Aug. 1, 1950 A. F. SHIELDS 2,517,449

CARTON BLANK FOLDING MACHINE

Filed June 3, 1947 6 Sheets-Sheet 1

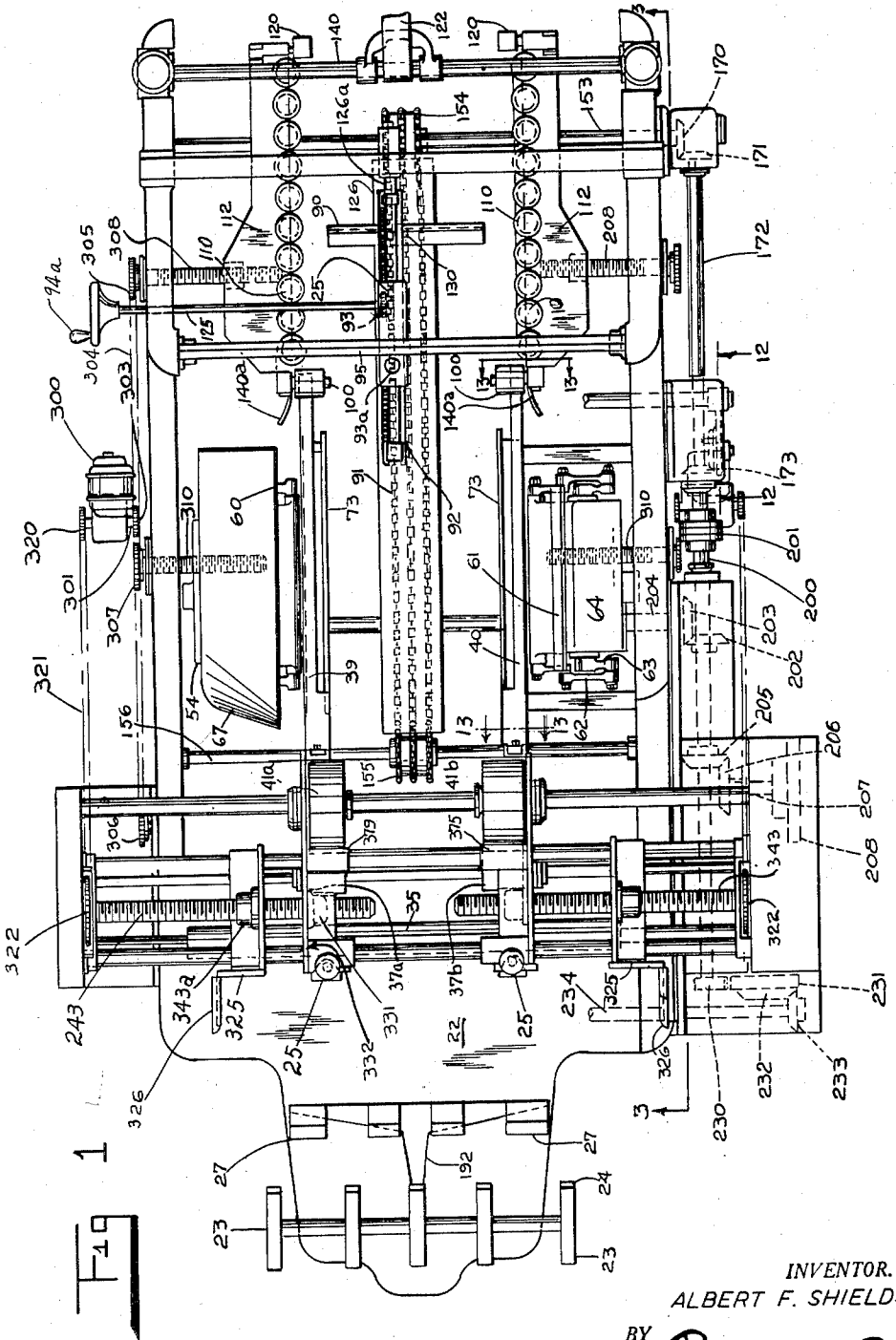

FIG. 1

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CARTON BLANK FOLDING MACHINE

