United States Patent

Le Febvre et al.

[15] **3,648,573**

[45] **Mar. 14, 1972**

[54] APPARATUS AND METHOD FOR FORMING CARTONS

[72] Inventors: **Alfred B. Le Febvre**, Danville; **Helmut E. W. Masch**, San Jose; **Louis Robert**, San Mateo; **Hugh B. Morse**, San Jose, all of Calif.

[73] Assignee: **Fibreboard Corporation**, San Francisco, Calif.

[22] Filed: **Apr. 29, 1970**

[21] Appl. No.: **32,836**

[52] **U.S. Cl.** .....**93/51 M**, 93/36 MM, 93/39.1 P, 93/59 ES, 93/59 MT, 93/59 PL, 93/84 FF

[51] **Int. Cl.** **B31b 1/46**, B31b 1/12, B31b 49/02

[58] **Field of Search** .....93/36 MM, 51, 59, 84 FF, 39.1 P; 269/21

[56] **References Cited**

UNITED STATES PATENTS

2,414,574	1/1947	Williams	269/21 X
2,583,641	1/1952	Gambert	93/59
2,998,680	9/1961	Lipkins	269/21 X
3,000,275	9/1961	Sevison	93/51
3,062,105	11/1962	Oxborrow	93/51
3,187,648	6/1965	Tserpes	93/59
3,303,761	2/1967	Monroe	93/59
3,331,728	7/1967	Lane	93/58
3,342,115	9/1967	Reinecke	93/51
3,364,825	1/1968	Baumgartner	93/59
3,421,416	1/1969	Benzon-Petersen	93/51.1
3,456,564	7/1969	McCandless	93/59
3,511,139	5/1970	Edkvist	93/51
3,533,332	10/1970	Young	93/39.1

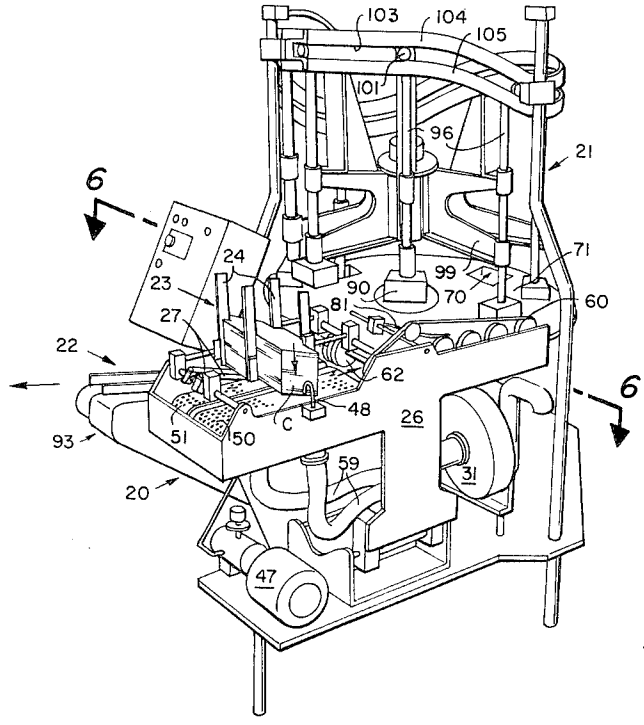
Primary Examiner—Wayne A. Morse, Jr.

Attorney—Fryer, Tjensvold, Feix, Phillips & Lempio

[57] **ABSTRACT**

An apparatus for forming cartons comprises feeding means, including a pivoted suction cup and cooperating vacuum belt conveying means, for individually feeding carton blanks to a forming means. Such forming means comprises a rotary table having a plurality of female forming dies radially positioned thereon. A ram-type male die is reciprocally mounted above the table to cooperate with each forming die to form the carton blank into tray form. Gas burner type nozzle means are mounted adjacent to the table to discharge heated air onto partially folded corners of a polyethylene-coated carton blank prior to when it is fully formed in the forming die. After the corners are compressed and sealed, stripping means engage the formed carton to move it onto a discharge conveyor.

21 Claims, 18 Drawing Figures



Patented March 14, 1972 3,648,573

9 Sheets-Sheet 1

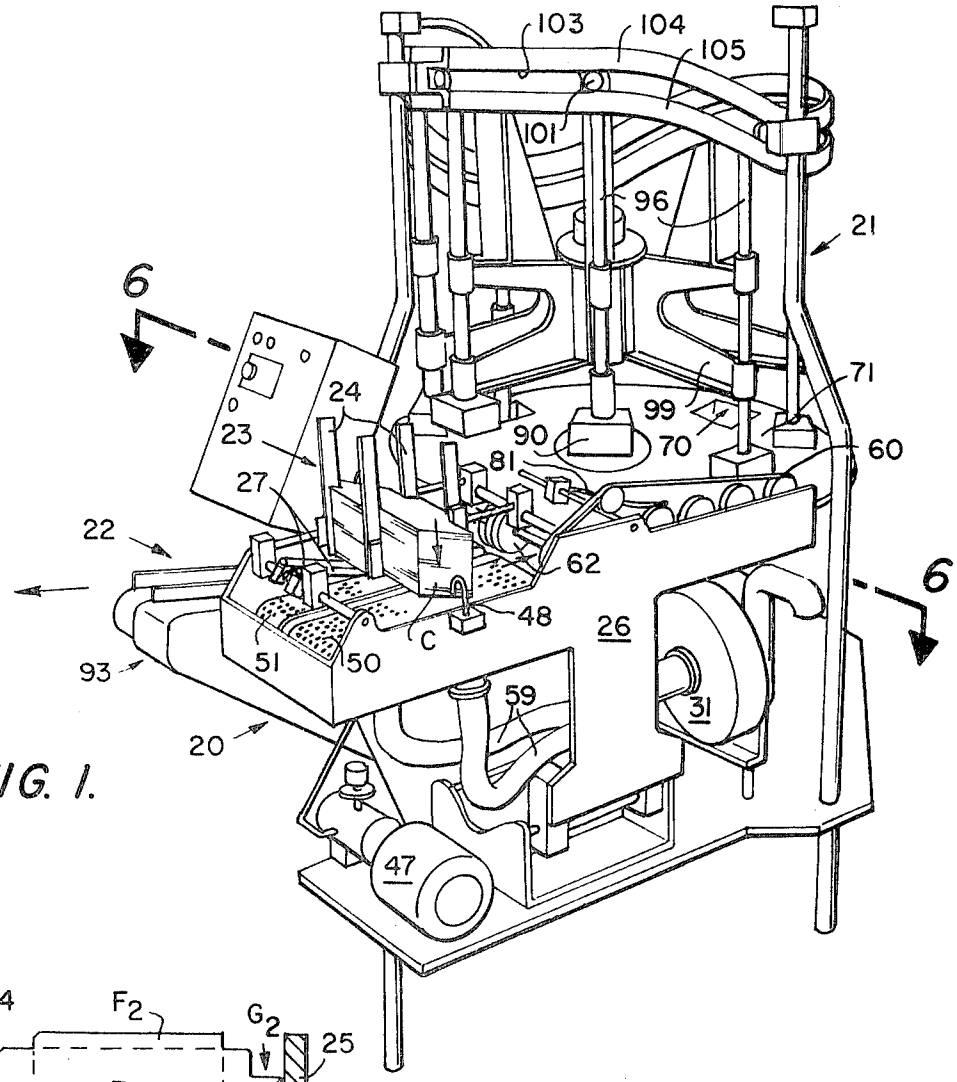


FIG. 1.

