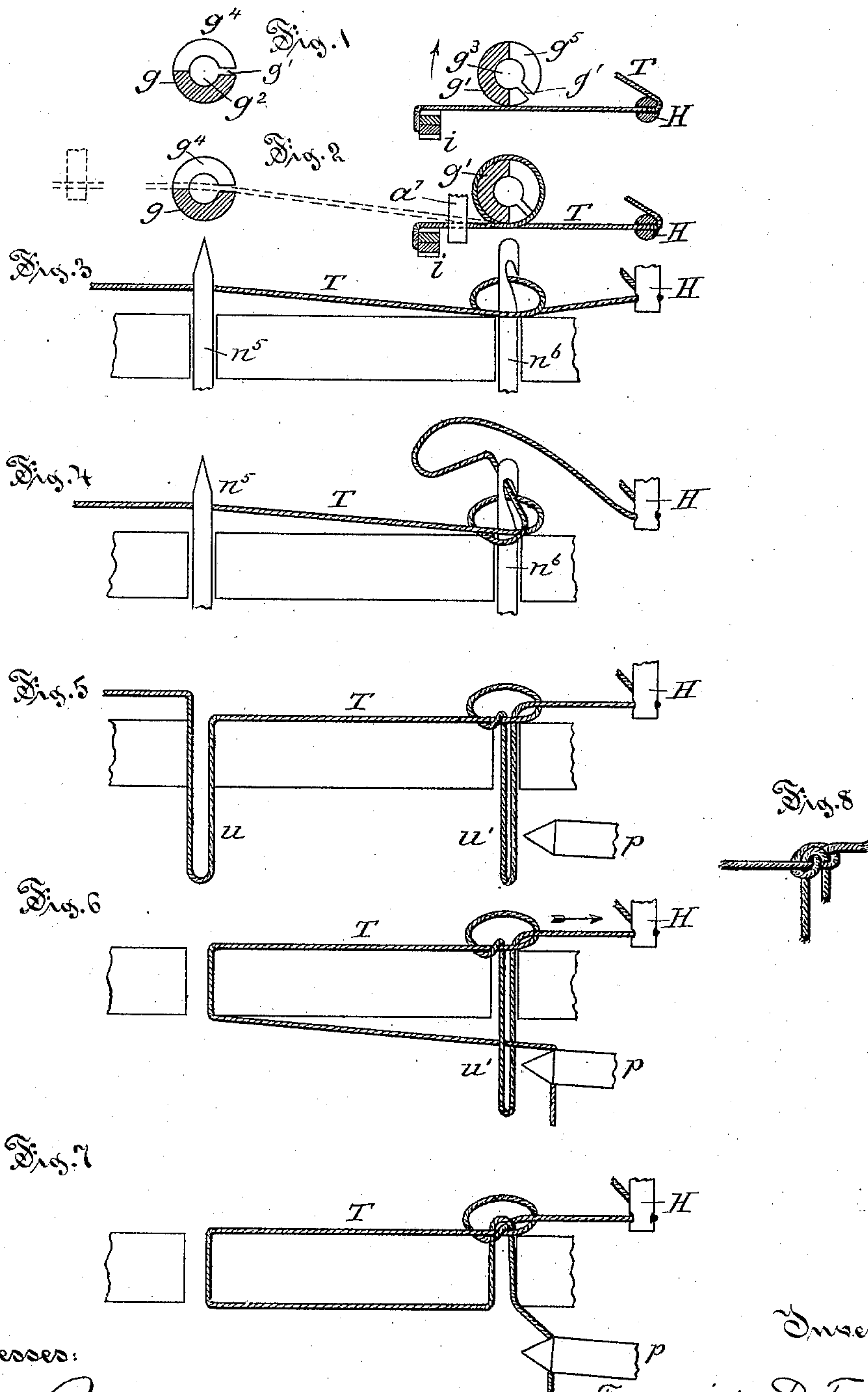
9 Sheets—Sheet 1.

F. D. TAYLOR & J. A. WHITE.

BOOK STITCHING MACHINE.

No. 365,651.

Patented June 28, 1887.



Witnesses:

Wm. Gorkman,

H. R. Williams.

Inventors:

Frederick D. Taylor
and
Joseph A. White
by
Simonds & Burdett,
Atty.

(No Model.)

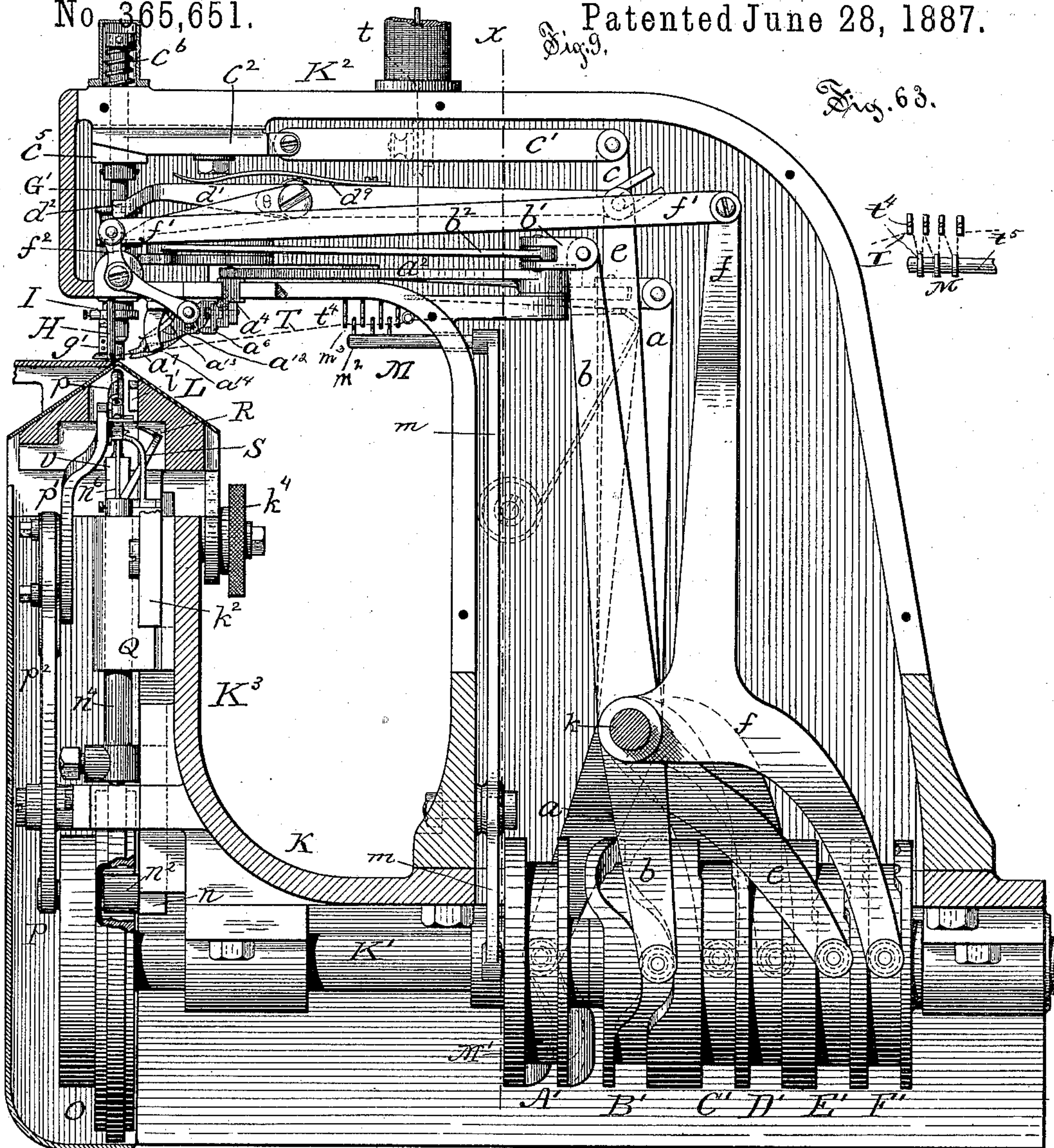
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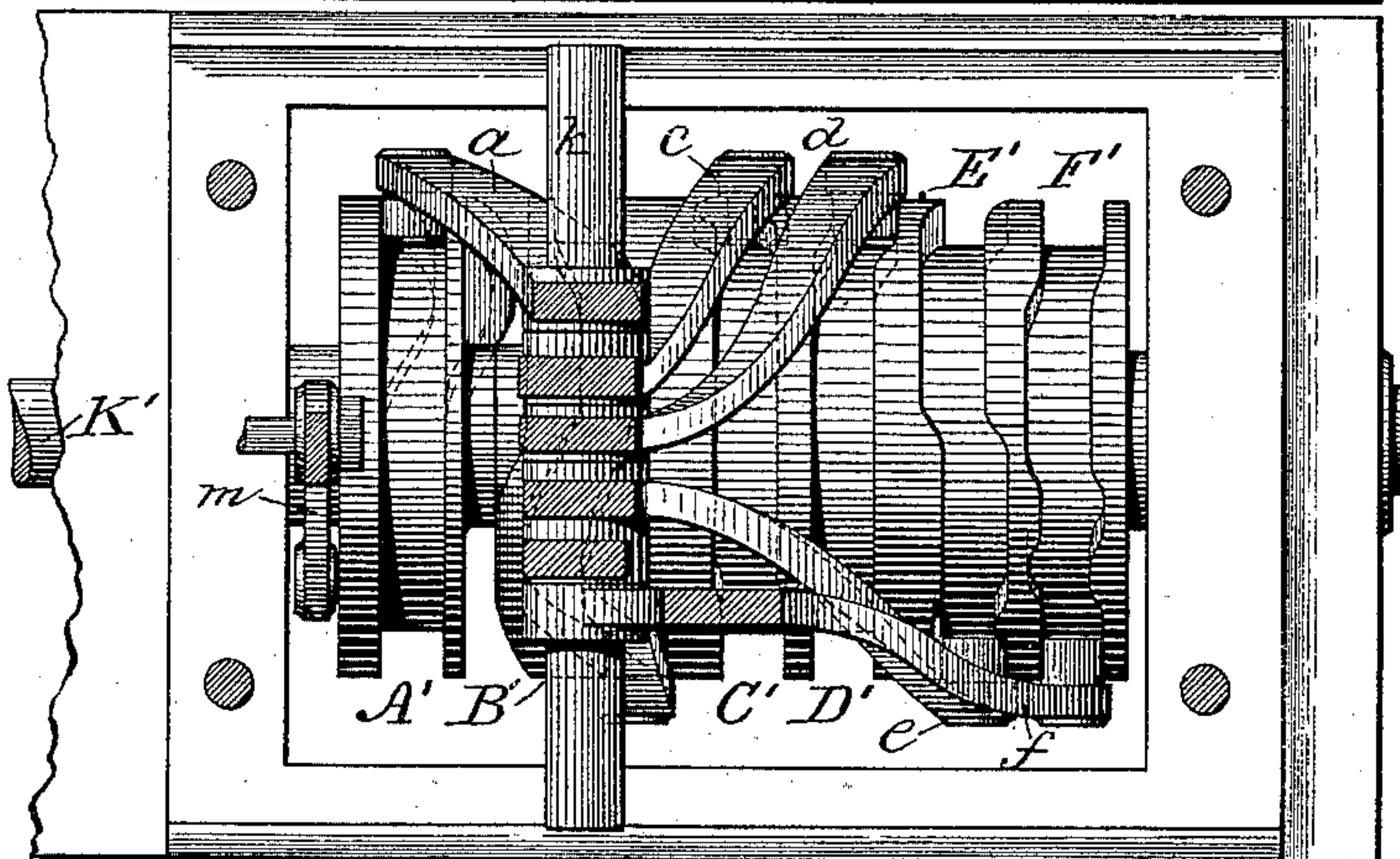


K^5

Fig. 10

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(No Model.)

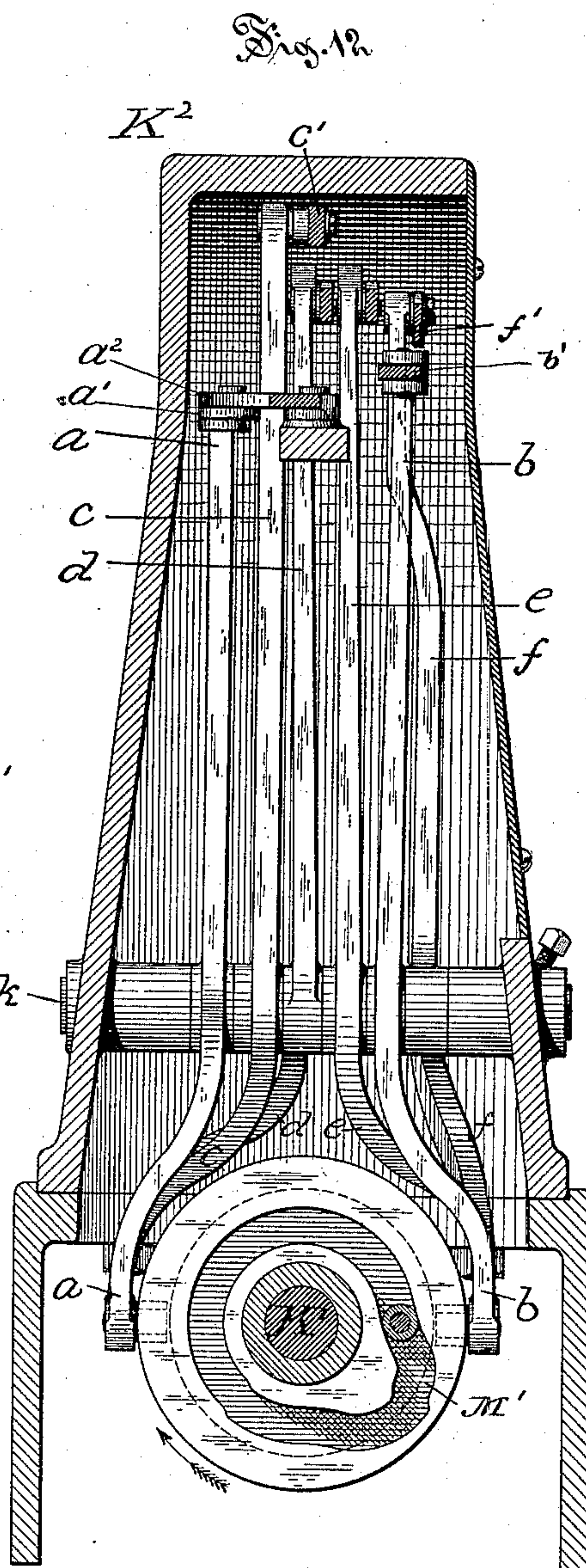
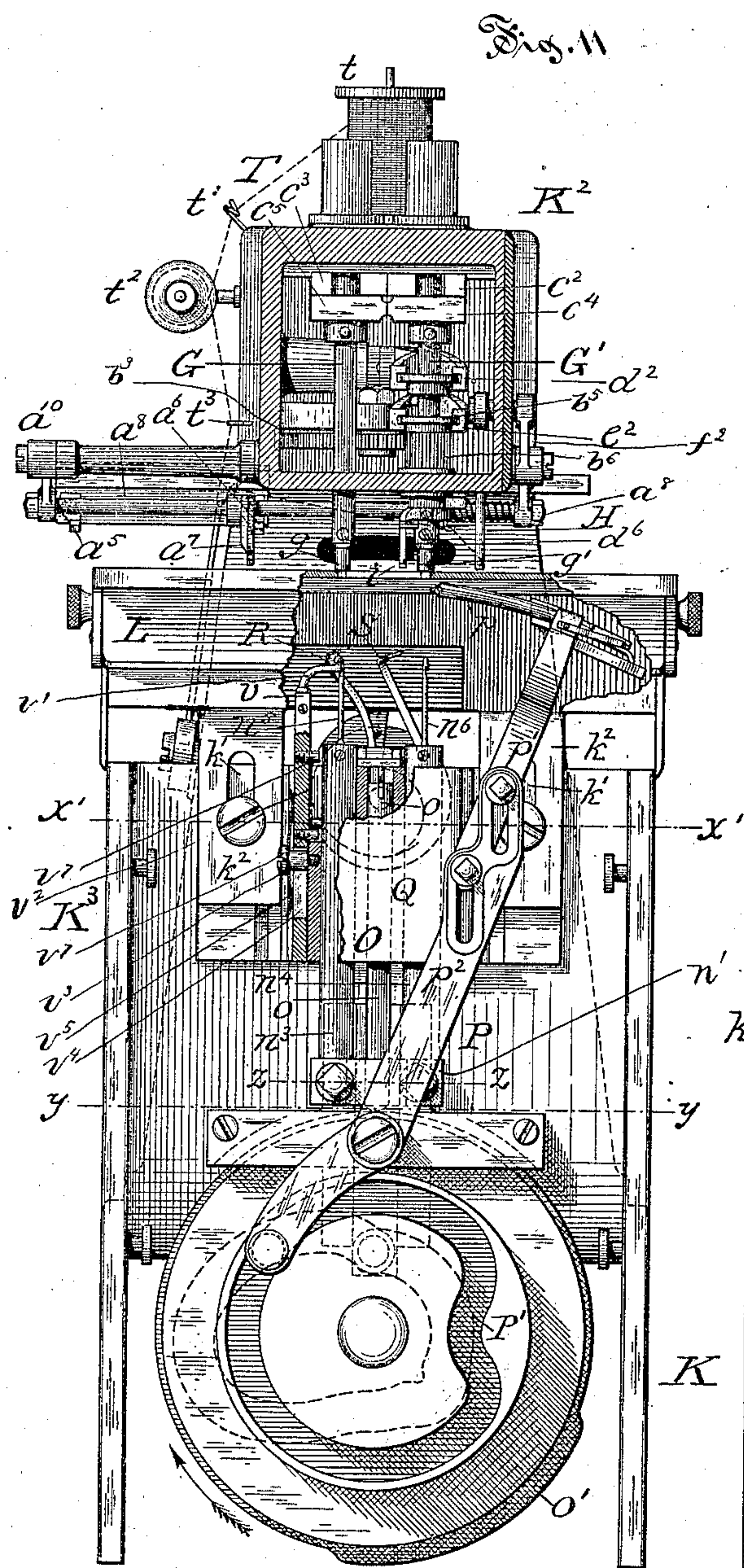
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Witnesses:

