

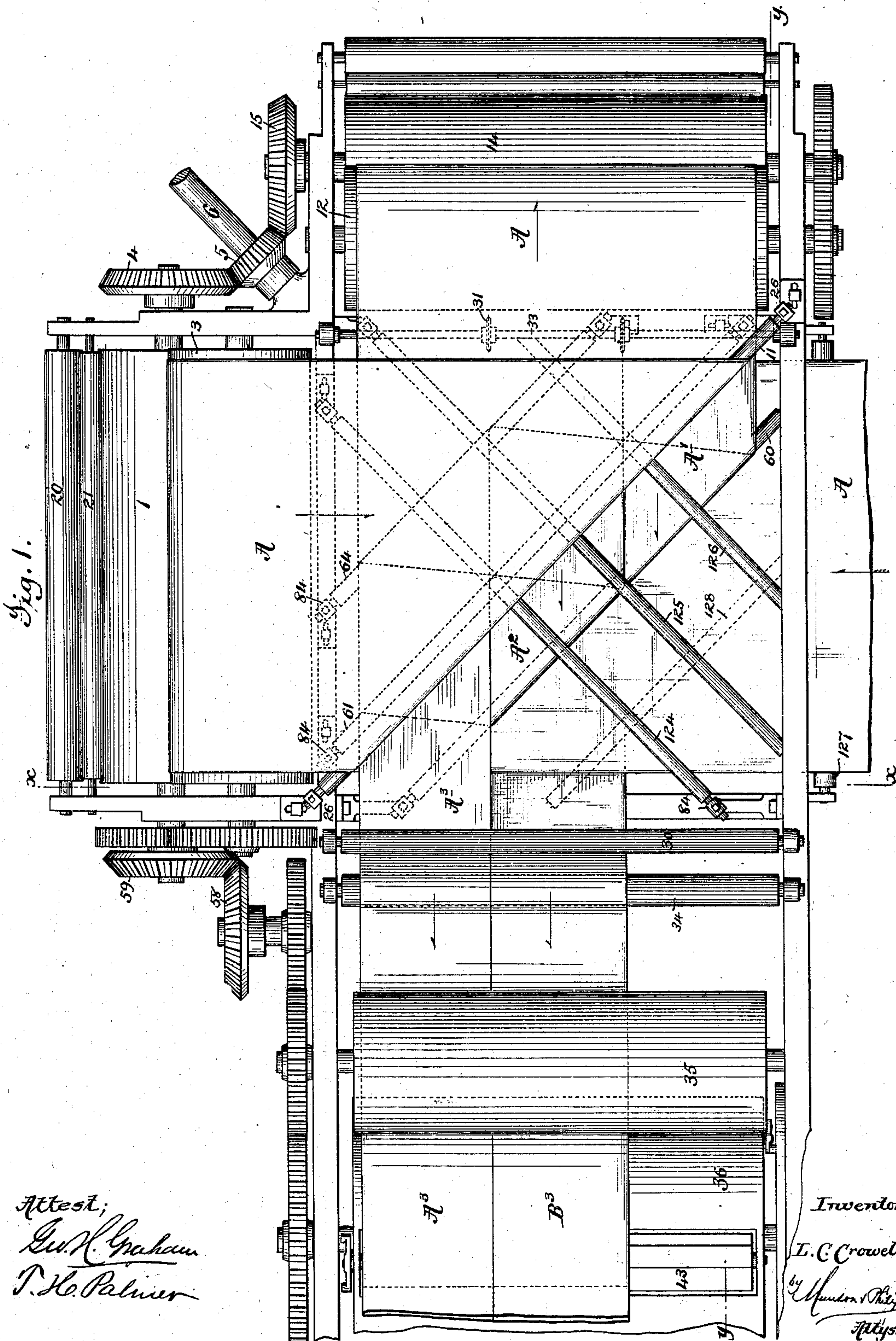
(No Model.)

9 Sheets—Sheet 1.

L. C. CROWELL.
WEB PRINTING MECHANISM.

No. 255,723.

Patented Mar. 28, 1882.



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T. H. Palmer

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(No Model.)

9 Sheets—Sheet 2.

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Fig. 2.

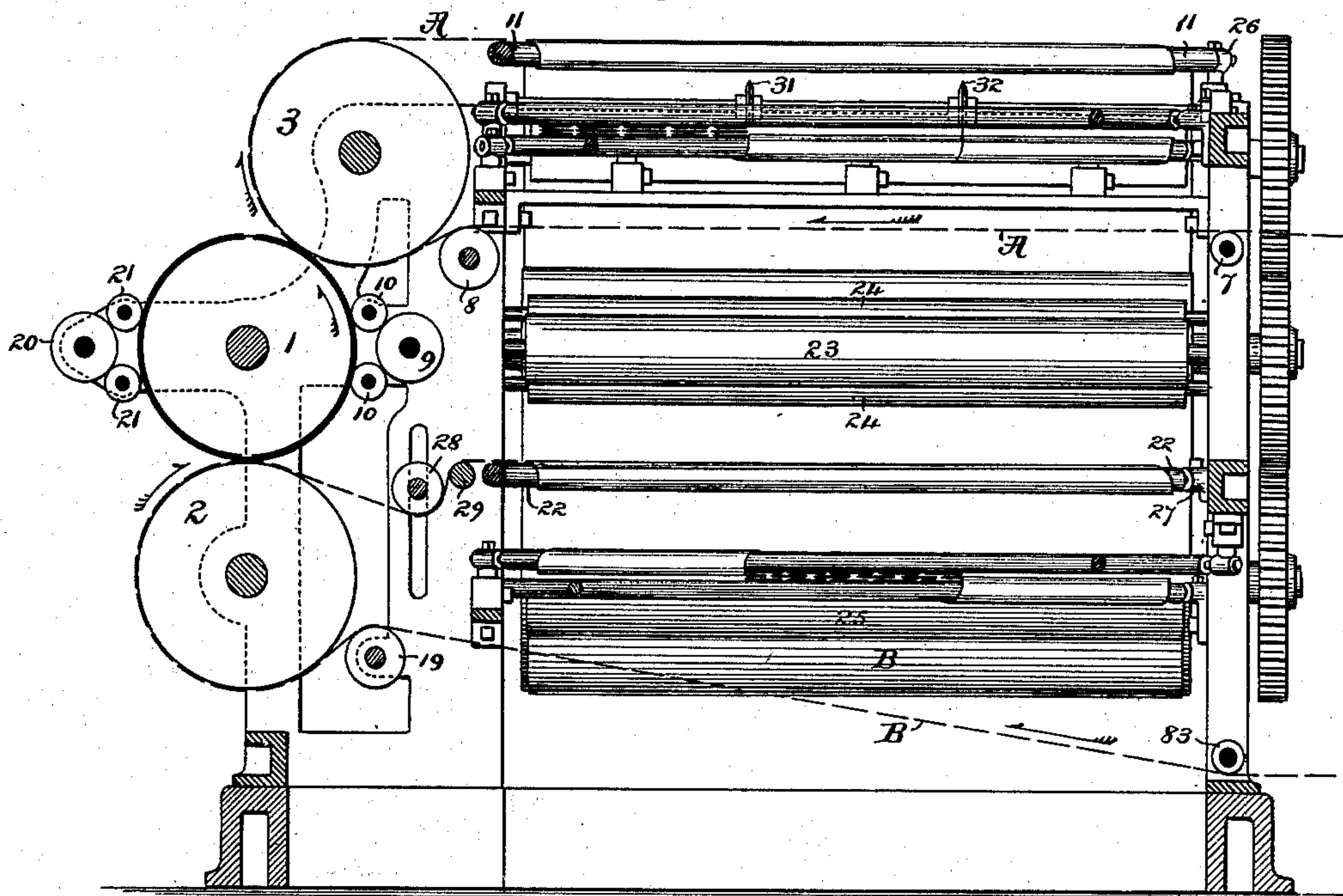
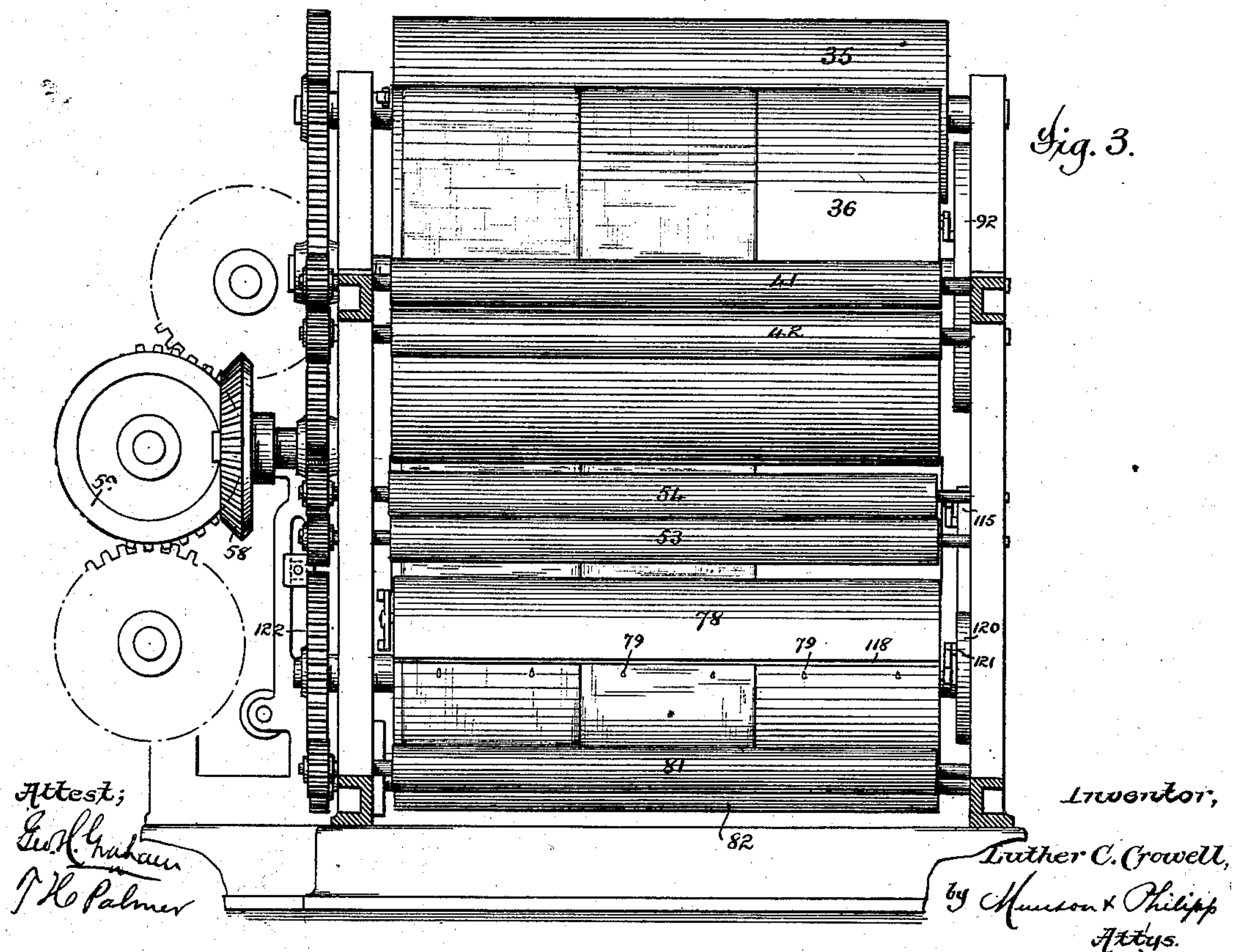


Fig. 3.



