July 1, 1969 J. C. BERNEY 3,452,653

APPARATUS FOR FOLDING CARTON FLAPS

Filed May 11, 1967 Sheet 1 of 4

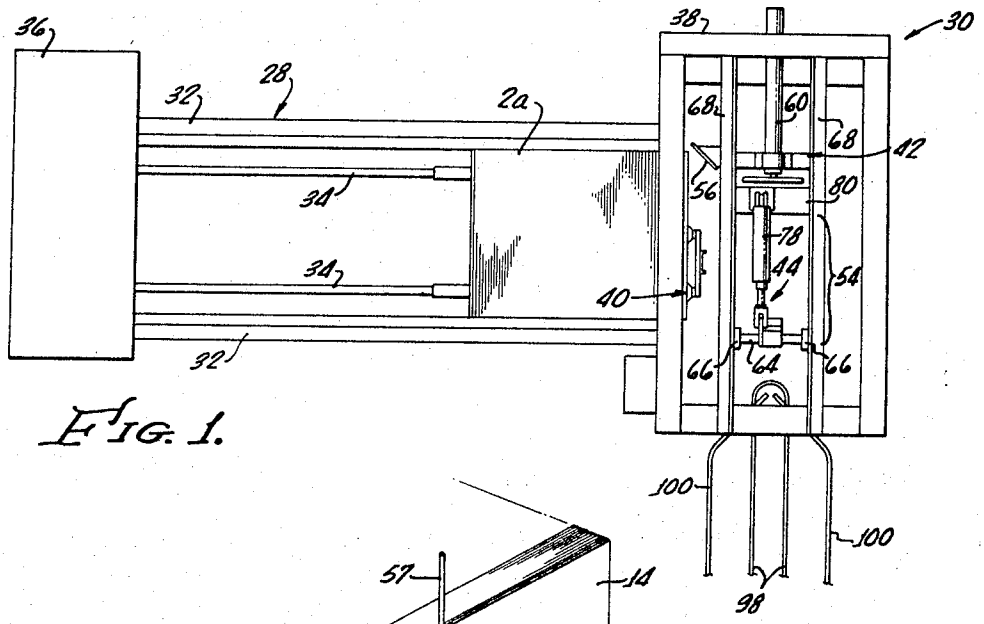


FIG. 1.

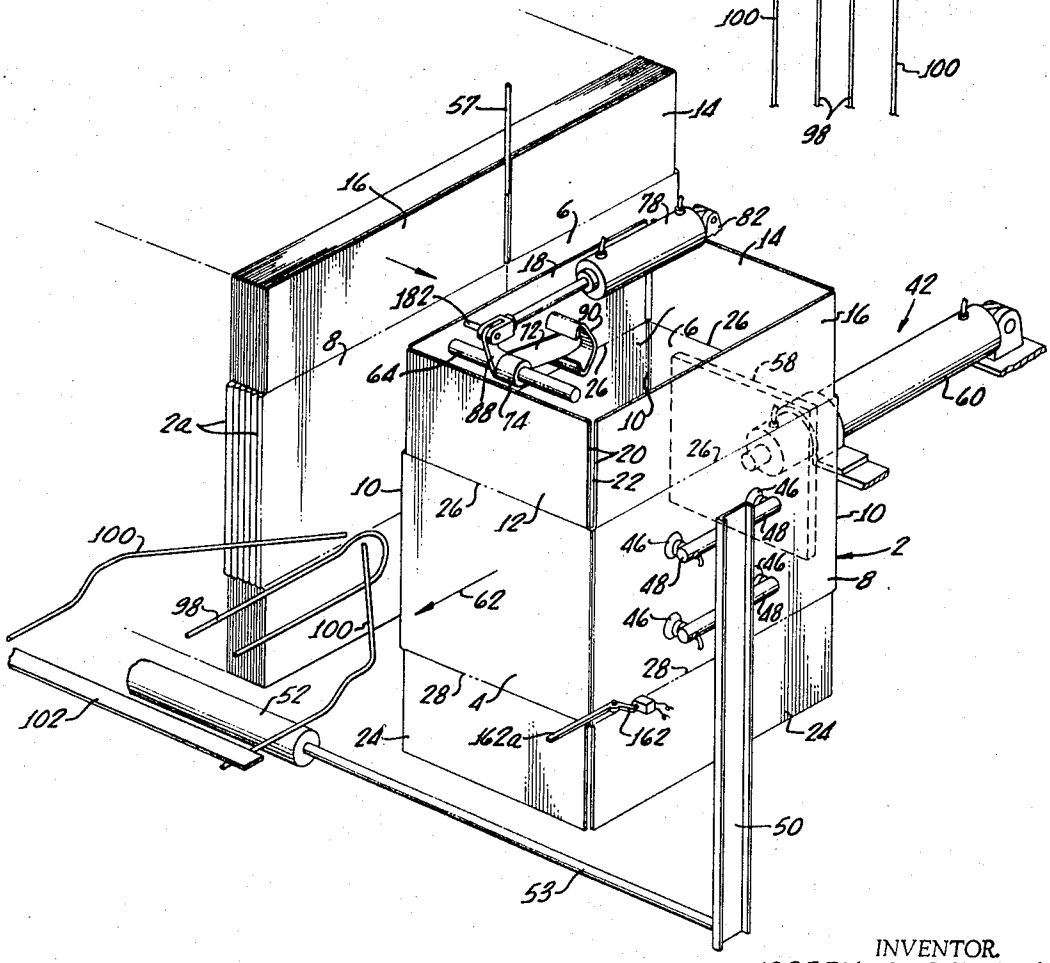


FIG. 2.

