5 Sheets—Sheet 1.

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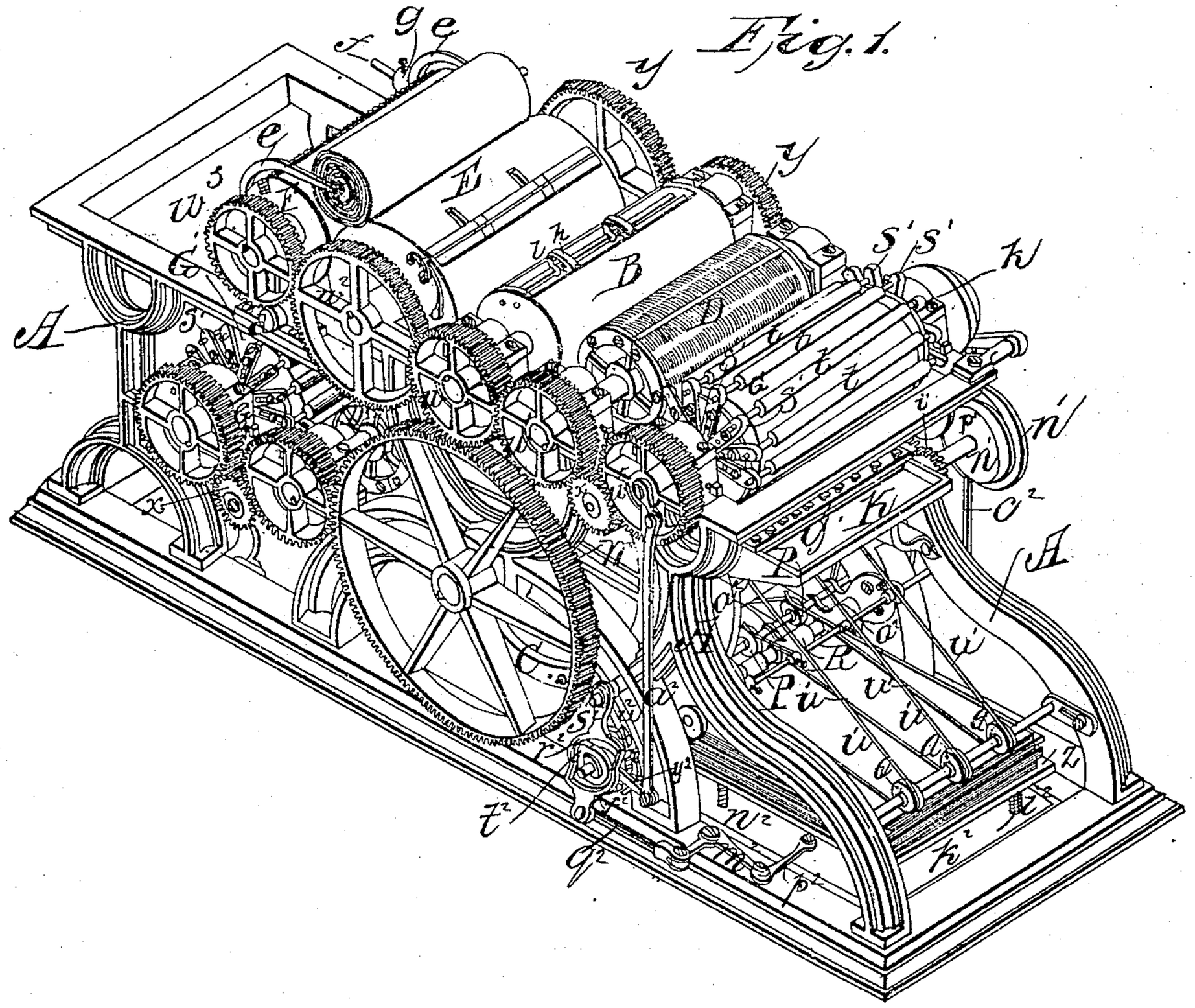
PRINTING PRESS.

No. 38,200. Patented Apr. 14, 1863

Fig. 1.



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John C. Atterbury

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by his attorney
W Bakewell

5 Sheets—Sheet 2.

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Fig. 2.

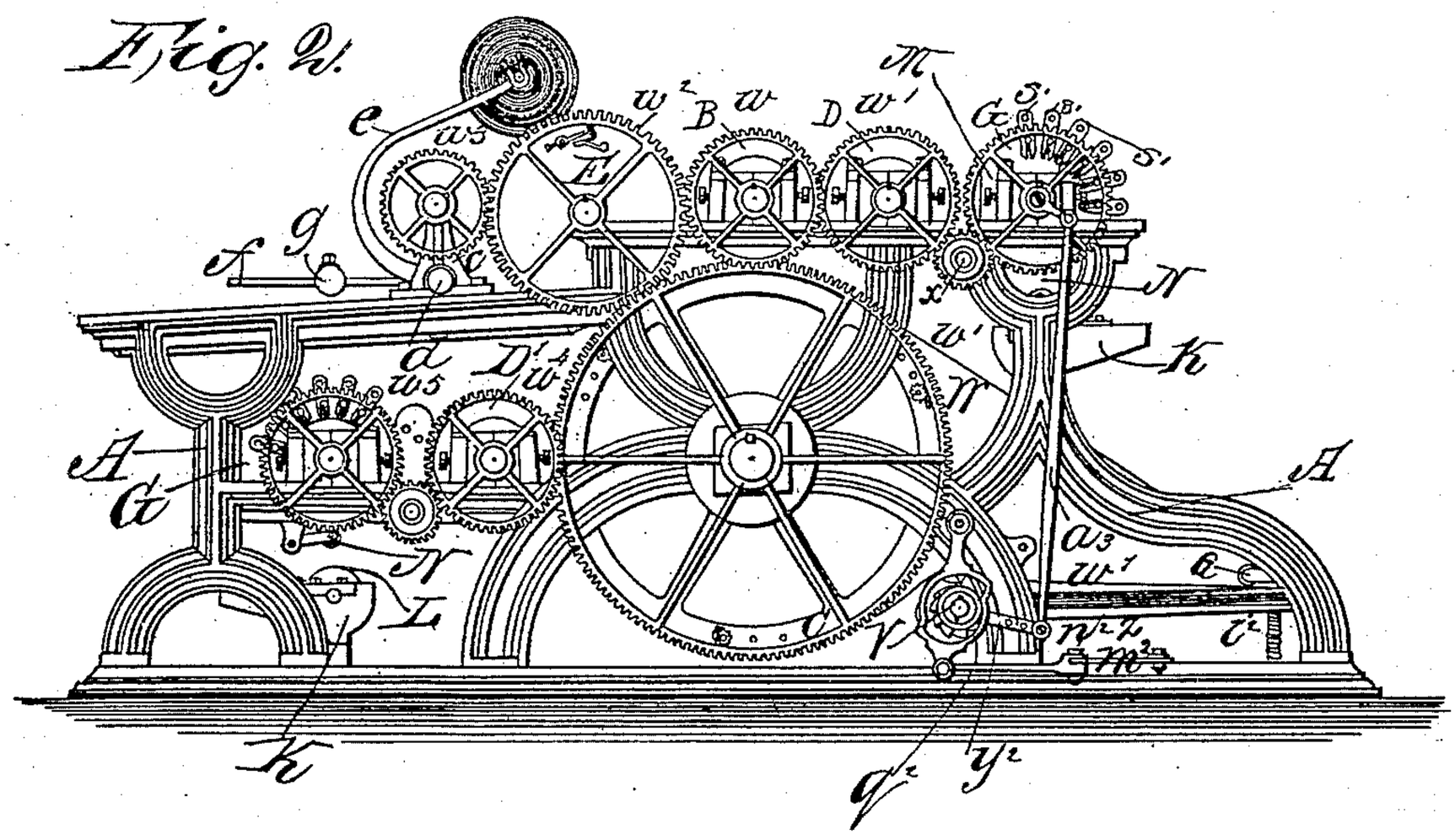
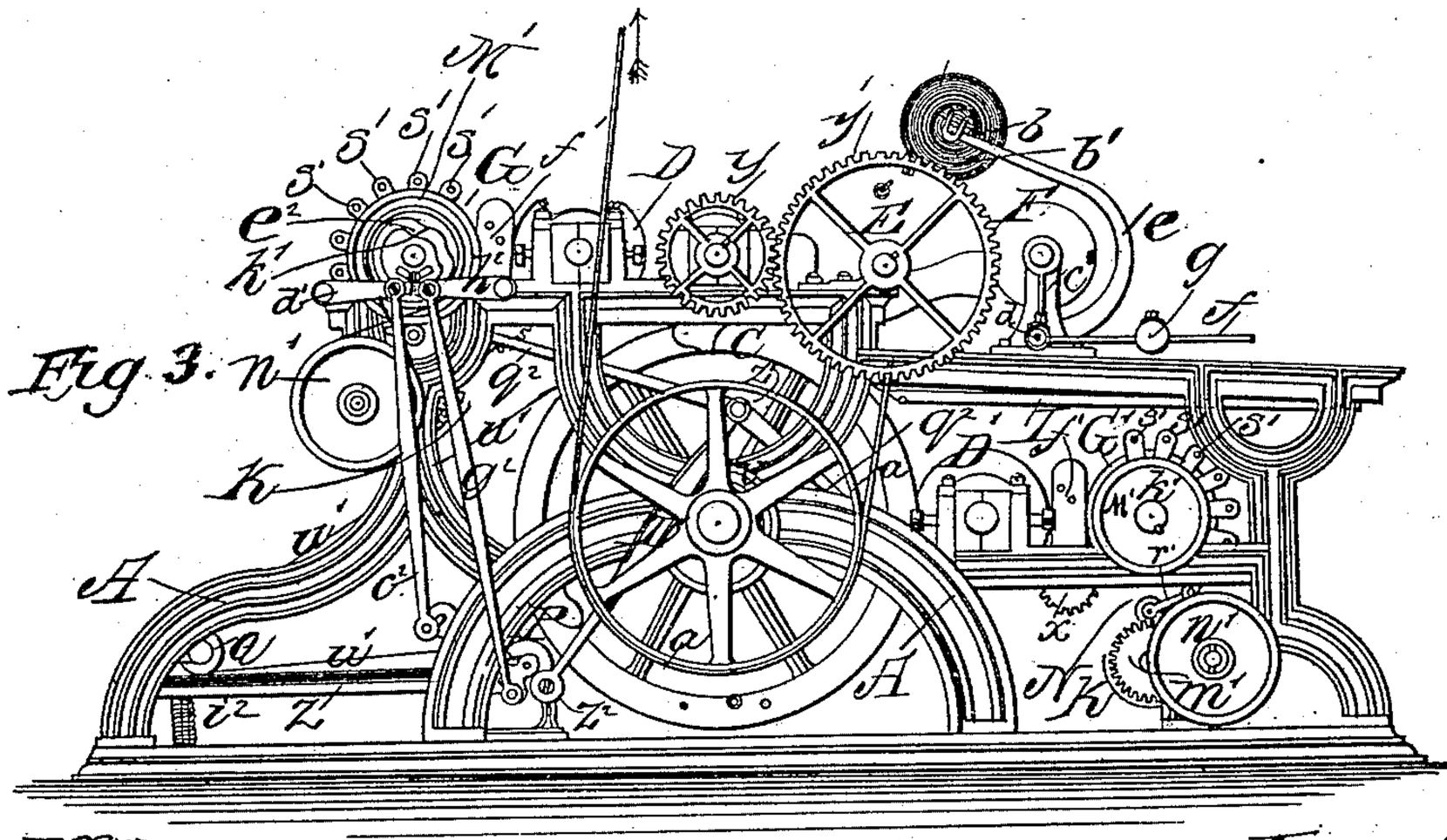


