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Fig. 1

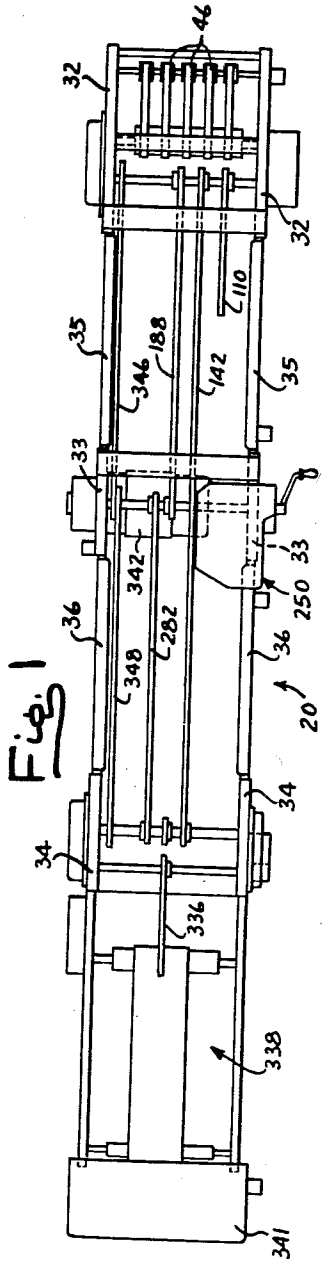
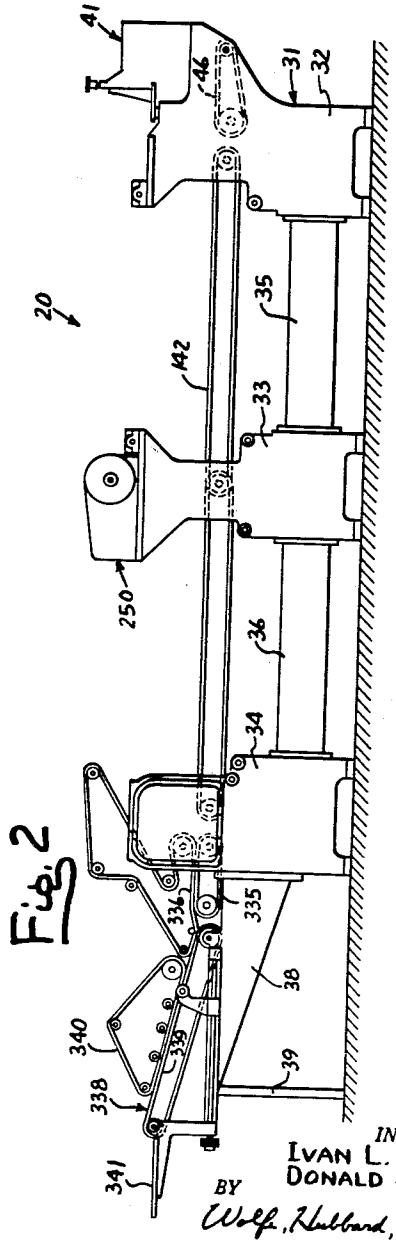


Fig. 2



INVENTORS
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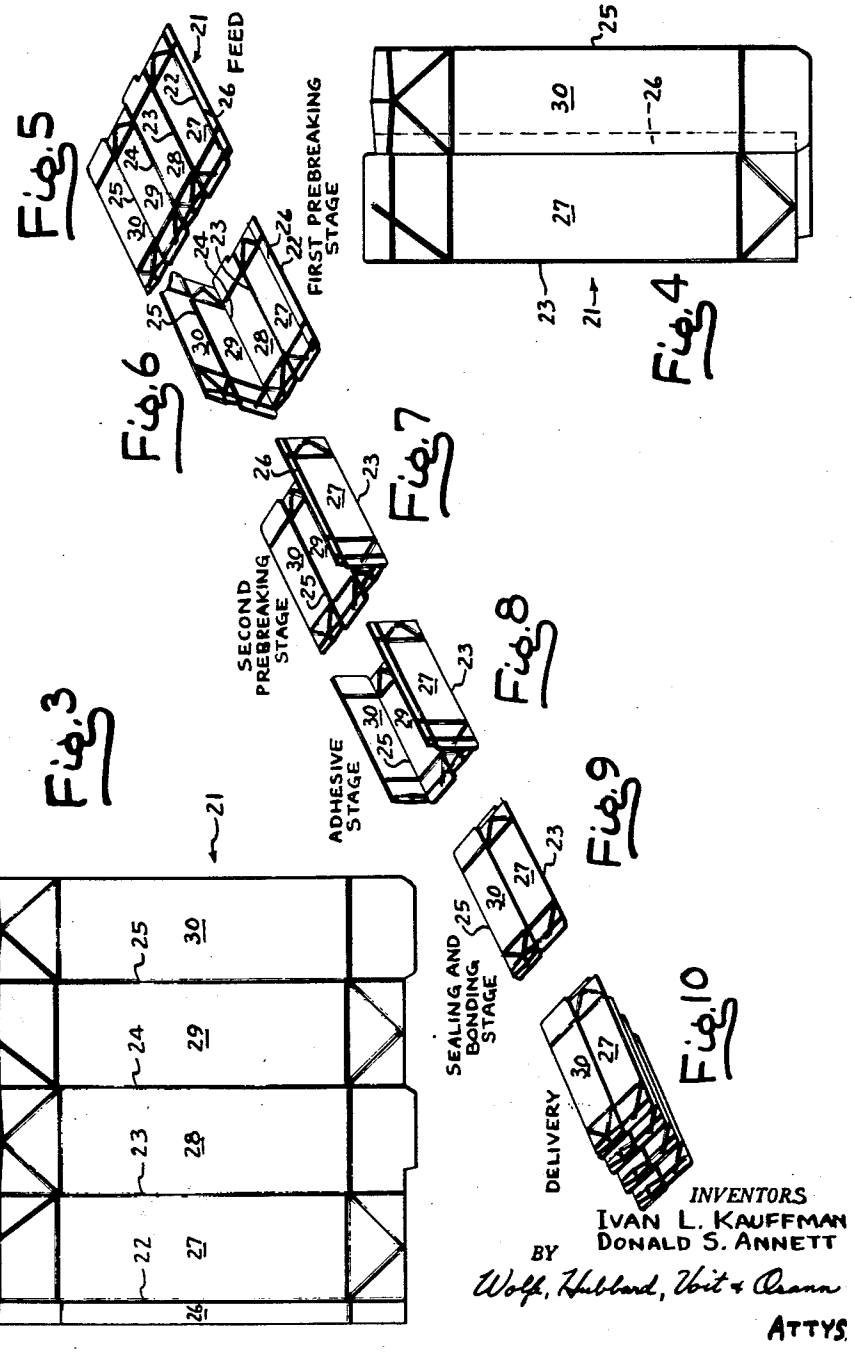


Fig. 5

Fig. 6

Fig. 4

Fig. 7

Fig. 8

Fig. 3

Fig. 9

Fig. 10

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Fig. 11

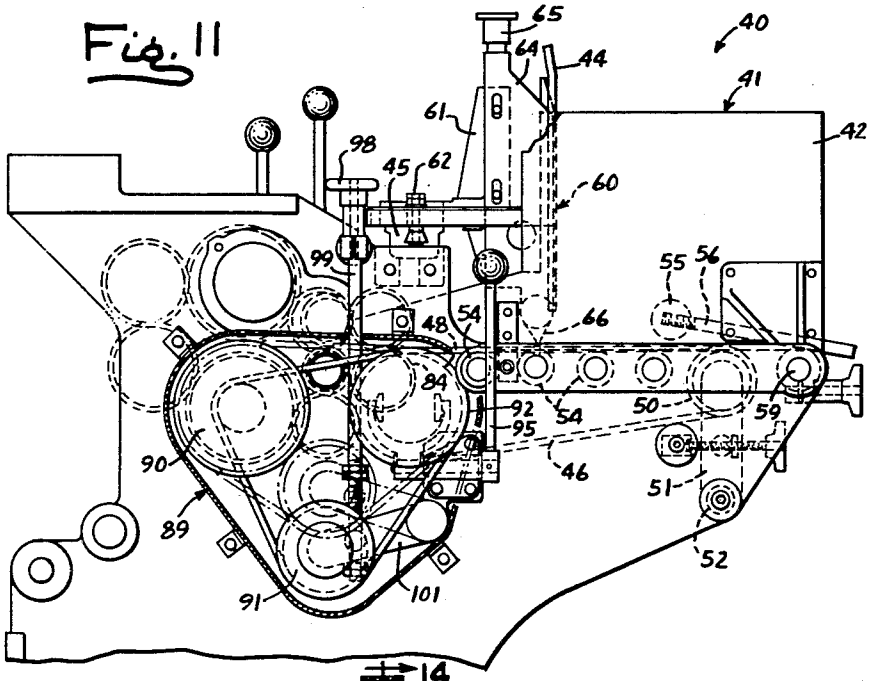
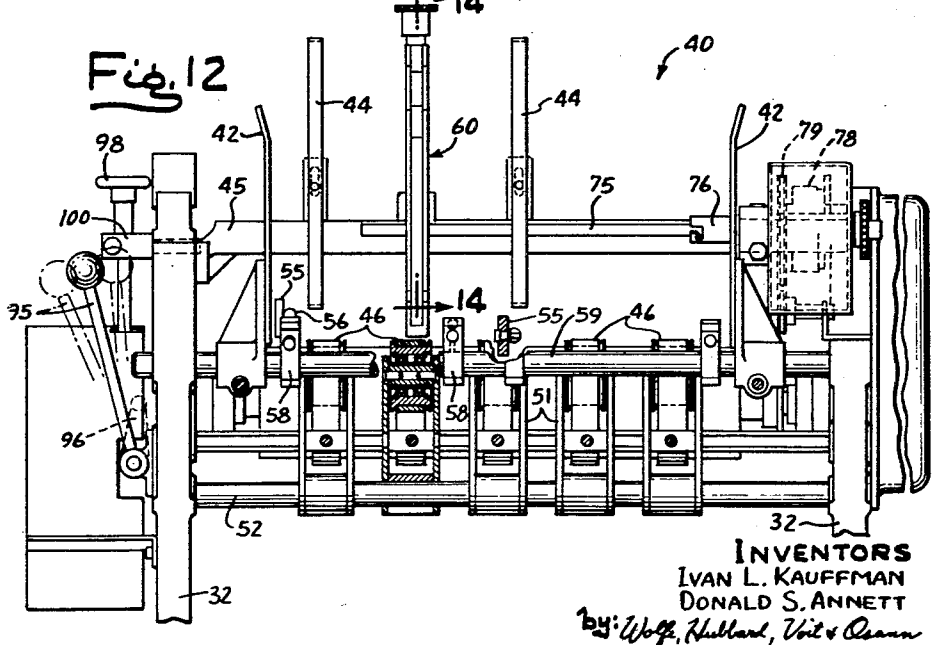


Fig. 12



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Fig. 13

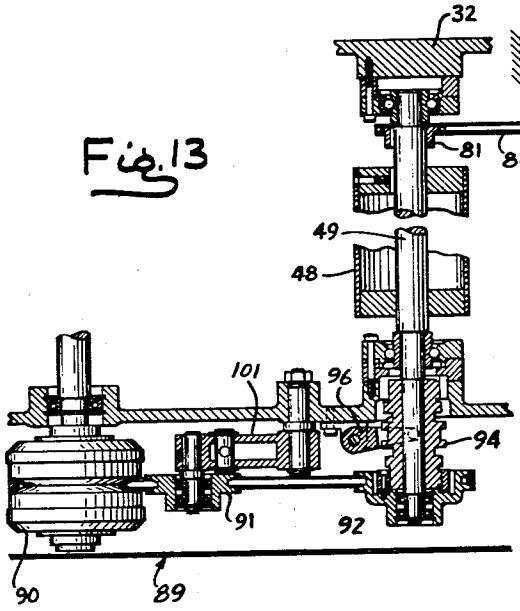


Fig. 14

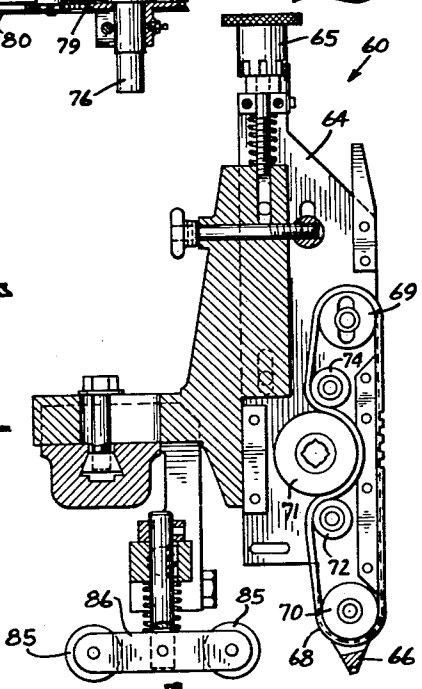
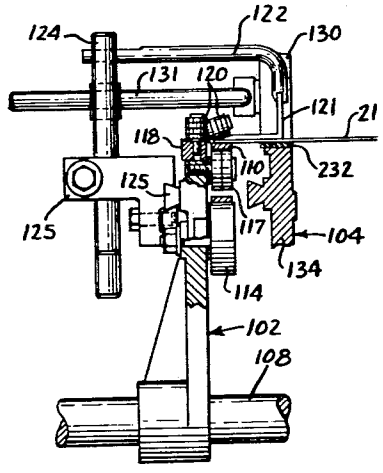


Fig. 17



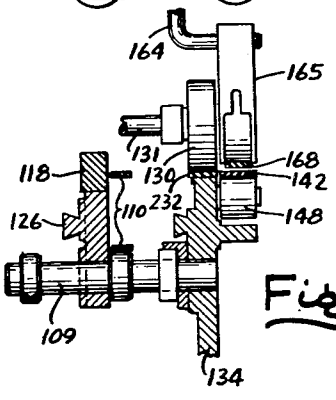


Fig. 18

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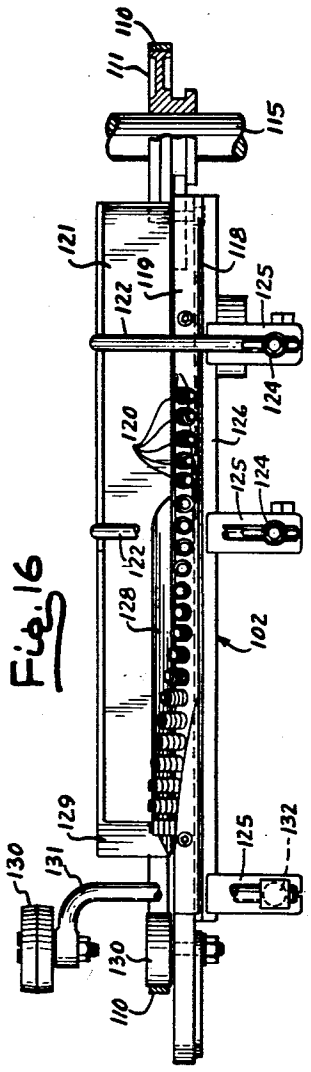


Fig. 16

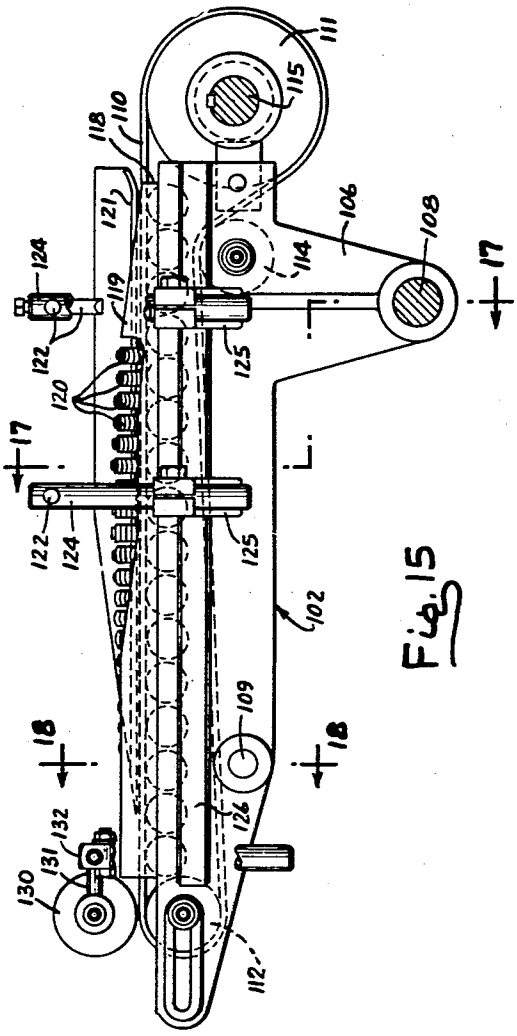


Fig. 15

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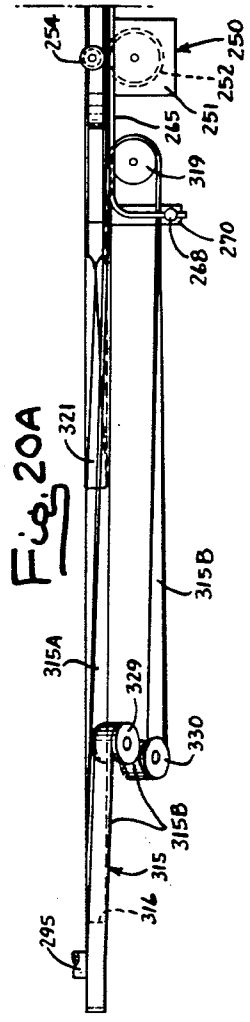


