United States Patent [19]

Johnson

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[54] PACKAGING MACHINE AND METHOD

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[73] Assignee: **Stone Container Corporation,** Chicago, Ill.

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[52] **U.S. Cl.** **53/32,** 53/191, 53/207, 53/223

[51] **Int. Cl.** **B65b 11/18,** B65b 49/00

[58] **Field of Search** 53/32, 191, 194, 207, 209, 53/223, 230, 381

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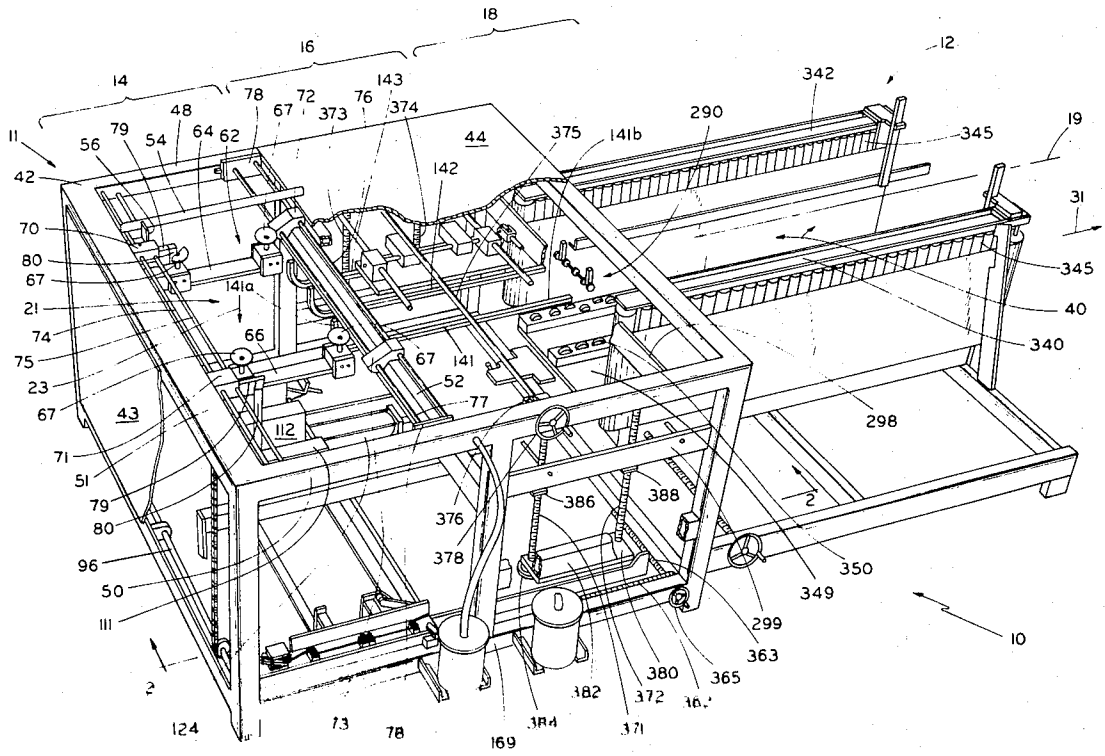
Primary Examiner—Travis S. McGehee
Assistant Examiner—John Sipos
Attorney, Agent, or Firm—Silverman & Cass

[57] **ABSTRACT**

A packaging machine operable to fold a paperboard blank into a carton about one or more articles to be packaged therein. The machine includes a blank folding station, a flap folding station, a package completion station, a first pusher mechanism for pushing a partially formed carton from the blank folding station to the flap folding station and a second pusher mechanism articulated with the first pusher mechanism and operable to move a partially formed package from the flap folding station to the package completion station at the same time a next succeeding partially formed carton is being moved by the first pusher mechanism from the blank folding station to the flap folding station. The stations are arranged in line with the direction of movement of the first and second pusher mechanism.

The method includes the steps of folding a carton blank with a product thereon at a blank folding station to erect end wall panels and partial side wall panels, then folding a top wall panel of the carton downwardly over the product while moving the partially formed carton to a flap folding station, then folding side flaps extending from the top wall panel against the partial side wall panels at the flap folding station, and folding an end flap hingedly connected to the top wall panel against one end wall at the package completion station to seal the carton into a complete package. The steps are performed sequentially along an in-line path of movement.

57 Claims, 13 Drawing Figures



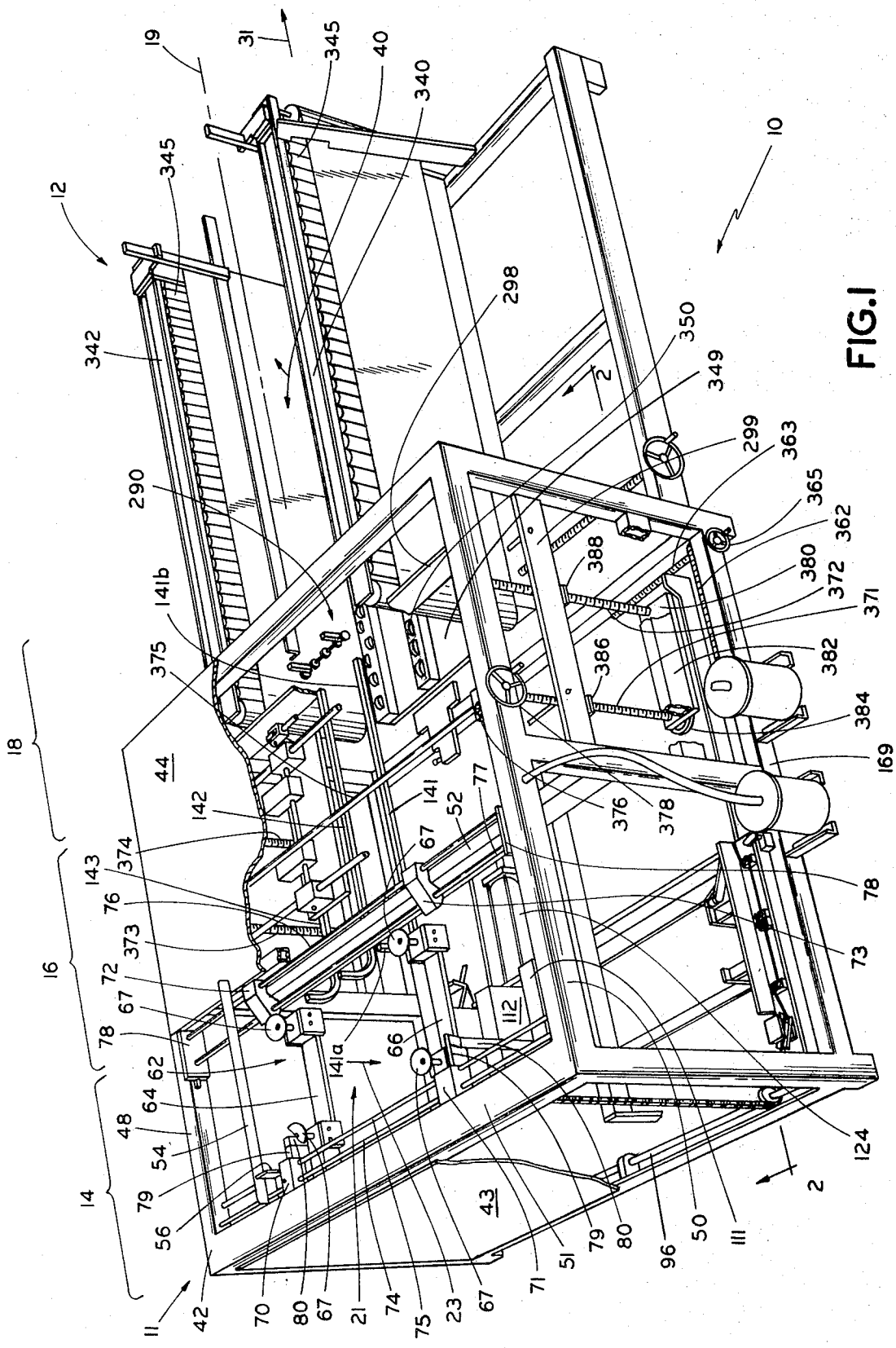

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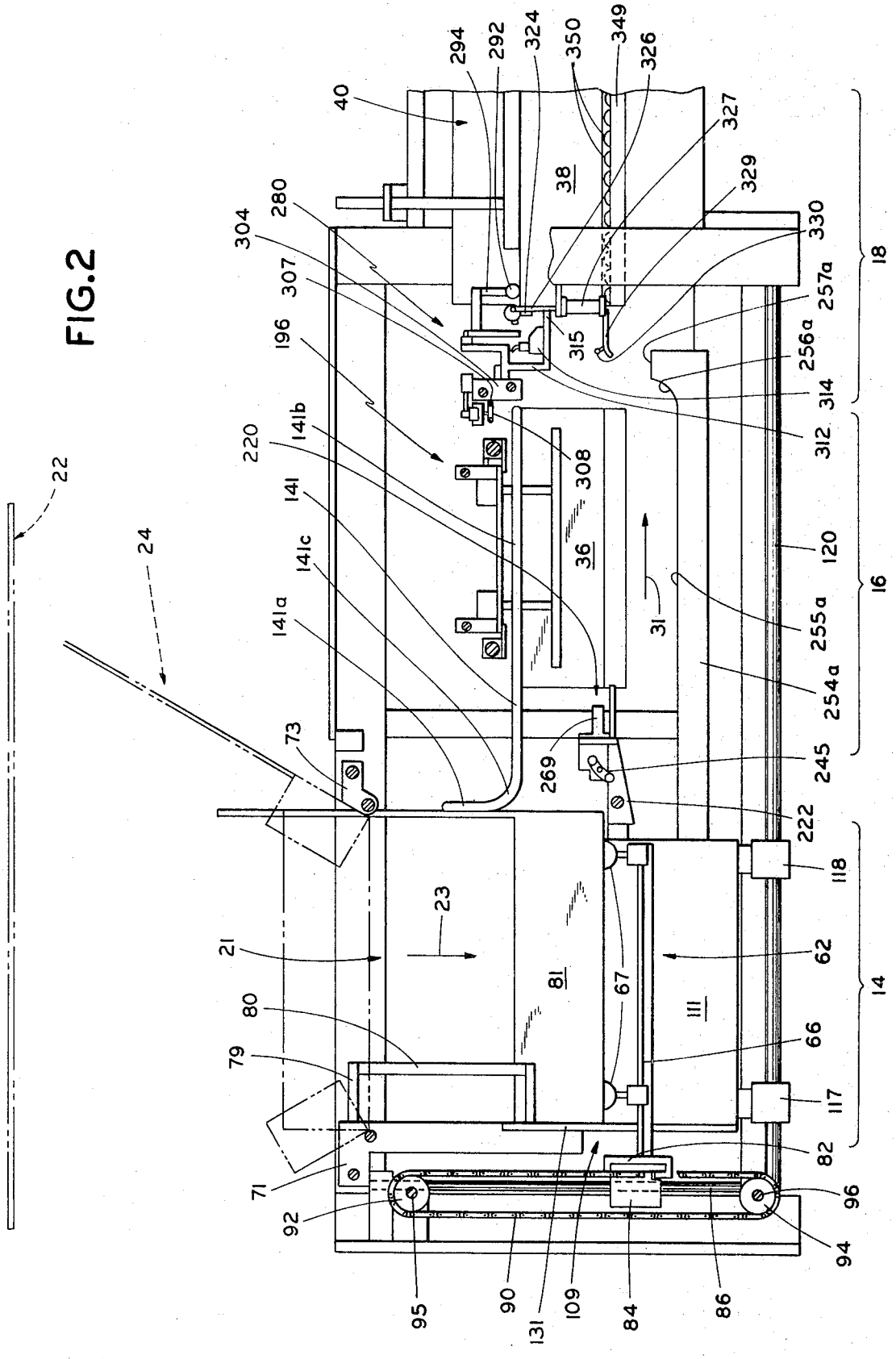
FIG.1

FIG.2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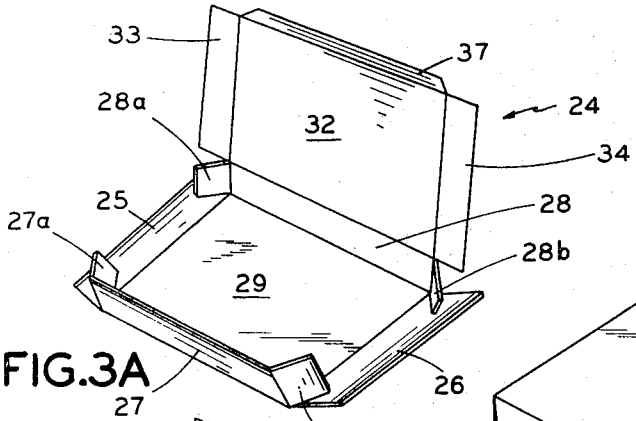


