United States Patent [19]

Sawada

[11] **3,797,370**

[45] **Mar. 19, 1974**

[54] **AUTOMATIC CARTON BOX FABRICATING APPARATUS**

[76] Inventor: **Tetsuya Sawada,** No. 35-24, Chiyohara-cho, Katsura, Ukyo-ku, Kyoto, Japan

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[21] Appl. No.: **180,616**

[30] **Foreign Application Priority Data**

Dec. 28, 1970 Japan 45-130132

[52] **U.S. Cl.** ..... **93/51 HW,** 93/49 R, 93/52

[51] **Int. Cl.** **B31b 3/26**

[58] **Field of Search** ..... 93/51 HW, 51 R, 52, 49 R

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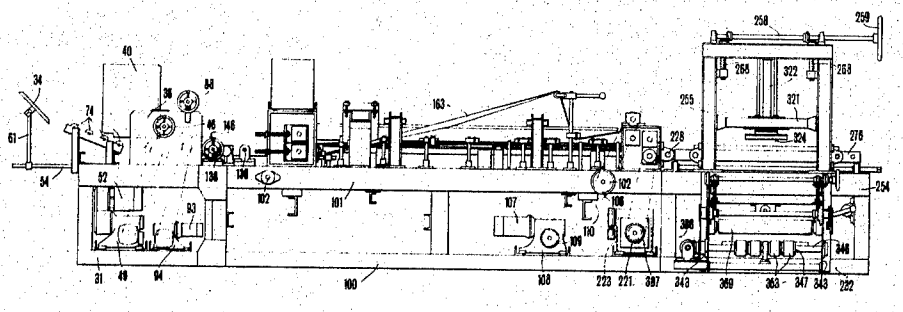
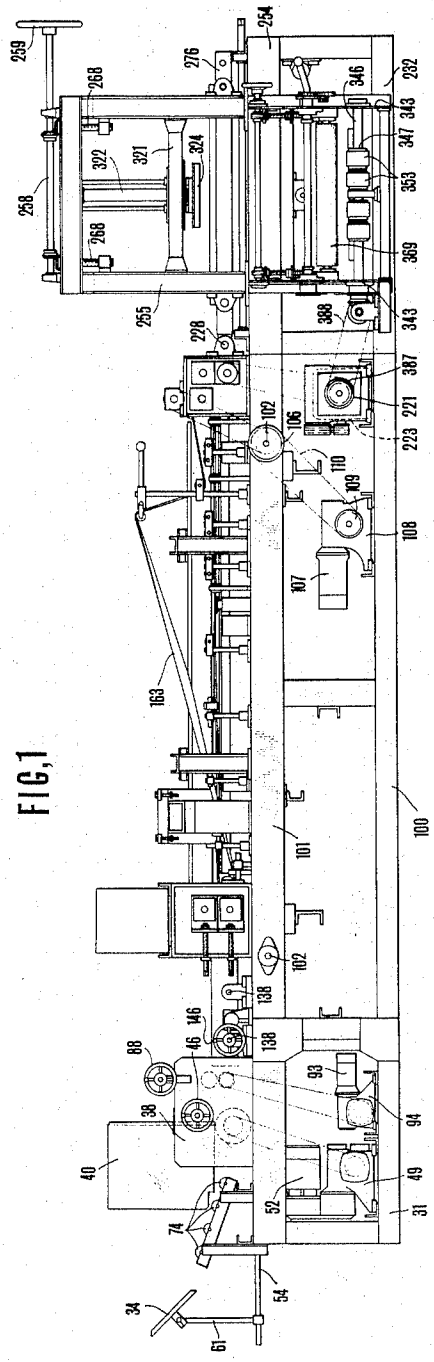
Primary Examiner—Roy Lake
Assistant Examiner—James F. Coan
Attorney, Agent, or Firm—Wenderoth, Lind & Ponack

[57] **ABSTRACT**

An automatic carton box fabricating apparatus. The apparatus has upper and lower endless feed belts conveying blanks supplied one by one therebetween. The endless belts support the lower portions of the parts of the blanks inside the creases on both side walls thereof. Guide members press the upper portions of the parts of both side walls similarly inside the creases thereof, and folding belts fold the portions of both side walls outside the creases thereof over the guide members during the advancement of the blank. A pressing plate presses down the bottom of the blank after the blank stops in a stopping position. At this point the side walls of the blank have been folded double by the guide members and folding belts. Guide rods bending upwards pieces provided on the ends of both side walls when the blank is pressed down by the pressing plate. Guide members also bending upwards both side walls after each of the pieces is bent upwards similarly during descent of the blank, and guide members also bend upwards both end walls after both side walls are bent upwards during descending of the blank plate. A receiving plate receives the carton made from the blank, supporting the bottom of the blank as it descends under the force of the pressing plate before the pressing plate reaches its lower limit of movement, and a delivery device carries the carton away to a desired place.

5 Claims, 35 Drawing Figures





FIG,1

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FIG. 2

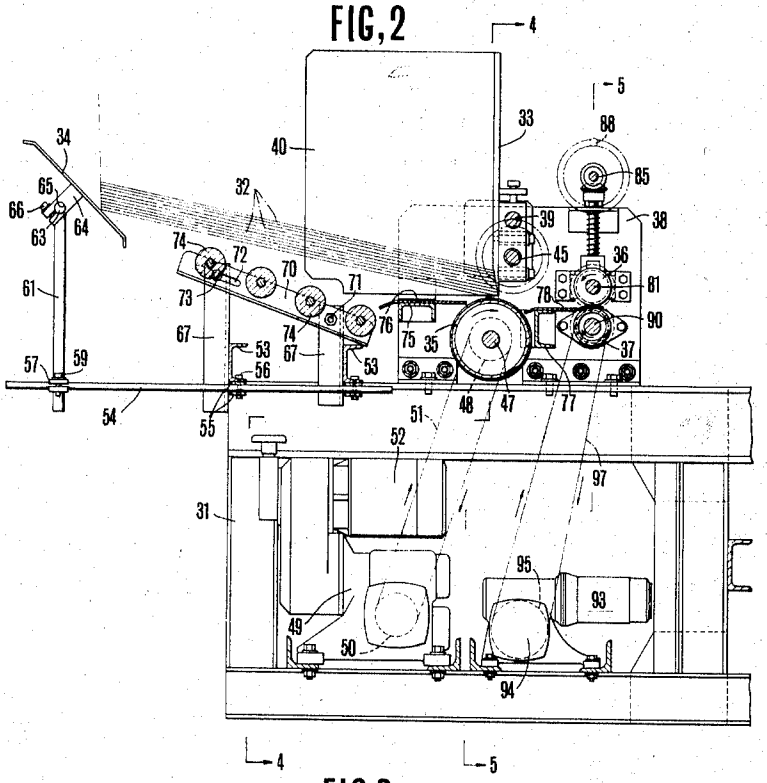
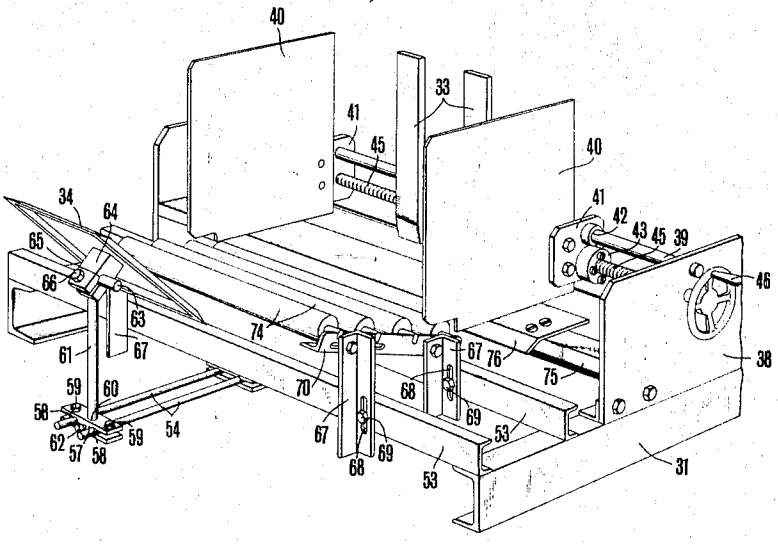


FIG. 3



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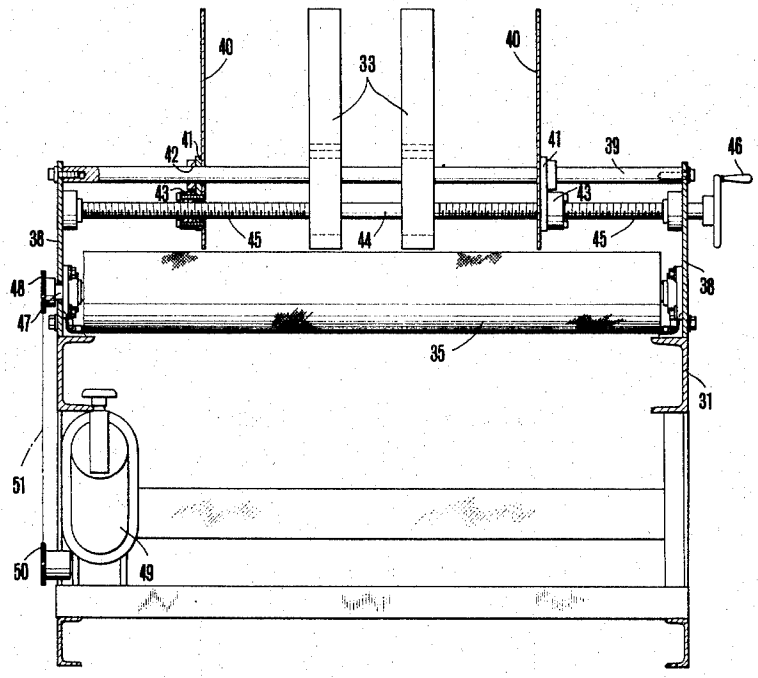
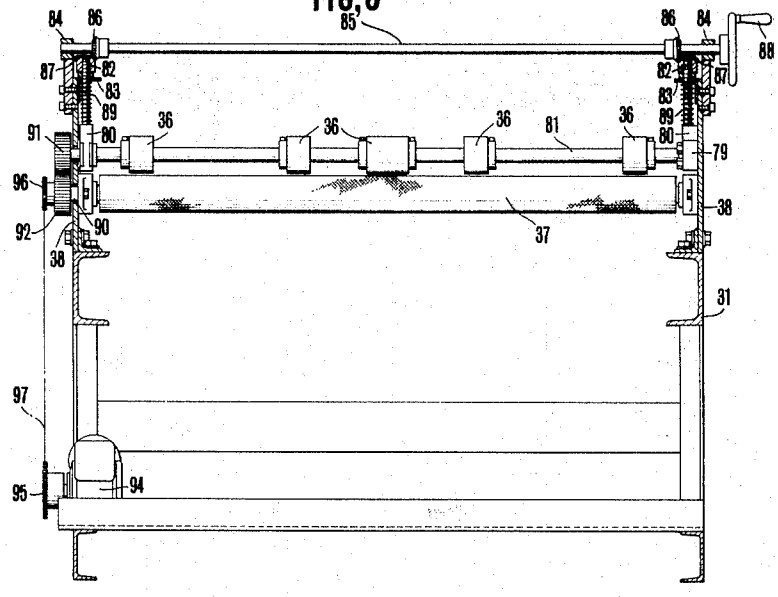
FIG,4



FIG,5



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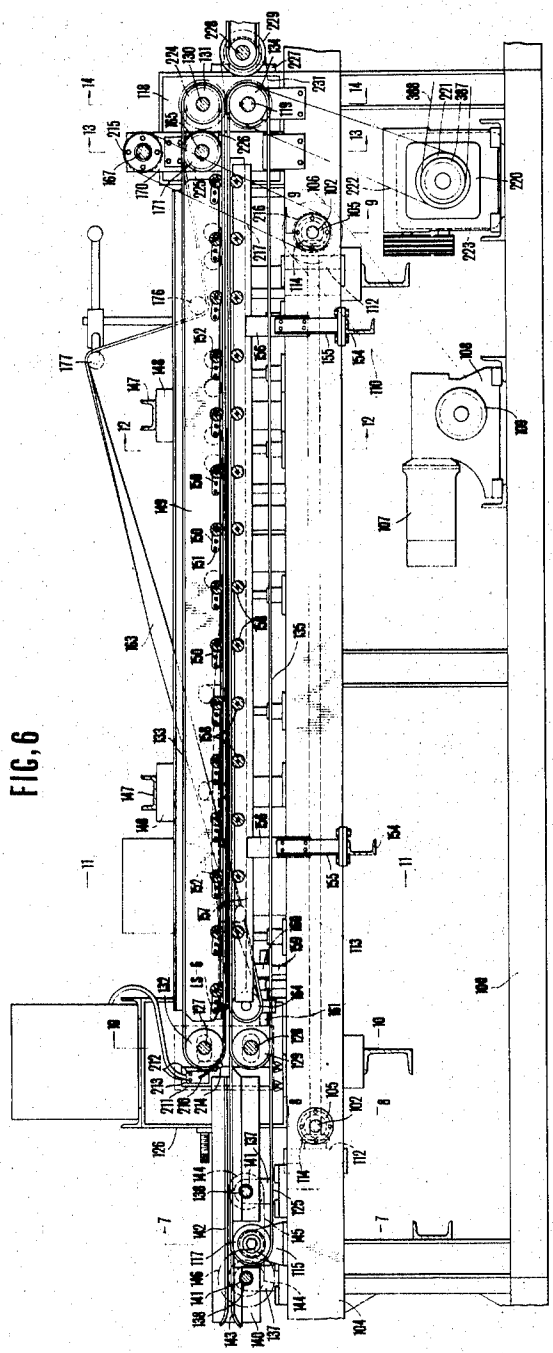

