No. 652,765. Patented July 3, 1900.

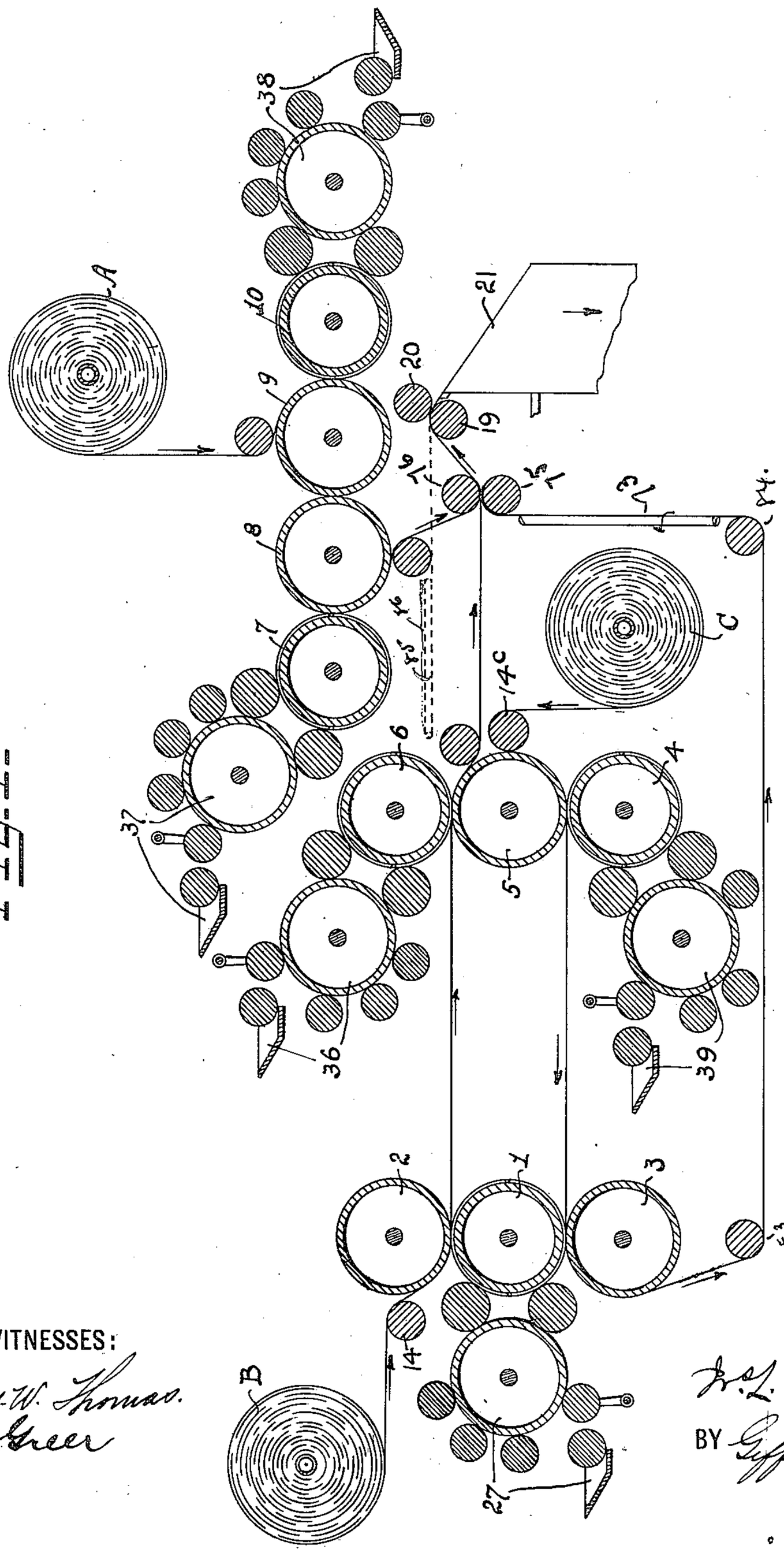
J. L. FIRM.

PRINTING MACHINE.

(Application filed Nov. 14, 1896.)

(No Model.) 4 Sheets—Sheet 1.

Fig. 1.



WITNESSES:

Chas. W. Thomas.

J. E. Greer

INVENTOR

J. L. Firm,

BY Gifford & Bull

ATTORNEYS.

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(No Model.) 4 Sheets—Sheet 2.

