(No Model.) 4 Sheets—Sheet 1.

R. MIEHLE.

MECHANICAL MOVEMENT.

No. 583,308. Patented May 25, 1897.

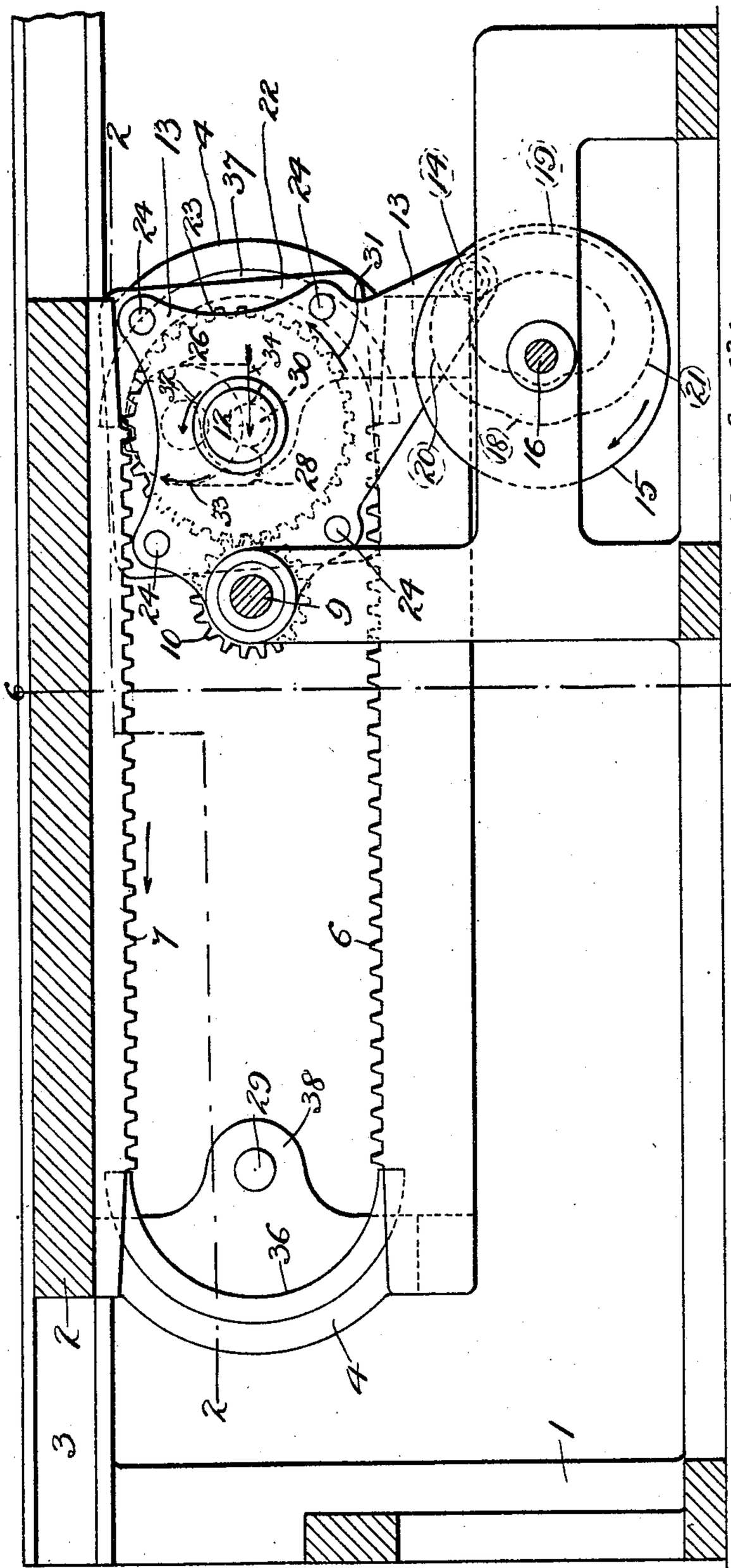

Fig. 1.

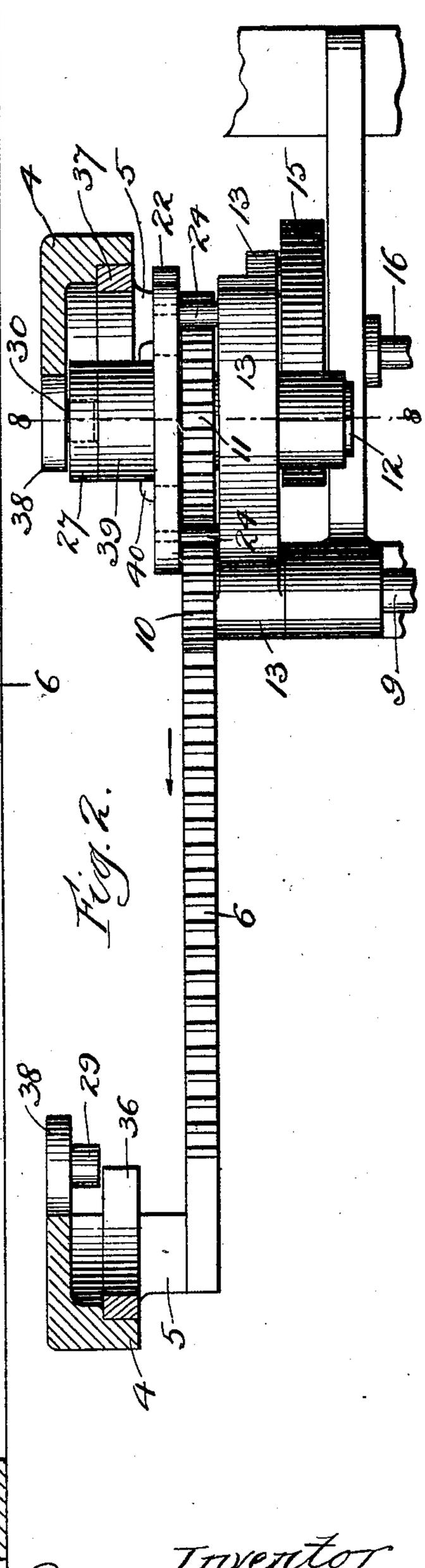

Fig. 2.

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(No Model.)

4 Sheets—Sheet 2.

R. MIEHLE.

MECHANICAL MOVEMENT.

No. 583,308. Patented May 25, 1897.

Fig. 3.

