

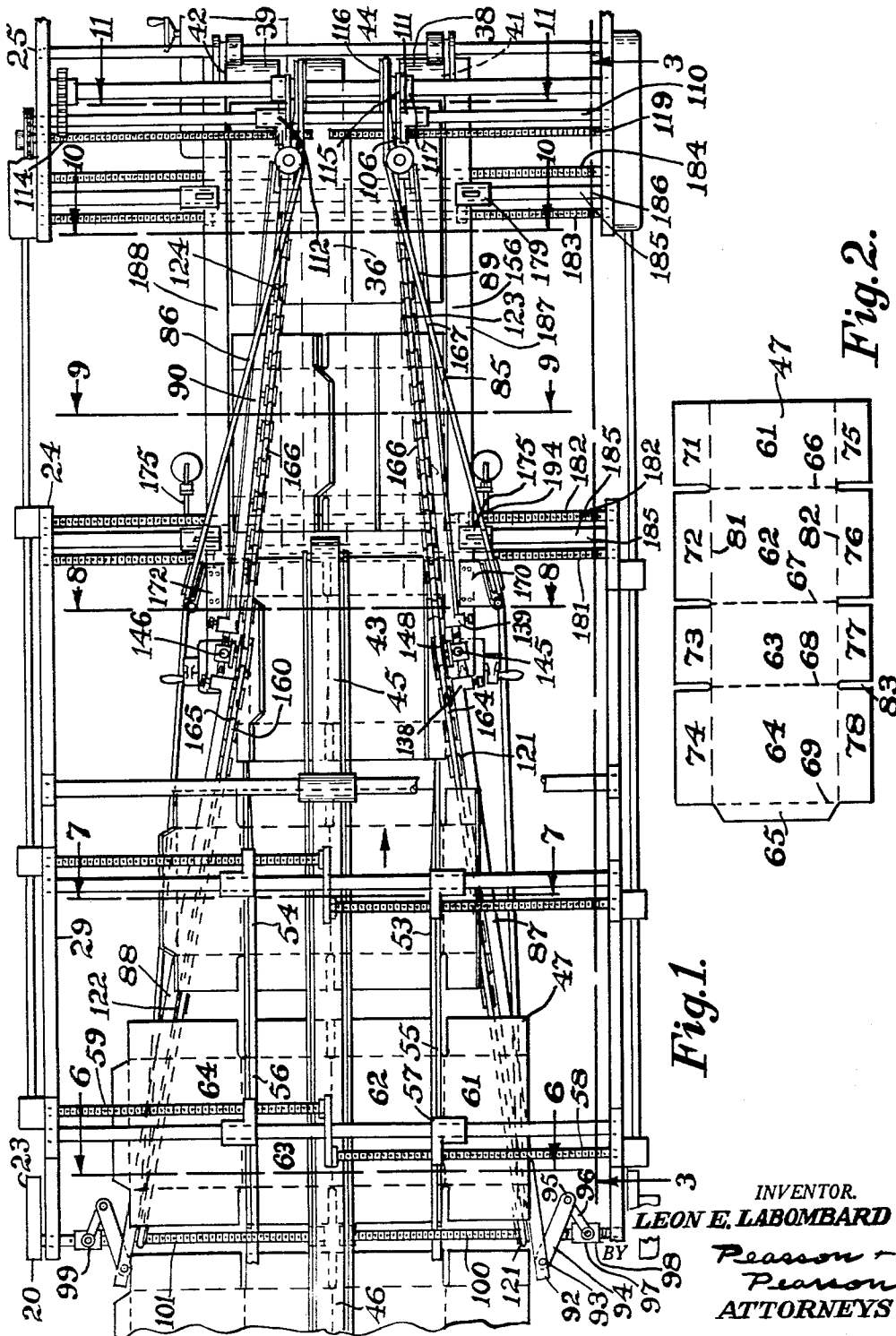
April 5, 1960

L. E. LA BOMBARD
FOLDER BELT APPARATUS

2,931,277

Filed Nov. 25, 1958

4 Sheets-Sheet 1



74	73	72	71
64	63	62	61
69	68	67	66
78	77	76	75
83			

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April 5, 1960