INVENTOR.
JOSEPH C. BERNEY

BY
FOWLER, KNOBBE
& MARTENS
ATTORNEYS.

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Filed May 11, 1967 Sheet 2 of 4

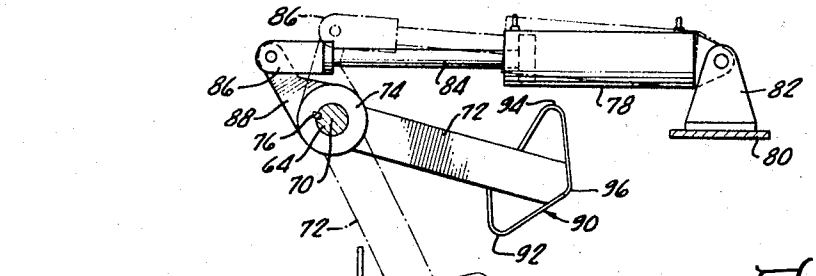


FIG. 3.

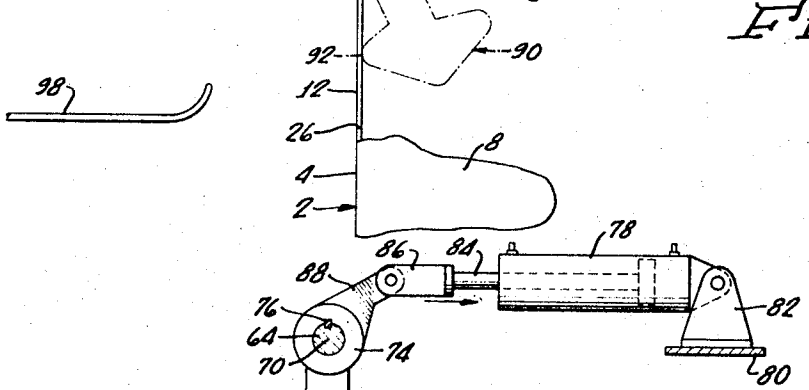


FIG. 4.

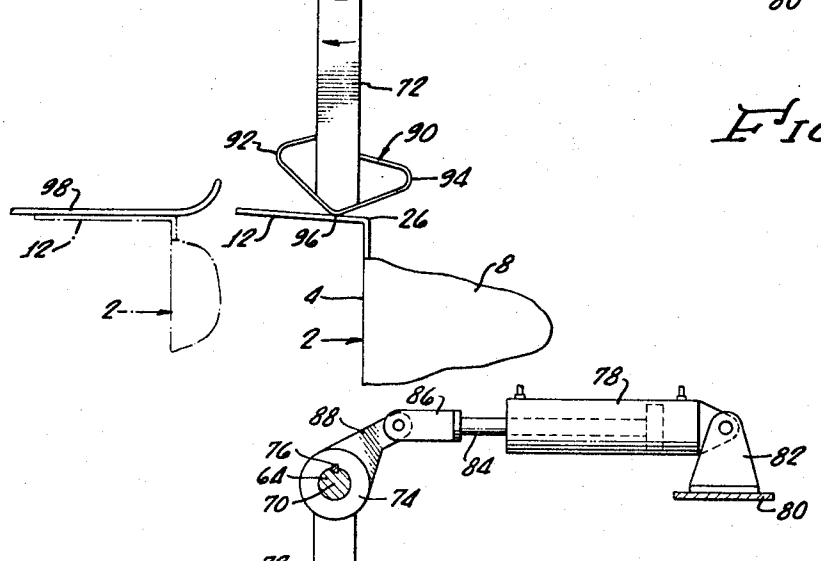


FIG. 5.

INVENTOR.
JOSEPH C. BERNEY

BY
FOWLER, KNOBBE
& MARTENS
ATTORNEYS.