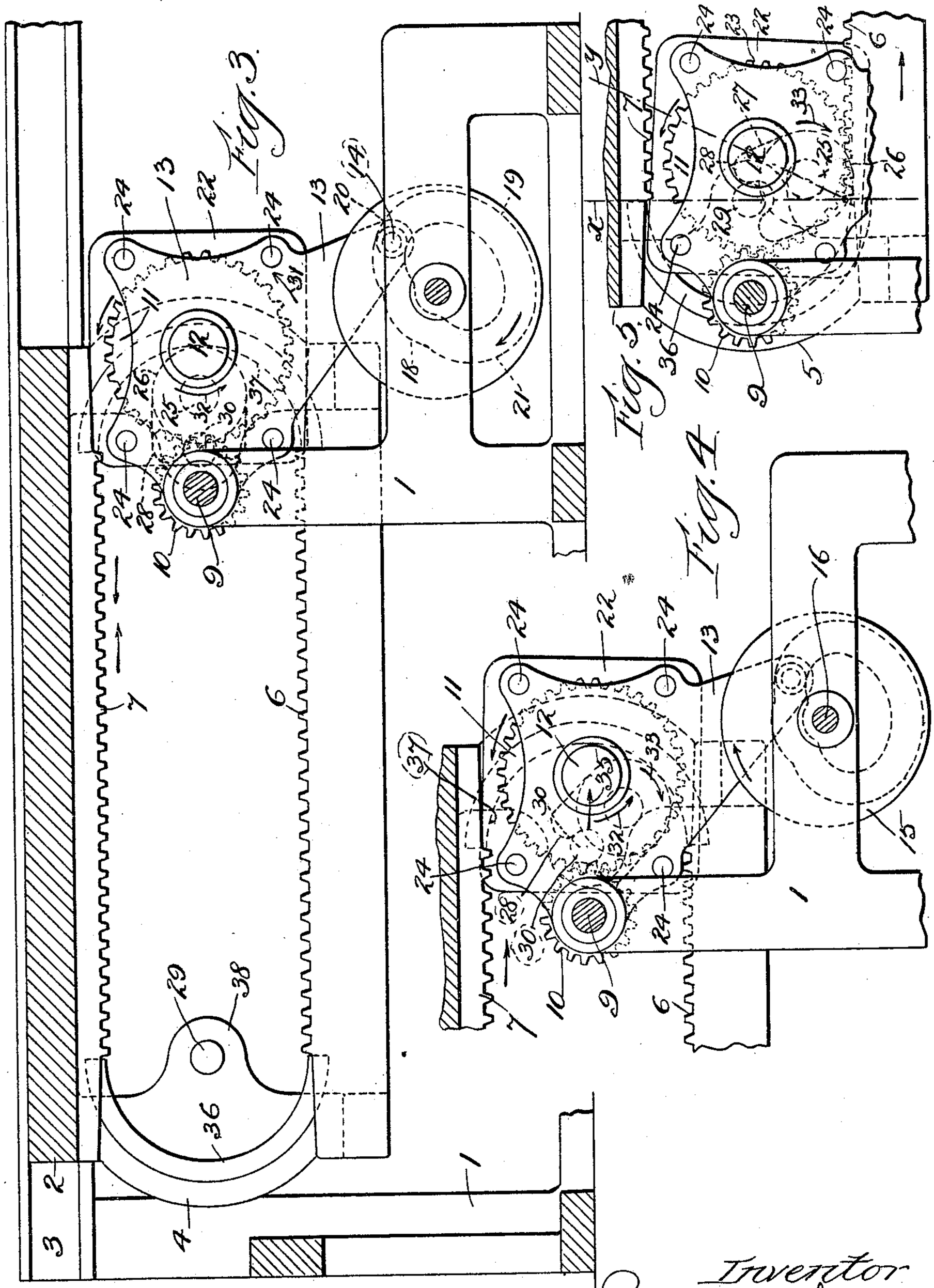

Fig. 2.

Fig. 4.

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MECHANICAL MOVEMENT.

No. 583,308. Patented May 25, 1897.

