

Sept. 17, 1968

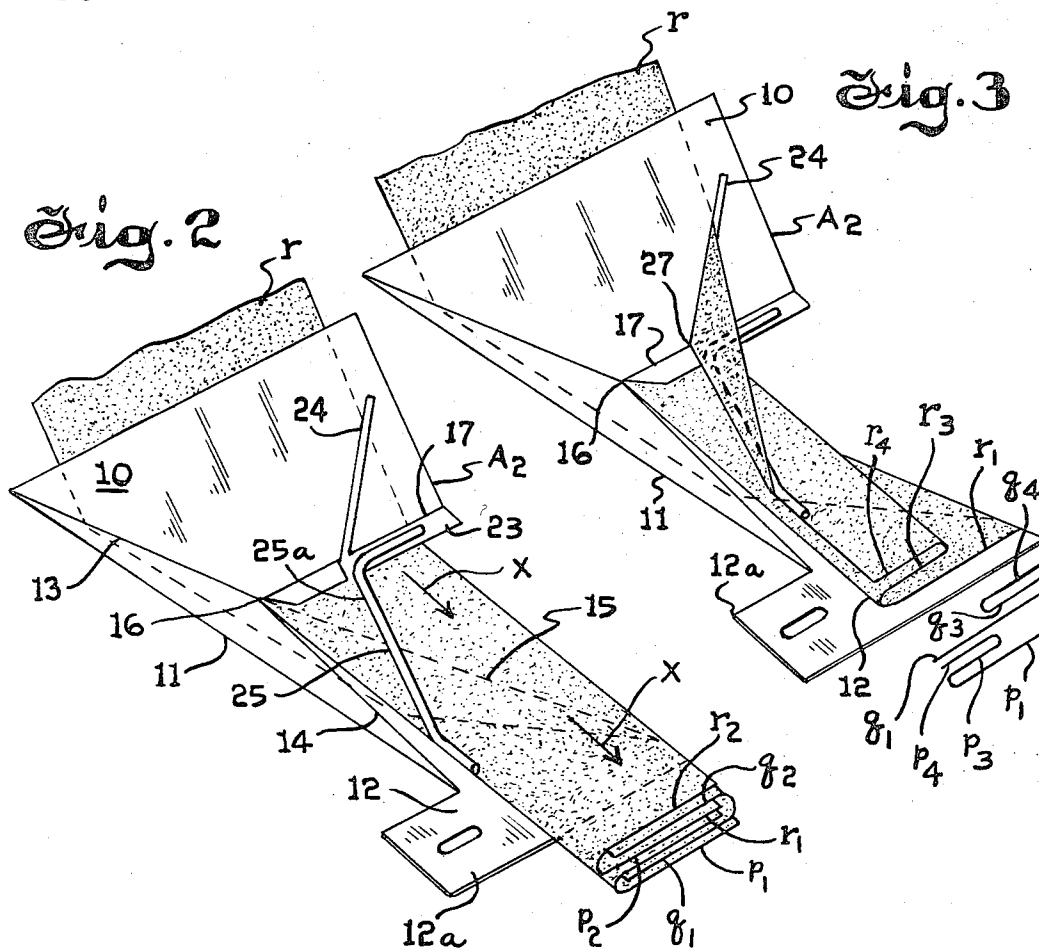
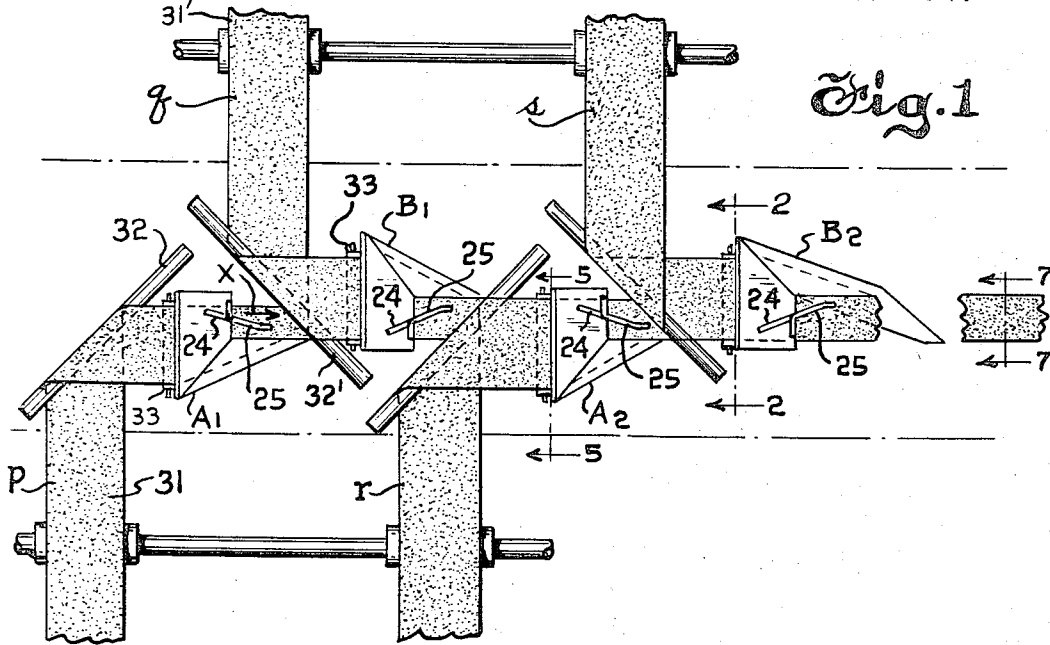
R. H. FRICK