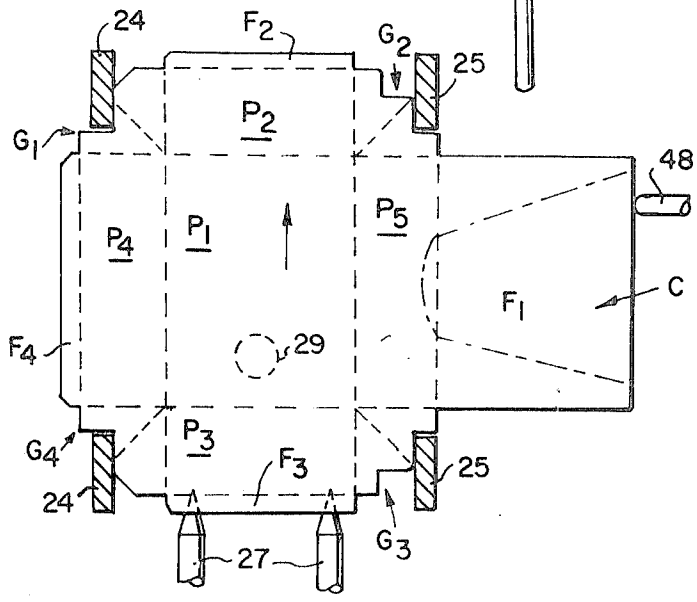


FIG. 2.

INVENTORS
ALFRED B. LeFEBVRE
HELMUT E.W. MASCH
LOUIS ROBERT
HUGH B. MORSE
BY
Dyer, Tjensvold, Hein, Phillips & Lempio
ATTORNEYS

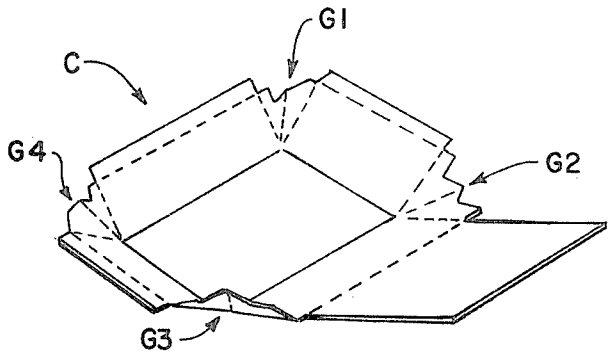


FIG. 3.

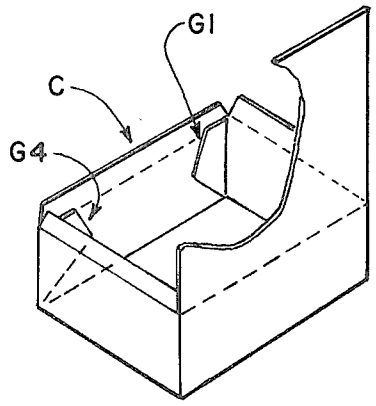


FIG. 4.

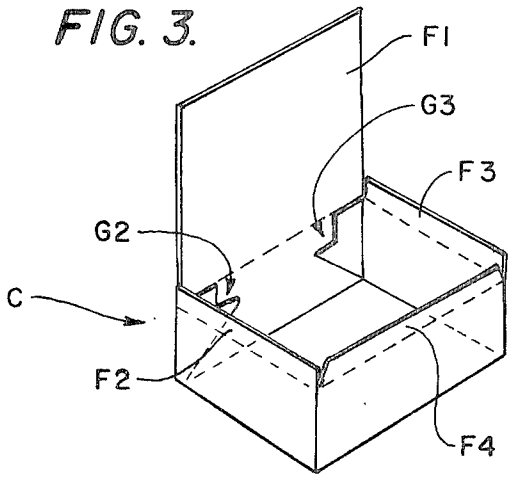


FIG. 5.

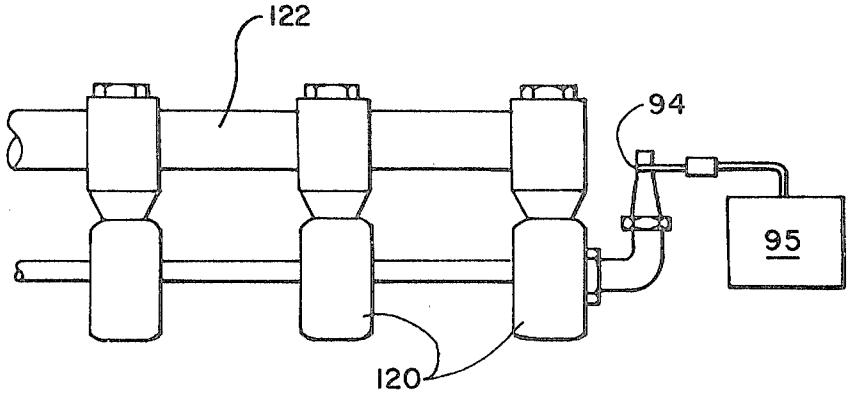


FIG. 8.

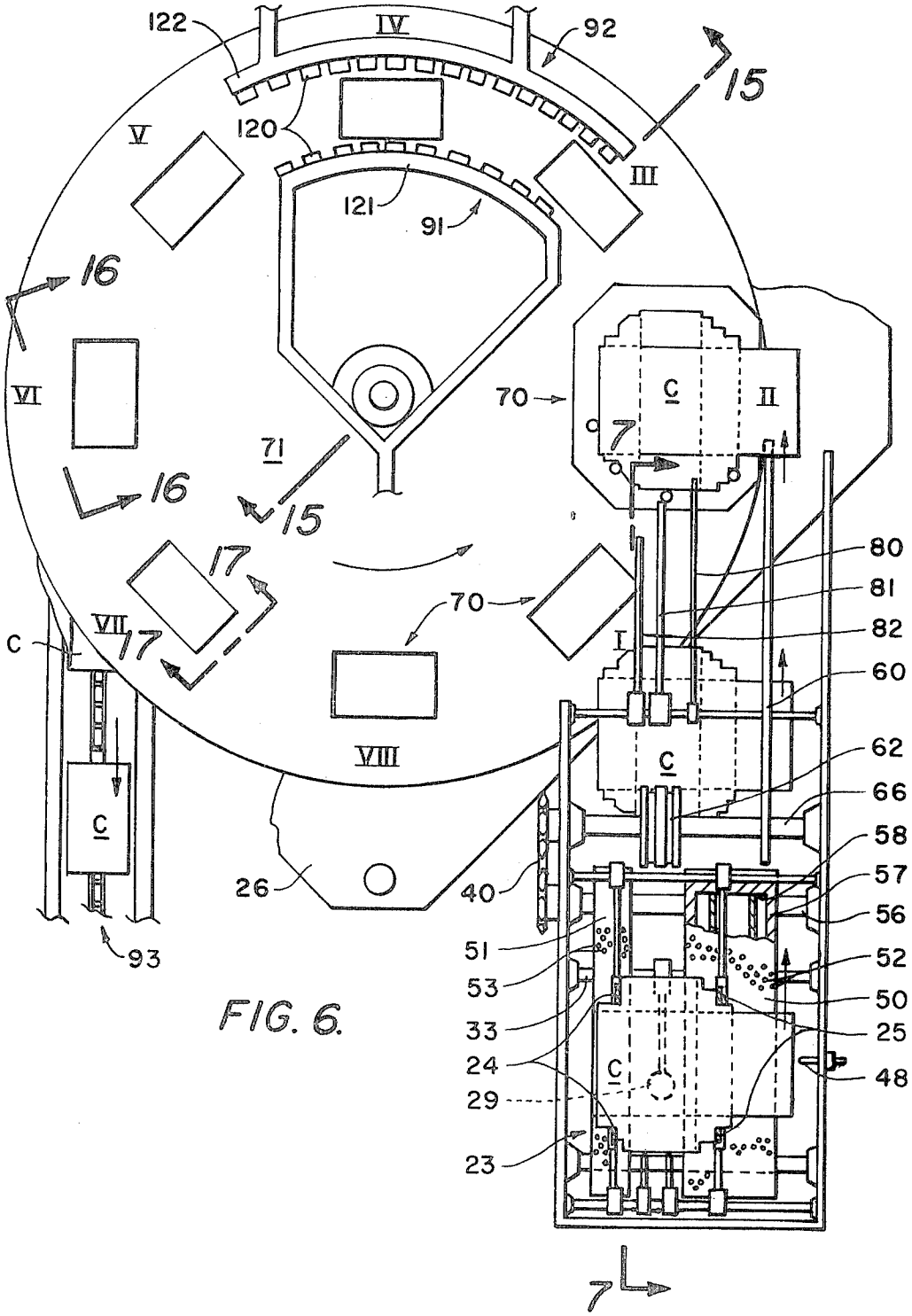

122
IV
92
15
120
V
III
121
91
16
VI
70
C
II
7
71
16
15
17
80
81
82
70
VII
17
I
60
C
62
66
58
57
56
52
50
25
48
C
26
40
51
53
33
24
29
23
93
7

FIG. 6.