FIG.3A

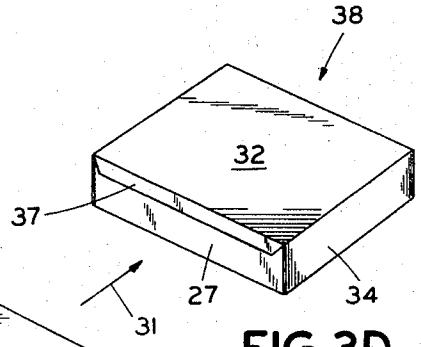


FIG.3D

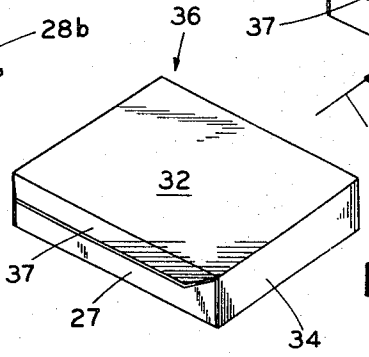
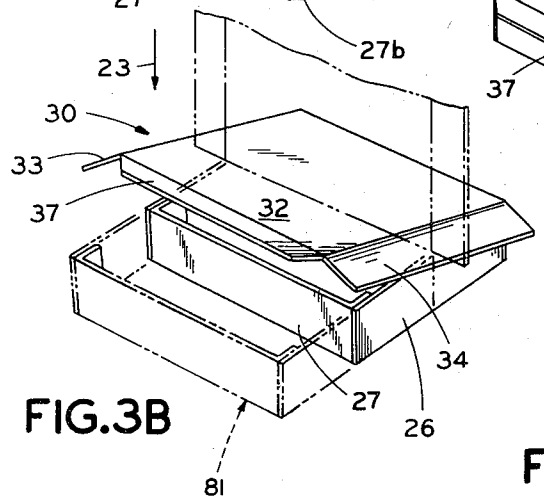


FIG.3C



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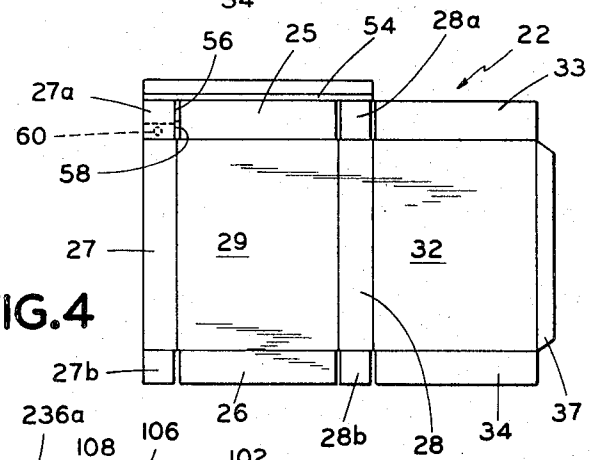
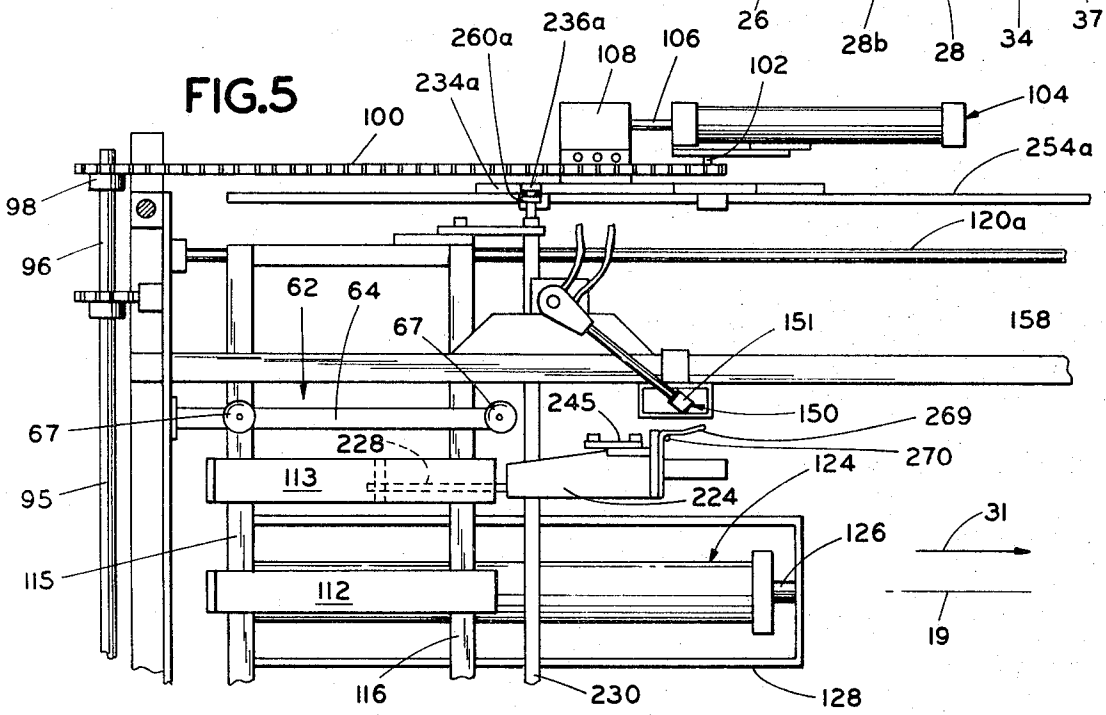


FIG.4

FIG.5



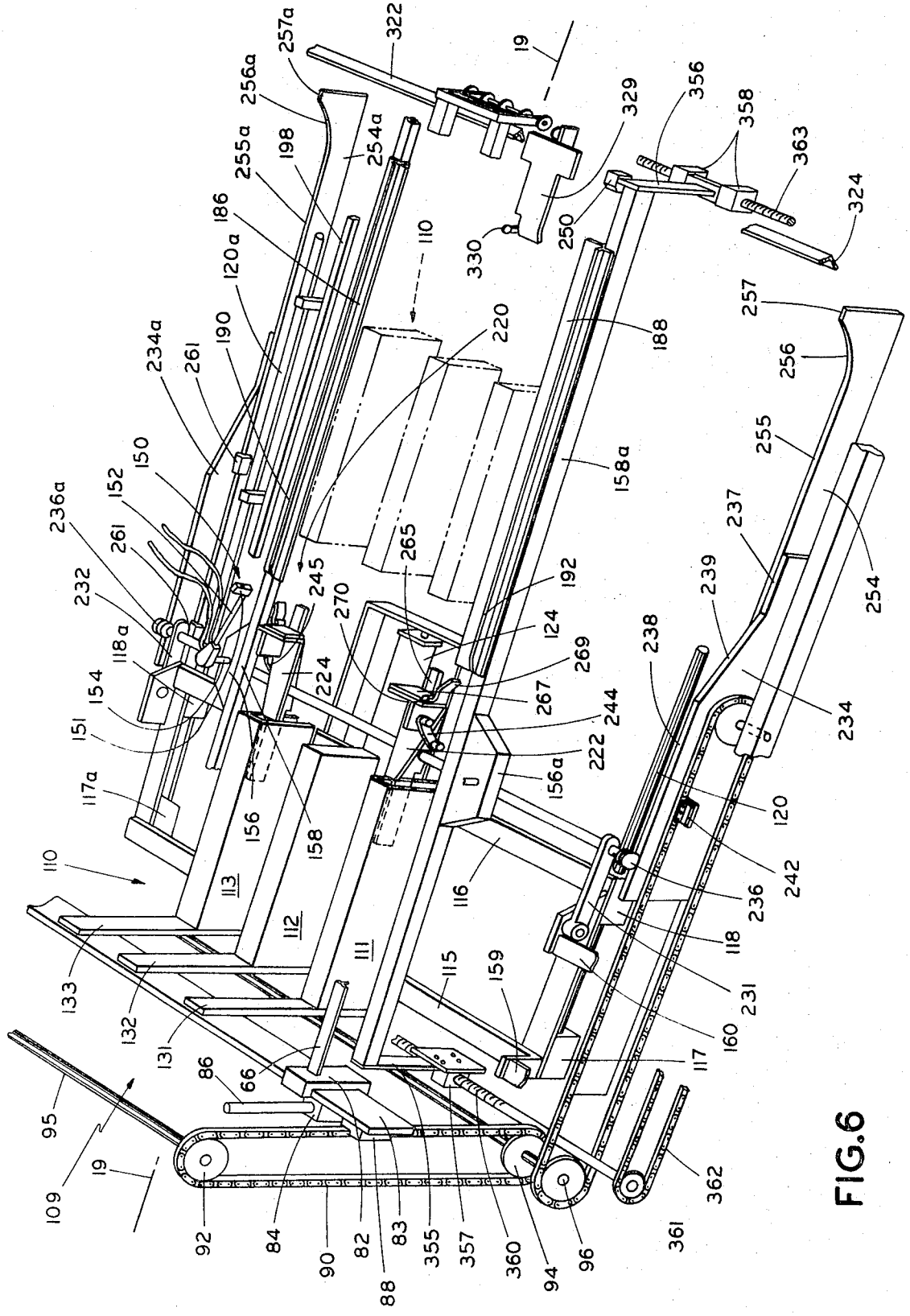

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FIG.6

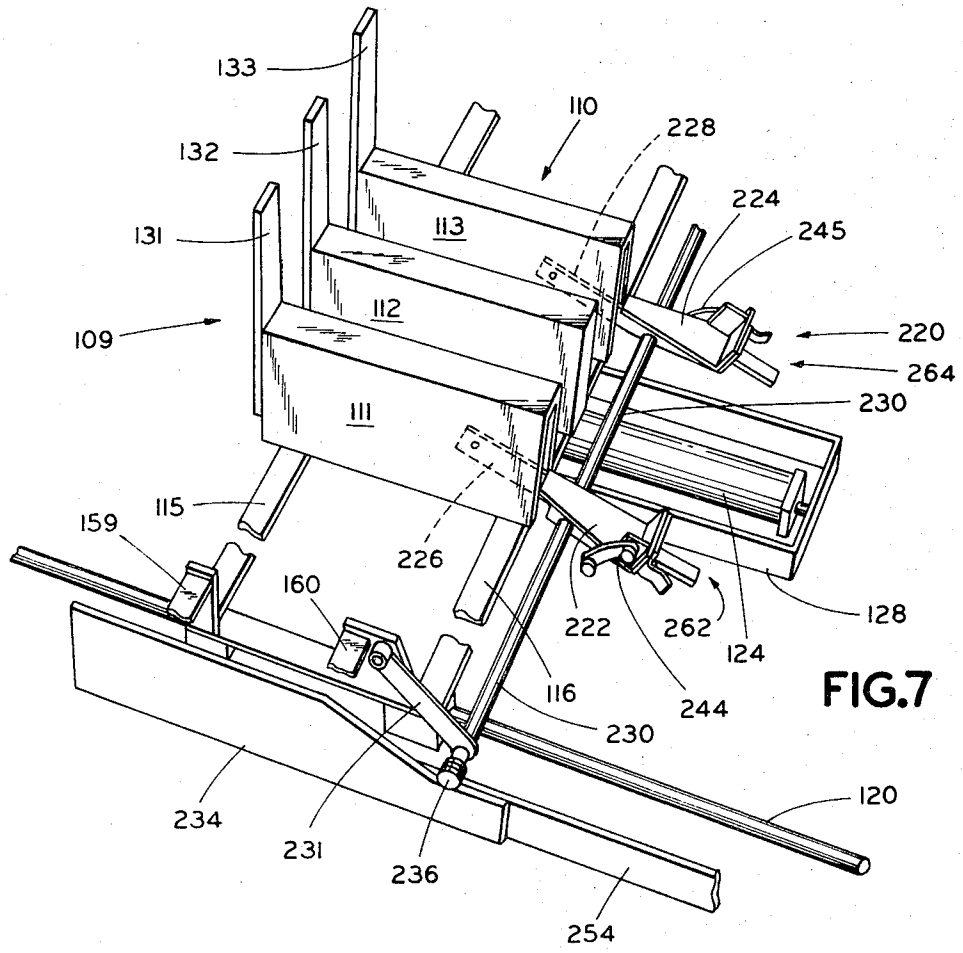
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FIG.7