3,401,928

MACHINE FOR PRODUCING A LONGITUDINALLY FOLDED STACK OF WEBS

Filed Aug. 19, 1966

3 Sheets-Sheet 1



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MACHINE FOR PRODUCING A LONGITUDINALLY FOLDED STACK OF WEBS

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Fig. 5

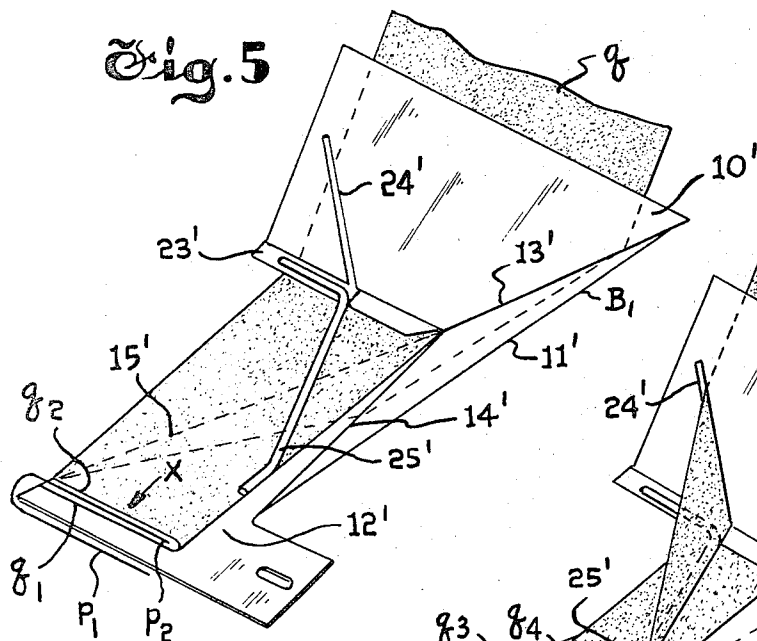


Fig. 6

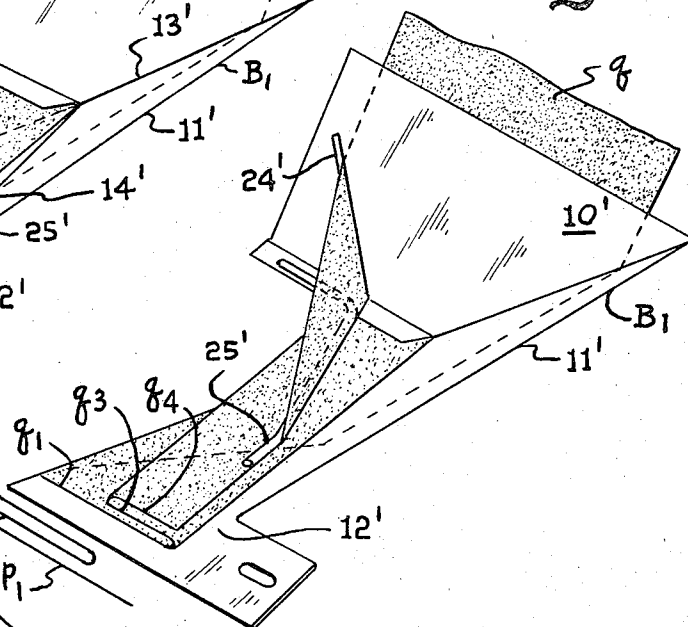


Fig. 12

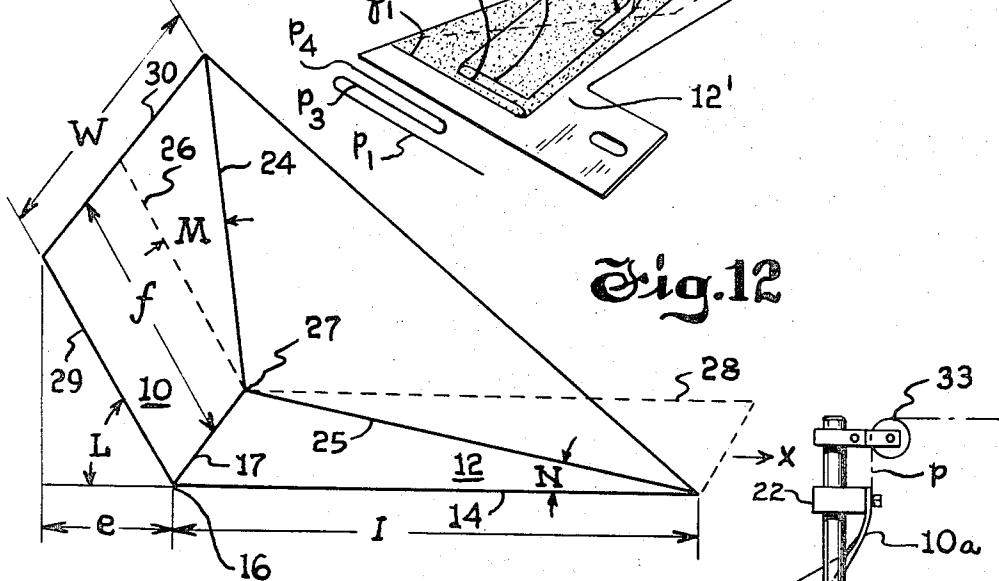
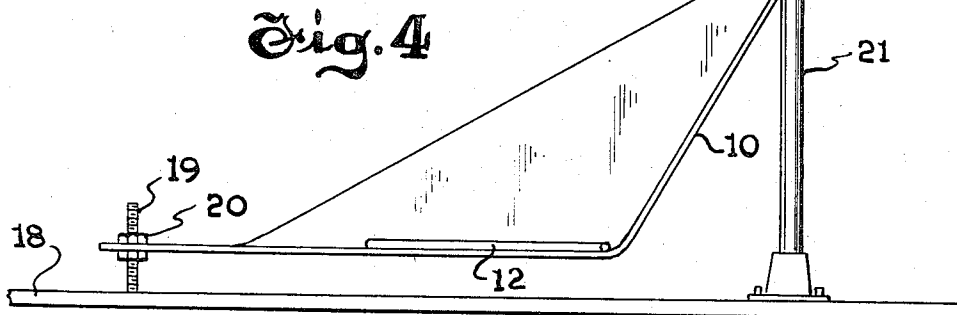


