

(No Model.)

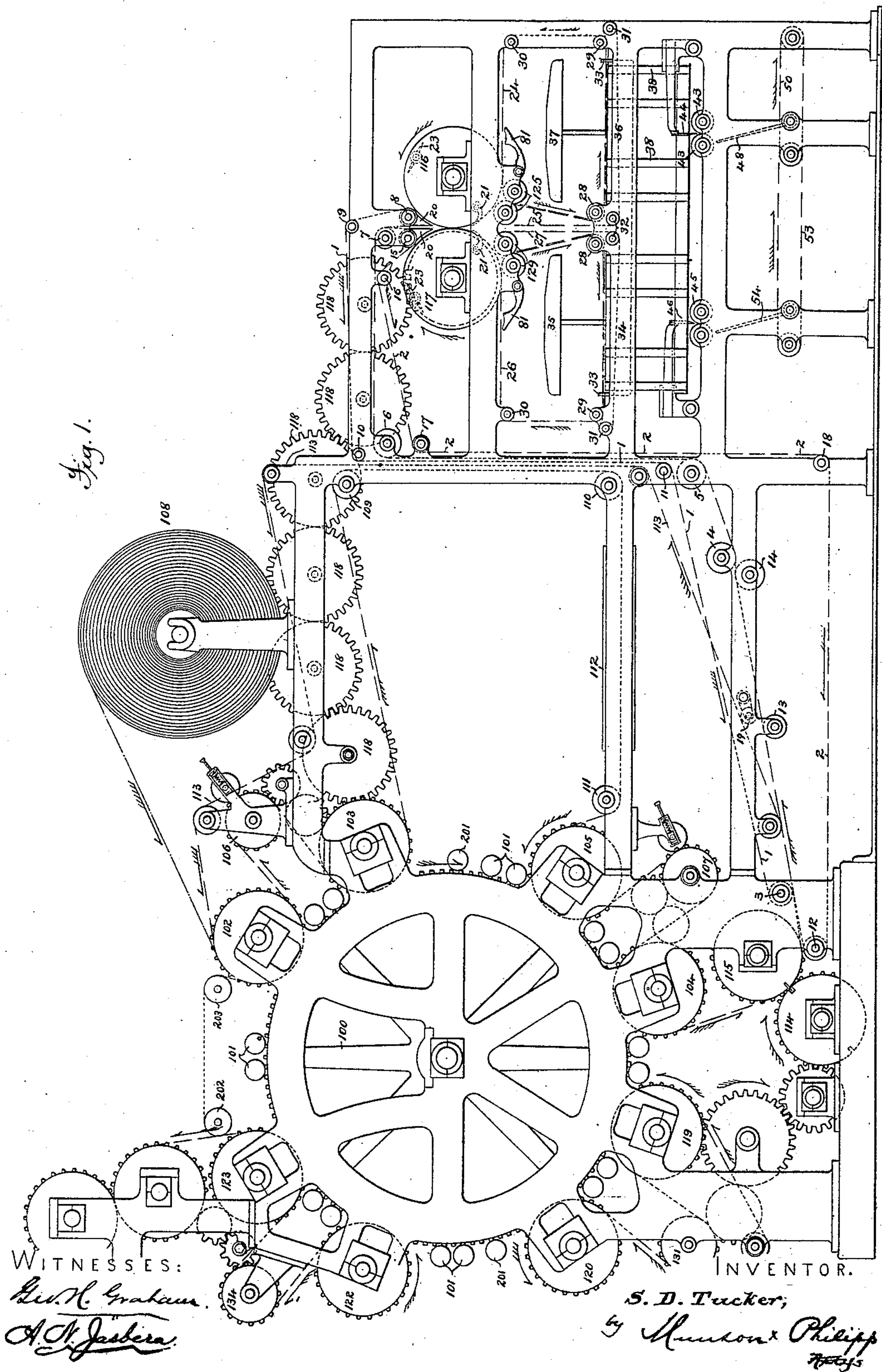
8 Sheets—Sheet 1.

S. D. TUCKER.

DELIVERY APPARATUS FOR PRINTING MACHINES.

No. 441,453.

Patented Nov. 25, 1890.



(No Model.)

8 Sheets—Sheet 2.

S. D. TUCKER.

DELIVERY APPARATUS FOR PRINTING MACHINES.

No. 441,453.

Patented Nov. 25, 1890.

Fig. 4.

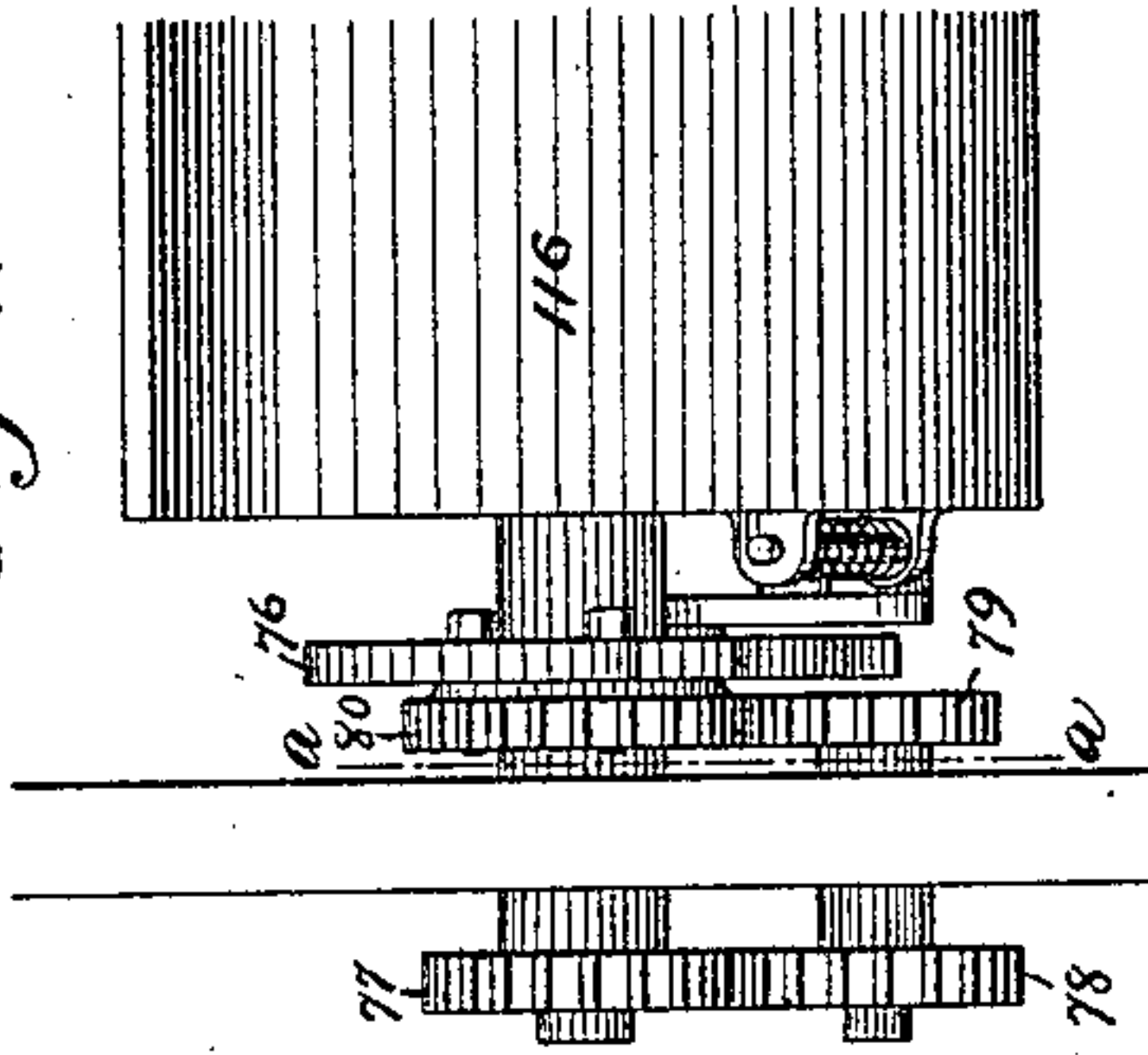


Fig. 5.

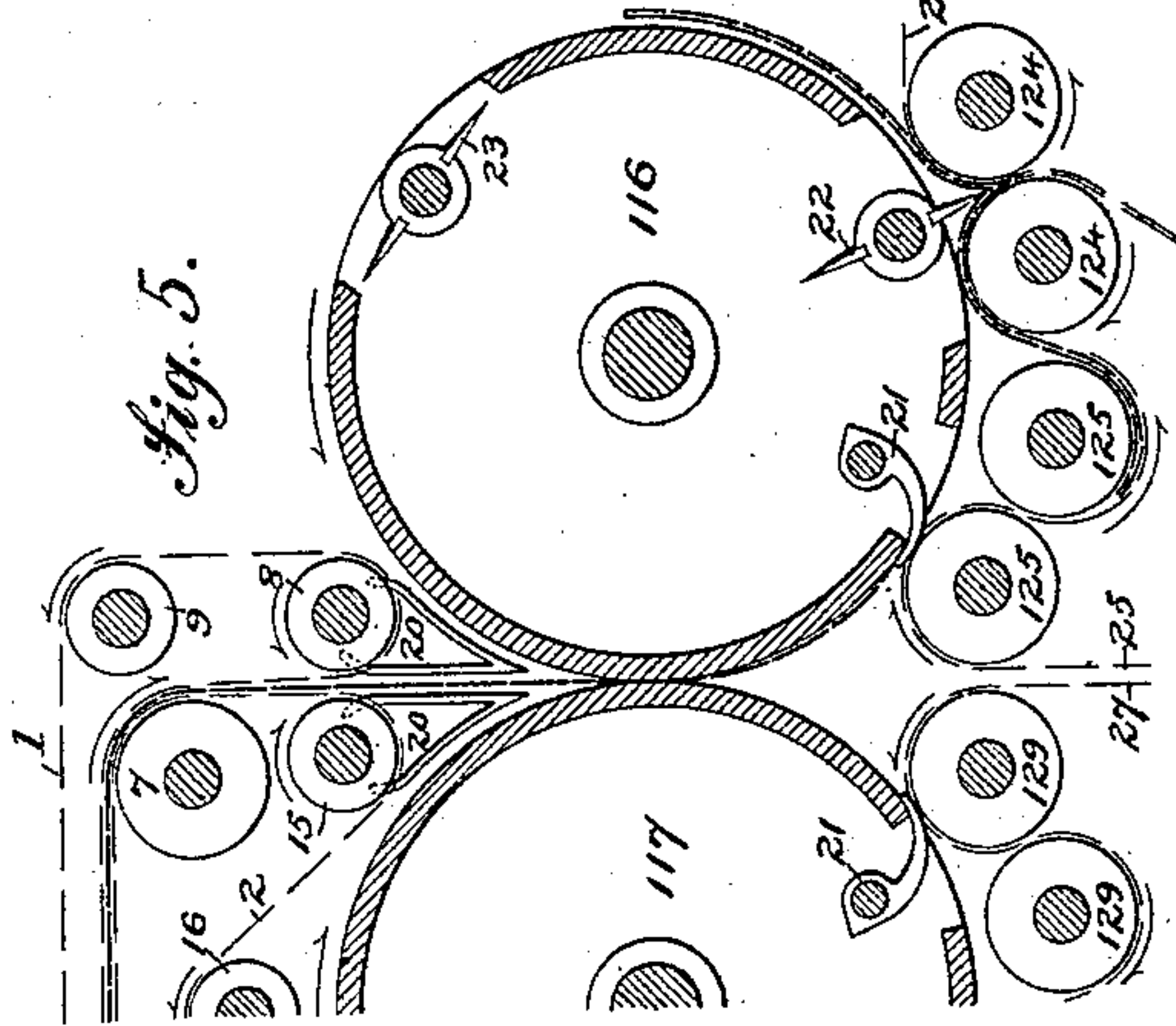


Fig. 3.

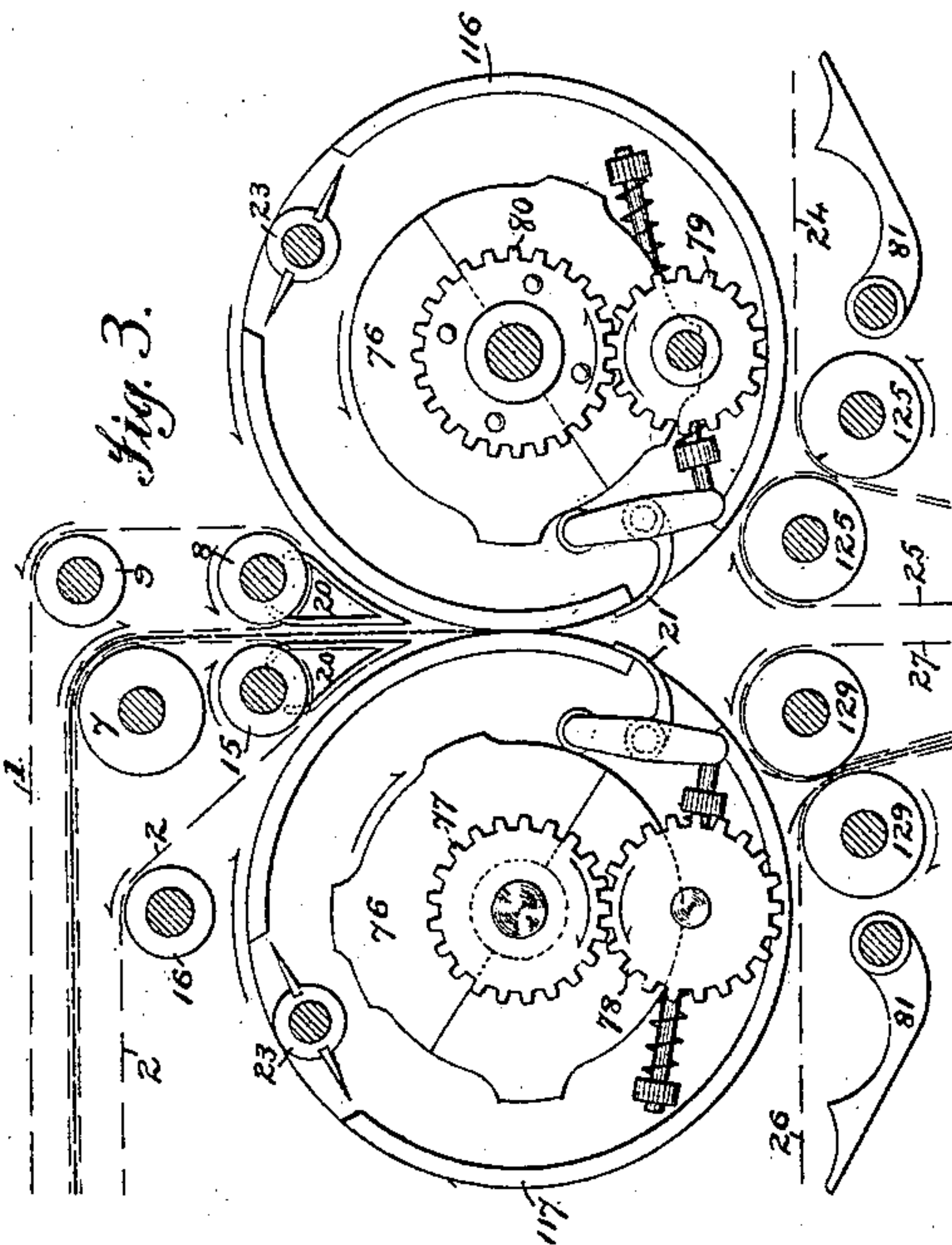


Fig. 6.

