Dec. 4, 1962 C. J. GREINER ETAL 3,066,932

PAPER FOLDING MACHINE AND METHOD

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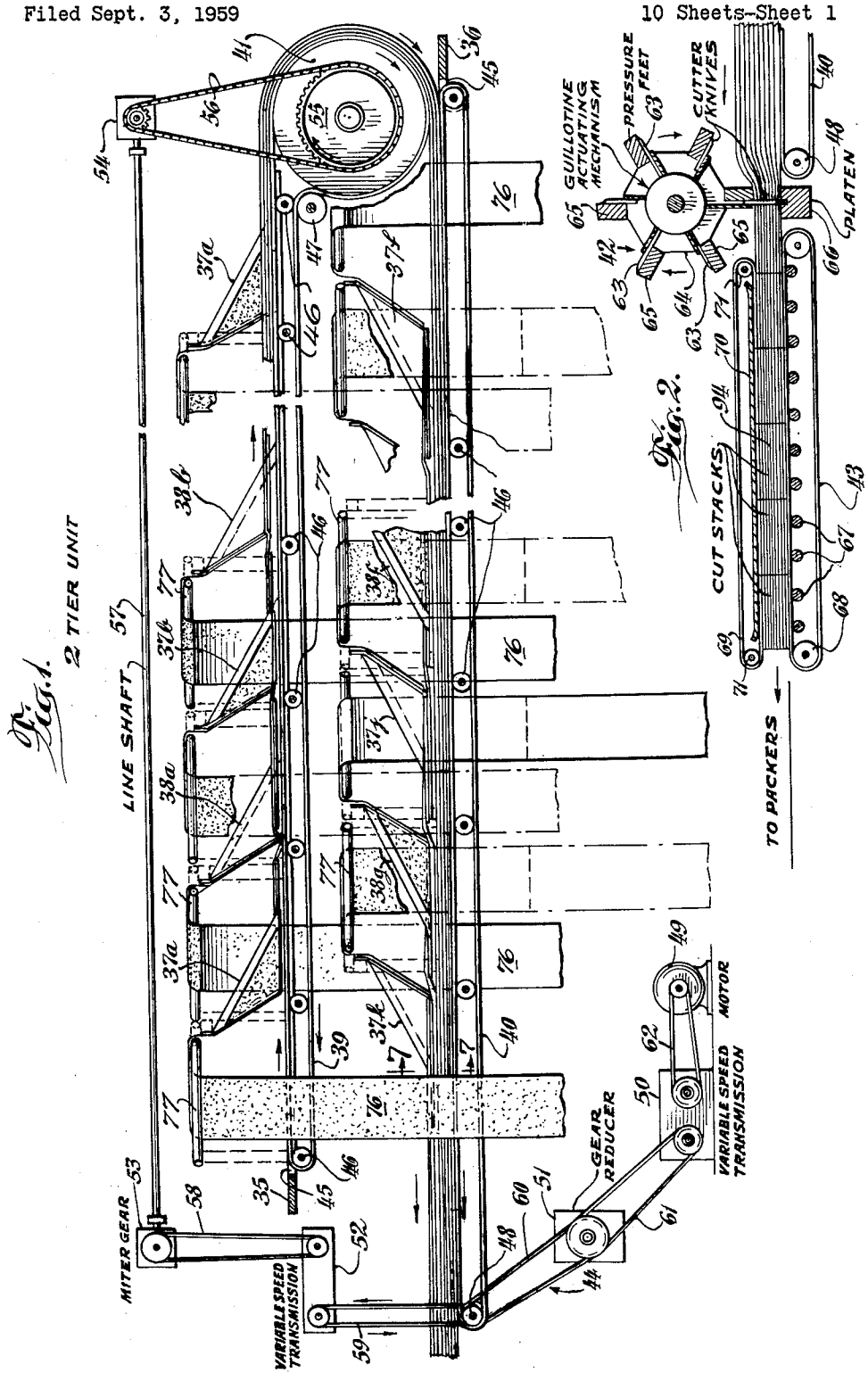


Fig. 1.

Fig. 2.

PAPER FOLDING MACHINE AND METHOD

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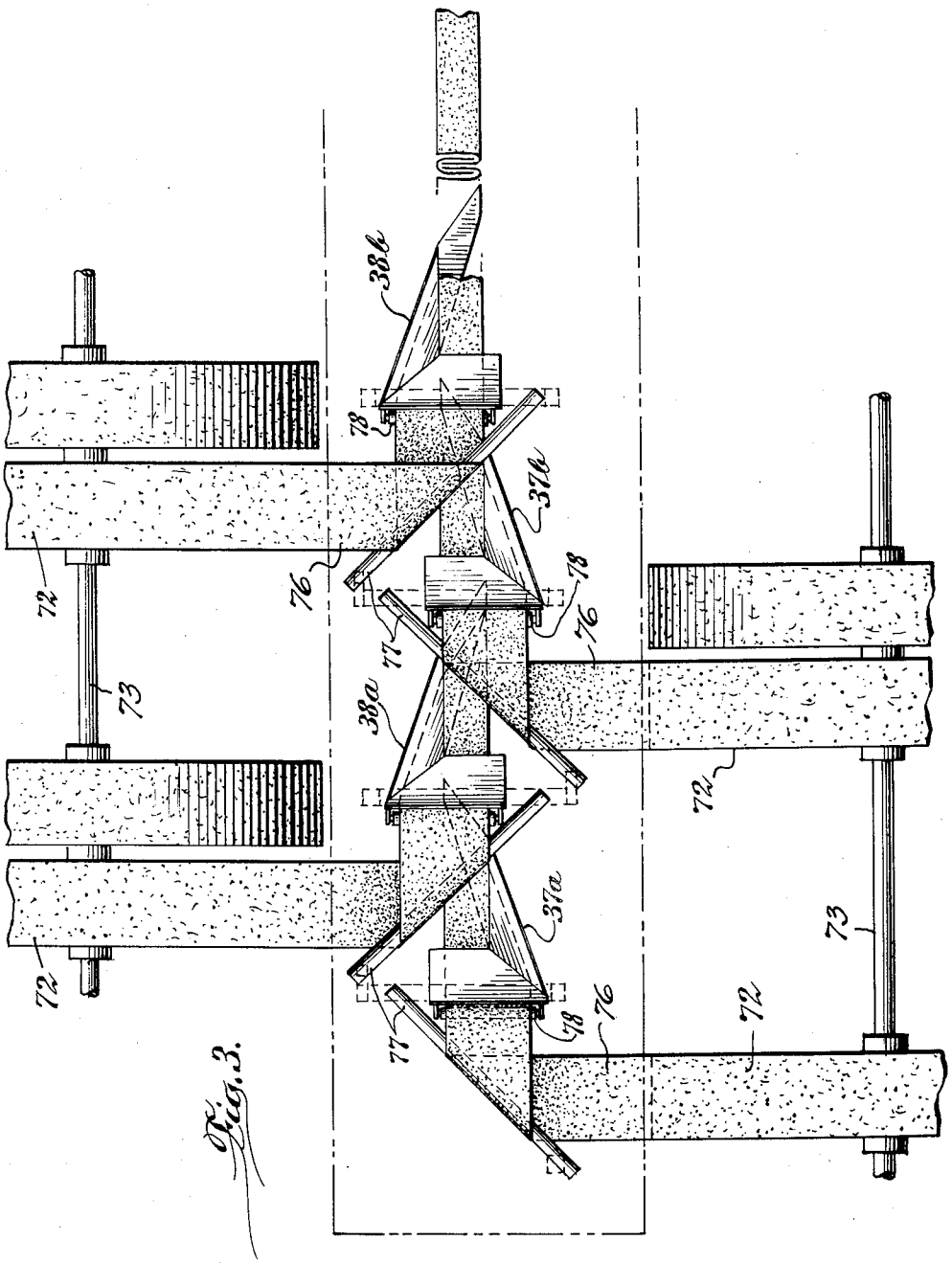


Fig. 3.

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PAPER FOLDING MACHINE AND METHOD

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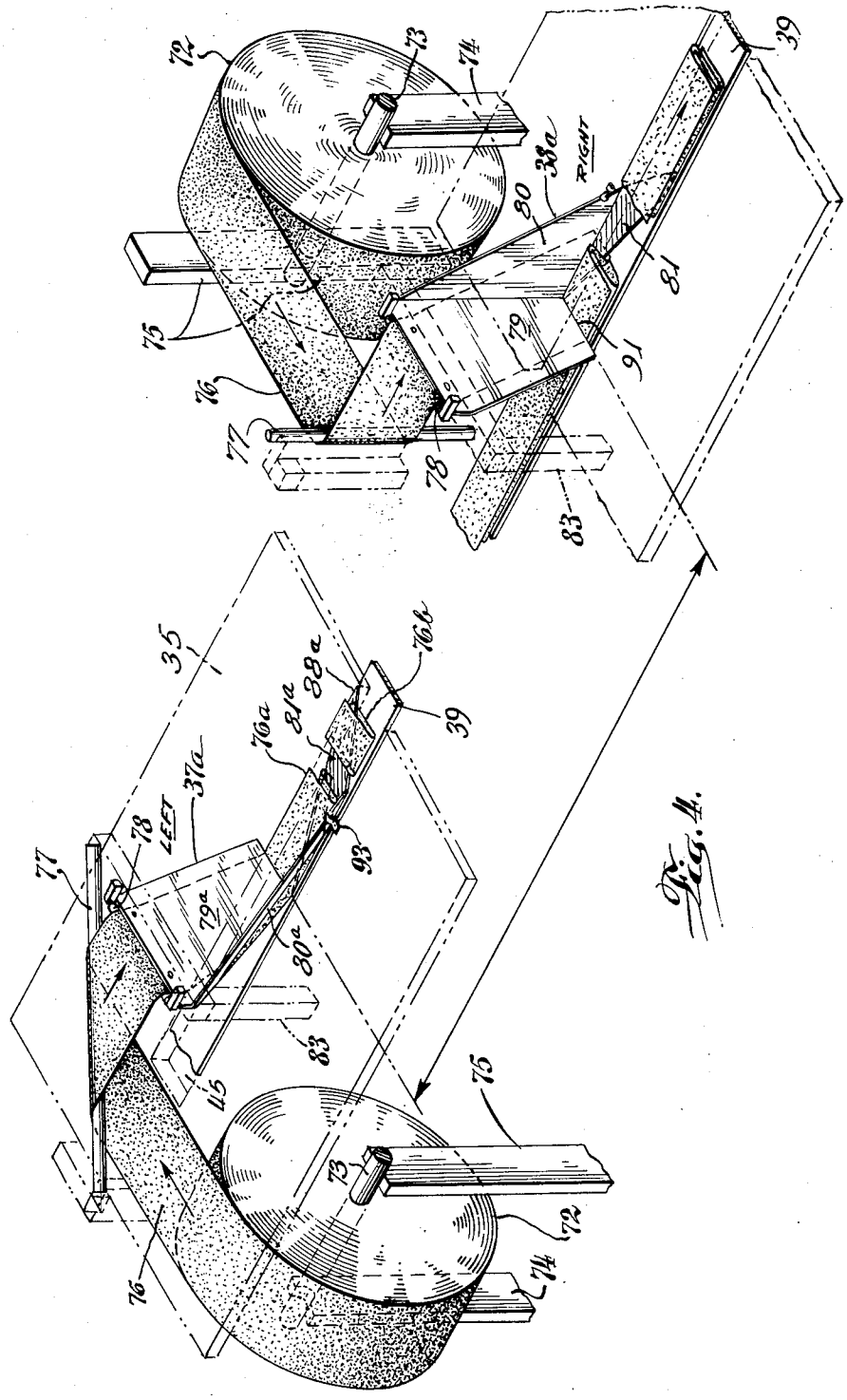


Fig. 4.