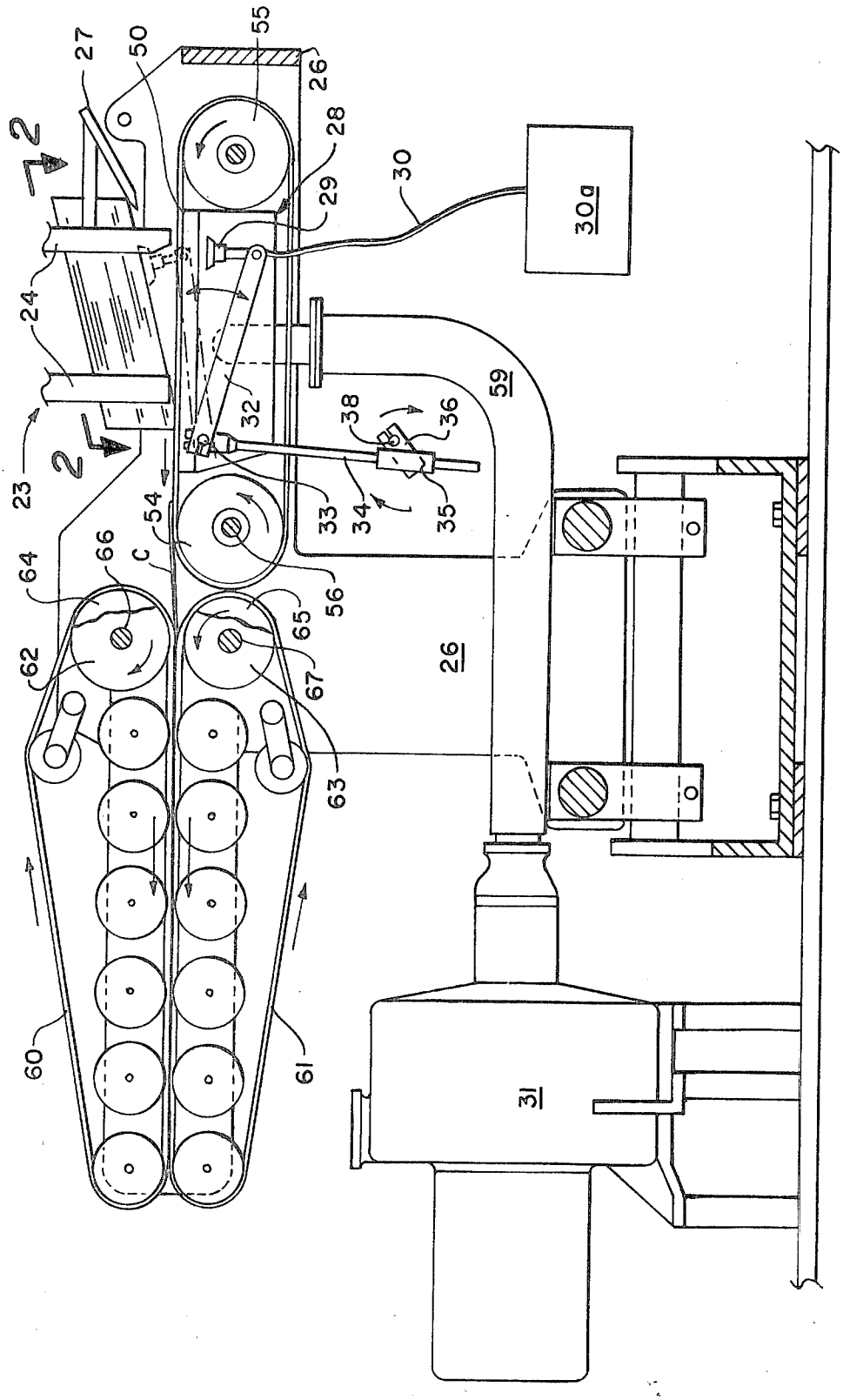

27
50
55
26
28
29
30
30a
24
23
2
2
32
38
36
59
33
34
35
54
64
66
C
56
65
62
67
63
26
60
61
31

FIG. 7.

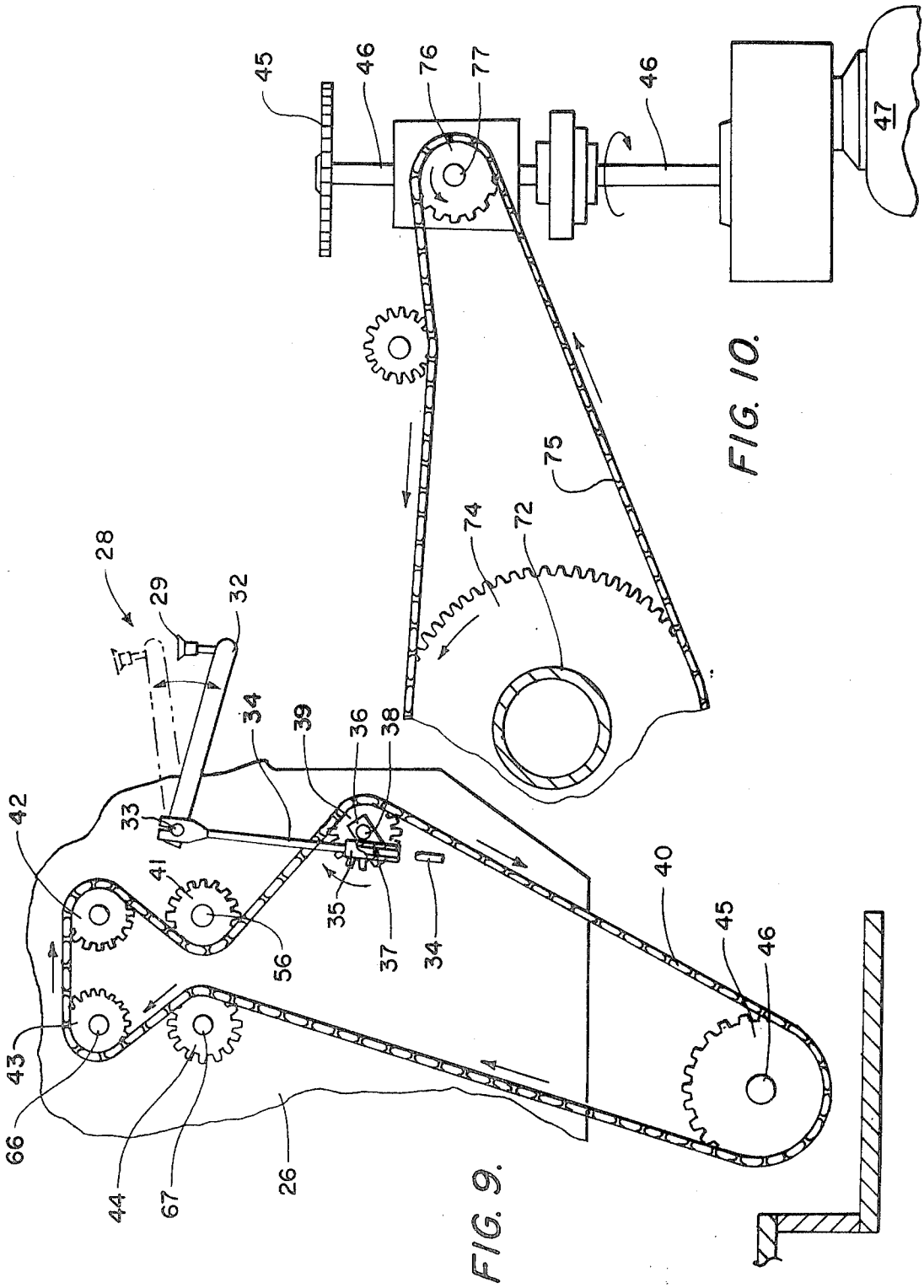

45
46
76
77
46
47
75
74
72
28
29
32
34
39
36
38
42
33
41
56
35
37
34
40
45
46
43
66
44
67
26

FIG. 10.

