8 Sheets—Sheet 1.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034. Patented June 12, 1877.

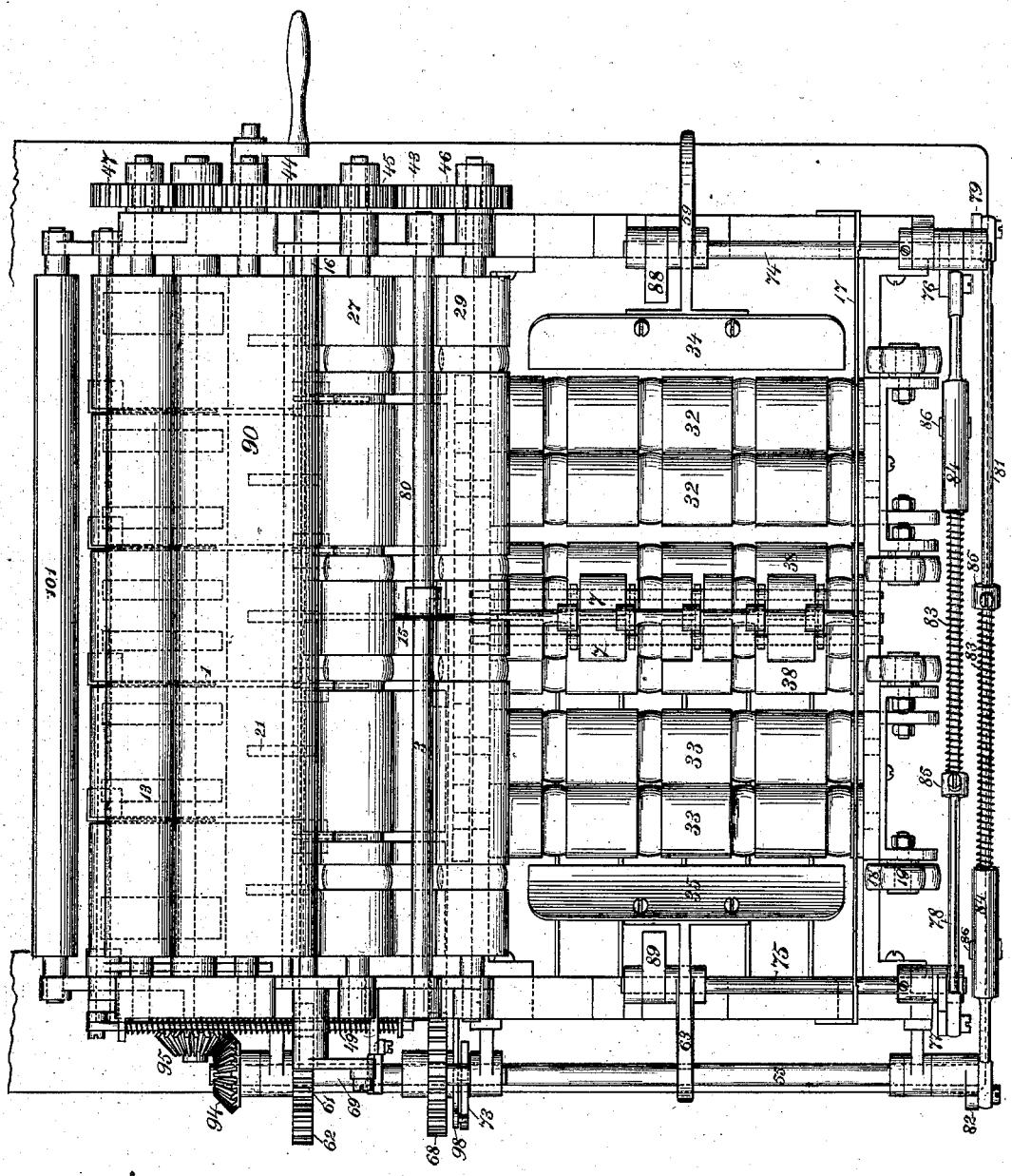


FIG. 1.

Witnesses
D. M. Somers
W. Ely.

Inventor
STEPHEN D. TUCKER
By Munson & Philipp,
ATTORNEYS.