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PAPER FOLDING MACHINE AND METHOD

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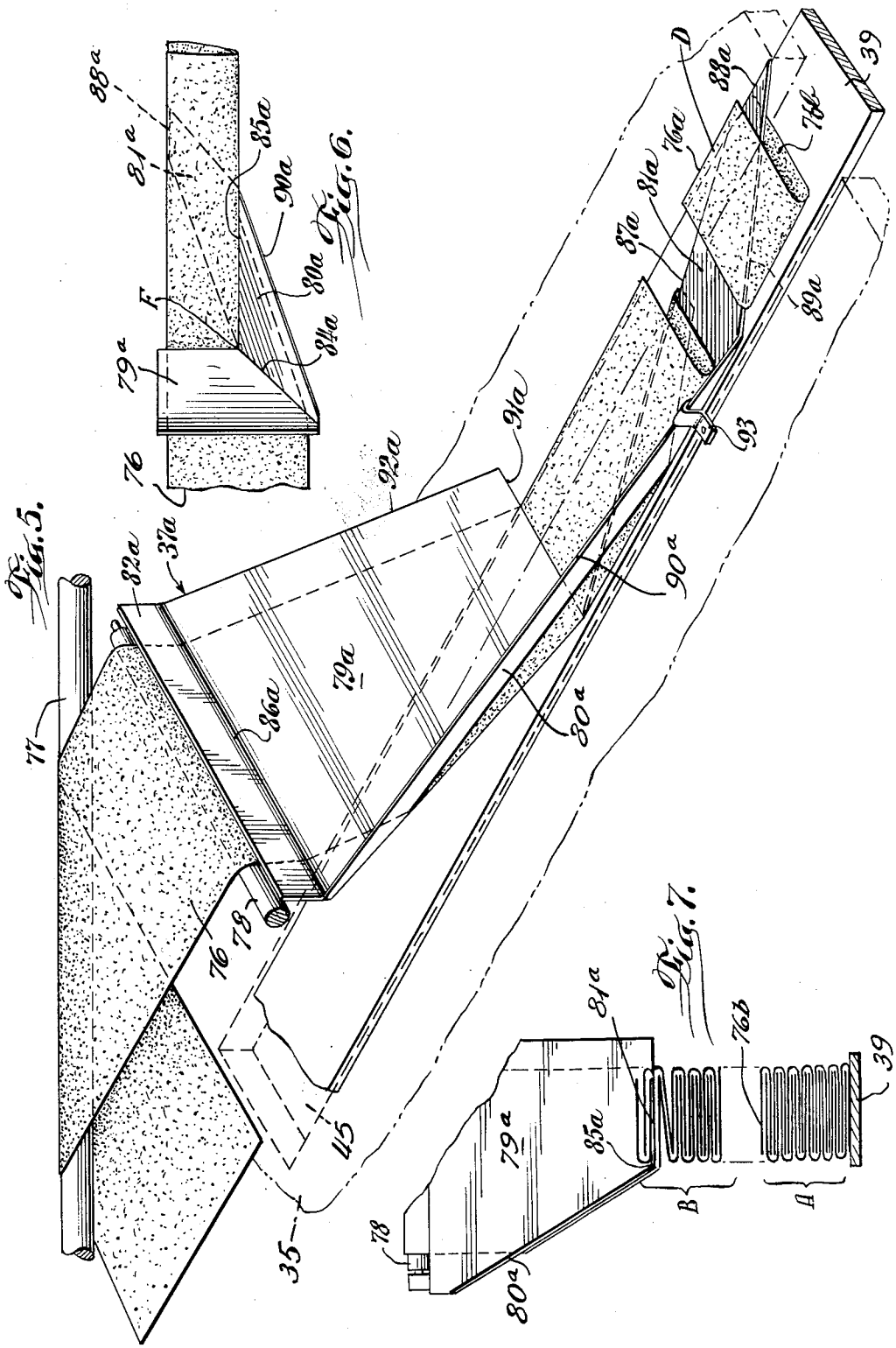

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PAPER FOLDING MACHINE AND METHOD

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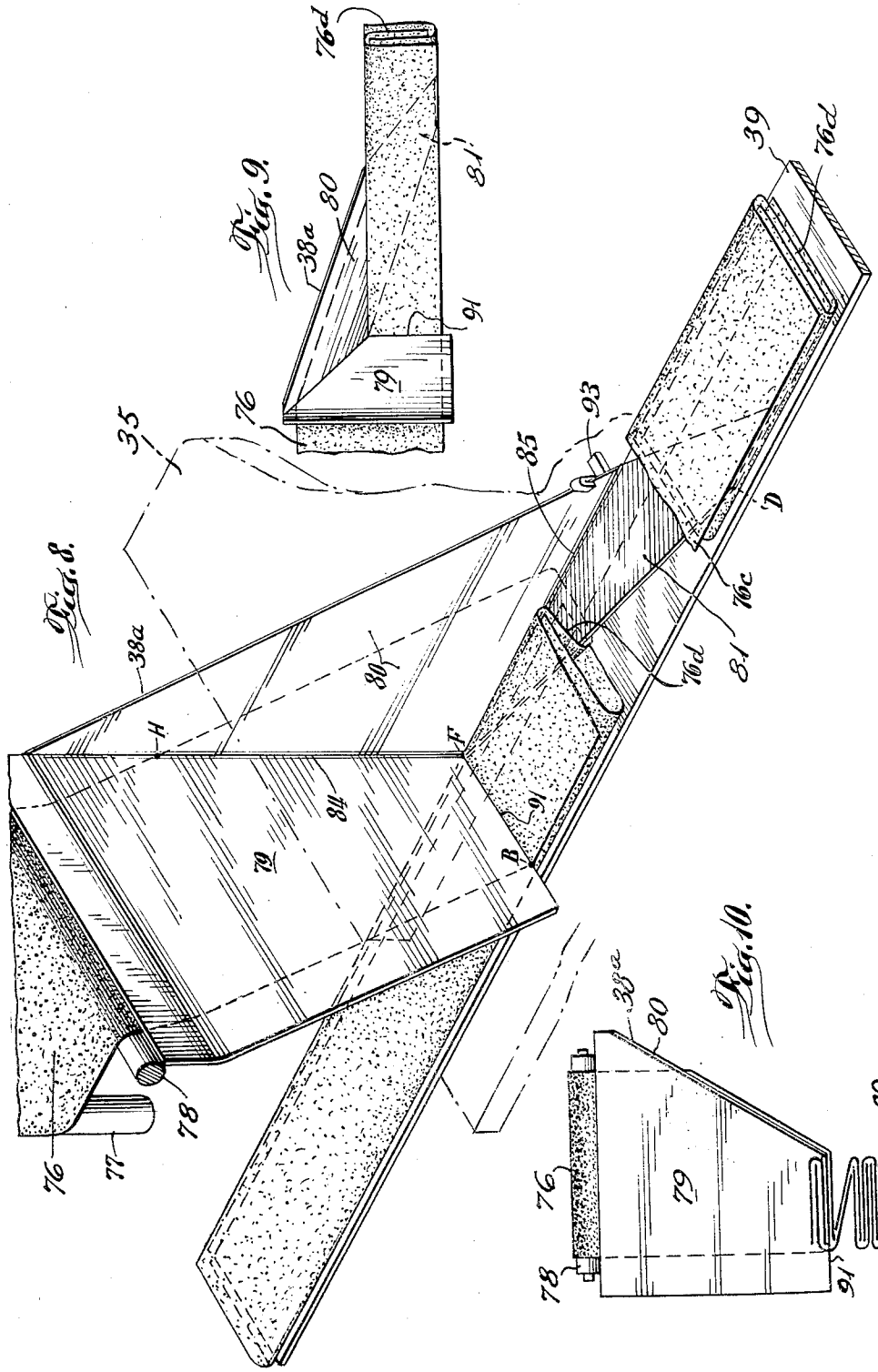

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PAPER FOLDING MACHINE AND METHOD

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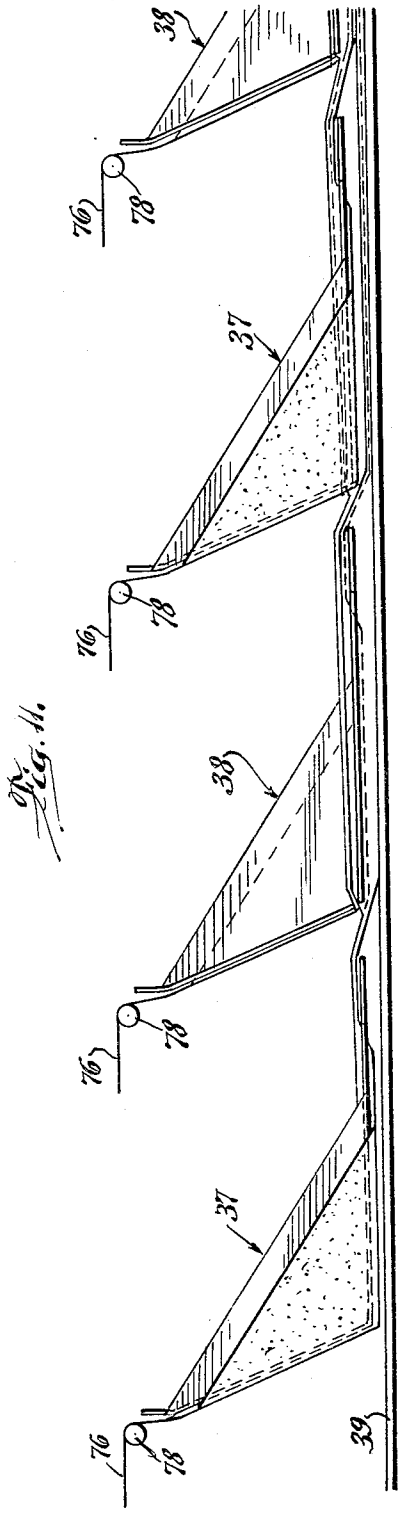


Fig. 11.

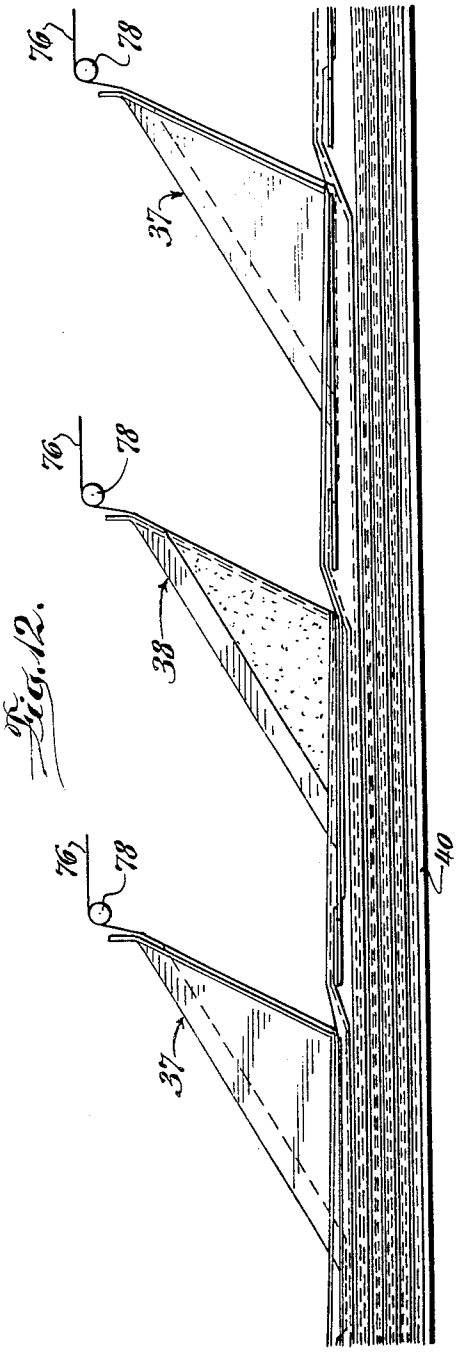


Fig. 12.

