9 Sheets—Sheet 1

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Sheet-Delivering Apparatus for Printing-Machines.

No. 214,067. Patented April 8, 1879.

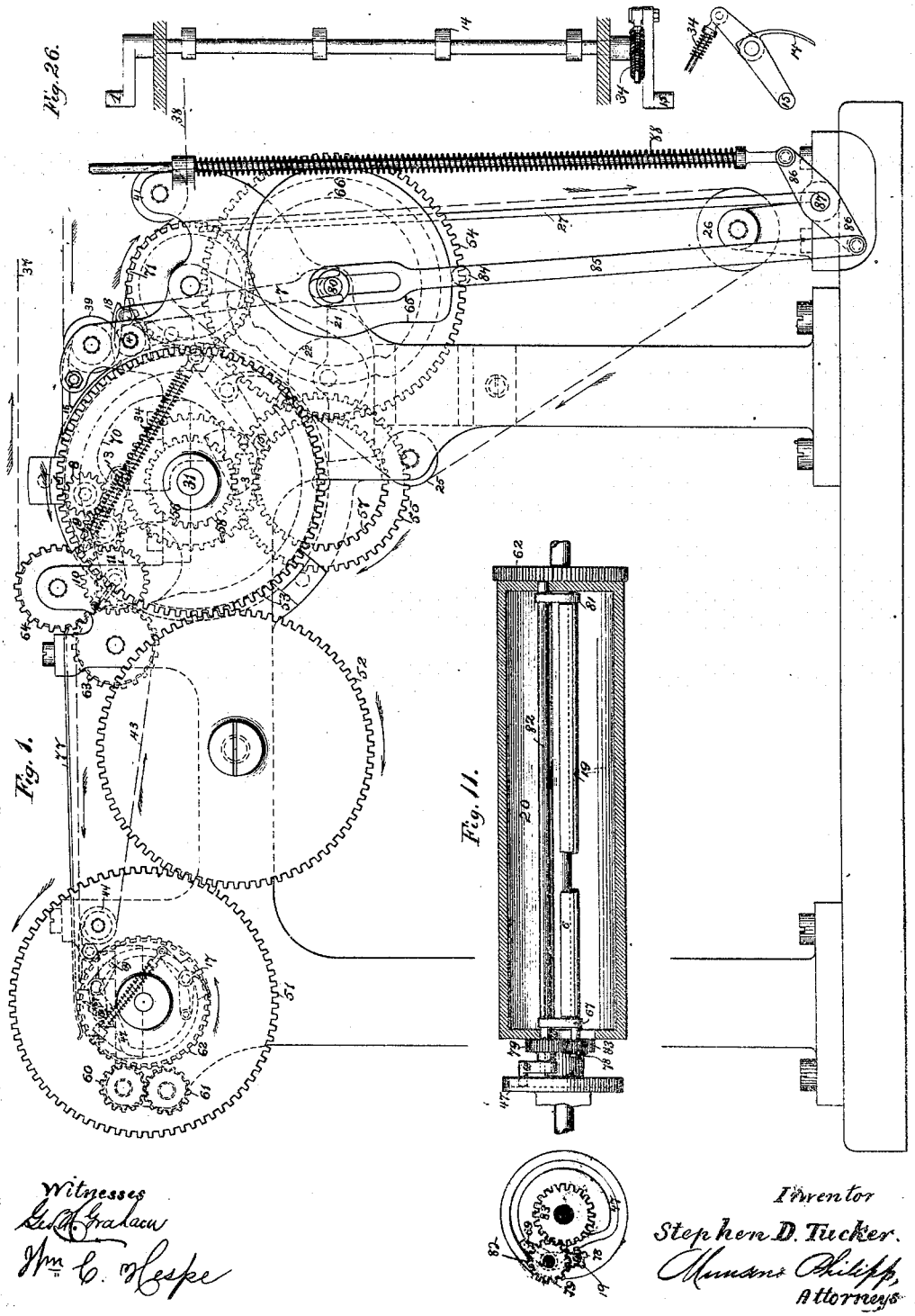

Fig. 26.

Fig. 1.

Fig. 11.

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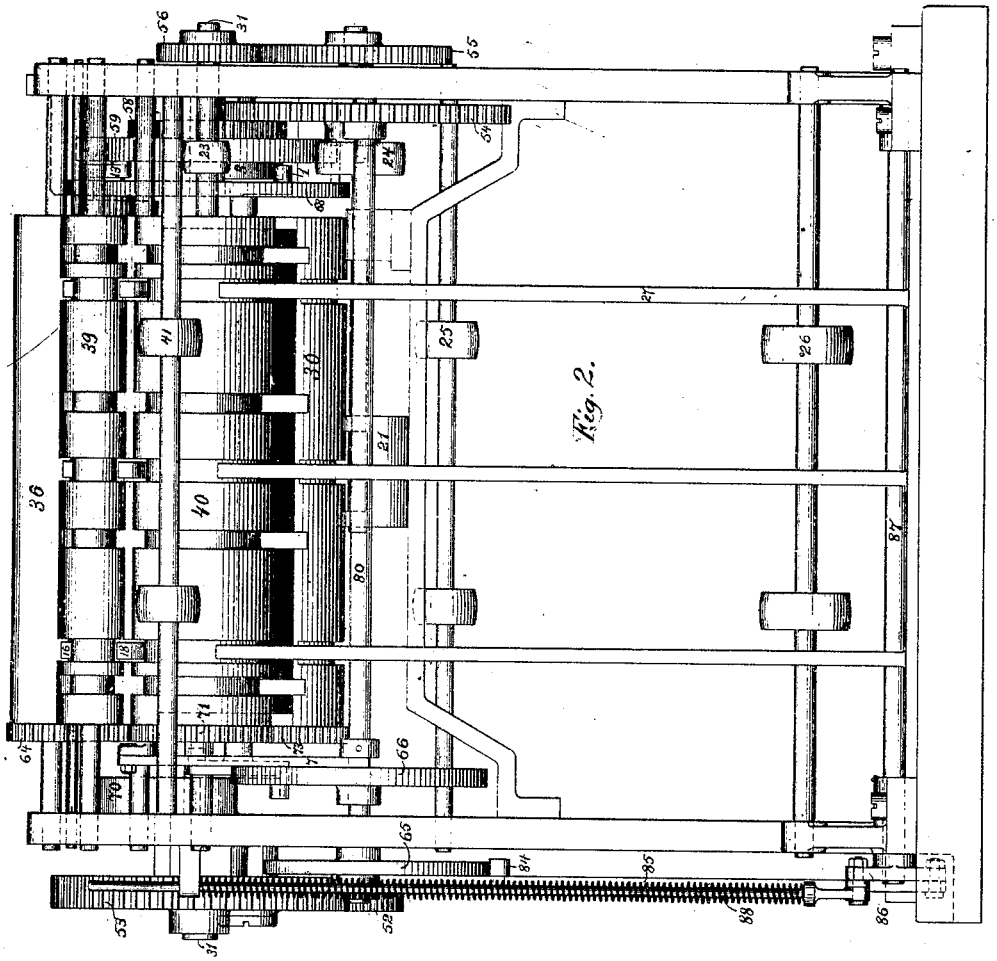

Fig. 2.

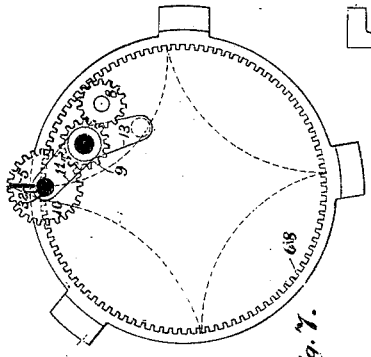

Fig. 7.

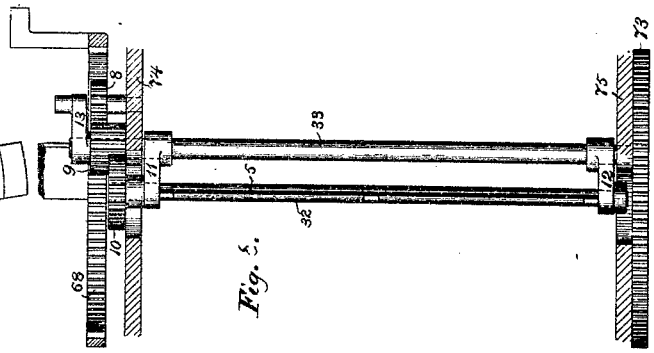

Fig. 5.

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9 Sheets—Sheet 3.