FIG. 6

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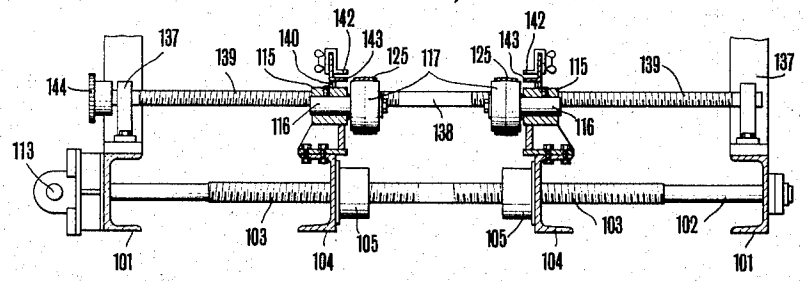
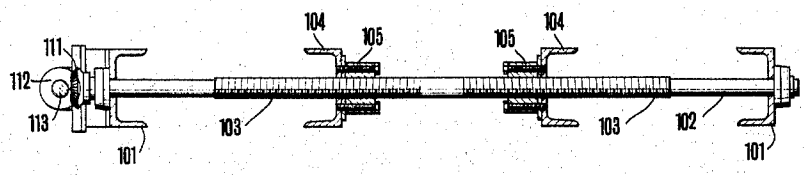
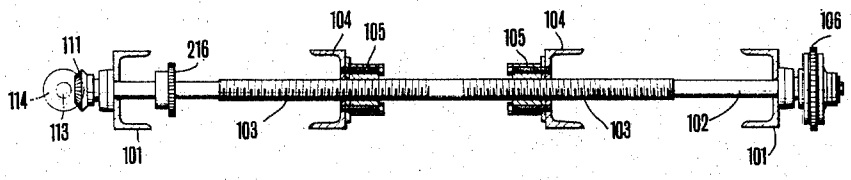
FIG,7



FIG, 8



FIG, 9



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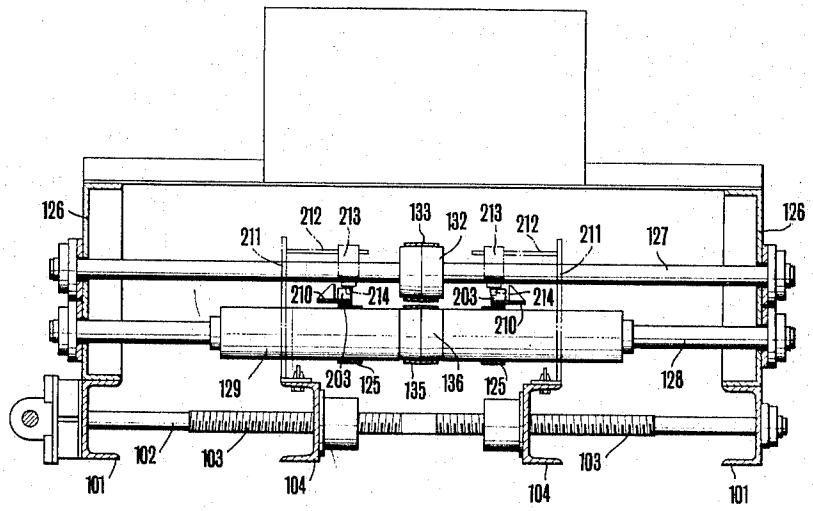
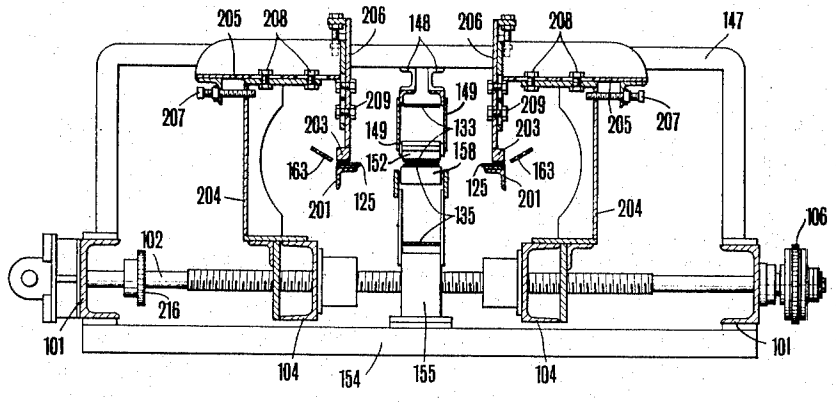
FIG,10



FIG,11



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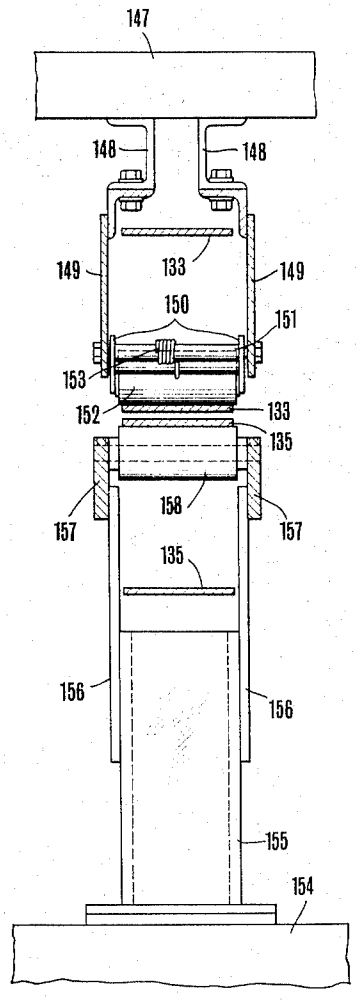
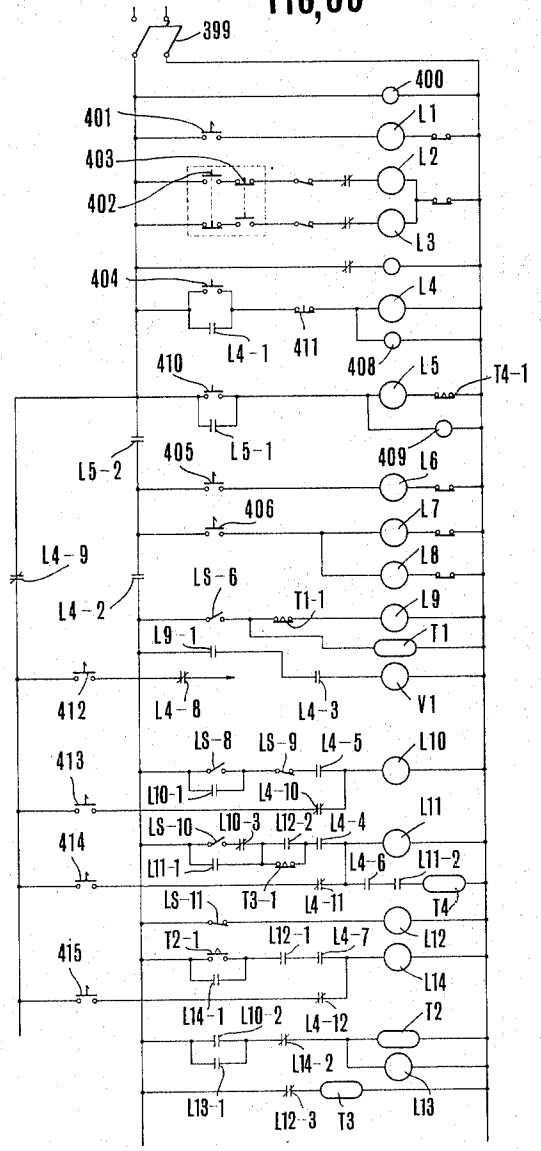
FIG,12



FIG,35



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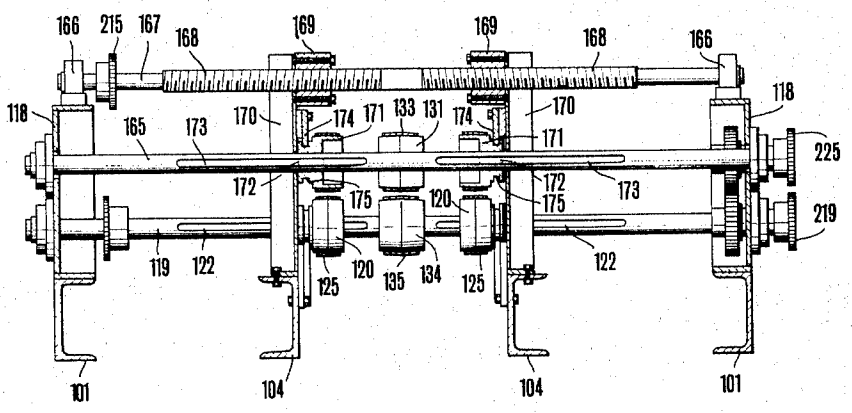
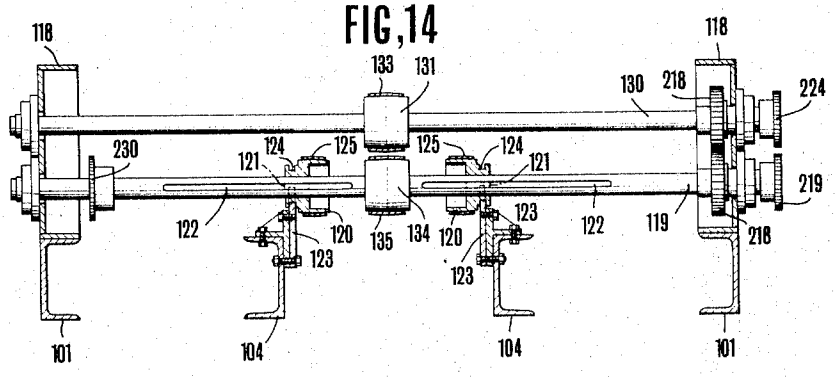
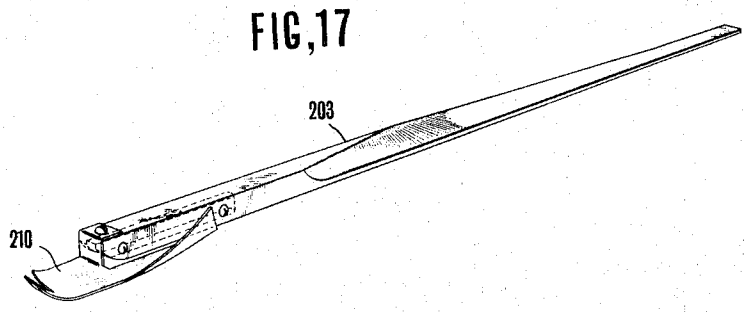
FIG,13



FIG,14



FIG,17



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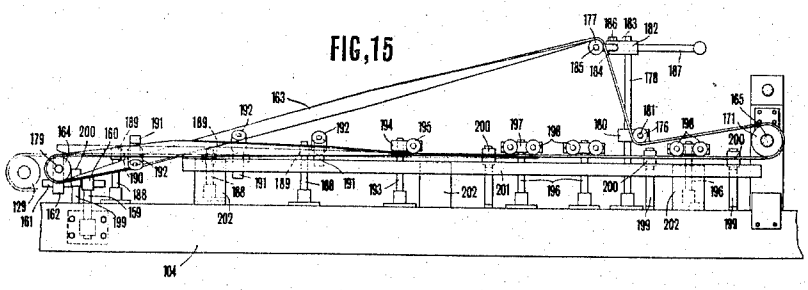
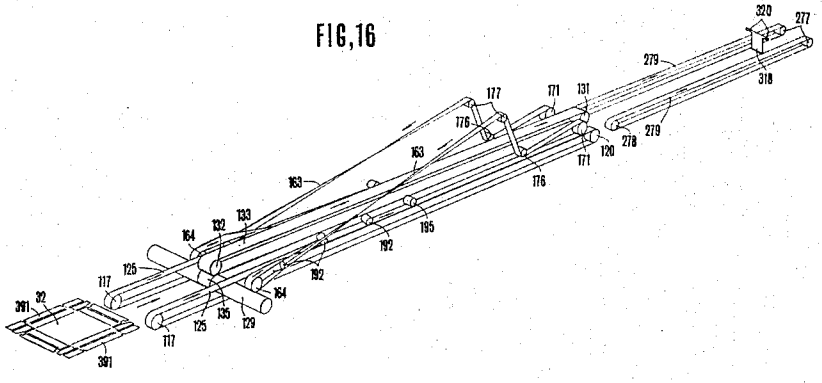
FIG,15



