Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 1 of 8

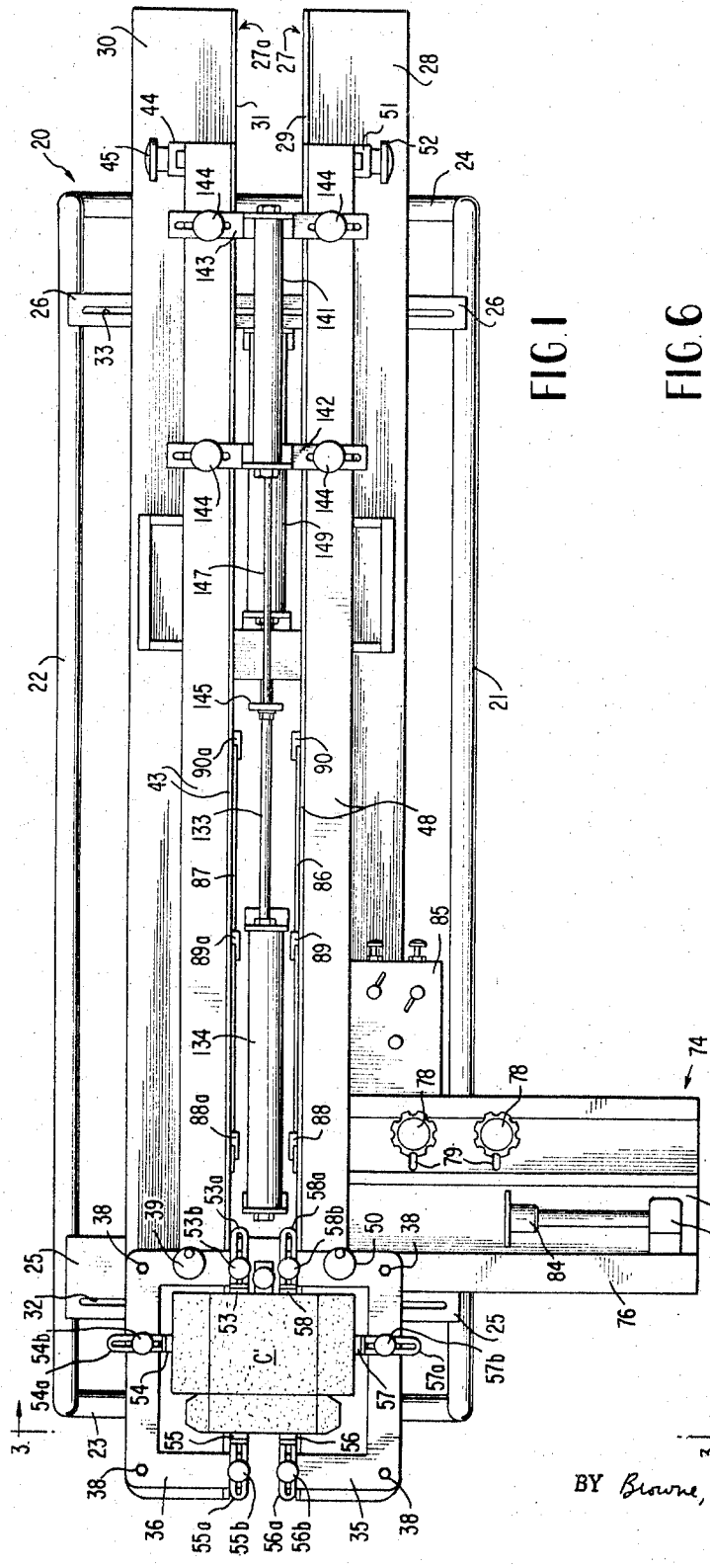


FIG. 1

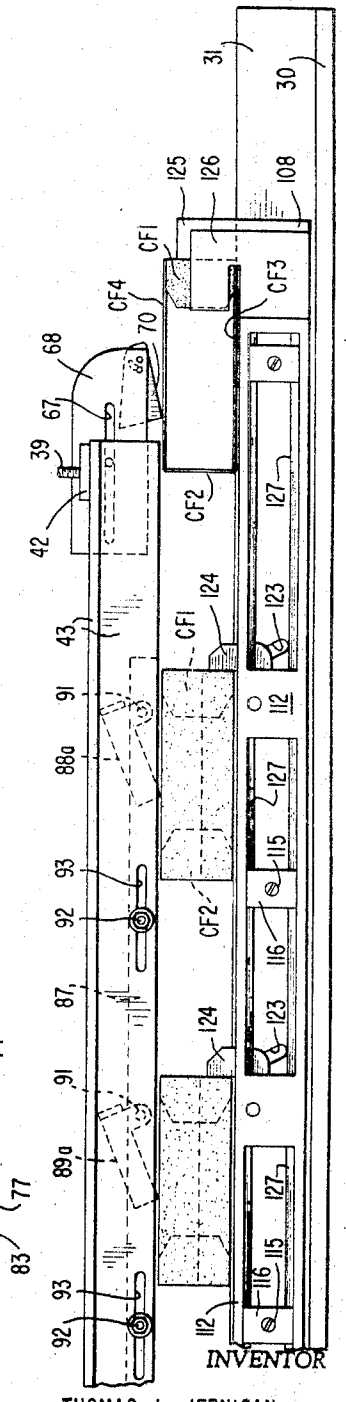


FIG. 6

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Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 2 of 8

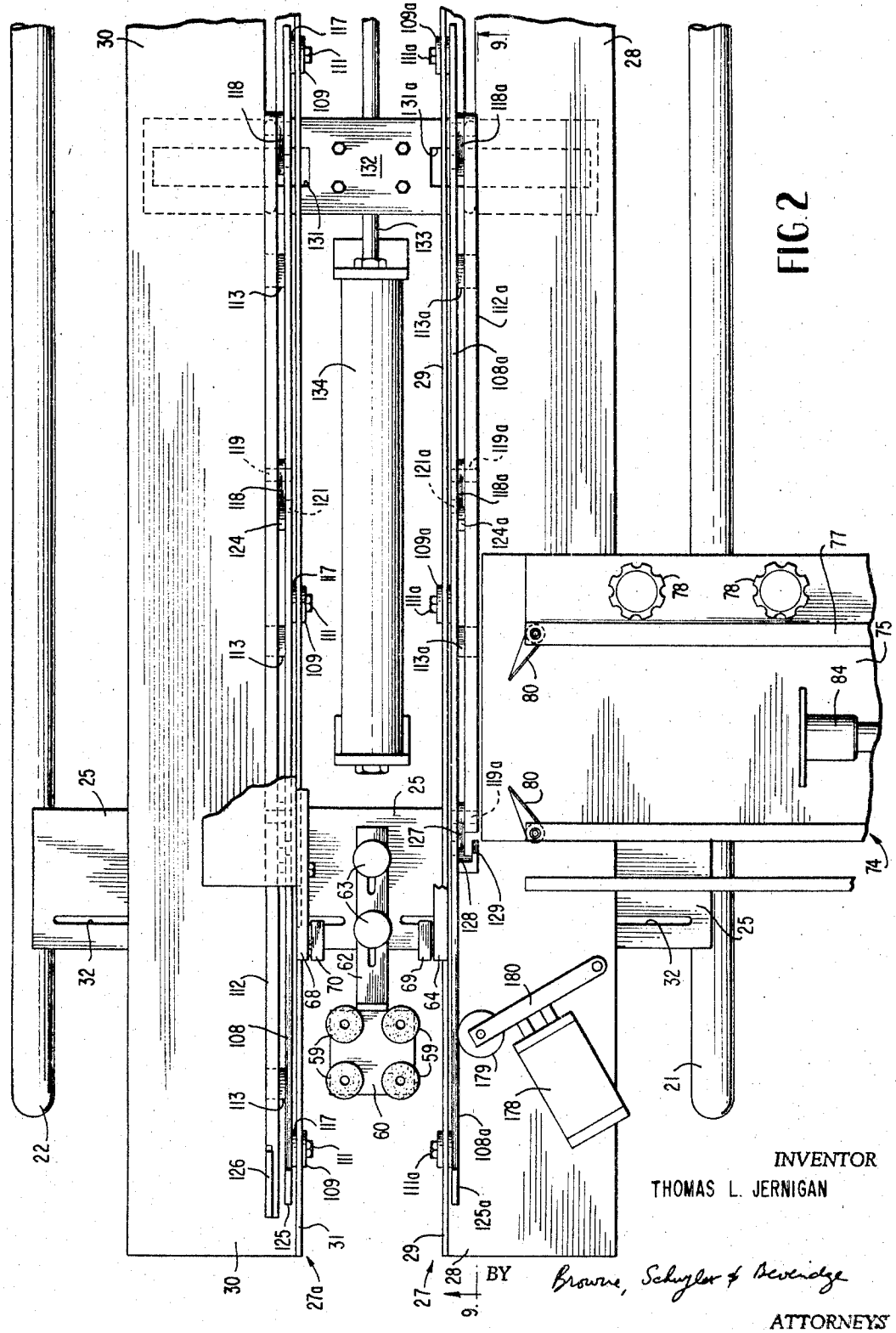


FIG. 2

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Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 3 of 8

