Sept. 3, 1963 H. L. WALKER 3,102,457

BOX MAKING MACHINE

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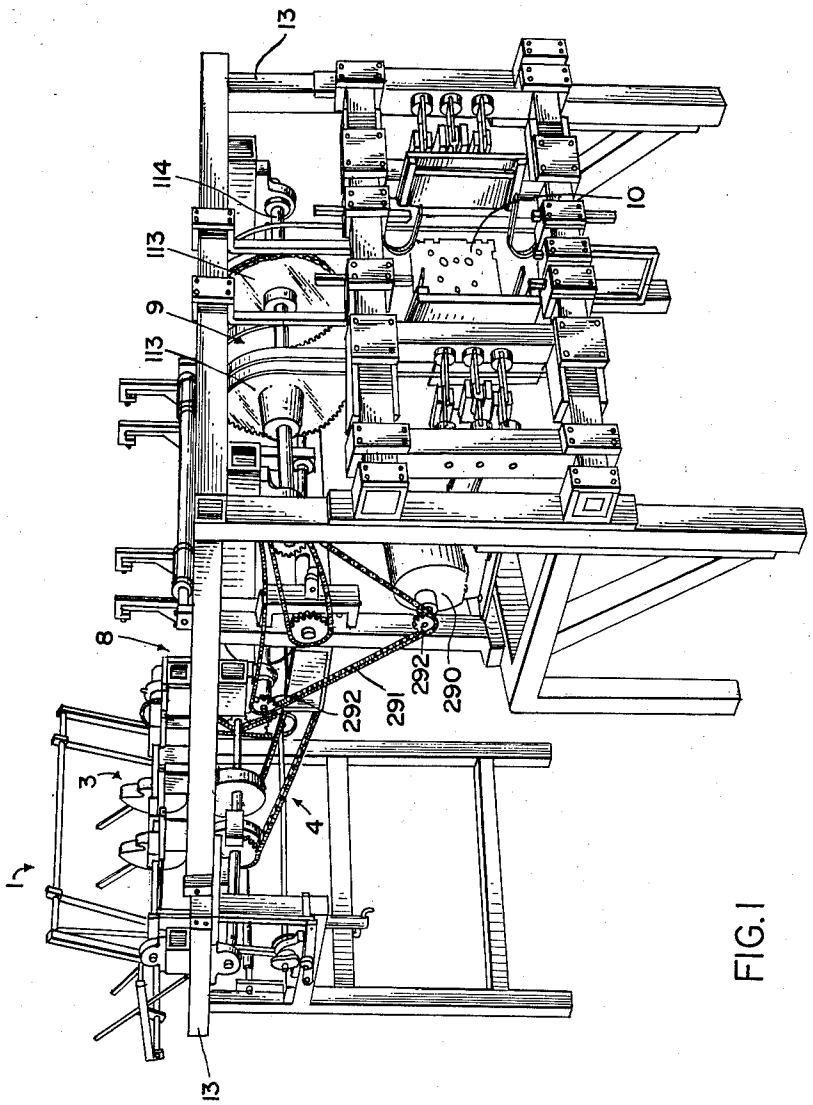


FIG. 1

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield.

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BOX MAKING MACHINE

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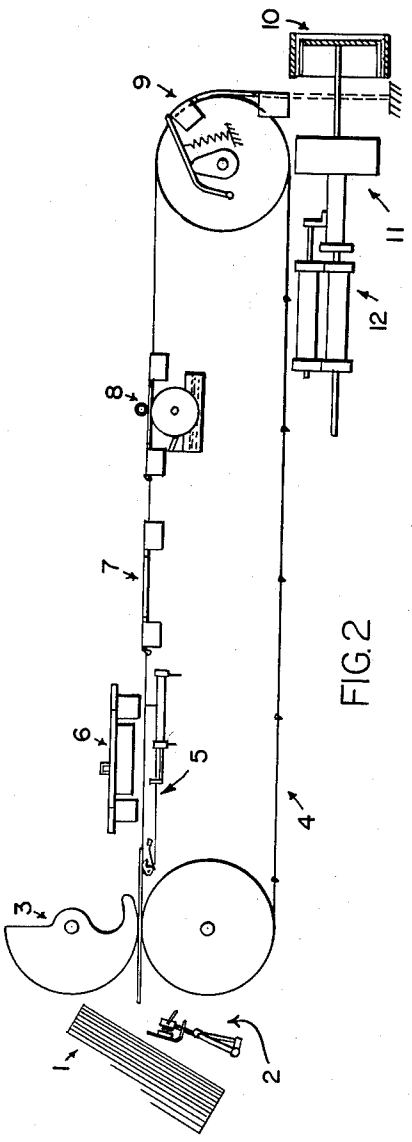


FIG. 2

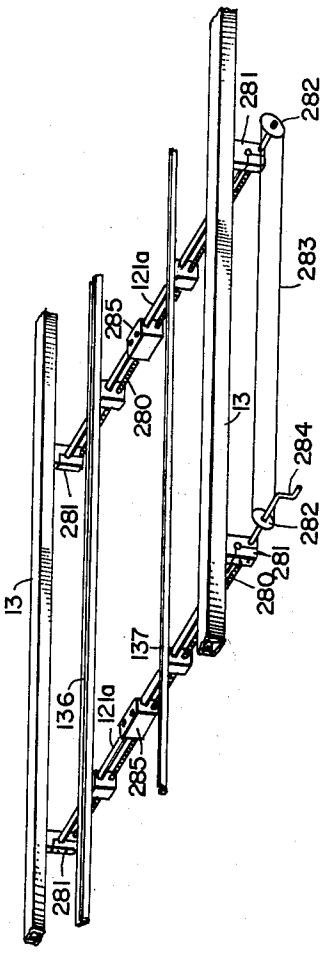


FIG. 3

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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BOX MAKING MACHINE

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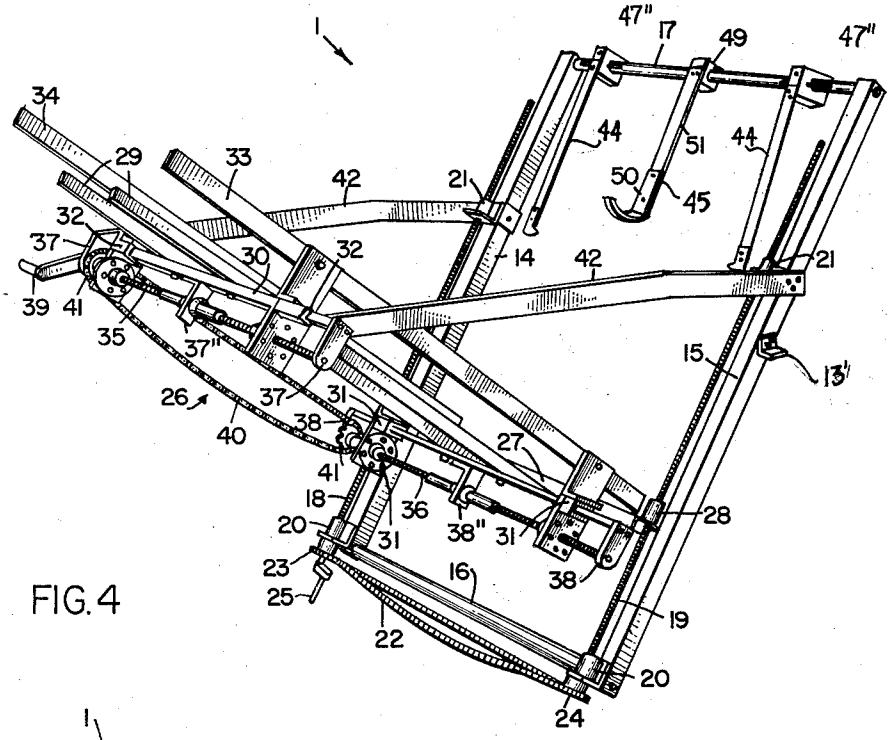


FIG. 4

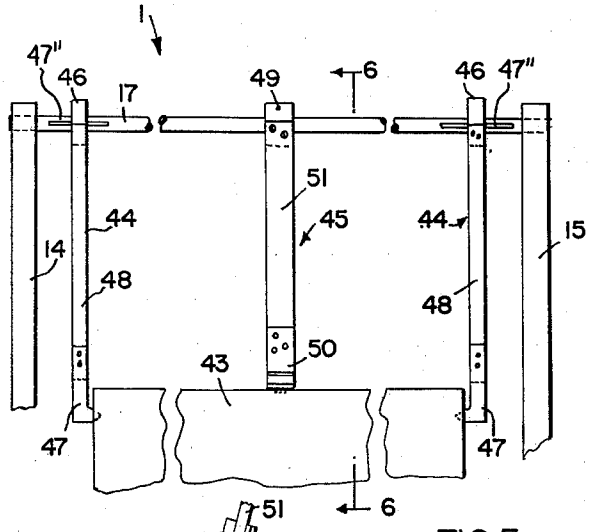


FIG. 5

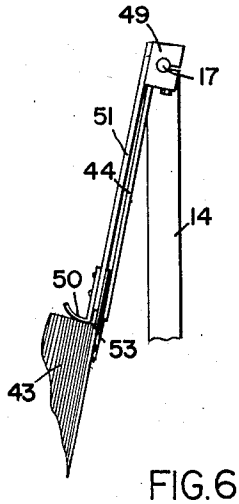


FIG. 6

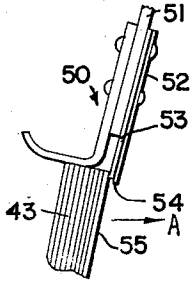


FIG. 7

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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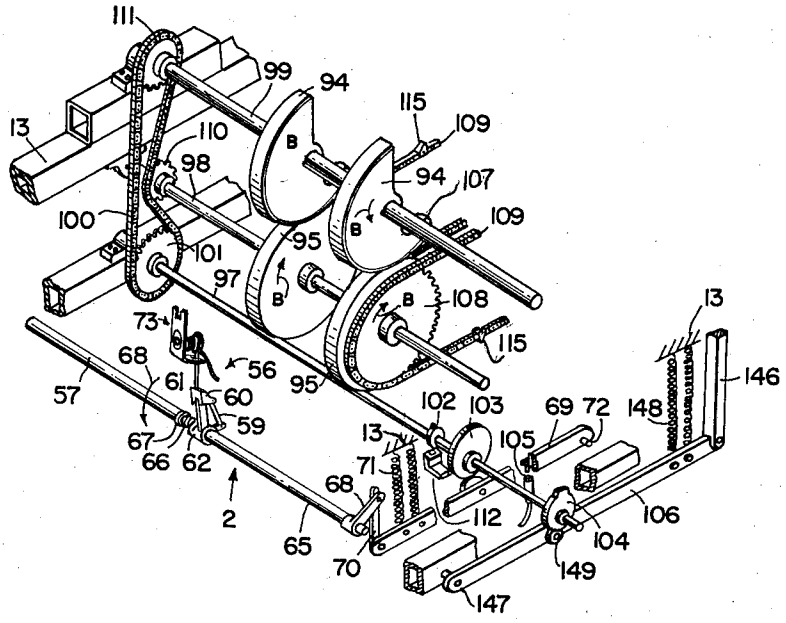


FIG. 9

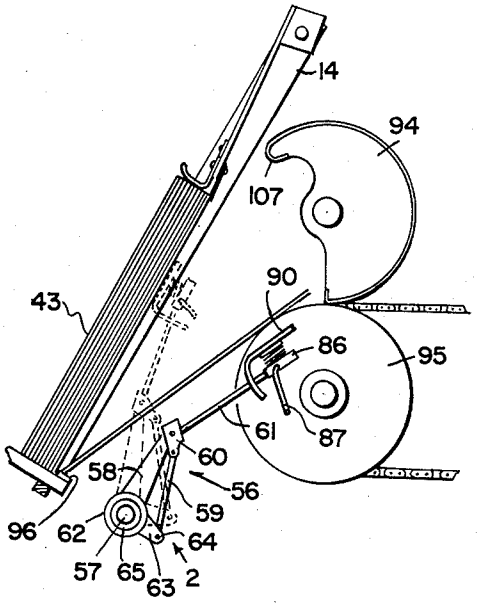


FIG. 8

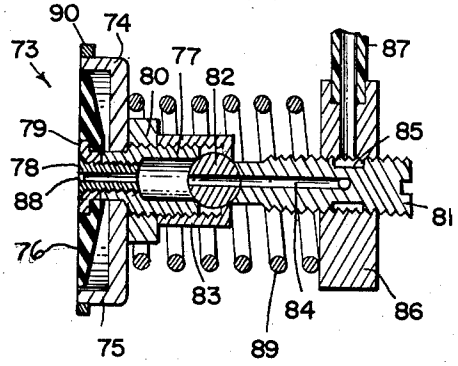


FIG. 10

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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BOX MAKING MACHINE

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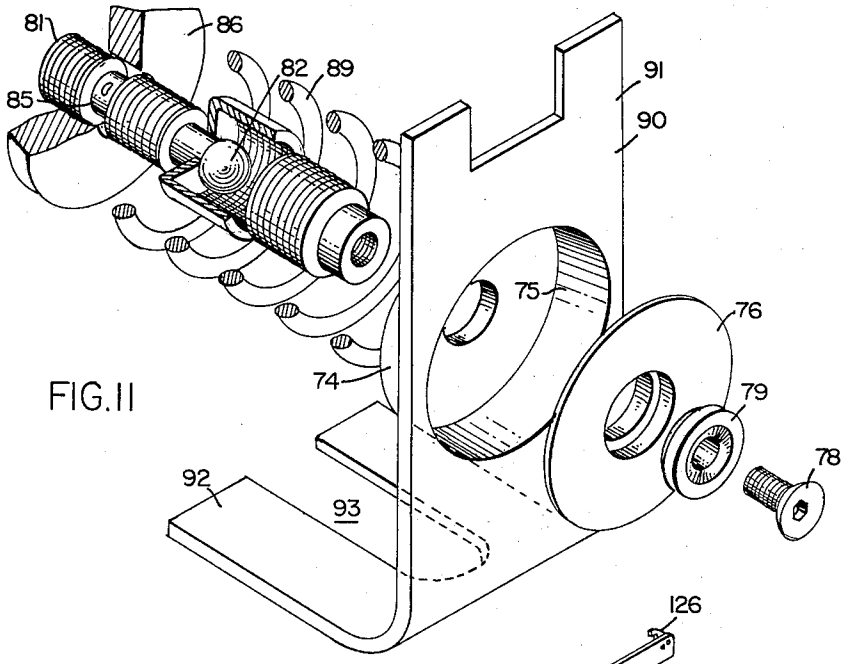


FIG. 11

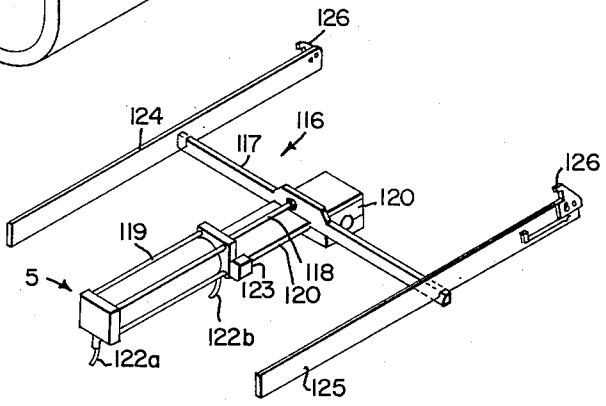


FIG. 12

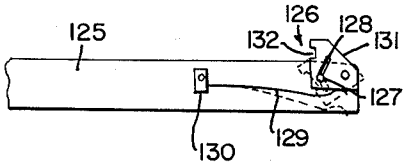


FIG. 13

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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FIG. 14

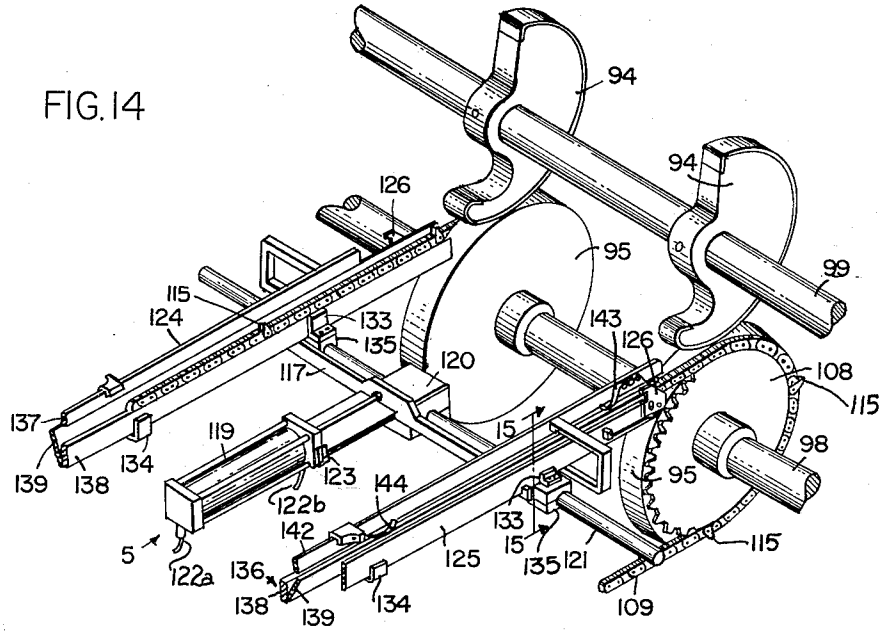


FIG. 17

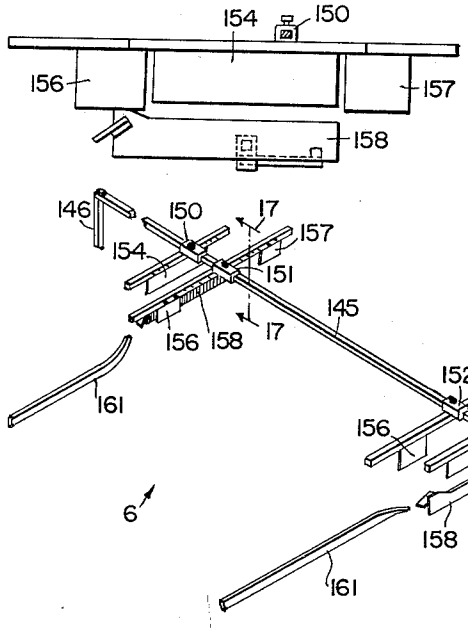


FIG. 16

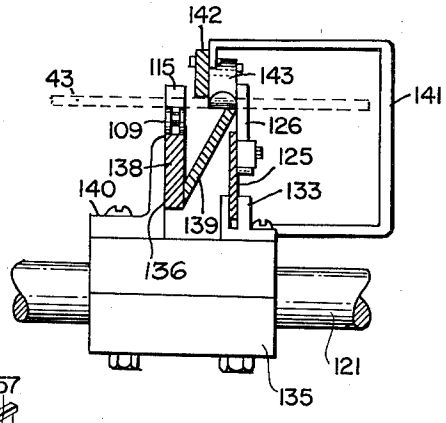


FIG. 15

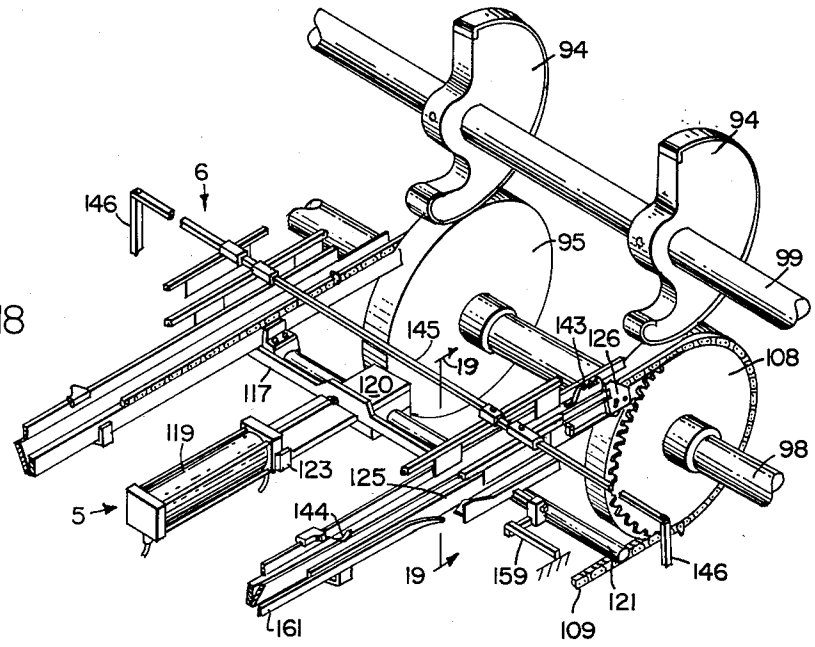
INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

Sept. 3, 1963 H. L. WALKER 3,102,457

BOX MAKING MACHINE

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FIG. 18



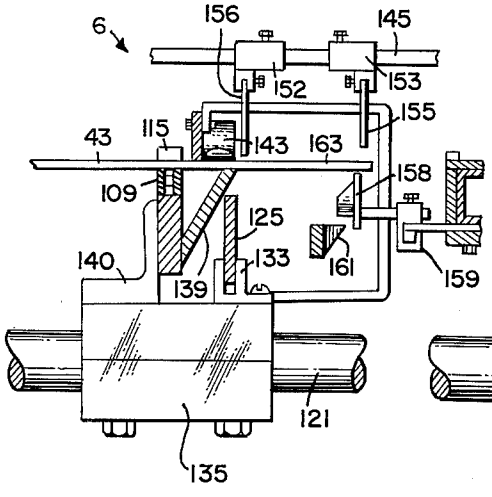


FIG. 19

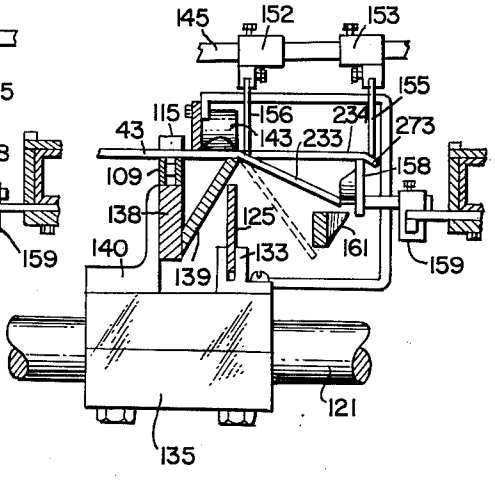


FIG. 20

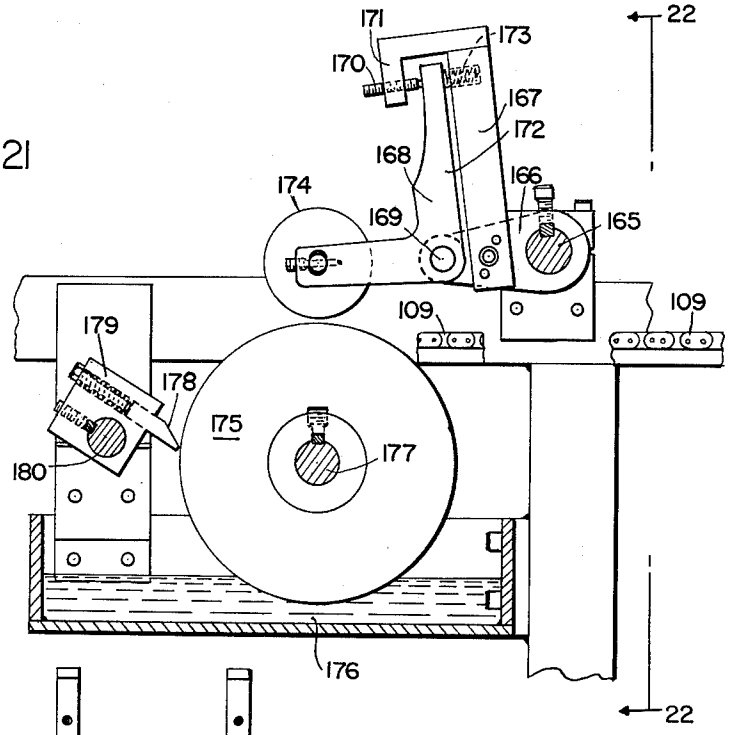
INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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FIG. 21



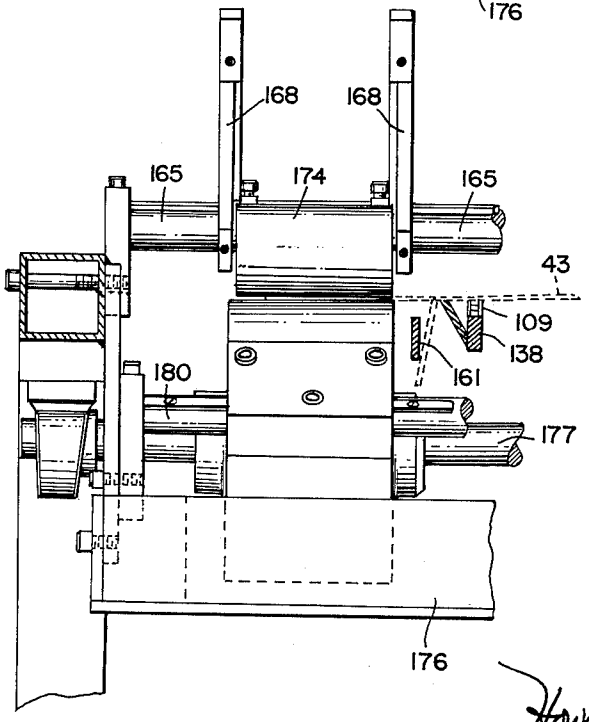


FIG. 22

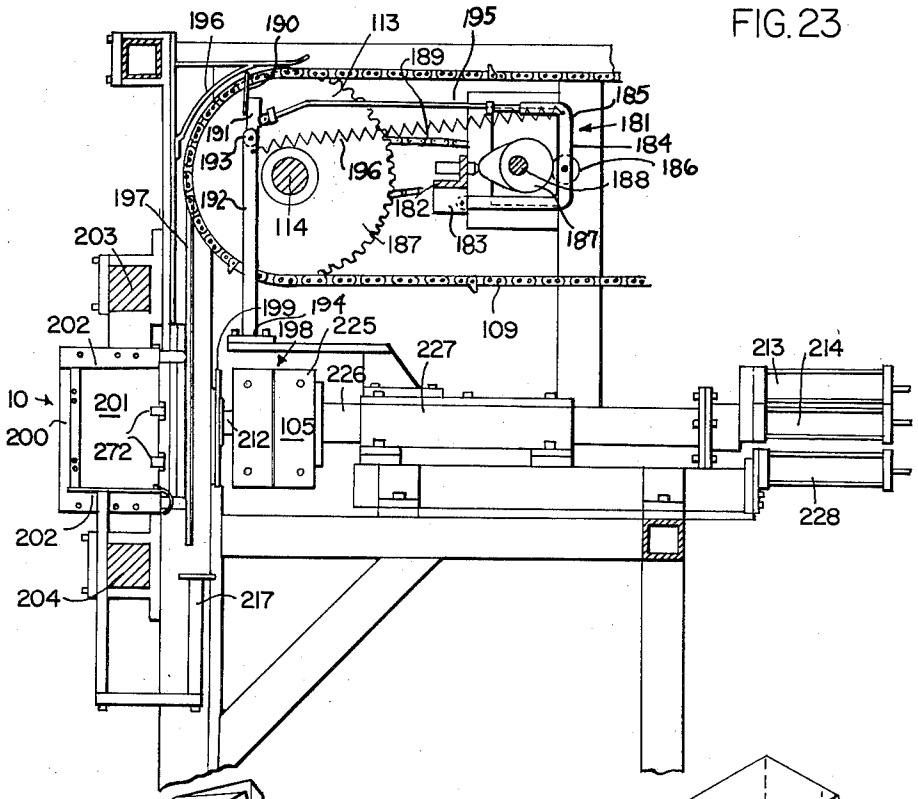
INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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FIG. 23



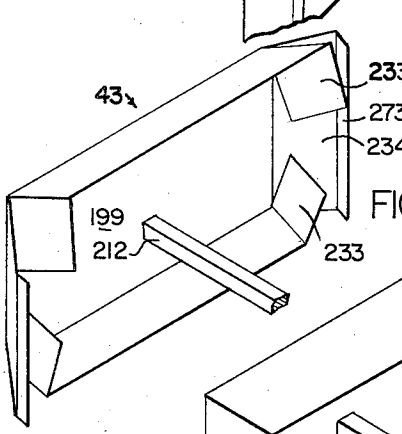


FIG. 24a

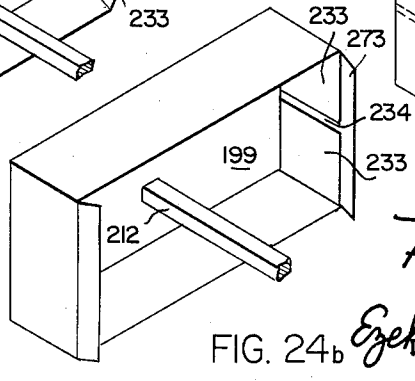


FIG. 24b

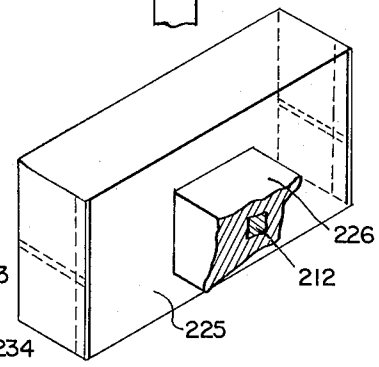


FIG. 24c

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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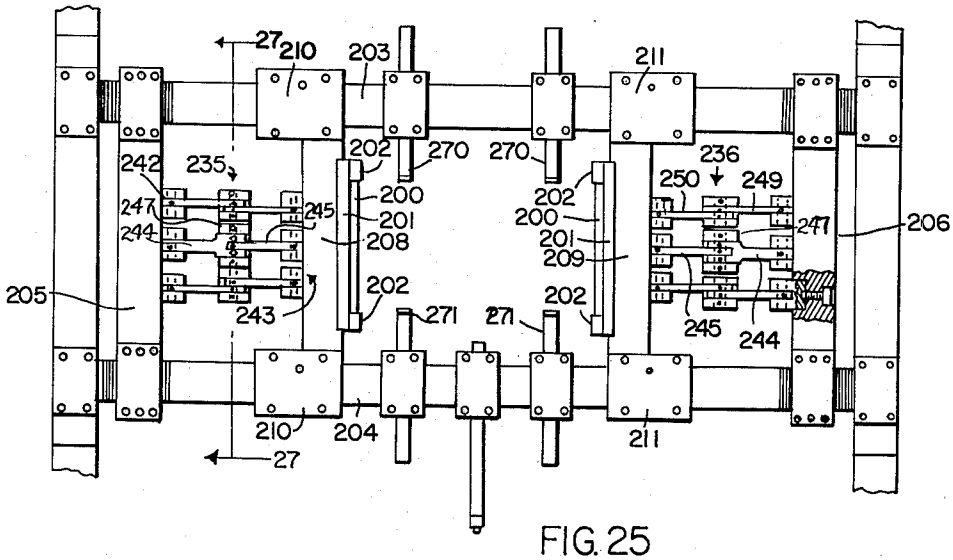


FIG. 25

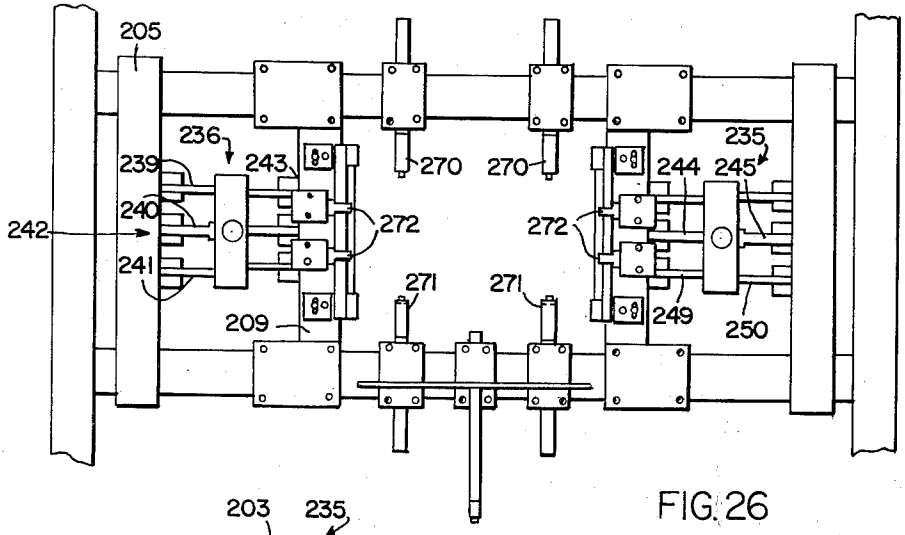


FIG. 26

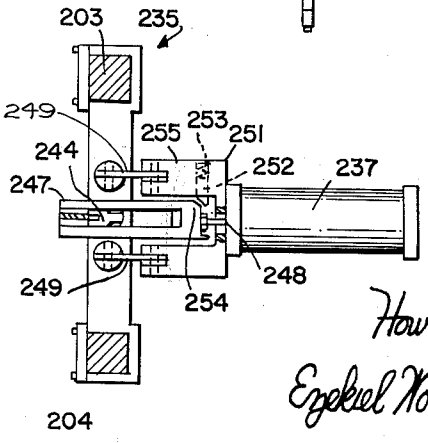


FIG. 27

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf, Wolf & Greenfield

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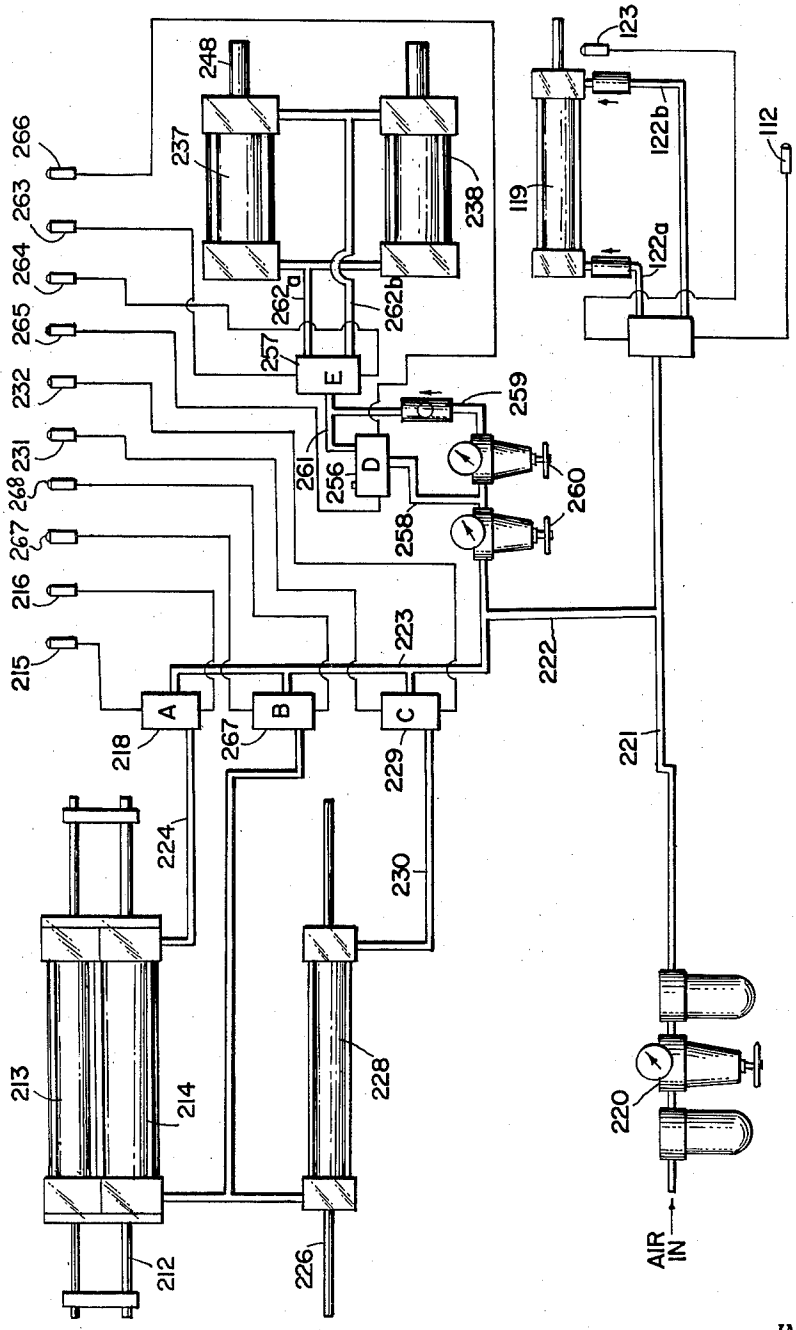


FIG. 28

INVENTOR.
Howard L. Walker
BY
Ezekiel Wolf Wolf & Greenfield

United States Patent Office 3,102,457 Patented Sept. 3, 1963

3,102,457
BOX MAKING MACHINE

Howard L. Walker, Quincy, Mass., assignor to Granite Machine Co., Inc., Hingham, Mass., a corporation of Massachusetts

Filed Oct. 21, 1960, Ser. No. 64,153
20 Claims. (Cl. 93—51)

The present invention relates to a box forming machine and in particular to a machine for manufacturing set up boxes from prescored blanks.

It is an object of the present invention to provide a relatively inexpensive machine for manufacturing set up boxes from prescored box blanks, with the machine adapted to operate efficiently, economically and with greater speed of production than heretofore possible.

It is also an object of the present invention to provide a machine of the type described which is readily adapted for manufacture of set up boxes of various sizes with a minimum amount of set up time required to make the machine ready for production.

It is also an object of the present invention to provide a machine of the type described having a unique and novel conveyor system wherein individual box blanks may be creased into a desired form with efficiency and accuracy. The present invention also provides a machine wherein the sides of the box are formed and secured together rapidly and efficiently immediately prior to ejecting the formed box from the machine. A further object of the present invention is to provide a unique and novel feed mechanism for feeding individual box blanks from a stacking rack into the machine successively with certainty and in precise preselected orientation. A further object of the present invention provides a unique mechanism for effectively applying adhesive material to selected portions of a box blank as it moves through the machine prior to forming the blank into a box.

These and other objects and advantages of the present invention will be more clearly understood when considered in conjunction with the accompanying drawings in which:

FIG. 1 is a perspective embodiment of the invention,

FIG. 2 is a schematic illustration of related portions of the invention,

FIG. 3 is a fragmentary view of portions of the frame and adjacent mechanism,

FIG. 4 is a perspective view of a blank stacking mechanism secured at the feed end of the invention,

FIG. 5 is a rear fragmentary view of a portion of the mechanism illustrated in FIG. 4,

FIG. 6 is a cross sectional illustration taken substantially along the line 6—6 of FIG. 5,

FIG. 7 is an enlarged detail of the proportion of the mechanism illustrated in FIG. 6,

FIG. 8 is a cross sectional detail of the feed end of the invention,

FIG. 9 is a fragmentary perspective view of the feed end of the present invention,

FIG. 10 is a detail of an element at the feed end of the invention,

FIG. 11 is an exploded view of the detail illustrated in FIG. 10,

FIG. 12 is a perspective fragmentary view of a device for registering the box blanks at the feed end of the mechanism,

FIG. 13 is a side fragmentary elevation of the detail shown in FIG. 12,

FIG. 14 is a perspective view of the feed end of the invention illustrating the detail shown in FIGS. 12 and 13 and taken from a position substantially opposite from that from which the view of FIG. 9 was taken.

FIG. 15 is a cross sectional detail taken along the line 15—15 of FIG. 14,

FIG. 16 is a perspective fragmentary detail of a flap folding assembly positioned near the feed end, and schematically illustrated in FIG. 2,

FIG. 17 is an elevational detail of portions of the mechanism illustrated in FIG. 16 and as illustrated along the line 17—17 of FIG. 16,

FIG. 18 is a fragmentary perspective view taken substantially from the same position as FIG. 14 but illustrating in addition thereto, details shown in FIG. 16,

FIG. 19 is a cross sectional detail taken substantially along the line 19—19 in FIG. 18,

FIG. 20 is a fragmentary detail taken along the line 19—19 of FIG. 18 but in a subsequent sequential step from the view illustrated in FIG. 19,

FIG. 21 illustrates a side cross sectional fragmentary elevation of a detail of the invention illustrating the adhesive applicating elements,

FIG. 22 is a fragmentary elevation taken substantially along the line 22—22 of FIG. 21,

FIG. 23 is a fragmentary cross sectional side elevation of the ejecting end of the invention,

FIGS. 24*a*, 24*b*, and 24*c* are schematic illustrations showing three successive steps in the formation of the box at the ejection end of the invention,

FIG. 25 is a front view of the ejecting end of the mechanism illustrating the box forming elements,

FIG. 26 is a rear view of the structure illustrated in FIG. 21,

FIG. 27 is a cross sectional view taken along the line 27—27 of FIG. 25,

FIG. 28 is a schematic illustration of the air pressure system utilized to actuate the interrelated operating components of the present invention.

As illustrated in FIGS. 1 and 2, a plurality of flat box blanks which are to be formed into set-up boxes are stacked on an adjustable stacking rack, generally illustrated at **1**. Blanks are removed individually and successively from the adjustable stacking rack **1** by a transfer mechanism generally illustrated at **2**. These blanks are then fed successively between the feed rollers assembly **3** on to an endless conveyor **4**. A blank registering or positioning mechanism **5** positions the blanks beneath side flap folding assembly **6** which partially folds the side flaps of the blank. The blank is then carried between channels by a transport mechanism **7** formed in part by the endless conveyor **4** through a gluing mechanism **8**. The creased and glued blanks are then carried off the endless conveyor **4** with the aid of a blank positioning mechanism **9**. The blanks are positioned in a box forming a die **10** by a ram assembly **11**. The ram assembly **11** forms the box in the box forming die **10** and through the action of the air pressure system illustrated in part at **12** ejects the box from the die after forming.

The adjustable stacking rack is best illustrated in FIGS. 4, 5, 6 and 7. The adjustable stacker is designed to support different sized and shaped stacks of box blanks. This rack is secured to the frame **13** (FIG. 1) at **131** (FIG. 4) and is formed with parallel side rails **14** and **15**, interconnected at their bottom ends by cross rail **16** and a rod **17** at their upper ends. A pair of lead screws **18** and **19** are mounted respectively on the rails **14** and **15** with each of the screws **18** and **19** journalled at their lower ends in journals **20** which are in turn fixed to the rails. The upper ends of the lead screws are secured by slidable journals **21** which are in turn slideably movable on the rails **14** and **15**. These lead screws **18** and **19** are operatively interengaged by the chain **22** and sprockets **23**, **24**, with the sprocket keyed respectively to the lead screws **18** and **19**. A handle **25** connected to one of the lead screws **18** turns the lead screws **18** and **19** uniformly.

A blank supporting carriage generally illustrated at 26 is vertically adjustable through operation of the lead screws 18, 19. A cross beam 27 is interengaged at its ends with the lead screws 18 and 19 by traveling journals 28 which are adapted to move along the lead screws as they rotate. A pair of bottom members 29 are rigidly secured and project normally from the cross beam 27. A second cross beam 30 parallel with cross beam 27 is rigidly secured to the bottom members 29. Cross beams 27 and 30 have slideably journalled on them slideable sleeves 31 and 32 respectively. Side frames 33 and 34 are rigidly connected to sleeves 31 and 32. The sleeves 31 on the beam 27 and the sleeves 32 on the beam 30 are adapted to slide on their respective cross beams so as to parallelly move the side frames 33 and 34 toward and away from one another in order to adjust the stacking rack for box blanks of different sizes.

Lead screws 35 and 36 are journalled respectively in supporting journals 37 and 38. Opposite end portions of the lead screws 35 and 36 on opposite sides, respectively, of the center journals 37'' and 38'' are reversely threaded. Sleeves 32 are respectively threaded on the lead screw 35 on opposite sides of the center journal 37'', while the sleeves 31 are respectively journaled on the lead screw 36 on opposite sides of the center journal 38''. A handle 39 is connected to lead screw 35 for rotation of this screw. A chain 40 and sprockets 41 operatively interengage lead screws 35 and 36 for simultaneous and synchronous rotation so that the side frames 33 and 34 may be moved toward and away from one another in parallel movement. The ends of the box support carriage 26 remote from the rails 18 and 19 are supported in relation to these rails by braces 42 which are connected at one end to the carriage preferably on the cross frame and at the other to the slideable journals 21.

Box blanks generally illustrated at 43 which may be of a variety of shapes and sizes rest with their bottom edges on the cross beams 27 and 30 and are secured in a uniform pile at the sides by the side frames 33, 34. The upper end of the stack of blanks are supported by the upper corner supports 44 and the indexing member 45. The upper corner supports 44 each comprise a mounting block 46. These blocks 46 engage the elongated keys 47'' on the rod 17 and are thereby non-rotatably but slideably keyed to the rod 17. A hook 47 is securely interconnected to each mounting block 46 by a spring leaf section 48. The indexing member 45 comprises a mounting block 49 fixed to the rod 17 with a J-shaped member 50 interconnected to the mounting block by a spring section 51, FIG. 7. The spring section 51 may be longitudinally adjustable on the block 49. The lower portion of the J-shaped member 50 is adapted to bear against and align the upper portions of the box blanks 43. The rearward surface of the bottom blank in the stack of blanks is engaged also by a pair of leaf springs 52 and 53 which are parallelly secured adjacent the J-shaped member 50 by suitable means. These springs 52, 53 may be secured to the spring section 51 by suitable means such as rivets. The forward spring 52 is somewhat longer than its parallel and adjacent spring 53 as illustrated at 54.

The individual box blanks are fed individually and successively in a manner hereafter described from the adjustable stacking rack 1. As illustrated in FIG. 7, the lowermost blank 53 is pulled rearwardly in the direction of the arrow A. This causes the springs 52, 53 to bend forwardly. Because of the difference in lengths of the springs 52, 53, spring 52 will snap into engagement with the second-most box blank before the spring 53 releases the bottom box blank. This section has been found to more effectively separate successive box blanks so that they will not run through the machine together.

The box blanks 43 are successively removed from the stacking rack 1 by the transfer mechanism 2 which is best illustrated in FIGS. 8 and 9. This mechanism 2 includes a blank engaging reciprocatable moving means 56

mounted for pivotal reciprocal movement on the shaft 57. The moving means 56 includes a forward arm 58 and rear arm 59. These arms are interconnected at their upper end by a cross member 60 which is pivotally interconnected at opposite ends to the upper ends of the arms 58 and 59. An upper arm 61 is rigidly connected to the cross member 60 and is adapted to rotate or move with it. The lower end of forward arm 58 is formed with a collar 62. A helical spring 66 coaxial with the shaft 57 engaged the collar 62 at one end and a second collar 67 also coaxial with the shaft 57 at its other end. The spring 66 biases the arm 58 in the direction of the arrow 68 and against the sleeve 65 (FIG. 9). A stop, not shown on shaft 57 engages the collar 62 to limit its rearward movement by spring 66.

A rearwardly projecting tongue 63 to which the rear arm 59 is pivotally interengaged at 64 is integral with an elongated sleeve 65. This sleeve 65 extends coaxially with and substantially ½ the length of the shaft 57 and passes freely through collar 62. The end of the sleeve 65 remote from the moving means 56 is rigidly connected to a lever arm 68, in turn connected to an elongated arm 69 through a connecting link 70. The shaft 57 is suitably secured at its opposite ends in the frame 13 of the machine. The elongated arm 69 is spring tensioned upwardly by means of the springs 71 which are connected at one end to the arm 69 and at the other to the frame 13 of the machine. The end of the arm 69 remote from the connecting link 70 is pivotally supported and secured at 72 in the frame 13 of the machine.

A blank engaging head 73 is secured to the upper end of the upper arm 61. This head is illustrated in detail in FIGS. 10 and 11. A cup 74 with side walls 75 is formed with a rubber diaphragm 76 positioned within the cup 74. The cup is mounted on an internally and externally threaded sleeve 77, with the cup and diaphragm 76 secured to the sleeve 77 by a screw 78 and metal washer 79. A lock nut 80 is positioned behind the cup and itself is threaded on the sleeve 77. The sleeve 77 is pivotally interengaged with the member 81. Member 81 is formed with a ball type socket 82 to which one end of the sleeve 77 is secured. An internally threaded retaining collar 83 pivotally interengages the sleeve 77 and the socket 82. The member 81 is formed with an axial bore 84 extending from the socket 82 to a point intermediate the ends of member 81. This bore 84 is connected to an annular groove 85 external of the member 81. Threaded over this groove 85 is the collar 86 which secures and interconnects the vacuum tube 87 with the groove 85. Thus, a vacuum created in the tube 87 will cause suction through the opening 88 in the cup 74. A helical spring 89 is interposed between the collar 86 and the rear surface of the cup 74 so that the sleeve 77 and member 81 will be normally tensioned in longitudinal alignment. A fork 90 is rigidly secured by force fit or other suitable means to the periphery of the cup 74. This fork 90 is formed with a facing section 91 and a lower angular section 92. The angular section 92 is formed with a slot 93 through which the upper arm 61 passes. This fork limits the degree of pivotal movement of the sleeve 77 with respect to the member 81.

In the operation of the transfer mechanism illustrated in FIG. 2, the cyclical downward movement of the arm 69 causes the removal of a single box blank from the stacking rack and its feeding between the feed rolls assembly. (The means for actuating the arm 69 will be described hereafter.) When arm 69 moves downwardly, it causes the rotation of the sleeve 65 in a direction opposite from that of arrow 68. This in turn causes the forward arm 58 to move rearwardly from a position illustrated in dotted outline in FIG. 8. In this initial dotted outline position, the head 73 engages the rearmost box blank 43. In this initial position, the spring 66 causes the fork, and therefore the suction cup 74 to lie flat against the box blank so that a vacuum created in the suction cup 74 will cause the head 73 to engage this

bottom-most box blank **43**. As the arm **69** moves downwardly the box blank **43** is pulled from the rack **1** to a position closely adjacent to the feed rolls **94** and **95**. In order to assure the proper positioning of the leading edge of this blank **43** between these feed rolls **94** and **95**, the head **73** continues to move clockwise (FIG. 8) beyond the position illustrated after the arm **58** has stopped, having engaged the stop member on the shaft **57**, (not shown).

This continued movement is caused by the continued rotation of the tongue **63** which causes the rear arm **59** to continue to move clockwise. This transfer mechanism therefore, provides a two step movement wherein the box is first pulled from the rack **1** to a position quite close to the rolls **94** and **95**. Continued clockwise movement then continues to pull the leading edge of the box blanks between the rolls **94**, **95** at which point the vacuum in the head is released. Thus, the upper edge of the box blank is fed directly between the feed rolls **94**, **95** while the bottom edge of the blank is held in the stacking mechanism by a stop illustrated at **96**, FIG. 8. The vacuum in the head **73** is controlled by a valve mechanism hereafter described.

At the forward end of the machine there are provided three transversely extending rotatable shafts, **97**, **98** and **99**. Shaft **97** is suitably journalled at its ends in the frame **13** of the machine and is driven through endless chain **100** and sprocket **101**. Mounted on the shaft **97** are the cams **102**, **103** and **104**. Cam **102** controls the operation of the blank registering or positioning mechanism **5**. The T-shaped blank registering or positioning mechanism **5** will be described in greater detail hereafter. Cam **103** controls the up and downward movement of the elongated arm **69**. Arm **69** in turn controls the operation of sleeve **65** and in addition air valve **105** (FIG. 9). The air valve **105** in turn controls the vacuum in the blank engaging head **73** so that the volume is periodically shut off to release box blanks at the mouth of the rolls **94**, **95**, when the arm **69** is down. Cam **104** operatively interengages arm **106** for purposes hereafter described.

Shafts **98** and **99** are suitably journalled on the frame. The shaft **98** is moveable over limited areas for adjustment of the rolls **95** which are mounted thereon. These lower rolls **95** are rubber covered and are adapted to engage and carry forward blanks which are fed singularly between them. The upper rolls **94** keyed to shaft **99** are segmented and are provided with forward projecting segments **107**. These rolls **94** are also rubber covered. Mounted on and keyed to shaft **98** are sprockets **108** which in turn are driven by transport chains **109**. These transport chains **109** are driven by means hereafter described. Shaft **98** is operatively interengaged with shafts **97** and **99** through the sprocket gears **110** mounted on shaft **98**, sprocket **111** mounted on shaft **99** and sprocket **101** mounted on shaft **97**. These sprockets are interconnected by endless chain **100**, so that the rolls **94** and **95** rotate in a manner illustrated by the arrows B.

A pair of transport chains **109** which comprise the endless conveyor **4** extend around the sprockets **108** mounted on shaft **98** at the feed end of the machine and around sprocket **113** mounted on shaft **114** at the rear or ejection end of the machine (FIG. 23). These chains **109** carry pairs of transversely aligned dogs **115** at spaced intervals. These dogs **115** are best illustrated in FIGS. 9, 15, 19 and 20. These forward edges of these pairs of dogs are each adapted to engage the rear edge of a box blank **43** as it is fed into the machine between the rolls **94** and **95**. The rotation of the driving rolls **95** and driven rolls **94** cause the box blanks **43** to feed therebetween until the trailing edge of the blank so fed is engaged by the dogs **115**. These dogs then carry the box blanks longitudinally through the machine except over a limited portion in which the blanks are carried by the blank registering or positioning mechanism **5** hereafter described.

This blank registering or positioning mechanism **5** is best illustrated in FIGS. 12, 13, 14 and 18. The blank

registering or position mechanism **5** engages the blank shortly after it has passed between the rolls **94** and **95** and been engaged by a pair of dogs **115**. It pulls rearwardly away from and at a rate faster than the moving dogs **115** to a stationary position under a side flap folding assembly **6**. The side flap folding assembly **6** is then actuated to cause suitable creases to be formed in the now stationary box blank. After the creases are formed, the dogs which are continuously moving with the chains **109**, reengage the now stationary and creased blank and continue to move it rearwardly to the subsequent stages. By moving the blank **43** more rapidly than the dogs, the blank may be positioned beneath the folding assembly **6** in a stationary position for a selected time interval during which time the creasing of the blank through the assembly **6** takes place.

The blank registering or positioning mechanism **5**, comprises a T-shaped frame **116** (FIG. 12). The cross member **117** of the T-shaped frame **116** is rigidly secured to a stem **118** in turn connected to the piston of the air cylinder **119**. The T-shaped frame **116** and air cylinder **119** are supported on a bracket **120** in turn connected to a shaft **121** which is fixed to the frame **13** (FIG 14). The piston in the air cylinder **119** is controlled for reciprocal movement through air tubes **122***a* and **122***b*. Valve **123**, illustrated in FIG. 12 and valve **112** illustrated in FIG. 9, control the reciprocatable movement of the piston in air cylinder **119** (see FIG. 28). When valve **123** is engaged by cross member **117** on forward movement of the cross member, the air pressure in the cylinder **119** is reversed to move the cross member **117** rearwardly toward the feed end of the machine. This cycle is repeated when valve **112** is synchronously closed on return of the cross member **117**.

Parallel bars **124** and **125** are formed with notches which interengage the cross member **117** at its ends (FIG. 12), with the notches formed intermediate the ends of the bars **124** and **125**. The parallel bars **124** and **125** are supported for longitudinal sliding movement on brackets **133** and **134** (FIG. 14). Bracket **133** is supported on mounting block **135** in turn adjustably secured to the rod **121**, FIG. 15. Bracket **134** is also secured by suitable means to the frame. Each of the bars **124** and **125** have pick-up fingers, generally illustrated at **126**, formed at the end closest to the feed end of the machine. These pick-up fingers **126** (FIG. 13) each project upwardly above the upper edges of the bars **124** and **125**. The pick-up finger **126** illustrated in FIG. 13, is interconnected with the bar **125** by a pin **127** which slideably interengages a slot **128** in the finger **126**. The finger **126** is spring tensioned toward its uppermost position by a leaf spring **129** which at one end engages the lower edge of the pick-up finger **126**, and which at the other end is secured to the rail **125** by block means **130**. The edges of the pick-up fingers **126** closest the feed end of the machine are bevelled as illustrated at **131** to permit the box blanks to ride over the fingers. These fingers are also provided with a notch **132** adapted to engage the rear edge of the box blank in order to pull it underneath the side flap folding assembly **6**. The T-shaped frame **116** reciprocates in synchronized movement with the movement of the dogs **115** secured to the chains **109**. The pick-up fingers **126** engage the rearmost edge of the box blanks which are being carried towards the ejection end of the machine by the dogs. These pick-up fingers are moved towards the ejection end at a rate more rapid than the dogs and therefore, pick-up fingers **126** pull the blank under the side flap folding assembly **6** at a rate more rapid than the forward movement of the dogs so that the blank moves away from the dogs by which it was initially engaged to a position under the folding assembly **6**.

Also supported on the frame is a pair of V-shaped channels **136** and **137** each having a vertical leg **138** and outwardly inclined leg **139**. These V-shaped channels

136 and 137 are each parallelly supported on the rod 121 as illustrated in FIG. 15, with a bracket 140 interengaging the leg 138 and the top of the block 135. Several similar such mounting means may be utilized as desired. Also secured to the mounting blocks such as illustrated at 135 in FIG. 15, are brackets 141. These brackets are each secured at one end to the mounting block 135 and at the other support an elongated guide rail 142. Secured to this guide rail are springs 143 and 144 which are adapted to engage and bear down against each box blank 43 when it is in a stationary position under the folding assembly 6. These springs 143 and 144 press downwardly on the blank 43 causing it to bear against the upper edges of the legs 139 of the V-shaped channels 136 and 137 while the blank is being creased. The chain 109 is carried on the upper edge of leg 138 as illustrated in FIG. 15.

The V-shaped channels 136 and 137 are moveable inwardly and outwardly on fixed rods 121*a* for adjustment to accommodate box blanks of different sizes, as illustrated in FIG. 3. In this arrangement the channels 136, 137 are supported by mounting blocks 135 on rods 121 and 121*a*. Those blocks 135 mounted on rods 121*a* are engaged by lead screws 280 which extend parallel to rods 121*a* and are reversely threaded at opposite ends. The lead screws 280 are journalled at their ends in journals 281 secured to the frame 13. The lead screws 280 are operatively interconnected by sprockets 282 and chain 283. A handle 284 integral with one of the shafts 121*a* is adapted to be turned for parallel movement of the channels 136, 137 toward and away from one another. The lead screws are also secured at their centers with the threads on either side in reverse directions by the journals 285. This mechanism is used to adjust the space between the channels 136, 137 for blanks of different sizes.

The folding assembly 6 crease the blank in the time interval during which the dogs 115 move into a reengaging position with the blank 43. This folding assembly 6 is best illustrated in FIGS. 16, 17, 18, 19 and 20.

The side flap folding assembly includes a transverse bar 145 which is secured at opposite ends to the vertical connecting rods 146 which support and operate the bar 143. These rods 146 are in turn connected at their lower ends, as illustrated in FIG. 9 to the free end of arm 106. Arm 106 is pivotally supported at its other end 147 to the frame 13. The arm 106 is normally tensioned upwardly by springs 148 connected at their lower end to the arm 106 adjacent the rod 146 and at their other end to the frame 13. The arms 106 and connecting rods 146 are moved downwardly against the tension spring 148 by the interengagement of cam 104, previously described, and the roller bearing 149 rotatably secured to the arm 106. Adjustably secured on the bar 145 are the sleeves 150, 151, 152 and 153. The sleeves 150 and 153 respectively support the upper center folding blades 154 and 155. The sleeves 151 and 152 each support a pair of side flap folding blades 156 and 157. These side flap folding blades 156 and 157 are normally aligned with the outer edges of the outwardly inclined leg 139. Lower blade 158 is secured to the frame by suitable adjustable support means illustrated at 159. This lower blade 158 has its outer surface aligned with the inner surface of blade 155.

After a box blank 43 has been positioned beneath the side flap folding assembly 6 as illustrated in FIGS. 19 and 20, and the blank is secured on the legs 139 by the springs 143 and 144, the bar 145 is actuated through connecting rod 146 to move downwardly. This, in turn causes the blades 154, 155 and 156 and 157 to move downwardly and to crease or bend the prescored flaps on the box blank 43. Blades 156 and 157 crease the outermost side flaps 233 (FIG. 24) causing the flaps 233 as illustrated in FIG. 20 to move downwardly beneath the guide rails 161. The other blades 154, and 155 crease the outer margin or tab 273 of the center flap 234 over the lower blade 158. This flap 234 remains above the rails 161. By separating the planes of flaps 233 and 234, glue is deposited only on the bottom portion of the center tabs 234 when the blank 43 is subsequently fed through the gluing mechanism 8.

The gluing mechanism 8 illustrated in FIGS. 21 and 22 includes a pair of units symmetrically positioned one on each side of the machine with each adapted to apply glue or other adhesive to the center flap 234, of a box blank 43 passing therethrough. Since each unit 8 is identical only one unit 8 will be described; that being the left unit, looking toward the feed end of the machine. In this arrangement, a rod 165 extends transversely across the machine and is suitably secured at its ends in the frame 13 of the machine. Slideably secured and keyed to this rod is the arm 166 which supports a pair of inverted L-shaped brackets 167 and the angle members 168 on either side. The inverted L-shaped brackets 167 are rigidly secured to the arm 166 while the angle members 168 are pivotally secured to the arm 166 at 169. One leg of each angle member 168 is engaged by the adjustable threaded screw 170 which is threaded through the lip 171 at the free end of the inverted L-shaped bracket 167. This leg 172 is tensioned against the screw 170 by a spring 73 which is interposed between the leg 172 and the main leg of the L-shaped bracket 167. The other end of each angle member 168 has one end of the pressure roll 174 adjustably journalled in it. The pressure roll 174 is spaced above a glue roll 175, the lower portion of which projects into the glue pot 176. The roll 175 is keyed for rotation to the shaft 177. A doctor bar adjustably mounted in a mounting block 179 is laterally adjustable on the keyed shaft 180. The keyed shaft 180 is suitably journalled or secured at its end in the frame 13. For convenience, a single glue pot may be utilized, extending all across the machine, instead of a single glue pot for each of the units 8 herein described.

Each box blank 43 is carried on the V-shaped channels 136, 137 by the chain 109. The opposite center flaps 234 project between the pressure rolls 174 and glue rolls 175, while the side flaps 233 are deflected downwardly by the guides or rails 161. After the flaps 234 have had glue adhesive applied to their underside, the dogs 115 on the transport chains 109 move the box blanks 43 to the end of the conveyor 4.

The box blanks 43 are then removed from the end of the conveyor 4 by an ejecting mechanism 181. The purpose of this mechanism 181 is to impart a positive downward movement of the box blanks after they leave the conveyor 4. This positive downward movement is necessary since box blanks 43 carrying the glued flaps 234 would move too slowly. The ejecting mechanism 181 is supported on the control valve bar 182. A clamp 183 mounted on the bar 182 has pivotally secured to it a C-shaped lever 184 with the lever 184 and clamp 183 interengaged at the lower free end of the C-shaped lever 184. The center portion 185 of the C-shaped lever 184 carries a cam roller 186 which engages the cam 187 secured to the rotatable shaft 188. The shaft 188 is in turn suitably journalled at its ends in the frame 13. This shaft 188 is rotated through a chain drive 189 which operatively interconnects sprockets, (not shown) on the shaft 114 and 188. A fork 190 having upwardly extending arms interconnected at the bottoms by a bight section is fixed at its bight section to a rocker arm 191. The lower end of this rocker arm 191 is pivotally interengaged with the supporting column 192 at 193. The supporting column, in turn, is supported at its base on the frame as illustrated at 194. The rocker arm 191 is also pivotably interengaged by the connecting rod 195 to the upper end of the C-shaped lever 184. The upwardly etxending arms of the fork 190 are adapted to engage the rear edge of a downwardly moving box blank 43. A spring 196 normally tensions the fork 190 to move downwardly with positive motion unless otherwise restrained by the cam 187. The

spring is interconnected between the column **192** and the C-shaped lever **184**. Through the rotation of shaft **188** a more positive rapid movement may be imparted to the box blank **43** than would occur if the box blank were allowed to drop from the end of the conveyor **4**.

Arcuate guide rods **196** guide the box blank **43** downwardly into a selected position in front of the box forming die **10**. Rails **197** at either side of the box forming die extend upwardly into arcuate alignment with the end of the conveyor **4**. These rails engage and maintain separate the center flap **234** from the side flaps **233** on each side of the box blank.

The box blank **43** drops down between the ram **198** and the box forming die **10** and rests at its lower edge on the platform **217**. This platform **217** may comprise a flat upper surface with supporting pillars sutably secured to the frame. At this point, the ram **198** forces the box blank **43** into the die cavity **10**, thereby folding the box along previously scored lines. This initial positioning of the box blank **43** within the die cavity **10** causes folding generally illustrated in FIG. 24*a*. Box blank **43** is pushed forward initially by the plate **199** which forms a portion of the ram **198** and has an outline conforming to the box bottom. The blank is moved forwardly through a synchronized operation, described more fully hereinafter, until the bottom of the blank **43** hits retaining ridges **200** formed on each side plate **201** of the die **10**.

The construction and operation of the ram **199** can best be understood by referring to FIGS. 23, 24 and 28. The ram **198** is actuated to push the box blank **43** into the die **10**. The ram comprises a plate **199** supported on a shaft **212**. The shaft **212** is in turn connected to the pistons of hydraulic air cylinders **213** and **214**. Cylinder **214** is the cylinder which drives plate **199** forwardly or in the reverse direction. Cylinder **213** is a damping cylinder which controls the speed at which the plate **199** moves so as to avoid tearing the box blank as it is forced into the die **10**. Forward movement of the pistons in the cylinders **213** and **214** is actuated by bleeder valves **215** and **216** which are mounted on the control valve bar **182** and are adapted to be actuated by cams mounted on the shaft **188**.

The bleeder valves **215** and **216** in turn actuate the control valve **218** which in turn controls the passage of air from the air pressure source **220** through the lines **221**, **222**, **223** and **224** to the cylinders **213** and **214**. Control valve **267** is controlled by bleeder valves **268** and **269**, in turn mounted for actuation by cams in the rotating shaft **188**. Control valve **267** controls return motion of valves **213**, **214** and **228**. Since the shaft **188** is continuously rotated through the chain drive **189**, the actuation of the bleeder valves **215** and **216** may be selectively synchronized so that the plate **199** will be driven forward into the box die at selected intervals calculated to initiate when the box blank **43** has reached the position in which it rests upon the platform **217**. This plate **199** is somewhat smaller in dimensions than the rectangular forming block **225**, which in a subsequent step forms the box into the shape generally illustrated in FIG. 24*b* and also acts as an anvil against which the side plates **201** will exert pressure by mechanism hereafter described, to glue the sides of the box together. The forming block or head **225** is mounted on the shaft **226** which is coaxial and surrounds shaft **212**. This shaft **226** is suitably journalled in supporting journals **227** which permit reciprocal movement of the shaft **226**, (FIG. 23). The shaft **226** is in turn connected to the piston of air cylinder **228**, (FIGS. 23 and 28). Cylinder **228** is controlled by control valve **229** through line **230**. Valve **229** is in turn controlled by bleeder valves **231** and **232**, which in turn are mounted on bar **182** and are actuated by cams on the rotating shaft, **188**.

When the box blank **43** is thrust into the die **10** by plate **199**, the opposite side plates **201** are in an intermediate or neutral position. These plates **201** are adapted to be parallelly displaced closer or farther apart than the neutral position in which they are located when the box blank is first forced into the die by mechanisms hereafter described.

After the head **225** has entered the die cavity **10**, the side plates **201** are moved inwardly against the side of the head **225** exerting pressure between the plates **201** and the head **225** onto the sides of the box blank. At this point, the box blank **43** has been folded to a position as illustrated in **24***b* wherein the side flaps **233** have been folded under the center flap **234**.

The box blank **43** is also properly located within the die **10** by top and bottom guide rails **202**. These rails **202** and the ridge **200** are adapted to be adjusted for receiving boxes of different sizes. The side plates **201** as well as the ridges **200** and rails **202** are supported on a framework which includes transversely extending parallel beams **203** and **204** (FIG. 25). These beams are secured on the frame **13** and are interconnected by beams **205** and **206** which are fixed during normal operation of this machine. These beams may, however, be adjusted for adapting the machine to receive or process blanks of different sizes. In addition, slideable beams **208** and **209** are slideably secured to the beams, **203** and **204** by the sleeves **210**, **211**. The beams **208** and **209** carry the slide plates **201**, the ridges **200** and guide rails **202**. The side plates **201** are actuated by toggle levers generally illustrated at **235** and **236** in FIGS. 25, 26 and 27. These toggle levers are in turn actuated by air cylinders **237** and **238** (FIG. 28). The toggle levers **235** and **236** are both identical and include in their construction three pairs of lever linkages **239**, **240** and **241**. Each of these linkages has one lever pivotally connected at one end to the fixed beam **205** or **206**, as the case may be, as illustrated at **242** (FIGS. 25, 26), and the other lever of the linkage pivotally connected at its outer end to the slideable beam **208** or **209**, as the case may be, as is illustrated at **243**. The levers **244** and **245** which comprise the center lever linkage **240** are pivotally interconnected at their adjacent ends to the control bar **247** (FIG. 27). This bar **247** may comprise a narrow yoke and stem, and is in turn connected at its stem to the shaft **248** which is connected to the piston of the air cylinder **237**. Each of the levers **249** and **250** which comprise the linkages **239** and **241** are pivotally interengaged at their inner ends and are connected to the yoke **251**. The yoke **251** is however secured rigidly to the cylinder **237**. The shaft **248** projects through a hole in the bight of this yoke **251** and is adapted to move reciprocally and independently of the yoke **251**. The linkages **239** and **241** operate as slaves and move in a direction opposite to linkage **240**, thereby effecting a scissor-like action of the toggle levers. A dog **252** is positioned in the upper arm **255** of the yoke **251**. This dog **252** engages the bevelled edge **254** formed on the rear of the control bar **247**. A spring **253** tensions the dog downwardly. The spring should be so selected to limit the rearward movement of the control bar **247** unless excessive pressure through the air cylinders is applied to overcome the force of spring **253**. When the control bar **247** is engaged and held by the dog **252**, the side plates **201** are in their neutral position. However, when excessive air pressure through the air cylinder system is applied so as to move the control bar **247** further rearwardly, overcoming the force of spring **253**, the side plates **201** move to their outermost or release position.

The air pressure system utilized to effect this movement is illustrated in FIG. 28. In this arrangement, the cylinders **237** and **238** which control respectively toggle levers **235** and **236** are synchronously controlled by controlled by control valve **256** and control valve **257**. Control valve **257** will control the flow of a lower amount of air pressure to the cylinders **237** and **238** than valve **256**. Thus, for example, 75 pounds of air pressure is applied through line **258** to valve **256**, while 20

pounds of air pressure is supplied through line 259 to valve 257. Suitable control of the air pressure may be effected by any suitable means such as the meters 260. Valve 256 is connected in series with valve 257 through line 261. Valve 257 is in turn connected to the cylinders 237 and 238 through lines 262*a* and 262*b*. Valve 257 is controlled by bleeder valves 263 and 264, while valve 256 is controlled by bleeder valves 265 and 266. Each of these valves are mounted on the control bar 182 for operation through cams mounted on the rotating shaft 188. Thus as the shaft 188 rotates, it causes a sequential operation of the bleeder valves 263, 264, 265 and 266. Valve 256 is first turned on permitting the application of full pressure of 75 pounds to the toggle levers. This is translated into approximately 2000 pounds pressure, being applied through the side plates 201 on to the sides of the box blank thereby effecting a firm pressure to glue the sides of the box blank. After a selected time interval, the pressure is released and valve 257 is actuated to return the plate to a neutral position. Since there is less pressure than would be applied when valve 256 is opened, the control bar 247 is stopped by the dog 252 under tension of spring 253 to hold the side plates 201 in neutral position. In this position there is sufficient room for withdrawal of the plate 199 and head 225. After withdrawal of the plate 199 and head 225 through action of the air cylinders 213, 214, and 228, the side plates 201 are fully opened to permit subsequent ejection of the formed box. In this subsequent sequential step, valve 256 is actuated to permit an overriding increased pressure to be applied to the cylinders 237 and 238. This increased air pressure overcomes the restraining force of spring 253 and forces the control bar 247 further rearwardly thereby further opening the toggle levers 235 and 236.

After the side plates 201 are opened all the way, the box may be removed from the die by suitable means such as a blast of air (not shown).

Top and bottom guides 270 and 271 are mounted respectively by adjustable means on the beams 203 and 204. These guides properly position the top and bottom portions of the box. Latches 272 project inwardly adjacent to the feed end of the die 10 (FIG. 23). These latches serve two purposes. They properly position the edge tabs indicated at 273 in FIG. 24 by projecting the tabs into the path of the forwardly moving head 225 so that the head will fold these tabs 273 over the flaps 233, as illustrated in FIG. 24*c*. The tabs 272 also engage and hold the box in the die 10 when it has been formed and when the head 225 is being rearwardly withdrawn together with the plate 199.

The entire mechanism may be driven from a single source of power such as motor 290 operatively interengaged with shaft 114 through the chain 291 and sprockets 292 (FIG. 1).

What is claimed is:

1. In a box forming machine, means for retaining a stack of box blanks, means for successively removing blanks from said stack, means for horizontally conveying said blanks in succession over a prescribed path at a first rate of speed, means for disengaging said blanks from said conveying means at a selected point in said path, and for thereafter moving said blanks over a portion of said path at a second and faster rate of speed than said first rate of speed, means for reengaging said conveyor means and said blanks at the end of said portion, means for effecting creases in said blanks in said path while disengaged from said conveyor means and means for thereafter forming boxes from said blanks with the edges of said boxes in part at least formed along said creases.

2. A device as set forth in claim 1 wherein said means for retaining a stack of box blanks comprises a stacking rack formed of a plurality of interengaged rails, a box blank supporting carriage, means adjustably securing said carriage to said rails whereby said carriage may be moved along said rails for accommodation of different sized blanks, and means projecting inwardly from said rails for removably interengaging said blanks.

3. In a box forming machine, means for horizontally conveying box blanks in succession over a prescribed path at a first rate of speed, means for disengaging said blanks from said conveying means at a selected point in said path and for thereafter moving said blanks over a portion of said path at a second and faster rate of speed than said first rate of speed, means for reengaging said conveyor means and said blanks at the end of said portion, means for effecting creases in said blanks in said path while disengaged from said conveyor means, and means for thereafter forming boxes from said blanks with the edges of said boxes in part at least formed along said creases.

4. A device as set forth in claim 3 having means for stopping the movement of said boxes in said portion of said path, and means synchronizing the operation of said creasing means with said stopping means whereby said creases are effected while said boxes are stationary.

5. In a box forming machine, means for horizontally conveying box blanks in sucession over a prescribed path at a first rate of speed comprising a pair of endless transport chains parallelly mounted for movement principally in horizontal planes, a plurality of dogs secured in spaced relation along said chains and adapted to engage individual box blanks and move said blanks with movement of said chains at said first rate of speed, means for disengaging said blanks from said dogs at a selected point in said path and for thereafter moving said blanks over a portion of said path at a second and faster rate of speed than said first rate of speed, means for reengaging said dogs and said blanks at the end of said portion means for effecting creases in said blanks in said path while disengaged from said conveyor means, and means for thereafter forming boxes from said blanks with the edges of said boxes in part at least formed along said creases.

6. A device as set forth in claim 4 wherein said creasing means comprise a plurality of parallelly arranged blades, means mounting said blades parallel to and laterally beyond said chains, means for moving said blades vertically and means coacting with said blades during said vertical movement for effecting creases in box blanks positioned between said blades and coacting means.

7. In a box forming machine, means for horizontally conveying box blanks in succession over a prescribed path at a first rate of speed comprising a pair of endless transport chains parallelly mounted for movement principally in horizontal planes, a plurality of dogs secured in spaced relation along said chain and adapted to engage individual box blanks with said blanks supported on said chains and with portions of said blanks projecting laterally beyond said chains, said dogs adapted to move said blanks with movement of said chains at said first rate of speed, means for disengaging said blanks from said dogs at a selected point in said path and for thereafter moving said blanks over a portion of said path at a second and faster rate of speed than said first rate of speed, means for reengaging said dogs and said blanks at the end of said portion, means for effecting creases in said laterally projecting portions of said blanks while in said path and while disengaged from said dogs, and means for thereafter forming boxes from said blanks with the edges of said boxes in part at least formed along said creases.

8. In a box forming machine, means for horizontally conveying box blanks in succession over prescribed path comprising a pair of endless transport chains parallelly mounted for movement principally in horizontal planes, plurality of dogs secured in spaced relation along said chains and adapted to engage individual box blanks with said blanks supported on said chains and with portions of said blanks projecting laterally beyond said chains, means for disengaging said blanks from said conveying

means at a selected point in said path for maintaining said blanks stationary at said point, means for effecting creases in said blanks at said point in the laterally projecting portions of said blanks, means for reengaging said conveyor means with said blanks subsequent to said creasing, means for thereafter forming boxes from said blanks with the edges at least in part formed along said creases and said means for disengaging said blanks includes a plurality of packup fingers, means supporting said fingers for reciprocal movement in the plane of said blanks and along a portion of said path, means adapted to interengage said fingers with said blanks at a second point in said path and release said blanks at said first point, means adapted to move said blanks at a speed faster than said blanks are moved by said conveying means along said path between said second and first points while said blanks are engaged by said pickup fingers.

9. A device as set forth in claim 8 wherein said pickup fingers are each supported on one of a pair of parallel bars extending parallel to said chains, and said bars are interconnected by a cross member and a stem normal to and engaging said cross member with means for reciprocating said stem.

10. A device as set forth in claim 9 wherein said chains are supported along said path each by an elongated member positioned parallel to and below said chains.

11. A device as set forth in claim 10 wherein said parallel bars are each slideably supported by a second elongated member.

12. A device as set forth in claim 11 wherein said blades are supported by a bar extending laterally across said device, and means adapted to move said bar downwardly for effecting said creases.

13. A device as set forth in claim 8 wherein means for applying cement to said laterally projecting portions of said blanks are positioned in said path.

14. A device as set forth in claim 13 wherein said means for applying cement comprise glue rollers positioned to engage the lower surface of said laterally projecting portions, means for applying glue to said glue rollers, pressure rollers, means supporting said pressure rollers for arcuate movement to and from spaced positions parallel to and above said glue rollers.

15. In a box forming machine an adjustable stacking rack comprising rail means lying in a major plane, carriage means for engaging the bottoms of a stack of box blanks, means adjustably securing said carriage means to said rail means for movement of said carriage means in parallel planes angular to said major plane of said rails from one end of said rack toward the other end, an indexing member for engaging the upper end of a box blank next adjacent said major plane, and, means securing said indexing member at said other end of said rack.

16. A device as set forth in claim 15 wherein said indexing member comprises a first and second spring in facing adjacent relation, said springs lying parallel to said major plane and extending toward said one end, with said first spring normally engaging said box blank next adjacent said major plane, and said second spring normally positioned more remote than said first spring from said blank and projecting farther toward said one end than said first spring.

17. In a box forming machine conveyor means for horizontally feeding partially formed box blanks, means for guiding said blanks from the end of said conveyor means into a vertical plane, means for moving said blanks in succession downwardly from the end of said conveyor means into said vertical plane, means for forming said blanks into boxes comprising means forming a die with movable side plates within which blanks may be shaped into boxes, a ram assembly adapted to press said blanks into said die having a flat plate and shaft integral therewith, adapted to project said blanks into said die, and a head having a shape conforming with said die adapted to press said blanks into pressure engagement with said die, means for moving said side plates toward and away from one another and into pressing relation with said head when said head is pressing said blanks into engagement with said die, means for actuating said means for moving said side plates into three positions including an inward position wherein said plates are in pressing relation with the side of said head and thereby adapted to apply pressure to portions of a box positioned between said side plates and head, a neutral position wherein said head may be moved relative to said side plates while portions of said box remain substantially stationary, and an outward position wherein said side plates are free of said portions of said box, and means for actuating said head.

18. A device as set forth in claim 17 wherein said means for moving said side plates includes toggle lever means with said plates each secured to said toggle lever means, and means for actuating said toggle lever means.

19. A device as set forth in claim 18 wherein said toggle lever means include pivotally interengaging levers with a lever at one end of said toggle lever means fixed to said plate and a lever at the other end of said toggle lever means fixedly secured.

20. A device as set forth in claim 19 wherein said means for actuating said toggle lever means includes an air pressure system having a plurality of air cylinders having air pressure controllable shaft connections operatively engaging said toggle lever system, and means for varying the air pressure in said cylinders for controllably moving said shafts.

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