14 Sheets—Sheet 1.

S. D. TUCKER.

SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

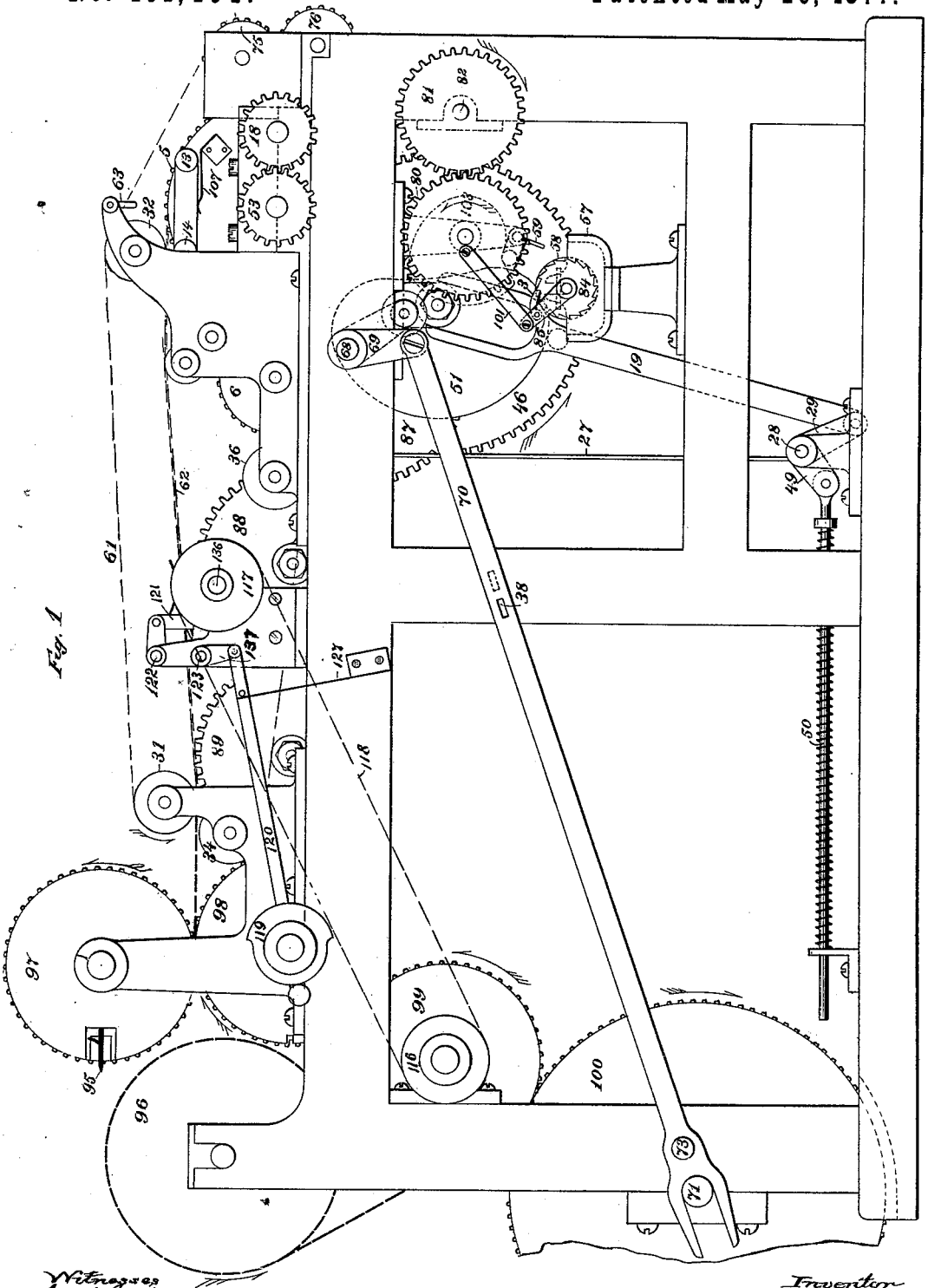

Fig. 1

Witnesses
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John L. Kluber.

Inventor
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By Munson & Philipp.
Attorneys

14 Sheets—Sheet 2.

S. D. TUCKER.

SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

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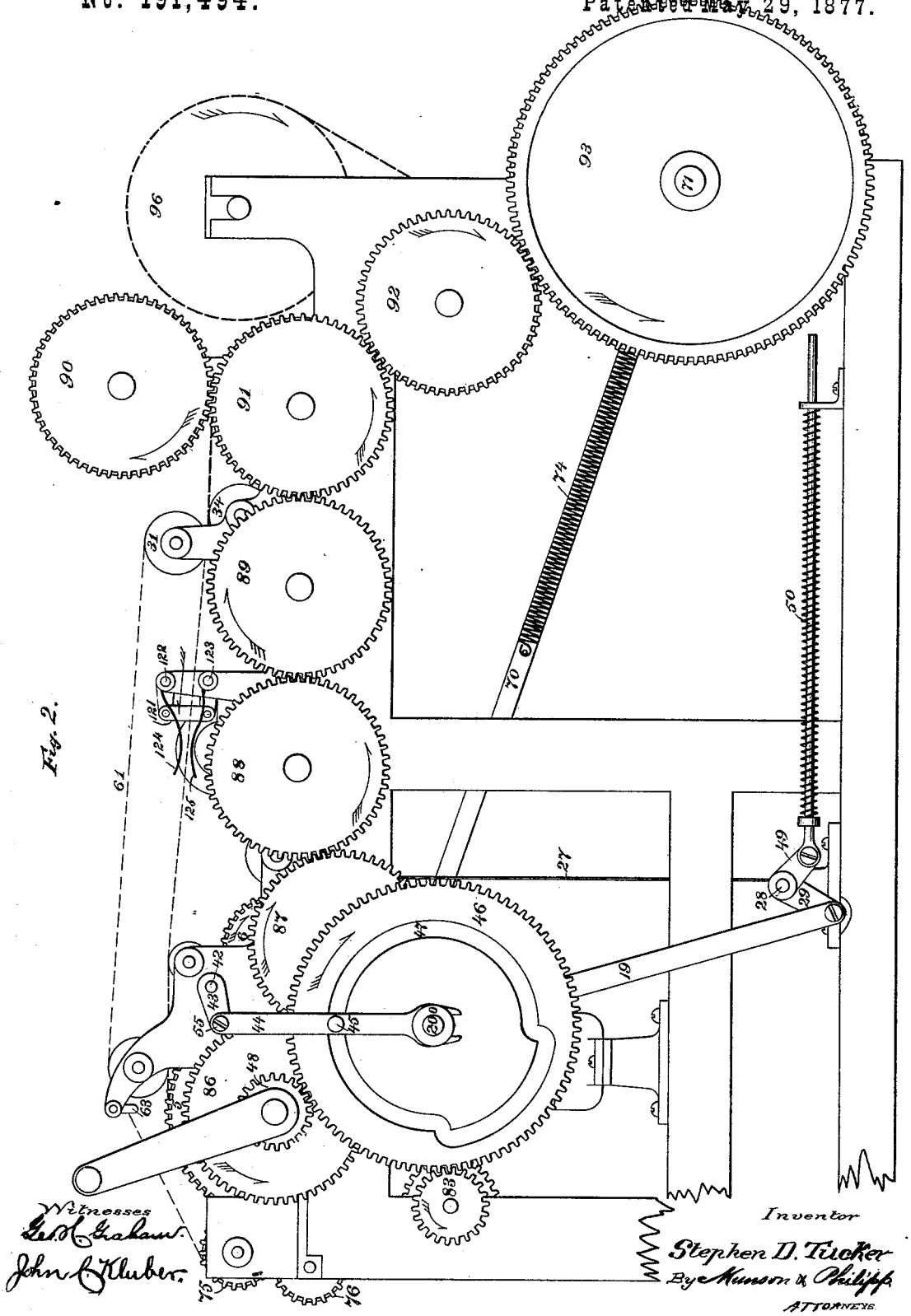

Fig. 2.

Witnesses
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14 Sheets—Sheet 3.

S. D. TUCKER.

SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

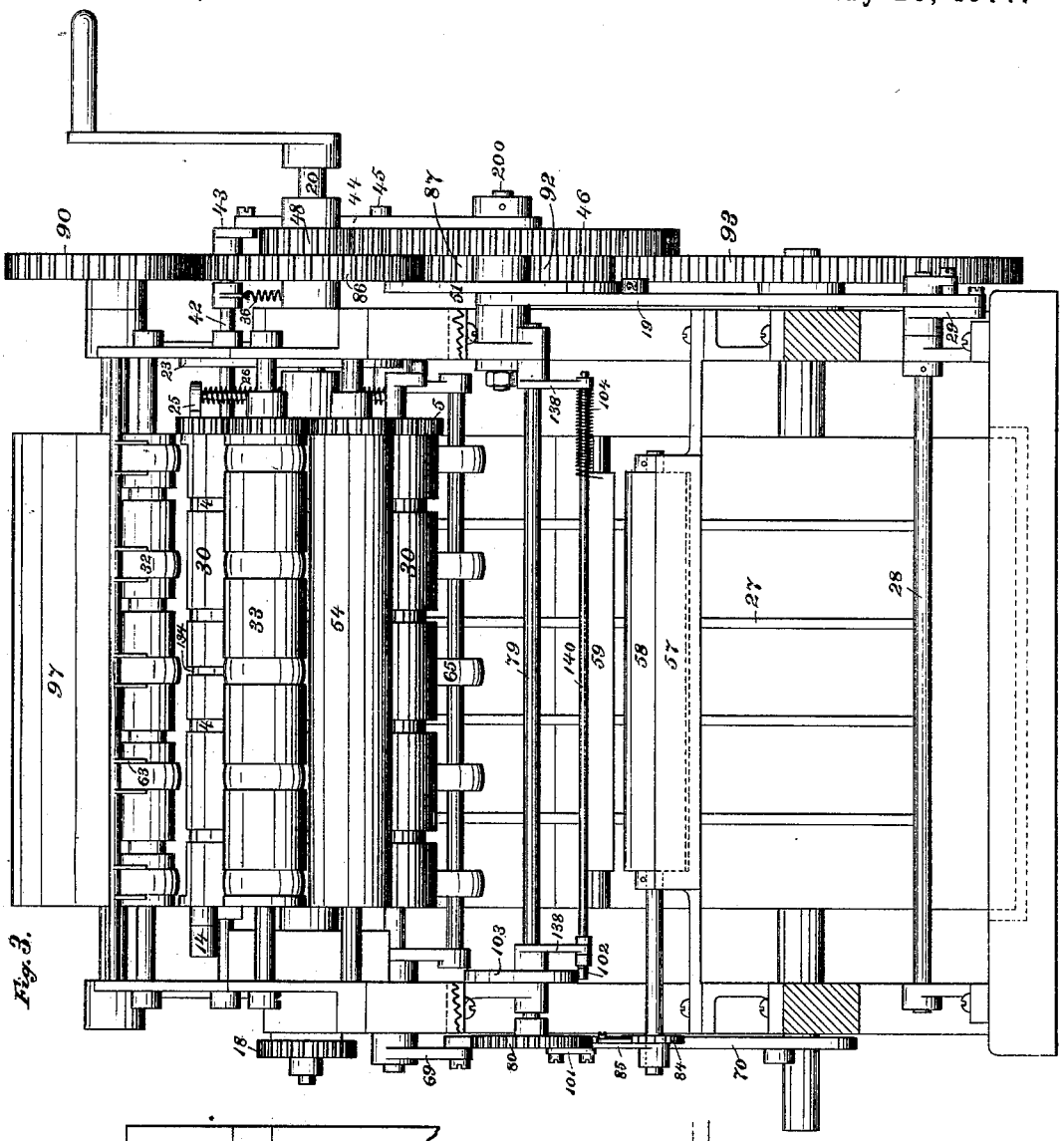

Fig. 3.

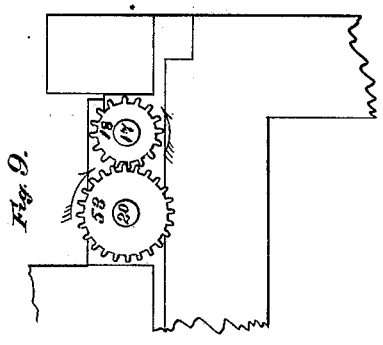

Fig. 9.

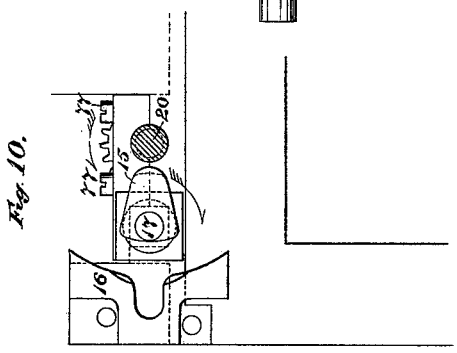

Fig. 10.

Witnesses
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14 Sheets—Sheet 4.

