

Feb. 25, 1964

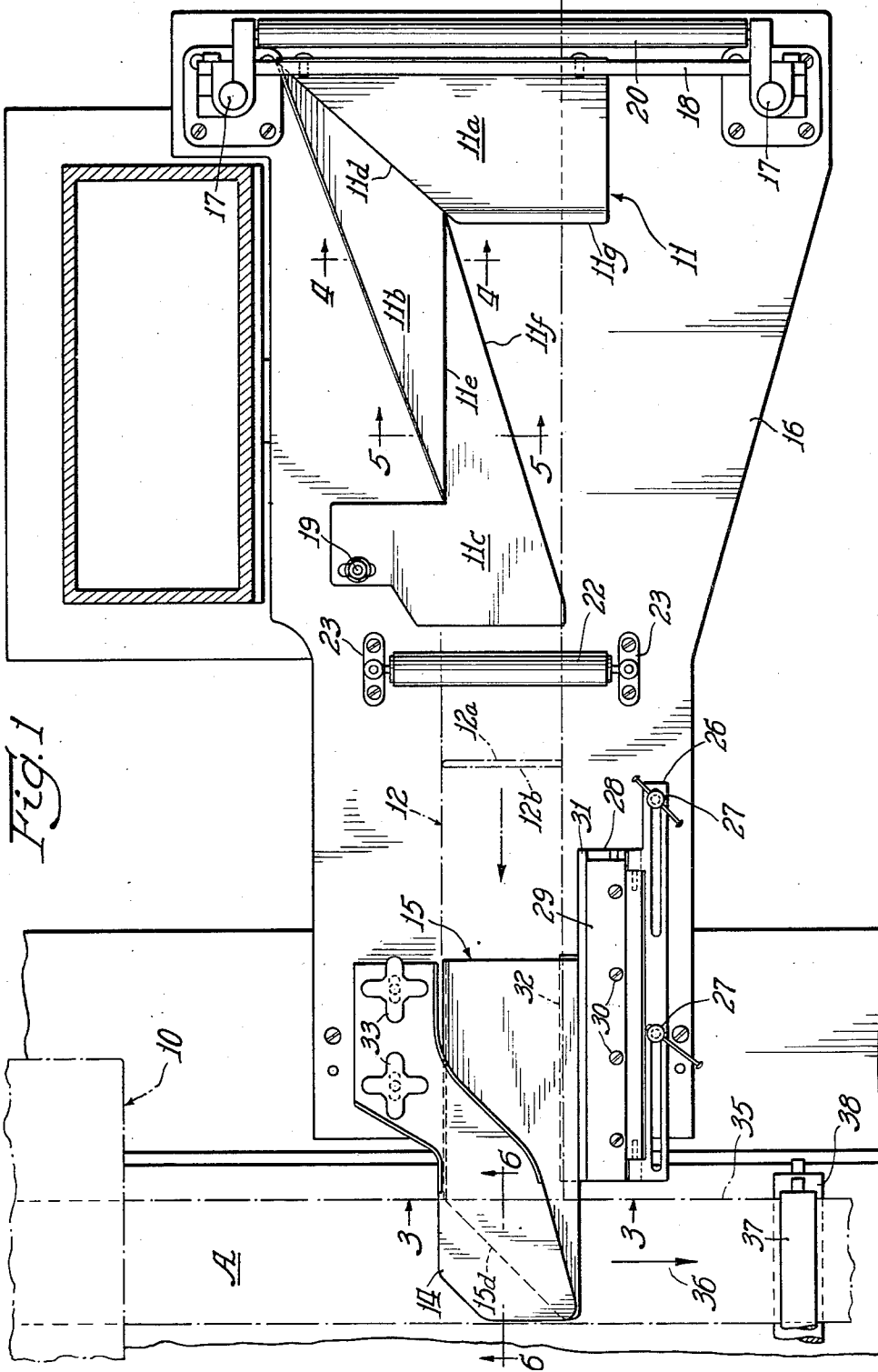
F. D. MOORE

3,122,361

METHOD AND APPARATUS FOR FOLDING SHEET MATERIAL

Filed Aug. 10, 1962

3 Sheets-Sheet 1