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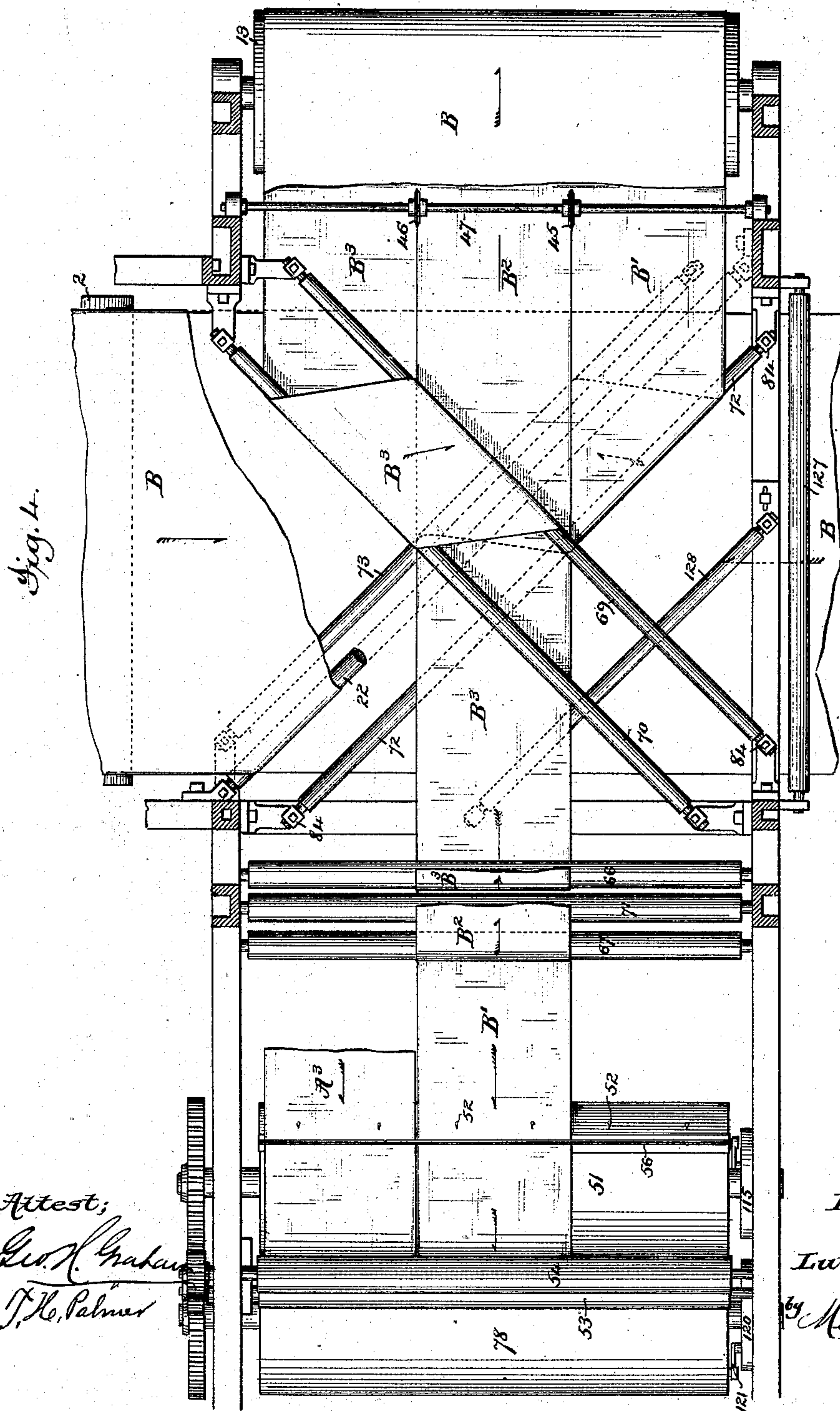
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9 Sheets—Sheet 3.

L. C. CROWELL.
WEB PRINTING MECHANISM.

No. 255,723.

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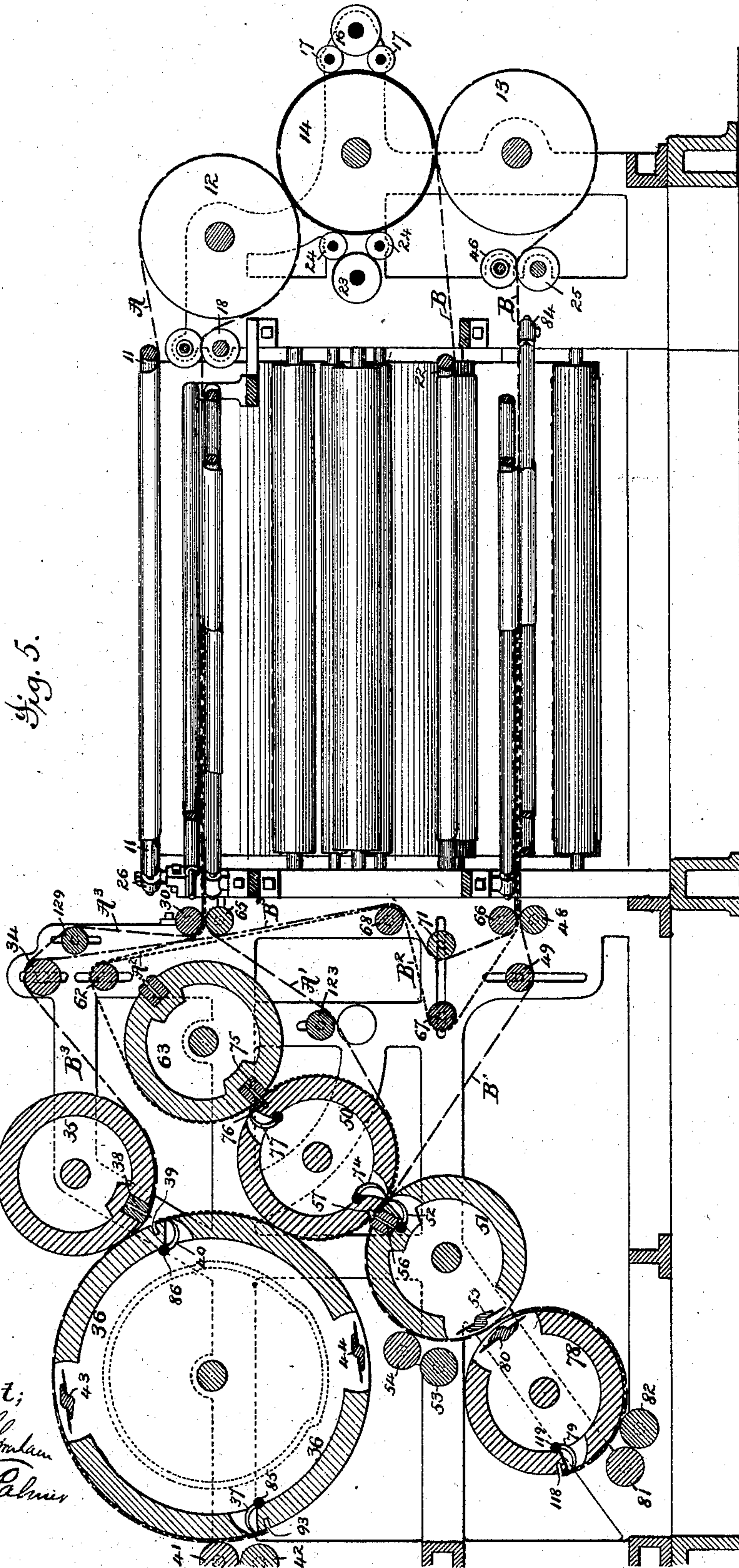
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9 Sheets—Sheet 4.

L. C. CROWELL.
WEB PRINTING MECHANISM.

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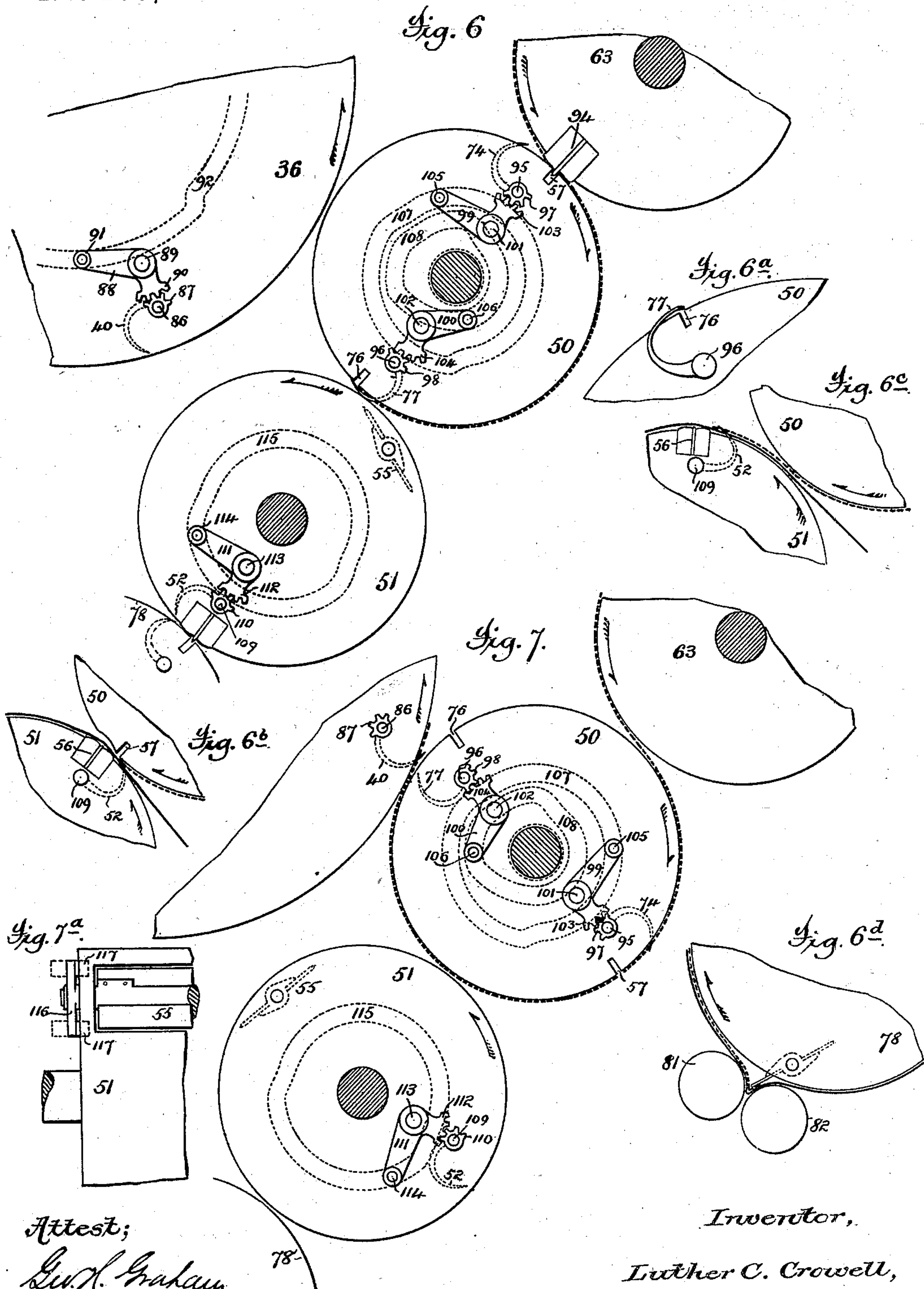
(No Model.)