Filed June 3, 1947 6 Sheets-Sheet 2

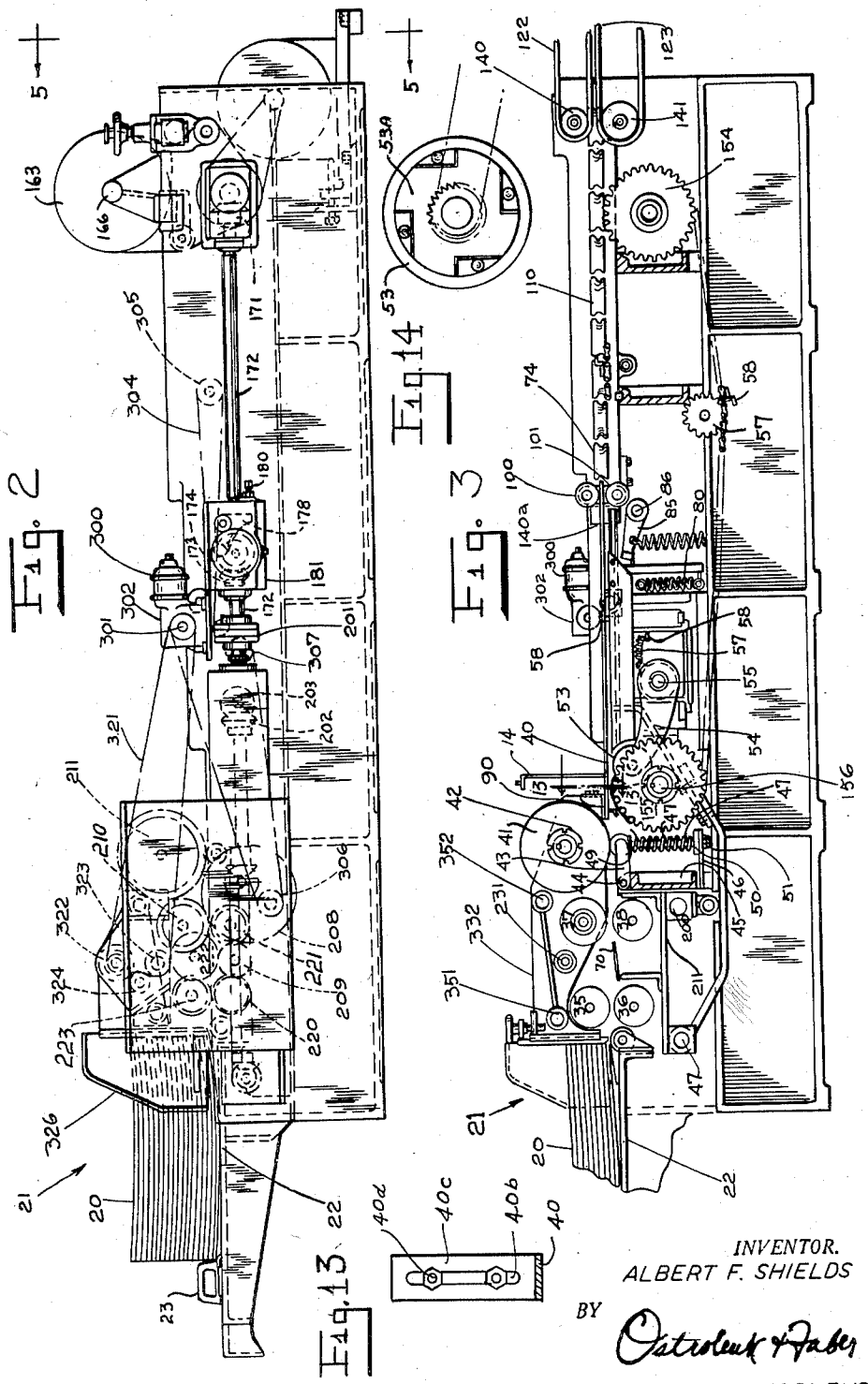

Fig. 2

Fig. 3

Fig. 14

Fig. 13

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CARTON BLANK FOLDING MACHINE

