United States Patent

Lattke

[15] **3,683,755**

[45] **Aug. 15, 1972**

[54] TRAY FORMING APPARATUS

[72] Inventor: **Horst G. Lattke,** Middletown, Conn.

[73] Assignee: **Emhart Corporation,** Bloomfield, Conn.

[22] Filed: **July 17, 1970**

[21] Appl. No.: **55,643**

[52] **U.S. Cl.**.....**93/51.1,** 93/44.1, 93/53 SD, 93/59 ES, 271/32

[51] **Int. Cl.** **B31b 1/32**

[58] **Field of Search**.....93/51.1, 51 R, 51 M, 53 SD, 93/44.1

[56] **References Cited**

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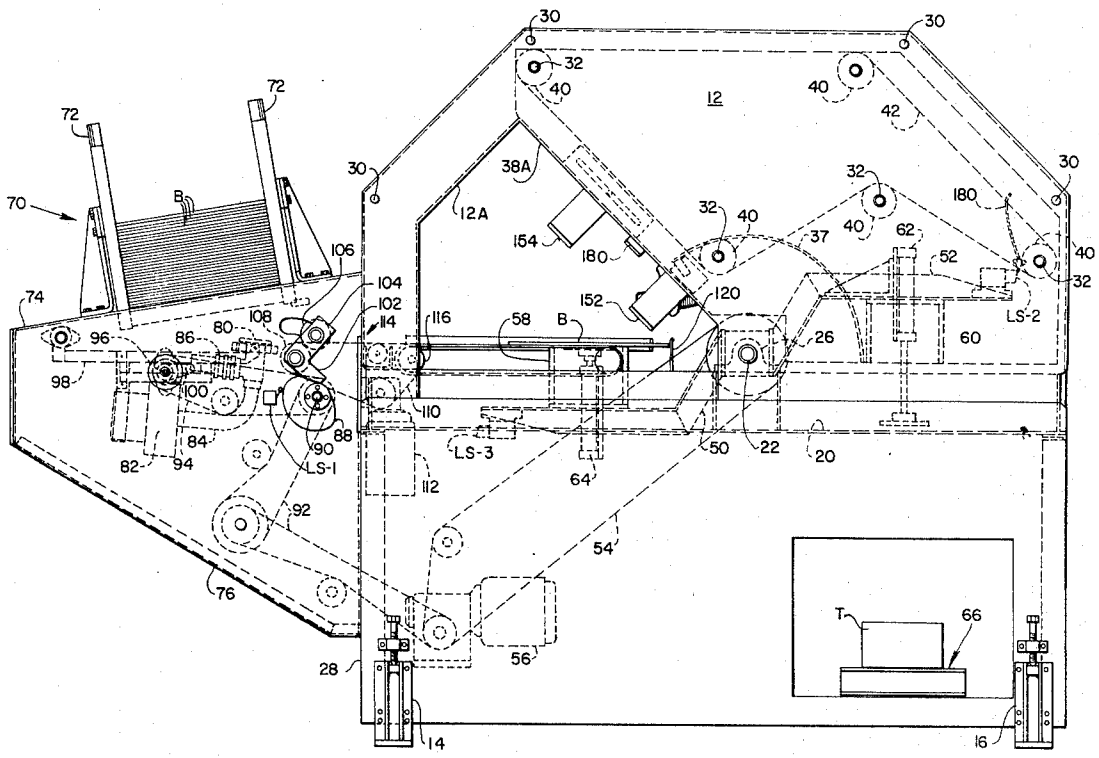
Primary Examiner—Bernard Stickney
Attorney—McCormick, Paulding & Huber

[57] **ABSTRACT**

Individual precut and prescored tray blanks are withdrawn from a stack and fed to an infeed station of the machine, each blank being provided with adhesive while enroute to said infeed station, and each blank being oriented with its end flaps in radially spaced relationship with respect to the axis of rotation of a mandrel which moves upwardly from beneath the blank to engage it at the infeed station and move it upwardly against four fixed corner tab deflecting plows. The inner radial edge of the blank is engaged by a pair of pivotally mounted fingers which fold the inner end flap through 90° as the blank is moved downstream by the mandrel. Projecting portions of these fingers also fold the corner tabs through 90° with respect to the inner end flap, while a pair of resilient leaf spring elements fold the outer end flap at substantially the same time. The outer pair of corner tabs are folded solely by the above mentioned fixed corner tab engaging plows. A pair of opposed side walls have upstream edges for supporting these flap folding elements, and also for supporting fixed side flap folding members so arranged as to engage the side flaps of the blank as it travels between the axially spaced side walls. The continuously moving mandrel then carries the folded tray through substantially 180° of its rotation to set the adhesive prior to arrival at a discharge station, where an eject cylinder carried within the mandrel, punches the tray downwardly so that it drops downwardly onto a take-away conveyor.

19 Claims, 8 Drawing Figures



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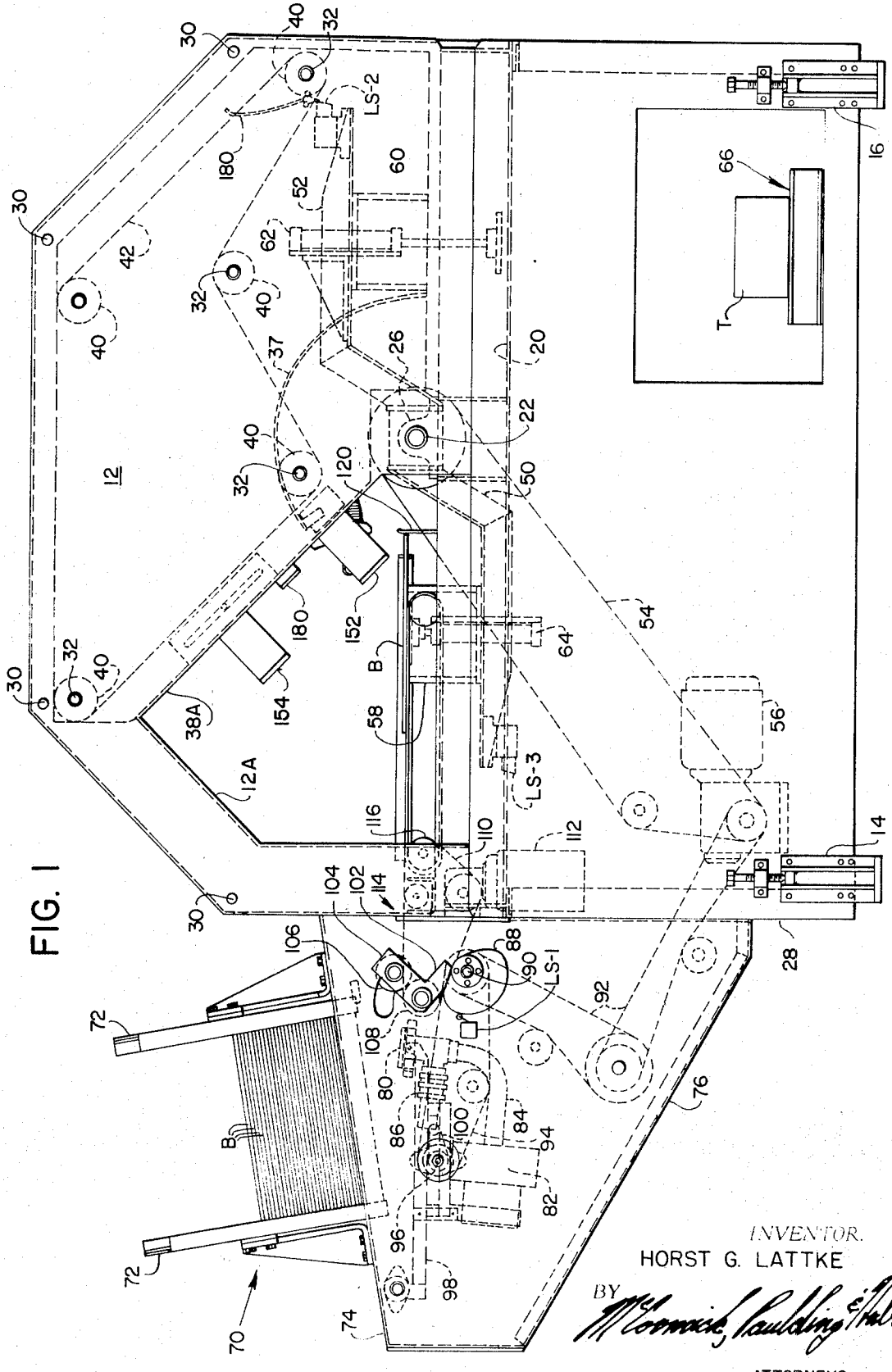


