United States Patent [19]

Berney

[11] **3,747,482**

[45] **July 24, 1973**

[54] **HANDLING APPARATUS FOR FOLDABLE CARTONS**

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[52] **U.S. Cl.** ..... **93/53 R**, 53/186

[51] **Int. Cl.** **B31b 1/80**

[58] **Field of Search** ..... 53/186, 374, 381, 53/382; 93/36 SQ, 53 R, 53 SD

[56] **References Cited**

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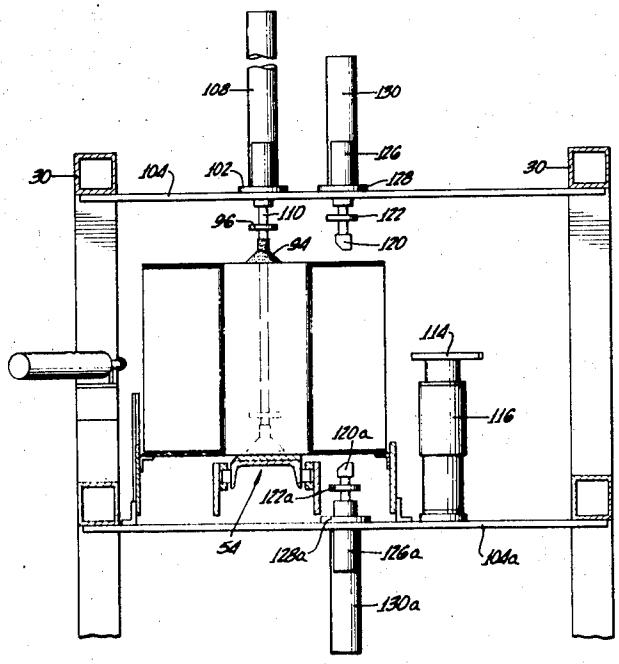
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Primary Examiner—Andrew R. Juhasz
Assistant Examiner—Horace M. Culver
Attorney—Fowler, Knobbe & Martens

[57] **ABSTRACT**

An automatic carton handling apparatus for erecting foldable cartons and positioning them adjacent to a packing machine of the kind which loads the cartons while they are resting on their side panels. The apparatus includes a feed magazine which feeds carton blanks from a stack to a loading station disposed below it, a reciprocating carriage for moving carton blanks from the loading station to a forming station, an opening mechanism for forming the cases into an essentially rectangular tubular configuration, pivotable arms for closing the bottom end flaps, rectilinear arms for closing the bottom side flaps, and a retractable pusher arm associated with the carriage for transferring the opened case from the forming station to a packing station. Included at the forming station is an arm for opening the leading top end flap of the opened carton and a flap flange for maintaining the flap in its opened position. The packing station has associated with it a pivoting carton positioning arm which pushes the opened carton against an end stop, an angular flanged packing horn, carton transfer arms for pushing the opened carton off the carriage onto the packing horn and a lowering arm which contacts the bottom of the carton on the packing horn and lowers the carton after it has been filled, to place the carton in an upright position on a conveyor. The apparatus is synchronized to sequentially feed the cartons in a downstream manner so that the cartons are opened, packed with canned goods, and moved downstream.

6 Claims, 14 Drawing Figures



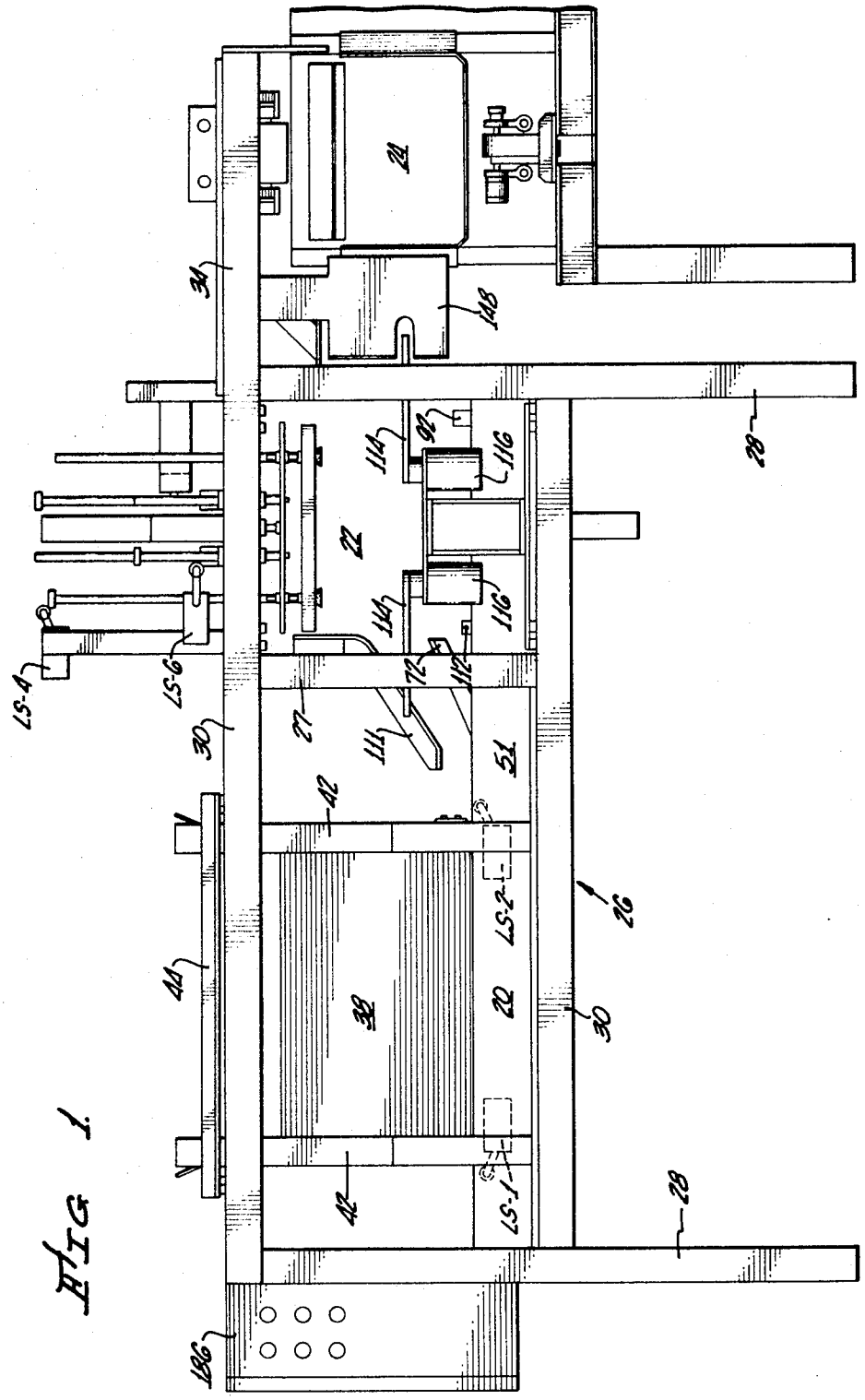

21
34
148
28
114
92
116
22
144
116
72
112
LS-4
LS-6
27
111
30
51
42
26
44
LS-2
LS-3
38
20
30
42
LS-1
28
186

FIG. 1.

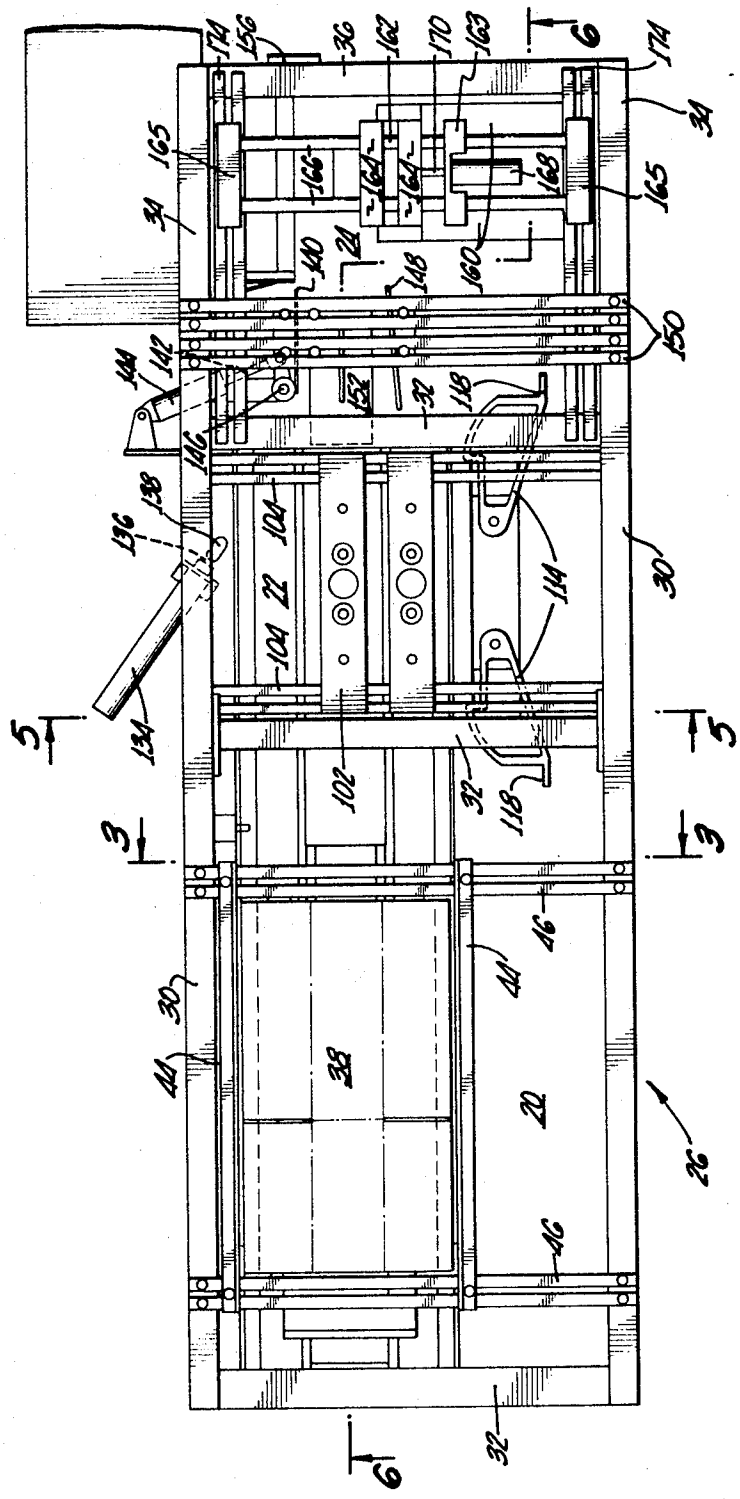

174
156
36
162
170
163
6
174
34
165
166
164
164
168
165
34
140
24
148
160
150
144
142
152
32
118
146
138
136
104
22
104
114
30
134
5
5
102
32
118
3
3
16
41
30
41
38
20
26
16
32
6