S. D. TUCKER.

SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

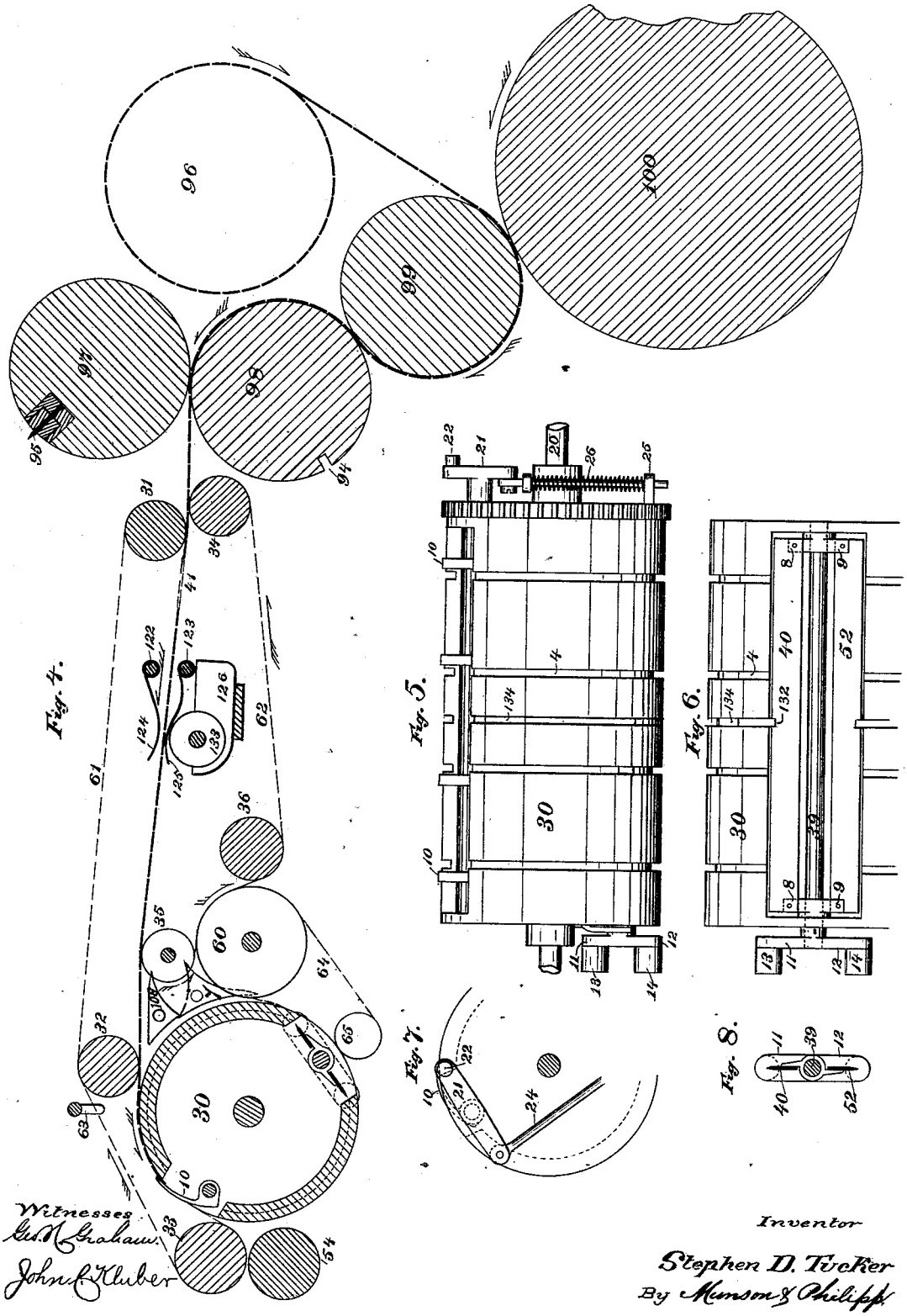

Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

Fig. 8.

Witnesses
Geo. M. Graham.
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14 Sheets—Sheet 5.

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SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

Fig. 14.

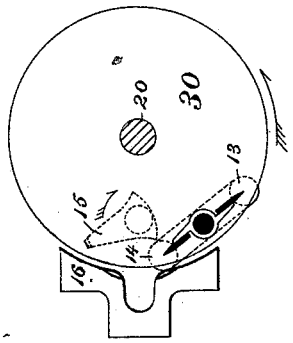


Fig. 13.

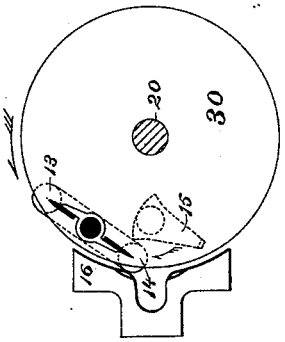


Fig. 15.

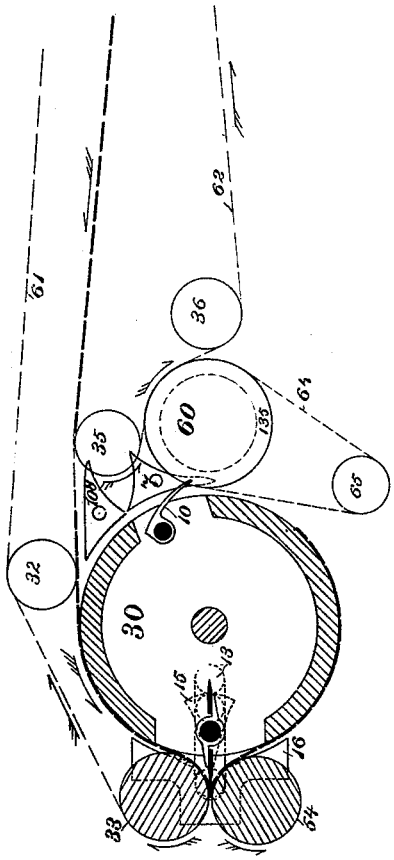


Fig. 11.

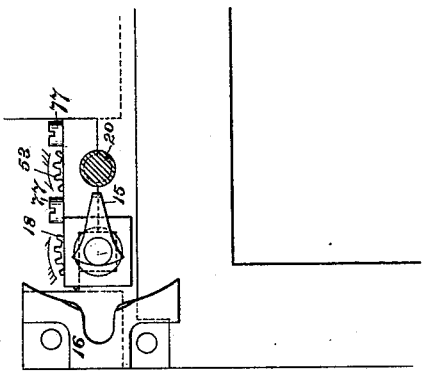
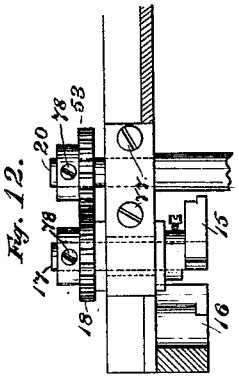


Fig. 12.



Witnesses
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14 Sheets—Sheet 6.

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SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877

Fig. 16.

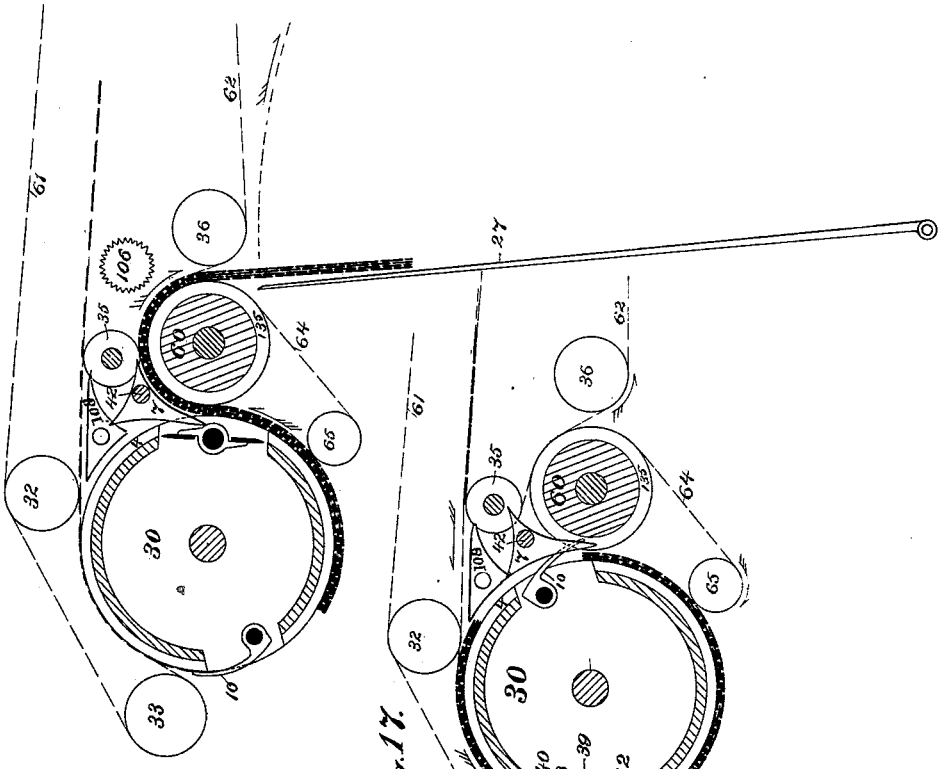


Fig. 17.

Fig. 18.

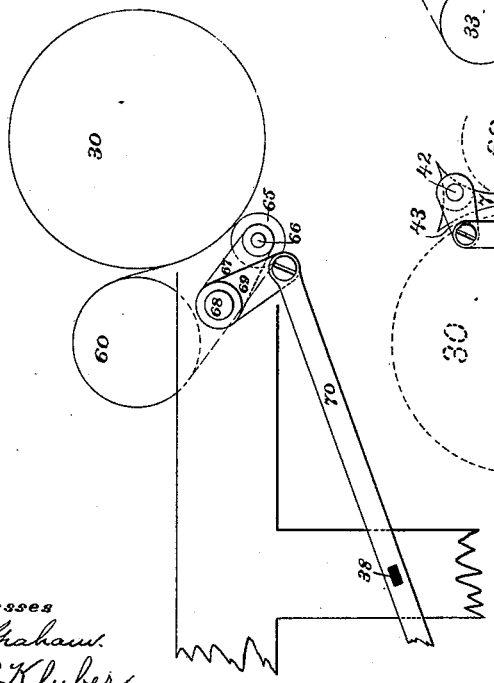
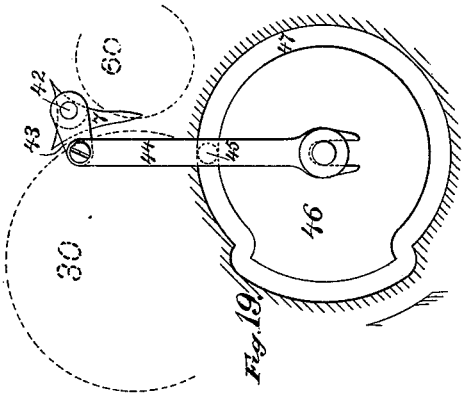


Fig. 19.



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14 Sheets—Sheet 7.

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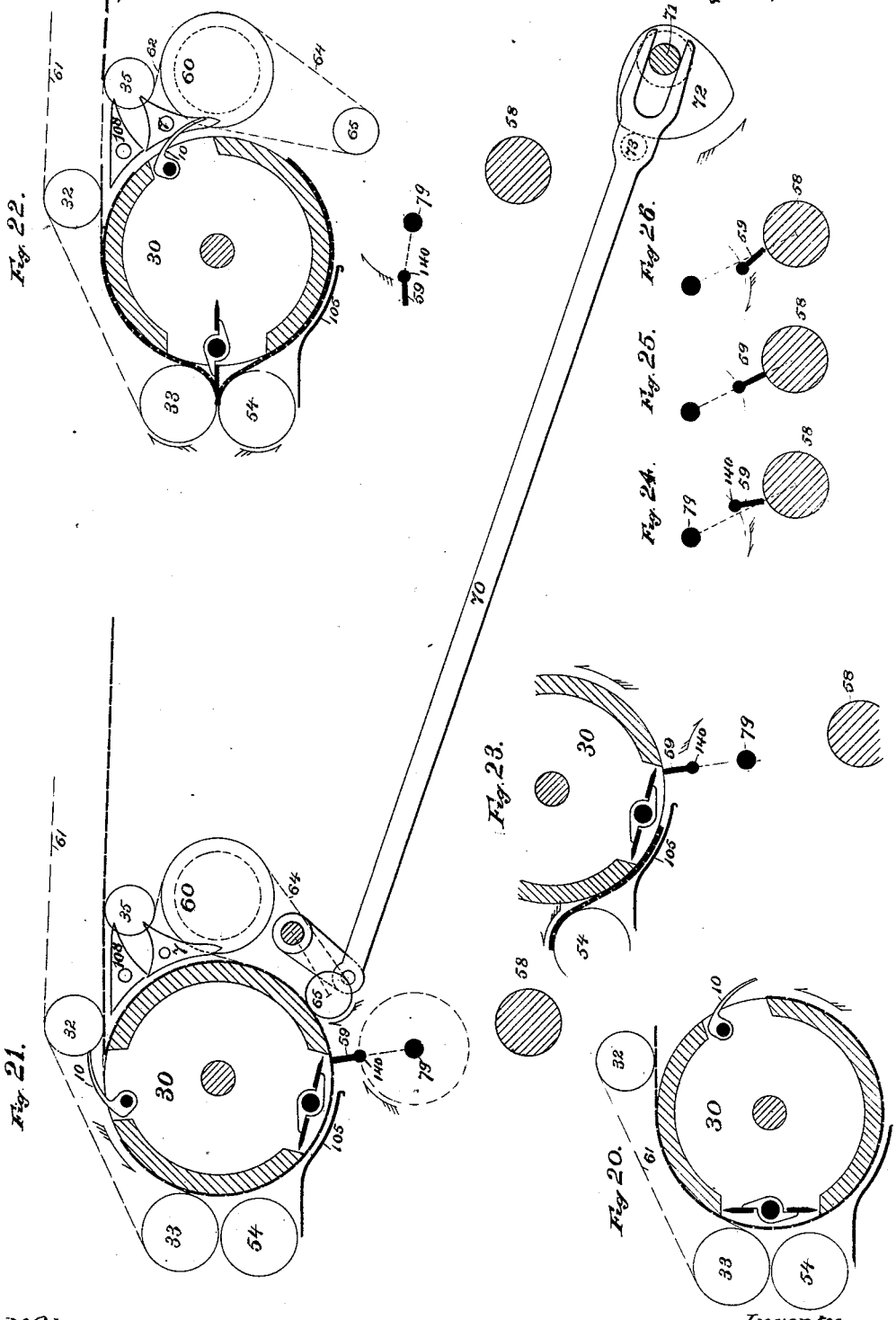
SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.



Witnesses
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14 Sheets—Sheet 8.