8 Sheets—Sheet 2.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034. Patented June 12, 1877.

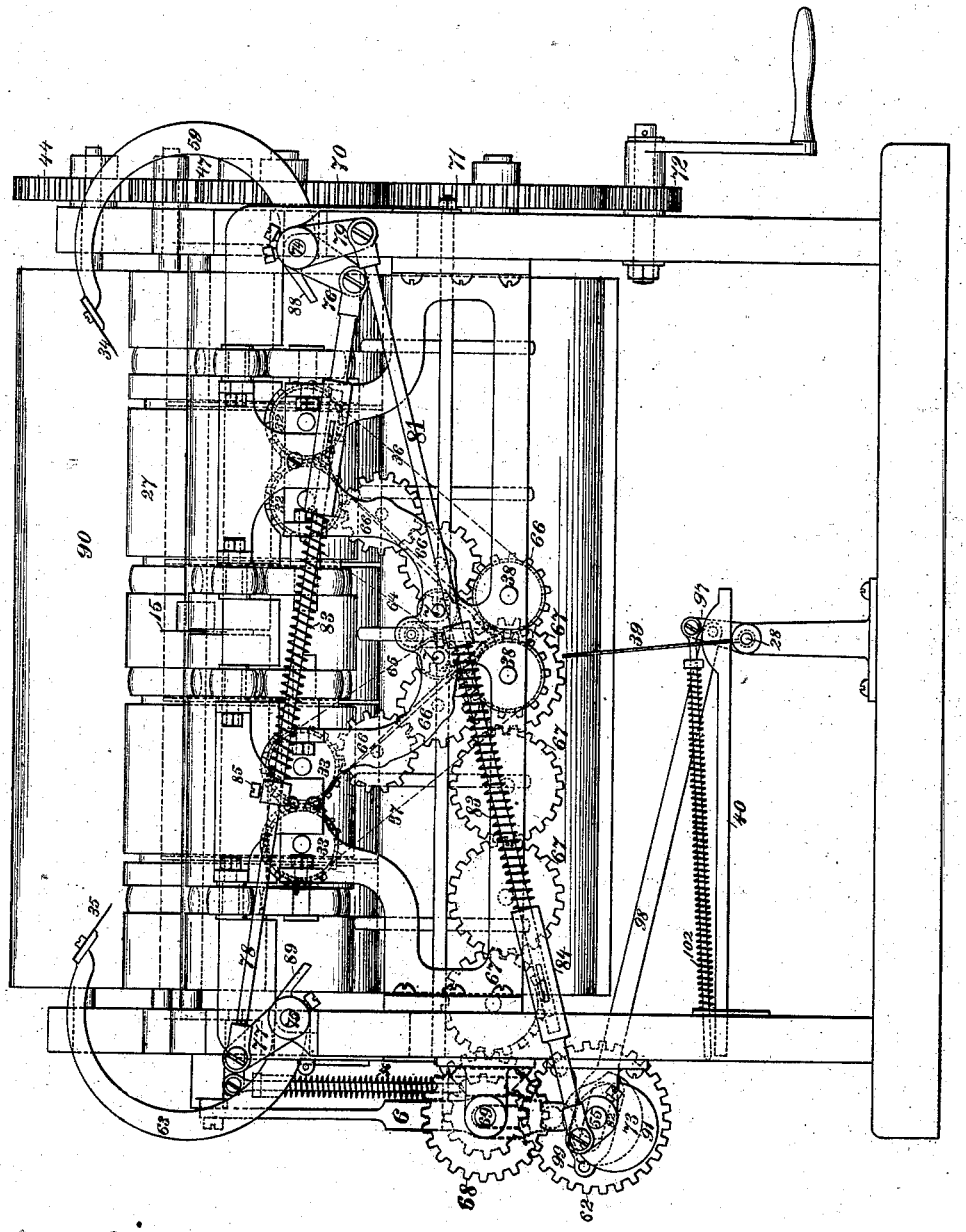


Fig. 2.

WITNESSES
D. McLonius
W. Ely.

INVENTOR
STEPHEN D. TUCKER
By Munson & Philipp.
ATTORNEYS

8 Sheets—Sheet 3.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034. Patented June 12, 1877.

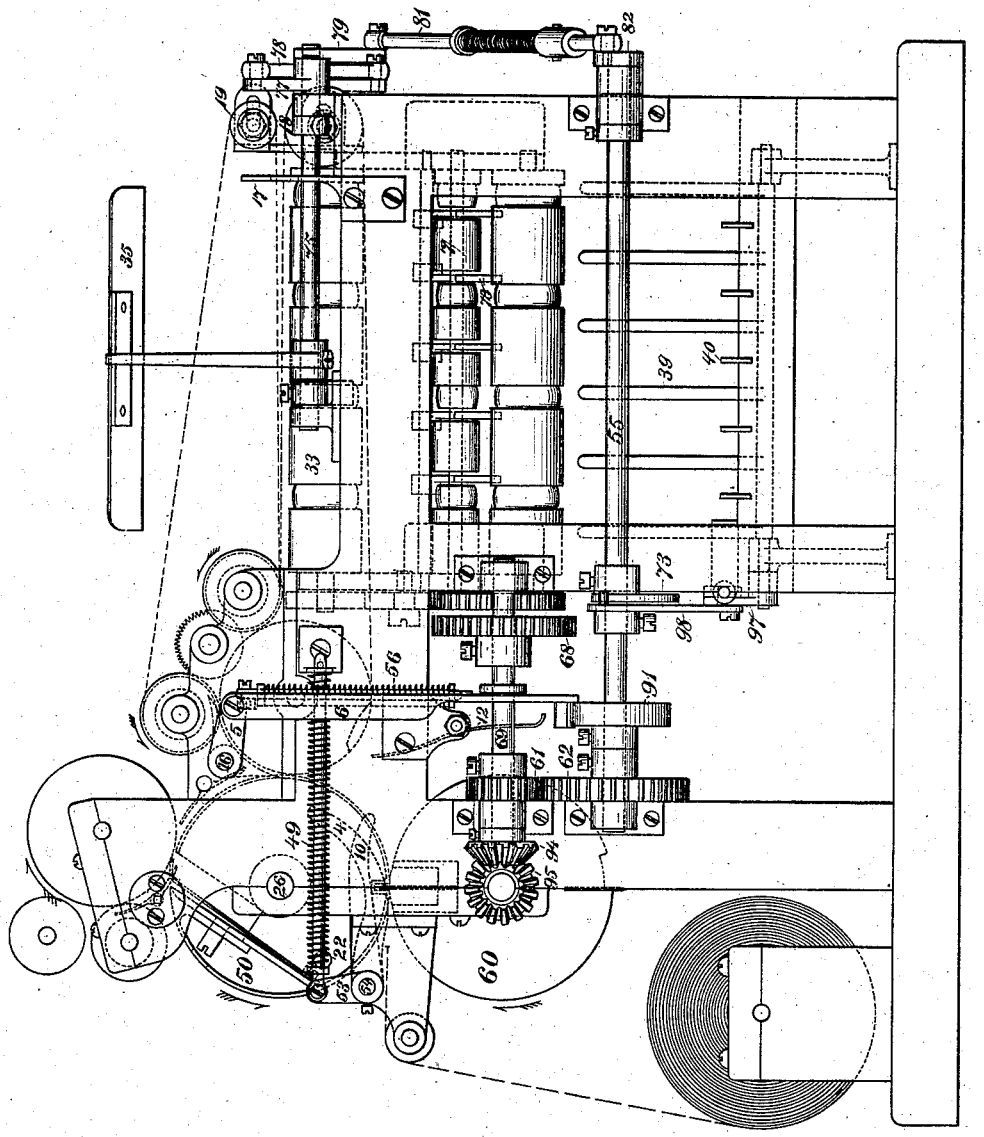


Fig. 3.

WITNESSES
D. M. Somers
A. Ely.

INVENTOR
STEPHEN D. TUCKER
By Munson & Philipp.
ATTORNEYS.

