

(No Model.)

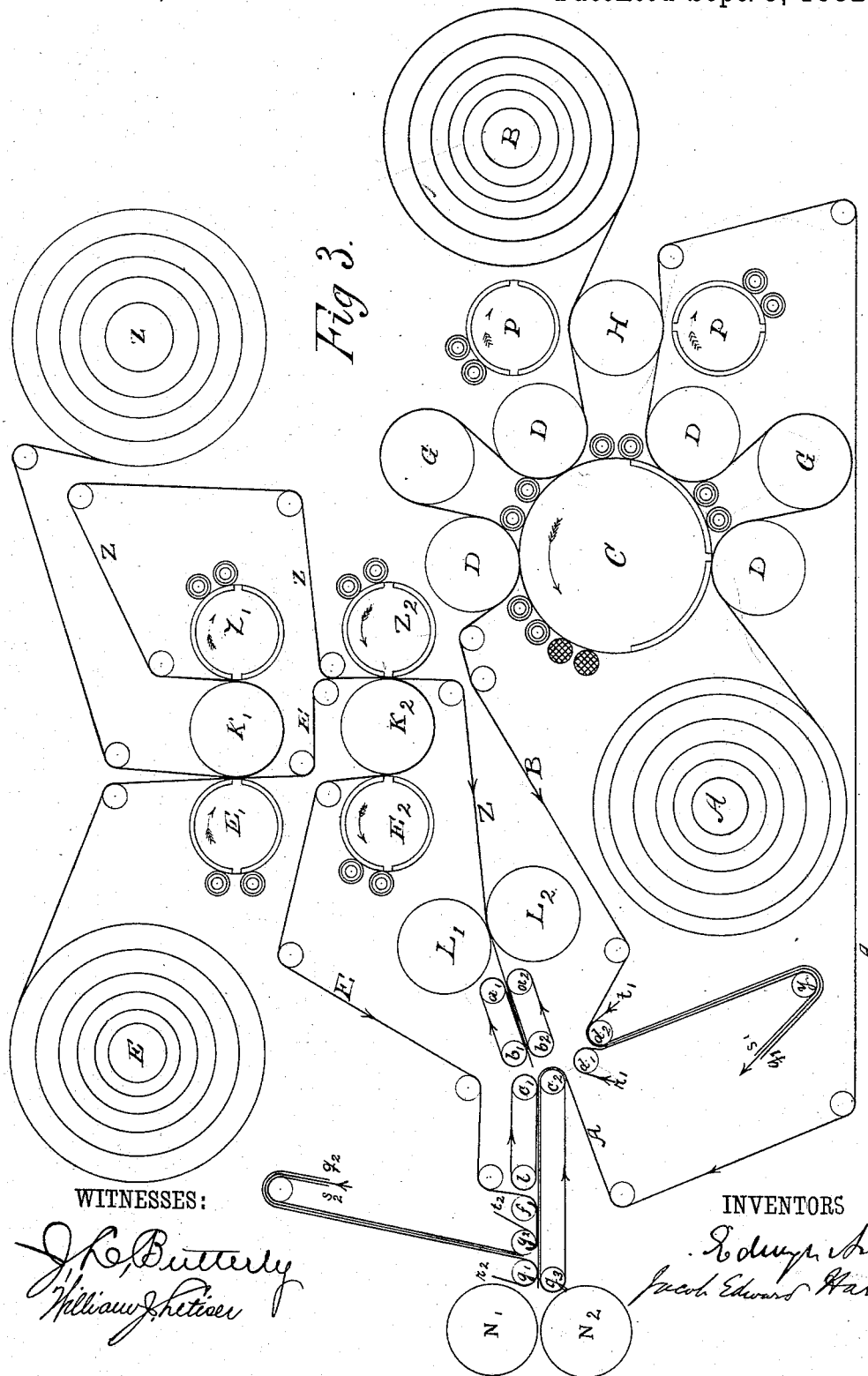
8 Sheets—Sheet 2.

E. ANTHONY & J. E. HARVEY.

PRINTING MACHINE.

No. 263,748.

Patented Sept. 5, 1882.



(No Model.)