Fig. 6

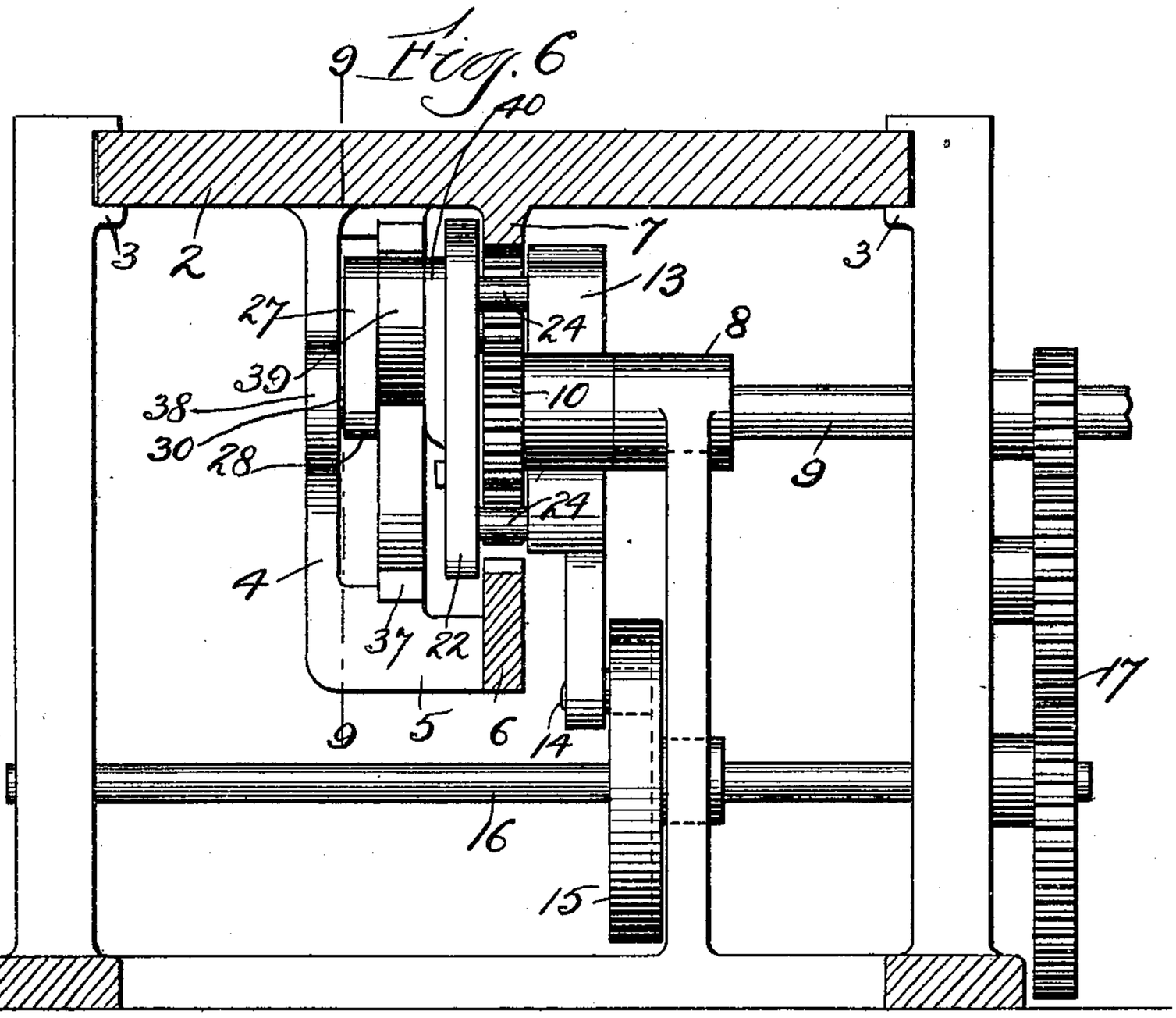


Fig. 7.

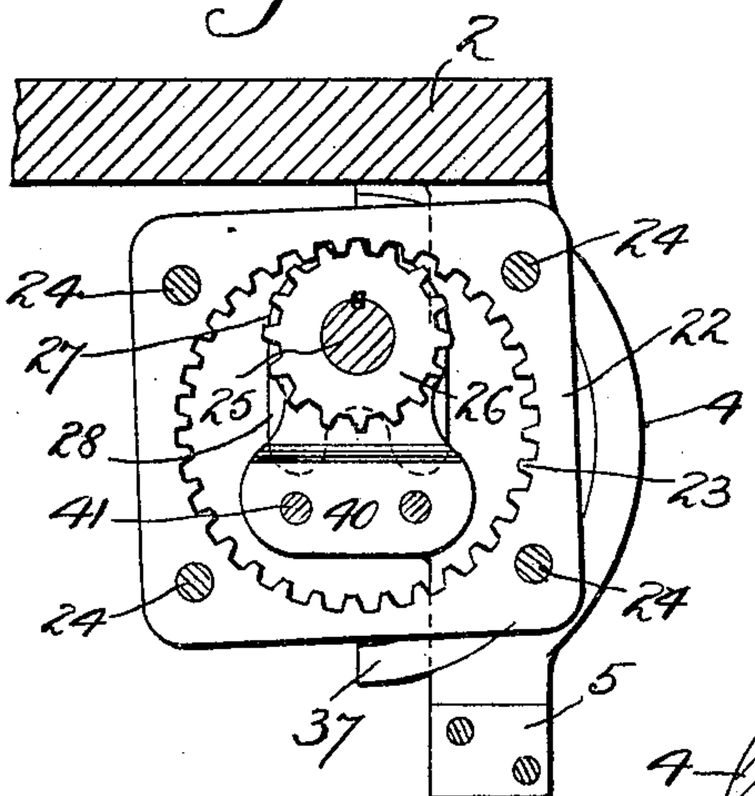
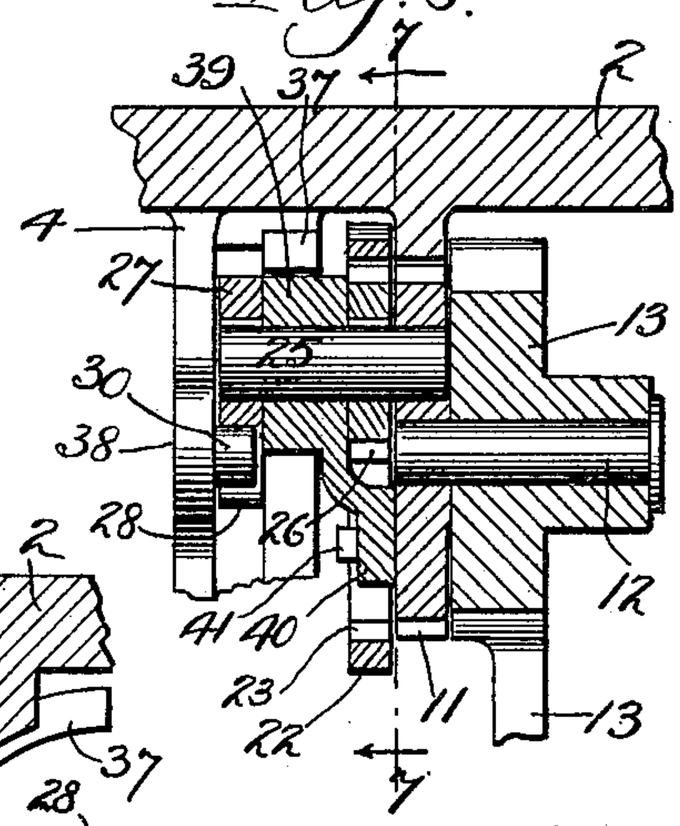


Fig. 8.



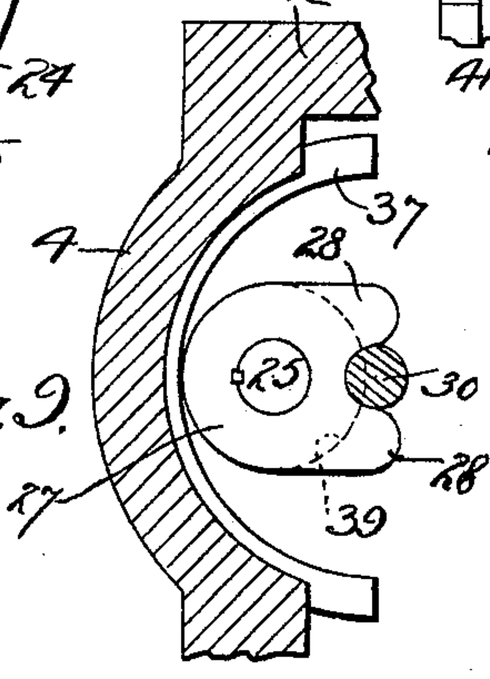


Fig. 9.

Witnesses
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(No Model.) 4 Sheets—Sheet 4.

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MECHANICAL MOVEMENT.

No. 583,308. Patented May 25, 1897.

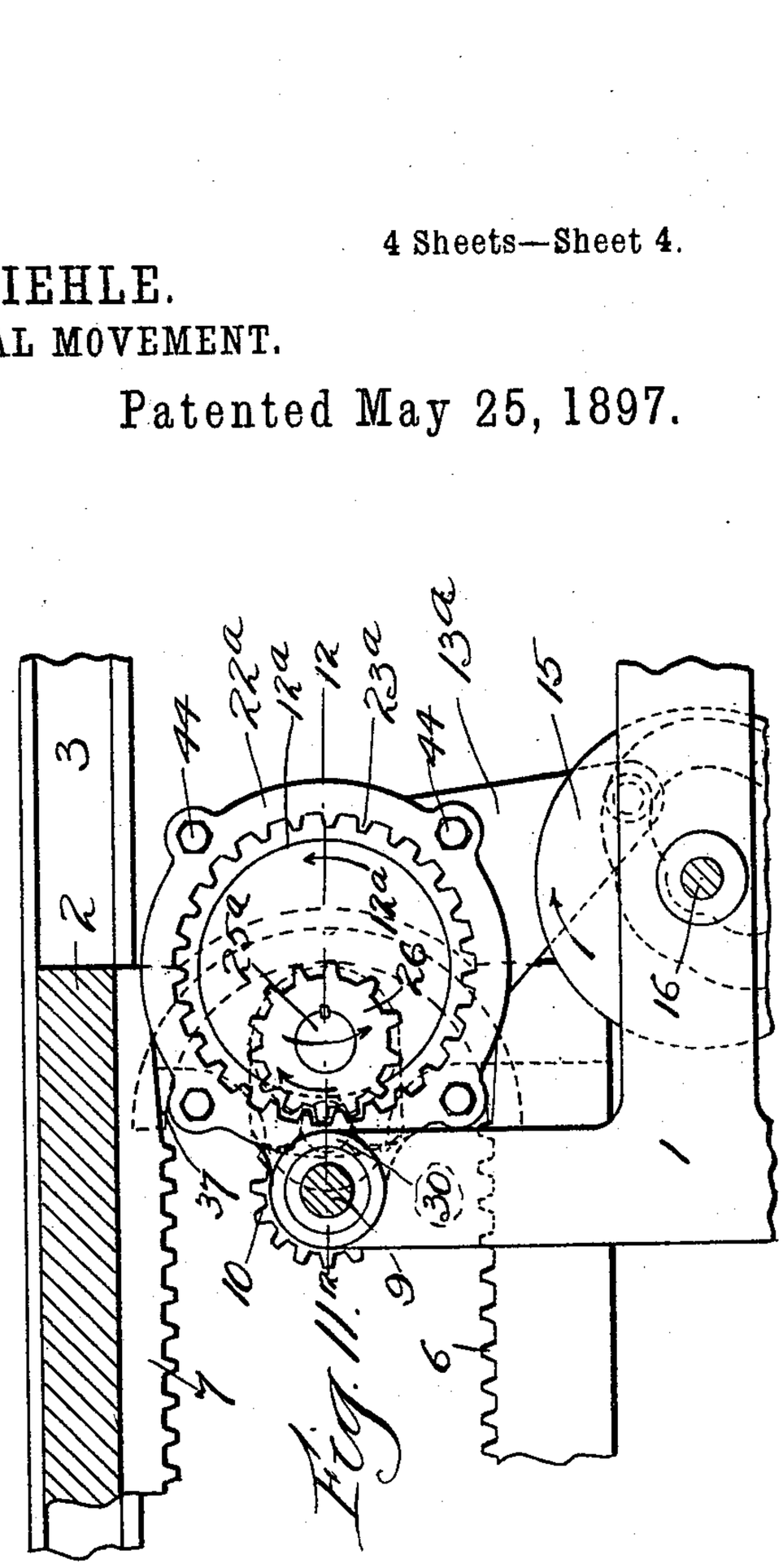

Fig. 11.

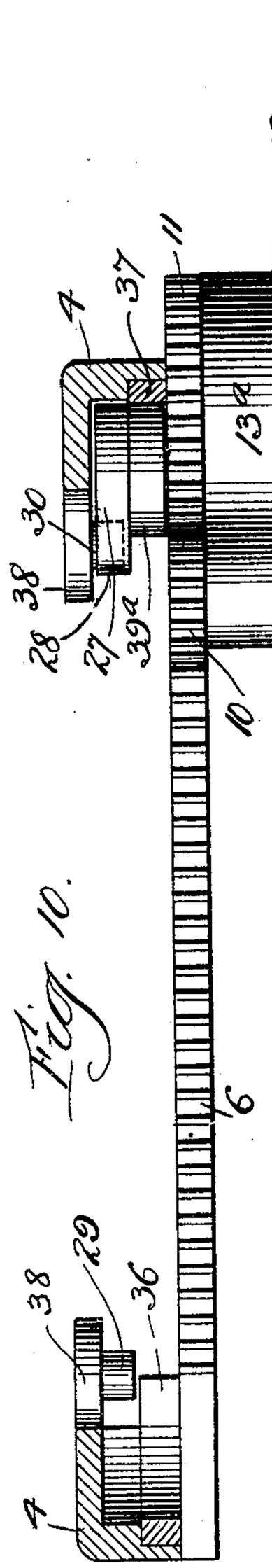

Fig. 10.

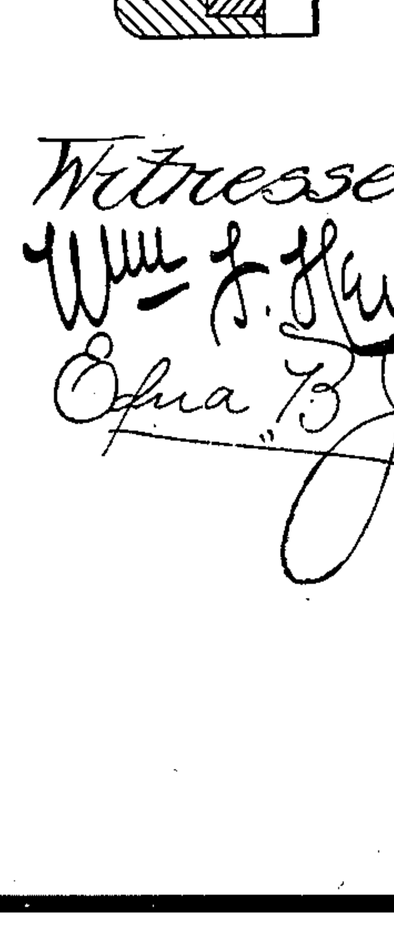

Fig. 13.

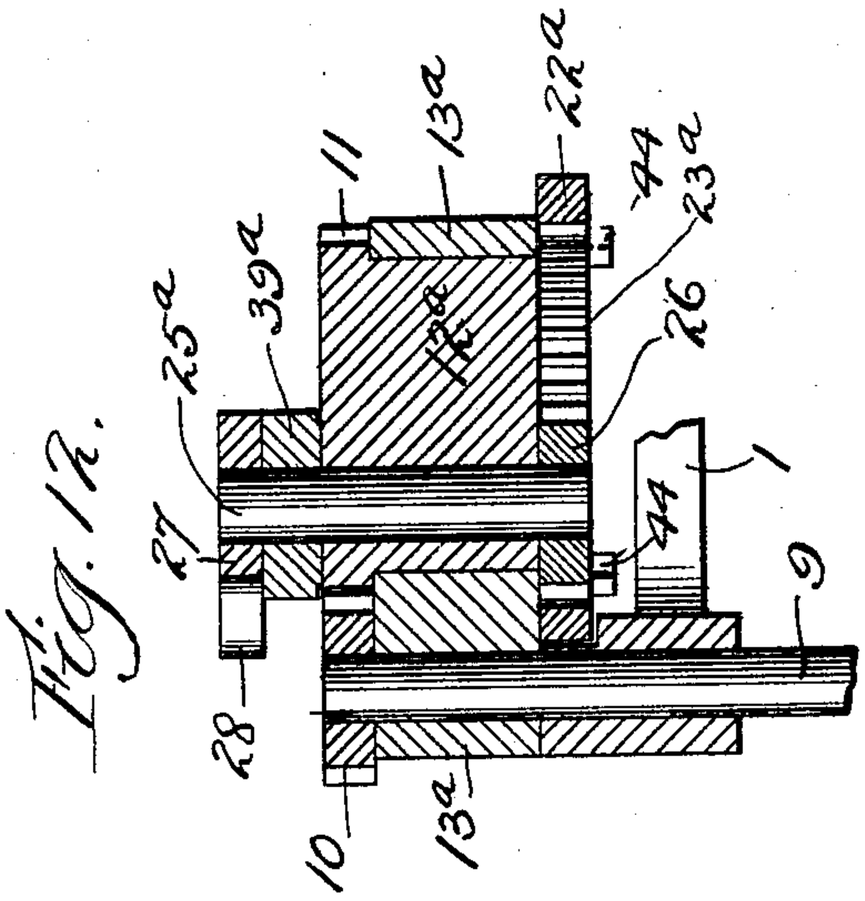

Fig. 12.

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UNITED STATES PATENT OFFICE.

ROBERT MIEHLE, OF CHICAGO, ILLINOIS, ASSIGNOR TO THE MIEHLE PRINTING PRESS AND MANUFACTURING COMPANY, OF SAME PLACE.

MECHANICAL MOVEMENT.

SPECIFICATION forming part of Letters Patent No. 583,308, dated May 25, 1897.

Application filed September 3, 1896. Serial No. 604,779. (No model.)

To all whom it may concern:

Be it known that I, ROBERT MIEHLE, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in Mechanical Movements, of which the following is a full, clear, and exact specification.

My invention relates to that class of mechanical movements employed for transforming a rotary movement into rectilinear or reciprocating movement; and my present invention has more especial reference to that class of such devices employed for imparting the desired to-and-fro or reciprocating motion to the beds of printing-presses.

The object of my present invention is to convert the rotary movement of a driving-shaft into rectilinear or reciprocating movement in the type-bed or part to be reciprocated, and in doing so to carry the bed back and forth throughout the greater part of its travel with a uniform movement, and as the bed approaches the limit of its traverse in either direction to gradually decrease the motion until absolutely arrested, and then start the bed on its return movement and as gradually increase the motion from a point of rest to the full maximum speed.

With these ends in view my invention consists in certain features of novelty in the construction, combination, and arrangement of parts by which the said ends and certain other ends hereinafter appearing are attained, all as fully explained with reference to the accompanying drawings, and more particularly pointed out in the claims.

In the said drawings, Figure 1 is a vertical longitudinal section of the part to be reciprocated, showing my improvements in side elevation. Fig. 2 is a plan sectional view taken on the line 2 2, Fig. 1, certain portions of the improvements being illustrated in elevation. Fig. 3 is a view similar to Fig. 1, showing the reciprocatory part at the full limit of its traverse in one direction. Fig. 4 is a similar view, partly broken away, showing the position of the parts shortly after the reciprocatory portion has started on its return movement. Fig. 5 is a similar view illustrating the position of the parts when the reciprocatory portion is about to reach the extremity of its return movement. Fig. 6 is a transverse sectional view taken on the line 6 6, Fig. 1. Fig. 7 is a longitudinal section taken on the line 7 7, Fig. 8. Fig. 8 is a vertical transverse sectional view taken on the line 8 8, Fig. 2. Fig. 9 is a vertical longitudinal section taken on the line 9 9, Fig. 6. Fig. 10 is a view similar to Fig. 2, illustrating certain modifications hereinafter explained. Fig. 11 is a side elevation thereof, partly broken away; and Fig. 12 is a section taken on the line 12 12, Fig. 11.

Like signs of reference indicate like parts throughout the several views.

In illustrating my invention I have shown it in connection with the type-bed of a printing-press, which is the part to be reciprocated and which is one in which the major part of the stroke or traverse is effected by a gear engaging alternately with two parallel rack-bars, but it will nevertheless be understood that the printing-press bed is only an example of the many reciprocatory parts of machinery to which my invention is applicable, and inasmuch as there are various other forms of mechanism for imparting the major portion of the stroke to such beds or parts—such, for instance, as a single rack-bar and shifting or alternately-acting gears—it will also be understood that this part also of the mechanism which I have shown in the drawings is merely an example and is capable of a wide range of variation or even radical change or substitution without departing from the fundamental principles of my present invention, which concerns itself solely with that part of the operation which relates to the gradual stopping and starting of the member to be reciprocated.

The double-rack and oscillating-gear mechanism in connection with which I have illustrated my present invention is of that variety in which the racks are located one above the other and in the same vertical plane, and the driving-gear is situated between the racks and shifts from one to the other on an arc concentric with a pinion on the main driving-shaft, and by which pinion the shifting-gear is driven, the oscillating or shifting gear being provided with suitable means for raising and

lowering it at the proper time, all of which may be of any well-known or suitable construction, but which I will now describe more in detail with reference to the drawings.

1 represents the supporting-framework of the press, upon which the type-bed 2 or portion to be reciprocated is mounted and slides in suitable guideways 3. In this example of press the under side of the bed 2 is provided with hangers 4, which at their lower ends have lateral projections 5, supporting the lower one, 6, of the parallel horizontal rack-bars, the upper one, 7, of such rack-bars being secured to the under side of the bed 2, as usual. Extending transversely of the frame and journaled in suitable bearings 8 is the main driving-shaft 9, to whose inner end is secured a pinion 10, with which meshes the aforesaid oscillating or shifting gear 11, which is interposed between the racks 6 7 and in the same vertical plane therewith, and being of less diameter than the distance between said racks is capable of alternately engaging therewith when raised and lowered. This oscillating gear-wheel 11 is journaled upon a stud-shaft 12, which in turn is rigidly mounted in and carried by an oscillating arm 13, whose center of oscillation is concentric with the driving-pinion 10. This may be effected by pivoting the arm 13 upon the shaft 9, so that the oscillating gear 11 will remain in mesh with the pinion 10 notwithstanding its change of position.

The lower end of the arm 13 is provided with a downward projection, as clearly shown in Fig. 1, upon which is mounted a lateral stud 14, which engages in a cam-groove formed in the inner face of a disk 15, mounted on a shaft 16 and being driven in unison with the shaft 9 by a suitable train of gearing 17. The cam-groove in the disk 15 comprises two concentric portions 18 19, the latter being of the larger radius, the adjacent ends of which are joined by eccentric portions 20 21. When the stud 14 is in engagement with the larger concentric portion 19, the arm 13 is raised, bringing the gear-wheel 11 into engagement with the upper rack 7. When the said stud 14 comes into engagement with the smaller concentric portion 18 of the cam-slot, the arm 13 is lowered, and the gear-wheel 11 is thereby carried downward into mesh with the lower rack 6.

By means of the mechanism thus far described the part to be reciprocated or bed 2 is, by the engagement of the gear-wheel 11 with one of the racks 6 7, driven in one direction until the end of the engaging rack arrives at a point directly in line with the vertical diameter of the gear-wheel 11. When this point is reached, such gear-wheel is by the action of the cam-slot in the disk 15 withdrawn from engagement with said rack, and during its next half-revolution is swung into position to engage the other rack, and thus drive said bed in the reverse direction until the end of said other rack reaches a point directly in line with the vertical diameter of the gear-wheel 11, as before described. This mechanism constitutes an example of the means herein referred to for driving the part or bed to be reciprocated throughout the greater portion of its traverse.

I will now describe the means for continuing the movement of the bed after the rack is released by the gear-wheel 11 and while such gear-wheel is passing from one rack to the other and gradually bringing the bed to a standstill and as gradually starting it again upon its return movement.

Supported directly between the racks 6 7 and in the same vertical plane therewith and so as to move in unison with the oscillating arm 13 is a plate 22, which is provided with a circular aperture arranged directly opposite the gear-wheel 11 and being preferably of the same diameter as said gear-wheel and having its edge provided with cogs or teeth, as shown at 23. The plate 22 may be thus supported by means of a number of studs 24, projecting from the arm 13 across the gear-wheel 11 in such a manner as to support the plate 22 without interfering with the rotation of the gear-wheel 11 and whereby the latter is arranged between the arm 13 and the plate 22. The revolving member or gear-wheel 11 is provided with a short shaft or pin 25, journaled loosely therein and projecting laterally from the inner face thereof like a wrist-pin, and keyed to this shaft 25, so as to revolve therewith, is a pinion 26, which is in constant engagement with the cogs 23, constituting an internal gear in the plate 22, and which, by its engagement with said internal gear 23 and the eccentric relation of the shaft 25 with reference to the gear 11, causes the shaft 25 to rotate in a direction the opposite of its bodily travel, or, in other words, opposite to the direction of rotation of the gear-wheel 11 while being revolved bodily by said gear 11. Mounted on the end of this shaft 25, and also keyed thereto so as to revolve in unison with the pinion 26, is a yoke 27, having a fork or bifurcated end 28 and which, in conjunction with the pinion 26 and shaft 25, constitutes a rotating bodily-revolving lever. Located at each end of the racks 6 7 is a lug 29 30, respectively, which lugs are adapted to travel back and forth in a horizontal line with the racks 6 7 and to alternately engage between the forks 28 of the yoke 27, and by means of which the yoke 27 and pinion 26, acting as a lever, taking the shaft 25 for its fulcrum, continue the movement of the racks 6 7 after they have been disengaged by the gear-wheel 11 until the racks come to a standstill, and then start them back again on their return movement and continue such movement until the gear-wheel 11 again comes into engagement. These parts are so proportioned that the prongs or forks of the yoke 27 will always permit one of the lugs 29 30 to either enter between them or recede therefrom when the yoke is in its horizontal position and will at

all times produce lateral pressure against one of the lugs as long as either of the latter is within their reach.

Assuming the parts to be in the position illustrated in Fig. 1 with the rack 7 just about to leave the gear-wheel 11, which is continuously revolving in the direction of the arrow 31, and the yoke 27 in an upright position, with its forks 38 embracing the lug 30, the operation is as follows: The further movement of the gear-wheel 11 in the direction of the arrow 31 will push the rack 7 entirely out of its reach, and at this instant the cam-slot in the disk 15 begins to lower the gear-wheel 11 to the lower rack 6. The rotation of the gear-wheel 11, which still continues during its transit, carries the pivot or shaft of the pinion 26 around in the direction of the arrow 32, or, in other words, it carries the independently-rotating bodily-revolving lever, hereinbefore referred to, in the direction of such arrow 32, and by virtue of the engagement of the pinion 26 with the non-rotative internal gear 23 the yoke 27 is caused to rotate about the axis of the shaft 25 in the direction of the arrow 33, and consequently the forks 28 push the lug 30 in the direction of the arrow 34 or in the same direction which the rack 7 had previously been moved by the gear 11 when in engagement therewith. The lower ends of the forks 28 thus continue to push the lug 30 to the left until they assume the position illustrated in Fig. 3, when the yoke will be horizontal, and its forks will from this point begin to recede; but inasmuch as the pinion 26 in tumbling the yoke 27 over the lug 30 also causes the lower one of the forks 28 to project upwardly on the left-hand side of such lug 30 it will be seen that this one of the forks presses the lug 30 in the direction of the arrow 35, Fig. 4, or, in other words, starts the racks 6 7 on their return movement and continues this movement until the yoke 27 arrives at a vertical inverted position with its forks projecting in the opposite direction to that indicated in Fig. 1, the yoke in the meanwhile having made a half-revolution around the lug 30 while passing from the position indicated in Fig. 1. By the time the yoke 27 arrives at this position—*i. e.*, a vertical inverted position—with its forks projecting upwardly, the gear-wheel 11 will have descended sufficiently far to engage with the lower rack 6, and the lug 30 will begin to pull away from the forks 28 when the racks start to move under the influence of the gear-wheel 11, and the gear 11 will take up and continue the movement of the racks until the rack 6 is about to pass out of engagement with such gear 11, as indicated in Fig. 5. When the parts reach this position, (shown in Fig. 5,) it will be seen that the yoke 27 is still revolving or traveling bodily around the axis of the gear-wheel 11 and in the direction of rotation of said gear, but by virtue of the engagement of the pinion 26 with the fixed gear 23 the yoke is rotating on its own axis in the opposite direction, or, in other words, is moving the upper ends of its forks 28 to the right, and being in position to receive the lug 29 between them and just about to begin to engage with said lug and continue its movement to the right. The forks of the yoke 27, however, do not become effective on the lug 29 and begin to force it to the right until the centers of the rotating yoke and the main gear 11 fall into a direct line, or a substantially direct line, passing through said centers and the final tooth on the lower rack, as indicated by the dotted lines *x y* in Fig. 5, or, in other words, until the yoke arrives at a position which is the converse of its position indicated in Fig. 1. It then begins to push the racks 6 7 farther to the right by virtue of its engagement with the lug 29, and it continues to push it to the right until the yoke arrives at a horizontal position with its forks 28 projecting in the opposite direction to that indicated in Fig. 3, whereupon all movement of the bed ceases, and the further bodily travel and independent rotation of the yoke 27 from this point on will move the racks from a position of rest in the reverse direction to that indicated by the straight arrow in Fig. 5, or, in other words, to the left, and will gradually increase this movement to the left until a speed is reached substantially equal to that which may be imparted to the racks 6 7 by the gear-wheel 11, and when this speed is reached the yoke 27 will again be in the position indicated in Fig. 1, or with its forks projecting downwardly, and inasmuch as the forks will then be moving in the same direction as the lug 29 is being moved under the influence of the gear 11, which by this time has engaged with the upper rack 7, it will be seen that such forks will rise away from the lug 29 and permit the latter to move out from between them. By the time the reciprocating racks reach the limit of their movement on the right, imparted to them by the gear-wheel 11, the yoke 27 will have tumbled over to a position to receive the lug 29 between its forks 28, and thus continue the movement to the right until the extreme limit of the movement is reached, and then return the racks again and continue their movement in the return direction until the upper one of the racks has been again engaged by the gear-wheel 11. Thus it will be seen that the forks of the yoke 27 are continuously revolving about a center which is in direct line with the centers of the lugs 29 30, and consequently is always in a position at the proper time to receive one or the other of such lugs and force it first in one direction and then in the other.

The yoke 27 itself of course begins to decrease the movement of the bed or portion 2 at the time the rack leaves the gear 11, and such yoke engages with and gains control of the pins or lugs 29 30, and will continue to control the movement and gradually decrease it until the forks 28 of the yoke reach a substantially horizontal position and would

otherwise let the pins 29 30 slip out; but in order that this slipping away of the pin from the forks may be prevented and the movement of the bed absolutely arrested I secure to the bed or portion 2, at some suitable point and at each end thereof, a curved shoe or projection 36 37. These shoes or projections 36 37 are preferably supported by the casting 4 5, which supports the lower one, 6, of the racks, and, if desired, they may be separate pieces set into the casting, as shown in the drawings, whereby they may be composed of metal of the proper hardness or quality, the lugs 29 30 being also supported by suitable brackets 38, carried by the same castings, whereby the shoes 36 37 and lugs 29 30 will move in unison and maintain a fixed relation. Mounted upon the shaft or pivot 25 is a stop-roller 39, which is adapted to come against the shoes 36 37 at about the time when the gear-wheel 11 begins to pass from one rack 6 7 to the other. This stop 39 is preferably formed integrally with a bracket 40, which is rigidly secured by bolts or rivets 41 to the inner face of the gear-wheel 11 at a point on the opposite side of the center thereof to that at which the shaft 25 is situated, such bracket being turned inwardly under the pinion 26 and projecting through the apertured plate 22, as clearly shown in Fig. 8. By this means it will be seen that the stop-roller 39 is virtually one piece with the gear-wheel 11 and will revolve about the center thereof in contact with the curved surface of one or the other of the shoes 36 37, which are curved concentrically with the gear 11 and are preferably semicircular in extent, so that the stop 39 will begin to engage therewith at the time the gear 11 begins to disengage with either of the racks 6 7, and by being thus revolved with the gear 11 will walk around the shoes 36 or 37 and will coöperate with the forks 28 in gradually decreasing the movement of the bed and avoiding any possibilty of the lug 29 or 30 slipping away from the forks 28 until one or the other of the racks 6 7 has been reëngaged by the gear-wheel 11, it being obvious that without the stop-shoes 36 37 and the stop 39 the motion imparted to the bed by the forks of the yoke 27 might, when such forks reach a horizontal position, continue the movement sufficiently far to prevent the forks 28 from returning the lug 30, for instance, from the position shown in Fig. 3 to the position shown in Figs. 4 and 5, inasmuch as the forks are open-ended and might permit the lug 30 or 29 to slip from between them.

In the form of my invention shown in Figs. 10 to 12, inclusive, I have located the oscillating or vibrating gear on one side of the oscillating arm 13 (indicated in this modification as 13^a) and the gear-plate or internal gear (referred to in the other form by the numeral 22) on the opposite side of said arm 13^a, such internal gear-plate being indicated in Figs. 10 to 12 by the numeral 22^a. The purpose of doing this is to bring the racks 6 7 closer to the shoes 36 37 and to avoid the necessity of employing the supporting-lugs 24 for the internal gear, thus rendering the structure more compact and durable and shortening the length of the shaft 25, which supports the revolving rotating lever before described—that is to say, shortening that portion of the shaft which protrudes from the inner face of the gear-wheel 11 to the yoke 27, and thereby rendering it more rigid and better able to withstand the strain to which it is subjected by the engagement of the yoke 27 with the lugs 29 30. In order, however, that the pinion which engages with the internal non-rotative gear for revolving the yoke 27 may still be equal to half the diameter of the gear-wheel 11 and at the same time revolve about the axis of such gear-wheel without intersecting the shaft of the latter, I mount the gear-wheel 11 upon a greatly-enlarged journal or hub 12^a, which is provided in the arm 13^a with a correspondingly-enlarged bearing, and which revolves with the gear 11, and through this enlarged bearing, and also through the gear 11, I pass the shaft 25^a, which is eccentric to the axis of the journal 12^a, and which carries at its outer end the pinion 26, that engages with the internal non-rotative gear 23^a, cut in the plate 22^a, while upon the inner end of the shaft 25^a is mounted the stop-roller 39^a and the yoke 27, the roller 39^a in this instance being loosely journaled upon the shaft 25^a, while the yoke 27 and pinion 26 are fixed to such shaft and constitute therewith the aforesaid revolving independently-rotating lever.

