4 Sheets—Sheet 1.

E. L. FORD.

DUPLEX PRINTING-MACHINE AND FOLDING APPARATUS COMBINED.

No. 195,115. Patented Sept. 11, 1877.

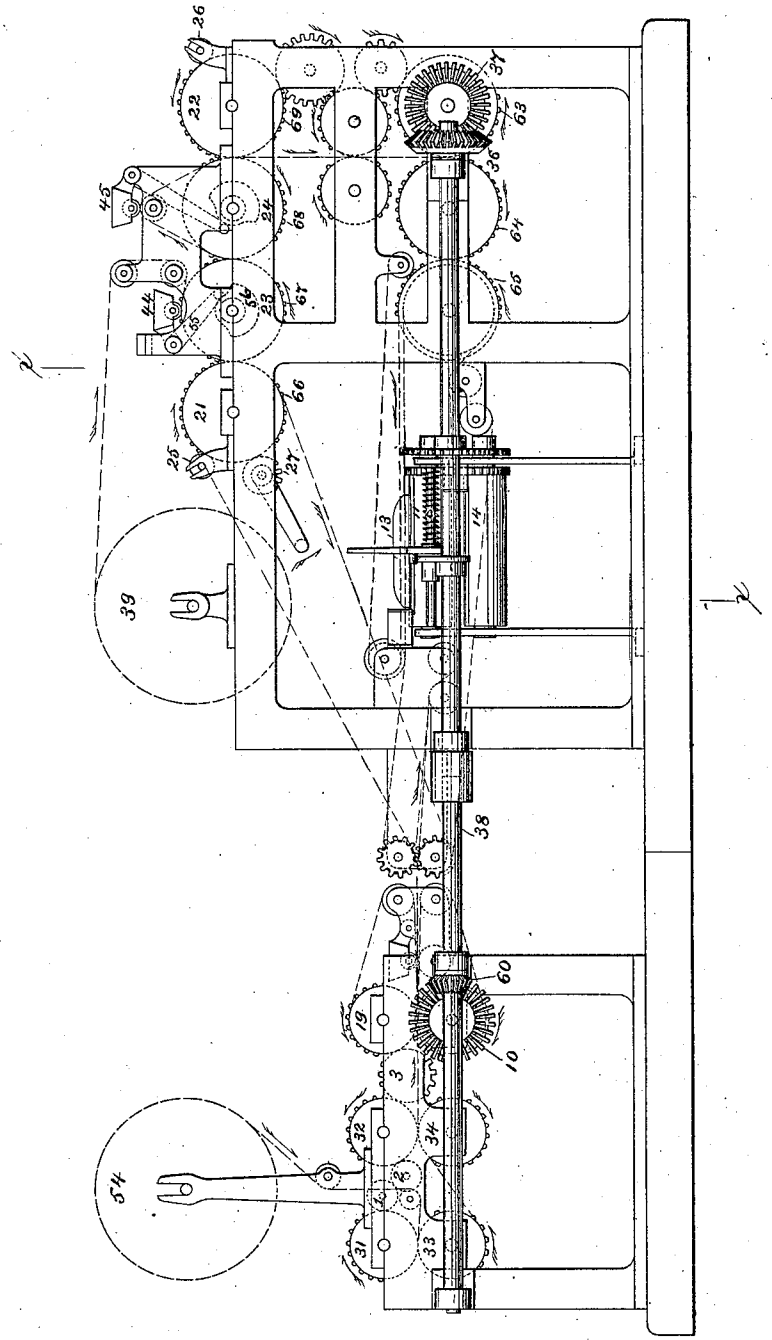


Fig. 1

Witnesses
L. H. Todd
N. J. Munson

Inventor
Edward Lloyd Ford,
By Munson & Philipp
Atty's.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

