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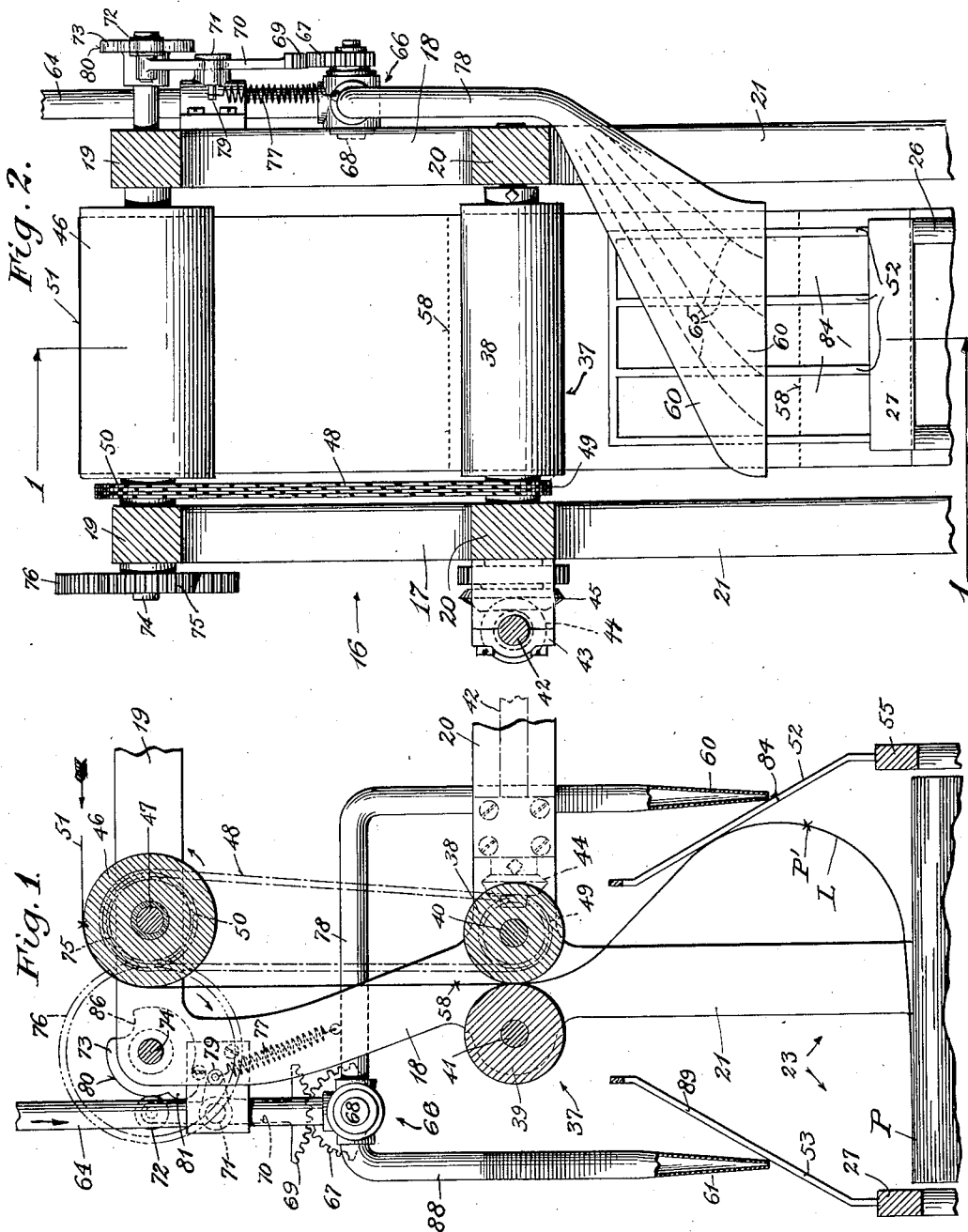
C. W. BRENN

2,016,539

FOLDING MACHINE

Filed Aug. 1, 1931

3 Sheets-Sheet 1



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Oct. 8, 1935.