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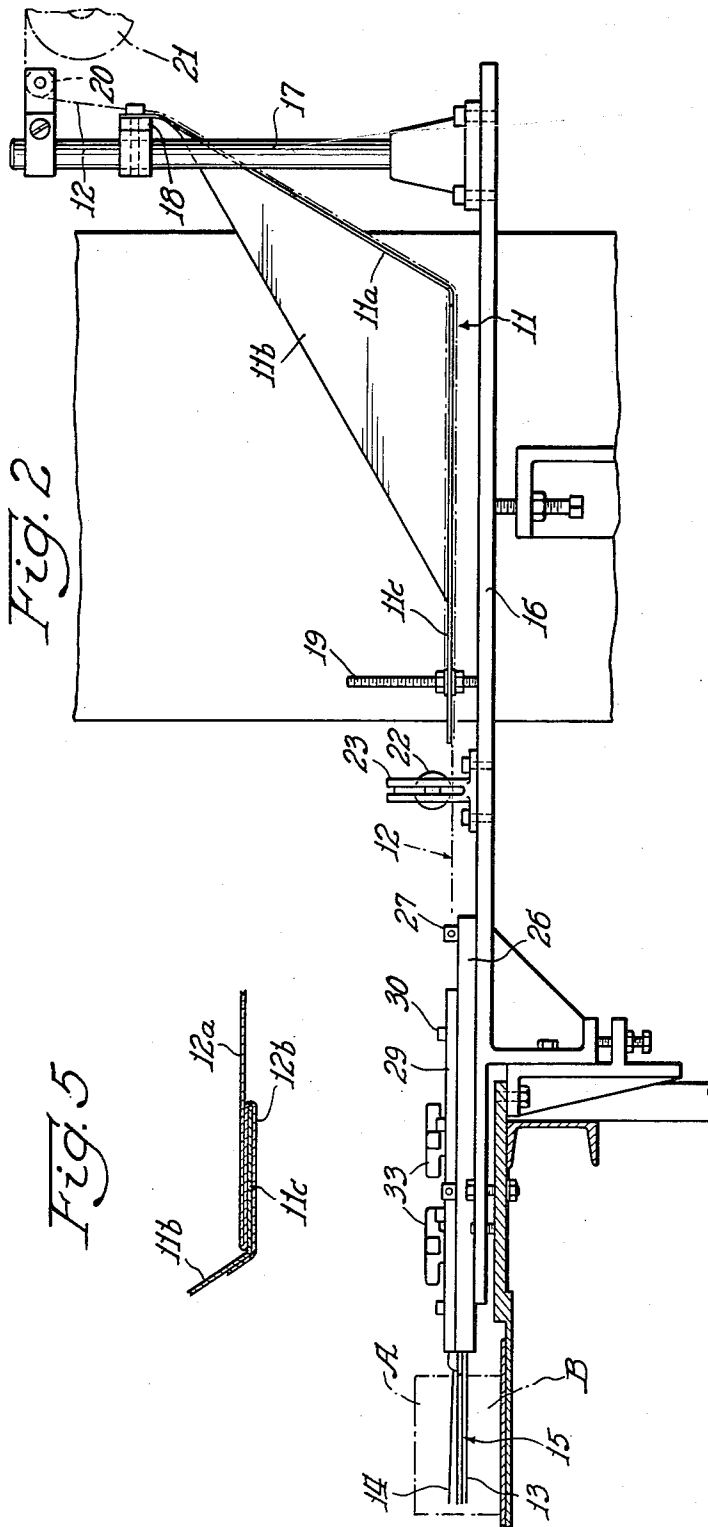
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METHOD AND APPARATUS FOR FOLDING SHEET MATERIAL