FIG. 9.

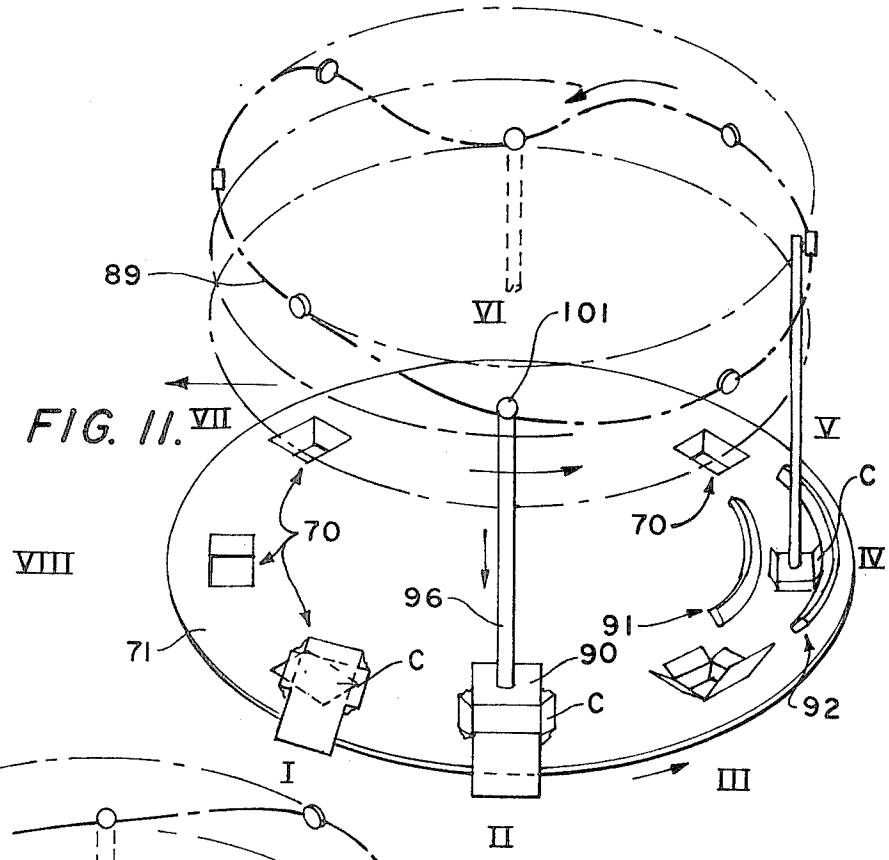

89
VI
101
VII
V
C
70
70
VIII
IV
96
91
71
C
90
C
92
I
III
II

FIG. 11.

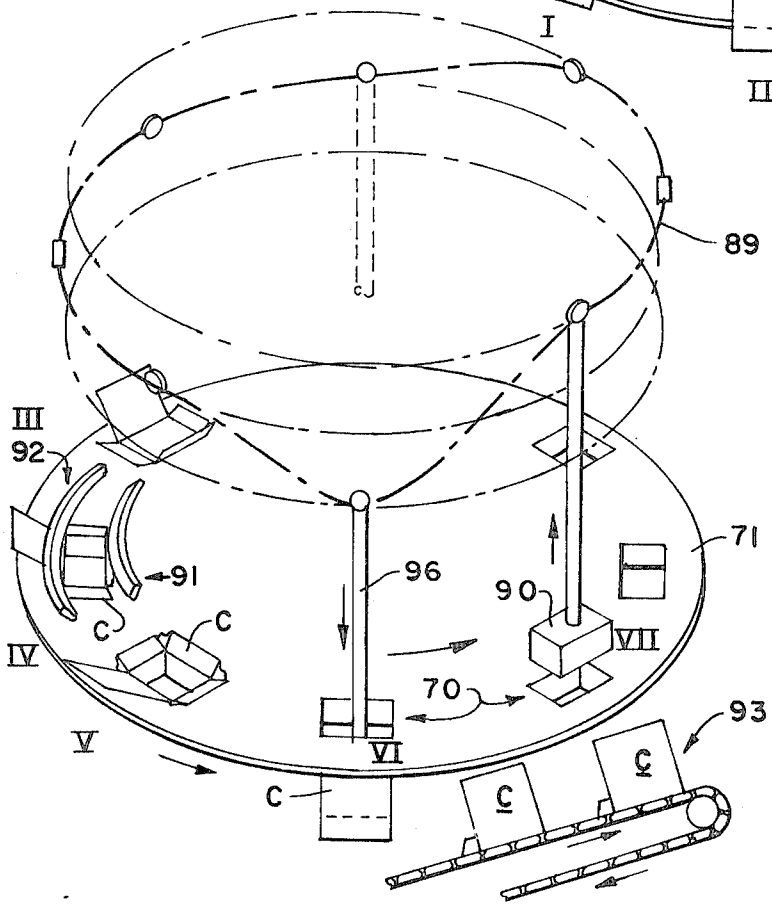

89
III
92
71
91
96
90
C
C
VII
IV
70
93
V
VI
C
C
C

FIG. 12.

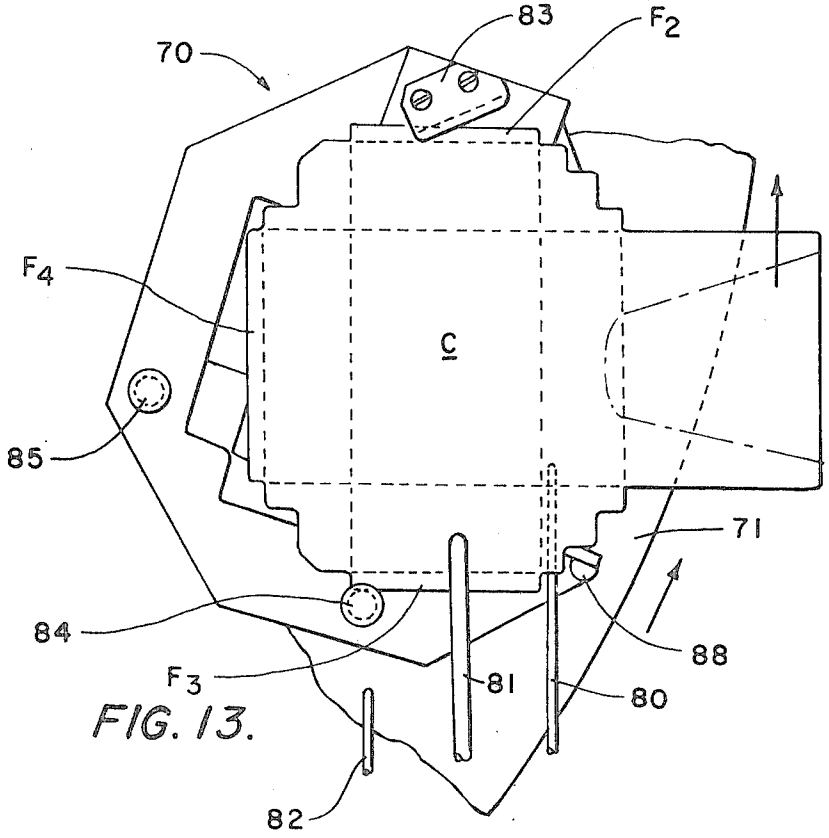


FIG. 13.