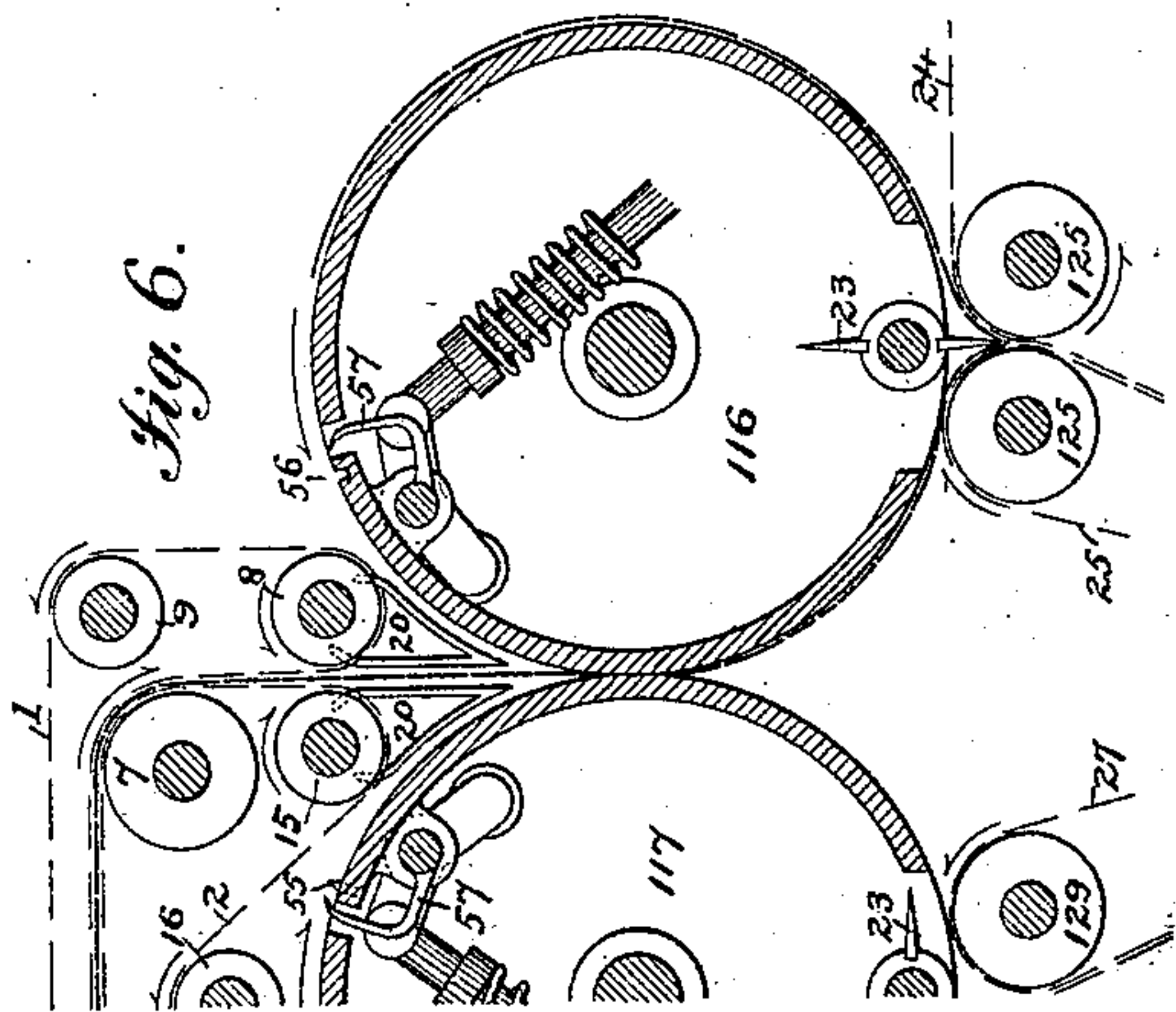
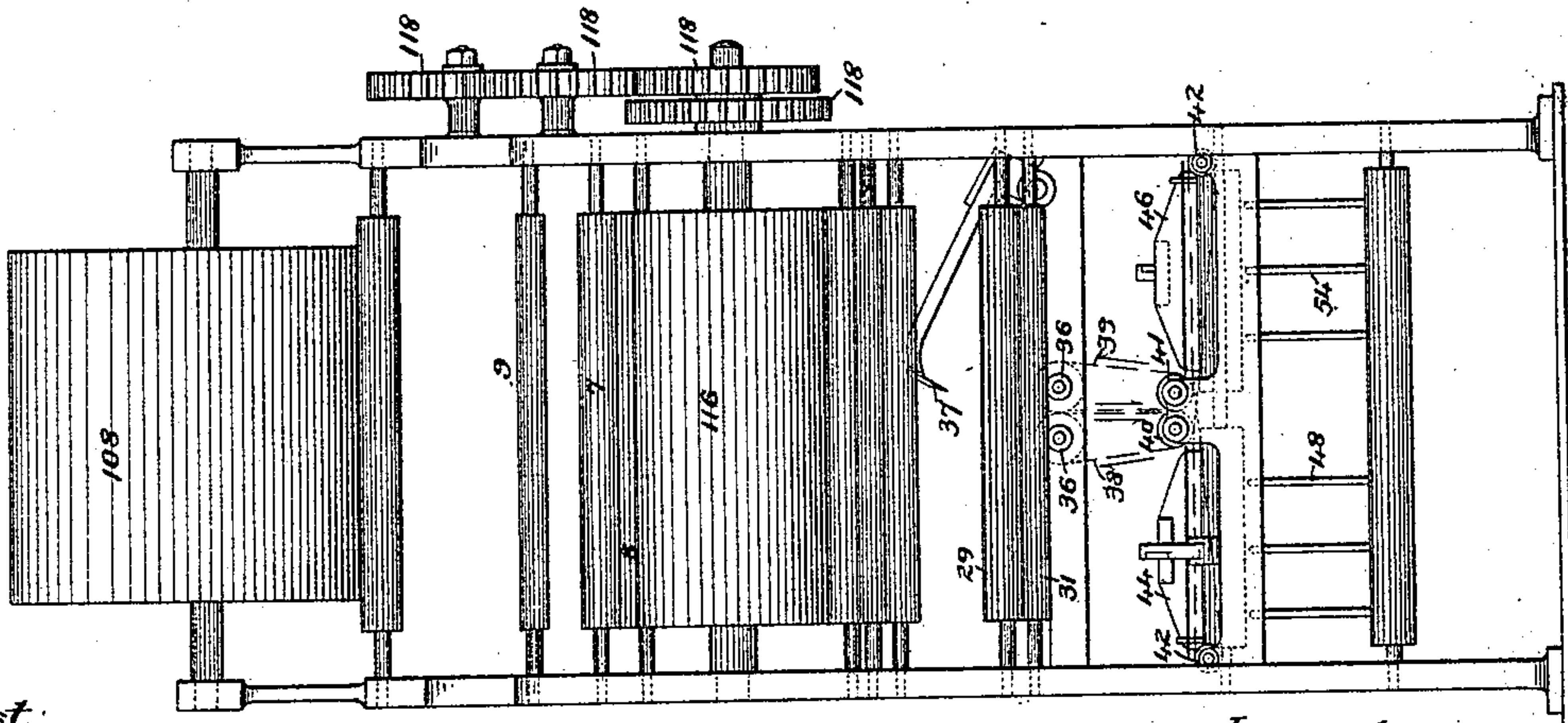


Fig. 2.



Attest;
A. H. Jasbera.
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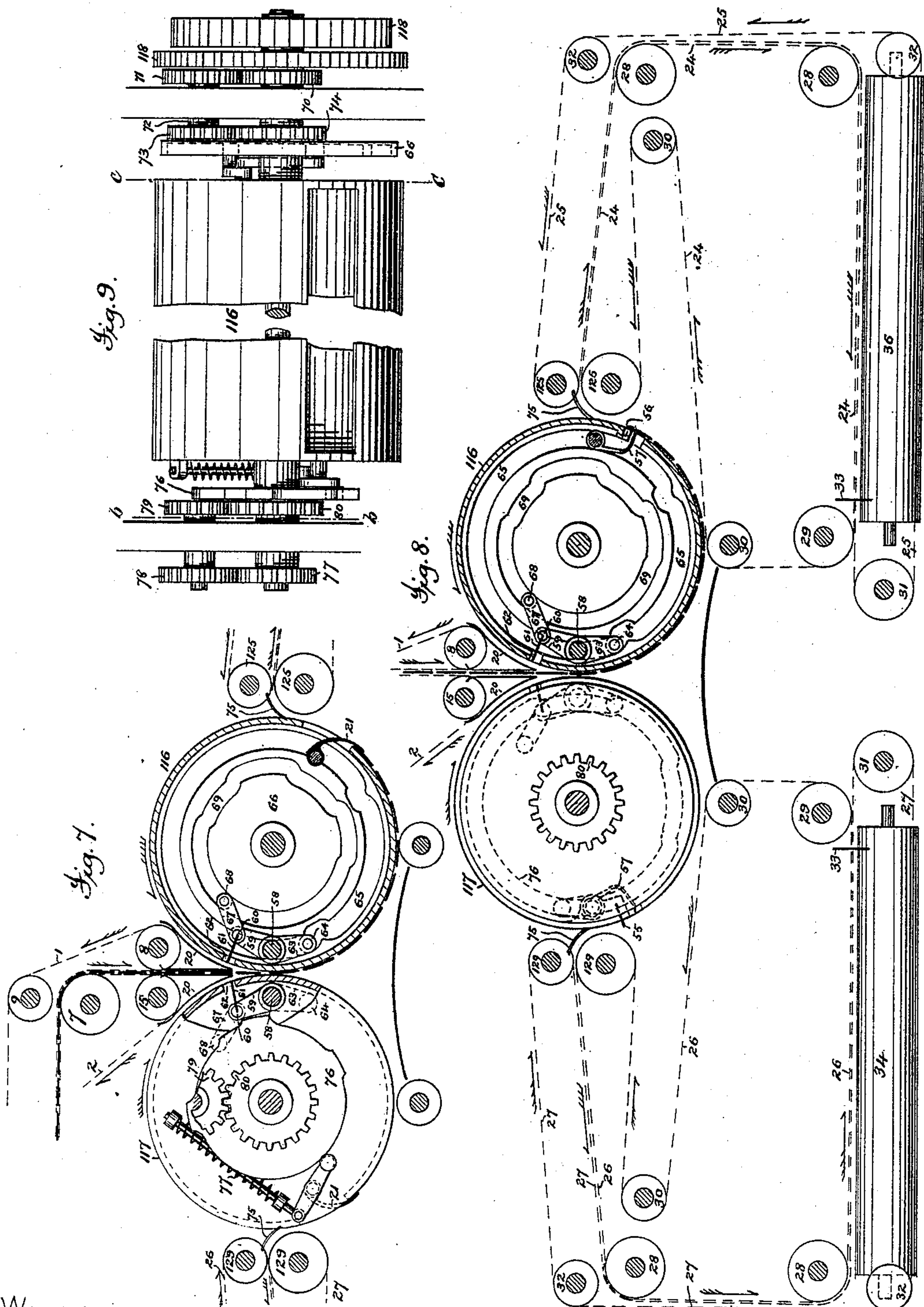
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S. D. TUCKER.

DELIVERY APPARATUS FOR PRINTING MACHINES.

No. 441,453.

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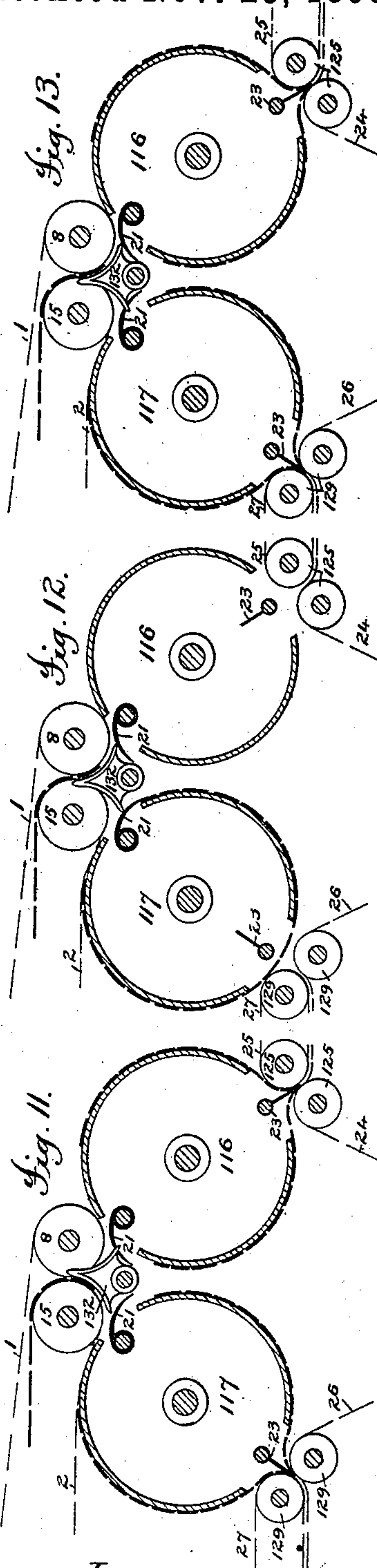
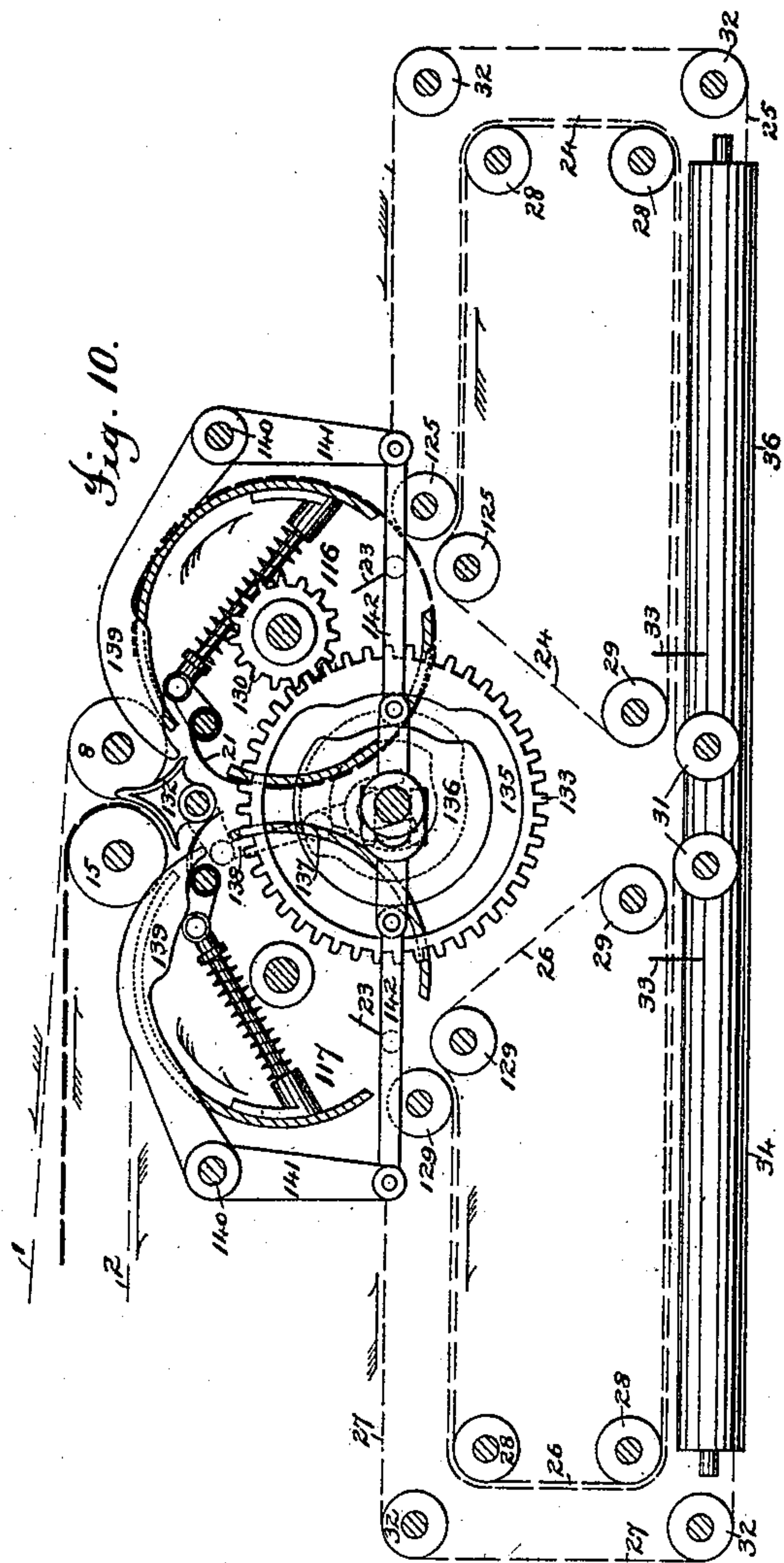
8 Sheets—Sheet 4.

S. D. TUCKER.

DELIVERY APPARATUS FOR PRINTING MACHINES.