FIG 3

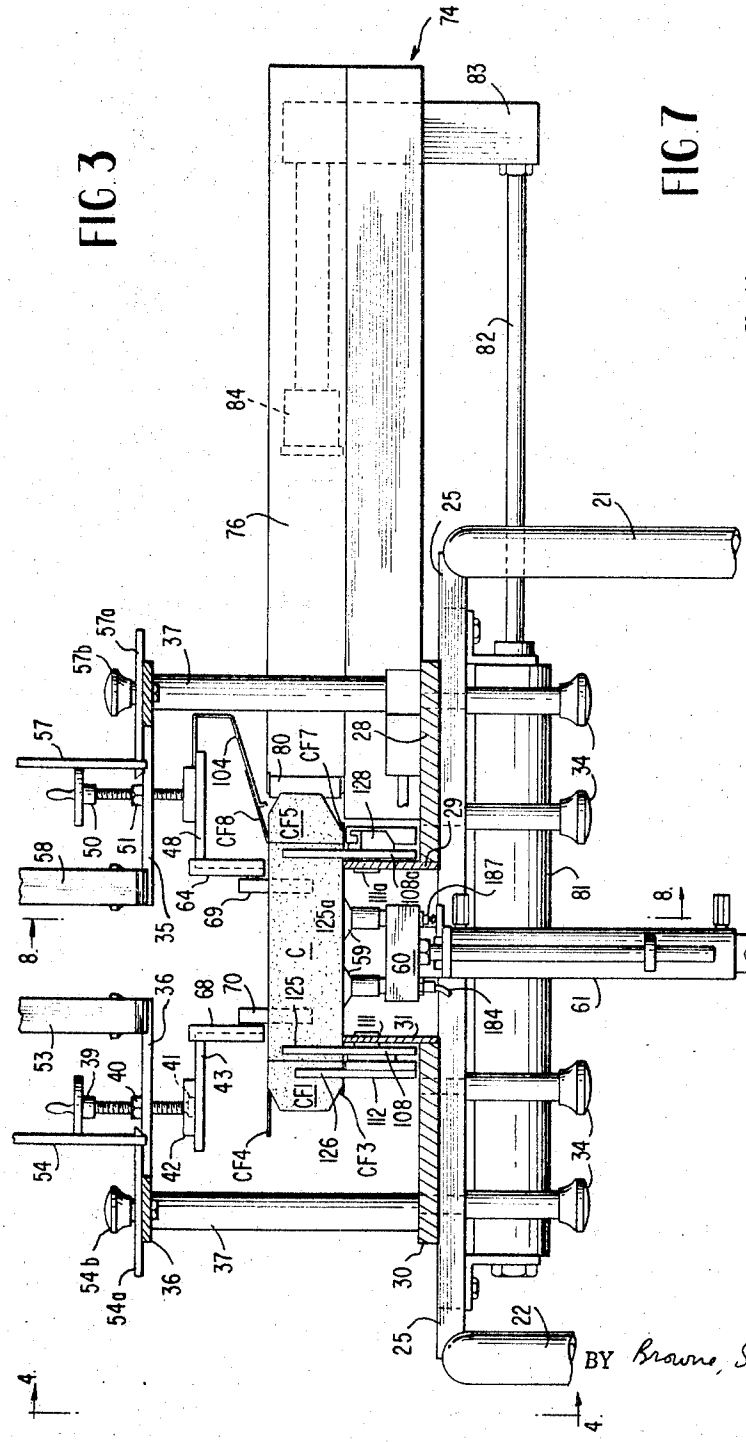
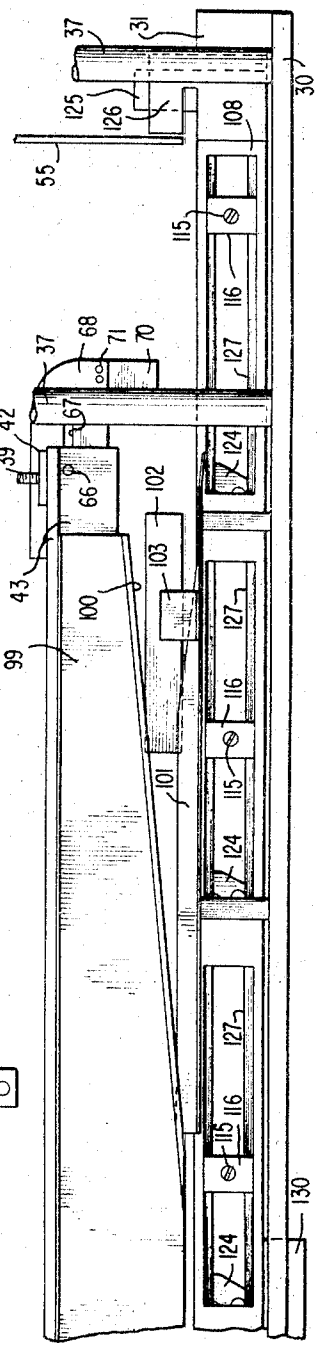


FIG 7



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Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 4 of 8

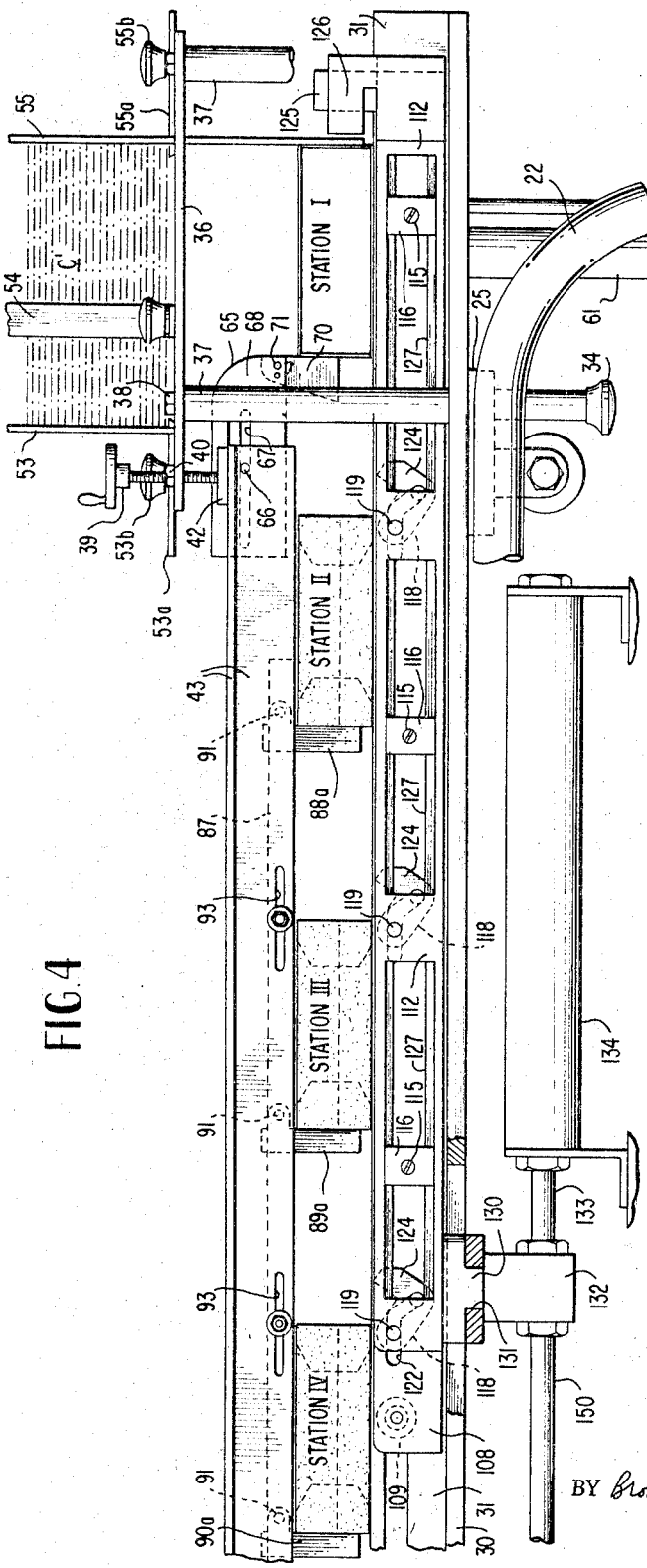


FIG. 4

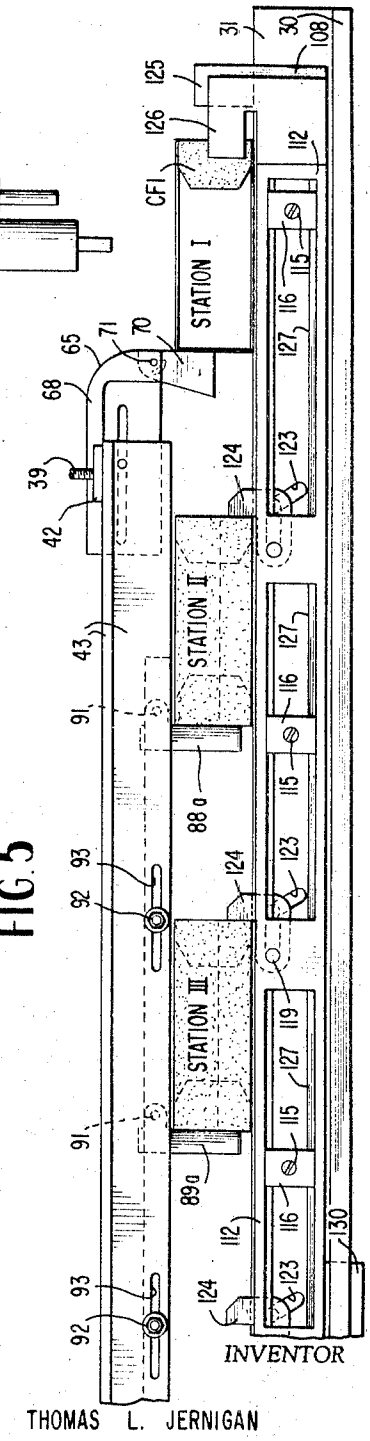


FIG. 5

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Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 5 of 8