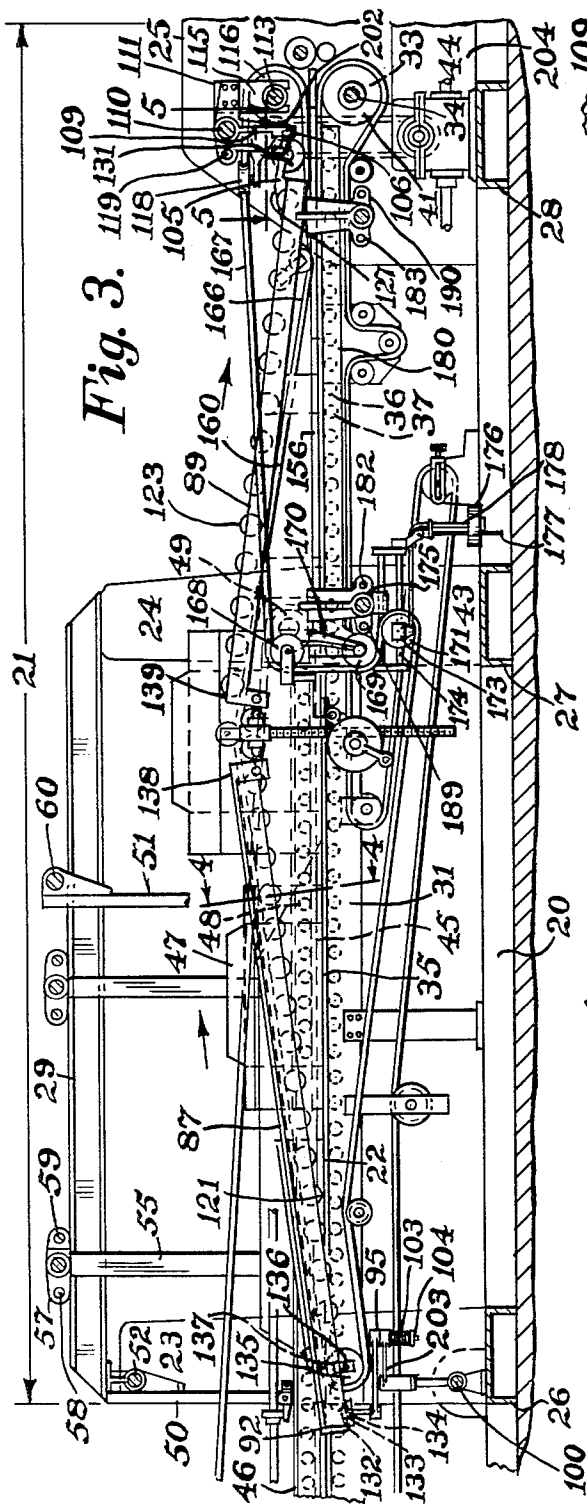
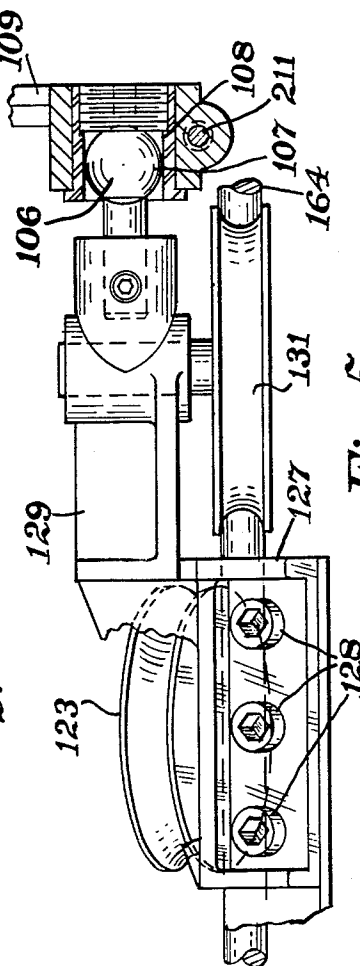
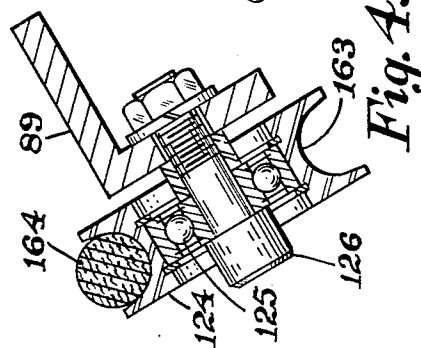
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

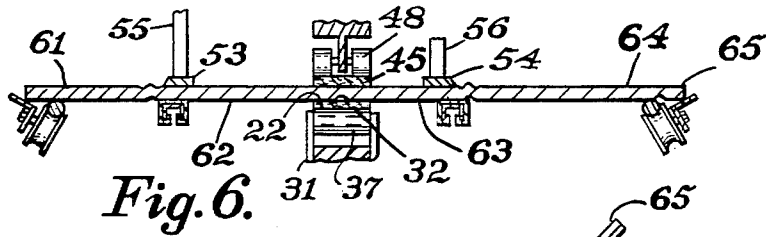


Fig. 6.

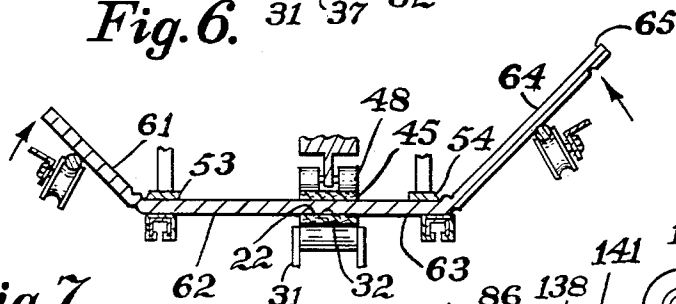


Fig. 7.

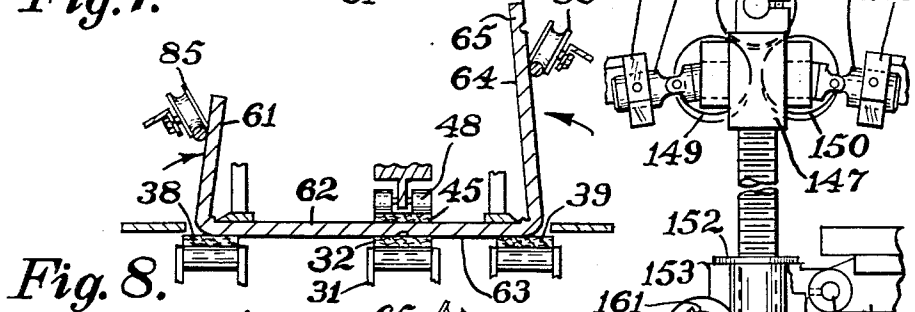


Fig. 8.

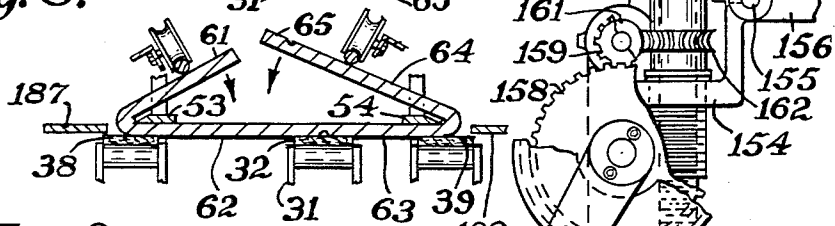


Fig. 9.

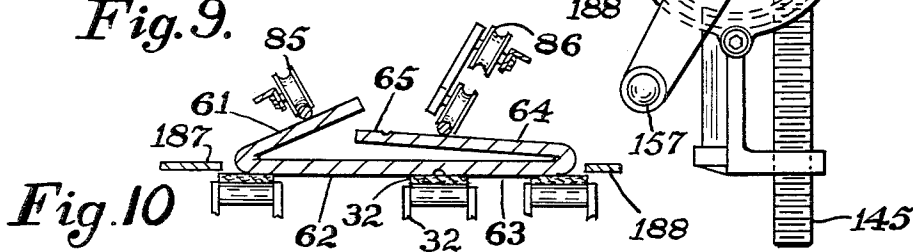


Fig. 10.

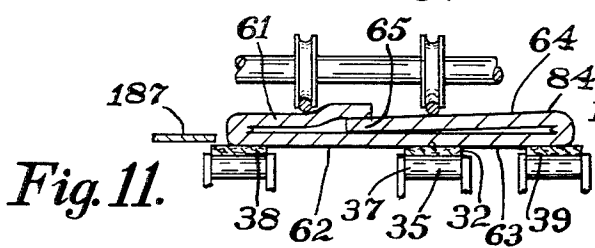


Fig. 11.

Fig. 12.
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4 Sheets-Sheet 4

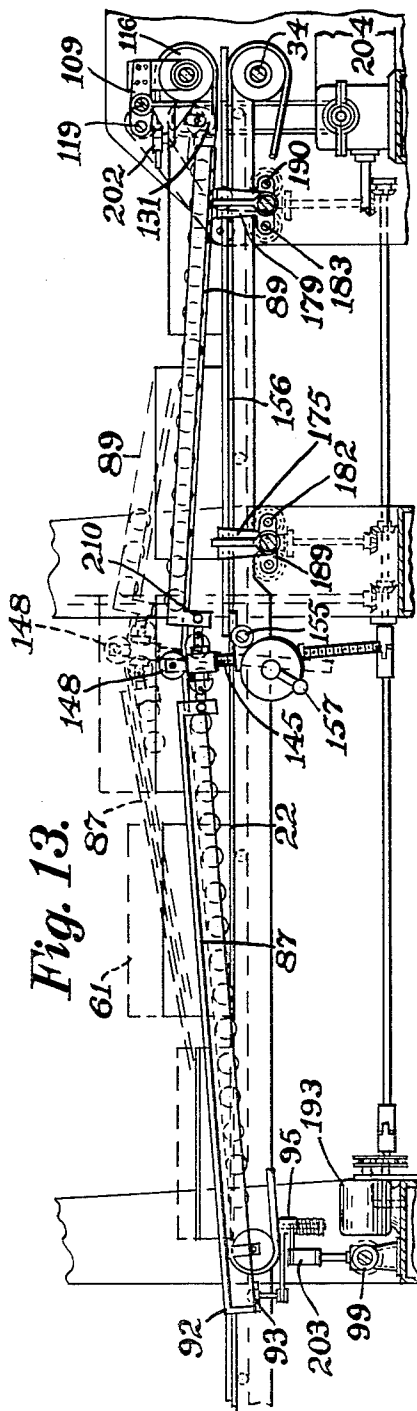


Fig. 13.

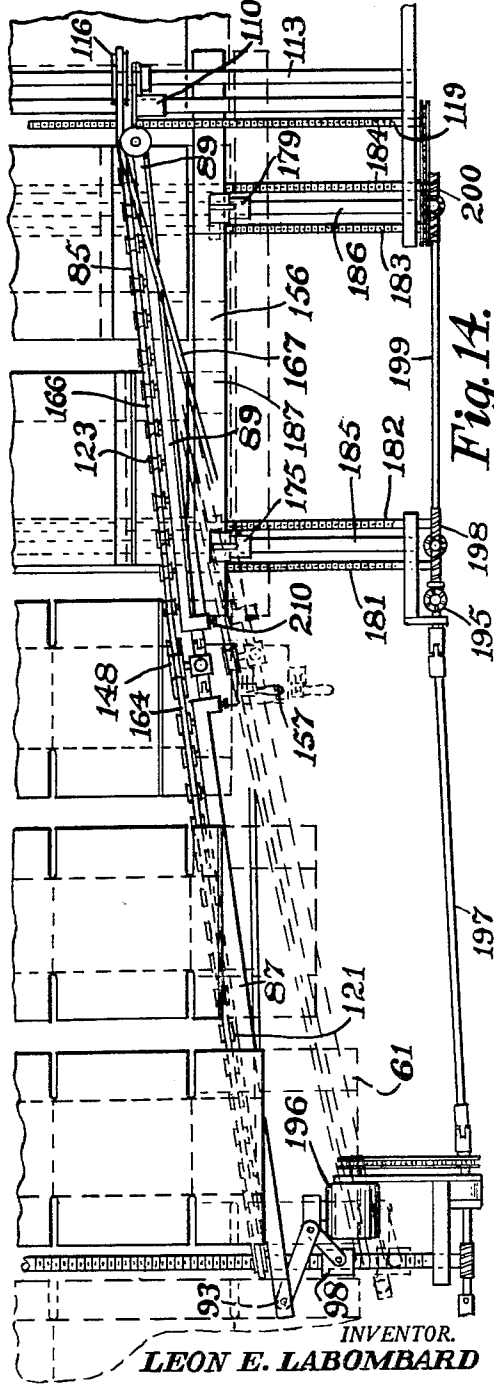


Fig. 14.

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2,931,277

FOLDER BELT APPARATUS

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Application November 25, 1958, Serial No. 776,382

10 Claims. (Cl. 93—52)

This invention relates to folder belt apparatus of the type used in paper box folding machines.

It has long been customary to advance a plurality of flat box blanks individually and successively along a path through the folding zone of a paper box folding machine and to fold the outer hinged panels of each blank over its inner panels, along longitudinal crease lines, by means of twisted folder belts. Such folder belts have usually been supported at each opposite end on a pulley, or roll, one of the same being a driven roll for the purpose of synchronization, and the operating stretches of the belts have usually been backed or supported at long intervals, if at all. It will be understood that the path of the operating stretch of a folder belt is generally helical and that a belt of flat cross section is, therefore, twisted. Such flat belts, if supported in grooved pulleys, have tended to twist out of the groove and it has been difficult to secure a continuous, smooth engagement with the face of the panels being upfolded.

In making boxes from relatively small blanks twisted fold belts, of flat cross section, have usually proved satisfactory since the whip of the panels and the resistance of the fold line is greatly reduced. However, when it is desired to fold blanks of corrugated paperboard, of the size now used to take the place of large wooden crates, it will be understood that problems of resistance to leverage at the fold line during upfolding, resistance to compression along the fold line during downfolding and whipping action of the large area panels during folding, are all greatly increased.

It has been proposed to use relatively wide belts of flat cross section as combined carrier and fold belts, the upper carrier belts being laterally spaced in substantial alignment with the longitudinal creases upon which folding is desired. In this type of machine the upper carrier belts extend nearly parallel to the path of the fold lines, first contacting the under face, near the base of, the panel to lift the same to perpendicular while the belt twists through an angle of 90° and then to engage the upper face, near the base of the panel, to press downwardly thereon while the belt twists through a second angle of 90° to carry the box forwardly. Where the panels are several feet in width, the outer portion of each panel is unsupported and may have a tendency to lag or whip. Similarly lateral pressure in an inward direction so near the crease line and applied by a twisted belt may tend to cause a misaligned fold, especially with fluted corrugated material.

It is the principal object of this invention to provide improved fold belt apparatus suitable for folding corrugated blanks of relatively large area at high speed and with commercially acceptable accuracy.

Another object of the invention is to provide a pair of fold belts which are independent of the carrier belts and movable laterally to positions wherein the belts support the outer edge portion of the blank panels during upfolding to prevent bending, whipping or twisting of the outer panels.

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A further object of the invention is to provide fold belts of circular cross section having operating stretches which are firmly backed throughout their length despite the helical path thereof, thereby overcoming the limitations of directional change caused in keeping flat belts on their pulleys.

Still another object of the invention is to provide fold belt apparatus well away from the fold line to utilize the leverage of the panels themselves for insuring a perfect on-the-crease fold without the danger of forcing, angling or crowding the blank. The gradual fold thus achieved avoids the throwing of glue by panels unduly whipped through the air while causing each panel to bow and then break on the preformed crease line thereof.

A still further object of the invention is to provide fold belt apparatus which is laterally adjustable to various sizes of blanks by motorized means for a rough setting and then manually adjustable to a fine setting, all while maintaining a firm straight backing for the round folder belts of the invention.

Another object of the invention is to provide independent speed adjustment means for the fold belts with relation to the speed of advance of the blanks, thereby overcoming any tendency for the larger area panel of each blank to lag behind and cause strain on the crease or misfolding.

