March 14, 1961 R. F. WINDSTRUP ET AL 2,974,571

CARTON FORMING AND LINING MACHINE

Filed April 9, 1956 7 Sheets-Sheet 1

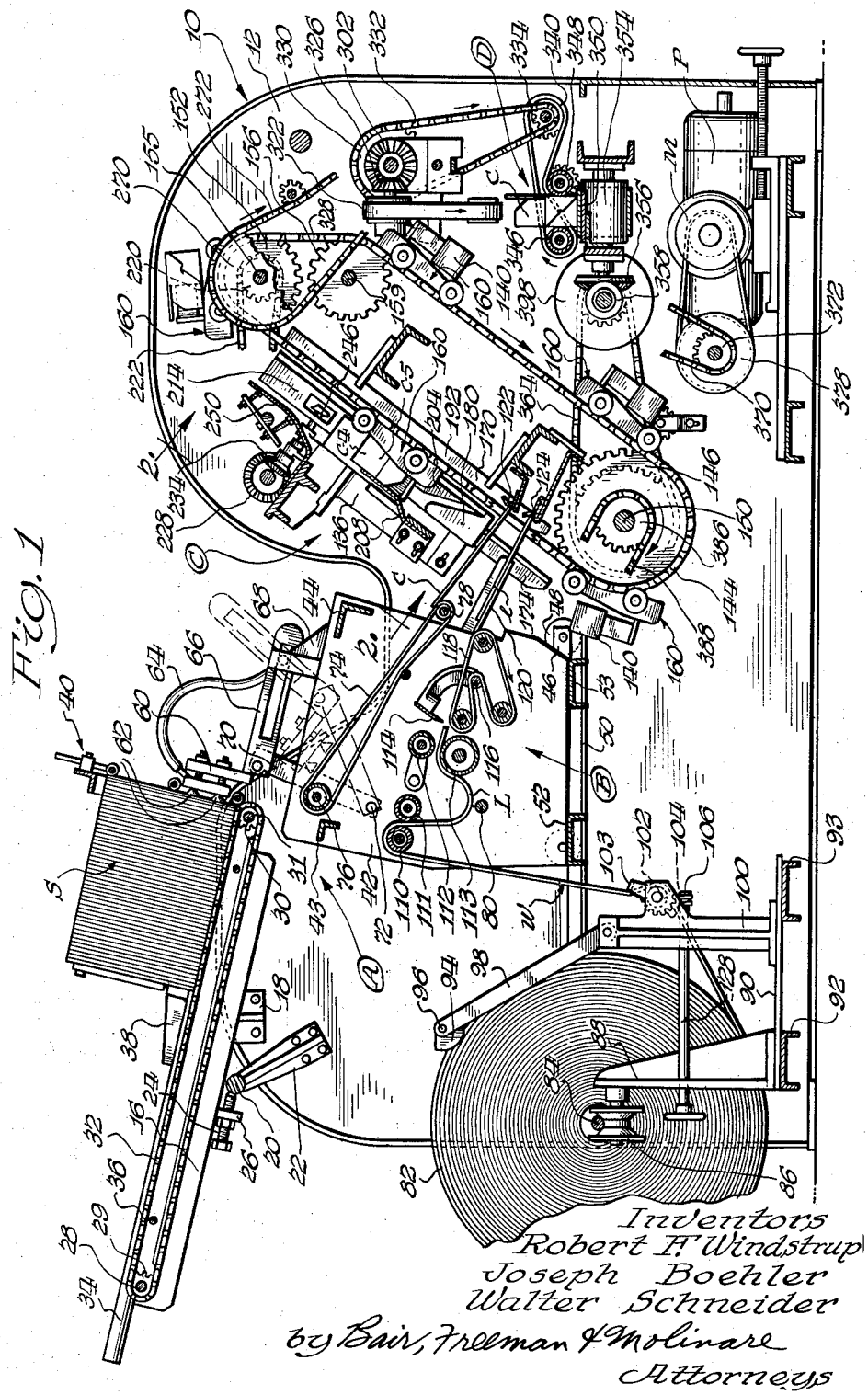


FIG. 1

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CARTON FORMING AND LINING MACHINE

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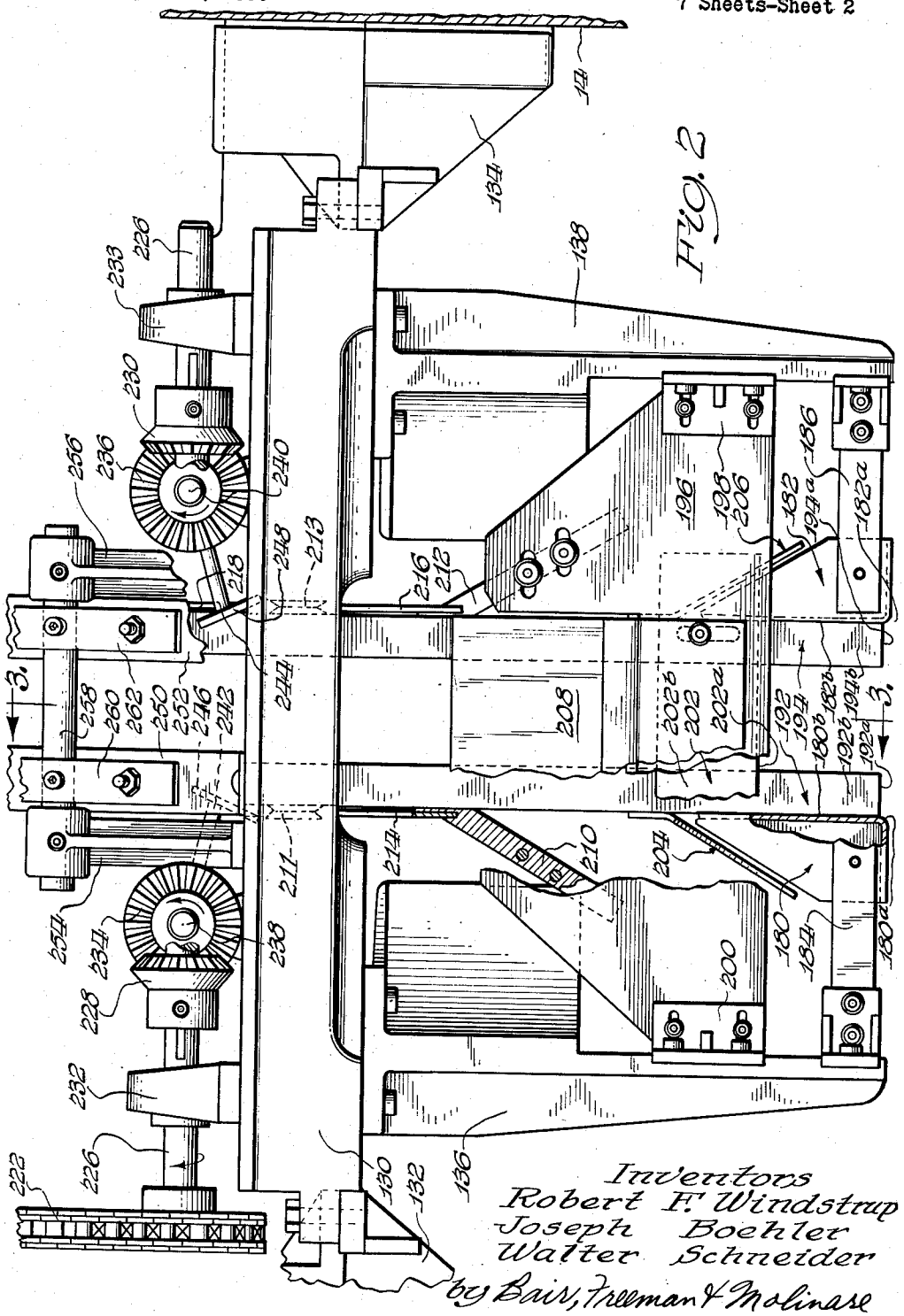


FIG. 2

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CARTON FORMING AND LINING MACHINE