FIG. 1

INVENTOR.
HORST G. LATTKE

BY McCormick, Paulding & Huber

ATTORNEYS

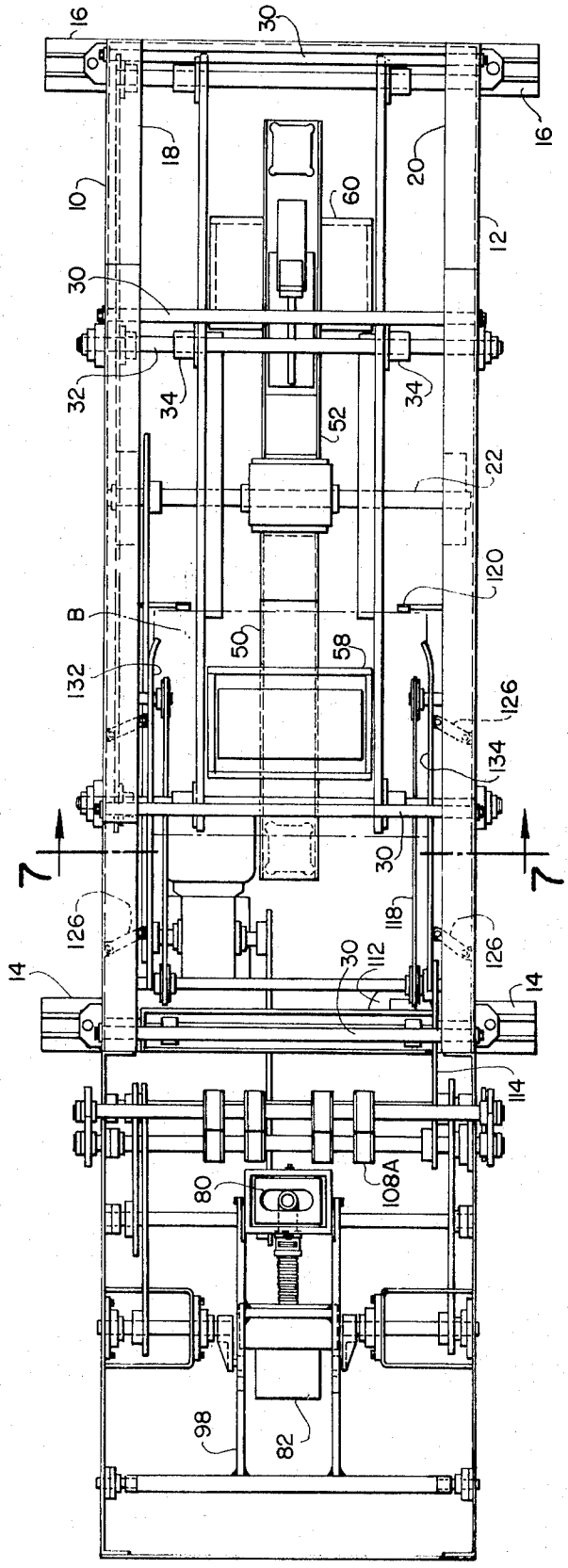

16
30
16
18
20
10
60
12
30
32
34
34
52
22
120
B
50
58
132
126
134
30
7
7
126
118
126
14
30
112
14
114
80
108A
98
82

FIG. 2

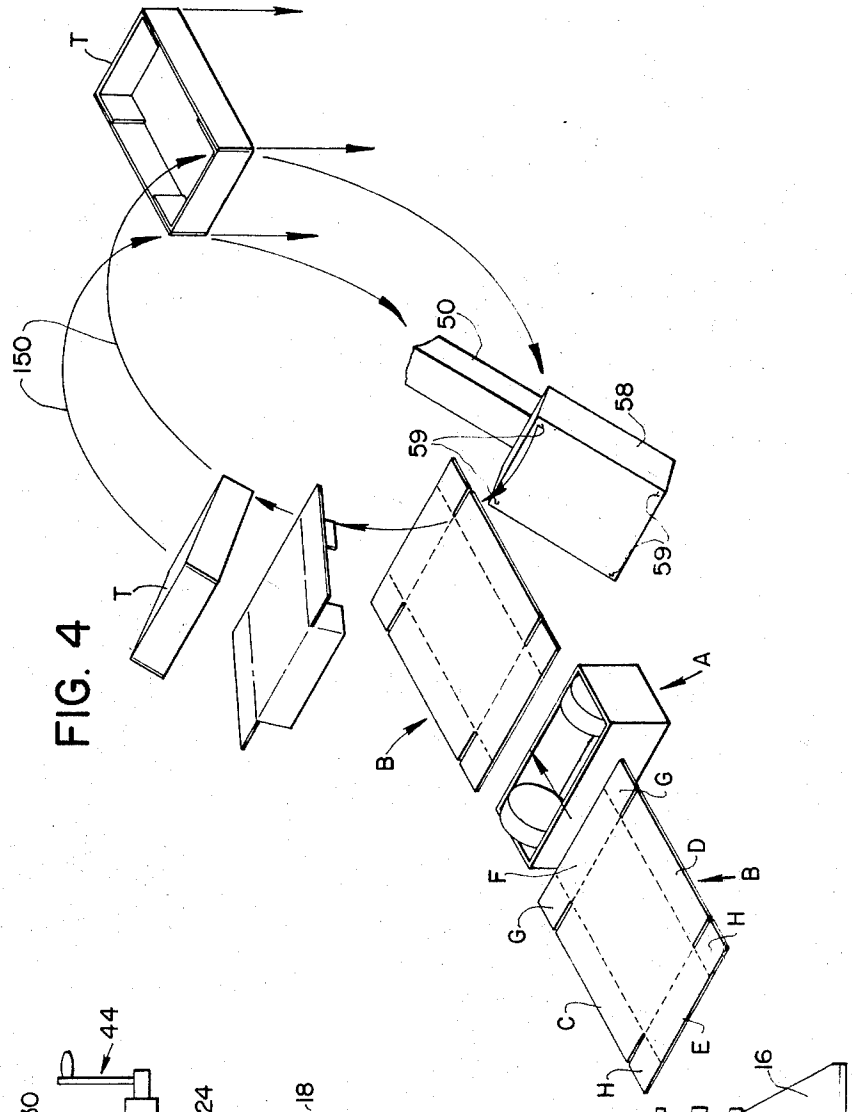