9 Sheets—Sheet 5

L. C. CROWELL.
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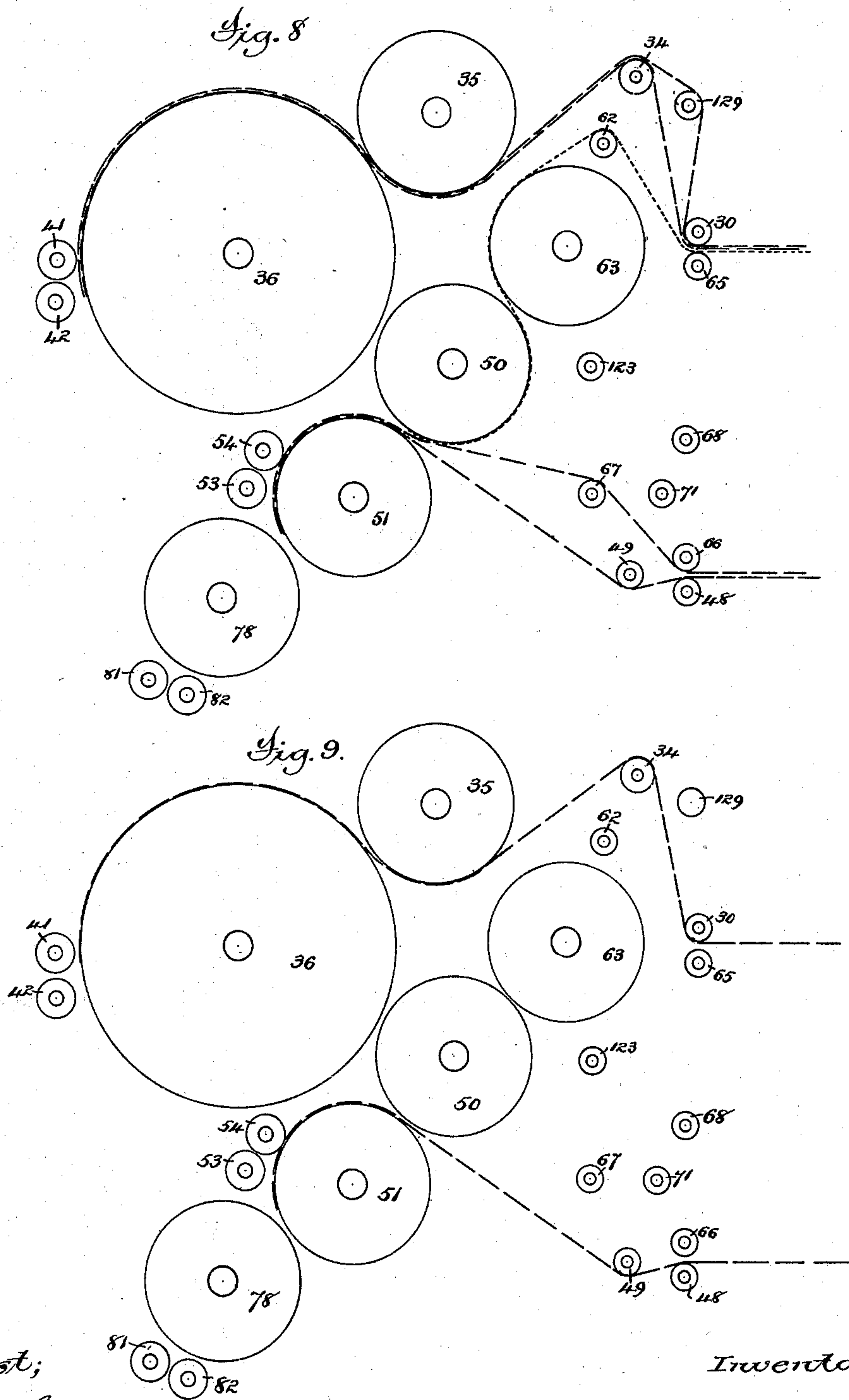
(No Model.)

9 Sheets—Sheet 6.

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9 Sheets—Sheet 7.

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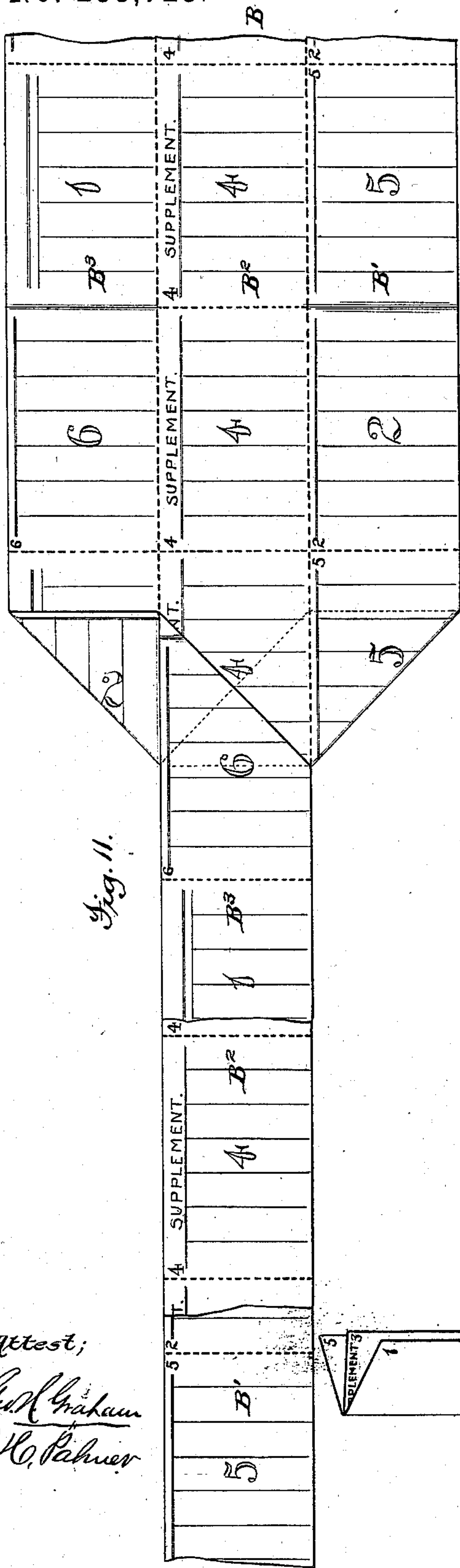


Fig. 11.

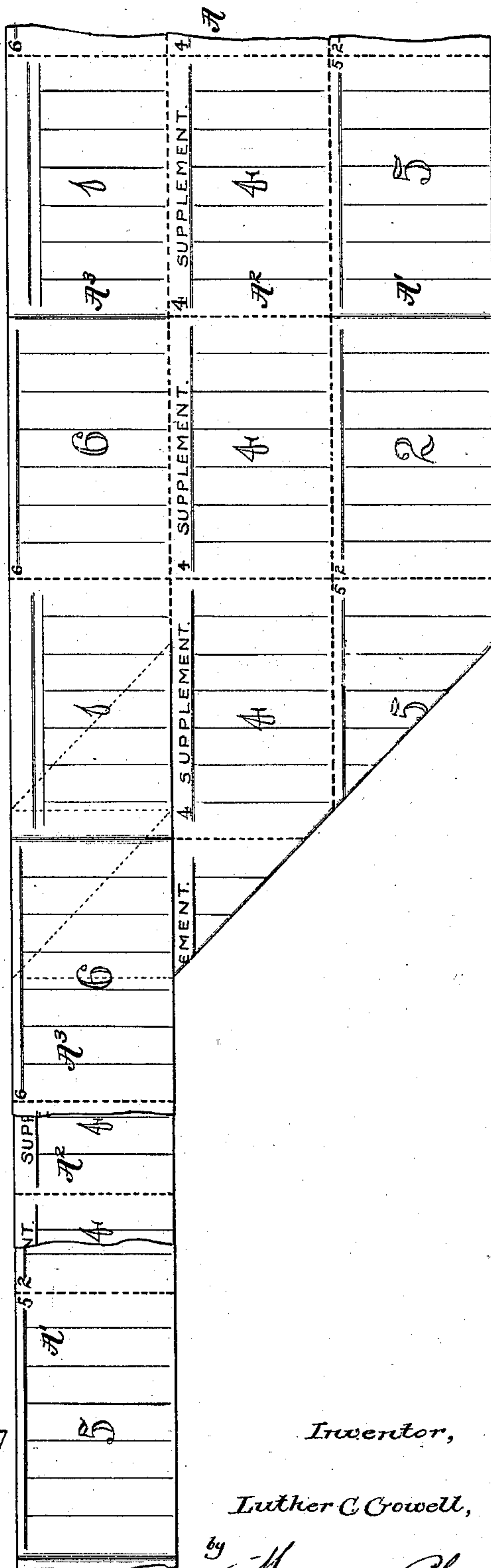


Fig. 10.

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(No Model.)

9 Sheets—Sheet 8.

L. C. CROWELL.
WEB PRINTING MECHANISM.

No. 255,723.

Patented Mar. 28, 1882.

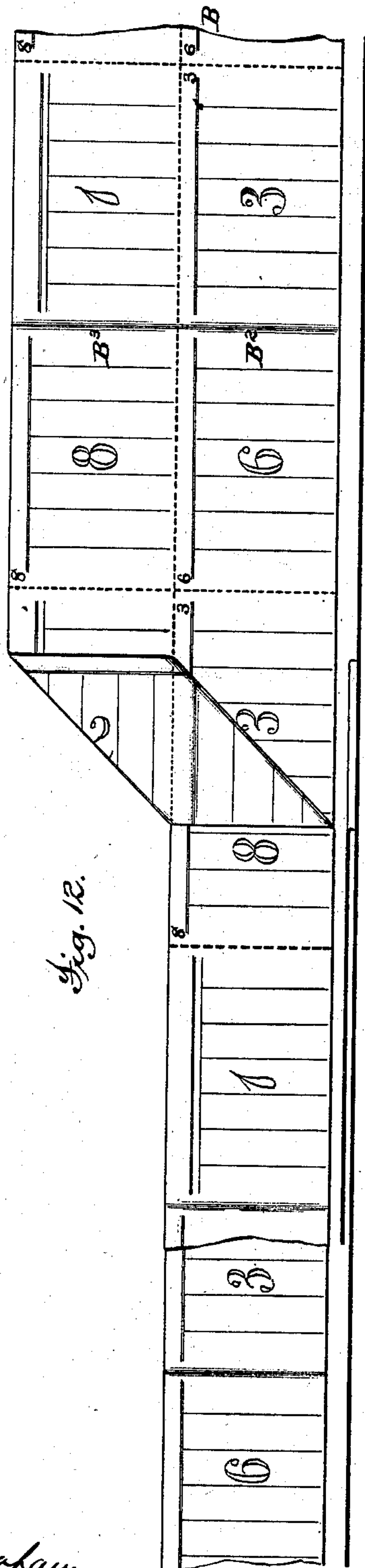


Fig. 12.

