

April 28, 1959

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2,883,916

APPARATUS FOR FOLDING BOX BLANKS

Filed Sept. 29, 1954

5 Sheets-Sheet 1

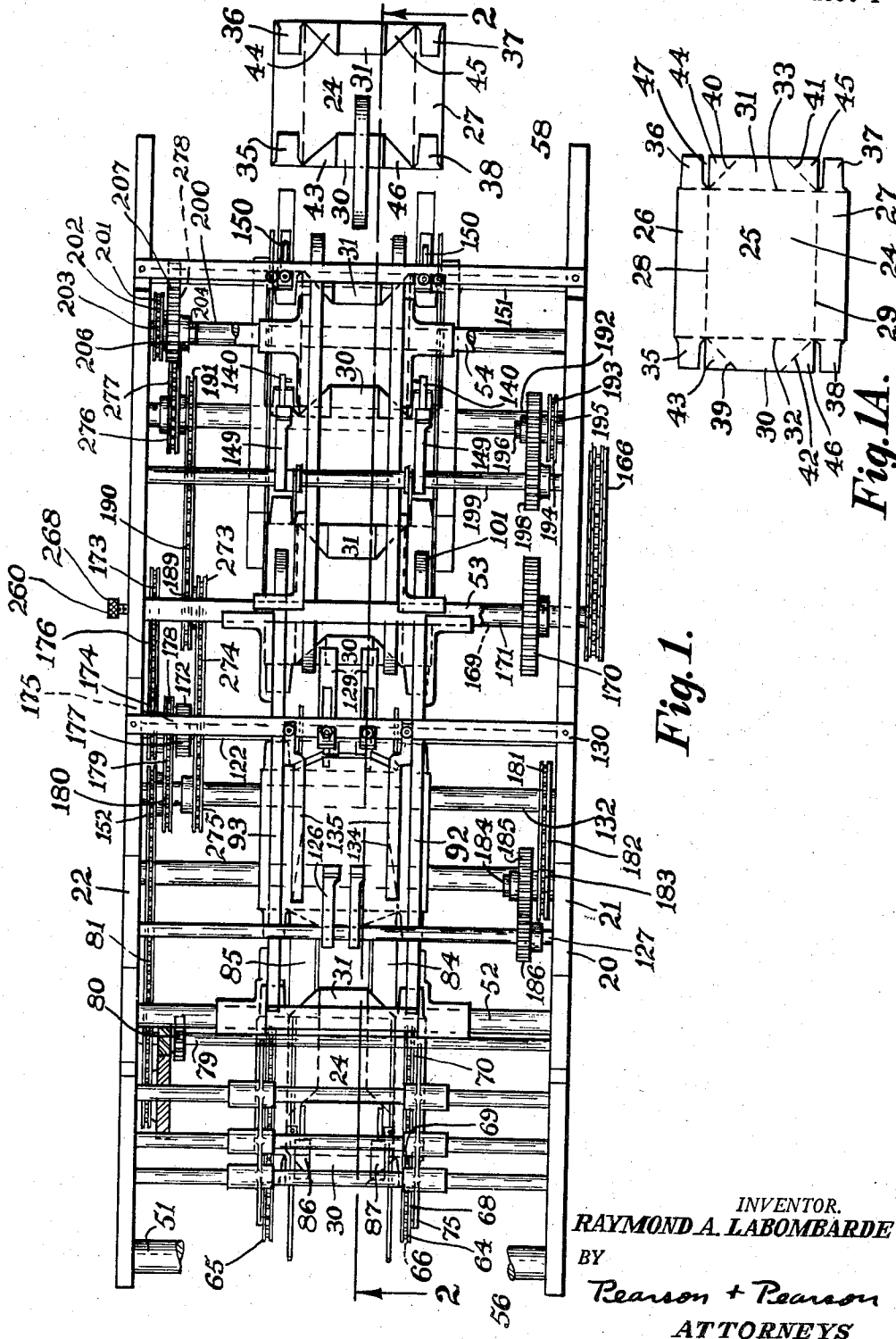


Fig. 1.

Fig. 1A.