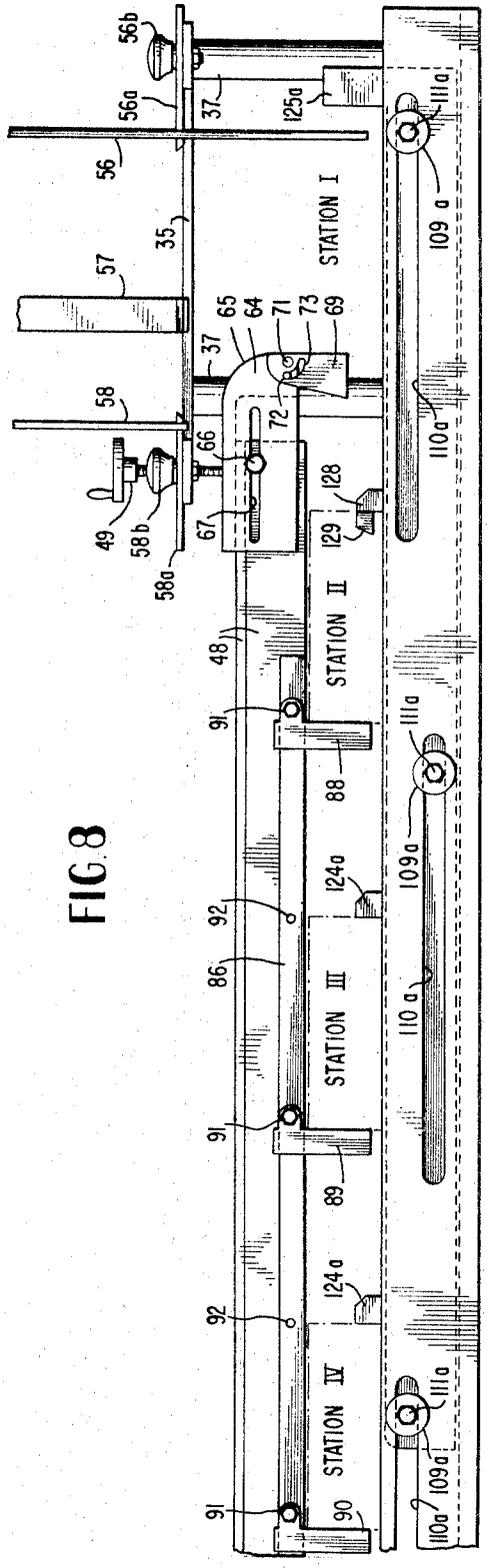


FIG. 8

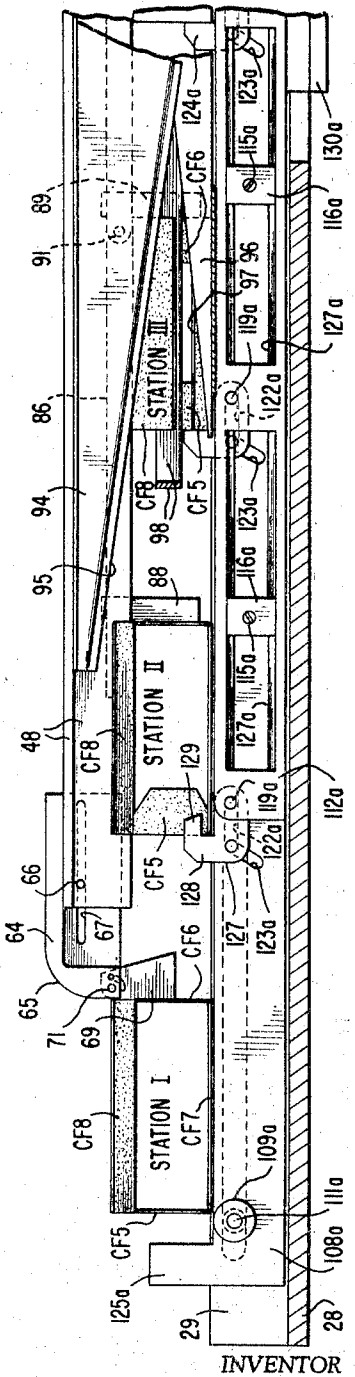


FIG. 9

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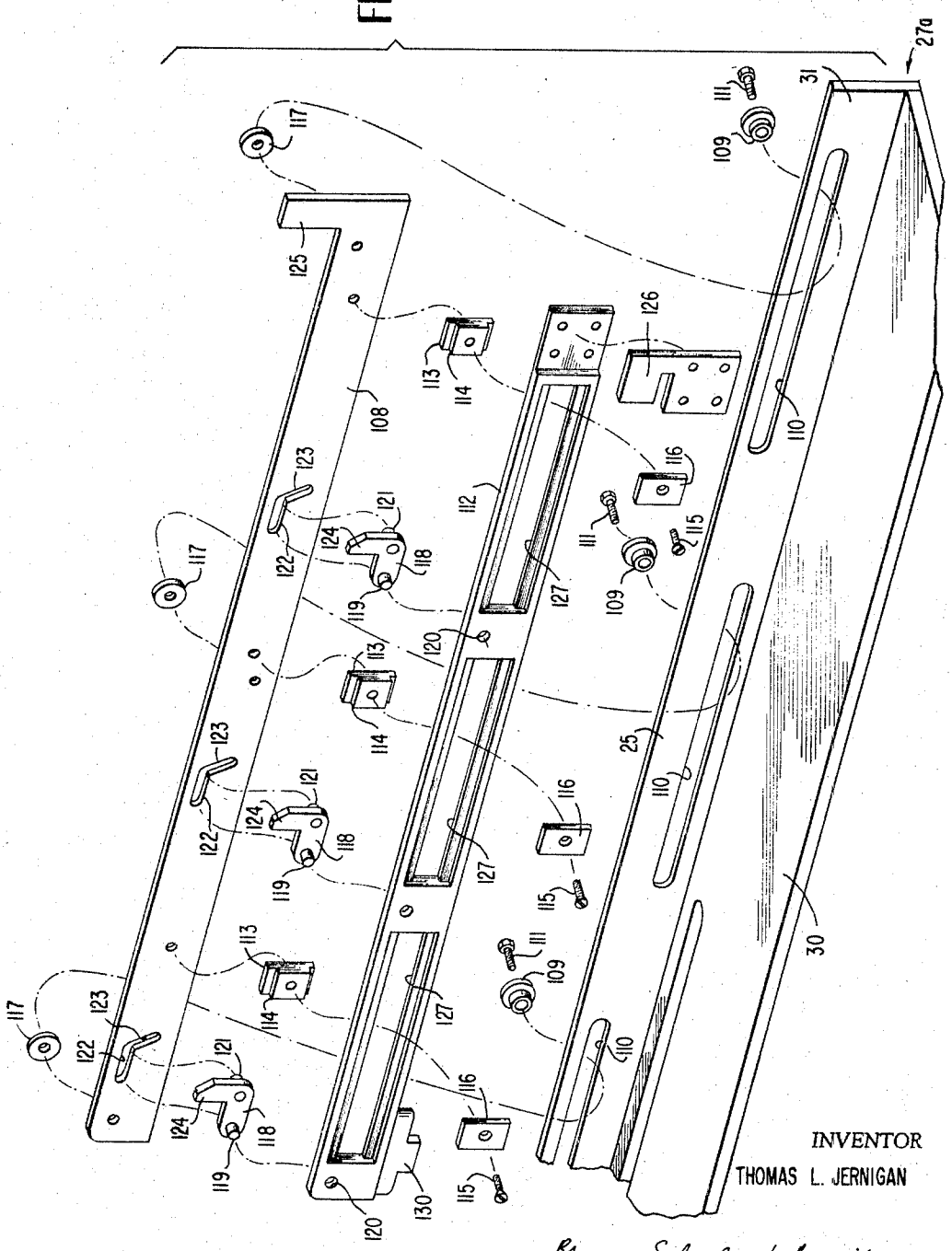
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Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 6 of 8

FIG. 10



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Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 7 of 8

FIG. 11

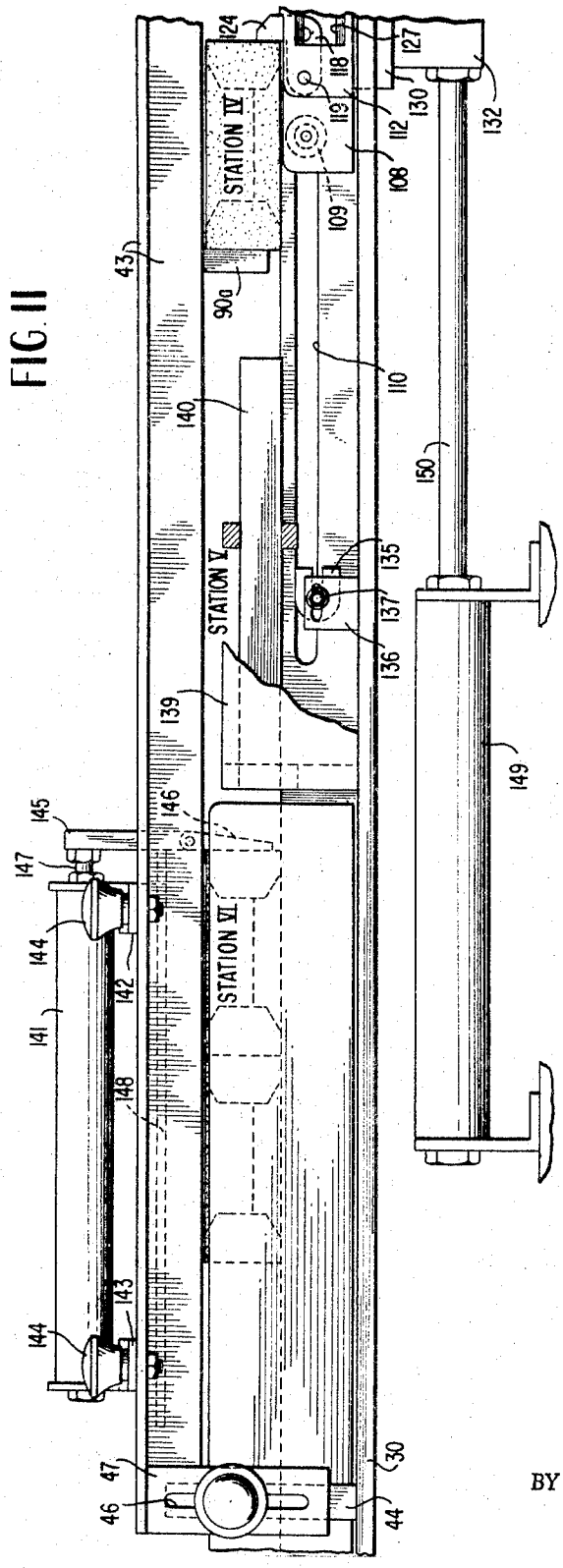
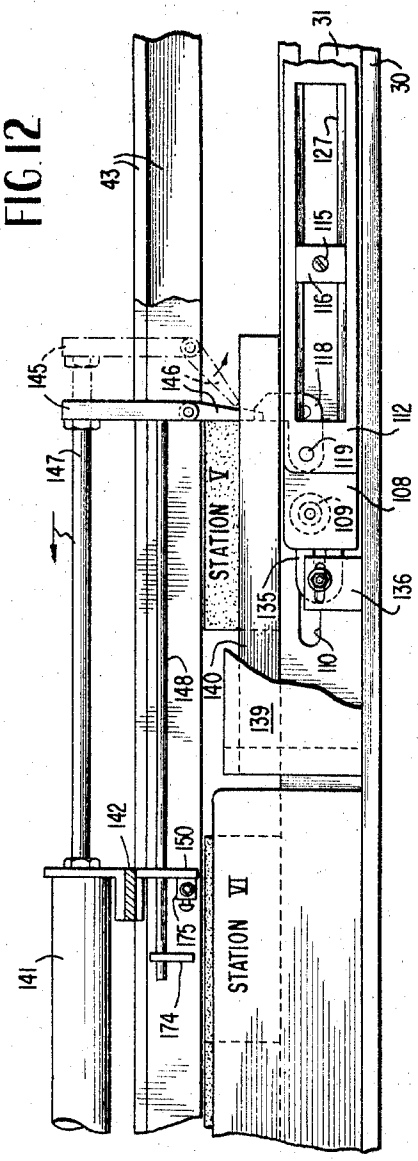