FIG. 2

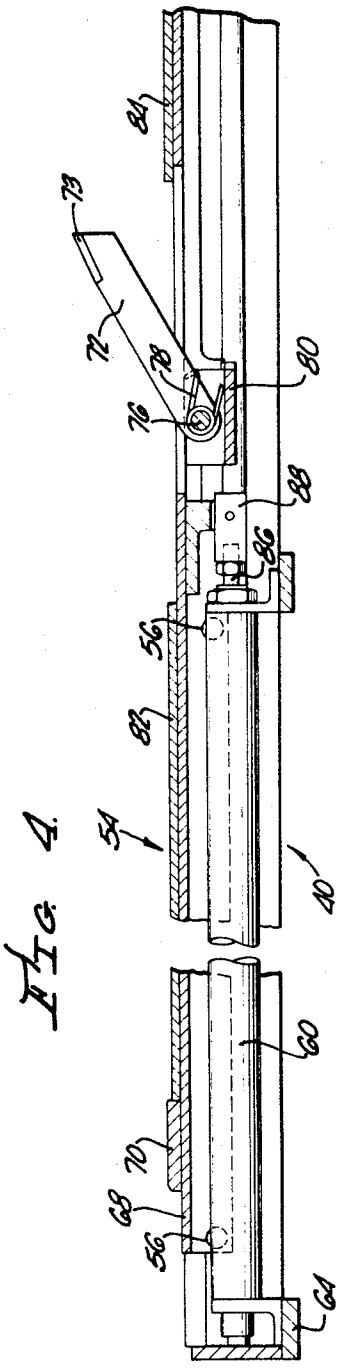


FIG. 4.

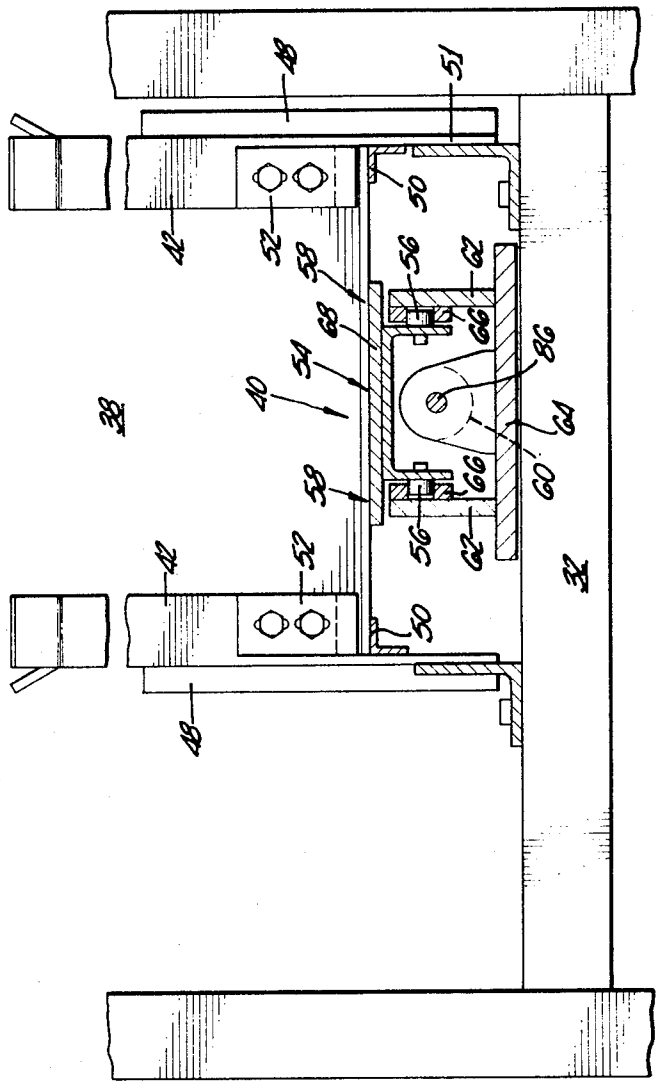


FIG. 3.

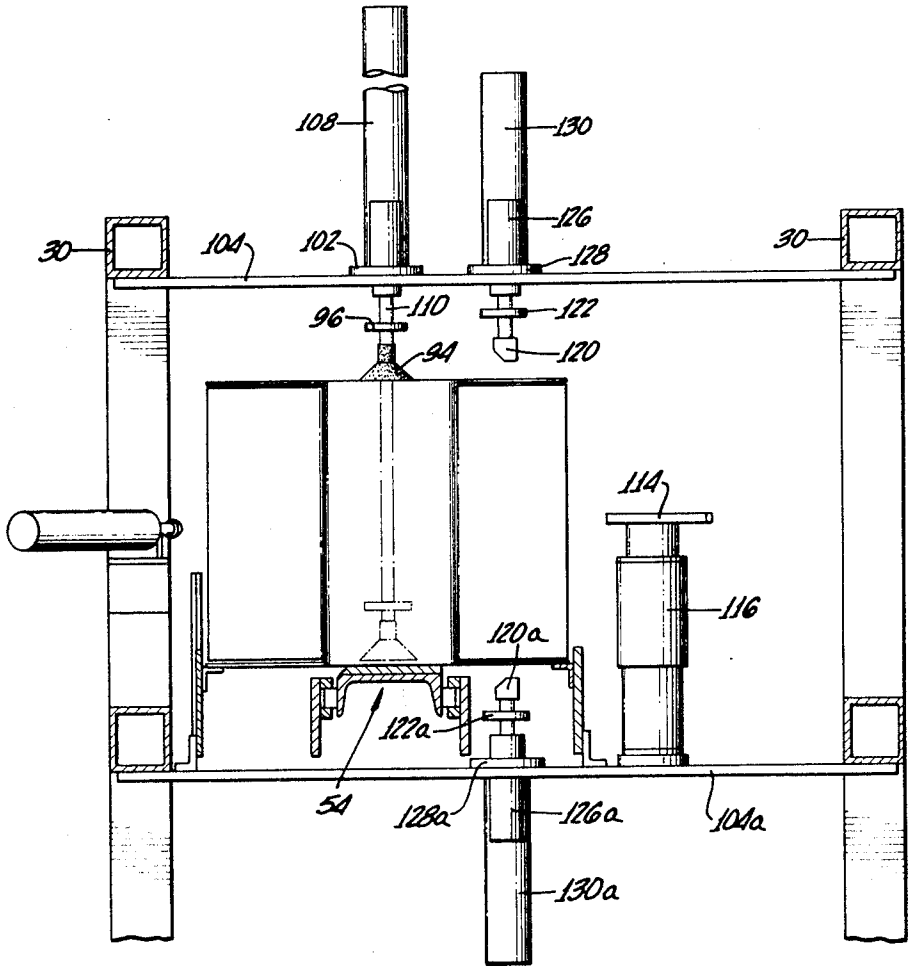

108
130
126
30
104
102
128
30
96
110
122
94
120
114
116
120a
122a
54
128a
126a
104a
130a

FIG. 5

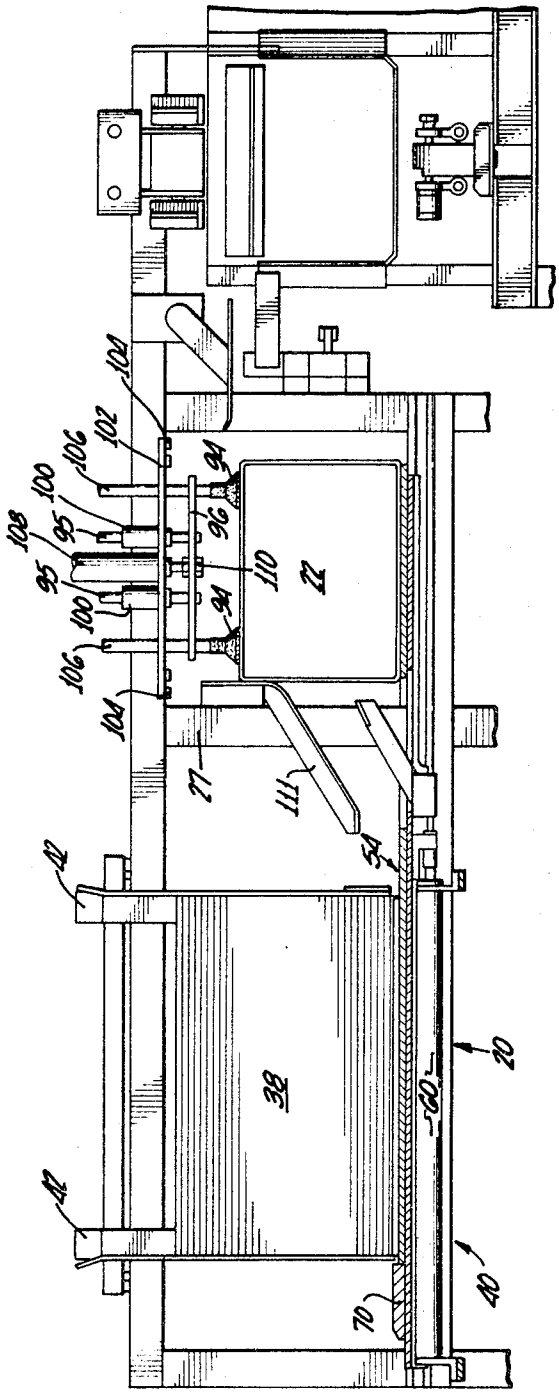


FIG. 6.

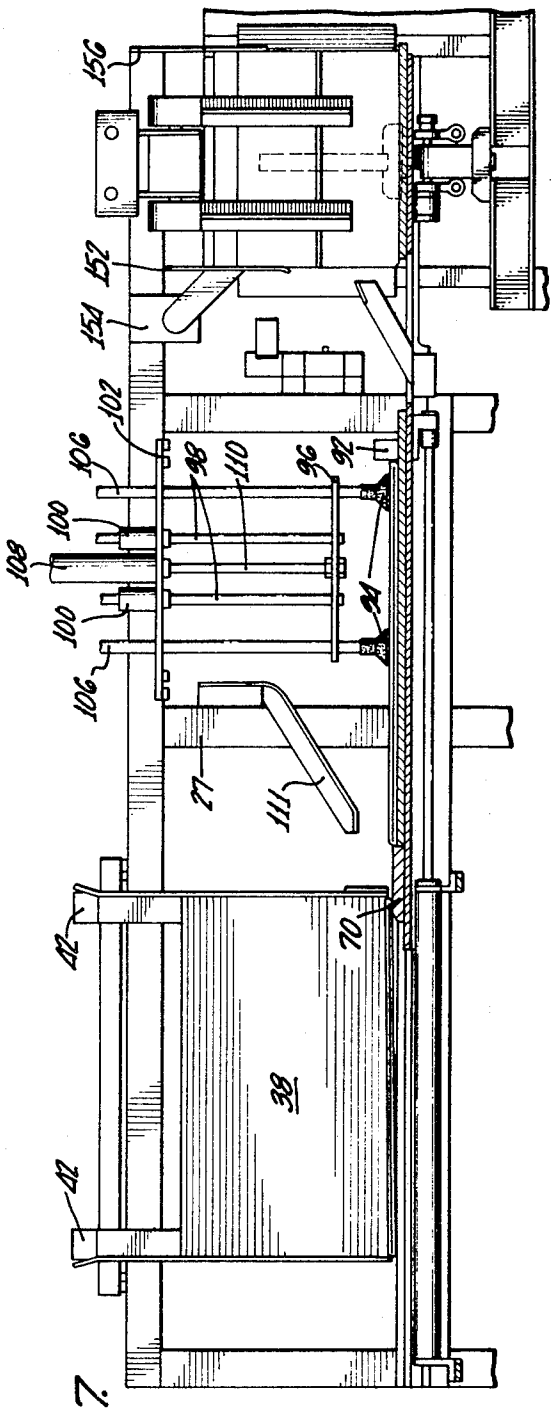


FIG. 7.