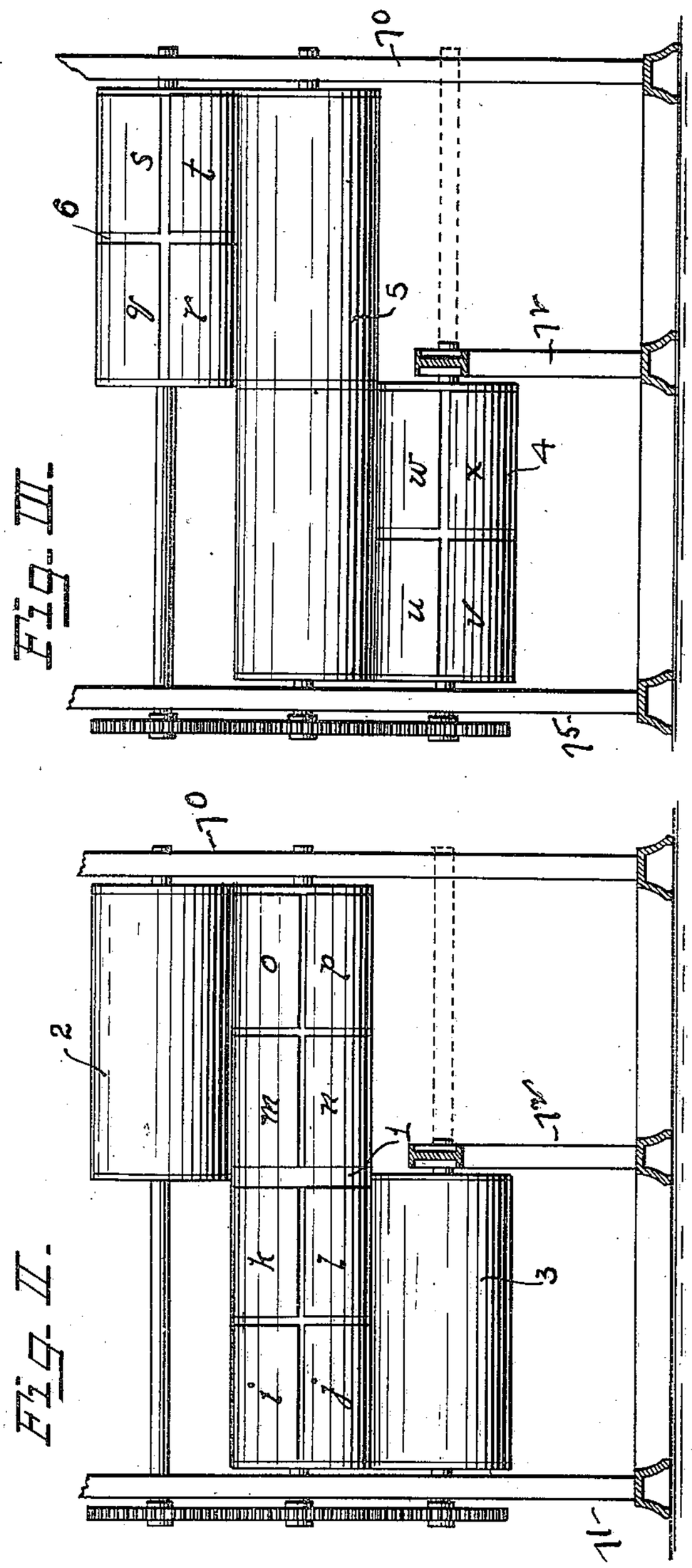

Fig. III.

Fig. II.

Fig. IV.

WITNESSES:

Chas. W. Thomas.

J. E. Greer

INVENTOR

Jo. L. Firm.

BY Gifford & Bull

ATTORNEYS.

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(No Model.) 4 Sheets—Sheet 3.

FIG. VI.