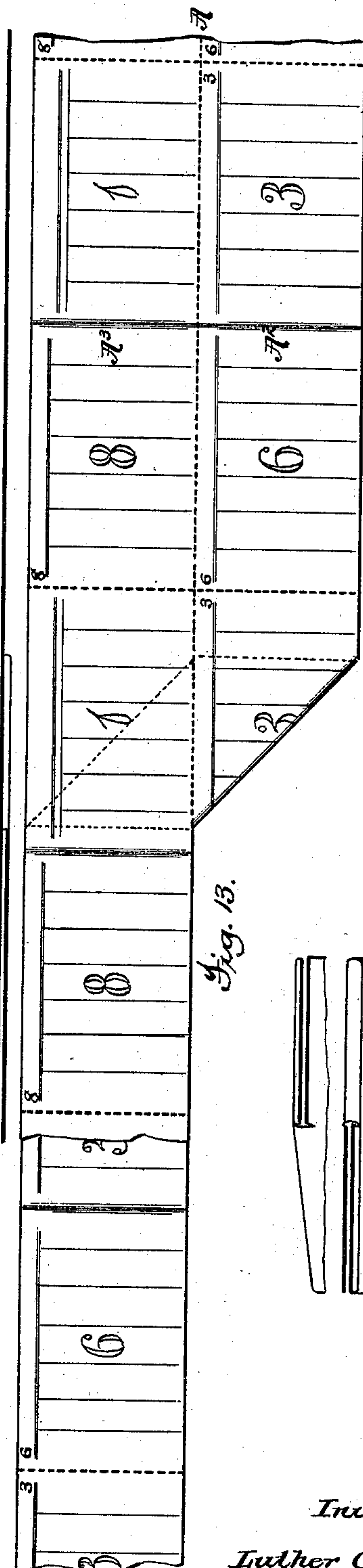
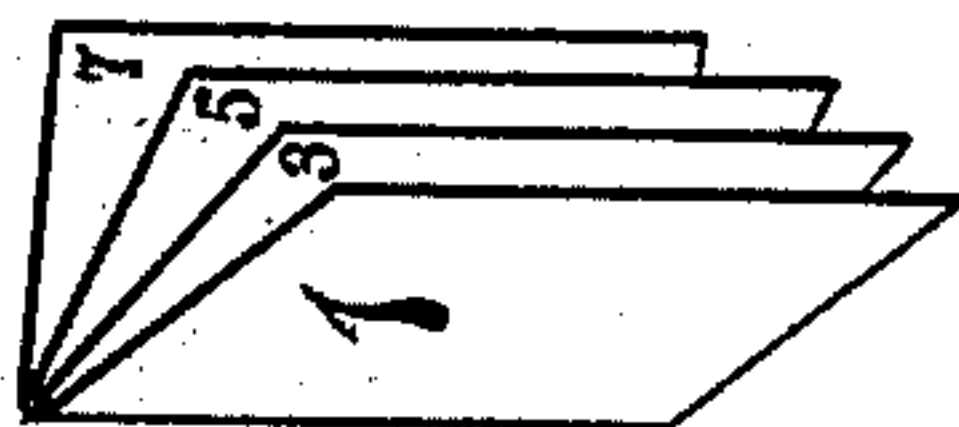


Fig. 13.



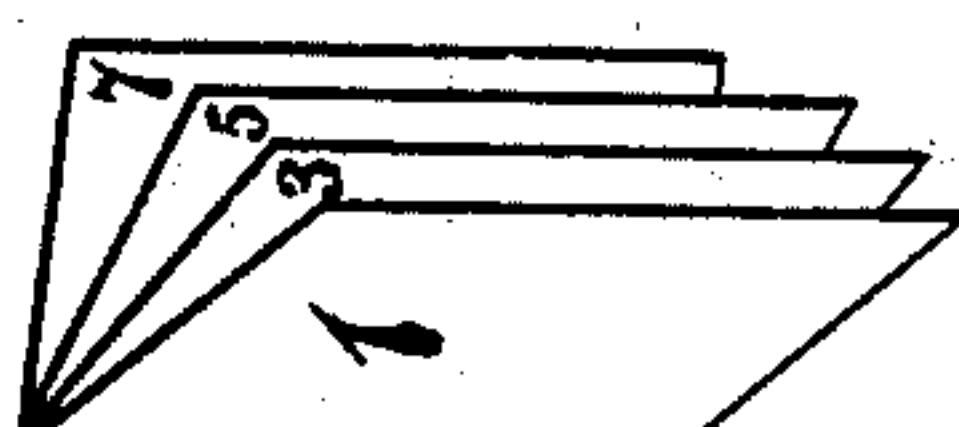
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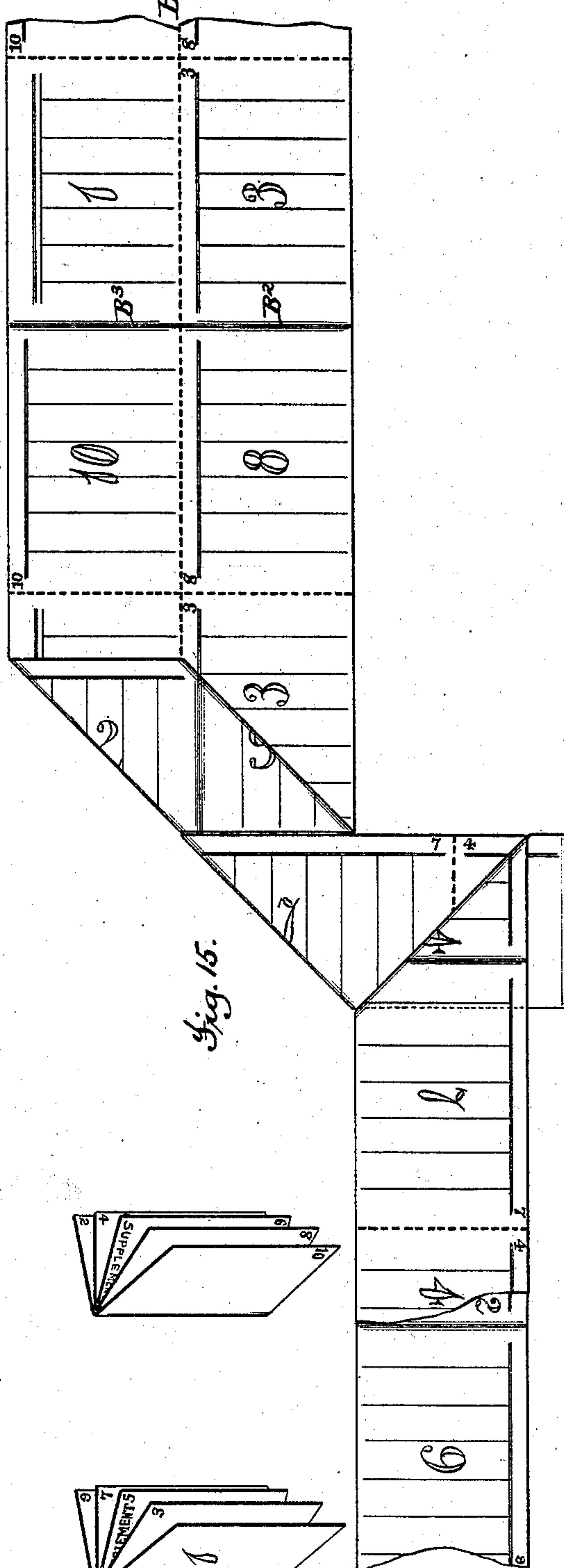
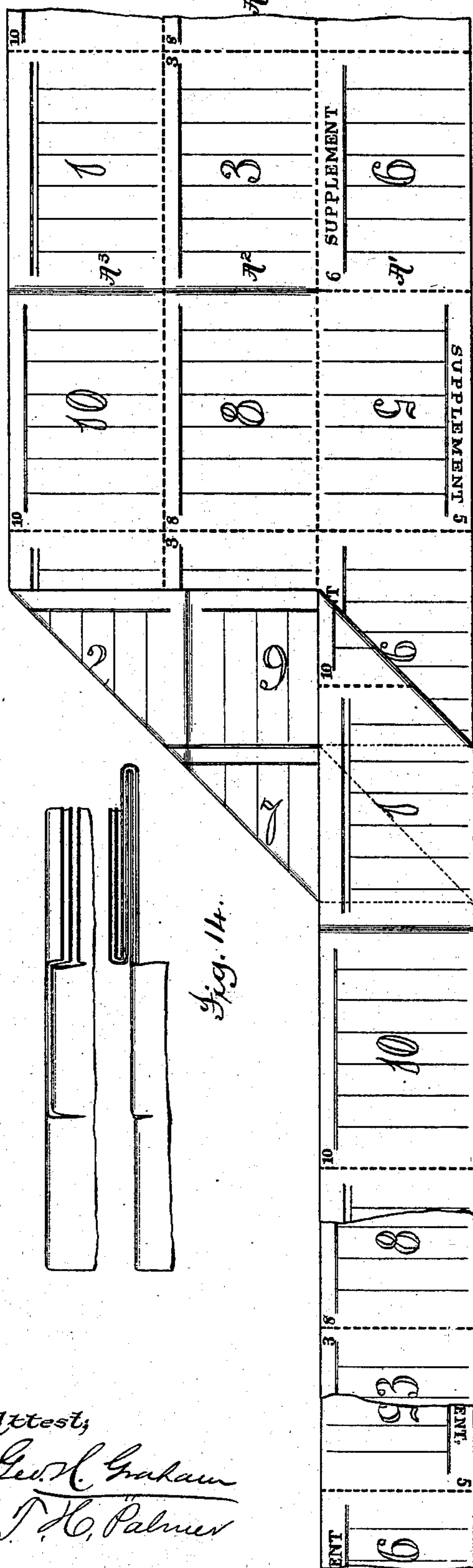
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9 Sheets—Sheet 9.

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UNITED STATES PATENT OFFICE.

LUTHER C. CROWELL, OF BROOKLYN, NEW YORK, ASSIGNOR TO R. HOE & CO., OF NEW YORK, N. Y.

WEB-PRINTING MECHANISM.

SPECIFICATION forming part of Letters Patent No. 255,723, dated March 28, 1882.

Application filed February 2, 1882. (No model.)

To all whom it may concern:

Be it known that I, LUTHER C. CROWELL, a citizen of the United States, residing in the city of Brooklyn, county of Kings, and State of New York, have invented certain new and useful Improvements in Web-Printing Mechanism, fully described and represented in the following specification and the accompanying drawings, forming a part of the same.

10 This invention belongs to that class of printing-machines which are adapted to print both sides of a moving web, sever the same into short lengths or sheets, and deliver such sheets as a folded product.

15 The invention relates more particularly to that class of these machines in which each type-cylinder is provided with a plurality of impression-cylinders, so that duplicate printed webs can be simultaneously produced from the same set of stereotype-plates.

20 It is the object of the invention to produce a mechanism of this character which, with the plates arranged upon the type-cylinder so that the columns of printed matter will lie across or transversely of the printed webs, will be capacitated to produce and deliver once folded transversely either of the following products, viz: a single sheet or folio, a single sheet or folio with a half-sheet supplement inset, two
30 single sheets or folios inset one within the other, (forming what is known as a "quarto,") a quarto with a half-sheet supplement inset, and three single sheets or folios inset one within the other, forming what is known as a
35 "sexto" or twelve-page product.

40 It will readily be seen that to produce from one web of paper a product consisting of one or more full or folio sheets with a half-sheet supplement requires a very differently organized mechanism and method of manipulation when the columns of printed matter lie across or transversely of the web from that required to produce the same product when the columns lie longitudinally of the web. In the latter
45 case the length of the supplement in the direction of its travel through the machine will be the same as that of the main sheet—that is to say, it will be equal to the length of the columns of printed matter and its width will
50 be equal to one-half that of the main sheet. Under these conditions the production from

one web of a folio with a half-sheet or two-page supplement may readily be accomplished by printing upon a web of sufficient width to receive the main sheet and supplement matter
55 abreast, the supplement portion being then split from the main portion, and by means of a web-turner transferred laterally and imposed upon the main portion, thus making a two-ply web, one ply being of one-half the width of the
60 other. The main web is then, either before or after being cut into sheets, folded longitudinally, so as to bring the supplement between its plies. When the plates are so arranged upon the type-cylinders that the columns of
65 matter extend around or circumferentially of the cylinders and the columns of printed matter lie lengthwise of the web the length of said columns and of the printed sheets will occupy the entire circumferential extent of the cylinders, and the only convenient way of varying
70 the size of the printed pages is to add or subtract an entire column. Therefore, if any change is to be made in the size of a folio or four-page paper, it must be to the extent of
75 four full columns, and in a folio with a half-sheet or two-page supplement such change must be to the extent of six full columns.