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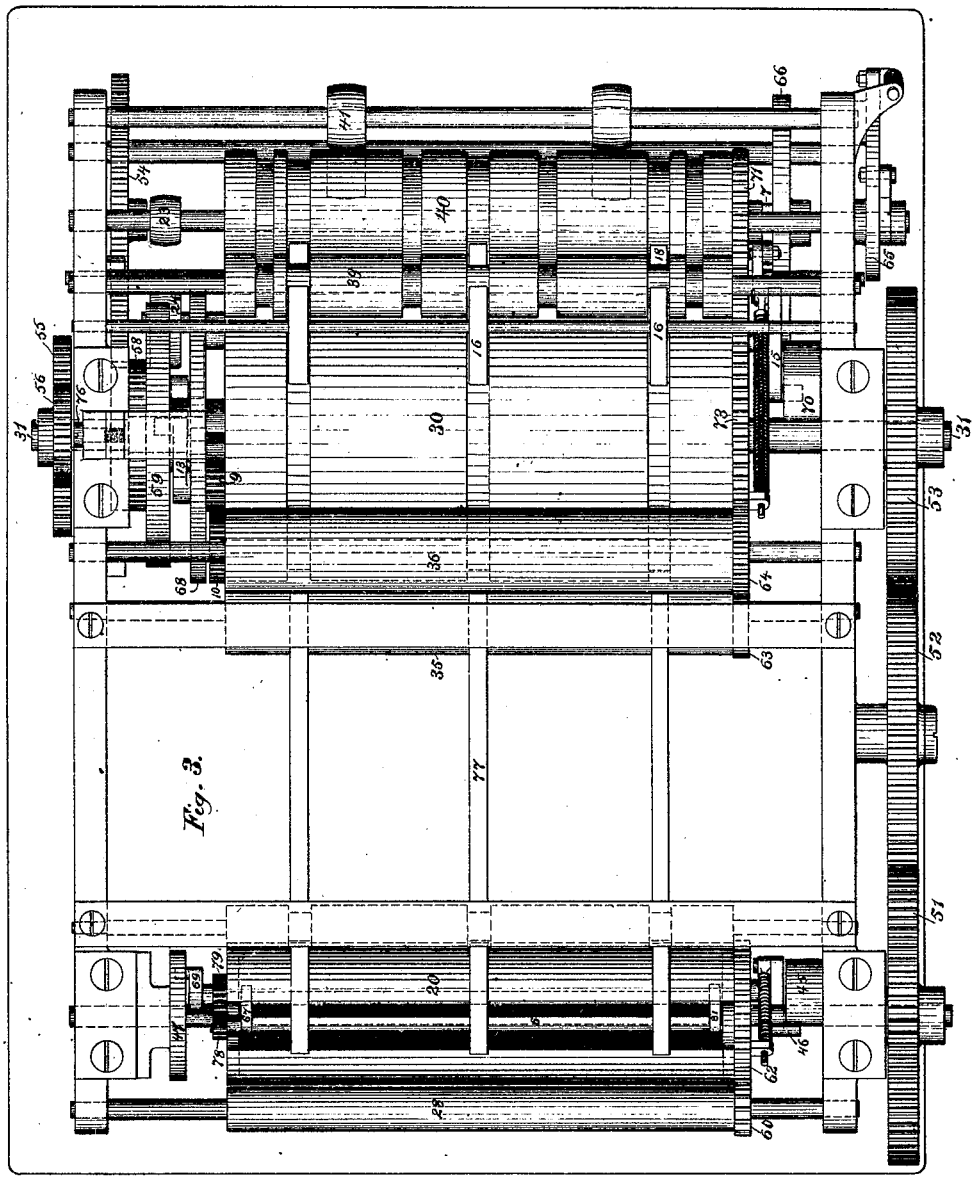

Fig. 3.

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9 Sheets—Sheet 4.

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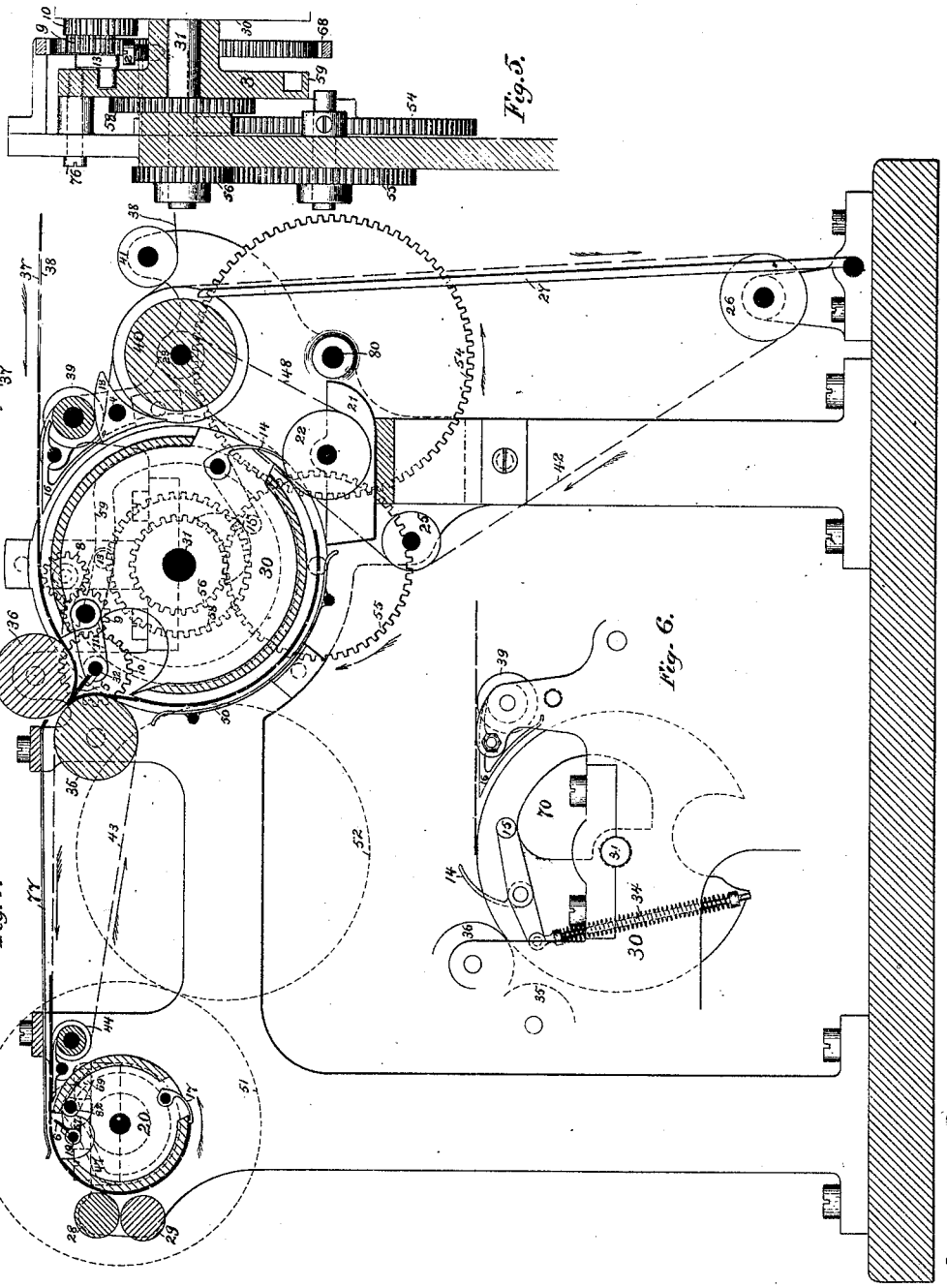

Fig. 4.

Fig. 5.

Fig. 6.

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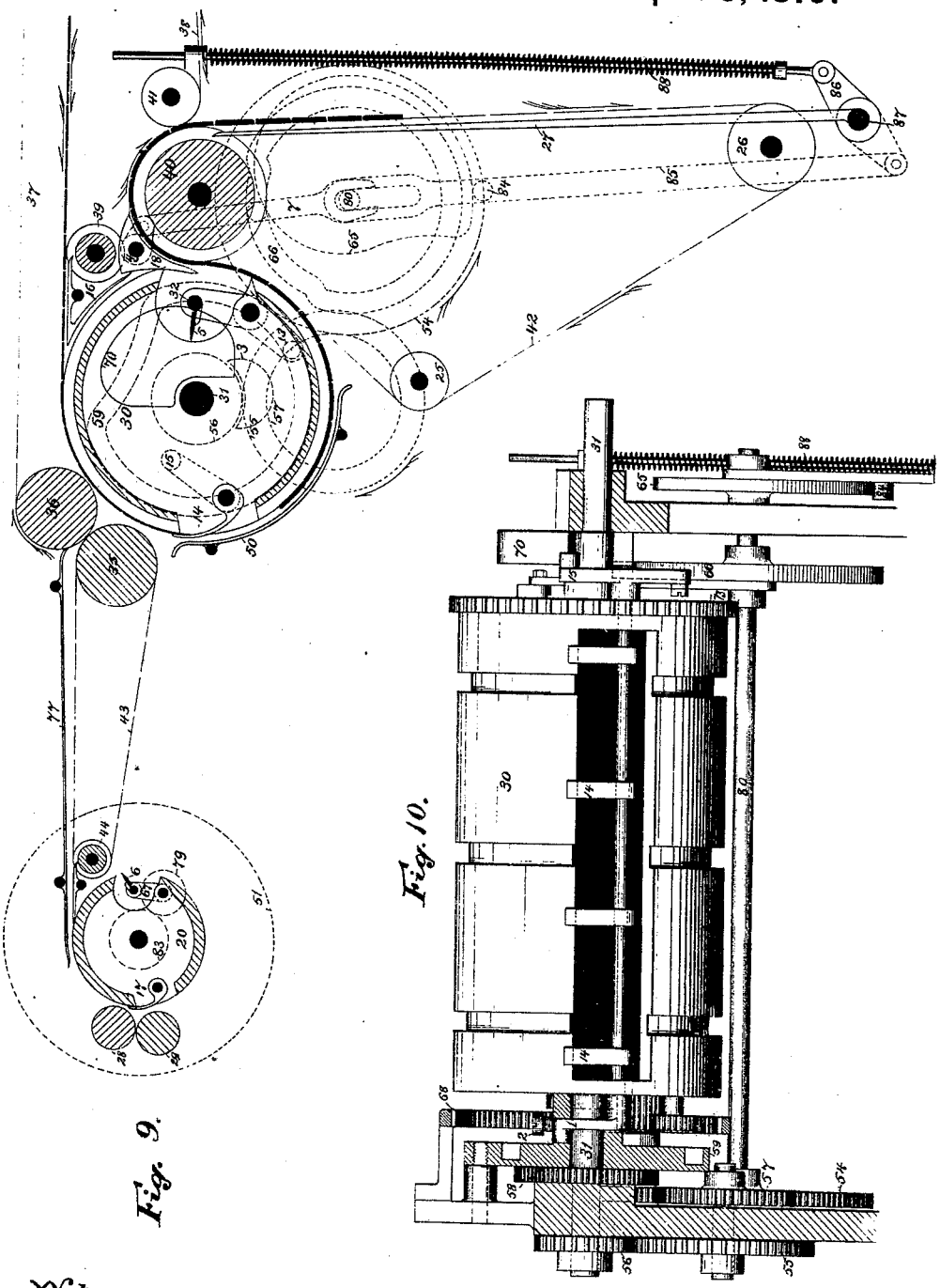

Fig. 9.