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Fig. 3

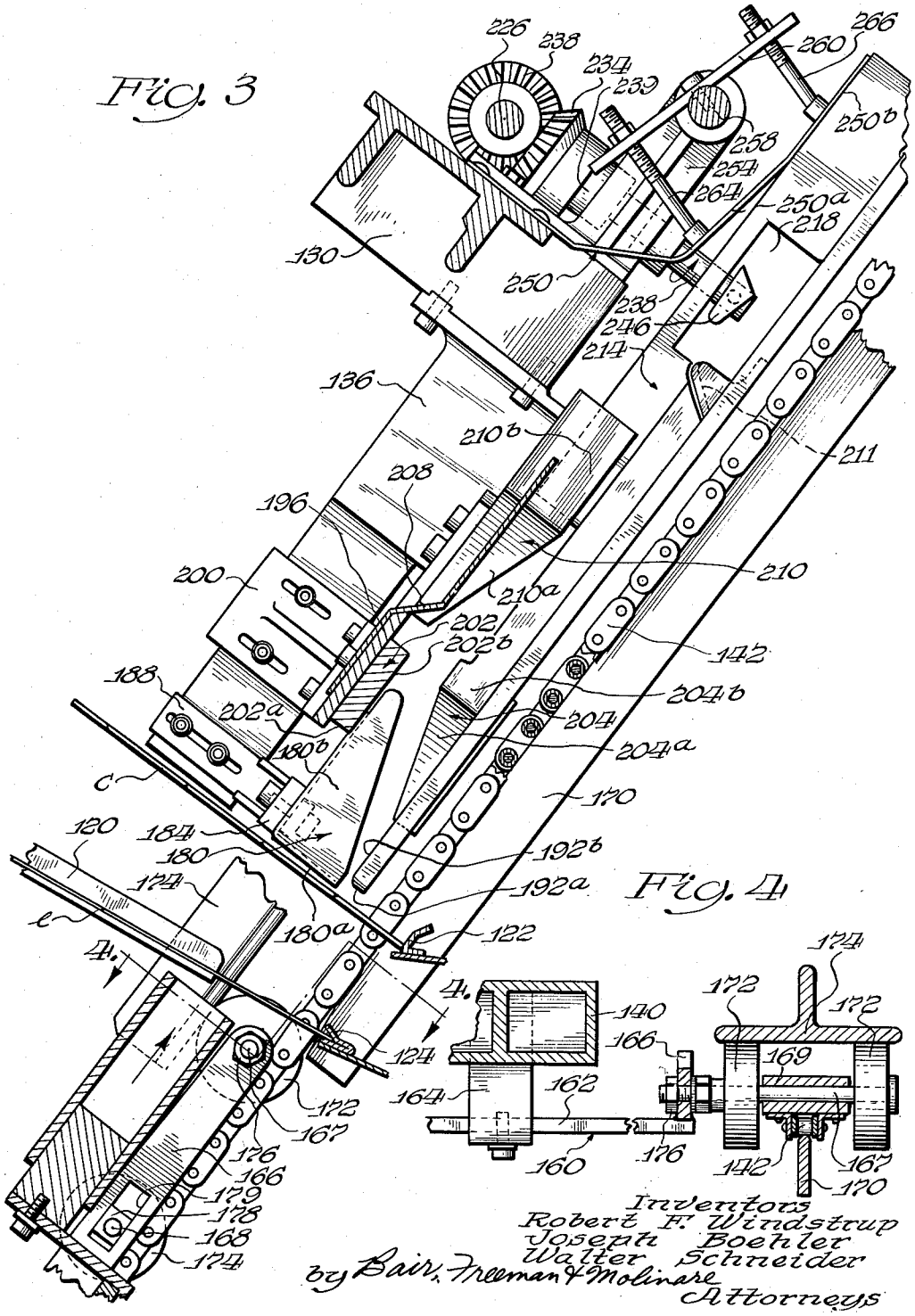


Fig. 4

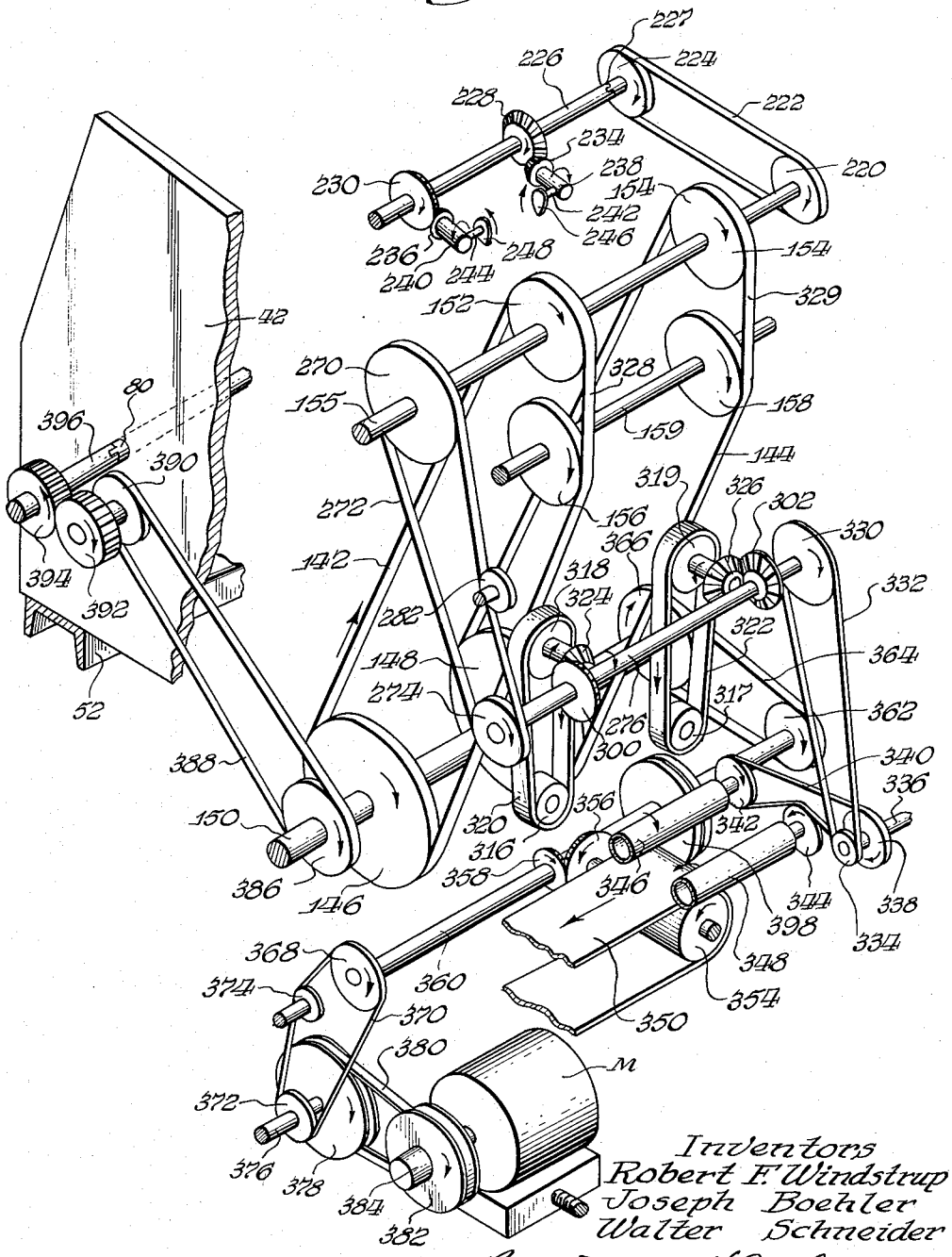
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March 14, 1961 R. F. WINDSTRUP ET AL 2,974,571