Fig. 20A

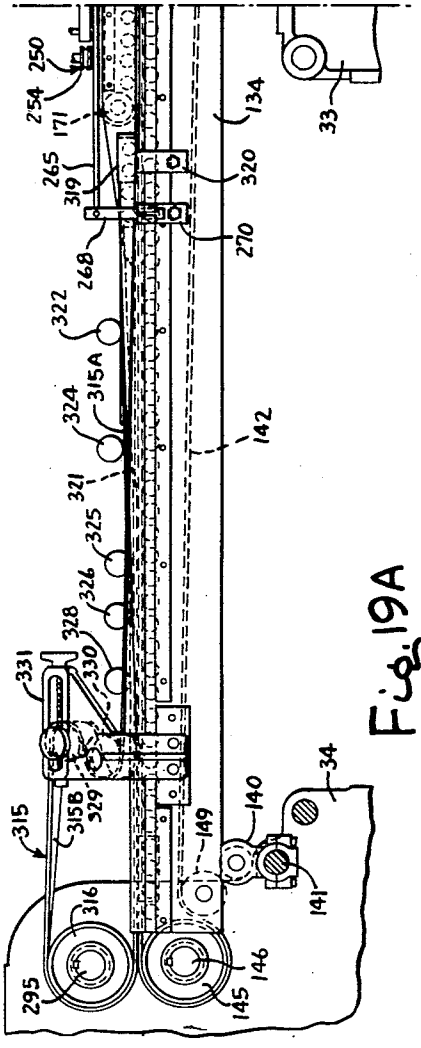


Fig. 19A

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METHOD AND APPARATUS FOR SIDE SEAMING CARTON BLANKS BY APPLICATION OF HEAT

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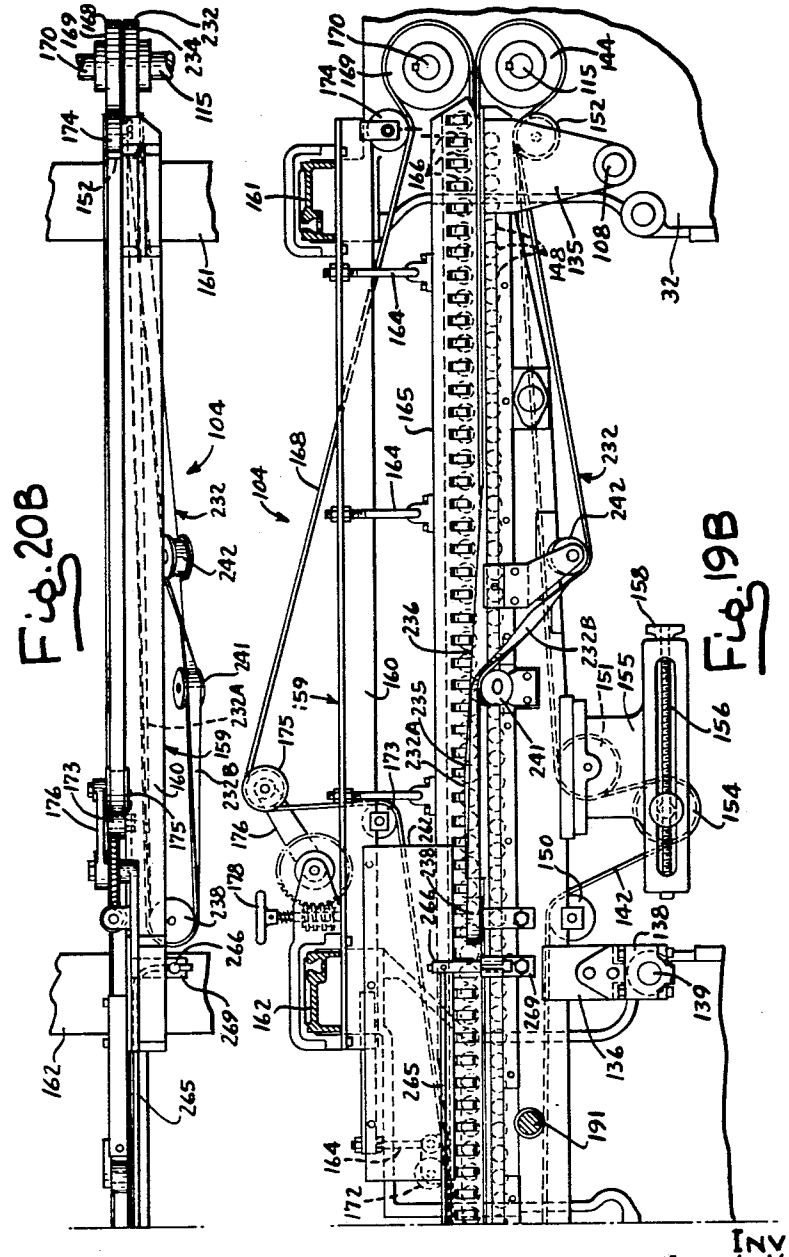


Fig. 20B

Fig. 19B

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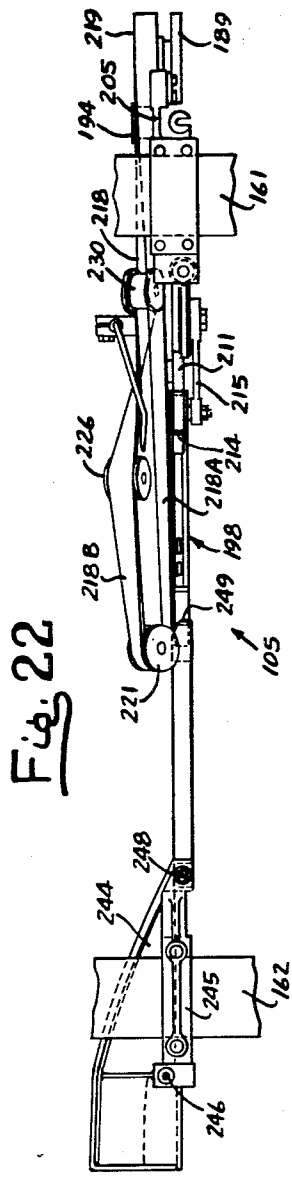


Fig. 22

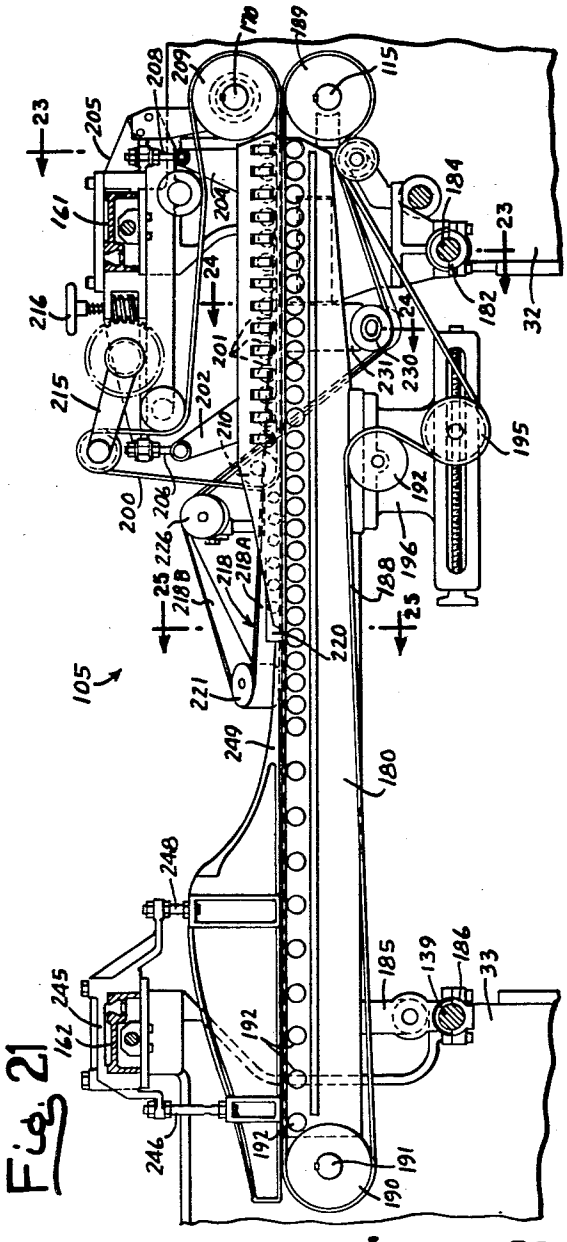


Fig. 21

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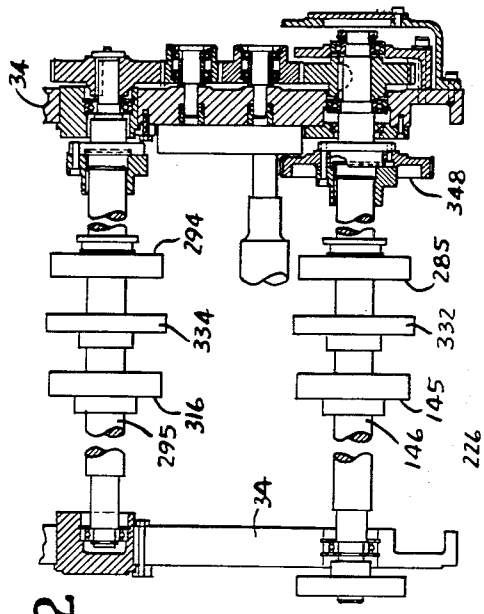


Fig. 32

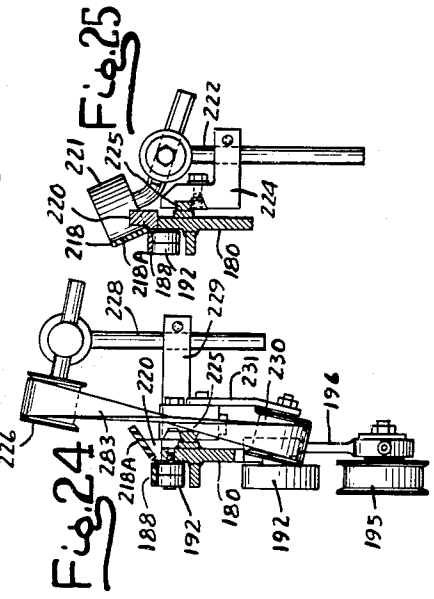


Fig. 24

Fig. 25

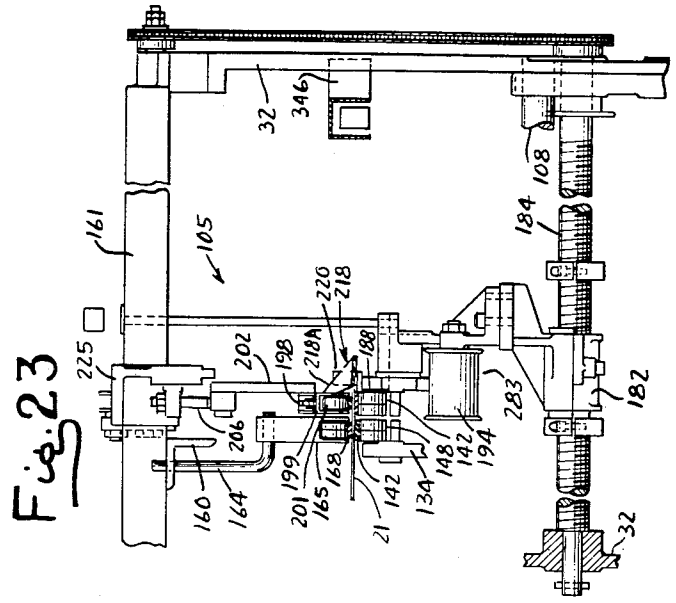


Fig. 23

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Fig. 26

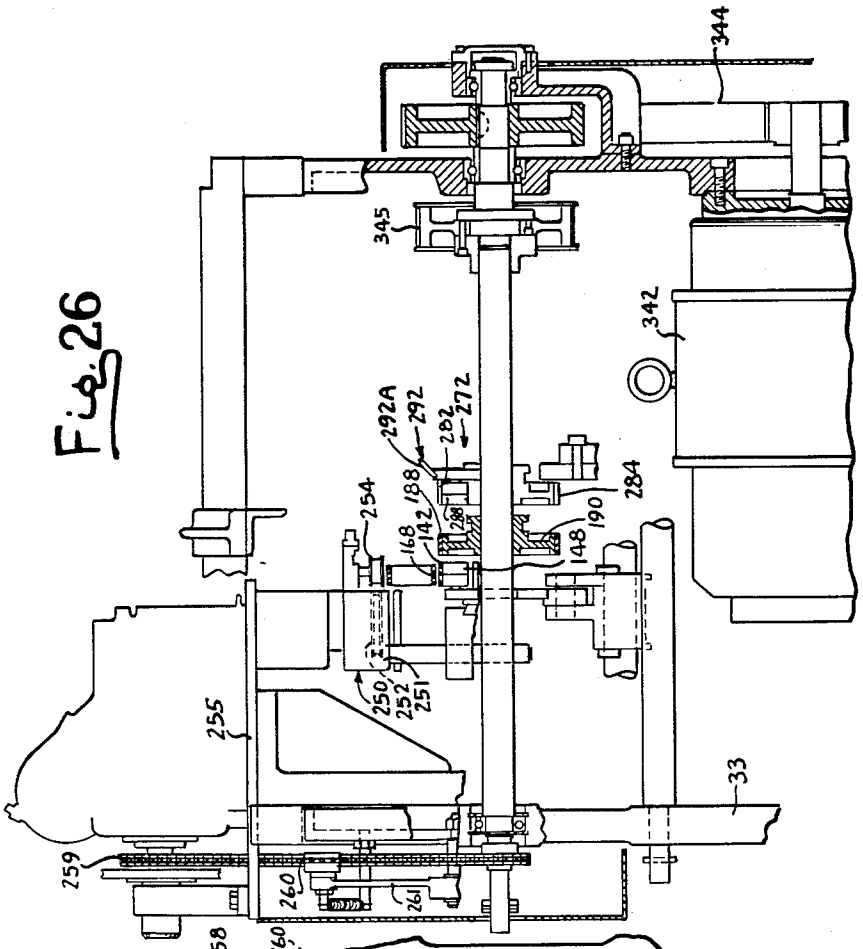
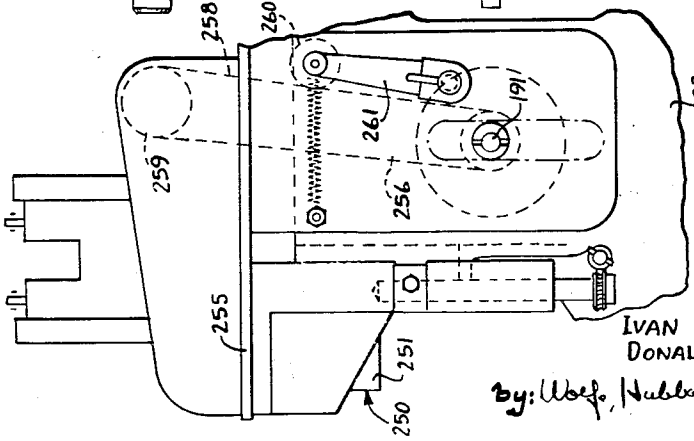


Fig. 27



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METHOD AND APPARATUS FOR SIDE SEAMING CARTON BLANKS BY APPLICATION OF HEAT

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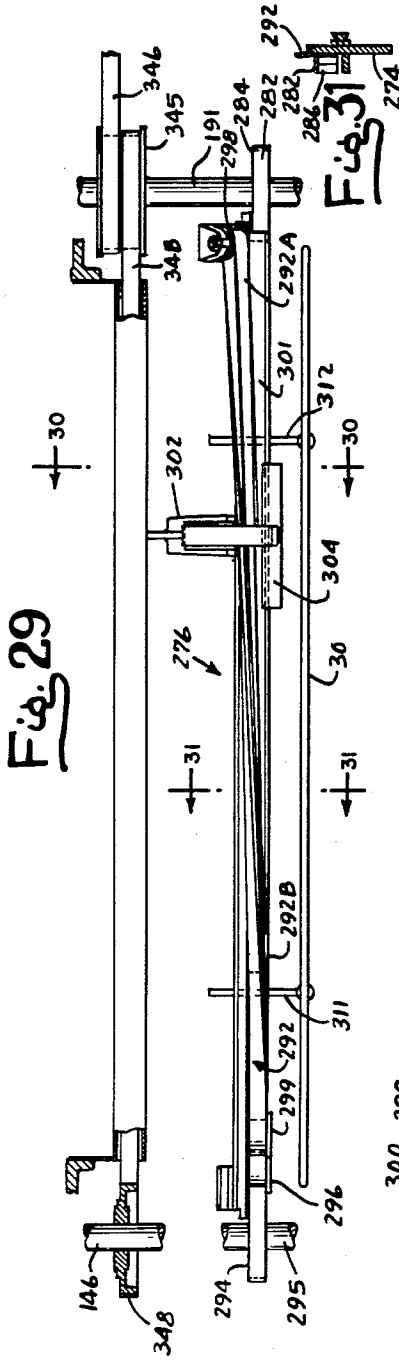