80 It is often desirable to vary the size of the pages of a paper by making them larger or smaller to a less extent than a full column, and this can only be done by making the columns longer or shorter. When the columns extend around the type-cylinders this cannot be done, because, as already stated, the columns in that
85 case must always occupy the whole circumference of the cylinders; but when the columns lie lengthwise of the cylinders they can be made longer or shorter to any desired extent, and a web correspondingly wider or narrower
90 can be used. For this reason it is desirable to have a mechanism so organized that the plates may be placed upon the type-cylinders so as to cause the columns of printed matter to lie across or transversely of the web. When
95 the columns of printed matter lie lengthwise of the web, the primary fold—i. e., that fold which is parallel with the columns and between the pages, and which, in order to deliver the product in the most desirable form, should be
100 made first—must be made longitudinally—i. e., in the direction of its travel—of the web or

sheet. To make such a fold requires a peculiar mechanism, which in many cases is undesirable. When the columns of printed matter lie across or transversely of the web this primary fold becomes transverse, as will readily be seen. For this reason, also, it becomes desirable to have a mechanism so organized that the columns of matter are printed transversely of the web.

Although the advantages accruing from having the columns of matter lie across or transversely of the web have been recognized and machines have been constructed to print in this manner and capacitated to produce and deliver folio and quarto products, no mechanism has heretofore been organized having the capacity to produce from a single web either of these products combined with a half-sheet supplement.

In said drawings, Figure 1 is a plan view of a mechanism embodying the present invention. Fig. 2 is a transverse vertical section upon the line *xx* of Fig. 1. Fig. 3 is a front elevation of the mechanism shown in Fig. 1. Fig. 4 is a horizontal section, showing the turning-bars which operate upon the lower web after it has been split. Fig. 5 is a longitudinal vertical section upon the line *yy* of Fig. 1. Figs. 6, 6^a, 6^b, 6^c, 6^d, 7, and 7^a are details showing the devices for operating the sheet-holding pins and one of the folding-blades upon the cutting, carrying, and folding cylinders. Fig. 8 is a diagram showing the course of the webs in entering the final-delivery mechanism when the product is a quarto with a supplement. Fig. 9 is a like diagram, showing the course of the webs when the product is a simple folio sheet. Figs. 10 and 11 are views showing the arrangement of the plates and the manner in which the webs will be disposed by the turners when the product is to be a folio with a supplement, Fig. 10 showing the upper and Fig. 11 the lower webs. Figs. 12 and 13 are like views, showing the webs when the product is to be a quarto, Fig. 13 showing the upper and Fig. 12 the lower webs. Figs. 14 and 15 are like views, showing the webs when the product is to be a quarto and supplement, Fig. 14 showing the upper and Fig. 15 the lower webs.

The mechanism by which the webs are perfected consists of two groups of printing mechanisms angularly disposed with relation to each other, as shown in Fig. 1, each group consisting of one type-cylinder and two impression-cylinders. The first group is composed of the type-cylinder 1 and the impression-cylinders 2 3, (see Fig. 2,) suitably mounted in bearings in the frame of the machine, the cylinders 1 2 being located in the same vertical plane, while the cylinder 3 is placed a little to the right of such plane, as shown in Fig. 2, to allow space for the introduction and removal of the plates. The position of the cylinders with relation to each other may, however, be considerably changed without departing from the invention. These cylinders are

connected so as to be uniformly driven by gears upon their respective shafts, motion being communicated to them through the bevel-gear 4 upon the shaft of the type-cylinder 1 from the bevel-gear 5 upon the driving-shaft 6. To the group of printing mechanisms thus constructed and arranged there are led two webs of paper, these webs being contained in rolls mounted upon suitable bearings and located at a convenient point at the right of the machine. The web A passes over the guide-rolls 7 and 8 and outward between the type-cylinder 1 and impression-cylinder 3, it being printed upon its lower side by the plates upon the cylinder 1 during such passage, the ink for the impression being supplied to the plates by inking mechanism of the usual construction, represented by the distributing-roll 9 and form-rolls 10. After being printed upon its lower side the web A passes around the impression-cylinder 3, thence backward in the direction from which it entered the machine, its unprinted side, which is then its underside, passing across the web-turner 11, which is angularly arranged across the path of the web. As the web advances its leading end is carried around the turner and laterally to the second group of printing mechanism. This group, like the first, consists of two impression-cylinders, 14. These are supported, like the first, in suitable bearings in the frame of the machine, and are connected by gears upon their respective shafts, so as to be uniformly driven, motion being communicated to them from the bevel-gear 5 upon the driving-shaft 6 through connection with the bevel-gear 15 upon the shaft of the type-cylinder 14. The web A passes over and around the impression-cylinder 12, thence between this cylinder and the type-cylinder 14, during which passage its other side is printed by the plates carried upon the type-cylinder, the ink for the impression being supplied by inking mechanism of the usual construction, represented by the distributing-roll 16 and the form-rolls 17. After receiving the second impression the web is led upward and around the guide-roll 18, and thence to a delivery mechanism, which will be hereinafter described. The second web, B, is likewise led from a roll of paper mounted in suitable bearings at a convenient point at the right of the machine under guide-roll 83 and over guide-roll 19 to the under side of the impression-cylinder 2 of the first printing mechanism. It thence passes upward and around said cylinder and between it and the type-cylinder 1, being printed during such passage upon its upper side by the plates upon the cylinder 1, ink for the impression being applied by inking mechanism, represented by the distributing-roll 20 and form-rolls 21, which inking mechanism is a duplicate of that located upon the opposite side of the type-cylinder, and already described. After being printed upon its upper side the web passes backward in the direction from which it entered the machine and across the web-turner 22, its leading end being carried around said turner and thence

laterally to the second group of printing mechanism. It passes outward between the impression-cylinder 13 and type-cylinders 14. During this passage its unprinted side receives
 5 an impression from the plates upon the cylinder 14, ink for this impression being supplied to the plates by inking mechanism represented by distributing-roll 23 and form-rolls 24. After receiving this last impression the web B
 10 passes outward and around the impression-cylinder 13, thence backward over guide-roller 25 and to the delivery mechanism before referred to. The web-turners 11 22, which consist of straight bars of wood or metal, are supported
 15 at their ends in brackets 26 27, attached to the frame of the machine. These brackets are made adjustable in any common manner, so that the turners may be adjusted both vertically and laterally, in order to insure that the webs shall
 20 be evenly and accurately introduced to the second printing mechanism.

In order to vary the distance traveled by the webs between the first and second impressions, to secure an accurate registration of
 25 these impressions, the webs, after receiving the first impression, pass over rollers, as 29, and under adjustable guide-rolls 28. (See Fig. 2.)

By adjusting roll 28 to different positions it will readily be seen that the distance traveled
 30 by the webs can be increased or diminished at pleasure, and thus the accurate registration of the first impression with the plates upon the second printing mechanism can be secured. In the drawings the web B alone is shown as
 35 supplied with this register-governing mechanism; but it is to be understood that a like mechanism is to be supplied for the web A.

It will be observed that by the operation thus far described the two webs A B have re-
 40 ceived the same printed matter, and that as they pass to the delivery mechanism the same printed matter—i. e., that received from the type-cylinder 1—will be upon the upper surface of both webs.

45 The type-cylinders as here shown are capacitated to receive six plates or pages of printing-surface each, their circumference being equal to that of two plates or pages crosswise of the columns.

50 The cylinders may of course be made of sufficient circumference to receive four, six, or any other even number of plates, and in length they may be made to receive any number from one up; but in order to give the machine the
 55 capacity hereinbefore mentioned the cylinders must carry three plates in length, and this number will be found sufficient for all ordinary purposes. As the webs A B pass over the rolls 18 25 they are split into three equal
 60 parts each by the slitters 31 32 and 45 46, mounted upon the shafts 33 and 47 and running in grooves in the rolls 18 and 25. The six webs thus formed, and which are designated as A' A² A³ and B' B² B³, are then act-
 65 ed upon by the delivery mechanism, now to be described, by which they are converted into

one or the other of the products before mentioned.

The delivery mechanism is composed of two distinct groups of devices, the first group con-
 70 sisting of turners, by which the webs may be transferred laterally and associated with each other, and the second consisting of cutting, gathering, and folding devices, by which the sheets are severed from the webs and then
 75 folded, or associated and folded.

The turners for transferring and associating the webs, and which constitute the first of the groups of delivery mechanism, are divided in-
 80 to two sets—one set to operate upon the webs A', A², and A³, and the other set to operate upon the webs B', B², and B³. (See Figs. 1 and 4.)

The turners for operating upon the upper webs A', A², and A³ consist of two sets of paral-
 85 lel bars, 60 61 64 and 124 125 126, arranged at or nearly at right angles to each other obliquely across the path of these webs as they pass between guide-rolls 18 and 30 65. The bars composing these turners are placed at
 90 such a distance from each other and at such an angle to the direction of the travel of the webs that the web A², by being led around the bars 60 61, will be transferred laterally a dis-
 95 tance equal to its width and placed beneath the web A³; that the web A', by being led around the bars 60 64, will be transferred laterally a distance equal to twice its width, so as to be placed beneath the webs A² and A³; that the web A², by being led around bars 124
 100 125, will be transferred laterally, so as to be placed over web A'; and that the web A³, by being led around bars 124 126, will be transferred laterally, so as to be placed over webs A' and A², all as clearly shown in Fig. 1.
 105

The turners for operating upon the lower webs B' B² B³ consist of the two sets of paral-
 110 lel bars, 69 70 and 72 73 128, arranged at right angles to each other and obliquely across the path of the webs as they pass between guide-rolls 25 and 48 66. The bars composing these turners are placed at such a distance from each other and at such an angle to the direction of the travel of the webs that the web B', by being led around the bars 72 73, will be trans-
 115 ferred laterally a distance equal to its width and placed beneath the web B², and that the web B³, by being led around the bars 69 70, will be transferred laterally in the opposite direction a distance equal to its width and placed
 120 over the web B², all as shown in Fig. 4.

It will be observed from the foregoing that the turners for operating upon the upper webs are so arranged as to associate the three webs in the path of the inside or outside ones, while
 125 those for operating upon the lower webs are arranged to associate the three in the path of the middle one. This arrangement may, however, be varied. The upper webs may be associated at the middle, and the lower webs
 130 may be associated at either edge, it only being essential that the two sets of webs, when

associated, shall not be in the same vertical plane.

The bars constituting the two sets of turners just described have their ends mounted in suitable supports, 84, attached to the frame of the machine, and so constructed in any convenient manner that the turner-bars may be adjusted both vertically and laterally. The lateral adjustment will permit the distance of the bars from each other and their angle to the direction of the travel of the webs to be varied, so as to capacitate them to operate upon and register properly webs of varying widths.