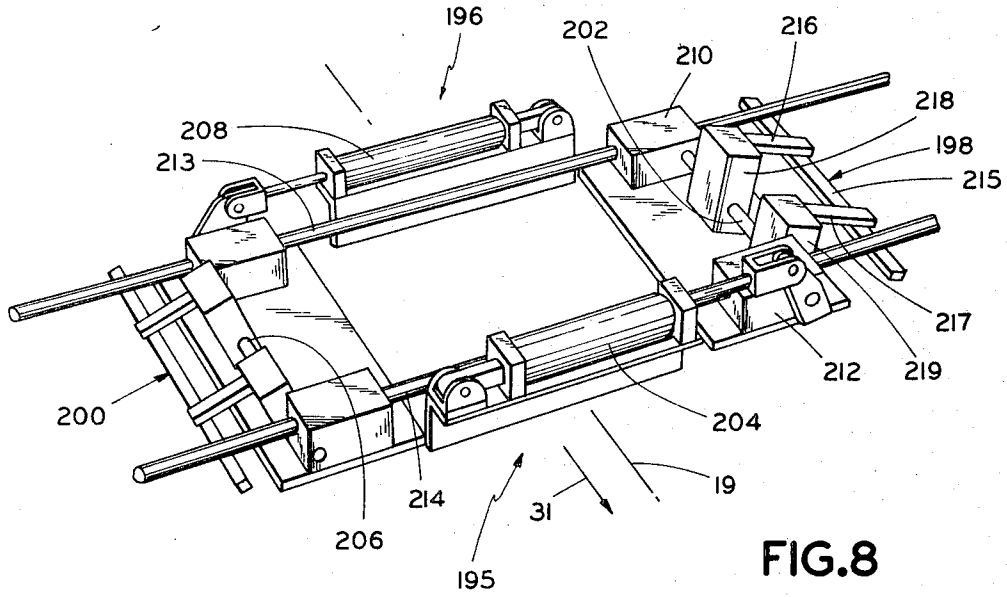
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FIG.8

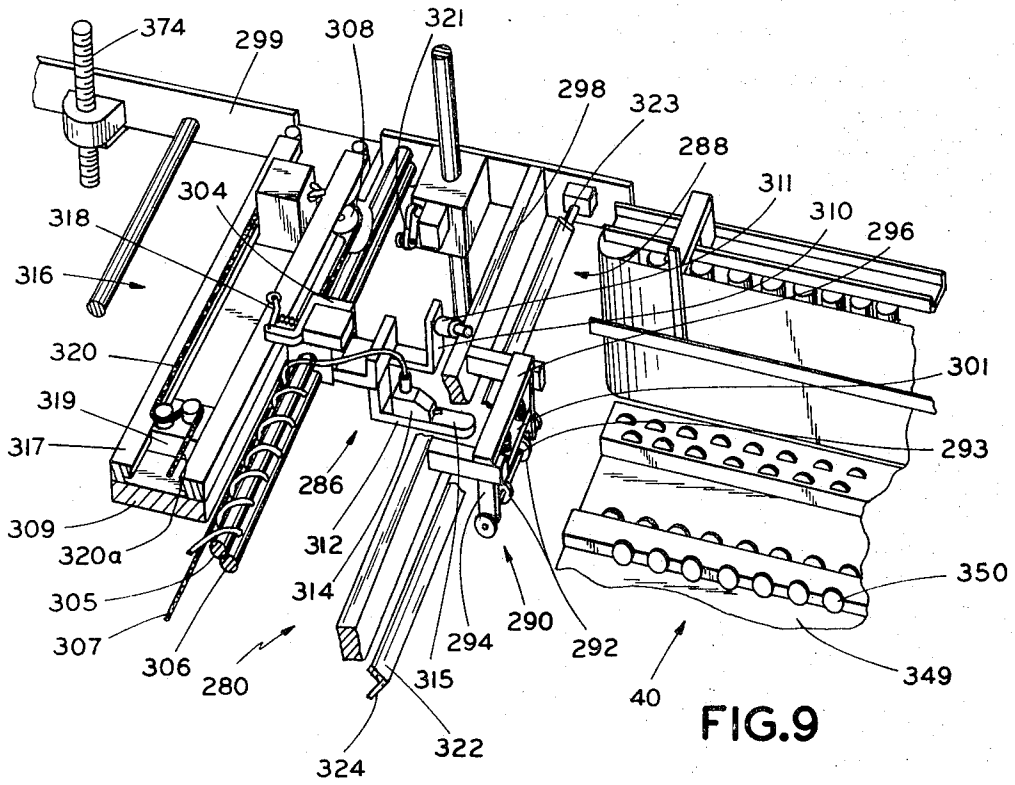
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FIG.9

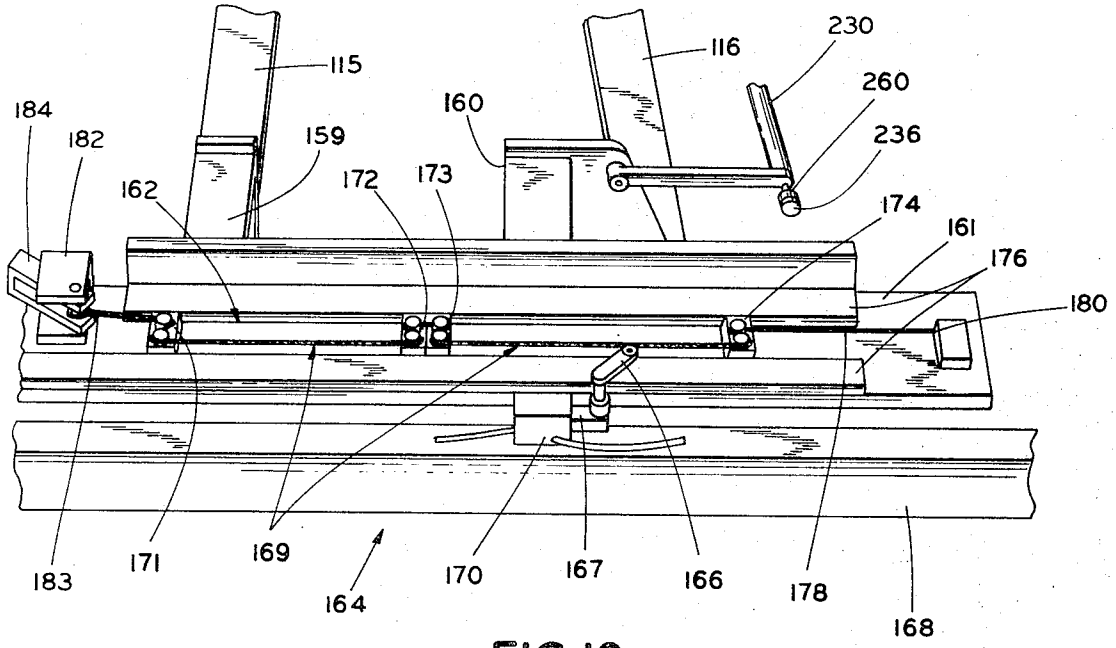
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FIG.10

PACKAGING MACHINE AND METHOD

BACKGROUND OF THE INVENTION

The invention relates to improvements in a packaging machine for sequentially folding paperboard blanks around one or more articles and discharging the completed and sealed carton. In operation, a prescored paperboard blank is positioned over an entrance opening of the machine with the product to be packaged supported on a panel of the blank. Then, the blank is drawn downwardly into the machine past stationary folding members which cause end wall panels and side wall panels to be erected perpendicular to said panel supporting the product. The partially erected blank then is moved horizontally for further folding and sealing same into a completed carton which thereafter is discharged from the machine. Feeding of carton blanks with articles thereon may be accomplished manually, semi-automatically or automatically within the purview of operation of the machine.

Packaging machines for folding paperboard blanks carrying a product into sealed cartons generally are well known. Examples of such prior packaging machines are disclosed in the following patents:

U.S. Pat. No. 3,482,372
U.S. Pat. No. 3,531,914
U.S. Pat. No. 3,543,469
U.S. Pat. No. 3,665,675
British Pat. No. 1,096,321
British Pat. No. 1,126,792

The machine of the present invention and the method carried out therewith provide for high speed production of packages along an in-line path of movement of a paperboard blank through the packaging machine. The various mechanisms of the machine to be described assure that the cartons formed are properly sealed and maintained properly squared at the corners thereof while the machine is operating at high speed production for a great variety of different products, including soft resilient ones. The mechanisms of the machine also are adjustable through a wide range of positions whereby the machine can be utilized in packaging elongate products as well as products or articles which are arranged in a square or rectangular array on a paperboard blank of a particular size. It is advantageous also to be able to handle packages of granular or like soft products, as distinguished from cans or cylinders having sufficient strength to resist damage during formation of the carton in the machine.

Further, high speed production is consistently maintained in the packaging machine embodying the invention by virtue of the means utilized to prevent warping of the cartons and jamming thereof in the machine during the sequence of panel and flap folding steps and linear transfer of the carton in its passage through the machine. This is done continuously for blanks passing through the machine in various stages of assembly.

SUMMARY OF THE INVENTION

According to the invention there is provided a packaging machine for sequentially folding carton blanks into sealed cartons about products, the machine including a blank folding station at which a blank carrying a product thereon is folded to erect end wall panels and partial side wall panels of the carton. A first pusher mechanism of the machine is operable on a forward stroke thereof to push the partially formed carton from the blank folding station to a flap folding station where side flaps extending from a top wall panel of the partially formed carton are folded against the side wall panels. During movement of the partially formed carton a top wall panel of the carton is folded downwardly over the product. A second pusher mechanism is articulated to the first pusher mechanism and is operable therewith on the forward stroke to push a partially formed package from the flap folding station to the package completion station at the same time a next succeeding partially formed carton is being pushed by the first pusher mechanism from the blank folding station to the flap folding station. At the package completion station an end flap or glue lap extending from the top wall panel is folded against one end wall of the carton to form a completed package.

Also, according to the invention, there is provided a method for folding paperboard blanks into cartons about products carried on each blank. The method includes the steps of: folding a paperboard blank with one or more articles arranged thereon at a blank folding station to erect end wall panels and partial side wall panels of the carton; moving the partially formed carton in a given direction from the blank folding station to a flap folding station and simultaneously folding a top wall panel of the carton downwardly over the article or articles; folding side flaps which are hingedly connected to the top wall panel of the carton against the side wall panels of the carton at the flap folding station; moving the partially formed package in a given direction from the flap folding station to a package completion station at the same time the next succeeding partially formed carton is being moved from the blank folding station to the flap folding station; and folding a glue lap hingedly connected to the top wall panel of the partially formed package against one end wall thereof, the stations being arranged in line with the given direction.

The wall panels referred to above as side and end walls are considered as being side and end wall panels with reference to the travel of the carton through the machine. However, after the cartons are formed the side walls as defined herein are referred to as end walls and the end walls as defined herein are referred to as side walls.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view with portions broken away of the packaging machine embodying the invention.

FIG. 2 is a fragmentary sectional view of the packaging machine taken along the line 2—2 of FIG. 1 and in the indicated direction.

FIGS. 3A–D are perspective views showing the sequence of assembling a blank into a sealed carton containing the articles as the blank is moved through the packaging machine of FIG. 1.

FIG. 4 is a diagrammatical top plan view of a paperboard blank positioned over the entrance opening of the packaging machine.

FIG. 5 is a fragmentary top plan view of a portion of the packaging machine.

FIG. 6 is a fragmentary perspective view of the first and second pusher mechanisms of the packaging machine with the pusher members of the second pusher mechanism in a raised package-engaging position.

FIG. 7 is a fragmentary perspective view similar to FIG. 6 of the first and second pusher mechanisms but with the pusher members of th second pusher mechanism in a lowered position not engaging a package.

FIG. 8 is a top perspective view of the flap tucker mechanisms of the packaging machine.

FIG. 9 is a fragmentary perpsective view of a portion of the package completion station of the packaging machine.

FIG. 10 is a fragmentary perspective view of the cam mechanism associated with the first pusher mechanism for controlling the application of adhesive to side wall panels of a partially formed carton as it is being moved from the blank folding station to the flap folding station.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The packaging machine embodying the invention is identified generally by the reference numeral **10** in FIG. **1.** The entrance end of the machine is designated generally at **11** and may be referred to as the front end of the machine. The exit end of the machine is designated generally at **12** and may be referred to as the rear end of the machine.

The machine **10** includes three stations, namely, a blank folding station **14** adjacent the front end **11,** a flap folding station **16** and a package completion station **18** adjacent the rear end **12** of the machine. The stations **14, 16** and **18** are spaced along and in-line with longitudinal axis **19** of the machine **10.** As a result, the machine **10** can be placed adjacent the exit end of an article or product feeding conveyor (not shown) and in line with the direction of movement of the conveyor.