Fig. 29

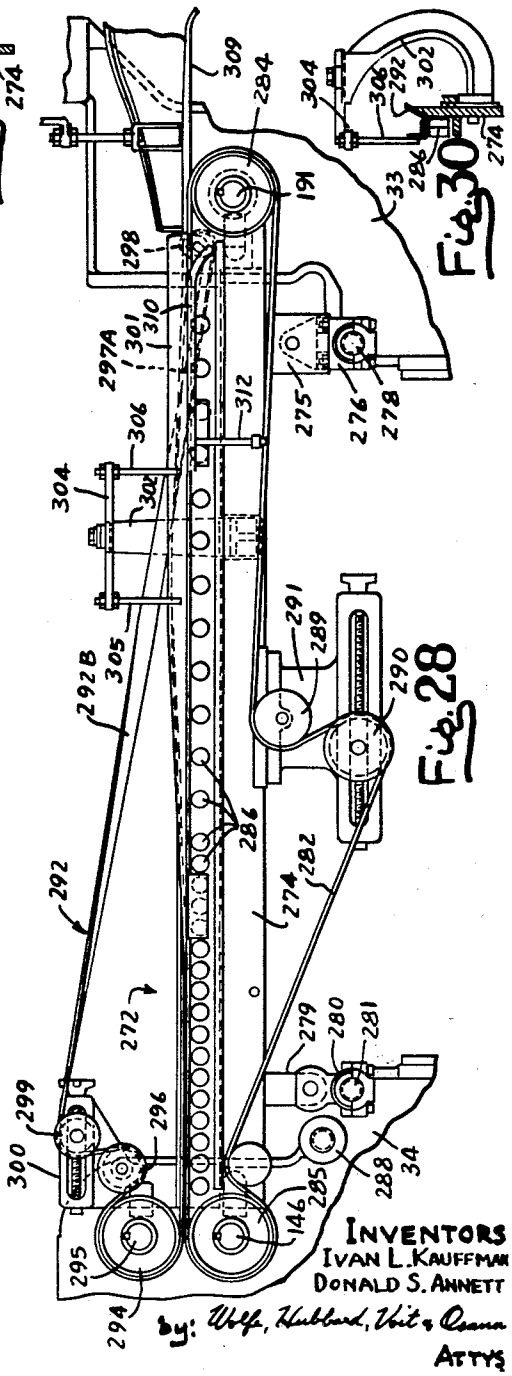


Fig. 28

Fig. 30

Fig. 31

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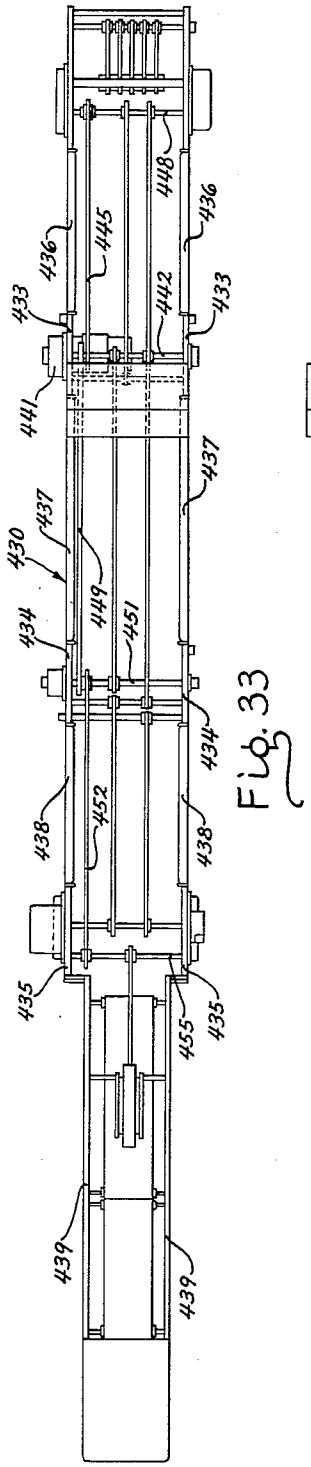


Fig. 33

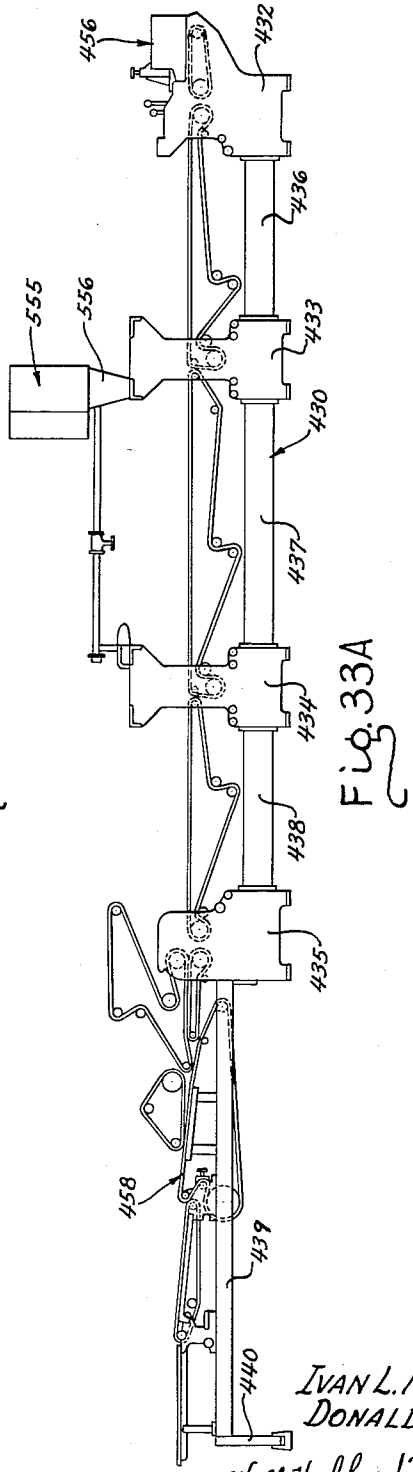


Fig. 33A

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METHOD AND APPARATUS FOR SIDE SEAMING CARTON BLANKS BY APPLICATION OF HEAT

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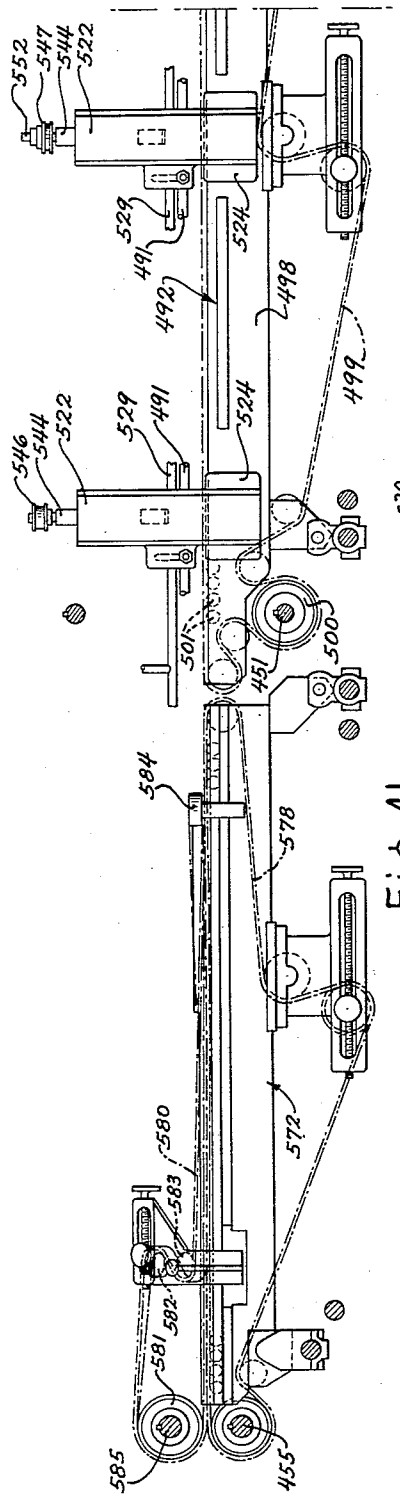


Fig. 41

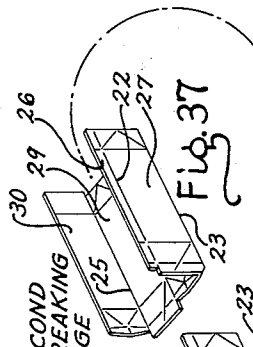


Fig. 37

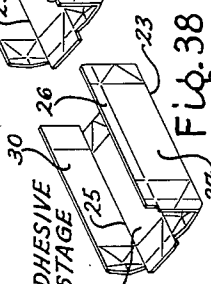


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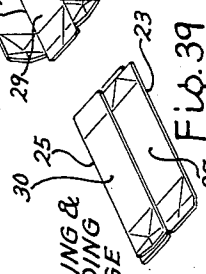


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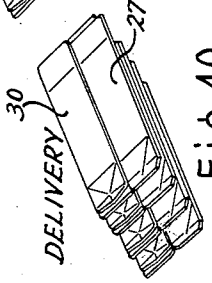


Fig. 40

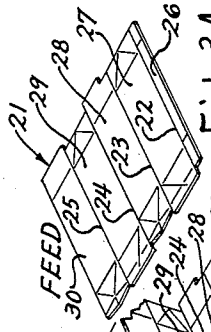


Fig. 34

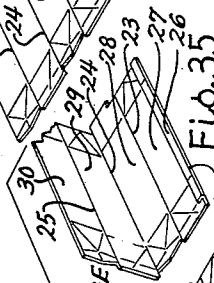


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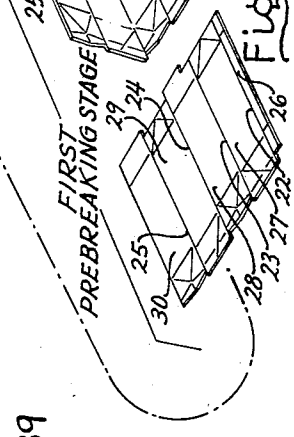


Fig. 36

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METHOD AND APPARATUS FOR SIDE SEAMING CARTON BLANKS BY APPLICATION OF HEAT

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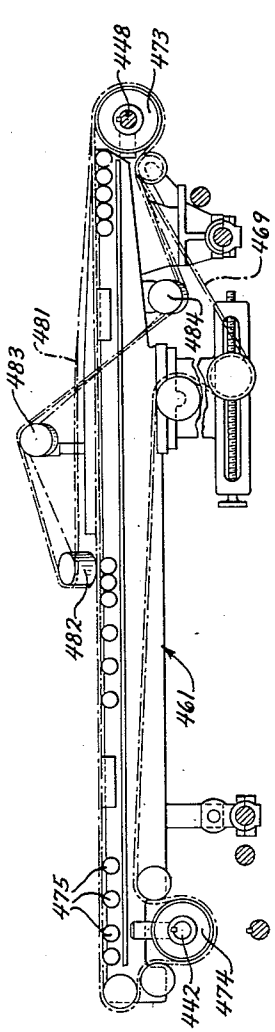


Fig. 42B

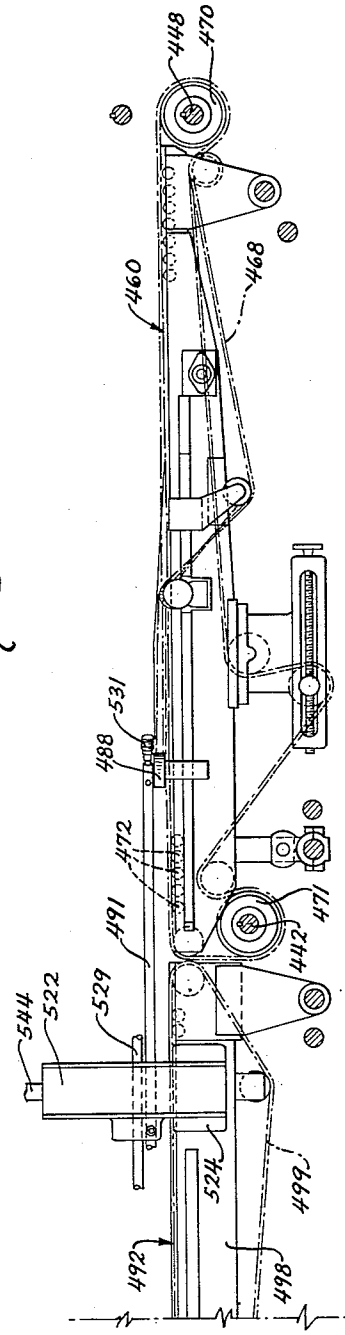


Fig. 41A

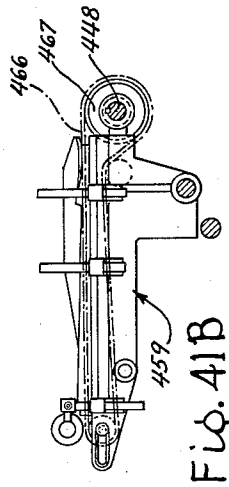


Fig. 41B

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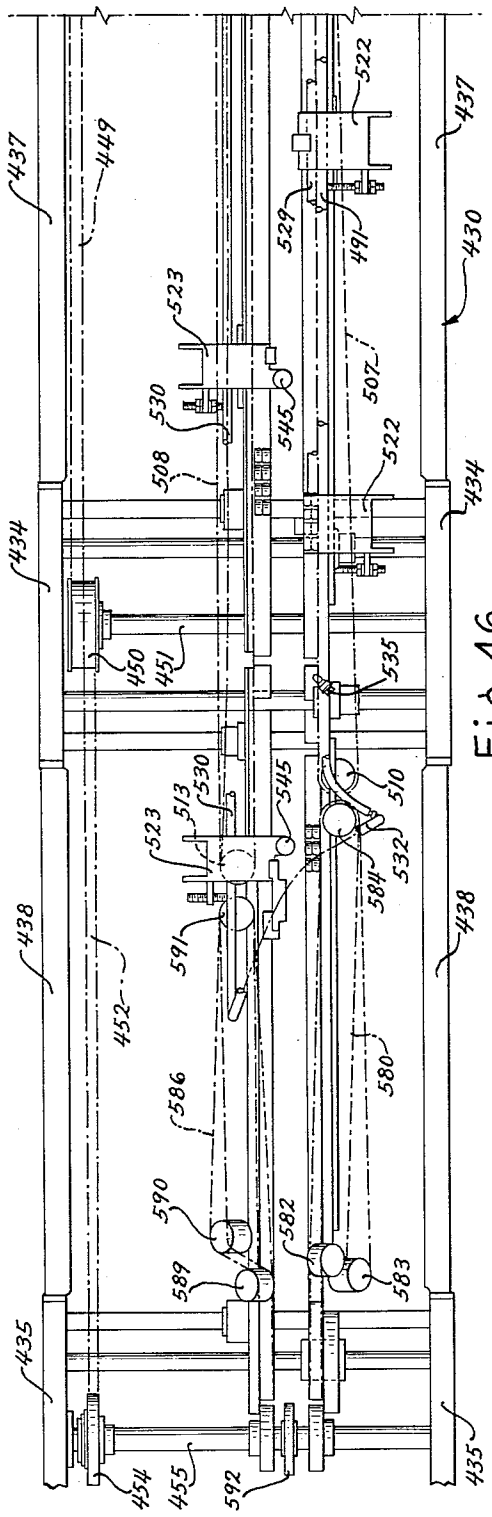


Fig. 46

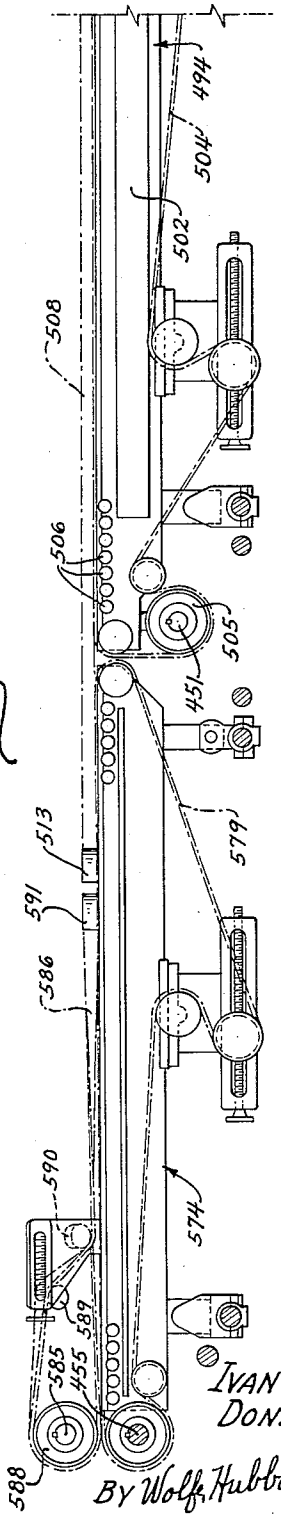


Fig. 42

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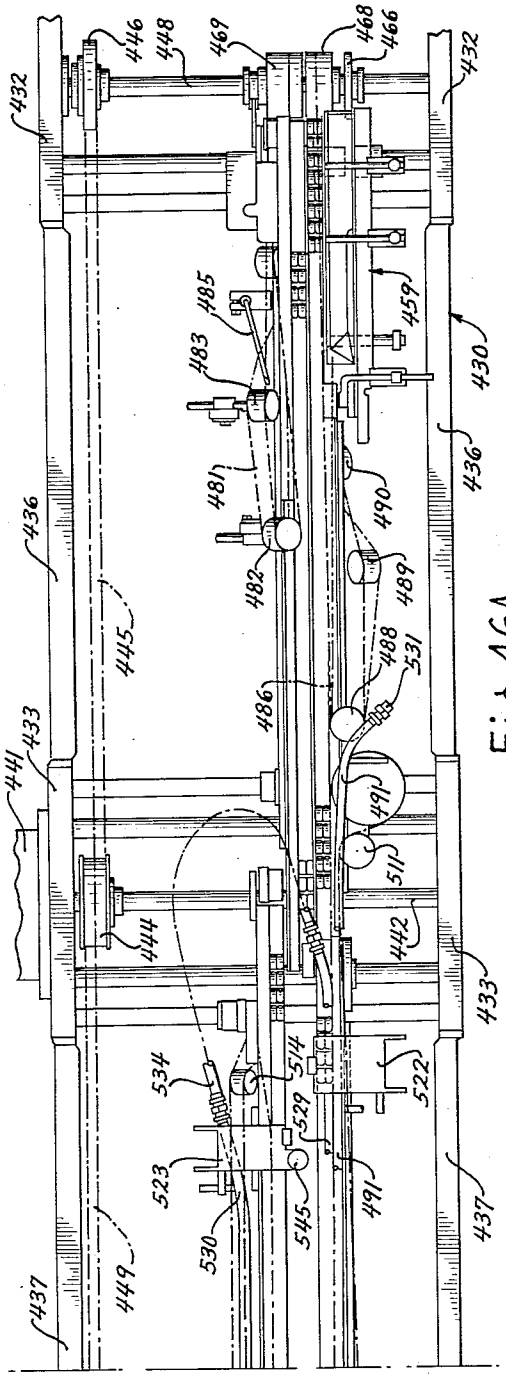


