Oct. 9, 1962 C. S. JOHNSON, JR 3,057,267

CARTON OPENING MECHANISM

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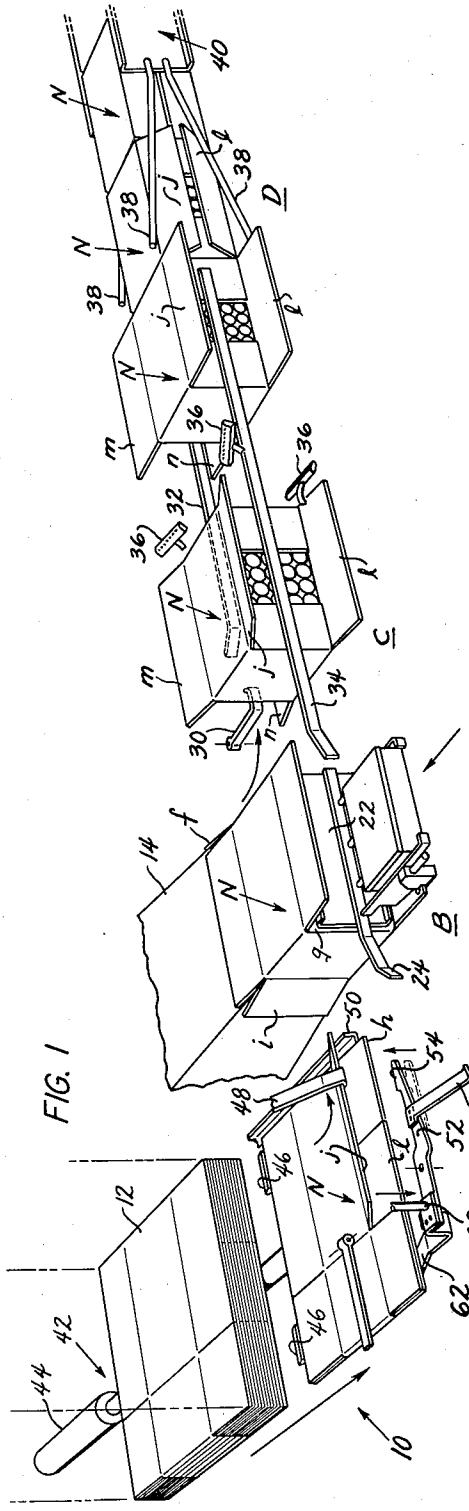


FIG. 1

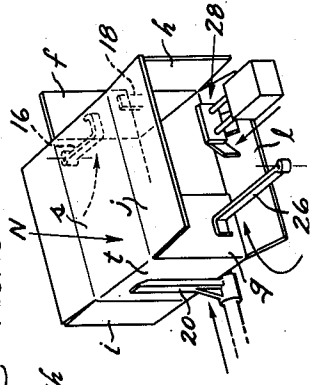


FIG. 1C

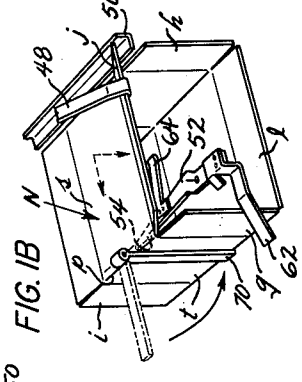


FIG. 1B

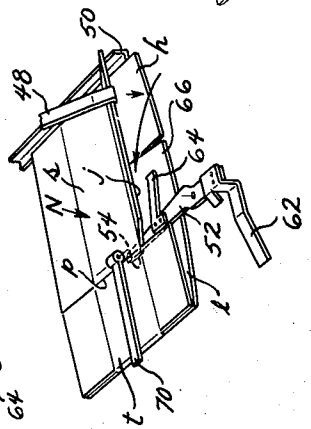


FIG. 1A

INVENTOR.
CURTISS S. JOHNSON, JR.
BY Teller & McCormick
ATTORNEYS

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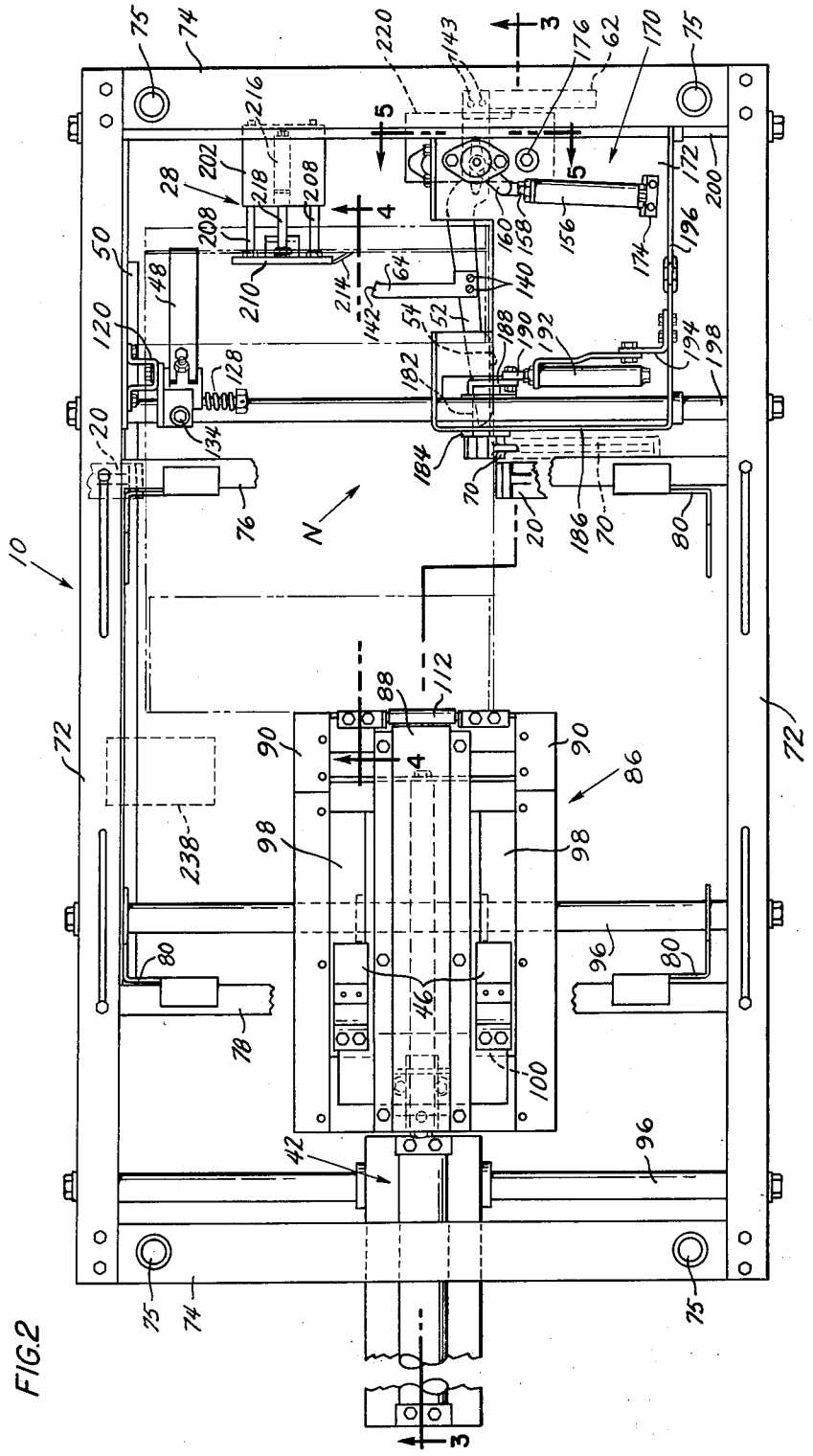