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PAPER FOLDING MACHINE AND METHOD

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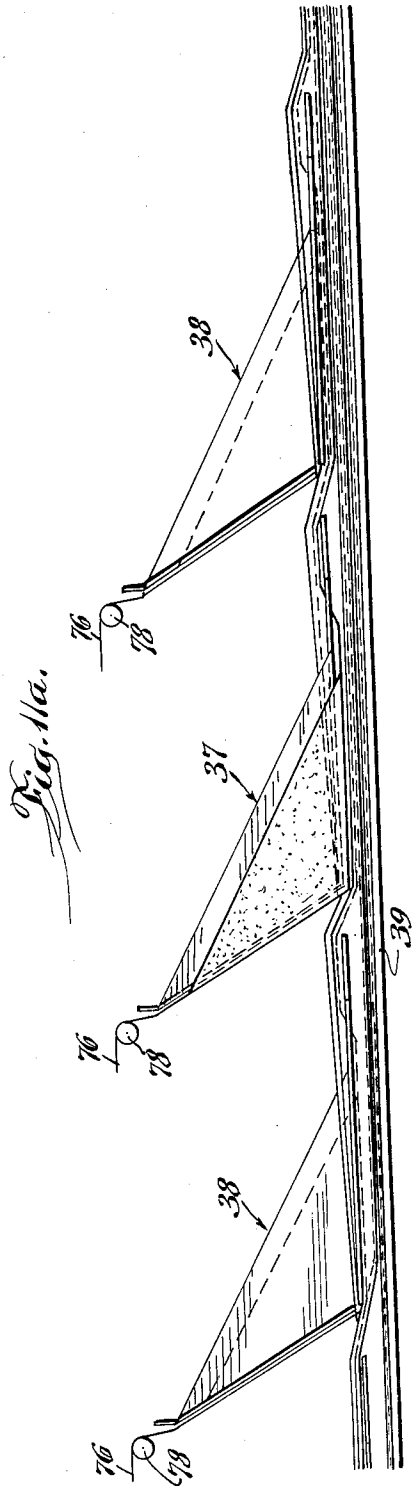


Fig. 11a.

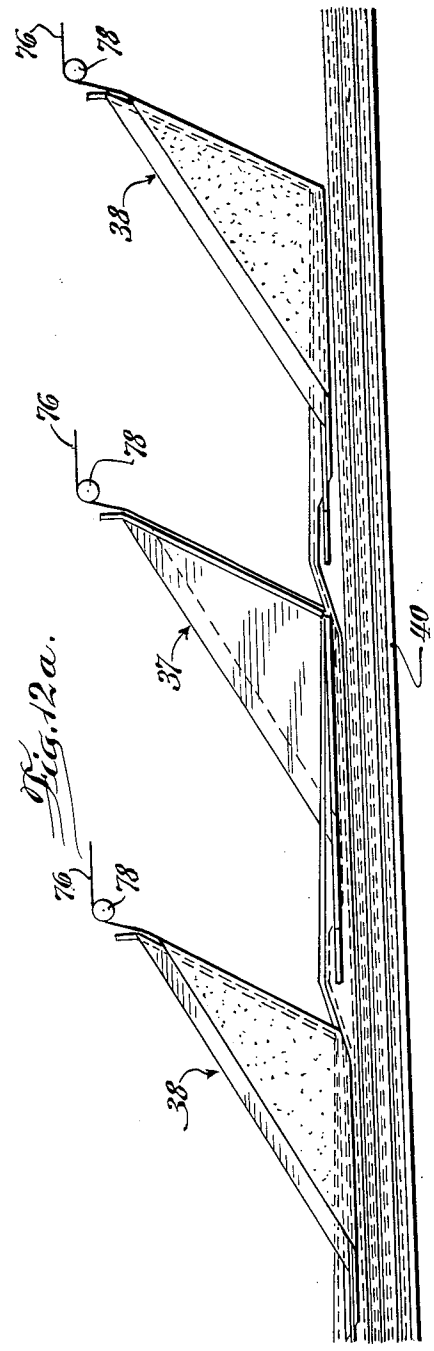


Fig. 12a.

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Fig. 13.

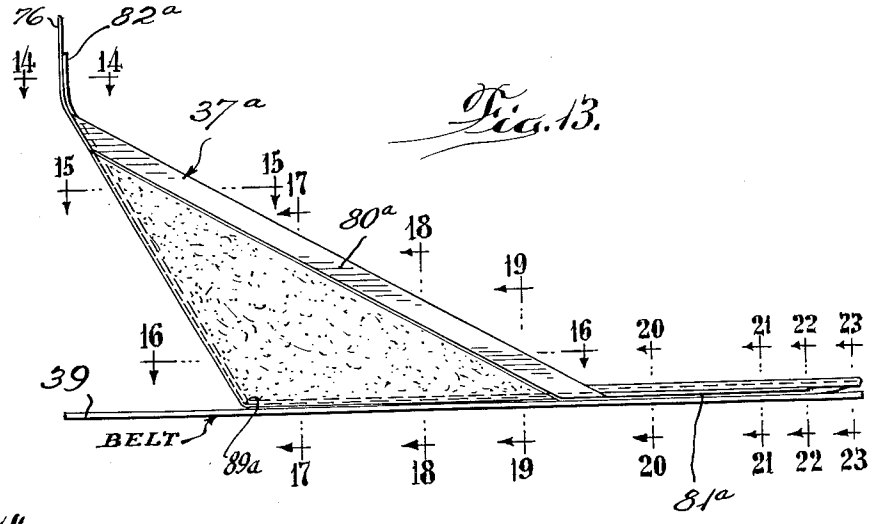


Fig. 14.

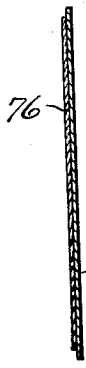


Fig. 15.

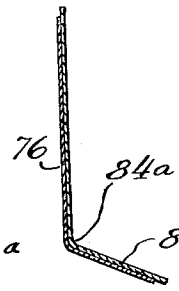


Fig. 16.

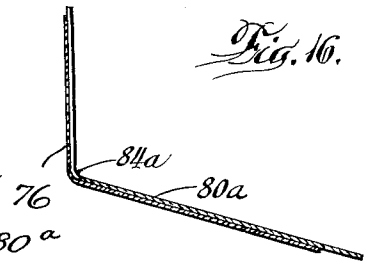


Fig. 17.

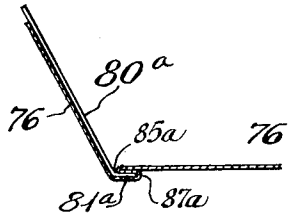


Fig. 18.

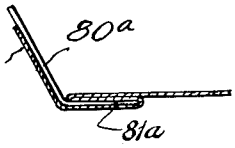


Fig. 19.

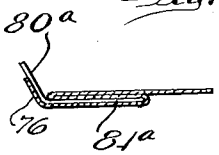


Fig. 20.

Fig. 21.

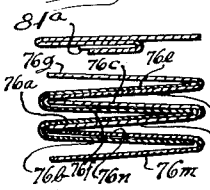


Fig. 22.

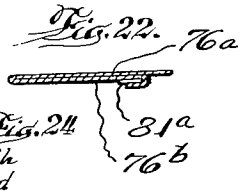


Fig. 23.

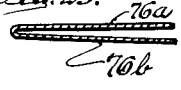


Fig. 24.

PAPER FOLDING MACHINE AND METHOD

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Fig. 25. (BLANK)

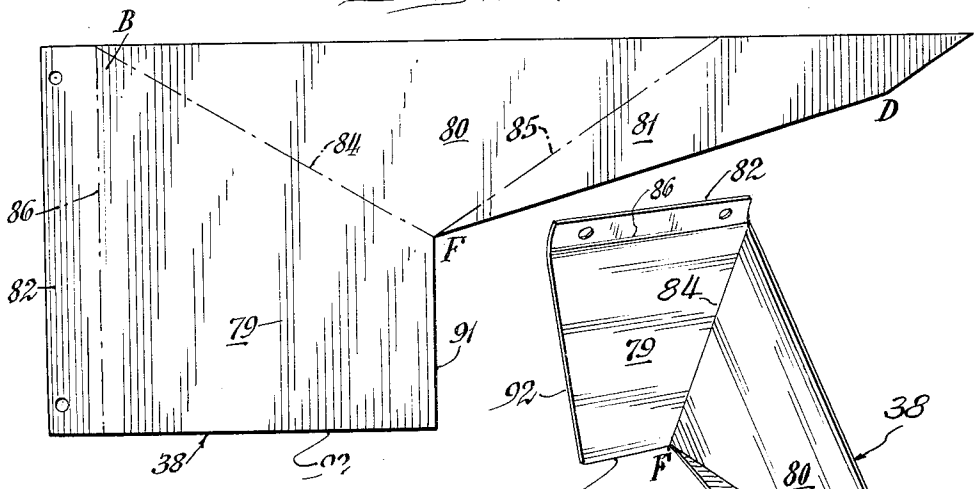



Fig. 27.

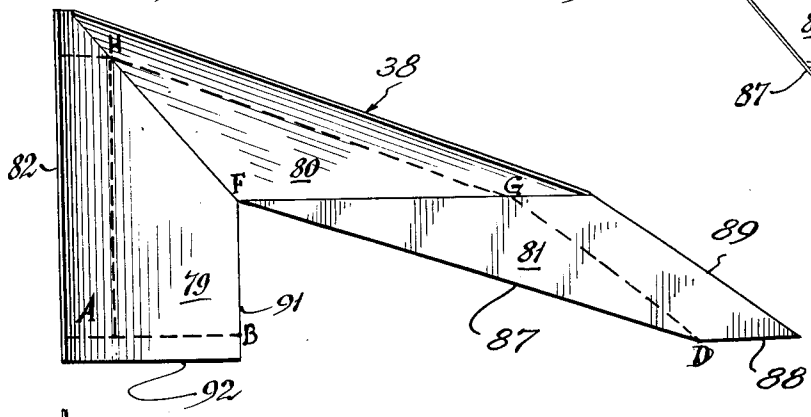
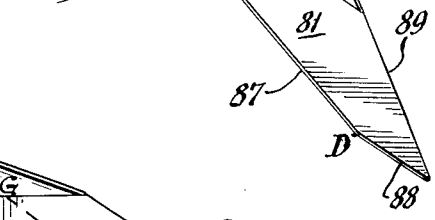



Fig. 26.