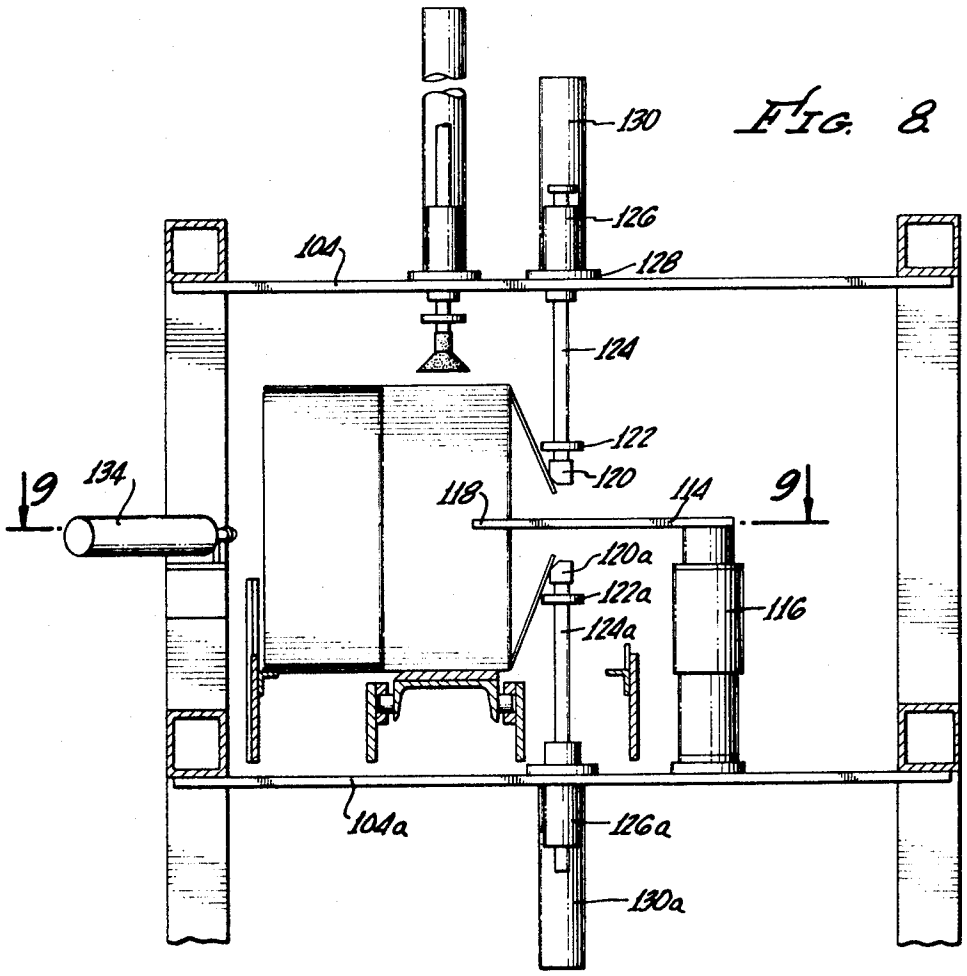

130
126
128
104
124
122
120
134
9
118
114
9
120a
122a
124a
116
104a
126a
130a

FIG. 8

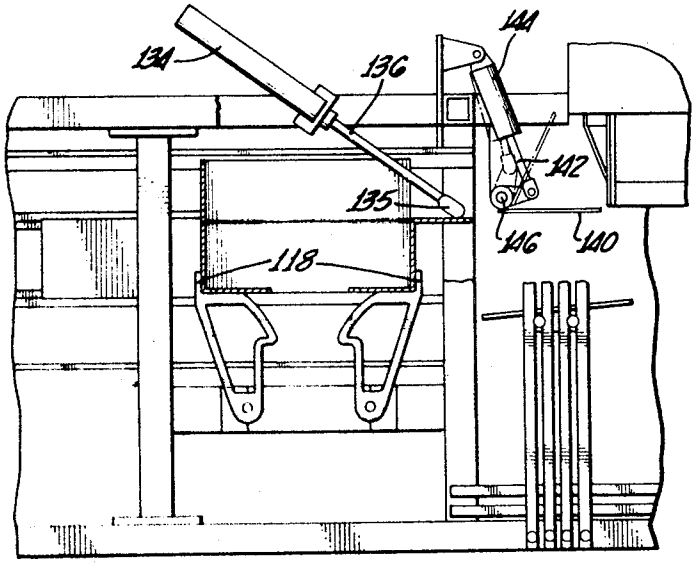

144
134
136
142
135
146
140
118

FIG. 9

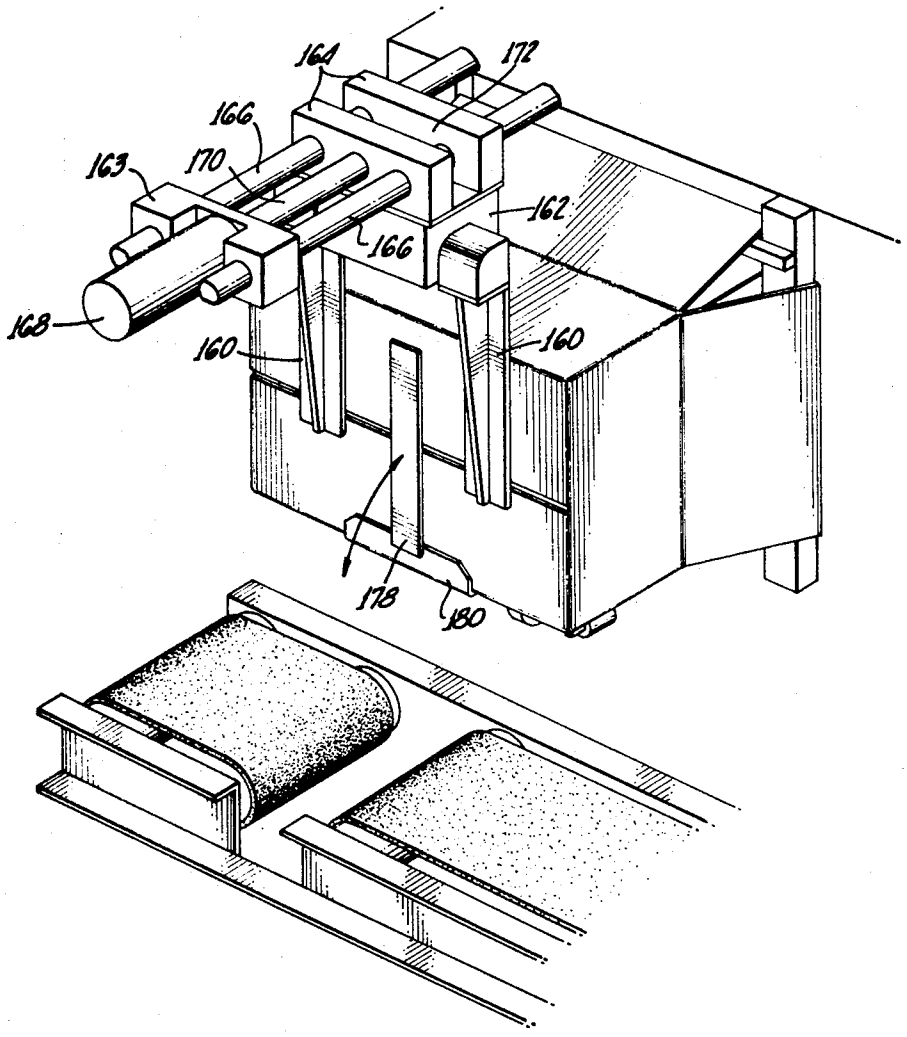


FIG. 10.

FIG. 11.

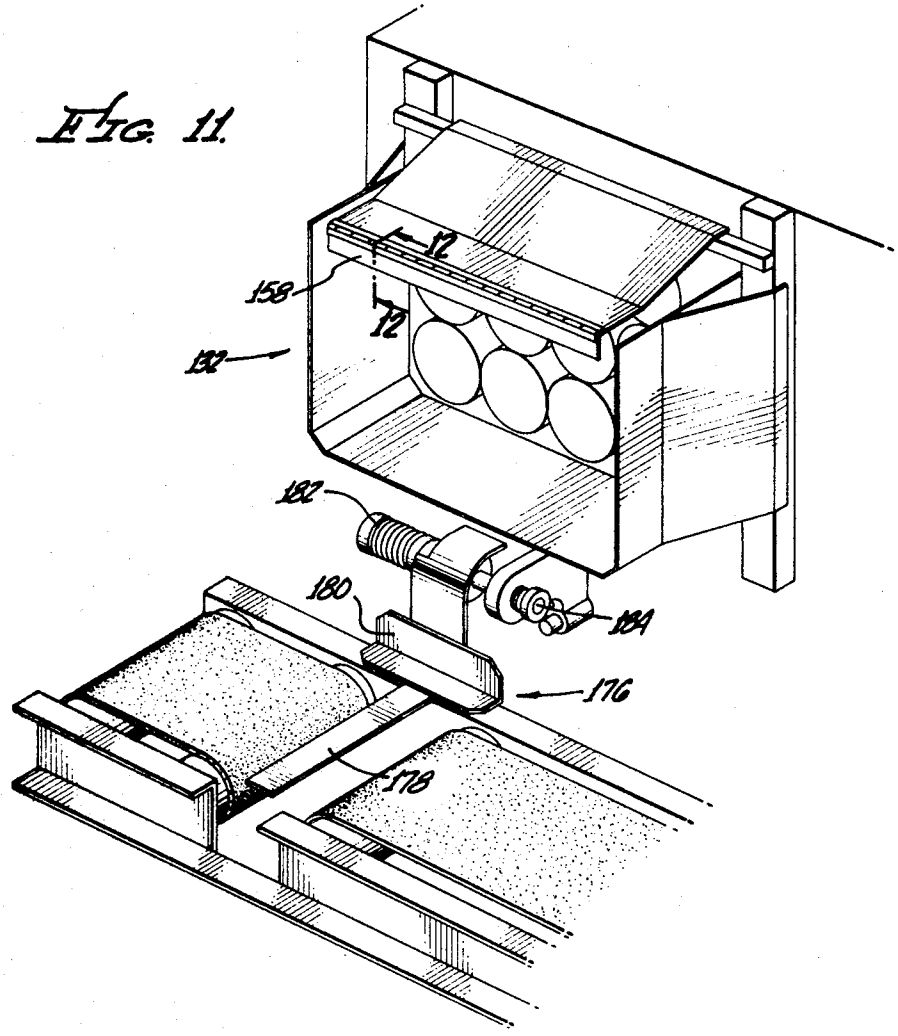
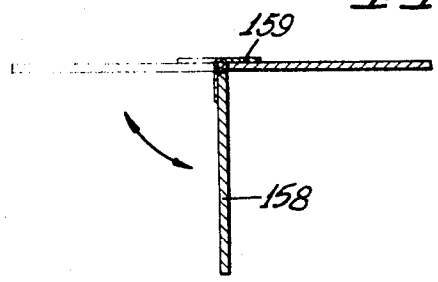


FIG. 12.