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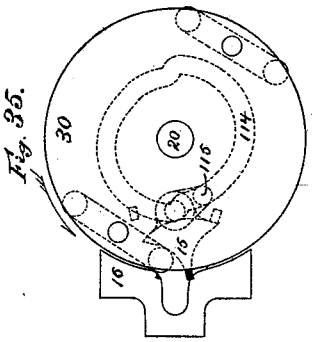
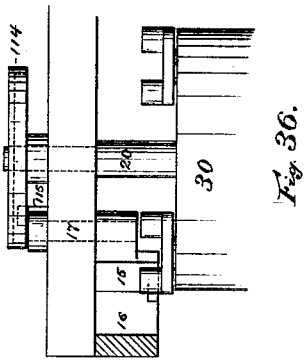
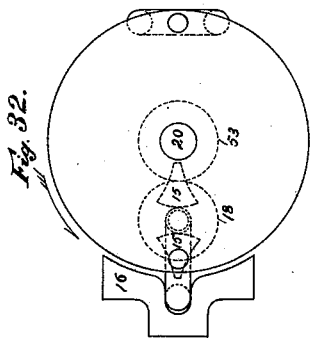
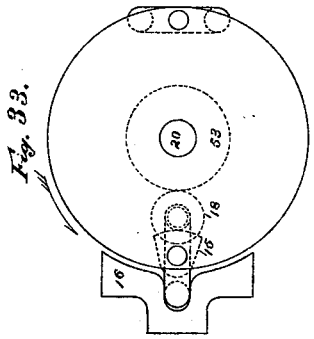
SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

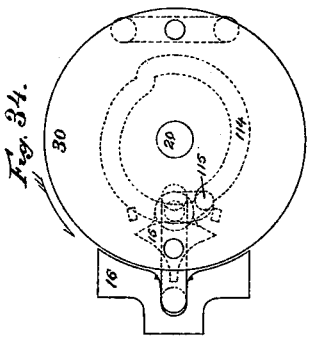
No. 191,494. Patented May 29, 1877.

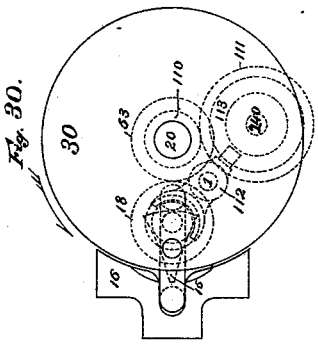


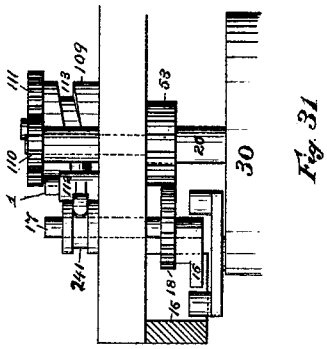


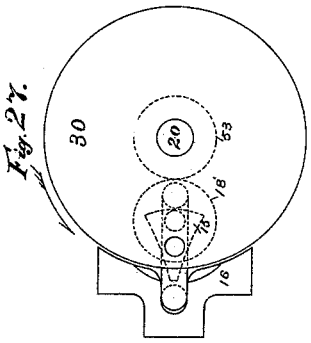


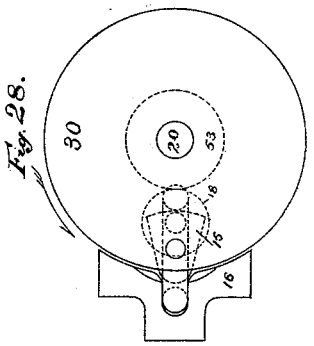


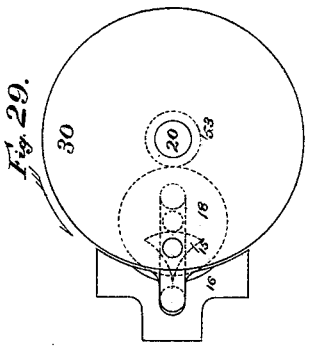












Witnesses
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14 Sheets—Sheet 9.

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SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

Fig. 39.

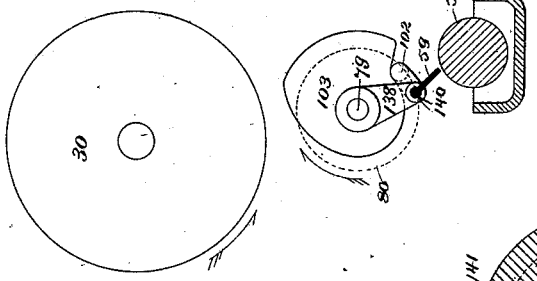


Fig. 41.

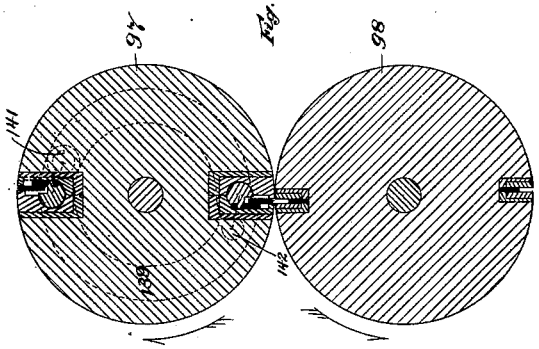


Fig. 38.

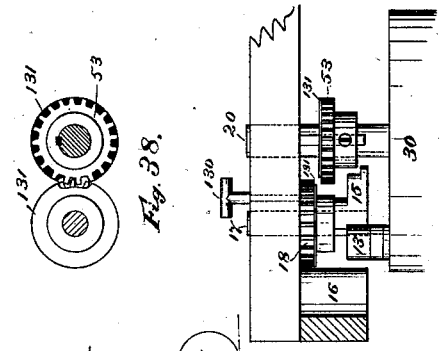


Fig. 37.

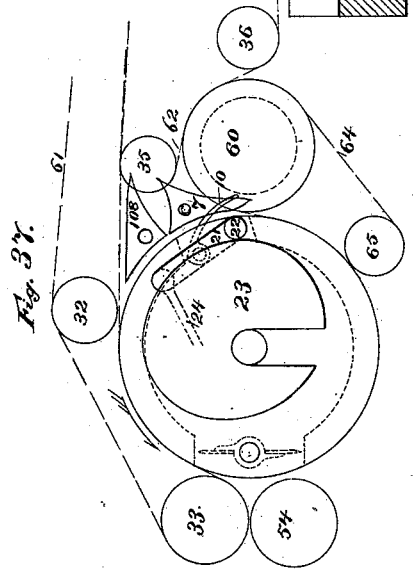
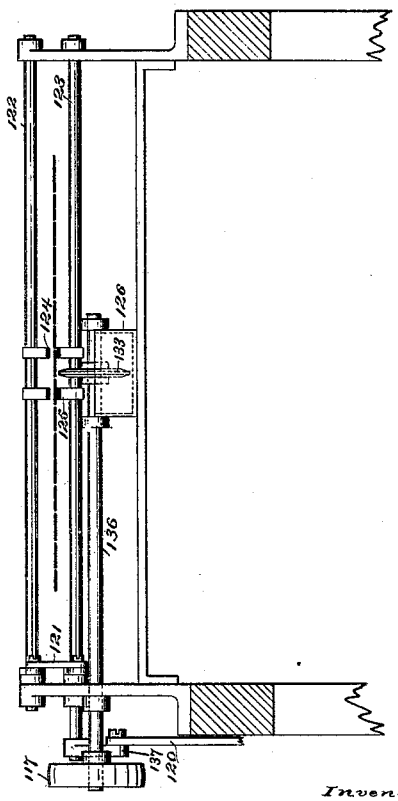


Fig. 40.



Witnesses
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14 Sheets—Sheet 10.

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SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

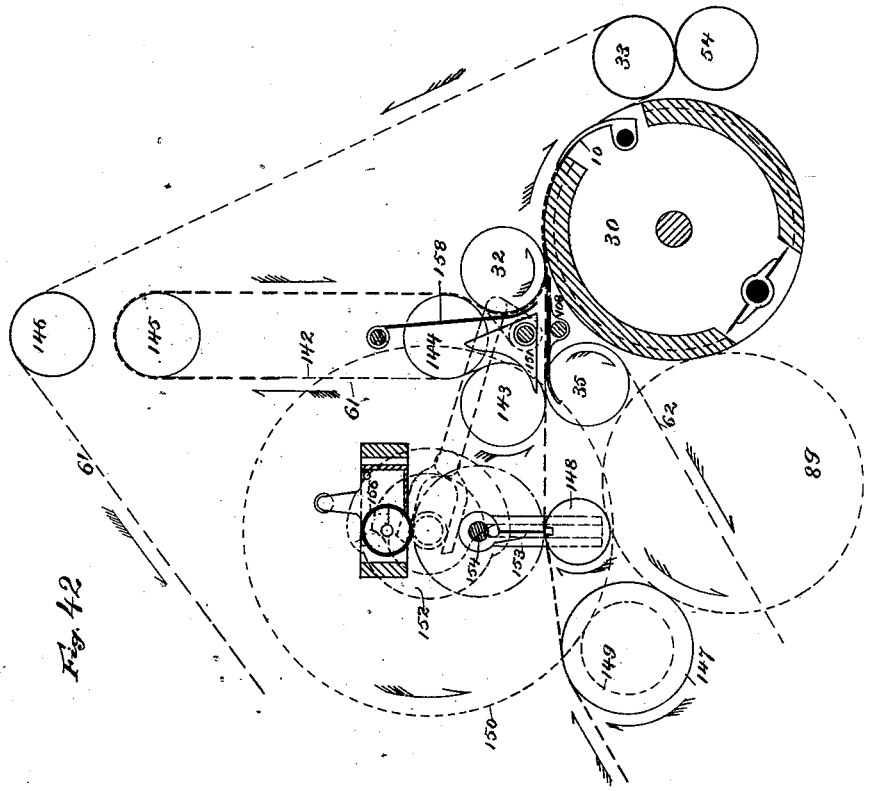

Fig. 42.

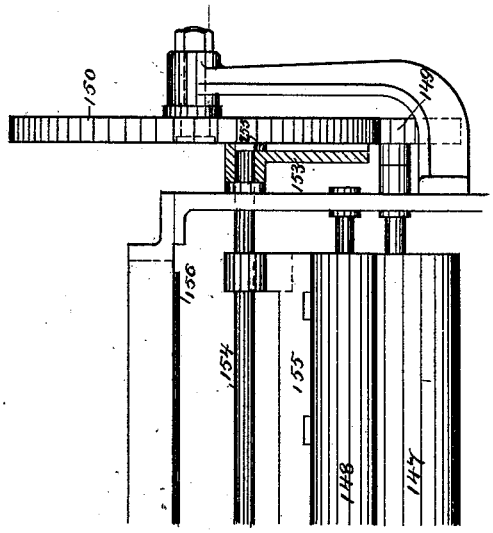

Fig. 43.

Witnesses
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14 Sheets—Sheet 11.

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SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

Fig. 44.

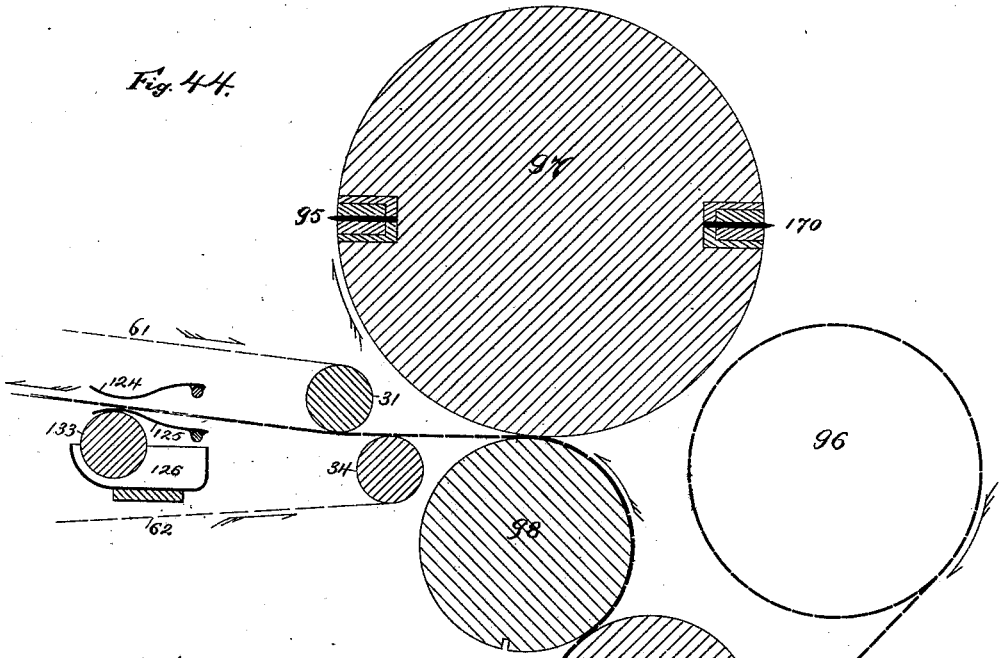

Fig. 45.

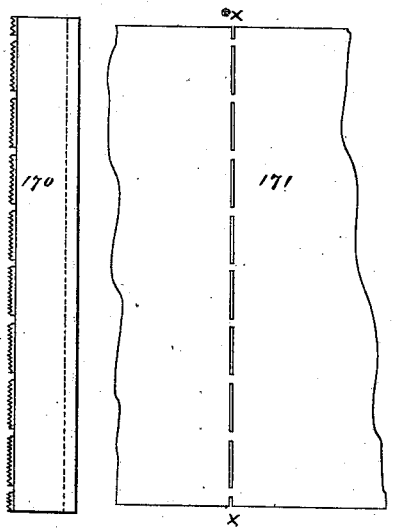

Fig. 46.