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5 Sheets-Sheet 2

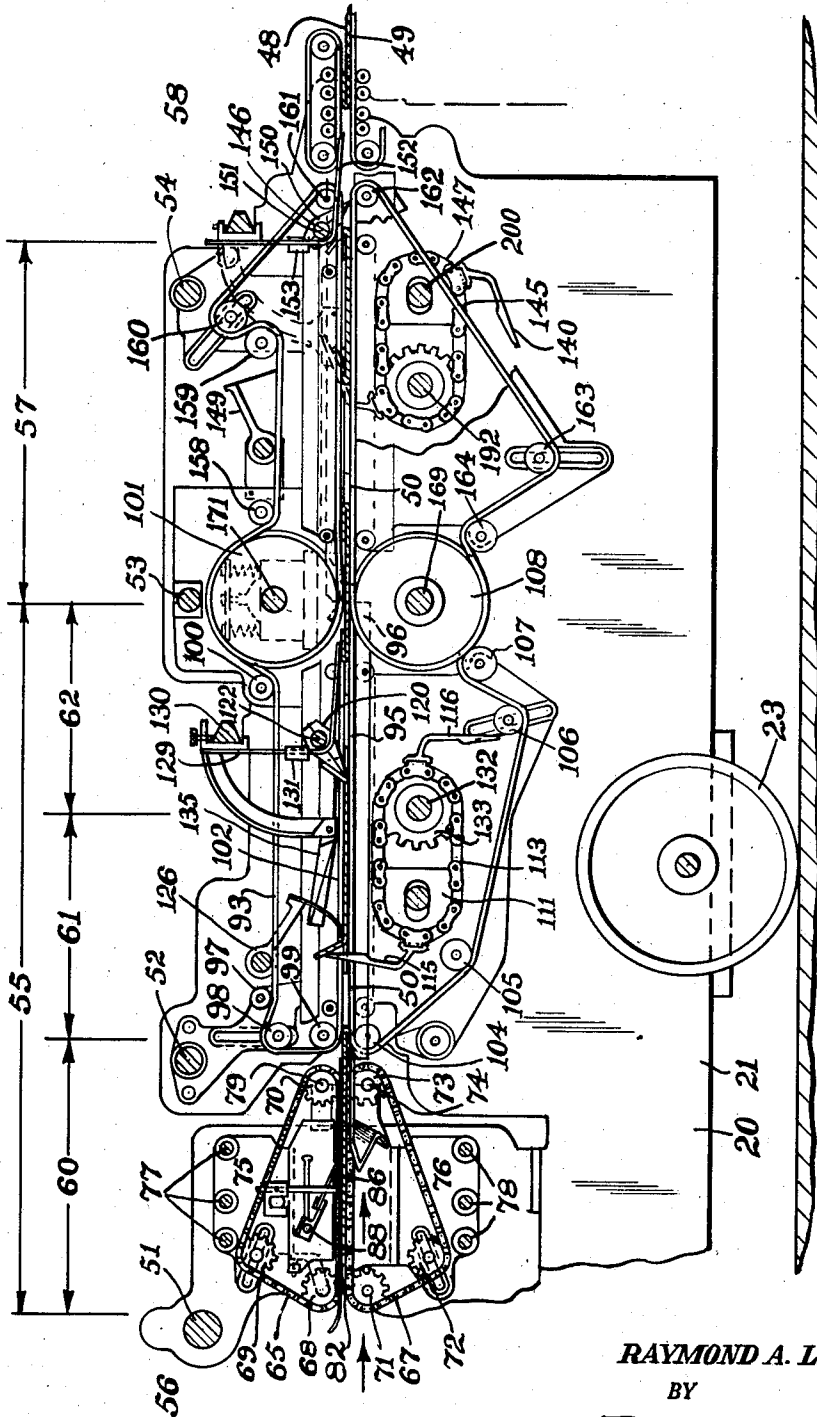


Fig. 2.

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5 Sheets-Sheet 3

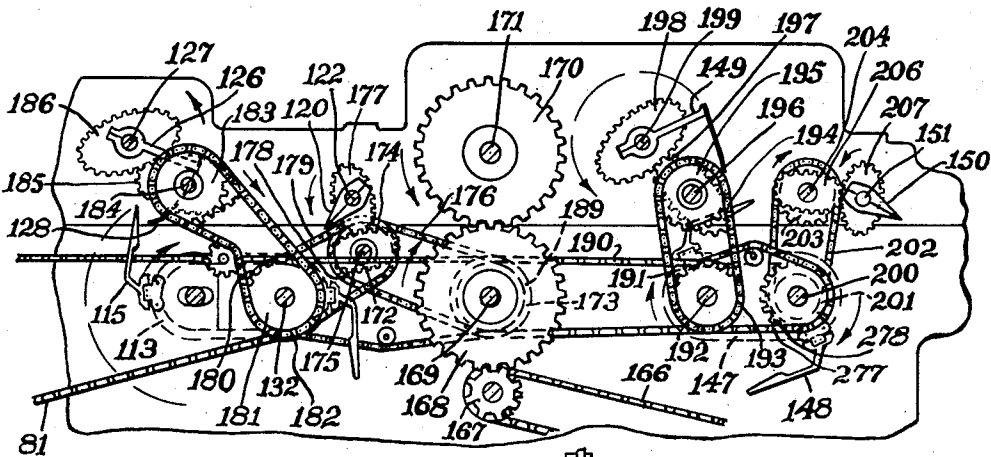


Fig. 3.

Fig. 4.

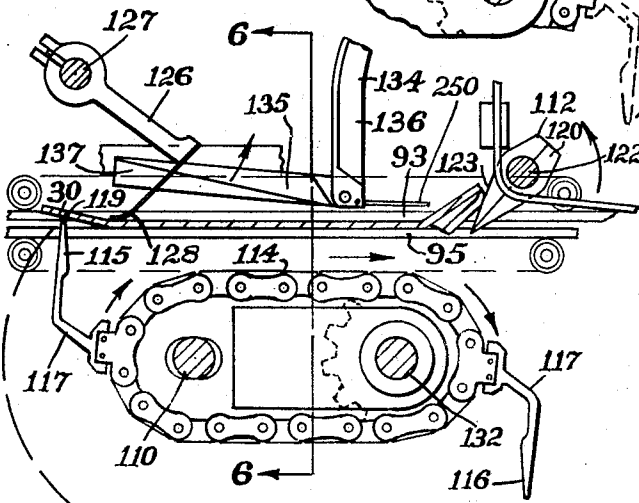
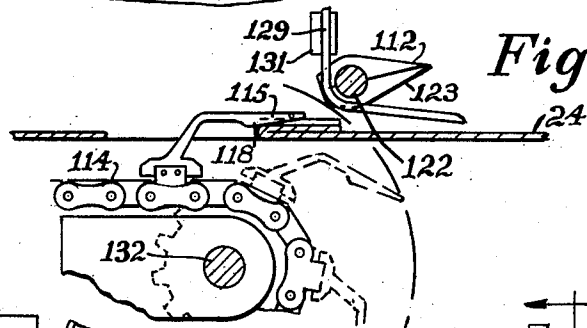


Fig. 5.

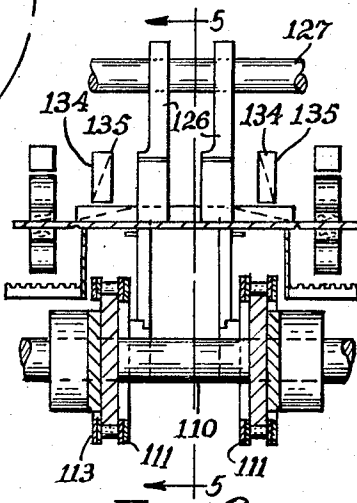


Fig. 6.