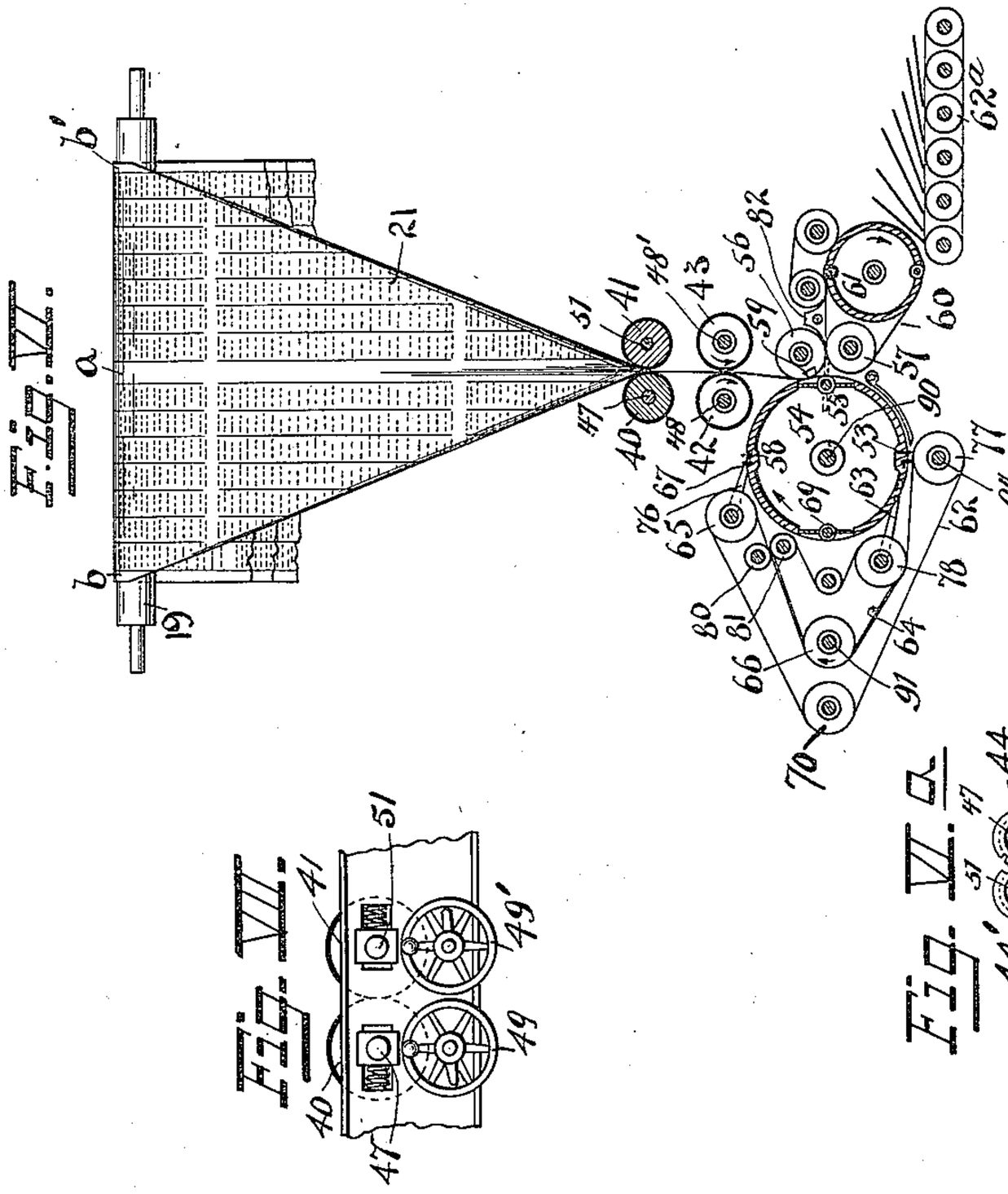


FIG. VII.

FIG. VIII.

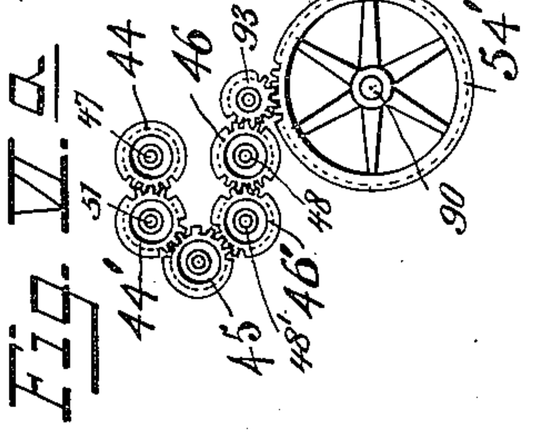
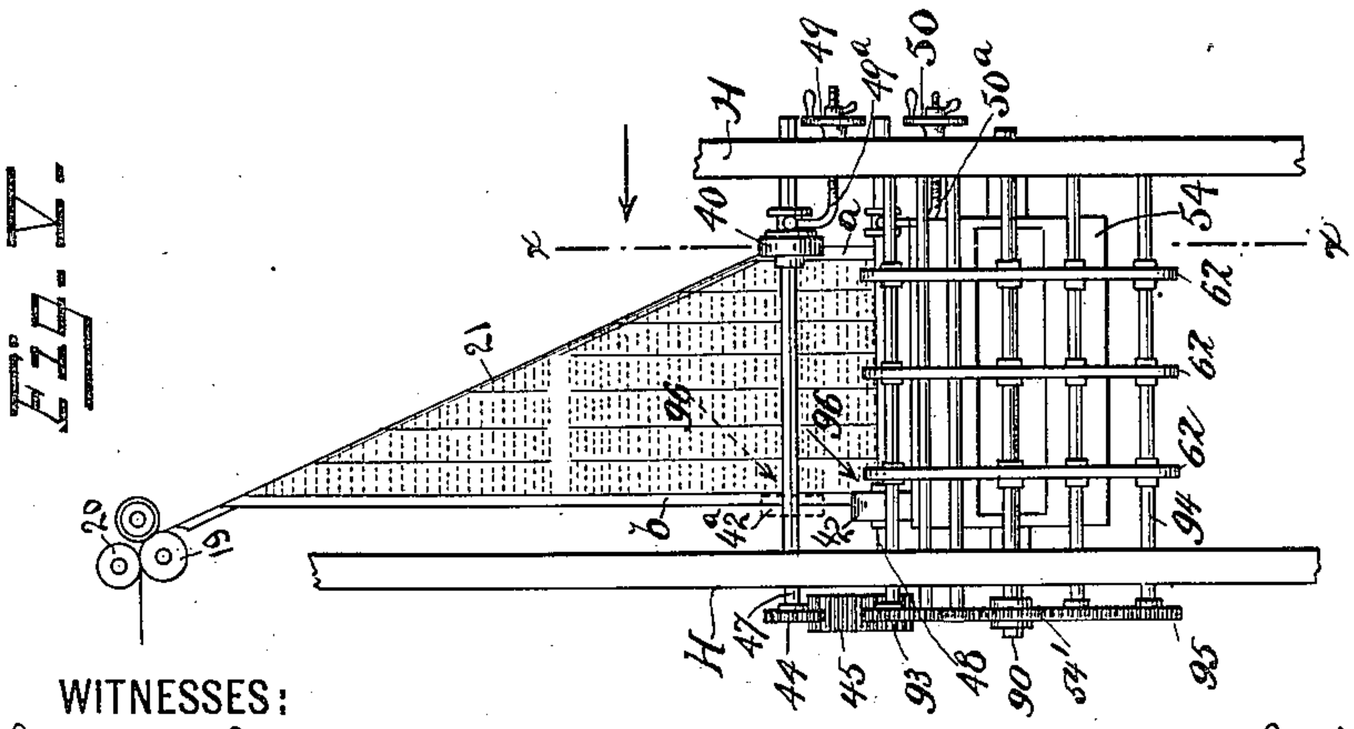


FIG. V.



