

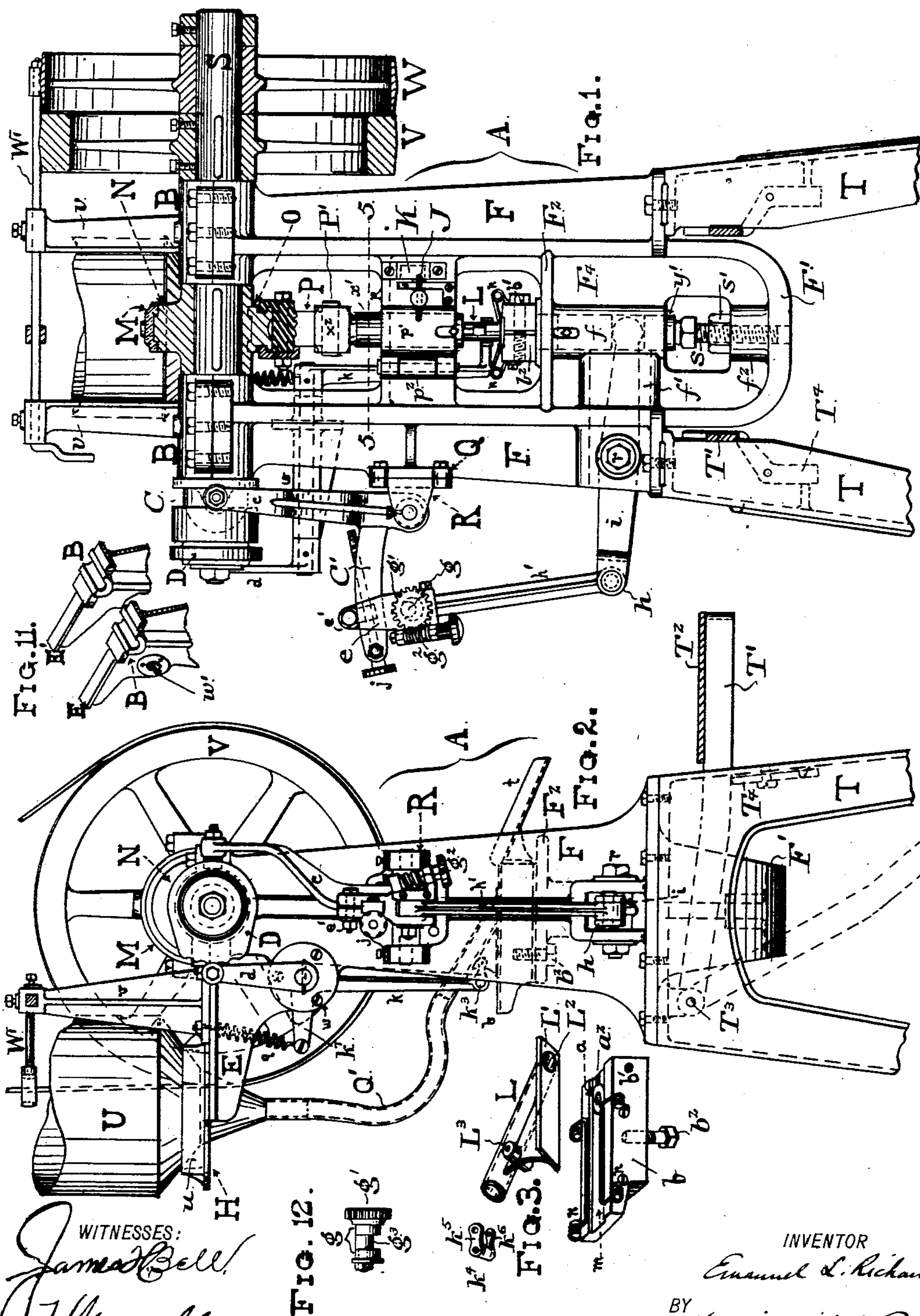
(No Model.)

3 Sheets—Sheet 1.

E. L. RICHARDS.  
PILL MACHINE.

No. 541,390.

Patented June 18, 1895.



WITNESSES:  
*James Bell*  
*J. H. Mendenhall*

INVENTOR  
*Emanuel L. Richards*  
BY  
*Hallamsworth & Maloy*  
ATTORNEYS

3 Sheets—Sheet 2.

No. 541,390.

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FIG. 4.