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5 Sheets-Sheet 4

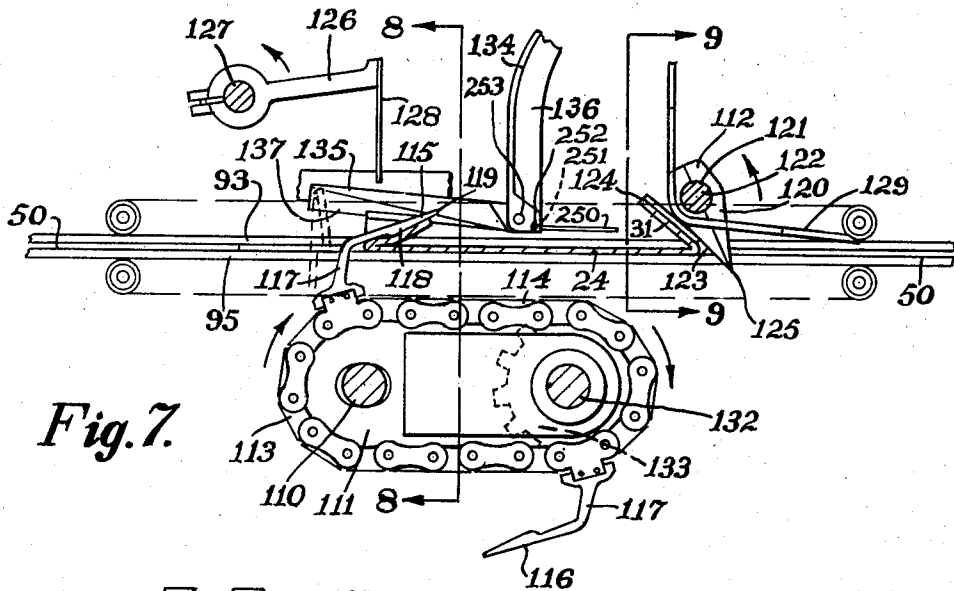


Fig. 7.

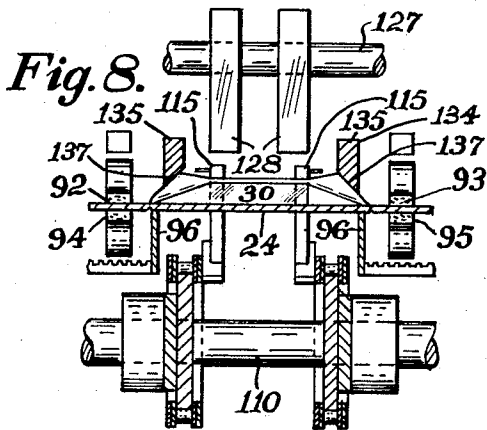


Fig. 8.

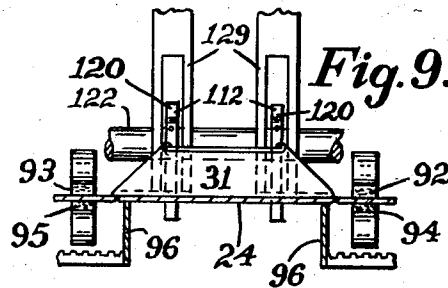


Fig. 9.

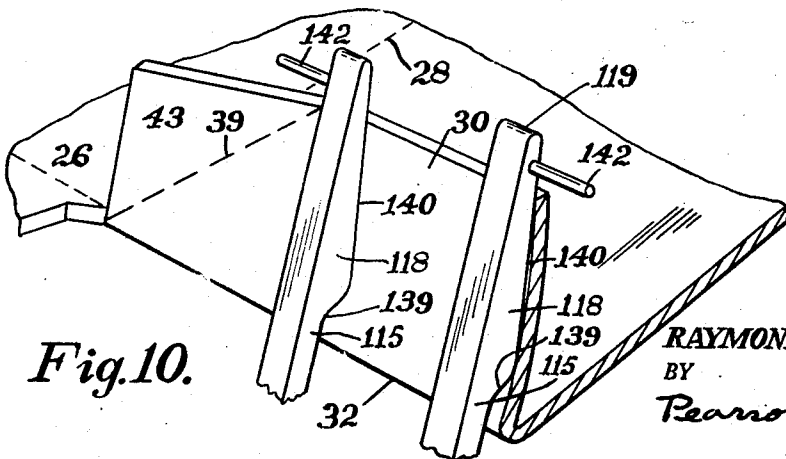


Fig. 10.

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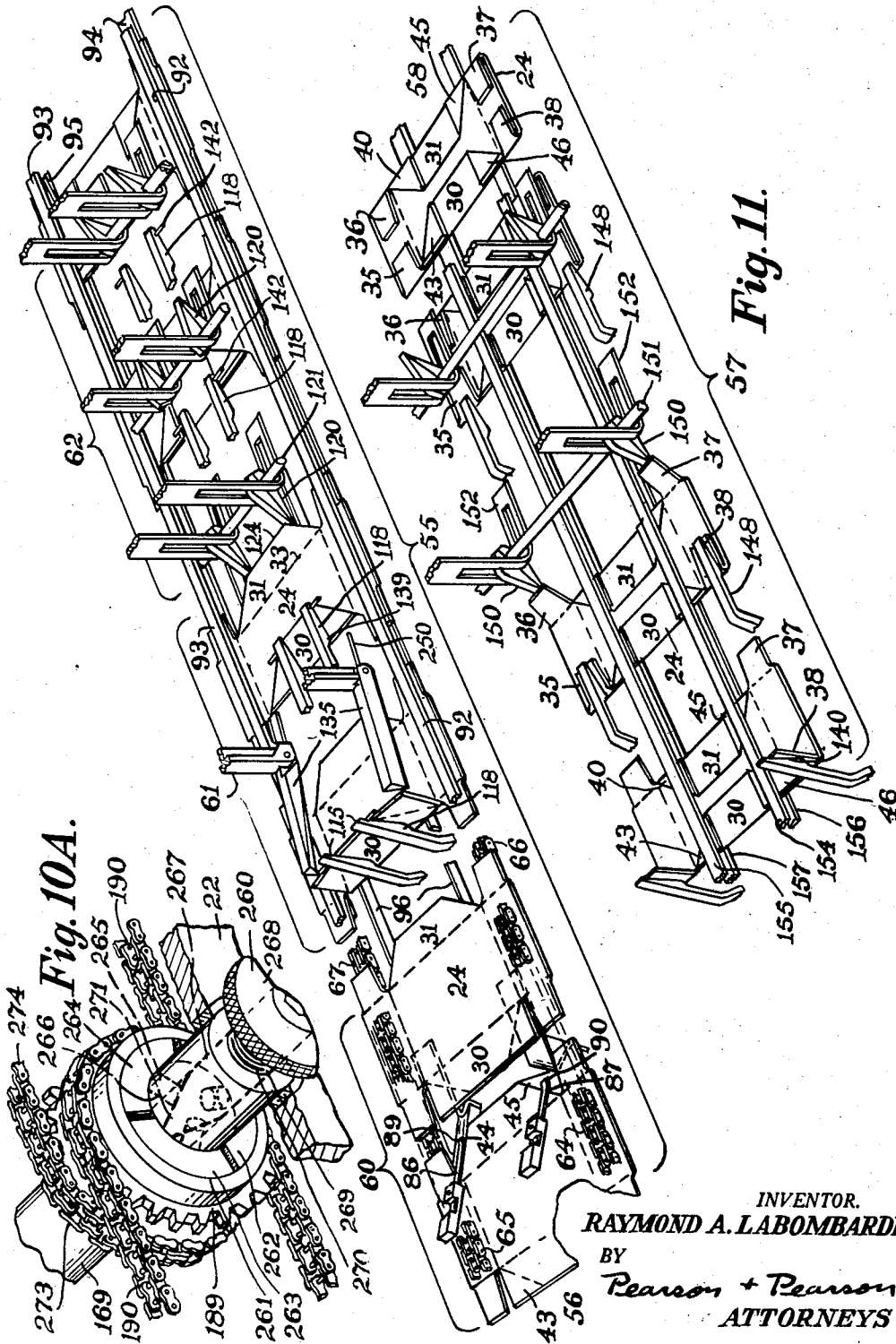
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5 Sheets-Sheet 5



