(No Model.) 5 Sheets—Sheet 1.

E. J. FROST.

Cylinder Printing Press.

No. 242,914. **Patented June 14, 1881.**

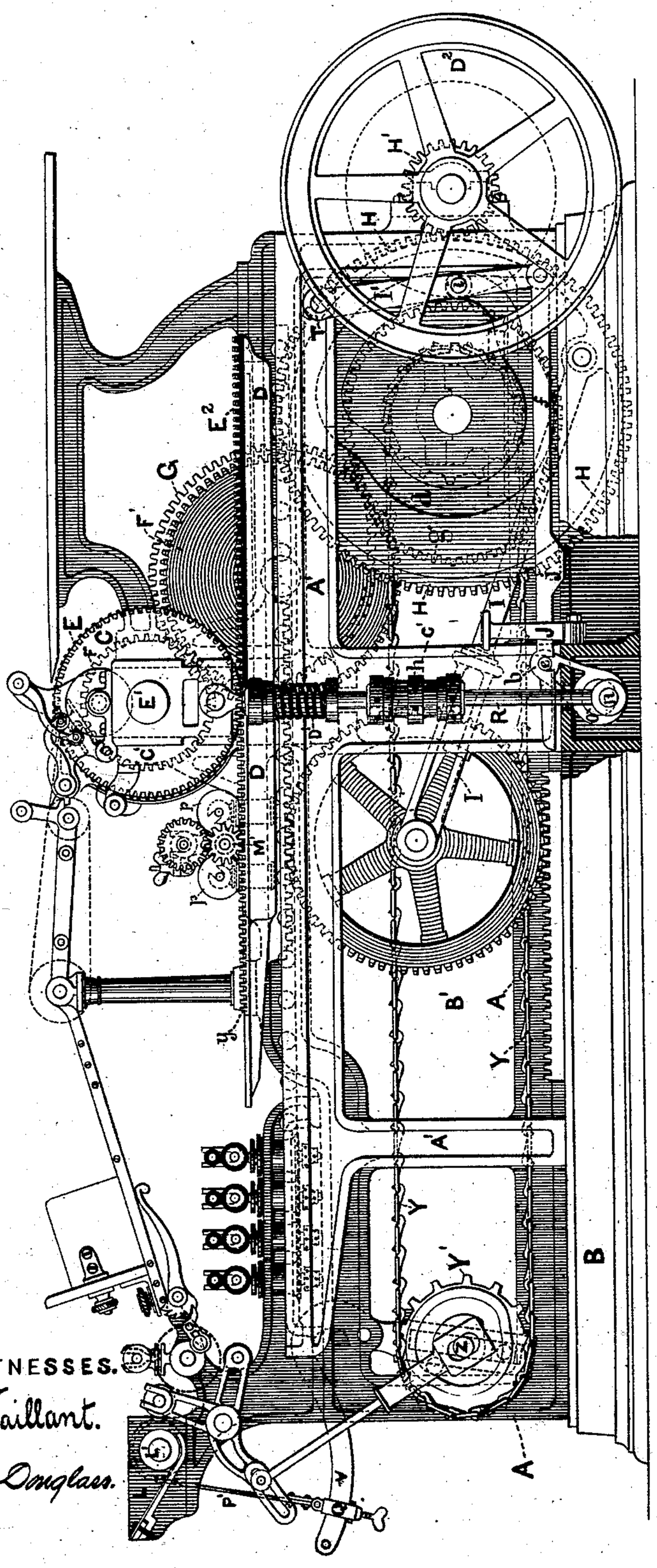


FIG. 1.

WITNESSES.

Geo. A. Vaillant.

J. Walter Douglass.

INVENTOR.

E. J. Frost

By Jos. L. Ralston

Atty.

(No Model.)

5 Sheets—Sheet 2.

E. J. FROST.

Cylinder Printing Press.

No. 242,914. Patented June 14, 1881.

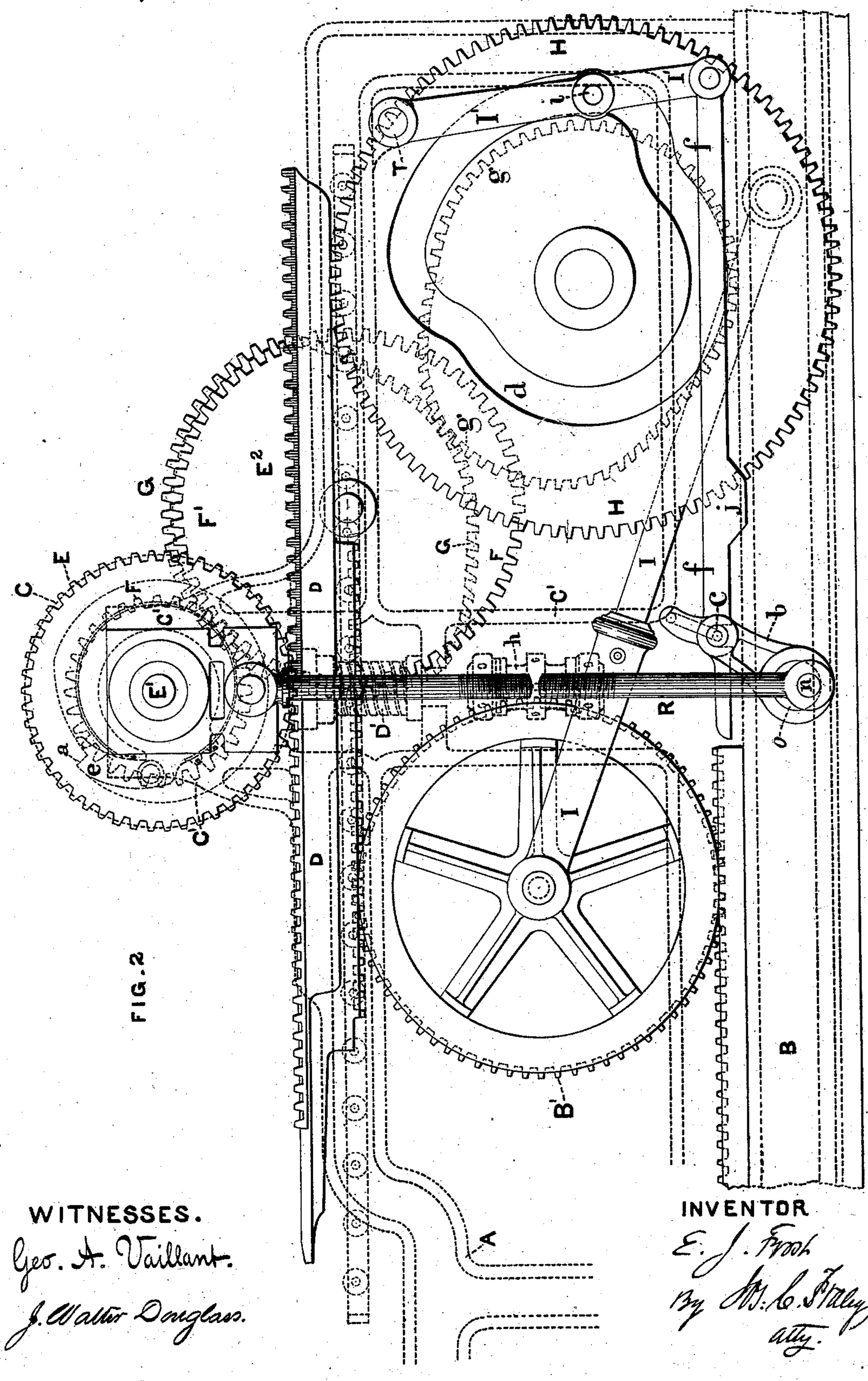


FIG. 2

WITNESSES.

Geo. A. Vaillant.

J. Walter Douglass.

INVENTOR

E. J. Frost

By Wm. C. Foley

atty.

(No Model.)

5 Sheets—Sheet 3.

E. J. FROST.

Cylinder Printing Press.

No. 242,914. Patented June 14, 1881.

FIG. 4.

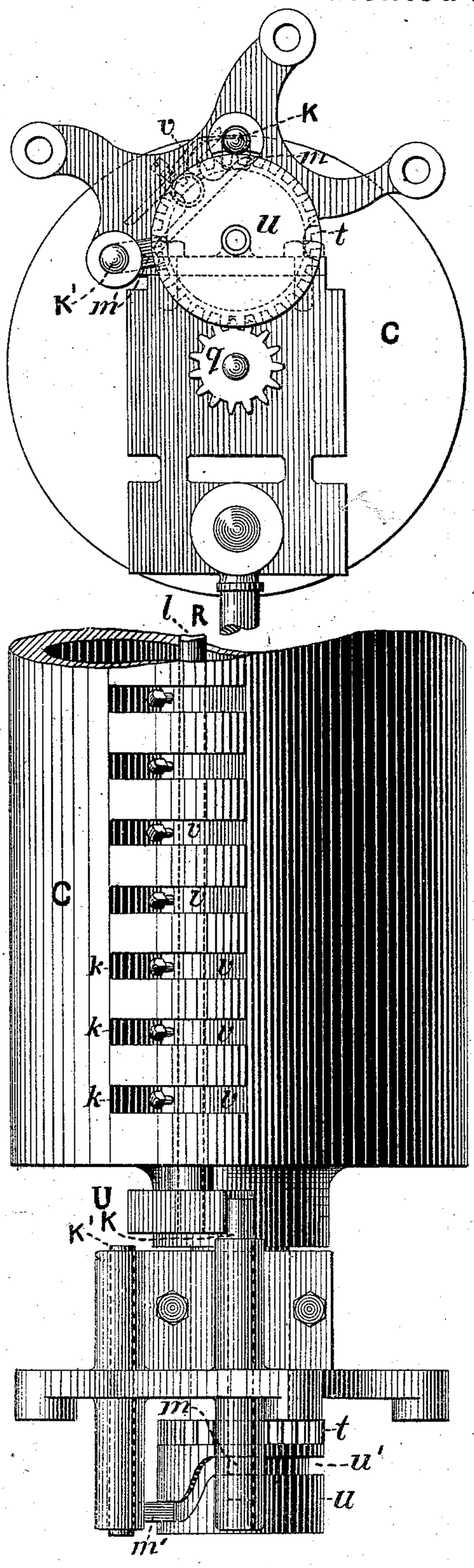


FIG. 5.

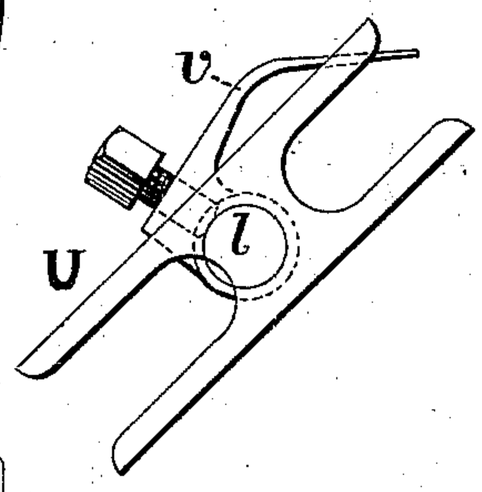


FIG. 3.

WITNESSES.

Geo. A. Vaillant.

J. Walter Douglass.

INVENTOR.

E. J. Frost

By Wm. C. Finley

atty.

(No Model.) 5 Sheets—Sheet 4.

E. J. FROST.

Cylinder Printing Press.

No. 242,914. **Patented June 14, 1881.**

FIG. 6.

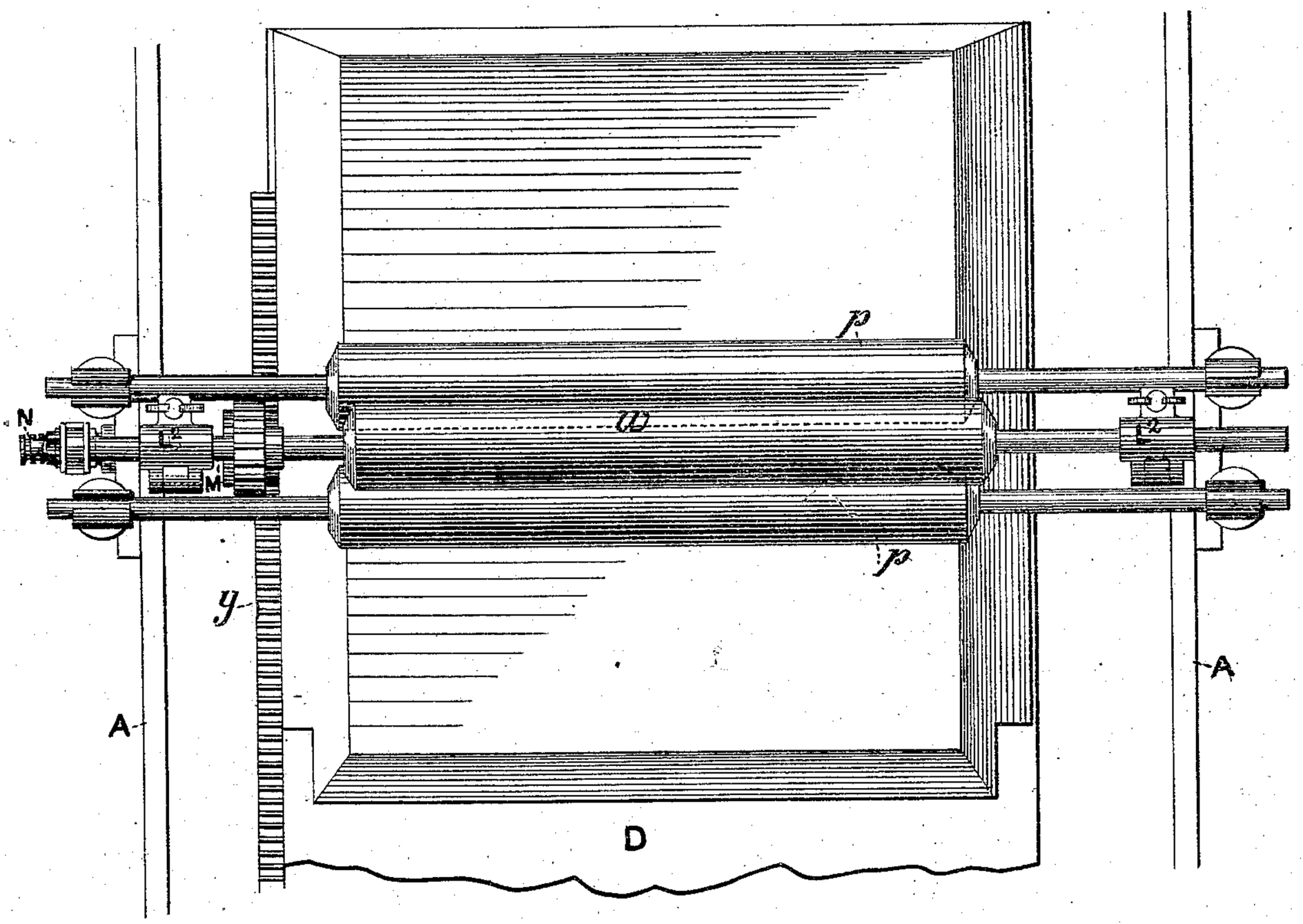


FIG. 7.

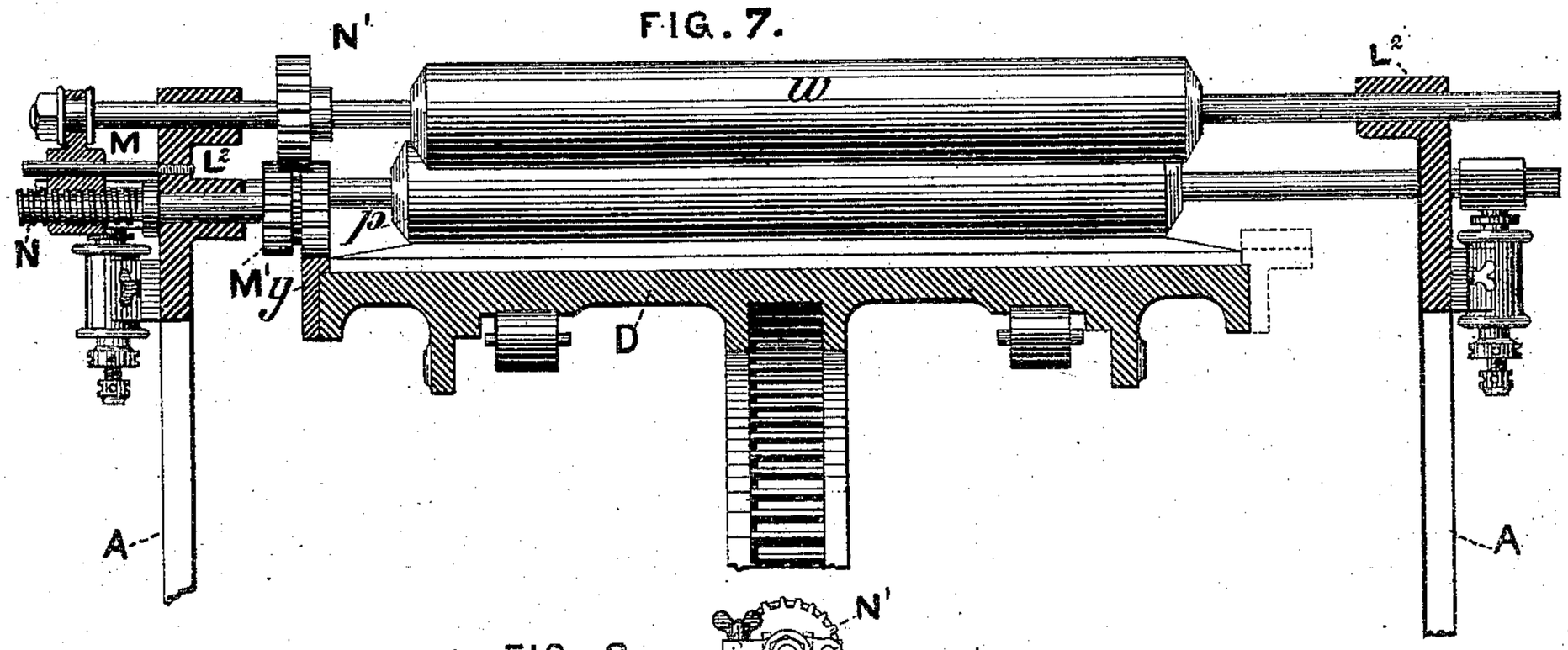
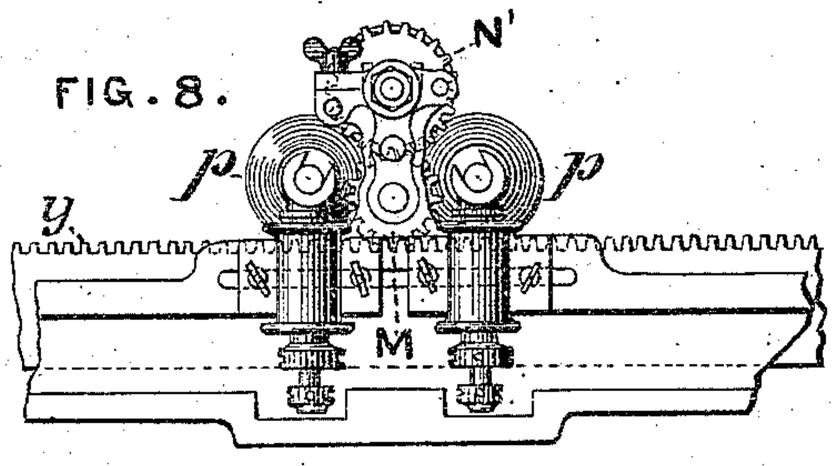


FIG. 8.



WITNESSES.

Geo. A. Vaillant.

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(No Model.) 5 Sheets—Sheet 5.

E. J. FROST.

Cylinder Printing Press.

No. 242,914. Patented June 14, 1881.

FIG. 11.

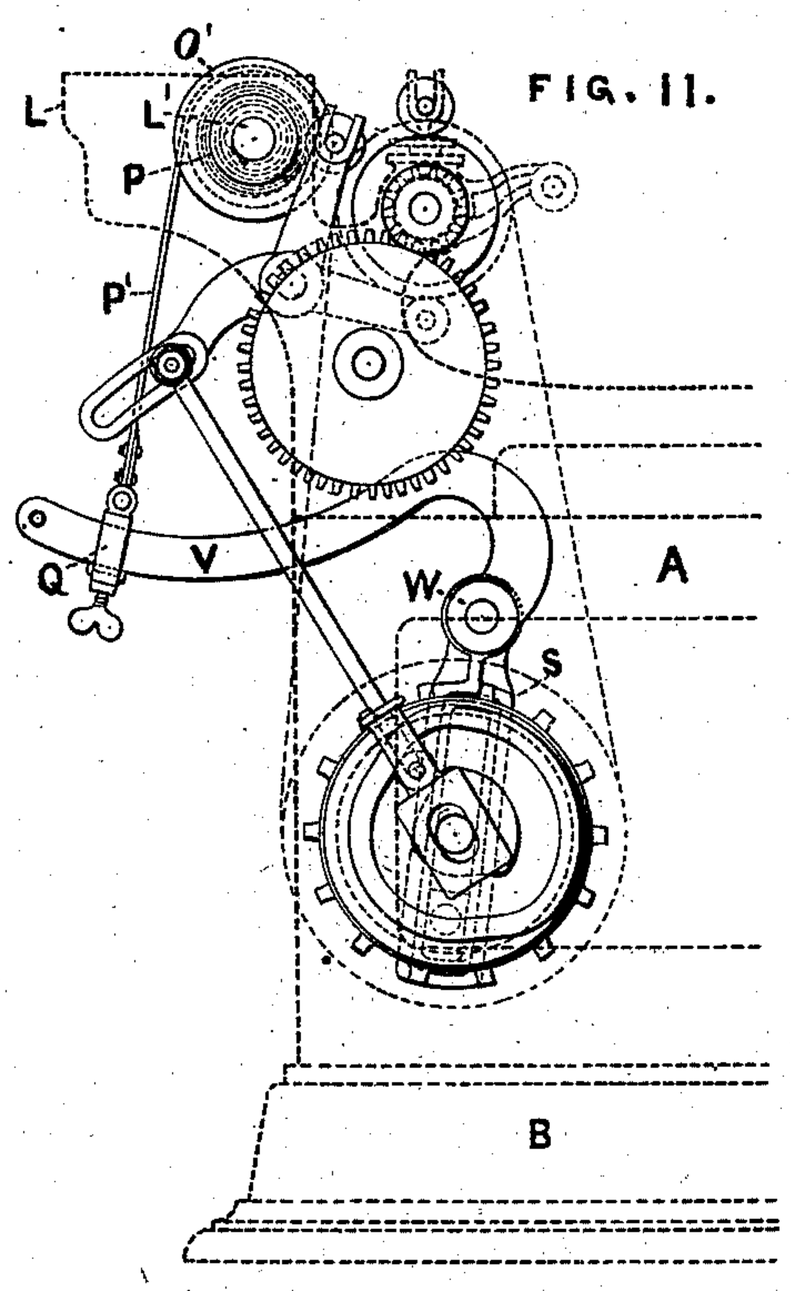


FIG. 10.

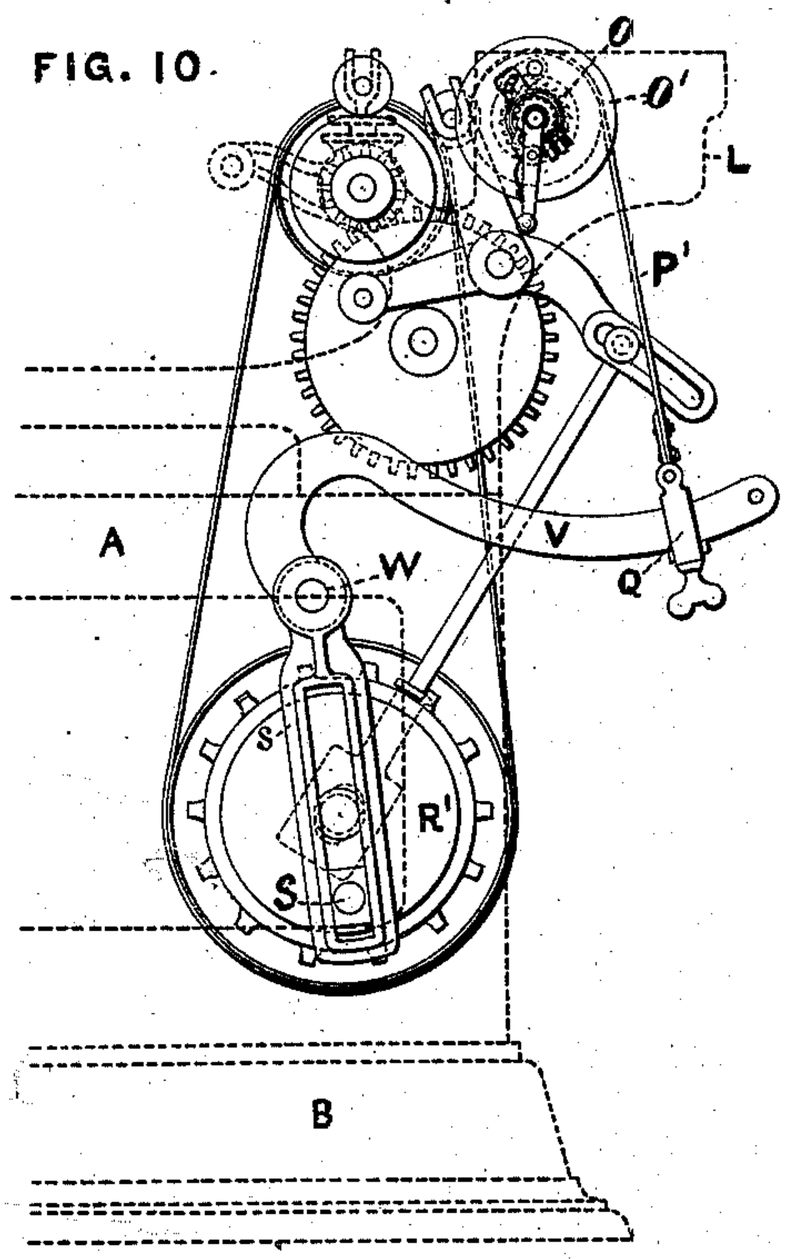
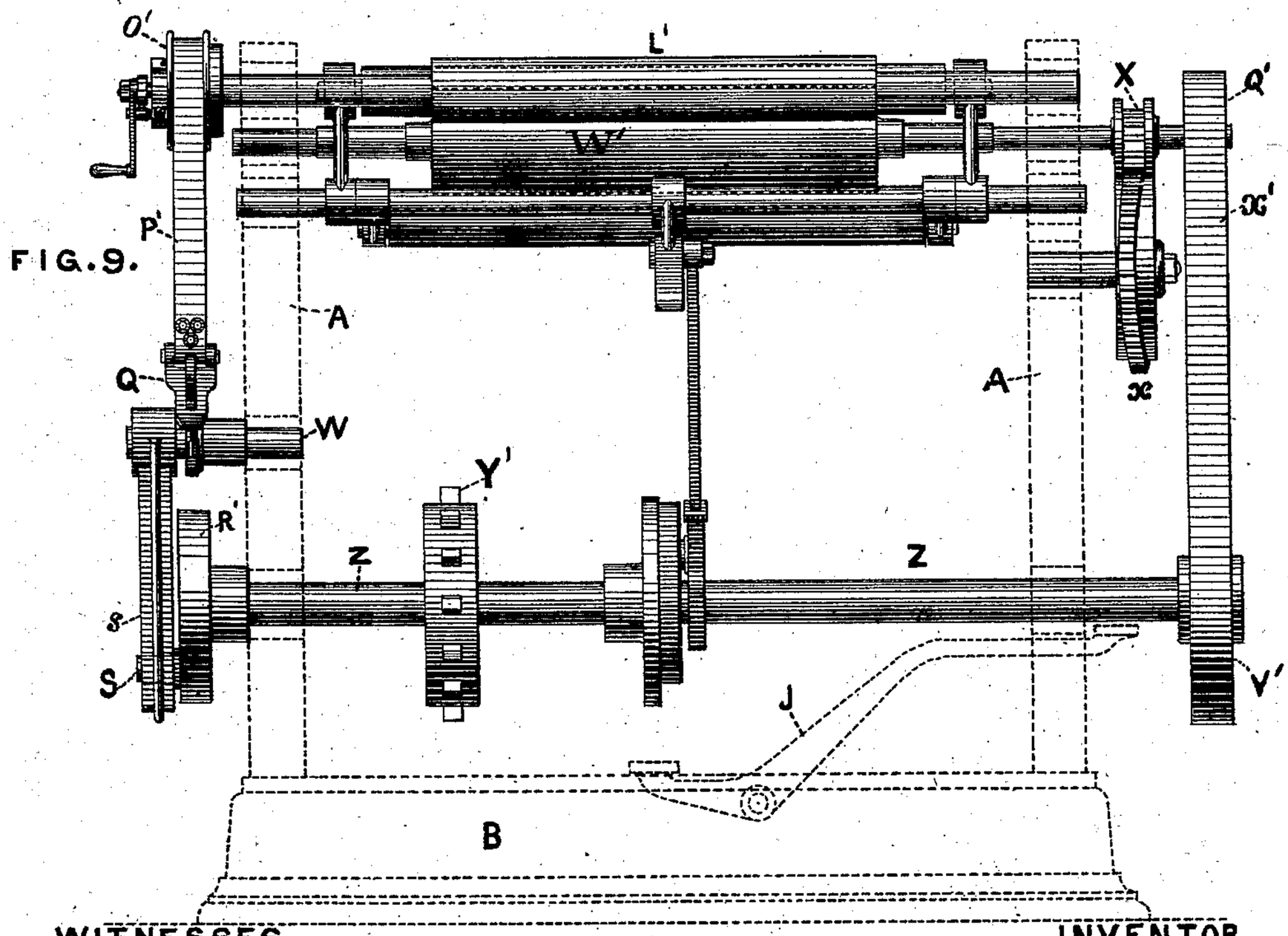


FIG. 9.



WITNESSES.
Geo. A. Vaillant.
J. Walter Douglass.

INVENTOR
E. J. Frost.
By Jos. C. Daly
atty.

UNITED STATES PATENT OFFICE.

EDWARD J. FROST, OF PHILADELPHIA, PENNSYLVANIA, ASSIGNOR OF TWO-THIRDS TO ROBERT N. TOPPAN, OF NEW YORK, N. Y.

CYLINDER PRINTING-PRESS.

SPECIFICATION forming part of Letters Patent No. 242,914, dated June 14, 1881.

Application filed November 10, 1880. (No model.)

To all whom it may concern:

Be it known that I, EDWARD J. FROST, of the city and county of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Cylinder Printing-Presses, of which improvements the following is a specification, reference being had to the accompanying drawings.

In these Figure 1 represents a side elevation of the press with one of the side frames or housings removed; Fig. 2, a side elevation of the system of gears by which the cylinder and table are driven and the cylinder is raised and lowered. Fig. 3 is a top view, and Fig. 4 an end view, of the cylinder, showing the mechanism for closing and opening the grippers. Fig. 5 is a view of the T-head which is attached to the griper-shaft. Figs. 6 and 8 are respectively plan and end views of the form-rollers and their actuating mechanism. Fig. 7 is a front view of the same, partly in elevation and partly in section. Fig. 9 is a front elevation of the fountain-roller and its accessories with their actuating mechanism. Figs. 10 and 11 are side elevations of the same, seen from opposite ends of the fountain-roller.

My improvements are specially adapted to be used in connection with that class of printing-presses known as "two-revolution cylinder-presses;" but I contemplate the use of some of them in connection with other forms of cylinder-presses.

A A are the housings or side frames, mounted upon the bed-plate B, which also serves as a base to an interior frame, A′, forming ways for the type bed or table D, which latter runs upon rolls in the usual manner.

The cylinder C is journaled in sliding boxes in the standards C′, its weight being counterbalanced by the springs D′.

The type bed or table D is run by means of a rack upon its under side and "railroad" gear B′, the driving-pulley D^2 being connected with the latter by means of the gears H H′ and connecting-rod I. The construction of these parts is well understood and need not be further particularized.

Upon one end of the cylinder-shaft E′ is mounted a gear, E, revolving freely thereon. The inner face of the gear-wheel E is recessed so as to form a shoulder or cam, *a*, as shown in Fig. 2. A spring latch or pawl, *e*, is pivoted to a collar fixed rigidly upon the end of the cylinder, and engages with the cam *a* when the gear E revolves in one direction, thus rotating the cylinder. The reverse revolution of the gear E disengages the latch and frees the cylinder. A rack, E^2, is rigidly attached to the table D, and reciprocates therewith. This rack E^2 is shown in dark shade in Figs. 1 and 2, and is upon the side farthest from the observer, as is also the gear E, with which the rack engages.

On the end of the cylinder-shaft, outside of the gear E, is rigidly mounted a second and smaller gear, F, meshing with a large gear, F′, journaled to the side frame.

On the face of the gear F′ is rigidly attached an irregular gear, G, a portion of whose periphery is concentric with that of the gear F′, while the remainder is constructed with a flattened curve, as shown. The flattened portion is arranged to mesh with a correspondingly-elongated curve on the irregular eccentric gear *g*, which also has a portion of its periphery concentric with that of the large gear and cam wheel H, driven by the pinion H′ on the shaft of the driving-pulley D^2. The irregular portions of the gears G and *g* are of such form that their revolutions exactly coincide with the unequal speed of the crank and railroad movement. During one half-revolution of the large gear-wheel H its motion is transmitted to the cylinder C by two independent systems of gearing—viz., the rack and latched pinion and the eccentric gears G *g*—and during the remaining half-revolution of the cam-wheel, or while the rack is returning, the pinion runs free on the cylinder-shaft and the cylinder is driven by the regular or circular portions of the gears G *g*. Thus during the period of impression the cylinder makes one complete revolution with a varying speed exactly conforming to the movement of the type-bed, and during the return of the type-bed the cylinder makes a second complete revolution with a uniform speed independent of the type-bed, but completed simultaneously with the return movement thereof. The purpose of this double system will be hereinafter explained.

A connecting-rod, R, is attached to the sliding box on each end of the cylinder, and passes through the counterbalance-spring to the crank-pin of the short-armed crank *n* on the end of a rock-shaft, *o*. The rock-shaft *o* extends across the bed-plate, and is provided with bearings in the bed-plate, the two connecting-rods R and their respective cranks being outside of the standards C′. Intermediate between the standards a longer crank, *b*, is attached to the rock-shaft, and a wrist-pin, *c*, on the crank *b* fits into a slot of the connecting-bar *f*. By means of the cam-wheel and pin *i* upon the vibrating arm I′, pivoted at T, the connecting-bar *f* is caused to reciprocate, thus alternately raising and depressing the cylinder. The configuration of the slot *d* in the cam-wheel H is such that these movements of the cylinder are sudden, and during the interval between them the cylinder is positively locked by reason of the position of the pin *i* in the outer and inner arcs of the slot *d*. The rise and fall of the cylinder are very slight, being only sufficient to permit it to clear the type-bed on the return movement of the latter, and hence the rack E^2 and pinion E are not thrown out of gear.

The connecting-rods R may each be made in two pieces, united by a sleeve-nut, *h*, as shown, so that they may be adjusted in the direction of their length. The connecting-bar *f* is provided on its under side with a projection or cam, *j*, and a bell-crank lever, J, (see Figs. 1 and 9,) having a treadle at its outer end, is pivoted to one of the side frames. The inner end or arm of the lever J, Figs. 1 and 9, when raised by depressing the treadle, is struck by the cam *j* as the connecting-bar *f* reciprocates and lifts the slotted end of the bar, so as to free the wrist-pin *c*, thus disconnecting the mechanism for raising and lowering the cylinder. When the inner end or arm of the bell-crank lever J is permitted to fall the slot again drops to the wrist-pin *c* and the rising-and-falling movement of the cylinder is resumed.