Filed June 3, 1947 6 Sheets-Sheet 3

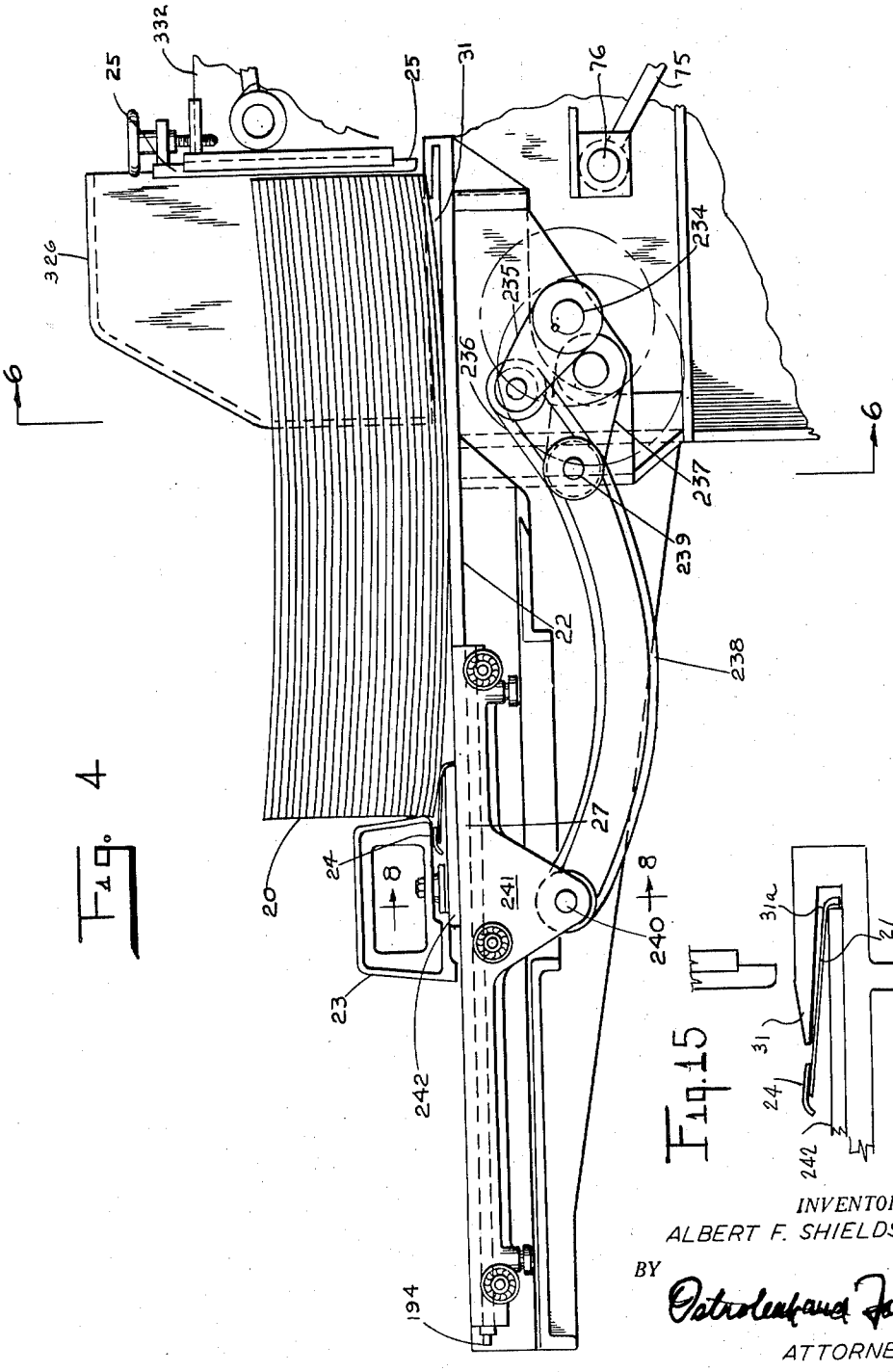

Fig. 4

Fig. 15

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Aug. 1, 1950 A. F. SHIELDS 2,517,449

CARTON BLANK FOLDING MACHINE

Filed June 3, 1947 6 Sheets-Sheet 4

Fig. 8

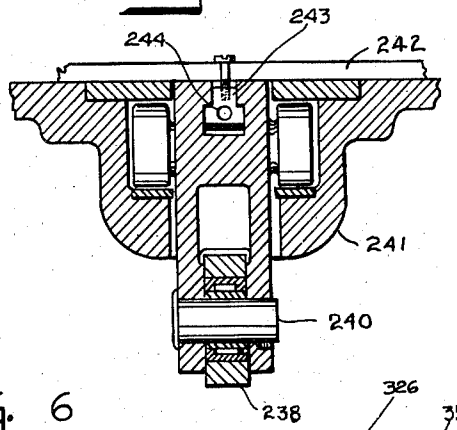


Fig. 6

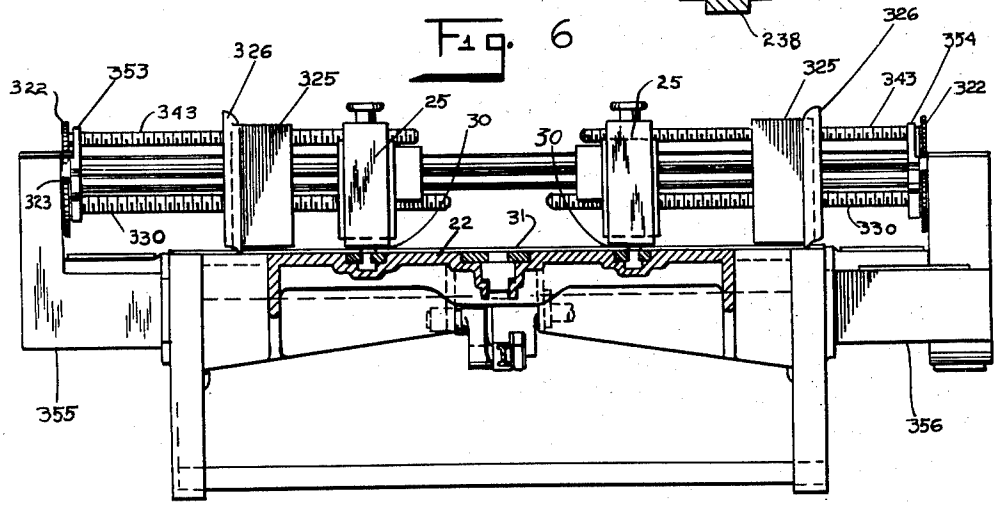
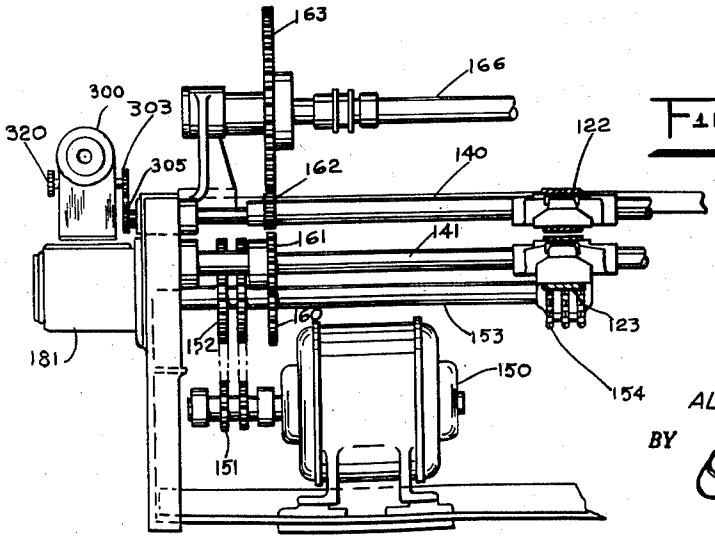


Fig. 5



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CARTON BLANK FOLDING MACHINE

