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CLOSING APPARATUS FOR CARTONER

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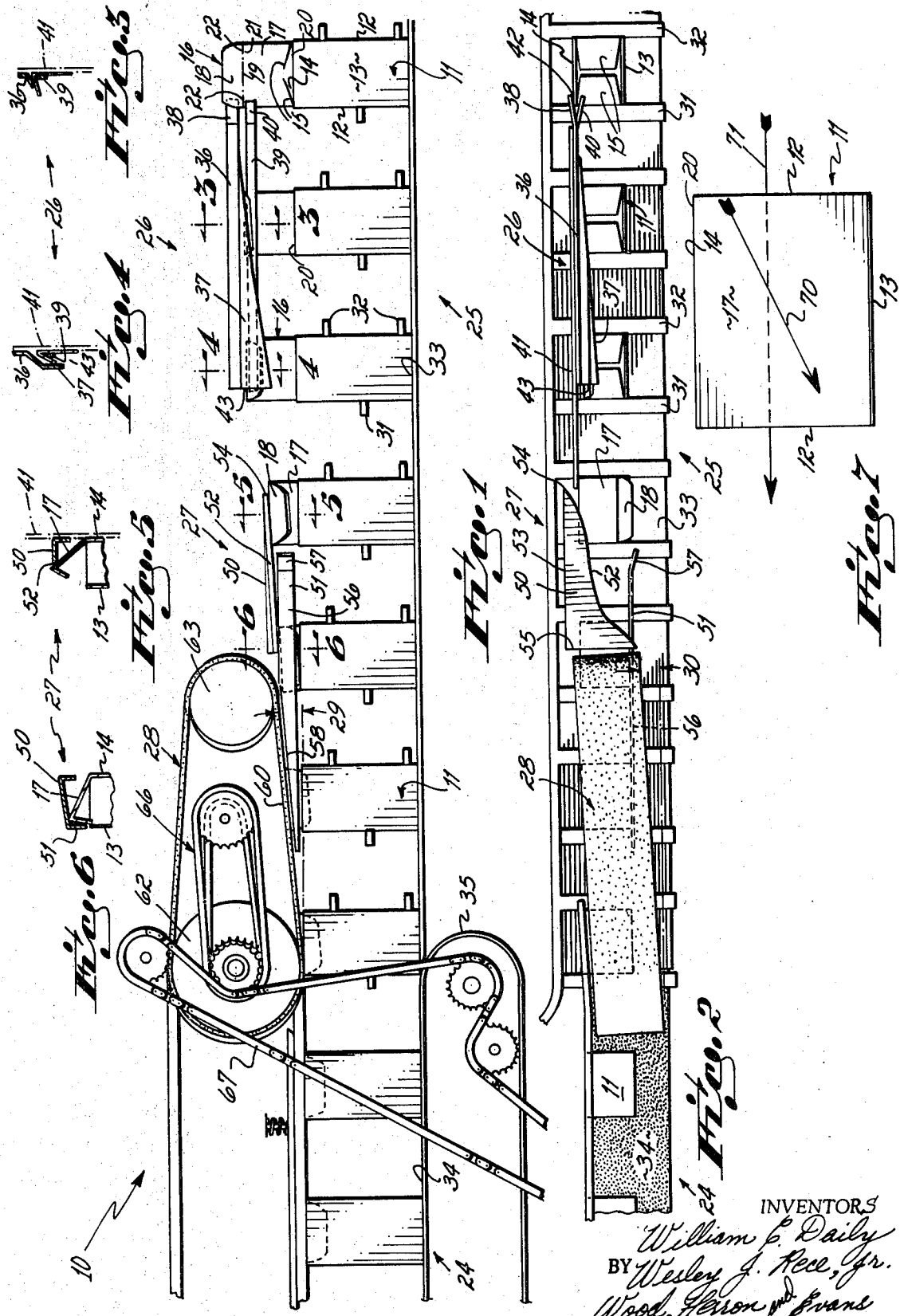

Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6

Fig. 7

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CLOSING APPARATUS FOR CARTONER

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ABSTRACT OF THE DISCLOSURE

An apparatus for closing the tuck flap of a carton while the carton is being transported upon a continuously moving conveyor. The apparatus includes a pair of plows for partially closing the carton and an angulated belt which engages the tuck flap to force it into the carton.