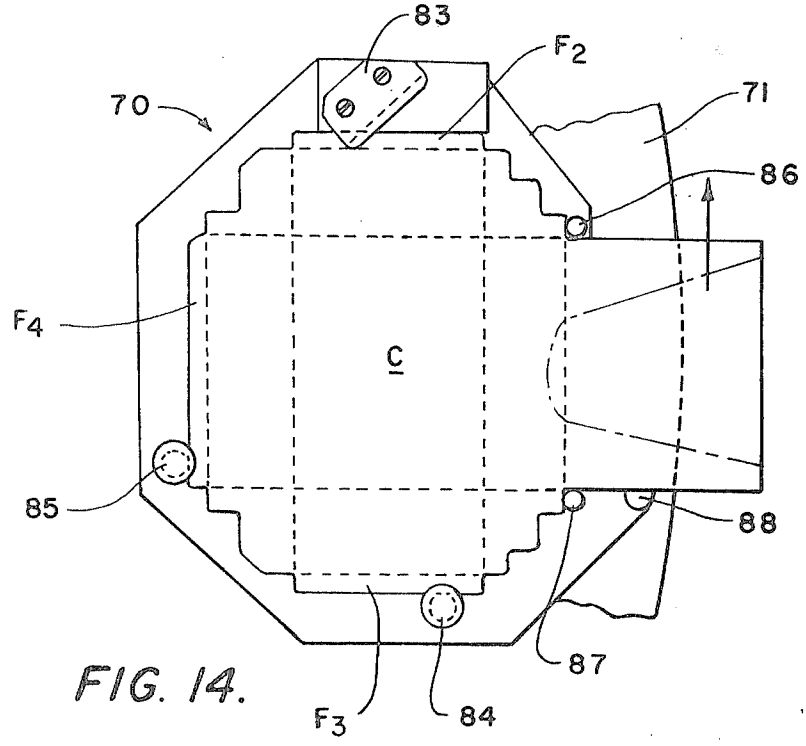


FIG. 14.

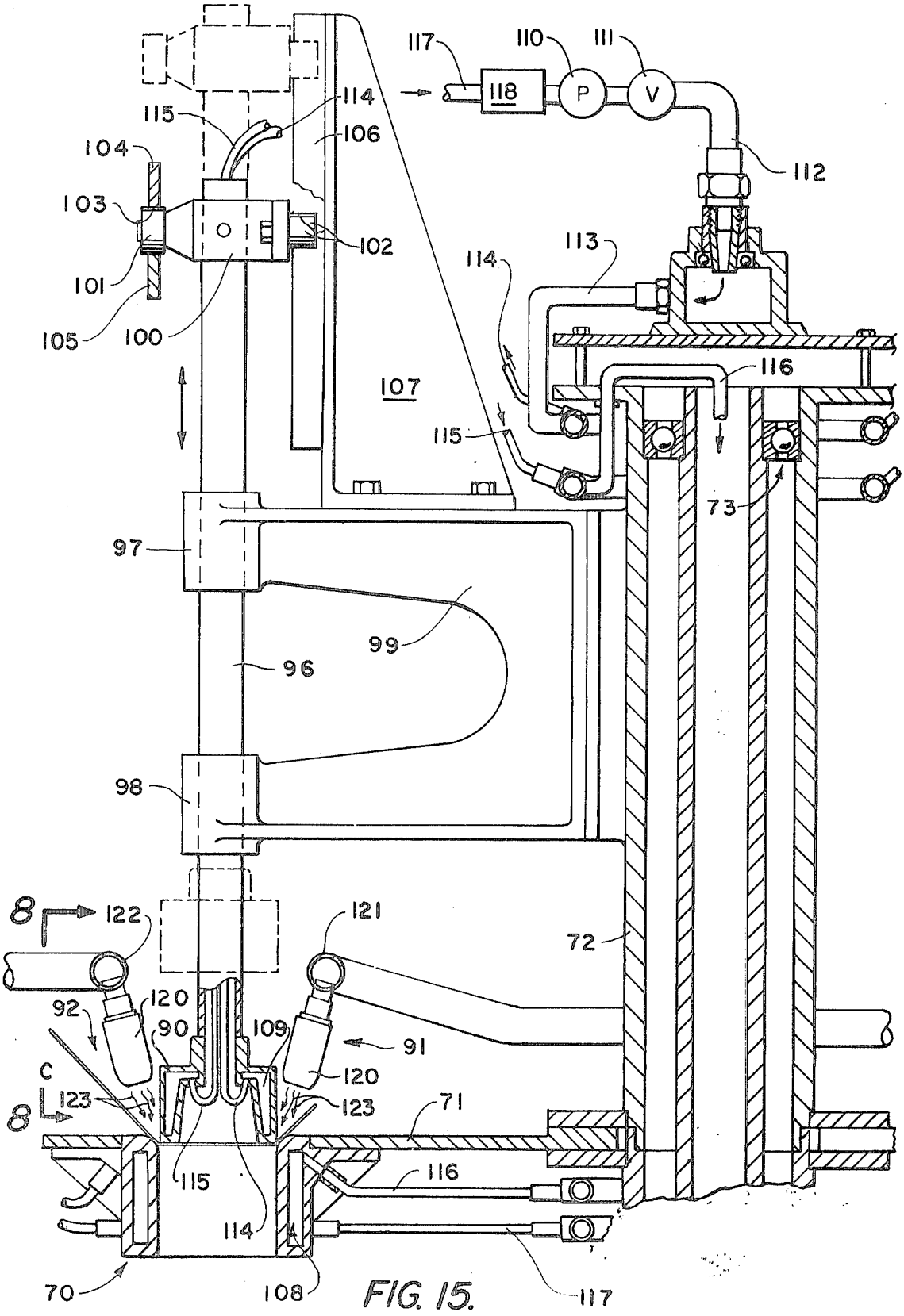

117
110
111
118
P
V
114
115
106
112
104
103
102
113
114
101
105
100
107
116
115
73
97
99
96
98
8
122
121
72
92
120
90
109
91
C
120
8
123
123
71
115
116
114
70
108
117

FIG. 15.