FIG.2

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CARTON OPENING MECHANISM

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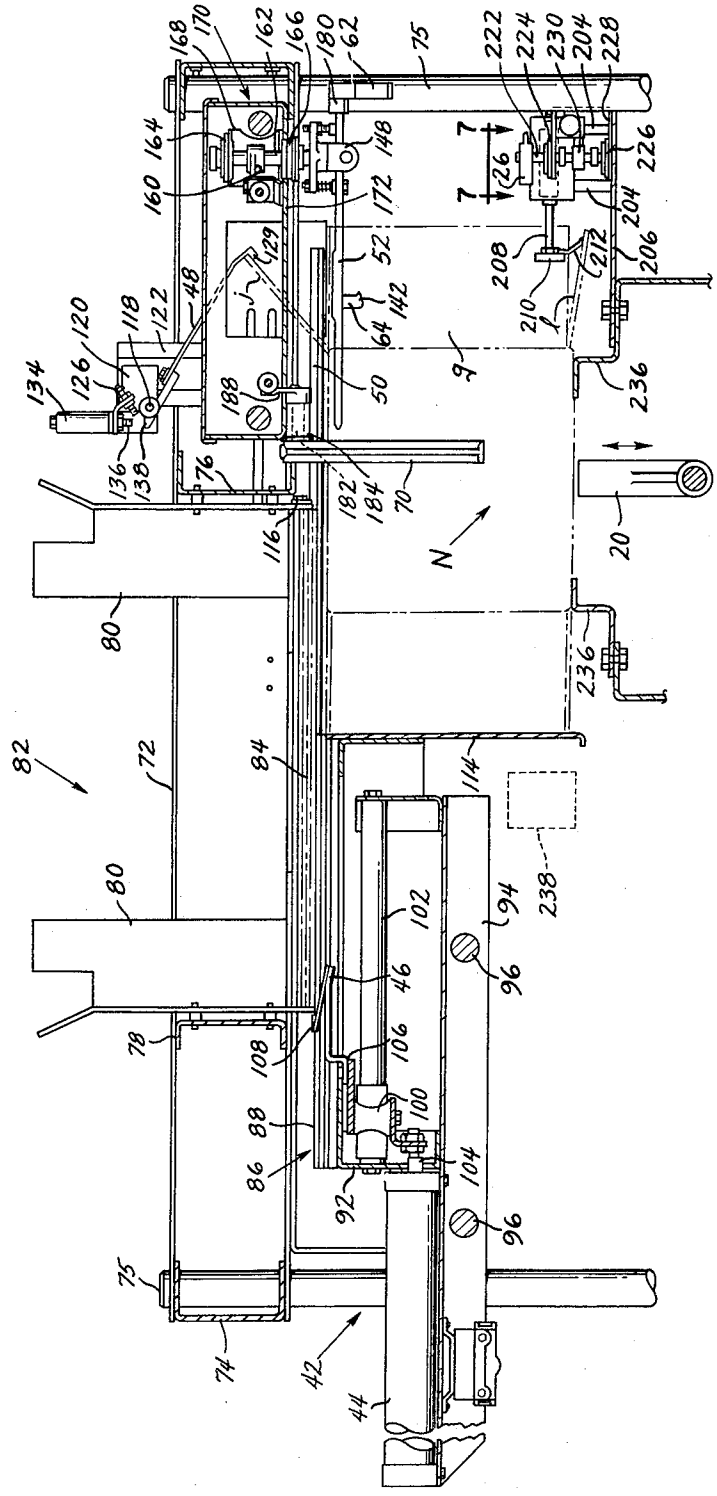