The cutting, gathering, and folding devices by which the sheets are severed from the webs and then folded, or associated and folded, and which constitute the second of the groups of delivery mechanism, consist of the cylinders 35, 36, 63, 50, 51, and 78 and the three pairs of folding-rolls 41 42, 53 54, and 81 82. These cylinders and rolls, which are arranged parallel to the last type-cylinder, are mounted in a suitable frame in substantially the relation to each other shown in Fig. 5, and are connected by suitable gears, so as to be driven in unison with each other and with the printing mechanism, motion being communicated to them from the bevel-gear 59 upon the shaft of the type-cylinder 1 through bevel-gear 58 and other suitable intermediates.

The cylinder 36, which is of twice the circumference of the type-cylinder, is provided at opposite points with sets of sheet-holding pins 37 40. These pins are mounted upon rock-shafts 85 86, journaled in the ends of said cylinder, said shafts being provided at one end with segmental gears, as 87. (See Figs. 6 and 7.) The shafts 85 86 are rocked so as to cause the pins to be protruded and retracted at the proper times by the bell-crank levers, as 88, mounted upon studs, as 89, fixed to the end of the cylinder, one arm of these levers being provided with segmental gears, as 90, and the other with bowls, as 91, running in the groove 92 of a stationary cam. (See Fig. 6.) The path 92 of the cam is such that as the pins pass the point of contact between cylinders 36 and 50 (see Figs. 6 and 7) the bell-crank, as 88, will rock the shafts 85 86 and cause the pins to protrude. The purpose of this will hereinafter appear. The pins will be held in this position until they arrive at the point of contact between cylinders 36 35, when the cam-path 92 will again move the bell-cranks so as to cause the pins to protrude still farther, (see Fig. 5,) the purpose of which will also be hereinafter explained. The cylinder 36 is also provided with cutting-grooves 39 93, located respectively just in advance of pins 40 37, which coact with the blade 38, carried by cylinder 35, to sever the portions of the webs held by one set of pins at the same time or immediately after the webs have been impaled upon the following set. It will be observed that cylinder 35 is of one-half the size of cylinder 36, so that the blade 38 will co-

operate with both cutting-grooves and sever the webs passing between it and cylinder 36 into sheets equal in length to the circumference of the type-cylinders. The cylinder 36 is also provided at points nearly equidistant from the cutting-grooves with the rotating folding-blades 43 44, which are constructed and operate in the usual and well-known manner, and which fold the sheets carried by the pins into the bite of rolls 41 42, the path 92 of the cam being of such form as to retract the pins and release the sheets at the proper time.

The cylinders 63, 50, 51, and 78, which are all of the same size as the type-cylinders, are provided with the following auxiliaries: The cylinder 63 carries at opposite points of its circumference the two severing-blades 75 94, which co-operate respectively with the cutting-grooves 76 57 upon the cylinder 50, the result being that the web or webs passing between these cylinders is or are cut into sheets of a length equal to one-half the circumference of the type-cylinders. The cylinder 50 is provided with two sets of sheet-holding pins, 74 77, located just in the rear of the cutting-grooves 57 76. (See Figs. 6 and 7.) These pins are mounted upon rock-shafts 95 96, journaled in the ends of the cylinder, and having upon one of their ends the segmental gears 97 98. The said shafts are rocked to protrude and retract their respective pins by the bell-crank levers 99 100, mounted upon studs 101 102 projecting from the end of the cylinder. One arm of these levers is provided with segmental gears 103 104, which engage with the segments 97 98 of the rock-shafts, and the other arm with bowls 105 106, which travel respectively in the path 107 108 of a stationary cam. The cam-path 107 is of such form that the lever 99 will be moved so as to cause the pins 74 to protrude at or just before the time when they arrive at the point of contact between cylinders 50 and 63, and cause them to retract when they arrive at the point of contact between cylinders 50 51. The cam-path 108 is of such form that the lever 100 will be moved so as to cause the pins 77 to protrude sufficiently to impale the web or webs at or just before the time when they arrive at the point of contact between cylinders 50 63. After the pins have impaled the web or webs and passed this point the cam-path changes so as to cause the shaft 96 to rock still farther, by which rocking the points of the pins (for a purpose to be hereinafter explained) are carried forward in the arc of a circle until they are brought nearly or quite in contact with the surface of the cylinder, as shown in Figs. 6 and 6^a. These pins remain in this position, so as to carry the ends of the webs impaled upon them past the bite of cylinders 50 51, cylinder 51 being provided with suitable grooves to allow the pins to pass until they arrive at the point of contact between cylinders 50 36, at which time the cam-path again changes, so as to move levers 100 and retract the pins.

The cylinder 51 is provided with a severing-blade, 56, which co-operates with the cutting-groove 57 of the cylinder 50, and at certain times with the cutting-groove 118 of the cylinder 78, as hereinafter set forth, and with a set of sheet-holding pins, 52, located just in the rear of the blade. The pins 52 are mounted upon the rock-shaft 109, journaled in the ends of the cylinder and provided upon one of its ends with the segmental gear 110. The shaft 119 is rocked to protrude and retract the pins by means of the bell-crank lever 111, mounted upon the stud 113 fixed to the end of the cylinder, one arm of which lever is provided with the segmental gear 112, which engages with the segment 110, and the other with the bowl 114, which travels in the cam-groove 115, all shown in Figs. 6 and 7. The path of this cam-groove, as shown in Figs. 6 and 7, is such that the lever 111 will be moved so as to retract the pins 52 at the point of contact between cylinders 51 78 and to protrude them shortly after they pass that point. The cylinder 51 is also provided at a point opposite to the pins 52 with a rotating folding-blade, 55, which, like the blades 43 and 44, is constructed and operated in the usual manner to fold the sheets carried by the pins 52 into the bite of the folding-rolls 53 54. The blade 55 can, however, for a purpose to be hereinafter explained, be rendered inoperative. This is accomplished, as shown in Fig. 7^a, by removing the crank-arm 116 from the shaft of the blade and reversing the position of the bowls 117, so that, instead of projecting outward to engage with the cam (not shown) by which the blade is rotated, they will project inward, as shown in dotted lines, and lock the blade by entering holes in the end of the cylinder. When the blade 55 is made inoperative the pins 52 will be retracted and protruded at the times hereinbefore set forth; but when the blade 55 is operative, so that the sheets carried by the pins 52 will be folded between rolls 53 54, the cam 115 will be shifted in position, so that the lever 111 will not be operated to retract the pins 52 until after they have passed the point of contact between cylinders 51 78, and consequently the pins will not be protruded until about the time when they arrive at the point of contact between cylinders 50 51.

The cylinder 78 is provided with a set of sheet-holding pins, 79, mounted upon a rock-shaft, 119, which are protruded and retracted by devices similar to those already described for operating pins 52 74, &c., the path of the cam 120, which operates the bell-crank lever 121, (see Fig. 3,) being of such form that the pins will be protruded at or just before the time when they arrive at the point of contact between cylinders 51 78, and retracted at the proper time to release the sheet or sheets carried by them, which are folded between rolls 81 82 by the rotating folding-blade 80, which, like those already mentioned, is constructed and operated in the usual manner.

The cylinder 78 is provided at a point just in advance of the pins 79 with a groove, 118, into which the blade 56 projects when it passes the point of contact between cylinders 51 78. In certain of the operations to be hereinafter described the cylinder 78 will not be required. It may therefore be disconnected from the rest of the mechanism during such operations by removing its gear 122, or it may be allowed to run idly, its pins 79 being rendered inoperative by removing the lever 121, or in any other suitable manner.

As already stated, the printing and delivery mechanism herein described is capacitated and adapted to produce and deliver either a folio or four-page product, a folio or four-page product with a two-page supplement inset, a quarto or eight-page product, a quarto or eight-page product with a two-page supplement inset, or a sexto or twelve-page product. If it is desired to produce and deliver a folio or four-page product, the cylinder 78 will be disconnected, or its pins 79 will be made inoperative in the manner described, the blade 55 will be made operative, and the cam 115 will be shifted to the proper position. The entire length of the type-cylinders will then be covered with plates, there being in such case, as already explained, three pairs of plates upon each cylinder, the pairs upon the cylinder 1 printing the first and fourth pages of the product and those upon cylinder 14 printing the second and third pages. In this case webs equal in width to the full length of the type-cylinders will of course be used. The web A, as it passes over guide-rolls 18, will be split into three equal divisions, A' A² A³, by the slitters 31 32, as hereinbefore explained. These divisions, each of which, as will be seen, contains the same matter as the others, will then be led forward side by side across the path of the web A as it enters the machine and beneath the guide-roll 30, (the turners not being used when the product is a folio,) thence over and around guide-roll 34, and between the cutting and folding cylinders 35 36. As the leading ends of the webs arrive at the bite of these cylinders they are impaled upon the pins 37 or 40, which are projected beyond the periphery of the cylinder 36 at this point for that purpose. The webs are then carried around upon the surface of cylinder 36 until a half-revolution has been completed, at which time the severing-blade 38, carried by the cylinder 35, coacting with the groove 39 upon the cylinder 36, will sever the webs, and the freshly-severed ends will, at the same time or immediately afterward, be impaled upon the other set of pins, to be carried forward in like manner. As the cylinder 36 continues its revolution the sheets impaled upon the pins 37 or 40 will be folded between rolls 41 42 by the rotating folding-blade 43 or 44, at which time their leading ends will be released by the retraction of the pins 37 or 40, as hereinbefore set forth. The freshly-cut ends of the webs, having in the

meantime been carried forward, will in like manner be severed and folded at the proper time by the other blade.

The operation just described, as will readily be seen, produces and delivers once folded three folio or four-page papers from the web A at each revolution of the type-cylinders.

It is to be remarked that the cylinder 36, although shown as of twice the diameter of the type-cylinders, may be of the same size as the type-cylinders, or of greater size than shown, according as may be found desirable in practice.

The web B, as it passes over guide-roll 25, will in like manner be split into three equal parts, B' B^2 B^3 , by the slitters 45 46, as hereinbefore explained. These divisions, which, as will readily be seen, will, like the divisions A' A^2 A^3 , each contain the same printed matter as the others, will be led across the path of the entering web B, over guide-roll 48, and beneath guide-roll 49, and thence side by side between the cutting and folding cylinders 50 51. As the leading ends of the webs arrive at the bite of these cylinders they will be impaled upon the pins 52, carried by the cylinder 51, (the pins 74 of the cylinder 50 being, as already explained, retracted at this point,) and carried around upon the surface of that cylinder in its revolution, and will at the proper time be folded between the folding-rollers 53 54 by the revolving folding-blade 55, the pins 52 being retracted at the same time so as to release their leading ends. When this cylinder, which is of the same diameter as the type-cylinders, has made a complete revolution, its severing-blade 56 coacting with the groove 57 upon the cylinder 50, will sever the webs, at which time the pins 52 will again impale the freshly-cut ends of the webs, carry them forward upon the cylinder, and the operation will be repeated.

The pins 77 of cylinder 50, although they will be protruded when passing between cylinders 50 51, will not in the operation just described impale the webs upon cylinder 51, owing to the fact that their points will at this time have been carried forward, so as to be nearly or quite in contact with the surface of their cylinder, as already explained, and shown in Fig. 6^a. This operation, as will readily be seen, like that previously described in connection with cylinder 36, produces three folio sheets from the web B for each revolution of the type-cylinders, the total product from the two webs A and B being six folio sheets for each revolution of the type-cylinders.

It will of course be seen that the machine may be made to produce less than its full capacity. The impression-cylinders may be made adjustable with relation to the type-cylinders, so that two of them may be withdrawn from operative position and only one web be printed upon. Webs of less than full width may also be used if it should be found desirable in any instance.

If it is desired to produce and deliver a product consisting of a folio or four-page paper having a two-page supplement inset, the blade 55 will be made inoperative in the manner already described, the cam 115 will be shifted so as to retract the pins 52 at the point of contact between cylinders 51 78, and the cylinder 78 and its pins 79 will be connected and made operative.