Fig. 4



Sept. 17, 1968

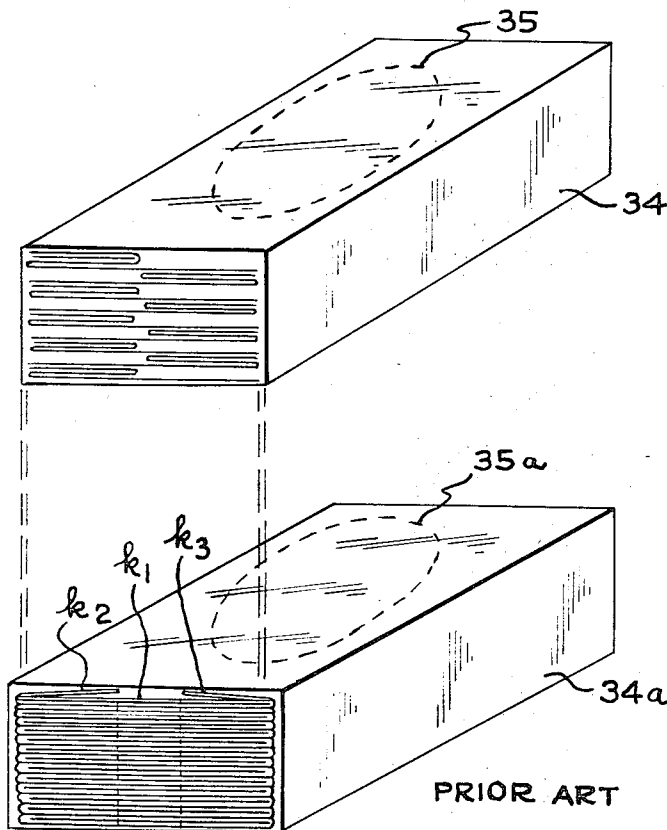
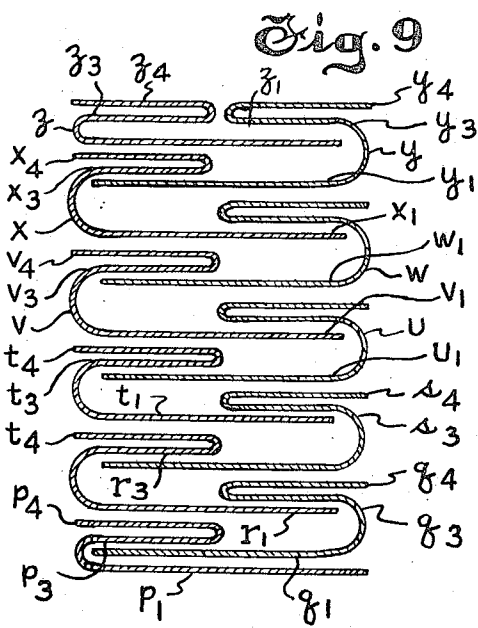
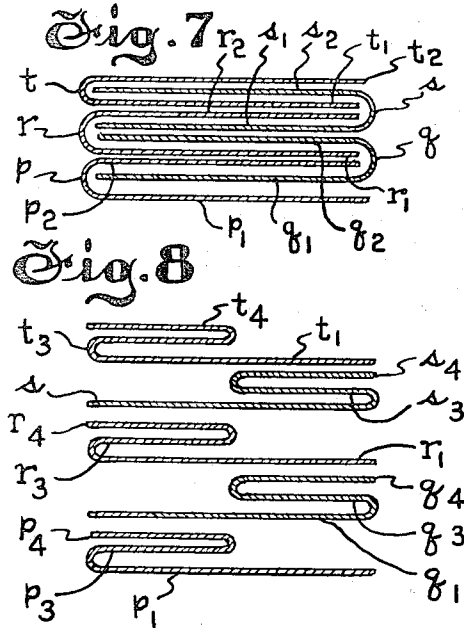
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3 Sheets-Sheet 3



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3,401,928 MACHINE FOR PRODUCING A LONGITUDINALLY FOLDED STACK OF WEBS

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Filed Aug. 19, 1966, Ser. No. 573,585
5 Claims. (Cl. 270—40)

ABSTRACT OF THE DISCLOSURE

A machine for folding uniform width webs of sheet material into a stack with each web being folded to have two quarter folds on the top surface and a half width fold on the bottom, the machine comprising a series of folding devices each of which overfolds the top quarter width fold and underfolds the bottom half width fold with respect to the intermediate quarter width fold and each folding device having first, second and third folding edges disposed in a single plane and joining at a single point, a fourth folding edge extending from said point at obtuse angles to said first and second folding edges so that the central zone of the web may be passed over the first folding edge while a lateral edge strip of the web passes successively over the fourth, second and third folding edges to be folded underneath the central zone of the web, each said folding device also including a fifth folding edge extending from a second point on said first folding edge spaced from said first point and extending obliquely with respect to said first folding edge and being disposed in the same plane as said fourth folding edge and a sixth folding edge substantially in said first named plane and extending from said second point to said second folding edge so that a lateral edge strip of the web may successively pass over said fifth and sixth folding edges to be folded over said central zone of the web.