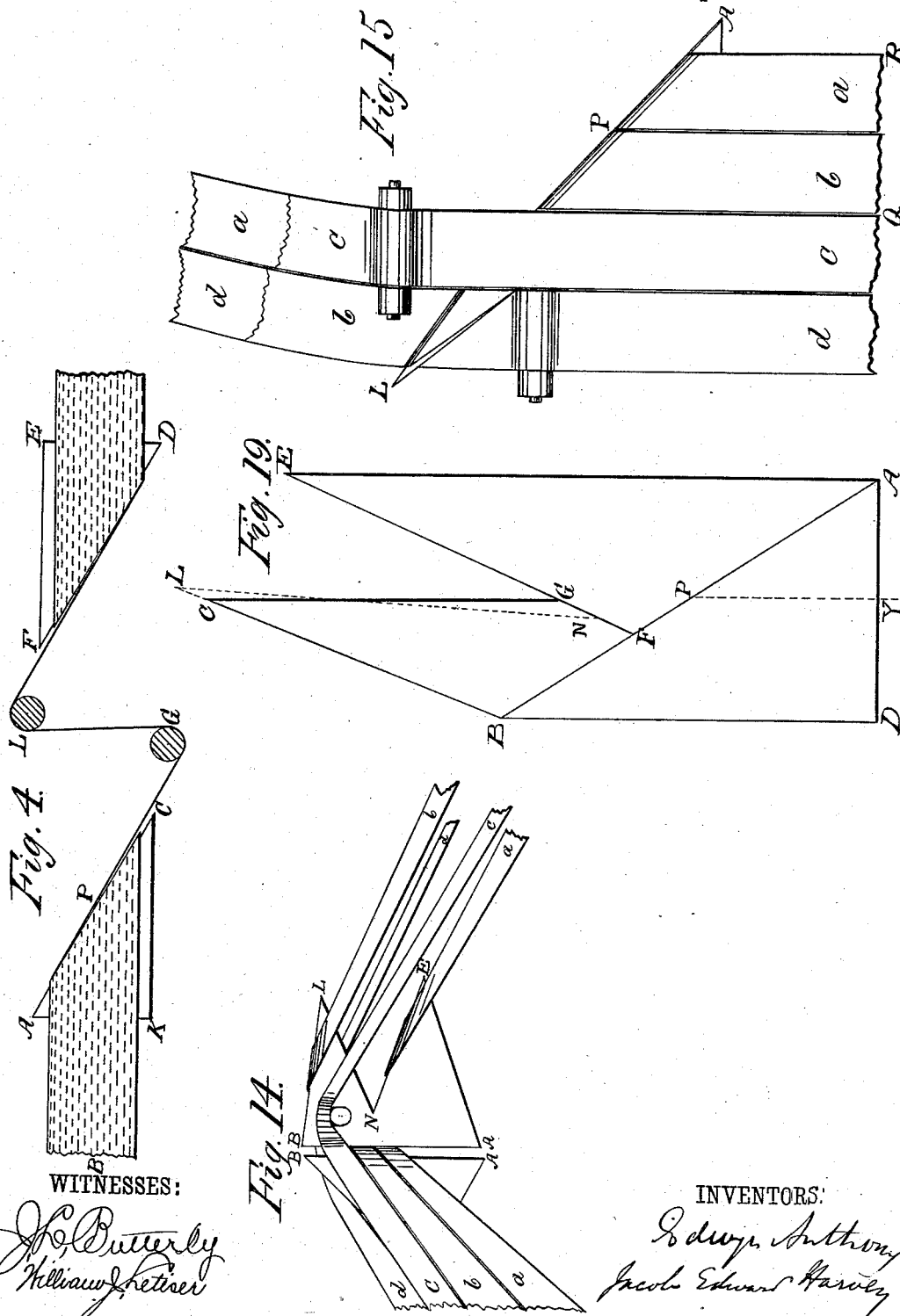
8 Sheets—Sheet 3.

E. ANTHONY & J. E. HARVEY.

PRINTING MACHINE.

No. 263,748.

Patented Sept. 5. 1882.



WITNESSES:

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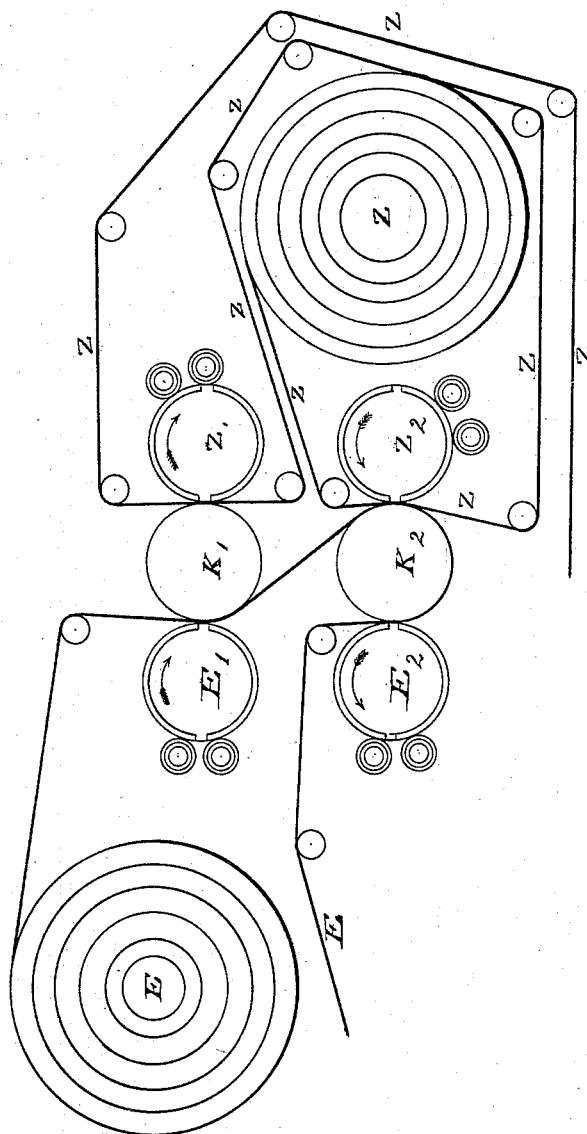
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E. ANTHONY & J. E. HARVEY.^{8 Sheets—Sheet 4.}
PRINTING MACHINE.

No. 263,748.

Patented Sept. 5, 1882.

Fig. 25.