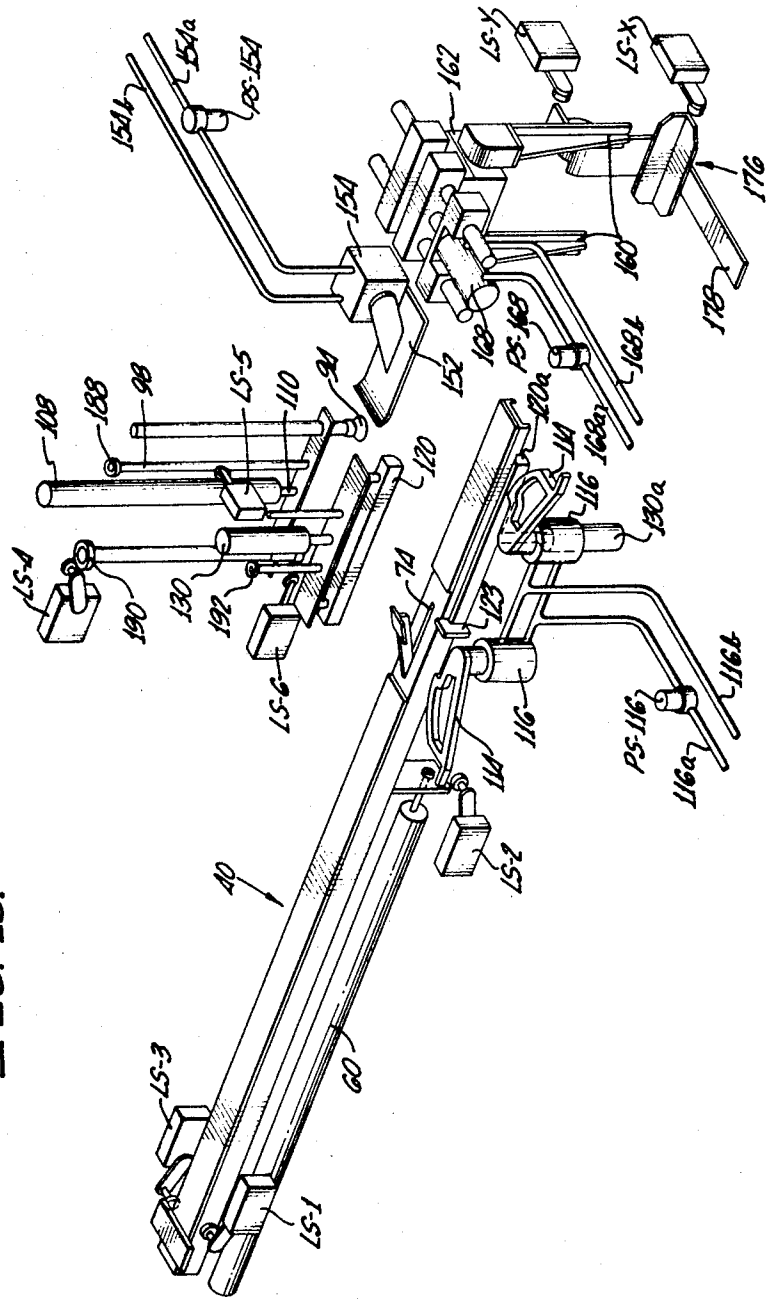

154b
154a
PS-154
162
LS-X
LS-X
176
154
160
178
168
PS-168
168b
168a
152
94
110
LS-5
98
188
108
120
114
116
130a
LS-4
190
130
192
74
123
LS-6
116
116b
PS-116
116a
114
LS-2
40
60
LS-3
LS-1

FIG. 13.

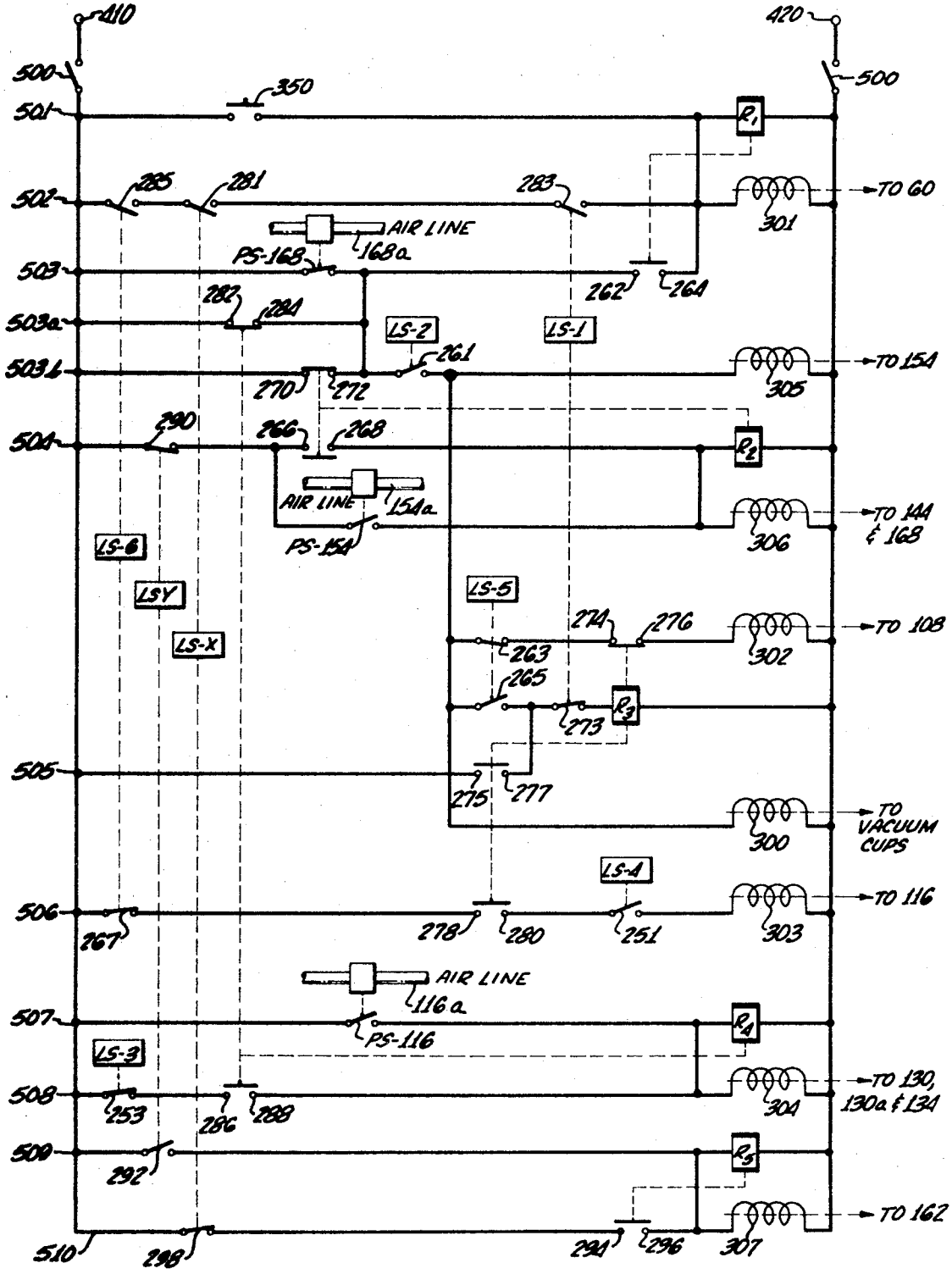

410
420
500
501
502
503
503a
503b
504
505
506
507
508
509
510
350
285
281
283
AIR LINE
168a
PS-168
262
264
301
TO 60
282
284
LS-2
LS-1
261
270
272
305
TO 154
290
266
268
AIR LINE
154a
PS-154
306
TO 144 & 168
LS-6
LSY
LS-X
LS-5
274
276
263
265
273
302
TO 108
275
277
300
TO VACUUM CUPS
LS-4
267
278
280
251
303
TO 116
AIR LINE
116a
PS-116
LS-3
253
286
288
304
TO 130, 130a & 134
292
307
TO 162
291
296
298

FIG. 14.

HANDLING APPARATUS FOR FOLDABLE CARTONS

BACKGROUND OF THE INVENTION

This invention relates to apparatus for setting up foldable cartons and more particularly to an apparatus for opening flattened foldable shipping container carton blanks into a rectangular shape and, where desired, folding their bottom flaps to a closed position. Additionally the apparatus transfers the opened cartons to a position where they are packed with canned goods and then transferred to a downstream position for further operation such as closing and sealing.

Conventional folding shipping containers of the rectangular four-flap type are typically manufactured from a single piece of cardboard, corrugated board, or the like, cut into a predetermined pattern and provided with indented fold lines to facilitate the folding into a rectangular case or carton, the term "carton" being used herein to designate a case of this type. The manufacturer usually folds the cardboard pattern once to bring two opposite edges together and then joins these two edges, such as with a strip of adhesive tape, for example, to form what is commonly known as a manufacturer's joint. When the carton is set up for use, the manufacturer's joint is at a corner defined by the meeting of an end and a side of the carton. The cartons are shipped in this compact folded form commonly known in the art as the "knocked down" condition of the carton. These are also known as carton blanks. Each carton must be set up by opening it to a rectangular shape and then folding the bottom flaps inwardly to a closed position. The opened cartons are then typically moved out to a conveyor to supply downstream packing stations.

SUMMARY OF THE INVENTION

The present invention is directed to an improved carton set up apparatus which may be automatically coordinated with a packing machine for higher operating speeds.