8 Sheets—Sheet 4.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034. Patented June 12, 1877.

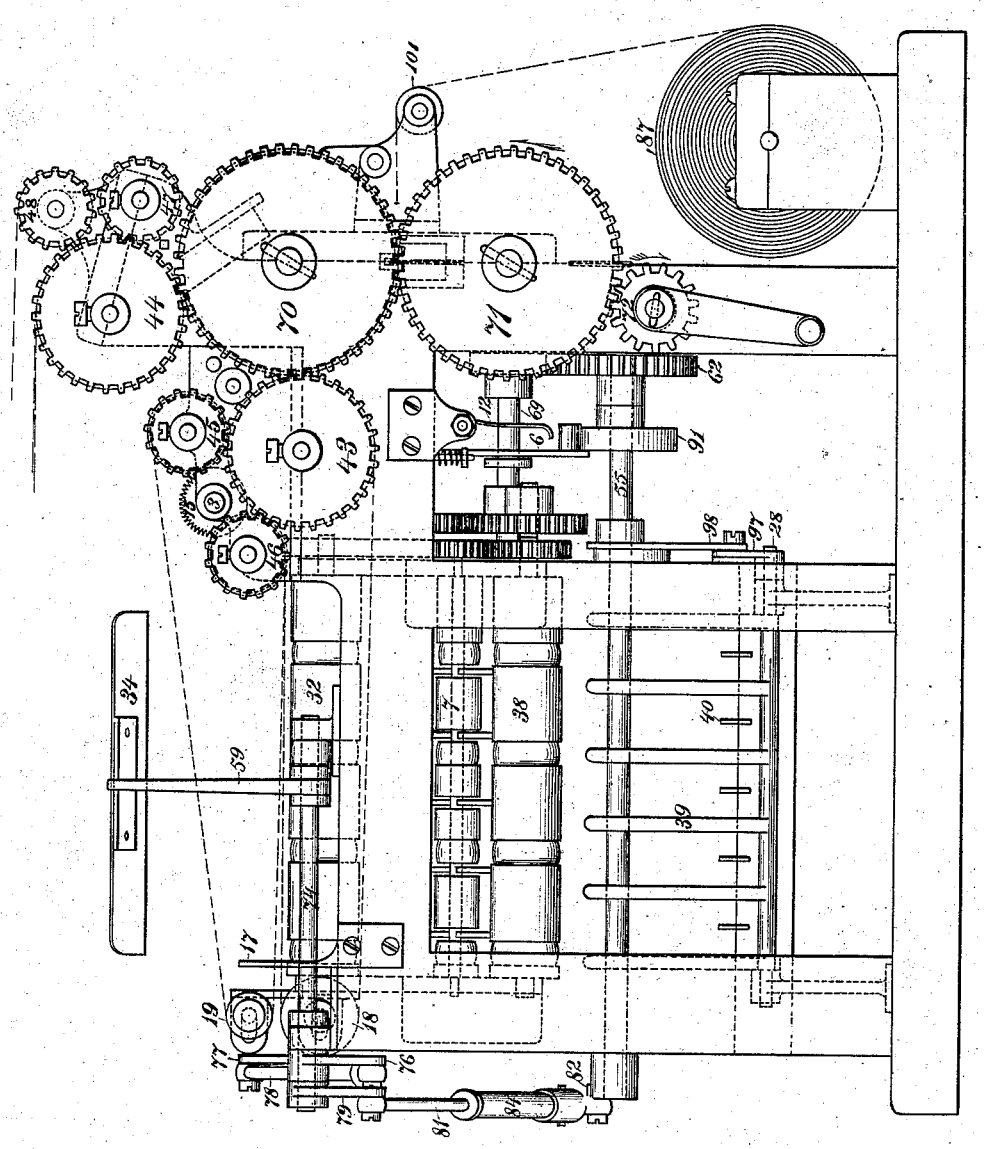


Fig. 4.

Witnesses

D. McSomers

W. Ely.

Inventor

STEPHEN D. TUCKER

By Munn & Philipp.

ATTORNEYS

8 Sheets—Sheet 5.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034. Patented June 12, 1877.

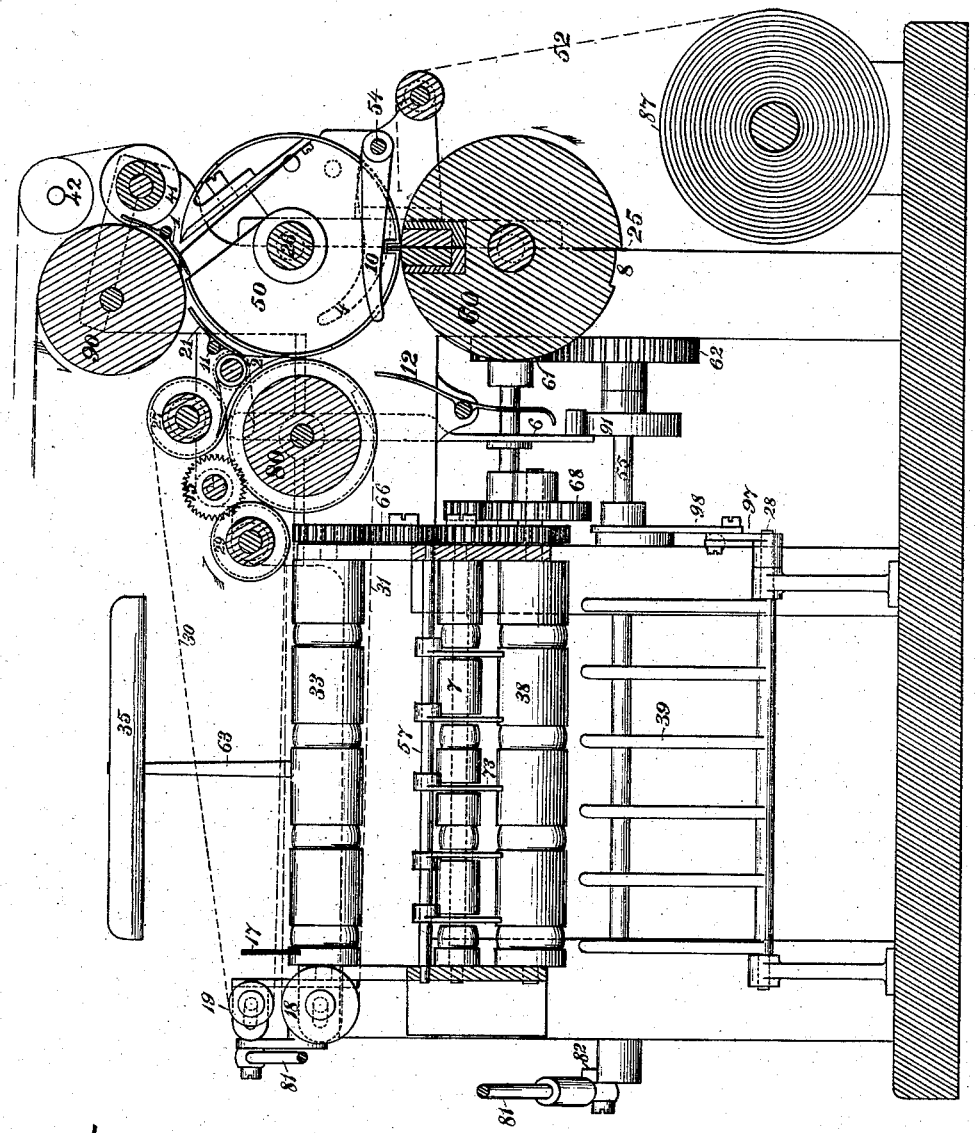


Fig. 5

Witnesses
D. McConnus
W. Ely.

Inventor
STEPHEN D. TUCKER
By Munson & Philipp,
ATTORNEYS.