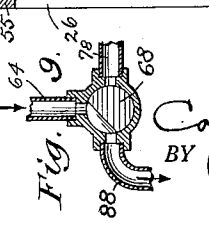
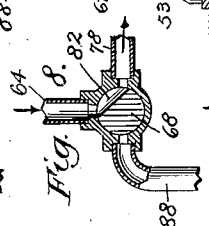
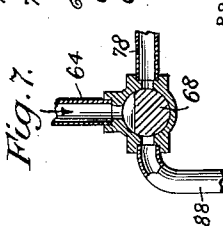
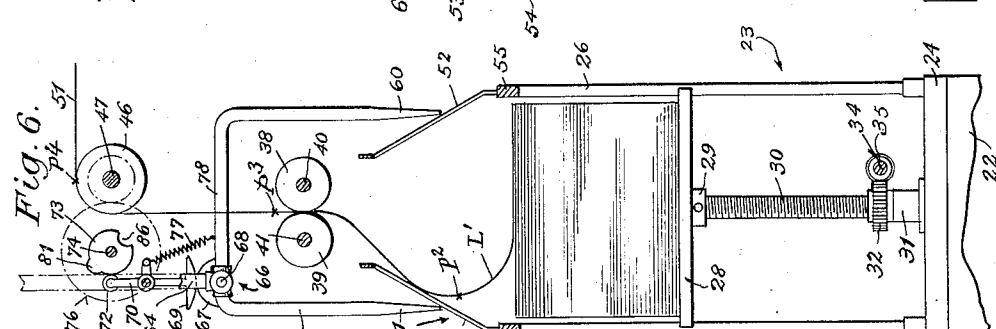
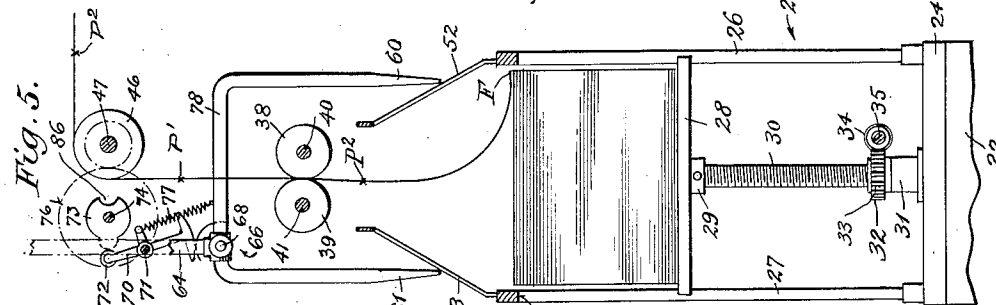
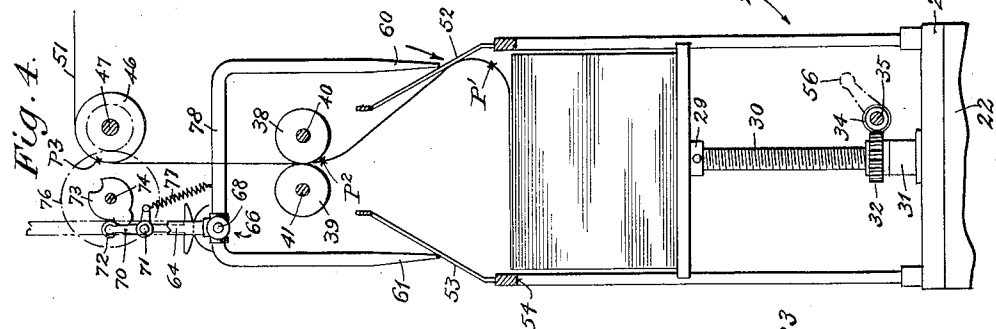
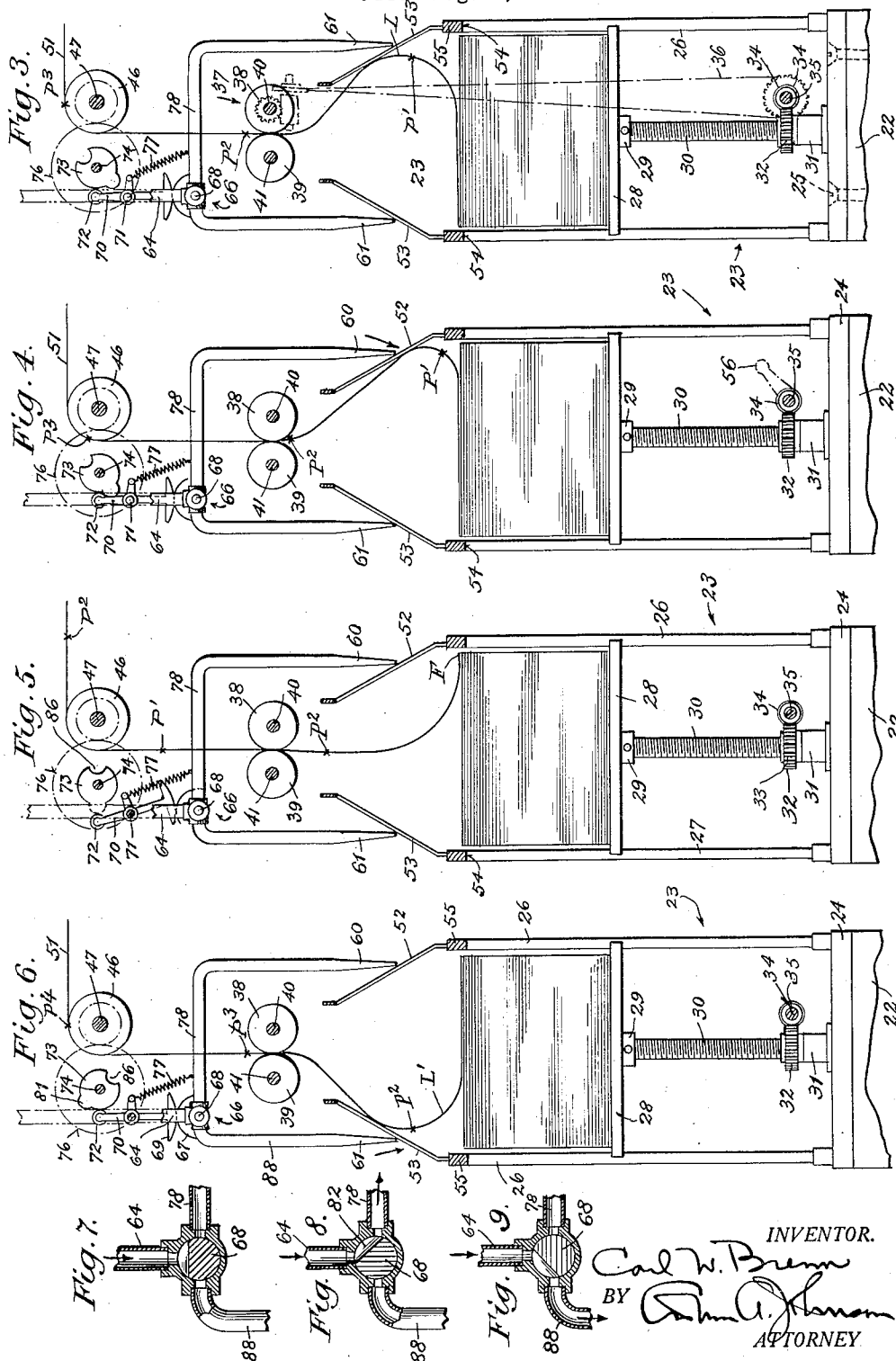
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2,016,539