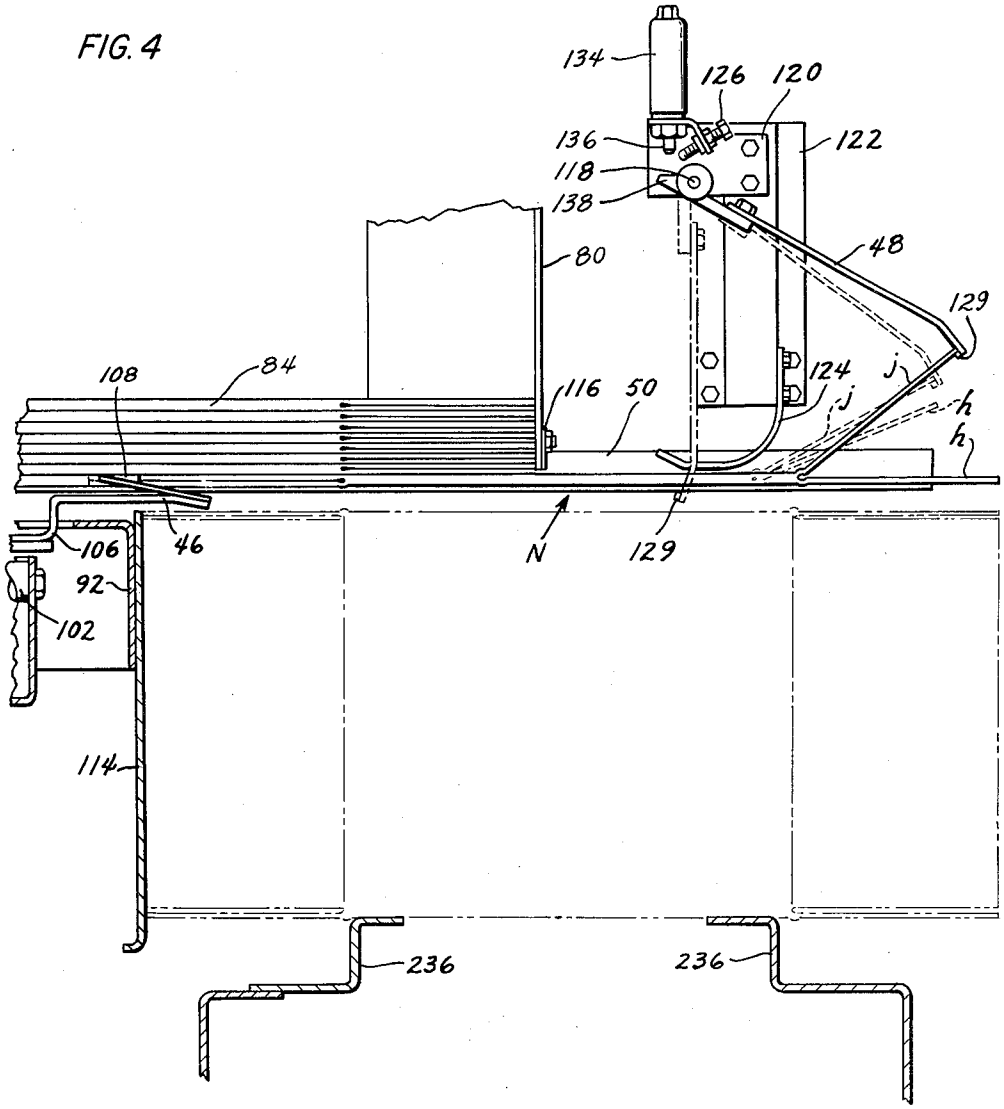
FIG. 3

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FIG. 4



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FIG. 5

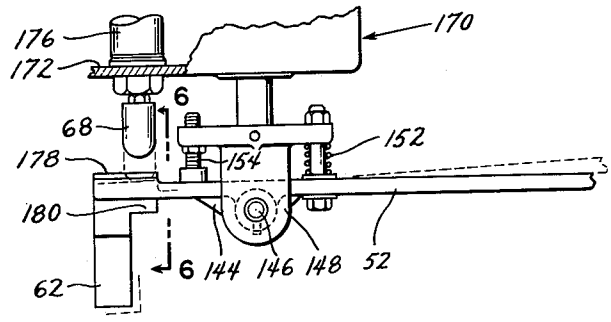


FIG. 6

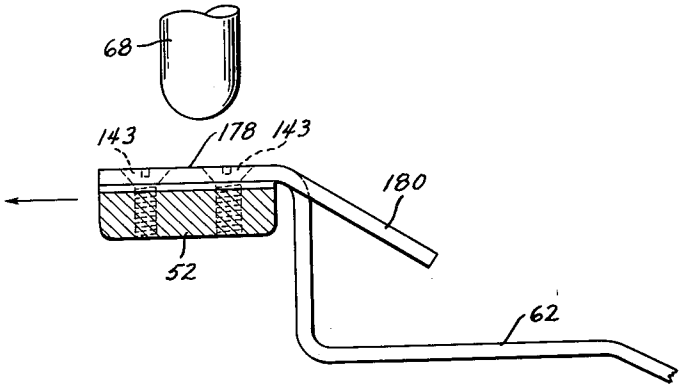
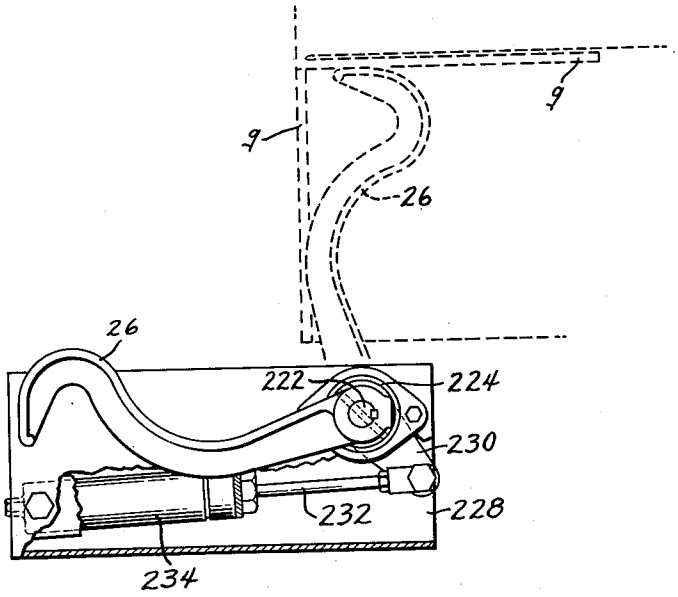


FIG. 7



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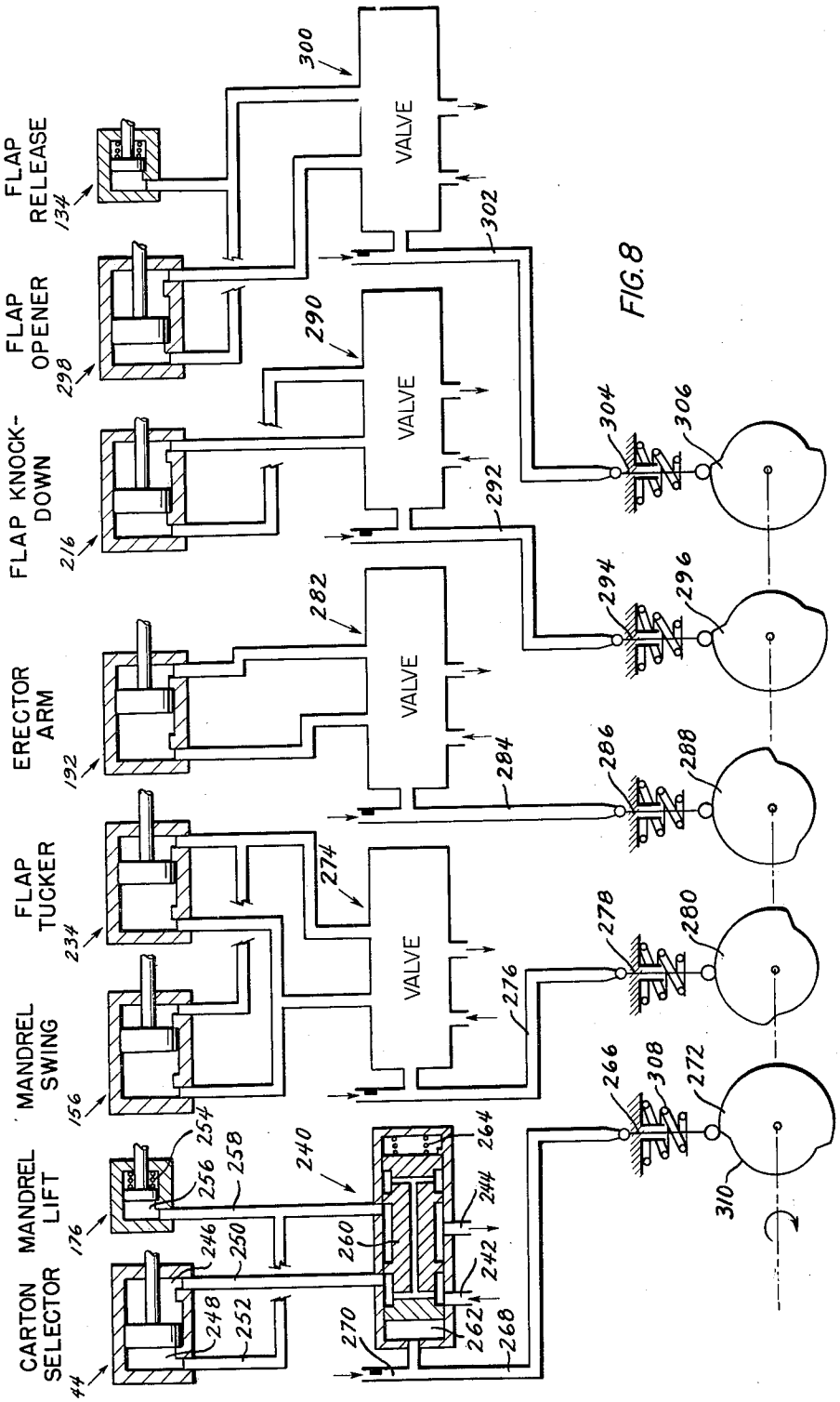


FIG. 8

United States Patent Office

3,057,267

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3,057,267

CARTON OPENING MECHANISM

Curtiss S. Johnson, Jr., Middle Haddam, Conn., assignor to Emhart Manufacturing Company, Hartford, Conn., a corporation of Delaware

Filed June 28, 1960, Ser. No. 39,253
14 Claims. (Cl. 93—53)

This invention relates generally to carton or case packing and sealing machinery and, more particularly, to a mechanism adapted to successively open or erect a plurality of collapsed cartons or cases for delivery to loading or packing apparatus and thence to gluing and sealing apparatus.

It is the general object of the invention to provide a carton opening mechanism which is particularly adapted to efficiently handle cartons of a wide variety of shapes and sizes and with various seam constructions and which is desirably simple in construction and yet exhibits a high degree of dependability and durability in use.

The drawings show a preferred embodiment of the invention and such embodiment will be described, but it will be understood that various changes may be made from the construction disclosed, and that the drawings and description are not to be construed as defining or limiting the scope of the invention, the claims forming a part of this specification being relied upon for that purpose.

Of the drawings:

FIG. 1 is a schematic illustration depicting the principal elements of and indicating the operation of a carton packing and sealing machine which incorporates a carton opening mechanism embodying the invention;

FIG. 1A is a schematic illustration showing elements of the carton opening mechanism in another stage of operation wherein a carton is partially open;

FIG. 1B is another schematic illustration showing elements of the carton opening mechanism in a third stage of operation wherein the carton is fully open or erect;

FIG. 1C is still another schematic illustration of the carton opening mechanism showing the carton open or erect and fully conditioned for transport to a succeeding station in the packing and sealing machine;

FIG. 2 is a plan view of a carton opening mechanism embodying the invention;

FIG. 3 is a longitudinal vertical section through the carton opening mechanism taken generally as indicated by the line 3—3 in FIG. 2;

FIG. 4 is an enlarged, fragmentary, longitudinal, vertical section taken generally as indicated by the line 4—4 in FIG. 2;

FIG. 5 is an enlarged, fragmentary, transverse, vertical section taken generally as indicated by the line 5—5 in FIG. 2;

FIG. 6 is an enlarged fragmentary section taken as indicated by the line 6—6 in FIG. 5;

FIG. 7 is an enlarged, fragmentary, horizontal section taken as indicated by the line 7—7 in FIG. 3; and

FIG. 8 is a schematic illustration of a pneumatic control system for the carton opening mechanism.

Referring particularly to FIGS. 1, 1A, 1B and 1C, it will be observed that a carton opening mechanism is indicated generally at **10**. Collapsed cartons are fed successively from the bottom of a vertical stack **12** and the cartons are opened or erected in a series of operations which take place with the cartons located at a first station A within the carton opening mechanism **10**. FIGS. 1A, 1B and 1C which depict these operations are displaced progressively from the station A for convenience of illustration only.