8 Sheets—Sheet 6.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034. Patented June 12, 1877.

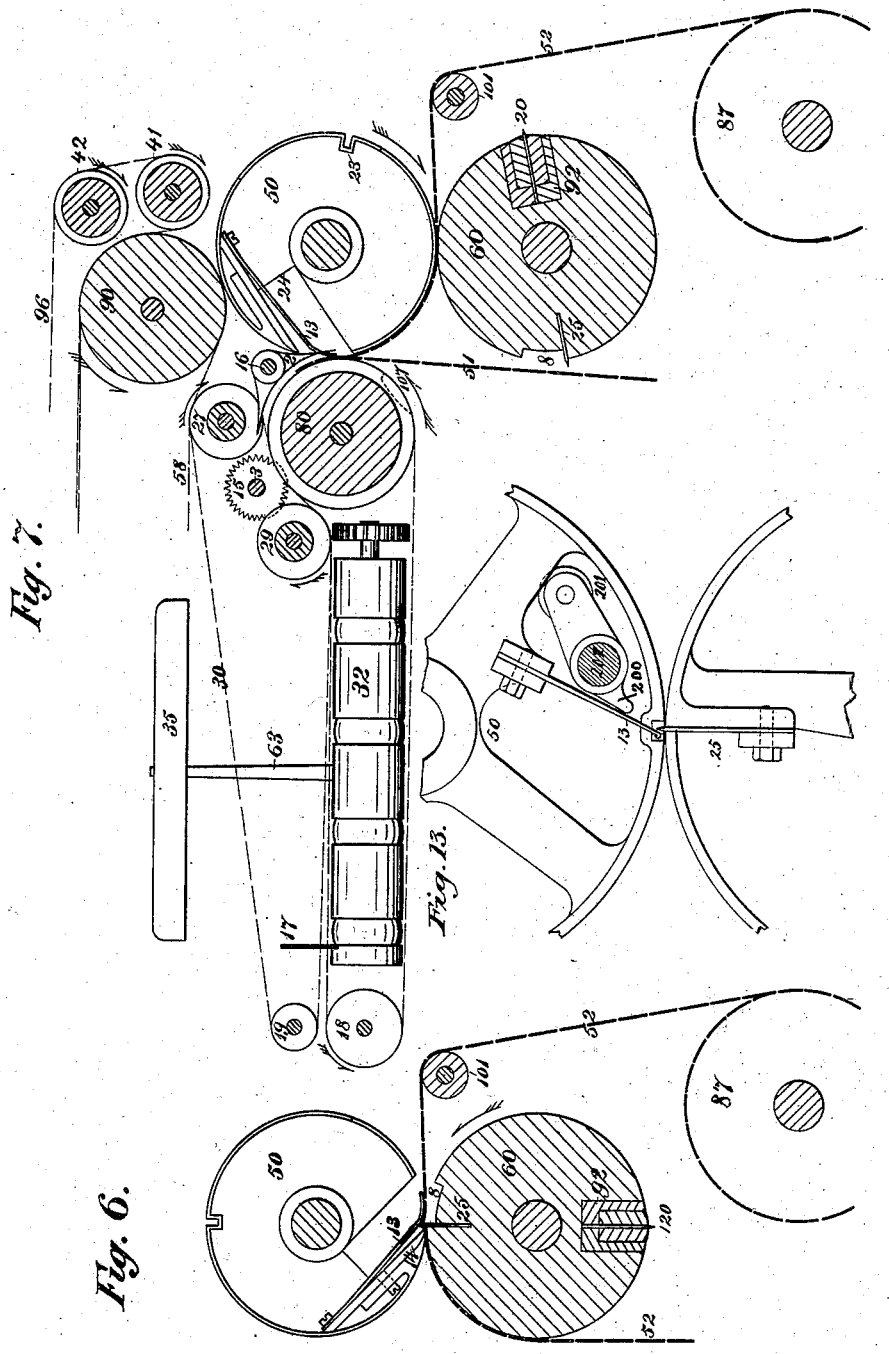


Fig. 7.

Fig. 13.

Fig. 6.

Witnesses
D. M. Somers
W. Ely.

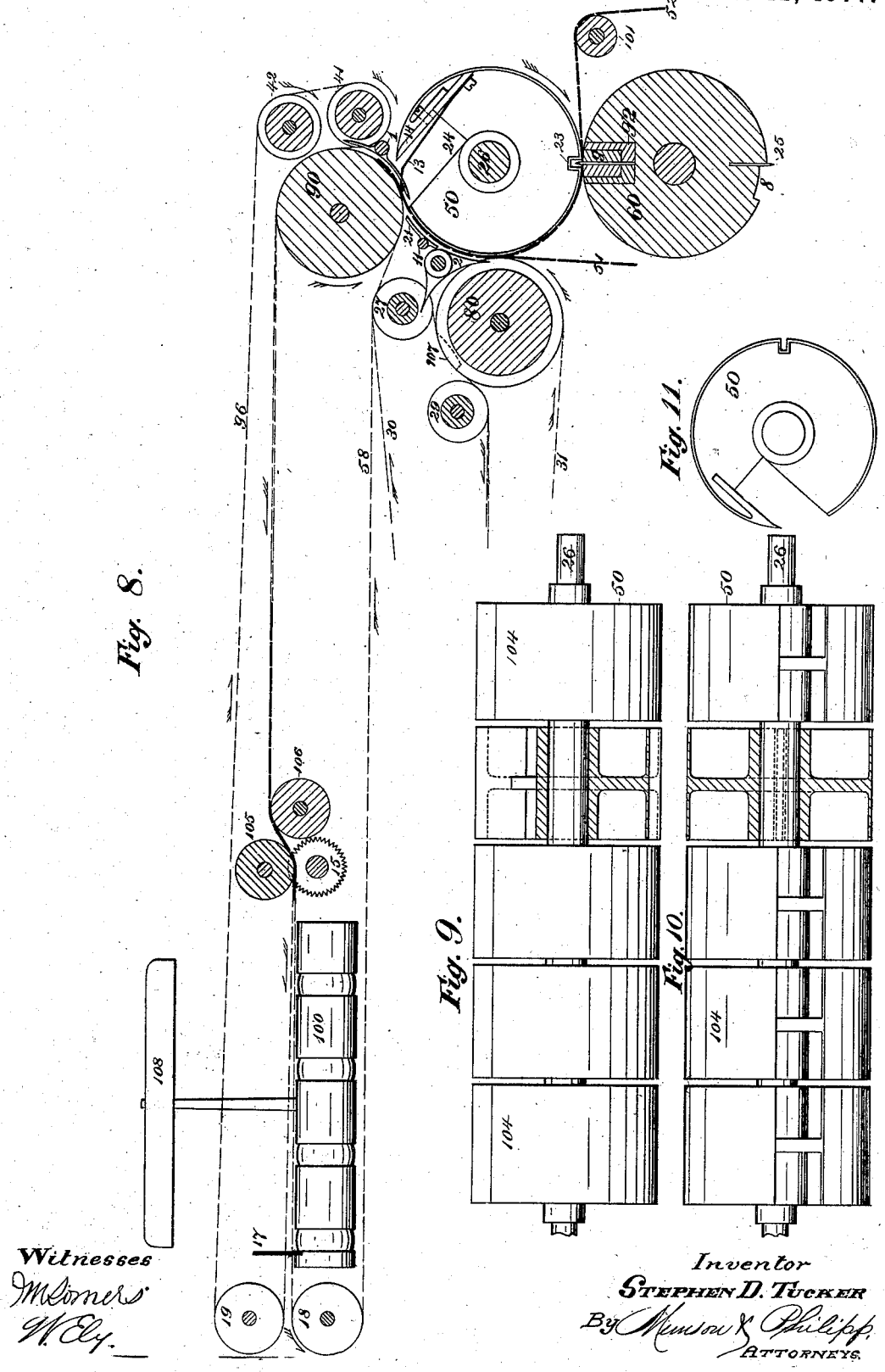
Inventor
STEPHEN D. TUCKER
By Munson & Philipp
ATTORNEYS

8 Sheets—Sheet 7.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034. Patented June 12, 1877.



Witnesses
M. Conner
W. Ely.