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3 Sheets-Sheet 2



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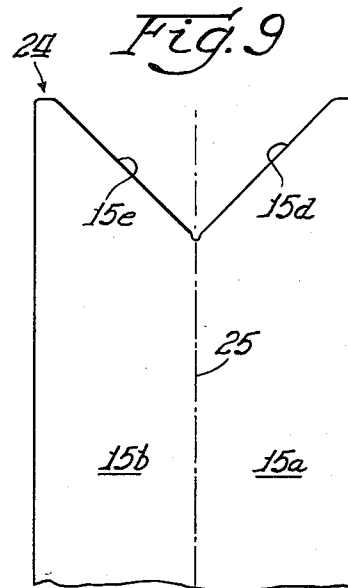
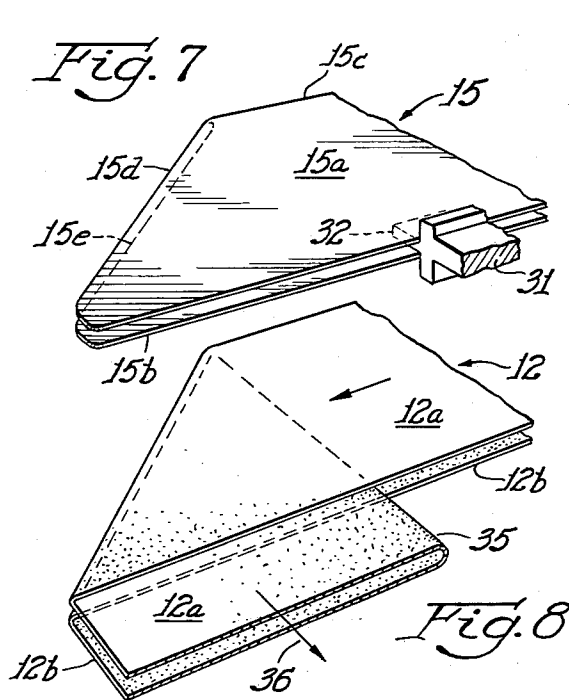
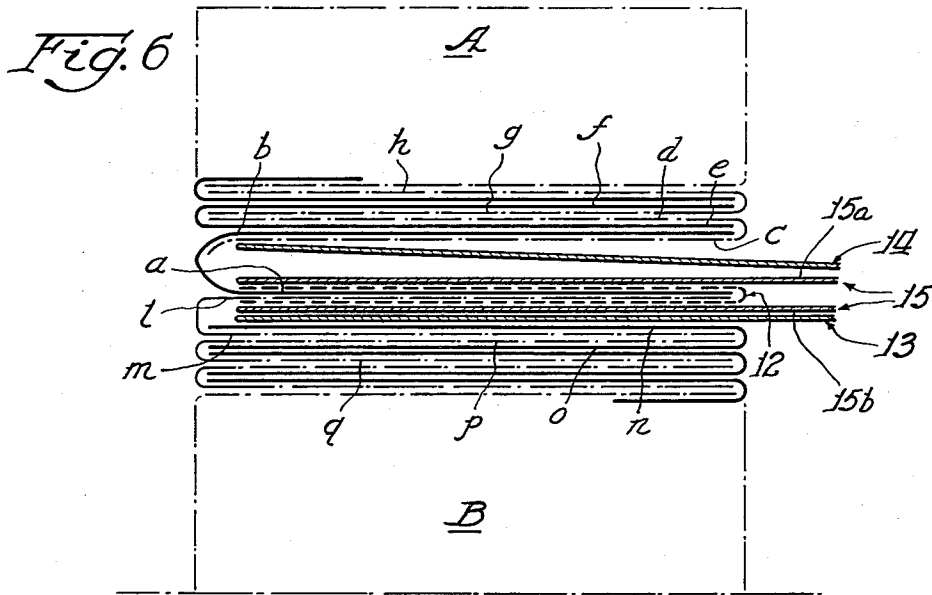
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METHOD AND APPARATUS FOR FOLDING SHEET MATERIAL

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3 Sheets-Sheet 3



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3,122,361

METHOD AND APPARATUS FOR FOLDING SHEET MATERIAL

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4 Claims. (Cl. 270-40)

My invention relates to papermaking machines and, more particularly, to devices for folding webs of paper or other sheet material.

Facial tissues composed of soft, absorbent paper are generally supplied in stacks within dispensing cartons. The tissues may be interfolded, that is, folded so that a portion of the top tissue of such a stack underlies a portion of the tissue just beneath in the stack, and the cartons are generally provided with slots in their upper panels through which the tissues may be withdrawn from the cartons one at a time. The interfolding causes a portion of each succeeding tissue in a stack to be partially drawn through the carton slot, so that it protrudes therefrom and is thus readily available to the user, when the top tissue is taken from the carton through the slot.