4 Sheets—Sheet 2.

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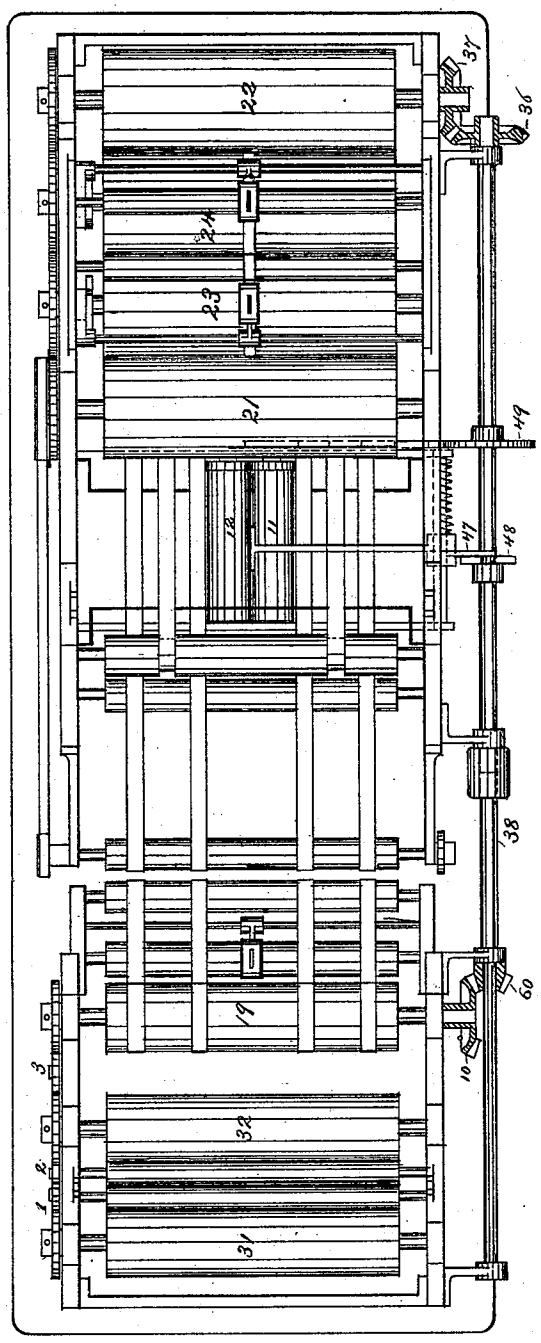


Fig. 2.

Witnesses:

L. H. Todd.

N. S. Munson

Inventor:

Edward Lloyd Ford,

by Munson & Philipp,

Atty's.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

4 Sheets—Sheet 3.

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Fig. 9.

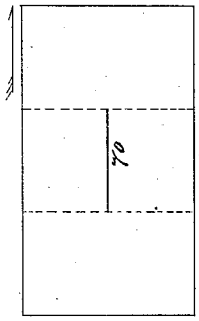


Fig. 11.

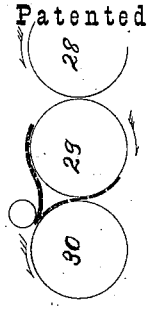


Fig. 13.

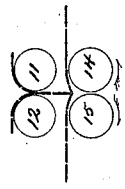


Fig. 8.

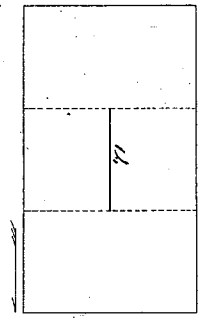


Fig. 10.

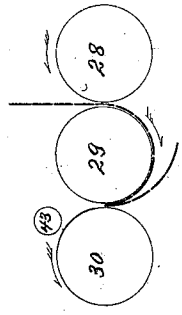


Fig. 12.

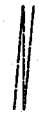


Fig. 7.

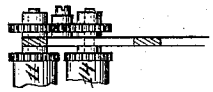
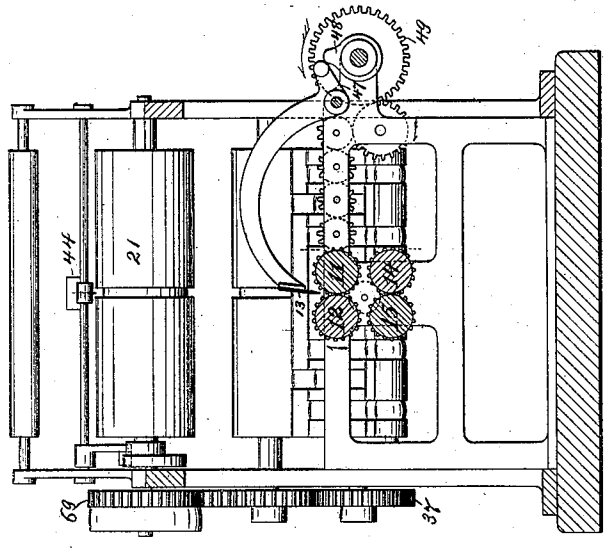


Fig. 3.