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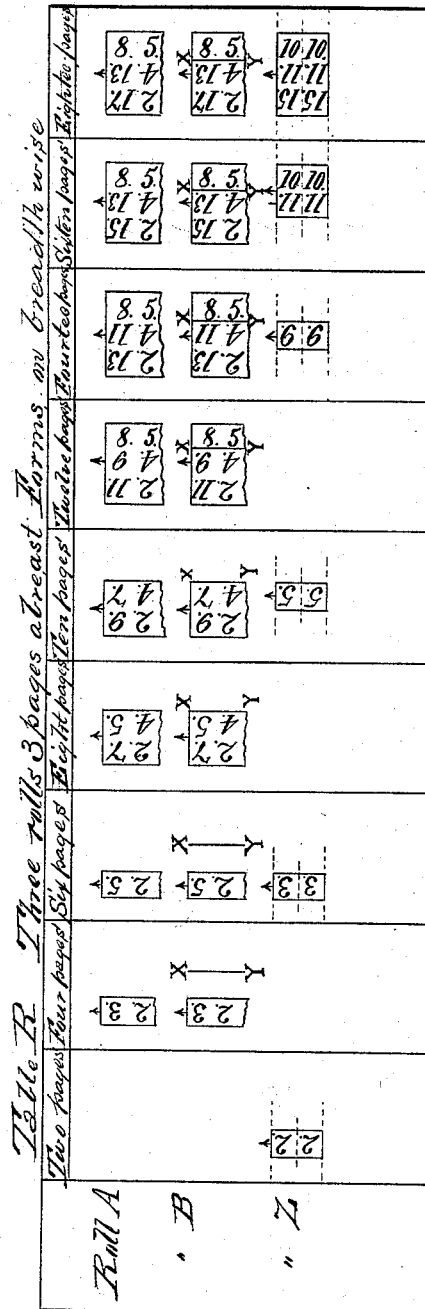
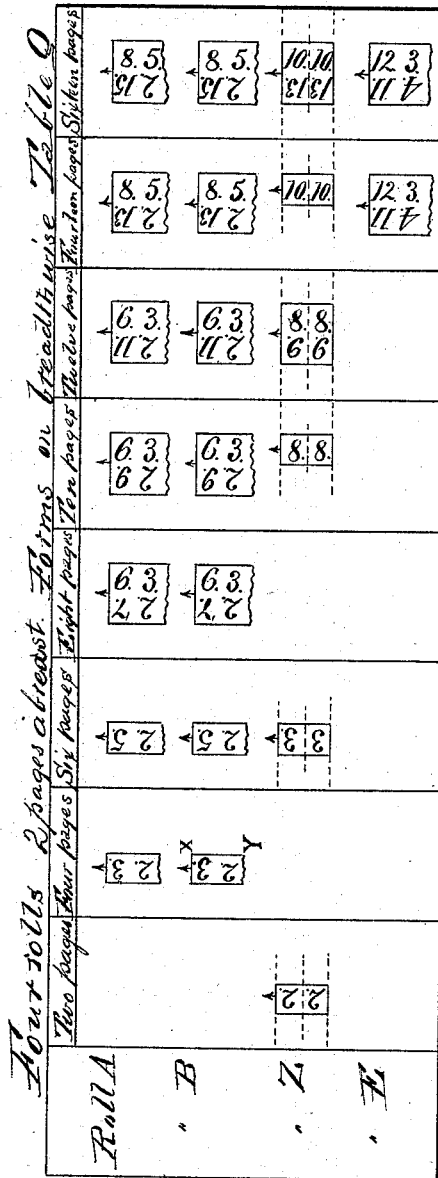
8 Sheets—Sheet 5.

E. ANTHONY & J. E. HARVEY.

PRINTING MACHINE.

No. 263,748.

Patented Sept. 5. 1882.



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8 Sheets—Sheet 6.

PRINTING MACHINE.

No. 263,748.

Patented Sept. 5, 1882.

Table A' Four rolls 2 pages abreast—Forms on Tenothwise.									
	Two pages	Four pages	Six pages	Eight pages	Ten pages	Twelve pages	Fourteen pages	Sixteen pages	
Roll A	$\begin{matrix} \uparrow x \\ 2 \\ 1 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 3 \\ 4 \\ 1 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 5 \\ 2 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 7 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 9 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 11 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 13 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 15 \\ 10 \\ 7 \end{matrix}$	
"				$\begin{matrix} \uparrow \\ 2 \\ 7 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 9 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 11 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 13 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 15 \\ 10 \\ 7 \end{matrix}$	
"			$\begin{matrix} \uparrow \\ 3 \\ 3 \end{matrix}$						
"									

Three rolls 3 pages abreast—Forms on Lengthwise Table R'								
	Two pages	Four pages	Six pages	Eight pages	Ten pages	Twelve pages	Fourteen pages	Sixteen pages
Roll A	$\begin{matrix} \uparrow \\ 2 \\ 2 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 3 \\ 2 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 5 \\ 2 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 7 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 9 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 11 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 13 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 15 \\ 10 \\ 7 \end{matrix}$
"	$\begin{matrix} \uparrow \\ 2 \\ 2 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 3 \\ 2 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 7 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 9 \\ 6 \\ 3 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 11 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 13 \\ 8 \\ 5 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 15 \\ 10 \\ 7 \end{matrix}$	$\begin{matrix} \uparrow \\ 2 \\ 17 \\ 8 \\ 5 \end{matrix}$
"								

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E. ANTHONY & J. E. HARVEY.

8 Sheets—Sheet 7.

PRINTING MACHINE.

No. 263,748.

Patented Sept. 5, 1882.

Table S' Four rolls.

Two pages	Four pages	Six pages	Eight pages	Ten pages	Twelve pages	Fourteen pages	Sixteen pages
<i>Roll A</i>	2 2 6 11 14 3	2 3 6 13 16 3	2 5 6 15 18 5	2 7 6 3 6 17 20 5	2 9 6 3 6 19 22 7	2 11 8 5 6 21 24 7	2 13 6 23 26 7
<i>" B</i>	2 2 6 11 14 3	2 3 6 13 16 3	2 5 6 15 18 5	2 7 6 3 6 17 20 5	2 9 6 3 6 19 22 7	2 11 8 5 6 21 24 7	2 13 6 23 26 7
<i>" C</i>	2 2 6 11 14 3	2 3 6 13 16 3	2 5 6 15 18 5	2 7 6 3 6 17 20 5	2 9 6 3 6 19 22 7	2 11 8 5 6 21 24 7	2 13 6 23 26 7
<i>" D</i>	2 2 6 11 14 3	2 3 6 13 16 3	2 5 6 15 18 5	2 7 6 3 6 17 20 5	2 9 6 3 6 19 22 7	2 11 8 5 6 21 24 7	2 13 6 23 26 7

Four pages at breast turns lengthwise.