WITNESSES:

Chas. W. Thomas.

Chas. J. Rathjen

INVENTOR:

J. L. Firm.

BY Gifford & Bull

ATTORNEYS.

No. 652,765. Patented July 3, 1900.

J. L. FIRM.

PRINTING MACHINE.

(Application filed Nov. 14, 1896.)

(No Model.) 4 Sheets—Sheet 4.

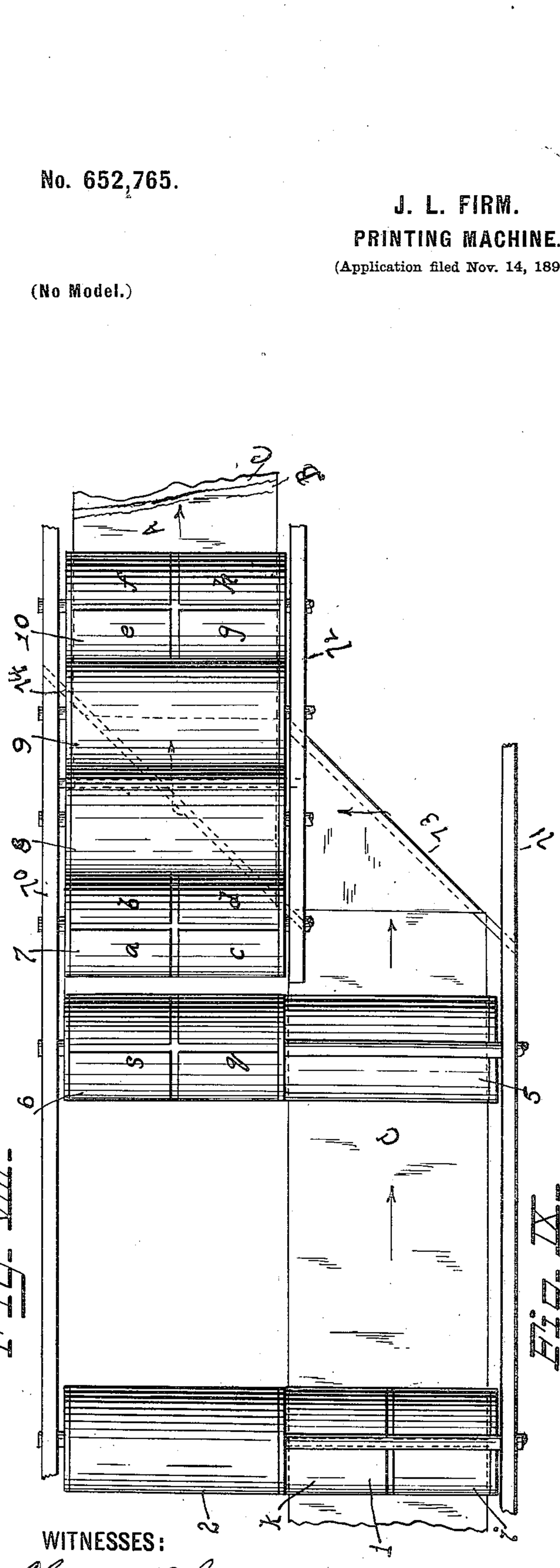


Fig. VIII.

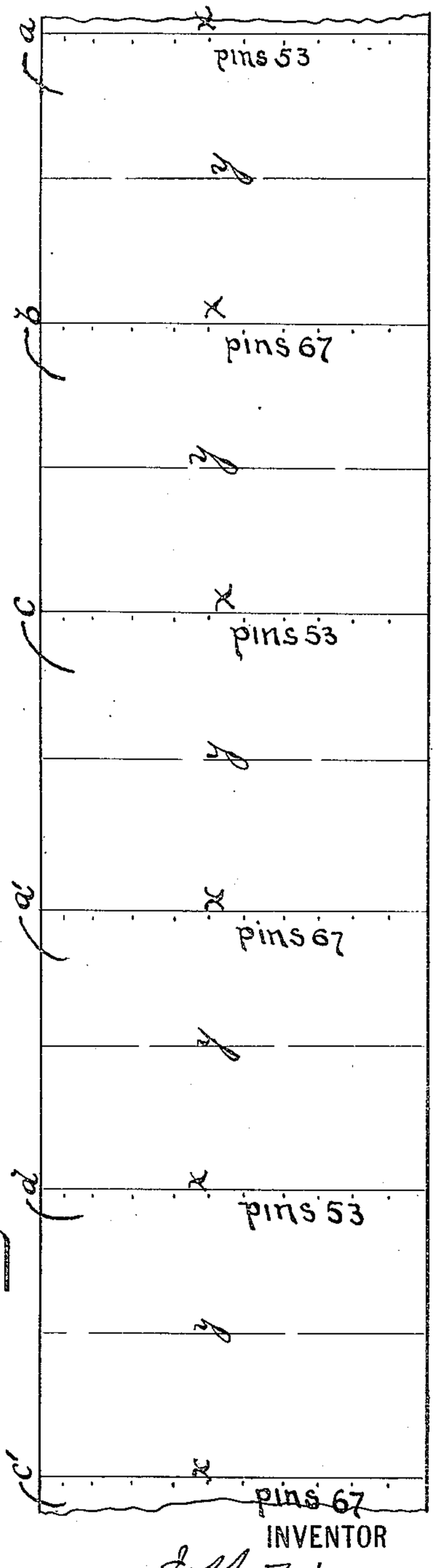


Fig. IX.