My invention relates to papermaking machines and paper products and more particularly to folded webs of paper or other sheet material and to machines for folding the webs.

Herbert H. Scholz and I have proposed in co-pending application, Ser. No. 567,440, filed July 25, 1966, a change or modification of the longitudinal web interfolding structures disclosed in Greiner et al. Patent 3,066,932, issued Dec. 4, 1962. In brief, this modification of the Greiner et al. structures essentially was the substitution of a modified type of folding device or board for one of the series of folding devices or boards disclosed in the Greiner et al. patent. The modified type of folding device was of such construction that it not only allowed the device to be used for interfolding a web passing over the device with a previously folded stack of webs, but the modified folding device also, on a re-threading, was capable of folding the web passing over the device back upon itself along the longitudinal center line of the previously interfolded stack of webs.

It is an object of the present invention to utilize a plurality of such modified folding devices or boards positioned in tandem and in a series so that the series of devices is not only capable of longitudinally interfolding a series of webs, similar to the interfolding action of the folding devices disclosed in the Greiner et al. patent, but is also capable of laying down a series of webs having the top halves folded back upon themselves along longitudinal center lines, without any interfolding between the webs, so as to form a Z-fold type of folded stack of webs.

The invention consists of the novel constructions, 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 partial plan view of a folding mechanism incorporating the principles of the invention and including a plurality of folding boards disposed in a series;

FIG. 2 is a view taken substantially on line 2—2 of FIG. 1 and showing an end perspective view of one of the folding boards of the invention;

FIG. 3 is a view similar to FIG. 2 but with the folding board being used in a different way;

FIG. 4 is a side elevational view of the folding board illustrated in FIGS. 2 and 3;

FIG. 5 is a view taken substantially on line 5—5 of FIG. 1 and showing an end perspective view of another folding board of the folding mechanism;

FIG. 6 is a view similar to FIG. 5 but with the folding board being used in a different manner;

FIG. 7 is a sectional view taken substantially on line 7—7 of FIG. 1 and showing a stack of paper webs that have been folded utilizing the folding mechanism illustrated in the previous figures;

FIGS. 8 and 9 are views similar to that of FIG. 7 but with the folding boards being threaded differently to fold the webs differently;

FIG. 10 is a perspective view of a carton of C-folded tissues constituting prior art;

FIG. 11 is a perspective view of tissues as folded in FIG. 8 and disposed in a carton; and

FIG. 12 is a diagrammatic illustration of one of the folding boards setting forth various dimensions and angles of the board.

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

Referring to FIG. 1 in particular, the folding mechanism of the invention may be seen to utilize two types A and B of folding boards or devices. The two types of folding boards A and B are alternately arranged in a series, with each type B device following a type A device and being arranged between two type A devices except for the last type B device in the series.

As seen in FIG. 1, the particular folding device B₁ follows the particular device A₁; the device A₂, which is identical to the first device A₁, follows the device B₁; and the device B₂, which is identical to the device B₁, follows the device A₂. Likewise, in the series of folding devices B₃, B₄, B₅, etc. (not shown), identical with device B₁, will respectively follow devices A₃, A₄, A₅, etc. (not shown), identical with device A₁.

Referring to FIG. 2 showing the device A₂, each type A device comprises flat sheet metal portions 10, 11 and 12 which are preferably made of a single piece of sheet material folded along lines 13 and 14. The portion 12 may be considered as a base portion preferably used in a horizontal position; and, as will be observed from FIG. 4, the portion 10 extends upwardly and at an obtuse angle with respect to the portion 12. The line 14, as will hereafter appear, extends parallel with the path X of movement of a web or webs passing over the folding board and parallel with the edges of the webs. The portion 12 terminates in an edge 15 which extends at an acute angle with respect to the line 14, the apex of the lines 14 and 15 being at a point 16; and the line 13, as well as the lower edge 17 of the portion 10, terminate at the point 16. The Greiner et al. Patent 3,066,932 may be referred to for the preferred relationship of the flat portions 10, 11 and 12 and the lines defining the edges of these portions with respect to each other, in order that a web may pass over the device and be folded by it without wrinkling or stretching of portions of the web.

The flat portion 12 is preferably provided with a side extension 12a at one end of the board by means of which the portion 12 may be supported from a table 18 (see FIG. 4), and the flat portion 10 is provided with an extension 10a by means of which the other end of the board may be supported. An upstanding stud 19 may be provided for supporting the portion 12, the stud extending through the extension 12a and a plurality of nuts 20 being provided on the stud above and below the portion 12a. The other end of the board may be supported by means of a standard 21 fixed on the table 18 with the portion 10a being fixed to a collar 22 that in turn is fixed on the standard 21.

The portion 10 is provided with a lip-like extension 23 meeting with the portion 10 along the line 17. A slot 24 is provided in the portions 10 and 23, and a rod 25 is fixed at one end to the lip portion 23 and terminates substantially above the line 14.