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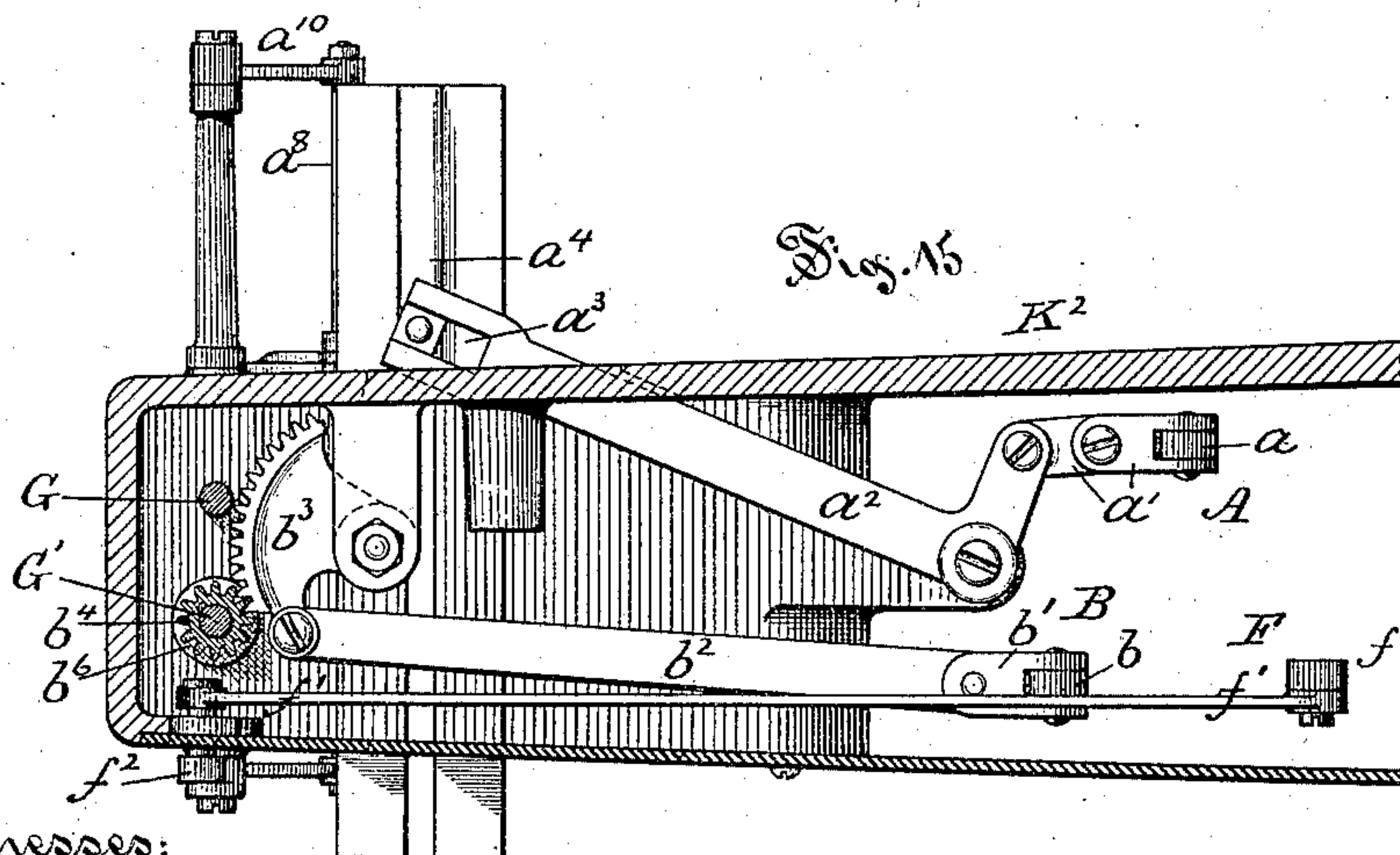
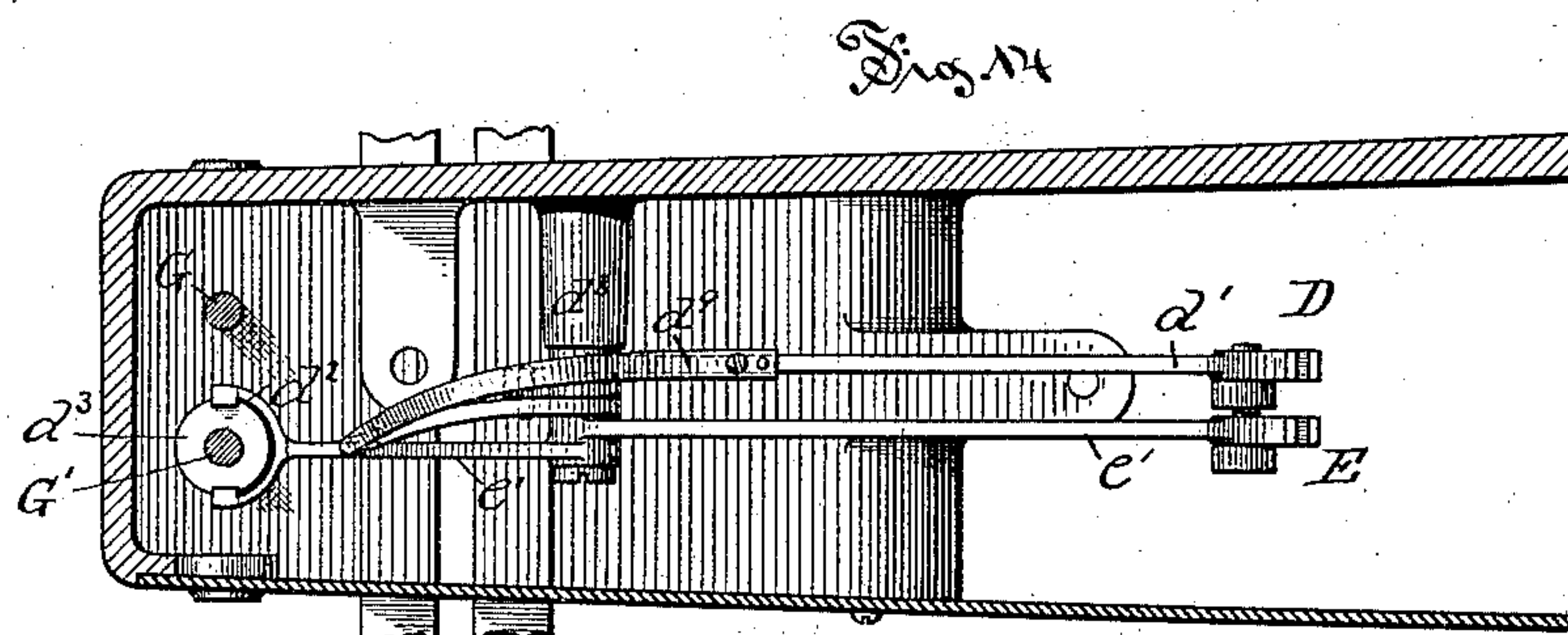
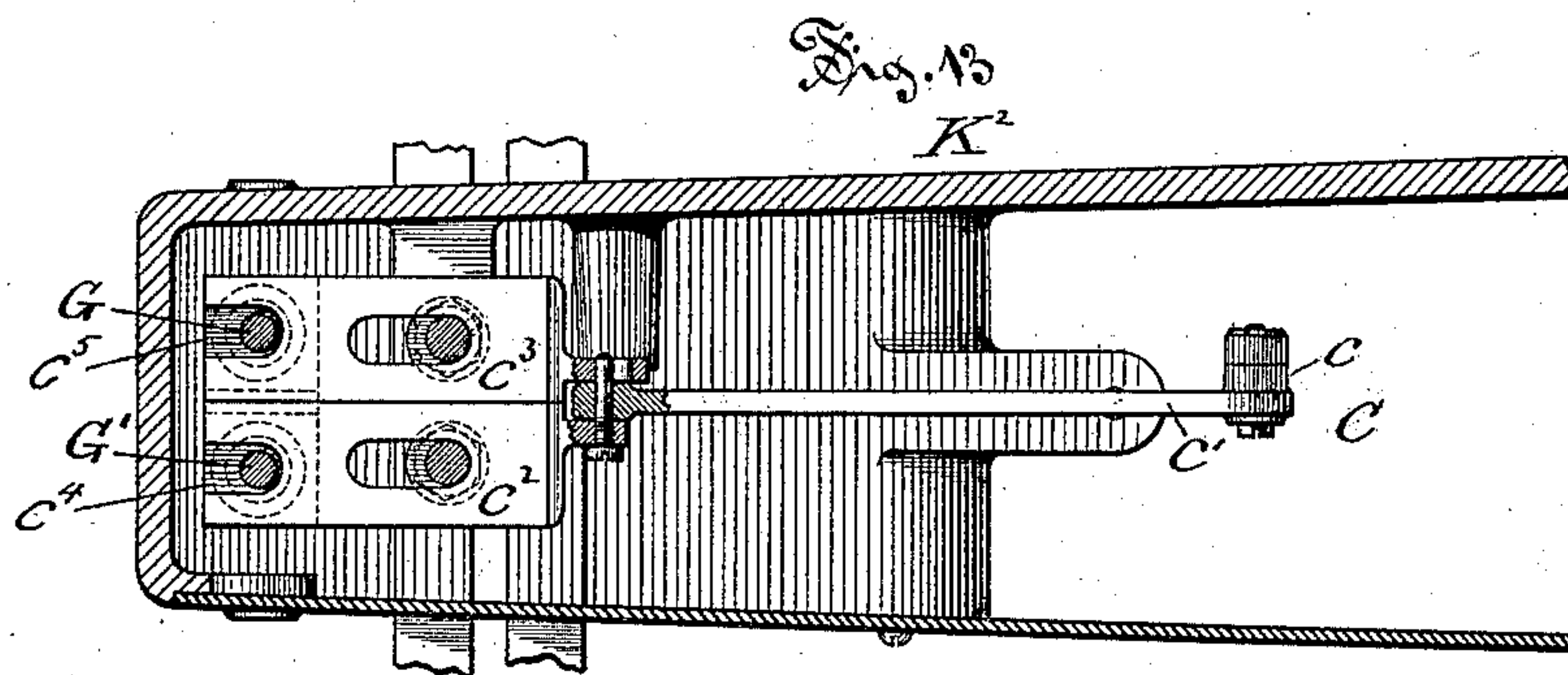
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(No Model.)

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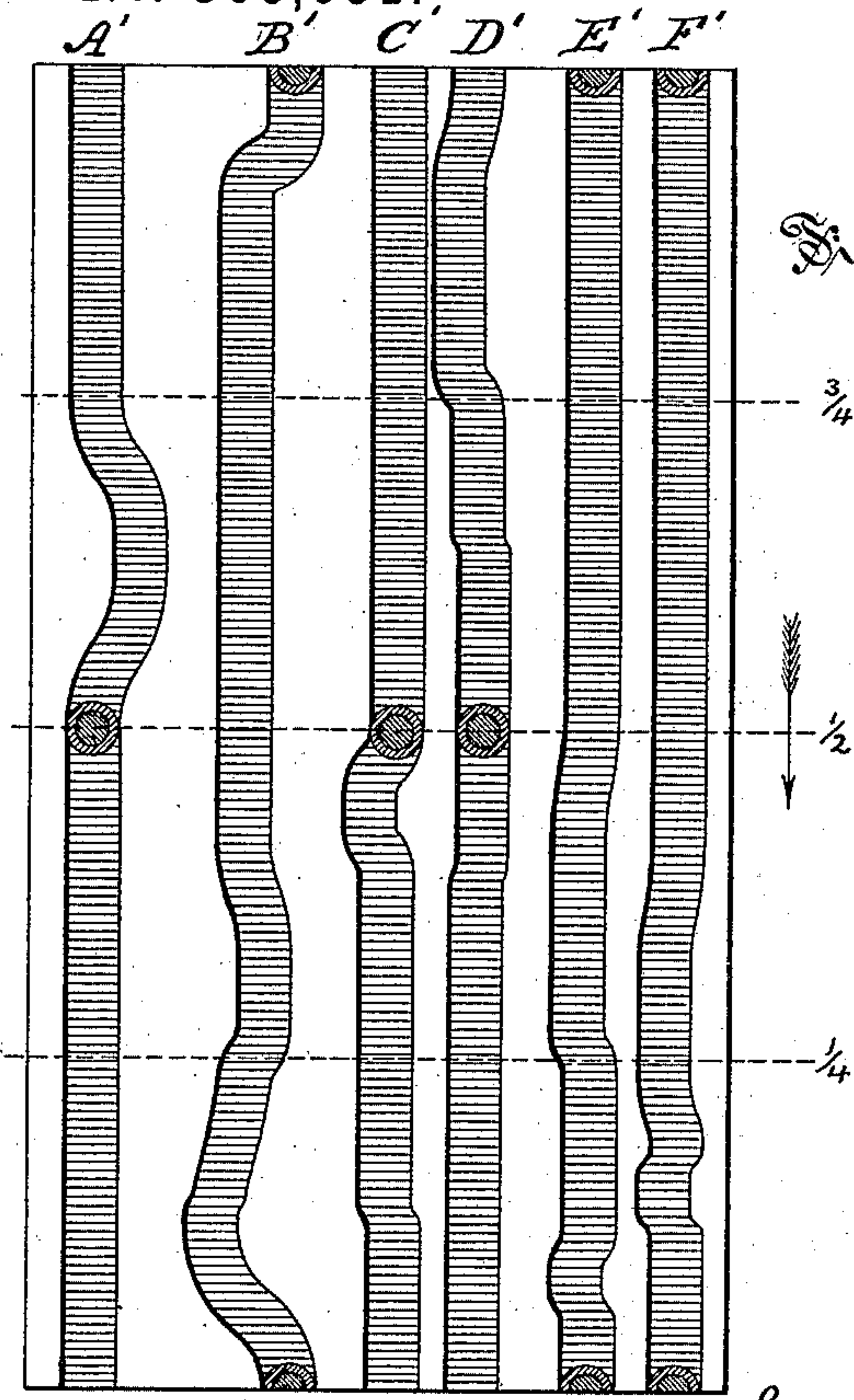


Fig. 16

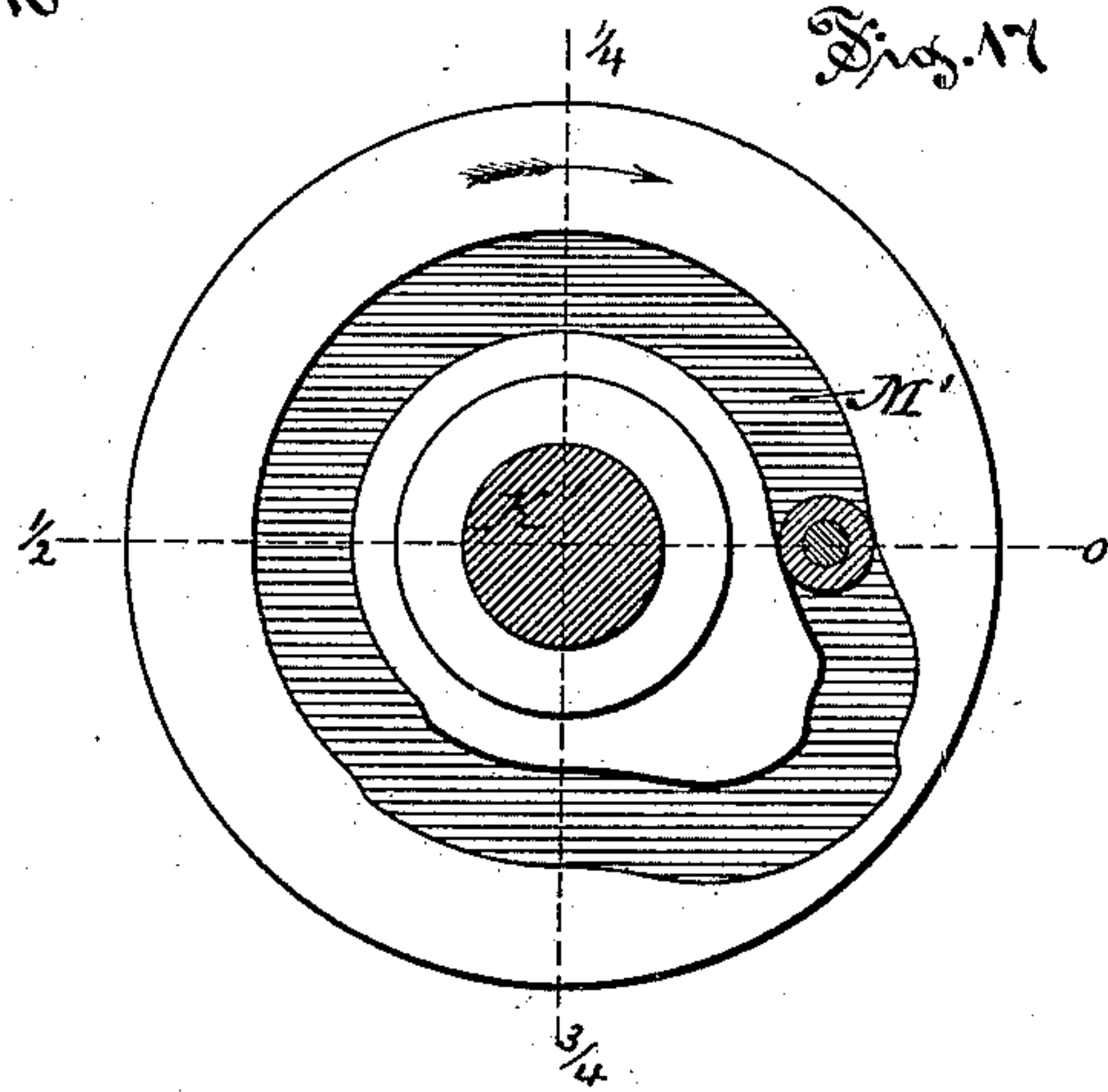


Fig. 17

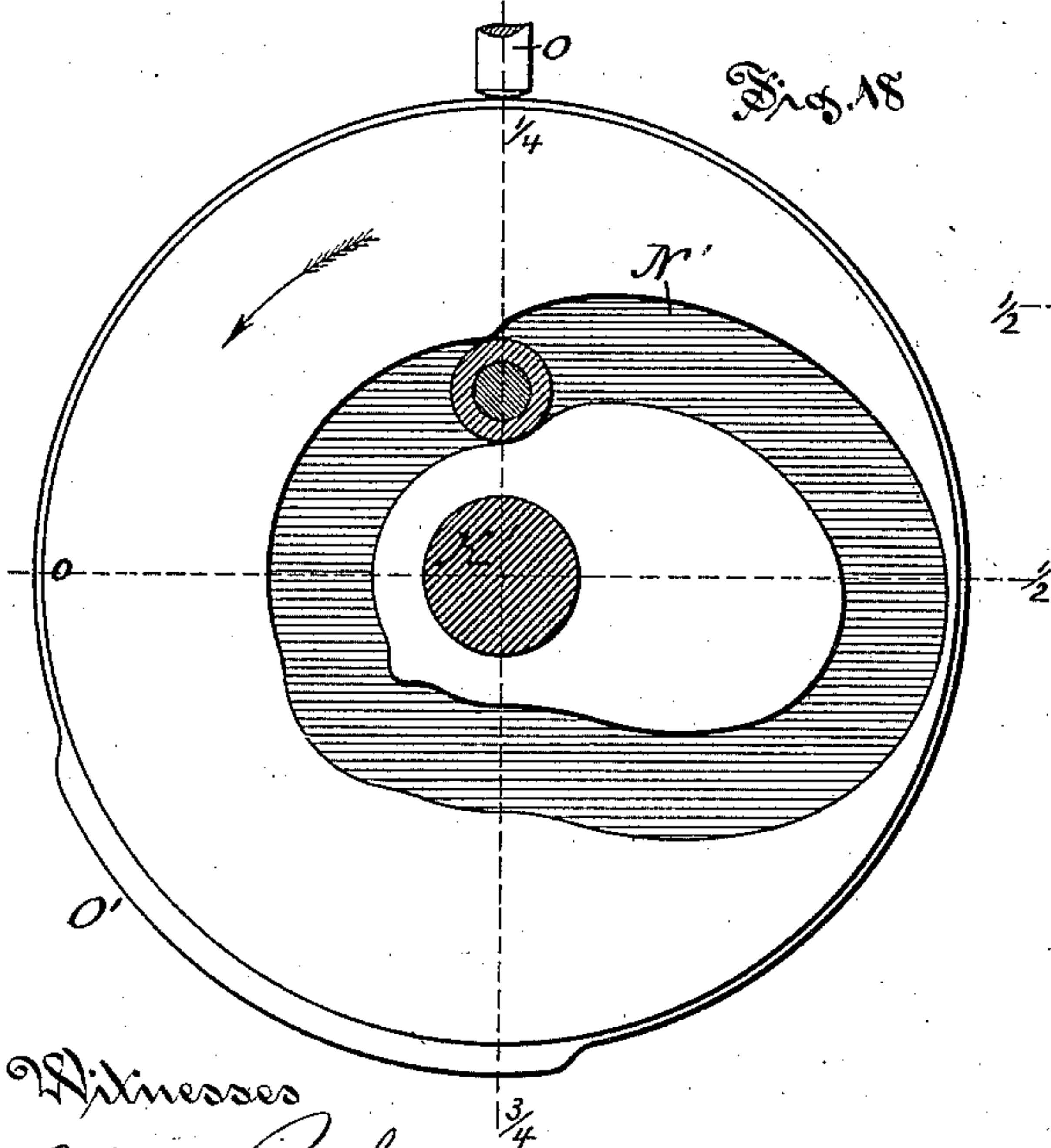


Fig. 18

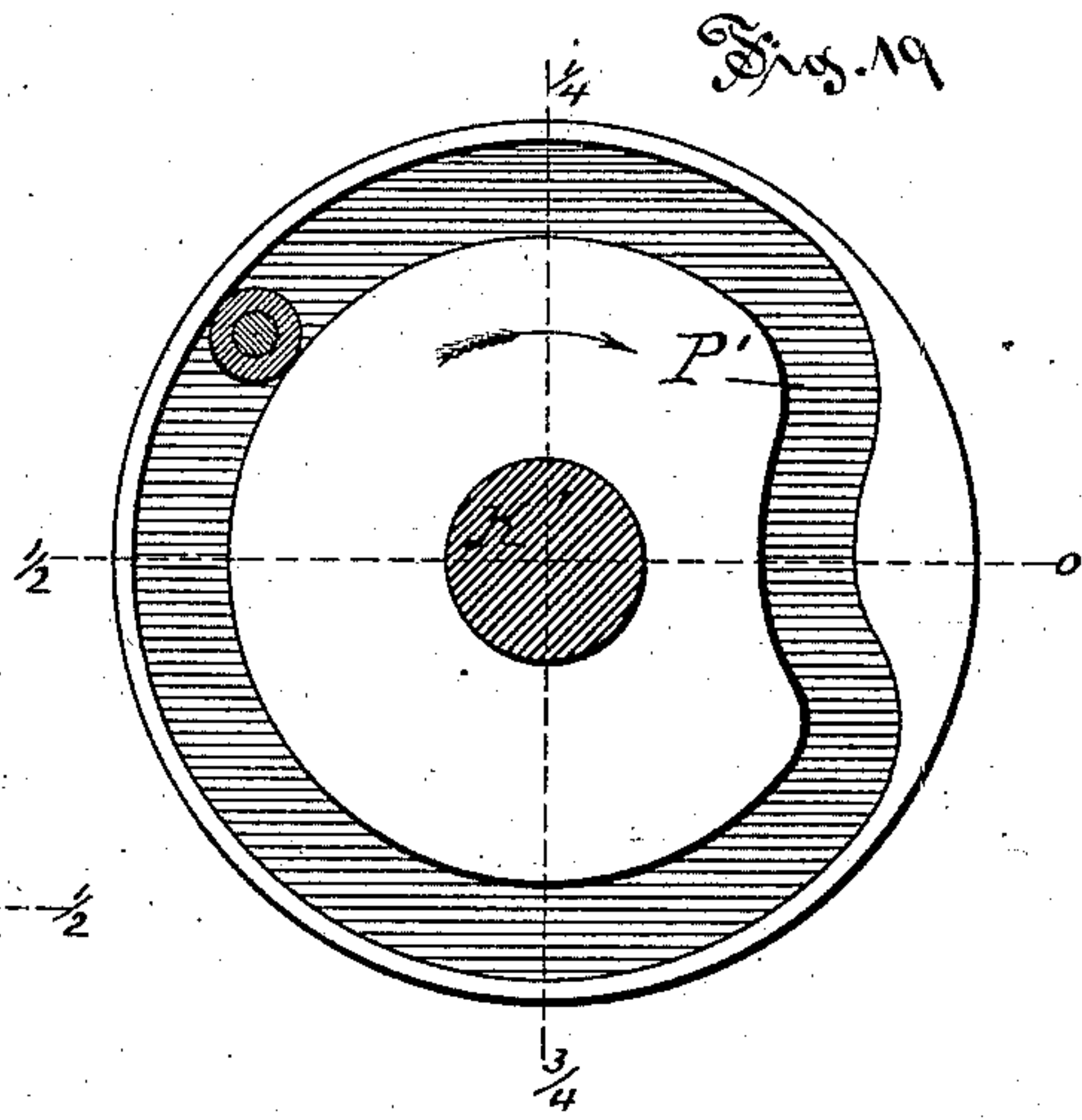


Fig. 19

Witnesses
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9 Sheets—Sheet 6.

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Fig. 20

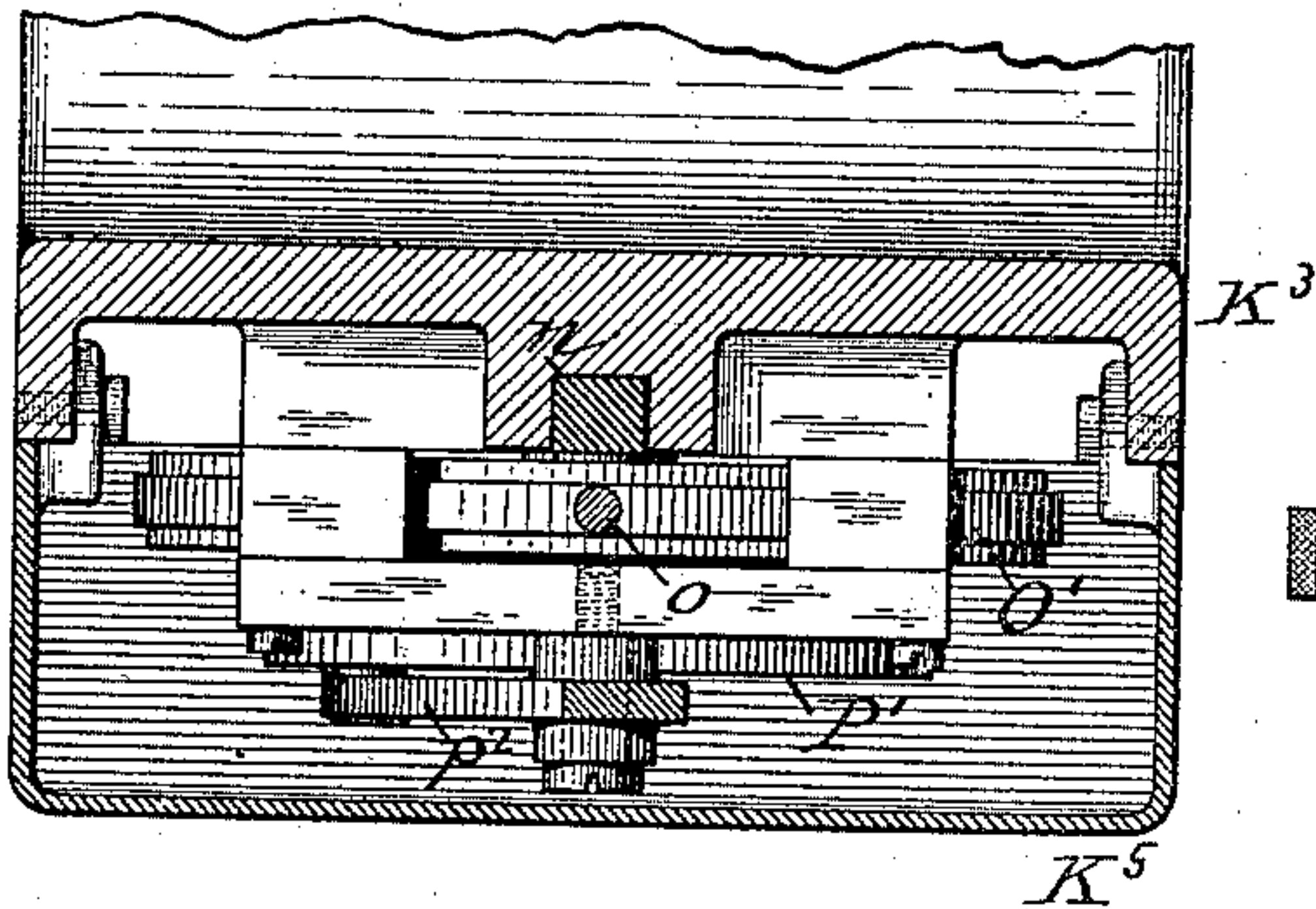


Fig. 21

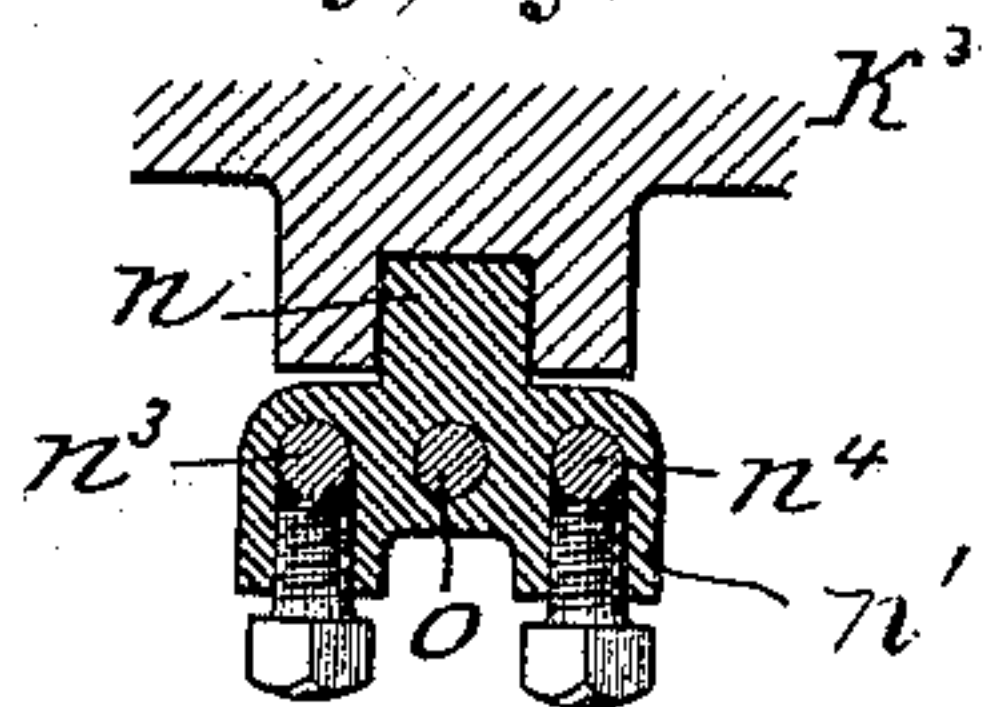


Fig. 22

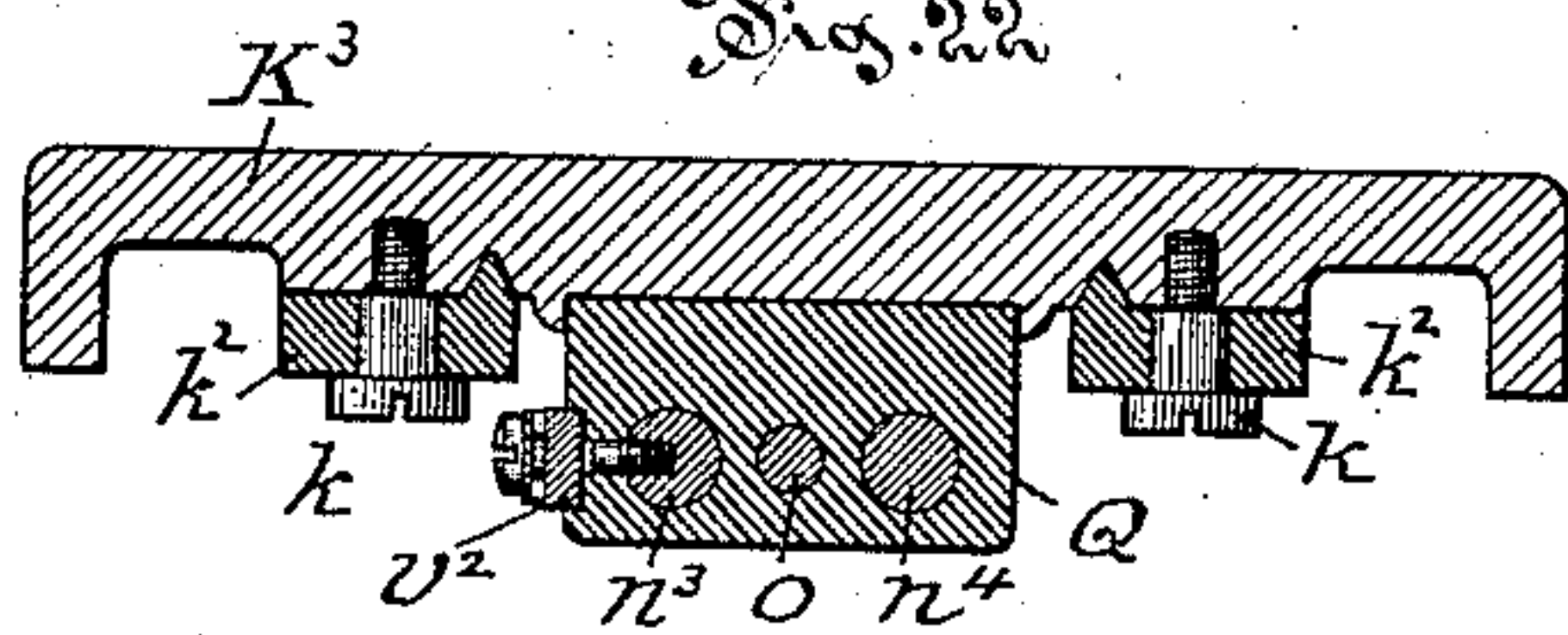
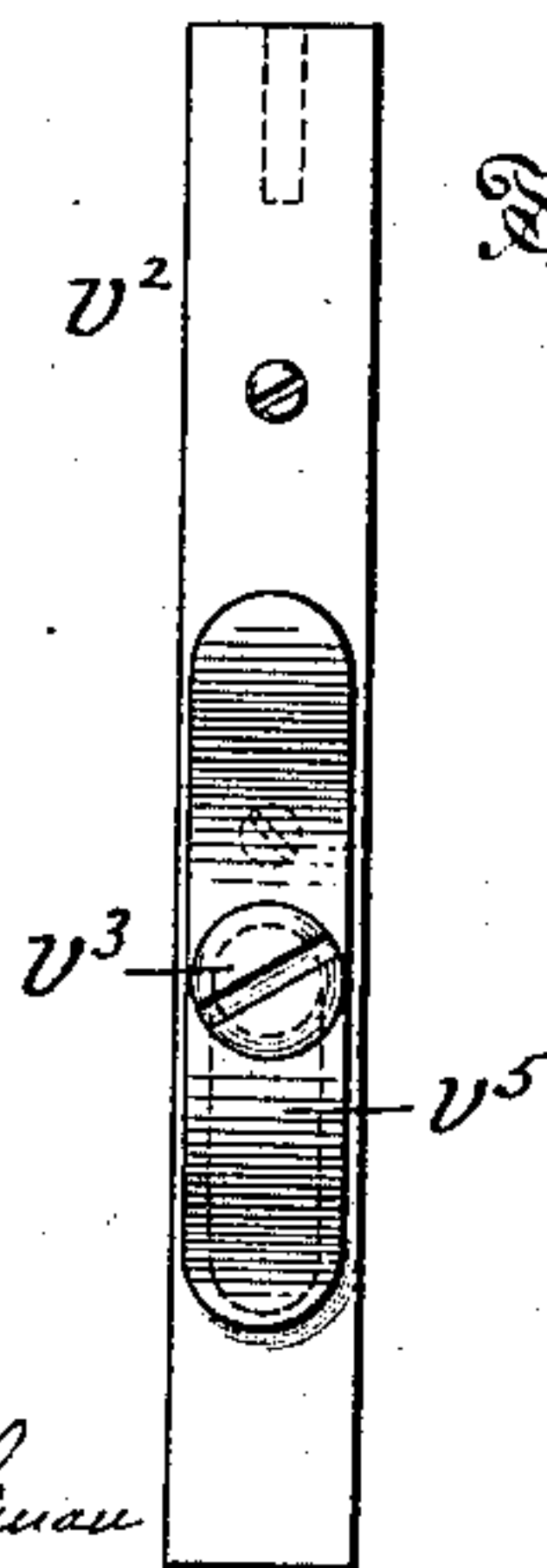


Fig. 23



Witnesses

Wm. Gorkin

H. R. Williams.

Fig. 24

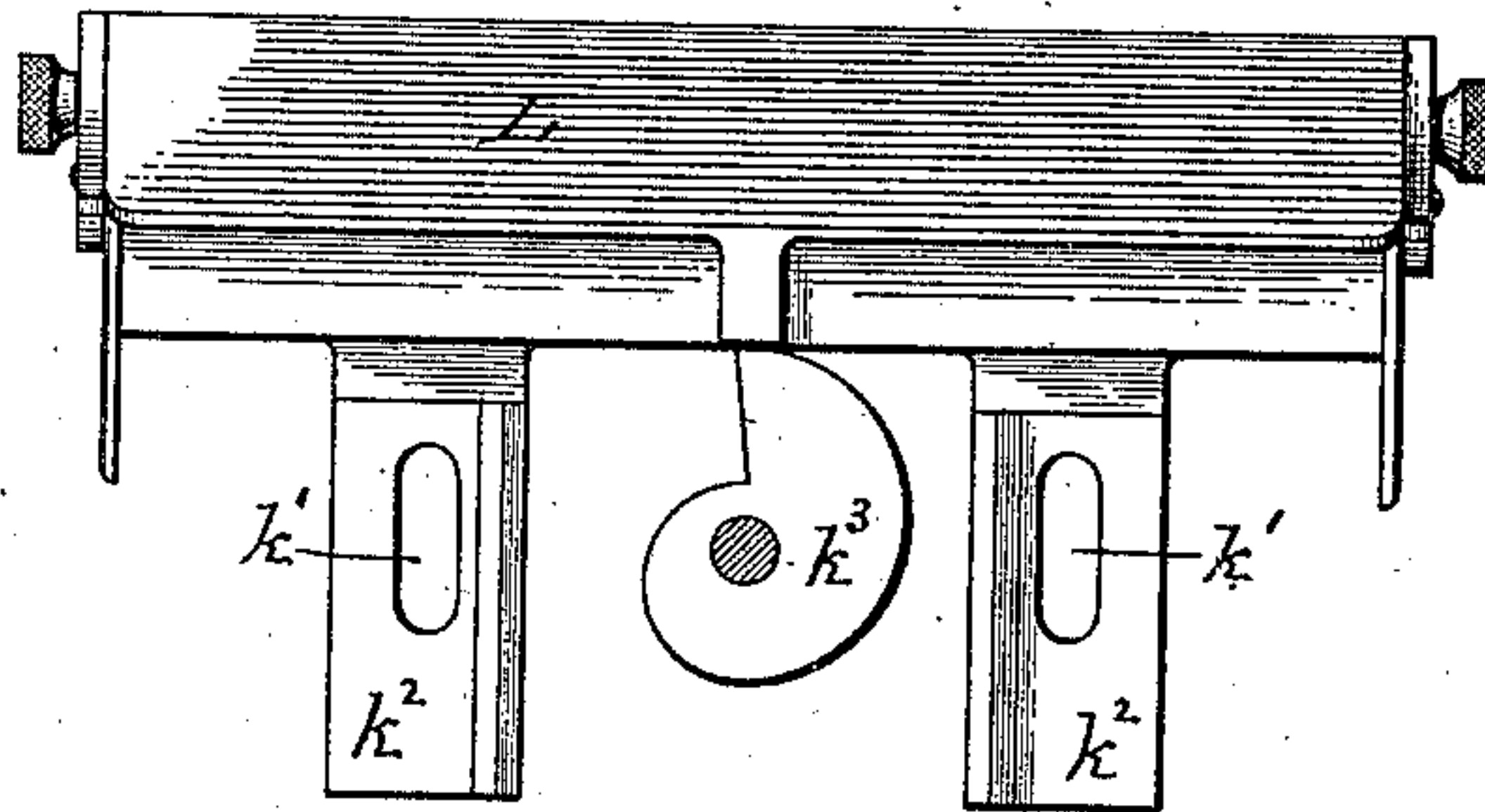


Fig. 25

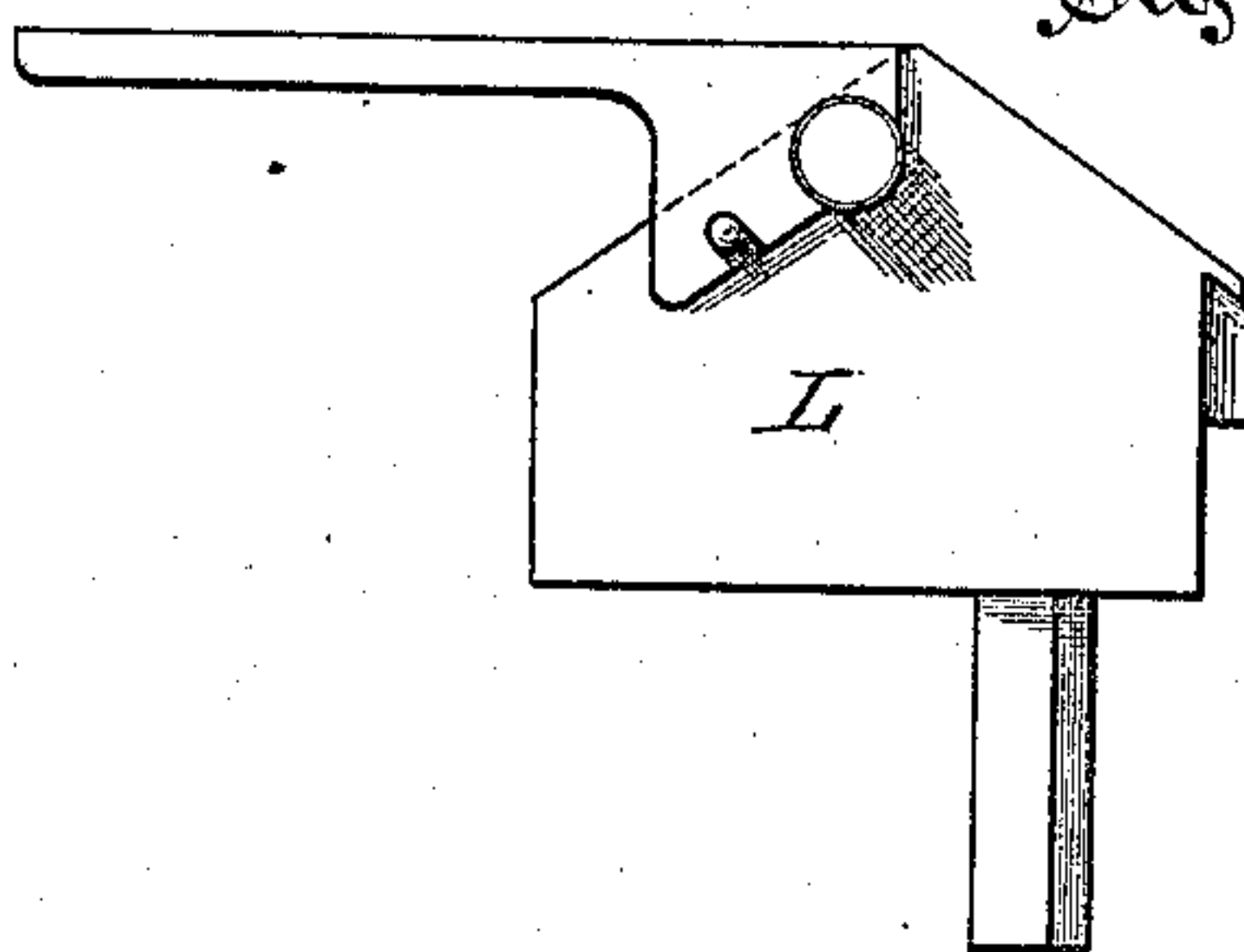
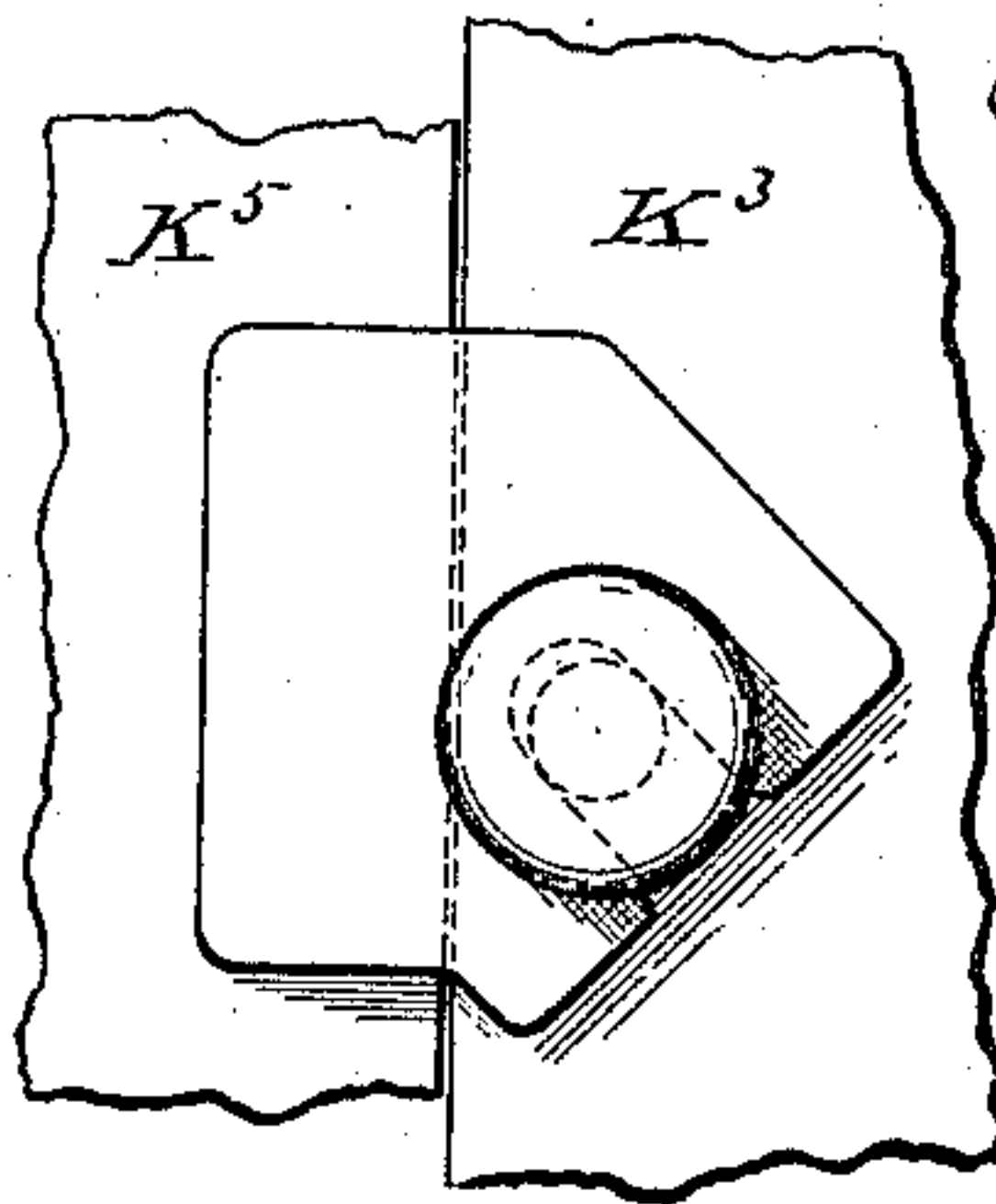


Fig. 26



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(No Model.)

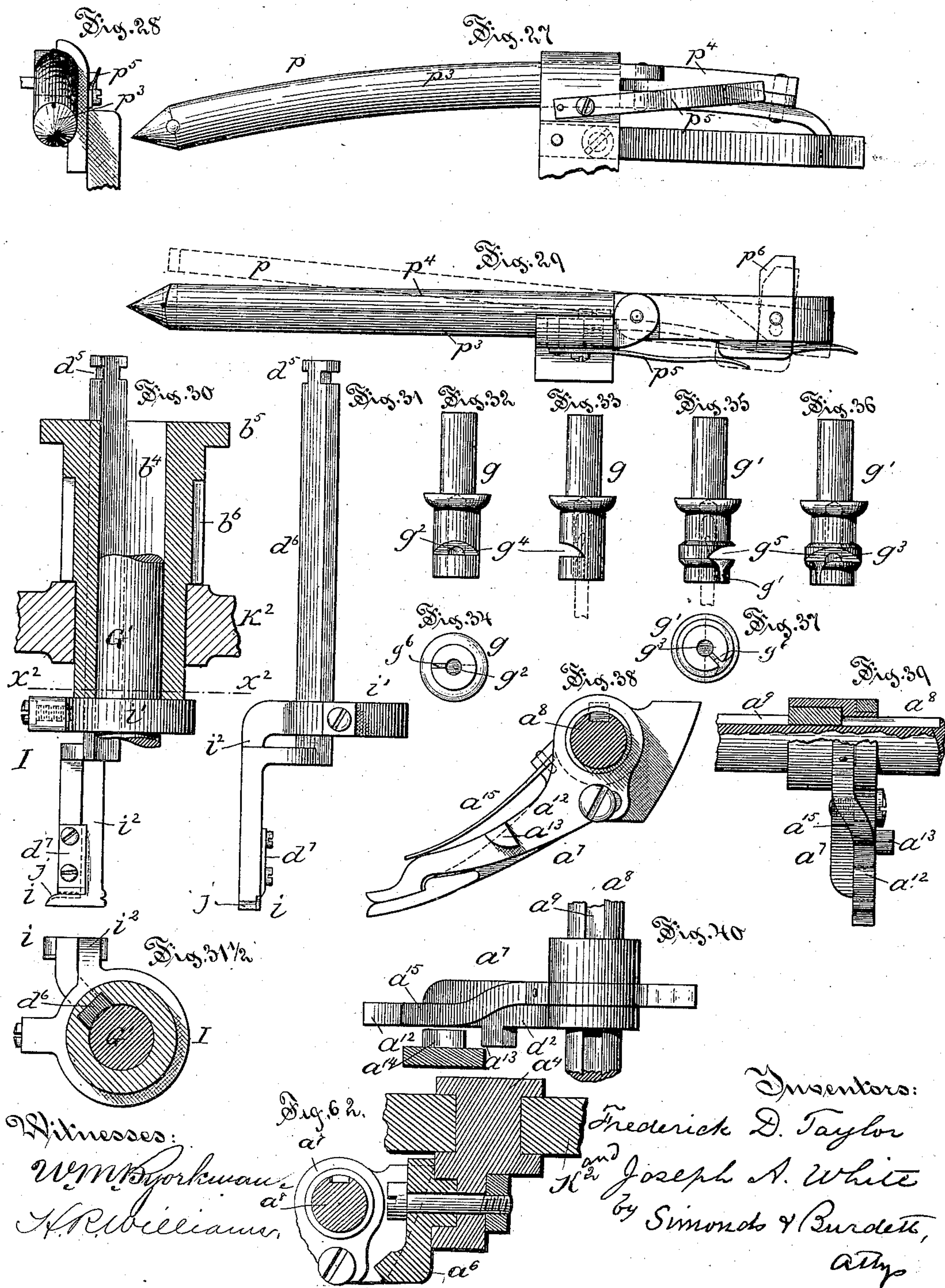
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(No Model.)

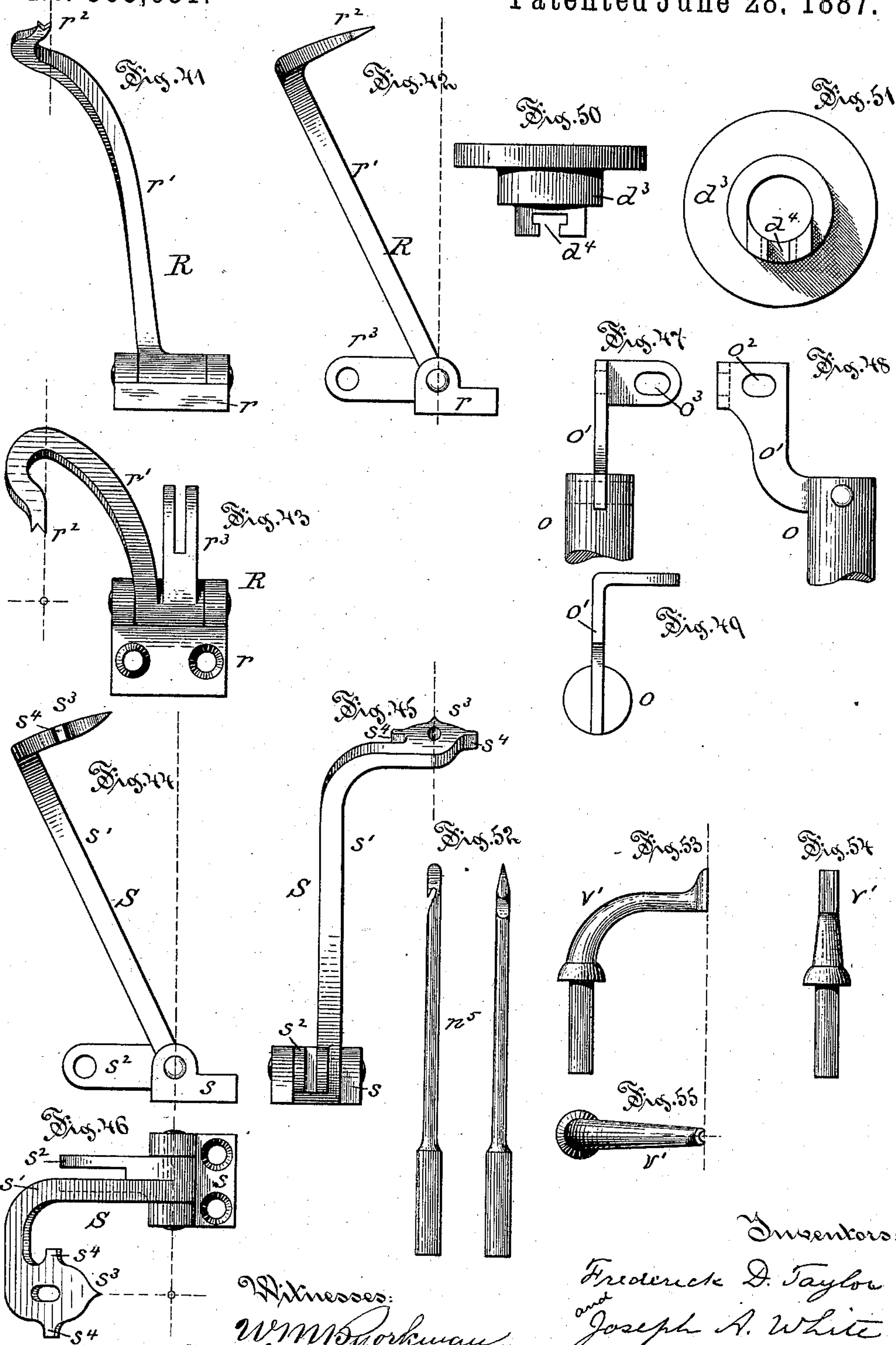
9 Sheets—Sheet 8.

F. D. TAYLOR & J. A. WHITE.

BOOK STITCHING MACHINE.

No. 365,651.

Patented June 28, 1887.



Witnesses:
W. M. Yorkman
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(No Model.)

9 Sheets—Sheet 9.

F. D. TAYLOR & J. A. WHITE.

BOOK STITCHING MACHINE.

No. 365,651.

Patented June 28, 1887.

Fig. 56

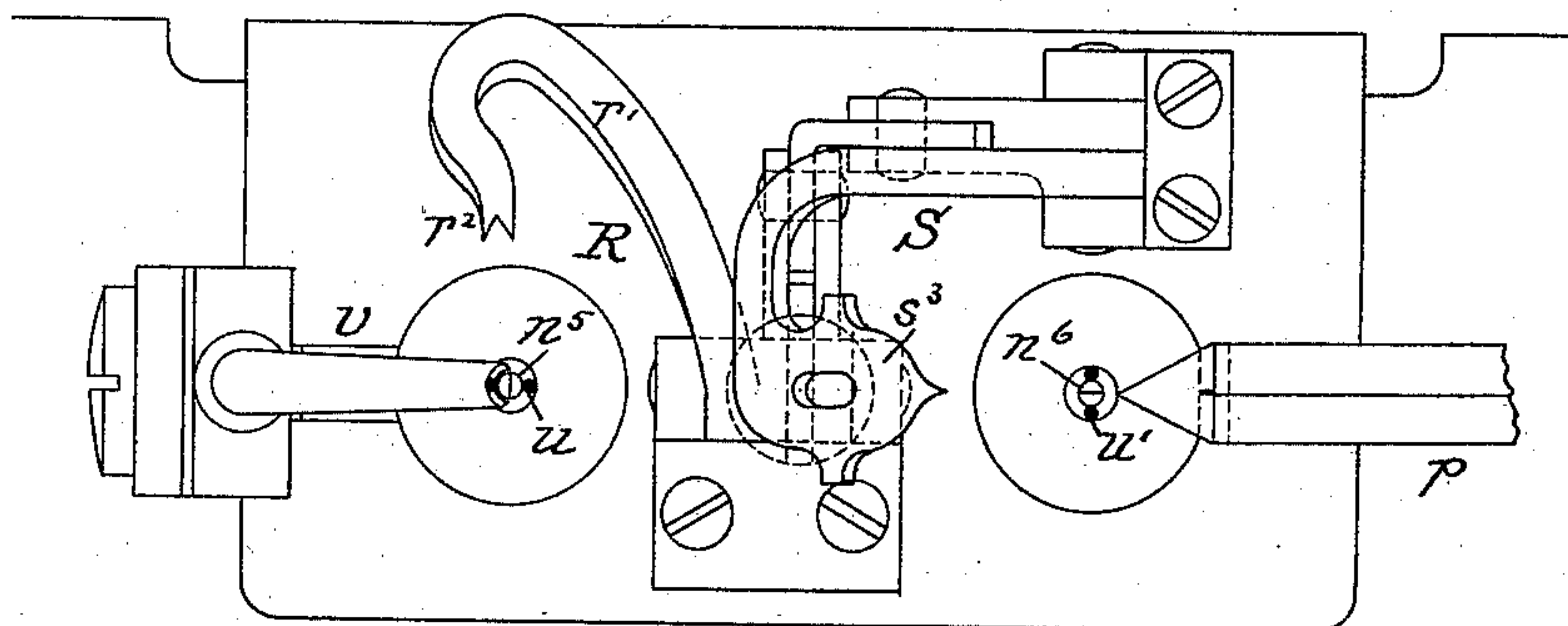


Fig. 57

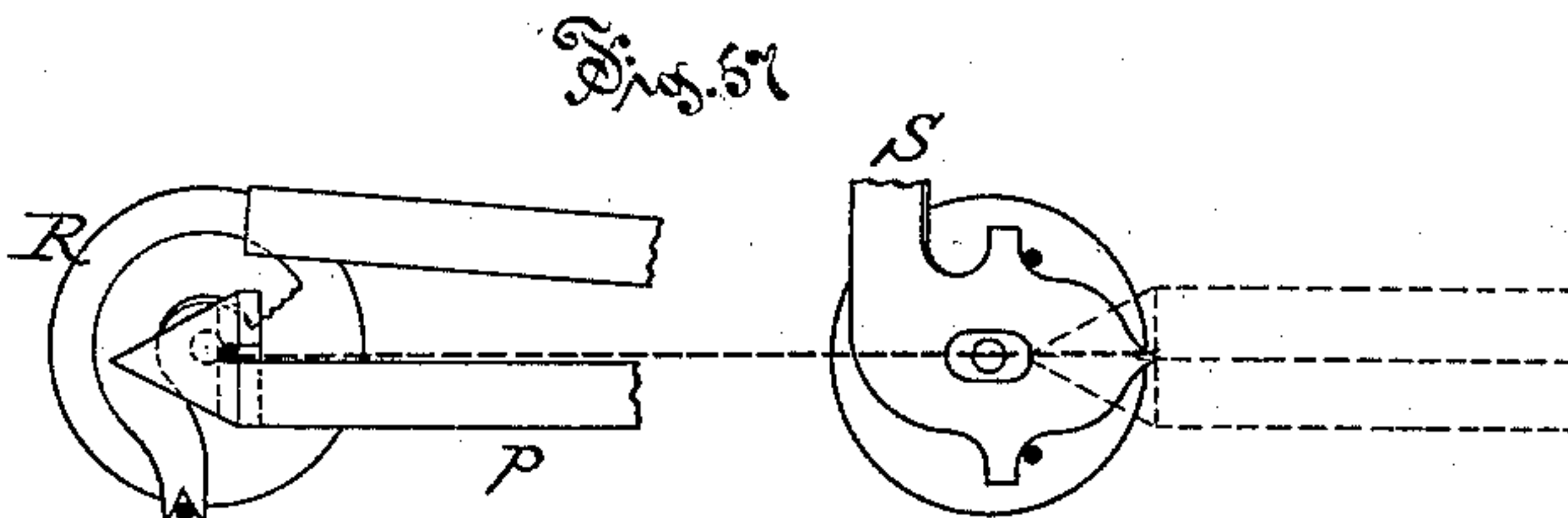


Fig. 58

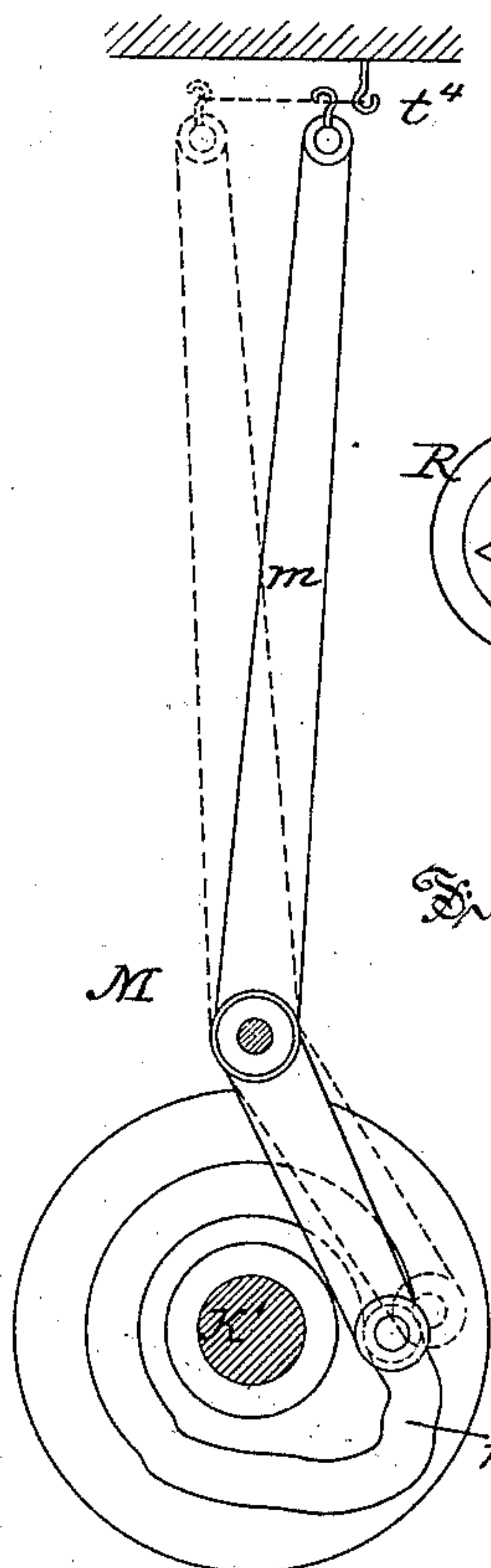


Fig. 59

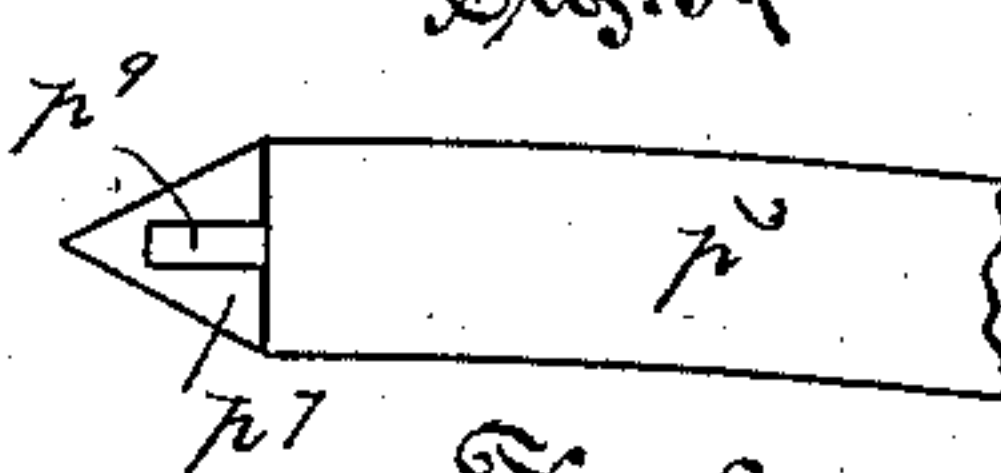


Fig. 60

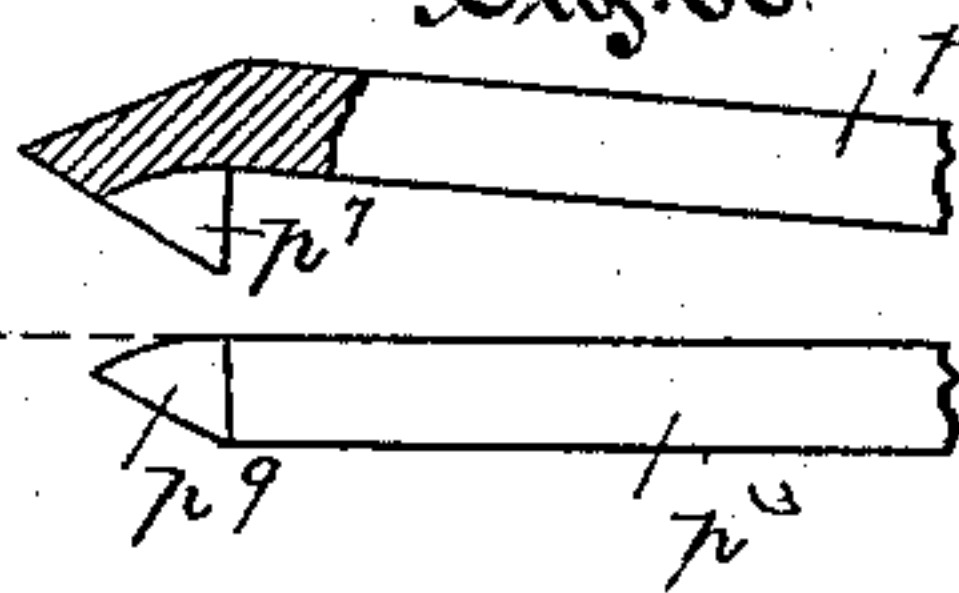
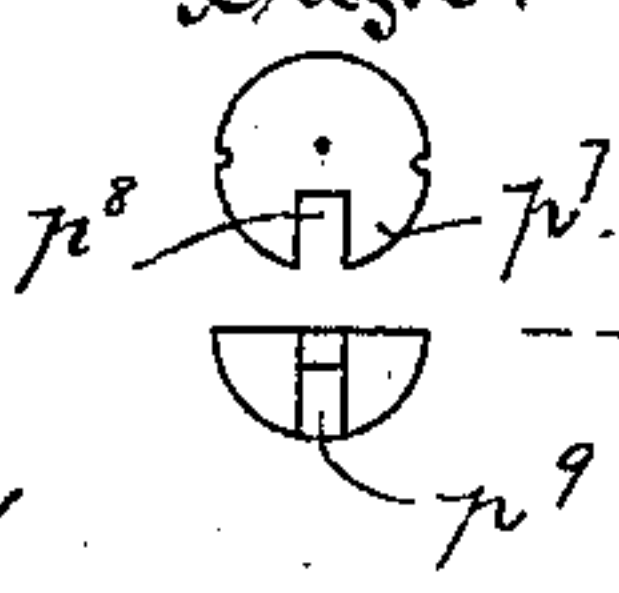


Fig. 61



Witnesses:

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Inventors:

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by Simonds & Burdett,
attys.

UNITED STATES PATENT OFFICE.

FREDERICK D. TAYLOR AND JOSEPH A. WHITE, OF HARTFORD, CONNECTICUT.

BOOK-STITCHING MACHINE.

SPECIFICATION forming part of Letters Patent No. 365,651, dated June 28, 1887.

Application filed March 3, 1886. Serial No. 193,843. (No model.)

To all whom it may concern:

Be it known that we, FREDERICK D. TAYLOR and JOSEPH A. WHITE, both of Hartford, in the county of Hartford and State of Connecticut, have invented certain new and useful Improvements in Book-Stitching Machines, of which the following is a full, clear, and exact description, whereby any one skilled in the art can make and use the same.

10 The object of our invention is to provide a machine by means of which a book, pamphlet, or the like may be automatically stitched and a knot that will not slip be tied in the thread, thus sewing the several leaves securely together.

15 Our improvement consists in the combination of the several devices whereby the pamphlet or book is stitched and a knot that will not slip (in this instance a weaver's knot) is tied automatically; and it further consists in details of the several parts of the machine and their combination, as more particularly hereinafter described, and pointed out in the claims.

25 Referring to the accompanying drawings, Figure 1 is a diagram view showing the relative position of the presser-feet and the end of the thread in the beginning of the operation. Fig. 2 is a diagram view illustrating the position of the thread in a further step in the operation. Figs. 3, 4, 5, 6, 7, and 8 are diagram views illustrating further steps in the operation of tying the knot. Fig. 9 is a detail view, in vertical section, of the case inclosing the operating parts, and, inside view, of the several 35 cams, levers, connecting-rods, and other devices. Fig. 10 is a detail top view of a part of the cam-shaft, showing the cams and connected levers. Fig. 11 is a detail front view, in elevation, of part of the machine, with parts broken away to show construction. Fig. 12 is a detail view, in vertical transverse section, on plane denoted by line $x x$ of Fig. 9. Fig. 13 is a detail view, in horizontal section, of the casing, and, in plan view, of the lever-connection of the presser-foot slide. Fig. 14 is a like view, in horizontal section, of the casing, and, in plan view, of the cutter-lever and the looper-lever. Fig. 15 is a detail view, 45 in horizontal section, of the casing, and, in top view, of the carrier-slide lever and part of the

device for retracting the looper. Fig. 16 is a diagram plan view showing the development of the several cams. Fig. 17 is a front view of the cam that operates the take-up device. 55 Fig. 18 is a front view of the cam that operates the needle-bar. Fig. 19 is a front view of the cam that operates the under thread-carrier. Fig. 20 is a detail view, in horizontal section, of part of the machine on plane denoted by 60 line $y y$ of Fig. 11. Fig. 21 is a detail view, in horizontal section, through the needle-bar yoke on plane $z z$ of Fig. 11. Fig. 22 is a detail view, in horizontal section, of part of the machine on plane $x' x'$ of Fig. 11. Fig. 23 is 65 a detail front view of the loop protector slide and spring. Fig. 24 is a detail front view of the adjustable cam. Fig. 25 is an edge view of the same. Fig. 26 is a detail view of the device used for connecting the casing and 70 cover. Fig. 27 is a detail side view, on enlarged scale, of the under thread-carrier. Fig. 28 is a front end view of the same. Fig. 29 is a detail top view of the same. Fig. 30 is a detail view, on enlarged scale, of the looper and cutter, 75 with parts broken away to show construction. Fig. 31 is a detail view of the thread-cutter. Fig. 31 $\frac{1}{2}$ is a detail view in section of the parts on plane $x^2 x^2$ of Fig. 30. Fig. 32 is a detail rear view of one of the presser-feet. Fig. 33 is 80 a detail side view of the same. Fig. 34 is a detail bottom view of this presser-foot. Fig. 35 is a rear view of the rotary presser-foot. Fig. 36 is a detail side view of the rotary presser-foot. Fig. 37 is a detail bottom view of the rotary 85 presser-foot. Fig. 38 is a detail side view of the jaws of the upper thread-carrier. Fig. 39 is a front view of the latter part with parts broken away to show construction. Fig. 40 is a top view of the device shown in Fig. 38, 90 and the arm bearing a lug that co-operates with one of the jaws of this thread-carrier to open the jaws is shown in top view in this figure. Fig. 41 is a detail front view, on enlarged scale, of one of the loop-spreaders. Fig. 42 is 95 a detail view of this spreader looking from the left. Fig. 43 is a detail top view of this loop-spreader. Fig. 44 is a detail front view of the loop-spreader appurtenant to the right-hand needle. Fig. 45 is a detail side view of 100 the latter, looking from the left. Fig. 46 is a detail top view of the latter. Fig. 47 is a detail

front view of the loop-spreader rod and the connecting arm between it and the loop spreaders. Fig. 48 is a view of the same part looking from the left. Fig. 49 is a top view of the same part. Fig. 50 is an edge view, on enlarged scale, of the collar that connects the thread-cutter and its lever. Fig. 51 is a detail bottom view of this latter part. Fig. 52 shows a detail side and front view of the needles used in our machine. Fig. 53 is a detail side view, on enlarged scale, of the loop-protector. Fig. 54 is a front view of the latter part. Fig. 55 is a detail top view of the same. Fig. 56 is a diagram view showing the relative position of the loop-spreaders, the loop-protector, and the end of the thread-carrier before the loops are spread. Fig. 57 is a detail top view of the front ends of the loop-spreaders and of the end of the thread-carrier, illustrating the operation of the latter in grasping the thread. Fig. 58 is a detail diagram view of the take-up lever and its connected cam. Fig. 59 is a detail side view of the point end of an alternate form of under thread-carrier. Fig. 60 is a detail top view of the latter opened and part broken away to show construction. Fig. 61 is a detail end view of the latter device as opened. Fig. 62 is a detail view, on enlarged scale, in cross-section, of the slide and of the adjustable arm on the upper thread-carrier slide, showing its relation to the upper thread-carrier. Fig. 63 is a detail top view illustrating the operation of the tension device.

Our invention as embodied in the within-described machine consists of a number of mechanisms and parts adapted to tie a weaver's knot in the thread used in stitching a book or pamphlet, and in order to get a better understanding of the operation of these parts attention is first called to the several steps taken in stitching and in tying the knot.

In the drawings, Figures 1 to 8 illustrate the several positions of the thread and several of the operating parts in successive steps in stitching and tying the knot; and in Fig. 1 the letter *g* denotes the left-hand presser-foot, and *g'* the right-hand presser-foot; *H*, the thread-guide, and *I* the looper, the jaws *i* and *j* on the lower end of which grasp the end of the thread *T*. In this view the thread is shown as passing through the guide in front of the foot *g* of one of the presser-rods and into the grasp of the looper-jaws. In Fig. 2 the position of the thread is shown after the looper has revolved about the presser-foot *g'* and thrown one turn of the thread about it. In Fig. 3 the thread is shown after the upper thread-carrier has pulled out a certain length of thread and the needles have risen through the table and pierced their way through the leaves laid upon it, (and held there beneath the presser-feet,) the needles rising into the central openings of the presser-rods. In Fig. 4 the position of the thread is shown in the next step in the operation of forming the knot, where the bight of the thread is thrown across the loop that was first formed in the thread. In Fig. 5 the position

of the parts is shown after the needles have been withdrawn and have pulled the loops through the openings in the leaves. After this the loops are spread by devices and means hereinafter described, and the end of the under thread-carrier, passing through the right-hand loop, grasps one turn of the left-hand loop, and in its return movement pulls the thread into the position shown in Fig. 6. By the operation of the take-up device the thread, while one end of it is held in the grasp of the under thread-carrier, is pulled backward through the guide and the thread thrown into the position shown in Fig. 7, the knot, however, being shown as loosely tied; and in Fig. 8 a further position of the knot more tightly closed is illustrated.

In order that the several operations may be performed automatically, we make use of mechanism and devices as follows:

The letter *K* denotes the frame or casing of the machine, that is made of any suitable material, as iron, cast to shape, and having bearings adapted to support the several operating shafts, levers, pivots, and other parts, and such casing may inclose the larger part of the mechanism, as shown in the drawings.

The letter *K'* denotes a cam-shaft borne in suitable bearings in the frame, and having on the rear part of the shaft a cylinder with cam-grooves *A'*, *B'*, *C'*, *D'*, *E'*, and *F'*, arranged in succession from left to right, as shown in Fig. 9, and the front end of this shaft bears several cam-blocks with peripheral and face cams. These several cams on the rear end of the shaft operate, respectively, the connected parts of the upper thread-carrier mechanism, *A*, the looper mechanism *B*, the presser-slide mechanism *C*, the cut-off mechanism *D*, the looper-lifting mechanism *E*, and the mechanism *F*, that rocks the upper thread-carrier to and from the presser-feet. The forward-projecting arm *K²* of the casing supports in suitable bearings vertically-moving presser-rods *G* and *G'*, arranged at any desired distance apart, and on an upright arm, *K³*, is borne a table, *L*, with its top sloping downward on both sides from a vertical plane passing through the axis of the presser-rods. By means of the cam *C'*, lever *c*, and connecting-rod *c'*, the slides *c²* and *c³* are reciprocated. The slides are each supported by a screw passing through a slot in the slide into the casing, and each has a beveled front edge, that by contact with the sloping upper surface of the blocks *c⁴* and *c⁵*, fast to the presser-rods, causes the latter to move lengthwise, the sloping surface of these parts being held in contact normally and the rods lifted by means of a spring, *c⁶*, held between the upper side of the casing and a collar on the upper end of each rod, as shown in Fig. 9. The forward movement of the slide *c²* pushes the presser-rods down and holds between their feet and the top of the table the leaves of a book or pamphlet while it is being stitched by the machine. The thread *T* extends from a spool, *t*, through an eye, *t'*, through the tension de-

vice t^2 , another eye, t^3 , and the several eyes t^4 , formed on the arms of the take-up device M, through the guide H in front of the presser-foot g' , and around the heel of the looper into the grasp of the jaws i on its lower end. The movement of the cam B' causes the lever b , the lower end of which bears on a pin a roller in contact with the cam, to swing back and forth, and by means of the link b' and connecting-rod b^2 causes the segmental gear b^3 to oscillate about the pivot, by means of which it is supported on the projection from the casing in a plane at right angles to the axis of the presser-rod. The teeth of this segmental gear are in mesh with teeth b^6 , formed in the outer surface of the tubular body b^4 of the looper. This tubular body b^4 , that forms a sort of sleeve closely fitted upon the presser-rod, that is free to move within it, extends downward through an opening in the casing, and has a flange, b^5 , at its upper end engaging in a groove in the forked end e^2 of the lever e' of the looper-lifting mechanism E. The lever e' is moved in a vertical plane by means of the lever e and the cam E' connecting and engaging, as shown in Figs. 9, 10, and 14. The teeth b^6 in the body part b^4 of the looper are long enough to provide for their engagement with the teeth of the gear b^3 at all times during the operation of the looper. The shaft K' bears on its outer end any suitable device, as a pulley or crank, by means of which the shaft may be rotated so as to revolve the several cams. The lever a is supported on a pivot, k , fast to the casing, and its lower end is provided with a pin, on which a roller is held in contact with the cam A', while the upper end of the lever a is connected, by means of links a' , to the short arm of a bent lever, a^2 , that is pivotally supported within the casing so as to swing in a horizontal plane, and has a slot, a^3 , in its front end, that engages a pin on the carrier-slide a^4 . (See Figs. 9, 12, and 15.) This slide is supported in a grooved way (see Fig. 9) and bears the arms a^5 and a^6 , the latter being adjustably attached to the slide by means of a clamp-bolt that passes through a slot in the slide, and they project forward in a position that causes them to come in contact with the opposite sides of the upper thread-carrier, a^7 , as the slide is reciprocated. The relation of the adjustable arm a^6 to the upper thread-carrier, a^7 , is shown in Figs. 9 and 62 of the drawings, and the slot through which the clamping-bolt passes to secure the arm and the slide is of sufficient length to enable one to vary to a considerable degree the distance that the thread-carrier a^7 may be moved away from the presser-rod by the movement of the slide. The other arm, a^5 , is rigidly attached to the outer end of the slide, and is intended to return the thread-carrier to the same position in relation to the presser-foot g' and the looper each time that the slide is reciprocated, the distance that the carrier a^7 is moved away from the looper only being adjustable. This upper thread-carrier, a^7 , is borne on a rod, a^8 ,

and is held against rotary movement thereon by means of a pin or key that takes into a groove, a^9 , in the rod, (see Figs. 38, 39, and 40;) but it is free to move endwise along the rod. This rod is supported at one end by a link, a^{10} , from a projection on the side of the arm K², and at the other end on the lower arm of the lever f^2 , that is pivoted to the casing. A rocking movement is imparted to this lever f^2 by means of the connecting-rod f' , lever f , and the cam F', (see Figs. 9, 10, 12, and 15,) and this rocking motion of the lever moves the rod a^8 , and with it the upper thread-carrier, in such manner that it is carried toward and from a vertical plane passing through the axis of the presser-foot, for a purpose that will be hereinafter explained. The lower part of the tubular body b^4 of the looper, that extends through the opening in the casing, is smaller than the part above it, so that a shoulder is formed that limits the downward movement of the body, while the upward movement is limited by a collar, i' , clamped upon the body and bearing a downward-extending leg, i^2 , that terminates in a foot, forming the lower one of the looper-jaws i , Figs. 30 and 31. The upper one of the jaws is formed by the lower end of the cutter-rod d^6 , that lies in a socket along the inner surface of the looper-body and bears on its upper end the T-shaped part d^7 , that fits into the socket d^4 in the collar d^3 , (see Figs. 50 and 51,) that connects the thread-carrier rod with its operating-lever d' , Fig. 14, which is moved by the lever d and cam D', Figs. 9 and 10. The lever d' is divided into two parts at the pivot d^8 , which parts are connected by a pin in the short arm of one taking into a slot in the other, and a spring, d^9 , fast to one lever, presses downward with its free end upon the top of the other in such manner as to force the collar and the cutter-arm downward with a yielding pressure, so that the grasp of the jaws upon the thread used in stitching is a yielding grasp. The purpose of the divided lever and spring is to enable the looper to be lifted over the standing part of the thread without releasing the end from the looper-jaws. The forward end of the cam-shaft K' bears the cam N' of the needle-operating mechanism N, the cam O' of the loop-spreader mechanism O, and the cam P' of the under thread-carrier mechanism, P. These latter mechanisms are in part attached to the inner surface of the upright arm K³ of the casing, the several rods being supported in sockets in the rod-guide Q and in the needle-bar n , which slides in a groove in the casing. The walls of this groove hold the needle-bar against any sidewise movement that might result from the action of the cam N' upon the roller n^2 , that is held in contact with the cam by a pin projecting from the lower end of the needle-bar n . The needle-rods n^3 n^4 are clamped in sockets in the cross head n' on the upper end of the needle-bar, and needles n^5 n^6 are secured in the upper ends of the needle-rods and in line with their axes. The lower end of the spreader-

rod o rests upon the periphery of the cam-block that bears the spreader-cam O' , and the upper end (see Figs. 47, 48, and 49) bears a bent arm, o' , with slots o^2 and o^3 formed in parts that lie at right angles to each other. Fast to the casing, near the upper end of the spreader-rod o , is the plate r , to which is pivoted the loop-spreader R , which consists of a bent lever pivoted to the plate at its angle, with a curved upper arm, r' , ending in a fork, r^2 , and a shorter lever-arm, r^3 , bearing a pin that projects into the slot o^2 of the spreader-arm. Near the plate r there is also secured to the casing the spreader-plate s , to which is pivoted the loop-spreader S , which consists of a bent lever pivoted to the plate near its angle, and having the upward-extending curved arm s' and the lower arm, s^2 , that bears a pin projecting into the slot o^3 of the spreader-arm. The upper end of the spreader-arm s' has a broadened finger, s^3 , with a pointed end and projecting side parts, s^4 . The function of this finger s^3 is to spread the parts of the loop, while the function of the projections s^4 is to throw the loop out of the eye of the needle n^6 . The under thread-carrier, p , is secured to the upper section, p' , of an extensible lever that is made up of the parts p' and p^2 , which lever is pivoted to the casing so that it oscillates, and in so doing moves the thread-carrier p below the table L in a plane passing through the axis of both of the presser-rods. The parts p' and p^2 of this lever are connected by means of bolts that pass through slots in the lower part, p^2 , the said slots being made in a direction across the length of the lever, so that when the lever is changed in length to adjust the under thread-carrier with reference to the position of the table the thread-carrier will bear the same relation to the axis of the presser-rod G' under the several adjustments of length possible. The slots, it will be noticed by an examination of Fig. 11, are located in lines that are substantially parallel to the axis of the presser-rod G' when this lever is in its normal position and holds the under thread-carrier in readiness to operate. A roller borne on a pin fast to the lower end of the thread-carrier lever is held in contact with the cam P' in such manner that by the rotation of the cam-shaft the lever and the under thread-carrier are oscillated, as described. This under thread-carrier, p , (see Figs. 11, 27, 29, 56, 57, 59, 60, and 61), is composed of two long slender parts pivoted together and forming jaws, the jaw p^3 being attached rigidly to the upper end of the thread-carrier lever, while the other jaw, p^4 , is pivoted to it (see Figs. 27 and 29) in such manner that the jaws open on opposite sides of the plane of movement of the thread-carrier. The jaws are held closed by means of a spring, p^5 , that is secured to the fixed jaw and thrusts against the side of the movable jaw at a point back of the pivot, and the latter jaw bears a projecting lug, p^6 , that at a certain time in the forward movement of this thread-carrier strikes a fixed projection, l' , on the casing

of the machine, (see Fig. 9), and thus causes the jaws to open just before they reach the farther loop. The outer end of this thread-carrier is pointed, to allow it to pass readily between the strands of one loop, u' , and has a hook on one of the jaws to catch one of the strands of the loop u . (See Figs. 56 and 57.) To prevent this strand from being pushed to the wrong side of the point of the thread-carrier by any slight divergence of the latter, its end is pointed and hook-shaped, as shown; but in the modified form shown in Figs. 59, 60, and 61 a further precaution is taken, by making the hook p^7 on the end of the movable jaw p^4 with a narrow socket, p^8 , on one side, into which the thin end p^9 of the fixed jaw fits. This thin end is rounded on the side next the opposite jaw, so that the point lies on one side of the central line and plane of motion of the thread-carrier. This insures the entrance of the strand between the jaws, so that it is grasped by the hooked end when the jaws close.

The several mechanisms are operated by the movement of the main shaft K' and the cams borne on it, and the kind, degree, and extent of the motion produced by these several cams and the relation of these movements each to the other are clearly shown in Figs. 16, 17, 18, and 19, the direction of the movement being indicated by the arrows overlying or adjacent to the several figures. A number of leaves having been placed upon the table beneath the presser-feet, which hold them firmly upon the table, and the thread arranged as already described, with its end in the grasp of the looper-jaws i , the rotary movement of the main shaft K' causes the looper to revolve in such manner that one turn of the thread is thrown around the presser-foot g' in the position as indicated in Fig. 2. At the same time the upper thread-carrier, a' , is moved laterally toward the looper by the operation of the rocking mechanism, and is swung inward toward the thread and grasps it at a point between the looper-jaws and the presser-foot g' , the forward movement of this upper thread-carrier causing the jaw a^{12} to open by the contact of the lug a^{13} on the movable jaw with the cam-lug a^{14} , fixed on the casing, and the tension of the spring a^{15} causes the jaws, after the two lugs have passed each other, to close upon and grasp the thread. In the meantime the needles n^5 n^6 have been lifted, have pierced the leaves, and have passed into the central sockets, g^2 g^3 , in the presser-feet. The end of the thread is released by the opening of the looper-jaws i and j by the mechanism already described, and the upper thread-carrier makes a return movement, (the looper having been moved in reverse direction enough to carry it out of the way of the thread-carrier,) carrying the thread with it and placing it in a lateral socket, g^4 , in the presser-foot g in such position that it is thrown into the eye of the needle n^5 . The looper with its jaws held open continues its revolution in the reverse direction to that which it first

made, and, catching a standing part of the thread at a point between the presser-foot g' and the thread-guide H, lifts it and throws it into the lateral socket g^5 in the presser-foot g' and into the open eye or hook of the needle n^6 , in the position indicated in Fig. 4. The downward movement of both of the needles is then begun, and the loops u u' are pulled through the work and the table to a point below the path of the under thread-carrier. While the loops are being formed the looper I is swung back and rests in a position between the presser-foot and the under thread-guide, H, the looper being lifted so as to clear the thread, and the cutter-blade being also raised by the opening of the looper-jaws. The looper rests or dwells in this position until the knot has been tied. Each presser-foot has an outlet-slot, g^6 , (see Figs. 34 to 37,) through which the thread is slipped when the loops u and u' are formed, and this places the length of thread between the presser-feet closely upon the work, enabling the turn that was formed about the right-hand presser-foot to be slipped clear of it when it is lifted, just before the knot is pulled taut. As soon as the loop u is formed, a loop-protector, v , (Figs. 11, 23, 53, 54, and 55,) is caused to hold the thread in the eye of the needle n^5 . This loop-protector consists of a bent arm, v' , fast to the upper end of the protector-slide v^2 , that is secured to the casing by a screw, v^3 , passing through a slot, v^4 , in said protector-slide and holding it against movement by the frictional grasp of the spring v^5 . A pin projecting from the side of the needle-bar n^3 is adapted, by contact with the pins v^7 on the protector-slide, to reciprocate the latter at certain points in the reciprocating movement of the needle-bar n^3 . The function of this protector is to hold the loop in the grasp of the needle while the under thread-carrier is making its return movement. By the forward movement of the spreader-arm the spreader R is swung forward and pushes the left-hand strand of the loop u forward, and at the same time the spreader S is swung over, so that the point of the finger is thrust between the strands of the loop u' , spreading them apart and carrying the loop out of the eye of the needle n^6 . The under thread-carrier then passes through the right-hand loop and grasps the right-hand strand of the loop u , and returns with it, pulling the thread between the strands of the loop u' , as indicated in Fig. 6 of the drawings. The take-up lever m , that is pivoted to the frame or casing, (see Figs. 9, 10, and 58,) is vibrated by means of the cam M' , a pin on the lower end of this lever projecting into the cam-groove, as shown in Fig. 58. To the upper end of this take-up lever is secured a projecting arm, m^2 , that bears several eyes or hooks, m^3 , that alternate with the eyes that are fast to the frame and lie between them, as shown in Fig. 9, in such manner that in the normal position of the lever m the thread T may be passed freely through the several

eyes without being bent. By the rotation of the cam-shaft K' the lever m is vibrated and the eyes on the end of the arm m^2 of the lever are pulled aside out of line with the eyes t^4 , so that a number of loops are formed in the thread, and in thus pulling the thread aside that portion of the loop u' that lies below the pamphlet is drawn up through the opening made by the needle n^6 by this backward pull upon the standing part of the thread, and a weaver's knot is tightly tied. The tension of the thread is of course sufficient to overcome the resistance to the movement of the take-up that is offered by this tying of the knot. The table L is attached to the upright arm K^3 of the casing by means of bolts k , passing through slots k' in the legs k^2 , and the cam k^3 bears the handle k^4 , with milled head, by means of which the cam is rotated and the table set at any desired height. (See Figs. 9, 10, and 24.) The working parts of this machine are all inclosed within the casing, and the front cover, K^5 , is movably attached to the arm K^3 by means of the lug having the downturned and open slot that fits upon a bolt or pin with a broadened head fast to the arm, as shown in Fig. 26. As soon as the knot has been securely tied, the jaws i of the looper are closed upon the thread, the blade d' cuts off the thread, and the looper is revolved to the position on the left of the presser-foot g' , the latter having lifted to allow the thread to pass beneath it. When the knot is tied after the stitching operation, the thread passes through the slot that joins the needle-holes in the table, and the work is readily removed therefrom.

It is obvious that many of the operations in the tying of the weaver's knot may be performed by mechanisms substantially the same as herein described, and we do not limit ourselves to the precise devices nor their exact combination, as herein described, for automatically tying this knot after stitching a book. The main advantage of the use of this knot is that it will not slip, and it overcomes a difficulty present in all the prior machines of this class.

The method or process involved in the operation of the within-described machine is not herein claimed by us; but it forms the subject-matter of another application duly filed in the Patent Office January 10, 1887, and of Serial No. 223,853.

We claim as our invention—

1. In a book-stitching machine, in combination, the upper thread-carrier, the table, the reciprocating needles, the presser-rods with feet, the revolving looper borne on one of the presser-rods and turning about its foot, the under thread-carrier, and the thread-cutter, all substantially as described.

2. In a book-stitching machine, in combination, the presser-feet with lateral slots and needle-sockets, and the swinging and reciprocating upper thread-carrier, all substantially as described.

3. In combination, the thread-guide H, the

reciprocating thread-carrier a^7 , borne on the swinging rod a^8 , and having jaws opened by the forward movement of the carrier, all substantially as described.

5 4. In combination, in the thread-carrier mechanism A of a machine of the within-described class, the several cams, links, and levers for imparting and changing the direction of the motion of the thread-carrier, the thread-carrier borne on the swinging rod a^8 , the slide a^4 , with a fixed arm, a^5 , and an adjustable arm, a^6 , adapted to engage the thread-carrier in the movement of the slide, all substantially as described.

15 5. In combination, in a machine of the within-described class, the reciprocating and swinging upper thread-carrier and its actuating mechanisms A and F, the reciprocating presser-rod G' , with its foot g' , having the thread-socket, the needle-socket, and the outlet-slot, and the revolving looper I, borne on the presser-rod G' , all substantially as described.

25 6. In combination, in a machine of the within-described class, the reciprocating and swinging upper thread carrier and its actuating mechanism A and F, the reciprocating presser-rod G' , the rotary and reciprocating looper I, borne on the said presser-rod, and the looper-actuating mechanisms B and E, all substantially as described.

35 7. In combination, in a machine of the within-described class, the reciprocating and swinging upper thread-carrier, the reciprocating presser-rod, the revolving and reciprocating looper, and the thread-cutter, all substantially as described.

40 8. In a book-stitching machine, in combination, a work-holding table, the reciprocating presser-rod G' , with foot g' , the sliding tubular looper-body b^4 , borne on the presser-rod, and having the gear-teeth b^6 and thread-grasping jaw, and the within-described loop-revolving mechanism, as and for the purpose set forth.

45 9. In a book-stitching machine, in combination with the looper-lifting mechanism E, the looper-body bearing the looper-jaw, and the sliding thread-cutter, carrying the cutter-blade, of the cutter mechanism D, all substantially as described.

50 10. In combination, in a machine of the within-described class, a reciprocating presser-rod bearing a presser-foot, a rotary and reciprocating looper, and a reciprocating thread-cutter borne by the looper, all substantially as described.

60 11. In a machine of the within-described class, in combination, a work-holding table, a presser-rod, G' , with a presser-foot, g' , having a central needle-socket, a lateral thread-socket, and an outlet-slot, all substantially as described.

65 12. In combination with the lever e' of the looper-lifting mechanism E, the looper-body b^4 , with a flange, b^5 , engaging the groove in the forked end e^2 of the lever e' , all substantially as described.

13. In combination with the lever e' , having a forked end, e^2 , with a groove, the looper-body b^4 , with flange b^5 engaging in the groove, and the teeth b^6 , the segmental gear b^3 , and connected parts of the looper-rotating mechanism B, all substantially as described.

70 14. In combination, the reciprocating presser-rod G' , the tubular looper-body b^4 , free to slide and rotate on the presser-rod, the collar i' , clamped to the looper-body and bearing on the leg i^2 , the jaw i , the sliding cutter-rod d^6 , borne in the socket in the looper-body and having on its lower end one of the jaws, j , and a cutter-blade, d^7 , and the several connected looper and cutter mechanisms B, D, and E, all substantially as described.

85 15. In combination with the upper thread-carrier mechanisms, A and F, the carrier-slide a^4 , with arm a^5 and adjustable arm a^6 , the swinging rod a^8 , supporting the sliding carrier a^7 , with the jaw a^{12} , having a lug, a^{13} , the cam-lug a^{14} , fast to the casing, and the spring a^{15} of the carrier, all substantially as described.

90 16. In the cutter-operating mechanism D, in combination, the lever d , formed in two parts, each supported on the pivot d^8 , the one part bearing a pin taking into a slot in the other part, and a spring, d^9 , fast to the one lever part and depressing the other, the cutter-rod d^6 , with the jaw j and cutter-blade d^7 , and the looper-body b^4 , supporting the complementary jaw i , all substantially as described.

100 17. In a machine of the within-described class, in combination, the casing, the adjustable table L, with clamp device, the underthread-carrier, p , and the extensible thread-carrier lever p' , all substantially as described.

105 18. In the within-described book-stitching machine, in combination, the vertically-adjustable table L, the under thread-carrier, p , and the extensible carrier-lever composed of parts p' and p^2 , joined by clamping-bolts passing through slots in the part p^2 , parallel to the axis of the presser-rod G' , whereby the relative position of the said axis and the point of the thread-carrier p is maintained under the several adjustments of the lever p' as to its length, all substantially as described.

115 19. In a book-stitching machine, in combination, the reciprocating and swinging upper thread-carrier, the adjustable table, the under thread-carrier, the presser-feet, the reciprocating needles, the revolving looper and the thread-cutter borne thereon, and the loop-spreaders, all substantially as described.

120 20. In a book-stitching machine, in combination, the reciprocating upper thread-carrier, a^7 , having thread-grasping jaws, the presser-feet borne in the sliding presser-rods G and G' , the vertically-adjustable table L, the reciprocating needles n^5 and n^6 , the under thread-carrier, p , borne on the extensible carrier-lever p' , and the thread-cutter, all substantially as described.

125 21. In the within-described book-stitching machine, in combination, the extensible thread-carrier lever composed of the parts p' and p^2 ,

the under thread-carrier, p , having a fixed jaw, p^3 , and a movable jaw, p^4 , pivoted thereto, the closing-spring p^5 , the movable jaw having a projecting lug, p^6 , and a jaw-opening lug, l , fast to the casing of the machine in the path of the moving thread-carrier, all substantially as described.

22. In the within-described book-stitching machine, in combination, the under thread-carrier, p , borne on the end of the extensible lever and having a rigid jaw, and a movable jaw opening to one side of the path of the center of the carrier, the end of the movable jaw being pointed and hook-shaped and having a lateral socket, and the thin end of the fixed jaw adapted to enter the said socket and having its point lying to one side of the said central line, all substantially as described.

23. In combination, in the loop-spreader mechanism O of a book-stitching machine, the cam-shaft K' , bearing cam O' , the reciprocating spreader-rod o , with an arm, o' , and the loop-spreaders R and S , engaged and moved by the said spreader-rod, all substantially as described.

24. In combination, the frame or casing K^3 , the loop-spreaders R and S , attached to the casing, the reciprocating spreader-rod o , with the angular arm o' , and slots o^2 o^3 , in which pins borne on the respective spreader-levers r^3 and s^2 engage, all substantially as described.

25. In a loop-spreader, in combination, the reciprocating spreader-rod o , engaging the spreader-lever, the plate r , and the bent spreader-lever pivoted to the plate and having on the end of the curved upper arm the fork r^2 , all substantially as described.

26. In a book-stitching machine, in combination, a table for supporting the work operated on, the reciprocating presser-feet, each with thread and needle sockets and outlet-slot, the reciprocating needles, the looper, the

loop-spreaders, and the thread-carriers, all substantially as described.

27. In a book-stitching machine, in combination with a work-holding table having an opening for the passage of a needle and a loop of thread, the reciprocating needle having an open eye or hook, the vibrating loop-spreader having the broadened finger s^3 , with pointed end, and projecting side parts, s^4 , whereby a loop, u' , is spread and disengaged from the needle, all substantially as described.

28. In a book-stitching machine, in combination, the loop-forming devices, the open-eyed needle, the loop-spreaders R and S , and the loop-protector v' , all substantially as described.

29. In combination with the reciprocating needle-rod n^3 , bearing the needle n^5 , the loop-protector slide v^2 , with the pins v^1 , the screw v^3 , holding the slide on the casing, the spring v^6 , and the pin projecting from the needle-bar and co-operating with pins v^1 , all substantially as described.

30. In combination with the within-described loop-forming and stitching devices, the take-up lever m , with the several thread-holding eyes on the arm t^3 , the alternate thread-holding eyes fast to the arm of the casing, and the cam M' , borne on the shaft K' , in sliding contact with the levers, all substantially as described.

31. In combination, in a book-stitching machine, a work-holding table, a reciprocating presser-rod bearing a presser-foot, and a rotary and reciprocating looper bearing thread-holding jaws, all substantially as described.

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