Witnesses
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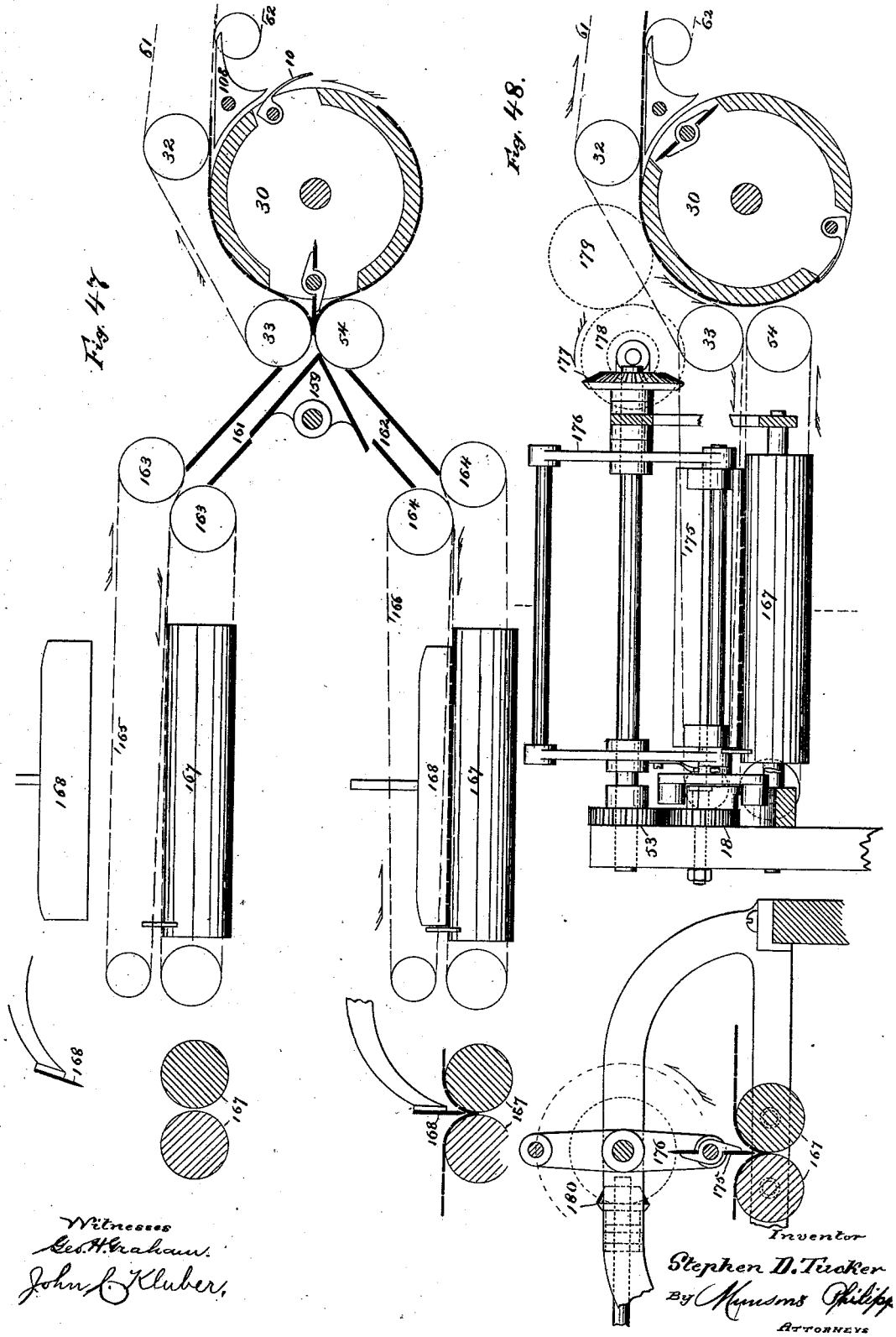
14 Sheets—Sheet 12.

S. D. TUCKER.

SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.



Witnesses
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14 Sheets—Sheet 13.

S. D. TUCKER.

SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.

Fig. 50.

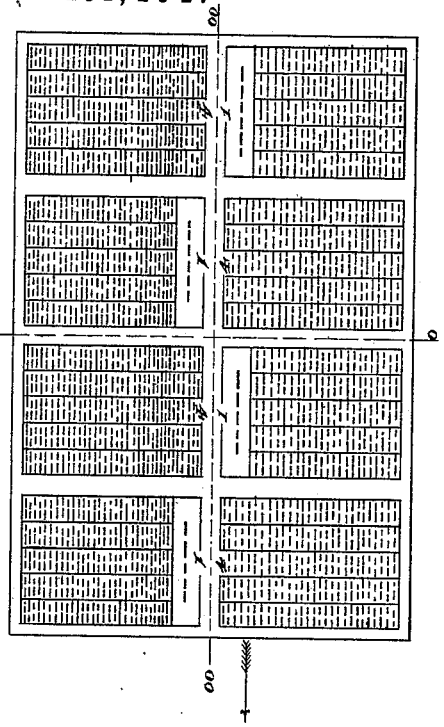


Fig. 52.

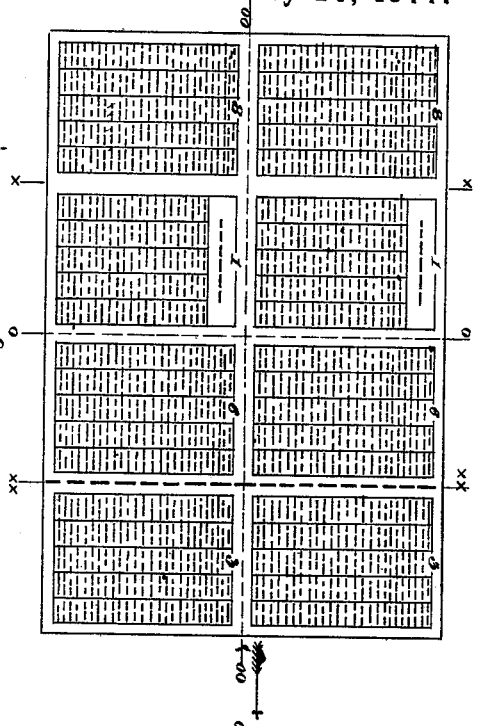


Fig. 49.

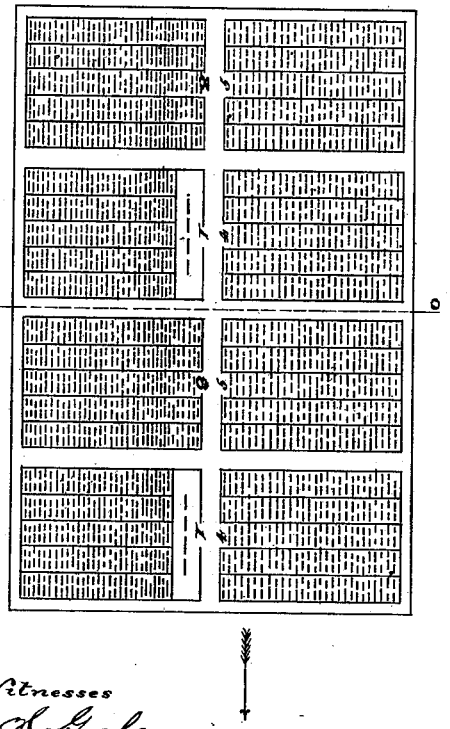
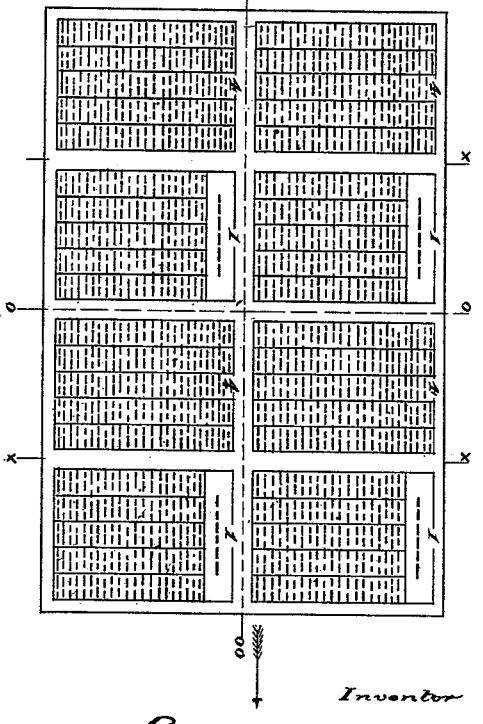


Fig. 51.



Witnesses
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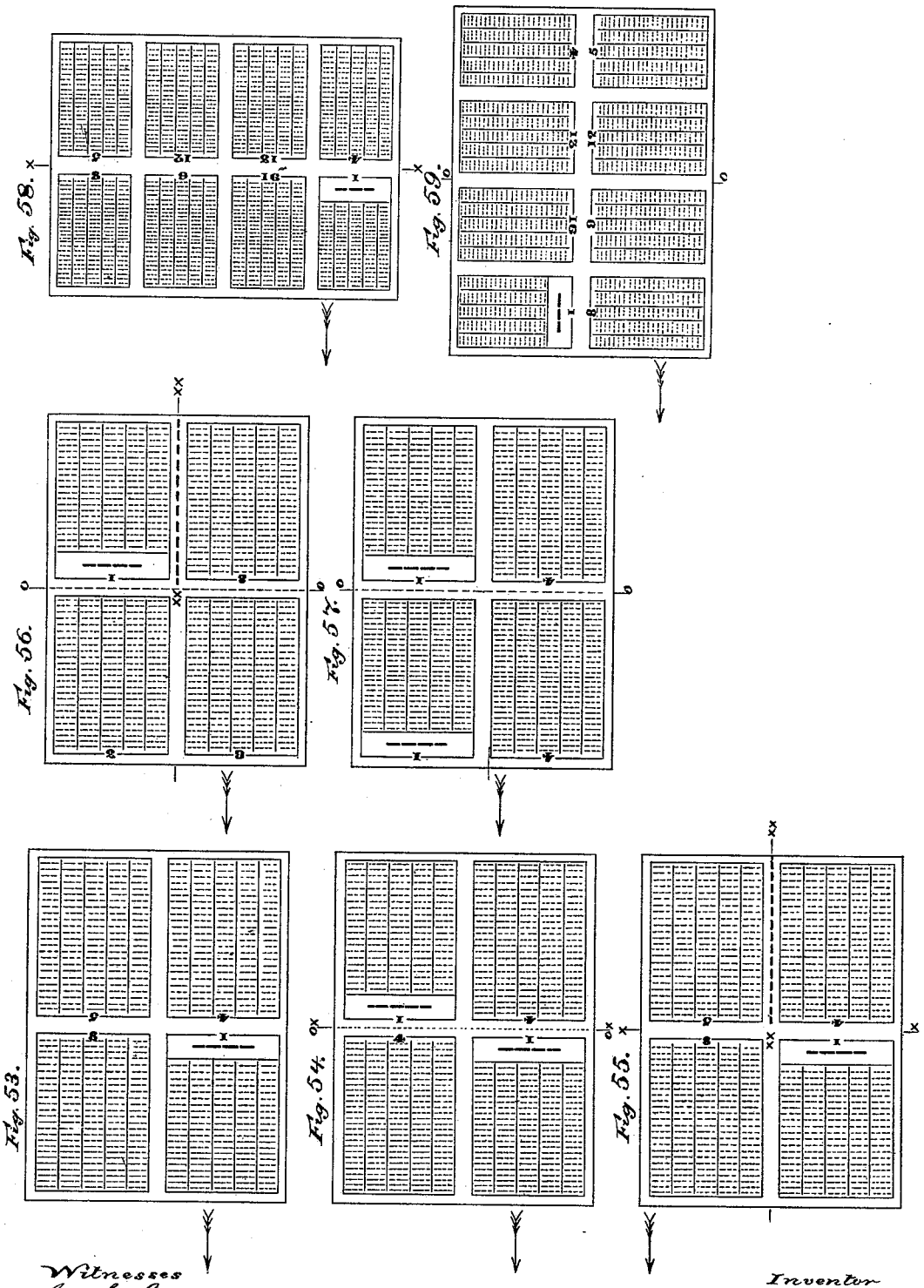
14 Sheets—Sheet 14.

S. D. TUCKER.

SHEET-DELIVERY MECHANISM FOR PRINTING-MACHINES.

No. 191,494. Patented May 29, 1877.



Witnesses
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John F. Kluber.

Inventor
Stephen D. Tucker
By Munson & Philipp.
Attorneys

UNITED STATES PATENT OFFICE.

STEPHEN D. TUCKER, OF NEW YORK, N. Y.

IMPROVEMENT IN SHEET-DELIVERY MECHANISMS FOR PRINTING-MACHINES.

Specification forming part of Letters Patent No. **191,494**, dated May 29, 1877; application filed May 5, 1877.

To all whom it may concern:

Be it known that I, STEPHEN D. TUCKER, of the city, county, and State of New York, have invented a certain new and useful Improvement in Sheet-Delivery Mechanism for Printing-Machines, of which the following is a description:

In the accompanying drawings is represented, in Figure 1, a right-hand-side elevation; Fig. 2, a left-hand-side elevation; Fig. 3, a rear end elevation; Fig. 4, a longitudinal section; Fig. 5, a plan view of the delivering-cylinder; Fig. 6, a similar view, showing more prominently the folding-blade it carries; Fig. 7, a view of one end of the delivering cylinder; Fig. 8, a sectional elevation of the folding-blade; Figs. 9, 10, 11, and 12, the flying and stationary cams for actuating the folding-blade, and the mechanisms for rotating the flying-cam; Figs. 13, 14, and 15, the folding-blade in the different positions it occupies during the folding operation; Figs. 16, 17, 18, 19, and 20, the mode of collecting many sheets and simultaneously delivering the same in a body; Figs. 21, 22, 23, 24, 25, and 26, the operation of applying a transverse line of paste to the sheet; Figs. 27, 28, and 29, means for operating the flying-cam so as to actuate the folding-blade at each first or second revolution of the delivering-cylinder; Figs. 30 and 31, means for automatically throwing the flying-cam out of and into operation; Fig. 32, an arrangement of two flying-cams operating upon two folders; Fig. 33, an arrangement of one flying-cam operating upon two folders; Figs. 34, 35, and 36, a vibrating flying-cam operating two folders; Fig. 37, the cam for actuating the gripers; Fig. 38, a means of throwing the flying-cam out of and into action; Fig. 39, a view of the mechanism for laying the transverse line of paste; Fig. 40, a rear elevation of the mechanism for laying the longitudinal line of paste; Fig. 41, a reduced scale modification of the cutting-cylinders; Figs. 42, 43, a sectional side and a rear elevation of a modification of the tranverse pasting mechanism; Fig. 44, a modification in which is embodied a cutting-cylinder, carrying two cutters or one cutter and one perforator; Fig. 45, plan and end views of the perforator removed; Fig. 46, a perforated web of paper; Figs. 47 and 48, mechanisms for imparting folds to the sheets in addition to the folding performed by the cylinder 30 and its accessories; Figs. 49, 50, 51, and 52, sheets printed from forms arranged according to "system A;" Figs. 53, 54, 55, 56, and 57, sheets printed from forms arranged according to "system B;" Figs. 58 and 59, sheets printed from forms composed of sixteen pages, the former arranged according to system A, and the latter according to system B.