The plates upon the type-cylinders will be arranged as follows: The end of the type-cylinder 1 which prints those portions of the webs A and B which, after the said webs are split, become A' and B' will carry the plates for printing pages 2 and 5 of the product. The end of this cylinder which prints those portions of the webs which, after being split, become A^3 and B^3 will carry the plates for printing pages 6 and 1. The middle portion of this cylinder, which carries the plates for printing those portions of the webs which become, after being split, A^2 and B^2 , will carry duplicate plates for printing page 4. That end of the type-cylinder 14 which prints those portions of the webs which, after they are split, become A' B' will carry plates for printing pages 1 and 6; and that end of this cylinder which prints upon those portions of the webs which, after they are split, become A^3 B^3 will carry plates for printing pages 2 and 5; and the middle of the cylinder which prints upon those portions of the webs which, after they are split, become A^2 B^2 will carry duplicate plates for printing page 3, all as clearly shown in Figs. 10 and 11. It will thus be seen that, while each of the webs A' , A^3 , B' , and B^3 contains the same printed matter as the others, the matter upon the upper sides of A' and B' is upon the lower sides of A^3 and B^3 , and vice versa. This arrangement of the matter upon the webs makes it possible to transversely fold the sheets severed from the webs A' B' and those severed from the webs A^3 B^3 in opposite directions, and yet have the proper pages—i. e., 1 and 6—upon the outside of the product in both cases. By folding these sheets in opposite directions I am enabled to sever the supplement-webs A^2 B^2 into half-sheets, or sheets one-half the length of the sheets severed from the other webs, and readily associate and fold such half-sheet or two-page supplements alternately with and into the full sheets severed from webs A' A^3 and B' B^3 . The operation by which this result is accomplished will now be described.

The section A^2 will be led around the turner composed of the bars 60 61 and transferred laterally, so as to be led forward beneath the section A^3 , and the section A' will be led around the turner composed of the bars 60 64 and transferred laterally, so as to be led forward beneath the section A^2 . (See Figs. 1 and 10.) The section B^3 will be led around the turner composed of the bars 69 70 and transferred laterally, so as to be led forward above section B^2 , and section B' will be led around the turner composed of the bars 72 73 and trans-

ferred laterally, so as to be led forward beneath the web B^2 . (See Figs. 4 and 11.) The three webs $A^1 A^2 A^3$ will be led forward between guide-rolls 30 65, and the three webs $B^1 B^2 B^3$ will likewise be led forward between guide-rolls 48 66. (See Fig. 5.) The webs $A^1 B^1$ then pass around rolls 123 and 49, respectively, and side by side enter together between cylinders 50 51. (See Fig. 5.) The web B^3 is led upward from roll 66 around rolls 71 and 68, and then by the side of web A^3 passes around roll 34, the two webs then entering side by side between cylinders 35 36. The web B^2 is led upward from roll 66 around rolls 67 and 68, it passing over roll 68 beneath web B^3 , and then by the side of web A^2 over roll 62, the two webs then entering side by side between cylinders 50 63. The leading ends of the supplement-webs $A^2 B^2$, which are carried over roll 62 and introduced between cutting and carrying cylinders 50 63, will be impaled by the pins 74 and carried around upon the cylinder 50. When this cylinder has made one-half a revolution two-page supplements will be severed from these webs by the blade 75 of the cylinder 63 coacting with the groove 76 of the cylinder 50, and the freshly-cut ends will at once be impaled by the pins 77. At the time the pins 74, carrying the now severed sections of the webs $A^2 B^2$, arrive at the bite of the rolls 50 51 the leading ends of the webs $A^1 B^1$, having pages 2 and 5 upon their upper surface, will have arrived at the same point, and will be impaled by the pins 52 of the cylinder 51, which at the same time will impale the severed sections of the webs $A^2 B^2$, the pins 74 being at that time retracted, as hereinbefore explained, so that as the cylinder 51 continues its revolution the pins 52 will carry the severed sections of the webs $A^2 B^2$ imposed respectively upon the leading ends of the webs $A^1 B^1$. The folding-blade 55 of the roll 51 being now inoperative, the sheets will not be folded between rolls 53 54; but when their leading ends arrive at the bite of the rolls 51 78 they will be taken by pins 79, pins 52 being retracted at that time, as hereinbefore described, and carried around upon the surface of the latter cylinder, the supplement portions being by this operation brought inside or next to the cylinder 78. When the pins 79 have arrived at about the position shown in Fig. 5 the severing-blade 56, coacting with groove 57 in roll 50, will sever the webs $A^1 B^1$, and as the roll 78 continues its revolution the folding-blade 80 will fold the sheets impaled on the pins 79 between the folding-rolls 81 82, the product thus delivered being two folio or four-page papers with two-page supplement inset. The pins 52 having in the meantime taken the freshly-cut ends of the $A^1 B^1$ and fresh supplement portions and carried them forward, the operation will be repeated. When the sections $A^2 B^2$ are severed by the blade 75, coacting with groove 76, the freshly-cut ends will be taken by the pins 77. When these pins arrive at the bite of the rolls 50 51 they will not be re-

tracted, but will remain protruded, (their points, as already explained, being in such position as not to impale the webs upon cylinder 51,) and carry the supplements held by them forward until they arrive at the bite of the rolls 36 50, at which time the pins 37 or 40 of the roll 36 will be protruded to impale the leading ends of these supplements, and the pins 77 being at the same time retracted, as already explained, the supplements will be transferred to and carried forward by the cylinder 36. When the pins 37 or 40, carrying these supplement-sheets, arrive at the bite of the rolls 35 36 they will be met by the leading ends of the webs $A^3 B^3$, having printed upon their under surfaces page 5, which will also be impaled upon these pins and carried forward upon the cylinder 36, the supplement by this operation being placed beneath the main sheet with the pages of matter in the proper order. When the cylinder 36 has made one-half a revolution from this point the webs $A^3 B^3$ will be severed by the blade 38, coacting with the groove 39 or 93, and will at the proper time be folded by the blade 43 or 44 between rolls 41 42.

From this it will be seen that the webs $A^1 B^1$ and the webs $A^3 B^3$ of the webs $A B$ form the main or folio sheet, and that the webs $A^2 B^2$ are divided into half-sheets, such half-sheets being alternately associated with the webs $A^1 B^1$ and with the webs $A^3 B^3$, and that the product of the machine, when operating in this manner, is four folio or four-page papers, each having an inset supplement of two pages, at each revolution of the type-cylinders. In this case, also, it is evident that the same product can be produced and delivered from a single web, the only difference being that the capacity of the machine will be reduced one-half.

When it is desired that the product shall be a quarto or eight-page paper, the same consisting of two folio or four-page sheets inset one within the other, webs of two-thirds the width of those used in the previously-described operations will be used, and the plates upon the type-cylinders will be arranged to print pages 1, 3, 6, and 8 upon the upper side of each web and pages 2, 4, 5, 7 upon the lower side of each web, as shown in Figs. 12 and 13. The web A will be split into the two sections $A^2 A^3$ by the slit 31, and the part A^2 will be led around the turner composed of the bars 60 61, so as to be transferred laterally and placed beneath the portion A^3 . The web B will be split into two portions, $B^2 B^3$, by the slit 46, and the portion B^3 will be led around the turner consisting of the bars 69 70, and transferred laterally, so as to be placed above the portion B^2 . The webs $B^2 B^3$ will then be led between rolls 48 66. The web B^2 will be led around roll 67 and the web B^3 around roll 71, after which the two webs will be led together around rolls 68 and 62 into the bite of cylinders 35 36. The webs $A^2 A^3$ will be led between rolls 30 65. The web A^2 will pass over roll 62 and the web A^3 over roll 34, after which they will together enter the bite of cyl-

inders 35 36, by the side of webs $B^2 B^3$. The leading ends of these webs will be impaled upon the pins 37 or 40, carried forward upon the surface of the cylinder in its revolutions, and at the proper time be severed by the blade 38 and folded between rolls 41 42 by one of the rotating folding-blades carried by said cylinder. The other set of pins, impaling the freshly-cut ends of the webs, will carry them forward in like manner, and the operation will be repeated. The product in this case, as will be seen from the foregoing, will be one quarto or eight-page paper from each of the webs A and B at each revolution of the type-cylinders.

It is to be understood that the webs may be associated in any order different from that shown, if desired. The web A^3 may be transferred so as to lie above web A^2 , or web B^2 may be transferred so as to lie above web B^3 .

When a quarto with a two-page supplement inset is to be produced, cylinder 78 and pins 79 will be made operative, blade 55 will be made inoperative, and cam 115 will be shifted so as to retract pins 52 as they pass the point of contact between cylinders 51 78. The upper web, A, will be of full width and the lower web, B, of two-thirds width. The plates upon the type-cylinder 1 which print upon those portions of the webs which, after splitting, become A^2 , A^3 , B^2 , and B^3 will contain matter for pages 1, 10, 3, and 8, and the plates which print upon the portion which becomes A' will contain matter for pages 5 and 6, said last-mentioned plates being so arranged upon the cylinder that the heads of the pages printed by them will be upon opposite edges of the web A' . The plates upon the type-cylinders 14 which print upon webs A^2 , A^3 , B^2 , and B^3 contain matter for pages 2, 4, 7, and 9, and the plates which print upon the portion which becomes A' contain matter for pages 5 and 6, all as shown in Figs. 14 and 15. The web A being split, the web A^2 is carried around a turner composed of the bars 124 and 125, and is transferred laterally over web A' . The web A^3 is carried around a turner composed of the bars 124 and 126, and is transferred laterally over web A^2 . The web B being split, the web B^3 is led around a turner consisting of the bars 69 70, by which it is transferred laterally over web B^2 . The associated webs $B^2 B^3$ are then led laterally around the bar 70, returned over the roll 127, and then led forward around the bar 128. By this last operation, as will be observed, the associated webs $B^2 B^3$ are reversed, so that pages 7 4 instead of pages 10 1 are upon the upper side, and are transferred so as to be led forward in the same vertical plane as webs $A' A^2 A^3$. By thus reversing webs $B^2 B^3$, I am enabled to readily associate and inset the half-sheet supplements severed from web A' alternately with the full sheets severed from webs $A^2 A^3$ and $B^2 B^3$ and produce a folded product in which the pages will occur in their proper order. After being disposed by the turners, as just described, the webs $A' A^2 A^3$ will be led between rolls 30 65. Web A' , containing the

supplement matter, will pass upward around roll 62 and into the bite of cylinders 50 63, where its leading end will be impaled upon the pins 74 and carried around to the bite of the cylinders 50 51, where it will be met by the leading ends of webs $B^2 B^3$, which are led between rolls 48 66, B^2 passing over roll 67 and B^3 under roll 49. The pins 74 being retracted at this point and the pins 52 protruded, the leading ends of webs B^2 , B^3 , and A' will be impaled on the last-named pins and carried around upon cylinder 51. The half-sheet supplement will be severed from the web A' by the blade 75 upon cylinder 63, and the freshly-cut end of the web will at the same time, or shortly afterward, be impaled by pins 77. When the pins 52 arrive at the bite of cylinders 51 78 they will be retracted, and at the same time the webs and supplement sheet will be impaled upon pins 79 and carried forward upon cylinder 78, by which the supplement is brought inside or next to the cylinder. When the cylinder 78 has made about one-half a revolution the webs $B^2 B^3$ will be severed by the blade 56, and, the pins 52 and the pins 74, carrying another supplement, having again come into position, the before-described operation will be repeated. Just before the cylinder 78 completes its revolution the pins 79 will be retracted and the sheets will be folded between rolls 81 82 by the blade 80. The supplement taken by the pins 77 will be carried around to the bite of cylinders 36 50, where it will be taken by the pins 37 or 40, in the manner hereinbefore set forth, and carried forward to the bite of cylinders 35 36, to be associated with the leading ends of webs $A^2 A^3$, which, after passing between rolls 30 65, are led respectively over rolls 34 and 129 34 to the bite of said cylinders. The leading ends of webs $A^2 A^3$ and the supplement thus associated will be carried around upon the cylinder 36, and at the proper time released from the pins and folded between rolls 41 42 in the manner already set forth.