CARTON FORMING AND LINING MACHINE

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Fig. 5



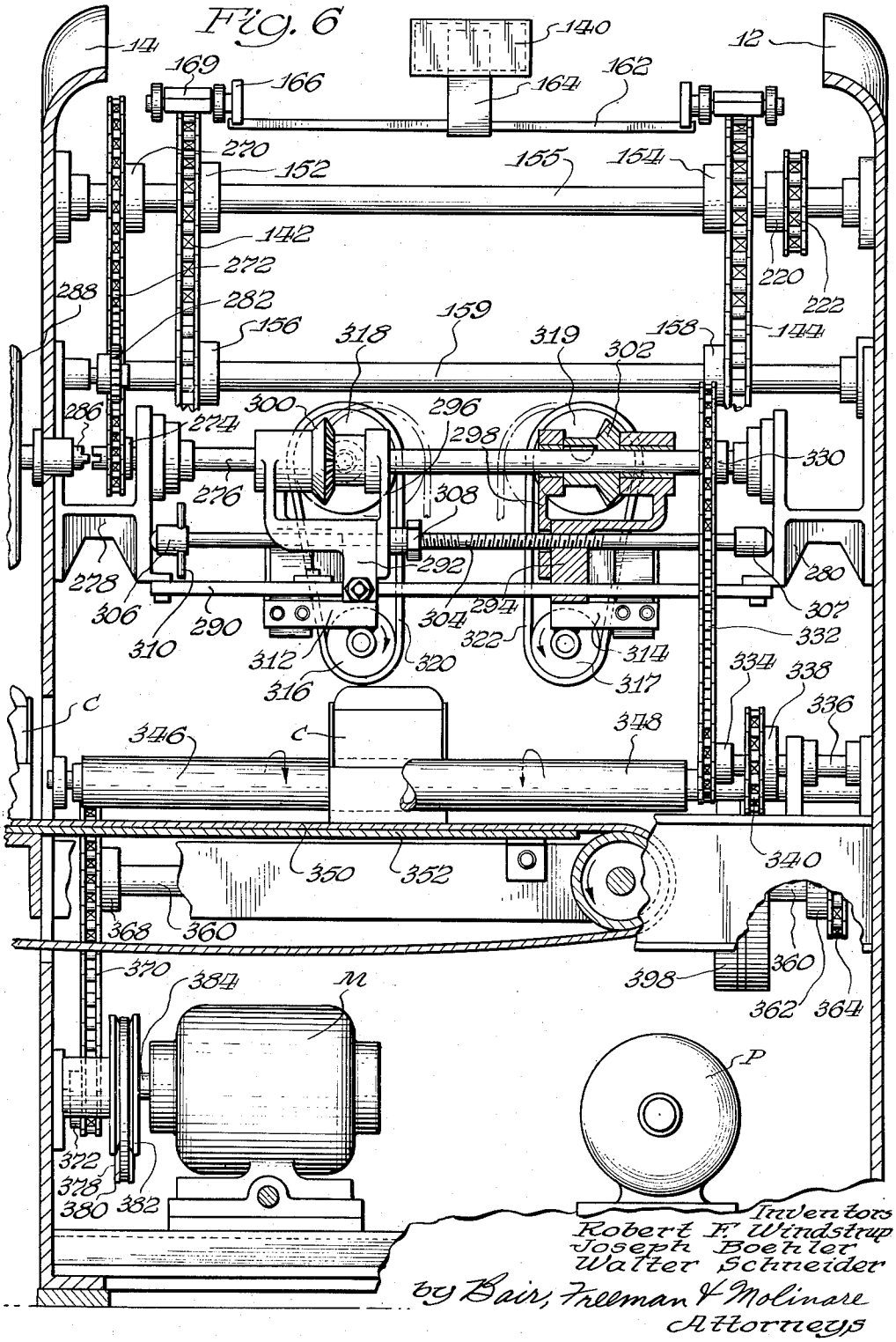
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CARTON FORMING AND LINING MACHINE

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Fig. 6



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CARTON FORMING AND LINING MACHINE

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Fig. 7

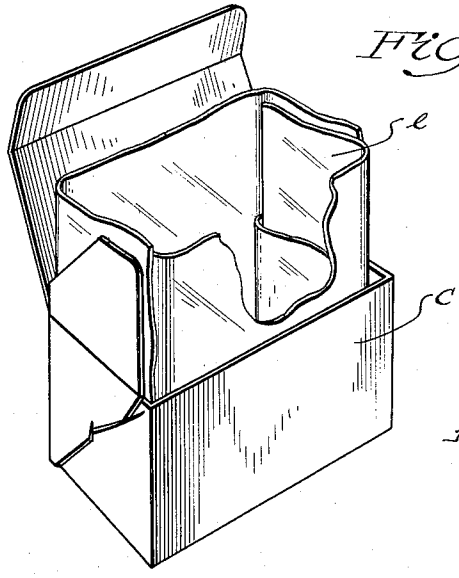


Fig. 8

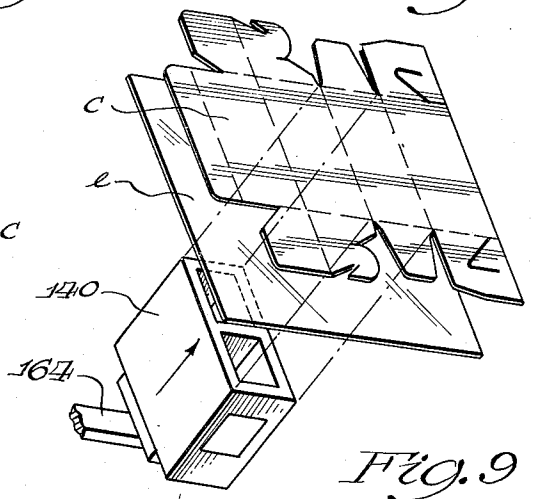


Fig. 9

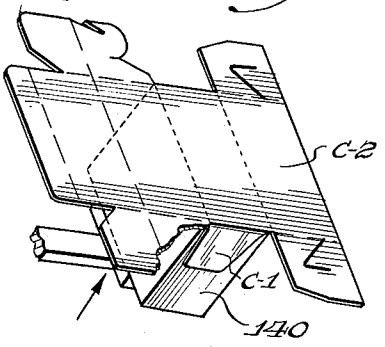


Fig. 9a

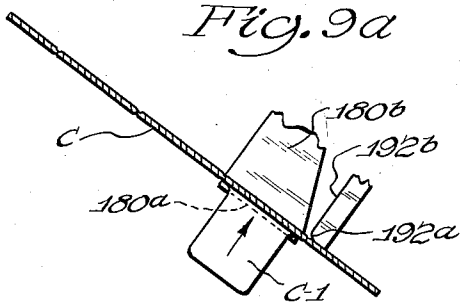


Fig. 10

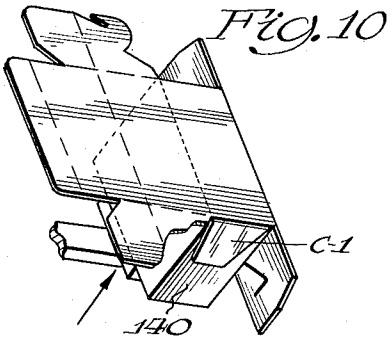
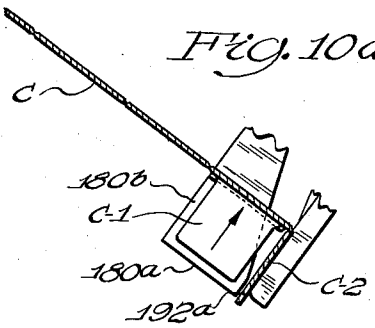


Fig. 10a



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March 14, 1961 R. F. WINDSTRUP ET AL 2,974,571