The non-rotative gear-plate 22^a is preferably formed of a separate plate secured to the outer face of the arm 13^a, or, more properly speaking, to the enlarged bearing of such arm, the arm and the plate being provided with corresponding flanges 42 43, respectively, for the passage of bolts or rivets 44, which secure the plate 22^a rigidly to the side of the arm. By this construction it will be seen that the length of that portion of the shaft which projects from the face of the wheel 11 (and which wheel constitutes the only support for such shaft) is considerably reduced and the desirability for the employment of the supporting-bracket 40 heretofore described is avoided. The means for supporting the non-rotative gear-plate 22^a is also by this arrangement simplified and rendered more durable and substantial.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater part of its movement, of a bodily-revolving lever also rotating on an independent axis in the opposite direction of its bodily travel and means in

connection with said part to be reciprocated, for engagement with said lever, substantially as set forth.

2. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revolving lever also rotating on an independent axis in the opposite direction of its bodily travel and means at each end of said part to be reciprocated for engagement with said lever, substantially as set forth.

3. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater part of its movement, of a bodily-revolving notched lever also rotating on an independent axis in the opposite direction of its bodily travel and means in connection with said part to be reciprocated for engaging in said notch, substantially as set forth.

4. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revolving forked or notched lever also rotating on an independent axis in the opposite direction of its bodily travel and lugs carried by said part to be reciprocated and projecting into the plane of and adapted to be engaged by the fork of said lever, substantially as set forth.

5. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revoluble lever rotatable on an independent axis and comprising a toothed portion forming a pinion, a second toothed portion engaging with said pinion and causing the same to rotate, and means in connection with said part to be reciprocated for engaging with said lever, substantially as set forth.

6. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revoluble lever rotatable on an independent axis and comprising a pinion, a non-rotative toothed portion engaging with said pinion and causing the latter to rotate and means in connection with said part to be reciprocated for engagement with said lever, substantially as set forth.

7. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revoluble lever rotatable on an independent axis and comprising a pinion, an internal gear surrounding said pinion and meshing therewith whereby said lever is rotated in the opposite direction of its bodily travel, and means in connection with said part to be reciprocated for engagement with said lever, substantially as set forth.

8. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revoluble lever rotatable on an independent axis and comprising a pinion, an internal non-rotative gear surrounding said pinion and causing said lever to rotate, and means in connection with said part to be reciprocated for engagement with said lever, substantially as set forth.

9. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a rotating member, a lever pivoted eccentrically to and carried by said member, a non-rotative gear, said lever comprising a pinion engaging with said gear and causing the rotation of said lever, and means in connection with said part to be reciprocated, adapted to engage with said lever, substantially as set forth.

10. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a rotating member, a lever pivoted eccentrically to and carried by said member and comprising a pinion, a non-rotative internal gear engaging with said pinion for causing the rotation of said lever, means in connection with said part to be reciprocated adapted to engage with said lever, a stop carried by said rotating member and a shoe or projection on the part to be reciprocated, adapted to engage with said stop, substantially as set forth.

11. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a rotating member, a lever pivoted eccentrically to and carried by said rotating member and comprising a pinion, a non-rotative internal gear engaging with said pinion for causing the rotation of said lever, means in connection with said part to be reciprocated, adapted to engage with said lever, a stop carried by said rotating member and having an axis concentric with the axis of said lever and a shoe or projection on the part to be reciprocated adapted to engage with said stop, substantially as set forth.

12. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a rotating member, a lever pivoted eccentrically to and carried by said member and comprising a pinion, a non-rotative internal gear engaging with said pinion for causing the rotation of said lever, means in connection with said part to be reciprocated, adapted to be engaged with said lever, a stop revolving with said rotating member and lever and a shoe or projection carried by said part to be reciprocated and being curved concentrically with the bodily travel of said stop, substantially as set forth.

13. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revolving lever also rotating on an independent axis in the oppo-

site direction of its bodily travel, means carried by said part to be reciprocated for engagement with said lever, a stop-roller revolving in unison with said lever, and a shoe curved concentrically with the bodily travel of said stop-roller and being semicircular in extent, substantially as set forth.

14. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revolving lever also rotating on an independent axis in the opposite direction of its bodily travel, means in connection with said part to be reciprocated adapted to engage with said lever, said lever having a supporting-shaft, a revolving member supporting said shaft and having a stop carried thereby, and shoes carried by said part to be reciprocated and adapted to be engaged by said stop, substantially as set forth.

15. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a rotating member, a shaft secured eccentrically to and supported by said rotating member and a pinion and yoke mounted on said shaft and constituting a lever, a non-rotative gear engaging with said pinion, and means carried by said part to be reciprocated for engaging with said yoke, substantially as set forth.

16. The combination with the part to be reciprocated, means comprising a rack and a gear for reciprocating said part throughout the greater portion of its movement, of a yoke revolving bodily with said gear and rotating on an independent axis in a direction opposite to the direction of rotation of said gear, and means in connection with said part to be reciprocated adapted to engage with said yoke, substantially as set forth.

17. The combination with the part to be reciprocated having parallel racks and an oscillatory gear mounted between and adapted to engage with said racks alternately, of a lever revolving bodily with said gear and rotating on an independent axis in the direction the reverse of the direction of rotation of said gear, and means carried by said reciprocating part for engagement with said lever, substantially as set forth.

18. The combination with the part to be reciprocated having parallel racks, an oscillatory arm, means for raising and lowering said arm, a plate secured to said arm and having an internal gear cut therein, a gear-wheel journaled on said arm between said plate and arm, a shaft projecting through said gear-wheel, a pinion on said shaft engaging with said internal gear, a yoke secured to said shaft, and means carried by said part to be reciprocated for engaging with said yoke, substantially as set forth.

19. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, said means being provided with a rotating member, of an oscillatory arm supporting said member, an enlarged journal on said rotating member passing through said arm, a shaft passing through said rotating member and journal, a pinion on one end of said shaft, a non-rotative internal gear with which said pinion engages, a yoke at the other end of said shaft, and means in connection with the part to be reciprocated for engagement with said yoke, substantially as set forth.

20. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revolving lever also rotating on an independent axis in the opposite direction of its bodily travel, a lug in connection with said part to be reciprocated for engagement with said lever, and means for holding said lever in engagement with said lug, substantially as set forth.

21. The combination with the part to be reciprocated and means for reciprocating said part throughout the greater portion of its movement, of a bodily-revolving lever also rotating on an independent axis in the opposite direction of its bodily travel, means in connection with said part to be reciprocated for engagement with said lever, and a curved shoe and stop-roller coöperating to hold said lever in operative engagement with said part to be reciprocated, substantially as set forth.

ROBERT MIEHLE.

Witnesses:
A. HOPKINS,
EDNA B. JOHNSON.