Filed June 3, 1947 6 Sheets-Sheet 5

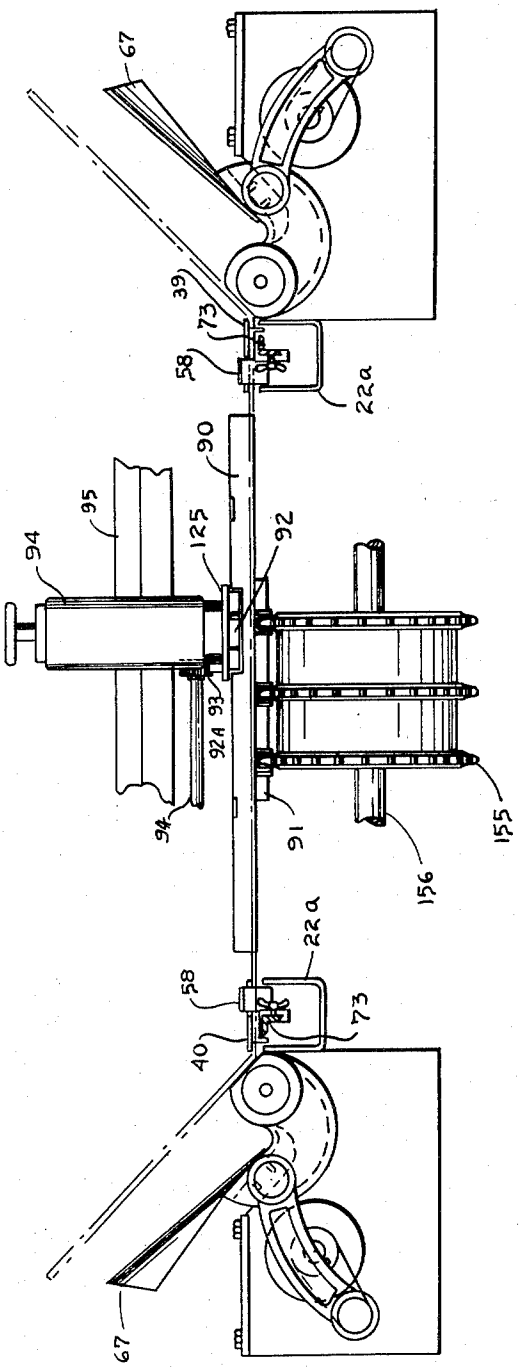

FIG. 7

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Aug. 1, 1950 A. F. SHIELDS 2,517,449

CARTON BLANK FOLDING MACHINE

Filed June 3, 1947 6 Sheets-Sheet 6

Fig. 9

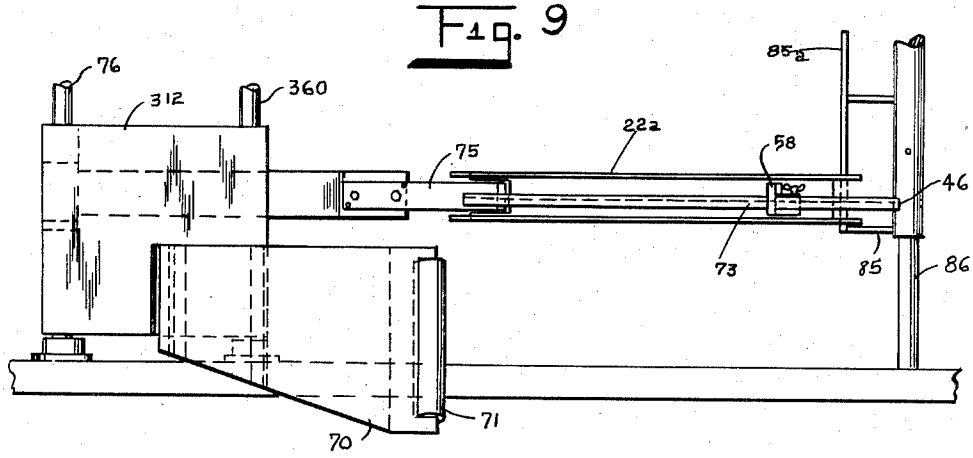


Fig. 10

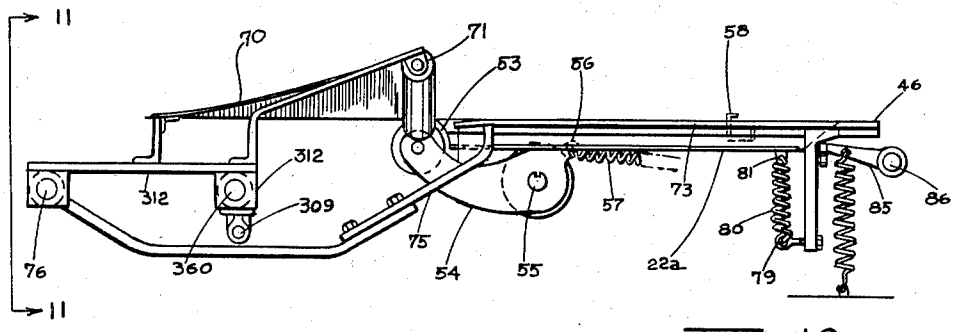


Fig 11

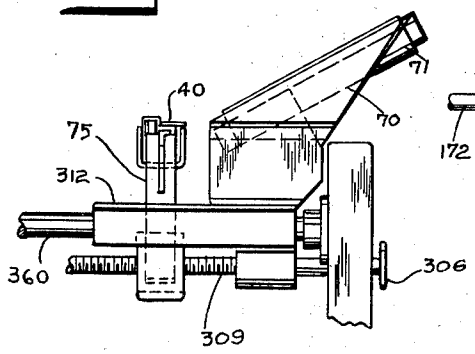
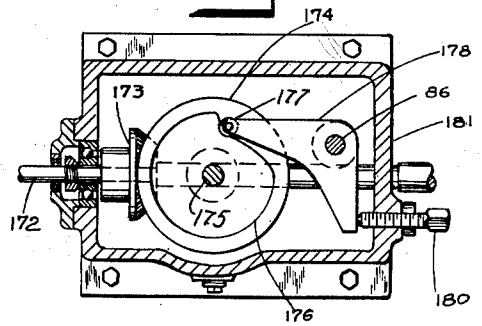


Fig 12



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Patented Aug. 1, 1950 2,517,449

UNITED STATES PATENT OFFICE

2,517,449

CARTON BLANK FOLDING MACHINE

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Application June 3, 1947, Serial No. 752,199

3 Claims. (Cl. 93—49)

1

My present invention is a continuation in part of my application Serial No. 696,085 filed September 11, 1946, and relates to carton blank folding machines and more particularly to a folding machine of the type generally shown in my prior Patent 2,336,507, wherein large size corrugated board or other paper blanks are to be passed from a stack through various folding elements and delivered to a tape applying mechanism.