Fig. 10.

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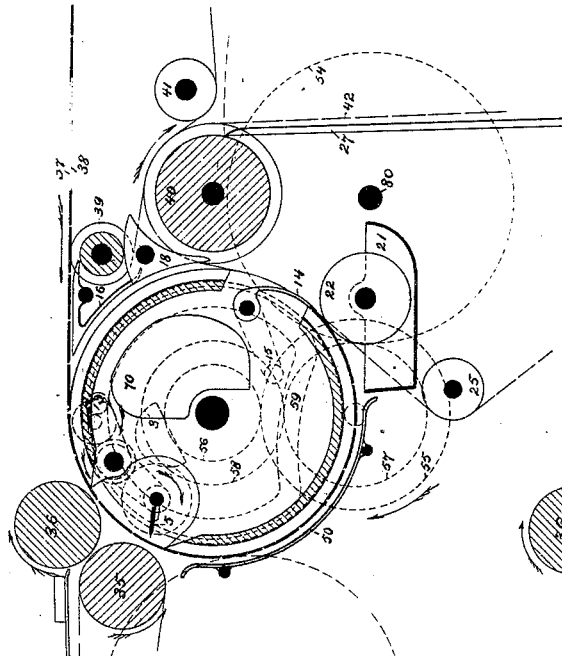


Fig. 14.

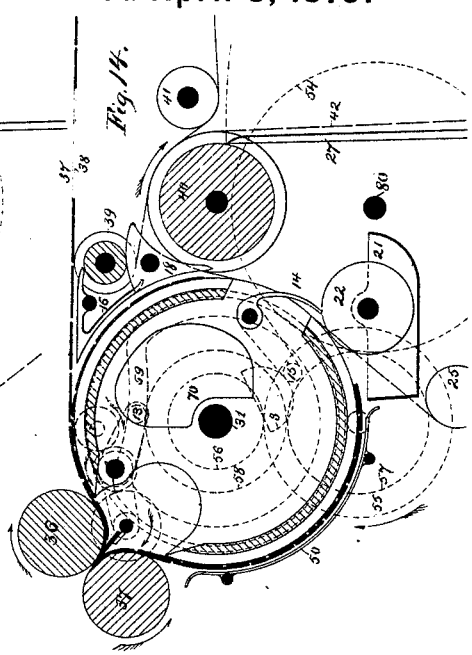
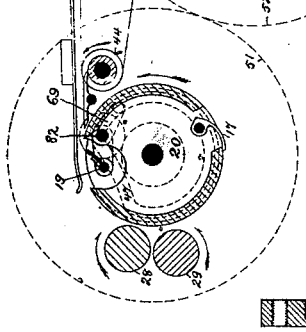


Fig. 13.



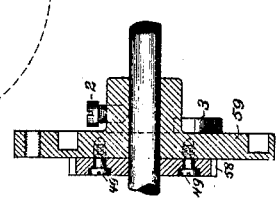
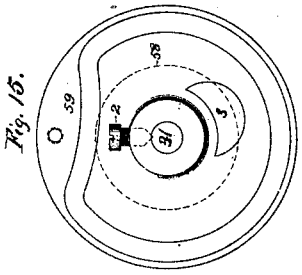


Fig. 15.



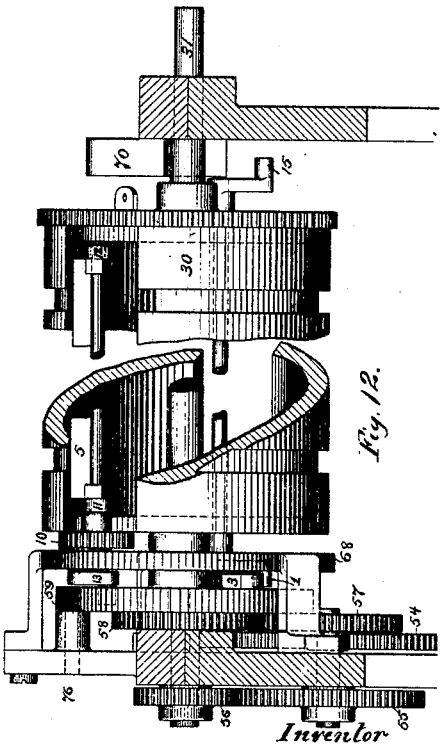


Fig. 12.

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9 Sheets—Sheet 7.

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Sheet-Delivering Apparatus for Printing-Machines.

No. 214,067. Patented April 8, 1879.

Fig. 18.

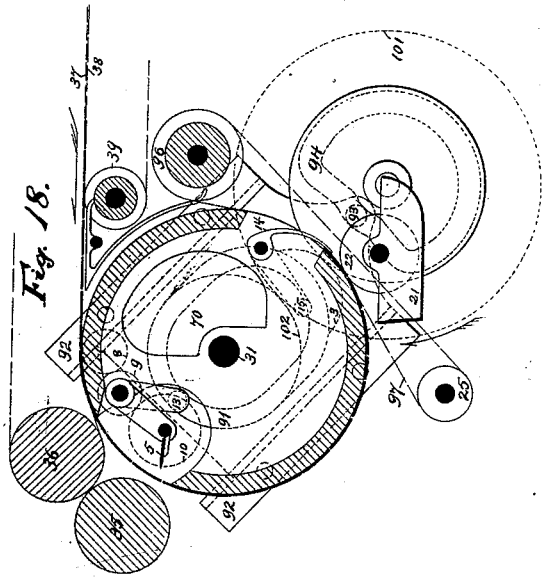


Fig. 17.

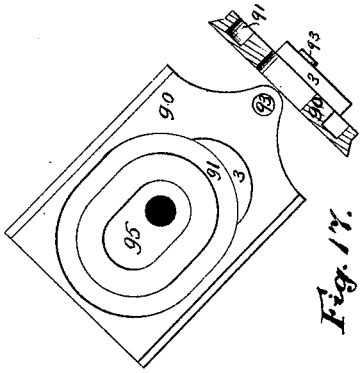


Fig. 19.

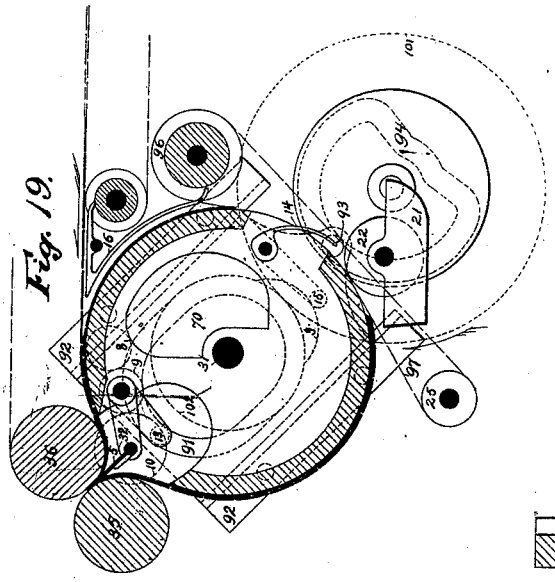
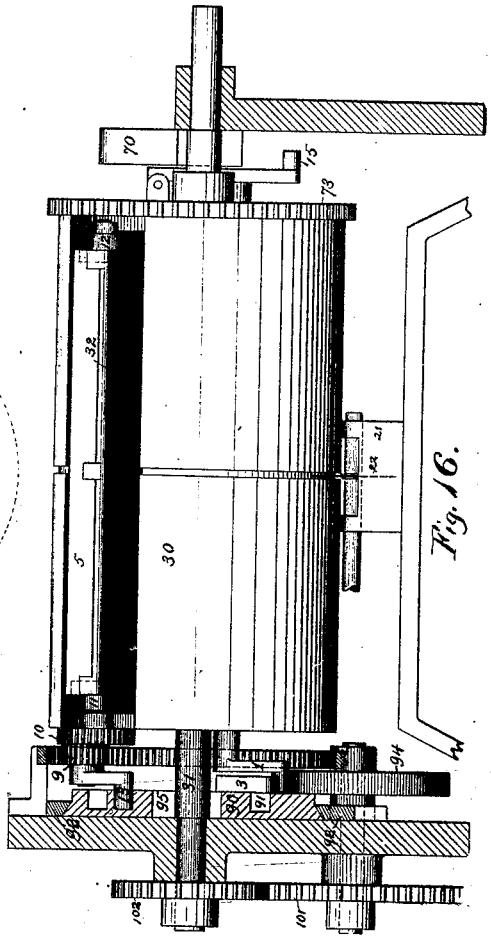


Fig. 16.



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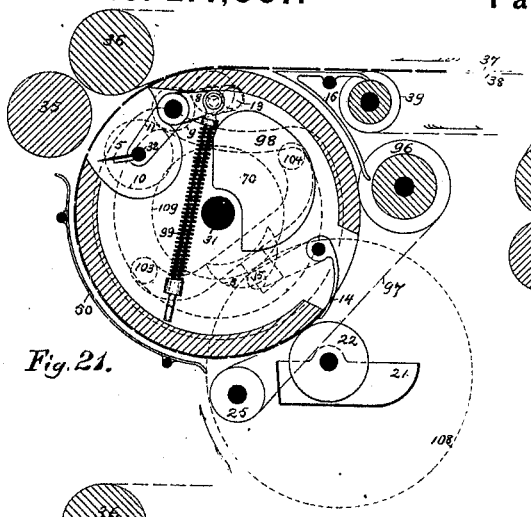

Fig. 21.