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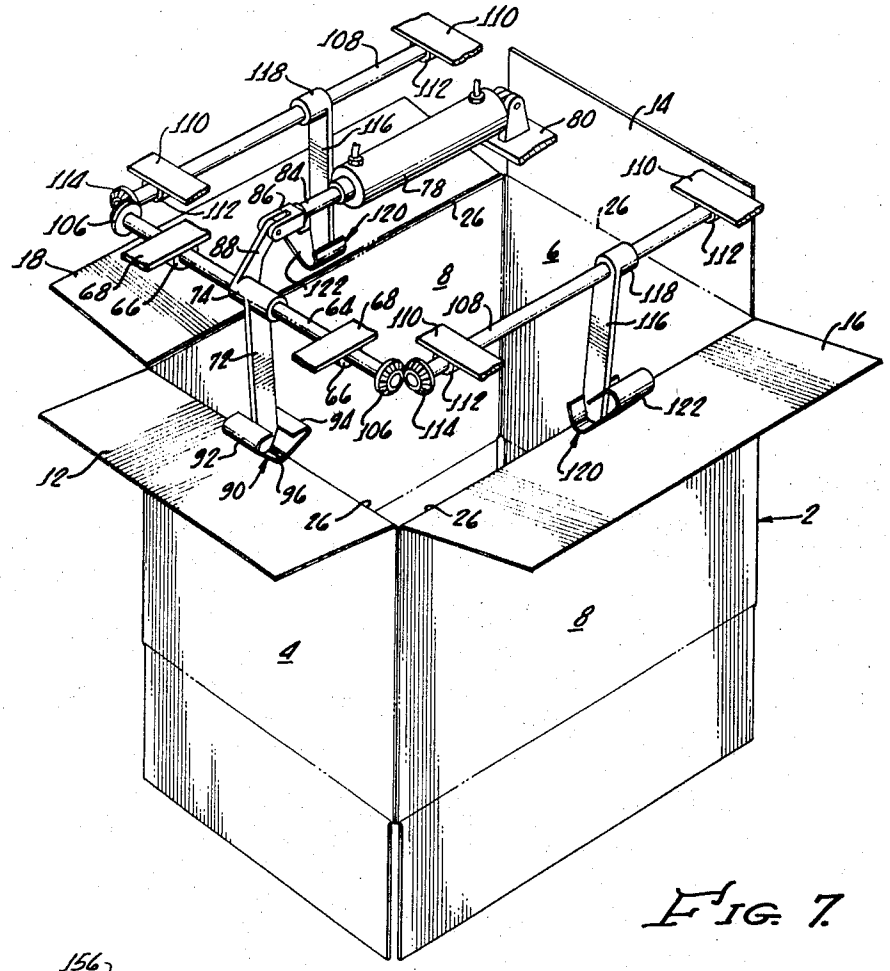


FIG. 7.

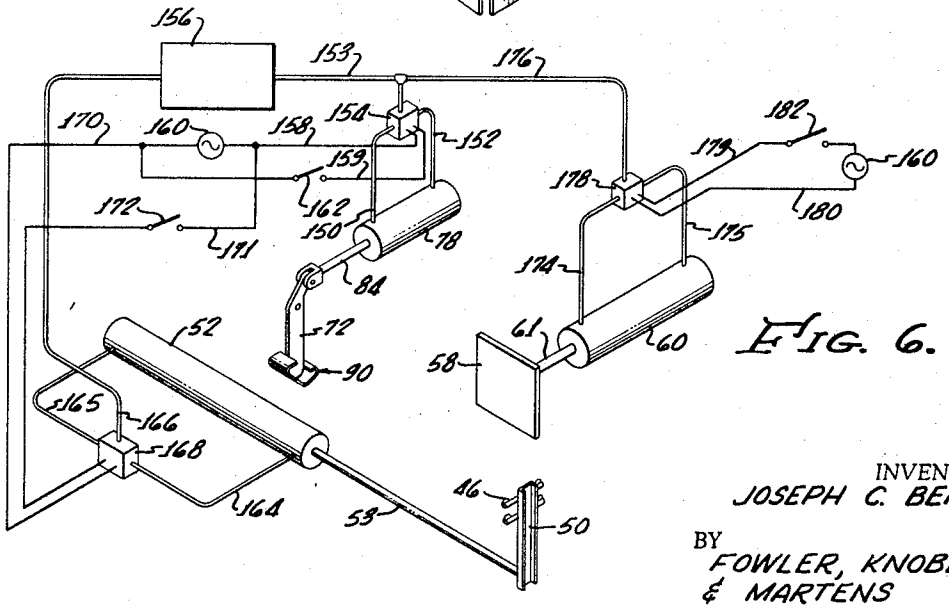


FIG. 6.

INVENTOR.
JOSEPH C. BERNEY

BY
FOWLER, KNOBBE
& MARTENS
ATTORNEYS.

