

July 7, 1970

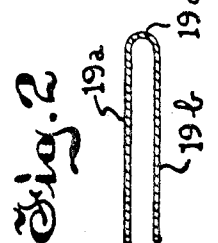
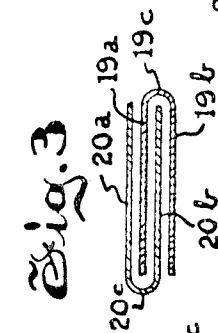
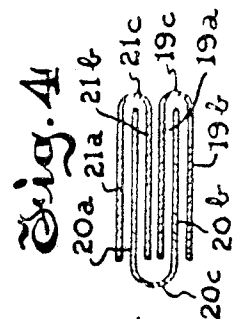
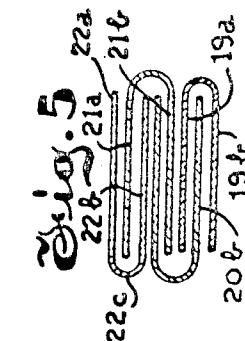
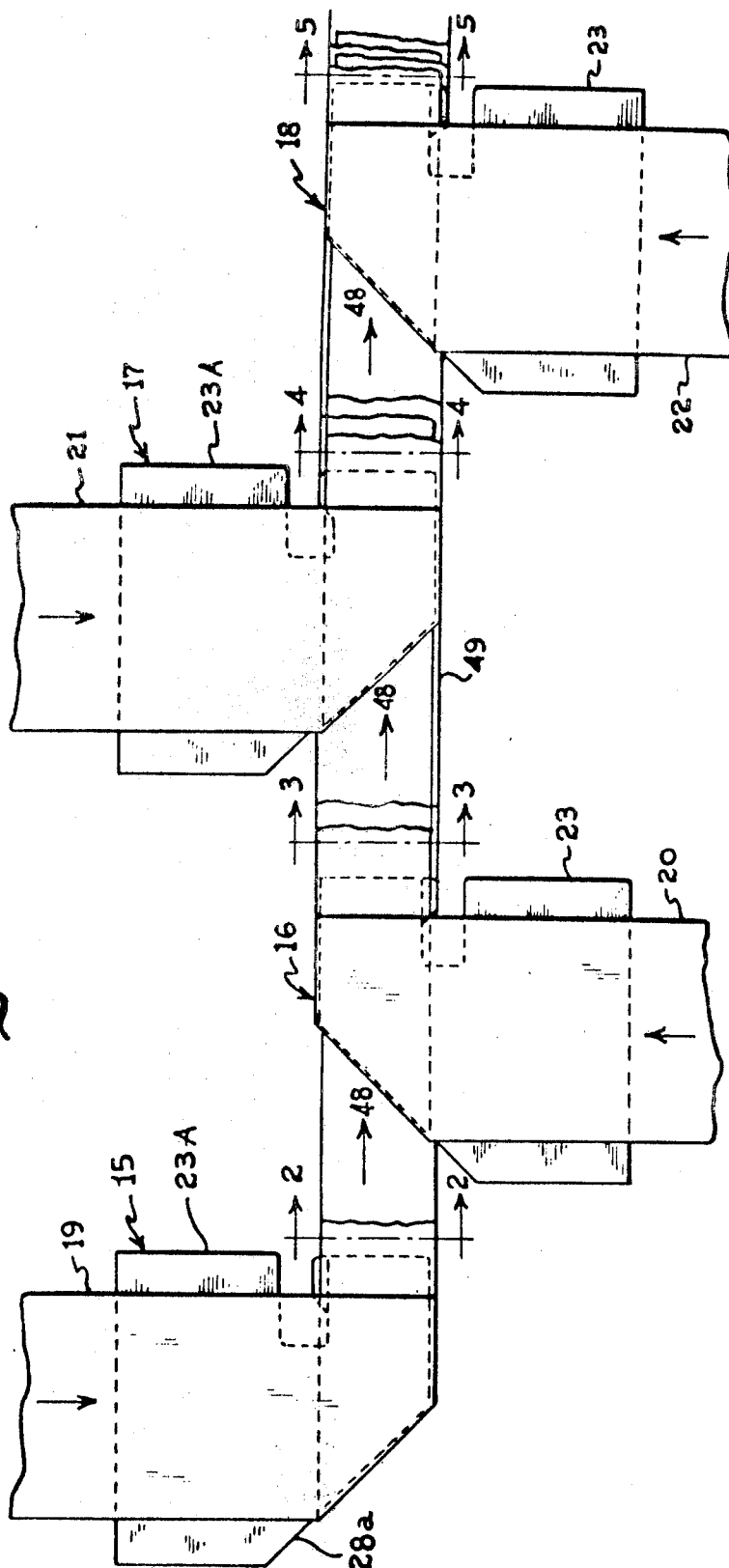
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PAPERMAKING MACHINE