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Fig. 11

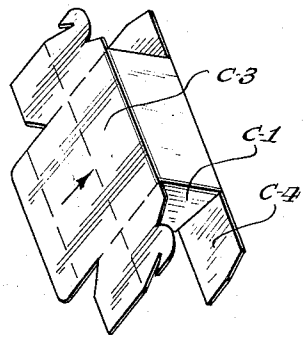


Fig. 12

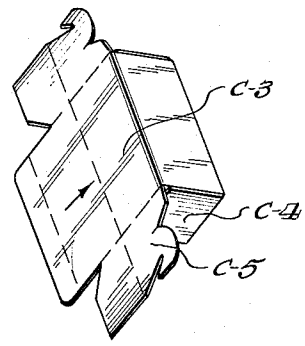


Fig. 13

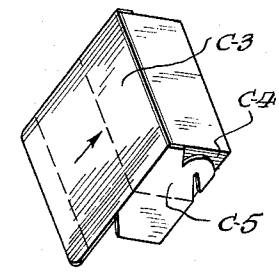


Fig. 11a

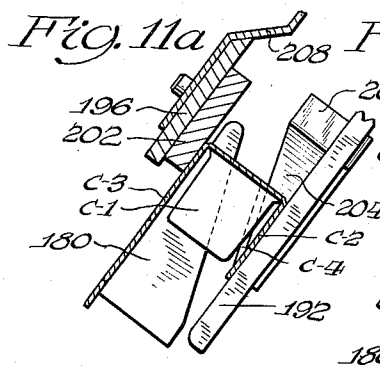


Fig. 12a

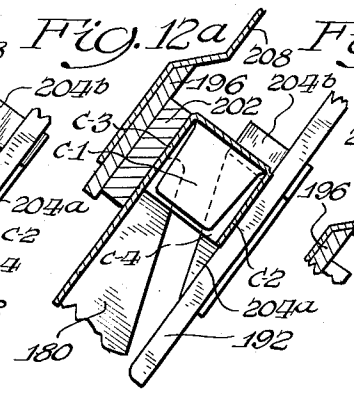


Fig. 13a

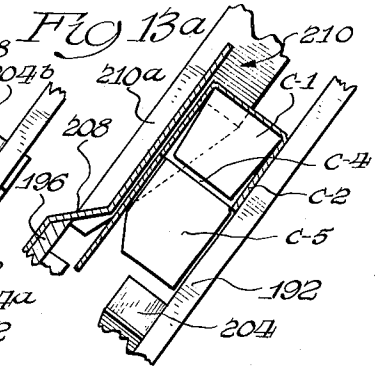


Fig. 14

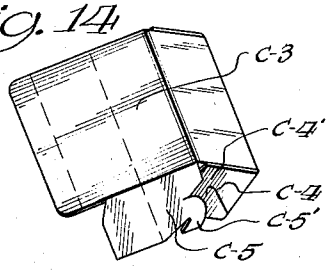


Fig. 15

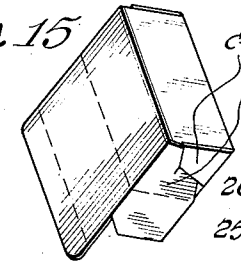


Fig. 15a

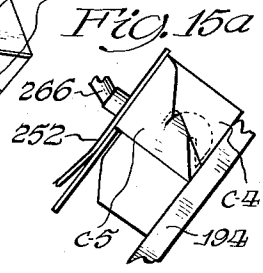


Fig. 14a

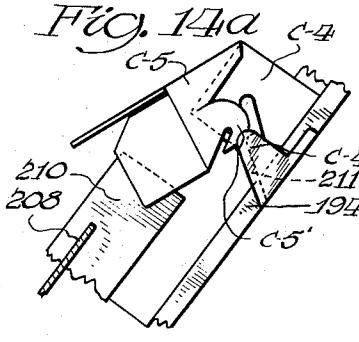


Fig. 14b

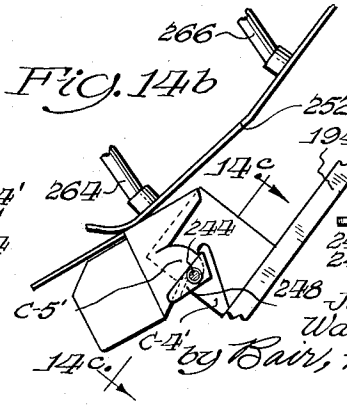


Fig. 14c



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United States Patent Office 2,974,571 Patented Mar. 14, 1961

2,974,571

CARTON FORMING AND LINING MACHINE

Robert F. Windstrup, Joseph Boehler, and Walter Schneider, Chicago, Ill., assignors to Peters Machinery Company, Chicago, Ill., a corporation of Illinois

Filed Apr. 9, 1956, Ser. No. 576,954

6 Claims. (Cl. 93—36.01)

This invention relates generally to a carton forming and lining machine, and more particularly to a novel fully automatic machine for simultaneously forming and folding a carton blank and liner sheet into a lined container adapted to be charged with material.

In the packaging of food products and other goods of a semi-fluid or greasy character, such as lard, margarine, dairy products, and the like, it is desirable to employ a carton having a moisture and grease resistant liner separately folded therein and readily removable from the carton together with the material contents. Former automatic machines for folding and lining cartons have been relatively slow and inefficient. Although the use of integrally lined and internally sealed containers eliminates the use of a separate liner, such containers are relatively costly and require dispensing by a consumer directly from the container rather than by separate removal and replacement of the entire contents in a unitary manner.

It is a primary object of the present invention, therefore, to provide a novel fully automatic machine to receive carton blanks and lengths of liner material from a feeding section, to move such blanks and liner sheets simultaneously through a series of carton forming and lining operations, and to discharge a completely formed and separately lined carton from the machine.

It is another object of this invention to provide an automatic carton forming and lining machine which is of compact size and arrangement, which is readily adjustable for various container sizes, and which is capable of extended operating runs at continuous high speed and efficiency.

It is a further object to provide a machine of this type, wherein the forming and lining section of the machine is oriented to provide a steeply inclined forming run along which the carton blanks and liner sheets are carried in a forward and upward direction as a sequence of folding and tucking operations are performed.

It is still another object to provide a machine of this type having a steeply upwardly and forwardly inclined carton-forming run cooperating with a carton stripping and discharge section adapted to remove completed cartons from the forming run first in a vertically downward direction and then laterally outwardly for discharge from the bottom of the machine, thereby enabling a highly compact and efficient arrangement of machine parts.

It is still a further object to provide an automatic machine to form and tuck a carton with a liner sheet, having a conveyor-carried block around which the carton is formed, wherein the block is directed along an upwardly and forwardly inclined path from the bottom of the machine, striking first the liner sheet and then the carton, thereby folding the liner sheet downwardly while engaging the carton blank thereabove to fully utilize gravity forces and enable the machine to operate with efficiency and reliability at high speeds.

It is yet another object of this invention to provide a machine of the type described, wherein formed and

lined cartons are removed from conveyor-carried forming blocks by means of stripper belts running in the same direction as the path of the blocks at the point of removal but at a relatively higher speed, and wherein a cooperating take-away conveyor having adjacent contra-rotating hold-down rollers is disposed below the stripper belts to laterally discharge the cartons from the machine.

Further objects and advantages of this invention will become apparent as the following description proceeds and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming part of this specification.

A preferred embodiment of the invention is shown in the accompanying drawing, in which:

Figure 1 is a vertical cross-sectional view taken along the longitudinal axis of a machine constructed in accordance with the present invention, with parts broken away and removed to simplify illustration;

Figure 2 is a fragmentary plan view, on an enlarged scale, taken substantially in the direction indicated by the line 2—2 on Figure 1, parts being broken away and removed to simplify illustration;

Figure 3 is a vertical sectional view taken substantially as indicated along the line 3—3 on Figure 2;

Figure 4 is a fragmentary sectional view taken substantially as indicated along the line 4—4 on Figure 3;

Figure 5 is a fragmentary perspective layout view showing the driving mechanisms for effecting operation of the machine;

Figure 6 is a vertical cross-sectional view, on an enlarged scale, taken substantially as indicated along the line 6—6 on Figure 1;

Figure 7 is a perspective view showing a lined carton as formed by the machine;

Figures 8 through 15 are perspective views illustrating the sequence of folding and tucking operations performed by the machine, the liner sheet being omitted from Figures 9 through 15 to simplify illustration;

Figures 9A through 15A are fragmentary sectional views along the forming and lining path of the machine illustrating the manner in which the various folding and retaining members of the forming and lining section effect container formation; and

Figure 14B, and Figure 14C taken substantially as indicated along the line 14C—14C on Figure 14B, illustrate the operation of the tucking fingers which effect final locking of the completed carton at the end of the forming and lining run.

Referring now more particularly to Figure 1 of the drawing, we have illustrated a machine constructed in accordance with the present invention. The structure and operation of the machine may be divided for convenience of description into three related sections. First, a carton magazine and feeder section A serves to provide a consecutive series of carton blanks. Second, a liner roll and feeder section B serves to provide a consecutive series of liner sheets simultaneously with the feed of carton blanks from section A. Third, a carton forming and lining section C combines the liner sheets and carton blanks and effects a series of folding and tucking operations to produce a formed and lined carton at the top of the machine. Finally, a carton stripper and discharge section D serves to remove the finished cartons from section C for lateral discharge from the bottom of the machine.

The machine comprises a supporting frame structure, indicated generally at 10 in Figure 1, which includes a pair of spaced parallel side castings or templates 12 and 14 (see Figure 6). A plurality of transverse support members or channels serve to rigidly tie the side castings together in a manner which provides rigid and

parallel alignment of the various driving and operating elements of the machine between the frame sides 12 and 14.

Carton magazine and feeder section A

As seen in Figure 1 of the drawing, a spaced pair of longitudinally elongated magazine support bars 16 are mounted in forwardly and downwardly inclined manner upon a pair of support brackets 18 carried by the frame sides 12 and 14. The brackets 18 adjustably mount the bars 16 so as to permit pivotal swinging to vary the angular inclination of the bars and to permit longitudinal sliding to vary the forward position of the bars. An abutment rod 20 is carried by a pair of brackets 22 secured to the frame sides 12 and 14, and extends horizontally across the upper rear end of the machine. Cooperating abutment screws 24 are adjustably carried by threaded flanges 26 of the bars 16. In this way, the position and angular orientation of the support bars 16 may be readily adjusted and rigidly secured as desired.

A pair of rotatable shafts 28 and 30 are suitably journaled for support by the bars 16, and serve to carry pairs of sprockets 29 and 31 for meshing engagement with a spaced pair of continuous link chains 32. The chains 32 provide a freely movable traveling surface for supporting a stack of carton blanks S thereon. Suitable guide rods 34 are provided for maintaining the stack S in properly confined and aligned relation, and may be laterally adjustable by means of a transverse adjusting shaft 36 to accommodate cartons of various widths. A feeder block 38 serves to provide a forwardly directed component of gravity force against the rear end of the stack S. A retainer mask 40 is mounted at the forward end of the magazine for retaining the stack S in a limited forward position thereon, while permitting downward removal of carton blanks when engaged and withdrawn by a vacuum head, in a manner to be hereinafter described.

A feeder assembly provides a cyclically operating mechanism for withdrawing a consecutive series of carton blanks from the magazine supported stack S and for feeding them downwardly and forwardly to section C of the machine. This feeder assembly comprises a spaced pair of vertical support templates 42, rigidly secured together by transverse channels 43 and 44. The templates 42 are rigidly mounted upon a carriage 46 having rollers 48 adapted to rest upon a support plate 50 rigidly carried between the frame sides 12 and 14 by means of suitable channel members 52 and 53. The operating mechanisms of the feeder assembly are supported by the templates 42, and are thereby adjustable therewith in accordance with selective positioning of the carriage 46 upon the plate 50. The operating mechanisms include a vacuum head 60 having a plurality of suction cups 62 resiliently biased in a direction toward the carton stack on the magazine. A vacuum supply line 64 serves to provide an intermittent source of suction to render the head 60 operative for removing and releasing carton blanks in accordance with a predetermined operating cycle.

The vacuum head 60 is carried by a carton stripping lever 66 in the form of a glide bracket pivotally and slidably carried by the support bracket 68 rigidly connected to the templates 42. A drive arm 70 is pivoted at its one end to the lever 66 immediately adjacent the head 60, and at its other end to a drive shaft 72. It will be apparent that rotation of the drive shaft 72 in a clockwise direction as seen in Figure 1 will serve to effect a swinging of the stripping lever 66 and the vacuum head 60 carried thereby in a downward arcuate path to the lower position indicated by dotted lines.

When suction is provided by the line 64, the cups 62 will engage and grip the forward carton of the stack S, and as the drive arm 70 actuates downward swinging movement of the head 60, the forward carton will be removed from the retainer mask 40 and carried toward a position overlying a plurality of downwardly inclined feeder belts 74. A suitable drive shaft and pulley 76, and a cooperating driven shaft and pulley 78, effect driving movement of the belts 74 in the direction indicated by the arrow toward the machine section C. It will be understood that suitable adjustable top and side guides (not shown) may be provided for cooperation with the feeder belts 74 to insure proper positioning and alignment of cartons upon the belts. Upon release of the suction supply to the cup 62, a carton *c* will be carried downwardly and forwardly by the feeder belts 74.

A main feeder power shaft 80 is continuously driven by the main machine power drive, as will hereinafter be described in connection with Figure 5. It will be understood that suitable mechanical linkages and couplings, the details of which do not form a part of the present invention, serve to transmit driving power from the feeder shaft 80 to the drive arm shaft 72 and the feeder belt drive shaft 76.

Liner roll and feeder section B

A roll of liner paper 82 provides a core 84 which is positioned on support pulleys 86. The pulleys 86 are carried by support brackets 88 which are mounted upon a support plate 90. Suitable channels 92 and 93 extend across the frame sides 12 and 14 for supporting the plate 90. The pulleys 86 are rotatably adjustable to permit selective positioning of the core 84 between the frame sides 12 and 14. When the pulleys 86 are locked in position, the core 84 will be freely rotatable for continuous removal of a web of liner paper therefrom. Because of the mounting of the carton magazine at a relatively high position at the rear end of the machine, a space of substantial size is provided therebelow, so that a paper roll of quite large diameter and consequently great web length may be utilized. The only limitations upon continuous machine operation are those of the carton blank and liner web supply. Cartons may be continuously added to the magazine as required, and the large roll of liner paper which may be supported within the machine is more than adequate for a normal operating shift. This arrangement of the carton magazine above the liner roll is both compact and efficient, and enables long and continuous machine operation.

Web guides 94 are laterally adjustable along a shaft 96 carried by pivot arms 98 which are rotatably secured to support posts 100. In this way, liner roll brake means is provided for continuously regulating the speed of rotation of the roll 82 as it decreases in diameter with removal of the liner web. The liner web, indicated at W in Figure 1, is drawn upwardly from the bottom of the roll 82 over a curling roller 102 and a cooperating curling bar 103. A gear 104 and cooperating screw 106, having a manually rotatable shaft 108, permits selective angular positioning of the curling bar 103.

The web W is threaded over a feed roll 110 and downwardly between an adjacent feed roll 111. The rolls 110 and 111 are suitably coupled for driving rotation by the feeder power shaft 80, in conventional manner. The web W is threaded between a pair of speed-up rolls 112 and 113. The upper speed-up roll 112 is intermittently positioned in spaced relation to the lower speed-up roll 113 so as to permit the formation of a loop L between the feed rolls 110, 111 and the speed-up rolls 112, 113. When the speed-up roll 112 is lowered into engagement against the web W, its driving speed being substantially greater than that of the feed rolls 110, 111, the loop L is rigidly drawn taut to measure off a predetermined sheet length of liner paper forwardly of the speed-up rolls 112, 113. A cutting knife 114 is rotatably carried by a cutting actuator shaft 116 for intermittently severing a sheet of liner paper. A liner belt 118 receives the con-

secutive cut lengths of liner paper and delivers them forwardly onto a liner chute **120**.

In normal operation, the feed rolls **110**, **111** are continuously driven and serve to withdraw the web W from the roll **82**, resulting in the formation of a loop L forwardly thereof. The speed-up rolls **112** and **113** periodically engage the forward end of the loop L and draw it taut to meter out a predetermined length or sheet of liner paper forwardly thereof. The knife **114** is then actuated to sever the sheet of liner paper, which is then carried forwardly by the belt **118** and discharged onto a chute **120**. A severed liner sheet is indicated at *l* disposed below the substantially simultaneously fed carton blank *c*.

A carton stop member **122** and a liner stop member **124** are disposed in generally parallel spaced relation laterally across the discharge ends of the carton and liner feed devices. The stops **122** and **124** provide receptor surfaces to receive and position a carton *c* and a liner sheet *l* in spaced, aligned relation one above the other at the lower end of the carton forming and lining run.

Carton forming and lining section C

Referring now more particularly to Figures 1 to 3 of the drawing, a main support member **130** is rigidly supported in horizontal relation between the frame sides **12** and **14** by means of a pair of support blocks **132** and **134** (see Figure 2). A pair of support brackets **136** and **138** are carried by the member **130** and extend downwardly and rearwardly therefrom in a relatively steeply and angularly inclined manner (see Figure 1). The brackets **136** and **138** provide rigid means for mounting a plurality of carton folding and forming members disposed along the carton forming path. In this way, the carton forming path is forwardly and upwardly directed along a substantial angle of inclination, preferably greater than 45°.

A plurality of forming blocks **140** are carried upwardly along the forming path by a pair of continuous link chains **142** and **144** providing a forming block conveyor. As best seen in Figure 5 of the drawing, a pair of driver sprockets **146** and **148** are mounted for rotation by a power shaft **150** (see also Figure 1). A pair of driven sprockets **152** and **154** are carried by a driven shaft **155**. The shaft **155** is positioned above and forwardly of the shaft **150** in parallel relation thereto. A pair of idler sprockets **156** and **158** are carried by an idler shaft **159** for meshing engagement with the chains **142** and **144**. A plurality of forming block carriages, each indicated generally by the numeral **160**, are spaced along the conveyor for driving movement thereby through the carbon forming path.

Each carriage **160** comprises a transverse bar **162** (see Figure 4), which removably carries a block support bracket **164** of the forming block **140**. End flanges **156** provide means for mounting the bar **162** upon forward and rear pairs of axles **167** and **168**. Hubs **169** rotatably support the forward axles **167**, and are secured to roller links of the conveyor chains **142** and **144**. Chain guides **170** are disposed along the forming run immediately below the roller links of the conveyor chains for supporting them in a linear path having a predetermined angular inclination parallel to the support brackets **136** and **138**.

Forward and rear pairs of rollers **172** and **173** are carried by the forward and rear axles **167** and **168**. Roller guide plates **174** are disposed along the forming run to engage the upper rolling surfaces of the rollers **172** and **173**, thereby further insuring stabilization and alignment of the carriages **160** as they are carried along the forming path by the conveyor chains. The rear axles **168** are slidably secured to the carriage end flanges **166** by means of glide blocks **178** received within slots **179** (see Figure 3). In this manner, the elongated carriages **160** are appropriately accommodated at the turn ends of the conveyor.

Referring now more particularly to Figures 2 and 3, a pair of first forming members **180** and **182** are secured by means of lateral support brackets **184** and **186** to adjustable connector brackets **188** and **190** for selective fixed support upon the brackets **136** and **138**. Each of the members **180** and **182** provide first folding edges, designated **180***a* and **182***a* respectively, and immediately adjacent holding surfaces, designated **180***b* and **182***b* respectively.

A pair of second forming members **192** and **194** are positioned immediately adjacent the first forming members **180** and **182**. The second forming members provide folding edges **192***a* and **194***a*, and holding surfaces **192***b* and **194***b*.

A transverse support plate **196** is secured by means of angle brackets **198** and **200** to the brackets **136** and **138** in a position overlying the forming run forwardly of the pairs of first and second forming members. A third forming member **202** is supported below the plate **196**, and provides a folding edge **202***a* and a holding surface **202***b*.

A pair of fourth forming members **204** and **206** are supported in spaced relation below the plate **196**, and provide inclined plow surfaces **204***a* and **206***a*, and parallel holding surfaces **204***b* and **206***b*.

A holding plate **208** is supported by the plate **196** so as to overlie the forming run forwardly of the forming plate **202** and in substantial alignment therewith. The forward edge of the plate **208** is freely swingable relative to the forming plates **192** and **194**, thereby providing resilient confinement for the forming cartons moving through the space therebetween.

A pair of fifth forming members **210** and **212** are adjustably carried below the plate **196**, and provide inclined plow surfaces **210***a* and **212***a* and holding surfaces **210***b* and **212***b*. A pair of throw-back fingers or tongues **211** and **213** provide engagement surfaces for effecting expansion or separating of the folded carton prior to final locking.

Side guides **214** and **216** extend forwardly along the forming path from the members **210** and **212**, and are more widely spaced apart than the members **210** and **212**. Apertures **218** are provided in the side guides **214** and **216** to permit projection therethrough of tucking fingers, which will hereinafter be described in detail.

The initial formation of the carton and liner along the forming run will now be described with particular reference to Figures 8 to 13 and Figures 9*a* to 13*a* of the drawing. As indicated in Figure 1, each forming block **140** is brought to the lower or starting end of the forming run by movement of its carriage **160** upon the conveyor chains **142** and **144**. The liner sheet *l* is first directly in the path of the forward movement of the forming block **140**, and the carton blank *c* is next in its path immediately beyond the liner *l*, as clearly illustrated in Figure 8.

In Figure 9, and in subsequent perspective and sectional figures illustrating formation of the carton, the liner sheet *l* has been omitted in order to to simplify illustration. It will be understood, however, that the liner *l* is first engaged by the forming block **140** and carried along with it through the forming run, being restrained by gravity until carried into engagement against the carton blank *c*. Thereafter, the effect of gravity, and the opposing forces provided by the forward movement of the forming block **140** and the restraint of the various folding and forming members serve to maintain the liner sheet *l* and the carton blank *c* in unitary relation. As the carton blank *c* is folded and formed, the liner sheet *l* is simultaneously folded and formed in loosely congruent and separate relation therewithin.

As clearly seen in Figures 9 and 9*a*, the forming block **140** first engages the bottom panel of the carton blank *c*, and carries the carton and the previously engaged liner

sheet into contacting engagement with the first forming members **180** and **182**. The folding edges **180***a* and **182***a* effect a first carton folding *c*–**1** of the carton end flaps at opposite sides of the bottom panel. This folding of the flaps is retained against the block **140** by the holding surfaces **180***b* and **182***b* as the block **140** continues upwardly along the forming path. In similar manner, the edges and holding surfaces of the second forming members **192** and **194** effect a second folding *c*–**2** of the carton front panel and retain it against the forming block **140** (clearly indicated by Figures 10 and 10*a*).

A third carton folding *c*–**3** of the back and top panel portions of the carton is next effected by the forming plate **202**, and these panel portions are held against the block **140**, as seen in Figures 11 and 11*a*. End flaps provided by the front panel are then folded by a fourth carton folding operation *c*–**4** performed by the plows **204** and **206**, as seen in Figures 12 and 12*a*. The fifth forming members **210** and **212** next effect a folding *c*–**5** of end flaps provided by the back and top panel portions of the carton, so as to position them in overlying relation relative to the end panels previously folded by operations *c*–**1** and *c*–**4**, as clearly indicated by Figures 13 and 13*a*.

Up to this point, the various folded panels of the carton, and the liner paper which has been similarly folded within the carton, have been maintained in relative folded relation by the various holding surfaces of the forming members, but the carton is not yet locked in assembled relation. After passing the fifth forming members **210** and **212**, therefore the foldings *c*–**3** and *c*–**5** are no longer restrained and tend to expand due to the normal resilience of the carton material. Such expansion is indicated in Figure 14. The foldings *c*–**1** and *c*–**4**, however, are maintained in relatively loosely overlying relation by the side guides **214** and **216**. At this stage, the carton is then carried past the guide apertures **218** where a tucking operation to lock the end panels folded by operation *c*–**5** into the end panels folded by operation *c*–**4** is begun. The means for performing this tucking operation will now be described in detail.

As best seen in Figure 5, a sprocket **220** is driven by the shaft **155**, and is coupled by means of a continuous link chain **222** and sprocket **224** with a tucker drive shaft **226**. The tucker drive shaft is preferably keyed, as at **227**, to permit unitary removal of the entire carton forming structure without disconnection or dismounting of the link chains and power drive. A pair of bevel gears **228** and **230** (see also Figure 2) are carried by the shaft **226**. Suitable bearing blocks **232** and **233** serve to mount the shaft **226** for rotation. Cooperating bevel gears **234** and **236** are rotatably carried by shafts **238** and **240**, also mounted by suitable bearing blocks **239** for rotation (see Figure 3).

Tucking arms **242** and **244** are carried by the rotatable shafts **238** and **240**, and extend outwardly therefrom substantially at right angles. Tucking plows **246** and **248** are carried by the arms **242** and **244**, respectively. As seen in Figure 2, the plows **246** and **248** are generally of flat or disc-like shape, and are disposed at a slight angle of inclination with respect to the longitudinal axes of the arms **242** and **244**. As the shafts **238** and **240** are rotated, in the directions indicated by the arrows on Figure 2, the plows **246** and **248** are moved arcuately inwardly through the guide apertures **218** and forwardly along the carton forming path.

Referring now to Figures 14, 14*a*, 14*b*, 14*c*, 15 and 15*a*, the operation of the tucking plows **246** and **248** for effecting a locking of the carton in its final form will be described. As the carton is moved forwardly along the forming path between the side guides **214** and **216**, the tucking plows **246** and **248** are being rotated toward the forming path. As the carton reaches the apertures **218** the plows are brought inwardly therethrough so as to engage and compress the carton therebetween. The carton end panels provide locking hooks *c*–**5**′ and slotted hooking panels *c*–**4**′ (see Figures 14 and 14*a*). The inward swinging movement of the tucking plows **246** and **248** effects a contacting engagement against the slotted hooking panels *c*–**4**′ so as to compress them inwardly in spaced relation to the adjacent panel portions of the folding *c*–**4** (see Figures 14*b* and 14*c*). In this way, a passageway is formed in the carton end panels to permit insertion of the hook *c*–**5**′ therethrough.

Locking plates **250** and **252** are carried by the main support members **130** in downwardly and forwardly extending relation therefrom so as to overlie the forming path immediately above and beyond the point of engagement between the tucking plows and the carton panels (see Figure 3). Brackets **254** and **256** (see Figure 2) support a rod **258** having flaps within which a pair of straps **260** and **262** are adapted to seat. Adjuster pins **264** and **266** screw-threadedly extend through the straps **260** and **262** and are secured at their lower ends to the plates **250** and **252**. In this way, the height of the plates **250** and **252** above the forming path, and the initial angular inclination of a forming portion **250***a* relative to a holding portion **250***b* may be selectively adjusted.

It will be apparent that as the tucking plows **246** and **248** engage and inwardly depress the slotted panel *c*–**4**′, the carton will be carried by the forming block below and into engagement with the locking plates **250** and **252**. The locking plates serve to swing the expanded back and top panel portion initially folded by operation *c*–**3** so as to effect insertion of the hooks *c*–**5**′ into locking engagement within the adjacent carton end panels. The final locked position of the various panel portions is clearly indicated in Figures 15 and 15*a*. The carton is now completely formed, locked, and lined, and may be removed and discharged from the machine for use in a subsequent filling operation as required.

Carton stripping and discharge section D

Because of the particular advantages of simultaneously forming and lining the carton along a steeply upwardly inclined forming path, the completed carton is initially positioned at the top forward end of the machine. Unless the carton is promptly removed from the forming block **140** and discharged from the machine at some convenient point, the carton will be carried downwardly and rearwardly back into the machine, thereby risking possible conflict with machine operating parts and soiling or contamination from the moving conveyor sections traveling thereabove. It is an important feature of the invention, therefore, to provide a novel arrangement of carton stripping belts and cooperating discharge conveyor, which operates to remove the cartons from the conveyor prior to return movement rearwardly into the machine.

Referring now to Figures 5 and 6 of the drawing, a sprocket **270** is carried by the upper driven shaft **155** of the carton forming conveyor. A continuous link chain **272** and a sprocket **274** complete a driving coupling of the shaft **155** to a stripper belt drive shaft **276**. Support brackets **278** and **280** provide bearing mountings for the shaft **276** between the frame sides **12** and **14**. An idler sprocket **282** cooperates with the chain **272**, and is rotatably supported by a shaft **284** mounted upon the bracket **278**. A stub shaft **286** extends through the frame side **14** and terminates outwardly in a hand wheel **288**. The inner end of the stub shaft **286** and the adjacent outer end of the stripper belt drive shaft **276** are matingly formed for rigid coupling connection when the stub shaft **286** is moved inwardly. In this way, means are provided for effecting manual driving rotation of the machine power system.

A support bar **290** is carried by the brackets **278** and **280** and serves to slidably mount a first set of bearing posts **292**, **294**, which in turn rigidly mount a second

set of bearing posts 296, 298. In this way, intermediate bearing support is provided for the shaft 276, and for mounting a pair of bevel gears 300 and 302 adapted to be laterally slidably keyed to and rotatably driven by the shaft 276. An adjusting screw 304, having oppositely threaded half-portions, extends through the bearing posts to enable adjustable positioning of the bevel gears and related parts toward and away from each other along the shaft 26. Abutment heads 306 and 307 are provided at opposite ends of the screw 304 for engagement with the support brackets 278 and 280. A lock nut 308 and a manual grip 310 are provided for fixed positioning and manual operation of the screw 304.

Brackets 312 and 314 are carried by the posts 292 and 294, and provide rotatable shafts for supporting a pair of lower pulleys 316 and 317. Similar brackets and shafts are provided for rotatably supporting an upper pair of pulleys 318 and 319. Stripper belts 320 and 322 are mounted for driving movement by the pulleys. Bevel gears 324 and 326 are coupled to the shafts of the upper pulleys 318 and 319, and meshingly engage the driven bevel gears 300 and 302. In this way, the drive shaft 276 operates to effect continuous driving movement of the stripper belts 320 and 322 with their inner adjacent contact surfaces moving downwardly, as indicated by the directional arrows on the pulleys 316 and 317 in Figure 6. By adjusting the spacing distance between the stripper belts 320 and 322, cartons of various widths may be accommodated.

As clearly seen in Figure 1, the idler sprockets 156 and 158 of the conveyor chains 142 and 144 serve to provide generally vertical running lengths 328 and 329 between the upper sprockets 152, 154 and the idler sprockets 156, 158. In this way, the formed cartons are carried generally vertically downwardly from the top of the forming conveyor to a position at the top of the stripper belts 322 and 324. It will be apparent that the stripper belts serve to engage the carton and effect its removal from the forming block 140 prior to rearwardly directed movement of the conveyor chains.

A sprocket 330 is carried by the stripper belt drive shaft 276, and is drivingly connected by means of a chain 332 and sprocket 334 to a shaft 336. A sprocket 338, a chain 340, and sprockets 342 and 344, transmit drive from the shaft 336 to a pair of hold-down rollers 346 and 348. The hold-down rollers 346 and 348 are aligned in generally horizontal, spaced parallel relation at opposite sides of a discharge conveyor belt 350 which is posiioned immediately below the lower ends of the stripper belts 320 and 322. The hold-down rollers 346 and 348 are oppositely rotated downwardly and inwardly toward the belt 350 as indicated by the arrows on Figure 6. A platform 352 insures a level and horizontal traveling surface for the conveyor belt 350. A belt driver pulley 354 carries a bevel gear 356 which meshingly engages a cooperating bevel gear 358 by a drive shaft 360. A sprocket 362 carried at one end of the shaft 360 is drivingly coupled by means of a chain 364 and sprocket 366 to the shaft 150. A sprocket 368 at the other end of the shaft 360 is drivingly coupled by means of a chain 370, sprocket 372, and cooperating idler sprocket 374 to a shaft 376. A pulley 378 is carried by the shaft 376, and is coupled by means of a belt 380 with a second pulley 382 mounted upon the drive shaft 384 of a motor M.

A sprocket 386 is carried by the shaft 150, and is drivingly coupled by means of a chain 388 and sprocket 390 to a gear 392 which meshes with a second gear 394 carried by a stub shaft 396. The stub shaft is releasably coupled to the feeder power shaft 80. Suitable manual lever means (not shown) are provided for disengaging the stub shaft 396 from the power shaft 80 for disconnecting the drive to the feeder section if desired.

A magnetic clutch 398 is carried by the shaft 360, and serves as a master disconnecting means between the motor M and the entire operating drive system of the machine. A vacuum pump P is mounted on the machine frame adjacent the motor M (see Figure 6), and is suitably coupled to the vacuum line 64 for operatively energizing the vacuum head 60 of the carton feeding section A in a cyclical manner to effect removal and feed of consecutive carton blanks.

It will be apparent that as formed cartons are carried downwardly along the vertical lengths 328 and 329 of the forming conveyor chains, the stripper belts 320 and 322 will operate to remove the formed carton from its forming block and discharge it vertically downwardly onto the conveyor belt 350. The adjacent hold-down rollers 346 and 348 engage the sides of the carton to insure its contacting engagement upon the discharge conveyor belt 350. In this way, the formed carton is carried along the discharge conveyor for laterally outward ejection at a convenient position adjacent the forward lower end of the machine.

Summary of practical operation

The sequence of operation of the carton forming and lining machine disclosed by the present invention may be summarized as follows:

The carton magazine and feeder section A operates to provide a carton blank *c* in aligned position at the lower end of the carton forming run. The liner roll and feeder section B simultaneously provides a liner sheet *l* immediately below the carton blank *c*. A forming block carried by the carton forming conveyor is carried along a steeply upwardly and forwardly inclined forming path so as to engage first the liner sheet *l* and then the carton blank *c*, and to carry them simultaneously in engaged relation through the forming run of the machine. A plurality of folding and forming members positioned along the forming run operate to effect a folding of a carton into its final form with a separable folded liner therewithin. The entire folding operation is performed in downward and rearward directions as the carton and liner are moved upwardly and forwardly, thereby utilizing gravity effects to facilitate the handling of the lightweight and flexible carton and liner sheet.

The completed carton is then removed from the forming conveyor, prior to its return run in a rearward direction through the machine, by means of vertically downwardly directed stripper belts. The formed carton is discharged from the stripper belts onto a horizontal discharge conveyor belt. Hold-down rollers at opposite sides of the discharge belt insure engagement of the lightweight cartons upon the discharge belt for rapid removal and lateral discharge from the machine.

Changes may be made in the construction and arrangement of the parts of our carton forming and lining machine without departing from the real spirit and purpose of our invention, and it is our intention to cover by the claims any modified forms of structure or use of mechanical improvements which may be reasonably included within their scope.

What we claim as new and desire to obtain by Letters Patent of the United States is:

1. An automatic carton forming and lining machine, comprising feeder means operative to deliver a carton blank to a predetermined rest position, liner feeder means operative to deliver a liner sheet to a predetermined rest position below the carton blank, conveyor means providing a continuous, straight linear carton forming run extending from a lower position immediately adjacent said carton blank and liner sheet rest positions to an upper position above and forwardly thereof, said forming run being steeply upwardly and forwardly inclined along its entire length, a forming block carried by said conveyor and adapted to engage first the liner sheet and then the carton blank and carry them simultaneously in engaged relation upwardly through the forming run, and folding and forming means along said forming run operative to

effect a downward folding of the carton into a final form having a separable folded liner therewithin.

2. An automatic carton forming and lining machine, comprising a carton magazine for supplying a plurality of carton blanks, feeder means operative to cyclically remove a carton blank from said magazine and deliver it to a predetermined rest position, a liner roll for supplying a continuous web of liner material, liner feeder means operative to withdraw and sever a liner sheet from said liner web and deliver it to a predetermined rest position below the carton blank, conveyor means providing a continuous, straight linear carton forming run extending from a lower position immediately adjacent said carton blank and liner sheet rest positions to an upper position above and forwardly thereof, said forming run being substantially perpendicular to the planes of said carton blank and liner sheet rest positions and being steeply upwardly and forwardly inclined along its entire length, a forming block carried by said conveyor and adapted to engage first the liner sheet and then the carton blank and carry them simultaneously in engaged relation upwardly through the forming run, and folding and forming means along said forming run operative to effect a downward folding of the carton into a final form having a separable folded liner therewithin.

3. An automatic carton forming and lining machine, comprising feeder means operative to deliver a carton blank to a predetermined rest position, liner feeder means operative to deliver a liner sheet to a predetermined rest position below the carton blank, conveyor means providing a continuous, straight linear carton forming run extending from a lower position immediately adjacent said carton blank and liner sheet rest positions to an upper position above and forwardly thereof, said forming run being substantially perpendicular to the planes of said carton blank and liner sheet rest positions and being steeply upwardly and forwardly inclined along its entire length, a forming block carried by said conveyor and adapted to engage first the liner sheet and then the carton blank and carry them simultaneously in engaged relation upwardly through the forming run, folding and forming means along said forming run operative to effect a downward folding of the carton into a final form having a separable folded liner therewithin, and carton stripping and discharge means disposed below the upper position of said carton forming run and operative to remove the formed carton from the forming block and eject it from the machine laterally of said forming run.

4. An automatic carton forming and lining machine, comprising feeder means operative to deliver a carton blank to a predetermined rest position, liner feeder means operative to deliver a liner sheet to a predetermined rest position below the carton blank, conveyor means providing a forming run extending from a lower position immediately adjacent said carton blank and liner sheet rest positions to an upper position above and forwardly thereof, said forming run being steeply upwardly and forwardly inclined, a forming block carried by said conveyor and adapted to engage first the liner sheet and then the carton blank and carry them simultaneously in engaged relation upwardly through the forming run, folding and forming means along said forming run operative to effect a downward folding of the carton into a final form having a separable folded liner therewithin, carton stripping and discharge means disposed below the upper position of said carton forming run, said last means including a pair of downwardly directed stripper belts operative to remove the formed carton from the forming block as it begins the return path along said conveyor, said stripper belts operating to carry said removed carton to a discharge belt, a pair of hold-down rollers at opposite sides of the discharge conveyor to insure engagement of the lightweight cartons upon the discharge belt for rapid ejection from the machine.

5. A method of simultaneously forming and lining a carton, comprising the steps of providing a carton blank and a liner sheet in spaced parallel rest positions with said liner sheet below and rearwardly of said carton blank, moving a forming block upwardly and forwardly in a straight linear path against said liner sheet and carrying it into engagement against said carton blank, continuing to carry said liner sheet and carton blank simultaneously in engaged relation upwardly and forwardly through a continuous and straight linear carton forming run extending steeply upwardly and forwardly, folding and forming said carton blank entirely along said forming run into a final carton form with a separable folded liner therewithin, carrying the formed carton downwardly from the uppermost forward end of said forming run and removing the formed carton downwardly from the forming block.

6. A method of simultaneously forming and lining a continuous series of cartons, comprising the steps of providing an intermittent series of pairs of carton blanks and liner sheets in spaced parallel rest positions inclined rearwardly and with each liner sheet below and rearwardly of the corresponding carton blank, moving a spaced series of forming blocks consecutively upwardly and forwardly in a straight linear path each against a liner sheet and carrying it into engagement against a carton blank, continuing to carry each liner sheet and carton blank pair simultaneously in engaged relation upwardly and forwardly through a continuous and straight linear carton forming run extending steeply upwardly and forwardly, folding and forming each carton blank into a final carton form with a separable folded liner therewithin, and continuously removing each formed carton from its forming block.

References Cited in the file of this patent

UNITED STATES PATENTS

1,993,605	Jahne	Mar. 5, 1935
2,116,362	Ness	May 3, 1938
2,135,409	Munn et al.	Nov. 1, 1938
2,394,935	Palmer	Feb. 12, 1946
2,515,621	Willbrandt	July 18, 1950
2,813,465	Schmied	Nov. 19, 1957