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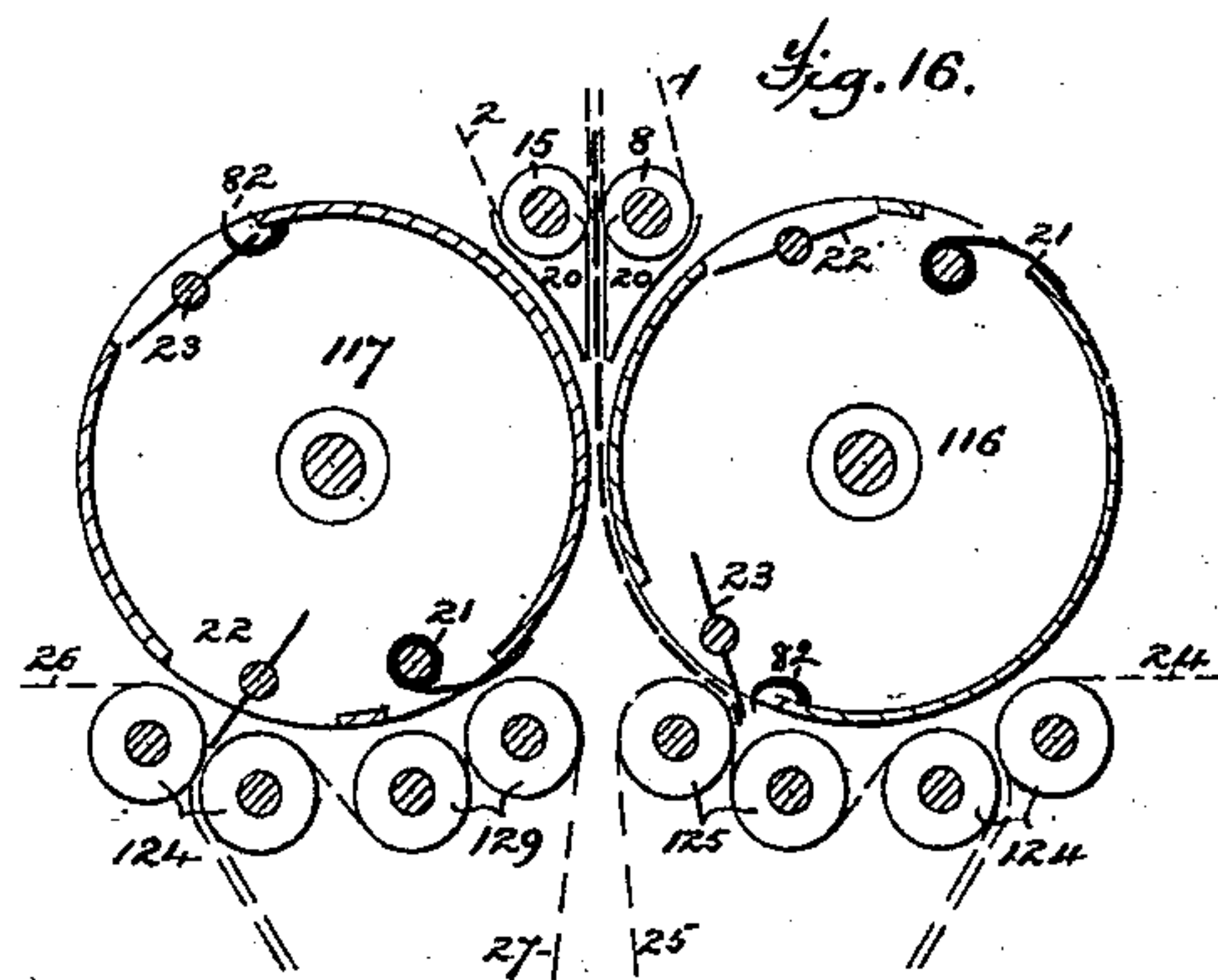
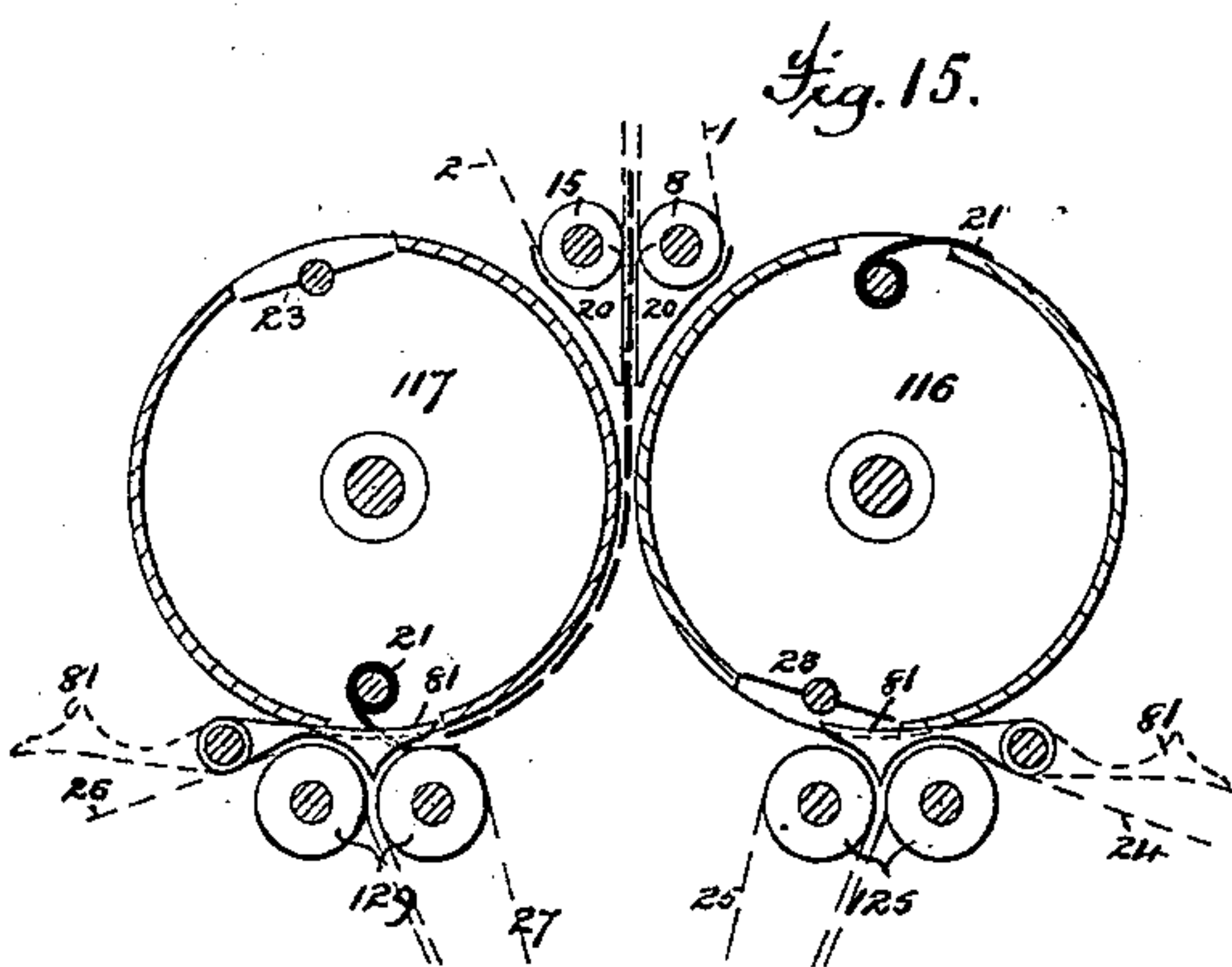
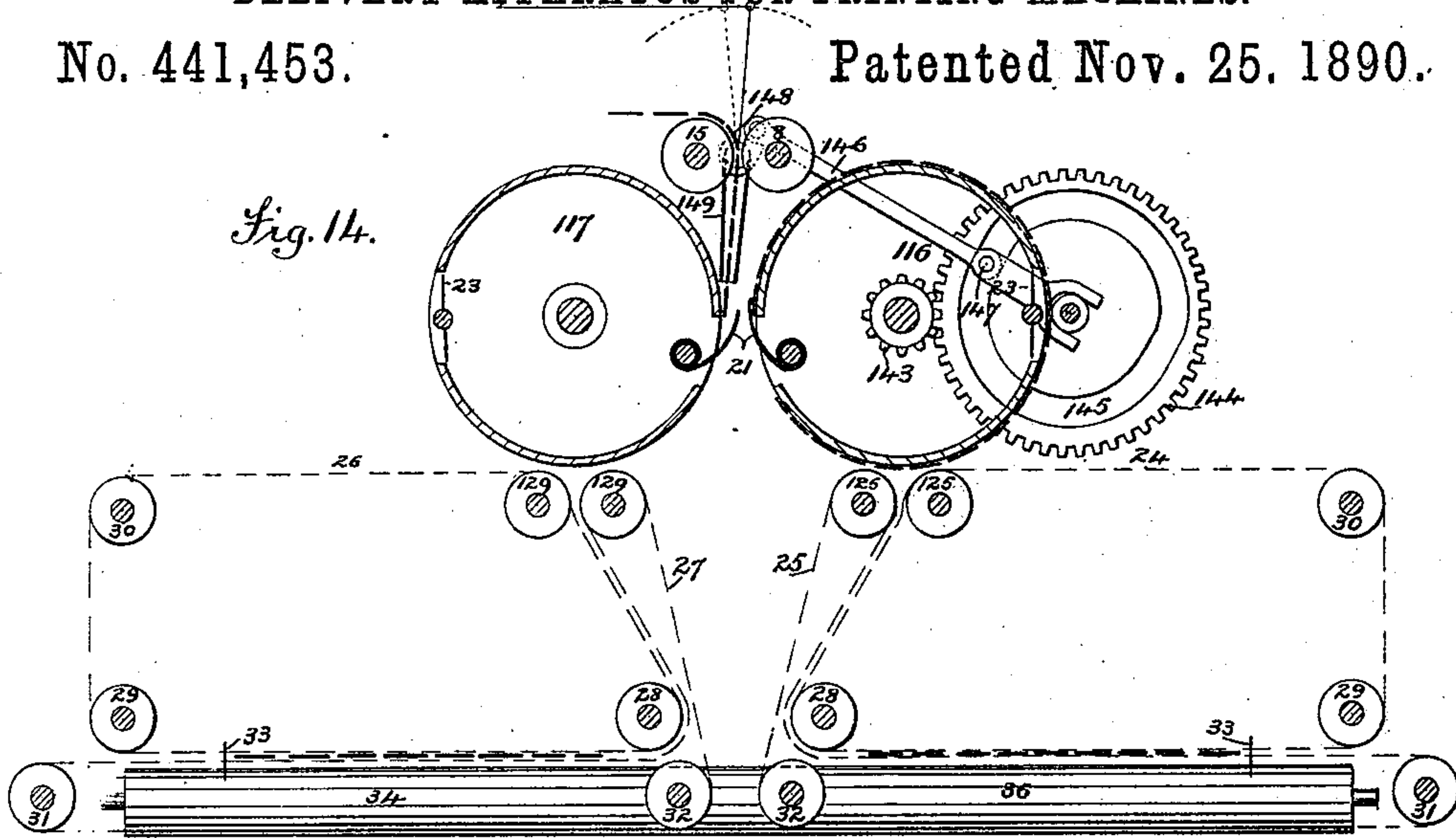
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S. D. TUCKER.

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(No Model.)