It is an object of the present invention to provide an improved method and apparatus for interfolding continuous webs of facial tissue or the like to provide a continuous stack of webs traveling in a predetermined path which may be severed crosswise after folding is completed, in order to produce stacks of interfolded tissues in lengths to fit the conventional cartons above referred to. More particularly, it is an object of the invention to provide such an improved method and apparatus in which webs are supplied from the side of the path in which the continuous webs travel in interfolded condition, with the method and apparatus being operative to turn the webs being supplied from the side into the path of the interfolded webs and at the same time to interfold the new webs with folds of previously folded webs traveling in this path.

More particularly, it is an object of the present invention to provide an improved folding device having upper and lower spaced web carrying portions with folding edges on the ends of these portions extending diagonally of the path of the interfolded webs. The diagonally extending folding edges are such that a web carried by such a folding device coming from the side of this path turns around these folding edges so as to be changed in direction to travel in the path of the interfolded webs, and the upper and lower web carrying portions of the folding device are spaced so that one or more folds of previously folded webs traveling in this path may pass between these portions whereby a fold or folds of the new web are positioned underneath a fold or folds of the previously folded web or webs.

The invention consists of the novel methods and constructions 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 a preferred form of the invention, illustrated with reference to the accompanying drawings, wherein:

FIG. 1 is a plan view of folding apparatus embodying the principles of the invention and including a folding device or board for interfolding a paper web with two continuous interfolded web stacks which are drawn over the folding board;

FIG. 2 is a side elevational view of the folding apparatus;

FIG. 3 is a sectional view on an enlarged scale taken on line 3-3 of FIG. 1;

FIGS. 4 and 5 are sectional views taken on lines 4-4 and 5-5 of FIG. 1;

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FIG. 6 is a sectional view, partially schematic and on an enlarged scale, taken on line 6-6 of FIG. 1;

FIG. 7 is a fragmentary perspective view of the folding board above referred to;

FIG. 8 is a perspective view of a paper web being drawn over the folding board illustrated in FIG. 7, and

FIG. 9 is a plan view of a sheet metal blank which is bent to form the folding board.

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

Referring now to the drawings, the illustrated folding apparatus comprises, in general, folding mechanism 10 which is arranged to produce two elongated stacks A and B of interfolded tissues, a folding device 11 for longitudinally folding a web 12 of tissue, a pair of web guides 13 and 14, and a folding device 15 which is constructed to interfold the web 12 with adjacent folds of the tissue stacks A and B.

The tissue stack A is made up of a web of paper tissue which is folded along a longitudinal center line so as to have folds *a* and *b*, a second web which is folded on a longitudinal center line to have web folds *c* and *d*, a third web folded in the same manner to have web folds *e* and *f*, a fourth web likewise folded to have web folds *g* and *h*, and a plurality of other webs folded in the same manner as the four webs specifically mentioned having folds *a* to *h*. As will be observed, the webs are longitudinally interfolded with the fold *c* of the second web between the folds *a* and *b* of the first web, with the fold *b* of the first web and the fold *e* of the third web between the folds *c* and *d* of the second web, and with the folds *d* and *g* of the second and fourth webs between the folds *e* and *f* of the third web, and each lower fold of each of the other folded webs in the stack A is likewise disposed beneath the upper fold of the next lowermost web in the stack. The stack A is a stack of webs of indefinite length, and it is contemplated that such a stack may be cut into segments or perhaps 10 inches in length. The resulting 10 inch substacks so formed may be packaged in cartons with a dispensing slot at the top, and due to the fact that the webs are interfolded as just described, the removal of the top web in the stack results in the top fold of the next lower tissue in the stack being partially pulled through the slot so that it may be easily grasped by the user.

The stack of tissues B is formed in the same manner as the stack A. The uppermost web of the stack B has upper and lower web folds *l* and *m*, the next lower web in the stack has web folds *n* and *o*; the third web in the stack has web folds *p* and *q*; and, in the case of each tissue, the lowermost fold is disposed below the uppermost fold of the next succeeding tissue in the stack to provide the interfolding previously described.