While the invention is not so limited, the carton opening mechanism **10** is particularly adapted for incorporation in a carton packing and sealing machine at right angles with respect to the longitudinal center line of the machine. That is, the carton opening mechanism **10** includes means adapted to feed collapsed cartons at right angles with respect to the direction of movement of a conveyor means which transports erected cartons from the opening mechanism to succeeding stations in the packing and sealing machine.

In the illustrative carton packing and sealing machine shown in FIG. 1 wherein the carton opening station is designated by the letter A, B designates a carton packing station, C a gluing station, and the letter D designates a carton sealing station. Erected cartons are transported substantially horizontally and in a straight line from station A to the stations B, C and D in succession, but collapsed cartons are delivered or fed to the opening station A substantially at right angles with respect to their subsequent travel.

To best understand the requirements for the carton opening mechanism **10**, consideration may be given first to the remaining elements of the carton packing and sealing machine. Each of said remaining elements is adapted for adjustments which enable the machine to accommodate cartons of different sizes and shapes and it is therefore a first requirement that the carton opening mechanism have a similar capability. At station B an erected carton N is loaded or packed by packing apparatus including a discharge funnel indicated generally at **14**. The mouth of the discharge funnel **14** is advantageously located closely adjacent a rear or loading end of the carton and within the rear flaps thereof. Accordingly, the leading rear side flap *f* of an erected carton N must be bent outwardly prior to or during transport from station A to station B in order that the said flap can clear the terminal portion of the funnel **14** adjacent its mouth. As best shown in FIG. 1C, a flap opener **16** operates to open said leading rear side flap *f* of the carton as required for clearance of the funnel **14**. Said flap opener **16** operates to open the flap at the opening station A and the flap is subsequently held open by a retaining member **18** during transport of the carton to the station B. The retaining member **18** rises into engagement with the said flap *f* as movement of the carton N from station A to station B commences at the urging of a finger **20** which may comprise a part of a conventional walking-beam type conveyor. The finger **20** also rises to engage the carton and both the said finger and the retaining member **18** are lowered out of engagement with the carton at station B.

The front side flaps *g* and *h* of the carton N at the end of said carton opposite the loading end are closed and held in such position during the carton loading or packing operation at station B. A platen or backing plate **22** holds said flaps in closed position during the loading or packing and is movable transversely away from said flaps to permit the unimpeded movement of the carton from station A and to station C. A plow **24** closes the leading front side flap *h* of the carton N as it is transported from the opening station A to the packing station B. The trailing front side flap *j*, however, is closed in the carton opening mechanism at station A and is held in closed position until it engages the plow **24** during transport to station B. As best shown in FIG. 1C, a swingable flap tucker arm **26** included in the carton opening mechanism **10** initially closes the trailing front side flap *g* at station A. During transport of the carton from station A to station B, the said flap is held closed first by a flap knock-down and hold device indicated generally at **28** and thereafter by the plow **24**.

After the carton N has been packed at station B, it is conveyed to the gluing station C where its trailing rear side flap *i* is closed by a swingable flap tucker arm **30**. The leading rear side flap *f* of the carton is closed as the carton arrives at station C by a suitable plow **32** and

both the leading and trailing front side flaps *g* and *h* thereof are held in closed position by a plow **34**. While the carton is at station C, or during transport therefrom to station D, a suitable adhesive is applied to the inner sides of the upper and lower front flaps *j* and *l* and the inner sides of the upper and lower rear flaps *m* and *n* by means of applicators **36, 36** which may be of conventional construction.

As the carton N is transported from station C to station D, suitable plows **38, 38** close the said upper and lower front flaps *j* and *l* and the upper and lower rear flaps *m* and *n* thereof prior to the entry of the carton into a compression unit indicated generally at **40**. Sealing of the carton flaps takes place in a conventional manner within the compression unit **40** whereupon the carton is fully conditioned for shipment.

In view of the foregoing, it will be apparent that an efficient carton opening mechanism must be adapted to handle cartons of various shapes and sizes and to rapidly open or erect a plurality of such cartons in succession. When the opening mechanism is incorporated in a carton packing and sealing machine of the type described generally above, the mechanism must be adapted to deliver or feed collapsed cartons to the carton opening station at right angles with respect to the direction of subsequent transport of the opened or erected cartons. Further, the opening mechanism must be adapted to close the trailing front side flap of an erected carton and to hold said flap in closed position as the carton is transported from the opening station.

The carton opening mechanism **10** fulfills all of the above-mentioned requirements and is yet of desirably simple construction and exhibits a high degree of dependability and durability in operation. Further, the said carton opening mechanism can readily accommodate cartons with a wide variety of seam constructions. Collapsed cartons are fed to the opening station A in a direction parallel to the seams and score lines thereon or, stated differently, said cartons are fed in a direction normal to the outer edges of their flaps. With this method of feeding collapsed cartons, the possibility of interference between overlapping seams of adjacent carton is minimized as is the possibility of interference between staples associated with overlapping seam portions of adjacent cartons. Thus, cartons with seam constructions other than the smooth flat type provided by taping can be efficiently fed singularly from the bottom of the stack **12** to the opening station A.

The means in the carton opening mechanism **10** for feeding collapsed cartons one at a time to the opening station A comprises a reciprocable carton selector indicated generally at **42** in FIG. 1. Said selector includes an air cylinder **44** operatively connected with pusher fingers **46, 46**. As will be described more fully hereinafter, the pusher fingers **46, 46** advance collapsed cartons, such as a carton N, horizontally and one at a time from the bottom of the stack **12**. A flap separating finger **48** depends in the path of the leading edges of vertically adjacent front flaps *h* and *j* of the collapsed carton N as the carton is advanced from the stack **12**. When engaged by said flap leading edges, the finger **48** swings upwardly and forwardly and pivotally lifts the said flaps whereby to separate the same in a riffling operation. Thus, when the carton N reaches the opening station A as shown in FIG. 1, the upper front flap *j* thereof is held in a forwardly and upwardly inclined position by the finger **48** to provide a space between said flap and the lower front carton flaps *l* and *h* therebeneath. The carton is supported at such time along one side edge portion thereof by a support rail **50** and at a rear portion thereof by the pusher fingers **46, 46**.

Still referring to FIG. 1, it will be observed that a thin elongated mandrel **52** is disposed in front of the collapsed carton N at the opening station A. The mandrel **52** is swingable generally horizontally rearwardly through the space between the separated front flaps of the carton to a position within the carton adjacent a bend or score line *p* thereon between adjacent upper panels *s* and *t* thereof. The bend or score line *p* may take any form suitable to facilitate bending and may of course be at a seam of the carton or the carton seam may be at any of the other three bend or score lines on the carton. In FIG. 1A the mandrel **52** is shown in position within the carton N and it will be observed that a bending edge **54** on said mandrel lies adjacent the score line *p*, but said edge is spaced from said score line on the side thereof opposite the aforesaid support rail **50**. The mandrel and its bending edge are so located for a purpose to be set forth hereinafter.

Referring again to FIG. 1, it will be noted that the mandrel **52** carries a transverse arm **62** which projects beneath a front corner portion of the carton N at the opening station A to lend vertical support to the carton when the mandrel is in its forward position. Said arm is swung away from and out from under the carton as shown in FIG. 1A when the mandrel **52** is swung rearwardly to its position within the carton. Another transverse arm **64** on the mandrel **52** extends angularly forwardly and downwardly from the mandrel when the latter is in its forward position, but it will be noted that said arm engages a lower front flap *l* of the carton N when the mandrel is swung rearwardly. The flap *l* is thus deflected downwardly by the arm **64**, which arm may be referred to hereinafter as a drag finger, and this results in a partial opening or erection of the carton. Stated differently, the score line between the lower panels of the carton N is "broken" downwardly by the arm or drag finger **64**.

Slight upward movement of the mandrel **52** is indicated by the arrow in FIG. 1. Preferably, said mandrel is swingable in a horizontal plane beneath the support rail **50** and is elevated during an initial portion of its rearward swinging movement so as to clear the lower front flaps *l* and *h* of an advanced carton N and to freely enter the space between said flaps and the elevated upper front flap *j* thereof. As will be described more fully hereinafter, the mandrel **52** is preferably pivotally supported for both horizontal and vertical swinging movements and a means for pivotally elevating the same is provided in the form of a plunger **68**. Said plunger is operated to pivotally elevate the mandrel only when the latter is in its forward position and the mandrel thereafter drops to its normal position during rearward movement thereof and when it is disposed within the carton as shown in FIG. 1A.