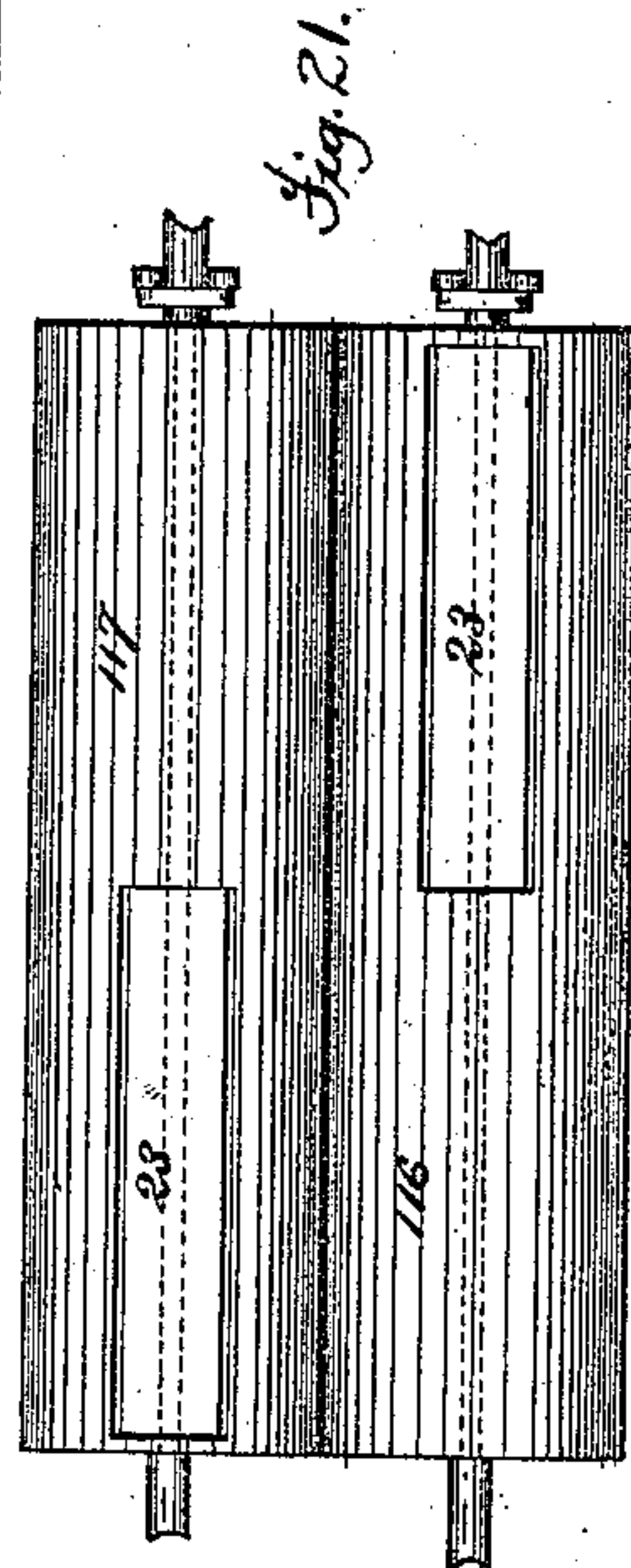
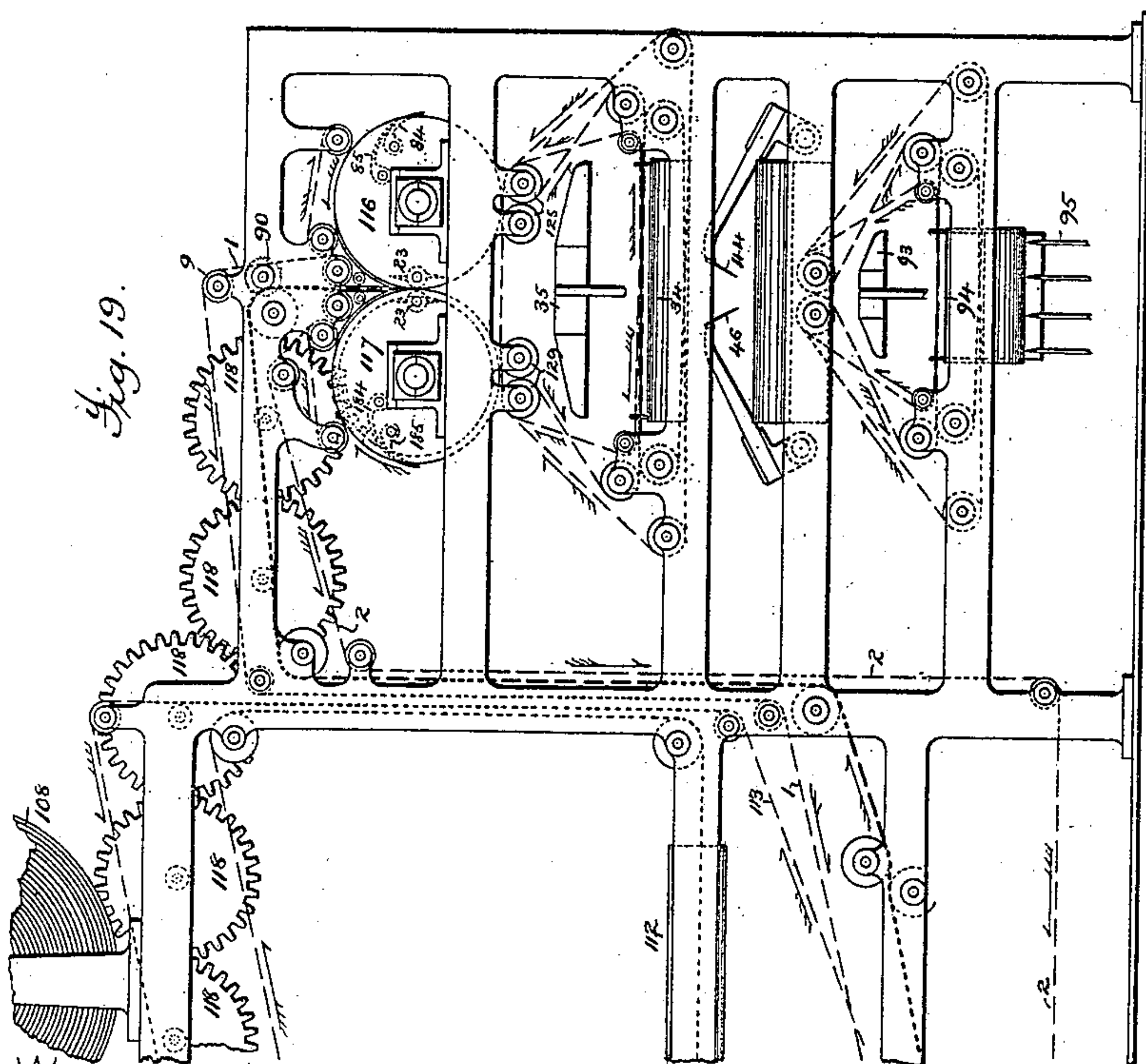
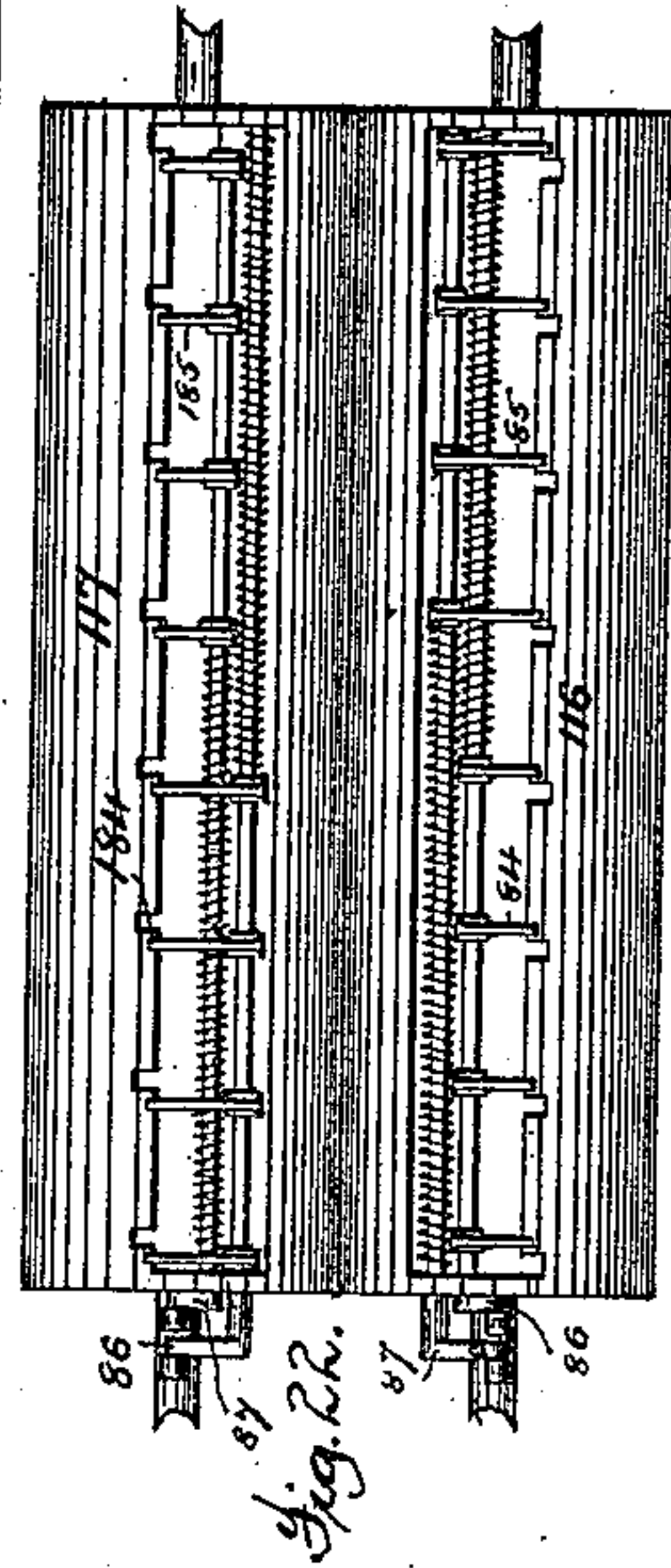
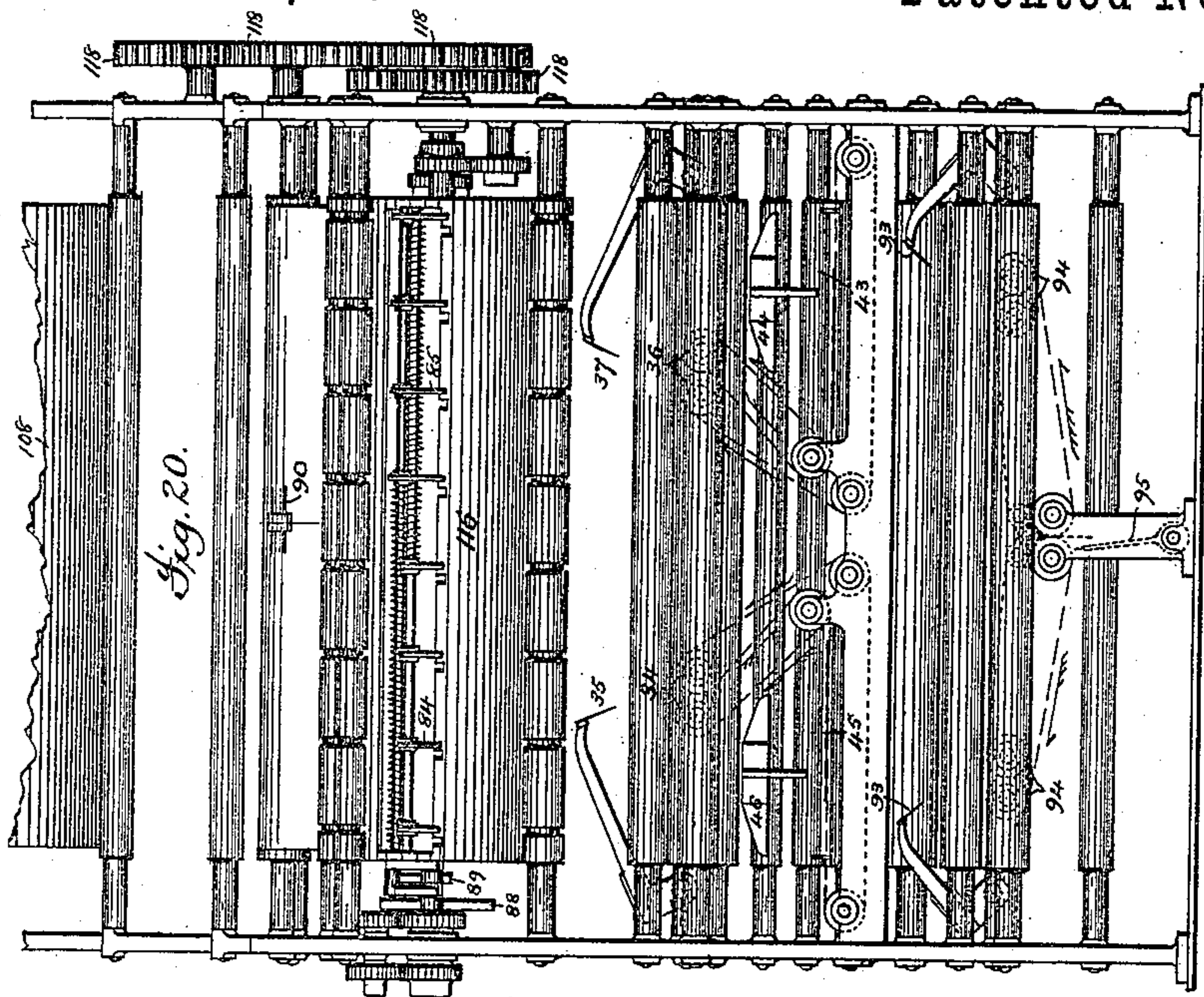
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DELIVERY APPARATUS FOR PRINTING MACHINES.

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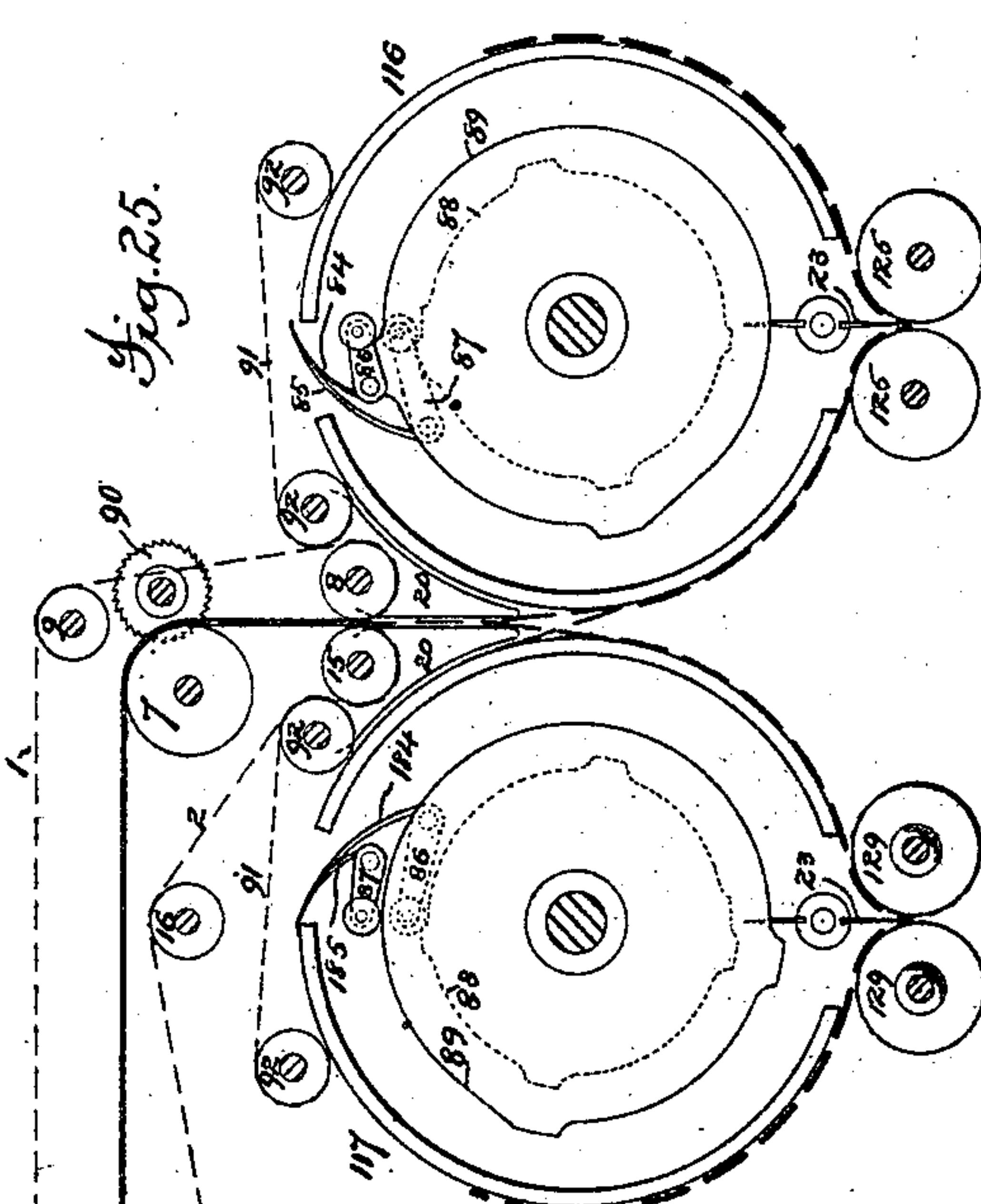
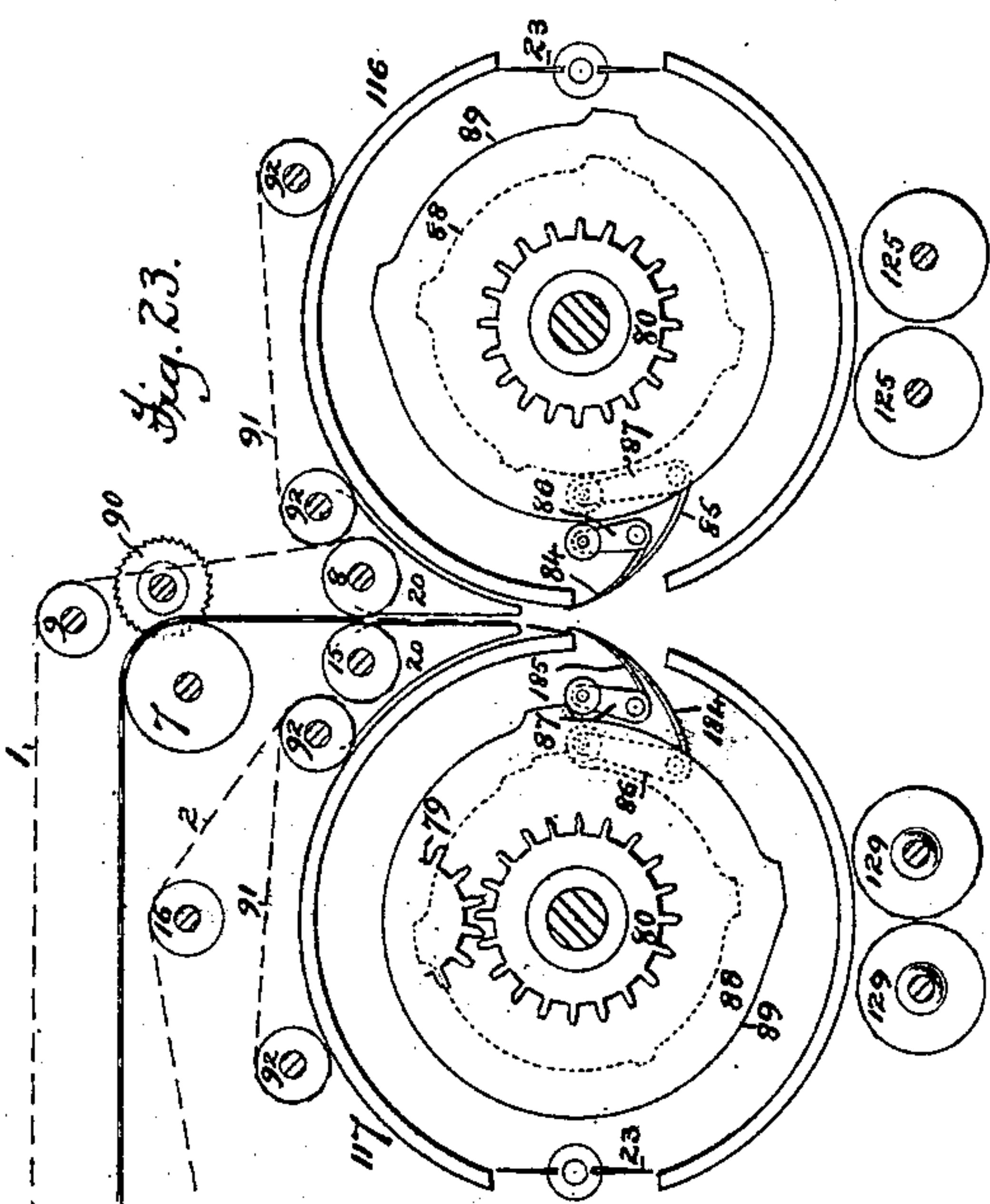
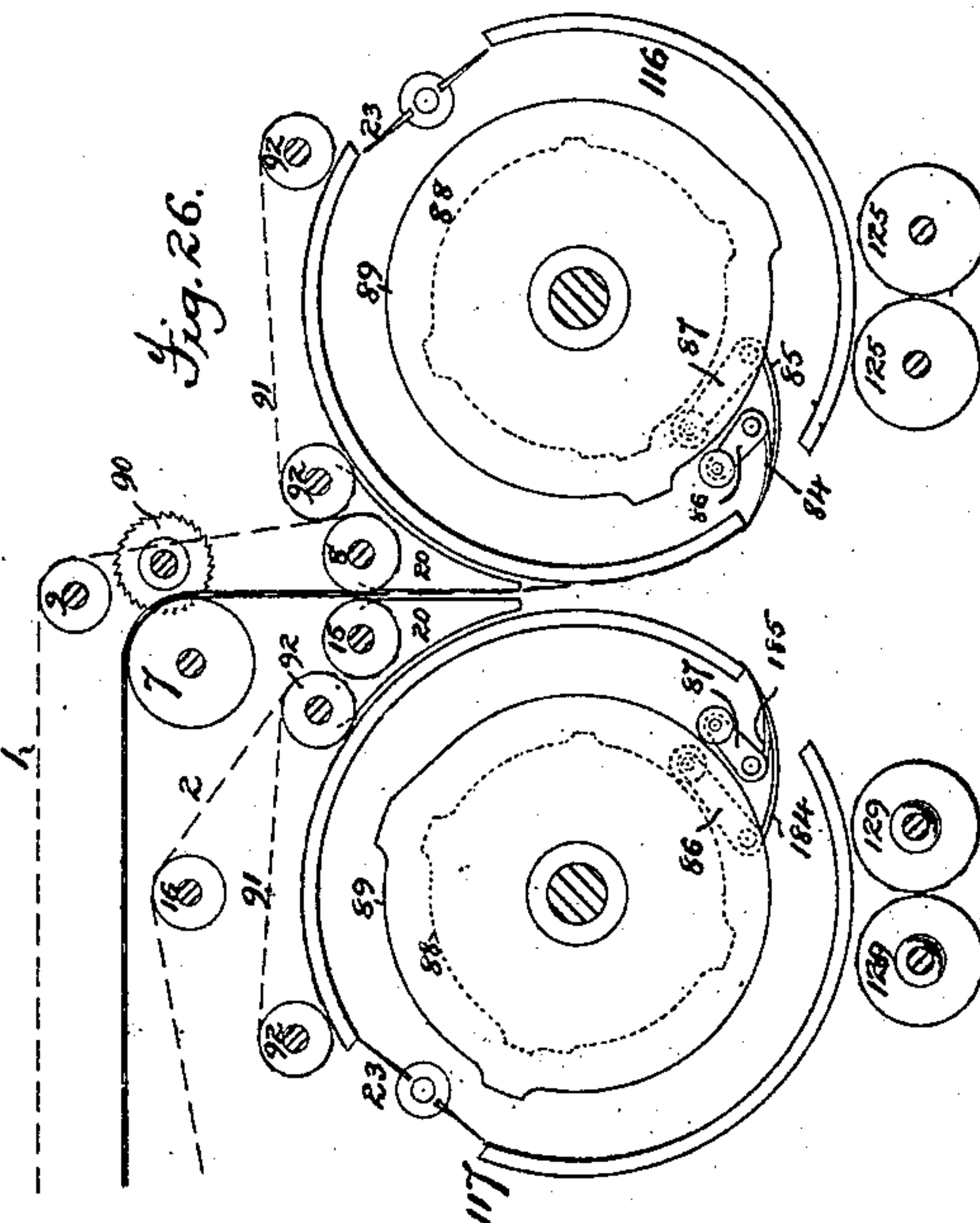
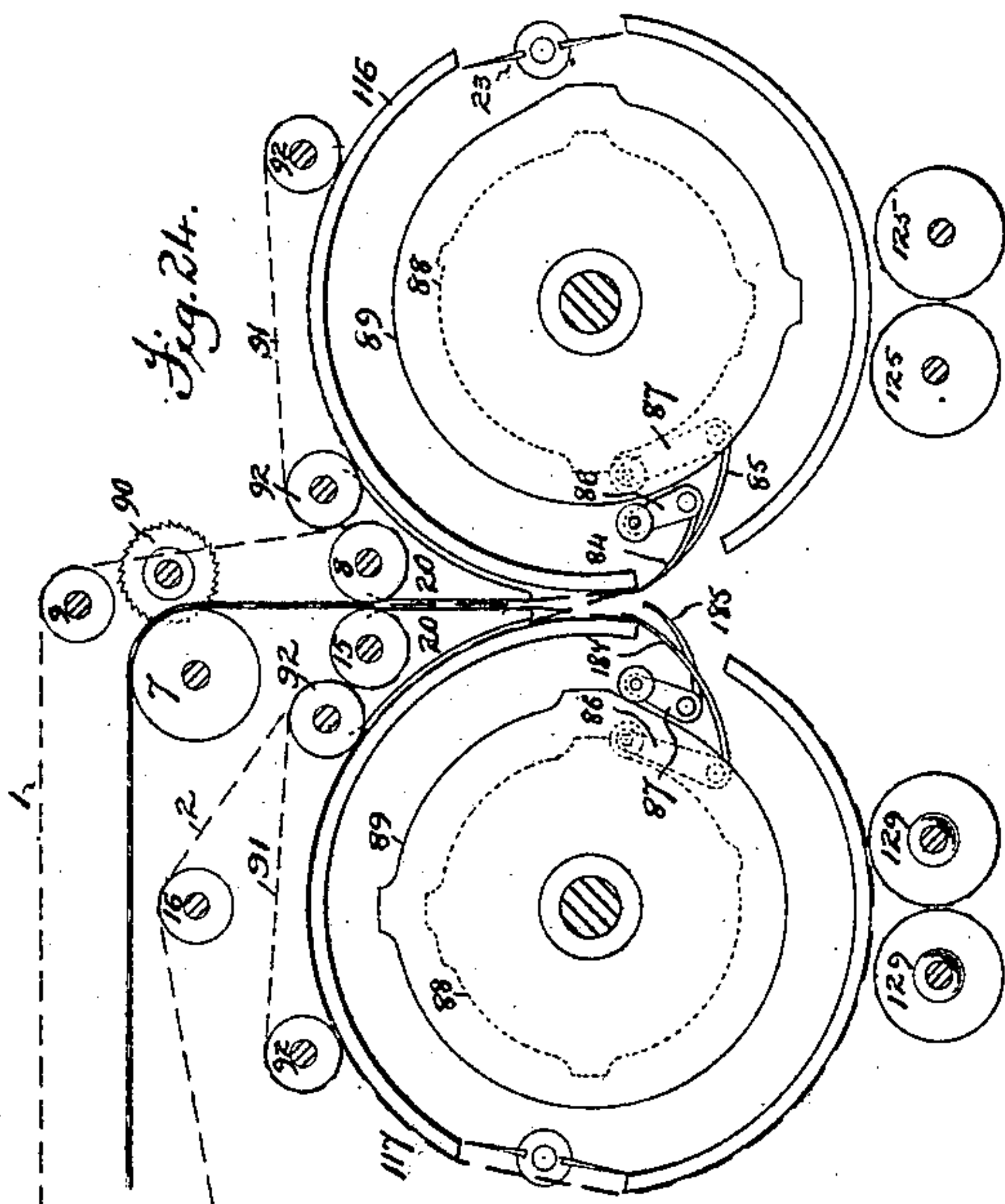
8 Sheets—Sheet 7.