July 1, 1969 J. C. BERNEY 3,452,653

APPARATUS FOR FOLDING CARTON FLAPS

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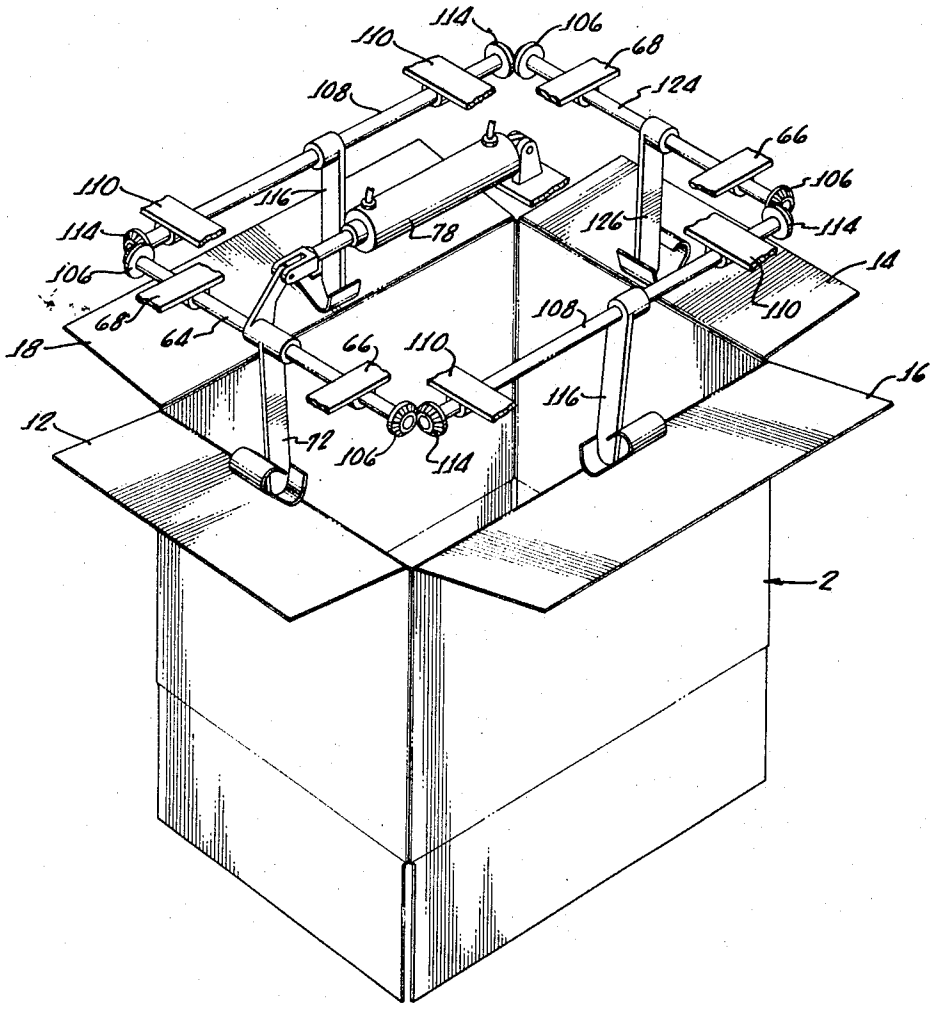


FIG. 8.

INVENTOR.
JOSEPH C. BERNEY

BY
FOWLER, KNOBBE
& MARTENS
ATTORNEYS.

United States Patent Office

3,452,653

Patented July 1, 1969

3,452,653

APPARATUS FOR FOLDING CARTON FLAPS

Joseph C. Berney, 2437 Bamboo St.,
Newport Beach, Calif. 95360

Filed May 11, 1967, Ser. No. 637,661
Int. Cl. B31b *1/28;* B31d *5/04*
U.S. Cl. 93—84 6 Claims

ABSTRACT OF THE DISCLOSURE

Apparatus for folding the top flaps of an open corrugated case includes one or more arms each of which pivots aboue an axis disposed above the flap it is to fold and parallel to the crease line of that flap. Each arm first strikes the flap a substantial distance above the crease line and then completes the crease by engaging the flap near the crease line. A single arm can be used for folding the leading flap of a carton as the arm is pivoted and then folding the trailing flap of the carton as the carton moves past the stationary arm.

Field of the invention

This invention relates to machines for erecting flattened foldable cartons such as corrugated cases and, more particularly, relates to apparatus for folding the flaps of such cartons after they have been formed to a rectangular configuration.

Applicant's co-pending application Ser. No. 482,801 filed Aug. 26, 1965, discloses a case forming machine in which flat or "knocked-down" corrugated cases are taken from a stack and pulled past a break plate which erects each one into a carton or case of generally rectangular configuration having an upright top and bottom flap extending from each of its end walls and side walls.

In the machine as disclosed in that application, the bottom flaps of the case are then closed in a series of operations but the top flaps are left in an upright position as the carton is conveyed away. It is often desirable, however, that the flaps be folded outwardly, e.g. so as not to interfere with entrance of a pressure plate for sealing the bottom flaps or entrance of the materials which will fill the carton.

Many devices can be found in the prior art for folding the flaps of a carton. For example, a plow formed by curved rods which cam the flaps open as the box moves past the rods often is used. However, such plows generally are designed to open side flaps and are not satisfactory for opening the leading end flap. Moreover, if the side flaps are not at the proper angle when they come into contact with the plow, a jam can result. Because of these problems, various devices have been developed to fold one or more of the flaps or to position the flaps properly for the plow.

Summary of the invention

This invention is an improved flap folder which is fast and dependable in operation while still being simple and economical to manufacture. A flap opener in accordance with this invention, includes an arm mounted for pivotal movement about an axis parallel to the crease line on which the flap is to be folded and means for pivoting the arm to fold the flap. One feature of the invention is that the arms first strikes the flap a substantial distance away from the crease line and then, as the arm continues to pivot, it engages the flap relatively near the crease line. Since the location of the initial blow is spaced from the crease line there is little danger of the arm bowing the side of the carton outwardly, rather than folding the flap along the crease line. This greatly increases the dependability of the machine, and substantially reduces the likelihood of jamming because of an improperly folded carton. The subsequent engagement nearer the crease line in advantageous in that it provides a relatively effective crease.