The machine **10** has an entrance opening **21** at the top thereof adjacent the front end **11.** A paperboard blank **22** (FIGS. **2** and **4**) can be placed over the entrance opening **21** and articles (not shown) positioned thereon. Referring to FIG. 3A the machine is operable to draw the blank **22** downwardly into the machine in a first direction indicated by arrow **23.** A blank **24** is shown beginning movement downwardly thereof into the machine. This downward movement causes folding of side wall panels **25** and **26** and end wall panels **27** and **28** perpendicular to bottom wall panel **29.** Additionally, end wall flaps **27***a* and **27***b* are folded inwardly of the end wall **27** inside of the side wall panels **25** and **26** and likewise, end wall flaps **28***a* and **28***b* are folded inwardly from the end wall **28** inside of the side wall panels **25** and **26.** By the time the blank **22** has reached its lowest position in the blank folding station **14,** side wall panels **25** and **26** and end wall panels **27** and **28** will be erected, as shown in FIG. **3B.**

FIG. 3B shows the partially formed carton **30** after moving from the station **14** toward the flap folding station **16** in a horizontal direction indicated by arrow **31,** normal to the first direction **23** and parallel to the longitudinal axis **19** of the machine **10.** A top wall panel **32** hingedly connected to the end wall **28** is folded downwardly over the articles on the bottom wall panel **29** and over the side walls and end walls as the carton **30** is moved to the station **16.** Thereafter, top wall panel **32** is held in place over the articles as carton **30** continues its movement along direction **31** to the flap folding station **16** and adhesive is applied to the outer surfaces of the side wall panels **25** and **26.**

After the carton arrives at flap folding station **16,** side flaps **33** and **34** hingedly connected to the top wall panel **32** are folded downwardly against the side wall panels **25** and **26** respectively, and are held in place against the side wall panels **25** and **26** for a short period of time, as shown in FIG. **3C.**

After a next succeeding blank **22** has been moved downwardly into the machine **10** and folded so as to erect side wall panels and end wall panels from the blank **22,** it is ready for movement to the flap folding station **16.** At that time, the partially formed package **36** seen in FIG. 3C, is moved to the package completion station **18** at the same time that the next succeeding carton is moved to the flap folding station **16.** At the package completion station **18,** adhesive is applied along the upper margin of the end wall panel **27.** Then, a rearwardly extending end flap **37** hingedly connected to the top wall panel **32** is folded down over the upper margin of the end wall **37** and held thereagainst for a short period of time while the now completed package **38** seen in FIG. 3D, is at the package completion station **18.**

The package completion station **18** includes a compression chamber identified generally at **40** in FIG. **1.** Subsequent to the folding of the end flap **37** over the end wall **27,** the completed package **38** is pushed into the compression chamber **40** and, as each package **38** travels through the chamber **40,** the flaps **33, 34** and **37** are pressed against the respective wall panels **25, 26** and **27** to facilitate the setting of the adhesive therebetween.

Inasmuch as each partially formed carton is held, at the flap folding station **16** and the package completion station **18** respectively for a short period of time, it will be understood that operation of the machine **10** is intermittent and completed packages **38** are intermittently moved through and ejected from the compression chamber **40.**

As shown in FIG. **1,** the machine **10** includes a generally rectangular framework **42** of suitable structural iron members within which the various mechanisms and elements of the machine are mounted. Portions of the framework **42** may be covered by panels shown partially at **43** and **44.** The entrance opening **21** is defined between horizontal front-to-rear extending frame members **48** and **50** and between horizontal laterally extending frame members **51** and **52.**

Extending upwardly from the top side of the machine **10** adjacent the entrance opening **21** are alignment members or bars **54** and **56.** The alignment bar **54** extends parallel to the longitudinal axis **19** of the machine and is adjustably mounted so that it can be positioned closer or farther from the frame member **48** depending upon the size of the blank to be folded and the shape of the package to be formed by the machine **10.** The alignment member or plate **56** extends transversely of bar **54** and upwardly adjacent the entrance opening **22** and is adapted to be received within a slit **58** of the blank **22** between the end flap **27***a* and the panel **25,** seen in FIG. **4.** The plate **56** is adjustably mounted so that its position can be changed both longitudinally and laterally of the machine to properly locate the plate for the particular size of blank to be folded.

The alignment bar **54** and the alignment plate **56** are utilized for properly aligning or centering a paperboard blank of a given size, such as the paperboard blank **22,** in proper position over the entrance opening **21.** As

best shown in FIG. 4, the free edge of the panel 25 is squared up against the bar 54 and the blank 22 is positioned over the entrance opening 21 with the plate 56 received in the slit 58 in position for commencement operation of the machine 10.

First, the flap 27*a* is depressed to press a button 60 to energize a vacuum system of the machine which causes the blank 22 to be held to a carriage 62. Then a start button (not shown) of the machine is depressed to cause the carriage 62 to move from a raised position at the entrance opening 21 to a lowered position (FIG. 2). Carriage 62 includes spaced apart, horizontally extending arms 64 and 66, each of which has adjustably mounted suction cups 67. Each cup 67 has a center port therein and is connected to a suitable vacuum source (not shown). The paperboard blank 22 is placed over the entrance opening 21 and supported on the suction cups 67 so as to hold the paperboard blank 22 on the carriage 62 when suction is applied. This is done before switch 60 is actuated to operate the vacuum system of the machine 10.

Adjacent the entrance opening 21 are situated a plurality of fold members including four fold blocks 70–73 and four folding bars 74–77 as best shown in FIG. 1. The fold blocks 70 and 71 are adjustably mounted on the folding bars 74 and 75 and the fold blocks 72 and 73 are adjustably mounted on the folding bars 76 and 77. The bars 76 and 77 are fixed at each end to adjustably mounted plates 78 which are adjustably attached to the frame members 48 and 50 of the framework 42. In this way, the bars can be moved rearwardly or forwardly relative to the longitudinal axis 19 of the machine 10 for changing the dimensions of the entrance opening 21.

When the blank 22 is drawn downwardly through the entrance opening 21 into the machine 10, the end wall panels 27 and 28 engage the pairs of bars 74, 75 and 76, 77 causing said end wall panels to be folded upwardly from the bottom panel 29 of the blank 22. Concurrently, end wall flaps 27*a*, 27*b*, 28*a*, 28*b* engage folding blocks 70–73 and are folded first upwardly and then inwardly of the panel 29. As the carriage 62 continues its movement downwardly, the panels 25 and 26 are folded upwardly by the pair of horizontally extending bars 79, one on either side of the path of movement of the carriage 62. Each of the bars 79 extends parallel to the longitudinal axis 19 in position to engage and fold the side wall panels 25 and 26 upwardly as the blank is moved downwardly. To maintain each side wall panel 25 and 26 in this folded position, a downwardly extended guide plate 80 is connected to each bar 79 for engaging each panel 25, 26.

The top wall panel 32 is vertically oriented after the carriage 62 has decended to its lowered position shown in FIG. 2. In the lowered position of the carriage 62, the end wall and side wall panels 25–28 of the blank are fully erected such that the blank is now a partially formed carton identified by the reference numeral 81.

Also shown in FIG. 2 in phantom lines are an unfolded blank 22 in position above the entrance opening 21 of the machine 10 and a partially folded blank 24 in the position it will take just after the carriage 62 starts its downward movement into the machine 10.

As shown in FIGS. 2 and 6, the arm 66 is connected to a bracket 82 which is adjustably mounted on a laterally extending plate 83 of the carriage 62. The plate 83 is fixed to guide blocks, one of which is shown at 84. Each guide block 84 is mounted on a vertical guide shaft 86. Adjacent each end of the plate 83 there is secured to the plate 83 a bracket 88 mounted on a drive chain 90 forming part of a drive mechanism for the carriage 62. Movement of the chain 90 will cause movement of the carriage 62 on the guide shafts 86. The guide shafts 86 maintain the arms 64 and 66 of the carriage 62 in proper location relative to the plate 83 during upward or downward movement of the carriage 62. The adjustable mounting of the brackets 82 permits the arms 64 and 66 to be moved one relative to the other either closer or further apart depending upon the size of the paperboard blank it is desired to fold within the machine 10.

As shown in FIGS. 2 and 6, each of the chains 90 is trained around upper and lower sprockets 92 and 94. The upper sprocket 92 is an idler sprocket mounted on a freely rotating shaft 95 and the sprocket 94 is mounted on a driven shaft 96. Although hidden from view in FIG. 2 and not shown in FIG. 6 it will be understood that the arm 64 is supported in the same way as the arm 66.

As best shown in FIG. 5, a drive sprocket 98 is mounted on the shaft 96 which is driven by chain 100. The chain 100 extends between the sprocket 98 and an idler sprocket (hidden from view) mounted on a stub shaft 102 fixed to and extending from a lower frame member of the machine 10. As shown in FIG. 1 the shaft 96 is suitably journalled on the framework 42 of the machine 10.

The drive mechanism for the carriage 62 includes a pneumatically or hydraulically operated piston and cylinder mechanism 104 which has a piston rod 106 extending therefrom. The piston rod 106 is connected to a bracket 108 which is secured to the chain 100. Extension or retraction of the rod 106 causes movement of the chain 100 in a rearward direction or a forward direction parallel to the longitudinal axis 19 of the machine 10. When the cylinder mechanism 104 is actuated to move the piston rod 106 outwardly and rearwardly of the machine 10 the chain 100 is moved in a counterclockwise direction to cause the carriage 62 to be raised at the blank folding station 14. Similarly when the piston rod 106 is retracted into the cylinder mechanism 104, the chain 100 is moved clockwise about the idler sprocket to cause the carriage 62 to be moved downwardly into the machine 10 to its lowered position. It will be understood that the button (not shown) controls the initial operation of the cylinder mechanism 104 to move the carriage 62 downwardly into the machine 10.

Located for movement across the folding station 14 is a first pusher mechanism generally identified by the reference numeral 109 in FIGS. 2 and 6. The pusher mechanism 109 includes a carton receiving platform 110 formed by three spaced apart hollow blocks 111, 112 and 113. The blocks 111–113 are supported on two cross members 115 and 116. To permit adjustment in size of the platform 110, blocks 111 and 113 are preferably adjustably mounted on the cross members 115 and 116. The ends of the cross members 115 and 116 on one side of the machine 10 are fixed respectively to blocks 117 and 118 which are slidably received on a horizontally extending guide shaft 120. The opposite ends of the cross members 115 and 116 also are fixed to blocks 117*a* and 118*a* slidably received on

a horizontal extending guide shaft **120***a*. The guide shafts **120** and **120***a* extend in the same direction as the longitudinal axis **19** such that the pusher mechanism **110** is arranged for movement in the second direction **31** parallel to the longitudinal axis **19.**

As best shown in FIGS. **5** and **7,** the first pusher mechanism **109** is moved by a pneumatic or hydraulic piston and cylinder mechanism **124** including a piston rod **126.** The outer end of the piston rod **126** extending from the cylinder mechanism **124** is connected to a U-shaped bracket **128.** The legs of the bracket **128** are secured to and under the cross members **115** and **116** whereby outward movement of the piston rod **126** causes movement of the bracket **128** and the first pusher mechanism **109** connected thereto in a forward direction indicated by the arrow **31.** Although not shown, it will be understood that the piston and cylinder mechanism **124** is fixed to the framework **42** of the machine **10.** As is apparent from FIGS. **2, 5** and **6,** arms **64** and **66** of the carriage **62** straddle the platform **110** when the carriage **62** is moved to its lowered position. Thus, as shown in FIG. **2** the arm **66** is located outwardly of the block **111** and as shown in FIG. **5** the arm **64** is located outwardly of the block **113.** As a result, the first pusher mechanism **109** can be moved to and from the blank folding station **14** irrespective of the position of the carriage **62.**

As best shown in FIGS. **6** and **7,** the first pusher mechanism **109** includes three pusher plates **131–133** which are secured respectively to the rear edges of the blocks **111–113** and extend upwardly therefrom. The pusher plates **131–133** are arranged to engage the rear wall of the partially formed carton when the first pusher mechanism **109** is actuated to move the partially formed carton **81** to the flap folding station **16.** Actuation of the cylinder mechanism **124** is controlled by a suitable limit switch (not shown) which is actuated as or after the carriage **62** reaches its lowered position shown in FIG. **2.** Of course prior to actuation of the cylinder mechanism **124,** the bottom panel **29** is disengaged from the suction cups **67** either by operation of a suitable control valve or by controlling the movement of the carriage **62** such that the suction cups move below the platform **110** when the carriage **62** moves to its lowered position. When the cylinder mechanism **124** is actuated, the pusher mechanism **109** makes a forward stroke of movement to push a partially formed carton, such as the carton **81,** from the blank folding station **14** to the flap folding station **16.** The position of the platform **110** at the end of a forward stroke is shown in phantom lines in FIG. **6.** After the first pusher mechanism **109** has completed a forward stroke of movement, the piston and cylinder mechanism **104** is actuated to return carriage **62** to its elevated position adjacent the entrance opening **21.** Either after or as the carriage **62** is retracted, a suitable limit switch (not shown) is actuated to actuate the cylinder mechanism **124** for retracting the piston rod **126** and returning first pusher mechanism **109** to its initial position shown in FIGS. **1, 2, 5, 6** and **7.**