Eighteen pages	Twenty pages	Twenty-two pages	Twenty-four pages	Twenty-six pages	Twenty-eight pages	Thirty pages	Thirty-two pages
2 7 10 7 6 11 14 3	2 9 12 9 6 13 16 3	2 11 12 9 6 15 18 5	2 13 14 11 6 17 20 5	2 15 14 11 6 19 22 7	2 17 16 13 6 21 24 7	2 19 16 13 6 23 26 7	2 21 18 15 6 25 28 9
2 7 10 7 6 11 14 3	2 9 12 9 6 13 16 3	2 11 12 9 6 15 18 5	2 13 14 11 6 17 20 5	2 15 14 11 6 19 22 7	2 17 16 13 6 21 24 7	2 19 16 13 6 23 26 7	2 21 18 15 6 25 28 9
2 7 10 7 6 11 14 3	2 9 12 9 6 13 16 3	2 11 12 9 6 15 18 5	2 13 14 11 6 17 20 5	2 15 14 11 6 19 22 7	2 17 16 13 6 21 24 7	2 19 16 13 6 23 26 7	2 21 18 15 6 25 28 9
2 7 10 7 6 11 14 3	2 9 12 9 6 13 16 3	2 11 12 9 6 15 18 5	2 13 14 11 6 17 20 5	2 15 14 11 6 19 22 7	2 17 16 13 6 21 24 7	2 19 16 13 6 23 26 7	2 21 18 15 6 25 28 9
2 7 10 7 6 11 14 3	2 9 12 9 6 13 16 3	2 11 12 9 6 15 18 5	2 13 14 11 6 17 20 5	2 15 14 11 6 19 22 7	2 17 16 13 6 21 24 7	2 19 16 13 6 23 26 7	2 21 18 15 6 25 28 9
2 7 10 7 6 11 14 3	2 9 12 9 6 13 16 3	2 11 12 9 6 15 18 5	2 13 14 11 6 17 20 5	2 15 14 11 6 19 22 7	2 17 16 13 6 21 24 7	2 19 16 13 6 23 26 7	2 21 18 15 6 25 28 9
2 7 10 7 6 11 14 3	2 9 12 9 6 13 16 3	2 11 12 9 6 15 18 5	2 13 14 11 6 17 20 5	2 15 14 11 6 19 22 7	2 17 16 13 6 21 24 7	2 19 16 13 6 23 26 7	2 21 18 15 6 25 28 9

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PRINTING MACHINE.

No. 263,748.

Patented Sept. 5, 1882.

[illegible][illegible]

WITNESSES:

WITNESSES:
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INVENTORS:

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UNITED STATES PATENT OFFICE.

EDWYN ANTHONY AND JACOB E. HARVEY, OF NEW YORK, N. Y.

PRINTING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 263,748, dated September 5, 1882.

Application filed May 16, 1882. (No model.)

To all whom it may concern:

Be it known that we, EDWYN ANTHONY and JACOB EDWARD HARVEY, subjects of the Queen of Great Britain, residing at the city of New York, in the county and State of New York, have invented a new and useful Improvement in Printing-Machines, of which the following is a specification.

Our invention relates to printing by means of the same machine and from two, three, four, or more rolls papers of various numbers of pages; and it consists in associating the rolls together (in the way hereinafter described) after they have been printed on both sides.

Figures 1, 2, 5, and 6 show the relative positions of the various sorts of webs in the cases to which they refer. Fig. 3 gives a general view of our invention for the case of four webs, (Fig. 25 showing a modification of a portion of the said mechanism.) Fig. 4 shows the device for reversing the web B. Figs. 7 to 13, 16 to 18, and 22 to 24 exhibit various stages in the process of combining webs together in accordance with our invention. Figs. 14, 15, and 19 show devices for reversing webs after they have been associated together. Fig. 20 shows the number of webs, their breadth, &c., when the limit of the printing mechanism is an L-breadth web, and papers from one to sixty-four pages are required to be printed, (the particular case shown is a sixty-two-page paper.) Fig. 21 gives similar details in a case where the limit is a thirty-page paper, and the tables Q R S Q' R' S' give the number of webs, their breadth, manner of printing, &c., in the cases to which they refer.

In order to apply the invention, the webs must have impressions on them and issue forth in the manner hereinafter specified; but provided they are so printed and do so issue the means whereby the result is accomplished is immaterial. When two rolls (call them A and B) are used they must both have the same matter printed on them, while the matter printed on one side of a web must be different from that printed on the other side. The webs must issue with the same pages uppermost on each. Any line drawn on one of the webs perpendicular to its edges must be parallel to any line similarly drawn on the other, and (when the webs are the widest the printing mechanism will print) their edges must lie in the same

pair of parallel planes. When three rolls are used two of them must issue as just described, and the third (call it Z) must have different matter printed on its two sides, such matter being different from that printed on the other two rolls, A and B. It must have imprinted on it (when the roll is the same breadth as the other two rolls) just half as many different pages as the other two rolls have on them, and a proportionate number when its breadth is greater or less than that of A or B. (This is fully illustrated by the tables Q R S Q' R' S'.) Its edges must travel in the same pair of parallel planes (or in planes parallel thereto) as do the edges of the other two webs. When four rolls are employed (and the limit of the breadth of the rolls is an even number of pages across) three must be as just described, and the fourth (call it E) must have on it different matter from what is on the other rolls, but the same matter on both sides of it, and the number of different pages printed on either side of it must equal the number of different pages printed on either side of A or B. It must likewise travel with its edges in the same pair of parallel planes in which the edges of A and B lie. For numbers of rolls greater than four, (the limit of their breadths being still an even number of pages,) the arrangement depends upon whether the number is odd or even.

Fig. 1 illustrates the employment of any even number, and Fig. 2 that of any odd number of rolls. In Fig. 1, A B Z E are as before described. On one side of E run any number of rolls, 1, 2, 3, &c., and on the other side the same number of corresponding rolls, 1', 2', 3', &c. Different matter must be printed on the two sides of every one of these additional rolls, and the number of pages printed on any one side must be the same as the number printed on a side of the roll A or B. Every pair of corresponding rolls, 1, 1', 2, 2', &c., must have the same matter printed on them in precisely the same way; but one must be turned one way up and the other the other, so that the under side of 1 will be the same as the upper side of 1', and vice versa, &c. All the rolls must be traveling between the same pair of parallel planes that A and B do. Fig. 2 (odd number of rolls) is the same as Fig. 1, except that a roll like E is not used.

When the printing mechanism prints at its

fullest capacity an odd number of pages abreast, then, if more than three rolls are used, it must be done as follows: The rolls A B Z being as before, all the additional rolls must be passed, with Z, between the cutting-cylinders $L_1 L_2$, hereinafter referred to, (see Fig. 3,) and follow the same course with it. Moreover, each of these additional rolls must issue from the printing mechanism printed in a similar way to the roll Z—that is to say, different matter must be printed on each side, such matter for each roll differing from that printed on any of the other rolls—and the number of different pages imprinted on any roll (when it is of the same breadth as the rolls A or B, and a proportionate number when its breadth is greater or less than that of A or B) must be just half as many as there are imprinted on the roll A or B.

The treatment of the rolls is partially identical in all cases; but it in a measure depends on the number of pages abreast which the printing mechanism is capable of printing, and also on whether the forms are placed lengthwise or breadthwise on the form-bearing cylinders. Tables Q, R, and S refer to the case of the forms on breadthwise, and tables Q', R', and S' to the forms on lengthwise.

In tables Q and Q' the printing mechanism is supposed capable of printing four rolls in the manner hereinbefore specified, each roll having two pages abreast, or one page only printed on it. Tables R and R' are for three rolls, with three pages abreast or less on each. Tables S and S' are for four rolls, with four pages abreast, or less, on each. The tables exhibit the number of rolls to be employed, the breadth of each, their relative positions, and the way in which the pages must be imprinted on them, for printing a paper of any number of pages from two up to the largest number that can be printed with the rolls, and limits of their breadths specified. For example, tables S S' are for any paper from two up to thirty-two pages, inclusive.

When the diagram of a roll is omitted it means that that roll is not used in printing the particular paper in question. For example, for a thirty-page paper (tables S S') we must use three full-breadth rolls, A, B, and E, and one three-quarter-breadth roll, Z, which must issue so that one of its edges lies in the same plane with one of the edges of the other rolls. Again, for a fourteen-page paper we must use two three-quarter-breadth rolls, A and B, and one quarter-breadth roll, Z, with its edges lying as there shown. The roll E is not used. (When we speak of a roll of a fractional breadth we mean a roll whose breadth is that fraction of the widest roll that the mechanism will print.)

It will be observed that we often have alternative ways of using rolls for printing any particular paper. Thus, if we have mechanism for printing four rolls with pages four abreast on each, we can print an eighteen-page paper, as shown

in table S, or as shown in table R; a sixteen-page paper, as shown in tables Q, R, or S, &c. Of course the number of the rolls and their respective breadths will be decided by the particular papers which any machine is required to print. The first treatment of the rolls is independent of their number, of their breadths, and of the lengthwise or breadthwise position of the forms. Take, therefore, any number of webs coming out, as shown in Fig. 1 or in Fig. 2. And now, referring to Fig. 3, and leaving out of view the printing part of the said figure, consider its left-hand portion, $L_1 L_2$, are a suitable pair of cutting-cylinders; $a_1 a_2, b_1 b_2, c_1 c_2$, &c., pairs of rollers. Tapes go round the rollers $a_1 b_1$ and $a_2 b_2$. The rollers $b_1 b_2$ oscillate in the arc of a circle, (whose center lies in the common tangent of the rollers $a_1 a_2$.) so that they deliver a sheet alternately between the rollers $c_1 c_2$ and between $d_1 d_2$. The rollers $c_1 c_2$ and $d_1 d_2$ touch a circle whose center is coincident with that of the circle just mentioned. Any other suitable device—such as a switch or switches, may be used instead of the oscillating rollers. All that is necessary is that the stream of sheets issuing from between a_1 and a_2 shall be divided into two streams, and this object can easily be accomplished, as is well known, in more ways than one. Tapes pass round the rollers b and c , and also round g_3 and c_2 .

In any convenient position is placed an apparatus, such as is hereinafter described. It is fixed so that a full-breadth web, after passing through it, will be opposite to the position it had before entering, but with its sides reversed. Fig. 4 illustrates a web passing through such an apparatus. Reverting to Fig. 3, tapes starting, say, from r pass round the roller d and next round any suitably-placed roller or rollers, y , thence from g the said tapes are passed through the aforesaid apparatus. Afterward (descending therefrom to g_2) they pass round the roller g_1 . The ends $r_2 r_1$ are now run together by skew-pulleys, or in any other suitable way. Similarly, tapes starting from t pass round d_2 , thence round y upward from s_1 through the aforesaid apparatus, and descend therefrom to s_2 , next round g_2 , and finally their ends $t_2 t_1$ are run together by skew-pulleys, or in any other suitable way. The roller f rotates in the same direction as the roller l . A guard, as shown in the figure, enters grooves in the rollers $g_2 f$. Its function is to prevent the sheets or web (while passing from $c_1 c_2$ to $g_1 g_3$) from coming against the roller g_2 , whose motion is in the contrary direction.