WITNESSES:

Chas. W. Thomas
J. E. Greer

INVENTOR

J. L. Firm.

BY Gifford & Bull

ATTORNEYS.

UNITED STATES PATENT OFFICE.

JOSEPH L. FIRM, OF JERSEY CITY, NEW JERSEY, ASSIGNOR TO THE GOSS PRINTING PRESS COMPANY, OF CHICAGO, ILLINOIS.

PRINTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 652,765, dated July 3, 1900.

Application filed November 14, 1896. Serial No. 612,046. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH L. FIRM, a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Printing-Machines, of which the following is a specification.

The object of this invention is to provide a simple and efficient arrangement of form and impression cylinders whereby the weight of the machine is reduced, while the capacity of the machine for perfecting webs of various combinations is maintained.

The machine contains other improvements, hereinafter set forth, which may be used in connection with the foregoing improvement or otherwise.

In the accompanying drawings, Figure 1 is a diagram showing in end view the arrangement of cylinders in rows for carrying out one part of my invention. Fig. 2 is a detail in elevation showing cylinders 1, 2, and 3. Fig. 3 is a detail in elevation showing cylinders 4, 5, and 6. Fig. 4 is a detail in plan view showing cylinders 7, 8, 9, and 10. Fig. 5 is a folding mechanism in side view. Fig. 6 is the same folding mechanism and a delivery mechanism in end sectional view on the section-plane *x x* of Fig. 5. Fig. 6ª is a detail looking from the left of Fig. 5, showing the gears for driving the rolls 40 41 42 43 and the tape-wheels 66. Fig. 7 is a detail. Fig. 8 shows in plan view the arrangement of the frames in which the form and impression cylinders are journaled. Fig. 9 shows the longitudinally-folded webs with the different cuts indicated thereon.

A, B, and C are three webs, two or more of which are to be printed on and associated in such manner as to enable them to be supplied to the folder 21, so that preferably by such folding and delivery mechanism as is shown in Figs. 5 and 6 they may be delivered folded as a product of six, eight, or ten pages or more. Each of the webs is in width equal to two pages abreast.

The cylinders employed in printing the web A are numbered 7, 8, 9, and 10 and are arranged with their axes in a horizontal plane, the two impression-cylinders 8 and 9 being next to each other and being flanked on either side by the form-cylinders 7 and 10, which are respectively inked by the inking mechanisms 37 and 38.

Only six cylinders are employed for printing both the webs B and C. Three of these cylinders, 1, 2, and 3, are arranged with their axes in a plane, preferably vertical, and consist of a form-cylinder 1, located between two impression-cylinders 2 and 3. The other three, 4, 5, and 6, are located with their axes in another plane, preferably vertical, and consist of an impression-cylinder 5 between two form-cylinders 4 and 6. The axes of cylinders 1, 2, and 3 are preferably in the same horizontal planes, respectively, with the axes of cylinders 5, 6, and 4. The form-cylinder 1 is inked by the inking mechanism 27, located outside of it, the form-cylinder 6 by the inking mechanism 36 above the level of cylinder 5, and the form-cylinder 4 by the inking mechanism 39 below the level of cylinder 5. Thus if a plane be imagined passing through the axes of form-cylinder 1 and impression-cylinder 5 on one side of this plane will lie impression-cylinder 2 and form-cylinder 6, with its inking mechanism 36. On the other side will lie impression-cylinder 3 and form-cylinder 4, with its inking mechanism 39. Moreover, the polygon, in the boundaries of which lie the axes of cylinders 1 2 3 and 4 5 6, is traversed in one direction by the web B from its entrance at the guide-roll 14, while the same polygon is traversed in the opposite direction by the web C from its entrance at the guide-roll 14ᶜ.

The form-cylinders 7 and 10, as shown in Fig. 4, are each of a length corresponding with the width of web A and of the diameter requisite for carrying two page-forms abreast on each semicircumference. For example, the cylinder 7 carries the page-forms *a b c d* and the cylinder 10 carries the page-forms *e f g h*.

The length of form-cylinder 1, as shown in Fig. 2, is double the width of the web B, and it carries four page-forms abreast on each semicircumference, or eight page-forms in all, which are lettered *i j k l m n o p*.

The length of form-cylinder 6, as shown in Fig. 3, corresponds with the width of the web

B, and it carries two page-forms abreast on each semicircumference, making four in all, which are lettered *q*, *r*, *s*, and *t*.

The length of form-cylinder 4 corresponds with the width of the web C, and it carries two page-forms abreast on each semicircumference, which are lettered *u v w x* in Fig. 3. The impression-cylinder 5 in length corresponds with the combined lengths of cylinders 4 and 6, so that it coöperates with both of them.

The arrangement of the cylinders is such that if a plane were passed through the machine perpendicular to the axes of the cylinders and in the margin at the middle of form-cylinder 1, between the forms thereon, on one side of said plane would lie the form-cylinders 6, 7, and 10 and impression-cylinders 2, 8, and 9 and on the other side of said plane would lie the form-cylinder 4 and impression-cylinder 3, while form-cylinder 1 and impression-cylinder 5 would each lie one-half on each side of said plane.