The provision of an improved packing station and the combination of such a packing station with the improved carton set up apparatus are also disclosed but are not claimed as part of the present invention. They are, instead disclosed and claimed in my co-pending application, Ser. No. 70,460, filed on even date herewith, entitled IMPROVED PACKING STATION FOR FOLDABLE CARTON HANDLING APPARATUS. Toward these ends, the apparatus has a feeder mechanism where a plurality of horizontally disposed carton blanks are maintained in a vertical stack and a carriage, mounted for reciprocating movement, shuttles back and forth to transfer the bottom carton blank from a loading station under the stack to a forming station where it is opened and its bottom flaps are closed. The opened carton is then transferred downstream to a packing station where the opened carton is placed on a packing horn located to the rear of the packing station.

In accordance with an aspect of the invention, vacuum cups at the forming station grip the upper side panel and lift it while restraining fingers, aligned with slots between the flaps on the upper side panel, act to partially restrain the bottom side panel. A break plate at the upstream end of the forming station strikes the trailing end panel of the carton blank as the upper side panel is being lifted so that, when the cups are fully withdrawn, the case is forced into a rectangular tubular configuration resting on its lower side panel, with its lowermost flaps facing toward the front of the forming station. Bottom end flap closing arms positioned adjacent to their respective flaps have camming surfaces which pivot in and close the bottom end flaps, while bottom side flap closing members, one disposed above and one below their respective flaps, move rectilinearly to partially close the bottom side flaps.

After forming of the carton, transfer to a subsequent station, shown herein as a packing station is automatically accomplished by a pusher arm which is integrally mounted on the carriage and which engages the rear panel of the formed carton in the forming station and moves the carton to the packing station at the same time that the carriage moves another carton blank into the forming station from the loading station.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention and its advantages will be more clearly understood with reference to the following description of a preferred embodiment thereof taken in conjunction with the accompanying drawings in which:

FIG. 1 is a front elevation view of the carton handling apparatus with a stack of carton blanks in the feeder;

FIG. 2 is a plan view of the apparatus with carton blanks in the feeder;

FIG. 3 is a sectional view on the line 3—3 of FIG. 2;

FIG. 4 is a sectional view on the centerline of the carton transfer carriage;

FIG. 5 is a sectional view on the line 5—5 of FIG. 2 with an opened carton in the forming station;

FIG. 6 is a sectional view on the line 6—6 of FIG. 2 with a case in the forming station;

FIG. 7 is a sectional view on the same line of FIG. 6 just after the case has been moved into the packing station and onto the horn;

FIG. 8 is a sectional view on the same line as FIG. 5 but after the flaps are closed;

FIG. 9 is a partial view of the top leading flap opening mechanism and the flap flange mechanism for holding the flap open, with the upper portion of the structure stripped away;

FIG. 10 is a partial pictorial view of the carton after transfer onto the packing horn with the lowering arm in its upward position;

FIG. 11 is a pictorial view of the packing horn and the associated carton lowering arm;

FIG. 12 is a sectional view of the hinged lip of the packing horn on the line 12—12 of FIG. 11;

FIG. 13 is a perspective view of the working parts of the apparatus with the structure stripped away; and

FIG. 14 is a schematic of the preferred control circuit.

In order to facilitate the understanding of the apparatus which is illustrated herein, there will first be given a general description of the entire apparatus followed by a detailed description of the structure of the apparatus so as to highlight those features of the invention which reside therein. Finally, in connection with the operation of the apparatus there will be described a pneumatic and electrical control system whereby all apparatus operations are carried out continuously and automatically.

STRUCTURE AND OPERATION OF AN EXEMPLARY APPARATUS INCORPORATING FEATURES OF THE INVENTION

1. In General

The drawings show several views of a preferred embodiment of the foldable carton handling apparatus utilizing the present invention. Referring to FIGS. 1 and 2, for ease of explanation the apparatus may be functionally divided into a loading station 20, a forming station 22, and a packing station 24.

The various mechanisms of the exemplary apparatus associated with the loading station 20 and the forming station 22 are supported in their desired relationship by a box-shaped framework, generally indicated by the reference numeral 26, as can best be seen in FIGS. 1 and 2 of the drawings. The framework 26 is defined by four vertically oriented leg members 28, between which four support beams 30 extend longitudinally. Six transverse braces 32, three on top and three on the bottom, complete the framework 26. To provide additional support and to serve as the mounting means for mechanisms associated with the forming station, two posts 27 (rear and front) extend between the upper and lower beams 30 in the vicinity of the center braces 32. To give support for the mechanisms associated with the packing station 24, the top support beams 30 are each provided with an extension 34. Rigidity is assured by a cross-brace 36 extending between the two extensions 34.

A case hopper 38 disposed above the loading station 20 acts as a receptacle for the folded carton blanks which are transferred by a reciprocating carriage 40 from the loading station 20 to the forming station 22 (shown in FIGS. 3 and 4) where they are opened and their flaps are closed, the carriage additionally acting to transfer the opened cartons from the forming station 22 to the packing station 24 so the opened cartons may be placed on a packing horn 132 and goods placed therein.

2. In Detail

a. Case Hopper

Referring to FIGS. 1, 2 and 3, the means for maintaining a plurality of horizontally disposed carton blanks in a vertical stack is provided by the case hopper 38. In order that the carton blanks may nestle within the case hopper 38 to be forced by gravity to the loading station 20 disposed directly below, the hopper is comprised of four vertically oriented staves 42 attached to the frame 26 so that the inner surfaces of each stave contacts one of the four corners of the carton blank, insuring a uniformly squared stack. For ease in placing additional carton blanks in the case hopper 28, the staves 42 are split a small distance down from their tops and bent outwardly so as to provide for a funnel-shaped entrance.

Maintaining the top of the staves 42 are support brackets 44 adjustably mounted on rails 46 which extend between the top beams 30, the adjustment being provided in order that carton blanks of varying lengths and widths may be used with the apparatus. Referring to FIG. 3, each stave 42 is attached at its bottom to, and is stiffened by, a fastening plate 48 which is in turn adjustably mounted to one of the bottom transverse braces 32. As the carton blanks are transferred from the loading station 20 under the feeder mechanism 38 to the forming station 22, they are partially supported by a pair of guide brackets 50 which pass from under the feeder mechanism into the forming station, the brackets being attached under the staves 42 to a pair of side beams 51 extending the length of the loading station and the forming station.

Since it is desired that only one carton blank be transferred from the feeder mechanism 38 upon movement of the reciprocating carriage 40, two throat guides 52 are adjustably mounted to the downstream staves, defining a throat opening of variable width which, in addition to insuring transfer of only one carton at a time, allows the use of carton blanks of varying weight and thickness.

From the above description it can be seen that the carton blanks are guided by the staves 42 and urged by gravity toward the bottom of the feeder mechanism 38 so as to be presented at the loading station 20 in a position where a single carton blank may be transferred to the forming station 22 by the reciprocating carriage 40.

b. Carton Transfer Carriage

As alluded to above, the carton transfer means is a carriage 40 which functions to shuttle back and forth between the loading station 20 and the forming station 22, carrying a carton blank each time it moves forward. To this end the carriage 40 is mounted for reciprocating motion under the feeder mechanism 38 so that its rear portion extends under the feeder mechanism and its forward portion extends into the forming station 22. With reference to FIG. 3, the bottom panels of the carton blanks contact a carriage bed 54 which moves on rollers 56 in a pair of tracks 58 mounted on the frame 26, the movement being initiated by a two-way air actuated carton transfer cylinder 60.

The tracks 58 are formed by a pair of upright rails 62 extending parallel to the side beams 51 and mounted on base plates 64 attached to the bottom braces 32 to permit transverse adjustment between the staves 42. Each of the upright rails 62 carries a pair of rods 66 with rectangular cross-section, spaced apart sufficiently to accommodate the rollers 56.

Referring to FIGS. 3 and 4, the supporting portion of the carriage bed 54 is a downwardly extending channel-shaped iron 68, to the outside of which are fastened the rollers 56 to support the carriage bed within the tracks 58. The rear portion of the carriage bed 54 which extends under the loading station 20, in addition to acting as a support for the carton blank, has an anchor plate 70 at its upstream edge which protrudes sufficiently above the level of the carriage bed to contact the trailing edge of a carton blank, causing it to be shifted downstream with the carriage bed 54. The anchor plate 70 is beveled at its rear edge so that, when the carriage bed 54 is retracted under the carton blanks in the feeder mechanism 38, the anchor plate will pass under them without catching.

Since a second function of the carriage 40 is to transfer an opened carton from the forming station 22 to the packing station 24, means are provided intermediate the carriage ends for engaging a formed carton, shown in FIGS. 4 and 13 as a latch-type pusher arm 72 which is inserted into the carriage bed 54 through a slot 74 and secured by a bushing 76 which is journaled to the channel 68. A cross piece 73 is attached to the outer end of the pusher arm 72 so as to provide a larger pushing surface against the rear panel of the opened carton. Since the carriage 40 retracts while an open carton is in the forming station 22, the pusher arm 72 must be

free to turn downward to cam under the opened carton and then to assume its original upward position to transfer another opened carton. This is accomplished by a spring **78** around the bushing **76**, with the spring being compressed between the bottom of the carriage bed **54** and a plate **80**, attached beneath the bushing, to bias the pusher arm **72** into its upward position. To insure that the supporting portion of the carriage bed **54** is at least level with the crosspiece **73** when the latter is in its cammed-down position, a rear support plate **82** is attached to the carriage bed **54** just forward of the anchor plate **70** but of slightly less thickness so the anchor plate still may contact a carton blank. A forward support plate **84** is attached ahead of the pusher arm to maintain the height of the carriage bed **54** uniform.

The air cylinder **60** which causes the reciprocating movement of the carriage **40** is attached under the carriage bed **54** on the base plate **64**, with its shaft **86** connected to the carriage bed through a bushing **88** and an L-shaped bracket **90** so that the shaft, as it extends and retracts, will move the carriage with it.

c. Forming Station

Referring again to FIGS. **1** and **2**, as the unopened carton blanks are transferred to the forming station **22**, they are positioned essentially by the length of travel of the carriage **40**, but a stop block **92** is attached near the downstream end of the forming station so as to contact the forward edge of the carton blank and insure that it does not move too far into the forming station.

1. Carton Opening Mechanism

Referring to FIGS. **2**, **5**, **6**, and **7**, the means for opening the carton is provided by a pair of vacuum cups **94** which are mounted in the forming station **22** so as to vertically descend and grip the top panel of the carton blank and to withdraw and open it. The cups **94** are attached to a leaf-shaped member **96** which is guided in its vertical up and down motion by guide rods **98** inserted through guide bushings **100** supported by a mounting plate **102** extending between a pair of rails **104** which are fastened between the top support beams **30**. The mounting plate **102** is adjustable so that the center line of the plate may be made to correspond with the center line of the carriage bed **54** in order to accommodate different size cartons. The vacuum for gripping is supplied to the cups **94** through a pair of hollow rods **106**.

Vertical motion of the cups **94** is accomplished through the use of a two-way air cylinder **108** vertically attached between the guide rods **98** so that its shaft **110** may be connected to the leaf-shaped member **96**, the cups **94** then descending and withdrawing upon extension and retraction of the shaft.