This invention relates to the delivering mechanism of printing-machines, being especially adapted to that class known as "web-perfecting," in which a web of paper passing between two sets of type and impression cylinders is printed upon both its surfaces and, passing between a pair of cutting-cylinders, said printed web is divided into sheets of an appropriate size. Printed sheets are thus produced with such great rapidity that an apparatus operating with like speed is required to deliver them.

This invention consists in a delivering mechanism in which is embodied a delivering-cylinder that receives the sheets from the printing-machine, and of accessories to said cylinder, which consist of a set of gripers to seize the front edges of the sheets, tapes to aid in carrying the sheets around with the cylinder, a switch to discharge the sheets from the cylinder, a folding-blade to enter the sheets into a folding device, and pasting devices for pasting or gumming the sheets, so that when folded they will adhere at certain margins.

These accessories will cause the delivering-cylinders to serve, first, as a collecting-cylinder that will gather or accumulate two or more sheets successively one upon the other on its surface, and then discharge them in a single body or mass therefrom to a piling apparatus, which will pile them open or flat; second, as a folding-cylinder to fold sheets by a folding-blade entering them into a folding device; third, as a combined collecting and folding cylinder, which will first collect two or more sheets and then enter them together into a folding device; fourth, as a combined collecting, pasting, and folding cylinder, which will collect two or more sheets, present them to a pasting device to receive paste or gum at the

desired margin, and then enter them into a folding device, so that when folded they will adhere together.

Many other features are involved in this invention, but need no preliminary mention, since they are set out at length in a clear and precise manner in the following description:

This invention is capable of use in connection with any form of printing-machine, or with any sheet furnishing or feeding mechanism; but it is especially adapted to be connected with a web-perfecting printing-machine in which the web is severed into sheets either before or after being printed. Such a machine contains two type and two impression cylinders and a cutting mechanism; but, as its structure is well known and forms no part of this invention, the last type and impression cylinders only are herein illustrated.

The paper is illustrated as being received from a reel, 96, and, passing between the said last type-cylinder 100 and impression-cylinder 99, being directed thence between a pair of cutting-cylinders, 97 98, the former of which is furnished with a cutting-blade, 95, which engages in a slot, 94, cut in the periphery of the cylinder 98. In passing through these cutting-cylinders the web is severed or partially severed, as the case may be, upon the lines which are to divide it into sheets. Said cutting-cylinders are geared together by toothed wheels 90 91, the latter gearing with a toothed wheel, 92, on the impression-cylinder 99, and this last wheel gearing with a toothed wheel, 93, on the type cylinder 100. The cutting-cylinders are of a circumference equal to the length of the desired sheet, or may be equal to the length of two sheets, as will hereafter appear, while the type-cylinder has an area equal circumferentially to the length of two sheets, and longitudinally to the length of one or two sheets, as may be desired, the purpose of which relative sizes of the cutting and type cylinders will be more fully hereinafter set out.

The delivering-cylinder 30 is mounted in suitable journals in the frame-work, and carries a driving toothed wheel, 86, at one end, which connects through a train of such wheels, 87 88 89, with the toothed wheel 91 on the lower cutting-cylinder. Motion may be imparted to the shaft of the delivering-cylinder 30, as is shown in the drawings, or to the shaft of either the cutting, type, or impression cylinders.

Endless carrying-tapes are stretched to conduct the sheets severed by the cutting-cylinders to the delivering-cylinder 30. The upper series 61 of these tapes are stretched from the roller 31 over the upper surface of the delivering-cylinder 30, around a roller, 33, and returned through guides 63 over a supporting-roller, 32, to the roller 31. The lower series 62 of these tapes pass from the roller 34 over roller 35 in contact with the upper surface of the receiving-cylinder 60, thence under a roller, 36, and return to the roller 34. These tapes receive motion from the delivering-cylinder 30 and receiving-cylinder 60, which are geared together by toothed wheels 5 6, and as the delivering-cylinder 30 is somewhat larger than the cutting-cylinders, the surface speed of these tapes is rendered greater than that of the cutting-cylinders, the result of which is that a sheet partially severed by the cutting-cylinder will, when nipped between the upper tapes and the surface of the delivering-cylinder, have its speed of travel accelerated to such a degree that it will be torn on the partially-severed line from the end of the web, thus producing a space, 41, between the rear end of said sheet and the forward end of the web, which provides room for the entrance of the gripers and switches between said sheets, as will be readily understood. When, however, the cutting-cylinders entirely sever the web into sheets, each sheet, as it is nipped upon the delivering-cylinder, is advanced rapidly to produce the space 41 between each successive sheet. In this latter case, conductors extending into grooves in each should bridge the space between the cutting-cylinders and rollers 31 34.

A third set, 64, of endless tapes are stretched around the receiving-cylinder 60 and a roller, 65, which latter is supported upon a shaft, 66, hung in arms 67 fast upon a shaft, 68. This shaft 68 is connected, by an arm, 69, with a rod, 70, by which the roller 65 and the tapes 64 may be held up against the delivering-cylinder 30, as in Figs. 4, 16, 17, 18, and 21, or be rocked down from that position, as is shown in Figs. 15 and 22, as may be desired, the purpose of which will hereinafter appear. This rod 70, Figs. 1 and 21, is bifurcated at one end to straddle the type-cylinder shaft 71, upon which is a cam, 72, which bears upon a friction-roller, 73, carried by the rod 70, and thus rocks said roller 65, and the tapes 64 it carries into the positions before described.

There is a series of switches, 7, hung upon a shaft, 42, between the delivering-cylinder 30 and the receiving-cylinder 60, which shaft 42 is rocked by means of an arm, 43, and connecting-rod 44, the latter being bifurcated at its lower end to straddle the shaft 200 of the cam-wheel 46, Figs. 2 and 19, and provided with a pin, 45, entering the cam-groove 47 cut in the face of the wheel 46. This cam-wheel 46 is rotated by a pinion, 48, fast on the shaft of the delivering cylinder 30, which gears with its toothed periphery.

A set of fixed guides, 108, are set above the switches to guide the sheets from the roller 35 and from the switches 7 to the roller 32.

The delivering-cylinder 30 is supplied with gripers 10 working through a recess in the same, which are fast upon a shaft hung in the ends of said cylinder. This shaft carries an arm, 21, one end of which is supplied with a friction-roller, 22, which runs upon a cam, 23, fixed to the frame-work, the other end being supported by a rod, 24, hung in an eye, 25, on the cylinder-head, and seated upon a spring,

26, said gripers being thus operated, as is common in printing-machines.

A fly-frame, 27, supported upon a shaft, 28, seated in suitable brackets in the frame-work, is automatically vibrated at proper intervals by means of a rock-arm, 49, connecting the shaft 28 with a spring-seated rod, 50, the movements of the shaft 28 being governed by a rock-arm, 29, and a rod, 19, which is bifurcated to straddle the shaft 200, and provided with a stud or pin, 2, bearing upon the face of a governing-cam, 51, fast on said shaft 200.

Thus equipped the delivering-cylinder 30 is capable of receiving sheet after sheet, which accumulate one on the other upon its surface to any predetermined number, which are delivered in a body therefrom and deposited by the fly-frame upon the piling-table. This function of the said cylinder is in itself well-known; but, in order that the operation of the delivering-cylinder 30 may be readily understood, it will now be briefly described.

The roller 65 is moved forward by means of the rod 70, so as to stretch the tapes 64 against the periphery of the cylinder 30, as in Figs. 16, 17, 18, and 21, being locked in that position by means of a key, which extends through an opening, 38, in the rod 70, and into a recess in the side-frame of the machine, or in any other convenient manner.

The leading end of the sheet carried forward by the tapes 61 62 is presented beyond the roller 32 in such a position over the delivering-cylinder that the gripers 10, which are opened, Fig. 37, by their arm 21 riding over the higher part of the cam 23, and closed as said arm descends upon the lower part of the cam, in which latter movement they bear down upon and seize the forward end of the sheet, as in Fig. 4, thus securing it upon the said cylinder, and causing it to be laid thereon as the rotative movement of the cylinder proceeds.

Each sheet is thus seized and held upon the cylinder by the gripers from the point occupied by the roller 32 to that occupied by the roller 65, and just after the head of a sheet has entered between the tapes 64 and the periphery of the delivering-cylinder 30, the gripers begin to open, Fig. 17, in order to be in position to seize the next sheet received upon said cylinder, as in Fig. 21. The sheet thus released is propelled onward by the pressure of the roller 65, and guided by the tapes 64. At the point where the tapes 64 leave the delivering-cylinder 30 and pass onto the receiving-cylinder 60 the switches 7 are so placed that, when in the position shown in Fig. 21, they will act as guides, directing and holding the sheets upon the delivering-cylinder 30, the guides 108 performing a like service.

The delivering-cylinder in its rotation carries the leading end or head of the sheet thus held upon it under the tapes 61, at the roller 32, reaching which another sheet received from the printing-machine will be laid upon the first, seized by the gripers, and treated in like manner as was the first, upon which it is laid. Any convenient number of sheets may thus be superposed upon the delivering-cylinder 30, and when the predetermined number (four in the machine illustrated) has been collected, the switches 7 are automatically shunted, so that their points are entered behind the sheets, and into recesses 4 cut in the surface of the cylinder 30, as in Fig. 16, whereby the curved back faces of the said switches are brought so as to coincide with the periphery of the receiving-cylinder 60. As the gripers 10 release the body of accumulated sheets the heads or leading edges of the same will be guided by the said switches 7 up over the receiving-cylinder 60, and between it and the tapes 62, by which the body of sheets will be conducted down before the fly-frame 27, which fly-frame will be automatically vibrated to deliver said four sheets in a single body upon the piling-table. While this body of sheets is thus passing off the cylinder to be delivered, a single sheet from the printing-machine will be received and seized by the fingers 10 upon the delivering-cylinder 30, as in Fig. 16, and when the tails of the body of sheets being delivered from the said cylinder 30 pass the point occupied by the end of the switches 7 said switches will be automatically rocked into the position shown in Fig. 17, so that the single sheets shall be conducted around the cylinder. The points of the switches 7, when in the position of Fig. 17, enter grooves 4, 134, and 135 in the periphery of the receiving-cylinder 60, and the gripers 10, which, when opened, project beyond the periphery of the cylinder 30, ride through these said grooves.

As is apparent, the fly-frame and switches must be operated so as to vibrate once to every four revolutions of the delivering-cylinder 30. It is also apparent that such gearing may be supplied in operating these several parts as to cause the delivering-cylinder to gather or accumulate any particular number of sheets. Six, however, are found to be a desirable number, since that quantity may be accumulated upon the delivering-cylinder 30 in the time occupied by the ordinary vibrations of a fly-frame.

It has been said that the gathering-cylinder is not, *per se*, a novelty; but said cylinder, when combined and operating as is hereinafter set forth, and when supplied with certain mechanism now to be particularly referred to, constitutes a novelty.

In all former arrangements of mechanisms for retaining a number of sheets upon a gathering-cylinder the entire circumferential area of said cylinder has been provided with guards for retaining the sheets thereon—that is to say, such guards are supplied from the point of reception to the point of delivery—as will hold or support the sheets upon the cylinder.

The gathering-cylinder herein illustrated is provided with gripers 10, which may seize the sheet at the point of reception—viz., just beyond the roller 32—and hold the same fixedly

upon the cylinder until the point of delivery is reached—viz., at the switches 7.

It is therefore apparent that the guards formed by the tapes 61, between the rollers 32 and 33, and by tapes 64, between the roller 65 and the switches 7, may be omitted, and that the gripers 10 will seize the sheets and carry them around with the cylinder until the switches 7 are reached, when the gripers will release and deliver said sheets to the switches, which, in the position shown in Fig. 16, will, by their front faces, guide and deliver them before the fly-frame as they are driven onward by the action of the roller 65.

Thus the gathering-cylinder provided with gripers requires no guard for retaining the sheets upon it from the point of reception, roller 32, to the point of delivery, switches 7; but as there is necessarily a considerable space between the switches 7 and the roller 32 over which the sheets will not be surely directed without the aid of a guide, such a device is provided in the fixed guides 108, one face of which coincides with the curved surface of the cylinder, and the other provides a support for the incoming sheet from the roller 35 to a point near the periphery of the cylinder 30.

The tapes between the rollers 32 33 are, however, advantageous, since they prevent the tail end of the sheet from flying off from the cylinder, as does also the guard-plate 105. The tapes 64 are also of great advantage, as they hold the sheet up against the cylinder after it is released by the gripers, and thus propel its forward end. Hence, when these tapes are omitted the roller 65 should be retained to propel each sheet onward.

The delivering-cylinder 30 is also supplied at one point of its periphery with a shaft, 39, hung in suitable supports in the cylinders, which shaft carries folding-blades 40 52, held upon it by suitable arms 8 9. This shaft protrudes through one of the heads of said cylinder, and is supplied with projecting arms 11 12, (see Figs. 5 and 6,) which carry, respectively, friction-rollers 13 14, through which arms semi-rotations are imparted to said folding-blade shaft by means of a flying cam and stationary cam, as will now be explained

The stationary cam 16 is secured to the frame-work, as in Fig. 11, and the flying-cam 15 is fixedly hung upon the end of the shaft 17, which is journaled in the side frame, as in Figs. 11 and 12. This shaft 17 has fastened upon it a toothed wheel, 18, which gears with a similar wheel, 53, fast upon the shaft 20 of the delivering-cylinder. These toothed wheels 53 and 18 have an equal number of teeth, Figs. 11 and 27, whereby the flying-cam 15 is caused to make one revolution in concert with a like movement of the delivering-cylinder, the result of which is that the said flying-cam is brought into the position shown in Fig. 13 at the time when the friction-roller 14 on the arm of the folder-blade shaft is in the position therein shown, and as the cylinder 30 moves in the direction of its arrow the flying-cam will be moved in the direction shown by its arrow, so that as these rotations proceed their constantly-changing positions will be such as to cause the curved face of the flying-cam to be brought upward, and form between it and the upper curved surface of the stationary cam 16 a guideway, which will direct said friction-roller 14 into the central portion or greatest depressed part of the stationary cam, as in Fig. 15, at which time the point of the flying-cam will be directly over the friction-roller 14, while the friction-roller 13 on the arm 11 of the folding-blade shaft will overlie the base of the flying-cam. As the rotations proceed the point of the said flying-cam 15 will be carried past the friction-roller 14, and its opposite side will form a guideway directing the roller 14 out from the stationary cam 16. By this operation of these devices the folding-blade shaft will be gradually revolved so as to project the folding-blade from the cylinder and cause it to enter between folding jaws formed in the instance illustrated by rollers 33 54; and when said blade has reached its greatest protrusion from the cylinder 30, it will stand between the folding jaws in the position shown in Fig. 15, from which position it will be gradually withdrawn into the cylinder, the path of travel which it describes in this movement being substantially an hypercycloidal curve. The folding-blade shaft will thus have made a semi-revolution, carrying its forward blade from the position shown in Fig. 13 through that illustrated in Fig. 15 into that shown in Fig. 14, where it is held by the spring-detent 107, whose rounded end enters a shallow recess in said shafts. It will be observed that the blade 52 now lies in the rearmost position, while that 40 is in the advanced position, and the latter will, of course, be the blade which is next affected by the movements of the cylinder and flying-cam. This mode of automatically projecting a folding-blade outward from a revolving carrier and between folding jaws and withdrawing the same into the said carrier, to be carried thereby and at the proper time again brought to and projected into the folding jaws, forms in itself no part of the present invention, being fully described in Letters Patent 171,196, granted to me December 14, 1875.

When it is desired to convert this delivery mechanism into a folding apparatus, which shall receive the sheets successively upon the surface of the cylinder and fold them transversely, the cam 72 is removed and the connecting-rod 70 is released so that its spring 74 will draw it back to rock the roller 65, and with it the tapes 64, into the position shown in Figs. 15 and 22, where they are of no effect, since the forward end of the sheet which is being folded is not required to be guided by them when it is released by the gripers. The switches may be thrown out of operation or be allowed to act, since the sheet being folded does not reach the point occupied by them.

Thus equipped, each sheet directed by the tapes 61 62 onto the cylinder 30 is seized by

the gripers 10, held upon the cylinder, and carried around with it until released, the middle of the sheet overlying the folding-blade.

The gripers 10 will commence their opening movement to release and render free the head of the sheet just as or a little before the folding-blade begins its outward movement to carry the middle of the sheet between the folding jaws formed by the rollers 33 54. The outward movement of the folding-blade draws the leading end of the sheet backward and doubles its middle into said folding-rollers 33 54, which, in consequence of their rotation, carry it out between them in a folded condition.

The said rollers 33 54 are geared together by toothed wheels 75 76, the wheel 75 meshing with the toothed wheel 5 on the cylinder 30, and the two thus rotated with a surface speed uniform with that of the surface movement of the cylinder 30.

The mechanism thus arranged is capable of imparting one fold to each sheet and delivering it from the folding-rollers 33 54. It may then receive further manipulation, as will be explained.

In order to adapt this mechanism to collect two or more sheets and simultaneously fold and deliver the same, the object being to collect separate sheets, which together form the complete newspaper, the following arrangement is made:

Supposing two to be the number of sheets desired to be thus treated, a flying-cam and proper gearing, such as is illustrated in Figs. 9, 10, and 28, is substituted for that last described and illustrated in Figs. 11, 12, and 27, and, like it, is carried upon a shaft, 17, supported in journals in the frame-work, and provided with a toothed wheel, 18, which gears with a toothed wheel, 53, on the shaft 20 of the delivering-cylinder. The toothed wheel 53, in this instance, has three teeth to each two provided upon the toothed wheel 18, whereby the said flying-cam is caused to make one and one-half turns to every one of the delivering-cylinder. If, however, more than two sheets are to be first collected and afterward simultaneously folded, these toothed wheels must be so proportioned as to cause the flying-cam to meet and operate the folding-blade at each third, fourth, or other revolution of the delivering-cylinder, as will be described. In this operation of collecting two sheets in succession it is apparent that the first must be directed around the cylinder so as to receive the second upon it, but that when the two are superposed and their leading ends are released from the gripers so that they may be carried through the folding-rollers, said leading ends must be kept free from engagement with the means which direct the first sheet onward with the cylinder when the gripers release it. To this end the rod 70, which is attached to the shaft carrying the roller 65 which supports the tape 64, is brought into operation by adjusting the cam 72 upon the shaft 71, which cam is so shaped as to reciprocate the rod 70 at every second revolution of the delivering-cylinder.

The switches 7 are made inoperative—that is, they are kept in the position to continuously guide the sheets around with the cylinder 30—for the reason that none of the sheets are to be directed to the fly-frame. This is done, in the present instance, by detaching the rod 44 by unloosening the screw 55. It might be accomplished by making the pin 45 screw-threaded, so as to be readily turned in and out of engagement with the cam-groove 47. The pasting mechanisms (yet to be described) are also made inactive, being thrown out of action by detaching their driving-wheels.

Thus equipped, one sheet will be delivered to the gripers and carried by them around with the cylinder 30. When the point is reached where the gripers release the sheet, the cam 72 will have rocked the tapes 64, or, if they are omitted, the propelling-roller 65, into the position shown in Fig. 21, which tapes or roller will then guide the sheet onward with the cylinder 30, as hereinbefore explained, and a second sheet will be received upon it, seized by the gripers, and carried onward with the cylinder 30. During this second revolution of the cylinder the cam 72 will have caused the tapes 64 and roller 65 to be rocked into the position shown in Fig. 22, so that when the two sheets are simultaneously released by the gripers their leading ends will be free, as in Fig. 22. As the cylinder revolves carrying the first sheet up on it, the point of the flying-cam will be pointed in toward the center of the cylinder 30, when the folding-blade arms pass it, (see Fig. 10,) thus leaving a free path for the said arms of the folding-blade, and as the said cylinder makes its next revolution with the second sheet upon it, the flying-cam will again have made one and one-half revolutions, bringing its point into position to operate the folding-blade, as in Figs. 14, 15, 28, and thus double the two sheets simultaneously into the nip of the folding-rollers 33 54, as shown in Fig. 22. The operation of the flying-cam and stationary cam in effecting the folding and withdrawing movements of the folding-blade, being the same as has been described with reference to the folding of each successive sheet, is not described here.

To throw the folding blade or blades out of action in a folding-cylinder, when, for instance, it is to be used as a collecting-cylinder to fly the sheets, the flying-cam may be rendered of non-effect by many constructions. Thus, it may be removed with its shaft, as in Figs. 9, 10, 11, and 12, where the cap covering its journal-box is made detachable by screws 77. Either of the driving toothed wheels 18 53 might be removed by means of their holding-screws 78, or the flying-cam 15 might be fixed upon the face of its toothed

wheel 18, and the two be adapted to slide freely on the shaft 17, passing out of and into gear with the driving toothed wheel 53, according as the cam is in or out of working position, as in Fig. 38. The flying-cam might be held constantly forward in its working position and the driving toothed wheel 53 slide upon a splined shaft into and out of gear with the toothed wheel 18 of the flying-cam, as in Fig. 38.

To readily determine the relative positions of the teeth of these wheels 18 53, their peripheries may be marked with indexes, showing proper points for their respective teeth to gear, or they may each carry a guard wire or plate, 131, cut away at a certain place, which will allow them to be moved out and in gear at that place and no other. A stop pin, 130, inserted through the frame-work into a hole in the cam-wheel will prevent its turning when out of action.

This apparatus is provided with longitudinal and transverse pasting mechanisms. The longitudinal pasting mechanism, Figs. 1, 40, consists of a disk, 133, revolving in a paste-reservoir, 126, placed just beneath the longitudinal center margin of the sheets in their passage to the delivering-cylinder 30. This disk 133 is fast upon a shaft, 136, extended through the side frame, and provided with a pulley, 117, which is rotated, by means of a belt, 118, from a pulley, 116, on the impression-cylinder shaft. The web or sheets of paper run through a guide having an opening in its lower plate, formed as illustrated, of fingers 124 125, placed on each side of the paste-dish. The upper member, 124, of this guide is fast upon a rock-shaft, 122, and the lower member 125 is fast upon a rock-shaft, 123. These shafts 122 123 are connected together by a link, 121, so as to move in unison and carry the paper up away from, or down upon, the paste-disk, as may be desired.

This movement is accomplished by a rock-arm, 137, fast upon the shaft 123, operated by a cam, 119, on the lower cutting-cylinder 98, through a connecting-rod, 120, furnished with a friction-roller, by which devices the paper is raised or lowered at such intervals of time as may be required to properly paste it longitudinally.

In order to adapt this machine to collect two sheets, paste the same transversely on the proper margin, and fold and deliver them adhering together, the apparatuses are arranged to collect and fold two sheets, as last described, and the transverse pasting mechanism is brought into action.

The transverse pasting mechanism consists of a paste-fountain, 57, furnished with a roller, 58, revolving to bring up the paste, which roller may be furnished with a scraper or doctor, to remove the excess of paste, as is commonly done in the ordinary ink-fountain.

The pasting-blade is a simple strip of metal fixed on a shaft, 140, which turns in arms 138, carried by a rotating shaft, 79, placed parallel with the cylinder 30. The blade turns independently of the rotative movement of its carrying-arms 138, for the purpose of retarding its movement at the pasting-roller, and accelerating it at the point of its engagement with the delivering-cylinder, as will be described. The shaft 79 carries at one end a toothed wheel, 80, meshing with a similar wheel, 81, on a cross-shaft, 82, (see Fig. 1,) which receives motion through a toothed wheel, 83, Fig. 2, from the toothed cam-wheel 46. This latter wheel is driven from the cylinder 30, and the gearing just described is so timed that the pasting-blade is revolved turn for turn with said cylinder, and as the cylinder revolves this blade comes alternately into contact with the fountain-roller 58, from which it receives a charge of paste, and with the sheet of paper, (carried by the cylinder) to which it imparts it.

The fountain-roller 58 is intermittingly rotated, to present to the action of the pasting-blade a surface charged with paste, by a ratchet-wheel, 84, actuated by a pawl, 3, carried by an arm, 85, rocked by an arm, 101, pivoted eccentrically to the face of the wheel 80.

As the pasting-blade 59, if allowed to simply rotate, and thus sweep over the surface of the slowly-moving fountain-roller 58, would gather a large quantity of paste upon its advanced side, and thus smear the paper, the said blade is so operated that as it approaches the fountain-roller, which is then stationary, its edge shall be carried directly against the periphery of the said roller; then said blade shall be turned so as to leave the said roller without dragging over any portion of its surface, and when the blade is thus free from the roller, and moves onward in its circular path, it is brought into a position so that its edge shall travel with the same speed as does the surface of the cylinder 30, or the paper carried by it.

In order to accomplish these movements of the pasting-blade its shaft 140, which is made to turn in the arms 138 which carry it, is provided at one end with a rock-arm, 102, which rides upon the periphery of a cam, 103, fixed upon the side frame, and at the other end is provided with a spring, 104, which constantly presses the rock-arm against the cam 103.

As the diameter of the circle described by the paste-blade when in its greatest extended position is less than that of the cylinder 30, and as this blade must move with the same surface-speed as does the cylinder when in co-operation with it to apply paste to the sheet it carries, it follows that the speed of said blade must be accelerated at that time; and as the fountain paste-roller is stationary, or nearly so, at the time when the blade is carried into contact with it to be charged with paste, its motion must be such that the blade will not sweep over the surface of the roller, but be carried quickly into contact with, and withdrawn from, the same. This is

accomplished by rocking the blade in its carrying-arms 138, independently of its movement in a circular path around the shaft 79. When the blade approaches the fountain-roller it stands in the position shown in Fig. 24, with its edge thrown forward of the center of its shaft, and consequently carried inward toward the shaft 79, in which position it stands over the fountain-roller. Now, the shape of the cam 103 is such that as the shaft 140 continues its circular movement the rock arm 102 will move and swing the blade backward, so that it will stand in alignment with its carrying-arms 138, and be extended its greatest distance from the shaft 79, at which time its edge is thrust into contact with the fountain paste-roller, as in Fig. 25.

As the shaft 140 further continues its circular movement the cam causes the blade to continue its rearward movement, raising its edge clear from the fountain-roller. When it has left the fountain-roller, as in Fig. 26, the shape of the cam 103 is such as to hold the paste-blade in its rearmost position during about one-third of its circular travel; and when it approaches the cylinder 30 the cam is so shaped as to turn it gradually forward, causing the edge of the blade to accelerate its motion so that its movement shall be equal to the speed of the cylinder, passing in contact with the paper it supports, applies paste thereto, as is seen in Fig. 21. When, however, the blade has been, in its foremost position, moved into contact with the sheet, its rock-arm 102 passes over the highest portion of the cam 103, until it descends to the lowest part of said cam, to be again brought into contact with the fountain-roller.