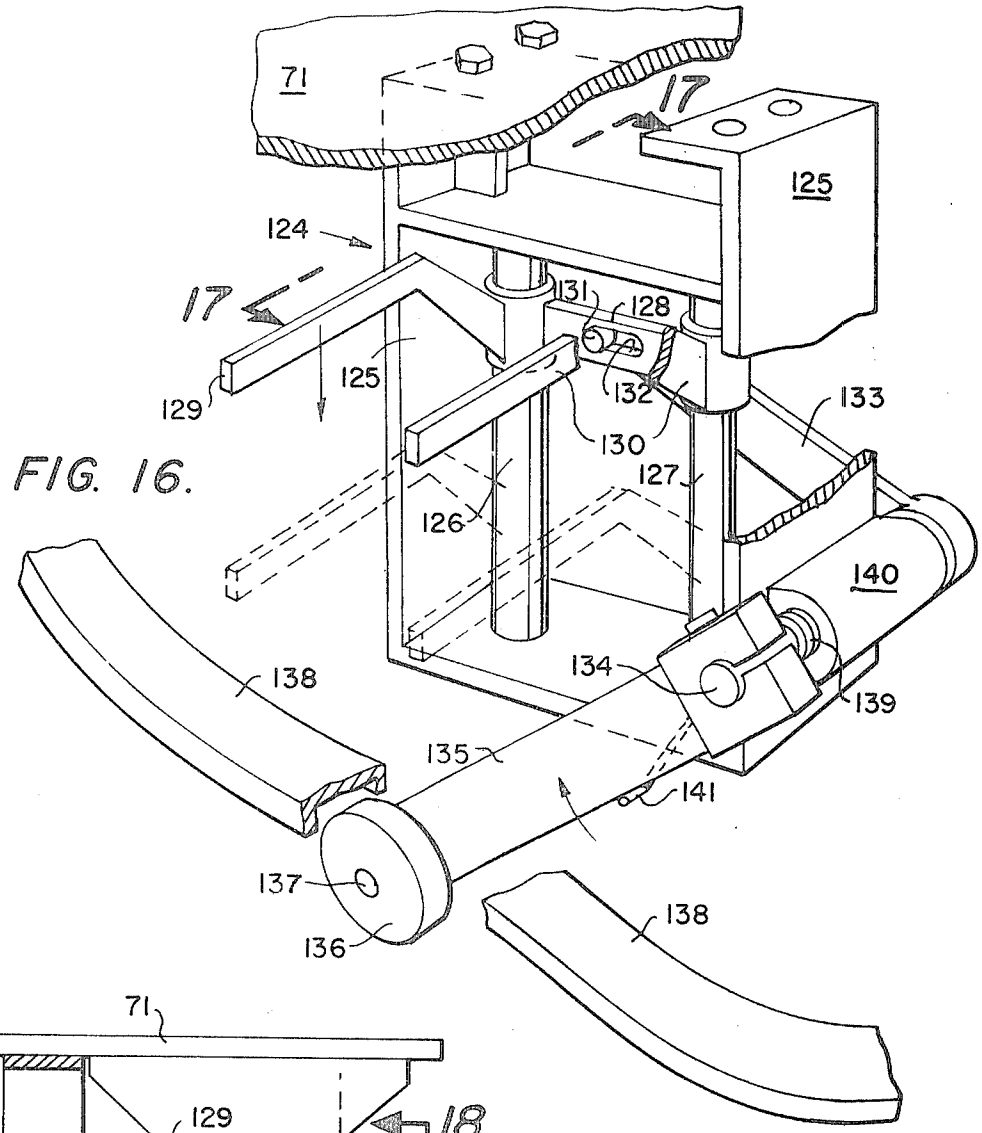


FIG. 16.

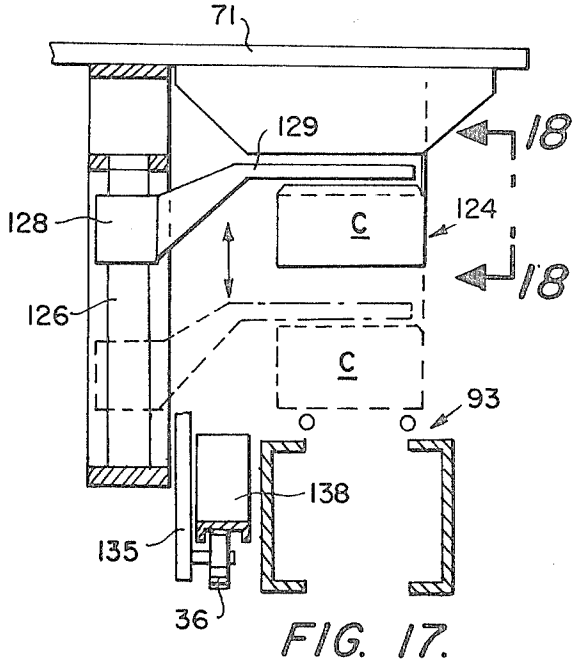


FIG. 17.

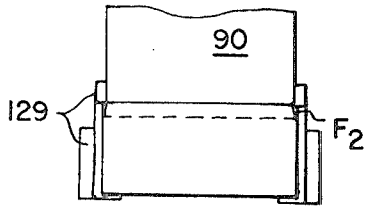


FIG. 18.

APPARATUS AND METHOD FOR FORMING CARTONS

BACKGROUND OF THE INVENTION

This invention relates to the packaging arts and more particularly relates to an apparatus and method for forming a flattened paperboard carton blank into tray or receptacle form adapted to have frozen foods or the like packaged therein. Such forming normally gives rise to numerous problems, such as an inability to assure tightly sealed corner closures at high speeds. In addition to the leakage and contamination problems arising therefrom, increased cartoon forming speeds also tend to distort and scar the carton to distort and scar the carton to impair its appearance and structural integrity.

SUMMARY AND OBJECTS OF THIS INVENTION

An object of this invention is to overcome the above, briefly described problems by providing an apparatus and method for expeditiously, efficiently and economically forming the tray or receptacle portion of a carton out of a flattened blank. The apparatus exhibits a number of novel combinations and subcombinations, including a carton blank feeding means comprising a movably mounted suction cup and cooperating vacuum belt conveying means for precisely conveying each blank to a carton forming means. The carton forming means comprises a rotary table having at least one forming or female die positioned thereon to have the blank formed therein by a cooperating ram-type male die reciprocally mounted above the table. During formation of the blank in the cooperating dies, a heated fluid is discharged onto corners of the blank to activate a pre-coated adhesive prior to final sealing.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects of this invention will become apparent from the following description and accompanying drawings wherein:

FIG. 1 is an isometric view of a preferred apparatus embodiment of this invention;

FIG. 2 is a top plan view of a carton blank, taken in the direction of arrows 2—2 in FIG. 7, adapted to be formed into the carton shown in FIGS. 3–5 by the FIG. 1 apparatus;

FIG. 6 is a partially sectioned and enlarged top plan view of the FIG. 1 apparatus, taken in the direction of arrows 6—6 in FIG. 1;

FIG. 7 is an enlarged sectional view taken in the direction of arrows 7—7 in FIG. 6 with parts broken-away for clarification purposes;

FIG. 8 is a sectional view taken in the direction of arrows 8—8 in FIG. 15;

FIGS. 9 and 10 schematically illustrate portions of drive systems employed in the FIG. 1 apparatus, with FIG. 9 being taken in the direction of arrows 9—9 in FIG. 6;

FIGS. 11 and 12 schematically illustrate the FIG. 1 apparatus in various modes of its carton forming operation;

FIGS. 13 and 14 are enlarged, top plan views of a forming die employed in the FIG. 1 apparatus with a carton blank being sequentially positioned thereon;

FIG. 15 is an enlarged, sectional view generally taken in the direction of arrows 15—15 in FIG. 6;

FIG. 16 is a partially sectioned and enlarged isometric view generally taken in the direction of arrows 16—16 in FIG. 6, illustrating carton stripping means employed in the FIG. 1 apparatus;

FIG. 17 is a view generally taken in the direction of arrows 17—17 in FIGS. 6 and 16; and

FIG. 18 is a view taken in the direction of arrows 18—18 in FIG. 17.

DESCRIPTION OF PREFERRED APPARATUS EMBODIMENT

The FIG. 1 apparatus comprises, in series, a feeding station 20 for individually conveying carton blanks C to a forming station 21 and a discharge station 22 for removing the formed

cartons therefrom. The FIG. 2 one-piece paperboard carton blank is preferably coated on both sides with a suitable laminant plastic coating, such as polyethylene, polyvinylidene chloride or other suitable heat sensitive coating which will reactivate (melt) at high temperatures such as 500° F. The blank may be suitably cut and scored to comprise a bottom panel P_1, side panels P_2 and P_3 and front and rear panels P_4 and P_5.

A top panel or cover flap F_1 is hingedly connected at a scoreline to the top edge of rear panel P_5 whereas vertically disposed minor flaps F_2, F_3 and F_4 are connected in a similar manner to panels P_2, P_3 and P_4, respectively. A tearline T_2 may be formed in the top and rear panels to define a removable tab adapted to be torn open to expose the carton's contents after the cover flap has been bonded to minor flaps F_2—F_4 to form a closed carton.