3,519,263

Filed Aug. 4, 1965

3 Sheets-Sheet 1

Fig. 1



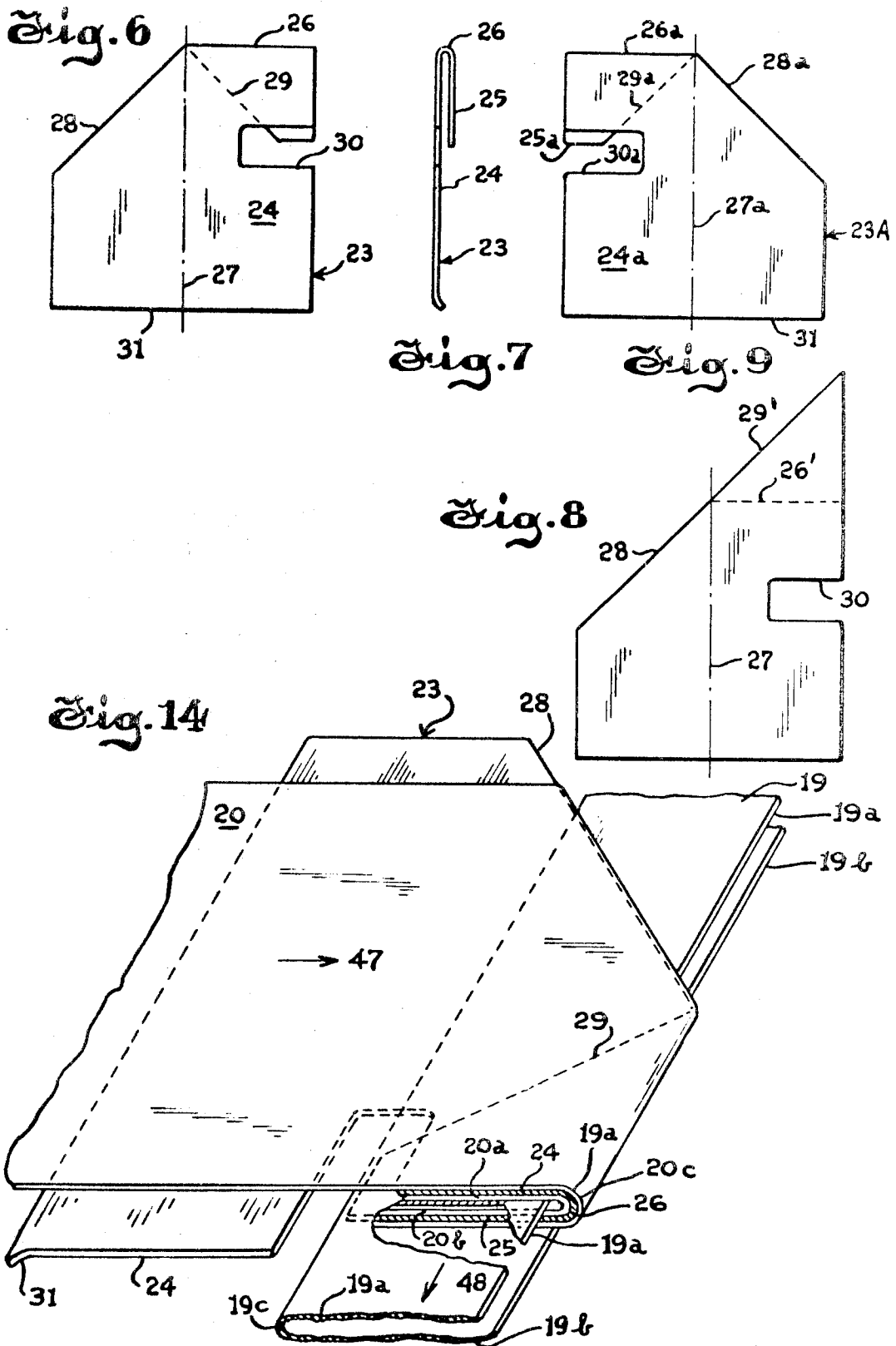
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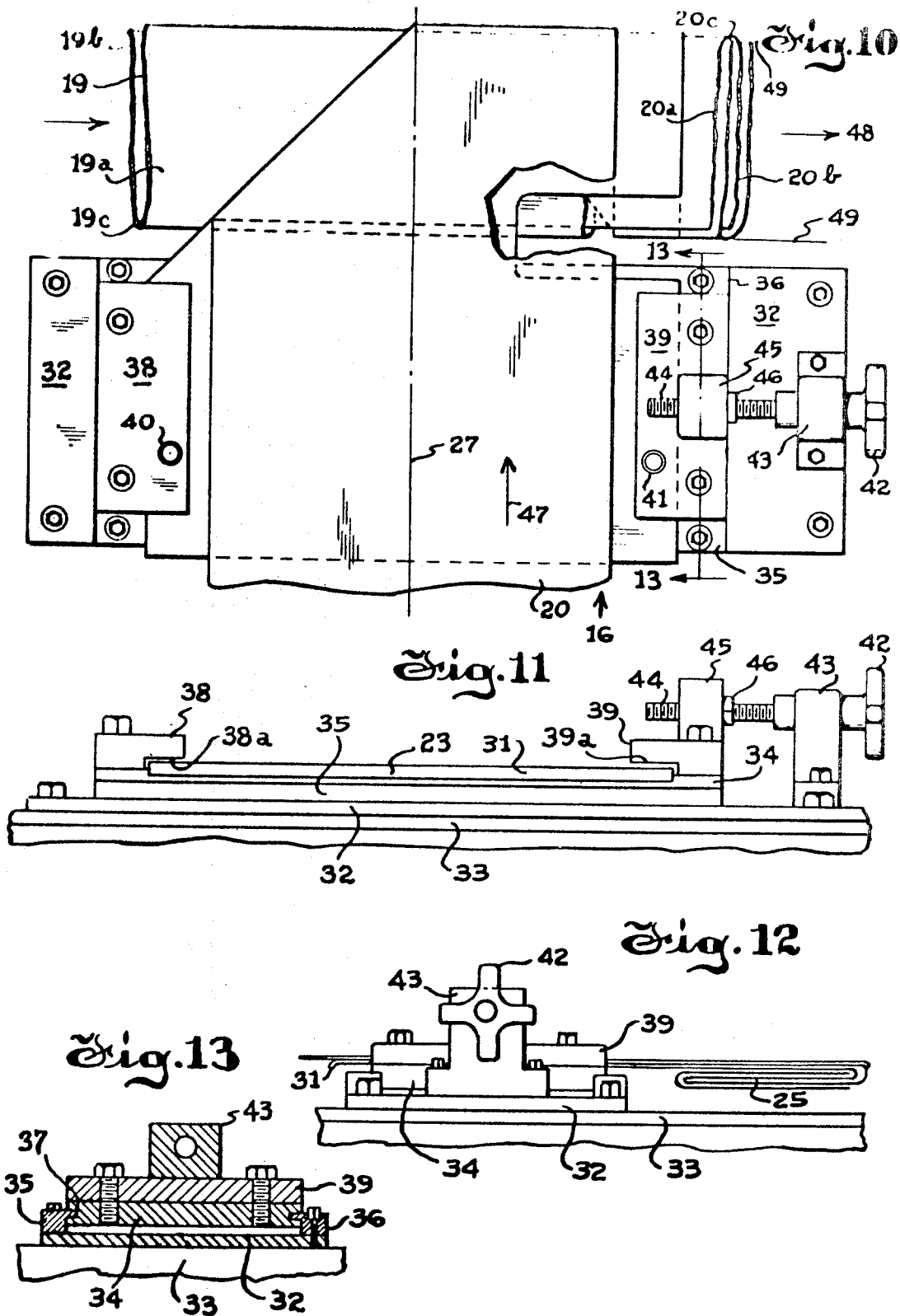
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PAPERMAKING MACHINE

Richard H. Frick, Neenah, Wis., assignor to Kimberly-Clark Corporation, Neenah, Wis., a corporation of Delaware

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9 Claims

ABSTRACT OF THE DISCLOSURE

A folding board for flexible web material having an edge extending slantwise across the board and being bent back on itself on a transverse line so that the slantwise edge on the main body of the board and the slantwise edge on the return bent portion of the board, together with the return bend on the transverse line, form folding edges for the web.