The cylinder itself is of the usual construction, and the details of the griper movement are shown in Figs. 3, 4, and 5. The griper-fingers *v*, working in the slots *k*, are attached to a shaft, *l*, running lengthwise through the cylinder and projecting beyond it at one end to receive the slotted T-head U. The griper-shaft is provided with bearings in the ends of the cylinder, and the gripers can be opened or closed by the oscillation of the head U, being held in either position by springs, as is well understood. To turn the griper-shaft head U, I mount upon the end of the cylinder-shaft a pinion, *q*, meshing with a second pinion, *t*, which has double the number of teeth of the pinion *q*. A cam-cylinder, *u*, is attached to the pinion *t*, and the sliding bolts K K′ are provided with pins *m m′*, respectively extending through slots in the bolt-sheaths. These pins fit the groove *w′* of the cam-cylinder *u*, and as the latter revolves the bolts are alternately protruded and withdrawn. The end of the protruded bolt strikes in the slot of the head U when the slot is turned toward it, but permits its passage when the slot of the approaching head is turned away from it. When the bolt strikes in the slot the head U is thereby turned through a quadrant, and the griper-shaft turns with it, thus opening or closing the gripers *v*. As the cam-cylinder *u* makes but one revolution for two revolutions of the main cylinder C, the protrusion of each bolt only takes place once during the two revolutions of the main cylinder. In the position shown in Fig. 3 the bolt K, which closes the gripers, has just turned the head U and is leaving the slot. The opening-bolt K′, having been previously withdrawn into its sheath, remains there until after the passage of the head U, and is then protruded by the cam-cylinder, so that on the return of the head U, whose slot is now turned toward the bolt K′, the head and griper-shaft will be turned back and the gripers opened.

The details of the form-rollers are shown in Figs. 6, 7, and 8. These rolls are three in number, and are mounted in bearings upon the side frames. One of them, *w*, known as the "rider," is mounted above but in contact with the others, *p p*, as shown. The journal-boxes L^2 of the rider *w* permit the longitudinal movement of its shaft, and to one end of the shaft is attached the screw-nut M, whose screw N is a prolongation of the shaft of pinion M′. A rack, *y*, fixed upon the side of the type bed or table, actuates the pinion M′ in opposite directions with each reciprocation of the table, and thus causes the rider *w* to move back and forth endwise, while at the same time it is rotated by the pinion N′, which meshes with the pinion M′. The rack *y* is shown light in Fig. 1, and is upon the side of the table nearest the observer.

The rider-roller, when the press is in use, needs to be frequently removed for cleansing, and if the screw-thread by which the reciprocating movement is effected is formed directly upon the roller-shaft, as has heretofore been done, it requires a careful adjustment in the screw-nut each time the rider is replaced, since the least inaccuracy would result in tearing out the thread. By attaching the rider-shaft to a secondary screw and nut, which always remain in position, I obviate this difficulty, and the rider can be thrown in and out of position quickly and without adjustment.

Motion is communicated to the fountain and inking roller system, Figs. 9, 10, and 11, from the main driving-shaft by means of the chain-gearing Y Y′, the gear-wheel Y′ being mounted upon the driving-shaft Z of this system. L′ is the fountain-roller, revolving in the ink-fountain L, which latter is constructed in the usual manner.

A ratchet-wheel, O, is mounted upon the shaft of the roller L′, and the box O′, which turns loosely upon the shaft of the roller L′,

is provided with a pawl, which engages with the ratchet O in one direction. Within the box O′ is the coiled spring P, arranged so as to be wound up by the revolution of the box in the direction in which the pawl engages with the ratchet.

The strap P′ is fastened to the rim of the box O′, and wound thereon in such a direction that the rotation of the box by the unwinding of the strap will wind up the spring P. The outer end of the strap P′ is provided with a slotted keeper, Q, adjustable by means of a set-screw upon the curved arm of the lever V.

A crank-pin, S, on the wheel R′ works in the slotted lower arm of the lever *s*, and as the lever is pivoted at W, the rotation of the wheel R′ produces a slow downward movement of the curved arm and strap and a quick upward return thereof.

The mechanism by which the doctor-rollers are vibrated is shown in Figs. 9, 10, and 11, but, being of the usual construction, need not be explained in detail.

Intermediate between the doctor-rollers is the distributing-roller W′, to which I desire to impart a longitudinal reciprocation, while at the same time it is revolved continuously in one direction. For this purpose I mount upon the shaft of the distributing-roller W′ (which is permitted to play endwise in its bearings) a flanged pinion, X, meshing with gear *x*, whose teeth are arranged upon a projecting waved rim, which fits between the flanges of the pinion X, and thus serves as a cam.

A pulley, Q′, is mounted upon the shaft of the distributing-roller W′ in such manner that the latter is permitted to play endwise therein and be rotated thereby. A belt, *x′*, and pulley V′ communicate motion from the shaft Z of the chain-gear Y′.

Having thus described the mechanical construction embodying my improvements, I will now proceed to explain the mode of operation thereof.

The sheet to be printed, having been seized by the griper-fingers, is brought down upon the cylinder. As the type-bed D commences its forward movement the cylinder is depressed by means of the connecting-rods R, and the sheet is thus pressed firmly against the type. The forward movement of the type-bed continues, and the cylinder is revolved in exact uniformity with its motion by means of the rack and pinion and the latch *e*. The type-bed then commences its return movement, and the latch *e* disengaging from the pinion, the latter runs free on the cylinder-shaft. The forward movement of the cylinder, however, is continued by means of the independent system of gears F F′, which has been permitted to conform to the previous irregular movement of the cylinder by means of the irregular eccentricity of the gears *g* G, and the cylinder therefore makes a second revolution synchronously with the return movement of the type-bed. This second revolution of the cylinder enables the sheet to be discharged in front thereof. The object of imparting motion to the cylinder through the two independent systems of gearing is as follows: To produce exact uniformity of movement during the period of impression, it is desirable that the cylinder should be driven directly from the type-bed; and, while it is not essential that the second revolution of the cylinder should be uniform throughout with the return movement of the type-bed, it is of the highest importance that it should be completed exactly at the same instant with such return movement; otherwise an accurate register cannot be obtained for the succeeding sheet at the commencement of the impression. I therefore provide the irregular and eccentric gears, which follow the varying movement of the type-bed during the period of impression, so that the system which drives the cylinder during the second revolution shall never be out of gear. Thus the danger of lost motion which might ensue if this system had to be thrown in and out of gear is averted, and, furthermore, a similar danger which might result from the failure of the latch *e* to engage instantaneously with the shoulder *a* is obviated, since the eccentric gears continue to positively rotate the cylinder. In light presses, where the strain upon the cylinder movement is not great, I contemplate using the train of eccentric gears alone for the purpose of driving the cylinder. As, however, it is difficult to make the irregular teeth of sufficient strength to bear the strain of driving the cylinder of a heavy press during the period of impression, and for other reasons above given, I deem it expedient in such heavy presses to provide the rack-and-pinion movement as the efficient power during that period.

The control of the mechanism which raises and depresses the cylinder is facilitated by the arrangement of the connecting-bar *f* with its cam *j* and the bell-crank lever J, so that the engagement and disengagement with the rock-shaft crank *c* are effected close by the cylinder, where the pressman usually stands.

The griper movement is peculiar chiefly in the particulars rendered necessary by the double revolution of the cylinder, the proportions of the pinions *t* and *q* and the configuration of the slot *u′* in the cam-cylinder *u* being such as to effect the protrusion and withdrawal of the opening and closing bolts at exactly the proper moments. Thus the closing-bolt is protruded at the moment before the gripers are to take the sheet, strikes the T-head U, and closes the gripers. It is then withdrawn and remains withdrawn during the whole of that revolution and nearly the whole of the second revolution of the cylinder, when it is again protruded to repeat the operation. After the T-head has been closed and has been carried past the point where the opening-bolt is situated, the opening-bolt is protruded so as to strike the T-head and open the gripers after the completion of the first revolution of the

cylinder, when the sheet is discharged. It is then withdrawn and remains withdrawn until after the passage of the T-head in the next revolution, when this operation is repeated.

The endwise-reciprocating movement of the rider-roller *w* is intended to effect the uniform distribution of the ink upon the lower ones, and is accomplished by means of the screw-and-nut attachment and the reciprocating rack upon the type-bed.

The driving mechanism of the fountain-roller is adapted to produce a slow revolution thereof during the period when the doctor-roller is taking up the ink therefrom, and to permit the extent of its rotation to be varied at will.

The revolution of the crank-pin S in the slotted lever-arm *s*, pivoted at W, occasions a slow depression of the curved lever-arm V, and thus slowly unwinds the strap P′, which, by means of the ratchet and pawl O, rotates the fountain-roller, and by adjusting the keeper Q at a point of the arm V nearer to the fulcrum W the length of stroke will be diminished without changing the comparative speed. When the stroke, however, is completed and the strap P′ is to be rewound upon the flanged box O′, it is desirable that this movement should be rapid, and therefore a quick upward return of the lever-arm V is effected by the revolution of the crank-pin S at the top of the slot *s*.

The distributing-roller W′ is rotated continuously in one direction by means of the pulleys Q′ V′ and belt *x*′, and at the same time the cam-gear *x* and pinion X cause it to reciprocate endwise, thus thoroughly distributing the ink received from and taken up by the doctor-rollers P^2 P^2.

I am aware that it is not new to use irregular gears to slow down the cylinders of single-revolution presses during the return of the type-bed, and that such devices have been used in connection with segments of gears to insure conformity of movement between the type-bed and cylinder during the period of impression; but in such cases the bed movement has been a regular one, and the irregular portions of the gears were operative, not during the period of impression, but during the return of the bed.

I am also aware that eccentric gears have been used in single-revolution cylinder-presses in combination with type-beds reciprocated by parallel-motion devices, as described in Letters Patent No. 128,731, dated July 9, 1872. Apart from the fact that no supplemental system of gearing is used in this device, it differs from my further feature of improvement, in that the gears effect but a single revolution of the cylinder for each complete reciprocation of the type-bed; and also in that the cylinder used must be of double the circumference necessary in mine, and must have a portion of the periphery cut away, in order to permit the return of the type-bed.

The use of a single crank and railway gear such as is above described for the purpose of driving the type-bed has been found highly desirable, and my improvements permit the combination, with a type-bed so driven, of a cylinder driven by a system of gearing independent of the type-bed-driving mechanism, though proceeding from the same prime mover. I also obtain by the double revolution of the cylinder the advantage of delivering the printed sheet face uppermost in front thereof, and am enabled to use a much smaller and lighter cylinder.

Furthermore, I am aware that the continuous revolution of the cylinder has been effected directly from the type-bed by means of two independent systems of gearing, alternately thrown in and out of gear, a device for this purpose having been patented to me in Letters Patent of the United States dated June 3, 1879. My present improvements differ from this last method, in that, while they drive the cylinder during the period of impression directly from the type-bed, they maintain the secondary system constantly in gear, and thus prevent any lost motion which might impair the accuracy of the register.

Having thus described the nature and object of my improvements, what I claim as new, and desire to secure by Letters Patent, is—

1. The combination of a type-bed driven at a varying speed, a cylinder driven during the period of impression directly from the type-bed, and a system of irregular gears driving the cylinder continuously, but conforming during the period of impression with the irregular movement of the type-bed, substantially as set forth.

2. The combination, with the connecting-rods R of the cylinder, of the cranks *n* and *b*, wrist-pins *c*, slotted connecting-bar *f*, cam *j*, and bell-crank lever J, substantially as specified.

3. The combination of the screw-nut M, screw N, pinions M′ N′, and rack *y* with the shaft of the rider-roller, substantially as and for the purposes specified.

4. The combination, with the strap of the fountain-roller, of the slotted lever *s* and crank-pin S, whereby a slow unwinding of said strap is effected and a quick return thereof permitted, substantially as specified.

EDWARD J. FROST.

Witnesses:
J. WALTER DOUGLASS,
GEO. F. FINDLAY.