Gusset folds G_1, G_2, G_3 and G_4 are suitably constructed at each corner of the tray or receptacle portion of the carton to form sealed corner closures thereat. FIG. 3 illustrates partial formation of the blank whereas FIGS. 4 and 5 illustrate complete formation of such tray portion by the FIG. 1 apparatus.

Referring to FIGS. 1, 2, 6 and 7, feeding station 20 includes a carton magazine 23 comprising opposed pairs of upright posts 24 and 25. The posts are secured to frame 26 of the apparatus and adapted to retain a plurality of stacked carton blanks C therein along with the tapered ends of spaced, stationary supports 27. Each of the supports underlie and engage marginal rear edge portions of the lowermost blank to aid in supporting the blanks in the magazine. The tapered ends of such supports are suitably positioned to permit the lowermost blank to be readily disengaged therefrom by removal means 28, comprising a flexible suction cup 29.

A flexible conduit 30 may be operatively connected to the suction cup in a conventional manner to communicate a negative pressure or vacuum (e.g., −5p.s.i.) thereto by means of a conventional vacuum source and control means 30*a* (FIG. 7). The vacuum cup is mounted on an arm 32 attached to a stub shaft 33 pivotally mounted on the frame of the apparatus. A rod 34 is attached at its upper end to the stub shaft to form a bellcrank arrangement with lever 32.

The lower end of the rod is slidably mounted in a sleeve member 35 pivotally mounted on a crank 36 by a pivot pin 37 (FIG. 9). The crank is attached to a continuously rotating drive shaft 38 which is driven by a sprocket 39. The gears are continuously driven by an endless chain 40 suitably mounted on sprockets 41–45. Sprocket 45 is mounted on a power shaft 46 which is driven via conventional gear type transmission means by a main drive motor 47 of the apparatus (FIG. 10).

Thus it can be seen that actuation of motor 47 and drive shaft 46 will function to continuously move chain 40 to rotate sprocket 37. Upon simultaneous rotation of crank 36, sleeve member 35 will reciprocate on rod 34 to oscillate stub shaft 33. Thus arm 32 will be pivoted between its dotted and solid line positions illustrated in FIGS. 7 and 9 to continuously remove a lowermost carton blank from the magazine. A stationary, laterally positioned guide wire 48 engages the edges of the blanks for aiding in such removal function.

The feeding station further includes vacuum belt conveying means shown as comprising spaced endless belts 50 and 51 (FIGS. 1, 6 and 7) having apertures 52 and 53 formed therethrough, respectively. Belt 50, for example, is mounted on a drive pulley 54 and idler pulley 55, the drive pulley being mounted on a drive axle 56 which is common to sprocket 41 (FIG. 9). Belt 51 is mounted in a like manner to also be driven by drive axle 56.

A hollow stationary support means or plate 57 is mounted below belt 50 to support same (FIGS 6 and 7). The portions of the support means engaging the belt may have a Teflon or like coating formed thereon to lower the coefficient of friction therebetween. The support means forms vacuum chambers 58 therein adapted to be evacuated by means of a conduit 59 communicating therewith. Such conduit communicates with

vacuum source **31** which may comprise a conventional centrifugal pump or the like (FIG. 7). Vacuum belt **51** is supported on a similar support means or plate in a like manner.

Thus it can be seen that when the lowermost flat carton blank C, having its forward edge only normally resting on belts **50** and **51**, is pulled downwardly onto the belts by vacuum cup **29** that such blank will be subjected to vacuum via apertures **52** and **53**. The suction cup disengages the blank automatically due to the intermittent action of valve means (not shown) of control means **30***a* when it descends below the belts. Thus the belts will function to grasp and move the blank toward forming station **21** and between a pair of flexible pinch belts **60** and **61** and a pair of nip rolls **62** and **63**.

As best shown in FIGS. **6** and **7**, the pinch belts are each suitably mounted on a plurality of spaced idler and takeup pulleys and are driven by powered pulleys **64** and **65**, respectively. Pulley **64** is driven by a shaft **66**, common to sprocket **43** (FIG. **9**), whereas pulley **65** is driven by a shaft **67** which is common to sprocket **44**. Nip rolls **62** and **64** are suitably mounted on and driven by shafts **66** and **67**, respectively.

Referring to FIG. **6**, the pinch belts and nip rolls deliver the carton blank to a forming or female die **70** mounted on and having its forming chamber extending completely through a rotary table **71**. Although eight such dies are shown, it should be understood that any desired number thereof may be employed. As shown in FIG. **15** the horizontally disposed table is secured to an upstanding hollow column **72** rotatably mounted on spaced roller bearing assemblies **73** (one shown).

As schematically illustrated in FIG. **10**, rotating column **72** is attached to and driven by a bull sprocket **74** which, in turn, is driven by an endless chain **75**. The chain is further trained on and driven by a sprocket **76** secured to a drive shaft **77**. The drive shaft is suitably driven by drive shaft **46** which is driven by main electrical drive motor **47** of the apparatus.

Referring to FIGS. **13** and **14**, stationary fingerlike guide wires **80**, **81** and **82** are suitably positioned to elevate and guide the blank onto the forming die. Flap F_2 of the carton blank engages under a locating plate **83** of locating means **83—88** to initiate the locating function. Upon continued rotation of the table flap F_4 will engage and be guided by locating button **84** whereas flap F_3 will subsequently engage locating button **85**. Locating pins **86**, **87** and **88** will assume the positions illustrated in FIG. **14**, relative to the blank, with locating pin **88** functioning as the primary means for completely removing the blank from pinch belts **60** and **61**.

Referring to FIGS. **11** and **12**, turntable **71** and its associated forming mechanisms have been divided into sub-stations I–VIII for explanation purposes. The upper heavy dotted line **89** schematically represents a cam profile exhibited during the carton forming operation. The following operations approximately occur at such stations:

I. Flattened carton blank C initiates registry over forming die **70**;

II. A male die **90** cooperates with die **70** to form a pair of die means for partially folding the carton blank therein;

(III) The carton blank is further folded to ready gusset folds G_1-G_4 thereof (FIG. **3**) for bonding;

(IV) Heat sealing means **91** and **92** discharge heated air onto the gusset folds;

(V) Die **90** begins its descent to compress gusset folds together to form tightly sealed corners;

(VI) Die **90** moves downwardly, below the table, to permit the formed carton to be ejected onto a discharge conveyor **93**;

(VII) Die **90** moves vertically upwardly; and

(VIII) Die **90** is fully repositioned for a second carton forming operation.

Referring to FIG. **8**, each bank of heaters **91** and **92** may be simultaneously ignited by means of a spark plug **94** exposed to the combustion chamber of one of the end heaters. Conduits then communicate the ignited gaseous fuel mixture to all of the heaters. An ignition control system **95**, comprising an on-off switch and 6,000V. electrical transformer, selectively energizes the spark plug.

Referring to FIGS. **1** and **15**, each male die **90** is secured to the end of a rod **96**, reciprocally mounted in spaced bearing journals **97** and **98**. Such bearing journals are secured to a bifurcated arm **99** which is, in turn, secured to rotatable column **72**. A bracket **100** is attached to the upper end of the rod and has a roller **101** and a pair of rollers **102** rotatably mounted thereon.

Roller **101** is guided in its rotary movements by an endless cam track **103**, defining cam profile **89** in FIGS. **11** and **12**, FORMED between spaced stationary bars **104** and **105**. The cam track and rod **96** comprise actuating means for linearly moving male die **90** into mating relationship with female die **70** for folding an forming the carton blank therein. Inboard rollers **102** preferably engage opposite sides of a vertically disposed guide means or bar **106** mounted on a bracket **107** attached to arm **99**. Such guide bar positively assures that rod **96** will only move vertically, without incurring any rotational or other extraneous movement.