In the making of cartons, it is necessary first to crease and slot the blanks in order properly to prepare them for the folding operation. Heretofore and prior to the advent of a specific folding machine for operating rapidly on blanks, it has been customary to fold these blanks manually and feed them into the taping machine. The folding operation for an ordinary square tubular box comprises bending over the two outer panels on the score lines so that the edges of the panels meet to form a collapsed tube. The maximum speed which can be expected from manual folding is of the order of from 10 to 30 blanks per minute. In addition, where the blanks have been incorrectly creased or scored prior to folding, it becomes necessary for the operator when bringing the edges of the folded panel together to twist the panels around the crease and adjust and reform the crease in order that the tube may be squared properly. This operation is very time consuming when performed manually; also the operator tends readily to place aside and discard blanks the panels of which are visibly askew, thus leading to a great deal of waste and additional operations.

My novel machine has for its primary purpose the rapid folding and delivering of the blanks at a rate ranging upward from 120 a minute to as high as 180 blanks per minute and even higher.

My novel device also embodies elements which will straighten and reform the crease in any blank in which the panels when folded are askew without slowing the rate of folding in any way.

Primarily my present invention is directed toward improvements in the device shown in my Patent 2,336,507 which improvements are invented in order to increase the folding rate of my machine, also to increase the range of the machine with regard to sheet sizes and materials to improve the reliability of operation and also to shorten the set-up time. These improvements include a stacking arrangement which will permit delivery of warped blanks to the folding apparatus, also where the side gages are automatically positioned when the folding width is set; prefolding elements which will start the panels to be folded around their bent line just prior to

2

the point where the blanks reach the folding plates, improved plates which are curved to extend the prefolding action; improved stop means which act on the unfolded portion of the blank for holding the blanks in proper position during folding; improved re-creasing means to re-form the creases in blanks, the panels of which would otherwise be askew; improved means for adjusting the machine to various sizes and arrangements of the blanks; and improved means for simplifying and integrating the drives for the various elements of the machine so that each operation will take place at the proper instant.

Also, my novel machine includes added means to insure bringing the blanks up to the stop under all conditions and preventing rebound; stripping means to insure that the folded blanks clear the retracted stop; folding bar limiting rolls to limit deflection of the folding bars and guide the folded blank into the straightening section.

Further objects of the present invention include improved feed-in or kicker arrangements, improved hold-down slat adjustment, improved folding bar adjustment, and improved feed-out elements between the kicker and the folding bars.

The foregoing and many other objects of my invention will become apparent in the following description and drawings in which:

Figure 1 is a top plan view of my novel improved folding machine.

Figure 2 is a side view of the novel folding machine of Figure 1.

Figure 3 is a side view partly in cross-section corresponding to the side view of Figure 2 taken on line 3—3 of Figure 1.

Figure 4 is an enlarged side view showing the stacking and feeding arrangement for the blanks to be folded.

Figure 5 is an end view of my novel machine taken from line 5—5 of Figure 2 looking in the direction of the arrows.

Figure 6 is a view partly in cross-section of the front gauge of the stacking device taken from line 6—6 of Figure 4 looking in the direction of the arrows.

Figure 7 is a cross-sectional view showing the manner in which the blank enters the region of the folding plates.

Figure 8 is a cross-sectional view taken on line 8—8 of Figure 4 looking in the direction of the arrows.

Figure 9 is an enlarged top plan view showing the arrangement of the pre-folding means for preparing the panels of the blanks for folding by the folding plates of my invention.

Figure 10 is a side view of the pre-folding means of Figure 9.

Figure 11 is an end view of the pre-folding means and stop device taken from line 11—11 of Figure 10 looking in the direction of the arrows.

Figure 12 is a side view partly broken away taken on line 12—12 of Figure 1 showing the means for operating the stop device out of stopping position after the blank has been folded.

Figure 13 is a detailed view taken from line 13—13 of Figures 1 and 3 showing the adjustment of the folding bars.

Figure 14 is a detail of the overrunning clutch feed-out arrangement.

Figure 15 is a detail of the forward end of the stacking table arrangement.

Referring now to Figures 1, 2 and 3, a stack of blanks **20** is placed on the bed **22** of the stacking section **21** of the machine between the rear gauge **23** and the front gauge **25**. The bottom blank in the stack is fed toward the right by the feed slat **27** through the spaces **30, 30** (Figure 6) between the front gauges **25, 25** and the bar **31** on which the stack is placed. The spaces **30** are adjusted so that they are just high enough to permit one of the blanks **20** to pass through while holding back the remainder of the stack. The blank passing through the spaces **30** passes over the bar **31** and then is pushed by the feed slat **27** between the upper and lower feed rolls **35** and **36**, respectively (Figure 3). Feed rolls **35** and **36** engage the blank and carry it forward to the upper and lower feed rolls **37** and **38**. Feed roll **38** on the underside of the blank extends across the width of the machine whereas the upper feed roll **37** actually consists of two rollers **37***a* and **37***b* (Figure 1) which are adjustable so as to engage only the unfolded panel of the blank; that is, feed rollers **37***a* and **37***b* are adjusted so that they are just inside the fold line as defined by the folding bars **39** and **40**.

The blanks are then fed by the feed rolls **37** and **38** between the upper and lower feed rolls **41, 42**. Upper feed roll **41** actually consists of two feed rolls **41***a* and **41***b* occupying the same position respectively, as feed rolls **37***a* and **37***b* as shown in Figure 1 and simultaneously adjustable with said feed rolls. The feed roll **42** on the underside is a single roll extending entirely across the machine and is rotatably mounted between the levers **43** which in turn are rotatably mounted on the pins **44** on opposite sides of the machine carried on lugs of the cross-bracket **45**. The lower end of cross-bracket **45** has secured thereto arm **46** having an opening through which the spring guide rod **47** passes (all of the foregoing may readily be seen in Figure 3). Compression spring **48** around the guide rod **47** bears between washer **49** on the underside of lever **43** and washer **50** on the upper side of arm **46** and thus biases lever arm **43** upwardly to bias the idling roll of **42** upwardly to tightly press the blank against the upper feed roll **41**.

The maximum lift of lever **43** and thus the maximum rise of idling roll of **42** may be controlled by the adjustable nuts **51** on the lower end of the guide rod **47**.

Rolls **35** and **38** are also spring biased in a manner similar to the springing means described for roll **42**.

The blank is then carried under the folding bars **39** and **40** and over the feed rolls **53** (see also Figure 10) which are rotatably mounted on each side on arms **54** rotatably supported on a center coaxial with shaft **55**.

The feed rolls **53** are provided with standard overrunning clutch arrangement as shown in Figure 14. Rolls **53** will feed the blank at the speed of the chain hereinafter described when driven by their drive members also hereinafter described.

The overrunning clutch arrangement, however, permits the feed-out rolls in front of the stacking device to feed out the blank at higher speed into the folding mechanism without initial interference from the slower moving rolls **53**. These rolls **53**, because of the overruning clutch arrangement, will rotate faster at the speed of the blank as it is fed out; but will drive the blank after it is fed out at a slower speed against the stop hereinafter described. The slower speed prevents marring of the front edges of the blank.

Each of the arms **54** has an extension **56** on the opposite side of the opposite side of the shaft **55** connected to tension spring **57**, which in turn is connected to a stationary lug **58** (Figures 3 and 10). The spring **57** biases the feed rolls **53** upwardly to engage and drive the blank. The feed rolls **53** engage the blank on each side by pressing it up against the folding bars **39** and **40** and thus carry the blank forward until its front edge engages the stops **58** mounted on stop bars **73**. The forward progress of the blank is thus arrested while the feed rolls **53** continue to rotate and press the blank against the stops **58**.

While the blank is in this position with its forward edge against the two stops **58**, the creases or scores on which the fold is to take place are in register with the outer sides of the folding bars **39** and **40**. This is, of course, obtained by an appropriate adjustment of the machine as hereinafter described, prior to the beginning of a run and by appropriate stacking of the blanks.

The folding bars **39** and **40** may be vertically adjusted to accommodate for different thicknesses of blanks. They are secured at the front flanges **40***a* of brackets **332** (Figures 1, 3, and 13) by slots **40***b* in the vertical flanges **40***c* of bars **39** and **40** which are engaged by clamping nuts **40***d*. These nuts may be loosened to permit the bars **39** and **40** to be raised or lowered and may then be tightened again.

While the blank is in the stop position against stop **58**, the folding plates **60** (Figure 1) which are each held on their respective cross arms **61** are driven around to fold the blank. Each of the cross arms **61** which supports its folding plate **60** is driven by link **62** which connects it to the crank **63**, which in turn is driven from the folding blank operating box **64**. The drive for folding plate **60** is thus substantially the same as described in my prior Patent 2,336,507.

The folding plate **60** is driven around by the mechanism thus described to fold the side panels of the blank around the folding bars **39** and **40** and to fold them down flat upon the remainder of the blank. The folding operation is facilitated first by reason of the fact that the folding plates **60** and **61** are downwardly bent at **67** in order that the side panels of the blank may readily ride up thereon. Also, the folding operation is further facilitated by means of the deflecting plate **70** on each side (seen specifically in Figures 9 to 11) each of which terminate in an angularly positioned roller **71** so that the side panels are folded up of the order of 25° between plate **70** and roller **71** on each side even before the blank reaches the folding position. The side panels are thus given an initial angularity with

respect to the moving blank so that the folding plates need not rotate the side panels through a full 180° but must as shown by an examination of Figure 11 rotate through approximately only 150°.

The stop bars 73 are as shown in Figure 10 supported by the bracket arm 75 which in turn is pivotally supported on the fixed shaft 76 on each side.

The stop bar 73 on each side has a downward extension 78, the lower end of which is connected by eye bolt 79 to the tension spring 80, which in turn is connected to the lug 81 secured to the U-shaped members 22a which are fixed to the width of the folding boxes and adjusted with them. Accordingly, the stop bar 73 on each side is maintained in raised position. The U members 22a serve to support the blank while in the folding section and then also serve to strip the folded blank from the stop when it retracts.

The two downward extensions 78 on each side of the machine each carry a roller 84 which is engaged by the lever bar 85a on the levers 85 on shaft 86. After the folding operation has been completed, the shaft 86 is rotated counterclockwise to rotate the lever 85 counterclockwise and push down the rollers 84 of extensions 78. This pushes down the stop bars 73 which move down with the bracket 75 which in turn rotates about the shaft 76. This in turn pulls down the stops 58 on each side and thus removes the stop members from the leading edge of the blank.

The machine is so arranged and timed that as soon as the stops 58 are depressed by the action of lever 85, slat 90 mounted across the chains 91 moves up into engagement with the rear of the folded blank and moves the blank beneath the hold-down strip 92 which strip is adjustably supported.