FIG,16



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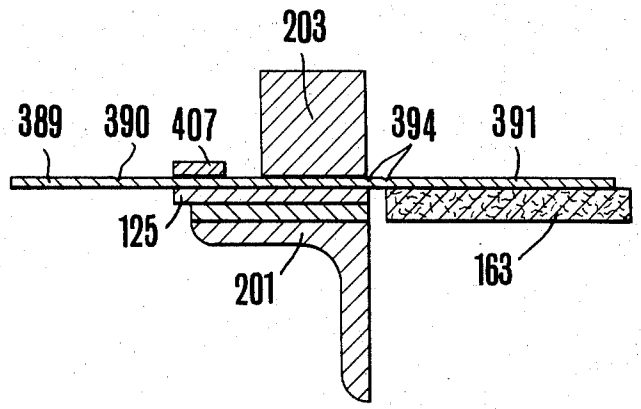
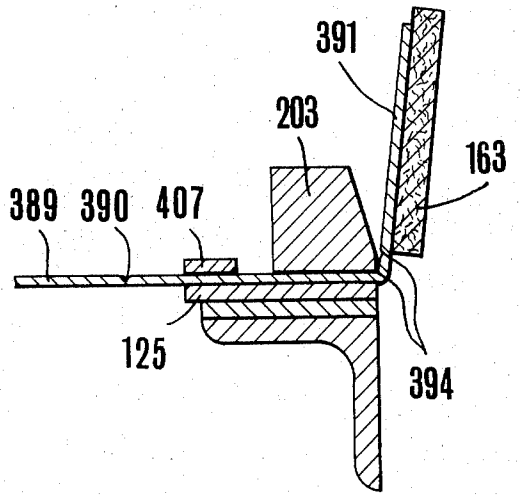
FIG,18



FIG,19



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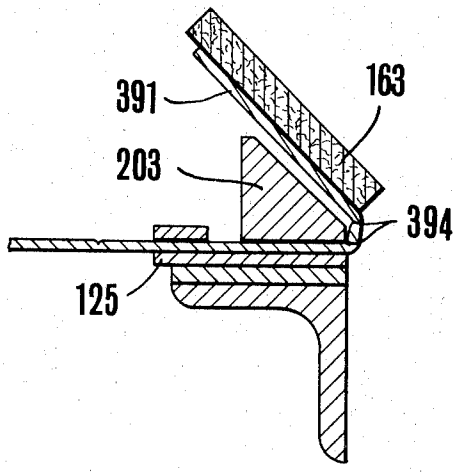
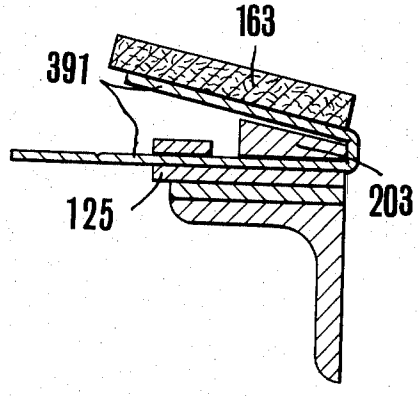
FIG,20



FIG,21



FIG,22

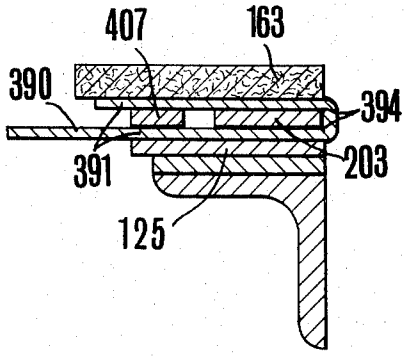


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FIG. 23

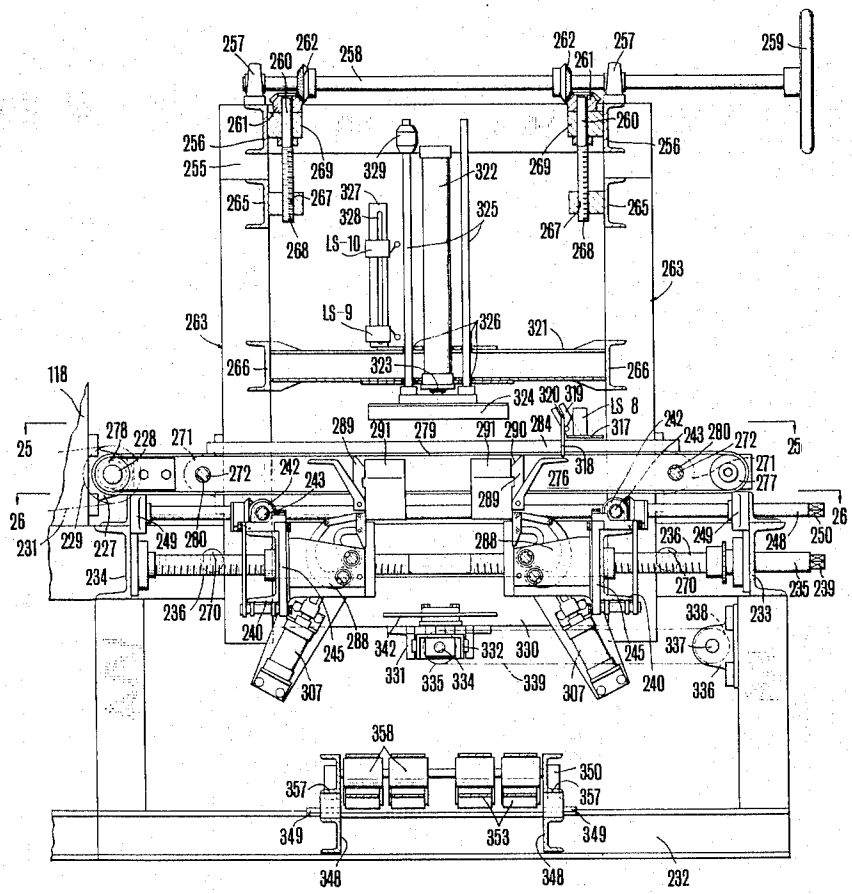

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FIG. 24

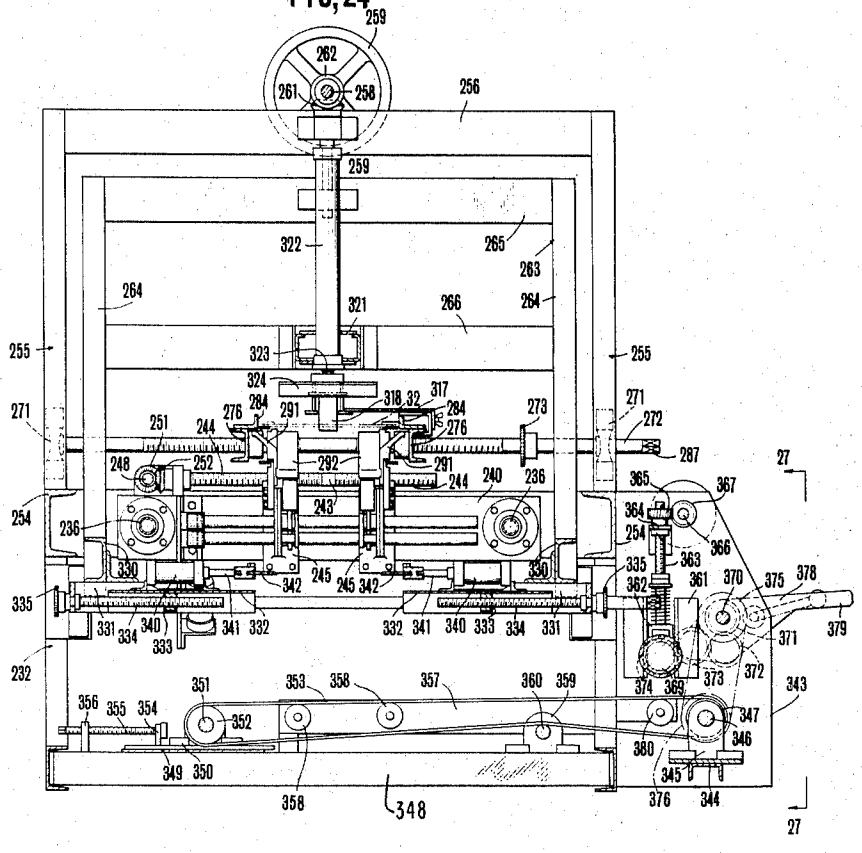

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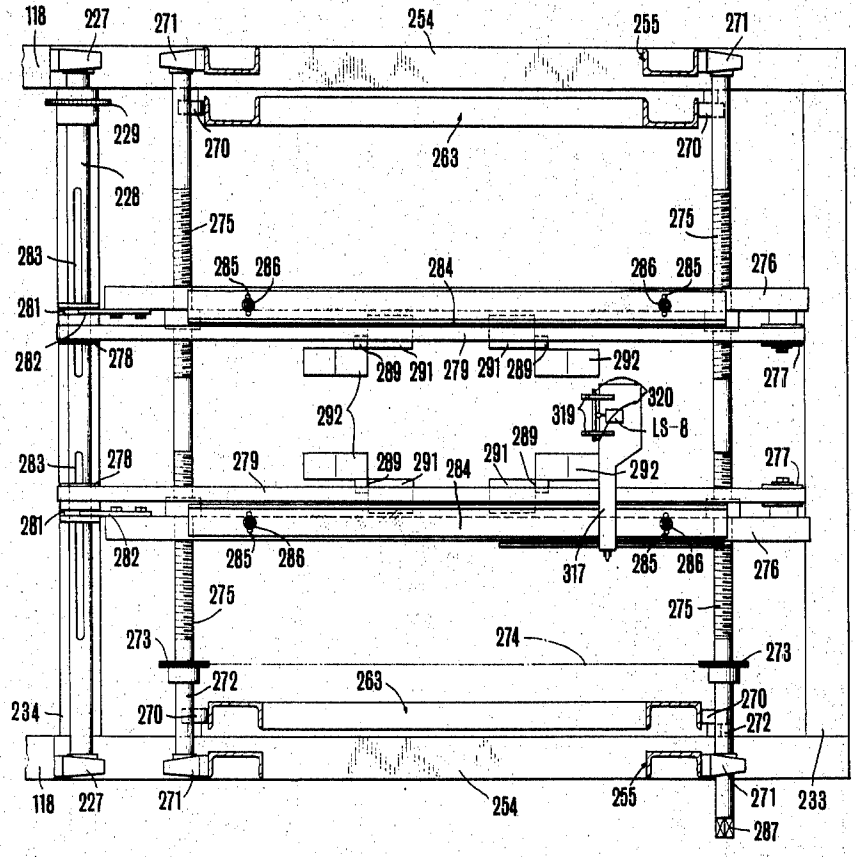
FIG. 25



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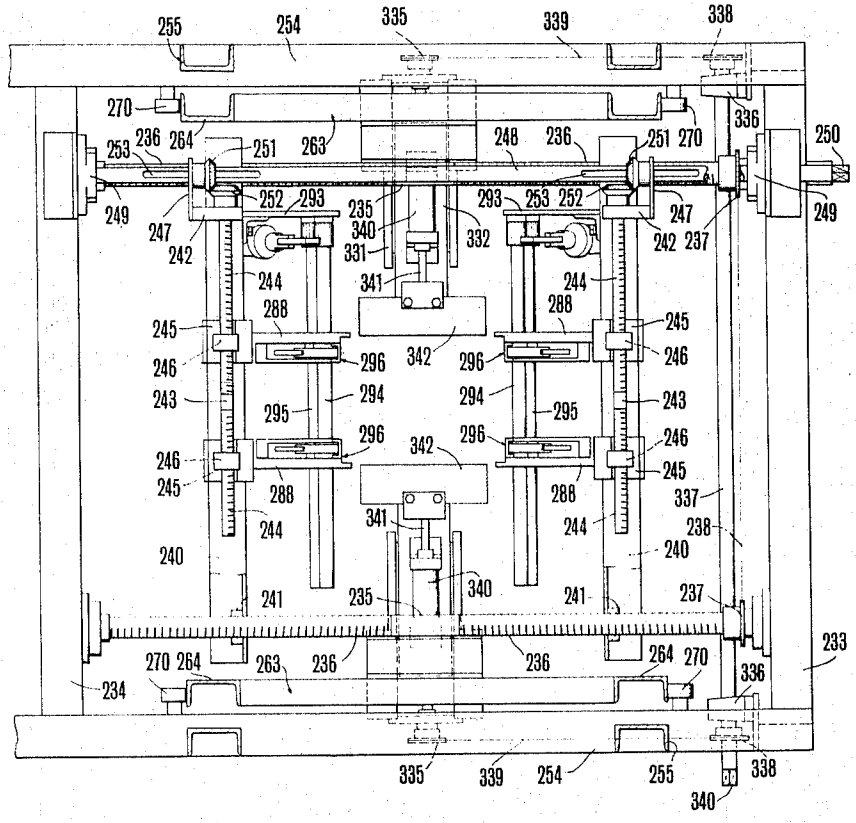
FIG,26