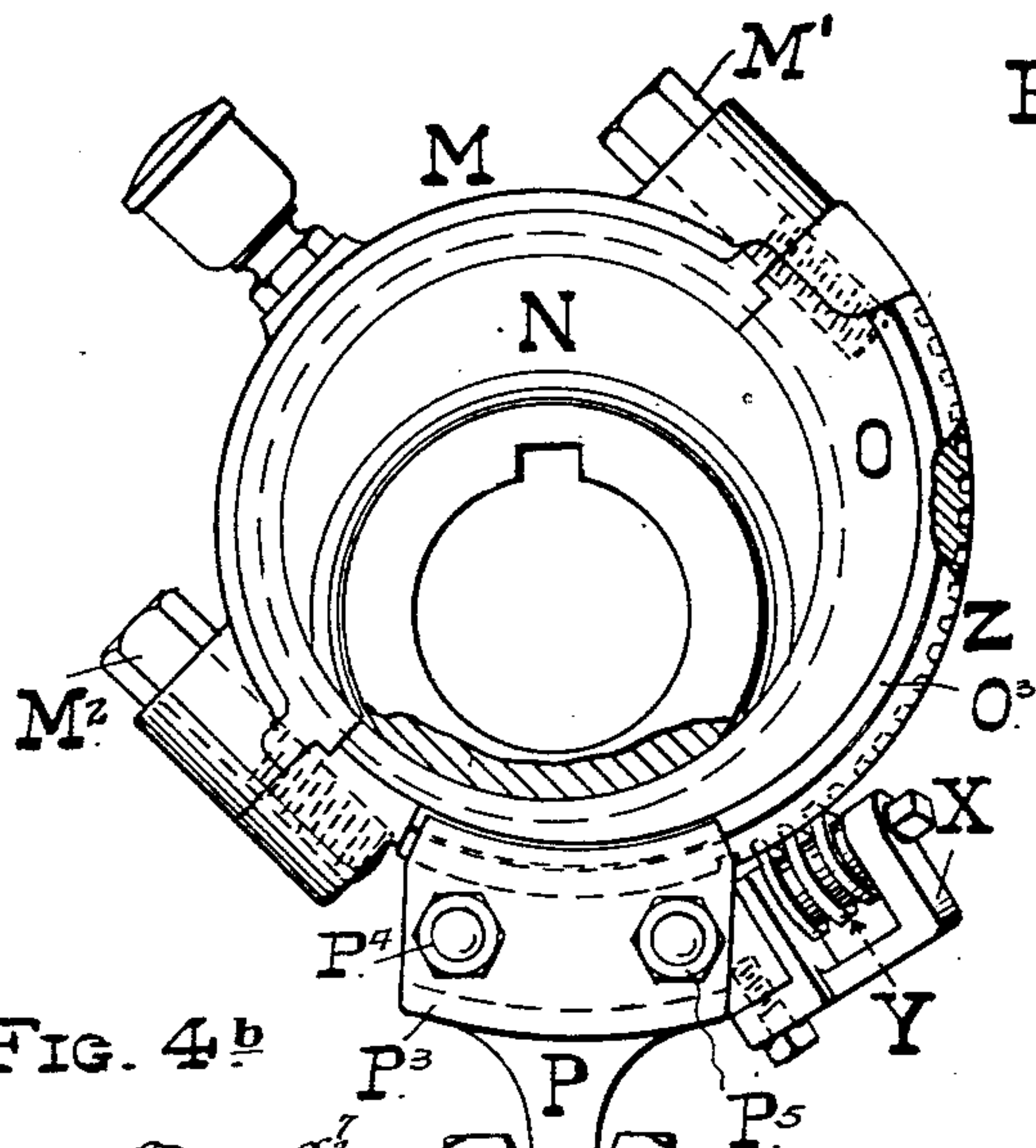
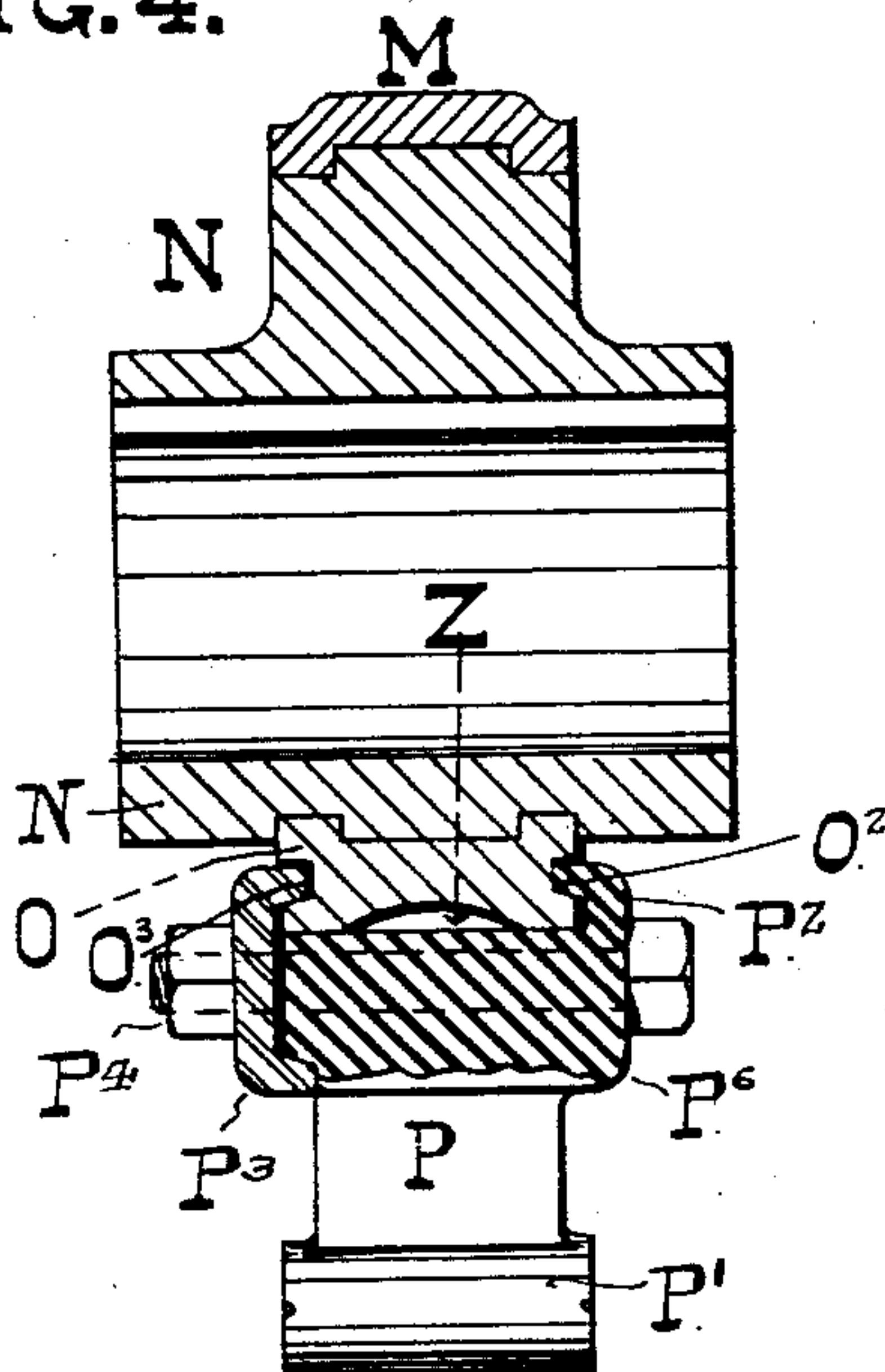
FIG. 4.<sup>a</sup>