FOLDING MACHINE

Filed Aug. 1, 1931

3 Sheets-Sheet 2



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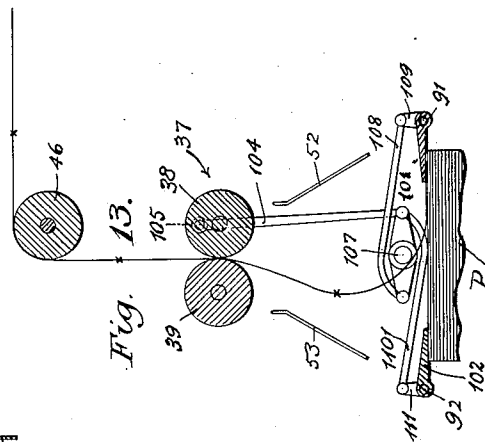
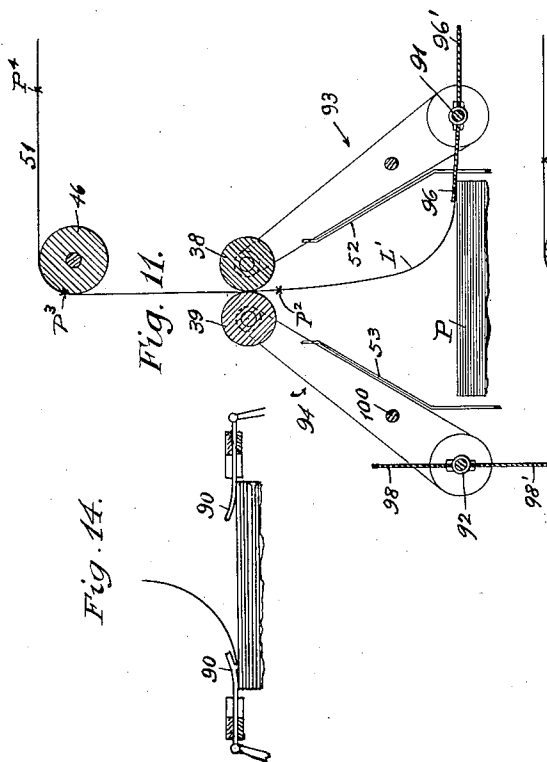
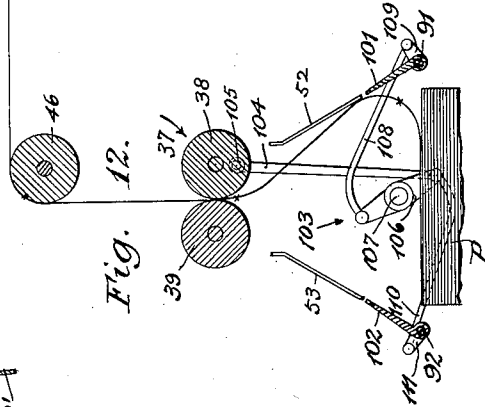
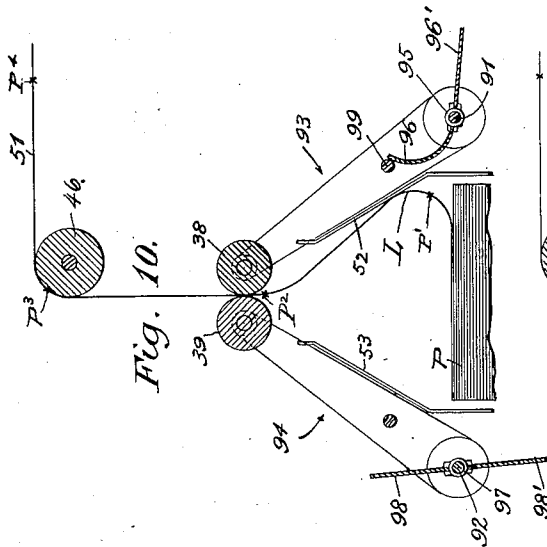
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2,016,539