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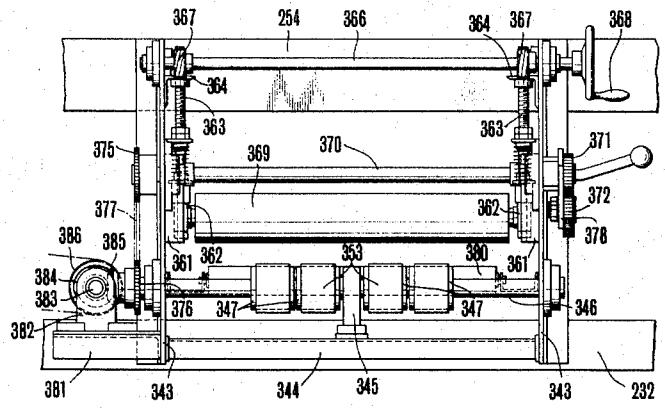
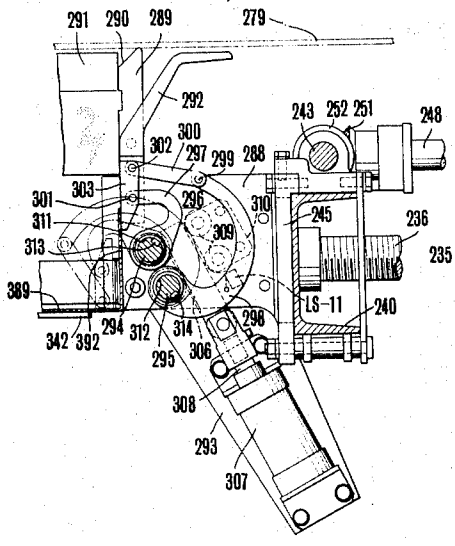
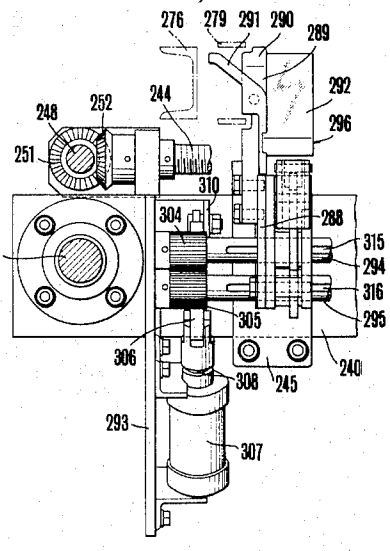
FIG,27



FIG,29



FIG,28



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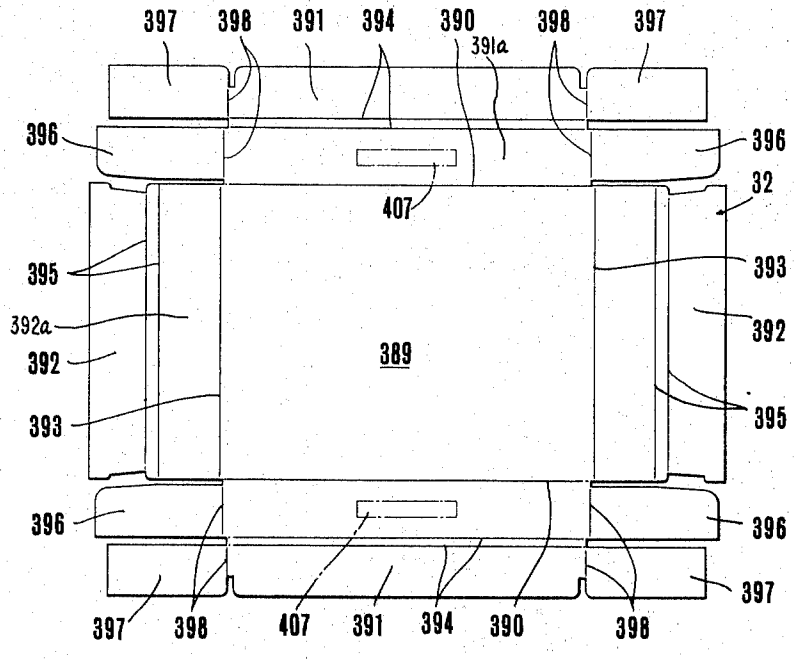
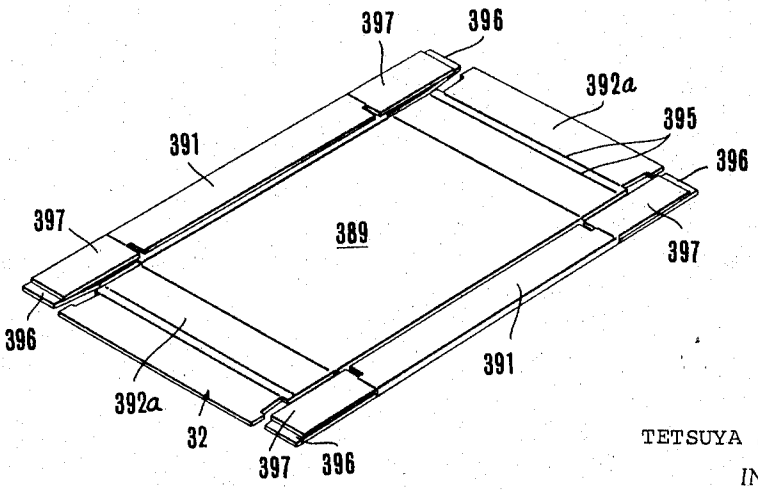
FIG,30



FIG,31



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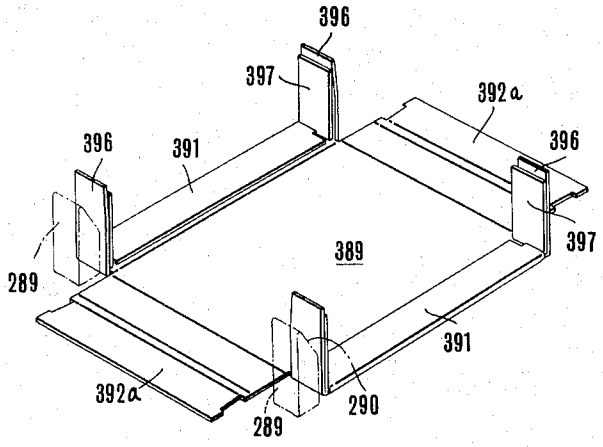
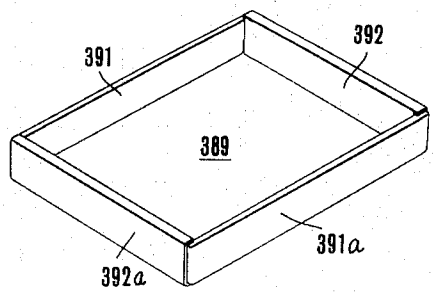
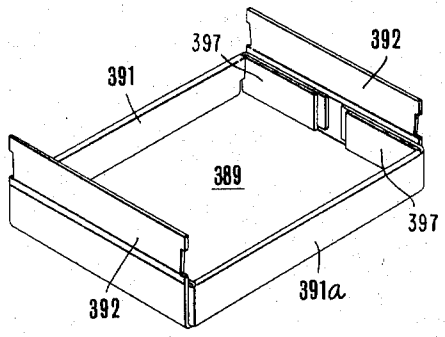
FIG,32



FIG,34



FIG,33



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AUTOMATIC CARTON BOX FABRICATING APPARATUS

This invention relates to an automatic carton fabricating apparatus for blending automatically blanks of paper board such as pasteboard and the like. When fabricating cartons from pasteboard and the like, heretofore, a process has been frequently used, wherein a carton is formed by cutting pasteboard in a suitable shape, and also making a blank with creases in required portions thereof and bending the blank manually into a carton. Also, various devices for automatically bending blanks have been proposed, but most of them are deficient in the efficiency of fabrication of cartons and in the quality of the carton fabricated.

The first object of this invention is to provide an apparatus for fabricating a carton fully automatically from blanks cut previously in a prescribed shape and creased by applying a small amount of bending to a very small portion and bending all the other portions without using any fittings.

The second object of this invention is to provide an apparatus for fabricating fully automatically cartons which are very rigid and which have an accurate shape, the peripheral walls of which are double and around the middle portion of the double wall on both sides of the carton the inner and outer walls thereof are adhered to each other with a bonding agent.

The third object of this invention is to provide an apparatus which has a device for feeding blanks automatically one by one from a pile of blanks and which performs fully automatically the operation of fabricating the carton from the blank plate supplied from the feeding device by bending it correctly in a sequence of steps previously prescribed and delivering a completed carton from a delivery portion.

The fourth object of this invention is to provide an automatic carton fabricating apparatus provided with adjusting device which, for fabricating cartons of different sizes, can simply move the required portions to correspond to the size.

These and other objects are accomplished by the parts, improvements, combinations and arrangements comprising the invention, a preferred embodiment of which is shown by way of example in the accompanying drawings, and herein described in detail.

Various modifications and changes in details of construction are within the scope of the appended claims.

FIG. 1 is a side elevation view of the whole of the carton fabricating apparatus according to this invention.

FIG. 2 is an enlarged, partially longitudinally sectioned side view showing the principal parts of the blank plate supply device.

FIG. 3 is a perspective view of the device of FIG. 2.

FIG. 4 is a longitudinal section on the line 4—4 in FIG. 2.

FIG. 5 is a longitudinal section on the line 5—5 in FIG. 2.

FIG. 6 is a longitudinally sectioned side view of the bending device for bending both side walls of the blank.

FIG. 7 is an enlarged section on the line 7—7 in FIG. 6.

FIG. 8 is an enlarged section on the line 8—8 in FIG. 6.

FIG. 9 is an enlarged section on the line 9—9 in FIG. 6.

FIG. 10 is an enlarged section on the line 10—10 in FIG. 6.

FIG. 11 is an enlarged section on the line 11—11 in FIG. 6.

FIG. 12 is an enlarged section on the line 12—12 in FIG. 6.

FIG. 13 is a section on the line 13—13 in FIG. 6.

FIG. 14 is a section on the line 14—14 in FIG. 6.

FIG. 15 is a side view of the bending belt of said bending device and the supporting device therefore.

FIG. 16 is a perspective view of said bending belt.

FIG. 17 is an enlarged view of a guide member positioned along said bending belt.

FIG. 18 through FIG. 22 are enlarged cross sections showing stages of the bending of the side walls of the blank while being bent by said bending belt and guide member.

FIG. 23 is an enlarged longitudinally sectioned view of the carton forming part of the apparatus.

FIG. 24 is a longitudinally sectioned front view of the part of FIG. 23.

FIG. 25 is a cross-sectioned plan on the line 25—25 in FIG. 23.

FIG. 26 is a cross-sectioned plan on the line 26—26 in FIG. 23.

FIG. 27 is a side view looking in the direction of the arrow 27—27 in FIG. 24.

FIG. 28 is an enlarged front view of the end wall bending part.

FIG. 29 is an enlarged side view of the part of FIG. 28.

FIG. 30 is a plan of the blank.

FIG. 31 through FIG. 34 are perspective views showing the order of steps in the blank plate.

FIG. 35 is the wiring diagram of the controlling circuit.

FIG. 1, a rear frame 31 has a blank supply device thereon. The blank supply device, as shown in FIG. 2, comprises stop plates 33 against which the front end of a pile of blanks 32 is piled, a supporting plate 34 similarly supporting the rear end of the pile of blanks, a delivery roller 35 located below the stop plates 33 and upper and lower feed rollers 36 and 37 in front of the delivery roller 35. The stop plates 33 are fixed near the center of a supporting rod 39 fixed to left and right side plates 38 mounted on the frame 31 at both ends thereof as shown in FIG. 3 and FIG. 4, and are two long vertical pieces. On opposite sides of the stop plates 33 are arranged the side stop plates 40 which engage the two sides of the pile of blanks 32. Guide holes 42 are formed in guide members 41 fixed at the lower front side of the side stop plates 40 for slidably mounting the plates 40 on the supporting rod 39. Threaded sleeves 43 are also mounted on the lower portion of the members 41 and are threaded on left and right hand external threads 45 on a shaft 44 having the ends rotatably mounted in said side plates 38.

