No. 687,904. Patented Dec. 3, 1901.

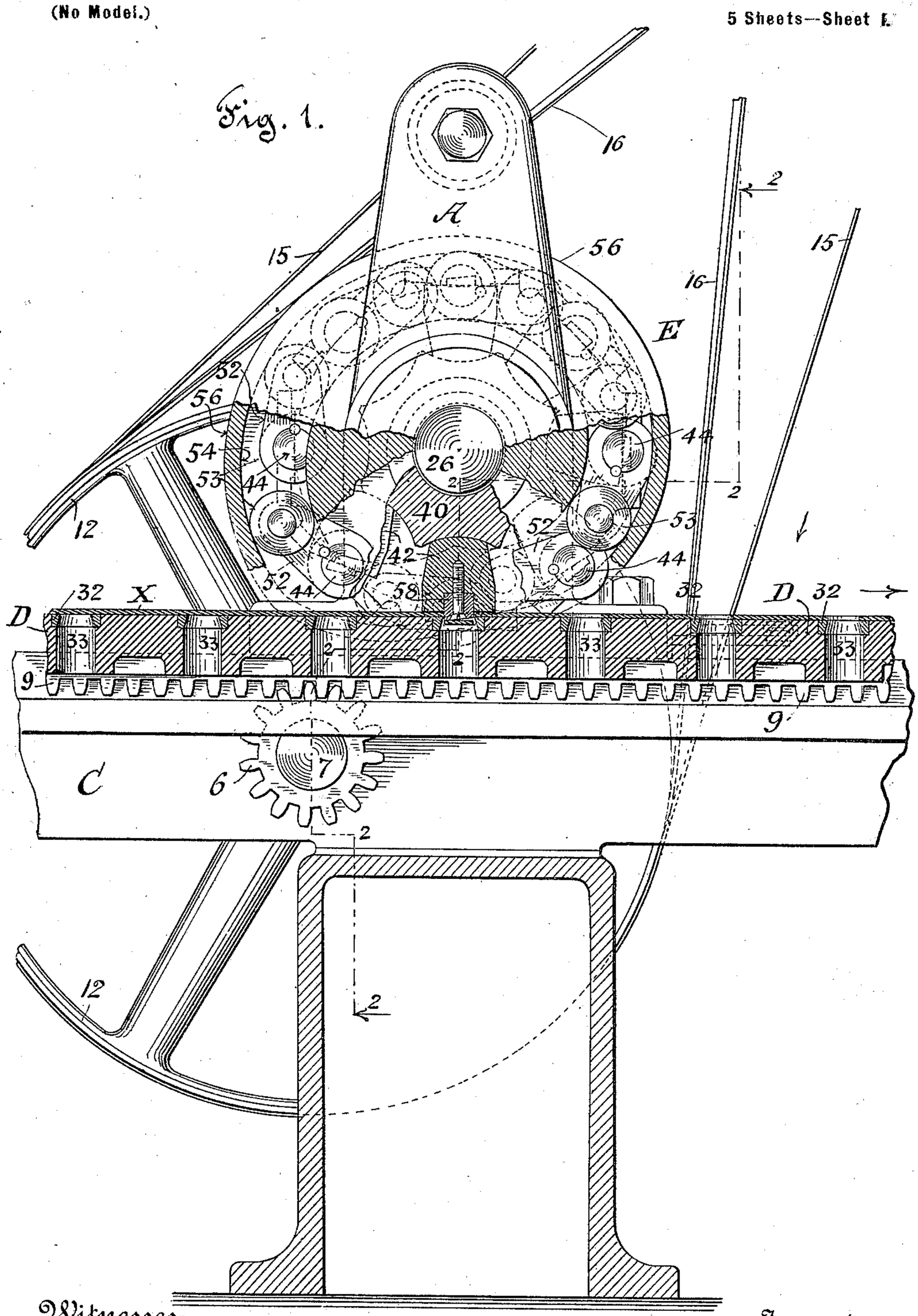
J. P. SEYMOUR.

ROTARY DIE PRESS.

(Application filed Oct. 3, 1901.)

(No Model.) 5 Sheets—Sheet 1.

Fig. 1.



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(No Model.) 5 Sheets—Sheet 2.

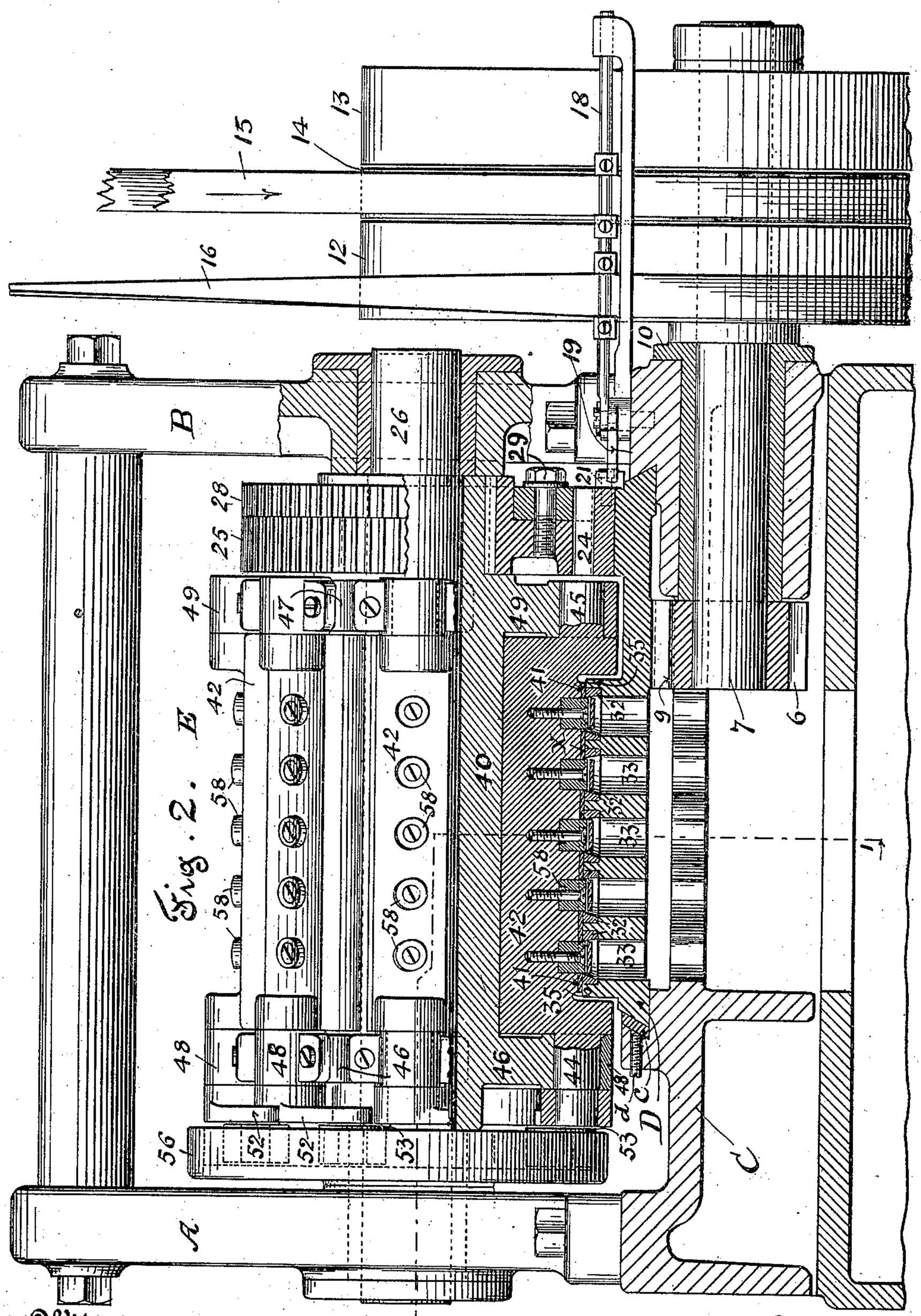

Fig. 2.

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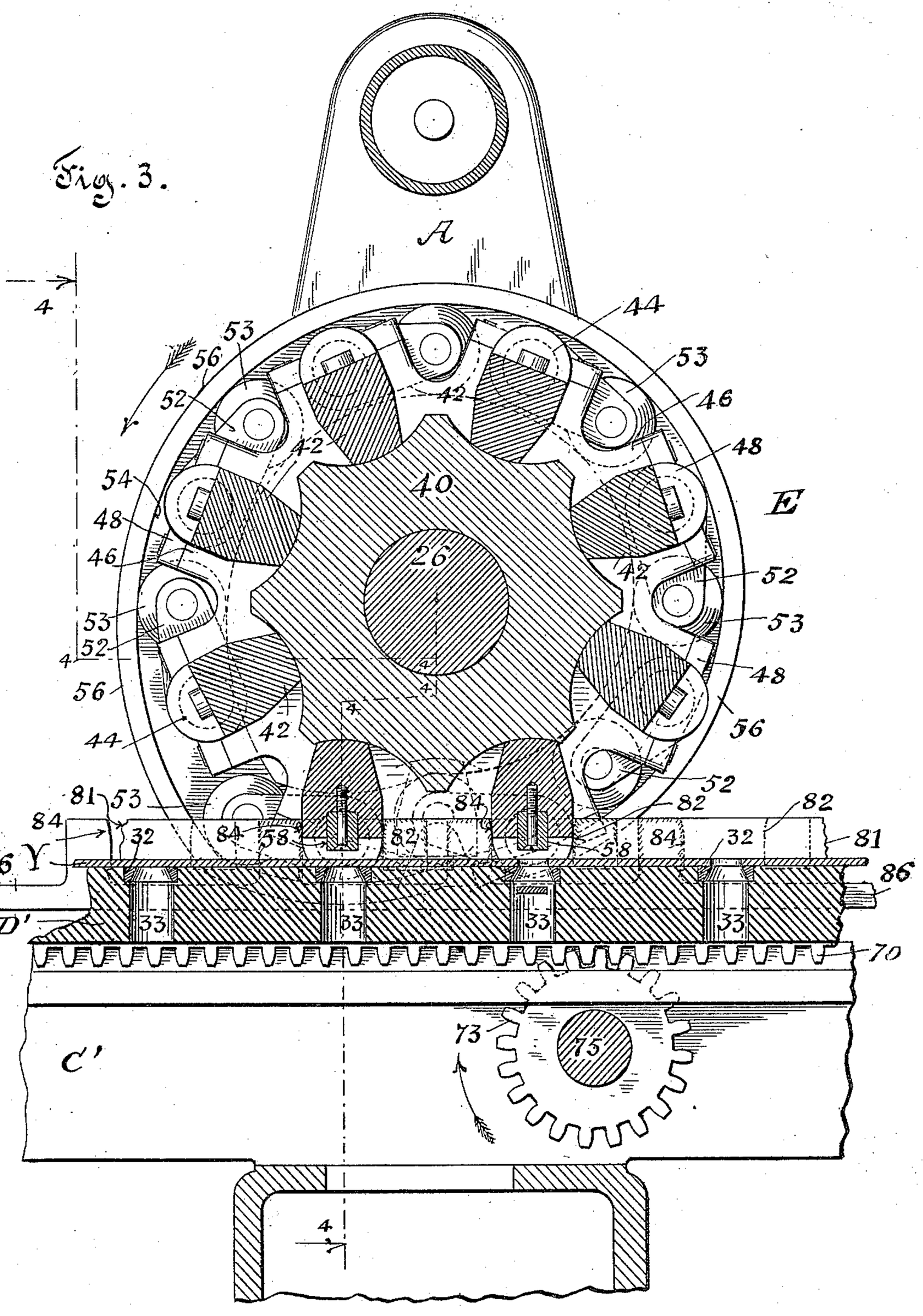
(No Model.) 5 Sheets—Sheet 3.

Fig. 3.



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(Application filed Oct. 3, 1901.)

(No Model.) 5 Sheets—Sheet 4.

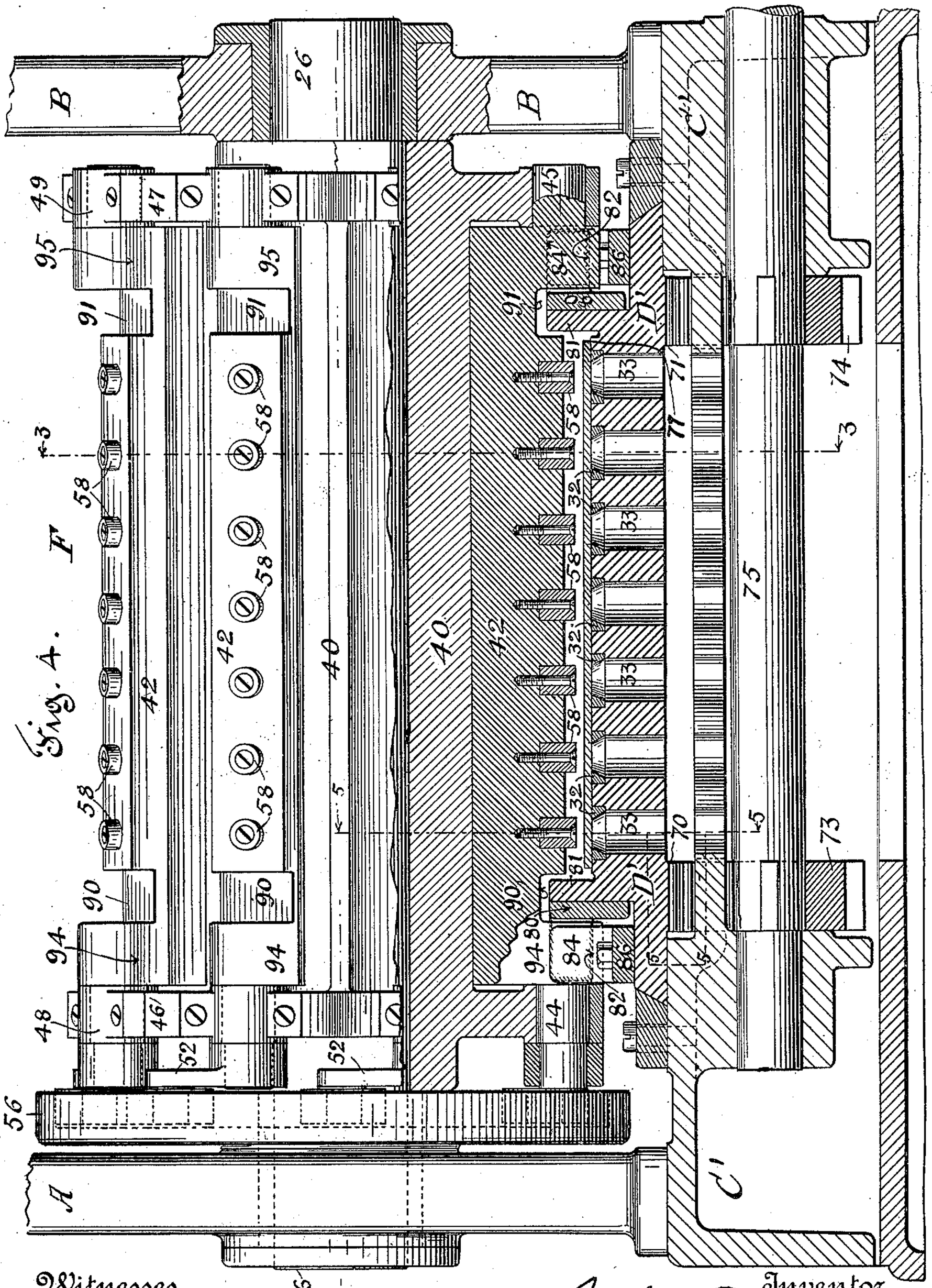

Fig. 4.

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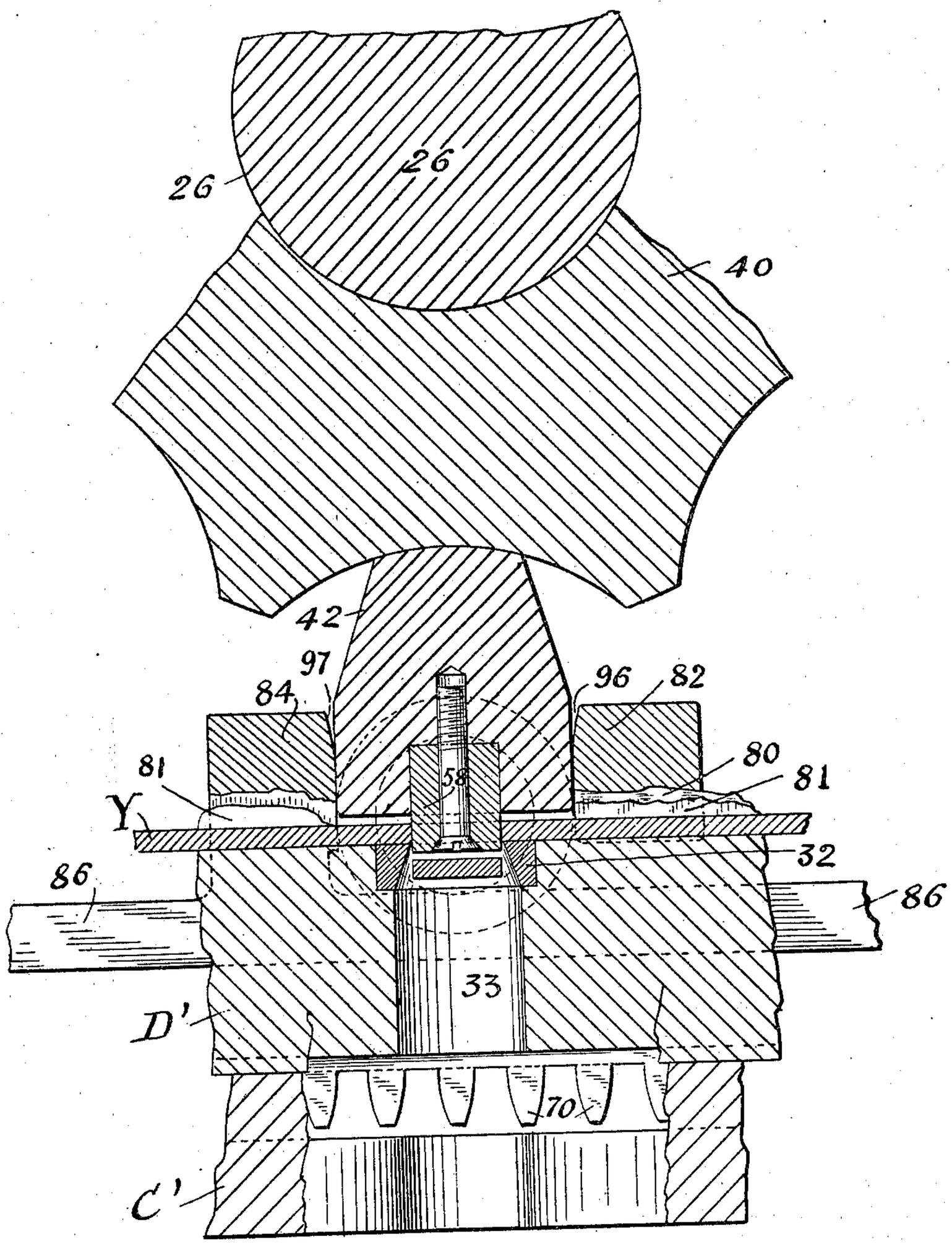
(Application filed Oct. 3, 1901.)

(No Model.) 5 Sheets—Sheet 5.

Fig. 5.



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UNITED STATES PATENT OFFICE.

JOHN P. SEYMOUR, OF RICHMOND, NEW YORK, ASSIGNOR OF ONE-HALF TO RALPH C. SEYMOUR, OF SOUTH ORANGE, NEW JERSEY.

ROTARY DIE-PRESS.

SPECIFICATION forming part of Letters Patent No. 687,904, dated December 3, 1901.

Application filed October 3, 1901. Serial No. 77,415. (No model.)

To all whom it may concern:

Be it known that I, JOHN P. SEYMOUR, a citizen of the United States of America, and a resident of the borough of Richmond, in the city of New York and State of New York, have invented certain new and useful Improvements in Rotary Die-Presses, of which the following is a specification.

This invention relates to improvements in rotary die-presses for stamping, punching, and similar purposes.

The invention belongs to die-presses of the kind described in the joint application filed in the United States Patent Office June 6, 1901, by Ralph C. Seymour and myself, Serial No. 63,409, which are distinguished by the fact that at least one set of dies is on a rotary carrier, the advance and recession of the male die into and from the female die being due to the rotary motion of the carrier, while at the same time both sets of dies have a lateral motion during the period of their interaction and at the same linear rate, the axes of the pair of interacting dies being maintained in parallelism during the period of interaction of said dies.

The present application particularly relates to a die-press wherein one set of dies, preferably the male dies or punches, is carried on a rotary carrier, and the other set of dies, preferably the female dies, is carried on a rectilinearly-moving bed. The female dies being carried by the bed are preferably rigidly fixed thereon with their axes vertical to facilitate the ready discharge from them of the punched blanks, the axes of the several female dies being parallel each to each. The complementary male dies are carried on a rotary carrier, the dies and the carrier being generally similar in construction and arrangement to the male dies and carrier which are described in the aforesaid application Serial No. 63,409. Each male die is therefore maintained accurately in parallelism and register with its corresponding female die during the operation of punching, and the result is a gradual and true entrance of the male die into the female die and then a gradual and true withdrawal of the male from the female die, which entrance and withdrawal is termed the "interaction of the dies," while the dies are simultaneously moving transversely to the direction of this interaction a distance equal to the travel of the female die during the time of said interaction, which transverse motion is called the "motion of translation" of the dies. To insure accurate register of the interacting pair of dies and that both dies shall have the proper speed of translation, I prefer to drive the bed from the prime mover by belting or gearing, &c., and to drive the rotary carrier from the bed, and then the male and female dies being properly spaced apart on their respective carrier and bed each coacting pair of dies will come accurately into register and parallelism at the beginning of the punching operation and will remain so throughout the interaction of the dies without jamming or binding on each other. For operating on thin sheets of material the driving connection between the bed and the rotary carrier is easily and simply effected by engaging a rack on the bed with a spur gear or gears on the carrier in the ordinary manner, and I show this simple form of machine in certain of the annexed drawings; but for operating on thick work it is necessary to provide special constructions for driving the rotary die from the bed in such a manner that the motion of the die which is on the rotary carrier in a straight line parallel with the motion of the die which is on the bed shall be at the same speed as the motion of said last-named die, since otherwise the interacting pair of dies would move out of register before the operation of punching was completed. The connection of the bed with the rotary carrier whereby the desired equality of motion is obtained is, broadly considered, an important part of my present invention, as well as the particular devices hereinafter described, which I prefer to use to obtain the said equality of motion.

Referring to the drawings which accompany the specification to aid the description, Figure 1 is a broken elevation and section, on the irregular line 1 1 of Fig. 2, of a machine adapted to operate on thin plates. The parts are shown in the position wherein a male die has just advanced to the greatest distance into a female die. Fig. 2 is a broken eleva-

tion and section of the same machine on the irregular line 2 2 of Fig. 1. Fig. 3 is a broken cross-section and elevation, on a larger scale and on the irregular line 3 3 of Fig. 4, of a machine adapted to operate on thick plates. The parts are shown in the position wherein one male die has just withdrawn from the sheet that is being punched and another male die is about to take onto the sheet. Fig. 4 is a broken longitudinal section and elevation on the irregular line 4 4 of Fig. 3. Fig. 5 is a broken cross-section, on very large scale, of a single pair of dies and part of the male-die carrier and bed of the female dies and showing the preferred manner of engaging the bed and carrier. The section is taken on the irregular line 5 5 of Fig. 4.

Like parts are indicated by the same reference letters and figures in the several views.

Referring to Figs. 1 and 2, A B are the end frames; C, the bed-plate, in the parallel undercut groove of which travels the reciprocating bed D, which contains one set of dies, preferably the female dies.

E is the rotary carrier, which contains the other set of dies, preferably the male dies. Said bed C is provided in the usual manner with the soft-metal strips *c* and screws *d* to insure true straight-line motion to the bed D and take up wear. Said bed D is driven by the pinion 6 on the counter-shaft 7, which meshes with the rack 9 on the under side of said bed D, and there may be a similar rack engaged by a similar pinion along each side of said bed D. Said counter-shaft 7, carried in a long box 10, is provided with two loose pulleys 12 13 and with the fixed pulley 14. A belt-shipper 18, actuated by a bent lever 19, which is thrown by studs 21 in the well-known manner as the bed D approaches the limits of its travel in one direction, shifts the flat belt 15 or the crossed belt 16 upon and off from the said fixed pulley 14, so as to reverse the motion of said bed D. In Fig. 2 belt 15 is seen on the fixed pulley 14, and said bed D is traveling from left to right in Fig. 1, as indicated by the horizontal arrow, said belts 15 16 being driven by pulleys actuated by the prime mover and not shown. A rack 24 in the upper side of said bed D meshes with the gear 25, which is fixed on the shaft 26 of said rotary carrier E, and said gear 25 is provided with the adjustable annular gear 28, which is secured to the face of gear 25 by bolts 29 to secure accurate register of the male and female dies and take up backlash in the manner well understood in the art. I may place a similar rack on the other side of said bed D and similar gears on the other end of said shaft 26, meshing therewith; but in machines for operating on thin sheets a single such rack and gears at one end of the carrier E are sufficient.

The female dies 32 are firmly fixed in chambers at the upper ends of holes 33, which extend through the raised part 35 of said bed D, as shown in Fig. 2, said raised part 35 being preferably of such a height that the upper faces of said female dies 32 are as nearly as possible in the horizontal plane through the axes of the arbors 44 45 of the yokes 42, which carry the male dies 58 at the instant when said male dies have entered to the greatest depth into the female dies, Figs. 1 and 2. Said female dies 32 are preferably undercut, as shown, to facilitate the discharge of the punched blanks, said blanks falling through said holes 33 into suitable receptacles. The male dies 58 are so arranged on the rotary carrier E that corresponding male and female dies will register as the carrier E rotates and the bed D travels, the yokes 42 oscillating as hereinafter described. Said carrier E has the polygonal hub 40, firmly fixed on said shaft 26, which turns in boxes in the end frames A B, as shown. Each face of said hub 40 is shaped on a concave arc struck from the axis of rotation of the corresponding yoke 42 as a center, and the inner face of each said yoke 42 is shaped on a convex arc struck from the same center, so that the said yoke will bear on said hub in all its positions. The arbors 44 45 of said yokes 42 respectively turn in journals 48 49 on the webs 46 47 of said hub 40, and on the outer ends of each arbor 44 is fixed an arm 52, which carries at its outer end a roller 53, which travels in a groove 54 of the cam 56, which cam is secured to the end frame A. Said male dies 58 are firmly bolted into sockets in said yokes 42, and said groove 54 in cam 56 is so shaped that just before a male die arrives at the position where it will take onto the sheet of material *x* which is being punched the male die will come accurately into register and parallel with its corresponding female die 32, the vertical axes of both dies being then in the same vertical line, and that said male die will remain accurately parallel and in register with its female die during the entire period of interaction of each pair of dies. The shape of said groove 54 is indicated in Figs. 1 and 3, and the construction of said cam 56, groove 54, hub 40, yokes 42, and male dies 58 is fully described in the aforesaid joint application Serial No. 63,409, and does not require to be again set forth in detail in this application. As any male die is carried beyond the limits of its interaction with its corresponding female die it gradually takes a position radial to its carrier E, turning again to a position parallel and in register with another female die when it again approaches its punching position, as is fully explained in said application Serial No. 63,409. The outer surface of each said yoke 42 is preferably depressed between the ends of the yoke, as indicated at 41 in Fig. 2, so that the cutting-faces of the male dies on each yoke are as nearly as possible in the plane through the axes of rotation of that yoke. Said yokes 42 are so positioned and arranged on said carrier E that the male dies 58 will register, as said, with their respective

coacting female dies as the said carrier rotates. With the thin material on which this type of machine is intended to operate the difference between the distance which the male die travels in a curved line while punching the material and the distance which the coacting female die travels in the same time in a straight line is too small to make any appreciable difference in the register of the dies.

The machine operates as follows: Said bed D being at one end of its travel and the machine at rest, the sheet of material X is placed in proper position on said bed D, which is provided with suitable guides, such as are employed in planers. The machine is then started up, and the bed D travels rectilinearly, as from left to right in Fig. 1, its motion rotating the carrier E, as hereinbefore described. The rotation of said carrier E soon brings one of the rows of male dies 58 to a position where the dies are just about to take onto the sheet X, and the cam-groove 54 will then have caused the yoke 42 of said row of male dies to turn so that said dies will be in accurate parallelism and register with the female dies of one row on the bed D, and said cam-groove 54 will maintain the said male dies in parallelism and register with the said female dies throughout the operation of punching. As the bed D continues to travel and the carrier E to rotate the male dies will each enter into its corresponding female die, punching blanks from the sheet X, which blanks fall through the bed D, as hereinbefore stated, said male dies then gradually withdrawing from their female dies and from the sheet X and being carried up and around by the rotation of the carrier E and back to another punching position, and so on as long as the bed D continues to travel in the same direction. As one row of male dies leaves the sheet X the male dies of the next yoke to the left will come to a position to take onto said sheet X and will then punch out said sheet and in their turn pass up and around again to the punching position, and so on for successive rows of male dies as long as the bed D continues to travel in the same direction. Of course if the bed D have a short travel the carrier may make less than a complete revolution and in that case will oscillate back and forth with the travel of the bed D. At the end of the travel of the bed D the aforesaid studs 21 will actuate the lever 19 and belt-shipper 18 and shift the flat belt 15 upon loose pulley 13 and the crossed belt 16 upon fixed pulley 14, reversing the travel of said bed D, and said studs 21 and belt-shipper 18 are preferably so adjusted that said bed will reverse its travel at the instant when all the male dies are withdrawn from the sheet X, which sheet may be quickly removed or shifted and another sheet placed on the bed D from the right, the new sheet being punched out on the reverse travel of the bed; but the operation of the dies on the reverse travel will be the same as hereinbefore described.

Referring to Figs. 3, 4, and 5, which illustrate a machine for operating on thick sheets, the male and female dies, yokes, cam, rotary carrier, and certain other parts are similar to the corresponding parts shown in Figs. 1 and 2 and hereinbefore described and are designated by the same reference letters and figures as the similar parts in said Figs. 1 and 2 and require no further description. The traveling bed D′ is now preferably provided on its under side with two parallel racks 70 71, with which, respectively, mesh pinions 73 74, fixed on the counter-shaft 75, which is provided with fast and loose pulleys (not shown) and driven by belts from a main shaft, a belt-shipper being actuated by studs on said bed D′ to reverse said bed at the end of its travel, as hereinbefore described in connection with the machine of Figs. 1 and 2. Said bed D′ preferably has the raised part 77, in which the female dies 32 (which are similar to the female dies 32 of the machine of Figs. 1 and 2) are fixed, as hereinbefore described. The upper part of each longitudinal side of said bed D′ is preferably formed with thick flanges 81 81, to which are bolted the flanges 80 of one set of teeth 82, as hereinafter described. On the upper face of said bed D′ and near each outer edge thereof are fastened teeth 84, the flanges 86 of said teeth being secured to said bed D′ by slots and bolts, so that said teeth 84 can be adjusted longitudinally of said bed D′ to secure accurate register of the male and female dies and take up wear. Each said tooth 84 may be made in a separate piece and separately secured to said bed D′, or, preferably, all said teeth 84 which are on the same side of said bed D′ may be formed on one long piece of metal and bolted as one to said bed, and this latter construction is indicated in Figs. 3 and 5. Similarly each tooth 82 may be a separate piece and separately adjustably secured to the flanges 81 of the bed D′, or all said teeth 82 on the same side of bed D′ may be one piece of metal and adjustably secured as one to said flanges, and we prefer the latter construction. Each of said yokes 42 has grooves 90 91 parallel to the travel of the bed D′ and intended to admit of the free movement of the said flanges 81 of said bed D′ and the teeth 82, which are bolted to said flanges. The webs 94 95 at the ends of said yokes are adapted to engage with the said teeth 82 84 on the same side of the bed D′, as the teeth of a spur-gear engage a rack, the shape of said webs 94 95 being similar to that of said yokes 42, and said teeth 82 84 are rounded off at the top, as indicated, respectively, at 96 97 in Fig. 5, to provide the necessary clearance. To adjust the said teeth 82 or 84, one of the yokes 42 is brought to the vertical position, wherein its male dies enter to the greatest depth into the corresponding female dies, and the said teeth 82 84 are then so adjusted that the vertical axes of the interacting male and female dies

are exactly in the same vertical line, (or the interacting dies are in exact register,) and the teeth are then firmly bolted to the bed D′. Now as the said bed D′ travels the male dies 58 will come into accurate register and parallelism with their corresponding female dies 32, notwithstanding the thickness of the sheet Y which is being punched, for the linear movement of any male die is necessarily the same as that of the said bed D′, since the teeth of the said bed are moving the yoke 42, in which that male die is, exactly the rectilinear distance which said bed and its female dies are traveling during the period while the teeth on said bed D′ are in engagement with said yoke 42, and it will be understood that the teeth on said bed D′ only engage one yoke just before the next yoke in advance is passing out of engagement with the next set of teeth in advance on the bed D′ and that the male dies of each yoke are turned by the cam-groove 53 to a position of parallelism and register with the corresponding female dies just before that yoke is engaged by the teeth on the bed D′, the yokes and male dies retaining this parallelism and register until just after the yoke has passed out of engagement with the teeth on said bed D′, at which instant the next yoke behind has just been engaged by the next set of teeth to the rear on said bed D′. Except at the instant when one yoke is just entering into or coming out of engagement with the teeth on the bed D′ only one yoke is engaged by the teeth on bed D′, and at that instant only two yokes are so engaged, so that the travel of the bed D′ absolutely and accurately determines the linear travel of those male dies which are interacting with corresponding female dies and maintains the linear motion of the interacting dies equal during the entire period of interaction, this linear motion being termed the "motion of translation" of the dies. The operation of the machine being in general similar to that of the machine shown in Figs. 1 and 2 requires no further explanation.

It is evident from the foregoing description that the invention, broadly considered, consists in a rectilinearly-traveling carrier for one set of dies and a rotary carrier for the other set of dies, the dies on the rotary carrier having the same motion of translation as the dies on the rectilinearly-traveling carrier during the period of interaction of the dies and also being maintained in parallelism and registry with the dies on said rectilinearly-traveling carrier during the said period of interaction. I can therefore evidently put one set of dies, as the female, on an endless belt which will be driven by pulleys and supported in any suitable manner, the belt engaging the rotary carrier to rotate the same at the proper speed. In this case the belt and carrier may travel and rotate, respectively, continuously in one direction. It is also evident that I can place but one male die in a yoke, the body of the die, in fact, then becoming the yoke and being turned by the cam-groove the proper angular distances to maintain parallelism and register with its corresponding female die in the same manner as the yokes 42 are turned.

Now, having described my improvements, I claim as my invention—

1. The combination in a die-press, of a die adapted to have a rectilinear motion and a corresponding and coacting die adapted to have a curvilinear motion and to be maintained in parallelism and registry with the first-named die during the interaction of the dies, substantially as described.

2. The combination in a die-press, of a rectilinearly-moving carrier, a die thereon, a rotary carrier and a corresponding and coacting die thereon, and devices for maintaining said last-named die in parallelism and registry with said first-named die during the interaction of said dies, substantially as described.

3. The combination in a die-press, of a rectilinearly-moving carrier and a rotary carrier in operative connection, coacting dies on said carriers, and means for maintaining the die on the rotary carrier in parallelism with the die on the rectilinearly-moving carrier during the interaction of the dies, substantially as described.

4. The combination in a die-press, of a rectilinearly-moving carrier, a die thereon, a rotary carrier, a die thereon, a cam and an operative connection between said cam and said last-named die whereby said die is maintained in registry and parallelism with said first-named die during the interaction of the dies, substantially as described.

5. The combination in a die-press, of a rectilinearly-moving carrier, dies thereon, a rotary carrier, a yoke pivoted thereon, dies on said yoke, and means for oscillating said yoke so as to maintain the last-named dies in parallelism with the first-named dies during the interaction of the dies, substantially as described.

6. In a die-press, the combination of a rectilinearly-moving carrier, a die thereon, a rotary carrier, a yoke pivoted thereon, a complementary die on said yoke, a cam, and devices operatively connecting said yoke with said cam, whereby said complementary die is maintained in parallelism with said first-named die during the interaction of said dies, substantially as described.

7. In a die-press, the combination of a rectilinearly-moving carrier, a die thereon, a rotary carrier, a yoke pivoted thereon, a complementary die on said yoke, a grooved cam, a roller adapted to travel in said groove as said carrier rotates, and operative connections between said roller and said yoke, whereby the roller oscillates the yoke to maintain said complementary die in parallelism with said first-named die during the interaction of the dies, substantially as described.

8. In a die-press, the combination of a rectilinearly-moving carrier, a die thereon, a rotary carrier, a complementary die thereon, an

operative connection between said carriers whereby each of the said dies moves the same distance in a direction parallel to the travel of said first-named carrier during the interaction of the said dies, and means for maintaining the complementary die in parallelism with the first-named die during said interaction, substantially as described.

9. In a die-press, the combination of a rectilinearly-moving carrier, a plurality of dies thereon, a rotary carrier, yokes pivoted thereon, complementary dies on said yokes, and means for oscillating said yokes so that said complementary dies shall remain in parallelism with their respective coacting dies during the period of interaction of the dies, substantially as described.

10. In a die-press, the combination of a rectilinearly-moving carrier, dies arranged in groups thereon, a rotary carrier, yokes pivoted thereon and spaced the same distance apart as are said groups, complementary dies on said yokes arranged in groups similar to the groups of said first-named dies, and means for oscillating said yokes to maintain each group of complementary dies in parallelism with the corresponding group of coacting dies during the interaction of the dies, substantially as described.

11. In a die-press, the combination of a rectilinearly-moving carrier, dies arranged in groups thereon, a rotary carrier, yokes pivoted thereon and spaced the same distance apart as are said groups, complementary dies on said yokes positioned the same distances apart as are the dies in said groups, devices operatively connecting said carriers whereby said complementary dies move the same distance parallel to the travel of said first-named carrier as do their coacting dies during the period of interaction of the dies, and devices for oscillating said yokes so as to maintain said complementary dies in parallelism with their said coacting dies during said interaction, substantially as described.

12. In a die-press, the combination of a rectilinearly-moving carrier, dies thereon, a rotary carrier, a plurality of yokes pivoted thereon and complementary dies on said yokes, and teeth on said first-named carrier adapted to engage said yokes and actuate said rotary carrier, substantially as described.

13. In a die-press, the combination of a rectilinearly-moving carrier, dies thereon, a rotary carrier, a plurality of yokes pivoted thereon and complementary dies on said yokes, and teeth disposed on said first-named carrier so as to simultaneously engage only one yoke except at the instant when said engagement is beginning, substantially as described.

14. In a die-press, the combination of a rectilinearly-moving carrier, dies thereon, a rotary carrier, a plurality of yokes pivoted thereon and complementary dies on said yokes, and teeth adjustably disposed on said first-named carrier so as to simultaneously engage only one yoke except at the instant when said engagement is beginning, substantially as described.

15. In a die-press, the combination of a rectilinearly-moving carrier, dies thereon, a rotary carrier, a plurality of yokes pivoted thereon and complementary dies on said yokes, means for oscillating said yokes so as to maintain said complementary dies in parallelism with said first-named dies during the interaction of the dies, and teeth on said first-named carrier disposed to simultaneously engage but one yoke except at the instant when said engagement is beginning, substantially as described.

16. In a die-press, the combination of a rectilinearly-moving carrier, dies thereon, a rotary carrier, a plurality of yokes thereon and complementary dies on said yokes, a cam, and operative connections between said cam and said yokes whereby said yokes are oscillated so that said complementary dies are maintained in parallelism with the first-named dies during the interaction of the dies, and teeth on said first-named carrier so disposed as to simultaneously engage only one yoke except at the instant when said engagement is beginning, substantially as described.

17. In a die-press, the combination of a rectilinearly-moving carrier, dies thereon arranged in groups, a rotary carrier, a plurality of yokes pivoted thereon the same distance apart as are said groups, complementary dies on said yokes, means for oscillating said yokes so as to maintain said complementary dies in parallelism with said first-named dies during the interaction of the dies, and teeth on said first-named carrier so disposed as to simultaneously engage only the yoke of those complementary dies which are at any time coacting with a group of dies on said first-named carrier except at the instant when said engagement is beginning, substantially as described.

Signed at New York city this 30th day of August, 1901.

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