FIG. 12



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Feb. 11, 1969 T. L. JERNIGAN 3,426,506

CARTON FOLDING MACHINE

Filed Nov. 22, 1966 Sheet 8 of 8

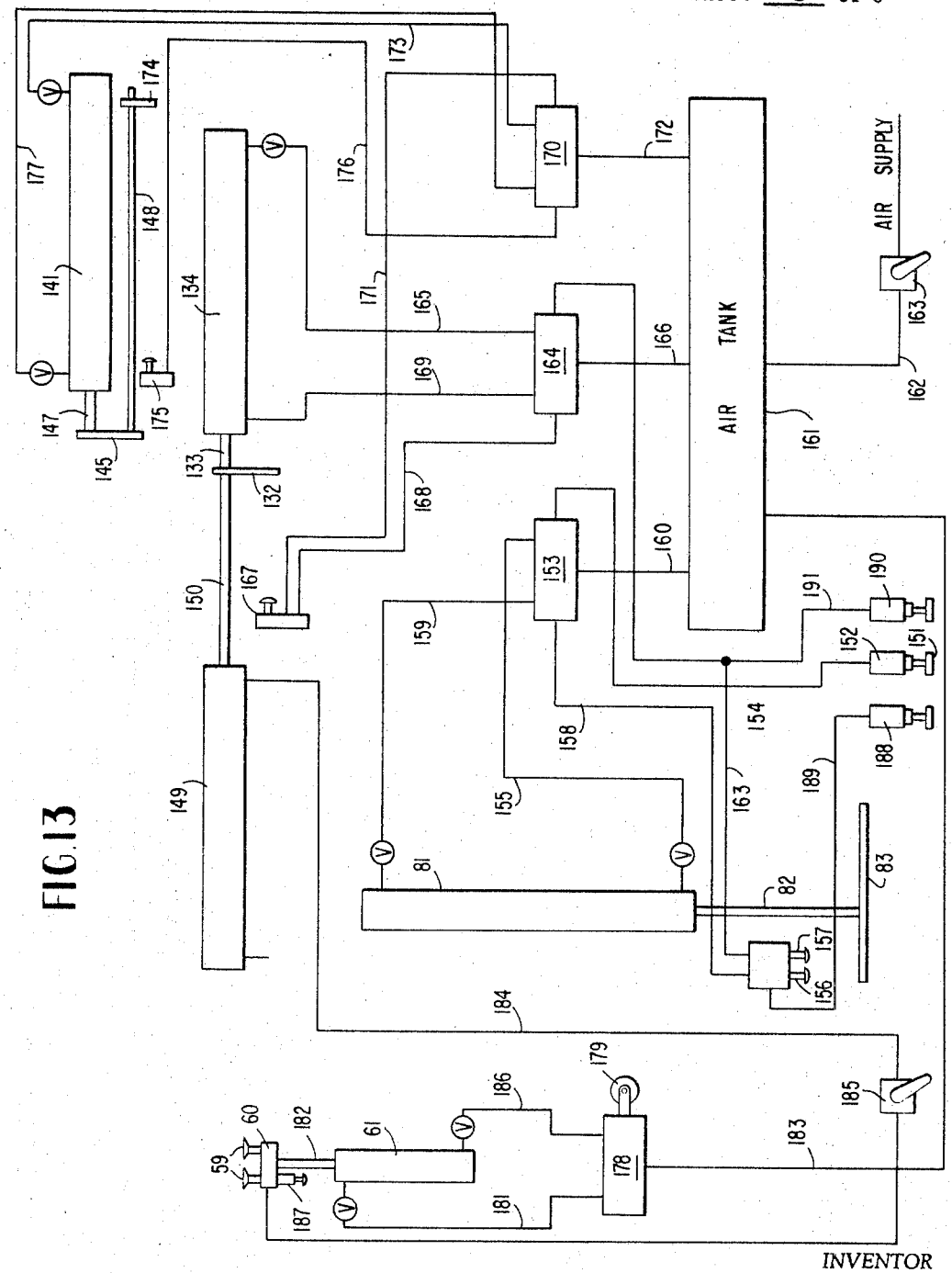


FIG. 13

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United States Patent Office 3,426,506
Patented Feb. 11, 1969

3,426,506

CARTON FOLDING MACHINE

Thomas L. Jernigan, Richmond, Va., assignor to Eskimo Pie Corporation, Richmond, Va., a corporation of Delaware

Filed Nov. 22, 1966, Ser. No. 596,299
U.S. Cl. 53—186 19 Claims
Int. Cl. B65b 49/00, 51/10, 51/32

This invention relates to an improved apparatus for folding and sealing cartons in which multiple items of goods are packaged and is particularly useful in packaging frozen confections.

It is common practice to package individual packs of goods, such as bars of frozen confections, in cartons which are supplied in a collapsed form. The six sided, collapsed cartons must be opened and the flaps at one end folded inwardly and sealed, the goods loaded into the carton through the other open end and then the flaps on the open end folded over and sealed after the goods have been inserted. The facing surfaces of the flaps are coated with a heat sensitive adhesive and are sealed together by applying heat and pressure.

Machines are known which automatically open the collapsed cartons one by one, present them for loading and then fold and seal the flaps of the filled cartons. However, such machines are complex and must be operated at a carefully established speed so that the cartons will be sealed in a satisfactory manner. In most machines the time in which the ends of the sealed carton are in contact with the heater unit is dependent upon the speed of loading and operation of the machine. Thus if an excessive interval occurs between the loading and expulsion of two successive cartons, an excessive amount of heat is applied to a carton which was previously loaded and is in contact with the heating element since the carton usually remains in contact with the heater until removed therefrom by expelling a loaded carton from the loading station.

A primary object of this invention is to provide an improved, and simple apparatus for folding and sealing cartons in which the operation can be carried out at any speed.

A further object is to provide an improved apparatus for automatically folding, loading and sealing cartons in a manner which is efficient, safe and can be readily controlled by a single operator.

A still further object is to provide an improved apparatus which carries a carton by means of a reciprocating carriage mechanism in multiple steps through the folding operations in which the motion of the carriage folds all of the flaps.

Yet still a further object is to provide an improved apparatus in which each folded carton is subjected to a predetermined amount of sealing heat independently of the speed of operation of the machine.

These and other objects are accomplished by the methods and apparatus described below in which each of the two units of a reciprocable carriage, which carries the cartons through the various operations, contain structural elements which move independently of each other to fold the side of the flaps on the trailing side of the carton with the carriage reciprocating rearwardly and forwardly on its supports to carry the carton in steps through the subsequent folding and sealing operations. In the first carriage cycle, the flaps on the back of the carton are folded to present the open end of the front of the carton to the operator at the loading station. In the second carriage cycle, after the carton has been filled, the flaps on the front end of the carton are folded over one another and in subsequent cycles the folded ends of the carton are placed in contact with a heater strip, along which the

carton is drawn by a reciprocating piston, at a speed which is independent of the operating speed of the reciprocating carriage. The cartons in collapsed form are stacked at the feed end of the machine and are individually drawn downwardly while being pulled into an open position with the flaps extended in timed relation to the reciprocating motion of the carton support carriage.

Other objects and features of the invention will be apparent by reference to the following description which is illustrated by the attached drawings in which:

FIGURE 1 is a plan view of the machine from above.

FIGURE 2 is an enlarged, fragmentary plan view of the feed end of the machine with parts broken away and the carton transporting carriage in the forwardmost position.

FIGURE 3 is a vertical end elevation at section 3—3 of FIGURE 1.

FIGURE 4 is a fragmentary side elevation at section 4—4 of FIGURE 3 with certain parts removed.

FIGURE 5 is similar to FIGURE 4 but with the carton transporting carriage slightly retracted toward the discharge station.

FIGURE 6 is similar to FIGURE 5 but with the carton transporting carriage still further retracted.

FIGURE 7 is similar to FIGURE 4 with the carton transporting carriage in the forwardmost position but showing the flat folding structure which was removed from FIGURE 4.

FIGURE 8 is a fragmentary longitudinal section along section 8—8 of FIGURE 3.

FIGURE 9 is a vertical side elevation along section 9—9 of FIGURE 2.

FIGURE 10 is a perspective, exploded view of the carton transporting carriage.

FIGURE 11 is a partial side elevation of the discharge end of the machine with the carton transporting carriage partially retracted in the position corresponding to that of FIGURE 5 and with some of the structure cut away.

FIGURE 12 is similar to FIGURE 11 but with the carton transporting carriage in the fully retracted position and additional structure cut away.

FIGURE 13 is a schematic diagram of the pneumatic system and actuators for operating the various elements of the machine.