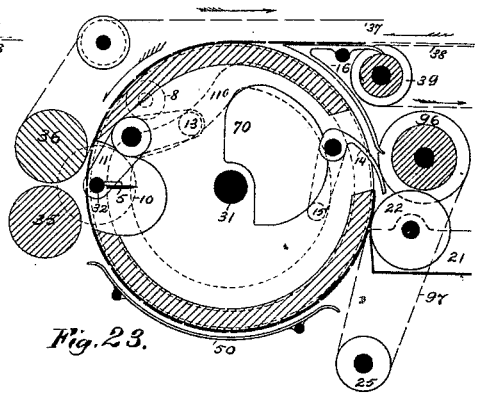

Fig. 23.

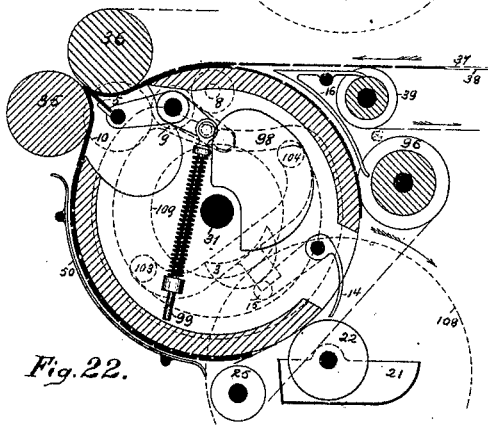

Fig. 22.

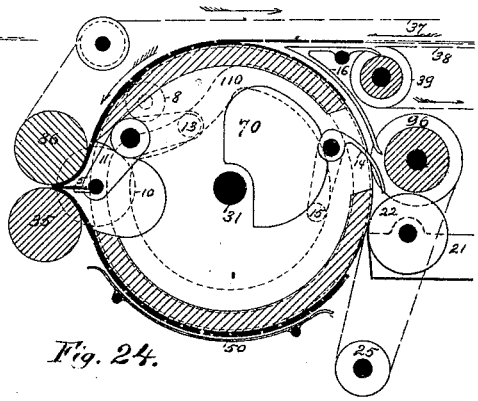

Fig. 24.

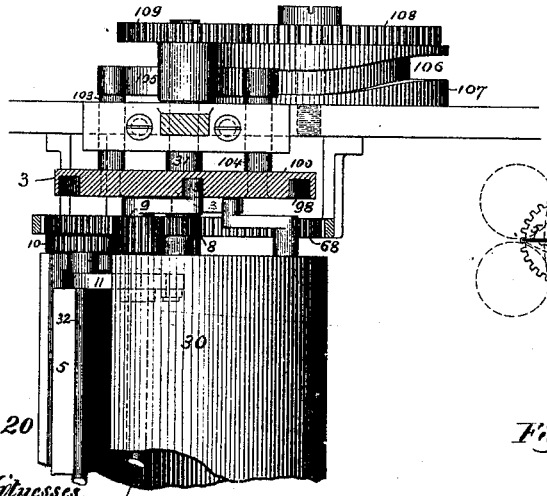

Fig. 20

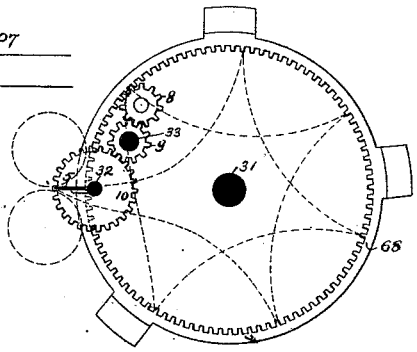

Fig. 25.

Witnesses.
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9 Sheets—Sheet 9.

S. D. TUCKER.

Sheet-Delivering Apparatus for Printing-Machines.

No. 214,067. Patented April 8, 1879.

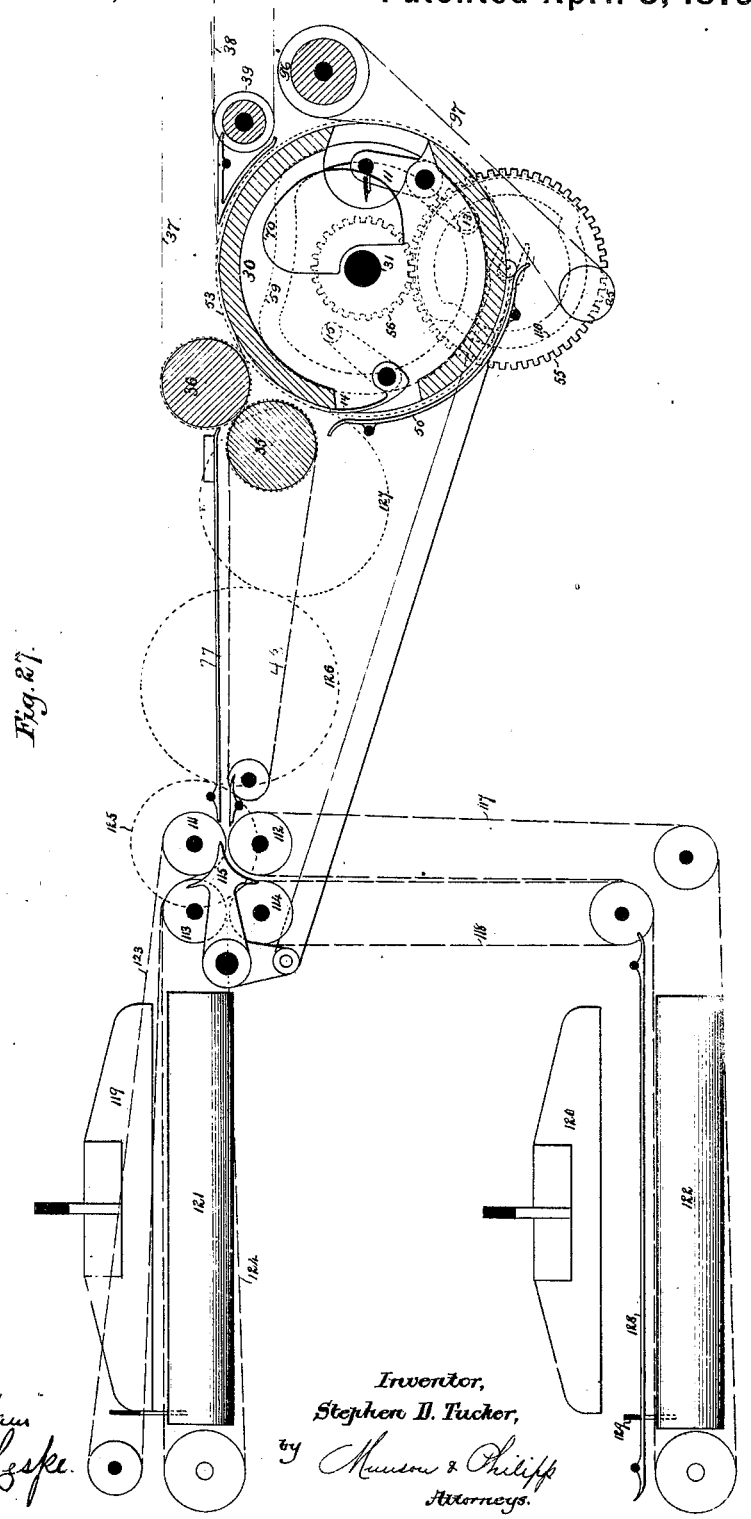

Fig. 27.

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UNITED STATES PATENT OFFICE.

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

IMPROVEMENT IN SHEET-DELIVERING APPARATUS FOR PRINTING-MACHINES.

Specification forming part of Letters Patent No. **214,067**, dated April 8, 1879; application filed September 16, 1878.

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 certain new and useful Improvements in Sheet-Delivering Apparatus for Printing-Machines; and I do hereby declare that the following specification, taken in connection with the accompanying drawings, is a full, clear, and exact description of the same.

In said drawings, Figure 1 is a side elevation of the apparatus, which, for convenience of illustrating their position, shows the arrangement of the gear-wheels as they appear when the apparatus is adjusted as in Fig. 12. Fig. 2 is a front-end elevation of the apparatus when adjusted to fold each successive sheet conducted to it, while Fig. 3 is a plan view, and Fig. 4 a longitudinal sectional elevation, of the apparatus so adjusted. Fig. 5 is an elevation of the mechanisms at one end of the cylinder 30, adjusted as in Figs. 2, 3, and 4, and as seen from the rear. Fig. 6 is a diagram showing the operation of the main griper-cam. Fig. 7 shows the fixed annular wheel or other gearing for operating the rotating folding-blade, and a diagram of the path of its folding-edge. Fig. 8 is a sectional plan view of said gearing and blade, and the heads of the cylinder which carries the same. Fig. 9 is a longitudinal sectional elevation of the apparatus, showing the mechanisms adjusted to collect, accumulate, or gather many sheets and deliver them in a single mass, Fig. 10 being a rear elevation of the cylinder and and its gearing so adjusted. Fig. 11 shows, in plan and end views, the structure of the secondary sheet-manipulating mechanism, the same being in the positions shown in Fig. 1. Fig. 12 is a rear elevation of the cylinder 30, showing the mechanisms adjusted to gather, collect, or accumulate two sheets, one upon another, and to paste together and fold the same as one product, Fig. 13 being a longitudinal section, and Fig. 14 a sectional diagram, illustrating this operation, while Fig. 15 shows, in side elevation and section, the construction of the folding-blade-projecting cam. Fig. 16 is a rear elevation of the cylinder 30, showing a modification of the folding-blade-projecting cam and the mechanism for moving it, Fig. 17 showing, in elevation and section, the construction of said cam; Figs. 18 and 19 being diagrams illustrating the operation of the apparatus so modified. Fig. 20 is a plan view, illustrating a further modification of the mechanism for operating the folding-blade-projecting cam, by which two or more sheets may be collected, pasted, and folded as a single product; Figs. 21 and 22 being diagrams illustrating the operation of the apparatus so modified. Figs. 23 and 24 are diagrams illustrating a modification of the mechanisms for actuating the folding-blade, whereby the operation of collecting two sheets, pasting, and folding them as a single product may be accomplished by properly proportioning the gearing for rotating said blade. Fig. 25 is a diagram showing the path of travel of the folding-edge of the blade in said operation. Fig. 26, Sheet 1, shows the griper-shaft in detail, with rock-arms on each end, to be operated by the two griper-cams; and Fig. 27 represents a further modification of the invention.

