Aug. 18, 1959 R. A. LABOMBARDE 2,899,872

FLAP FOLDING APPARATUS AND METHOD

Filed May 8, 1956 6 Sheets-Sheet 1

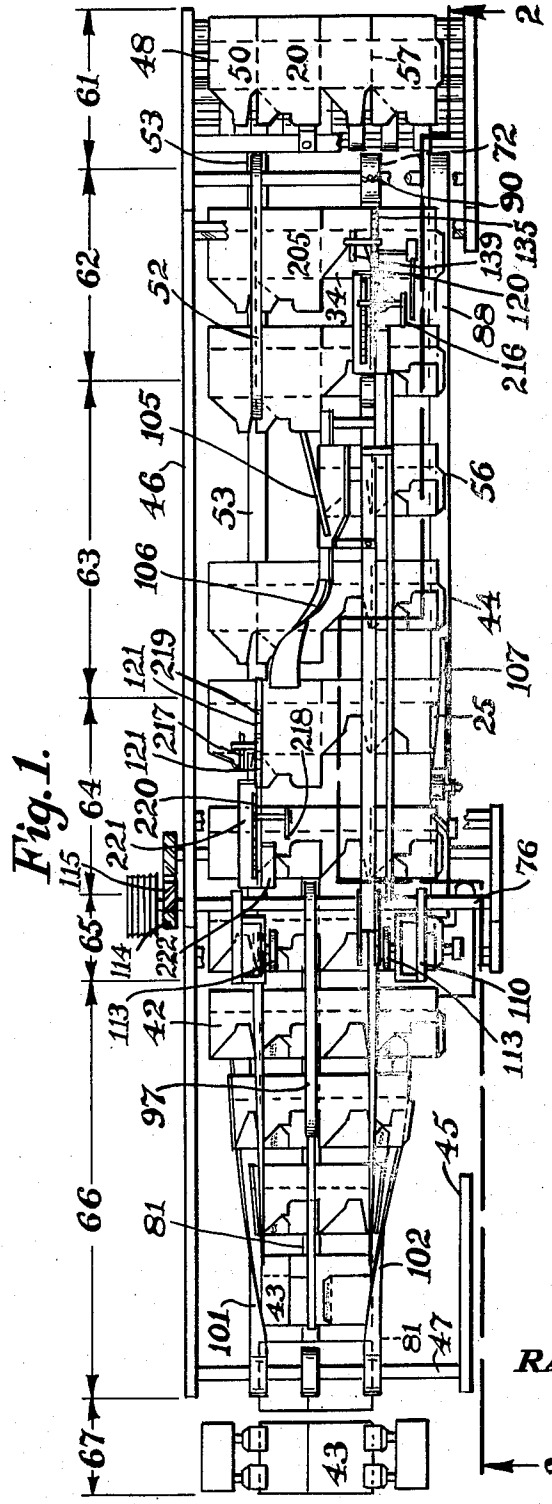


Fig. 1.

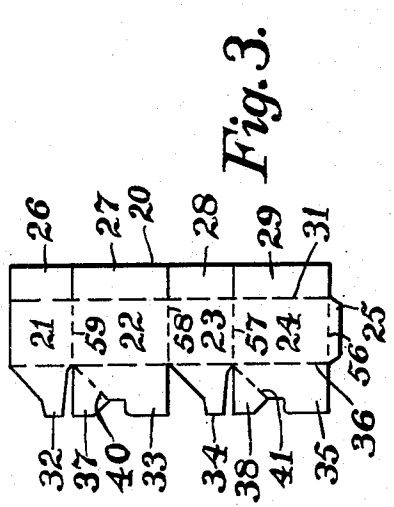


Fig. 3.

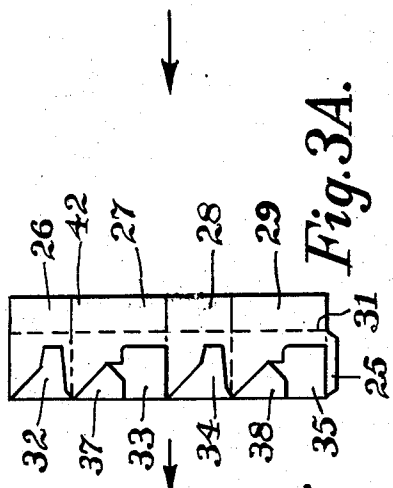


Fig. 3A.

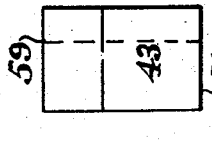


Fig. 3B.

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FLAP FOLDING APPARATUS AND METHOD

Filed May 8, 1956 6 Sheets-Sheet 2

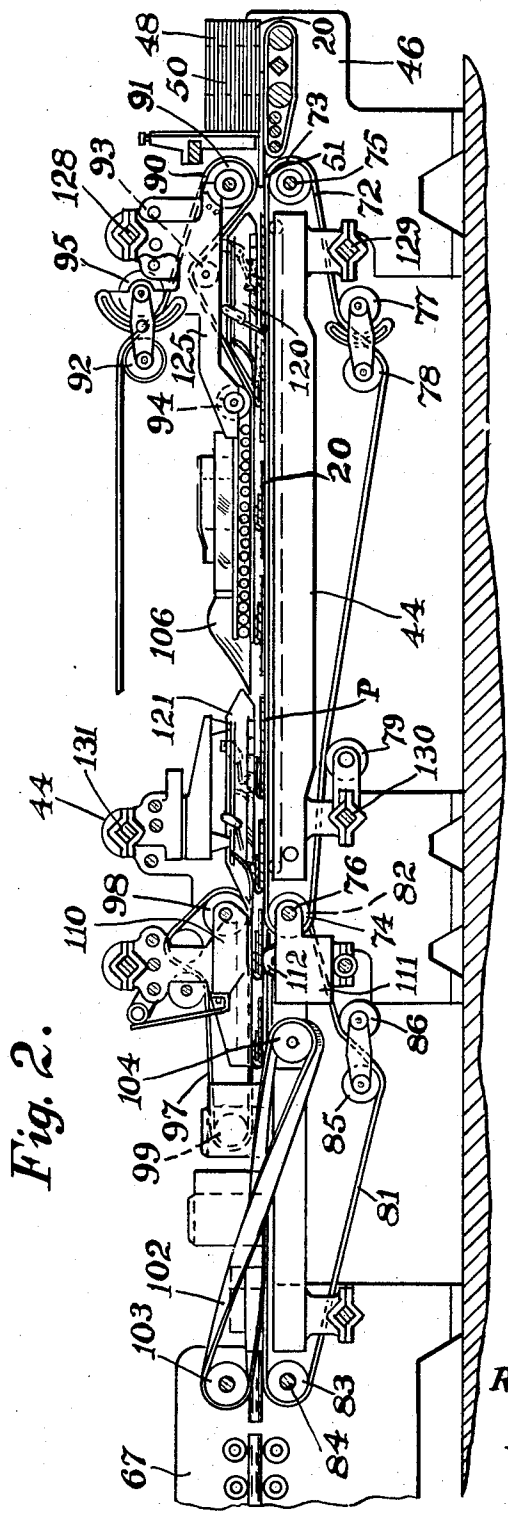


Fig. 2.

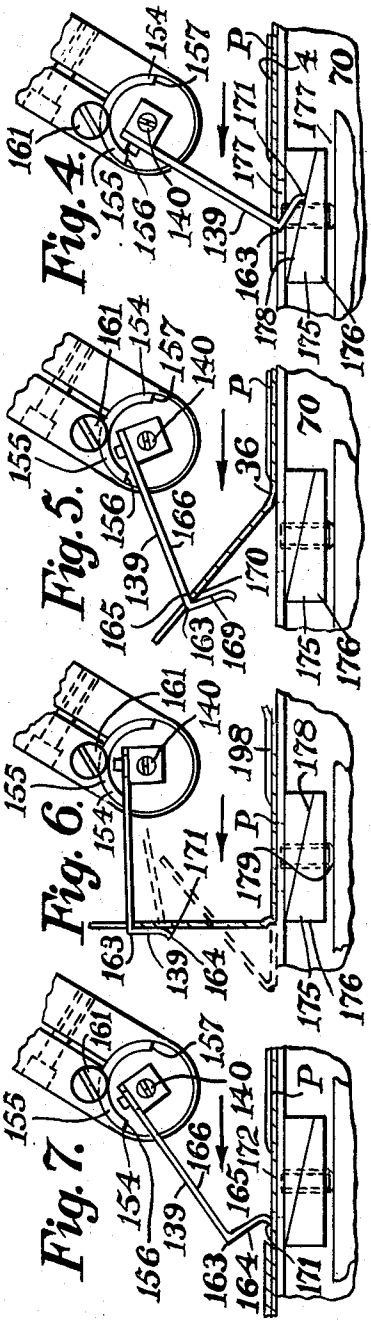


Fig. 4.