My invention relates to papermaking-machines and more particularly to apparatus and methods for longitudinally folding sheet material webs and for interfolding the webs with each other.

It is an object of the present invention to provide improved folding methods and apparatus which may utilize a plurality of folding boards each effective for longitudinally folding a web, with the boards each being so constructed that a portion of the board may carry a web fold of a previously folded web and dispose it between folds that are being produced by the board. More particularly, it is an object of the invention to provide an improved folding board of this type which is very simple in construction and is essentially all located in a single plane.

The invention consists of the novel methods, arrangements and devices 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 diagrammatic plan view of interfolding apparatus comprising a plurality of interfolding boards and embodying the principles of the invention;

FIGS. 2, 3, 4 and 5 are sectional views on an enlarged scale and taken on lines 2—2, 3—3, 4—4 and 5—5, respectively, of FIG. 1;

FIG. 6 is a plan view of one of the folding boards utilized in the apparatus;

FIG. 7 is a side view of the folding board illustrated in FIG. 6;

FIG. 8 is a plan view of a sheet metal blank from which the board illustrated in the preceding two figures may be fabricated;

FIG. 9 is a view similar to FIG. 6 and showing a board of the same type but of opposite hand;

FIG. 10 is a plan view on an enlarged scale of one of the folding boards, together with mechanism for mounting the board;

FIG. 11 is an elevational view of the board and the mounting mechanism shown in FIG. 10;

FIG. 12 is an end view of the board and its mounting mechanism;

FIG. 13 is a sectional view taken on line 13—13 of FIG. 10; and

FIG. 14 is a perspective view of one of the folding boards in operation in longitudinally folding a web passing over the board.

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

Referring now to the drawings and in particular to

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FIG. 1, the interfolding apparatus may be seen to comprise folding assemblies 15, 16, 17 and 18. Paper webs 19, 20, 21 and 22 pass over the assemblies 15, 16, 17 and 18, respectively, and are longitudinally folded along their longitudinal center lines by the assemblies. Each of the assemblies comprises a folding board 23 or a folding board 23A, which is of the same type as the board 23 but is of opposite hand. A board 23 is illustrated more in detail in FIGS. 6 and 7, and a board 23A is illustrated more in detail in FIG. 9.

Each of the folding boards 23 is a piece of sheet metal having a main plate portion 24 and an auxiliary plate portion 25 which has been folded underneath the plate portion 24 along a return bent edge 26 of the folding board. The edge 26 constitutes a folding edge for a web to be passed over the folding board and extends at right angles with respect to the longitudinal center line 27 of the folding board. The folding board, in addition, has folding edges 28 and 29 which extend at 90° with respect to each other and at 45° with respect to the longitudinal center line 27 and which meet on the center line 27. The folding edge 28 is an edge of the main plate portion 24, and the folding edge 29 is an edge of the auxiliary plate portion 25. A notch 30 is provided in the plate portion 24 as illustrated, and the plate portion 24 is also preferably provided with a downwardly bent or rounded base edge 31.

Each folding board 23 may be made from a sheet metal piece or blank illustrated in FIG. 8. The blank has the edge 28 which extends at 135° angles with respect to the longitudinal center line 27 and with respect to the left-hand edge of the blank and the edge 28 extends at an angle of 45° with respect to the right-hand edge of the blank, as the blank is illustrated in FIG. 8; and the right half of the edge 28 is designated as the edge 29'. The blank is bent along a fold line 26' extending at right angles to the center line 27 whereby the portion between the edge 29' and the fold line 26' is doubled underneath the main portion of the blank so that it extends parallel with the main portion of the blank and provides the auxiliary plate portion 25. The folding edge 26 is thus formed by the return bent portion of the blank along the fold line 26', and the edges 26 and 28 subtend an obtuse angle of 135°. The edge 29 is located beneath and is spaced from the plane of the main plate portion 24 having the edges 26 and 28 thereon, and the edge 29 extends at an angle of 45° with respect to the edge 26 and terminates at the common point between the edges 26 and 28 as the folding board is seen in plan as in FIG. 6, looking in a direction normal to the plane of the main plate portion 24.