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APPARATUS FOR FOLDING BOX BLANKS

Raymond A. Labombarde, Nashua, N.H.

Application September 29, 1954, Serial No. 459,114

5 Claims. (Cl. 93—49)

This invention relates to a method and apparatus for overfolding the leading and trailing flaps of paper box blanks as the blanks are advanced at a predetermined speed along a straight path through a box folding machine. It especially relates to the overfolding of such flaps in one direction while also overfolding angular tabs on such flaps in the opposite direction.

The apparatus used in this invention for overfolding the leading flaps is described in detail in my copending application, Serial Number 448,616, filed August 9, 1954. The apparatus used in this invention for overfolding the trailing flaps is described in detail in my copending application, Serial Number 448,720, filed August 9, 1954 which issued as Patent No. 2,839,972, June 24, 1958.

It has heretofore been proposed to fold leading and trailing flaps in one direction and to fold angular tabs, on such flaps, in the opposite direction as flat box blanks are advanced continuously along a horizontal paper line in a folding machine. However, the devices proposed, while satisfactory at low speed, have included numerous moving folding elements, stationary or moving cams and the like whereby malfunctioning sometimes occurs at the high speed required for modern paper box machines. In addition such devices have required long blank travel thus occupying valuable floor space and have often failed to adequately provide for holding down the blank during folding and holding down the folded parts after folding. Similarly some such devices require a transfer in mid-fold from one device to another or seek to fold a flap on an accurate fold line while, at the same time, folding a tab on the flap in the opposite direction.

An object of this invention is to combine leading and trailing flap folding mechanism in an exceptionally short line of blank travel by advancing the trailing flap folding mechanism beyond the leading flap folding mechanism to hold down both leading and trailing flaps and tabs.

Another object of the invention is to provide folding means and mechanism capable of overfolding leading and trailing flaps in one direction and overfolding leading and trailing tabs on such flaps in the opposite direction without the latter interfering with the accurate folding of the former.

Still another object of the invention is to provide improved trailing flap folding mechanism for use in overfolding both trailing flaps and trailing tabs on such flaps, which mechanism causes the trailing flap to bow inwardly at the time the trailing tab is folded rearwardly, thus preventing breakage on the line of articulation of the tab.

A further object of the invention is to provide such improved trailing flap folding mechanism with means for holding down an overfolded trailing tab while holding down an overfolded trailing flap.

A still further object of the invention is to provide an improved method of folding knockdown boxes wherein the leading and trailing flaps are upfolded without substantial resistance and wherein pressure in opposite directions on the same flap takes place only before or after that flap has folded on the correct line of articulation.

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A still further object of the invention is to provide a machine for folding leading and trailing flaps and tabs of paper box blanks that is very versatile, that may be quickly adjusted to various sizes of box blanks and that may be manufactured and maintained at comparatively low cost.

In the drawings:

Fig. 1 is a plan view of the machine of this invention.

Fig. 1A is a plan view of one type of blank folded by the machine.

Fig. 2 is a side view in section on line 2—2 of Fig. 1.

Fig. 3 is a fragmentary side view showing the drive connections for synchronizing the operation of the machine.

Fig. 4 is an enlarged fragmentary side view of a hooked folding finger of the trailing flap folding mechanism about to release an overfolded trailing flap and tab to the leading mechanism.

Fig. 5 is an enlarged fragmentary side view in section on line 5—5 of Fig. 6 showing the commencement of a fold.

Fig. 6 is an elevation in section on line 6—6 of Fig. 5.

Fig. 7 is a view similar to Fig. 5 showing a leading and a trailing flap nearly overfolded.

Fig. 8 is an elevation in section on line 8—8 of Fig. 7.

Fig. 9 is an elevation in section on line 9—9 of Fig. 7.

Fig. 10 is an enlarged fragmentary perspective view showing the bowing of a trailing flap by the recessed portion of the hooked folding fingers just before a trailing tab folds on its angular line of articulation.

Fig. 10A is an enlarged fragmentary perspective view of the wedge lock double sprocket whereby all trailing flap folding mechanisms may be simultaneously adjusted to accommodate various sizes and shapes of blanks, and

Fig. 11 is an elongated perspective diagrammatic view in two sections showing the functioning of the various parts of the invention in folding a flat blank ready for gluing.

As shown in Figs. 1 and 2 the machine of this invention is mounted on a frame 20 having side frame pieces 21 and 22 and preferably mounted on wheels such as 23. The machine may thus be wheeled around a factory and placed in front of other machines for the purpose of overfolding the leading and trailing flaps of box blanks for use in such other machines.

In Fig. 1A a typical flat paper box blank 24 is illustrated of one type used in making knockdown boxes connected at the corners by glue tabs. Blank 24 includes a bottom panel 25, a pair of side wall flaps 26 and 27, articulated to panel 25 on lines 28 and 29, and a pair of end wall flaps 30 and 31, articulated to panel 25 on lines 32 and 33. Lines 32 and 33 are extended across side wall flaps 26 and 27 to define four attachment flaps therein designated 35, 36, 37 and 38. Angular lines of articulation 39, 40, 41 and 42 are formed in the end wall flaps 30 and 31 to define four attachment tabs therein designated 43, 44, 45 and 46. Suitable slits such as 47 are also provided in a well known manner and the upper surface of blank 24 is designated 48 while the under-surface thereof is designated 49.