Referring primarily to FIGURE 1, it can be seen that the structure for the carton folding machine is supported on a welded tubular frame **20** having two symmetrical longitudinally extending segments with tubes **21** and **22** extending horizontally along the front and back of the machine with the two ends of the tubes **21** and **22** curved downwardly to form the four vertical supports and joined together at the bottom by the two cross pieces **23** and **24** at the feed and discharge ends of the machine. For purposes of this description the feed end, or forward end of the machine, is the left end of the machine as seen in FIGURE 1 at which the stacked, collapsed cartons C′ are located and the discharge or after end of the machine is the right hand end as viewed from FIGURE 1. The bed of the machine is supported on the welded tubular frame **20** by cross plates **25** and **26** extending transversely between the top rails **21** and **22** at the feed and discharge ends of the machine, the cross plates being welded to the top rails **21** and **22**. As best seen in FIGURES 2 and 3, the bed of the machine comprises the front bed section **27** and the back bed section **27*a*** extending longitudinally of the machine and resting on the cross plates **25** and **26**. Reference to the front of the machine and the front of the carton in this description means those portions illustrated on the lower side of FIGURE 1 on which the loading platform **74** and control panel **85** are located and reference to the back of the machine and carton means the opposite side comprising the upper side of FIGURE 1.

The front bed section 27 comprises a flat, horizontal bottom bed plate 28 with its edge abutting and affixed to a side bed plate 29 extending vertically upwardly therefrom to form an L bed section. The back bed section 27*a* similarly comprises the horizontal bottom bed plate 30 affixed to the vertically extending side bed plate 31. The two bed sections 27 and 27*a* are supported on the cross plates 25 and 26 in a spaced apart array parallel to the side tube frames 21 and 22 to have the vertically extending side plates 29 and 31 back to back and spaced apart slightly less than the length of a carton. The bottom bed plates 28 and 30 are each adjustably connected to the cross plates 25 and 26 by suitable fittings which connect through slots 32 and 33 in the cross plates, such as the screw fittings 34 illustrated in FIGURE 3.

Two U-shaped feed support plates 35 and 36 are supported above the forward end of each o f the bed sections 27 and 27*a* by vertically extending posts 37 in which the lower ends of the posts are affixed to the bottom bed plates 28 and 30 and the upper ends of the posts are held to the feed support plates 35 and 36 by the bolts 38, there being two posts 37 for each feed support plate. The open ends of the U-section face each other to form a semi-enclosure encompassing the stack of collapsed cartons C' (see FIGURES 1–3). A threaded support post 39 (FIGURE 3) with hand wheel extends vertically downwardly through a threaded connection 40 in the inboard leg of the back feed support plate 36 with an enlarged lower end 41 of the support post 39 being contained within a block 42 which is affixed by welding or other means to the upper horizontal portion of an elongated L-shaped back superstructure channel 43 that is supported above and extends with and substantially the length of the back bed section 27*a*. A vertical pillar 44 extends upwardly near the discharge end of the back bottom bed plate 30 and has a knobbed screw connector 45 which extends through a slot 46 in an ear 47 which depends vertically downwardly from the vertical plate of the superstructure channel 43 (see FIGURES 1 and 9). Thus the height of the superstructure channel 43 above the bed plate 27*a* may be adjusted by means of the threaded support post 39 and the knobbed screw connector 45. The bottom edge of the vertically depending segment of the superstructure channel 43 is spaced above the top edge of the back side plate 31 by a distance slightly greater than the height of an opened carton. In a similar manner a front superstructure channel 48 is supported above the front bed section 27 at one end by a hand wheel threaded support post 49 and threaded connection 50 and at the other end by the vertical pillar 51 and knobbed screw connector 52.

Referring now to FIGURES 1, 3 and 4, three vertical carton guide bars 53, 54 and 55 are supported by the back feed support plate 36 by a slidable connection on each of the three sides of the feed support plate. Each of the vertical carton guide bars has a slotted horizontally extending segment 53*a*, 54*a* and 55*a* through which knob connectors 53*b*, 54*b* and 55*b* extend for threaded connection to the feed support plate 36. Similarly three vertical carton guide bars 56, 57 and 58 are connected to the front feed support plate 35 through knobbed connectors 56*b*, 57*b* and 58*b* extending through the slotted horizontal segments 56*a*, 57*a* and 58*a* of the guide bars. All of the vertical carton guide bars except the outermost bars 55 and 56 at the feed end of the machine terminate at the level of the feed support plates, the outermost carton guide bars 55 and 56 extending downwardly toward the bed sections 27 and 27*a* as illustrated in FIGURE 8. Thus the six vertical guide bars 53, 54, 55, 56, 57 and 58 may be adjusted inwardly and outwardly to accommodate and hold a stack of collapsed cartons C' as illustrated in FIGURES 1 and 4, the adjustment of the vertical guide bars permitting various sized cartons to be supported.

As best seen in FIGURES 3 and 4, four suction cups 59 are mounted on a vertically movable suction head 60 supported below the collapsed stack of cartons C' by a piston within the pull-down cylinder 61 which is adjustably attached to the cross plate 25 through a slotted horizontal arm 62 and threaded connectors 63 which screw into the cross piece 25 through the slots in the arm 62. A carton unfolding cam 64 having a rounded upper forward edge 65 is bolted to the forward end of the front superstructure channel 48 by the bolt 66 extending through the slot 67 in the unfolding cam and a similar unfolding cam 68 is similarly bolted to the back superstructure channel 43 for horizontal adjustment. Carton squaring lugs 69 and 70 are pivotally mounted at the forward lower edge of each of the carton unfolding cams 64 and 68 by a pinned connector 71, the pivoting motion of the squaring lug being restricted by the stop pin 72 in an arcuate slot 73 in each of the squaring lugs 69 and 70. As will be subsequently explained, when a flattened carton from the stack C' is pulled downwardly by the suction head 60 and cups 59, the engagement of the curved forward surfaces 65 of the unfolding cams 64 and 68 causes the carton to open into the unfolded position with the flaps extended as illustrated in FIGURE 3, the squaring lugs 69 and 70 holding the carton in the squared, open position with the bottom resting on the top edges of the side bed plates 31 and 33.

A package loading platform 74 having a horizontal bottom 75, which is essentially level with the top edge of the side bed plates 29 and 31, and having parallel, spaced apart sides 76 and 77 extending vertically upwardly from the bottom 75 is affixed to the front bottom bed plate 28 and frame on the front of the machine, one of the sides 77 being mounted for variable spacing from the other side by the knobs 78 attached to threaded connectors extending through the slots 79 in the side plate structure. A spring loaded pivoting stop 80 is mounted at the inboard end of the side frames 76 and 77 to extend partially inwardly from each side frame. An air actuated package loading cylinder 81 is bolted to the underside of the cross plate 25 such that the piston rod 82 connected to the piston of the cylinder 81 attaches through a vertical member 83 to a package loading ram 84 to provide reciprocating motion of the ram along the length of the package loading platform 74. A control panel 85 with various controls, to be described later, is mounted on the bottom bed plate 28 to the right of the package loading platform 74 as viewed from FIGURE 1.

Referring to FIGURES 4 and 8, support bars 86 and 87 are fixed along the lower edges on the inner facing surfaces of the front and the back superstructure channels 48 and 43, respectively, with each support bar pivotally supporting three downwardly depending squaring lugs 88, 89 and 90 and 88*a*, 89*a* and 90*a* spaced along the length of the support bar at the after end of stations II, III and IV at which each of the cartons stops in the folding operation to be subsequently described, station II being opposite the package loading platform. Each of the squaring lugs has a straight forward edge which normally hangs vertically in contact with the leading side of a carton with each lug pivoting about its pivot 91 in the manner shown in FIGURE 6 to swing upwardly and clear of the cartons as they are drawn along the bed plate sections. The support bars 86 and 87 are each adjustably mounted on the superstructure channels 43 and 48 to be adjusted longitudinally of these channels by bolts 92 which extend through longitudinally extending slots 93 at spaced intervals along the length of the superstructure channels.

As best seen in FIGURE 9, immediately to the right of the loading platform a top flap folding rail 94, having a lower edge 95 which extends downwardly at an acute angle from the top edge of the superstructure channel in the direction of motion of the cartons, is affixed to the front superstructure channel 48 on the front of the machine in a position to contact the top flap CF 8 of the carton as it is drawn along the bed section 27 and 27*a* from station II opposite the package loading platform 74 to fold the top front flap CF 8 of the carton downwardly. The lower edge 95 of the top flap folding rail 94 is carried vertically downwardly until it reaches substantially

the level of the top of the side bed plate **29** and then extends horizontally toward the discharge end of the apparatus where it is terminated in the vicinity of the heaters, to be subsequently described, and thus form the front side of a tunnel through which the folded cartons are drawn. A vertically extending bottom carton flap folding rail **96** with a top edge **97**, which is angled upwardly toward the discharge end of the machine, is supported by the top of the control box **85** to extend vertically upwardly just inside the top flap folding rail **94** and terminates inside the top folding rail. A post on the top of the control panel **85** supports a leading flap folding bar **98** which extends inwardly beneath the lower edge of the top flap folding rail **94** and then curves toward the discharge end of the machine parallel to and terminates behind the top flap folding rail **94**. As indicated in FIGURE 3, a top flap supporting bracket **104** is supported from the top horizontal plate of the front superstructure channel **48** and this bracket extends from the feed station past the package loading station **74** toward the discharge end of the apparatus and supports the front top flap CF **8** of the carton C in a position somewhat above the horizontal until the carton is drawn from station II into engagement with the top flap folding rail **94**.

A similar vertically depending top flap folding rail **99** is affixed to the back superstructure channel **43** on the back side of the machine, as illustrated in FIGURE 7 but is located closer to the feed end of the machine and prior to the cartons arriving at station II opposite the package loading platform **74**. The back top flap folding rail **99** has the same angled lower edge **100** which decends toward the discharge end of the machine at an acute angle to the horizontal so as to contact the flap of the carton and fold it downwardly. The back top flap folding rail **99** extends rearwardly, as does the front top flap folding rail **94**, to form the other side of the closed tunnel through which the cartons are drawn subsequent to station II. An upwardly extending back bottom flap folding rail **101** extends upwardly from the back side bed plate **31** to lie just inside the top flap folding rail **99**. A back leading flap folding bar **102** parallel to the top and bottom flap folding rails is supported inside these rails by the post **103** affixed to the back side plate **31**.