As shown in FIG. 1A, the carton N is conditioned to be opened or erected by means of an erector arm **70**. The erector arm **70** is swingable vertically downwardly into engagement with the upper panel *t* of the carton N so as to pivot said panel downwardly through approximately 90° about the aforesaid bending edge **54** of the mandrel and along the score line *p* and to erect the carton. Due to the aforementioned location of the mandrel bending edge **54** in spaced relation with the score line *p*, the action of the erector arm **70** in opening or erecting the carton also serves to pull the carton leftwardly off the support rail **50**. When this occurs, the carton drops to a level established by the upper surface of the mandrel **52** whereat the upper surface of the carton panel *s* is spaced below the support rail **50**. Subsequent retraction of the mandrel **52** from its position within the carton and release of the upper front carton flap *j* by the flap separating finger **48** permits the carton to be transported horizontally beneath the support rail **50** from the opening station A to the packing station B.

Turning now to the detailed construction of the carton opening mechanism **10**, it will be observed in FIG. 2 that the said mechanism includes a generally rectangular frame comprising spaced parallel side members **72, 72** and connecting end members **74, 74** supported

by corner legs **75, 75**. Supported by and between the side members **72, 72** of the frame are front and rear parallel cross members **76** and **78**. Said cross members are each adjustable longitudinally of the carton opening mechanism **10** and they in turn support four similar rectangularly spaced upright corner members **80, 80** of a vertical magazine indicated generally at **82** in FIG. 3. At least two of the corner members **80, 80** of the magazine **82** are adjustable transversely and along the supporting members **76** and **78** by suitable means not shown. Thus, the width as well as the length of the magazine **82** is variable to accommodate collapsed cartons of various sizes and shapes. Cartons are disposed in the magazine **82** in horizontal planes one upon the other in a vertical stack as shown at **84** in FIG. 3.

The stack of collapsed cartons **84** is supported vertically by a horizontal table **86** which has a longitudinally extending center panel **88** and similar longitudinally extending side panels **90, 90** spaced transversely from the center panel **88**. The upper surfaces of the table panels **88** and **90, 90** are substantially flat and lie in a common plane, and the lowermost collapsed carton in the stack **84** rests thereon to support the stack. All of said table panels are connected with and supported by a frame member **92** of the table **86** which is in turn mounted on a carrying frame **94** supported by a pair of spaced parallel transverse mounting rods **96, 96**. The carrying frame **94** is adjustable transversely in the carton opening mechanism along the mounting rods **96, 96** so as to be centered transversely for collapsed cartons of different sizes and shapes.

The aforementioned carton selector **42** is operatively associated with the table **86** and the pusher fingers **46, 46** of the selector are movable longitudinally respectively in longitudinal slots **98, 98** defined by and between the central panel **88** of the table and the side panels **90, 90** thereof. Said pusher fingers **46, 46** are carried by a crosshead **100** slidable along a longitudinal rod **102** as best shown in FIG. 3. The crosshead **100** is in turn connected with and reciprocally driven by a piston rod **104** of the aforementioned air cylinder **44**, said cylinder being mounted on and supported by the carrying frame **94**.

The pusher fingers **46, 46** are of like construction and each preferably comprises a generally V-shaped spring steel member disposed on its side and having an offset **106** at the free end of one arm for connection with the crosshead **100**. At the free end of the other arm of the said member, a pusher lug **108** projects upwardly and is adapted to engage the edges of the rear flaps of a collapsed carton as shown in FIG. 3 to advance the carton at the bottom of the stack **84**. In FIG. 4 the pusher fingers **46, 46** are shown in advanced position and a carton N advanced by the fingers has its rear portion disposed beneath the remaining cartons in the stack **84** and supported vertically by the said pusher fingers. In advanced position the fingers **46, 46** are deflected downwardly by the remaining cartons in the stack **84**, but said fingers snap upwardly when they are retracted beyond the rear edges of the cartons in said stack. Thus, the pusher fingers **46, 46** may be reciprocated successively by means of the air cylinder **44** and the crosshead **100** to successively advance collapsed cartons at the bottom of the stack **84**. The cartons slide freely forwardly over the upper surfaces of the aforementioned table panels **88** and **90, 90** and off the forward end of said table over a small freely rotatable roller **112** best shown in FIG. 2. In advanced position, the carton N has its rear edge substantially in vertical alignment with or slightly forwardly of the front surface of a vertical backing plate **114** attached to the table frame member **92**. A small gage plate **116** supported for vertical adjustment on one of the forward corner members **80** of the magazine **82** may be set to assure that cartons are advanced from the stack **84** singularly.

The previously mentioned support rail **50** projects horizontally forwardly from the magazine **82** and may be secured to one of the corner members **80, 80** thereof by suitable means not shown. As best shown in FIG. 4, said rail supports one side edge portion of an advanced but collapsed carton such as the carton N as described above.

The detailed construction of the flap separating finger **48** is also best illustrated in FIG. 4. Said finger depends from and is pivotally supported by a horizontal pivot pin **118** in turn supported by a mounting bracket **120** carried on an upright support member **122** attached to the side frame member **72** adjacent the support rail **50**. Said member **122** also carries a rearwardly curved carton hold-down arm **124** which engages advancing cartons and holds the body portions thereof in horizontal planes as the front flaps thereof are pivotally lifted by the separating finger **48**. As shown in broken line, the separating finger **48** depends substantially vertically from the pivot pin **118** when at rest and the finger is held in such position by means of an adjustable stop screw **126** and a biasing spring **128** connected therewith. The biasing spring **128**, best illustrated in FIG. 2, urges the finger **48** downwardly and rearwardly against the stop screw **126** and in a clockwise direction against the urging of a carton as the front flap edges thereof engage the finger during advance of the carton from the stack **84**.

From the foregoing, it will be apparent that the flap separating finger **48** is engaged by the leading edges of vertically adjacent front flaps on a collapsed carton, such as the carton N, during advance of the carton from the stack **84**. A short rearwardly projecting member **129** at the lower end portion of the finger **48** extends beneath leading edge portions of such carton flaps as their edges engage the finger and said member serves to pivotally lift the vertically adjacent front carton flaps as the finger is swung forwardly and upwardly by said flaps. Moreover, the member **129** serves to riffle the said flaps and to separate the same as they are swung or pivoted upwardly by the finger **48** during further advance of the carton. That is, the leading edge portion of a lower front flap, such as the flap *h* on the carton N, slides off the rearwardly projecting member **129** on the finger **48** when the said flap has reached a given angle above the horizontal. Said lower front flap thereafter falls to its normal position in a horizontal plane as indicated in full line in FIG. 4, but the upper front flap *j* is held in an upwardly and forwardly inclined angular relationship with said lower flap by the finger **48** and the member **129**.

There is also operatively associated with the flap separating finger **48** a flap release device including an air cylinder **134** and a plunger **136**. The flap release device is operable automatically to release the upper front flap of an advanced carton, such as the flap *j*, after the aforementioned mandrel **52** has been entered in the carton and, preferably said device operates to release said flap after the carton has been opened or erected as will be described. The flap releasing operation of the device involves the actuation of the air cylinder **134** and vertical downward movement of the plunger **136**. When the plunger is so moved, it engages an upper portion **138** of the flap separating finger **48** and effects an additional upward and forward, or counterclockwise, swinging movement of said finger whereby to disengage the rearwardly projecting member **129** from the edge portion of the upper front flap *j*.