The present invention consists in a folding-blade supported upon a shaft in a revolving carrier, and rotated by means of a pinion on said shaft, a stationary annular wheel, and two intermediate wheels, whereby said blade is caused to rotate in the proper direction, and will, when projected from and withdrawn toward the center of said carrier, co-operate with stationary rollers, and effect a folding operation. It also includes a revolving carrier, preferably in form a cylinder, adapted to receive sheets upon its surface, and provided with means for collecting many sheets thereon, and also supporting a single folding-blade, which is provided with mechanisms whereby it is caused to rotate within the periphery of said carrier, except when it is projected to co-operate with a pair of stationary folding-rollers, and with mechanisms whereby it is projected outward from and withdrawn toward the center of said carrier at each revolution, or at each second or other repeated revolution of the carrier, at which time its edge enters between and withdraws from said rollers, and performs the folding operation.

It further consists in a cam for projecting and withdrawing said folding-blade at the proper times.

The invention further includes the combination, with the blade-projecting cam, of an auxiliary cam for actuating the gripers of the carrier in proper time to release the sheet supported upon the carrier, so that the same may be correctly folded, whether the apparatus be adjusted to fold each successive sheet or to collect two or more sheets and fold them as one.

It also comprises other constructions and combinations of mechanisms, all of which will be more particularly hereinafter pointed out and distinctly claimed.

The various mechanisms constitute a sheet-delivering apparatus, which is designed to be attached to and be driven from a web-perfecting printing-machine, though it will manipulate sheets fed to it by any means. Its primary sheet-manipulating mechanism consists of a revolving carrier, which, for the reason that, as herein arranged, it is designed to receive and support sheets upon its surface, is shown to be constructed in the form of a cylinder, 30. This cylinder is provided with mechanisms whereby successive sheets received upon its surface may be folded singly as they are delivered therefrom, or many sheets may be laid one on another upon its surface, and, thus collected, be delivered therefrom as a single pack or body; or two or more sheets may be collected upon its surface and folded in a single pack as they are delivered, the same being pasted so as to adhere together, if desired.

In all of these operations the sheets are received in succession from tapes 37 38, to which they are delivered by the cutting-cylinders of the web-printing machine, as in Patent No. 191,494, and which tapes lead the sheets onto said cylinder 30. The upper tapes, 37, passing in contact with the upper surface of the cylinder 30, are returned over the upper of a pair of folding-rollers, 35 36, which, geared together by toothed wheels 63 64, are driven from a toothed wheel, 73, Fig. 3, fast to one end of the cylinder 30, and thus revolve in unison with said cylinder and drive the tapes 37 with a like speed. The lower tapes, 38, run parallel with the tapes 37, pass over a roller, 39, pass in contact with a delivery-cylinder, 40, and return under pulleys 41 toward the aforesaid cutting-cylinders.

The cylinder 40 is driven by a toothed wheel, 71, which gears with the wheel 73, and is thus moved in unison with the cylinder 40, thereby imparting the same surface-speed to the tapes 38 which the tapes 37 have, and hence causing the two sets of tapes to feed the sheets uniformly.

The space between the rollers 39 and the surface of the cylinder 30 is spanned by guards 16, which insure the proper direction and even passage of the sheets. This cylinder 30 is made larger than the cutting-cylinders, and as it runs turn for turn with them it has a greater surface-speed, in order that the sheets shall be separated a distance apart, as is fully described in the aforesaid patent. This cylinder is recessed at one point to accommodate the gripers 14, whose shaft is hung in the heads of the cylinder and provided with a spring-seated arm, 34, and a rock-arm, 15, at one end, and with a rock-arm, 1, at the opposite end. (See Figs. 1 and 26.) Its rock-arm 15 engages and is operated by a cam, 70, fixed to the side frame in such a position that said gripers will be opened to receive and closed to seize the leading edge of an incoming sheet, and thus hold the same onto the cylinder, and also open at the proper time and extent to release sheets to be discharged at the switches 18. Its rock-arm 1 engages and is operated by the auxiliary cam 3, supported on the face of the blade-shaft-projecting cam 59, whereby the said gripers are opened at the proper time to release a sheet or sheets when the same are to be folded. Both of these operations will be more fully hereinafter described.

The cylinder 30 supports also a folding mechanism, the folding-blade whereof is provided with means whereby it is rotated continuously upon its own axis, and, though turned outward many times during each revolution of its carrying-cylinder 30, it so turns within the periphery of said cylinder, except at the proper time when it is to co-operate with the stationary folding-rollers, and then is protruded beyond the periphery of the cylinder and entered between said rollers. To this end this folding-blade 5 projects from a shaft, 32, that is journaled in arms 11 12 fast upon a rock-shaft, 33, the latter being journaled in the heads 74 75 of the cylinder, Fig. 8. The blade-shaft 32 has a pinion, 10, fast upon its end, which gears with an intermediate toothed wheel, 9, turning freely upon the rock-shaft 33. This intermediate 9 is made wide enough to gear with an intermediate toothed wheel, 8, which, revolving on a stud projecting beyond the head 74 of the cylinder, gears with a fixed annular wheel, 68, secured to the side frame. By the arrangement the pinion 10 on the folding-blade shaft is kept outside of the annular wheel 68, and is free to be moved in and out without coming in contact with it. The rock-shaft 33 has a rock-arm, 13, the stud or roller on the end of which runs in the groove of a folding-blade-projecting cam, 59, Figs. 2, 4, and 5. This cam 59 is hung on the shaft 31 of the cylinder 30, and provided with means for causing it to revolve independently of said cylinder, and with means for causing it to revolve in unison with said cylinder, which means and modes of operation will be hereinafter explained. It is also provided with means for securing it in a stationary position with respect to said cylinder, which consists of a screw-pin, 76, Fig. 5, passing through the side frame and entering a socket in said cam-wheel. This stationary adjustment of said cam-wheel is its position when the mechanisms are arranged to fold each sheet received upon the cylinder 30, which is the operation of the apparatus now to be described.

As the cylinder 30 revolves it carries with it the folding-blade 5, the shafts 32 33, the pinion 10, and the intermediates 9 8, and, as the latter is made to rotate by running in the annular wheel 68, it causes the folding-blade 5 to receive a like motion through the intermediate 9 and pinion 10. Thus the folding-blade 5 will be caused to rotate upon its axis as many times during each revolution of the cylinder 30 as the teeth of the pinion 10 are proportioned to those of the annular wheel 68. In the present instance this proportion is as one is to four, and hence said blade will make four rotations during each revolution of the cylinder 30. As the cylinder 30 revolves to produce these rotations of the blade the rock-arm 13, traversing the lower part of the groove of the cam 59, now stationary until its greatest depression is reached, causes the blade-shaft 32 to be projected outward from the center of the cylinder 30, and as the pinion 10 partakes of this same movement and is kept in constant gear with the intermediate 9 by reason of its carrying-arms 11 12 being fixed on the shaft of said intermediate, it follows that the said blade will be given the compound movements of rotation and outward projection, and will thus be protruded through an opening in the cylinder, and it is so timed as to be turned or entered between the folding-rollers 35 36. As the motions proceed the folding-blade, continuously rotating, will be withdrawn from said folding-rollers by reason of its rotation and the inward movement given to its shaft 32 by the action of the cam 59 on the rock-arm 13 while the latter is traversing the low part of the groove in cam 59 from the point of its greatest depression to that of its least depression or where it joins the concentric portion.

When the arm 13 has entered and is traversing the concentric part of the groove in the cam 59 the blade 5 and its shaft 32 and pinion 10 will have reached the extent of their inward movement; and the said devices are retained at such a point within the cylinder that, though the folding-blade continues to rotate, and its edge is turned outward three more times during one revolution of the cylinder and toward the periphery thereof, said blade will not be projected beyond said periphery. The edge of the folding-blade is thus caused to describe the path indicated by the dotted lines in Fig. 8, and hence may be advantageously employed with a carrier adapted to support upon its surface the sheets which are to be manipulated.

A sheet emerging from the conducting-tapes 37 38 will be guided onto the cylinder 30, and seized and held thereon by the gripers 14, which gripers are opened at the proper point to receive the sheet by the cam 70, and closed by the spring-seated arm 34, to seize the same when the rock-arm passes off said cam. Thus held, the sheet will be carried around with the cylinder, its middle portion overlying the point occupied by the folding-blade 5. As this folding-blade, constantly rotated by the action of the fixed annular wheel 68, the intermediates 9 and 8, and pinion 10, approaches the folding-rollers 36 35, the rock-arm 13 will enter and traverse the first half of the low part of the groove of the cam 59, thereby causing the shaft 32 and the folding-blade it carries to be gradually rocked outward. As the rotation of the blade continues, it brings the edge of the blade into contact with the sheet, thus causing said blade to press the sheet outward, and to double it into the nip of the folding-rollers 36 35, the edge of the said blade, by its rotative and outward movements, being carried over the curved surface of the roller 36, and between it and the roller 35, as in Fig. 4.