FIG. 4**b**

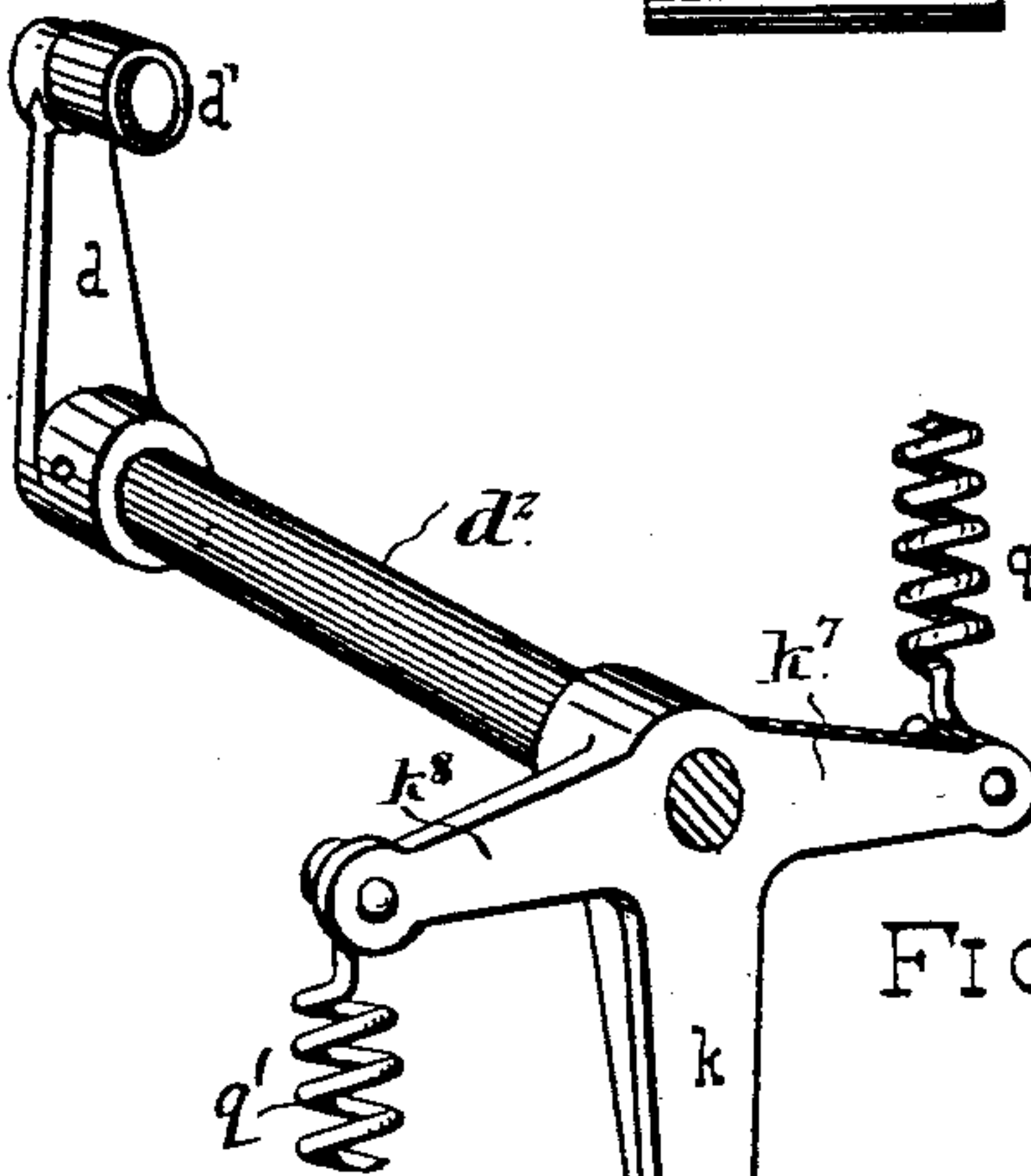
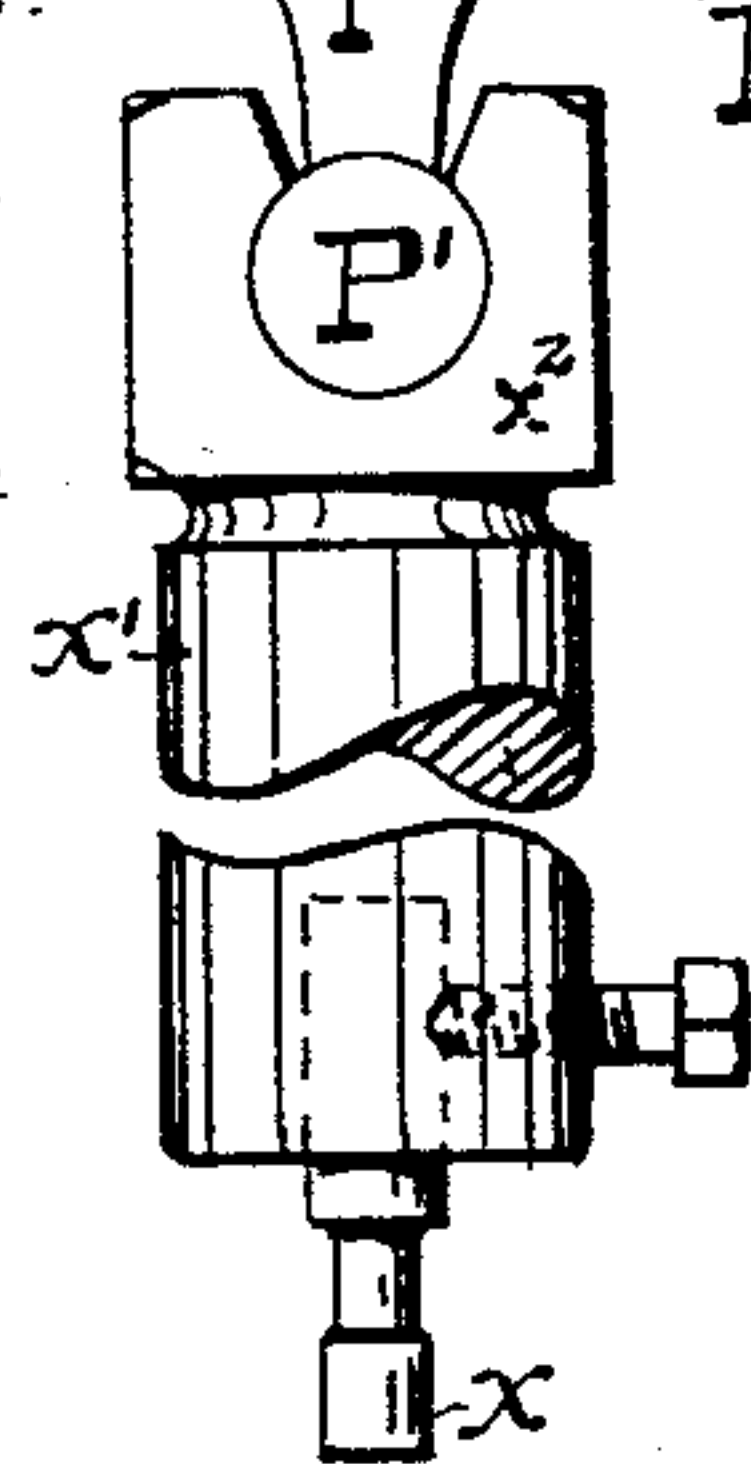