Fig. 5.

Fig. 6.

Fig. 7.

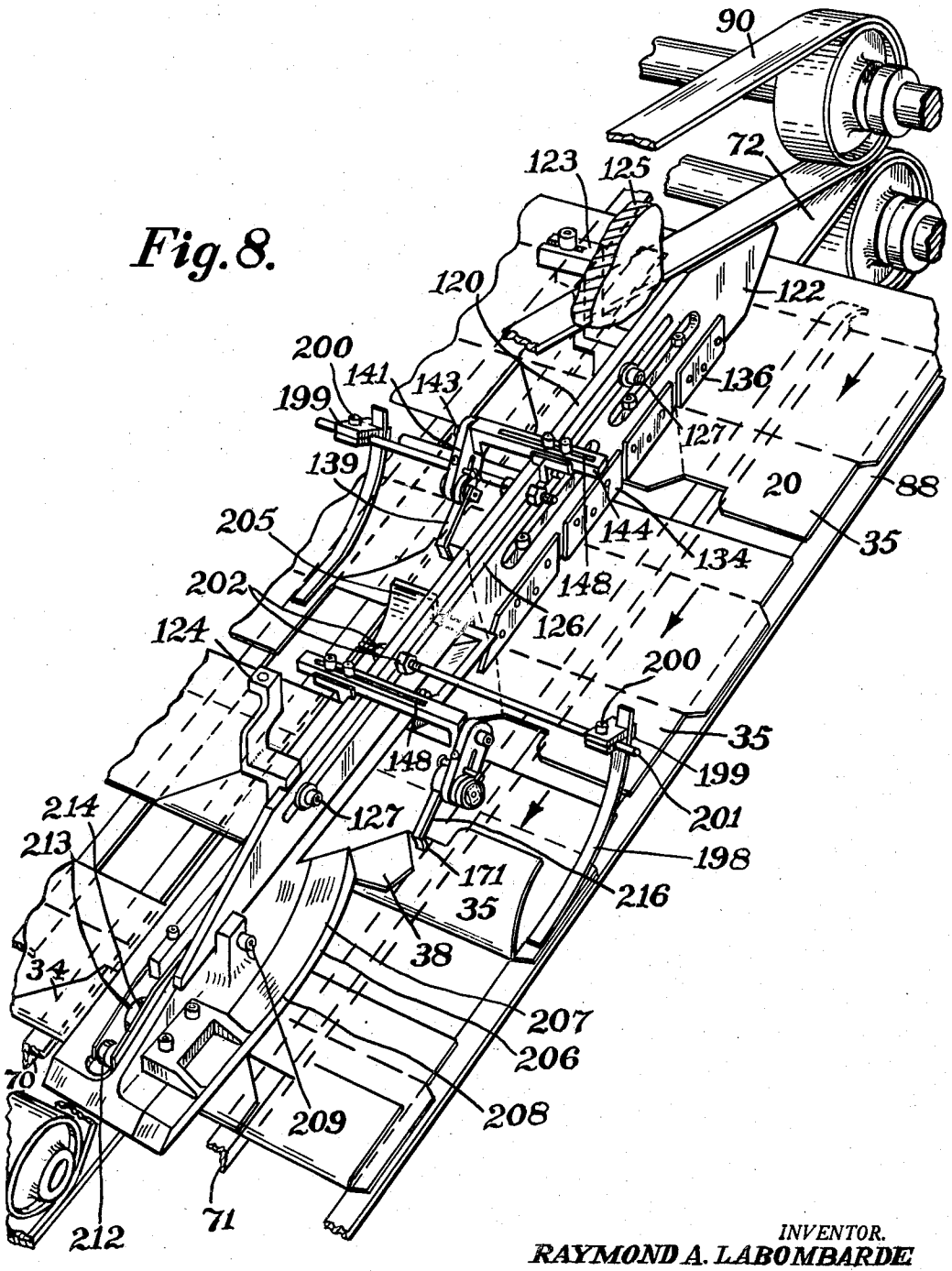
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FLAP FOLDING APPARATUS AND METHOD

Filed May 8, 1956 6 Sheets-Sheet 3

Fig. 8.



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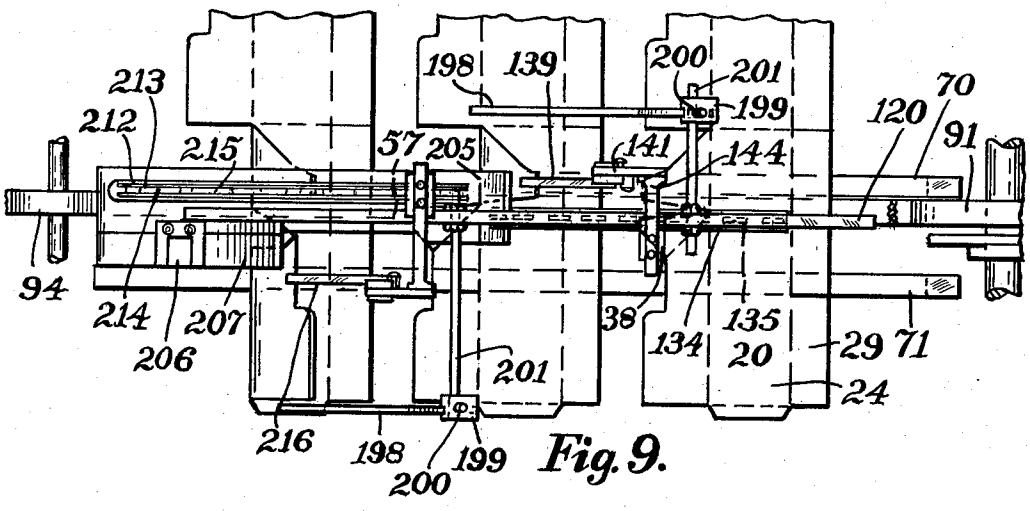


Fig. 9.

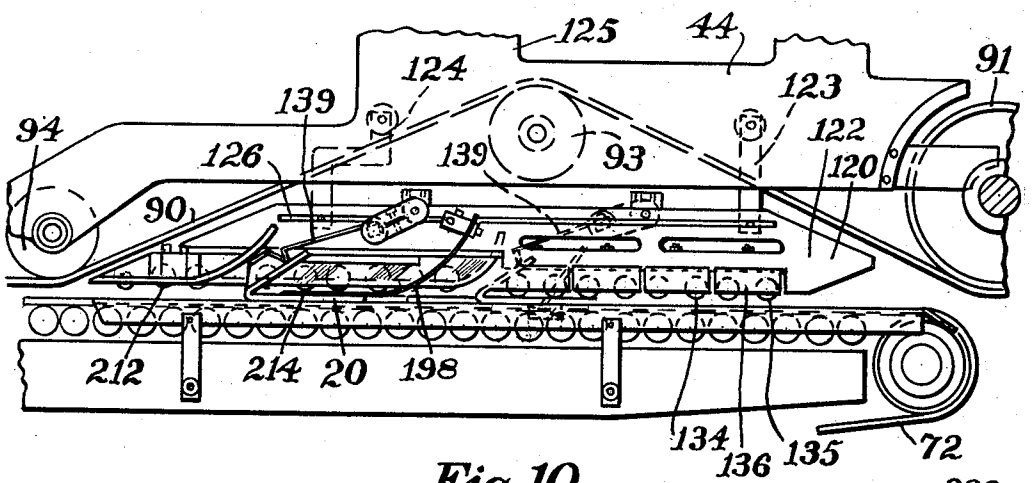


Fig. 10.