In presently preferred form, the mandrel **52** comprises a thin elongated knifelike member as best shown in FIGS. 2 and 3. In said figures, the mandrel **52** is shown in its aforementioned rearward position within an advanced carton N. The carton N has been opened or erected as described above and pulled off the support rail **50**, the bending edge **54** of the mandrel **52** having been posi-

tioned within the carton before erection thereof in the manner described above in connection with FIG. 1A. The aforementioned drag finger **64** preferably takes the form of a thin elongated sheet metal member attached at one end to the mandrel **52**, as by means of screws **140**, **140**, and extending transversely and angularly downwardly from the mandrel. The lower or free end portion **142** of the drag finger is rounded or curved upwardly to provide a smooth surface for engagement with the lower front flap of a carton during rearward swinging movement of the mandrel. The aforementioned support arm **62** on the mandrel **52** preferably takes the form of an elongated sheet metal member attached at one end to the mandrel by means of screws **143**, **143** best shown in FIG. 6. Said arm extends downwardly and transversely with respect to the mandrel so as to support an advanced collapsed carton with the mandrel in its forward position.

As best shown in FIG. 5 wherein a portion of the mandrel is shown in its forward position, the mandrel **52** has a small integrally formed bearing member **144** between its ends which is provided with a suitable bore for receiving a pivot pin **146** held at opposite ends in suitable apertures in the depending arms of a yoke **148**. The pivot pin **146** extends horizontally and the mandrel **52** is supported thereby for pivotal movement in a vertical plane. A biasing spring **152** urges the mandrel in a clockwise direction in FIG. 5 to a normal position in a horizontal plane wherein it is held by a stop screw **154**. Thus, the mandrel is adapted to be pivoted in a counterclockwise direction whereby to elevate the same for free entry in the space between separated front flaps of an advanced carton. The horizontal plane in which the mandrel lies when at rest is preferably disposed beneath the support rail **50** as mentoined above.

Horizontal swinging movement of the mandrel **52** is effected by means of an air cylinder **156** best shown in FIG. 2 and having its piston rod **158** connected with a crank arm **160**. As best shown in FIG. 3, the crank arm **160** is fixedly connected with a vertical rockshaft **162** which is supported by upper and lower bearings **164** and **166**. The lower end portion of the rockshaft **162** is fixedly connected with the yoke **148** so as to rotate the same and thereby angularly rotate the mandrel **52** in a horizontal plane. The upper bearing **164** for the rockshaft **162** is supported by a bracket **168** mounted on a generally boxlike housing **170** and the lower bearing **166** is supported in a lower wall **172** of said housing. The air cylinder **156** is also supported on said bottom wall **172** of the housing **170** by means of a suitable bracket **174**. As shown, a forward or pushing stroke of the piston rod **158** of the air cylinder effects approximately a 90° forward horizontal swinging movement of the mandrel **52**, and a pulling or retracting stroke of said rod effects approximately a 90° rearward horizontal swinging movement of said mandrel to its position within an advanced carton.

The aforementioned plunger **68** which is operated to pivotally elevate the mandrel **52** for free entry into an advanced carton has operatively associated therewith an air cylinder **176** shown in FIG. 2 and partially shown in FIG. 5. The plunger **68** is urged downwardly by the said air cylinder into engagement with a flat upwardly facing surface **178** on the aforementioned supporting arm **62** to pivot the mandrel **52** in a counterclockwise direction in FIG. 5. As will be seen, the plunger **68** is operated to so pivot the mandrel **52** at the beginning of a rearward swinging movement of the mandrel and the flat surface **178** is swung out from under the said plunger as such movement of the mandrel occurs. A short downwardly inclined transverse flange **180** adjacent said surface **178** engages the plunger **68** as the surface **178** is swung away from the plunger and allows the mandrel to swing angularly downwardly to its aforementioned normal horizontal position. Note also that the flange **180** serves to urge the plunger **68** upwardly in the event that the air cylinder malfunctions holding the plunger in its downward position when the mandrel is thereafter swung forwardly.

The aforementioned erector arm **70** is swingable as described in a vertical plane downwardly into engagement with an upper panel of an advanced carton to erect the carton and pull the same off the support rail **50**. As best shown in FIG. 3, the erector arm **70** is fixedly mounted on a horizontal rockshaft **182** journaled in a bearing **184** mounted on a side wall **186** of the housing **170**. The rockshaft **182** is rotated angularly to swing the erector arm through approximately 90° from an upper broken line position in FIG. 2 to a downward full line position best shown in FIG. 3. A crank arm **188** rotates the rockshaft **182** and is in turn driven by an air cylinder **192** best shown in FIG. 2. As shown, the erector arm **70** is swung upwardly to the broken line position in FIG. 2 in response to a forward or pushing stroke of the piston rod **190**, and said arm is swung downwardly to the full line position shown in FIG. 3 by a pulling or retracting stroke of said rod. The air cylinder **192** is supported by a suitable bracket **194** mounted on a side wall **196** of the housing **170**.

To accommodate cartons of different sizes and shapes, the mandrel **52** and its associated parts and the erector arm **70** and its associated parts may be simultaneously moved transversely in the carton opening mechanism **10** by transverse adjustment of the housing **170**. Said housing is adjustably mounted on and supported by a pair of spaced transversely extending rods **198** and **200** secured at opposite ends in the side frame members **72**, **72**.

As best shown in FIGS. 2 and 3, the aforementioned flap knock-down and hold device **28** comprises a boxlike housing **202** supported on upright brackets **204**, **204** carried by a plate **206** which forms a lower portion of the frame of the carton opening mechanism **10**. A pair of horizontally extending support rods **208**, **208** are slidably supported within the housing **202** for forward and rearward movement. At their rear ends, said rods carry a flat plate **210** disposed in a vertical plane and provided with a downwardly and forwardly extending flange **212** at its lower edge. The plate **210** also carries a lead-in flange **214** which is inclined forwardly therefrom and which engages the closed trailing front side flap *g* of an erected carton N and directs the said flap into engagement with the plate **210** when the carton is transported transversely from the carton opening mechanism as described above. The plate **210** and the flanges **212** and **214** thereon are moved rearwardly to the position shown in FIGS. 2 and 3 by means of an air cylinder **216** within the housing **202** and a piston rod **218** connected with the plate. When said parts are so located, the flange **212** bends the lower front flap *l* of the erected carton N downwardly as best shown in FIG. 3 and the lead-in flange **214** and the plate **210** are in position to hold the trailing front side flap *g* of the carton closed during transport. The air cylinder **216** may of course also be operated to move the plate **210**, the flanges **212**, **214** etc. forwardly to a position in front of an erected carton.

With the carton N erected as shown in broken line in FIG. 3 with its upper and lower front flaps *j* and *l* in diverging relationship with respect to each other, the trailing front side flap *g* of said carton can be readily folded into closed position as described above in connection with FIG. 1C. The aforementioned flap tucker arm **26** is best shown in FIG. 7 and its location in the carton opening mchanism **10** is indicated generally by the broken line **220** in FIG. 2. In FIG. 3 the tucker arm **26** is shown mounted on an upper end portion of a vertical rockshaft **222** journaled in upper and lower bearings **224** and **226**. Said bearings are supported by a mounting bracket **228** supported on the frame plate **206**. A crank arm **230**, best shown in FIG. 7, rotates the tucker arm **26** through approximately 90° from a forward position indicated in full line in FIG. 7 to a rearward broken line position. During rearward swinging movement of the

arm 26, the trailing front side flap *g* of an erected carton N is closed as shown. The crank arm 230 is connected with and driven by a piston rod 232 of an air cylinder 234 and, as shown, said cylinder is adapted to swing the tucker arm 26 rearwardly and forwardly respectively in response to pulling and pushing strokes of its piston rod.

As mentioned, the finger 20 which moves an erected carton N from the carton opening mechanism to station B for packing may form part of a conventional walking-beam type conveyor. Preferably there are two such fingers disposed on opposite sides of the carton and two fingers 20, 20 are shown schematically so disposed in FIGS. 2 and 3 in position beneath the erected carton N. The fingers 20, 20 rise into engagement with opposite sides of the carton to transport the same in a known manner when the carton is fully conditioned for transport as described above. Since the said fingers and their associated parts in a walking-beam conveyor are or may be conventional as mentioned and part of the packing and sealing machine proper, further description thereof is deemed unnecessary. It is to be observed, however, that the fingers rise into position for transporting erected cartons in properly timed relation with the operation of the carton opening mechanism 10.

Suitable guide and support rails for erected cartons are shown at 236, 236 in FIG. 3. Said rails may extend transversely into the carton opening mechanism 10 from the packing and sealing machine proper. An erected carton is supported by the rails in the carton opening mechanism 10 prior to transport to the packing station B and the carton may slide along said rails during transport.