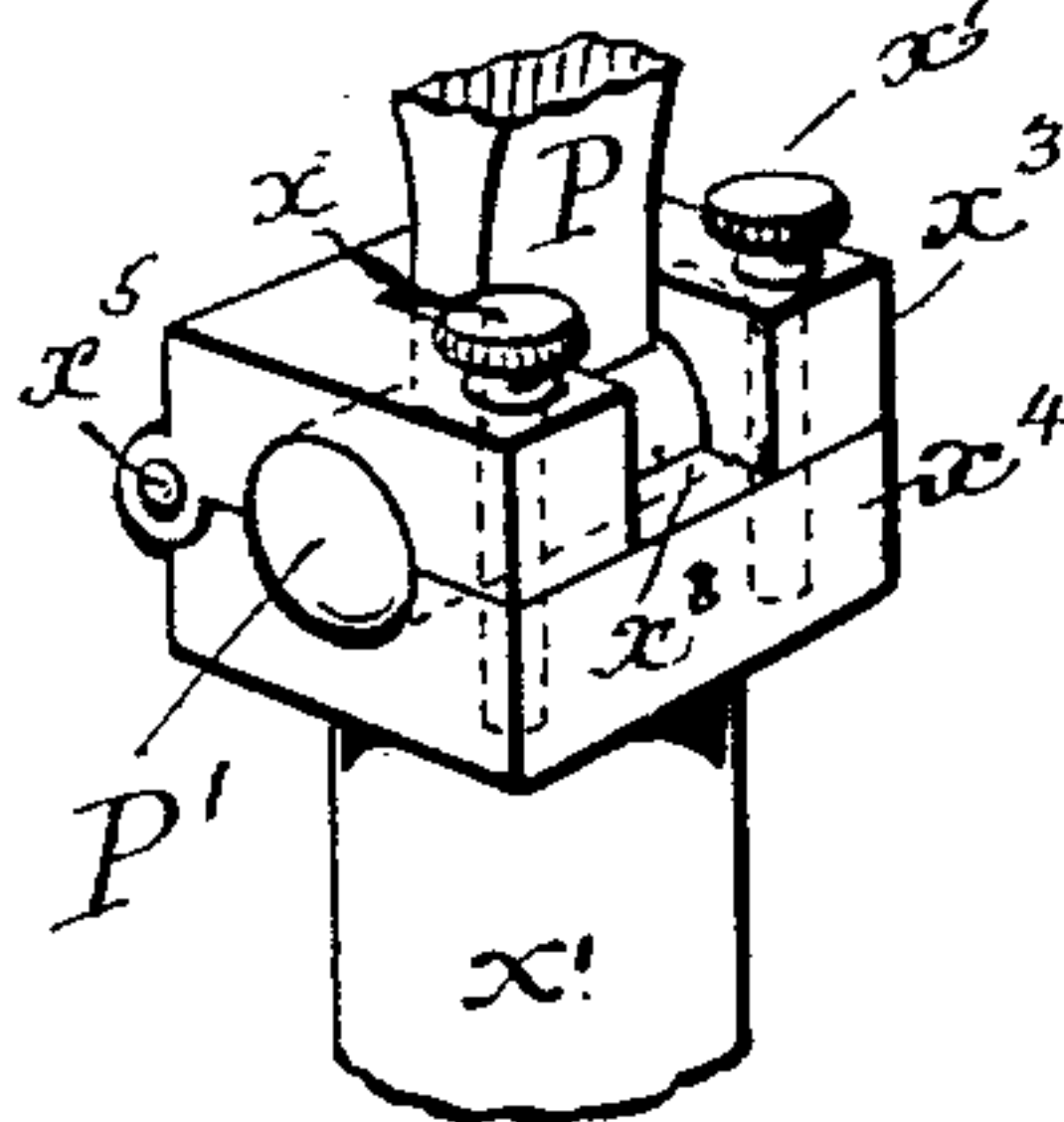
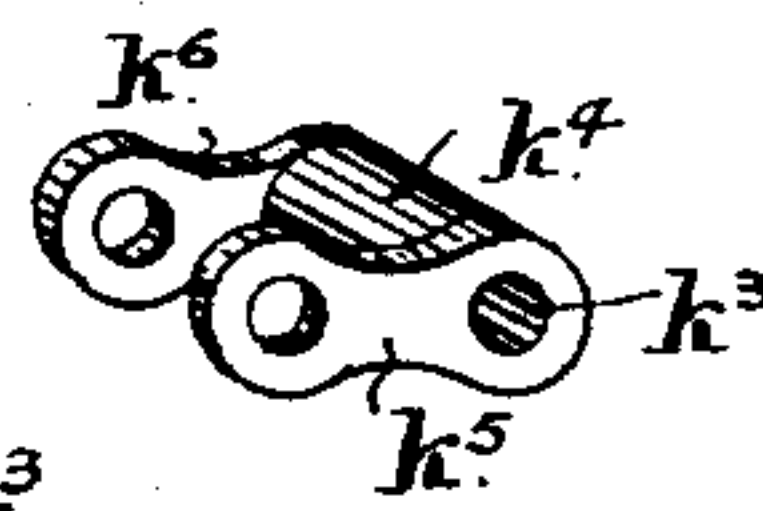