The pasting-blade may make any number of complete turns to one of the cylinder; but in that case its shaft must run in bearings that have a slight rising and falling or oscillating motion, so as to bring the blade into contact with the paper on the cylinder only at the proper time. As the line of paste must be applied to the center cross-margin of the sheet, the pasting-blade will be brought into contact with the first sheet collected, as last hereinbefore described, nearly on a line with the edge of the leading folding-blade; and since the said folding-blade lies slightly below the surface of the cylinder 30, the pasting-blade will force the paper slightly into the cavity thus formed, as in Fig. 21; but the center margin of the second sheet never reaches the pasting-blade, for it is forced, together with the first sheet, upon which it has been laid, into the nip of the folding-rollers, through which the two are together drawn and caused to adhere together by the transverse line of paste applied to the outer surface of the first sheet. The pasting-blade at the second revolution of the cylinder strikes into the then uncovered cavity occupied by the folding-blade, as in Fig. 23. The guard 105 will, of course, prevent the ends of the sheets being folded from drooping down onto the pasting-blade. The pasting apparatus may be located so as to apply the paste to the sheets at any point in their passage to the folding devices, and to either side of the sheet, as may be required, or it may be omitted altogether.

Instead of collecting the two or more sheets by the operation of the cylinder 30, as hereinbefore described, they may be collected by making the first sheet travel a greater distance than the second, and the first and second a greater distance than the third, so that they will all meet together, as described in Patent No. 131,217, granted to Hoe & Tucker, September 10, 1872, and thus collected be carried by the cylinder 30 to the action of the folding devices.

The collection of two sheets (which may be two four-page sheets to form one eight-page paper) by this method is illustrated in Fig. 42, where the tapes 61 are made to pass under a pulley, 143, up over a pulley, 145, and thence under the roller 32, being returned, in this instance, over a pulley, 146. A third set, 142, of tapes runs over pulleys 144 and 145, forming, with the tapes 61, a prolonged passage-way, the entrance to which is governed by a switch, 151, operated by a cam, 152. The first or outside sheet, forwarded by the tapes 61 62, is directed up into this prolonged passage-way by the switch 151, while the second or inside sheet is carried directly to the cylinder 30, for the reason that the switch 151 is rocked into the position shown to so direct it. The first sheet thus travels the longer distance, and emerges from the prolonged passage-way, being directed by the guard 158, just in time to join the second sheet in the common path and be laid thereon, seized by the gripers, and carried onward to be folded or doubled by the folding-blade into the folding-rollers 33 54.

An instance of the location of the pasting mechanism, so as to operate upon the upper surface of the sheet, is also illustrated in Fig. 42, Fig. 43 being a rear elevation of it. It consists of a revolving blade, 155, which is so geared as to make one revolution to every second sheet that passes, and it is so timed that after taking a charge of paste from the fountain-roller 156 above it, it will apply the same to the center margin of the alternate or inside sheet. When the two sheets are brought together by the collecting apparatus last described, the outside one (the first, which has traveled through the prolonged passage-way) falls upon the inside one, and the two travel on together and are received upon the cylinder and folded on the pasted margin. The paste-blade 155 is hung by arms fast to a shaft, 154, that makes one revolution to every two revolutions of the delivering-cylinder 30, and the diameter of the circle the paste-blade describes is equal to half the diameter of the folding-cylinder 30, from which it follows that to make the edge of the blade travel with the same speed as the sheet while it is in contact with and applying the line of paste thereto,

the velocity of the blade must be increased to four times its normal speed. To effect this the shaft 154 of the pasting-blade is driven by the well-known differential motion in which the axes of the driven and driver are placed parallel with, but eccentrically to, each other, and the motion is communicated by a crank-pin, as 255, in the one working in a slotted arm, as 153, carried by the other. In this arrangement, in proportion as the speed of the driven, which is the paste-blade 155, is augmented in one part of its revolution it is correspondingly reduced in the opposite part, and advantage is taken of this by putting the paste-fountain at the point of the reduced travel of the paste blade, so that when the edge of the blade passes the paste-roller to receive its charge of paste it is then moving at the same speed as the slow-running paste-roller. The paper, while being pasted, is supported by a roller, 148, having a longitudinal groove in its surface, and this roller is driven by gearing, so that the paste blade will always strike over this groove, thus when from any cause there is no sheet upon it to receive the paste the roller will not be smeared. The paste-blade is cut away, as shown, so as to bridge the tapes 61 62, and thus neither apply paste to or cut them off.

In this modified pasting apparatus the driving toothed wheel 150 gears with a similar wheel, 89, which is one of the train connecting the cutting-rollers with the cylinder 30. The fountain-roller 156 may be slowly or intermittingly revolved in like manner as is the same device in Fig. 1, and this mechanism may be arranged to be thrown out of action, if desired.

To cause the folding-blade to operate at every revolution of its cylinder, the flying-cam will run turn for turn with the cylinder, which may be accomplished by its actuating toothed wheels, which each have an equal number of teeth, as in Figs. 11, 12, 27. To make it operate at every alternate revolution of the cylinder, the wheels for driving the flying-cam may be changed, so that the flying-cam will make one and one-half turns to one of the cylinder, as in Figs. 9, 10, 28. The same result may be attained by changing the driving toothed wheels 18 53, so that the cam will only make one revolution to two revolutions of the cylinder, as in Fig. 29; but this construction makes it necessary to use a sharp-pointed cam, which structure is not advantageous. Other changes in the times of operating the folding-blade may be made by changing the driving toothed wheels to different proportions. Another method of changing the time of the folding-blade is to make the driving toothed wheels 53 on the shaft 20 of the cylinder 30 wider than the flying-cam wheel 18, so that when in its working position the flying-cam will project a certain distance inward beyond the side of the driving toothed wheel 53. This may be done, as in Figs. 30, 31, by providing the flying-cam shaft with a grooved wheel, 241, fast on its outer end, in the groove of which wheel one end of an actuating lever-arm, 112, enters, its opposite end entering the groove of the cam 113. This cam revolves on a stud, 240, fixed to the frame-work, and is provided with a toothed wheel, 111, meshing with a similar wheel, 110, on the extreme outer end of the cylinder-shaft 20. As the cam revolves its groove causes the actuating lever-arm 112 to slide on its stud, and carry the flying-cam from and toward the end of the cylinder 30, its wheel 18 at all times remaining geared with the wheel 53. As soon as the folding-blade has been operated and passed by the flying-cam 15, this latter, with its wheel 18, will be automatically drawn back, so that, by the time the folding-blade again approaches, the flying-cam will be drawn back out of its path of travel, and the blade will pass by unoperated. During the next revolution of the cylinder the flying-cam may be advanced to its working position, or it may be kept back while the cylinder makes two or more revolutions, and then advanced. Thus the folding-blade can be made to operate at each first, second, third, or any desired revolution of the cylinder.

A folding-cylinder is sometimes furnished with two folding-blades, whereby the folding operation is accomplished twice at every revolution of the cylinder. To operate these blades successively the flying-cam may make two revolutions to one of the cylinder, thus operating each blade as it passes; or the cam-wheel 18 may run turn for turn with the cylinder, and have two flying-cams, 15, on it at opposite points of its circumference, each of which will operate a blade as it passes. (See Fig. 32.) To operate alternate blades, one of these flying-cams may be removed, or the flying-cam may be caused to make a revolution for every blade that passes, as in Fig. 33, and be reciprocated in and out of the reach of each alternate blade by properly proportioning its toothed wheel 18 to its driving-wheel 53. This last arrangement is also applicable to folding-cylinders carrying three or more blades, as it will operate each first, second, third, or any desired blade.

Instead of the flying-cam making complete revolutions, as above described, it may, in certain cases, as when operating each folding-blade as it passes, simply vibrate its point back and forth over the recess in the female or stationary folding-cam, as in Figs. 34, 35, 36, by means of a suitable cam, 114, attached to the folding cylinder-shaft or elsewhere, in the groove of which cam 114 runs the end 115 of a rock-arm attached to the flying-cam shaft 17. While the folding-blade is passing, the point of the cam will move over the female cam in the same direction as if driven by gearing, and in the interval between the passages of the folding blade or blades it will be vibrated to resume its normal position, in readiness to again operate and actuate the next passing blade. In this manner a cylinder, having any

desired number of folding-blades in it, can be successfully operated.

The delivering-cylinder 30 might be constructed of a series of short cylinders, set at a distance apart upon a common shaft, thus providing between their edges openings corresponding with the grooves 4 134, and this cylinder might be driven by other gearing than that shown—for instance, miter-gears and a shaft connecting it with the shaft of the type or impression cylinder. And as this delivering-cylinder constitutes an endless carrier, the function of which is to support the sheets, it may be substituted by other constructions which provide an endless carrier for the sheets.

The several rollers which carry tapes, as well as the folding-rollers, may be provided with reduced peripheries at the points occupied by the tapes, or, instead of being continuous, they might be composed of a number of pulleys fixed upon a common shaft.

The folding-rollers might be placed at any other point of the periphery of the cylinder 30, a lower position being sometimes advantageous. Moreover, though folding-rollers are herein shown, it is obvious that the folding-blade may be projected into jaws formed by longitudinal strips or bars, in which case a reciprocating frame-work, carrying gripers, might advance, seize the folded sheet, and withdraw and deposit it upon a piling-table or over another set of folding devices.

Though the folding-blade herein shown is composed of two blades secured opposite to each other on a common shaft, it is obvious, since only one of said blades acts at a given time at the folding jaws or rollers, that a single blade only is required; but, if that construction be adopted, then said single blade, after the folding operation is completed, in which it is turned into a rearward position, may, during its circular travel around to again co-operate with the folding-jaws, receive a semi-rotation, to be brought into proper position by means of a flying-cam placed in the inside of the cylder 30.

The motions imparted to the folding-blade may, in some arrangements of this apparatus, be derived from an internal wheel and a pinion on the blade-shaft, as is described in Patent No. 171,196, granted to me December 14, 1875.

Furthermore, though gripers have been described as a means for carrying the sheets around with the cylinder 30, it is practicable to omit them, as is set forth in the Patent of December 14, 1875, No. 171,196, hereinbefore referred to.

The mechanisms and their operations, as thus far described, are adapted to the manipulation of printed sheets of any width equal to or less than that of the type and cutting cylinders, and of a length equal, or nearly so, to the circumference of the cutting-cylinders. If that is the size of the sheets to be manipulated, of course the type-cylinder need be no larger than the cutting-cylinders, but, as has been stated, the type-cylinder has an area circumferentially equal to the length of two sheets, and longitudinally equal to the width of one or two sheets, as may be desired.

If it is desired to print and fold the ordinary four or eight page newspapers of the present day, the pages of type or stereotype-plates may be arranged on the type-cylinders in such positions as to adapt the printing, cutting, collecting, piling, pasting, and folding mechanisms comprised in this apparatus, to—

First, print on both sides, cut off, and pile open or flat eight-page sheets;

Second, to print, cut off, and pile open or flat four-page sheets;

Third, to print, cut off, and fold four-page sheets;

Fourth, to print, cut off, paste, fold, and cut into leaves eight-page sheets.

In web-printing machines in which one "form" covers the whole circumference of the type-cylinders the size of the sheets cut from the web of paper can be varied in but one direction, and that is in the direction of the length of the type-cylinders, or, in other words, in the width of the web. From this it is evident that, with a type-cylinder of a given diameter, in order to have the facility of increasing or diminishing the size of the newspaper by lengthening or shortening its columns, the number of pages remaining the same, the columns of type or of the stereotype-plates must run lengthwise of the type-cylinders, and this will be designated herein as system A. Per contra, to have the facility of increasing or reducing the number or width of its columns the columns of type or of stereotype-plates must run around the cylinders, and this will be designated as system B.

As the position of the pages on the type-cylinders and the cutting, collecting, piling, pasting, and folding mechanisms will differ materially in the two cases, the operation of system A—that is, in which the columns of the pages run lengthwise of the type-cylinders—will first be described.

It must be understood that the pages of type or stereotype-plates on one cylinder are for printing one side of the web and those on the opposite cylinder are for printing its opposite side.

Also, let it be understood that the pages herein referred to as being placed on the type-cylinders may be type, stereotype, electrotype, engraved blocks or plates, designs on stone or zinc, or any other printing surface whatever.

The circumference of these cylinders must be sufficient to take on four pages side by side and their length suitable for two pages placed end to end and abutting together at the center, as in Figs. 49 to 52.

For printing, cutting, and piling open or flat eight-page sheets, two pages are placed side by side at each end of their respective cylinders, their heads abutting together at

the center in the usual manner, and these four pages will form a set for printing one side of the sheet. (See Fig. 49, which represents the paper printed at one revolution of the type-cylinder.) As these four pages will cover but one-half of the circumference of the cylinders, a duplicate set is similarly placed on their other half.

The cutting-cylinders for cutting the web into sheets will be half the size of the type-cylinders, as in Fig. 41, or, in certain cases, they may be of the same diameter as the type-cylinders, as in Fig. 44, and furnished with two cutting devices at opposite points of their circumference, as in Fig. 41, one or both of which are so arranged as to be easily thrown out of action. This may be done by simply removing the cutting-blade, or by withdrawing both the cutting-blade and its actuating-shaft, as is described in Patent No. 180,966, granted to me August 8, 1876; or, if the construction shown is used, then, since the motion of the vibrating rock-arm which is derived from the cam-groove 139 and imparted to the cutting-blade is quite short, the cutting-blade may be rendered inoperative by removing the friction-roller 141 from said rock-arm, as is represented in Fig. 41. This done, the cam-groove will have no effect upon the rock-arm 142, and the cutting-blade will not be protruded from the cylinder. When one cutting-blade only operates, and its carrying-cylinder is one-half the size of the type-cylinder, the length of paper printed at each revolution of the type-cylinders will be cut on the line *o*, Fig. 49, into two sheets, having four pages on each side, thus forming eight-page sheets, that will issue from the press sidewise. These will be carried to and caught by the fingers of the cylinder 30, which is of the usual size, collected, and retained upon it until, say, six sheets are accumulated, when they will be discharged in a body or mass to the sheet-flier 27, which will pile them open or flat on a table, as is done by the well-known Hoe web-printing machine.

If it be desired to print and pile open a four-page sheet, then four sets or pairs of pages, each pair duplicates of the other, are put on the respective type-cylinders, two pairs side by side at each end, with their heads to the center, as in Fig. 50.

The paper is printed and cut into sheets of eight pages, each of which is collected on the cylinder as before, but as they are discharged from the sheet-flier they pass by a circular saw or cutter, 106, adapted to be thrown into action against or projected into a groove in the cylinder 60, which slits them longitudinally, on the line *o o*, into half sheets, or now four-page sheets, which are piled open, as in the case of the eight-page sheets hereinbefore described.

To print and fold four-page sheets the pages are placed on the type-cylinders in the position last described, except that their heads, instead of abutting together at the center of their cylinders, all point in one direction, as in Fig. 51. The web is cut on the line *o*, and the eight-page sheets are received on the cylinder 30 as before. But the discharging-switch of this cylinder is now thrown out of action and the folding-blade is brought into operation, as has heretofore been described, so that this cylinder now becomes a folding-cylinder. The sheets, as they are received, are caught by the fingers and carried around until they are successively entered by the folding-blade and folded on the line *x*, between the folding-rollers, on issuing from which they may, if desired, be again folded, either in the same direction or at right angles thereto. A circular saw, like that 106, may be arranged to cut these sheets longitudinally—that is, on the line *o o*, either before or after these folds, (the latter preferred,) into two four-page sheets, which may be conveyed off to be further or cross folded.

To print and fold eight-page sheets the set of four pages are placed side by side in a row around one end of their respective type-cylinders, and a duplicate set around their opposite ends with their heads all pointing in one direction, as in Fig. 52. The paper when thus printed and cut from the web, on the line *o*, will form eight-page sheets, the two ends of which will be duplicates of each other, and these sheets, by reason of the position of the pages on the type-cylinders, will form alternately the inside and outside sheets of an eight-page newspaper, and as such will be folded together on the lines *x*, *x x*. To perform this the folding-blade of the cylinder is, by the mechanism shown in Figs. 9, 10, 28, 29, now made to operate at each second revolution only of the cylinder, so that when the first or inside sheet of the paper reaches it, it is not folded, but, by the aid of the swinging tapes 64, is carried a second time around the cylinder 30, in the manner hereinbefore described for collecting two sheets and simultaneously folding the same.

But now, if desired, the transverse pasting apparatus, Fig. 39 is brought into action, and the first sheet, in passing around the cylinder 30, receives a line of paste or gum along the margin *x x* just where the fold is to be made. As the sheet passes around a second time it receives the second or outside sheet of the paper on top of it, and the folding-blade now doubles the two sheets together on the lines *x*, *x x* into the folding device. But this transverse line of paste may be applied to the second sheet of the pair by the apparatus shown in Figs. 42, 43, in which case the first sheet of the pair will travel through the prolonged passage way to meet and be laid upon the second sheet of the pair which in passing under the pasting apparatus receives a line of paste upon its upper surface. The two sheets will then together pass onto the cylinder 30, be doubled on the pasted line by the folding-blade, and adhere together as they emerge from the folding-rollers. The folded sheets

are slit in two on the line *o o*, either before or after being folded, by the circular saw before mentioned, each half now being a complete double or eight-page sheet folded and cut into leaves.

If, now, it be desired to have the facility of increasing or diminishing the size of the newspaper by increasing or diminishing the number or width of its columns, then, as previously stated for system B, the columns of the pages must run around the type-cylinders, the circumference of which will be the length of two pages placed end to end, and their length sufficient for the width of two pages placed side by side. (See Figs. 53 to 57.) The cutting-cylinders (or it may be only the cylinder carrying the cutting-blades) are of the same diameter as the type-cylinders, (see Fig. 44,) and are provided with cutting devices 95, placed diametrically opposite each other, and arranged so as to be easily thrown out of action, as has been described, or with one cutting-blade, 95, and one perforating-blade, 170. This latter may be constructed to be inserted and removed from the cylinder 97, or be operated therein as are the cutting-blades shown in Fig. 41. Its teeth are arranged as is shown in Fig. 45, whereby the cut it makes will only partially divide the web, as in Fig. 46, which is thus left just strong enough to undergo manipulation in folding and piling, but weak enough to be readily separated by slight force.

For printing and piling open eight-page sheets, the four pages for each side of the sheet are placed on their respective cylinders, as just described, with their heads abutting together, (see Fig. 53,) and one of the cutting devices is thrown out of operation. The sheets will thus issue from the press endwise, and be collected and piled open precisely in the manner already described in the former case, where they issue from the press sidewise.

For printing and piling open four-page sheets, the pairs of pages are placed side by side on their cylinders, the pairs on the opposite side of the cylinders being duplicates of these. (See Fig. 54.) One of the cutting-blades in the cylinder 97 is then removed and a perforating-blade, 170, adjusted in its place, as in Figs. 44, 45. The cylinder 97 will then partially cut or perforate the sheets on the line *o x*, but not sufficiently to make them separate at this point during collecting and piling. Thus they will be piled as eight-page sheets, but may be easily torn apart on the perforated line *o x* by hand, a quantity at a time, into four-page sheets.

For pasting and folding eight-page sheets, the pages are placed on the type-cylinders and the sheets cut off the same as just described for flying open eight-page sheets. (See Fig. 55.) The longitudinal pasting mechanism is now brought into action, and as only one-half of the length of the sheets requires to be pasted—namely, that portion indicated by the dotted lines *x x*, *x x*—they are pressed into and out of contact with the pasting-disk 133 by the guide-fingers 124 125, between which the sheets run, which raise and depress them at the proper time, as has been described.

The delivering-cylinder 30 has a central groove, 134, around it, and the folding-blade is also cut away at the point 132, so that the longitudinal line of paste on the sheets will not touch either. As the blade of the folding-cylinder forces the sheets between the folding-rollers the two halves of the sheet will be folded together on the line *x*, and the line of paste will cause them to adhere. Of course, the pasting can be omitted, if desired.

Another manner of placing the pages on their cylinders, for printing by system B and folding the sheets, is to point the heads of the pages all in one direction around their cylinders, instead of having them abut together, as in the preceding case. (See Figs. 56 and 37.) The cutting-cylinders may then be one-half the size of the type-cylinders, and provided with one cutter; or they may be of the same size, and provided with two cutters at points opposite each other, as before described, so that the paper will always be cut on the line *o* into two four-page sheets. The collecting and folding cylinder will then be of one-half the size of the type-cylinders.

For folding eight-page papers, these two four-page sheets will be cut apart on line *o*, Fig. 56, and collected on the cylinder, the first one received being the inside sheet and the succeeding one the outside sheet, and these are folded together at every second revolution of the cylinder into the nip of the folding-rollers, and from thence are conveyed off to be further folded, as already described for system A, paste being applied on the line *x x* by the longitudinal pasting mechanism, or omitted, as in the preceding case.

For printing and folding four-page sheets by this method the type-cylinders must have two pairs of their respective duplicate pages, so that now all the four-page sheets will be duplicates, which are to be cut apart on line *o*. (See Fig. 57.) The collecting and folding cylinder is then arranged to fold at every revolution, so that it becomes a folding-cylinder only, and the four-page sheets, as they are received, are folded singly.

The foregoing description of printing, cutting, piling, pasting, and folding paper refers principally to eight-page sheets and the same cut in two to make two half-size or four-page sheets; but it is equally applicable to sheets of sixteen or other numbers of pages. In place of the eight-page sheet, suppose it be required to work, say, a sixteen-page sheet of the same size. Then each page above referred to on the type-cylinders would be replaced by two pages of about one-half their size, and the length of the large pages would be the width of the two small ones, and the columns in these would naturally run at right angles to those in the large page. (See Figs. 58, 59.)

This sheet can be printed and folded by either system A or B, according as it may be desired to increase or diminish its size, by altering the length of the pages or their width, as heretofore explained. The positions of the pages in the two systems may by changed in relation to each other to suit the manner in which the folds are made. The sheets emerging from the folding-rollers 33 54 have folds made across them—that is, at right angles to their line of travel. But sheets are also ordinarily cross-folded—that is, folded parallel to their line of travel—and it is very necessary that eight-page sheets, and half or four-page sheets, should be thus folded in the same machine. It has been already described in both systems A and B that eight-page sheets may be formed of two four-page sheets, an inside and an outside one, collected one on the other, and thus receive their first fold and perhaps, also, a second parallel fold together, the folding-blade of the combined collecting and folding cylinder being then inoperative at every second revolution of the cylinder, but while folding four-page sheets singly the folding-blade folds a sheet at each revolution. It follows from this, first, that both eight-page and four-page sheets, as they issue from the folding-rollers, are of the same size; second, that there will be twice as many four-page sheets as eight-page ones; third, that, by reason of the fold the sheets have just received, their breadth is reduced one-half, and consequently a wide space is left between the successive sheets.

These sheets may be directed by a movable switch, 159, operating in connection with the folding-rollers 33 54; diverging channels 161 162, at the delivery ends of which are placed slowly-moving receiving-rollers 163 164, and endless tapes 165 166, which carry them alternately to a folding device, by which they are a second time folded, as is shown in Fig. 47, and claimed in another application.

If this apparatus be used for imparting to the sheets their second fold (which obviously will be parallel with or at right angles to the first fold, according as the folding-blade for making it is placed) the movable switch will, when directing four-page sheets, be vibrated twice the number of times it moves when directing eight-page sheets, which movement may be made by changing its actuating-cam, as is apparent.

The cross-folding may be accomplished by a pair of rollers, 167, and a vibrating blade, 168, co-operating therewith, or by a rotating folding-blade and folding-rollers, such as are illustrated in Fig. 48 and the Patent No. 171,196 granted to me December 14, 1875.

In this illustration all the sheets, of whatever size, issuing from the folding-rollers 33 54, may be conducted directly to a second folding mechanism of either of the vibrating or rotating order, and this mechanism will be provided with such change gearing as will adapt its movements to operate quickly when once-folded sheets are small, such as four pages, or slowly when they are large, such as eight-page sheets.

This duplication of folding devices may be continued so as to impart any convenient number of folds to a single sheet, any of which folds may be parallel with or at right angles to any of the preceding ones, as may be desired.

In this apparatus the rotating folding blade 175 is mounted in a revolving carrying-frame 176, which receives its motion through miter-wheels, as 177 180, through gear-wheels 178 179 from the toothed wheel 5, Fig. 2, which drives the folding-rollers 33 54. The movements of the flying-cam 15, being imparted by the gear-wheels 18 53, as in the former cases. This folding-blade co-operates with folding-rollers 167, as is shown in the end view in Fig. 48.

It is to be understood that the following devices are not herein claimed, viz.: A cylinder provided with means for accumulating two or more sheets in a body upon its surface, and means for delivering the same in a mass therefrom, and such mechanisms when provided with a pair of conducting-tapes leading directly onto the cylinder; a printing mechanism, having combined with it a cutting and a rotating folding mechanism; a cutting and a folding mechanism combined; means for controlling the leading end of a sheet and delivering it within the range of action of a rotating folding-blade.

What, therefore, is claimed is—

1. A collecting-cylinder provided with gripers for seizing and retaining sheets thereon, and with means for propelling said sheets when released from the gripers, all substantially as described.

2. A delivering-cylinder provided with means for collecting many sheets thereon, and with mechanism for folding such sheets, said collecting means and folding mechanism being constructed substantially as described, so that either may be rendered inactive while the other remains operative.

3. The combination, with a revolving carrier supporting a rotating folding-blade, of a flying-cam, for operating said folding-blade at each second or repeated revolution of said carrier, all substantially as described.

4. The combination, with a delivering-cylinder and folding devices, of rocking tapes or rollers 65, all substantially as described.

5. The combination, with a revolving carrier supporting a rotating folding-blade, of interchangeable cam 15 and actuating toothed wheels 18 53, all substantially as described.

6. The combination, with a revolving carrier supporting a folding-blade, of means for automatically rendering the actuating mechanism of the said folding-blade inoperative at any given time or times of the passage of said folding-blade past its co-operating folding device, all substantially as described.

7. The combination, with a delivering-cylinder, provided with means for collecting two

or more sheets thereon, and mechanisms for folding the same, of means for propelling the leading end of the sheet or sheets until the desired number are collected, which means is automatically thrown out of action to free said leading end when the body of sheets are folded, all substantially as described.

8. The combination, with a delivering-cylinder, provided with means for collecting two or more sheets laid one upon the other in succession thereon, of means for pasting one or more of said sheets, and means for simultaneously folding the same sheets, all substantially as described.

9. A collecting-cylinder, provided with means for receiving sheets at one point, and with means for delivering sheets at two points, all substantially as described.

10. The combination, with a rotating folding mechanism and a longitudinally-pasting mechanism, of a sheet-guide, for automatically moving the sheet or web into and out of contact with said pasting mechanism, all substantially as described.

11. The combination, with a paste-fountain roller and the delivering-cylinder, of a rotating paste-blade and mechanism for accelerating and retarding the movement of said paste-blade, so that it shall travel with the same speed as the surface of the delivering-cylinder in applying a transverse line of paste to the paper carried by said delivering-cylinder, and be carried into contact with the fountain-roller, so as not to sweep over its face, all substantially as described.

12. The combination, with the delivering-cylinder and paste-fountain roller, of the revolving paste-blade 59, rock-arm 102, and actuating-cam 103, substantially as described.

13. A cylinder provided with a cutting-blade and a perforating-blade, the said perforating-blade being removable, substantially as described.

14. The combination, with the cylinder 30 and sheet-directing tapes 61 62, delivering the sheets directly to the cylinder, of the fixed guides 108, substantially as described.

15. The combination with the cylinder 30, sheet-directing switch, and fixed guides 108, arranged together so as to conjointly guide the sheets, substantially as described.

16. The combination of the toothed wheels 18 53 with plates 131, substantially as described.

17. A delivering-cylinder, provided with mechanisms substantially as described, whereby it operates continuously as a collecting-cylinder, and intermittingly as a folding mechanism, all substantially as described.

18. The combination with a rotating folding mechanism, a rotating web-cutting mechanism, and interposed carrying-tapes, which move at a greater surface-speed than the cutting mechanism, all substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

STEPHEN D. TUCKER.

Witnesses:
H. T. MUNSON,
M. B. PHILIPP.