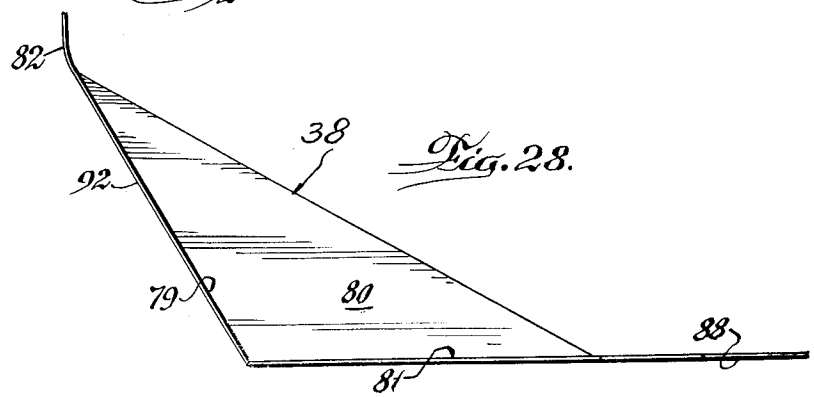




Fig. 28.

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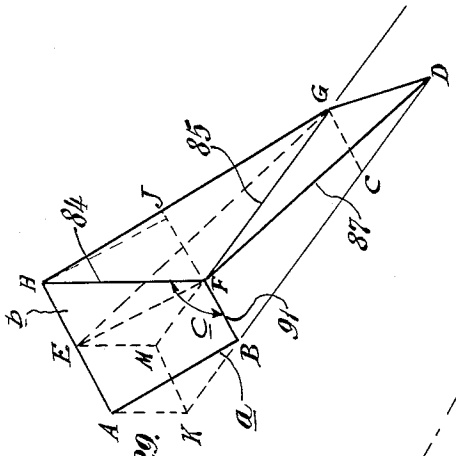


Fig. 29.

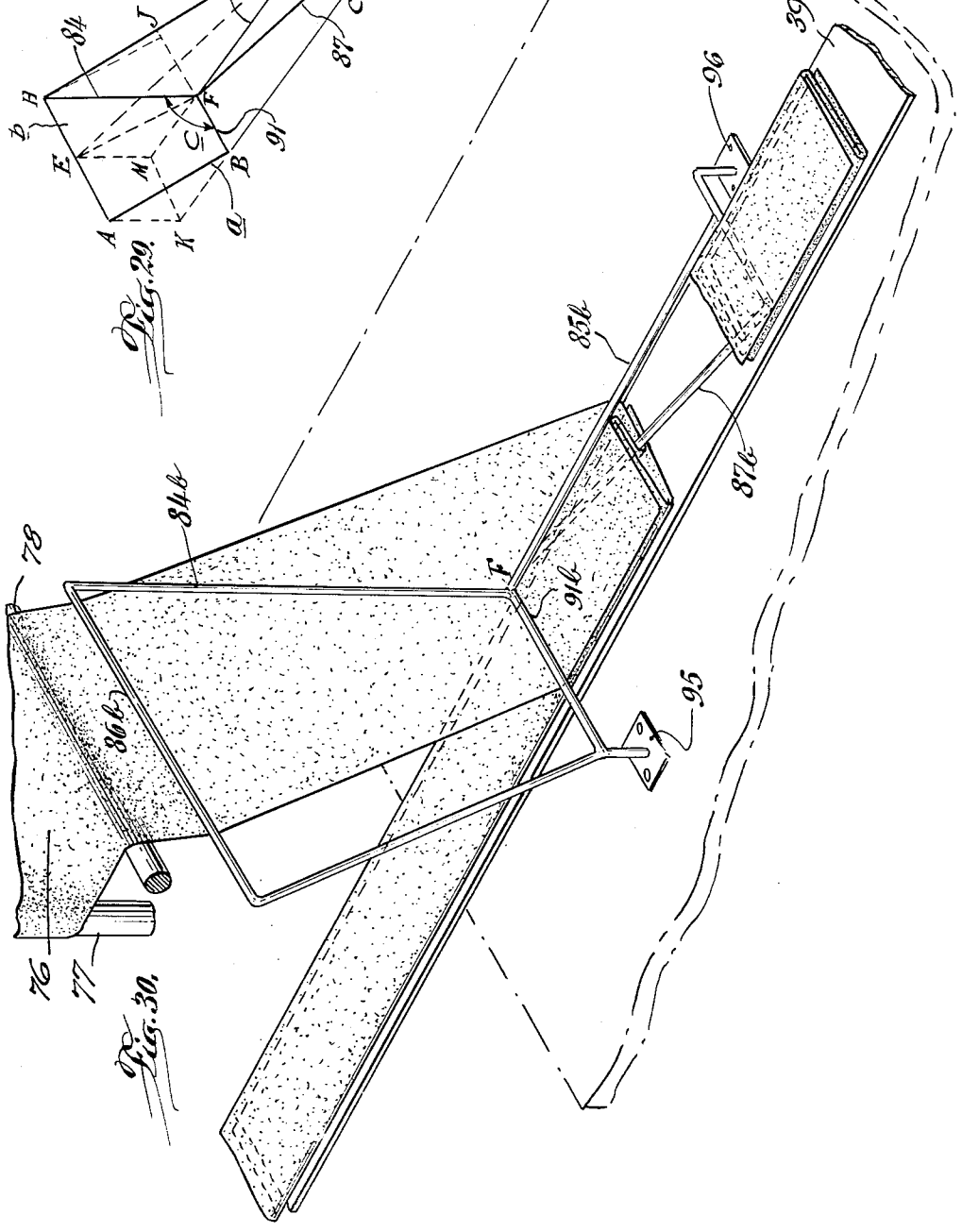


Fig. 30.

United States Patent Office 3,066,932 Patented Dec. 4, 1962



3,066,932

# PAPERFOLDING MACHINE AND METHOD

Charles J. Greiner, Menasha, and Harold V. Rutkus, Neenah, Wis., assignors to Kimberly-Clark Corporation, Neenah, Wis., a corporation of Delaware

Filed Sept. 3, 1959, Ser. No. 837,977
35 Claims. (Cl. 270—40)

Our invention relates to papermaking machines and particularly to machines for interfolding webs of paper or other sheet material.

Facial tissues composed of soft, absorbent paper are generally supplied in stacks within dispensing boxes or packages. The tissues may be interfolded, that is, folded so that portions of the top tissue on a stack underlie portions of the tissue underneath, and the boxes are generally provided with slots in their upper surfaces so that the tissues may be withdrawn from the boxes one at a time. The interfolding causes a portion of each succeeding tissue to be partially drawn through the slot, so that it is readily available, when the top tissue is drawn from the box.

Such stacks, or multiples of two or three such stacks which may be separated after interfolding, are generally produced individually by automatic machines. These machines fold an end portion of each individual sheet over an end portion of the preceding sheet, and due to the speed and sudden reversal of motions of parts required for such interfolding action, the machines are quite noisy. Furthermore, inasmuch as the individual stacks or multiples of two or three stacks only are produced at a time, the output of such machines is limited.

It is an object of the present invention to provide an improved method and apparatus for interfolding continuous webs of paper or like material which may be cut crosswise after interfolding is completed, in order to produce stacks of interfolded paper, such as tissues, in sizes to fit the conventional boxes or packages above referred to.

More particularly, it is an object of the invention to provide such an improved method and apparatus which retains the continuous webs being interfolded in full control at all times during the interfolding process so that the interfolding is accurate and fast.

Still more particularly, it is an object of the invention to provide such an improved method and apparatus by means of which a longitudinal half of a web of paper or the like is continuous folded underneath the other half, with a number of webs being successively folded with respect to each other, so that succeeding webs are folded underneath the top halves of previously folded webs to produce continuous stacked interfolded webs that may be subsequently cut crosswise to produce the interfolded individual stacks for use in the dispensing packages previously mentioned.

It is another object of the invention to produce an improved folding board over which a web may be drawn so as to continuously fold one-half of the web underneath the other half, whereby a succession of these folding boards may be utilized for providing the interfolded continuous webs mentioned above.

The invention consists of the novel constructions, arrangements, devices and methods to be hereinafter described and claimed for carrying out the above stated objects, and such other objects, as will be apparent from the following description of preferred forms of the invention and methods for interfolding webs, illustrated with reference to the accompanying drawings, wherein:

FIGURE 1 is a side elevational view of the main section of a web interfolding machine embodying the principles of the invention and which includes right-hand and left-hand folding boards disposed in upper and lower tiers;



FIGURE 2 is a side elevational view of the terminal section of the interfolder;

FIGURE 3 is a fragmentary plan view of the interfolder taken on an enlarged scale;

FIGURE 4 is a perspective view of a right-hand and a left-hand folding board, together with associated structure and web folded thereby, taken on a still greater enlarged scale;

FIGURE 5 is a perspective view of a left-hand folding board and associated structure and folded web on a further enlarged scale;

FIGURE 6 is a plan view of the left-hand folding board shown in FIGURE 5;

FIGURE 7 is an end view of a left-hand folding board together with a stack of previously folded webs and taken on line 7—7 of FIGURE 1;

FIGURE 8 is a perspective view of a right-hand folding board with associated other structure and folded web;

FIGURE 9 is a plan view of the right-hand folding board;

FIGURE 10 is an end view of a right-hand folding board with previously folded web;

FIGURE 11 is a side elevational view of a plurality of consecutive folding boards in the top tier with folded web;

FIGURE 11*a* is a continuation of FIGURE 11 showing additional folding boards in the top tier;

FIGURES 12 and 12*a* are side elevational views of folding boards in the lower tier;

FIGURE 13 is a side elevational view of a left-hand folding board with a web folded thereby;

FIGURES 14, 15, 16, 17, 18, 19, 20, 21, 22, and 23 are sectional views taken respectively on lines 14—14, 15—15, 16—16, 17—17, 18—18, 19—19, 20—20, 21—21, 22—22, and 23—23 in FIGURE 13 in the directions indicated;

FIGURE 24 is a sectional view of a plurality of webs interfolded by the illustrated interfolding machine;

FIGURE 25 is a plan view of a sheet metal blank prior to bending to form a right-hand folding board;

FIGURE 26 is a perspective view of a right-hand folding board;

FIGURE 27 is a plan view of the right-hand folding board shown in FIGURE 26;

FIGURE 28 is a side elevational view of the right-hand folding board illustrated in the preceding two figures;

FIGURE 29 is a schematic view of a right-hand folding board illustrating various dimensions of the board, and

FIGURE 30 is a perspective view of a modified form of folding board which is illustrated as a right-hand type.

Like characters of reference designate like parts in the several views.

Referring now to the drawings, the illustrated web interfolding machine may be seen to comprise, in general, upper and lower platforms **35** and **36**, a plurality of left-hand folding boards **37** (the ones specifically illustrated in FIGURE 1 being designated as **37***a*, **37***b*, **37***e*, **37***f*, **37***j*, and **37***k*) and a plurality of right-hand folding boards **38** (the ones specifically illustrated in FIGURE 1 being designated as **38***a*, **38***b*, **38***f*, and **38***g*) mounted alternately in upper and lower tiers on the platforms **35** and **36**, travelling endless belts **39** and **40** for the upper and lower platforms respectively, a driving wheel **41** on one end of the machine for the webbing being interfolded and for the upper belt **39**, a guillotine-type cutting mechanism **42** for the webbing, a supporting belt **43** for the webbing after being cut by the cutting

mechanism 42, and mechanical driving mechanism 44 for the driving wheel 41 and the belt 40.

The upper platform 35 is provided with a longitudinal slot 45 in it, and the upper pass of the belt 39 travels lengthwise in the slot. The belt 39 is supported on rollers 46 which in turn are rotatably supported with respect to the platforms 35, and the belt 39 also extends around a guide roll 47 and the drive wheel 41 as shown. The belt 40 extends through a similar slot 45 in the lower platform 36 and is supported by rollers 46 rotatably positioned with respect to the lower platform 36. The belt 40 also extends around a drive roll 48.