With reference to FIGS. **1**, **6**, and **7**, as the upper side panel is being lifted, means at the forming station for striking the trailing end panel of the carton blank are provided by an angular break plate **111** installed at the upstream end of the forming station **22** between the posts **27**. The striking of the trailing end of the carton as the cups **94** move upward assist in forming the carton into a rectangular, tubular configuration. To restrain the lower panel of the carton, a transversely extending retaining finger **112** is placed in the forming station so that the finger coincides with a slot between the flaps on the upper panel but engages the flaps on the lower panel.

2. Bottom End Flap Closing Mechanism

Referring to FIGS. **1**, **5**, and **8**, the means provided for closing the bottom end flaps comprise a pair of camming arms **114** attached to the shafts of a pair of rotatable air cylinders **116** mounted in front of the forming station **22** so that, as the cylinders pivot inwardly, the camming arms rotate to fold the bottom flaps closed while a pair of elbows **118** located at the outer ends of the camming arms restrain and square the opened carton (See FIG. **9**).

3. Bottom Side Flap Closing Mechanism

The means at the forming station for closing the bottom side flaps are shown in FIGS. **5** and **8**. A pair of vertically spaced members **120** and **120***a* are mounted above and below the respective bottom side flaps and are movable toward one another to contact and partially close the bottom side flaps. The mounting and movement of the bottom side flap members is essentially the same as the operation of the case opening mechanism in that the members **120** and **120***a* are mounted on leaf-shaped members **122** and **122***a* whose vertical motion is guided by a pair of rods **124** and **124***a* which in turn are received by a pair of guide bushings **126** and **126***a* mounted on plates **128** and **128***a* extending between guide rails **104** and **104***a*. Vertical motion is achieved through a pair of two-way air cylinders **130** and **130***a* vertically mounted between the guide rods **124** and **124***a* in the same manner as the case opening mechanism.

In order to prevent the opened carton from being dislocated when the carriage **40** retracts after the case is opened and the flaps are closed, the closing member **120***a* has a small projection **123** (shown in FIG. **13**) attached at its rear end so as to contract the lowermost side flap and hold it while the carriage **40** retracts and the pusher arm **72** is pushed against it.

4. Leading Top End Flap Opening and Restraining Mechanisms

The packing horn **132** resides to the rear of the packing station **24** in close proximity to the travel of the opened carton so that it is necessary to insure that the leading top end flap is opened sufficiently so as to not become entangled with the packing horn. Referring to FIGS. **2** and **9**, to this end a double acting two-way air cylinder **134** is mounted to intersect at an angle with the rear of the forming station **22** so that, as its shaft **136** extends, a knob **135** attached thereto opens the leading top end flap. For retaining the flap in its opened position while the carton is being transferred to the packing station, a flap flange **140** is mounted on the shaft **142** of a second two-way air cylinder **144** so that, when the shaft is extended the flange will reside parallel to the line of travel of the carton, the flange pivoting about a point **146** so that at the desired time the flange may be rotated backwardly to pull the flange away from the packing horn **132**.

d. Packing Station

Once the carton blank has been formed and its flaps have closed, transfer is accomplished to the packing station **24** from the forming station and the packing station on a pair of rails **150** guides and closes the bottom flaps in their essentially closed position. Forming of the carton having been accomplished, the mechanisms associated with the packing station **24** will insure that the carton is properly positioned to be packed with goods.

1. Carton Positioning Arm

In order to position an opened carton in the packing station **24** for movement onto the packing horn **132**, a

carton positioning arm **152** is mounted at the upstream end of the packing station on the shaft of a pivotable air cylinder **154** so that the arm **152** may swing from a normally horizontally disposed position to a vertical position in which it contacts the rear of an opened carton and pushes the carton against an end plate **156.** The pivotable cylinder **154** is mounted on the rails **150** in order to permit an adjustment to be made for differently sized cartons.

2. Packing Horn

Goods to be packed in the opened cartons will be directed from the packing equipment to the opened carton through the packing horn **132** which is generally rectangular with flared walls, is attached to the packing equipment, and is positioned to the rear of and adjacent to the packing station **24** as shown in FIG. **11.** The front end of the horn **132** is of a shape and size to allow it to enter into a carton as the latter is pulled onto the horn. To keep the leading end flap of the carton out of the horn while the carton is being conveyed to its position opposite the horn, the upper wall of the horn terminates in a hinged plate **158** which extends downward into the mouth of the horn, the plate being biased downwardly by a spring biased latch **159** and being free to swing out of the horn into a horizontal position to permit unimpeded passage of goods into the carton.

3. Case Transfer Arms

In accordance with the invention claimed in my above-referenced co-pending patent application, means are provided for pushing the carton off the carriage **40** and onto the packing horn **132.** Referring to FIGS. **2** and **10,** in the exemplary embodiment disclosed herein this means comprises a pair of case transfer arms **160** which, in their normal positions, depend vertically near the front of the packing station **24** to contact the bottom of an opened carton and to move it directly onto the packing horn, the arms in addition having means to cause them to pivot upwardly and away from the bottom of the carton after it has been positioned on the packing horn. The combined rectilinear and pivoting arm movements are attained by mounting the arms **160** on the output shafts of a pivotable air powered actuator **162** and mounting the actuator **162** on the undersides of a pair of blocks **164** which are slideably mounted upon a pair of rods **166** mounted upon a pair of anchor blocks **165** so as to extend between the front and the rear of the packing station. The anchor blocks **165** in turn are slideably mounted on a pair of rails **174** so as to allow the use of various size cartons in the packing station.

Rotational movement of the case transfer arms **160** is brought about by the actuator **162.** In order to slide the actuator **162** and its associated case transfer arms **160** toward and away from the packing horn **132,** a linear two-way cylinder **168** is rigidly mounted by means of a bracket **163** upon the rods **166** in the position best shown in FIG. **2.** The linear two-way air cylinder **168** has a shaft **170** which is attached to one of the blocks **164** so that, when the shaft **170** extends, the blocks **164** and hence the arms **160** are caused to slide toward the packing horn **132.** Conversely, when the shaft **170** is retracted the entire assembly is slid away from the packing horn.

4. Case Lowering Arm

Referring to FIGS. **10** and **11,** a lowering arm **176** is provided for causing a packed carton to be placed in an upright position on a conveyor belt disposed below the packing station **24.** The arm itself is comprised of a flat tongue portion **178** attached at its rear to a right angle plate **180** which acts to support a corner of the opened carton, these parts being connected under the packing horn **132** so as to allow rotation of the tongue portion **178** from a horizontal position below the packing station to a vertical position adjacent to and contacting the bottom of an opened case while on the packing horn **132.** In order that the tongue portion **178** spring upwardly of its own accord when released, a spring **182** is attached to a shaft **184** about which the arm will rotate, so that the arm is biased in an upward direction. The shaft **184** is supported under the packing horn **132** by inserting it into a plate attached under the packing horn. The spring tension, while sufficiently large to raise the arm **176** does not prevent the weight of a packed carton from forcing the tongue portion **178** to its horizontal position under the packing station **24** and above a conveyor. The conveyor, shown in FIGS. **10** and **11,** while not part of the invention, nevertheless provides a means for taking packed cartons away from the packing station so the case handling apparatus may automatically open and pack another carton.

PNEUMATIC AND ELECTRICAL CONTROLS FOR THE EXEMPLARY APPARATUS

1. In General

The operation of the carton handling apparatus is sequentially controlled through the use of various pneumatic cylinders shown in FIG. **13,** and electrical controls shown in FIG. **14.**

Air is selectively gated to initiate extension and retraction of the various cylinder shafts by means of solenoid valves **301–307** while vacuum is gated to the carton opening cups **94** by solenoid **300.** The air cylinders themselves are of two types, both of which have a two-way action. The linear cylinders are of the kind where air may be gated to either side of a shaft head causing it to extend or retract. The pivotable cylinders are of the type in which, by selectively applying air to one of two inputs, their shafts may be made to turn through a given arc.

Relays R–1 through R–5, by means of their contact terminals, provide desired holding paths for maintaining power to the various solenoids. The solenoids and relays are located along with miscellaneous control devices in a control box **186** attached to the frame **26.**

Electrical switching to the relays and solenoids is accomplished by eight limit switches LS–1 through LS–6 and LS–X and LS–Y, the locations of which are shown in FIGS. **1** and **13.** Supplementing the limit switches are pressure switches PS–**116,** PS–**154** and PS–**168.** These switches are of the type which become actuated by sensing a pressure difference between two points. As shown in FIGS. **13** and **14,** each is installed in one of the air lines to its respective cylinder so as to actuate when the pressure in the line reaches a desired magnitude relative to atmospheric pressure. This pressure occurs when the associated cylinder shaft reaches the limit of its travel and the pressure in the cylinder approaches the pressure of the air source.

2. Detailed Description and Operation

The operation of the apparatus will be best understood by following a carton as it passes through the apparatus. Referring to FIG. **6,** the feeder mechanism **38** is adjusted to receive the desired size of carton blanks, a stack of which are horizontally disposed between the

staves 42 so as to be urged by gravity to the loading station 20 where the bottom carton blank will be supported partially by the guide brackets 50 (not shown in FIG. 6) and partially by the carriage bed 54 in preparation for being transferred out.

a. Prepare For Feeding Carton Blank Into Forming Station and Opened Carton Into Packing Station

Referring to FIG. 13, and, assuming no case has been left in the apparatus, the carton transfer air cylinder 60 is retracted. Consequently, the case transfer carriage 40 is also retracted so that its rear portion is under the loading station 20 and its forward portion extends into the forming station 22.

The forming station mechanisms are in a position to receive an unopened carton. The carton opening cylinder 108 has its shaft 110 retracted, thereby causing the vacuum cups 94 to be fully withdrawn. The bottom end flap cylinders 116 have the bottom end flap closing arms 114 rotated outwardly toward the front of the forming station 22. The bottom side flap closing cylinders 130 and 130*a* and the leading top end flap closing cylinder 134 (shown in FIGS. 2 and 9) are in their retracted positions. Referring to FIG. 2, the flap flange cylinder 144 has its shaft 142 extended so as to place the flap flange 140 in a position where it will hold the top leading flap open.