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(No Model.)

8 Sheets—Sheet 8.

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DELIVERY APPARATUS FOR PRINTING MACHINES.

No. 441,453.

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Fig. 27.

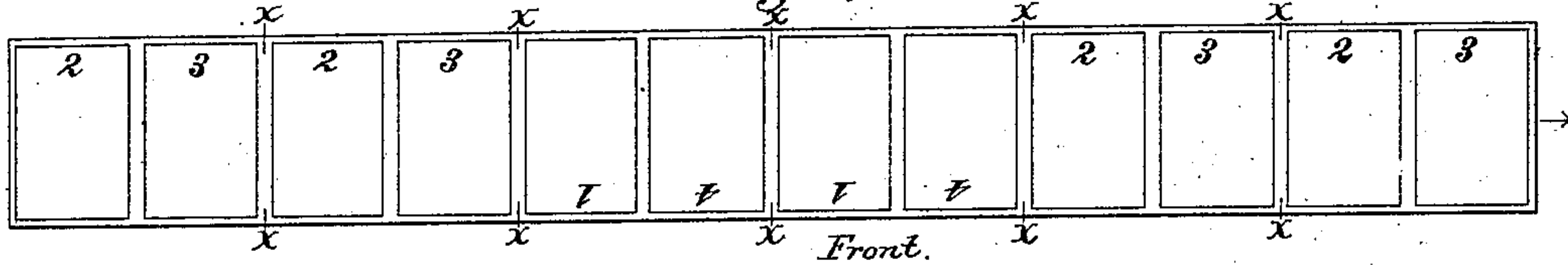


Fig. 28.

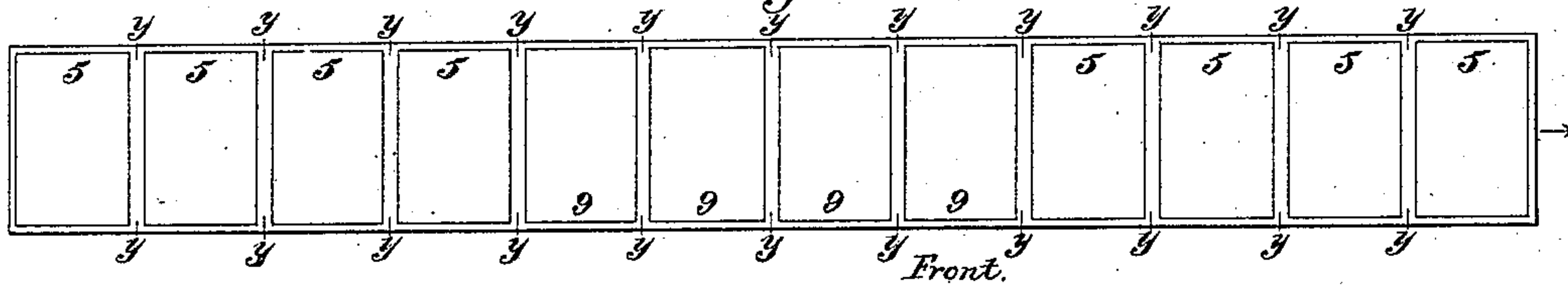


Fig. 29.

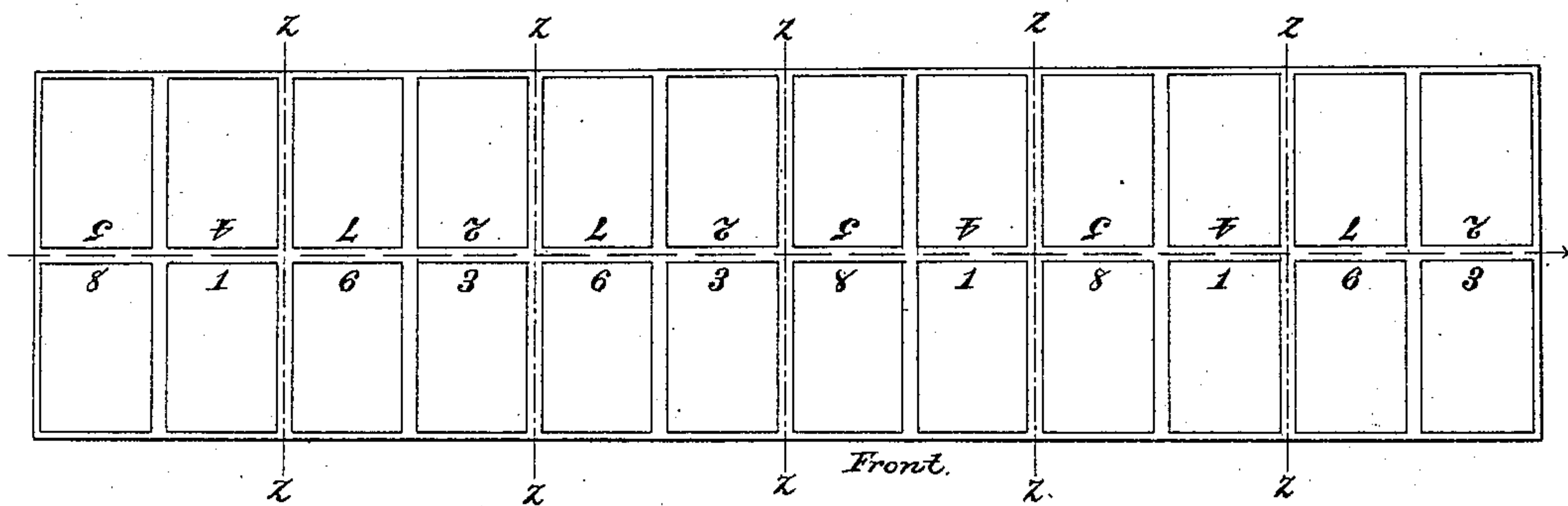
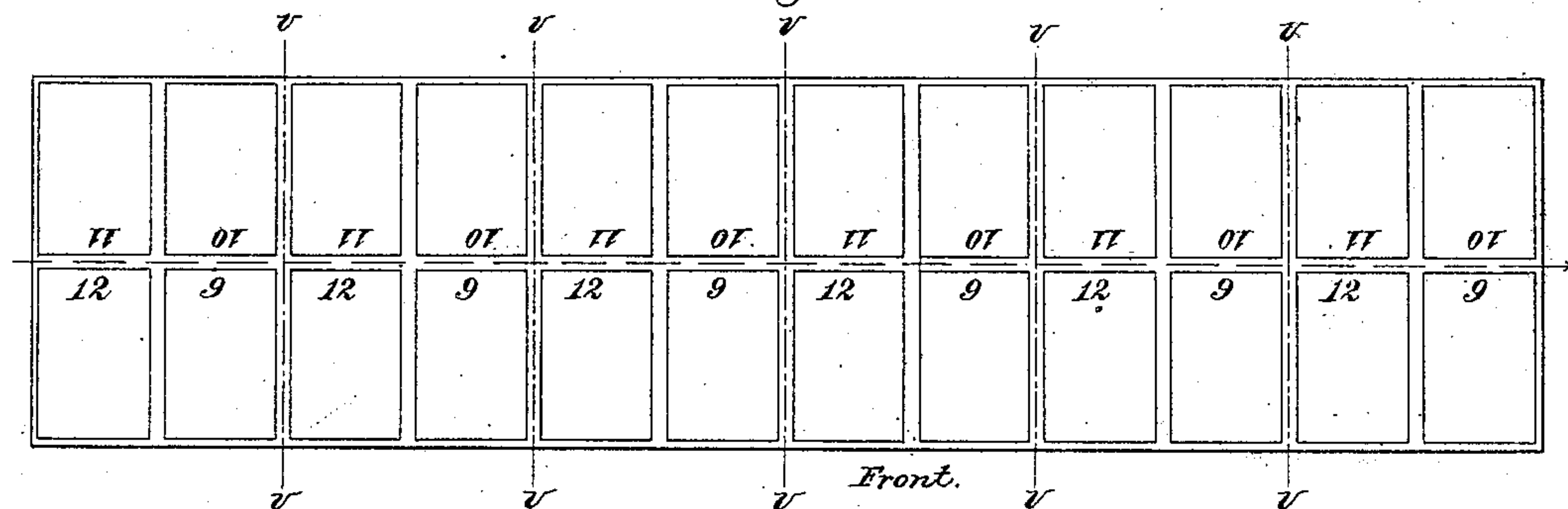


Fig. 30.



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by Manton & Phillips

Attys.

UNITED STATES PATENT OFFICE,

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

DELIVERY APPARATUS FOR PRINTING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 441,453, dated November 25, 1890.

Application filed February 26, 1883. Serial No. 86,264. (No model.) Patented in England October 3, 1881, No. 4,285.

To all whom it may concern:

Be it known that I, STEPHEN D. TUCKER, a citizen of the United States, residing in the city of New York, county of New York, and State of New York, have invented certain new and useful Improvements in Delivery Apparatus for Printing-Machines, (for which English patent No. 4,285, dated October 3, 1881, has been granted,) fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

In order to produce newspapers at the speed required by most of the large establishments of the present day, it is necessary to use rotary mechanism and to print upon the paper while in the web, and it is also often desirable for various reasons, but particularly to save the expense and delay incident to stereotyping, to print directly from the type instead of from stereotype-plates. For the sake of economy in construction and to secure compactness in the machine, it has also been found desirable in this class of machines to place the forms for printing both sides of the web upon a single type or form cylinder and to provide the same with a plurality of impression-cylinders, so that by printing the first side of a web, turning it over, and presenting its opposite side to the form-cylinder both of its sides may be successively printed from the same forms of type. In such case, of course, both sides of the web will contain the same printed matter, but the travel of the web between the printing of its opposite sides is so distanced that the inside pages of the sheet upon one side of the web will fall opposite the outside pages of the sheet upon the opposite side of the web, and vice versa. When printing is done directly from the type on a cylinder, it is necessary to make the cylinder of a comparatively large size, as in practice it is found impossible to successfully secure ordinary parallel type onto a cylinder as small as those commonly employed in web-printing machines which print from stereotype-plates. When a cylinder of sufficient size to successfully carry the forms in type is used, it will be found so large that the forms for printing both sides of an ordinary newspaper will occupy very much less than its whole circumference. This last fact makes

necessary, in order that the web may receive continuous printing, the use of register-rolls and an increased number of impression-cylinders, so that the forms may be enabled to make two or more duplicate and succeeding impressions upon each side of the web at each revolution of the form-cylinder. In machines of this kind the columns of type must run lengthwise the cylinder, and in order to properly print a web on both its sides the heads of one half the forms must point in one direction and the heads of the remaining half in the opposite direction. When the web is cut into sheets, it is desirable to deliver by themselves all sheets whose heads lie in the same direction. If they are to be delivered open, two sheet-fliers are used. If they are to be folded, two folding mechanisms are provided, which fold their respective sheets in the proper directions.

The present invention relates to a folding delivery apparatus adapted to operate in conjunction with a printing mechanism of this character, the invention consisting in the various features of construction and combinations of parts, which will be hereinafter fully explained, and particularly pointed out in the claims.

In the accompanying drawings, Figure 1 shows in side elevation a printing mechanism of the character specified provided with a delivery apparatus arranged to print and fold an ordinary folio or four-page newspaper. Fig. 2 is an end elevation of the same. Fig. 3 is an enlarged end view of the folding-cylinders shown in Fig. 1. The view of the right-hand cylinder is taken on the line *a a* of Fig. 4. Fig. 4 is a side view of one end of one of the folding-cylinders, showing the revolving gripper-cam and the gears that drive it. Fig. 5 is a cross-section of the folding-cylinders, showing also auxiliary devices which capacitate them to impart an additional transverse fold to the sheets. Fig. 6 is a like view of the same cylinders, showing them provided with sheet-holding pins instead of grippers. Fig. 7 is an end view of the same cylinders when provided with grippers and with blades which are operated alternately to tuck and nip the sheets to fold them. The view of the left-hand cylinder is taken on the line *b b* of Fig. 9, showing the revolving gripper-cams,

and the right-hand cylinder is taken on the line *c c* of the same figure, showing the tucking and nipping cams. Fig. 8 is an end view of the same cylinders provided with blades that operate to tuck and nip the sheets and also with a web-severing device, but with sheet-holding pins in place of grippers. Fig. 9 is an elevation showing the gears and cams for operating the blades and grippers or pins of Figs. 7 and 8. Fig. 10 is an end elevation, upon a somewhat smaller scale, of the same cylinders provided with folding-blades of a modified form and arranged to fold off their sheets simultaneously. Figs. 11, 12, and 13 are diagrammatic sections of the same cylinders, showing the parts in different positions. Fig. 14 is a like view of the folding-cylinders arranged to accomplish the same result in a different manner. Figs. 15, 16, 17, and 18 are like views showing the folding-cylinders modified to operate upon half-sheets or supplements. Fig. 19 is a side elevation of the delivery apparatus of a double-width machine arranged to fold a quarto or eight-page newspaper. Fig. 20 is an end elevation of the same. Figs. 21 and 22 are views showing the folding-blades and grippers of a double-width machine. Figs. 23, 24, 25, and 26 are diagrammatic views, on an enlarged scale, illustrating the operation of the cylinders of Figs. 21 and 22 in associating and folding sheets. Fig. 27 shows the order in which the impressions will occur upon a single-width web when a four-page paper is to be produced. Fig. 28 shows the order of the impressions upon a single-width web when two-page or half-sheet papers or supplements are to be produced. Fig. 29 shows the order of the impressions upon a double-width web when an eight-page paper is to be produced, and Fig. 30 shows the order of the impressions upon a double-width web when four-page papers or supplements are to be produced.

By reference to Fig. 1 it will be seen that the printing apparatus is adapted to operate upon two webs simultaneously; but for convenience the mechanism will be first briefly described in connection with its operation upon one of the webs, after which those parts which are added to capacitate the machine to operate upon two webs will be enumerated and described so far as may be necessary.

The printing mechanism shown in the present case is substantially the same as that shown in Letters Patent No. 367,123, granted to me July 26, 1887, and consists of a form-cylinder 100, which is of the usual construction and of a size sufficient to permit ordinary type to be securely fastened to its periphery. This cylinder is mounted in bearings in an appropriate frame, and is provided with means for carrying four forms of type, which, for convenience, it will be assumed are of a size suitable for printing the four pages of an ordinary folio or four-page newspaper. These forms are arranged in pairs located diametrically opposite each other upon the cylin-

ders, each pair occupying one-fourth of its circumference, the columns of matter lying, as is necessary in machines of this class, parallel with the axis of the cylinder, and the forms being so arranged that those for printing pages 3 2 and 4 1 will, as the cylinder revolves, follow each other in the order named around the cylinder. The spaces upon the cylinder between the groups of forms are occupied by ink-distributing tables or surfaces, which are supplied with ink from a fountain through the rolls 201 in the usual manner, the ink being taken from the tables and supplied to the forms by the ordinary inking mechanism represented by the rolls 101, as in the manner of the well-known Hoe type-revolving press.

Inasmuch as the forms cover only one-half of the circumference of the type-cylinder, it becomes necessary, as hereinbefore set forth, in order to print the whole surface of the web, that each form should act twice upon each side of the web at each revolution of the cylinder. To accomplish this, four impression-cylinders 102 103 104 105 and two register-rolls 106 107 are provided. The web to be printed is led from a roll 108 around the first impression-cylinder 102, thence outward around the register-roll 106, and thence inward around the second impression-cylinder 103. The register-roll 106 is placed at such a distance from the impression-cylinders 102 103 that the advance edge of the impression on the web given by the first pair of forms against cylinder 102 will arrive upon cylinder 103 just in time to exactly join with the rear edge of the impression given by the same pair of forms against that cylinder. From this it results that this pair of forms makes two impressions upon the web in succession, the second impression being just in advance of the first. Following the rear edge of the impressions made by this pair of forms against cylinder 102 will be a blank space equal to the space upon the form-cylinder between the groups of forms. At the end of this space the second pair of forms will make an impression upon the web against cylinder 102, and passing to cylinder 103 will make a second impression just in advance of the first, which second impression will just join the impression given by the first pair of forms upon cylinder 102, and thus fill the blank space referred to. This operation being repeated at each revolution of the form-cylinder, one side of the web will be wholly covered, the pages occurring twice in succession—as 3 2, 3 2, 4 1, 4 1—as shown in Fig. 27. After passing the impression-cylinder 103 the web now printed upon one side is conducted around guide-rolls 109 110 111 and a web-turner 112, which operates to reverse the web, so that its unprinted side is presented to the forms as it passes around impression cylinders 105 104. After passing cylinder 105 the web passes outward around register-roll 107, and thence inward around cylinder 104. The

operation of the form-cylinder in connection with the impression-cylinders 105 104 to print the side of the web now presented is exactly the same as that already described in connection with cylinders 102 103 for printing the first side of the web, and therefore needs no further description. The distance traveled by the web between cylinders 103 105 will be so regulated by the position of the rolls 109 110 111—one or more of which may be adjustable—that the impressions made by the forms upon the opposite sides of the web will be in exact register; but pages 3 2 will be backed by forms 4 1, and vice versa.

In putting the forms onto the cylinder 100 the heads of the forms 3 2 are placed to the front of the machine, as it is represented in Figs. 1 and 2, and the heads of forms 4 1 are placed to the rear or right. When the web has been printed on one side and turned over and the pages 3 2 have been backed by the forms 4 1, and vice versa, as has been explained, it will be apparent that the heads of the pages in register on opposite sides of the web will point in the same direction, and also that two succeeding sheets will have their heads to the front and two to the rear alternately, as shown on the printed web, Fig. 27. The printed web on leaving the last impression-cylinder 104 passes between the cutting-cylinders 114 115, by which it is partially severed into sheets on the lines $x x$, Fig. 27, and then enters between two series of accelerated tapes 1 2. The tapes 1 pass around pulleys 3, under pulleys 4 5, over pulleys 6 7, under pulleys 8, over pulleys 9 10, and under pulleys 11 to pulleys 3. The tapes 2 pass around pulleys 12, over pulleys 13 14, under pulleys 4 5, over pulleys 6 7, under pulleys 15, over pulleys 16 17, and under pulleys 18 to pulleys 12. As the leading edges of the sheets arrive at the nipping-pulleys 4 14 they are parted from the web and working-spaces gained between them in the usual manner as they are conveyed by the tapes to the folding-cylinders 116 117.

As before stated, the printing-machine represented in Fig. 1 is a two-roll machine—that is to say, it is adapted to print upon two rolls or webs of paper simultaneously—by which its production from one set of forms is doubled. To accomplish this, the form-cylinder is provided with a second set of impression-cylinders 119 120 122 123 and register-rolls 131 134 and also a web-turner, the exact counterparts of those already described, but located at the opposite side of the form-cylinder. The second roll of paper to be printed and the first pair of impression-cylinders 119 120 are placed at the bottom, and the second pair of impression-cylinders 122 123 and also the cutting-cylinders are placed at the top, and a separate delivery apparatus is provided for this second printing mechanism.

The printing mechanism above described may also be provided with tapes 113, arranged as shown and described in my patent, No.

367,123, before referred to, for conducting the leading end of the web through the machine.

It may here be mentioned that in folding newspapers it is requisite, however small the paper may be folded up, that the title or heading on the first page should always be left in sight. Now, it is obvious from an inspection of the printed web, Fig. 27, which represents the web as it issues from the printing-machine above described, that to accomplish this it is necessary that the two succeeding sheets having pages 3 2 uppermost must be folded through their center margins in one direction, and the next two sheets having pages 4 1 uppermost must be folded in the opposite direction to bring page 1 on the outside. To accomplish this, two folding-cylinders 116 117 are provided. The cylinders are mounted in a frame-work and geared together to run in unison and receive motion from the impression-cylinder 103 or some other suitable part of the printing mechanism through the train of intermediate gears 118. These folding-cylinders are each furnished with a set of grippers 21, closed by a spring in the usual manner, and also with a rotating folding-blade 23 of the construction shown and described in Letters Patent No. 171,196. The cylinder 116 is provided with a pair of co-operating folding-rolls 125 and the cylinder 117 with a similar pair 129. The grippers 21 are operated to take the proper sheets as they are presented to the cylinders by revolving cams 76, (see Figs. 3 and 4,) which are fitted to run loosely on one end of their cylinder-shafts just inside the frame-work. As the cylinders must alternately take two sheets in succession, these cams must be in the same operative position at every fourth revolution of the cylinders, and this is done by making them revolve either three or five times while the cylinders revolve four times. As here illustrated, these cams make three revolutions while the cylinders make four, and they receive their respective motions from gears 77, secured on the outer ends of the cylinder-shafts, which mesh with gears 78 of equal size.

The gears 78 are fixed on the outer ends of short shafts that run through the frame-work and have pinions 79 on their inner ends, which mesh into gears 80, running loosely on the cylinder-shafts, and to which the revolving cams 76 are bolted, said cams being made in two parts, so as to be removed at pleasure, and the gears 79 80 being so proportioned that the cams will make three revolutions while the cylinders make four. By this arrangement when the cylinders have made one revolution the cams will have made but three-fourths of a revolution, and as the friction-rollers on the arms on the outer ends of the gripper-shafts run on the peripheries of the cams in the usual manner it is obvious that during this revolution of the cylinders these friction-rollers will have passed over one-fourth of the circumference of the cams, and that during four revolutions of the cylinders they will

make a complete circuit of the cams. The peripheries of these cams are so shaped that during two successive revolutions of the cylinders they will operate the grippers to seize the sheets presented, carry them around over the folding-rollers 125 or 129, and release them as the rotating folding-blade folds them into the nip of these rollers, while during the next two succeeding revolutions the grippers will remain closed, the cams being so timed with each other that first one cylinder will seize and fold two successive sheets and then the other will seize and fold two successive sheets, and so on alternately. Now let it be supposed that the first sheet from the printing mechanism as it emerges from between the guides 20 and enters between the folding-cylinders has the pages 3 2 next to the cylinder 116 with their heads toward the rear of the machine. When the leading edge of this sheet arrives at the proper point, it will be seized by the grippers of the cylinder 116 and folded transversely through the folding-rolls 125 with pages 4 1 on the outside. Two series of tapes 24 25 pass around the rolls 125, downward around the rolls 28, (see Fig. 1,) and outward over the longitudinal folding-rolls 36, where they separate the tapes 24, returning around the rolls 29 30 and the tapes 25 around the rolls 31 32 to the folding-rolls 125. These tapes carry the sheet downward and outward over the folding-rolls 36 against a stop 33, with page 1 facing downward. The sheet is then folded between the folding-rolls 36 by an ordinary vibrating blade 37, and is thence carried downward between two series of tapes 38 39 around a roll 40, (see Fig. 2,) from whence the tapes 38 return direct to the folding-rolls 36, while the tapes 39 carry the sheet outward the front of the machine, over the transverse folding-rolls 43, (see Fig. 1,) and then return around the rolls 42 41 to the folding-rolls 36. The upper half of the first page of the sheet will now be next to the folding-rolls 43, between which it will be folded by the blade 44, thus leaving the title or heading exposed across both its sides. The sheet is then laid on a series of slowly-moving bands 50, or it may be packed in a trough by a slightly-vibrating fly-frame 48. Meanwhile the second sheet from the printing mechanism will have arrived in the same position as the first one, and will, at the next revolution of the cylinder 116, be seized by the same grippers and folded by the same blades and rolls in the same manner as the first one. The third sheet will, as it enters between the folding-cylinders, have its pages 3 2 next to cylinder 117 and its heading to the front of the machine, and will be seized by the grippers of the cylinder 117 and be folded between the rolls 129, with pages 4 1 on the outside. It will then be conveyed by the two series of tapes 26 27 downward and outward over the longitudinal folding-rolls 34, with page 1 downward, and will be folded between the rolls by a blade 35, after which it will be car-

ried downward by tapes similar to tapes 38 39 and outward toward the rear of the machine, over the transverse folding-rolls 45, with the upper half of page 1 facing downward. It will then be folded between these rolls by the blade 46 and laid on the slowly-moving bands 53 by the fly 54. The fourth sheet is folded precisely the same as the third, the fifth and sixth the same as the first and second, and so on, each cylinder operating alternately to fold two sheets in succession. It is not necessary that the one set of rotating and vibrating folding-blades should be thrown out of operation while the opposite set are folding their sheets. They will simply operate uselessly but harmlessly.

The form-cylinder in printing mechanisms of the class hereinbefore described is not always made of such size that the forms cover only one half of its circumference. If the paper to be printed is of small size, the forms may cover one-third or one-fourth of the cylinder, in which case the number of impression-cylinders, and consequently the number of successive impressions made by each form at each revolution of the form-cylinder, will be proportionately increased. In such case the folding-cylinders 116 117 will be so operated that, instead of each taking two sheets in succession, they will take three, four, or more successive sheets, according to the number of impression-cylinders. So, also, in some cases when the forms are numerous or of large size they may cover the entire surface of the form-cylinder, in which case only a single impression-cylinder will be used for each side of the web, and in such case the folding-cylinders will be arranged to take alternate sheets instead of alternate pairs or series of sheets, so that in all cases the sheets having their columns headed in the same direction and having the same matter upon their upper or outer surfaces will be taken by the same cylinder and folded with the proper pages upon the outside. It is the attainment of this desired result that makes the delivery apparatus just described particularly applicable to printing mechanisms of this class.

It is sometimes desired to give two parallel transverse folds to the sheets before giving them a longitudinal fold. To accomplish this, the cylinders 116 117 are each provided with an auxiliary folding blade 22 and a pair of auxiliary folding-rolls 124, as shown in Fig. 5. In this case, as before, it will be assumed that the first sheet has its pages 3 2 next the cylinder 116. As this sheet enters between the cylinders it will be taken by the grippers 21 of the cylinder 116 and be folded by the blade 23 between the folding-rolls 125, precisely the same as already described. The tapes 25, which also issue from the rolls 125, will carry the once-folded sheet up between the rolls 125 and 124 and feed it forward between the cylinder 116 and the rolls 124, with page 1 next to said rolls, until it arrives at a proper

point, when it will be folded between them by the blade 22. As the twice-folded sheet emerges from between the rolls 124 it will be carried downward and outward by the tapes 24 25 and presented to and operated upon by the subsequent folding mechanism in the manner already described. The second sheet will be folded the same as the first, and the third and fourth sheets, with pages 3 2 next to the cylinder 117, will be taken and folded by the cylinder 117 in the same manner as were the first and second sheets by the cylinder 116.

In the construction shown in Fig. 6 the folding-cylinders are provided with a severing-blade 55 and coacting groove 56, of any ordinary construction, by which the cutting-cylinders 114 115 are dispensed with and the tapes 1 2 run at the same speed as the printing-cylinder, and the web is permitted to remain unsevered until it reaches the folding-cylinders. As there will be no interval between the sheets thus severed, grippers can not be used and sheet-holding pins 57 are used in their stead. These pins are mounted upon rock-shafts journaled in the heads of the cylinders, said shafts being provided with the usual devices for protruding and retracting the pins at the proper times. In this case, of course, as with the grippers shown in Fig. 3, the pins will be actuated by a cam, which will cause them to protrude only at the times when their cylinders are to receive and carry forward the sheets, the pins at other times remaining retracted within the cylinders.

The folding-cylinders, instead of being provided with rotating folding-blades, may be provided with blades which will operate to both tuck and nip the sheets, so that each cylinder may be operated as a tucking and nipping folding-cylinder to the other, as shown in Figs. 7 and 8. Referring to these figures, it will be seen that each of the folding-cylinders carries a rock-shaft 58, journaled in its heads and provided with rock-arms 59, in the ends of which is mounted a rock-shaft 60, to which is secured a blade 61, the edge of which rests in a longitudinal recess 62 in its cylinder. The rock-shafts 58 are each provided at one end with an arm 63, having a stud or friction-roller 64, which travels in a path 65 of a cam 66, loosely mounted upon the shaft of its cylinder. The shafts 60 are also each provided at one end with a rock-arm 67, having a stud or friction-roller 68, which travels in a second path 69 of the cam 66. The paths 65 69 are so shaped that each time the studs 64 68 make their complete circuits the arms 63 67 will be rocked twice, thereby causing the blades 61 to be twice projected through the recesses 62 beyond the peripheries of the cylinders and twice oscillated, so as to be brought in nipping contact with the forward walls of said recesses, and the paths 65 69 are so related to each other that the blades 61 will be oscillated to nip against the walls of their

recesses only when in their retracted position.

To effect the proper tucking and nipping action of the blades 61 with relation to each other, the cams 66 are mounted loosely upon the shafts of the cylinders, and are caused to revolve in the same manner and in the same relation to the cylinders as has been described in the case of the gripper-cams in Fig. 3, so that the studs 64 68 will only make a complete circuit of the cams to four revolutions of the cylinders. Thus the blades will twice tuck and twice nip during four revolutions of the cylinder, the cams upon the two cylinders being so adjusted that the blade of one cylinder will receive the tucking motion, while the blade of the opposite cylinder receives its nipping motion, and vice versa.

The operation of the folding-cylinders when thus equipped will be as follows: The leading end of the first sheet, with pages 3 2 next to the cylinder 116, having been taken by the grippers 21 of that cylinder will be carried forward by said cylinder during one-half of a revolution, which will bring the tucking and nipping blades 61 of the two cylinders together. The cams 66 will be so adjusted that at this time the blade 61 of the cylinder 116 will be caused to protrude beyond the periphery of its cylinder and tuck the fold-line of the sheet between the blade 61 of the cylinder 117 and the forward wall of its recess 62. Simultaneously with this the cam 66 of the cylinder 117 will rock the blade 61 of that cylinder, so as to cause it to nip the fold-line of the sheet thus presented against the forward wall of its recess, and at the same time the blade 61 of the cylinder 116 will be retracted and the grippers 21 of that cylinder will be operated to release the leading end of the sheet. The sheet thus held by its central fold-line will be transferred to the cylinder 117 and carried forward by said cylinder until the blade 61 arrives opposite the pair of rolls 129, which in this case, instead of being folding-rolls, will be simply receiving-rolls. At this point the fold-line of the sheet will be released from the nip of the blade and the wall of its recess and guided between the rolls 129 and tapes 26 27 by fixed guides 75. The sheet thus delivered to the tapes 26 27 will be by them conducted above the pair of folding-rolls 34, with the first page facing downward, in the manner shown in Fig. 8, where it will receive its second fold and be delivered, as already set forth. Upon the second revolution of the cylinder 116 its grippers will be again actuated to take the leading end of the second sheet, and as the blades 61 again come together the operation just described will be repeated, and the second sheet will in like manner be delivered to the folding-rolls 34. Upon the third revolution of the cylinders the grippers of the cylinder 116 will remain idle, and the grippers of the cylinder 117 will take the leading end of the

third sheet, which will have pages 3 2 next to said cylinder and carry it forward upon their cylinder. When the central fold-line of this sheet arrives at the proper point, the cams 5 66 will have passed to such positions that the blade of the cylinder 116 will remain retracted, while the blade of the cylinder 117 will be protruded and tuck the fold-line of this sheet between the blade of the cylinder 116 and the forward wall of its recess, 10 while at the same time the blade of the cylinder 116 will be operated to nip the fold-line of the sheet thus presented and carry it forward upon its cylinder, where it will be delivered between the rolls 125 and carried 15 by the tapes 24 25 to the folding-rolls 36 with the first page downward. Upon the fourth revolution of the cylinders the same operation will be repeated and the fourth sheet delivered to the rolls 36. At the end of the 20 fourth revolution of the cylinders the cams 66 will have completed their third revolution and be in the same relative position to the cylinders as at the commencement of the operation just described, so that the fifth sheet will be taken by the cylinder 116 and delivered the same as the first, and so the operation will be repeated.

In the organization shown in Figs. 5 and 7 30 the grippers of the folding-cylinders operate precisely as described in connection with Fig. 3.

In the organization shown in Fig. 8 the folding-cylinders, instead of being provided 35 with grippers, are provided with sheet-holding pins and with a severing mechanism the same as described in connection with Fig. 6.

When the web is so printed that it is necessary that the two cylinders take and fold 40 alternate sheets, or that each cylinder should take and fold three or more sheets in succession, the cams which operate the tucking and nipping blades will be so modified in form as to give the blades this action.

As herein shown, the printing mechanism 45 is so organized that two succeeding sheets must be folded in one direction and the next two in the opposite direction.

In the delivery apparatus just described it 50 will be observed that each folding mechanism folds its two successive sheets at the same speed they are printed, and then operates twice idly while the opposite mechanism folds two sheets, so that each mechanism operates 55 four times and yet folds but two sheets.

In the organization shown in Fig. 10 the folding-cylinders are so arranged as to fold 60 their two successive sheets at equal intervals by folding them at their alternate revolutions, thus reducing the operations of all the folding devices one-half and permitting them to operate at a correspondingly-reduced speed. This is effected by removing one of the blades of the rotating folder so that the remaining 65 blade will only be in an operative position at each second revolution of its cylinder, as shown and described in United States Letters

Patent No. 214,066, or in any other suitable manner, and the gripper-cams are so brought 70 into and out of action as to cause the grippers to co-operate with the folding-blades. The folding-cylinders are placed a slight distance apart, and in this case they revolve from each other at the top, the sheets as they issue 75 from between the rollers 8 15 being directed to their respective cylinders by a vibrating switch or sheet-director 132. This switch and the grippers are operated as follows: The cylinder 116 has on its shaft a pinion 130, which drives a cam-wheel 133 of four times its size, 80 this wheel being provided with cam-grooves 135 136 upon its opposite sides. The groove 136 in the rear side of the wheel embraces a stud 137, projecting from the forked rod 138, the upper end of which is jointed to an arm 85 on the shaft of the switch. The shape of the groove 136 is such that it will cause the switch to direct two sheets in succession to each cylinder. The gripper-cams 139 are mounted 90 upon rock-shafts 140, from which extend arms 141, the ends of which are connected to rods 142, provided with studs which rest in opposite sides of the groove 135 of the cam 133, so that the wheel as it revolves will rock the gripper-cams in and out of action alternately. 95 With the cylinders thus equipped, let it be supposed that the first sheet as it issues from between the rollers 8 15 has pages 3 2 on its upper side with their heads to the rear, as heretofore. Owing to the direction in which 100 the cylinders revolve, this sheet is directed by the switch 132 to the cylinder 117, as shown in Fig. 10. As its gripper-cam 139 and rotating folding-blade are in operative position during the first revolution of the cylinder, 105 the sheet will be taken and folded through the rolls 129, as shown in Fig. 11, from whence it will be taken by the tapes 26 27 and conveyed outward and downward over the folding-rolls 34 and folded through them by the 110 vibrating blade 35 with page 1 on the outside, as heretofore described. The second sheet will also be directed to and taken by the cylinder 117 at its second revolution; but as the single blade of the rotating folder is now 115 turned inward the sheet will not be folded, and as the cam-groove 135 has in the meantime rocked the gripper-cam 139 out of operative position it is not released, but is carried around again, as shown in Fig. 12. The 120 cam-groove 135 will now have moved the switch 132 to its opposite position, so that the third sheet with pages 4 1 on its upper side and with their heads to the front will be directed to the cylinder 116, and as the gripper- 125 cam and folding-blade of this cylinder will be in operative position, as will also be the folding-blade and gripper-cam of the cylinder 117, both cylinders will during their third revolution fold their sheets simultaneously 130 through their respective folding-rolls 125 129, as shown in Fig. 13. These sheets will then be conveyed by their respective tapes 24 25 and 26 27 over the folding-rolls 34 36, through

which they will be folded by the same stroke of the vibrating blades 35 37 with page 1 on the outside. The fourth sheet will also be directed to and taken by the cylinder 116; but at the 5 fourth revolution the single blade of the rotating folder 23 will not be in position to fold the sheet, nor will the gripper-cam 139 be in position to release it, (see Fig. 10,) so it will be carried around to the fifth revolution. By 10 this time the switch 132 will be moved and the gripper-cams rocked into position, so that the fifth sheet will be taken by the cylinder 117, and this sheet, together with the fourth sheet on cylinder 116, will be folded through 15 the rolls 125 129 simultaneously, as shown in Fig. 11. The sixth sheet will also be taken by cylinder 117, but will not be folded at this revolution, (see Fig. 12,) but will be carried around and folded at the seventh revolution 20 of the cylinders simultaneously with the seventh sheet, which will have been taken by the cylinder 116, and so the operation will continue to be repeated.

It will be observed that it is necessary in 25 the organizations shown in Figs. 8 and 10 that the sheets, after passing between the rolls 125 129, should be carried inward over the folding-rolls 34 36. To accomplish this, the tapes 24 25 and 26 27 are arranged to take 30 a somewhat different course of travel, and certain of the leading-rolls have been duplicated, as will be seen by reference to said figures. It will also be observed that in figures 10 and 14 the folding-rolls 34 are but a 35 continuation of the rolls 36, rolls 31 then being cut midway of their lengths to permit rolls 34 36 to extend transversely to them, and this construction may be adopted in any of the organizations shown.

40 In the organization shown in Fig. 14 the sheets are folded at equal intervals, as just described, and the devices, though somewhat changed in form, perform precisely the same functions as in the previous arrangement. 45 The folding-cylinders 116 117 revolve toward each other at the top, and the sheets are directed to their respective cylinders by vibrating guide or sheet-director 149, between which they pass. The cylinder 116 has on its shaft 50 a pinion 143, which drives a wheel 144 of four times its size, and this wheel has a cam-groove 145 formed in its side and so shaped that by means of the forked rod 146 its stud 147, which rests in the cam-groove, and the 55 rock-arm 148, fixed to the sheet-guide 149, it causes the guide to oscillate and deliver two sheets in succession to each cylinder.

The grippers are operated by revolving cams, such as described in connection with 60 Figs. 3 and 4, which are so shaped as to cause the grippers to properly co-operate with the rotating folding-blades. The rotating folding-blades are double-edged, as in Figs. 3 and 4, and are caused to operate at alternate revolutions only of their cylinders in the manner 65 shown and described in United States Letters Patent No. 191,494. On account of the di-

rection in which the cylinders revolve, the sheets having pages 3 2 on their right-hand side, as they issue from the rollers 8 15, must 70 be taken by the cylinder 116, and those having pages 4 1 on their right-hand side must be taken by the cylinder 117, as in the organization shown in Figs. 3 and 4; but the order and manner of taking and folding the 75 sheets is the same as described in connection with Figs. 10 to 13. If the web is so printed that alternate sheets must be directed to each cylinder, the devices which operate the vibrating sheet-director and the grippers and 80 folding-blades will be so modified as to give these parts the proper action. The vibrating guide or switch may, if desired, be used in connection with several of the other organizations shown. 85

If it is desired to produce two-page papers or supplements, it can be done by the printing mechanism shown in Fig. 1 in the following manner: The type-cylinder, instead of carrying four forms, will of course carry but 90 two, and these will be placed upon opposite sides of the cylinder with their heads pointing in opposite directions. One of these forms will contain matter for page 5 if, for example, the product is to be a supplement 95 for a four-page paper, and the other will contain matter for page 6. The web will be led from the inner roll (not shown) around the impression-cylinders 119 120 and register-roll 131, where it will receive two impressions 100 from each of the two forms upon the type-cylinder, which impressions will be separated by blank spaces equal to the width of the forms. The web will then be turned in the manner already described and receive the 105 same impressions upon its opposite side while passing around impression-cylinders 122 123 and register-roll 134, page 6 falling opposite page 5, and vice versa. After this it will be led over guide-rolls 202 203 and around the 110 impression-cylinders 102 103 and register-roll 106, where it will receive the same impressions upon the same side, the guide-rolls being so adjusted that the impressions made upon the 115 web in passing over the cylinders 102 103 will cover the blank spaces left between the impressions received upon the cylinders 122 123. One side of the web will now be entirely covered with impressions, which will occur in the order shown in Fig. 28—that is 120 to say, there will be four pages 5 followed by four pages 6, &c., the columns of the pages being headed in opposite directions. After passing cylinder 103 the web will be again turned in passing turner 112, and will then 125 pass around impression-cylinders 105 104 and register-roll 107, where the printing of the first side of the web will be completed by filling the blank spaces left in passing cylinders 119 120. The web thus perfected will then 130 pass between the cutting-cylinders 114 115, which will now be supplied with two cutting-blades instead of one, so that the web will be partially severed upon the lines *y y*. The

pulleys 19 will be lowered, so as to cause the tapes 1 2 to bite upon the paper at a point nearer the cutting-cylinders, so as to separate the half-sheets from the web and convey them to the folding mechanism. To fold these two-page sheets, one of the folding-cylinders 116 117 is set one-half a revolution in advance of the other, as shown in Fig. 15, and the revolving gripper-cams are removed and stationary ones substituted that will cause the grippers to operate at each revolution of the cylinders. As these two-page sheets are the size of four-page sheets once folded, the fold at the rolls 125 129 will be omitted, and the switches 81 will be turned from the position shown in Figs. 1 and 3 into the position shown in Fig. 15, where they will rest in grooves formed in the folding-cylinders and guide the sheets unfolded through the rolls 125 129. The first half-sheet will in this case be taken by the grippers upon the cylinder 117 and carried forward with said cylinder until the grippers arrive at the rolls 129, when they will be opened and the sheet will be guided off the cylinder by the switch 81 between the tapes 26 27. The second half-sheet will be taken by the grippers upon the cylinder 116 and in like manner guided by its switch 81 between the tapes 24 25, and so the operation will be repeated, the sheets as they pass from the control of the tapes 24 25 and 26 27 being operated upon by the subsequent folding mechanism, as before described. The folding-blades 23 in this case need not be thrown out of operation, as they will be provided with recesses, which will enable them to pass the switches.