T
150
50
58
59
59
T
A
B
G
D
B
F
G
H
C
E
H

FIG. 4

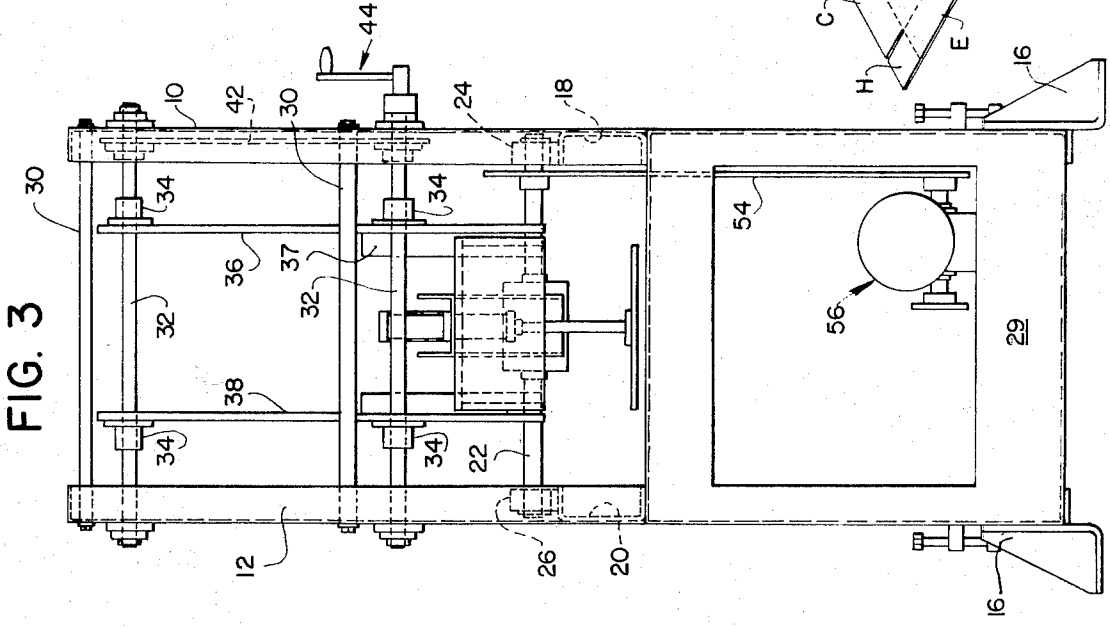

44
10
42
30
24
18
16
30
34
34
54
36
37
32
32
56
29
38
34
34
22
12
26
20
16

FIG. 3

FIG. 5

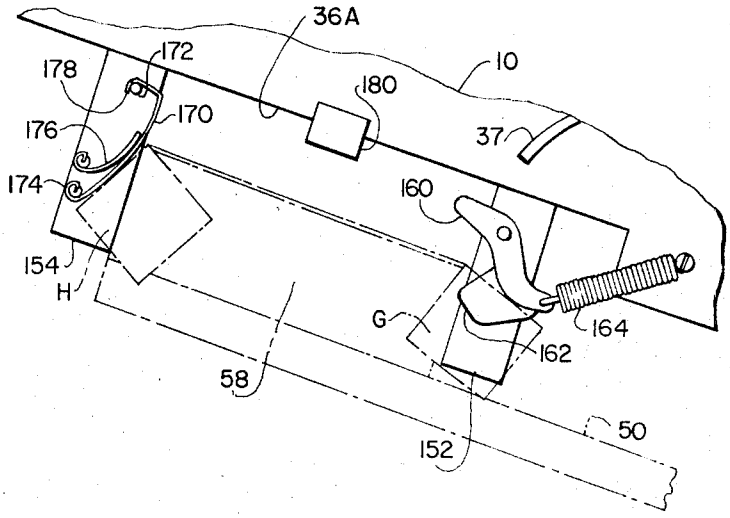
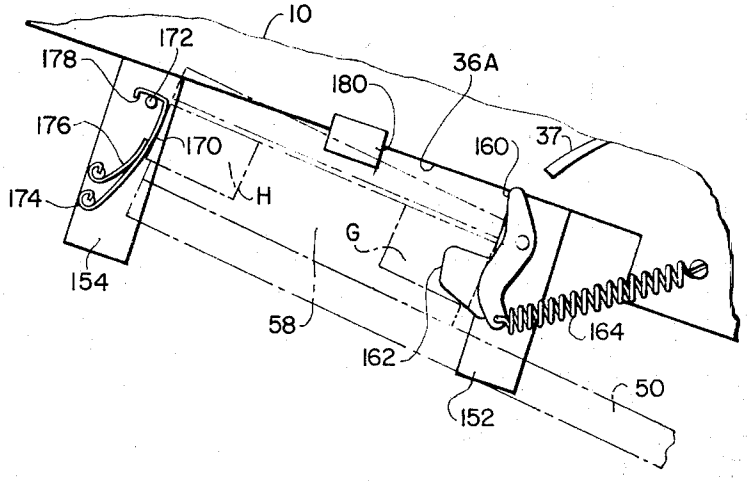