Fig. 3.



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5 Sheets—Sheet 3.

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Fig. 4.

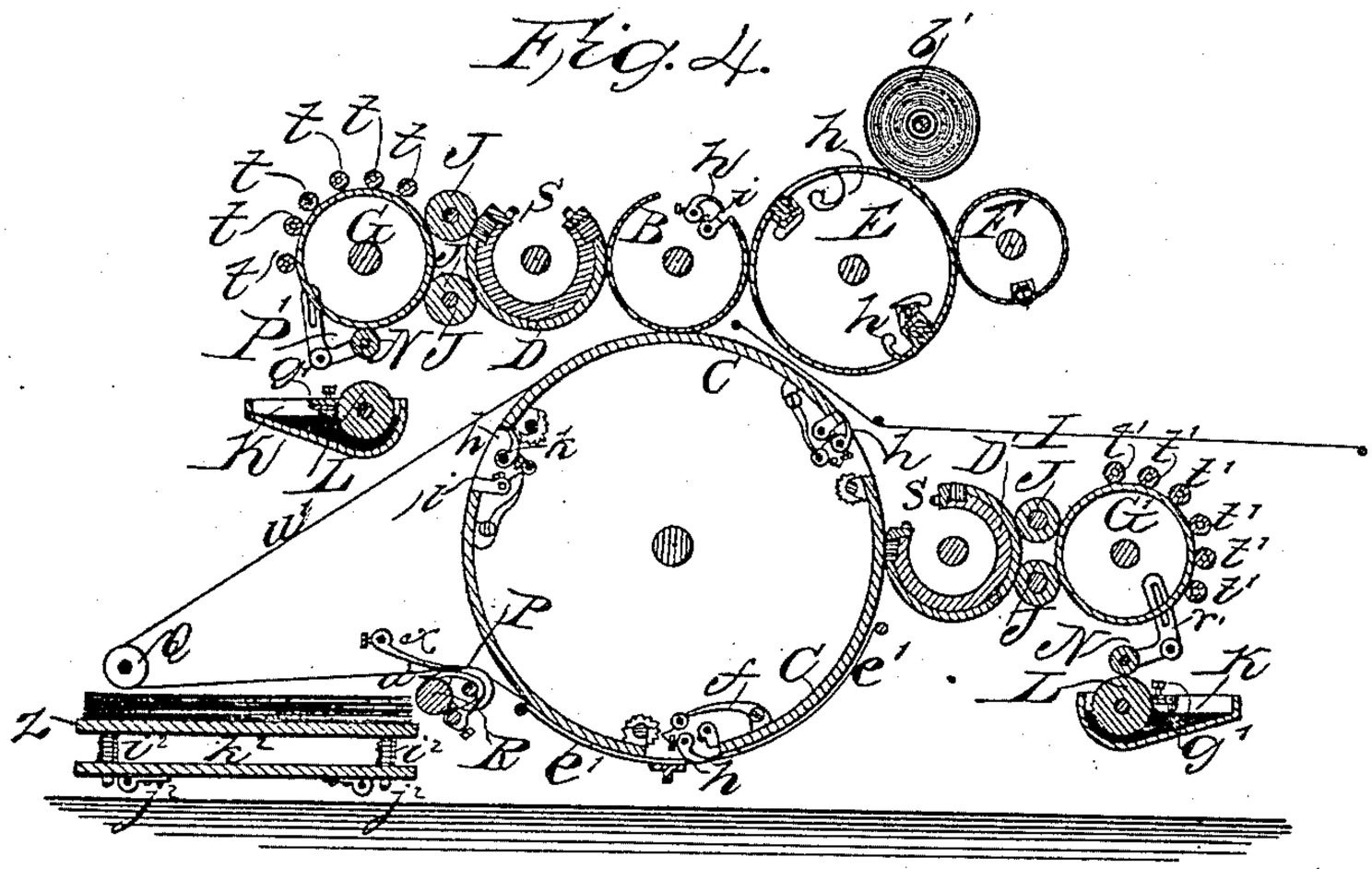
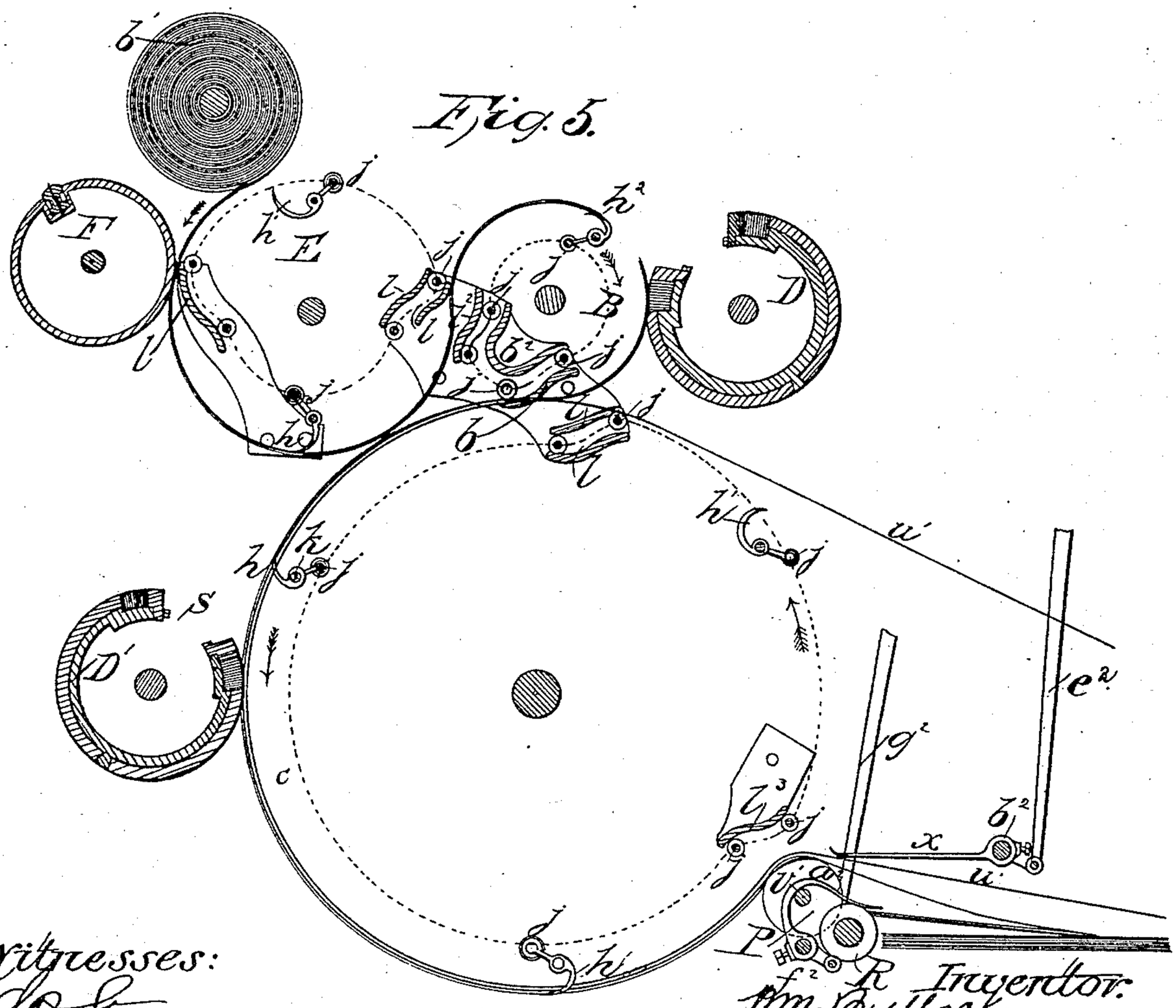


Fig. 5.



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5 Sheets—Sheet 4.

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Fig. 7.

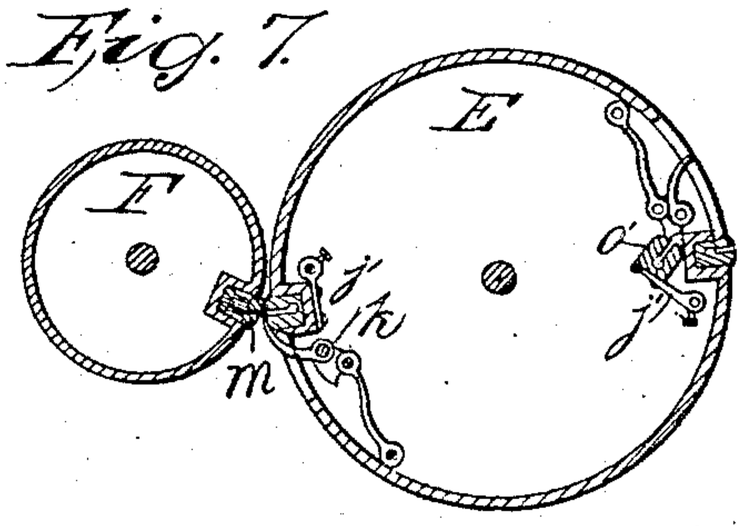

Fig. 6.

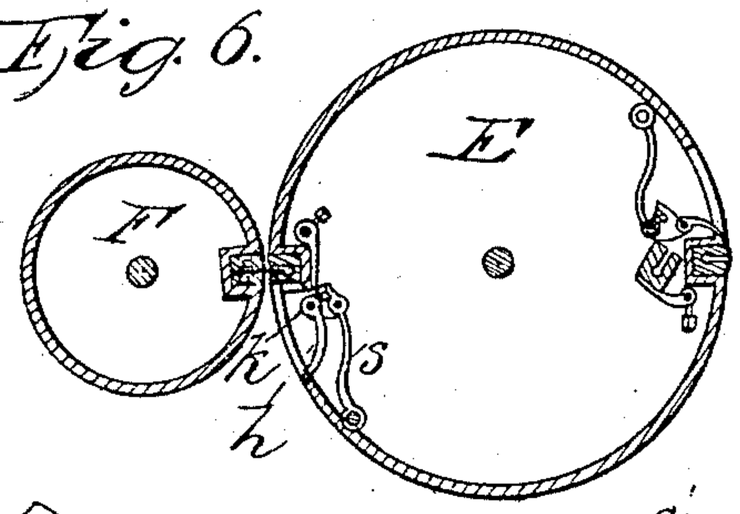

Fig. 9.

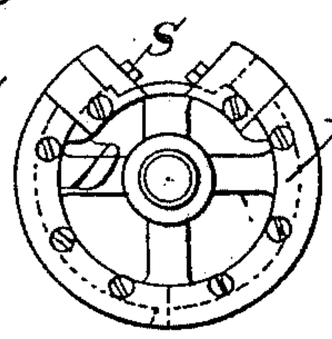

Fig. 8.

Fig. 11.

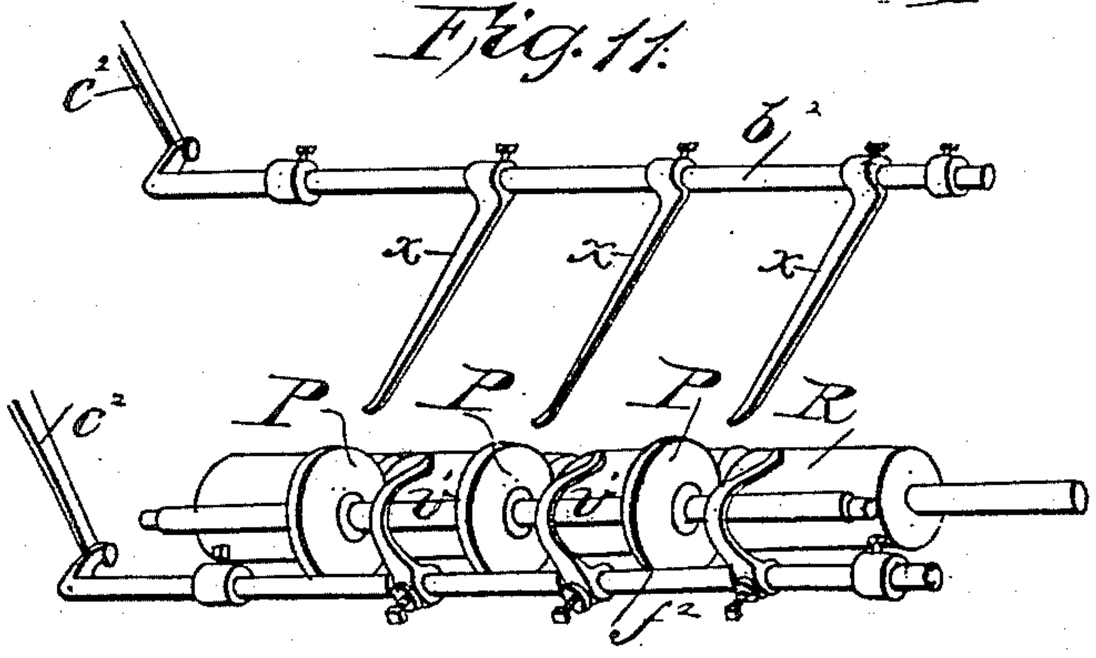

Fig. 10.

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5 Sheets—Sheet 5.

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Fig. 12.

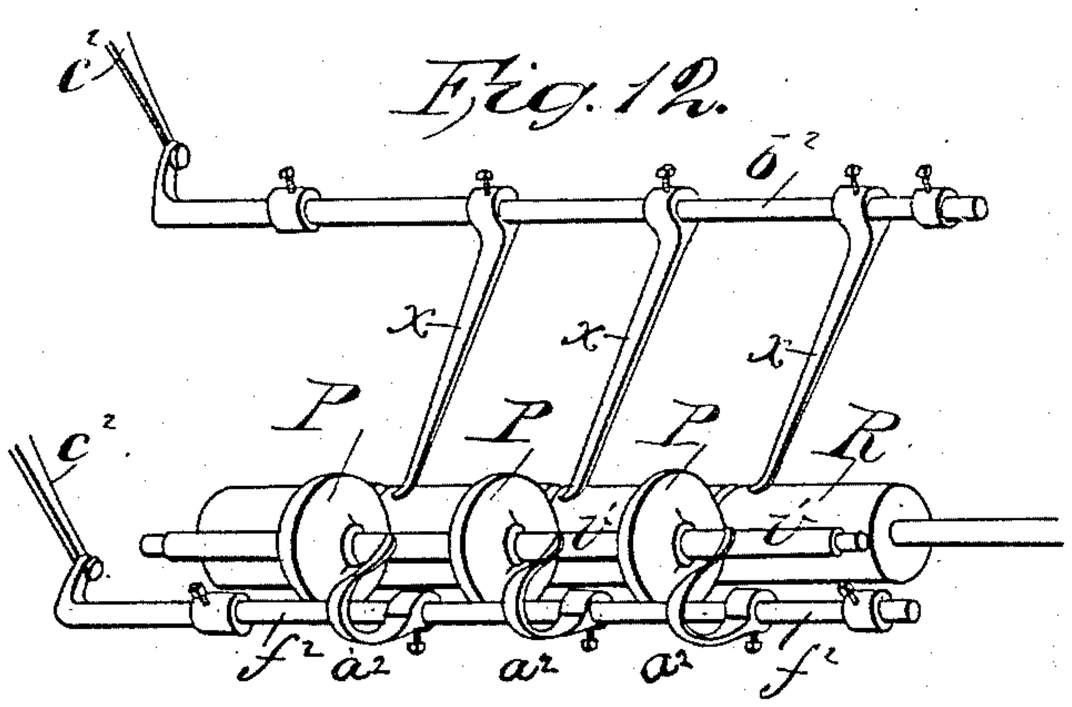


Fig. 13.

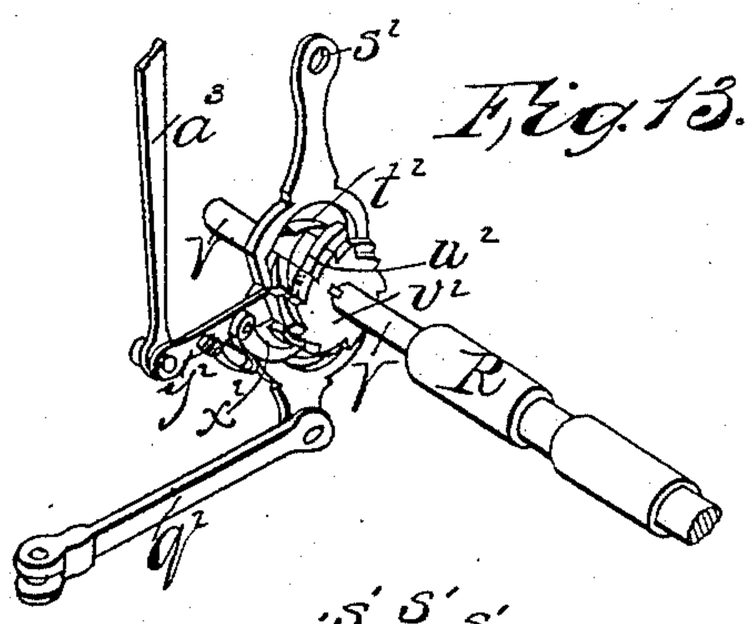
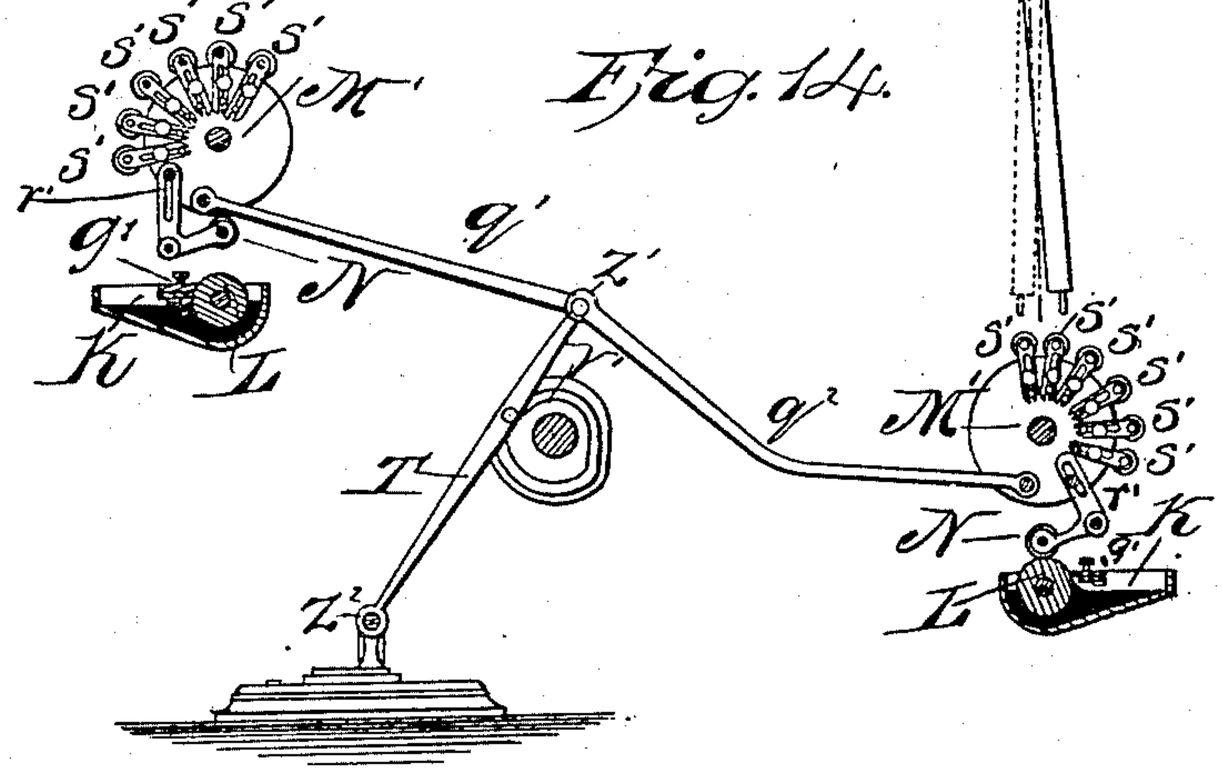


Fig. 14.



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Inventor:
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UNITED STATES PATENT OFFICE.

WILLIAM BULLOCK, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO HIMSELF, CALVIN ADAMS, AND GEO. S. SELDEN, OF SAME PLACE.

PRINTING-MACHINE.

Specification forming part of Letters Patent No. **38,200**, dated April 14, 1863.

To all whom it may concern:

Be it known that I, WILLIAM BULLOCK, of Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Printing-Machines; and I do hereby declare that the following is a full, clear, and exact description thereof.

My improved machine for printing from movable type or stereotype-plates belongs to that class of power printing-presses in which the paper is furnished to the machine in a continuous web or roll, and by which the sheets are severed from the web, printed on both sides, and delivered from the machine thus "perfected." In power printing-machines the chief objects to be attained, besides simplicity of construction and neatness and regularity of execution, are the perfecting of the sheets, or printing them on both sides, without the aid of two machines, and this by passing them once only through the press, and the attainment of the highest degree of speed in the operation. The former result—that is, the "reiteration" of the sheet on the same machine at one operation and without any intermediate manipulation—has been accomplished by the use of two or more type-cylinders and of complicated machinery for inking the forms and turning the sheet; but the rapidity of execution is necessarily limited by the speed with which the blank paper can be fed in and the printed sheets delivered from the machine, so that for want of an apparatus capable of delivering the sheets as fast as they can be printed in the most approved machines now in use where a high speed is attained the delivery is accomplished by the use of several distinct delivery apparatuses involving the employment of a number of hands. In my machine, however, there is but one delivery apparatus, which is simple in construction and works as rapidly as the machine can be driven and the sheets printed, so that by my invention the great obstacle to the rapid operation of the printing-press is successfully overcome.

In more particularly describing my invention so as to enable those skilled in the art to make and use my improved machine, I desire to refer to the drawings which accompany and form part of this specification, and which comprise fourteen figures, marked Nos. 1 to 14, consecutively, in each of which like letters of reference are employed to designate the same parts of the machine; but in Figures 1 to 4, in order to avoid confusion, several of the minor parts of the machinery are not lettered, although shown in the drawings.

Fig. 1 is a perspective representation of my improved printing machine, viewed from the front end and left-hand side thereof. Fig. 2 is a side elevation of my printing-machine from the left-hand side. Fig. 3 is a side elevation of my printing-machine from the right-hand side thereof. Fig. 4 is a longitudinal sectional elevation of my machine viewed from the right-hand side, the frame-work being left out so as to exhibit more clearly the relative position and operation of the parts. Fig. 5 is an enlarged sectional representation of the type-cylinders, showing, also, the arrangement and relative position and operation of the grippers on the cutting and impression cylinders, and the cams by which they are worked, and the relative position and operation of the delivering apparatus. Fig. 6 is a sectional representation of the cutting-cylinders in the relative position which they occupy when severing a sheet of paper from the roll. Fig. 7 is a sectional view of the small cutting-cylinder and the large cutting-cylinder, exhibiting the position of the parts immediately after a sheet of paper has been cut from the roll, and showing the manner in which the sheath of the cutter presses the loose end of the paper against the large cutting-cylinder so as to insure its being caught by the grippers as they close. Fig. 8 is a perspective representation of the upper and lower cutters detached from the cutting-cylinders. Fig. 9 is a side view of one of the type-cylinders, and Fig. 10 is a longitudinal section of Fig. 9. Fig. 11 is a perspective representation of the fly apparatus for delivering the printed sheets, with the fly-rods raised and the curved fingers for holding the sheets lowered. Fig. 12 is a similar view to Fig. 11, showing the position of the parts when the fly-rods are down and the curved fingers raised. Fig. 13 is an enlarged representation of the mechanism for shifting the delivering-table so as to separate the sheets into piles of equal number. Fig. 14 shows the mode

of communicating the intermitting vibratory motion to the transferring ink-roller and small distributing ink-rollers. Figs. 1 to 4, inclusive, are drawn to the same scale. The other figures are on a larger scale, so as to exhibit the details more clearly.

In the drawings, Figs. 1 and 2 exhibit one side of the machine, which, for the sake of distinction, I call the "left-hand" side, while Figs. 3 and 4 show the opposite or right-hand side. The end of the machine which is nearest to the eye in Fig. 1 I call the "front" or "discharging" end, being that at which the printed sheets are delivered from the press. The other end I call the "rear" or "receiving" end, being that at which is situate the paper-feeding apparatus.

In the drawing, A is the frame of the machine, which is made of iron, and has parallel sides supporting the various shafts and cylinders of the press, which are placed horizontally between them. The upper part of the frame, at the front end, is horizontal, and is raised a little above the rear end. Near to the center of the machine is situate the large impression-cylinder C, which is two or more times the diameter of the type-cylinders D D′, to which are attached the stereotype-plates, or forms of type, as the case may be.

In the drawings the large or second impression-cylinder, C, is three times the diameter of the type-cylinders D D′, and the machine therefore prints three sheets of paper at each revolution.

B is the first impression-cylinder, the diameter of which is equal to that of the first type-cylinder, D, with which it revolves in rolling contact to the face of the type or stereotype-plates fixed thereon.

G is the ink-distributing cylinder, which supplies ink to the form rollers J J, placed between it and the first type-cylinder, D. The second impression-cylinder, C, revolves in rolling contact with the face of the type or stereotype-plates on the second type cylinder, D′.

G is the ink-distributing roller, which inks the form-rollers J J of the second type-cylinder, D′. Beneath each ink-distributing roller G and G′ is an inking apparatus, consisting of an ink-fountain, K, a fountain-roller, L, and ductor-roller N.

The paper is supplied to the machine from a continuous roll, b', which rests against and is unwound by a feed-roller, E. The feed-roller E is also one of the cutting-cylinders, which, with the other cutting-cylinder, F, by means of a serrated cutter, cuts off from the web sheets of paper of the required uniform size. In front of the second or large impression-cylinder are the delivering and counting apparatuses, by which the sheets are automatically delivered from the machine as fast as printed, laid in piles, and counted. The cylinders B, C, D, D′, G, G′, and E are hollow, and their lengths and diameters vary in different machines, according to the required capacity of the press, their length determining the width of the machine. On the shaft of the second impression-cylinder, C, but outside of the frame A, is fixed a pulley, a, (see Fig. 3,) which serves as the master-wheel, to which power is communicated from the steam-engine or other prime motor, and from which all the other parts of the machine having positive motion receive their movements—some by means of a train of gearing-wheels (shown on the left-hand side of the machine in Figs. 1 and 2) and others by belts and pulleys, as seen in Fig. 3. The gearing and pulleys to communicate motion to the parts are attached to the shafts which they drive, and are placed outside of the frame.

Before explaining more minutely the construction and operation of the principal parts of the press I will describe their relative motion, and how it is derived. On the shaft of the large impression-cylinder C (at the opposite extremity from that on which is placed the pulley a) is a large cog-wheel, W, (see Figs. 1 and 2,) which gears into a small cog-wheel, w, which is fixed on the end of the first impression-cylinder, B, placed vertically over the second or large impression-cylinder, C. The cog-wheel w gears into a cog-wheel, w', at the extremity of the shaft of the first type-cylinder, D, placed in front of it. The axis of the two cylinders D and E may be in the same horizontal plane. In the rear of the large impression-cylinder C, and below the cutting-cylinders, is the second type cylinder, D′, which carries on its shaft a cog-wheel, w^4, gearing into the cog-wheel W, on the large impression-cylinder C. The small cog-wheels w, w', and w^4 are all of the same diameter, being one-third of that of the large cog-wheel W, and consequently all revolve at the same speed, or thrice as fast as the large cog-wheel W. The ink-distributing cylinders G and G′ have each a cog-wheel, w^5, which gears into an idler, x, interposed between it and cog-wheels w' and w^4, on the shaft of the type-cylinders D and D′, respectively. All the cog-wheels already described are situate in the same vertical plane. On the shaft of the first impression cylinder, B, on the right-hand side of the machine, is a cog-wheel, y, (which takes into a large toothed wheel, y', of twice the diameter of the cog-wheel y,) fixed to the end of the shaft of the large cutting-cylinder E, which causes the cutting-cylinder E to revolve once for two revolutions of the first impression-cylinder, B. This gearing is placed on the right-hand side of the machine, while the rest of the gearing is on the other side, because the large cutting-cylinder E is not quite twice the diameter of the first impression-cylinder, for the reason hereinafter explained, and the small cutting-cylinder F is one-half the diameter of the large cutting-cylinder E. At the other end of the shaft of the large cutting cylinder E, on the left-hand side of the machine, is a large toothed wheel, w^2, which gears into a small cog-wheel, w^3, (of half the diameter of the wheel w^2,) at the end

of the shaft of the small cutting cylinder F, so as to cause it to revolve twice for each revolution of the large cutting-cylinder E. The cog-wheel w^2, on the large cutting-cylinder E, does not take into the cog-wheel w on the first impression-cylinder, B. Immediately beneath the small cutting-cylinder F, at the base of the standards *c c*, which support it in the frame A, is a shaft, *d*, placed horizontally across the machine, and turning freely in bearings in the standards *c c*. Near to each end of the shaft *d*, and rigidly attached to it, are two arms, *e e*, which are curved upward and forward over the small cutting-cylinder F, as seen in Fig. 3. In a slot in an extremity of each of the arms *e e* is placed the axis of the wooden spool *b*, around which is wound the roll of printing-paper *b'*, which is to be fed into the machine. The spool *b* turns freely on the rod which forms its shaft or axis, the ends of which also turn in slotted bearings at the extremitiy of the arms *e e*, so that there shall be no obstruction to the free unwinding of the paper. As the extremity of the arms *e e*, carrying the spool of paper *b'*, when in the position shown in Fig. 3, extend considerably forward of the shaft *d*, to which they are attached, the spool of paper will rest against the surface of the large cutting-cylinder E, which serves as a feed-roller, and thus prevents the spool unwinding more rapidly than it is caused to do by the rotation of the cylinder E, over which it passes, the paper being wound on its spool in one continuous web or sheet. If the roll of paper is large and heavy, its weight, pressing against the large cutting-cylinder E, which operates as a feed-roller, would be greater than necessary to secure the requisite degree of pressure to keep the paper tight as it is unwound from the spool, and the consequence will be that the paper will unwind on as well as off the spool, and thus become loose around it. The arrangement hereinbefore described of attaching the arms *e e*, which carry the spool of paper *b'* to the shaft *d*, below and only a little in the rear of the cylinder E, on which the spool rests, not only relieves the cylinder E of much of the weight of the roll of paper, but also performs the very important purpose of preserving a uniform degree of pressure as the roll of paper diminishes in size and weight. It is obvious that the more the axis of the spool of paper is inclined from a vertical position to the shaft *d* the greater will be the proportion of its weight borne by the cutting-cylinder E and the less by the shaft *d*. As the paper is unwound from the roll its diameter is gradually diminished and its weight is proportionally reduced, and, as it is leaning against the cutting-cylinder E, the angle of inclination from a vertical position is increased as the axis of the spool approaches nearer to the periphery of the cutting-cylinder. Thus, although the actual weight of the roll of paper is gradually diminished, the proportionate amount of the weight borne by the cylinder is gradually increased, so that the actual pressure on the cylinder remains very nearly if not quite the same when the spool is full as when it is nearly empty. If, therefore, such a degree of pressure of the spool of paper against the large cutting-cylinder or feed-roller E as will cause it to feed regularly, without loosening the paper on the spool, is secured when the spool is placed on the machine, it will thereafter require no further adjustment. To effect this adjustment I extend from the shaft *d* a lever, *f*, which is rigidly attached thereto. On this lever or arm *f* is a weight, *g*, which may be slid backward and forward and fastened at any desired point on the lever *f*. The weight *g* thus serves as a counter-balance to the roll of paper, and by it the pressure of the roll of paper on the feed-roller or cylinder E may be so adjusted as that it will unwind from the spool by the motion of its feed-roller at each revolution thereof a length of paper exactly equal to the periphery of the feed-roller or large cutting-cylinder E, without loosening the paper remaining on the spool.

The size of the separate sheets of paper printed on the machine is regulated by the periphery of the larger cutting-cylinder E, which serves as a feed-roller, as just stated, and which, in the machine shown in the drawings, severs from the web two sheets of equal size at each revolution. As the periphery of the first impression-cylinder, B, is more than half that of the large cutting-cylinder E, each sheet does not entirely surround the first impression-cylinder, B, the difference being equal to the space desired to be left between the edge of the several sheets in their passage through the machine. The paper, being thus fed in by the positive motion of the large cutting-cylinder E, passes downward in the direction of the arrow in Fig. 5, lying close to the surface of the cylinder E until it is severed by the blade of the cutter in the small cutting-cylinder F, as hereinafter described, when the loose end of the web from which a sheet has been cut is immediately seized by the grippers or curved fingers *h h* in the large cutting-cylinder E, by which it is held until it is severed from the web, when it reaches the first impression-cylinder, B, the grippers on which seize it and carry it forward. On the large cutting-cylinder E, whose diameter is twice that of the small cutting-cylinder F, and the periphery of which is equal in length to two sheets of paper to be printed on the machine, there are two sets of grippers, *h*, which are placed diametrically opposite to each other, and the construction and operation of which will be presently described. The large cutting-cylinder E has also two sets of female cutters, also placed diametrically opposite to each other, and in such relative position to the grippers *h* that when the grippers are closed they pass over the female cutter, holding fast the forward end of the paper which is being fed into the machine, and from which a sheet has been severed. The female

cutters are set in such position that in the revolution of the machine each will in turn coincide with the male cutter on the small cutting-cylinder F, to sever a sheet; and the two sets of grippers are so placed, relatively to the grippers on the first impression-cylinder, B, that they will each in turn coincide with the single set of grippers on the first impression-cylinder, B. As the large cutting-cylinder E revolves with the roll of paper resting against it, it unwinds the paper onto itself, which, passing down between the two cutting-cylinders E and F, is cut off when the length of a single sheet has passed between them; then immediately the grippers in front of the female cutter seize the forward end of the paper, carrying it round until they reach the grippers on the first impression-cylinder, B, which seize the sheet just as the grippers on the cutting-cylinder E release it, and carry the sheet away to be printed by the first type-cylinder, D. As the paper is seized by the grippers on the first impression-cylinder, B, it is severed from the web between the cutters, as before described. Grippers, similar to those in the upper cutting-cylinder, E, are used also in the two impression-cylinders B and C for the purpose of seizing the paper at the right time and carrying it forward through the machine, and in each case are similarly constructed. They are rigidly attached at intervals to rods *k*, which are placed horizontally below the surface of the hollow cylinders B, C, and E. Their construction and arrangement is shown in Fig. 6. The surface of the cylinders is intermitted where they occur, to allow them to retire inside the cylinder. The extremity of each of the grippers rests on a pad, *i*, (see Fig. 4,) so as to hold the paper firmly. The gripper-rod has a crank at one end, projecting from the end of the cylinder, on which crank is a small roller, *j*, (see Fig. 5,) which, as the cylinder revolves, works between cam-guides *l*, attached to the frame of the machine, thus opening or closing the grippers at the right point of time. A spring, *s*, has on its free end a small roller, which enters a groove in a shoulder or projection on the gripper-shaft in each set, and serves to retain the grippers open or closed until moved by the cam and crank.

Fig. 5 serves to illustrate the operation of the grippers on the cylinders B, C, and E, as effected by the cam-guides, the arrows indicating the direction in which these cylinders revolve, the dotted lines the path of the roller at the end of the crank of each of the gripper-rods, and the blue lines the sheets of paper as they are seized, held, and carried round by the grippers.

In Fig. 5 each of the grippers marked h h^2 is closed, and has hold of a sheet of paper, and the grippers h' are open, having released the paper. The grippers h' on the large cutting-cylinder E (see Fig. 5) close, and seize the loose end of the paper at the moment when the cam-roller *j* has passed between the cam-guides *l l*, and hold it, carrying it round until the edge of the paper held by the grippers h' comes within reach of the grippers h^2 on the first impression-cylinder, B, which takes place when the cam-roller *j* on the gripper h^2 passes through the cam-guides l^2, at which moment the grippers on the upper cutting-cylinder release the paper, and those on the first impression-cylinder seize it, carrying it round, as shown in Fig. 5, in front of, and in rolling contact with, the first type-cylinder, D, by which the sheet is printed in white, or on one side only. So soon as the length of paper drawn forward by the cylinders E and B is equal to the required length of sheet, it is severed from the roll by the cutters in the cutting-cylinders E and F. One of the cutting-cylinders, it matters not which, carries a steel blade, *m*, (see Figs. 7 and 8,) which has serrated edges, and which is fastened to a back plate, *n*. Parallel to the back plate, and attached thereto by pins *p* and springs *q*, is a face-plate, *r*, composed of two strips, which slide up and down on the pins *p p* on either side of the serrated cutter, and which, when raised by the springs *q q*, inclose the edge of the cutter between them. The steel blade, with its shield or face-plate, is set in either of the cutting-cylinders, (in the drawings it is placed in the small cylinder F,) so that the edge of the cutter shall project beyond the periphery of the cutting-cylinder and enter a grooved plate, *t*, set in the other cutting-cylinder in a proper relative position to the blade of the cutter. On either side of the groove in the plate *t* is a strip of india-rubber cloth, *u*, or other similar substance, between which and the face-plate, on either side of the cutter *m*, the paper may be held while the cutter enters it to sever the sheet. When, in the revolution of the cutting-cylinders, the sheath or face-plate of the cutter *m* comes in contact with the projecting india-rubber strips on the opposite cylinder, the sheath or face-plate *r* is depressed into the groove of the cutting-cylinder, and the teeth of the cutter enter the paper far enough to sever so much of the piece of paper as has passed between the cutting-cylinders from the web behind it, the paper being held so firmly by the india-rubber strips *u u* as to prevent its being forced up into the slot, instead of being cut, as might otherwise be the case. Another and very important function of the sheath or face-plate *r* in the cylinder carrying the male cutter, when, as in my machine, one of the cutting-cylinders performs the work of a "layer-on"—that is, carries the sheet of paper forward and delivers it to the impression cylinder to be printed—is that of pressing the loose end of the paper against the large cutting-cylinder or feed-roller E, so as to insure its being caught by the grippers as they close. This operation is exhibited in Fig. 7. As the piece of paper which is being unwound from the web or spool b' passes down in contact with the face of the large cutting-cylinder E, by its revolution it passes between

the cutting-cylinders E and F an unbroken sheet, until the male cutter comes in contact with the female cutter, as in Fig. 6. The paper is then cut, and the end of the paper from which the sheet has been severed would hang down perpendicularly, away from the face of the cylinder E, so that as the grippers *h* close immediately after the sheet is severed they would strike under and not over the edge of the paper, and thus fail to seize it, were it not pressed toward the large cutting-cylinder E. As the male cutting apparatus passes round after severing the sheet, the sheath-pieces *r* are pressed outward by the springs *q q*, as before described, and in so doing the upper one of them presses the loose end of the sheet from the small cutting-cylinder F toward the face of the large cutting-cylinder E just as the grippers *h* are closing, and thus they effectually prevent the sheet escaping the grippers, as it otherwise would do. The grippers or curved fingers *h* in the impression-cylinders C and B, and in the large cutting-cylinder E, although they are set on rods placed within the periphery of their respective cylinders, yet in opening and closing their points describe an arc of a circle outside of the circumference of the cylinders; and as these grippers *h* in the impression-cylinders B and C operate at the point where the peripheries of those cylinders almost touch each other, they are not placed exactly in juxtaposition, but each gripper a little to one side of the corresponding gripper in the other cylinder, and openings are left in each of the cylinders C and B to allow the grippers to pass. In the case of the large cutting-cylinder E, however, the grippers *h*, in the first impression-cylinder, B, operate when exactly opposite to the female cutting apparatus or grooved plate *t*, and as it is necessary that this grooved plate *t* should extend uninterruptedly across the face of the large cutting-cylinder E, parallel to its axis, so that the paper may be cut entirely across, it is necessary to make special provision for the passage outward of the grippers *h* in the first impression-cylinder, B, when seizing the sheet from the large cutting-cylinder E. This I accomplish by making the grooved plate *t* in sections, as seen in Fig. 8, and inserting two small sections, *o' o'*, opposite to the point where the grippers *h* in the first impression-cylinder are situate. These small sections *o' o'* of the grooved plate *t* are attached to a rod or shaft, *z*, extending across and inside of the large cutting-cylinder E, parallel to its axis, by means of short arms *j' j'*. These small sections *o' o'* are a little wider than the fingers *h* in the first impression-cylinder, B, so that when the rod *z* is turned they recede and leave an opening in the face of the cylinder E and through the grooved plate *t*, to allow of the opening and closing of the grippers *h* in the first impression-cylinder, B. The sections *o' o'* have india-rubber pads on either side of the groove or slot, into which the cutter-blade *m* enters, and, when in place, form, with the pieces *t t*, a continuous strip, groove, and pad. The rod *z*, which causes the sections *o' o'* to recede and rise again, is operated simultaneously with the grippers *h* in the large cutting-cylinder E by motion communicated from the gripper-rod *k*, which is worked, as before stated, by a crank passing between cam-guides *l*. This simultaneous motion is effected by a cam, *v*, which, when the grippers in the large cutting-cylinder E are thrown open, (as they always are when the paper is being severed by the cutters, see Fig. 6), presses up against a short lever, *a'*, at the end of the rod *z*, and turn it so as to force the sections *o'* up into place between the strips *t t*, but when the grippers *h* close the cam *v* drops down, releases the short lever *a'*, and allows the spring *c'*, which presses down the lever *a'*, to turn the rod *z* so as to cause the sections *o' o'* to recede into the cylinder E, as before stated. The points of the grippers *h* in the large impression-cylinder rest, when closed, on the face of the india-rubber strips *u* on the face of the grooved plate *t*, which performs the same office of giving the grippers a good hold on the paper as does the pad *i* in the impression-cylinder. In case the grippers on the cutting-cylinder E should fail to seize hold of the paper by any accident, the paper, instead of being carried to the first impression-cylinder, B, will pass between the cutting-cylinders downward and fall on the apron or blanket I, placed under the cutting-cylinders E and F, and above the second type-cylinder, D', and its inking apparatus, and when severed by the cutters will drop down and be out of the way. The same thing will occur in case of any break in the paper—the scrap will thus pass off, instead of going through and perhaps clogging up the machine. The type-cylinders D and D', which are of equal diameter and similar construction, are adapted either for movable type or stereotype-plates, or for a combination of both, as shown in the drawings. (See Figs. 9 and 10.) The space or depression S in the circumference of the type-cylinders occurs at the point which will come opposite to the grippers in the impression-cylinders B and C, with which they revolve in rolling contact, which gives free space for the grippers to pass, as they always project slightly from the face of the cylinder. When the sheet of paper thus severed from the roll has been carried by the first impression-cylinder, B, in front of the first type-cylinder, D, and been printed in white, it is carried round, in the direction indicated by the arrow on the cylinder B in Fig. 5 until it reaches the second impression-cylinder, C, which is placed immediately below the first impression-cylinder, B, and very nearly touches it. This second impression-cylinder is similar in construction to the first, except that it is larger, being two, three, or more times the diameter of the other, as may be desired. The size of this second impression-cylinder determines the capacity of the machine, which will

print on both sides, at each revolution of this cylinder, as many sheets as the second contains diameters of the first impression-cylinder. In the drawings the second impression-cylinder is three times the size of the first, and is calculated to receive and print at one revolution three sheets of paper. The principal object of this increased size of the second impression-cylinder is to reduce the liability to set-off of the ink from the printed sheet to the impression-surface of the cylinder, and from the cylinder back to the printed sheet. The impression-cylinders B and C are hollow, and their surface is covered with felt or other blankets in the usual way, the first impression-cylinder, B, having only one blanket, and the second impression-cylinder, C, having three—that is, one for each impression-surface. The sheet of paper, having been printed in white on the first impression-cylinder, B, by the type or stereotype-plates of the first type-cylinder, D, as before described, is carried round to the second impression-cylinder to receive reiteration. There are three sets of grippers, h, h^2, h', on the second impression-cylinder, C, placed at equal distances apart, and in such relative situation to the grippers h^2 on the first impression-cylinder, B, that on each revolution of the first cylinder, B, its grippers come exactly opposite to one set of grippers in the second cylinder, C, so that, as the cylinders B and C run in the direction indicated by the arrow in Fig. 5, the gripper h^2 on the cylinder B will release the sheet of paper just as the grippers h^2 on the cylinder C seize hold of it. The sheet, thus held, is carried forward by the second impression-cylinder, C, as shown in Fig. 5, so as to pass in contact with the second revolving type-cylinder, D′, which prints it on the other side. As the circumference of the first impression-cylinder, B, is exactly contained a certain number of times in the large impression-cylinder C, it is obvious that each sheet of paper delivered to the large cylinder C is received by a different set of grippers and lies on a different portion of the surface of that cylinder to its predecessor, and therefore the blankets on the large cylinder are less frequently used, and are less exposed to set-off than they would be if the two impression-cylinders were of equal size. The sheets thus printed on both sides pass round under the large impression-cylinder, as seen in Fig. 5, to the delivering-apparatus at the front end of the machine. As the sheets are held in front by the grippers and are pressed close to the second impression-cylinder by the type-cylinder, and the motion of the impression-cylinder C is very rapid, there is little probability of the rear or loose end of the sheet falling down; but, to prevent this, an apron composed of a number of curved strips of iron, e', (see Fig. 4,) is placed near to and parallel with the under side of the large impression-cylinder C, which serves to guard the sheet and prevent its wrinkling as it passes underneath the second impression-cylinder, C.