The aforementioned flap opener 16 which opens the leading rear side flap *f* of an erected carton N may form a part of the carton opening mechanism 10 or, said opener may be part of the packing and sealing machine proper and may be located between the carton opening mechanism and the carton packing apparatus at station B. One appropriate location for the said flap opener in the carton opening mechanism 10 is indicated by the broken line 238 in FIGS. 2 and 3. Said opener may be identical with the flap tucker described above, but is of course arranged to open rather than to close the leading rear side flap *j* of the erected carton.

Control means for the carton opening mechanism 10 may take various forms within the scope of the invention, but a pneumatic control system of the type shown schematically in FIG. 8 is preferably provided. In said control system, a first control valve 240 is operatively connected with a high pressure air line 242 and a vent or relief line 244 and with the aforementioned air cylinder 44 of the carton selector 42 and the air cylinder 176 which operates the plunger 68 for pivotally lifting the mandrel 52. The air cylinder 44 has front and rear air chambers 246 and 248 communicating respectively with air lines 250 and 252 leading to the control valve 240. The air cylinder 176 has a front spring chamber 254 and a rear air chamber 256 which communicates with a branch air line 258 connected with the air line 252.

The control valve 240 is of a two-position type and is operable in moving from one position to the other to reverse the connection of the lines 250 and 252 with the air line 242 and the vent or relief line 244. Said valve need not be described in detail as the construction and operation of such two-position valves is well known and, further, the valve shown is merely exemplary of a type that may be employed. It will be obvious that air under pressure from the line 242 will be directed to the line 250 and the front chamber 246 of the air cylinder 44 to urge its piston to the rearward position shown when a valve member 260 in the valve 240 is positioned as shown. At such time, the rear chamber 248 of the air cylinder 44 is vented through the line 252, the control valve and the line 244. The piston in the air cylinder 176 is also moved rearwardly by venting the air chamber 256 therein through the lines 258, 252, the control valve and the line 244, the spring in the chamber 254 of said cylinder serving to so move the cylinder piston. The valve member 260 is held in the position shown by air pressure in a chamber 262, but it will be obvious that said valve member may be moved leftwardly to another position at the urging of a spring 264 when pressure in the chamber 262 is dissipated. When the valve member 260 moves leftwardly to its other or second position, the air line connections are reversed with the result that the pistons in the air cylinder 44 and the air cylinder 176 are moved to their forward positions.

Air pressure in the chamber 262 of the valve 240 is controlled by means of a vent valve 266 adapted to open and close an orifice at the free end of a vent conduit 268 connected with said chamber. A restricted air supply conduit 270 communicates with the vent conduit 268 and pressurizes the chamber 262 when the vent conduit is closed by the valve 266. When the valve 266 is open, pressure in the conduit 268 and in the valve chamber 262 is dissipated causing the valve member 260 to move leftwardly as described. Opening and closing movement of the valve 266 is controlled by a rotary cam 272 in a manner to be described hereinbelow.

Operation of the air cylinder 156 which controls horizontal swinging movement of the mandrel 52 and of the air cylinder 234 associated with the tucker arm 26 is controlled by a single control valve 274 which may be identical with the control valve 240 in both construction and operation. The valve 274 is, in turn, controlled in its operation by means of a vent conduit 276, a vent valve 278, and a rotary cam 280. The air cylinder 192 which operates the erector arm 70 has an associated control valve 282 like the control valves 240 and 274 and said valve is regulated in its operation by means of a vent conduit 284, a vent valve 286, and a rotary cam 288. The air cylinder 216 which operates the flap knock-down and hold device 28 is similarly operated by a control valve 290, a vent conduit 292, a vent valve 294 and a rotary cam 296. When the aforementioned flap opener 16 is included in the carton opening mechanism 10, an air cylinder 298 for operating the same may be connected with a control valve 300 in common with the aforementioned flap release air cylinder 134. A vent conduit 302 associated with the control valve 300 extends to a vent valve 304 operatively associated with a rotary cam 306.

It will be apparent that the rotary cams 272, 280, 288, 296 and 306 may be mounted on a common shaft for rotation in unison to control the operation of their associated control valves whereby to regulate the operation of the corresponding air cylinders and the devices actuated by said air cylinders. Noting that all elements shown in FIG. 8 are in the positions which they assume at the beginning of a cycle of operation of the carton opening mechanism and that clockwise rotation of the control cams through 360° completes a cycle of operation, the operation of the control system in relation to the working parts of the carton opening mechanism may be readily understood with the aid of a brief description.

As the cams commence clockwise rotation at the beginning of a cycle operation of the carton opening mechanism, the cam 272 allows the vent valve 266 to assume an open position at the urging of a biasing spring 308 and said valve may remain open for approximately 135° of the cycle as indicated by the cam drop 310. Opening of the valve 266 results in dissipation of the pressure in the chamber 262 of the control valve 240 and in shifting of the valve member 260 leftwardly whereupon the pistons in the air cylinders 44 and 176 are urged forwardly or outwardly to advance a collapsed carton and to pivotally elevate the mandrel 52 for free entry into the carton. At approximately 90°, the cam 280 opens the vent valve 278 causing the control valve 274 to reverse air line connections for the air cylinders 156 and 234. The pistons in said two cylinders thereupon move rearwardly causing the mandrel 52 to be

entered in the advanced carton and causing the tucker arm **26** to be swung forwardly to a position in front of the carton. At approximately 135°, the pistons in the air cylinders **44** and **176** are returned to the positions shown withdrawing the aforementioned pusher fingers **46, 46** of the cam selector **42** from beneath the rear edge portions of the advanced carton and lifting the plunger **68** of the mandrel pivoting device. The carton is now ready for erection and the cam **288** opens the vent valve **286** at approximately 135° causing the control valve **282** to effect rearward movement of the piston in the air cylinder **192.** This results in a downward swinging movement of the erector arm **70** and erection of the carton. With the cycle approximately half completed or at about 180°, the cam **296** opens the vent valve **294** causing operation of the valve **290** which results in forward movement of the piston in the air cylinder **216** and operation of the flap knock-down and hold device **28.** Thereafter, and at approximately 235°, the control cam **280** operates to close the vent valve **278** whereupon the mandrel is withdrawn from the erected carton and the tucker arm **26** is swung rearwardly to close the trailing front side flap of the carton. At or about the same time, the cam **306** opens the vent valve **304** causing operation of the valve **300** which results in forward movement of the piston in the air cylinder **298** and forward movement of the piston in the air cylinder **134.** Thus, the leading rear side flap of the carton is opened and the flap separating finger **48** releases the upper front flap of the carton. The carton is now fully conditioned for transport to the packing station B in the packing and sealing machine whereupon a new cycle of operation of the carton opening mechanism will be initiated by continuing clockwise rotation of the control cams.

The invention claimed is:

1. A carton opening mechanism comprising a means for advancing a collapsed carton in a horizontal plane and in a direction normal to the outer edges of its flaps, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front flaps of the carton during advance of the same, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said front flaps whereby to separate the same, a thin elongated mandrel swingable generally horizontally rearwardly from a position forwardly of an advanced carton through the space between the separated leading flaps thereof to a position within the carton and adjacent a bend line thereon between adjacent upper panels thereof, and an erector arm swingable downwardly into engagement with one of said upper carton panels so as to pivot said panel downwardly through approximately 90° about said mandrel and along said bend line whereby to erect the carton.

2. A carton opening mechanism comprising a magazine for holding a vertical stack of collapsed cartons disposed in horizontal planes, a reciprocable carton selector for advancing cartons horizontally at the bottom of the stack one at a time and in a direction normal to the outer edges of their flaps, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front flaps of a carton during advance of the carton from the stack, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said flaps whereby to separate the same, a thin elongated mandrel swingable generally horizontally rearwardly from a position forwardly of an advanced carton through the space between the separated front flaps thereof to a position within the carton adjacent a bend line thereon between adjacent upper panels thereof, and an erector arm swingable downwardly into engagement with one of said upper carton panels so as to pivot said panel downwardly through approximately 90° about said mandrel and along said bend line whereby to erect the carton.