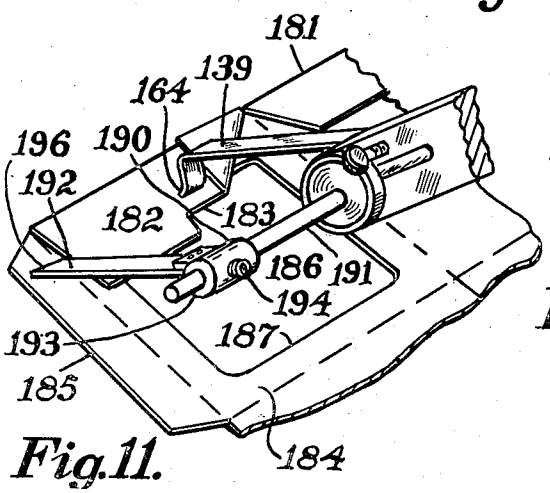


Fig. 11.

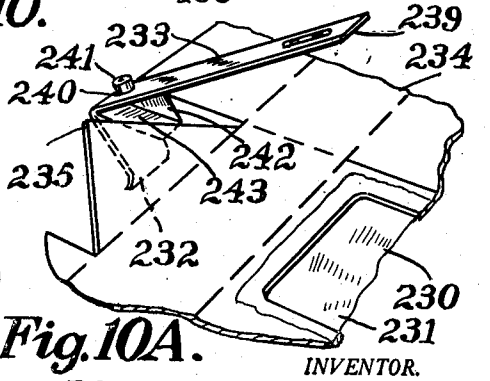


Fig. 10A.

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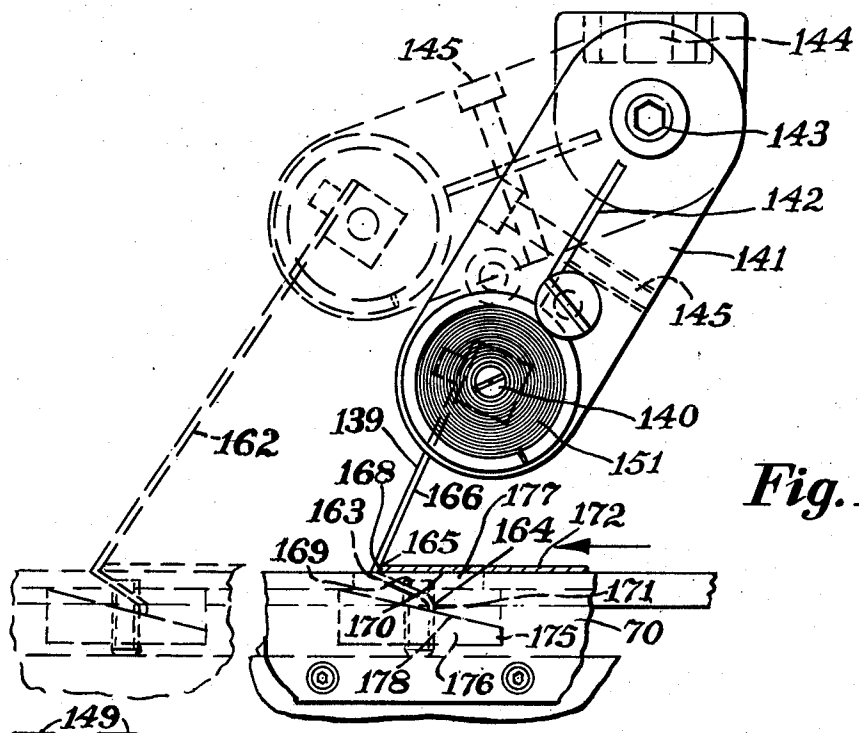


Fig. 12.

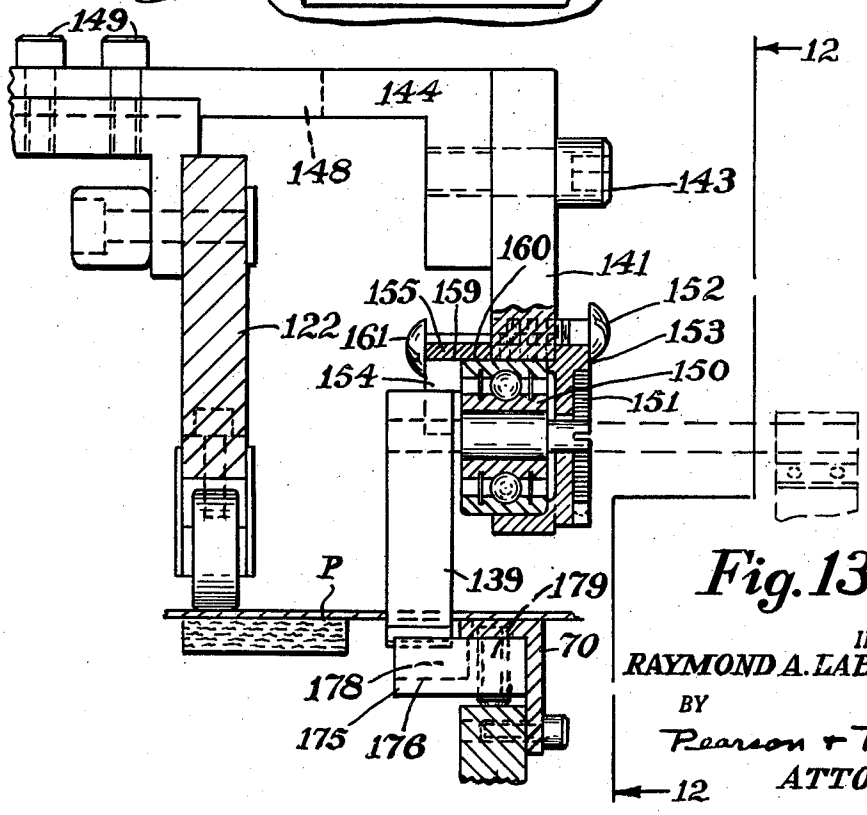


Fig. 13.

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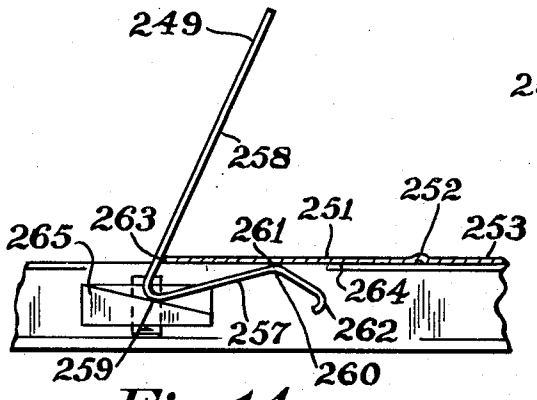


Fig. 14.

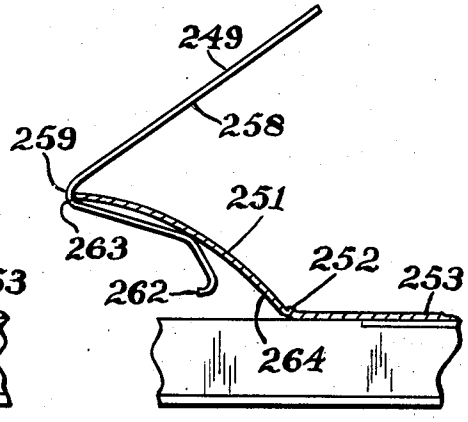


Fig. 15.

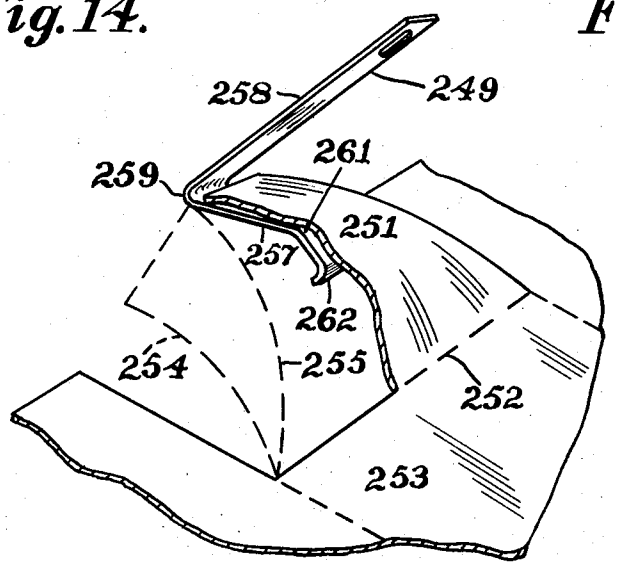


Fig. 16.