The gripers 14 are simultaneously opened to release the sheet by contact of their rock-arm 1 with the auxiliary cam 3, which stands in the position shown in Figs. 1 and 4. The sheet thus entered between the rollers 36 35 will at once be seized by and fed outward between them in a folded condition, while the folding-blade 5, still continuing its rotation, and being moved inwardly by the action of the last half of the low part of the groove of the cam 59 upon its arm 13, will be withdrawn from between said folding-rollers, during which movement its edge will be carried over the curved surface of the roller 35. As the movement of the leading end of the sheet is reversed and it is drawn backward in passing through the rollers 36 35, it is prevented from drooping by means of guards 50, which are fixed on rods so as to coincide with the curved surface of the cylinder 30. As the cylinder continues to revolve, the gripers 14 will seize a second sheet emerging from the tapes 37 38, which sheet will be folded by the blade 5 in like manner as was the first sheet; but before said blade reaches its position for co-operation with the folding-rollers 36 35 it will have made three complete rotations idly or inoperatively within the periphery of the cylinder, for the reason that its shaft is held in its innermost position while its actuating rock-arm 13 is traversing the concentric part of the groove of the cam 59, as before explained.

The cylinder 30 is also furnished with mechanisms whereby many sheets may be collected upon its surface and delivered therefrom in a single body, as will now be described. (See Figs. 9, 10.)

An ordinary collecting or accumulating cylinder is provided with an entrance-channel for the sheets, a delivering-channel for the same, means for directing successive sheets upon its surface and there retaining them, so that they will collect one upon another, and with means for stripping the same therefrom in a single mass.

In the present instance, the entrance-channel is constituted by the tapes 37 and the directing-guards 16, and the delivering-channel by the delivering-cylinder 40 and a set of stripping-switches, 18.

The gripers 14, aided by the tapes 42, the

tails of the stationary guards 16, which are concentric with the cylinder, and the faces of the switches 18, retain the sheets upon the cylinder, and said switches operate to strip the same therefrom, all of which will presently be made more clear.

In order that the folding-blade shall be rendered inoperative at the folding-rollers 36 35, through which it would otherwise fold the sheets, as before described, and to adjust the apparatus so as to perform the collecting operation only, its projecting cam 59 is released from the hold of the screw-pin 76, which is removed, as shown in Fig. 10. Said cam is then partially rotated on its shaft, so that the rock-arm 13 of the folding-blade shaft shall be held in that part of its groove which is concentric with the cylinder 30, whereby the folding-blade 5, its shaft 32, and pinion 10 will be held within the periphery of the cylinder, in which position said cam 59 is fixed to the shaft 31 by the set-screw 2, Figs. 5 and 10, and will revolve continuously with the cylinder 30. With the cam 59 thus held the rock-arm 13 will receive no motion therefrom, and, though the folding-blade will continue to rotate, its movements will be wholly rotative, and it will not be projected beyond the periphery of the cylinder. As the auxiliary cam 3 will revolve with the cam 59 and cylinder 30, it will, of course, have no effect upon the gripers 14, so that the gripers will be operated solely by the main griper-cam 70. The switches 18 are mounted upon a shaft, 4, (see Figs. 1, 2, 9,) which is rocked at proper intervals by means of a rock-arm and a rod, 7, the stud projecting from the side of which latter runs in the groove of a cam-wheel, 66. The front faces of the switches are curved so as to co-incide with the periphery of the cylinder 30 when in the position shown in Fig. 4, and their rear curved faces in like manner coincide with the periphery of the delivering-cylinder 40 when in the position of Fig. 9, the said cylinders being grooved to permit this movement of them.

The cam-wheel 66 is mounted upon one end of a shaft, 80, which, at its opposite end, carries a toothed wheel, 54, that is geared to a toothed wheel, 57, (the latter being removed, as in Fig. 4, when each sheet is to be folded, as in the operation hereinbefore described,) which is on a short shaft projecting through the side frame, that carries on its other end an intermediate toothed wheel, 55, which gears with a pinion, 56, fast on the shaft 31 of the cylinder 30. (See Fig. 10.) As the pinion 56 has one tooth to every two teeth of the wheel 55, and the wheel 57 on the same shaft has one tooth to every two teeth of the wheel 54, it follows that the latter will make one revolution to every four of the cylinder 30, and hence will rock the switches 18 into the position shown in Fig. 9 at every such fourth revolution, while the shape of the cam 66 will cause them to stand as in Fig. 4 during the intervening revolutions of said cylinder.

A fly-frame, 27, whose shaft 87 is hung in bearings fixed on the base-plate, is vibrated at proper intervals by the following means: It is held up so that its ends enter the grooves in the delivering-cylinder by a cam, 65, on the shaft 80, which bears against a stud, 84, on a rod, 85, that connects with one end of a T-head, 86, on its shaft 87, and when the highest part of this cam passes said stud a spring-seated rod, 88, forces the fly-frame downward. A set of tapes, 42, driven by the receiving-cylinder 40, are stretched over the same, pass down before the fly-frame when in its upright position, and return around pulleys 26 25, running for a short distance in contact with the cylinder 30.

The operation of the mechanisms thus adjusted is as follows: Each sheet delivered upon the cylinder 30 by the tapes 37 38 is seized by the gripers 14, which clamp it upon said cylinder, and thereby cause it to be laid thereon and to be carried around with said cylinder. Just before the gripers reach the cylinder 40 they are opened by the operation of the cam 70, thus releasing their hold upon the sheet, which is then nipped and held upon the cylinder by the tapes 42. From the point where the tapes 42 leave the cylinder and run over the delivering-cylinder 40 the curved faces of the switches 18, standing with their front surfaces concentric with the said cylinder, as in Fig. 4, aided by the curved tails of the guards 16, guide the sheet onward, while the tapes 42 act as a means for driving it. The head of this sheet is thus brought to the entrance-point, where a second sheet is received upon it, the gripers 14, which have remained open as their rock-arm 15 traversed the cam 70, closing down upon the heads of the two sheets and carrying them together around with the cylinder precisely as the first sheet was carried. This operation is repeated a third and fourth time, whereupon four sheets will have been gathered, collected, or accumulated, one upon another, on the surface of said cylinder; but when the tails of the first three sheets have passed the point occupied by the switches 18, the pinion 56 will have, through the intermediates 55 and 57, so far rotated the toothed wheel 54 that the low part of the groove in the cam-wheel 66 will, through the rod 7, have rocked the toes of said switches into the grooves of the cylinder 30, as in Fig. 9. In this position they will intercept the heads of the four collected sheets, strip off said sheets from the cylinder 30, and guide them over the delivering-cylinder 40, from whence they are conducted by the tapes 38, 42, and pulleys 41 down before the fly-frame 27, and when their tails have about cleared the pulleys 41 the rotation of the shaft 80 will have carried the high part of the cam 65 clear of the roller-stud 84 on the rod 85, thereby permitting the spring-seated rod 88 to quickly vibrate the fly 27, which will deliver said four sheets upon a suitable piling-table. As the tails of these four col-

lected sheets clear the switches 18, said switches will be quickly rocked into the position shown in Fig. 4, to guide the fifth sheet, or the first of a new pack of four sheets, around with the cylinder to the entrance-point, where it will receive a second sheet upon it, and the described collecting operation will be repeated.

If it is desired to collect more than four sheets, the wheel 54 will be properly proportioned to the pinion 57.

In order to adjust the mechanisms to collect two sheets and fold, or paste and fold, the two together, (see Figs. 12 to 15,) the cam 59 is disconnected from the shaft 31 by removing the set-screw 2. The toothed wheel 57 is then reversed on its shaft, so that it will be disconnected from the wheel 54, but will align with and gear into the toothed wheel 58, (see Fig. 12,) which wheel is fixed to the back of the cam 59 by means of fastening-screws 49, as is seen in Fig. 15; and thus properly connected and timed, said cam 59 will be revolved with said wheel 58, and operate as will presently be made clear. The rotation of the cylinder 30 will then, through its pinion 56 and the intermediate wheels 55 and 57, cause the wheel 58 and the cam-wheel 39, now secured to the latter, to revolve in the same direction that it moves; but as the wheel 55 is twice the size of the pinion 56, as already described, and as the wheels 57 and 58 are of equal size, it follows that the cam 59 will make but one turn to each two of said cylinder 30.

A removable pasting apparatus (such as is described in a pending application filed by me June 11, 1878, and shown in some of the preceding figures to more clearly illustrate its relation to the other mechanisms) is now adjusted in place. It consists of a pasting-disk, 22, running in a paste-vat, 21, and mounted upon a shaft, which is supplied with a pulley, 24, by which it is constantly rotated, through a belt, 48, from a pulley, 23, on the shaft of the delivering-cylinder 40. (See Figs. 1 and 4.)