FIG. 6.

FIG. 7.



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FIG. 5.



(No Model.)

3 Sheets—Sheet 3.

E. L. RICHARDS.  
PILL MACHINE.

No. 541,390.

Patented June 18, 1895.

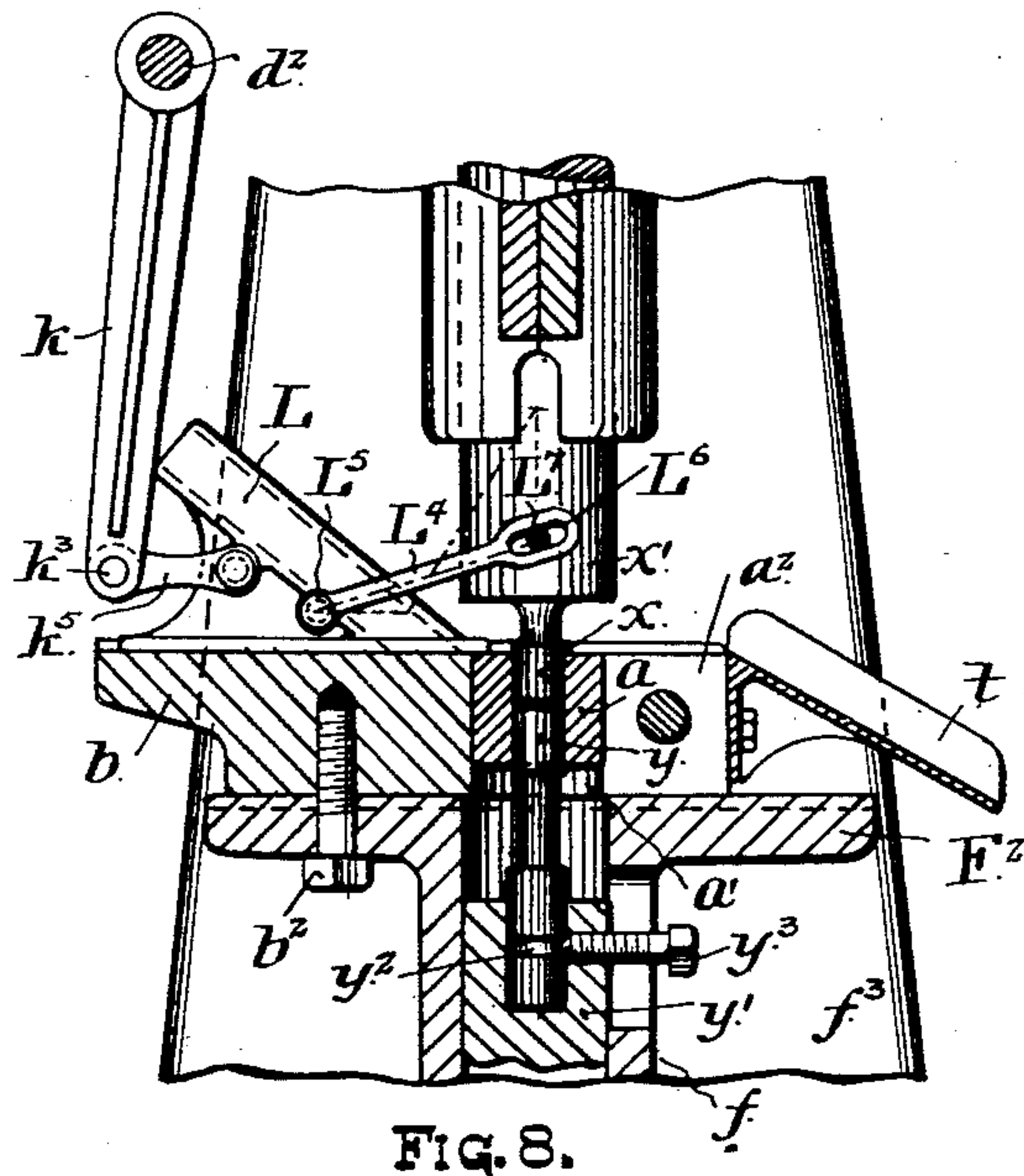


FIG. 8.

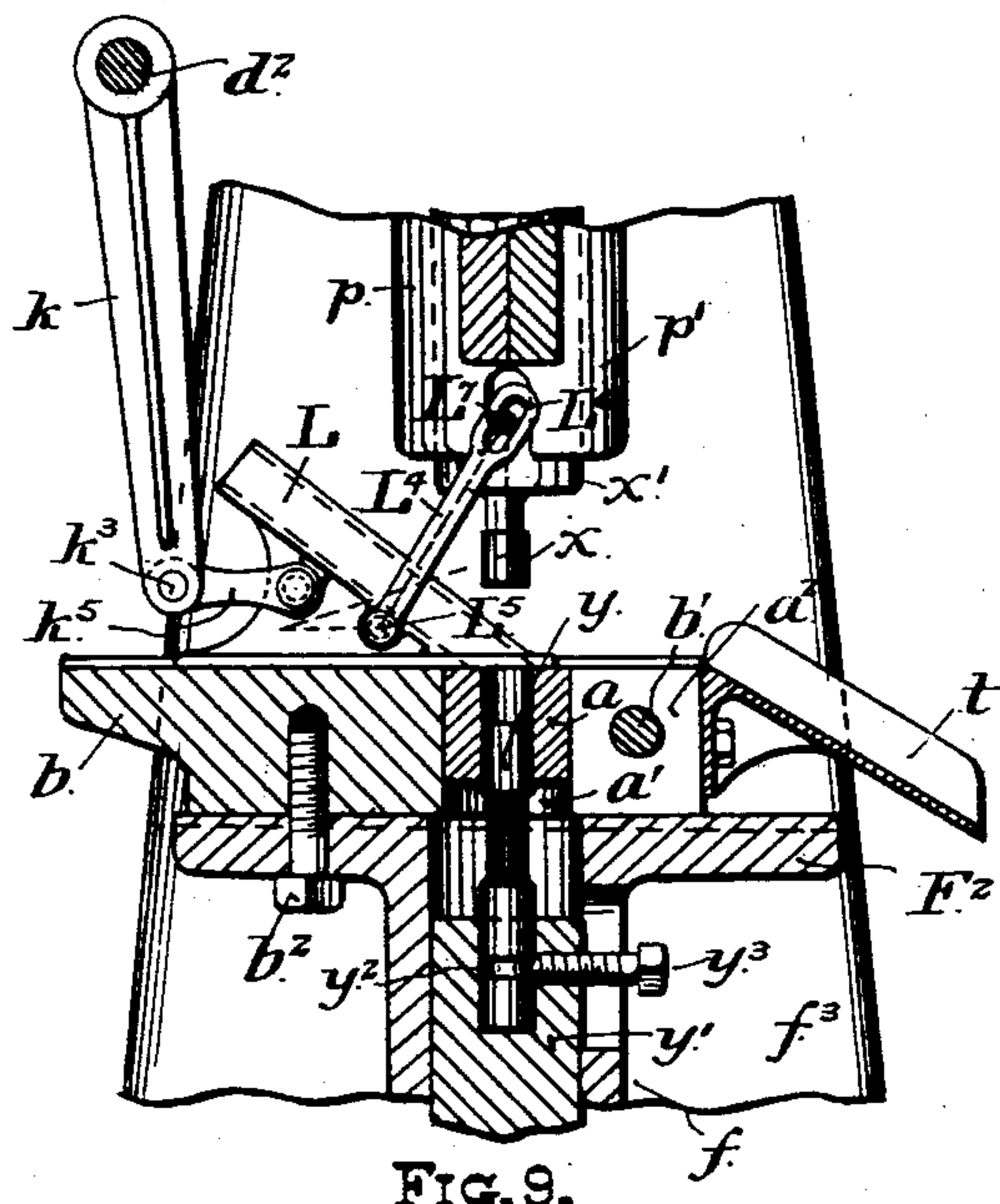
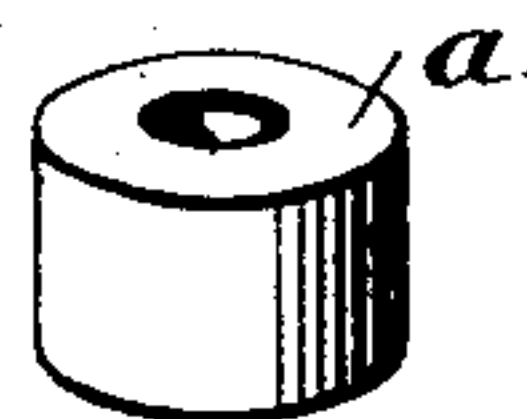


FIG. 9.

FIG. 10.



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# UNITED STATES PATENT OFFICE.

EMANUEL L. RICHARDS, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR TO  
EDWARD H. HANCE, ANTHONY M. HANCE, JOSEPH C. HANCE, AND ED-  
WARD H. HANCE, JR., OF SAME PLACE.

## PILL-MACHINE.

SPECIFICATION forming part of Letters Patent No. 541,390, dated June 18, 1895.

Application filed December 8, 1893. Serial No. 493,133. (No model.)

*To all whom it may concern:*

Be it known that I, EMANUEL L. RICHARDS, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Machines for Making Pills, Tablets, &c., whereof the following is a specification, reference being had to the accompanying drawings.

My invention relates to that class of these machines wherein powdered or plastic material is compressed into the desired form, between reciprocating punches acting within a surrounding die.

In the accompanying drawings, Figure 1 represents a front view, partly in elevation and partly in vertical section, of a machine embodying my invention. Fig. 2 is a side elevation thereof. The remaining figures are detail views, Fig. 3 being a view in perspective of the block which holds the die and of the feed-slide which is adapted to move upon said block, showing also the links whereby said feed-slide is connected with its actuating device, the several parts being represented as detached from one another. Fig. 4 is a side view of the eccentric and two-part strap connected with the upper plunger, certain portions being represented as broken away to clearly exhibit the construction. Fig. 4<sup>a</sup> is a sectional view through said eccentric, strap, and adjacent parts on a vertical plane coinciding with the axis of rotation. Fig. 4<sup>b</sup> is a detail view, in perspective, of a modified device for attaching the plunger-head to the eccentric. Fig. 5 is a horizontal section through the housings and intermediate parts on the line 5 5 of Fig. 1, showing the construction of the separable guide within which the upper plunger moves. Fig. 6 is a view in perspective of the rock-shaft and bell-crank lever for actuating the feed-slide. Fig. 7 is a view of the link whereby the said feed-slide is connected with the bell-crank. Figs. 8 and 9 are vertical central sections through the die-block and adjacent parts, showing two different positions of the punches and feed-slide. Fig. 10 is a view in perspective of the die detached from the block. Fig. 11 is a view in perspective of the upper ends of the housings. Fig. 12 is a view of the eccentric pin whereby

minute regulation of the stroke of the lower plunger is obtained.

Referring to the general views, A indicates the frame-work of the machine, consisting of the upright housings, F, F, united at the bottom by the downwardly depending inverted yoke, F', above which are the intermediate web, F<sup>4</sup>, the transverse shelf, F<sup>2</sup>, and, at a still higher level, the flanged web, F<sup>3</sup>, (see Fig. 5,) all of which are cast in one piece with said housings and, while affording supports, as will hereinafter be described, for certain of the working parts, also serve to strengthen the frame, whose strains, as will be seen, are substantially self-contained.

The housings, F, F, are secured to arched base pieces, T, T, which together form a four-legged pedestal therefor. At the upper end of the housings, F, F, are formed transverse bearings, B, for the main driving shaft, S, on which are mounted, in the usual manner, the fast pulley, V, and loose pulley, W, provided with a belt-shifter, W', mounted in the uprights, v, whose braces rest upon brackets, E, E, projecting rearwardly from the top of the housings. Said brackets, E, E, also support an open frame, H, which carries the feed-hopper, U, containing the material to be acted upon. Upon the shelf, F<sup>2</sup>, is secured by means of the screw, b<sup>2</sup>, the block, b, which contains the cylindrical, tubular die, a, in whose central cavity the punches approach one another to compress the material. The upper surface of the block, b, is grooved longitudinally, as indicated at m, to receive and guide the flat base, L', of the feed-slide, the top of the die, a, being flush with the bottom of the groove, m, in order to permit the free reciprocating movement of the slide. The die, a, is detachably secured near one end of the block, b, in a cylindrical cavity, a', (see Figs. 8 and 9,) from which a vertical slot, a<sup>2</sup>, extends entirely through to the front end of the block.

A transverse screw, b', extends through the block across said slot, whereby the two portions of the block, b, adjacent to the opening, a', may be forced together so as to clamp the die, a, rigidly in position.

The upper punch, x, and the lower punch, y, fit snugly within the cavity of the die, a,



which may be cylindrical or prismatic as desired. The punches  $x$  and  $y$  are secured in sockets formed respectively in the end of the upper plunger,  $x'$ , and the end of the lower plunger,  $y'$ , axial rotation of each punch, for the purposes of adjustment, being permitted by means of a circumferential groove near the base of the punch, engaging with a set screw in its plunger, as shown in the case of the lower punch at  $y^2$ ,  $y^3$ , in Figs. 8 and 9.

The upper plunger,  $x'$ , reciprocates vertically within a tubular bearing,  $p, p'$ , (see Fig. 5,) the rear half,  $p$ , of which is integral with the web,  $F^3$ , extending across between the housings,  $F$ . The front half,  $p'$ , of said bearing is hinged to the rear portion at  $p^2$ , (as shown in Figs. 1, and 5,) a turnbuckle latch,  $J$ , engaging with a socket piece,  $K$ , to hold the hinged portion firmly in position when closed.

At the upper end of the plunger,  $x'$ , is a square head,  $x^2$ , across which a cylindrical cavity, open at the top, is formed to receive the transverse cylindrical bearing-piece,  $P'$ , of a short pitman,  $P$ , whose upper end is connected with the strap of the driving eccentric. The bearing-piece,  $P'$ , fits snugly in the cavity of the head,  $x^2$ , and engages therewith in a vertical direction, but is free to move laterally, so that the plunger head,  $x^2$ , may be slid off sideways from the bearing-piece,  $P'$ , and thus detached from connection with the driving mechanism. Such detachment of the plunger may be effected by opening the front hinged portion,  $p'$ , of its guide, swinging the plunger forwardly outward by a slight rotation of the driving eccentric in that direction, and then sliding the plunger laterally until the head has cleared the bearing-piece,  $p'$ .

The driving mechanism for the upper plunger is shown in detail in Figs. 4 and 4<sup>a</sup>. An eccentric,  $N$ , is suitably mounted upon the shaft,  $S$ , and provided with a two-part strap, the parts  $M$  and  $O$  being secured together by means of bolts,  $M', M^2$ , whose sockets are suitably mounted at the meeting ends. The exterior periphery of the part,  $M$ , is preferably concentric with its inner or bearing surface, but the exterior periphery,  $Z$ , of the part,  $O$ , is eccentric to the inner periphery thereof. On each side of the part,  $O$ , is a deep groove, as indicated at  $O^2$ ,  $O^3$ , respectively, said grooves being substantially parallel with the outer periphery,  $Z$ .