The cylinders arranged as above described are journaled in frames or uprights 70, 71, and 72, as shown in plan view in Fig. 8. In Fig. 8 the webs in the act of being printed are omitted; but that portion of the web C which is shown as returning underneath the inking mechanism 39 in Fig. 1 is shown in Fig. 8 as advancing in the direction of the arrows to the turning-bar 73 and thence transversely through an opening in the frame 72 to the turning-bar 74, by which last turning-bar it is turned so as to run parallel with the webs A and B, the three webs being associated, as shown in Fig. 1, between the rollers 75 and 76, whence they run together between the rollers 19 and 20. Thus when the three webs reach the rollers 19 and 20 each web will have the imprint on each side of two pages abreast, with the columns running lengthwise of the web and a longitudinal margin extending longitudinally along the middle of each web. The pages on one side of this longitudinal margin constitute the first half of the product and the pages on the other side the last half, and the pages are so arranged relatively to each other that it only requires to make a fold on the longitudinal margin for the purpose of making the product in regular book or newspaper form.

The longitudinal-folding mechanism by which the three webs which emerge from between the rollers 19 and 20, printed and associated, as before described, are folded may be as follows, referring to Figs. 5 and 6: 21 is the ordinary V-shaped frame or former, over which the associated webs pass to the folding-rollers at its apex. Instead of using the ordinary folding-rollers I employ at the apex a pair of wheels 40 41 at the crease, which are so short as to contact with the paper only on the longitudinal margin *a* on opposite sides of the fold, and I employ another pair of wheels 42 43, so short and so located in line with the base of the former 21 as to only come in contact with the paper on the longitudinal margins *b b'* next the two edges which are brought together. Thereby the folding-wheels are so located that they do not come in contact with the ink on the printed portion of the longitudinally-folded web, and by coming in contact only with the unprinted margins the ink is prevented from offsetting onto said folding-wheels. To drive and properly adjust said folding-wheels, the following construction may be employed: The wheel 40 is fixed upon a shaft 47, so mounted as to be capable of sliding axially in its bearings. The axial adjustment of the shaft 47 is controlled by hand-wheel 49 through a shipper-rod 49^a. The wheel 41 is fixed upon a shaft 51, so mounted as to slide axially in its bearings, and the axial adjustment of which is controlled by hand-wheel 49'. In Fig. 5 only one of these shows, as both are in the same horizontal plane. The wheels 42 and 43 are fixed, respectively, to the shafts 48 and 48', each of which shafts is free to slide axially in its bearings and each of which is controlled as to axial adjustment by its respective hand-wheel and shipper-rod, as 50 and 50^a, only one of which appears in Fig. 5 for the reason given above. By such means the operator may adjust axially the shafts 47 51 and the shafts 48 48' while the machine is running in such way as to cause the wheels to overlap the paper on the margins to the required extent. The shafts 47, 51, 48, and 48' are driven from the shaft 90 of carrier 54 as follows: 54' is a gear-wheel fixed on the shaft 90 and which drives an intermediate broad-faced gear 93, which drives gear 46, fast on shaft 48, which drives gear 46', fast on shaft 48', which drives broad-faced intermediate gear 45, which drives gear 44', fast on shaft 51, which drives gear 44, fast on shaft 47. By having the intermediate gears 93 and 45 broad-faced permits of the axial adjustment of the shafts 51 47 and 48 48' before described. The gear 66', fixed on shaft 91 of tape-wheel 66, is driven from the gear 54' by the intermediate gear 92. The folding-wheels 40, 41, 42, and 43 I prefer to make of brass, so as not to have slipping contact, or they may be covered with rubber or leather for the same purpose, as indicated in Fig. 6 by heavy lines. The wheels 42 and 43 are of a little greater diameter than the rolls 40 and 41 to draw the edges of the web close to the former 21, as indicated by the arrows 96. The difference in diameter between the wheels 42 43 and the wheels 40 41 is exaggerated in the drawings for the purpose of illustration. The proper difference is very slight and must be determined by the constructor, so as by the greater surface speed of the wheels 42 43 to draw the edges of the paper close to the former without requiring undue slip between the paper and the wheels 42 and 43, having in view the fact that the paper will stretch more at these edges than at the folded margin, in contact with which the wheels 40 and 41 come.

It will be seen that the wheels 40 and 41 act upon the paper before it is acted upon by the wheels 42 and 43, so that the crease is made at the fold before the edges of the paper are forced together. This mode of operation is very much to be preferred for producing the proper conditions, or, in other words, it is very much to be preferred that in the path of the paper the wheels engaging the fold should be in advance of the wheels engaging the edges. If desired, the wheels 42 and 43 may be transferred to the position shown by dotted lines at 42^a, Fig. 5.