As further illustrated in FIG. **15**, dies **70** and **90** are each preferably completely jacketed therearound with chamber means **108** and **109**, respectively, for circulating a coolant such as water therethrough for heat-sink purposes. As schematically illustrated therein, a pump **110** and valve **111** may be utilized to selectively circulate and communicate such coolant through conduits **112**, **113** and **114** and to chamber **109** of the male die. Such fluid is then communicated from chamber **109** to chamber **108** of the female die via conduits **115** and **116**. A conduit **117** returns the fluid to a heat exchanger **118** for recirculation purposes by means of pump **110**.

Referring to FIGS. **6** and **15**, opposed heat sealing means **91** and **92** each comprise a plurality of identical gas burner type nozzle means or heaters **120** positioned in arcuate arrays adjacent to table **71**. The heaters of heating means **91** and **92** are fixedly mounted on stationary conduits **121** and **122**, respectively, which function to communicate a combustible gaseous fluid, such as a commercially available natural gas-air mixture, to the heaters. Such heaters and a conventional fuel source and control means thereof are fully disclosed in U.S. Pat. application Ser. No. 869,193 for "Apparatus and Method for Heat Sealing Cartons," filed on Oct. 24, 1969 by George Schafer et al. Such application is assigned to the Assignee of this application.

As described therein each heater may be of the type identified as model No. SH–2 and manufactured by Selas Corp. of America. Such heater comprises a metallic housing having a suitable refractory and insulative material formed therein to define a combustion chamber. As above stated, ignition means **94** and **95** function to ignite the gaseous fuel communicated to the combustion chambers by conduits **121** and **122**. Due to well-known combustion and heat transfer phenomena, including the expansion of the ignited gas-air mixture, a heated fluid stream **123** (FIG. **15**) is discharged from each heater and directed toward gusset folds G_1–G_4. The heated fluid is discharged in sufficient volumes and maintained within acceptable temperature and pressure ranges to activate (melt) the adhesive (e.g., polyethylene), but to prevent carton distortion or scorching.

Through stations V and VI (FIGS. **6** and **12**), cam track **103** (FIG. **15**) functions to move rod **96** downwardly to fully fold and form the gusset folds to bond or seal them together. At stations VI and VII the formed carton is discharged onto conveyor means **93**. Rod **96** thereafter moves upwardly through stations VII and VIII to ready male die **90** for a subsequent carton forming operation.

Referring to FIGS. **16–18**, a carton stripping means **124** is preferably utilized to positively strip the carton off each male die **90**. The stripping means comprises a bracket **125** bolted or otherwise suitably secured to table **71**. Upstanding guide bars **126** and **127** are secured to the bracket and slidably mount a reciprocating member **128** thereon. The member comprises parallel arms **129** and **130** secured thereto for engagement with the top edges of side flaps F_2 and F_3 of the carton.

Reciprocal movement is imparted to member 124 by means of a pin 131 positioned in a lost motion slot 132 formed through the member. The pin is secured to a first lever arm 133 of a bellcrank mechanism further comprising a rockable shaft 134 having arm 133 and a second lever arm 135 attached to opposite ends thereof. A roller 136 is rotatably mounted on a pivot pin 137, secured to arm 135, to engage a stationary cam track 138 mounted below table 71.

A coil portion 139 of a biasing spring is mounted on shaft 134 and has one end anchored to a housing 140. The housing, journaling shaft 134 therein, is secured to bracket 125. The other end or finger portion 141 of the spring engages arm 135 to constantly urge roller 136 against cam track 138.

Thus it can be seen that upon rotation of table 71, through stations VI and VII, that the roller will engage the cam track to rock shaft 134 to move member 128 downwardly to its dotted lined position in FIGS. 16 and 17. Thus arms 129 and 130 will engage flaps F_2 and F_3 of the carton to strip it off male die 90. The formed carton will then be deposited onto moving conveyor 93 wherefrom it may be transported to a frozen food filling and final sealing apparatus. Suitable drive mechanisms (not shown) may be employed to drive and conveyor via the apparatus' main drive motor.

What is claimed is:

1. An apparatus for forming cartons comprising feeding, forming and discharge stations arranged in series, said feeding station comprising a magazine for retaining a plurality of flattened carton blanks therein, removal means for individually removing said carton blanks from said magazine and conveying means for receiving said blanks from said removal means and for transferring each blank tangentially to a rotary table of said forming station, said forming station further comprising at least one pair of cooperating male and female die means disposed adjacent to the periphery of said table for folding and forming a carton therein and actuating means for moving said male and female die means into mating relationship to form said carton upon rotation of said table, said male die means reciprocally mounted above said table and said female die means fixedly mounted on said table, and locating means positioned about said female die means and cooperating with said conveying means for receiving and guiding a tangentially fed carton blank and for pivoting such carton blank into precise registry over said female die means upon rotation of said table.

2. The invention of claim 1 wherein said female forming die defines a forming chamber extending completely through said rotary table.

3. The invention of claim 1 wherein at least one of said female forming and male dies is jacketed therearound with a chamber means and means for circulating a coolant through said chamber means for heat sink purposes.

4. The invention of claim 3 wherein each of said female forming and male dies has one of said chamber means jacketed therearound.

5. The invention of claim 1 wherein said actuating means comprises means forming a stationary cam track mounted above said table and means attached to said male die and guided by said cam track for linearly moving said male die relative to said female forming die.

6. The invention of claim 5 wherein said cam track is endless.

7. The invention of claim 5 further comprising guide means operatively associated with said actuating means for guiding linear movements of said male die.

8. The invention of claim 1 wherein a plurality of said male and female die means are radially disposed about said table.

9. The invention of claim 1 wherein said conveying means comprises at least one perforated belt movably mounted adjacent to said removal means, a support means at least partially mounting said perforated belt thereon, chamber means formed in said support means to be exposed to said perforated belt and means for drawing a vacuum in said chamber means.

10. The invention of claim 9 further comprising additional conveying means mounted between said first-mentioned conveying means and said table for receiving said blanks from said first-mentioned conveying means and for transferring them to said table.

11. The invention of claim 9 wherein said removal means comprises a suction cup movably mounted adjacent to said magazine.

12. The invention of claim 1 wherein said forming station further comprises nozzle means mounted adjacent to said table for discharging a heated fluid onto portions of an adhesively treated carton blank prior to its formation by said cooperating male and female die means.

13. The invention of claim 12 wherein said nozzle means comprises at least one set of heaters circularly disposed adjacent to said female die means for discharging said heated fluid theretowards upon rotation of said table.

14. The invention of claim 13 wherein two sets of said heaters are fixedly mounted adjacent to said female die means, said sets positioned to oppose each other.

15. The invention of claim 13 wherein each of said heaters comprises a combustion chamber, means for communicating a gaseous fuel to said combustion chamber, means for communicating said combustion chambers with each other and ignition means for substantially simultaneously igniting said gaseous fuel in all of said combustion chambers.

16. The invention of claim 1 wherein female die is formed completely through said table and said discharge station comprises stripping means positioned beneath said table for stripping a formed carton off said male die means when it descends through said female die means.

17. The invention of claim 16 wherein said discharge station further comprises a discharge conveyor for receiving said formed carton.

18. A method for forming a carton comprising the steps of

conveying a flattened carton blank tangentially with respect to a rotating table,

positioning said flattened carton blank over a hollow female forming die by engaging edges thereof with locating means disposed about said female forming die, said female forming die being fixedly mounted on said rotary table adjacent to the periphery thereof, and

rotating said table while simultaneously moving a male die into said female forming die to form said carton therein.

19. The invention of claim 18 further comprising the step of discharging a heated fluid onto corner folds of said carton prior to when said carton is fully formed by said dies to seal said corner folds together.

20. The invention of claim 18 further comprising the steps of moving said male die and formed carton below said table and stripping said carton off said male die.

21. The invention of claim 18 further comprising the steps of conveying said flattened carton blank toward said table on a belt and simultaneously subjecting said carton blank to a vacuum to hold it on said belt.

* * * * *