As shown in FIGS. **1** and **2,** three L-shaped stationary guiding and folding members **141–143** extend longitudinally across the flap folding station **16** between the blank folding station **14** and the package completion station **18.** The members **141–143** are identical so only member **141** will be described in detail. The member **141** has a short leg **141***a* which extends upwardly at the blank folding station **14** toward the entrance opening **21** and adjacent the path of movement of the carriage **62.** Also, the member **141** has a longer leg **141***b* which extends horizontally across the flap folding station **16** parallel to the longitudinal axis **19.** A rounded portion **141c-143c** connects the two said legs **141***a* and **141***b.*

As blank **22** is carried downwardly into the machine, top wall panel **32** will be folded upwardly and ride against the short legs **141***a–143a* of the guiding and folding members **141–143.** Then, as shown in FIG. **2,** the partially formed carton **81** resting on carriage **62** and on the platform **110** has its top wall panel **32** in a generally upright or vertical position in engagement with the short legs **141***a–143a* of the guiding and folding members **141–143.** When the first pusher mechanism **109** is operated to move the partially formed carton **81** forward to the flap folding station **16,** the top wall panel **32** slidingly and frictionally engages the rounded portion **141***c–143c* of each of the members **141–143,** and is folded downwardly over the side and end wall panels **25–28** of the carton. Seen in FIG. **3B** is a partially formed carton with the top wall panel **32** partially folded over as the carton **30** has started moving toward the flap folding station **16.**

Thereafter, top wall panel **32** continues to slidingly and frictionally engage the longer legs **141***b–143b* of the guiding and folding members **141–143.** In this way, top wall panel **32** is maintained in place until the side flaps **33** and **34** are folded downwardly against the side wall panels **25** and **26** and secured thereto. As a result, undesired forward movement of the end wall panel **28** forwardly of the forward edges of the side wall panels **25** and **26** is minimized, if not altogether prevented.

At the same time that the partially formed carton **81** is moved from the blank folding station **14** to the flap folding station **16,** adhesive applicators on either side of the path of travel of the partially formed carton **81** are actuated to apply adhesive to the side wall panels **25** and **26** at selected locations along the length thereof. One such adhesive applicator is shown in detail at **150** in FIGS. **5** and **6.** The adhesive applicator **150** includes extruders **151** mounted at the free end of a horizontally extending arm **152.** The arm **152** is fixed at its other end to a vertical shaft **154** rotatably journalled to a supporting bracket **156** fixed to a longitudinally extending frame member **158.** It will be understood that when the first pusher mechanism **109** begins its forward stroke, the extruders **151** is rotated in a horizontal plane to a position adjacent the path of movement of the partially formed carton **81** to the position of the extruders **151** shown in FIGS. **5** and **6.** Although not shown, it will be understood that a sprayhead is mounted on bracket **156a** fixed to frame member **158a** on the other side of the path of movement of the pusher mechanism **109.** The longitudinally extending frame members **158** and **158a** are adjustably mounted so that they can be moved closer or farther apart depending upon the size of package being formed by the machine **10.**

Referring to FIG. **10,** two brackets **159, 160** extend upwardly from the frame members **115** and **116** respectively of the supporting framework for the first pusher mechanism **109.** The brackets **159** and **160** also extend outwardly from the center of the machine **10.** A rectangular plate **161** is mounted on the brackets **159, 160** and extends in a direction generally parallel to the lon-

gitudinal axis 19 of the machine 10. A cam track mechanism 162 forming part of a cam mechanism 164 for operating the adhesive applicators 150 is mounted on the plate 161. The cam mechanism 164 also includes a cam follower 166 which is pivotally mounted on a stationary support 167. The support 167, in turn, is mounted on a frame member 168 of the framework 42. The cam track mechanism 162 includes an adjustable cam track 169 which, when the pusher mechanism 109 moves forwardly, engages the cam follower 166 to pivot the same laterally of the longitudinal axis 19 of the machine 10. Such pivotal movement of the cam follower 166 operates a suitable valve mechanism 170 for causing adhesive to be sprayed from the sprayhead 151 of each applicator 150 onto the side wall panels 25 and 26. Adhesive will be applied so long as the cam follower 156 is engaging the cam track 169.

The cam track mechanism 162 includes a plurality of capstan blocks 171-174 which are adjustably mounted in a bracket 176 fixed to the plate 161. A cable 178 is trained about the capstan blocks 171-174 so that a portion thereof is positioned to engage the cam follower 166 and thereby form the cam track 169. The cable 178 is fixed at one end 180 and is releasably held in a tensioning device 182 at the other end 183. The tensioning device 182 has an overcenter toggle member 184 for adjusting the tension on the cable 178. Viewing the cam mechanism 164 shown in FIG. 10, movement of the toggle arm 184 outwardly and to the right will move the end 183 of the cable 178 to the right and outwardly "overcenter" to put slack in the cable thereby allowing the position of the capstan blocks 171–174 to be shifted in order to change the length and location of the cam track 169. Then, when the toggle arm is moved to the left, the end 183 of the cable is moved to the left and slightly inwardly "overcenter" where movement of the arm 184 is stopped thereby making the cable 178 taut to establish the cam track 169.

As best shown in FIG. 6, the flap folding station 16 includes a pair of spaced apart guide rails 186 and 188 which extend horizontally, generally parallel to the longitudinal axis 19 and which are mounted on the frame members 158 and 158*a*. The plaform 110 moves between the rails 186 and 188 and the side edges of the partially formed carton 81, 30 are received on and supported by the guide rails 186 and 188. The guide rails 186 and 188 each have an elongate flange 190, 192 which extends upwardly therefrom in position to engage the side wall panels 25 and 26 of the carton for guiding the travel of each carton into and through the flap folding station 16. It will be understood, however, that when the first pusher mechanism 109 completes its forward stroke of movement, the platform 110 will be located in the middle of the flap folding station 16 as shown in phantom lines in FIG. 6. After the first pusher mechanism 109 has moved to this position, flap tucker mechanisms 195, 196 at the flap folding station 16 are operated to move tuckers or flippers 198, 200 downwardly into engagement with the side flaps 33 and 34 to fold the same against the side wall panels 25 and 26.

A portion of one of the tuckers, namely, the tucker 198, is shown in FIG. 6 in its lowered position. In FIG. 8, the tuckers 198 and 200 are shown in their raised positions. Pivotal movement of the tucker 198 from its raised position to a lower flap engaging position about a shaft 202 is controlled by a piston and cylinder mechanism 204. Likewise pivotal movement of the tucker 200 about a shaft 206 is controlled by a piston and cylinder mechanism 208. Since the tuckers 198 and 200 are substantially identical, only the tucker 198 will be described in detail.

As best shown in FIG. 8, the pivot shaft 202 about which the tucker 198 pivots is mounted between a pair of blocks 210 and 212 which, in turn, are slidably mounted on parallel spaced horizontal shafts 213 and 214 which extend transversely of the longitudinal axis 19 of the machine 10. The ends of shafts 213 and 214 are mounted to a vertically adjustable framework whereby the vertical position of the tucker mechanisms 195 and 196 can be adjusted for cartons of different height. The slidable mounting of the blocks 210 and 212 permits adjustment of the tucker 198 laterally of the longitudinal axis 19 of the machine 10 to enable the tucker mechanisms 195, 196 to be adjusted for cartons of different width. As shown, the tucker 198 has an inverted π shape defined by a horizontally extending bar 215 which is connected by two arms 216 and 217 to blocks 218, 219 respectively. The blocks 218 and 219 are fixed to the shaft 202.

It will be appreciated that at completion of the forward stroke of the first pusher mechanism 109, a limit switch (not shown) will be actuated to cause operation of the cylinder mechanisms 204 and 208 to rotate the tuckers 198, 200 downwardly to push the flaps 33 and 34 against the outer surfaces of the side wall panels 25 and 26 to which adhesive has just been applied by the applicators 150.

A second pusher mechanism 220 is articulated or pivotally connected to the first pusher mechanism 109 and operable therewith for pushing a partially completed package 36 from the flap folding station 16 to the package completion station 18 at the same time a succeeding partially formed carton is being moved from the blank folding station 14 to the flap folding station 16. As shown in FIG. 7 the second pusher mechanism 220 includes two spaced apart pusher members 222,224. The pusher member 222 includes an arm 226 which extends into the hollow block 111 and is connected to and between the side walls of the block 111. Likewise, pusher member 224 includes an arm 228 which extends into the hollow block 113 and is pivotally secured to the side walls thereof. The pusher members 222 and 224 are interconnected by an elongate bar 230 which extends between the pusher members 222 and 224. It will be understood that the pusher members 222 and 224 are slidable on the bar 230 so that when the position of the blocks 111 and 113 on the frame members 115, and 116 are adjusted, the pusher members 222 and 224 will then easily slide on the bar 230 to the new position. The bar 230 is pivotally connected to the supporting framework for the first pusher mechanism 109 by arms 231 and 232. In this respect arm 231 is pivotally connected to bracket 160. Of course, the pivot axis of the arms 231 and 232 is located so as to be coaxial with the pivot axis of the arms 226 and 228 of the pusher members 222 and 224. Before the machine 10 is operated, the pusher members 222 and 224 are in a lowered, retracted, non-package engaging position shown in FIG. 7. Then, when the carriage 62 has been moved to its lowered position with a partially formed carton thereon, pusher members 222 and 224 are raised to a package engaging position shown in FIG. 6. The pusher members 222, 224 are en-

abled or raised to the package engaging position by a cam mechanism which includes a pair of movable cam tracks **234, 234***a* and cam followers **236, 236***a* mounted adjacent each end of the rod **230.** Each of the cam followers **236, 236**a can be a disc or roller mounted adjacent one end of the rod **230.**

As best shown in FIG. **5,** the bracket **108** not only is connected to the chain **100,** but also is connected to the movable cam track **234***a.* The connection is such that when the piston and cylinder mechanism **104** is operated to move the carriage **62** from its raised position to its lowered position, the cam tracks **234, 234**a are moved in the direction indicated by the arrow **31** forwardly from the blank folding station **14** toward the flap folding station **16** to engage the cam followers **236, 236***a* and thereby raise the bar **230** and the pusher members **222** and **224** mounted thereon.

Since cam tracks **234** and **234***a* are substantially identical only cam track **234** will be described in detail. As shown in FIGS. **6** and **7,** cam track **234** has a lower cam surface **237** on which the cam follower **236** normally rests, a higher, horizontally extending cam surface **238** spaced rearwardly of the cam surface **237,** and an inclined cam surface **239** extending between and connecting the cam surfaces **237** and **238.** When the cylinder mechanism **104** is operated, the cam follower **236** is moved along the cam surfaces **237, 239** and **238** and raised thereby to a package engaging position shown in FIG. **6.** This results, of course, in the upward rotation of the pusher members **222** and **224** about their pivot axis to the platform **110.** Although the cam track **234***a* is moved directly by the piston and cylinder mechanism **104,** the cam track **234** is moved by means of a chain **241** driven by the shaft **96.** The chain **241** is connected by a bracket **242** to the side of the cam track **234.** In this way, both of the cam tracks **234,234***a* are moved simultaneously outwardly from the blank folding station **14** for raising the pusher members **222** and **224.**

It will be understood that movement of the pusher members **222, 224** to their package engaging position also serves to actuate a suitable limit switch which causes operation of the piston and cylinder mechanisms **204** and **208** to raise the tuckers **198** and **200** to their non-flap engaging position shown in FIG. **8.**