It will be obvious that blanks of other forms can be used with this invention and that the purpose of the machine is to overfold the leading and trailing elements of a blank articulated on transverse lines of articulation, toward each other and to also overfold the leading and trailing elements of a blank, articulated on angular lines of articulation, away from each other. To avoid confusion hereinafter, all elements of the blank 24 articulated on transverse lines of articulation such as lines 32 and 33 have been termed flaps and all elements of the blank articulated on angular lines of articulation, such as lines 39, 40, 41 and 42, have been termed tabs.

The blanks 24 are stacked flatwise one on top of the other in a magazine of any convenient type and fed indi-

vidually and successively to the machine all by mechanism well known in the trade and, therefore, not illustrated. As the successive individual blanks are continuously advanced in a straight path along the paper line 50 of the machine, the lines of articulation 32 and 33 are transverse, or lateral, to the longitudinal direction on blank advancement. Thus flaps 36, 31 and 37 are the leading flaps and tabs 44 and 45 are the leading tabs while flaps 35, 30 and 38 are the trailing flaps and tabs 43 and 46 are the trailing tabs.

Suitable transverse frame supports such as the rods 51, 52, 53 and 54 are provided on frame 20 to space the side frame pieces 21 and 22 apart a distance sufficient to accommodate the usual maximum width of blank to be folded on the machine. Longitudinally, the machine is divided into two major zones comprising zone 55 extending from the magazine end 56 to intermediate of the machine and zone 57 extending from intermediate of the machine to the delivery end 58. The inner, or longitudinally, centrally disposed, leading and trailing flaps are overfolded in one zone such as 55 while the blanks are held down and conveyed by the outer portions of the blank. Similarly, the outer leading and trailing flaps are overfolded in the other zone such as 57 while the blanks are held down and conveyed by the inner portions thereof. A zone such as 57, wherein flaps having no angular tabs are to be folded, requires only the leading and trailing flap folding mechanism shown therein. The zone such as 55 for folding leading and trailing flaps having angular tabs thereon, however, is further subdivided into a first, or leading tab folding zone 60, a second or trailing flap and trailing tab folding zone 61, and a third or leading flap folding zone 62.

As best shown in Fig. 2, the first zone 60 of major zone 55 includes two upper conveyor chains or belts 64 and 65 and two lower conveyor chains or belts 66 and 67. The upper chains 64 and 65 are each trained around sprockets such as 68, 69 and 70 and the lower chains 66 and 67 are each trained around sprockets such as 71, 72 and 73. The said sprockets are each journalled in oppositely disposed upper and lower frame plates such as 75 and 76, the plates being laterally movable on frame rods such as at 77 and 78. The sprockets such as 70 and 73, are, however, each mounted on a lateral shaft 79 or 74, suitably journalled in side pieces 21 and 22 and rotated by gears such as at 80 and a drive chain 81 in synchronization with the drive mechanism of the machine. The upper and lower chains such as 65 and 67 form an entrance nip 82 for receiving each successive blank from a magazine and advancing the blank through the first zone 60 along the portion of the horizontal path, or paper line 50 in that zone. Since the leading angular tab, or tabs, are to be folded in zone 60 the pairs of opposite upper and lower conveyor chains are laterally positioned in that zone to engage and advance some other portion of the blank in order not to interfere with such folding.

Under the path of each leading tab such as 44 and 45 of each blank such as 24, a stationary underfolding channel or guide 84 or 85 is mounted. Preferably underfolding channels 84 and 85 are identical with the type shown in U.S. Patent No. 2,329,353, granted Sept. 14, 1943, to Leon La Bombard and serve to completely underfold an angular tab on a blank passing thereover. Above each underfolding channel and above the path of each leading tab a resilient leaf spring such as 86 or 87 is fixed, preferably on a transverse rod such as 88 supported on side plates 75 and 76. The free terminal ends 89 and 90 of the springs 86 and 87 are in the path of the leading tabs and press the tabs downwardly out of their flat horizontal plane and into the underfolding channel positioned thereunder. Pivoted, or travelling, folding elements are thus avoided in the first zone 60 and each successive blank 24 is delivered to the next succeeding zone 61 with its leading tabs 44 and 45 com-

pletely underfolded to underlie the bottom surface 49 of the blank by the leading tab folding means 84, 85, 86 and 87.

In the remaining portion of major zone 55, comprising zones 61 and 62, two sets of oppositely disposed upper and lower conveyor belts such as 92, 93, 94 and 95 are provided, in extension or continuation of the conveyor chains such as 64, 65, 66 and 67 and in engagement with the outer elements of the blanks. The inner elements of the blank, namely leading flap 31, underfolded leading tabs 44 and 45, trailing flap 30 and trailing tabs 42 and 43 are thus not obstructed in folding by such conveyor belts. A pair of elongated, stationary supporting bars such as at 96 extend under the path of the underfolded leading tabs to prevent their unfolding in the space between channels 84 and 85 before the leading flap 31 is upfolded. The upper conveyor belts such as 92 and 93 are each trained around pulleys such as 97, 98, 99 and 100 and around a driving drum or pulley such as 101 to cause the lower stretch 102 thereof to advance above the paper line 50 in the direction of the arrow. Similarly, the lower conveyor belts 94 and 95 are each trained around pulleys such as 104, 105, 106 and 107 and around a driving drum or pulley such as 108 to cause the upper stretch 109 thereof to also advance along the paper line 50 in the direction of the arrow.

The trailing flap folding mechanism 111 and the leading flap folding mechanism 112 of this invention is similar to that described in detail in my above mentioned copending applications. The trailing flap folding mechanism 111 includes an endless carrier 113, mounted in a longitudinally extending vertical plane below the path of advance of the blanks 24 along paper line 50. The upper stretch 114 of carrier 113 advances with, but at a less rate of advance than the rate of advance of a blank. One or more hooked folding fingers 115 or 116 have their base portion 117 rigidly and non pivotally fixed to carrier 113 and have a forwardly turned hooked portion 118 preferably of greater length than the depth of a flap to be folded thereby. The terminal tip 119 of each hooked folding finger 115 travels in a parti-circular path around the fixed lateral axis 110 of carrier 113 at increased angular speed to engage and overfold forwardly a trailing flap such as end wal flap 30. Thereafter, the hooked portion 118 overlies the overfolded trailing flap and advances with the same to hold it in overfolded position as the finger is carried along the upper stretch 114 of the carrier 113. Because the speed of carrier 113 is less than that of the conveyor belts 92, 93, 94 and 95 the folded trailing flap gradually draws away from under the hooked portion 118 and is completely released therefrom before the hooked portion 118 drops below the paper line 50.

The leading flap folding mechanism 112 includes a substantially straight, rigid, radially extending folding finger 120, rotating around a fixed lateral axis 121 formed by a lateral shaft 122, journalled in side frame pieces 21 and 22 of frame 20. The straight finger 120 reversely rotates around axis 121 to present an inclined preferably tangential trailing folding surface 123 to the leading edge 124 of each blank 24. The terminal tip 125 of each finger 120 reaches below the paper line 50 to intercept the leading edge 124 and the horizontal component of the angular rate of advance of finger 120 is less than the rate of advance of each blank 24 during upfolding of the leading flaps thereof. Thus the leading edge 124 of each leading flap 31 slides up the trailing surface 123 as that surface advances more slowly than the blank until the flap is upfolded to an angle of about 90°. The trailing surface 123, in its rearward lower quadrant, preferably advances at the same horizontal rate as that of a blank to complete the overfolding of each leading flap.

Preferably a continuously rotating holddown arm 126, powered by a lateral shaft 127 and having a flexible hold-

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down element 128 is provided for each trailing flap folding mechanism 111 and a stationary combined folder and holddown bar 129, carried by a transverse bar 130 is provided for each leading flap folding mechanism 112. A movable flap stop 131 may be mounted on finger 120, or on the holddown bar 129 as shown, to cause a more positive fold on the line of articulation 33 of flap 31. The shaft 122 causes finger 120 to reversely rotate and the shaft 132 which drives sprocket 133 of endless carrier 113 causes the carrier to forwardly travel around its axes by the mechanism best shown in Fig. 3 and to be hereinafter described.

It should be noted that the fixed lateral axis 121 and shaft 122 of the straight folding finger 120 is positioned longitudinally of the machine intermediate of the leading flap folding zone 62 and is just in advance of, and above, the area in which the hooked portion 118 of each hooked folding finger 115 drops below the paper line 50. The inclined trailing, folding surface 123 of straight folding finger 120 is thus presented to the leading edge 124 of each leading flap such as 31 at the same time that the tip 119 of the hooked folding finger 115 is engaging and unfolding a trailing flap 30. As illustrated in Fig. 5 contact with both the leading and the trailing flap is thus toward the centre of the blank with the folding finger 120 tending to prevent forward movement of the blank relative to the upper and lower holddown belts as the hooked finger 115 sweeps around its path to forwardly fold the trailing flap. Contact of both folding fingers is also only over a small area adjacent the leading or trailing edge of the respective flaps, rather than flatwise over the entire depth of the flap thereby enabling the flap to bow and then bend on the proper crease line. The folding finger 120 in this particular location, as best shown in Fig. 4 is arranged to serve as a holddown element for the overfolded trailing flap of each blank at the time when the hooked portion 118 of a finger 115 has slid rearwardly nearly the depth of the flap, is pressing down only near the crease line and is about to release the flap entirely. The holddown bar 129 supplements this function because of the critical importance of holding down the trailing flaps as they traverse the zone in which the leading flaps were folded, this zone not being able to be obstructed by stationary trailing flap holddown members.

The trailing tab folding means 134 of the invention includes a rigid folding bar such as 135 supported above the paper line 50 by a bracket such as 136, the bracket 136 being carried by the transverse bar 130. The folding bar 135 extends along the trailing flap folding zone 61, above the paper line 50 but is not in the path of a trailing flap during the unfolding of that flap to about 90°. The trailing flap is thus enabled to be freely upfolded without substantial resistance. When a trailing flap such as flap 30 has been bowed and then upfolded on its crease line such as 32 and is about to be forwardly downfolded by the hooked finger 115 the angular tabs such as 42 and 43 thereon each encounter the shaped undersurface such as 137 of one of a pair of bars such as 135. Thus the angular trailing tabs 42 and 43 are overfolded in one direction while the trailing flap is downfolded through its second angle of 90° whereby the trailing flap overlies the blank and the trailing tabs overlie the trailing flap.

As best shown in Fig. 8 it is preferred to use a pair of hooked folding fingers such as 115 each laterally positioned to engage opposite sides of a trailing flap near the angular tabs thereon. It should be noted that if the trailing flap is outwardly bowed at the time the overfolding of the tabs commences the tabs usually fracture at their crease line thus ruining the blank. As shown in Fig. 10, each hooked portion 118 of each hooked folding finger 115 is therefore provided with a recessed portion 139 and a flat folding surface 140 extending from the recessed portion to the terminal tip 119. Thus while

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the tip 119 of finger 115 accomplishes the upfolding of each trailing flap, when the flap is upfolded the flat surface 140 has come into flatwise engagement with the major depth of the flap except for the portion near the crease line 32 and opposite the recessed portion 139. The upper section of the trailing flap is thus pushed inwardly on each opposite side causing an inward bow therein, as illustrated, and facilitating the bowing and folding of the tabs such as 43 on their angular lines of articulation such as 39. It should be noted that at this point the laterally projecting members such as 142 on the hooked fingers 115 are above the path of folding of the tabs such as 43 and do not obstruct the same.

As shown in Fig. 7, the hooked portions 118 continue their angular path around the fixed lateral axis 110 until they have overfolded the trailing flaps and are then ready to advance, while holding down the flap along a rectilinear path parallel to and above the paper line 50. As the blank proceeds along its path, however, the hooked portion 118 travels at a less rate of advance along upper stretch 114 of carrier 113 and gradually the overfolded trailing flap draws away from thereunder. However, the hooked portion 118 continues to hold down the flap until the flap is at least under shaft 122 and the projecting members 142, being on a slightly higher plane, overlie and hold down the adjacent overfolded angular tab.

As best shown in Fig. 9 the holddown means for the leading tabs not only includes the elongated support bars 96 but the leading flap folding fingers 120 are laterally positioned to also hold down the leading tabs during upfolding of the leading flaps. When the leading flaps such as 31 of each blank such as 24 arrive in the leading flap folding zone 62, the straight folding fingers 120 are each in the path of the underfolded leading tabs thereon and the pressure of the folding fingers in upfolding is applied to the surface of the underfolded tabs.

In zone 57, the outer leading and trailing flaps 35, 36, 37 and 38 are overfolded by trailing flap folding mechanism 145 and leading flap folding mechanism 146 both corresponding to mechanisms 111 and 112 respectively. Trailing flap folding mechanism 145 includes an endless carrier 147 one or more hooked folding fingers 115 and preferably a rotating holddown member 149. The leading flap folding mechanism 146 includes the straight folding finger 150, reversely rotating around the fixed lateral axis of the shaft 151 and preferably includes the bifurcated flap holddown bars 152 as well as flap stops 153. In zone 57, two sets of upper and lower holddown belts 154, 155, 156 and 157, trained around pulleys such as at 158, 159, 160 and 161, 162 163 and 164, as well as around the drums 101 and 108 form the conveyor means for each blank 24 and the belts are positioned laterally to engage and hold down the inner leading and trailing flaps and tabs as shown in Fig. 1.

The drive mechanism for synchronizing the rate of advance of the blanks with the folding mechanism of the invention is shown in Fig. 3. The belt or chain 166, leading from any suitable source of power such as an electric motor not shown, drives a gear 167 which in turn drives a gear 168 on the shaft 169 of the drum or pulley 108. Gear 168 is meshed with a similar gear 170 which drives the shaft 171 of drum or pulleys 101, thereby powering the upper and lower blank conveyor belts in zones 61 and 62 of zone 55 and in zone 57. A sprocket 173 on shaft 169, drives a sprocket 174 on a shaft 175, by means of chain 176, the shaft 175 carrying a speed cycle change gear 172 thereon. The speed cycle change gear 172 is meshed with a similar gear 177 on the shaft 122 of the folding finger 120 whereby the finger 120 rotates at less speed in its first lower quadrant and at greater speed in its second lower quadrant.

Another sprocket 178 on shaft 175 is connected by chain 179 to a double idler sprocket 180 on the shaft 132, sprocket 180 also including a sprocket 152 which drives chain 81. A double sprocket 273, carried by shaft

169, drives a chain 274 trained around sprocket 275 for powering shaft 132. A sprocket 181 on shaft 132 is connected by chain 182 to a sprocket 183 on stub shaft 184, the stub shaft 184 carrying a speed cycle change gear 185. Gear 185 is meshed with a similar gear 186 on shaft 127 for the holddown member 126 thereby causing that member to advance at the same speed as a blank with its flexible holddown element 128 at the line of articulation of a trailing flap. The member 126 accelerates quickly out of the way of a flap after the flap has upfolded by reason of the speed change cycle gears.

A sprocket 189 forming part of double sprocket 273 on shaft 169 is connected by a chain 190 to a double sprocket 191 on shaft 192 of the endless carrier 147 thereby powering the carrier. Sprocket 276 which forms part of double sprocket 191 is connected by chain 277 to idler sprocket 278 on shaft 200 sprocket 278 forming part of idler sprocket 201. Shaft 192 also carries a sprocket 193 connected by a chain 194 to a sprocket 195 on shaft 196, the stub shaft 196 carrying a speed change cycle gear 197 meshed with a similar gear 198 on shaft 199 for driving the holddown member 149. The shaft 200 of endless carrier 147 includes idler sprocket 201 connected by a chain 202 to the sprocket 203 of stub shaft 204. Stub shaft 204 drives a speed cycle change gear 206 meshed with a similar gear 207 on the shaft 151 of straight folding finger 150.

The drive chain 81 for the upper and lower blank conveyor chains in the first zone 60 of zone 55 is powered by a sprocket 352 on shaft 132. It will thus be seen that all of the endlessly travelling or rotating parts of the mechanism are synchronized with the blank conveyor means to function at the desired time during the passage of successive blanks along paper line 50.

The operation of the machine and method of the invention is illustrated diagrammatically in Fig. 11, the view being split into an upper section showing zone 55 and a lower section showing zone 57. A blank such as blank 24 is continuously advanced at a predetermined rate through both zones and after passage therethrough the leading and trailing flaps are folded toward each other and the leading and trailing tabs are folded away from each other.

In zone 60 chains 64, 65, 66 and 67 advance the blank 24 under the terminal ends such as 90 of the springs such as 86 and 87 thus pressing the leading angular attachment tabs 44 and 45 down into the underfolding channels 84 and 85. The blank moves into zone 61 with tabs 44 and 45 completely underfolded and resting on the elongated supports such as 96.

In zone 61 the hooked portions 118 of the hooked folding fingers 115 sweep around their fixed lateral axis to rise above the paper line 50 in rear of the blank and freely upfold the trailing flap 30 to about 90°. At the same time, the reversely rotating straight folding fingers 120 have intercepted the leading edge 124 of the leading flap 31, at the underfolded leading tabs 44 and 45 and the leading flap 31 is freely upfolded by sliding up the incline formed by fingers 120 as the fingers 120 advance more slowly than the blank. The trailing angular tabs 42 and 43 are overfolded by the folder bars such as 135 while the hooked folding fingers 115 complete the second angle of 90° in the overfolding of the trailing flap 30. Because the flap 30 is inwardly bowed by the recessed portion 139 and flatwise engaged by the flat surface 140 of fingers 115 the angular tabs do not fracture but fold easily on their angular lines of articulation 39 and 42.

In crossing the gap of the leading flap folding zone, wherein the leading flap is upfolded, the hooked folding fingers 115 hold down the overfolded flap 30 and the lateral projections 142 hold down the overfolded tabs 43 and 46. However, because the fingers 115 are travelling rectilinearly on the upper stretch 114 of endless carriers 113 at less speed than that of the blank, the hooked

portion 118 gradually slides depthwise of the flap 30 until just beyond the shaft 122 of the fingers 120 it has released the trailing flap and trailing tabs and passes below the paper line 50. The trailing flap and trailing tabs are then held down by the leading flap folding mechanism until they pass under the conveyor belts 154, 155, 156, 157 in zone 57.

In zone 57 the hooked fingers 148 and the straight fingers 150 operate in the same manner to overfold the trailing flaps 35 and 38 and to overfold the leading flaps 36 and 37.

The mechanism of the invention has been described and illustrated as operating on blanks of such longitudinal depth that the leading flaps are unfolded at about the same time the trailing flaps are upfolded. However, with blanks of greater longitudinal depth the leading edge of the leading flap would encounter the leading flap folding mechanism and overfold the leading flap before the trailing flap was overfolded by the trailing flap folding mechanism. With blank of less longitudinal depth, than that shown, the trailing flap folding mechanism would overfold the trailing flaps, and then advance with those flaps up to the leading flap folding mechanism thus performing their valuable blank holddown function during the upfolding of the leading flaps.

It should be noted that no prefolding of the angular tabs is required with this invention, thus eliminating the mechanism required for this function and shortening the floor space required accordingly. It should also be noted that the machine will accommodate various sizes of blanks having flaps ranging from one inch to five inches in longitudinal depth without having to adjust the moving parts but only requiring a raising or lowering of the angle of the bar 135 of the trailing tab folding means 134.

Preferably a rod such as 250 is mounted in extension of the undersurface 137 of each stationary folding bar 135 to holddown an overfolded trailing tab 30 in cooperation with the lateral projections 142 on the hooked folding fingers 115. The rods such as 250 are slidable in a slot or groove 251 in a bar 135 and adjustable to various lengths by means of a set screw 252. The angle of the bars such as 135 can be adjusted by set screws such as 253 to downfold flaps of various longitudinal depths. (See Fig. 7.)

As shown in Fig. 10A, the rotating holddown arms 126 and 149, the endless carriers 113 and 147 and the leading flap folding fingers 120 and 150 may all be simultaneously adjusted from a single shaft for various sizes of blanks. The moving mechanism in both zones 61 and 62 of zone 55 and in zone 57 is powered from the double sprocket 273 and by loosening the same on shaft 169 and revolving it to a new position relative to the shaft a new adjustment is secured. A novel wedge lock mechanism 260 is provided for accomplishing such loosening and tightening from outside the machine. As shown double sprocket 273 includes a smooth interior bore 261 in which three segmental elements 262, 263 and 264 are contained. The segmental elements 262, 263 and 264 are each carried by a pin such as 265 passing through a hole 266 into the hollow interior 267 of shaft 169. A hand wheel 268 is carried by a thrust screw 269 threaded at 270 in the end of shaft 169, outside frame 20, the terminal end 271 of screw 269 being tapered and pointed. When the screw 269 is tightened, the pointed end 271 forces the pins such as 265 radially outward thus forcing each segment such as 262 against the bore 261 and causing the sprocket 273 to revolve with shaft 169. When screw 269 is loosened the segments such as 262 no longer frictionally engage the bore 261 and the sprocket may be manually moved to a new position with relation to shaft 169.

The shifting of sprocket 273 relative to shaft 169 simultaneously adjusts all of the moving parts of the device except that the leading flap folding fingers such as 120 and 150 usually require readjustment with relation to

their respective shafts. Sprocket 173 has been omitted from Fig. 10A for clarity.

I claim:

1. In a paper box blank folding machine, apparatus for overfolding opposite leading and trailing flaps toward each other and overfolding the triangular tabs in such flaps away from each other, said apparatus comprising means for continuously advancing a succession of spaced individual box blanks along a straight path; leading tab folding means fixed along said path for freely and completely underfolding each leading tab; timed trailing flap folding mechanism mounted further along said blank path including a pair of laterally spaced, hooked folding fingers advancing temporarily with each blank for freely upfolding each trailing flap forwardly through an angle of about 90° and then further folding said trailing flap forwardly and downwardly against backfolding opposition through a second angle of about 90° to overfolded position; trailing tab folding means fixed above said blank path and opposing the movement of each trailing tab on said trailing flap only during the said second angle of about 90° for overfolding said trailing tabs, timed leading flap folding mechanism mounted still further along said blank path including a continuously rotating, straight folding finger longitudinally aligned with each underfolded leading tab and advancing temporarily with each blank, said mechanism freely folding each leading flap rearwardly through an angle of about 180° while holding down said overfolded leading tabs and fixed holddown means for holding down said flaps and tabs after overfolding, whereby said flaps fold on the correct line of articulation without substantial resistance from a direction opposite to folding.

2. A combination as specified in claim 1 wherein each hooked finger of said trailing flap folding mechanism includes a laterally projecting holddown member proximate the terminal end thereof adapted to overlie and hold down an overfolded trailing tab on an overfolded trailing flap held down by said hooked finger.

3. As an article of manufacture a hooked folding finger for use in overfolding and holding down the trailing flaps and trailing flap tabs on paper box blanks advancing through a paper box folding machine, said finger comprising a base adapted to be mounted in fixed upstanding relationship on an endless carrier; a forwardly turned terminal hooked portion in extension of said base at least equal in length to the depth of a trailing flap and a laterally projecting holddown member proximate the terminal end of said hooked portion adapted to overlie and hold down a trailing flap tab when said hooked portion is overlying and holding down a trailing flap.

4. A folding member for use in overfolding a trailing angular tab on a trailing flap of an advancing box blank, said member comprising a bracket adapted to support a folding bar above the path of an advancing blank, a folding bar adapted to extend longitudinally above the path of an advancing blank, said folding bar being fixed by a single horizontal pivot to the bottom portion of said bracket and being pivotable thereon to various angles in a vertical plane, a tab folding surface on the underside of said folding bar adapted to overfold an angular tab engaging the same; a rod longitudinally slideable in one end of said folding bar for forming an extension of said folding surface, means for fixing said rod with relation to said bar and means for fixing the angle of said bar with relation to said bracket.

5. In a paper box blank folding machine, apparatus for overfolding opposite leading and trailing flaps toward each other said apparatus comprising means for continuously advancing a succession of spaced individual box blanks along a straight path at a predetermined speed through a first and a second folding zone; folding mechanism in each said folding zone including movable hooked folding fingers for overfolding the trailing flaps, rotatable straight fingers for overfolding the leading flaps and rotatable holddown members for holding down the blanks during the folding of the trailing flaps; chain and sprocket means connecting all of said mechanisms to a common, unitary drive sprocket, a smooth inside bore in said common drive sprocket; a plurality of radially movable segments within said bore and encircling a hollow drive shaft each having a pin extending into said hollow shaft and a thrust screw threaded in said drive shaft and having a tapered end adapted to engage said pins, said screw being turnable from outside said machine for moving said segments radially into and out of frictional engagement with said sprocket bore for disconnecting said shaft and sprocket whereby said sprocket may be turned relative to said shaft to collectively and automatically adjust the relative positions of all of said folding mechanism.

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