Each of the stacks A and B of interfolded tissues may be formed in any suitable manner, such as, for example, by a series of the folding devices disclosed in Patent 2,642,279, issued June 16, 1953, to Oliver E. Teall, or a series of the folding devices of the type disclosed in a co-pending application of Harold V. Rutkus and Charles J. Greiner, Serial No. 837,977, filed September 3, 1959, on Paper Folding Machine and Method (now Patent No. 3,066,932, issued December 4, 1962). Such series of folding devices could, of course, be utilized for forming an ultimate, relatively high, stack of tissues consisting of the stacks A and B combined; however, since a folding device is required for each of the webs, a very long series of folding devices would be required. In order to form the stacks A and B separately as is proposed herein, two series of such folding devices would be required with only half of the total number of folding devices being utilized for each of the stacks A and B and with one-half of the total number of folding devices being disposed on two levels, a lower level for the stack B and a higher level

for the stack A, thus halving the total length of the machine.

When two such upper and lower series of folding devices are utilized, however, the separate stacks A and B result, and if it is desired that segments of the stacks A and B be packed in the same carton one above the other, it is also desirable that the two stacks A and B be interfolded with each other, so that tissues may be withdrawn from the carton without interruption between the uppermost and lowermost substacks A and B in the carton. The folding device 15, as will be made hereinafter apparent, functions to connect and interfold together the two tissue stacks A and B before any severance into segments of the stacks A and B takes place.

Any suitable type of folding device may be utilized for folding the web 12 lengthwise along its longitudinal center line. The folding device 11 that is illustrated is of the type disclosed in the aforementioned Rutkus and Greiner patent application, Serial No. 837,977, and constitutes a sheet metal folding board having plane portions 11a, 11b and 11c which have folding edges 11d and 11e between them and which have terminal folding edges 11f and 11g. The plane portion 11c extends substantially horizontally; the plane portion 11a extends upwardly and obliquely with respect to the portion 11c; and the portion 11b extends obliquely with respect to both portions 11a and 11c.

The folding device 11 is suitably mounted with respect to a horizontal table 16 by means of standards 17 and a bar 18 which extends between the standards and to which is fixed the upper end of the plane portion 11a. The other end of the folding device is supported with respect to the table 16 by means of a stud 19. A roller 20 is disposed between the standards 17, and the web 12 passes over the roller from a roll 21 onto the plane portion 11a at the upper end of the plane portion 11a. The web is so disposed laterally of the folding device 11 that the longitudinal center line of the web passes beneath the point joining the three folding edges 11g, 11e and 11f, and the half of the web 12 on one side of the longitudinal center line passes directly downwardly on the surface 11a and passes under the folding edge 11g and over the horizontal plane portion 11c producing a top fold 12a. The other half of the web travels downwardly on the surface 11a, over the folding edge 11d, over the plane surface 11b, under the folding edge 11e beneath the horizontal plane surface 11c, and over and around the folding edge 11f, being thereby folded through 180 degrees to produce an underfold 12b.

A roller 22 is supported by standards 23 fixed to the table 16 and functions to hold the upper and lower folds 12a and 12b of the web 12 in contact and to crease the web 12 along its longitudinal center line.

The folding device 15 comprises an upper plane portion 15a and a lower plane portion 15b joined at one edge 15c. The folding device 15 is rectangular except for diagonally extending folding edges 15d and 15e on the ends of the plane portions 15a and 15b, respectively. The folding device 15 is formed from a flat sheet metal blank 24 illustrated in FIG. 9, which is bent or folded back upon itself along a longitudinal center line 25 to thereby form the flat portions 15a and 15b connected at the edge 15c.

The folding device 15 is mounted with respect to the table 16 by means of a mounting strip 26 adjustably fixed to the table by means of studs 27. A support plate 28 is pivotally mounted with respect to the strip 26, and an upper clamping plate 29 is fixed with respect to the plate 28 by means of screws 30. A key strip 31 is disposed between the parts 28 and 29 and is clamped between them by means of the screws 30. The strip 31 has a relatively thin terminal portion 32 disposed between the flat portions 15a and 15b of the folding device 15, and the portions 15a, 15b and 32 are suitably fixed

together to support the folding device 15 with respect to the plate 28 and the table 16.