The use of fixed cylinders for deflecting the path of a web is shown in Rose's British specification, No. 12,715, of the year 1849, and methods of reversing a web so as to bring the under side uppermost are given in Sandeman's British specification, No. 3,319, year 1870; but perhaps it may be proper to more fully explain the aforesaid apparatus, which is adopted from

between the rollers g_1 and g_3 must be considered separately for each way of placing the forms on the cylinders.

Forms on Lengthwise.

5 In the three tables Q' R' S' the webs may be taken direct from g_1 g_3 to a pair of cutting-cylinders, N_1 N_2 , which must sever the webs transversely along lines whose distance from
10 one another equals the length of a page.

Table Q'.—Consider, for example, the case of a fourteen-page paper. The webs will issue from between N_1 and N_2 , Fig. 3, on one another, as shown in Fig. 7, and having been cut transversely along the lines A G, E B, C D, &c., then the A B's must go to one folding mechanism and the E D's to another, or the E D's may be passed through a reversing apparatus such as shown in Fig. 4, and then (both being
15 now the same way up) they may be conveyed to the same folding mechanism, it being such as to be capable of folding a continuous stream of sheets.

Table R'.—Consider, for example, the case of
25 a sixteen-page paper. Here the webs must be severed longitudinally as well as transversely, so that they will issue from between N_1 and N_2 on one another, as shown in Fig. 8, and having been cut longitudinally along the line
30 E F and transversely along the lines A G, C D, H B, &c., then the portions C B must be brought in any suitable way onto the portions A D. They will then be as shown in Fig. 9, and may be conducted to a folding mechanism capable of folding the stream C
35 E in one direction and the stream L B in the other; or, the stream L B may be passed through a reverser, such as Fig. 4, and then, both streams being now the same way up,
40 they may be passed to a mechanism capable of folding two such streams.

Table S'.—Consider, as an example, the case of a twenty-six-page paper. This case is illustrated by the Figs. 10 and 11, and the same
45 remarks apply to these figures as those which we have just made with reference to the Figs. 8 and 9.

Forms on Breadthwise.

50 Table Q.—Consider, for example, the case of a ten-page paper. The webs may be taken direct from the rollers g_1 and g_3 , Fig. 3, to mechanism which shall sever them longitudinally along the line B D and transversely along the
55 lines A C, E F, &c., as indicated in Fig. 12. Thence they must be conducted to a folding mechanism which will fold the A B's in one direction and the D F's in the other; or the D F's may be first reversed by Fig. 4, as described above.

60 Table R.—Take, for example, the case of a fourteen-page paper. The webs, after passing between g_1 and g_3 , must be severed longitudinally along the lines A B, C D, E F, Fig. 13.
65 Then they must be conducted to and be passed through a reverser such as is sketched in Figs. 14 and 15. They will issue from the said re-

verser as shown in Fig. 16, the C F's being on the top of the G B's, but the reverse way up, and the E H's being underneath the A D's, 70 with the reverse side uppermost. The webs must now be cut transversely along the lines G C, K D, &c., Fig. 16, and be afterward conveyed to a suitable folding mechanism.

Table S.—Consider, as an example, the case 75 of a thirty-page paper. This case is illustrated by the Figs. 17 and 18, and similar remarks apply to these figures as were made above with reference to Figs. 13 and 16.

We will now describe more fully the reverser 80 sketched in Figs. 14 and 15. Referring to Fig. 19, A D B is a triangular plane of any suitable material. The angle D is a right angle and the angle D B A any convenient angle less than forty-five degrees. A B C G E A is a 85 pentagon-shaped plane made of any suitable material. The angles at C and E are equal to any convenient angle less than forty-five degrees. The lines B D, C G, and E A are parallel when the figures are in one plane and situated as shown in Fig. 19, and G C is drawn
90 so as to pass through Y, the middle point of D A. The breadth of D A, the length of B F, &c., depend upon the breadth of the web, the angle D B A, and the angles C and E. As an 95 example, take each of the three last-mentioned angles equal to thirty degrees. Then take D A one-half broader than half the full breadth of the web—i. e., one-half broader than Q R, Fig. 15. Then make the angle A B C equal to 100 one hundred and twenty degrees, and take the length B F equal to the breadth Q R, Fig. 15. The edge B A of the piece D B A and the edges B C and G E of the pentagon-shaped piece must be rounded, so as to prevent their having 105 a tendency to tear the webs when passing over them. The edge C G does not come in contact with the web. It is better that it should take a position such as is shown by the dotted line L N rather than that shown by the line G 110 C and that B C should be continued to the point L. By this means the portion of the web which passes over the edge G E will have free scope to pass, if it happen to go a little below the point G, and the portion of the web 115 which passes over B C will be supported if it pass beyond the point C.

The planes of the pieces A D B and A B C G E A must be inclined to one another at an angle equal to seventy degrees thirty-two minutes, approximately. The edge B A of the one piece and the edge B A of the other should be placed parallel and close together, but with a space between them just sufficient to allow the web to pass freely. The breadths a b are passed 125 through the reverser, as illustrated by Figs. 14 and 15, P being the middle point of B A, Fig. 19. The breadth a passes over the edge A B of the piece A D B, and thence over the edge N E of the other piece, issuing therefrom, shifted transversely from its course by two such breadths as the breadth a , but so that the lines taken perpendicularly across its breadth are parallel to lines similarly drawn across the web 130

one described in Sandeman's aforesaid specification. A K C and F E D, Fig. 4, are triangular-shaped frames, made of any suitable material. They are equal in all respects. The angles at K and E are right angles, and those at C and F are equal to any convenient angle less than forty-five degrees. Taking, for example, each of the angles at C and F to be one of thirty degrees, then, first, the planes of the triangles must be inclined to one another at an angle of one hundred and nine degrees and twenty-eight minutes approximately; second, the edges A C and F D must be placed so as to be parallel to one another with any convenient distance between them, and so that the plane drawn through K C perpendicular to the plane of the web before it enters the apparatus may pass through the point D; third, the rollers L and G must be fixed so that L touches the edge D F, produced of the triangle F E D, and G the edge A C, produced of the triangle A K C. The axis of G must be inclined at an angle of fifty-four degrees and forty-four minutes approximately to K C, at an angle of sixty degrees to A C, and the axis of L must be parallel to that of G. The rollers L and G should be placed at a sufficient distance apart to admit of other webs, &c., passing freely through one or other of the open spaces A G L and D L G. Thus, reverting to Fig. 3, the web A, the set of tapes from g_3 to c_2 , the set from e to c_1 , and the web E will all pass through one of the said spaces A G L, D L G.