The dispositions of the slot 24 and of the bar 25 are preferably those set forth in the co-pending application of Richard H. Frick and Herbert C. Scholz, Ser. No. 567,440, hereinabove referred to, in order that a web passing through the slot 24 and over the bar 25 will not be wrinkled, and these relationships are briefly the following:

$$\cos L = \text{One} - \frac{W^2}{2fl}$$

$$\tan N = \frac{W}{2e}$$

$$\tan M = \frac{W}{2f}$$

The angle M denotes the angle at which the slot 24 is disposed with respect to a vertical line 26 that extends upwardly on the flat portion 10 from a point 27, which is the substantial point of intersection of the slot 24 and the inner or folding edge 25a of the bar 25. Assuming that the portion 12 is horizontal, the line 26 lies in a vertical plane which also includes a line 28 that is a longitudinal center line of a stack of interfolded webs, with the plane being parallel with the direction of movement X of the folded webs. The side edge of the stack of folded webs, as will hereinafter appear, is substantially along the line 14, and a line 29 is an imaginary line in the flat portion 10 extending upwardly and in the same vertical plane as the line 14. The lines 26 and 29 are, of course, parallel, and the same is true for the lines 14 and 28. The angle N is the angle between the bar 25 and the line 14 which is parallel with the direction of web travel X. The angle L is the angle at which the portion 10 extends with respect to the portion 12. The quantity W is equal to the width of the web portion which is folded over by the bar 25—the quantity W may, for example, in the case to be hereinafter described, be equal to one-half the width of the interfolded stack of webs or one-fourth the width of a web prior to any folding. The distance f is the distance from the line 17 to a line 30, which is the distance W in length and which intersects with both the lines 24 and 29 and is parallel to the line 17. The distance e is the component of the distance f along the path X and l is the distance from the line 17 to the intersection of the bar 25 and the line 14.

A paper web p from a roll 31 of paper web is supplied to the first folding device A₁ (see FIG. 1). A guide bar 32 receives the web p from the roll 31; and the bar 32 is suitably mounted with respect to the table 18, at a 45 degree angle with respect to the direction X at which the webs pass under the folding devices on the table 18. The standard 21 for the device A₁ is provided with a guide roll 33 at its upper end, and the web p passes from the guide bar 32 onto the roll 33 and from thence onto the lower face of the flat portion 10 of the first folding device A₁.

All of the type A folding devices in the folding mechanism are identical. A type B folding device is a reverse

image of a type A folding device as above described, and the first folding device B₁ in the series is shown in FIGS. 5 and 6. Each of the devices B basically is made up of plane sheet metal portions 10', 11' and 12', slots 24' and rods 25', and these parts are in the same dispositions with respect to each other as have been previously mentioned with respect to corresponding parts in a type A device. The first type B folding device B₁ is supplied with a web q from a roll 31' which passes over a guide bar 32' to a roll 33, and these parts correspond with the similarly numbered parts described above in connection with the first folding device A₁.

The subsequent folding devices A₂ and B₂ illustrated in FIG. 1 are similarly supplied with webs r and s respectively, and still additional folding devices in the series (not illustrated) are similarly supplied with webs t, u, v, w, x, y and z (not shown in FIG. 1).

The series of type A and type B folding devices alternately arranged, as illustrated in FIG. 1, may be utilized for producing an interfolded web as illustrated in FIG. 7. In this case, the folding devices function substantially the same as the two types of folding devices described in the above mentioned patent to Greiner et al., No. 3,066,932; and, in this case, the slots 24 and 24' and the rods 25 and 25' of the folding devices are not used.

For such interfolding, the webs (q to z) passing onto their respective folding boards each has a longitudinal one-half of it passing down the lower surface of the plane portion 10 or 10' and under the lip 23 or 23' into a path of movement of the folded stack of webs in the direction X along the upper surface of the table 18. The other longitudinal halves of the webs pass under the plane portions 10 or 10', under the plane portions 11 or 11', under the plane portions 12 or 12' and around the folding edges 15 or 15' so that these halves of the webs are folded underneath the first longitudinal halves of the webs. If the particular board under consideration is one of the boards subsequent to the first board A₁, the second longitudinal one-half of the web being folded under the first longitudinal one-half is at the same time also inserted underneath the uppermost fold of the stack of webs folded by previous folding boards.

The operation of the folding board B₁ is particularly shown in FIG. 5, and it will be observed that the left half of the web q, as the device B₁ is illustrated in this figure, passes downwardly underneath the plane portion 10' and under the lip 23' to move in the path of travel of the interfolded webs indicated by the arrow X. The right half of the web q passes downwardly on the lower surface of the plane portion 10', around the bend line 13', on the undersurface of the plane portion 11', around the bend line 14', on the undersurface of the plane portion 12' and from thence around the edge 15' of the portion 12 to thereby underfold this half of the web underneath the first half of the web that passes underneath the lip 23'. The half of the web passing underneath the lip 23' is indicated by the web fold q₂ in FIGS. 2 and 5, and the half of the web underfolded by passing around the portions 10', 11' and 12' is indicated by the web fold q₁ in these figures.

The web p has been folded by the previous board A₁, and the upper fold p₂ of this web has been trained to pass over and to lie in contact with the upper surface of the plane portion 12' of the board B₁, so that as the lower fold q₁ is folded by the folding edge 15' underneath the top fold q₂, the fold q₁ is at the same time positioned underneath the top fold p₂ of the previous web p. Thus, the web q has been longitudinally interfolded by the folding board B₁ with the previously folded web p.

The subsequent folding device A₂ functions substantially in the same manner except that it folds a web from the other side of the stack, and the similar operation of the board A₂ is illustrated in FIG. 2. As seen in this figure, the right half of the web r passes underneath the portion 10 and the lip 23 into the path X so as to become

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the web fold r_2 . The left half of the web r passes underneath the portions 10, 11 and 12 and from thence around the folding edge 15 so as to be folded underneath the web fold r_2 to thereby become the web fold r_1 . The web fold q_2 of the interfolded stack of webs leaving the folding device B_1 is trained to pass over the horizontal plane portion 12, and the web fold r_1 is thereby not only folded under the web fold r_2 but is also at the same time folded under the web fold q_2 on the top of the previously folded stack of webs so as to complete the interfolding.