As shown in FIG. **6** the upper cam surface **238** of the cam track **234** does not extend the full length of the guide rails **186** and **188.** As a result, shortly after the pusher mechanisms **109** and **220** begin their forward stroke, the cam followers **236** and **236***a* ride off or disengage the cam surface **238.** At that time, pusher members **222** and **224,** which are traveling astride the guide rails **186** and **188,** will engage and ride on the guide rails **186** and **188.** To facilitate this engagement of the pusher members **222** and **224** on the guide rails **186** and **188,** each of the pusher members has a roller assembly **244,245** mounted thereon. Each of the roller assemblies **244,245** includes a curved elongate bar which has a roller mounted at each end thereof and which is pivoted intermediate the ends thereof to the respective pusher member **222,224.** These rollers engage the guide rails **186,188** to provide a rolling friction engagement of the pusher member along and on the guide rails **186** and **188.** At the end of a forward stroke of movement of the first and second pusher mechanisms **109** and **220,** the forward roller of each roller assembly **244,245** will engage a seat, one of which is shown at **250** in FIG. **6.** Each of the seats **250** is connected to and extends from one of the adjustable frame members **158,158**a. After the forward roller of each roller assembly moves onto one of the seats **250,** the rear roller of the assembly will disengage from the guide rail **186** or **188** and depend downwardly from the seat **250** and the respective pusher member **222** or **224.** As a result, when the pusher mechanisms **109,220** begin their return stroke the roller assemblies will not engage the guide rails **186** and **188.** However, the pusher members **222,224** will not fall when retracted but instead, will be lowered. Lowering of the pusher members **222, 224** is effected by another cam mechanism which includes a pair of horizontally extending stationary cam tracks **254,254***a* each of which has a horizontally extending cam surface **255,255***a* and an inclined curved cam surface **256,256***a* at the forward end thereof which extends upwardly from the cam surface **255,255***a* to a seat **257, 257** *a.* This cam track **254,254***a* is engaged by a second cam follower **260,260***a* mounted adjacent each end of the bar **230.** When the forward roller of each roller assembly **244,245** engages on the seat **250,** the second cam follower **260,260***a* will positioned over and on one of the seats **257,257***a.* Then, when the pusher mechanisms **109** and **220** are retracted on a return stroke thereof, the cam followers **260,260***a* will ride on the cam surfaces **256,256**a and **255,255***a* of the cam tracks **254,254***a.* With this arrangement, the pusher members **222** and **224** are smoothly lowered below the flap folding station **16** and then retracted rearwardly of the machine **10** beneath the flap folding station **16** to their initial position between the blank folding station **14** and the flap folding station **16** as shown in FIG. **7.**

As best shown in FIGS. **5** and **6,** the cam track **234***a* has two hook-shaped runners **261** fixed thereto which ride on the cam surface **255***a* of the cam track **254***a* and which support the cam track **234***a* on the cam track **254***a.* Although not shown, it will be understood that similar runners are fixed to the cam track **234** for slidingly supporting the cam track **234** on the stationary cam track **254.**

To facilitate engagement of the pusher members **222** and **224** with the rearwardly facing end wall of a carton of a partially formed package **36** at the flap folding station **16,** each of the pusher members **222,224** includes a jaw formation **262,264.** Jaws **262** and **264** are substantially identical so that only the jaw **262** will be described in detail. As shown in FIG. **6,** jaw **262** has a first surface **265** and a second surface **267** which are oriented 90° one relative to the other and which form the jaw **262** with a generally V-shape. The surfaces **265** and **267** are formed on the pusher members **222** and **224** in such a manner that when the pusher members **222,224** are in a package engaging position, the first jaw surface **265** is generally horizontal to engage the underside of a partially formed package **36** at the flap folding station and the second jaw surface **267** is generally vertical to engage the rearwardly facing end wall of the partially completed package **36.** A guide flange **269** extends angularly outwardly and forwardly from the flange surface **267** for guiding the corners of a partially completed package into engagement with the jaws **262** and **264** of the second pusher mechanism **220.**

As previously described, the rearwardly facing end wall panel **27** has end flaps **27***a* and **27***b* connected thereto which are folded inwardly of the side wall pan-

els 25 and 26. As a result there is a corner of space at each rear corner of the partially completed package 36. This corner of space results from the fact that the end edge of each side wall panel 25 and 26 is spaced forwardly of the rearwardly facing outer surface of the end wall 27. As a result, if the adhesive between the end flaps 27*a* and 27*b* and the side wall panels 25 and 26 has not sufficiently set or cured when the jaw surfaces 267 engage the end wall 27, the end wall 27 could be pushed inwardly of the partially formed package 36. To prevent such deformation of the partially formed package 36 and to maintain the corners of the partially formed package 36 properly squared, each of the jaws 262 and 264 has a rib 270 at the corner or junction between the guide flange 269 and the second jaw surface 267. This rib will fit into the corner space referred to above and will engage the rear edge of each side wall panel 25 and 26 thereby to maintain the second jaw surfaces 267 spaced rearwardly of the end edge of each of the side wall panels 25 and 26 and to prevent the vertically extending jaw surfaces 267 from pushing the end wall panel 27 inwardly of the partially formed package 36.

After a first blank 22 has been folded in the blank folding station 14 and the thus partially formed carton 81 is moved to the flap folding station 16, a next succeeding blank 22 is placed over the entrance opening 21. When the carriage 62 brings the next succeeding blank 22 downwardly into the machine 10, the cam tracks 234, 234*a* are moved forwardly to raise the pusher members 262 and 264 of the second pusher mechanism to their package-engaging position. Then when the first pusher mechanism 109 pushes the partially formed carton 81 to the flap folding station 16, the second pusher mechanism 220 moves the partially formed package 36 at the flap folding station 16 to the package complete station 18. This is best shown in FIG. 2 where a partially formed carton 81 is on the platform 110 in the blank folding station 14 and a partially completed package 36 is at the flap folding station 16. Note that the pusher members 222 and 224 are in the raised package-engaging position ready to engage and move a partially formed package 36 to the package completion station 18. In FIG. 2, a completed package is shown at the package completion station 18. Operation of the pusher mechanisms 109 and 220 will result in the movement of the carton 82 to the position of the partially formed package 36 at the same time the partially formed package 36 is moved to the position of the completed package 38. After the pusher members 222 and 224 have completed their forward stroke of movement and actuate a limit switch to begin the rearward stroke of movement, an end flap folding and sealing mechanism 280 (FIGS. 2 and 9) is operated.

Referring to FIG. 9, the flap folding and sealing mechanism 280 includes an adhesive applying device 286 and a flap closing device 288. The end flap folding and sealing mechanism 280 also includes a pressure applying roller assembly 290 for applying pressure to the end margin of the top wall panel 32 adjacent the end flap 37. The assembly 290 includes a plurality of rollers 292 which is mounted on a shaft 293 which is movable vertically in mounting brackets 294 which depend from a framework 296. The framework 296 is secured to a crossbeam which extends between and is secured to two plates, one of which is shown at 299. The crossbeam 298 and the plates 299 form part of the vertically adjustable framework mounting the tucker mechanisms 195 and 196. This framework also mounts the end flap folding and sealing mechanism 280. A spring mechanism 300 extends between the mounting framework 296 and a plate 301 situated above the rollers 292 for resiliently urging the plate 301 and rollers 292 downwardly. When a partially formed package 36 is moved into the package completion station 18 by moving the same into the rear end of the compression chamber 40, the spring biased rollers 292 will engage the top wall panel 32 of the partially formed package 36 and press downwardly thereon. When the pusher members 222 and 224 have completed their forward stroke, the spring biased rollers 292 will be pressing upon the end margin of the top wall panel 32 adjacent the end flap 37 as best shown in FIG. 2. With this arrangement, the roller assembly 290 urges the inner surface of the top wall panel 32 against the top edge of the end wall panel 27 thereby frictionally to hold the end wall panel 27 in place.

The adhesive applying device 286 includes a carriage 304 which is mounted for reciprocal movement on two guide shafts 305 and 306 which are secured to and extend between the plates 299. The carriage 304 is moved by a cable 307 which extends between pulleys mounted to and beneath a frame member 309 which also extends between and is secured to the plates 299. One of the pulleys is shown in FIG. 9 and identified by the reference numeral 308. Although not shown it will be understood that the ends of the cable 307 are connected to a piston rod which is movable in a direction parallel to the cable 307 underneath the frame member 309. This piston rod extends from a pneumatically or hydraulically operated cylinder and the delivery of pressurized fluid to the cylinder is throttled for controlling the speed of movement of the carriage 304.

A bracket 310 mounting a guide roller 311 extends outwardly from the carriage 304. The roller 311 rides on the upper surface of the cross beam 298. An L-shaped bracket 312 extends downwardly and forwardly from the carriage 304 for supporting a sprayhead 314. As shown, the outer end 315 of the bracket 312 is rounded and is spaced from the sprayhead 314. The end 315 forms a guide bar which engages the end wall panel 27 of a partially completed package 36 as the carriage 304 travels across the package completion station 18.

Operation of the adhesive applying device 286 is initiated when the pusher mechanisms 109 and 220 being their return stroke; then, the device 286 crosses the package completion station and guide bar 315 engages the end wall 27 of the partially formed package 36 and forces the end wall 27 slightly inwardly, particularly if the end wall 27 is slightly bowed at the mid-portion thereof. In this way the guide bar 315 maintains the end wall 27 at a predetermined distance from the sprayhead 314 as the sprayhead 314 travels across the package completion station 18. The sprayhead 314 is operated by a cam mechanism 316 which will be described below, to apply adhesive to selected locations along the lateral extent of the end wall 27. The roller assembly 290 holds the end wall 27 in place after it is moved by the guide bar 315 by reason of the frictional engagement between the undersurface of the top wall panel 32 and the upper edge of the end wall 27.

The cam mechanism 316 includes an adjustable cam track mechanism 317 which is mounted on frame mem-

ber **309** and which extends across the package completion station **18.** The mechanism **316** also includes a cam follower **318** mounted on the carriage **304.** The cam track mechanism **317** is similar to the cam track mechanism **162** shown in FIG. **10** and includes a plurality of capstan blocks **319** which are releasably mounted on frame member **309** and a cable **320** which is trained about the capstan blocks **319** so that a portion **320***a* of the cable **320** is in the path of movement of the cam follower **318** and thereby forms a cam track. The cable **320** is secured at one end **320***b* as shown in FIG. **9.** Although not shown, the other end of the cable **320** is adjustably secured to the frame member **309** such as by an overcenter toggle locking device similar to the device **182** shown in FIG. **10.** In this way the cable **320** an be slackened for adjusting the length and position of the cam track **320***a* and then can be tightened for fixing the cam track **320***a* in place. Accordingly, as the carriage **304** traverses the package completion station **18,** the cam follower **318** will engage the cam track **328** at selected locations along the length of the frame member **309** for operating the sprayhead **314** and applying adhesive to selected locations along the lateral extent of the end wall panel **27** of each partially formed package **37** after it arrives at the package completion station **18.**

After the carriage **304** completes its traverse of the package completion station **18** it engages one of two limits switches located at each side of the package completion station for operating the flap folding device **288.** One such limit switch is identified by the reference numeral **321** in FIG. **9.** The device **288** includes a bar **322** which has an L-shaped cross section. The bar **322** extends across the package completion station **18** and is rotatably journalled at each end, one journalled end **323** being shown in FIG. **9.** The bar **322** is rotatable so that an elongate flat surface **324** on the bar **322** can be rotated downwardly into engagement with the end flap **37** to force the end flap **37** against the upper margin of the end wall panel **27** to which adhesive has just been applied by the sprayhead **314.**

As best shown in FIG. **2** a bracket **325** is fixed to the bar **322** and the outer end of a piston rod **326** extending from a piston and cylinder mechanism **327** is connected to the bracket **325** in such a way that movement of the rod **326** causes rotation of the bar **322.** Operation of the cylinder device **327** is controlled by the limit switches **321.**

The folding downwardly of the flap **37** by the flap folding device **288** completes the formation of the package **38.** To assist the setting of the adhesive between the end flap **37** and the end wall **27,** the bar **22** is maintained in the downwardly rotated position engaging the end flap **37** until a succeeding partially formed package is moved onto an apron **329** which receives and guides each partially formed package into the compression chamber **40.** A limit switch **330** is mounted on the apron **329.** When a partially completed package **36** being pushed by the second pusher mechanism **220** engages the limit switch **330** the cylinder device **327** is operated to rotate the bar **322** upwardly.

As one of the partially formed packages **36** is being moved from the flap folding station **16** to the package completion station **18,** it engages the back side of a completed package **38** at the package completion station **18.** When this occurs the front end wall panel **28** of the next succeeding partially formed package engages against the folded end flap **37** of the completed package **38** thereby maintaining pressure on the end flap **37** while the adhesive between the end flap **37** and the rear end wall **27** sets. The compression chamber **40** is of conventional design and includes side frames **340** and **342** in which are mounted, in a generally upright position, a plurality of pressure applying rollers **345** as best shown in FIG. **1.** A continuous belt or web **346** is trained around each row of rollers **345** on each side of the compression chamber **40** for facilitating movement of completed packages **38** through the compression chamber **40.** As a completed package **38** moves into the compression chamber **40** the sides of the package, namely the side flaps **33** and **34** engage the belts **346** and move the belts **346** on the rollers **345** while the rollers **345** are pressing against the sides of the completed package **38.** This is accomplished by providing an interference fit between the belts **346** and the sides of the package **38,** that is to say, the distance between the belts **346** is slightly less than the width of each completed package **38.**

As shown in FIGS. **1, 2** and **9** the compression chamber also includes a bottom wall **349** mounting a plurality of idler rollers **350** which facilitate travel of the packages **338** through the chamber **40.** As explained above, as each completed package **38** is moved into the compression chamber **40** pressure is applied to the package sides by the rollers **345.** This pressure against the package sides tends to impede movement of the completed packages **38** through the compression chamber **40.** As a result the succeeding packages will press against the end flaps **37** of the preceding packages and thereby hold the end flaps **37** in place. In this way, as each completed package travels through the compression chamber **40,** pressure is applied to the flaps **33, 34** and **37** of the package **38** to hold the flaps against the respective wall panels **25, 26** and **27** while the adhesive between the wall panels **25–27** and flaps **33, 34** and **37** sets.