A carriage **105**, which draws the opened cartons from the station I, where they have been drawn down to rest on the top edge of the side bed plates **29** and **31**, is installed to lie on the outside of the front and back side bed plates **29** and **31** to reciprocate lengthwise of the bed sections **27** and **27***a*. The carriage comprises a front portion **106** and a back portion **107** which are supported outside the front and back side bed plates **29** and **31**, respectively. The back portion **107** of the carriage is illustrated in an exploded view in FIGURE 10. Referring to this figure, an inner carriage rail **108** is supported for movement longitudinally of the back bed section **27***a* by three rollers **109**, each of which is supported in a longitudinally extending slot **110** extending through and spaced apart along the length of the back side bed plate **31** with the rollers **109** being bolted to the inner carriage rail **108** by bolts **111**, spacers **117** on bolts **111** separating the inner carriage rail **108** and the side bed plate **31**. An outer carriage rail **112** is affixed to the inner carriage rail **108** for limited longitudinal movement relative to the inner rail by the slides **113** having central projecting portions **114** which fit into longitudinally extending cutouts **127** piercing the outer carriage rail **112** at spaced intervals along its length, the slides **113** being affixed to the inner and outer carriage rails, respectively, by the bolts **115** and keeper plates **116** which are held against the central portion of the slides **114** by the bolts **115** when inserted through the slide **113** and threaded into the inner carriage rail **108**. Three carton drawing lugs **118** are connected between the inner and outer carriage rails **108** and **112** at spaced intervals along their length by pins **119** which protrude from both sides of the drawing lug **118** with one end of the pins pivotally resting in holes **120** of the outer carriage rail and the other end of the pins resting in the upper portion of the slots **122** cut through the inner carriage rail **108** at spaced intervals along its length, and by the cam pins **121** which protrude from one side of the lugs **118** to rest in either the upper portion of the slots **122** or the downwardly extending lower portions **123** of the slots. Thus relative longitudinal motion between the inner and outer rails **108** and **112** is possible through the sliding motion of the slides **113** in the central cutouts **127** of the outer carriage rail **112** and limited by the range of motion of the support pin **119** and cam pin **121** in the slots of the inner carriage rail **112**. Obviously as the outer carriage rail **112** moves rearwardly (to the left in FIGURE 10) relative to the inner carriage rail **108**, the cam pin **121** rides upwardly within the lower end of the slot **123** to raise the projecting tip **124** of the cam lugs above the top edge of the carriage rails and above the top edge of the side plate **31** to which the inner and outer carriage rails are slidably affixed. As will be subsequently described, the projecting tips **124** of the carton drawing lugs engage the cartons and draw them along the length of the bed sections **27** and **27***a* toward the discharge end of the apparatus. The forward end of the inner carriage rail **108** has an upwardly extending projection **125** which also engages and draws the cartons along the bed sections from station I, as will be subsequently explained. The forward end of the outer carriage rail **112** carries an upwardly extending trailing flap folding lug **126** which is bolted or riveted to the rail to extend above the top of the outer carriage rail.

The front portion **106** of the carriage **105**, which is generally similar to the structure described above of the back portion **107** of the carriage **107**, is supported on the outside of the front side bed plate **29** by rollers **109***a* in three slots **110***a* spaced along the length of the front side bed plate **29**, the structure of the front carriage portion **106** being identified by the same numerals utilized for the above description of the back portion **107** of the carriage but identified by the suffix *a*. However, an important difference exists between the front outer carriage rail **112***a* and the back outer carriage rail **112**. As may be noted in FIGURE 2 and also FIGURE 10, the front outer carriage rail **112***a* has but two cut out sections **127***a* instead of the three illustrated in FIGURE 10 for the back outer carriage rail **112** so that the structure to the right of the hole **120** supporting the pin **119** of the carton drawing lug **118** as seen in FIGURE 10 is omitted from the front outer carriage rail **112***a*. Further, on the front outer carriage rail **112***a*, the forwardmost carton drawing lug **127** is shaped differently from the previously described other drawing lugs **118** and has an upwardly projecting drawing lug tip **128** with an extension **129** which projects toward the front of the machine and extends rearwardly parallel to the main lug **127** to overlie the outer carriage rail **112***a*, as illustrated in FIGURE 2.

The bottom, after edge of each outer carriage rail **112** and **112***a* has a downwardly extending projection **130** and **130***a* fitting into slots **131** and **131***a* which extend partially lengthwise at both end portions of a cross bar **132** which extends transversely of the bed sections **27** and **27***a* and is affixed to the piston rod **133** on the end of the piston in the air actuated carriage drive cylinder **134** mounted on the machine frame to lie longitudinally of and below the bed sections **27** and **27***a* (FIGURE 4). Thus the carriage drive cylinder **134** moves the front and back portions of the carriage **105** along the bed sections **27** and **27***a* between its forward and after positions through the cross bar **132** and its connection to the outer carriage rails **112** and **112***a*. Magnets **135** are affixed to stop posts **136** mounted on the bed sections **27** and **27***a* at a location representing the furthermost point toward the discharge end to which the carriage **105** is retracted by bolts **137** extending through slots **138** in

the stop posts (see FIGURE 12). The forward ends of the magnets **135** contact the rear ends of the inner carriage rails **108** and **108***a* in their rearmost retracted positions.

Referring now to FIGURES 11 and 12, the discharge end of the bed sections vertically extending heater support plates **139** are each supported by the bottom bed plates **28** and **30** to extend vertically upwardly on the outside of and above the side bed plates **29** and **31** in line with and as an extension of the top flap folding rails **94** and **99** to contain the folded sides of the cartons. A longitudinally extending heater **140** is mounted on the inner surface of the support plates **139** with the heaters protruding slightly inwardly from the support plates **139** to lightly contact both sides of the folded cartons as they are carried into the space between the heaters by the carriage **105** as it is retracted to its aftermost position. An air actuated carton withdrawing cylinder **141** is affixed to the end portion of the superstructure channels **43** and **48** near the discharge end of the machine to be positioned parallel to, above and between the superstructure channels by slotted brackets **142** and **143** attached at either end of the cylinder **141** and knob threaded connectors **144** extending through each of the slots in the brackets **142** and **143** and screwed into the top plates of the superstructure channels **43** and **48**. A downwardly extending retracting arm **145** having a pivoting lower tip **146** is affixed to the end of piston rod **147** on the piston of the withdrawing cylinder **141**, the tip **146** being pivotable upwardly and toward the discharge end of the machine as illustrated in the dotted lines in FIGURE 12 so that the retracting arm **145** can be extended forwardly toward the feed end of the machine over the top of a carton. A switch actuating rod **148** is affixed to the retracting arm **145** at one end and the other end carries a switch actuator **174** to actuate a valve, identified later, carried by a support bracket **150** which is supported by the cylinder support bracket **142**. A vacuum cylinder **149** is supported by the machine frame in a position below the bed sections **27** and **27***a* in line with and rearwardly of the carriage reciprocating cylinder **134**, the piston rod **150** of the vacuum cylinder connecting the carriage cross bar **132** opposite the connection of the piston rod **133** of the reciprocating cylinder **141**. As will be subsequently explained, the cylinder **149** is a vacuum source for the suction cups **59** which are mounted on the suction head **60** and draw the collapsed cartons one at a time to the level of the carriage **105**.

Operation of the machine is best understood by referring to the schematic pneumatic diagram of FIGURE 13 in conjunction with the other drawings. The two bed sections **27** and **27***a* are spaced apart a sufficient distance that the bottom of a carton C, which is drawn downwardly by the reciprocating suction head **60** from the stack C′ after being pushed to the open position with the flaps extended by being drawn down over the curved top surfaces of the unfolding cams **64** and **68**, rest on the top edges of the side bed plates **29** and **31** with the carton C extending outwardly on both sides past the inner carriage rails **108** and **108***a* but not as far as the outer carriage rails **112** and **112***a* but with the open flaps extending beyond the outer carriage rails **112** and **112***a* as indicated in FIGURE 3. Similarly the superstructure channels **43** and **48** are laterally adjusted so that the top flap folding rails **94** and **99** are just outside the edges of the cartons as they are drawn toward the discharge end and in a position to engage and fold the top flaps CF **4** and CF **8** downwardly. Upon actuating the loading control knob **151** on the control panel, the flow control valve **152** connected to the four-way valve **153** by the line **154** shifts the control valve **153** to a position pressurizing line **155** connected between the valve **153** and the package loading cylinder **81** to extend the loading ram **84** and push packages, which have previously been placed in the loading platform **74**, into a carton with the front flaps fully opened at station II. The forward extension of the ram **84** in pushing the packages into the open carton actuates the bleeder valve controls **156** and **157** and the valve control **156** through line **158** connected to the four-way valve **153** shifts the valve **153** to pressurize the line **159** connecting between the valve **153** and the other end of the loading cylinder **81**, thereby returning the ram **84** to the retracted position so that another load of packages can be placed in the loading platform. Air under pressure is supplied to valve **153** by line **160** connecting between the valve and an air tank **161** whose air pressure may be replenished from time to time by line **162** which may be closed by shut off valve **163**.

The full extension of the loading ram **84** also actuates the flow control valve **157**, which is connected by line **163**, to another four-way valve **164** which is shifted to a position to pressurize line **165** connected between the valve **164** and the carriage drive cylinder **134** and drive the carton transporting carriage **105** to the fully retracted position, the four-way valve **164** being connected to the air tank **161** by line **166**.