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United States Patent Office 2,899,872 Patented Aug. 18, 1959

2,899,872

FLAP FOLDING APPARATUS AND METHOD

Raymond A. Labombarde, Nashua, N.H.

Application May 8, 1956, Serial No. 583,494

20 Claims. (Cl. 93—49)

This invention relates to an improved apparatus and method for overfolding the leading flaps of flat foldable articles advancing along a path at high speed such as thirty or forty thousand articles per hour.

The overfolding of leading flaps is especially important in the folding paper box art wherein the blanks are advanced with the flaps which form the bottom of the box in the lead whereby said flaps may be overfolded, receive adhesive and then be folded on longitudinally extending fold lines to create a collapsed box with a collapsible bottom. It has long been proposed to advance a plurality of foldable articles individually and successively along a path through a folding machine by means of registration chains and to provide timed, power operated folding devices along the path to accomplish the desired folds. An example of such a folding machine is found in U.S. Patent No. 830,032 to Wright of September 4, 1906. Such power driven, timed, oscillating folding fingers and timed registration carriers can be operated accurately at low speeds.

However, the demand for speed in the industry has been such that registration carriers have been somewhat superseded by non-registration carriers in the form of pairs of opposed upper and lower carrier belts. With untimed friction belts the blanks can be advanced in a rapid stream whereby they form a blur to the eye and appear to flow through the machine. Consequently the use of timed, power driven, folding devices, has been superseded by article actuated, untimed folding devices. Thus, regardless of the spacing of the flat sheets or blanks in the rapidly moving stream, the advancing movement itself will cause certain folds to take place. An example of such a folding apparatus, usable with untimed, rapidly advancing box blanks, is the tongue bender disclosed in U.S. Patent 1,370,654 to La Bombard of March 18, 1921, wherein a spring operated finger with a curved hook oscillates upwardly to upfold a leading tongue advancing therebelow. A disadvantage of this type finger is that with a hinged element larger than a tongue or tab such as an elongated leading flap, the flap may push the finger out of its way or may be dropped by the finger and fail to fold at all. Other examples of such folding apparatus are found in U.S. Patent 2,598,809 to Liebl of June 3, 1952, and U.S. Patent 2,647,447 to Andre of August 4, 1953, wherein the finger forms a substantially vertical barrier in the path of a leading flap and causes the flap to slide up the barrier before, or while, oscillating in the direction of travel of the blank.

It should be noted that while the use of a hooked finger to upfold a leading tongue of an advancing article is known, its successful application to a high speed stream of individual articles is not easy or simple. A speed of thirty thousand articles per hour causes such a flap folding finger to oscillate about five hundred times per minute and a single failure to fold, or a fracture of a single article, may cause a jam in later stacking operations, while also making the machine somewhat unacceptable in the trade. It should also be noted that each article

in the stream must be under control during its rapid passage through the machine, but that the flaps and panels being overfolded or prefolded must have free space, unobstructed by hold-down belts or bars, in which to accomplish the desired folds. In addition, space is at a premium in box folding operations and it is desirable to perform as many operations as possible, such as feeding, prefolding, overfolding, glueing and box forming in the shortest possible space.

An object of this invention is to provide an improved method and apparatus for overfolding all of the leading flaps of flat foldable box blanks while the blanks are advanced at high speed in untimed relation along a path.

Another object of the invention is to provide an improved folding unit capable of overfolding two adjacent leading flaps of rapidly advancing box blanks within a short folding zone and with no ripping, distortion or loss of control of the blanks.

Another object of the invention is to provide an improved folding unit capable of overfolding two juxtaposed leading flaps, both on the same side of the centre crease of rapidly advancing box blanks, in cooperation with a single lower carrier and without losing control of, twisting or rupturing the blanks.

A further object of the invention is to provide an improved folding apparatus having a folding hook of the above mentioned La Bombard type but capable of high speed operation without malfunction or misfunction.

Still another object of the invention is to provide a folding hook oscillatable at high speed to overfold a leading flap of each of a rapidly moving stream of closely spaced box blanks without missing a blank or mutilating a blank.

A still further object of the invention is to provide folding apparatus of the oscillatable hook type having positive stop means at the top of its stroke to quickly reverse its path and having shock absorbing means at the bottom of its path to prevent reversal of its path.

Other objects and advantages of the invention will be apparent from the claims, the description of the drawings and the drawings in which

Fig. 1 is a plan view of a straight line folding machine in accordance with the invention and arranged to overfold all of the leading flaps of flat foldable box blanks advancing in untimed relation therethrough.

Figure 2 is a side view of the folding machine shown in Fig. 1.

Fig. 3 is a slightly enlarged view of a typical box blank foldable in the machine of this invention.

Fig. 3A shows the blank of Fig. 3 with its leading flaps and tabs folded by the machine.

Fig. 3B shows the blank of Fig. 3A folded and glued into a collapsed box.

Fig. 4 is an enlarged, fragmentary, side elevation of the improved folding apparatus of the invention showing the folding finger of this invention in its normal position with the hooked portion below the path of an advancing leading flap and the right angular notch intercepting the leading edge thereof.

Fig. 5 is a view similar to Fig. 4 showing the leading flap moving the hook around its pivot while the hook uplifts the leading flap.

Fig. 6 is a view similar to Fig. 4 showing the folding finger in engagement with the positive stop means at the top of its stroke, the leading flap having folded on its fold line and being downfolded by the tip of the finger.

Fig. 7 is a view similar to Fig. 4 showing the leading flap completely overfolded and the tip of the folding finger pulled downwardly by the spring, to ride on the upper face of the main body of the blank.

Fig. 8 is a perspective view from the delivery end of the machine of a folding unit of the invention arranged

to fold two adjacent leading flaps in a short folding zone.

Fig. 9 is a fragmentary, enlarged plan view of the folding unit of Fig. 8.

Fig. 10 is a side elevation of the unit shown in Fig. 9.

Fig. 10A is a view of the preferred form of folding finger modified to ride over the windows of box blanks and modified to better engage a flap having an obliqued leading edge.

Fig. 11 is a fragmentary perspective view, similar to Fig. 8 of a modification.

Fig. 12 is an enlarged, fragmentary, side elevation showing the range of adjustment of the folding device of this invention by using fingers of different lengths.

Fig. 13 is a front view, partly in section, of the device shown in Fig. 10.

Fig. 14 is a side elevation similar to Figs. 4–7 of a modification form of folding finger particularly adapted to fold leading flaps upon which a diagonal tab is to be simultaneously overfolded.

Fig. 15 is a view similar to Fig. 14 showing the upward bow in a leading flap produced by the modified folding finger, and

Fig. 16 is a perspective view of the operation of said modified folding finger.

In the drawings, a typical flat, foldable article capable of being folded in the machine of this invention is best shown at **20** in Fig. 3. The flat box blank **20** includes side wall panels **21**, **22**, **23** and **24** and a glue lap **25**. Cover flaps **26**, **27**, **28** and **29** are hingedly connected to the side wall panels along a fold line **31** and bottom flaps **32**, **33**, **34** and **35** are hingedly connected to the side wall panels along a fold line **36**. Bottom flaps **33** and **35** are provided with tabs **37** and **38**, diagonally articulated thereto at **40** and **41** and the bottom flaps are arranged to form a collapsible bottom on a collapsible box formed from blank **20** when suitably folded and glued. Other types of blanks are also foldable on the machine of this invention but blank **20** is selected for illustration because the bottom flaps thereof are specially long with relation to the corresponding dimension of the side wall panels and present difficult folding and holddown problems.

As shown at **42** in Fig. 3A, the purpose of the machine is to advance a plurality of flat foldable articles such as box blank **20** individually and successively at high speed, and as closely spaced as possible, while folding the leading flaps rearwardly and folding any diagonal tabs thereon in the opposite direction. Thereupon, glue is applied to the glue lap **25** and to portions of the overfolded leading or bottom flaps and tabs and the side wall panels are overfolded inwardly as illustrated in Fig. 3B to form a completed collapsed box **43** with a collapsible bottom of a well known type.

A folding machine constructed in accoordance with this invention is shown at **44** in Figs. 1 and 2 and includes side frame pieces **45** and **46** suitably connected by transverse rods and shafts such as **47** all in a well known manner. A suitable magazine **48** is provided, at the forward or entrance end of the machine, arranged to feed each successive end sheet, or blank **20** from a stack **50** of such sheets in to the entrance nip **51** of opposed pairs of belt carriers such as **52**, **53** and **72**, **90**. In certain prior devices it has been proposed to grip and advance alternate portions of the blank such as panels **24** and **22** while overfolding the leading flaps of the other panels such as **23** and **21** and to then in a subsequent folding zone, grip the alternate panels **23** and **21** while folding the leading flaps of the other panels. Such gripping and advancing has been accomplished between upper and lower carrier belts in two sections, the first section or zone being aligned with one set of alternate panels and the second section being aligned with the other set of alternate panels.

However, in order to increase the speed and efficiency of box opening and filling machines now in general use, it has been found desirable to prefold box blanks on their longitudinally extending fold lines whereby the collapsed boxes will open more rapidly, accurately and easily. For example, it will be noted that each blank **20** includes four longitudinally extending fold lines **56**, **57**, **58** and **59**. Fold line **56** is termed the first or glue lap crease line, fold line **57** is termed the second crease line, fold line **58** is termed the mid, centre, or third crease line and fold line **59** is termed the fourth crease line. Thus in modern automatic packaging, the collapsed box, or carton, such as **43** must be prefolded on the first and third crease lines **56** and **58** before it is finally folded on the second and fourth crease lines **57** and **59** into the form of a collapsed box. It will be apparent that if alternate leading flaps are folded together, as in the prior art, the upper carrier belts on the remaining flaps and panels would not permit a prefold of the blank on the mid crease line **58** since one of the two panels on each side thereof would be being held down at all times. After a leading flap has been overfolded and its diagonal tab oppositely folded, the flap and tab must be held in folded position. Therefore, securing a prefold on a mid crease line when the portion being upfolded contains already folded flaps and tabs presents a considerable problem.

The machine of this invention accomplishes the objective of prefolding on the first and third crease line as well as overfolding all of the leading flaps and tabs with a minimum length of machine and a maximum of control of the rapidly advancing stream of blanks. As shown in Fig. 1 it is constructed with a feed zone **61**, a first leading flap fold zone **62** for overfolding the flaps and tabs **34**, **35** and **38** on one side of the third crease line, a first and third crease line prefold zone **63** wherein the glue lap **25** is prefolded on first crease line **56** and the panels **21** and **22** are prefolded on third crease line **58**, a second leading flap fold zone **64** for overfolding the flaps and tabs **32**, **33** and **37** on the other side of the third crease line **58**, an adhesive applying zone **65**, and a second and fourth crease line fold zone **66** wherein the blanks become completed, flattened, prefolded, collapsed boxes. The boxes such as **43** are delivered from the last mentioned zone onto a stacker **67** of any well known type.

Extending the full length of the machine are laterally spaced supporting bars such as **70**, **71**. A pair of laterally spaced lower carrier belts such as **53** and **72** extend from the feed zone **61** to the adhesive applying zone **64**, being trained around suitable pulleys such as **73** and **74** on shafts **75** and **76** and suitable tension and idler pulleys **77**, **78** and **79**. A central lower carrier belt **81** extends from adhesive supplying zone **64** to the end of zone **66** and is trained around pulley **82** on shaft **76**, pulley **83** on shaft **84** and tension and idler pulleys **85** and **86**. A third lower carrier belt **88**, co-extensive with the pair of belts **53** and **72**, is preferably provided under the path of glue lap **25**, the belt **88** being trained around suitable pulleys such as **73**, **74**, **77**, **78** and **79**.

It has been found that proper control of advancing blanks requires that some portion thereof should be gripped between an upper carrier belt and a lower carrier belt throughout the full length of the passage through a folding machine. In the machine of this invention as best shown in Fig. 1, an upper carrier belt **52** extends from feed zone **61** through flap folding zone **62** and cooperates with lower belt **53** to control the blanks while the leading flaps on the other side of the blank are being overfolded. A second upper carrier belt **90** is raised well above the paper line P in zone **62** to permit such overfolding. Upper belt **52** terminates at the end of zone **62** to leave zones **63** and **64** free of obstruction for prefolding of the blanks on third crease **58** and for overfolding of the leading flaps on that side of the machine. Upper carrier belt **90** drops down to paper line P in zones **63** and **64** to control the advance of the blanks in

cooperation with lower carrier belt **72** in those zones. Upper carrier belts **52** and **90** are trained around suitable pulleys such as **91, 92, 93, 94** and **95** in a well known manner and are transversely movable with their respective lower belts **53** and **72** as well as driven at the same speed also in a well known manner. A third upper carrier belt **97** is centrally disposed above the central lower carrier belt **81** to control the blanks through glue zone **65** and box folding zone **66**, the belt **97** being trained around pulleys such as **98** and **99** and being driven and transversely movable all in a well known manner.

Suitable twisted folding belts such as **101** and **102**, trained around pulleys such as **103** and **104** are provided in zone **66** to fold the blanks on the second crease line **57** and the fourth crease line **59** into the completed collapsed boxes **43**. Similarly a suitable twisted folding bar **105** and stationary panel opener **106** is provided in zone **63** for prefolding the blanks to an angle of 90° or more on the third crease line **57** and then flattening the same and a glue lap prefolder **107** is provided in zone **63** for prefolding the glue lap 180° and opening the same. Upper and lower glue pots such as **110** and **111** are provided in zone **65** for applying adhesive to the glue lap and other desired portions of the blanks after all of the flap overfolding has been accomplished and just before the final folding on crease lines **57** and **59**.

The above mentioned twist belt pulleys and the roller applicators such as **112** and **113** of the above mentioned glue pots are driven with the blank advancing carrier belts by suitable interconnections well known in the trade and not illustrated or described herein in detail. However, as shown in Fig. 1 the shaft **76**, to which the other moving elements of the machine are connected directly or indirectly, is driven by the gears **114** and **115** which in turn are driven by a suitable source of power such as an electric motor not shown.

Having thus described the zones of the machine, the operations which take place in those zones and the basic blank advancing and control means in the various zones, the novel apparatus and method will now be described whereby high speed flap folding is achieved without loss of control. Attention is drawn to zones **62** and **64** of the machine in which adjacent pairs of leading flaps and tabs are overfolded. In each such zone a folding unit **120** or **121** is located, the units being identical and therefore requiring that only one thereof be described.

Folding unit **120**, as shown in Figs. 8–10, includes a single longitudinally extending support **122** of rigid material carried by a pair of brackets **123** and **124** depending from a frame piece **125** of the machine **44**. Support **122** is provided with a longitudinal slot **126** for the pins such as **127** of the brackets whereby it may be moved longitudinally. The frame piece **125** carries the pulleys **91, 93** and **94** of upper carrier belt **90** up and around the support **122** and is transversely movable with the lower belt **72** and its assembly on the square shafts **128, 129, 130** and **131** by suitable threaded screw members not shown. The longitudinal centre line of support **122** is positioned along and above the path of a longitudinal crease line such as **57** of the blank **20** and folding unit **121** is similarly positioned in alignment with crease line **59** in its zone **64**.

First article presser means **134** is provided on one side of the longitudinal centre line of support **122**, in the forward half thereof, and preferably comprises a plurality of longitudinally aligned, freely revoluble rollers such as **135** arranged in cages such as **136**. The rollers **135** press down on the leading flap **38**, panel **24** and cover panel **29**, just outside the crease line **57**, thus causing the blank to be firmly engaged between the rollers and the lower carrier belt **72** on one side of the blank as well as being gripped between upper and lower carrier belts **52** and **53** on the other side of the blank. However, the space above the path of leading flap **34** is not obstructed and the flap **34** is thus free to be overfolded in a zone co-extensive with the zone of cages **136**.

On the opposite side of the longitudinal centre line of support **122** from the cages **136** first, article actuated, hooked, folding finger **139** is oscillatably mounted thereon. Finger **139** is arranged to oscillate upwardly on a pivot pin **140** carried by a clamp member **141**, the clamp member **141** being split at **142** and supported on a pivot pin **143** on bracket **144** carried by support **122**. A suitable clamp screw **145** is provided across split **142** and a suitable threaded nut **146** is provided to permit clamp **141** to be angularly adjusted to various positions around pin **143**. Bracket **144** is slotted at **148** to receive set screws such as **149** whereby it may be adjusted laterally of support **122**.

Finger **139**, as stated above, is intended to oscillate about five hundred times a minute and is therefore mounted in ball bearings such as at **150**, shown in Fig. 13. A coil spring **151** is provided to return the finger **139** downwardly to its normal position after the finger has been oscillated upwardly in overfolding a leading flap. A set screw **152** is provided for adjusting the tension of spring **151** in cooperation with a spring housing **153**. The rapid return of the finger **139** to the paper line P is essential and, in addition, to spring **151** a positive stop means **154** is provided. Stop means **154** is formed by an arcuate member **155** having a leading face **156** and a trailing face **157**. Member **155** is concentric with the pivot axis of finger **139** and is normally adjusted thereabout to cause the leading flat face **156** to form a barrier in the path of upward oscillation of the finger, intermediate of the length thereof, at exactly the point where a leading flap is desired to fold on its line of articulation. The curved underface **159** of member **155** is supported on the projecting exterior face **160** of bearing **150** extending laterally from clamp member **141** and the member **155** may be rotated thereon, and clamped in various desired positions by a set screw **161**.

It should be noted that if spring **151** is too weak a leading flap may ride up the finger and then slip by without folding. If the spring **151** is too strong, on the other hand, it may fracture the flap or cause the flap to fold on the wrong fold line. However, with spring **151** adjusted to a tension which permits a leading flap to oscillate upwardly with the finger, until the finger strikes leading face **156** and stops, the stopped finger then causes the continually advancing flap to exert back pressure at its fold line which causes a proper fold on that line. Immediately upon folding, the flap loses its tendency to press the finger upwardly and the finger **139** is enabled to rebound from face **156**, in cooperation with the now effective downward pressure of spring **151**, to quickly return to the paper line P and ride along the upper face of the same blank. As indicated in Fig. 12 the normal angle of finger **139** to the paper line P may be changed by adjustment of clamp member **141** or a finger of different length such as at **162** may be substituted for finger **139** depending on the length of the flap to be overfolded.

Finger **139** is bent at **163**, preferably at a right angle whereby the terminal hooked portion **164** forms a right angular notch **165** with the shank **166** of the finger. The normal position of notch **165** is on level with, or slightly below the level of the paper line P, and the path of the flat articles through the machine. Thus the leading edges such as **168** of the leading flaps may first strike the shank **166** of a finger **139** and then slide into notch **165** with the flat upper face **169** of the hooked portion **164** supporting the underface **170** of the flap as shown in Fig. 5. The flap bows slightly as it folds upwardly and finally breaks or bends on its line of articulation **36** and overfolds rearwardly with the terminal tip **171** of finger **139** pressing against the underface **170** of the flap. Thus the finger performs its return stroke mainly while riding on the downfolding flap and then rides along the upper face **172** of the flat article. The remainder of the return

stroke of finger 139 occurs when the tip 171 thereof falls off the upper surface 172 of the article down to its normal position well below the path of the articles as shown in Fig. 4 and Fig. 12.

While a positive stop and rapid rebound are desirable at the top of the stroke of finger 139 such a stop and rebound are very undesirable at the bottom of the stroke.

Shock absorbing, or braking, means 175 is therefore provided in this invention to cause the finger 139 to stop and remain stopped in its normal downward position. Means 175 includes a block 176, preferably of rigid material, and positioned partially in a recess 177 in a longitudinally extending support such as 70 or 71 below the level of the paper line and article path. Block 176 is provided with an inclined plane face 178 in the path of the terminal tip 171 of finger 139 and arranged to have a wedging engagement therewith. A set screw 179 is provided for adjustably positioning the block 176 forwardly or rearwardly in the recess 177 and a slot 180 is provided in the support 70 or 71 for adjusting screw 179 along slot 180. Inclined face 178 slows the tip 171 down to a stop and holds it in stopped position, thereby eliminating all tendency for the rapidly oscillating finger to rebound up again before the next successive article arrives.

Certain flat articles, such as the type of box blank in which there is a window, have edges that face in the direction of travel but that are not leading edges and are not intended to be engaged by hooked fingers such as 139. As shown in Fig. 11, for example, the box blank 181 includes leading flaps such as 182, a leading edge 183, wall panels such as 184, a glue lap 185, an opening 186 with a forward edge 187 facing in the direction of travel of the blank. Article follower means 190 is therefore provided including a shaft 191, suitably fixed in extension of the pivot pin 40, by welding, to oscillate therewith. A follower arm 192, preferably of rigid, non-resilient material is sleeved at 193 on rod 191 and adjustable transversely and angularly thereon by a set screw 194. The terminal tip 196 of follower 192 is arranged to ride along the upper face of some portion of the flat box blanks 181, removed laterally from the window 186 to keep the hooked portion 164 of finger 139 just above the path of the articles until the window 186 has passed thereunder. Preferably the top 196 is aligned with the glue lap 185 of such articles since the windows 186 are usually in the wall panels and the glue lap is usually co-extensive longitudinally with the wall panels. Thus the finger 139 is enabled to overfold the leading flaps 182 of a box blank 181 by engaging leading edge 183 but will not engage the edge 187 of window 186 because arm 192 maintains the finger 139 above the paper line P until the window has passed by the finger.

A resilient hold-down strip 198 is preferably provided beside each hooked finger 139 for holding down adjacent portions of the flat articles such as blanks 20 or 181 while the leading flaps are being overfolded. Strips 198 are carried by split clamps 199, operable by set screws 200 and supported by rods 201 adjustably mounted by nuts 202 in the slot 126 of support 122.

A tab overfolding bar such as 205 and 206 is also mounted on support 122 and serves to back-fold any triangular tabs such as 37 and 38 on a box blank 20 while the leading flaps to which the tabs are diagonally articulated such as 33 and 35 are being overfolded. Each bar such as 205 includes an upwardly curved portion 207 and a straight portion 208 parallel to and above the paper line P. Portion 207 engages a tab such as 38 and causes it to back fold and portion 208 holds down the tab and flap flatwise until the appropriate upper belt such as 90 is reached by the blank. Each bar such as 205 or 206 is connected to support 122 by nuts 209 as best shown in Fig. 8.

Each folding unit such as 120 also includes second article presser means 212 extending longitudinally of the rearward half of support 122 on the same side of the longitudinal centre line thereof as the first folding finger 139. Means 212 is substantially identical with means 134 and comprises a plurality of cages of freely revoluble rollers aligned on the inside of fold line 57 to free flap 35 for overfolding. It is preferred that the cages 213 and rollers 214 of means 212 be mounted in a slot 215 in the holddown and tab overfold bar 205 whereby both the rollers 214 and the bar tend to hold the flap such as 34 in overfolded position. The second article actuated, hooked, folding finger 216 is identical with the first finger 139 but mounted in the rearward half of support 122 on the same side thereof as the first article hold-down means 134.

The second folding unit 121, as stated above, operates in the same manner as unit 120 and includes hooked folding fingers 217 and 218, presser roller cages 219 and 220, tab and flap hold-down bars 221 and 222 and the other parts of unit 120 disclosed herein.

In operation it will be apparent that a plurality of flat foldable articles such as box blanks 20 may be delivered individually and successively into the carrier belts such as 52 and 53 by the feeding mechanism 48. The blanks may be advanced at a rate of about thirty thousand an hour through the various zones of the machine 44 to arrive at the stacker 67 as collapsed boxes such as 43. In the forward part of zone 62 the upper and lower carrier belts 52 and 53 grip and advance one side of the blanks while the rollers 135 of unit 120 and lower carrier belt 72 grip and advance the other side of the blank. Alongside rollers 135 the folding finger 139 overfolds the leading flap 34 and delivers the folded flap under the holddown bar 205. In the rearward part of zone 62, the control of the blank is passed laterally to the other side of fold line 57 when rollers 135 terminate their grip and the rollers 214 grip and advance the blank in cooperation with lower carrier belt 72. Thus leading flap 35, adjacent to flap 34 is provided with space above its path for overfolding by the finger 216. As flap 35 is lifted, its diagonal tab 38 is retarded by bar 206 and caused to backfold, the folded flap and tab then being held down by bar 206. Resilient strips such as 198 hold down the adjacent portions of the blank while the above specified flaps and tabs are being folded.

In zone 63 upper carrier belt 90 is of sufficient width to straddle fold line 57 and hold down overfolded flaps 34 and 35 as well as backfolded tab 38, and grips and advances the blanks in cooperation with lower carrier belt 72. Fold bar 105 upfolds the wall panels 21 and 22 and their attached flaps on third crease line 58 while the glue lap is prefolded by prefolder 107 on its crease line 56 and panel opener 106 flattens the panels 21 and 22.

In zone 64 the blanks are still being gripped and advanced between carrier belts 90 and 72 while folding unit 121 operates on adjacent flaps 32 and 33 on the other side of the machine. Cages 219 hold down and advance the blanks in cooperation with lower carrier belt 53 while folding finger 217 overfolds flap 32 and delivers the overfolded flap under the holddown bar 220. Control then shifts to roller cages 220 from cages 219 and finger 218 is enabled to overfold flap 33 while bar 222 backfolds tab 37 and holds the same overfolded.

In zone 65 the flaps and tabs are held down by suitable members such as 224 while the upper and lower glue pots 110 and 111 apply a coating of adhesive thereto. The central upper and lower carrier belts 81 and 97 grip and advance the blanks in zones 65 and 66 and twist belts 101 and 102 fold the panels 21 and 24 inwardly on longitudinal crease lines 59 and 57 to form a completed collapsed box such as 43.

It should be noted that there are certain blanks for forming large boxes of low height in which the web of material along crease lines 56, 57, 58 and 59 is very narrow longitudinally while the blank is very wide laterally. Such blanks tear easily under longitudinal strain and the roller cages of the folding unit of this invention prevent

such tearing. Because the side of the blank upon which the flaps are being overfolded is pressed down on the lower carrier by the rollers, that side is advanced alongside of the side of the blank gripped between carrier belts and twist or loss of control is avoided.

The follower means shown in Fig. 11 is especially useful when the blank window is not covered by transparent material, or the blank has a cut-out with a forward facing edge since it prevents the folding finger falling below the paper line. However, as shown in Fig. 10A when a blank window **230** is covered by transparent material **231**, a curved tip **232** on a folding finger **233** has been found to enable the finger to ride over the window without causing fracture of the blank such as **234** or other malfunction. As also shown in Fig. 10A, certain blanks are constructed with one or more leading flaps have diagonal or obliqued leading edges such as at **235**. It has been found that the ordinary hooked folding finger may either scar or dent such a flap upon high speed engagement therewith or may fail to engage and permit the flap to advance without folding. The folding finger **239** of this invention is therefore provided with an aperture **240** for a screw **241**, the screw supporting an angular filler piece **242** having an inclined face **243** corresponding to the angle of the oblique leading edge to be engaged by the finger. The piece **242** is reversible and may be shaped to accommodate leading flaps having various degrees of obliquity on their leading edges.

As shown in Figs. 14–16 a modified form of folding finger **249** is especially adapted to fold leading flaps having diagonal tabs articulated thereto at high speed and without fracturing the flap at the diagonal line of articulation. Such a flap is shown at **251**, articulated laterally at **252** to a blank **253** and having a triangular tab **254** articulated diagonally at **255**. It will be understood that a hooked folding finger pulling the leading edge of an advancing flap rearwardly tends to bow the flap downwardly with the longitudinal centre of the flap lower than the leading edge thereof. This downward bow, however, tends to cause the glue tab on the flap, which is simultaneously being overfolded forwardly, to fracture on its diagonal line of articulation. An upward bow in the flap, such as shown in Figs. 14–17, not only does not cause a fold line fracture, but causes the flap and tab to present less resistance to the folding apparatus.

The finger **249** is similar to fingers **139** and **239** except that the trailing hooked portion **257** is not normal to the shank **258** at the notch **259** but instead is at an acute angle thereto and bent inwardly as at **260** to form an inner flap engaging face at **261**. Thus the face **261** is nearer to the centre of oscillation of the finger **249** than the notch **259** or the outwardly curved terminal tip **262** and normally the face **261** is in the plane of the path of the advancing blanks as shown in Fig. 14. The leading edge **263** of each successive blank **253** is guided into the notch **259** as the finger oscillates upwardly while the face **261** engages an intermediate longitudinal portion of the underface **264** of the flap thereby bowing the flap upwardly while the finger is upfolding the same as shown in Fig. 15. A tab **254** may thus be easily bent forwardly on its line of articulation **255** without danger of fracture. The block **265** engages the outside of the notched portion **259** to serve as shock absorbing means in the same manner as described above and the tip **262** is adapted to ride along the upper face of the blanks without misfolding any forward facing edges except the leading edges of the leading flaps.

I claim:

1. An untimed, article actuated, folding apparatus for overfolding the leading flaps of each of a plurality of flat foldable articles advancing individually and successively along a path through a folding machine, said apparatus comprising a folding finger supported at its upper end for oscillation of its lower end in the direction of the path of said articles, said finger having a trailing, hooked portion normally presenting a notch in the path of the leading edge of a flat leading flap of an article advancing along said path and having a terminal tip normally well below the path of said articles, said finger being adapted to engage the leading edge of each successive article with said notch and then to be swung upwardly and forwardly by said advancing article while folding a leading flap thereof upwardly and rearwardly; stop means, below said article path, supporting said finger in said normal position; positive stop means in the path of upward oscillation of said finger and adapted to stop the oscillation thereof at a predetermined distance above the path of said articles to cause a leading flap to fold on its line of articulation, and spring means associated with said finger and adapted to oppose the upward oscillation thereof with a predetermined increasing pressure and to return said finger downwardly when opposite article pressure is released.

2. Folding apparatus as specified in claim 1 wherein said finger is pivotally supported at its upper end and said positive stop means is an arcuate member, concentric with the pivot axis of said finger and having a terminal flat end face forming an abutment in the path of upward oscillation of said finger, intermediate of the length thereof.

3. Folding apparatus as specified in claim 1 wherein said folding finger is pivotally supported at its upper end in an angularly movable split clamp and said positive stop means is an arcuate member movably mounted on said clamp whereby the pivot axis and stop point of said finger may be varied to accord with the length of the flap to be folded thereby.

4. Folding apparatus as specified in claim 1 plus a follower arm operatively connected to said finger, said arm having a free terminal tip arranged to ride on a portion of the upper face of a flat article advancing thereunder for maintaining said folding finger above the path of said articles during the passage thereby of each successive article.

5. An untimed, article actuated, folding apparatus for overfolding the leading flaps of each of a plurality of flat foldable articles advancing individually and successively along a path through a folding machine, said apparatus comprising a folding finger of rigid material supported at its upper end for oscillation of its lower end in the direction of the path of said articles, said finger having a trailing, hooked portion normally presenting a notch in the path of the leading edge of a flat leading flap of an article advancing along said path and having a terminal tip normally well below the path of said articles, said finger being adapted to engage the leading edge of each successive article with said notch and then to be swung upwardly and forwardly by said advancing article while folding a leading flap thereof upwardly and rearwardly; positive stop means in the path of upward oscillation of said finger and adapted to stop the oscillation thereof at a predetermined distance above the path of said articles to cause a leading flap to fold on its line of articulation, spring means associated with said finger and adapted to oppose the upward oscillation thereof with a predetermined increasing pressure and to return said finger downwardly when opposite article pressure is released and shock absorbing means associated with said finger and adapted to stop the downward oscillation thereof, with said terminal tip at its normal position below the path of said articles and with no tendency to rebound upwardly therefrom.

6. Folding apparatus as specified in claim 5 wherein the hooked portion of said folding finger is angularly bent at right angles to the main body thereof, to form a right angular notch normally in the path of the leading edge of the flat leading flap of an advancing article for assuring engagement therewith.

7. Folding apparatus as specified in claim 5 wherein said shock absorbing means comprises a block of rigid material having a flat, inclined face below the path of said

articles and in the path of the free end of said finger for braking the downward oscillation thereof with a wedging engagement.

8. Folding apparatus as specified in claim 5 wherein said finger is supported at its upper end on an angularly movable clamp for selectively displacing said finger forwardly or rearwardly relative to the path of said articles and said shock absorbing means is a slideable block having an inclined flat face, said block being displaceable forwardly or rearwardly, relative to the path of said articles to locate said face in wedging engagement with the terminal tip of said finger below the path of the articles.

9. In combination with a single lower carrier, a folding unit for overfolding two juxtaposed leading flaps both on the same side of the center crease of each of a plurality of flat foldable articles advancing individually and successively along a longitudinal path through a folding machine, said unit comprising a single longitudinally extending support of rigid material mounted above said path on said machine and slideably adjustable therealong and thereacross, said support being aligned with said carrier and aligned with the path of the juxtaposed edges of said pair of juxtaposed leading flaps; first article presser means, cooperating with said lower carrier, said means extending longitudinally of the forward half of said support on one side of the longitudinal centre line thereof; a first article actuated, hooked, folding finger oscillatably mounted in the forward half of said support, on the opposite side of the longitudinal centre line thereof, and adapted to overfold a first said juxtaposed leading flap passing therebelow while the advancing article is held down and advanced along the path of the second said juxtaposed leading flap by said first presser means in cooperation with said lower carrier; second article presser means cooperating with said lower carrier, said means extending longitudinally of the rearward half of said support on the same side thereof as said first folding finger; a second article actuated, hooked, folding finger oscillatably mounted in the rearward half of said support on the same side thereof as said first presser means, and adapted to overfold said second juxtaposed leading flap while said advancing article is held down and advanced along the path of said first juxtaposed leading flap by said second presser means in cooperation with said lower carrier; and diagonal tab backfolding means, carried by said support, said means comprising a stationary, longitudinally extending bar, just above the paths of said first and second juxtaposed leading flaps, adaped to overfold a diagonally articulated tab on one of said flaps and hold down said flaps and said tab after overfolding thereof.

10. A combination as specified in claim 9 plus a rigid longitudinally extending support on said machine, alongside and below the path of each flap to be overfolded by said fingers, each said support having mounted thereon a longitudinally displaceable block with an inclined face projecting laterally therefrom in the path of the terminal tip of a finger for stopping said finger without rebound.

11. A folding unit as specified in claim 9 plus shock absorbing means below the path of articles advancing through said machine and in the path of the free end of each said oscillatable, hooked folding finger for stopping said fingers in flap engaging position with no tendency to rebound away therefrom.

12. A combination as specified in claim 9 wherein said shock absorbing means comprises a block of rigid material below the path of said articles and in the path of the free end of each said finger, said blocks being each movably supported on said machine and each having a flat inclined face adapted to brake the downward oscillation of a finger with a wedging engagement.

13. An untimed, article actuated, folding unit for overfolding a pair of adjacent leading flaps of flat foldable box blanks advancing along a path through a folding machine, said unit comprising a first set of freely revoluble presser rollers longitudinally aligned along the outer side of the path of the longitudinal crease line between said flaps, for pressing the outside flap down on a lower carrier belt; a first article actuated, hooked, folding finger oscillatably mounted on the inner side of said crease line path for overfolding the inside flap in the longitudinal zone defined by said rollers; a second set of freely revoluble presser rollers longitudinally aligned along the inner side of said crease line path beyond the zone defined by said first set, for pressing the blank with its overfolded inside flap down on said lower carrier belt, a second article actuated, hooked, folding finger oscillatably mounted on the outer side of said crease line path for overfolding the outer flap in the longitudinal zone defined by said second set of rollers; a resilient holddown strip in each zone defined by said rollers for pressing down on the upper face of each blank passing thereby along lines laterally removed from said rollers and fingers, a tab backfolding bar on each unit above the path of any diagonal tabs on said blanks and article actuated follower means operatively connected to each said folding finger and adapted to maintain said finger out of the path of said articles during the passage thereby of each article but to permit the finger to engage the leading edge of each successive article.

14. A unit as specified in claim 13 plus shock absorbing means supported on said machine below the path of said articles and below said unit, said means being in the path of the free ends of said fingers and arranged to prevent rebound thereof.

15. The method of overfolding the leading flaps of flat foldable box blanks advancing individually and successively along a path at high speed which comprises the steps of frictionally engaging the upper and lower faces of said flat articles, on one side only of the center fold line thereof and advancing the articles at high speed along said path, simultaneously pulling upwardly and rearwardly first on one leading flap and then on the juxtaposed leading flap on the other side of the center fold line of said blanks to overfold the same while frictionally engaging and forwardly urging only the lower faces of the flaps of said flat articles on said other side of the centre fold line of said blanks; then frictionally gripping the upper and lower faces of said blanks on said second mentioned side of the center fold line and continuing the high speed advance of said blanks while simultaneously pulling upwardly and rearwardly first on one leading flap and then on the juxtaposed leading flap on said first mentioned side of the center fold line of said blanks to overfold the same while frictionally engaging and forwardly urging only the lower faces of the flaps of said flat articles on said first mentioned side of the centre fold line of said blanks.

16. Folding apparatus as specified in claim 1 wherein the hooked portion of said folding finger is normal to the shank thereof except that the terminal tip portion is forwardly curved for riding over a recess in a blank.

17. Folding apparatus as specified in claim 1 plus a filler piece mounted in the notch of said finger and having an oblique face adapted to engage a correspondingly obliqued leading edge of a leading flap.

18. A machine for folding and glueing box blanks to form collapsible tubular containers with collapsible bottoms therefrom, said machine comprising means for advancing a plurality of flat box blanks individually and successively along a path through said machine, panel prefolding means along said path adapted to prefold each successive blank along longitudinally extending panel crease lines, said prefolding means including mechanism for prefolding one half of each said blank toward the other half on the mid, centre or third crease lines of said blanks and back to flatwise position, adhesive applying means and final panel folding means further along said path adapted to deposit a coating of adhesive on the overfolded panels, flaps or tabs of said blanks and finally

fold the same into completed collapsed containers with collapsible bottoms and flap overfolding apparatus located in rear of said mid-crease prefolding mechanism and in advance of said adhesive applying means along said path, said apparatus including untimed, article actuated hooked folding fingers adapted to overfold two juxtaposed leading flaps on one side of the mid crease of each successive blank and then the other two juxtaposed leading flaps on the other side of the mid crease of each successive blank after each said mid-crease prefolded blank has returned to flatwise position on said path and before each said blank enters said adhesive applying means.

19. Folding apparatus as specified in claim 1 wherein the trailing hooked portion of said folding finger is bent inwardly to form a flap engaging inner face located between said notch and said tip, said face being nearer the axis of oscillation of said finger than said notch and adapted to engage a longitudinally intermediate portion of the underface of a leading flap when the leading edge thereof enegages in said notch to create an upward bow in said flap as the flap is upfolded by said finger.

20. In combination with a single lower carrier a folding unit for overfolding two juxtaposed leading flaps both on the same side of the center crease of each of a plurality of flat foldable blanks advancing individually and successively along a longitudinal path through a folding machine, said unit comprising a single longitudinally extending support of rigid material mounted above said path on said machine and slideably adjustable therealong and thereacross, said support being aligned with said carrier and aligned with the path of the slit between said juxtaposed leading flaps; first blank presser means cooperating with said lower carrier, said means extending longitudinally of the forward half of said support on one side of the longitudinal centre line thereof; a first blank actuated, hooked, folding finger oscillatably mounted in the forward half of said support, on the opposite side of the longitudinal centre line thereof, and adapted to overfold a first said juxtaposed leading flap passing therebelow while the advancing blank is held down and advanced along the path of the second said juxtaposed leading flap by said first presser means in cooperation with said lower carrier; second blank presser means cooperating with said lower carrier, said means extending longitudinally of the rearward half of said support on the same side thereof as said first folding finger and a second blank actuated, hooked, folding finger oscillatably mounted in the rearward half of said support on the same side thereof as said first presser means, and adapted to overfold said second juxtaposed leading flap while said advancing blank is held down and advanced along the path of said first juxtaposed leading flap by said second presser means in cooperation with said lower carrier.

References Cited in the file of this patent

UNITED STATES PATENTS

2,598,809	Liebl	June 3, 1952
2,647,447	Andre	Aug. 4, 1953
2,655,082	Amyx et al.	Oct. 13, 1953
2,764,918	La Bombard	Oct. 2, 1956
2,765,714	Wischusen	Oct. 9, 1956