The transverse folding and delivery mechanism by which the webs are treated after emerging from the mechanism before described may be of the construction shown in Fig. 6, which is capable of delivering the products either without or with the superposition of succeeding cuts upon one another. When no superposing is desired, the forward edge of the longitudinally-folded webs will be pinned upon the pins 53, borne by the carrier 54, which rotates in the direction of the arrow placed upon it in the drawings. When this carrier has rotated to the position shown in Fig. 6, the folder will fold the webs transversely between driven folding-rollers 56 and 57. As the webs are drawn between these rollers the knife 58, which is borne by the carrier 54, acting against the matrix 59, borne by the folding-roller 56, will cut the webs transversely, and the transversely-folded cut thus made will be received by the tape 60 and after passing over the cylinder 61 will be deposited upon the delivery-table 62^a. The carrier 54 may have a pinning, folding, and transversely-cutting mechanism on each semicircumference, as shown, and may therefore be employed to deliver at each rotation two transversely-folded cuts. If, however, it be desired to superpose the cuts upon one another before transversely folding them, the first cut that comes along and is pinned by the pins 53, (which for convenience I will designate as "cut" *a* on Fig. 9,) after reaching the position of those pins shown in Fig. 6, instead of being immediately folded by the folding-knife 55 will, by permitting the folding-knife 55 to remain at rest and operating only folding-knife 69, be advanced onto the tape 62 and stripped from the pins 53 by the stripper 63 and thence passed between the tapes 62 and 64, past the guide-rollers 65 and 66, until by the guide-roller 65 and finger 76 its forward end is pressed again in contact with the surface of the carrier 54; but while this cut has thus been making an excursion away from the carrier 54 and back again the speed of the tapes 62 and 64 has been such that when its forward end is a second time pressed in contact with the carrier 54 it is impaled not upon the pins 53, by which it was first impaled, but by the pins 67. The carrier therefore makes one rotation between the time when the cut leaves one set of pins below the carrier and when it is received by the other set of pins above the carrier. Moreover, during said excursion of cut *a* cut *b* has been impaled by pins 67 and instead of being permitted to advance onto the tape 62 is by the attendant torn off of the carrier and thrown away. Still, during the said excursion of cut *a* the cut *c* is impaled on pins 53 and advanced onto the tape 62, so as to start upon the same excursion as cut *a*, with a space between it and cut *a* equivalent to one-half the rotation of the carrier 54. Therefore when cut *a* has finished its excursion and become impaled on pins 67 in the position of those pins shown in Fig. 6 it will be carried forward by those pins, which will impale the forward end of cut *a'* on top of cut *a*. Then the folding-knife 69 upon coming opposite the opening between folding-rollers 56 and 57 will force the cuts *a* and *a'* between the rollers 56 and 57, so as to fold them transversely, with the cut *a* inside of the cut *a'*. The cut *d*, which follows *d'*, will be impaled by pins 53 and started on the same excursion already described for cut *a*, being a distance behind the cut *c* equivalent to one-half the rotation of the carrier 54. The cut *c* upon finishing its excursion will have its foward end impaled by the pins 67, and said pins will carry it forward and impale on top of it the cut *c'* and will carry the two superposed cuts forward until they are folded between the rollers 56 and 57 by the folding-blade 69, with the cut *c* inside of the cut *c'*. Thus the operation will continue indefinitely, each alternate cut going on the excursion and each intermediate cut being folded outside of one of the cuts that has been on the excursion referred to. Therefore in printing the pages the cut *a* will contain pages 13 to 24 and the cut *a'* will contain pages 1 to 12. Cut *c* will contain pages 13 to 24 of another production and cut *c'* will contain pages 1 to 12. The cut forming the first half of the production will always be the third removed from the cut constituting the last half.

In Fig. 9 the pins 53 and pins 67 are shown by dots. The lines of transverse cut are lettered *x* and the lines of transverse fold are lettered *y*. The rollers 77, 78, 66, and 65, which, together with roller 70, carry the tapes 62 and 64, are positively driven from the shaft of carrier 54 by gears, as indicated in Fig. 6^a. Rolls 80 and 81 are mounted upon shafts positively driven as above and between the wheels carrying the tapes 62 and 64, which are loose upon the same shafts. The peripheral speed of the rolls 80 and 81 is greater than that of the tapes, and their shafts are movable toward and from each other, so that the web may be gripped between them and hurried forward, if desired.

I claim—

1. In a printing-machine, in combination, the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the coöperating impression-cylinders 2 and 3 on opposite sides of a plane cutting said

cylinder 1 transversely to its axis, mechanism whereby two webs are guided to said cylinders on opposite sides of said plane, mechanism whereby one of said webs is conducted across said plane and onto the other web, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

2. In a printing-machine, in combination, the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the parallel impression-cylinder 5, the impression-cylinders 2 and 3 coöperating with cylinder 1 on opposite sides of a plane cutting the same transversely to its axis, the form-cylinders 4 and 6 coöperating with cylinder 5 on opposite sides of said plane, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

3. In a printing-machine, in combination, the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the parallel impression-cylinder 5, the impression-cylinders 2 and 3 coöperating with cylinder 1 on opposite sides of a plane cutting said cylinders 1 and 5 transversely to their axes, the form-cylinders 4 and 6 coöperating with cylinder 5 on opposite sides of said plane, and the form-cylinders 7, 10 and impression-cylinders 8, 9 all arranged on one side of said plane, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

4. In a printing-machine, in combination the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the parallel impression-cylinder 5, the impression-cylinders 2 and 3 coöperating with cylinder 1 on diametrically-opposite sides thereof and on opposite sides of a plane cutting said cylinders 1 and 5 transversely to their axes, the form-cylinders 4 and 6 coöperating with said cylinder 5 on diametrically-opposite sides thereof and on opposite sides of said plane, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

5. In a printing-machine, in combination, the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the impression-cylinders 2 and 3 coöperating with said cylinder 1 on diametrically-opposite sides and on opposite sides of a plane cutting said cylinder 1 transversely to its axes, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

6. In a printing-machine, in combination, the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the parallel impression-cylinder 5, impression-cylinders 2 and 3 coöperating with cylinder 1 on opposite sides of a plane cutting said cylinders 1 and 5 transversely to their axes, the form-cylinders 4 and 6 coöperating with cylinder 5 on opposite sides of said plane; the planes, respectively containing the axes of cylinders 1 and 5 and cylinders 2 and 6 and cylinders 3 and 4 being parallel with one another, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

7. In a printing-machine, in combination the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the impression-cylinder 5, the impression-cylinders 2 and 3 coöperating with cylinder 1 on opposite sides of a plane cutting said cylinders 1 and 5 transversely to their axes, the form-cylinders 4 and 6 coöperating with cylinder 5 on opposite sides of said plane; the planes containing the axes of cylinders 2, 1 and 3 and of cylinders 6, 5 and 4 being parallel with each other, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

8. In a printing-machine, in combination the form-cylinder 1, carrying a plurality of forms abreast for the pages of the same product, the parallel impression-cylinder 5, the impression-cylinders 2 and 3 coöperating with cylinder 1 on opposite sides of a plane cutting said cylinders 1 and 5 transversely to their axes, the form-cylinders 4 and 6 coöperating with cylinder 5 on opposite sides of said plane, the form-cylinders 7 and 10 and impression-cylinders 8 and 9 all arranged on the same side of said plane with the cylinders 2 and 6, mechanism whereby three webs are guided respectively to the cylinders 7, 8, 9, 10, the cylinders 2, 6 and the cylinders 3, 4, mechanism whereby one of said webs is conducted across said plane and associated with the other two, and mechanism whereby the printed webs are folded one inside of another, substantially as described.

9. In the folding mechanism of a printing-press the combination of a former with two sets of folding-wheels engaging respectively the folded and marginal edges of the sheet after leaving the former, the set engaging the folded edge being placed in advance of the other set to engage and fold the paper while the marginal edges are still separated.

10. In the folding mechanism of a printing-machine in combination, a former, folding-wheels 40, 41 located near the apex of the former and confined in their operation substantially to the margin adjacent to the fold and folding-wheels 42, 43, located substantially in line with the base of the former and confined in their operation substantially to the margin adjacent to the edges; said wheels 42, 43, having higher surface speed than said wheels 40, 41, substantially as described.

11. In the folding mechanism of a printing-machine in combination, a former, folding-wheels 40, 41 located near the apex of the former and confined in their operation substantially to the margin adjacent to the fold and folding-wheels 42, 43, located substantially in line with the base of the former and confined in their operation substantially to the margin adjacent to the edges and mech-

anism whereby said wheels may be axially adjusted during the operation of the machine, substantially as described.

12. In combination, a carrier, as 54, two sets of holding devices mounted thereon, as the pins 53 and 67, mechanism whereby a web is conducted to said carrier, mechanism whereby a cut from the web, as *a*, is conveyed away from and returned to said carrier; the movement of the said parts being so timed that the forward edges of said cut *a* and of the incoming web are successively secured by one of said sets of holding devices to said carrier; and mechanism whereby said cut *a* and a cut, as *a'*, from said incoming web are folded together off of said carrier; said set of retaining devices positively engaging with the paper so that the leading edges of such cuts *a* and *a'* are in register when the folding takes place, substantially as described.

13. In a printing-machine folding mechanism, in combination, the folding-rollers 56 and 57, a carrier 54, a folding-blade mounted upon said carrier, conveying mechanism on the opposite side of said carrier from said folding-rollers whereby a cut from a web may be conveyed away from and returned to said carrier to be associated with another cut from the same web; the point at which said cut is returned to the carrier being in advance of the point at which the cut to be associated with it from the incoming web reaches the carrier and holding mechanism whereby said first-named cut is held to the carrier before being associated with said last-named cut, said holding mechanism positively engaging the associated cuts so that the leading edges of such cuts are in register when the folding takes place, substantially as described.

14. In a printing-machine folding mechanism, in combination, the carrier 54, the folding-blade and two sets of pins mounted thereon, mechanism whereby a cut is conveyed away from and returned to said carrier; the said pins and said mechanism being so arranged that the cut is returned to and held on the carrier in advance of being associated with another cut from the incoming web, said pins positively engaging the associated cuts so that the leading edges of such cuts are in register when the folding takes place, substantially as described.

15. In a web-folding apparatus, in combination, the carrier, guides for presenting a web thereto at a point, guides for conducting a leaf away from and back to said carrier at a second point less than a cycle of movement removed from the first point, means whereby said leaf is fastened to the carrier at said second point and whereby the web is subsequently fastened to the carrier over said leaf at said first point, said means of fastening positively engaging the paper so that the leading edges of the associated cuts are in register when the folding takes place, substantially as described.

16. The combination with the longitudinal folder of a printing-press of two sets of folding-wheels engaging respectively the opposite edges of the folded web, the set which engages the folded edge of the web being placed to engage the web in advance of the other set or while the marginal edges are still separated.

Signed at New York, in the county of New York and State of New York, this 13th day of November, A. D. 1896.

JOSEPH L. FIRM.

Witnesses:
CHAS. J. RATHJEN,
J. E. GREER.