To understand the operation of the carton transporting carriage **105** and the transfer of the cartons along the bed sections **27** and **27***a* through the folding structure, reference should be made primarily to FIGURES 3–9. As previously noted, when a collapsed carton is pulled downwardly from the stack C′ by the reciprocating suction head **60**, whose operation will be subsequently described, the carton is caused to assume an open position by being pulled down between the space between the opening cam **65** and the forwardmost guide bars **56** and **57**, which space corresponds to the width of an open carton. The bottom of the open carton rests on the top edges of the side plates **29** and **31** and the inner carriage rails **108** and **108***a* with the forward upwardly projecting tips **125** and **125***a* of the inner carriage rails being forwardly of the trailing edge of the carton and the back trailing flap folding lug **126** on the back outer carriage rail **112** also being forwardly of the trailing flaps CF **1** and CF **5** of the carton, as illustrated in FIGURES 4 and 9. The initial retracting motion imparted to the outer carriage rails **112** and **112***a* by the extension of the piston in the drive cylinder **134** causes the outer carriage rails **112** and **112***a* to slide rearwardly relative to the inner carriage rails **108** and **108***a* until the carton drawing lug pins **119** engage the ends of the slots **122**. This rearward motion of the outer carriage rail **112** brings the flap folding lug **126** into contact with the back trailing flap CF **1** of the carton at station I, as illustrated in FIGURE 5. Referring now to FIGURE 9, it can be seen that the initial rearward motion of the front outer carriage rail **112***a* brings the tip extension **129** of the forwardmost drawing lug **127** into contact with the front trailing flap CF **5** of the carton at station II to fold it inwardly. After this first initial rearward motion of the outer carriage rails **112** and **112***a*, both the inner and the outer carriage rails are moved rearwardly by the motion of the rollers **109** and **109***a* along the slots **110** and **110***a* in the side bed plates **29** and **31**. While the cartons are at stations I–IV, the sides of the carton are maintained upright and in a square position by the squaring lugs **69–70**, **88–90** and **88***a*–**90***a*, these lugs pivoting upwardly to clear the cartons as they are drawn rearwardly by the drawing lugs of the carriage **105**. The carton at station I is drawn to station II by the tip projections **125** and **125***a* on the front and back inner carriage rails **108** and **108***a*, respectively. During this motion the leading flap CF **2** on the back of the carton first engages the leading flap folding bar **102** on the back of the machine (FIGURE 7) to fold the leading flap CF **2** inwardly, and then the bottom flap CF **3** and top flap CF **4** on the back of the carton are respectively engaged by the edges of the bottom and top flap folding rails **101** and **99** to fold these flaps inwardly over the

trailing and leading flaps CF 1 and CF 2, with the top flap CF 4 being outermost. Thus the carton arrives at station II with the flaps on the back of the carton in the fully folded positions whereas the flaps on the front of the carton remain open, the top flap CF 8 being held in a slightly elevated position by the bracket 104 so that packages from the loading platform 74 may be easily pushed into the carton by the action of the ram 84.

Reverting to FIGURE 13, after the carton from station I has been drawn to station II by the extension of the piston in the carriaged rice cylinder 134, the cross piece 132 actuates another flow control valve 167 which is connected by line 168 to the four-way valve 164 so as to shift the valve 164 to pressurize the line 169 and cause the carriage drive piston to be retracted within the cylinder 134 and drive the carriage 105 to the forward position. During the initial forward motion of the carriage cross bar 132, the outer carriage rails 112 and 112*a* are moved forwardly relative to the inner carriage rails 108 and 108*a* until the cam pins 121 on the carton drawing lugs 118, which move forwardly with the outer carriage rails relative to the inner carriage rails, ride down and engage the lower end of the downwardly extending slot portion 123. This forward motion of the drawing lugs 118, 118*a* and 127 both lowers the projecting tips 124, 124*a* and 128 of the drawing lugs below the level of the side bed plates 29 and 31 to permit the drawing lugs to pass beneath the cartons at the various stations and locks the inner and outer carriage rails 108, 108*a*, 112 and 112*a* together for return to the forward position. The magnets 135 contacting the rear ends of the inner carriage rails 108 and 108*a* ensure relative motion between the inner and outer carriage rails during the first initial forward motion of the outer carriage rails 112 and 112*a*, the inner carriage rails 108 and 108*a* being pulled from the magnets 135 when the cam pin 121 of the carton drawing lugs engages the forward ends of the slots 123 and locks the inner and outer carriage rails. The carton drawing lugs remain in the lowered position until the outer carriage rails 108 and 108*a* start to move rearwardly when the carriage starts its next retracting motion and the relative motion between the inner and outer carriage rails lifts the drawing lugs as previously described.

As previously explained, the initial retracting motion of the front outer carriage rail 112*a* folds the trailing flap CF 5 on the front of the carton at station II in the manner shown in FIGURE 9 and then the carton at station II is drawn toward station III by the upwardly projecting portions 128 and 124 of the carton drawing lugs which lie above the inner carriage rail 108*a* and engage the trailing side on the front portion of the carton. As the carton from station II moves rearwardly the leading flap CF 6 on the front of the carton strikes the leading flap folding bar 98 and is folded inwardly on the carton and immediately thereafter the bottom flap CF 7 and the top flap CF 8 on the front of the carton are contacted by the edges of the bottom and top flap folding rails 96 and 94 to fold inwardly the top and bottom flaps CF 7 and CF 8 on the front of the carton, again the top flap CF 8 being outermost. The next reciprocating motion of the carriage 105 carries the carton from station III to station IV where the sides of the carton are maintained in their folded position by the extensions of the top folding rails 94 and 99. Upon the carriage 105 being again withdrawn toward the discharge end of the machine, the folded carton from station IV is drawn by the projecting portions 124 of the last drawing lug 118 into station V where the sides of the carton come into contact with the heater strips 140.

Again reverting to FIGURE 13, it may be noted that the flow control valve 167 is connected to another four-way valve 170 by line 171 so that actuation of the flow control valve 167 shifts the valve 170, which is connected by line 172 to the air tank 161, to pressurize line 173 connected between the valve 170 and the carton withdrawing cylinder 141 to extend the piston rod 147 and place the retracting arm 145 in the fully extended position with the tip 146 of the retracting arm outside the trailing side of the carton at station V, as indicated by the dotted lines in FIGURE 12. The extension of the retracting arm 145 causes the switch actuator 174, affixed to the switch actuating rod 148 connected to the retracting arm 145, to actuate the valve control 175 which is connected to the four-way valve 170 by line 176 and shift the valve to pressurize the line 177 and retract the piston of the carton retracting cylinder 141, thereby drawing the retracting arm 145 and the engaged carton from station V past the end of the heater 140 to the discharge station VI (see FIG. 11). A bleeder valve on the retracting cylinder 141 permits adjustment of the speed of retraction of the retracting piston and retracting arm 145 to vary the time that the carton is in contact with the heater strips 140 at station V. It should be noted that the period of time for which a carton remains in contact with the heater strips 140 at station V is the same, within the limits of adjustment of the bleeder valve as previously noted, regardless of the intervals at which the carriage 105 is reciprocated, the carton withdrawing piston actuating the withdrawing arm 145 only after each rearward stroke of the carriage 105 which normally places a carton in contact with the heater strips 140 at the station V. Once a carton is placed at station V, the retracting cylinder 141 is automatically actuated to withdraw the carton from station V after it has been in contact with the heater bars 140 for the time interval which has been determined to be optimum for sealing the cartons.

A spring loaded four-way valve 178 is supported on the forward end of the front bottom bed plate 28 and actuated by cam 179 connected to the valve 178 through pivoting arm 180, the cam 179 engaging the outer surface of the front inner carriage rail 108*a* when the carriage rail is in the forwardmost position with the carriage driving piston fully retracted, as illustrated in FIGURE 2. When the cam 179 is in contact with the inner carriage rail 108*a*, the valve 178 is positioned to pressurize line 181 connected between the valve 178 and the carton pull down cylinder 61, thereby causing the piston rod 182 of the pull down cylinder 61 to be fully retracted and hold the suction head 60 in the fully lowered position beneath the level of the top edges of the side bed plates 29 and 31, the valve 178 being connected to the air tank 161 by the line 183. The interior of the vacuum cylinder 149, whose piston is connected by piston rod 150 to the piston rod 133 of the carton main drive cylinder 134, is connected by suction line 184 to the suction head 60 and suction cups 59 through a manually operable cutoff valve 185. Thus, when the piston of the carton main drive cylinder 134 is extended to retract the carriage 105, a vacuum generated in the vacuum cylinder 149 is transmitted to the suction head 60 and cups 59 via the line 184. Retraction of the carton carriage 105 and inner carriage rail 108*a* cause the cam 179 to move away from the valve 178 and this spring loaded valve 178 is shifted to pressurize line 186 connecting between the valve 178 and the pull down cylinder 61 to cause the pull down cylinder piston rod 182 to be extended and raise the suction head 60 to an elevated position and bring the suction cups 59 into contact with the lowermost collapsed carton in the stack C'. Return of the carriage 105 to the forward position upon retraction of the piston in the main drive cylinder 134 moves the cam 179 back against the spring loaded pressure of the valve 178 and shifts the valve 178 to pressurize the retracting line 181 and retract the suction head 60 downwardly, the suction cups 59 carrying a carton downwardly past the unfolding cams 64 and 68 to unfold another carton and place it in the lowered position with the bottom resting on the side bed plates 29 and 31 ahead of the upwardly projecting tips 125 and 125*a* of the inner carriage rails 108 and 108*a*, as indicated in FIG-

URE 3. A button bleeder valve **187** mounted on the lower side of the suction head **60** is opened by engagement with a stop on the top side of the pull down cylinder **61** when the suction head **60** reaches the fully lowered position and connects the vacuum lines within the suction head **60** to the atmosphere, thereby relieving the suction in the cups **59** and releasing the carton.

A control valve **188** on the control panel is connected through line **189** to control valve **156** so the loading ram may be withdrawn at any time by actuating the control for valve **188**. Another control valve **190** is connected to line **163** by line line **191** so the piston of the carriage drive cylinder **134** may be extended and the carriage **105** drawn toward the fully retracted positions.

While the above descriptive matter describes and illustrates a preferred embodiment of the invention, it should be understood that the invention is not restricted solely to the described embodiment but that it covers all modifications which should be apparent to one skilled in the art and which would fall within the scope and spirit of the invention.