The edges A C and F D should be somewhat rounded, so as not to have a tendency to tear the web while passing over them. The web should be passed over the triangle A K C so that its central line shall pass over the middle point, P, of the side A C. The course of the webs to their arrival at the rollers g_1, g_3 (see Fig. 3) can now be traced. The web A passes between the rollers c_1, c_2 , and thence between the rollers g_1, g_3 . The web B passes between the rollers d_1, d_2 , thence round y and other suitable rollers, and next through an apparatus—such as Fig. 4—which is to be fixed as previously directed. The web will issue therefrom, as before remarked, opposite to its position before entering, but with sides reversed. It is then conveyed by suitable rollers to g_1, g_2 , and thence passes between g_1 and g_3 . The web Z (and when they are used the additional webs hereinbefore referred to as following the same course with it) passes between the cutting-cylinders L_1, L_2 , which sever it transversely. (The dotted lines in the tables Q R S, Q' R' S' show where these severances are to be made.) After it has been severed the oscillating rollers b_1, b_2 convey alternate sheets between the rollers c_1, c_2 and between the rollers d_1, d_2 .

The oscillation of the rollers b_1, b_2 may complete the severance of the sheets, if, as is usual, they have not been completely severed by the cutting-cylinders. Thus part of the web Z passes onto the top of the web A and passes with it between the rollers g_1 and g_3 , and the other part of the web Z passes onto the top of

the web B, is reversed with it, and ultimately passes with it between g_1 and g_3 . The web E passes round the roller f , and thence between the rollers g_1 and g_3 . When the webs 1 2 3, &c., and their correspondents, 1' 2' 3', &c., are used they also must pass between g_1 and g_3 , the one set on the one side of E and the other set on the other side. Thus all the webs pass between g_1 and g_3 , none of them having necessarily been cut either longitudinally or transversely, except Z, which, as before remarked, is severed transversely by L_1 and L_2 along the dotted lines indicated in the tables Q R S, Q' R' S'.

By a slight modification of the above-described mechanism and a different arrangement of the pages the web Z may be associated with A and B as follows: The web Z is cut transversely, as before, and alternate parts brought onto A; but the other alternate parts are reversed (by a reverser which will reverse without transferring a full-breath web) and afterward brought onto the web B, the said web B being reversed, as previously described, but before instead of after its association with the said parts of Z. This plan is more complicated than that previously and more fully explained. We mention it only to satisfy the rule that an inventor should disclose all he knows.

It should be noticed that the relative distances of travel of the webs A and B, when the forms are on lengthwise, should be such as to bring the webs out in the way indicated by Fig. 5, and when they are on breadthwise in the way indicated by Fig. 6.

We should also observe that the central line spoken of with reference to Fig. 4 means (in the case of an even number of pages being the limit of the capacity of the printing mechanism) the central line of the widest web that can be printed. The tables Q, R, S, &c., illustrate this point. Thus, for example, in table Q, (four-page case,) table S, (twelve-page case,) table Q', (two-page case,) and table S' (fourteen-page case) $x y$ is the line of the web which must pass over the point P, Fig. 4, and similarly for the other cases. Thus it is only when a full-breadth web is used that the edges of the web will, after leaving the apparatus, be opposite the positions they had before entering it. When the limit of the printing mechanism is three pages abreast the line of the web, which passes over the point P, must be not the central line of the widest web that can be printed, but the line indicated by $x y$ in the tables R and R'. Thus when a web the full three breadths is used it will come out shifted transversely by one-third of its breadth. Similarly, whenever the limit of the printing mechanism is any odd number of pages abreast the line which passes over the point P must be not the central line of the widest web that can be printed, but a line situated at a distance therefrom equal to half the breadth of a page measured across the web.

The course of the webs after they issue from

before it entered the reverser. The breadth b passes over the same edge A B, and thence over the edge B L, and issues therefrom, shifted transversely from its course by the same space that a was, and, as before, with the lines across it parallel to their former positions. The breadths c d do not pass through the reverser c , being conducted by suitable roller or rollers over the apparatus to meet the breadth a , and d being conducted under the apparatus to meet the breadth b . Thus the breadths b and d are brought onto one another, and similarly the breadths a and c , a being on the contrary side of c to that which b is of d .

Whatever the number of rolls, (provided the number of pages abreast on each roll is not greater than four,) the mechanism for treating them after they have been printed on both sides will be precisely the same as that hereinbefore described for three and four rolls. For example, eight rolls with four pages abreast as the limit will print any paper from two to sixty-four pages, inclusive. Thus Fig. 20 exhibits the arrangement of the rolls when printing a sixty-two page paper, (forms on breadthwise,) and their treatment will be exactly the same as that hereinbefore described with reference to table S.

When the number of pages abreast is more than four, then, whatever the number of the rolls, the treatment until they have passed between the rollers g_1 and g_3 , Fig. 3, will be exactly as previously described. The after treatment will be very similar, the transverse cutting remaining the same, and the variations being as follows:

Forms on breadthwise.—The longitudinal cutting will be as before—*i. e.*, the webs must be severed into one-page breadths—but the reverser (as described by Figs. 14, 15, and 19) must have three or more edges, like B L and N E, instead of two only, their number being such that all the breadths except two are brought onto the said two breadths. They can then go to the folding mechanism, as before.