The driving mechanism 44 includes a motor 49, a variable speed transmission 50, a gear reducer 51, the drive roll 48, a variable speed transmission 52, a miter gear 53, and a second miter gear 54. The drive wheel 41 is driven by means of a sprocket 55 and a drive chain 56 from the miter gear 54, and the miter gear 54 is driven through a line shaft 57 from the miter gear 53. The miter gear 53, the transmission 52, the roll 48, the gear reducer 51, and the variable speed transmission 50 are driven from each other and from the motor 49 by means of drive chains 58, 59, 60, 61 and 62, respectively.

The cutting mechanism 42 comprises a plurality of cutter knives 63 positioned on a rotatable drum 64. Pressure feet 65 are fixed on the periphery of the drum 64, one in back of each of the knives 63, as shown. The knives 63 are movable radially with respect to the drum and are adapted to cooperate with a platen 66 positioned below the drum 64.

The belt 43 located behind the cutter mechanism 42 is supported by relatively small diameter rollers 67 and relatively large diameter end rolls 68. An endless belt 69 is disposed beneath an elongated shoe 70 above the belt 43 and extends around end rolls 71.

The interfolding machine utilizes a plurality of rolls 72 of the sheet material, such as paper tissue, which it is desired to interfold. One of these rolls 72 is provided for each of the folding boards 37 and 38, and the rolls are positioned on opposite sides of the platforms 35 and 36. Each of the rolls is supported by means of a shaft 73 extending through the roll and a back stand comprising a pair of uprights 74 and 75 supporting opposite ends of the shaft 73. The paper web 76 from each of these rolls extends around a guide bar 77 and a guide roller 78 onto the respective folding board. The roller 78 for each board is positioned at the upper edge of the board and is supported from the platform 35 or 36 on which the board is disposed. The respective guide bar 77 is also supported from this platform and extends at a 45 degree angle with respect to the belts 39 and 40, and the slots 45 in which the belts are disposed.

Referring to FIGURES 25 to 28 in particular, each of the right-hand folding boards 38 may be seen to comprise flat sheet metal portions 79, 80, and 81. The board includes also a flange portion 82, by means of which the board is attached to a suitable support 83, that in turn is fixed with respect to one of the platforms 35 and 36. The board may be made from a flat piece of sheet metal shown as a flat blank in FIGURE 25. The blank is bent along lines 84 and 85 to form the flat portions 79, 80, and 81 that extend at angles to each other, and the blank is bent along the line 86 to provide the upper fastening flange portion 82. As will be observed, the flat portion 81 is bounded by outer edges 87, 88 and 89 and by bend line 85; the flat portion 80 is bounded by the outer edge 90 and by bend lines 84 and 85; and the flat portion 79 is bounded by a lower edge 91, a side edge 92 and bend lines 84 and 86.

When the folding boards 38 are in place with respect to the platforms 35 and 36, the flat portions 81 are horizontal and parallel to the platforms and are spaced somewhat from the belts 39 and 40 carried by the platforms. Brackets 93 are fixed with respect to the flat portions 80 and are also fixed with respect to the platforms 35 and 36 for the purpose of holding the flat portions 81 in a position parallel to and spaced predetermined distances from the belts 39 and 40.



Each of the left-hand folding boards 37 is constructed similar to the folding boards 38 except that the metal bends are made on the left side instead of the right. Referring to FIGURES 5 and 6, it will be observed that the left-hand folding board 37 illustrated has flat portions 79*a*, 80*a*, and 81*a* corresponding to the portions 79, 80, and 81 of the boards 38. The board 37 is bent along the bend lines 84*a* and 85*a* which correspond to the bend lines 84 and 85 of the right-hand boards 38. The boards 37 are fixed in place by means of flanges 82*a* and brackets 93, and the board 37 has edge surfaces 87*a*, 88*a*, 89*a*, 90*a*, 91*a*, and 92*a* corresponding to the edges of 87 to 92 respectively of the boards 38.

In the operation of the interfolding machine, a web of paper 76 is drawn around each of the right-hand folding boards 38 and is folded by the board lengthwise of the paper into two thicknesses or folds each one-half the width of the unfolded web. Referring to FIGURES 8 and 9 showing right-hand folding board 38*a*, the paper web 76 is drawn over the bar 77 adjacent to the folding board and over the roller 78 adjacent the flange 82 of the board. The web then passes under the oblique flat portion 79, and the web is so positioned laterally on the roller 78 that its longitudinal center line passes directly underneath the point F which is at the junction of the bend lines 85 and 84 and the edge 91. The left half of the web 76, to the left of the point F as seen in FIGURE 8, travels forwardly longitudinally of the web underneath the lower folding edge 91 which is parallel with the platform on which the folding board is mounted. The right half of the web travels over the bend line 84, over the exterior surface of the flat portion 80, around the bend line 85, over the lower surface of the flat portion 81 so as to be turned under the left half of the web, 180 degrees around the edge 87 of the portion 81 so as to be reversed and thence forwardly over the upper surface of the flat portion 81 underneath the original left half of the web. In order that there may be no wrinkling of the web as its right half passes over the flat portions 80 and 81 and around the bend line 85 and edge 87, the distances lengthwise of the web between corresponding points along lines crosswise of the web during folding should remain the same. In order for this condition to obtain, we have found that each of the folding boards 38 should be constructed with dimensions and angles in a certain relationship to each other.

Referring to FIGURE 29, this figure illustrates the boundaries of the web as it passes over the various edges and bend lines of one of the right-hand folding boards 38. After passing over the roller 78, the web strikes the underside of the flat portion 79 on the horizontal line AH. The right edge of the web passes over the bend line 84 at the point H; it passes over the bend line 85 at a point G; and it passes over the edge 87 at the point D. The right half of the web extends from the point F to the web boundaries shown by the lines HG and GD, and the web passes over the edge 87 between the points F and D. The left edge of the web passes over the flat portion 79 along a line AB and extends horizontally along a line BD. The center of the web passes underneath the point F and passes over the horizontal line AH at the point E. The line FJ is perpendicular to the right edge of the web, and the line CG is perpendicular to the left edge of the web.

The angle *a* or ABK is the angle indicating the inclination from horizontal of the oblique back surface 79. The angle *b* or AHF is the angle from the horizontal line AH at which the bend line 84 extends, and the angle *c* is the supplement of angle *b* and is the angle BFH or the angle of the bend line 84 with respect to the edge 91.

The angles *a* and *b* and the distance EH, which is equal to one-half the width of the web, may be considered in-

dependent variables. The angle $a$ may vary between 0 and 180 degrees, and the angle $b$ may vary from 0 to 90 degrees. In order that there may be no stretching or loosening of the web as it passes over the folding board, mathematical analysis indicates that the distance FG should have the following relation with respect to one-half the width of the web which is the distance EH:

$$FG=\frac{EH\,(\cos a\cos b\pm\sqrt{\sin^2 a+\cos^2 a\cos^2 b})}{\sin^2 a\sin b}$$

or

$$FG=\frac{w\cos a\cos(180°-c)\pm\sqrt{\sin^2 a+\cos^2 a\cos^2(180°-c)}}{2\sin^2 a\sin(180°-c)}$$

where $w$ is the width of the web.

In the specific case in which both angles $a$ and $b$ are 60 degrees, then, $FG=EH$ (1.77).

With the distance FG being determined, the other distances in FIGURE 29 may be determined. It may be mathematically shown that $FG=GD$, since

$$AB+FG+CD=HJ+JG+GD$$

if there is to be no stretching of either edge of the paper when it proceeds from the horizontal line AH to the point D where the points originally at A and H now coincide. By substituting equal quantities, the equation becomes $FG+CD-JG+GD$; and subsequent mathematic simplification results in the equation $FG=GD$. Likewise, it can be shown by simplifying the original equation that

$$CD=JG$$

In view of the fact that the line FJ is perpendicular to the line HG and in view of the fact that the line CG is perpendicular to both lines FG and BD, with these additional identities, along with the relationship between FG and EH stated above, the other quantities in the FIGURE 29 diagram may be determined. Since FG equals GD, and the lines FG, GD, and FD are all in the same plane which is defined by the flat portion **81**, it will be apparent that the line FD constitutes the base of an isosceles triangle in which the two sides FG and GD are equal.

An actual folding board **38** is, for practical purposes, extended beyond the edges of the web; however, this involves no difficulty in view of the fact that the edge **92** of the flat portion **79** is parallel to the line AB; the exterior edge **90** of the oblique portion **80** is parallel to the line HG and the external edge **89** of the flat portion **81** is parallel to the line GD. Due to these extensions, the edge **88** is provided which is parallel to the bend line **85** and which, along with the bend line **85**, extend parallel to the direction of movement of the web at the edges of the web in its folded condition.

FIGURE 25 indicates a flat sheet metal blank from which a right-hand folding board **38** is bent. Its basic dimensions may all be obtained from the dimensions of the figure shown in FIGURE 29.

A left-hand folding board **37** may be constructed from the same blank as a board **38** and which is shown in FIGURE 25, the difference being that the bends are made oppositely.

In operation, the motor **49** drives the belt **40** through the variable speed transmission **50**, the gear reducer **51**, and the roller **48**. The belt **39** is driven from the roller **48** through the transmission **52**, the miter gears **53** and **54**, the sprocket **55**, and the drive wheel **41**. The speeds of the two belts **39** and **40** may be made substantially the same by adjustment of the transmission **52**.

A paper web **76** extends from the roll **72** adjacent the first left-hand folding board **37***a* at the left end of the upper platform **35** as seen in FIGURE 1, over the bar **77** and the roller **78** adjacent this folding board, and underneath the board **37***a*. The roll **72** is axially adjusted so that the center of the web **76** passes directly underneath the point F at the intersection of the edges **87***a*, **85***a* and **91***a* of the folding board; and the paper web in being drawn around the bend lines **84***a* and **85***a*, the flat portions **80***a* and **81***a*, and the edge **87***a* has its left half folded under its right half substantially as shown in FIGURES 5, 6 and 14 to 22 to form an upper fold **76***a* and a lower fold **76***b*. It will be observed more particularly from FIGURES 14 to 22 that the right half of the web travels directly down the oblique portion **79***a*, and after it passes the lower edge **91***a* of the flat portion **79***a*, it continues its travel horizontally on top of the flat portion **81***a*. The left half of the web is initially completely travelling on the oblique flat portion **79***a* and subsequently moves onto the oblique flat portion **80***a*. The left half continues to travel along the outer surface of the flat portion **80***a* and after passing the point F, begins to travel also on the bottom surface of the flat portion **81***a*. As the web continues, it travels around the oblique edge **87***a*, and this edge is initially effective at the point F.

The left edge of the web travelling over the folding board **37***a* first crosses the bend **84***a* and travels on to the portion **80***a*, preceding other lateral points on the web toward its center, which cross the bend **84***a* at points closer to the center point F. The left edge of the web travels the longest distance over the portion **80***a*, and points closer to the center of the web travel shorter distances depending on their spacing from the center of the web. Points closest to the center of the web in its left half travel across the bend **85***a* sooner than do points farther out in this portion of the web, and points at the left edge of the web travel last across the bend **85***a*. Likewise, as the web travels forwardly, points closer to the center on the left edge of the web travel first beneath the horizontal surface **81***a* and are first folded 180 degrees around the edge **87***a*, and the edge **87***a* is effective from its beginning at the point F to its ending at the point D on the board to fold the remaining width of the web, so that its original left-hand edge is underneath its right-hand edge when the web reaches the point D.