Inventor
STEPHEN D. TUCKER
By Munson & Philipp
ATTORNEYS.

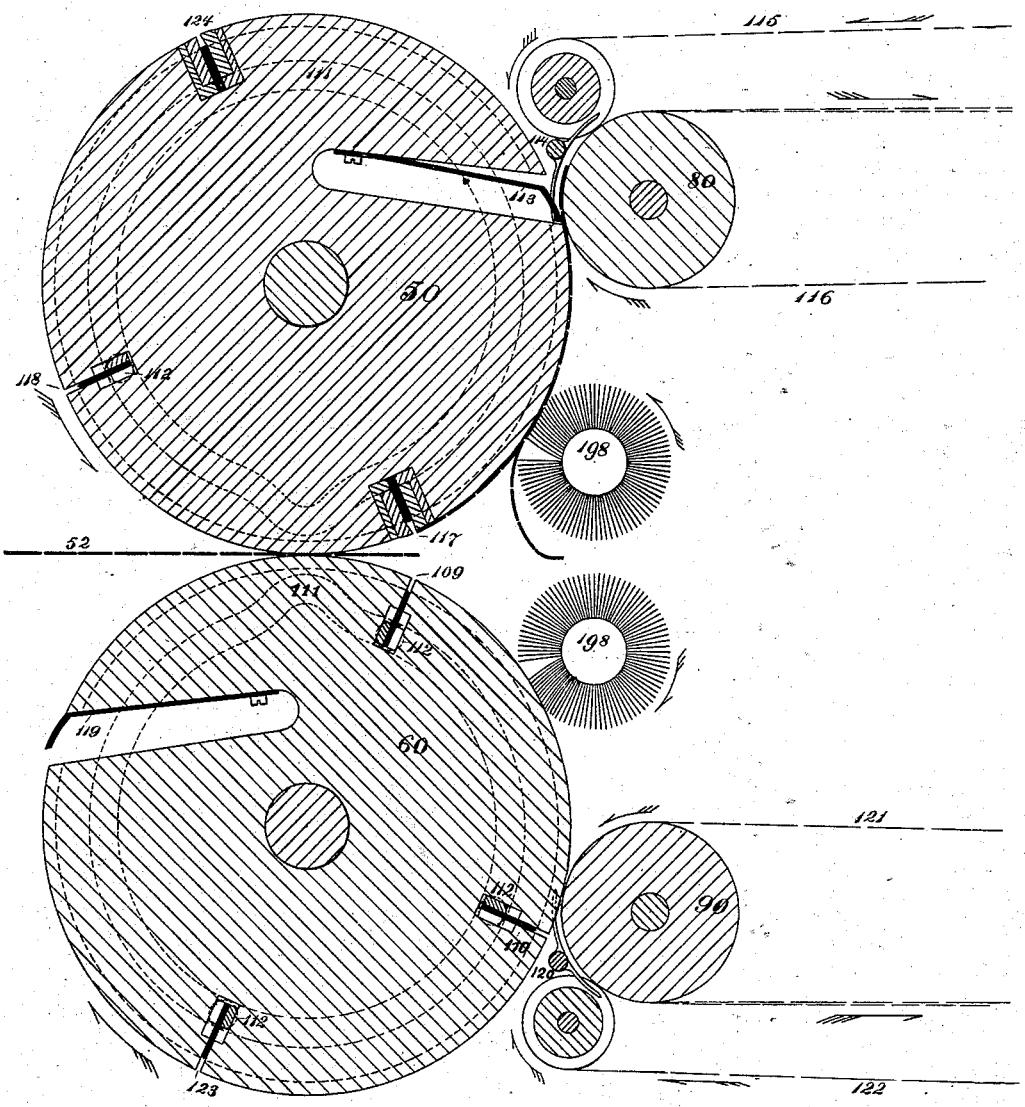
8 Sheets—Sheet 8.

S. D. TUCKER.

FOLDING-MACHINE.

No. 192,034 Patented June 12, 1877.

Fig. 12.



Witnesses
D. McComers
W. Ely.

Inventor
Stephen D. Tucker
By Munson & Philipp
ATTORNEYS

UNITED STATES PATENT OFFICE.

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

IMPROVEMENT IN FOLDING-MACHINES.

Specification forming part of Letters Patent No. **192,034**, dated June 12, 1877; application filed December 2, 1876.

CASE A.

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 Folding-Machines, of which the following is a specification:

In the accompanying drawings, Figure 1 is a plan view; Fig. 2, an end elevation; Fig. 3, an elevation of one side of the apparatus; Fig. 4, a similar view of the opposite side; Fig. 5, a longitudinal sectional elevation; Figs. 6, 7, and 8, sectional views of detached parts, showing the mode of cutting the web and folding and guiding the sheet; Figs. 9, 10, and 11, views showing details of the cylinder 50; Fig. 12, a modification of the cutting and folding cylinders; and Fig. 13, a modification of the mode of operating the nipping-springs 13.

This invention consists of a cutting, folding, and delivering apparatus adapted to be attached to printing-machines of that class in which a continuous web of paper is printed.

By means of this improved machanism a printed web is severed into sheets, said sheets folded and dispersed in two or more paths of travel, whereby they are delivered out of the machine, or are directed to supplemental folders, and, when a second or more times folded, are assembled, so as to be folded or otherwise delivered together out of the machine.

Modifications and details of construction and arrangements of parts form important features of the invention; but they are too fully hereinafter described to need preliminary description.

The folding and cutting cylinders 50 and 60 are mounted in suitable bearings in the frame-work, and are geared together by means of toothed wheels 70 and 71, Fig. 4, which are actuated by a driving-pinion, 72, receiving motion in any suitable manner.

These cylinders are each provided with one member of a cutting and one member of a folding apparatus, and have a mode of operation by which a web of paper is divided transversely into suitable lengths or sheets, which are folded centrally and dispersed through either of two paths of travel, which direct them to a second folding apparatus or deliver them from the machine.