FOLDING MACHINE

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3 Sheets-Sheet 3



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2,016,539

FOLDING MACHINE

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13 Claims. (Cl. 270—79)

This invention relates to folding fabric strips, and more particularly, to means for folding continuous paper strips in zigzag fashion to form a pile or stack for use in manifolding machines and the like.

Such paper strips usually consist of a succession of connected leaves or printed forms between each two of which there is provided a transverse weakening line, and it is along this line that the strips are folded. In general, it is, of course, highly desirable to have the zigzag folded pile perfectly square and true, and for this reason it is important that the strips be folded exactly on the transverse weakening line which is accurately produced in the web by the printing press. When used for manifolding machines, it is important that the fold be produced on the weakening line so that there will be no tendency for the strip to tear along the fold instead of along the line of weakness.

Heretofore, many attempts have been made to fold such strips. In my Patent, #1,805,161, granted May 12, 1931, there is disclosed a folding machine which does accurately fold the strips on the lines of perforations because the nature of the mechanism is such that the fold is formed by reason of the line of perforations and not because of a nicely timed and accurately operating mechanism. The device of my prior patent, however, is adapted for use where the web feeds intermittently—part of the folding mechanism operating during the period of intermission.

An object of this invention is to provide a folding device for continuous strips which is capable of operating on a continuously feeding strip and in which both the right and left hand folds are produced while the web is feeding at a high rate of speed. Such a device may be used with a rotary press which has a higher speed and greater production than the presses, usually flat, which feed intermittently.

The object of this invention is attained by providing mechanism for forming preliminary loops or bends in the strip as it is fed and then applying pressure to the loop so that the latter breaks on the line of perforations. Once having been broken, a crease or fold is formed which, in the subsequent operations of the device, is pressed down tightly to form a compact fold.

The objects of this invention may be carried out by various means. For instance, as in one illustrated embodiment of the invention, the folding of the web may be produced by streams of air, or other fluid, applied to the preliminary loop.

In another form, the folds are produced by a

wiping device preferably of flexible material, which engages the preliminary loop and flattens it, causing the loop to break on the line of perforations. Again, in another form of this invention, oscillating fingers are employed for doing this.

In the broader aspects of the invention, the preliminary loop may be supported on one side by any suitable means while pressure is applied on the other side to break the loop and form a fold, but it is preferable and one of the features of this invention, to have the folds formed on the previously folded portion of the web, that is, directly upon the top of the stack, and for this purpose the present invention provides a constant level stacking device for supporting the stack during the folding operation and maintaining the top of the stack always in a predetermined position relative to the fold-producing means.

Other features and advantages will hereinafter appear.

In the accompanying drawings—

Figure 1 is a sectional view of a folding machine forming one physical embodiment of this invention.

Fig. 2 is a front elevation of the part shown in Fig. 1.

Fig. 3 is a diagrammatic view of the form of the invention shown in Figs. 1 and 2, showing the web being forced down toward the zigzag folded pile to produce the initial loop or bend ultimately forming the right hand fold; Fig. 4 is a similar view, but shows the web still further advanced and just before the pressure is applied to the top of the loop by the blast of air; Fig. 5 shows the right hand loop formed; and, Fig. 6 shows the preliminary loop, which produces ultimately the left hand fold, being formed.

Figs. 7, 8 and 9 are sectional views of a two-way valve used in the form of the invention shown in Figs. 1 to 6; Fig. 7 showing the valve in its normal condition, and Figs. 8 and 9 showing the position of the valve during the breaking of the web to form the right and left hand folds, respectively.

Fig. 10 is a schematic view of another form of this invention in which the folds are produced by flexible arms adapted to engage the preliminary loop at the proper time.

Fig. 11 is a similar view, showing the right hand fold being formed.

Fig. 12 is a view similar to Fig. 10 of another physical embodiment of this invention, wherein the folds are formed by oscillating arms engaging and pressing down the preliminary loop in the web.

Fig. 13 is a view similar to Fig. 11, showing the right hand fold being formed and the previously formed left hand fold being pressed down at the same time.

Fig. 14 is a schematic view of a slidable fold-supporting shelf.