Fig. 46A

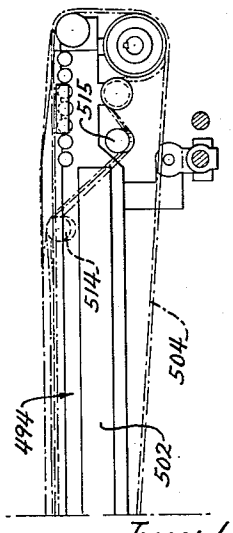


Fig. 42A

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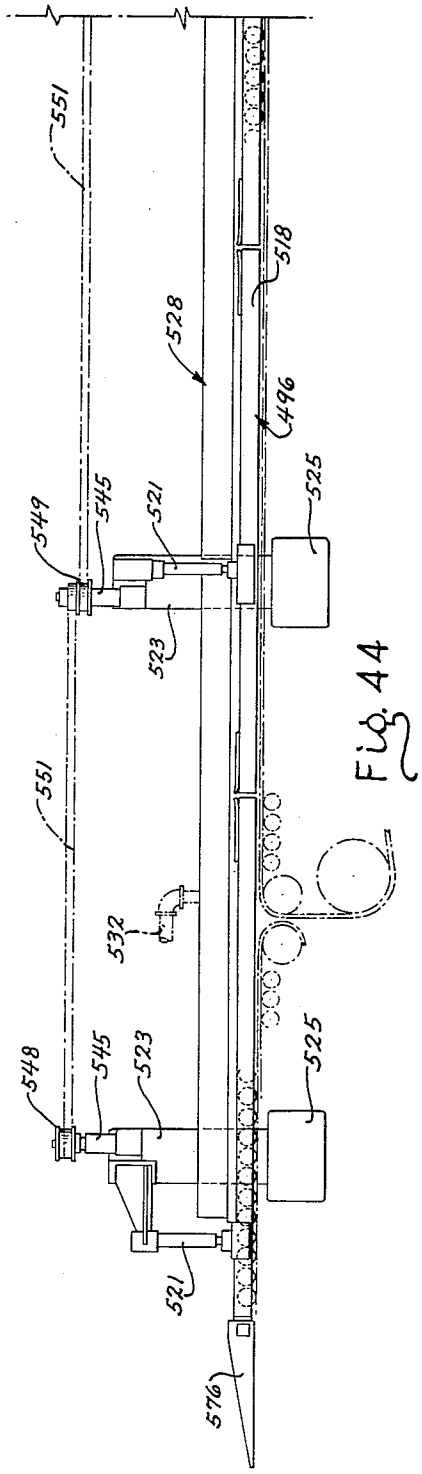


Fig. 44

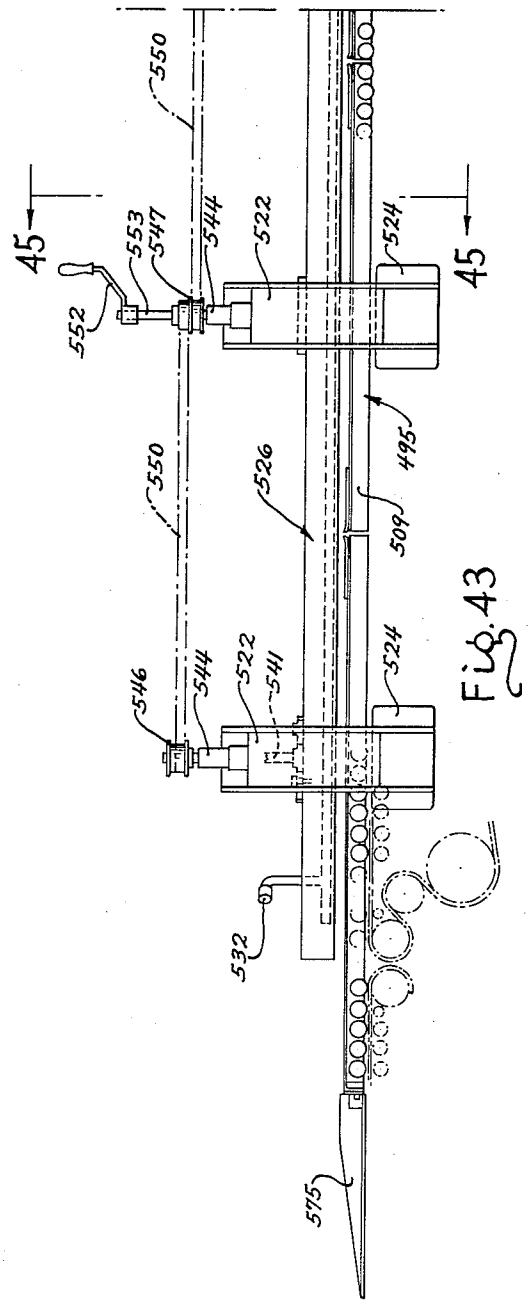


Fig. 43

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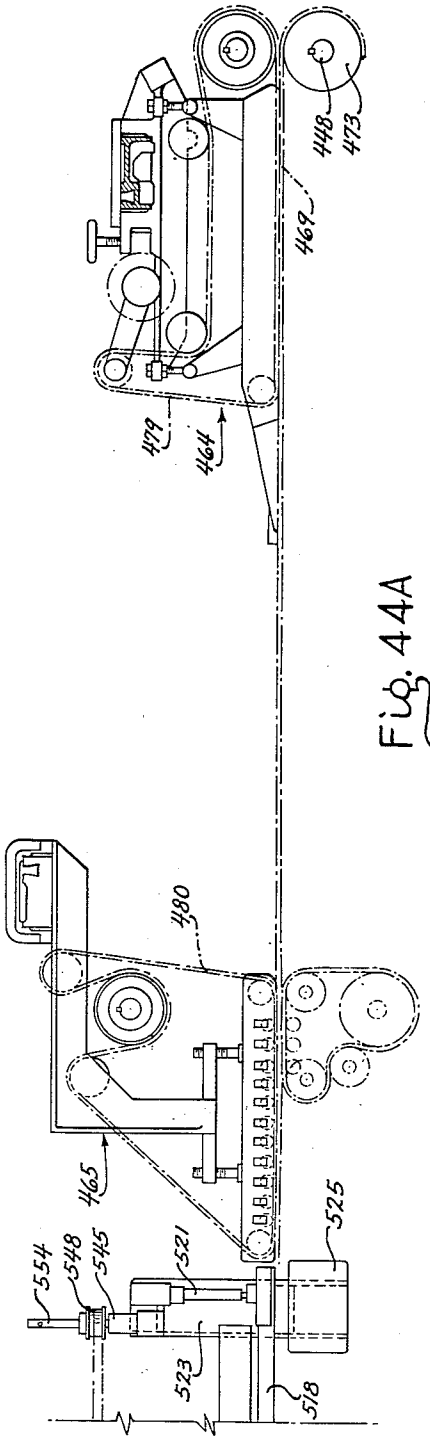


Fig. 44A

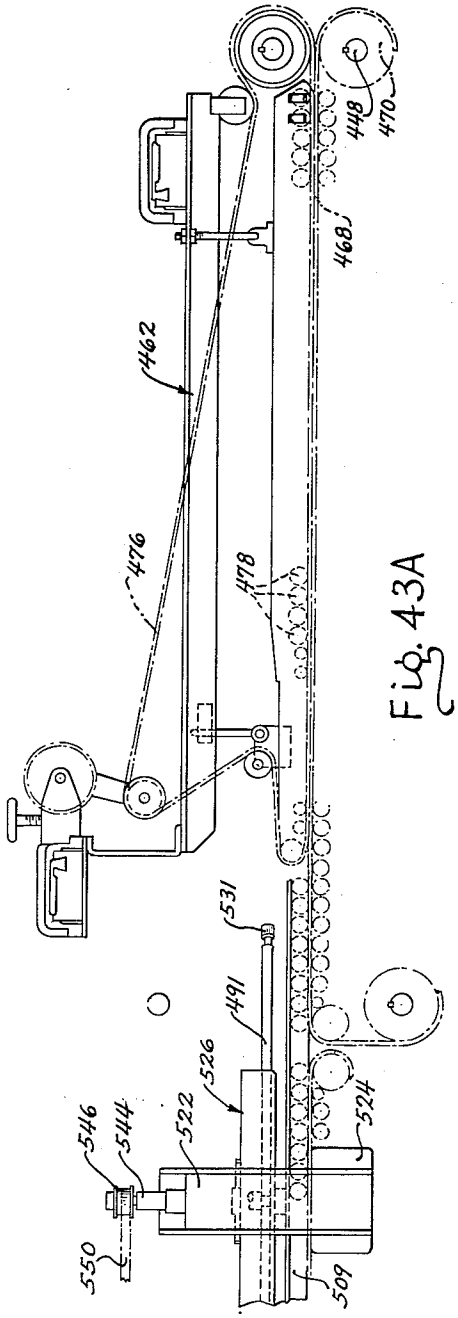


Fig. 43A

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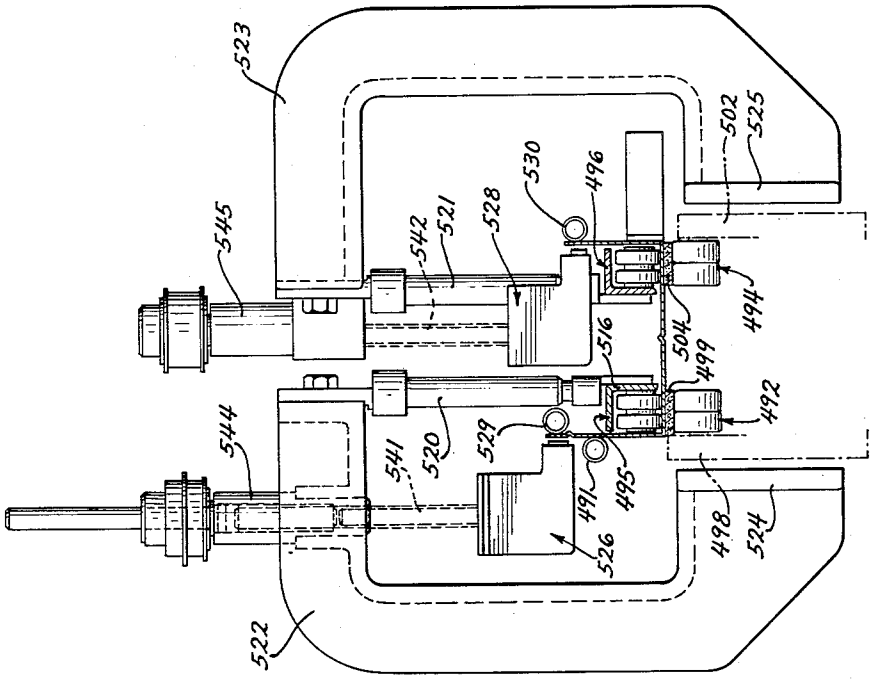


Fig. 45

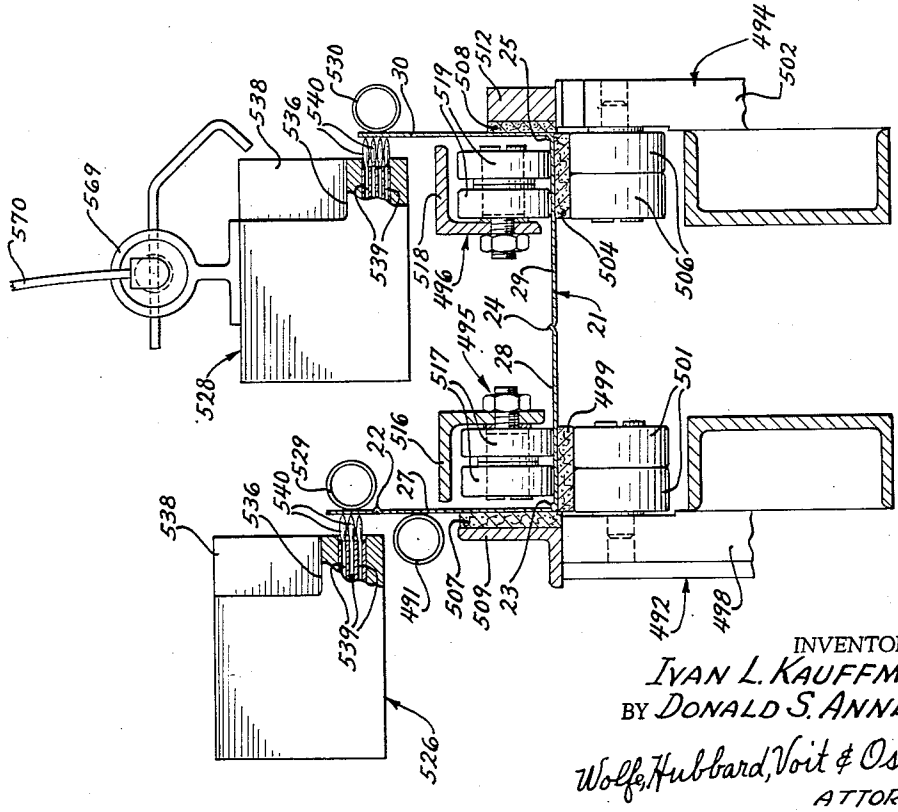


Fig. 48

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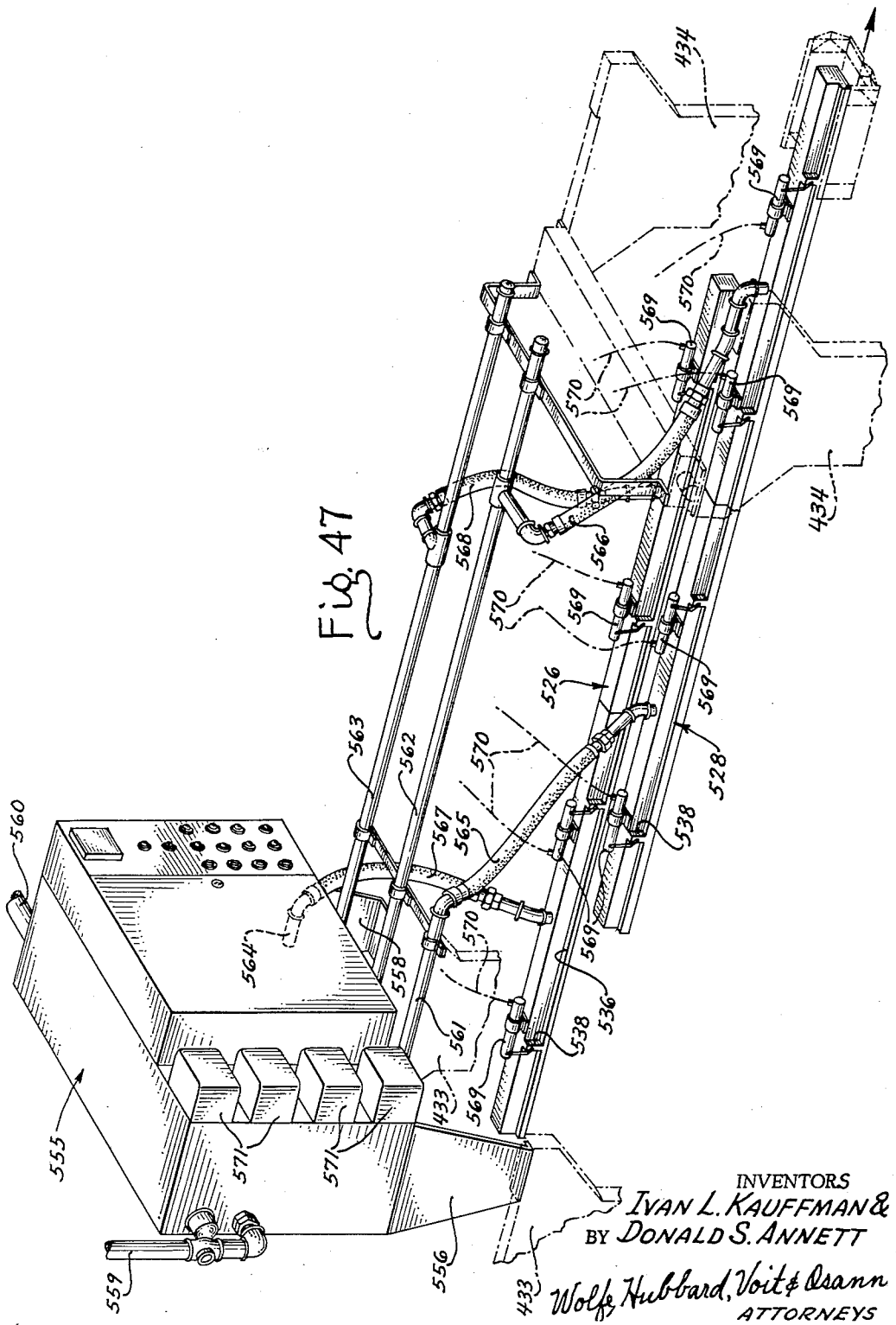
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Feb. 25, 1964 I. L. KAUFFMAN ETAL 3,122,070

METHOD AND APPARATUS FOR SIDE SEAMING CARTON BLANKS BY APPLICATION OF HEAT

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Fig. 47



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METHOD AND APPARATUS FOR SIDE SEAMING CARTON BLANKS BY APPLICATION OF HEAT

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11 Claims. (Cl. 93—52)

This application is a continuation-in-part of our earlier copending application Serial No. 69,593, filed November 16, 1960, now Patent No. 3,085,480 issued April 16, 1963.

The present invention relates to the field of carton making and, more specifically, to a novel method and apparatus for side seaming a carton blank of paperboard or the like. The invention finds particular, but by no means exclusive, utility in heat sealing the side seam of plastic coated paperboard carton blanks of the type disclosed in the applications of Harry B. Egleston and Charles Z. Monroe, Serial Nos. 707,259, now abandoned, and 122,571, filed in the United States Patent Office on January 6, 1958 and July 7, 1961, respectively.

In the manufacture of certain types of cartons, such, for example, as paperboard cartons for milk and other dairy products, it is important that the adhesive applied to the carton blank be located with precision. This may be due to a variety of reasons including sanitation, appearance, or some requirement dictated by the structure or manner of assembling the carton. These considerations are particularly significant with respect to heat sealing of the side seam on a carton blank preparatory to manipulating the blank into flat-folded tubular form for shipment to the place where it will be erected, filled and sealed.

Heretofore, a number of expedients have been utilized for positioning a carton blank for side seaming, but all have undesirable limitations. One such method involves locating the blank by means of its cut lateral edge remote from the glue flap. Another involves locating by means of the lateral edge of the glue flap itself. Both of these arrangements are disadvantageous in that the lateral edges used for reference are not always clean cut. Still another mode is to utilize a pair of laterally spaced parallel belts or guide bars straddling a partially folded panel in the blank. This is also subject to error in that it may permit the blank to become skewed by an angle proportional to the distance between the belts.

In addition to precision of location of adhesive in making a carton seam, the introduction of plastic coated carton stock and fast-setting thermally activated adhesives make the time factor from application to bonding a critical element. Where conventional practice is followed, the parts of the blank to be glued are bent through an angle of 180° from the application of the adhesive to joining of the glued surfaces together. This results in an undesirable time delay prior to bonding.

Having the foregoing in mind, one object of the present invention is to provide a novel method and apparatus for precisely positioning a carton blank during the side seaming operation by taking advantage of the structure of the carton in a simple but highly effective manner.