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

Fig. 1 is a plan view of the panel overfolding zone of a box forming machine constructed in accordance with the invention, parts being broken away for clarity.

Fig. 2 is a plan view of a typical blank foldable into a collapsed tubular box by the apparatus of the invention.

Fig. 3 is a side elevation, in section on line 3—3 of Fig. 1, with parts broken away for clarity.

Fig. 4 is an end view in section of one of the fold belt guides of the invention.

Fig. 5 is a fragmentary plan view of the rear, or delivery, end of one of the pairs of fold guides of the invention.

Figs. 6—11 are diagrammatic, end elevations in section on the corresponding section lines of Fig. 1, showing the various stages of folding of the apparatus of the invention.

Fig. 12 is a fragmentary side elevation of the intermediate support means for a pair of fold belt guides.

Fig. 13 is a fragmentary side elevation of one of the fold belt units of the invention showing in full lines the position assumed for small blanks and in dotted lines the position assumed for larger blanks, and

Fig. 14 is a plan view of the device shown in Fig. 13, and also showing the motorized lateral adjustment means.

As shown in the drawings, 20 is the frame of a paper box folding machine of any well known type, the portion illustrated being only the panel overfolding zone 21, since the feed zone, glue zone, creasing zone and stacking zone are not pertinent to the invention. For convenience, the apparatus illustrated is designed for use with the apparatus of my copending patent applications Serial No. 698,868 filed November 25, 1957 and entitled Apparatus and Method for Feeding Sheets, Serial No. 709,977, filed January 20, 1958 and entitled Method and Apparatus for Creasing Blanks, and Serial No. 730,003 filed April 21, 1958 and entitled Method and Mechanism for Squaring-Up Boxes. It will be understood that the entire apparatus is suitably synchronized to feed flat blanks individually and successively along the paper line 22, which is a straight horizontal path, to create complete collapsed tubular boxes and that the folding apparatus illustrated would be useful with any other similar machine. Suitable upright main side frame pieces such as 23, 24 and

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25 and cross frame base pieces such as 26, 27 and 28 are provided as well as the upper frame pieces such as 29.

Extending the full length of the machine, including the panel overfolding zone 21, is a lower centre carrier 31 in the form of a relatively wide endless belt 32 trained around suitable carrier pulleys such as the driven pulley 33 powered by the driven shaft 34. The upper stretch 35 of the belt 32 extends along the longitudinal centre line of the zone 21, indicated at 36, and is supported by a plurality of spaced cage rolls such as 37 at the level of the paper line 22. A pair of laterally spaced lower carrier belts 38 and 39 are provided on each opposite side of lower carrier 31, the carrier belts 38 and 39 being trained around suitable pulleys such as the driven pulleys 41 and 42, also carried on driven shaft 34. The carrier belts 38 and 39 extend from the intermediate portion of zone 21, at 43, to the rearward end portion of the zone 21, at 44, to assist in advancing the blanks while downfolding is taking place near the end of zone 21.

An upper, centre, carrier belt 45 extends along the longitudinal centre line 36 from the forward end portion of zone 21 at 46, to the intermediate portion of the zone at 43 to positively advance the box blanks, such as 47 individually and successively, while upfolding is taking place in zone 21. A succession of individual, flat box blanks, or other sheets, are thus advanced along the paper line 22 at high speed, under the control of the upper and lower centre carrier belts 32 and 45 in the upfolding section of zone 21 and under the control of the lower carrier belts 32, 38 and 39, plus the upper fold belts to be described later, in the downfolding section of zone 21. Suitable cage rolls, such as 48 are provided for the upper carrier belt 45 and belt 45 is trained around pulley 49 but driven by a suitable drive pulley, at the other end thereof not shown, all in a well known manner.

The upper carrier belt 45 is supported with its lower operating stretch at the level of paper line 22 by hanger members 50 and 51 depending from the cross shafts 52 and 60, the cross shafts being supported by the upper frame pieces such as 29 on each opposite side of zone 21. A pair of folder swords 53 and 54 are provided to extend along the inside of the longitudinal crease line of each blank 47 upon which the outer panels are to be overfolded. Swords 53 and 54 are each supported by one or more hanger members such as 55 or 56 depending from threaded brackets such as 57, the brackets being movable toward and away from the centre line 36 by the left hand threaded shafts 58 and the right hand threaded shafts 59.

As best shown in Fig. 2 the flat blanks 47 to be folded on the machine of this invention are usually of corrugated paperboard material and include the side panels 61, 62, 63 and 64 and the glue flap 65, defined by the longitudinal crease lines 66, 67, 68 and 69. End flaps such as 71, 72, 73, 74, 75, 76, 77 and 78 may also be defined therein by the lateral crease lines 81 and 82 and slits such as at 83. Adhesive of any suitable type is applied along flap 65 and the longitudinal crease lines 66 and 68 are firmly impressed with a deeply defined crease in advance of the overfolding section 21. As best shown in Figs. 6 to 11, the outer panels 61 and 64 are overfolded on the crease lines 66 and 68 in zone 21 with the glue flap 65 overlapping panel 61 to thus form a collapsed tubular box 84 ready for stacking.