The first folding device A_1 functions in exactly the same manner as the folding device A_2 except that, inasmuch as the folding board A_1 is the first of the series of boards, there are no previously interfolded webs; and the folding board A_1 thus simply has the effect of folding the fold p_1 under the fold p_2 .

The subsequent type A boards function in the same manner as the type A boards just described, and the subsequent type B boards function in the same manner as the board B_1 . All of the folding boards, subsequent to the first board A_1 , function similarly to unfold a longitudinal half of the web passing over the board as well as to fold a longitudinal half of this web underneath the uppermost fold of the previously interfolded stack of webs. It will be understood that, for setting up the folding mechanism, each of the individual webs is threaded over its respective folding board A_1, B_1, A_2, B_2 , etc., and the resultant webs are interfolded by hand in the movement path X; and, in order to set the machine in operation, the webs in their interfolded condition are simply drawn along in the path X by any suitable web pulling mechanism (not shown) so that individual webs are drawn over their individual folding boards and along the path X.

The boards A_1, B_1, A_2, B_2 , etc., function with respect to webs p, q, r, s and t , in order to produce the interfolded stack of webs which is shown in FIG. 7. Referring to FIG. 7, it will be observed that the web fold q_1 lies between the web folds p_1 and p_2 ; the web folds r_1 and p_2 lie between the web folds q_1 and q_2 ; the web folds q_2 and s_1 lie between the web folds r_1 and r_2 ; the web folds r_2 and t_1 lie between the web folds s_1 and s_2 ; and the web fold s_2 lies between the web folds t_1 and t_2 so that the stack of webs is effectively interfolded. Thus, if the elongate stack of folded webs is cut into segments, the top fold t_2 of the stack may be grasped; and in pulling and in removing the cut segment of the web t from the stack, the fold s_2 will at the same time be pulled upwardly; and, assuming that the segment of interfolded webs is in a carton with a dispensing window in its top panel, the top fold s_2 will be partially pulled through the window for subsequent removal. This particular arrangement of interfolded webs is particularly suitable if the webs are of creped tissue suitable for facial usage, and the tissues may thus be removed one at a time from the enclosing carton, and each tissue will pull a fold of the succeeding tissue into view for ready subsequent usage. Although only the five webs p, q, r, s and t have been illustrated in FIG. 7, it will be obvious that the succeeding folding boards in the series will produce subsequent folded webs which are interfolded with themselves and with previously folded webs in the same manner and with the same pattern as is illustrated with respect to the webs p to t in FIG. 7.

In the event that it is desired to produce a non-interfolded stack of webs, the slots 24 and 24' and the folding rods 25 and 25' may be utilized. In this case, each of the folding devices is threaded in a slightly different manner with the particular web folded by the device.

Referring to FIG. 3 illustrating the folding device A_2 , it will be observed that the right fourth of the web r is directed through the slot 24 and over the folding bar 25 instead of passing underneath the lip 23 with the rest of the right half width of web r . The distance from the point 16 to the end of the slot 24 at point 27, in the particular form of the folding device illustrated, is equal to one-fourth the width of the complete web r , and the

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right one-fourth of the web r as it passes through the slot 24 and over the folding rod 25 is folded over the other one-fourth of the web which would otherwise constitute a part of the web fold r_2 if the board A_2 were used as first described. Thus, as is illustrated in FIG. 3, with the slot 24 and the rod 25 being utilized; the folding device A_2 folds the half web fold or width r_1 underneath; a quarter fold r_3 passes underneath the lip 23 so as to remain on top of the web fold r_1 ; and a quarter width web fold r_4 is folded on top of the quarter width web fold r_3 . None of the previously folded webs, utilizing the boards in this manner, passes over the plane portion 12; and, therefore, there is no interfolding. The web p is folded by the first type A board in the same manner as the web r is folded by the board A_2 ; and the web p appears as shown in FIG. 3; with a bottom half width fold p_1 and upper quarter folds p_3 and p_4 .

The board B_1 , functioning in the same manner as do the type A boards as just described, has the left one-quarter of the web q passing through its slot 24' and over its folding bar 25' (see FIG. 6). The board B_1 folds in the same manner as the boards A_1 and A_2 but in the opposite direction so that the board B_1 produces a lower one-half width web fold q_1 and upper one-quarter width folds q_3 and q_4 .

The boards as used in this manner do not interfold, and the stack produced by the boards operating in this manner is illustrated in FIG. 8. All of the webs are folded in the same manner so that each has two, one-fourth width, folds located above a full one-half width fold. This folding may be termed a modified Z-fold, and the webs simply lie one on another. Due to the fact that the type A boards and type B boards fold in opposite directions, the one-fourth width folds lie on opposite sides of the stack and the crease or fold between the quarter width folds lies substantially on the longitudinal center line of the stack of folded webs. If the webs p, q, r, s and t are of facial quality tissue cut into segments and packaged in cartons with openings in the top panels, the segments of the individual webs may be withdrawn through the top openings individually without disturbance of the webs located underneath, since the boards used in this manner do not interfold the webs. In particular, referring to FIG. 8, it will be observed that the web p , with its half fold p_1 and its quarter folds p_3 and p_4 , is located in the stack completely beneath all parts of the web q . Likewise, the web q , with its half fold q_1 , and its quarter folds q_3 and q_4 is located below all parts of the succeeding webs r, s and t . Also, it will be observed that the quarter folds p_3 and p_4 extend from the left side of the stack substantially to the longitudinal center of the stack while the quarter folds q_3 and q_4 of the web q also extend substantially to the longitudinal center of the stack, but from the right hand side of the stack. The other webs alternate from opposite sides of the stack as illustrated. Since the quarter folds of the individual webs extend to the longitudinal center of the stack, the crease between the quarter folds of the uppermost web segment may be easily grasped by a person thrusting his hand through the tissue withdrawal opening in the top panel of a carton in which segments of the folded webs are packaged, so that the uppermost web can be easily grasped and withdrawn from the carton.