The external threads 45 are left and right hand threads, and the threaded sleeves 43 threaded on the external threads are of course left and right hand threaded. Accordingly, when the shaft 44 is turned by a handle 46 at the end of the shaft 44, both the left and right side plates 40 are moved toward or away from each other, depending on the direction of rotation.

The delivery roller 35 is rotatably journaled on the ends of shafts 47 projecting from both ends thereof in bearings on said side plates 38, and also on the periph-

ery of the roller 35 is provided a rubber layer having an uneven surface, and a space is provided between the peripheral surface of the roller 35 and the lower ends of said stop plates to permit a blank to pass therethrough. On the end portion of one shaft 47 is fixed a sprocket 48, and around a sprocket 50 fixed on the output shaft of a reduction gear 49 mounted on the rear of frame 31 and the sprocket 48 is wound an endless transmission chain 51. A motor 52 driving the input shaft of the adjustable reduction gear 49 is mounted on the rear of frame 31.

A pair of front and rear supporting frames 53 are fixed on the rear upper portion of the rear frame 31, and on the bottom of the frames 53 is mounted a pair of left and right longitudinal supporting rods 54 extending to the rear of the rear frame 31. The supporting rods 54 are held between a pair of clamping plates 55 engaging the upper and lower sides of the supporting rods 54 and secured by bolts 56 threaded into the lower parts of the supporting frames 53, whereby the position of the supporting rods 54 can be adjusted by loosening bolts 56.

The rear ends of the supporting rods 54 extend through holes 58 in both sides of a supporting member 57, and slots extend from the holes 58 to the ends of the member 57. The opening of the slots can be reduced by the bolts 59, whereby the member 57 can be fixed at a desired position on the supporting rods 54. In the center of the member 57 is a vertical hole 60, and in hole 60 is a supporting rod 61. A bolt 62 threaded into the member 57 fixes the supporting rod 61 at a desired height. The upper end portion 63 of this supporting rod 61 is bent laterally parallel to the frames 53, as shown in FIG. 2 and FIG. 3, and on the upper end portion 63 extends through a hole 65 in a supporting piece 64 projecting from the lower side of said supporting plate 34 for rotatably supporting plate 34. In supporting piece 64 is a slot extended from the lower end thereof to the hole 65, and by narrowing the slot by a bolt 66 the supporting plate can be fixed at a desired angle.

To each of said supporting frames 53 are fixed left and right pairs of supporting frames 67, which can be adjusted by bolts 69 extending through oblong holes 68 into tapped holes in the supporting frames 67. The tops of the front supporting frames 67 are lower than the tops of the rear supporting frames 67, and on the upper ends of the front left and right supporting frames 67 are fixed the front ends of a pair of the left and right roller supporting frames 70 by bolts 71, and the rear ends of the supporting frames 70 are fixed on the rear supporting frames 67 by bolts 73 extending through oblong holes 72 at the rear end of each of the supporting frames 70.

If the height of the top of each of the supporting frames 67 is adjusted by loosening the bolts 71 and 73, the angle of inclination of the roller supporting frames 70 can be adjusted. On the roller supporting frames 70 are journaled shafts projecting from both ends of a plurality of guide rollers 74 extending between the supporting frames 70.

On supporting frames 75 fixed to and extending between side plates 38 at a location between the front ends of the roller supporting frames 70 and said delivery roller 35 are attached guide plate 76 for the blanks 32. In front of the delivery roller 35 is also attached a supporting frame 77 extending between the side plates 38 and fixed thereon are guide plates 78 for the blanks 32.

Said feed rollers 36 are fixed on a shaft 81 rotatably mounted at both ends thereof in a pair of bearings 80 movable vertically along upright guides 79 disposed on the front inner sides of both side plates 38 respectively, and as shown in FIG. 5, the rollers 36 are fixed along the shaft 81 at suitable intervals.

On each bearing 80 is mounted a vertical threaded rod 82 this threaded rod 82 passes loosely through a hole formed in a supporting plate 83 extending inwards from the upper end of each side plate 38 as shown in FIG. 5. In bearings 84 extending upwards from the top of each side plate 38 outside the position at which the supporting plates 83 are mounted, are rotatably mounted the ends of a shaft 85, and on this shaft 85 are mounted bevel gears 86 respectively, above said supporting plates 83. The bevel gears 86 are meshed with bevel gears 87 having threaded holes through the centers thereof and threaded on the rods 82. On the end portion of the shaft 85 is provided a handle 88, and the shaft 85 and the bevel gears 86 can be turned by the handle 88 so that the bevel gears 87 mexhed therewith are turned and thereby the threaded rods 82 are moved vertically together with the bearings 80 and the position of the rollers 36 can be adjusted. In the embodiment shown in FIG. 5, because the left and right bevel gears 87 are rotated in opposite directions, the holes in the centers of the bevel gears 87 and the threads of the rods 82 are left and right hand threads, during the rotation of the shaft 85, the left and right bearings 78 are moved vertically simultaneously and the shaft 81 is always maintained horizontal. Compression springs 89 are disposed between the bearings 80 and the supporting plates 83 and push down on the bearings 80.

Said feed roller 37 is long as shown in FIG. 5, shafts 90 at each end thereof being rotatably journaled in bearings on the inside of the side plates 38. One end of shaft 81 and the end of one shaft 90 are fitted loosely in holes in the side plate on the respective end of the feed roller 37 and shaft 81 and project outside the side plate 38. One the ends of shafts 81 and 90 are respectively mounted gears 91 and 92 which are meshed with each other.

On said rear frame 31 are mounted a motor 93 and an adjustable reduction gear 94, the input shaft of which is driven by the motor 93, and around a sprocket 95 mounted on the output shaft of the reduction gear 94 and a sprocket 96 on the end of said shaft 90 is wound an endless transmission chain 97. Around the periphery of each of the feed rollers 36 and 37 is applied a rubber layer and the rubber layer on the periphery of the roller 37 has an uneven surface.

A middle frame 100, shown in FIG. 1, has the front portion thereof integrally connected with the rear frame 31. On a pair of front and rear shafts 102 rotatably journaled in bearings disposed on the front portion and the rear portion of a pair of left and right upper members 101 of the middle frame 100 are formed respectively a right hand external thread 103 and a left hand external thread 103 as shown in FIG. 8, and FIG. 9, and threaded sleeves 105 are threaded on the external threads 103. The sleeves 105 are mounted on the front and rear portions of a pair of left and right movable frame members 104 which are parallel with the upper members 101 and which are positioned between the upper members 101.

One end of the front shaft **102** projects outside the corresponding upper member **101** as shown in FIG. **9** and on the end thereof is mounted a sprocket **106.** Near the front portion of the middle frame **101** are mounted a motor **107** and a reduction gear **108** the input shaft of which is driven by the motor **107,** and around a sprocket **109** mounted on the output shaft of the reduction gear **108** and the sprocket **106** at the end of said shaft **102** is wound an endless transmission chain **110.** The other ends of the front and rear shafts **102** project respectively outside the corresponding upper member **101,** and on each thur projecting end is mounted a bevel gear **111.**

In bearings **112** mounted near the front and the rear of the outside of the upper member **101** adjacent the locations of the bevel gears **111** are rotatably mounted the ends of a longitudinal transmission shaft **113,** and bevel gears **114** are mounted on both ends of the transmission shaft **113** and are meshed with the bevel gears **111** mounted on the ends of each of said shafts **102,** so that the front and rear shafts **102** are rotated together so that the speed of rotation and the direction of rotation of the shafts **102** are equal.

Subsequently, when the shafts **102** are rotated by said motor **107** through the reduction gear **108,** the transmission chain **110** and the transmission shaft **113,** the movable right and left frame members **104** are moved toward or away from each other while remaining parallel.

As shown in FIG. **7,** on the rear portions of the movable frame members **104** are provided bearings **115,** and on shafts **116** extending inwardly from bearings **115** are rotatably mounted opposed pulleys **117.** On the front portion of the upper members **101** are mounted upright supporting frames **118,** as shown in FIG. **6,** FIG. **13** and FIG. **14,** and both ends of a shaft **119** are rotatably journaled in bearings on the lower front portions of the supporting frames **118.**

Around the middle portion of the shaft **119** are mounted a pair of right and left pulleys **120** which are slidable along the shaft. The pulleys **120** each have a slide key **121,** and each key **121** is fitted slidably into a corresponding longitudinally extending keyway **122** formed in the shaft **119,** so that the pulleys **120** are rotated together with the shaft **119** regardless of the position of the pulleys **120.** Moreover, shifters **123** are mounted on the inside of the right and left movable frame members **104** and extend upwardly therefrom and are engaged in peripheral grooves **124** formed on the outside of the pulleys **120,** so that the pulleys **120** are moved together with the movable frame members **104.** Engaged around said pulleys **117** and **120** are the end portions of a pair of right and left endless belts **125** for feeding the blanks **32.**

On the upper rear portion of each of said upper members **101** are upright supporting frames **126,** as shown in FIG. **10,** and the ends of a pair of upper and lower shafts **127** and **128** are rotatably journaled on upper and lower pairs of bearings on the supporting frames **126.** The inside surfaces of the upper and lower runs of belts **125** contact a long roller **29** fixed at about the middle of the shaft **128.**

In bearings provided above the bearings for the shaft **119** on said supporting frames **118** are rotatably journaled the ends of a shaft **130,** and at the middle of this shaft is fixed a pulley **131.** Around the pulley **131** and the pulley **132** fixed at the middle of said shaft **127** are the ends of an upper endless belt **133** for feeding the blanks **32.** Around the middle portion **136** of said roller **129** and a pulley **134** fixed to the middle of said shaft **119** is engaged a lower endless belt **135** for feeding the blank plate **32,** and a space the size of the thickness of a blank **32** is provided between the opposed surfaces of said upper and lower endless belts **133** and **135.** The middle portion **136** of the roller **129** is in the shape of a low angular crown to prevent the endless belt **135** from moving off the middle portion **136.**

On the rear portion of the upper members **101** are fixed front and rear pairs of bearings **137,** as shown in FIG. **7,** in which are rotatably journaled the ends of a pair of front and rear shafts **138.** On the right and left portions of shafts **138** are formed external left hand and right hand threads **139,** respectively, and on the external threads **139** are threaded right and left guide frames **140,** having female threaded bores **141** therein. On the facting surfaces of the guide frames **140** are attached upper and lower pairs of guide rails **142** and **143** respectively.

The guide rails **143** are attached integrally to the guide frame **140** so that the upper surface of the endless belt **125** and those of the guide rails **143** are nearly on the same level and are located outside each belt **125** as shown in FIG. **6** and FIG. **7,** and the guide rails **142** are fixed to the guide frames **140** by screws so that the height thereof is adjustable, and the space between the guide rails **142** and **143** is adjusted so that the edges of a blank **32** can be slidably inserted between the guide rails. The end portions of opposed guide rails **142** and **143** diverge up and down as shown in FIG. **6** so that the edges of a blank supplied from the space between the feed rollers **36** and **37** will enter the space between the guide rails **142** and **143** easily.

On one end of each of said shafts **138** is mounted a sprocket **144,** and around the sprockets **144** is wound an endless chain **145,** and at the other end of one of the shafts **138** is fixed a handle **146.** When the handle **146** is turned, both shafts **138** are rotated together and the right and left guide rails are moved toward or away from each other.

Near the front and rear of said upper members **101** are mounted inverted U-shaped supporting frames **147** as shown in FIG. **6** and FIG. **11,** and to the lower sides of the upper middle portions of the supporting frames **147** are attached interposed members **148** and on the lower sides of the interposed members **148** are fixed a pair of right and left side frames **149** positioned on both sides of the upper portion of said belt **133** as shown in FIG. **6,** FIG. **11,** and FIG. **12.**

Between the lower portions of the side frames **149** are rockably pivoted on shafts **151** the rear ends of a plurality of rocking frames **150,** and on the front end of the rocking frames **150** are rotatably journaled rollers **152** contacting the inner surface of the lower portion of said belt **133.** On the shaft **151** is mounted a spring **153** to press the roller **152** against the inner surface of the lower portion of the belt **133** as shown in FIG. **12.**

On the lower portions of the upper members **101** are fixed the ends of a pair of front and rear cross members **154** as shown in FIG. **6** and FIG. **11,** and on the middle portion of each of the cross members **154** is mounted a supporting stand **155.** On both sides of each of the supporting stands **155** are fixed supporting plates **156** positioned on both sides of the lower portion of the belt

133, and at the upper ends of each of the supporting plates 156 are fixed narrow side plates 157, also seen in FIG. 12, parallel with both sides of the belt 135 and which are sufficiently long so that the ends thereof reach to a point near the ends of the belt 135 at the front and rear thereof. Between the side plates 157 are rotatably journaled a plurality of rollers 158 on which the inner surface of the upper portion of the belt 135 rests, a roller 158 being located right below each of said rollers 152 respectively.

On the inner sides of the movable frame members 104 are mounted the lower ends of supporting rods 159 at a location just in front of the roller 129 as shown in FIG. 6 and FIG. 15, and to a connector 160 on the upper end of each supporting rod 159 is fixed a supporting rod 161 directed rearwardly of the middle frame 100. At the rear portion of the supporting rod 161 is mounted a connector 162, and on the upper portion of the connector 162 is a short shaft 179 parallel with the shaft 128 of said roller 129. On the shaft 179 is rotatably mounted a reversing pulley or roller 164 around which extends the rear end of one of a pair of right and left endless folding belts 163. The connectors 160 and 162 are fixed on the supporting rods 159 and 161 by set screws, so that the height of the supporting rod 161 or the direction of the shaft 179 can be adjusted freely by loosening the screws and also the axial position of the roller 164 can be adjusted.

On the supporting frame 118 on the front portion of the upper members 101 are rotatably journaled in suitable bearings, the ends of a shaft 165 located to the rear of said shaft 130, and similarly in bearings 166 on the supporting frames 118 are rotatably journaled the ends of a shaft 167.

On the rear portion of said movable frame members 104, as shown in FIGS. 6 and 13, are fixed supporting frames 170 having holes in which are loosely fitted the shaft 165 and internally threaded sleeves 169 into which the right and left external threads 168 on the shaft 167 are threaded. On the shaft 165 are slidably mounted reversing pulleys 171 slidable in the direction of the shaft and located inside the supporting frames 170.

Each of the pulleys 161 has a slide key 172 thereon and each key 172 is slidably fitted into a corresponding longitudinally extending keyway on the shaft 165, so that the pulleys 171 can be rotated together with the shaft 165 regardless of the position of the pulleys 171 therealong. Moreover, shifters 174 extend downwards inside the right and left supporting frames 170 and are engaged in peripheral grooves 175 on the outside of the pulleys 171 so that the pulleys 171 will be moved along with the supporting frames 170.

The right and left external threads on said shaft 167 are right hand and left hand threads, and one of the shafts 102 and shaft 167 are rotated together by an endless transmission chain 217 extending around a sprocket 215 fixed on the end of the shaft 167 and a sprocket 216 fixed on said one shaft 102, and thereby, when the movable frame members 104 and 105 move, the supporting frames 170 move together with the frame members 104 without inclination of the upper portion thereof. Around the pulleys 171 are engaged the front and rear ends of said folding belts 163, but while said pulleys 164 are located outside the endless belts 125, as shown in FIG. 16, the pulleys 171 are located above the endless belts 125. Each belt 163 as it is led forward from the pulley 164 at the rear portion of the apparatus is turned over through 180° and the upper and lower surfaces are reversed, and it is led rearward from the top of the pulley 171, and passes under the pulley 176 as shown in FIG. 15 and FIG. 16 and over the upper side of the pulley 177 from in front thereof and is directed obliquely downwardly and rearwardly and is twisted through 180° in the opposite direction to the first direction of reversal and returned to the initial state between the pulley 177 and the lower portion of said pulley 164. The pulleys 176 are rotatably mounted on shafts 181 attached to the connectors 180 fixed on a pair of upright supporting rods 178 on the movable frame members 104. On the upper ends of the supporting rod 178 are also mounted connectors 182, in each of the connectors 182 is fixed a shaft 183, and on a shaft 185 at the end of an arm 184 provided on the shaft 183 is rotatably mounted the pulley 177.

Because the shafts 183 are fixed to the connectors 182 by the bolts 186, when the bolts 186 are loosened, the shaft 183 can be turned together with the arm 184 by a handle 187 mounted on the shaft 183, and the pulley 177 can be moved up and down and so that the tension of the belt can be adjusted.

Moreover, because the connectors 180 and 182 are fixed to the supporting rod 178 by tightening the bolts, when the bolts are loosened, the connectors 180 and 182 can be moved up and down rod 178.

As shown in FIG. 15 a plurality of upright supporting rods 188 are mounted on the rear portion of the movable frame members 104 at appropriate intervals, and on each of the supporting rods 188 is mounted a connector 189. In a bearing 191 mounted on a shaft 190 fixed to each connector 189 is rotatably journaled a roller 192. The rollers 192 nearest to the rollers 164 engage the inner surfaces of both upper and lower runs of the belts 163, while the other rollers 192 are inclined at suitable angles to engage the upper surface of the lower portion of the belt 163. Because each of the connectors 189 is fixed to the corresponding supporting rod 188 by a bolt, the height/thereof can be adjusted by loosening the bolt, and also the angle of each roller 192 can be adjusted by loosening the bolt holding the corresponding bearing 191.

On the movable frame members 104 in front of the supporting rods 188 at a suitable interval therefrom, are upright supporting rods 193. In a bearing 194 fixed on each of the supporting rods 193 is rotatably mounted a horizontal roller 195 engaging the upper surface of the lower portion of the belt 163.

Furthermore, on the movable frame members 104 in front of the supporting rods 193 at a suitable interval therefrom are a plurality of upright supporting rods 196. On each of the supporting rods 196 is mounted a bearing 197, and in both sides of the bearing 197 are rotatably journaled horizontal rollers 198 engaging the upper surface of the lower portion of the belt 163. The height of bearings 194 and 197 can each be adjusted with respect to the supporting rods 193 and 196.

Inside each of the movable frame members 104 is mounted a plurality of supporting frames 199 at suitable intervals, and on each of the supporting frames 199 is rotatably independently mounted a vertical roller 200 to prevent the belt 163 from shifting off the roller 164 engaging the outer edge of the lower portion of the belt 163.

Guide rails **201**, shown in FIGS. **11** and **15**, extend parallel with each other and support the upper runs of each of said belts **125** and are fixed to the movable frame members **104** by a plurality of supporting members **202**. A layer of low friction material is provided on the guide rails **201** for enabling the belt **125** to slide more smoothly.

FIG. **17** shows the right hand guide members **203** positioned above said guide rails **201**, as seen in FIGS. **10** and **11**, and it has a shape as shown in FIG. **17**. The left hand guide member has the opposite handed shape. The members **203** are mounted on the lower ends of supporting plates **206** attached to the inner sides of receiving plates **205** mounted on the upper portions of supporting frames **204**, which in turn are mounted on the movable frame members **104**. The transverse position of the receiving plates **205** with respect to the supporting frames **204** can be adjusted by adjusting bolts **207** and also the receiving plates **205** are secured to the supporting frames **204** by clamping bolts **208** and the supporting plates **206** can be adjusted to the desired position by bolts **209** extending through elongated holes in the supporting plate attaching portion of the receiving plates **205** and fixed thereto. At the rear ends of the guide members **203** are fixed guide plates **210** which are curved upwards as shown in FIG. **6** and FIG. **17**. The guide plates **210** are located below the rear end of the belt **133**. A blank **32** is led into the space between the belts **133** and **135**. The rear portion of each of the guide members **203** has a square cross-section, but from about midway of its length, the outer surface thereof is gradually inclined inwardly until the guide member is a thin flat plate at the front end. This is shown in FIG. **19**, FIG. **20**, FIG. **21** and FIG. **22**, which show the relationship of the blank and one guide member at various points therealong.

The belt **163** is gradually twisted through 180° around the lower outside edge of the guide member **203** as shown in FIG. **18** through FIG. **22**, and at the front end of the guide member **203**, it is above the member **203**.

As seen in FIGS. **6** and **10**, on the movable members **104** are fixed a pair of right and left supporting plates **211** located at the rear of said roller **129**, and from the upper portion of the facing surfaces of the supporting plates **211** project arms **212**. At the ends of the arms **212** are fixed supporting pieces **213**, and to the supporting pieces **213** are attached nozzles **214** for dispensing bonding agent onto appropriate portions of the blanks **32**. Each of the supporting pieces **213** is adjustably mounted so that the position thereof with respect to each arm **212** can be adjusted and the position of the nozzle **214** can thus be adjusted.

As seen in FIG. **14**, inside the supporting frame **118** near one end of the upper and lower shafts **130** and **119** are gears **218** having the same diameter, and the gears **218** are meshed with each other, so that the upper and lower shafts **130** and **119** are rotated together in the opposite direction at the same speed.

On the outer end of the lower shaft **119** is mounted a sprocket **219**, and around the sprocket **219** and a sprocket **221** mounted on the output shaft of an adjustable reduction gear **220** disposed on the front portion of the middle frame **100** is wound an endless transmission chain **222**. The input shaft of the reduction gear **222** is driven by a motor **223** mounted on the front portion of the middle frame **100**.

On the end of said shaft **130** is mounted a sprocket **224**, and an endless transmission chain **226** is wound around this sprocket **224** and a sprocket **225** mounted on the end of the shaft **165** to the rear thereof, so that the shafts **130** and **165** are rotated together in the same direction at a fixed speed ratio.

As shown in FIG. **6**, a pair of the right and left bearings **227** are mounted on the front portion of the supporting frame **118**, and in the bearings **227** are rotatably mounted the ends of a shaft **228**. An endless transmission chain **231** extends around a sprocket **229** mounted on the shaft **228** and a sprocket **230** mounted on said shaft **119**, so that the shaft **119** and **228** are rotated together in the same direction at a fixed speed ratio.

On the rear end of said side frame **149** is a limit switch (LS–6) for detecting the entry of a blank **32** between the belts **133** and **135**.

The direction in which the respective belts **133**, **135**, **125**, and **163** are driven is shown by the arrows in FIG. **16** and the speed of said belts is the same.

In FIG. **1** and FIGS. **23–27** is shown a front frame constructed integrally with the middle frame **100** at the front portion thereof. On upper cross members **233** and **234** at the front and rear portions of this frame **232** are rotatably journaled the front and rear ends of a pair of right and left shafts **235** having external right and left hand threads **236** respectively. On the front portion of each of the shafts **235** is fixed a sprocket **237** and around the sprockets **237** is wound an endless transmission chain **238** which causes the right and left shafts **235** to rotate in the same direction at the same speed. The front end of one of the shafts **235** projects from the front portion of the cross member **233** and a square shaft portion **239** is provided at the front end of the shaft **235** for removably mounting a handle thereon.

A pair of front and rear crosswise supporting members **240** are provided, each of which has threaded sleeves **241** at each end which are threaded on the front and rear external threads of each of the shafts **235** so that the front and rear member **240** are moved toward and away from each other when the right and left shafts **235** are rotated. On one end of each of the front and rear members **240** is mounted a supporting frame **242** and in each of the supporting frame **242** and in each of the supporting frames **242** is rotatably mounted one end of a shaft **243**. On each of the shafts **243** is formed right and left hand external threads as shown in FIG. **26**.

Mounting frames **245** are slidably mounted on each of the crosswise members **240** and a female threaded portion **246** on the upper portion of each of the mounting frames **245** is threaded onto the external threads of the shafts **243**. Through holes in supporting plates **247** fixed on the outside of each of the supporting plates **242** loosely extends a longitudinal shaft **248**.

The shaft **248** is located right above one of the shafts **235** and the front and rear ends thereof are rotatably journaled in bearings **249** fixed on the upper portion of the front and rear cross members **233**. The front end of the shaft **248** projects forwards from one of the bearings **249** and has a square shaft portion **250** on the end thereof for removably mounting a handle thereon.

On the shaft **248** are slidably mounted bevel gears **251** located inside the supporting plates **247**. The bevel gears **251** mesh with corresponding bevel gears **252** on the ends of said shafts **243**.

In the bores of said bevel gears **251** are fixed keys which are slidably engaged in long key grooves **253** in the shaft **248** so that the bevel gears **251** are rotated together with the shaft **248** regardless of the positions of the bevel gears **251** therealong. When the shaft **248** is rotated, the bevel gears **252** meshed with the bevel gears **251** are rotated in opposite directions from each other, and because the direction of the external threads **244** are opposite to each other, the mounting frames **245** are simultaneously moved toward or away from each other. On upper members **254** on both sides of the front frame **232** are mounted inverted U-shaped upper frames **255.** On the upper middle portion of the cross members **256** of the frames **255** are mounted bearings **257** and between the bearings **257** is rotatably mounted a longitudinal shaft **258.** On the front end of the shaft **258** is mounted a handle **259.** Inside the middle portion of each of the cross members **256** is fixed a bearing **269** and bevel gears **261** are mounted on the upper ends of vertical shafts **260** rotatably mounted in the bearings **269** respectively. Gears **261** are meshed with the bevel gears **262** mounted on said shaft **258.** Inside the upper frames **255** are arranged inverted U-shaped movable frames **263.** The movable frames **263** have integrally connected between the upper ends and the upper middle portions of right and left vertical members **264** cross members **265** and **266.** On the inside face of the inner middle portion of the cross members **265** of each of the movable frames **263** is formed a projection having a threaded hole **267** therein and in each of the holes **267** is threaded external threads **268** on said shafts **260.** The external threads **268** on one shaft are right hand threads and the threads on other are left hand threads so that when the shaft **258** is rotated by the hande **259,** the shafts **260** are rotated simultaneously in opposite directions by the bevel gears **262** and **261,** and thereby each of the movable frames **263** is moved up and down simultaneously and kept at the same level.

The outside of each vertical member **264** of each of the movable frames **263** is contacted by a guide roller **270** mounted on the frame **232** so that the movable frames **263** are guided so as to move up and down vertically. On the lower portion of the outsides of the front and rear vertical members of said upper frames **255** are mounted bearings **271** respectively as shown in FIG. **23** and FIG. **25,** and in the bearings **271** are rotatably mounted crosswise shafts **272.** An endless transmission chain **274** is wound around sprockets **273** fixed respectively near the end of each of the shafts **272** so that both ends **272** are rotated together in the same direction at the same speed. On each of the shafts **272** are formed external right hand and left hand threads. Further, at the end of one of the shafts **272** is provided a square shaft portion **287** for removably mounting a handle thereon.

As shown in FIG. **23** and FIG. **25** a pair of right and left movable supporting frames **276** have threaded holes **280** therein at the front and rear ends thereof which are threaded respectively on the external threads **275** on said shafts **272.** When the shafts **272** are rotated, the movable supporting frames **276** are moved toward or away from each other while being kept paralle. Inside the front ends of the supporting frames **276** are rotatably journaled pulleys **277,** and around the pulleys **277** and pulleys **278** slidably mounted on shaft **228** are wound endless belts **279** for feeding a blank **32.** On the outside of the pulleys **278** are provided peripheral grooves **281,** and shifters **282** are provided at the rear ends of the supporting frames **276** which are engaged with the peripheral grooves **281,** whereby the pulleys **278** are moved together with the supporting frames **276** so that the belts **279** are always parallel. Further, inside each of the pulleys **278** is a key, and the key is engaged slidably in a keyway **283** in the shaft **228,** so that the pulleys **278** are always rotated together with the shaft **228** regardless of the position of the pulleys **278** therealong.

On the movable supporting frames **276** are fixed a pair of right and left guide frames **284** for supporting the sides of the blank **32** conveyed on the belts **279.** The guide frames **284** are L shaped in section as shown in FIG. **24,** and at the front and rear portion of the bottom thereof are formed crosswise oblong holes **285** respectively as shown in FIG. **25,** and the guide frames **284** are fixed to the supporting frames **276** by threading the clamping bolts **286** through the crosswise oblong holes **285** into the threaded holes formed in the supporting frames **276.**

Accordingly, the position of the guide frames **284** with respect to the supporting frames **276** can be adjusted by loosening the clamping bolts **286.** Inside each of said fixing frames **245** is mounted a frame **288** respectively, and on each of the frames **288** is an upright longitudinal end flap folding guide rod **289** in the shape of a square bar having inwardly inclined upper end surfaces **290** thereon. On the side of each of the guide rods **289** toward which the inclined surface **290** is inclined is fixed a side wall panel folding guide member **219** for bending the side wall panels of the blank **32** and the upper half of each of the members **291** is bent outwards. Further, on the opposed sides of the guide rods **289** perpendicular to said above mentioned sides are mounted end wall panel folding members **292** for bending the front and rear end wall panels of the blank **32.** The members **292** are also inclined outwardly from a point near the lower end thereof and further have the upper end thereof directed horizontally outwards.

At one end of the opposed sides of said cross members **240** are mounted fixing plates **293** respectively, and in the respective plates **293** are rotatably mounted the ends of a pair of upper and lower shafts **294** and **295.** Each of the shafts **294** and **295** extend loosely through upper and lower holes in said frames **288.** An end wall folding device **296** is mounted on each of the frames **288.** Each device comprises a pair of rocking arms **297** and **298** having mounting holes **311** and **312** at the lower ends thereof by which the arms are slidably mounted on the respective shafts **294** and **295.** A connecting piece **300** is pivoted to the outer end of the rocking arm **298** by a shaft **299** and a folding piece **303** is pivoted on the outer ends of the arm **297** and the connecting piece **300** by shafts **301** and **302** respectively, as shown in FIG. **28** and FIG. **29.** On the shafts **294** and **295** are mounted gears **304** and **305** and a rack **306** is meshed with the gears **304** and **305.** Rack **306** is connected to a piston rod **308** projecting from a cylinder **307** fixed to the lower portion of one of the fixing plates **293.** The back of the rack **306** is engaged with a pair of guide rollers **309** which are journaled on a supporting plate **310** fixed to the fixing plate **293.** In the mounting holes **311** and **312** of the rocking arms **297** and **298** are fixed keys **313** and **314,** respectively, which are slidably engaged in long keyways **315** and **316** in the shafts **294** and **295,** so that the rocking arms

297 and 298 rotate together with the shafts 294 and 295 regardless of the position of the rocking arms 297 and 298 therealong. Near the front portion of said guide grame 284 on one side of the apparatus is fixed a supporting arm 317 as shown in FIG. 24, and the free end thereof projects between the guide frames 284. As seen in FIG. 24, notches in a pair of supporting pieces 319 on the outer end of the supporting arm 317 have pins 320 on both sides of the upper end of an operating piece 318 engaged therein.

The operating piece 318 is rocked forwards around the pin 320 when it is engaged and pushed by the front edge of a blank 32 advancing along the guide frames 284. A limit switch LS 8 is fixed on the end portion of the supporting arm 317 and is actuated by the operating piece 318 when it is rocked forwards.

On the center of each of the cross members 266 of the movable frames 263, as shown in FIG. 23 and FIG. 24, are mounted the ends of a frame body 321, and in the center of the frame body 321 is mounted the lower end of a vertical cylinder 322 which extends therethrough. From the lower end of the cylinder projects a piston rod 323, and on the lower end of the piston rod 323 is mounted a square pressing plate 324. To the upper surface of the pressing plate 324 are connected the lower ends of guide rods 325 extending parallel with the sides of the cylinder 322. Rotation of the pressing plate 324 is prevented by the sliding fit of guide rods 324 in guide holes 326 formed in the frame body 321. A vertical supporting plate 327 is mounted on the frame body 321 at one side of the guide rod 325, and in the supporting plate is a vertical elongated hole 328. Limit switches LS–9 and LS–10 are adjustably mounted at a desired position on the upper and lower portions of the supporting plate 327 by clamping screws extending through the hole 328. On the upper end of the guide rod 325 nearer to the supporting plate 327 is fixed an operating piece 329 for operating the limit switches LS–9 and LS–10.

Between the lower ends of the vertical members 264 of each of said movable frames 263 is connected a cross member as shown in FIG. 23 and FIG. 24. In the center of the lower portion of each cross members 330 is mounted a guide frame 331, and in each of the guide frames is disposed a sliding body 332 slidable transversely of the apparatus. A threaded hole is provided in the lower portion of each sliding body 332, and a threaded shaft 334 is threaded therein and has the outer end thereof mounted rotatably in the outer end of the guide frame 331.

Each of the threaded shafts 334 projects outwards beyond the guide frames 331 respectively and sprockets 335 are mounted thereon. On the front of both sides of said front frame 232 are mounted a pair of right and left bearings 336 and in the bearings 336 are rotatably journaled the ends of a shaft 337. Around a pair of the right and left sprockets 338 mounted on the ends of the shaft 337 and said sprockets 335 is wound an endless transmission chain 339. One end of the shaft 337 extends beyond the sprocket 338 and has a square shaft portion 340 thereon for mounting a handle thereon. The threaded shafts 334 are provided with right hand thread and left hand threads, so that they are rotated simultaneously in the same direction by rotation of the shaft 337 through the transmission chains 339, the sliding bodies 332 are moved toward or away from each other. On the upper portion of each of the sliding bodies 332 is mounted a transverse cylinder 340 positioned parallel with direction of reciprocating movement of the sliding body, and at the ends of the piston rods 341 projecting from the facing ends of the cylinders 340 are fixed receiving plates 342 which face each other. The receiving plates 342 are kept in a horizontal position by a suitable rotation stop.

On one side of the front frame 232 is mounted a pair of front and rear supporting plates 343, as seen in FIG. 24, and at the lower portion of the supporting plates 343 are mounted the ends of a supporting frame 344, shown in FIGS. 24 and 27. At the upper portion in the center of the frame 344 is mounted a bearing 345, and in the bearing 345 and bearings provided in both side plates 343 is rotatably journaled a shaft 346.

On the shaft 346 are fixed four pulleys 347, two being located on each side of the bearing 345. On a movable base 349 slidably mounted on a portion of a transverse frame 348 at the lower portion of said rear frame 232 are mounted a plurality of bearings 350, and in the bearings 350 is rotatably mounted a shaft 351 which is parallel with said shaft 346. In the shaft 351 are mounted pulleys 352 corresponding to said pulleys 347, and between the pairs of pulleys 347 and 352 are stretched endless belts 353 for delivering the folded cartons out of the apparatus. Further, at the rear portion of the movable base 349 is provided a supporting piece 354, and in the supporting piece 354 is loosely fitted the end of a threaded shaft 355 having a large diameter head portion engaged with the front surface of the supporting piece 354. The threaded shaft 355 is threaded into a threaded hole in the supporting piece 356 on the frame 232, so that the movable base 349 is moved by rotating the threaded shaft 355 to adjust the tension of the belts 353. In the lower portion of the frame 232 are provided a pair of right and left side frames 357, and on the side frames 357 are rotatably mounted a plurality of sets of carrier rollers 358 for supporting the under surfaces of the upper runs of the belts 353. The sets of rollers 358 are spaced along frames 357 at suitable intervals. On the frame 232 is mounted a pair of bearings 359, and in the bearings is rotatably journaled return rollers 360 engaging the lower run of the belt 353. At about the middle portion of the inner surface of the supporting plates 343 are mounted bearings 362 which are movable up and down along vertical guide frames 361, and on the bearings 362 are mounted the threaded rods 363. The threaded rods are fitted loosely through receiving frames 364 mounted on the inside of the upper portion of the side plates 343. Worm wheels 365 are rotatably mounted on the receiving frames 364 so as not to move up and down, and said threaded rods extend through threaded bores in the worm wheels, so that the bearings 362 are moved up and down together with the threaded rods 363 when the worm wheels 365 are rotated. In the bearings 362 are rotatably journaled shafts at both ends of a roller 369.

In bearings on the inside of the upper portion of the right and left supporting plates 343 are rotatably journaled the ends of a shaft 366, and a pair of worms 367 are mounted on the shaft 366 and mesh with the worm wheels 365.

The bearings 362 are moved up and down upon rotation of the shaft 366 by means of a handle 368 on one end of shaft. An operating plate 378 is rotatably mounted on a shaft 370 which in turn is rotatably

mounted between the right and left supporting plates 343 and on the operating plate are rotatably mounted a gear 372 meshed with a gear 371 fixed on the shaft 370 and a gear 373 meshing with the gear 372. On one end of the shaft of said roller 369 is fixed a gear 374 with which gear 373 can be engaged or from which it can be disengaged. Around a sprocket 375 fixed on the end of the shaft 370 and a sprocket 376 fixed on the end of said shaft 346 is wound an endless transmission chain 377 and whereby the shafts 346 and 370 are rotated together. When the gears 373 and 374 are meshed with each other, the belt 353 and the roller 369 are driven together. The operating plate 378 is rocked by means of the handle 379 to engage the gear 373 with or disengage it from the gear 374 on the roller 369. When the height of the roller 369 is to be adjusted by means of the handle 368, the adjustment may be made easily after disengaging the gear 373 from the gear 374. The operating plate 378 is constructed so that it can to hold the gears 374 and 373 in a condition of engagement or disengagement by means of a suitable clamping screw. The roller 369 is for finally pressing the carton delivered out of the apparatus on the belt 353 to define the height thereof. On the outside of the roller 369 is a provided rubber layer, under the belt 353 right below the roller 369 is disposed a roller 380 supporting the underside of the upper run of the belt 353 and the shafts at both ends of the roller 380 are rotatably journaled in the bearings arranged on the supporting plates 343.

As shown in FIG. 27, on a supporting base 381 disposed at the lower portion on the outside of one of the supporting plates 343 is provided bearings 382, and a bevel gear 384 is mounted on a shaft 383 rotatably journaled in the bearings 382. A bevel gear 385 at the end of said shaft 346 is meshed with bevel gear 384, and around a sprocket 386 mounted on the shaft 383 and a sprocket 387 integral with said sprocket 221 on reduction gear 220 (see FIG. 6) is wound an endless transmission chain 388, whereby the belts 353 are driven together with the other belts.