When the folding cylinders are provided with two folding-blades and two co-operating sets of folding-rolls, as in Figs. 5 and 16, so as to impart two parallel transverse folds to a four-page sheet, it will be desirable to impart one transverse fold to the two-page sheets. For this purpose the grippers are made inoperative and remain permanently closed, and the cylinders are provided, just in advance of the folding-blades 23, with a series of fixed sheet-holding pins 82, which will impale the forward edge of the sheets as they pass between the cylinders. The folding-blades 23 will be operated in the usual manner, and the pins 82 will be arranged so as to project through recesses in the edges of said blades. The forward edge of the first sheet will be taken by the pins upon the cylinder 116, and as it arrives above the rolls 125 the blade 23 will be operated to throw its leading end off the pins and into the bite of said rolls, by which and the tapes 25 it will be carried forward and re-presented to the cylinder above the rolls 124, between which it will then be passed by the blade 22, as were the four-page sheets heretofore described. The second sheet will be taken by the pins upon the cylinder 117 and in like manner guided between the rolls 129, to be

in turn folded by the blade 22 between the rolls 124.

In Fig. 17 substantially the same organization is shown, except that the pins 82 are placed in the rear instead of in advance of the folding-blades 23, and are provided with means by which they are rocked to impale and release the sheets. In this case the sheets instead of being guided between the rolls 129 125 are carried past said rolls by the pins, and are released in time to be folded between the rolls 128 124 by the blades 22.

The same organization is shown in Fig. 18, except that instead of pins a second set of grippers 13 are provided for seizing and retaining the forward ends of the sheets to carry them past the rolls 129 125 to be folded between the rolls 124.

When the cylinders 116 117 are each provided with two pairs of co-operating folding-rolls and two folding-blades, so as to impart two parallel transverse folds to the sheets, as shown in Fig. 5, it will sometimes be desirable to omit one of these folds, and this may be done by shifting the cams which operate the blades 23 and grippers 21, so that said grippers will retain their hold upon the sheets for a longer time, and so that said blades will pass the rolls 125 129 and then fold the sheets between the rolls 124 128.

When it is desired to produce only folio or four-page papers, the machine will only be made of a width suitable for that purpose, as shown in Fig. 2; but if it is desired to capacitate the machine to produce quarto or eight-page papers it will be made of a width capable of operating upon a double-width web, as shown in Fig. 20. In the latter case the forms will be placed upon the form-cylinder with the heads of the forms meeting at the center, one group of forms containing matter for pages 3 6 and 2 7, and the other group matter for pages 1 8 and 4 5, so that the web will be printed as shown in Fig. 29. The web will be severed upon the lines $z z$ and will be split longitudinally into four-page sheets by a slitter 90, located as shown in Figs. 23 to 26, or in any other convenient position, and the succeeding four-page sheets associated to form the eight-page product. To effect this the blades 23 of the folding-cylinders will be arranged as shown in Fig. 19, but will extend only one half the length of the cylinders, these half-length blades being located at opposite ends of the cylinders, as shown in Fig. 21. These folding-blades are also arranged to fold only at alternate revolutions of the folding-cylinders, as already described in connection with Fig. 14, thus folding sheets at regular intervals. The folding-cylinders are each provided with two sets of grippers 84 85 and 184 185, each set operating upon only one-half the length of their respective cylinders, (see Fig. 22) and mounted upon separate shafts and operated independently through rock-arms 86 87, which are acted upon by re-

volving gripper-cams 88 89, the gripper-shafts being provided with the usual springs for holding the grippers closed when not opened by the cams.

5 The operation of this organization will be as follows: As the leading edges of the first pair of sheets, which, let it be supposed, contain upon their right-hand or outer surfaces pages 3 6 and 2 7, respectively, emerge from between
10 the guides 22, both sets of grippers upon the cylinder 117 will be operated so as to seize both sheets and carry them forward upon said cylinder, as shown in Fig. 23, the folding-blades not operating at this revolution of the cylinders.
15 When the cylinders have completed their first revolution, the leading ends of the second pair of sheets bearing upon their right-hand or outer surfaces pages 1 8 and 4 5, respectively, will arrive in position to be seized
20 by the grippers. Both sets of grippers upon the cylinder 117 will again be opened. The set 184 will at once close, grasping the sheet bearing pages 1 8 upon its outer surface so as to carry it forward upon the cylinder
25 117, imposed upon the sheet already there bearing pages 3 6 upon its outer surface. At the same time the grippers 85 of the cylinder 116 will be operated so as to take the sheet bearing pages 2 7 upon its outer surface
30 from the cylinder 117 and carry it forward upon the cylinder 116, together with the sheet just emerging from between guides 20 and bearing pages 4 5 upon its outer surface, the grippers 185 upon the cylinder 117 remaining open until after these sheets are carried out of their reach by the cylinder 116, as
35 shown in Fig. 24. When the cylinders have made three-fourths of a revolution from this point, the blades 23 will both be operated and fold the pairs of imposed sheets off their respective cylinders and between the folding-rolls 125 129, as shown in Fig. 25, from
40 which they will be conducted by the tapes to the subsequent folding mechanism, as shown in Fig. 19. At the completion of the second revolution of the cylinders both sets of grippers upon the cylinder 117 will remain closed and both sets upon cylinder 116 will be operated to seize the edges of the third pair of
45 sheets bearing pages 1 8 and 4 5, respectively, upon their right-hand or outer surfaces as they emerge from the guides 20, as shown in Fig. 26. At the end of the third revolution of the cylinders both sets of grippers upon the cylinder 116 will open, the set
50 85 immediately closing, so as to grasp the incoming sheet bearing pages 2 7 upon its outer surface and associate it with the sheet already upon the cylinder, while the grippers 184 of the cylinder 117 will be operated to transfer the sheet bearing pages 1 8 from the cylinder 116 and associate it with the incoming sheet bearing pages 3 6. When the cylinders have completed three-fourths of a revolution from this point, the folding operation
55 before described will be repeated, and at the end of the fourth revolution both sets of grippers

upon the cylinder 117 will again be opened to take both sheets, and the operation will be repeated. The movements just described will be imparted to the grippers by the peculiar configuration of the cams 88 89, said cams being mounted loosely upon the shafts of their respective cylinders, and rotated by trains of gears similar to those already described in connection with Figs. 3, 4, 5, and 7, so as to make three revolutions to four revolutions of the cylinders, thereby bringing them into the same relative position with the cylinders at the end of every fourth
70 revolution. As the folding-cylinders 116 117 carry around the first pair of sheets the grippers do not open until the leading edges of the sheets are well under the sets of carrying-tapes 91. These tapes embrace a portion of
75 the cylinders and return over the rolls 93 and serve to control and forward the sheets until the leading edges are again taken by the grippers in connection with the incoming pair of sheets. At the second revolution of the cylinders the grippers release the sheets, and they are folded between the folding-rolls just before their leading edges reach the tapes. It will of course be understood that pins may be used instead of grippers in the organization just described, the same as shown in Figs. 6 and 8.
80

The final folding mechanism in the double-width structure illustrated in Figs. 19 and 20 is substantially the same as that already described, except that an extra pair of folding-blades 93 and folding-rolls 94 are provided, so as to impart an extra fold to the sheets, after which the sheets are delivered to opposite sides of a double-acting fly 95, instead of being delivered to two flies.
85

The operation of the printing mechanism in producing folio or four-page papers from a single-width web has already been explained. If, however, it is desired to produce four-page papers or supplements from a double-width
90 web, it may be done by placing the forms for printing the four pages upon the form-cylinder in a single group. The forms for printing the first and fourth pages of the paper will be placed side by side upon one end of the cylinder and those for printing the second and third pages upon the other, the heads of the forms being at the center of the cylinder. If, as illustrated in Fig. 30, this product is to be a supplement for an eight-
95 page paper, the forms for printing pages 12 9 will be upon one end of the cylinder and the forms for pages 11 10 upon the other. A double-width web will then be led through the printing mechanism in the manner already set forth for producing two-page papers or supplements, in which operation it will be printed in the order illustrated in Fig. 30. The web thus printed will be severed into sheets upon the line *vv*, which sheets
100 will be split longitudinally by the slit 90, after which the sheet will pass to the folding mechanism. All the sheets having pages 9 12 upon their right-hand or outer surfaces

will, as they emerge from the guides 20, be taken and folded by the cylinder 117, and those with the same pages upon their left-hand or inner surfaces will be taken by the
 5 cylinder 116, so as to bring those pages always at the outside. To effect this the cams for operating the grippers upon the folding-cylinders will be removed, and stationary
 10 cams, which will operate the grippers 85 and 184 only, will be substituted. The cams for operating the folding-blades will also be arranged so that each blade will operate at
 15 each rotation of the cylinder. The sheets will then be led to subsequent folding mechanism in the manner already described. The speed of the latter, however, must be doubled, as there will be double the number of sheets to be folded.

I do not claim herein the combination of
 20 two folding mechanisms arranged to fold sheets in opposite directions and means for directing sheets alternately to said mechanisms, as this is claimed in my application for Letters Patent No. 357,555, filed July 2, 1890.

25 I do not claim herein the patentable features of the printing mechanisms shown and described, nor its combination with a collecting mechanism arranged to associate the sheets into lots or with transverse and longitudinal severing mechanisms, as these features are claimed in my Letters Patent No.
 30 367,123, before referred to.

What I claim is—

1. The combination, with a web printing
 35 and severing mechanism, of two folding-cylinders arranged to fold sheets in opposite directions and provided with sheet-controlling devices, and means for operating said sheet-controlling devices at suitable intervals to
 40 cause each of said cylinders to take and act upon one-half of the sheets produced by said printing and severing mechanism and presented to said cylinders, substantially as described.

45 2. The combination, with a web printing and severing mechanism, of two folding-cylinders arranged to fold sheets in opposite directions and provided with sheet-controlling
 50 devices, and means for operating said sheet-controlling devices at suitable intervals to cause each of said cylinders to act alternately upon the line of sheets produced by said printing and severing mechanism, substantially as described.

55 3. The combination, with a web printing and severing mechanism, of two folding-cylinders arranged to fold sheets in opposite directions and provided with sheet-controlling devices, said cams being so timed
 60 that the folding-cylinders act alternately upon the line of sheets produced by said printing and severing mechanism, substantially as described.

65 4. The combination, with a web printing and severing mechanism, of two folding-cylinders arranged to fold sheets in opposite di-

rections and provided with sheet-controlling devices, and means whereby said sheet-controlling devices may be operated at suitable
 70 intervals to cause said cylinders to act alternately upon a single line of sheets produced by said printing and severing mechanism or to act continuously upon two lines of sheets produced by the same mechanism, substan-
 75 tially as described.

5. The combination, with a web printing and severing mechanism, of two folding-cylinders arranged to fold sheets in opposite di-
 80 rections and provided with sheet-controlling devices, and cams for operating said sheet-controlling devices so timed that the folding-cylinders may be caused to act either alternately upon a single line of sheets produced
 85 by said printing and severing mechanism or to act continuously upon two lines of sheets produced by the same mechanism, substantially as described.

6. The combination, with a web printing and severing mechanism, of two folding-cyl-
 90 inders arranged to fold sheets in opposite directions and provided with sheet-controlling devices, and means for operating said sheet-controlling devices at suitable intervals to cause said cylinders to act alternately upon a
 95 number of sheets in succession, substantially as described.

7. The combination, with a single type or form cylinder and a plurality of impression-
 100 cylinders and register-rolls arranged to print both sides of a web from the same forms, of web-severing mechanism, two folding-cylinders arranged to fold sheets in opposite di-
 105 rections and provided with sheet-controlling devices, and means for operating said sheet-controlling devices at suitable intervals to cause each of said cylinders to take and act upon one-half of the sheets severed from the web, substantially as described.

8. The combination, with a single type or
 110 form cylinder and a plurality of impression-cylinders and register-rolls arranged to print both sides of a web from the same forms, of web-severing mechanism, two folding-cylinders arranged to fold sheets in opposite di-
 115 rections and provided with sheet-controlling devices, and means for operating said sheet-controlling devices at suitable intervals to cause said cylinders to act alternately upon the line of sheets severed from the web, sub-
 120 stantially as described.

9. The combination, with a single type or form cylinder and a plurality of impression-
 125 cylinders and register-rolls arranged to print both sides of a web from the same forms, of web-severing mechanism, two folding-cylinders arranged to fold sheets in opposite di-
 130 rections and provided with sheet-controlling devices, and means for operating said sheet-controlling devices at suitable intervals to cause said cylinders to act alternately upon a number of sheets in succession, substantially as described.

10. The combination, with a single type or

form cylinder and a plurality of impression-cylinders and register-rolls arranged to print both sides of a web from the same forms, of web-severing mechanism, two folding-cylinders arranged to fold sheets in opposite directions and provided with sheet-controlling devices, means for operating said sheet-controlling devices at suitable intervals to cause said cylinders to act alternately upon the line of sheets severed from the web, and final folding and delivery mechanism arranged to cooperate with said folding-cylinders, substantially as described.

11. The combination, with two folding-cylinders, as 116 117, arranged to fold sheets in opposite directions and provided with sheet-controlling devices, of means for operating said sheet-controlling devices at suitable intervals to cause said cylinders to act alternately upon the line of sheets presented to them, substantially as described.

12. The combination, with two folding-cylinders, as 116 117, arranged to fold sheets in opposite directions and provided with web-severing mechanism and sheet-controlling devices, of means for operating said sheet-controlling devices at suitable intervals to cause said cylinders to act alternately upon the line of sheets presented to them, substantially as described.

13. The combination, with a pair of folding-cylinders, as 116 117, and their sheet-controlling devices, of means for operating said sheet-controlling devices at suitable intervals to take sheets alternately, but to fold the sheets off from said cylinders simultaneously, substantially as described.

14. The combination, with a pair of folding-cylinders, as 116 117, and their sheet-controlling devices, of cams for operating said sheet-controlling devices, said cams being so timed that the sheet-controlling devices of the two cylinders operate to take sheets alternately, but to fold the sheets off from said cylinders simultaneously, substantially as described.

15. A folding-cylinder provided with sheet-controlling devices, and cams for operating said sheet-controlling devices to take sheets at unequal intervals and fold them at equal intervals, substantially as described.

16. The combination, with a web-printing mechanism, a slit for splitting the web longitudinally into sections, and sheet-severing mechanism for said sections, of a folding mechanism for each line of sheets, said folding mechanism being arranged to fold in opposite directions, substantially as described.

17. The combination, with a web-printing mechanism, a slit for splitting the web lon-

gitudinally into sections, and sheet-severing mechanism for said sections, of two folding-cylinders arranged to fold sheets in opposite directions, and means for operating the sheet-controlling devices of said cylinders to fold the sheets severed from the two sections in opposite directions, substantially as described.

18. The combination, with a web-printing mechanism, a slit for splitting the web longitudinally into sections, and sheet-severing mechanism for said sections, of two sheet associating and folding cylinders arranged to fold in opposite directions, and means for operating the sheet-controlling devices of the two cylinders to associate and fold in opposite directions the sheets severed from the two sections, substantially as described.

19. The combination, with two cylinders, as 116 117, each provided with two sets of sheet-holding devices, of cams for operating said devices, said cams being so timed as to operate said devices both singly and simultaneously, substantially as described.

20. The combination, with a web-printing mechanism and transverse longitudinal severing mechanism, of two folding-cylinders rotating in opposite directions, each cylinder being provided with two series of sheet-controlling devices, each series extending over one-half of the length of the cylinder, and means for operating said series of sheet-controlling devices singly and simultaneously, substantially as described.

21. The combination, with two cylinders, as 116 117, each provided with two sets of sheet-holding devices and one folding-blade, of means for operating said sheet-holding devices both singly and simultaneously to effect the association and release of sheets, and means for operating said blades simultaneously to fold said associated sheets, all substantially as described.

22. The combination, with the sheet-carrying cylinder and its sheet-retaining devices, of a rotating cam for operating said sheet-retaining devices, the axis of said cam being in line with the axis of the cylinder, and means for rotating the cam at a speed different from that of the cylinder, whereby the said sheet-retaining devices are operative at certain revolutions of the cylinder and inoperative at other revolutions of the cylinder, all substantially as described.

In testimony whereof I have hereunto set my hand in the presence of two subscribing witnesses.

STEPHEN D. TUCKER.

Witnesses:

CHAS. W. CARPENTER,
CHAS. E. HOTCHKISS.