Another feature of this invention is that the arm is adapted to be pivoted to fold one carton flap and then retained in its pivoted position as that flap is moved away from the arm and a second flap is moved past the stationary arm to strike and fold the second flap. Thus, one ram can be used to fold two flaps, e.g., both end flaps of a single carton, each time it pivots.

In one embodiment of this invention, three arms are operatively connected for simultaneously folding the side flaps and the leading flap outwardly. As the case is conveyed from the folding station the lowered end flap arm strikes the trailing flap to fold it outwardly so that all four flaps are positioned for contacting guide rods which need only hold the flaps in their folded positions.

In another embodiment of the invention four arms are used to simultaneously fold all four flaps outwardly thereby balancing the forces on the carton as the arms strike the flaps.

These and other features, objects and advantages of this invention will be apparent from the following detailed description when read with reference to the accompanying drawings.

Brief description of the drawings

FIG. 1 is a plan view of an exemplary box forming machine including a carton flap folder constructed in accordance with this invention;

FIG. 2 is an enlarged perspective view of portions of the box forming machine of FIG. 1 with an open carton in the forming station, illustrating particularly the relationship between the carton opening mechanism, the carton ejector and the top end flap folder;

FIGS. 3–5 are sectional views in elevation illustrating the top end flap folder at various positions of its operating cycle;

FIG. 6 is a diagram of the electro-pneumatic control system for the flap folder, carton opening mechanism and ejection mechanism;

FIG. 7 is a perspective view illustrating a modified embodiment of the top flap folder; and,

FIG. 8 is a perspective view illustrating another modified embodiment of the top flap folder.

Description of the preferred embodiments

Referring first to FIG. 2, an exemplary carton such as a corrugated case **2** which is formed and folded in accordance with this invention includes front **4** and rear **6** end walls or panels and a pair of side walls or panels **8** all joined along their common vertical edges **10** to form a rectangular configuration when the carton is opened. Four top flaps **12**, **14**, **16** and **18** extend upwardly from the front end panel, the rear end panel, and each side panel of the carton respectively, the four flaps being separated from each other along their vertical edges **20** to define a slot **22** between adjacent flaps. Similar bottom flaps **24** depend from the lower edge of each of the end and side panels. All of the flaps can be folded inwardly or outwardly from their upright position along a crease line or indentation formed at the upper **26** and lower **28** edge of each panel. The cartons normally are flattened with one end and side panel abutting the other end and side panel for convenience in shipping and storage as illustrated by the typical flattened cartons **2***a* in FIG. 2.

As shown in FIGS. 1 and 2, a plurality of the flattened cartons **2***a* are stacked on edge in a supply magazine **28** which feeds them to a box forming or erecting machine

30. The exemplary magazine shown includes a frame 32 and a power operated feed mechanism 34 for continuously urging the stack forward or to the right in FIG. 1. The controls and drive mechanism for the magazine are housed in an enclosure 36 at the rear of the magazine.

The box forming machine 30 at the forward end of the magazine includes a frame 38, a carton opening mechanism 40, a carton ejecting mechanism 42, and a top flap folding mechanism 44. The carton opening mechanism includes four vacuum grippers 46 mounted on a pair of horizontal arms 48 which are supported on a vertical channel 50. A pneumatic or hydraulic cylinder 52 and piston mounted beneath the magazine are operatively connected to the bottom of the channel 50 by a piston rod 53 to reciprocate the grippers 46 back and forth to grip the side panel 8 of a flattened carton in the supply stack and pull the side panel across the forming station 54. As the carton is pulled into the forming station, its rear panel 6 strikes a break plate 56 mounted on the frame, and the break plate forces the carton to open to the rectangular configuration. A finger 57 is aligned with the slot between flaps 14 and 16 of the knocked down carton flap 18 to hold that flap and its associated side panel 8 back as the other side panel is pulled into the forming station. As the carton achieves its rectangular configuration, the finger 57 passes through the slot between the flaps 14 and 18.

An exemplary ejector 42 for removing the opened carton from the forming station 54 includes a pusher plate 58 which is reciprocated by a hydraulic or pneumatic piston and cylinder assembly 60 to contact the rear end panel 6 and to eject the open carton in the direction of the arrow 62 in FIG. 2.

The carton opening mechanism 40, ejection mechanism 42 and magazine 28 are illustrated somewhat schematically in FIGS. 1 and 2, as their specific structures do not form a part of this invention except to the extent that they broadly cooperate with the flap opener 44. Those mechanisms can, for example, be of the type disclosed in applicant's co-pending application Ser. No. 482,801 referred to above, with certain modifications of the ejector mechanism to avoid interference with the top flap folder 44, as will be readily apparent to one skilled in the art. In addition, the bottom flap folding mechanism as disclosed in that co-pending application may be used in the box forming machine with the top folder constructed in accordance with this invention.