3. A carton opening mechanism as set forth in claim 1 wherein said flap separating finger includes a short rearwardly projecting member which extends beneath the leading edge portions of vertically adjacent front carton flaps as they engage said finger and which serves to pivotally lift and riffle said flaps during said upward and forward swinging movement of the finger, said member also serving thereafter to hold an upper front flap above and in angular relationship with a lower front flap.

4. A carton opening mechanism as set forth in claim 3 and including a flap release device operable automatically after entry of said mandrel in a carton to effect additional upward and forward swinging movement of said separating finger whereby to disengage the said rearwardly projecting member thereon from said upper front flap of the carton.

5. A carton opening mechanism as set forth in claim 1 wherein said mandrel includes means operable during said rearward movement of the mandrel to depress at least one front flap on an advanced carton whereby to deflect the lower panels of said carton downwardly and to partially erect the carton.

6. A carton opening mechanism as set forth in claim 4 wherein said flap depressing means on said mandrel comprises a transverse angularly downwardly extending drag finger which is drawn over the upper surface of at least one of said front flaps to depress the same as said mandrel is swung rearwardly into the carton.

7. A carton opening mechanism comprising a magazine for holding a vertical stack of collapsed cartons disposed in horizontal planes, a reciprocable carton selector for advancing cartons horizontally at the bottom of the stack one at a time and in a direction normal to the outer edges of their flaps, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front flaps of a carton during advance of the carton from the stack, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said front flaps whereby to separate the same, a thin elongated mandrel swingable generally horizontally rearwardly from a position forwardly of an advanced carton through the space between the separated front flaps thereof to a position within the carton adjacent a bend line thereon between adjacent upper panels thereof, an erector arm swingable downwardly into engagement with one of said upper carton panels so as to pivot said panel downwardly through approximately 90° about said mandrel and along said bend line whereby to erect the carton, a flap knock-down device for bending the lower front flap of an erected carton downwardly about its bend line, and a flap tucker arm swingable rearwardly from a position forwardly of an erected carton to bend one front side flap of the carton inwardly to a closed position.

8. A carton opening mechanism comprising a magazine for holding a vertical stack of collapsed cartons disposed in horizontal planes, a reciprocable carton selector for advancing cartons horizontally at the bottom of the stack one at a time and in a direction normal to the outer edges of their flaps, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front flaps of a carton during advance of the carton from the stack, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said front flaps whereby to separate the same, a thin elongated mandrel swingable generally horizontally rearwardly from a position forwardly of an advanced carton through the space between the separated front flaps thereof to a position within the carton adjacent a bend line thereon between adjacent upper panels thereof, an erector arm swingable downwardly into engagement with one of said upper carton panels so as to pivot said panel downwardly through approximately 90° about said mandrel and along said bend line whereby to erect the carton, a flap knock-down device for bending the lower front flap of an erected carton downwardly about its bend line, a flap tucker

arm swingable rearwardly from a position forwardly of an erected carton to bend one front side flap of the carton inwardly to a closed position, and conveyor means for transporting an erected carton from said opening mechanism in a direction substantially normal to the direction of advancement of the carton from the aforesaid stack.

9. A carton opening mechanism comprising a means for advancing a collapsed carton in a horizontal plane and in a direction normal to the outer edges of its flaps, a carton support rail adapted vertically to support an advancing carton along one side edge thereof, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front flaps of the carton during advance of the same, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said front flaps whereby to separate the same, a thin elongated mandrel swingable generally horizontally rearwardly from a position forwardly of an advanced carton through the space between the separated leading flaps thereof to a position within the carton, said mandrel having a bending edge which lies adjacent a bend line between adjacent upper panels of the carton but which is spaced from said bend line on the side opposite said support rail when the mandrel is in its said position within the carton, and an erector arm swingable downwardly into engagement with the upper carton panel opposite said support rail so as to pivot said panel downwardly through approximately 90° about said bending edge on said mandrel whereby to pull said one side edge portion of the carton off the rail and to erect the carton.

10. A carton opening mechanism comprising a magazine for holding a vertical stack of collapsed cartons disposed in horizontal planes, a reciprocable carton selector for advancing cartons horizontally at the bottom of the stack one at a time and in a direction normal to the outer edges of their flaps, a carton support rail extending forwardly from the bottom of said stack for vertically supporitng one side edge portion of a collapsed carton advanced from the stack, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front carton flaps during advance of a carton from the stack, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said flaps whereby to separate the same, a thin elongated mandrel swingable generally horizontally rearwardly from a position forwardly of an advanced carton through the space between the separated front flaps thereof to a position within the carton, said mandrel having a bending edge which lies adjacent a bend line between adjacent upper panels of the carton but which is spaced from said bend line on the side opposite the aforesaid support rail when the mandrel is in said position within the carton, and an erector arm swingable downwardly into engagement with the upper carton panel opposite said support rail so as to pivot said panel downwardly through approximately 90° about said bending edge on the mandrel whereby to pull the aforesaid one side edge portion of the carton off the support rail and to erect the carton.

11. A carton opening mechanism as set forth in claim 9 wherein said mandrel has a transverse arm thereon which projects beneath a front portion of an advanced carton and supports the same when the mandrel is in its said forward position, said arm being swung away from the carton when the mandrel is swung rearwardly to its said position within the carton.

12. A carton opening mechanism comprising a magazine for holding a vertical stack of collapsed cartons disposed in horizontal planes, a reciprocable carton selector for advancing cartons horizontally at the bottom of the stack one at a time and in a direction normal to the outer edges of their flaps, a carton support rail extending forwardly from the bottom of said stack for vertically supporting one side edge portion of a collapsed carton advanced from the stack, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front carton flaps during advance of a carton from the stack, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said flaps whereby to separate the same, a thin elongated mandrel swingable rearwardly in a generally horizontal plane beneath said support rail from a position forwardly of an advanced carton, means for elevating said mandrel during an initial portion of a rearward swinging movement thereof so that the mandrel can pass through the space between the separated front flaps of an advanced carton to a position within the carton, said mandrel having a bending edge which lies adjacent a bend line between adjacent upper panels of the carton but which is spaced from said bend line on the side opposite the aforesaid support rail when the mandrel is in said position within the carton, and an erector arm swingable downwardly into engagement with the upper carton panel opposite said support rail so as to pivot said panel downwardly through approximately 90° about said bending edge on the mandrel whereby to pull said one side edge portion of the carton off the support rail and to erect the carton.

13. A carton opening mechanism as set forth in claim 12 wherein said mandrel is pivotally supported for swinging movement in both horizontal and vertical planes, and wherein said mandrel lifting means includes a device which pivots the mandrel vertically during an initial portion of its said rearward horizontal swinging movement to enter an end portion thereof in the space between separated front flaps of an advanced carton.

14. A carton opening mechanism comprising a magazine for holding a vertical stack of collapsed cartons disposed in horizontal planes, a reciprocable carton selector for advancing cartons horizontally at the bottom of the stack one at a time and in a direction normal to the outer edges of their flaps, a carton support rail extending forwardly from the bottom of said stack for vertically supporting one side edge portion of a collapsed carton advanced from the stack, a depending flap separating finger located so as to be engaged by the leading edges of vertically adjacent front carton flaps during advance of a carton from the stack, said finger being swingable upwardly and forwardly when engaged by said flap edges to pivotally lift and to riffle said flaps whereby to separate the same, a thin elongated mandrel swingable rearwardly in a generally horizontal plane beneath said support rail from a position forwardly of an advanced carton, means for elevating said mandrel during an initial portion of a rearward swinging movement thereof so that the mandrel can pass through the space between the separated front flaps of an advanced carton to a position within the carton, said mandrel having a bending edge which lies adjacent a bend line between adjacent upper panels of the carton but which is spaced from said bend line on the side opposite the aforesaid support rail when the mandrel is in said position within the carton, an erector arm swingable downwardly into engagement with the upper carton panel opposite said support rail so as to pivot said panel downwardly through approximately 90° about said bending edge on said mandrel whereby to pull said one side edge portion of the carton off the support rail and to erect the carton, and conveyor means for transporting an erected carton horizontally from said opening mechanism beneath said support rail in a direction substantially normal to the direction of advancement of the carton from the aforesaid stack.

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