The cylinder 50 is constructed, as is shown in Figs. 9 and 10, of rings or short cylinders 104, keyed upon the shaft 26, so as to provide spaces between them, in which spaces the guiding-fingers 10 and switches 2 move, and into which the conductors 1 extend.

The cutting mechanism consists of a blade, 20, (which may have a serrated edge,) set in the periphery of the cylinder 60, so as to protrude a short distance therefrom, being preferably held in a removable box, 92, and provided with cushions 9, of rubber or similar elastic material, set upon each side of it, which cushions press the web against the periphery of cylinder 50 during the operation of severing it, and thus insure a perfect cut, the rearmost cushion clamping the leading end of the severed web, as in Fig. 8, and thus carrying it onward through the cylinders.

The co-operating cutting mechanism consists of a simple longitudinal slot, 23, in the periphery of the cylinder 50; but the cutting devices may be of any other well-known form, those illustrated being selected as of advantageous construction.

The folding mechanism consists of a simple blade, 25, set in the periphery of the cylinder 60 so as to protrude a short distance therefrom.

The co-operating folding mechanism consists of a jaw, 14, formed by one side of a longitudinal recess, 24, cut at an angle in the cylinder 50, which jaw is provided with a series of nipping-springs, 13, fixed upon its inner face. These nipping-springs have their outer ends bent at an angle, so as to project beyond the periphery of the cylinder. In the operation of folding, the blade 25 will push aside these springs 13 and insert the fold of paper between them and the jaw 14, as in Fig. 6, and when the folding-blade is withdrawn by the rotation of the cylinders the springs will close upon the jaw 14 and press the doubled edge of paper between them and said jaw, the recess 8 in the cylinder 60 providing a clearage for the free ends of the springs to permit this movement. The sheet thus held by its doubled edge will be carried onward with the cylinder 50 in its circular course. Other folding mechanisms may be substituted for those herein shown, as the precise construction shown is not essential.

The respective members of the cutting de-

vice may be carried by the cylinders 50 and 60, as is illustrated, or the cylinder 50 may support the male cutting, and the cylinder 60 the female cutting, device. But if a stationary cutting-blade be used in the cylinder 50, then the delivering-cylinders 80 90 must be placed sufficiently far from it to permit the projecting blade to pass without touching them, and recesses must be cut through the blade to correspond with the spaces between the sections of the cylinder 50, into which the guiding-fingers 10, switches 2, and conductors 1 enter. The sheets will not then be entirely severed from the web at the points opposite these spaces; but the guiding-fingers 10, by their action, which will be hereinafter fully explained, will strike the sheets at these points and tear them apart from the web, and also prevent the leading end of the web from following around the cylinder 50.

The delivering-cylinders 80 90 journaled in the side frames are actuated by toothed wheels 43 and 44, meshing into the toothed wheel 70 and they co-operate with the folding mechanism, as will fully hereinafter appear. These delivering-cylinders are, respectively, provided with tapes 31 and 58, which lead from them to pulleys, such as 18, beyond gages or stops 17, and each have arranged, in proper relation to them, tape-rollers 27 29 and 41 42, suitably journaled in the frame-work, and provided with tapes 30 and 96, which lead from them beyond gage-bars 17 to and around pulleys 19. These tape-rollers are actuated by pinions 45, 46, 47, and 48, meshing with the toothed wheels 43 and 44. These rollers and tapes carry the once-folded sheets over the second folding-rollers, as will be presently explained.

The delivering-cylinder 80 has mounted, parallel with it, a shaft, 3, supporting a rotary cutter, 15, which cutter may have either a serrated or a smooth edge, working in a suitable groove in said delivering-cylinder, or be provided with a ground edge, working in shearing contact with a similar cutter fixed upon the delivering-cylinder.

This arrangement of cutter might be used with the cylinder 90; but, as it is preferable to divide the sheet just before it is delivered to the folding-rollers, mechanism for that purpose is provided, as is shown in Fig. 8, where it is arranged in proper relation to the rollers 105 and 106.

The guiding-fingers 10, Fig. 5, which control the leading end of the sheet and web, are hung on a shaft, 54, rocked by means of a curved arm, 4, (see Fig. 3,) which is engaged by a stud, 22, protruding from the end of the cylinder 50. These guiding-fingers are thus depressed at each revolution of the cylinder to throw the leading end of the sheet and web off from said cylinder, and at the same time, in case a stationary cutting-blade is used in the cylinder 50, will tear asunder the sheet from the web at the points left uncut, as previously described. The guiding-fingers are then quickly retracted within the cylinder by a spring-seated rod, 49, pivoted to a rock-arm, 53, fast on the shaft 54. The switches 2, which control the movements of the once-folded sheet, are hung on a shaft, 16, which is rocked by means of a rock-arm, 5, and connecting-rod 6, whose lower end carries a bowl bearing upon a cam, 91, on the cross-shaft 55, being moved in the opposite direction by a spring-seated rod, 56. Curved conductors 21 are fixed on a rod, 11, in a position to guide sheets carried past the switches 2 onward to the delivering-cylinder 90, and similar curved conductors 1 are placed so as to direct said sheets around said delivering-cylinder 90, as will be explained.

The folding-rollers 32 32 and 33 33 are geared together, so as to revolve in unison, and are driven from the delivering-rollers 38 38 (geared together in like manner) by two trains of gear-wheels, 66, actuated by a like train, 67, meshing with a toothed wheel, 68, which is fast on a shaft, 69, rotated by miter-gears 94 95, connecting it with the shaft of cylinder 60. A series of endless tapes, 36, connect one of the folding-rollers 32 with one of the delivering-rollers 38, and one of the folding-rollers 33 is, in like manner, connected with one of the delivering-rollers 38 by similar endless tapes 37. Similar endless tapes 64 and 65 extend from one of the folding-rollers 32 and 33, and run over pulleys 7 7, being thereby stretched nearly parallel with the tapes 36 37, and, in connection with them, serving to carry the sheets from the rollers 32 32 and 33 33 to and between the rollers 38 38. As the pulleys 7 supporting these converging tapes cannot extend them fully between the rollers 38 38, it is found expedient to provide guides 73, (see Fig. 5,) which are bars or plates bent into angular form, and hung on a rod, 57, so as to reach down between said rollers and form guideways for the sheets.

The shaft 69 also imparts motion to the parallel shaft 55 by means of toothed wheels 61 and 62.