Folding boards 23 are incorporated in the assemblies 16 and 18 and have their main plate portions 24 mounted parallel with each other and preferably horizontal and at approximately the same level. Any appropriate mounting mechanism may be used for each of the boards 23 leaving the upper surface of the main plate portion 24 free for the passage of a paper web thereover. The assembly 16 incorporating an appropriate mounting mechanism is illustrated in FIGS. 10, 11, 12 and 13; and, referring to these figures, the mounting mechanism may be seen to comprise a base plate 32 mounted on a table 33. A plate 34 is movably disposed on the plate 32 by means of a pair of gibs 35 and 36 which are fixed to the plate 32 and have flanges extending inwardly into notches 37 formed in the side edges of the plate 34. The main plate portion 24 of the folding board 23 that is incorporated in the assembly lies flat on the plate 34 and has its auxiliary plate portion 25 extending outwardly beyond the plate 34. A pair of plates 38 and 39 are fixed on the side edges of the plate 34, and the plates 38 and 39 are provided with notches 38a and 39a receiving side edges of the folding board 23,

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the notches being of sufficient depth so that the folding board 23 may slide longitudinally (in the direction of its center line 27) within the notches and between the plate 34 and the overlying plates 38 and 39.

The folding board 23 is fixed in its supporting mechanism and particularly with respect to the plates 38 and 39 by means of set screws 40 and 41 which extend through the plates 38 and 39. The folding board 23 may be adjustably moved longitudinally simply by releasing the set screws 40 and 41 so that the board may slide in the notches 38a and 39a and on the plate 34, and the set screws 40 and 41 are retightened in order to fix the board from this direction of movement.

Adjusting mechanism is provided for moving the board 23 transversely (at right angles to the longitudinal center line 27) which comprises a hand knob 42 rotatably mounted but axially fixed within an upstanding lug 43 that is fixed on the base plate 32. A screw 44 is fixed with respect to the hand knob 42 and extends through and has screw threaded relationship with an upstanding lug 45 which is fixed with respect to the plate 39. In order to move the plate 34 so that it moves longitudinally with respect to the gibs 35 and 36 and so that it carries the folding board 23 transversely, it is only necessary to turn the hand knob 42 in one direction or the other. A stop nut 46 is preferably provided on the screw 44 for fixing the board 23 in this direction of movement.

As previously mentioned, each of the assemblies 15 to 18 functions to fold the paper web passing over the assembly along the longitudinal center line of the web. The action of the folding board 23 of the assembly 16 in performing this function with respect to the web 20 is illustrated in FIGS. 10 and 14. Each of the assemblies 15 to 18 function in the same manner with respect to their respective webs, and it will be assumed that the web 19 has been previously longitudinally folded to provide longitudinal folds 19a and 19b on opposite sides of a center crease 19c and that the web 19, as so folded, travels underneath the main plate portion 24 of the board 23 incorporated in the assembly 16, as is illustrated in FIGS. 10 and 14. The upper web fold 19a is trained between the plate portions 24 and 25 of the board 23, and the lower web fold 19b is positioned below the plate portion 25 of the board 23. The web 19 is drawn by any suitable means (not shown) in the direction 48 and in the path 49.

The web 20 is drawn onto and travels on the folding board 23 of the assembly 16 in a direction parallel with the longitudinal center line 27 of the board 23 and as indicated by the arrow 47. The center line of the web 20 coincides with the center line 27 of the folding board, and the left half of the web 20 (as seen in FIG. 10) makes a 180° turn around the folding edge 28 of the folding board and travels as a longitudinal web fold 20a in the direction indicated by the arrow 48, in a path 49, and in contact with the undersurface of the main plate portion 24 of the board 23. The path 49 extends at 90° with respect to the longitudinal center line 27, and the folding edge 28 extends at 45° with respect to the center line 27. The right half of the web 20, as seen in FIG. 10, makes a 180° turn around the folding edge 26, so that it travels on the undersurface of the auxiliary plate portion 25 of the board; and then this half of the web makes another 180° turn around the folding edge 29, so that this half of the web then travels as the web fold 20b in the path 49 in contact with the upper surface of the auxiliary plate portion 25. The folding edge 29 is also at 45° with respect to the center line 27 of the folding board, so that the web fold 20b underlies the web fold 20a and is in the path 49. It will be noted that the crease 20c between the folds 20a and 20b is substantially in line with the folding edge 26 and is on the lefthand edge of the path 49 looking in the direction 48.

It will be observed that the crease 19c of the web 19 is on the right-hand of the path 49 looking in the direction 48,

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and the top fold 19a of the web 19 is positioned between the plate portions 24 and 25 and is supported by the underlying auxiliary plate portion 25. Therefore, as the web 20 is folded longitudinally into the folds 20a and 20b, these folds embrace the fold 19a, since the top fold 20a is in contact with the lower surface of the main plate portion 24 and the lower fold 20b is in contact with the upper surface of the auxiliary plate portion 25. These folds thus create an interfolded relationship between the webs 19 and 20, as is shown in FIG. 3. The web 20 is drawn along with the web 19 in the path 49 by the same web drawing means (not shown) previously mentioned in connection with the web 19.

The assemblies 16 and 18 include identical folding boards 23. The assemblies 15 and 17 include identical folding boards 23A, and the boards 23A are identical with the boards 23 except that they are reversed with respect to their longitudinal center lines (the center line 27 for the board 23 and the center line 27a for the board 23A). Referring to FIG. 9, the board 23A therein illustrated includes folding edges 28a, 26a and 29a corresponding to the folding edges 28, 26 and 29 in the folding board 23 and includes also the underlying auxiliary plate portion 25a corresponding to the plate portion 25. The folding boards 23A function in the same manner as the boards 23 except that the boards 23A may be positioned oppositely with respect to the boards 23 and draw webs from the other side of the apparatus. The web 19 in the assembly 15, for example, has its left edge, as seen in FIG. 1, passing over the folding edge 28a and thus underlying and in contact with the main plate portion 24a of the board as the web passes from left to right, as seen in FIG. 1. The right-hand half of the web 19 passes over the folding edges 26a and 29a of the board, and this half of the web thus travels in the path 49 and in the direction 48 and is in contact with the upper surface of the auxiliary plate portion 25a of the board 23A. Since the web 19 is the first web utilized by the assembly, there is no previous web that passes between the board portions 24a and 25a, and thus the board 23A in the assembly 15 supplies only the web folds 19a and 19b having the crease 19c between them.

The assembly 17 including a folding board 23A folds the web 21 similarly to the folding of the web 19 by the assembly 15 and produces web folds 21a and 21b with a crease 21c on the right-hand edge of the path 49 looking in the direction 48. The web fold 20a, which is the uppermost fold of the stack of webs in the path 49 approaching the assembly 17, is trained to pass between the plate portions 24a and 25a of the board 23 in the assembly 17; and thus the upper web fold 20a is disposed between the folds 21a and 21b of the web 21, producing an interfolded relationship between the webs shown in FIG. 4.

The assembly 18 functions the same as the assembly 16 and produces a folded web having an upper fold 22a and a lower fold 22b. The uppermost fold of the stack of webs traveling in the path 49 to the assembly 18 is the fold 21a, and this fold passes between the main plate portion 24 and the auxiliary plate portion 25, so that the web fold 21a is interfolded between the web folds 22a and 22b of the web 22, producing the interfolded web configuration illustrated in FIG. 5.

It will be apparent that as many additional assemblies, similar to the assemblies 15 to 18, may be incorporated in the folding machine as desired. The folding boards 23 are alternated with the folding boards 23A so that the return bent folding edges 26 and 26a alternate on the opposite sides of the path 49, and webs are alternately taken from opposite sides of the machine. In the case of each folding board, the uppermost fold of the previously interfolded web travels between either the plate portions 24 and 25 or plate portions 24a and 25a, so that the web that is longitudinally folded by the particular folding board has its lower web folded and positioned

underneath the web fold which was previously on the top of the interfolded sausage of webs as the webs approach the particular folding board.

Any suitable mechanism may be provided for drawing the webs in the direction 48 along their path 49, and this mechanism may, for example, include a pair of driven rolls (not shown) between which the interfolded sausage of web passes. In threading the machine, each of the webs to be folded by the apparatus is drawn from its supply roll (not shown) over the folding board operative to fold the web and into the path 49, passing each upper fold of the sausage between the plate portions 24 and 25 or 24a and 25a of the succeeding folding board. After the machine has been so threaded with the webs, the rolls or other mechanism for pulling the interfolded sausage of webs along the path 49 is driven to cause the boards 23 and 23A of the various folding assemblies to be operative to continuously produce the interfolded sausage of webs. The interfolded web sausage may then be cut into lengths so as to provide interfolded tissue stacks which may be packed in cartons for subsequent facial or other usage. The notches 30 and 30a provided in the folding boards 23 and 23A are only for the purpose of facilitating the initial threading of the various webs through the folding apparatus.

For proper folding, it is desirable that each of the webs be folded along its longitudinal center line, and in order to adjust the folding boards to attain this result, the hand wheels 42 for the board may be appropriately adjusted to align the center lines of the individual boards with the center lines of the webs passing over the boards. Each of the boards 23 and 23A, in order to secure satisfactory interfolding, is longitudinally adjusted so that its return bent edge 26 or 26a extends slightly beyond the edges of the web folded by the previous board in the apparatus, and longitudinal adjustment of the boards may be made simply by releasing the set screws 40 and 41 and retightening them after appropriate movement by hand of the boards in this direction.

It will be apparent, from the above description of the folding apparatus and its operation, that really only the folding edges 26, 28 and 29 of the boards 23 and folding edges 26a, 28a and 29a of the boards 23A are important in order to provide the desired interfolding. Therefore, the boards 23 and 23A may have their plate portions 24, 24a, 25 and 25a removed or punched out, as desired, but leaving these edges; and interfolding of the webs will remain the same.

I wish it to be understood that the invention is not to be limited to the specific methods and devices 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.

I also wish it to be understood that the above "Abstract of the Disclosure" shall not be used for interpreting the scope of the claims and that any reference characters appearing in the claims are to be considered as having no effect on the scope of the claims.

What is claimed is:

1. A folding device for folding a web of flexible sheet material longitudinally and comprising first and second folding edges extending from a common point and disposed in a common plane with an obtuse angle between the edges and a third folding edge disposed underneath said plane and extending from beneath said point in a direction between said first and second folding edges as viewed in a direction normal to said plane, whereby a first longitudinal fold of a web may be drawn over for 180° and folded by said first folding edge to travel in a path that has an edge co-incident with said second folding edge and a second longitudinal fold of said web may be drawn over said second folding edge to be folded underneath said plane as viewed in said direction and may then be folded for 180° over said third folding edge

so as to place the second fold in juxtaposition with respect to said first fold in said path.

2. A folding device for folding a web of flexible sheet material longitudinally and comprising first and second folding edges extending from a common point and disposed in a common plane with an angle of 135° between the edges and a third folding edge disposed underneath said plane and extending from beneath said point between said first and second folding edges and at an angle of 45° with respect to said second folding edge as viewed in a direction normal to said plane, whereby a first longitudinal fold of a web may be drawn over for 180° and folded by said first folding edge to travel in a path that has an edge co-incident with said second folding edge and a second longitudinal fold of said web may be drawn over said second folding edge to be folded underneath said plane as viewed in said direction and may then be folded for 180° over said third folding edge so as to place the second fold in juxtaposition with respect to said first fold in said path.

3. A folding device for folding a web of flexible sheet material longitudinally and comprising first and second folding edges extending from a common point and disposed in a common plane with an obtuse angle between the edges and a third folding edge disposed between said first and second folding edges as viewed in a direction normal to said plane and extending from a point that is co-incident with said first named common point as so viewed and said third folding edge being disposed in a plane which is spaced from and parallel with said first named plane, whereby a first longitudinal fold of a web may be drawn over for 180° and folded by said first folding edge to travel in a path that has an edge co-incident with said second folding edge and a second longitudinal fold of said web may be drawn over said second folding edge to be folded underneath said plane as viewed in said direction and may then be folded for 180° over said third folding edge so as to place the second fold in juxtaposition with respect to said first fold in said path.

4. A folding device for folding a web of flexible sheet material longitudinally and comprising a piece of rigid sheet material having first and second folding edges extending from a common point with an obtuse angle between the edges, said rigid piece having a return bent portion which extends back under the main portion of the piece so that the return bend forms said second folding edge, said return bent portion terminating in a third folding edge which is disposed between said first and second folding edges viewed in a direction normal to the plane of the main portion of the piece of sheet material and which extends from a point that is co-incident with the common point between said first and second folding edges, whereby a first longitudinal fold of a web may be drawn over for 180° and folded by said first folding edge to travel in a path that has an edge coincident with said second folding edge and a second longitudinal fold of said web may be drawn over said second folding edge to be folded underneath said plane as viewed in said direction and may then be folded for 180° over said third folding edge so as to place the second fold in juxtaposition with respect to said first fold in said path.