Witnesses:

L. H. Todd.

N. J. Munson

Inventor.

Edward Lloyd Ford,

by Munson & Philipp,

Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

4 Sheets—Sheet 4.

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DUPLEX PRINTING-MACHINE AND FOLDING APPARATUS COMBINED.

No. 195,115. Patented Sept. 11, 1877.

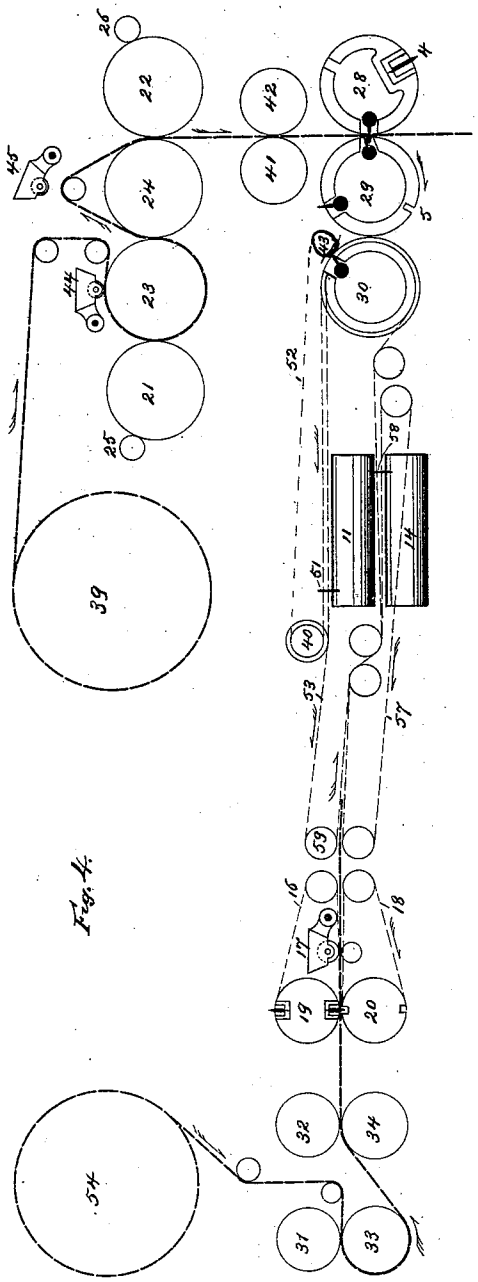


Fig. 4.

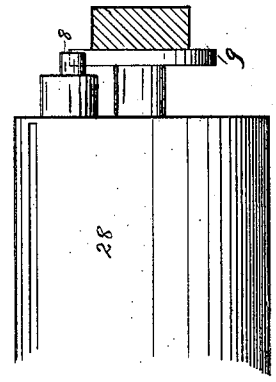


Fig. 6.

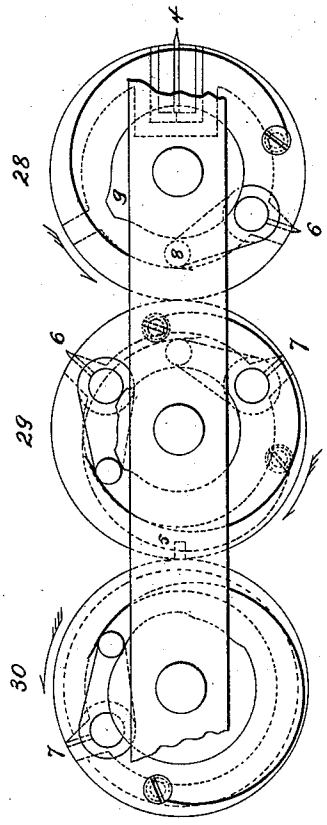


Fig. 5.

Witnesses:

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N. S. Munson.

Inventor:

Edward Lloyd Ford,

by Munson & Philipp

Attys.

N. PETERS, PHOTO-LITHOGRAPHER, WASHINGTON, D. C.

UNITED STATES PATENT OFFICE.

EDWARD L. FORD, OF NEW YORK, N. Y., ASSIGNOR TO R. HOE & CO., OF SAME PLACE.

IMPROVEMENT IN DUPLEX PRINTING-MACHINES AND FOLDING APPARATUS COMBINED.

Specification forming part of Letters Patent No. 195,115, dated September 11, 1877; application filed July 9, 1877.