The apparatus thus adjusted will operate as follows: The successive sheets delivered to the surface of cylinder 30 are each, in turn, seized at the point of their entrance thereon by the gripers 14 and carried around with the cylinder. The first sheet of a pair thus seized and held upon the cylinder makes a complete revolution with it; but it is not folded, because during this first revolution of the cylinder 30 the depressed or working part of the cam 59 has been in the meantime revolved by the gear-wheels 56 55 54 58 to a point directly opposite its normal or working position. (See Fig. 13.) The auxiliary finger-cam 3 on the cam 59 has also been rotated to a point opposite its normal position, so that this first sheet is not released until it nearly reaches the delivery-cylinder 40, when the gripers are opened by the cam 70 to receive the next incoming or second sheet. Consequently the first sheet is carried well into the nip of the tapes 42, which, together with the switches 18 and guides 16, conduct it around until it is caught by the tapes 37, where the second sheet is deposited upon it. The gripers 14 now close on the two sheets, and they are carried around until their heads nearly reach the pasting-disk, by which time the cam 59 will have completed its revolution, so that the auxiliary cam 3 will be in position to open the gripers at the point just indicated. (See Fig. 14.) The depressed or working part of the folding-cam has also now arrived at its working position, so that the folding-blade is now thrown outward, and the two overlying sheets just released by the gripers are doubled into the folding-rollers without their heads having reached the pasting-disk 22 or the tapes 42.

The first sheet, in passing the pasting-disk, has a longitudinal line of paste laid upon its central part, by which it will be caused to adhere to the second sheet when the two are pressed together and passed through the folding-rollers.

The folding-blade-projecting cam may be alternately moved into a position where it will not cause the projection of said blade into cooperating position with respect to the folding-rollers 36 35 as it passes the point occupied by them when the cylinder 30 is carrying the first sheet of a pair, and into a position to project said blade between the folding-rollers when the cylinder carries two associated sheets which are to be doubled into the nip of said rollers by other means than is hereinbefore described. Thus said cam may be reciprocated toward and from the folding-rollers, as in Figs. 16 to 19, or be reciprocated toward and from the cylinder-head laterally into and out of engagement with the rock-arm attached to the folding-blade shaft, as in Figs. 20 to 22, inclusive.

In Figs. 16 to 19 a reciprocating cam, 90, is shown as provided with suitable guide-ledges—as the beveled sides—(see Figs. 16, 17,) adapted to run in corresponding guides formed by the beveled side pieces 92 92, attached to the side frame. It is provided with a stud, 93, which runs in the groove of a cam-wheel, 94, whereby it is moved to and from the folding-rollers 36 35, a recess, 95, cut through its center admitting this movement of it. It is also provided with an elliptical groove, 91, the ends of which are true semicircles, in which runs the rock-arm 13 of the folding-blade shaft.

The cam-wheel 94 is caused to make one revolution to each two of the cylinder 30 by the following means: The said cam-wheel is fast upon one end of a short shaft, which carries at the opposite end a toothed wheel, 101, which meshes with a pinion, 102, fast upon the end of the shaft 31 of the cylinder 30, and as the number of teeth of the pinion 102 are to those of the wheel 101 as one is to two, it follows that said wheel 101, and consequently the cam-wheel 94, driving the reciprocating cam 90, will make one revolution while the cylinder is making two revolutions. The said cam-wheel 94 thus carries the reciprocating cam 90 into the position shown in Fig. 18 during that revolution made by the cylinder 30 in receiving the

first sheet of a pair, when the folding operation is to be suspended, and into the position shown in Fig. 19 during that revolution of the cylinder when a second sheet is received and collected upon the first, when the folding operation is to be effected.

The operation of the apparatus as thus modified will now be described, it being understood that the mechanisms shown in these figures and marked by similar characters, as in the preceding illustration, are constructed and operate as before described.

As this modification of the apparatus is not designed to deliver sheets flat, the fly 27, the tapes leading thereto, and the switches 18 will, of course, be dispensed with, though tapes 97, running over pulleys 25 96 and bearing against the face of the cylinder 30 from a point just in advance of the pasting-disk 22 to a point near the tails of the guards 16, and operating as do the tapes 42 with the cylinder 30, will be required. The arm 13 on the end of the shaft 33, for moving the folding-blade in and out of the cylinder, points in the opposite direction to those previously illustrated herein, which causes the groove in the folding-cam in which this arm runs to assume a different shape from the former one.

As the first sheet of a pair is received and carried around upon the cylinder 30 the reciprocating cam 90 will stand as in Fig. 18, so that the groove in its upper end will be concentric with the periphery of the cylinder, and consequently the end of the rock-arm 13, which actuates the folding-blade shaft, will traverse said groove without being moved thereby, thus retaining the shaft 32 of said blade in its innermost position; but when the cylinder 30 has so far revolved that the leading end of the first sheet is approaching the point of reception of the second sheet, the cam-wheel 94 will have so far revolved as to have caused the stud 93 to pass out of the low part of its groove 94 and into the high part thereof, thus reciprocating the cam 90 upward or into its forward position, as in Fig. 19, when the groove 91 of the folding-cam 90, in its lower end, will be concentric with the periphery of the cylinder 30, and the groove in its upper end will stand in an eccentric position with relation to said periphery, where it remains during about five-eighths ($\frac{5}{8}$) of the revolution of the wheel 94, or while the cylinder 30 makes about one and one-quarter ($1\frac{1}{4}$) revolution. The end of the rock-arm 13 following this groove 91 remains in an unchanged position with respect to its movement for projecting the blade-shaft until the cylinder has so far revolved as to carry the second sheet upon the first and bring the middle portion of the collected pair of sheets near to the part occupied by the folding-rollers 36 35. Now, as the folding-blade approaches this point the end of the rock-arm 13, following the upper end of the cam-groove 91, (then in its eccentric position,) is forced outward, thus projecting the blade-shaft 32, and causing the folding-blade to double the sheets into the nip of the folding-rollers and forced inward, thus withdrawing said blade-shaft and folding-blade, causing a folding operation precisely like that first hereinbefore described. The cam 90 does not again change its position until the folding-blade again approaches the folding-rollers, when it is quickly moved into the position shown in Fig. 18, and the operation is repeated.

Another construction of reciprocating cam for folding two sheets associated together to form one product is shown in Figs. 20 to 22, inclusive. It is in form like those illustrated in Figs. 1 to 11, and is marked 100 for convenience of reference. It has a cam-groove, 98, the low part of which is about one-fourth its whole extent, and carries upon its face the auxiliary griper-cam 3. This cam 100 is fixed to the inner ends of rods 103 104, which slide in bearings through the side frame, the connecting cross-bar of which has an arm which runs in the groove 106 of a cam, 107, mounted upon a stud secured to the side frame. This cam 107 is fast to a toothed wheel, 108, which is driven from a pinion, 109, fast on the end of the shaft 31 of the cylinder 30, and as the pinion 109 is but one-half the size of the wheel 108 the cam 107 is caused to make but one revolution to each two of the cylinder 30. The rods 103 104 are long enough and the throw of the cam 107 is such that the cam 100 will be reciprocated to and from the end of the cylinder 30, so as to engage with and disengage from the end of the rock-arm 13, which actuates the rock-shaft 33, that supp s the folding-blade shaft, which rock-arm, when disengaged from the cam 100, is held in the position shown in Fig. 21 by a spring-seated rod, 99, that is attached to an arm projecting from said shaft 33 inside of the cylinder for this purpose. Thus held, the end of the rock-arm is in position to enter the high part of the groove in the cam 100 at any point thereof. This cam 100, when in its innermost position, acts to move the rock-arm 13 inward to throw the folding-blade shaft outward, and thus project the said blade between the folding-rollers 36 35, and reverse the movements to withdraw the said blade. Said folding-cam is reciprocated to and from the ends of the folding-rollers and cylinder at certain periods of the revolution of said cylinder, as will be best understood from a description of the operation of this modified apparatus. In such description the mechanisms which (marked the same) are like those hereinbefore described are to be understood as having the construction and mode of operation there set forth.

As the first sheet is received and carried around upon the cylinder 30, the cam 107 will have so rotated as to withdraw the cam 100 from engagement with the rock-arm 13, which latter, together with the folding-blade shaft, will, under the influence of the spring-seated rod 99, stand in the position shown in Fig. 21, whereby the folding-blade 5, though con-

stantly rotating, being caused to so move within the peripheral line of the cylinder, will thus not co-operate with the folding-rollers 36 35, to fold the said first sheet. Just after the cylinder has so far revolved as to have received a second sheet upon the first sheet on its surface the cam 107 will have so far revolved as to move the cam 100 inward to receive the end of the rock-arm 13 in the high or concentric point of its groove, following which groove, as the cylinder continues to revolve, it will force said arm inward and move the blade-shaft outward, thus projecting the blade so that it will be moved into co-operation with the rollers 36 35 and double the two sheets into the nip of the same, the outward movement of the rock-arm 13 and consequent inward movements of the blade-shaft and blade following in like manner, as before described. As the cylinder continues to rotate to receive the first sheet of a second pair the cam 107 will be revolved to withdraw the cam 100 out of engagement with the rock-arm 13, which will again assume the position shown in Fig. 21, and the described operation be repeated.

It is obvious that only that section of the cam 100, or the low part thereof, which constitutes the outer portion of the said fourth part of its cam-groove need be reciprocated in and out of position for engagement with the rock-arm 13, and the cam 100 is to be considered herein as constructed in that manner, or as heretofore described.

To fold each sheet singly, the pinion 109 may be removed and the cam 107 rotated until the cross-bar 105 and cam 100 take their innermost position, where they will constantly remain. This projection of a constantly-rotating folding-blade without the periphery of its revolving carrier at each second revolution thereof to co-operate with folding-rollers mounted in stationary bearings at a given point relative to such carrier may be accomplished by means of a stationary blade-shaft-projecting cam, if the proportion of the gearing which rotates the said folding-blade is such as to cause it to make three and one-half (3½) revolutions to each revolution of its carrier, which construction is shown in Figs. 23 25. The blade-projecting cam therein designated 110, like the similar cam 59, is fixed stationary by being fastened to the frame, its operation in projecting the blade-shaft being the same as said cam 59 and effected at each revolution of the cylinder 30. But while this blade-shaft is projected at the first revolution of the cylinder when it is carrying the first sheet of a pair, the revolution of the blade will be so timed by the gearing that said blade will be pointed inward when passing the point occupied by the folding-rollers 36 35, and will hence pass by them without affecting the sheet; and as the blade-shaft is drawn inward by the action of said cam before the blade rotates far enough to touch the sheet, it follows that said first sheet will be carried around upon the cylinder to receive the second sheet upon it, and that the said blade will rotate idly in its innermost position until two sheets have been collected, one on the other, upon the cylinder, and said blade-shaft is again projected at the folding-rollers. At this second projection of its shaft the blade will be making that part of its revolution in which the blade is pointed outward, and will consequently double the two sheets into the nip of the rollers 36 35.