In the accompanying drawings, the printing press proper is not illustrated because the present invention may be used with printing presses of various kinds and with other feeding devices, both continuous and intermittently operated, and it will be apparent to those skilled in the art how the device of the present invention may be attached to and driven by any particular printing press, or other device.

The form of the invention shown in Figs. 1 to 9, inclusive, is at present considered preferable because of its simplicity in structure and operation, and comprises a main frame 16 formed of two similar side plates 17 and 18, each having a horizontal upper arm 19 and a lower arm 20 which may, if desired, be cast as an integral part of the frame of the printing press or the like with which the folding machine of the present invention is intended to be used, or, it may be provided with brackets or other suitable clamping means by means of which it may be attached to any printing press.

The side plates 17 and 18 are also provided with vertical arms 21 which extend downwardly toward the floor, and at their lower ends are interconnected with a cross bar or web 22 which serves as a base for a stacker 23 employed by the present invention. The cross member may be made integral with the side plates, or it may be a separate piece suitably fastened to the lower end of both of the arms 21.

The stacker 23 may comprise a bottom plate 24 fixed to the base 22 with screws 25 and provided with vertical standards 26 and 27 which serve to prevent displacement of the pile and serve as a guide for a movable platform 28. The latter comprises a substantially rectangular plate recessed at its sides to accommodate the standards 26 and 27 to be guided thereby, and on its underside is provided with a boss 29 having a rotatable connection with the upper end of a screw 30. The screw extends downwardly through a boss 31 and through the plate 24 and base 22 and has a nut 32 threaded thereon which serves to limit and control movement of the platform. The nut is provided with a worm thread 33 having driving engagement with a worm 34 mounted on a shaft 35 having suitable bearings in the vertical arms 21 and having a driving connection 36 with a feed mechanism 37 for the paper webs and operates in predetermined unison therewith.

The folding machine of the present invention comprises a web feeding device having a pair of pressure rollers 38 and 39 mounted on shafts 40 and 41, respectively, which are suitably journaled in the main frame side plates 17 and 18. Rotation of the feed rollers is produced through a drive shaft 42, having suitable connection to the main feeding mechanism of the printing press, journaled in a bracket 43 on the side plate 17 and being provided at its front end with a bevel gear 44 which meshes with a cooperating bevel gear 45 fixed to the end of the shaft 40 of the roller 38. The arrangement is such that the feed rollers 38 and 39 are driven at the same peripheral speed as the printing press feeding mechanism.

An idler roller 46 is also mounted between the side plates 17 and 18 for free rotation on a shaft 47 and is preferably on a plane with the web as

it issues from the printing press. A chain drive 48 is provided between a sprocket wheel 49 on the feed roller 38 and a slightly larger sprocket wheel 50 on the idler roller shaft 47.

Operation of the device thus far described requires merely taking the web 51, feeding it a short surplus length from the printing press, then passing this surplus over the idler roller 46 downwardly through the feed rollers 38 and 39, and into the upper end of the container 23. The platform 28 is moved to the raised station where the top of the platform engages the underside 54 of the standard cross bars 55 by merely lifting the platform and screw to this station and spinning the nut 32 downwardly on the shaft 30 until it engages the top of the boss 31, in which position it will be retained.

If desired, platform raising movement may be effected by providing a crank 56 on the worm shaft 35 and any usual clutch or slip-connection, so that the main drive 36 may be disconnected while the crank 56 is rotated. Thus, it is merely necessary for the operator to cut out the main drive 36 and rotate the crank until the platform is moved to the desired upper station, then close the clutch or slip-connection again.

The outer end of the web is laid upon the platform 28 and, as it has sufficient free length, several right-hand and left-hand folds may be made therein, whereupon the printing press may be operated in the usual manner.

As the printing press operates, the web 51 issues from it in the direction of the arrow in Fig. 1, and is pulled over the idler 46 downwardly between feed rollers 38 and 39 into the container 23 where, due to the downward pressure of the paper by the feed rollers 38 and 39 and means provided by the present invention, it is folded upon itself.

The feed rollers 38 and 39 and the stacker 23 are so located relatively that the bight of the feed rollers is substantially midway between the points of the right and left hand folds, and the feed rollers are located far enough above the stacker platform 28 or the top of the pile or stack P thereon so that as the feed rollers are operated, the web is pushed downwardly onto the pile P or the platform of the stacker 23, to provide a slack in the web sufficient to form a loop rising from the stack or pile P to the pressure rollers 38 and 39.

If the fold just previously formed in the web is a left hand fold, the loop L will bend toward the right-hand side of the stack, as shown in Fig. 3. As the advancing continues, the loop will be extended and more convex, for instance as shown in Fig. 4.