To all whom it may concern:

Be it known that I, EDWARD L. FORD, of the city, county, and State of New York, have invented an Improvement in Duplex Printing-Machine and Folding Apparatus Combined, of which the following is a specification:

This invention consists in the combination of mechanisms which produce two or more perfected printed sheets, associate the same together, and simultaneously fold and deliver them as one product.

It also consists in the combination of multiplex printing mechanisms and a folding mechanism, whereby the products of said printing mechanisms are brought together and folded one within the other to form a book or book-like package.

It also comprises a method of operation and various auxiliary devices, all of which are too particularly hereinafter pointed out to need preliminary description here.

An apparatus embodying one form of the invention is fully illustrated in the accompanying drawings, and will now be particularly described.

In said drawings, Figure 1 represents a side elevation; Fig. 2, a plan view; Fig. 3, a cross-section taken on line *x x* of Fig. 1; Fig. 4, a longitudinal section; Figs. 5 and 6, details of the rotary cutting and folding mechanism; Fig. 7, a side view of the gearing connecting the last folding-rollers; Figs. 8 and 9, obverse and reverse sides of the pasted sheet; Figs. 10, 11, and 13, diagrams showing the modes of folding; and Fig. 12, a section of a folded sheet.

The embodiment of this invention herein illustrated shows two printing mechanisms, which are of the well-known construction of web-perfecting machines, printing webs of paper of the same width.

One of said machines consists of type-cylinders 21 22 and impression-cylinders 23 24, which are arranged in a horizontal plane and suitably journaled in operative contact in the frame-work. The type-cylinders are each furnished with inking apparatuses of a well-known construction, of which one each of the form-inking rollers is shown, the same being marked 25 26. These type and impression cylinders are geared together by toothed wheels 66 67 68 69, so as to run with uniform surface speed, and are driven by a pinion, 27, on a driving-shaft.

Below the said cylinders are arranged three cylinders, 28 29 30, each provided with folding devices, and the cylinders 28 29 are furthermore provided with a cutting mechanism, the said cylinders thus constituting a rotating cutting and folding mechanism, the construction and operation of which will be fully set forth in the description of the operation of the apparatus. These cylinders are geared together by toothed wheels 63 64 65, so as to run in unison, and are driven from the type-cylinder 22 by a train of gears, as is seen in Fig. 1. A pair of calendering-rollers, 41 42, are also operated by this same train of gears; but, in practice, they will preferably derive motion direct from the main shaft, as may the cylinders 28 29 30.

The second printing-machine consists of type-cylinders 31 32 and impression-cylinders 33 34, arranged one above the other in pairs, and supplied with inking apparatuses of ordinary construction, as in the first machine. It also comprises a cutting mechanism consisting of cylinders 19 20, carrying, respectively, male and female cutting-instruments. These cylinders 31 33 and 32 34, as well as the cutting-cylinders 19 20, are geared together, to run in unison. They are connected by intermediate wheels 1 2 3, and are driven from the first machine by a bevel-gear, 10, on the shaft of the lower cutting-cylinder 20, which engages with a bevel-gear, 60, on a shaft, 38, connecting, through bevel-gears 36 37, with the driving-shaft of the cylinder 28 in the first machine.

The other parts of these machines not particularly hereinafter described will be readily understood from a description of the operation of the mechanisms now to be set forth.

A roll of paper, 39, which may rest upon brackets made so that the roll can be traversed endwise to keep the travel of the paper in proper position for receiving the impression, as is usually done, may be led over damping-boxes, which will damp one or both sides of the paper by means of a number of small jets fixed in pipes

attached to the inside of each box, which latter are made large enough to receive the waste water; or the damping apparatus may be of any other common construction. The web of paper, in passing into the machines, may then be carried into contact with the surfaces of steam-heated cylinders, which will cause the water to thoroughly permeate the paper.

The web is passed over and under leading-rollers, and between the type and impression-cylinders 21 23, passing through which it receives its first impression upon one surface. The cylinder 23 is surmounted by a paste-box, 44, hung in a frame, which, by means of a lever, 55, and cam 56, is lifted and dropped at proper intervals to cause the pasting-wheel to deposit a line of paste for a suitable distance upon the proper margin on the side of the web, as in Fig. 8, where the heavy mark 71 illustrates the line of paste thus deposited upon it. The printed web is then led between the impression-cylinders 23 24, and by suitable rollers is guided with its opposite side uppermost under a second pasting apparatus, consisting of a paste-box, 45, which is hung in a swinging frame operated in like manner as the first, and which is lifted and dropped to deposit the line of paste 70 for a suitable distance along the proper margin upon the opposite surface of the web, as is seen in Fig. 9.