The folding-blades 34 35 are mounted on the ends of curved arms 59 63, securely fastened on shafts 74 75, which shafts are connected together so as to be rocked in unison, and simultaneously operate the folding-blades by rock-arms 76 77 and a connecting-rod, 78, and receive motion by means of a rock-arm, 79, fast on the shaft 74, and a connecting-rod, 81, extending from the crank-arm 82 on the shaft 55. These connecting-rods 78 and 81 (see Fig. 1) are constructed in two sections, one (the rod section) sliding telescopically within the other or sleeve section, 84. They are held together by keys 86 inserted through slots in the sleeve-section 84, and through an elongated slot in the rod-section, and are held extended to their maximum length by means of springs 83, which bear against the sleeve-section 84, and upon collars 85, which are secured on the rod-sections.

The power necessary to produce the required

vibrations of the folding-blade and to double the sheet into the bight of the folding-rollers is not sufficient to overcome the springs 83, and hence, in the ordinary working of the machine, the said springs serve only to keep the rod 81 extended; but, if any obstruction opposes the perfect operation of either or both of the folding-blades, one or both of the connecting-rods will slide over the key 86 and within the sleeve 84, thus compressing the spring 83, which will yield, and prevent the said obstruction from causing injury to the folding-blades. In folding different thicknesses of paper the blades may be set to properly enter the folding-rollers by means of collars and set-screws, which provide for their adjustment upon the shafts 74 75. Their range of motion in the direction of the rollers may also be determined by stops, in the present case illustrated as arms 88 89, adjustable on the shafts 74 75, and abutting against the side frames.

When thin paper is to be folded the folding-blades are adjusted to enter fully into the nip of the folding-rollers, and yet so as not to be seized by them. This adjustment may be determined by the stop-arms 88 89, and, by reason of the provision of the yielding folder-actuating rods 78 81, can be nicely made without danger to the perfect operation of the machine, since the said rods will yield when the stop-arms 88 89, a pasted seam, buckled sheet, or other obstruction opposes its perfect operation. These folding-blades are timed and actuated, and their operation is such that they will descend upon the sheet, and, by their friction, partially arrest its motion, and also bend or curve it before the tapes have carried it against the gage 17 to register it over the folding-rollers in position for its second fold. By thus slightly curving the sheet it is given a form which possesses great longitudinal strength. Thus partially arrested and curved, the sheet will still be carried onward to the gage 17, which it will strike without being buckled or otherwise injured by the force of the blow. The sheet thus manipulated will reach its position for receiving a second fold just before the folding-blade has descended far enough to force it into the nip of the folding-rollers.

The fly-frame 39, which swings from a point under the delivering-rollers 38 38 down onto the delivering-table 40, is fixed upon a shaft, 28, rocked by a rock-arm, 97, and a rod, 98, extending therefrom, yoked over the shaft 55, and carrying a stud, 99, upon which bears a cam, 73, fast on shaft 55. The return movement of the fly is accomplished by a spring-seated rod, 102.

The operation is as follows:

The web of paper 52, either from a roll, 87, or from the impression-cylinder of a printing mechanism, is led over a guide-roll, 101, through the folding and cutting cylinders 50 and 60, between which it is nipped and carried forward until its end depends from the cylinder 60, as in Fig. 6, it being guided into this position by the deflectors 12, Fig. 5, which are curved arms, fixed upon a rod extending from the side frames of the machine.

As the cylinders 50 60 revolve the folding devices are brought into co-operation, as in Fig. 6, to fold the web, the folding-blade 25 fixed to the cylinder 60 forcing the web of paper which overlies it into the nip of the nipping-springs 13. As the cylinders continue their rotation the folding-blade 25 will be withdrawn, thus allowing the springs 13 to close down onto the jaw 14 and clamp the double edge of the web thereon, the recess 8 in cylinder 60 permitting full play to the curved ends of the springs 13 in this closing movement. Thus held, the double web will travel onward with the cylinder 50 until the curved ends of the springs 13, bearing against the periphery of the delivering-cylinder 80, force the springs open and release the sheet from their hold. When thus released the sheet will be guided so as to follow the periphery of the delivering-cylinder 80 by the switches 2 when they stand in the position shown in Fig. 7. The sheet is thus guided between the tapes 30 and 31, which run over the pulleys 27 and 29 and cylinder 80, and is carried thereby out over the folding-rollers 32 32 and 33 33 until it abuts against the gage or stop 17, where it rests in a position to receive its second fold, which is accomplished by means of a vibrating folding-blade, as 35.

When the cylinders 50 60 have completed a revolution the cutting devices will have been brought into operative contact, as in Fig. 8, to sever the partially-folded end from the web, thus forming a sheet. When the web is severed its leading end will be carried forward and thrown off from the cylinder 50 by the guiding-fingers 10, so as to droop down in front of the cylinder 60, and it will be folded and severed, as has been set forth. These automatically-moved guiding-fingers are then drawn within the cylinder 50, so as not to obstruct the proper action of the folding devices.

In the present apparatus the once-folded sheet 51 is divided centrally as it passes over the top of the delivering-cylinder 80 by a circular cutter, 15, on shaft 3, which, extending into a groove in the said cylinder 80, is rotated by the contact of the passing sheet. A positive movement might, however, be imparted to this cutter by a toothed wheel connecting its shaft with the toothed wheel 45. The two once folded sheets thus formed are carried out over the folding-rollers 32 32 33 33 and against the gage 17, as before described. These two once-folded sheets are simultaneously doubled into the nip of the second folding-rollers 32 32 and 33 33 by means of the vibrating folding-blades 34 and 35. The two independent once-folded sheets are thereby a second time folded, and are assembled together at the delivering-rollers 38 38 (see Fig. 2) by means of the tapes 36 64 and 37 65 and the guides 73. The said tapes and folding and delivering rollers are run with uniform surface speed by

means of the gearing hereinbefore described, and the said folding-blades are simultaneously operated, thereby folding the two sheets at the same moment, carrying them onward with perfect uniformity of travel, and bringing their leading edges evenly together at the rollers 38 38, whence they are delivered before the vibrating fly-frame 39, or, if desired, by tapes before a third folding apparatus, by which the two may be a third time folded. It is evident that instead of being assembled after the second fold they may receive a third fold, and then be assembled and flown, as just described. If delivered before the fly-frame 39, they will be piled upon a table, in this instance made up of parallel bars 40, along which the sheets, as they accumulate, are forced to slide by the vibrating action of the fly-frame.

The speed of delivery is necessarily limited by the length of time required in operating vibrating folders in excess of that occupied by the rotating folder, from which fact it follows that the highest speed at which the rotating folder will operate cannot be utilized when one set of vibrating folders are used to give the sheet its subsequent fold. Hence, in order to attain the highest speed at which the rotating mechanism will fold sheets cut from a web, I have provided a second delivering-cylinder, 90, furnished with conductors and tapes, leading to a second set of folding-rollers and folding-blades, by which alternate sheets once folded by the rotating cylinders 50 60 are conveyed to and folded between the rollers 100. (See Fig. 8.)