Hold-down slat 92 is provided with a rack 92a engaged by pinion 93 on shaft 94 provided with handle 94a. Rotation of handle 94a will adjust the hold-down slat 92 longitudinally by feed screw 93 operated by knurled knob 94 on the cross bar 95. The hold-down strip 92 is adjusted so that it extends just in front of the stops 58. The front end is curved upwardly so that panels which tend to spring up after being folded will be guided down again and their edges brought to abutting position. As soon as the slat 90 on chains 91 engages and moves it forward further through the machine, the guide presses down on the same between the panels and prevents the folded blank from opening up.

The blank is then carried forward between the limiting rolls 100, 101 which as shown in Figure 3 loosely control the position of the delivery end of folding bars 39 and 40. Since the folding bars 39 and 40 are supported from the front guide elements of the stacking device and since the free or delivery ends of the folding bar are substantially distant from their supports, they may be moved through a small angle.

The rollers 100, 101 above and below, respectively, each of the folding bars 39 and 40 limit the upward and downward movement of the free ends of the folding bars 39 and 40 so that they will not be flexed to too great an extent. These rollers also serve, in addition to controlling the position of the free ends of the folding bars 39 and 40, to control the blank and hold it in a somewhat central position so that the edges of the blank will be properly engaged by the straightening rolls 110.

The straightening rolls 110 are each mounted

on stub shafts 111 which in turn are supported on the adjustable plates 112, 112. Straightening rolls 110 on each side are aligned with each other and are provided with grooves as shown in Figure 3 adapted to receive the folded edge of the blank. The plates 112, 112 are adjusted so that the peripheries of the aligned rollers 110 on each side are spaced apart by a distance which is slightly less than the width of the folded blank. The slat 90 forces the blank between the rolls 110 with the edges of the blank riding in the annular grooves on each side. Since the rolls are thus spaced slightly closer together than the width of the blank, the crease or fold is adjusted and spread vertically.

The movement of the slat which maintains the body of the blank normal to its direction of travel holds the blank at the correct angles with respect to the rolls 110 so that in a properly folded blank the crease is adjusted regularly on each side. Where the score line was initially incorrect or where the panel was folded improperly, the score lines are adjusted and straightened so that recreasing rolls 120 may then recrease or press the fold properly. The rolls 110 adjust and spread the crease to a greater width at that portion of the blank which has been widened by the skewed folding. As the blank leaves the crease adjusting rolls 110, it passes between the pressure rolls 120, 120 which recreases the blanks as the blanks are delivered. Since the blank is maintained with its side edges exactly parallel to its path of movement by the slat 90, the recreasing operation performed by recreasing rolls 120 forms the crease in exactly the right position.

I have found that panels which have been skewed so that the trailing or leading edge of the panel projects over the edge of the main body of the box by more than a quarter of an inch have been straightened and properly recreased by this operation. Blanks which had been improperly scored, so that when folded up the panel would be skewed, have been corrected and straightened during the passage through the folding machine.

My machine, therefore, reduces the waste of blanks and makes it possible to utilize blanks even though they have been improperly or carelessly creased or scored.

This type of recreasing operation has also been described in my prior Patent 2,336,507 wherein several spaced crease adjusting rolls are shown on each side. While spaced crease adjusting rolls have been able properly to recrease and correct skewed blanks, I have found that by placing the crease adjusting rolls 110 in closely spaced relation as shown in Figures 1 and 3, a greater degree of skew may be corrected.

Each of the said slats 90 mounted across the chains 91 has a recess 130 so that it may readily slide or move on either side of the hold-down slat 92.

The folded blanks are preferably delivered to a taping machine and the bar 126a serves to hold down the panels of the folded blank right up to the point of tape application. Side guides 140a are provided to guide the blanks into the straightening section without marring the front corners of the box.

The apparatus comprises, as previously pointed out, a number of improved elements, each of which cooperate with each other and with the entire machine in order to provide for increased speed and facility of operation.

Referring to Figure 5, a variable speed D. C. motor 150 with the sprocket 151 drives the

sprocket 152 which is mounted on shaft 153 which carries sprocket 154 of Figure 1. Sprocket 154 provides power to pull the chains 91. Chains 91 are in turn held by idler sprockets 155 on shaft 156 (Figures 1 and 3). Idler sprocket 157 (Figure 3) is adjustably mounted to tighten the chains. Shaft 153 also holds sprocket 160 which in turn drives sprockets 161, 162, and 163 thus driving the lower delivery shaft 141 and the upper delivery shaft 140 and the taper cam shaft 166.

Referring to Figure 1, the end of shaft 153 holds a bevel gear 170 which drives bevel gear 171 on shaft 172. Bevel gear 173 on shaft 172 (also in Figure 12) drives bevel gear 174 on stud 175 and so drives drop-off cam 176 which is mounted on bevel gear 174. Roller 177 on arm 178 engages the periphery of cam 176; thus an oscillatory motion is imparted to lever 178 and to shaft 86 on which it is mounted; the shaft 86 as mentioned before serves to retract the stop 58. Set screw 180 held in housing 181 engages an arm of lever 178 and serves to limit the angular motion of the lever 178 and also of the shaft 86.

Referring back to Figure 1, the shaft 172 is connected to shaft 200 by means of the coupling 201. Bevel gear 202 on shaft 200 drives bevel gear 203 on shaft 204 which provides power to both of the folding boxes 64. Bevel gear 205 on shaft 200 drives bevel gear 206 on shaft 207 and thus turns the spur gear 208 which also is keyed to shaft 207.

Referring to Figure 2, gear 208 meshes with gear 209, 210, and 211 and thus drives gears 220, 221 and 222. Gear 222 drives gear 223. It can be seen that by means of this gearing the feed rolls 35, 36, 37, 38 and 41 are all driven. Also that gears 35 and 38 are pivotally held on the centers of gears 222 and 209, respectively, so that these feed rolls when spring biased will adjust themselves to any thickness of blank.

Referring back to Figure 1, gear 230 on shaft 200 drives gear 231 which holds bevel gear 232. Bevel gear 232 drives bevel gear 233 on the kicker drive shaft 234.

Referring to Figure 4, the crank 235 which is keyed to 234 drives link 236 which in turn drives crank 237 and link 238. Link 238 is a pin-connected link which transfers the variable rotary motion of pin 239 on link 237 to a variable reciprocating motion of pin 240 on kicker carriage 241. Carriage 241 carries the kicker bar 242 in such a manner that the bar is adjustable relatively to the carriage by means of the T-shaped member 243 and the screw 244. The spring kickers 27 are mounted on the kicker bar 242 in order to obtain adjustment for uneven blanks.

The bar 31 cooperating with the elevated kicker makes it possible to take warped sheets without interfering with kicking or ejecting operation. Bar 31 is undercut at 31*a* to permit the spring kickers 27 to enter beneath and thus make possible the feeding out of short sheets.

All members which engage the edges of the blank are provided with nuts which in turn are driven by screws all of which are driven from a common source on each side of the machine in order to adjust the machine for different widths of blanks.

The motor 300 in Figure 2 drives the shaft 301 through a worm gear reduction 302. Shaft 301 holds a sprocket 303 (Figure 1) which engages a chain 304 which passes over sprockets 305, 306, and 307. Sprockets 305, 306 and 307 drive screws 308, 309 of Figure 10 and 310 of Figure 1, respectively, and these in turn serve to adjust the straightening roll bracket 112, the stop and deflector assembly of Figure 10, and the folding box 64 of Figure 1, respectively. At the other end of shaft 301 is a sprocket 320 which by means of chain 321 drives sprockets 322 and 323. Sprocket 324 is an idler for the purpose of tightening chain 321.

Referring to Figure 6, sprocket 322 is keyed to screw 343 which engages nut 343*a* of Figure 1 mounted on frame 325. Frame 325 holds the side gauge 326 shown also in Figures 2 and 6. Sprocket 323 is keyed to screw 330 which engages nut 331 on frame 332 shown on Figures 1 and 3. Frame 332 serves to hold front gauge 25 and also the folding guide bar 39. Since the sprocket 322 contains half as many teeth as the sprocket 323 and since their respective screws 343 and 330 have the same lead, the frame 325 which holds the side gauge 326 will be moved twice as far as the frame 332 for a given movement of the chain 321 and of the sprocket 320. The frames 325 and 332 are supported on bars 351 and 352 in Figure 3. These bars are held at both ends by the brackets 353 and 354 (Figure 6) which are mounted on housings 355 and 356, respectively.

Referring to Figure 10 in a similar manner, the cariage 312 is mounted on the two bars 76 and 360 which are in turn supported in the side frames of the machine.

In the foregoing I have described my invention solely in connection with an illustrative embodiment thereof. Since many modifications and variations of my invention will now be apparent to those skilled in the art, I prefer to be bound not by the specific descriptions herein but only by the appended claims.

I claim:

1. In a folding machine for forming flat collapsed tubular box blanks from flat and scored sheets, said sheets having a pair of longitudinally extending side sections defined by score lines and foldable about said score lines into said collapsed tubular arrangement; stop members mounted on said machine; means for moving said blanks successively against said stop members, means for folding over the side sections, said folding operation releasing said blanks from said stop, said folding means comprising a pair of oppositely disposed folding plates, means for rotating said plates about an axis parallel to the score lines defining said longitudinally extending side sections, said plates being rotatable and engaging the side sections during rotation, and rotating said side sections into face to face relation with the body of the blank; a pair of folding bars extending in the direction of movement of the blank, the outer edges of the folding bars coinciding substantially with the score lines between the main body of the blank and the extending side sections; a pair of longitudinal bars; said stop members being mounted on said longitudinal bars, said longitudinal bars underlying the folding bars, said blank passing between said longitudinal bars and the folding bars; and a feed roll beneath the folding bars and biased upwardly toward the folding bars, drive means for said feed roll; an overrunning clutch connection between said drive means and said feed roll; said overrunning clutch connection permitting a blank to be moved in under said folding bars between said folding bars and said feed roll at greater speed than the driving speed of said feed roll.

2. In a folding machine for forming flat collapsed tubular box blanks from flat and scored sheets, said sheets having a pair of longitudinally extending side sections defined by score lines

and foldable about said score lines into said collapsed tubular arrangement; stop members mounted on said machine, means for moving said blanks successively against said stop members; means for folding over the side sections; means for releasing said stop members from said blanks on completion of the folding operation, means for moving said folded blanks over and beyond said stop members after the release of said stop members from said blanks, and means for holding down the adjoining edges of the side sections after folding, said means comprising a longitudinal slat; said slat being movable longitudinally and means operable from the side of the machine for moving said slat.

3. In a folding machine for forming flat collapsed tubular box blanks from flat and scored sheets, said sheets having a pair of longitudinally extending side sections defined by score lines and foldable about said score lines into said collapsed tubular arrangement; stop members mounted on said machine, means for moving said blanks successively against said stop members; means for folding over the side sections; means for releasing said stop members from said blanks on completion of the folding operation,

means for moving said folded blanks over and beyond said stop members after the release of said stop members from said blanks, and means for holding down the adjoining edges of the side sections after folding, said means comprising a longitudinal slat; said slat being movable longitudinally and means operable from the side of the machine for moving said slat, said last mentioned means comprising a rack connected to said slat; a rotatable shaft; a crank on one end of said shaft; and a gear on the other end meshing with said rack.

ALBERT F. SHIELDS.

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