This invention relates to automatic or semi-automatic cartoners and more particularly the invention relates to a method and apparatus for closing cartons by inserting a tuck panel into the carton and driving it into closed position.

In the apparatus to which the invention is directed, cartons are opened from a flat state in which they are shipped and are conveyed in buckets or between transport lugs on an endless conveyor. The cartons may be either horizontally or vertically oriented and are filled either manually or automaticaly with the desired contents. The carton end structure is folded to closed condition by the apparatus of the present invention. The carton end structure normally includes two side flaps hinged to the side walls of the carton and a tuck flap which includes an end panel hinged to one wall of the carton and a tuck panel hinged to the end panel.

In general there are two ways to close such a carton. Where the tolerances are such that there is a sloppy fit between the carton walls and the tuck panel, the carton can be closed simply by plowing the tuck flap into closed position. The plowing to closed position is effected by conveying the carton past stationary plows whose surfaces engage and bend the tuck flap into final position.

Plowing a tuck flap to closed position is not feasible in high-speed apparatus wherein there are close tolerances between the carton walls and the tuck flap. The frictional forces resisting introduction of the tuck panel into the carton cause a bunching or crumpling of the tuck flap during the closing operation. It has therefore been the practice to provide a more certain or reliable closure apparatus even though such apparatus requires a complex of moving elements. These elements, driven through an oil gear box containing a cluster of gears, perform the following four functions:

(1) Elements pre-break the score lines of the tuck flap;

(2) A thin blade is inserted into the carton and forms a wall along which the tuck panel is guided;

(3) Elements insert a corner of the tuck panel; and then

(4) Elements finally drive the tuck panel fully into the carton.

An objective of the present invention has been to provide a new flap closing apparatus which provides a superior closing operation while eliminating the complexity and expense of the apparatus which performs multiple closing operations.

This objective of the invention is attained by providing, as final closing apparatus, an endless belt whose lower flight engages the tuck flap, the lower flight being angulated in both longitudinal and transverse directions to apply a controlled wiping force to the tuck flap which avoids crumpling and bunching at the hinge line.

In the preferred form of the invention, the linear speed of the belt is slightly greater than the linear speed of the carton so that as the belt and carton move together, the belt exerts a slight wiping action in the longitudinal direction due to the higher speed and exerts a slight wiping action in the transverse direction, that is, from the hinge line of the tuck flap toward the tuck panel, due to the transverse angulation of the belt.

In operation, a conveyor grasps a carton and conveys it through a tuck flap pre-break plow and a tuck flap starting plow which sequentially fold the tuck panel with respect to the end panel along their common score line and then partially insert the tuck panel into the carton. With the tuck panel partially inserted, the conveyor which securely holds the carton brings the carton into enagement with the lower flight of the overhead belt.

The downward angle of the belt forces the tuck panel into the carton and the linear overspeed of the belt forces the end panel slightly ahead of the carton so that the trailing edge of the tuck panel can reliably enter the carton unhindered by the carton's trailing side wall. The transverse angulation of the belt attempts to pull the end panel forwardly, that is, away from its hinge line to avoid crowding of the end panel toward its hinge line.

Prior to the engagement of the tuck flap by the belt, it must be broken on its two scorelines, that is the scoreline between the rear wall and end panel and the scoreline between the end panel and the tuck panel. These breaks must be made in order to begin the insertion of the tuck panel into the end of the carton prior to its engagement by the belt. Not only must the scorelines be broken, but they must be broken rather precisely for any canting or angulation of the scorelines will result in a failure of proper closing of the carton. It has, therefore, been an objective of the invention to provide, in combination with the belt closing apparatus, a plow structure for breaking the scorelines. This objective is attained by providing for a sequential breaking of the scorelines, and more particularly by pre-breaking the scoreline between the tuck panel and end panel while maintaining the end panel in the plane of the wall to which it is hinged. This co-planar relationship between end panel and carton wall provides a resistance against twisting of the end flap due to the frictional plowing force of drag applied to it during gthe pre-break operation.

Thereafter the scoreline between the end panel and carton wall is broken, while guiding the tuck panel barely into the carton ready for engagement by the belt.