By the operations just described it will be seen that two quarto or eight-page papers with two-page supplements inset are produced at each revolution of the type-cylinders.

When a sexto or twelve-page product is to be produced the plates upon cylinder 1 will contain matter for pages 1, 3, 5, 8, 10, and 12, and those upon cylinder 14 will contain matter for pages 2, 4, 6, 7, 9, and 11, and webs of full width will be used. The webs, after being split, are passed around the turners in the same manner and associated in the same order as when the product is to be a folio with supplement inset. The webs $A' A^2 A^3$ will be led between rolls 30 65, and, after passing respectively over rolls 129 34, 34, and 62, will enter one upon the other into the bite of cylinders 35 36. The webs $B' B^2 B^3$ will be led between rolls 48 66, and, after passing respectively over rolls 71 68 62, 67 68 62, and 49 67 68 62, will enter one upon the other, beside webs $A' A^2 A^3$, into the bite of cylinders 35 36. The lead-

ing ends of both sets of webs will be impaled upon the pins 37 or 40, carried forward upon cylinder 36, severed at the proper time by knife 38, and will finally be released by the pins and
 5 folded between rolls 41 42 by the folding-blade 43 or 44, the product in this case being two twelve-page papers at each revolution of the type-cylinders.

The various products herein described may,
 10 and usually will, after being delivered from rolls 41 42, 53 54, or 81 82, pass to other folding or delivery devices, to be still further manipulated.

When a quarto or sexto is produced it will
 15 usually be found most desirable to deliver the products of both sets of webs from the same folding-rolls, as herein described; but it is not necessary that they should be so delivered. The product of the lower set of webs may be
 20 delivered from the rolls 53 54, if it should be found desirable. When a quarto or sexto is produced, or when only one web is printed, the cylinders 63, 50, 51, and 78 may be thrown out of gear and rendered idle.

25 The rolls 49, 67, 71, 123, 62, 129, and 34 are made adjustable to any extent desirable, as shown in Fig. 5, so that when the turners are not so adjusted as to properly register the webs the distance traveled by them may be varied
 30 so as to bring them into proper register with each other and with the cutting devices.

In order to make it certain that the half-sheet supplement will never cling to the carrying-cylinders 36 78, and so fail to be properly folded into the main sheets, it may be
 35 found desirable to cause the rear edge of the supplement to extend a short distance back of the fold-line of the main sheet, so as to be caught by the folding-blade, as shown in Fig. 6^a. This can be accomplished by shifting the
 40 gearing connecting cylinders 50 51, so that the cutting-groove 57, instead of meeting blade 56, will meet cylinder 51 slightly in the rear of the blade, as shown in Fig. 6^b. The cylinder
 45 50 will be provided with a depression just in advance of groove 57, so that the blade 56 will not sever the webs carried upon pins 79 until it arrives at the bite of cylinders 51 78. The leading end of the supplement will be taken
 50 by pins 52; but as this end extends only to groove 57 it will fall behind the leading end of the main sheet, which will extend to blade 56. (See Fig. 6^c.) The supplement being one-half the length of the main sheet, its rear end will
 55 of course extend past the center or fold line, so as to be caught by the folding-blade. In consequence of setting back cylinder 50 the pins 37 and 40 will impale the supplements carried by pins 77 nearer their leading ends than
 60 they will the main sheets, so that the rear ends of the supplements upon this cylinder will also extend slightly beyond the center or fold-line of the main sheets.

If it is desired to secure the supplements to
 65 the main sheets or the main sheets forming a quarto or sexto product to each other, it can be readily accomplished by pasting mechan-

isms of the character described in United States Patent No. 244,559, or by other well-known forms of pasting mechanism, which
 70 may be located at convenient points, so as to apply transverse lines of paste at the proper places upon the supplement or main webs, or both, the guide-rolls over which the various webs are led being in such case so positioned
 75 as to afford room for these pasting devices to operate.

The arrangement of the plates upon the type-cylinders may be greatly varied from that specified, the order of turning and associating
 80 the webs being varied to correspond, all of which will readily be understood by one skilled in the art of printing.

It will also be seen that web-turners of the form shown in United States Patent No. 85
 181,250 may be substituted for those herein shown, if it should be found desirable.

The printing mechanism herein shown is not claimed in the present case, as such a mechanism forms the subject-matter of another ap-
 90 plication for United States Letters Patent.

The present delivery mechanisms, although especially adapted to operate with the printing mechanism herein shown, is capable of being used advantageously with any printing
 95 mechanism which is capacitated to perfect two webs. It may also be used to produce a folio, a folio with supplement, or a quarto with a printing mechanism which perfects but one web, such web being of sufficient width to be
 100 split into three sections.

What is claimed is—

1. The combination, with mechanism for severing two webs into sheets, of mechanism for associating alternate sheets severed from one
 105 web with the sheets severed from the other, all substantially as described.

2. The combination, with mechanism for severing three webs into sheets, of mechanism for associating alternate sheets severed from one
 110 web with the sheets severed from the other two, all substantially as described.

3. The combination, with mechanism for severing three sets of webs into sheets, of mechanism for associating alternate sheets severed
 115 from one set with the sheets severed from the other two, all substantially as described.

4. The combination, with web-turners arranged to transfer two webs laterally over or under a third web, of mechanism for associat-
 120 ing alternate sheets severed from the middle web with those severed from the top and bottom webs, all substantially as described.

5. The combination, with two sets of web-turners, each arranged to transfer two webs
 125 laterally over or under third webs, of mechanism for severing the six webs into sheets and mechanism for associating alternate sheets severed from the middle webs with those severed from the top and bottom webs, all sub-
 130 stantially as described.

6. The combination, with two web-turners arranged to transfer two webs laterally over or under two other webs, of a transverse cut-

ting mechanism adapted to operate upon both sets of associated webs, all substantially as described.

7. The combination, with two web-turners arranged to transfer two webs laterally over or under two other webs, of transverse cutting and folding mechanisms adapted to operate upon both sets of webs, all substantially as described.

8. The combination, with web-turners arranged to transfer four webs laterally over or under a fifth web, of mechanism for severing the five webs into sheets and mechanisms for associating alternate sheets severed from the middle web with the pairs of sheets severed from the top and bottom pairs of webs, all substantially as described.

9. The combination, with two sets of web-turners, each arranged to transfer two webs laterally over or under other webs, of transverse cutting mechanism adapted to operate upon both sets of webs, all substantially as described.

10. The combination, with two sets of web-turners, each arranged to transfer two webs laterally over or under other webs, of transverse cutting and folding mechanism adapted to operate upon both sets of webs, all substantially as described.

11. The combination, with mechanism for severing three webs into sheets, the sheets from one web being one-half the length of the sheets from the others, of mechanism for associating alternate short sheets with the longer sheets severed from the other two webs, all substantially as described.

12. The combination, with web-turners arranged to transfer two webs laterally over or under another web, of mechanism for severing the webs into sheets, the sheets from the middle web being of one-half the length of the sheets from the other two, and mechanism for associating alternate short sheets with the longer sheets from the upper and lower webs, all substantially as described.

13. The combination, with mechanism for severing two webs into sheets and mechanism for folding said sheets, of mechanism for severing a third web into sheets and mechanism for associating alternate sheets from the said third web with the sheets severed from the other two, all substantially as described.

14. The combination, with mechanism for severing two webs into sheets and mechanism for folding said sheets, of mechanism for severing a third web into sheets of one-half the length of the sheets severed from the other webs and mechanism for associating alternate sheets from said third web with the longer sheets from the other two, all substantially as described.

15. The combination, with mechanism for severing two sets of webs into sheets and mechanism for folding the same, of mechanism for severing a third set of webs into sheets of one-half the length of the sheets severed from the other sets and mechanism for associating

alternate sheets from said third set with the longer sheets from the other two sets, all substantially as described.

16. The combination, with mechanism for severing three webs, of mechanism for associating alternate sheets from one of the webs with the sheets from the other two and mechanism for folding the sheets so that the said alternate sheets shall be inset, all substantially as described.

17. The combination, with mechanism for severing three sets of webs into sheets, of mechanism for associating alternate sheets from one set with the sheets from the other two sets and mechanism for folding the sheets so that the said alternate sheets shall be inset, all substantially as described.

18. The combination, with mechanism for severing two sets of webs into sheets and mechanism for severing a single web into sheets, of mechanism for associating alternate sheets from said single web with the sheets severed from said sets and mechanism for folding said sheets so that the sheets from said single web shall be inset, all substantially as described.

19. The combination, with two rotary sheet-carrying mechanisms, of a third rotary sheet-carrying mechanism adapted to associate the sheets carried by it alternately with those carried by the other two, all substantially as described.

20. The combination, with two rotary cutting and sheet-carrying mechanisms, of a third cutting and sheet-carrying mechanism adapted to associate the sheets carried by it alternately with those carried by the other two, all substantially as described.

21. The combination, with two rotary cutting and sheet-carrying mechanisms, of a third sheet cutting and carrying mechanism adapted to associate the sheets carried by it alternately with those carried by the other two, and rotary folding mechanisms adapted to fold the sheets so that the said alternate sheets shall be inset, all substantially as described.

22. The sheet-holding pins, as 77, in combination with means for protruding them to such a position that they will pass in contact with a sheet or web without impaling it, all substantially as described.

23. The pins 77, in combination with cylinder 50 and cam 108, said cam being so shaped as to protrude the pins to impale the web or sheet and then carry their points forward, so as to be out of contact with a passing web or sheet, substantially as described.

24. A sheet-carrying cylinder, as 50, provided with two sets of sheet-holding pins, in combination with means for protruding said pins to impale a sheet or web at the same point, a second means acting on one set of the pins to protrude them still farther, and means for retracting the sets at different points, all substantially as described.

25. The combination, with the cylinder, as 51, of the cylinder, as 50, provided with two sets of sheet-holding pins and means for pro-

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truding one set of said pins to such a position that they will pass in contact with the sheet or web upon the former cylinder without impaling it, all substantially as described.

5 26. The combination of cylinder 50, pins 74 77, bell-cranks 99 100, and cams 107 108, said cam 108 being so shaped as to give two outward movements to pins 77, substantially as described.

10 27. A folding-blade, as 55, provided with a reversible operating-arm, as 116, in combination with a folding-cylinder having devices for locking said arm when reversed, all substantially as described.

15 28. The combination, with the cylinder, as 63, carrying one member of a cutting mechanism, and the cylinder, as 50, carrying the other

member of a cutting mechanism, and mechanism for retaining sheets upon its surface, of the sheet-carrying cylinders, as 36, 51, and 78, all 20 substantially as described.

29. The combination of the sheet-carrying cylinders, as 50 51, the two being so timed that the leading ends of the sheets transferred from the former to the latter will fall slightly in the 25 rear of the sheets carried by the latter, substantially as described.

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

LUTHER C. CROWELL.

Witnesses:

J. A. HOVEY,
T. H. PALMER.