It is also possible using the modified Z-fold and using the type A and type B boards in the manner just described, to interfold the paper webs, and the webs as so interfolded are illustrated in FIG. 9. In this case, each of the boards after the first board A_1 , has the lowermost one-fourth fold of the previously folded web trained on and traveling over the horizontal plane portion 12 or 12' of the board, so that the half fold of the web folded by the particular board is inserted between the half fold and the lowermost quarter fold of the previously folded web.

As previously described in connection with FIG. 6, the folding board B_1 has the effect of folding the half width fold q_1 under the fold q_3 and folding the quarter width fold q_4 over the fold q_3 . If the fold p_3 of the previously folded web is made to travel on and pass over the upper surface of the plane portion 12' of the board B_1 , the fold q_1 is inserted between the folds p_1 and p_3 as shown in FIG. 9. The operation of the board A_2 in utilizing the slot 24 and rod 25 is illustrated in FIG. 3; and, as previously described, the board operating in this manner underfolds the one-half width fold r_1 under the one-fourth width fold r_3 and overfolds the one-fourth width fold r_4 over the one-quarter width fold r_3 . If the fold q_3 from the previously folded web is made to pass along and over the upper surface of the plane portion 12 of the board A_2 , the fold r_1 is positioned between the folds q_1 and q_3 as shown in FIG. 9. The first folding board A_1 functions in the same manner as the board A_2 , but there is no previously folded web traveling under the board A_1 into which its lower one-half width fold p_1 may be positioned.

The subsequent type A boards and the subsequent type B boards function in the same manner as just described in connection with the board A_2 and the board B_1 to fold the lowermost one-half width fold produced by the particular board in between the one-half width and lowermost one-fourth width folds produced by the previous folding board, and thus the type of interfolding in FIG. 9 is produced by the boards operating in this manner. With this type of interfolding, it will be observed that the one-quarter width folds of any particular web having the subscripts 3 and 4 are positioned between the one-half width folds of the subsequent two webs. For example, the folds p_3 and p_4 from the web p passing over the folding board A_1 are located between the one-half width folds q_1 and r_1 of the subsequent two webs q and r . As will be observed, on the top of the stack as shown in FIG. 9, there are four folds present, namely the folds z_3 , z_4 , y_3 , and y_4 . Each of these folds is one-fourth width and therefore the fold lines between these folds lie along the longitudinal center of the stack. Therefore, assuming that a segment of the stack as illustrated in FIG. 9 is positioned in a carton with a windowed top panel, the user's hand may be reached into the carton through the window and either of the webs z or y may be grasped in order to remove a web segment from the carton. Since the webs are interfolder, a withdrawal of one web from the carton acts to pull a lower web partially through the window of the carton so as to make it available. In order to increase the adherence of one web with respect to the other to promote this action, the tissue webs as so folder may be compressed, such as for example, as is described in Patents 3,172,563, issued to Kenneth J. Harwood on Mar. 9, 1965, and 3,172,564 issued to Kenneth M. Enloe and LeRoy L. Peterson on Mar. 9, 1965; and such compression also has the effect, as described in these patents, of allowing the webs to be packed in cartons of less height than would otherwise be possible.

Referring to FIG. 8, it will be observed that the modified Z-folded webs, without interfolding, provide an edge on the top of the stack along the longitudinal center line of the stack, which is a folded edge rather than a cut edge. With this arrangement, there is no opposite edge, cut or otherwise, on the top surface of the stack; and a person may easily grasp the folded edge on the top of a cut segment of the web stack for the purpose of removing the top web out of a carton, for example, for the cut segment.

In addition, it will be noted that since the folded edge on the top of the stack extends to the longitudinal center line of the stack, the stack may be exactly one-half the width of each of the webs before folding. A stack, such as is illustrated in FIG. 8, is shown positioned in FIG. 11 within a carton 34 having an oval shaped perforation line 35 in its top panel for the purpose of providing an opening in the top panel when the perforation line is

broken. Since the FIG. 8 stack is equal in width to one-half the width of a tissue web prior to folding, the carton 34 may be only slightly greater in width than this dimension.

The conventional tissues now on the market which are individually removable from a carton are ordinarily C-folded, as illustrated in FIG. 10, each tissue comprising a lower bottom fold k_1 extending for the width of the stack and upper narrower folds k_2 and k_3 . A carton 34a for the C-folded tissues is slightly larger than the stack of tissues in width and is also commonly provided with an oval shaped perforation line 35a which provides an opening in the top panel for removal of the tissues one at a time from the carton. A gap of about 1/4 inch is commonly provided between the inner cut edges of the folds k_2 and k_3 so as to allow a person reaching through the opening in the top panel to grasp one or the other of the cut edges forming the ends of the folds k_2 and k_3 of the uppermost web segments. Due to this gap between the folds k_2 and k_3 , the width of the stack of webs must be greater than one-half the width of a web in its unfolded condition; and, therefore, both the width of the C-folded stack of webs as well as the width of the carton for the stack segments must be greater than the widths of the stack of web segments and carton, respectively, using the modified Z-fold, as will be noted from comparing FIG. 10 with FIG. 11. Thus, a carton for the modified Z-folded tissues may be less space consuming than a carton for the conventional C-folded tissues.

With respect to the modified Z-folded tissues as interfolded, illustrated in FIG. 9, the width of the stack also may be exactly equal to one-half the width of a web as contrasted to the C-folded tissues, a stack of which has a width greater than one-half the web width.

The combination folding boards A_1 , B_1 , A_2 , B_2 , etc., which may be used to either provide a modified Z-fold as illustrated in FIG. 8, or a conventional interfold as illustrated in FIG. 7, allow the machine to be used for making either type of tissue stack with only a rethreading of webs to make the change. In this connection, it may be desirable to utilize the FIG. 8 type of folding with relatively deep cartons, while utilizing the FIG. 7 interfolding with thinner cartons and simply by rethreading the same machine, either type of folding may be produced, and two separate machines are not necessary.

It is to be understood that the invention is not to be limited to the specific constructions, arrangements 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.

What is claimed is:

1. In a machine for folding uniform width webs of sheet material into a stack of a width of one-half web width, a plurality of folding devices disposed in series and each adapted to fold a web drawn over the device and along an ultimate path of travel, each of said folding devices having web guide means over which a longitudinal intermediate zone of its respective web may be drawn along said path without being folded over or under adjacent web zones and each said folding device including first folding means across which a first web edge zone on one side of said intermediate zone may be drawn and which folds the web zone underneath said intermediate web zone along a first fold line and each said folding device also including second folding means across which a second web edge zone on the other side of said intermediate zone may be drawn for the purpose of overfolding said second edge zone over said intermediate zone on a second fold line, said folding devices being positioned with respect to each other so that said first fold line produced by said folding devices are substantially on the longitudinal center of the respective webs folded by said devices and on opposite sides of said path for alternate ones of said folding devices in said series and

the second fold lines for alternate ones of said folding devices in the series are disposed substantially one-fourth the width of the web from opposite edges of the respective webs folded by the devices as the webs travel over said folding devices into said path so that the machine produces an elongate stack of folded webs in said path with each web being overfolded from substantially the longitudinal center of the stack to an edge of the stack.

2. In a machine as set forth in claim 1, said guide means of each said folding device including a first straight edge over which the longitudinal intermediate zone passes and said first folding means including a second folding edge having a point of intersection with said first edge and extending along one edge of said path, a third folding edge extending diagonally from said point to the other edge of said path with said three folding edges disposed in a common plane, and a fourth folding edge extending at obtuse angles with respect to said first and second folding edges whereby the first web edge zone of the respective web passes successively over said fourth, second and third folding edges to be folded underneath said intermediate web zone.

3. In a machine as set forth in claim 2, said second folding means of each said folding device including a fifth folding edge disposed in a common plane with said fourth folding edge and extending from a point spaced from said first named point and at an obtuse angle with respect to said first folding edge and a sixth folding edge extending from said second named point obliquely to said second folding edge whereby said second edge zone of the respective web passes successively over said fifth and sixth folding edges to be folded over said intermediate zone.

4. In a machine for folding a stack of webs of sheet material, a plurality of folding devices disposed in tandem and each adapted to fold a web drawn over the device and along an ultimate path of travel, each of said folding devices having a surface over which a longitudinal intermediate zone of its respective web may be drawn along said path without being folded over or under adjacent web zones, each said folding device also having a plurality of folding edges across which a first web edge zone on one side of said intermediate zone may be drawn and which fold the edge zone underneath said intermediate web zone, each said folding device also having a plurality of other folding edges across which a second web edge zone on the other side of said intermediate zone may be drawn for the purpose of overfolding said second edge zone over said intermediate zone whereby to produce a stack of such folded webs traveling in said path, said surface of each of said folding devices extend-

ing at an angle with respect to said ultimate path and having the complete width of the web folded by the device passing over said surface, said plurality of other folding edges including an edge in said surface and an edge providing bar in said path and extending at an acute angle across said path, said second edge zone passing sequentially over said first edge and over said bar so as to overfold said second edge zone over said intermediate zone.

5. In a machine for folding a stack of webs of sheet material, a plurality of folding devices disposed in tandem and each adapted to fold a web drawn over the device and along an ultimate path of travel, each of said folding devices having a surface over which a longitudinal intermediate zone of its respective web may be drawn along said path without being folded over or under adjacent web zones, each said folding device also having a plurality of folding edges across which a first web edge zone on one side of said intermediate zone may be drawn and which fold the edge zone underneath said intermediate web zone, each said folding device also having a plurality of other folding edges across which a second web edge zone on the other side of said intermediate zone may be drawn for the purpose of overfolding said second edge zone over said intermediate zone whereby to produce a stack of such folded webs traveling in said path, said surface of each of said folding devices extending at an angle with respect to said ultimate path and having the complete width of the web folded by the device passing over said surface, said first named plurality of folding edges including a first edge in said surface, a second edge extending in said ultimate path and at the edge of the said stack, and a third edge in said path and extending at an acute angle across said path, said first edge zone passing over said first, second and third edges sequentially in order to fold said first edge zone underneath said intermediate web zone, said plurality of other folding edges including a fourth edge in said surface and a fifth edge provided by a bar in said path and extending at an acute angle across said path, said second edge zone passing sequentially over said fourth and fifth edges so as to overfold said second edge zone over said intermediate zone.

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