The web is thence led between the type and impression cylinders 24 22, and receives its second impression upon its opposite surface. Thus printed upon both surfaces and pasted along the proper margins, it is directed to the cutting and folding cylinders 28 29 30, passing between the cylinders 28 29, as in Fig. 4, where its end is severed by the cutting-blade 4 set in the periphery of the cylinder 28, and working into a slot, 5, in the cylinder 29.

The cylinder 28 also carries a creaser, 6, as does the cylinder 29, which devices are hung upon shafts and rocked by means of cams. The cylinder 29 is also provided with a nipping-jaw, 7, as is the cylinder 30, which devices are hung and operated in like manner to the creasers 6. When the cylinders have so far revolved as to carry a suitable length of the web through them, the creaser 6, carried in the cylinder 28, is vibrated by its arm 8 following the cam 9, against which it is held by a spring, and doubles or wipes the web into a recess in the cylinder 29, against one side of which the doubled edge of the web is pressed by the nipping-jaw 7, which is quickly vibrated into an open position by the high part of its operating-cam to thus receive it, and quickly closed to nip the doubled edge of said web as the creaser 6 is withdrawn by its cam and the continued rotation of the cylinder 28. Thus seized, the web is carried around the cylinder 29, and between it and the cylinder 30, and when the proper length has passed between the cylinders 28 29 the cutter 4 again comes into operation to sever it and form a sheet. This sheet, doubled at the proper point, (one-third its length in this instance,) is carried by its folded edge, which is held by the nipping-jaw 7, between the cylinders 29 30 until the appropriate point of it is in proper position between them, when the creaser 6 in cylinder 29 comes into operation upon it, and doubles it on a line parallel with the first fold into a recess in the cylinder 30, where it is seized by the nipping-jaw 7 of that cylinder, the nipping-jaw 7 of the cylinder 29 releasing its hold upon the leading-edge or first fold at the proper time to permit the said sheet to be carried around by its second folded edge by the nipping-jaw of the cylinder 30.

As the sheet passes between the cylinders 29 30, as in Fig. 10, the surfaces of its two free ends are lapped together, and caused to adhere along the pasted line 70, and when a second time folded its free ends are again lapped together, and caused to adhere on the pasted line 71 as it passes between the cylinder 30 and the roller 43. The cylinder 30 delivers the twice-folded sheet to carrying-tapes 52 53, the nipping-jaw 7 of cylinder 30 releasing the sheet at the proper time.

The tapes 52 extend from a roller, 43, to the roller 40, and overlie the folding-rollers 11 12, and the tapes 53 run around the cylinder 30, under the folding-rollers 11 12, and over a roller, 59, the two sets thus leading from the cylinder 30 to the said folding-rollers 11 12, which comprise, in part, the mechanism for imparting to the sheet its third fold, which is made at right angles to the preceding folds, as follows: The tapes 52 53 convey the twice-folded sheet out over the folding-rollers 11 12, against a gage, 51, and under the folding-blade 13, which blade may be a rotating device, but is shown as a vibrating blade fast upon a shaft, which is rocked by an arm, 47, extending from it into contact with a cam, 48, on the shaft 38. It acts to double the sheet in its center through the rollers 11 12, which are geared together, and driven by a train of gears meshing with the toothed wheel 49 on the shaft 38.

The web 54 from the second machine passes from a reel hung in a like manner to that in the first machine, is led over guide-rollers, and between the type-cylinder 31 and impression-cylinder 33, to receive its first impression around the latter, and then between the second type-cylinder 32 and impression-cylinder 34, by which it is printed upon its opposite surface. It is then led between the cutting-cylinders 19 20, which sever it into proper-sized sheets, which are carried by means of endless tapes 16 18 under a paste-box, 17, and between the leading-tapes 53 and a companion set, 57, which introduce it over a pair of folding-rollers, 14 15, and against a gage, 58, and under the folding-blade 13, where it lies in a plane just beneath that occupied by the product of the first machine. The products of the two machines in this manner arrive almost

simultaneously in position, one above the other, over the folding-rollers 11 12 14 15 and under the folding-blade 13. The said blade then descends and doubles the two together, and unites them by the pasted lines upon their binding-margins, thus completing a bound book, which is delivered out of the machine.