It will be apparent that the completed packages **38** are intermittently moved through the compression chamber **40.** Specifically, they are indexed forwardly a distance equal to the length of one completed package each time the pusher mechanisms **109** and **220** complete a forward stroke.

The various folding, sealing and moving mechanisms and devices of the packaging machine **10** of the invention are adjustable to permit the machine **10** to form blanks of widely diverse sizes into cartons around articles of diverse configurations thereby to form respective packages of conforming configurations. In this respect the guiding and folding blocks **70–73** are adjustably mounted on the rods **74–77** so that they can be moved relative to the frame members **48** and **50** as desired. The bars **76** and **77** are mounted on the end plates **78** releasably secured to the frame members **48** and **50.** Likewise, the end plates **78** can be moved longitudinally of the machine **10** parallel to the longitudinal axis **19** for adjusting the positions of the bars **76** and **77** relative to the bars **74** and **75.** The positions of the suction cups **67** on the arms **64** and **66** also can be adjusted. The positions of the arms **64** and **66** can be adjusted by moving the brackets **82** on the plate **83.** As best shown in FIG. **6** the longitudinally extending frame member **158***a* is fixed to and extends between two legs **355** and **356** which in turn are supported on blocks **357** and **358.** Although not shown, the frame member **158**

is supported on similar blocks. The blocks **357** supporting the frame members **158** and **158***a* are received on a threaded shaft **360** which is secured to a sprocket **361** driven by a chain **362.** The blocks **358** supporting the other end of each of the frame members **158** and **158***a* are also received and supported on a screw threaded shaft which is identified by the reference numeral **363.** The shaft **363** is connected to a sprocket hidden from view around which the claim **362** is trained. As best shown in FIG. **1** the shaft **363** extends through the frame member **169** of the framework **42** and has a handwheel **365** connected to the outer end thereof. Rotation of the handwheel **365** will rotate shafts **363** and **361** and in this way move the frame members **158** and **158***a* closer or farther apart thereby to adjust the position of the adhesive applicators **150** and the guide rails **186** and **188.**

The positions of the blocks **111** and **113** can be adjusted on the frame members **115** and **116** to change the size of the platform **110** and to change the position of the pusher members **222** and **224.**

The framework which supports the tucker mechanisms **195** and **196** as well as the end flap sealing and folding mechanism **280** and which is defined in part by the crossbeam **298** and the end plates **299** is adjustably supported on four vertically disposed threaded shafts **371, 372, 373** and **374.** Although not illustrated in detail the guide shafts **213** and **214** extend between and are secured to the plates **299** for supporting the tucker mechanism **195** and **196.** The guiding and folding members **141–143** are secured to the framework defined by the crossbeam **298** and the end plates **299.** The upper ends of each of the threaded shafts **371** and **373** has a gear mounted thereon which is not visible in FIG. **1.** Extending between the frame members **48** and **50** is a drive shaft **375** which has a worm gear mounted adjacent each end thereof. One worm gear is partially shown in FIG. **1** and is identified by the reference numeral **376.** The drive shaft **375** extends through the frame member **50** and has a handwheel **378** connected to the outer end thereof.

Since the mounting of the threaded shafts **373** and **374** is the same as the mounting of the shafts **371** and **372** only the mounting of the shafts **371** and **372** will be described in detail with reference to FIG. **1.** The lower end of each of the shafts **371** and **372** is suitably journalled in a plate **380** which in turn is rigidly secured to the under side of a horizontally extending frame member **382** of the framework **42.** The threaded shafts **371** and **372** extend through the plates **380** and each has a sprocket mounted on the depending lower end thereof. A chain **384** is trained around the sprockets which are hidden from view in FIG. **1** whereby rotation of the shaft **371** will cause corresponding rotation of the threaded shaft **372.** The shafts **371** and **372** are threadingly received through respective brackets **386** and **388** which are fixed to and support the plate **299.**

Rotation of the handwheel **378** will cause rotation of the drive shaft **377** which will rotate worm gears **376** to rotate shafts **371** and **373.** Such rotation of the shafts **371** and **373** will cause corresponding rotation of the shafts **372** and **374** by means of the chain **384.** Thus, all four of the threaded shafts **371–374** will be rotated simultaneously to raise or lower the framework defined in part by the crossbeam **298** and the plates **299.** In this way the guiding and folding members **141–143,** the flap tucker mechanisms **195** and **196** and the end flap folding and sealing mechanism **280** can be vertically adjusted simultaneously.

The cam mechanisms **164** and **316** are adjustable for adjusting the positions of the cam tracks **169** and **320***a.* Another handwheel **390** is mounted to a supporting framework **395** for the compression chamber **40** and is connected to a suitable screw thread mechanism connected to the side frames **340** and **342** in such a way that rotation of the handwheel will cause movement of the side frames **340** and **342** relative to one another.

The numerous adjustments for the mechanisms and devices of the machine **10,** many of which have been described above, permit the machine **10** to process packages of different sizes rendering the machine **10** versatile and adaptable for many different packaging operations.

It will be understood that variations and modifications to the machine **10** will occur to those skilled in the art without departing from the spirit or scope of the invention. Accordingly the invention is only to be limited as necessitated by the following claims.

What it is desired to secure by Letters Patent of the United States is:

1. A packaging machine for folding a paperboard blank into a carton about one or more articles to be packaged, said packaging machine comprising a blank folding station where a blank with one or more articles arranged thereon is partially folded to erect, from the blank, end wall panels and side wall panels of the carton; a flap folding station where side flaps extending from a top wall panel of the partially formed carton are folded against the side wall panels; a package completion station where an end flap of the carton is folded against at least one end wall panel of the carton; first pusher means operable on a forward stroke thereof to push the partially formed carton from said blank folding station to said flap folding station during which movement of the partially formed carton a top wall panel of the carton is folded downwardly over the article or articles; and second pusher means articulated to said first pusher means and operable therewith on said forward stroke to push a partially formed package from said flap folding station to said package completion station at the same time a subsequent partially formed carton is being pushed by said first pusher means from said blank folding station to said flap folding station, said station being arranged in line with the direction of movement of said first and second pusher means.

2. The packaging machine according to claim **1** including means for moving said second pusher means to a position where said second pusher means will travel in a path which does not engage the partially formed package at the flap folding station during a return stroke of said first and second pusher means.

3. The packaging machine according to claim **2** wherein said means for moving said second pusher means is operable to move said second pusher means to a position where said second pusher means will travel under a partially completed package at said flap folding station during said return stroke of said first and second pusher means.

4. The packaging machine according to claim **1** including means for holding said second pusher means in a package engaging position prior to and during said forward stroke of said second pusher means, and means

for lowering said second pusher means after completion of said forward stroke.

5. The packaging machine according to claim 4 wherein said means for holding said second pusher means in a package engaging position during said forward stroke of said second pusher means includes at least one guide rail extending in said given direction and at least one roller assembly mounted on said second pusher means and situated so as to engage and ride on said guide rail during said forward stroke of said first and second pusher means.

6. The packaging machine according to claim 5 wherein said packaging machine includes at least one seat spaced from the forward end of said guide rail and located at said package completion station for receiving and holding said roller assembly at the completion of said forward stroke of said second pusher means.

7. The packaging machine according to claim 4 wherein said means for lowering said second pusher means includes at least one cam follower mounted on said second pusher means and a cam track which extends between said stations and on which said cam follower rides during a return stroke of said second pusher means, said cam track having a first, horizontally extending cam surface which extends beneath said flap folding station and a second inclined cam surface which extends upwardly from said first cam surface at said package completion station to a position where it receives said cam follower when said second pusher means begins said return stroke.

8. The packaging machine according to claim 7 wherein said second pusher means has a second cam follower mounted thereon, said blank folding station includes a generally vertically reciprocable carriage which is operable to carry a paperboard blank downwardly into said machine past stationary folding members for erecting the side and end wall panels, and a reciprocable cam track is operatively connected to said carriage and is moved forwardly in said given direction when said carriage is moved downwardly, said cam track having a cam surface which engages and raises said second cam follower during said forward movement to lift said second pusher means to a package engaging position.

9. The packaging machine according to claim 1 wherein said second pusher means are initially in a lowered position and said packaging machine includes means for raising said second pusher means to a package engaging position prior to said forward stroke thereof.

10. The packaging machine according to claim 9 wherein said blank folding station includes first means for folding a blank about two pairs of score lines to erect, from the blank, side and end wall panels of the carton, said first means being operatively connected to said means for raising said second pusher means in such a manner that operation of said first means causes operation of said raising means.

11. The packaging machine according to claim 9 wherein said raising means includes a cam follower on said second pusher means and a movable cam track which is mounted for movement to and from said blank folding station and which has a cam surface which engages and raises said cam follower during outward movement of said cam track from said blank folding station to lift said second pusher means to said package engaging position.

12. A packaging machine according to claim 1 wherein said second pusher means includes two spaced apart pusher members each having a first end pivotally connected to said first pusher means and a second end adapted to engage a corner of a partially formed package.

13. The packaging machine according to claim 12 wherein a bar extends transversely of and between said pusher members and is connected to said pusher members.

14. The packaging machine according to claim 13 wherein at least one cam follower is mounted on said bar, and said machine includes a movable cam track operable upon movement thereof to engage and raise said cam follower to lift said pusher members to a package engaging position.

15. The packaging machine according to claim 13 wherein at least one cam follower is mounted on said bar and said machine includes a cam track extending between said stations and having a first, horizontally extending cam surface located beneath said flap folding station and a second inclined cam surface at said package completion station, said second cam surface extending upwardly from said first cam surface to a position for receiving said cam follower at the beginning of a return stroke of said pusher members.

16. The packaging machine according to claim 13 wherein each pusher member has a roller assembly mounted thereon, said flap folding station has two guide rails extending substantially the length thereof and terminating at said package completion station, a first pair of cam followers are mounted on said bar, one at each end of said bar, said machine includes two spaced apart movable cam tracks operable to engage and raise said cam followers to lift said pusher members to a package engaging position and to lift said roller assemblies to a position in line with said guide rails, said cam followers engaging said cam track during at least a portion of each forward stroke of said pusher members and at least until said roller assemblies are above said guide rails, a second pair of cam followers are mounted on said bar, one at each end of said bar, and said machine includes two spaced apart stationary cam tracks each extending between said stations and each having a first horizontally extending cam surface located beneath said flap folding station and a second inclined cam surface at said package completion station, said second cam surface extending upwardly to a position for receiving one of said second cam followers at the beginning of a return stroke of said pusher members.

17. The packaging machine according to claim 12 wherein each of said pusher members has a jaw at the free end thereof, said jaw being generally V-shaped and having first and second jaw surfaces which are constructed in such a manner that when said pusher members are, in a package engaging position, said first jaw surface is generally horizontal to engage the underside of a partially formed package and said second jaw surface is generally vertical to engage one end wall of the partially formed package.

18. The packaging machine according to claim 17 wherein a guide flange extends angularly outwardly from each second jaw surface, said guide flanges being adapted to guide a partially completed package into engagement with said pusher members as said pusher

members are moved into engagement with the partially completed package at said flap folding station.

19. The packaging machine according to claim **18** wherein a rib is situated at the inside corner of the junction between each guide flange and each second jaw surface, each of said ribs being in position to engage the end edge of one of the side wall panels of the partially completed package and bear thereagainst when said pusher members are moved forwardly, thereby to prevent the vertically disposed second jaw surfaces from pushing the rearwardly facing end wall of the partially completed package inwardly of the side wall panels during said forward stroke of said pusher members.

20. The packaging machine according to claim **1** including means for applying an adhesive to the side wall panels of each partially formed carton while said first pusher means is moving the partially formed carton from said blank folding station to said flap folding station.

21. The packaging machine according to claim **20** wherein said adhesive applying means includes a pair of spaced apart adhesive applicators and cam means for controlling operation of said applicators.

22. The machine according to claim **21** wherein said cam means includes a cam track mechanism which has an adjustable cam track and which is movable with said first pusher means and a cam follower.

23. The packaging machine according to claim **22** wherein said cam track mechanism includes a cam track holder, capstan blocks releasably mounted in said holder, a cable trained around said capstan blocks and forming said cam track which engages said cam follower, and means for adjusting the tension on said cable whereby the cable can be made slack to permit adjustment of the position of the capstan blocks and then can be made taut to form said cam track.