Referring now to FIGS. 1–3, the top flap opener includes a horizontal shaft 64 the ends of which are rotatably mounted in journal boxes 66 on two of the longitudinal frame members 68. The axis 70 of the shaft is disposed above and slightly forward of the forward end panel 4 of an open carton in the forming station and parallel to the crease line 26 associated with the leading flap 12. An end flap opening arm 72, mounted on the shaft 64 by a collar 74 on one end of the arm, is keyed to the shaft by a spline 76 so that the arm 72 rotates with the shaft 64. A hydraulic or pneumatic cylinder 78 is pivotally mounted on a cross frame member 80 by upright brackets 82 and a piston rod 84 extending out of the cylinder has a forked end 86 which is pivotally connected to a crank 88 on the shaft 64. As the piston rod 84 retracts, the arm 72 is pivoted from the raised position shown in solid lines in FIG. 3 to the lowered position shown in FIG. 4.

A striker plate 90 fixed on the distal end of the arm 72, includes forward and rear portions each of generally triangular cross-sectional configuration protruding from the arm. The forward and rear portions each have an apex 92 and 94 respectively which is a substantial distance above the lower end of the arm when the arm is in its lowered position. The length of the arm 72 relative to the carton size is adjusted so that when the arm 72 is in the lowered position the lowermost point on the arm 96, i.e. the central part of the striker plate 90, is at about the same height as, or slightly above, the crease line 26 of the front top flap.

As is shown in FIG. 3, as the piston rod 84 is retracted to pivot the shaft 64 and arm 72 from its raised position over the carton, the forward apex 92 of the striker plate 90 initially strikes the front flap 12 a substantial distance above the crease line 26 to initiate folding of the flap 12 outwardly along the crease line 26. As the arm 72 continues to pivot toward the lowered position, the flap 12 is progressively folded until, as the arm 72 nears its lowered position, the flap is no longer engaged by the forward apex 92 but is instead engaged nearer the crease line 26 by the lower portion 96 of the striker plate on the arm. As this lower portion 96 of the striker plate is only slightly above the crease line 26 when the arm is completely lowered to its vertical position as shown in FIG. 4, it folds the front flap 12 to a substantially horizontal position. Thus, the forward apex 92 initiates the fold by line contact only at a sufficient distance above the crease line 26 to assure that the flap 12 folds rather than bows forward under the impact of the arm 72, and then as the arm continues downward, the lower portion of the arm completes the fold to the horizontal position. The actual distance above the crease line at which the forward apex should strike the flap of course varies with different carton structures, but about 1½" to 2" has been found satisfactory for a wide range of cartons.

After the front flap 12 has been folded downward, the carton is ejected or conveyed to the left as shown in FIGS. 2 and 4 and the horizontal front end flap is held in the horizontal position by a guide 98 mounted forward of the forming station on a cross frame member 102. Upwardly and inwardly curved rods 100 also mounted on the cross frame member 102 plow the side flaps 16 and 18 outward as the carton continues forward, and lower guide rails or tracks (not shown) support the carton from below, e.g. in the manner shown in the above-referred to co-pending application.

Referring now to FIG. 5, the arm 72 remains in its lower position as the carton is ejected. As the rear end flap 14 of the carton approaches the arm 72, it strikes the rear apex 94 of the striker plate. The rear apex 94 hits the rear flap 14 a substantial distance above the crease line 26 to avoid bowing, and as the carton continues forward, the flap is folded outward to the horizontal position first by the apex 94 of the striker plate and then by the lower portion 96 of the striker plate which engages the flap near the crease line and completes the fold to the horizontal position. The rear flap 14 is then held in the horizontal position by the guide 98 as the case is moved on.

A simple exemplary control diagram is shown schematically in FIG. 6. Referring now to that figure as well as to FIG. 2, the cylinder 78 of the top flap folding mechanism 44 is schematically illustrated with fluid pressure lines 150 and 152 connecting opposite ends of the cylinder to a solenoid operated valve 154 joined by line 153 to a source of fluid pressure 156. The solenoid valve 154 is electrically energized through a normally open switch 162 and leads 158 and 159 connected to a source of electrical power 160. When the switch is open, the valve is deenergized permitting fluid pressure to be applied through the line 152 to the right end of the cylinder 78 causing the piston rod 84 to be extended. Conversely, when the switch is closed, the valve is energized which permits fluid pressure to be applied through line 150 to the left end of the cylinder 78, causing the piston rod 84 to be retracted.

Similarly, the piston rod 53 in the cylinder 52 of the carton opening mechanism 40 is positioned by fluid pressure from the pressure source 156 through pressure lines 164, 165 and 166 as controlled by a solenoid operated valve 168, which in turn is connected to the electrical power source 160 by leads 170 and 171 and a normally open switch 172. When the switch 172 is open, the valve 168 is deenergized and fluid pressure is applied through the lines 166 and 165 to the left end of the cylinder 52, causing

the piston rod **53** to be extended. In the reverse situation, the switch **172** is closed and the valve **168** is positioned to permit fluid pressure to be applied through line **164** to the right end of cylinder **52** causing the piston rod **53** to be retracted.

The ejector piston rod **61** in the cylinder **60** is positioned by fluid pressure from the pressure source **156** through pressure lines **174**, **175** and **176** as controlled by a solenoid operated valve **178**, which in turn is energized by the power source **160** through leads **179** and **180** and a normally open switch **182**. When the switch **182** is open, high pressure applied from the line **176** through the valve **178** and the line **174** to the left end of the cylinder **60** holds the ejector piston rod **61** in its retracted position. When the switch **182** is held closed, the solenoid valve **178** is energized causing fluid to be applied through the line **175** to the right end of the cylinder **60** so that the piston rod **61** is extended.

In operation, the channel **50** carrying the suction cups **46** is moved to and from the magazine **28** to withdraw a carton. This is accomplished by manually operating the switch **172** and energizing the valve **168** causing fluid to be applied to the right end of the cylinder **52** and hence the piston rod **53** is retracted; releasing the switch **172** reverses the piston so that the rod **53** is once more extended. The return movement of channel **50** or the presence of a carton **4** is used to close the normally open switch **162** to operate the solenoid **154** so that fluid pressure is applied to the left end of the cylinder **78** to retract the piston rod **84** and thus cause the flap opening arm **72** to lower the front flap of the carton. As the flap opening arm **72** reaches its lowered position, the crank **88** carrying the arm **72** closes the normally open switch **182** energizing the solenoid valve **178**. This causes fluid pressure to be applied to the right end of the cylinder **60** so that the ejector **61** is extended to eject the carton. When the carton is completely ejected the long arm **162***a* on the switch **162** is released so that the switch opens. The solenoid valve **154** is thus deenergized, permitting the piston rod **84** to be extended. This action releases the switch **182** to deenergize the solenoid **178** permitting the ejector piston rod **61** to be retracted. The cycle may then be repeated.

It should be understood that the electrical-pneumatic control system can be entirely integrated to function completely automatically, in accordance with known principles. As partially explained, the movement of the various piston rods is utilized to control the opening and closing of limit switches controlling the solenoid valves. These switches, in turn, may be properly connected to suitable relays and other switching devices (not shown) to obtain entirely automatically the necessary sequence of operation. All details of such a system are not disclosed herein in that they are not necessary to obtain an understanding of this invention.

In a modified embodiment of the flap opener shown in FIG. 7, the ends of the shaft **64** extend beyond the elongate supporting frame members **68** and each end has a bevel gear **106** fixed on it. A pair of side shafts **108** extend rearwardly from the ends of the front shaft **64** and are disposed above and slightly outboard of the crease line **26** of the side panels **8**. Each of these shafts is rotatably mounted on the cross frame members **110** in bearings **112** and includes a bevel gear **114** on its forward end which cooperates with one of the bevel gears **106** on the front shaft so that both side shafts **108** rotate with the front shaft **64**. An arm **116** is keyed to each of the side shafts by a collar **118** and spline (not shown) in the same manner as the end flap arm **72** is keyed to the front shift **64**. Each of the side flap arms **116** includes a striker plate **120** quite similar to the striker plate **90** on the end flap arm, except that each side striker plate **120** has a protrusion **122** only on the outboard side of the arm.

As the pneumatic or hydraulic cylinder **78** of this embodiment is actuated to retract the piston rod **88**, all three flap folding arms **72** and **116** rotate to the lowered position so that the striker plate of each of the three arms hits one of the flaps **12**, **16** and **18** a substantial distance above the crease line **26** to initiate the fold and then completes the fold with the lower portion of the striker plate which is at about the level of the crease line and engages the flap nearer the crease. As the lowered side arms **116** are outboard of the rear flap **14**, the carton **2** can then be ejected forward with all three of the arms **72** and **116** in the lowered position without interference with the rear flap. As the rear flap **14** moves past the lowered end folding arm **72**, the rear protrusion of the arm folds the rear flap outwardly as shown in FIG. 5. Suitable guides downstream from the forming station retain all four flaps in their horizontal position as the carton is conveyed on.

In the modified embodiment illustrated in FIG. 8, a fourth shaft **124** is pivotally mounted on the frame members **68** and is operably connected to shaft **108** by bevel gears. Shaft **124** together with shafts **108** and shaft **64** form a rectangular configuration over the carton. When cylinder **78** is actuated, an arm **126** fixed on the shaft **124** rotates simulanteously with the arms **72** and **116** so that all four top flaps of the carton are struck above the crease line and folded simultaneously to an outward position with each flap being creased by the lower portion of an arm.

While the invention has been described with reference to particular preferred embodiments, those embodiments should be considered as exemplary only, and the scope of the invention should be measured in accordance with the following claims.

I claim:

1. Apparatus for folding carton top flaps such as corrugated cases along a crease line from a generally upright position to a generally horizontal position, comprising:

an arm mounted for pivotal movement about a horizontal axis betweeen a first raised position and a second lowered position, said axis being above a box forming station;

means for positioning a carton with an upright flap adjacent the arm and the crease line along which the flap is joined to a wall of the carton parallel to said axis;

means responsive to a carton being positioned at the forming station for pivoting the arm from the first position to the second position to fold the front flap of the carton outwardly;

means on the arm for initially striking the upright flap a substantial distance from the crease line to initiate the fold as the arm pivots from the first position toward the second position;

means on the arm for engaging the flap relatively close to the crease line as the arm completes its movement to the second position;

means responsive to pivoting of the arm to the second position for moving a carton forward from the box forming station past the arm with the arm in the second position;

means on the arm for initially striking a second upright carton flap a substantial distance from its crease line to initiate the fold as the carton moves past the lowered arm;

means on the arm for engaging said second flap relatively close to the crease line as the carton continues to move past the stationary arm;

means responsive to movement of the rear flap of the carton past the arm which returns the arm to the first position;

second and third arms mounted above the carton for pivotal movement between a raised position and a lowered position about second and third horizontal axes respectively, each of the second and third axes being disposed perpendicular to the first axis;

means on each of the second and third arms for initially striking a respective one of the upright side flaps of

the carton a substantial distance above the crease line as the arms pivot from the raised position to the lowered position to initiate the fold and for engaging the side flap relatively close to the crease line as the arm completes its movement to the lowered position; and,

means coordinating the movement of said three arms to pivot downwardly simultaneously.

2. Apparatus for folding the flaps of a rectangular corrugated case having four flaps each joined to a respective wall of the case along a crease line comprising:

means for positioning the case at a folding station with said four flaps each disposed generally in the plane of the case wall to which it is joined and all extending from the case in the same direction;

four arms each disposed adjacent a different one of the four flaps and mounted for pivotal movement about an axis parallel to the crease line of that flap;

means for pivoting the four arms with the case at the folding station at least opposite ones of the arms being pivoted simultaneously;

means on each of the four arms for striking the adjacent flap as the arm is pivoted so that all four flaps are folded.

3. Apparatus for folding a flap of a carton in accordance with claim 2 wherein the four arms are all pivoted simultaneously and strike the inner side of the flaps to fold the flaps outwardly.

4. Apparatus for folding a flap of a carton in accordance with claim 2 wherein the pivotal axis of each arm is so positioned relative to the folding station that the flap which that arm folds is disposed generally between said axis and the crease line of said flap before the flap is folded.

5. Apparatus for folding carton top flaps such as corrugated cases along a crease line from a generally upright position to a generally horizontal position, comprising:

an arm mounted for pivotal movement about a horizontal axis between a first position and a second position;

means for positioning a carton with an upright flap adjacent the arm and the crease line along which the flap is joined to a wall of the carton parallel to said axis;

means for pivoting the arm from the first position to the second position;

a surface on the forward side of the arm intermediate the ends of the arm for initially striking the upright flap a substantial distance from the crease line to initiate the fold as the arm pivots from the first position toward the second position;

a surface on the distal end of the arm at substantially the same height as the crease line when the arm is in the second position for engaging the first flap relatively near the crease line as the arm completes its movement to the second position,

means for moving a carton past the arm with the arm in the second position;

a protrusion on the rear side of the arm having a rearward apex intermediate the ends of the arm for initially striking the second upright flap a substantial distance from its crease line to initiate the fold as the carton moves past the lowered arm; and,

said surface on the distal end of the arm being at substantially the same height as the crease line of the second flap when the arm is in the second position for engaging the second flap relatively near the crease line as the carton continues to move past the stationary arm.

6. In a box forming machine, means for folding four upright flaps of a rectangular carton to a generally horizontal position comprising:

a box forming station for receiving a carton;

a first horizontal shaft mounted above a carton at the forming station and slightly forward of the front panel of the carton;

second and third horizontal shafts extending perpendicularly from the opposite ends of the first shaft slightly outboard of the side panels of the carton;

gear means on the ends of the shafts operably connecting the shafts for rotation together;

an end flap folding arm fixed on the first shaft and having a striker plate on its distal end including a forward portion having a forward apex a substantial distance above the distal end of the arm and a rearward portion having a rearward apex also a substantial distance above the distal end of the arm;

a side flap folding arm fixed on each of the second and third shafts and having a striker plate on its distal end including an outboard apex a substantial distance above the distal end of the arm;

each of the three arms being of a length so as to extend downward to about the lower edge of the top flaps when the arms are in the vertical position; and,

means for rotating the three shafts to pivot the three arms simultaneously from a raised position over the upright flaps of the carton to a lowered generally vertical position.

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WAYNE A. MORSE, JR., *Primary Examiner.*

U.S. Cl. X.R.

53—382; 93—36.3, 49

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,452,653 July 1, 1969

Joseph C. Berney

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 13, "above" should read -- about --; line 66, "arms" should read -- arm --. Column 2, line 11, "ram" should read -- arm --. Column 5, line 12, after "pressure" insert -- fluid --; line 30, after "lower" insert -- and open --; line 68, "shift" should read -- shaft --. Column 6, line 21, "simulanteously" should read -- simultaneously —; line 37, "betweeen" should read -- between --. Column 8, line 19, after "front" insert -- end --.

Signed and sealed this 14th day of April 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents