CONTAINER FOLDING MACHINE

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This invention relates to improvements in machines for making containers or cartons from blanks by a series of folding operations.

The invention more specifically relates to machines which are provided with blanks of paper, pasteboard, laminated material and the like to be folded finished cartons. The blanks are pre-cut and have a bottom, with side and end walls hingedly attached thereto to be folded at right angles to the bottom to erect the carton. The blank has a continuous web portion at the corner between the ends of the side wall and end wall which must be broken inwardly between the walls. The end walls have an extension flap hingedly attached along the upper edge which functions to secure the carton walls in erected form by being tucked down within the box between the side walls to lie over the infolded web portion holding it flat against the inside of the end wall to support the erected walls.

The invention finds embodiment in a folding machine which forms the above described blank into a container and is especially suited to the type of machine which erects the side and end walls by means of a plunger pushing the carton blank down through stationary folding dies and employs tucking elements which fold and tuck the end wall extension down into the container against the inner side of the end wall.

An object of the invention is to provide a machine which will successively and automatically fold a series of containers by receiving a flat carton blank, performing a series of folding operations to transform it to a complete erected container and eject the completed container to receive and fold a succeeding container.

A further object is to provide a machine which will rapidly fold a carton while insuring accuracy in forming the fold lines and proper timing of the successive folding of the carton elements, and which will correctly infold the carton web portions insuring their proper positioning against the end wall.

Another object is to provide a mechanism which removes the carton from the plunger after the side walls have been erected, accurately positioning the carton relative to the mechanism, which includes and tucks the end wall extensions within the carton, and thereafter securely and immovably holds the carton to expedite accuracy and sureness in the infolding operation.

A further object is to provide a driving mechanism which will operate the tucking mechanisms in proper timed relationship to the other working parts and which will allow convenient and rapid adaptation to the folding of various length containers.

These and other objects will become apparent in the full and complete disclosure of invention in the specification when taken in connection with the accompanying drawings in which:

Fig. 1 is a plan view of the carton folding machine; Fig. 2 is a sectional view of the mechanism taken along line 2—2 of Fig. 1; Fig. 3 is a sectional view of the mechanism taken along line 3—3 of Fig. 2; Fig. 4 is a perspective of the machine having portions removed for clarity showing the plunger forcing the blanks through the folding members to fold the carton; Fig. 5 is a perspective view of the mechanism of Fig. 4 at a later point of progression of the plunger descent; Fig. 6 is a perspective of the mechanism having portions removed for clarity and being at a later point of progression of the plunger descent than Fig. 5; Fig. 7 is a sectional view of the mechanism taken along line 7—7 of Fig. 2 as the plunger has partly descended in the forming wall; Fig. 8 is a sectional view of the mechanism of Fig. 7 after the plunger has descended and has begun ascending; Fig. 9 is a perspective of the mechanism having portions broken away for clarity taken from the inside corner of the carton as the extension flap is about to be folded into the carton; Fig. 10 is a perspective view of the mechanism of Fig. 9 at a later point of progression of the folding of the flap; Fig. 11 is a perspective view of the mechanism of Fig. 10 as the flap completes its folding; Fig. 12 is a perspective of the machine with one end broken away, illustrating the operation of the linkage driving the mechanism which tucks in the extension flap; and Fig. 13 is a perspective of the mechanism having portions removed illustrating the driving linkage for operating the elements of the mechanism in timed relationship.

In the drawings illustrating a machine embodying the preferred form of the invention, Fig. 1 shows a flat carton blank 16 before folding. The center panel of the blank forms the floor or bottom 18 of the carton. Side walls 19 are foldably attached to the sides of the bottom along fold lines 20. The side walls are comprised of outer sheet 21 connected to the carton bottom and an inner sheet 22 which is an extension of the outer sheet being attached thereto along the top edge 23 and folded down to be glued face to face therewith. The formation of this double side wall is completed before the blank is presented to the present machine. End walls 24 are foldably attached to the bottom along the fold lines 26. The end walls have extension tucking flaps 28 foldably attached along the upper edge 36. A continuous extension between the ends of the side and end walls forms a web 32 at the corner of the container blank which must be broken inwardly along the diagonal fold line 34 to fold the carton. The web is attached to the end wall along fold line 36 and to the side wall along fold line 38. The various fold lines may be scored or perforated to aid the folding operation. The end wall extensions have laterally extending triangular shaped ears 42 attached to the tucking flap along line 43. When the carton is folded, the diagonal edge 44 of these ears locks underneath inclined edge 46 of the inner sheet 23 of the side wall thereby securing the tucked end wall extension 28 as best shown in Fig. 11. A narrow flap 45 is attached along the top edge 47 of the extension flap to lie on the bottom of the carton to add rigidity to the carton.

In addition to the elements of the carton illustrated, modifications may exist in the structure, and the features of the invention may be adapted to machines which will fold other and varied types of cartons.

The machine embodying the present invention for folding a carton from the illustrated blank is shown with the plunger 48 poised before pushing the blank down through the stationary folding dies in Figs. 1, 2 and 3. The plunger is a rectangular block having a base 50 the size of the container bottom. Each end has a vertical central raised portion 52 and the sides have vertical channels 54 for purposes which will later appear. A wear plate 55 is carried in each side having
3 its surface flush with the wall and may extend slightly above the plunger wall. The plunger is carried for its travel by a power actuated U-shaped arm 56 sliding on a pair of vertical guide rods 58. The guide rods are mounted on the main frame 59. A pair of horizontal frame members 60 is attached to the main frame and carries the container folding die elements. The container blank is positioned beneath the plunger by being slid along a pair of ways 62, mounted on members 60 having vertical guides 64, until the forward edges of the blanks strike the blank positioning stops 65. Directly beneath the plunger is the recessed forming well 66 which is defined by the arrangement of stationary folding members or dies also carried on frame member 60 and positioned to surround the plunger with a small clearance as it pushes the carton blank diagonally.

At each end of the folding well is an end wall folding die 68 and at each side is a side wall folding die 70, the dies having inwardly and downwardly curved convex surfaces. The dies are mounted to have their upper surfaces in the same horizontal plane so that all walls of the carton side are in the same horizontal plane. The downwardly curved shoulders of the side wall dies lead to vertical walls 71 which form the side walls of the lower part of the forming well. The end walls of the lower well are formed by the tacker plates 72 which are upright in their normal position. Stationary vertical abutment plates 74 are below the tacker plates to complete the lower forming well enclosure.

An important feature of the invention resides in providing the side folding dies with a sharper radius of curvature than the end folding dies. This greater side curvature folds the side walls more rapidly than the end walls in order to assure positioning of the infolded web against the end wall and preventing the possibility of its being positioned against the side wall.

Positioned at each corner of the well between the end and side wall dies and lying in a vertical and substantially diagonal plane is a corner infolding or breaking blade 76 which has a downwardly and inwardly curved edge 78 to break the web corners of the carton inwardly as the plunger pushes the blank between the curved end and side dies. The curvature of the blade is preferably slightly greater than that of the side wall dies to infold the web along the diagonal line 34. As the well will be folded inwardly along its diagonal fold line and thereby be forced inside the box as the walls are folded upwardly. The upper edge of the blade preferably lies at the same level as the folding dies, thus beginning the breaking of the web corner inwardly simultaneously with the folding of the walls. By positioning the folding blades and side and end folding dies at the same level, the moment the carton begins descending, all portions will begin to be folded at the same time, thus eliminating unnecessary travel of the plunger.

As the plunger moves in its descending path into the forming well 66 the dies 68 and 70 begin forcing the walls 19 and 24 up against the ends and side of the plunger and the breaking blade begins forcing in the corner webs 32. This action is best shown in Fig. 4. As the corner web is broken inwardly by the blade, the folding of the side wall along line 22 is more rapid than the folding of the end wall along line 26, thereby directing the infolded corner web section toward the end wall. Thus the web will fold more rapidly along its line of attachment 36 to the end wall, than along line 38 of attachment to the side wall. This is necessary if the folding of all parts is to be concurrent and the web is to be folded to lie against the end wall, because fold line 36 must be folded through 180° while fold line 38 will only be folded through 90° in the same time interval. By the control of the rates of folding of the carton elements along their fold lines, all elements are sure to be positioned in their correct relative position.
the forming well as is best shown in Fig. 7. This removes the support from below the carton 105 which has been previously folded. The carton will remain suspended without the shoe support because of the friction between the carton and the carton side and end walls and the plunger forming well consisting of the vertical end walls 71 and the abutting plates 75. The plunger 48, continuing in its descent, moves the previous end of the finger 80 camming them to the next side of the plunger path. The base of the plunger carrying the new carton will then strike the top edge of the previously completed carton pushing it out below the ejected carton 105, shown ejected in Fig. 8.

As the plunger reaches its lowestmost position, shown in Fig. 8, the finger 80, snaps over the top edge of the carton 23 of the container into the vertical channel 54 of the plunger. The wear plate 55 extends above the plunger wall a distance sufficient to hold the carton release lug 5, depressed when the plunger is at the bottom of its descent. When the plunger ascends, the finger riding in the plunger channels strip the carton from the plunger (shown in Fig. 8) where it remains temporarily supported by the friction of its walls against the sides of the well.

As the plunger moves upwardly, the carton release lug 59 in the wear plate until the plate clears the release lug 94, allowing the supporting shoes 100 to snap upwardly against the carton, thereby clamping it rigidly up against the finger 80. It will be noted that the distance from the base of the supporting shoe 100 to the top of the supporting shoe is equal to the height of the support base of the carton in order to clamp the container side walls 19 of the container in order to clamp the container securely and in exact position for the operation of tucking the end wall extension flap inside the carton.

Referring now to Figs. 9, 10, 11 and 12, the carton is shown held between the supporting shoe and the finger 80, the plunger is withdrawn. The end and side walls of the container are held in their upright folded position between the abutting plates and vertical die walls.

The carton end wall extension flaps 103 extending above the carton top now lie against the machine end tanker plates 72 which are mounted on cross bars 106 eccentrically by pintles 105 lying on either side of the carton end walls as is illustrated in Figs. 2, 9, 10, 11 and 12. The axis of the pintles lies substantially along the top edge 30 of the end wall. The pintles are rotated in pillow blocks 109 (Fig. 12), such as may be coupled to a bar 111 which is carried by the horizontal frame member 60.

The tanker plate is positioned in a vertical plane slightly outward from the pintle axis. The base of the tanker plate is above the supporting shoes 100 a distance equal to the height of the container end wall. To tuck the extension of the end wall inside the supporting shoes, the tanker plate is rotated on the pintles through an arc of 180°. As the tanker plate rotates through the first 90° (Fig. 10) the extension flap is folded inward about fold line 30. The lateral ears 42 strike the upper sloped surface of the fingers as shown in Fig. 10. It is evident that the fingers 80 are positioned a distance equal to the height of the end wall extension flap 28 or height of container in order that the carton ears will strike the finger edges when the extension is being folded. The ears strike the back of the fingers and are brought inwardly with a gradual motion folding along the fold lines of attachment 43. This prevents the tabs from being broken or over creased in high speed operation as might be the case if no cam surface were provided and the extension flap were rapidly swung into the container.

The end tucker continues its pivotal rotation until it has pivoted a full 180° to the position shown in Fig. 11, pressing the end wall extension flap 28 tightly against the inner face of the end wall 24 to allow the locking edge 44 of the ears to snap underneath the inclined lock edge of the side wall. The narrow flap extension 45 bends about its line of attachment 47 to lie against the bottom of the carton. The end tuckers have each an inner face of the end wall and thereby the complete crease. It is evident from tucking the relationship of the carton elements that the fold line 30 must be broken in proper place or the carton will not lock in complete form. In order to accomplish folding at high speed, the carton must be positioned accurately and held securely with respect to the tucking blade. This has been accomplished by the supporting shoes coacting with the finger 80 to reliably position and support successive cartons.

During the time the tucker blade has been operating the plunger has ascended, a new blank has been positioned over the well and the plunger has again begun its descent, pushing the blank down through the die. The tucker blade pivots back to the vertical position to permit the descending plunger to pass and push out the completed carton.

The mechanism is powered through a short drive shaft 114 or by a motor (not shown). The drive shaft 114 carries a crank wheel 116 which drives a pinion 118 connected to the U-shaped arm 56 carrying the plunger. As the drive shaft rotates, reciprocating the plunger, the tucker blade is operated in timed relationship to tuck the carton extension flaps into the carton. At the instant the plunger, in its ascent, allows the supporting shoe to move to support the carton, the end tucker blade begins tucking in the extension flap. The blades will have moved into the carton and returned to vertical position by the time the plunger again descends and strikes the carton release lug, causing the support shoes to release the carton. This timed relationship between the plunger and folding block is obtained through the following driving mechanism.

The drive shaft carries a chain 120 and sprocket 122 driving a second sprocket 124 on a second shaft 126 which also carries a disc cam 128. A follower arm 130 pivoted at 132 carries a follower 133 actuated by the cam and thereby drives a connecting rod 134 which in turn oscillates a shaft 136 through a crank arm 138. A similar secates shaft 136 through a crank arm 140, is secured at the opposite end of the oscillatory shaft 136. Tension springs 142 are connected between the cranks and 140 and the frame and 60 aid in returning the linkage as the follower begins to move to the low portion of the cam. Drive bar 144 is secured longitudinally between the ends of cranks 138 and 140 to drive two push rods 146 which are attached thereto and are laterally adjustable along the bar by moving the spacing clips 148 which are clamped to the drive bar to prevent the push rods from sliding along the bar.

The upper end of each push rod is pivotally connected by a pin 149 to a crank arm 150 pivotally mounted on the pillow block 109. A second shorter crank 152 is attached to the pintles carrying the tucking blades. A short connecting rod 154 joins the ends of these cranks. As the push rod 146 is reciprocated through the action of the cam 128 and connected linkage in the apparent manner, the first crank 150 moves through an arc of approximately 90°. The second tucker crank 152 being much shorter connected to the first moves through an arc of 180° thereby pivoting the tucker blade through 180°. Fig. 12 shows the surface position of the elements when the blade is in the tucked position and Fig. 13 shows the elements with the blade in the vertical position. If the machine is to be adjusted for larger containers by replacing the dies and folding assembly with an assembly having folding blades and dies which are spaced farther apart, the unit may be changed by removing the bolts 156, one of which is shown in Fig. 12, which hold the cross bars 60 in place. By removing the pins 149, the bars 60 carrying the folding members may be removed and a unit of the desired size may be positioned in the
machine. The bolts 156 and pins 149 are then replaced. The drive mechanism can be easily changed to accommodate the replaced folding mechanism by shifting the spacing on the 148 outward and thereby sliding the push rods along the longitudinal bar a sufficient distance to give them the correct relative position for driving the tucker blade.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and have described in detail the preferred embodiment. However, it should be understood that I do not thereby intend to limit the invention to the specific form disclosed, but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

I claim as my invention:

1. In a mechanism for folding cartons from blanks, the combination of a plunger movable to and from the end of a path and having a blank with side walls folded against the sides carried thereby, a stripper member resiliently held in the path to snap over the upper edge of the carton as the plunger passes to said path end, a supporting member movable between a release and a holding position and being resiliently held in holding position, said member having a shoe attached thereto positioned at the end of said path in holding position and supporting a formed carton against the stripper, the distance from the shoe to the stripper being equal to the height of the container wall, and a follower member operatively connected to the supporting member projecting into the path ahead of the stripper to release a previously formed carton as the plunger moves blank to the end of the path.

2. In a mechanism for folding a carton from a blank having a bottom, side and end walls, an extension flap on the top of the end wall for tucking inside the carton and lateral ears on the extension sides for locking the extension flap in tucked position, the combination of means for erecting the side and end walls of the carton, a tucking member, an extension flap about the top edge of the end wall inwardly and downwardly into the carton, a camming member positioned inside the end wall and in the plane of the side wall a distance from the top edge of the end wall equal to the distance from said top edge to said ear, said camming member having a surface sloping inwardly toward the container to gradually fold the ears along the line of attachment to the extension flap.

3. In a mechanism for folding a carton from a blank having a bottom, side and end walls, an extension flap on the top of the end wall for tucking inside the carton and lateral ears on the extension sides for locking the extension flap in tucked position, the combination of a plunger carrying a carton having the side and end walls folded against its sides, a stripper member movable over the upper edge of the carton side wall, said member being positioned a distance from the carton end wall equal to the distance from the ears to the top edge of the carton end wall and having a surface sloping downwardly into the container, and a tucking member folding the extension into the carton, the ears striking said stripper surface to be folded along their line of attachment.

4. In a mechanism for folding containers from blanks having a bottom, side and end walls, and a continuous web portion between the ends of the side and end walls, the combination of a plunger, a forming well having a central opening large enough to admit the plunger and a pair of convex die members on the sides and a pair of die members on the ends, and means to break the corner web inwardly, the upper surfaces of the die members being in one plane so the sides will begin to fold simultaneously when the plunger and die members are moved relatively toward each other, the radius of curvature of the end folding dies being greater than the side folding dies to fold the side walls up at a faster rate to cause the infolded web to pass along the end wall of the plunger.

5. In a mechanism for folding containers from blanks having a bottom, side and end walls, and a continuous web portion between the ends of the side and end walls, the combination of a plunger, a forming well large enough to admit the plunger pushing a blank, a pair of folding dies defining two sides of the well, a second pair of folding dies defining the ends of the well, and a second pair of vertical thin blades arranged in each corner of the well lying substantially a vertical diagonal plane, the blades having an inner corner rounded toward the well.

6. In a mechanism for folding containers from blanks having a bottom, side and end walls, and a continuous web portion between the ends of the side and end walls and extensions on the top edge of the end wall, the extensions having a lateral ear on each side, the combination of a plunger, a forming well for admission of the plunger carrying a blank, a pair of side folding members defining the sides of the well and a pair of end folding members substantially the width of the end wall and curving inwardly and downwardly defining the ends of the well, and corner breaking blades lying in a vertical diagonal plane at the corners of the well, the blades spaced from the end wall dies a distance at least the thickness of the carton material to allow the ears to pass therebetween to be folded outwardly.

7. In a mechanism for folding containers from blanks having a bottom, side and end walls, and a continuous web portion between the ends of the side and end walls, the combination of a plunger, a forming well for admission of the plunger, a pair of side folding members being inwardly curved and defining the sides of the well, a pair of end folding dies being inwardly curved and defining the ends of the well and having the upper surfaces lying in the same plane as the upper surfaces of the side dies, the radius of curvature of the side folding dies being less than the end folding dies to direct the web along the end wall, and a blade member lying in a substantially diagonal plane and having the corner curved inwardly, the radius of curvature of said blade member being at least as small as the radius of curvature of the side wall dies.

8. In a mechanism for folding cartons from blanks including a reciprocating plunger and folding means positioned at the sides of the path of movement of the plunger to fold portions of the blank against the plunger as the blank is carried by the plunger past said folding means to a rest position below the latter, the reciprocating stripper members positioned to engage the upper edge on the folded portions of the carton as the latter reaches said rest position, the Folding means being positioned below and outwardly of said rest position, springs for moving said supporting members inwardly and upwardly against the bottom of a stripped carton to clamp the latter against the stripper members, and means to move said supporting members to said position outwardly of said discharge position when said plunger is in and adjacent said discharge position.

9. In a mechanism for folding cartons from blanks including a reciprocating plunger and folding means positioned at the sides of the path of movement of the plunger to fold portions of the blank against the plunger as the blank is carried by the plunger past said folding means to a rest position below the latter, spring actuated stripper members positioned to engage the lower edge of the folded portion of the carton as the latter reaches said rest position, members pivotally mounted at their upper ends outwardly of the path of movement of said plunger above said rest position, carton supporting means carried by the lower ends of said arms below said rest position springs connected to said arms to move said supporting members inwardly and upwardly against the bottom of a stripped carton to clamp the latter against the stripper members, and means for positioning the travel of the plunger above and adjacent said rest position and engageable by the plunger and a carton thereon.
to move said supporting members outwardly of said rest position when said plunger is in and adjacent said rest position.

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