Referring again to FIG. 13, the packing station is now ready to receive an opened carton for packing. The carton positioning cylinder 154 has pivoted the carton positioning arm 152 upwardly to a horizontal position so that an opened carton may pass under it. The carton transfer arms 160 are rotated downwardly to their vertical position by the pivotable cylinder 162, and the case transfer cylinder 168 is retracted to hold the arms near the front of the packing station. The lowering arm 176 is in its lowered position so the tongue portion 178 is disposed horizontally, below the packing station 24 and in a position to allow an opened carton to pass.

b. Feed Carton Blank Into Forming Station

Referring to FIG. 14, power for the apparatus is provided in the form of 110–117 volts AC and is supplied by means of a pair of bus lines 410 and 420 through switch 500. The operating sequence is initiated by the transfer of an unopened carton upon the carriage 40 from the loading station 20 to the forming station 22. Referring to FIGS. 6, 7, and 14, the carriage 40 is moved out of the loading station 20 by pushing a cycle/start switch 350 to energize and actuate solenoid 301, thereby gating air to extend the shaft 86 of cylinder 60 connected to the carriage. A holding path to solenoid 301 is established through leg 503 and the normally closed contacts of PS–168 because, as power is applied to solenoid 301, it is also applied to relay R–1, closing its normally open contacts 262 and 264. Referring to FIG. 6, as the carriage 40 moves forward, the anchor plate 70 contacts the rear of the carton blank so as to cause the carton to move with it.

c. Initiate Carton Blank Forming Operations

Referring to FIGS. 5 and 7, when the carriage is fully extended, the unopened carton will lie in the forming station 22 under the vacuum cups 94, which are in their retracted positions, ready to be opened. The length of travel of the carriage 40 determines the distance the carton blank will be transferred, but the stop block 92 is positioned in the forming station 22 so as to contact a leading edge and insure the carton does not move too far. The carton is opened by gripping its upper panel and pulling the carton upward into an essentially rectangular tubular configuration, with the carton lying on its side panel in the forming station 22, with its bottom flaps open and pointing toward the front of the forming station. Referring to FIGS. 13 and 14, the vacuum cups 94 are lowered when the movement of the carriage 40 out of the loading station 20 causes the limit switch LS–2 to be actuated, closing its normally opened contacts 261. Through leg 503, the normally closed contacts 263 of LS–5, and the normally closed contacts 274 and 276 of relay R–3, solenoid 302 is enabled, gating air to cylinder 108 to extend its shaft 110 (shown in FIGS. 5 and 7). At the same time vacuum is applied to the vacuum cups 94 through the actuation of solenoid 300.

When the cups have become fully extended, a washer 188 on one of the guide rods 98 (FIG. 13) actuates LS–5. This momentarily opens the normally closed contacts 263 and disables solenoid 302, causing air to be gated to cylinder 108 so that it will retract to withdraw the cups 94 which have gripped the upper panel as shown in FIGS. 5 and 6. At the same time, the normally open contacts 265 of limit switch LS–5 are momentarily closed and, through the normally closed contacts 273 of limit switch LS–1, relay R–3 is actuated. The relay R–3 remains actuated through its holding path which is established through leg 505 and its normally open, now closed, contacts 275 and 277. The actuation of relay R–3 opens its normally closed contacts 274 and 276, disabling the cups 94 from descending again until relay R–3 drops out prior to the time when another opening sequence is to occur.

Referring to FIGS. 6 and 7, as the cups 94 lift the upper panel away from the bottom of the forming station 22, the retaining fingers 112 act to restrain the bottom panel of the unopened carton so that opening begins. As the upper panel is lifted, the rear panel will contact the angled break plate 111 so that the rear panel is forced forward, causing the carton to have an essentially rectangular tubular configuration when the cups are fully withdrawn. The withdrawal of the cups allows a second washer 190 to actuate limit switch LS–4. This indicates that the carton is fully opened and initiates the bottom flap closing sequence.

In the bottom flap closing sequence, the pivotable cylinders 116 swing the camming arms 114 inwardly to close the bottom end flaps. The withdrawal of the cups 94 and the resulting actuation of limit switch LS–4 closes its normally open contacts 251 in leg 506 to enable solenoid 303 through the normally closed contacts 267 of limit switch LS–6 and the normally open, now closed, contacts 278 and 280 of relay R–3 to gate air to cylinder 116. As the arms 114 cam inwardly and close the bottom end flaps, the elbows 118 contact the forward and rear panels of the opened carton so as to square it in the forming station 22. The forward elbow 118 acts to restrain the forward panel while the top leading flap is opened as described below.

After the bottom end flaps are closed, the next step is to close the bottom side flaps and to fold forward the leading top flap. Referring to FIGS. 13 and 14, when the bottom end flap closing arms 114 become pivoted inwardly, the pressure switch PS–116 in air line 116*a* is actuated. Line 116*a* supplies air to cylinder 116 to cause its shaft to rotate the arms 114 inwardly so as to fold the end flaps. When the shaft is fully rotated, pressure builds up in the line, actuating PS–116 which

closes its contacts. This allows power to be applied through leg **507** to solenoid **304**, gating air to cylinders **130** and **130***a* so that the closing bars **120** and **120***a* move in from the top and bottom respectively to contact their respective bottom side flaps and partially close them. This can be best seen in FIG. **8**. At the same time, solenoid **304** also gates air to cylinder **134**, extending its shaft **136** to open the top leading flap as shown in FIG. **9**. A holding path is established in leg **508**, since at the same time that solenoid **304** is actuated power is also applied to relay R–4, closing its normally open contacts **286** and **288**. The path is completed through the normally closed contacts **253** of LS–3.

At this point, the carton has been fully opened and its bottom flaps are closed, completing the functions to be performed in the forming station. The next step is to initiate transfer of the carton to the packing station **24**.

d. Transfer Formed Carton Into Packing Station

To provide a clear path for the carton transfer, it is necessary to withdraw the bottom end flap closing arms **114**. To this end a third washer **192** is located at the top of one of the bottom side flap closing member guide rods to actuate the limit switch LS–6 disabling leg **506** through the opening of the normally closed limit switch contacts **267**. Actuation of the limit switch LS–6 disables solenoid **303** shutting off air pressure in line **116***a* and gating air pressure to air line **116***b*. The shaft of the bottom end flap cylinders **116** swings the arms **114** away from the carton to remove the elbows from their contact with the forward and rear panels of the carton. Since pressure to line **116***a* is shut off, PS–**116** in the air line deactuates and opens, disabling leg **507**; however, power is maintained to relay R–4 and solenoid **304** through leg **508** as described above. In order to complete the transfer of a carton, the carriage **40** is retracted so as to position the pusher arm **72** against the rear panel of the carton as the carriage moves forward. Because the arm **72** is cammed under the opened carton in the forming station **22** when the carriage is retracted, the bottom side flap closing members **120** and **120***a* remain extended in order that a projection **123** which is attached to the trailing edge of the lower member **120***a* (shown in FIG. **13**), will contact the rear of its flap so as to prevent the carton from being dislocated by the cammed arm **72** as the carriage retracts.

Referring to FIG. **14**, retraction of the carriage **40** depends on the completion of certain initial operations in a series of operations in the packing station **24** which are performed concurrently with the opening sequence that has just been described. If these initial packing operations, which are performed upon the carton in the packing station have been completed (these operations having yet to be described), pressure switch PS–**168** will be actuated and its opened contacts will disable leg **503** and will cut power from the solenoid **301**. With its power cut off, solenoid **301** will gate air so that the shaft **86** of cylinder **60** is retracted, taking the carriage **40** with it.

To initiate forward motion of the carriage so as to transfer an unopened carton as well as the opened carton, normally it is not necessary to again push the cycle/start switch **350** because the solenoid **301** will be enabled through leg **502**. The normally opened contacts **285** of LS–6 are closed due to the closing member **120** being in its extended position, LS–1 was actuated and its normally opened contacts **283** were closed when the carriage was retracted, and the lowering arm **176** is in its down position so that the normally open contacts **287** of LS–X are also closed. As described above, solenoid **301** is again held through leg **503** since at this time PS–**168** has closed as a result of the completion of all of the packing station operations.

Referring to FIGS. **6** and **7**, as the carriage **40** moves forward, the pusher arm **72** contacts the rear of the opened case in the forming station **22** and causes the carton to be transferred into the packing station **24**. Referring to FIG. **9**, the flap flange **140** is in a position parallel to the line of travel of the forward leading top flap so that the forward leading top flap is maintained in its opened position. Additionally, as can be seen from FIG. **11**, the lip **158** prevents the leading top flap from entering the horn, the flap coming to rest in a position downstream of the packing horn.

Although the extension of the closing members **120** and **120***a* was necessary so as to maintain the bottom side flaps of the carton which is in the forming station in a closed position as the carton moves from the forming station, for the feeding of the carton into the forming station it is necessary that the closing members **120** and **120***a* be retracted. Referring to FIGS. **13** and **14**, as the carriage moves forward it momentarily actuates LS–3. This opens the normally closed contacts **253** of limit switch LS–3 in leg **508** sufficiently long to disable solenoid **304** which, when disabled, gates air to cylinder **130** and **130***a* in such a manner as to withdraw the closing members **120** and **120***a*. Although the leading top flap cylinder **134** opened the flap and maintained it in its opened position during the initial part of the carton transfer, its shaft **136** is also withdrawn for the case forming sequence by the disabling of the solenoid **304** through the opening of limit switch contacts **253** of LS–3. With the closing members **120** and **120***a* and the flap opening shaft **136** all withdrawn, the forming station is in a condition to accept another unopened carton for forming.

e. Prepare Carton in Packing Station to Receive Goods

The operations which are now performed on a carton in the forming station **22** have been described. The operations to be performed on the carton which is transferred into the packing station **24** are to allow the carton to be packed. First, although the opened carton has been moved into the packing station **24**, it must be properly positioned in front of the packing horn **132**. The carton positioning arm **152** rotates down and pushes the opened carton against the end plate **156**. This step is initiated as the carton transfer carriage **40** becomes fully extended, and actuates LS–2, closing the normally opened contacts **261** in leg **503**. In addition to enabling the desired cylinders in the forming station, the closing of contacts **261** also enables the solenoid **305** to gate air to line **154***a* to cause cylinder **154** to pivot the carton transfer arm **152** down against the rear panel of the opened carton in the packing station.

Once having been positioned in front of the packing horn, the opened carton is transferred onto the packing horn. Referring to FIGS. **10**, **13**, and **14**, when the carton transfer arm **152** becomes pivoted fully downward, the pressure switch PS–**154** in line **154***a* becomes actuated and its now closed contacts through leg **504** and the normally closed contacts **290** of LS–Y cause solenoid **306** to be actuated. A holding path is established, since relay R–2 is actuated, closing its normally open contacts **266** and **268**. The enabling of solenoid **306**

causes two things to happen simultaneously. Referring to FIG. 9, air is gated to cylinder 144, retracting its shaft 142 and causing the flap flange 140 to withdraw to a position away from the packing horn 132. This allows the rear top flap to come between the retracted flap flange 140 and the trailing wall of the packing horn. At the same time, air is gated through cylinder 168 extending its shaft 170 to move the support block 164 along the rods 166 in the direction of the arrow 172. This causes the arms 160, which are attached below, to contact the bottom of the opened carton in order to hold its bottom flaps closed and to push the carton onto the horn. The bottom flaps were retained in their closed configuration during the transfer of the carton from the forming station 22 to the packing station 24 by the guide bracket 148 adjustably mounted between the forming station and the packing station. The normally closed terminals 282 and 284 of relay R-4 in leg 503*a* and the normally closed contacts 270 and 272 of relay R-2 are connected in parallel with PS-168 to insure that any flutter in air line 168*a* during the time that cylinder 168 is extended does not cause leg 503 to be disabled and withdraw the carriage.

f. Prepare Apparatus For Next Carton Opening and Transfer Sequence

Once the opened carton has been transferred onto the packing horn 132, the carton is almost ready to be packed. Before the carton is packed, the apparatus is caused to prepare itself for another carton opening and transfer sequence. As a part of this sequence, the carriage may be retracted, since the carton is supported on the packing horn 132 by the case transfer arms 160, and therefore the carriage 40 is no longer required for support. The retraction of the carriage 40 is conditioned on the case transfer arms 160 becoming fully extended toward the horn 132 by the shaft 170. Pressure switch PS-168 actuates upon full extension of the shaft because it is located in air line 168*a* which supplies air to extend the shaft. When PS-168 actuates, its contacts open to disable leg 503 and remove power from the solenoid 301. This gates air to cylinder 60 so that retraction of its shaft 86 withdraws the carriage 40.