The oblique edge **87***a* thus functions to reposition the original left half of the web toward the right edge of the web and underneath the right half of the web, and, since it extends for one-half the original width of the web and for the effective length of the board is continuously effective to completely turn the left half of the web underneath the right half of the web as the web continues to pass under the board. As shown in FIGURE 23, the web has been folded back upon itself to form the upper and lower folds **76***a* and **76***b* when the web has proceeded beyond the end of the folding board **37***a*. The belt **39** is effective for drawing the web underneath the left-hand folding board **37**; and the web, as so folded, extends around the wheel **41** and onto the belt **40** which also pull the web toward the cutter **42**. Other webs will be interfolded and positioned above the web from the first folding board **37***a* before the web from this board reaches the wheel **41** as will be described.

As is shown in FIGURE 3, the left-hand and right-hand folding boards are staggered with respect to each other so that the points F on the boards lie at opposite edges of the belt **39** or **40**, and the fold lines **85** and **85***a* and the edges **88** and **88***a* are just above and co-incident with the edges of the belts and are at the edges of the folded webs. The paper rolls **72** are so adjusted axially on their shafts **73** that the right half of the web travelling over each left-hand folding board **37** is in alignment with the belt underneath, and the left half of each web travelling over a right-hand folding board **38** is aligned with the belt.

The folded web from the first left-hand folding board **37***a* is positioned with its upper fold **76***a* over the hori-

zontal portion 81 of the succeeding right-hand folding board 38*a* as illustrated in FIGURES 4 and 8. The web 76 for the first right-hand folding board 38*a* travels over the bar 77 for this board and the roller 78 adjacent to the board. The web travels under the board 38*a*, and the board 38*a* functions similarly to the board 37*a* ahead of it, except that the fold is made oppositely. The belt 39 draws the web from the first folding board 37*a* forwardly, and the web 76 from the second folding board 38*a* is drawn by friction forwardly along with the web from the first board 37*a*.

The left-hand half of the web for the board 38*a* travels down the under surface of the portion 79 of the board and under the edge 91 of the board and continues its forward motion horizontally. The right half of the web travels down the under surface of the portoin 79, around the bend 84, on the under surface of the portion 80, over the bend 85, underneath the horizontal portion 81, and around the folding edge 87, so that the right half is folded underneath the left half of the web to produce an upper fold 76*c* and a lower fold 76*d*.

As has been explained, the folded web 76 from the first folding board 37*a* is originally positioned so that its upper fold 76*a* is above the horizontal surface 81 of the succeeding right-hand folding board 38*a*, and its lower fold 76*b* is positioned underneath the portion 81 of this board. The fold 76*b* is the part of the web actually in contact with the belt 39 for drawing the web forward. The right half of the web 76 travelling under the first right-hand folding board 38*a* is folded by the horizontal portion 81 of this board and is in contact with it; and since the portion 81 is between the web folds 76*a* and 76*b*, the right half of the web 76 travelling around this board 38*a* thus is positioned between the folds 76*a* and 76*b* as fold 76*d*. The left half of the web 76 travelling over the first right-hand folding board 38*a* is applied to the web stack as it travels over the edge 91 on the top of the fold 76*a* and appears as the fold 76*c* (see FIGURE 24). Thus, the left-hand folding board 37*a* has produced a folded web with its crease at the left as seen in FIGURE 24 and with folds 76*a* and 76*b*, and the following first right-hand folding board 38*a* has produced a folded web with its crease on the right side as seen in FIGURE 24 and with its lower fold 76*d* disposed between the folds 76*a* and 76*b* and with its upper fold 76*c* above the upper fold 76*a* produced by the first left-hand folding board 37*a*.

The webs 76 from the first boards 37*a* and 38*a* pass underneath the horizontal portion 81*a* of the second left-hand board 37*b* with the exception of the top fold 76*c* which passes over the top of the portion 81*a*. The board 37*b* functions the same as the board 37*a* in providing a creased web which is folded at the left side as seen in FIGURE 24 with one fold being directly underneath the flat portion 81*a* which, in this case, is immediately below the fold 76*c*. The folding board 37*b* thus produces a web 76 with folds 76*e* and 76*f*, with fold 76*e* being on top of the stack of webs and fold 76*f* lying directly underneath the previous top fold 76*c*.

Likewise, the second right-hand folding board 38*b* has the top fold 76*e* from the preceding folding board passing over the top of its flat horizontal portion 81, and this folding board, like the preceding right folding board 38*a*, produces a top fold 76*g* overlying all other folds and a lower fold 76*h* positioned just underneath the fold 76*e* which is the previous top fold, with the crease in the paper being to the right as seen in FIGURE 24.

Each succeeding folding board in the upper tier on the platform 35 has the same action, namely, it produces a top fold on top of all other folds from the preceding boards, and it produces a lower fold positioned just underneath the top fold from the preceding board. The left-hand folding boards produce webs folded on the left as seen in FIGURE 24, and the right-hand folding boards produce webs folded on the right as seen in this figure. Although, as many of these folding boards may be positioned on the upper platform as desired, it is contemplated that preferably half of the total number of folding boards shall be positioned on the top platform and the other half on the lower platform 36.

Assuming that half the folding boards are on the top platform 35 and the other half on the lower platform 36, half of the webs in the completed stack will have been interfolded by the time the webs reach the wheel 41. The interfolded webs at this time will appear as seen in the portion A of the stack of webs shown in FIGURE 7, but they will be inverted. The webs travel around with the wheel 41, and the wheel pulls the webs, augmenting the action of the belt 39 in drawing the webs from the rolls 72 and over the folding boards on the upper platform 35. The interfolded webs are then passed onto the lower belt 40 and under the folding boards on the lower platform. The webs from the upper platform are inverted by the wheel 41 and appear as the portion A of the stack of webs shown in FIGURE 7. The first folding board on the lower platform 36 is of the same type as the first folding board on the upper platform 35. In the illustrated case, the first board on the upper platform 35 is the left-hand board 37*a* so, therefore, the first board on the lower platform 36 is a left-hand board 37*f*.

The lowermost fold on the upper platform, namely the fold 76*b*, is the uppermost fold when the stack of interfolded tissues is inverted by the wheel 41, and the uppermost fold 76*b* passes over the flat portion 81*a* of the left-hand board 37*f*. The left-hand board 37*f* functions the same as the preceding left-hand boards in providing a folded web having its crease on the left, with the view being taken looking back toward the folding board, the board producing an upper fold 76*m* which is on top of all preceding folds and a lower fold 76*n* which is immediately beyow the fold 76*b* that passes over the horizontal flat portion 81*a* of the board.

Each succeeding left-hand folding board and each succeeding right-hand folding board has the same action as the preceding boards of the same type, namely producing a top fold overlying the previous folds and producing a bottom fold just underlying the previous top fold, with the folding boards on the lower platform 36 operating to build up the stack of interfolded tissues from the bottom of the stack as it appeared on the uppermost platform and providing the portion B of the stack as it appears in FIGURE 7.

The stack of interfolded webs is complete by the time the webs pass the last folding board 37*k*. It will be understood that all of the webs are continuous from the rolls 72 from which the webs are drawn up to this point, each of the webs passing from one of the rolls, over a bar 77 and roll 78, and over one of the folding boards. As will be apparent, each of the folding boards produces a longitudinally folded web which is interfolded with and added on to the folded webs produced by the previous boards, and with the folding boards on the lower platform 36 being effective to add interfolded webs onto the portion of the stack which is on the bottom at the upper platform.

Interfolded webs pass from the belt 40 into the cutter 42. The drum 64 is rotated by any suitable mechanism and may augment the action of the belt 40 in drawing the webs forwardly. Each time that one of the pressure feet 65 becomes aligned with the platen 66, the associated knife 63 is moved radially outwardly toward the platen 66 so as to cut the interfolded webs 76 into clips or individual stacks 94 of interfolded paper. These clips pass forwardly between the belts 43 and 69 and underneath the shoe 70, and upon emerging from between the two belts 43 and 69, the stacks may be suitably packed. The pressure feet 65 of the cutting mechanism 42 function to compress the interfolded webs; and the

shoe 70, which is effective on a plurality of successive stacks 94, functions to hold the stacks compressed for a sufficient time so that they retain their compressed height when subsequently released by the shoe.

It is contemplated, in particular, that the paper web 76 may be that used for well-known facial tissue, which is relatively soft and compressible; and the shoe 70 is thus effective in giving a permanent set to the stacks 94. The stacks when removed from between the two belts 43 and 69 may be packed into the usual dispensing boxes for such facial tissues which have a dispensing slot in the top surface and which allow the tissues from the stack in the box to be removed one at a time through the slot. During such dispensing, the frictional contact between adjacent folds of the tissue pull the sheets one by one from the box, so that, as one sheet is removed, the sheet below it is partially pulled through the slot in the box and is readily available for use.

As is apparent from the foregoing description, the important parts of each of the folding boards are the folding lines and folding edges. If it is desired to make the boards out of material other than sheet metal, such as of rods, this can be done; and the flat portions 79, 80 and 81 and the flat portions 79*a*, 80*a* and 81*a* may be dispensed with. A right-hand folding board is illustrated in FIGURE 30 which is made from metal rods and which functions in the same manner as do the sheet metal folding boards 38, since the folding lines and folding edges are retained.

The folding board shown in FIGURE 30 comprises rod portions 86*b*, 84*b*, 91*b*, 87*b* and 85*b* fixed together at a point F. The rod portion 86*b* is in the same position as the fold line 86 and functions to initially guide the full width of the web. The rod portion 84*b* is in the same position as is the fold line 84 and provides a guide for the right half of the paper web. The rod portion 85*b* extends horizontally at the right edge of the interfolded webs and functions to guide the right half of the web. The rod portion 87*b* corresponds to the edge 87 and extends diagonally across the width of the interfolded webs so as to serve as a diagonal folding edge. The rod portion 91*b* extends transversely of the left half of the web to fold the left half of the paper. The top fold of a web from a preceding folding board extends over and is supported by the diagonal rod portion 87*b* in order that interfolding may take place. The rod portions 86*b*, 84*b*, 91*b*, 85*b*, and 87*b* function in the same manner as the edges and fold lines 86, 84, 91, 85 and 87 in the folding boards 38. The right-hand folding board illustrated in FIGURE 30 may be supported in any suitable manner as from plates 95 and 96 fixed on one of the platforms 35 or 36. A left-hand folding board, as is apparent, may be made from rod portions in the same manner as the illustrated right-hand board shown in FIGURE 30 except that the parts are reversed so that the rod portions will correspond to and extend in the same directions as the edges and fold lines 86*a*, 84*a*, 91*a*, 85*a* and 87*a*.

Although the longitudinal centers of the paper webs have been described as passing underneath the points F of the folding boards, it will be apparent that if unequal folds of the paper are desired for any reason, the paper rolls may be moved axially. For example, the roll 72 for the folding board 37*a* as shown in FIGURE 4 could be moved to the right, so that the lower fold 76*b* is narrower than the upper fold 76*a*.

The paper interfolding machine above described advantageously produces interfolded stacks of paper, such as facial tissue, with a minimum of noise. The interfolding action is continuous, and there are no oscillating or rapidly moving parts that would cause undue noise. In view of the fact that folding boards, which may be simply pieces of sheet metal properly bent, are utilized for the interfolding action, the machine as a whole is relatively cheap. Due to the lack of complicated mechanism, actions and moving parts, the machine may be economically maintained in operating condition.

In the illustrated machine, the webs being folded are folded toward the bottom, that is, the upper halves of the webs proceed along the lines of travel of the belts, and the other halves are turned under the top halves. The parts of the web being folded under are maintained taut around the surfaces and edges of the folding boards, and the other parts of the web, as well, also remain taut about the folding boards. The folding boards of the invention, constructed according to the formulae given above, have their surfaces and folding edges of such relative magnitudes that all longitudinal fibers of the webs, as the webs pass around and are folded by the boards, have the same tension, across the full widths of the webs. There is thus no tendency for the webs to be stretched or compressed on any of their longitudinal fibers, and the webs thus do not wrinkle as they pass around the folding boards. The webs are thus under full control at all times, and there is thus no possibility of poor and inaccurate interfolding due to lack of control of the portions of the webs being folded.

We wish it to be understood that the invention is not to be limited to the specific constructions and arrangements shown and described, except only insofar as the claims may be so limited, as it will be understood to those skilled in the art, that changes may be made without departing from the principles of the invention.

What is claimed is:

1. A folding device for folding a web of sheet material which is drawn over the device and emerges from the device in a folded condition in a predetermined path, comprising a folding edge extending from a point at an edge of the path transversely across the path, a second folding edge extending from said point parallel with said path edge, a third folding edge extending from said point obliquely of said path to the other edge of the path, and a folding fourth edge extending from said point outwardly and obliquely at an obtuse angle with respect to said first named edge whereby a longitudinal fold of said web may be drawn over said first named folding edge in said path and another fold of said web may be drawn over said other folding edges and thereby folded under said first-named fold to provide a folded web.

2. A folding device for folding a web of sheet material which is drawn over the device and emerges from the device in a folded condition in a predetermined path, comprising a web carrying surface extending at an angle to said path and terminating at a folding edge extending from a point at an edge of the path transversely across the path, a second folding edge extending from said point obliquely of said path to the other edge of the path, and a surface connecting said first named surface with said second folding edge whereby a longitudinal fold of said web may be drawn under said first named folding edge in said path and another fold of said web may be drawn over said surfaces and said second folding edge to be thereby folded under said first named fold to provide a folded web.

3. A folding device for folding a web of sheet material which is drawn over the device and emerges from the device in a predetermined path comprising a first web carrying surface terminating in a first folding edge extending from a point at an edge of the path transversely across the path and also terminating in a second folding edge extending from said point at an obtuse angle with respect to said first folding edge, a second web carrying surface lying parallel to the path and terminating in a third folding edge extending from said point parallel with said path edge and terminating also in a fourth folding edge extending from said ponit obliquely of said path to the other edge of the path, and a third web carrying surface terminated by said second and third folding edges, whereby a longitudinal fold of said web may be drawn over said first folding edge in said path and over said first

surface and another fold of said web may be drawn over said other folding edges and said other surfaces to be thereby folded under said first mentioned fold to provide a folded web.

4. A folding device for folding a web of sheet material comprising first, second, and third folding edges extending from a common point in a single plane, said first and third folding edges being at right angles with each other and said second folding edge extending between said first and third folding edges, and a fourth folding edge extending from said point at angles to said second and third folding edges and at an obtuse angle with respect to said first folding edge.

5. A folding device for folding a web of sheet material comprising first, second, and third folding edges extending from a common point in a single plane, said first and third folding edges being at right angles with each other and said second folding edge extending between said first and third folding edges, and a fourth folding edge extending from said point at angles to said second and third folding edges and at an obtuse angle with respect to said first folding edge, said second and third folding edges being defined by a flat part of sheet material, said fourth and third folding edges being defined by a second part of sheet material, and said first and fourth folding edges being defined by a third part of sheet material.

6. A folding board for a web of sheet material comprising a sheet metal part which is bent along two lines from a point on its edge to provide first and second folding edges, said part having two exterior edges extending from said point providing third and fourth folding edges, said second, third, and fourth folding edges lying in a common plane with said second and third folding edges being at right angles to each other and said fourth folding edge lying obliquely between said second and third folding edges, said first folding edge extending at angles with respect to said second and fourth folding edges and being at an obtuse angle with respect to said third folding edge.

7. A folding device for folding a web of sheet material which is drawn over the device and emerges from the device in a folded condition in a predetermined path comprising a piece of sheet material which is bent along first and second bend lines extending from a point at the edge of the sheet material piece so as to provide first and second folding edges, said sheet metal piece having two external edges extending from said point providing third and fourth web folding edges, said second and fourth folding edges being defined by a first plane part of said piece which lies above said path and parallel to it with said second edge extending along the edge of the path, said third folding edge lying across said path and defining a second plane part of said sheet material piece along with said first folding edge which extends at angles to the path, and said first and second folding edges defining a third plane part of said piece, whereby a longitudinal fold of said web may be drawn over said second part and under said third folding edge in said path and another longitudinal fold of said web may be drawn over said first, second and fourth folding edges and over said parts to be folded over said first named fold to provide a folded web.

8. A folding board for folding a web of sheet material which is drawn over the board and emerges from the board in a folded condition in a predetermined path comprising a surface extending at an angle with respect to said path on which the web may be drawn from a source of web supply and terminating in a folding edge extending transversely across the path across which a longitudinal fold of the web may be drawn, and a series of other surfaces and folding edges the last of which extends obliquely across the path and which are so arranged to fold a second fold over the first mentioned fold with all points of the web having the same over-all distance of travel in both folds as the web travels over the folding board.



9. A folding board for folding a web of sheet material which is drawn over the board and emerges in a folded condition in a predetermined path, comprising a first folding edge extending from a point at an edge of the path transversely across the path, a second folding edge extending from said point parallel with said path edge, a third folding edge extending from said point obliquely of said path to the other edge of the path, and a fourth folding edge extending from said point outwardly and obliquely at an angle $c$ with respect to said first edge, said first and fourth folding edges defining a first plane surface extending at an angle $a$ with respect to said path, said second and third folding edges defining a second plane surface parallel with said path, and said second and fourth folding edges defining a third plane surface, said third folding edge constituting the base of an isoceles triangle wherein each of the triangle sides is equal to the following quantity defined in the terms of said angles $a$ and $c$ and the width $w$ of the web:

$$\frac{w\left[\cos a \cos (180°-c) \pm \sqrt{\sin^2 a + \cos^2 a \cos^2 (180°-c)}\right]}{2 \sin^2 a \sin (180°-c)}$$

10. A machine for interfolding webs of sheet material to produce a continuous stack of webs traveling in a predetermined path comprising a plurality of successive folding boards, and mechanism for drawing webs from web supply rolls over said boards and along said path, each of said boards comprising a folding edge extending directly across the path over which a longitudinal fold of web may travel from the respective web roll and having a second folding edge extending diagonally across the path and surfaces for transferring another longitudinal fold of the web on to said second folding edge over which the fold is reversed so that each board produces one fold below the other, said diagonally extending folding edge of each board after the first being adapted to have a fold produced by the preceding board pass over it so that each successive board produces a fold underlying a fold from the previous board, said folding edges and surfaces of each board being so disposed that the distances between corresponding points across the width of the respective web remain the same as the web passes over the board.

11. In a machine for interfolding webs of sheet material to produce a continuous stack of webs travelling in a predetermined path which is substantially half the width of the web, a plurality of folding boards, and means for drawing sheet material webs across said boards from respective web supply rolls, each of said boards having a first plane surface over which the full width of a web travels from a supply roll, said first plane surface being defined by a first folding edge extending directly across the path and across which a web fold travels longitudinally of the path and by a second folding edge extending at an obtuse angle with respect to said first folding edge, a second plane surface extending above and parallel to the path and defined by a third folding edge lying parallel with an edge of the path and a fourth folding edge lying diagonally across the path, said second and fourth folding edges defining a third plane surface joined to the other plane surfaces whereby another fold of the web may travel around said second and third plane surfaces and the folding edges defining the surfaces so as to be folded under the first named fold, said second plane surface of each folding board after the first board being adapted to have the upper fold of the web from the previous folding board extending thereover so that each succeeding board is effective to provide a fold from the board both on top of and underneath the top fold produced by the previous folding board thereby producing a continuous stack of interfolded webs.

12. In a machine for interfolding webs of sheet material to produce a continuous stack of interfolded webs travelling in a predetermined path, means for drawing said webs along said predetermined path and including

a driving wheel effective on the webs, a first folding board having a first plane surface over which a full width of web passes from a source of web supply defined by a first folding edge over which one-half of the web passes to produce an upper fold and defined by a second folding edge extending at an angle with respect to said first edge, a second plane surface extending over and parallel with said path and having a third folding edge extending parallel with an edge of the path and a fourth folding edge extending diagonally across the path, and a third plane surface defined by said second and third folding edges, whereby the other half of the web passes around said second and third plane surfaces and their folding edges so as to be folded under said first named fold, and a plurality of succeeding folding boards each having the same parts and folding edges as said first folding board and having the top fold from the previous board overlying the said second plane surface of the succeeding board so that each succeeding board is effective to produce folds both above and below the top fold produced by each preceding folding board thereby to produce a stack of continuously interfolded webs, and a cutter mechanism for cutting said continuous stack of interfolded webs into segments.

13. In a method of producing interfolded webs of sheet material, the steps which comprise, folding a web of sheet material longitudinally of the web to produce first and second exterior folds travelling in overlapped condition in a predetermined path with a longitudinal fold line on one edge of said path by drawing said first fold forward longitudinally of the web in said path and turning said second fold underneath said first fold from said path edge and then drawing said second fold across a straight edge which lies obliquely of said path and underneath said first fold and which reverses said second fold, and continuously longitudinally folding succeeding webs in the same manner as aforesaid having fold lines alternately on opposite edges of said path with the first fold of each preceding web travelling above the straight edge for the succeeding web so that the second fold of the succeeding web is positioned below the first fold of the preceding web.

14. In a method of producing interfolded webs of sheet material, the steps which comprise, folding a web of sheet material longitudinally of the web to produce first and second folds travelling in overlapped condition in a predetermined path with a longitudinal fold line on one edge of said path by drawing said first fold forward longitudinally of the web in said path and drawing said second fold across a first straight edge substantially coextensive with said fold line to thereby turn said second fold underneath said first fold from said path edge and subsequently drawing said second fold across a second straight edge lying obliquely of said path from said path edge and underneath the first fold, and continuously longitudinally folding succeeding webs in the same manner as aforesaid and alternately from opposite edges of said path with the two straight edges for each succeeding web extending alternately from opposite edges of said path and with the first fold of each preceding web travelling above the said second straight edge for the succeeding web so that the second fold of the succeeding web is positioned underneath the first fold of the preceding web.

15. In a method of producing interfolded webs of sheet material, the steps which comprise, folding a web of sheet material longitudinally of the web to produce first and second folds travelling in the overlapped condition in a predetermined path with a longitudinal fold line on one edge of said path by drawing said first fold forward longitudinally of the web in said path and folding said second fold underneath said first fold from said longitudinal fold line by successively drawing said second fold around first and second and third straight edges, said first straight edge extending from a point on said longitudinal fold line outwardly and obliquely at an obtuse angle wtih the longitudinal fold line and said second straight edge extending from said point substantially coextensively with said fold line and said third straight edge extending diagonally across and within said path from said point and underneath the first fold, and continuously longitudinally folding succeeding webs in the same manner as aforesaid and alternately from opposite edges of said path with said points from which said straight edges are disposed being alternately on opposite edges of said path with the first fold of each preceding web travelling above said third straight edge for the succeeding web so that the second fold of the succeeding web is positioned below the first fold of the preceding web.

16. In a method of producing interfolded webs of sheet material, the steps which comprise, folding a web of sheet material longitudinally of the web to produce first and second exterior folds travelling in overlapped condition in a predetermined path with a longitudinal fold line on one edge of said path by drawing said first fold forward longitudinally of the web in said path beneath a first straight edge extending from a point on said path edge directly across the path and turning said second fold underneath said first fold from said path edge by successively drawing said second fold across second and third and fourth straight edges, said second straight edge extending from said point outwardly and obliquely at an obtuse angle with respect to said path edge and said third straight edge extending substantially coextensively from said point with said path edge and said fourth straight edge extending from said point diagonally across and within said path and below said first fold and continuously longitudinally folding succeeding webs in the same manner as aforesaid and alternately from opposite edges of said path with said points from which said straight edges are disposed being alternately on opposite edges of said path for succeeding webs with the first fold of each preceding web travelling above the said fourth straight edge for the succeeding web so that the second fold of the succeeding web is positioned below the first fold of the preceding web.

17. A machine for interfolding webs of sheet material to produce a continuous stack of webs travelling in a predetermined path and comprising a plurality of successive folding devices disposed in a series and spaced from each other, mechanism for drawing a web from a web supply roll for each of said devices and along said path, each of said devices comprising a folding edge extending directly across the path over which a first web fold travels from the respective web roll and a second folding edge extending diagonally across the path and underneath said first fold and additional edges for transferring a second longitudinal web fold onto said second folding edge over which the fold is reversed so that each device produces one fold below the other, said diagonally extending folding edge of each said device after the first being having a fold produced by the preceding said device passing over it so that each successive said device produces a fold underlying a fold from the previous said device.

18. In a method of producing interfolded webs of flexible sheet material, the steps which comprise, continuously longitudinally folding a web of the sheet material into a pair of overlapping folds that are in substantial contact, and continuously longitudinally folding a second web of the sheet material and inserting a fold of said second web between the folds of said first named web so that said second web embraces a fold of said first named web after separating the folds of said first named web to permit such insertion.

19. In a method of producing interfolded webs of flexible sheet material, the steps which comprise, continuously longitudinally folding a web of the sheet material into a pair of overlapped folds that are in substantial contact to provide a stack of web folds, and continuously

longitudinally folding each of a series of subsequent webs of the sheet material and inserting a fold of each said subsequent web between an exterior fold of the stack of web folds produced by prior webs and the other folds of the stack so that each of asid subsequent webs embraces said exterior fold after separating said exterior fold with respect to said other folds to permit such insertion.

20. In a method of producing interfolded webs of flexible sheet material, the steps which comprise, continuously longitudinally folding a web of the sheet material into a pair of overlapping folds that are in substantial contact to provide a vertical stack of web folds while drawing the folds along a substantially horizontal path, and continuously longitudinally folding each of a series of subsequent webs of the sheet material and inserting a fold of each said subsequent web between the top fold of the stack of web folds produced by prior webs and the other folds of the stack so that each of said subsequent webs embraces said top fold after separating said top fold from said other folds in the stack to permit such insertion.

21. In a method of producing interfolded webs of flexible sheet material, the steps which comprise, utilizing a plurality of the sheet material webs having passes thereof extending in a row with alternate ones of the webs laterally staggered with respect to the others, continuously longitudinally folding a first one of the webs to produce a pair of exterior folds that are in substantial contact and moving it in folded condition in a path parallel with said row, laying a first fold of a second of said webs on the top of and in substantial contact with an exterior fold of the first web, continuously longitudinally folding the second web and at the same time inserting the second fold of the second web under said last named exterior fold of said first web after separating said last named exterior fold from the fold beneath it to permit such insertion, and laying on and folding under in the same manner folds of third, fourth and sequential webs one after the other with respect to the stack as completed by the preceding web to form a stack of interfolded webs travelling along said path.

22. In a method of producing interfolded webs of flexible sheet material, the steps which comprise, continuously longitudinally folding a web of the sheet material into a pair of overlapping folds that are in substantial contact to provide a stack of web folds, continuously longitudinally folding each of a series of subsequent webs of the sheet material, separating the folds of the previously folded web of the stack of web folds and inserting a fold of each subsequent web into said stack of web folds as permitted by said separation, and laying the other fold of each of said subsequent webs onto an exterior surface of the stack of web folds as completed by the previous webs so as to build up the stack of folded webs.

23. In a method of producing interfolded webs of flexible sheet material, the steps which comprise, continuously longitudinally folding a web of the sheet material at a certain station into a pair of overlapping folds that are in substantial contact so as to provide a stack of web folds while drawing the web past said station, and continuously longitudinally folding a series of subsequent webs and positioning such webs one at a time on said stack at a series of stations spaced from each other and from said first named station while drawing said subsequent webs past said series of stations with the resulting folds of each said subsequent web being positioned on opposite sides of and in contact with exterior folds of said stack to embrace the latter fold after separating said last named exterior fold from the remainder of the stack of web folds so as to permit the insertion of a fold of each said subsequent web between said last named exterior fold and the remainder of the stack.

24. In a method of producing interfolded webs of flexible sheet material, the steps which comprise, continuously longitudinally folding a web of sheet material into a pair of overlapping folds by drawing one of the folds in a predetermined path and turning the second fold to extend across said first fold and drawing said second fold across a turning edge which lies obliquely of said path and which reverses said second fold so that the second fold also travels in said path, and continuously longitudinally folding succeeding webs in the same manner as aforesaid with the said obliquely extending folding edge for each succeeding web being disposed between the folds of the preceding web so that a fold of the succeeding web is positioned between the folds of the preceding web.

25. In a method of producing interfolded webs of sheet material, the steps which comprise, folding a web of sheet material longitudinally of the web to produce first and second exterior folds travelling in overlapped condition in a predetermined path with a longitudinal fold line on one edge of said path by drawing said first fold forward longitudinally of the web in said path and turning said second fold to extend across said first fold from said path edge and then drawing said second fold across a folding edge which lies obliquely of said path and which reverses said second fold, and continuously longitudinally folding a succeeding web in the same manner as aforesaid having a fold line on the opposite edge of said path with the said folding edge for the succeeding web being disposed between the first and second folds of the preceding web so that the second fold of the succeeding web is positioned between the first and second folds of the preceding web.

26. In a method of producing interfolded webs of sheet material, the steps which comprise, folding a web of sheet material longitudinally of the web to produce first and second exterior folds travelling in overlapped condition in a predetermined path with the longitudinal fold line on one edge of said path by drawing said first fold forward longitudinally of the web in said path and turning said second fold underneath said first fold from said path edge and then drawing said second fold across a folding edge which lies obliquely of said path and underenath said first fold and which reverses said second fold, and continuously longitudinally folding a series of succeeding webs in the same manner as aforesaid having folding lines on alternate edges of said path with the first fold of each preceding web traveling above said folding edge for the succeeding web so that the second fold of the succeeding web is positioned below the first fold of the preceding web.

27. In a method for continuously longitudinally folding a web of flexible sheet material into first and second folds, the steps which comprise, drawing a lateral strip of the web constituting its first fold in a predetermined path after passing the fold over a folding edge extending transversely across the path with the source of web supply being so disposed that the fold extends at an angle to said path prior to passing over the folding edge, and passing the other longitudinal strip or fold of the web over a series of other folding edges the last of which extends obliquely across said path and which are so arranged that the second web fold is folded over the first fold with all points of the web having the same overall distance of travel in both folds as the web travels over the said folding edges.

28. The method of folding sheet material in elongate strip form consisting of the steps of maintaining said material under tension while continuously moving said material through a predetermined path, and causing a lateral portion of said material to be first underfolded along a line parallel to said path and progressively reverse folding the underfolded portion of said stock along a line disposed obliquely of said path for alignment with the nonfolded portion of said material and continued movement through said path.

29. The method of folding elongate flexible sheet stock consisting of the steps of continuously drawing said stock under tension through a multiple segment path including a first segment through which the entire width of said

stock moves in a single plane, a second segment extending obliquely therefrom through which one portion of the stock moves through one plane while another portion thereof moves through a plane disposed obliquely to the first mentioned plane of said second segment with said first plane of said second path segment leading into and transversely of a third path segment of planar configuration, said second plane of said second segment leading into and in marginal alignment with said third path segment to direct the stock portion passing thereover underneath that portion of the stock which has passed through the first mentioned plane of said second segment, and thereafter continuing the underfolding of the stock from said second plane of said second segment by causing it to be progressively drawn around a folding element leading from the position of terminal intersection between the first and second planes of said second segment obliquely across said third path segment.

30. In a machine for interfolding webs of flexible sheet material, a device for continuously folding a first web of the sheet material longitudinally of the web to provide a pair of overlapping exterior folds that are in substantial contact, and a second device for continuously folding a second web of the sheet material longitudinally of the web and having a part extending between the overlapping folds of the first web to separate the folds and for continuously inserting a portion of the second web between the folds of said first web after such separation.

31. In a machine for interfolding webs of flexible sheet material, means for drawing a pair of the webs longitudinally thereof, a device for continuously longitudinally folding a first one of the webs to provide a pair of overlapping exterior folds travelling in a predetermined path as the webs are so drawn, and a second device for continuously longitudinally folding the second web as the webs are so drawn to provide a pair of folds travelling in said path in alignment with the folds of said first web and having a folding edge over which a fold of the second web travels and which reverse folds the web fold and which extends between the folds of said first web so that the second device is effective for continuously inserting said last named fold of the second web between the folds of said first web.

32. In a machine for interfolding webs of flexible sheet material, means for drawing a plurality of the webs longitudinally thereof, a device for continuously longitudinally folding a first one of the webs as the webs are so drawn to provide a pair of overlapping exterior folds that travel in a predetermined path, and a series of second and third and successive similar such devices for continuously longitudinally folding respective successive webs as the webs are so drawn to produce web folds moving in said path and each such device in said series having a folding edge over which a fold of its web travels and which reverse folds the web fold and which extends beneath an exterior fold of the stack of folds formed from previous webs so that the successive device is effective to insert said last named fold of its web between said exterior fold and the remainder of the stack of web folds as the web folds travel in said path.

33. In a machine for interfolding webs of flexible sheet material, a device for continuously folding a first web of the sheet material longitudinally of the web to provide first and second overlapping exterior folds as said first fold is drawn in a predetermined path and including means for turning said second fold across said first fold from an edge of said path and a folding edge which lies obliquely of said path and along a surface of said first fold and which reverses said second fold so that it overlaps said first fold and travels with it in said path, and a second similar device for continuously folding a second web longitudinally of the web from the opposite edge of said path with said obliquely extending folding edge of said second device being disposed between said folds of said first web so that said second device continually inserts the second fold of said second web between the folds of said first web.

34. In a machine for interfolding webs of flexible sheet material, a device for continuously folding a web of the sheet material longitudinally of the web to produce first and second exterior folds travelling in substantial contact and over-lapped condition in a predetermined path with a longitudinal fold line on one edge of said path as the web is drawn forward longitudinally in said path and effective for turning said second fold underneath said first fold from said path edge and including a straight edge which lies obliquely of said path and underneath said first fold and which reverses said second fold, and similar successive devices for succeeding webs for folding the webs in the same manner as aforesaid to have fold lines alternately on opposite edges of said path with the straight edge for each successive device having the first fold of each preceding web travelling over it so that the second fold of the succeeding web is positioned underneath the first fold of the preceding web.

35. A folding device for folding a web of sheet material which is drawn over the device and emerges from the device in a folded condition in a predetermined path comprising a folding edge extending transversely across the path across which a first longitudinal fold of the web may be drawn from a source of web supply, and a series of other folding edges the last of which extends obliquely across the path and which are so arranged to fold a second fold of the web over said first fold with all points of the web having the same overall distance of travel in both folds as the web travels over the folding device.

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