Another object of the invention is to provide a method and apparatus of the character set forth which will be particularly well adapted for high speed heat sealing of the side seam of a carton blank having a coating or surface of thermoplastic material, selected areas of the latter being utilized to form the adhesive juncture of the seam.

A further object of the invention is to provide a novel method and apparatus for heat sealing a carton blank having a coating or surface of thermoplastic material and which method and apparatus will be susceptible of

high speed operation by minimizing substantially the time elapsing between activating the thermoplastic coating and bringing the activated surfaces together to form a bond or seal.

Another object of the invention is to provide a method and apparatus of the foregoing type whereby the heating time required for heat sealing the plastic coated carton blank is substantially minimized, reducing the amount of heat energy driven into the paperboard and retaining the energy primarily in the plastic coated surface thereof, minimizing the chance of damage or deterioration of the plastic coated surface, and leaving the body of the paperboard substantially cool so as to accelerate setting and sealing.

A further object is to provide a method and apparatus of the character set forth wherein the closing time required for effecting the seal will also be substantially minimized, thereby minimizing the total amount of heat energy required to effect the seal.

Still another object of the invention is to provide a novel conversion unit adapted to modify the operation of an existing adhesive applicator type side seam gluing machine into a heat sealed type machine, thereby substantially increasing the effective operating speed and productivity of the machine.

Other objects and advantages will become apparent from the following detailed description, taken together with the accompanying drawings, wherein:

FIGURE 1 is a plan view of an illustrative apparatus embodying the present invention and by means of which the method of the invention may be carried out.

FIG. 2 is a side elevation of the apparatus of FIG. 1.

FIG. 3 is a plan view showing the inside face of an illustrative carton blank adapted to be glued by the use of the method and apparatus of the present invention.

FIG. 4 is a plan view of the blank of FIG. 3 after the same has been glued and folded in a flat collapsed tubular shape adapted for presentation to a forming, filling, closing and sealing machine.

FIGS. 5 to 10, inclusive, are stop-motion sequential views illustrating the successive stages through which the blank of FIG. 3 is put in practice of the method and operation of the apparatus of the present invention.

FIG. 11 is an enlarged fragmentary side elevation of the feed mechanism of the illustrative apparatus described herein.

FIG. 12 is an enlarged fragmentary end elevation of the feed mechanism of FIG. 11.

FIG. 13 is a broken transverse sectional view through a portion of the feed mechanism and taken in the plane of the line 13—13 in FIG. 11.

FIG. 14 is a fragmentary vertical sectional view taken in the plane of the line 14—14 in FIG. 12.

FIG. 15 is a side elevation of the glue flap folder frame of the illustrative apparatus described herein.

FIG. 16 is a plan view of the glue flap folder frame of FIG. 15.

FIGS. 17 and 18 are, respectively, end elevations of the glue flap folder frame with certain of the parts being illustrated in vertical section to bring out detail.

FIGS. 19A and 19B are companion side elevational views of the left-hand folder frame of the apparatus.

FIGS. 20A and 20B are corresponding companion plan views of the left-hand folder frame of FIGS. 19A and 19B.

FIGS. 21 and 22 are, respectively, side elevation and plan views of the first right-hand folder frame of the illustrative apparatus.

FIGS. 23, 24 and 25 are vertical sectional views taken through the first right-hand folder frame in the planes of the lines 23—23, 24—24 and 25—25, respectively, of FIG. 21.

FIG. 26 is a vertical sectional view through the central portion of the illustrative apparatus and showing the relation of certain of the blank carrier means to the adhesive applicator.

FIG. 27 is a fragmentary side elevational view of the apparatus as shown in FIG. 26.

FIGS. 28 and 29 are, respectively, elevation and plan views of the second right-hand folder frame of the apparatus.

FIGS. 30 and 31 are enlarged fragmentary vertical sectional views taken through the second right-hand folder frame in the planes of the lines 30—30 and 31—31, respectively, of FIG. 29.

FIG. 32 is an enlarged developed sectional view taken axially of the main drive shafts and drive pulleys at the discharge end of the folder frames.

FIG. 33 is a plan view of another illustrative apparatus embodying the invention and by means of which the method of the invention may be practiced.

FIG. 33A is a side elevation of the apparatus of FIG. 33.

FIGS. 34 to 40, inclusive, are stop-motion sequential views illustrating successive stages through which a blank such as the one shown in FIG. 3 passes in practice of the method and operation of the apparatus exemplified in FIGS. 33 and 33A.

FIGS. 41 and 41A are companion side elevational views of the left-hand folder frame assemblies of the apparatus shown in FIGS. 33 and 33A.

FIG. 41B is a side elevation of the glue flap folder frame of the apparatus of FIGS. 33 and 33A.

FIGS. 42, 42A and 42B are companion side elevational views of the right-hand folder frame assemblies, heat, folder and prebreak sections, respectively, of the apparatus of FIGS. 33 and 33A.

FIGS. 43 and 43A are companion side elevational views of the left-hand top carrier assembly, heat and prebreak sections, of the apparatus of FIGS. 33 and 33A.

FIGS. 44 and 44A are companion side elevational views of the right-hand top carrier assembly, heat and prebreak sections, of the apparatus of FIGS. 33 and 33A.

FIG. 45 is an enlarged transverse sectional view taken through the top carrier and folder frame assemblies in the plane of the line 45—45 in FIG. 43.

FIGS. 46 and 46A are companion plan views of the prebreak, heat and folder sections of the apparatus shown in FIGS. 33 and 33A.

FIG. 47 is an enlarged fragmentary perspective view of the burner assembly and control panel for the heat section in the apparatus of FIGS. 33 and 33A.

FIG. 48 is an enlarged fragmentary transverse sectional view taken through an intermediate plane in the heat section of the illustrative apparatus of FIGS. 33 and 33A.

While the invention is susceptible of various modifications and alternative constructions, certain illustrative embodiments have been shown in the drawings and will be described below in considerable detail. It should be understood, however, that there is no intention to limit the invention to the specific forms or modes disclosed, but, on the contrary, the intention is to cover all modifications, alternatives and equivalents falling within the spirit and scope of the invention as expressed in the appended claims.

General Procedure and Organization

Turning now to FIGS. 1 to 10, inclusive, the invention is there exemplified in a novel method and in an illustrative apparatus 20 through which the method may be carried out. In the present instance, the objective is to perform a side seaming operation on a flat carton blank such, for example, as the one disclosed in Egleston and Monroe applications Serial Nos. 707,259 and 122,571 referred to earlier herein. To this end, a cut and scored blank 21 is manipulated through a number of stages

while undergoing continuous, straight line motion and ultimately emerges as a flat folded, open-ended tube, as shown in FIG. 4, adapted for presentation to forming, filling, closing, and sealing equipment.

Referring more specifically to FIG. 3, the inside face of the carton blank 21 is there shown with a plurality of spaced apart, substantially parallel longitudinal score lines 22, 23, 24 and 25 dividing the face of the blank into a relatively narrow glue flap 26 adjacent one marginal edge thereof and a plurality of side panel areas 27, 28, 29 and 30 which in this case are of approximately equal width. The blank also includes a series of transverse and angular score lines which facilitate formation of the top and bottom closures of the carton when erected but for present purposes these latter lines need not be further considered.

Starting with the blank 21 in the flat, unfolded condition illustrated in FIG. 5, the first step in the practice of the method of the invention is to move the blank along a support in a straight line running longitudinally of the longitudinal score lines 22, 23, 24 and 25 therein. As an incident to such motion, the blank is subjected to a first prebreaking stage, illustrated in FIG. 6. While passing through this stage, the glue flap 26 is folded out of the plane of the blank through an angle of approximately 180° about the score line 22, the inner face of the glue flap thereupon abutting the inner face of the side panel area 27. At the same time, the side panel areas 29 and 30 are folded upwardly as a unit out of the plane of the blank about the score line 24 and through an angle of approximately 110°.

Still under continuous straight line motion along the support, the blank 21 is then subjected to a second prebreaking stage, illustrated in FIG. 7. In this stage, the glue flap 26 is folded backwardly about the score line 22 through an angle of approximately 90° and, at the same time, the side panel area 27 is folded about the score line 23 upwardly out of the plane of the blank through an angle of approximately 90° until the glue flap and the side panel area 27 are substantially coplanar and perpendicular to the original plane of the blank. By the same token, the panel areas 29 and 30 are folded backwardly about the score line 24 until they have returned approximately to the original plane of the blank.

The blank then continues its straight line motion along the support and enters into the adhesive stage, illustrated in FIG. 8, where it its subjected to contact with an adhesive applicator. The latter is adapted to apply a fast-setting thermally activated adhesive to the outside face of the glue flap, as in the present instance, but may also be adapted to activate thermoplastic adhesive material already presenton the glue flap. The glue flap 26 is precisely positioned for adhesive application by reason of the perpendicular relationship between the side panel area 27 and the side panel area 28 which remains in the original plane of the blank. Thus, it will be perceived that the corner score line 23, and the precise lateral dimension of the side panel area 27, accurately position the glue flap for reception of the adhesive from the adhesive applicator. As an incident to passing through the adhesive stage, the side panel are 30 on the opposite edge of the blank is broken upwardly about the score line 25 through an angle of approximately 90° from the original plane of the blank.

The adhesively activated blank, still moving in a straight line, then enters the sealing and bonding stage, illustrated in FIG. 9. At this point, the side panel area and glue flap 26 are downfolded against the inside face of the blank at an angle of approximately 90°, followed in quick succession by downfolding of the side panel area 30 into abutting relation with the glue flap. The application of ironing pressure to these abutting elements serves to complete the bonding and sealing of the side seam and the blank thereupon emerges as a flat folded collapsed tube. Completed blanks are collected at the discharge station, illustrated in FIG. 10, for subsequent

presentation to forming, filling, closing and sealing equipment.

With the foregoing in mind, attention may now be given to the illustrative apparatus 20 in greater detail. Referring more specifically to FIGS. 1 and 2 which are primarily diagrammatic views, it will be noted that the apparatus 20 is organized upon a relatively long main frame 31. In the present instance, the frame 31 comprises three pairs of laterally spaced side frame members 32, 33 and 34 formed of relatively heavy plate material and maintained in longitudinally spaced relation by means of intermediately situated pairs of side rails 35, 36. In addition, the side frames 34 include cantilever brackets 38 which may be supported adjacent their outboard ends by means of column 39.

Feed Mechanism

The apparatus 20 includes a high-speed feed mechanism 40 (FIGS. 11 to 14) which is adapted to hold a supply of cut and scored flat blanks 21 and to present them one at a time in precisely oriented form to the carrying mechanism which moves them through the subsequent stages of the machine.

As shown in FIGS. 11 and 12, the feed mechanism 40 comprises a magazine 41 defined by a pair of laterally spaced plates 42 adapted to hold a stack of flat blanks 21. In this instance, the magazine is adapted to receive the blanks with their inside faces up, their longitudinal score lines aligned with the plates 42, their longitudinal edges abutting the plates 42, and with their top edge leading in so far as their subsequent movement is concerned. The stacked blanks, when so positioned in the magazine, are adapted to bear against a pair of laterally spaced, adjustable stop bars 44 mounted at the inner end of the magazine on a heavy transverse bar 45.

Underlying the magazine 41 are a plurality of power driven feed belts 46 disposed in laterally spaced relation and extending around a common drive roller 48 fixed to a shaft 49 (FIGS. 11, 12 and 13). The belts 46 extend from the roller 48 to a plurality of idler pulleys 50 journaled on individually adjustable tensioning arms 51, the latter being rockably mounted on a transverse support shaft 52. The upper flights of the feed belts 46 are disposed horizontally and supported by a plurality of aligned support rollers 54 (FIG. 11) situated between the drive roll 48 and idlers 50.

The stack of blanks 21 is supported in the magazine with its inner or leading end downwardly inclined against the feed belts 46 and its outer or rearward end raised and resting upon a plurality of laterally spaced adjustable support rollers 55. The latter are mounted on adjustable arms 56 which extend into the magazine. The roller support arms 56 are, in turn, adjustably secured to mounting brackets 58 carried by a fixed transverse support shaft 59 spanning the side frames 32.

For the purpose of effecting positive feeding of blanks one at a time in rapid succession from the bottom of the stack, the magazine 41 is equipped with a power feed gate 60 (FIGS. 11, 12 and 14). The latter comprises an upstanding mounting bracket 61 which may be adjustably mounted on the transverse bar 45 as by means of one or more clamping bolts 62. The bracket 61 carries gate member 64 which is mounted thereon for limited vertical sliding movement as determined by adjustment handwheel 65. Projecting from the lower end of the gate member 64 and forming a rigid extension thereof is a fixed finger 66. The gate member is so adjusted as to have a clearance with the nearest underlying feed belt 46 approximately equal to but slightly greater than the thickness of one of the blanks 21. Operatively associated with the finger 66 and also carried by the gate member 64 is a power driven, endless flexible member which in this case happens to be an externally toothed belt 68 (FIG. 14). The latter extends in a loop between upper and lower idler rollers 69, 70, journaled on the gate member, and is driven by pulley 71 which is held in driving engagement therewith by associated idlers 72, 74. The drive pulley 71, in turn, is splined or otherwise slidably keyed to shaft 75. The latter is connected by drive sleeve 76, protective slip clutch 78, sprocket 79, chain 80 and sprocket 81 to said roll drive shaft 49 (FIGS. 12 and 13).

By reason of this arrangement, it will be appreciated that the lower portion of the stack of blanks 21 is urged downwardly and forwardly so that the lower portion of the stack of blanks in the magazine, that is the portion below lower ends of the stop bars 44, is wedged down against the inclined abutting surface of the finger 66. Due to the weight of the stack, and the positive downward pressure exerted by the belt 68, the leading marginal edge portion of the lowermost blank in the stack is frictionally engaged by the belts 46 and slipped under the projecting end of the finger 66, resulting in rapid withdrawal of the blank from the magazine and presentation to the next portion of the apparatus for subsequent processing. As soon as one blank has left the magazine in this manner, the next blank above it in the stack drops down against the feed belts 46, past the end of the finger 66, repeating the same withdrawal action. This arrangement permits the feeding of blanks in rapid succession and with no overlapping as they progress through the principal processing stages of the apparatus 20.

Blanks discharged from the magazine 41 are presented to a pair of guide rolls 82, 84 (FIG. 11) which, in turn, present them to movable support means taking them further through the machine. In order to insure proper transfer from the magazine to the rolls 82, 84, and avoid the possibility of jams in between, the power gate 60 may have associated therewith one or more pairs of hold-down rollers 85. The latter may conveniently be carried on downwardly biased frames 86, the latter being mounted on depending brackets 88 fastened to transverse strip 45.

The feed mechanism 40 may be driven at a great variety of speeds, depending upon the operating speed of the apparatus 20. This is accomplished in the present instance by means of a small power transmission 89 (FIGS. 11 and 13), including a split drive pulley 90, an idler 91 and a driven pulley 92. The driven pulley 92 is in this case coupled to the feed belt drive shaft 49 by means of an appropriate clutch 94. The clutch 94 is actuated by means of manual control lever 95 and shifter yoke 96 which is rigidly secured thereto. The speed of the driven pulley 92 and feed belt shaft 49 may be precisely adjusted by means of handwheel 98 situated at the upper end of a vertically disposed control rod 99, carried in a bracket 100 on the machine side frame 32. The lower end of the control rod 99 threadedly engages a pivoted crank arm 101 which carries the idler 91. This arrangement affords a wide range of feeder speeds and contributes to the versatility of the apparatus.

First Prebreaking Stage

As the blank 21 enters the first prebreaking stage (FIG. 6) provision is made for breaking the glue flap 26 about the score line 22 through an angle of substantially 180° and folding it back on the inside face of the blank. At the same time, the blank is broken about the score line 24 with the panels 29, 30 being raised upwardly as a single coplanar unit into a position perpendicular to or a little beyond the original plane of the blank. This is accomplished through the coaction of a glue flap folder frame 102, a left-hand folder frame 104, and a first right-hand folder frame 105, including their respective carrier, pressure, and folder belts.

The glue flap folder frame 102 (FIGS. 15 to 18) is rigidly mounted longitudinally of the machine between the side frame members 32 and side rails 35. In the present instance, the glue flap folder frame has at one end a relatively heavy depending bracket 106 fixed upon a transverse strut 108 spanning the side frames 32. The

opposite end of the glue flap folder frame 102 is mounted on a fixed transverse stub shaft 109 which projects laterally from adjacent left-hand folder frame 104.

Operatively associated with the glue flap folder frame 102 is a traveling support comprising a carrier belt 110 which is trained over a drive pulley 111 and a pair of idler pulleys 112, 114 (FIG. 15). The drive pulley is fixed to a transverse shaft 115 driven from an appropriate power source in the apparatus. The idler 112 remote from the drive pulley 111 is adjustable with respect to the frame 102 for controlling tension of the belt 110. The upper flight of the carrier belt 110 is supported longitudinally between the pulleys 111, 112 by means of a plurality of underlying support rollers 117 journaled in longitudinally spaced relation along the upper portion of the folder frame 102. The belt 110 is adapted to support the blank along the marginal edge portion of the side panel 27 immediately adjacent the score line 22 which separates it from the glue flap (FIG. 17).

For engaging the glue flap 26 and making the initial bend of it about the score line 22, the glue flap folder frame 102 is provided with a prebreaker bar 118. The latter has adjacent its leading end an inclined ramp 119 which terminates in a plurality of manipulating rollers 120 on progressively inclined axes. The rollers 120 are disposed in longitudinally spaced relation along the folder frame 102 and their axes are disposed first at an obtuse angle and then increasingly inclined toward the folder frame 104 until they approach the horizontal at the far end or innermost end of the folder frame 102.

Upon reference to FIG. 17, it will be appreciated that as the blank 21 and its glue flap 26 move past the ramp 119 and progressively inclined manipulating rollers 120, these elements act to fold the glue flap about the score line 22 and toward the inside or upper face of the blank. By the time the blank has reached the end of the glue flap folder frame 102, the glue flap 26 has been folded through an angle of substantially 180°.

In order to hold-down the blank 21 and maintain it in precise lateral position for accurate breaking along the score line 22, the folder frame 102 is provided with a hold-down shoe 121 overlying the inside face of the blank. The shoe 121 may be adjustably mounted on the folder frame 102 as by means of hanger brackets 122, support columns 124, and adjustable clamping brackets 125 slidably positionable on a cleat 126 of dovetailed cross section running longitudinally of the frame 102.

In order to accommodate the glue flap 26 as it is folded progressively toward the inside face of the blank, the adjacent longitudinal edge portion of the hold-down shoe 121, as well as its trailing end portion, may be relieved or chamfered as at 128, 129. This facilitates the making of a decisive break and a relatively sharp fold on the score line 22.

As the blank passes out of engagement with the trailing end of the hold-down shoe 121, a portion of its inside face previously covered by the shoe is engaged by a hold-down roller 130 (FIGS. 15, 16, 17). The latter in this case is journaled on a hanger 131 supported by an upstanding column 132. The column 132, in turn, is adjustably secured to the folder frame 102 by means of a clamping bracket 125 similar to those described earlier herein and also adapted to engage the cleat 126.

The left-hand folder frame 104 (FIGS. 19A, 19B, 20A, 20B) constitutes one of the main supporting and guiding means for the blank 21 in its passage through the entire machine. In so far as the first prebreaking stage is concerned, the folder frame 104 serves primarily as a moving support and locating means maintaining the blank in position as it is acted upon by the associated folder frames 102 and 105.

For present purposes, it will suffice to note that the left-hand folder frame 104 comprises a keel-like support beam 134 running longitudinally of the machine (FIGS. 19A and 19B). At its end adjacent the feeder (on the right as viewed in FIG. 19B) the beam 134 has a depending bracket 135 which engages transverse support strut 108 between the side frame members 32. In its intermediate portion, the beam 134 has a second depending bracket 136 with a nut 138 at its lower end engaging a transverse positioning screw 139 spanning the side frame members 33. Adjacent its trailing end (on the left as viewed in FIG. 19A) the beam 134 has a third depending support bracket 140 which engages a transverse strut 141 spanning the side frame members 34.

Operatively associated with the support beam 134 and extending along its entire length is a carrier belt 142. The belt 142 is trained over a main drive pulley 144, keyed or otherwise fixed to the drive shaft 115, and a second main drive pulley 145, keyed or otherwise fixed to a drive shaft 146 adjacent the delivery end of the machine. The upper flight of the belt 142 is supported at closely spaced longitudinal intervals by means of support rollers 148 mounted on the beam 134 in any suitable manner (FIGS. 19A, 19B). The lower flight of the belt 142 is trained over fixed idlers 149, 150, 151, 152, and adjustable idler 154. The latter is carried by a depending bracket 155 which includes adjusting screw 156 and knob 158 for regulating belt tension.

With the arrangement just described, the belt 142 is adapted to engage the underside or outside face of the blank 21 along the marginal edge portion of its side panel 28 adjacent the score line 23, and to maintain that engagement throughout all the processing stages of the apparatus. In order to facilitate holding the blank in precise position laterally of the belt 142 as the blank moves through the machine, the folder frame 104 is provided with a top carrier assembly 159 (FIGS. 19A, 19B, 20A, 20B). The latter comprises a structural member 160, which in this case happens to be a structural angle member, extending longitudinally of the machine and adjustably supported by transverse slide bars 161, 162. The bar 161 spans the tops of the side frames 32, while the bar 162 similarly spans the tops of the side frames 33. Suspended in depending relation from the structural member 160, as by means of hangers 164, is a pressure shoe 165 which is disposed in overlying relation with the belt 142 and its support rollers 148. In the present instance, the pressure shoe 165 is fashioned as an inverted channel member having a plurality of longitudinally spaced rollers 166. The latter are resiliently loaded or biased so as to bear downwardly against the lower flight of a pressure belt 168 disposed in overlying registered relation with the carrier belt 142 for a little over half the length of the latter. Under the action of pressure rollers 166, the belt 168 is adapted to coact with the carrier belt 142 for effectively gripping the blank therebetween. The pressure belt 168 is trained over a main drive pulley 169, keyed or otherwise fixed to shaft 170, adjacent the feeder, and a plurality of fixed idlers 171, 172, 173, 174, and an adjustable idler 175. The idler 175 is journaled on the free end of a rockable arm 176 positionable as by means of handwheel 178 and a worm and gear mechanism to regulate belt tension.

Turning now to the first right-hand folder frame 105 (FIGS. 21–25), it will be noted that the same comprises a keel-like support beam 180 mounted longitudinally of the machine and spaced laterally to the right of the folder frame 104 as viewed from the feeder end of the machine. One end of the beam 180 is carried by means of a depending bracket 181 fixed to a nut member 182 on a transverse positioning screw 184 which spans the side frames 32. The opposite end of the beam 180 is carried by a depending bracket 185 connected to a nut member 186 on transverse positioning screw 139 which spans the side frames 33.

The support beam 180 has operatively associated therewith a carrier belt 188 adapted to engage the under-

side of the blank side panel 23 adjacent the score line 24. The latter is trained over a main drive pulley 189 keyed or otherwise fixed to the shaft 115, and a second main drive pulley 190, keyed or otherwise fixed to the shaft 191. The upper flight of the belt 188 is supported at closely spaced longitudinal intervals by means of support rollers 192 journaled on the beam 180 (FIGS. 21, 23–25). The lower flight of the belt 188 is trained over fixed idlers 192, 194, and adjustable idler 195. The latter, like the idler 154 described earlier herein, is mounted on a depending bracket 196 and is adjustable thereon for regulation of belt tension.

Mounted in overlying relation with the belt 188 is a top carrier assembly 198 comprising a longitudinally disposed pressure shoe 199 and a cooperating pressure belt 200 pressed against the belt 188 by the shoe 199. The shoe 199 in this case is fashioned as an inverted channel member and includes a plurality of resiliently loaded or biased rollers 201 adapted to bear against the lower flight of the pressure belt 200. The shoe 199 is held in position by means of a pair of upstanding brackets 202, 204, suspended from horizontal yoke member 205 as by means of hangers 206, 208. The yoke member 205, in turn, is adjustably secured to the transverse slide bar 161. The belt 200 is trained aroung a main drive pulley 209 keyed or otherwise fixed to the shaft 170, and around fixed idlers 210, 211, 212 and an adjustable idler 214. The latter is mounted at the free end of a rockable adjusting arm 215 positionable as by means of handwheel 216 and a worm and gear arrangement to control belt tension.

Provision is made in the folder frame assembly 105 for engaging blank side panels 29, 30 as a unit and breaking them upwardly about the score line 24 through an angle of approximately 110° with respect to the original plane of the blank. This is accomplished by the use of a relatively wide folder belt 218 traveling at the same speed as the blank and adapted to effect broad engagement with the outside surface of the side panel 29 as the blank moves along under the action of the carrier and pressure belts 142, 168 and 188, 200. In this instance, such breaking action takes place during the time the glue flap is being broken and may continue for a short interval thereafter.

The belt 218 is spaced adjacent to, and on the right-hand side of, the carrier and pressure belts 188, 200, as viewed in FIG. 23. It is trained around a drive pulley (FIG. 22) fixed to the shaft 115 in close, laterally spaced relation with the drive pulley 189 of carrier belt 188. The belt 218 includes a folding flight 218A running along the support beam 180 and having an upwardly inclined twist which becomes progressively steeper in the direction of motion of the blank through the machine. The flight 218A is supported and guided by a backing bar 220 (FIGS. 23, 24, 25) secured to the top of the beam 180 and having an upper face which changes in inclination from horizontal to approximately vertical in the direction of motion of the blank.

At the end of the flight 218A remote from the drive pulley 219, the belt 218 is trained around an inclined idler 221 partially overlying the carrier belt 188. The idler 221 is disposed so that its outer periphery, and hence the plane of the belt 218 in that area, will make an acute angle of approximately 80° with the plane of the belt 188. The idler 221 is adjustably mounted on a column 222 carried by clamp bracket 224 which engages a cleat 225 running longitudinally of the beam 180.

The return flight 218B of the belt 218 runs from the idler 221 over a second inclined idler 226 (FIGS. 21, 22 and 24) mounted somewhat higher than the idler 221 and disposed a little further to the right as viewed in FIG. 24. The idler 226 is adjustably mounted by means including a column 228 and a clamp bracket 229 which also engages the cleat 225. The return flight 218B extends from the idler 226 in a downwardly inclined direction, with a twist, and passes over inclined idler 230 carried by depending bracket 231 adjustably clamped to the cleat 225. From the idler 230, the flight 218B passes over common fixed idler 194, which also carries the belt 188, and thence to the drive pulley 219.

By reason of the arrangement just described, as the blank 21 is carried along the folder frames by the belts 142, 168, 188, 200, the folding flight 218A of the belts 218 engages a wide area of the underside of the side panel 29. Due to the progressive inclination of the flight 218A and the backing bar 220, the side panel 29 and its associated side panel 30 are cammed upwardly as a unit so as to break about the score line 24. This continues until the upward folding or breaking movement of the side panels 29, 30 has caused them to move through an angle of approximately 110° with respect to their original position in the plane of the blank. At this point, the first prebreaking stage is completed.

Second Prebreaking Stage

In the second prebreaking stage, exemplified in FIG. 7, provision is made for breaking the side panels 27, 28 relative to one another about the score line 23 and at the same time for down-folding the side panels 29, 30 to a position approaching the original plane of the blank in preparation for breaking them relative to each other about the score line 25. Also, as an incident to the second prebreaking stage, the glue flap 26 is urged back toward a coplanar relationship with the side panel 27 as the latter is folded upwardly into a substantially perpendicular position about the score line 23.

In furtherance of the foregoing, the left-hand folder frame 104 is provided with a folder belt 232 (FIG. 19B) adapted to engage the underside of the side panel 27 adjacent the score line 23 and to cam the panel 27 upwardly shortly after it passes the pressure roller 130 (FIG. 17). The folder belt 232 is trained over a drive pulley 234 fixed to the shaft 115 in close, laterally spaced relation to the drive pulley 144 of belt 142 and on the left of the latter as viewed from the feeder end of the machine. The belt 232 has a folding flight 232A extending along a backing bar 235 fixed to the beam 134 of the left-hand folder frame. The backing bar 235 has an inclined ramp 236 defined in its upper surface and having a lateral inclination which increases progressively in the direction of blank movement until it reaches a substantially vertical attitude. The folding flight of the belt 232 terminates at a fixed idler 238 spaced adjacent the end of the backing bar 235 (FIG. 19B) and which is adapted to rotate in a horizontal plane. The idler 238 is disposed in partially overlying relation with the beam 134 and its outer periphery is spaced from the pressure shoe 165 by a distance slightly greater than the thickness of the folder belt 232. The idler 238 is journaled on a clamp bracket 239 which is adjustably secured to a cleat 240 running longitudinally of the beam 134. The folder belt 232 also has a return flight 232B extending from the idler 238, thence to fixed idler 241, thence downwardly and with a twist to fixed idler 242, thence to common fixed idler 152 which also supports the belt 142, and thence to drive pulley 234. Tension in the belt 232 may readily be regulated by adjusting the position of one or more of the fixed idlers 238, 241 or 242.

It will be appreciated that, by reason of the construction just described, as the side panel 27 moves out of engagement with the pressure roller 130, the underside of the side panel 27 will be pressed upwardly by the belt 232 toward the pressure shoes 165 and with a progressively increasing thrust. At the same time, the glue flap 26 tends to spring back partially toward its original position coplanar with the side panel 27. Accordingly, as the side panel 27 approaches the fixed idler 238, the belt 232 folds the panel 27 to substantially a perpendicular position with respect to the original plane of the blank. As an incident to such action, the glue flap is brought against the vertical

side surface of the pressure shoe 165 tending to make it approach a coplanar relation with the panel 27.

In order to provide for down-folding of the side panels 29, 30 in preparation for breaking them relative to each other about the score line 25, the first right-hand folder frame is provided with a fixed folder shoe 244 having a contour somewhat similar to that of a moldboard plow. The shoe 244 is disposed in longitudinally aligned, overlying relation with the beam 130 of the folder frame, being supported by means of a yoke 245 adjustably fixed to transverse slide bar 162 and a pair of hangers 246, 248 (FIGS. 21 and 22). The shoe 244 has a sword-like extension 249 extending past the idler 221 and almost to the end of the backing bar 220. The extension 249 is adapted to engage the inside face of side panel 29 adjacent the score line 24 and to being camming the same outwardly and downwardly. Such action is increased by the downwardly inclined underside of the shoe 244 which ultimately forces the side panel 29 down to an almost horizontal position, carrying with it the side panel 30.

Adhesive Stage

From the first prebreaking stage, the blank 21 continues to travel in a straight line along the moving support defined by the carrier belts 142, 188, and enters the adhesive stage (FIGS. 8, 19A, 19B, 20A, 20B, 26 and 27). During the course of the adhesive stage, the glue flap 26 is precisely positioned by the consistent lateral dimension of its associated upfolded side panel 27 and then adhesively treated either by application of thermally activated adhesive or by activation of thermoplastic adhesive material already present on the glue flap. At approximately the same time, the side panel 30 is folded upwardly relative to the side panel 29 so as to break about the score line 25 therebetween.

In keeping with the foregoing, the apparatus includes an adhesive applicator 250 (FIGS. 19A, 20A, 26 and 27) which may take a number of specific forms. The applicator may, for example, supply a wide variety of adhesives and apply them to the blank or it may, on the other hand, supply sufficient energy to activate one or more selected areas of thermoplastic adhesive material already present on the blank. In the present instance, the applicator 250 is adapted to apply to the outside face of the glue flap 26 one or more beads of fast-setting thermally activated adhesive.

More specifically, the adhesive applicator 250 comprises a reservoir housing 251 containing an appropriate adhesive melt and an adhesive roller 252 having a portion of its periphery projecting slightly beyond one side of the housing 251. The housing is mounted alongside the path of the glue flap in closely spaced relation therewith so that the adhesive rollar makes rolling contact with the outer face of the glue flap to deposit the adhesive thereon. By the same token, the applicator also includes a back-up roller 254 of somewhat smaller diameter than the adhesive roller and positioned to make rolling contact with the inside face of the glue flap while the adhesive roller is acting on the opposite side.

The applicator 250 may conveniently be mounted on an adjustable support platform 255 carried by one of the intermediate side frames 33 (FIGS. 26 and 27). The applicator may be power driven to effect positive rotation of the rollers 252, 254 and also to maintain a steady supply of thermoplastic adhesive in the reservoir housing 251. In the present instance, driving power is supplied to the applicator 250 from main drive shaft 191 which runs transversely of the side frames 33. The shaft 191 may include at its outer end a sprocket wheel 256 connected by chain 258 to a corresponding sprocket 259 on the applicator. Chain tension may be controlled by means of an idler 260 meshing with the chain and mounted on the end of a resiliently biased arm 261.

Provision is made for precisely locating the glue flap 26 by utilizing the lateral dimension of its adjacent side panel 27 and for maintaining the glue flap and its adjacent side panel in such precise position relative to the plane of the blank during the adhesive operation. In furtherance of such objective, the left-hand folder frame 104 includes a backing sheet 262 (FIGS. 19A, 19B) fixed between the structural support 160 and the left-hand face of the pressure shoe 165 adjacent their trailing ends. Substantially coplanar with the backing sheet is a relatively short guide bar 264 interposed between the trailing end of the sheet and the closest side of the adhesive reservoir housing 251. Mounted in close, laterally spaced relation with the backing sheet and guide bar 262, 264 is a fixed guide rail 265. The latter is adapted to bear against the marginal edge portion of the outside face of the side panel 27 adjacent the glue flap so as to maintain the perpendicular relation of the side panel to the original plane of the blank and its moving support. In this case, the guide rail 265 is supported on a pair of adjustable columns 266, 268 attached to the folder frame beam 134 as by means of clamping brackets 269, 270 (FIGS. 19A, 19B, 20A, 20B). The adjustment of the columns 266, 268, and the guide rail 265 is such that the latter runs substantially parallel with the path of the blank and slightly below the reservoir housing 251.

As noted earlier herein, the side panel 30 is broken relative to the side panel 29 by being folded upwardly about the score line 25 as an incident to the adhesive operation. To accomplish this, and also to effect subsequent manipulation of the side panel 30, the apparatus includes a second right-hand folder frame 272 extending between the side frames 33, 34 and situated to the right of the first right-hand folder frame 105 as viewed from the feeder end of the apparatus (FIGS. 28, 29).

The second right-hand folder frame 272 comprises a longitudinal beam 274 (FIG. 28) supported at one end by a depending bracket 275 fixed to a nut 276 on transverse adjusting screw 278, the latter running transversely of the side frames 33. The opposite end of the folder frame beam 274 is supported by a depending bracket 279 fixed to a nut 280 on transverse adjusting screw 281 which runs transversely of the side frames 34. The folder frame 272 includes a carrier belt 282 somewhat similar to carrier belts 142, 188 described earlier herein. The carrier belt 282 extends between a drive pulley 284, keyed or otherwise fixed to shaft 191, and a drive pulley 285, keyed or otherwise fixed to the shaft 146. The upper flight of the carrier belt 282 is supported longitudinally by a plurality of aligned, longitudinally spaced, support rollers 286 journaled on the beam 274 in any suitable manner. The lower flight of the carrier belt 282 is trained around fixed idlers 288, 289 and adjustable idler 290. The latter is adjustably mounted on a depending bracket 291 carried by the beam 274 and may be shifted in the manner described earlier herein for regulation of belt tension.

The folder frame 272 is also provided with a folder belt 292 trained around a drive pulley 294, keyed or rigidly fixed to main shaft 295, thence around fixed idlers 296, 298, and adjustable idler 299 which is shiftably mounted on bracket 300 for regulating belt tension (FIG. 28). The folder belt 292 has a lower or folding flight 292A which extends from the fixed, inclined idler 298 and along a laterally inclined guide surface on top of the folder frame beam 274, ultimately assuming a longitudinal twist and then flattening out as it approaches the main drive pulley 294 (FIGS. 28, 29 and 26). The belt 292 also has a return flight 292B which extends from the drive pulley 294 and idlers 296, 299 directly to the inclined idler 298, making a single longitudinal twist therebetween.

Operatively associated with the folder belt 292 and adapted to hold down the blank side panel 29 as the side panel 30 is broken upwardly about the score line 25 by the belt 292, is a hold-down shoe 301. The latter, in this instance, happens to be a structural angle

member disposed with one of its flanges closely overlying the carrier belt 282 and having a free edge adjacent the folding flight of the belt 292 (FIG. 30). The hold-down shoe extends longitudinally for the greater part of the length of the folder frame 272 and is held in position by means of a large offset bracket 302. The bracket 302 is rigidly fixed to the beam 274 and has a horizontal yoke 304 at its top, the latter being connected to the hold-down shoe 301 as by means of a pair of hangers 305, 306. To facilitate breaking of the blank at the score line 25, the adjacent free edge of the hold-down shoe 301 may be chamfered or tapered as at 303 (FIG. 30).

In order to preclude downward and lateral bowing of the intermediate side panels 28, 29 of the blank on the prefolded score line 24 as a result of manipulation of the side panels 27, 30 during and subsequent to the adhesive operation, a fixed central support means is interposed between the right- and left-hand folder frames 272, 104. This comprises a support bar 309 (FIG. 28) anchored in any suitable manner adjacent the feeder end of the folder frame 272, and a support rail 310 running substantially the length of the folder frame 272 and carried by brackets 311, 312 fixed in any suitable manner to its beam 274.

Sealing and Bonding Stage

From the adhesive stage, the blank 21, still moving in a straight line on the carrier belts 142, 188, 282, enters the sealing and bonding stage (FIGS. 9, 19A, 20A, 28, 29). During this stage, the side panel 27 and adhesively activated glue flap 26 are rapidly downfolded through approximately 90° against the inside face of the blank, followed a short interval later by similarly rapid downfolding of the side panel 30 through approximately 90°, until the free marginal edge portion of the latter abuts against the glue flap 26 to form an adhesive juncture therewith. Such action is thereupon followed by the application of pressure on the side seam area to complete the transformation of the blank into the flat folded collapsed tube illustrated in FIG. 4. The foregoing is accomplished in part by the action of a folder belt 315 mounted on the left-hand folder frame 104, and in part by the folder belt 292, mounted on the second right-hand folder frame 272.

The folder belt 315 (FIG. 19A) is trained between a main drive pulley 316, keyed or otherwise fixed to the shaft 295, and a fixed idler 319 mounted on the folder frame beam 134 and adapted to rotate in a horizontal plane. The idler 319 may conveniently be journaled on an adjustable clamp 320 engaging the cleat 240 on the side of the beam 134.

The belt 315 has a folding flight 315A extending between the idler 319 and the drive pulley 316. The folding flight 315A, which is substantially vertical at the idler 319, has a longitudinal twist causing it to incline progressively toward the pressure shoe 165 as it moves away from the idler 319. In the course of such action, the folder flight 315A tends to overlie a progressively increasing area of swordlike extension 321 of pressure shoe 165, carrying with it the side panel 27 and glue flap 26 and camming them downwardly about the score line 23. Such downfolding action is further accentuated by the use of a plurality of longitudinally spaced rollers 322, 324, 325, 326, and 328 adjustably mounted in brackets on the beam 134 and each oriented to force the folding flight 315A a little flatter. The return flight 315B of the folder belt 315 runs from drive pulley 316 over inclined adjustable idler 329 and fixed idler 330, both carried by the bracket 331, thence rearwardly along beam 134 to the horizontally disposed fixed idler 319.

Shortly after the downfolding of the side panel 27 and glue flap 26 is initiated, the folder belt 292 of the second right-hand folder frame initiates similar downfolding of the side panel 30 about the score line 25 and toward the inside face of the blank (FIGS. 28, 29, 30, 31). Such folding action is brought about by the lateral inclination of the twisted folding flight 292A of the folder belt 292 and is facilitated by the tapered or chamfered edge portion 308 of the folder shoe 301. Accordingly, as the blank approaches the ends of the folder frames 104, 272, the marginal edge portion of the side panel 30 is brought into abutting relation with the adhesively activated glue flap 26, forming an adhesive juncture therewith and converting the blank 21 into a flat collapsed tube such as illustrated in FIG. 4.

The blank is thereupon moved by the carrier belts 142, 188, 282 into engagement with a pair of pressure rolls 332, 334 (FIG. 32) fixed respectively to the drive shafts 146, 295 between the drive pulleys 145, 285 and 294, 316. Thus disposed, the pressure rolls 332, 334 are adapted to apply substantial sealing pressure to the newly formed adhesive juncture, or in other words, to the side seam, of the blank. This results in completion of the formation of the side seam and transformation of the blank into the flat collapsed tube shown in FIG. 4.

From the pressure rolls, the completed, flat folded blank is presented to an appropriate delivery means such as transfer belts 335, 336 (FIG. 2) and delivery conveyor 338. The latter preferably includes belts 339, 340 which are arranged to run at a somewhat slower linear speed than the carrier, folder, and transfer belts described earlier herein. Consequently, as successive blanks are discharged from the apparatus and presented to the delivery conveyor, they tend to overlap in a well-known manner and to accumulate on delivery table 341, thus facilitating subsequent handling and packaging.

Main Drive

While it will be appreciated by those skilled in the art that the various carrier, pressure, and folder belts of the apparatus 20 are driven in timed relation to each other at a common linear speed, it might be helpful to indicate briefly the arrangement of the main driving means. Referring more specifically to FIG. 26, it will be noted that a main drive motor 342 is mounted in the lower portion of the apparatus between the side frames 33. The motor 342 is drivingly connected, as by means of a heavy duty belt 344, to drive shaft 191 journaled transversely of the side frames 33. The shaft 191 has keyed or otherwise fixed thereon a main drive pulley 345 (FIGS. 26 and 29) drivingly connected by means of belt 346 to the main drive shaft 115 at the feeder end of the machine. The shaft 115 is journaled transversely of the frame members 32 and geared to its companion drive shaft 170. By the same token, the main drive pulley 345 is drivingly connected as by means of belt 347 and pulley 348 to shaft 146 journaled transversely of the frame members 34, the latter being geared to its companion drive shaft 295 (FIGS. 29 and 32). By reason of such positive driving arrangement of the main pulleys of the carrier, pressure, and folder belts, severe unbalances in belt tension are virtually eliminated and high-speed operation of the machine at rates of 1200 blanks per minute, for example, is greatly facilitated.

MODIFICATIONS

General Procedure and Organization

Turning now to FIGS. 33 to 48, inclusive, there is shown another illustrative apparatus 430 embodying a modification of the invention and through which a modification of the method of the invention may be carried out. In this case, the modified apparatus and method are also adapted to perform a side seaming operation on the carton blank 21, converting it from the flat form shown in FIG. 3 to the flat-folded, open-ended, tubular form illustrated in FIG. 4 for presentation to forming, filling, closing and sealing equipment. The blank 21 is cut and scored as described earlier herein. However, in this in-

stance it is provided with a coat of heat sealable thermoplastic material which may be adhesively activated over selected areas and utilized for forming the adhesive juncture of the side seam.

With the blank 21 in the flat, unfolded condition illustrated in FIG. 34, and in accordance with the modified method of the invention, the blank 21 is passed through the successive stages illustrated sequentially in FIGS. 34 to 40, inclusive. In general, the sequence is quite similar to that described previously herein. Thus the blank 21 passes under continuous straight line motion along the support from the feed stage through first and second prebreak stages, an adhesive stage, a sealing and bonding stage, and finally a delivery stage. In the present instance, there are certain differences in the prebreaking and in the adhesive stages.

Referring more specifically to FIG. 36, it will be noted that toward the end of the first prebreaking stage, the blank 21, having been prebroken along the score lines 22 and 24, is returned to a flat-folded condition. The glue flap 26, previously folded through an angle of 180°, is permitted to spring back to a position approaching its original one. In the second prebreaking stage (FIG. 37), the side panel 27 adjacent the glue flap 26, and the side panel 30 remote therefrom, are both folded upwardly about score lines 23 and 25, respectively. In this condition, the blank is passed to the adhesive stage.

In accordance with the modified method of the present invention, provision is made for side seaming the carton blank 21 by means of a high-speed heat sealing operation utilizing the thermoplastic coating or surface already present on the blank. This is accomplished by application of thermal energy to the blank with such speed and efficiency that the heat is confined substantially to the thermoplastic surface of the blank and not driven into the body of the blank. It is also accomplished by minimizing substantially the time elapsing between thermally activating the thermoplastic coating or surface on the areas of the blank to be joined and bringing the activated surfaces together to form a bond or seal. This also minimizes chances of damage or deterioration of the thermoplastic coating and the paperboard body of the blank, leaving the body relatively cool so as to accelerate setting and sealing of the activated material.

In the present instance, the blank 21 is moved at high speed and in a predetermined path relative to one or more precisely controlled sources of thermal energy so that heat is applied selectively to the glue flap and to the side panel area remote therefrom, activating the thermoplastic coating thereon. During such action, the areas selectively activated by application of heat are precisely positioned by the respective uniform lateral dimensions of the two upstanding side panels 27, 30, the former adjacent the glue flap 26 and the latter remote from the glue flap. Heat is applied to the outside face of the glue flap 26 and to a corresponding marginal edge area on the inside face of the side panel 30 remote therefrom. All of the foregoing takes place while the blank 21 is moving at high speed with continuous straight line motion.

Upon completion of the adhesive or heating stage and emergence of the blank from the heating devices, its high speed straight line motion continues, the upstanding side panel areas being cammed downwardly toward the inside face of the blank 21 and the thermally activated areas of the glue flap 26 and the remote side panel 30 being brought into abutting contact (FIG. 39). This initiates the side seam adhesive juncture which is further strengthened and set by passing the blank through an ironing means prior to its presentation to the delivery conveyor (FIG. 40). The completed side seam is not only fluid-tight but possesses relatively high mechanical strength compared to other areas of the blank.

Referring next to FIGS. 33 and 33A, there is shown an illustrative apparatus 430 embodying a modified form of the invention and adapted to carry out the method thereof. This apparatus 430 is generally similar to the apparatus 20 described earlier herein but is somewhat longer and differs in certain important respects.

Turning first to the similarities, it will be noted that the apparatus 430 comprises a relatively long main frame 431 which in this instance includes four pairs of laterally spaced side frame members 432, 433, 434 and 435. The latter are connected and maintained in longitudinally spaced relation by connecting pairs of side rails 436, 437 and 438. The main frame further includes, at the delivery end, a pair of side rails 439 and a corresponding pair of outboard columns 440.

The apparatus 430 includes a main drive motor 441 (FIGS. 33 and 46A) connected in any suitable manner to a main drive shaft 442 journaled transversely of the side frame members 433. The shaft 442 includes a main drive pulley 444 connected via belt 445 to drive pulley 446 of shaft 448 which is journaled transversely of the frame members 432 (FIG. 46A). The pulley 444 is also connected via drive belt 449 to drive pulley 450 of shaft 451 journaled transversely of the frame members 434 (FIGS. 46, 46A). The pulley 450 is, in turn, connected by a drive belt 452 to drive pulley 454 of shaft 455 journaled transversely of the side frame members 435 (FIG. 46). The shafts 442, 448, 451 and 455 are positively and drivingly connected to the carrier, pressure, and folder belts of the apparatus, causing all such members to be driven in timed relation to each other at a common linear speed. Such arrangement facilitates high-speed operation of the apparatus at rates such, for example, as 1200 blanks per minute.

At the right-hand end of the apparatus 430 (as viewed in FIGS. 33 and 33A), there is situated a high-speed feed mechanism 456 adapted to hold a supply of cut and scored blanks 21 to present them rapidly and individually to the other units of the apparatus. In the present instance, the feed mechanism 456 is substantially identical to the feed mechanism 40 described earlier herein and reference may be made to that portion of the present description for further details thereof.

A delivery mechanism 458 is situated at the opposite or left-hand end of the apparatus 430 and supported on the side rails 439. The mechanism 458 is somewhat similar to the delivery mechanism of the apparatus 20 and the present invention is not concerned with the details of such mechanism.

Situated between the feed mechanism 456 and the delivery mechanism 458 are the prebreaking stages (between side frame members 432 and 433), the heat stage (between side frame members 433 and 434), and the folding stage (between side frame members 434 and 435), of the apparatus. The prebreaking and folding stages are quite similar to those of the apparatus 20. However, the heat stage of the apparatus 430 differs considerably from the adhesive stage of the apparatus 20.

Prebreaking Stages

The prebreaking stages of the apparatus 430 comprises glue flap folder frame 459 (FIG. 41B), first left-hand folder frame 460 (FIG. 41A), first right-hand folder frame 461 (FIG. 42B), first left-hand top carrier assembly 462 (FIG. 43A), and first and second right-hand top carrier assemblies 464, 465 (FIG. 44A). The folder frames 459, 460 and 461 are adjustably disposed in relatively close laterally spaced relation between the side rails 436 (FIG. 46A). The first left-hand top carrier assembly 462 is adjustably mounted in aligned and overlying relation with the folder frame 460. In like manner, the first right-hand top carrier assembly 464 is adjustably disposed in aligned overlying relation with the folder frame 461. The second right-hand top carrier assembly 465, on the other hand, is laterally offset from the folder frame 461.

The folder frames 459, 460, 461 are similar to those described earlier herein in connection with the apparatus

20 and for present purposes a further detailed description is not required. Suffice it to note that the glue flap folder frame 459 supports a carrier belt 466 for the blank driven by pulley 467 fixed to drive shaft 448. As the blank traverses the folder frame 459, the carrier belt 466 engages the outer or bottom face of the side panel 27 and the glue flap 26 is broken upwardly about the score line 22 through an angle of 180° until it is pressed against the inside face of the side panel 27. The folder frames 460, 461 are respectively provided with carrier belts 468, 469 for transporting the blank. The belt 468 is trained around drive pulleys 470, 471 on shafts 448, 442, respectively, and its upper flight is supported by a plurality of longitudinally spaced rollers 472 (FIG. 41A). By the same token, the carrier belt 469 is trained around drive pulleys 473, 474 on shafts 448, 442, respectively, and its upper flight is similarly supported by longitudinally spaced rollers 475 (FIG. 42B). All of these carrier belts include suitable tensioning idlers. As the blank moves through the prebreaking stages, the carrier belt 468 engages the outer or under surface of the side panel 27, while the carrier belt 469 engages the outer or under surface of the panel 28.

The first left-hand top carrier assembly 462 is provided with a pressure belt 476, the lower flight of which is adapted to cooperate with the carrier belt 468 by engaging the upper surface of the side panel 27 and pressing it against the belt 468. Such action is facilitated by longitudinally spaced biasing rollers 478 which press downwardly on the lower flight of the belt 476. Similarly, the first right-hand top carrier assembly 464 is provided with a pressure belt 479 adapted to cooperate with the belt 469 over the first portion of its length by egnaging the upper surface of the side panel 28 and pressing it downwardly against the belt 469. The second right-hand top carrier assembly 465 is provided with a pressure belt 480 adapted to bear against the upper surface of the side panel 29 toward the end of the prebreaking stages.

The first and second right-hand top carriers are in this instance longitudinally spaced apart a substantial distance in order to permit the blank to be broken first about the score line 24 and then about the score line 25 as it traverses the prebreaking stages. This is accomplished in part by the use of an angularly disposed folder belt 481 trained around skewed idlers 482, 483 and 484 on the folder frame 461, the belt being driven from the shaft 448. The belt 481, with the assistance of guide bar 485 (FIG. 46A) engages and cams the panels 29, 30 upwardly about the score line 24 through an angle substantially more than 90°. As the blank passes out of engagement of the folder belt 481, the panels 29, 30 are cammed downwardly by means of a plow or other appropriate guide (not shown) and then held down due to contact between the pressure belt 480 of the laterally offset top carrier 465.

The blank thereupon passes through the substantially flat condition shown in FIG. 36, but only very briefly. Another folder belt 486 trained over skewed rollers 488, 489, 490 on the first left-hand folder frame 460, engages the outer or under surface of the side panel 27, breaking it upwardly about the score line 23 and presenting it to the angularly disposed guide bar 491 (FIGS. 41A, 46A). A short time later, side panel 30 is similarly broken upwardly about the score line 25 as an incident to presentation to the heat stage.

Heat Stage

Referring more specifically to FIGS. 33A, 46 and 46A, it will be noted that the heat stage of the apparatus 430 is situated intermediate the side frame members 433, 434 and side rails 437. The heat stage may be included initially in factory built apparatus or may be supplied as a conversion unit for use with conventional glue applicator type side seaming machines already in use in the field.

The heat stage includes second left-hand and right-hand folder frames 492, 494 (FIGS. 41, 41A, 42, 42A), together with second left-hand and third right-hand top carriers 495, 496 (FIGS. 43, 44), respectively associated therewith. The left-hand folder frame 492 comprises a longitudinal support beam 498 having a carrier belt 499 mounted thereon and driven by means of pulley 500 fixed to drive shaft 451. The upper flight of the carrier belt 499 is adapted to support the blank as it moves through the heat stage of the apparatus and, for this purpose, the beam has a plurality of closely spaced, longitudinally aligned rollers 501 journaled thereon (FIGS. 41, 48). In like manner, the right-hand folder frame 494 comprises support beam 502 disposed longitudinally of the machine and provided with a carrier belt 504 driven by pulley 505 of the drive shaft 451. The upper flight of the belt 504 is adapted to support the blank and is in turn supported on a plurality of longitudinally spaced rollers 506 journaled on the support beam 502 (FIGS. 42, 42A, 48). The folder frames 492, 494 are adjustably mounted in laterally spaced relation between the side frame members 432, 433, their spacing being selectively determined by the size of the particular carton blank being processed in the apparatus. Such mounting and adjustment is similar to that already described for the folder frames of the apparatus 20.

The folder frames 492, 494 also include folder belts 507, 508, respectively, and which are adapted to help maintain the upstanding side panels 27, 30 of the blank in precise position during passage through the heat stage (FIGS. 45, 48). Accordingly, it will be noted that the belt 507 is mounted on the left-hand folder frame 492 in such manner that it has a flight immediately adjacent and perpendicular to the underlying carrier belt 499 for engaging the outer face of the side panel 27. This flight of the belt 507 may be supported as by means of one or more upstanding abutments or guides 509 mounted longitudinally along the top of the support beam 498. The belt 507 may be trained around horizontally disposed rollers 510, 511 and driven in timed relation with the main drive of the apparatus. Similarly, the folder belt 508 is arranged on the right-hand folder frame 494 so that it has a flight immediately adjacent and perpendicular to the carrier belt 504 for engaging the outer face of the side panel 30. This flight of the folder belt 508 is supported as by means of one or more fixed upstanding abutments or guides 512 mounted longitudinally along the top of the support beam 502. The belt 508 may be trained about horizontally disposed roller 513 and skewed rollers 514, 515, being driven in timed relation with the associated carrier belt 504 (FIGS. 42, 42A, 46A).

Operatively associated with the left-hand folder frame 492 and disposed in overlying relation therewith is the second left-hand top carrier 495 (FIGS. 43, 43A, 45 and 48). The latter in this case comprises a longitudinally disposed angle member 516 which carries a plurality of closely spaced double rollers 517 adapted to bear against inside face of the blank and hold it against the underlying support belt 499. As indicated in FIG. 48, it will be noted that the rollers 517 engage the upper or inside face of the side panel 28 adjacent the score line 23. Similarly, the third right-hand top carrier 496 comprises a longitudinally disposed angle member 518 carrying a plurality of longitudinally spaced double rollers 519 adapted to bear against the inside face of the blank and hold it against the underlying carrier belt 504 (FIGS. 44, 45 and 48). The arrangement is such that the rollers 519 engage the upper or inside face of the side panel 29 adjacent the score line 25.

The top carriers 495, 496 are mounted on a plurality of hanger members 520, 521 each of which may include an appropriate vertical adjustment means. The hanger members 520, 521 are, in turn, fixed in depending relation to corresponding ones of a plurality of generally C-shaped brackets 522, 523 secured to respective ones of

the folder frame support beams 498, 502 as by flanges 524, 525.

Thermal applicator means is provided in the apparatus 430 for facilitating high-speed heat sealing of the side seam by precisely controlled application of heat to one or more selected areas of the thermoplastic coating or surface of the blank 21 as it traverses the heat stage. In this case, the selected areas are the outside face of the glue flap 26, and the corresponding marginal edge portion of the inside face of the remote side panel 30.

The foregoing is accomplished in the illustrative apparatus 430 by the use of elongate thermal applicators 526, 528, in the present instance gas burners, mounted in overlying and partially laterally offset relation with the respective right and left-hand folder frames and top carriers 492, 495, 494, 496 (FIGS. 45, 48). Each applicator or burner 526, 528 is adapted to apply heat directly to the blank surface area exposed thereto incident to passage through the heat stage. At this time, the blank 21 is in the condition illustrated in FIGS. 38, 45 and 48, with the glue flap 26 and adjacent side panel 27 broken about the score line 23 and standing perpendicular to the side panels 28, 29 of the blank, and the side panel 30 broken about the score line 25 and also standing perpendicular to the side panels 28, 29. Moreover, the blank is precisely maintained in this posture by the carrier belt 499 and folder belt 507, the carrier belt 504 and folder belt 508, and longitudinally disposed guide bars 491, 529, and 530. The bars 491 and 530 tend to prevent the otherwise unsuppported portions of the side panels 27 and 30 above the folder belts from springing or bowing outwardly. By the same token, the bars 529 and the bar 530 also serve as backup supports or guides for those areas of the blank being selectively heated by the burners 526, 528.

In order to preclude damage to other areas of the blank than those being thermally activated, and to localize the heat zones as far as possible, the guide bars 491, 529, 530 are of hollow tubular construction and cooled by circulating water or other suitable cooling fluid. For this purpose, the bars may be conveniently connected into a cooling circuit as by means of coolant lines 531, 532, 534 and 535 (FIGS. 46, 46A.).

Each of the thermal applicators or burners 526, 528 is constructed as a relatively long, hollow boxlike member of generally L-shaped cross section with the base portion 536 of the L horizontally disposed and extending toward the respective folder frame and top carrier assembly associated therewith. The projecting end of the base portion 536 has a relatively thick wall reinforced along the length of each burner by means of longitudinally spaced ribs 538 (FIGS. 47 and 48). Each extended base portion 536 is formed with a plurality of gas passages 539 distributed throughout the length of the burner, each passage being adapted to support a small but high stable flame 540 (FIG. 48).

The burners 526, 528 are suspended from the brackets 522, 523 by means of adjustable hanger members 541, 542, respectively. The latter in this instance may be threadedly engaged with corresponding adjusting sleeves 544, 545 swivel mounted on the brackets 522, 523 (FIGS. 43–45). By means of appropriate connections, in this case adjusting pulleys 546, 547, 548, 549 and connecting belts 550, 551, both burners may be precisely adjusted individually in a vertical direction. A detachable hand crank 552 may be used for such purpose, being adapted to engage upstanding extension 553, fixed to one of the sleeves 544, to adjust the burner 526, and to engage the extension 554, fixed to one of the sleeves 545, to adjust the burners 528 (FIGS. 43, 43A, 44, 44A).

The foregoing arrangement permits vertical adjustment of the burners 526, 528 to accommodate different sizes of carton blanks. Lateral adjustment for this purpose is accomplished as an incident to lateral adjustment of the folder frames 495, 496 which carry the brackets 522, 523. Fine vertical and lateral adjustment of the burners for proper alignment and clearances may conveniently be effected through the individual connections of the various hanger members 541, 542 (not shown in detail).

Because the folding and sealing operation involves downfolding of the side panel 27 and glue flap 26 ahead of the side panel 30, the burners are longitudinally offset to compensate for this slight time lag. The time difference involved is only a fraction of a second. For example, the total exposure time of a blank to active heating when the appaartus 430 is operating at a linear speed of 1000 feet per minute may be on the order of six-tenths of a second. Accordingly, upon reference to FIGS. 43, 43A, 44, 44A and 47, it will be noted that the burner 528 which engages the marginal edge portion of the side panel 30 is advanced relative to the burner 526 in the direction of blank movement by a distance which may, for example, be slightly greater than the length of the blank 21. The result is that the burner 526 initiates the heating of the surface of the glue flap 26 slightly before the burner 528 initiates the heating of the side panel area 30. By the same token, heating of the glue flap 26 by the burner 526 is completed slightly ahead of the heating of the side panel area 30 by the burner 528, permitting downfolding of the glue flap 26 and its associated side panel to commence while the panel 30 is still being heated.

A suitable mixture of air and gas is supplied under pressure to the interior of each burner 526, 528, so proportioned that combustion is substantially complete and no residue is left on the blank. This is accomplished through the use of a control and indicator panel 555 supported on a pair of laterally spaced brackets 556, 558 which, in turn, are fixed to side frame members 433 (FIGS. 33A and 47). The panel 555 receives gas from supply line 559 and air from supply line 560 (FIG. 47). The mixture of gas and air is conducted from the panel 555 via distribution lines 561, 562, 563 and 564, connected to the respective burners as by means of flexible sections 565, 566, 567, and 568. The latter permit appropriate adjustment of the burners both vertically and laterally.

In order to assure safe and reliable operation of the burners 526, 528 under all operating conditions, the latter are provided with a plurality of ignition and flame detector devices 569 (FIGS. 47 and 48) connected by suitable electrical wiring 570 with appropriate circuitry in the panel 555, including ignition transformers 571. Such circuitry (not shown) serves to facilitate safe performance of the burner assembly during starting, running and shutdown of the apparatus.

Folding Stage

Structurally, the folding stage of the apparatus 430 is closely similar to that of the sealing and bonding stage of the apparatus 20 described earlier herein. During such stage, the side panel 27 and thermally activated glue flap 26 are rapidly downfolded through an angle of approximately 90° against the inside face of the blank, followed shortly thereafter by rapid downfolding of the side panel 30 with its thermally activated marginal edge area through approximately 90° until the thermally activated areas abut against each other to form the adhesive juncture of the side seam. This downfolding action, which may, for example, occur within two-tenths of a second when the apparatus is operating at a linear speed of 1000 feet per minute, is followed by the application of pressure on the side seam to complete the seal and thus transform the blank into the flat folded collapsed tubular form shown in FIG. 4. It is believed that those skilled in the art will appreciate the construction and operation of the folding stage of the apparatus 430 from the foregoing description and in the light of the brief discussion which follows.

Referring more specifically to FIGS. 41–44 and 46, it will be noted that the folding stage of the apparatus 430 includes the third left-hand folder frame 572, the second

right-hand folder frame 574, and respective swordlike extensions 575, 576 of the third right-hand top carrier 496 and second left-hand top carrier 495. The folder frames 572, 574 are disposed in adjustable and laterally spaced relation with each other and in alignment with the folder frames 492, 494 of the heat section.

The left-hand folder frame 572 (FIGS. 41, 46) comprises a carrier belt 578 aligned with and driven from shaft 455 in timed relation with the carrier belt 499. Similarly, the right hand folder frame 574 (FIGS. 42, 46) comprises a carrier belt 579 aligned with and driven from shaft 455 in timed relation with the carrier belt 504. The left-hand folder frame 572 also includes a folder belt 580 having a folding flight skewed from the vertical toward the horizontal in the direction of motion of the blank, the belt being trained around drive pulley 581 and idlers 582, 583, 584. The pulley 581 is fixed to shaft 585 which is driven in timed relation to the shaft 455. In like manner, the right-hand folder frame 574 has a folder belt 586 driven by the pulley 588 on shaft 585 and trained around idlers 589, 590, 591. The folder belt 586 is also skewed progressively toward the horizontal in the direction of the movement of the blank. It will be noted that the idlers 584 and 591 are staggered and that the belt 580 is somewhat longer than the belt 586 so as to initiate downfolding of the side panels 27 and glue flap 26 prior to downfolding of the side panel 30. Transfer of the blank from the carrier belts 499, 504 to the carrier belts 578, 579 while maintaining the blank in proper alignment under continuous straight line motion is achieved at least in part by the guiding effect of the swordlike extensions 575, 576 of the respective top carriers 495, 496. At the point of transfer, the second score line 23 of the blank is aligned with the left-hand edge of the carrier belts 499, 578. This reference relationship is maintained for all sizes of blanks processed in the apparatus.

To apply increasing pressure to the blank as it passes through the folding stage, apparatus 430 may include a series of progressively skewed pressure rollers adapted to bear against the outside faces of the downfolded side panels 27, 30, such as described earlier herein with respect to the apparatus 20. It may also include a set of ironing rolls 592 fixed to the shaft 455 and its companion shaft 585 between the drive pulleys for the carrier and folder belts so as to bear directly on the newly formed side seam. The blank, in complete flat folded tubular form is thereupon presented to the delivery mechanism of the apparatus. Alternatively, the ironing rolls may be located at the entrance of the delivery mechanism rather than in the folder stage.

In certain instances, it may be desirable to provide a guide or backup support in the folding stage to keep the side panels 28, 29 from sagging as the panel 27 with the glue flap 26, and the panel 30, are downfolded to complete the side seam. Such support (not shown) may conveniently be a longitudinally disposed bar mounted between the folder frames 572, 574 having a top surface substantially coplanar with the top surfaces of the carrier belts 578, 579.

We claim as our invention:

1. A method for side seaming a flat carton blank having a plurality of parallel longitudinal score lines dividing the same into side panel areas and a glue flap adjacent one of said areas, said glue flap having thermoplastic material thereon, said method comprising the steps of moving the carton blank longitudinally of the score lines therein and along a support, prebreaking the blank about each said score line by folding one or more said panel areas and said glue flap out of the plane of said blank, exposing the thermoplastic material on said glue flap to a gas burner to create an activated adhesive area on said glue flap while the same and its adjacent side panel area are folded substantially perpendicular to the plane of said blank, folding said glue flap and its adjacent side panel in the same direction against the face of said blank, folding another side panel area against the folded glue flap, and applying pressure thereto to complete the adhesive bond.

2. A method for forming a side seam in a flat carton blank having a plurality of parallel longitudinal score lines dividing the same into a plurality of panel areas, at least one said panel area having thermoplastic material thereon, said method comprising the steps of moving the carton blank longitudinally of the score lines therein and along a support, prebreaking the blank about each said score line by folding one or more said panel areas out of the plane of said blank, exposing the thermoplastic material one said one panel area to a gas burner to create an activated adhesive area on said one panel area while the same is folded substantially perpendicular to the plane of said blank, folding said one panel area in the same direction against the face of said blank, folding another said panel area against said one panel area, and applying pressure thereto to complete the adhesive bond.

3. A method for side seaming a flat carton blank having a plurality of parallel longitudinal score lines dividing the same into side panel areas and a glue flap adjacent one of said areas, said blank having thermoplastic material thereon, said method comprising the steps of moving the carton blank longitudinally of the score lines therein and along a support, prebreaking the blank about each said score line by folding one or more said panel areas and said glue flap out of the plane of said blank, successively creating corresponding activated adhesive areas of thermoplastic material on said glue flap and on the side panel area remote therefrom by successive exposure to thermal elements while said glue flap and said remote side panel area are folded out of the plane of said blank, folding said glue flap and its adjacent side panel in the same direction against the face of said blank, folding said remote side panel area against the folded glue flap, and applying pressure thereto to complete the adhesive bond.

4. A method for side seaming a flat carton blank coated with heat sealable thermoplastic material and having a plurality of parallel longitudinal score lines dividing the blank into side panel areas and a glue flap adjacent one of said areas, said method comprising the steps of moving the carton blank longitudinally of the score lines therein and along a support, prebreaking the blank about each said score line by folding one or more said panel areas and said glue flap out of the plane of said blank, thermally activating by direct exposure to radiant heat an area of said thermoplastic material on said glue flap while the same and its adjacent side panel area are folded substantially perpendicular to the plane of said blank, folding said glue flap and its adjacent side panel in the same direction against the face of said blank, folding another side panel area against the folded glue flap, and applying pressure thereto to complete the adhesive bond.

5. A method for forming a side seam in a flat carton blank having a heat sealable thermoplastic material on its surface and also having a plurality of parallel longitudinal score lines dividing the same into a plurality of panel areas, said method comprising the steps of moving the carton blank longitudinally of the score lines therein and along a support, prebreaking the blank about each said score line by folding one or more said panel areas out of the plane of said blank, thermally activating by direct exposure to radiant heat an area of said thermoplastic material on at least one said panel area while the same is folded out of the plane of said blank, folding said one panel area in the same direction against the face of said blank, folding another said panel area against said one panel area, and applying pressure thereto to complete the adhesive bond.

6. A method for side seaming a flat carton blank having a coating of thermoplastic material thereon and a plurality of parallel longitudinal score lines dividing the same into side panel areas and a glue flap adjacent one of said areas, said method comprising the steps of moving the carton blank longitudinally of the score lines therein and

along a support, prebreaking the blank about each said score line by folding one or more said panel areas and said glue flap out of the plane of said blank, activating through selective exposure to radiant heat corresponding areas on said glue flap and on the side panel area remote therefrom while said glue flap and said remote side panel area are folded out of the plane of said blank, folding said glue flap and its adjacent side panel and said remote side panel in the same direction against the face of said blank so as to bring said corresponding areas into abutment, and applying pressure thereto to complete the adhesive bond.

7. Apparatus for side seaming a flat carton blank having a coating of thermoplastic material thereon and a plurality of parallel longitudinal score lines dividing the same into side panels, and a glue flap adjacent one of said side panels, said apparatus comprising, in combination, a movable support, means for moving the carton blank longitudinally of said support, means associated with said support for prebreaking the blank about each score line by folding one or more of said side panels and said glue flap out of the plane of the blank, means for positioning said glue flap relative to said support for thermal activation of the thermoplastic material thereon by utilizing the lateral dimension of said adjacent side panel while the same and said glue flap are folded out of the plane of said blank, flame applicator means for selectively applying heat to said glue flap while the same and its said adjacent side panel are folded out of the plane of said blank, means for folding said glue flap and said adjacent side panel in the same direction against the face of said blank following application of heat to said glue flap, means for folding another side panel against said folded glue flap, and means for applying pressure to said other side panel and folded glue flap to complete an adhesive bond therebetween.

8. Apparatus for side seaming a flat carton blank having a coating of thermoplastic material thereon and a plurality of parallel longitudinal score lines dividing the same into side panels and a glue flap adjacent one of said side panels, said apparatus comprising, in combination, a movable support, means for moving the carton blank longitudinally of said support, means associated with said support for prebreaking the blank about each score line by folding one or more of said side panels and said glue flap out of the plane of the blank, means for positioning said glue flap relative to said support for thermal activation of the thermoplastic material thereon by utilizing the lateral dimension of said adjacent side panel while the same and said glue flap are folded out of the plane of said blank, flame applicator means for selectively applying heat to said glue flap and to the corresponding area of the side panel remote therefrom while the glue flap and its said adjacent side panel and said remote side panel are folded out of the plane of said blank, means for folding said glue flap and said adjacent side panel in the same direction against the face of said blank following application of heat to said glue flap, means for folding said remote side panel against said folded glue flap, and means for applying pressure to said remote side panel and folded glue flap to complete an adhesive bond therebetween.

9. Apparatus for forming a seam in a carton blank coated with heat sealable thermoplastic material and having a plurality of longitudinal score lines each defining a corner when the blank is formed into a carton, said apparatus comprising, in combination, means for moving the blank longitudinally of said score lines and in continuous straight line motion along a linear path, means for folding portions of said blank sequentially about each said score line, means for constraining opposed lateral edge portions of said blank generally perpendicular to the plane thereof while said blank moves along said path, means for applying radiant heat directly and selectively to said opposed lateral edge portions while so constrained to activate their thermoplastic coating, and means for downfolding said opposed lateral edge portions sequentially into contact with each other to form an adhesive juncture therebetween.

10. In an apparatus for side seaming a flat carton blank having a surface of heat sealable thermoplastic material and a plurality of longitudinal score lines dividing the same into side panels with a glue flap adjacent one of said side panels, the combination comprising means for moving the blank in a continuous straight line path, means for prebreaking the blank about each said score line as an incident to motion along said path, means for folding said one side panel and said glue flap generally perpendicular to the plane of said blank, means for folding the side panel remote from said glue flap generally perpendicular to the plane of said blank, a pair of elongate gas burners disposed respectively in spaced relation to said glue flap and the marginal edge portion of said remote side panel, said burners being adapted to activate the thermoplastic material on said glue flap and said marginal edge portion of said remote panel as an incident to movement of said blank along said path.

11. In an apparatus for side seaming a carton blank having a surface of thermoplastic material by thermally activating selected areas of said material thereon, the combination of a pair of laterally spaced folder frames each having a carrier belt thereon, a pair of top carriers mounted in overlying relation with respective ones of said folder frames and adapted to hold the blank against said carrier belts, a pair of gas burners extending longitudinally of said folder frames and top carriers, said burners being mounted in overlying and partially laterally offset relation with respective ones of said top carriers, and means for supporting said burners from respective ones of said folder frames.

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