As the carriage 40 retracts, it deactuates LS-2 and the resultant opening of the contact 261 disables solenoid 305. This gates air to cylinder 154 through air line 154*b*, causing the carton positioning arm 152 to be raised. Since air line 154*a* has its air supply cut off, PS-154 opens and won't close again until LS-2 is actuated to close its contacts 261.

Thus, the full extension of the case transfer arms 160 toward the horn 132 serves to initiate the retraction of the carriage 40 enabling the case transfer sequence. It also serves indirectly to initiate the raising of the case lowering arm 176 to its vertical position in order that it be ready to perform its function when the carton on the horn has been filled. The latter function is performed by well known components which are therefore not shown. They include a latching electromagnet, a position sensing switch, and a delay device.

Briefly, the lowering arm 176 is retained in its horizontal position against the force of its biasing spring 182 by a latching electromagnet which is deenergized to release the arm 176 into its vertical position. The full extension of the arms 160 toward the horn 132 is sensed by a position sensing switch in the path of the carton as it is pushed onto the horn 132 and electrically connected in series with the coil of the latching electromagnet. In order to make sure that the lowering arm 176 is not released until after the carriage 40 has been retracted, a time delay device is connected between the carton sensing switch and the latching electromagnet. The delay is designed to open the circuit to the latching electromagnet a short time after the carriage has cleared the lowering arm 176.

Once the carriage 40 has been retracted and the case lowering arm 176 has been raised into its position against the case upon the horn 132, the carton transfer arms 160 may be moved away from the bottom of the carton so that they will not interfere when the carton is lowered.

Pulling the arms out of the way is initiated when the lowering arm 176 rises to its vertical position where it actuates the limit switch LS-Y. The normally closed contacts 290 of LS-Y in leg 504 open and disable the solenoid 306, gating air to line 168*b* and causing the cylinder 168 to retract and to pull the arms 160 rectilinearly away from the bottom of the case toward the front of the packing station 24.

The gating of air to line 168*b* shuts off air in line 168*a*, dropping the pressure in line 168*a*. This deactivates PS-168 and closes its contacts. The closing of PS-168 provides the holding path when the power is later supplied to solenoid 301 and relay R-2 through leg 502. At the same time, the normally open contacts 292 of LS-Y in leg 509 close and complete a path for current to solenoid 307 which then gates air to cylinder 162, causing the case transfer arms 160 to swing up to a horizontal position. At the same time that solenoid 307 is actuated the relay R-5 is also energized and, through its normally opened contacts 294 and 296 and the normally closed contacts 298 of limit switch LS-X in leg 510, holds the power to the solenoid.

g. Pack Goods and Remove Carton

The carton having been positioned upon the horn 132, it is next packed by goods shoved into the carton through the horn. The weight of the canned goods in the carton acts to force the lowering arm 176 down against the bias of the spring 182 so as to lower the carton onto the conveyor. The lowering of the carton actuates LS-X and opens its normally closed contacts 298, disabling solenoid 307 and allowing the case transfer arms 160 to swing down to their initial vertical position. This lowering sequence also automatically enables the next carton handling sequence to begin, because the lowering of the transfer arm 176 and the actuation of limit switch LS-X close the normally opened contacts 281 on leg 502, again enabling solenoid 301 and gating air to the carriage 40.

From the foregoing it can be seen that there has been described a new and improved carton handling apparatus. The cartons are automatically removed from a stack and opened. Their bottom flaps are automatically closed and the cartons are moved to a subsequent station where they may be packed and placed in a position for transfer to a downstream position. The sequence of opening the cartons, closing the flaps, and moving them on to the subsequent station is completely automatic, and since it is sequentially controlled, provides optimum operating speeds for handling cartons.

What is claimed is:

1. Apparatus for forming foldable cartons received as flat carton blanks comprising:

a. means for maintaining a plurality of said carton blanks in a stack;

b. means for carrying the first carton blank from said stack to a forming station;
c. means at said forming station for gripping a side panel of said carton blank and pulling it rectilinearly;
d. means at said forming station for restraining the opposite side panel of said carton blank to force it to open into a tubular rectangular configuration;
e. a pair of arms, each having a camming surface and terminating at their free ends in an elbow; and
f. means for moving said arms between an open position in which they extend adjacent to but spaced from the open bottom end flaps, through an intermediate position in which their camming surfaces move against and gradually fold said bottom end flaps toward one another, and a closed position in which said end flaps are held closed by said arms and the end panels of said carton are firmly grasped between, and are squared by, said elbows.

2. Apparatus for forming foldable cartons received as flat carton blanks comprising:
a. means for maintaining a plurality of said carton blanks in a stack;
b. means for carrying the first carton blank from said stack to a forming station;
c. means at said forming station for gripping a side panel of said carton blank and pulling it rectilinearly;
d. means at said forming station for restraining the opposite side panel of said carton blank to force it to open into a tubular rectangular configuration;
e. a pair of arms, each having a camming surface and terminating at their face ends in an elbow, said pair of arms being pivotally mounted for turning upon axes spaced apart by a distance which is shorter than the length of said carton and wherein the cam surface and elbow of each said arm form a right angle; and
f. means for moving said arms between an open position in which they extend adjacent to but spaced from the open bottom end flaps, through an intermediate position in which their camming surfaces move against and gradually fold said bottom end flaps toward one another, and a closed position in which said end flaps are held closed by said arms and the end panels of said carton are firmly grasped between, and are squared by, said elbows.

3. Apparatus for forming foldable cartons received as flat carton blanks comprising:
a. means for maintaining a plurality of said carton blanks in a stack;
b. a carriage mounted for reciprocating movement to carry the first carton blank from said stack to a forming station;
c. means for moving said carriage with a carton blank upon it from a retracted position under said stack to a forward position in said forming station and for returning said carriage to its retracted position to receive another carton blank from said stack;
d. means defining a subsequent station downstream from said forming station;
e. a portion of said carriage extending into said forming station when said carriage is retracted;
f. spring loaded latch means on said carriage portion for engaging the back of a formed carton in said forming station, said carriage portion moving with an engaged, formed carton on it to said subsequent station when said carriage is in its forward position;
g. means at said forming station for gripping a side panel of said carton blank and pulling it rectilinearly;
h. means at said forming station for restraining the opposite side panel of said carton blank;
i. said spring loaded latch being retractable into the body of said carriage, said latch being retracted by being pulled against and under the opened carton in said forming station when said carriage is retracted; and
j. means for closing the bottom side flaps including a pair of spaced members respectively mounted on opposite sides of said bottom side flaps and movable toward one another from a first position out of contact with said side flaps to a second position at least partially closing said side flaps, one of said members having a projection for engaging in said second position the rear edge of a flap of said carton so as to prevent said carton from being dislocated when said latch is pulled against it.

4. Apparatus for forming foldable cartons received as flat carton blanks, each having a pair of side panels, end panels, bottom end flaps, top end flaps, bottom side flaps, and top side flaps comprising:
a. means defining a loading station, a forming station, and a subsequent station spaced successively downstream along a common axis;
b. means at said loading station for maintaining a plurality of carton blanks in a vertical stack wherein the carton blanks lie horizontally with their side flaps extending parallel to said axis;
c. an elongate carriage mounted for reciprocation along said axis between a first position in which it extends along the bottom of said loading and forming stations and a second position in which it extends along the bottom of said forming and subsequent stations;
d. means upon said carriage at its upstream end for engaging the bottom carton blank in said stack so that it is transferred into said forming station when said carriage moves downstream;
e. means at said forming station for lifting the upper side panel of said carton blank while restraining its trailing end panel so as to force said carton blank to open into a tubular rectangular configuration;
f. means at said forming station for closing the bottom side flaps including a pair of arms mounted for reciprocation in a common vertical plane against said side flaps;
g. means at said forming station for closing the bottom end flaps including a second pair of arms mounted for movement against said end flaps in a horizontal plane and having cam surfaces for gradually bending said end flaps toward one another into a fully closed position;
h. means upon said carriage intermediate its ends for engaging the formed carton in said forming station so that it is transferred to said subsequent station when said carriage moves downstream; and
i. said second pair of arms each having elbows extending from said cam surfaces for squaring the sides of said carton when said end flaps have been fully closed.

5. Apparatus for forming foldable cartons received as flat carton blanks, each having a pair of side panels,

end panels, bottom end flaps, top end flaps, bottom side flaps, and top side flaps comprising:

a. means defining a loading station, a forming station, and a subsequent station spaced successively downstream along a common axis;

b. means at said loading station for maintaining a plurality of carton blanks in a vertical stack wherein the carton blanks lie horizontally with their side flaps extending parallel to said axis;

c. an elongate carriage mounted for reciprocation along said axis between a first position in which it extends along the bottom of said loading and forming stations and a second position in which it extends along the bottom of said forming and subsequent stations;

d. means upon said carriage at its upstream end for engaging the bottom carton blank in said stack so that it is transferred into said forming station when said carriage moves downstream;

e. means at said forming station for lifting the upper side panel of said carton blank while restraining its trailing end panel so as to force said carton blank to open into a tubular rectangular configuration;

f. means at said forming station for closing the bottom side flaps including a pair of arms mounted for reciprocation in a common vertical plane against said side flaps;

g. means at said forming station for closing the bottom end flaps including a second pair of arms mounted for movement against said end flaps in a horizontal plane and having cam surfaces for gradually bending said end flaps toward one another into a fully closed position;

h. means upon said carriage intermediate its ends for engaging the formed carton in said forming station so that it is transferred to said subsequent station when said carriage moves downstream;

i. said means for engaging the formed carton in said forming station being a latch retractable into the body of said carriage, said latch being retracted when said carriage moves upstream; and

j. said pair of arms for closing the bottom side flaps are vertically spaced members respectively mounted above and below respective ones of said bottom side flaps and movable toward one another from a first position out of contact with said side flaps to a second position at least partially closing said side flaps, one of said members having a projection for engaging in said second position the rear edge of a side flap of said carton to prevent said carton from being dislocated when said latch is pulled against it.

6. Apparatus in accordance with claim **5** wherein said latch is spring loaded and is retracted by being pulled against and under the opened carton in said forming station when said carriage moves upstream.

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