36A
172
178
10
180
170
176
37
174
160
154
H
G
164
162
58
50
152

FIG. 6


10
172
178
36A
180
176
170
37
160
174
H
G
154
58
164
162
50
152

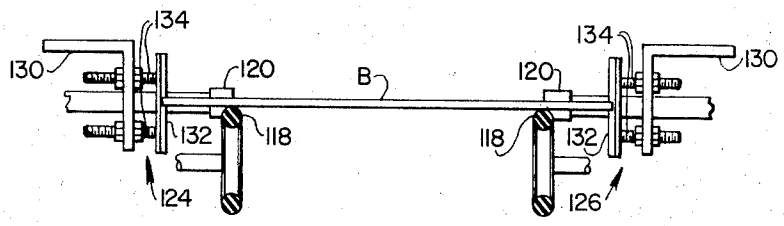

134
130
120
B
120
134
130
132
118
118
132
124
126

FIG. 7

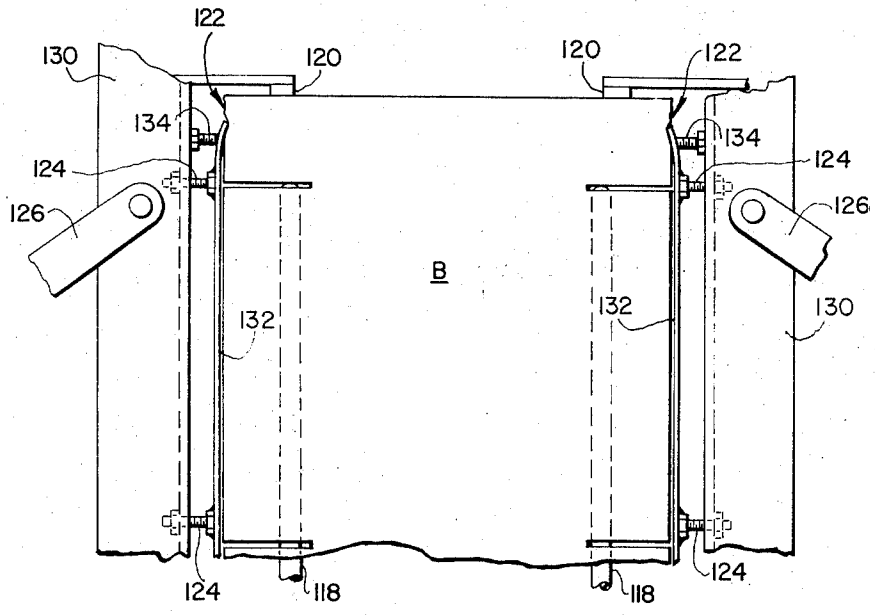

122
130
120
120
122
134
134
124
124
126
126
B
132
132
130
124
118
118
124

FIG. 8

TRAY FORMING APPARATUS

BACKGROUND OF THE INVENTION

Machines for forming trays from flat blanks by folding side and end flaps around a mandrel are old in the art. For example, U.S. Pat. No. 3,080,796 issued to Twitchell et al. in 1963 shows one such machine adapted to feed blanks from the bottom of a stack to a position wherein a reciprocating mandrel moves into contact with the blank to force it past resilient flap folding elements which fold the side and end flaps through 90°. However, this machine is not adapted to fold blanks which have been provided with strips of adhesive at predetermined portions. In the Twitchell machine, the blanks are not provided with corner tabs, but rather have short strips of tape applied to each of the four corners of the folded blank or tray to hold the side flaps in position.

U.S. Pat. No. 3,512,459 issued to DiFrank in 1970 shows a machine for folding blanks which do have corner tabs, and which blanks are provided with adhesive while enroute to a forming station after having been withdrawn from the magazine by a vacuum feed table. Other supporting means is provided at the forming station, while the feed table returns for another blank, and a reciprocable mandrel engages the blank from above so that pivotally mounted flap folding elements may operate sequentially on the blank as it is held at the forming station by the mandrel. The side and the end flaps as well as the corner tabs are folded while the blank is held in a stationary condition, after which the mandrel urges the blank, in its folded condition, downwardly into a compression unit where the blank is held in its folded condition until the adhesive sets.

In the Twitchell patent the tray must be held together with strips of tape at its four corners, and the machine is not adapted for folding blanks with corner tabs, which blanks are provided with an adhesive at preselected portions as they move from a magazine to a forming station. In the DiFrank patent the blank does have corner tabs, but the mandrel is moved in a reciprocating discontinuous fashion, and the flap folding elements themselves must be driven while the blank is held at the forming station with the result that a rather complex mechanism is provided for forming the resulting tray. One aim of the present invention is to provide a machine in which the motion of the mandrel is continuous, and which motion is also used to fold the side flaps and end flaps and corner tabs as the blank is fed past movably mounted elements which need not be driven as in the machine disclosed in DiFrank. This aim of the present invention must be fulfilled in a machine wherein the folded blank, or tray, is held in a compressed condition long enough to set the adhesive after being so formed

The machine disclosed herein accomplishes the foregoing aim as well as others to be discussed hereinbelow by providing a mandrel which rotates so as to move the blank between pivotally mounted flap elements to form the tray while it is moving downstream, which mandrel also serves to move the folded tray through a compression section of the machine so as to set the adhesive, and finally which mandrel includes means for ejecting the formed tray at a discharge station. All of the above functions are accomplished by a

continuously rotating mandrel in the machine to be described.

Machines for continuously moving a blank while its flaps are so folded are somewhat rare. Intermittently operated rotary carriers have been shown in prior art patents however. For example, U.S. Pat. No. Re 214,445 issued to Waters in 1940 shows one such rotary device, and U.S. Pat Nos. 1,808,014 and 1,864,632 both issued to Bergstein in 1931 and 1932 respectively are further examples of such machines. A continuously rotating mandrel or carton forming device which is adapted to move a blank between fixed and movably mounted flap folding, elements is shown in U.S. Pat. No. 2,220,960 issued to Jurgens et al. in 1940. However, the machine disclosed in the Jurgens patent does not show or suggest the above-mentioned advantages to forming a flat blank which has been supplied with a quantity of adhesive. For example, Jurgens not only fails to reveal an adhesive applying station, but the Jurgens patent does not disclose adjustably mounted side walls for forming trays of various size, and so designed as to set the adhesive as the tray is continuously moved by the mandrel, not only through the infeed station and through the end flap and side flap forming stations, but also through the compression station of the machine and through the discharge station. At the discharge station the present machine provides for rejecting the formed tray without interrupting the motion of the mandrel.

A further aim of the present invention is to provide an apparatus for forming upwardly open trays from flat precut blanks by a movable mandrel wherein the blank so formed is adapted to be accurately positioned at an infeed station so as to be engaged by the mandrel with the result that its end and side flaps are folded on predetermined score lines as the blank is accurately held in position by novel blank retaining means at said infeed station. The foregoing object is accomplished in spite of the fact that each blank is with drawn from a stack of like blanks, and fed quite rapidly to the infeed station by novel mechanism in the form of a pair of rollers one of which is driven and the other of which comprises a back-up roller driven by a blank fed therebetween which back-up roll is pivotally mounted for oscillatory motion from and to a blank engaging position in cooperation with the means for withdrawing the lowermost blank from the stack.

SUMMARY OF INVENTION

The machine disclosed and claimed herein accomplishes the foregoing aims and objects by utilizing a novel mechanism for withdrawing the lowermost blank from a stack of like blanks, feeding it past an adhesive applying station to an infeed station where the blank is accurately and firmly held in position by unique side guides prior to being engaged by a rotating mandrel to be continuously conveyed through the machine to a discharge station. The mandrel moves the blank downstream between inner and outer pairs of fixed plows, which plows at least partially deflect the four corner tabs carried by the inner and outer end flaps of the blank. The side flaps are separated from these corner tabs by precut notches, and the inner pair of fixed plows carry pivotally mounted end flap folding fingers which are engaged by the blank and pivot

through predetermined angular displacements so that corner tab folding plows carried on these fingers serve to fold the associated pair of corner tabs through 90° with respect to the inner end flap even as the inner end flap itself is folded by these fingers. The outer end flap is folded by a pair of resilient leaf spring members carried by the outer pair of corner tab folding plows, and the side flaps are subsequently folded by fixed plows comprising a part of the upstream edges of two paralled axially spaced side walls between which the folded blank or tray is continuously moved through a substantial angle, preferably 180°. These side walls are adjustably mounted and serve to hold the tray while the adhesive sets and while the continuously rotating mandrel is moving the tray to the discharge station. At the discharge station an eject cylinder, carried within the mandrel, ejects the tray onto a take-away conveyor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side elevational view of a machine for forming trays from flat blanks according to the present invention.

FIG. 2 is a plan view of the machine shown in FIG. 1.

FIG. 3 is an end view showing the discharge end of the machine shown in FIGS. 1 and 2.

FIG. 4 is a schematic isometric view showing several successive positions of a blank as it is acted upon by the mechanism of FIGS. 1 through 3 inclusively during the path of movement of said blank through the machine.

FIG. 5 is a detailed vertical sectional view through a plane extending radially through the axis of rotation of the mandrel, and through the blank carried thereby showing in detail the instantaneous configuration of the inner and outer end flap folding elements.

FIG. 6 is a view similar to FIG. 5 but taken at a slightly later instant of time.

FIG. 7 is a vertical sectional view of a portion of the apparatus shown in FIG. 2, being taken on the line 7—7 of that view, but with portions of the machine being omitted for clarity.

FIG. 8 is a plan view of the mechanism shown in FIG. 7.

DETAILED DESCRIPTION

Turning now to the drawings in greater detail, FIGS. 1, 2 and 3 show in side elevation, plan and end views respectively the overall configuration of the machine described herein and embodying the invention set forth in the appended claims. The machine includes an elongated frame comprising left and right-hand vertically extending fixed side walls **10** and **12** supported upon two pairs of laterally spaced feet **14** and **16**. Intermediate the upper and lower edges of these side walls **10** and **12** a pair of longitudinally extending channel shaped support members **18** and **20** are provided. These members extend the full length of these side walls **10** and **12** as best shown in FIG. **2**. A rotary shaft **22** extends laterally across and between the space between the channel members **18** and **20**, being journaled at each end in a bearing block supported on the upper flange of each of these channels as shown in FIG. **3** at **24** and **26**. The side walls **10** and **12** comprising the fixed frame of the machine are supported in the area below the longitudinally extending channels **18** and **20** by upstream and downstream end walls **28** and **29** respectively. The side walls **10** and **12** are supported in the area above the longitudinally extending channels **18** and **20** by a plurality of laterally extending support rods **30, 30** mounted at each end to the end walls **10** and **12** respectively.

Still with reference to FIG. 3, and as also shown in FIGS. **1** and **2**, several rotary shafts **32, 32** are also provided in the space between the fixed side walls **10** and **12** of the machine frame, and each of these includes a left and a right-hand threaded end portion, respectively, for rotatably supporting correspondingly threaded nuts **34, 34**, which nuts in turn carry adjustably mounted side walls **36** and **38** arranged in paralled relationship to the fixed walls **10** and **12** and adapted to be moved toward and away from one another in accurately spaced relationship to the center line of the machine simply by rotating the five shafts **32, 32**. These shafts **32, 32** are connected to one another by a plurality of sprockets **40, 40** all of which have entrained thereon a chain **42** which chain can be driven in one or an opposite direction in response to rotation of one of these shafts **32**. A hand crank or the like, best shown in FIG. **3** at **44**, is provided for adjusting the lateral spacing of the walls **36** and **38**.

The rotary shaft **22** defines the main axis of the machine, and supports a rotary device which in the embodiment shown comprises a pair of generally diametrically opposed radially extending arms **50** and **52** which arms are adapted to rotate in a clockwise direction as viewed in FIG. **1** in response to rotation of a chain drive mechanism indicated generally at **54** from the main drive motor **56** located in the lower portion of the machine. Each of these arms **50** and **52** is adapted to carry an adjustable mandrel, **58** and **60** respectively, the shape of these mandrels being so chosen as to correspond to the dimensions of the bottom of a blank from which a tray is to be formed. Means is provided on each of these arms **50** and **52** for ejecting a formed tray generally downwardly at the position shown for the arm **52** in FIG. **1**, and said means comprises an air driven eject cylinder **62** which is shown in FIG. **1** in its extended condition as for example after discharging a formed tray T at this station so that the tray drops downwardly onto a take-away conveyor **66**. The eject cylinder **64** associated with the mandrel **58** at the infeed station of the machine is shown in its retracted position so as to allow a blank B to be received at said infeed station to be engaged by the mandrel **58** as the arm **50** rotates said mandrel through the infeed station to lift the blank B through flap folding devices to be described in greater detail hereinbelow, for forming the blank B into a tray T as indicated schematically in FIG. **4**.

Means is provided for feeding blanks to the infeed station of the machine, and as shown in FIG. **1** said means includes a blank magazine, indicated generally at **70**, wherein a plurality of these blanks B,B are stacked one above another so as to be sequentially withdrawn from the lower end of the magazine to be fed into the machine from left to right as viewed in FIG. **1**. It will of course be apparent that these blanks might also be fed to the infeed station through an opening **12A** in the fixed frame side wall **12** of the machine, or through a similar opening **10A** in the opposite side wall **10** without departing from the scope of the present invention.

The magazine **70** is of conventional construction and comprises at least four corner posts **72, 72** at least three of which are adjustably mounted so as to accommodate blanks of various size, and these blanks are preferably stored in a slightly inclined position so as to be readily withdrawn from one side edge before the other to a horizontal position for transfer in a horizontal direction to the infeed station of the machine in a manner to be described. The magazine is supported on an inclined upper table portion **74** of a cantilevered portion of the machine frame **76**. The cantilevered portion **76** of the machine frame is joined to the front wall **28** of the machine frame by conventional means and houses the blank withdrawing means to be described.

Means is provided for withdrawing the lowermost blank B in the stack, and preferably said means comprises a pivotally mounted vacuum cup **80** which is adapted to be oscillated between the broken line position shown in FIG. **1** and a blank pick-up position wherein the vacuum cup **80** is located in engagement with the lowermost blank in the stack. Vacuum control means is provided for selectively connecting the vacuum cup **80** to a source of suction or vacuum when the cup reaches the pick-up position referred to and until said cup is returned from the pick-up position to the broken line position shown. The vacuum cup **80** is connected to a vacuum pump, indicated generally at **82**, by means of a line **84** which line is normally not vented to atmosphere, but which may be so vented by opening a solenoid valve indicated generally at **86**, A limit switch LS–**1** is provided on the cantilevered portion **76** of the machine frame for engaging a cam **88** located on a rotating shaft **90** continuously driven in one direction by drive means indicated generally at **92** from the primary drive motor **56** mentioned above. The shaft **90** also carries a sprocket for driving a drive chain **94** which rotates a shaft **96** associated with the lever arm **98** upon which the vacuum cup **80** is mounted. The shaft **96** carries a crank arm **100** which oscillates in a counterclockwise direction so as to lift the lever arm **98** through a predetermined angular displacement to permit the vacuum cup **80** to sequentially contact the lowermost blank B in the magazine **70** after which the crank arm **100** continues to rotate back to the position shown in said counterclockwise direction in order to cyclically move the vacuum cup **80** through its limited angular displacement for engaging and pulling downwardly by gravity the lowermost blank in the stack. When a blank B has been so withdrawn from the stack, it occupies a horizontal delivery position on a roller **108**. The rotary cam **88** then closes limit switch LS–**1** causing solenoid valve **86** to open and venting the vacuum within the vacuum cup **80** and hence releasing the blank. Means is provided for feeding the blank from this delivery position to the infeed station described above, and said means will now be described in detail.

Still with reference to FIG. **1**, the rotary cam **88** also acts upon the depending crank arm **102** of a bellcrank **104** so as to rotate the bellcrank **104** in a counterclockwise direction from the position in which it is shown to a blank engaging or active position wherein a back-up roller **106** operates in conjunction with a continuously driven roller **108** for feeding a blank from the delivery station between these rollers **106** and **108** generally toward the infeed station of the machine. More particularly, when the vacuum cup **80** has withdrawn the lowermost blank from the stack and has moved this blank to the delivery position, the leading edge of said blank will be located adjacent the periphery of the continuously driven roller **108**. This roller **108** is continuously driven in a clockwise direction by a drive chain **110** which chain **110** is continuously driven by an auxillary drive motor **112**. However, until the vacuum is released to atmosphere by means of the solenoid valve **86** the blank B will remain at the delivery position, with the result that the oscillatory movement of the bellcrank **104** can be timed in relationship to the release of vacuum in the cup **80** so that just prior to movement of the back-up roller **104** from the solid line position shown to its active position, wherein said back-up roller engages the blank B at the delivery position, the vacuum is released by closing of limit switch LS–**1**. FIG. **2** shows the continuously driven blank feeding roller **108** as comprising a plurality of axially spaced blank engaging rolls **108**A carried on a single shaft continuously driven in one direction by the auxillary drive motor **112**. A drive chain **114** is entrained on a sprocket associated with this auxillary motor **112** and with the shaft upon which the continuously driven roller **108** is located. This chain **114** also passes over a third sprocket **116** associated with a nylon belt conveyor **118** which serves to feed the blank downstream from the driven and back-up rollers, **106** and **108** respectively, to the infeed station, and more particularly against a fixed stop **120**. A pair of fixed guides, **132,132** supported from the fixed frame of the machine by brackets **126,126**. Referring more particularly to FIG. **7**, the nylon belt conveyors **118,118** are continuously driven in the direction for carrying a blank to the infeed station and said blank travels between the side guides **132,132** each of which guides is adjustably supported on an angle member **130** connected to the machine frame by the brackets **126,126**. Each guide comprises a longitudinally extending spring steel member supported at spaced locations from the angle member by screws **124,124** best shown in FIG. **8**. In order to prevent the blank B from bouncing against the fixed stops **120,120** these spring steel guides **132,132** are provided with in-turned downstream end portions, located slightly upstream of the fixed stops **120,120** and so spaced laterally with respect to one another as to forcably deform a short segment of the side edge **122** of a blank fed therebetween against the fixed stops **120,120**. As a result of so deforming the side edges of the blank B, in the manner suggested in FIG. **8**, the blank is prevented from bouncing back from its position against the stops **120,120**.

The downstream edge portions of these spring steel guides **132,132** are adapted to be adjusted in a desired position so as to permit the operator of the machine to set them at the desired spacing to assure that the blank B does not bounce against the stops **120,120** and that the blank is accurately located at the infeed station of the machine prior to being engaged by the mandrel **58** as it passes through the infeed station and moves the blank through the machine for forming it into a tray. Adjusting screws **134,134** are carried by the depending web portion of the angle member **130** of each side guide for this purpose, and the inner end of each screw **134** abuts the spring steel flexible guide **132** as best shown in FIG. **7** so as to urge the downstream edge por-

tion of the resilient guide **132** into a desired position against the restraining force of the screws **124,124** which support the guide **132** as described.

Turning next to a detailed description of the path of movement of the blank from its initial position at the infeed station mentioned above, to its discharge position mentioned briefly hereinabove, one of the plurality of arms, for example the arm **50**, is adapted to carry a rectangular mandrel **58**, which engages the underside of the blank B to carry it upwardly in a downstream direction through substantially 180° of angular rotation prior to discharging the tray T downwardly as a result of actuation of an eject cylinder **62** provided for this purpose in the mandrel. The blank B will have been preglued, or provided with a predetermined quantity of adhesive, in traveling to the infeed station by a conventional applicator device A best shown in FIG. **4**. As will be apparent from FIG. **4**, the blank B is formed into a tray T by mechanisms to be described, and this forming operation is accomplished through a relatively small angular displacement of the blank in its 180° of rotation in the machine. It is an important feature of the present invention that during a major portion of this angular travel the tray will have been formed into its final shape, and as a result of having been preglued, the tray is held in this configuration for a significant portion of the machine cycle so as to set the adhesive while the tray is being conveyed between the adjustable side walls **36** and **38**. A pair of arcuate inner radial wall segments **37** and **39** are shown in FIG. **1**, for holding the inner end flap of the blank against the inner side of the mandrel **58**. While an adjustable outer radial wall might be provided for accomplishing the same purpose with respect to the outer end flap it has been found to be unnecessary when the adjustable side walls **36** and **38** are properly positioned. It will also be apparent that other means might be provided for holding the outer end flap in position against the outer face of the mandrel **58** during this compression portion of the travel of the tray, indicated generally by the arrows **150,150** in FIG. **4**. For example, weighted belts or the like might be provided between fixed locations on the machine frame for holding the outer end flaps in position during this portion of the machines cycle. Still with reference to FIG. **4** it will be seen that the mandrel **58** is provided with prongs or needles **59,59** which are adapted to engage the cardboard blank so as to hold the blank in accurately indexed position on the mandrel during its travel from the infeed station to the folding station of the machine. It should also be mentioned that other variations of the mandrel **58** might be conceived within the scope of the present invention. For example, a slug of articles to be packaged might be prepositioned at the infeed station on a rotating arm of the type shown at **50** so that upward movement of the arm **50** causes these articles themselves to act as a mandrel for forming the blank B into a tray, and for providing a convenient manner for forming the tray simultaneously with the filling of the tray with a slug or group of articles to be packaged.

Each of the blanks B,B can be seen from FIG. **4** to include side flaps, C and D, as well as outer and inner end flaps, E and F respectively, all of which are connected to a bottom panel of the blank along prescored fold lines as indicated by the broken lines in FIG. **4**. In the type of blank with which the present machine is concerned, each blank further includes corner tabs G, G and H, H associated with the inner and outer end flaps, F and E respectively, and connected to these end flaps along prescored fold lines but separated from the side flaps C and D by precut notches as is conventional practice in the art. As described above, and as suggested in FIG. **1** the flat blank B is fed to an infeed station defined by the fixed stop **120** and is held in accurately indexed relationship to the stop as a result of the novel side guides with their inturned trailing edge portions for deforming the leading edge portion of the blank slightly so as to hold the blank in an accurate position with respect to the axis of rotation defined by the shaft **22**. As so disposed the blank is oriented in a plane which is horizontal and radially disposed with respect to the axis of rotation of the mandrel **58**. The side flaps C and D can be seen to also be disposed radially, and the end flaps oriented in spaced radial relationship to one another. The end flap F will be referred to herein as the inner radial flap and the end flap B will be referred to as the outer one. With further reference to FIG. **1**, the adjustable side walls **36** and **38** can be seen to have upstream edges **36A** and **38A** which terminate downstream of the infeed station itself so that the blank B will not engage the side walls as it is fed to the infeed station. As said blank is moved downstream of this position, in an upward direction, by the rotating mandrel **58**, it will be acted upon by flap folding devices carried by these side walls.

The said upstream edges of these left and right hand side walls carry inner and outer radial pairs of fixed plows, best shown in FIGS. **5** and **6** at **152** and **154** respectively. More particularly, each of the side walls **36** and **38** carries a pair of fixed inner plows **152,152** located in the path of movement of the inner corner tabs G,G of the blank and an adjustably mounted pair of outer plows **154,154** associated with the outer corner tabs H,H of the blank so as to engage these corner tabs and deflect them as the blank is moved downstream beyond the infeed station by the mandrel **58**. The adjustably mounted outer pair of plows **154,154** permit carton blanks of various size to be readily accomodated. Thus, the blank B, as it is conveyed upwardly on the mandrel **58**, first engages these four corner tabs deflecting plows which deflect these corner tabs at least slightly prior to engaging of the blank with other flap folding devices to be described.

The inner and outer pairs of flap folding devices differ from one another, and FIGS. **5** and **6** show these devices in detail, as well as indicate their manner of operation. The inner means for folding the inner end flap F comprises a pair of pivotally mounted flap folding fingers which are mounted on the corner tab deflecting plows **152** and **152** respectively. Each finger includes a projecting portion **160** normally oriented in the path of movement of the blank so as to be engaged by the blank generally adjacent the fold line associated with the end flap F to cause this finger to pivot in a clockwise direction as viewed in FIGS. **5** and **6** from the position shown in FIG. **5** to the position shown in FIG. **6** as the blank and associated mandrel move through the successive positions shown in these views. Each finger also includes a corner tab deflecting plow **162** carried on a depending portion of the finger which

plow is adapted to engage the corner tab so as to deflect it downwardly, after having been engaged by the fixed plow **152**, so as to further bend said corner tab G about its fold line. Spring biasing means **164** is provided for urging the pivoted finger toward the position shown in FIG. **5** during this preliminary engagement period. As the blank B moves form the FIG. **5** position to the FIG. **6** position the finger will pivot in a clockwise direction as mentioned above, the spring **164** will extend slightly allowing this predetermined angular displacement, with the result that the plow **162** provided for this purpose on the finger causes the corner tab G to assume a position oriented at 90° with respect to the end flap F itself. At the same time the depending portion of finger is so oriented as to urge the end flap F against the inner surface of the mandrel **50**. As can be seen from FIG. **6** the finger will ultimately align itself with the arcuate surface **37** on the adjustable side wall **36** thereby holding the end flap F positively in this position as the folded tray is conveyed through the compression section of the machine in the manner described above. Still with reference to FIGS. **5** and **6**, the corner tab engaging plows **152,152** associated with the pivoted fingers **160,160** are arranged outboard of these fingers so as to engage the corner tabs and fold them slightly prior to the further folding through substantially 90° accomplished by the plows **162,162**. The plows **162,162** provided on the depending lower portions of the fingers **160, 160** are also offset axially outwardly with respect to these fingers to allow the folded blank to pass therebetween to the compression section.

Considering next the folding of the outer end flap E associated with the radially outer end of the blank, FIGS. **5** and **6** show resilient leaf spring members **170, 170** mounted to the outer pair of corner tab deflecting plows **154,154** respectively. Each of these leaf spring members **170** is of generally L-shape, and has a projecting or cantilevered portion which is normally oriented in the path of movement of the end flap E as the blank is moved through the successive positions shown in FIGS. **5** and **6** so that the end flap E of the blank engages these resilient leaf springs to fold the end flap E through substantially 90° as the blank is moved downstream by the mandrel. Each of these leaf spring members **170** is pivotally mounted at its lower end, cantilever fashion, on a fixed post **174** and may include a back-up spring **176** which is similarly arranged should the additional restoring force be required in folding particularly stiff blanks. A stop member **172** is provided for engaging an outer end portion **178** of each of these springs **170,170** so as to hold the leaf spring member in its normal position in the path of movement of the blank as mentioned above. As a result of locating these springs **170, 170** on the adjustably mounted outer pair of plows **154,154** respectively, it will be apparent that the machine can be conveniently and quickly set up to accomodate blanks of various sizes.

Once the inner and outer end flaps, F and E respectively, of the blank have been folded through substantially 90°, and the corner tabs have been turned inwardly toward one another in the manner described above with reference to the inner corner tabs, and as a result of the fixed plows **154,154** associated with the outer corner tabs H,H, the side flaps C and D are engaged by fixed plows **180, 180** associated with the upstream edges **38A** and **36A** of the adjustable side walls **36** and **38** respectively for folding the side flaps C and D downwardly and causing the adhesive coated portions of the corner tabs and/or side flaps to engage one another. Further rotation of the mandrel **58**, and the associated tray T, between the side walls **36** and **38** serves to set the adhesive so that when the tray and mandrel arrive at the discharge station, indicated generally at **60** for the mandrel in FIG. **1**, a limit switch LS–**2** is closed by engagement with a fixed cam surface **180**, defined in the machine frame, opening a solenoid valve (not shown) for extending the eject cylinder **62** and thereby discharging the tray T from the mandrel allowing it to drop downwardly onto the take-away conveyor **66**.

I claim:

1. Apparatus for forming trays from initially flat rectangular blanks which include side flaps and end flaps connected to a bottom panel on prescored fold lines, and corner tabs connected to the end flaps and separated from the side flaps by precut notches; said apparatus comprising a magazine for storing a plurality of such blanks, means for withdrawing the blanks individually and feeding each to an infeed station, means for applying adhesive to selected portions of the blank as it is fed to said infeed station, at least one blank engaging mandrel rotatably supported on an axis in the machine for arcuate movement through the infeed station to engage a blank oriented in a plane which is radially oriented with its side flaps radially disposed and its end flaps oriented in spaced radial relationship to one another, said blank being moved arcuately in a downstream direction by said mandrel, axially spaced walls located on either side of the path of movement of said mandrel and having upstream edges spaced downstream from said infeed station, inner and outer pairs of fixed plows mounted to said side walls and projecting beyond said upstream edges thereof to engage the corner tabs and deflect them as the blank is moved downstream beyond the infeed station, non-powered means for subsequently folding said end flaps and for further folding said corner tabs simultaneously therewith, and means for folding said side flaps so that said upstream edges of said side walls hold said side flaps against the corner tabs which are in turn held in place by said mandrel to set the adhesive while the tray is moved arcuately between said side walls.

2. The combination set forth in claim **1** further characterized by means for adjusting said side walls toward and away from one another to accommodate carton blanks of various size.

3. The combination set forth in claim **1** further characterized in that said non-powered means for folding said end flaps comprises at least one pair of pivotally mounted flap folding fingers each of which fingers has a portion for engaging said one end flap to fold it back through substantially **90°** as the blank is moved downstream by said mandrel, said fingers being mounted for limited pivotal movement in response to passage of the mandrel and an associated blank, said pivotal movement of said pair of fingers occurring about a common axis spaced radially away from the fold line associated with said one end flap.

4. The combination set forth in claim **3** further characterized in that said flap folding fingers further include projecting plows for engaging said partially

deflected corner tabs to urge them into a substantially 90° orientation with respect to their associated end flaps at the same time during which said fingers are folding said end flaps through substantially 90°, and a fixed guide rail of arcuate contour associated with each side wall for holding said end flap in its folded position as said mandrel moves the blank downstream.

5. The combination set forth in claim 3 further characterized in that each of said flap folding fingers is pivotally mounted to one of said corner tab deflecting plows, each of said fingers having a projecting portion which is normally oriented in the path of movement of said blank and which is engaged by the blank adjacent said fold line associated with said one end flap to cause said finger to pivot through a predetermined angular displacement as said mandrel and its associated blank move therepast.

6. The combination set forth in claim 5 further characterized that each of said fingers further includes a projecting plow portion located opposite said projecting portion with respect to said pivot axis, which plow portion is offset axially with respect to said end flap engaging projecting portion for engaging one of said partially deflected corner tabs to urge it into a substantially 90° orientation with respect to its associated end flap in response to said predetermined angular displacement of said finger.

7. The combination set forth in claim 6 further characterized by biasing means for urging each pivoted finger toward said normal position for returning said finger to said normal position following the passage of said mandrel and an associated blank.

8. The combination set forth in claim 1 further characterized in that said means for folding said end flaps comprises at least one pair of resilient leaf spring members mounted to one pair of corner tab deflecting plows, each of said leaf spring members having a projecting portion which is normally oriented in the path of movement of one of said end flaps to be engaged thereby and to fold said end flap through substantially 90° as the blank is moved downstream by said mandrel, said spring members being flexed slightly in response to passage of the mandrel and an associated blank so as to resiliently return to their normal orientations following the passage of said mandrel and blank.

9. The combination set forth in claim 8 further characterized in that said means for folding said end flaps further comprises a pair of pivotally mounted flap folding fingers carried by the other pair of corner tab deflecting plows for engaging the other one of said end flaps and folding it back through substantially 90° as the blank is moved downstream by said mandrel, said fingers being mounted for limited pivotal movement in response to passage of the mandrel and an associated blank about a common axis spaced radially away from the fold line associated with said one end flap.

10. The combination set forth in claim 9 further characterized in that said flap folding fingers further include projecting plows for engaging said partially deflected corner tabs to urge them into a substantially 90° orientation with respect to their associated end flap at the same time during which said fingers are folding said end flaps through substantially 90°, and a fixed guide rail of arcuate contour associated with each side wall for holding said end flap in its folded position as said mandrel moves the blank downstream.

11. The combination set forth in claim 9 further characterized in that each of said flap folding fingers has a projecting portion which is normally oriented in the path of movement of said blank and which is engaged by the blank adjacent said fold line associated with said one end flap to cause said finger to pivot through a predetermined angular displacement as said mandrel and its associated blank move therepast.

12. The combination set forth in claim 11 further characterized in that each of said fingers further includes a projecting plow portion located opposite said projecting portion with respect to said pivot axis, which plow portion is offset axially with respect to said end flap engaging projecting portion for engaging one of said partially deflected corner tab to urge it into a substantially 90° orientation with respect to its associated end flap in response to said predetermined angular displacement of said finger.

13. The combination set forth in claim 12 further characterized by biasing means for urging each pivoted finger toward said normal position for returning said finger to said normal position following the passage of said mandrel and an associated blank.

14. The combination set forth in claim 9 further characterized by means responsive to the arrival of said mandrel and folded blank at a discharge station which is angularly spaced from said infeed station for ejecting the folded blank, said means including an eject cylinder carried by said mandrel.

15. The combination set forth in claim 14 wherein said eject means further includes a limit switch so arranged as to be tripped by arrival of said mandrel at said discharge station, and a valve located in a line connecting said eject cylinder to a source of fluid under pressure, said valve being operable in response to tripping of limit switch to actuate said cylinder at said discharge station as aforesaid.

16. The combination set forth in claim 9 wherein said means for withdrawing the blanks from said magazine comprises a vacuum cup pivotally mounted for limited angular movement from and to a blank pick-up position in engagement with the endmost case, conveyor means for moving the blank from a delivery position to which said vacuum cup has moved the blank toward said infeed station.

17. The combination set forth in claim 16 wherein said conveyor means includes a continuously driven roller which engages a leading edge portion of the blank when said blank has been so withdrawn by said vacuum cup, vacuum control means for selectively connecting said cup to a source of vacuum when said cup reaches said pick-up position and for venting said cup to atmosphere when the blank has reached said delivery position.

18. The combination set forth in claim 17 wherein said conveyor means further includes a back-up roller for said continuously driven roller, a crank arm pivotally supported in co-axial relationship with said driven roller and defining a movable axis for said back-up roller, cam means for cyclically oscillating said crank arm between a blank engaging position wherein said back-up roller cooperates with said driven roller to feed a blank therebetween and an inactive position wherein said back-up roller moves in the downstream direction out of the path of movement of a blank being moved into said delivery position and onto said driven roller.

19. The combination set forth in claim 14 wherein said infeed station and said discharge station are oriented 180° apart with respect to the axis of rotation of said mandrel, said blank being conveyed generally horizontally into a horizontal position at said infeed station and said mandrel engaging said blank from below to move it upwardly through 180°, and said eject cylinder serving to eject the folded blank downwardly at said discharge station, and a take away conveyor for receiving the downwardly discharged folded blank or tray.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,683,755 Dated August 15, 1972

Inventor(s) Horst G. Lattke

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1, line 61, after "flap" insert --folding--.

Col. 3, line 9, "paralled" should be --paralleled--.

Col. 4, line 13, "paralled" should be --paralleled--.

Col. 6, line 48, "forcably" should be --forceably--.

Col. 8, line 46, "accomodated" should be --accommodated--.

Col. 9, line 7, "form" should be --from--.

Col. 9, line 59, "accomodate" should be --accommodate--.

Signed and sealed this 8th day of May 1973.

(SEAL)
Attest:

EDWARD M.FLETCHER,JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents