Dec. 14, 1971 O. DORFMANN 3,626,660

CARTON ERECTING AND PACKAGING MACHINE

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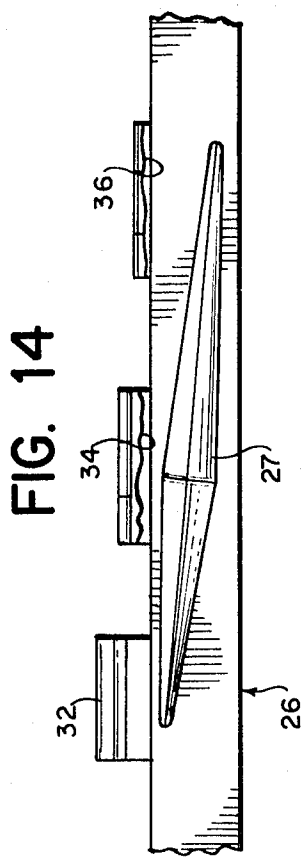


FIG. 14

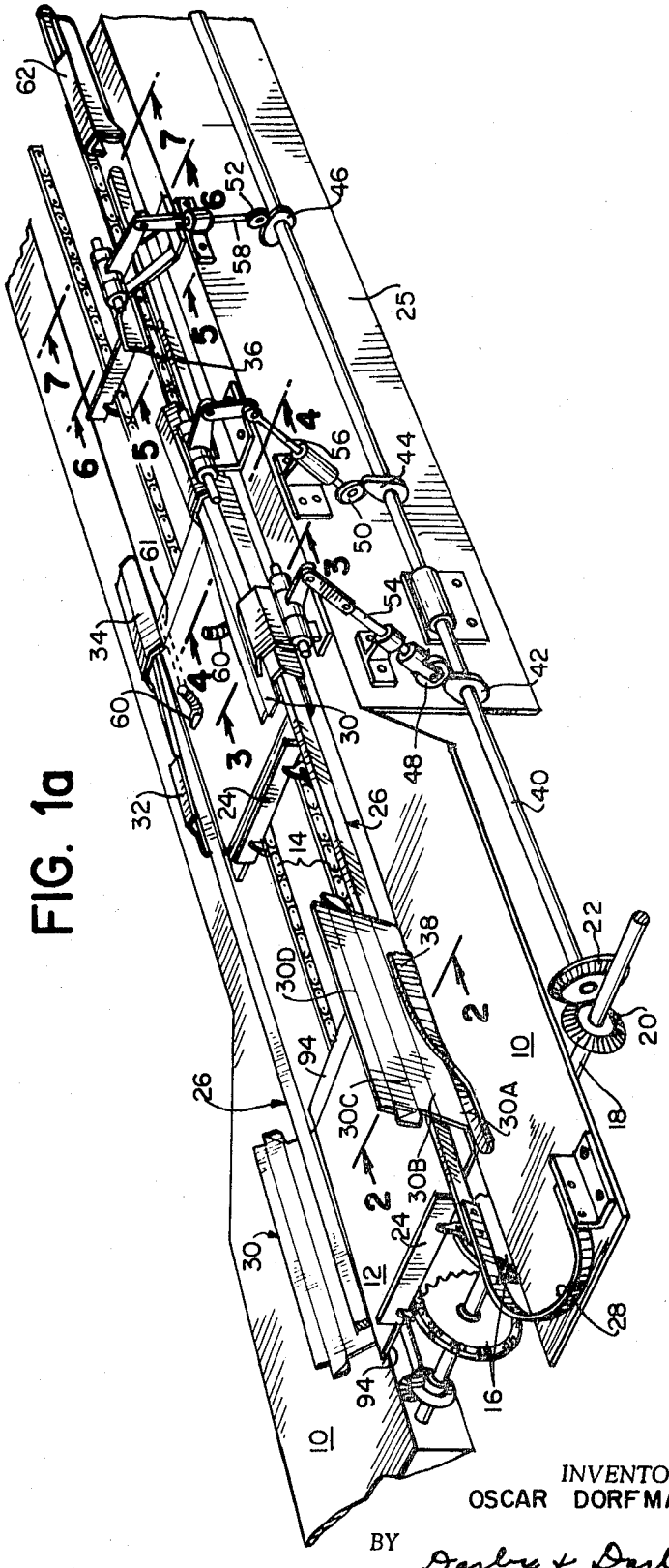


FIG. 1a

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CARTON ERECTING AND PACKAGING MACHINE

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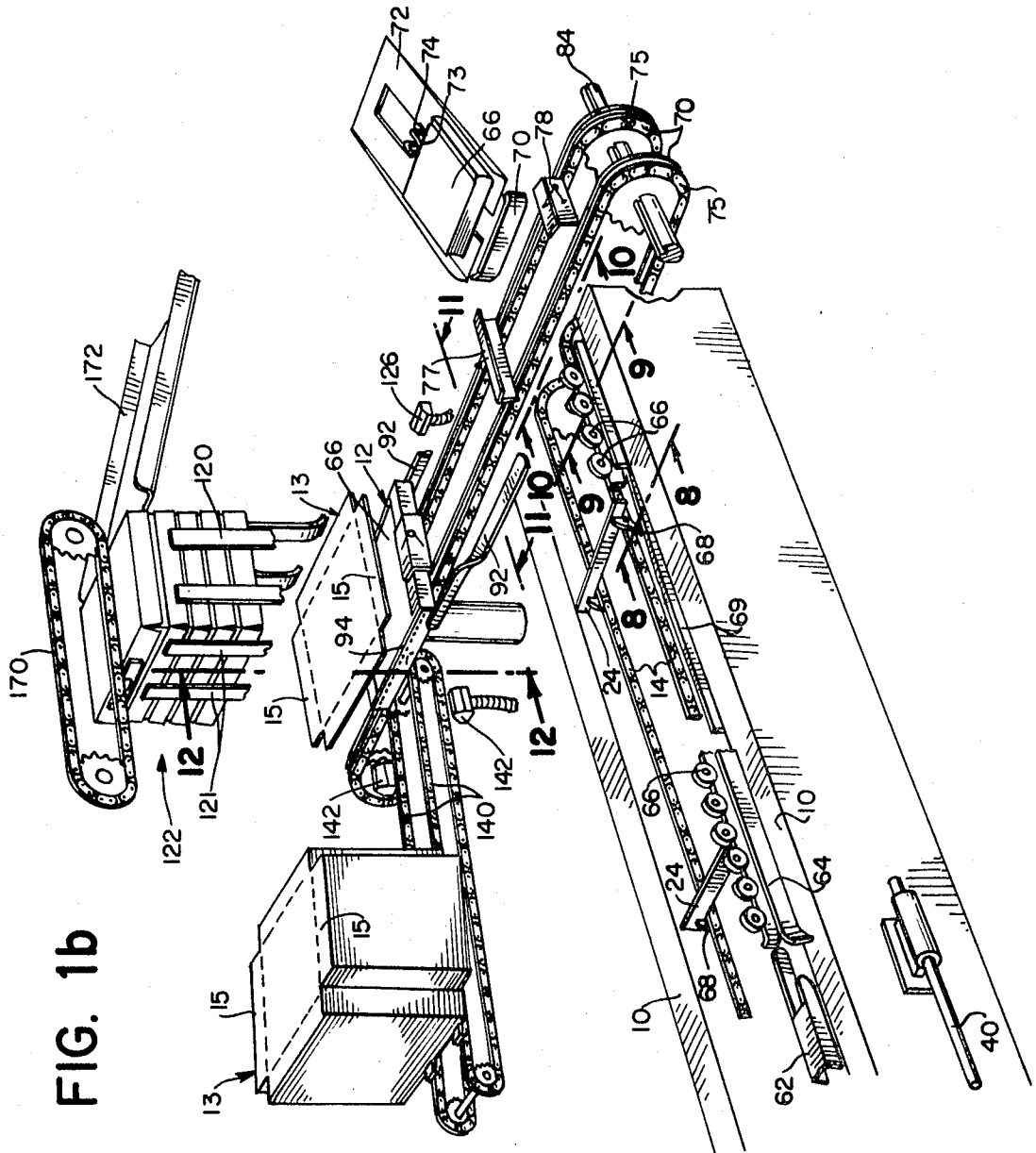


FIG. 1b

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CARTON ERECTING AND PACKAGING MACHINE

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FIG. 2

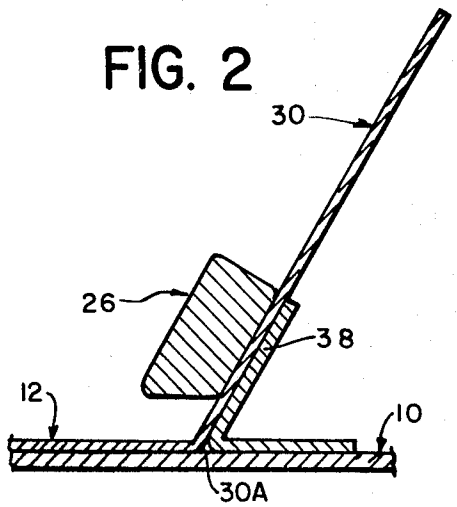


FIG. 3

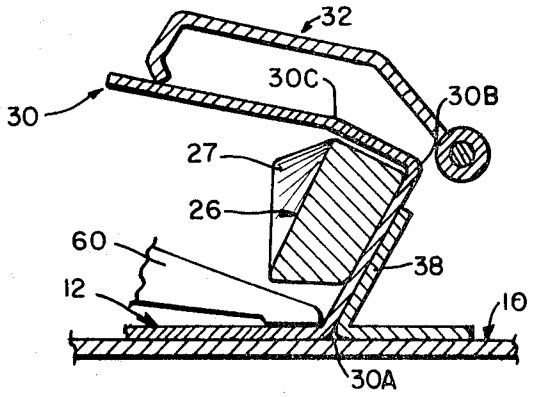


FIG. 4

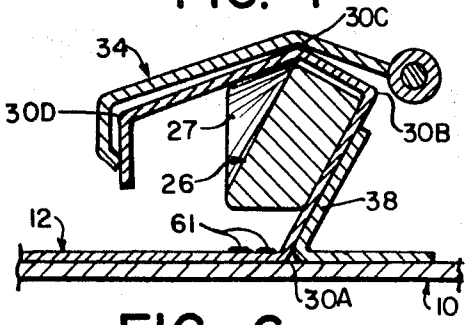


FIG. 5

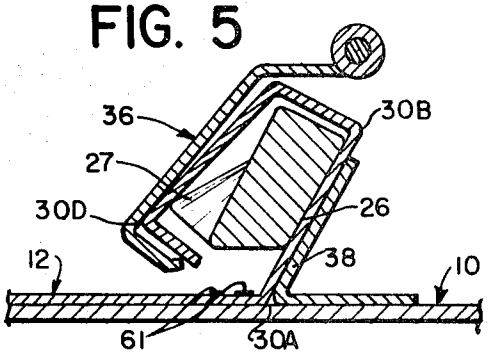


FIG. 6

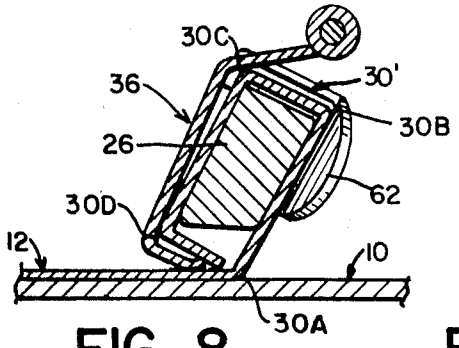


FIG. 7

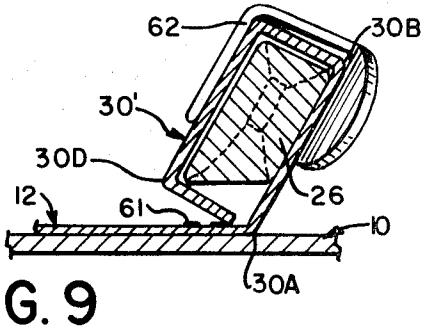


FIG. 8

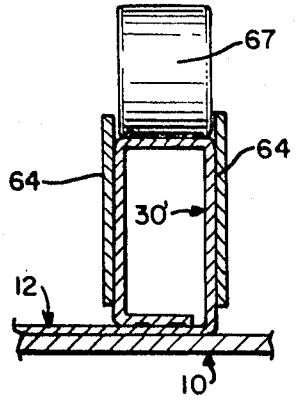
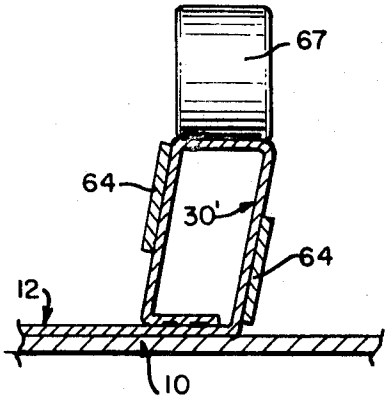


FIG. 9



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FIG. 10

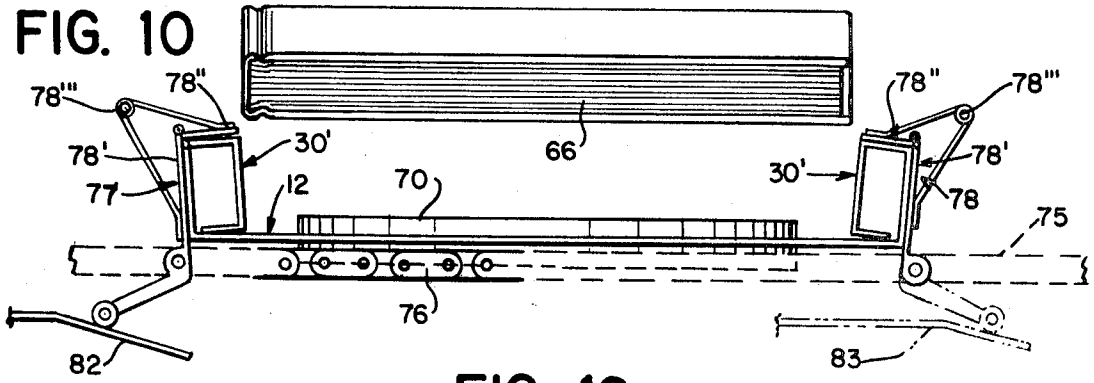
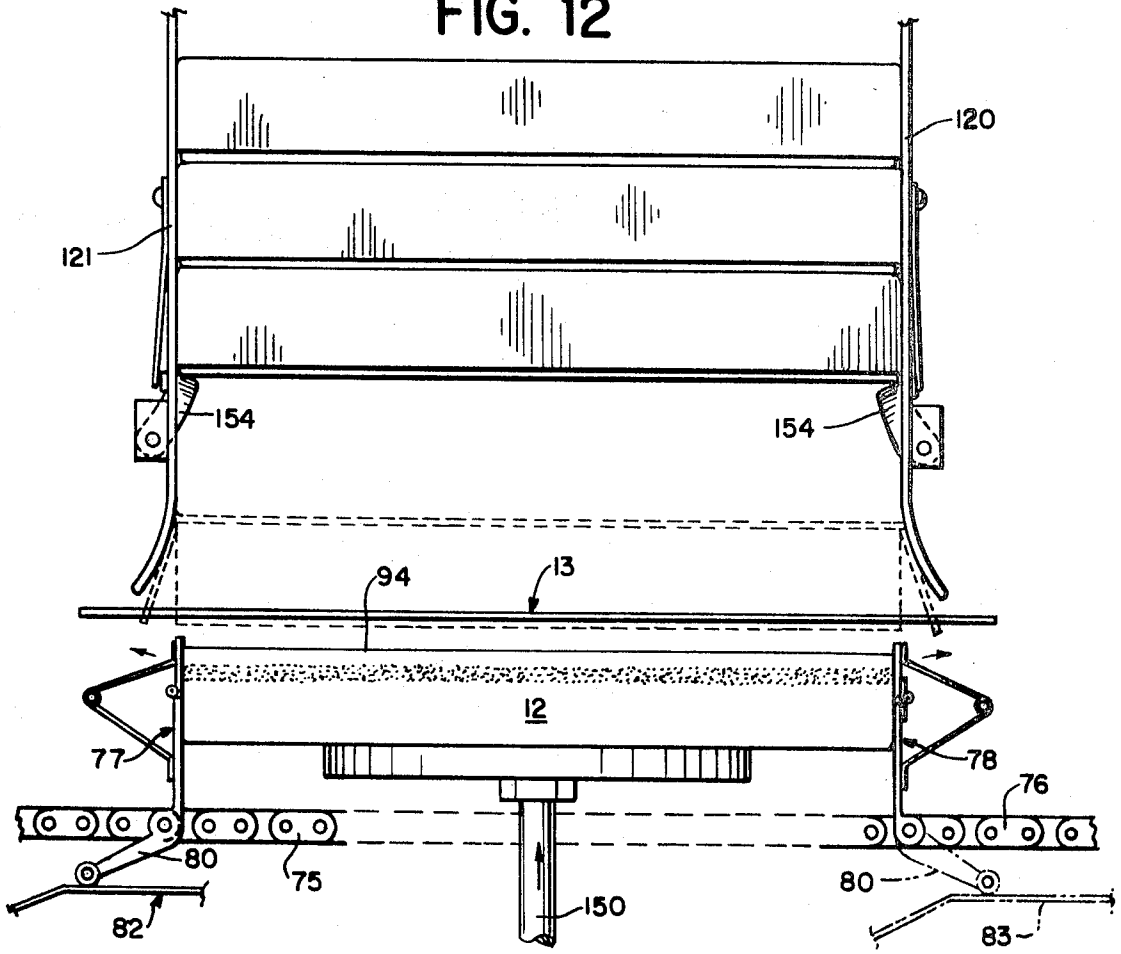


FIG. 12



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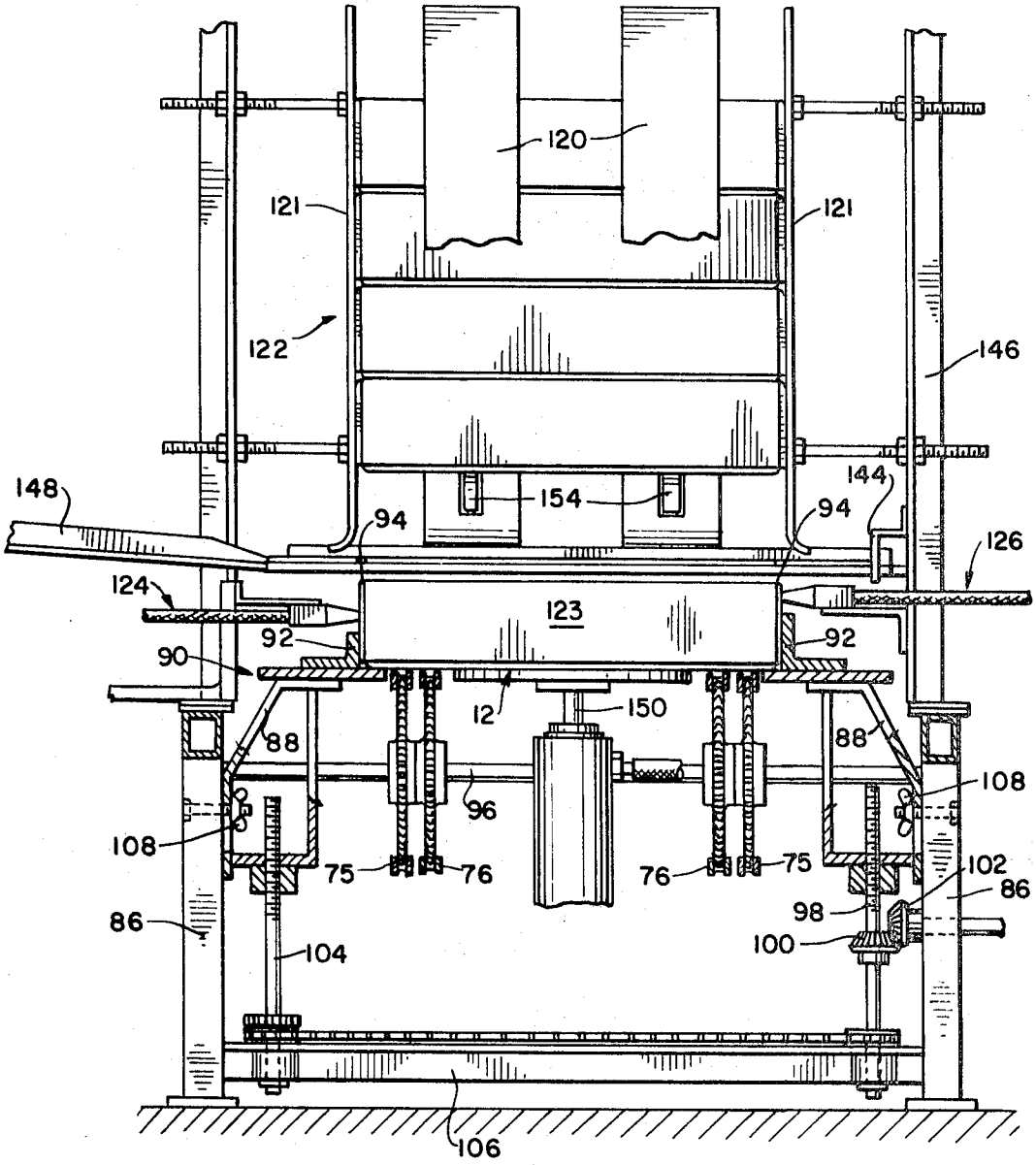
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CARTON ERECTING AND PACKAGING MACHINE

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FIG. 11



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CARTON ERECTING AND PACKAGING MACHINE

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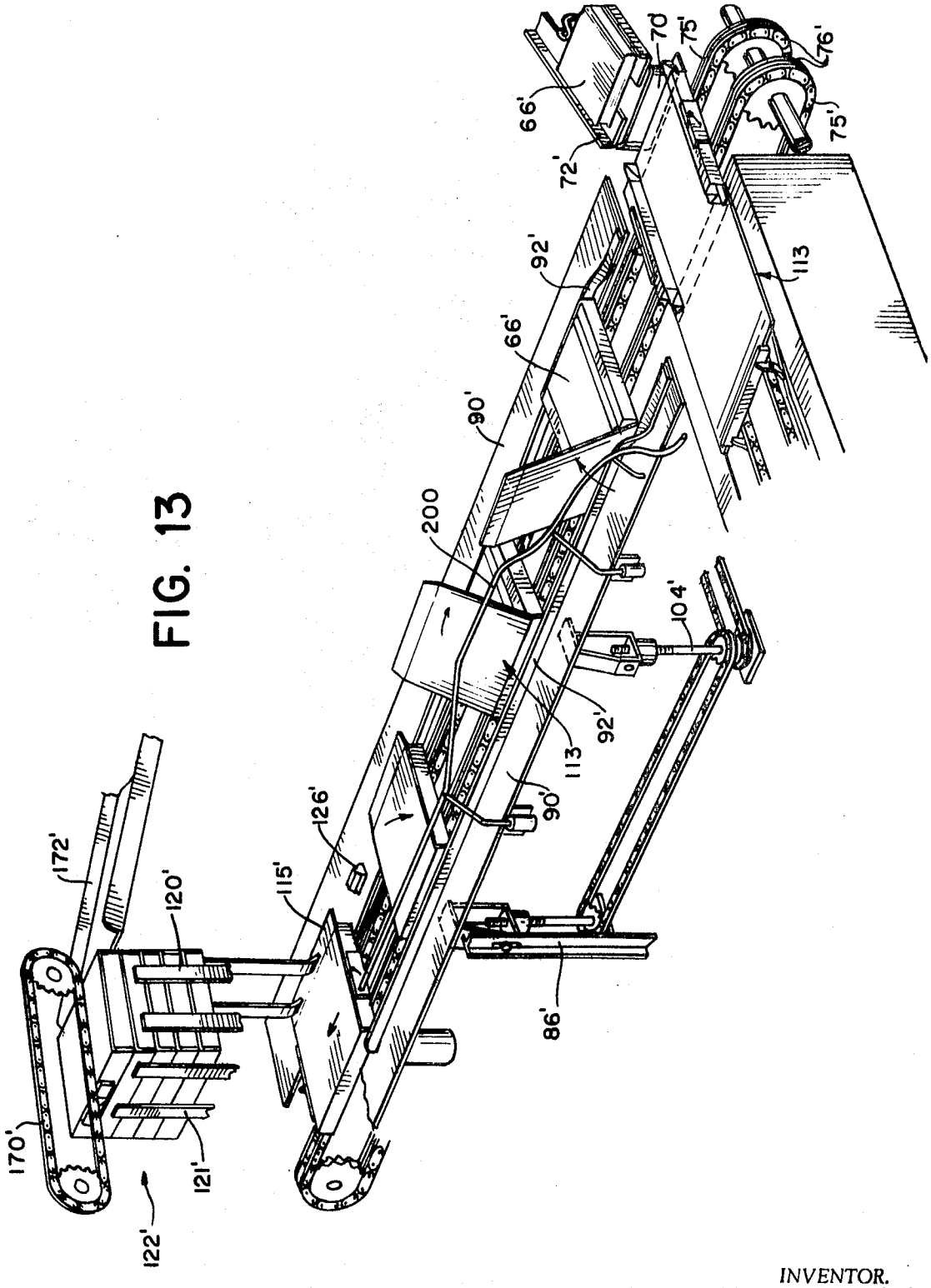


FIG. 13

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CARTON ERECTING AND PACKAGING MACHINE

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FIG. 15

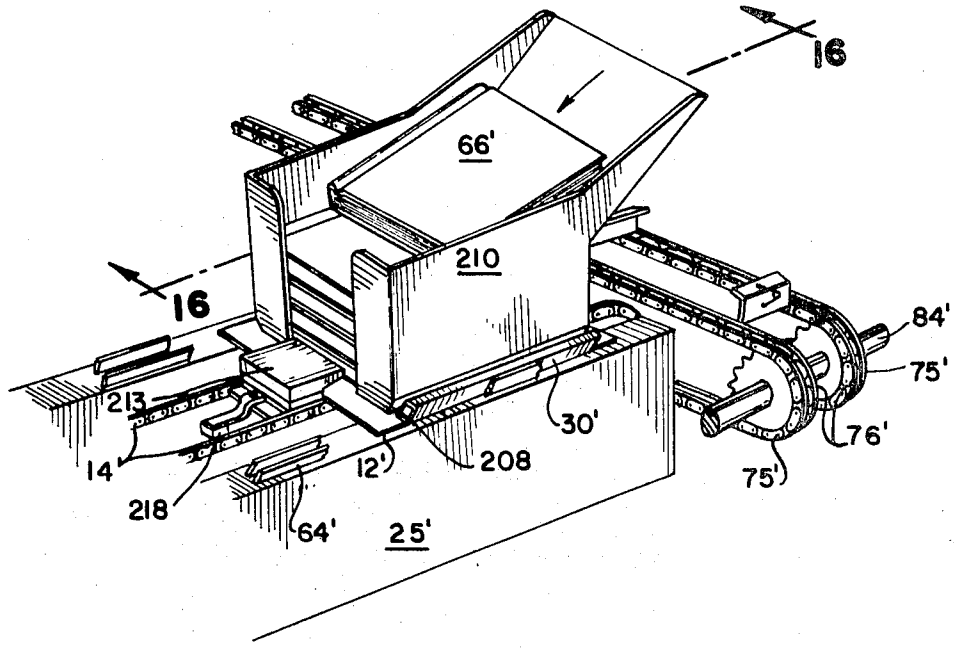
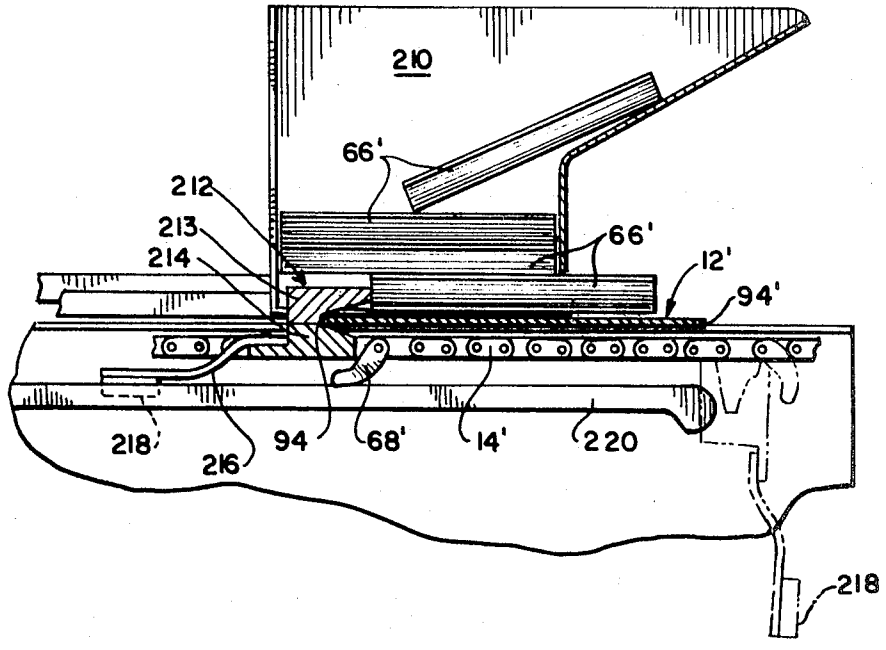


FIG. 16



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United States Patent Office 3,626,660 Patented Dec. 14, 1971

3,626,660

CARTON ERECTING AND PACKAGING MACHINE

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Filed Apr. 7, 1970, Ser. No. 26,227
Int. Cl. B65b 11/18, 25/14, 61/00
U.S. Cl. 53—183 24 Claims

ABSTRACT OF THE DISCLOSURE

An automatic carton erecting and packaging machine is described. Tubular bumpers are automatically formed on a carton blank by folding the blank's side flaps over a forming bar by a series of roll-over cams. The newly formed bumpers are then spread apart for the insertion of the article to be packaged into the partially erected carton. When operating with a double (two part) blank carton, the filled carton and its cover are simultaneously conveyed into engagement for the final gluing and closing operation. When operating with a single blank carton, a curved plough closes the carton cover as it is conveyed to the final gluing and closing operation.

In an alternate embodiment, a contoured flight which conveys the carton blank through the bumper forming operation also engages the article to be packaged and inserts it into proper position in the carton blank.

This invention relates to a machine for automatically erecting, filling and closing cartons which have tubular side walls.

In packaging books and records for shipment, it has been found advantageous to utilize cartons having tubular side walls. The tubular side walls serve as bumpers which hold the article contained in the carton securely in place and provide protection for the corners of the article. In the single blank version of cartons of this type, the top or cover is integral with the rest of the carton. In the double blank version, the top is a separate piece. These cartons are often shipped to users with the bumpers erected and glued in place so that it is only necessary for the user to fill the cartons and close and glue the cover. However, because of the substantial freight costs involved in shipping the partially erected cartons, many users, especially the larger ones, prefer to have the carton blanks shipped to them unerected in a flat position so that they can erect, fill and close the cartons themselves. On the other hand, many of the smaller users still prefer to have the cartons shipped to them in a partially erected condition so that all they must do is fill and close the cartons.

In order to meet the requirements of the larger users, automatic packaging machines have been developed which erect, fill and close the cartons. One problem with these conventional packaging machines is that a funnel and plough arrangement is used to erect the tubular bumpers. Unavoidably, a great amount of friction is produced during this operation and it often results in deforming the front edges of the carton bumper.

Furthermore, difficulty is encountered in many of the conventional packaging machines during the insertion of the article to be packaged into the partially erected carton because of the close fit between the bumpers and the article. This operation is often done manually because of these difficulties, thereby detracting from the automated nature of the system and causing further expense.

Another problem with these conventional automatic packaging machines is that they cannot be modified for the small user who only needs the machine for filling and closing the partially erected cartons. And, a further problem is that the machines are often only adapted for use with a single blank carton or a double blank carton, but not both.

Another problem with the conventional packaging machine is that it is usually adapted to operate only on carton blanks of a uniform size. However, many users are involved in packaging books, records and other articles and therefore require a machine which is capable of performing the erecting, filling and closing operations on carton blanks of various sizes.

It is accordingly an object of this invention to provide an automatic carton erecting and packaging machine for erecting, filling and closing single blank and double blank cartons with tubular side bumpers.

It is a further object of this invention to provide an automatic carton erecting and packaging machine which does not deform the front edges of a carton during the erecting of the carton's side bumpers.

It is a further object of this invention to provide an automatic carton erecting and packaging machine which automatically spreads apart the carton bumpers for easy insertion of the article to be packaged into the carton.

It is a further object of this invention to provide an automatic carton erecting and packaging machine which permits the filled carton to be transported to the closing operation without damaging the carton's bumpers.

It is a further object of this invention to provide an automatic carton erecting and packaging machine for a double blank carton whereby the movement of the filled lower half of the carton toward the closing operation is synchronous with the movement of the top half of the carton to the closing operation.

It is a further object of this invention to provide an automatic carton erecting and packaging machine which may be modified for use with partially erected or preformed cartons.

It is a further object of this invention to provide an automatic carton erecting and packaging machine for single and double blank cartons which is easily adaptable to carton blanks of different sizes.

This invention provides an automatic carton erecting and packaging machine for both single blank and double blank cartons which are fed into the machine unerected and also for single blank and double blank cartons which are fed into the machine with preformed bumpers. The invention is best understood by dividing its description into three sections corresponding to the machine's functional operations, i.e., erecting, filling and closing the carton blank.

The first section of the machine is the erecting section in which tubular bumpers are formed on an initially flat carton blank. A longitudinally extending, continuously moving dual chain drive is mounted on appropriate supporting structure. Several flights are collapsibly mounted on the dual chain drive in order to engage the rear of a flat carton blank and push it forwardly along the machine's erecting section. The side flaps of the initially flat carton blank first engage a curved plough which raises the side flaps to an angle of approximately sixty degrees. Each carton then progresses to the bumper forming operation where a series of roll-over cams bend the carton's side flaps over a forming bar as the carton moves forwardly. The roll-over cams permit the bumper forming operation to proceed at a relatively high speed in comparison to the conventional erecting process where funnels are used. This is because the cams have only line contact with the side flaps of the carton thereby reducing the amount of friction involved in the operation. The newly formed tubular bumpers then engage channel-like guideways which insure that the bumpers retain their shape and which spread the bumpers at an angle away from the carton for

easy insertion of the article to be packaged into the carton as the carton moves forwardly.

The filling section of the machine, in which the article to be packaged is inserted into the carton, is perpendicular to the machine's erecting section. Two dual chain drives with synchronized, intermittent stop and go motion extend the length of the machine's filling section. A collapsible L-shaped flight is mounted on each of the dual chain drives so as to each engage a tubular bumper of the carton as it enters the machine's filling and closing section. In the preferred embodiment, as the article to be packaged is approaching the machine's filling section from one side, the carton is approaching simultaneously from the other side. The insertion of the article into the carton occurs when the two dual chain drives are stopped. After insertion of the article into the carton, the carton moves transversely toward the machine's closing section.

In an alternate embodiment of the invention, a hopper full of articles to be packaged is positioned over the machine's erecting section and a book positioning flight is substituted for the filling section's ordinary flight. The positioning flight is contoured so that its lower portion engages the rearward end flap of the carton and its upper section engages the lowermost article in the hopper and pushes it onto the carton blank as the blank progresses forwardly along the machine's filling section. The positioning flight is contoured so that when the article is pushed out from the hopper it is correctly positioned in the carton blank. In this embodiment the bumper spreading operation is performed by the sides of the hopper.

In the closing section of the machine, glue is applied to the carton blank and the cover, and the cover is placed on the filled carton and secured in position. The packaged article is then transmitted to a conveyor for delivery to the customer. The machine's closing section is located at the end of the two dual chain drives in the machine's filling section and rises vertically from the machine's filling section to the delivery conveyor. When a double blank carton is used for packaging the article, a cover conveying mechanism, which is located perpendicular to the machine's filling section and aligned with the machine's closing section, supplies a cover for the filled carton. As the cover and the carton approach the closing section simultaneously they both have glue applied to their surfaces. When the cover and the carton are exactly positioned, the two dual chain drives and the cover conveying mechanism (which are both connected by a right angle drive) stop and a piston positioned beneath the carton pushes it upwardly into engagement with its cover and into a carton stacking cage in which the glued sections of the carton and cover have sufficient time to dry. As each succeeding carton and cover is pushed into the stacking cage, the preceding carton and cover is pushed upwardly in the open-top cage until it reaches a conveyor or other appropriate mechanism which transmits the packaged article for delivery to the customer.

When a single blank carton is used to package the article, a curved plough in the machine's filling section closes the cover of the carton before it moves into position in the closing section of the machine. The cover conveying mechanism, of course, is not needed in this operation. With this exception, the closing of the single blank carton proceeds the same as with a double blank carton.

Another feature of this invention is that the filling section of the machine is vertically adjustable so that cartons of various thicknesses can be operated on without the necessity of making several overhead adjustments.

Another feature of this invention is that the machine's erecting section is horizontally adjustable and the distance between the L-shaped flights in the machine's filling section is adjustable to accommodate carton's of varying widths.

A further feature of this invention is that the machine can operate on cartons with preformed bumpers of the single blank or double blank variety. This is simply accomplished by feeding the erected cartons into the machine's erecting section and deactivating the roll-over cam drive. The cartons proceed to then move to the bumper spreading operation and continue through the machine in the same manner as the unerected cartons described above.

These and other objects and features of this invention will be more readily understood and appreciated by reference to the following descriptions and drawings, in which:

FIG. 1*a* is a perspective view of the front portion of the erecting section of the machine of this invention;

FIG. 1*b* is a perspective view of the rear portion of the machine's erecting section illustrated in FIG. 1*a* and of the filling and closing sections of the machine;

FIG. 2 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*a*, taken along the line **2—2**;

FIG. 3 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*a*, taken along the line **3—3**;

FIG. 4 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*a*, taken along the line **4—4**;

FIG. 5 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*a*, taken along the line **5—5**;

FIG. 6 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*a*, taken along the line **6—6**;

FIG. 7 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*a*, taken along the line **7—7**;

FIG. 8 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*b*, taken along the line **8—8**;

FIG. 9 is an enlarged, partial cross-sectional view of the erecting section of the machine illustrated in FIG. 1*b*, taken along the line **9—9**;

FIG. 10 is an enlarged side elevational view of a portion of the filling section of the machine of this invention taken along the line **10—10** in FIG. 1*b*;

FIG. 11 is an enlarged cross-sectional view of the filling and closing sections of the machine of this invention taken along the line **11—11** in FIG. 1*b*;

FIG. 12 is an enlarged, side elevational view of the closing section of the machine of this invention also partially illustrated in FIG. 1*b*;

FIG. 13 is a perspective view of the rear portion of a first alternate embodiment of the filling and closing sections of the machine of this invention adapted for a single blank carton;

FIG. 14 is a side elevational view of a portion of the erecting section of the machine;

FIG. 15 is a perspective view of a second alternate embodiment of this invention illustrating an article inserting mechanism; and

FIG. 16 is an enlarged cross-sectional view of the article inserting mechanism illustrated in FIG. 15, taken along the lines **16—16**.

In the following description, the automatic erecting and packaging machine of this invention is described in three parts, corresponding to the function that the particular section of the machine performs, namely, erecting, filling or closing the carton. Furthermore, the description of the preferred embodiment of the machine relates to its operation on an unerected, double-blank carton. In a first alternate embodiment of the machine, its operation on an unerected, single-blank carton is described. In a second alternate embodiment of the machine, a mechanism for inserting the article to be packaged into the carton blank is described. Since the mechanisms on each side of the various sections of the machine are the same and function in a similar manner, only the mechanisms on one side of the machine are described below except

where the same mechanisms on opposite sides of the machine function differently.

(I) PREFERRED EMBODIMENT

(a) Erecting section

Referring to FIG. 1*a*, the front portion of the erecting section of the machine is illustrated. The remainder of the machine's erecting section is illustrated in FIG. 1*b*.

The lower blank **12** of a double blank carton is composed of side flaps **30** and forward and rearward edges **94**. Score lines **30A**, **30B**, **30C** and **30D** are stamped into each of the carton blank's side flaps **30** to permit the side flaps to be more easily bent into tubular bumpers. When the carton blank is thick, the score lines **30A**, **30B**, **30C** and **30D** may be alternately cut to permit further ease in bending. The carton blank **12** is fed onto the machine in a substantially flat position by a conventional feeder.

The bottom surface of the carton blank **12** engages a split table **10** wihch extends longitudinally the length of the machine's erecting section. Two power chains **14** are positioned between split table **10**. The power chains **14** are each driven by a wheel sprocket **16** which is attached to power axle **18**. A source of power (not shown) is provided at one end of the power axle **18**. A slidable gear wheel **20** is also attached to power axle **18** on each side of the machine so as to engage a stationary gear wheel **22**.

Depending vertically from the horizontal table **10** is vertical plate **25** through which the power axle **18** is slidably mounted at the beginning (referring to FIG. 1*a*, the left side) of the machine's erecting section. The split table **10** is horizontally movable toward and away from the sprockets **16** in order to adapt the erecting section of the machine to a carton having a greater or lesser width than the carton illustrated in FIG. **1***a*. Accordingly, when table **10** is moved horizontally outwardly, the slidable gear wheel **20** must be adjusted a like degree to engage the stationary gear wheel **22**.

As previously mentioned, when the carton blank **12** is initially placed onto the machine, it is in a substantially flat position (not shown). A flight **24** which is collapsibly attached to the power chains **14** engages the rear of the carton blank **12** and pushes it forwardly along the length of the erecting section of the machine. There are several flights **24** spaced along the length of the machine's erecting section each of which pushes a carton blank forwardly through the various operations to be performed in the erecting section. Since the movement of the power chains **14** is continuous, each of the cartons **12** is pushed uninterruptedly along the length of the machine's erecting section.

A forming bar **26** which extends along a substantial part of the erecting section of the machine is supported on the horizontal table **10** by a U-shaped bracket **28**. As explained in detail below, the purpose of the forming bar **26** is to provide a member about which the side flaps **30** of the carton blank **12** may be bent in order to form the desired tubular bumpers. To accomplish this result, it is necessary that the forming bar **26** coact with the roll-over cams **32**, **34** and **36** which are mounted on the vertically depending plate **25**. The forming bar **26** is substantially the shape of a parallelogram and supported at an angle of approximately sixty degrees with the horizontal, as illillustrated in FIGS. 2–7.

Referring now to FIG. 2, as the carton blank **12** progresses forwardly from its initial position on the machine, the blank's side flaps **30** each engage a curved plough **38** which is mounted on each side of the split table **10**. The curved plough **38** forces the blank's side flap **30** to bend at score line **30A** at an angle of approximately 60° with the horizonal as the carton blank progresses forwardly. While the curved plough **38** operates on the outer surface of the side flap **30**, the forming bar **26** engages the inner surface of the side flap **30** and prevents it from folding over.

Referring back to FIG. 1*a*, the roll-over cams **32**, **34** and **36** are each supported on the plate **25** depending vertically from the split table **10**. The gear wheel **22** transmits rotational movement from the power axle **18** to the driven axle **40** which is rotatably mounted on vertical plate **25**. Cams **42**, **44** and **46** are each attached to the driven axle **40** and each respectively drives roll-over cams **32**, **34** and **36** by respectively engaging rollers **48**, **50** and **52** which are rotatably mounted at one end of lever arms **54**, **56** and **58** respectively. Lever arms **54**, **56** and **58** are respectively pivotally attached to roll-over cams **32**, **34** and **36** and are each slidably mounted in a sleeve attached to the plate **25**. The rotational motion transmitted to driven axle **40** by slidable wheel gear **20** causes cams **42**, **44** and **46** to rotate thereby imparting rotational motion to roll-over cams **32**, **34** and **36** respectively.

As the carton blank **12** progresses forwardly, the roll-over cams coact with the forming bar **26** to form a tubular bumper from each of the side flaps **30**. The curved plough **38**, though shown partially broken away for illustration purposes in FIG. 1*a*, continues along the length of the machine's erecting section to a point just short of roll-over cam **32**, so that as cam **32** is turning the leading end of the side flap **30**, the curved plough **38** is maintaining the rear end of the side flap **30** at approximately a 60° angle.

A second carton blank **12** is illustrated in FIG. 1*a* after having progressed from its initial position in the machine's erecting section to a position where each of the side flaps **30** is simultaneously engaged by the roll-over cams **32** and **34**. A glue gun **60** is located between roll-over cams **32** and **34** on each side of the machine and supported from above (not shown) the horizontal table **10** so as to be in wiping contact with the carton blank **12** as it progresses forwardly along the machine's erecting section. The glue is stored in a vat supported above the machine with hoses leading to each of the glue guns **60**. The glue gun **60** applies a thin film of a conventional hot melt-slow working glue in two strips onto the top surface of the carton blank **12**. Although the purpose of this glue application is to secure the tubular bumpers in place once they have been formed, this operation can be omitted when the fit between the tubular bumpers and the article to be packaged is sufficiently tight that the sides of the article retain the formed bumpers in place.

Referring now to FIG. 3, the carton blank's side flap **30** is shown being bent over forming bar **26** at score lines **30B** and **30C** by roll-over cam **32** while being supported by plough **38**. Glue gun **60** applies glue to the carton blank **12**. Only the tip of roll-over cam **32** contacts the carton blank's side flap **30** in forming bends in the side flap at score lines **30B** and **30C**. As a result, there is only line contact between roll-over cam **32** and the side flap **30**. As the cam rotates through a predetermined number of degrees and the carton blank progresses forwardly, the line contact between the cam and the side flap generates an imaginary spiral on the side flap.

Since there is only line contact between the roll-over cam and the side flap, there is only a small friction between them. And since roll-over cams **34** and **36** have the same line contact with side flap **30** as cam **32**, the amount of friction involved in erecting the tubular bumpers of the carton blank is relatively small in relation to the amount of friction produced by using funnels and the like in the bumper-forming operation. The reduced friction permits the operation to proceed at a relatively high speed.

Referring to FIGS. 3–7 and 14, a triangular member **27** is attached to the inside surface of forming bar **26** on a diagonal as illustrated in FIG. 14. The triangular member increases in cross-sectional area progressing from roll-over cam **32** to the middle of roll-over cam **34** and decreases in cross-sectional area an equivalent amount progressing from the middle of roll-over cam **34** to the end of roll-over cam **36**. The triangular member cooperates with the forming bar **26** to form the tubular bumpers by engaging the side flap **30** at various points as it is progres-

sively bent over the forming bar by roll-over cams **32**, **34** and **36**.

When the rotation of the roll-over cam **32** is completed, the carton blank's side flap **30** is in the position illustrated in FIG. 4. In this position, the leading edge of side flap **30** is being bent over forming bar **26** and triangular member **27** by roll-over cam **34** while being supported by plough **38**. Two strips of glue **61** have been applied to the top surface of the carton blank **12** by the glue gun **60**. The bend in side wall **30** at score line **30B** has been completed and the bend at score line **30C**, which was initiated by roll-over cam **32**, is given further definition by roll-over cam **34**. Also, a bend at score line **30D** in side flap **30** is formed by roll-over cam **34**. Similar to roll-over cam **32**, there is only line contact between roll-over cam **34** and the side wall **30**.

Referring now to FIG. 5, the roll-over cam **36** engages the carton blank's side flap **30** and further defines the bends in the side wall at score lines **30C** and **30D** by bending the side flap over the forming bar **26** and the triangular member **27**, with only line contact between the roll-over cam **36** and the side wall.

Referring to FIG. 6, the carton blank **12** is shown having progressed along the machine's erecting section to the end of roll-over cam **36**. In this position, the rotation of the roll-over cam **36** has been completed and a tubular bumper **30'** has been formed from side flap **30**. After the completion of the rotation of roll-over cam **36**, right angle bends have been formed in the side flap at score lines **30B**, **30C** and **30D**.

Referring now to FIGS. 1*a* and 6, a guideway **62** is attached to each side of split table **10** forward from the roll-over cam **36** so that the leading edge of a carton blank's tubular bumper **30'** enters the guideway **62** before the rearward edge of the carton blank's tubular bumper leaves the roll-over cam **36** as the blank progresses forwardly on the machine. The guideway **62** retains the newly formed tubular bumper in place.

Referring now to FIGS. 1*a* and 7, the carton blank's tubular bumper **30'** is shown at a position on the machine at which the forming bar **26** begins to taper to a smaller cross section, as illustrated in dotted lines. As the leading edge of the tubular bumper **30'** is entering the guideway **62**, the rearward edge of the bumper is leaving the forming bar **26**. Although the guideway **62** is initially offset at an angle of approximately 60° with the horizontal in order to assure a smooth transition for the bumper from forming bar **26** which is also angled at 60°, the guideway gradually twists to an angle of approximately 90° (FIG. 1*b*) with the horizontal further along the length of the machine so that the tubular bumper is forced to an upright position and the portion of the bumper after the bend at score line **30D** is brought into contact with the glue strip **61**.

Referring now to FIG. 1*b*, the rearward portion of the machine's erecting section is illustrated along with the filling and closing sections of the machine which are described in more detail below. In the rearward portion of the erecting section of the machine, a guideway **64** with overhead rollers **66** suspended on a conventional weight bar (not shown) is positioned on each side of split table **10** directly following the guideway **62**. As previously mentioned, after the carton blank's tubular bumper **30'** is formed by the roll-over cams, the bumper enters guideway **62** at an angle of approximately 60° and is twisted by it to an angle of approximately 90° so that when the bumper enters guideway **64**, the slight pressure applied by the overhead rollers **66** is sufficient to glue the bumper in place. As illustrated in FIGS. 1*b* and 8, rollers **66** bear down against the top portion of the bumper **30'** thereby forcing the lower portion of the bumper into engagement with the glue strips **61**. The guide rails **64** prevent the side walls of the tubular bumper from buckling as the carton blank progresses forwardly along the machine's erecting section.

Referring again to FIG. 1*b*, as the carton blank progresses further along the machine's erecting section to the position illustrated by line **9—9**, the guide rails **64** angle outwardly approximately 10°, as illustrated in FIG. 9, so that the tubular bumper **30'** is bent outwardly. In this position the carton blank is ready to leave the machine's erecting section and enter into the filling section of the machine. The tubular bumpers are bent outwardly so that they do not interfere with the insertion of the article **66** to be packaged into the carton, as described in more detail below. The bumper spreading operation is necessary because of the tight fit between the article **66** and the inner sides of the bumper after the article is packaged.

Referring again to FIG. 1*b*, each set of angle cams **68** which are pivotally mounted on the power chains **14** prevent the flight **24** corresponding to that particular set of angle cams from collapsing backwardly. The lower portion of each of the angle cams **68** engages a rail (not shown) which extends substantially the length of the erecting section of the machine. The forward and rear edges of the rail are tapered downwardly so that the angle cam **68** runs off the rail as the carton blank **12** approaches the filling section of the machine thereby allowing the flight **24** to collapse backwardly so as not to crush the carton blank **12** against the stop plate **70** in the machine's filling section. The flight **24** then proceeds around the underside of the power chains **14** and assumes an upright position as it reaches the upper side of the power chain so that it is in a position to push the rear edge of another carton blank forwardly.

(b) Filling section

Although the movement of the power chains **14** in the erecting section of the machine is continuous, the movement of the two adjacent sets of power chains **75** and **76** is the filling section is intermittent. A piling up of carton blanks in the filling section is prevented by positioning the flights **24** in the erecting section a sufficient distance apart so that the filling section power chains **75** and **76** progresses forwardly one unit before the erecting section's dual chain drive **14** presents another carton blank for filling.

The carton blank **12** is initially stamped (sized and pre-scored) so that the article **66** to be packaged fits snugly between the carton blank's tubular bumpers **30'**. Simultaneous with the forward movement of the carton blank **12** toward the machine's filling section is the movement of the article **66** down a conveyor **72** toward the carton blank **12**. As the carton blank **12** leaves the machine's erecting section, guide rails **64** maintain the rearward portions of the carton's bumpers at an angle of approximately 80° with the horizontal (FIG. 9). The forward portions of the carton's bumpers are simultaneously being held apart by engagement with article **66** which is being pushed by pusher **74** into the carton blank. Thus, the article **66** and the guide rails **64** coact so that bumpers are continuously held spread apart as the carton blank leaves the machine's erecting section and enters its filling section.

Referring to FIG. 1*b*, the conveyor **72** is positioned at an inclined angle. The pusher **74** has a projecting end **73** which pushes the article **66** down conveyor **72** and into the partially erected carton blank **12**. The pusher **74** which moves forwardly in a slant on the conveyor **72** is driven by a motor which is synchronized with the movement of the carton blank **12** into the machine's filling section. The height of the lower edge of the conveyor **72** is greater than the height of the stop plate **70** so that the plate does not interfere with the pushing of the article **66** into the carton blank.

Referring now to FIGS. 1*b* and 10, the article **66** to be packaged is shown about to be inserted into the carton blank **12** which is progressing forwardly toward stop plate **70**. The outer surfaces of the forward portions of the bumpers of the carton blank **12** are engaged by the flights

77 and 78 which are attached to power chains 75 and 76 respectively in the filling section. Angle cams 80, which are each attached to the filling section flights 77 and 78, each engage rails 82 and 83 respectively which are supported beneath the filling section's drive chains 75 and 76. Rails 82 and 83 angle upwardly for a short distance at the intersection of the erecting and filling sections of the machine and then proceed on a level along the length of the machine to beneath the closing section of the machine where the rails 82 and 83 angle downwardly (as illustrated in FIG. 10).

As a result of the initial angling of rails 82 and 83 at the intersection of the filling and erecting sections of the machine, the flights 77 and 78 are initially bent outwardly to receive the carton blank's tubular bumpers 30'. As the filling sections's drive chains 75 and 76 progress forwardly along the length of the filling section, each of the angle cams 80 respectively engages the level portions of rails 82 and 83, thereby forcing flights 77 and 78 to assume a substantially vertical position. Since the tubular bumpers of the carton are retained by the flights 77 and 78, the bumpers also are forced to a substantially vertical position as the drive chains progresses forwardly along the machine's filling section.

Although the article inserting mechanism is located in the machine's filling section in the preferred embodiment, it could be located completely in the machine's erecting section (as described in the second alternate embodiment) or at another position along the machine's filling section.

Since flights 77 and 78 are identical, only flight 78 is described in detail. Flight 78 is composed of a side wall 78' and a top wall 78" which is pivotally attached to the side wall so that it is free to rotate away from the top surface of the blank's tubular bumper. A spring 78"' urges the flight top wall 78" to the closed position illustrated in FIG. 10. It is necessary for the top wall to be pivotally attached because when the packaged tubular wall carton is pushed upwardly in the closing section of the machine, as described in detail below, the top wall 78" must open upwardly, as illustrated in FIG. 12.

Flight 77 is attached to outer drive chains 75 and flight 78 is attached to inner drive chains 76. The outer drive chains 75 are adjustable by their sprockets so that flight 77 can be moved forwardly and rearwardly thereby adjusting the distance between flights 77 and 78 to conform to the width of the carton blank 12.

Although the movement of the drive chains 75 and 76 is intermittent, it is synchronized with the movement of the erecting section's dual chain drive by adjusting the speed ratio between the drive chains 75 and 76 and the drive chains 14. This is accomplished by connecting the filling section driver axle 84 to an appropriately timed power source. After the article 66 has been completely inserted into the carton blank 12, the drive chains 75 and 76 are activated and the filled carton progresses forwardly along the filling section of the machine towards its closing section.

Referring now to FIG. 11, posts 86 which are located at one end of the filling section of the machine and two similar posts (not shown) which are located at the other end of the machine provide support for the machine's filling section. A bracket 88 is adjustably mounted on each of the supporting posts 86 so that the bracket may be raised or lowered. In FIG. 11 the bracket is shown in its lowered position. Horizontal table 90 on which the carton blank 12 travels as it progresses along the length of the erecting section of the machine is supported on the top surface of each bracket 88. Curved ploughs 92, illustrated in FIG. 1*b*, raise the forward and rearward edges 94 of the carton blank from a horizontal position to a vertical position. When the carton blank 12 is initially placed in the erecting section of the machine, the forward and rearward edges 94 of the carton blank 12 are in a horizontal position. As the carton progresses forwardly along the length of the machine's erecting section, the carton's rearward edge is pushed by flight 24 into the filling section of the machine. While the carton blank is in the machine's erecting section it is necessary to maintain its leading edge in a horizontal position so that the article 66 may be inserted into the carton with no interference. The curved ploughs 92 raise the carton's forward and rearward edges 94 to a vertical position so that they will be in position for the final gluing and closing operation.

The drive chains 75 and 76 are rotatably supported on an axle 96, each end of which is journalled into one of the supporting posts 86.

A lead screw 98 is threaded into one of the supporting brackets 88. A gear wheel 100 is attached to the non-threaded portion of the lead screw so as to engage a driver gear wheel 102 which is connected to a rotating power source (not shown). By a sprocket and chain belt arrangement, the rotary motion imparted to the lead screw 98 by the power source is also transferred to lead screw 104 which is threaded into the other supporting bracket 88.

In operation, when the power source is activated the driver gear wheel 102 imparts rotational movement to lead screws 98 and 104. Since the lead screws are each attached to crossbar 106, the rotational movement of the lead screw causes supporting brackets 88 to move upwardly or downwardly. The wing nuts 108 which secure the supporting brackets to posts 86 are, of course, loosened before vertical adjustment of the supporting brackets is begun. Once the vertical adjustment is completed, the brackets 88 and all the structure that the brackets support are in a raised position. Thus, the horizontal table 90 and the curved ploughs 92 may all be raised or lowered by the vertical adjustment of the supporting brackets 88 while the chain drives 75 and 76 remain at the same horizontal level.

The vertical adjustability feature of the filling section of the machine enables the machine to operate on cartons having different thicknesses. For purposes of this discussion, a carton having a shallow depth is designated a normal size carton and a carton having a greater depth is designated a large size carton.

When an article is to be packaged in a normal size carton, the carton blank is initially placed in the erecting section of the machine. The carton blank then progresses along the erecting section during the formation of its tubular bumpers and progresses to the filling section of the machine where an article is inserted into the carton as described above. During this operation, the filling section of the machine is at its raised level (the opposite of which is shown in FIG. 11). When the filling section of the machine is at its raised level, the height of the table 90 is slightly greater than the non-adjustable height of the table 10 in the erecting section of the machine. In order to permit smooth transmission of the normal size carton from the machine's erecting section to its filling section, the filling section table 90 is angled slightly downwardly (not shown) where the erecting section intersects the filling section for a distance approximately equivalent to the width of the carton. A carton exiting from the machine's erecting section encounters the slightly angled portion of table 90 and progresses forwardly to the horizontal portion of table 90 without encountering any difficulty due to the differences in height between tables 10 and 90.

When an article is to be packaged in a large size carton, certain adjustments must be made in the erecting section of the machine to compensate for the increased length of the carton blank's side flap 30 which provides the carton with its greater depth. The roll-over cams 32, 34 and 36, the guideway 62, the guide rails 64 and the forming bar 26 must be replaced or adjusted to accommodate the larger size bumpers. After these adjustments have been made, the large size carton blank progresses along the erecting section of the machine during the

formation of its bumpers in the same manner as a normal size carton.

If the filling section of the machine is retained at the raised level used for normal size cartons, the large size carton would interfere with the closing ploughs **120** which face the filling section of the machine and which form part of the carton-stacking cage **122**. Although the closing ploughs **120** which face the filling section of the machine are shown cut away in FIG. 11 in order to illustrate another feature of the invention, they extend the length of the other closing ploughs **121** which form the rest of the carton-stacking cage **122**. In order to overcome this interference problem, it is necessary to lower the operating surface of the machine's filling section to the position which is illustrated in FIG. 11. In this position, the large size carton **123** fits beneath the carton-stacking cage **122** so that there need not be any overhead adjustments when a large size carton is used. Since the erecting section table **10** is the same height as the filling section table **90** when it is adjusted for a large size carton, there is a smooth transmission of the large size carton between the machine's erecting and filling sections.

As illustrated in FIG. 1*b*, the carton blank **12** progresses along the length of the filling section of the machine to beneath the carton-stacking cage **122**. Glue guns **124** and **126** (FIG. 11) are positioned on each side of the machine's filling section so that they are in wiping contact with the turned-up rearward and leading edges **94** of the carton blank **12**. As the carton blank **12** progresses along the filling section of the machine past the glue guns, a strip of glue is deposited on the outer surface of the rearward and forward edges **94** of the carton.

One of the advantages of the vertical adjustability feature of the filling section of the machine is that the glue guns **124** and **126** need not be vertically adjusted for differences in the thicknesses of various size cartons. These differences are compensated for by adjusting table **92**. As illustrated in FIG. 11, the glue gun **126** is positioned higher than the glue gun **124**. This permits easier opening of the packaged carton by the user by providing an unglued portion of the carton cover flap which may be easily grasped and torn open.

After the gluing operation, the carton blank **12** continues forwardly along the machine's filling section until the carton is positioned directly beneath the carton-stacking cage **122**. The exact positioning of the carton is accomplished by timing the intermittent travel of the drive chains **75** and **76** so that when the carton blank **12** is positioned directly beneath the carton-stacking cage **122**, the drive chains stop.

As illustrated in FIG. 1*b*, a stack of carton tops **13** is positioned in a hopper or other suitable dispenser directly in line with the carton-stacking cage **122**. The movement of a carton top **13** to a position directly over the carton blank **12** is provided by drive chains **140** which are connected by a right angle drive or similar device to the drive chains **76** in the machines erecting section. Accordingly, the intermittent motion of the machine's filling section is transferred to the drive chains **140**.

Each of the carton tops **13** in FIG. 1*b* is pulled out from the bottom of the hopper (not shown) holding the stack of carton tops by a conventional suction puller composed of a timed vacuum pump with suction cups. The actuation of the vacuum pump is timed to synchronize with the intermittent motion of the filling section's drive chains. The suction cups engage the bottom surface of a carton top **13**, pull it down from the hopper and deposit it on a horizontal table from which it is pushed forwardly to the carton-stacking cage **122** by a flight attached to the drive chains **140**. As the carton top **13** progresses forwardly along the drive chains **140**, glue guns **142** positioned on either side of the drive chains deposit strips of glue on the bottom surface of the carton top's end flaps **15**. The flight which pushes the carton top into the carton-stacking cage **122** is the same as and operates similarly to flight **24** in the machine's erecting section.

Referring again to FIG. 11, a stop plate **144** is attached to supporting plate **146**. The stop plate ensures that the carton top **13** is positioned directly above the carton blank **12**. The carton top **13** progresses along guide rails **148** as it enters the carton-stacking cage **122**. The movement of carton blank **12** and carton top **13** into position beneath the carton-stacking cage is synchronized so that the top and blank reach the position beneath the cage at exactly the same time.

(c) Closing section

The filled carton blank **12** is now ready for closing. Referring to FIG. 12, filled carton blank **12** is positioned directly beneath the carton-stacking cage **122**. Carton top **13** is positioned directly above the filled carton blank **12**. Cartons in various stages of closing in the carton-stacking cage are designated **19**, **21**, and **23**. At this moment, the drive chains in the filling section of the machine stop and the piston pusher **150** is actuated. The movement of the piston pusher **150** is synchronized with the inserting of the article into the carton blank in the filling section of the machine. The pusher **150** engages the bottom surface of the carton blank **12** and pushes the filled carton upwardly so as to engage carton top **13**. As the filled carton blank **12** rises, the carton top's end flaps **15** engage the curved closing ploughs **120** and **121** (FIG. 10) which bend the end flaps into engagement with the sides of the carton's tubular bumpers.

The piston pusher **150** pushes the closed carton upwardly until it passes the camming elements **154** which are pivotally mounted on the inside of the carton-stacking cage. Once the carton **12** has been pushed past the cams **154**, the cams pivot downwardly so as to hold the carton in the position illustrated by carton **23**. As a carton progresses further upwardly in the carton-stacking cage as a result of being pushed from beneath by the following carton to be closed, a greater pressure is applied to the sides of the carton to ensure that the end flaps of the carton are sealed to the side walls of the carton. This is produced by slightly angling the closing ploughs **120** and **121** so that the perimeter of the carton-stacking cage **122** tapers slightly from the bottom to the top. The packaged and glued cartons remain in the carton-stacking cage a sufficient time to permit the glue to dry and set.

The flights **77** and **78** are hinged at the top so that when the carton **12** is pushed upwardly, the hinges open providing no resistance to the carton's upward movement. When the movement of the drive chains begins again, the angle cams **80** run off their respective angled tracks **82** and **83**, travel around the underside of the machine's filling section and back to the position illustrated in FIG. 10. Referring again to FIG. 1*b*, a continually moving conveyor belt **170** has a flight attached to it which pushes the cartons coming out of the cage down a chute **172** for delivery.

(II) FIRST ALTERNATE EMBODIMENT

Referring now to FIG. 13, an alternate embodiment of the automatic carton erecting and packaging machine of this invention is illustrated. In the preferred embodiment, the operation of the machine is described on a double blank carton; in this embodiment, the operation of the machine on a single blank carton is described.

As previously mentioned, in a single blank carton the carton top is integral with the lower carton blank. Accordingly, there is no need in this operation for the separate conveying of carton tops into engagement with corresponding lower carton blanks. Furthermore, the only adjustment that must be made in the erecting section of the machine to accommodate the single blank carton is the longitudinal distance between the flights **24**. The flights **24** should be spaced approximately twice as far

apart as when a double blank carton is being operated on. The formation of tubular bumpers on the single blank carton and the inserting of an article to be packaged into the open carton also proceed the same as with a double blank carton, as described above. Accordingly, those features of the alternate embodiment of this invention designated by primed numerals respond to the same description as, and are the same as, those features in the preferred embodiment designated by corresponding numerals.

The major difference when operating on a single blank carton **113** is the addition of a top closing plough **200** onto the filling section of the machine, as illustrated in FIG. 13. Also, the closing plough **92'** on each side of table **90'** is lengthened so that the forward and rearward edges of carton blank **113** are raised from a horizontal position to a vertical position a short distance after the insertion of the article **66'** into the carton blank. As the closing plough **92'** engages the rearward edge of carton blank **113**, the top closing plough **200** engages the top of the carton blank and progessively forces it over the carton blank as the blank proceeds forwardly along the machine's filling section.

A glue gun **126'** is supported on the table **90'** above curved plough **92'**. As the carton blank **113** proceeds past the glue gun in wiping engagement, strips of glue are applied to the outer surface of the blank's forward edge. When the carton blank **113** is in position beneath the carbon-stacking cage **122'**, the drive chains **75'** and **76'** stop and the piston pusher forces the carton blank upwardly into engagement with the closing ploughs **121'** which close edge **115** of the carton over the carton's glued surface.

As in the description of the preferred embodiment, each succeeding carton pushes the preceding carton higher in the carton-stacking cage **122'** until the carton **113** reaches the top of the cage from which it is pushed to chute **172'** by drive chain **170'**.

(III) SECOND ALTERNATE EMBODIMENT

Referring now to FIGS. 15 and 16, an alternate embodiment of the book inserting mechanism of this invention is described. In the preferred embodiment, the book inserting mechanism is positioned perpendicular to the path of the carton in the machine's filling section and in line with the approaching carton blank in the machine's erecting section. In this embodiment, the article inserting mechanism is positioned at the end of the erecting section of the machine. Since many of the features of the preferred embodiment are the same as those in this embodiment, those features of the embodiment designated in FIGS. 15 and 16 by primed numerals correspond to the same description as and are the same as, those features in the preferred embodiment designated by corresponding numerals.

Referring now to FIG. 15, a hopper **210** filled with articles **66'** to be packaged is positioned at the end of the machine's erecting section. Articles **66'** are fed into the hopper **210** either manually or by a machine from the right, as indicated by the arrow in FIG. 15. The width of the hopper **210** at its base **208** corresponds to the inner width of the carton blank **12'** being operated on by the machine. The hopper base **208** is tapered along its length so as to engage the inner surface of the bumper **30'** which has been tilted outwardly by guideway **64'**. In this way, the bumpers are held spread apart during the insertion of the article **66'** as in the preferred embodiment.

Referring now to FIGS. 15 and 16, a book positioning flight **212** is attached to the two power chains **14'**. As in the preferred embodiment, the positioning flight **212** is collapsibly mounted on the power chains **14'** by angle cams **68'**. Each angle cam **68'** engages a rail **220** which is level along the length of the machine's erecting section and which slopes downwardly as the carton blank approaches the perpendicularly extending drive chains **75'** and **76'**. As the angle cam **68'** runs off the rail **220**, the positioning flight **212** collapses downwardly, as indicated in dotted lines on the righthand side of FIG. 16. The downward slope in the rail **220** is arranged so that the flight **212** collapses downwardly when the filled carton blank **12'** is completely positioned on power chains **75'** and **76'** in flights **77'** and **78'** respectively. A counterweight **218** which is attached to the flight **212** by a lever arm **216** causes the flight to collapse downwardly when angle cam **68'** runs off rail **220**.

The positioning flight **212** is composed of a lower section **214** and an upper section **213** which is mounted atop the lower section. The lever arm **216'** is connected to the flight's lower section **214**. The flight's lower section **214** cooperates with the lower part of the upper section **213** to provide a surface for pushing the carton blank's rearward edge **94'** forwardly. The upper part of the flight's upper section **213** extends forwardly from its lower part to engage the article **66'** to be packaged and push it outwardly from hopper **210**. The horizontal distance between the upper and lower engaging surfaces of the flight's upper section **213** is approximately equivalent to the length of the carton blank's rearward edge **94'**. Thus, the flight **212** does not begin pushing the article **66'** out of the hopper **210'** until the article is positioned directly over the carton blank **12'**. In this way, the article is not pushed onto the forward or rearward end flaps **94'** of the carton blank.

In operation, positioning flight **212** is progressing forwardly with drive chains **14** and pushing carton blank **12'** by engaging its rearward edge **94'**. As the flight **212** approaches hopper **210**, the upper part of the flight's upper section **213** engages an article **66'** and progressively pushes it outwardly from hopper **210** onto the carton blank **12'**. As the article **66'** is being pushed outwardly, the following article **66** to be packaged assumes the position of its predecessor in the hopper **210**. When the carton blank **12'** is positioned on drive chains **75'** and **76'**, each angle cam **68'** runs off the rail **220** and the flight **212** collapses downwardly. This prevents the filled carton blank **12'** from being pushed off the drive chains **75'** and **76'**.

When the book inserting mechanism of the second alternate embodiment of this machine is used, it is not necessary for the movement of the drive chains **75'** and **76'** to be intermittent, since the book inserting operation takes place in the machine's erecting section. Accordingly, the movement of drive chains **75'** and **76'** is continuous and driver axle **84'** is connected to driver axle **40'** which extends the length of the machine's erecting section. This speeds up the carton erecting, filling and closing process and permits the machine to handle sixty to seventy cartons per minute.

While embodiments of various aspects of the invention have been shown in the drawings, it is to be understood that this disclosure is for the purpose of illustration only and that various changes in shape, proportion and arrangement of parts, as well as the substitution of equivalent elements for those herein shown and described, may be made without departing from the spirit and scope of the invention as set forth in the appended claims.

I claim:

What is claimed is:

1. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular rectangular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, said bumper forming means comprising support means,

first folding means pivotally mounted on said support means and positioned so as to engage the carton blank side flap in line contact when the carton blank is transported past said first folding means, a bar mounted inwardly of said side flap from said first folding means on said support means and positioned so that the carton blank side flap is bent over said bar by said first folding means when the carton blank is transported past said first folding means, second folding means pivotally mounted on said support means rearward of said folding means and positioned so as to engage in line contact the carton blank side flap which has been partially formed into a tubular bumper by said first folding means, when the carton blank is transported past said second folding means, and third folding means pivotally mounted on said support means rearward of said second folding means and positioned to engage in line contact the carton blank side flap, which has been further formed into a tubular bumper by said second folding means, when the carton blank is transported past said third folding means.

2. The combination recited in claim 1 wherein said folding means comprises a generally C-shaped cam pivotally mounted to said support means.

3. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, said bumper forming means comprising support means, folding means pivotally mounted on said support means and positioned so as to engage the carton blank side flap in line contact when the carton blank is transported past said folding means, a bar mounted inwardly of said side flap from said folding means on said support means and positioned so that the carton blank side flap is bent over said bar by said folding means when the carton blank is transported past said folding means, said bar being generally in the shape of a parallelogram and being inclined at an angle of approximately 60° with the bottom of the carton blank when the blank is transported past said bar.

4. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, said bumper forming means comprising support means, folding means pivotally mounted on said support means and positioned so as to engage the carton blank side flap in line contact when the carton blank is transported past said folding means, a bar mounted inwardly of said side flap from said folding means on said support means and positioned so that the carton blank side flap is bent over said bar by said folding means when the carton blank is transported past said folding means, and

means for actuating said folding means into engagement with the carton blank side flap to fold said flap against said bar according to a pre-selected folding pattern.

5. The combination recited in claim 4 wherein said actuating means comprises a first shaft which is rotatably mounted on said support means, means attached to said folding means for converting the rotary motion of said first shaft to back and forth pivotal motion of said folding means.

6. The combination recited in claim 5 further comprising carton transporting means which comprises a second shaft that imparts rotary motion to said first shaft.

7. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, said bumper forming means comprising support means, folding means pivotally mounted on said support means and positioned so as to engage the carton blank side flap in line contact when the carton blank is transported past said folding means, a bar mounted inwardly of said side flap from said folding means on said support means and positioned so that the carton blank side flap is bent over said bar by said folding means when the carton blank is transported past said folding means, and a second bar being generally triangular in cross-section and being mounted on the inward face of said first bar so as to engage the carton blank side flap as it is bent over said first and second bars by said folding means.

8. The combination recited in claim 7 wherein said second bar tapers from its center so as to form diminishing cross-sectional areas proceeding from the center to either end.

9. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, said bumper forming means comprising support means, first folding means pivotally mounted on said support means and positioned so as to engage the carton blank side flap in line contact when the carton blank is transported past said first folding means, a bar mounted inwardly of said side flap from said first folding means on said support means and positioned so that the carton blank side flap is bent over said bar by said first folding means when the carton blank is transported past said first folding means, and second folding means pivotally mounted on said support means rearward of said first folding means and positioned so as to engage in line contact the carton blank side flap, which has been partially formed into a tubular bumper by said first folding means, when the carton blank is transported past said second folding means, said second folding means pivotal point being positioned on said support means above said first folding means pivotal point relative to the bottom of the carton being folded in order that said second folding means may begin pivoting downwardly at a point where

said first folding means finishes pivoting downwardly.

10. The combination recited in claim 9 further comprising a third folding means which is pivotally mounted on said support means rearward of said second folding means and positioned to engage in line contact the carton blank side flap, which has been further formed into a tubular bumper by said second folding means, when the carton blank is transported past said third folding means.

11. The combination recited in claim 10 wherein said third folding means pivotal point is positioned above said second folding means pivotal point on said support means in order that said third folding means may begin pivoting downwardly at a point where said second folding means finished pivoting downwardly.

12. The combination recited in claim 10 wherein said first bar extends along said support means from said first folding means to said third folding means.

13. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, and

means for inserting the article to be packaged into the carton blank, said article inserting means comprising a first conveyor, a flight attached to said conveyor, said flight having an upper and lower portion, said flight upper portion extending outwardly from said flight lower portion wherein said flight lower portion is for engaging the rearward edge of a carton blank and said flight upper portion is for engaging the article to be packaged and inserting it into the carton blank inwardly from the forward and rearward edges of the carton blank, said article inserting means further comprising a hopper for stacking the articles to be packaged and adapted to discharge a single article through its base, said hopper being positioned directly above the path of travel of said conveyor, said hopper having a central opening in the path of travel of said flight which permits said flight upper portion to engage the article to be packaged without interference from said hopper.

14. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, and

means for inserting the article to be packaged into the carton blank, said article inserting means comprising a first conveyor, a flight attached to said conveyor, said flight having an upper and lower portion, said flight upper portion extending outwardly from said flight lower portion wherein said flight lower portion is for engaging the rearward edge of a carton blank and said flight upper portion is for engaging the article to be packaged and inserting it into the carton blank inwardly from the forward and rearward edges of the carton blank, said tubular bumper forming means being positioned along said first conveyor and further comprising a hopper for stacking the articles to be packaged and adapted to discharge a single article through its base, said hopper being positioned rearwardly of said tubular bumper forming means along said conveyor, said hopper base being tapered downwardly so that the outwardly facing sides of said hopper base engage and spread apart the carton blank tubular bumpers to facilitate the insertion of the article to be packaged into the carton blank.

15. The combination recited in claim 4 wherein said transporting means comprises a first conveyor, a flight which is mounted on said first conveyor for engaging the rearward edge of the carton blank and a first table positioned on each side of said first conveyor for supporting the carton blank.

16. The combination recited in claim 15 wherein said transporting means further comprises a second conveyor which is positioned perpendicular to said first conveyor, a second flight which is mounted on said second conveyor for engaging the rear tubular bumper which is formed from the carton blank side flap and a second table positioned on each side of said second conveyor for supporting the carton blank.

17. The combination recited in claim 16 wherein said transporting means further comprises a piston extending perpendicular to the plane formed by the intersection of said first and second conveyors for engaging the carton blank bottom side and pushing the carton upwardly.

18. A automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection of the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, and

means for spreading apart the carton blank tubular bumpers in order to facilitate the insertion of the article to be packaged into the carton blank, said bumper spreading means comprising support means, a second guideway attached to said support means, said second guideway being twisted from an initially erect position to a tilted position in order to engage the tubular bumper formed from the carton blank side flap and tilt it outwardly for the easy insertion of the article to be packaged, said bumper spreading means further comprising a second support means, an L-shaped flight attached to said second support means and positioned directly adjacent said second guideway in order to engage the tubular bumper formed from the carton blank side flap as the carton blank moves from said first to said second support means.

19. An automatic carton erecting and packaging machine for use with an unerected carton into which an article is to be packaged, the carton blank having a bottom, forward and rearward edges, side flaps and a top, comprising:

means for transporting the carton blank through the carton erecting and packaging machine and

means for forming a tubular bumper from each of the carton blank side flaps to provide protection for the packaged article, said bumper forming means engaging said carton blank by line contact engagement with each carton blank side flap, and

means for closing the carton blank, comprising a piston which normally extends vertically so as to engage the bottom side of the carton blank and push the carton blank upwardly into engagement with a carton top which is positioned directly above the carton blank and a cage formed by vertically extending bars arranged to correspond to the approximate cross-sectional area of the carton blank, said cage being

positioned directly over said piston so that the upward thrust of said piston forces the carton blank into said cage.

20. The combination recited in claim **19** wherein said bars are flared outwardly at their bottom ends so as to force the edges of the carton blank top into engagement with the sides of the carton blank and wherein said cage tapers in cross-sectional area from the bottom in order to increase the pressure of the sides of the carton blank as it moves upwardly in said cage.

21. The combination recited in claim **19** further comprising means to adapt the automatic carton erecting and packaging machine to cartons of varying depths.

22. The combination recited in claim **21** wherein said carton depth adapting means comprise a conveyor for transporting the carton blank toward said carton blank closing means, a table coextensive with said conveyor upon which the carton blank is supported as it is transported toward said carton blank closing means, said table being vertically adjustable so that said carton blank closing means need not be adjusted for various carton blank depths.

23. Apparatus for forming tubular rectangular bumpers on a carton blank having side flaps and rearward and forward edges, comprising

a conveyor for transporting the carton blank from a first to a second position; support means positioned on said conveyor,

a plurality of C-shaped cams spaced along the length of said conveyor and sequentially actuated into line contact engagement with the carton blank side flaps,

a first bar mounted inwardly of said side flap from said C-shaped cams on said support means and positioned so that the carton blank side flap is bent over said bar by said C-shaped cams, and

a second bar being generally triangular in cross-section and being mounted on the inward face of said first bar so as to engage the carton blank side flap as it is bent over said first and second bars by said C-shaped cams.

24. Apparatus for inserting and positioning an article to be packaged into a carton blank having rearward and forward edges comprising

a conveyor for transporting the carton blank from a first to a second position;

a hopper for dispensing the article to be packaged positioned above said conveyor; and a flight attached to said conveyor having upper and lower portions; said flight lower portion for engaging the carton blank rearward edge and said flight upper portion extending outwardly from said flight lower portion for engaging the article in said hopper and inserting it into the carton blank inwardly from the forward and rearward edges of the carton blank, said flight upper portion extending outwardly from said flight lower portion a length equal to the length of the carton blank rearward edge, said hopper having a central opening in the path of travel of said flight which permits said flight upper portion to engage the article to be packaged without interference from said hopper.

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U.S. Cl. X.R.

53—185, 209, 287, 387; 93—52