The folding mechanism shown in connection with the primary sheet-manipulating mechanism may, when acting to fold sheets which are not to be accumulated, have such sheets fed directly between its carrier and the folding-rollers 36 35, in which case the carrier need not be constructed as a cylinder, 30, but may be a frame-work capable of supporting the shafts 32 33.

The folded sheets converging from the rollers 36 35 may be delivered in their once-folded condition, or they may be carried to a secondary folding-machine and be again folded one or more times on lines parallel with their first fold, at right angles thereto, or both, by folding mechanism such as is shown in any of the following patents may be used, viz., 171,196, 180,880, 188,987, 191,494, 191,819, 192,034, 195,115, and 197,691.

Herein are shown two forms of a secondary sheet-manipulating mechanism, one of which is a folding-machine constructed in like manner as is that of the secondary sheet-manipulating apparatus contained in my application filed June 11, 1878. It consists of a cylinder, 20, provided with gripers 17, the rock-arm 46 of which is operated by a cam, 45, and a rotating folding-blade, 6, mounted fast upon a shaft, 19, which turns in its carrying-arms 67 81, which are secured to a rocking shaft, 82, that is hung in the heads of cylinder 20. These arms 67 81 and the shaft 19 they carry are rocked by means of a rock-arm, 69, running in a grooved stationary cam, 47, the said shaft 19 being revolved by means of a pinion, 78, fixed upon its end, that gears with an intermediate, 79, which, turning freely on the shaft 82, remains constantly geared with a stationary driving toothed wheel, 83, that is fastened to the frame-work, in this instance being attached to the cam 47. This blade 6 co-operates with stationary folding-rollers 28 29, which are geared together by wheels 60 61, and rotated by means of a toothed wheel, 62, fixed to one end of the cylinder 20. As the intermediate wheel 79 and arms 67 81, supporting the blade-shaft 19, to which the pinion 83 is fixed, are hung upon the same shaft 82, it follows that said pinion will remain in gear with and be constantly driven by the said intermediate, whatever may be the degree to which the blade-shaft is projected by the cam 47. Thus, as at each revolution of the cylinder 20 the folding-blade will be rotated a number of times, according to the proportion its pinion 78 has to its driver 83, and by means of the arm 69 and the cam 47 will, during one of these rotations, have its carrying-shaft moved

outward and inward, so that the blade will enter between the folding-rollers 28 29, and be withdrawn therefrom in performing the operation of folding.

The cylinder 20 is made one-half the size of the cylinder 30, for the reason that the sheets manipulated by it, having been once folded, are reduced to one-half their original length. It is driven from the toothed wheel 53 on the shaft 31 of the cylinder 30 by means of the wheels 52 51, and, though making equal turns with said cylinder 30, it runs with but one-half its surface-speed. The sheets from the folding-rollers 36 35 are directed to its gripers by means of endless tapes 43, which run from the folding-roller 35 to a roller, 44, above which tapes are conductors 77, which keep the sheets from flying upward, while a set of guards span the space between the roller 44 and the cylinder 20.

The once-folded sheets emerging from the rollers 36 35 may be conveyed to a secondary mechanism constructed as is shown in Fig. 27. They are directed by a conducting mechanism formed by the tapes 43 and conductors 77 to the nip of a pair of forwarding-rollers, 111 112, which are geared together to run in unison, and driven at or about one-half the surface-speed of the carrier 30 by means of a toothed wheel, 125, that is actuated by the toothed wheel 53 on the shaft 31 through a train of wheels, 126 127, the said toothed wheel 125 being twice the diameter of the roller 111. As the wheels 53 and 125 run tooth for tooth, and consequently at the same surface-speed, it follows that the roller 111, of one-half the size of said wheel 125, will run at one-half its surface-speed as well as that of the carrier 30.

The forwarding-rollers 111 112 discharge the folded sheets to two subsidiary folding-machines of the well-known vibrating type, wherein a folding-blade, as 119 or 120, is vibrated at suitable intervals, to double sheets beneath it into the nip of pairs of folding-rollers, as 121 or 122, which, revolved in unison, carry the sheets between them and deliver them in a now twice-folded condition.

In this arrangement sheet-conveying tapes 117 118 lead from the rollers 112 114 to the lower subsidiary folding-machine, and similar tapes 123 124 lead from the rollers 111 113 to the upper subsidiary folding-machine. Sheet-directing switches 115 are also provided, which switches 115 are so vibrated by a cam-groove, 116, with which the toothed wheel 55 is provided in its outside face for the purpose, that their points are alternately moved from the grooves in the rollers 111 into those in the roller 112, and vice versa, thus standing in the grooves of roller 111, as shown, while one sheet is passing through the rollers 111 112 and 112 114, which sheet will thus be directed into the tapes 117 118, the former, aided by the guards 128, carrying it out against a gage, 129, where it lies over the folding-rollers 122 and under the folding-blade 120. This blade descends at the proper time and doubles the sheet into the nip of said folding-rollers, from which it emerges folded a second time at right angles to its first fold. As soon as this first sheet passes their points, the switches will be vibrated into the groove of the roller 112, so as to direct the second sheet into the tapes 123 124, which lead to the upper subsidiary folding-machine, between the rollers 121 of which the blade 119 will double said sheet, which will thus be folded in like manner as was the first.

The construction of these vibrating folding devices, though well understood by those skilled in this art, is described in said Patent No. 191,819.

Of course any one of the modified forms of the blade-projecting cams hereinbefore described will operate to project at the proper time a folding-blade constructed, mounted, and rotated by a stationary driving-wheel, as shown in Figs. 1 to 11, and the scope of the invention is to be understood as contemplating the use of any one of the said cams with this mode of rotating the folding-blade.

Though the construction of the folding-blade-projecting cams and the arrangements of mechanism for actuating them shown in Figs. 16 to 22 are within the broad scope of the present invention, the right is reserved of claiming them specifically in an independent patent.

The combination of a single folding-blade supported in a revolving carrier with mechanisms for projecting it between one and the same pair of folding-rollers at each second revolution of said carrier is not broadly claimed herein.

What is claimed herein is—

1. The combination of a revolving carrier, supporting a rotating folding-blade, its shaft, and pinion from arms on a rock-shaft, with a cam for intermittingly actuating said rock-shaft, and thereby projecting the folding-blade from said carrier, and with a stationary internal wheel, as 68, and intermediate wheels, as 9 8, gearing it with said pinion, whereby said blade is projected while rotating, substantially as described.

2. The combination of a folding-blade, supported upon a shaft in a revolving carrier, and rotated by means of a pinion on its shaft, a stationary internal wheel, and two intermediate connecting-wheels, whereby said blade is caused to rotate in the proper direction, and may be projected from and withdrawn toward the center of said carrier in co-operating with stationary folding-rollers, substantially as described.

3. The combination, with a revolving carrier, of a folding-blade, as 5, its shaft 32, pinion 10, arms 11 12, shaft 33, arm 13, cam 59, intermediate wheels 9 8, and stationary internal driving-wheel 68, substantially as described.

4. The combination of a revolving carrier provided with means for collecting two or more sheets upon its surface, and which supports a single rotating folding-blade, of mech-

anism for imparting the rotative movements to said blade, and mechanism for causing said blade to be projected into co-operative relation to stationary folding-rollers at each second or other repeated revolution of said carrier, all substantially as described.

5. The combination, with a revolving carrier provided with means for collecting two or more sheets upon its surface, and which supports a rotating folding-blade, of mechanism for imparting the rotative movements to said folding-blade and a cam for projecting and withdrawing the folding-blade shaft, whereby said blade is caused to move from and toward the center of said carrier and co-operate with stationary folding-rollers at each second or repeated revolution of the carrier, all substantially as described.

6. The combination, with a revolving carrier provided with means for collecting two or more sheets upon its surface, and which supports a rotating folding-blade, of mechanism for imparting the rotative movements to said folding-blade, and a cam for projecting the shaft of said folding-blade from and withdrawing it toward the center of said carrier, and means for automatically moving said cam into proper positions with respect to the folding-rollers at each second or other repeated revolution of the carrier, whereby said blade is caused to enter and withdraw from the folding-rollers at such times as the folding operation is to be effected, all substantially as described.

7. The combination, with a revolving carrier provided with means for collecting two or more sheets upon its surface, a folding-blade supported thereby, and mechanism for rotating said blade, of the revolving blade-shaft-projecting cam 59, all substantially as described.

8. The combination, with a revolving carrier provided with means for collecting two sheets upon its surface, gripers to control the same, a folding-blade carried thereby and projected therefrom into co-operative relation with the folding-rollers at every second revolution of said carrier, of main and auxiliary griper-cams, as 70 and 3, all substantially as described.

9. The combination of the carriers 30 and 20, each provided with mechanisms for folding sheets, the said carrier 20 being of one-half the size of the carrier 30, and driven turn for turn therewith, said carrier being connected by a sheet-conducting mechanism, and adapted to impart parallel folds to the same sheet or pack of sheets, 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:
CHAS. W. CARPENTER,
FRANKLIN T. GROSS.