The objectives of this invention along with its advantages will become more apparent when considered in combination with the following detailed description of the accompanying drawings of which:

FIG. 1 is a diagrammatic side elevational view of a flap closure apparatus, constructed in accordance with the principles of this invention, attached to a portion of a carton conveyor of a conventional packaging apparatus;

FIG. 2 is a diagrammatic top plan view of FIG. 1;

FIG. 3 through 6 are diagrammatic cross-sectional views taken along lines **3—3** through **6—6** of FIG. 1 illustrating the sequential steps necessary for preparing a carton flap of the final closing to be completed by the principles of this invention; and

FIG. 7 is a top plan view of a carton illustrating the vectors applied to the end panel during the final flap tucking operation.

GENERAL DESCRIPTION AND OPERATION

The apparatus of the invention is indicated generally at **10** and is shown in association with cartons **11** which the apparatus is to close. The cartons are shown in a vertical attitude but it is to be understood that the invention is equally applicable to horizontally conveyed car-

tons. The carton **11**, as can best be seen in FIG. 1, has a pair of side walls **12—12** joined by a front wall **13** and a rear wall **14**. The side walls **12** have integrally formed side flaps **15—15**, and the rear wall **14** has an integral tuck flap or closure flap **16** hinged thereto along a score line **20**. The tuck flap **16** includes an end panel **17** and a tuck panel **18**, the tuck panel being hinged along score line **19** to the end panel. The ends of the score line **19** may be cut as at **21** to provide a pair of locking slits **22—22**.

After filling and certain preliminary closing operations, the carton **11** is conveyed by the apparatus **10** as shown at the right side of FIG. 1, that is, with the side flaps **15—15** folded inwardly and the closure flap **16** held vertically with respect to the rear wall **14**.

The apparatus **10** includes a carton conveyor **25**, located below a flap pre-break plow **26** and a flap closure plow **27** which bends the tuck panel **18** forwardly to begin the closing operation. Downstream of the plows **26**, **27** and also above the conveyor **25** is a final flap tuck station which has as its main component an endless belt **28**. The belt **28** has a linear speed slightly in excess (approximately 5 to 10%) of the linear speed of the conveyor **25**. This belt **28** is oriented with respect to the conveyor **25** to provide an acute longitudinal angle **29** (FIG. 1) and an acute transverse or lateral angle **30** (FIG. 2). The angle **29** is approximately 5° and the angle **30** is approximately 3°.

Cartons **11** are conveyed through the apparatus **10** by the conveyor **25** to sequentially: pre-break and over fold the tuck panel **18** along score line **19** while maintaining the end panel in the plane of rear wall **14**; plow the closure flap **16** downwardly with respect to the rear wall along its hinge line with rear wall **14** so that the attached tuck panel **18** is partially inserted into the carton; and to tuck the panel **18** fully into the carton so that it may be locked therein by the lock slits **22–22**, these functions being accomplished respectively by the pre-break plow **26**, the closure plow **27** and the tuck belt **28**.

The longitudinal angle **29** forces the tuck panel **18** into the carton and the transverse angle **30** forces the flap away from its hinge line to preclude crowding of the end flap at its hinge line, and the linear overspeed of the belt **28** assists the angles in tucking the panel **18** into the carton. That is, the belt drives the end panel **17** forwardly with respect to the carton **11**, thus assisting the trailing portion of the tuck panel **18** to enter the carton. The closed carton is then deposited on a discharge conveyor **25** to be transported from the apparatus.

DETAILED DESCRIPTION OF THE APPARATUS

The conveyor **25** driven by means (not shown) is a conventional platform conveyor. As can best be seen in FIGS. 1 and 2, the conveyor includes three vertically oriented endless chains which carry a plurality of transport lugs **31** and **32**. These lugs **31** and **32** extend laterally from the chains and overhang a platform **33** which is substantially flush with an upper run **34** of belt **35** which forms the discharge conveyor **24**.

As stated above, the three chains are vertically oriented and, as can best be seen in FIG. 2, the transport lugs **31** of the centrally disposed chain form a bracket or support for the leading side wall of the carton **11** while the lugs **32** of upper and lower chains form a bracket or support for the trailing side wall. Thus oriented, the transport lugs **31**, **32** positively grasp the carton **11** and hold it firmly during the flap closure operation to be accomplished by the various stations **26**, **27** and **28** as the carton is being conveyed therethrough.

The leading lugs **31** are shiftable with respect to the trailing lugs **32** by shifting the center chain and its sprocket (not shown) with respect to the upper and lower chains. Shifting of the lugs **31** with respect to the lugs **32** makes the conveyor **25** adaptable for cartons of various widths. Cartons of various depths are accommodated by the

lengths of the laterally disposed lugs **31**, **32** and the transverse dimensional size of the platform **33**, while cartons of various heights are accommodated by rasing or lowering the platform **33**.

As previously stated, the pre-break plow **26** is effective to over fold the tuck panel **18** with respect to the closure flap **16**. That is, an acute angle is formed between the tuck panel **18** and the end panel **17**. Referring now to FIGS. 1–4, the prebreak plow **26** includes an upper tuck plow **36** having a downwardly angulated plow blade **37** at its downstream end and a rearwardly angulated tab **38** at its upstream end. The plow **26** also includes a lower closure flap front brace **39** having a forwardly angulated tab **40** at its upstream end and an elongated flat rear flap brace **41**. The brace **39** is substantially parallel to the brace **41** and spaced therefrom a sufficient distance to permit the flap **16** to pass therebetween and to maintain the end panel in the plane of the rear wall **14** to which it is hinged. Additionally, the top edge of the brace **39** is co-linear with the score line **19** of the carton **11**. The tabs **38** and **40** of the plow **36** and brace **39** are oriented with respect to each other to form a flap guide or mouth **42** (FIG. 2). Downstream from the mouth **42**, the downwardly angulated plowing blade **37** overhangs the brace **39** and cooperates therewith to form a tuck flap throat **43**.

A carton is conveyed through the plow **26** so that its flap **16** is fed into the mouth **42**. In this manner, the tuck panel **18** passes in front of the tab **38** of plow **36** and behind the tab **40** of brace **39** and the top edge of the brace **39** is aligned with the score line **19**. Thus, conveyance of the carton through the plow **26** causes the tuck panel **18** to be folded along score line **19** by the co-action of braces **36** and **39**, the back-up brace **41** and the plowing blade **37**, see FIGS. 3 and 4. That is, the blade **37** is effective to force the panel **18** down and bend it along the score line **19** over the brace **39** while the brace **39** and the back-up plate **41** hold the panel **17** in a vertical attitude. As the carton is moved farther through the plow **26**, the plowing blade **37** continues its folding of the flap so as to over fold it as it is forced through the throat **43**.

It is desirable than the panel **18** be over folded to form an acute angle at this stage of the closure operation because of the resiliency of the paper carton. That is, the panel **18** has a tendency to return to its original attitude unless the paper is broken along the score line by over folding it. If the paper were not broken along the score line **19**, the panel **18** could spring back and form an obtuse angle with the panel **17** and thus would be forced down along the outside edge of the front wall and the carton would not be closed. Additionally, this breaking of the resiliency of the paper at the score line **19** enables the tuck flap to be more easily handled during the final tuck operation.

The plow station **27** comprises a pair of flap guides **50**, **51**. As best seen in FIGS. 1, 2, 5 and 6, the guide **50** is positioned to guide the panel **17** and the guide **51** is positioned to guide the tuck panel **18**. As shown in FIG. 1, the guide **50** is generally triangular in configuration and outlined along its forward edge to provide a curvilinear flap guiding edge **52**, a straight marginal edge **53** along its rear surface, a pointed end **54** at its upstream end, and a base section **55** along its downstream end. The guide **50** is supported along its rear edge **53** by means (not shown) to overhang the conveyor platform **33**.

The tuck flap guide **51** (also supported by means not shown) is positioned below and substantially forward of the guide **50**. This guide **51** is an elongated strip **56** which has its upstream end **54** flared outwardly and is tapered at its downstream end **58**. The downstream taper of strip **56** underlies the belt **28** and parallels the angle **29**.

Cartons are conveyed below the plow **27** with their upstanding closure flap **16** passing in front of the pointed

end **54** of the guide **50**. Thus oriented, continued movement of the carton through the plow **27** causes the panel **17** to become engaged with the curvilinear edge **52** which in turn directs the panel **17** toward its closed attitude by plowing or forcing it beneath the guide **50** (FIG. 5). While the panel **17** is being forced closed by the guide **50**, the movement of the carton through the plow station causes the pre-bent tuck panel **18** to pass behind the flared end **57** of the guide **51** and subsequently behind the elongated strip portion **56** of the guide **51**. A downwardly angled portion of the guide **50** in cooperation with the strip **56** of guide **51** starts the tuck panel **18** into the body of the carton (FIG. 6). While in this partially closed condition, the carton engages the angulated lower flight **60** of the belt **28** at the flap tuck station.

As mentioned above, this station has as its principal element an endless belt **28**. This belt **28** is wrapped around a driven drum **62** at its downstream end and an upstream idler drum **63**. The idler drum **63** is substantially smaller in diameter than the drum **52**, and because they are located on the same horizontal center line, their radial dimensional differences create the longitudinal angle **29** with respect to the conveyor platform. The transverse axes of the drums **62**, **63** parallel each other and are angulated with respect to the carton conveyor to form the transverse angle **30**.

The flap tucking belt **28** has a linear speed slightly in excess of the conveyor's linear speed. To this end, the belt **28** is driven by a chain and sprocket speed increasing mechanism **66**. The speed increasing mechanism **66** in turn is driven from the conveyor drive (not shown) of the apparatus by a drive chain **67**.

Partially closed cartons conveyed beneath the belt **28** are completely closed and locked by the force of the belt on the tuck flap, the force including longitudinal and transverse wiping actions provided by: the longitudinal angle **29** which urges the closure flap down into the carton; the transverse angle **30** which tends to force the closure flap forwardly and thus avoid crowding of the end panel **17** along its hinge line **20**; and the linear overspeed of the belt which forces the closure flap **17** and attached tuck panel **18** downstream slightly with respect to the carton so that the trailing edge of the tuck flap can reliably enter the carton.

As can best be seen with reference to FIG. 7, the belt's transverse angle **30** and the belt overspeed combine to provide a force vector in the direction of arrow **70** on the closure flap **17**, while the flap is forced downwardly into the carton by the longitudinal angle **29** as a result of the carton being conveyed through the closure station in the direction of arrow **71**. While moving in the direction of arrow **71**, the closure flap **17** is forced forwardly because of the linear overspeed of belt **28**, thus providing a very effective means for inserting the trailing edge of the tuck panel **18** into the carton **11** to insure that both of the lock slits **22** are properly engaged by the side flaps **15**. With the carton closed, it is forced onto the take-off conveyor **24**.

For the sake of clarity the invention has been described and will be claimed in relation to the closing of a vertical carton. It is to be understood that the invention is

equally applicable to a horizontally oriented carton, the closing apparatus being disposed at right angles to its present position for that application.

Having described our invention, we claim:

1. Apparatus for closing cartons, each of which has a tuck flap including an end panel hinged to one wall of said carton and a tuck panel hinged along a scoreline to said end panel and adapted to be tucked into said carton, the apparatus including a conveyor having a linear section for conveying cartons linearly past a closing mechanism, said closing mechanism comprising,

a pre-break plow including means for bending said tuck panel upon its scoreline while maintaining said end panel in the plane of the wall to which it is hinged,

said pre-break plow having

front and rear braces between which said end panel passes to maintain said end panel in the plane of the wall to which it is hinged,

a downwardly angulated plowing blade overhanging said front brace to bend said tuck panel over said front brace through an angle greater than 90°,

means for bending said end panel over the end of said carton while guiding said tuck flap into the open of said carton,

an endless belt overlying said conveyor and engageable by said end panel,

said belt having a lower flight inclined downwardly in the direction of movement of the conveyor,

means for driving said belt to move said lower flight generally in the direction of movement of said conveyor to force said tuck panel fully into said carton.

2. Apparatus according to claim **1** further comprising:

means for guiding said tuck panel into said carton as said carton passes under said belt.

3. Apparatus according to claim **1** in which said lower flight of said belt lies at an acute transverse angle to the direction of movement of said conveyor.

4. Apparatus according to claim **1**, in which said lower flight of said belt defines an acute longitudinal angle with the direction of movement of said conveyor, and an acute transverse angle to the direction of movement of said conveyor.

5. Apparatus according to claim **4** in which said longitudinal angle is approximately 5°.

6. Apparatus according to claim **4** in which said transverse angle is approximately 3°.

7. Apparatus according to claim **4** in which the linear speed of said lower flight is approximately 5 to 10 percent faster than said conveyor.

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