The web guides 13 and 14 are fixed with respect to the table 16 by means of screws 33, and a spacer plate 34 is provided between the parts 13 and 14 for holding them properly spaced respectively below and above the plane portions 15b and 15a of the folding device 15, as illustrated in FIG. 3.

The web stacks A and B travel in vertical alignment from the folding device 10 along a path 35 in the direction of the arrow 36. The stacks A and B may be drawn along as continuous lengths by any suitable mechanism, such as by upper and lower driven rolls 37 and 38. The upper and lower edges 15d and 15e of the folding device 15 extend diagonally across the path 35 with the outer tips of the device 15 being located downstream in the path 35 of the web stacks A and B, and the web guides 13 and 14 also extend across the path 35 as shown in FIG. 1. The web guides 13 and 14 are so disposed and spaced with respect to each other that they provide a slight separation of the web stacks A and B, the web guide 14 being disposed in the stack A just within the lowermost web fold a of the stack A, and the web guide 13 being disposed within the stack B just underneath the uppermost web fold l of the stack B, as illustrated in FIG. 6. The web 12 has been folded by the folding device 11 along a longitudinal center line with the upper and lower folds 12a and 12b as previously described, and the folded web 12 passes over the folding device 15 with its fold in contact with the closed, folded edge 15c of the device 15. The upper fold 12a passes around the edge 15d of the folding device 15 through 180 degrees, and the top fold 12a then is in alignment with and passes along the path 35. At the same time, the bottom fold 12b passes upwardly and around the lower edge 15e of the folding devices 15 through 180 degrees and travels along with the upper fold 12a in the path 35. The manner in which the web folds 12a and 12b turn in passing over the folding edges 15d and 15e is illustrated in FIG. 8. Both of the external web folds a and l of the web stacks A and B are trained to pass between the folding edges 15d and 15e of the folding device 15; and, therefore, since the web folds 12a and 12b are in contact with the inner surfaces of the folding device 15, the web folds 12a and 12b are thereby inserted respectively between the web folds c and a and between the web folds l and n, so that the web 12 in effect ties together the two stacks A and B and continues the interfolding pattern from the lowest tissue of the stack B to the uppermost tissue of the stack A. When the combined stack consisting of the parts A and B is severed into segments, the web 12 thus assures that the dispensing action due to the interfolding, with each uppermost web drawing the web just below it through the slot in the carton, shall be complete through the combined stack A—B.

It will be observed from FIG. 9 that the folding edges 15d and 15e in the sheet metal blank extend at angles of 45 degrees with respect to the longitudinal center line 25 of the blank prior to folding of the blank into its operative form. The edge 15c and, therefore, the folding device 15 as a whole, as will be observed from FIG. 1, extend at an angle of 90 degrees with respect to the path of travel of the stacks A and B indicated by the arrow 36, and the web 12 is thus fed between the web stacks A and B as above described at this 90 degree angle with respect to the path of travel of stacks A and B. The folding edges 15d and 15e extend diagonally across and move particularly at an angle that bisects the angle at which the web 12 initially travels with respect to the path of travel of the stacks A and B, namely at 45 degrees with respect to the path of travel of the web stacks A and B indicated by the arrow 36, so that the web 12 as it is interfolded with the stacks A and B does not wrinkle and is not stretched more along any particular longitudinal fiber than along any other.

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The folding device 15 advantageously turns a folded web from one direction to another and due to its spaced overlapping top and bottom plane portions 15a and 15b allows a web fold or web folds of previously folded webs to pass between these portions so that the web passing over and being changed in direction by the folding device is interfolded with the folds of the previously folded webs. It will be apparent that although I have disclosed only a single folding device 15 extending at right angles with respect to the path of travel 35, a plurality of such folding devices 15 may be utilized in connection with a stack of tissues traveling along the path 35, each of the folding devices 15 being so disposed to add an additional web to the stack traveling along the path, such as to the bottom or top of the stack. For such operation, the top or bottom fold of the stack simply passes between the plane portions 15a or 15b so as to have a fold of the web 12 passing over the folding device 15 inserted beneath the external fold of the stack traveling along the path 35. If the folding device 15 is used to add an additional web to the top or bottom of a previously interfolded stack of webs, the folded webs would appear the same as shown in FIG. 6, but with all webs of either the stack A or stack B absent.

I 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 apparent to those skilled in the art that changes may be made without departing from the principles of the invention.

What is claimed is:

1. In apparatus for folding flexible sheet material webs, the combination of mechanism for interfolding a plurality of sheet material webs to provide a stack of interfolded webs with a lower fold of each upper web underlying the upper fold of a web below it in the stack, means for drawing said webs in a continuous length along a predetermined path, means for longitudinally folding an additional sheet material web so that it has two overlapping folds, and a folding device for interfolding said additional web as so folded with one of the external webs of the stack of interfolded webs, said device comprising a pair of spaced overlapping sheet material parts joined together along a side edge of each part, each of said parts being provided with an end edge extending diagonally with respect to the joined side edges and the device being so disposed that an external fold of one of the stack of interfolded webs travels between said end edges, said additional web being drawn longitudinally over said folding device with its folds in contact with said opposite parts and with its fold traveling along said joined side edges, and with each of the overlapping folds of said additional web traveling around and being folded by one of said end edges so that the additional web is longitudinally folded and passes between said parts and has one of its resulting folds inserted beneath the external fold of said interfolded stack that passes between said parts.

2. In apparatus for folding flexible sheet material webs, the combination of mechanism for interfolding a plurality of the webs to provide a pair of continuous aligned upper and lower stacks of the sheet material with a lower fold of each upper web underlying the upper fold of each lower web in each stack providing interfolding of the webs in each stack, means for drawing said webs in a continuous length along a predetermined path, means for longitudinally folding an additional sheet material web so that it has overlapping folds, and a folding de-

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vice for interfolding said additional web with adjacent external web folds on said stacks, said device comprising a pair of spaced overlapping sheet metal parts having a joint along one side edge of each part with each of said parts being provided with an end edge extending from an end of said joint and diagonally with respect to said joint, said device being so disposed that the adjacent external folds of said two stacks of interfolded webs travel between said end edges, said additional web traveling longitudinally of said folding device with its folds in contact with said overlapping parts and with its fold traveling along said joint, each of said overlapping folds of said additional web being drawn around and being folded by one of said end edges so that the additional web is longitudinally folded and passes between said parts and has one of its resulting folds inserted above the lowermost fold of the upper stack and has its other fold inserted beneath the uppermost fold of said lower stack as said stacks of webs travel in said path.

3. In a method for interfolding webs of flexible sheet material, the steps which comprise, providing a continuous stack of interfolded sheet material webs in which a lower fold of each upper web underlies the upper fold of a lower web in the stack, and drawing said stack in a predetermined path, longitudinally folding an additional web to have a pair of overlapping folds and drawing the web in a path extending at an angle to said first named path, and drawing the folds of said additional web over a pair of spaced aligned straight edges which are disposed diagonally across said first named predetermined path with an external fold of said stack of webs being passed between said straight edges whereby said additional web has its overlapping folds changed in direction to travel in said first named path and one of the overlapping folds of said additional web is disposed between the exterior fold of said stack and the remainder of the stack as the stack travels in its said path.

4. In a method for interfolding webs of flexible sheet material, the steps which comprise, providing a pair of aligned upper and lower interfolded continuous stacks of sheet material webs wherein the lower fold of each upper web underlies the upper fold of each immediately adjacent lower web in the stack, drawing said stacks along a predetermined path, longitudinally folding an additional web so that it has a pair of overlapping folds and drawing the additional web in a second predetermined path that is at an angle with respect to said first predetermined path, passing the overlapping folds of said additional web around a pair of spaced aligned straight edges, said straight edges lying diagonally across said first predetermined path with one end of each of said straight edges being in alignment with the fold of said additional web and the edge of said first path and the other ends of said straight edges extending in the direction of movement of said continuous stacks and at an angle from said fold that is equal to half the angle between said first and second paths, adjacent exterior folds of said upper and lower stacks being passed between said straight edges and the folds of said additional web being drawn across said straight edges so that the straight edges turn the latter folds so that they travel in said first path to dispose each of the overlapping folds of said additional web between the exterior fold of one of said stacks and the remainder of the stack.

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