When it is in this condition, according to the present invention, pressure is applied in the direction of the arrow shown in Fig. 4 to the loop to reverse and flatten it out. When pressure is applied to the loop, the loop will break at the line of perforations P' which is the weakest part of the web in the loop, and the means applying the force is made sufficient to substantially flatten out the web adjacent the line of perforations, and thus produce the fold F, as shown in Fig. 5. The feeding of the web continues during this operation and causes a loop L' to be formed bulging toward the left-hand side of the stack. This loop becomes larger as the web is forced down and finally pressure is applied in the direction of the arrow shown in Fig. 6 to cause the web to break on the line of perforations P2 and form the left-hand fold.

When this left-hand fold is formed, the means which applies pressure to the loop to break the loop on the line of perforations also applies pressure to the previously formed left-hand fold which is thereby still further flattened out. When the left-hand fold is reversed and flattened down, the web, in being advanced, will form a right-hand loop L as shown in Fig. 3, and these operations continue in that sequence.

If desired, the loop L may be kept within bounds so as to properly be operated upon by the pressure applying means by guide plates 52 and 53 which extend upwardly from the stacker toward the pressure rollers 38 and 39, and form a chute or channel in which the web is confined during the folding operation. Provision of these guide plates 52 and 53 and the resulting channel in which the web is folded permits the web to be fed and folded at a higher rate of speed.

The pressure for breaking and finally creasing and folding the web in a pile may be obtained in divers ways—several being shown in the accompanying drawings.

Referring to the form of the invention shown in Figs. 1 to 9, the pressure is applied by blasts of air, the device comprising a pair of long narrow nozzles 60 and 61 overlying points of the right-hand and left-hand folds in the pile P and connected to a suitable source of fluid pressure through a line 64. The nozzles are provided with a series of plates 65 on the interior thereof, to effect an even distribution of fluid pressure along the entire long opening.

Preferably, the fluid pressure line 64 is provided with a two-way valve 66 adapted to be controlled by the feed mechanism 37 in such manner that the fluid pressure is released only at predetermined times. To this end there is provided a segmental gear 67 fixed to the valve plug 68 and a mating segmental gear 69 on the lower end of a lever 70 pivotally mounted on a stud 71 and having a roller 72 at its upper end engaging a cam disk 73 mounted on a shaft 74. A gear 75 on the idler roller shaft 47 meshes with a gear 76 on the cam disk 73 to rotate the latter in exact predetermined ratio with the feed rollers. A spring 77 connected to the pipe 78 and to a finger 79 on the lever 70 normally tends to keep the roller 72 in engagement with the periphery 80 of the cam disk 73.

With this mechanism, the web is advanced in the manner hereinbefore described to the station shown in Fig. 4, and upon further advance of the feeding mechanism, the cam disk 73 is rotated by the chain 48 until the lobe 81 thereon moves into engagement with the roller 72 and moves the latter in a counter-clockwise direction against the tension of the spring 77 and moves the lever sector 69 in a counter-clockwise direction, and the latter in turn moves the meshing valve sector 67 in clockwise direction to move the valve plug 68 from the position shown in Fig. 7 to the position shown in Fig. 8, whereupon air under pressure is passed from the line 64 through a valve plug cut-out 82 to the nozzle 60 and issues from the latter through slots 84 in the plate 52 downwardly against the loop L causing the loop to break at the line of perforations P', reversing the direction of the loop, and pressing the creased portion firmly against the right-hand fold previously formed.

Almost immediately the lobe moves out of registry with the roller 72 and moves the roller onto a dwell 80, whereupon the valve plug 68 is again moved to the neutral non-feeding position, shown in Fig. 7, and the sheet of paper lays down and across the top of the pile 63 toward the left until

the natural bowed portion engages the inwardly extending plate 52 while the latter forms the initial left hand loop L', as shown in Fig. 6, and at a predetermined point a notch 86 of the rotating cam disk 73 rides into engagement with the roller 72 to move the lever sector 69 in a clockwise direction under the influence of the spring 77 while the latter moves the cooperating valve plug sector 67 in a counter-clockwise direction until the valve plug 68 is moved into the position shown in Fig. 9, whereupon the air under pressure passes from the line 64 through a plug cut-out 82 through a pipe 88 to the nozzle 61 where it in turn passes through suitable slots 89 in the plate 52 to break the loop and form a close fitting left-hand fold.

If desired, a one-way valve and one-way release might be provided in place of the two-way valve 66 and alternating release so that fluid pressure will be released upon both the right-hand and left-hand folds of the pile as either a right-hand or left-hand starting fold is made, but at the present time it is considered preferable to have the alternating arrangement as just described in detail.

The arrangement so far described is such that the pile P itself serves as a platform upon which succeeding right-hand and left-hand folds are made, but the present invention in its broader aspects is not limited to this arrangement. For instance, slidable or disappearing tables or shelves 80' shown in Fig. 14, may be used if desired.

When the pile P is built up to the desired height, either by running the continuous strip 51 to its outer end and down through the feed rollers 38 and 39, or by cutting the paper as at P2, the zig-zag folded pile will be complete and it may be taken from the stacker 23 for use in any desired manner. By removing the finished pile and returning the platform 28 to its upper station again, it is possible to start and build up a new pile in the same manner as with the pile just removed.