The blank 32 will now be described. The blank 32 is shown in FIG. 30, and at opposite sides of the bottom panel 389 are provided a pair of right and left side wall panels 391a joined to the bottom panel along creases 390. Similarly at the front and the rear of the bottom panel 389 are a pair of front and rear end wall panels 392a jointed to the bottom panel along the creases 393, and end wall panel extensions 392 joined to the end wall panels along fold lines 395. Side wall panel extensions 391 and end wall panel extensions 392 are joined to the side wall panels and end wall panels along creases consisting of two fold lines 394 and 395, respectively, parallel with each other. At the ends of the side wall panels 391*a* and side wall panel extensions 391 are end flaps 396 and 397 respectively, joined to the panels along creases 398.

FIG. 35 is the wiring diagram, and the detail thereof will be explained together with the explanation of the operation of the apparatus.

In the wiring diagram in FIG. 35, when the power source switch 399 is closed, the pilot lamp 400 will be lighted. Then, when the switch 401 is closed, the relay L1 is actuated and thereby the motor of the air compressor for operating the cylinders will start. Either of the switches 402 for adjusting the width of the blank which can be handled is closed, then the relaty L2 or L3 is actuated, thereby the motor 107 will start to rotate in a forward direction or in a reverse direction, and thereby the distance between the movable frame members 104 is changed, so that it will be in a position suitable for the blank plate 32 used. After the adjustment of the interval between the feed rollers 36 and 37 with the handle 88 and the interval between the side receiving plates 40 with the handle 46 in the blank supply device, and the adjustment of the associated parts by rotation of the shafts 235, 248, 258 and 272 and the like carried out by the handles in the carton forming section, a number of blanks are piled up on the delivery rollers 35 and the supporting plate 34 within the space defined by the receiving plate 33 and the side receiving plates 40 as shown in the chain lines in FIG. 2.

When the switch 404 for automatic operation is pushed, the pilot lamp is lighted and the relay L4 is actuated, the A contact L4–1 thereof is closed and while the relay L4 is self-held, the other A contacts L4–2, L4–3, L4–4, L4–5, L4–6 and L4–7 are closed, and the B contacts L4–8, L4–9, L4–10, L4–11 and L4–12 are opened.

Next, when the starting switch 410 is closed, the relay L5 is actuated and the pilot lamp 409 is lighted, similarly the A contacts L5–1 and L5–2 are closed and thereby the full automatic circuit is closed, the relay L12 is actuated, and thereby the A contacts L12–1 and L12–2 are closed and the B contact L12–3 is opened.

Then, when the conveyor switch 405 and the supply switch 406 are closed, the relays L6, L7 and L8 are actuated, the motor 223 and the motors 52 and 93 start, all the belts start to run, and the delivery roller 35 and the feed rollers 36 and 37 begin to rotate in the direction of the arrow in FIG. 2.

First, the lowest blank plate 32 is delivered between the receiving plate 33 and the roller 35, and is advanced while being sandwiched between the feed rollers 36 and 37 and the side wall panel extensions 391 on side walls 391a enter between the upper and lower guide rollers shown in FIG. 6 and the like, and also the side wall panels located inside the creases 394 are advanced while resting on the belts 125. After the blank has advanced a little, the bottom panel 389 enters between the upper and lower belts 133 and 135. When the front edge of the blank pushes the limit switch LS–6, the relay L9 is actuated and the time switch starts, the A contact L9–1 of the relay 9 is closed, the solenoid valve VI for the nozzles 214 is opened only for T seconds, bonding agent is dispensed from the nozzles 214, and as indicated in FIG. 30, on the inner portions of the side walls 391 are formed adhering portions 407, and after T seconds the contact T1–1 of the time switch is cut off.

When the blank plate 32 advances further, the side wall panels 391*a* inside the creases 394 enter between the guide members 203 and the belts 125 after passing the undersides of the guide plates 210, and the side wall panel extensions 391 on the belts 163 in the position as shown in FIG. 18. When the blank 32 advances further, the side wall panel extensions 391 are bent over the side wall panels 391*a* by the action of the guide members 203 and the belts 163 as shown in FIG. 19, FIG. 20, FIG. 21 and FIG. 22, and are adhered in the folded over condition by the bonding agent. FIG. 18 through FIG. 22 show the folding of only one side wall panel extension, but it will be seen that the other side wall panel extension 391 is similarly folded.

After the operation as above described, the blank **32**, the side wall panel extensions of which are folded over, is advanced from between the upper and lower belts **131, 163,** and **125,** as shown in FIG. **31,** and rests on the belts **279** of the device shown in FIG. **23.** When the front edge of the blank **32** as it is guided in its movement along the right and left guide frames **284** as shown in FIG. **24** strikes the operating piece **318,** and the piece **318** pushes the limit switch LS–**8,** the relay L**10** is actuated, the A contact L**10**–**1** is closed, and while the relay L**10** is self-held, the A contact L**10**–**2** is closed and the B contact L**10**–**3** is opened and the relay L**13** is actuated, the A contact L**13**–**1** is closed, and while the relay L**13** is self-held, the time switch T**2** is started. After T seconds the contact T**2**–**1** of the switch T**2** is closed and thereby the relay L**14** is actuated, the contact L**14**–**1** thereof is closed and the B contact L**14**–**2** is opened. When the relay L**14** is actuated, the solenoid valve for controlling the cylinders **340** in FIG. **24** is actuated and the receiving plates **342** are advanced. When the relay L**10** is actuated, the solenoid valve for operating the cylinder **322** is also actuated, the piston rod **323** is lowered, and the bottom **389** of the blank **32** supported by the belts **279,** is pressed down by the pressing plate **324.** Thereby, the flaps **396** and **397** at the ends of the side walls **391** which have been folded double as shown in FIG. **31** are bent upwards by the inclined surfaces **290** of the guide rods **289,** as shown in FIG. **32,** and then the side walls **391***a* are bent upwards by the guide members **291** as shown in FIG. **33,** and moreover, the end wall panels **392** are bent upwards by the guide members **292.** Thereupon, the bottom **389** is supported by the receiving plates **342** which are advanced as shown in FIG. **29.**

When the blank **32** is lowered to the position above described, the operating piece **329** actuates the limit switch LS–**9.** Thereby, the relay L**10** is returned to its initial condition, and the air for the cylinder **322** is switched on and the pressing plate **324** is raised. During the rise of the pressing plate, the operating piece **329** actuates the limit switch LS–**10.**

Thereby, the relay L**11** is actuated, the A contact L**11**—**1** is closed and self-held and the A contact L**11**–**2** is closed, the solenoid valve of the cylinder **307** of the bending device is actuated and the rack **306** is pushed up.

The upper and lower gears **304** and **305** are thus rotated and turn the respective rocking arms **297** and **298** as shown by the chain lines in FIG. **29,** the bending piece **303** folds the end wall panel extensions **392** inwards around the creases **395** and fold them against the inside of the end walls **392***a*. Flaps **396** and **397** are held between end wall panel extensions **392** and end wall panels **392.** A carton, the peripheral wall of which is a double wall as shown in FIG. **34,** is thus fabricated When each of the racks **306** is risen to its highest position, a portion of the rack **306** actuates the limit switch LS–**11** to open it.

Thereby, the relay L**12** and the relay L**14** are restored to their initial conditions and the receiving plates **342** which have been advanced previously and have been supporting the bottom panl **389** are retracted. When the relay L**12** is restored to its initial condition, the A contacts L**12**–**1** and L**12**–**2** are opened, and also the B contact L**12**–**3** is closed, the time switch T**3** is started, and after T seconds the contact T**3**–**1** is cut off, the relay L**11** is restored to its initial condition, and the air circuit to the cylinder **307** is switched over, and the racks **306** are lowered and also the bending piece is retracted. Thereupon, as the receiving plates **342** have been already retracted, the completed carton drops onto the belts **353** and is conveyed thereby, and when passing along the belts **353** between the roller **369** and the roller **380** in FIG. **24,** the upper and lower edges of the double carton side walls and also the end walls are pressed, the creases **394** and **395** are properly folded and the height of the carton is also made uniform. Then the carton is conveyed out of the apparatus on the belts **353.**

Then, the A contact L**11**–**2** of said relay L**11** acts to actuate the time switch T**4** to cut off the contact T**4**–**1** after T seconds, the set time of the time switch T**4** which is the time from the start of the bending operation to completion thereof. The time switch T**4** is the safety device for cutting off the full automatic circuit when the bending operation is not finished in a predetermined time due to a jam of the blanks **32.** When the push button switch in series with said switch **404** for automatic operation is opened, the automatic circuit after the relay L**4** becomes inactive, as the B contact L**4**–**9** is closed, and with the manual switches **412, 413, 414** and **415** all portions may be automatically operated freely.

It is necessary to regulate the travelling speed of the blank **32** due to said delivering roller **35** and feed rollers **36** and **37** to a speed slower than the feeding speed thereof depending on the belts **133, 125,** and **163,** so that the blank can be fed onto the belts **279** at suitable intervals necessary for fabricating the carton; that is, it is preferable to feed a succeeding blank **32** onto the belts **279** at around the time when the fabricated carton is dropped on the endless feed belts **353.** Adjustment of these speeds may be accomplished freely by adjusting the speeds of said reduction gears **49, 94** and **220.**

The present invention is for fabricating a carton by automatically bending a blank previously cut to the proper size and having suitable creases, and because both side walls and both end walls are double thicknesses, the carton is very rigid, and because the panels of the side walls are adhered integrally to each other with bonding agent in addition to being double, in the succeeding steps of the folding process the other portions are bent relative to both rigid side walls, so that bending is very reliable, and accurate bending is performed. Because bending of both side walls is carried on while moving the blank, the invention makes the efficiency of productivity remarkably high.

What is claimed is:

1. An automatic carton fabricating apparatus for fabricating cartons from a blank having a bottom panel, opposed pairs of side wall panels joined to said bottom panel along fold lines and each of which has a panel extension thereon joined to the side wall panel along a fold line, and each end of the side wall panels and extensions has an end flap thereon joined to the corresponding panel along a fold line, and opposed pairs of end wall panels joined to the bottom panel along fold lines and each of which has a panel extension thereon joined to the end wall panel along a fold line, said apparatus comprising a feed means for supplying blanks one at a time, upper and lower endless feed belts for conveying the blanks supplied one at a time sandwiched between said feed belts, endless supporting belts extending parallel to said feed belts for supporting the

lower surfaces of the side wall panels of the blanks conveyed by the feed belts and positioned inside the fold lines on the blanks between the side wall panels and the panel extensions, guide members above the supporting belts for pressing the upper surfaces of the side wall panels downwardly onto said supporting belts, folding belts on opposite sides of said feed belts extending along the path along which the blanks are carried by said feed belts for folding each side wall panel extension on the fold line thereof upwardly and over the guide members to a position above the corresponding side wall panel during the advancement of the blanks, a guide means positioned at the end of the run of said feed belts for receiving and supporting a blank having the side wall panels folded, a pressing plate having the same shape as the bottom panel of the carton and positioned above said guide means and movable up and down below the level of the guide means to engage and press the upper surface of the blank in the area of the bottom panel after the blank has been received and stopped in a position on the guide means, end flap folding guide members adjacent the path of said pressing plate for engaging the end flaps and folding them upwardly as said pressing plate moves down, side wall panel folding guide members adjacent the path of said pressing plate below the level of said end flap folding guide members and engaging both side wall panels and folding them upwardly, whereby the end flaps previously bent upwardly extend horizontally at right angles to said side wall panels, end wall guide members and folding means adjacent the path of said pressing plate below the level of said side wall folding members for engaging the end wall panels and bending them upwardly as said pressing plate moves down and folding the end wall extension panels over the end flaps and against the inner surface of said end wall panels, a receiving plate means supporting the bottom panel, and a delivery device below said receiving plate means for receiving the thus folded carton from the receiving plate means and removing it from said apparatus.

2. An automatic carton fabricating apparatus as claimed in claim **1** in which said folding belts each comprise an endless belt extending along the first part of the path of the blanks along said feed belts parallel to said supporting belts, and then twisting through 180° and over said guide member adjacent thereto and above the adjacent supporting belt, reversing pulleys at each end of the run of said folding belt around which said belt runs, and guide pulleys guiding said endless belt as it runs from the reversing pulley at the end of the path of the blanks along the feed belts outwardly away from the feed belts and twisting through 180° in the opposite direction from that in which it was twisted in said firstmentioned twisting.

3. An apparatus as claimed in claim **1** in which said guide means comprises parallel endless belts, guide frames extending parallel to said endless belts adjacent both sides thereof, and a stop positioned between said endless belts for limiting the advancement of the blank.

4. An apparatus as claimed in claim **1** in which said receiving plate means comprises a horizontally openable gate plate which is openable when the carton is completed thereby causing the carton to drop on the delivery device.

5. An apparatus as claimed in claim **1** in which said feed means comprises a slant plate supporting the ends of a supply of blanks remote from said feed belts, a roller supporting the ends of the blanks toward the feed belts at a level below the level of the slant plate, and a vertical gate plate above the roller for permitting the blanks to pass one at a time between the roller and the gate plate.

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