Forms on lengthwise.—The webs must be severed longitudinally along more than one line. Then they must be brought by a reverser—such as illustrated by Figs. 14, 15, and 19, or its extension, just described—so that all the strips are running, as shown in Figs. 8 and 10. Then the remainder of the treatment will be as previously described. For example, a printing mechanism capable of printing three rolls five pages abreast would print any paper from two to thirty pages, inclusive. Fig. 21 shows the arrangement of the rolls for a twenty-eight-page paper. Treating them in the manner previously described they will issue from between the rollers g_1 and g_3 , Fig. 3, as shown in Fig. 22. Then (having cut the rolls longitudinally along the dotted lines, Fig. 22) let the breadth d by a reverser similar to Fig. 19 be shifted onto f and the double breadth b a shifted underneath c b , and so that a comes, with its reverse side uppermost, underneath c ,

and b with its reverse side uppermost, but without having been transversely shifted. The webs will then be running as in Fig. 23. They must then be severed transversely along the lines A B, C D, E F, &c., and then the C F's brought onto the A D's in any suitable way. The webs will then be traveling as in Fig. 24, and may be conducted to any suitable folding mechanism.

In all the preceding we have supposed that it is required to be able to print at pleasure any number of pages from one up to the maximum number that the mechanism under consideration will print, (since an odd-paged paper may always be regarded as an even-paged paper, of which one or some other odd number of pages are blank, it was unnecessary to consider odd numbers of pages.) When, however, only numbers of pages which are even multiples of two are required to be printed then the result can always be attained without the use of a roll—such as Z; but when Z is dispensed with the printing mechanism must be able to print at its fullest capacity an even number of pages abreast. With this fact in mind, and using any or all of the rolls A B E, 1 1', 2 2', &c., (according to the particular case in view,) and treating them in the manner hereinbefore described, any paper whose pages are even multiples of two—*i. e.*, 4, 8, 12, 16, 20, &c., paged papers—can be produced without the use of the roll Z and corresponding mechanism.

As to mechanism for printing the rolls.—Referring to Fig. 3, P P are form-bearing cylinders, the forms on the one being duplicates of those on the other. C is another form-bearing cylinder. H is the impression-cylinder for the cylinders P P, and D D, &c., are the impression-cylinders for C. The course of the webs A and B can be plainly seen from the figure, and no further explanation is needed, as we do not herein claim this manner of printing on two rolls. It is obvious that the webs A and B will issue in the way hereinbefore stated to be necessary for employing the first part of our invention. The web C is printed on by the form-bearing cylinders Z_1 and Z_2 . Different forms—*i. e.*, forms containing different matter—must be placed on each of them, and the number of different pages on each cylinder must be (when Z is a full breadth web) one half of the number of different pages that there are on the cylinder C. The roll E is printed by the cylinders E_1 E_2 . The forms on E_1 must be the duplicates of those on E_2 , and the number of different pages on each cylinder must be the same as the number of different pages on the cylinder C.

The form-bearing cylinders E_1 E_2 Z_1 Z_2 , &c., may be larger than here drawn, their circumferences being any multiples of the arcs occupied by the forms and impression-cylinders being placed around each cylinder, corresponding in number to the said multiple. We have made the two impression-cylinders K_1 and K_2 do duty for four form-bearing cylinders. This,

however, is a detail, and, instead, four impression-cylinders may be employed, in the usual way. As drawn, the web Z may cause a set-off onto the web E at the time they both pass between Z_2 and K_2 , a drawback which may be avoided by taking the web Z in the manner shown in Fig. 25. The course of the webs in Fig. 3 is easily traced. The web Z is conveyed round K_1 and receives an impression on one side between K_1 and Z_1 . It then passes on between K_2 and Z_2 and receives its second impression. The web E receives its first impression between E_1 and K_1 . It then passes round K_2 and receives its second impression between K_2 and E_2 .

In the case of the limit of the printing mechanism being an even number of pages across the web, then when five rolls or any larger odd number of rolls are used the roll E is not required. The pair of added rolls $1_1 1'_1$, Fig. 2, may be printed by mechanism precisely similar to that which prints the rolls A and B. After they have thus been printed on both sides one web—say No. 1—may be taken direct to and round the roller f . The other one, $1'_1$, must first be taken through a reverser—such as shown in Fig. 4—and thence to and round the said roller f . Any number of pairs of additional rolls may be thus printed, their positions relatively to $A_1 B_1 Z_1$ and to each other being indicated by Fig. 2. When the number of rolls is even E is used, and the positions of the pairs of added rolls (relatively to $A_1 B_1 E_1 Z_1$ and to one another) are indicated by Fig. 1.

As previously observed, when the number of pages across is odd, then, whether the number of rolls be odd or even, all the added rolls must be similar to Z_1 and be distributed with it alternately to the roll A and to the roll B.

What we herein claim as our invention is—

1. The combination of a mechanism for printing a plurality of webs (so that matter shall be imprinted on each web in the way hereinbefore described) with mechanism for reversing without transferring one of the said webs, and mechanism for bringing together the said reversed web and the other web or webs, whereby the webs become one product and may be operated on together in the subsequent folding processes, all substantially as described.

2. The combination of mechanism for printing a plurality of webs (so that matter shall be imprinted on each web in the way hereinbefore described) with mechanism which cuts the webs, mechanism which associates transversely-severed portions of one web alternately with one and the other of two of the other webs, mechanism for reversing one of the last-mentioned webs and its associated part, and mechanism for bringing together the reversed web (with the respective associated parts of the said severed web) and the other web or webs, all substantially as described.

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