5. A folding device for folding a web of flexible sheet material longitudinally and comprising a piece of rigid sheet material terminating in a first folding edge that extends from a certain point on a longitudinal line of the rigid piece at an angle of 45° with respect to said line, said rigid piece having a doubled back portion which extends back under the main portion of the piece along a second folding edge extending from said point and disposed at 90° with respect to said line, said doubled back portion terminating in a third folding edge that extends at 45° with respect to said line whereby a first longitudinal fold of a web may be drawn over for 180° and folded by said first folding edge to travel in a certain path that extends at 90° with respect to said line and a second

fold of said web may be drawn over and folded successively for 180° at each fold over said second and third folding edges so as to place the latter fold in juxtaposition with respect to said first fold in said path.

6. Folding apparatus comprising a series of folding devices each of which is adapted to receive and longitudinally fold a web of flexible sheet material so that the folded webs travel in a certain path, each of said devices comprising a piece of rigid sheet material terminating in a first folding edge that extends from a certain point on a side edge of said path at an angle of 45° with respect to said path edge, said rigid piece having a doubled back portion which extends back under the main portion of the piece along a second folding edge extending from said point along said last named path edge, said doubled back portion terminating in a folding edge that extends at an angle of 45° with respect to said last named path edge, whereby a first longitudinal fold of a web carried by said piece may be drawn over and through 180° by said first folding edge to travel in said path and a second fold of said web may be drawn over and folded successively for 180° at each fold over said second and third folding edges so as to place the latter fold in juxtaposition with respect to said first fold in said path, said folding devices being alternately arranged to carry webs from opposite sides of said path and each of the folding devices being arranged to carry the top fold of a previously folded stack of webs produced by previous folding devices in said series between its doubled back and main portions so that the top fold is positioned between the web folds produced by the folding device.

7. In a method for continuously longitudinally folding a web of flexible sheet material into first and second longitudinal folds, the steps which comprise, drawing the web of sheet material in unfolded flat condition and during such movement folding a lateral strip of the web constituting its first fold under itself about a folding edge that extends slantwise with respect to the direction of movement of the sheet material in its unfolded condition, folding another lateral strip of the web constituting its second fold under itself and under said first fold along a folding edge that is disposed in the same plane as said first folding edge and has a common point with said first folding edge and extends at an obtuse angle with respect to said first folding edge, and then folding said second fold through 180° along a folding edge disposed underneath said plane and extending from beneath said point in a direction between said first and second folding

edges viewed in a direction normal to said plane so that the second fold is juxtapositioned beneath the first fold in said path.

8. In a method for continuously longitudinally folding a web of flexible material into first and second folds which travel in a predetermined path, the steps which comprise, drawing a web of sheet material from one side of said path and folding a lateral strip of the web constituting its first fold under itself and into said path about a fold line that extends at 45° to an edge of the path, folding another lateral strip of the web constituting its second fold under itself and under said first fold along a fold line that extends along said last named path edge and then folding said second fold upwardly and back upon itself along a fold line that extends at 45° with respect to said last named path edge and at 90° with respect to said first named fold line so that the second fold is disposed beneath the first fold in said path.

9. In a method for interfolding webs of flexible sheet material, longitudinally folding each of said webs into first and second folds which travel in a predetermined path by drawing each web from one side of said path and folding a lateral strip of the web constituting its first fold under itself and into said path about a fold line that extends from an edge of said path at 45° with respect to said path edge, folding another lateral strip of the web constituting its second fold under itself and under said first fold along a fold line that extends longitudinally of said path along said last named path edge and then folding said second fold upwardly and back upon itself along a fold line that extends from said path edge at 45° with respect to said path edge so that the second fold is disposed beneath the first fold in said path, said webs being introduced alternately from opposite sides of said path into said path and each being folded as above mentioned with the uppermost fold of the previously folded webs in said path being trained to pass between said first and second folds of the web being subsequently introduced and folded into said path whereby to interfold the webs.

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P. V. WILLIAMS, Assistant Examiner