24. The packaging machine according to claim **1** wherein said flap folding station includes means for folding side flaps hingedly connected to the top wall panel of a partially formed carton downwardly into engagement with the side wall panels, said means including first and second tuckers which are mounted for movement to and from positions adjacent the side walls of a partially formed carton at said flap folding station, said tuckers being operable to engage and move the side flaps hingedly connected to the top wall panel downwardly into engagement with the side wall panels of the partially formed carton, and being operable to hold the side flaps in engagement with the side wall panels while the carton, now forming part of a partially formed package, is at said flap folding station.

25. The packaging machine according to claim **1** wherein said package completion station includes a flap folding mechanism for folding an end flap extending from the top wall panel of a partially formed package downwardly into engagement with one end wall of the partially formed package thereby to complete the package.

26. The packaging machine according to claim **25** including means for applying adhesive to the one end wall at selected locations along the lateral extent thereof prior to the operation of said flap folding mechanism.

27. The packaging machine according to claim **26** wherein said adhesive applying means includes a carriage mounting an adhesive applying head, means for moving said carriage at a predetermined speed in a direction transversely of said partially formed package and means for operating said head at selected intervals of travel of said carriage during each stroke movement of said carriage between opposite sides of said package completion station for applying adhesive to the one end wall at selected locations along the lateral extent of the one end wall.

28. The packaging machine according to claim **27** wherein said carriage is mounted on a bar extending transversely of the direction of movement of said pusher means.

29. The packaging machine according to claim **27** wherein said carriage is operated by said moving means at the beginning of the return stroke of said second pusher means.

30. The packaging machine according to claim **27** wherein said carriage has a guide bar extending horizontally therefrom parallel to the direction of movement of said pusher means, said guide bar having a rounded free end for slightly engaging and riding along the upper margin of the one end wall of the partially completed package as said carriage is moved across said package completion station to maintain the one end wall spaced a predetermined distance from the adhesive applying head while the carriage is moving across said package completion station.

31. The packaging machine according to claim **27** including cam means for controlling the operation of said adhesive applying head.

32. The packaging machine according to claim **31** wherein said cam means includes means for forming a cam track which extends across said package completion station, and a cam follower on said carriage.

33. The packaging machine according to claim **32** wherein said cam track forming means includes a cam track holder, a plurality of releasably mounted capstan blocks in said holder, a cable trained about said capstan blocks and forming said cam track, and means for adjusting the tension on said cable for permitting adjustment of said capstan blocks to adjust the locations of said cam track.

34. The packaging machine according to claim **30** wherein said package completion station includes means for applying pressure against the margin of the top wall panel adjacent the end flap so that the inner surface of the top wall bears against the top edge of the one end wall, whereby, after the guide bar has been moved past the one end wall, the frictional engagement between the top edge of the one end wall and the top wall panel holds the one end wall in place while the end flap is folded thereagainst.

35. The packaging machine according to claim **25** wherein said package completion station includes means for applying pressure against the margin of the top wall panel adjacent the end flap so that the inner surface of the top wall panel bears against the top edge of the one end wall to prevent the one end wall from being forced inwardly of the package when the end flap is folded thereagainst.

36. The packaging machine according to claim **35** wherein said pressure applying means includes a plurality of spring biased rollers located above the path of travel of the packages and in position to engage and to bear against the top wall panel of a partially formed package at the package completion station.

37. The packaging machine according to claim **25** wherein said flap folding mechanism includes an elon-

gate bar which extends transversely of the direction of movement of said second pusher means and which has an elongate flat surface, and means for rotating said bar to bring said elongate flat surface into engagement with said end flap for moving said end flap into engagement with the upper margin of the one end wall.

38. The packaging machine according to claim **37** including control means for controlling rotation of said elongate bar, said control means being operable to rotate said bar upwardly at the beginning of said forward stroke of said second pusher means and to rotate said bar downwardly at the beginning of a return stroke of said second pusher means.

39. The packaging machine according to claim **1** wherein said package completion station includes a compression chamber into which partially completed packages are moved by said second pusher means, said compression chamber having means along the sides thereof for engaging and applying pressure against the folded side flaps of completed packages and for partially inhibiting forward movement of the packages so that a succeeding package pushed into the compression chamber by the second pusher means bears against the one end wall of the preceding package to apply pressure to the folded end flap of the preceding package, the movement of the preceding package being partially inhibited by said pressure applying side walls.

40. The packaging machine according to claim **1**, including at least one guiding and folding member which extends between said blank folding station and said flap folding station in position to engage the top wall panel of a partially formed carton when it is moved to said flap folding station, said guiding and folding member having an elongate portion which extends longitudinally across said blank folding station and a curved portion which extends upwardly from the elongate portion at said blank folding station so as to be in position to guide and fold the top wall panel of a partially formed carton downwardly in proper alignment with the side and end wall panels over the article or articles being packaged as the partially formed carton is moved to said flap folding station.

41. The packaging machine according to claim **40**, including a vertically adjustable framework situated at said flap folding station and mounting thereunder said at least one guiding and folding member, and means for vertically moving said framework whereby the vertical position of said framework can be changed to enable said machine to handle packages of different heights.

42. The packaging machine according to claim **1**, wherein said first pusher means includes a supporting framework and an adjustable platform mounted on said framework, said platform being laterally adjustable for adjusting the width of said first pusher means and also said second pusher means connected thereto whereby said packaging machine can be easily adapted for forming packages of different widths.

43. The packaging machine according to claim **5**, including an adjustable mechanism for supporting said at least one guide rail, and means for adjusting said mechanism to change the position of said at least one guide rail laterally of the longitudinal axis of said machine.

44. The packaging machine according to claim **13**, wherein said pusher members are slidably mounted on said bar so that the position of said pusher members relative to each other can be easily adjusted by sliding said pusher members on said bar.

45. The packaging machine according to claim **16**, wherein each of said guide members is mounted on a longitudinally extending frame member, each frame member being supported at each end thereof on a block which is screw threadedly received on a threaded shaft and wherein said machine includes means for rotating said threaded shafts simultaneously to move said frame members closer or farther apart and thereby change the positions of said guide rails.

46. The packaging machine according to claim **21**, wherein each of said adhesive applicators is supported on an adjustably mounted frame member and wherein said machine includes means for moving said frame members closer or farther apart thereby to adjust the positions of said adhesive applicators.

47. The packaging machine according to claim **24**, including a vertically adjustable framework mounted at said flap folding station and said flap folding means being supported by said framework whereby the height of said flap folding means can be adjusted for packages of different heights.

48. The packaging machine according to claim **24** wherein a vertically adjustable framework is mounted at said flap folding station and each of said tuckers is releasably supported on a bar extending laterally across said machine whereby the distance between said tuckers can be easily adjusted by sliding said tuckers on said bars.

49. The packaging machine according to claim **26**, wherein said flap folding mechanism and said adhesive applying means are supported on a vertically adjustable framework and said machine includes means for vertically moving said framework.

50. The packaging machine according to claim **39**, wherein said compression chamber includes spaced apart pressure applying sidewalls and means for moving said sidewalls closer or farther apart thereby to adjust the pressure applied by said sidewalls to completed packages and to enable the compression chamber to handle packages of different widths.

51. A packaging machine operable to form paperboard blanks into cartons about one or more articles to be packaged, said machine being of the type having an entrance opening over which a paperboard blank is placed, a carriage which is movable to and from said entrance opening, which receives the blank thereon, and which has means for holding the blank thereto during movement thereof, means adjacent said entrance opening for guiding the blank during its movement with said carriage in a first direction and for folding the blank into a partially formed carton as it is carried downwardly into said machine on said carriage, and first pusher means for pushing the partially formed carton from said carriage in a second direction laterally of said first direction to a flap folding station in said machine and past a stationary folding member which folds a top wall panel of the carton downwardly over the article or articles and which slidingly and frictionally engages the top wall panel to hold the same in place, and said machine including second pusher means articulated to said first pusher means and operable therewith to push a partially formed package from said flap folding station to a package completion station in said machine at the same time a subsequent partially formed carton is being pushed by said first pusher means from

said carriage to said flap folding station, said carriage, said flap folding station and said package completion station being arranged in line with the direction of movement of said first and second pusher means.

52. In a packaging machine which is operable to fold a blank into a carton about an article or articles to be packaged and which includes a blank folding station, a flap folding station, a package completion station, and first pusher means for pushing a partially formed carton from said blank folding station to said flap folding station, the improvement comprising second pusher means articulated to said first pusher means and operable therewith for moving a partially formed package from said flap folding station to said package completion station at the same time said first pusher means is moving a partially formed carton from said blank folding station to said flap folding station.

53. A method for folding paperboard blanks into cartons about one or more articles to be packaged, said method comprising the steps of: folding a paperboard blank with one or more articles arranged thereon at a blank folding station to erect, from the blank, end wall panels and side wall panels of the carton; moving the partially formed carton in a given direction from the blank folding station to a flap folding station while simultaneously folding a top wall panel of the carton downwardly over the article or articles; folding side flaps, which are hingedly connected to the top wall panel of the carton, against the side wall panels of the carton at the flap folding station; moving the partially formed package in the given direction from the flap folding station to a package completion station at the same time a subsequent partially formed carton is being moved from the blank folding station to the flap folding station; moving an adhesive applicator transversely of said partially formed package and adjacent to one end wall thereof and operating said applicator to apply adhesive to said one end wall at selected locations along the lateral extent of said one end wall while simultaneously moving a guide member along and slightly in engagement with said one end wall to maintain said one end wall spaced a predetermined distance from said adhesive applicator; and folding an end flap hingedly connected to the top wall panel of the partially formed package against said one end wall, said stations being arranged in line with the given direction.

54. The method according to claim **53** including the step of applying pressure against the margin of said top wall panel adjacent said end flap so that the inner surface of said top wall panel bears against the top edge of said one end wall thereby, after said guide member has been moved past said one end wall, the frictional engagement between said top edge of said one end wall and said top wall panel holds said one end wall in place while said end flap is folded thereagainst.

55. A method of folding paperboard blanks into cartons about one or more articles to be packaged, said method comprising the steps of: folding a paperboard blank with one or more articles arranged thereon at a blank folding station to erect, from the blank, end wall panels and side wall panels of the carton; moving the partially formed carton in a given direction from the blank folding station to a flap folding station while simultaneously folding a top wall panel of the carton downwardly over the article or articles; folding side flaps, which are hingedly connected to the top wall panel of the carton, against the side wall panels of the carton at the flap folding station; moving the partially formed package in the given direction from the flap folding station to a package completion station at the same time a subsequent partially formed carton is being moved from the blank folding station to the flap folding station; folding an end flap hingedly connected to the top wall panel of the partially formed package against one end wall thereof; and applying pressure against the margin of the top wall panel adjacent said end flap so that the inner surface of said top wall panel bears against the top edge of said one end wall to prevent said one end wall from being forced inwardly of said package when said end flap is folded thereagainst, said stations being arranged in line with the given direction.

56. A method for folding paperboard blanks into cartons about one or more articles to be packaged, said method comprising the steps of: folding a paperboard blank with one or more articles arranged thereon at a blank folding station to erect, from the blank, end wall panels and side wall panels of the carton; moving the partially formed carton in a given direction from the blank folding station to a flap folding station while simultaneously folding a top wall panel of the carton downwardly over the article or articles; folding side flaps, which are hingedly connected to the top wall panel of the carton, against the side wall panels of the carton at the flap folding station; moving the partially formed package in a given direction from the flap folding station to a package completion station including a compression chamber at the same time a subsequent partially formed carton is being moved from the blank folding station to the flap folding station; folding an end flap hingedly connected to the top wall panel of the partially formed package against one end wall thereof; and intermittently pushing completed packages through said compression chamber and applying pressure against said folded flaps while said completed packages are in said compression chamber, said stations being arranged in line with the given direction.

57. A method for folding paperboard blanks into cartons about one or more articles to be packaged, said method comprising the steps of: folding a paperboard blank with one or more articles arranged thereon at a blank folding station to erect, from the blank, end wall panels and side wall panels of the carton with said end wall panels folded inwardly of said side wall panels; moving the partially formed carton in a given direction from the blank folding station to a flap folding station while simultaneously holding at least two edges of said side wall panels of each partially formed carton in a predetermined position relative to said one end wall and while simultaneously folding a top wall panel of the carton downwardly over the article or articles; folding side flaps, which are hingedly connected to the top wall panel of the carton, against the side wall panels of the carton at the flap folding station; moving the partially formed package in the given direction from the flap folding station to a package completion station at the same time a subsequent partially formed carton is being moved from the blank folding station to the flap folding station; and folding an end flap hingedly connected to the top wall panel of the partially formed package against one end wall thereof, said stations being arranged in line with the given direction.

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