Two overfolding mechanisms 85 and 86 are provided, each on an opposite side of the longitudinal centre line 36 and substantially coextensive in length with the overfolding zone 21. The mechanisms 85 and 86 are substantially identical, but reversed, so that a detailed description of only one such mechanism is necessary for an understanding of the invention. The mechanisms 85 and 86 each include a pair of longitudinally extending guides such as 87, 89 and 88, 90, each guide being

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straight and of rigid material such as metal, of right angular cross section. For convenience I term the guides 87 and 88, the forward, or upfolding guides and the guides 88 and 90 the rearward, or downfolding guides.

Each forward or upfolding guide such as 87 inclines upwardly from the forward end portion of zone 21, at 46, at a level just below the paper line 22, to the intermediate portion of zone 21, at 43, at a level well above the paper line 21 and converges toward the opposite forward guide 89. The forward end 92 of each forward guide such as 87 is pivoted at 93 to the terminal end of an arm 94, the arm 94 being in turn pivoted at 95 to an arm 96, pivotally mounted at 97 on interiorly threaded sleeve 98. The sleeves such as 98 and 99 are each threadedly mounted on a transverse driven shaft 100, or 101 forming part of the motorized lateral adjustment means of the invention to be described later herein. A coil spring 103 and central rod 104 are mounted at pivot 95 of the pair of arms 94 and 96 to continually exert a resilient clamping pressure thereon. It will be apparent that the turning of shaft 100 or 101 will cause the sleeves 98 and 99 and the forward ends of the guides 87 and 88 to move laterally inwardly or outwardly but that the forward ends of the guides may also be manually displaced laterally, by overcoming the clamping action of the springs 103, to further adjust the position of the guides.

Each rearward, or downfolding guide, such as 89 inclines downwardly from the intermediate portion of zone 21, at 43, at a level well above the level of paper line 22 to the rearward portion of zone 21, at 44, at a level just above the level of the paper line 22, and converges toward the opposite rearward guide 90. The rearward end 105 of each rearward guide such as 89 is mounted for pivoting in a vertical plane preferably by means of a swivel joint 106, including the ball 107 and the socket 108. A socket such as 108 is formed in the depending arm 109 of each of a pair of opposite brackets 111 and 112, the brackets 111 and 112 being laterally slidable on the keyed cross shaft 110. A pair of oppositely threaded shafts 114 and 119 forming part of the lateral adjustment means of the invention is threadedly engaged in the opposite brackets 111 and 112 to move the same laterally. Each bracket such as 111 includes a yoke 115 straddling the driven shaft 113 between the fold belt pulley 116 and the collar 117 thereof, and also includes an idler pulley 118 for guiding the nonoperating stretch of the fold belts.

Each straight rigid guide 87, 88, 89 and 90 is provided with a plurality of belt pulleys such as 121, 122, 123 and 124, rotatably mounted therealong at closely spaced intervals. The belt pulleys are identical in size and journaled in suitable ball bearings, such as at 125, in Fig. 4, to their respective guides, by the bolts 126. The rearward end 105 of each rearward guide such as 89 and 90, preferably includes a bracket such as 127 (Fig. 5) attached thereto by bolts 128 and having an angularly offset portion at 129 to which a pulley 131 is journaled.

The forward end 92, of each forward, or upfolding guide is provided with swivel joint means 132 connecting it to the terminal end of each arm 94 preferably by means of the socket 133 and the ball 134. (Fig. 3) The end 92 is also provided with an enlarged belt pulley 135 journaled on a lug 136 fixed to the guide by any convenient means such as welding at 137 (Fig. 3).

The adjacent meeting or intermediate ends 138 and 139 of each pair of guides such as 87, 89 or 88, 90 are flexibly connected to permit each pair of guides to be adjusted to various upfolding and downfolding angles relative to the path of the flat blanks along paper line 22. As best shown in Fig. 12 the adjacent ends 138 and 139 are each provided with swivel joint means in the form of the universal joints 141 and 142, of a well known type mounted on the single, upstanding, tiltable

post, 145 or 146, on each opposite side of the machine. Each post such as 145 includes a cap such as 147 carrying the three belt pulleys 148, 149 and 150 and post 145 is exteriorly threaded for engagement with the threads of the sleeve 152. Sleeve 152 is rotatably mounted in the yoke 153 of the bracket 154, the bracket being mounted to pivot in a vertical plane on the pivot 155 carried by the longitudinally extending frame piece 156. A manually operable hand crank 157 is mounted on bracket 154 to rotate a gear 158 which in turn rotates the gears 159, worm gear 161 and gear 162 fixed to sleeve 152. Thus, by turning hand crank 157, the effective length of the post 145 above paper line 22 may be increased and decreased to vary the inclination of the upfolding guides 87 and 88 and the downfolding guides 86 and 89.

The rearward support means 202 of each pair of guides such as 87 and 89, comprising the depending arm 109 and swivel connection at 106, does not yield longitudinally as the post 145 is raised or lowered, but the forward support means 203 of each such pair of guides, comprising the pivoted arms 94 and 96, can yield longitudinally by flexing of the arms. In its lower positions the post 145 thus tilts toward the forward end of the machine and in its higher position post 145 tilts toward the rearward end of the machine as shown in Figs. 13 and 14.

All of the belt pulleys specified above, such as pulley 124 (Fig. 4), have belt grooves 163 of part-circular cross section. The pair of endless folder belts 164 and 165 are preferably of circular cross section. As shown, each folder belt such as 165 is trained over the pulleys 121 of the upfolding guide 87 of each pair of guides and the belt is then directed by the pulleys 148, 149 and 150 of the post 145 under the pulleys 123 of the downfolding guide 89 of each pair of guides. The operating stretch 166 of each belt such as 165 then passes under pulley 131 and around the end drive pulley 116 carried by driven shaft 113.

The return, or non-operating stretch 167 of each belt such as 165 passes around an upper belt pulley 168, a lower belt pulley 169 and a tension belt pulley 171 in the intermediate portion 43 of zone 21 and thence around the enlarged pulley 135 at the forward portion 46 of zone 21. The pulleys 168 and 169 are supported on suitable brackets 170 and 172 carried by the frame piece 156. Tension pulley 171 is rotatably mounted on a sleeve 173 slidable longitudinally on a rod 174, the rod 174 being supported on the bracket 175. A counterweight 176 is guided on the rod 177 which depends from bracket 175 and the counterweight is connected by the flexible cable 178 to the sleeve 173 whereby constant tension is applied to each belt 165 regardless of the angle of inclination or declination of the guides such as 87 and 89. Bracket 175 and a corresponding bracket 179 both of which support the frame piece such as 156 are laterally movable on, and controlled by, threaded shafts such as 182 and 183 as part of the lateral adjustment means of the invention. The brackets 189 and 190 which support the frame piece such as 180 which in turn supports the side carrier belt pulleys 41 and 42 are laterally controlled by threaded shafts 181 and 184.

The brackets 175 and 179 of each frame piece such as 156 are laterally slidable on the cross shafts 185 and 186 and each frame piece carries a longitudinally extending side bar 187 or 188 paralleling the path of the blanks at the level of paper line 22. The flat blanks have already been upfolded on their longitudinal crease lines, with the outer panels at 90° angles, when they reach the end of the upper centre carrier belt 45 (Fig. 8) and are then supported on the three lower carrier belts as they pass through the downfolding section (Fig. 9).

Preferably the brackets 175 and 179 move laterally more rapidly than brackets 189 and 190 so that the side bars 187 and 188 will expose more of the side carrier belts when the blanks are of increased width. With nar-

rower blanks the side bars may nearly cover the side carrier belts.

The side bars 187 and 188 are positioned close to the outside of the crease lines 66 and 68, to prevent any possible twisting of the blanks as the panels 61 and 64 are downfolded to form collapsed tubular boxes (Fig. 11). Preferably the bars 187 and 188 do not touch or rub on the blanks and they may be set at about one quarter of an inch away from the crease lines while still performing their function. It will be apparent that the lateral movement of each frame piece, such as 156, will cause the oppositely disposed side bars 187 and 188, and the intermediate support means 194 of the fold belts, including post 145, to move simultaneously as a unit toward and away from the longitudinal centre line 36. This lateral movement is accomplished by the rotation of the threaded shafts 182 and 183, which form part of the lateral adjustment means 195.

As best shown in Fig. 14, the lateral adjustment means 195 of the invention also includes the electric motors 196, 193 a suitable circuit to a source of power and a suitable switch not shown, and a train of shafts and gears indicated generally by the numerals 197, 198, 199 and 200. In addition to revolving shafts 181, 182, 183 and 184 the power train rotates shafts 114 and 119 which laterally move the rearward support means 202 for the folding apparatus, including arm 109, and the forward support means 203 thereof including the sleeves 98 and 99. The shafts 58 and 59 of the swords 53 and 54 are similarly rotated for lateral adjustment.

After the operator has secured a rough adjustment of the apparatus by the motorized lateral adjustment means 195, the flexibly mounted folder belt apparatus is adjusted by the vertical adjustment means 204, including the manually operable crank 157, to conform to the dimensions of the new run of blanks. The turning of crank 157 changes the inclination of guides 87 and 88 and the declination of guides 89 and 90 so that the outer panels 61 and 64 are supported on a smooth helical path near the outside edges thereof as the panels are lifted upwardly on their fold lines and then pressed downwardly into overfolded position (Figs. 6-11).

The drive shaft 113 of the fold belts and the drive shaft 34 of the lower carrier belts are suitably synchronized, in a well known manner, with the drive of the upper carrier belt 45. Preferably a speed change device such as 204 is incorporated into the power drive of the fold belts 164 and 165, as shown in Figs. 1 and 13. By varying the relative speed of the folder belts to the speed of advance of the blanks, compensation can be made for any tendency toward distortion of the blanks due to wind resistance or the like at high folding speeds.

The fold belt mechanisms 85 and 86 of this invention, unlike the flat fold belts of the prior art, provide a firm supporting engagement for the panels 61 and 64 of each blank even though the path of the belts is substantially helical. Because the fold belts 164 and 165 are of circular cross section the change of direction of the belts from upfolding to downfolding is accomplished with a continuous tangential contact between belt and panel and with no tendency for the belt to twist out of the grooved pulleys spaced along each pair of pulley guides. The swivel joint means at each end of each guide enables each guide of each pair to be turned on its longitudinal axis and clamped in place by suitable set screws such as 210, 211. Thus the entire group of pulleys on each guide can be positioned to present the belt trained thereover to the panels to be overfolded whether the blanks be large or small. The gradual fold achieved by the mechanisms 85 and 86 prevents whipping of the panels during upfolding while the wide angle of convergence possible with the upfolding guides gives panels of large area the support required to prevent bowing of the panel or angling of the blank.

I claim:

1. A machine for forming collapsed tubular boxes from flat box blanks, said machine comprising blank carrier means advancing said blanks individually and successively along a path through a panel overfolding zone in said machine; two pairs of longitudinally extending guides of rigid material, each pair flexibly mounted on said machine on an opposite side of the longitudinal centre line of said path and coextensive in length with said zone; a plurality of belt pulleys rotatably mounted at closely spaced intervals along said guides; a pair of longitudinally extending, endless fold belts, each trained over the pulleys of one guide, and under the pulleys of the other guide of each pair for upfolding and then downfolding the panels of each successive blank; drive means for driving said fold belts in synchronization with said carrier means, motorized lateral adjustment means, on said machine for moving each said pair of guides as a unit laterally toward and away from the longitudinal centre line of said path and vertical adjustment means on said machine for flexing each said pair of guides in a vertical plane to various positions of inclination and declination relative to said path.

2. Apparatus as specified in claim 1, wherein said flexing means includes swivel support means at each opposite end of each said guide for turning each guide on its longitudinal axis, said pulleys each have a pulley groove of parti-circular cross section and said belts are each of circular cross section whereby said belts are firmly backed when following a helical path.

3. Apparatus as specified in claim 1 wherein said vertical adjustment means includes a pair of arms pivotable in a horizontal plane on said machine and pivotally supporting one end of each said pair of guides, a single upstanding post pivotable in a vertical plane on said machine and pivotally supporting the adjacent ends of said guides intermediate of said zone, a fixed pivot on said machine supporting the other end of each said pair of guides for pivoting in a vertical plane and means on said machine associated with said single post for increasing and decreasing the effective length thereof to thereby vary the inclination of the guides of each said pair of guides.

4. A combination as specified in claim 1 wherein the drive means for said endless belts includes independently adjustable speed change mechanism for varying the speed of the belts relative to the speed of advance of said blanks.

5. Apparatus for overfolding the outer panels of a plurality of flat box blanks of corrugated paperboard advancing individually and successively along a path through an overfolding zone of a box forming machine, said apparatus comprising two opposed, laterally movable, pairs of rigid guides extending longitudinally and convergently from the beginning of said zone to the end thereof, the guides of each pair being in extension of, and angularly movable at their adjacent ends relative to, each other, front support means for the front end of each pair of guides, mounted at the beginning of said zone, including a pair of arms pivoted to swing laterally of said machine, intermediate support means for the adjacent ends of each pair of guides, mounted intermediate of said zone, including a threaded upstanding

post pivoted to swing longitudinally of said machine, manually operable threaded means for raising and lowering said post to vary the inclination of the guides of each pair; rear support means for the rear end of each pair of guides, mounted at the end of said zone, including a horizontal pivot for swinging each pair of guides in a vertical plane; swivel joints connecting each end of each guide to its support means for turning each guide on its longitudinal axis; a plurality of closely spaced pulleys, each having a parti-circular groove therein, rotatably mounted at close intervals along said guides and on said support means; a pair of opposite folder belts, of circular cross section, each belt trained over the pulleys of one guide and under the pulleys of the other guide of each pair for engaging and overfolding the adjacent panels of said blanks, belt tension means on said machine for maintaining uniform tension on said fold belts regardless of the angular relation of said guides and motorized, lateral adjustment, means on said machine for moving said apparatus toward and away from the longitudinal centre line thereof.

6. A combination as specified in claim 5 wherein said front support means includes a coil spring operably connected to the pivot connection of said pair of arms to resiliently clamp said arms in various angular positions whereby the front end of said guides may be manually moved laterally and remain in the position to which moved.

7. Apparatus for overfolding the outer panels of a plurality of flat box blanks advancing individually and successively through the overfolding zone of a folding machine, said apparatus comprising a pair of opposed fold belts, of circular cross section, each having an operating stretch extending longitudinally and convergently from below the path of said blanks, at the beginning of said zone, to a level well above said path, intermediate of said zone, and thence to a level just above said path, at the end of said zone, two opposed pairs of straight, rigid, guides on said machine, each having a plurality of spaced, grooved pulleys therealong for backing and supporting said belts; means supporting the guides of each pair on said machine for angular movement relative to each other; lateral adjustment means on said machine for moving said supporting means, said guides and said belts as a unit toward and away from the longitudinal centre line of the machine and drive means for said belts.

8. Apparatus as specified in claim 7 wherein said guide supporting means includes swivel means for turning each guide of each pair independently on its longitudinal axis.

9. Apparatus as specified in claim 7 wherein said belt drive means includes independent mechanism for varying the speed of the belts relative to the speed of advance of said blanks.

10. Apparatus as specified in claim 7 wherein said belt drive means includes a counterweight actuated tension pulley associated with each belt for applying a predetermined tension thereon regardless of variations in the path of each belt.

No references cited.