Figs. 11 to 13 inclusive, disclose two other embodiments of the present invention, similar to that form shown in Figs. 1 to 10, in the provision of means for looping the web as it is advanced by the feeding mechanism and applying pressure to the loops to produce a succession of right-hand and left-hand folds in the web, near the apex of succeeding loops, on the transverse weakening lines.

That form shown in Figs. 10 and 11 is characterized by the provision of mechanical means instead of fluid pressure means for making the final fold. To this end there is provided a pair of rotatable shafts 91 and 92, having suitable driving connections 93 and 94 with the feed mechanism. Upon the shaft 91 there is secured a sleeve 95 carrying fingers 96 and 96', and upon the other shaft 92 there is provided a similar sleeve 97 carrying fingers 98 and 98' which are adapted to alternately move down through suitable apertures in the plates 52 and 53 upon the initial starting right-hand and left-hand loops in order to apply thereto a pressure producing a final fold. As the continuous web 51 is fed through the rollers 38 and 39 a right-hand loop L is formed, as shown in Fig. 10, upon the top sheet of the pile P, and upon continued rotation of the feed mechanism 37, the rotating finger 96 which is restrained for a time by a transverse rod 99 sweeps past the rod down onto the right-hand loop L to apply pressure thereto, breaks the loop, sweeps over the crease, and forms a right-hand fold.

Upon further rotation of the feed mecha-

nism 37 the finger 96, because of its resiliency, is moved over and clear of the right-hand side of the pile, and the web 51 is fed across the top of the next succeeding top strip of the pile just formed, to produce an initial starting left-hand fold L' similar to the right hand fold L. At the same time the rotating finger 98 moves into engagement with the transverse rod 100 to be bowed and delayed thereby and is then snapped down upon the left-hand loop L to break the-loop and form a left-hand fold. The next succeeding right-hand fold is formed by the rotating finger 96' and the next succeeding left-hand fold is formed by the finger 98' in the same manner as the right-hand and left-hand fold, just described.

Because the fingers sweep down upon and across the loops the break of the loop occurs on the transverse weakening lines, rather than at any point adjacent it as might occur if positive mechanical means held and folded the paper web. Thus, the mechanism of the present invention insures a good square and true zigzag folded pile which will function properly in the manifolding machine or other device in which it is intended to be used.

If desired, the ratio of the driving connections 93 and 94 between the feed mechanism and the shafts 91 and 92 may be such that each of the shafts need be provided with but a single finger, and also the drive may be arranged to move the right-hand and left-hand fold forming fingers into engagement with the pack P each time either a right-hand or left-hand fold is formed; such an arrangement being disclosed with that form of the invention shown in Figs. 12 and 13.

In the latter form the transverse shafts 91 and 92 are provided with non-yielding fingers 101 and 102 respectively, and the driving mechanism 103 is adapted to impart oscillating movement to the fingers, rather than rotating movement as with the form shown in Figs. 10 and 11. The arrangement is such that right-hand and left-hand loops are formed and the oscillating fingers 101 and 102 move down upon the looped portion of the webs, to the position shown in Fig. 13 to break the loop and form a right-hand and left-hand final fold, each time either a right-hand or left-hand loop is formed.

The driving mechanism 103 comprises a link 104, having a pitman connection 105 on the feed roller 33, extending downwardly to a lever 106 mounted on a stud 107. This latter lever is provided with one link 108 extending to an arm 109 on the finger 101 and another link 110 extending to an arm 111 on the finger 102. As the pitman connection is operated the link 104 is given a reciprocating movement and in turn oscillates the lever 106 and fingers 101 and 102.

These fingers 101 and 102 are arranged to be quickly moved back to the inoperative position, as shown in Fig. 12, as soon as the operation of forming the fold is completed, so as to be out of the way at the time of forming a loop in the web as the latter is issued from the feeding mechanism 37. If desired, these fingers in the inoperative position, may, as shown, be used to form a part of the plates 52 and 53 and thereby assist in forming the starting loops.

If preferred, the drive mechanism 103 may, similar to the form shown in Figs. 10 and 11, be such that the fingers 101 and 102 are alternately oscillated to move down upon the pile, e. g. the finger 101 moves down upon the loop L' to form a right-hand fold and subsequently the left-

hand finger 102 is oscillated down toward the stack P to form a left-hand fold.

The present invention has been described in detail as applied to a machine in which the web is fed continuously; however, because the final fold pressure applying means are controlled by the feed mechanism it may be used equally well with machines in which the web is intermittently fed.

Other variations and modifications may be made within the scope of this invention and portions of the improvements may be used without others.

Having thus described the invention, what is claimed as new and for which it is desired to obtain Letters Patent, is:—

1. A folding machine for producing a zigzag folded pile from a continuous web having transverse weakening lines at regular intervals, comprising a support; a noncreasing web feeding mechanism located above the support adapted to impart to the web an impetus toward the support carrying the web to form into alternate right-hand and left-hand loops according to the hand of the previous fold, each loop including a transverse weakening line; and means for flattening said loops to form right and left-hand folds on the transverse weakening lines.