The operation of the mechanism will then be as follows:

When a folded sheet has been directed to the folding-rollers 32 32 33 33 by the switches 2, as has been described, the said switches will be moved, by the action of the cam 91, into the position shown in Fig. 8, so as to direct the succeeding folded sheet onward to the cylinder 90, which movement will be aided by the conductors 21; and, as the contact of the ends of the nipping-springs 13 with the cylinder 80 would open them and release the sheet, the delivering-cylinders 80 90 are made two-thirds of the diameter of the folding-cylinder, so that they will make three revolutions to two revolutions of the folding-cylinder, and that portion of the periphery of the cylinder 80 presented to the action of the springs at the second revolution of the cylinder 50 is cut away, as is represented by dotted lines at 107 in Figs. 7 and 8. This construction enables the said springs to pass the cylinder 80 without being affected thereby; but said springs will be opened as they bear against the periphery of cylinder 90, when the second sheet will be released from the nipping-springs, as was the first, and the conductors 1 will guide it around the cylinder 90 and between the tapes 96 58, which will carry it out over the second folding-roller 100, through which it will be folded by the vibrating folder 108.

As the said sheet passes between the rollers 105 and 106, and in contact with the cutter 15, it will be divided into two once-folded sheets, as before described with reference to the first sheet. Two sets of folding-rollers 100, folding-blades 108, collecting and delivering mechanisms, whose construction and arrangement are like that illustrated in Fig. 2, will be arranged to fold, assemble, and deliver the said sheets in a manner similar to that described with reference to the sheets folded through rollers 32 32 33 33.

The several tape-rollers may, of course, be pulleys or spools, and the folding-rollers may be continuous, or be made up of pulleys set on a common shaft, and the switches 2 may vibrate in grooves cut in the rollers and cylinders, or between the pulleys, when that is their construction.

This system of diverting once-folded sheets alternately into distinct paths of travel, by which they are conveyed to separate folding devices, is made the subject-matter of another application, and is, therefore, not herein claimed broadly; but it is to be observed that the duplex delivering mechanism herein described may operate with folding-cylinders such as 50 and 60 when their cutting mechanism is removed and the web is severed by independent cutters.

In Fig. 12 the cylinders 50 60 are represented of circumferential dimensions equal to the length of two sheets, and they are furthermore provided with double sets of both folding and cutting devices. The cutting-blades 109 123 and folding-blades 110 118 move in radial slots, and are projected from or withdrawn into the cylinders by means of their shafts 112, which are elongated to extend into grooves 111 in stationary cam-plates fixed to the frame of the machine.

The delivering-cylinders 80 90 are also differently arranged, all of which will be well understood by a description of the operation of this modification of my apparatus. The web 52, led through the cylinders, has its leading end kept from following either cylinder by rotating brushes 198, which carry it between them. The folding-blade 110 doubles the web into the nip of the springs 113, which carry it onward until the delivering-cylinder 80 opens the springs and releases the sheet, which is directed, by the conductors 114, out between the tapes 115 116, whence it may be delivered to a second folding apparatus, or out of the machine. As the cutters 109 117 come into operative contact they sever the web, and its new leading end is carried out between the brushes 198, as before explained.

When the second set of folders 118 119 come into operative position, the web will be nipped by the springs 119 and carried downward until the springs engage the delivering-cylinder 90, when they will be opened and the sheet directed by the conductors 120 to the tapes 121 122, by which it will be carried out to a second folding apparatus, or be otherwise delivered. When a sheet's length has passed

through the cylinders the second set of cutting devices 123 124 will come into operation and sever the web, as before described. These cylinders thus successively cut and fold the web into sheets, which sheets are alternately delivered to the two sets of tapes. The cutting and folding of the web take place at the point of contact of the two cylinders, the cam-groove 111 being so shaped at this point as to suddenly project the cutting or folding blades.

This system might be carried still further by supplying two delivering-cylinders to each of the cylinders 50 60, as has been already described with reference to the cylinder 50, and guiding-fingers may be applied to these cylinders to prevent the leading end of the web from following them.

To avoid the danger of tearing the sheet of paper by the folding-blade 25 thrusting it into the recess of the upper cylinder 50 against the pressure of the spring 13, this spring may be elevated automatically both to receive and release the folded sheet, as shown in Fig. 13.

In this modification the springs 13 will not project beyond the periphery of the cylinder 50, but are lifted by fingers 200 mounted on a rock-shaft, 202, carried by lugs from the inner face of the cylinder 50. This shaft at its extremity has a lever carrying a friction-roller, 201, and a fixed projection or pin on the frame of the machine is so situated that by the rotation of the cylinder 50 the friction-roller 201, in passing under it, will raise the springs to receive the folded paper. To release the same at one or more points alternately or in succession, cam-shaped projections may be thrown into the path of the roller 201, so as to rock the shaft 202 and release the folded sheet at any desired part of the revolution of the cylinder A.

I am aware of the English Patent No. 1,581 of 1870, and also that the same forms the subject-matter of an application for Letters Patent of the United States. The crank mechanism operating the folding-blades is not herein claimed, since it forms the subject-matter of another application.

What is claimed, therefore, as my invention is—

1. A pair of cylinders provided with cutting mechanisms and with a folding-blade and co-operating nipping devices, in combination with a delivering-cylinder, substantially as described.

2. The combination, with a pair of cylinders provided with sheet-folding devices, of two delivering-cylinders and a device for directing the sheets alternately to said delivering-cylinders, all substantially as described.

3. In combination with mechanism imparting to a sheet its first fold, a cutter for dividing it into two sheets, mechanism for subsequently folding said sheets, and devices for collecting said sheets together and delivering the same, all substantially as described.

4. The combination of the guiding-fingers with the cutter and its carrier, whereby the parts of the web are torn asunder on the partially-severed line, substantially as described.

5. The combination, with a folding-blade and an actuating device vibrating said blade positively in both directions, of an interposed yielding mechanism, which is provided with means for adjusting its resistance so that the said yielding mechanism shall operate when the ordinary movements of the folding-blade are obstructed, all substantially as described.

6. The combination of folding-cylinder 50, delivering-cylinders 80 90, and switches 2, substantially as described.

7. The combination, with the folding-blades, of rods provided with adjustable elastic portions, connecting the said blades together, or either of them, with the actuating mechanism, all substantially as described.

8. The combination with the pairs of folding-rollers 32 33, of the delivering-rollers 38 and connecting tapes, substantially as described.

9. The combination of a rotating carrier supporting a single sheet-folding device with means for delivering the sheets it carries into co-operating folding devices alternately at two or more points, all substantially as described.

10. The combination, with a rotating carrier supporting a sheet-folding device, of the co-operating sheet-receiving cylinders, one of which cylinders is provided with a recess, as 107, 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,
CHAS. W. CARPENTER.

6 pp 50 words.