Before describing the apparatus used for delivering and counting the printed sheets, I will explain the construction and operation of the inking apparatus. Connected with each of the type-cylinders D and D′ is a separate inking apparatus placed in front of the first type-cylinder, D, and in the rear of the second type-cylinder, D′. As these inking apparatuses are alike in construction and similarly connected with their respective type cylinders, a description of one set will suffice, the other set being marked with the same letters in the drawings. At the distance of a few inches from the type-cylinder D or D′, and diametrically opposite to its impression-cylinder B or C, is the ink-distributing cylinder G, which may be of the same diameter as the type-cylinder, and moves in the same direction and with like velocity, having a toothed wheel, w^5, on its shaft, of similar size and number of cogs as the cog-wheel w^4 on the type-cylinder, an idler, x, being placed between them to communicate motion from one to the other. Between the type-cylinder D and the ink-distributing-cylinder G are two form-rollers, J J, which have no positive motion of their own, but revolve on their axes by rolling contact with the type-cylinder D and ink-distributer G. These form-rollers ink the type as the type-cylinder revolves in contact with them. The degree of pressure of these rollers against the face of the type is regulated by bringing their bearings nearer together on the standards f' by screws or otherwise, and thus pressing them more closely against the cylinders D and G. Beneath the ink-distributer is the ink-fountain K, containing the printing-ink, and partially immersed therein is a cylindrical fountain roller or ductor, L, of the same length as the ink distributer G. A scraper, g', (see Figs. 1 and 4,) attached to the sides of the ink-fountain K, extends parallel to the ductor, in contact with it throughout its entire length, so as to scrape off the superfluous ink which attaches to the ductor as it revolves in the ink-fountain. The ductor is revolved by means of a cord passed around a pulley, k', (see Fig. 1,) placed at the end of the shaft of the ink-distributing cylinder G, on the right-hand side of the machine, so as not to interfere with the gearing on the other side, and thence around a pulley, n', on a short shaft, p', which carries a small pinion, i', (see Fig. 3,) gearing into a cog-wheel, m', at one end of the ductor-roller L. Thus the motion of the ink-distributing cylinder G gives a much slower motion to the ductor-roller, the relative degree of which may be changed by altering the position of the cord on the cone-pulleys n' and k', which have two or more grooves of different diameters. Between the ink-distributing cylinder G and ductor L is interposed a transferring ink-roller, N, which is a cylinder of small diameter and the same length as the ductor L and distributing cylinder G, and which has its bearings at the extremity of the short arms r' r', one on

each side of the machine. On the right hand of the machine the arm r' is bent at right angles, the center of motion being in the angle, the long arm projecting upward against the face of the disk M′ and pivoted to it, as seen in Fig. 14, so as to be vibrated by the motion of the disk M′, as hereinafter explained. This transferring-roller N vibrates between the ink-distributing cylinder and ductor at each revolution of the large impression-cylinder, being in contact with the ductor L during about one-half of the revolution, and with the ink-distributer G during the other half-revolution, as seen in Fig. 4, where the transferring-roller N is in one position in the inking apparatus at one end of the machine and in the other position at the other end. In order to spread the ink more finely and evenly over the surface of the ink-distributing cylinder G, a number of small distributing-rollers, t' t', are arranged longitudinally over the upper part of the distributing cylinder, parallel to, but not touching, each other. These small distributing-rollers have a lateral play of an inch or two, as well as a revolving motion on their axes, and are therefore not quite so long as the ink-distributing cylinder, so that they may move to and fro in the direction of their axes. The shafts of these small rollers have their journals in standards s' s', projecting from two disks, M M′, one at each end of the distributing-cylinder G. Through the center of these disks passes the shaft of the distributing-cylinder G, but the disks do not revolve with it—one of them, M, on the left-hand side of the machine, being fixed and stationary, and the other, M′, on the right-hand side, being loose, so as to allow of a partial revolution on its axis. The standards s' s', &c., forming the bearings for the journals of these small distributing-rollers, are attached to these disks M and M′ by screws, so that they can be raised or lowered to regulate the pressure of the rollers t' t' on the distributing-cylinder G. The purpose of giving one of the disks, M′ on each ink-distributing cylinder a slight motion on its axis is to shift the shafts of the rollers t' out of parallelism to the axis of the cylinder, so as to give them an inclination first in one direction and then in the other, but all the time keeping the surface of the rollers t' t', &c., in contact with that of the distributing-cylinder G, which produces the effect of causing them to move sidewise to and fro along the ink-distributing cylinder, while they are revolving on their axes. This motion of the two disks M′ on the right-hand side of the machine, which produces the longitudinal vibration of the small distributing-rollers t' and transferring-roller N, is effected by means of the rods q' and q^2, the former of which, q', is pivoted to the moving disk M′ at the front end of the machine, and the latter, q^2, is pivoted to the moving disk M′, at the rear end of the machine, the rod q^2 being curved so as to avoid the second type-cylinder, D′. These rods q' q^2 are connected at z' to the free end of the lever-arm T, which is pivoted at z^2 to the frame of the machine. On the lever-arm T is a projecting pin or roller, which enters an eccentric slotted cam, V′, on the axis of the pulley a on the second impression-cylinder, C, so that on every revolution of the cylinder C the lever-arm T and the rods q' q^2 are moved backward and forward, and communicate their motion to the disks M′ M′. Around the second impression-cylinder, C, there are placed several endless tapes, u' u', which pass over (but not around) a series of disks, P, on a horizontal shaft, v', placed in front of the second impression-cylinder, C, and a little above its lowest point, and thence pass around a series of pulleys, Q, by which they are kept tightly stretched, so as to press upon the periphery of the disks P. As the printed sheets of paper on the second impression-cylinder, C, are outside of the tapes, and are brought round under the cylinder C to the point where the tapes leave the cylinder C and pass over the disks P, they are carried by tapes away from the impression-cylinder C, over the disks, P and under the tapes, as seen in Fig. 5, the cam-guide l^3 being so situate and adjusted as to open the grippers and release the forward end of the sheet of paper just at the point where the tapes u' u' leave the circumference of the cylinder C. Immediately in front of the tape-disks P is a horizontal delivering-roller, R, which has an intermitting rotary motion communicated to it by the mechanism for separating the sheets into piles, as hereinafter described. The grippers having released the paper, and the forward edge of it having passed on to the disks P, it is carried forward between the tapes u' and disks P until the rear end drops onto the surface of the delivering-roller R, being struck down by the points of the fly-rods X, as in Fig. 12. Just as the fly-rods X strike down the rear end of the sheet, the curved fingers a^2 rise up over the edge of the sheet held down by the fly-rods, and, as the fly-rods rise immediately, the curved fingers fall on the sheet, holding it down to the surface of the delivering-roller. This operation is repeated every time the rear edge of a sheet of paper comes within reach of the ends of the fly-rods. The intermitting rotation of the delivering-roller R prevents the accumulation of sheets of paper thereon, and drops them down on the delivering-table Z at the front end of the machine, the tapes u', which are extended over this table, keeping the sheets smooth and even. The fly-rods X are much shorter than those ordinarily used in printing-machines, and as they are only required to strike down the sheets as they pass under their points, and hold them down while the curved fingers rise and fall again over the edge of the sheets, the stroke of the fly may be very short and rapid. The fly-rods are rigidly attached to the horizontal fly-shaft d^2, (see Figs. 11 and 12,) and are so situate that the tips of the rods can strike the periphery of the delivering-roller R, as in Fig. 12. One

end of the fly-rod shaft b^2 has a short crank pivoted to a connecting-rod, c^2, the upper extremity of which is pivoted to an arm, d^2, (see Fig. 3,) from which projects a pin into a slotted eccentric cam, e^2, attached to the extremity of the shaft of the ink-distributing cylinder G, the slotted cam e^2 being so shaped as to leave the fly-rods raised up from the delivering-roller, as seen in Fig. 11, during the entire revolution of the ink-distributing cylinder, excepting for a moment, when they are suddenly struck down to the position shown in Fig. 12, and then as suddenly raised again. The curved fingers a^2 are made of steel, their points being elastic and turning up slightly, so as to press on the paper and hold it firmly without tearing it. They are rigidly attached to the finger-shaft f^2, placed horizontally across the machine under the disk-shaft v', which carries the tape-disks P, but so that the curved fingers pass from the rear of the shaft of the tape-disks over it, and press on the delivering-roller R in front of it, as seen in Fig. 5. The curved fingers are connected with and attached to the slotted eccentric-cam e^2 by a connecting-rod, g^2, and arm h^2, in like manner as the fly-rods are, but the pins on arms d^2 and h^2, which unite in the slotted cam e^2, are so relatively situate that the fly-rods strike down just as the curved fingers rise, and rise just as the curved fingers fall, so that during the remainder of the revolution of the slotted cam e^2 the curved fingers are pressed down and the fly-rods are elevated, as in Fig. 11. Fig. 12 shows the position of these parts just as the rear end of a sheet of paper has left the tape-disks. It is only the rear end of the sheet of paper that is acted upon by the fly-rods and curved fingers, and that just as it is about to leave the machine, which is one reason why, by this apparatus, they can be delivered so rapidly. As the fly-rods and fingers are operated once on every revolution of the ink-distributing cylinder, which revolves exactly three times as fast as the large impression-cylinder C, the three sheets printed on every revolution of the cylinder C are thereby passed out of the machine and piled rapidly on the table Z. The delivering-table Z is placed at the front end of the machine, near the ground and under the tapes w'. It is supported at the four corners on spiral springs i^2, resting on a base board, k^2. (See Figs. 2 and 3.) It is connected with a mechanism by which the table is shifted first to one side and then to the other, at regular intervals, remaining at rest between each shift, so that the printed sheets are laid in piles of any required number, each alternate pile overlapping the edge of the other an inch or two, as seen in Fig. 1, thus counting and separating the sheets mechanically. The base board k^2 of the delivering-table is supported by two transverse rods, j^2 j^2, (see Fig. 4,) on which it slides sidewise. Attached to the frame, on a level with the base-board, is a bent lever, m^2, having its turning-point at n^2. (See Fig. 1.) To one arm of this lever m^2 the base-board of the table Z is connected by a rod, p^2, and the other arm of the lever m^2 is connected by a rod, q^2, with the lower extremity of a cam-yoke, r^2. This cam-yoke is pivoted to the frame at s^2. Inside of the cam-yoke r^2, and attached to the projecting extremity of the shaft or axis V of the delivering-roller R, revolves a cam, t^2, with one projection or operating-point, which, when the cam completes each half-revolution, pushes the cam-yoke to one side, and on completing the next half revolution pushes the cam-yoke back again. This alternating motion of the cam-yoke, acting through the lever m^2, slides the base-board k^2 and table Z sidewise suddenly to and fro, with a period of rest between each sidewise motion, the length of this period of rest determining the number of sheets which will be delivered on each separate pile before the table is shifted and a new pile commenced. On the left side of the machine the shaft of the delivering-roller R projects beyond the frame A, and on it, alongside of the cam t^2, are placed two ratchet-wheels, u^2 and v^2, the former of which, u^2, is loose on its axis and turns without revolving the shaft, while the latter, v^2, is rigidly attached to its shaft and causes it to revolve when it is turned. Each ratchet-wheel has ten teeth. The diameter of the loose ratchet-wheel u^2 is greater than that of the tight ratchet-wheel v^2, while the depth of teeth in each is the same, excepting that one only of the ratchet-teeth in the loose wheel u^2 is cut so deep as to cause the pawl x^2, working in the teeth in the loose wheel, u^2, and extending over the tight ratchet-wheel v^2, to sink deep enough to take into whichever of the teeth of the tight ratchet-wheel v^2 may be in range therewith. Thus, when the pawl x^2 has turned the loose ratchet-wheel u^2 one complete revolution, it will have turned the tight ratchet-wheel v^2 one tooth, and with it the shaft of the delivering roller R one-tenth of a revolution. This contrivance is shown in Fig. 13, where it will be seen that the pawl x^2 enters the teeth in the ratchet-wheel u^2, but does not reach the teeth in the ratchet-wheel v^2, but that at one point on the wheel u^2 there is a tooth cut deeper than the rest, which allows the pawl x^2 to reach them. The arm y^2 carries the pawl x^2, and is pivoted to the connecting-rod a^3, the other extremity of which is attached to a pin on the cog-wheel w^5 on the first ink-distributing cylinder, G, so that on each revolution of the ink-distributing cylinder the connecting-rod a^3 and arm y^2 rise and fall, causing the pawl x^2 to turn the loose ratchet-wheel u^2 one tooth and as the ink-distributing cylinder revolves once for each sheet printed on the machine, the ratchet-wheel u^2 will revolve once, and the ratchet-wheel v^2 will advance one tooth, when ten papers are printed and delivered, and the ratchet-wheel v^2 and cam t^2 will complete a revolution when one hundred papers are printed and delivered; but, as the cam t^2 moves the delivering-table Z to one

side on each half-revolution which it makes, it will do so every time that fifty sheets are printed and delivered. As all the main cylinders in the machine, excepting the second impression-cylinder, C, and the feed-roller E and delivering-roller R, make one complete revolution for every sheet printed and delivered, it is obvious that a counting apparatus may be easily attached to any of these wheels.

My printing-machine,, constructed as described, may be safely run at a speed of six thousand revolutions per hour, and where the second impression-cylinder is three times the diameter of the type cylinders (as in the drawings) will print on both sides, deliver, and count eighteen thousand sheets of newspapers or other printed matter in an hour, and this without other attention than is necessary to supply a fresh roll when the paper is expended, and to remove the piles of printed paper from the delivering-table, which is an amount of work with only one feeding and delivering apparatus far exceeding anything which has hitherto been accomplished in the history of printing machines.

Having thus described my improvements in letter-printing machines and the mode of carrying the same into effect, what I consider to be new therein, and claim as my invention, and desire to secure by Letters Patent, is—

1. The feeding of the paper into the printing-machine from a continuous roll or web by means of a feed-roller revolving in contact with the paper-roll, which rests against it.

2. Hanging the shaft of the spool or axis of the roll of paper in bearings at one extremity of two arms, which are rigidly attached at their other extremity to a shaft, which is left free to turn on its axis in a fixed bearing, whereby the roll of paper is kept in an accurately horizontal position at right angles to the path of the paper through the machine.

3. Placing the bearings of the arms which carry the spool of paper below, but not directly under, the feed-roller, so that, being slightly inclined toward the feed-roller, the roll of paper will press with a portion only of its weight thereon, in order that the angle of inclination may be gradually increased by the diminution in size of the roll of paper as it is unwound from the spool, and thus, although its weight is continually decreasing, the relative degree of pressure on the feed-roller may be correspondingly increased, and thereby a uniform actual pressure be maintained.

4. The use of a counterpoise so connected with the shaft and arms which carry the spool of paper as that, by adjusting the counterpoise, the degree of pressure on the feed-roller of the roll of paper can be so regulated as to cause the paper to unwind onto the feed-roller without the roll of paper on the spool becoming loosened, as it would do were the whole or too great a proportion of the weight of a large roll of paper allowed to press upon the feed-roller.

5. Combining in one the feed-roller and one of the cutting-cylinders, substantially as hereinbefore described.

6. The use of grippers or other equivalent device for seizing the sheets of paper on the feed-roller, and thereby causing it to carry the sheets of paper directly to the first impression-cylinder, substantially as described.

7. Transferring the sheets of paper from a feed-roller, moving at a slower speed, to the impression-cylinder, or that device which carries the sheets forward from the cutters to the type-cylinder, moving at a higher speed, by means of a pair of grippers on the feed-roller and on the impression-cylinder, without the use of tapes or other similar device for that purpose, and thus leaving a space between the sheets of paper as they pass through the machine, without checking or intermitting the feed.

8. The use of a set of grippers on one of the cutting-cylinders, which are opened and closed by a stationary cam, or other equivalent device, by means of which such cutting-cylinder also performs the work of a "layer on," seizing the end of the paper before it is severed from the web, and carrying it round to the point of contact of such cutting-cylinder with the first impression-cylinder, which latter takes the sheet as the cutting-cylinder yields it up, the cutter on the male cutting-cylinder severing the paper when a sheet of sufficient length has passed between the cutting-cylinders.

9. The employment of a yielding sheath, consisting of two strips, placed one on each side of a serrated cutter, for the purpose of holding the paper firmly against the edges of the slot in the female cutting-cylinder while the cutter is severing a sheet of paper from the web, and also for the purpose of pressing the loose end of the web or uncut sheet, as it passes between the cutting-cylinders immediately after the sheet which has just been severed therefrom, toward the opposite cutting-cylinder until the grippers on the cutting-cylinder seize hold of it, and thus preventing the paper from passing down out of the reach of the grippers.

10. Permitting the escape from the machine of any pieces of paper which the grippers on the large cutting-cylinder fail to take hold of, or of any part of a sheet which may be torn from the web, by leaving a free passage between the large cutting-cylinder and the first impression-cylinder, so that such scrap will fall away when severed from the web by the cutter without being seized by the grippers on the first impression-cylinder, or being carried any farther through the machine, thus preventing the clogging of the machine and removing a fruitful source of annoyance and delay in the operation and damage to the machine.

11. Transferring the sheet of paper after it is printed in white immediately from the first to the second impression-cylinder by means of the grippers placed on the second impression-cylinder, which seize the sheet of paper

just as the grippers on the first impression-cylinder release it, without the use of tapes, cylinders, or other mechanical device not contained in the impression-cylinders for that purpose, substantially as described.

12. The use of a scrap-blanket or apron interposed between the cutting apparatus and the type-cylinder and inking apparatus, to prevent any dust or scraps of paper from falling on the type or inking cylinders.

13. The delivering apparatus, consisting of short fly-rods, having a rapid stroke in a small arc up and down, so as to strike the rear end of the printed sheets as they pass from the machine, in combination with the curved fingers for holding the rear end of the sheets during the upstroke of the fly-rods and until their downstroke, and of a roller to receive the stroke of the fly-rods and the pressure of the curved fingers, and by an intermitting rotation to pass the sheets forward when released by both fly-rods and curved fingers, or other equivalent device, by which the paper is arrested at its rear end on its passage from the machine, whereby a very rapid delivery of the sheets is effected.

14. The use of a delivering-table for the reception of the printed sheets beneath and in the rear of the delivering apparatus, which table remains stationary during the delivery of the printed sheets, until a certain number—say, fifty or one hundred—have been deposited upon it, when it suddenly moves an inch or two to one side, and is again stationary until an equal number of sheets are delivered, when it moves back again, and so on, alternating from side to side for the purpose of counting and separating the sheets into piles of any required number, substantially in the manner hereinbefore described.

15. Communicating an alternating lateral movement to the small ink-distributing rollers on the face of the large ink-distributing cylinder by giving a simultaneous reciprocating motion to one end of their bearings, for the purpose of securing a more perfect and uniform distribution of the ink.

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