2. The method of producing a zigzag folded pile from a continuous web having transverse weakening lines at regular intervals which consists in forming a natural loop in the web to include a transverse weakening line therein and applying pressure to the loop at one side of said line of weakness to cause the web to fold at the transverse line of weakness.

3. A folding machine for producing a zigzag folded pile from a continuous web having transverse weakening lines at regular intervals, comprising a web feeding mechanism adapted to impart to the web alternate right-hand and left-hand loops each including a transverse weakening line; and means for directing fluid pressure toward the loops for flattening said loops to form right-hand and left-hand folds on the transverse weakening lines.

4. A folding machine for producing a zigzag folded pile from a continuous web having transverse weakening lines at regular intervals, comprising a support; a noncreasing web feeding mechanism adapted to impart to the web an impetus toward the support causing the web to form into alternate right-hand and left-hand loops each including a transverse weakening line; and means for applying pressure to said loops to break the loop on the transverse line of weakness.

5. A folding machine for producing a zigzag folded pile from a continuous web comprising a noncreasing web feeding mechanism adapted to impart a rolling right-hand and left-hand travel of the web across the top of the previously formed portion of the pile and at the same time form a natural loop in the web; and means for applying pressure to said loop to break the latter and thereby reverse the travel of the web across the top of the pile.

6. A folding machine for producing a zigzag folded pile, from a continuous web having transverse weakening lines at regular intervals, comprising a noncreasing web feeding mechanism adapted to impart a rolling right-hand and left-hand travel of the web across the top of the previously formed portion of the pile and at the same time form a loop in the web, including one of the transverse weakening lines; and means for

applying pressure to said loop to break the latter on the transverse weakening line and thereby reverse the travel of the web across the top of the pile.

5 7. A folding machine for producing a zigzag folded pile, from a continuous web having transverse weakening lines at regular intervals, comprising a noncreasing mechanism for feeding the web continuously and adapted to impart a rolling
10 right-hand and left-hand travel to the web and at the same time produce a natural loop, including a transverse line of weakness, in the web.

8. A folding machine for producing a zigzag folded pile from a continuous web comprising a
15 support; a noncreasing means to continuously feed the web toward the support with impetus to form alternate right-hand and left-hand loops; web guiding means adapted to shape the right-hand and left-hand loops in the webs; separate
20 means for flattening said right and left-hand loops to form folds; and means, having an operative connection with the feeding means, for operating said separate means at predetermined points in the operation of the feeding means to
25 alternately form the right-hand and left-hand fold.

9. A folding machine for producing a zigzag folded pile from a continuous web comprising noncreasing means to continuously feed the web
30 and form preliminary right-hand and left-hand loops; web guiding means adapted to shape the right-hand and left-hand loops in the webs; separate means for flattening said right and left-hand loops to form folds; and means, having an
35 operative connection with the feeding means, for operating said separate means at predetermined points in the operation of the feeding means to form the right-hand and left-hand fold.

10. A folding machine for producing a zigzag
40 folded pile from a continuous web comprising a noncreasing web feeding mechanism; means to produce starting right-hand and left-hand loops in the web as it issues from the feed mechanism; pivotally mounted oscillating fingers adapted to
45 produce final right-hand and left-hand folds in

the web; and a driving connection between the feed mechanism and said fingers for automatically moving the fingers into operative position at predetermined points in the operation of the feeding mechanism.

11. A folding machine for producing a zigzag
5 folded pile from a continuous web having transverse weakening lines, comprising a web feeding mechanism; means to produce starting initial right-hand and left-hand loops in the web on
10 the transverse weakening lines as it issues from the feeding mechanism; a pair of nozzles overlying the pile near the folded ends thereof; an air line connected to said nozzles; and a two-way valve in said air line having an operating
15 connection with the feeding mechanism adapted to alternately pass a stream of air first to one and then the other of said loops through said nozzles to produce final right-hand and left-hand
20 folds in the web on the transverse weakening lines.

12. A folding machine for producing a zigzag folded pile from a continuous web having transverse weakening lines, comprising a web feeding
25 mechanism; means to effect starting initial right-hand and left-hand loops in the web on the transverse weakening line as it issues from the feeding mechanism; an air supply line; and a pair of stationary nozzles, connected to said air supply line, overlying the pile near the folded ends
30 thereof and adapted to direct a stream of air on the starting initial loops and produce final right-hand and left-hand folds in the web.

13. A folding machine for producing a zigzag
35 folded pile from a continuous web, comprising a web feeding mechanism; an air line; air line nozzles overlying the pile near the folded ends thereof; and a two-way valve in the nozzle air line having an operating connection with the feeding mechanism and controlled thereby to
40 alternately pass a stream of air to one and then the other of said nozzles to produce a right-hand and left-hand fold in the web as it issues from the feeding mechanism.

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