The pitman,  $P$ , is adjustably connected with the part,  $O$ , in the following manner: The head,  $P^6$ , of the pitman fits snugly against the exterior of the periphery of the part,  $O$ , and is provided with an inwardly projecting flange,  $P^2$ , which engages in the groove,  $O^2$ , running along one side of the part,  $O$ . A detachable clamp piece,  $P^3$ , is fitted to the other side of the pitman-head, being secured in position by means of bolts,  $P^4, P^5$ , which pass through the pitman head. Said clamp-piece,  $P^3$ , is provided with flanges along its upper and lower edges, one of said flanges engaging beneath

the outwardly projecting side of the pitman-head; the other flange engaging in the groove,  $O^3$ , situated upon the adjacent side of the part,  $O$ . On the front face of the pitman head is a bracket in which is mounted a worm,  $Y$ , adapted to engage with worm teeth formed in the outer periphery,  $Z$ , of the part,  $O$ . When the bolts,  $P^4, P^5$ , are loosened, rotation of the worm,  $Y$ , will shift the two-part strap,  $M, O$ , rotatively with relation to the pitman,  $P$ , and as the grooves of the part,  $O$ , (wherewith the flanges of the pitman-head and clamp-piece engage,) are eccentric to the inner periphery of the strap, this rotative adjustment, in one direction or the other, will shorten or lengthen the stroke of the pitman, since the part,  $O$ , acts substantially as a curved wedge between the pitman-head and the eccentric. When the requisite adjustment has been reached, the pitman-head is clamped fast against the part,  $O$ , by means of the bolts,  $P^4, P^5$ , and clamp-piece,  $P^3$ .

The plunger,  $y'$ , of the lower die, is mounted in a tubular guide-piece,  $f$ , which extends downwardly from the shelf,  $F^2$ , and is also integral with the web,  $F^4$ . At that side which is toward the left in Fig. 1, and toward the front in Fig. 2, the tubular guide,  $f$ , is slotted so as to communicate with a lateral opening through the enlarged offset,  $f'$ , of the web,  $F^4$ , which continues horizontally outward beyond the side of the housing. Opposite to the said opening, the lower plunger,  $y'$ , is provided with a vertical slot to admit the rounded inner end of a lever,  $i$ , mounted upon a horizontal fulcrum,  $r$ , in the offset of the housing and projecting laterally outward to a point of engagement,  $h$ , with a connecting rod,  $h'$ , whereby it is reciprocated in a vertical plane, by mechanism which will hereinafter be described.

The lower end of the plunger,  $y'$ , rests upon the head of a screw,  $s$ , which is mounted in a boss,  $f^2$ , supported upon the yoke,  $F'$ . Said screw,  $s$ , is provided with a jam-nut,  $s'$ , whereby it may be locked in any given position. Assuming that the range of movement of the lower plunger can be varied by the mechanism which will presently be described, the purpose of the screw,  $s$ , is to afford a positive support for the plunger when it is in its lowest position and receiving the thrust of the upper plunger, the adjustment of the screw,  $s$ , being obtained by depressing the lower plunger to its extreme downward position, then setting the screw,  $s$ , up into rigid contact with its lower end, and finally securing the jam-nut,  $s'$ , in position so as to insure permanency.

The connecting rod,  $h'$ , is actuated to effect the vertical reciprocation of the lever,  $i$ , by means of a bell crank lever engaging with a cam on the main driving shaft. This cam, indicated at  $C$ , (Fig. 1) has a groove, shown in dotted lines, which receives a roller upon the upper end of the curved arm,  $c$ , of the bell-crank, pivoted upon a horizontal axis mounted in the bracket,  $R$ , which projects



laterally from a pad, Q, cast upon the side of one of the housings. The other arm, C', of said bell-crank is segmental in form and is embraced by the vertically slotted head, e, of the connecting rod, h', which is adjustably secured to said arm by any convenient means, such as the screw, j, attached to the outer end of the arm and engaging in a threaded cavity passing through one side of the head. A transverse clamping screw, e', serves to lock the head, e, fast in any given position, by compressing the sides thereof against the sides of the arm, C'. Means for further and very minute adjustment are also provided by connecting the rod, h', to the head, e, by means of a transverse pin, g, rotatably mounted in the lower part of the head and having an eccentric part to which said rod is attached.

The connecting rod, h', extends into a slot in the lower portion of the head and is there attached to the eccentric middle portion, g<sup>3</sup>, of said pin, (see Fig. 12,) so that rotation of the pin will practically increase or diminish the total length of the connecting rod, and head by varying the point of connection between them. Rotation of the pin, g, is effected by means of a worm-gear, g', mounted on one end thereof and engaging with a worm, g<sup>2</sup>, carried by the head, e.

It will be noted that the throw of the upper plunger is adjustable by means of a two-part strap, M, O, whereby it is connected with its driving eccentric, and that the throw of the lower plunger is primarily adjustable by shifting the connecting rod, h', inward or outward upon the segmental arm, C', of the bell-crank, and secondarily and minutely adjustable by means of the eccentric pin, g'. The utmost nicety of regulation in the relative movements of the parts is therefore obtainable, a point of great importance in this class of machines. Furthermore, as the throw of the upper plunger is positive, and the support of the lower plunger rigid during the moment of compression, there is no tendency of the machine to vary its operation by the springing of the parts or from other cause.

The feed apparatus consists of a hopper, U, mounted on a shelf, H, resting on the brackets, E, E, having a downwardly depending flexible tube, Q', leading therefrom to the rigid tube, L, of the feed-slide. The flat base, L', of the feed-slide moves freely, as above stated, in the groove, m, of the die-block, b, being retained in position against vertical displacement by means of the springs, n, n, mounted upon the opposite sides of the block and bearing downward upon the upper surface of the base. The feed-slide is pivotally connected to a downwardly projecting arm, k, of a T-shaped bell-crank, (see Fig. 6,) by means of a double link whose arms, k<sup>5</sup>, k<sup>6</sup>, embrace a tubular bearing, L<sup>3</sup>, near the rear of the feed-slide, and are secured thereto by a pin which passes through said bearing. The other end of the link is connected with the laterally projecting stud, k', on the lower end

of the bell-crank arm, k, by means of a pin, k<sup>3</sup>, mounted in said stud and passing through a tubular bearing, k<sup>4</sup>, across the end of the link. The bell-crank, k, k<sup>7</sup>, k<sup>8</sup>, is rigidly attached to a rock-shaft, d<sup>2</sup>, which is journaled in a tubular bearing, w, extending horizontally outward from the face of one of the brackets, E, to which it is secured opposite to the hole, w', (see Fig. 11,) through which the inner end of the shaft, d<sup>2</sup>, passes. On the outer end of the said rock-shaft, d<sup>2</sup>, is rigidly secured a lever arm, d, having at its upper end a cam roller, d'. This roller engages with a cam surface formed on the periphery of the cam, D, which is mounted at the extreme end of the main shaft, S, a portion of said cam surface having the short scalloped or wavy outline, shown in Fig. 2, in order to give the lever arm, d, a shaking or quick vibratory movement to and fro during the period of its maximum throw.