What is claimed is:

1. An automatic carton folding and sealing machine comprising

a support frame,

a support bed affixed to said frame for supporting the lower side of an open carton for movement from the upper to the lower end of said bed as the carton is filled, folded closed and sealed,

means for drawing a flat, collapsed carton with flaps projecting from its top and bottom ends downwardly from a stack of collapsed cartons to a fully opened position resting on said bed at a first station at the upper end of said bed,

a carriage movably supported by said bed for reciprocating motion between a forward and a rear position longitudinally of said support bed a fraction of its length,

said carriage comprising,

two pairs of longitudinally extending rails of which each pair is disposed in juxtaposition on opposite sides of said bed with each of the rails of a pair connected for limited movement relative to each other longitudinally of said bed between a propelling position and a retracting position and one of each of said pairs of rails movably supported by said bed for movement between said forward and rear positions,

a plurality of carton propelling means having carton contacting surfaces engageable with the trailing side of the open cartons on said bed and supported by said rails at intervals spaced along their length,

means for moving at least some of said carton contacting surfaces between an extended position in which said surfaces project above the level of said support bed when said rails of each pair are in said propelling position and a retracted position in which said surfaces are below said support bed when said rails of each said pair are in said retracting position,

said carton propelling means being oppositely spaced in pairs along said rails with said pairs separated by a distance longitudinally of said bed that a carton is propelled between successive stations located along said bed between said first station and a sealing station at the lower end of said bed by successive movements of said rails between said forward and rear positions,

means for interconnecting each of the outermost of the two pairs of rails,

a first flap folding lug supported from the forward end of one of said pairs of rails and movable relative to the adjacent rail to engage and fold closed the trailing flap on the bottom side of a carton at said first station as said rails are moved relative to each other from said retracting to propelling positions, and

a second flap folding lug supportingly carried by said pair of rails opposite said one pair having said first flap folding lug and movable into engagement with and folding closed the trailing flap on the top side of a carton at a filling station subsequent to said first station as said rails move relative to each other between the retracted and propelling positions,

means supported by said frame and connected to said rail interconnecting means for moving said carriage along said bed between said forward and rear positions to propel cartons from said first station through subsequent stations,

carton bottom flap folding means supported from said frame to engage and fold inwardly the leading flap and remaining flaps on the bottom of the carton as it is propelled along said bed between the first station and a filling station,

carton top flap folding means supported from said frame to engage and fold inwardly the leading flap and other flaps on the top of the carton subsequent to it being propelled from the filling station toward the sealing station by said carriage, the trailing flap of the carton top being folded closed by said second flap folding lug as said rails move between said retracting and said propelling positions as said carriage initiates movement of the carton out of the filling station,

heater strips supported from said frame to contact the top and bottom folded carton flaps at a sealing station at the lower end of said bed subsequent to the filling station and,

means for propelling each carton from said sealing station in contact with said heating strips in timed relation to the movement of said carriage.

2. The automatic carton folding and sealing machine described in claim **1** wherein

the innermost of each pair of rails is movably supported from said bed,

one each of said adjacent rails of each said pair having a plurality of longitudinally extending cams spaced at intervals along the length of said rail with one end portion of each cam substantially horizontal and the other end portion extending downwardly at an angle thereto,

each said carton propelling means is a generally L-shaped lug having a projecting tip at one end and pivotally supported by the other of said adjacent rails of each said pair for movement between an extended position in which said tip extends above said bed to contact the trailing side of a carton and a retracted position in which said tip is below the level of said bed and cartons,

each said lug has cam followers projecting from each opposite end with both followers engaging one of said cams and spaced such that both followers are within the limits of one end portion of said cam when the followers are at one extremity of said cam and each follower engages a different end portion of said cam, thereby pivoting the lugs between said extended and retracted positions as said adjacent rails move relative ot each other between said propelling and retracting positions, and

the forward end of the innermost of said adjacent rails of each pair has a projection extending above the level of said bed to engage the trailing side of a carton at the first station and propel the carton toward the filling station as said rails are moved from said forward to said rear positions.

3. The automatic carton folding and sealing machine described in claim **2** wherein

said second flap folding lug is a projection extending rearwardly from the tip of that one of said L-shaped lugs engaging and propelling the trailing top side of the carton from the filling station.

4. The automatic carton folding and sealing machine described in claim **3** wherein said first flap folding lug extends upwardly from the forward end of the outermost of said one of said pairs of rails above the level of said bed into engagement with and folds the carton flap across the open carton and as said rails move relative to each other between said retracted and propelling positions.

5. The automatic carton folding and sealing machine described in claim **1** wherein at least one carton squaring ear is pivotally mounted on said frame to extend vertically into contact with the leading side of the opened carton at the first station and hold the carton in an uncollapsed, open position.

6. The automatic carton folding and sealing machine described in claim **5** wherein at least one carton squaring ear is pivotally mounted on said frame to extend vertically into contact with the leading side of the opened carton at stations subsequent to said first station to hold the cartons in an uncollapsed and open position.

7. The automatic carton folding and sealing machine described in claim **6** wherein said carton squaring ears are weighted lugs pivotally mounted above the top level of the cartons propelled along said bed with the lower portion of the lugs hanging vertically downwardly to contact the leading side of a carton at the station.

8. In a carton folding and sealing machine in which a succession of open cartons with protruding flaps is propelled along a support bed for being filled, folded closed and sealed, a carriage for propelling said cartons from the forward to the rear ends of said support bed through flap folding means to a sealing station, said carriage comprising:

a pair of longitudinally extending inner rails spaced apart in a facing relationship,

a pair of longitudinally extending outer rails each disposed alongside one of said inner rails and on the opposite side of the other of said inner rails,

means supporting both rails of one of said pairs for reciprocating movement longitudinally along an adjacent section of said support bed between a forward and a rear position on said bed,

a first of said pairs of rails each having a plurality of longitudinally extending cam surfaces spaced at intervals along its length with one end portion of each said cam surface extending parallel to the longitudinal axis of said rail and the other end portion extending downwardly therefrom at an angle,

a plurality of carton propelling lugs each having an upwardly projecting tip at one end,

means pivotally connecting the other end of each said lug opposite said upwardly extending tip to one of a second of said pairs of rails at intervals spaced along said rail to pivotally support each said lug,

each said propelling lug having two cam followers at opposite ends of the lug with both followers engagingly restricted within the end limits of one of said cam surfaces and the spacing between said two followers being such that both of said followers are within the limits of said one end portion of said cam surface when the followers are at one extremity of said cam surface and each follower is within the limits of a different end portion of said cam surface when the followers are at the other extremity of said cam surface, thereby moving said one end of said lugs upwardly and downwardly as the pivoting lugs move forwardly and rearwardly along said cam surfaces and said inner and outer rails move longitudinally relative to each other a limited distance within the range of the end limits of said cam surfaces,

and means for interconnecting one of said pairs of rails for movement of said rails on said support bed between said forward and rear positions, during which movement said inner and outer rails moving relative to each other a limited distance and said propelling lugs pivot between (1) an extended position in which the upwardly projecting ends thereof engage the cartons to propel them along the support bed as the rails are moved from the forward to rear position and (2) a retracted position below the level of the cartons supported on said bed as the rails are returned from the rear to the forward position,

said inner and outer rails being locked together for movement upon engagement of said followers at either end limit of said cam surfaces.

9. The carriage described in claim **8** additionally comprising a projection extending above the level of said support bed at the forward end of each of one of said pairs of rails to engage the first of a succession of cartons and propel it to a position where the forwardmost of said drawing lugs will engage the carton when the rails are returned to the forward position from the rear position.

10. The carriage described in claim **9** wherein said one pair of rails carrying said carton propelling projections are said inner rails,

said rail interconnecting means connect between said outer rails and

the forward end of one only of said outer rails has a flap folding lug extending upwardly above the top of said support bed juxtaposed alongside one of said projections to engage and fold closed a trailing edge on the bottom side of the carton as said outer rails move forwardly relative to said inner rails before said carton engaging projections on said inner rails contact the carton and propel it along said support bed.

11. The carriage described in claim **10** wherein said cam surfaces are slots extending longitudinally within said rails and

said followers are pins projecting from a side of said propelling lug and contained within one of said slots.

12. The carriage described in claim **11** wherein said propelling lugs are pivotally supported between adjacent inner and outer rails and

each said rail support means movably supports each inner rail on a face of said bed support opposite the adjacent outer rail.

13. The carriage described in claim **12** wherein said carriage additionally comprises means for slidably interconnecting said adjacent inner and outer rails to permit longitudinal, relative motion of said adjacent rails,

the horizontally extending end portion of each said slot being closest to that end of said rail nearest said rear position and

each said propelling lug being pivotally mounted at its rear end to said outer rail.

14. The carriage described in claim **10** wherein a carton drawing lug supported on the outer rail opposite said one only outer rail has a flap folding projection extending rearwardly of the rear edge of said upwardly projecting tip on the outer face thereof to contact and fold closed a trailing flap of the top side of the carton during the initial rearward relative motion of said outer rail and before said upwardly projecting tip of the drawing lug engages the trailing edge of the carton.

15. In a carton folding and sealing machine having means for propelling along a support bed a succession of cartons each with at least one open end and flaps proturding therefrom to pass: (1) from a filling station at which each open carton is filled, (2) through means engaging and folding closed the protruding flaps of each carton to close the open carton end and (3) into a sealing station having heating strips contacting the folded carton flaps to activate an adhesive on the flaps which seals closed the filled cartons, the improvement of:

a withdrawal arm movable between a first position engaging each carton propelled into the sealing station and a second position in which the engaged

carton is withdrawn from the sealing station in contact with said heating strips,

means separate from said carton propelling means moving said withdrawal arm between in first and second positions,

a control actuating said withdrawal arm moving means in timed relationship to said carton propelling means operations and

means controlling the velocity at which said withdrawal arm moving means operates between said first and second positions.

16. The carton folding and sealing machine of claim **15** in which said withdrawal arm and moving means include:

a fluid actuated piston movable within a cylinder and mounted to one side of said support path in a position to clear the propelled and withdrawn cartons,

a piston rod attached to said piston,

an arm connected to an end portion of said piston rod to extend toward the cartons and having a movable tip positionable into the path of the cartons for engagement with individual cartons at the sealing station and

a fluid source connected to said cylinder to drive said piston in reciprocating motion.

17. The carton folding and sealing machine of claim **16** in which said cylinder is mounted parallel to said heating strips which are disposed on opposite sides of the support bed and said tip is pivotally mounted on the end of said arm.

18. The carton folding and sealing machine of claim **17** in which said control includes:

a valve interposed between said cylinder and fluid source,

a first valve control actuated by said propelling means when a carton is positioned in the sealing station in contact with the heating strips to position said valve for moving said piston and arm to one of said positions and

a second valve control actuated by the movement of said piston into said second position to position said valve for moving said piston and arm to the other one of said positions.

19. The folding and sealing machine of claim **17** in which said actuating cylinder is mounted above and parallel to said support bed to lie beyond the sealing station on an opposite side from the filling station with said arm depending vertically downwardly and said piston in said second position is at that end of said cylinder most remote from said sealing station.

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