In passing from the cutting-cylinders 19 20 to the folding-rollers, the sheets from the second printing-machine are carried by tapes 53 57, which are driven by rollers which are speeded above that of the printing-machine, and thus advance the incoming sheet at such speed as will separate it from the end of the web, and permit it to enter the folding-machine and be folded before the succeeding sheet is in like manner received, thus preventing one sheet from interfering with another, and the folding-machine from becoming clogged.

The mechanism thus far described is adapted for the production of a printed book consisting of one sheet of twelve pages folded several times to form the body, and of a sheet of four pages forming the cover of said book, which latter sheet is carried into the apparatus which imparts the last fold to the two sheets, so as to underlie the first and to be doubled with it to form a completely-folded product consisting of two separate sheets.

The mechanisms may be adapted alike to newspaper and book work. In the former case a large-sized main sheet may be combined with a smaller-sized one, or supplemental sheet, so as to unite the two as one product by the act of imparting the last fold to them.

These sheets may be folded and cross-folded as many times as is desirable and according to the number and size of the pages printed upon each. In this case the pasting mechanisms will be increased in number, and be brought into operation at the proper times to paste the necessary margins to cause all of the binding-edges to adhere together.

It is obvious that, while the second sheet is, in the illustration, carried over a separate pair of rollers placed beneath those over which the first sheet is directed, the tapes carrying the two sheets may be separated but a slight distance, and both lead over the same pair of folding-rollers.

It is also obvious that the products of two or more printing-machines, whether of the same or of varying sizes, may each be carried into the same folding-machine, whether it be of the rotating type, as in Fig. 5, or of the vibrating type, as in Fig. 3, by which machine they will be doubled or folded one within the other, and delivered as a single product; but, if operated upon by a rotating folder, it is apparent that the several sheets must be delivered simultaneously thereto, while in the case of the vibrating folder they may be delivered in succession thereto, and the folding operation be suspended until all of the sheets are in position to be operated upon.

The product of the one printing-machine may be two or any number of times larger than the product of the other printing-machine, in which case it may be folded one or any number of times before it is carried into the folding apparatus to be folded simultaneously with the product of the second printing-machine. In book-work, and especially in that class of book-work which is to receive a cover, as pamphlets, it is desirable to impart several folds to the main sheet before it is combined with the smaller sheet or cover in the final folding operation.

It is apparent that the structure of the printing-machines need not be of the class illustrated, known as "web-perfecting," but may be of any known construction capable of delivering sheets, by means of tapes or equivalent conductors, into a folding-machine.

In the folding apparatus illustrated by Figs. 3 and 13 the folding-blade 13 is constructed and operated so that it simply doubles the sheet overlying the rollers 11 12 into said rollers, which, feeding it through them, causes the doubled edge of such folded sheet to act as a folder, (it being stiff enough for that purpose,) which will double the sheet overlying the rollers 14 15 into said rollers, and pass through the same with it. This has been found in practice to be a desirable mode of operation when the two sets 11 12 and 14 15 of rollers are used; but it is apparent that the folding-blade 13 might be wide enough, and its stroke such as to operate through the rollers 11 12 and into the rollers 14 15.

It is to be understood that the following devices are not herein claimed: A printing mechanism having combined with it a cutting and a rotating folding mechanism; a cutting and a folding mechanism combined; means for controlling the leading end of a sheet and delivering it within the range of action of a rotating folding-blade; no part of the rotary folding mechanism illustrated in Figs. 4 and 5; and no part of the pasting or calendering devices or such as combined with the printing mechanism.

What is claimed is—

1. The combination of two independent printing mechanisms which produce two printed sheets with mechanisms for automatically associating said sheets together, and folding and delivering the same as a single product, all substantially as described.

2. The combination of a folding apparatus with two independent printing mechanisms, whereby the products of the printing mechanisms are automatically carried into the folding apparatus and simultaneously doubled or folded, all substantially as described.

3. The combination of pasting devices, folding apparatus, and two independent printing mechanisms and connecting mechanisms, whereby sheets from the printing mechanisms

are automatically pasted along the proper margins, and simultaneously doubled or folded to form a single product, all substantially as described.

4. The method of automatically printing webs of paper, cutting the same into sheets, automatically associating said sheets one over the other, and simultaneously folding said sheets together to form a single product, all substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

EDWARD L. FORD.

Witnesses:
H. T. MUNSON,
JOHN C. KLUBER.