Springs, q, q', attached at one end to the bell-crank arms, k<sup>7</sup>, and k<sup>8</sup>, and at the other to the frame of the machine, normally tend to hold the roller, d', in operative contact with the surface of the cam, D. The movement of the rock-shaft, d<sup>2</sup>, effected by means of said cam, shifts the feed-slide to and fro along the upper surface of the block, b, the extreme limit of motion in one direction being such that the aperture, L<sup>2</sup>, of the tube, L, is over the opening in the die, a. This position corresponds with the period of contact between the cam roller, d', and the short scalloped portion of the cam, D, so that the feed-slide is shaken over the mouth of the die, a, to facilitate the discharge of the material into the latter.

As a guard to insure the withdrawal of the feed-slide from above the die when the punch is about to descend, I provide the device shown in detail in Figs. 8 and 9, and consisting of a link, L<sup>4</sup>, pivotally connected to the feed slide at L<sup>5</sup>, and engaging at its other end by means of a slot, L<sup>6</sup>, with the pin, L<sup>7</sup>, mounted upon the side of the plunger, x'. If for any reason the actuating mechanism of the feed-slide should fail to properly withdraw the same, prior to the descent of the plunger, x', the link connection between the plunger and the slide will force the slide backward, so as to preclude the possibility of the punch striking against it, a danger to which machines of this class are peculiarly liable.

At the front end of the die-block, b, I attach a chute, t, which leads outward to a point over a shelf, T<sup>2</sup>, on which the receptacle for the tablets or pills is placed to catch them as they are discharged from the chute, t. For convenience of access to the front of the machine, the shelf, T, is mounted upon arms, T', pivoted to the pedestal at T<sup>3</sup>, and supported in their raised position upon latches, T<sup>4</sup>, by tripping which the shelf can be dropped down between the front legs of the pedestal.

The general operation of the machine is as follows: The plungers having been adjusted



so that the punches,  $x$ ,  $y$ , approach one another in the die,  $a$ , to the required degree of closeness, the material to be compressed is placed in the hopper. The upper plunger being raised, and the lower one depressed to its lowest position, the feed-slide moves forward until its aperture,  $L^2$ , is over the punch,  $a$ , when the shaking action due to the scallops on the cam,  $D$ , takes place, thus facilitating the discharge of the material into the die. After filling the cavity thereof the feed slide retreats and the upper plunger,  $x'$ , descends, compressing the material into the desired form between the upper punch,  $x$ , and the lower punch,  $y$ , whose plunger is rigidly supported during the period of compression, by means of the screw,  $s$ . Upon the rise of the upper plunger, the lower one follows it and ejects the compressed tablet, by rising until the face of the punch,  $y$ , is flush with the top of the die,  $a$ . The feed-slide then advances and the front edge thereof pushes the tablet forward into the chute,  $t$ , whence it is discharged into the receptacle on the shelf,  $T^2$ .

A convenient modification of the device for permitting the upper plunger to be readily detached from the eccentric strap, is shown in Fig. 4<sup>b</sup>. In this arrangement the head of the plunger,  $x'$ , is divided horizontally into two portions,  $x^3$  and  $x^4$ , hinged together at the rear, as indicated at  $x^5$ , and clamped together by screw-bolts,  $x^6$ ,  $x^7$ . The upper half,  $x^3$ , of the head is slotted upon the front at  $x^8$ , the slot being of sufficient width to freely receive the downwardly depending pitman,  $P$ , whose transverse bearing-piece,  $P'$ , engages in a tubular socket which is bi-sectioned by the plane of separation of the portions,  $x^3$  and  $x^4$ .

When it is desired to remove the plunger, the screw-bolts,  $x^6$ ,  $x^7$ , are disengaged and the upper portion,  $x^3$ , of the block is thrown backward so as to clear the pitman,  $P$ , when the piece,  $P'$ , can be withdrawn.

The various capacities of the several parts having been explained in connection with the literal description thereof, I do not deem it necessary to repeat them as preliminary to my claims, which are as follows:

1. The combination, with the upper and lower plungers and their actuating mechanism, arranged substantially as set forth; of the housings,  $F$ ,  $F$  arranged symmetrically on each side of said plungers and affording a two-fold bearing for the actuating shaft; the yoke,  $F'$ ; the support mounted therein for the lower plunger during the act of compression; the guide,  $f$ , for the lower plunger; and the guide,  $p$ , for the upper plunger; said yoke and said guide being integral with the housings, whereby all strains due to the compressing operation are equably distributed through and substantially restricted to the housings.

2. The combination with the upper plunger and with the housing arranged on each side thereof, of a two-part guide, one part of which is integral with the housings; a vertical hinge connecting the other part of said guide therewith; and locking mechanism, substantially as set forth, whereby said guide may be quickly opened or closed and secured and immediate access to the plunger obtained, substantially as set forth.

3. The combination with the plunger, and its driving eccentric, of a strap having a curved groove upon its face, the curvature of said groove being non-coincident with that of the inner periphery of the strap; a pitman connected with the plunger and engaging within said groove, and a clamp, whereby said pitman may be secured at different points in said groove.

4. The combination, with the plunger and its driving eccentric; of an eccentric-strap having a portion of its exterior periphery of a curvature non-coincident with that of its inner periphery and having a groove upon its face of a curvature parallel with said portion of the exterior periphery; a pitman connected with the plunger and having a flange which engages with said groove; a clamp for securing said pitman to said strap at different positions in said groove; a worm gearing on the periphery of the strap and a screw mounted on said pitman and operatively engaging with said worm-gearing, substantially as set forth.

5. The combination with the upper and lower punches and their respective actuating mechanism, and with the die wherein said punches approach; of a slotted and grooved die-block; means for clamping the slotted portions of said block together to support said die; a feed-slide moving in the groove of said block; springs retaining said feed-slide against vertical displacement, and actuating mechanism, substantially as set forth, for said feed-slide.

6. The combination with the upper plunger and its actuating mechanism and with the feed-slide and its actuating mechanism, of a guard-link pivotally connected with said plunger and said slide, substantially as and for the purposes set forth.

7. The combination with the pitman, of the two-part hinged plunger head, having a transverse cavity to receive the pitman bearing, the upper part of said head being slotted upon its front face to admit the pitman, and means, substantially as set forth for securing the two parts of the head together.

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